THE PROFESSIONAL MAGAZINE FOR E CTRONICS AND COMPUTER SERVICING

ELECTRONIC™

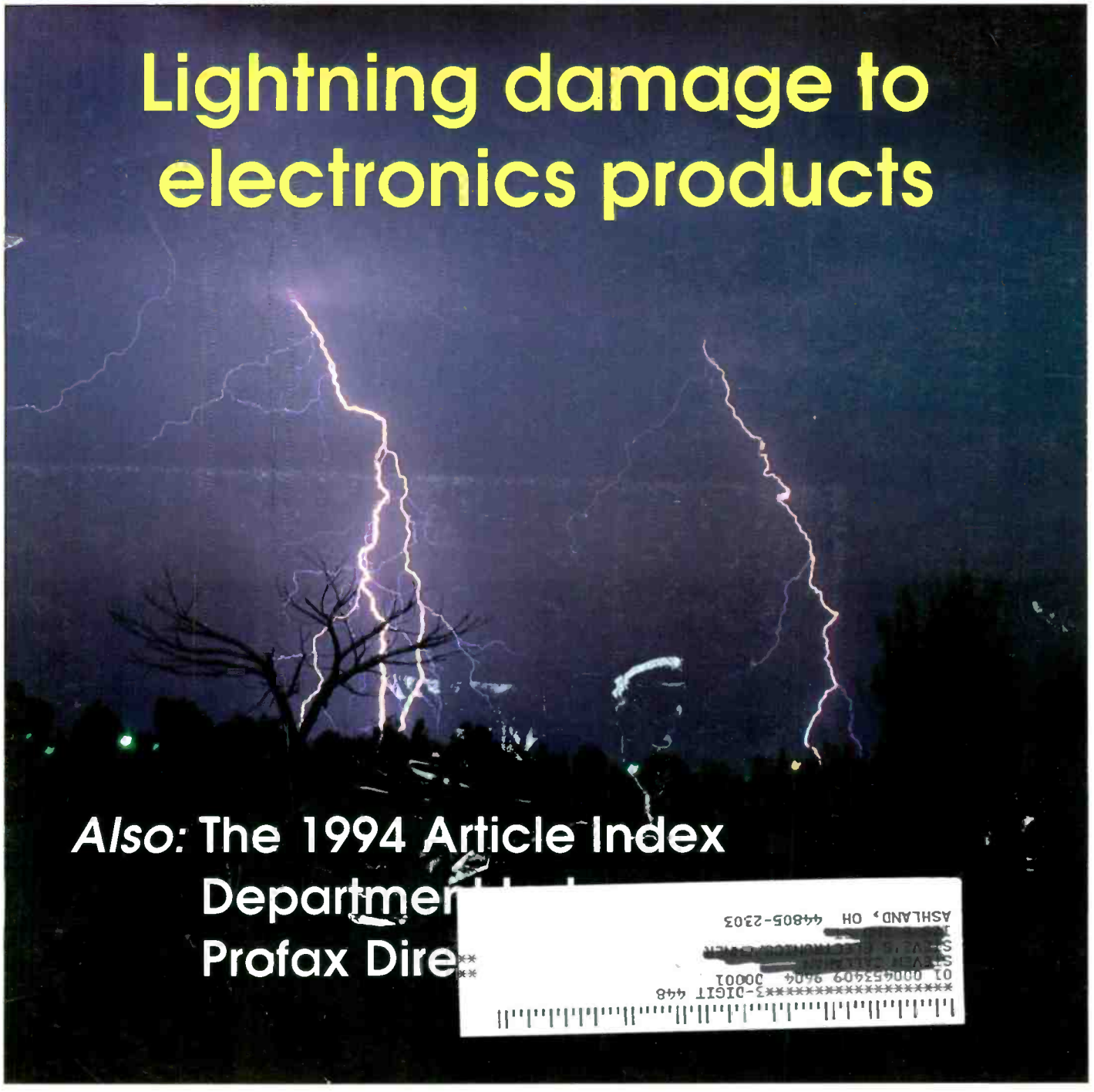
Servicing & Technology

January 1995/$3.00

Computer diagnostics

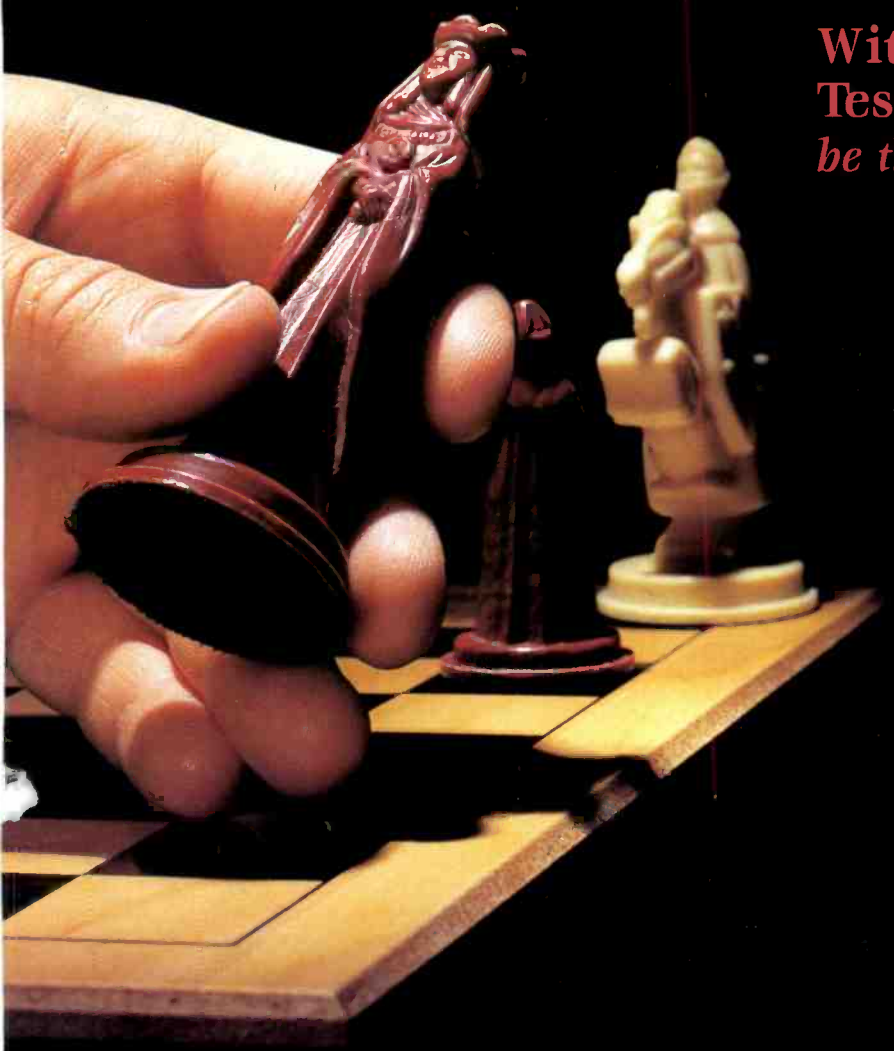
Computer monitor repair without a schematic

Lightning damage to electronics products



Also: The 1994 Article Index
Departmen
Profax Dire

Plan Your Strategy...



With Sencore Electronic Test Equipment – *It could be the best move you ever make!*

For All Your Test Instrument Needs:

- TV Servicing
- VCR Servicing
- Business Management
- Monitor Servicing
- Cable Test Equipment
- Component Testing

- 10 Day Free Trial

- 30 Day Money Back Guarantee

- After Sale Support

- Free Business Management Software Demonstration Disk

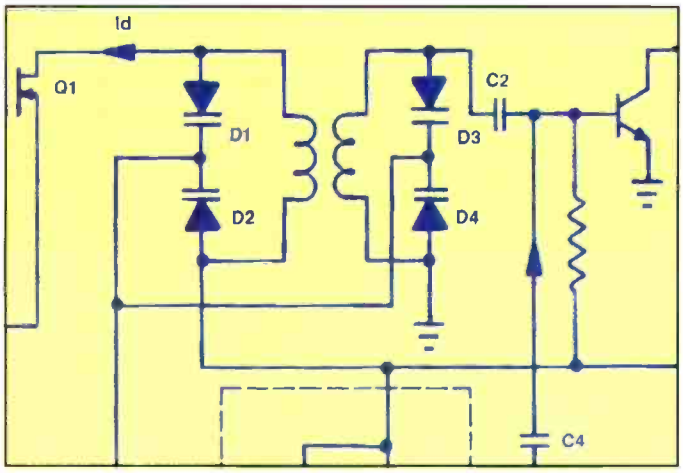
- Free Video Demonstration Tapes

Call 1-800-SENCORE
(736-2673)

SENCORE
3200 Sencore Drive, Sioux Falls, SD 57107
Direct: (605)339-0100 Fax: (605)339-0317

Circle (22) on Reply Card

Contents



page 10

page 46

FEATURES

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

EDITORIAL INDEX

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

DEPARTMENTS

ON THE COVER

Lightning, such as these bolts that struck during a Colorado storm, can create powerful surges that damage electronics equipment. Even at a distance of miles there is enough power left to kill fragile electronics if a lightning bolt hits a power line. If a customer brings equipment into the service center and says that it worked fine before the last storm, then you know that the first places to look for trouble are the power supply and the

Surveys

Every month in this magazine we include a mini survey form. Some months we have asked readers to describe to us their troubleshooting methods. Other months we have asked readers to let us know if they have ever had trouble obtaining replacement parts or service literature. Other subjects we have surveyed readers about include asking how readers have managed to keep their businesses in operation in spite of the adverse business climate, and asking them if much of the troubles they experience in servicing has to do with oxidized or otherwise contaminated contacts.

These surveys have been useful to us in planning future editorial and just in understanding better the problems faced by consumer electronics servicing technicians. Over the many months during which we have been including these survey cards in the magazine, we have received thousands of responses. Thanks to all of you who have taken the time to complete them and send them in.

It has occurred to us that the readers who have participated in these surveys might be interested in hearing about the results of these surveys, so from time to time we'll use this space to share some of the survey results with readers.

Just to be sure that everyone understands the significance of these surveys, we'd like to say up front that statistically they have no significance at all. For one thing, the sample is self selecting. That is, a proper survey requires that the survey be sent to a randomly selected subset of the entire population: in this case the readers of **ES&T**. For these surveys, we only receive responses from readers who choose to return them.

For another thing, we have many thousands of readers and only a hundred or two that return the forms. This further negates any statistical value for the survey. Still, we feel the results are useful for editorial purposes, and interesting as well.

In the July issue, for example, we asked the question "Have you ever had any problems in obtaining replacement parts or service literature for any particular type of consumer electronics product?" Of 146 survey forms that were returned, 138 indicated that the respondents had had problems obtaining replacement parts and/or service literature. While this result is not statistically significant for the reasons cited above, the fact that such an overwhelming proportion of the respondents had in fact experienced problems suggests that it's not a minor problem.

It was also interesting to read some of the answers that readers supplied to the request "Please let us know what your thoughts are on this problem." Here are some samples.

One reader cited as a reason given by the manufacturer for refusing to send replacements "Had to be authorized by the company." In his thoughts, however, the reader states "At a later call back I was told by a receptionist that that was bull, and she gave me a number to call for the parts." Apparently sometimes persistence pays off.

Another reader states "It's frustrating to troubleshoot, identify a problem and then be unable to obtain the required part."

"We try to only get stung once with this type of problem," says another reader. "Thereafter, the company is placed on our list of manufacturers to avoid. We just have to refuse to service, or affix a disclaimer regarding parts availability."

Another reader wrote "I'm just trying to make a living. As a customer who may buy these products I will try to find other products from manufacturers who will provide needed information and buy those. As a service tech, I will inform my customers to buy products from manufacturers who will provide parts and literature so it can be repaired locally and not have to be in a position where they may be forced to buy new after the warranty has expired."

From survey results, it would seem that the problem of obtaining replacement parts and service information is widespread. On the other hand, it appears that most reputable manufacturers of products with recognizable name brands go out of their way to be cooperative and supply parts and information.

If any of our readers, either servicers, manufacturers or distributors have any further light to shed on this situation, we'd like to hear from them.

Nils Conrad Persson

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC
Servicing & Technology

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

EDITORIAL
Nils Conrad Persson, *Editor*
Linda Romanello, *Associate Editor*

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

PRODUCTION
Elizabeth Ryan, *Art Director*
Barbara Terzo, *Associate Art Director*
Susan Reale, *Assistant Art Director*
Edmond Pesonen, *Electronic Composition Mgr.*
Dorothy Kehrwieder, *Production Manager*
Emily Kreutz, *Advertising Production*
Pat Le Blanc, *Phototypographer*

BUSINESS
Richard A. Ross, *Publisher*
John Dorr, *General Manager*
Frank V. Fuzia, *Controller*
Simon Schatzmann, *Circulation Director*
Catherine Ross, *Circulation Manager*
Melissa Nitschke, *Operations Manager*
Carol Licata, *Data Processing*
Denise Pyne, *Customer Service*

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

NESDA
Member, Electronic Servicing Dealers Association

ETA

Electronic Servicing & Technology (ISSN 0278-9922) is published 13 times a year by CQ Communications, Inc. 76 N. Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. Second class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year $24.75, two years $45. Foreign countries—one year $30.75, two years $57. Entire contents copyright 1995 by CQ Communications, Inc. Electronic Servicing & Technology or CQ Communications, Inc. assumes no responsibility for unsolicited manuscripts. Allow six weeks for delivery of first issue and for change of address. Printed in the United States of America.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801.

CQ Communications, Inc. is publisher of CQ The Radio Amateur's Journal, Popular Communications, Micro-Computer Journal, CQ Radio Amateur (Spanish CQ), CQ Amateur Radio Equipment Buyer's Guide, CQ Amateur Radio Beginner's Buyer's Guide, Popular Communications Communications Guide, and Electronic Servicing & Technology.

CES Interactive postponed until 1996

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG) announced the postponement of its CES Interactive Show (CES-I) scheduled for May 11–13, 1995 in Philadelphia.

"After reviewing the pressure and stress put on potential exhibitors, buyers and journalists to decide between two major industry shows being held at the same time, on two separate coasts, we chose to do what was best for the interactive industry and reschedule our Show in 1995 to May 1996," said Gary J. Shapiro, vice president EIA/CEG. "Although exhibit sales of CES-I were strong and early indications were that buyers preferred CES-I we feel it will be better for the video game and interactive industries to have one show only during these dates and concentrate our efforts on a successful Winter CES for these segments and the entire consumer electronics industry."

"It is difficult for any company to decide between two promotional venues being held at the same time and we appreciate the EIA's willingness to step aside in 1995 and do what is in the best interest of the video game industry," said Peter Main, vice president, marketing, Nintendo of America Inc. "We continue to view CES as one of our primary marketing avenues and we look forward to participating in a strong Winter CES in 1995 and future CES-produced shows."

"Thomson Consumer Electronics is extremely disappointed that CES Interactive will be postponed until 1996," said Joe Clayton, executive vice president, marketing and sales, Thomson Consumer Electronics. "Although CES is one of the best tradeshow management groups, one show during May is best for the interactive industry and EIA, as always, has put the industry's best interests first."

The EIA plans to hold CES Interactive '96 in Orlando, Florida in May 1996.

Many VCR owners own more than one VCR

Forty-three percent of people owning VCRs have more than one with younger VCR owners dominating that group, according to a survey conducted by the Electronic Industries Association.

About 35 percent of people with VCRs use them at least a few times per week, a result which doesn't waver across the young and old or rich or poor, the EIA survey indicated.

"Because of the overall success of the VCR and the number of multiple VCR owners, this is a classic case of the razor/razor blade theory as it relates to blank tape. As a result, on average, U.S. households overall own about 144 million blank video tapes not to mention the number of pre-recorded tapes that have been sold. The VCR is a phenomenal success story and many other consumer electronics product categories have harvested the results of its prosperity. And, this success continues to grow," said Gary Shapiro, group vice president of EIA's Consumer Electronics Group. (This year alone about 12.5 million VCRs and 390 million blank video tapes will be sold in the U.S.)

The EIA survey found that more than half of all VCR owners have at least 10 self-recorded video tapes in storage. High income baby boomers (ages 35–49) are the group most likely to keep self-recorded tapes.

The survey also uncovered the fact that the more people record and the more they keep self-recorded tapes, the more price sensitive they become. On average, people buy recognizable brand names about 50 percent of the time.

Impulse purchases—to record events—is the key motivator driving blank video tape sales. Tapes are bought infrequently since most people purchase tapes only a few times each year. Extra recording doesn't necessarily translate into more trips to the store for tapes, according to the survey.

Mass merchants account for nearly one-half of blank video tape sales.

September video sales shatter nearly all previous records: 3 million color TVs sold

The Electronics Industries Association's Consumer Electronics Group (EIA/CEG) announced today that September video unit sales shattered nearly all previous records. EIA/CEG's Video Tracking Survey showed sales of color TVs surpassed the 3 million unit mark in a single month for the first time ever.

Stan Hametz, vice president of the VHS group of Matsushita Electronics Company cites strong product demand and quality of products available as only part of the surge. "Naturally we're pleased with these figures. Most important is the fact that nearly all product categories are showing solid growth, VCRs, camcorders, and TV/VCR combinations were also strong. For those economic naysayers who thought consumers had reached their saturation point for video products, I say think again. We expect a strong Christmas, and I think these latest figures are strong indicators of that happening. Distributors and retailers are seeing increased demand by consumers who continue to see considerable competition.

Additionally, at the same time sales of VCR decks recorded an all-time record month with sales of more than 1.7 million units. Many of these strong sales are reflected in the robust results posted by the nation's largest CE retailers, as well as non-traditional consumer electronics distribution channels. Best Buy and Circuit City both scored near 20 percent increases in same store sales in September. Overall, video sales were up 12 percent in the third quarter, and are 12 percent ahead of the pace last year.

Color TV sales were up 13 percent in the third quarter on record volume. According to the EIA/CEG Video Tracking Survey consumer intentions to purchase a new color TV sometime in the next six months rose throughout September. The percent of consumers looking to make a TV purchase rose from six percent in the early part of the month to a high of seven percent during the last two weeks.

VCR sales were up 10 percent in the third quarter, the best quarterly performance since fourth quarter 1992. Roughly five percent of the consumers polled intend to purchase a VCR deck in the next six months. Equally important was the fact that camcorder sales were up, albeit only two percent, however, they remain at four percent annual growth. The EIA/CEG Video Tracking Survey indicates that three percent of households plan to make a camcorder purchase in the next six months.

And after rising 84 percent in July, TV/VCR combination sales were up 20 percent in August, and were up 18 percent in September for an aggregate third quarter gain of 32 percent.

"What's important to note from these results is that consumers' interest and purchases are high for consumer electronics goods, and in particular the video segment of the industry," continued Hametz.

Literature

Catalog of computer-based instrumentation products

National Instruments offers a new, full-color 1995 catalog describing more than 900 software and hardware products that engineers and scientists use to develop integrated instrumentation systems for test and measurement and process monitoring and control, using industry-standard personal computers and workstations.

The 1995 catalog is color-coded into five sections—Software, GPIB/Serial Interfaces, Data Acquisition, VXI/MXI, and Customer Education. The first four sections feature comprehensive tutorials, complete with application examples, to help readers learn more about IEEE 488.2, SCPI, plus in-data acquisition (DAQ) systems, signal conditioning accessories, VXI, and MXI. Complete ordering, pricing, and warranty information is also included. The catalog includes expanded sections on how to choose hardware and software for IEEE 488, plug-in DAQ, serial, and VXIbus products. Also new to the 1995 catalog are separate listings of instrument drivers by industrial I/O and test and measurement categories.

Circle (50) on Reply Card

Catalog of technical supplies

HMC offers a detailed, fully-illustrated buying guide of electronic tools, test equipment and technical supplies for the assembly, testing and repairing of electronic products. The catalog contains a larger-than-ever selection of brand-name items including precision hand tools, test instruments, datacom/telecom equipment, tool kits, soldering/desoldering systems, lamps and magnifiers, static control products, industrial chemicals and adhesives, measurement and inspection instruments, work stations and PC board handling equipment.

Circle (51) on Reply Card

Depot repair line card

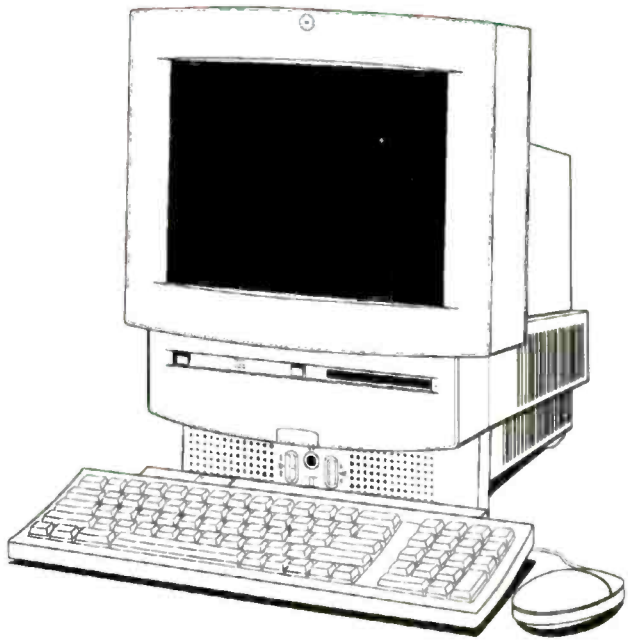
Galco Industrial Electronics has just published the company's first Depot Repair Line Card which contains an alphabetic listing of over 1,200 manufacturers whose products the company repairs most frequently. The card also explains the company's warranty terms, shipping documentation requirements, delivery terms, rush repair charges and additional essential information about doing business with them.

The company designed the card to serve as a convenient, easy-to-use reference tool for its customers. It is designed to complement the more extensive repair capabilities manual (RCM) which can be requested by completing a request form located within the line card.

Circle (52) on Reply Card

Computer diagnostics

By The ES&T Staff



For servicing of consumer electronics products a wide array of diagnostic products is available: oscilloscopes, function generators, signal generators, DMMs. Actually, while we seldom think of it as such, a typical DMM is quite a nifty collection of test instruments in one small package: ac voltmeter, dc voltmeter, ohmmeter, ac milliammeter, dc milliammeter, semiconductor junction tester, continuity tester, and frequently more.

When the task is to isolate a fault in a typical consumer electronics product, this array of test instruments can get the job done in most cases. The training of the competent technician provides him with a basic set of skills that gives him an idea of where the fault may lie. The manufacturer's literature gives the technician a roadmap of the product, and in most cases provides callouts of voltages and resistances, and even prints waveforms that should appear at certain test points.

Once the technician has isolated the fault to a specific area of the circuitry, he can apply the test equipment to determine if the vital signs of this product match those in a correctly functioning product, and when he finds voltages, resistances or waveforms that are anomalous, he can check the components in that area to uncover any that are faulty.

Computers are different

While computers have become consumer products during the past few years by virtue of the fact that millions of them are now being used in homes, testing them when they fail frequently is different from testing other, more traditional consumer products. For starters, in a TV, for example, waveforms are repetitive. If you hook up your oscilloscope to a given test point in the set, the waveform that appears at that test point repeats over and over, so the technician merely has to adjust the controls of the oscilloscope to cause it to appear to stand still on the face of the oscilloscope.

In the case of a computer, however, the signal at many test points will vary depending upon what the software is doing at any particular instant. And while the oscilloscope is very useful in servicing computers, this fact makes the oscilloscope somewhat less useful in servicing personal computers than it is in servicing other consumer electronic products.

The DMM can be useful in servicing personal computers as well. For example, if a problem has occurred and the technician suspects that the voltages produced by the power supply are incorrect because of a defect in that circuitry, he can check them with a DMM. Or if some problem suggests that a resistor is burned open, or a capacitor is shorted, he can check those possibilities. But as in the case of the oscilloscope, the usefulness of the DMM in servicing personal computers is limited.

Diagnostic software

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 and how they're configured, and report that on the screen or in printed form or a file on disk. The kinds of information that this type of software provides are such things as whether there's 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. The program repeatedly writes a pattern of bits into memory and then reads it, and checks what came out with what was written in. If the information read out of memory is different from what was written in, it reports that that portion of memory is faulty.

Some diagnostic programs perform repeated reads and writes to the hard disk. If any areas of the disk give inconsistent results, the program flags them as bad so the computer won't attempt to write on those areas.

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

The diagnostic software program used by any technician should be carefully selected, depending on his level of exper-

tise, how deeply he plans to get into computer servicing, and how much he wants 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 the computer didn't boot up. It's almost impossible to determine the cause without 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 shut 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. Further confusing the situation is that 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 six categories of diagnostic programs. These six will suggest when you would need a product from that category, describe what the product in that category is supposed to do, and explain what to look for when purchasing a product in that category.

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 dead PC. A dead PC is a PC that will not boot from either the floppy or hard drive. When a dead PC is turned on, nothing will happen: a cryptic set of beeps will be emitted, or some general failure description will be displayed on the monitor.

Every BIOS does a power-on self test (POST) when you turn the system on. The POST can normally identify the exact cause of failure on a non-bootable system, but the operator has no idea what that cause is, because there's nothing on the computer to display it.

By plugging a POST reader card into an expansion slot in the computer, the technician can monitor and display the systems signals and POST codes during boot. By checking the signal or code against the documentation that came with the POST reader card, the technician can determine the exact cause of failure.

Documentation is the most important feature of a good POST reader card. The documentation that comes with many POST reader cards only references the test being performed, and doesn't identify the chip or device that causes the test to fail. Without proper documentation the card is useless.

The standard ISA bus architecture POST reader card will work in ISA or EISA slots. If you work on Micro Channel systems, you will need a card with a Micro Channel adapter. The card should have the ability to monitor I/O ports 80, 84, 90, 300, and 680. These are the I/O ports to which the BIOS manufacturers emit POST codes.

Diagnostic software

Diagnostic software is used to determine and correct problems on a bootable system. A bootable system is one that you can boot from either the floppy drive or the hard drive. Problems can 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 identified and corrected, or if it is determined that there is no hardware problem, then you can move on to software problems. Software corruption such as CMOS, partitions, FATs, root directories, sub directories, data, and viruses should be able to be identified and fixed quickly, and, more important, without the loss of data.

Fixed disk utilities

A fixed disk utility is required when the hard drive cannot be accessed at all but there is not a hardware failure, or when the hard drive fails to boot but can be accessed from the "A" prompt after booting from the floppy drive, or when the hard drive can be booted and accessed but there are still problems.

These errors can be caused by improper CMOS configuration, hard drive jumpers, controller jumpers, partition corruption, data corruption, bad sectors, hardware failures, and software problems.

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

Fixed disk utilities are O/S specific. Get the utility that applies to the O/S 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. A bit string search is helpful when the DOS structure has completely collapsed. A technical support line is a must.

Floppy disk drive utilities

A floppy disk drive utility is used when the floppy drive reports an error and it is not the floppy diskette.

Floppy utilities should test, clean, and help realign floppy drives.

Floppy utilities should be able to run a head cleaning routine that moves the floppy heads across the entire surface of the cleaning diskette. If a problem still exists after cleaning, the utility should be able to test and find the floppy problem.

Ordinarily, it is not worth a technician's time to realign a floppy drive. But, for technicians who do realign drives, realignment can be attempted on most floppy drives in about 20 minutes with a floppy utility with realignment capabilities. Data recovery is normally not performed on floppy diskettes either, but if it is crit-

ical data you will find that fixed disk utilities have data recovery capabilities for floppy diskettes.

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.

A virus utility will run a string search for all-known viruses either manually by the technician or automatically in the background on the system by the utility. If a virus is found, the utility will let the user know and then correct.

All virus utilities are O/S specific. You will need a virus utility for the O/S that you are using (normally DOS). 90% of the viruses on the market locate in the bootloader of the master partition. The utility should have the ability to write a generic DOS bootloader onto the hard drive over the bootloader virus. This will delete the virus and the system will boot if the virus has not performed a destructive feature such as formatting the drive and erasing all the data.

The last 10% of the viruses will have to be found with a bit string search. This will only work if the virus utility knows what to look for. A new and unknown virus which has not been recorded onto the virus utility will not be found. The utility should be able to manually and automatically do all of the above.

Windows utilities

A Windows utility is used when you are having a problem, but only when running under Windows. It should be able to 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 run under Windows. If you are having a Windows problem, 90% of the time you will not be able to run the Windows utility. Use diagnostic software to determine if a hardware failure occurred or not. If not, start to reconfigure DOS, Windows, and all software programs 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

Lightning damage to electronics products

By Jurgen Ewert

Lightning can create powerful surges that damage audio and video equipment, or any other kind of electronics equipment. There are methods of measuring voltage, current and time of a lightning bolt, and the data obtained amaze electronics technicians. Where lightning is concerned we are dealing with voltages in the hundreds of millions of volts and currents of tens of thousands of amps.

Even at a distance of miles there is enough power left to kill fragile electronics if a lightning bolt hits a power line. The deadly voltages for transistors and ICs are between ten and a few hundred volts, and currents of a few mA can destroy sensitive components.

Recently at an artificial lightning demonstration at the Museum of Science in Cambridge, MA, viewers were advised to unplug all power cords and antennas and stay away from their plumbing and phone (except cordless ones) in case of a storm. However, not many people have seen such a demonstration, and many may not be aware of the risk of a lightning surge hurting them or demolishing their valuable electronics equipment. Most service technicians, however, have probably experienced increasing business after thunderstorms pass through their area.

This article will first discuss possible causes for lightning damage to home electronics, and then share some examples from my own repair practice.

There are two basic ways in which surges caused by lightning can get into electronics equipment: through the antenna input or through the power line. As a result, the tuner and the power supply are the parts of electronic equipment that can be destroyed by lightning surges.

Ewert is an independent consumer electronics servicing technician.

Antenna input and tuner

High voltages can get into the antenna jack even if there has not been a lightning strike nearby. Even a high electric field strength at the antenna can cause a high voltage at the antenna input that can destroy the first stage of the tuner. If lightning strikes near the antenna, the high current creates a very strong electromagnetic field that can induce high voltages in the input circuits.

A direct strike into the antenna is practically deadly for every piece of equipment and can be dangerous for people near the antenna wire. In the worst case scenario it can cause a fire.

Figure 1 shows a typical tuner schemat-

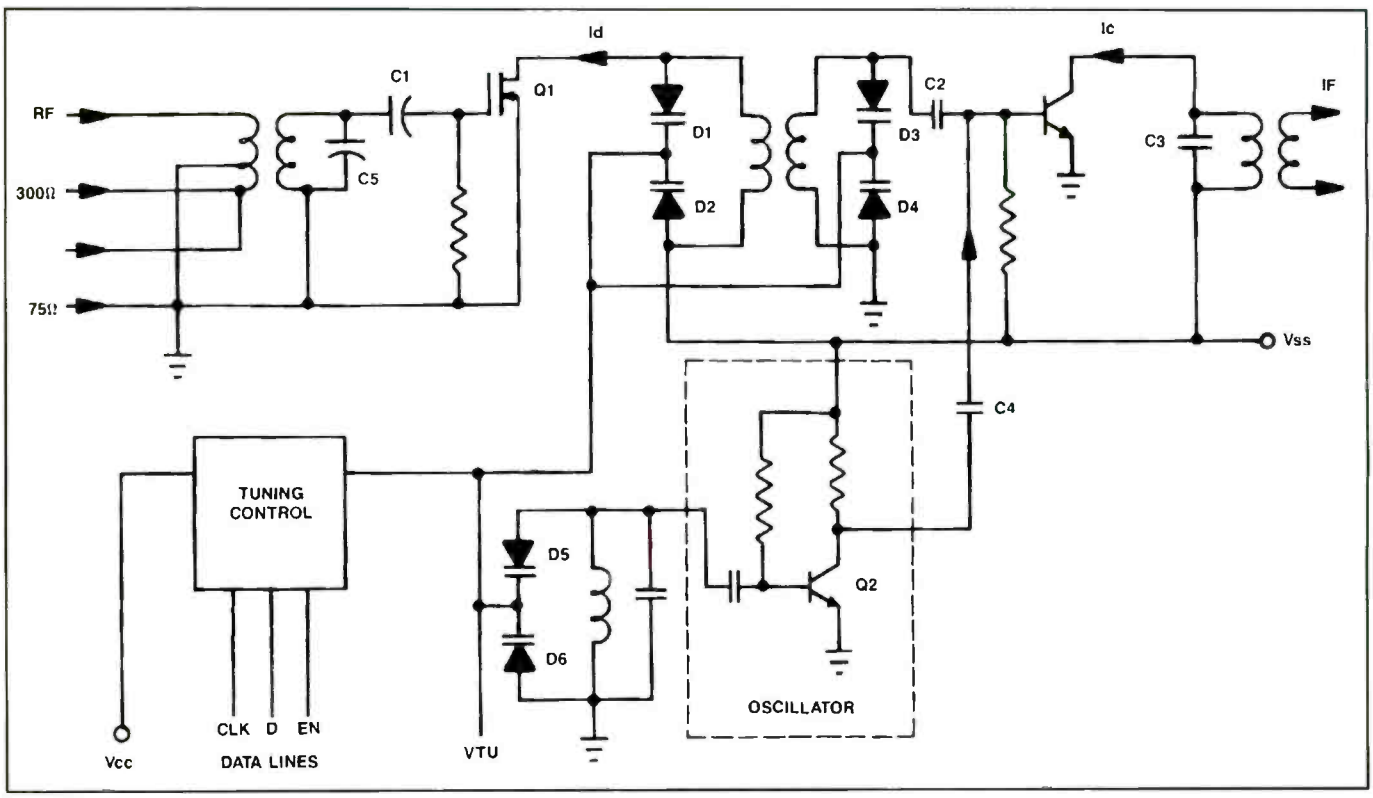


Figure 1. Shows a typical tuner schematic. If a lightning surge gets into the antenna input, the first component to be destroyed is usually transistor Q1, which is a MOSFET in this example.

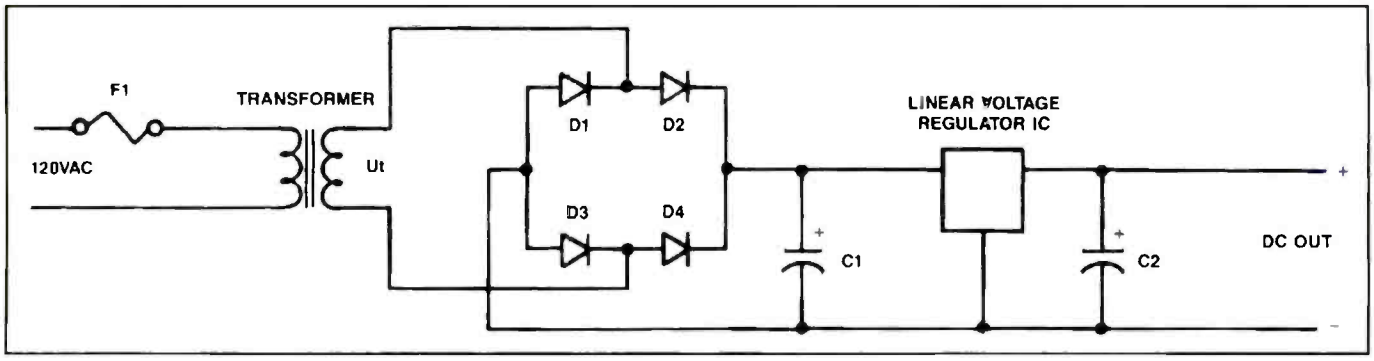


Figure 2. In the linear power supply shown here, the power transformer and the diodes are directly exposed to any type of surge on the ac line. These are the components most often destroyed in a lightning storm.

ic. If a lightning surge gets into the antenna input, the first component to be destroyed is usually transistor Q1, which is a MOSFET in this example. It can happen that the surge wrecks other components such as capacitors C1 and C5 or resistor R3, and it is possible that a trace around the input transformer can blow.

Usually it is not easy to troubleshoot a tuner and sometimes it is easier to replace it, particularly if the tuner was built using surface mount technology (SMT). Since a tuner is very expensive, it is important to be sure it is bad before ordering a new one. To determine this, a good approach is to first measure the dc supply voltages (V_{SS} and V_{CC}) at the tuner. If these are all right, then it is necessary to check the tuning voltage, Vtu, and/or the data lines. If these tests don't show any values that are far off, it is time to inject an IF signal into the output of the tuner. If sound and/or picture appear, then it is pretty certain that the tuner is the problem.

Power line and power supply

Another way for surges created by lightning to enter an electronics product is through the power line. A lightning strike into this line causes high voltages which can exceed the maximum voltages of components in the power supply. Usually some diodes are demolished and as a result the fuse blows.

The type of power supply determines exactly how the surge destroys it. There are two kinds: linear power supplies and switch-mode power supplies (SMPS).

In the linear power supply represented in Figure 2, the power transformer and the diodes are directly exposed to the surge. These are the components most often destroyed in a lightning storm. High surge voltage can exceed the maximum insulation voltage of the wire in the transformer and short some windings. This causes an increase of the primary current, usually resulting in a blown fuse.

If the transformer holds up, the surge can destroy some of the diodes, D1 through D4, by exceeding the breakdown voltage, resulting in a shorted diode. It is easy to check diodes with an ohmmeter. If the reading is close to zero in both directions, replacement is necessary. Usually the surge does not destroy all four diodes.

Conditions in an SMPS are different. Figure 3 shows the circuit of an SMPS. Here the diodes are the first components exposed to the surge. The switching control and the switching transistor are also in danger, but very often the smoothing circuit with the high capacitance protects these components.

If the fuse is not blown, the best method to troubleshoot the SMPS is to measure the voltage at the smoothing circuit first and then check the oscillation at the switching transistor. The voltage at the smoothing capacitor should be around 160V if the diodes are undamaged.

If the voltage at the smoothing circuit is correct, but there is no oscillation at the switching transistor, the first components to check are the parts on the primary side of the transformer, keeping in mind that components on the secondary side can be demolished. If all components on the primary side appear to be all right, it is still worth looking at the rectifiers and regulators on the secondary side. Rarely does the transformer in an SMPS get wrecked, but anything can happen. So it is a good idea to look at it for burn marks.

Some examples of actual lightning damage

If a customer brings one or more pieces of equipment into the service center and tells you that this equipment worked fine before the last thunderstorm, then you know that the first places to look for trouble are the power supply and the tuner.

One of my customers brought in a VCR and a TV after a severe thunderstorm. Both pieces of equipment were completely dead. I asked her if she had disconnected the equipment during the thunderstorm. She had not.

The VCR

First I checked the VCR, a Toshiba Model M-228. This VCR contains a switch-mode power supply. A quick look at the power supply showed that fuse F1 was intact. Then I looked for obvious damage, such as burned components, but didn't find anything. At that time I didn't have a schematic of the VCR, so I checked the diodes in the power supply. Diode D2 was shorted.

After replacing D2, (a 1N4148), and applying power, the VCR emitted a whistling noise, but it still didn't work. After taking another close look at the components in the power supply, I found that the shell of IC1 was cracked. There was no way to proceed without a schematic. To order a service manual costs money and takes time.

Before I called the customer, I opened the set so I could give her the whole picture about both pieces of equipment. (The technical side of the TV story will come later.) She agreed to the estimated price and I ordered the service manual.

The schematic of the power supply (Figure 4) shows that IC1 is an optocoupler that regulates the switching control and provides isolation between the secondary side and the primary 120Vac part of the SMPS. Making sure to cover all possibilities, I replaced the optocoupler, IC1, and the voltage reference, IC2. The problem still remained.

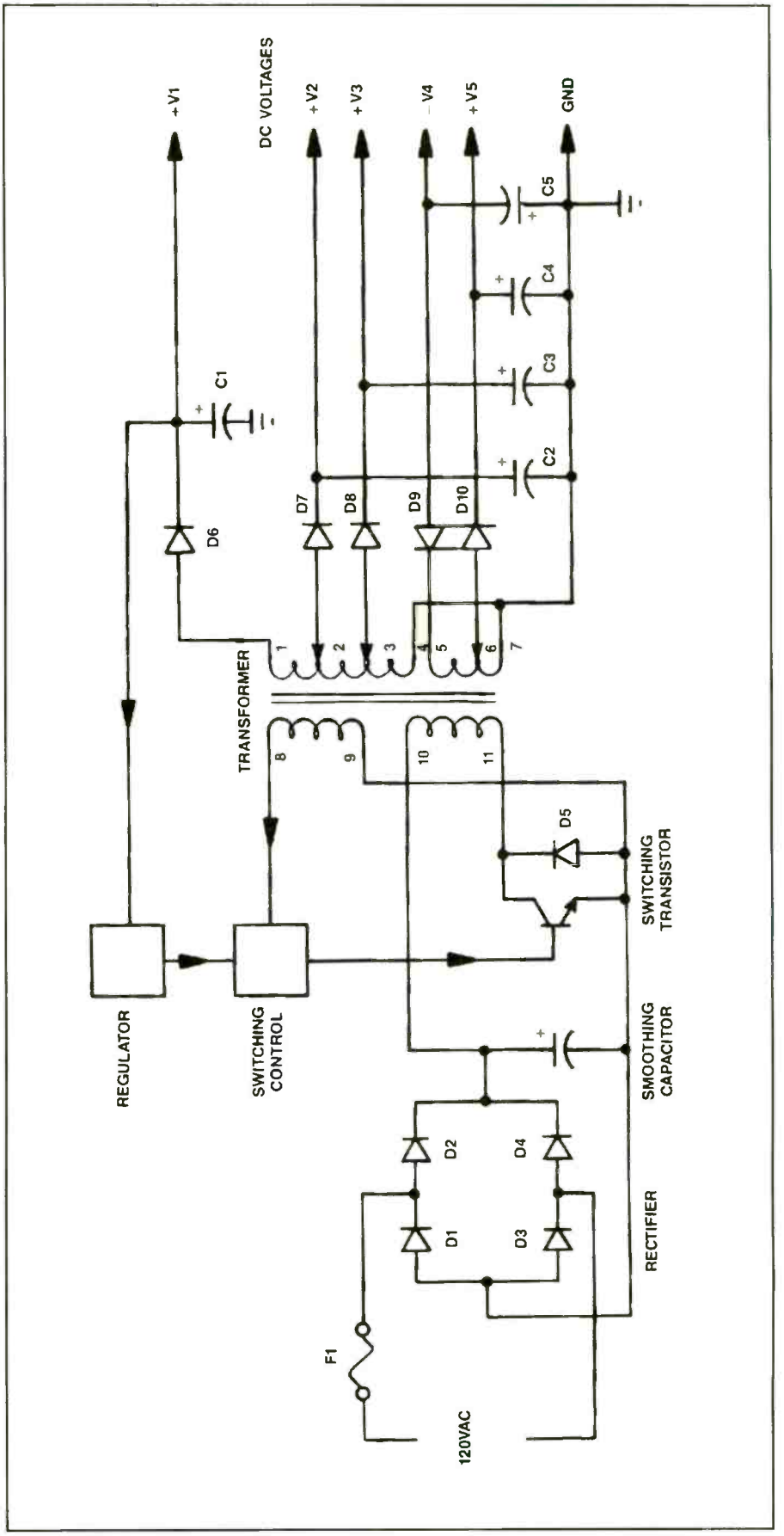


Figure 3. Conditions in a switch-mode power supply (SMPS) are different from those in a linear power supply. In this SMPS circuit the diodes are the first components exposed to the surge. The switching control and the switching transistor are also in danger, but very often the smoothing circuit with the high capacitance protects these components.

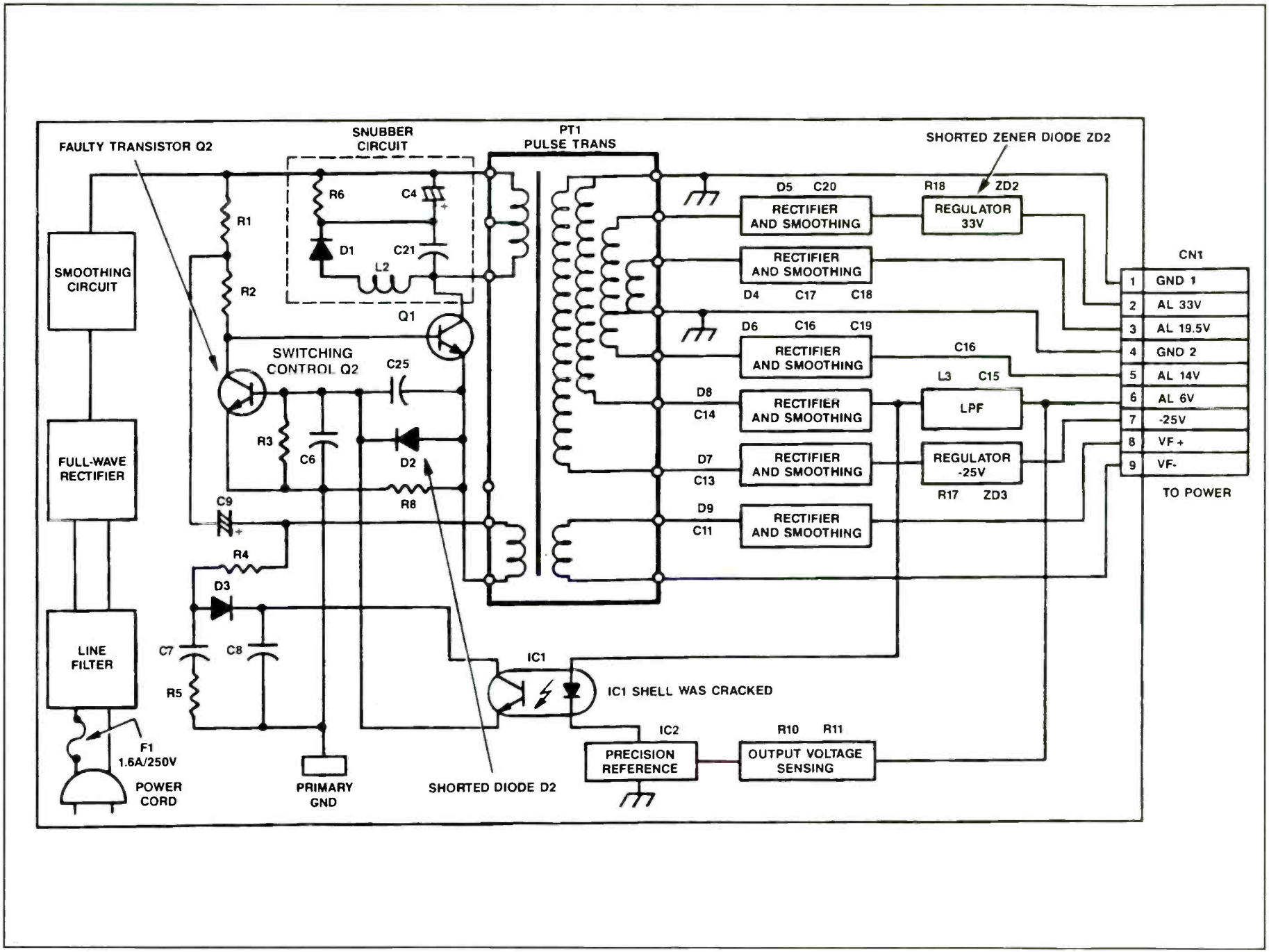


Figure 4. Power supply of the Toshiba VCR model M-228. IC1, which was cracked, is an optocoupler that regulates the switching control and provides isolation between the secondary side and the primary 120Vac part of the SMPS.

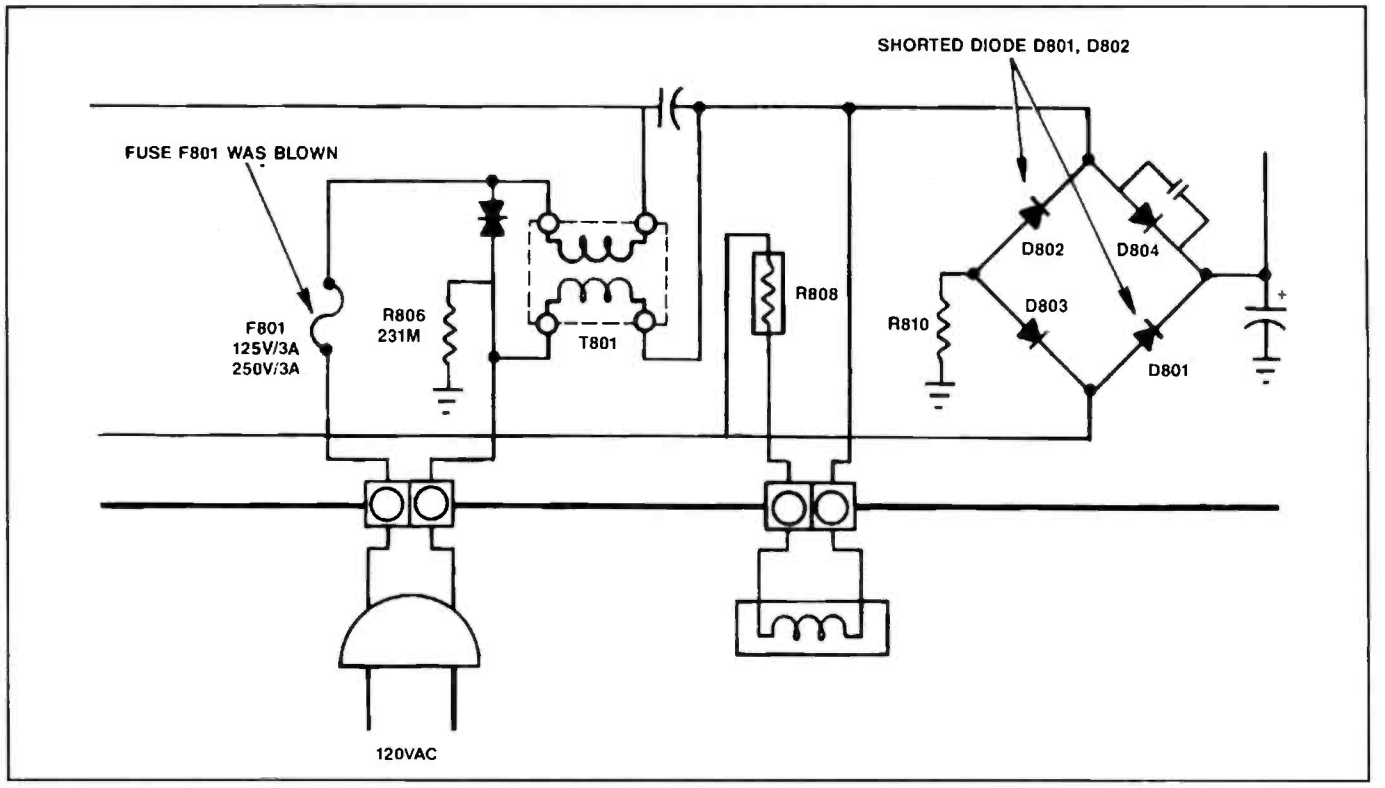


Figure 5. Part of the power supply of the Toshiba TV, CF1311J

So I checked the other components on the primary side of the transformer and found the switching control transistor Q2 faulty. To make sure there was nothing still wrong with the power supply, I tested the components on the secondary side. Here I found that zener diode ZD2 was shorted. After replacing these parts the VCR worked perfectly. Voltages at the power supply had all the specified values.

This is not a VCR problem you would want on your bench every day, but it provides a good example of a complex repair.

The TV set

Examining the TV set, a Toshiba Model CF1311J, I found that fuse F801 was blown, but I didn't think it would be an easy repair. I knew from previous experience that in 90% of the cases the replacement of a fuse doesn't solve the problem, but I tried it anyway. When I turned on the TV, the new fuse blew immediately.

Next I checked diodes D801 through D804 in the power supply, and found that D801 and D802 had shorted out. After replacing these diodes and putting in a new fuse, I used a variable transformer to slowly raise the power voltage. When the voltage was approximately 80V, I turned on the TV and snow appeared on the screen. The current was not excessive, so I raised the ac power voltage to 120V. Since the current was still less than 1A I was pretty sure I had solved the problem (see Figure 5).

After connecting an RF signal from the video generator to the antenna input, I was disappointed because there was no sound and picture and the on-screen display showed channel numbers running from 2 to 69. Evidence now seemed to point to a tuner problem. I removed the isolation capacitor that is incorporated in the antenna socket from the tuner input and fed the RF signal directly into the tuner. Still only snow appeared on the screen. It was time to talk to the customer about a costly repair and to get the service manual.

After I got the schematic I measured the dc voltages at the tuner. The voltages were all very close to the values shown on the schematic. Then I checked the DATA and CLOCK inputs with the oscilloscope. The pulses at these pins looked good (see Figure 6).

When I injected an IF signal at the output of the tuner, a picture appeared on the screen, so there was something clearly wrong with the tuner. The tuner in this set is built using surface mount devices, and it appears only as a block on the schematic. Since there was no way to troubleshoot the tuner, I ordered a new one. The price

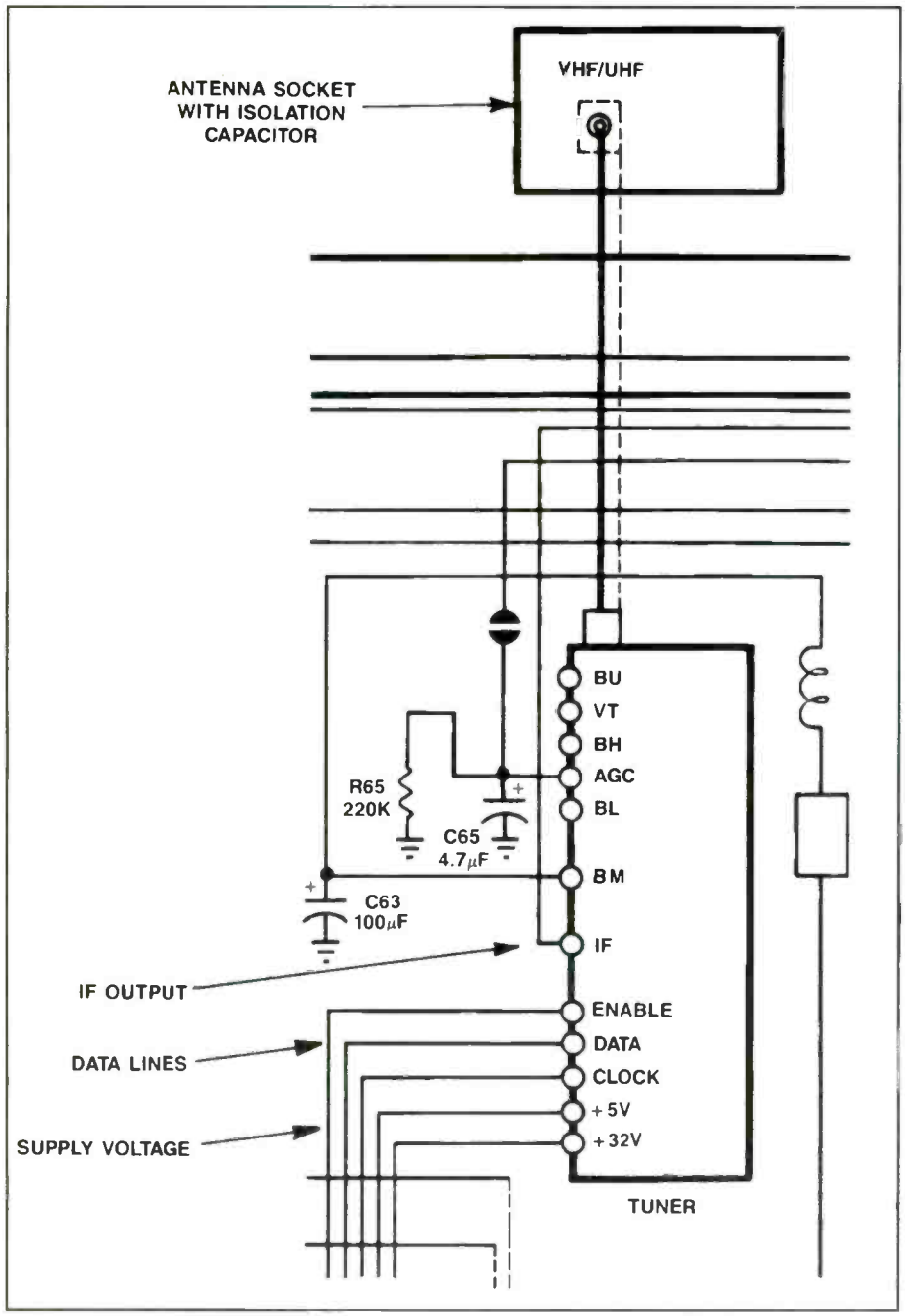


Figure 6. The tuner of the Toshiba TV, CF1311J

for it was not too high, but the whole repair was quite expensive and challenging.

The important finishing touch

After working on a piece of equipment, particularly on the power supply or the tuner, it is very important to perform an ac leakage current test to protect the customer from a hazard and yourself from a law suit.

I'm particularly careful with this test if I know that the equipment had seen a power surge, because a flashover can weaken the insulation of a wire or a component, causing an increase of the leakage current. You can find the circuit and a description of how to perform the test in all service manuals.

The easiest way to perform this test is by using an isolation transformer with a built in leakage tester.

Both of these repair stories show that lightning can cause severe damage to home electronics equipment. In some cases, it might not be economical to fix the equipment, because the destruction is too complex. Hopefully this article has given you some guidelines for your next post-thunderstorm service job. ■

Magnetic recording principles: Audio and video

By Lamar Ritchie

Audio and video tape recording have provided immense opportunities for entertainment in the home. They have also provided innumerable opportunities and problems for service technicians.

An understanding of magnetic recording tape construction and recording principles can help a service technician in diagnosing a problem found in audio or video recorders.

The principles of magnetic recording

The basic principle of all magnetic recording is the same, whether the information recorded is video or audio. A thin plastic "tape," coated with very fine magnetic particles such as iron oxide or chromium dioxide, is moved past an electromagnetic "head" at a constant velocity.

During recording, a variable current is sent to the head, producing a variable intensity magnetic field which in turn produces regions of varying degrees of alignment of the magnetic domains on the surface of the tape.

During playback, movement of the recorded tape across the head gap causes a varying ac voltage to be induced in the head's coil.

Ritchie is an electronics instructor at Kentucky Tech, Hazard Campus.

Audio recording requires a bias signal

The audio ac voltage cannot simply be applied to the magnetic head as is. There are two reasons for this:

- the tape's surface, being a ferromagnetic material does not have linear characteristics, and
- the head produces an output whose amplitude is not linear with frequency.

The biggest problem caused by the nonlinear characteristic of the tape's ferromagnetic material occurs at the lower end of the characteristic curve, where alignment of the magnetic domains does not start to occur until some definite, non-zero amount of magnetizing field is applied (Figure 1). To place the audio signal in the linear region, an ultrasonic *bias*, in the range of 60KHz to 100KHz, is used (Figure 2).

The audio signal is superimposed on the high-frequency ac bias, producing a variation of the ac signal, the peaks of which do not extend into the non-linear region of the tape's characteristics.

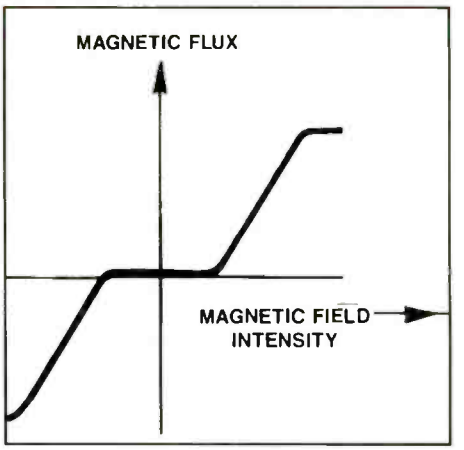


Figure 1. The biggest problem caused by the nonlinear characteristic of the tape's ferromagnetic material occurs at the lower end of the characteristic curve, shown here, where alignment of the magnetic domains does not start to occur until some definite, non-zero amount of magnetizing field is applied.

The actual signal that is applied to the head has much less variation in it than shown in the diagram. For purposes of the diagram, the variation was magnified for clarity. The actual level of the bias ac may be several volts and the audio in milli-

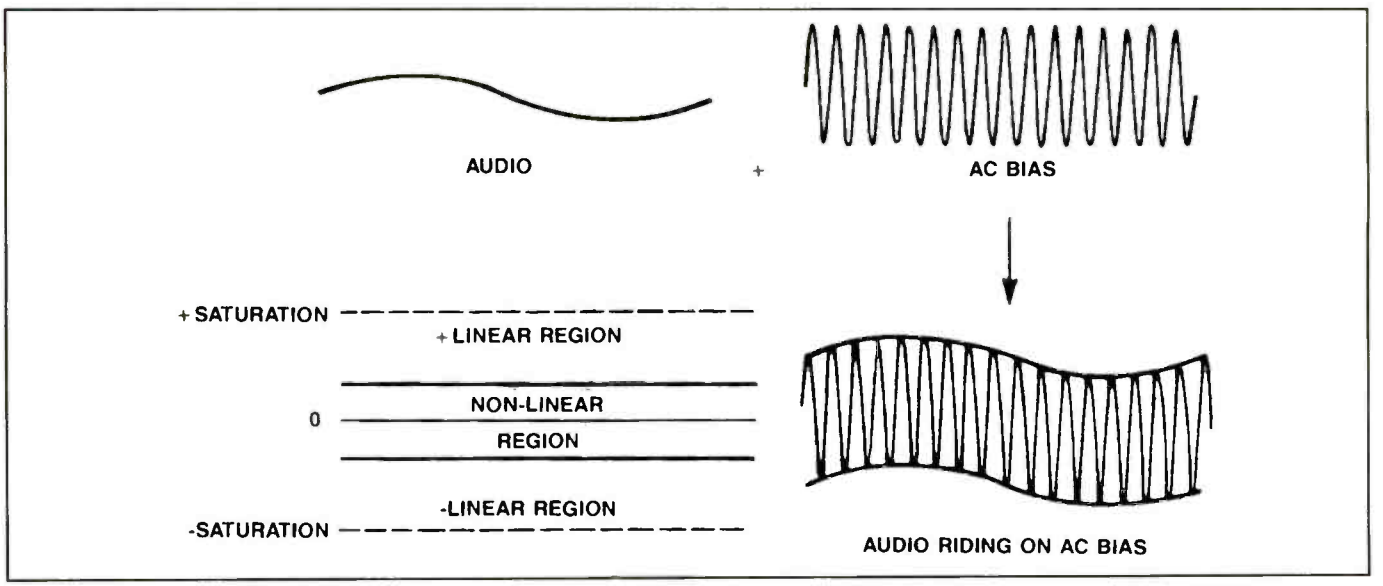


Figure 2. To place the audio signal in the linear region, an ultrasonic bias, in the range of 60KHz to 100KHz, is used.

PROFESSIONAL GRADE EQUIPMENT

REEL TO REEL RECORDERS

TAPE WIDTH	TRACKS	SPEED (in./sec.)	SPEED (cm/sec.)
2" (5.08cm)	24-48	15,30	38.1/76.2
1" (2.54cm)	2-16	15,30	38.1/76.2
1/2" (1.27cm)	2/4/8	15,30	38.1/76.2
1/4" (.64cm)	2	7-1/2,15	19.1/38.1

CONSUMER GRADE EQUIPMENT

CASSETTE TAPE

TAPE WIDTH	TRACKS	SPEED (in./sec.)	SPEED (cm/sec.)
1/4"	1/2/4	1-7/8, 3-3/4	4.8/9.5
		7-1/2,15	19.1/38.1

8-TRACK CARTRIDGE

TAPE WIDTH	TRACKS	SPEED (in./sec.)	SPEED (cm/sec.)
1/4" (.64 cm)	8	3-3/4	9.5

CO-PLANAR HUB CASSETTE

TAPE WIDTH	TRACKS	SPEED (in./sec.)	SPEED (cm/sec.)
.15" (.38 MM)	2/4	1-7/8	4.8 (3-3/4 on some 4-track recorders)

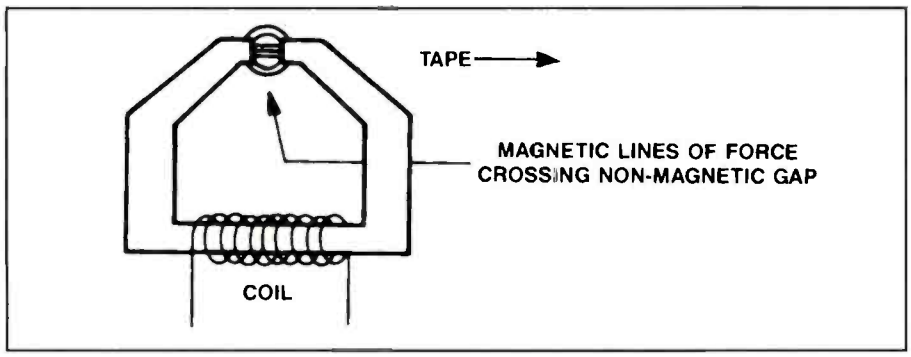


Figure 3. The head places the varying alignment of the magnetic domains on the tape.

volts. The ac bias actually drives the head into magnetic saturation.

In fact, the bias is not recorded, or recorded very little. The bias drives a particular magnetic domain of the tape around the hysteresis loop several times and as the tape moves on and the magnetic field applied to it falls to zero, it comes to rest at a certain magnetization depending on the signal current.

The magnetic recording head

Figure 3 shows how the head places the varying alignment of the magnetic domains on the tape. The head contains a small non-magnetic gap that is placed in contact with the tape as it goes by. The two ends of the gap act as the poles of the electromagnet. The tape has a relatively high magnetic permeability and acts as a low reluctance path for the lines of force across the gap. As the lines of force vary in intensity, the degree of alignment of the tape magnetic domains is varied.

The actual size of these small magnetized areas of the tape is called the "recorded wavelength." The recorded wavelength is determined by the *tape speed and signal frequency* (Figure 4).

The head nonlinearity problem

One of the basics that most electronics courses teach is that the induced voltage in a conductor by generator action is proportional to the change in magnetic field intensity in the vicinity of the conductor. This is, in turn, proportional to the speed of motion of the conductor through a magnetic field. This principle also applies to the head during playback of the signal.

Higher frequency signals cause a faster change in the field for the same tape speed, and therefore, a higher output voltage from the head. As the frequency increases, the output of the head will increase by 6dB per octave. The output, then, must be equalized by a filter having opposite characteristics.

As for the range of frequencies that can be recorded on magnetic tape, the upper limit is determined by the speed of the tape motion relative to the head *(writing speed)*, and the width of the head gap. Maximum output will occur when the recorded wavelength is twice the width of the head gap. From there on, the output will decrease and reach minimum when the recorded wavelength is equal to the width of the head gap. At this frequency, both a north and a south pole are positioned within the gap and the fields will thus cancel. Figure 5 illustrates the change in relative output of the head as the frequency changes.

The recorded wavelength of a signal is equal to the writing speed divided by the signal frequency.

Limitations in the recording process

Figure 5 indicates the response under ideal conditions and other factors have influence. Since the slope rises 6dB/octave it is important to have very little noise to extend the usable frequencies. The tape itself is the biggest factor here.

Random non-uniformities in the oxide coating cause random noise. On poor tape, oxide not bound well will come of and worsen the problem. Other factors that limit performance are:

- *"Fringing" of the field.* A smearing of the recorded pattern because the field extends a little outside of the tape.
- *Self erasure of higher frequencies.* As the domains swing around quickly, inertia carries them past the correct alignment and they come to rest at a more random point (ac fields are used to erase tapes for this reason).
- *Separation losses resulting from imperfect contact between the tape and the head.* This loss amounts to about 55dB

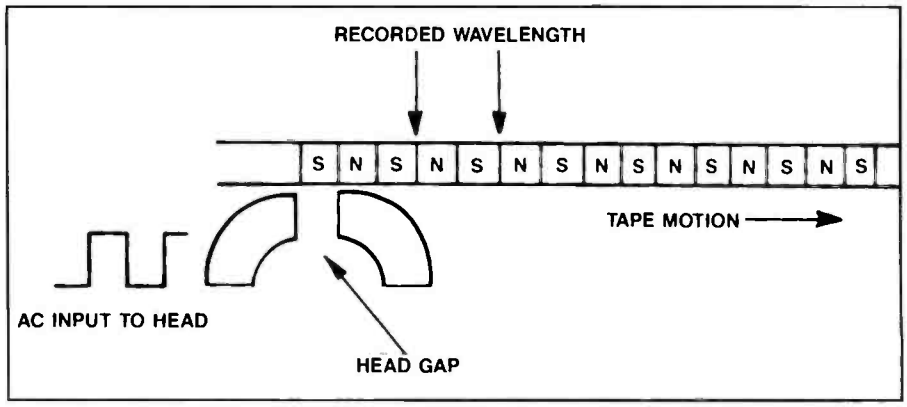


Figure 4. The actual size of the small magnetized areas of the recorded tape is called the "recorded wavelength." The recorded wavelength is determined by the tape speed and signal frequency.

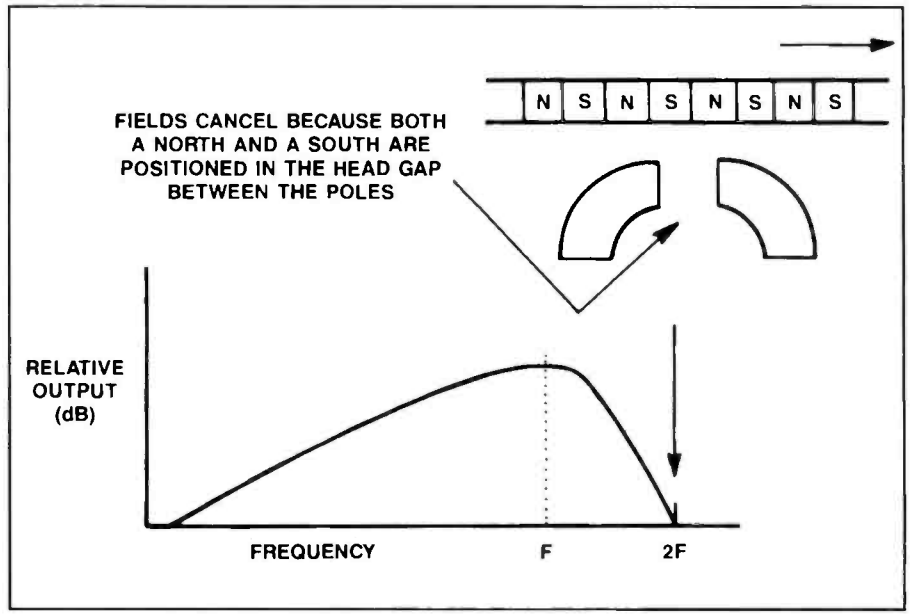


Figure 5. This illustration shows the change in relative output of the head as the frequency changes. The recorded wavelength is equal to the writing speed divided by the signal frequency.

for a tape-to-tape separation of one recorded wavelength.

• *Printthrough can be a problem with magnetic tape.* In printthrough, the magnetic pattern on a length of tape bleeds through to adjacent wraps of the tape.

At present, the dynamic range of equalization is about 60dB to 70dB. This gives a frequency range of about 10 octaves. For audio frequencies, 20Hz to 20KHz, then, direct recording of frequencies can be used, since that represents 10 octaves.

Some of the standards for audio tape are shown in Table 1.

Multiple tracks

To obtain maximum recording time from a given length of magnetic tape, most consumer audio recorders use multitrack recordings. Of course, for stereo sound, two channels (tracks) are required for each recording. The tracks for each recording usually take up only half of the width of the tape so that the tape can be turned over to record on the "back side."

To help prevent crosstalk between channels, the tracks are separated for some formats. The track formats for reel-to-reel and the now obsolete 8-track recorders are as shown in Figure 6.

For 1/2 track (monophonic) reel-to-reel, the top half of the tape width is simply side 1 (track 1) and the bottom half of the tape is side 2.

The mono reel-to-reel is not compati-

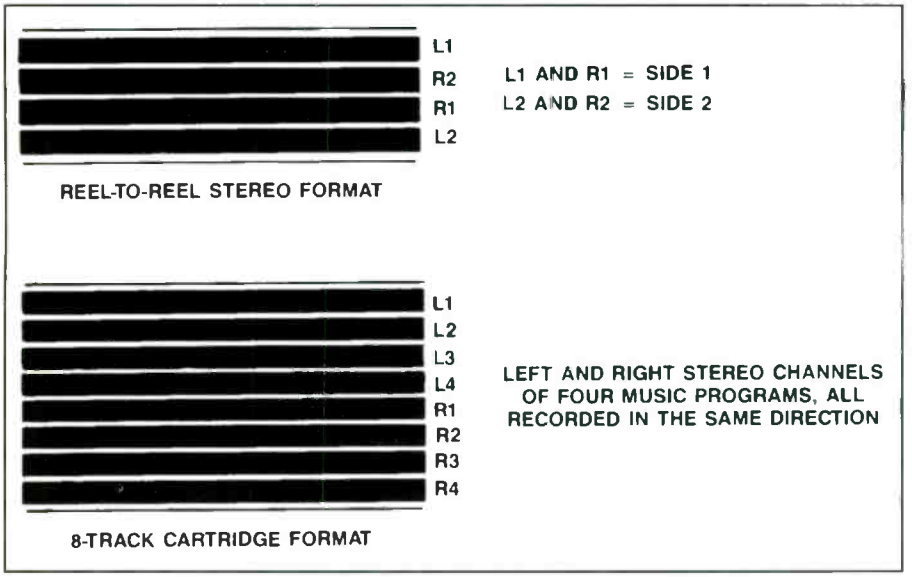


Figure 6. The track formats for R-R and the now obsolete 8-track recorders.

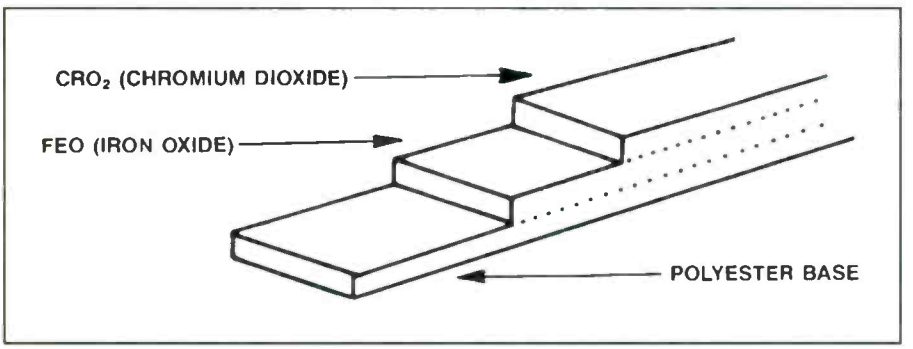


Figure 7. Audio tape is constructed something like this.

ble with the stereo format, because front and rear channels will overlap. The separation between tracks is not needed as much, today, because of better heads and tape. The cassette format, therefore, has the tracks for each channel adjacent to each other. This arrangement provides compatibility, meaning a mono player can play a stereo recording, and both channels will play through the one amp.

Improvements in fabrication of the tape

As for the tape itself, old tape was dull on the oxide side with a shiny backing. Newer tape may be textured, or "roughed up" on the non-oxide side to reduce slippage, and may be highly polished on the oxide side to get a smoother surface that will reduce head wear. The tape will be constructed something like that shown in Figure 7.

Every time a tape is recorded in a tape recorder, it is first erased. To cause this erasure, a high level of the ac bias signal is applied to an 'erase' head at the beginning of the tape path. Lower frequency ac (60Hz) can be used over a large length (entire tape) in a "bulk eraser." The tape is either placed on the eraser for a short time, or a handheld bulk eraser is moved around the reel or case a few times.

The same heads are generally used for playback and recording. Some machines, however, have separate play and record heads, primarily to make immediate monitoring of recorded sounds possible.

Video tape recording

Articles in future issues will discuss video tape recording principles. ■

Computer monitor repair without a schematic

By Thomas V. Kappel

While it's generally desirable to refer to the service literature when servicing consumer electronics products, a great many computer monitors can be serviced even if service literature is not available. In fact, a good technician can frequently determine within the first fifteen to thirty minutes if the problem is major or minor, and if it might be possible to service it without a schematic. In today's world of low cost, high-volume, easy replacement electronics, this speedy technical diagnostic ability can often make the difference between profit and loss, or even business or bankruptcy.

Many products can be serviced without service literature.

The shotgun replacement of major components in a suspected defective computer monitor will occasionally work; if you're lucky and experienced. Usually, though, you'll invest too much time and money in a repair and all too often come out losing in the long run. Still, with a little bit of thinking, observing and understanding, a great many products can be serviced without service literature.

An Apple monitor with a color problem

One good example of a product that was serviced without service literature is an Apple computer monitor with a color problem. We began experiencing a number of failures in the Apple color monitors used mainly with the Apple IIgs system. Our local school system has thousands of these in classroom use. The failure would cause the screen to be overdriven, completely washed out, and display only one of the primary colors; red, blue or green.

The RGB board in this monitor is mounted to the socket on the neck of the picture tube. It unplugs easily and can be exchanged or ordered from Apple or other parts repair or supply houses. I was not able to obtain a schematic diagram for this monitor, either from the manufacturer or second-source suppliers. As it turned out, the problem became an incredibly easy repair, even without documentation.

Measurement of voltages, resistances, and other circuit parameters frequently provide immediate help in spotting any discrepancy, and guide the technician to the cause of the problem.

Problems in the RGB drive board are quite often easy to repair because there are three separate drive circuits, one for each color, that can be used to compare against each other. Measurement of voltages, resistances, and other circuit parameters frequently provide immediate help in spotting any discrepancy, and guide the technician to the cause of the problem. That's exactly what happened in this case.

When the monitor was brought in, the screen was as bright red as it could get. The external brightness and contrast controls had no effect at all on the picture. We did not have a replacement board in stock nor did we have service literature. We decided to attempt to service the monitor to the component level without the schematic diagram.

Checking the transistor collectors

There are three main output transistors on the RGB board, listed as Q6b2, Q6g2 and Q6r2. A quick comparison check of the collector voltages on these transistors showed that the voltage on the collector of Q6r2 was 0V.

I unsoldered the collector lead of this 2SC2688 transistor and performed a junction resistance check. The transistor was not shorted, and, in fact, seemed to be in good operating condition. Leaving the collector connection unsoldered, I again applied power to the monitor. The screen was still bright red, but a voltage check on the printed circuit trace to which the transistor collector was connected showed that there was no supply voltage to the collector of the transistor.

I followed the trace on the board back from the collector pad. The first component that I came to in the supply line was an inductor, L6r2, a 6.2µH inductor. A voltage measurement at this point revealed that there was supply voltage on one side of this device, but nothing on the other. A resistance check showed the coil to be wide open.

I replaced the coil, resoldered the collector of Q6r2 and again applied power to the monitor. The screen was now restored to normal. After I tracked and adjusted the monitor and allowed a reasonable burn-in period to test the repair, it was returned to the school.

Since then, I've encountered this coil failure repeatedly in this type of monitor. The failure has occurred in each of the different drive circuits: red, blue and green. It is now standard procedure in our service center to replace all three of these coils when a monitor with this problem is brought in for repair. It eliminates callbacks to replace the other coils later. Naturally, we ordered a stock of the coils to have on hand and this repair now only takes a few minutes.

Vertical collapse in a VGA monitor

The next monitor we decided to attempt to service without service literature was a low-cost, off-brand, imported VGA monitor. We didn't have the slightest idea who made it, who imported it, or where to get service literature or replacement parts. Searching for this information can consume a great deal of time. Actually, I'm pretty sure that we fixed the monitor in less time than it would have taken to

Kappel is Telecommunications Engineer for the Albuquerque Public Schools and manages the Computer Maintenance and TV/Video Maintenance Departments.

locate the importer, and determine whether or not they stocked service literature or replacement parts.

There was no vertical deflection in this monitor. A bright white line ran across the screen from left to right. I removed the back of the monitor and looked around. I located what appeared to be a vertical output transistor, and, not too far from it, a vertical deflection integrated circuit.

These books (master semiconductor replacement guides) are worth their weight in gold when attempting to service a defective unit without a schematic.

A quick voltage and resistance check of the vertical output transistor seemed to indicate that it was in working condition, biased properly, and ready to work. We turned our attention to the vertical deflection IC.

Now remember, I didn't have a schematic, but the components were distinctly labeled, and I did have a handy master semiconductor replacement guide from the local parts distributor. These books are worth their weight in gold when attempting to service a defective unit without a schematic. It doesn't matter whether the book lists ECG, NTE, SK, or any other brand of replacement component; what you want are the books with diagrams and transistor and integrated circuit pin layouts. These books are wonderful. They give you picture layouts of ICs and transistors, and often voltage and current ratings for transistors.

Checking the voltages

In troubleshooting a defective unit, whether computer or TV, I usually look for faulty or unexpected voltage readings with the set powered, rather than resistance measurements with the set unplugged. Voltage readings are to me a more positive troubleshooting process.

In troubleshooting a defective unit, whether computer or TV, I usually look for faulty or unexpected voltage readings with the set powered, rather than resistance measurements with the set unplugged.

Care must be taken to avoid damage to test equipment, the unit under test, and, most important, the servicing technician.

In this example of vertical collapse, the symptom was a bright white line across the screen. This line could burn the phosphor if left on for a long time, and ruin the monitor's picture tube, so I turned down the screen drive and brightness to prevent this from happening. I used a variable isolation transformer to provide a measure of safety to the technician and the test equipment. Finally, nothing beats care and common sense when working on hot, live, defective equipment.

With the set powered up, I measured V_{CC} on the vertical deflection IC. The master replacement guide indicated a typical V_{CC} for this device of 24V. V_{CC} on this unit measured 0V.

I traced the printed circuit wiring, which led to a low-resistance resistor. There was voltage on the supply side of this resistor, but the voltage on the IC side was 0V. This was obviously a fusible resistor, which had burned open when the IC shorted. A resistance check of the resistor confirmed that it was wide open.

Checking the IC

This troubleshooting so far is only guesswork, but with the evidence available it seemed a logical assumption that the IC had shorted, causing excessive current, which caused the fusible resistor to blow. A resistance check of the integrated circuit from V_{CC} to ground did not indicate a dead short. The resistance check did not *positively* indicate a defective IC, nor confirm what the voltage readings seemed to indicate.

Still, the power supply output was apparently good and the fusible resistor was open, which implicated the deflection IC as the likely cause of the problem. I replaced the IC and resistor and made sure that all the solder connections were clean and good.

I powered the set slowly with the variable ac supply while monitoring the voltage at the IC side of the supply resistor. In addition, I connected an oscilloscope probe to the vertical output pin of the IC, and monitored for drive waveforms from the IC to the output transistor.

The problem appeared to be corrected. The waveform and voltages all came up normal. High voltage came up and when I turned up the screen and brightness we had full, normal, vertical deflection.

The repair took only 30 to 40 minutes, even without a schematic diagram. Sometimes you get lucky. Of course there are times when you're not so lucky.

Good records help

One good piece of advice is to keep a symptom and cure notebook in the service center. Write down every repair, especially the difficult troubleshooting ones, by make and model number. This book is worth its weight in gold the first time you have to troubleshoot a problem that's similar to one you've already seen.

One good piece of advice is to keep a symptom and cure notebook in the service center. Write down every repair, especially the difficult troubleshooting ones.

Of course nothing beats having a good, accurate, schematic diagram of the unit you're working on, but products can be serviced without a schematic diagram. Quite often it turns out to be simple to repair these units and provide a profit for the business.

Don't be afraid to take a quick look inside and to push your left-brain technical logic ability to the limit. Some of my best moments have come in accepting and repairing these challenges. ■

ES&T Calendar of Events

January 6-9, 1995
1995 International Winter Consumer Electronics Show (CES)
The Electronic Industries Association's Consumer Electronics Group
Las Vegas, NV

April 7-9, 1995
1995 Mobile Electronics Show (MES)
The Electronic Industries Association's Consumer Electronics Group
Philadelphia, PA

April 19-21, 1995
Electronic Distribution Show and Conference
Las Vegas Hilton Hotel
Las Vegas, NV

May 17-18, 1995
Systems Support Expo
World Trade Center
Boston, MA
10:00 am to 5:00 pm daily, 207-846-0657 Fax

May 19-20, 1995
Electronics Technicians Association Annual Convention
Philadelphia Wireless Technical Institute
Philadelpha, PA

Saturday, June 17-Monday, June 19, 1995
CES Specialty Audio & Home Theater Trade Show
The Electronic Industries Association's Consumer Electronics Group
Chicago, IL

October 26-27, 1995
Systems Support Expo
Moscone Center
San Francisco, CA
10:00 am to 5:00 pm daily, 207-846-0657 Fax

Coping with hard drive problems—Part I

By Stephen J. Bigelow

Hard disk drives (Figure 1) have long been a focal point of PC technology. Replacing damaged drive systems (or upgrading systems that have become obsolete) is probably the most frequently undertaken procedure for PCs. It can also be a complex and frustrating experience. The mix of PC architectures, drive interfaces, drive controller boards, and software device drivers that are available today raises serious technical issues for service professionals. This article offers a set of symptoms and procedures to help you troubleshoot new drive installations, and track down problems that develop with existing drive systems.

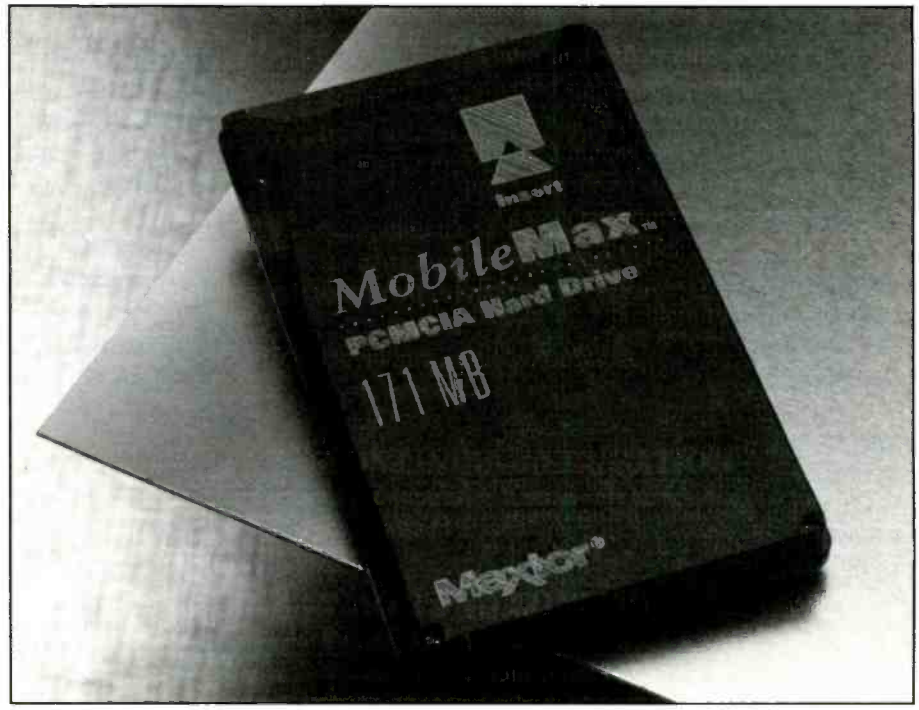


Figure 1. Hard disk drives have long been a focal point of PC technology.

The hard drive system

Before getting right into the troubleshooting, it is important for a technician to know the various parts of a hard drive system. Experienced troubleshooters can feel free to skip this section, but might find it a handy review. Generally speaking, a hard drive system consists of only two parts; the hard drive mechanism itself, and the hard drive controller circuit. It sounds simple enough, but there are variations between drive types and controllers that you should understand.

Hard drives

The basic structure of a hard drive has changed very little since the early 1980s. Of course, there have been vast improvements in the materials and mechanisms found within a drive, but the essential way in which those components are put together have remained very consistent. Figure 2 shows a current hard drive assembly. There are five critical elements: the platters, the heads, the head actuator, the spindle motor, and the drive electronics board. The mechanical components are sealed into an enclosure collectively known as the head disk assembly.

The disk platters are thin circles of aluminum or ceramic composite. Each platter is coated with magnetic recording media. Metal oxides are used on older drives, while newer drives use high-quality thin-film media. It is this medium that holds data in the form of magnetic flux patterns. A spindle motor is used to rotate the platters at rates from 3600 to 7200 RPM (the newer drives spin faster).

Reading and writing flux patterns to the media is done with a read/write (R/W) head. One R/W head is used for each platter side. For example, a drive with two platters will use up to four R/W heads. R/W heads are mounted on long, thin arms and positioned over platter surfaces.

Since information is recorded on the platters in concentric circles (called tracks), it is necessary to move the R/W heads in and out along the platter radius. The drive component that causes the motion is a head actuator, a motor driving a mechanical linkage that moves the head/arm assemblies.

Older drives used a stepping motor as the head actuator, but newer drives use smaller, faster voice-coil actuators that push and pull the head/arm assembly; rather like the d'Arsonval movement that drives the needle across the face of an analog multimeter.

The drive electronics board is mounted to the outside of the sealed drive assembly. It is responsible for several tasks. First, it must handle all of the low-level functions that make the drive work (such as operate the spindle motor, run the head actuator, modulate and demodulate signals to and from the R/W heads, and select the head to be running at any one time).

Second, drive electronics must communicate with the drive controller board, so there is some amount of high-level control logic at the drive. Only the oldest drives (such as the ST506) were "dumb"—all high-level logic and control were on the drive controller board. Newer drives (such as IDE and SCSI) place much more "intelligence" on the drive itself.

Drive controllers

The hard drive controller forms an important link between the PC and the drive mechanism. Traditionally, it is the hard drive controller that translates PC

Bigelow is a technical author and computer consultant at Dynamic Learning Systems in Marlboro, MA.

commands and data into the low-level signals that operate the drive. With the benefit of very large scale integration (VLSI), more and more intelligence is being placed on the drive itself rather than its controller.

Recent drive designs (such as IDE) place all of the high-level functions on the drive. Its "controller" board is little more than a bus buffer between the drive and PC expansion board (known as a paddle board). There are four types of drives and drive controllers that you should be familiar with; ST506, ESDI, IDE, and SCSI. Each interface will have a different effect on your troubleshooting.

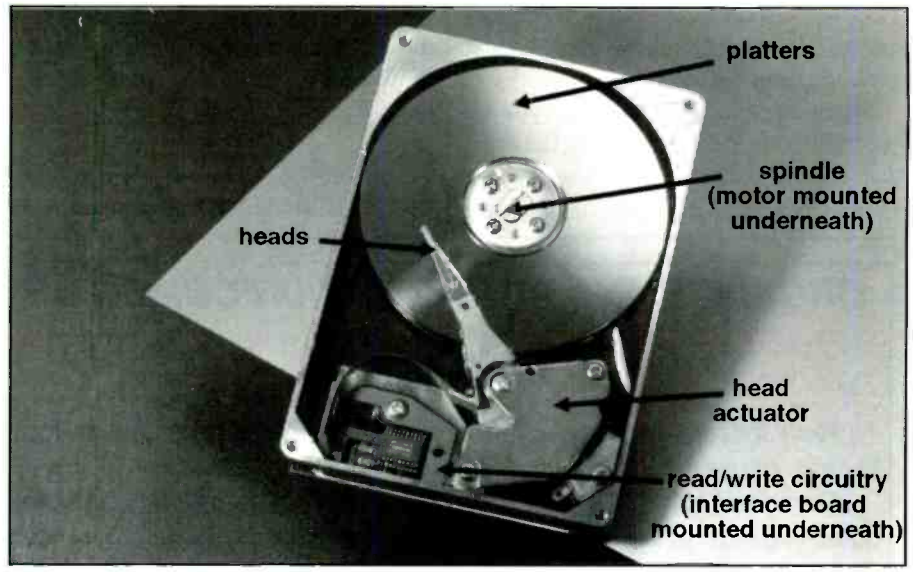


Figure 2. Here is a current hard drive assembly showing the five critical elements.

ST506/412

The venerable ST506/412 drive interface was originally designed by Seagate Technologies about 15 years ago, followed shortly thereafter by the ST412 interface. Although the drives were huge and offered stunningly small capacity by today's standards, there were two factors that made the interface popular. First, IBM adopted the Seagate ST412 for their original XT. Second, the XT's open bus architecture allowed drives and interface boards to be fully interchangeable: drive X would work with controller board Y without special cables or modifications.

The XT had no inherent hard drive support, so the hard drive BIOS was included on the controller board. The IBM AT (and later systems) placed ST506/412 support in the motherboard BIOS. Since this support is often weak at best, many later controllers continued placing BIOS support on the controller board itself. It was then simply a matter of disabling controller or motherboard BIOS support.

The ST506/412 represents the classical perception of the hard drive system where the controller makes all of the operational decisions for the drive, and the drive simply carries out those operations. Drives got much larger through the next several years, but the ST506/412 interface was limited by very slow data transfer speed and a lack of expandability.

Few drives over 150MB were ever designed for ST506/412. Newer interfaces had already arrived. By today's standards, the ST506/412 interface is considered obsolete. However, you will likely find ST-506/412 drive/controller combinations in older systems (particularly XTs) as they come across your workbench.

When you encounter a system employing an ST506/412 drive, your only configuration settings are the Drive Select (DS) jumpers, and the terminating resistor. These are especially important in systems with two drives.

ESDI

The Enhanced Small Device Interface is the first major example of a PC standard developed by a consortium of drive manufacturers (led by Maxtor Corporation). Introduced in 1983, ESDI was intended as a new "high-performance" (at the time) standard to replace the already aging ST506/412. ESDI was indeed an improvement; offering practical data rates up to 15Mbits per second.

Some implementations of the ESDI controller will automatically read and enter the drive parameters into the system. Drive defect mapping was also accomplished easily for rapid, reliable low-level formatting. The physical interface between the drive and controller was remarkably similar to the ST506/412, but ESDI's advantages caused the American National Standards Institute (ANSI) to adopt ESDI as a formal PC standard (now known as X3.170a-1991).

The date of this latest standards document is a testament to ESDI's broad appeal; eight years is a long time in the PC world. However, ESDI systems proved too expensive for all but professional systems. The introduction of fast, inexpensive IDE systems, as well as the broad implementation of SCSI devices served to stifle ESDI's growth.

At this point, very few new systems are implemented with ESDI drive interfaces. If you service high-end systems, you will likely encounter ESDI drives and controllers. Cables and drive configuration issues for ESDI drives are identical with ST506/412 units.

IDE

By the mid-1980s, electronic integration had advanced enough to place controller circuitry directly on the drive itself. Such Integrated Drive Electronics (IDE) devices offer fast data throughput, low cost, and easy installation. The IDE "controller board" is little more than a bus interface which can be placed on a small, half-slot, board, or even integrated directly on the motherboard. A single 40-pin ribbon cable connects the drive to its interface. Today, most PCs with ISA or EISA bus architectures use IDE drives.

Even with IDE's advantages, IDE drive systems are not without their disadvantages. The most serious problem with IDE is their capacity limitation. IDE drives are typically limited to about 500MB (although designers are working to overcome this limitation). The second problem is the lack of expandability. You can theoretically place two IDE drives in the same PC, but since each drive has its own controller, one of the controllers must be disabled, and that drive must be driven from the other controller. Given the wide

variations between IDE controller circuitry, the two drives must often be from the same manufacturer.

When configuring an IDE drive you are typically concerned with setting the drive as a master (mandatory in a single-drive system) or slave. In most cases, this selection is made with a single jumper, although some drives use a second jumper to indicate that a slave drive is present.

SCSI

The Small Computer System Interface (SCSI) is the newest, and perhaps the most significant interface scheme for the PC. Unlike the other drive interfaces, SCSI is not a controller, but a bus. It's a system-level interface that can be used to interconnect a wide variety of devices (such as hard drives, tape drives, CD-ROMs, scanners, printers, and so on). The SCSI host adapter board serves to connect the PC bus to the 50-pin SCSI bus.

A SCSI bus does not communicate directly with the device itself (i.e. a hard drive), but rather to the SCSI controller built into each device. A single SCSI bus can support up to eight devices (or SCSI IDs). One ID is always the SCSI host adapter. The other seven IDs may be almost any combination of SCSI-compatible peripherals.

Since a typical PC will support up to four host adapters, the system can carry as many as 28 devices. SCSI hard drives easily surpass the traditional 500MB limitation imposed by IDE.

SCSI has been around for several years, but acceptance has been slow due to relatively high cost and the incompatibilities of early SCSI implementations. Now that SCSI-2 systems are widely available, compatibility is still an issue—but not that great.

The primary advantage to SCSI is its expandability. Numerous devices can be added to the system without occupying multiple PC bus slots. The other key advantage to SCSI is the large capacity offered by SCSI-compatible hard drives. Many SCSI drives are available with capacities of 2GB or more.

The next installment of this article will describe how to go about troubleshooting hard disk drives when they appear to be causing problems.

About the author

Stephen J. Bigelow may be contacted at Dynamic Learning Systems, P.O. Box 805, Marlboro, MA 01752. You may send fax messages to the author at (508)-366-9487, or leave electronic mail on TechNet BBS (508)-898-9995 or CompuServe at 73652,3205. Readers interested in the author's books; *Troubleshooting and Repairing Notebook, Palmtop, and Pen Computers: A Technician's Guide* and *Troubleshooting and Repairing PC Drives and Memory Systems* are welcome to contact the publisher TAB/McGraw-Hill at 800-822-8138. ■

Component replacement on motherboards

By David Presnell

Previous computer articles in this magazine have dealt with the advantages and disadvantages of component-level servicing of computers. In most cases, it is more economical to replace the motherboard rather than repair it. However, if you generally swap boards, you will eventually find yourself with a pile of faulty motherboards laying around collecting dust.

In all likelihood, in time you will have more than one board of the same type. One day when you have nothing better to do, it might occur to you to attempt to restore one of the boards to working condition by replacing defective parts on it with good parts from the other defective board. Once you have restored one of the boards to working condition, you can sell it as refurbished at a fraction of the price of a new board, and still net enough to cover the cost of the repair, and possibly provide a few dollars profit.

This article will discuss inexpensive ways to replace defective components with reclaimed components, including surface mounted devices, on the motherboard without destroying the board.

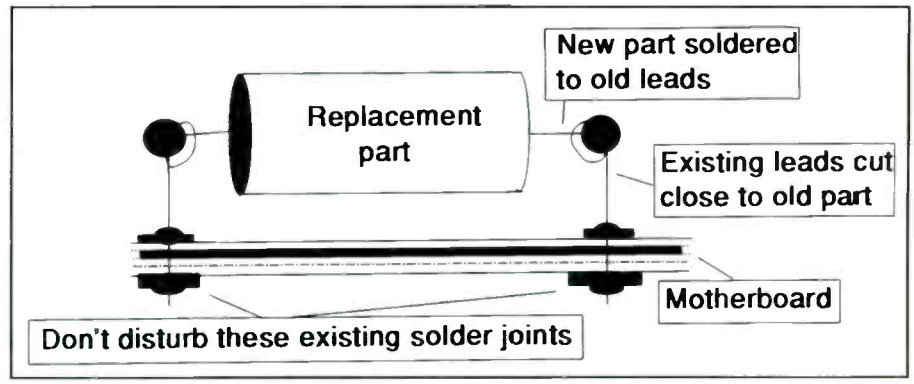


Figure 1. Leave the existing leads in the motherboard by cutting close to the old part. Then, bend the old leads and solder the new part in without disturbing the motherboard.

Tools required

There are many useful pc board rework tools available to help you replace chips on the motherboard. In fact, as long as you have a constant supply of cash available, you can continue to receive new and better gadgets daily. However, since this article is about using reclaimed parts to fix used boards, we will keep it both simple and inexpensive.

The first tool you will need is a portable butane-fueled soldering iron with a 1mm tip. These are available in kits with torch tips and various accessories. You can, however, purchase just the iron with a 1mm tip (or smaller where available) from almost any parts supplier for around $40. You can pick up a container of butane from your local drugstore for a few dollars more.

The reasons you should use this type of iron on motherboards are quite simple. It's not plugged into the ac line so it won't cause electrostatic discharge, it's light and easy to use with surface mounted devices, the 1mm tip is much finer than most electric soldering irons, and the temperature is easy to control. However, if you already have a fine tip static-grounded ac iron designed for surface mounted devices, by all means use it.

Next, you will need some of your favorite solder, sized no bigger than 0.015 in diameter. The finer the better. Whatever you use needs to be around 60/40 with a melting point of no more than 370F.

You will also need some desoldering braid no wider than 0.05 inches, strips of transparent or duct tape, a good pair of tweezers, a pair of helping hands type movable part clamps, a dental probe, a good magnifying lamp, a 15X or higher loupe, and some calm nerves.

Working with motherboards

Begin by grounding the board you are working on to a good earth ground with a jumper wire, and wear a grounding wrist strap. This will help reduce the chance of static damage. Since you will be working with used parts and used boards, it may be helpful to first clean the board by brushing lightly with a fine brush to remove dust from the surface.

To prevent electrostatic buildup, any components you remove should be placed into some kind of antistatic material until they will be installed on the other board. A piece of aluminum foil will serve. Never touch the leads of ICs with your ungrounded hands.

Removing parts for use on another board

To remove a standard component (such as a resistor or capacitor) undamaged from a board that you don't plan to use again, it is best to simply desolder the part. If the leads are long enough, you can simply clip the leads close to the motherboard. In the case of DIP ICs, you can try a solder sucker or desoldering braid, and carefully work each lead loose until the IC comes out.

To remove surface mounted devices (SMDs), carefully wick the solder from the top of the leads with desoldering braid, removing as much solder as possible. Be careful not to overheat the IC. Once the solder pads look clean, heat each lead over the pad.

With a dental probe, carefully lift the lead just enough to clear the pad, then remove the heat from the pad. Hold the lead away from the pad until the pad cools. This takes some practice. You don't want to lift the lead too high or you risk breaking the lead off the SMD.

Some leads don't give, and you may have to heat the lead and slide a small aluminum strip under the lead to keep it from sticking. These strips can be cut from a soft drink can (about 1/4-inch wide by 2 inches long) with a pair of scissors, but be careful—these strips are sharp. You

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

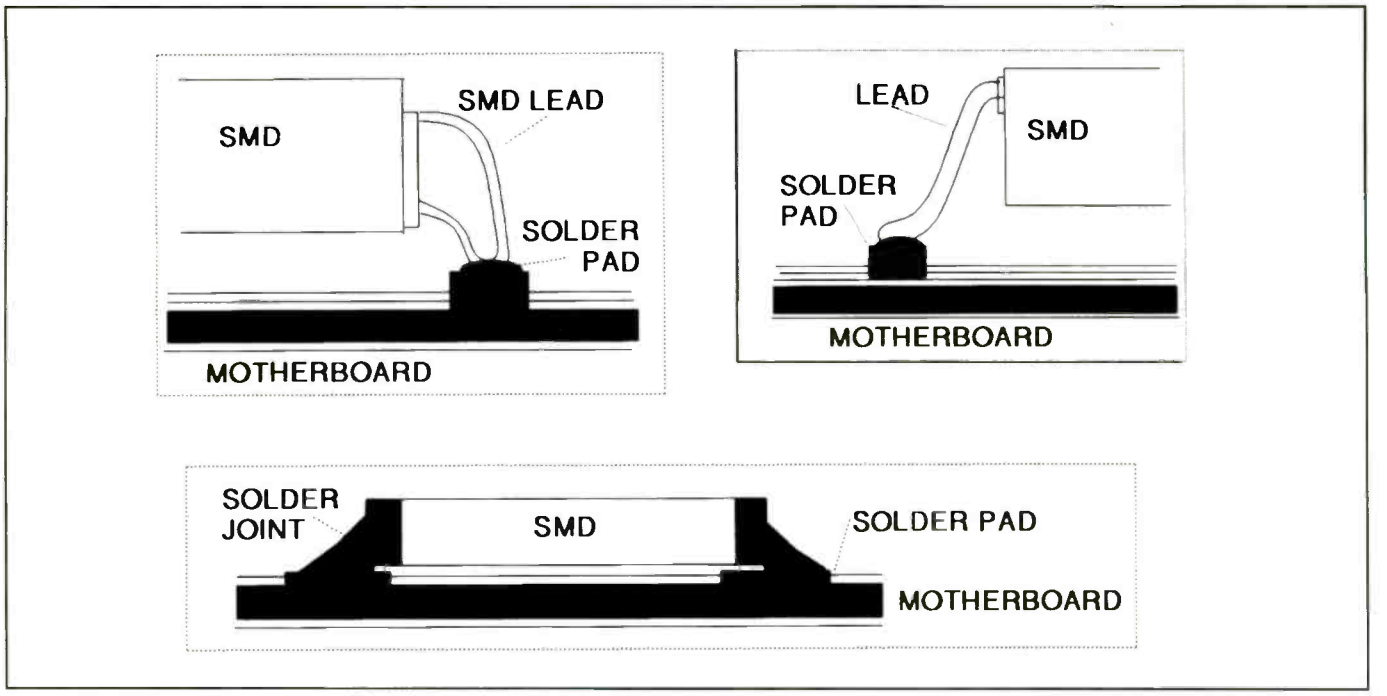


Figure 2. Three types of Surface Mounted Devices.

can wrap a piece of tape around one end of the strip to make them easier to handle if you wish. I have several of these strips in my SMD kit.

If the SMD is a resistor or capacitor, remove as much solder as you can from each lead. Then insert the point of the dental probe under the SMD and heat each side and apply slight upward pressure with the probe until the chip comes loose.

Before actually removing any part, you should carefully note the position of the chip in relation to the diagram on the motherboard. Making a rough diagram of the part layout will help when putting the part on another board. Note any dots, notches, or marks on the chip. These usually line up with dots or marks on the motherboard.

Removing the defective parts

When you want to remove a defective part from a motherboard that is to be restored, the idea is to avoid damage to the motherboard. In the case of two-lead components, such as resistors and capacitors, simply cut the leads as close to the *component* as you can, without disturbing the leads at the motherboard. Roll these leads into small loops and solder the replacement part to these loops (Figure 1).

Remember, a motherboard may be multilayered, meaning that traces may be attached to the part internally, as well as on the outside of the board. Trying to desolder such a part will likely make the motherboard worthless.

In the case of a multileaded part, such as a transistor or DIP IC, carefully cut it off. To do so, carefully score the leads right up next to the part with a sharp hobby knife. Continue this until the leads separate from the part. You should have leads sticking straight up out of the board.

With a fine pair of needle nose pliers, bend the top of each lead in half making an upside down U-shape toward the inside where the chip was. Now solder the replacement chip to these bent-in leads, being careful that no leads touch any others.

To remove SMDs that you think may be bad, use desoldering braid and remove the chip using the same procedure as you used with the SMDs in the procedure described above. Use care; this chip may not be bad and you may want to reinstall it. Be especially careful not to damage the solder pads or small traces close to the SMD. Don't hold the iron on the board for more than a few seconds (Figure 2).

Since we have covered the replacement of traditional parts, the rest of this article will concentrate on the replacement of surface mount devices.

Soldering SMDs

Once you have removed the defective part from the motherboard, lightly brush the pads with a fine camel hair brush to remove any loose foreign material. Next, clean the pads with a piece of sponge dampened with flux remover or contact cleaner, but don't use too much.

Now you can prepare the pads to receive the chip. When working with SMDs, a small drop of solder goes on the pad and is allowed to dry. The SMD is placed in correct position over the pads, and heat from the tip of the iron is applied

(Continued on page 41)

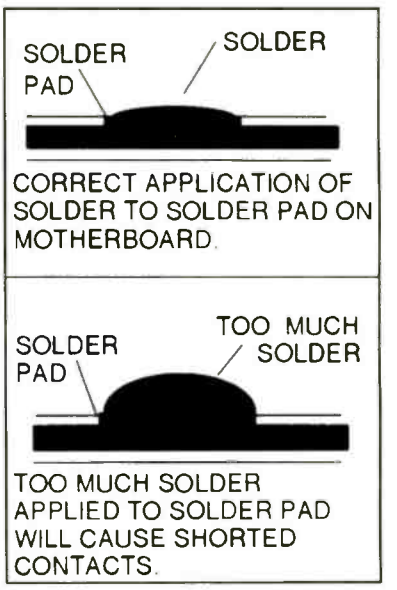


Figure 3. It does not require much solder on the pad to hold the SMD properly.

Component replacement on motherboards *(from page 28)*

to the leads (one at a time) until the leads stick to the small pads of solder.

The pads (usually small silver squares) on the motherboard are first prepared by applying a small amount of solder to each pad (Figure 3). The worst thing to do is to apply too much solder. Too much will flow to the next lead and possibly destroy the chip, traces, or related parts.

The best way to do this is to cut small pieces of 0.015 diameter solder no longer than the solder is thick. These little pieces of solder are placed one to a pad, then heated with the tip of the iron until they melt over the pad. Again, referring to Figure 3, the solder should just cover the surface of the pad and be raised slightly above the pad in the middle.

In the bottom half of Figure 3, you will see a bubble of solder. This is too much and should be removed with wick and tried again. Unlike soldering traditional parts, all you want is to have just enough solder on the pad to stick the lead to the pad when heated. You're not trying to cover the lead with solder as you would with a traditional component. Be careful not to overheat the board. Never hold the iron in place for more than a few seconds.

With the replacement SMD nearby, determine the proper placement of the chip. Carefully look at the leads of the chip and straighten any that are out of shape. Now position the chip in place on the motherboard. When aligned properly, each lead should be centered in its pad. This is important. If the leads are out of center on the pads, they could easily cause a short by touching another pad.

Once the chip is in place, hold it down with either your finger or a clamp device such as a pair of helping hands. Next, tape two sides of the chip down to the motherboard with small strips of duct tape or clear transparent tape to hold the chip in place while soldering (Figure 4). Be sure the chip is in proper position all the way around. A 15X or larger printer's loupe will be of great help at this point.

When you're sure the leads are all centered in their pads, and the chip is oriented correctly on the board, heat the portable butane soldering iron on high. With a dental probe or tooth pick in one hand, and the soldering iron in the other, proceed to touch the iron tip to one of the corner leads directly centered over the pad that is underneath.

Apply solder to pads first as shown in figure 3. Then tape SMD down to the motherboard in the proper position. Next touch hot iron tip to SMD leads one at a time for a moment until lead sticks to solder pad. Don't get the chip too hot, or it will be destroyed.

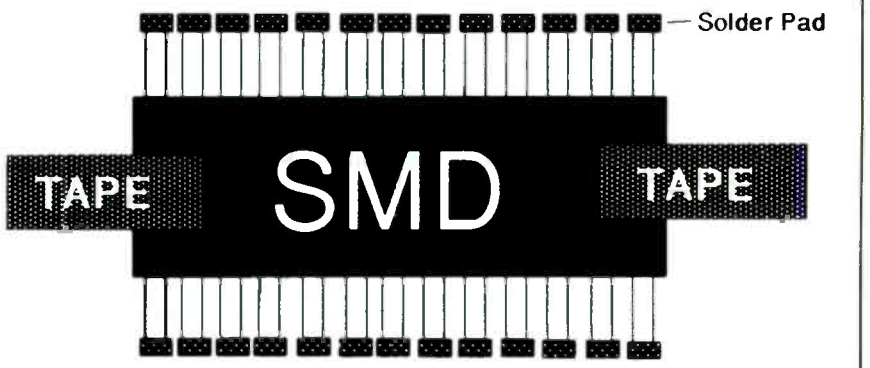


Figure 4. Be careful not to let solder short to another pad. Use very fine wire solder and a fine tip iron. In many SMDs the leads are .25 inches apart or less.

In a few seconds, using the dental probe or tooth pick, try to push the lead down into the melted pad of solder. If the solder gives and seems liquid, remove the iron but hold the dental probe or tooth pick in place with a slight downward pressure until the solder sets up. Continue with the other corner leads until all four corners are secure.

If nothing has moved, solder the rest of the leads in the same fashion. If the chip or board seems to be getting too hot at any time, stop and let everything cool before you decide to proceed.

If you have some electronic soldering paste on hand, you might try to place a small drop on each pad and allow it to dry for a few minutes before placing the chip. This often helps the chip to stay in place as well as aids the sticking of the lead to the solder.

Once the SMD has cooled, use the loupe and carefully inspect each lead for solder shorts between two or more leads. Using your dental probe, hook the edge of the probe under each lead and lift slightly to be sure the leads are attached. If any lead gives, reheat it with the iron. Finally, clean the pads with a piece of sponge or lint free cloth and a small amount of flux remover or contact cleaner. Let it air dry.

Practice makes perfect

When soldering SMDs, the more you do, the better you'll get at it. Make your first attempt with boards and small SMD ICs you'll never use; thus if you make mistakes it won't matter anyway. Once you're comfortable with the process, you can move on to the larger ICs. With practice you will be able to replace a 128-pin SMD in about 15 minutes.

There are many accessories available to make working with SMDs easier. Check with your parts supplier for information on the vast array of SMD tools. I have a Dot Maker kit that uses the paste solder and flux. It places a small dot of paste solder on the pad that you heat to melt. It works well, but I tend to apply too much of everything. There are also grounded irons available that heat and remove SMDs in one step—a good investment if you plan on removing a lot of surface mounted devices.

The important thing to remember when working with surface mount technology is to be patient. Take your time, and proceed only when you're sure everything is the way it should be.

Summary

You will find it almost impossible to locate schematics on many of the motherboards available today. I rarely ever throw anything away. When I have in my possession two motherboards of the same type, it's only a matter of time before those boards are laying on the bench. By applying simple logic, you can often locate the defective area without schematics.

Of course, this is a "spare time" project, but you can easily sell the repaired board for 50% of the price of a new board. You can inventory these low cost, repaired and tested boards until needed. The more you repair, the easier and faster it will become. ■

Diagnostic software

Windsor Technologies has released version 3.50 of its PC-Technician PC3030, Professional Level Personal Computer Diagnostic System product. It replaces all previous products in this line. Significant changes since version 3.0 include: support for troubleshooting Pentium-based PC systems, support for troubleshooting additional SCSI Host Adapters including the Adaptec AHA-1540/42 C&CF, AHA-1740/42A, and AHA-2840/42A and the SCSI fixed disk drives attached to them, support for serial testing COM4 (COM1, COM2 & COM3 already supported) and up to 64 user-defined serial port addresses, improved memory tests with support for memory testing up to one (1) gigabyte of extended memory, and a new, improved, and expanded user handbook, combining test and function descriptions and extensive error code information.

Significant changes since version 2.63 include: the software is no longer copy-protected, so an operational copy can be made for daily use while the original system diskettes are stored in a safe place, all Certification Tests can be toggled on/off. As a result, the Certification Test Menu can be customized to fit any specific testing needs, the program is provided on permanently write-protected 5¼ inch (360K notchless) and 3½ inch (720K switchless) media. Thus, SYSTEM Diskettes cannot be accidentally written to or infected by a virus.

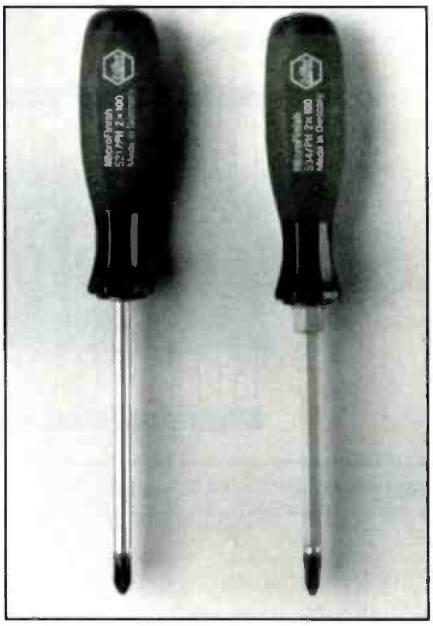
The product operates independent of the operating system, and provides over 200 tests and functions for all 8086, 8088, 80286, 80386, i486, Pentium (ISA, EISA, MCA, and PCI) and compatible computers.

Circle (60) on Reply Card

New screwdrivers

Willi Hahn Corporation offers a new range of screwdrivers, MicroFinish Phillips screwdrivers. These screwdriver handles have a positive gripping "non slip surface" which improves power transmission and allows maximum force and comfort even with dry, oily or wet hands.

The handles are made from cellulose acetate which eliminates the risk of sharp/foreign objects becoming embedded in the handle as can happen with soft rubber two-component handles. The handles are



impact resistant, oil and grease resistant, cadmium free, and also have good insulating properties.

These screwdrivers feature chrome-vanadium-molybdenum hardened and tempered tool steel blades for exceptional tool life, wear resistance and high torque performance (RC58-60).

Circle (61) on Reply Card

PC Diagnostic software program

Ultra-X introduces QuickTech–Pro, a professional-level PC diagnostic software program, designed to meet the needs of system developers and integrators, OEMs, technicians, MIS professionals, and end users who want to quickly test and troubleshoot core system components, functions and peripherals.

For maximum flexibility and portability, the software runs from only one 3½ or 5¼ diskette. It does not have to be installed on a hard drive to execute any of the tests.

The main menu provides easy access to over a dozen test groups which range from system information and RAM testing functions, to continuous loop burn-in and system board component testing. On-line help is available for all functions and is only a keystroke away whenever the user needs extra information on the test being performed or results being viewed.

The program's advanced diagnostics can quickly troubleshoot malfunctioning systems, isolate random failures (such as base or extended RAM problems) and perform system maintenance before problems occur. The program offers a variety of tests, including multiple pattern base, extended, external cache, and video RAM tests; floppy and hard drive tests and utilities; keyboard and mouse tests; parallel and serial port tests; monitor and video board tests; CPU, video and hard drive throughput analysis and performance evaluations and more.

Additionally, the diagnostic provides a burn-in function which runs multiple tests continuously, thereby allowing the user to thoroughly check new or repaired components or complete systems. The program also provides a comprehensive printer test which supports over 700 printers.

Circle (62) on Reply Card

Line separator

Extech's new Line Separator permits easy access to a 2-wire or 3-wire power cord. A standard clamp meter can then be used to easily and safely record line current. The unit separates the hot/live conductor from the neutral (and ground) wire. Two or three-prong plugs can be tested as the line separator is placed between a wall outlet and a power cord. A x10 multiplier range allows precise measurements of low current levels.

Circle (63) on Reply Card

Computer memory upgrades

Memory upgrade enhancements for proprietary computer systems from *American Micronics, Inc.* (AMI), now come with free software support for the 500 most popular software packages available. A toll-free help line awaits users 24 hours a day, 7 days a week. Typical technician response time is two minutes. This approach to memory upgrades solves the support problem spurred by the explosive demand for increased memory required by current software. Also, installation of memory modules for users without onsite or dealer assistance is provided through step-by-step telephone guidance, ensuring successful memory upgrading. Product choices are broad ranging, with module choices typically meeting or exceeding the megabyte offerings of the original manufacturer. Expansion modules are available for Compaq, AST,

DELL, ALR, NEC, HP, all popular brands of laptops, desktops and workstations.

Circle (64) on Reply Card

Bench DMM

Wavetek Corporation announces a new, low-cost $3^3/_4$ digit, 4000 count, benchtop DMM with a built-in frequency counter and capacitance meter for electronic depot repair, production test and laboratory applications.

This DMM, Model BDM35, features: ac and dc voltage measurement to 750/1000V in five ranges; ac and dc current measurement in five ranges to 10A; resistance measurement in six ranges to 40MΩ; a diode test and continuity functions. The meter is autoranging and all functions are selected via push buttons on the front panel. To assure quality measurements, the meter features basic dc accuracy of ± 0.1%. For user safety and ease of use, input jacks are boldly labeled, and both the 2A and 20A jacks are fully fused. The large LCD display has both a 42-segment bargraph and digits that are 0.5 inches in height for easy readability in bench applications.

Other key features include: data hold, min/max record, mem/read—which records the meter's last function and the measurement taken in that function, and hold, which freezes the display for viewing at a later time.

In addition, the unit also combines the convenience of a frequency counter and capacitance meter in a single unit.

Circle (65) on Reply Card

Hot-air rework and repair station

Cooper Tools introduces the WHA 1000 System, an integrated rework and repair station marketed under the Weller brand name.

The station has adjustable temperature and air flow, and provides both hot air and suction capabilities in one. Built-in vacuum pickup allows for easy chip removal with no need for additional tools. A source of shop air is the only requirement, which makes rework and repair simpler and less expensive.

The system can be mounted to a table or used as a hand-held unit, and is available with either heated or nonheated rework tables. It works with either the company's hot air nozzles or other manufacturers' nozzles when used with adaptors.

Additional features include ESD-safe materials for the protection of sensitive components and an adjustable table for precise positioning.

Circle (66) on Reply Card

VCR cross-reference book and disc

The fifth edition of the *VCR Cross-Reference and Parts Cross Reference* is available in both paper and software editions from *The International Society of Certified Electronics Technicians* (ISCET).

The software allows the user to search by manufacturer for model numbers and description for part numbers, and a subsearch by manufacturer and part-description is also a feature of the program. The editing sequence for parts shows on screen all substitutes for the part entered.

There are 1,704 models and 4,943 parts with all updated prices in the 128-page laser-printed book. Even though the model and part numbers have been increased by hundreds, the new edition of the book cuts the number of pages in half by using a reference system crossing each model and part to its matching category.

Circle (67) on Reply Card

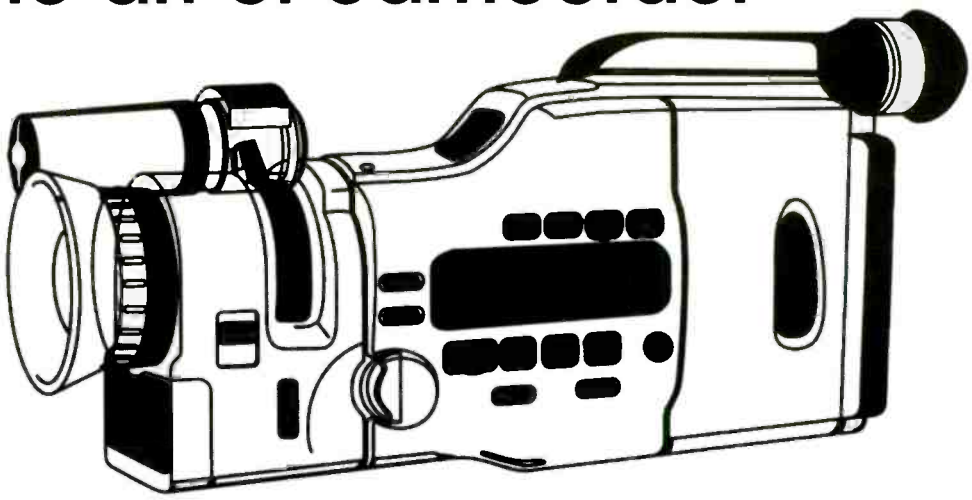
Electronic component locator

The Electronic Component Locator V.2.2 from *Tech Assist* now cross references over 3400 manufacturers and 1500 distributors. It contains 1100 categories of products including electronic components, chemicals and value added products and services. Each distributor's office includes contact names, addresses, phone and fax numbers and allows the user to add notes. The Electronic Component Locator will print custom reports and the user can query by an letter, group of letters or words. The E.L.C. V.2.2 will run from the floppy or hard drive and only requires 350K memory to run. A screen saver is built in for those who want to leave it on all day. This version has been updated as of November 1, 1994, it covers the entire United States and will assist purchasers of practically any component, even discontinued or obsolete, in their search for better pricing and specific parts.

Circle (68) on Reply Card

The gentle art of camcorder repair

By T.V. Kappel



Of all the high technology consumer electronic devices on the market today, the highly reliable camcorder is the bear to repair.

These little hand-held cameras are dropped, sat on, kicked, tripped and knocked over on a tripod, and, occasionally, treated little better than a hockey puck. Then, of course, they're brought in to you for repair. The symptom? "Why, it just quit working." Then you're asked, "Do you give free estimates?" Sometimes all this leads you to feel that the gentle art of karate should be used to service them.

Evaluating the damage

The first step in evaluating and possibly repairing these complicated units is a little like medical triage. You need to determine as quickly as possible if the patient is only slightly hurt or poised at the door of the graveyard of video cameras.

The slightly hurt ones can be rushed into the operating room. The others you cover either with a, "Not worth cost of repair," black cloth estimate, or a major medical estimate that approaches the cost of a vital organ transplant. In some of these latter cases, that's exactly what you'll be doing: transplanting complete boards for ones that have been brutally cracked and even smashed. Your fingers will be crossed the whole time hoping that the operation will save the patient. They won't pay you if it doesn't.

Kappel is Telecommunications Engineer for the Albuquerque Public Schools and manages the Computer Maintenance and TV/Video Maintenance Departments.

All kidding aside, repairing camcorders is tough. For the initial evaluation, it isn't even necessary to put the best service technician on the job. You actually need your best and fastest *evaluator* to take the first look. This is the triage part of the initial repair.

By the way, in spite of all this gloom and doom, these devices can be serviced profitably. This will undoubtedly help your bottom line and your reputation immensely.

The case tells a tale

To quickly estimate a repair, the first step is not to power up the camera and see what the symptom is, but to closely examine the outside case of the camera itself.

These new lightweight plastic covers are very forgiving to even sledgehammer blows to them. They bounce in, smash the delicate electronic boards underneath and

If you plan to service camcorders, be sure that you have a good supply of small hand tools and screwdrivers

bounce back out with little or no sign on the outside. The operative words here are, *little* or *no*.

Carefully examine the outside case of the camcorder for tiny fractures, telltale scratches, and dents on the lenses. Sometimes the customer will make efforts to clean and hide these as much as possible: not to hide these damage indicators from the service technician, but from the perpetrator's parent or spouse.

If you suspect that the unit has been seriously damaged, open it and examine it carefully before you apply power. By doing so, you may prevent further dam-

If you suspect that the unit has been seriously damaged, open it and examine it carefully, before you apply power

age of the smoke and fire kind with a physical examination first. If you see no sign of serious abuse, then power it up and observe for symptoms.

Damage behind the lens

There was one unit I examined that was drop-kicked when the neck strap came loose on one end of the clip and the camera fell nose first to the ground. The patient was in a complete coma with little or no vital signs. There was a small dent on the lens extension in front of the glass, but little sign of other damage.

When I carefully opened the case, after taking out hundreds of tiny screws, I found small printed circuit boards with surface mounted resistors, capacitors, and discrete devices. Also, little bits of gray plastic fell out onto the workbench.

If you plan to service camcorders, be sure that you have a good supply of small hand tools and screwdrivers. Standard sizes of screwdrivers are too large. Precision tools are available through many catalogs or at local hobby shops.

I've found that one of the most useful tools to have around for camcorder servicing is a hand-held, variable speed,

hobby drilling and grinding rotary tool, which I've often used to grind and drill out a headless screw or create a replacement body part. This tool is worth its weight in platinum when necessary.

Back to the operating room

In this particular case, the camera had been dropped on its lens. The lens was driven backward, breaking the plastic mounts holding it in place and shearing off a surface mounted capacitor and two resistors positioned on a board behind the lens itself.

One of the most useful tools to have around for camcorder servicing is a hand-held, variable speed, hobby drilling and grinding rotary tool

I obtained replacements for the surface mounted components and installed them. This required a good variable temperature soldering or desoldering tool for this delicate part of the operation. Here again, the standard iron and soldering tips would be much too large for the job. Manufacturers do make good equipment to help you with this kind of work, but it is expensive. The last one I bought was in the five hundred dollar price range with a tip assortment that helps unsolder surface mounted IC's.

After I replaced the components, I carefully examined the board for cracks, broken or pulled loose traces. Next I checked the resistances of the circuit paths of the parts that I had replaced using the ohms function of a DMM. It all seemed okay.

The hardest part of this repair was in reattaching the lens to the broken mount. I debated on ordering a new case side. This is one of those parts that must be ordered directly from the manufacturer and may come on a slow boat from the orient. Moreover, replacing this part would have added to the cost of the repair. It was a judgment call as to the extent of the damage to the case and whether it was repairable or not.

In this case, the screw mounts were intact. The screws had, however, been forcibly torn out of the plastic mounts, stripping the threading, and leaving gray plastic dust and particles to fall on my bench.

I used a slightly larger screw than the original, and applied a dab of epoxy to cover the heads and bond them to the plastic. I crossed my fingers and hoped the owner could manage to be a little more careful in the future and this unit would not come back again. Getting those screws out in the future, should it be necessary, would be a job for the high-speed, hand-held drill and grinder tool.

The electronics, mechanics and optics checked out after I fired it up and ran it through a series of tests. Everything appeared to be operating properly, so I spent the hour of a thousand screws reassembling the camcorder, filled out the paperwork, and notified the customer that it was ready. Then, with a heavy sigh, I turned to the next one.

Actually, considering the thousands of cameras out there, and the complexity of their mechanics and electronics and the abuse they are subjected to, they are extremely reliable. I'm sure the percentage of camcorders that come in for repair are a very small fraction of the hordes out there in the hands of potential abusers.■

S.O.S. TV

By The ES&T Staff

George Bluze of S.O.S. TV in Largo, FL, is quiet and courteous to a fault. Because of that, it takes someone just meeting him a little while to recognize that he is a gifted technician, an astute businessman, and a trade association leader at all levels. Bluze has been in consumer electronics service in one way or another since 1945.

While studying at New York Technical Institute in Newark, NJ, Bluze worked part time for Franklin Radio and Television in nearby East Orange, NJ, where he quickly advanced from his entry-level position of outside service technician to bench technician and then finally to service manager.

In 1951, Bluze moved to Denver to start a servicing business with a close friend. They chose Denver because there had previously been no local TV stations there due to the FCC new station freeze in effect since World War II. They opened Telemasters TV Service shortly after the lifting of the freeze and the first TV station started broadcasting. It was an exciting time and business boomed for a while. When things settled down, Telemasters continued to provide a steady livable income for two families until Bluze decided to sell out to his partner.

Married while in Colorado, Bluze moved with his wife Marge and their son Allen to Palisades Park, NJ, where they founded S.O.S. TV.

After 15 successful years in New Jersey, the Bluzes retired to Largo, FL. This retirement, which lasted only two years, ended when the Bluzes established S.O.S. TV in Largo.

George and Marge Bluze have been very active in servicing organizations and have always tried to attend technical and management seminars whenever possible. George has held a number of offices, including President of the National Electronics Service Dealers Association (NESDA) and the Florida Electronic Sales and Service Association (FESA).

The result of that willingness to constantly strive to accumulate new and more skills, and a constant study of the business to see what's working and what's not, has allowed the Bluzes to be extraordinarily successful in running a sales and service consumer electronics business. And they have been very generous in sharing their knowledge with others.

The importance of image

"Your company's image is extremely important," says George Bluze. "People like to deal with successful businesses. Think about the difference image makes in restaurants, medical facilities, legal firms, etc. How much more are you willing to pay when you have confidence in what you receive from them? The same things apply to our business. Consumers are not only willing, but happy to pay professional rates when a professional does the work and it is backed up by a well run company with a good reputation."

"Invoices are very important," says Bluze. The way a bill is presented can make the difference between a happy or an unhappy customer, and can increase your income. Bluze has developed wording that explains every labor operation in great detail.

S.O.S. TV has enhanced its professional image by being careful about the presentation of invoices, business cards, letterheads, advertising, keeping promises, employees' attire and attitude, attention to detail, service vehicles, store appearance, test equipment, telephone calls. Bluze feels that all of these are as important as technical ability. They might even be more important.

The S.O.S. formula for success

The things that have contributed most to the success of S.O.S. TV, according to George Bluze, are:

• Insistence on maintaining the cleanest, neatest, well organized, best equipped service department possible. Allen Bluze was the first in the family to recognize the importance of this aspect of the business. As time went by and the Bluzes saw the benefits derived from doing it his way, they "have become fanatical about neatness and cleanliness."

• Using a good replacement parts pric-

Figure 1. George, standing at left, and Marge Bluze, seated behind the counter, manage S.O.S. TV, a successful consumer electronics sales and service business in Largo, FL.

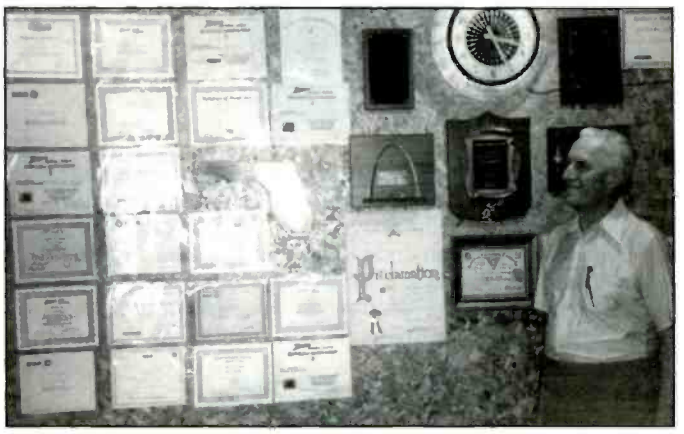


Figure 2. One reason for the success of S.O.S. TV is that the Bluze family recognize the importance of constantly learning, both the technical aspects of the business, and the business side, and of active membership in professional organizations. Here George Bluze displays many of the diplomas and plaques he has earned.

Figure 3. The service center at S.O.S. TV is neat, and full of test equipment and service literature. Frequently, a tour through this facility is the clincher that gives a prospective customer the confidence to buy from S.O.S.

Figure 4. George Bluze shows off the accessory display rack at S.O.S. TV. Sale of accessories provides additional income for the business.

ing system. S.O.S. TV uses a pricing chart developed by Sperry Tech of Lincoln, NE, that provides a more realistic method of calculating gross margins necessary to make a profit. A sliding scale is used. Low cost items are calculated at the highest gross margin. Items costing over $40 are calculated at the lowest percentage. This allows the company to make a reasonable profit on replacement parts in spite of such things as losses from shrinkage, inadvertent omissions of some parts from bills, parts broken or burned out during trial substitution during troubleshooting, and obsolescence.

Other factors that reduce the actual profit on parts include the cost of the computer used to maintain the inventory database, the time needed to make entries, the time spent researching part numbers and placing orders, shipping charges, long distance telephone calls, and the cost of the physical space needed to stock parts. Bluze feels that if he were using manufacturers' suggested list prices, the parts department would be operating at a loss. Unfortunately, Bluze says, many manufacturers pay little or no markup on parts used to perform their warranty service and Bluze has had to subsidize these losses with parts profits performing non-warranty service.

• Implementing non-refundable, up-front deposits on repairs. This helps the cash flow, eliminates most unprofitable repairs, reduces abandoned sets, helps keep the service area uncluttered, causes a higher percentage of estimates to be approved because people don't want to lose the deposit, and makes higher bills more acceptable because the customer is thinking of the balance due rather than the entire bill. The few customers we lose because they're unwilling to pay the deposit most likely wouldn't have approved the estimate anyway.

• Computerizing the entire operation, including invoicing, inventory, bookkeeping, word processing and electronic mail. The computerized inventory control system enables S.O.S. TV to check usage so that they know what quantity of each part to stock. It eliminates the unwise purchase of some specials by showing which parts are slow movers. Parts that show no movement for a full year are gradually disposed of and taken off the inventory.

Use of the computer shows gross margins on each part. It helps keep track of price increases and overcharges by distributors. It saves time: someone can look up if the part is in stock and its physical location. It produces a counter price list which shows selling price only and is used when selling parts over the counter.

It is tied into the bookkeeping system, which simplifies reports and is indispensable at tax time. All invoices and correspondence are more professional because they are done by word processing. Being computerized creates a more professional image and shows that the company is involved with new technology.

• Membership in professional organizations and the knowledge I gained from other dealers and seminars over the years.

Knowing where to advertise

"We do most of our advertising in the yellow pages," says Bluze. "Newspaper advertising in my area is monopolized by the larger dealers and is not effective for me. The street my business is located on is the exact borderline between the areas served by the St. Petersburg and Clearwater telephone books, so I am forced to advertise in both books. While the cost of this advertising is high, we find it to be worthwhile. It is the main source for our getting new customers.

"We advertise that we employ technicians certified by the International Society of Electronic Technicians, and our computer prints it on all of our invoices.

"We encourage customers to take a tour of our service facilities. We frequently use this to close sales of new televisions."

Communication is important

"When we have a problem with anyone, whether it is a customer, manufacturer, supplier or someone in local government, we communicate," says Bluze. "We frequently make things happen that would have been impossible if we just sat by and complained to ourselves. If we don't make something good happen, we prevent something bad from happening."

Honesty is still the best policy

"Largo Florida is known as the 'lightning capital of the world,'" says Bluze. Lots of solid state products go bad from powerline surges during these storms. Summertime is very busy for S.O.S. because of this. Insurance companies are very busy with claims from lightning related damage. Many dealers and consumers file phony or inflated claims. This causes problems with legitimate claims.

"I have contacted several insurance companies and offered my services," says

Figure 5. Allen Bluze, son of George and Marge, their chief technician, makes a delicate adjustment of a VCR.

Figure 6. Recently, SOS has added video editing equipment to their sales inventory. It's not a high-volume type of product, but it is a high-cost/high-profit item, and the hobbyists who use the equipment keep coming back for the latest products.

Bluze. "I refuse to say that a problem was caused by lightning when there is no possibility that it was caused by lightning." This established a reputation for S.O.S. with insurance companies that they would provide an honest diagnosis.

"We get some referrals from insurance companies, and have been used on occasion to follow up on a suspected fraudulent claim," says Bluze.

A few thoughts

George Bluze spends a great deal of time thinking about his business. Here are a few of his ideas.

"Just because customers pay their bills without complaining, that doesn't necessarily mean that they were satisfied. You should find ways to determine whether or not they are really happy."

"The best roadman I ever employed was not a good technician, but he had the ability to make up for his lack of knowledge with his cheerful personality."

"The best salesman I ever employed spent very little time explaining all the technical features of the products he sold. He had the ability to quickly inspire customer confidence and he knew when to 'close' the sale."

Changing when change is needed

"The survival of my business may have depended on my willingness to accept the challenges, reverse my course and try new ideas as they arose," says Bluze. "It is my firm belief that we must bend with the tide and never be afraid to try something new. One major success can make up for a dozen minor mistakes."

About ten years ago, the sales department at S.O.S. TV was more profitable than the service department. Frequent newspaper advertising and carrying a large selection of merchandise was the proven way for Bluze to conduct business. S.O.S. stocked five major brands of televisions, wide screens, VCRs, cameras and accessories. They sold mostly high-end merchandise and didn't even stock or advertise leader models. "Sales were good and I knew I was doing things right," says Bluze.

"Or was I?" Competition from large discount chains and catalog stores kept getting more intense and gross margins were shrinking at the same time business expenses were increasing. "We were wasting a lot of time demonstrating products and losing the sale to the mass merchandisers. To add insult to injury, some of these lost customers came back to us when they needed warranty service or product instruction."

The solution was a complete change of thinking. S.O.S. took its losses and got rid of excess stock as quickly as possible. "In less than 12 months, I eliminated two brands and stabilized the sales inventory at about one-quarter of what it was originally." By decreasing inventory and using more care in selecting products, S.O.S. was able to achieve more turns on merchandise. This, along with the elimination of floorplan interest, has made the sales department profitable once more.

During this same period, S.O.S. entered the computer service field and set up a motor home as a mobile service facility. This proved to be a good move at the time.

More emphasis on service

"There is practically no customer loyalty anymore when it comes to sales," Bluze says. "However, it is still possible to keep service customers happy if they know they can't get better service anywhere else. The customers worth keeping accept a reasonable price if the service is outstanding. So, I changed my way of thinking as far as my service department was concerned."

Now that sales were no longer as profitable, Bluze began to make a greater effort to getting service customers to approve repair estimates. "I started to devote more time to improving inventory and billing procedures and giving our service department a more professional path to follow," says Bluze.

S.O.S. was faced with the problem of trying to justify higher charges on products that keep getting lower in replacement cost. Part of the solution was to start turning down or giving higher estimates on off-brand products and other undesirable repairs. Estimate charges are now payable in advance. This has eliminated many undesirable repairs and helped the business cash flow.

Bluze says "I discontinued doing warranty service on brands that wouldn't pay realistic rates, increased my yellow-pages advertising and raised my prices. To borrow a familiar phrase, we have become known as the 'most expensive service company in our area, but we're darn well worth it.'"

Continuing to improve

Bluze continues to make improvements at S.O.S. TV that should keep the company successful for years to come. Faced with the increasing difficulty to match prices of discount stores, S.O.S. joined a buying group and on many items

Figure 7. Marge Bluze, President of S.O.S., is shown here taking care of the front desk.

Figure 8. The showroom at S.O.S. TV is neat, and provides a comfortable atmosphere in which customers can evaluate the products.

has been able to not only match, but beat a discounter's price and still make a reasonable profit on the sale.

S.O.S. has begun to sell and service video editing systems. These do not have broad appeal, but they are high-end, high-profit items, and the video hobbyists keep coming back for the latest products.

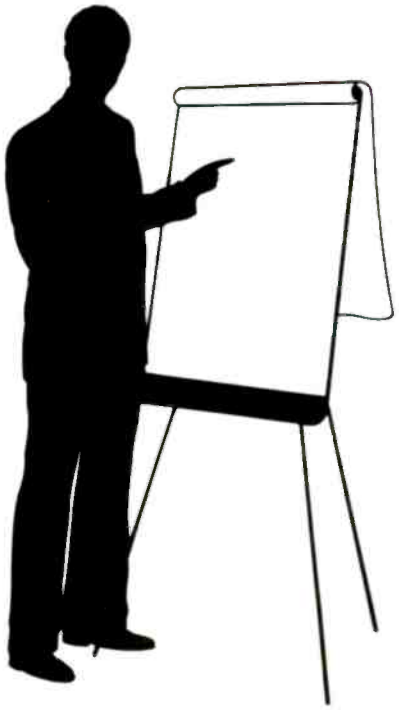
In short, what has made and kept S.O.S. TV successful is the willingness to work hard to be the best in their business, the commitment to constantly study and learn both the technical and business aspects of consumer electronics sales and service and to make changes when necessary, and the desire to give their customers the best that they can give.

Contributions have been recognized

All of the qualities that have made George Bluze successful with the support and aid of his wife and son, have been recognized. In a ceremony in August of 1994 at the annual National Professional Electronics Conference in Portland, OR, George Bluze was inducted into the Electronics Industry Hall of Fame. The purpose of this Hall of Fame is to honor individuals who have made outstanding contributions to the electronics industry, or have served as inspiring examples for others to follow.

The success of George Bluze is not limited to his own business, but has been of benefit to the entire community of consumer electronics servicing. ■

Transactional leadership



By John A. Ross

When the subject of leadership is discussed, one interesting and important fact becomes clear: no real consensus about the characteristics of a leader exists. Arguments about leadership traits and theories of leadership are popular subjects in the academic world, but discussions about leadership are also important for those of us involved in everyday management decisions. As a follower, it is important that I have the ability to recognize the actions and motivations of those in leadership positions. As a leader, it is equally important that I understand the actions and motivations of my followers and that I do not abuse power.

Personal characteristics

In the past, leadership was defined in terms of personal characteristics: an individual's innate maturity, intelligence, drive and friendliness separated him from followers. Of course, these opinions seem to ignore leaders, such as Hitler or Stalin, who either failed to exhibit overwhelming friendliness, or had the wrong personal motivations. Along with that problem, the "school of leadership traits" continued to find more characteristics that defined leadership. Unfortunately, many of the newly discovered leadership traits were also the traits of non-leaders.

So we find that the qualities or traits of a leader are undefinable. But we also know that leadership and leaders emerge every day. Rather than consider traits, we can look at a variety of approaches that individuals use when confronted with leadership situations. In the last article, I identified some of those approaches as transactional, social, political, moral, reform, executive and intellectual. Two other important approaches that bear much discussion are the contingent and transformative approaches. Most of us use one or more of those approaches every day.

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

Transactional leadership

Let's take a look at one of the most common forms of leadership: transactional leadership. When Sara, owner of an electronics service business, interviews Tim and discusses duties and compensation, she also describes a series of transactions between her organization, herself and Tim. Both Sara and Tim realize that the other has power; each also recognizes that the other is a person. Effectively, an exchange occurs and continues; if the duties and compensation remain mutually satisfactory for Sara and Tim. The duties and compensation define the purpose behind the employer/employee relationship. If either Sara or Tim falters, the purpose is lost and the relationship dissolves.

In its base form, transactional leadership is merely management or the maintenance of the status quo. Both Sara and Tim must keep their part of the bargain. As a result, the leadership involved in making and maintaining the transaction has a temporary, almost shallow, quality. In terms of leadership, this shallowness remains, even if the transactions move from work-for-money to work-for-personal-satisfaction. Although Sara may reward Tim with congratulatory letters or company-wide recognition for his contributions, the relationship between the two still involves a transaction.

We all know that there is nothing wrong with transactional leadership as long as the status quo is maintained. If either Sara or Tim attempt to take advantage of the other and move the transactions into their favor, though, then misunderstandings and problems occur. If Tim believes he should receive more money, for example, he may not work as hard, take longer breaks, or quit. On the other hand, Sara may use the power of position to retaliate against Tim for his actions. She can make him more accountable, provide stiff evaluations, or terminate him. Each option illustrates the superficial, temporary qualities of transactional leadership.

Despite the dangers involved with transactional leadership, we can look at that style as the building block for other leadership approaches. As Sara and Tim engage in the transaction and seek to maintain its constancy, a higher level of communication may develop between the two parties.

Although Tim believes that he deserves more money, he may conclude that the company doesn't have the resources to pay higher wages. In contrast to taking a hard approach in response to Tim's actions, Sara may reconsider the situation. Instead of relying on traditional rewards, she could give Tim more of a role in making decisions. Quite possibly, a managerial decision to "empower" Tim may cut company expenses.

It's evident that transactional leadership can move you towards either conflict or a higher level of leadership. It is also readily apparent that taking either path involves both the leader and the follower. Indeed, when we consider the actions of Sara and Tim as they step away from transactional leadership, it becomes difficult to discern which individual has the leadership role at a given time. Surprisingly, this accentuates one essential point of leadership: at any moment, the leader may assume the role of follower.

Books

***Microwave Oven Repair, 3rd Edition*, By Homer L. Davidson, TAB Books, 480 pages, 457 illus., $24.95 paperback, $44.95 hardcover.**

Microwave ovens are the most affordable and versatile cooking appliance available to today's consumers. Their safe efficiency and speed has changed the way we cook, eat, and live. In *Microwave Oven Repair, 3rd Edition*, Homer L. Davidson gives electronics students, apprentices, and technicians all the hands-on information they need to troubleshoot and repair almost any microwave oven.

Like many other consumer electronics products, microwave oven technology continues to improve. Revised to reflect the latest innovations in this technology, this new edition contains dozens of all-new diagrams that illustrate today's microwave circuitry, details on the latest test equipment and procedures used by major appliance manufacturers, and specific solutions to more than 200 common microwave oven malfunctions.

Davidson's clear instructions and hundreds of photographs and illustrations show readers how to perform radiation leakage tests, fix defective switches, replace a magnetron, install a new fan motor, and much more. This time-saving manual also includes valuable case histories—what solved a particular problem and what didn't in real-life situations.

Davidson is the author of more than 600 magazine articles and 20 books, including *Care and Repair of Lawn and Garden Tools* and *Troubleshooting and Repairing Audio Equipment, 2nd Edition*. He is a regular contributor to **Electronic Servicing & Technology** magazine.

TAB Books, McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850

***Electric Motors and Control Techniques, 2nd Edition*, By Irving M. Gottlieb, TAB Books, 304 pages, 200 illus., $22.95 paperback, $34.95 hardcover.**

From household appliances to automobiles, and virtually anywhere mechanical motion is powered by electrical energy, solid-state electronics is the key to greater flexibility, reliability, and reduced energy consumption. Written for anyone who works with electric motors, *Electric Motors and Control Techniques* explains how different types of motors operate and how electronic control devices can be used to improve efficiency in a wide range of applications.

Updated to cover state-of-the-art digital stepper motors and microprocessor controls, as well as new motor and control techniques for electric vehicles, this second edition contains in-depth coverage of: dc motors, ac motors, commutator-type motors, non-commutator-type motors, electric motor control applications, and electric vehicle energy sources.

Gottlieb is an electrical engineer who has extensive experience with electric motors and electronic control systems. He is author of *Power Supplies, Switching Regulators, Inverters, and Converters—2nd Edition*, *Practical RF Power Design Techniques*, and *Regulated Power Supplies—4th Edition*.

TAB Books, McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850

***Easy Laser Printer Maintenance and Repair*, By Eric Kuaimoku, Windcrest, 224 pages, 200 illus., $18.95 paperback, $28.95 hardcover.**

This book is for those who want to get their laser printers up and running quickly and inexpensively. It covers all of today's laser and LED printers, giving readers information and guidance needed to perform their own repairs.

Easy-to-follow, illustrated instructions demonstrate how to solve electrical problems in power supplies, image formation systems, sensors, circuit boards, and wiring; improve the quality of a printer's output by eliminating spots and streaks; and fix common mechanical problems, such as jams and misfeeds in paper transport systems. Step-by-step troubleshooting flowcharts make it easy to identify the cause of problems and perform the necessary repairs. A list of the tools and required cleaning supplies is also included.

Windcrest, McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850

***Hands-on Guide to Oscilloscopes*, By Barry Ross, TAB Books, 224 pages, 115 illus., $21.95 paperback.**

The oscilloscope is the most important piece of electronic test equipment for both hobbyists and technicians, but until now, there has been surprisingly little general information available. The manuals that come with new oscilloscopes are written specifically for a particular brand and model, and used oscilloscopes frequently don't come with a manual.

The *Guide* is a reference for beginning technicians, test engineers, and electronics hobbyists who want to learn modern oscilloscope techniques. In this introductory guide, Ross explains step by step how these instruments work, how to calibrate them, and how to use them to test components and circuits. He also offers helpful advice on how to choose the right oscilloscope for you.

Other topics covered in this well-illustrated handbook include the latest digital storage and trigger circuit techniques; high-voltage and current probes; and methods for making accurate time, rise-time, voltage, phase, modulation, and cursor measurements. In addition to providing clear descriptions of different oscilloscope functions and circuits (both analog and digital), Ross includes real-world examples of oscilloscope applications at the end of every chapter.

Ross has worked for 30 years as an electronic design engineer, specializing in the manufacture of oscilloscopes.

TAB Books, McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850

***Repairing PCs: An Illustrated Guide*, By Michael F. Hordeski, Windcrest, 400 pages, 193 illus., $22.95 paperback, $34.95 hardcover.**

In this PC repair guide, computer owners and service technicians will get money-saving advice on how to maximize PC performance and unlock the potential of processor and memory expansion upgrades; minimize down-time; and troubleshoot and repair a variety of PCs, that includes XTs, 286, 386, 486, Pentiums, and compatibles.

This revision of *Repairing IBM PCs and Compatibles* includes new material on CD-ROMs, 486-based computers and the Pentium-based PCs. Readers will learn how to test processors, memory, hard disks, mouse units, networks, and power supplies without using special equipment. The book also teaches valuable skills for diagnosing and repairing hard disks before serious problems occur, and ways to recover data that DOS cannot read.

Windcrest, McGraw-Hill Inc., Blue Ridge Summit, PA 17294-0850

Photofacts

These Photofact folders have been released by Howard W. Sams & Co. for January 1995.

CROSLEY
CT3132C401 3418
CT3132C402 3418
31Z101-00AA 3418
31Z101-00BB 3418

FISHER
FVH-805 . . . . . .VCR-259
FVH-805A VCR-259
FVH-810 . . . . . .VCR-259

JC PENNEY
NC-37A 3424
1048 3424
685-1048-00 3424
685-1224 3424

MAGNAVOX
MD2607C101 3420
PS1960B121 3422
TR2510C101 3420
19E614-00AA 3422
25E501-00AA 3420
25E501 3420
25E502 3420
25TRC10101 3420

PANASONIC
ADP233 3425
AEDP236 3413
AREDP212 3421
CT-20R11CS 3425
CT-20R11S 3425
CT-27SF11S 3413
CT-27XF11CS 3413
CT-F29L5S 3413
CT-F29L5LS 3413
CT-F29L5VS 3413
CT-31S60R 3421

PHILCO
P1321RC201 3416
13G602 3416

QUASAR
AEDC233 3412
SP2016K 3412
SP2016CK 3412

RCA
CTC166A 3414
X20330GSFB1 3414
X20330GSNX1 3414

SANYO
AVM-1304 3419
G6Y-13040 3419

SEARS
564.53340550 . . . . .(sim. to) VCR-259

SONY
KV-ST2050 3415
KV-20S10 3415
KV-21RS10 3415
KV-2190RS 3415
KV-27S10 3423
KV-29RS10 3423
KV-32S10 3423
SCC-F84L-A 3423
SCC-F84N-A 3423
SCC-F85G-A 3423
SCC-F85J-A 3423
SCC-F89F-A 3423
SCC-G92C-A 3415
SCC-G93C-A 3415
SCC-G93F-A 3415
SCC-G94E-A 3415
SCC-G94F-A 3415

SYLVANIA
SRC1361401 3417
SRC1361404 3417
13Y401 3417

COMING NEXT MONTH

In February, **ES&T** will present several features that will help service technicians get the job done:

VCR Servicing: VCRs are far more than just a product. Every VCR is a complex system that consists of the electromechanical subsystem that transports the tape past the heads at the proper speed, spins the video head drum, and turns the magnetic signals on the tape into audio and video, and an electronics subsystem that processes the signals and generates the picture and sound. This article will delve into portions of these systems and provide readers with useful VCR servicing advice.

New technology update: Technology continues to move ahead at a breakneck pace. Consumer audio and video systems now provide sound and pictures in the home that rival the movie theater experience and are getting better. Personal computers continue to push into the world of consumer electronics and get more powerful every year. Personal communications continues to evolve to the point where an individual will one day be able to communicate with any other individual at any point on the earth's surface. In this article we will report on some of the amazing advances that are taking place in consumer electronics technology.

General software: From time to time over the past few years, ES&T has reported on the availability of personal computer software that is useful to consumer electronics service facilities: service center management software and diagnostic software. But if service centers are only using those two types of software, they're probably not using their computers to the fullest. software exists, and continues to be developed at a prodigious rate. In this article, ES&T will describe some of the other software products that can be useful in service centers: such programs as word processors, schedulers, calendar makers, electronic circuit simulation programs, drafting programs and more.

1994 Article Index

1994 Department Index

Back Issue Order Form

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC
Servicing & Technology

To Order Back Issues

Send $3.50 Per Issue
(Check, Money Order, Mastercard, VISA, Discover and AMEX).

Send All Correspondence To:

Electronic Servicing & Technology
76 North Broadway, Hicksville, NY 11801
Call 516-681-2922;
FAX 516-681-2926

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Issue(s) Orders: _____

_____

_____

☐ Payment Enclosed ☐ Money Order
☐ MasterCard ☐ VISA ☐ AMEX

Card # _____ Exp. Date _____

Signature: _____

Profax Ten-Year Directory

(January 1984-December 1994)

January 1984	Profax #
RCA KCS206 B&W	2033
NAP E34 chassis	2034
February 1984	
NAP 19C2 chassis	2035
RCA KCS213 B&W	2036
March 1984	
GE AF/C chassis	2037
April 1984	
GE GL/X chassis	2038
GE XK B&W chassis	2039
NAP E32 chassis	2040
May 1984	
RCA CTC111 series	2041
June 1984	
GE XJ B&W chassis	2042
NAP E32-58, -59 chassis	2043
July 1984	
GE EC/K chassis	2044
NAP K10 chassis	2045
August 1984	
RCA CTC123 series	2046
NAP RD425SI & RXC192SL chassis	2047
September 1984	
NAP E53-45, -46 ,-47, -48 chassis	2048
GE XE B&W chassis	2049
October 1984	
RCA CTC132/132 series	2050
November 1984	
GE AB/AC chassis	2051
NAP BD 3911 SL01 B&W chassis	2052
December 1984	
RCA KCS B&W AM/FM/clock	2053
Hitachi NP81X chassis	2054
January 1985	
GE CM chassis	2055
NEC C13-304A chassis	2056
GE XM-E chassis	2057
February 1985	
GE PC-A chassis	2058
Hitachi CT2516 chassis	2059

March 1985	Profax #
GE GK chassis	2060
Hitachi CQ4X chassis	2061
April 1985	
RCA CTC117 chassis	2062
NAP UXC chassis	2063
May 1985	
GE EC-A chassis	2064
NEC DJ-60EN(R) chassis	2065
June 1985	
GE EP-B chassis	2066
July 1985	
GE 19PC-F/H chassis	2067
August 1985	
GE PM-B chassis	2068
September 1985	
NAP EC-31-52, -56 & -58 chassis	2069
RCA CTC118 chassis	2070
October 1985	
NAP E-34-18, -32 & -33 chassis	2071
RCA CTC121 chassis	2072
November 1985	
GE BC-N chassis	2073
GE EP chassis	2074
December 1985	
GE PC-J chassis	2075
RCA CTC126 chassis	2076
January 1986	
RCA MMC 100, video monitor	2077
GE PM-A chassis	2078
February 1986	
GE BC-A chassis	2079
RCA 117 chassis	2080
March 1986	
RCA CTC133 chassis	2081
April 1986	
GE 25 PC(J) chassis	2082
RCA CTC120 chassis	2083
May 1986	
GE HP chassis, tuning/control systems	2084A
GE HP chassis, chroma	2084B

June 1986	Profax #
RCA CTC125 chassis	2085
RCA 207 series weather clock	2086
July 1986	
GE NF chassis	2087
GE PM-C chassis	2088
August 1986	
RCA CTC136 chassis	2089
September 1986	
RCA CTC130-S1 chassis	2090
October 1986	
GE X110 chassis, B&W TV	2091
GE TV/AM/FM clock radio	2092
November 1986	
RCA B&W TV basic service data, UVM chassis	2093
GE 14-inch portortable color. TV, RS-A chassis	2094
December 1986	
GE X110 chassis (cont.)	2095
RCA UWJ chassis	2096
January 1987	
GE color TV, MK-2 chassis	2097
February 1987	
RCA color TV supplement, CTC117-S2	2098
GE color TV, MK-1 chassis	2099
April 1987	
Hitachi color TV, CT2250B, CT2250W chassis	3000
May 1987	
RCA color TV, VDM140 chassis	3002
GE color TV, NF chassis update	3003
GE 5-inch B&W TV, 7-7130A chassis	3004
June 1987	
Hitachi color TV, CT1358 chassis	3005
RCA color TV, CTC135 chassis	3006
July 1987	
Zenith color TV, D13085/D1910B chassis	3007
GE color TV, MK-1 chassis, Model 8-1938	3008
August 1987	
Zenith color TV, D2500W chassis	3009
Hitachi color TV, CT2020W, CT2020B chassis	3010
September 1987	
Zenith color TV, SD2501W chassis	3011
Hitachi color TV, CT2250B, CT2250W chassis	3012
October 1987	
RCA color TV, CTC134 chassis	3013
November 1987	
GE color TV, CTC140 chassis	3014
December 1987	
Hitachi color TV, chassis CT0911	3015
Zenith color TV, chassis SD2097S	3016
January 1988	
Zenith PV800 color monitor	3017
Hitachi color TV, CT1358 chassis	3018
February 1988	
GE VCR, 1VCR2018W Model	3019
March 1988	
GE 8-4500 projection TV	3020
April 1988	
NAP projection TV, E54-10 chassis	3021
Zenith color TV, C2020H chassis	3022
May 1988	
RCA PVM050 color TV	3023
Hitachi CT2652, CT2653 color TVs	3024
June 1988	
Hitachi color TVs, CT2647/CT2648/CT2649 chassis	3025
NAP projection TV, E54-15 chassis	3026
July 1988	
GE Model 1VCR2006W VCR	3027
Zenith color TV, CM-139/B-0 (B) chassis	3028
August 1988	
Hitachi color TV, CT1344 chassis	3029
NAP color TV, E51-56 chassis	3030
September 1988	
RCA color TV, PVM035 chassis	3031
GE color TV, NC-05X3/06X1 chassis	3032
October 1988	
Hitachi CT3020W/CT3020B color TV	3033
Zenith CM-139/B-3 (I) SD2511G/SD2581H color TV	3034
November 1988	
Hitachi VHS VCR, Model VT-63A	3035
NAP RD4502SL/RLC312SL color TV monitors	3036
December 1988	
GE proj. TV, PW chass., Mod. 40PW3000KA01	3037
January 1989	
Hitachi color TV, CT1955, NP85XA chassis	3038
NAP color TV, series 19C2 chassis (Magnavox)	3039
February 1989	
RCA/GE color TV, CTC145/146 chassis	3040
Zenith col. TV, CM-140/b-2(G) chass. (Models SE2503G/SE2505P, SE2507N/SE2509H)	3041

March 1989	Profax #
NAP color TV, chassis E34-11	3042
Hitachi color TV, chassis CT1941/CT19A2, NP83X chassis	3043
April 1989	
GE VHS VCR, Model 1VCR2002X	3044
Hitachi CT1955 color TV	3045
May 1989	
Zenith CM-14-0/B-3(1) color TV (Models SE2721H/SE2725R/SE2727H)	3046
GE color TV, 1987 CTC136	3047
June 1989	
RCA P42000-S1 projection TV (additional Models: RVM46700, 46GW700, P46000)	3048
NAP color TV, chassis E54-15 (Magnavox RD8518 and RD8520; Philco Model P8190S; Sylvania PSC410 and PSC420)	3049
July 1989	
Hitachi CT2066 color TV	3050
RCA CTC135 color TV	3051
August 1989	
GE CTC135-S1 color TV	3052
Zenith CM-140/B-2(I) color TV	3053
September 1989	
RCA CSM055 col. TV/AM/FM/clock radio	3054
October 1989	
Hitachi CT2086 B/W chassis G7NU3 color TV	3055
Zenith PV4661H rear-projector col. TV	3056
November 1989	
GE 1987 8-4500 projection color TV	3057
RCA/GE CTC145/146 color TV	3058
December 1989	
ZENITH CM-140/DIGITAL(C) chassis color TV (Models SE3135P/SE3191H/SE3535H /ZB2771H/ ZB2771H2/ZB2777H/ZB2777H2/ZB2797P/ZB2797P2 /ZB2797Y/ZB2797Y2/ZB3193H/ZB3193Y/ ZB3539T/ZB3539Y)	3059
January 1990	
Hitachi CT1395W G7NSU2 color TV	3060
February 1990	
Zenith CM-139/B1 (Y) and (K) color TV Receivers Models SD2097S (Y) and SD1327W3, SD1327Y, SD1327Y3(K)	3061
March 1990	
RCA/GE CTC148/149-S2 chassis color TV	3062

April 1990	Profax #
Hitachi G7XU2/3 chassis color TV G7XU2—Models CT2087B/W, A087 (MT2870 through MT2878) G7XU3—Models CT2088B/W, A088 (MT2880, MT2886, MT2887)	3063
May 1990	
Zenith PV-140/Digital (G) Rear Proj. digital TV receiver, Zenith surround stereo system	3064
June 1990	
Hitachi CT4580K, VP7X2 chassis projection TV	3065
July 1990	
Zenith PV454-1P chassis color TV	3066
August 1990	
RCA/GE TX81 chassis color TV	3067
September 1990	
RCA/GE CTC156 chassis color TV	3068
October 1990	
Hitachi VP9X1 chassis color TV	3069
November 1990	
RCA/GE CTC169 (PV) chassis color TV	3070
December 1990	
RCA CTC91 chassis color TV	3071
January 1991	
RCA CTC99 chassis color TV	3072
February 1991	
RCA CTC107 chassis color TV	3073
March 1991	
RCA/GE CTC168 chassis color TV	3074
April 1991	
RCA/GE CTC86 chassis color TV	3075
May 1991	
RCA/GE KCS203 chassis B&W TV	3076
June 1991	
RCA CTC96 chassis color TV	3077
July 1991	
RCA CTC107 chassis color TV	3078
August 1991	
Hitachi CT1947/CT19A7 chassis color TV	3079
September 1991	
Hitachi CT2541/2542 chassis color TV	3080

October 1991	Profax #
RCA/GE CTC167 chassis color TV	3081
November 1991	
RCA/GE CTC166 chassis color TV	3082
December 1991	
RCA/GE CTC169 chassis color TV	3083
January 1992	
RCA/GE CTC 168 chassis color TV	3084
February 1992	
Hitachi AP13 color TV	3085
March 1992	
Hitachi VT-M40A color TV	3086
April 1992	
Hitachi 3267E VCR	3087
May 1992	
RCA/GE CTC 168-53 color TV	3088
June 1992	
Hitachi VT-M231A VCR	3089
July 1992	
Hitachi VT-F551A VCR	3090
August 1992	
RCA/GE color TV No 7-7800A	3091
September 1992	
RCA/GE TX82 color TV	3092
October 1992	
Sharp Model 13C-M100 color TV	3093
November 1992	
Sharp Model 27C-5200 color TV	3094
December 1992	
Hitachi VT M150A VCR	3095

1992/1993 Profax Schematics Special Issue:
Curtis Mathes Projection TV: Models SMP 4100, 4600, 5210
Hitachi Camcorder Model UM-E2A
Memorex Pocketvision 26, Catalog Number 16-163
Mitsubishi VCR Model HS-U55
Panasonic color TV Model SR400EK
RCA/GE VCR Model VG4202
Sharp color TV Model 27SV65
Toshiba color TV Model CF2077A: CX21772
Zenith color TV: Models SD5515/SD5535/SD555G

January 1993	Profax #
Sharp Model 20C-5300 color TV	3096
February 1993	
Sharp chassis No. 25S1 color TV	3097
Sharp VCR Model VCA45U	3098
March 1993	
Sharp Model 20C-S200	3099
Sharp VCR Model VC-H86U/C	3100
April 1993	
Sharp Model 27SV70	3101
May 1993	
Sharp VCR Model VC-H870U/C, VC-8870U/C	3102
Sharp Model 20SB65 color TV	3103
June 1993	
Sharp VCR Model VC-A503U, VC-A504U/C	3104
July 1993	
Sharp VCR Model VC-H903U/C, VC-H904U/C	3105
August 1993	
Sharp VCR Model VC-H87U/C	3106
September 1993	
Sharp Models 19E-M4OR, 19E-M5OR color TV	3107
October 1993	
RCA color TV Model CTC176	3108
November 1993	
Hitachi Proj. color TV Models 55EX7K, 50EX6K, 46EX3B/4K, 50ES1B/K 46EX3BS/4KS	3109
December 1993	
Sharp color TV Model 19E-M50	3110

1993/1994 Profax Schematics Special Issue:
Curtis Mathes VCR/Model GV730/740
Hitachi TV/Model NP 83LX
IBM Monochrome Display/Model 8503
Magnavox TV/Model RD0945C101, RD0946T101
Memorex Portable Compact Disc Player/Model CD-3360
Memorex VCR/Model 29
Mitsubishi TV/Model CS-3535R/CK-3536R, CS3135R/CK-3136R
Panasonic CTM1353R
JC Penney TV/Model 2003
Sharp color TV/Sigma 9700 chassis
Thomson Consumer Electronics color TV/RCA CTC175
Toshiba VCR/Model M222, M222C, M227C, M227L

January 1994	Profax #
Memorex Portavison 9-inch color VHF/UHF TV monitor	3111
February 1994	
Hitachi VHS VCR Models VT-F350A, VT-F351A, AW	3112

March 1994	Profax #
Sharp color TV Model 20SB55, chassis No 20R1	3113
April 1994	
GE VCR Models 9-7100, 9-7115, 9-7120, 9-7215	3114
May 1994	
Hitachi VCR Model VM-2400A (U,PX), AW	3115
June 1994	
Thomson Consumer Electronics color TV: TX825	3116
July 1994	
Sharp CTV Models 13F-M40, 13F-M50, 13F-M100, 13F-M150	3117
August 1994	
Hitachi Video camera/recorder, Models VM-2700A,VM-3700A (U,C)	3118
September 1994	
Sharp CTV Models 25F-M40/50/100/120, chassis No SN 41	3119
October 1994	
Hitachi VCR Model VM-1700A (U,C)	3120
November 1994	
Hitachi VCR Models VT-F380Z/F381A, VT-F382A/F385A	3121
December 1994	
Thomson Consumer Electronics color TV: TX825	3122

Profax number index—1984-1994

Profax #	Month	Year
2033-2034	Jan	84
2035-2036	Feb	84
2037	Mar	84
2038-2040	Apr	84
2041	May	84
2042-2043	Jun	84
2044-2045	Jul	84
2046-2047	Aug	84
2048-2049	Sep	84
2050	Oct	84
2051-2052	Nov	84
2053-2054	Dec	84
2055-2057	Jan	85
2058-2059	Feb	85
2060-2061	Mar	85
2062-2063	Apr	85
2064-2065	May	85
2066	Jun	85
2067	Jul	85
2068	Aug	85
2069-2070	Sep	85
2071-2072	Oct	85
2073-2074	Nov	85
2075-2076	Dec	85
2077-2078	Jan	86
2079-2080	Feb	86
2081	Mar	86
2082-2083	Apr	86
2084A-2084B	May	86
2085-2086	Jun	86
2087-2088	Jul	86
2089	Aug	86
2090	Sep	86
2091-2092	Oct	86
2093-2094	Nov	86
2095-2096	Dec	86
2097	Jan	87
2098-2099	Feb	87
(Note: numbers 2100-2999 were skipped)		
3000	Apr	87
3002-3003	May	87
3005-3006	Jun	87
3007-3008	Jul	87
3009-3010	Aug	87
3011-3012	Sep	87
3013	Oct	87
3014	Nov	87
3015-3016	Dec	87
3017-3018	Jan	88
3019	Feb	88
3020	Mar	88
3021-3022	Apr	88
3023-3024	May	88
3025-3026	Jun	88
3027-3028	Jul	88
3029-3030	Aug	88
3031-3032	Sep	88
3033-3034	Oct	88
3035-3036	Nov	88
3037	Dec	88
3038-3039	Jan	89
3040-3041	Feb	89
3042-3043	Mar	89
3044-3045	Apr	89
3046-3047	May	89
3048-3049	Jun	89
3050-3051	Jul	89
3052-3053	Aug	89
3054	Sep	89
3055-3056	Oct	89
3057-3058	Nov	89
3059	Dec	89
3060	Jan	90
3061	Feb	90
3062	Mar	90
3063	Apr	90
3064	May	90
3065	Jun	90
3066	Jul	90
3067	Aug	90

Profax #	Month	Year
3068	Sep	90
3069	Oct	90
3070	Nov	90
3071	Dec	90
3072	Jan	91
3073	Feb	91
3074	Mar	91
3075	Apr	91
3076	May	91
3077	Jun	91
3078	Jul	91
3079	Aug	91
3080	Sep	91
3081	Oct	91
3082	Nov	91
3083	Dec	91
3084	Jan	92
3085	Feb	92
3086	Mar	92
3087	Apr	92
3088	May	92
3089	Jun	92
3090	Jul	92
3091	Aug	92
3092	Sep	92
3093	Oct	92
3094	Nov	92
3095	Dec	92
3096	Jan	93
3097	Feb	93
3098	Feb	93
3099	Mar	93
3100	Mar	93
3101	Apr	93
3103	May	93
3103	May	93
3104	Jun	93
3105	Jul	93
3106	Aug	93
3107	Sep	93
3108	Oct	93
3109	Nov	93
3110	Dec	93
3111	Jan	94
3112	Feb	94
3113	Mar	94
3114	Apr	94
3115	May	94
3116	Jun	94
3117	Jul	94
3118	Aug	94
3119	Sep	94
3120	Oct	94
3121	Nov	94
3122	Dec	94

Company Index—1984–1994

	Profax #	Month/Year
CURTIS MATHES		
Projection TV Set:	Special	1992/93
Models SMP 4100, 4600, 5210		
VCR Model GV 730/740	Special	1993/94
GENERAL ELECTRIC		
AF/C chassis	2037	Mar 84
GL/X chassis	2038	Apr 84
XK B&W chassis	2039	Apr 84
XJ B&W chassis	2042	Jun 84
EC/K chassis	2044	Jul 84
XE B&W chassis	2049	Sep 84
AB/AC chassis	2051	Nov 84
CM chassis	2055	Jan 85
XM-E chassis	2057	Jan 85
PC-A chassis	2058	Feb 85
GK chassis	2060	Mar 85
EC-A chassis	2064	May 85
EP-B chassis	2066	Jun 85
19PC-F/H chassis	2067	Jul 85
PM-B chassis	2068	Aug 85
BC-N chassis	2073	Nov 85
EP chassis	2074	Nov 85
PC-J chassis	2075	Dec 85
PM-A chassis	2078	Jan 86
BC-A chassis	2079	Feb 86
25 PC(J) chassis	2082	Apr 86
HP chass., tuning/control systs.	2084A	May 86
HP chassis, chroma	2084B	May 86
NF chassis	2087	Jul 86
PM-C chassis	2088	Jul 86
X110 chassis, B&W TV	2091	Oct 86
TV/AM/FM clock radio	2092	Oct 86
14-inch portable color TV	2094	Nov 86
X110 chassis (cont.)	2095	Dec 86
CTC140 chassis, color TV	3014	Nov 87
MK-1 chassis, Model 8-1938	3008	Jul 87
MK-1 chassis	2099	Feb 87
MK-2 chassis	2097	Jan 87
NF chassis update, color TV	3003	May 87
7-7130A chassis, 5-inch B&W	3004	May 87
1VCR2006W Model, VCR	3027	Jul 88
1VCR2018W Model, VCR	3019	Feb 88
NC-05X3/06X1 chassis, color TV	3032	Sep 88
Projection TV 8-4500	3020	Mar 88
PW chass., Model 40PW3000KA01 proj. TV	3037	Dec 88
VHS VCR, Model 1VCR2002X	3044	Apr 89
Color TV, 1987 CTC136	3047	May 89
CTC135-S1 color TV	3052	Aug 89
1987 8-4500 projection color TV	3057	Nov 89
VCR, Models 9-7100, 9-7115, 9-7120, 9-7215	3114	Apr 94
HITACHI		
Projection color TV. Models 55EX7K, 50EX6K,	3109	Nov 93

	Profax #	Month/Year
46EX3B/4K, 50ES1B/K, 46EX3BS/4KS Camcorder Model UM-E2A	Special	1992/93
Color TV, chassis AP13	3085	Feb 92
NP81X chassis	2054	Dec 84
CT2516 chassis	2059	Feb 85
CQ4X chassis	2061	Mar 85
CT1358 chassis, color TV	3005	Jun 87
CT2020W, CT2020B chassis	3010	Aug 87
CT2250B, CT2250W chassis	3000	Apr 87
CT2250B, CT2250W chassis	3012	Sep 87
CT1344 chassis color TV	3029	Aug 88
CT1358 chassis color TV	3018	Jan 88
CT2647/CT2648/CT2649 chassis color TVs	3025	Jun 88
CT2652, CT2653 color TVs	3024	May 88
CT3020W/CT3020B	3033	Oct 88
VHS VCR, Model VT-63A	3035	Nov 88
CT1955 color TV, NP85XA chassis color TV, chassis CT1941/CT19A2, NP83X chassis	3038 3043	Jan 89 Mar 89
CT1955 color TV	3045	Apr 89
CT2066 color TV	3050	Jul 89
CT2086 B/W chassis G7NU3 color TV	3055	Oct 89
CT1395W G7NSU2 color TV	3060	Jan 90
G7XU2/3 chassis color TV	3063	Apr 90
G7XU2 - Models CT2087B/W, A087 (MT2870 through MT2878) G7XU3 - Models CT2088B/W, A088 (MT2880, MT2886, MT2887)		
CT4580K, VP7X2 chassis proj. TV	3065	Jun 90
NP 83LX color TV	Special	1993/94
VP9X1 chassis color TV	3069	Oct 90
CT1947/CT19A7 chassis color TV	3079	Aug 91
CT2541/2542 chassis color TV	3080	Sep 91
VCR Model 3267E	3087	Apr 92
VCR Model VT-F551A	3090	Jul 92
VCR Model VT-M40A	3086	Mar 92
VCR Model VT-150A	3095	Dec 92
VCR Model VT-M231A VCR Model VT-F350A, VT-F351A, AW	3112	Feb 94
VCR Model VM-2400A (U,PX), AW	3115	May 94
VCR Model VM-1700A (U,C)	3120	Oct 94
VCR Models VT-F380Z/F381A, VT-F382A/F385A	3121	Nov 94
Vid. cam./rec. Mods. VM-2700A, VM-3700A (U,C)	3118	Aug 94
IBM		
Model 8503 Monochrome Display	Special	1993/94
MAGNAVOX		
Model RD0945C101, RD0946T101 color TV	Special	1993/94
MEMOREX		
Pocketvision 26 TV, Catalog Number 16-163	Special	1992/93
Model CD-3360 Portable Compact Disc Player	Special	1992/93
Model 29 VCR	Special	1992/93
Portavision 9-inch color VHF/UHF TVMonitor	3111	Jan 94
MITSUBISHI		
Model CS-3535R/CK-3535R	Special	1992/93
CS3135R/CK3136R color TV VCR Model HS-U55	Special	1992/93
NAP		
E34 chassis	2034	Jan 84
19C2 chassis	2035	Feb 84
E32 chassis	2040	Apr 84
E32-58, -59 chassis	2043	Jun 84
K10 chassis	2045	Jul 84
RD 425S1 & RXC 192SL chassis	2047	Aug 84
E53-45, -46, -47, -48 chassis	2048	Sep 84
BD3911 SL01 B&W chassis	2051	Nov 84
UXC chassis	2063	Apr 85
EC-31-52, -56 & -58 chassis	2069	Sep 85
E-34-18, -32 & -33 chassis	2071	Oct 85
E51-56 chassis, color TV	3030	Aug 88
E54-10 chassis, projection TV	3021	Apr 88
E54-15 chassis, projection TV	3026	Jun 88
RD4502SL/RLC312SL color TV monitors	3036	Nov 88
Color TV, series 19C2 chassis (Magnavox)	3039	Jan 89
Color TV, chassis E34-11	3042	Mar 89
Color TV, chassis E54-15 (Magnavox RD8518 and RD8520; Philco Model P8190S; Sylvania PSC410 and PSC420)	3049	Jun 89
NEC		
C13-304A chassis	2056	Jan 85
DJ-60EN(R) chassis	2065	May 85
PANASONIC		
Model CTM1353R color TV	Special	1993/4
Model SR400EK color TV	Special	1992/93
JC PENNEY		
Model 2003 color TV	Special	1993/94
RCA		
KCS206 B&W	2033	Jan 84
KCS213 B&W	2036	Feb 84
CTC111 series	2041	Mar 84
CTC123 series	2046	Apr 84
CTC131/132 series	2050	Oct 84
KCS B&W AM/FM clock	2053	Dec 84
CTC117 chassis	2062	Apr 85
CTC118 chassis	2070	Sep 85
CTC121 chassis	2072	Oct 85
CTC126 chassis	2076	Dec 85
MMC100, video monitor	2077	Jan 86
CTC117 chassis	2080	Feb 86
CTC133 chassis	2081	Mar 86

	Profax #	Month/Year
CTC120 chassis	2083	Apr 86
CTC125 chassis	2085	Jun 86
207 series weather clock	2086	Jun 86
CTC136 chassis	2089	Aug 86
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
CTC134 chassis, color TV	3013	Oct 87
CTC135 chassis, color TV	3006	Jun 87
VDM140 chassis, color TV	3002	May 87
PVM035 chassis color TV	3031	Sep 88
PVM050 color TV	3023	May 88
P42000-S1 projection TV (additional Models: RVM46700, 46GW700, P46000)	3048	Jun 89
CTC135 color TV	3051	Jul 89
CSM055 color TV/AM/FM/clock radio	3054	Sep 89
CTC91 chassis color TV	3071	Dec 90
CTC99 chassis color TV	3072	Jan 91
CTC107 chassis color TV	3073	Feb 91
CTC96 chassis color TV	3077	Jun 91
CTC107 chassis color TV	3078	Jul 91
CTC175 chassis color TV	Special	1993/94
CTC176 chassis color TV	3108	Oct 93
RCA/GE (Thomson Consumer Electronics)		
Color TV, Model 7-7800A	3091	Aug 92
Color TV, CTC145/146 chassis	3040	Feb 89
CTC145/146 color TV	3058	Nov 89
CTC148/149-S2 chassis color TV	3062	Mar 90
CTC156 chassis color TV	3068	Sep 90
CTC169 (PV) chassis color TV	3070	Nov 90
CTC168 chassis color TV	3074	Mar 91
CTC86 chassis color TV	3075	Apr 91
KCS203 chassis B&W TV	3076	May 91
CTC167 chassis color TV	3081	Oct 91
CTC166 chassis color TV	3082	Nov 91
CTC168 chassis color TV	3084	Jan 92
CTC168-53 chassis color TV	3088	May 92
CTC169 chassis color TV	3083	Dec 91
TX81 chassis color TV	3067	Aug 90
TX82 chassis color TV	3092	Sep 92
VCR Model VG4202	Special	1992/93
Color TV: TX825	3116	Jun 94
Color TV: TX825	3122	Dec 94
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
TOSHIBA		
Color TV Model CF2077A: CX21772	Special	1992/93
VCR Model M222, M222C, M227C, M227L	Special	1993/94
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 (I) 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(I) 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 Recievers Models SD2097S (Y) and SD1327W3, SD1327Y, SD1327Y3(K)	3061	Feb 90
PV-140/Digital (G) Rear Proj. Digital TV	3064	May 90
Receiver, Zenith surround stereo system PV454-1P chassis color TV	3066	Jul 90

Classified

Classified advertising is available by the word or per column inch.
By-the word. $1.65 per word, per insertion, pre-paid Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 additional. No agency discounts are allowed for classified advertising by the word. Contact Linda Romanello at 516-681-2922 to place your classified ad (by-the-word). Mastercard, VISA, American Express and Discover are accepted for FAX or mail orders.
Per column Inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising please call 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

Send your order, materials and payments to:
Electronic Servicing & Technology, 76 North Broadway, Hicksville, New York 11801
Attn: Linda Romanello
Phone: 516-681-2922 FAX: 516-681-2926

FOR SALE

****...NewsFlash...TROUBLESHOOTING TIME DOWN—PROFITS UP!!!**** Our **NEW COMPUTERIZED TIP PROGRAM** helps reduce your bench troubleshooting time. The COMPUTERIZED TIP PROGRAM contains over **15,000 VALUABLE, TIME SAVING, MONEY MAKING TIPS!!!** TVs, VCRs, CAMCORDERS & other electronics. **PROFESSIONAL BOARD LEVEL REPAIRS. ADD** tips. **PRINT** tips. Owners of our **COMPUTERIZED TIP PROGRAM** say this is the ****BEST**** technical tip program on the market today. Want to hear it for yourself? Talk to our customers and let them tell you how much they like our TIP PROGRAM. Works on **ANY** IBM compatible computer. The Price? **Only $100.00!!!** (limited time only) Prepaid orders within the continental U.S.A. are shipped **FREE. **FREE** Demo! **FREE** Phone Call! Have your own tips? Ask about our TIP EXCHANGE policy with FREE Updates!!!** NEWS EXTRA: Price goes up sometime in 1995. **Place your order NOW!!! CALL 1-800-215-5081. HIGHER INTELLIGENCE SOFTWARE, 60 Farmington Lane, Melville, NY 11747.**

******If you are looking for one main technical information computer program that will help you in your business then LOOK NO MORE.**** SERVICE TIPS IS THAT PROGRAM. SERVICE TIPS contains 16,068 Technical Tips** on TVs, VCRs, Camcorders & other Electronic Equipment. Not only can **YOU** Revise or Print any SERVICE TIP in the program **YOU CAN ADD** your own tips. All information is in alphabetical order by Brand, Model & Chassis & Symptom with up to 3 lines of symptom & 8 lines of concise Solutions, Part Numbers, Values & Locations. Unlike some other programs, our information comes direct to us from a network of technicians across the country many of whom are members of electronic associations such as **NESDA-NYS, NESDA, TESA-LI and METSDA**. SERVICE TIPS was created & designed by 2 CET's who are technicians/owners of their own service centers for over 20 years along with a full time programmer. **The cost for the 16,068 SERVICE TIPS is ONLY $129.95 a demo disk is available. For more information or to order CALL 1-800-621-TIPS (621-8477) (from US & Canada) or Write ELECTRONIC SOFTWARE DEVELOPERS, Inc. at 826 So. Main Street, South Farmingdale NY 11735.**

VHS-VCR Repair Solution Sets I - IX. Each contains 150 symptoms and cures, cross reference chart, free assistance, $19.95 each, all nine $49.95. Visa/MC. **Eagle Electronics**, 52053 Locks Lane, Granger, IN 46530.

FOR THOSE SERVICERS WHO ARE NOT COMPUTERIZED ELECTRONIC SOFTWARE DEVELOPERS NOW HAS AVAILABLE FIVE Individual Editions of SERVICE TIPS in Laser Book Form. Each individual book contains easy to read cures for those "extremely tough repairs" on COLOR TVs & VCRs saving hours of troubleshooting time. The **ZENITH Module Repair Book** has 248 cures for Modules 9-124 thru A-9740 for $29.95, **EMERSON** has 351 tips for $24.95, **GOLDSTAR** has 334 tips for $24.95, **NEC** has 164 tips for $19.95 & **SANYO/FISHER** has 455 tips for $29.95. **ORDER ANYONE OR ALL 5 EDITIONS FOR $75.00 (a $54.75 SAVINGS).** MAIL CHECK OR MONEY ORDER TO: **ELECTRONIC SOFTWARE DEVELOPERS, INC.** 826 So. Main St., South Farmingdale, NY 11735.

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

TV CASE HISTORIES: Booklet with 2,150+ histories. Satisfaction assured. Only $45 (plus $2.90 for 2-day priority). **Mike's Repair Service**, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 30 years. Send SASE for samples. 410-272-4984, 11am-9pm.

FOR SALE

HOW WOULD YOU LIKE TO HAVE ACCESS TO A LARGE COLLECTION OF TECH TIPS UPDATED DAILY? ALL YOU NEED IS A COMPUTER AND A MODEM. YOU CAN CALL TECH SUPPORT B.B.S. ONLINE 24 HOURS. FOR A FREE TRIAL CALL **BBS** AT (216) 794-2865 OR FAX US WITH YOUR QUESTIONS AT (216) 733-8847. WRITE US AT PO BOX 6235 AKRON, OHIO 44312-0235. SUBSCRIPTIONS $19.95.

Sencore VA62. Good, used. Price negotiable. Leonard Smith, 2414 Dartmouth, Wichita Falls, TX 76308, (817) 767-5490.

OEM Parts—Sharp, Brother, IBM, Lexmak faxes, Z-Copiers, Laser printers, Typewriters, LapTops. **Parts Depot** (908) 899-4595, (908) 295-3980 Fax.

Sencore VA48 with probes and extras. Contact: Kurt at Griffing TV, Windsor, MA 203-688-6271.

LOOKING FOR THE TV-MAN TECH-TIP PROGRAM? . . . . . WE'RE NOW ON PAGE 12 . . . . . YES, WE ARE LIKE THE BUNNY RABBIT THAT JUST, "KEEPS ON GOING."

* * * * * * * * * * * **FREE ZENITH CURES** * * * * * * * * * * *
Earn $$$ Repair Zenith TV modules found in over 1000 models, 1983-1993. Symcure manual shows you how. $89.95 or send SASE for **FREE** samples. **ZMEX**, 807 Queen Palm Lane, Sarasota, FL 34243.

REDUCED 85%. Diehl Mark III $69, Diehl Mark V Horizontal circuit tester $179. New. Conductive coating for remote control keypads $9.99 ppd. **WEEC**, 2411 Nob Hill Road, Madison, WI 53713. 608-238-4629, 608-233-9741.

SERVICE DATA & HARD TO FIND PARTS previously-owned SAMs, manufacturers data, books, FREE catalog. AG Tannenbaum, Box 110, E. Rockaway, NY 11518. 516-887-0057, Fax 516-599-6523.

MISCELLANEOUS

WANT TO DO Service Center Business Part-Time. CET Journeyman Qualified. Ship to me UPS. **Consumer Electronics**, (812) 295-4240.

BUSINESS OPPORTUNITIES

TV/VCR REPAIR 15 Yrs. reputation, only shop in town, beautiful Ketchikan in S.E. Alaska. EVERYTHING for $40K. 907-225-2350.

Readers' Exchange

Readers' Exchange has been reinstated as 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

WANTED

Citizen's Band radio service manuals—new, used or copies. Please send a list of what you have and the price. *Contact: Jordan Hillrich, 732 Queen St., Regina, Sask., Canada S4T 4A3.*

Service manual or schematic for Toyomenka 9-inch color TV Model 1939CR1 1985. Will pay for copy or copy and return. *Contact: John 904-477-6736.*

Working keyboard for QUME QVT-102A computer terminal. *Contact: Karl at Hilltop Electric, 614 Main St., Saint Remy, NY 12401-8740.*

Schematic and manual for Protek P-3502 scope. Copy o.k. *Contact: Bill's TV Service, Rt. 1, Box 11, Sulphur Springs, TX 75482, 903-885-5170.*

Looking for a book from Tab on how to hook electronic test equipment up to a Commodore 64 computer. *Contact: James Sickles, 810 Schoeneck Rd., Ephrata, PA 17522.*

Sharp TV yoke #KYS-60159, Fisher VCR loading motor assembly 143-0-3404-03700, Sencore SC-61 scope. *Contact: Ed Herbert, 410 N. Third St., Minersville, PA 17954.*

Schematic for Packard Bell PB8539VG color monitor and Teco TE95165 color monitor. Will buy, rent or copy. *Contact: Moosehead Electronics, 920 W. 18th St., Merced, CA 95340, 209-723-4712.*

Schematic for SAE (Scientific Audio Electronics, Inc.) integrated amp Model A7 (with replacement parts section). Engineered by SAE. *Contact: 510-286-1092 (Dept. of transp.), 415-285-5064 (after 4:00 p.m.).*

Service manual for Toshiba Beta V-M501; home/car audio service literature, parts, etc. Send list with prices to *John Hickman, 716 Lloyd Dr., Baytown, TX 77521 or call 713-422-6855 after 4 pm. central time please.*

Flybacks wanted (used or surplus) Hitachi 2432091, GE EP77x48, Thordarson FLY-474, Sharp RTRNF 1158CW-S. *Contact: W. Worley, 305 Hickory Bend, Enterprise AL 36330, 205-347-5281.*

TEKFAX manuals 100, 102, 115, 118 and 120. *Contact: Charles T. Huth, 229 Melmore St., Tiffin, OH 44883, 419-448-0007.*

VCR owner's manual and service manual for Sanyo VCR4400. Will purchase or copy and return. *Contact: R.J. Blackwell, 2925 R1665 Ave., Baltimore, MD 21216, 410-362-6678.*

Have schematic but need a parts source for a Crumar OMB-2. *Contact: David Bean, Mobile TV Service, Route 1, Box 160, Rupert, ID 83350, 208-436-4136.*

Tuner for 1979 RCA 25 inch console TV. Serial #9282 21 1443. Model #GD 708 S. New or used. *Contact: Paul 702-795-8815.*

Good Akai cylinder motor part #BM-M3223A020B or Akai VCR Model VS515U. *Contact: Cliff Good, 216-757-7775.*

FOR SALE

Sencore SC-61 in excellent condition, used very little. Complete with all probes and manuals and in original box. *Contact: Kevin at 716-265-4113.*

All new Sencore: SC3100 auto tracker, VC93 VCR analyzer, PR57 isolation transformer $2,000.00+ take over payments. *Contact: P.O. Box 54, Joyce WA 98343, 206-928-3356.*

Sencore CVA94 camera video analyzer and VR940 light box as new condition, asking $1,995.00. *Contact: 208-365-3786.*

Sencore VC93 video analyzer new condition will sell for best offer. *Contact: Shaun at 303-867-2835.*

CRT 470 restorer/rejuvenator with 23 sockets adaptors. Almost complete adapters with manuals, $250.00. *Contact: Ramos at 619-423-9257.*

B&K 1077B television analyst, $100.00; Heath Kit IM-17 solid state voltmeter, $25.00; Heath Kit IG-78 color bar-dot generator, $40.00; more. All test equipment with manuals & leads. Sams Photofacts, 145 sets assorted. Make offer. All copies of ES&T dating back to 1967. *Contact: James Messick, 574 Larkin Ln., Montgomery, AL 36109, 205-279-9059.*

Old/new tubes in original cartons–twelve 2CS6 at $5.00 each, one 2C40 at $5.00 each, three 5R4 at $9.50 each, two 5U4 at $15.00 each, five 6AC7 at $23.00 each, more. *Contact: Al Nikora Sr., 5298 Argyle Ct., Sterling Hgts., MI 48310, 810-268-6938.*

Sencore VG91 universal video generator and TVA92 TV video analyzer; less than one year old; still under warranty. *Contact: 316-742-3594.*

Sencore VA62, VC63, NT64, $1,950.00. Both excellent condition with probes and manuals. Price negotiable. *Contact: 314-464-6501.*

Sencore VC93 VCR analyzer complete with service manual, test tape, all cables and operating manual. Mint condition. Asking $2,150. *Contact: Andy Kirschenbaum at East Coast Radio Service, 718-229-4883.*

Sencore SC61 dual trace scope, VA62 video analyzer, with VC63 and NT64, CR70 picture tube checker/restorer and a PR57 isolation power supply. All for $4500.00. *Contact: Harvey Martin, 8810 Churchill Pl., Jonesboro, GA 30236, 404-471-1407.*

Sencore VA48 with horizontal output drive isolation transformer and IF attenuator $400.00 or best offer. *Contact: 619-448-1910 before 10 a.m. pacific time.*

Sencore FET and transistor tester Model TF151 and B&K 1076 TV analyst both for $150.00 or trade for radios. *Contact: Daniel Seidler, 3721 W. 80 St., Chicago, IL 60652, 312-284-8221.*

Rider manuals Vols. 1 through 5, plus 8, 11 and 13 with/index for Vols. 1 through 10. All are in good condition. $150.00 plus UPS. *Contact: Jim Constantino at 215-624-5334.*

Old new tubes in original cartons one 6CH8 at $16.00 each, seven 6u5/6E5 at $22.00 each, seven 6L6G at $23.00 each; two 6507 at $40.00 each, one NE16Bulb at $5.00 each, four 26E6 at $5.00 each. *Contact: Al Nikora Sr., 5298 Argyle Ct., Sterling Hgts., MI 48310 810-268-6938.*

RCA Service data consumer electronics books 1966 to 1978 and Sams Photofacts. *Contact: Ann Bichanich (Jay's), 15 1/2 W. Lake St., Chisholm, MN 55719.*

Tektronix 82, 585, 585A, R fiche manuals. Tektronix 585A operator's manual (paper). *Contact: John 713-422-6855 after 4p.m. central time.* Also, miscellaneous surplus components—crystals, fuses, pots, caps, etc. *Send large SASE to John Hickman, 716 Lloyd Dr., Baytown, TX 77521.*

Sencore SC3100 scope, $2,295 and CVA 94 waveform/vectorscope, $1,995 (only used once). Must sell now! Original boxes and manuals. *Contact: Rick Campbell, 7E Amberglow Circle, Woodlands, TX 77381 or 409-321-5748.*

Tektronix 492 Spectrum analyzer, 02Hz to 200GHz w/265-40GH3 waveguide mixer w/18-265 waveguide mixer w/diplexer external mixer. $9,000.00 or best offer. *Contact: 615-256-2852.*

Sencore Model SC61 waveform analyzer drive width 60MHz useable to 100MHz. Dual channel-digital read out DCV-VPP-Frequency. $1,000. *Contact: 215-725-0322.*

PA81, complete with all cables, SG80 and VCR analyzer in original shipping boxes and everything is like new. *For price or to make offer contact: 405-226-1609. Call evenings.*

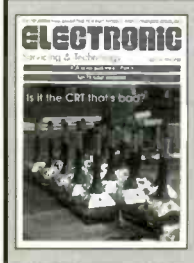
Sencore VA62, VC63, NT64, $1,950; SC61, $1,950; all format VC93, $2,100. All like new, with probes and manuals. Price negotiable. *Contact: 314-464-6501.*

Sencore VA62, VG63, NT64, $1,200; SC61 scope, $1,200; SG165 stereo analyzer, $500.00. B&K 1251 NTSC generator, $350.00 new factory VCR and TV manuals and more. *Contact: Steve at 908-281-0300.*

Advertiser's Index

Company	Page Number	Reader Service Number	Advertiser Hotline
American Hakko Products	45	20	800/88 HAKKO
Anatek Corporation	21	21	800/999-0304
Andrews Electronics	7	22	800/289-0300
Antique Automobile Radio	67	23	800/WE FIX AM
Caig Labs	12,15	40	800/CAIG-123
Chemtronics	3	25	800/645-5244
Computer Monitor Maintenance	22	26	800/466-4411
Fluke Corporation	BC	24	800/59-FLUKE
Fox International	23	25	800/321-6993
ISCET	67		817/921-9101
International Components Corp.	67	26	800/645-9154
MAT Electronics	43	27	800/628-1118
MCM Electronics	21	28	800/543-4330
NESDA	23,52		800/433-5557
PTS Electronics	8	45	800/844-7871
Parts Express	14	29	800/338-0531
Satellite Dealers Association	43	43	317/653-4301
Sams, Howard & Company	49	30	800/428-7267
Sencore	IFC,5	32,42	800/SENCORE
Sperry Tech	67	33	800/228-4338
TV Man Tech Tips, Inc.	12	41	800/474-3588
Tech Assist, Inc.	7	34	800/274-3785
Tentel	19	35	800/538-6894
Thomson Consumer Elec.	68, IBC	38	
Tritronics, Inc.	45	37	800/638-3328

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.

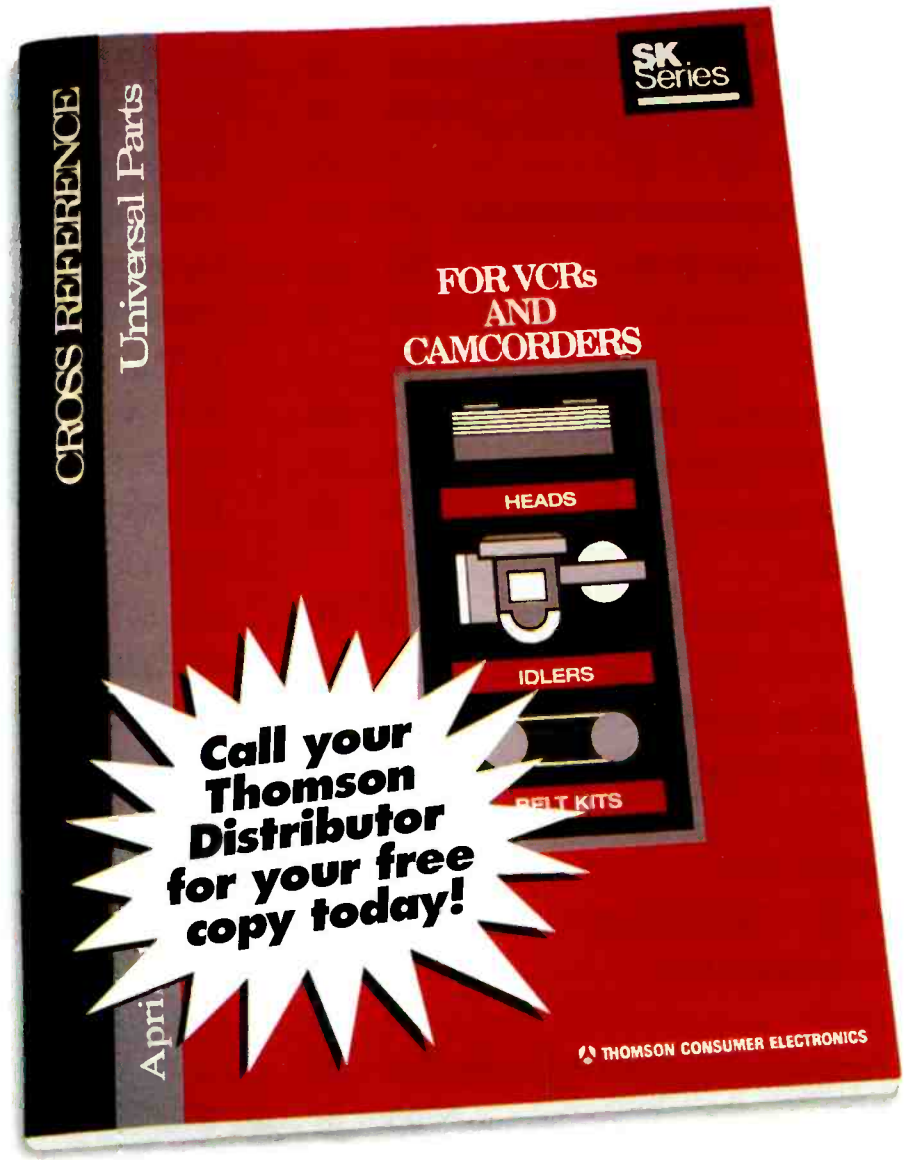


SALES OFFICE

PHONE (516) 681-2922

FAX (516) 681-2926

SK's JUS



ALABAMA
CARMICHAEL ELECTRONICS INC
DOTHAN AL • 800-633-0911

ARIZONA
ARIZONA WHOLESALE SUPPLY CO
PHOENIX AZ • 800-877-0771

CALIFORNIA
ANDREWS ELECTRONICS INC
SANTA CLARITA CA • 800-289-0300
ARDCO ELECTRONICS SUPPLY
SAN FRANCISCO CA • 800-652-1023
CHUCK HURLEY'S ELECTRONICS INC
SACRAMENTO CA • 800-655-4004
INLAND ELECTRONIC SUPPLIERS
HIGHLANDS CA • 800-833-9254
INLAND ELECTRONICS SUPPLIERS
MODESTO CA • 800-692-5788
INLAND ELECTRONICS SUPPLIERS
SAN JOSE CA • 800-262-1130
JACK C ARBUCKLE CO
BAKERSFIELD CA • 805-325-5816
JACK C ARBUCKLE CO
FRESNO CA • 209-264-6554
MARTIN DISTRIBUTING CO
HUNTINGTON PARK CA • 800-660-8771

FLORIDA
C&S ELECTRONIC SUPPLY CO.
ORLANDO FL • 800-321-6993
DOW ELECTRONICS INC
JACKSONVILLE FL • 800-627-2870
DOW ELECTRONICS INC
ORLANDO FL • 800-627-2950
DOW ELECTRONICS INC
TAMPA FL • 800-627-2900
FOURAKERS ELECTRONICS INC
TALLAHASSEE FL • 800-635-0420
HERMAN ELECTRONICS
MIAMI FL • 800-938-4376
RES MARKETING INC
TAMPA FL • 800-444-7304
TRITRONICS INC
FT LAUDERDALE FL • 800-365-8030
VANCE BALDWIN INC
FT LAUDERDALE FL • 800-432-8542
VANCE BALDWIN INC
MIAMI FL • 800-432-8542
VANCE BALDWIN INC
TAMPA FL • 800-299-1007
VANCE BALDWIN INC
WEST PALM BEACH FL • 800-367-1611

GEORGIA
DOW ELECTRONICS INC
ALBANY GA • 800-627-2810
DOW ELECTRONICS INC
NORCROSS GA • 800-627-2810
DOW ELECTRONICS INC
SAVANNAH GA • 800-627-2890
FOURAKERS ELECTRONICS INC
MACON GA • 800-554-4347
FOURAKERS ELECTRONICS INC
VALDOSTA GA • 800-122-2801
WHOLESALE INDUSTRIAL ELECTRONICS
NORCROSS GA • 800-282-1857

ILLINOIS
DELTRONICS DISTRIBUTING CO
BELLEVILLE IL • 618-236-0366
HOWARD ELECTRONIC
CHICAGO IL • 312-254-9091
KLAUS RADIO INC
PEORIA IL • 800-475-5287
LACO ELECTRONICS INC
DECATUR IL • 217-423-0191
LACO ELECTRONICS INC
MT VERNON IL • 800-642-4960
TRI-STATE ELECTRONIC CORP
MOUNT PROSPECT IL • 800-445-0896
UNION ELECTRONICS INC
SOUTH HOLLAND IL • 800-638-6657

INDIANA
ESP/ELECTRONIC SERVICE PARTS
INDIANAPOLIS IN • 800-382-9976

IOWA
GIFFORD-BROWN INC
DES MOINES IA • 800-369-4433

KANSAS
ACME RADIO SUPPLY CO
TOPEKA KS • 800-544-8521
MANHATTAN ELECTRONICS CORP
OVERLAND PARK KS • 800-821-3114

KENTUCKY
RADIO ELECTRONIC EQUIPMENT CO
LEXINGTON KY • 606-255-6661
RANDOLPH & WARREN
LOUISVILLE KY • 800-765-7278
RANDOLPH, HALE & MEREDITH INC
BOWLING GREEN KY • 502-781-1460

LOUISIANA
SOUTHERN ELECTRONICS INC
SHREVEPORT LA • 800-521-4391

MASSACHUSETTS
E A ROSS CO INC
FALL RIVER MA • 800-828-4901
ELECTRONIC DISTRIBUTORS CORP
NORTH QUINCY MA • 617-328-7300
NASH ELECTRONIC SUPPLY INC
LEOMINSTER MA • 508-537-0707
TEE-VEE SUPPLY COMPANY INC
MEDFORD MA • 800-255-5854

MARYLAND
FAIRWAY ELECTRONICS INC
HAGERSTOWN MD • 800-654-5052
FAIRWAY ELECTRONICS INC
KENSINGTON MD • 800-352-1474
TRITRONICS INC
ABINGDON MD • 800-638-3328

MICHIGAN
BURSMA ELECTRONIC DIST. INC.
BENTON HARBOR MI • 800-777-6261
BURSMA ELECTRONIC DIST. INC.
GRAND RAPIDS MI • 800-777-2604
BURSMA ELECTRONIC DIST. INC.
TRAVERSE CITY MI • 800-777-6261
ELECTRONIC PARTS SPECIALIST
FLINT MI • 810-238-7311
REMCOR ELECTRONICS INC
OAK PARK MI • 800-482-2133

MINNESOTA
NESS ELECTRONICS INC
MINNEAPOLIS MN • 800-247-1318
PACE ELECTRONICS INC
ROCHESTER MN • 800-444-7223

MISSOURI
CENTRAL MISSOURI DISTRIBUTING CO
JEFFERSON CITY MO • 314-636-3149
CITITRONIX INC
ST LOUIS MO • 800-846-2484
DELTRONICS DISTRIBUTING
ST LOUIS MO • 800-443-0665

MISSISSIPPI
N & H ELECTRONICS
HATTIESBURG MS • 800-264-8808

NEBRASKA
SCOTT ELECTRONIC SUPPLY CORP
LINCOLN NE • 800-333-7952
SCOTT ELECTRONIC SUPPLY CORP
OMAHA NE • 800-333-7953

NEW JERSEY
LINWOOD WHOLESALE INC
WALL TOWNSHIP NJ • 800-326-0313

T GREW!

Quality Universal Video Parts.

The only way we can make your business our business is to grow in your direction. That's why we've expanded our product line to include the video and camcorder parts that take more wear and tear than other parts. And, we've done it at such a minimal cost, these quality parts have generic pricing. Plus, our new product line is so inexpensive, yet so efficient, it allows you to turn your job estimates into jobs completed. The SK Universal Line, it's quality without the cost.

Now for a limited time, you can get our complimentary Cross Reference. This cross-reference guide was designed by a professional serviceman, to accurately help you find the right part. Just one more way Thomson Consumer Electronics is making life a little easier. Call your TCE distributor today.

- **Parts That Are Easy To Order–Just ask your TCE Distributor.**
- **Parts That Come With An Easy-To-Use Cross Reference.**
- **Parts That Have Quality Without The Cost.**

Use SK Universal Parts With Confidence.

THOMSON CONSUMER ELECTRONICS, INC.

PANSON ELECTRONICS
PINE BROOK NJ • 800-255-5229

NEW MEXICO

R & R ELECTRONIC SUPPLY CO
HOBBS NM • 505-393-1613

NEW YORK

EIGER ELECTRONICS INC
DEER PARK NY • 800-835-8316

GMB SALES
FARMINGDALE NY • 800-874-1765

RADIO EQUIPMENT CORP
BUFFALO NY • 716-874-2690

STANDARD ELECTRONICS INC
AMHERST NY • 800-333-1519

STANDARD ELECTRONICS INC
SYRACUSE NY • 800-333-1639

NORTH CAROLINA

SOUTHEASTERN ELEC SUB/CAMBAR
FAYETTEVILLE NC • 800-682-3670

SOUTHEASTERN ELEC SUB/CAMBAR
RALEIGH NC • 800-682-5707

OHIO

EXCEL DISTRIBUTING INC
CINCINNATI OH • 800-733-3329

FOX INTERNATIONAL LTD INC
BEDFORD HTS OH • 800-321-6993

MCM ELECTRONICS
MORAINE OH • 800-543-4330

SUPERIOR ELECTRONIC PARTS CO INC
PARMA OH • 800-875-7942

OKLAHOMA

RADIO SUPPLY INC
OKLAHOMA CITY OK • 800-522-3821

OREGON

DOUBLE O ELECTRONICS DISTR INC
PORTLAND OR • 800-452-7688

PENNSYLVANIA

CLEARFIELD ELECTRONIC SUPP CO
HYDE PA • 800-635-0325

CRS ELECTRONICS
PITTSBURGH PA • 412-431-7700

CUMBERLAND ELECTRONICS INC
HARRISBURG PA • 800-922-2271

CUMBERLAND ELECTRONICS INC
LANCASTER PA • 800-242-3703

CUMBERLAND ELECTRONICS INC
YORK PA • 800-632-9025

H B F ELECTRONICS INC
PHILADELPHIA PA • 800-426-4230

LINWOOD WHOLESALE INC
MARCUS HOOK PA • 800-326-0313

SOUTH CAROLINA

HARLEY'S WHOLESALE ELECTRONICS
SPARTANBURG SC • 800-326-7961

WHOLESALE INDUSTRIAL ELECTRONICS
CHARLESTON SC • 800-868-2211

WHOLESALE INDUSTRIAL ELECTRONICS
COLUMBIA SC • 800-868-2213

WHOLESALE INDUSTRIAL ELECTRONICS
GREENVILLE SC • 800-868-2215

TENNESSEE

ELECTROTEX TENNESSEE INC
MEMPHIS TN • 800-460-1808

RANDOLPH HALE & MATTHEWS INC
CLARKSVILLE TN • 800-227-8652

RANDOLPH & RICE INC
NASHVILLE TN • 615-255-5601

SHIELDS ELECTRONICS SUPPLY INC
BRISTOL TN • 800-325-0007

SHIELDS ELECTRONICS SUPPLY INC
CHATTANOOGA TN • 800-508-0733

SHIELDS ELECTRONICS SUPPLY INC
KNOXVILLE TN • 800-235-7615

TOWNSEND ELECTRONIC SUPPLY
JACKSON TN • 800-926-8726

TEXAS

APOLLO WHOLESALE ELECTRONICS INC
FT WORTH TX • 817-877-5854

APOLLO WHOLESALE ELECTRONICS INC
IRVING TX • 800-488-2782

ELECTROTEX INC AIRLINE
HOUSTON TX • 800-275-7801

ELECTROTEX INC AUSTIN
AUSTIN TX • 800-460-1806

ELECTROTEX INC BEAUMONT
BEAUMONT TX • 800-460-1803

ELECTROTEX INC CORPUS CHRISTI
CORPUS CHRISTI TX • 800-460-1805

ELECTROTEX INC DALLAS
DALLAS TX • 800-460-1807

ELECTROTEX INC RICHMOND
HOUSTON TX • 800-460-1801

ELECTROTEX INC WINKLER
HOUSTON TX • 800-275-7801

ELECTROTEX INC SAN ANTONIO
SAN ANTONIO TX • 800-460-1804

INTERSTATE ELECTRIC CO
DALLAS TX • 800-527-4029

R & R ELECTRONIC SUPPLY CO
ABILENE TX • 915-677-2974

R & R ELECTRONIC SUPPLY CO
AMARILLO TX • 800-300-7991

R & R ELECTRONIC SUPPLY CO
DALLAS TX • 915-566-9693

R & R ELECTRONIC SUPPLY CO
EL PASO TX • 915-566-9693

R & R ELECTRONIC SUPPLY CO
LUBBOCK TX • 800-299-7000

R & R ELECTRONIC SUPPLY CO
ODESSA TX • 915-332-9167

WILTRONICS SUPPLY INC
PARIS TX • 800-426-6317

WILTRONICS SUPPLY INC
TYLER TX • 800-657-2404

UTAH

BALLARD SUPPLY CORPORATION
SALT LAKE CITY UT • 800-662-8561

WEST VIRGINIA

ELECTRONIC SUPPLY INC
HUNTINGTON WV • 303-523-6443

WISCONSIN

G M POPKEY CO
GREEN BAY WI • 800-444-5920

G M POPKEY CO
MADISON WI • 800-444-5320

G M POPKEY CO
NEW BERLIN WI • 800-444-9320

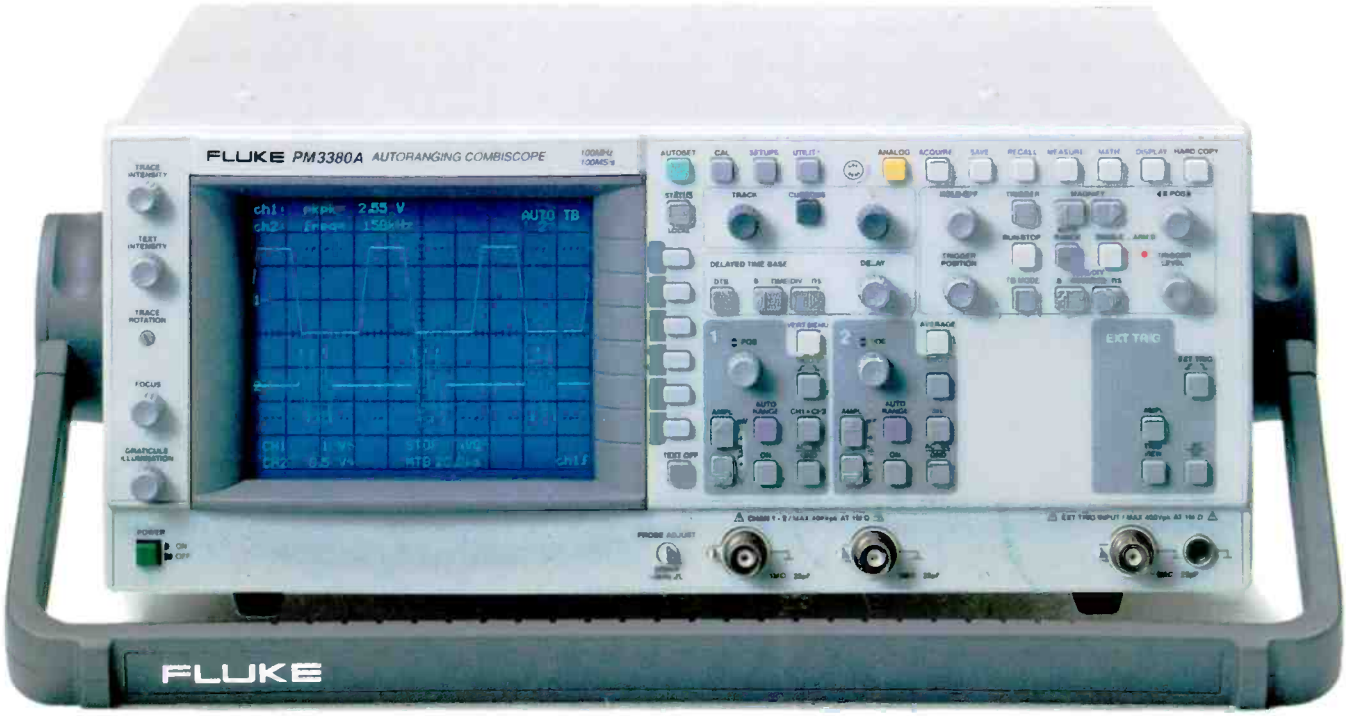
G M POPKEY CO
WAUSAU WI • 800-444-7920

TAYLOR ELECTRIC CO
MEQUON WI • 800-558-6970

Not all 800#'s are interstate.

Circle (38) on Reply Card

Now you can concentrate on your work without worrying about adjusting the scope.



Introducing the new Fluke PM 3380A CombiScope™ with Autoranging.

Now there's a better, faster way to get the measurements you need, and at a much lower cost.

Think about it! A 2-channel, 100 MHz analog/digital oscilloscope that lets you concentrate on the problems you have to solve rather than on constantly readjusting the time base and attenuators to get a good view of the signal.

How can that be? Autoranging. A unique feature that automatically scales signals and puts them in the picture, letting you probe around the circuit with ease. Even when an unexpected event sends your signal off-screen, Autoranging brings it right back.

- Autoranging
- 18 automatic measurements
- Analog scope built in
- On-probe switch for mode changing
- Trigger view: Almost another channel
- True digital peak-detection
- Glitch triggering
- Video line counter and TV trigger
- Oversampling digital peak detection
- Waveform processing and mathematics
- Closed-case calibration
- 3-year warranty parts and labor
- 5 year CRT warranty
- Exceptional value at **$3,495.00**

This Fluke scope has an impressive array of intuitive and intelligent features usually found in scopes of twice the price. And all are contained in one compact unit that will give you years of dependable service.

Call **1-800-44-FLUKE** today and see how easy it can be to put this scope to work for you.

FLUKE®

Circle (24) on Reply Card