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ELECTRONIC Servicing & Technology

T.M.

January 1996

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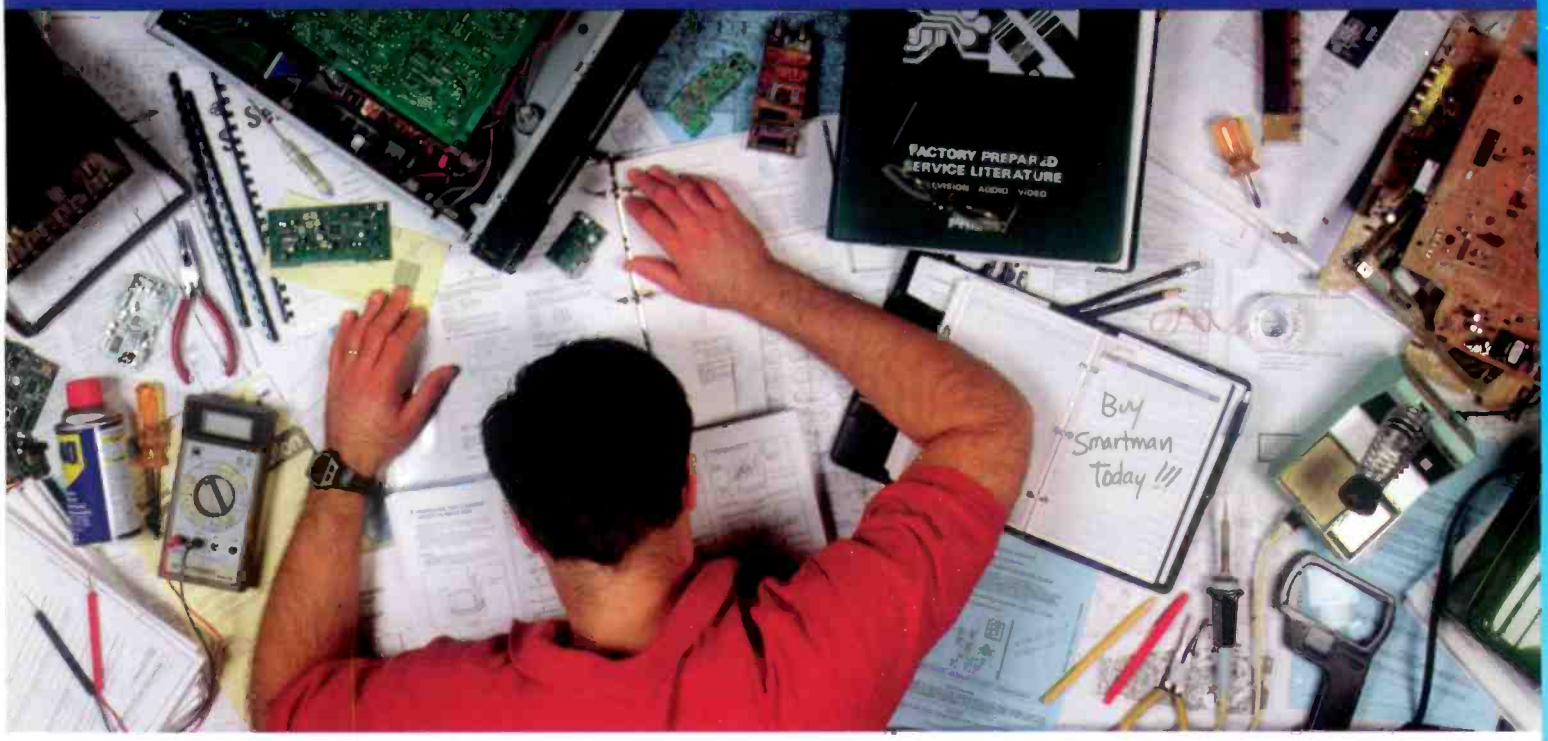

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THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

Volume 16, No. 1 January 1996

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DEPARTMENTS

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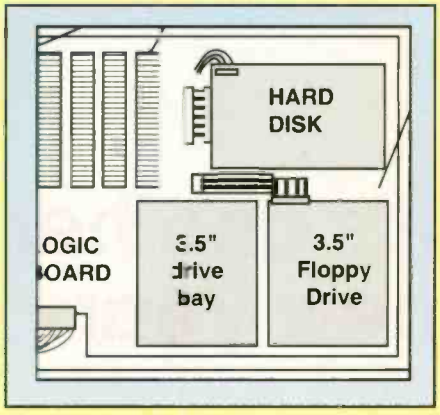
ES&T presents its annual article, department, and Profax schematics 1994 indexes.

ON THE COVER

The IBM and the Apple Macintosh take two different approaches to the realization of personal computing, but they both essentailly get the same jobs done: word processing, data base handling, spread sheet, and more. Many of the techniques and equipment used to service the two computers are similiar. (Photo courtesy Sencore)



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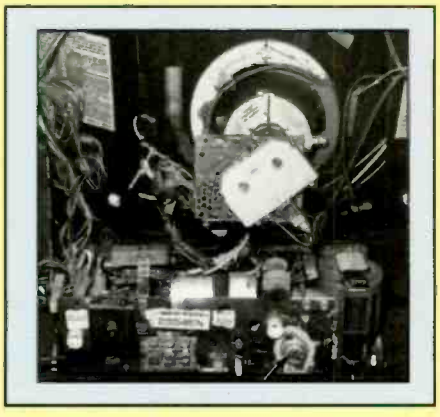

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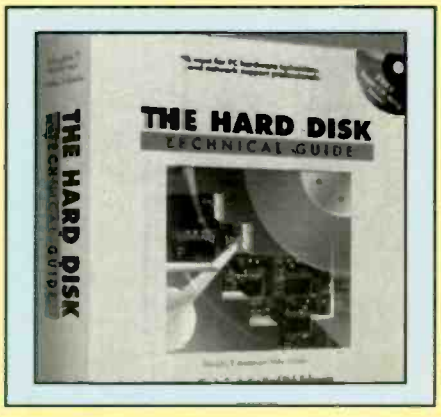

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It's another new year

It's another new year, a time when many people look back on the previous year, evaluate what kind of year it was, and look forward to the new year with resolutions to do things better. In the hustle-bustle of daily life it's easy to get sidetracked and just get on with trying to finish everything that must be done. At the beginning of the new year it can be helpful just to slow down and think about where we're going.

ES&T has made a couple of changes for the new year. If you take a look at the departments, such as Products and Literature, you'll see that we've brightened them up a little with some new graphics at the top of the page. It's not a big or important change, but we hope it makes the magazine look a little brighter.

More important, we have an entirely new entity, an annual newsletter about the business side of servicing. If you haven't seen a copy yet, you will soon. It's an eight page newsletter called "*Strictly Business.*"

Many service centers, especially some of the smaller centers, have difficulty introducing and employing good business practices. They're too busy with the business of servicing to go out and take a course in business management or accounting, so they continue to operate with makeshift business practices. "*Strictly Business*" is designed to help those service centers by providing business-oriented articles that they can read and follow and, we hope, thereby improve their business acumen.

Of course, we publish a "Business Corner" article in most issues of **ES&T**, but the limited space available for those articles doesn't really allow us the opportunity to provide much in the way of details. "*Strictly Business*" sidesteps the space problem and gives us room to publish a number of the more in-depth articles. And one of the best things about "*Strictly Business*" is that it comes to readers at no extra cost; it's included with the price of the subscription. Please let us know what you think after you've had a chance to look over your copy.

Some new year's resolution suggestions

Of course not everyone cares to make new year's resolutions. But there are those of us in whom hope springs eternal, and we try to better our personal and working lives by making resolutions at the new year to do things differently. Here, in no particular order, are a few suggestions that could help a consumer electronics service technician, manager or service center owner improve their business in 1996.

- Join an association.
- Attend a trade show.
- Send a technician to a technical course
- Learn more about the local, county, state and other laws that govern your type of business.
- Read a book, or take a course in business practices.
- Read a book or take a course on electronics theory.
- Read a self-help/motivational book on a subject of interest to you.
- Write a letter to the editor of **ES&T** and let him know what kinds of articles you'd like to see in **ES&T** in 1996 and beyond.
- Write up a troubleshooting tip and send it to **ES&T**.

For myself, I'm going to resolve to get out more among technicians and service center owners and learn more about their information needs and problems.

It pays dividends

While it sometimes seems that making resolutions and following through with them is more trouble than it's worth, it can pay dividends. We've found that by constantly trying to keep abreast of new developments in consumer electronics, and trying to stay informed about the information needs and problems faced by service centers, we've been able to make changes in the editorial coverage of **ES&T** that makes it more useful.

Good luck in keeping your resolutions, and Happy New Year!

Nils Conrad Persson

knowledge is power.

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CES Habitech '96

CES Specialty Audio & Home Theater

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NEWS

Philips Service Company servicer referral program

Starting approximately September 1, 1995, consumers who call the Philips Service Company (PSC) Information Center for the location of their nearest servicer will be asked to enter their five-digit postal zip code.

The PSC computer system will read the first three digits of the zip code and look up all the servicers in that area.

Assuming the consumer lives in an area covered by one of PSC's factory service centers, the computer will give out the name, address, city, state and phone number of the factory service center, and the same information for the top three independent servicers in the area, based on their rolling three-month Quality of Service (QOS) score.

If the consumer wants more choices, he or she can press "5" from a touch tone phone and get the listings for more servicers, in alphabetical order, regardless of QOS score.

A QOS score of 85 or higher will qualify a servicer to be placed in the first group of listings given out by either PSC's voice response unit or by live operators. All listings of 85 or higher will be rotated on each inbound inquiry so that everyone will get a reasonably equal number of referrals in the long run.

EIA's world wide web site continues to grow

The Electronic Industries Association's homepage on the World Wide Web (WWW), originally launched in June by the Association's Consumer Electronics Group (CEG), is expanding. Joining CEG's web pages online are EIA's Engineering and Public Affairs Departments.

"As expected, the World Wide Web site is growing and will eventually encompass every facet of the Electronic Industries Association," said Peter F. McCloskey, president of EIA. "It is our goal to make this the best homepage possible, not just for diehard Internet users, but for our members, the press and anyone interested in the US electronics industry."

McCloskey continued, "We are particularly interested in having our members be able to access our homepage and get the information they need at the click of a button, giving them a doorway to the full benefits of EIA membership. To ensure EIA succeeds in this mission, we are creating a members only section, accessible through special passwords."

EIA's homepage will continue to grow over the coming months as other Groups, Divisions and Departments add specialized information. CEG, the Engineering Department and the Public Affairs Department will continue to maintain their current pages as well as creating new and improved sites. Eventually, members will be able to register for conferences or order publications via the homepage.

"Since June when the Consumer Electronics Group put up its homepage it has increasingly been accessed by 4800 people a week," commented Gary Shapiro, CEG Group Vice President. "With this tremendous interest by consumers and media, our members' information, as well as our own, is being disseminated in a way never used before."

Engineering pages feature user-friendly search engine

The Engineering Department section of the EIA homepage currently includes a listing of all EIA, The Telecommunications Industry Association (TIA) and JEDEC standards in the Global Engineering Documents catalog. A special feature of the standards homepage is a search engine allowing web browsers to easily access standard information using keywords. New enhancements include pages describing the status of all EIA engineering projects and standards proposals.

"We are happy to offer an electronic catalog of our standards and a database of our open projects via the internet," commented Dan Bart, EIA/TIA vice president, standards and technology. "Glyn Finley, vice president, Market Research, is doing a phenomenal job coordinating each Department's development and ensuring a universal, consistent group of pages. We are all very excited about the Web site and its continuing enhancement."

In addition, a subset of Departmental Engineering Committees' homepages

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
ELECTRONIC
Servicing & Technology

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

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SALES OFFICE
Electronic Servicing & Technology
76 N. Broadway, Hicksville, NY 11801
516-681-2922; FAX 516-681-2926

Diane G. Klusner, *Director of Advertising*
Emily Kreutz, *Sales Assistant*

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

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have been scheduled for beta-tests on the Internet in the fourth quarter of 1995. Through a secured "Members Only" area, EIA members will have access to minutes, agendas and working documents.

News and publications on the net

The Public Affairs Department homepage will have several features designed to maximize user friendliness and fast access. In the works are three sections: News, Publications and Membership. The News section features recent press releases, cover stories from the *Executive Report* and stories from the Annual Report.

"It is essential that the media have quick and easy access to the Association's position on the latest issues of the day." commented Mark V. Rosenker, vice president, Public Affairs. "Using our web site, we will be able to provide this service."

A listing of the EIA Publication Index will be made available on the Public Affairs Department homepage with full descriptions and eventually, online ordering capabilities. Finally, the Public Affairs Department is developing a homepage with a complete listing of member companies. In the future, member companies wishing to have their homepage linked to EIA's will be able to do so on the membership page as a free service.

More coming soon!

Internet users should expect to see other EIA Groups and Departments coming online soon. The Government Division will be the next section to offer various materials on the homepage with Government Relations following soon after.

EIA encourages World Wide Web users to explore the homepage. Interested persons may simply type in the address, http.://www.eia.org, and click on the hypertext links to the Consumer Electronics Group, the Engineering Department or the Public Affairs Department.

Now celebrating its 71st year, the Electronic Industries Association is the national trade organization representing U.S. electronics manufacturers. Committed to the competitiveness of the American producer, EIA represents the entire spectrum of companies involved in the manufacture of electronic components, parts systems and equipment for communications, industrial, government and consumer uses.

At home, many families want music everywhere, EIA/CEG survey finds

Americans are listening to music throughout the house and increasingly want high quality sound in several rooms, according to a national survey announced today by the Consumer Electronics Group of the Electronic Industries Association (EIA/CEG).

According to the EIA/CEG survey, which was conducted in May and announced at the CES Specialty Audio and Home Theater Show, the living room or family room is the most common household location for listening. Among the entire sample of 1,200 families, 53 percent say they listen to music frequently in one of those areas and another 33 percent say that they do so occasionally.

However, among families who own complete stereo systems made up of separate components, the numbers jump to 65 percent who frequently enjoy music in the living room, and 25 percent who occasionally do so.

The stereo owners also report recurring listening in other parts of the house, according to the EIA/CEG research. Specifically, 30 percent listen frequently in the bedroom, 28 percent in the kitchen, 15 percent on the porch or deck, 11 percent in the garage and 10 percent listen frequently in the bathroom.

Specifically, when asked if they had "a stereo system, boombox, portable radio or something else," in the rooms where they listen to music, 90 percent of those families with component systems who frequently listen in the family or living room have a stereo system in that room.

Among those families with stereo component systems who frequently listen in the bedroom, 56 percent have a stereo system there; in the kitchen, 47 percent; on the porch or deck 46 percent; in the garage 44 percent; and in the bathroom, 25 percent.

Families are installing multiple stereo systems because, for a significant number, having high quality sound wherever they listen is an important consideration.

For example, 84 percent of component system owners who frequently listen to music in the living or family room said it is important to have high quality sound in that room. High quality sound is important to 68 percent of those who listen frequently in the bedroom, 56 percent in the kitchen, 63 percent on the porch or deck. And among those who frequently listen in the bathroom, 41 percent said having high quality sound is important.

The quality of sound is critical, the research found, because while the music is primarily for background or atmosphere, a significant number of each room's frequent listeners are listening intently. Among the stereo component system owners who frequently listen in each room, the number who do so intently include: 19 percent in the bedroom, 9 percent in the kitchen, 8 percent in the bathroom, 10 percent on the porch or deck, and 13 percent in the garage. The most intent listening is carried out in the living room or family room where 25 percent of the frequent listeners said they listen to music intently.

Information contained in this release was obtained during May 1995 via telephone interviews. Approximately 1,200 interviews were conducted with U.S. heads of households across three groups: 500 home theater system owners, 574 component stereo system owners, 500 randomly selected consumers not owning a home theater or stereo system. Individual samples will not add to total interviews since some consumers owned both a home theater system and stereo system. Survey questions were designed by CEG and administered by the Verity Group, Inc. from their headquarters in Fullerton, CA. All results have a margin of error of +/- 4 percentage points.

Speaker and CD sales star in July

Highlighting July's audio sales numbers, speaker sales skyrocketed 70 percent over last year's July figures, according to the Electronic Industries Association's Consumer Electronics Group (EIA/

(Continued on page 46)

LITERATURE

LAN items featured in catalog

Jensen Tools announces its latest tool catalog with a special 8-page insert featuring dozens of LAN-related items. This is in addition to the 9 networking pages in the main catalog.

The 72-page full-color catalog includes comprehensive selections of the most in-demand items from all of the company's lines. Besides networking, tool kits, cases and testers, the listing covers items for computer, and telcom installation, maintenance and repair.

Circle (80) on Reply Card

Personal computer hardware training

Computer Maintenance Training Company, Inc. expands their Desktop Training offerings with the addition of several PC Hardware Maintenance Courses. The new programs are available as "Plug In Units" which allow a student, once prerequisites are met, to select the sequence and content of their training by choosing only the Plug In Units which meet their specific requirements. Among the new Plug In Units available are: Introduction to PC Hardware; PC Hardware Repair; DOS and Windows for PC Hardware Repair and Introduction to PC LANs. Additional units covering Novell Networks are planned for release in January, 1996.

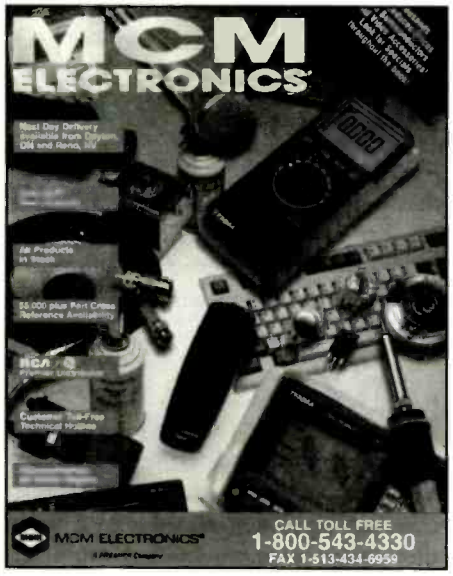
Class sizes are limited to six students and each Plug In Unit includes hands-on lab exercises to give students practical experience.

Circle (81) on Reply Card

Parts and accessories catalog

MCM Electronics announces their newest catalog—number 36.

The catalog contains over 2,700 new items, including project accessories, semiconductors, connectors, test equipment, computer products, audio, TV, VCR and appliance repair parts. This catalog also introduces LAN Cable test products from Paladin and Triplett, crimping tools from Sargent, and many other new items for the electronics service technician. In addition it introduces hundreds of new repair parts for servicing TV's/VCR's and more. Catalog 36 also announces permanent price reductions on semiconductors, video heads, flybacks, motors, and many other items used every day in consumer electronics service.



Circle (82) on Reply Card

Free issue of newsletter

BiblioData, publisher of the industry-respected directory *Fulltext Sources Online*, announces publication of a new monthly newsletter covering the use of the Internet for business research and competitive intelligence.

The CyberSkeptic's Guide to Internet Research targets business librarians and researchers who need to find substantive information via the Internet. The newsletter is a practical, skeptical—but hopeful—look at a major source of information, the Internet. One feature is a listing of Internet sites organized by Subject Areas.

The newsletter differs from other periodicals that mention Internet by being timely (monthly issues), focusing critically on research sources, and targeting Internet users who are also familiar with professional online vendors (such as DIALOG and Nexis) so comparisons can be made.

BiblioData had produced a Premier Issue dated November 1995 and will send a free copy to all who inquire, as long as supplies hold out.

The CyberSkeptic's Guide to Internet Research costs $149 for ten issues during the year.

Circle (83) on Reply Card

Service and repair directory on the Internet

Computer Network Services, Inc. (CNS) announced that they are sponsoring a new Service and Repair directory on the Internet.

Over 30 million worldwide computer users are estimated to be dialing into the World Wide Web (WWW) on the Internet. The Service and Repair Directory allows computer users to quickly search by company or geographical region for a local or specialized repair facility. Detailed information about supported manufacturers' warranty, products serviced, and additional company information is listed for each company in the directory.

The directory also lists companies that specialize in parts location and distribution. Companies with their own WWW page(s) receive a free link from their listing in the Service and Repair Directory. This allows the user to quickly reference more information about any particular company from within the directory.

Interested persons can view the Service and Repair Directory on the Internet at http://www.cns-nj.com/service.

Coaxial Connectors catalog

A new catalog that features a broad line of 7/16 RF coaxial connectors for wireless communications applications is being offered by Tru-Connector.

The High Power 7/16 RF Coaxial Connectors Catalog features a full line of standard connectors in straight, right angle, and between series configurations that fit popular cables from 0.041" to 0.685" dielectric diameters. Plugs, jacks, panel receptacles, and a wide variety of combination heads and adapters are included.

Providing performance specifications and a description of the body, center contact, and inner/outer conductor material options, the 12-page catalog includes line drawings for each item along with compatible cable types.

Circle (84) on Reply Card

Pace Incorporated 1996 training schedule

Pace Incorporated, Laurel Maryland, announces its 1996 Pacenter Training Schedule. Pacenter Training teaches the skills, techniques and process control development necessary to perform high quality, non-destructive assembly and repair on all types of electronic modules and assemblies. Open enrollment for 1996 classes at the Laurel MD Training Center has been scheduled as follows:

Universal Repair for Electronics (PCT-200) is an in-depth, hands-on, program covering Hi-Rel Soldering, component removal, circuitry repair and ESD control.

• Multilayer and Flexible Circuit Repair (PCT-300) is an advanced, hands-on, course covering the latest techniques needed for excavations, interfacial connections and internal conductor repairs, as well as the latest repair technology for broken conductors and land areas. (Prerequisite: PCT-200)

• Surface Mount Technology (PCT-400) is a comprehensive program emphasizing the safe installation and removal of SMCs which covers the latest developments in this rapidly advancing area of electronic assembly, rework and repair.

• The PACE Instructor Training Seminar is an intensive 1-week course designed for personnel involved in solder instruction. Prior attendance at either a PACE PCT-200 or PCT-400 course (or equivalent) is a must. Class size is limited so everyone gets individual attention.

Circle (85) on Reply Card

Computer diagnostics

By The ES&T Staff

When we think of "diagnostic software," we ordinarily think of the powerful and useful programs that companies put out to perform diagnoses of computers. In a larger sense, though, diagnostic software has been in use for as long as electronics products have been in existence.

For example, any time a technician plays a known-good video tape and observes the TV screen to try to determine what might be the problem with a malfunctioning VCR, he is using diagnostic software. Or when a technician applies a signal generator at some point in the circuit and evaluates the output, and thereby the intervening circuitry, he's using diagnostic "software" (the injected signal), to diagnose the product.

Diagnostic software

The real advancement in diagnostic software represented by computer diagnostic software as we know it today is the automation that it provides. Even with using the older diagnostic products described above it still took the hands of the technician to apply the signals, and his eyes and mind to interpret the results. With computer diagnostic software products, the software performs all of the tests and provides an analysis that's largely independent of human interpretation.

In the case of computers, because the software loaded into the computer determines what function the computer will perform, it's possible to load software into the computer that turns it into a diagnostic tool. Even better, it can be used to diagnose many of its own problems.

Furthermore, software is available that will probe the computer, determine what components are in the computer, how they're configured, and then report that on the screen, in printed form, or a file on disk. The kind of information that this type of software provides, tells you if there is a mouse installed, or a modem, and how much RAM there is, and the capacity of the disk drive.

When a computer exhibits problems, if the disk drive, the CPU, and certain portions of the memory are operating properly, the service technician will be able to use diagnostic software to perform many diagnostic checks.

Some of the tests

A diagnostic program can check out memory (RAM) to see if it's all operating properly. Some diagnostic programs read and write to the hard disk over and over. If any areas of the disk give inconsistent results they are marked as bad so the computer won't attempt to record information on those areas.

Some diagnostic programs check only a few areas of the computer, others check just about everything. Some diagnostics operate under DOS, some under Windows, and still others use their own independent operating system.

Technicians should use care in selecting a diagnostic software program, depending on their levels of expertise, how deeply they plan to get into computer servicing, and how much they want to spend.

POST cards

When the computer is first turned on, it goes through a series of checks to make sure everything is operating properly before starting up. If certain portions of the computer check out as faulty, the computer shuts down. That checkout procedure is known as the power-on self test (POST). When the POST senses a problem and shuts the computer down, there's no indication of why it didn't boot up. It's almost impossible to determine the cause without a lot of trial and error.

There is a test device called a POST card, however, that will provide a visual indication of each step of the POST, and hold an indication of the last POST step performed before the computer shuts down. That provides the technician with an indication of where to look to find the problem. POST cards are available from a number of manufacturers.

Some PC diagnostic tools

There are a lot of personal computer diagnostic products available to technicians, and more are being produced every day. And to further confuse the situation, diagnostics are being bundled in with some operating software.

As one example, DOS 6.22 comes with a diagnostic called ScanDisk, which checks the disk and reports if any portions are faulty. Additionally, some of the hardware manufacturers are bundling diagnostic software with their products. In an attempt to make sense of the diagnostic market, we'll describe 6 categories of diagnostic programs.

The diagnostic tools described here fall into the following six categories:

- POST reader cards
- Diagnostic software
- Fixed disk drive utilities
- Floppy disk drive utilities
- Virus utilities
- Windows utilities.

POST reader cards

A POST reader card is used to determine the cause of failure on a PC that will not boot from either the floppy or hard drive: a dead PC. When a dead PC is turned on it will not operate. A series of beeps will be emitted, or some general failure description will be displayed on the computer monitor.

By plugging a POST reader card into the computer, the technician can monitor the systems signals and POST codes during the boot up process and thereby determine the cause of failure. Good documentation is the most important feature of a good POST reader card.

Diagnostic software

Diagnostic software is used to determine and correct problems on a bootable system: one that you can boot from either the floppy drive or the hard drive. Problems range from hardware failures, hardware configuration problems, software corruption, and software configuration problems.

Diagnostic software should have the ability to determine the difference between hardware problems and software problems. Once the hardware problem is corrected, or if it is determined that there is no hardware problem, you can then move on to software problems.

Fixed disk utilities

A fixed disk utility is used to test, fix, and perform data recovery on a hard

drive. Fixed disk utilities are operating system specific. Get the utility that applies to the operating system that you are working on (normally DOS). The utility must not rely on the DOS structure to be intact since this is normally where the problem resides. An easy to use editor which can display in hex or ASCII in 256 byte or 512 byte screens is required.

The editor should have features to repair (in order): the bootloader, partition tables, boot signature, volume boot sector, volume boot signature, FAT 1, FAT 2, root directories, subdirectories, and data files. Automated features save time but there should be manual capabilities for all of the above features as well.

Floppy disk drive utilities

A floppy disk drive utility is used when the floppy drive reports an error and the problem is not the floppy diskette. A good floppy utility can test, clean, and help realign floppy drives.

Ordinarily, it is not worth a technician's time to realign a floppy drive, but realignment can be attempted on most floppy drives with a floppy disk utility that features realignment capabilities.

Virus utilities

A virus utility is useful when you suspect that there may be a virus present. These occasions include: cases when a known virus has attacked a system, cases when there is no hardware failure but the system is having problems and a virus is suspected, and on a routine basis to find and delete a virus that may be on the system but has not been activated yet.

Windows utilities

A Windows utility is used when you are having a problem, but only when running under Windows. A Windows utility should detect Windows and software configuration problems. A Windows utility should be a program that does not run under Windows but can look at Windows and the software running under Windows, and detect the configuration problem.

Unfortunately all Windows utilities have to be run under Windows. If you are having a Windows problem, 90% of the time you will not be able to run the utility. Use diagnostic software to determine if a hardware failure occurred or not. If not, start to reconfigure DOS, Windows, and all software running under Windows until you solve the problem. ■

POST reader card and diagnostic software manufacturers

Accurite Technologies Inc.
231 Charcot Avenue
San Jose, CA 951311
408-433-7980

All Micro Inc.
1250 Rogers Street. Suite D
Clearwater FL, 34616
813-446-6660

American Megatrends, Inc.
6145-F Northbelt Parkway
Norcross, GA 30071
404-263-8181

Central Point Software Inc.
15220 NW Greenbrier Parkway
Suite 200
Beaverton, OR 97006
800-445-4064

Dariana Software
5241 Lincoln Avenue, Suite B5
Cypress, CA 90630
714 236-1380

Data Depot
1710 Drew Street, Suite 5
Clearwater, FL 34615
813-446-3402

Diagsoft Inc.
5615 Scotts Valley Drive, Suite 140
Scotts Valley, CA 95066
408-438-8247

Disk Technician Corp.
1940 Garnet Avenue
San Diego, CA 92109
619-274-5000

Fifth Generation Systems
10049 N Reiger Road
Baton Rouge, LA 70809-4562
504-291-7221

Gibson Research Corp.
35 Journey Avenue
Aliso Viejo, CA 92656
714-362-8800

Landmark Research International Corp
703 Grand Central Street
Clearwater, FL 34616
800-683-6696

McAfee Associates Inc.
2710 Walsh Avenue, Suite 200
Santa Clara, CA 95051
408-988-3832

Micro 2000
1100 E Broadway, Suite 301
Glendale, CA 91205
818-547-0125

Renasonce
5173 Waring Road, Suite 115
San Diego, CA 92120
619-287-3348

RG Software Inc.
6900 E. Camelback Road, Suite 630
Scottsdale, AZ 85251
602-423-8000

Symantec Corp.
10201 Torre Avenue
Cupertino, CA 95014-2132
800-554-4403

Tech Assist Inc.
11350 66th Street Suite 105
Largo, FL 34643
800-274-3785

Touchstone Software Corp.
2130 Main Street, Suite 250
Huntington Beach, CA 92648
714-969-7746

Trackmate
5305 E. Shore Drive
Conyers, GA 30208
800-486-5707

Ultra X Inc.
2005 De La Cruz Boulevard, Suite 115
Santa Clara, CA 95050
800-722-3789

Windsor Technologies
130 Alto Street
San Raphael, CA 94901
915-456-2200/

Servicing the Macintosh computers Three parts

By David Presnell

Personal computers have become firmly ensconced among the products that constitute the class known as consumer electronics. Millions of consumers now feel that an IBM compatible computer or an Apple Macintosh computer are an indispensable adjunct to the home. Consumers are now using personal computers to balance the family budget, compose letters, write term papers, play games, communicate electronically, and much more.

Because personal computers are now consumer items, this magazine regularly publishes how-to types of articles that describe servicing procedures for personal computers.

Until now the coverage of personal computer servicing has dealt largely with the IBM compatibles. That preponderance of coverage has not been because the staff of **ES&T** feels any favoritism toward IBM compatible computers, but simply because most of the technicians who service computers and who write articles on computer servicing are most familiar with IBM compatibles.

Moreover, service literature and replacement components for the Macintosh have been made more difficult to obtain by non- authorized servicers.

Presnell is owner of an independent computer servicing business and a freelance technical writer.

The drought ends

Fortunately, David Presnell, a skilled computer service technician and talented writer, has gathered enough information and access to replacement components to become successful in Macintosh servicing. He has also taken the time to write several articles about it.

Since so little information on the servicing of Macintosh computers has been presented in this magazine up until now, the **ES&T** staff felt that rather than publish these article in successive issues, it would make more sense to gather them into a single issue.

The three-part article that follows deals with the complete spectrum of Macintosh service: Part 1 is an introduction to the Macintosh computer; Part 2 discusses the dead computer and start-up problems; Part 3 looks into many operating problems that can occur after the Mac is started.

Some practical assistance

In addition to providing an introduction to the operation of the computer as well as a checklist of steps to take when troubleshooting the Macintosh, this article series provides a list of some of the available diagnostic software and a list of suppliers of Macintosh servicing information and parts.

We hope that these articles will prove to be helpful to readers who have requested information on Macintosh servicing, and others who may now find some encouragement to service these computers as a result of the information provided here.

Servicing the Macintosh - Part 1

Computer-related articles in past issues of this magazine have primarily discussed IBM compatible computers. The IBM and its clones are popular computers, however, they're not the only computers. The Apple Macintosh has earned the right to be classified as one of the larger selling systems available today. It's no accident. Apple was one of the first companies to develop the small computer, known as the Apple 1.

Today, the Macintosh is available in many models and configurations to accommodate the needs of the user (See Figure 1). Apple has recently released the Apple Power Macintosh line of computers available with new hardware and software that allows the MAC to run both MAC and IBM PC software. As of this writing, a Power Macintosh is available with a processor speed of 132 MHz.

The Macintosh, like every other computer, requires occasional service. But, there is very little information available about servicing the Macintosh, or Mac, as it is commonly called. That makes it not only a profitable business move to offer Mac service, but one that will be gladly accepted by Mac users in your service area. The market for Mac service includes schools, libraries, government institutions, the home computer market, printing and graphic arts companies, and many others.

Beginning with this article, I will introduce you to the Mac with a general discussion of some of the main differences between Macs and IBMs. We will dispel some fears about using the Mac by learning some of the terminology and hardware common to the Mac computer, as well as basic operation. Later, we will move into software and hardware diagnostics, servicing, and repair.

Mac hardware

The Mac is a computer that, like other computers, needs a system hardware and software program working together to carry out the user's requirements.

The modern Mac has a case, power supply, monitor, floppy disk drive, keyboard, a motherboard (known as a logic board in Mac language), a central processing chip or processor, RAM (random access memory), modules or SIMMs (single in-line memory modules), ROM (read only memory), a special section of battery backed-up RAM known as the parameter RAM or PRAM, which together with the ROM works similar to the CMOS (complimentary metal-oxide semiconductor) RAM and ROM BIOS

THE MACINTOSH COMPUTER

MAC Plus

MODEL	CPU	MHz	MATH	FLOPPY	RAM
MAC Plus	68000	8 MHz	No	800k	Up to 4 MB
MAC II	68020	16 MHz	Yes	1.44 MB	Up to 8 MB
MAC IIx	68030	16 MHz	Yes	Superdrive	Up to 8 MB
MAC IIci	68030	25 MHz	Yes	Superdrive	Up to 128 MB
MAC SE/30	68030	16 MHz	Yes	Superdrive	Up to 128 MB
MAC IIfx	68040	40 MHz	Yes	Superdrive	Up to 128 MB
MAC LC	68020	16 MHz	No	Superdrive	Up to 10 MB
MAC IIsi	68030	20 MHz	Yes	Superdrive	Up to 17 MB
CLASSIC	68000	8 MHz	No	Superdrive	Up to 4 MB
CLASSIC II	68030	20 MHz	Yes	Superdrive	Up to 17 MB
Quadra 700	68040	25 MHz	Yes	Superdrive	Up to 68 MB
Quadra 900	68040	25 MHz	Yes	Superdrive	Up to 256 MB

Performa Line

475	68040	25 MHz	Yes	Superdrive	Up to 36 MB
577	68040	33 MHz	Yes	Superdrive	Up to 36 MB
636	68040	33 MHz	Yes	Superdrive	Up to 36 MB

Power Mac's (with Power PC processors)

9500	604	132/120	Yes	Superdrive	Up to 768 MB
8100	603	100 MHz	Yes	Superdrive	Up to 264 MB
7100	601	80 MHz	Yes	Superdrive	Up to 136 MB
6100	601	66 MHz	Yes	Superdrive	Up to 136 MB

Figure 1. The Macintosh line since the MAC plus.

(basic input/output system) used in IBM compatibles, and a mouse.

Most Macs contain a hard disk and a printer. Macs may have attached: a CD-ROM (compact disk ROM) drive, a modem, a scanner, or just about any other device modern technology can come up with. A Mac can stand alone or can be hooked up to a network.

GUI

As you can see, the Mac sounds a lot like every other computer sold today. The original differences between a Mac and an IBM were those of user friendliness. The Mac came equipped with what is called the GUI or graphical user interface. The GUI was more of a software development than a hardware development, but the Mac used hardware that assisted the GUI, such as a processor that could access all the available RAM as one block.

In contrast, the Intel 8086 used in early IBM and compatible computers could only access one 64k segment of memory at a time, placing limitations on the size of the programs in memory, thus limiting graphics ability.

The GUI depends heavily upon the mouse for the input or access of commands. Where the DOS (disk operating system), used in IBM and compatible computers uses word commands such as COPY, the Mac has an *icon* or graphic representation of the application and its related files. The Mac also represents attached devices such as the hard disk and floppy disk with icons.

MOTOROLA 68000 PROCESSORS						
Chip #	**Registers**	**Data**	**Address**	**Math**	**MEM. MGR**	**Cache**
MC68000	32 Bit	16 Lines	24 lines	No	No	No
MC68020	32 Bit	32 Lines	32 Lines	No	No	Yes
MC68030	32 Bit	32 Lines	32 Lines	Onboard	Yes	Yes
MC68040	32Bit	32 Lines	32 Lines	Enhanced	Yes	Yes

Figure 2. The Motorola series of processors used in the Macintosh.

To copy a file in DOS, the COPY command has to be typed along with the correct path both ways. With the Mac, a copy is made of the file by simply clicking on the icon with the mouse and dragging the icon to the folder or device icon you wish to copy it to. This allowed users to operate the Mac with little computer training or experience.

Drawbacks of both computers

The early Macs had their drawbacks too. By modern standards, the Motorola 68000 processor was weak in math handling ability, and the early Mac itself was low on memory and speed, considering the graphics that were being demanded of it by the operating system (see Figure 2). The IBM PC, however, had good math handling capabilities with little or no graphics.

I/O

The Mac has a system of I/O (input/output) quite different than the IBM machines. The Mac currently uses the SCSI (small computer system interface; pronounced scuz-ee) standard for most I/O operations. Using one SCSI port, a cable could be chained to many devices, one after the other, including an external hard disk, a scanner, a CD-ROM and other devices.

In the back of most Macs, you will also find a port for the keyboard known as the APPLE DESKTOP BUS or ADB port, printer port (known as APPLE TALK in which several computers can be networked to that same printer), and a serial port on some machines. The mouse is plugged directly into an ADB port on the side of the keyboard. Modern Macs also contain NuBus slots for easy expansion with plug-in cards.

Monitors, power supplies and keyboards

The first Mac monitors were monochrome with graphics capabilities. Today, the Mac color graphics monitors equal the best SVGA (super video graphics array) 0.28 DPI monitors available. Mac power supplies would seem to be too low in wattage for the equipment they support, but they last about as long as any other power supply and usually supply all the power needed. The Mac keyboard looks much like any 101 key enhanced keyboard, but don't try to plug it into an IBM PS2.

Interchangeability

Mac hardware and IBM hardware are generally not interchangeable. Things are beginning to get confusing about hardware. The Mac uses a SCSI hard disk setup for a Mac. IBM compatibles can be equipped with SCSI hard drives set up for the IBM. The cards are different, so tread lightly when you think you can reconfigure a Mac hard disk to work on an IBM or vice versa. Of course, it is amazing what an overworked technician can "make work."

How the Mac operates

The Mac uses two primary types of software: *system* software and *application* software. In terms only, the Mac system software could be compared to DOS and Windows files put together. I said in terms only, because the system is totally different than DOS or Windows. However, I will make such comparisons when feasible to help move the learning curve along at a rapid pace. Probably the largest difference between a Mac and an IBM is terminology.

A Mac must have the system software available on a disk at startup. As the name suggests, the system software is a segment of program code that sets up the system and makes it usable by application programs. Application software is the program you use such as a word processor, data base, desktop publisher, and so on.

Where DOS arranges data in directories and files, the Mac does so using *folders* and *files*. The Mac can be thought of as a large file cabinet full of file folders. Each folder has a separate name with a picture called an icon on it to represent its name. Each folder contains files pertaining to that folder. Each file has a name and can be represented with another picture icon.

The Mac's *system files* are contained in the *system folder* which consists of the system file, a file called the *finder*, files known as *system resources*, and *system extension* files. There must be a copy of the system folder on the startup disk before the Mac will boot or start up. Such a startup disk must contain at least the system file and the finder.

Power up

When the Mac is powered up, all registers are reset by the clock. The ROM is accessed, and a set of diagnostics are run similar to the POST (power on self test) diagnostics run on IBM compatibles.

Next, the processor calls the ROM's basic set of operating instructions into action. The Mac contains a segment of battery backed-up RAM memory called parameter RAM or PRAM. The PRAM stores time, date, and other setup information. The ROM and PRAM together work similar to the ROM BIOS and CMOS RAM chips of the IBM compatible.

Next, a beep, chime, or melody will sound once if no hardware problems were found. The Mac then looks for a disk with the system folder on it to bootstrap the computer. If everything checks out and the system was found, an icon appears on the screen with a smiling face. This is known as a "Happy Mac" icon.

A "Welcome to Macintosh" dialog box appears for a few moments, and *extension icons* may appear at the bottom of the screen. *Extensions* are similar to device drivers and TSR (terminate and stay resident) programs used by DOS. We'll discuss those in more detail, shortly. The system, desk accessories (DA's), sounds, fonts, CDEV's, INIT's, the finder, and any applications designated to run at startup are loaded, and the desktop appears.

After startup, all available disk drive icons appear on the right of the screen. The *finder menu bar* appears across the top of the screen. The *trash icon* appears at the lower left of the screen. The hard disk folder may open showing the available applications as icons or a list, depending on how the Mac was set up. Remember that the hard disk is represented as an icon like a folder or file.

Double clicking with the mouse on the icon *opens* the icon like opening a folder and displays the contents of the icon onscreen as other icons (either files or folders), or as a list of file and folder names. Applications can be viewed by icon, name, date, or in other ways. This is changed easily under the VIEW menu button on the menu bar across the top of the screen.

The GET INFO item under the FILE menu is helpful when problems occur. After startup, GET INFO will tell you about the Mac and its configuration. The ABOUT menu item under the APPLE menu will give you more information about the application being run. The FIND FILE menu item under the APPLE menu will locate every occurrence of a file you wish to locate.

The system folder

As I mentioned earlier, the system folder is accessed, and certain parts of it are loaded into RAM at startup. Let's take a closer look at the contents of the system folder.

The primary file of the system folder is the system file, which is the main start-up and operation file of the Mac. The system file provides basic fonts, sounds, keyboard layouts, language code information, desk accessories (DA's), and patch codes (ROM code changes such as system updates that can be used without changing the ROM chip).

The system folder contains a file known as the finder. The finder creates and keeps organized what is known as the *desktop*. The desktop is what you see in the screen background after startup. The desktop is also the area that you perform work in. The finder keeps files organized so you can find them easily.

Generally, the finder keeps track of the desktop by storing information in a hidden file known as the *desktop file*. When new files are added or unwanted files are removed, this is recorded in the desktop file. The finder finds files when you click on an icon. The finder displays icons, cursors, etc. the finder includes the menu bar

MAC TERMINOLOGY

ACTIVE WINDOW: The front window you are working in. Has lines across the t itle bar. Clicking on a windows title bar brings it to the front and makes it active.

APPLE MENU: The menu item at the top left of the screen with the picture of the apple on it. Usually available on all applications.

CHOOSER: A DA accessed in the apple menu that allows the user to set up harware such as printers, scanners, networks, etc.

CLOSE BOX: A small square located in the far left corner of the active windows title bar. Click on it to close the window.

CONTROL PANELS (CDEVS): Also known as Control Panel Devices, CDEVS files are located in the System Folder.

DESKTOP: What you see in the screen background after startup. This is the area you perform work in. Includes the fider, menu bar, ICONS, cursors, etc.

DESK ACCESSORIES (DA's): Accessories such as the alrm clock, calculator, chooser, CDEV's, key caps, scrapbook. Accessed under the Apple Menu. DA files are located in the System Folder.

DIALOG BOX: A message box asking for input, or giving you options or an error message.

DOCUMENT: Another name for a file you create on the MAC.

EXTENSIONS: Memory resident programs that add features to the MAC. Includes RDEVS, INITS, and CDEVS.

FINDER: Part of the System software that keeps the desktop and files organized so you can find them. The Finder displays windows, ICONS, cursors, menu bars, etc.

FOLDER: A place where a common group of files are kept. Much like a DOS directory or subdirectory.

ICON: A graphic representation or picture of a file or device. MAC uses ICONS rather than file and drive names for file access.

INITIALIZE: To prepare something. Another name for format.

INITIALIZATION PROGRAMS (INITS): INIT's are small memory resident EXTENSIONS that set up the System at start-up with some special feature such as an anti-virus program.

INSTALLER: A program used to install files in the MAC. Usually each application comes with its own installer.

LAUNCHER: A program that creates fake or alias ICONS that locates and starts the application. The launcher is used much like a menu system, often starting automatically when the computer boots.

LOCAL TALK: A network connection that allows MAC's to be connected to a local area network. Apple Talk is a connection used to share the same printer with several MAC's.

MAC CHECK: A diagnostic program that comes with MAC's.

MENU BAR: Pull down menus across the top left of the screen.

NUBUS: An I/O bus on some MAC's that allows easy upgrades.

RDEVS: Resource device drivers also known as CHOOSER EXTENSIONS and include drivers such as printer drivers.

RESOURCES: Files located in the System Folder that set up and maintain the computer in a certain way. Includes FONTS and DA's.

SCSI (pronounced scuz-ee): Small Computer Systems Interface used by the MAC to chain devices from one port such as hard disk. Each device is assigned a number in the chain. The last device must usually contain a SCSI terminator.

SYSTEM FOLDER: Contains all files necessary to operate the MAC. Must include the Sytem File and Finder to be a start-up disk.

TRASH: An ICON in the lower right corner of the screen where unwanted files can be dragged to remove them from the desktop.

Figure 3. Terms common to the Macintosh Computer.

at the top of the screen when you start the Mac. The finder may or may not be active when applications are running.

In later system versions, the system included a file known as the *multifinder*. The multifinder comes on system version 5.0, and later. The multifinder is like the finder, however, it always stays in memory when you leave it so you can get back to it quickly. In system 7.0 and later versions, the finder has been changed to operate like the multifinder of earlier versions.

The system folder uses and includes files known as *system resources*. The system file itself is composed of a group of system resources. Resources include files known as desk accessories or DA's and items such as fonts and sounds. Resources must normally be in the system folder before you can use them, however, utilities can be used to place resources in other locations where they are made available to the system. A file known as FONT/DA mover is one such utility. At startup, the resources are listed under the Apple menu (the far left menu item with a picture of an apple on it). The apple menu is usually available in all applications.

Desk accessories or DA's are a group of resources located under the Apple menu such as the alarm clock, control panels, key caps, and scrapbook. You can click on these to change their settings. The *chooser*, itself, is a resource.

Certain resources such as printer resources must usually be selected in the chooser (under the APPLE menu), and set up before you can use them. If you had two different printers attached to the Mac, you would simply click on the APPLE menu to open the pull down list. Click again on the chooser, and set up the printer you want to use to print out this particular item. The chooser is also used to set up a network and many other devices.

The system folder also contains files known as *system extensions*. Extensions are files that customize the system folder. Extensions are often memory resident utilities (or programs that run in the background) and may include memory resident device drivers. Extensions are of three basic types: *chooser extensions* or RDEVS (also known as *resource devices*), *initialization* files or INITS, and *control panel devices* or CDEVS.

Extensions can place a spell checker into memory and make it available to the applications. An Extension can be used to upgrade an older version of an application to work with the current system.

Extensions are the largest cause of conflicts on the Mac. Much like DOS TSR programs, some after-market extensions can lock up the computer, cause failure to boot problems, or mimic hardware problems. We will discuss extension problems in part two of this article.

Initialization files or INITS are extensions that customize the system at start-up with code changes and certain device drivers. INITS are usually referred to as Extensions in System 7.0 and later versions. INITS can often be customized by the user through the chooser and control panel under the Apple menu.

Control panels or CDEVS are a group of extensions that allow you to control the way the mouse, keyboard, sound, and other devices operate while you use the computer. Each control panel device or CDEV is located under the APPLE menu under control panel.

Extensions use valuable memory space and usually run in the background. For these reasons alone, extensions can cause serious conflicts. Too many extensions or incompatible ones can slow the operation of the computer, cause it to bomb, or keep it from starting up.

Getting to know a Mac

You don't have to own a Macintosh computer to become familiar with one. Locate a Mac you can use, such as one at your local library. Sit down with the Mac and read through the operating manuals (Figure 3), and practice some applications.

Look at the various folders, including the system folder. Use the finder's menu bar, and use the Apple menu which contains the chooser, control panel, and so on. Study the desktop to be sure you understand what everything means. Use the menu bar to change the view from icons to a list by name. You will quickly get the feel for the Mac and how it operates. As you work, try to understand the relationship between the system file, the resource files, extensions (or INITS), CDEVS, DAs, and the hardware. In part two of this article, we will begin troubleshooting the dead Mac and start-up or boot problems.

Servicing the Macintosh - Part 2

Part 1 of this article dealt with the basic operation of the Macintosh computer. This part will introduce basic diagnostics and repair of the dead computer and computers with start-up or boot problems.

If you have not had a chance to work with a Mac and become familiar with its operation, it would be advisable for you to do so before attempting any of the repairs mentioned in this article. You should also be familiar with terminology specific to the Mac, as well as general operating procedures as covered in the Macintosh User's Guides.

Before beginning any diagnostics, you should back up the hard disk. You should also have a System 6.XX Mac Emergency Disk on a low density floppy, and a System 7.XX start-up disk on a 1.44MB floppy. An emergency disk is simply a floppy disk prepared as a system start-up disk containing a system folder with the system file and finder. This disk should also contain any disk repair utilities, such as Disk First-Aid supplied with the system software.

You should also have available the Utilities disk containing the HD setup utilities of the proper version and a copy of Mac Check. Most Mac owners will have this software with their computers.

Basic diagnostics

The best method I have found to locate problems in the Mac is to divide all the possible problems into three general groups. Then, once the problem is traced to one of the three groups, remove suspect files or components one at a time until the problem is located.

The three general problem groups are:

- A dead computer
- A computer with start-up problems
- A computer that starts up normally but gives problems during operation.

The dead computer is often the easiest to fix. The problem in such a case may be

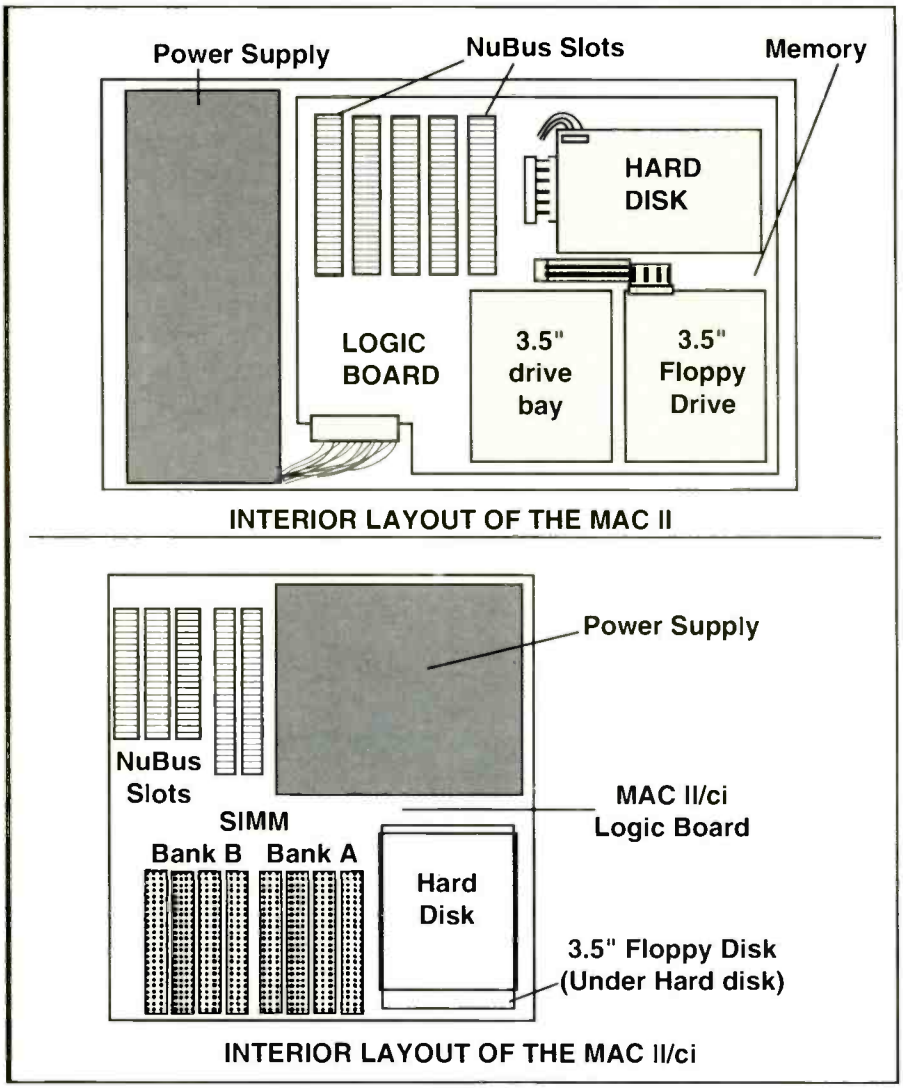


Figure 1. This is what you'll see when you take the cases off of the Mac II anad II/ci.

nothing more than a loose connection, or a faulty fuse or switch.

Diagnostics are available for the Mac in both software and firmware versions. A chart of companies providing diagnostics for the Mac is available in Part 3 of this article. Apple supplies a couple of basic diagnostics with most Macs called MAC CHECK and DISK FIRST-AID. These tools, a little patience, and a lot of common sense will solve many Mac problems without the need for additional diagnostics.

Gathering information and preserving data

In any computer service call, try to determine if anything has occurred recently that may have caused the problem. Determine if any changes have been made. Has the computer been moved or upgraded? Has a new operator been using the Mac? These and other questions can often help you diagnose the problem much faster.

It is also a good practice, as mentioned above, to attempt a back-up of the customer's hard disk where possible. You should explain to your customer that certain procedures may cause a permanent loss of data on their hard disk. The problem itself may have already caused data loss. It is part of our jobs as professionals to inform and educate the public, as well as protect ourselves from potential legal problems.

Component-level service

If you wish to perform component level repairs on the Mac, you will need to obtain service data from a company such as Sams, or from the original equipment manufacturer. In most cases, it is more cost effective to replace the defective board or component with a new or refurbished one. Several companies exist that repair and exchange parts for the Mac at reasonable prices.

The dead Mac

When you encounter a dead Mac, check to be sure that power is getting to the computer. Check all plugs, switches, cables and connectors. Check that the keyboard and mouse are plugged in correctly. Check the surge suppressor. Check the monitor switch, brightness control, and cables. Be sure all attached devices are turned on before switching on the Mac. SCSI devices, when switched on late, may not be fully operational when the Mac looks for them. In such cases, the Mac may simply lock up and look dead. Be sure that all SCSI devices, such as an external hard disk, are plugged in and switched on before the Mac is.

Once you're sure power is getting to the computer, listen for the power supply fan and hard disk motor. If neither seems to be operating, open the case and check all fuses. Some power supplies have internal and external fuses.

The logic board (or motherboard) may have up to two fuses on it. Check these with a continuity tester. Figure 1 shows the interior layouts of the Mac II anad II/ci. Check for any output voltage of the power supply. The connector (usually 15 pin) supplies several +5V, one or more –5V, and one or more 12V lines as well as ground lines. The supply may be labeled with proper output voltages under load.

Disconnect external devices

If output voltages are incorrect or nonexistent, reconnect the power supply to the logic board, and disconnect all external devices from the logic board one at a time to see if the power supply begins operating.

If disconnection of one of the external devices causes the power supply to begin operating, there is a short (or overload) on one of the attached devices. If the power supply is still dead, turn off the Mac and unplug each plug-in card one at a time, and turn the Mac back on. If the power supply starts operating then, that plug-in card is shorted causing the overload. If the supply still won't operate, unplug the power supply from the logic board and try the supply to see if the fan begins operating. If it doesn't, repair or

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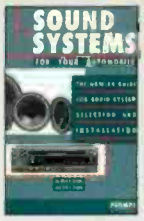

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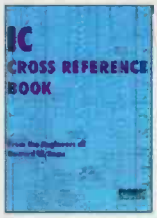

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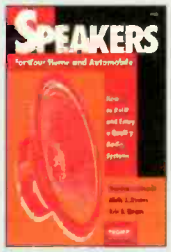

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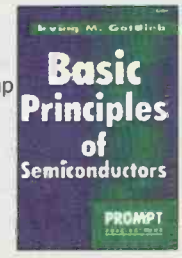

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replace the power supply. The procedure outlined above takes about ten minutes or less after you do it a few times.

Check the hard disk

If the power supply fan is running and output voltages are correct, listen for the hard disk drive motor for operation. If the hard disk is not spinning at power on, check that the hard disk is getting power. Check the internal connectors and plug-in cards (if equipped). Disconnect the hard disk and try booting the computer from a system floppy disk. If the computer boots, replace the hard disk plug-in cards (if equipped), cables, and the hard disk itself, in that order. If the computer will not boot from the floppy drive, the logic board (motherboard) is probably the cause. Try a replacement logic board.

If the hard disk seems to be operating and the computer still doesn't boot, check that the monitor light is on. If not, be sure power is getting to the monitor. Check all cables on external monitors, especially the power cable, for an open line. If power is getting to the monitor, check the monitor's internal fuse. Check that the monitor's transformer is not open or shorted. Check for the existence of high voltage. If any problems are found, repair or replace the monitor.

It could be the monitor

If the monitor seems to check out, locate the two batteries located on the logic board; usually 3.6V, either soldered in or in a battery box. If voltage is below that listed on the batteries, replace both as a set. Battery B1 powers the real time clock and PRAM. Battery B2 powers the computer's electronic start-up switch located on the keyboard. On some Macs with the electronic start-up switch, a dead battery will keep the Mac from starting. In fact, the Mac may just sit there dead until the battery is replaced.

Earlier Macs used only one battery located in a compartment in the back of the computer. Portable Macs often use a 9V battery. I recommend replacing these batteries every three years, even though they often last much longer.

Next, check the fuses on the logic board. On most Macs, there are two fuses on the logic board in close proximity to the ADB and SCSI logic board connections. Failure of these fuses will cause the ADB or SCSI ports to stop functioning. If the hardware seems to be working, there may be a start-up problem.

Start-up problems

Start-up problems occur when the Mac is getting power, the monitor power light is on, and the fan and hard disk seem to be operating, but the Mac will not boot the System. At start-up, the Mac normally beeps or chimes once to let you know everything is working. More than one beep or chime (usually with an error message on screen) indicates a start-up problem. An icon of a "Sad Mac" usually indicates a hardware problem with either the RAM or ROM chips. The computer may simply lock-up after the "Welcome to Macintosh" dialog box. I consider all of these start-up problems.

Many start-up problems can be caused by faulty hardware. As mentioned above, weak batteries can cause start-up problems. Too many NuBus cards installed on the logic board can overload the power supply and cause a failure to start or shut down during operation. Remove unused NuBus cards, or upgrade the power supply with a higher wattage version to solve these problems.

Multiple chimes and error codes

When start-up errors are indicated by multiple beeps or chimes, check the ROM and RAM chips to be sure that they haven't come loose in their sockets. Application of some contact cleaner may solve the problem. If the chimes persist, try replacing the RAM banks one at a time. If this does not solve the problem, the cure is usually a replacement of the logic board.

When I first began servicing Macs, I decided that I needed to know what all of the hundreds of Mac error codes and sound codes stood for. I assumed that knowing the codes would help solve the problem. The fact is, unless you are a machine code programmer, the codes are of little use.

A code showing a math problem in the CPU could actually have been caused by a locked up RAM chip or even a power surge, for that matter. These codes, more often than not, will lead you in the wrong direction. Common sense will often locate the problem faster than searching for the code on one of the long lists. However, the start-up chimes may often help you identify a faulty RAM chip.

A start-up chime followed by a higher tone and possibly another higher tone, then followed by two high and two low tones indicates a RAM check error. This does not necessarily mean the RAM chips are bad, but that would be the best place to start. Support chips and the CPU itself could be overheating or locking up causing the problem.

Be sure to check that all SCSI devices are turned on before the Mac. You can also unplug the Mac and disconnect all external SCSI devices one at a time and restart the Mac to see if the error chimes or codes change. If they do, you may have found the problem.

Sad Mac icon

When an icon of a Mac with a sad face appears, a hardware problem has been found during start-up diagnostics. The Sad Mac icon will usually contain an error code below it. Run diagnostics using a firmware card such as the SNOOPER card from MAXA Corporation. Check all of the potential causes listed above under "multiple chimes and error codes." The problem is likely an unseated or bad RAM SIMM module. Replace the RAM chips or SIMMs one at a time. If the problem still exists, replace the logic board.

Disk error icons

If the Mac presents an icon of a disk on-screen with a question mark or an X in it, then the Mac cannot find a disk with the system on it or the disk, if a known system disk is damaged.

To troubleshoot this one, be sure that any external drives are plugged in and turned on before starting the Mac. Check the SCSI chain for proper termination. A terminator (resistor pack) should exist at the end of the SCSI chain. Each SCSI device is given an ID number, usually with a switch located close to the SCSI port on the device. Check to be sure that the ID number is set to the device manufacturer's recommendations.

Try to start the computer from a floppy disk prepared as a system disk (an emergency disk as outlined above). If the Mac starts from the floppy disk, there is probably an extension conflict in the system folder. The cause could also be a duplicate system folder or file on the hard disk; a damaged system or finder file; a damaged desktop file; a damaged or corrupted PRAM; or physical damage to the boot blocks or structure of the hard disk.

If the hard disk icon appears on the

desktop, back up as many of the user's files as you can. While in the hard disk, remove all of the extensions from the extension folder within the system folder. Don't delete them, just drag them out of the system folder so they will not be accessed at start-up. Restart the Mac under the special menu.

If the Mac now starts from the hard disk, the problem was an extension or init. To locate the problem, replace them one at a time into the extension folder and restart the Mac each time until the problem reappears. When the problem extension is found, remove or upgrade it. In older systems, extensions may not reside in a separate extension folder. These are simply dragged from the system folder as noted above.

If no extension problems were found, use the FIND FILE command under the APPLE menu and check in the hard disk for every occurrence of the system file and finder. There should be only one system folder with one system file and finder. Some users drag the icon of an application from the floppy disk to the hard disk to install it. This incorrect method copies everything from the floppy to the hard disk.

Often, such floppy disks contain a system folder so that the disk can be used as a start-up disk for installation. This second copy of the system folder will be copied onto the hard disk. The system may not even be the same version.

Such duplicate systems will cause many problems until corrected. The correct way to install anything from a floppy is to use the installer program provided with the software. If no duplicate files were found, there may be a problem with the system file itself.

Create a folder such as OLD SYSTEM using the NEW FOLDER command under the FILE menu. Drag the system folder to this new one to copy all of its contents. Trash everything from the system folder that you can. Now install a new system from the original Apple System Disk using the installer provided. Doing this will remove all of the custom settings in the system folder. You will need to drag certain resources and extensions from the Old System folder to the system folder. The Mac will put them in the right folder for you.

Is the desktop file corrupted?

If replacing the system files does not solve the problem, the Desktop file may be corrupted. To rebuild the Desktop file, shut down the Mac. Press and hold down the Apple key (just left of the space bar), then press and hold down the OPTION key (one key to the left of the APPLE key). Now, start up the Mac while these keys are pressed down.

Remember, the Desktop file stores information about files on the disk and provides this information to the finder. This file gets larger every time a new file is added. It does not get smaller, however, when files are removed. This file can get corrupted very easily. Rebuilding the desktop removes unneeded information or cleans up the desktop, thus making the file shorter and more efficient.

If rebuilding the desktop does not solve the problem, the PRAM may be corrupted. Remember, the PRAM data is maintained by a battery. Anything that causes the PRAM to become corrupted will be maintained by the battery. A corrupted PRAM can be caused by time glitches, power surges, or just about anything else.

Zapping the PRAM

A corrupted PRAM might indicate a hard disk ID as a number that cannot be recognized by the system; so, to the sys-

tem, the hard disk doesn't exist. Restoring the PRAM to its default settings is known as *Zapping* the PRAM. Zapping the PRAM is done differently on different systems.

If the Mac is operating under System 6.XX or below, press and hold down the SHIFT, OPTION, and Apple keys with one hand. Then, with the mouse, click on the APPLE menu. Next, click on the control panel menu item. This will zap the PRAM on System 6 and below.

On Macs with System 7.XX, select RESTART from the SPECIAL menu. Immediately press and hold down the Apple key, OPTION key, P and R keys, and continue holding these keys down until the Mac restarts itself a second time. This may take a little practice, but you can use both hands to hold the keys down. The Mac begins restarting and then senses the zapping procedure and automatically restarts a second time to ZAP the PRAM.

Damaged hard disk driver

If the Mac still fails to start from the hard disk, the driver on the hard disk may be damaged. Insert a start-up disk containing the HD SETUP program for this disk (usually with the original Apple System software). Update the hard disk driver on the hard disk. Replace the system as outlined above. Now try to start the Mac. This procedure will also normally fix damaged boot blocks on the hard disk.

If this does not solve the problem, start the Mac from a SYSTEM floppy disk with DISK FIRST-AID on it (usually on the Apple System UTILITIES disk). Run DISK FIRST-AID and read all of the prompts and dialog boxes carefully before clicking the mouse. If DISK FIRST-AID found problems it could not fix, you may wish to try one of the available utilities such as Norton utilities for Macintosh, Symantec utilities for Macintosh, or Mac Tools Pro from Symantec.

As a last resort, format the hard disk

If these utilities are not available or they cannot fix the hard disk, the last resort, yet often the best one, is to format the hard disk. Be sure you have backed up the hard disk. Perform a format on the hard disk and reinstall the system from the original Apple System disk. Restore the backed up files. Check for any duplicate files, especially system files from the restore procedure.

If this does not solve the hard disk problem, the drive will probably have to be replaced; however, refer to the "Dead Mac" section above, and perform the test contained there first. If DISK FIRST-AID did not find any problems with the hard disk, check the batteries on the logic board. They may be weak enough to be causing the problem. If in doubt, replace them with new ones and see if the problems go away. Test the hardware as outlined above in the "Dead Mac" section.

If the hard disk icon does not appear on the desktop at all, try another hard disk. If it is not recognized, the problem is likely the logic board. If it is recognized, the hard disk electronics are bad and will require repair or replacement.

Take your time and think about what you are about to do, and why. Use the Apple operation manuals if you are not sure about an operating procedure. Isolate the problem area by removing as many variables as possible, and proceed to test the results of each variable removed. Part 3 of this article will look at the many operating problems that can develop while the user is running applications on the Mac.

Servicing the Macintosh - Part 3

Part 1 of this article was an introduction to the Macintosh computer. Part 2 discussed the dead computer and start-up problems. This part, Part 3, will look into the many operating problems that can occur after the Mac is started.

There are many references in this article to diagnostic software and firmware. Figure 1 is a chart of some common diagnostic software and firmware. Refer to Figure 1 when diagnostics are mentioned in this article. Figure 2 is a list of suppliers of Macintosh parts, software, upgrades, and accessories.

Always attempt a back-up of the hard disk before you begin working on a malfunctioning Mac. Operating problems are usually more of an annoyance than they are destroyers or data, however, they can be an early indication of more serious problems.

Problems can be caused by the user

Many operating problems are caused by improper use. Check the operation manual of the application being used and discuss proper procedures with the user.

Many times you will find users shutting down the Mac by turning the power off while in an application. Eventually, this will cause serious file corruption. Advise your customers that when they're ready to shut down the computer that they should close all applications they're working in, return to the FINDER desktop, and select SHUT DOWN under the SPECIAL menu. This procedure will effectively close all open files properly and eliminate file corruption. If you power up a Mac and a dialog box appears stating that the Mac was not shut down properly last time, then you know for sure that the user is not shutting down properly.

Another common user problem is what I call "Mouse Blasting." Some users click before they think. This usually leads to problems. Some users will click the mouse multiple times trying to open a window or start an application. What they're doing is repeatedly opening and closing the window or application every

COMPANIES PROVIDING MACITOSH DIAGNOSTICS

SYMANTEC 1452 Kifer Road, Sunnyvale, CA 94086
1-800-441-7234 503-334-6054

Providers of:
Norton Utiltities For Macintosh - Includes disk scan and repair utilities; Data recovery and maintenance.
SAM for the Macintosh - Virus detection and repair utilities.
MacTools Pro - RAM boot and fix-on-the-fly disk repairutility; Virus detection and repair; Disk optimizer and backup; Over 50 additional utilities for the professional.

TEKNOSYS INC. 3923 Coconut Palm Drive, Suite 111
Tampa, FL 33619, 813-620-3494

Providers of:
HELP - Desktop technical support software. Searches the Mac for over 10,000 hardware and software problems and provides an extensive printout.

MAXA CORP. 116 Maryland Ave. Suite 100
Glendale, CA 91206, 818-543-1300

Providers of:
SNOOPER Diagnostic software and firmware - provides professional, comprehensive tests on the hardware including CPU, memory, logic board, clock, Bus and ADB activity, disk drives, monitor, and more.

The following diagnostic programs are available for these Authorized Apple Resellers (both open 24 hours a day, 7 days a week):

MacWAREHOUSE 1-800-255-6227
MacMall 1-800-222-2808

Apple Personal Diagnostics - comprehensive hardware and software diagnostics. Versions 1.1 covers the Power Macintosh line of computers.
Conflict Catcher 3.0 - Start-up file management and conflict locator.
DiskExpress II 2.20 - Disk optimizer; defragmantaion; disk repair
VIREX 5.5 - Virus detection and repair.

Figure 1. Companies providing diagnostic software and firmware for the Macintosh.

SUPPLIERS OF MACINTOSH OEM PARTS

OEM PARTS *(NEW AND USED)*

NIE INTERNATIONAL
3000 EAST CHAMBERS
PHOENIX, AZ 85046
1-800-633-2869
FAX: 1-602-470-1540

Computer Products & Services
951 Clint Moore Road
Boca Raton, FL 33487
1-800-879-9999
FAX: 1-407-994-4608

REPAIRED PARTS *EXCHANGE*
Mac Works
1-913-642-6336

Pre-Owned Electronics
205 Burlington Road
Bedford, MA 01730
1-800-274-5343

NEW OEM SYSTEMS
NEW OEM UPGRADES
OEM SOFTWARE
OEM *ACCESSORIES*

MacWarehouse
PO Box 3013
1720 Oak Street
Lakewood, NJ 08701

Creative Computers MacMail
2645 Maricopa Street
Torrance, CA 90503
1-800-222-2808
FAX: 1-310-222-5800

Computer Discount Warehouse
1020 E. Lake Cook Road
Buffalo Grove, IL 60089
1-800-MAC-4CDWss
(1-800-622-4239)

Figure 2. Suppliers of Macintosh replacement parts, hardware, systems, and upgrades.

time they click more than twice. So, the small clock cursor sits and spins waiting for the user to stop clicking. In a Mac, usually one or two clicks does the job.

In many cases where operating problems are occurring, you will learn that the customer has just upgraded the SYSTEM, added new or old applications, added some EXTENSIONS or INITS, or added some hardware. The problem can often be corrected by setting up the Mac properly. Follow the installation instructions that come with the upgrade, or software. If it's not compatible with a certain SYSTEM, the instructions will usually tell you. You can also call the software companies support number listed in the manual that comes with the software.

Always question the customer about any changes that have been made recently. A few will be reluctant to tell you about that a cup of coffee that jumped up off of a table and came flying across the room at just the perfect angle to enter the floppy disk port of the MAC.

Error messages

If the customer has been getting dialog boxes with error messages or codes in them, the problem is most likely a setup and configuration problem or a conflict.

Utilities such as "Help" from Teknosis will aid you greatly in locating such a problem. If during operation a dialog box appears asking if the user wishes to format the hard disk, don't click OK. Cancel the message. If the Mac is locked up, turn the power off and boot from a floppy disk. Rebuild the desktop, update the hard disk driver, and run Disk First-Aid as outlined in part 2 of this article.

EXTENSIONS or INITS are a major cause of problems during operation. If you suspect such a problem, remove the EXTENSIONS from the SYSTEM folder as outlined in part 2 of this article. If the problem goes away, try to determine which EXTENSION is causing the problem. Help and another diagnostic called Conflict Catcher can be of great assistance in locating EXTENSION conflicts.

Fonts and font managers are another major cause of problems. Most font managers such as Suitcase are memory resident. The Mac normally requires all fonts to be located in the System folder. Since the System folder is very limited as to how many fonts it can hold, utilities such as Suitcase place fonts outside the System folder and makes them available to the system when needed.

If problems are occurring with these utilities, first try reinstalling the font manager. Next, try reinstalling the fonts. If this doesn't help, try an upgraded version of the font manager. Check the memory

setup to be sure that enough memory has been allowed for the application being used. Documents with many fonts can require larger amounts of memory.

Viruses

The Mac may have a virus. I have found viruses more common in Mac's than other computers. This is largely because Mac users exchange software more than IBM users. Also, there is a lot of shareware for the Mac that seems to contain viruses. A good, up-to-date, anti-virus program such as MacTools Pro or VIREX will usually remove the virus.

Sometimes, the anti-virus software can be the cause of the problem, especially if it is set up as a memory resident utility. In such cases, study the software program's manual to be sure it's set up correctly and that it is compatible with the system version being used.

Duplicate files

Check for duplicate files on the hard disk. Install a new System folder from the original Apple System disk using the installer. If these procedures do not solve the problem, a true hardware problem may exist. Proceed with diagnostics as outlined in part 2 of this article beginning with the Dead Mac.

Bombs

If a specific application crashes, bombs, or locks up, re-install the program using the original program disk and installer. Once installed, be sure the application is set up correctly.

Check all of the cables, connectors, and switches. Something could have come loose. Check the fuses on the logic board. If the keyboard and mouse don't respond, try replacing the keyboard and mouse. Check for viruses and conflicts as outlined above. This would be a good time to run a full set of software diagnostics such as Mac Check or Snooper, and software designed to locate conflicts such as Conflict Catcher.

Slow hard disk

A common problem with a computer that has been used for a while and on which data has been recorded and erased over and over is a fragmented disk. In this situation, data associated with either a program or data file may be scattered all over the disk. In order to retrieve this data, the head must search all over the disk. This causes the disk to operate slowly. In order to correct this problem, defragment the hard disk with an after-market defrag program such as those provided with Norton Utilities for Macintosh, Symantec Utilities for Macintosh, or MacTools Pro.

Another possible cause of slow hard disk operation is that the disk may simply be too full. The disk must have enough room for temporary storage and for hidden file use. Remove any unused or unneeded files. Reduce the number of EXTENSIONS, INITS, CEDVS, or DAs, if possible. EXTENSIONS for devices, such as a scanner, may be installed when one is not connected to the Mac. Also, be sure the user is shutting down properly.

Not enough memory

On occasion you will be faced with a "Not Enough Memory" error message. In some cases, it is apparent that the Mac actually requires more physical RAM. In such a case, upgrade the Mac to a level required by the applications.

In many other cases, however, Macs with plenty of available RAM get a "Not Enough Memory" error message on a regular basis. The cause of the problem can be traced to improper use of the MEMORY CDEV under Control Panel in the Apple Menu. Reduce or turn off the RAM DISK. Make the DISK CACHE smaller. Check other controls, and experiment with different settings until the optimum setting is found for this system and its application. Often, the Apple User manuals offer the best setup for a given Mac.

The system itself can use a large amount of RAM. Too many EXTENSIONS or other memory resident programs will make less RAM available for applications. Turn off or remove unneeded EXTENSIONS or INITS.

Memory problems can be caused by improperly installed applications. Be sure the application is installed properly. If in doubt, reinstall the application using its installer. Set up the application according to the recommendations in the user manual for that application.

Applications may need to be allocated a certain amount of memory. This is done under the GET INFO menu item when the application is selected. Zapping the PRAM may also free up more memory. The procedure for this is covered in part 2 of this article.

Most operating problems can be solved by being sure everything, including the hardware, system, and applications are installed, set up, and being used correctly. Be sure there are no conflicts or duplicate files, especially SYSTEM files on the hard disk.

The more Macs you service, the better you'll get. It's a profitable addition to any computer service business. The biggest obstacle to overcome is the fear of something new. Take the time to study the operating manuals and the Mac itself, and you will succeed at servicing the Macintosh.

ES&T Calendar

International Winter Consumer Electronics Show
January 5-8, 1996
Las Vegas, NV

Mobile Electronics Show
April 19-21, 1996
Orlando, FL

CES Orlando '96—
The Digital Destination
May 23-25, 1996
Orlando, FL
703-907-7500

CES Habitech
May 23-25, 1996
Orlando, FL
703-907-7500

1996 CES Specialty Audio and Home Theater Show
May 23-25, 1996
Orlando, FL
703-907-7500

1996 Satellite Dealers Association Annual Conference
June 13, 14, 15
Faribault, MN 55303
800-288-3824

Servicing intermittent horizontal circuits

By Homer L. Davidson

Intermittent problems in the horizontal circuits may be caused by many different components. The vertical and horizontal deflection IC may become intermittently faulty, or it may have an intermittent supply voltage source. An intermittent driver transistor or poor soldered connections at the driver transformer can produce intermittent sweep problems.

A faulty horizontal output transistor, poor emitter resistor terminals or poor soldered connections may cause intermittent horizontal deflection (Figure 1). Intermittent shutdown may occur if a component in the horizontal driver, the horizontal output circuit, or any of the voltage sources providing power to these circuits is defective.

Horizontal drifting off frequency with lines in the picture may result if any of the small electrolytic capacitors or the horizontal deflection IC becomes defective. When horizontal tearing and pulling occurs, suspect electrolytic capacitors in the oscillator circuits or voltage sources. If the voltage supplied to the horizontal oscillator deflection IC becomes incorrect it can cause horizontal lines in the picture.

An intermittent or dead TV chassis may be the result of a defective driver or horizontal output stage. One of the most troublesome circuits is the horizontal driver transformer. Poor connections between this transformer and the PC board, or shorted turns in its primary winding may cause intermittent problems.

Always try resoldering the transformer connections when the symptom is an intermittent sweep. Don't overlook the possibility that the horizontal output transistor is intermittently faulty, or that there may be badly soldered terminals if the set is intermittently faulty or dead.

Monitoring the horizontal circuits

The cause of intermittently faulty horizontal circuits may be tracked down by monitoring with the oscilloscope and DMM. Connect the scope to the horizontal deflection IC output drive terminal.

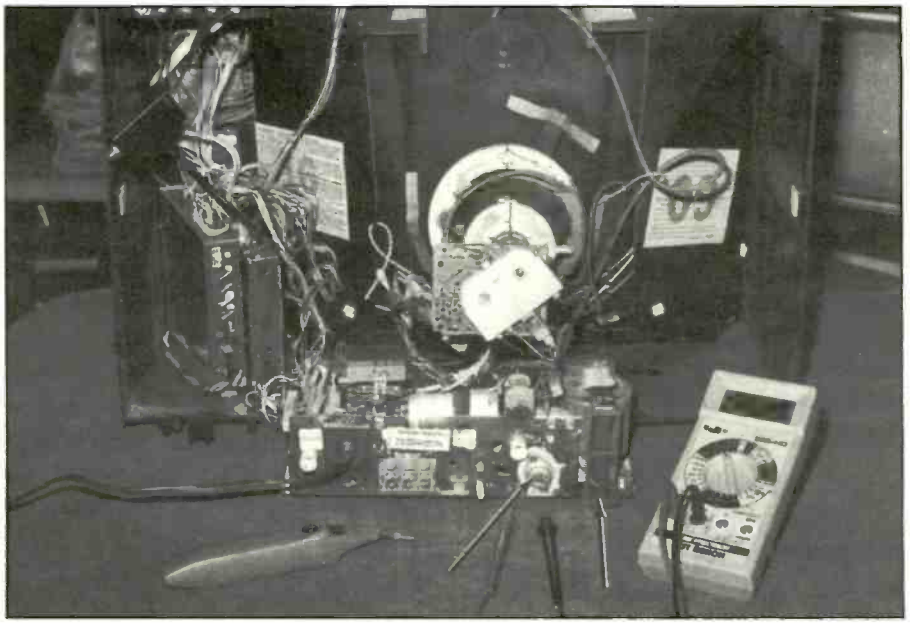

Figure 1. The horizontal output transistor and transformer cause their share of problems in the horizontal circuits.

Make sure the scope test probe or leads are clipped into the circuit, so they will not slip off and fall down into other circuits where they could cause added damage. If the horizontal drive waveform disappears, the IC or supply voltage source may be intermittent.

Connect the DMM lead to the supply voltage terminal of the deflection IC. If this voltage drops or becomes zero when the intermittent fault occurs, suspect a leaky deflection IC or dc voltage source from the low voltage power supply (Figure 2). Of course, when the horizontal deflection IC voltage comes from the fly-

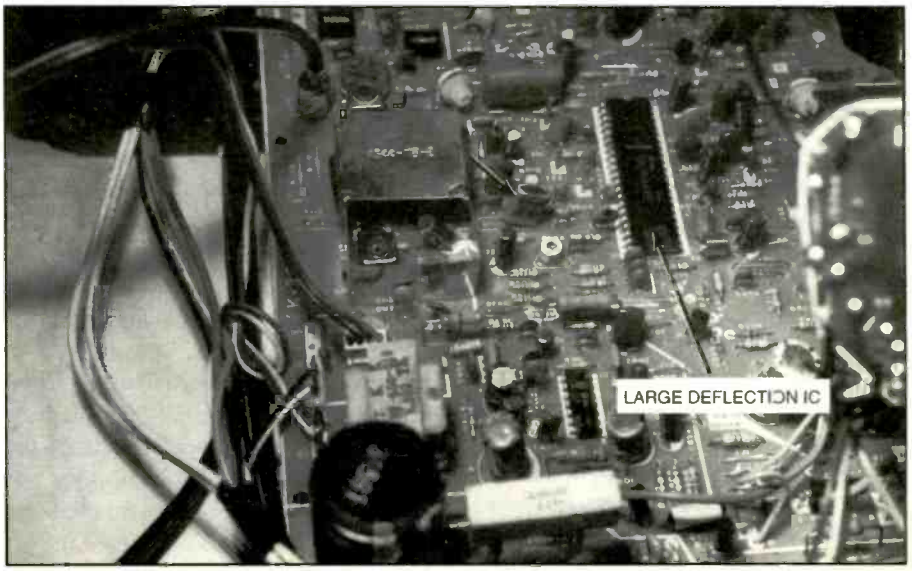

Figure 2. One large IC may contain the IF/ SIF/Chroma/AFT/Horizontal/and Vertical deflection circuits.

Davidson is a TV servicing consultant for **ES&T**.

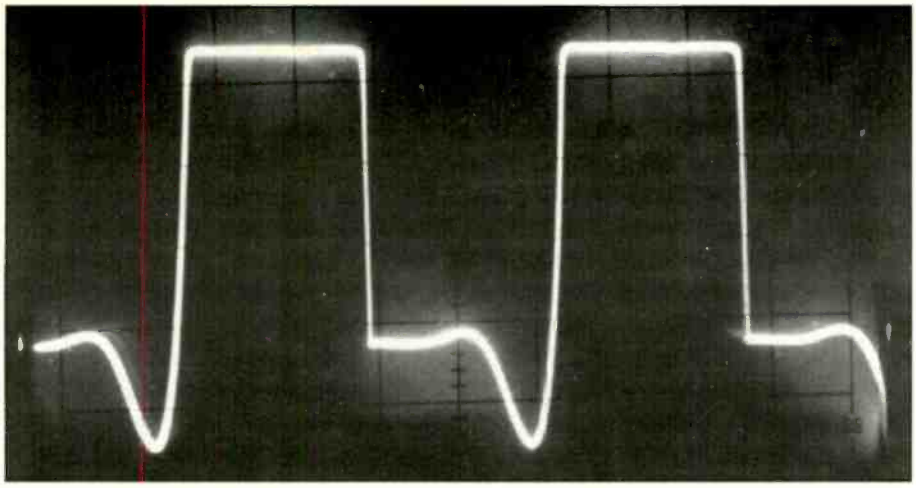

Figure 3. Check the waveform at the base and collector terminal of the horizontal driver transistor for sufficient drive voltage.

back winding circuits, any intermittent component in the horizontal circuits may cause shutdown.

If the voltage source for the deflection IC is taken from the low voltage power supply, the horizontal oscillator and amp circuits can be monitored without any problems. With the scope at the output terminal and the DMM at the IC voltage supply terminal, the horizontal deflection IC oscillator circuits can easily be monitored.

A defective deflection IC may appear open internally, which could cause the supply voltage to increase, or a leaky IC may lower the supply voltage source causing the elimination of the horizontal drive pulse. This horizontal drive waveform can be monitored up to the base terminal of the driver transistor (Figure 3).

If the horizontal deflection waveform seems normal but the chassis shuts down and appears intermittent, monitor the drive waveform at the horizontal output transistor. Then monitor the horizontal output transistor waveform with the scope probe placed near the flyback or where the yoke ties into the flyback circuits.

By first monitoring the driver output and then the horizontal output, the complete horizontal circuits can be monitored. Voltage and signal injection must be used in the TV chassis if the horizontal deflection IC supply comes from the horizontal output transformer.

Intermittent and now dead

The color TV chassis may operate several hours or days before the intermittent fault occurs. Often problems in such sets are found to be in the horizontal and output circuits. Check and resolder the connections between the driver transformer and the PC board wiring.

Measure the resistance of the primary winding of the driver transformer and compare it to the value specified on the schematic. Some manufacturers do not list the transformer winding resistance. Inspect the condition of the voltage or isolation resistor in series with the primary winding to the driver collector terminal.

The horizontal output transistor can become intermittently faulty and cause the horizontal sweep to be intermittent. If you observe this symptom, check the condition of the emitter and collector terminals. Badly soldered connections of emitter resistor can cause intermittent sweep. If the horizontal output circuits are first intermittent and then the chassis remains dead, check for a defective horizontal out-

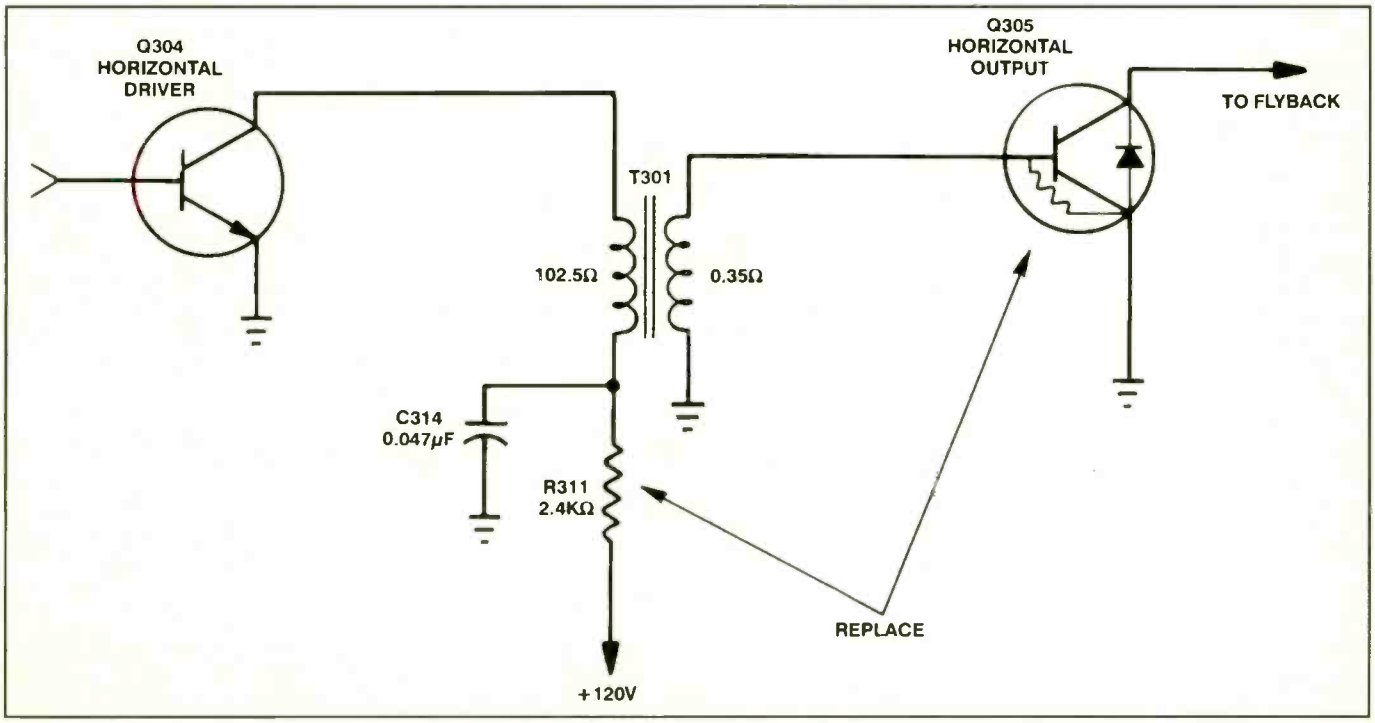

Figure 4. The intermittent and dead Emerson MS250RA TV chassis was caused by a defective R311 (2.4KΩ) resistor and a defective Q305.

put transistor. Suspect a defective flyback when other components test normal.

Dead Emerson MS250RA

A customer complained of problems with an Emerson MS250RA TV set. At first this set became intermittently faulty, and ultimately became completely dead. Initial tests revealed that the horizontal output transistor was leaky and line fuse F101 was open.

After the output transistor and fuse were replaced, the transistor became warm when the power line voltage was gradually raised using a variable transformer. There was no drive pulse at the base terminal of Q305 (Figure 4). In this model, the horizontal and vertical sweep IC, IC201, receives the supply voltage from the 8.3V flyback secondary circuits.

To determine if the IC was normal, with the set's power cord disconnected, I supplied 8.5V at pin 39 from the bench power supply. A scope check at pin 24 indicated that the horizontal oscillator deflection circuits were good. This same square waveform was found on the base terminal of the horizontal driver Q304. These circuits operated for four hours without intermittent shutdown.

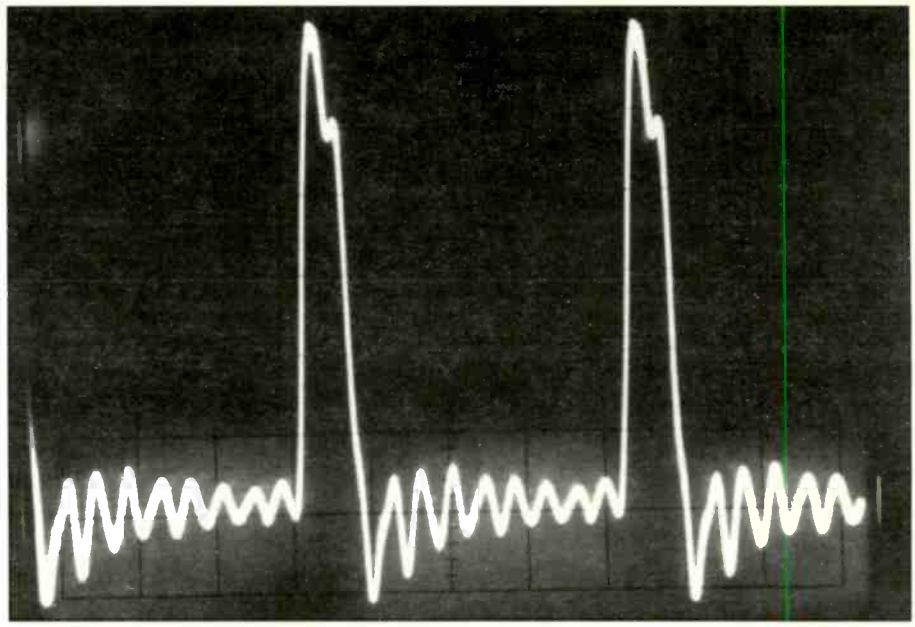

Figure 5. A test conducted by placing the oscilloscope probe near the flyback transformer will indicate if horizontal circuits are functioning.

Next, with line power applied, I checked the collector voltage at the horizontal driver transistor. A very low voltage measurement indicated a defective

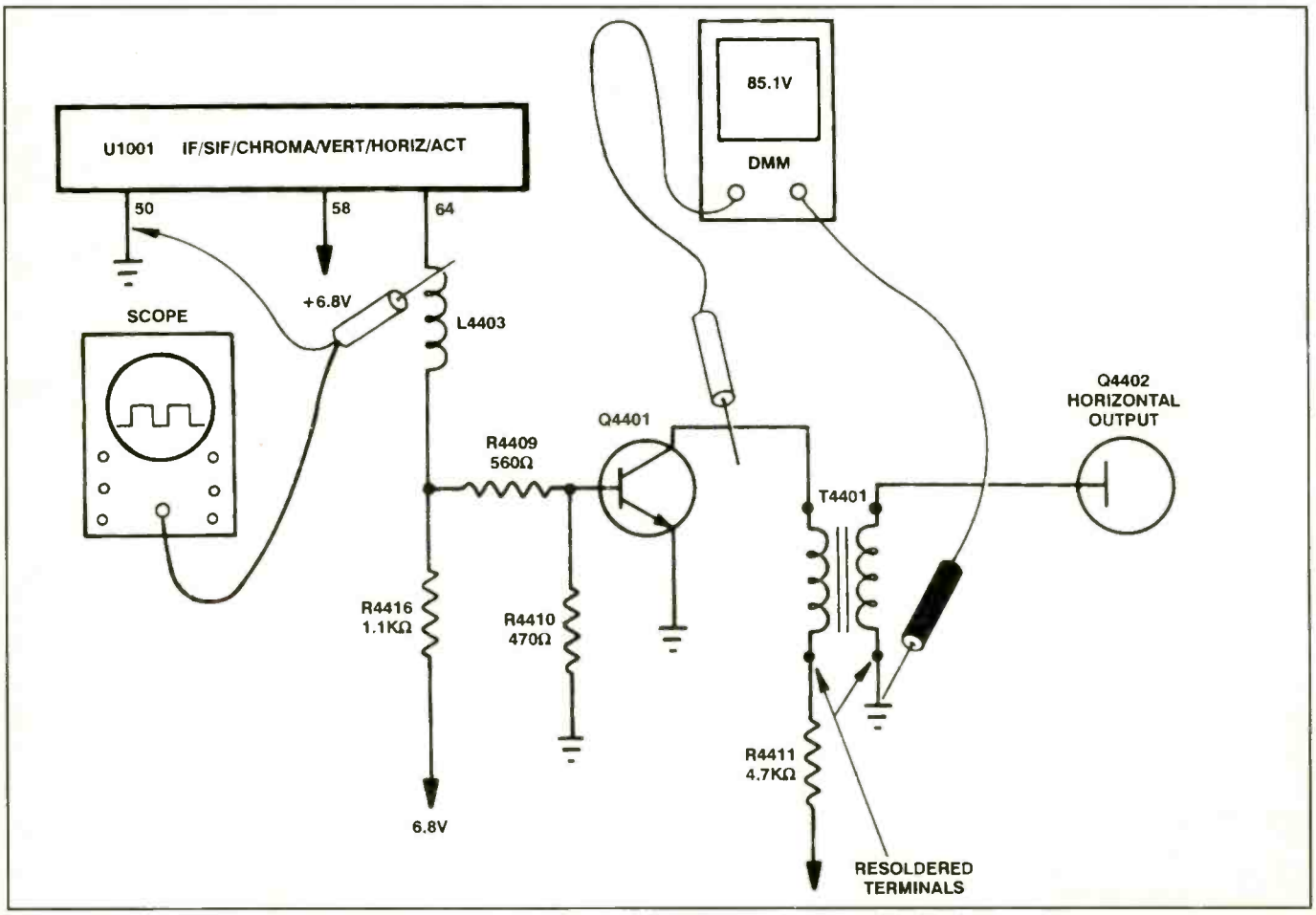

Figure 6. Monitor the intermittent shutdown horizontal circuits in an RCA CTC146 chassis at the drive pin 64 of U1001 and collector terminal of driver Q4401 with scope and DMM.

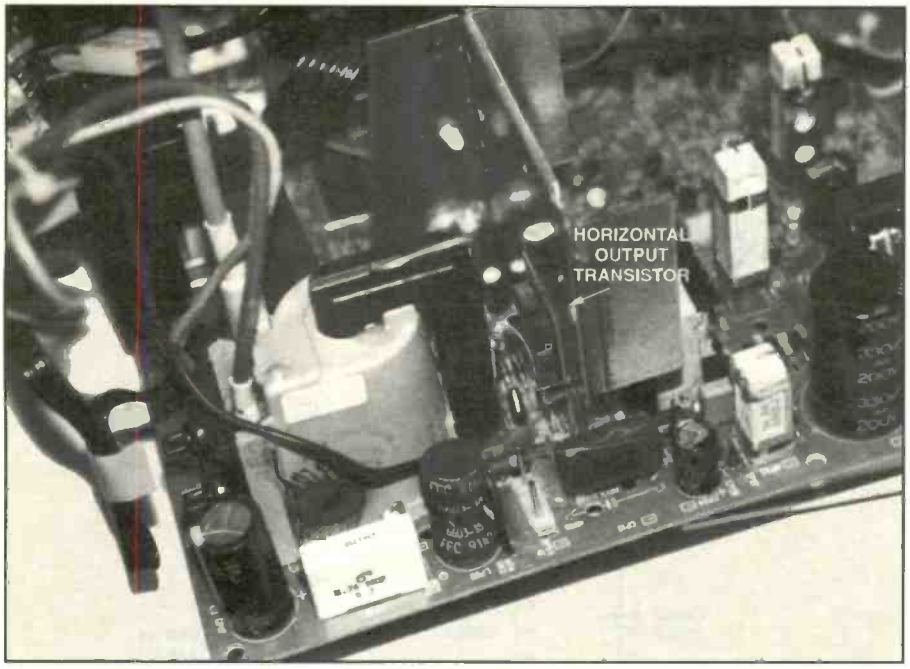

Figure 7. The new TO-218 type output transistor is insulated away from the heat sink in the latest RCA chassis.

driver stage. Often, when the dc voltage at the horizontal driver transistor is high, the drive voltage is incorrect, or the drive transistor is open. In this case, the drive voltage was present, but the collector voltage was low.

I made a close inspection of components in the vicinity of the driver transformer, T301. Isolation resistor R311 appeared to have been overheated.

The primary winding of T301 measured 100.7Ω; close to normal. I replaced R311 (2.4KΩ). I cleaned and resoldered all of the driver transformer terminals. Transistor Q304 tested normal in the circuit. After replacing the horizontal output transistor (Q305) with an ECG2302 universal replacement, R311, and resoldering the terminals of transformer T301, the set was brought back to life.

Intermittent shutdown

Although shutdown may be caused by a problem in the low voltage circuits, horizontal shutdown problems are ordinarily caused by malfunctions in the horizontal circuits. Intermittent or shutdown problems can result from insufficient drive pulse at the output transistor and drive transformer circuits.

An open emitter-to-base terminal of the drive transistor can cause intermittent shutdown. Even the horizontal output transistor can become intermittent. Improper drive to the horizontal output transistor can result from a defective drive transistor or poorly soldered driver transformer connections.

When shut down occurs immediately after turn on, suspect the low voltage sources. On the other hand, excessive

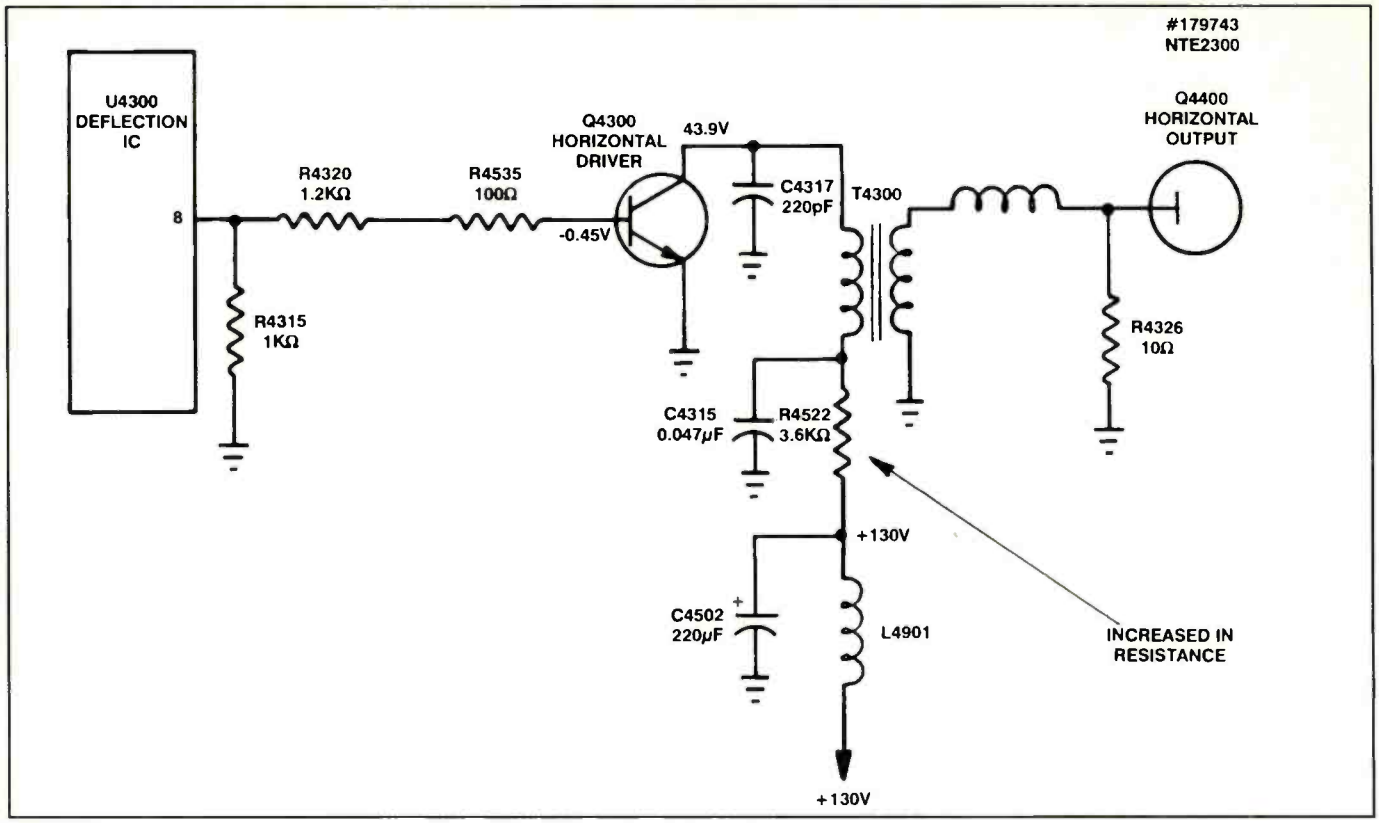

Figure 8. In an RCA CTC140 set, in which Q4400 failed over and over, replacement of R4522, C4315 and C4702 solved the problem.

voltage applied to the driver and horizontal output transistors can cause chassis shut down as well.

To isolate the cause of the problem, monitor the horizontal output circuits with a scope connected to the base of the horizontal output transistor or place the probe near the flyback transformer (Figure 5). Connect a DMM to the 120V source feeding the horizontal driver and output transistors. If the B+ 120V drops to zero at shutdown, suspect the low voltage circuits. If the scope waveform drops out, even though B+ voltage is normal, suspect the horizontal circuits.

Intermittent shutdown
RCA CTC146

The customer complained that some days his RCA CTC146 TV set would operate normally, while at other times when first turned on, the set would shut down. I connected a scope probe to pin 64 of the horizontal deflection IC (U1000) and the DMM voltage lead to the collector terminal of driver transistor (Q4401). The collector voltage measured 85.1V when the TV was operating normally. These two connections should indicate if the deflection IC, driver, and driver collector voltage, plus the 140V source feeding the driver and output transistors were good.

When the chassis shut down, there was no drive pulse from pin 64, indicating a defective horizontal oscillator circuit or supply voltage (Figure 6). In the schematic, I showed that the deflection IC (U1000) supply voltage (6.8V) was obtained from the flyback circuits. The DMM measurement had fallen below 1V, indicating that either the 140V source, driver transistor (Q4401), or contacts on the driver transformer (T4401) were defective.

Often the collector voltage of the driver transistor may drop half way down if the drive waveform at its base terminal disappears, but this condition won't cause this voltage to be as low as 1V. The first thing I did was to resolder the transformer contacts, which restored the chassis to normal. I disconnected one terminal of R4411 from the circuit and measured its resistance. It was good. The voltage at the primary winding measured 80.5V.

Other causes of shutdown of this set immediately after turn on, in addition to the horizontal circuits, are the zener diode (CR3104) in the base circuit of the 12V standby transistor (Q3107) and CR4118 in the regulated 12V source of flyback winding secondary circuits.

Keeps destroying output transistors

When either the intermittent horizontal deflection IC waveform or drive voltage is missing at the horizontal output transistor, the transistor will be damaged. Only if the drive waveform is missing for several seconds, however, will the output transistor be destroyed.

The intermittent or absent drive waveform can result from a defective deflection IC, improper supply voltage, a leaky or open driver transistor, and poor driver transformer terminals or a defective transformer. Another possible cause of this problem is a burned or poor terminal connection of the isolation resistor supplying voltage to the driver transformer.

The intermittent horizontal problem is more complex if the horizontal output transistor operates for a few days or weeks and becomes damaged resulting in a dead chassis. After replacing a shorted or leaky output transistor make sure the transistor does not run extremely warm. If the transistor runs too warm, it will not last very long. It seems the new flat-type output transistors have a tendency to run warmer than the older T-043 types (Figure 7).

Besides improper drive voltage, the horizontal output transistor's life can be shortened by a defective horizontal out-

put transformer or by an overload in the flyback circuits. An open damper diode can quickly damage the horizontal output transistor. An increase in the resistance of the voltage isolation resistor supplying voltage to the driver transistor and transformer can lower the supply voltage which will result in a lower drive waveform.

Open or dried up electrolytic capacitors connected to the driver supply voltage source can shorten the life of the horizontal output transistor. Replace both the small electrolytic capacitor and the bypass capacitor as well as the isolation resistor at the driver transformer. If the H.O.T. runs excessively warm or lasts only a few days or weeks, replace the horizontal driver transformer after other components have been replaced.

RCA CTC140 chassis keeps destroying H.O.T.

Within six days after I had serviced this RCA CTC140 set, which included replacement of the horizontal output transistor, it was brought back in for service. Callbacks are a nuisance and take up valuable service time, but as a TV technician you must find the trouble, repair and replace the chassis back into service within a short time.

If something like this happens to you, carefully measure voltages within the driver and horizontal output circuits, scope the drive pulse at the driver output and at the base of the output transistor, and observe the output waveform. Make sure that the amplitude of the waveform and the correct voltages are applied to the driver and output transistors. If you have to replace a defective replacement for the horizontal output transistor, replace it with a manufacturer's exact replacement.

In this CTC140 chassis, Q4400 was replaced a couple of times after being damaged after operating for several hours on the service bench (Figure 8). The voltage at the horizontal driver transistor (Q4300) was 12.6V too low. The supply voltage at resistor R4522 was close to the 129.7V specified on the schematic.

The appearance of the resistor indicated that it had run warm for some time. I replaced R4522 because it had increased in resistance. I also replaced capacitors C4315 and C4702 which restored the life of the horizontal output transistor. ■

Test Your Electronics Knowledge
Consumer Electronics

By Sam Wilson

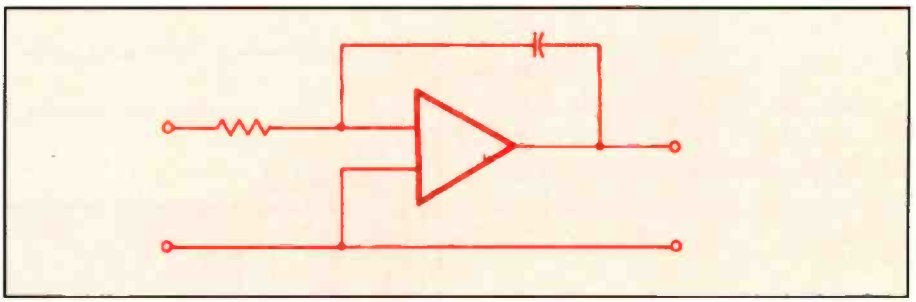

Figure 1. Is this a differentiating circuit or an integrating circuit?

Here are some questions related to consumer electronics.

1. Which of the following is correct regarding an elliptically polarized TV signal?
   A. There is no such thing.
   B. It is produced by signals reflected from water tanks.
   C. It gives fewer problems with ghosts.
   D. It results in a picture with better horizontal resolution.

2. To match a balanced transmission line to an unbalanced transmission line with minimum loss, use a(n)_____.

3. Is the following statement correct? Asynchronous counters are faster than synchronous counters.

4. Four JK flip flops can be used to make _____ counts.

5. Increasing the gain of an operational amplifier circuit will
   A. increase its output bandwidth.
   B. decrease its output bandwidth.

6. Increasing the amount of reverse voltage across a varactor diode will
   A. increase its capacitance.
   B decrease its capacitance.

7. Another way of writing transistor alpha is
   A. h_{FE}
   B. h_{FB}

8. The circuit in Figure 1 is called
   A. a differentiating circuit.
   B. an integrating circuit.

9. The high-frequency response of a video amplifier is improved by use of a
   A. varactor diode.
   B. constant-current diode.
   C. peaking coil.
   D. Schmitt trigger.

10. What is the output of the gates in Figure 2?

_____

Wilson is the electronics theory consultant for **ES&T.**

(Answers on page 43)

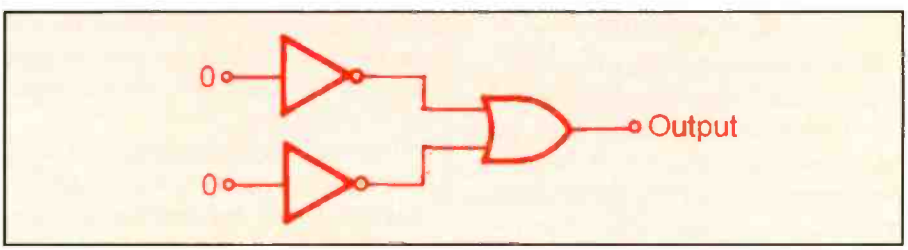

Figure 2. What is the output of these gates?

What Do You Know About Electronics?

Mostly Radio

By Sam Wilson

I get many publications and advertisements in the mail every month. I try to seek out subjects that I think will interest **ES&T** readers. In this issue I have included information I have received in the past two months.

No broadcast radio operators need apply

According to an article in Radio World, the FCC has waived its rules in order to allow unattended operation of radio broadcast stations. Fully-automated stations are now possible. This move was requested by the NAB (National Association of Broadcasters).

The ruling eliminates the need for a Restricted Radio Telephone Operator Permit. Not much has been eliminated here. The "test" didn't really test very much. The hardest part was remembering your name and address.

History lesson

On a recent news broadcast I heard that over 50% of high school graduates do not know history. That is supposed to be news? I'd like to know what kind of questions they asked to test history knowledge. What did they consider to be the important dates and events on the test?

When I went to school they left out a lot of the really good stuff in history class; like who was R.A. Fessenden, and what great thing did he do in 1902?

Of course, every reader of WDYKAE? could answer that one. Fessenden was the first to send music by radio. The music was received at a distance of 48 miles.

RDS and RBDS

RDS (Radio Data System) has been in operation in Europe for a long time. The U.S system, RBDS (Radio Broadcast Data System), is about to be launched. Both systems allow FM stations to transmit data to anyone with a receiver equipped to receive it. A few examples of how it can be used are given here:

- Promotional information (such as the name of the recording company and rating of the songs and music being played).
- The name of the artist(s).
- Title of song(s) and music being played on the station.

Stations can earn additional income by using the extra RBDS system for paging, and leasing the system to companies with special applications. One example is the use of the RBDS system to broadcast stolen or lost credit card information.

Figure 1 shows the spectrum of the FM station with RBDS and the newly-allotted dual SCA (subcarrier authorization) services. The allotment for RBDS is a low-amplitude, narrow-band signal.

Radio listeners who want to adapt their current radios to RBDS will need an add-on unit that displays the added information in an alpha-numeric readout. The station can use 16 different data groups. Each one has four blocks of information that is 26 bits long.

There are 16 possible data groups available, but only 13 have been assigned. Your job, should you decide to accept it, is to come up with an exciting new application for the remaining groups.

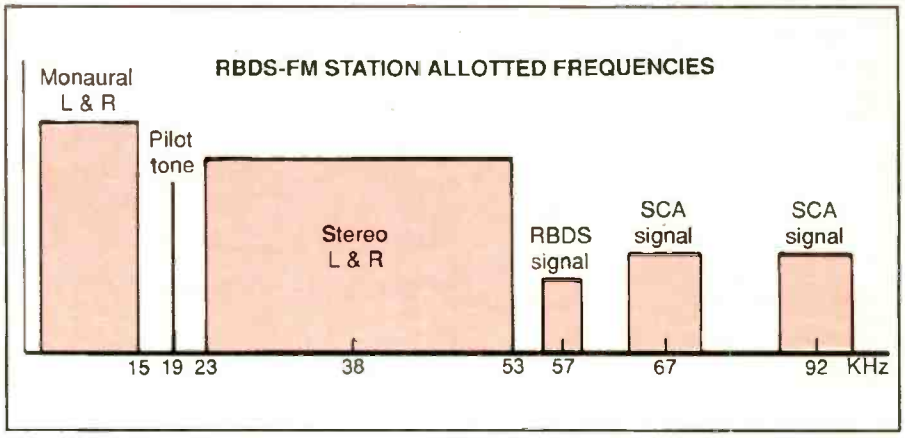

Figure 1. This is the spectrum of the FM station with RBDS and the newly-allotted dual SCA services. The allotment for RBDS is a low-amplitude, narrow-band signal.

There's another million dollar idea.

One application of RBDS allows the consumers to select their favorite entertainment format. The RBDS equipped radio will page through stations and select one with the desired format (talk show, news, rock n' roll, whatever). There are over 30 program types to choose from.

Maybe, just maybe, you will find something you like on the radio.

Who will be able to service these?

A company called ROLLS Corporation of Salt Lake City, UT, has announced a new audio system. Their model RP220 provides clear sonic quality and performance for the working musician, studio engineer, or anyone who needs a preamp with a "warm, smooth, analog sound."

The RP220 uses 12AX7A tubes in a unique configuration to give smooth, controllable gain with true transformer balanced inputs. The RP220 has several inputs and outputs, and MIC/line switches on the inputs and outputs to adapt to any performing or studio situation.

Why tubes?

The primary purpose of a preamp is to provide low-noise gain to microphones and instruments without coloring or distorting the sound in any way. But any

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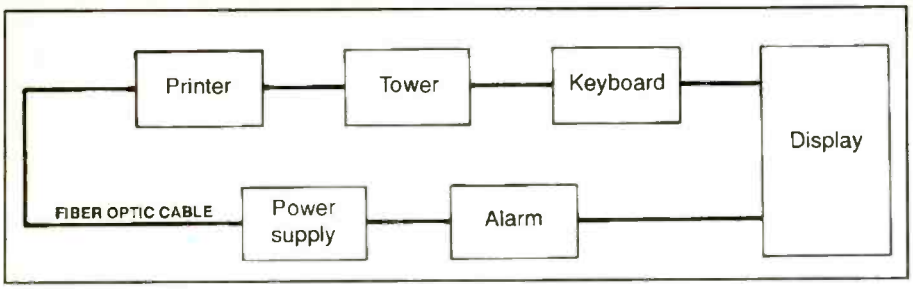

Figure 2. Here's a way to use fiber optic conductor as a burglar alarm: thread the cable through your computer, printer, tower, etc., then connect it via the appropriate optical interface to the alarm. This scheme can also be used to protect your stationary test equipment.

audio electronic device seems to have a characteristic "sound." Sometimes that sound can be pleasing, sometimes not. Tube preamps have gained in popularity recently because some audiophiles do not like the so-called "digital sound" of digital recording equipment.

Many engineers prefer the "sound" of analog recording equipment but like the editing and predictability of digital. Because tubes have some natural compression before they clip, and when they do clip they have a more even harmonic structure, they have a smoother sound than solid-state preamps. Attempts to duplicate these characteristics with solid-state circuits have had limited success.

Specifications for the RP220:

- •Frequency Response: 20Hz to 20 KHz, +1dB
- •Input Impedance: 600Ω balanced low Z, 10kΩ line, 1MΩ instrument.
- •THD: 0.05% typical
- •Max Gain: 40dB Instrument or line, 60dB low Z
- •Indicators: 5-segment output level, +48V LEDs, Power Status LED
- •Dimensions: 3.5" x 6" x 19" (89mm x 162mm x 482mm)
- •Power: 120Vac (230Vac) 15VA.

Speaking of FM

This is a good place to review some basic FM terms.

The *frequency deviation* (ΔF) of an FM signal is the amount of frequency change above and below the carrier (center) frequency. Deviation is measured in Hertz.

The *modulation index* (ß) is the ratio of the frequency deviation to the audio frequency that produces that deviation.

The *frequency deviation* and *modulating frequency* are related to the *modulation index* by the following equation:

frequency deviation modulation index = modulating (audio) frequency

In symbols, that would be:

$\Delta F\ ß = \Delta F/F_m$

The sidebands of an FM signal can reach out a great distance from the center frequency. A practical measurement is to include only the sidebands that have an amplitude of 10% or more of the center frequency. The usual equation for the bandwidth is:

bandwidth (BW) = $2 \times F_M (1+ß)$

Vocabulary time

Vocabulary is an important part of your electronics knowledge. O.K., so you know:

- what a goniometer is used for,
- what an Adcock antenna looks like,
- what a vector diagram of the coriolus effect on a 600mph jet traveling west-to-east looks like.

Knowing those definitions might get you points on next month's Test Your Electronics Knowledge.

But what if someone asks you to define thermography? Can you do it? (My Dictionary of Technical Terms spells it thermiography, but a company that makes them spells it thermography).

Sure you can define it. You know that everything in the universe radiates heat at temperatures above absolute zero. You also remember that the heat is radiated in the form of infrared radiation. And you know that thermography is the technology of measuring temperature at a distance by measuring the amount of infrared radiation from a body and converting it to degrees temperature.

Plastic cable

Not all fiber optic cable is made with glass. DuPont developed a plastic fiber optic cable called Crofon that has been in use since 1969. It can be bought in a 1mm (0.0394 inch) diameter cable encased in a 2.2mm optical cladding.

Joe Risse sent me the plans for using any fiber optic conductor as a burglar alarm (Figure 2). The idea is to thread the cable through your computer, printer, tower, etc., then connect it via the appropriate optical interface to the alarm. This alarm system can also be used to safeguard your stationary test equipment.

When the burglar cuts the fiber optic conductor it breaks the light beam and sets off the alarm. You can design this simple system yourself. Use their CLOE-1040. Get the specs from:

Crofon Marketing
774 Limekiln Road
New Cumberland, PA 17070

CEG). CD players also had an excellent month across the board, especially in the autosound category. While overall audio sales decreased slightly in July by one percent, year-to-date figures show a six percent increase in audio equipment, totaling more than $4.2 billion.

"With the growth of home theater and the audiophile market, consumers are realizing how high-quality speakers improve any audio system," said Katherine Gornik, president of Thiel Audio products Company and chair of EIA/CEG's audio division. "Using four or five speakers to achieve surround sound capabilities enhances the audio environment and creates a new listening experience for your favorite music and a new viewing experience for your favorite movie. As consumers learn more about the wide range of high performance audio products, we expect audio sales volumes to increase for both 1995 and 1996."

The separate components market posted the best numbers in July rising eight percent from July 1994. Speaker sales jumped 70 percent in dollar terms compared to July 1994 figures. Factory shipments of traditional shelf, floor and wall-mount speakers were up 35 percent to $24 million in the month and totaled $156 million in the year-to-date. High-capacity CD players (10 or more discs) also showed continued growth in July, rising 21 percent to $4 million.

Audio system sales remained strong overall, rising five percent to the highest monthly sales total this year and a new record tally for the month of July. Compact system sales rebounded from slower second quarter sales with a 22 percent July surge and totaled $538 million through the first seven months of the year for a gain of eight percent. Rack system sales fell 27 percent in July and are down two percent in the year-to-date, totaling $278 million in sales.

Autosound sales slipped three percent from July 1994. Although sales of head units and amps softened, speaker sales surged. Factory dollar volume of car audio speakers rose eight percent in July, the largest gain in several months. Car CD players rose ten percent in July and were up 29 percent in the year-to-date. At the same time, cassette tape head unit sales fell 22 percent from last year.

Cassette tape recorders and personal portable CD players were the two brightest spots in July's portable audio market. Sales of microcassette, shoebox and mini-standard recorders were up 15 percent in July with shipments of $20 million. In the first seven months of the year, sales for these items were up 17 percent totaling $123 million. While personal portable CD player sales continue to be strong, boombox CD players saw some disappointment. Total sales of one-piece and three-piece models fell by more than 20 percent in July. For the year-to-date, shipments were off seven percent. ■

Test Your Electronics Knowledge

Answers to the quiz

(from page 43)

1. C - The reflected wave is out of phase with the incident wave and it is effectively canceled. That eliminates the reflected (ghost) signal.

2. BALUN (BALanced to UNbalanced) transformer, or 300Ω to 75Ω matching network.

3. B - Synchronous counters are faster because all digits change at the same time. The disadvantage is the (sometimes) heavy load on the power supply.

4. sixteen (0 to 15)

5. B - I'm still waiting for someone to show me how to increase the gain and bandwidth of an amplifier at the same time.

6. B - Increasing the reverse voltage increases the size of the depletion region. The depletion region acts like the dielectric. Increasing it means moving the "plates" (N and P regions) further apart.

7. B - It stands for "hybrid Forward Base parameter."

8. B - That is what it is *called*. As many readers have pointed out, it only approximates integration.

9. C - It is a coil wrapped around a resistor. The resistor lowers the Q and that results in a greater bandwidth.

10. Logic 1

[Continued from page 45]

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SCC-F84U-A 3580
SCC-F85P-A 3580
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Will Total Quality Management work for you?

The pros and cons of implementing TQM

By John A. Ross

In a series of past issues, the "Business Corner" section of this magazine has explored the fourteen points of the Total Quality Management (TQM) philosophy. As set forth by W. Edwards Deming, those points offer advice about instituting leadership, empowering workers, providing resources for a successful work environment, and moving the organization toward TQM-style management.

The TQM approach redefines "quality" for the workplace and asks that organizations incorporate quality into every process. Quality, in this sense, becomes the attribute or attributes of a product or service that the customer values. This combined emphasis on quality products and customer needs, and the success enjoyed by companies using TQM, have spurred continuing interest.

The "Business Corner" articles presented positive applications of TQM. Despite the continuing popularity of the approach, it is useful to consider whether TQM will work for your situation. Rather than solely rely on the 14 points for this discussion, this article will look at the central characteristics of TQM.

Those concepts are: 1) a systems approach to management; 2) the support of top-level management; 3) participative management and teamwork; and 4) the use of evaluative processes. Each of those characteristics must be in place for the approach to work as designed. Unfortunately, those characteristics do not always spell success for organizations implementing TQM.

TQM characteristic number 1: A systems approach to management

The systems approach to management considers four principal factors:

- *inputs*; anything needed to accomplish organizational purposes,
- *throughputs*; the processes and activities of the organization,
- *outputs*; the things produced by the organization, and
- some type of *feedback* or *monitoring* device.

As a result, the use of systems theory also means that the TQM approach can only be understood as parts working in relation to other parts. The benefits of the use of a systems model becomes evident early in the TQM process since point 1 tells us that the organization must acknowledge, clarify, maintain and carefully focus its vision.

A typical situation:

As an example of the systems approach to quality, a television service organization will receive customer service orders (inputs). The service orders become part of the process. Within the process, one individual may review the service order, analyze the skills needed to address the problem, assign the work, and then dispatch a team to perform the service on the television (throughputs).

Outputs of the systems approach are, it is hoped, a repaired television, customer invoices, and accounting records. Feedback may appear as payments and customer recommendations. This systems approach to quality seems simple until the organization discovers that it is possible that external influences also may have long-term effects on the process.

The ownership supplies and controls resources such as equipment, parts, and training for the service department (inputs). The personnel department identifies the qualifications that the service personnel should possess, advertises available positions, schedules interviews, and makes recommendations about employee selections (inputs). In addition, the company has to maintain close relationships with a variety of suppliers (throughputs). Customers ask for courteous, qualified, and efficient personnel to quickly repair their televisions and respond when the repairs are not completed (feedback).

Why TQM works:

With that situation, the individual parts of a system are important because each part contributes to the success of the whole. The application of systems theory means that each piece of the organization has a relationship to its external environment. In this case, the conduct of the technicians, the hiring practices of the personnel department, and the purchasing habits of the manager have a direct relationship to customer needs and satisfaction. The success of the service company depends on happy customers.

With TQM, the quality that goes into the production process and the management of the organization are the cooperative functions of everyone in the organization. The systems approach works well for the television service company because it brings each of the separate units of the company into an active framework.

According to a long-time manager, the use of the systems model "sets an active framework for goal attainment and helps to maintain control of the system." An independent quality control specialist voiced nearly the same opinion concerning the use of systems theory and TQM. In his words, corporations must take a "systems approach to quality."

Why TQM may not work:

One problem with the application of the systems theory is that it places a higher priority on organizational goals rather

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

than individual goals. For the service company, the over-emphasis on inputs, throughputs, and outputs may not allow new ideas to rise to the surface. As an example, the service technician may have a better method for scheduling calls. Or, an individual with outstanding potential may become "pigeon-holed" because of his contribution to the inputs, throughputs, and outputs of the system.

Even though the organizational emphasis may seem necessary and well-founded, an overemphasis on the task may cause some top level managers, subordinate managers, and other subordinates to ignore ethical dilemmas, potential legal problems, or other consequences given through the completion of a task.

As an example, when the U.S. Postal Service implemented a result-oriented management system during the 1970s, lower level managers gave false reports about goal attainment in an attempt to lessen the pressure on themselves.

Throughout the TQM philosophy, feedback in the form of statistical information is a central concept that defines high quality standards. However, the type and amount of feedback given by top level managers, subordinate managers, the work force, and the customers also can affect continual process improvement.

Indeed, for TQM, the quality of feedback seen throughout the organization is crucial. Feedback opens a window for observation and monitoring. Measurements made throughout the process help to ensure that the end output will match the desired output and that all parts of the process are improving. An absence of feedback or the provision of tainted feedback can manipulate the entire process and take away the control needed for management. Moreover, the required attention to detail and constant flow of information may require additional forms and more time for interpretation.

For the television service company, this approach can bog every process down, as managers insist on receiving duplicate reports or intricate forms from the technicians for the purpose of illustrating and verifying completed results. Here, the production of paperwork, rather than the attainment of the original organizational objectives, becomes the main objective. As a consequence, the organization has a tendency to overemphasize quantitative goals.

The reliance on feedback and quantitative goals sets up opportunities for management failures and increases the possibilities for employee dissatisfaction. Arguably, the correct uses of statistical feedback and measures hinge on the correctness of the data.

As British economist Ely Devons eloquently pointed out in 1954, the sole reliance on quantitative analysis by an organization may be the same as a tribal shaman examining the entrails of a chicken. For both the tribal and modern cultures, the examination has merit. However, the sole reliance on, and the assumed credibility of some type of quantitative data may be misleading.

TQM characteristic number 2: The support of top-level management

TQM requires that top levels of management both support and understand the management and change processes. Before any organization can implement TQM, the top-level management must make a commitment to their training about TQM, their decision to hire a TQM consultant, the time taken to draft an organization vision statement and goals, the time taken to draft policies, and obtain needed tangible resources.

With his 14th point, Deming advises top-level management to, "put everybody in the company to work to accomplish the transformation." With this advice, TQM asks departments and management to act as productive, interrelated units. Top management in the TQM scheme has the responsibility of maintaining the cohesiveness of the units.

A typical situation:

Recently, Ted, a services section manager, attended a staff meeting for his computer service organization. At the meeting, the owner asked everyone to make a list of recommendations for the future direction of the company. In addition, the owner went on to say that the recommendations could involve management, personnel, equipment, and other resources. Finally, the owner stated that the organization would respond to changing customer demands by enacting a strategic planning effort.

Ted left the meeting with a smile on his face. For years, he had requested personnel and equipment but had never received any response. During the weekend, Ted prepared and reviewed his recommendations. As he headed towards the office the next Monday, Ted felt confident that his recommendations would receive their deserved recognition. At the next staff meeting, his confidence grew even more as the owner read his recommendations to the staff.

Today, six months have passed since that staff meeting. Ted's section continues to request equipment and other resources. Other sections in the organization received new computer systems and additional personnel. When the owner speaks to Ted, he never mentions the staff meeting or the later requests. Ted is puzzled and wonders how to react.

Why TQM works:

Here, the word "transformation" is a key term since transformation requires an eye toward continual quality improvement and an understanding of personal interactions within the organization.

The transformation occurs when managers cease to look at the organization as a collection of independent parts but rather as an interactive whole. Although Ted hasn't received the resources that he needs, the transformation of the entire organization requires an awareness of each section.

In addition, the transformation of the organizational attitude also means that management must recognize how each section contributes to the success of the organization. With the TQM philosophy, the organizational attitude becomes an attitude geared towards quality and customer satisfaction. Therefore, the organization must define the link between those two characteristics. As a result, this new attitude initially may result in the uneven allocation of resources.

Why TQM may not work:

As an ideal, TQM has all the ingredi-

ents that would attract top-level management attention. Every manager would like to have an organization where individuals consistently strive for the best, constantly keep improving, and where empowered employees make decisions. In short, the ideal is a winning team.

An electrical engineer confirms that top management support and understanding is essential for the successful application of the TQM approach. He tells us that, when top management misinterprets the process and only provides half-hearted support, TQM fails. Furthermore, he finds that TQM only works when top management understands that the TQM systems approach consists of a number of interrelated pieces and that the TQM strategy is based on long-term, quality-oriented goals rather than short-term fixes.

A quality control manager also points out that "lackluster top management support can defeat the best of intentions when attempting to implement TQM." The management approach can fail because of the lack of commitment given to organizational change by top-level management. As the situation with Ted shows, top managers may consider the implementation of TQM as a cost-cutting strategy and withhold support for the approach when the expected cost benefits do not become evident.

Complete managerial commitment requires the recognition that organizational change is not a short-term effort. Certainly, the transformation of Ted's organization requires an organization-wide response by his managers. However, as Ted suspects, total transformation may be an excuse for no action or may present a message about the importance of one section as compared to another.

Although empowerment has rapidly become a cliche, that concept is one fundamental piece of the TQM strategy since empowerment implies trust. Managers who have little or no trust of their employees or are highly competitive often find empowerment difficult if not impossible. From this perspective, the actions of the top-level manager, not his or her words, carry more weight for the employees. For Ted, managerial actions have affected his confidence in the organization and may encourage conflict.

TQM characteristic number 3: Participative management and teamwork

Through participative management and teamwork, TQM asks for leadership to emerge at all levels. Because employee expertise is valued, everyone contributes actions and knowledge toward a common cause. With everyone involved in the decision-making, it becomes easier for everyone to understand the everyday processes, to see the causes of the problems, to find and test alternatives, and makes it easier for everyone to gather the information that they need.

Some problems require the coordinated efforts of people from different areas while other problems are so complex that only integrated group discussions yield quality problem-solving decisions. From there, the collective group of individuals can make rational, fact-based decisions. With everyone participating in the decision, the solution will reflect the interest of the group as a whole and implementation will be easier.

The TQM approach adds quality throughout the entire process by emphasizing employee expertise. Several of TQM's 14 points emphasize the well-being of the individual within the organization. That emphasis takes the form of individual empowerment through the collective decision-making of participative management and through the availability of resources. Both of those organizational characteristics cause pride in the workplace to flourish.

Quality evolves from that pride, becomes an organizational attitude and drives the organization to a higher level. As a result, quality exists when employees are secure in the workplace and are allowed to exhibit pride in their workmanship. Security and pride-in-workmanship evolve from cooperation and the absence of competition in the workplace.

A typical situation:

Several months ago, a new manager assumed control of the information systems department in a research and development company. Like most new managers, Bob had many ideas for changing and improving the department. Rather than push his ideas onto the thirty employees, Bob divided them into quality improvement teams and gave them the mission of defining the strengths and weaknesses of the department, and making recommendations for improvements. In contrast to his predecessor, Bob also instituted participative management. Each of the thirty employees gained additional management-level responsibilities and, as a result, became more accountable.

Why TQM works:

Studies completed in 1987 and 1990 conclude that the vast majority of organizations utilized employee involvement as a method for improving the bottom line. According to those studies, companies found that participative management produced gains in productivity, quality, and employee motivation. With efficiency and effectiveness a welcome by-product of increased employee morale, top level management made employee participation a priority for business reasons rather than reasons such as a better working environment or enhanced opportunities for growth.

Bob's actions illustrate that a key part of continued process improvement is the setting up of process-action teams. These teams consist of individuals that have expert knowledge about given areas. Members of process action teams apply the principles and tools of TQM and their knowledge about the processes to identify opportunities for process improvement. In addition, the process-action teams seek to understand existing processes and identify where the greatest gains can be realized from process improvement; to provide recommendations for process improvement; and to implement process improvement.

Why TQM may not work:

TQM offers to include everyone in the decision-making process by emphasizing the importance of participative management. However, in some opinions, participative management works as another method for manipulating employees. From this viewpoint, employee partici-

pation becomes crucial for the implementation and acceptance of organizational goals supported by the top-level management. While Bob may have the best intentions, he is in a position to use his influence, as a new superior, to gain consensus from the teams.

Also, the ideal of participative management may not be applicable in all cultural settings. From this perspective, the successful application of participative management depends both on managerial and employee trust and participation. A leading psychologist considers the limits of participative management by saying that: "Surely trustfulness depends also on who the manager is dealing with. To trust psychopaths or paranoiacs is not generous but foolish. Any outlook which encourages us to trust everybody is an unrealistic dogma. . . ." The facts do tend to support participative management insofar as the culture is good enough, the people are psychologically healthy, and the general conditions are good.

For Bob, the move towards participative management occurred before trust could build between himself and his employees and with little awareness of employee potential. Quite possibly, some of Bob's employees may not have the willingness or the required abilities to assume added responsibilities.

As a new manager, Bob may have a need to remain involved in much of the decision-making. Yet, his move toward participative management may make this involvement more difficult. The total reliance on participative management may allow managers to delegate all authority to their subordinates.

In these situations, those given direct responsibility for organizational processes become less involved in the decision-making processes. Those given advisory positions gain involvement through delegation and gradually take over the details of the process. With the wholesale delegation of responsibility away from the line managers, goal displacement or the turning away from the original goals of the organization may occur.

As shown, TQM and the continuous adding of quality to a process calls for participative management and teamwork. An important reason for the success of the teamwork concept is the advantage given by pooled knowledge and judgment, and the elimination of turf control. Nevertheless, participative management may fail when it quiets voices that should be heard.

Often, a certain project or problem requires clear lines of authority. When confronted with truly complex problems, teams may not be able to agree on the one best solution. As a result, the presented solution is the result of a compromise or is compromised. If the majority produces a bad decision, then the teamwork process may be ruined.

TQM characteristic number 4: Individual values

The successful implementation of TQM requires an assessment of the strengths and weaknesses of both the structure and culture of an organization. An organizational culture is the collective values and beliefs of an organization's members that develops over a number of years and is passed on to new members.

In some cases, the organizational culture is reflected in the symbols used by an organization, its rhetoric, and the actions of its members. Some organizations have cultures that radiate success and have a clear sense of mission; others have rigid patterns of behavior or cultivate distrust among managers and workers.

Organizational structures can be summarized in two basic forms. A centralized, functional structure has a clear vertical chain of authority for decision-making and communication. In addition, it has many explicit rules and specialized functions. Decisions are usually made from the top down with rewards tied to individual or group performances. In this type of organization, employees are valued because of their compliance and the goals revolve around giving the customers the most for their money.

A decentralized, product-oriented structure has a network of influence and communication and few general rules. Decisions are made both from the top down and from the bottom up while employees are rewarded for creative teamwork. The organizational goals involve leadership and quality in the products and services provided.

As with all management theories, TQM has both good and bad characteristics. Much of the advice given by TQM, such as the prioritization of pride in workmanship, empowerment of the individuals, and quality, would work well when meshed with any organizational management theory. The important characteristic of all management theories is recognizing how the individual as a resource in the organization balances against the human needs of the individual.

TQM seeks to bring out the positive characteristics of individual behaviors within the organizational context. For managers, an assessment of individual reactions to change may show that the organizational culture itself is a barrier to quality production. Once the top management makes a total commitment to the "quality vision" and the concept of teamwork, the organizational culture can begin to change.

When the leadership recognizes the need for empowered employees, education, training, and recognition, employee attitudes change. In addition, the awareness of external pressures also affects the willingness of employees to change.

According to one quality consultant, concerns about market share prompted his organization to move toward TQM-style management. In his words, the organization found "that a sense of distributed accountability for quality created ownership. The total commitment to continuous improvement increased the focus on the needs of the customer."

Because of the external influences of market pressures and customer opinion, both the organizational culture and individual attitudes changed. In many instances, the response by management to these pressures is also a response to requests made by employees.

A typical situation:

Each of the previously presented situations offers a taste of organizational culture. The application of the systems approach seems to ignore culture while concentrating on organizational terms such as inputs, throughputs, outputs, and feedback. In one instance, a section man-

ager understood that he had the support of the top management but didn't see the results of that support.

From the perspective of that manager, those top managers lacked an awareness of his organizational and personal needs. In another instance, a new manager decided to implement participative management and team processes without taking a careful look at the organizational culture or the talents, strengths, and weaknesses of his employees.

Why TQM works:

The effect and promise of organizational change becomes apparent when reviewing the application of TQM in actual circumstances. According to a quality control manager for a leading electronics manufacturer, concerns about market share prompted the corporation to move towards the TQM philosophy.

Once the top management had made a total commitment to the "quality vision" and the concept of teamwork, the organizational culture began to change. The managers recognized the need for empowered employees, education, training, and recognition.

By establishing corrective action teams, department quality teams, and process improvement teams, the organization gained a commitment to quality. Again quoting the quality manager, the organization found "that a sense of distributed accountability for quality created ownership. The total commitment to continuous improvement increased the focus on the needs of the customer."

Because of the external influences of market pressures and customer opinion and the internal recognition of the need for change, a balance occurred between organizational and individual values.

Why TQM may not work:

Instituting TQM means instituting change. Surprisingly, though, the TQM process does not affect all employees in the organization and does not represent a total organizational commitment. A 1990 survey of companies utilizing quality management showed that only 17 percent of the respondents reported the complete use of TQM throughout the company. On the average, 41 percent of the employees in Total Quality Management companies were covered by TQM programs.

The study concluded that such unionization, organizational size, competitive conditions, and the effect of downsizing has a direct bearing on the acceptance of TQM-style practices.

Each of the issues mentioned above has a direct bearing on individual values, organizational cultures, and even on organizational structures. Each also suggests change and the problems, such as turf battles, interpersonal conflict, and resource control, that can occur with change. The partial implementation of TQM can isolate some portions of an organization while seeming to favor others.

While the TQM philosophy seeks to eliminate competition between sections or departments, scattered acceptance of TQM practices throughout an organization may lead to less communication between sections or less-than-adequate commitment from the leadership.

Conclusion

One of the key points made throughout the "Why TQM works" and "Why TQM may not work" segments is that TQM involves a total approach to quality. As each of the "May not work" sections shows, the emphasis on only one part of the TQM philosophy often causes problems. Thus, implementing TQM involves the even integration of systems theory, top management support, participative management, teamwork, and an attention to individual values.

With this integration, TQM becomes more of an organization-wide philosophy than merely another management fad. In addition, the 14 points of TQM become more applicable and more realistic. The need for an integrated approach to obtaining quality and the fact that the TQM approach implies change also requires a different style of management.

That is, as the TQM philosophy advises, the manager must become a leader. While demonstrating commitment to the TQM cause, the manager-turned-leader must also demonstrate a commitment to values and principles. As a result, the individual in the lead position not only influences actions and decisions but also attitudes and opinions as well. ■

Additional TQM Reading Material

Because of space limitations, this article cannot provide all information about the TQM approach to management. However, many fine references about the subject exist. Here is a brief list of available TQM literature:

-*Dr. Deming: The American Who Taught the Japanese Quality*,
By Rafael Aguayo

-*Why TQM Fails and What to Do About It*
By Mark Brown, Darcy Hitchcock, and Marsha Willard

-*Out of the Crisis*
By W. Edwards Deming

-*Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity, and Competitiveness*
By H.J. Harrington

-*What is Total Quality Control? The Japanese Way*
By Kaoru Ishikawa and David Lu

-*Implementing TQM: Competing in the Nineties Through Total Quality Management*
By Joseph Jablonski

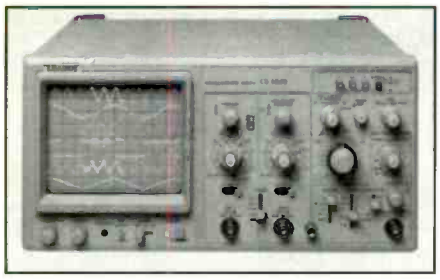
-*Employee Involvement and Total Quality Management: Practices and Results in Fortune 100 Companies*
By Edward Lawler, Susan Mohrman, and Gerald Ledford

-*Achieving Total Quality Management by Michael Perigord. Total Quality Management: Text, Cases, and Readings*
By Joel Ross

-*The Deming Route to Quality and Productivity: Roadmaps and Roadblocks*
By William Scherkenbach

-*The Race Without a Finish Line*
By Warren Schmidt and Jerome Finnegan

PRODUCTS



Delayed sweep oscilloscope

Model LS 1040, a new 40MHz analog oscilloscope added to *Leader's* line features 3-channel operation with up to 6 traces on screen in the delayed sweep mode. Sensitivity ranges from 5V/div down to 5mV/div in 10 steps, (to 0.5mV/div with the X10 magnifier). Bandwidth drops to 5MHz with the magnifier on. Ch3 only is switch selected to 0.1 or 0.5 V/div. Vertical modes are CH1, CH2, CHOP, ALT and ADD (subtract with CH2 inverted) and CH3 (TRIPLE). A CH1 output jack provides 50mV p-p per div of displayed signal to make use of CH1 as a high-gain preamp. X-Y operation is standard with 1MHz X-axis bandwidth and less than 3 degree phase shift between X and Y at 100kHz.

The main time base ranges from 0.2s/div to 0.1µs/div in 20 steps, and a X10 magnifier results in a maximum sweep speed of 10ns/div. The delayed sweep time base ranges from 50ms/div to 0.1µs/div.

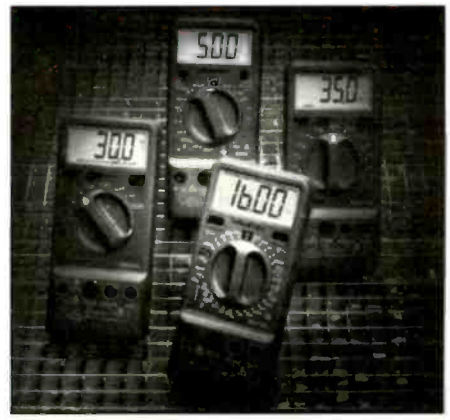
ALTernate triggering maintains stable display for asynchronous signals, and the SOURCE selector selects the trigger from ALT, CH1, CH2, CH3 (EXT) and LINE. Trigger coupling may be set to AC, HF-REJ, DC, TV-V, or TV-H (to ensure positive triggering on video signals).

Circle (90) on Reply Card

Digital Multitesters

Wavetek Corporation announces four additions to the proven XL family of handheld digital multitesters, two autoranging (DM30XL and DM35XL), one extended function (DM16XL), and one capacitance/resistance meter (CR50). In addition to the standard DMM functions, voltage, current, resistance, diode test and continuity, each meter in this series offers specialized additional functionality.

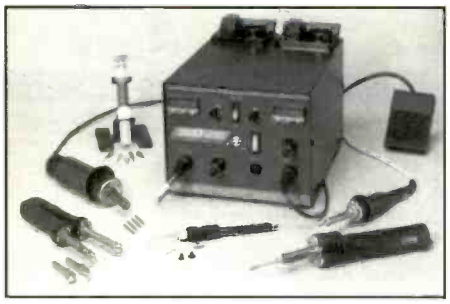
The DM30XL and DM35XL offer special features such as a 3200 count display, bargraph, Data Hold (which freezes the reading on the display for later viewing), an Auto-Off feature to preserve battery life, a diode tester and continuity beeper. The DM30XL and DM35XL measure resistance to 30MΩ and ac/dc voltage to 600V. The DM16XL, while pocket sized, incorporates extensive functionality. This new meter includes a dependable frequency counter which measures frequencies to 15 MHz. The DM16XL reliably tests capacitance, transistor gain and logic, and measures resistance to 20MΩ. The CR50 is a full range capacitance and resistance meter with zero adjust to eliminate the effects of the test leads. The CR-50 features seven resistance ranges, 20Ω to 20MΩ with a 0.01Ω resolution, and nine capacitance ranges, 200pF to 20µF with 0.1pF resolution, making the CR50 a full capacitance meter. As an added value, this meter offers a continuity and diode test at a price competitive to a capacitance meter only.



Circle (91) on Reply Card

Repair/rework system

The SMD-250 system is the most advanced SMT/PTH repair center from *APE*. Two programmable digital controllers feature responsive closed loop temperature control with LED readout of Set & Operating temperature and an instant-rise vacuum rotary pump. The unit is a complete surface mount and conventional component repair and rework station, that will perform these functions: SMD removal (hot air), thermal SMD removal, conventional thru-hole desoldering, reflow soldering, heat tweezing,



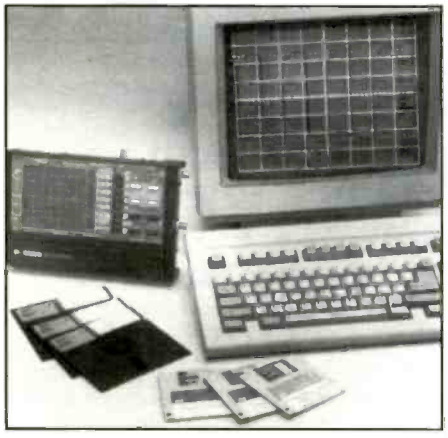
vacuum handling, conventional soldering, and solder paste dispensing.

Circle (92) on Reply Card

DSO's incorporate PC software

Two complete PC Software packages, compatible with the *HC Protek* series of digital storage oscilloscopes are now available in 5-1/4 or 3-1/2 inch PC disks. This enables the PC to directly capture waveforms on the PC screen in real time.

The Model SW01 software allows the user to control DSO operation from a PC via a standard RS-232 Interface which is



built into each of the scopes involved. The software not only provides real time capture of waveforms but permits measurement and manipulation of the captured waveform on the PC screen in addition to the ability to zoom in and compress and expand the time base. Other features include: downloading captured waveforms to most printers, storing the waveform to a disk in an ASCII file, and exporting this file to another program.

The package supports oscilloscope models P-2820, a 20 MHz DSO, and P-2840, a 40 MHz DSO. Both units feature a 20 Ms/S sampling rate, CRT readout and horizontal plus vertical cursors. Both of these models are handheld, battery operated and incorporate LCD screens as well as horizontal and vertical cursors.

Circle (93) on Reply Card

DMMs

Amprobe Instrument announces The Ultimate Series, Models AM-90 and AM-91, handheld, professional quality digital multimeters with bench-top features. The AM-91 offers dc plus ac true RMS with

a 20 KHz ac bandwidth for non-sinusoidal waveform measurements, as well as a back lighted LCD display for all light condition applications. The AM-90 is an average sensing DMM RMS calibrated.

The measuring functions include dc voltage, dc and ac voltage (AM-91), dBm (AM-91), adapter input, frequency, duty cycle, resistance, conductance, continuity test, capacitance, diode test, dc and ac current, a dual display LCD so you can view two variables at the same time, acV and Hz, acA and Hz, ADP and Hz, nS and G ohms, duty percent and Hz.

Circle (94) on Reply Card

Soldering fume absorber

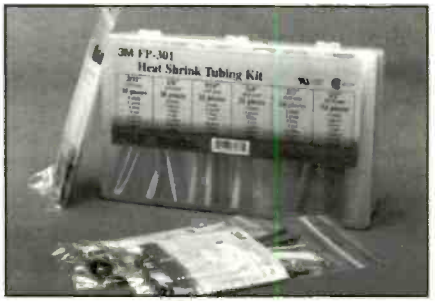
A new dual station tabletop fume absorber for use with all popular makes of soldering irons to filter soldering gases and recirculate clean air for creating a safer working environment is being introduced by *Bonkote America, Inc.*

The Smoke Buster II is a tabletop fume absorber that features two universal clip-on tubes which fit onto all popular makes

of soldering irons. It incorporates a patented multiple-stage pump which is driven by shop air to remove 99.99% of particulates from soldering fumes.

The combination of micro filters for gases and particulates are easily replaced. Electric versions and units with more than two work stations are optional.

Circle (95) on Reply Card



Heat shrink tubing kit

A kit filled with an assortment of heat shrink tubing for electronic and design engineers to use on small R&D projects or prototype development is now available from *3M*. The plastic case is filled with 133 pieces of 6-inch lengths of *3M* FP-301 heat shrink tubing in six diameters and seven colors.

The expanded diameters included in the kit are 3/32 inch, 1/8 inch, 3/16 inch, 1/4 inch, 3/8 inch, and 1/2 inch. Each diameter has a corresponding refill pack that allows the customer to purchase a single package of a specific diameter to replenish the kit. FP-301 is a 2:1 shrink ratio polyolefin heat-shrinkable tubing that is widely used in a variety of electronic and electrical applications.

Circle (96) on Reply Card

BOOKS

***Mobile electronics wiring guide*, By Neil Janoff, The Consumer Electronics Manufacturers Association, $50.00**

The Consumer Electronics Manufacturers Association (CEMA), a sector of the Electronic Industries Association (EIA), published the *EIA Wiring Guide Series*. Long a favorite section of the association's Mobile Electronics Monitor monthly newsletter, each guide in the series covers a different vehicle model. OEM wiring color codes and plug callouts are illustrated for each model and from each use in installation of aftermarket mobile electronics equipment.

The compilation of these guides (parts 1-52) from the Monitor is now available as a series. Written by 12-volt industry veteran, Neil Janoff, a technical support specialist in the mobile electronics market, the series offers clear, concise information in an easy-to-understand and easy-to-use format.

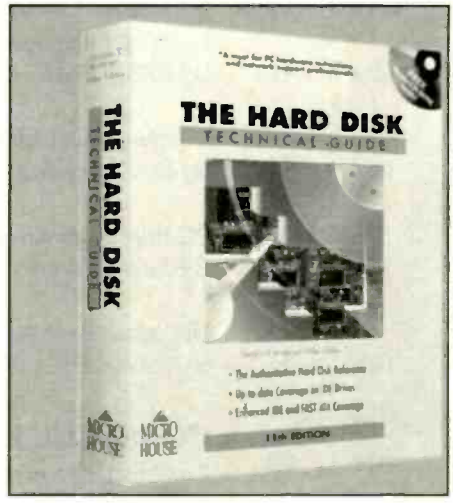
To order the series, contact CEMA's Member Relations Department at 2500 Wilson Boulevard, Arlington, VA 22201, tel: 703-907-7646, fax: 703-907-7601. Bulk ordering is available. Companies that belong to CEMA's Mobile Electronics Division are eligible for discounts of the series and other member benefits.

The Consumer Electronics Manufacturers Association (CEMA) is a sector of the Electronics Industries Association (EIA), the 71-year-old Arlington, Virginia-based trade association representing all facets of electronics manufacturing. CEMA represents U.S. manufacturers of audio, video, consumer information, accessories, mobile electronics and multimedia products. CEMA's Mobile Electronics Division also represents 12-volt retailers, distributors, sales representatives and service companies.

The Consumer Electronics Manufacturers Association, 2500 Wilson Boulevard, Arlington, VA 22201-3834

***The Hard Disk Technical Guide, 11th edition*, Micro House International, 512 pages, $49.95**

Micro House International announces the publication of the 11th edition of the company's *Hard Disk Technical Guide*. The perfect-bound, soft-cover volume is a practical how-to guide and an easy to use field reference for today's most popular hard disk drive formats used by desktop computer manufacturers.



The Guide now contains 512 pages of setup specifications and procedures for over 2,300 of the industry's most common hard drives and controllers. It focuses on the four most prevalent hard drive interface formats used today: ST-512/406, ESDI, SCSI, and IDE.

In addition to installation procedures, the guide includes BIOS drive tables, IDE jumper settings for hard drives and controller cards, a glossary of terms, and a directory of manufacturers with company description, address and telephone, fax, technical support, and BBS numbers.

Also included with each book is a free, bonus CD-ROM (a $50.00 value according to the publisher) with setup utilities and a copy of EZ-Drive, Micro House's 60-second, IDE hard drive installation and upgrade utility.

Orders can be placed directly by calling 1-800-926-8299 or via the Micro House World Wide Web home page, http://www.microhouse.com

Micro House International, 4900 Pearl East Circle #101, Boulder, CO 80301

***Mecklermedia's Official Internet World Internet Yellow Pages*, Modern Age Books, $39.95**

Modern Age Books announcs that its technology will be the basis for the electronic version of IDG's latest release, *Mecklermedia's Official Internet World Internet Yellow Pages*. The publication is the largest and most comprehensive compilation of Internet addresses to date.

The Yellow Pages will contain more than 10,000 printed Internet addresses and a CD-ROM—based on Modern Age Books' Technology—containing more than 27,000 addresses.

"We are excited to have been selected by IDG to provide the electronic version of a publication which we believe sets the standard for Internet reference materials," said Micheal Segroves, President and Chief Executive Officer of Modern Age Books. "This forward-looking reference tool is designed to simplify the complex workings of the Internet and allow searches for Internet sites off-line, a feature which will save the customers the cost of on-line searches."

John Osborn, IDG's Publishing Director for Internet World Books, said, "The inclusion of Modern Age Books' technology made it possible to offer our customers a printed reference work with all-inclusive electronic capabilities."

"In addition to the database and information management features, the electronic version of our Internet Yellow Pages contains another user-friendly device—an Internet browser from Quarterdeck that allows on-line users to easily and immediately access the Internet sites they have selected," Osborn said.

Modern Age Books, 617-449-0020

***Principles of Semiconductor Network Testing*, By Amir Afshar, Butterworth-Heinemann, 213 pages, $64.95**

Principles of Semiconductor Network Testing lays the foundation for understanding semiconductor test philosophy. There are eight chapters in which digital, analog, and mixed-signal test procedures are explained in clear, straightforward language, suitable for all levels of semiconductor product, test, and design engineers.

Beginning with an examination of diode and transistor operation, *Principles of Semiconductor Network Testing* goes on to explain digital signal processing and different ground designs for various frequencies. The step-by-step procedures and comprehensive information on microcircuit test procedures, practical noise identification and clues for suppression, make this book useful for the semiconductor professional at every level.

Butterworth-Heinemann, 313 Washington Street, Newton MA 02158-1626

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ES&T 1995 Department Index

Profax Ten-Year Directory

(January 1985-December 1995)

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GE XM-E chassis	2057
February 1985	
GE PC-A chassis	2058
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MITSUBISHI

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NAP

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NEC

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PANASONIC

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Model CTM-2092S Chassis ALEDP203	Special	1994/95

JC PENNEY

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RCA

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CTC117 chassis	2080	Feb 86
CTC133 chassis	2081	Mar 86
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CTC130-S1 chassis	2090	Sep 86
B&W TV basic service data	2093	Nov 86
UWJ chassis	2096	Dec 86
CTC117-S2 color TV supplement	2098	Feb 87
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RCA/GE (Thomson Consumer Electronics)

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CTC166 chassis color TV	3082	Nov 91
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VCR Model VG2030	3132	Nov 95

SHARP

Model 13C-M100 color TV	3093	Oct 92
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-S200 color TV	3099	Mar 93
Model 20SB65 color TV	3103	May 93
25S1 chassis color TV	3097	Feb 93
Model 27C-5200 color TV	3094	Nov 92
Model 27SV65 color TV	Special	1992/93
Model 27SV70	3101	Apr 93
Sigma 9700 chassis color TV	Special	1993/94
VCR Model VC-A45U	3098	Feb 93
VCR Model VC-A504U/C	3104	Jun 93
VCR Model VC-H86U/C	3100	Mar 93
VCR Model VC-H87U/C	3106	Aug 93
VCR Model VC-H870U/C, VC-8870U/C	3102	May 93

VCR Model VC-H903U/C, VC-H904U/C	3105	Jul 93
color TV Model 20SB55, chassis No. 20R1	3113	Mar 94
Models 13F-M40, 13F-M50, 13F-M100, 13F-M150	3117	Jul 94
Models 25F-M40/50/100/120, chassis No SN 41	3119	Sep 94
TV/VCR combination Models 20VT-G60, 20VT-G100	Special	1994/95
20VT-G200, Chassis VN-51		
VCR Model VC-H946U, VC-H948U	Special	1994/95
VCR Models VC-A502U, VC-A506U, VC-A507U	3123	Jan 95
color Television Model 19TF30, Chassis SN40a	3124	Feb 95
VCR Model VC-H925U/H927U	3129	Aug 95
TV/VCR combination Model 13VT-F40/13VT-F100	3131	Sep 95
TOSHIBA		
color TV Model CF2077A: CX21772	Special	1992/93
VCR Model M222, M222C, M227C, M227L	Special	1993/94
TV Model	Special	1994/95
ZENITH		
D2500W chassis, color TV	3009	Aug 87
D13085/D1910B chassis, color TV	3007	Jul 87
SD2501W chassis, color TV	3011	Sep 87
CM-139/B-0 (B) chassis color TV	3028	Jul 88
CM-139/B-3 (l) SD2511G/SD2581H	3034	Oct 88
C2020H chassis color TV	3022	Apr 88
PV800 color monitor	3017	Jan 88
color TV, CM-140/b-2(G) chassis	3041	Feb 89
CM-14-0/B-3(1) color TV (Models SE2721H/SE2725R/SE2727H)	3046	May 89
CM-140/B-2(l) color TV	3053	Aug 89
PV4661H rear-projector color TV	3056	Oct 89
CM-139/B2 Models SD5515, SD5535, SD555G	Special	1992/93
CM-140/DIGITAL(C) chassis color TV (ModelsSE3135P/SE3191H/ SE3535H/ ZB2771H/ZB2771H2/ ZB2777H/ZB2777H2/ZB2797P/ ZB2797P2/ZB2797Y/ZB2797Y2/ZB3193H/ ZB3193Y/ ZB3539T/ZB3539Y)	3059	Dec 89
CM-139/B1 (Y) and (K) color TV Receivers	3061	Feb 90
Models SD2097S (Y) and SD1327W3, SD1327Y, SD1327Y3(K)		
PV-140/Digital (G) Rear Proj. digital TV receiver, Zenith surround stereo system	3064	May 90
PV454-1P chassis color TV	3066	Jul 90
TV L-line C-8 Chassis	Special	1994/95
color TV receiver Model SD2501W, SD2509H,SD5533G, SD5553H, SS6503G, SS6505P, SS6507H	Special	1994/95

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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 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

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Phone: 516-681-2922 FAX: 516-681-2926

FOR SALE

********** *17,400 Technical TIP Repairs* **********
- - Call for an ***Absolutely FREE*** *version of the* ***TIP PROGRAM - READ ON -- VALUABLE, TROUBLESHOOTING TIME-SAVING, TECHNICAL REPAIRS*** *for servicing* ***TV's, VCR's, Projection TV's CAMCORDER's*** *& other electronics, organized in an easy to use Computer Program -* ***The TECHNICAL TIP REPAIR Program. Still the Largest Technical Tip Database of>>>PROFESSIONAL BOARD & COMPONENT LEVEL REPAIRS*** *<<<. ADD your own tips. PRINT tips. BACKUP & save your own tips. Owners of our* ***COMPUTERIZED TECHNICAL TIP REPAIR PROGRAM*** *say this is the* ***"BEST"*** *Technical Tip program on the market today. Works on* ***ANY*** *IBM compatible computer with a hard drive (Also works on some Apple Macintosh computers).* ***NEW VERSION - works in DOS & WINDOWS. *NO* COPY PROTECTION!!! >>> SPECIAL HOLIDAY Pricing EXTENDED for January<<<. We were the first and still the BEST.>>> FREE*** *SHIPPING for Prepaid orders (U.S.A). Have your own tips? Ask about our* ***TIP EXCHANGE*** *policy with >>>****FREE>>> Updates!*** *- - -Call for an* ***Absolutely FREE*** *version of the* ***TIP*** *program!!! That's right. Just give us your name & address & phone # and that's it - NO credit card numbers needed - it's* ***Really FREE*** *- Nothing to return - NO obligation to buy anything !!!* ***CALL 1-800-215-5081/1-516-643-7740. HIGHER INTELLIGENCE SOFTWARE, 60 Farmington Lane, Melville, NY 11747.***

((24,000)) THE LARGEST TECH-TIP PROGRAM IN THE USA. ((24,000)) "NEVER BEFORE HAS THERE BEEN AN OFFER LIKE THIS" THE *PROOF IS IN OUR PRODUCT - TEST OUR FULL PROGRAM.* ((((((((((((((((((((((((("FREE" "FREE" "FREE")))))))))))))))))))))))))) We are so sure you will find our computer Tech-Tip Program to be **THE BEST OFFERED ANYWHERE**, that we will ship our **ENTIRE PROGRAM** at **NO COST TO YOU**. Test 1 week, if you are dissatisfied, simply return the program Postage Paid - there is absolutely **NO RISK OR COST TO YOU. "OUR TRUST IS IN YOUR SATISFACTION".** ********** ***(Proven to pay for itself within a few repairs)*********** **FEATURES INCLUDE:** FCC-ID cross reference manual covering VCR's & Microwave, Product Processing Forms. Repairs 1977 thru Nov. 1995, TV, VCR, CD, LD, Projection, Monitor, Stereo, Camcorder, Amplifier, Combo Units, Fax Machine, Satellite, etc., **SEMI-ANNUAL NEWSLETTER** with **Step-By-Step Repairs** using today's techniques. **NEW** product information, **Industry News and Service Center Assistance. WE ARE THE ONLY TECH-TIP COMPANY** that publishes our **ENTIRE PROGRAM IN PAPER MANUALS**, for service centers who are not computerized. **"FREE"** format changes to computer or paper at each update. **One-time membership "PAYS." OUR MEMBERS RECEIVED ((10,000)) NEW TECH-TIPS "FREE" IN OUR NOV. 95 UPDATE.** To those Computerized, we offer the **MOST ADVANCED DOS** or **TRUE WINDOWS SYSTEM**, in which you may Enter or Print Out repairs. Our program covers complex repairs, **192 BRANDS ALL IN ONE CONVENIENT PROGRAM.** Press 1 key and print out all the repairs on a particular model or chassis. Repairs are collected daily at three major service centers and sent weekly to our Data Center where each Tech-Tip is gone over completely. Additional Lookup and Cross Reference information is added. This process is how we constantly **IMPROVE** and **INCREASE** the program **FOR YOUR BENEFIT** at each **UPDATE. SAVE TIME** diagnosing, **ORDERING** service manuals and **RESEARCHING** part numbers you may not need! **GET TO THE BOTTOM LINE "PROFITABLY,"** Call and speak to a technician **Ed Erickson, NESDA Member and President of (TV-Man Tech-Tips, Inc.) YOU'LL BE GLAD YOU DID! (800) 474-3588 (407) 750-9922 9-9 EST.** Look for us in **a seminar** in your area, or your **1996 NESDA Directory.**

FOR SALE

ATTENTION ALL 1st TIME BUYERS DON'T WAIT - RECEIVE 17,933 SERVICE TIPS. PURCHASE SERVICE TIPS NOW AND YOU WILL RECEIVE AS A BONUS 2 Volumes of Updates FREE containing 683 ADDITIONAL SERVICE TIPS. THIS FREE BONUS OFFER IS GOOD UNTIL FEBRUARY 1st 1996. This NOW makes SERVICE TIPS the most comprehensive technical tips program available today. *Our program contains 17,250 plus 683 additional SERVICE TIPS from* ***ACTUAL TECHNICIANS FINDINGS*** *on TV's, VCR's, Camcorders and other consmer electronic equipment. Our database contains information on products that* ***YOU ARE SERVICING NOW!*** *Our database has no useless information, such as Black & White or tube type sets. Because this program was developed for the technician by technicians, who own and manage their own service centers, they see the products that are failing today and the importance of repairing them economically. That is why* ***SERVICE TIPS is an INDISPENSABLE TOOL FOR YOUR SERVICE CENTER. It will definately increase your profits, reduce your troubleshooting time and lower your parts expenses****. Organized in ALPHABETICAL ORDER by Brand Model/Chassis & Symptom with 3 lines for Symptom and 8 for Solution. It includes Part Numbers, Values, Locations and Concise Solutions.* ***SERVICE TIPS INSTALLS IN MINUTES*** *works in DOS and is Windows Compatible. YOU CAN* ***REVISE, EDIT*** *or* ***PRINT*** *any service tip in our database* ***OR YOU CAN ADD YOUR OWN INFORMATION*** *and it will automatically be alphabetized and sorted.* ***SERVICE TIPS HAS MULTIPLE WAYS TO BACKUP ALL OR PART OF THE DATA****. These are just some of the features that are included in our program.* ***SERVICE TIPS is available for ONLY $149.95*** *plus s&h. For more information or to order* ***CALL US at 1-800-621-8477*** *(from US & Canada) and you will receive not only the SERVICE TIPS Program, but our SPECIAL BONUS as well. ELECTRONIC SOFTWARE DEVELOPERS INC. 826 SO MAIN ST., SOUTH FARMINGDALE NY 11735*

TV CASE HISTORIES: Booklet with 2,440+ histories. Satisfaction assured. Only $49 (plus $3.00 for priority mail). **Mike's Repair Service**, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 31 years. Send SASE for samples. 410-272-4984,1-800-2-FIX TVS 11am-9pm.

Sencore Models VA62A, SC61, VC63, AND TF46. All in excellent condition. Complete Package $2500.00. Will sell separately. Call 217-794-5467 (evenings).

TEST EQUIPMENT BOUGHT & SOLD: OSCILLOSCOPES, ETC. 1-408-738-4206. FAX 1-408-736-6946.

SERVICE DATA & HARD TO FIND PARTS previously-owned SAMs, manufacturers data, books, FREE catalog. **AG Tannenbaum**, Box 386, Ambler, PA 19002, (215) 540-8055, fax (215) 540-8327.

******SONY TUNER CURE****** 1-465-371-11/-12 Stop Replacing! Repair easily yourself & save! Send $15.00: **TEK Enterprises**, 212 Marabou Drive, Newark, DE 19702.

SENCORE EQUIPMENT (all models). We **BUY, SELL & TRADE** all models. Please call **"CHOICE ELECTRONICS"** for all of your test equipment needs. Complete financing options available on all testing equipment. Call 605-361-6386, ask for Lance Tople.

FOR SALE

ELECTRONICS SOFTWARE DEVELOPERS ANNOUNCES THE RELEASE OF ITS LATEST COMPUTER PROGRAM!!!!!!! FCC and MODEL to MODEL CROSS REFERENCE PROGRAM *- it will enable you to cross reference 94 Brands with over 3,000 models and over 200 FCC numbers. This* ***NEW*** *program is easy -to- use and all information is in alpha-numerical order and covers VCR's, Camcorders, TV's, and Computer Monitors. Compiled from technicians' information, our easy-to-use format will* ***SAVE YOU TIME AND MONEY*** *as well as* ***ELIMINATING UNNECESSARY PARTS COSTS*** *and* ***DUPLICATE SERVICE LITERATURE.*** *To order send check or money order for $39.95 plus $3.50 shipping and handling to Electronic Software Developers Inc., 826 S. Main St., S. Farmingdale, NY 11735 OR for Credit Card Orders* ***CALL 1-800-621-8477. DON'T HAVE A COMPUTER - this information is also available in book form for $49.95 plus $3.50 shipping and handling.***

FURTHER PRICE REDUCTION. Diehl Mark III $49, Diehl Mark V Horizontal circuit tester $169. New. Conductive coating for remote control keypads $9.99 ppd. **WEEC**, 2411 Nob Hill Road, Madison, WI 53713. (608)-238-4629, (608)-273-8585.

Surplus electronic test equipment for sale at deep discounts. Write, phone, or fax to request the current list. Jim Stevenson, 3401 Sunny Slope Road, Bridgewater, NJ 08807. Phone: 908-722-6157, Fax: 908-722-6391.

Sencore LC102 Auto-z, Capacitor/Inductor analyzer. Like new only about 40 hours of use. $1200.00 or offer. 701-746-7933 ask for Gary or e-mail address: gosowski@plains.nodak.edu

FOR SALE

Test Equipment: H/P 334A Distortion Analyzer (just calibrated), $1500.00. **Leader** LFM3610 W&F Meter $390.00, LJM-1851 CD Jitter Meter, $1200.00, LDC-824S 520 Meg. Counter, $400.00, 325A-60MHz Dual Portable Scope, $1000.00. **Sencore** SG165 AM-FM Stereo Analyzer, $500.00, PA81 Stereo Power Amp. Analyzer with all options, $1200.00, LC102 Capacitor/Inductor Analyzer, $1000.00. **All equipment in new or mint condition** with manuals and boxes. Will ship anywhere. Brian in Fla. 407-830-9319, Leave message.

Free 9-516/517 MODULE CURE!!! Stop Replacing! Repair easily yourself. Send business SASE: **TEK Enterprises**, 212 Marabou Drive, Newark, DE 19702.

BUSINESS OPPORTUNITIES

TV/VCR/Microwave Repair Business For Sale. Located in growing, thriving, upscale area of Phoenix. Large and loyal customer base. Selling as turn-key operation, other options available. Lovely 2BR home in nearby retirement area also available. Call 602-598-0158, 10-6 M/F, 10-1 Sat (MST).

READERS' 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, and may be no more than approximately four magazine column lines in length (about 20 words).
- All submissions must be typed or printed clearly!

Send your Readers' Exchange submissions to:

Readers' Exchange, Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801

FOR SALE

Sams Photofacts from 2000-2480, 427 folders to be sold as a group only, $625.00 plus 1/2 of shipping cost. *Contact: Mike's Repair Service, PO Box 217 Aberdeen Proving Ground, MD 21005, 410-272-4984, 11AM-9PM.*

Established TV-Radio repair business for sale. In business for over 30 years. Telephone listed in several directories. Testing equipment, tools, inventory, Sams, etc. Storefront in Waldwick, NJ, option to terminate lease or renew at location. *Contact: Joeseph Contaldi, Esq. 201-487-9333*

Fully-equipped service center for sale by owner. All test equipment manuals, microfiche, inventoried parts and cash register included. A "steal" at $10,000. *Contact: John, 605-582-2716.*

Sencore waveform analyzer (SC61) $1250.00, video analyzer VA62 with accessories (NT64, VC63) $1400.00, micro-ranger (DVM56A) $150.00, multimeter (DVM37) $130.00, B&K tube tester (607) $40.00. Like new. *Contact: Tonya, 410-644-6047.*

Sencore equipment, VA62A, $1600.00, ST65, $350.00, VC93, $1500.00. All equipment in excellent condition. All cables, manuals, and original boxes included. *Contact: Bruce, 603-878-2815.*

Panasonic portable data terminal, model no. KX-D4910D. Turned on less than 48 hours. Like new. Case and cords included. B&K dual trace oscilloscope, model no. 1474, 30 MHz sweep. With one probe, fully functional with clear and bright trace. *Contact: 810-795-5400.*

Sencore video analyzer, model VA48, excellent condition, all instructions, drugstore type. Tube analyzer, works good, illuminated, $125.00 plus shipping. *Contact: Maurer TV, 29 S. 4th Street, Lebanon, PA 17042, 717-272-2481.*

Sencore VG91, TVA92, SC3100, CR70, PR57, complete with test leads. All in excellent condition, $7,000.00. *Contact: Tony, 808-553-3435.*

Sencore SC61, CM2000, VA62, NT64, PA81, and PR57. Original boxes, cables, excellent condition. All or separate, all for $5,000.00. *Contact: Mike, 503-839-6609, 503-825-3268 (evenings).*

WANTED

H.H. Scott A-457 amplifier, Bayly 345A distortion analyzer, Phillips PM3207 oscilloscope, Bell & Howell 34 oscilloscope, Waveform 403B audio generator, Tektronix 1A1 plug-in, MA COM Videocipher II 2000E, need service manuals. CRT for Tektronix 434 oscilloscope, charger/supply for RCA camcorder CPR 150, plus owner's manual. *Contact: Mr. Rejean Mathieu, 819-874-1049, fax 819-874-0704.*

Panasonic RS-876S need schematic, it is no longer available. Browning Golden Eagle Mark III need original or copy of owners manual. *Contact: Stephen Hall, PO Box 401, Winfield, WV 25213, 304-586-4884.*

Jackson 648-1T tube tester, need plug-in panel and/or circuit diagram in order to test old tube types. *Contact: Howard, 914-232-4738.*

Phase Linear power amp, model dual 500 S/N 1898. *Contact: Dannie Watson, Watson's TV Servicing/Tech, 278 Wright Street, Westbury, NY 11590.*

ADVERTISERS' INDEX

We'd like to see your company listed here too. Call Diane Klusner at 516/681-2922 to work out an advertising program tailored to suit your needs.

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