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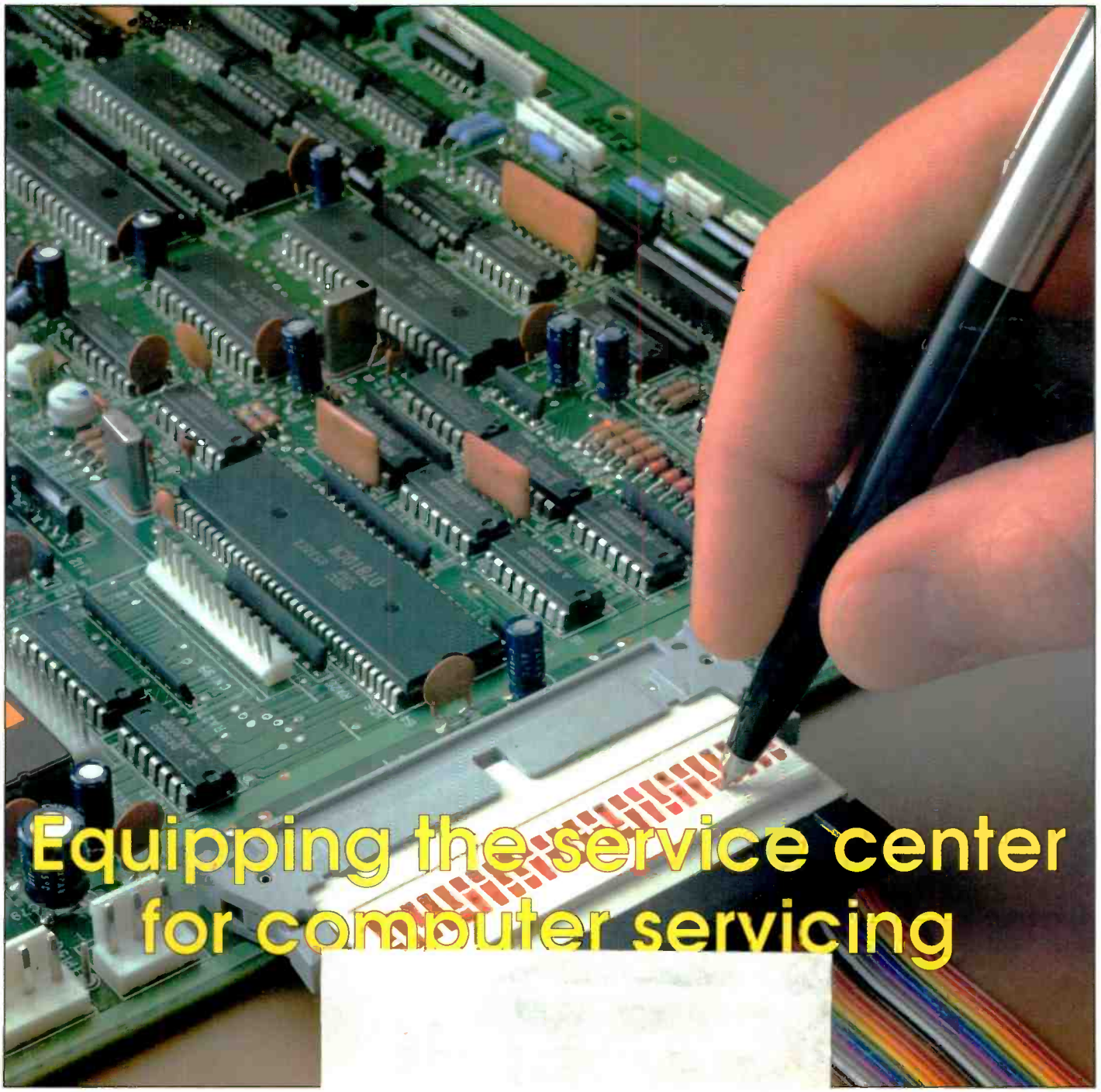

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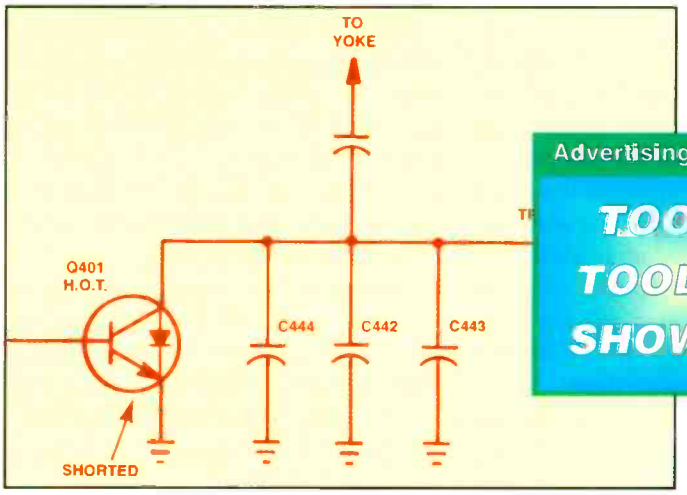

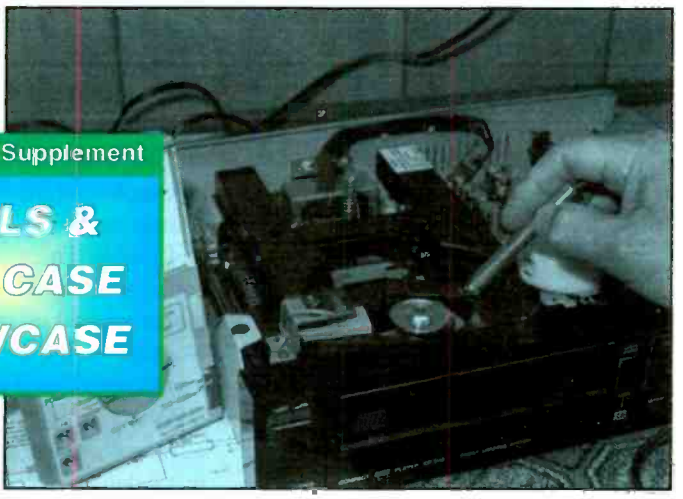

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ON THE COVER

Falling hardware prices and an increasing array of software for consumer applications have contributed to the increasing appearance of computers in homes. Some study, and acquisition of diagnostic software and a few pieces of computer-specific test equipment, can prepare the consumer electronics service center to service these products. (Photo courtesy of 3M)

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

Rethinking service

Most consumer electronics servicing technicians service down to the component level. There are several good reasons for that. In the early days of consumer electronics (read radio and TV, and vacuum tubes) products were constructed on unified chassis. All of the components and sockets were mounted on the single chassis and wired to each other with wire and solder. There *were* no modules that could be removed and replaced. If a technician wanted to get a defective product working again, he had to find the bad component(s) and replace them.

As technology in consumer electronics advanced, some products were designed in modular fashion. In some cases with these products it made sense to exchange modules to get the product back up and running. But in many cases, even though the product was designed to be modular, and to be repaired by replacing modules, it was more cost effective to service to the component level.

For one thing, many of these modules were very expensive. Service centers felt that it was wrong of them to charge a customer to replace a several hundred dollar module when they could use a few tests to find the defective resistor or transistor on the printed circuit board. Not only that, but the cost to maintain an inventory of modules might severely tax the financial situation of a small to medium size service center.

For many reasons, including those, consumer electronics servicing technicians tend to have a mindset that the correct way to service a product is to find the component or components that have failed and replace them.

One of the other reasons that technicians prefer to troubleshoot to the component level is the sheer intellectual challenge. For the same types of reasons that some people do crossword puzzles or indulge in other mental challenges, technicians just want to demonstrate to themselves and others that they can solve a problem to its most fundamental cause.

Anyone who understands consumer electronics and the technicians who keep the products operating, applauds that attitude. It's admirable that these technicians want very much to exercise their skills, and at the same time to save their customers and themselves money.

In some areas of consumer electronics today, however, things are changing; notably in the area of computers. IBM and compatible computers are one hundred percent modular. One of these units is assembled by piecing together a motherboard, a video card, disk drive controllers, the disk drives, a printer controller, a mouse controller, and a power supply module, among other things.

Because of intense competition among suppliers, many of these modules are extremely inexpensive. A power supply may cost around $60.00. A video card will typically cost less than $100.00. Even the motherboard will probably cost just a few hundred dollars.

Because of these extremely low module prices, in many cases it simply doesn't make sense to troubleshoot to the component level. How much time can a technician spend troubleshooting, locating a replacement component and installing the new component, when the cost of a replacement for the module is $60.00?

When faced with some of these newer products, a consumer electronics center that is steeped in the venerable tradition of service to the component level, needs to reevaluate its approach to service, in order to be sure in every individual case that it is servicing the product in the most efficient, cost effective manner.

Keep those articles coming

The editorial in the July 1993 issue mentioned to readers that we're constantly looking for good solid technical articles. Many readers responded and we have recently published articles written by them. Several of those who sent articles to us in response to that invitation are now regular authors. Thanks, guys, and keep them coming. We could use more!

The pace of change in consumer electronics is continuing to accelerate. If you can provide us with articles that explain how some of this new technology works, or how to service it, especially TV and video, write or call me at P.O. Box 12487, Overland Park, KS 66282-2487; 913-492-4857. I'll get a copy of our writers' guidelines out to you immediately.

Nils Conrad Person

Satellite from space trade show

The ProShow, a live satellite delivered audio program for satellite dealers and electronic technicians, announces its spring topic line-up. Scheduled dates include: May 1, Tools of the Trade; May 8, Servicing What You Sell and Selling Your Service; May 15, Troubleshooting Tricks and Tips; May 22, InterAssociation Cooperation; May 29, Service Centers—When to Farm Out the Work.

Each Sunday night, the ProShow revolves around a particular topic. Often, the show features interviews from experts on the topic, but the majority of time is devoted to callers.

"The topic gives us a starting point, but it is really the callers who determine the content of each show," explains ProShow host Fred deFerbrache. "One caller can touch off an important or pressing issue and the rest of the show moves in that direction. It is really the listener's show. I just get it started and answer the calls."

The first portion of The ProShow includes a short prepared newscast. This delivers the fast breaking stories that impact on the satellite and electronics industry.

"The ProShow is a powerful way to get news and information to the industry. Besides having the immediacy of radio, it pools the experience of its listeners," commented Dick Glass, the president of SDA and ETA-I. "In this way, the listeners become the eyes and ears of the industry."

The first ProShow aired on October 18th, 1992. It is produced in conjunction with the national Satellite Dealers Association and the Electronics Technicians Association, International by Electronics Professionals, Inc. It can be heard on the Omega Radio Network (Galaxy 3, Channel 17 at 5.8MHz) every Sunday night from 9:00 pm to 11:00 pm EST. The call-in phone number is 219-293-9664. Dealers are encouraged to set up a VCR in their stores to automatically record the show.

TVs score high in serviceability inspection

The International Society of Certified Electronics Technicians (ISCET) has begun conducting inspections of electronic products that have not been authorized by the manufacturers of that product.

In its second ISCET sponsored Serviceability inspection, two televisions were inspected at the Florida Electronic Service Convention, January 14, 1994, in Jacksonville. The Goldstar Model GCT 2054S scored an 84.48% for a good rating. The Samsung Model TXB 2015/CX scored 85.29% which just slipped it into the very good category.

Sets are rated on the criteria of product identification, back removal, and re-installation, preparation for and performance of in-home or minor in-shop service, preparation for and performance of major bench servicing, and service data considerations. Four other sets were rated in August at the National Professional Electronics Convention. All were rated as fair. Even though these inspections were not authorized by the manufacturer, some manufacturers have chosen to purchase their reports following the inspections.

The Serviceability program is a joint effort among the manufacturers, the technicians, and ISCET to improve product serviceability in the future. A manufacturer can schedule a confidential inspection at his selected site by contacting the ISCET office.

Computer case settled out of court

An independent computer service dealer, unable to afford the expenses of a Supreme Court trial, has agreed to the terms of a computer manufacturer. Part of the terms was an agreement to not compete with that manufacturer for the service of its products or any peripheral equipment.

Peak Computer Corp., the independent service company, was sued by MAI Systems Inc., a computer manufacturer turned servicer, for alleged violations of the U.S. Copyright Act. MAI says that the software that operates its computers is only licensed to the people who bought and own the computers and that only those owners who are licensed may turn the computer on. They charged that Peak—and any other independent service company not approved or licensed by MAI—may not turn the computer on for service without breaking the law. They contend—and two lower courts agreed—that, when a computer is turned on, a "copy" of the operating program is made into the computer's RAM, and that this violates § 117 of the U.S. Copyright Act. The latest decision was rendered in the Ninth U.S. circuit court of Appeals in California.

The case was appealed to the Supreme Court in 1993 and the application was accepted. However, the service dealer's business liability insurance was, effectively, canceled and trials were imminently pending to award damages based upon the Ninth Circuit Court's decision. Unable to afford the substantial penalties or the legal fees for the appeal, Peak owner, Vince Chiechi, was forced to capitulate to the MAI-offered settlement. In return for MAI not enforcing a judgement that could have called for as much as a million dollars, Peak allegedly agreed not to service or maintain any of MAI's computers and to not solicit any of MAI's customers for the repair or maintenance of any peripheral equipment.

With this settlement, the decision of the Ninth Circuit Court has now become the law of the Ninth Circuit. However, other cases based on the same premise are pending around the country. NESDA and NIAS officials, who consider the decision by the Circuit Court to have created an "intolerable legal situation," are reasonably sure that one or more of these cases will ultimately reach the Supreme Court.

In the meantime, NESDA is continuing its efforts to establish a legal fund, the Service Industry Signal (SIS), based upon voluntary contributions from independent service industry professionals and supporters. Such a fund would permit NESDA to (1) file additional Friend of the Court briefs in the Supreme Court as needed; (2) promote legislation to aid independent servicers in obtaining repair parts and service manuals from appliance, computer, and consumer electronics manufacturers; and (3) possibly render assistance to a financially strapped independent that is caught up in a precedent-setting case (such as Peak).

NESDA is asking all affected service dealers and technicians and their associations to contribute to the "S.I.S." legal

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ELECTRONIC Servicing & Technology

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

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defense fund. Contributions may be sent to: SIS Fund, c/o NESDA, 2708 W. Berry St., Fort Worth TX 76109, or call 817-921-9061.

Forty-four vendors to sponsor fiber optic training conference

Forty-four vendors of fiber optic products have joined together to sponsor "Fiber U," the second annual Fiber Optic Installers' Conference July 25 through 28, 1994 in Long Beach, CA. The conference will include a combination of twenty-five classroom seminars and hundreds of hands-on workshops, plus the building of a demonstration fiber optic cable network as part of the training program for installers and users of fiber optics.

Fiber optics has become a household word recently, since its enormous bandwidth makes it ideal for the backbone of the planned "national information infrastructure." To allow the mass deployment of fiber throughout the country, more trained installers are needed quickly.

"Fiber U" is the only hands-on training conference for fiber optics. It began in Nashville, Tennessee in 1993 as a way for vendors of fiber optic products to train a large number of installers conveniently. Two hundred attendees came to Nashville and participated in 18 seminars and 90 hands-on workshops.

At the Long Beach Conference, a complete fiber optic network will be built, using virtually every type of fiber optic component, by the attendees as part of their training. Attendees will be trained on the network, pulling cables through conduit, splicing and terminating and testing installed cables in a realistic setting.

The 44 sponsors represent every type of fiber optic products needed for installing and maintaining any type of network. To make the installation even more realistic, several networks will be operating on the network during the conference, including a video surveillance system for conference security.

For more information on the conference, contact Louise Downing, Conference Coordinator, at Fotec. 800-50-FIBER, Fax 617-241-8616, email 541-0037 @ MCImail.

DSS installations

The Satellite Dealers Association has learned that the business owned by SDA Secretary Greg Woods has been commissioned by Thomson Consumer Electronics to install the first working Digital Satellite Systems (DSS). These initial (several dozen) systems, used in what is called "beta testing," will provide user information back to Thomson, from actual home environments. It will also give statistics vital to ascertaining the total job of installing the DSS 18-inch dishes, wiring and instructing users as to operation.

Technicians employed by "The Satellite Shop," operated by Woods out of Whitestown, IN, will be gaining direct experience in this installation and testing program. Users being equipped with some of the initial production of DSS hardware are primarily V.I.P.s associated with TCE in the central Indiana area. ■

Equipping the consumer electronics service center for computer servicing

Part 1—Learning about computers, obtaining the equipment and developing an approach to diagnosis and service.

By David Presnell

All electronic equipment is subject to malfunction at any time. This is true of the IBM computer and its clones, as well as TVs, VCRs and other consumer electronics products. The rapid growth of the low-cost computer has resulted in the sale of millions of these systems over the last few years. Many consumers buy their new computer systems at discount centers, mail-order houses, and other places that don't specialize in computers. Computer sales have become an add-on product line to department stores, home appliance centers, and hardware stores. These businesses often know little about the computers they sell.

Computer service for these computers is usually offered by a subcontracting firm, typically offering a one-year on-site service agreement. Once this service contract has expired, the computer user turns to local suppliers for service. The first stop is usually their favorite consumer electronics service center. Buyers of the new low-cost computers are often not familiar with how to use their new computers, much less how to fix many of the simple problems and conflicts that occur.

This article will look into some of the many common problems that arise within the computer. It will look at both hardware and software problems and suggest some simple ways to troubleshoot them. To get started in computer service as quickly as possible, it is best, at first, to swap out defective mother boards, I/O cards, and power supplies, for working ones, rather than attempt to diagnose down to the component level. Actually, in many cases, because of the low cost of replacements and the high cost of a technician's time, board or module level service makes sense even for the experienced technician.

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

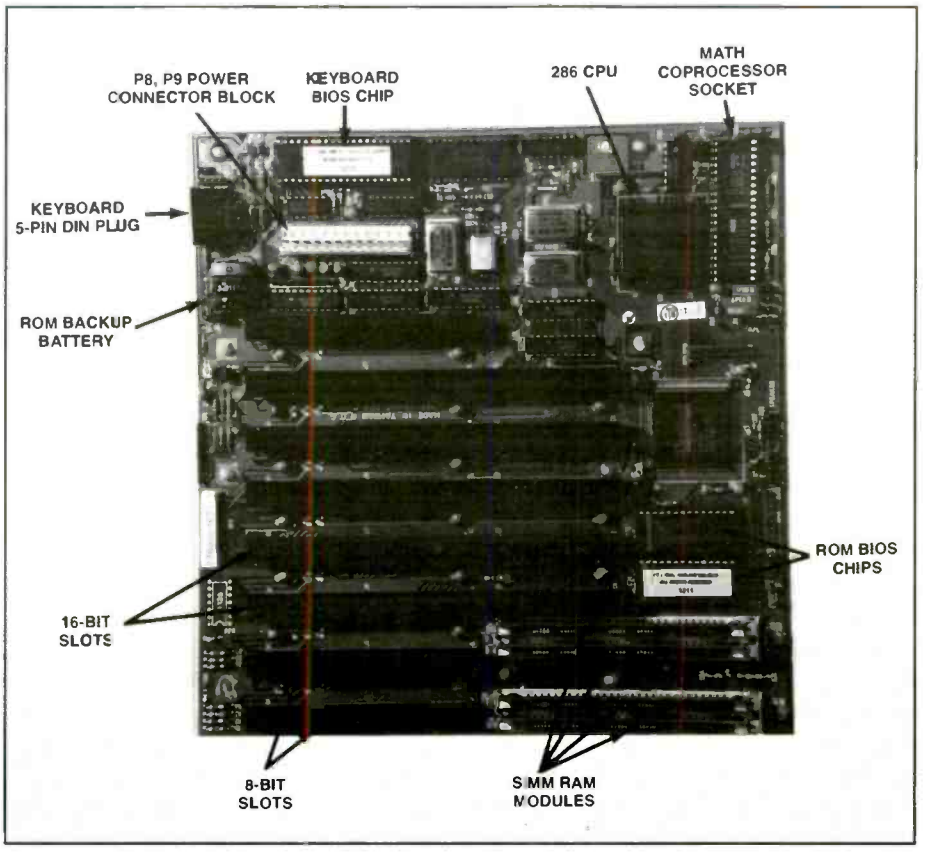


Figure 1. When you take the cover off of a typical IBM compatible computer, (power off of course), you'll find something that looks like this. This is the mother board.

A good addition to your business

Suppose you service TV's and VCR's for a living, and one day you receive a call from a good customer asking you to look at his computer. You reply "I'm sorry but I don't work on computers, and I don't know anyone around here who does." Later, you may find out that the problem was nothing more than a fuse, and that a company 50 miles away charged them $75.00 to replace it. You could have replaced that fuse and saved your customer a costly trip out of town.

Why are so many people afraid of computers? Computers are no harder to work on than any other electronic equipment. In fact, with a little knowledge, they're easier. Does a sick VCR diagnose itself? With the proper software, a computer can.

Start by learning computer operation

What will you need to know before adding computer service to your bench? The best advice I can give here is to obtain a computer. Buy one, rent one, use one at

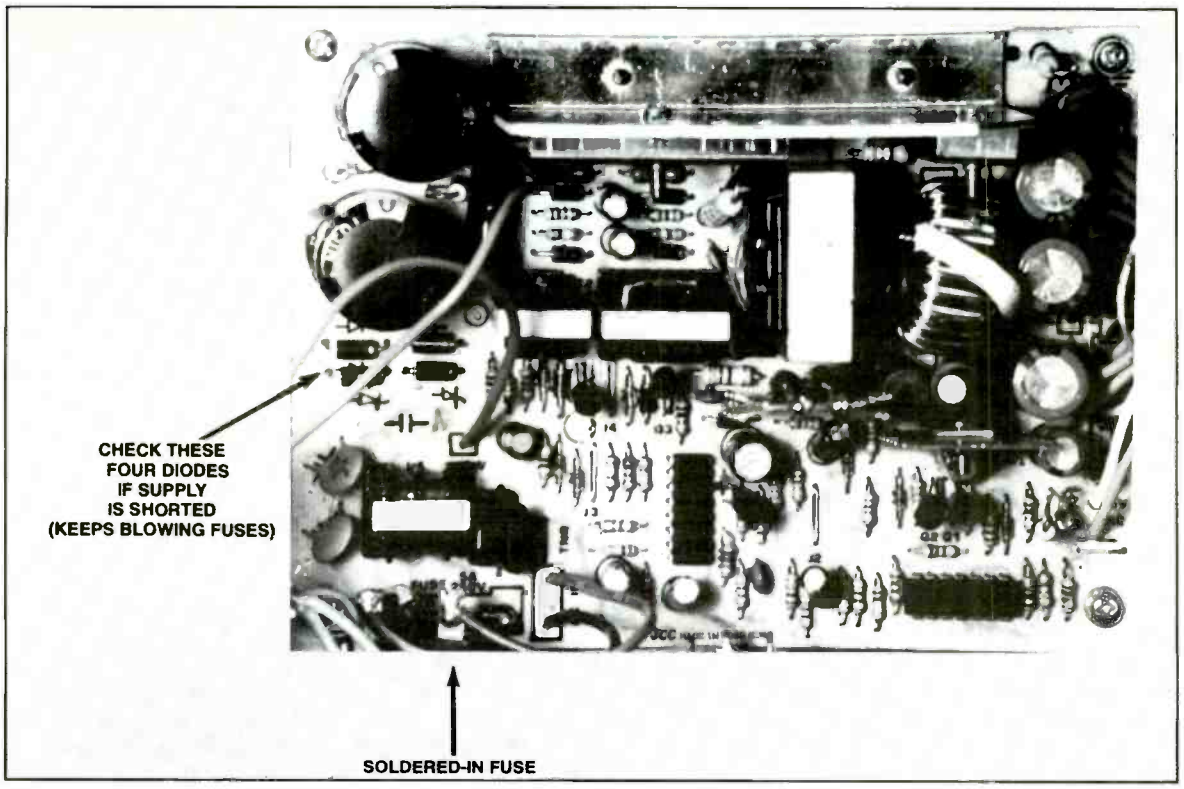


Figure 2. The power supply has a soldered-in fuse that will required a soldering iron for replacement. If the power supply keeps blowing fuses, check the condition of the four diodes.

the public library, or borrow a friend's. An IBM compatible XT or AT with a hard drive will do nicely. It needs to have MS-DOS (version 5.0 or above) loaded as the primary operating system. There is a version 6.0 out, but 5.0 will serve your needs.

Once you have a computer, sit down in front of it with the MS-DOS manual in hand and learn DOS. You can never become proficient as a computer service technician until you learn at least the fundamentals of MS-DOS. In fact, you will need to understand the basic operation of a computer, the basic parts of the computer, and DOS before you will obtain any real benefit from this or any other computer service article. Don't despair, it's easy.

Sit down with your computer operator's manual and learn the basics. Take the cover off (power off of course) and explore. Locate the mother board (Figure 1), floppy disk, hard disk, I/O cards, power cables, keyboard plug, monitor card, power supply. Locate the fuse coming out of the back of the power supply, if it has one there, and any batteries mounted on the mother board. As with any modern electronics circuits, use care inside. Before you handle chips or other parts, put on a static wrist strap. Think before you act. Common sense will take you a long way in computer service. And remember, you cannot take anything regarding computers as an absolute. When I'm absolutely sure, then I'm usually wrong. Keep that bit of advice in mind as you begin to work on computers.

The tools of the trade

You probably have most of the hardware and tools you will need to service computers. I should mention the importance of high quality tools—they're far less expensive in the long run. Apart from the basic hand tools, hex wrenches, and other goodies, you may need a good dental probe set, and a good pair of medical quality tweezers. A good U-shaped chip puller will come in handy for socketed DIP chips. I carry a portable soldering kit (butane type) to remove soldered-in CMOS RAM batteries and fuses in the field (Figures 1 and 2). They're light and portable, and you don't have to worry about static zapping the mother board from the tip. If you buy a butane-powered portable soldering iron, get the smallest tip you can obtain.

In the field, I carry a good DMM with a continuity beeper, and a 100MHz logic probe. It's easy to acquire more than you need, so regarding your computer service bench, keep it trim. I would strongly suggest an isolation transformer for switching-power-supply service. If you plan to service monitors, you will need a service bench similar to the one you use for TV service. With the proper schematics, any good TV technician can service monitors, so this article will concentrate on the computer itself. See Table 1 for a complete list of tools, accessories and test equipment you should have for personal computer servicing.

Replacement parts

Buy parts only as you need them, especially if you're just starting. You can acquire a fortune in boards and chips that you'll rarely ever use. If you find some good suppliers, you can often obtain computer parts overnight for a modest additional shipping fee. You can and will acquire old computers for parts in the beginning. However, it's only fair to charge used prices for used parts.

Servicing software

Your major investment will be in computer servicing software and firmware. Servicing software consists of diagnostic programs on floppy disks that will help you locate the computer's problem(s).

Firmware includes plug-in cards and chips that will help you diagnose problems when the computer won't boot.

You will need an MS-DOS boot disk (or system disk) with you. This disk will often allow you to start up the computer when there's a problem with the hard drive that won't allow the computer to boot. Few computer owners can even find their manual, much less the original DOS disk that came with the computer. On the boot disk that you carry with you, you will also want the following DOS files: BACKUP, RESTORE, SYS, CHKDSK, EDIT, QBASIC, HELP, DEBUG, DISKCOPY, FORMAT, MIRROR, SETVER, UNDELETE, UNFORMAT, XCOPY, and any other DOS files that you think will assist you in the field.

If you're familiar with DOS, you will know that the above files are from MS-DOS 5.0 and will have to be placed on a high density 1.2MB floppy in order to fit them all on. You should also have a boot disk of the MS-DOS 3.2 (or close version) for older XT systems. I carry one boot disk of each for all four sizes of floppy disk. You should obtain these operating systems from the software supplier of your choice.

You will also need to obtain your diagnostic software. I use diagnostics from Landmark Research. See the listing at the end of this article for addresses. You can purchase direct or from many suppliers such as Jensen Tools. I recommend that you obtain one of each of the following types of software programs: XT service diagnostics; 286 service diagnostics; 386 service diagnostics; 486 service diagnostics; a general diagnostic program, and a hard disk diagnostic program. Also useful is a program called DOS UTILS from Ontrack Computer Systems, or a utilities program from another supplier.

Another type of product I suggest obtaining is a POST reader card, that will help you diagnose the problem when the computer fails to boot. Also, you may want to obtain a set of ROM POST (power-on self test) chips for XT, AT-single chip, and AT double chip ROMs. When a computer won't boot, it cannot recognize the operating system, thus, it cannot use diagnostic software. These POST products are basically operating system independent. With them you can often determine the problem when a computer won't boot. The ROM POST chips replace the mother boards ROM chips and produce standard POST codes. From these codes or beeps, you can look in the manual and determine the problem area.

You can expect to invest around $2500 for all the diagnostic items mentioned. You can also try out the many shareware products (with caution) on the market. One of those I recommend is IBM AT Disaster Prevention or a similar product available from any good source of shareware. This program and like products will capture and store the ATs current CMOS setup settings to a floppy disk file, and when the need arises, will restore that file to CMOS RAM. You might try a recognized shareware company such as The Software Labs (their disk 495).

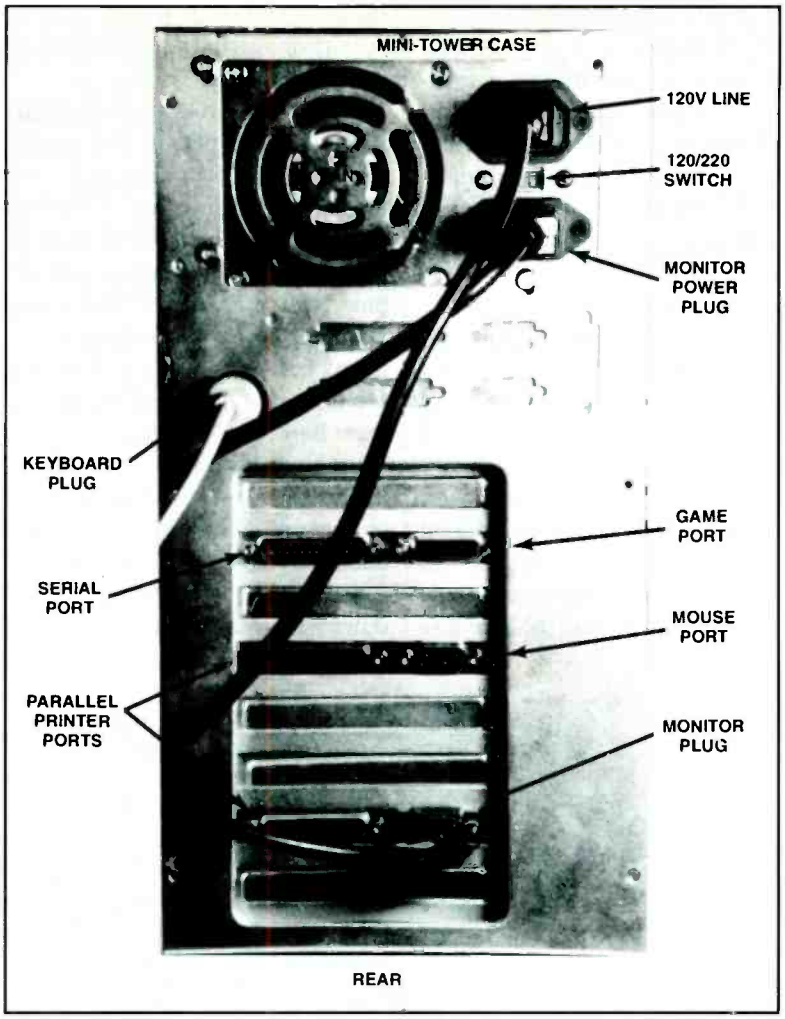


Figure 3. The back of the computer has provisions for connection to the power line, and all of the peripherals. If you encounter a dead computer and you determine that there is power at the plug, check to see if the power cord and monitor cord are plugged in well, and that the 110/220 switch is in the correct position.

Table 1

TOOLS AND TEST EQUIPMENT
- Standard tools
- Standard electronic servicing test equipment
- Electrostatic discharge preventative wrist strap
- Dental probes
- Tweezers
- IC puller
- Portable soldering iron
- Logic probe
- Isolation transformer
- Service literature/schematics

SOFTWARE
- DOS boot disk (system disk) with other DOS programs on it
- Diagnostic software and firmware utilities

BOOKS
- DOS manual
- Operating software manuals
- Diagnostic software/firmware manuals

Using diagnostic software

Before you attempt to use any of the diagnostic software and firmware mentioned above, read all the manuals and directions that come with the diagnostics. Once you've read them, read them again. As a computer technician, you must understand the tools you're using before you use them.

When you've read through everything at least twice, write protect all of your original disks then make backup copies of all the disks you've received. You may even want to make a couple of copies of each—one for the field, and one for the bench. Remember to use low density disks for any programs that will be used on XTs or PS2 25s. I put anything that will fit (not all of the programs will) on low density disks, both $5^1/_4$ and $3^1/_2$. That way the disks will work on both high and low density drives. Put your originals away in a safe place.

Next, write protect your copies. This would include placing the small black tape tab from your label sheet over the notch of a $5^1/_4$ disk, and sliding open the tab on a $3^1/_2$ disk. Why write protect them? Imagine picking up a nasty computer virus from a customer's computer and transferring it to a dozen more computers before someone realizes that you are the cause of wiping out the data on their hard disk. Write protecting your disks protects you and your customers.

Now that you've learned your computer, learned DOS, studied your diagnostics documentation, made backup disks, and write protected everything, proceed to sit down with your diagnostics (both soft and firm), and learn how to use them. Use care, and read through your manual as you proceed at the keyboard.

If you have any data on your hard disk, I would suggest you back it up before using any of the diagnostic programs. Most of them can and will lose your data if you make mistakes, which is especially likely while you're learning. This will also be good experience for you. If it's at all possible, always back up your customer's data before performing potentially destructive procedures.

Once the hard drive is backed up correctly, you can run all of the diagnostics many times through until you become comfortable with them, even to the point of reformatting the hard disk. I will reference many of these procedures within this article, but space won't allow for me

Table 2

PROBLEM	POSSIBLE CAUSE	SOLUTION
Computer works correctly except when running a specific program	Software	Check setup. Change if necessary. Or try reinstalling program
Computer operates normally with floppy disk but operates incorrectly or not at all with hard disk	CMOS RAM setup, the hard disk, or the disk controller card. If the problem is caused by the hard disk it may be either a bad program (such as COMMAND.COM) on the disk, a mechanical problem with the disk, or both.	If the computer boots okay off of the floppy but will not recognize the hard disk, then the problem is most likely a dead CMOS battery if the computer is an AT. Check the battery and replace it if necessary, then run setup.If the computer is an XT, the problem is most likely a bad controller card.
Computer locks up or gives error messages during operation of some programs	Messages such as "not enough memory" may indicate that program has used all available memory, or that extended or expanded memory managers are not operating as they should be (computer is set up wrong). When small programs are run and such a message appears in DOS, the cause may be a bad memory chip.	Check for bad software or viruses. If lockups occur randomly within any program or even when no application program is running, check for a fault on the motherboard
Monitor problems	Bad monitor or improper setup	If monitor display was bad immediately on turn-on, check monitor. If monitor was good on turn-on, but became wrong after startup procedure, check startup file for problem. Set up VGA or possibly CMOS RAM.
Dead computer at turn-on	Bad power supply, bad power cable, burned/broken foils on motherboard.	Check visual and audible indications such as lights, fans, disk drive operation. Check power supply. Check power cable connections. Check outlets. Check motherboard foils.

to explain the operation of each function. Also, if you are going to perform a destructive procedure, such as formatting, *always* backup before proceeding.

Diagnostic approach

Computer problems can be divided into three major categories:

- software problems;
- hardware problems; and
- combined problems.

This article will explore each of these three areas. Just as with any other service problem, many are not related to the product at all, but are caused by some external problem. We will first look at common problems unrelated to the product.

If you're called out to service a dead computer, first consider the most likely cause. Check the outlet to see if it has power. Follow the power cord to the surge protector. (If the computer doesn't have a surge protector then it's your duty to sell the customer one.) Is the surge protector light on? Is the breaker tripped (or fuse blown) on the surge protector? If you're not sure, test the outlets on the strip with a meter.

If all is well, continue on to the back of the computer. Are the power and monitor cords plugged in securely? Is the 110V/220V switch in the correct position (Figure 3)? If the computer has an external screw-in type fuse, check it. If it's blown, try a replacement if you have one. If it blows again, you've already located the general problem area: the power supply.

If the computer seems to be working, but the monitor is blank, check the controls in front and rear of the monitor, especially the brightness. You will be surprised at how many calls you will get for which the problem is nothing more than a brightness control turned down.

If the keyboard is not working, turn it upside down and check the AT/XT switch if it has one. Make sure the switch is in the proper position. Also, make sure the keyboard is plugged in correctly.

At this point, question the customer. Find out all you can about how the computer was acting before the trouble occurred. Who has been using it?

Did they hear anything unusual, smell anything, or notice that the computer has not been working right for several days?

Just as a doctor asks you "where it hurts," you must determine from your customer as much as you can about the problem and how it occurred. Has the computer been moved recently. Have new programs been installed. Has anything been done differently. I responded to a service call in which the customer told me over the phone that he thought his computer had a virus. When I arrived, I questioned him regarding symptoms.

As I began, I noticed that there was an area of lost data on his hard disk that crossed several files, mostly on the boot sector of the drive. While I worked he asked me the tell-tale question: "Do you think that dropping the computer could have caused it?" He informed me that he had just moved it downstairs and had dropped it about six steps from the bottom of the stairs. Yes, bouncing computers can cause hard disk problems.

That brings up another point. Many computer users know little about their machines. You must treat your customers with kid gloves if you want repeat business. This customer was very embarrassed to tell me what really happened. My response was to proceed to recover as much data as possible, reformat the hard disk, (locking out bad sectors), then reload his data and programs. All worked

well! He was very happy. He had already accepted in his mind that the computer had to be replaced. I kept my opinions to myself about how to handle a computer.

Determining where the problem is

The toughest part of the computer technician's job is to determine whether the problem is software (the programs), hardware (the boards, chips, cords, and connectors), or a combination of the two.

You must take your time, and use careful consideration in this process. Here is where digital theory can be of use. For all practical purposes, however, I have devised a simple method to determine which area to concentrate on. The following questions will help you determine whether software or hardware problems exist, or a combination of both.

• Does the computer work correctly except when running a specific program? If so, this is most likely a software problem. Try re-installing the program that causes the problem. If you're familiar with the program, check the setup. The program may simply be set up incorrectly.

• Does the computer operate normally off of a floppy disk but refuse to operate correctly or at all while trying to use the hard disk? This symptom suggests a problem with either the CMOS RAM setup, the hard disk, or the disk controller card. If the problem is caused by the hard disk it may be either a bad program (such as COMMAND.COM) on the disk, a mechanical problem with the disk, or both. If the computer boots okay off of the floppy but will not recognize the hard disk, then the problem is most likely a dead CMOS battery if the computer is an AT. Check the battery and replace it if necessary, then run setup. If the computer is an XT, the problem is most likely a bad controller card.

• Does the computer lock up or give error messages during operation of any program? Messages such as "not enough memory" may simply indicate that the program has used all of the memory that is available, or that extended or expanded memory managers are not operating as they should be (computer is set up wrong). However, when small programs are run and such a message appears in DOS, the cause may be a bad memory chip. Lockup can be caused by bad software or viruses, but if lockups occur randomly within any program or even when no application program is running, suspect a fault on the motherboard as the most likely cause.

• Monitor problems are self evident just as are common TV problems. However, monitor problems could be caused by the monitor, the display card located on the mother board, connecting cables, or a chip on the mother board. Improper setup of a VGA monitor can cause some effects that may be seen as problems by some. When you turned the computer on, was the problem immediate, or did it start only after the computer had completed its start-up routine? If the monitor was okay to start with, but became wrong only after the computer completed the start-up, you probably have to do nothing more than set up the VGA controller or possibly the CMOS RAM.

• Does the computer seem dead when turned on? After checking the basics mentioned above (checking power, etc.), look to see if the power light on the computer case is working. What about the monitor power on light? Are all the switches on? Place a floppy disk in drive A and type A: then press ENTER. Does the floppy disk drive light up? Can you hear the disk drive

working? Can you hear the power supply fan working? See Table 2 for a table of these steps.

Going through these five basic steps will not fix the computer, but will help you determine which diagnostic approach to take. The basic idea is to determine what is working and to temporarily discount that area as the problem area. As you continue to see what works or responds to a given action, your direction will become more clear. You will also notice what does not work or respond as it should, and this will lead you to place the correct diagnostic disk in the drive, install firmware as needed, or take the computer back to the bench for more advanced study.

Many corrective procedures may be effected with nothing more than typing a few keys on the keyboard. Remember, a computer with MS-DOS is a powerful tool within itself. Pressing the right keys can correct many problems without further assistance.

See the second part of this article, "Specific solutions to specific problems," below for information on how to diagnose and correct common problems that you will encounter in servicing personal computers.

Part 2—Specific solutions to specific problems

Part 1 of this article, "Learning about computers, obtaining the equipment and developing an approach to diagnosis and service," which appears on page seven of this issue, suggests an approach to learning about personal computers and obtaining the equipment and information necessary to service personal computers. This second part describes some common problems you will encounter in servicing personal computers and suggests an approach to solving these specific problems.

Software problems

Software problems can be some of the most frustrating problems to correct on a computer. People will assume that you, as a computer technician, know all there is to know about every program they have. What customers don't realize is that there are thousands of programs, and no human could possibly know them all. If you have time, try to learn all you can about as many popular programs as you can. All programs produced by Microsoft are good programs to learn. Popular programs such as Word Perfect, Lotus 123, Quicken, MS-Windows, will certainly cross your path. It would be profitable for you to learn as much as you can about these programs.

I will look into various common software related problems and ways to try to correct them. First, let's consider the problem of "missing data or files on the hard disk."

Restoring missing data

One of the most likely and most frequent causes of missing data is operator error. It's not unusual for a computer owner to format the non backed-up hard disk then call the technician to get their data back. Deleted and erased files are another cause of missing data. If the customer has done nothing after such mistakes happen, recovery is often a simple and painless process. However, if the customer has tried to fix it by copying over these deleted areas, recovery may be hopeless. If they happen to be using MS-DOS 5.0 or above, however, then all may not be lost.

If a hard disk that's using MS-DOS 5.0 or above has been accidentally formatted, then you can try the following: Boot the computer with an MS-DOS boot disk in drive A:. When the customer formatted the disk, they may have been prompted to put a blank formatted disk in drive A: to save DOS's mirror (UNFORMAT) information. If they did so, and have this disk, by all means use it. Unformat will use the information on the floppy to recover the drive. If you have this unformat floppy, at the A: prompt (with the MS-DOS disk in drive A:) type UNFORMAT C:. *Note: The floppy you booted from must contain the unformat and mirror related commands. See your MS-DOS manual for more information.*

If you do not have this unformat floppy disk, then at the A: prompt type UNFORMAT C:/L. This command will try to unformat the disk using any existing information in the root directory and file allocation table (FAT). Follow on-screen prompts, and think before you press that enter key. You may be able to recover most non-fragmented files on the disk.

Undeleting

DOS 5.0 and 6.0 also have a utility called UNDELETE to be used when a file has been accidentally deleted using the DEL or ERASE command. Check your DOS manual for instructions on using UNDELETE. For all practical purposes, I use DOSUTILS SCAN to attempt recovery of deleted files as described below.

If your customer is using a version of DOS earlier than 5.0, you can probably forget using DOS to attempt an unformat or undelete. The first step might be to try using a file recovery utility. Insert the utilities disk in drive A: and invoke the program. From the main menu select the file recovery utility and follow on-screen instructions. Although, the file recovery utility may not recover a formatted disk, it will recover deleted files in most cases. There are also utilities available that will spend hours or even days trying to recover data from a formatted disk, however, I don't own any of these programs.

Customers should have backed up their data on a regular basis. They should also have all of their original programs on floppies. Thus, if neither unformat or file recovery works, then proceed to install their programs back onto the hard disk, then load any data they may have backed up. One such incident will teach your customers a valuable lesson: backup data often.

If the customer's data is really valuable, and they have no backup, then you can remove the hard disk and send it to specialty companies (listed in the back of computer magazines) and have them attempt to recover the data. Not many of your customers will want to pay the high cost of such service (around $150 per hour).

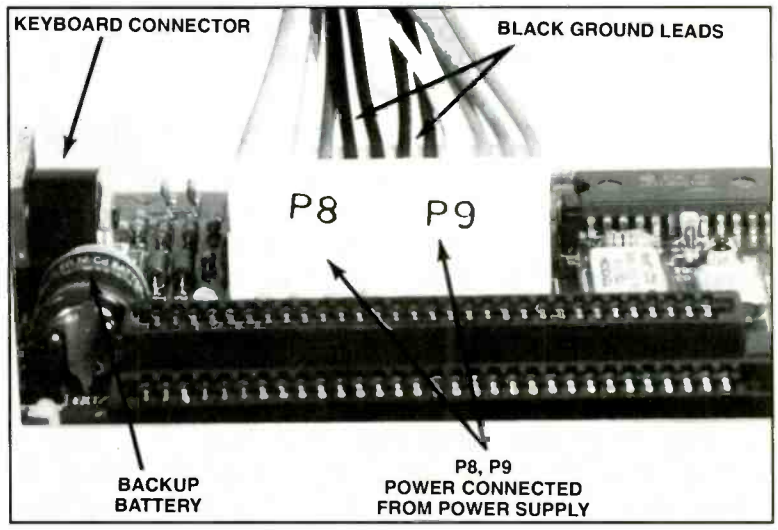
Bad programs

Another common cause of missing data is bad programs. Believe it or not, some programs have small areas that simply do not work correctly. That's why software developers often release X.01 corrected versions shortly after a new program comes out. These areas can cause all kinds of problems. Also, programs can, for some unknown reason, stop working or begin working in an unpredictable manner.

In these cases, first try re-installing the

Figure 4. If the computer is dead, turn the power off, remove the cover and locate the power cables coming out of the power supply going to the boards and drives of the computer. Use a DMM to check the voltages.

Figure 5. If the computer is dead, but the power supply has a correct +5v output, take a reading off of the yellow +12V line. This reading will normally be just above or below +12v. If this line proves okay, then check downstream to see where the power stops.



program from the original disk. If the customer does not have the original, but has an illegal copy, then this may be the problem. Suggest they obtain a legal copy from their software supplier. You can always try the software technical support line for assistance. This number is usually located on the inside cover of the user's manual if the customer can find it.

Viruses

Another cause of missing data is viruses. Although, I think computer viruses have been overplayed, they do exist. If the computer acts strange, try running an anti-virus program. If the operating system is MS-DOS 6.0, you can type MSAV to start Microsoft Anti-virus. You might try one of the many anti-virus programs on the shareware market. Be sure to buy from a company that guarantees 100% virus free software.

Keep in mind that missing data is not always missing. Look through the directories and subdirectories on the hard disk. You may find the customer's data in a place you never imagined. One word processor was saving all WP50 data files in the DOS subdirectory just as it had been told by the user, but when asked to load one, WP50 couldn't find the file because it wasn't where it was supposed to be.

Another common problem is that the program won't start or run correctly. The most common cause is that the program is set up wrong. You might try looking through the pull down menus if the program has them. You may find the item that needs changing. The main menu may also offer ways in which to change or configure the system to work properly. As a last resort, try re-installing the program from the original installation disk. This should get the program back to the default setup that works best in most cases.

Cross-linked files/lost clusters

Another cause of software problems is something called "Cross-linked files and /or lost clusters." This is often caused by turning off the computer while programs are running (abrupt power down). You can read about this problem in your MS-DOS manual. To correct these problems, DOS provides a tool called CHKDSK. CHKDSK can do a lot to help maintain your computer's files. I type CHKDSK at the C: prompt soon after I sit down at any computer.

This program will give you information about the size and available space of both the hard disk and memory. It will also tell you if there are any cross-linked files or lost clusters on the disk. When run by typing CHKDSK, the program will only show you what it found. However, if CHKDSK showed problems, then if you type CHKDSK/F, it will try to fix any lost clusters. CHKDSK is limited in that it will not generally fix cross-linked files.

The simplest way to explain cross-linked files is that two programs have become intertwined. This problem occurs in the FAT; and when it occurs, usually one or all of the involved files may have to be deleted from the computer, then reloaded if necessary later. At this point, use a utility program such as DOSUTILS.

Conflicts

Another common cause of programs not running correctly is software or hardware conflicts. Some programs will not run correctly when terminate-and-stay-resident (TSR) programs are running in the background. To quickly see if a TSR program is causing the problem, boot the computer from a system floppy (without autoexec.bat and config.sys) in drive A. Then type C: and press enter to get into the hard disk. Start the program and determine if the problems still exist. By booting from a clean floppy you can be sure that no TSR programs are running in the background. If this doesn't solve the problem, there may be a hardware conflict or even a true hardware fault.

Full software diagnostics starting with a program like PC PROBE would be in

order at this point. If all shows up okay, then begin looking at the root directory and continue through each subdirectory looking for files relating to the problem program. Files have a funny way of getting in the wrong place. Again, you may try re-installing the software, or check its setup. It's possible that a conflict exists between the program and the monitor (program not setup correctly for the type monitor being used) or the printer.

Another common problem is trying to use certain DOS programs from the MS-Windows program. When you go to DOS without shutting Windows down, Windows is still running in the background (eating up memory). You have shelled out to DOS. You are not actually at the clean DOS prompt. Many programs will not operate properly when started from within another program, or while another program is running in the background.

Hardware problems

Computer hardware problems are not as common as software problems, but you can be sure that many of the millions of personal computers now in use will develop a hardware problem at some point.

Dealing with a dead computer

A common problem is the dead computer. After checking the power cords to be sure the computer is getting power, listen for the operation of the fan (if the computer is equipped with one). Also check to see if the power light is working. When you turn on the switch, listen for a beep from the computer. If all this indicates a dead computer, turn the power off, remove the cover and locate the power cables coming out of the power supply going to the boards and drives of the computer.

When you look inside the computer, you may find an unused four-socket power connector just lying to the side. If not, unplug one from one of the floppy disk drives. If the plug is a small one, off of a 3.5-inch drive, you can insert a small bare wire into the socket to hook your meter to. If you can find a standard four-socket plug, use it (see Figure 4). The meter's probes will fit nicely into its holes. Look for a connector with a red wire, two black wires, and a yellow wire. Normally the red wire is +5V, the yellow +12V, and the black wires are ground.

Take a meter reading from the red (+5V) to ground. You can attach the meter's ground lead to the metal case of the power supply, but it's simpler and surer to attach both to the power connector. Set your meter to read 5Vdc (or the next level up). Turn on the computer. If the power supply is working as it should, you will get a reading just under or just over +5V, depending upon the load placed on the power supply by the other components.

If the power supply shows no output, then locate the fuse. If it's available externally you should have already checked it with the meter. Usually, you will have to remove the power supply cover to check the fuse. This will usually require you to remove the power supply from the case. You may wish to take the computer back to your bench at this point. If the fuse is blown, replace it with one of the correct size and value. Power up the supply. If this fuse blows, then the power supply will have to be replaced.

You can obtain replacement supplies and boards from many sources. A number of them are listed at the end of this article. Be sure to order the correct size supply for the case, and the same or higher wattage. Different case styles use different size supplies. Your supplier will be able to help you get the right size. You should consider the cost of a new supply before spending too much time trying to fix an old one. Typically, supplies will run from $39.00 to $89.00 depending on the wattage, size, and whether the supply is UL listed or not. Always try to obtain a UL listed supply.

I must emphasize the importance of checking input power to the supply. If you had the supply cover off to check the fuse, set your meter to 120Vac. Using the case as ground, power up and carefully take a reading on the line input side of the fuse (or the 120V line coming into the supply). If you don't measure an input voltage, check those cables again. Power cords do open occasionally.

If the power supply is producing the correct voltages

If the power supply has a correct +5V output, take a reading off of the yellow +12V line. This reading will normally be just above or below +12V. If this line proves okay, then (power down) locate the mother board power connectors P8 and P9 (Figure 5). Make sure both of these connectors are seated firmly into the mother board. These two connectors will always be positioned so that the black

ground lines (usually two or more) on each connector are side by side.

On these connectors, most have a red +5V, yellow +12V, white -5V, (white is -12V on some) and violet or blue -12V. You can insert a small length of bare wire down each connector (where the wire from the power supply enters the back of the connector) you wish to check. Be sure not to short any two lines together.

Using the logic probe

If all the lines indicate correct voltages, power down and hook up your logic probe according to its instructions. I usually operate mine from an independent +5V supply. However, you can connect the black lead to the power supply case, and the red lead to +5V at one of the power connectors +5V (red) lines. Use care at this point. Be sure to use precautions to avoid electrostatic discharge damage before proceeding any further.

Once your probe is working, (you can test it by touching the tip to any ground with the power on), locate any DIP chip on the mother board. Look the chip up in one of the many reference manuals if you have one. Locate the Vcc or other +5V pin and carefully touch the probe tip to this pin. Never short two pins with the probe tip. (You can burn tiny foils on the motherboard.) All you are doing is trying to determine if any voltage is getting to the chips.

If you don't have a chip reference, just probe each pin on the chip. If you light the probe with some highs and lows, then some power is getting to this chip. You can locate and check other chips the same way, but use care, especially with the surface mount (flat pack) chips. As you're working, look over the board to see if anything looks out of place. Also look for burned places on the board, especially those in close proximity to P8 and P9, the main power connectors. If power is not getting to the chips, and the power supply seems ok, you will probably need to replace the mother board.

Power-on self-test

Many IBM compatibles produce a POST (power on self test) when first turned on. This POST performs a basic diagnostic on the CPU, the RAM memory, the I/O ports, and other hardware. Although limited, if POST finds a problem, it may produce error codes on the screen, or beeps from the computer's speaker, or both. It could mean nothing more than a loose plug-in card or connector or a corrupted CMOS RAM. However, it could indicate a faulty mother board. Since POST codes vary widely from manufacturer to manufacturer, it's difficult to determine what the beeps or codes mean. You might look in the back of the books that came with your diagnostic software. They list many POST codes from many of the most common manufacturers.

At this point, you've checked all wiring and connectors and found no shorts. You've made sure that all plug-in boards are firmly seated into the mother board. Plug in a POST reader card (power off) and follow the manufacturer's directions. The codes displayed on the card should show the problem. If not, the next step is to install the ROM POST chip(s) as outlined in the instruction manual. If either of these diagnostics indicate the problem (probably with the mother board), proceed to correct the problem, which is usually a replacement of the mother board, I/O card, or re-setup of the computer's CMOS RAM.

Try disconnecting the problem

If a computer is not working correctly, generally beeping more than twice (maybe pausing then repeating the beeps), and firmware diagnostics do not find the problem, you might try a crude but effective procedure that I use occasionally. With the computer off, unplug one item, then turn the power back on to see if the beep remains. Power down, plug the item back in, then unplug another; then power back up and listen for the beep. This technique is both fast and effective.

I power down and start with the hard disk and floppy disk I/O card(s). Unplug them from the mother board and listen to see if the beeps stop or change. If they do, you may have found the fault. If the beep continues unchanged, then power down and plug them back in, and unplug the monitor card. Power up again to test. Continue this until all plug-in cards have been checked. This will often lead you to the problem. You might even try unplugging the ROM chips, RAM chips, or modules, any other plug-in chips, including the CPU (if a plug-in type).

Remember to power down, unplug, power up, see if any change occurred, power down, then plug in the chip or module you removed. Also remember to use a static strap when removing or replacing chips. While the chip is out, place it on a conductive surface, such as the conductive foam that static-sensitive ICs come in or a piece of aluminum foil. Never touch the pins on any chip while it is removed.

Determining what's in the computer

Most of the other computer hardware problems will be such that the computer will boot, but, it will not operate correctly when booted. Many problems related to hardware can be quickly located using programs that check the computer and provide a readout of the computer's composition, and diagnostics. My procedure is to place a disk with the diagnostic program *PC PROBE* in drive A: and attempt to start it from there. Using PC PROBE, the first thing you want to do is to look at the system and to see what it is composed of. Under the Info menu item select "System Info" and proceed to look at the system information that the software has determined. For example, if the diagnostic software shows no hard disk when one is present, you may have already found the problem. In this case, an indication of no hard disk present, the CMOS backup battery is probably dead or weak.

You might notice less memory indicated than the computer has, thus meaning a bad RAM chip. You might also notice that a monochrome monitor is indicated, when you're looking directly at a super VGA monitor. If this is the case, the VGA BIOS chip may require setup, (usually a program located on the hard disk under a subdirectory such as TVGA or SVGA or VGA).

Using the diagnostics

If this information does not indicate a problem, select the diagnostics menu. You will start with "Select Test Mode," or similar step, from the diagnostic menu. When open, this window will allow you to select single test or batch test. Try the single test first. Run all of the tests except the memory test and the drive test. If no problem shows up, run these tests again. If no problem shows up this time, run the memory test.

If after running these tests, no errors are indicated, then the problem is most likely a hard disk or software problem, or possibly a CMOS SETUP problem. Run a good hard disk diagnostic program to

List of companies that provide diagnostic software

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

Jensen Tools
7815 South 46th St.
Phoenix, AZ 85044-5399
800-366-9662

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

Ontrack Computer Systems, Inc.
6321 Bury Drive
Eden Prairie, MN 55346
800-752-1333

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

The Software Labs (Shareware)
100 Corporate Point Suite 195
Culver City, CA 90230-7616
310-410-2030

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

Tech Assist Inc.
5590 Ulmerton Road
Clearwater, FL 34620
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

check the hard disk. General diagnostics are good to locate the problem area, while specific diagnostics will help pinpoint and correct the problem.

If the hard disk diagnostic indicates that there are no problems with the disk drives, then I will proceed to run service diagnostics. Each of the service diagnostic disks that I use is specific to a specific CPU. There is a separate disk for an XT, AT-286, 386, 486, or PS2. These diagnostics are more specific than the general diagnostic software, more technical, and generally more powerful. I use these diagnostics to run extensive tests on the hardware. Service diagnostics also contain utilities that will pay for the programs in a short time. Some clone computers have a CMOS RAM that is difficult to set up using the built-in setup program. Service diagnostics has a utility that will do a nice job of setting up such a CMOS RAM. In fact, it can setup some segments of the CMOS that cannot be setup from within some of the older on-chip setup programs at all.

Software diagnostics and firmware will not locate all problems, but you can be sure many of them will be found easily with the proper diagnostic software and firmware tools.

Combined problems

Combined problems occur when both software and hardware problems exist at the same time. A hard disk controller card malfunction, for example, could also cause damage to programs loaded on the hard disk. CMOS RAM setup problems from a dead CMOS battery is also a combined problem. A crashed hard disk from dropping the computer could have caused

severe mechanical damage, as well as file and data loss.

You should approach the multi-symptom computer with a *hardware first, software second* approach. Get the hardware working so you can take a closer look at the software.

Run your hardware diagnostics as necessary to locate and correct any hardware problems. For example: replace the CMOS battery; replace the controller card; check the hard disk to see if bad areas can be locked out; and recover any data or replace the hard disk as the need may be.

Now that you have any hardware problems working to your satisfaction, proceed to locate and correct any software problems. If you have data loss, always try to recover as much as you can before proceeding with a full or partial format. If some hardware problem has written over some EXE files, try reloading (or re-installing) them. With a little patience you can restore the system to optimum performance with minimal loss of data in most cases.

Putting it all together

Common sense will carry you a long way in computer service. Learn all you can about computers and DOS before you attempt service. Some could ask how anyone could learn or keep up with computers or DOS as fast as they change. You can't really, but you can learn the basics about computers and DOS, then learn how and where to locate the advanced information when you need it.

For example, I carry a copy of the MS-DOS 5.0 manual as part of my field service kit. I also carry all of the diagnostic user's manuals that came with my software and firmware diagnostics.

A few of my special customers have programs such as Word Perfect and Lotus 123. I have reference manuals on these programs and others. When the call comes in that "I can't get WP to print my envelopes," I proceed to lug my WP reference manual on site. I sit, read, and experiment, until I locate the problem. Guess what? The next time I encounter that problem, I don't need the manual. That's called getting paid to learn.

To date, I've never had a customer complain about my looking it up in the book. In fact, many will seem amazed when you pull a 500-page technical manual out of your service kit. In the background you often hear comments like "that guy really knows computers," all because I pulled out a manual. People are just about as afraid of books as they are of computers.

On my bench, I have a few spare mother boards, I/O cards, a couple of floppy disk drives, a spare monitor and card, and a couple of old hard drives that work. These parts are not for sale. I occasionally use them to check and see if my diagnostics were correct. For example, your diagnostics indicates that the problem may be the hard disk. It takes but a few minutes to unplug the suspected hard disk (still mounted in the case) and plug its connectors (from the controller card and power supply) to a known good hard drive. If the known working drive operates with the system while the suspected drive did not, then you have truly located the problem.

With a little care, you can take a known working mother board and carefully unplug all necessary connectors and cards from the suspect mother board (still mounted in the computer case) and plug them into the good one to see if everything else is working. If all else fails, just swap parts until the thing starts working.

As you can see, computer service is just like all other service jobs. You do whatever is necessary to fix it at the least cost possible. Computer service can be a profitable addition to your business. ■

Will Total Quality Management work for you—Part eight

By John Ross

This is the eighth part in the Business Corner series on W. Edwards Deming's Total Quality Management.

TQM Point 8

Drive out fear so that everyone may work effectively for the organization. Fear is one of the most destructive of human emotions. Point 8 of the TQM philosophy accurately maintains that fear causes problems with both quality and production in the workplace. On the management side, the notion of "job security" may allow a sense of paranoia to block the sharing of ideas or information. Many employees are often afraid to ask for instructions regarding their work, or to say that they need more resources. Finally, fear of argument or reprimand often prevents employees from talking openly about on-the-job problems.

Several years ago, an employee of a consumer electronics service company arrived at a customer site and, after several minutes realized that he didn't have the parts needed to complete the service procedure. Already behind schedule and not wanting to tell his superior that he hadn't packed the proper parts, he wrapped aluminum foil around the blown OEM fuse. After all, he had already endured a verbal reprimand for the same type of oversight, and he really did intend to return the next day with the proper fuse.

Unfortunately, as often happens, the employee didn't go back to the site because of a heavy work schedule and personal plans.

As you might already suspect, the original intermittent power supply problem surfaced to start a fire in the customer's home. Not surprisingly, the customer sued the service company and the employee lost his job. The publicity surrounding the case eventually forced the company to close its doors. Among other things, fear turned an easily preventable situation into a horror story.

Abolishing fear in the workplace can and should be an everyday responsibility for management. Several methods that address both employer and employee fear exist. Certainly, avoiding on-the-job friendships might seem wise in the context of maintaining distance and power. However, every employee experiences a wide range of personal problems that may affect their job experience. For managers and supervisors, having empathy for the human side of employees may be the first step toward better management and to providing support at the right time.

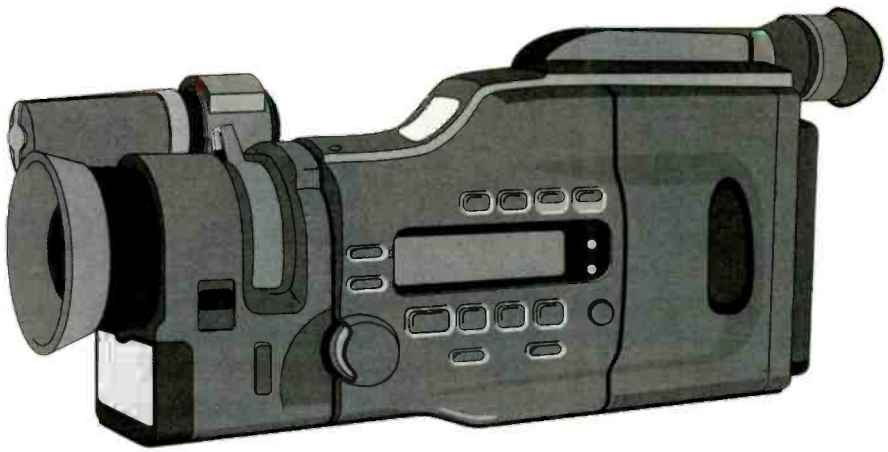
In the last "Business Corner" article, we saw how a person's position can block the type of communication that every organization needs. The manager in that situation did not realize that problems existed in his department. Crossing the informal and formal barriers that exist between supervisors and employees often allows both parties to gain an understanding of the roles that each play. In some instances, managers or supervisors may want to join their employees as they work through the day. In other instances, managers or supervisors may want to involve their employees in the decisions that affect the well-being of the organization. Each type of occasion will provide opportunities for both the manager and the employee to build a healthy working relationship and solid communications.

Unquestionably, ridding the workplace of fear can provide many advantages. From a purely financial point of view, confident employees are more productive and efficient. As the "blown fuse" example shows, fear will often result in some very tangible costs for both the employer and the employee. Obviously, the employee lost his job while the employer sacrificed money. The true long-term cost of fear, however, cannot be measured. Fear, caused by a lack of understanding or closed-minded attitudes, can feed irrational behavior and can breed disloyalty. In the example, both individuals lost the respect of their peers and customers. Thus the incident teaches a crucial lesson. While a fearful employee never stays long, a feared manager is not likely to prosper. ■

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

Camcorder servicing

By The ES&T Staff



For those who are new to camcorder servicing, and for those who have been servicing camcorders for some time, we'll start with one basic statement: a camcorder consists of both a camera and a videocassette recorder. It's easier to understand and service these products if you can get a picture of the camcorder as a whole, and appreciate just what a complex product it is. Its electronics and mechanical systems are similar to those that you'd find in a VCR, and its optics are like those that you'd find in any camera, and include the electronics circuitry and mechanical gadgets that adjust the optics for such functions as zoom, focus and autofocus. In addition, a camcorder also contains a small video monitor, called the electronic viewfinder or EVF, that allows the user to see exactly what he's capturing on film.

Of course, there is an important subset of circuitry that a VCR contains that a camcorder does not: a tuner.

It's impossible to do justice to camcorder servicing in a relatively brief magazine article, so here's what this article will do:

- explain the functions of some of the circuits that are unique to camcorders,
- emphasize the power circuits, and describe some of the possible failure modes caused by problems in the power circuits. This article will be based on the Hitachi VM-2400 video camcorder. See the Profax schematic diagrams in this issue for the inside story on this camcorder.

The sensor

One of the problems in dealing with new technology, such as camcorders, is the difficulty that design engineers have in coming up with terminology that is descriptive of the functions performed by a given component or circuit segment. So, engineers who work for different manufacturers, even within "Japan, Inc.," may call the same things by different names. Or, even if they call things by the same name, the technical literature from different manufacturers may place different degrees of emphasis on the terms.

For example, in the service manual for the Hitachi VM-2400, the circuits and components that are used to convert the image formed by the camera lens into an electrical signal and condition it so that it can be processed by the signal processing circuitry is called the "sensor." Flipping through the manuals of other manufacturers showed that while some seemed to call it the sensor, others either did not, or simply did not employ that terminology.

Another possible source of confusion here is that camcorders have, as do VCRs, other totally unrelated sensors, which sense excessive moisture (dew sensor), the end of tape, and other conditions that warrant shutting down of the mechanisms.

In this camcorder, the "sensor" is the image sensor, which primarily consists of the CCD imager (IC001), the sensor driver (IC005), the pre-process circuits (IC003) and other support circuitry. All of this circuitry is located on the sensor PCB.

The CCD

The beginning of the entire process of recording a scene using a camcorder is the conversion of a visual (light) image to an electronic signal. In most consumer camcorders, that's accomplished by using a charge-coupled device array (CCD). A CCD is a device that outputs an electrical signal when light falls on it. A typical two-dimensional camcorder CCD array may be able to generate thousands of pixels (picture elements).

The picture information signal generated by the CCD is then transmitted to the pre-process IC where the video signal is conditioned and separated into the luminance (brightness) and chrominance (color) signals.

These signals are sent to the process section where they are processed, then output to the main luminance/chroma section, then ultimately to the video head where they are recorded onto the tape.

Troubleshooting the camcorder

In any system as complex as a camcorder, there are literally hundreds of things that can go wrong and cause improper operation. Some of these things may cause little more than slight misadjustment of the color, or a little noise in the picture. Other things may cause the VCR to cease functioning altogether.

In this article, we will focus on the power generation and distribution circuits in the camcorder. Here are some steps to take when you run into a camcorder problem.

Camcorder doesn't operate at all

The circuitry described here may be found in this month's Profax.

The power for a typical camcorder is supplied either from a charged battery or from an external power supply. There is no power supply circuitry, as such, on a camcorder. That is, the circuitry that steps

down the ac line voltage rectifies and regulates it. The camcorder is dc only.

When the operator is using the camcorder in portable mode, the power comes from the battery. When the camcorder is plugged in, the power is dc from the adapter. The adapter is where the voltage transformation, rectification and regulation take place.

Power for the various functions and circuits of the camcorder takes a tortuous route. The raw B+ comes either from the battery, via the dc light control pc board, then via a 2A fuse to the system control board for distribution, or via the dc input jack on the system control board, back to the dc light control board, then via the 2A fuse back to the system control board.

In addition to appearing on the system control board, this unregulated 9.6V (A9.6V) is routed to the switching regulator, where it is used as a source for the regulator, which produces several regulated voltages which are used as supplies on the system control PC board, and/or further distributed to other circuitry within the camcorder.

The switching regulator also develops the B+ for the capstan and cylinder. This signal is routed to the main servo printed circuit board.

From there, the cylinder and capstan B+ are routed to the capstan motor drive pc board, and the cylinder B+ is routed to the cylinder motor drive circuits.

The A9.6V is also routed to several other boards, including the trouble sensor board, and the process (encoder) circuit board. From the process (encoder) circuit board, the A9.6V is, in turn, routed to the dc-to-dc pc board. Here this voltage is used as a source of supply to generate all of the voltages for the camera section: C-8V, C15V, C9V and C5V.

When power supply problems occur in a camcorder, tracking down the problem and correcting it becomes to some extent an exercise in following circuit traces, and detective work.

Tracking down power problems

Based on this analysis, it's possible to isolate power problems by performing a little detective work. For example, if the camcorder has power, and everything seems to be operating, but when some or all of the camera functions, such as zoom, or focus, don't operate, there is likely a problem with the dc-to-dc converter.

One possibility is that the A9.6V source voltage is not arriving at the dc-to-dc converter input plug. Check at pin 1 of CN1DD. If there is voltage here, one of the foils on the board may be burned or cracked, or one or more components on the board may be faulty. If there is no voltage at this point, trace the A9.6V circuit back until you find the point where the voltage appears.

If only one of the camera functions is not operating properly, the problem may be that the motor that controls that function is defective, or the voltage that controls that function may be absent. Check the input to the inoperative motor. If the input is present, check the motor. If the input is absent, track back to see where it disappears.

Suppose the opposite is true. If the camera is totally dead, the main power is either not getting to the camera at all, or is being shortstopped somewhere. If the camcorder is being operated on a battery, the obvious steps here are to check the battery, operate the camcorder with a different battery, or operate the camcorder using the ac adaptor.

If the camcorder remains totally dead, try tracing the power path. Check to see if there is A9.6V at pin 4 of the dc control board. If not, is the fuse blown? If there is power here, check step by step until you reach the inputs of the dc-to-dc converter and the switching regulator.

Divide and conquer

A camcorder is a complex device, but its circuits are pretty much neatly divided into functions, and the circuitry for each function is grouped on a single circuit board. The power circuit, on the other hand, snakes throughout the entire system. In general, troubleshooting of camcorder power circuits is accomplished in the familiar manner of starting from a point where the power is absent and moving toward the power supply until you find the point where it is present, or starting from the power supply and moving down stream until it disappears.

Along the way, it helps if you can read the route maps and signposts that the manufacturer has put there for you, such as plug and connector numbers and circuit designations. See the sidebar for some notes on labeling of the interconnections among printed circuit boards.■

A note on the nomenclature

Here are some comments on the camcorder schematic diagrams that might help you navigate around the schematics in this month's Profax while following the circuit descriptions in this article.

Connections among various printed circuit boards is by means of various plugs and connectors. Thus, on the sensor schematic diagram, there's a plug at the lower left, PG002. The notation just below the plug says "to Process (Process) PG102". Below that is notation [P5-14].

All of that information lets us know that this plug on the sensor printed circuit board is connected to a plug on the process printed circuit board, and that the signal from this circuitry is input to the process circuitry. This PC board, furthermore, plugs directly into the process PCB without benefit of an intermediate connector. The notation [P5-14] informs us that the process PC board will be found on page 5-14 of the manufacturer's original document.

In cases where there is some kind of connector between pc boards, the diagram tells you that. In some cases, the connector is permanently fastened to one of the boards and plugs on to the other board at the other end, and in some cases there are plugs on both boards and the connector plugs at both ends.

For example, the dc-to-de converter board in the VM-2400 has a permanently attached connector CN1DD (the DD standing for dc-to-dc), which plugs at the other end into PG107 on the Process pc board. On the other hand, the process pc board has a plug PG104 which connects to a plug on the autofocus board, PG06AF (AF for autofocus), via a connector that plugs into both plugs, CN201 (CN for connector).

Servicing TV standby circuits

By Homer L. Davidson

In order for remote-control TV sets to be able to be switched on using the remote control transmitter, the remote control receiver at the set must be powered, even when the set is turned off. The standby power circuits provide voltage to the standby circuits when the TV chassis is turned off. In other words, the standby circuits are on all the time while the TV circuits are off. Occasionally, these circuits develop problems and must be serviced. Always use an isolation transformer when servicing TV standby circuits (Figure 1).

When the TV "on" button on the remote control transmitter is pressed, the voltage supplied by the standby power supply activates the remote control receiver circuits to enable the chassis to begin operation. When none of the buttons on the remote unit will operate the TV chassis, suspect a defective remote control transmitter. Check the remote transmitter with the IR (infrared) card or remote tester. If the results of this test are inconclusive, substitute another remote to see if it will operate the TV.

If the remote control transmitter appears to be operating normally, suspect problems within the TV standby circuits. If the set doesn't respond when you press the "on/off" button on the remote-control transmitter, possible causes are a defective standby power source, defective remote control circuits or a dead TV chassis. Determine if the TV chassis is dead by using the "on/off" button at the set, or by shunting around the standby circuits.

Standby or TV circuits?

In older remote-control TV sets, the remote-control transmitter actuated an ac energized relay to provide power-line voltage to the TV chassis. You may find dc-operated relays in later standby circuits. Other standby circuits, as in the RCA chopper power supply and Sylvania's standby/full power supply enable the switched mode power supply (SMPS) to activate the standby transistor circuits from the chopper or switched mode power transformer.

Davidson is a TV servicing consultant for ES&T.

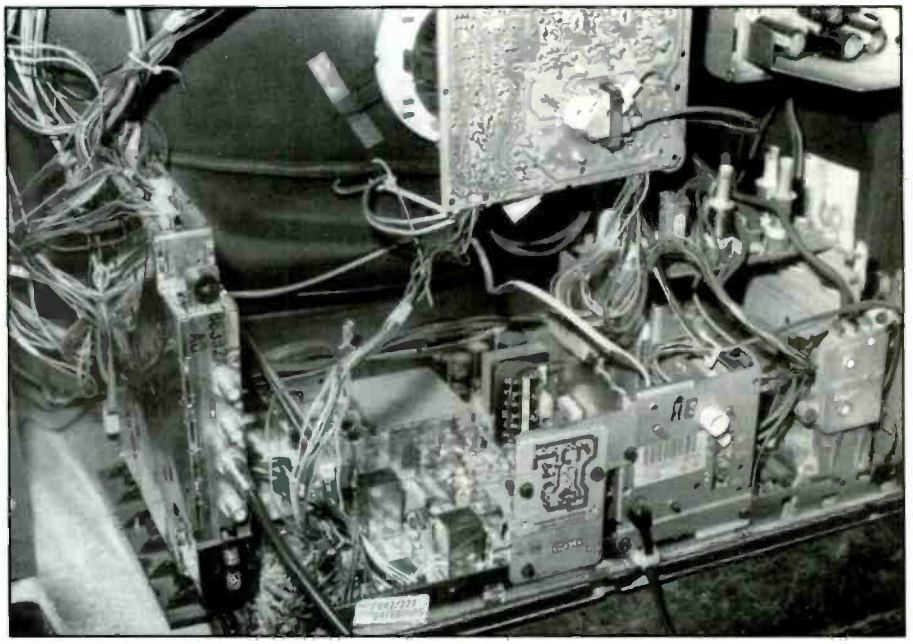


Figure 1. Check over the TV chassis to locate the remote relay and control circuits. Always use an isolation transformer when servicing standby TV circuits.

In some cases, the standby circuits are not included on the TV schematic. You can, however, easily spot the power relay of the standby circuits on the TV chassis. With the TV on the service bench, trace the switch contact wires back to the power line to determine which contacts must be shorted in order to bypass the relay. If there are only two switched contacts on the relay, clip a test lead across the switched contacts to see if ac voltage is applied to the TV chassis (Figure 2). You know that there are problems in the standby circuits if bypassing this relay brings the set to life.

Another method to determine if the TV chassis is alive is to take a power cord with alligator clips, connect it across the bridge-rectifier diodes, and plug that cord into the power line. Look for the degaussing coil and thermistor in the power-line circuit. Make sure that the clips are opposite the common ground and B+ voltage terminals of bridge rectifiers. If the TV chassis still does not come on, the problem is in the TV chassis, not the standby circuits. Often the standby transformer is mounted off of chassis while the standby circuits may be near or included in the tuning circuit board.

Transistor or relay circuits?

In the latest RCA standby circuits, the chopper transformer is on all the time, and the secondary winding provides voltage to the standby circuits via the chopper output circuits. When the chopper output transistor is turned on by the regulator IC, current flows through the primary winding, transferring energy to the secondary winding of the transformer. This pulsating voltage is rectified by a silicon diode and supplies 15V source to the 5V standby regulator (Q4601). The 5V standby voltage is developed at the emitter terminal of Q4601.

In the case of another set, the Sylvania 25/26B1 chassis, the standby power supply is alive anytime the TV set is plugged in. A standby power transformer supplies voltage to a transistor-operated dc relay circuit (Figure 3). A 33V supply provides voltage to the "on/off" relay. In addition to the 33V source, a 10.5Vdc source is fed to the 5V IC regulator (IC303), where the 5V source voltage is developed for use by the microcomputer, IC302.

The 5V source is applied to pin 28 of IC302 and when the set is on, a low signal at pin 1 will keep Q471 off allowing the 10.5V source to forward bias Q472.

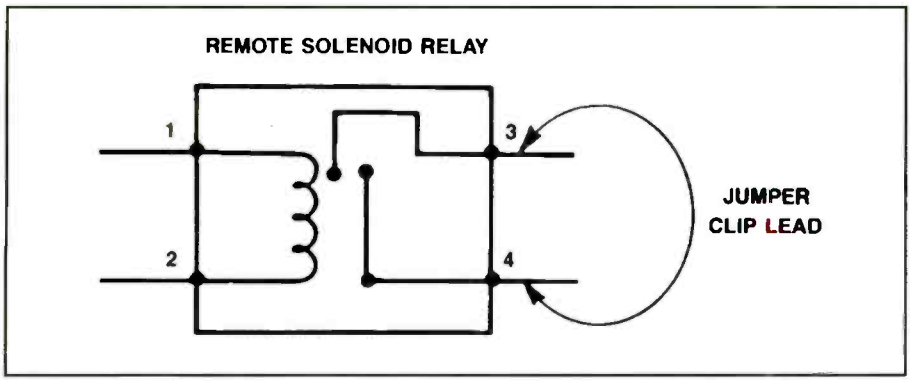


Figure 2. With the TV chassis on the service bench, bypass the relay by clipping a test lead across the relay contacts to determine if the TV chassis is functioning.

Relay K476 is energized through Q472 when the transistor is forward biased.

A high signal from IC302 pin 1 will turn on Q471, taking the supply source to ground, allowing Q472 to turn off. With no voltage applied to the relay, the contacts open, removing ac voltage.

Turn-on methods

Another way to force the chassis to operate, besides clipping around the relay points, is to clip a wire from pin 1 of the microcomputer, IC302, to ground (Figure 4). The Sylvania C9 series chassis can be turned on by connecting across the collector and emitter terminals of the mode switch transistor (Q410). The RCA CTC-168/169 chopper power circuits can be turned on by placing a jumper across the buffer transistor (Q4306).

Standby circuit problems

Problems in the standby circuits may be caused by dirty relay points or an open relay solenoid coil. Clean up the switch contacts with a thin piece of cardboard and cleaning fluid. Fine sandpaper may be used to clean up tarnished silver contacts, but don't use emery, which is conductive. Forcing the switch contacts closed using an insulated pen or a plastic rod, should cause the TV chassis to come on, if the set is not defective. You may have to remove the top plastic cover of the relay in order to do this.

If you measure a voltage across the solenoid coil, suspect that the coil is open. You may find both switching and coil winding terminals on the relay. A quick continuity measurement with ohmmeter across the coil terminals may indicate an open winding. Check the standby voltage source when a relay that checks good will not energize.

The standby voltage source may be low or absent causing the remote circuits to malfunction. Leaky silicon diodes may blow the main fuse or open the primary winding of the standby transformer. Because the secondary winding consists of heavy wire, if there is a heavy overload or if there are leaky components in the voltage source or connecting circuits, the primary winding, which is a lighter gauge wire, may open. Do not overlook a leaky transistor or microcomputer IC. Remember, some standby circuits may perform in cold or hot ground circuits.

Low dc voltage may result from transistor and zener diode regulation. Often

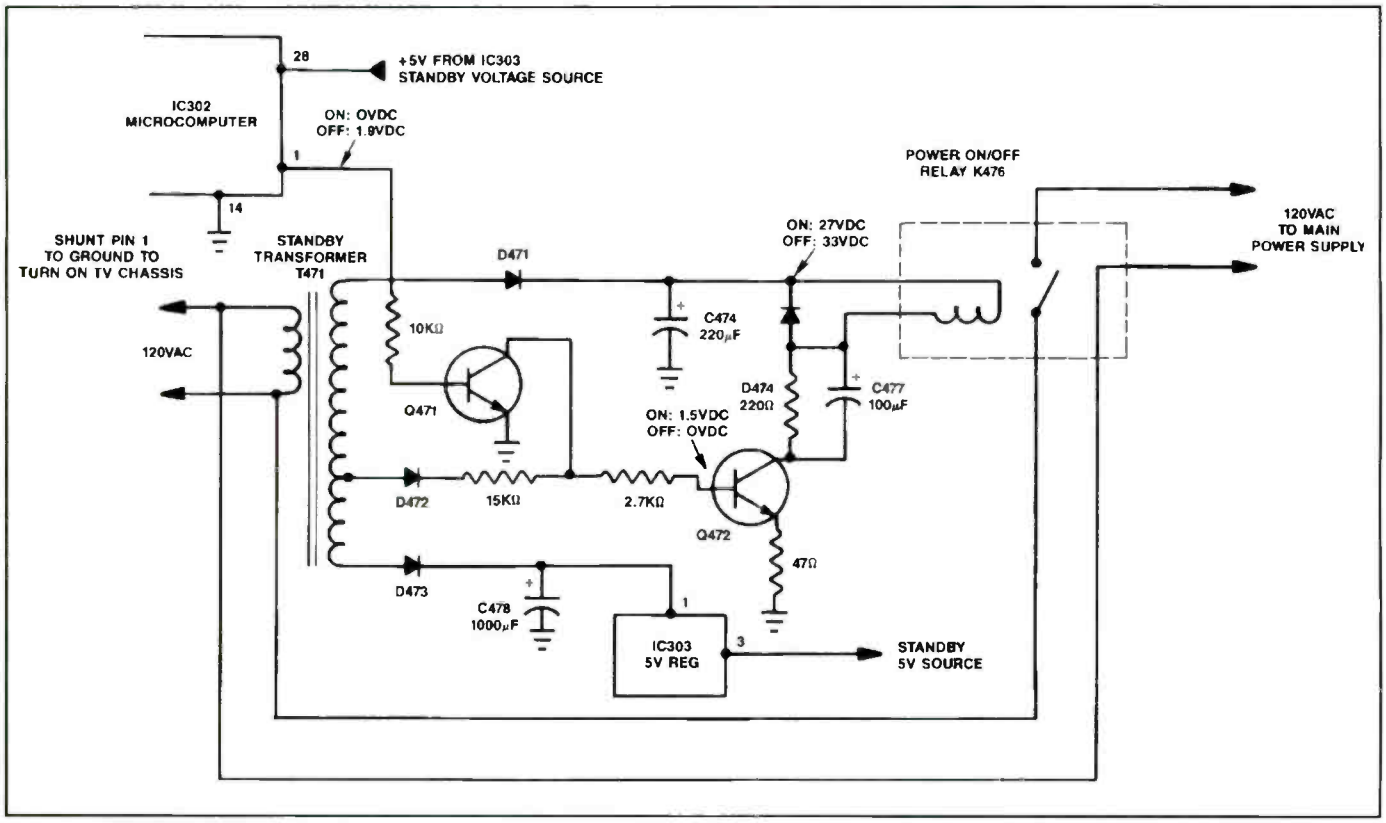


Figure 3. The standby remote circuits within the Sylvania 25/26B1 chassis look like this.

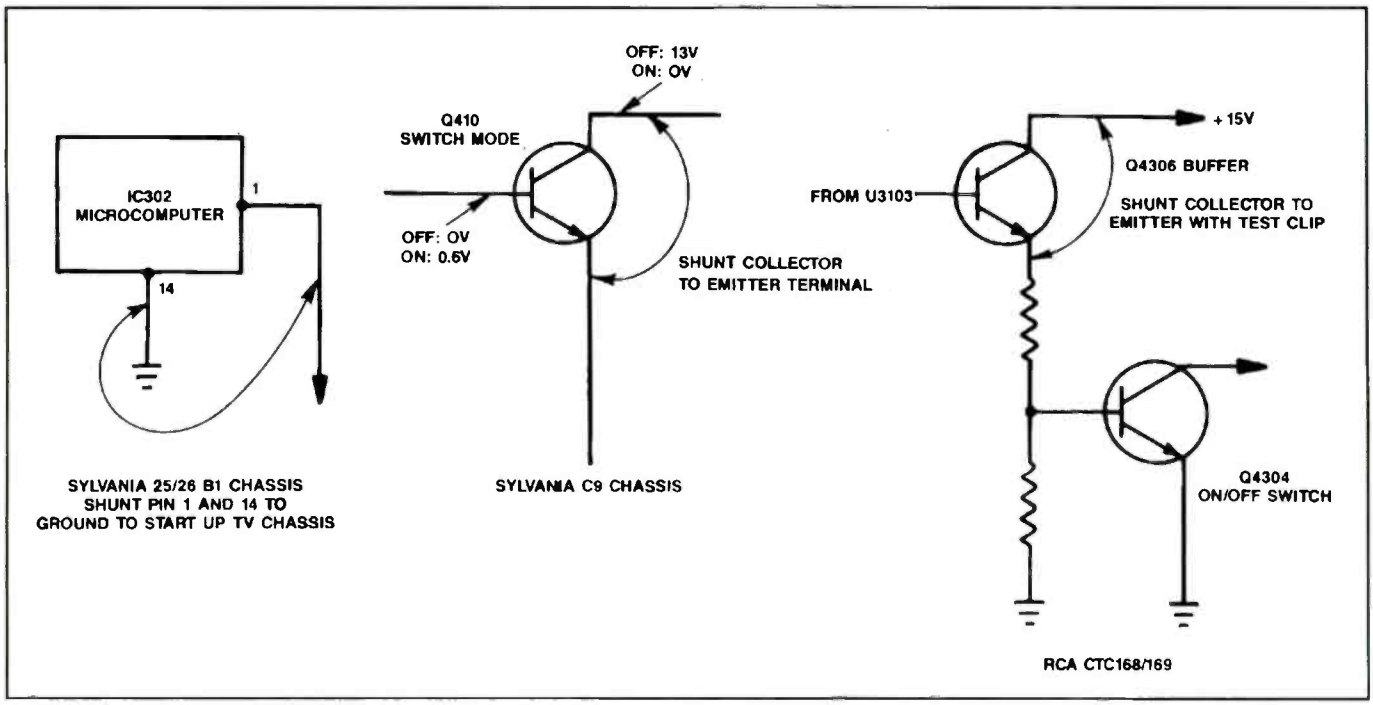


Figure 4. Use one of these methods to start up the Sylvania and RCA chassis with a clip test lead.

zener diodes may overheat and become leaky. Regulator transistors may appear leaky or become open if the dc standby voltage is missing. Do not overlook a low-voltage dc source. Standby voltage test points may be found in some standby circuits. Remember, low or missing standby voltage source will prevent the remote circuits from operating.

Standby voltage source

The standby circuits may consist of a voltage source with halfwave or fullwave rectification. The standby power transformer provides stepped-down ac voltage to a halfwave or fullwave bridge circuit (Figure 5). Standby voltages may energize a relay or provide regulated voltage to transistor, IC and microcomputer circuits. Often, the standby voltage is fairly low, +5V to +12V, to microcomputer or transistor turn on/off circuits. Relay dc voltages may operate from 12V to 20V. Some standby circuits may operate from a 120Vdc to 150Vdc source in chopper or SMPS power circuits.

Silicon diode D101 rectifies the 14Vac voltage to dc and operates relay RL1

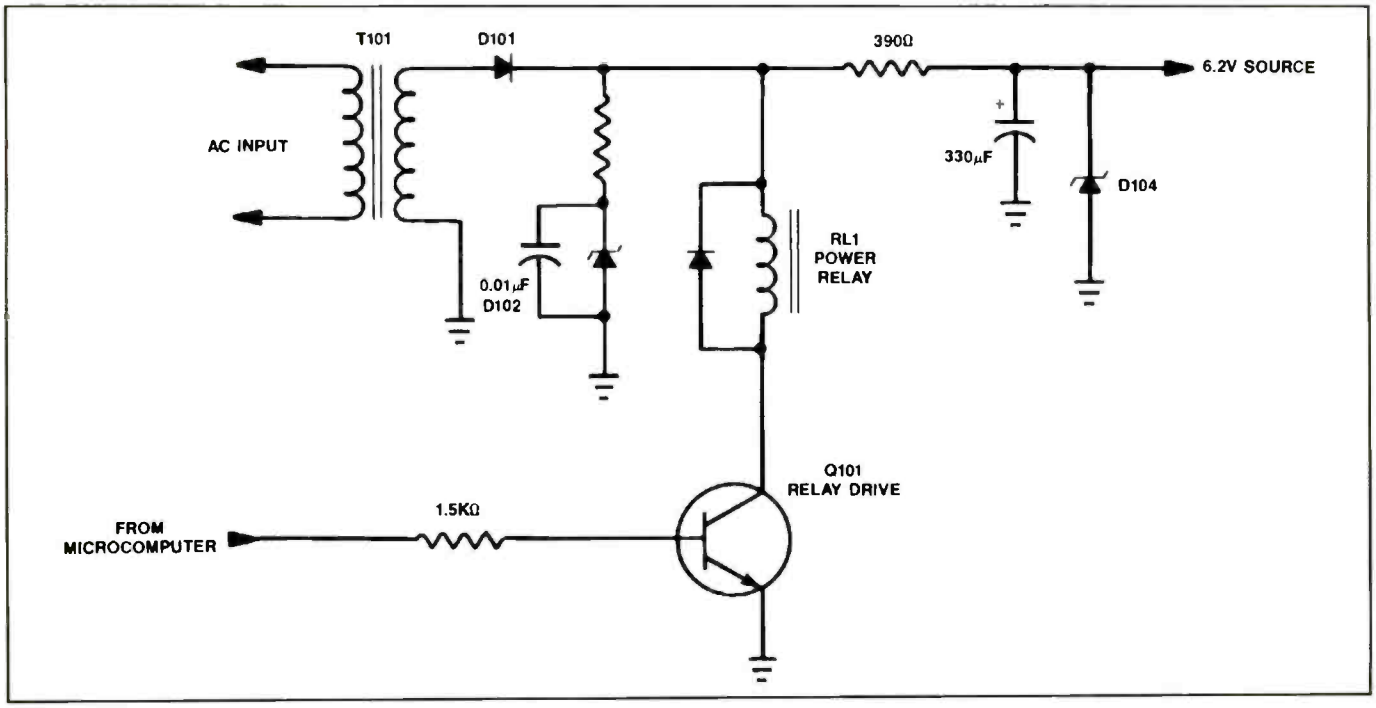


Figure 5. A typical halfwave standby voltage source with standby power transformer and power relay.

when the microcomputer turns on the relay driver or switch transistor. C101 and R102 provide RC filtering in the 6V source. Zener diode D104 regulates the 6V source. D102 provides 14V regulation with R101 (120Ω). The 14Vdc standby voltage source applies voltage across the relay solenoid winding with Q101 to ground. Q101 acts as a turn-on switch or relay driver when turned on by a microcomputer chip. When Q101 is turned on, the collector to emitter terminals form a switch to ground, applying the return voltage to the standby relay.

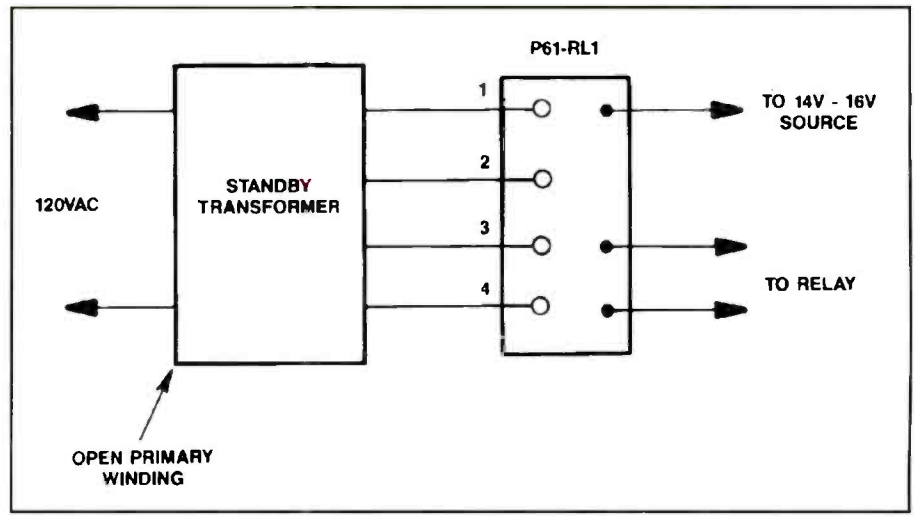


Figure 6. The remote control would not turn the TV on in a General Electric 1313C-2 portable. Diagnosis revealed that the primary winding of the standby transformer was open.

General Electric 13BC-2 transformer

In a General Electric 13-inch portable, the remote control transmitter would not turn the TV on. I located the standby relay and clipped a jumper wire across the relay points. When the power cord was plugged in, the TV sound and picture came up at once. The remote problem was definitely in the standby circuits or in the remote transmitter.

When the remote transmitter tested normal, I concluded that the trouble must be in the TV chassis. After locating the standby transformer, I found the standby power supply on the BC interface board. I measured the voltage at the main filter capacitor C5 (1000μF). It was zero. A check of the schematic revealed that all voltages of the tuner control came from terminal strip PE247, supplied by the BC interface board.

Silicon diodes YO1 and YO3 checked normal according to the diode tester. A quick test across the diodes showed that the ac voltage was zero. I shut the set down and made a continuity check of the secondary transformer windings at RL1 on the interface board. They were good. When I measured the primary winding with the ohmmeter, this winding was open (Figure 6). Replacing the standby transformer solved the problem.

No 12V standby voltage: Sharp 13H44B portable

The remote control would not turn on a 13-inch 13H44B Sharp color portable TV, so I pulled the chassis back to locate the standby transformer and circuits. Power transformer T701 is mounted off of the PWB-F board containing the standby power voltage and tuning control circuits. The primary winding contains pc wiring RE1 and RE2 and the secondary winding ac voltage is found at RE4 and RE5 of the PWB-F board.

Voltage across the main filter capacitor (C1604), in the standby circuits, tested around +20V (Figure 7). This dc voltage feeds through R1601 to the collector of the 120V regulator transistor (Q1601). Voltage at the emitter terminal was zero, with higher than normal voltage at the collector terminal. Diodes D1605 and ZD1601 tested normal. Often, when a leaky or open voltage regulator is found, the base diodes appear leaky.

I tested Q1601 in-circuit with the diode junction test of the DMM. It appeared to be open. I tested the transistor once again after removing it from the chassis. It was defective. I looked up the 2SC1983 regulator in the semiconductor manual and found that Q1601 could be replaced with

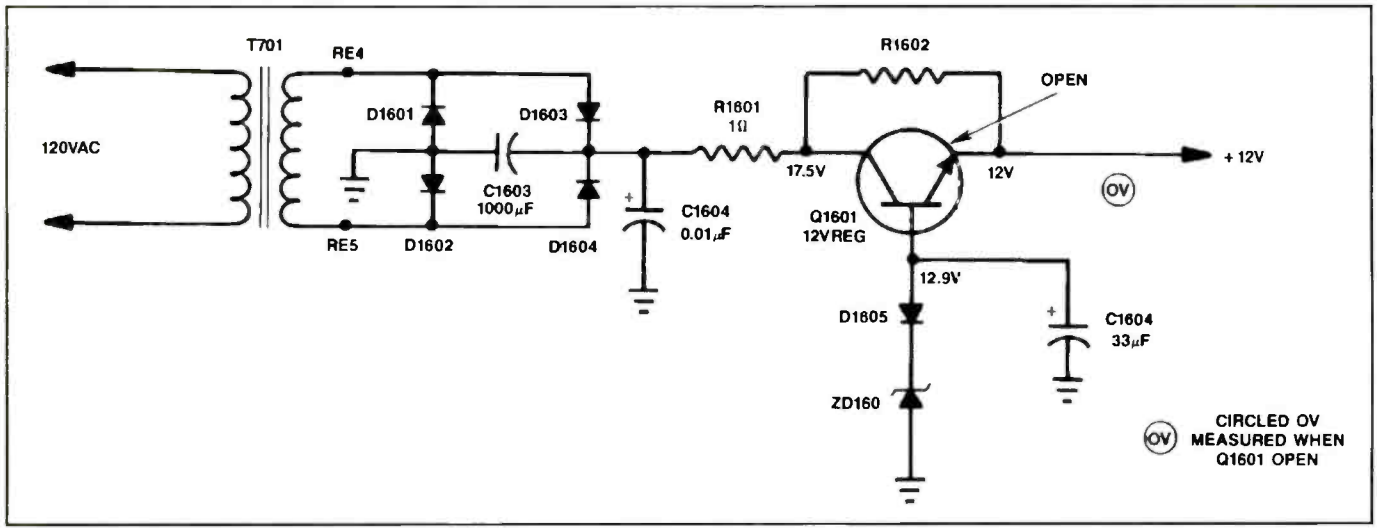


Figure 7. The voltage regulator Q1601 was found open in the standby 12V source in a Sharp 13H44B TV.

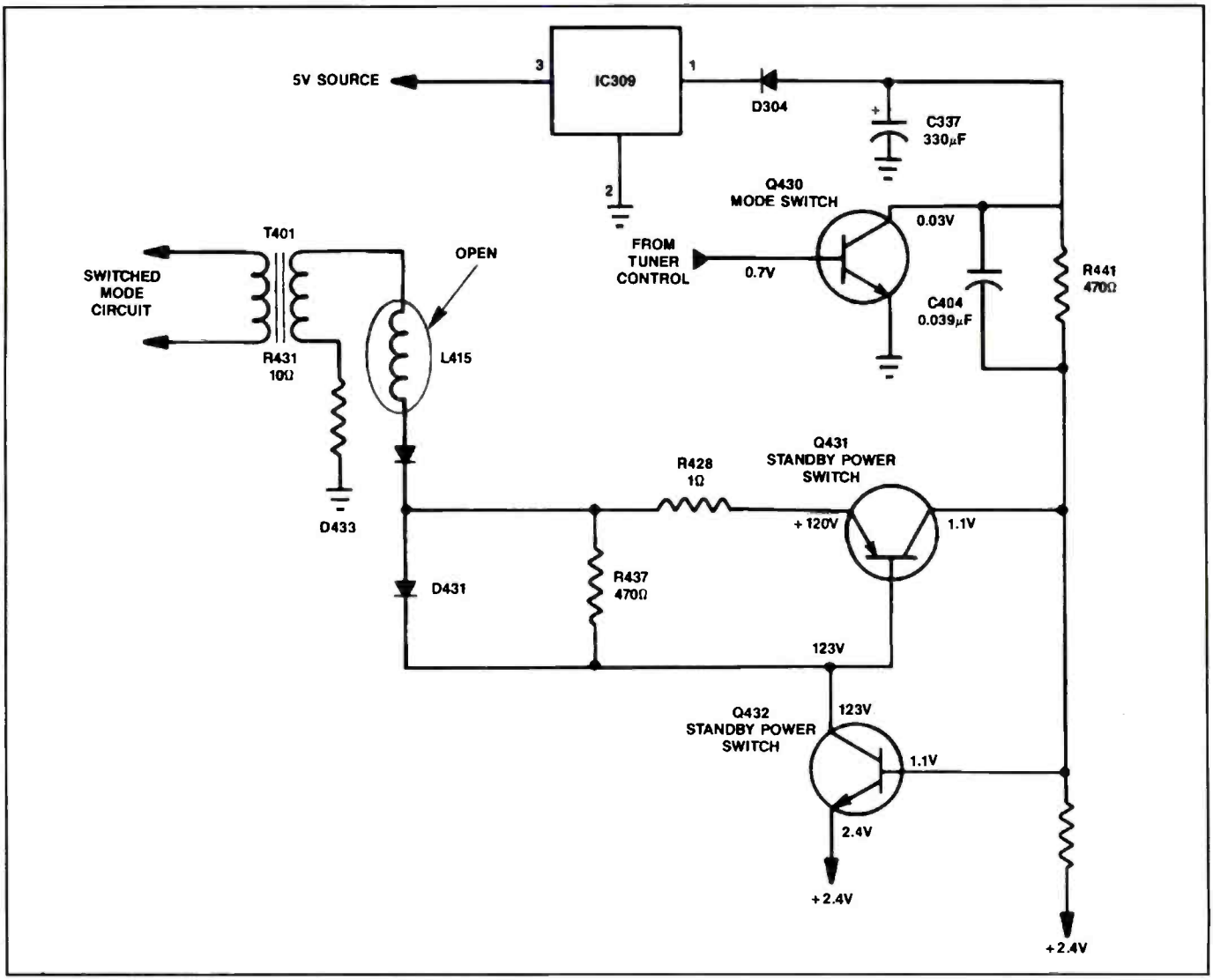


Figure 8. Extremely low voltage at the emitter terminal of Q431 was caused by open coil L415 in the 120V source of the standby power switch transistor.

a SK3929 universal replacement. After I installed the replacement transistor, the 12V standby voltage source came up and the set now operated normally.

Philco 20C805: No remote action

This 20C805 Philco 20-inch TV has a standby and full-power circuits like those found in Sylvania's Switched-Mode Power Supply (SMPS) circuits. When the set is plugged into the power receptacle the SMPS begins running in the standby mode. This particular set remained inoperative, no matter what button I pressed on the remote control transmitter.

I began my diagnosis by locating the switch-mode transistor (Q410), standby power switch (Q431), and standby power switch (Q432) in the front center of the TV chassis (Figure 8). I connected a jumper wire across the collector and emitter terminal to turn on the TV set. The chassis began to operate.

Voltages measured on Q431 were very different from the specifications. The emitter voltage should be rather high, but was very low. I checked R438 (1Ω) resistor and D433 and both were normal. The ac voltage on the anode of D433 was zero, as was the dc voltage at the cathode terminal. The cause of the problem was an open coil, L415. L415 couples the ac voltage to the silicon diode from the switched mode power circuits.

No remote operation in an RCA CTC166

In an RCA CTC166 chassis the remote control would not operate the set. The 5V standby source was very low. In another CTC166 chassis, the 5V source was missing entirely. When the standby power supply voltage is extremely low, look outside the standby voltage sources to find the overloaded component. The IE preamp IC (U3401) was found leaky in both of these cases.

Conclusion

When a TV set that has a remote control fails to respond to commands from the remote control transmitter, first check the standby voltage source for low or missing voltage. Check the diodes, filter capacitor, voltage regulator transistor and zener diodes in the standby voltage source. Look outside the voltage source, when the voltage is extremely low to find a leaky component overloading the standby circuits. Locate the standby transformer or relay connected to the standby remote circuits when a schematic is not available.

Test Your Electronics Knowledge

TYEK revisited

How much do you remember from previous TYEKs?

By J.A. Sam Wilson

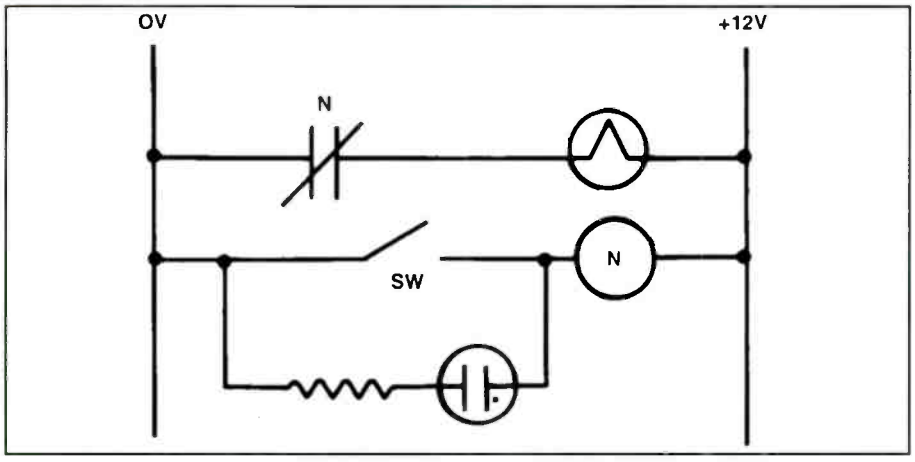


Figure 1. Will the neon lamp in this circuit glow when the switch is opened or closed?

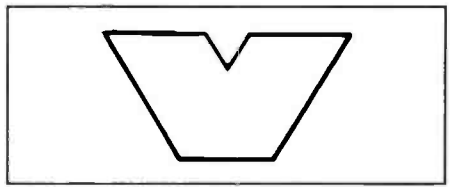


Figure 2. What does this symbol stand for?

The questions in this issue were taken from previous TYEKs.

1. Which of the following is a measure of power?
   A. ergs
   B. joules
   C. joules per second
   D. erg-seconds^2

2. The period [T] of a certain pure sine wave is 0.001 second. Can you find the second harmonic of this waveform?

3. Regarding the circuit of Figure 1, the neon lamp will glow when the switch [SW] is
   A. opened.
   B. closed.
   C. Neither choice is correct.

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

4. Everyone knows that a strain gauge measures strain. Or, does it? Do not confuse the terms stress and strain. Which of the following is correct?
   A. Stress is the force that produces strain.
   B. Strain is the force that produces stress.

5. Is the following statement correct? The current gain of an emitter follower is less than one.
   A. correct
   B. not correct.

6. What does the symbol in Figure 2 stand for?

7. Which of the following electric motors is likely to be damaged if it is operated without a mechanical load?
   A. step motor
   B. shunt-wound motor
   C. series-wound motor
   D. capacitor start motor
   E. synchronous motor

8. Anything you do to increase the gain of an amplifier will automatically decrease its
   A. distortion.
   B. cost.
   C. phase shift.
   D. bandwidth.

9. The reciprocal of reactance is
   A. susceptance.
   B. conductance.
   C. elastance.
   D. impedance.

10. A certain analog meter is rated at 100,000Ω per volt. The amount of current required for full-scale deflection is
   A. 100 microamperes.
   B. 50 microamperes.
   C. 25 microamperes.
   D. 10 microamperes.
   E. 1 microampere

(Answers on page 62)

Environmentally-safe spray cleaner and preservative

Introduced by *Caig* is an environmentally-safe aerosol for its ProGold product line. ProGold's active ingredients are formulated to clean, lubricate and protect gold, base metals and other precious metal connector surfaces without the need for carrier solvents for dilution or cleaning surfaces. The spray container provides short bursts of 100% concentrate of the product via a precision metered valve.

The substance is a non-abrasive/non-corrosive formula that conditions gold connectors, enhancing the conductivity characteristics to efficiently transmit electrical signals. It coats the entire connector surface, providing protection from abrasion (insertion resistance) and wear, arcing and RFI, tarnishing and atmospheric contamination. Pretreating with the product will reduce intermittent connection problems, increase transmission quality and product reliability according to the company.

The cleaner/preservative is for use on edge connectors, batteries, interconnecting cables, plugs, sockets, switches, relays, and other metal surfaces, etc.

Circle (100) on Reply Card

DOS technical support

An updated release of TechSource for DOS, a hyper-text database resource published using the Folio Views engine, has been announced by *Ontrack Computer Systems*. Designed for use by technical support and computer service technicians, the software provides information about hardware, software, product histories, field reports, and operating systems—both current and out-of-date versions—and more. The product now includes Disk-Source, a hard disk drive and controller encyclopedia, and System Source, a reference to computer system boards including jumper settings and BIOS information.

This product provides information for people working in DOS, Novell, Unix, and Macintosh environments. Functions include product history, as well as hardware, software, and operating system information. Hardware information includes various jumper settings, and hardware and software interactions. Software information includes features, limitations, configuration details, and hardware and software interactions.

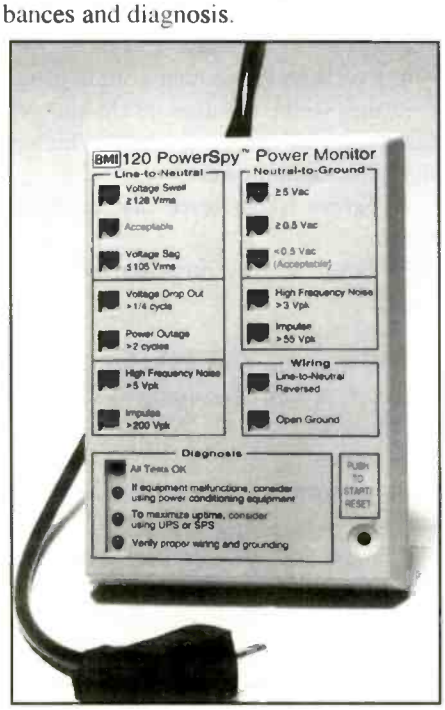
DiskSource, which is also available as a separate product, contains technical specifications on more than 3,000 hard disks, with drive jumper settings on over 1,200 disk drives and 400 controller cards, plus more than 60 BIOS charts.

SystemSource, available as a separate product, is a comprehensive collection of technical information on more than 500 system boards from more than 35 different manufacturers.

Circle (101) on Reply Card

Power monitor

BMI's new 120 PowerSpy power monitor detects wiring errors and all power disturbances on line-to-neutral and neutral-to-ground voltage. Users plug their sensitive load into the unit's stacking plug, then into the outlet. Front panel LEDs light to indicate power disturbances and diagnosis.



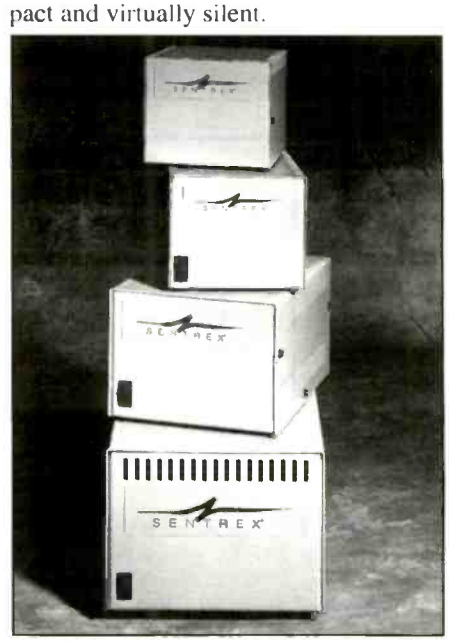
If a power disturbance occurs, a latching red LED lights and stays lit until the user presses reset. At the same time, the appropriate diagnosis LED also latches on, indicating suggested actions, such as installing power conditioning. If power fails, the monitor stores LED settings for 48 hours.

The product detects wiring errors, sags, swells, impulses, waveshape faults, high-frequency noise, and power failures.

Circle (102) on Reply Card

Isolation transformer

Shape Electronics has announced the availability of Sentrex isolation transformers, offering protection of electrical equipment from the harmful effects of noise, spikes and surges on power lines. The transformers are lightweight, compact and virtually silent.



Isolation transformers may be used in any application that is vulnerable to damage from electrical noise on power lines, including factory automation equipment, mini-computers, automated teller machines, laboratory equipment and home entertainment systems. The transformers are especially well-suited for generator-powered applications since they are not affected by frequency fluctuations, and loads with high inrush current such as laser printers, copiers and motors.

This device acts as a barrier, isolating equipment from the contaminants of the power utility, such as spikes and surges. This "isolation" reduces the electrical

(Continued on page 41)

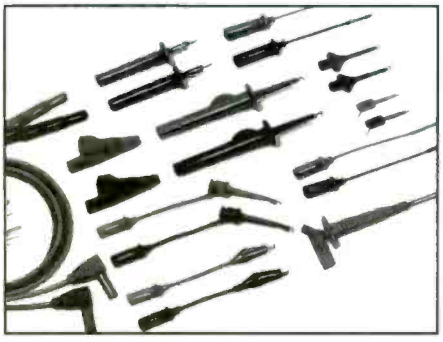
 (from page 28)

noise and virtually eliminates the noise on the ground, stopping "ground loop" currents and improving the overall operation and reliability of the equipment being protected. A built-in solid-state MOV device offers additional electrical surge suppression.

Circle (103) on Reply Card

Modular test lead kits

The 9100 series kits from *Probe Master* are available with up to 25 different modular plug-in accessories, such as sprung hooks, pincer hooks, wire piercing hooks, extender probes, alligator clips, and five-way telephone clips. The leads are designed for long term reliability with flexible strain relief, 440 strands of wire and silicone insulation. They are softer yet impervious to hot soldering iron burns. Kits are offered with straight retractable shrouded banana plugs or right angle fixed shrouded banana plugs.



Circle (104) on Reply Card

Air-power spray bottle replaces conventional aerosols

Tech Spray, Inc. has introduced The Spritzer, a new air-power spray bottle that provides an environmentally conscious alternative to conventional aerosols.

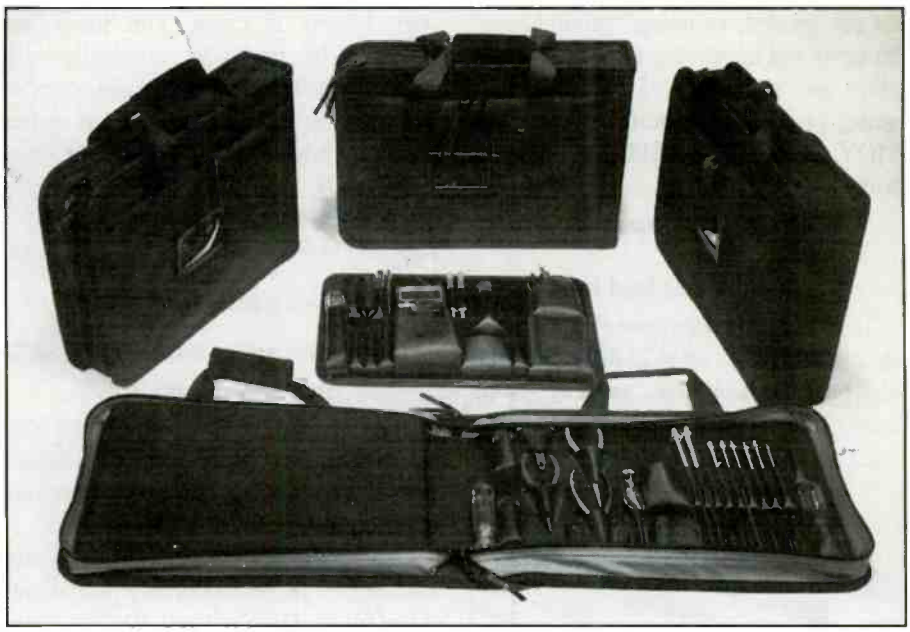
The refillable, reusable spray bottle uses only compressed air as a propellant. After filling The Spritzer with liquid and replacing the lid, a simple pump built into the base of the polypropylene bottle is used to pressurize the unit.

In addition to the environmental advantage, customers can save money by buying liquid solvents in bulk. The durable unit will replace the use of more than 500 aerosol cans.

The Spritzer uses no harmful chemical propellants and its use has the potential of reducing waste. The dispenser also complies with EPA recommendations for "not-in-kind" cleaning alternatives.

Circle (105) on Reply Card

★ ★ ★ SHOWCASE OF TOOLS & TOOLCASES ★ ★ ★



Every type of work requires a set of tools. The artist, the craftsperson, the technician, the mechanic; each profession needs an assortment of tools that is specifically designed to assist in getting the job done thoroughly, efficiently, neatly.

The consumer electronics service technician requires an extensive and varied assortment of tools to perform the operations required to gain access to the operating components of the product being serviced.

To begin with, the technician may need some screwdrivers, nutdrivers, wrenches, pliers, etc., simply to get the back or cover off of the product.

Once inside the product, the technician may still need the same tools, along with some additional tools, to disassemble the chassis further to gain access to test points and suspected portions of the circuitry.

Once the technician has diagnosed the problems, he will need tools such as IC pullers, soldering/desoldering tools, common hand tools, etc., to remove the failed component(s) or module(s) and to install the replacement parts.

Many of the common hand tools can be used in servicing a broad variety of consumer electronics products, but many specific products require specific tools in order that servicing may be completed quickly by the technician and efficiently.

For TV work, for example, the list of special tools may include an assortment of nonferrous alignment tools. The tape transport of a VCR requires several specialized tools for adjustment. If you're going to be servicing personal computers, you'll probably want to have IC insertion and extraction tools, Torx fastener drivers, and a keycap puller for the keyboard.

Depending upon what specific products you'll be servicing, you may need, or wish you had, specialized soldering/desoldering tools and tips.

Tool kits/cases

When it comes to assembling a tool case so that you can get as much work done on site as you possibly can, the problem of selecting tools becomes even more critical than the selection of tools for the service center. You want to have every tool on hand that you might possibly need, but not a single tool that you'll never use. After all, there's no point in lugging around excess weight. You want every tool in its place so you don't forget anything when you go out to make the call, and especially when you leave the site. You want your toolcase to be lightweight, but rugged.

Assembling a set of tools

So how do you decide what you'll need in the way of tools, and how do you find out about those useful special tools without which you might have more difficulty getting the job done, or possibly even damage the very product that you're trying to restore to operation?

A very good way to determine what tools you'll need to get a particular product serviced is to study the service manual for that product, if you can obtain one. Usually good service literature provides a list of special tools that the service technician will need to complete service on the product.

Another way to assemble the array of tools you'll need is to consult with a colleague who is already servicing similar products.

One of the best ways to be sure that you have the right tool at hand is to consult an established, reputable vendor of tools and/or tool cases. These companies deal with service technicians and service managers every day, and in most cases offer a kit of tools, or several variations, for each specific type of service.

Thus, if you plan to service personal computers, for example, these companies will have available several tool kit selections, depending how deeply you want to get into it, and how extensive your tool selection is already. The same is true for copier service, telecommunications service, or service of other products.

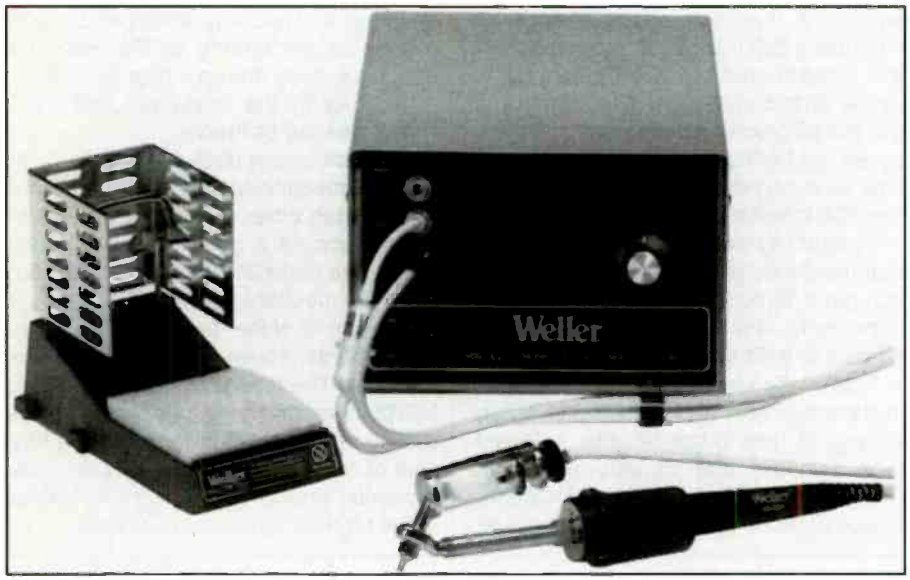
Check out the showcase

A number of tool and tool case vendors are featured in this issue. The space that they have been given in addition to their ads has allowed them to tell readers a little about themselves and the products and services they offer.

If you're in the market for tools, toolkits or toolcases to expand the line of products you'll be servicing, shop around in our showcase and see if you find what you're looking for. If you don't see it, ask: that is, check the appropriate number on the reader service card. ■

RS Electronics

34443 Schoolcraft
Livonia, MI 48150
Phone: 313-525-1155
800-366-7750
Fax: 313-525-1184



Founded in 1929, RS Electronics ranks as one of the top electronics distributors in the U.S. We offer electronic components and test equipment from more than 200 manufacturers. Our company constantly strives to achieve a high quality of service in supplying products to a wide variety of maintenance and service organizations—from small independent service centers to the service divisions of America's largest companies. We have compiled an enviable record.

In spite of this success, RS has not forgotten that companies that maintain and service electronics equipment can't always buy their supplies in large quantities. At RS, you can buy what you need at reasonable prices, even if you only need a few items.

Our product line

The RS Electronics product line includes oscilloscopes, DMM's and test probes from Tektronix, Fluke, B&K and Leader; diagnostic circuit testers from Huntron; soldering and desoldering tools from Weller, Ungar and OK Industries; chemicals and cleaning supplies from Techspray; hand tools from Diamond, Ungar, Utica, Wire-Wrap and Xcelite; fuses, circuit breakers, wire and heat shrink tubing, switches and resistors; all in stock and available for immediate delivery.

To maintain our high standards of service and our high standing with our customers, we work tirelessly to identify customer needs and to respond with effective solutions. Flexibility and creativity are the hallmarks of RS Electronics.

RS Electronics offers a broad range of services that is unique in the industry, from simple off-the-shelf shipments to full strategic partnerships.

At a time when many distributors are reducing their product lines as an economy measure, RS Electronics is, in contrast, continuing to expand its product line in order to meet the needs of customers. We supply millions of components from over 200 product lines. RS maintains substantial inventories at our three regional warehouses, available for immediate delivery. We are a broad line distributor with depth and breadth of product in ALL major categories.

The RS Electronics line of tools and tool cases

Our line of tools and cases includes:

- Cooper Tools
  - Bonney
  - Diamond
  - Erem
  - Ungar
  - Utica
  - Xcelite
- GC Thorsen
- Greenlee Tools
- Ideal
- Leviton
- 3M
- Paladin
- Platt

Convenient locations

With fully-stocked branch offices in ten cities in the U.S. (see advertisement on the inside back cover for locations) open from 8 a.m. to 5 p.m., RS Electronics is able to deliver orders quickly and accurately. Our dedicated Fax order lines are operational 24 hours a day, seven days a week, 365 days a year. If your order is placed before 4 p.m., in more than 99% of cases we are able to ship stock items the same day.

Have a look at our catalog

To receive a copy of the latest RS Electronics catalog to see the many ways in which we can fill your electronic products needs, contact your closest RS branch office, or check the appropriate number on the Reader Service card in this issue. ■

Tentel

4475 Golden Foothill Pky.
El Dorado Hills, CA 95762
Phone: 916-939-4005
800-538-6894
Fax: 916-939-4114

A VCR contains rubber belts, wheels, idlers, gears, brakes and tension bands that are there to maintain the proper torques and tape tensions during the various loading, play, rewind, fast forward, and stop modes. All of these, plus the actual video head tips are subject to normal wear.

Every time the consumer plays a tape, these components stretch, wear, shift position, and are stressed. Contaminants and oxygen, in the air, cause many of these parts to age and break down even without use.

By the time a VCR requires service, several of these components are probably out of tolerance. Nine out of ten (90%) VCRs brought in for service have mechanical, rather than electronic, problems. When a customer brings in a VCR for service, the entire tape transport system should be checked.

Since many components in the transport are subject to wear during its use, once the immediate cause of the problem has been corrected, you should perform a thorough check of the other mechanical components to be sure that they too are in proper operating condition.

If you merely correct the immediate problem and return the VCR to its owner without a thorough check, there's an increasing risk that one or more mechanical components will soon either fail or cause erratic operation. The result of all this is a disgruntled and possibly lost customer, and either a callback that wastes time or, even worse, the customer tosses the VCR in his closet and purchases a new one, carefully selecting a different VCR manufacturer. (It's the same for cars, if you get a "lemon" and the dealer can't fix it properly, the customer will typically change to a different manufacturer)!

That's why every VCR service should include a check, and adjustment if necessary, of tape guide heights, holdback tape tension, and numerous torques (including FF, REW, brakes and restoring torques). All of these checks and adjustments are specified in the service manuals of every manufacturer. You may also find it valuable to check the video head wear to see how many more hours of life the VCR owner can expect from them.

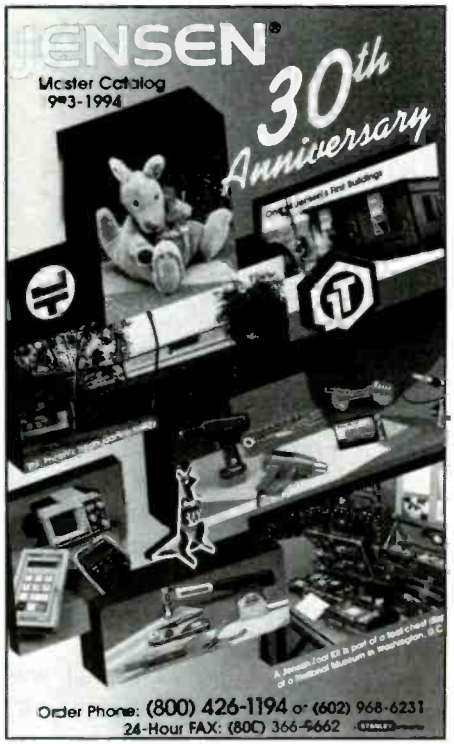
With the proper tools: torque, back tension gauge, reference plane, head protrusion gauge, etc., all of the tests and adjustments can be performed in just a few minutes.

A thorough test and adjustment will allow the service center to do it right the first time, and possibly collect a little more money for performing all the work that should be done anyway, plus you'll avoid disappointing the customer and avoid those dreaded callbacks.

And how much does it cost for all the required mechanical test tools? More than or less than other necessary test equipment, such as a good scope? Actually much less than! $1100 to $1700 will buy all of the mechanical test tools you need to perform all of the mechanical tests and adjustments shown in factory service manuals. The time you save in servicing VCRs more efficiently, performing higher quality repairs, and in avoiding the high cost of callbacks will easily pay for these products; providing the best VCR repair value for their hard-earned money.

Jensen Tools

7815 South 46th Street
Phoenix, Arizona 85044-5399
Phone: 800-426-1194
Fax: 800-366-9662



Jensen Tools Inc. is a major catalog supplier of tools, tool kits and cases, test equipment and other products to electronics technicians and communications service personnel. Jensen publishes and distributes full-color catalogs several times a year to customers and prospects in all fifty states, Canada and overseas.

All leading brands of meters and other test equipment can be found in Jensen catalogs. In addition to standard hand and power tools, there are specialized and hard-to-find items, some of which are available only from Jensen. Jensen brand tools carry a lifetime guarantee.

Jensen continuously seeks to increase its product lines and enlarge its customer base in order to develop and offer specialized tools and tool kits for any and all applications and disciplines.

Jensen is a value-added distributor with an enviable reputation for customer service. In addition to a full range of quality, Jensen-engineered tool kits for state-of-the-art computer, telecom, and communications field service, Jensen offers custom kit and custom case design services, free technical support, a full satisfaction guarantee and free shipping to any location in the United States. For more information and a free catalog, call 800-426-1194 or Fax your request to 800-366-9662. ■

Platt Luggage

4051 W. 51st St.
Chicago, IL 60632
Phone: 312-838-2000
800-222-1555
Fax: 312-838-2010

Platt Luggage, an industry leader for over 70 years, is expanding its line of cases for business and industry to meet the growing needs of its customers. Platt incorporates rapid prototyping techniques, modern production facilities, and the most durable materials with fine craftsmanship to produce business cases which outlast the competition.

From custom orders to full line items, Platt Luggage has always been at the forefront of industry innovation. Case interiors, as well as exteriors, can be custom modified to meet the exact dimensions of any piece of equipment, or to satisfy any on the job requirements.

From vacuum formed to injection molded cases to sewn soft-sided zipper bags to ATA shipping cases there is nothing Platt can't do. Having designed cases to hold a vast array of products, including: service tools, instrumentation, electronic components, computers, circuit boards, and telecommunications equipment, Platt demonstrates its capabilities through customer satisfaction and repeat business.

To order an off-the-shelf solution to your case requirement, simply call Platt Luggage in Chicago, IL at 800-222-1555 for the name and number of your local representative, a copy of the newest catalog, and your nearest Platt Authorized distributor.

Consultations on custom designs are handled exclusively through the Design and Engineering Department at the Chicago headquarters. After initial specification review, Platt will give you an exact price on prototyping, and an estimate of full production including delivery date. Imprinting or silk screening of corporate logos on custom case orders is also available at a nominal charge.

If you are in need of a custom case solution, or a single unit to fill a specific need, call your Authorized Platt representative. Platt manufactures every case for maximum durability, ultimate longevity, and the utmost in appearance.

DEN-ON INSTRUMENTS (U.S.A.), INC.

2580 Corporate Place, F-103
Monterey Park, CA 91754
Phone: 213-266-5960
800-397-5960
Fax: 213-266-5963

DEN-ON INSTRUMENTS (U.S.A.), INC., manufacturer of high-quality desoldering and soldering equipment is located in Monterey Park, California near downtown Los Angeles, and is a 100% owned subsidiary of DEN-ON INSTRUMENTS Co., LTD. (Japan).

Customer service is DEN-ON's number one priority.

DEN-ON INSTRUMENTS is the inventor of the first truly 100% portable desoldering tool (SC-5000) that was introduced in the U.S.A. in 1988 and upgraded to the ***SC-7000***. This desoldering unit is unique because it does not require any hoses like bench top units. All components are housed within the hand piece; motor, vacuum pump, and heater. This unit also has the capability to be a hot air gun just by switching a lever. The SC-7000 is small in size, and high in performance. This unit has the same amount of vacuum if not *MORE* than other desoldering systems. Perfect for use on Through Hole or SMD components with the **NEWLY RELEASED SD-KIT** and **SMD ATTACHMENT HEADS**.

DEN-ON has also developed a **NEW SMD REWORK STATION *SD-2000*** using one hot-air nozzle that quickly moves along the X and Y axes repeatedly and can be set for different sizes of SMD components without changing heads for other size components.

DEN-ON also manufactures high-quality soldering stations and a soldering iron analyzer (KC-1) that checks for MIL-Specs. One of the stations is microprocessor controlled (SS-8000) and others are designed for Fine-Pitch soldering (SS-8100, SS-8200). Another unique tool is an Ultrasonic Soldering Station (US-9000) that solders on glass, ceramic, aluminum, and stainless steel.

DEN-ON INSTRUMENTS has a strong distributor network throughout the United States and also an International network that services 42 countries worldwide.

Call our toll-free number, 800-397-5960, to find out who your local distributor is.

Books

The Illustrated Dictionary of Electronics, By Stan Gibilisco, TAB Books, 768 pages, 664 illus., $28.95 paper.

The Illustrated Dictionary of Electronics has definitions, abbreviations, acronyms, illustrations, schematics, diagrams, and conversion tables for the electronics professional. This reference is now in its sixth edition—with updated definitions and enhanced illustrations from front to back.

No matter what the level of skill—student, hobbyist, engineer, or technician—this dictionary covers a broad spectrum of informational needs. Gibilisco thoroughly covers the terminology of computers, robotics, lasers, TV, radio, IC technology, digital and analog electronics, audio and video, power supplies, and fiberoptic communications.

Terms are defined clearly and precisely, with as little technical jargon as possible.

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

HDTV: High-Definition Television, 2nd Edition, By Stan Prentiss, TAB Books, 336 pages, 131 illus., $16.95 paper, $30.00 hardcover.

As the Federal Communications Commission prepares to choose a standard high-definition television system for the U.S. market, HDTV continues to advance both technologically and legislatively towards full acceptance in North America. *HDTV: High-Definition Television, 2nd Edition* addresses the full spectrum of issues surrounding high-definition television, giving readers a look at the latest technical and legislative aspects of high-definition television.

A member of the FCC panel of experts evaluating the various HDTV systems, Stan Prentiss is able to bring to this new edition the most current information on competing transmission and receiving systems under development, their advantages and disadvantages, and the methods being used to produce them. He also includes updated information on the ATSC test laboratory and test procedures, FCC and congressional regulation of HDTV research and development, industry standards for HDTV, and experimental HDTV instrumentation and technological variants.

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

The MIDI Buying Guide, By Donald P. Kozak, Electronic Music Products & Publications, 240 pages, free to educators, $5 to general public.

The MIDI Buying Guide has been designed to help computer-MIDI musicians, music educators, professionals, performers, parents, music students, and home users find high-quality, MIDI-related products. Included in this extensive MIDI Buying Guide are product descriptions with graphic-illustrations of MIDI software and hardware, educational MIDI-products, keyboards/sound modules, unusual musical devices, equipment reference books and MIDI interface hardware. Hundreds of products are featured that are compatible with most personal computers, including: IBM/compatible, Windows, Macintosh, Amiga, Atari, Commodore 64/128, Apple IIe, IIGS, Laptop, Powerbook, and the newest Intel and PowerPC-based computers.

Throughout the buying guide, nearly every premier software and MIDI manufacturer has products featured or listed—including add-on sound card and products for expansion into the exciting world of multimedia. This buying guide is free to educators but a $5.00 refundable fee to all others is charged.

In addition, the guide includes MIDI hardware and software for older computer systems and curriculum references for school districts that desire MIDI-instructional products for: older Mac's, Apple II's, GS, Comodore 64/128, and DOS systems.

Sound Management Publications Peabody, MA 01961

Handbook of Power Signatures, BMI, 290 pages, $35.00 paper.

The second edition of the *Handbook of Power Signatures* includes identifying features, cause, symptoms, and solutions for the most common power disturbances printed by the 4800 PowerScope, 8800 PowerScope, and the 8010 PQNode power monitors.

The book's 290 pages include updated and expanded information on simultaneous voltage and current monitoring, harmonics analysis, power quality surveying, safety practices, report writing, new tables, frequently used equations, a glossary, and a recommended reading list.

BMI , 3250 Jay Street, Santa Clara, CA 95054

Troubleshooting and Repairing Notebook, Palmtop, and Pen Computers: A Technician's Guide, By Stephen J. Bigelow, Windcrest, 352 pages, 260 illus., $24.95 paper, $34.95 hardcover.

Devoted entirely to portable computers, this book is an on-the-job companion for anyone interested in getting in on the ground floor of this burgeoning market. From test equipment and tools to techniques, this hands-on guide provides information needed to build a successful career troubleshooting and repairing these special computers.

With the aid of many helpful illustrations, the book takes readers step by step through procedures such as s afely assembling and disassembling small computers and making delicate PC board repairs. There's also in-depth instruction on diagnosing and repairing:

- Floppy drives, hard drives, and memory card drives
- Keyboards, pen digitizers, mice, joysticks, and more
- Peripherals
- Power supply problems
- Faulty LCD and Plasma displays
- Interface circuits

Loaded with useful features, this manual also includes an informative list of computers, parts, and information sources; and a time-saving appendix summarizing problems and solutions.

Windcrest, TAB Books/McGraw Hill, Blue Ridge Summit, PA 17294-0850

The Programmer's Guide to the Amibios, By American Megatrends, Inc., Windcrest, 464 pages, 100 illus., $32.95 paper, $43.95 hardcover.

American Megatrends, Inc., manufacturers of AMIBIOS, has now created a comprehensive programmer's guide of information on this software. This guide not only describes all standard ISA and EISA system BIOS functions, but includes complete documentation of the new PCMCIA Socket Services, Advanced Power Management (APM), and Peripheral Component Interconnect (PCI) BIOS functions.

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

Photofact

PHOTOFACT

These Photofact folders for TV receivers and other equipment have been released by Howard W. Sams & Co. for May 1994.

GE
VG7500 ..... VCR-252
9-7450 (sim. to) VCR-252

HITACHI
C732 3316
CY33 3316
CY35 3316
M1CLXU 3316
27AX4B 3316
31DX21B 3316
31GX31B 3316
31KX39K 3316

JCPENNEY
K-50MZ70 3324
2509 (LP) 3324
855-9486 (LP) 3324
685-2509-00 (LP) 3324

MAGNAVOX
HD1321C4 3320
RR1333C401 3320
RR1333C403 3320
RR1333C404 3320
RR1338C101 3320
RR1338C104 3320
RR1340W4 3320
RR1342C404 3320
RR1350C402 3320
RR1350C403 3320
RS1966B421 3322
RS1972C421 3322
XR1333C401 3320
XR1333C404 3320
XR1342C4 3320
13Y401 3320
19Y402 3322

PANASONIC
ADP223 3325
CT-13R1R 3325

PHILIPS
MR2121 3327
20R200C401 3327
20R200C402 3327
20Y100 3327
20Y102 3327

QUASAR
AEDC226 3315
AMDC223 3318
QC-14T15J 3318
QC-29SX15J 3315
SXF2715J 3315
TP1315HJ 3318
TP1315J 3318
YAEDC226 3315
YAMDC223 3318

RCA
E13200WNF03 3323
E13201WNC03 3323
E13201WNF03 3323
E13203BKF04 3321
E13320SEC04 3321
E13320SEF04 3321
E13321KWC04 3321
E13321KWF04 3321
E13322BTF04 3321
TX82TB 3323
TX82TC 3323
TX82XB 3323
TX825TC 3321
TX825UC 3321
VPT200 ..... VCR-252
VR250 ..... VCR-252
X13101GSC03 3323
X13101GSF03 3323

SAMSUNG
K52MD1 3314
TC7100S 3314
TXB3115/CX 3314
VR-2410 (sim. to) VCR-252
VR-2610 (sim. to) VCR-252

SEARS
CTC177BF 3317
274.42798390 3317

SHARP
20E-S300 3326
20E-S4900 3326

ZENITH
SL2767S 3319

Circle (87) on Reply Card

What Do You Know About Electronics?

More about capacitor time constants and the GROL

By J.A. Sam Wilson

I have always said that the good part of teaching was the exchanges I had with the best students. They have taught me much. When I got careless they let me know, and when I presented them with valuable information they let me know about that too. I miss that exchange, but I do get much of the same thing by writing this column.

A good example is the letter I got this week from Phillip J. Andres IV who makes Wheaton, IL his home. Here is his letter:

Dear Mr. Wilson,

I have always enjoyed your quizes and columns, but today I have to speak out about your hidden puzzle on page 55 of the December '93 ES&T.

Of course, we all know that when cur-

Wilson is the electronics theory consultant for ES&T.

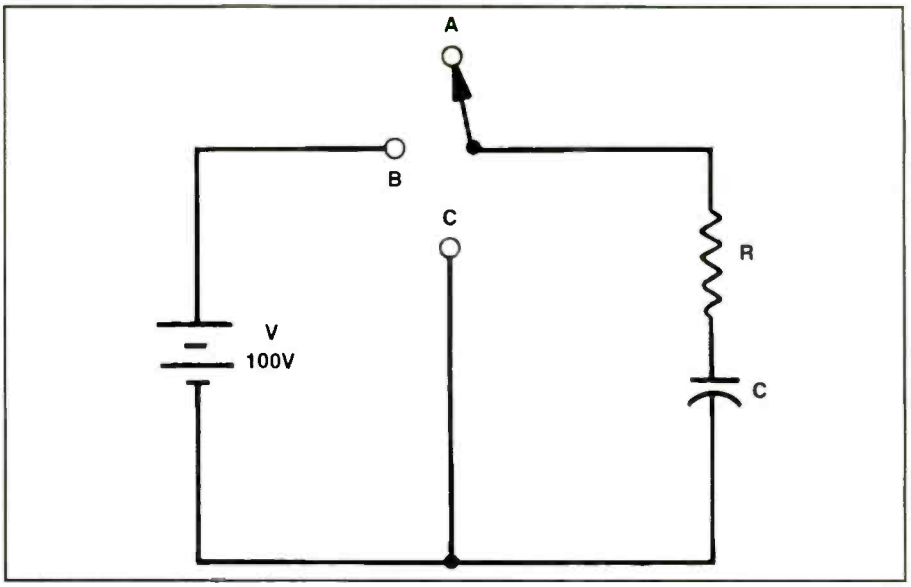


Figure 1. This time constant circuit permits the capacitor to be charged or discharged, depending on the position of the multi-position switch.

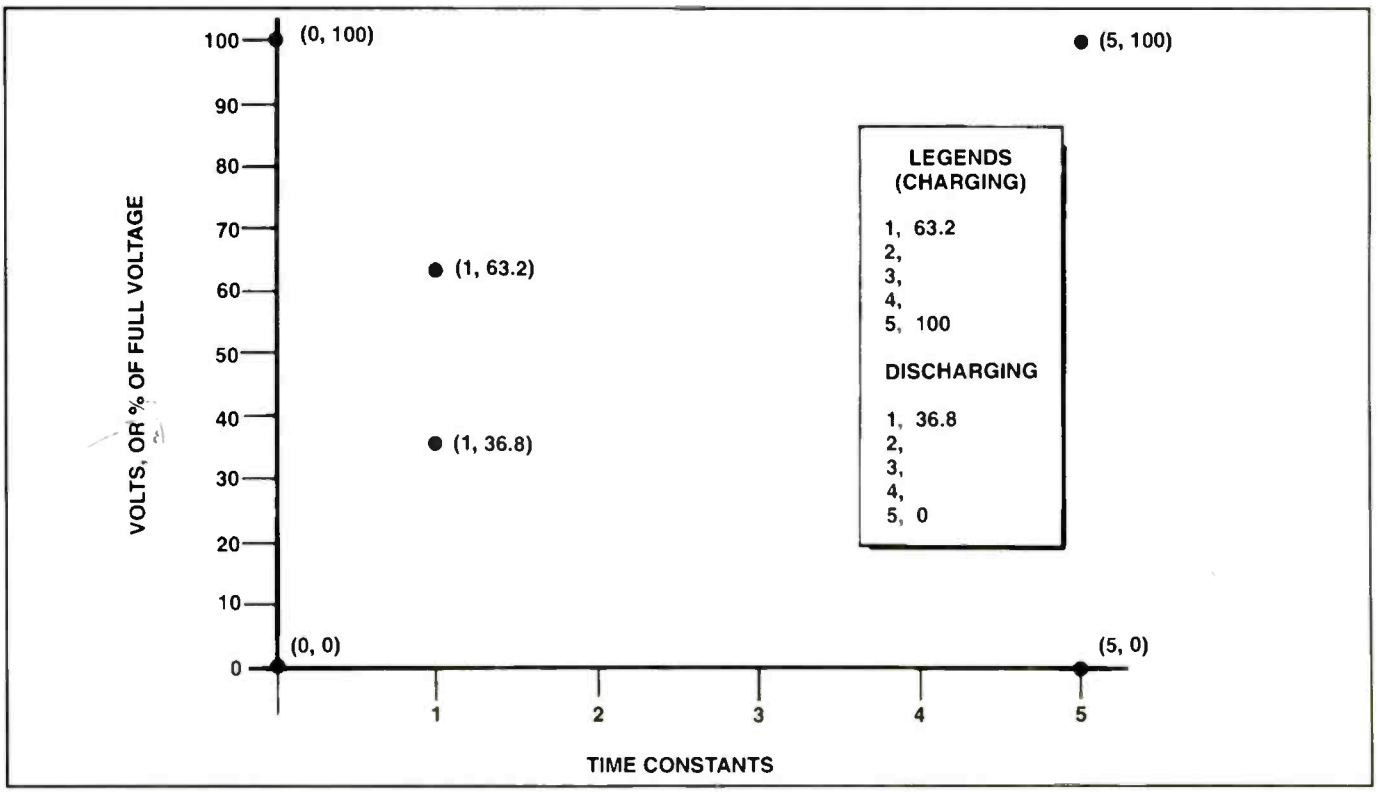


Figure 2. You can use this system of coordinate axes to plot the charge or discharge of an RC circuit.

TABLE 1

Step 1: Voltage of the previous step: V
Step 2: Subtract the voltage in Step 1 from 100: V
Step 3: Multiply the voltage in Step 2 by 0.632: V
Step 4: Add the voltage in Step 3 to the voltage in Step 1: V
Step 5: Enter the value on the graph and in legend for a charging capacitor

Example—

To plot the point on the second time constant line after the point on the first time constant line has been plotted:

TABLE 1

Step 1: Voltage of the previous step: 63.2V
Step 2: Subtract the voltage in Step 1 from 100: 36.8V
Step 3: Multiply the voltage in Step 2 by 0.632: 23.3V
Step 4: Add the voltage in Step 3 to the voltage in Step 1: 86.5V
Step 5: Enter the value on the graph and in legend for a charging capacitor

Table 1. This is a step-by-step procedure to find the time-constant points on the RC charging graph.

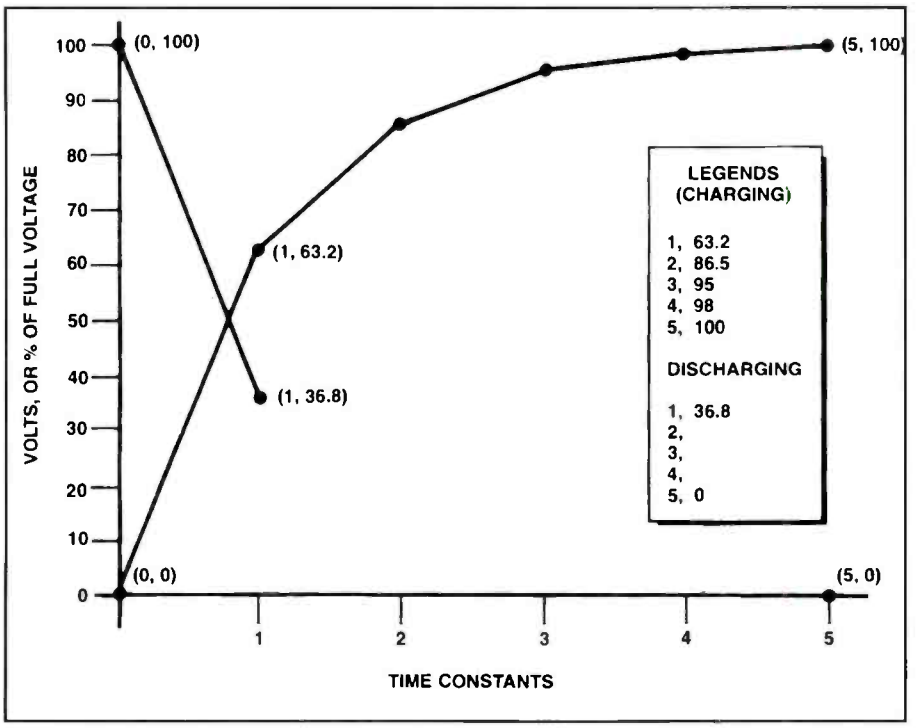


Figure 3. Connecting the points that you have plotted on the charging time-constant coordinate axes with straight lines gives this piecewise curve.

rent flows in the same direction in parallel conductors, the conductors will be attracted to each other, not repelled. It was the attraction of the strands to each other which reduced the flexibility. The effect would occur without the sheath.

Just wanted you to know I was paying attention.

Phil Andres

Many thanks for your letter Phil (and, to everyone else who caught that error but forgot to write to me about it)!

You are absolutely right! I was in a hurry and put down something I *thought* I knew without checking.

Historically, this fact came up when Mr. Ampere set out to define current measurement. He used the attraction or repulsion between two parallel wires carrying current to define an amount of current. Later, the unit of current was named the Ampere in his honor.

So much for writing things I thought I remembered, I'll look it up next time.

I still say there is an invention lurking in that subject—something that hasn't been done before.

Confucius Says (or, people says Confucius says): He who makes too many mistakes does nothing, but, he who makes no mistakes also does nothing.

A piecewise approach to GROL time-constant problems

The GROL exam is the new FCC exam that is used to replace the previous first and second class licenses. GROL stands for General Radio Operator License.

So far, we have looked at the solution of time constant problems using a mathematical approach and a graphical approach. Now we will extend the graphical approach so that you don't need a universal time constant curve. Part of the method in this issue makes it possible to easily solve all of the time constant problems in the FCC GROL exam.

The graphical method of solving time constant problems discussed previously required a universal time constant curve as a starting point. But, what to do if you can't lay your hands on a universal time constant curve?

The answer is that you can construct the curves by using some very easy calculations. It is easier if you have a calculator that can handle *addition, subtraction, multiplication, and division.*

The time constant circuit of Figure 1 permits the capacitor to be charged or discharged. Both curves will be developed.

Refer to Figure 2. It is the coordinate pair that you will use to plot a piecewise time constant curve. The horizontal axis is used for time constants and the vertical axis represents the applied voltage, or the percent value of the applied dc voltage. For convenience we can say the vertical axis is marked for 100V. However, it can also represent 100% of any voltage.

Start the simple graphical procedure by constructing coordinates shown in Figure 2. It doesn't make any difference what space you use for the marks as long as they are evenly spaced on the two coordinates. There is no relationship between

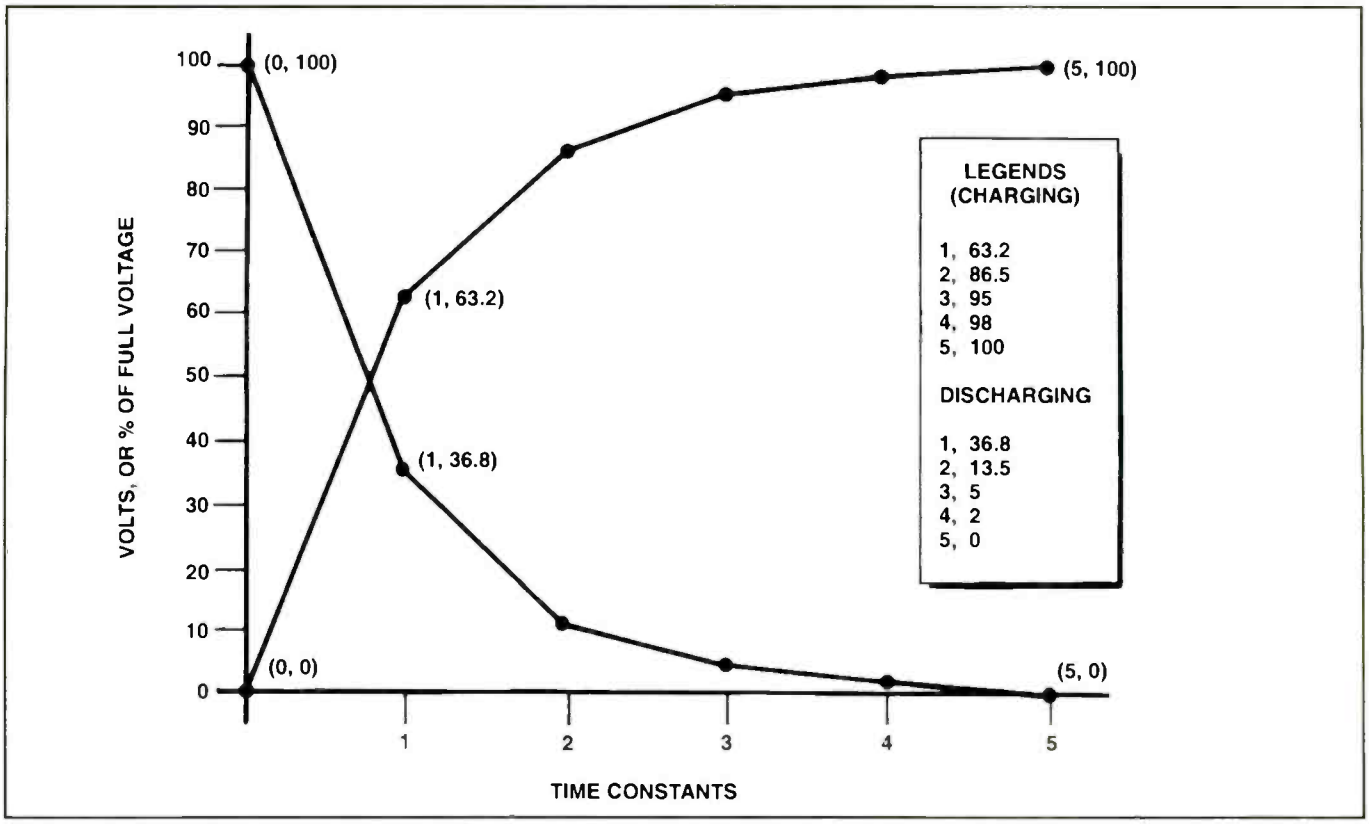


Figure 4. The complete charging/discharging curves for the RC time-constant circuit of Figure 1 look like this.

the sizes of vertical and horizontal spaces.

You know that at the start of the charging cycle (T = 0) the voltage across the capacitor is 0V. That point (0,0) has been marked on the graph (Figure 2).

Remember that the capacitor is not charged at the start. When the switch is turned to potition 'B' capacitor (C) begins to charge through resistor 'R'. It has been shown that at the end of one time constant the voltage across the charging capacitor will be 63.2% of the applied voltage. That is the same as 63.2V on our graph. That point (1,63.2) has been marked on Figure 2.

For practical applications the capacitor is considered to be fully charged at five time constants. So, (5,100) has been marked on the graph.

At the start of the discharge period the voltage across the capacitor is considered to be 100V. Point (0,100) has been marked on the graph.

It has been shown that voltage across the discharging capacitor will drop to 36.8% of the original full-charge voltage in one time constant. That point, (1,36.8) is marked on the graph of Figure 2.

At the end of five time constants the voltage (for practical purposes) has dropped to 0V. The point (5,0) has been marked on the graph.

So far there have been six points marked on the coordinates in Figure 2.

We now continue with the construction of the charging time-constant curve. At one time constant the voltage across the capacitor is 63.2V. Subtract that from 100 and you get 36.8V. That is the remaining voltage at one time constant. The capacitor will charge 63.2% of that remaining voltage during the next interval: 0.632 x 36.8V = 23.3V.

That is how many volts the capacitor will charge during the period between the first and second time constant. Then add that voltage to the 63.2V at the first time constant:

63.2V + 23.3V = 86.5V

So, at the second time constant the voltage across the capacitor is 86.5V. Mark that value on the graph and enter it into the legend shown on the graph.

In order to simplify the problem of finding the points on the charging graph, a step-by-step procedure is given in Table 1.

TABLE 2

	Time Constant Value *1*	Time Constant Value *2*	Time Constant Value *3*	Time Constant Value *4*	Time Constant Value *5*
Charging Voltage, or % of full voltage	63.2	86.5	95	98	100
Discharging Voltage, or % of full	36.8	13.5	5	2	0

Table 2. Performing all of the calculations for the first five time constants for charging and discharging of the RC time constant circuit of Figure 1 yields these data.

Continue to determine the remaining time constant values. Enter the values on the coordinates of Figure 2 and in the legend.

Connect the dots on the graph with straight lines. That gives you the piecewise-charging time-constant curve. At this point, your graph looks like the one in Figure 3 and the complete data is shown in the legend.

Making the discharge curve

When the switch in Figure 1 is turned to position C, the capacitor discharges through the resistor.

To mark the points on the graph for the piecewise discharge curve all you have to do is subtract the point marked on the graph for the charge curve from 100. That gives you the point for each time constant.

For example, the point marked for the first time constant is 63.2V. Subtract that value from the full voltage of 100V and you get 36.8V. Mark that point on the first time constant line. It is the first point on the discharge curve.

For the second time constant line note that the point on the charging curve is 86.5V. Subtract that voltage from 100V and you get 13.5V. That voltage has been marked on the discharging time constant line and also entered into the legend of Figure 4.

Continue that procedure and mark the voltage on each time constant line until you have marked the five lines.

Connect the dots with straight lines and you have the piecewise time constant curve for the discharging capacitor. Your graph now looks like the one in Figure 4. Be sure to complete the data in the legend as shown in Figure 4.

If you are one of those lucky people with a flair for drawing you can add curvature between the dots on the graph. That will bring you closer to the actual time constant curve.

By choosing 100V as the supply voltage, the graphs we have made can be marked in percent along the left edge. So, the 63.2V mark is at 63.2% of the maximum supply voltage, the 86.5V mark is at the 86.5% mark, etc.

Solving FCC time-constant (GROL) problems

Now direct your attention to Table 2. It is a compilation of all data in the legend. It gives the percent of full voltage for each time constant.

So what? *Every time constant problem in the GROL exam is for the voltage at some exact value of time constant as shown in the table.*

If you followed the instructions for getting the points in the legends you can answer any time constant problem in the GROL exam! Here are three questions and their solutions. The questions are copied word-for-word from the pool of questions used by the FCC.

1. After two time constants, the capacitor in an RC circuit is charged to what percentage of the power supply voltage?

Answer—From Table 2 the answer is 86.5%.

2. What is the time constant of a circuit having a 100μF capacitor in series with a 470kΩ resistor?

Answer—You don't need the table for this one, but, you do need to be able to calculate time constants to solve some of the problems in the GROL exam.

$T = RC = 470 \times 10^3 \times 100 \times 10^{-6} = 47$ seconds.

3. How long does it take for an initial charge of 800Vdc to decrease to 294Vdc in a 450μF capacitor when a 1MΩ resistor is connected across it?

Answer—First, find the time for one time constant.

$T = RC = 1 \times 10^6 \times 450 \times 10^{-6} =$ 450 seconds.

Note that 294/800 = 0.3675 = 36.8%. That is the value for the first time constant on the discharge curve. Therefore, the capacitor will discharge from 800V to 294V in one time constant, or, 450 seconds. ■

Understanding the CRT numbering system

By The ES&T Staff
Based on Sencore Tech Tip 145

It's not absolutely essential to be familiar with component numbering systems, but it can help reduce errors in ordering of a replacement part. This brief article explains the numbering systems on CRTs both before and since the introduction of the Worldwide Type Designation System (WTDS).

Most CRTs are registered according to some kind of industry standard. These standards define certain characteristics of the tube. Since April 1, 1982, these standards have been combined into a single worldwide standard. Before that date, several non-universal standards were used.

Old standards

CRTs manufactured before April 1, 1982 were registered differently in the United States, Japan and Europe. In general, the registration number broke down into three parts.

The first part of the old-type CRT number is a series of digits which signify the minimum diagonal viewing measure of the CRT. For American tubes, this size is in inches. Thus a 19VACP22 would have a viewing diagonal measure of 19 inches. Japanese tubes have this distance in millimeters.

The next part of the CRT number consists of one to four letters which designate a particular CRT within a group of CRTs having the same screen size. The final part of the CRT designation indicates the type of phosphor used. Black and white video CRTs use a P4 designation for American listings or a B4 listing for Japanese listings, while color CRTs use a P22 (American) or B22 (Japanese) listing. Computer CRTs or scope CRTs may use some other type of phosphor, and will have a different number following the "P" or "B." But, as you see, the "P" or "B" is not part of the tube designation.

Some CRTs have listings that do not have a "P" or "B" ending. The most common non-standard ending is "TC01" or TC02." These CRTs always have bonded yokes (or some other component) permanently attached to the CRT neck. The "TC__" ending simply indicates the type of yoke plug the CRT uses to connect to the chassis. The CRT is identical to one with a "P22" or "B22" ending. For example, a 15VAETC01 is identical to a 15VAEP22.

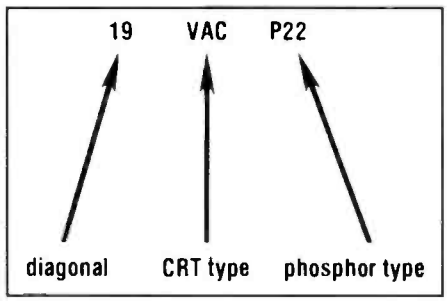


Figure 1. Before April 1 1982, the number used to identify picture tubes was different in the United States, Europe and Japan. Here is the number from an American CRT from that vintage. The first two digits identifies the diagonal picture size, the second set of characters designates the CRT type and the third set of characters designates the phosphor type.

WTDS standard

Since April 1, 1982, a new system for categorizing and numbering CRTs has been in use. This system is officially called Worldwide Type Designation System (WTDS) for picture tubes and monitor tubes. Until the adoption of this system, American, Japanese and European tube manufacturers had all numbered their tubes differently. This led to confusion and incomplete or inaccurate information. The WTDS number was an effort to simplify and unify CRT designations.

The WTDS number consists of six groups of symbols. The first symbol defines the application of the tube. This symbol is always a single letter; either an A for picture tubes or an M for video monitor tubes. A second group of symbols is a two-digit number that defines the minimum diagonal view. This measurement is always listed in centimeters (1 inch = 2.54 centimeters).

The next group of symbols consists of three letters that designate a family code for the CRT. Tubes within a particular family have specific mechanical and electrical characteristics. These letters are assigned alphabetically beginning with AAA followed by AAB, AAC, etc.

One or two digits follow the family code. These digits indicate a specific member within a particular family. A different member number would be assigned to tubes within the same family that have different neck diameters, for example. A single digit member symbol indicates a monochrome tube while a two-digit number indicates a color tube.

Following the one or two digit member symbol is the phosphor type designation. Color picture tubes are designated by the single letter X, while color monitor tubes may have some other single letter designation. Monochrome picture tubes are designated by the two letters WW. Other monochrome tubes, such as video monitors, have a different specific two-letter code to designate the phosphor type.

Some tubes contain integral neck components, such as bonded yokes. These tubes have a sixth group of symbols assigned to them. A two-digit number is used to define the characteristics of these integral neck components. ■

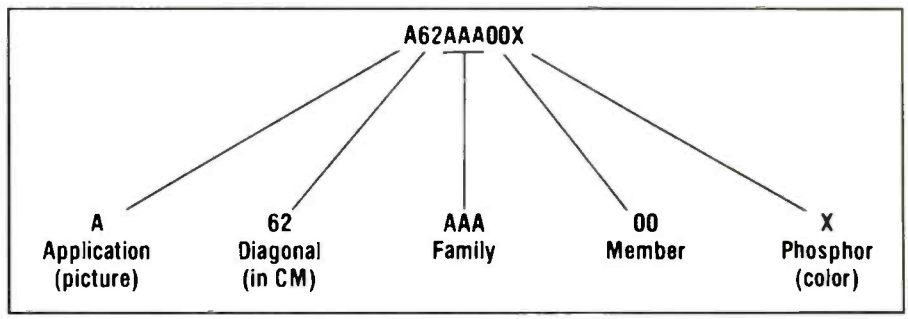


Figure 2. When the Worldwide Type Designation System (WTDS) was introduced in April of 1982, CRTs from all over the world were identified with the same six groups of symbols. One of the changes for U.S. manufacturers is that the diagonal size was now expressed in millimeters.

A local bus primer

By John Kull

Throughout the history of the personal computer, hardware and software have played catch up with the advancing microprocessor technology. Computer bus speed has been one area in need of enhancement. A new technology called "local bus" is probably the most exciting upgrade to come along in the computer industry in a long time.

For the Windows or graphics based program user, local bus can mean faster screen drawing and data transfer than was previously possible. If you are not familiar with local bus technology, this article will provide some background information on current computer bus technology and explain what local bus technology is and what it can offer in terms of increased performance.

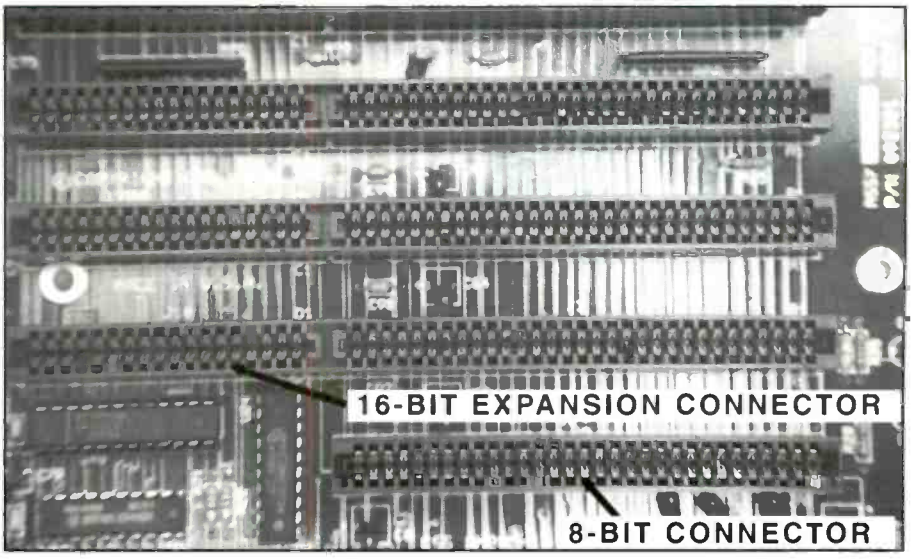


Figure 1. Eight-bit connector and sixteen-bit extension connector.

The expansion bus

The expansion bus provides the pathway to system memory, control and power. The original IBM PC used an 8-bit data bus and a 20-bit address bus that ran at the system clock speed of 4.77MHz. Connection to the bus was made via a 62-pin, 0.1-inch edge card connector (Table 1). As the PC evolved, the AT class was introduced. It contained an 80286 microprocessor with a 16-bit data bus and a 24-bit address bus that operated at a clock speed of 6MHz (Table 2). The larger address and data buses required an additional 36-pin connector that mounted behind the existing 62-pin connector (Figure 1).

With the introduction of the 80386 microprocessor, the clock speeds increased from 8MHz to 16MHz and the data and address buses increased to 32 bits. It became obvious that the bus standard was in need of an overhaul. At this point in PC history, IBM and the compatible industry chose separate paths in their development of a new bus standard.

IBM developed a new protocol that was incompatible with the original standard it had developed. The new technology was called MCA, or Micro Channel Architecture. It used a new style edge card connector with a 0.05-inch pin spacing (Figure 2). The design specification of MCA allowed bus speeds as high as 33MHz.

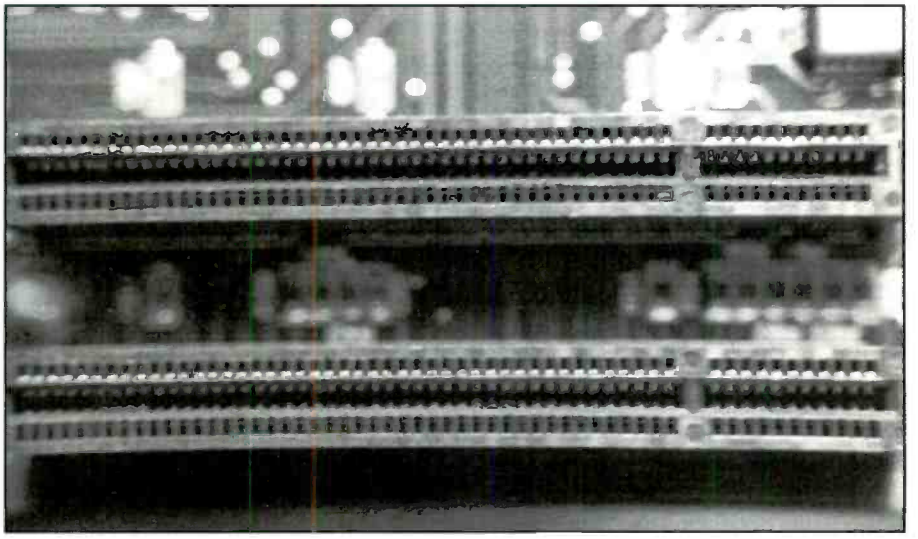


Figure 2. The Micro Channel Architecture of the IBM computers features this new style edge connector with 0.05-inch pin spacing.

The EISA bus

The compatible industry decided to make their new standard compatible with the existing technology. The old standard developed by IBM was then referred to as ISA, for Industry Standard Architecture and the new technology was called "EISA," for Enhanced Industry Standard Architecture. EISA used a double-height connector with two rows of contacts. The top row was for ISA signals and the bottom row carried the EISA signals. An EISA card was designed to slip past the top row of connectors and access the bottom row.

EISA provided access to the 32-bit ad-

Kull is a medical electronics technician at the St. Louis Regional Medical Center.

TABLE 1

8 BIT ISA BUS CONNECTIONS

Pin Number	I/O	Signal	Signal Description
A1	I	I/O CHK	I/O CHANNEL CHECK
A2	I/O	SD7	DATA BIT 7
A3	I/O	SD6	DATA BIT 6
A4	I/O	SD5	DATA BIT 5
A5	I/O	SD4	DATA BIT 4
A6	I/O	SD3	DATA BIT 3
A7	I/O	SD2	DATA BIT 2
A8	I/O	SD1	DATA BIT 1
A9	I/O	SD0	DATA BIT 0
A10	I	I/O CHRDY	I/O CHANNEL READY
A11	O	AEN	ADDRESS ENABLE
A12	I/O	SA19	ADDRESS BIT 19
A13	I/O	SA18	ADDRESS BIT 18
A14	I/O	SA17	ADDRESS BIT 17
A15	I/O	SA16	ADDRESS BIT 16
A16	I/O	SA15	ADDRESS BIT 15
A17	I/O	SA14	ADDRESS BIT 14
A18	I/O	SA13	ADDRESS BIT 13
A19	I/O	SA12	ADDRESS BIT 12
A20	I/O	SA11	ADDRESS BIT 11
A21	I/O	SA10	ADDRESS BIT 10
A22	I/O	SA9	ADDRESS BIT 9
A23	I/O	SA8	ADDRESS BIT 8
A24	I/O	SA7	ADDRESS BIT 7
A25	I/O	SA6	ADDRESS BIT 6
A26	I/O	SA5	ADDRESS BIT 5
A27	I/O	SA4	ADDRESS BIT 4
A28	I/O	SA3	ADDRESS BIT 3
A29	I/O	SA2	ADDRESS BIT 2
A30	I/O	SA1	ADDRESS BIT 1
A31	I/O	SA0	ADDRESS BIT 0
B1	—	GND	GROUND
B2	O	RESET	SET DRIVER
B3	—	+5V	+ 5 VOLTS
B4	I	IRQ2/9	INTERRUPT REQUEST 2/9
B5	—	+5V	+5 VOLTS
B6	I	DRQ2	DATA REQUEST 2
B7	—	-12V	-12 VOLTS
B8	I	OWS	CARD SELECT (XT ONLY)
B9	—	+12V	+ 12 VOLTS
B10	—	GND	GROUND
B11	O	SMEMW	MEMORY WRITE
B12	O	SMEMR	MEMORY READ
B13	I/O	IOW	I/O WRITE
B14	I/O	IOR	I/O READ
B15	O	DACK3	DMA ACKNOWLEDGE 3
B16	I	DRQ3	DMA REQUEST 3
B17	O	DACK1	DMA ACKNOWLEDGE 1
B18	I	DRQ1	DMA REQUEST 1
B19	O	DACK0	DMA ACKNOWLEDGE 0
B20	I/O	CLK	CLOCK
B21	I	IRQ7	INTERRUPT REQUEST 7
B22	I	IRQ6	INTERRUPT REQUEST 6
B23	I	IRQ5	INTERRUPT REQUEST 5
B24	I	IRQ4	INTERRUPT REQUEST 4
B25	I	IRQ3	INTERRUPT REQUEST 3
B26	O	DACK2	DMA ACKNOWLEDGE 2
B27	O	T/C	TERMINAL COUNT
B28	O	ALE	ADDRESS LATCH ENABLE
B29	—	+5V	+ 5 VOLTS
B30	O	OSC	OSCILLATOR
B31	0	GND	GROUND

Table 1. Eight-bit ISA connections.

dress and data path. (EISA met with very limited success. Most users found the ISA bus provided them with sufficient performance). EISA and MCA both provided 32-bit access but both were limited to an 8MHz or 10MHz speed limit.

The main reason for the 8MHz speed limit is compatibility. Most expansion

cards were designed to run at 8MHz. The 8MHz speed limit allowed the faster microprocessors to be compatible with the older hardware. However this creates a data bottleneck. Data races between the microprocessor and memory at the system clock speed on a 32-bit data bus, but encounters a "bottleneck" at the 8MHz, 16-bit expansion bus. To slow down the microprocessor, "wait states" are added.

A wait state is a system clock cycle during which the microprocessor "waits" for the device with which it is communicating. Wait states are also used in faster microprocessors to communicate with slower memory chips. Many motherboards contain hardware jumpers or software settings to determine memory wait states. The net result is a slowdown in system performance.

The local bus

Local bus motherboards provide access to the processor's 32-bit address and data buses via special local bus slots on the motherboard. An additional 124 pin, 0.05-inch socket is mounted in line with the ISA connectors and provides access to the local bus (Figure 3). This allows for direct data transfer to the microprocessor and eliminates the data bottleneck.

The bus specifications allow for speeds up to 66MHz and transfers data via a 32-bit data path. Compared to the ISA bus, which operates at 8MHz and transfers data via a 16-bit data path, the local bus can exchange data up to six times as fast. As with all good things in life, the local bus does have a catch.

A special expansion card is needed for each device

To take advantage of the local bus technology a special expansion card is needed for each device that will access the bus. Currently, expansion cards are available for video, hard drive and network controllers. At first, most local bus systems were proprietary and required the user to purchase all expansion cards from the original manufacturer. Some vendors still incorporate the local bus video into the motherboard. Most offer two expansion slots for access to the bus. Fortunately, two standards were developed and have been adopted by the industry.

The two standards are: VESA (Video

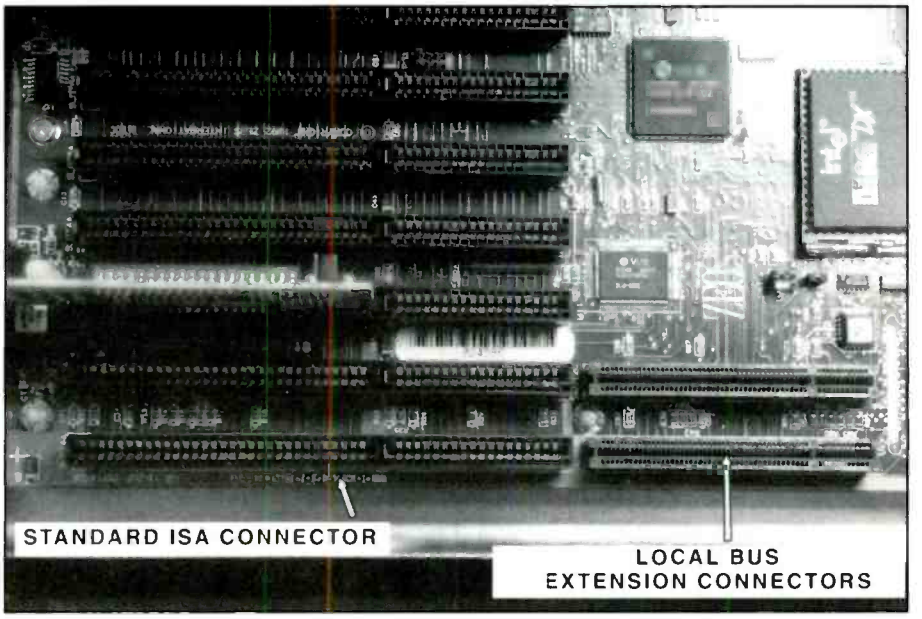


Figure 3. In some newer IBM compatible computers, an additional 124-pin, 0.05-inch socket is mounted in line with the ISA connectors and provides access to the local bus.

TABLE 2

16 BIT ISA BUS EXTENSION CONNECTIONS

Pin Number	I/O	Signal	Signal Description
C1	O	SBHE	SYSTEM BUS HIGH ENABLE
C2	I/O	LA23	UNLATCHED ADDRESS BIT 23
C3	I/O	LA22	UNLATCHED ADDRESS BIT 22
C4	I/O	LA21	UNLATCHED ADDRESS BIT 21
C5	I/O	LA20	UNLATCHED ADDRESS BIT 20
C6	I/O	LA19	UNLATCHED ADDRESS BIT 19
C7	I/O	LA18	UNLATCHED ADDRESS BIT 18
C8	I/O	LA17	UNLATCHED ADDRESS BIT 17
C9	O	MEMR	MEMORY READ
C10	O	MEMW	MEMORY WRITE
C11	I/O	SD08	DATA BIT 8
C12	I/O	SD09	DATA BIT 9
C13	I/O	SD10	DATA BIT 10
C14	I/O	SD11	DATA BIT 11
C15	I/O	SD12	DATA BIT 12
C16	I/O	SD13	DATA BIT 13
C17	I/O	SD14	DATA BIT 14
C18	I/O	SD15	DATA BIT 15
D1	I	MEMCS16	MEMORY 16-BIT CHIP SELECT
D2	I	I/OCS16	I/O 16-BIT CHIP SELECT
D3	I	IRQ10	INTERRUPT REQUEST 10
D4	I	IRQ11	INTERRUPT REQUEST 11
D5	I	IRQ12	INTERRUPT REQUEST 12
D6	I	IRQ15	INTERRUPT REQUEST 15
D7	I	IRQ14	INTERRUPT REQUEST 14
D8	O	DACK0	DMA ACKNOWLEDG 0
D9	I	DRQ0	DMA REQUEST 0
D10	O	DACK5	DMA ACKNOWLEDGE 5
D11	I	DRQ5	DMA REQUEST 5
D12	O	DACK6	DMA ACKNOWLEDGE 6
D13	I	DRQ6	DMA REQUEST 6
D14	O	DACK7	DMA ACKNOWLEDGE 7
D15	I	DRQ7	DMA REQUEST 7
D16	—	+5V	+5 VOLTS
D17	I	MASTER	MASTER
D18	—	GND	GROUND

Table 2. Sixteen-bit ISA bus extension connections.

TABLE 3
VL LOCAL BUS 32 BIT EXTENSION CONNECTIONS

Pin Number	I/O	Signal	Signal Description
A1	I/O	DAT01	DATA BIT 1
A2	I/O	DAT03	DATA BIT 3
A3	—	GND	GROUND
A4	I/O	DAT05	DATA BIT 5
A5	I/O	DAT07	DATA BIT 7
A6	I/O	DAT09	DATA BIT 9
A7	I/O	DAT11	DATA BIT 11
A8	I/O	DAT13	DATA BIT 13
A9	I/O	DAT15	DATA BIT 15
A10	—	GND	GROUND
A11	I/O	AT17	DATA BIT 17
A12	I	V_{cc}	+5 VOLTS
A13	I/O	DAT19	DATA BIT 19
A14	I/O	DAT21	DATA BIT 21
A15	I/O	DAT23	DATA BIT 23
A16	I/O	DAT25	DATA BIT 25
A17	—	GND	GROUND
A18	I/O	DAT27	DATA BIT 27
A19	I/O	DAT29	DATA BIT 29
A20	I/O	AT31	DATA BIT 31
A21	I/O	ADR30	ADDRESS BIT 30
A22	I/O	ADR28	ADDRESS BIT 28
A23	I/O	ADR26	ADDRESS BIT 26
A24	—	GND	GROUND
A25	I/O	ADR24	ADDRESS BIT 24
A26	I/O	ADR22	ADDRESS BIT 22
A27	I	V_{cc}	+ 5 VOLTS
A28	I/O	ADR20	ADDRESS BIT 20
A29	I/O	ADR18	ADDRESS BIT 18
A30	I/O	ADR16	ADDRESS BIT 16
A31	I/O	ADR14	ADDRESS BIT 14
A32	I/O	ADR12	ADDRESS BIT 12
A33	I/O	ADR10	ADDRESS BIT 10
A34	I/O	ADR08	ADDRESS BIT 8
A35	—	GND	GROUND
A36	I/O	ADR06	ADDRESS BIT 6
A37	I/O	ADR04	ADDRESS BIT 4
A38	O	WBACK	CACHE WRITE BACK. RESERVED USE
A39	I/O	BE0	BYTE ENABLE 0
A40	I	V_{cc}	+5 VOLTS
A41	I/O	BE1	BYTE ENABLE 1
A42	I/O	BE2	BYTE ENABLE 2
A43	—	GND	GROUND
A44	I/O	BE3	BYTE ENABLE 3
A45	I/O	ADS	ADDRESS DATA STROBE
A46	—	KEY	KEY
A47	—	KEY	KEY
A48	I/O	LRDY	LOCAL READY
A49	I/O	LDEV<<X>>	LOCAL DEVICE
A50	O	LREQ<<X>>	LOCAL REQUEST
A51	—	GND	GROUND
A52	I/O	LGNT	LOCAL BUS GRANT
A53	I	V_{cc}	+ 5 VOLTS
A54	O	ID2	CPU IDENTIFIER PIN 2
A55	O	ID3	CPU IDENTIFIER PIN 3
A56	O	ID4	CPU IDENTIFIER PIN 4
A57	O	LKEN	LOCAL CACHE ENABLE
A58	I/O	LEADS	LOCAL EXT ADDRESS STROBE
A59	—	N.C.	NO CONNECTION
A60	—	N.C.	NO CONNECTION
A61	—	N.C.	NO CONNECTION

Table 3. VL local bus 32-bit extension connections.

Electronics Standards Association) VL bus specification, currently the most popular, and the PCI, Peripheral Component Interconnect standard developed by Intel.

The VESA standard

The VL, or VESA Local, standard was introduced in August of 1992 and caught on very quickly. Designed around the 80486 microprocessor's local bus, the standard was easy and inexpensive to implement. This translated into low cost to the consumer and made it a very attractive upgrade.

Pin Number	I/O	Signal	Signal Description
A62	—	N.C.	NO CONNECTION
B1	I/O	AT00	DATA BIT 0
B2	I/O	DAT02	DATA BIT 2
B3	I/O	DAT04	DATA BIT 4
B4	I/O	DAT06	DATA BIT 6
B5	I/O	DAT08	DATA BIT 8
B6	—	GND	GROUND
B7	I/O	DAT10	DATA BIT 10
B8	/O	DAT12	DATA BIT 12
B9	I	V_{cc}	+ 5 VOLTS
B10	I/O	DAT14	DATA BIT 14
B11	I/O	DAT16	DATA BIT 16
B12	I/O	DAT18	DATA BIT 18
B13	I/O	DAT20	DATA BIT 20
B14	—	GND	GROUND
B15	I/O	DAT22	DATA BIT 22
B16	I/O	DAT24	DATA BIT 24
B17	I/O	DAT26	DATA BIT 26
B18	I/O	DAT28	DATA BIT 28
B19	I/O	DAT30	DATA BIT 30
B20	I	V_{cc}	+ 5 VOLTS
B21	I/O	ADR31	ADDRESS BIT 31
B22	—	GND	GROUND
B23	I/O	ADR29	ADDRESS BIT 29
B24	I/O	ADR27	ADDRESS BIT 27
B25	I/O	ADR25	ADDRSSS BIT 25
B26	I/O	ADR23	ADDRESS BIT 23
B27	I/O	ADR21	ADDRESS BIT 21
B28	I/O	ADR19	ADDRESS BIT 19
B29	—	GND	GROUND
B30	I/O	ADR17	ADDRESS BIT 17
B31	I/O	ADR15	ADDRESS BIT 15
B32	I	V_{cc}	+ 5 VOLTS
B33	I/O	ADR13	ADDRESS BIT 13
B34	I/O	ADR11	ADDRESS BIT 11
B35	I/O	ADR09	ADDRESS BIT 9
B36	I/O	ADR07	ADDRESS BIT 7
B37	I/O	ADR05	ADDRESS BIT 5
B38	—	GND	GROUND
B39	I/O	DR03	ADDRESS BIT 3
B40	I/O	ADR02	ADDRESS BIT 2
B41	—	N.C.	NO CONNECTION
B42	O	RESET	SYSTEM RESET FOR VL DEVICES
B43	I/O	D/C	DATA/CODE STATUS (IDENTIFY)
B44	I/O	M/IO	MEM OR I/O STATUS (IDENTIFY)
B45	I/O	W/R	READ/WRITE STATUS (IDENTIFY)
B46	—	KEY	KEY
B47	—	KEY	KEY
B48	O	RDYRTN	READY RETURN
B49	—	GND	GROUND
B50	I	IRQ9	INTERRUPT REQUEST 9
B51	I/O	BRDY	BURST READY
B52	I/O	BLAST	BURST LAST
B53	O	IDO	CPU IDENTIFIER PIN 0
B54	O	ID1	CPU IDENTIFIER PIN 1
B55	—	GND	GROUND
B56	O	LCLK	LOCAL CPU CLOCK
B57	I	V_{cc}	+ 5 VOLTS
B58	I/O	LBS16	LOCAL BUS SIZE=16 BITS
B59	—	N.C.	NO CONNECTION
B60	—	C.	NO CONNECTION
B61	—	N.C.	NO CONNECTION
B62	—	N.C.	NO CONNECTION

The VL bus connects the peripherals directly to the microprocessor's bus via a 124-pin, 0.05-inch connector (Table 3). This places quite a load on the microprocessor's address and data lines and limits the number of expansion connectors to two. Some motherboards add buffering to the bus, which increases the connector count to three. Electrical characteristics of the connectors determine the maximum bus speed.

If a device is integrated into the motherboard, speeds as high as 66MHz can be obtained. If one device is inserted into a local bus connector the maximum speed is reduced to 40MHz. The speed is then further reduced to 33MHz when a second device is added. Capacitance loading of the connector limits the expansion slots to three. For most consumers this is not a problem, since video and hard drive controllers are currently the only products available to access the local bus.

The PCI standard

The PCI standard was designed to work with high-end chips beyond the 80486, such as Intel's Pentium processor and other, non-Intel, chips. As in the case of the VL standard it uses the 124-pin 0.05-inch connector. However, it multiplexes the address and data lines, which limits the system speed to 33MHz (Table 4). Unlike the VL bus standard, PCI does not connect the peripheral directly to the microprocessor's bus. It creates a separate bus using a controller and accelerator chip set. This technique allows the PCI standard to be microprocessor independent.

Another attractive feature of PCI is automatic peripheral configuration. This allows the end user to install expansion cards without worrying about such things as memory addresses, DMA channels and IRQ settings. In addition, the PCI standard can support up to six peripherals. The main disadvantage to PCI over VL is high cost. This could change as the PCI standard becomes more popular.

Although the two standards are technically not compatible they have some similarities. Both designs use the additional 0.05-inch pin spacing socket made popular by IBM in its Micro Channel Architecture. The MCA style connector is mounted in-line with the existing ISA connectors. Both designs are also upgradeable from 32 bits to 64 bits to work with Intel's new Pentium processor.

Achieving high-speed data transfer

Both VL and PCI local bus technology use a process called burst transfers to transfer data at high speed. In a normal exchange of data between devices, the transmitting device first sends an address to the receiving device and then follows with data. The process is simply repeated over and over until all the data is sent. Burst transfers eliminate the repetitive address step by assuming all addresses are

PRODUCT INFORMATION

Digital industrial multimeters

Amprobe Instrument announces the introduction of the "Tradesmen Series," Models AM-16, AM-17 and AM-18, digital industrial multimeters. All models measure dcV, acV, diode test, continuity and resistance. Model AM-17 adds capacitance, Model AM-18 adds dc and ac current and capacitance. Features include: circuit protection on

all ranges, 3 1/2 digit, 2000 count, annunciated display, auto or manual ranging, overload, low battery, polarity annunciators, rugged high-impact molded case, auto zero on all ranges, 0.1Ω resolution, and expandable to measure ac current to 1000A, dc current to 600A, temperature and power with optional accessories.

Circle (110) on Reply Card

Soldering iron/torch kit

Philips ECG has announced that its butane-powered Soldering Iron/Torch is now available in a 10-piece kit (J-500KT) complete with carrying case, four different tips and other accessories.

The product is a compact, lightweight, hand-held tool that features a see-through refillable butane tank, a temperature control for accurate adjustment of tip temperature, and a built-in igniter. Applications for this tool include electrical/electronic circuit repair, forming heat-shrink tubing, light gauge welding, brazing, light plumbing, jewelry and eyeglass frame repair, model building, arts and crafts, and thawing frozen locks.

The kit includes the soldering iron/torch, a solder tip, blow torch tip, hot knife tip, heat blower tip, metal safety stand, a cleaning pad, spare flints and a half-ounce of 60/40 rosin core solder—all encased in a heavy-duty, fitted carrying case. Additional tips are optionally available.

Circle (111) on Reply Card

TABLE 4
PCI LOCAL BUS 32 BIT EXTENSION CONNECTIONS

PIN	I/O	SIGNAL	SIGNAL DESCRIPTION
A1	I	TRST	TEST RESET
A2	I	+12V	+ 12 VOLTS
A3	I	TMS	TEST MODE SELECT
A4		TDI	TEST DATA INPUT
A5	I	+5V	+5 VOLTS
A6	O	INTA	NTERRUPT A
A7	O	INTC	INTERRUPT C
A8	I	+5V	+ 5 VOLTS
A9	NA	NA	RESERVED
A10	I/O	+5V	+ 5 VOLTS
A11	NA	NA	RESERVED
A12	—	GND	GROUND
A13	—	GND	GROUND
A14	NA	NA	RESERVED
A15	I	RST	RESET
A16	I/O	+5V	+ 5 VOLTS
A17	I	GNT	GRANT (BUS MASTER ONLY)
A18	—	GND	GROUND
A19	A	NA	RESERVED
A20	I/O	AD30	ADDRESS/DATA BIT 30
A21	I	+3.3V	+ 3.3 VOLTS
A22	I/O	AD28	ADDRESS/DATA BIT 28
A23	I/O	AD26	ADDRESS/DATA BIT 26
A24	—	GND	GROUND
A25	I/O	AD24	ADDRESS/DATA BIT 24
A26	I	IDSEL	INITIALIZATION DEVICE SELECT
A27	I	3.3V	+3.3 VOLTS
A28	I/O	AD22	ADDRESS/DATA BIT 22
A29	I/O	AD20	ADDRESS/DATA BIT 20
A30	—	GND	GROUND
A31	I/O	AD18	ADDRESS/DATA BIT 18
A32	I/O	AD16	ADDRESS/DATA BIT 16
A33	I	+3.3V	+3.3 VOLTS
A34	I/O	FRAME	CYCLE FRAME
A35	—	GND	GROUND
A36	I/O	TRDY	TARGET READY
A37	—	GND	GROUND
A38	I/O	STOP	STOP
A39	I	+3.3V	+3.3 VOLTS
A40	I/O	SDONE	SNOOP DONE
A41	I/O	SBO	SNOOP BACKOFF
A42	—	GND	GROUND
A43	I/O	PAR	PARITY
A44	I/O	AD15	ADDRESS/DATA BIT 15
A45	I	+3.3V	+3.3 VOLTS
A46	I/O	AD13	ADDRESS/DATA BIT 13
A47	I/O	AD11	ADDRESS/DATA BIT 11
A48	—	GND	GROUND
A49	I/O	AD09	ADDRESS/DATA BIT 9
A50	—	KEY	KEY
A51	—	KEY	KEY
A52	I/O	C/BE0	BUS COMMAND/BYTE ENABLE 0
A53	I	+3.3V	+3.3 VOLTS
A54	I/O	AD06	ADDRESS/DATA BIT 6
A55	I/O	AD04	ADDRESS/DATA BIT 4
A56	—	GND	GROUND
A57	I/O	AD02	ADDRESS/DATA BIT 2
A58	I/O	AD00	ADDRESS/DATA BIT 0
A59	I/O	+5V	5 VOLTS
A60	I/O	REQ64	REQUEST 64-BIT TRANSFER
A61	—	+5V	+5 VOLTS
A62	—	+5V	+5 VOLTS

Table 4. PCI local bus 32-bit extension connections.

consecutive. The initial address is sent to the receiving device followed by a "burst" of data. The receiving device increments the addresses as it receives the data. The length of a data burst is unlimited, however, each new "burst" of data requires a new address.

Another technique called "bus mastering" allows data to be exchanged between bus devices without using the micro-

PIN	I/O	SIGNAL	SIGNAL DESCRIPTION
B1	I	-12V	-12 VOLTS
B2	I	TCK	TEST CLOCK
B3	—	GND	GROUND
B4	O	TDO	TEST DATA OUTPUT
B5	I	+5V	+5 VOLTS
B6	I	+5V	+5 VOLTS
B7		NTB	INTERRUPT B
B8	O	INTD	INTERRUPT D
B9	0	PRSNT1	EXPANSION CARD PRESENT 1
B10	NA	NA	RESERVED
B11		PRSNT2	EXPANSION CARD PRESENT 2
B12	—	GND	GROUND
B13	—	GND	GROUND
B14	NA	NA	RESERVED
B15	—	GND	GROUND
B16	I	CLK	CLOCK
B17	—	GND	GROUND
B18	O	REQ	REQUEST (BUS MASTER ONLY)
B19	I/O	+5V	+5 VOLTS
B20	I/O	AD31	ADDRESS/DATA BIT 31
B21	I/O	AD29	ADDRESS/DATA BIT 29
B22	—	GND	GROUND
B23	I/O	AD27	ADDRESS/DATA BIT 27
B24	I/O	AD25	ADDRESS/DATA BIT 25
B25	I	+3.3V	3.3 VOLTS
B26	I/O	C/BE3	BUS COMMAND/BYTE ENABLE 3
B27	I/O	AD23	ADDRESS/DATA BIT 23
B28	—	GND	GROUND
B29	I/O	AD21	ADDRESS/DATA BIT 21
B30	I/O	AD19	ADDRESS/DATA BIT 19
B31	I	+3.3V	+3.3 VOLTS
B32	I/O	AD17	ADDRESS/DATA BIT 17
B33	I/O	C/BE2	BUS COMMAND/BYTE ENABLE 2
B34	—	GND	GROUND
B35	I/O	IRDY	INITIATOR READY
B36	I	+3.3V	3.3 VOLTS
B37	I/O	DEVSEL	DEVICE SELECT
B38	—	GND	GROUND
B39	I/O	CLOCK	CLOCK
B40	I/O	PERR	PARITY ERROR
B41	I	+3.3V	+3.3 VOLTS
B42	I/O	SERR	SYSTEM ERROR
B43	I	+3.3V	+3.3 VOLTS
B44	I/O	C/BE1	BUS COMMAND/BYTE ENABLE 1
B45	I/O	AD14	ADDRESS/DATA BIT 14
B46	—	GND	GROUND
B47	I/O	AD12	ADDRESS/DATA BIT 12
B48	I/O	AD10	ADDRESS/DATA BIT 10
B49	—	GND	GROUND
B50	—	KEY	KEY
B51	—	KEY	KEY
B52	/O	AD08	ADDRESS/DATA BIT 8
B53	I/O	AD07	ADDRESS/DATA BIT 7
B54	I	+3.3V	+3.3 VOLTS
B55	I/O	AD05	ADDRESS/DATA BIT 5
B56	I/O	AD03	ADDRESS/DATA BIT 3
B57	—	GND	GROUND
B58	I/O	AD01	ADDRESS/DATA BIT 1
B59	I/O	+5V	+ 5 VOLTS
B60	I/O	ACK64	ACKNOWLEDGE 64-BIT TRANSFER
B61	I	+5V	+ 5 VOLTS
B62	I	+5V	+ 5 VOLTS

processor or system memory. A bus "master" controls which devices have access to the bus and prevents interference between devices. Both VL and PCI can support up to three bus masters.

Computers that can be upgraded to local bus

Any 80286, 80386, or 80486 system with a desktop or tower case can be upgraded with a local bus motherboard.

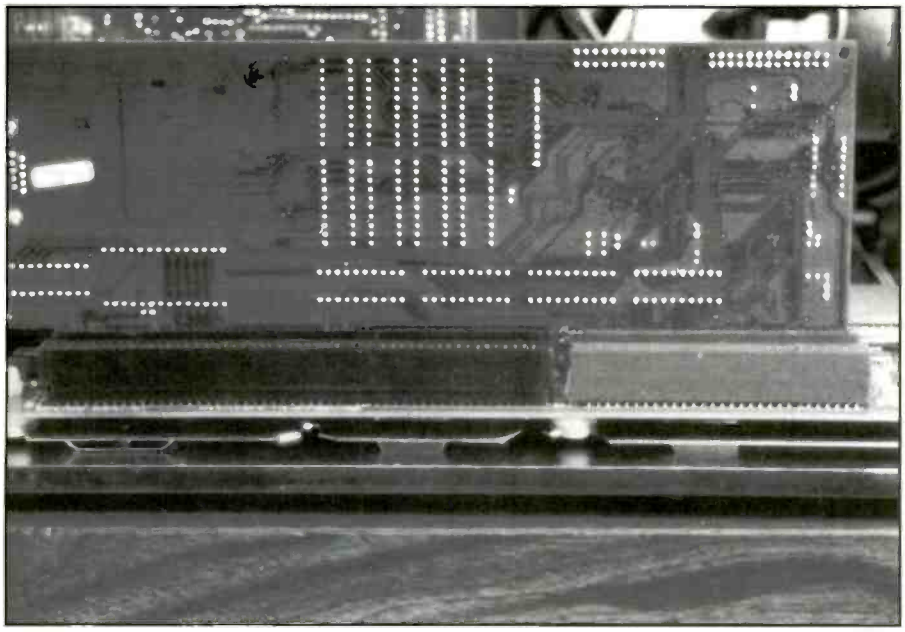


Figure 4. A local bus expansion card connects to the ISA and local bus connectors.

(Slim line cases are usually proprietary systems and require the original vendor's hardware to fit properly). In addition, it may be necessary to upgrade the power supply to a 200W or 250W unit if a smaller power supply is present in the system.

The old or defective motherboard is removed and the local bus board is installed in its place. The local bus expansion cards are then inserted into their special slots. A local bus expansion card connects to the ISA and local bus connectors (Figure 4).

Software drivers are usually included with the expansion cards or may be incorporated with a particular program's software. Check the expansion cards documentation for details.

Choosing a local bus system

Upgrading to local bus can provide significant system performance increases. Two questions remain: Who can benefit from local bus? Which system should you choose or recommend to your customer?

The biggest benefit will come to the graphics-based program user. However, a DOS-based program user will see some improvement as well. The price of a VL motherboard makes it impossible to ignore when upgrading or repairing an 80286 or 80386 PC. The difference in price of an 80486 ISA motherboard and an 80486 VL motherboard is insignificant. (Many vendors don't even list 80486 ISA motherboards on their price sheets.) In addition, VL peripheral expansion cards are competitive in price with their ISA counterparts.

Either VL or PCI can increase the performance of a PC. Which should you choose or recommend to your customer? VL is dominating the market right now, because support is good and it is inexpensive. A number of major manufacturers support PCI. This seems to indicate future support for this standard. PCI is more expensive to implement which increases the price of the PC, but may offer advantages in the future. As with any consumer product, as popularity increases the prices should drop.

VL seems the choice for now. As with any new consumer product we will have to watch the industry and make our decision based on current conditions and future projections.

If a customer comes to you complaining of slow screen drawing or data transfer, tell them that they need to get on the bus—the local bus. ■

Test Your Electronics Knowledge

Answers to the quiz

(from page 27)

1. C. Power is the time RATE of doing work or using energy.

2. No. A pure sine wave has no harmonic frequencies.

3. C. The neon lamp cannot glow because the applied voltage is too low. It is necessary to have at least 60V to start neon lamps.

4. A. By definition.

5. B. The voltage gain is less than one. There is current gain.

6. It is the symbol for the Arithmetic Logic Unit (ALU) in a microprocessor.

7. In a series-wound motor, the armature and field windings are connected in series. If this type of motor is operated without a mechanical load, its speed will increase until it is destroyed.

8. D. The product of the gain and bandwidth is a constant.

9. D. By definition.

10. D. The full-scale deflection current is equal to the reciprocal of the ohms-per-volt rating.

Literature

Catalog of electronic parts and components

The MCM Catalog contains over 20,000 high-demand parts and components—more than 1,000 of them introduced for the first time in this latest edition. Among the categories of products offered are: semiconductors, television parts, power supplies, home security alarms, telephone parts and accessories, connectors, tools, batteries, speakers, VCR parts and more; including the company's own line of value-priced TENMA test equipment. The company has expanded its lines of computer and cellular products and has introduced a selection of appliance repair parts.

Circle (50) on Reply Card

Catalog of test equipment, tools and supplies

This 244-page catalog from Contact East lists test instruments and tools for engineers, managers, technicians, and hobbyists. Featured are quality products from brand-name manufacturers for testing, repairing, and assembling electronic equipment. Product highlights include new DMMs and accessories, soldering tools, custom tool kits, EPROM programmers, power supplies, ELF meters, helpful reference books, breadboards, scope meters, datacom tools and testers, adhesives, measuring tools, precision hand tools, portable and bench top digital storage scopes. Also included are the company's lines of communication test equipment, soldering/desoldering systems, static protection products, ozone safe cleaners, magnifiers, inspection equipment, workbenches, cases and more.

Circle (51) on Reply Card

PC replacement parts catalog on floppy disk

PC Parts Express announces the availability of their catalog of replacement parts for personal computers and peripherals on floppy disk. The program consists of three basic modules that allow the user to perform three separate but related operations. The "Spare parts catalog item search" segment allows the user to search the data base to determine if a needed part is available from this supplier. The "Order processing" segment allows the user to automatically generate an order as he searches through the parts listed and selects those he wants to order. The "Utilities" program segment contains modules that allow the customer to set up and/or change his ordering information, make changes to the printer setup, a note on using the catalog, and a complete tutorial on searching for parts and ordering using the catalog. The catalog contains replacement parts for products by these manufacturers: AST, Canon, Compaq, Epson, Fujitsu, HP, IBM, Kingston, Micro House, NEC, Okidata and Toshiba. The program allows the user to look up the parts needed, and as he does so, automatically enter them into an order form which can then be printed out and mailed to the company, or faxed directly using the computer's fax/modem, if it has one. The catalog comes on one compressed floppy disk. When expanded it requires nearly 8 Mbytes of hard disk space.

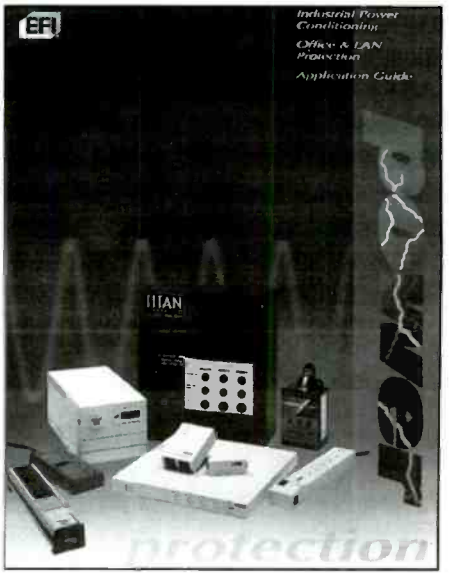
Circle (52) on Reply Card

Production equipment catalog

Now available is the Eraser Company's new 144-page, full-color, 1994 catalog, which includes new products used for wire stripping, cutting, dereeling, twisting, soldering, etc.

The catalog is divided into ten sections, covering all aspects of wire processing and component lead preparation. Several technical guides present information on choosing the proper equipment for an individual application.

Circle (53) on Reply Card



Catalog describes power protection products

A new, full-line "Power Protection" catalog is now available from EFI.

This 24-page, full-color, long-form product catalog describes a facility-wide solution to power and data line protection from transient voltages and other power problems typically found in commercial, industrial and medical facilities. In addition to in-depth product descriptions, the company's patented product technologies and value-added warranty programs are fully described.

The catalog also includes all available model numbers for over 50 categories of power protection products and services. Complete technical specifications are included, as are typical applications, important features, advantages and benefits, and full ordering guides for all products.

Circle (54) on Reply Card

Application note explains harmonics

BMI's new application note #230, "Harmonics: Sources, Symptoms, and Solutions," explains the causes and effects of harmonics, how to detect and measure harmonics, as well as how to avoid and solve the resulting problems.

The five-page application note includes two case studies on the hazardous effects of harmonics, one featuring a transformer explosion, the other, CRT flicker. The application note also presents instruments for use in harmonics detection and measurement.

Circle (55) on Reply Card

Correction to the article

"Simple power supply and probe adapter aid testing"

By Roger D. Redden

In the February 1994 issue of **Electronic Servicing & Technology** we published an article entitled "Simple power supply and probe adapter aid testing." There was an omission in one of the graphics that accompanied that article.

The power supply was described this way: "The power supply becomes useful when plugged into an isolated, variable ac source, such as an isolation transformer followed by a variable transformer. When plugged into such a source, this power supply can provide from 0Vdc to more than 150Vdc, depending on the amount of current drawn and the top voltage of the variable transformer used. This makes it useful to test a suspected IHVT at its operating voltage level, or to check a zener diode with a voltage rating up to about 150Vdc.

Caution! This power supply is capable of supplying an output that could be lethal! Do not plug it directly into an ac outlet. You must use it with an isolation transformer. To remind myself, I attached a label near the plug with the printed warning, *'Isolated Only.'*"

Figure 1 shows the circuit that accompanied that article. The power supply will work fine with the circuit as shown. Unfortunately, the capacitor will hold a charge for a long time so that if you touch the outputs even with the unit unplugged, you could receive an uncomfortable shock.

If you build this power supply, be sure to add the bleeder resistor as shown in Figure 2. With this resistor in the circuit, the capacitor voltage will bleed away through the resistor in a relatively short period of time. ■

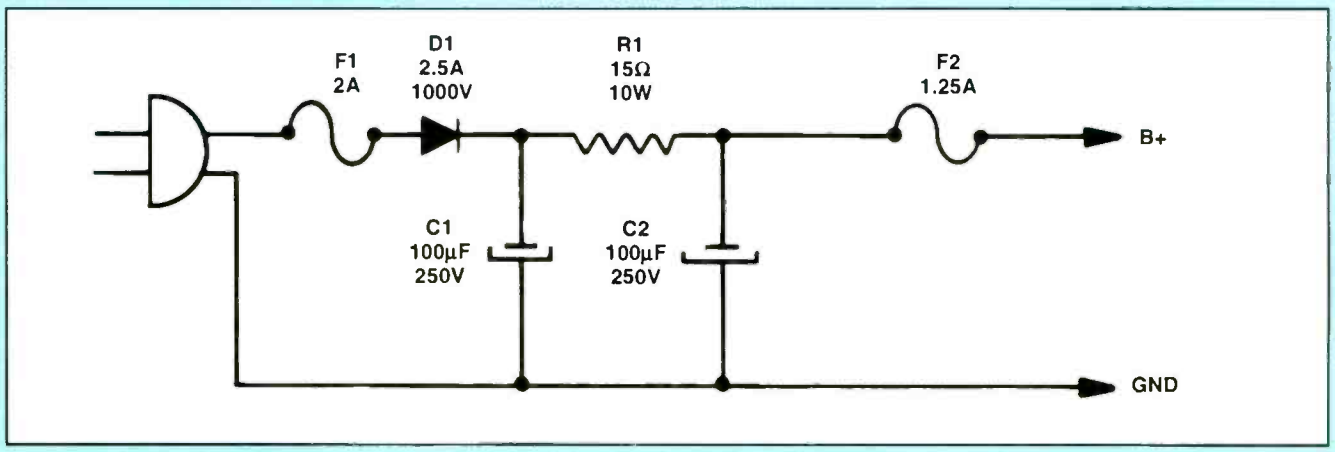


Figure 1.

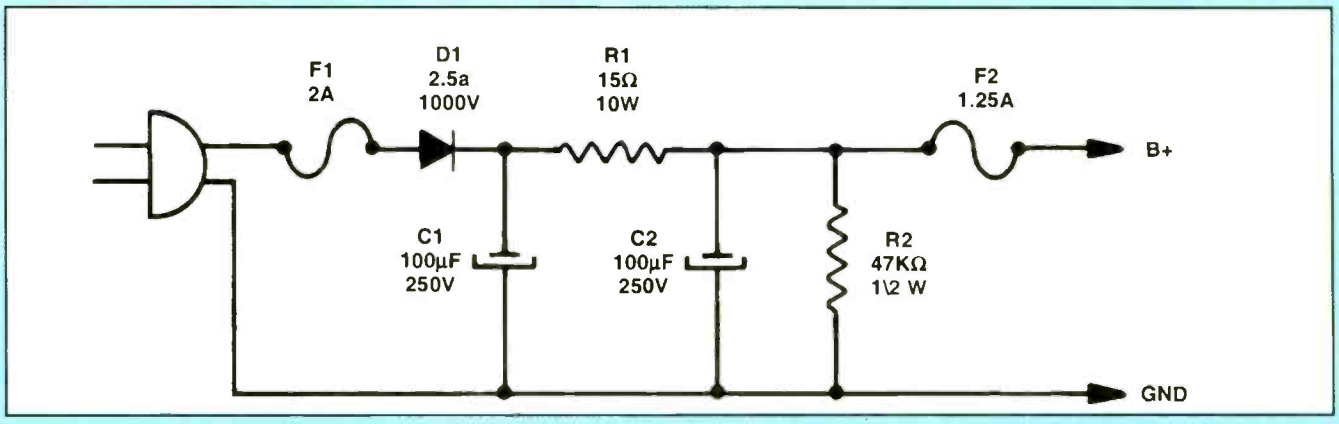


Figure 2.

Classified

Classified advertising is available by the word or per column inch.
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Per column Inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising please call 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

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Picture tube for Broksonic 5 inch color TV, model cert. 2610 UL. 150AYB22. *Contact M. Mitchell, 1665 Brownstone #3, Toledo, OH 43614.*

Chrysler car radio schematics for past 10 years, fiche, paper, or copies OK; also need Sams 2313-2334, 2338, 2369-2389, 2460-2557, and JVC HR-7300U or Tatung VRH-8200U VHS service manual. *Contact Randy Baeseman, 8301 S. Mountain Rd., Wausau, WI 54401, (715) 359-6604 (6 p.m. to midnight).*

Flyback 334P09403 for Mitsubishi, model CK2582. *Contact Dales TV, Rt. 1, Box 236, Mountainview, MO 65548, (417) 934-6655.*

JVC VCR service manuals. *Contact Truman McGregor, 3601 Jefferson Ave., Texarkana, AR 75502, (501) 773-6488.*

Schematic for (or ability to borrow) Mobile Authority Power Supply, model 810ZX. Also front panel glass for Frigidaire Flair range, model48C27912. *Contact Warren Shukis, 1479 Prince Edward Way, Sunnyvale, CA 94087, (510) 651-5112.*

Sams Photofacts, 2400 to present, any quality, will pay C.O.D. *Contact Reynolds TV & Video Service, 3510 Adams Ave., San Diego, CA 92116, (619) 284-9239.*

Microfiche reader, Variac, VCR service manuals. *Contact Nick, (717) 383-3975.*

Owner's manual or copy for Toshiba VCR model M-6000. *Contact Ron Purkhiser, 56 Oakhurst Dr., Munroe Falls, OH 44262, (216) 688-6624.*

Schematic for Apple monitor Model A2M2056 and same for other Apple monitors; meter for Sencore CR168 CRT tester. *Contact Steve Baker, 164 River Road, Hackettstown, NJ, (201) 927-0949.*

Schematic for color TV Contec Model MN-1347, chassis N13-08. *Contact Donald Stevens, 1005 N. Brookfield, South Bend, IN 46628, (219) 233-3746.*

Will pay for flyback transformer for Mitsubishi TV, model CK2582, p/n 334P09403, no longer available from Mitsubishi. *Contact Dales TV, Rt. 1 Box 236, Mountainview, MO 65548, (417) 934-6655.*

RCA yoke 150468, Magnavox cartridge 560355. *Contact Frank Szwanek TV, 303 Nothe Blaine, Box 237, Mullen, NE 69152.*

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Sams Photofacts; RCA Service Data Consumer Electronic Products books (1967–1978). *Contact Ann Bichanich (Jays), 15 1/2 W. Lake St., Chisholm, MN 55719, 1-(218) 254-4421.*

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Set of ES&T magazines from Nov. 74 to Jan. 91 (except Jul. 89), make offer. *Contact Mike Krajewski, 20 Criscoe St., Toronto, Ont., (416) 767-9014 (after 7 p.m.).*

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