THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC™

Servicing & Technology

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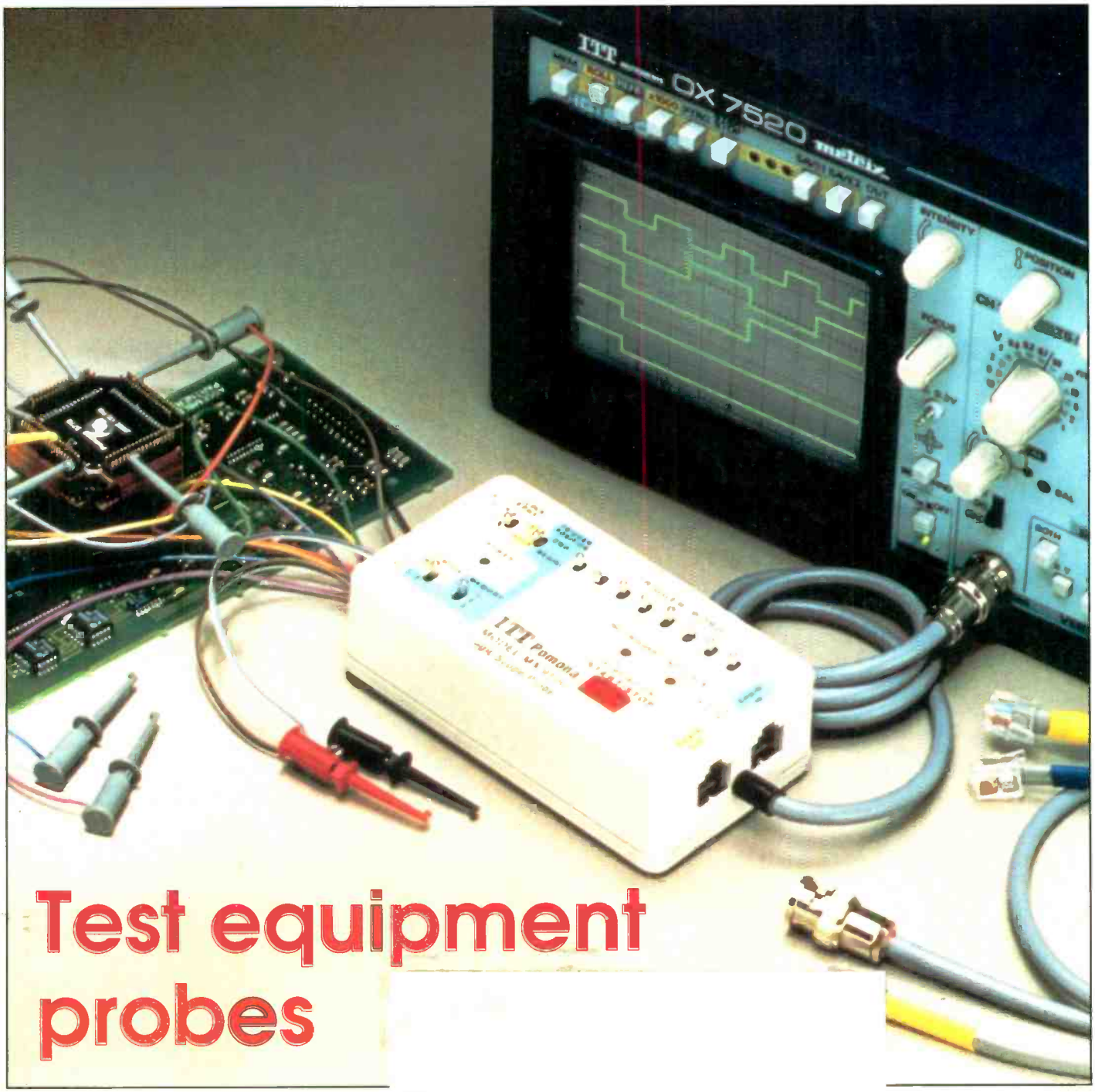


Test equipment probes

ctronics

Lance Flaxmer has been a fan of the Sencore instrument line since his business was founded in 1986. Lance started his business like many of the service centers throughout the country. He had a strong interest and curiosity in electronics that pointed him toward servicing from a small building next to his house. Lance was fortunate to outgrow the original building during the first year of business, and is now in a 9,000 square foot building, and doing warranty work for RCA, GE, Sharp, Toshiba, Sanyo/Fisher, and soon to add Magnavox. His growth primarily came from his ability to diversify in the products being serviced.

Lance attributes his success to his business layout that allows his customers to see his well equipped service bench from the customer counter. MP Electronics' reputation for quality servicing, advertising in local papers and radio, yellow page listing (which he attributes as his main advertising source), and his test instruments have helped to build his business to what it is today.

Everyone uses the SC3100 "AUTO TRACKER" at MP Electronics. They tell us the autoranging, built-in meter, and ohmmeter are the most popular features of the "AUTO TRACKER." With the "AUTO TRACKER" on the bench and business coming in the door, we look for MP Electronics to expand even further.

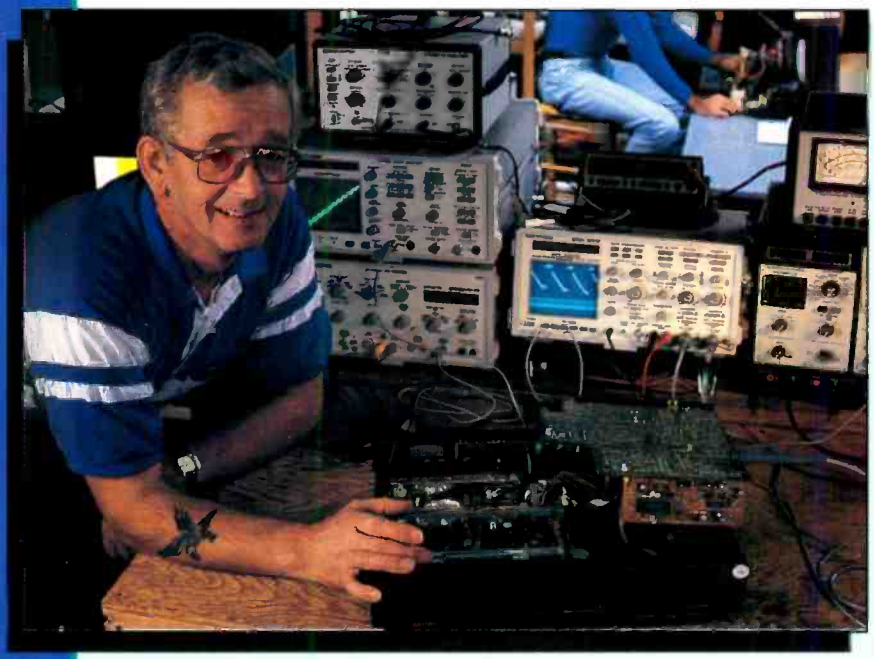
hstar nications

Rick Aldon made the decision to get involved in electronics when he failed a 13th grade physics class. It was from that point he decided that electronics was not going to defeat him. His business began as a hobby in 1970 and grew into a full-time business by 1976. Most of the advertising for Northstar Communications is by "word of mouth" and a yellow pages ad. Rick feels by providing good quality service to his customers, his reputation will speak for itself.

Sencore's Tech Tips and dedication to providing a good quality "after-the-sale support" is the biggest advantage in working with Sencore, says Rick. He claims they are essential in the fact that he can learn from someone else's experience. Rick depends on his VG91 Universal Video Generator and TVA92 TV Video Analyzer to reduce the time spent troubleshooting, and in most cases to help him diagnose down to the component level. Combining the VG91 and TVA92 with the technical support he receives from Sencore, Rick feels he's ready to tackle any video problem that comes his way.

SENCORE
CUSTOMER SPOTLIGHT:

MP Ele

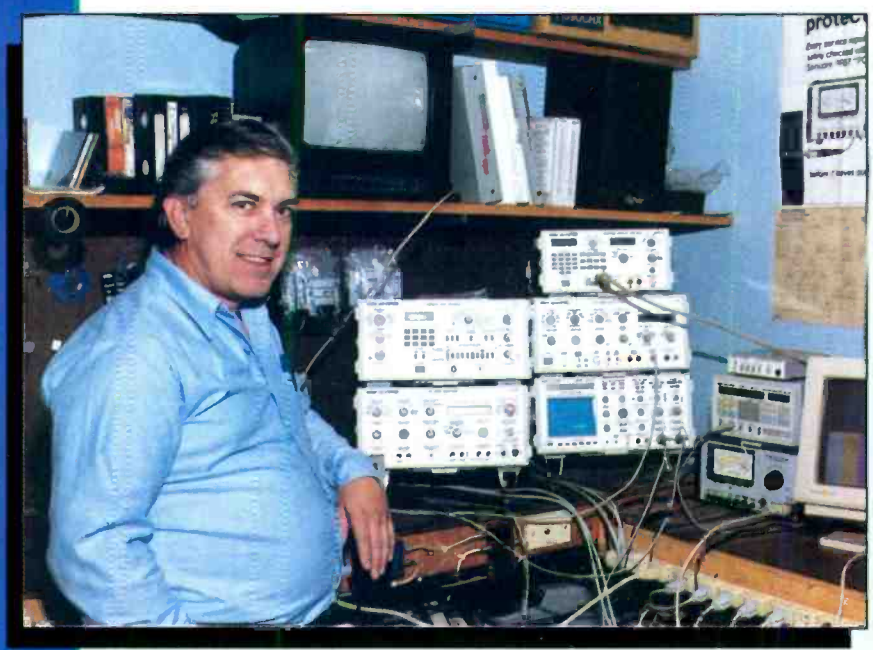


"When you work on today's consumer products, you need Sencore instruments. If you don't have the equipment, you simply can't profitably fix the products."

Customer Name: Lance Flaxmer, Owner
Business Name: MP Electronics
City: Hickory
State: North Carolina
Years In Business: 7 years
Products Serviced: TV, VCR, audio, monitors, camcorders, and projection TV
Number Of Employees: 3 technicians (Lance, Bruce, and Paula) Wife - Carol (books)
Key To Business Success: Diversification in products serviced.
Sencore Instruments Owned: SC3100, VC93, CVA94, VR940, CR70, PR57, TF46, SC61, VA62, ST66, LC76
Advice To Other Servicers: Disregard the bad image of doing warranty work and do it anyway. It helps fill the slow times, can help pay the bills, and provides an essential service to your customers.

SENCORE
CUSTOMER SPOTLIGHT:

Nort
Commu



"When all you do is service work, your test instruments can make the difference."

Customer Name: Rick Aldon, Owner
Business Name: Northstar Communications
City: Ontario
Province: Quebec
Years In Business: 17 years
Products Serviced: TV, VCR, audio, monitors, camcorders, CB radio, and video games
Number Of Employees: 2 technicians
Key To Business Success: Have the right equipment for all types of service work and get involved in many different areas of servicing.
Sencore Instruments Owned: VG91, TVA92
Advice To Other Servicers: If you're just starting out or have been in the business, take advantage of Sencore's financing program - make the equipment pay for itself. Plus it helps free up your working capital.

SENCORE

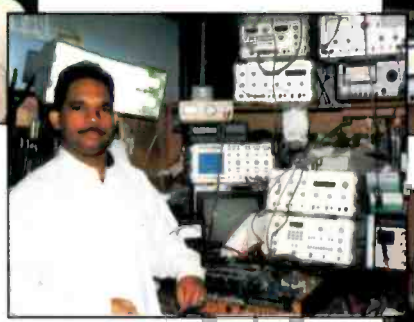
Customer Appreciation Celebration

David Jouvenat, LC102 Owner

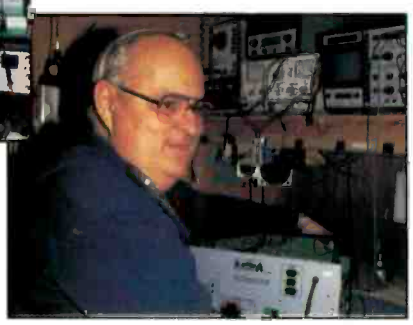
Gil Foley, CVA94 & VR940 Owner

Steve Thompson, VC93 Owner

Phil Casella, CM2000 Owner



Andres Ventura, CR70 & PR57 Owner



Don Hollinger, SM2001 Service Center Manager

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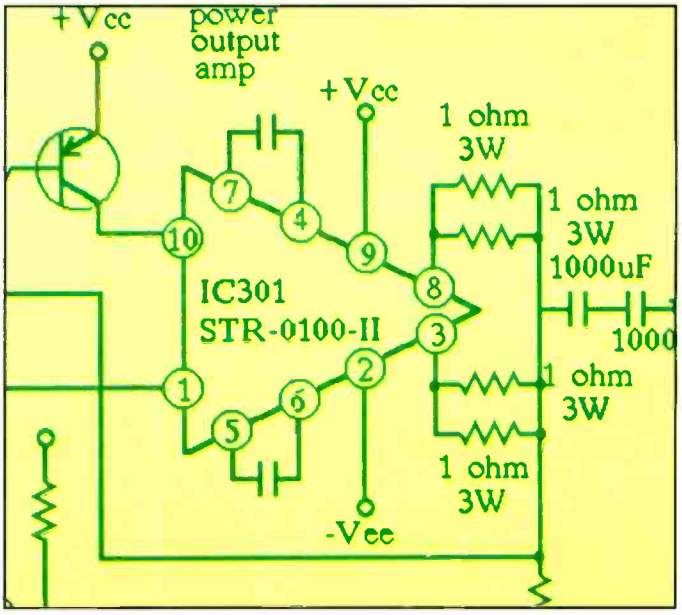

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FEATURES

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

EDITORIAL INDEX

In this issue, **ES&T** presents its annual update on the articles, departments and Profax schematics that we have published in 1993.

DEPARTMENTS

ON THE COVER

Very few consumer electronics service procedures are completed without hooking up the unit to some kind of test equipment. Between the unit being serviced and the test equipment there are test probes. It's important to make sure that the test probes being used are adequate to the task. (Photo courtesy ITT Pomona)

Another attempt to restrict choice of servicing

It seems to be a growing trend. The tendency for a number of manufacturers to attempt to rigidly control the servicing of their products is distressing. Not too long ago, there was the court fight between a California company, Image Technical Services, and Kodak over whether Kodak had the right to refuse to sell replacement parts to non-authorized service center as a way to monopolize service.

You may remember that in the editorial in this magazine in October 1991, we reported that Image Technical Service (ITS), which services office equipment, had sued Eastman Kodak Company in an attempt to force Kodak to sell replacement parts to them.

Back in 1985, ITS was servicing Kodak equipment such as microfiche readers and microfilm equipment. ITS became so successful in competing with Kodak's own service organization that Kodak halted sales of replacement parts to independent servicers throughout the U.S. A lawsuit brought by ITS and others to force Kodak to sell replacement parts to independent servicers was thrown out by a federal judge in San Francisco. Subsequently, an appellate panel ordered it back for trial. The Supreme Court had agreed to hear Kodak's appeal for dismissal.

As we reported in the editorial in the September 1992 issue, the ruling by the Supreme Court had the effect in this case that Kodak may not require people who bought their office products to also buy the service from Kodak.

This decision returned the case to the San Francisco District Court, the one that had originally ruled in favor of Kodak. However, that court's original ruling, that a company that does not have monopolistic power in the sale of its products can't have monopoly power in the servicing of that product, was overturned by the Supreme Court's decision.

More recently, NESDA has announced that a computer company, MAI Systems, has sued a service company, Peak Computers, for copyright infringement. According to the news item (see the News section in this issue), MAI claims that when the computer is turned on a copy of the software is copied into the computer's RAM, and that it is a copyright infringement for anyone not specifically authorized by the company to thus use the company's "intellectual property."

Amazingly, the courts have so far upheld MAI Systems' claim.

As pointed out by the NESDA announcement of this imbroglio, if this ruling is not struck down in a higher court, not only will it make servicing of these products illegal for any independent service center, but it will set a precedent that could make it possible for other manufacturers to follow suit. After all, the NESDA argument goes, ".... if this ruling is allowed to stand, all manufacturers of computers, automobiles, office products, and eventually almost every type of product manufactured; including appliances, radios, TV sets, heating and air conditioning controls, etc.; could claim a similar "right" to "intellectual property."

Actually, if you give it a little thought, restricting the use of "intellectual property" of the company to only the manufacturer and the purchaser of the product is a little bit like making it illegal for anyone but the purchaser of a book to read it. Extend this concept to music on tape or CD, and it would be permissible for you to listen to your music, but woe be to you if you have some friends over to listen to music, or let a friend borrow some of your CDs.

We certainly hope that the legal action that NESDA is pursuing in this case, as described in this months News, is successful. But if it's not, here's a suggestion. Every product from every manufacturer that tries to keep the servicing of its products to itself or only a few authorized dealers, either by legal means, or by refusing to sell service information or replacement parts, should come with a warning label, similar to the warnings that come on cigarette packages and alcoholic beverages. Something like this ought to do:

WARNING: Purchase of this product could be hazardous to your freedom of choice in servicing. The manufacturers of this product have chosen to restrict servicing of this product to itself and a few carefully chosen service centers. If this product fails for any reason, owner will not be able to bring it to his or her local, friendly, competent service center. Owner will be forced to return it to the factory for service or exchange at whatever rates the manufacturer chooses to set.

Of course that won't happen. But if manufacturers are successful in adopting a policy such as this in order to attempt to limit service choice, servicers everywhere should do everything in their power to make the public aware of the policy. If consumers buy these products they may have no choice of where to have it serviced. But if they are aware of such policies, consumers do have a choice of whose product to buy in the first place.

Nils Conrad Persson

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News

Digital HDTV alliance makes key technology decisions

The Digital HDTV "Grand Alliance" today announced a series of important technology decisions on key building blocks that will make up the digital high-definition television system being proposed to the Federal Communications Commission (FCC).

The technologies selected—for digital video compression, transport, scanning formats and audio technology—reflect the Grand Alliance's commitment to system excellence and responsiveness to the needs and concerns of consumers, broadcasters, cable operators, computer interests and the telecommunications industry.

Representatives of the Grand Alliance presented the technologies today to the Technical Subgroup to the FCC's Advisory Committee on Advanced Television Service, which endorsed the technology decisions. Today's technology decisions incorporate modifications of the GA system that had been recommended earlier by the Technical Subgroup.

Following approval of the full Advisory Committee, the Grand Alliance can proceed with construction of most aspects of the prototype system, which is expected to be tested next year.

Because of the Grand Alliance system's interoperability between entertainment television and computer and telecommunications technologies, today's decisions represent significant progress toward the establishment of the National Information Infrastructure.

Beyond entertainment television applications, digital HDTV can be an engine that helps drive deployment of the National Information Infrastructure—by advancing the development of receivers with high-resolution displays and of a high-data-rate path to the home for the delivery of a multitude of entertainment, education and information services.

Since the Grand Alliance was formed, the seven organizations involved have been evaluating technologies to decide on key elements that will be at the heart of the "best of the best" HDTV system.

The video compression and transport technologies selected by the Grand Alliance are based on proposed international MPEG-2 (Moving Picture Experts Group) standards. The scanning formats selected are focused primarily on computer-friendly progressive scanning, while offering an interlaced mode important to some broadcasters. The audio technology selected is a six-channel, CD-quality digital surround sound system. The last major technical decision—the broadcast and cable transmission subsys tem—is expected in early 1994 following testing of competing technologies.

The Digital HDTV Grand Alliance, announced on May 24, represents the merging of technologies developed by the three groups that had been vying for the digital HDTV standard in the United States: AT&T and Zenith Electronics Corporation, General Instrument Corporation and the Massachusetts Institute of Technology, and a consortium composed of Thomson Consumer Electronics, Philips Consumer Electronics and the David Sarnoff Research Center.

Home electronics installation association sets '94 Expo

CEDIA, the Custom Electronic Design and Installation Association, has announced that its 1994 Fall Management Conference and Trade Expo will be held in Dallas, September 8-11, 1994. Exhibits and workshops will be located at the Infomart and the Fairmont Hotel will be the site for the popular banquet and official headquarters lodging for the event.

According to Eric Bodley, CEDIA president, last year's event, also held at the Infomart, was the association's largest ever and attracted more than 2,100 attendees and nearly 100 exhibitors. It was so successful that the committee did not find it necessary to consider alternative sites.

The 1993 Expo was the first that CEDIA held at the Infomart, an exhibition-only venue with 87,000 square feet of exhibit space. It proved so popular to attendees and exhibitors, Bodley said, that the only discussion about venue was clearing the dates.

Bodley noted that while the agenda has not been finalized, he expects there to be more hands-on panels and workshops than last year and is looking forward to a series of educational panels which will focus on both the basics and the evolving nature of the custom electronics installation industry. "While the specifics will not be final until later in the year," he said, "I think it is safe to say that we will have major sessions on Home Entertainment and Systems Integration."

In addition, he said that an innovation of the 1993 Expo would be continued for '94. "We had such support for the manufacturers' seminars from both attendees and exhibitors that we will probably expand them."

CEDIA is a national trade association of companies which specialize in planning or installing electronic systems for the home—typically, single- or multi-room home entertainment systems, home theaters, media rooms, home automation, security systems, communications systems, and other residential electronics. The association was founded in 1989, and has approximately 500 members.

For further information (incl. fre

referrals to qualified custom installation companies around the world), contact Billilynne Keller, executive director, CEDIA, 8335 Allison Pointe Trail, Indianapolis, IN 46250. 1-800-CEDIA-30.

NESDA/ISCET/NIAS file another Supreme Court friend-of-the-court brief in behalf of independent service

The National Electronics Service Dealers Association (NESDA)—including its two other divisions, the International society of Certified Electronics Technicians (ISCET), and the National Independent Appliance Servicers (NIAS), and many of its associate state organizations—will soon have another legal presence in the U.S. Supreme Court. NESDA, its divisions, and its associate organizations represent several thousands of independent small-business service dealers and professional electronics technicians in every conceivable field throughout the United States and in many foreign countries. The service organizations filed a Friend-of-the-Court brief in Washington DC on November 22, 1993 on behalf of Peak Computer Corporation and the interest of independent service.

Peak Computer Corporation was sued by MAI Systems Inc. for alleged violations of the U.S. Copyright Act. MAI says that the software that operates its com-

(Continued on page 66)

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC
Servicing & Technology

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Understanding computer diagnostics

Introduction

A personal computer is a collection of electronics components interconnected in such a way as to perform a useful function. Based on that description, a computer is very much like a TV, VCR or camcorder. Right?

As far as it goes, that description is pretty much correct. The problem is it doesn't go far enough. If we only consider the electronic nature of a computer, it's pretty much like any other electronic product. But the definition of a computer requires that we add the words "under the control of a software program." That qualifier makes a computer very much different from any other electronics product.

A computer is really not just a computer. It's really an all-purpose information processing machine. Load up a word-processing program into a "computer" and it's a word processor. Recent studies have shown that well over half of all "computers" are used almost *exclusively* as word processors.

Load a database program into a "computer" and it's a data processor, allowing the user to store, sort, print out, etc. all the names and addresses or other data in the computer in any specified way.

Load a spreadsheet program into a "computer" and it truly becomes a computer, allowing the user to input and manipulate numbers, perform calculations, and execute other jobs.

Something else that differentiates a computer, at least an IBM or compatible, from most other electronics products is that it can be pieced together according to the buyer's specifications. When you buy a computer these days, you ordinarily have the choice of whether it will have an 80386 or 80486 processor. Of course, there are other processors available, but most compatibles sold these days are based on one or the other of these processors. And with either processor, you can specify if it is to be an SX (16-bit bus) or DX (32-bit bus).

Once you've specified the type of processor, you then decide on the amount of RAM you need. The buyer can stick with 640K of RAM, or go all the way up to several megabytes. And how about the disk drive? 20Mbytes, 40, 80, 130M bytes? More? And which kind of drive will it be? RLL? MFM? IDE?

Will you want to have a mouse installed? How about a modem? What kind of video display?

Obviously, there are a lot of choices, so any technician called in to service someone's computer will not necessarily know what he's working on. And most likely, unless he's very technical, the owner let himself be guided by the sales person, or just bought an attractively priced package and doesn't really know what the system consists of.

Diagnostic software

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

Furthermore, software can be made that will probe the computer, determine what's in the computer, and report that on the

screen or in printed form or a file on disk. So many diagnostic programs contain not only the diagnostic software, but software that will tell the technician or user whether there's a mouse installed, or a modem, and how much RAM there is, and the capacity of the disk drive.

As long as a disk drive, the CPU, and certain portions of the memory are operating properly, when a computer exhibits problems, a diagnostic software program will allow the service technician to perform many diagnostic checks. It's kind of like turning the computer into a test instrument to check itself out.

Some of the tests

One of the checks that a diagnostic program can do is check out memory (RAM) to see if it's all operating properly. The program writes a pattern of bits into memory and then reads it, and checks what came out with what was written in. It does this repeatedly. If the information read out of memory is different from what was written in, it reports that that portion of memory is faulty.

Other tests check other portions of the computer. For example, some diagnostic programs perform repeated reads and writes to the hard disk. If any areas of the disk give inconsistent results, the program flags them as bad so the computer won't attempt to write on those areas.

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

The diagnostic software program used by any technician should be carefully selected, depending on his level of expertise, how deeply he plans to get into computer servicing, and how much he wants to spend.

POST cards

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

There is a handy device, however, called a POST card, manufactured by a number of manufacturers, that will provide a visual indication of each step of the POST, and holds an indication of the last POST step performed before the computer shut down. That provides the technician with an indication of where to look to find the problem.

A diagnostic program example

Diagnostic products for technicians are similar but different. That is, three different oscilloscopes from three different manufacturers will have three different looks about the front panel, will have three different approaches to the controls that manipulate the trace, and will have three different approaches to reading out waveform parameters. But all oscilloscopes are made for observing waveforms, so once you have learned about one, you know a little something about all of the products in that category.

Something similar is true of diagnostic programs. They're all different. They take different approaches to checking a computer's innards, have different user interfaces, some are more comprehensive in their set of tests, some are easier to use than others, and some are more sensitive and accurate.

However, once you've learned the features of one diagnostic software package, you know something about diagnostics that's applicable to all diagnostics.

For that reason, we're presenting here a description of the experiences of one of our regular authors using one specific diagnostic program, with the intention that it will provide readers with a feel for what diagnostics in general can do to help in servicing of computers.

Take your choice

In addition to the description of the features of one diagnostic program, we present a list of the names and addresses and telephone numbers of a number of manufacturers of computer diagnostic and utility programs. If you think that computer diagnostics will be of use to you, contact one or several to find out what they have to offer. ■

Computer diagnostic product review

By John A. Ross

As a microcomputer specialist, I am always looking for new products that will help me complete technical repairs faster. Unfortunately, the sheer number of microcomputer products on today's market makes finding such a product a challenge. Compounding the challenge, some of the products that all of us encounter are either no longer manufactured, include no manufacturer's service information, or contain unlabeled components.

However, several third-party manufacturers have introduced products that help in diagnosing problems in microcomputers. One of those manufacturers, Micro 2000, a California-based company, has introduced a microcomputer diagnostic kit, Microscope, Version 5.0, that covers many service needs. Pictured in Figure 1, the complete kit features a software diagnostic application, a POST reader card, two technical manuals, a set of three wrap plugs, and a copy of the text, "Upgrading and Repairing PCs."

Figure 1. This diagnostic software kit features a software diagnostic application, a POST reader card, two technical manuals, a set of three wrap plugs, and a copy of the text, "Upgrading and Repairing PCs."

This diagnostic software package utilizes a proprietary environment that allows it to work independently of the microcomputer operating system. Consequently, it skirts many of the DOS functions that may obscure system faults. The software provides different types of system information, a wide range of diagnostic test routines, and a set of comprehensive utilities.

System information

Accessing the system information menu allows the user to find information about the microcomputer system board, adapter cards, the read-only memory (ROM), interrupt request (IRQ) lines, drive partitions, and processor registers. When a system fails, technicians can use this information to not only track the failure symptom, but also to reconfigure the system. The system information menu breaks down into sub-menus that will be described below.

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

System configuration

Through the system configuration menu, the software runs a series of routines that display the system type, the revision date for the BIOS (basic input/output system), and a listing of the detected system hardware. One list shows devices detected by the software. This list contains information about the type of microprocessor used in the system, whether the system contains a coprocessor, and the type of coprocessor installed.

In addition, the list shows the number of attached floppy disk drives and the number of attached hard disk drives, as well as information about the video adapter, serial and parallel ports, and the system memory. The memory information breaks down into video memory, base memory, extended memory, and expanded memory.

A second list shows how the devices are set in the CMOS data area by the user. If the information detected by the software disagrees with the configuration stored in the battery-backed CMOS ROM, the diagnostic software marks the item with an asterisk. Like the first list, the second shows if a coprocessor is installed. Furthermore, the list shows the number and types of floppy drives set in the CMOS, and the number and types of hard disk drives set in the CMOS. Concerning the CMOS system memory settings, the list shows the amount of base memory and it shows the amount of extended memory.

Active ROM search

Many hard disk and video controller cards include an additional ROM BIOS that works in tandem with the main system BIOS. The active ROM search displays the memory addresses used by the extended BIOS in hex form. Using this form, the software displays the 256-byte increment signature of the memory address, the length of the ROM, and the ending offset of the ROM.

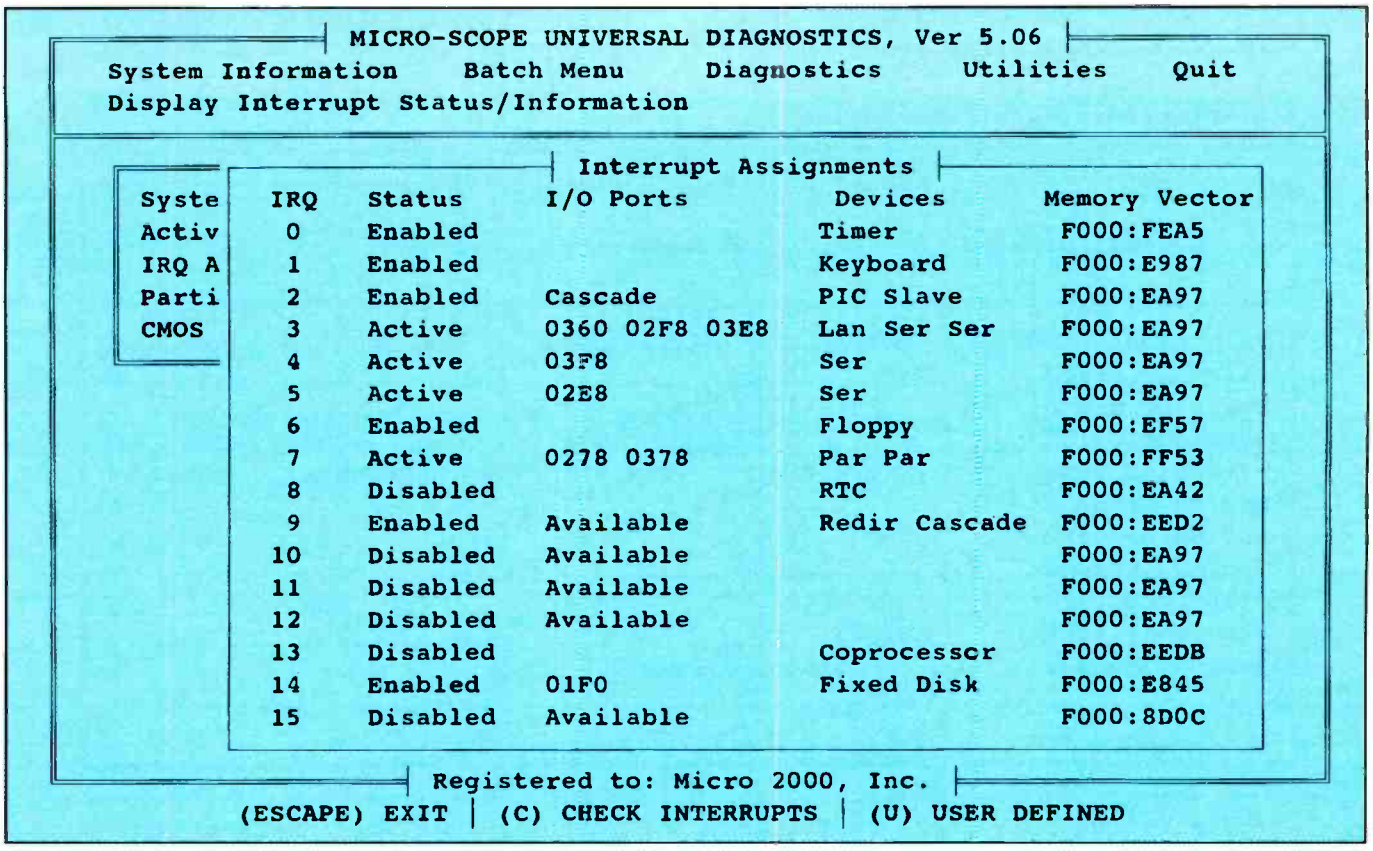


Figure 2. The Interrupt Assignment display screen shows the IRQ number, the status of the interrupt, the I/O port used, the type of device using the interrupt, and the memory vector for the interrupt.

As the manual shows, this information is important because each adapter has a specific, configurable, ROM BIOS address. Address conflicts can result in the malfunctioning of one or more adapters. To further aid technicians, the active ROM search identifies the ROM extension and attempts to match it with a respective device.

IRQ assignments

As a follow-up to the active ROM search display, this software also displays the system interrupt request or IRQ assignments. The information provided by this section is important for anyone who installs additional equipment into the microcomputer system. Many times, technicians will spend valuable time attempting to solve interrupt conflicts after installing additional serial ports, modems, or local-area network communication cards. As Figure 2 shows, the interrupt assignment display screen shows the IRQ number, the status of the interrupt, the I/O port used, the type of device using the interrupt, and the memory vector for the interrupt.

By pressing either the "C" key for "check interrupts" or the "U" key for "user defined," a technician can check the enabled or disabled state of the interrupt masked register in the 8259 programmable interrupt controller. Additionally, technicians can check the I/O port addresses of any attached communications device that use non-dedicated IRQs. Devices using dedicated IRQs, such as keyboards and fixed disks, are shown in a separate "devices" column.

Partition tables

The fourth menu selection under system configuration provides information about the hard disk drive partition table. Fixed disks may have as many as four physical partitions with the first partition containing the master boot record. Along with showing the partition status, the partition table also shows the starting and ending head, the starting and ending sector, and the starting and ending cylinder for the hard disk drive. In addition, the table shows the type of DOS used.

Choosing to access the partition table display/edit menu shows the display featured in Figure 3. At times, a corrupted partition boot sector or volume boot sector will prevent the accessing of a hard disk drive. The display/edit menu allows technicians to correct those sectors. As illustrated in the figure, the display/edit screen shows the number of bytes per sector, the number of sectors per cluster, and the number of sectors reserved for the boot sector.

In addition, the screen depicts the number of file allocation table (FAT) copies, the maximum number of root directories, the total number of sectors per volume, the number of sectors per FAT, and the number of sectors per track on the disk. Particularly helpful, the screen also shows the number of heads contained in the hard disk drive and the number of hidden sectors.

CMOS display/edit

Through the CMOS display/edit menu, technicians can check the CMOS battery condition and the status of the real-time clock registers. Also, they can edit specific areas of the system configuration information contained in the CMOS. This information becomes useful if the CMOS battery should fail or if a power surge corrupts the CMOS RAM. Among the areas

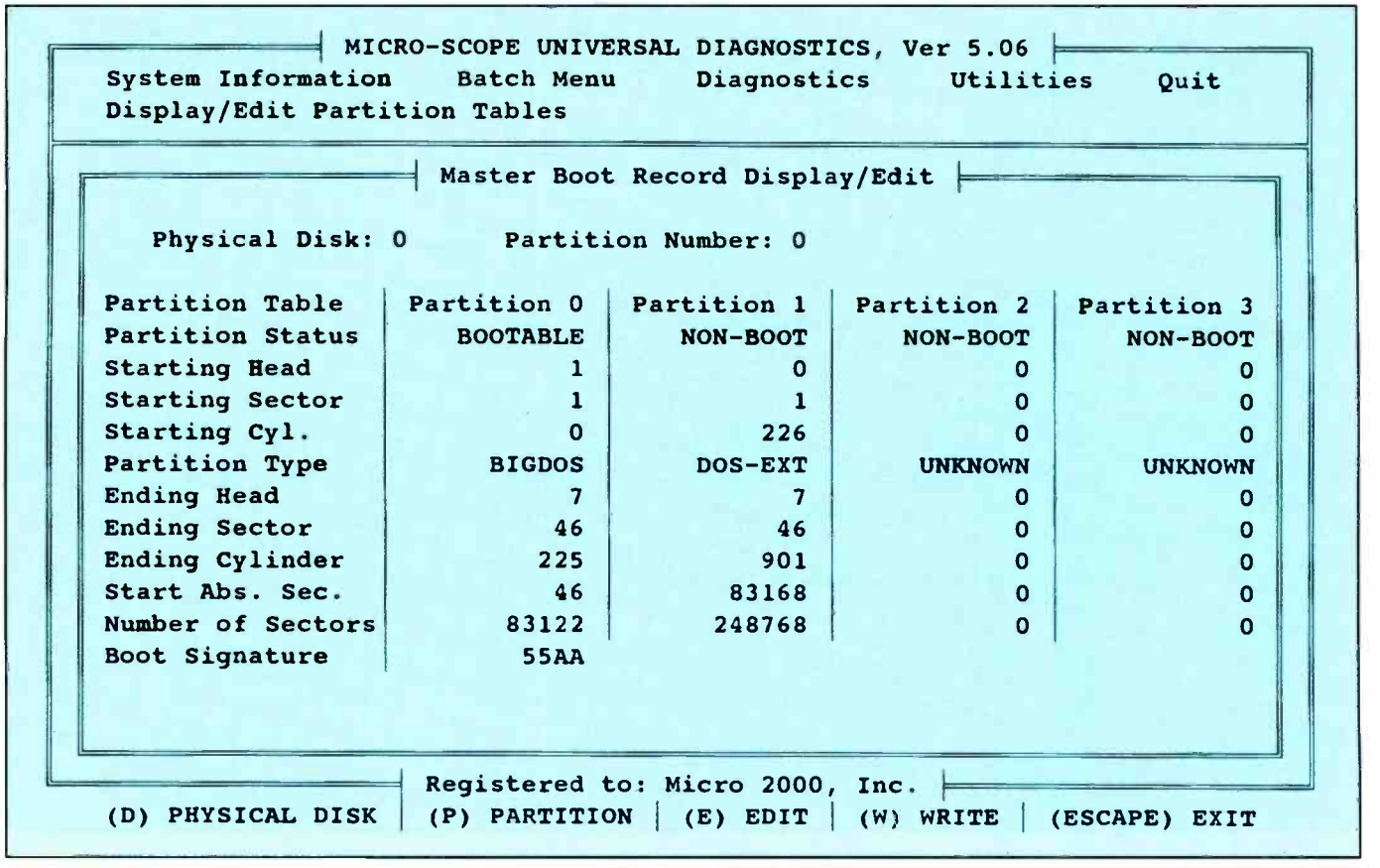


Figure 3. Choosing to access the partition table display/edit menu shows this display. At times, a corrupted partition boot sector or volume boot sector will prevent the accessing of a hard disk drive. The display/edit menu allows the technician to correct those sectors. As illustrated here, the display/edit screen shows the number of bytes per sector, the number of sectors per cluster, and the number of sectors reserved for the boot sector.

available for editing are the date and time, the number and media type of floppy disk drives, the number and type of hard disk drives, the type of video adapter, the status of the coprocessor, and the amount of base and extended memory.

When used with systems that utilize the MCA or micro-channel architecture, the CMOS edit/display screen displays the programmable option select registers utilized by that type of system. Those of you who work with IBM's MCA systems realize that each adapter installed in the system requires an adapter description file. As the system boots, it compares the adapter ID number with the information contained in the adapter description file. The ADF is contained in the CMOS ROM. If the compared information differs, the system must be reconfigured.

Batch menus

In addition to showing the system configuration settings, this software also contains a complete set of system diagnostics. The diagnostics cover the system board, the coprocessor, the system memory, floppy and hard disk drives, communications ports, and the video memory. The batch menus give technicians several choices for using the preliminary test routines. Technicians can run all tests continuously or for a set number of routines and select single tests. As with other diagnostic packages, this one also records discovered errors in an error log.

The preliminary system board tests cover the processor, the 8237A-series direct memory access (DMA) ICs, and the 8259-series programmable interrupt controllers. While the system memory tests check the base, cache, extended, and expanded memory areas, the video memory tests check specific amounts of video memory. The batch menu tests run the floppy disk drives through standard read and format tests.

Diagnostics menus

The diagnostics menus provide a more extensive set of tests for the same components tested through the batch menu. In addition, the tests break down into separate routines for different types of Intel and Intel-compatible microprocessors. These routines check both 16-bit and 32-bit registers, the logical instruction sets, and the arithmetic functions of the microprocessors.

For the DMAs, the tests cover the four channels of the single DMA used in XT-style microcomputers and the eight channels of the two DMAs used in AT-style systems. The interrupt controller tests verify the operation of the programmable interrupt controller ICs. Since the system board tests are more extensive, though, they also cover the 82C206 integrated peripheral controllers on newer boards.

Throughout the base memory tests, the software displays the test, the base memory area tested, the segment tested, and the number of passes. The software checks the cache memory by causing subsequent writes to the physically-mapped area of the cache. As the text explains, this causes the cache reads and writes to stay within the static RAM rather than the main system memory.

Extended memory tests check the extended memory area above 1024 kilobytes. Like the base memory tests, the extended memory diagnostics show the type of test, the tested area, the tested offset,

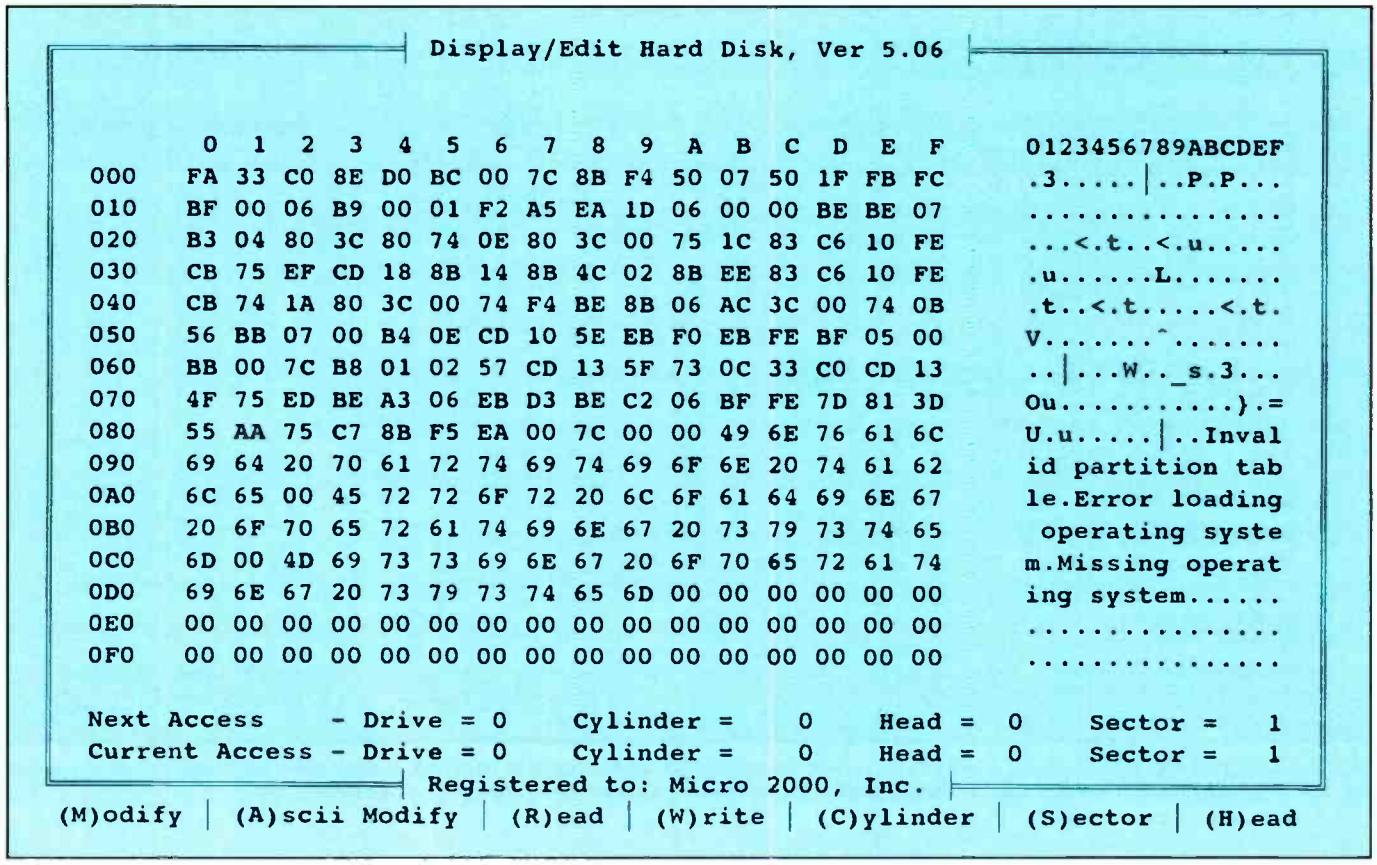


Figure 4. The memory display window shows the 1024K of real mode memory from segment 00000 through segment F0000. At the bottom of the window, the segment, offset, and actual address also is shown. Technicians can use the memory display and the Active ROM search option to find whether a program is currently utilizing the system memory.

the tested segment, and the number of performed tests. Instead of checking memory addresses, the expanded memory tests check the action of the expanded memory software drivers. The drivers should cause the correct paging of the expanded memory into the base memory.

Various tests exist for both the floppy disk and hard disk drives. Looking at the floppy disk drive menu, technicians may use the software to select the drive number and media type with the listed media types ranging from the $5^1/_4$ inch, 360K to 3.5 inch, 2.88M. In addition, the software allows the user to manually define media types so that non-standard media types may be tested as well as media types that may be developed in the future. After choosing the drive and media types, technicians can select the format diskette, butterfly, read, or write test.

The format test checks the formatting capabilities of the drive through the application of a non-DOS format. While the read and write tests sequentially check the reading and writing of a floppy disk by the drive, the butterfly test uses the read test functions in a different way. It reads the first sector, the last sector, the second sector, the second from last sector, and then follows that pattern while reading inward. This test works the head and drive electronics to their limits. When the test reaches the middle of the disk, it reverses and reads outward. All this helps to detect intermittent, drive alignment, and electronic component failures in the drive.

As in the case of the floppy disk drive tests, the hard disk drive diagnostics allow technicians to select the drive and perform the read, write, and butterfly checks. Because of the differences between hard and floppy disk drives and because of the variety of available hard disk drive types, other tests also remain.

For MFM and RLL hard disk drives, technicians can set the interleave and determine drive parameters. For MFM, RLL, and IDE drives, the diagnostics also allow the mapping of bad sectors and low-level formatting. Because ESDI and SCSI drives rely on the controller card BIOS for a low-level format routine, the software has an option for using the BIOS routine. In addition, technicians can test the separate controller cards used by the MFM, RLL, ESDI, and SCSI disk drives and the integrated controller card used with IDE disk drives.

As with many other diagnostics, this software offers tests for the serial and parallel ports. With the serial port tests, technicians can check the external and internal line status, the keyboard, mouse, and modem. In addition, technicians can select, display, and test the selected port, IRQ, I/O, Baud, and UART.

Just as important, technicians also can set the port configuration, baud rate, parity, and the data and stop bits. The same type of select, display, and test routines apply to the parallel port signals, pins, and status. Additionally, the tests check the parallel port data, control and status latches, and the interrupt level.

Finally, this diagnostics software tests the video adapter. The tests check the memory, video attributes, the video character set, the screen alignment, text and graphics modes, and the screen paging. While the attributes test shows the bits

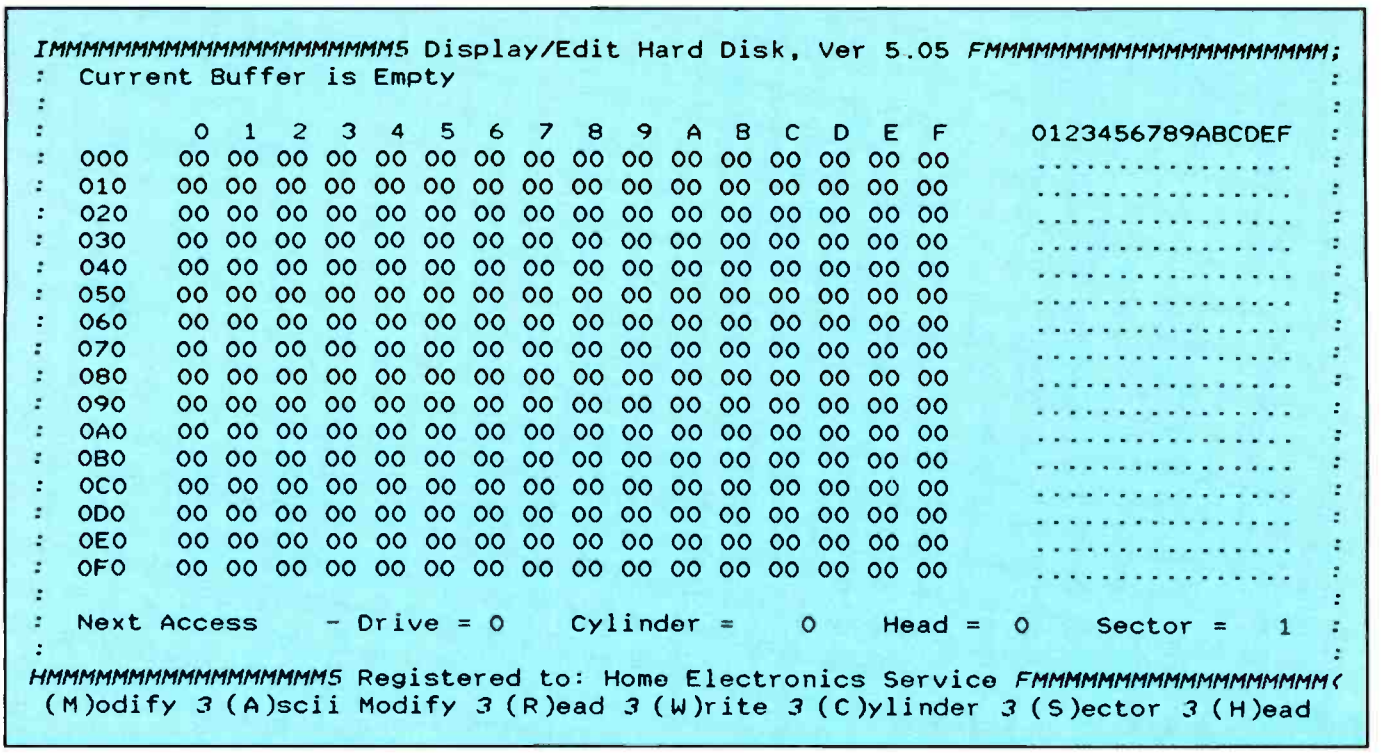


Figure 5. Using the appropriate editors, a technician can edit the contents of either a floppy or hard disk. In each case, a display/edit window shows the disk information in both hex and ASCII. This illustration shows how the window would appear for a fixed disk drive.

and hex locations for different display combinations, the screen alignment test displays a crosshatch pattern. An option also exists for checking the convergence.

Utilities

Another set of valuable service options is shown under the utilities menu. Those options give technicians the capability for displaying the contents of the system memory, editing the disk contents, cleaning the floppy disk drive, and resetting the display attributes from monochrome to color. From that list, the system memory and disk options warrant the most detailed discussion.

As shown in Figure 4, the memory display window shows the 1024K of real mode memory from segment 00000 through segment F0000. At the bottom of the window, the segment, offset, and actual address also is shown. Technicians can use the memory display and the active ROM search option to find whether a program is currently utilizing the system memory. The manual provides details about the system ROM BIOS, ROM BIOS extension, controller card ROM BIOS segment addresses, and driver addresses.

Using the respective editors, a technician can edit the contents of either a floppy or hard disk. In each case, a display/edit window shows the disk information in both hex and ASCII. Figure 5 shows how the window would appear for a fixed disk drive. Again in each case, the edit menus provide the options for modifying, reading, and writing with specific cylinders, sectors, and heads. The fixed disk option under the utility menu also allows the rebuilding of the master boot sector. Often, when a fixed disk drive fails to boot, the information usually found in the master boot record is either missing or corrupt.

POST

Troubleshooting "dead" PCs is often a challenging endeavor. All microcomputer systems go through a power-on self test (POST) during the boot-up process. During this POST, the computer scans and tests many of its circuits. The failure of any of a number of subsystems can prevent the powering up of the main system.

The only way to determine which of the many subsystems in the computer was the one that caused it to fail to boot is to remove power, insert a POST reader card in one of the computer's expansion slots, and again turn the system on. A POST reader card displays the diagnostic signals and POST codes simultaneously, allowing technicians to monitor the system as it boots.

Figure 6 shows the POST Probe, Micro 2000's POST reader card. The LEDs, switches, jumpers, probe and pads, and hex display on the card are labeled. While four LEDs monitor bus voltages, four other LEDs indicate whether the address latch enable, I/O write, I/O read, and memory read/write functions of the BIOS are operating. Other LEDs show the presence of the RESET, clock high/low signals, and the oscillator high/low signals.

Without the correct clock frequencies, the internal functions of the microprocessor will not occur. In older systems, the oscillator signal controls the system timing. To aid the interpretation of the LED readouts, the manual lists the signal functions and probable symptom causes.

With the addition of a test probe, this POST reader card also doubles as a logic probe for testing CMOS and TTL ICs. Three LEDs display the high-state (above 2.6Vdc), tri-state (between 0.8Vdc and 2.6Vdc), and low-state (less than 0.8Vdc) logic transitions. Using combinations of the LEDs, the logic probe indicates the presence of voltages ranging from +12 Vdc to -5Vdc and -12Vdc.

In addition to the logic probe, this unit also features a two-LED hexadecimal display. As soon as the diagnostics tool detects a system fault, the display shows a code that corresponds with the error codes listed in the manual. Technicians can cross-reference those codes with expected fault areas found in the troubleshooting guide. Figure 7 shows an example of the troubleshooting reference section.

Since the POST reader card installs into both IBM-compatible and micro-channel microcomputer systems, it features configuration jumpers and dip switches. In one position, the jumpers set the card for ISA/EISA diagnostics; the other position works for MCA systems. The DIP switches set the input/output port for the card as it works with ISA, EISA, and MCA.

Product support

Part of good product support involves having adequate technical manuals. The manuals that come with these products include more than the necessary essentials. The software manual contains information about troubleshooting computers and describes errors generally displayed by the diagnostics.

The manual for the probe provides the same type of detail. While 31 pages of the manual cover the POST routines for major BIOS manufacturers, 139 pages show the POST codes, text descriptions for the codes, plus possible reasons for failure and suggestions for troubleshooting. In both the routine and code sections, the information is broken down according to manufacturer.

The POST probe manual also includes a 60-page "chip pinouts" section that could easily double as a primer for many technicians. Figure 8 provides an example of the information found in that section. Providing product support also involves support for the product after its purchase. The company offers phone support for its products through a technical support line. Knowledgeable technical support personnel answer questions from 8:00 a.m. to 5:00 p.m. PST. When I attempted to contact the support personnel, I waited approximately two hours before they returned my call.

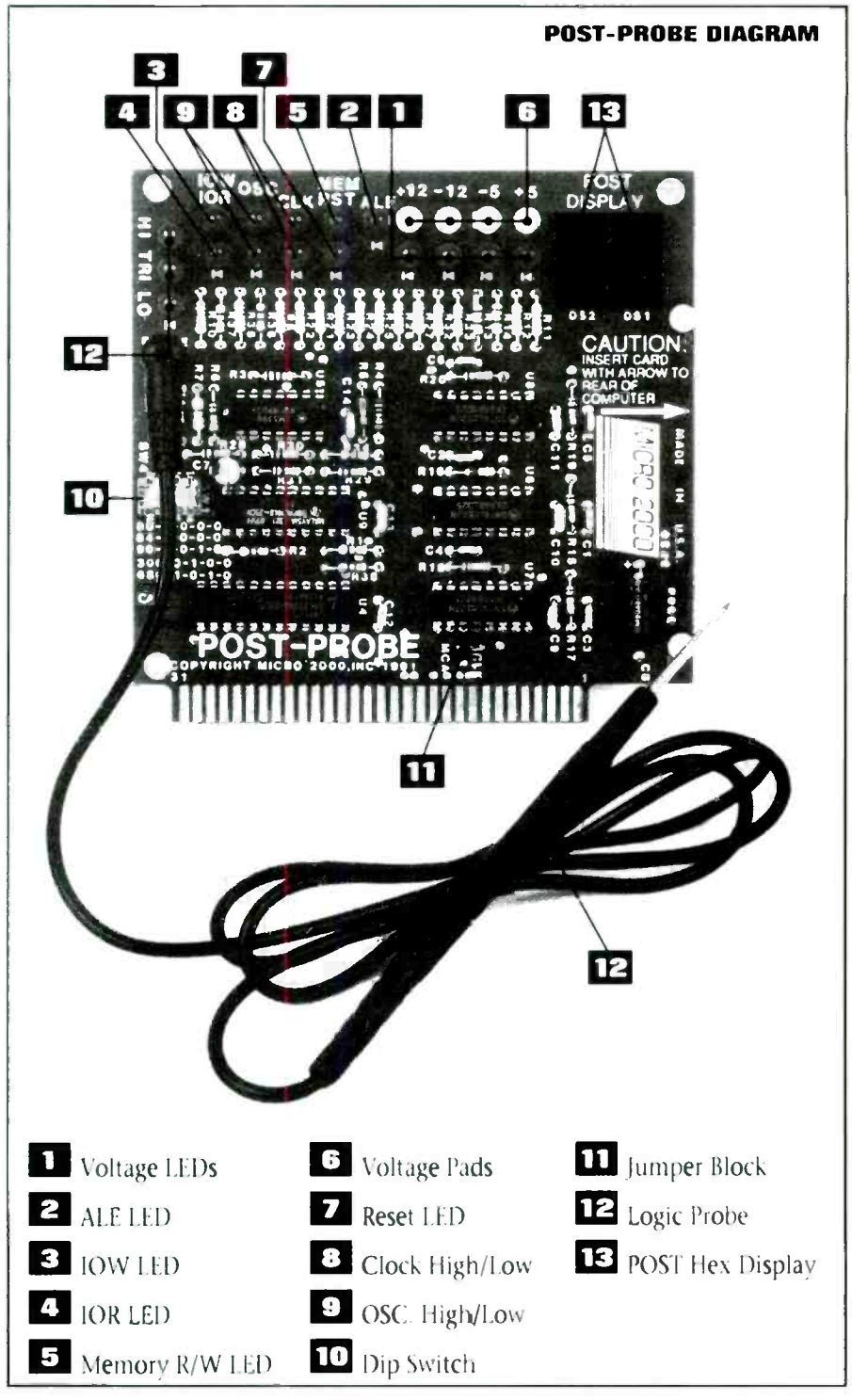


Figure 6. A POST reader card, such as this one, allows the technician to determine the cause when the computer fails to boot up.

Conclusion about the product

I encountered few problems when working with the software. On one occasion, my staff and I used the software to diagnose a CMOS problem in a Microtech 80386SX-based microcomputer that uses the AMI BIOS. Because of the CMOS problem, the system configuration had disappeared. After the owner had told us that the system contained an 80-megabyte hard disk drive and we had entered the configuration data for that drive into the CMOS, the software showed that the system had an 80-megabyte drive. Since we could not make the system boot with those drive parameters, we removed the case and found that the system actually contained a 120-megabyte disk drive.

As we interpreted the manual, the CMOS display/edit portion of the system configuration menu should have shown that a configuration mismatch was en-

POST CODES - IBM PS/2 (MCA) BIOS **POST CODES - IBM PS/2 (MCA) BIOS**

I/O 680 CODE	TEST DESCRIPTION	POSSIBLE FAILURE	TROUBLESHOOT SECTION REF.
49	TIMER 0 TEST	49 PIT CHIPS	SEC. B.4,6
4A	TIMER 2 TEST	4A PIT CHIPS	SEC. B.4,6
4B	TIMER INITERRUPT OCCURED	4B PIT CHIPS	SEC. B.4,6
4C	TIMER 0 FAST/SLOW TEST	4C PIT CHIPS	SEC. B.4,6
4D	TIMER 0 INTERRUPT TEST	4D PIT CHIPS	SEC. B.4,6
4E	8042 BUFFER FREE	4E 8042 CHIP,CMOS	SEC. B.9
4F	8042 SOFT/HARD RESET	4F 8042 CHIP	SEC. B.9
50	PREPARE FOR PROTECTED MODE	50 8042,BIOS	SEC. B.9
51	ENTER PROTECTED MODE	51 8042 CHIP,BIOS	SEC. B.9
52	PROTECTED MEMORY TEST	52 MEMORY CHIP	SEC. B.8
53	MEMORY TEST COMPLETE	53 MEMORY,CMOS	SEC. B.5,6,8
54	EXIT PROTECTED MODE	54 8042,BIOS	SEC. B.9
55	TEST FOR LOOP	55 JUMPER SET TO LOOP	N/A
56	8042 DISABLE	56 8042 CHIP	SEC. B.9
57	8042 SELF TEST COMMAND	57 8042 CHIP	SEC. B.9
58	8042 CHECK FOR ERRORS	58 8042 CHIP	SEC. B.9
59	KEYBOARD TEST	59 8042,KEYBOARD	SEC. B.9
5A	INITIALIZE MOUSE	5A RAM, MOUSE	SEC. B.9
5B	DISABLE MOUSE	5B N/A	N/A
5C	INITIALIZE BIOS VECTORS	5C BIOS,RAM,PIT	SEC. B.8
5D	INITIALIZE BIOS VECTORS	5D BIOS,RAM PIT	SEC. B.8
5E	INITIALIZE BIOS VECTORS	5E BIOS,RAM,PIT	SEC. B.8
5F	BIOS DATA AREA	5F BIOS DMA, PIT	SEC. B.2,4,6
60	DETERMINE DISKETTE RATE	60 FDC/DRIVE	SEC. A

Figure 7. As soon as the POST reader card detects a system fault, the display shows a code that corresponds with the error codes listed in the manual. Technicians can cross-reference those codes with expected fault areas found in the troubleshooting guide.

tered into the CMOS. An asterisk indicates a mismatch. However, no mismatch symbol appeared. From the manual, we had determined that Microscope would not only show the connection of a fixed drive into the system, but would also approximate or sense the parameters of the installed drive. When we called the company about this problem, they assured us that the drive identification feature exists in the software. A later edition of the Microscope manual will document the feature for its users.

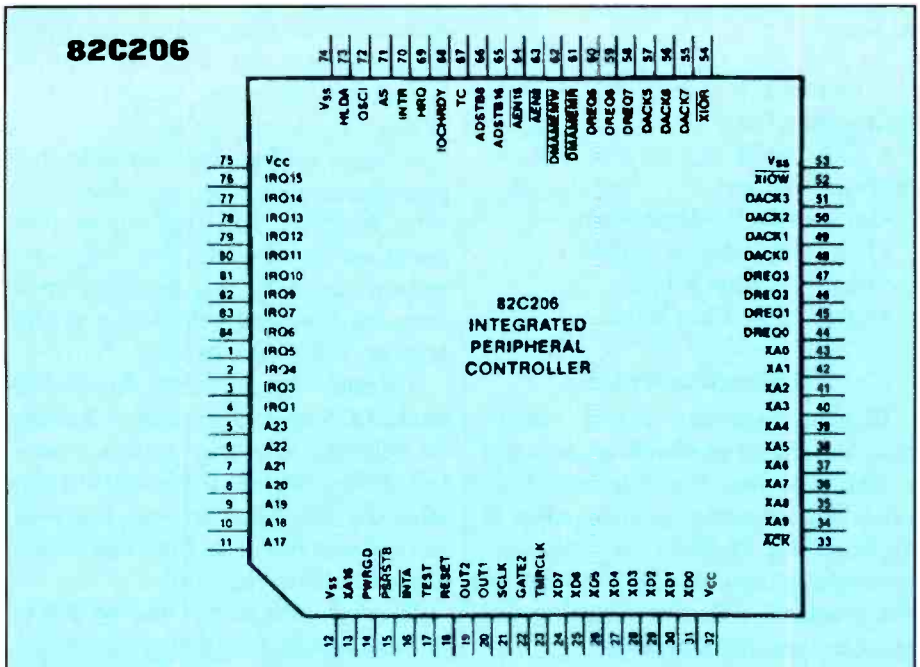
Despite those few problems, this is a useful diagnostic product. It is functional and simple to use. The software incorporates many options into one package previously seen only in many different packages. In addition, the software offers functions—such as the IDE low-level format—not seen in some other packages. Because of the well-written manual and the easily-followed menuing system, even novice technicians can solve difficult problems.

As if to illustrate this point, an ATT 6286 came into our service area with several failure symptoms. The symptoms included intermittent printing problems and floppy disk errors. Our least experienced technician took the call and attempted to identify the faults with the software. Within two minutes, through the use of the butterfly test, she found that the floppy disk drive had intermittent read problems.

Checks of the system board and the parallel port disclosed no further errors. A call to the user confirmed the technician's suspicion that the printing problems occurred only when the operator was using the floppy disk drive.

Conclusion about the POST reader card

Like the software, the POST probe offers functionality and simplicity. The combination of the hexadecimal display on the card and the troubleshooting ref-



The 82C206 Integrated Peripheral Controller incorporates two 8237 DMA controllers, two 8259 Interrupt controllers, one 8254 Timer/Counter, one MC146818 Real Time Clock, 74LS612 memory mapper, in addition to several other TTL/SSI interface logic chips to offer a single chip integration of all the peripherals attached to the peripheral bus (X-Bus) in the IBM PC AT while offering a complete compatibility to the IBM PC AT architecture, the chip offers enhanced features and improved speed performance, These include an additional 64 bytes of user RAM for the Real Time Clock, and drastically reduced recovery specifications for the 8237, 8259 and 8254. Variable wait state options are provided for the DMA cycles. Programmable delays are provided for the CPU access to the internal registers of the chip. The chip also provides an option to select 8 or 4 MHz system clock.

The 82C206, along with the CS8220 PC AT Compatible CHIPSet, provides a highly integrated high performance solution for a PC AT compatible implementation.

The 82C206 is implemented using advanced CMOS technology and is packaged in an 84-in PLCC>

Figure 8. The POST reader card manual also includes a 60-page "chip pinouts" section that would make a good primer for many technicians.

erence section in the manual make the POST probe a valuable tool for troubleshooting "dead" PCs. Furthermore, the addition of the logic probe, tri-state indicators, and the MCA adapter make the diagnostic tool even more attractive. The following case history verifies the usefulness of the POST probe.

Working with a "no-name" microcomputer that refused to power-up, we installed the POST probe in an effort to find the defect. Within seconds, the diagnostic tool showed that the proper voltages were in place on the system bus. Referring to the LED indicator on the card and to the list of error codes in the reference manual, we found that a defect existed in the CMOS area. After inspecting the system board, we discovered a broken connection on one IC pad. Inserting the POST probe, finding the defect, and correcting the problem took about ten minutes.

Microcomputer diagnostic kit

The Microscope software and POST probe are available separately, or as a complete kit from: Micro 2000, Inc., 1100 East Broadway, Suite 301, Glendale, CA 91205. 818-547-0125 or 818-547-0397.

Some PC diagnostic tools

There are a lot of personal-computer diagnostic products available to technicians, and more are being produced every day. In an attempt to make sense of the diagnostic market, we'll describe 38 popular diagnostic tools, separated into six categories. These six categories will suggest when you would need a product from that category, describe what the product in that category is supposed to do, and explain what to look for when purchasing a product in that category.

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

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

The software products in each category are listed in alphabetical order by product name. At the end of the article, the companies are listed in alphabetical order by company name.

POST reader cards

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

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

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

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

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

Make sure the POST reader card has separate LED's to monitor the power supply, oscillator signals, clock signals, reset signal, address latch enable signal, memory signal, I/O write signals, and I/O read signals. This will allow you to determine the exact failure on a system that failed before the BIOS could start POST.

Engineers will want a card with a tri-state logic probe connected to the card so they can do pin level testing with one hand. A Technical Support Line is a must.

Some of the POST reader cards are listed here:

- Kickstart I—Landmark Research International Corp.
- Kickstart II—Landmark Research International Corp.
- Pocket Post II—Data Depot
- Post Probe—Micro 2000 Inc.
- Racer II—Ultra X Inc.
- Racer PSII—Ultra X Inc.

Diagnostic software

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

Diagnostic software should have the ability to determine the difference between hardware problems and software problems. Once the hardware problem is identified and corrected, or if it is determined that there is no hardware problem, then you can move on to software problems. Software corruption such as CMOS, partitions, FATs, root directories, sub directories, data, and viruses should be able to be identified and fixed quickly, and, more important, without the loss of data.

Software configuration problems between the operating system, software drivers, Windows, and applications programs are so numerous that diagnostic software products only briefly address them, but a knowledgeable technical support line will be able to help.

A diagnostic program that doesn't rely on the DOS operating system will allow the technician to boot any system, regardless of the operating system, and to determine the difference between hardware and software problems since none of the original software is loaded.

The diagnostic should also be able to be loaded under the DOS operating system to determine software problems, since the original software that might be causing the problem needs to be loaded to be tested. This is done after determining whether a hardware problem exists.

The diagnostic software product should be able to display, edit, and test the following: Hardware configuration, CMOS

configuration, ROM addressing conflicts, IRQ conflicts, I/O conflicts, partition corruption, POS registers, processor, coprocessor, PIC's (8259), DMA's (8254), 640k base memory (including where the operating system [O/S] is loaded), 256k cache memory, all expanded memory, all extended memory (must be able to deal with 16 meg BIOS readdressing), all video memory (must be able to set SVGA modes to test above 256k).

Outside of the central portion of the computer itself, the diagnostic should be able to exercise floppy drives (must be able to set any media format), hard drives (must be able to low-level format all drive types including IDE drives), serial ports (must be able to do internal and external test and be able to set any port configuration), parallel ports (must be able to do internal and external test and be able to set any port configuration), video adapters (must be able to set modes, align cathode tubes, and test up to 2 meg memory), floppy and hard drive editors (must be able to edit track zero), and batch testing (must be selectable). A technical support line is a must.

Some of the diagnostic software packages are listed here:

- AMIDiag (Software)—American Megatrends, Inc.
- AMI Diagnostic Kit (Card and Software)—American Megatrends, Inc.
- Check It Pro—Touchstone Software Corp.
- Micro Scope—Micro 2000 Inc.
- PC Certify—Landmark Research International Corp.
- PC Clinic Pro—Data Depot Inc.
- PC Probe—Landmark Research International Corp.
- PC Technician—Windsor Technologies
- QA Plus/FE—Diagsoft Inc.
- QA Plus—Diagsoft Inc.
- Quick Tech II Plus—Ultra X Inc.
- SB Probe—Renasonce
- Service Diagnostics—Landmark Research International Corp.
- Trouble Shooter—All Micro Inc.

Fixed disk utilities

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

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

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

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

The editor should have features to repair (in order): The bootloader, partition tables, boot signature, volume boot sector, volume boot signature, FAT 1, FAT 2, root directories, subdirectories, and data files. Automated features save time but there should be manual capabilities for all of the above features. A bit string search is helpful when the DOS structure has completely collapsed. A technical support line is a must.

Some of the hard drive utilities are listed here:

- CPR Data Recovery—Tech Assist Inc.
- Disk Technician Gold—Disk Technician Corp.
- Mace—Fifth Generation Systems
- Norton Utilities—Symantec Corp.
- PC Tools—Central Point Software Inc.
- Spinrite—Gibson Research Corp.

Floppy disk drive utilities

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

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

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

Ordinarily, it is not worth a technician's time to realign a floppy drive, but for technicians who do realign drives, realignment can be attempted on most floppy drives in about 20 minutes with a floppy utility with realignment capabilities. Data recovery is normally not performed on floppy diskettes either, but if it is critical data you will find that fixed disk utilities have data recovery capabilities for floppy diskettes.

Some of the floppy disk-drive utilities are listed here:

- Drive Probe—Accurite Technologies Inc.
- Rescue—All Micro Inc.
- Trackmate—Trackmate

Virus utilities

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

A virus utility will run a string search for all known viruses either manually by the technician or automatically in the background on the system by the utility.

If a virus is found, the utility will let the user know and then correct.

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

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

Some virus utilities are listed here:

- McAfee—McAfee Associates
- Norton Antivirus—Symantec Corp.
- PC Tools—Central Point Software, Inc.
- Vi Spy Professional Edition—RG Software Inc.

Windows utilities

A Windows utility is used when you are having a problem, but only when running under Windows.

It should detect Windows and software configuration problems.

A Windows utility should be a program that does not run under Windows but can look at Windows and the software running under Windows, and detect the configuration problem.

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

Some Windows utilities are:

- Norton Desktop for Windows—Symantec Corp.
- QA Plus Win—Diagsoft Inc.
- Skylight—Renasonce
- Win Probe—Landmark Research International Corp.
- Winsleuth Gold Plus—Dariana Software

Names and addresses of companies that manufacture the products named in this article are:

Accurite Technologies Inc.
231 Charcot Avenue
San Jose, CA 95131
408-433-7980

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Tech Assist Inc.
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
415-456-2200 ■

The information presented in "Some PC diagnostic tools," beginning on page 15, is courtesy of micro 2000, Inc.

Will Total Quality Management Work for You?—Point 6

By John A. Ross

In Business Corner, for the past five months we have been looking at the management theory called Total Quality Management. In this installment, we'll talk about Point 6 of the TQM concept propounded by W. Edwards Deming.

TQM point 6

Institute training on the job.

All of us would agree with TQM Point 1 as Deming identified employee training as an important part of implementing quality. However, looking at Point 5, it becomes evident that he intends to take the emphasis on training to another level. As managers, many of us totally rely on the passing of knowledge from one employee to another or on self-training as methods for training employees. In some instances, employee training only appears as an afterthought. Understandably, the reasons for the lack of formal employee training include a lack of time, a lack of money, and an overemphasis on short-term goals.

With his sole emphasis on instituting training in Point 6, Deming is attempting to drive a key point home about quality.

The problem of miscommunication

Before we move to his emphasis, think back to elementary classroom exercise called "gossip." In this exercise, the teacher would have the pupils stand in a line and would whisper a sentence to the first child in the line. Then, that child would whisper the same sentence to the next child. Going down the line, each child repeated the sequence. When the last child said the line aloud, it had become something completely different than the original sentence whispered by the teacher. The exercise illustrates how words—and information—can change when passed from individual to individual.

When we have a total reliance on self-training or the passing of knowledge from one employee to another, two things can happen. If we are lucky enough to correctly interpret everything that we read or have an employee who has some teaching skills, everyone may benefit. Time and money savings combine with the passing of quality knowledge.

However, the opposite may also occur. Many employees learn their skills from either other poorly trained employees, the wrong experiences, or poorly written documentation. Like the children in the gossip game, many different—and sometimes incorrect—interpretations of the same information can emerge. In the electronics industry, the incorrect interpretation of information may lead to costly downtime, wasted parts, and decreased profitability.

The importance of training

Top-level managers and owners must realize that training needs must be met before employees begin to make errors on the job. Although finding sources of training for employees is not difficult, maintaining the commitment to training is more difficult because it involves planning and an investment. Manufacturers, universities and consulting firms offer both technical and management training on a variety of levels and scales.

A manager or owner should view the short time spent away from the job on training as a long-term investment. Employers should never consider training as a fringe benefit for their employees or as something implemented only when things go wrong. So that employees realize the importance of their training, many firms either offer time off or partial payment for employee training.

Training is essential

Management and employee training is not something accomplished only during the weekend, evenings, or when time permits. If considered a spare-time activity, training usually does not happen. After making your commitment to formal employee training, make learning a planned part of the work day.

When your employees see the commitment that their ownership and management has made to their on-the-job performance, their loyalty, pride-in-workmanship, and commitment to quality will become readily apparent. Other benefits will follow. ■

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

Test equipment probes—Part 3

By Vaughn Martin

The first two parts of this series covered some of the fundamentals of test equipment probes. This segment will look at how to interpret probe specifications and how to select the best probe for a given application.

How does probe loading affect measurements?

A high-impedance probe is important for both pulse risetime and amplitude measurements. But the capacitive and resistive elements of the impedance are not equally important in both measurements.

In pulse risetime measurements, capacitance is more important than resistance because minimizing probe capacitance reduces risetime error. For flat top (amplitude) measurements, probe capacitance is less important if the pulse duration is at least five times longer than the RC time constant. However, the probe capacitance still degrades the risetime.

When measuring pulse amplitude, a high resistance probe (10MΩ) will give minimum amplitude error; however, any significant tip capacitance will still degrade the leading edge.

For sinewave amplitude measurements, a probe should have the highest possible impedance at the frequency of interest. Loading varies directly with frequency.

What is the waveform risetime?

Observed risetime is the speed with which a scope responds to a changing signal level. For active (FET) probes, observed risetime is approximately equal to the square root of the sum of the squares of all the risetimes in the system (scope, probe and DUT). However, passive probes don't follow this rule.

In fact, some passive probes actually enhance the performance of specific scopes by working in conjunction with a scope's input circuitry to provide a system bandwidth greater than that obtained by injecting the signal directly into that input.

As a general rule, however, take the lower of the two bandwidth figures as the limit. For example, for a 150MHz scope and a 250MHz probe, assume the system bandwidth is 150MHz. For a 300MHz scope and a 350MHz probe, assume the system bandwidth is 300MHz. Accurately measuring very fast DUT risetime requires minimal probe and scope risetimes.

Martin is Chief Engineer in the Automatic Test system Division at Kelly Air Force Base.

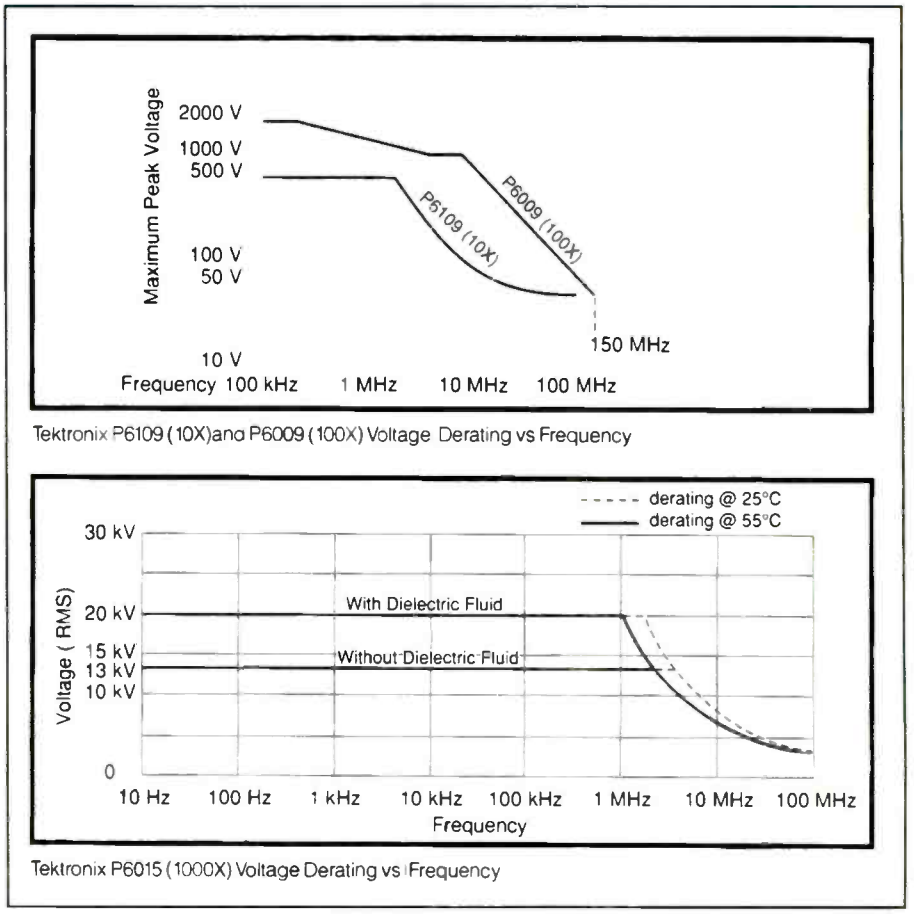


Figure 1. A voltage derating vs frequency graph for two commercially available probes.

What is the peak voltage?

If you are measuring signals in circuits that have large voltage peaks, then you need a probe that can safely handle the signals. For passive probes, the maximum input voltage is typically 500V peak. Active probes usually have a small dynamic range: typically ±0.6V to ±60V. High voltage probes can handle peak voltage from 2kV to 40kV, depending on type. All probes follow a voltage derating with frequency and/or pulse width specification (Figure 1).

What is the waveform amplitude?

Manufacturers state probe maximum input voltage for passive probes (or dynamic range for active probes) as dc plus peak ac. To cover all situations, dc max (dc plus peak ac) is also the maximum safe input before electrical damage occurs. For example, ignoring frequency derating, we can say that a passive probe is linear from OV to 500V.

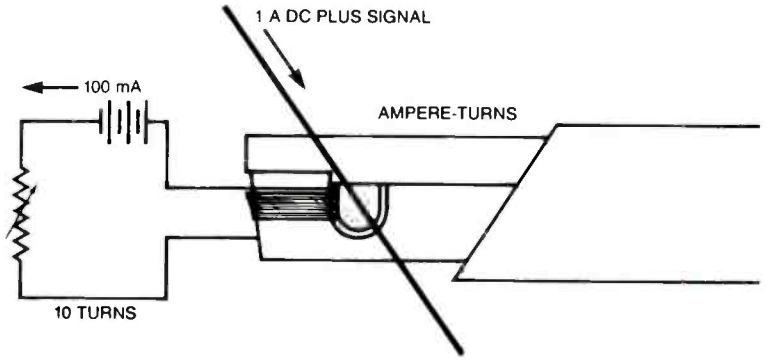
Dynamic range specifications imply a linear operating range. Outside the range we have the maximum safe input specification (before damage). For example, for the Tektronix P6201 FET Probe, the dynamic range is ±0.6V (or ±200V with attenuators).

What is the duty cycle?

A waveform's duty cycle is the ratio of the pulse train's "on" time to its period.

ADVANTAGES

- Can cancel or offset the DC component
- Can extend the range for unidirectional pulses or pulse trains



DISADVANTAGES

- May degrade hf performance

Figure 2. DC current blocking.

A symmetrical square wave has a 50 percent duty cycle (also called "duty factor"). That is important only when you are using the probe near its maximum peak pulse limits—with high voltage probes, in particular. For example, Tektronix specifies its P6015 High-Voltage probe at 40kV peak with a 10 percent maximum duty cycle.

What is the bandwidth?

For amplitude accuracy, the bandwidth of your scope/probe combination must be wider than the DUT bandwidth. As a rule-of-thumb, use a scope/probe combination that has a risetime at least four times faster than the measurement you expect to make. A 4:1 ratio gives you a risetime measurement within 3%.

A narrow probe bandwidth (relative to the DUT's maximum frequency content) attenuates high-frequency sinewaves and rounds the edges of pulses. Probe bandwidth is affected by the probe resistance and capacitance, as well as by the cable and connector transmission characteristics.

How important are system aberration specs?

Aberrations are variations in the signal caused by the probe or scope, or both. Typically, ±4% peak-to-peak aberrations are tolerable. This percentage is a measure of the deviation from the flat section following the leading edge, assuming an ideal step function at the input.

Is timing important to your measurement?

When two or more signals are being compared, it may be important to consider the effects, if any, of any differences in transit time through the probe cables. Applications where transit time is important are: time coincidence measurements, propagation delay measurements and power measurements (when a combination of voltage and current probes are used).

Transit time is a fixed quantity and is a function of the length and propagation velocity of a specific probe cable. A typical probe cable has a propagation velocity of about 4.2 nanoseconds per meter.

Phase shift implies a frequency component and is stated in degrees.

Factors contributing to phase error are:

- The cable length (because it affects transit time).
- The difference between the two transit times.
- Capacitive loading, which causes slew (degraded risetime) at the source, which in turn causes timing errors.
- Digital miscounting caused by capacitive loading induced slew.

Note: probes that have wide compensation ranges (15pF to 60 pF) and high-tip capacitance can introduce high error problems. It can be shown that probes with an excessive compensation range have a necessarily high tip capacitance, all other factors being equal. That's why probes generally limit the upper compensation range to cover only the scope input capacitance they are designed to work with.

How to select the best probe for your needs

The process of selecting a probe may be as simple as selecting the probe supplied or recommended by the manufacturer of the scope, or as complex as selecting a probe to make high current measurements on new power supply designs.

The correct attenuator (10X) or active probe should provide specified bandwidth at the probe tip. With few exceptions, probes are not designed to increase the bandwidth of your scope. Bearing these facts in mind, check the following guidelines for the type of application area you are interested in and then refer to manufacturer spec sheets for your scope model, or if not listed, select a probe to match your scope's bandwidth and input capacitance.

Remember probes from one manufac-

Current probes convert flux fields to voltage by transformer action — by surrounding the conductor under test with a magnetic circuit and capturing some of its field.

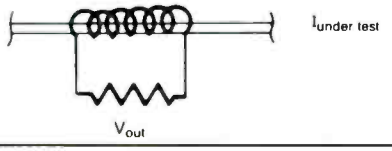


Figure 3. The principle of operation for a current probe.

turer are compatible with other manufacturer's scopes, provided that the basic requirements of bandwidth and input capacitance are met. Even probes that incorporate features of a given manufacturer, such as CRT or knob-skirt read-out and identify functions, are also compatible with scopes not incorporating these features; however, they will be non-functional.

Selection guidelines for general purpose, maximum bandwidth applications

1. Select or use the probe specified by the scope manufacturer as the standard accessory or recommended accessory probe for that scope.

2. Select an active 10 X probe providing about 2pF capacitive loading and 10MΩ input resistive loading if your circuit output level is no greater than 12Vpp, or 120Vpp with a 100X attenuation probe (for 1MΩ or 50Ω inputs).

Selection guidelines for general purpose, maximum sensitivity applications

1. Select a 1 X / 10 X switchable probe that gives you high sensitivity at 1 X at reduced bandwidth (about 12MHz) and low capacitive and resistive loading at 10 X, up to 200MHz.

Selection guidelines for maximum sensitivity applications

1. For low frequency use, choose a 1 X probe for low-cost wide dynamic range, and low bandwidth applications (up to 30MHz). Use 10 X probes for general purpose work.

2. For high-frequency use, choose an active probe (FET) with a 1 X sensitivity. These will provide high sensitivity, low capacitive loading and wide bandwidth (up to 900MHz). Trade-offs are their price, as well as narrow dynamic range.

Selection guidelines for minimum circuit loading at high frequencies

1. Select a passive 50Ω type probe providing about 1pF capacitive loading if your circuit can accept a resistive loading of 500Ω (10 X) or 5kΩ (100 X). This requires that the scope be able to accept a 50Ω input provision.

2. Select an active 10 X probe providing about 2pF capacitive loading and 10MΩ input resistive loading if your circuit output level is no greater than 12Vpp, or 120V with a 100 X attenuation probe (for 1MΩ / 50Ω inputs).

3. Select a bias/offset probe for high speed ECL probing. This provides about 1.3pF loading and 450Ω resistive loading. The dc offset feature helps cancel the effects of probe resistive loading under user-selectable conditions.

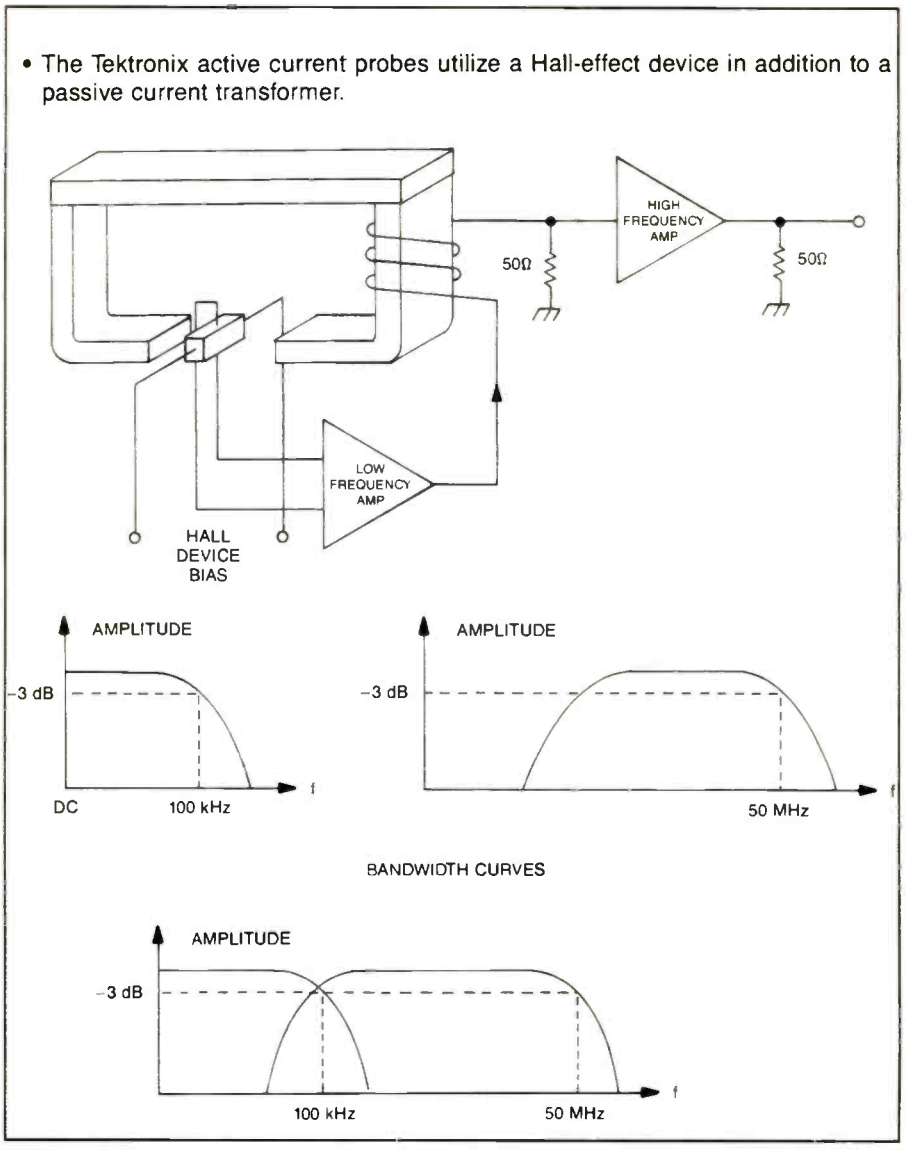


Figure 4. The principle of operation for an active current probe.

For high voltages

High-voltage probes are derated with frequency, so it is important to know your signal characteristics before choosing a specific probe. If your signals are from dc to about 100kHz, you can select a high-voltage probe from its maximum dc voltage specs.

If your signals are beyond about 100-kHz, or are pulses, single-shot or repetitive, you will need to consult the manufacturer's detail specs to determine if your first-look probe will do the job.

Selecting the right current probe

Current can be derived from voltage measurements made across an added or existing resistor and simply applying Ohm's Law: I = E/R. This may be a valid method for some applications, but in most cases, the added resistance and/or probe capacitive loading can change the circuit operation and, therefore, produce inaccurate test results.

A current probe offers the minimum circuit loading possible and, therefore, gives the most accurate test results. Current probes are classified as ac responding (ac) or ac and dc responding (dc), and are either a fixed core or split-core configuration. You need to know a lot more

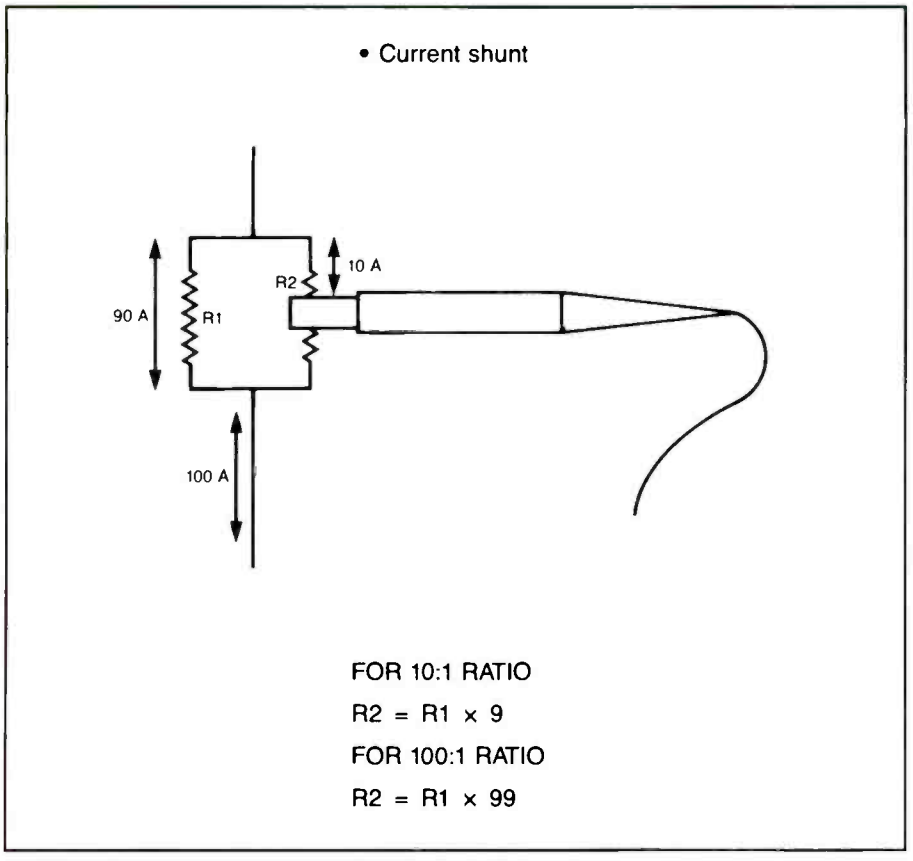


Figure 5. Using current shunts to increase current measuring capabilities by a factor of 10 and 100.

about the total signal being measured when selecting a current probe.

An application example: repetitive signals.

To illustrate the use of the catalog information, we will take a typical switching power supply application as an example. You need to measure current, risetime, repetition rate (frequency) and monitor waveshape. Output signal is undirectional, based at ground potential.

What probe do you need? The basic specs involved in selecting a current probe for making either continuous or single-shot measurements.

Selection steps: This is a repetitive waveform with a substantial dc content (because it's undirectional). Most ac current probes cannot handle more than 0.5 Adc without special techniques, such as dc current bucking (Figure 2); so we will only consider dc current probes for this application, refer to Figures 3, 4 and 5.

The final installment of this article series, which will be published in the January issue, will provide a number of tips on using oscilloscope probes. ■

CMOS RAM battery failure—Part 4

By David Presnell

The past three installments of Computer Corner, in the October, November and December 1993 issues, discussed CMOS RAM, and the battery used to maintain the information that is entered into this RAM to tell the BIOS how the computer is configured. A case history of the author's experience with a failing CMOS battery was also presented with a description of how the author replaced the battery and got the system back up and running again.

Last month's installment describes how to confirm that a problem is caused by CMOS battery failure, and, in general, how to install a new battery and restore the configuration information that was lost when the battery failed.

When nothing goes as it should, there are drastic measures you can try, but only as a last resort. Under no circumstances should you partition or format the disk drive. Also, there are some "tricks of the trade," including some other helpful software utilities. We will discuss some of them in this, the final installment of this Computer Corner series.

If all else fails

After you have replaced a CMOS backup battery and nothing goes as it should in trying to restore the configuration information lost when the battery quit, there are drastic measures you can try, but *only* as a last resort. Again, under *no* circumstances should you partition or format the disk drive. First, if you have no programs or data to assist you with the setup procedure, you can try entering a type number in setup and then booting from the hard disk (no floppy in drive A:).

This can be a long process. The idea is to select a type then save it, restart the computer to attempt to get the C:\ prompt. You may have to go through 46 types to find the correct one. If it happens to be a type 47 (user definable) you might try looking on the case of the hard drive. The information you need may be written directly on the drive cover.

Trying this procedure could very well lock up the system requiring you to remove the CMOS battery and start all over. As a professional, it is assumed by the public that you have the necessary tools to do an adequate job. For profitability's sake, I would advise you to obtain the necessary tools and software before you attempt any work on a computer.

You will find out quickly, as you do more computer related work, that you will be forced to purchase more and more software programs to aid in the diagnostics and repair of computers. Many tasks such as CMOS setup can be done without them; but time is money. Manual setup can take an hour or more. With software such as Disk Manager, setup can be completed in seconds. Thus, you can pay for the software the first time you use it.

By following these guidelines and making use of programs such as Disk Base, Disk Manager, DOSUTILS, and others, you should have the system back up and running in no time. As you may now realize, replacing a CMOS backup battery can be much more than simply replacing a battery.

Tricks of the trade

There is available a 6V AA battery holder from Dalco Electronics (Part Number 98855) for about $1.75. These can be fitted with standard AA batteries and plugged directly into a modern AT motherboard's external battery port. Change a jumper setting and now your CMOS RAM is protected by this battery pack. I also have one of these battery holders to which I have soldered a dummy CMOS battery. This device will fit directly into many on-board battery holders. I also carry one that can be hardwired directly to the motherboard.

As a computer service technician, you are expected to get the customer's computer up and running fast. When you arrive on-site and discover an AT with a dead CMOS battery, you might be able to plug in the AA battery pack and set up the CMOS as outlined within this article. Your customer is back up and running in about an hour or less.

Then, when you obtain the necessary lithium replacement battery, you can return and install the new battery, remove your temporary battery pack, check the setup (which you should have recorded), and be on your way to another service call within a few minutes. These little AA battery packs can be very valuable. I carry several in my service kit, and I suggest you do too.

Prevention

As you may know, much of this setup work can be prevented, provided some measures are taken prior to CMOS battery failure. DOSUTILS (and other such programs) has a utility called Disk Look (DL) that will automatically backup and restore crucial areas of the hard disk that define its logical structure, including FATs (file allocation tables) and root directories. This critical backup should be done on all computers.

Next, there are programs available that backup the CMOS setup information. For example, I know of two shareware programs that provide this function.

REPLICA (from Scott M. Russell, P.O. Box 534, Thorndale, PA 19372-9998) will create a copy of your system's start-up information including your partition table, boot sectors, FATs, CONFIG.SYS file, AUTOEXEC.BAT file, and related device drivers. Replica will create a bootable disk in the event your hard disk crashes. CMOSMGR (from S.B. Behman, The Whizard, 20581 Ashley Way, Saratoga, CA 95070) will capture and store your current CMOS setup settings to a file and should your CMOS ever need to be restored, it will use that file to do so.

You should check with your shareware supplier or contact the people mentioned above and obtain a copy of each of these programs. Then use them. By using

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CMOSMGR before the CMOS battery fails, you will be able to get your customer's computer up and running in only a few minutes when the battery does go. If the FAT and boot sector files are not available on floppy disk, should a crash occur in one of these vital areas, data loss is likely to occur. That's another article.

There are many programs that can help you with CMOS backup. You might also give Norton Utilities a try. Whatever you choose, read any documentation that comes with it. If it's shareware, by all means register it. Learn how to use the programs before you erase a customer's hard disk.

Replace batteries regularly to avoid problems

The best way to avoid problems is to pre-sell your customers on the idea of CMOS battery replacement every three years. When you arrive, first look at the BIOS setup, then make a written record of the standard and advanced CMOS setup tables. Also, make a disk backup of the setup if you have the software available. Next, power down, remove the cover, replace the battery (which you have obtained in advance); setup the CMOS from your record, power up and test out the system, power down and replace the cover, and you're finished. This procedure will take about 10 to 15 minutes.

You can generally charge about $50 to $70 for the procedure, including the battery. For this procedure I carry a Portasol Model P-1K Cordless Butane Gas Operated Soldering Tool Kit, the replacement battery (type obtained when I first discussed the need with the customer), an AA battery pack (in case the replacement battery won't work for some reason), and a clip-on static strap. I also have all the necessary diagnostic software with me as well. When all should be simple, it's usually not.

Occasionally, you will come upon a customer who has tried to replace the battery himself. In most cases, all you will have to do is set up the CMOS tables. However, I arrived on-site to a computer in which the customer had installed the battery, setup the hard drive type different from the original and had proceeded to partition and format the hard disk. His question to me was "What has happened to all my client's records? All I did was replace the battery!"

In such a case, you can use one of many file recovery programs to attempt to unformat the drive. If new files have not been written over the disk, your chances are good. In this case, I used DOSUTILS recovery utility, and within an hour or so had this hard disk back in operation with all files intact.

Summary

In conclusion, I will suggest a few service business practices I believe will be of use to someone just getting started in computer service.

1. Never assume a simple job will be simple.
2. Never tell the customer what you think the problem is or how long it will take to fix. Simply tell them you'll look at it and give them a call.
3. Never guarantee when a job will be ready. It will usually take longer.
4. Take your time. Look at the screen before you start hammering down on the keyboard. Read and follow instructions.
5. Know how to back your way out of a program. It is possible to get so deep in some diagnostic programs that you will end up with a locked up computer.
6. Learn the fastest and lowest cost ways of correcting a problem. There are many paths but only one profitable one.
7. Do not underestimate your cost.
8. When you come across a dead CMOS battery, be calm and follow this article to success. ■

Should you consider commercial sound?—Public address, paging and intercom systems

By Ron Johnson

What's the difference between typical consumer audio equipment and the commercial sound equipment used in public address, paging and intercom systems? That's what I'll be talking about this month. If you're interested in servicing this kind of equipment, or selling and installing it, there are a few important points you should know.

Public address systems can be divided into various categories, in various ways. One way is to split them down the middle into lower-end commercial public address systems, and high-end professional sound reinforcement systems.

The low-end, or commercial types of systems, can be further divided into paging systems, intercoms, background music systems, distributed sound, fast-food drive-through systems, and a number of variations and combinations of these.

The high-end systems are very similar to the professional sound reinforcement systems used by touring musicians, except that the equipment is permanently installed. If you work further into this area you can get into night club, recording studio, and broadcast equipment.

Since the "bread and butter" of sound contracting is commercial equipment let's take a look at some of the features of a typical medium-power public address system.

The imaginary system we're going to talk about is a sound system for a small grocery store. It will provide background music from a consumer tape deck or AM/FM radio which will be muted when the press-to-talk switch on a paging microphone is depressed. A commercial music source could also be used if the customer desired. The microphone signal is connected to the heart of the system, a commercial sound distribution amplifier with a 70V output, which drives inexpensive ceiling speakers. This particular amp, the Rotel QA-100, one I used frequently when I was in this business, also has a built in AM\FM radio.

Johnson is a journeyman electronics servicing technician and an instructor of technology at the Northern Alberta Institute of Technology in Edmonton, Alberta, Canada.

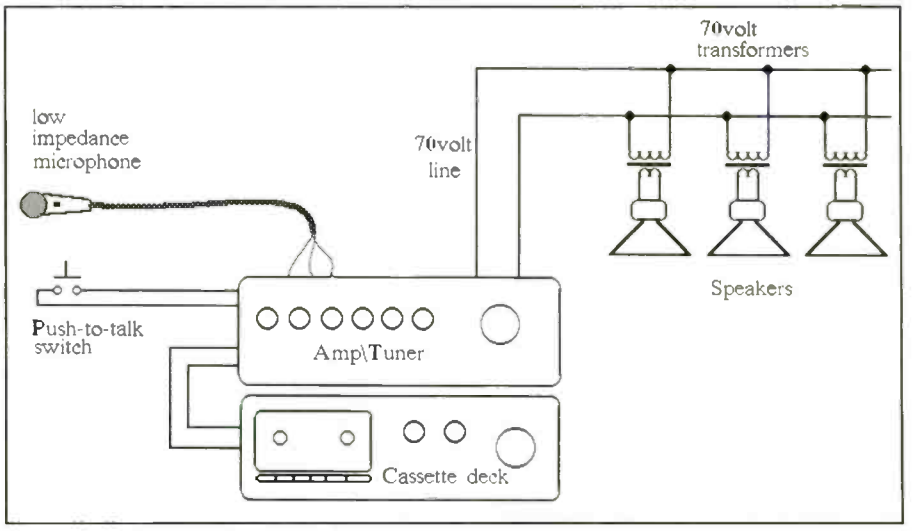


Figure 1. A simple commercial sound system might look like this.

Figure 1 shows a block diagram of the components of the system. As we discuss each section of the system I'll point out some of the features that make this equipment different from other equipment you may have worked on.

Microphones

The system in Figure 1 shows one microphone, with a three-conductor cable,

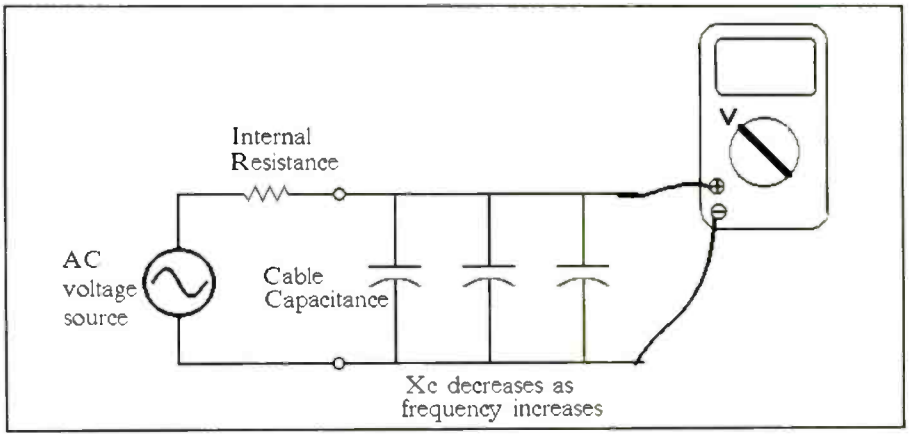


Figure 2. In a commercial sound system, the microphone cable appears to the microphone like a parallel capacitor that increases in value with length. As the frequency of the signal increases, the impedance of the capacitance will drop.

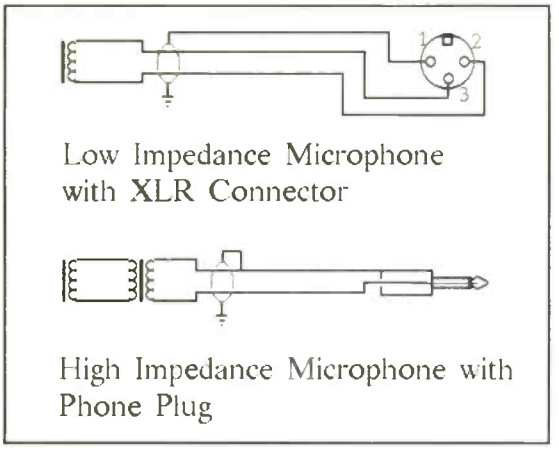


Figure 3. Microphone connections will depend on whether the cable is a balanced or an unbalanced line.

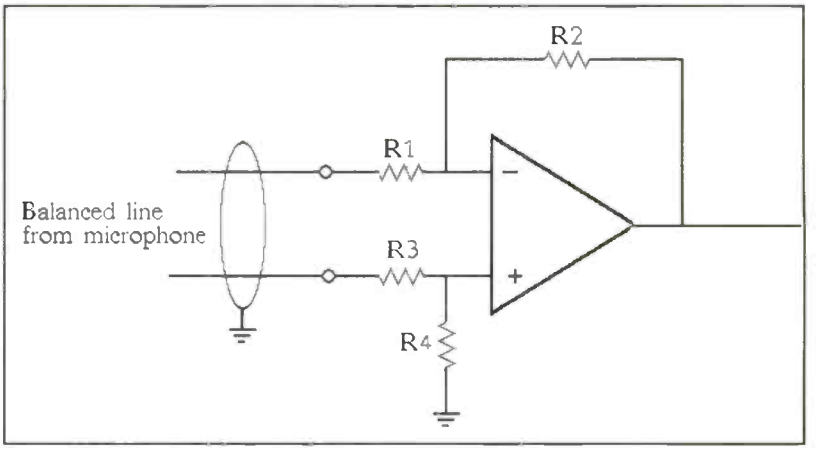


Figure 4. Microphone preamps using operational amplifiers make use of the common-mode rejection characteristics of the op amp to cancel out the noise on both sides of the line. This is a difference amp configuration that accomplishes this.

connected to the amplifier. This amplifier can accept two low-impedance microphones (balanced or unbalanced) or one low-impedance and one high-impedance microphone. The low-impedance mics are connected to screw terminals on the back of the amp, while the high-impedance one uses a quarter-inch phone plug, which plugs into the front panel.

If you're new to microphones or (like the rest of us) need to brush up on your theory about input impedances, etc., the next couple of paragraphs will give you a quick overview.

Microphone impedance

I've already mentioned that there are two categories of microphone impedances: low and high. Although there is quite a bit of theory behind the subject, for practical purposes we can simplify this a bit.

First, low-impedance microphones are used when running long microphone lines (up to about 200 feet) because they don't attenuate the high frequencies as much as high-impedance microphones do. Think of the microphone itself as an ac voltage source with an internal resistance (or impedance) in series with it. The cable looks like a parallel capacitor which increases in value with length (Figure 2).

As the frequency of the signal increas-

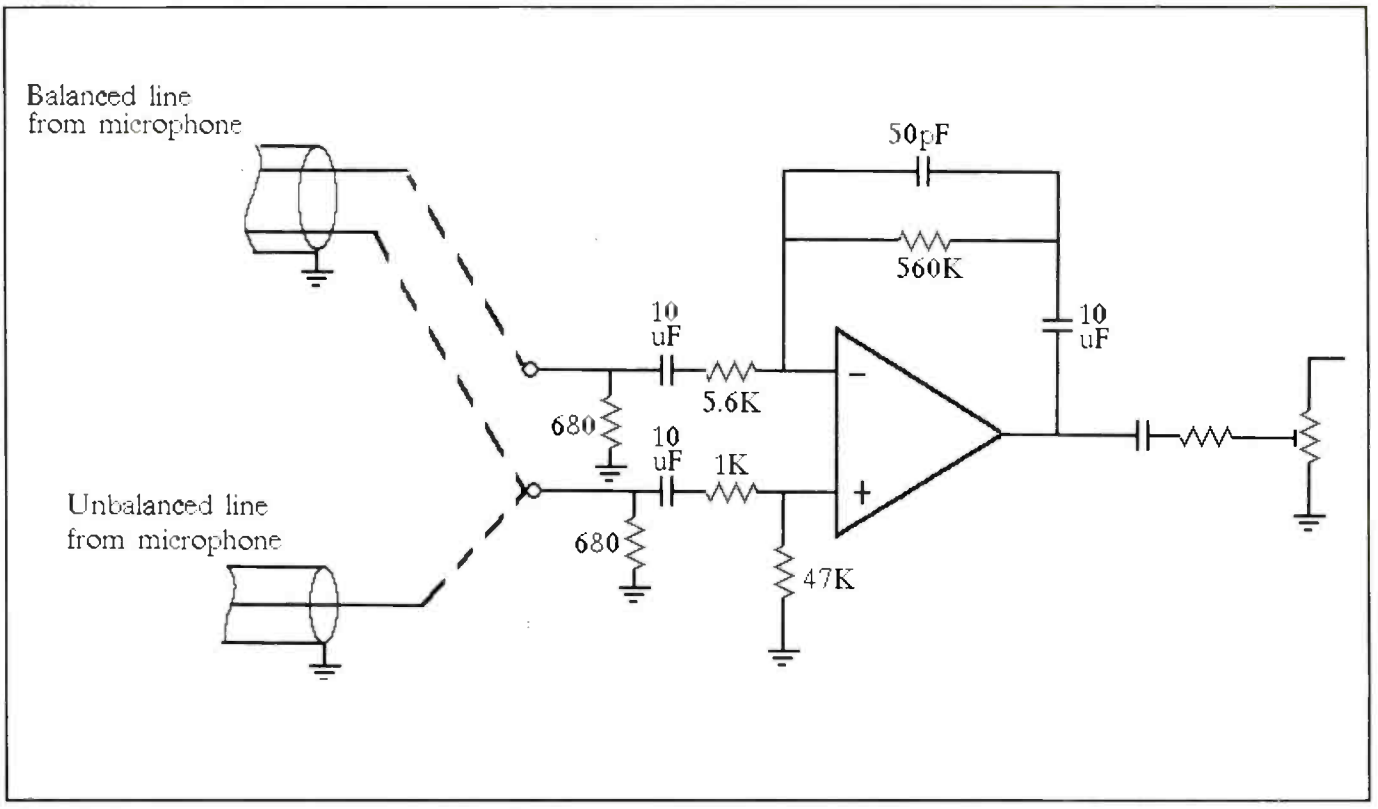


Figure 5. The input of the rotel amp is a bit unusual. The low-impedance inputs accept balanced or unbalanced lines.

es, the impedance of the capacitance will drop. The microphone internal impedance and the capacitive reactance of the cable form a voltage divider in which the voltage across the capacitive reactance is the level of the signal reaching the amplifier. As the signal frequency increases, the signal reaching the amplifier decreases. The higher the microphone impedance the worse the problem becomes because voltage is dropped across the mic impedance and never reaches the amplifier.

All of this just indicates that lower mic impedances allow you to run the wiring farther without degrading the high-frequency response of the signal. For short distances, high-impedance mics work fairly well. The advantage of low-impedance microphones is offset somewhat by the fact that their signal levels are lower and, because of this and the longer lines involved, induced noise can become a problem. To overcome the problem, balanced lines are used.

Balanced vs unbalanced lines

Figure 3 shows the wiring for balanced and unbalanced lines. Balanced lines use two conductors inside an overall shield. The mic output is connected to the two lines and the shield is grounded to the amplifier chassis (which should be at earth ground). Grounding the shield causes induced noise currents to be shunted to ground. You can think of the shield as a magnetic barrier around the signal lines. In addition, any noise induced onto both wires (common-mode noise) can be subtracted out using an input transformer or the differential input stage of an op amp.

Unbalanced lines (again, usually used with high-impedance mics) are shorter and have one side of the microphone output connected to the center conductor and the other side connected to the shield. While not as efficient at rejecting noise as balanced lines, they are much shorter (less than 20 feet), so they don't pick up as much noise anyway.

Standard specifications for low- and high-impedance microphones are about 250Ω for low-impedance and about 50kΩ for high-impedance. I have seen variations from these standards, though. There are lots of different kinds of microphones: dynamic, ribbon, condenser, etc. One of the most common types, the dynamic microphone is basically an inductive device. Sound waves acting on a diaphragm move a small coil in a magnetic field creating an electrical signal.

Most dynamic microphone coils are low-impedance. To convert them to high impedance, an impedance matching transformer is installed inside the microphone body. You can also get impedance matching transformers in separate packages with connectors on each end to allow easy conversion of existing microphones. Actually voltage output of a microphone varies from one type to the next and the sound pressure level it is picking up but is generally in the order of 10μV to 1mV.

Input circuits

Microphone input circuits are set up to match impedances with the type of microphone connected. Older microphone inputs, (especially tube amps, but also some semiconductor circuits), used balancing and matching input transformers on balanced microphone inputs. Connecting the signal to the input of a transformer (which is isolated from ground) allowed

(Continued on page 43)

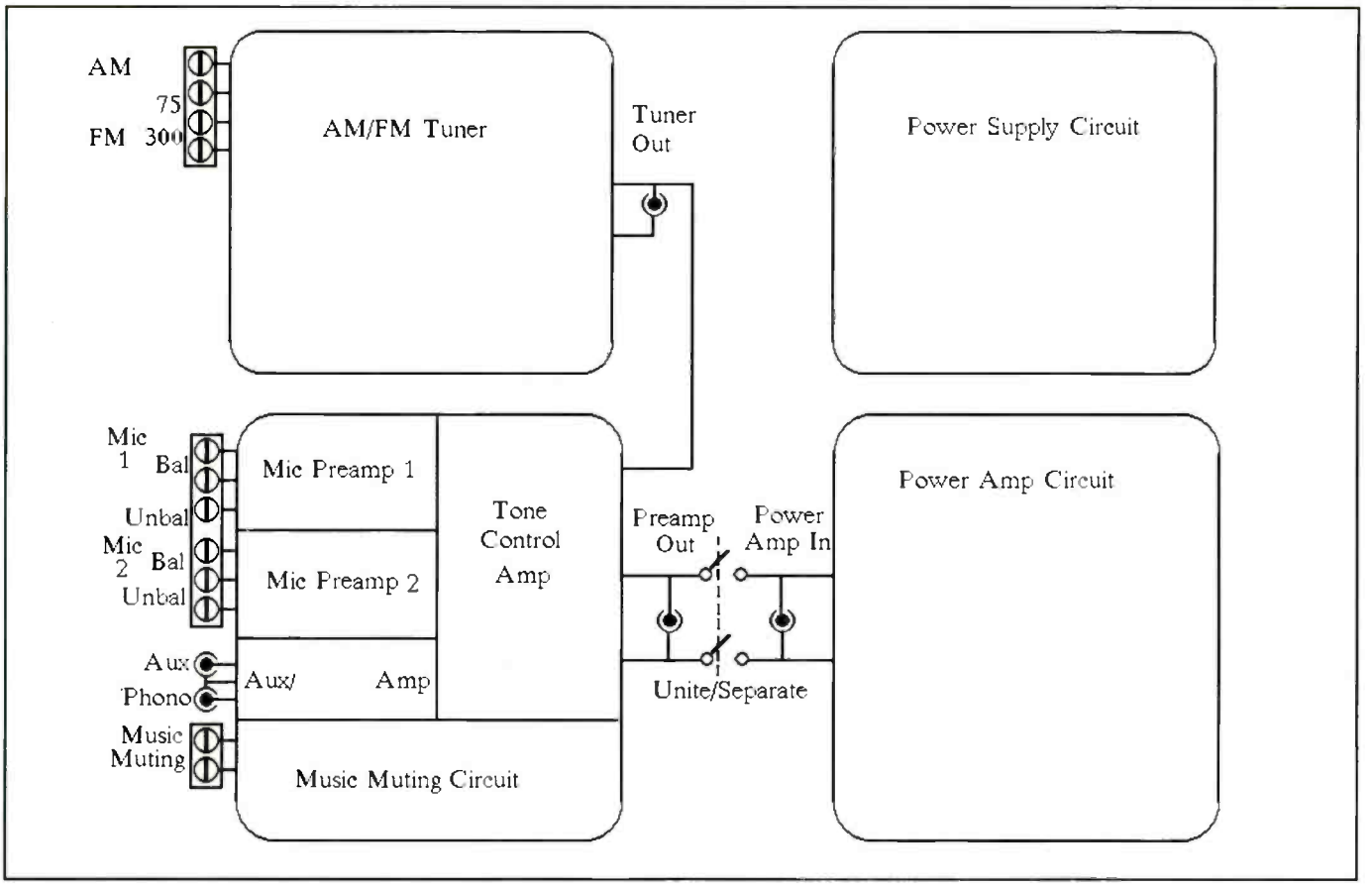


Figure 6. This block diagram shows the layout of a typical PA amp.

the signal to be connected through to the amplifier while rejecting the noise present on both lines (because they were equal and opposite going into the transformer so they canceled).

Microphone preamps using operational amplifiers make use of the common-mode rejection characteristics of the op amp to cancel out the noise on both sides of the line. Figure 4 shows a difference amp configuration that accomplishes this. If R1 equals R3 and R2 equals R4 the gain is simplified to the ratio of R2 divided by R1. As long as the resistor values are exact, and the op amp specifications are good, practically all of the common-mode noise signal should be rejected.

The input of the Rotel amp is a bit unusual. First, the low-impedance inputs accept balanced or unbalanced lines. You don't often see this on public address amplifiers. Analyzing the circuit suggests they have made some design compromises to accomplish this. The result is a more versatile input amp which probably doesn't reject common-mode noise as efficiently as it should. See Figure 5.

They've used a 4558 dual op amp and capacitively coupled the inputs, outputs and even the feedback loop. The two 680Ω resistors from each input terminal to ground create the input load impedance reflected back to the microphone. (The sensitivity of the microphone varies depending on the terminating impedance.) As Figure 5 shows, the input amp is a difference configuration when connected in balanced mode. The unusual aspect of this design is that the resistors are not matched as in the previous example. This means common-mode signals will not be completely rejected. The reason for using this design is unclear but may relate to unbalanced operation.

When an unbalanced input is connected, the input to the op amp's inverting input is left open. Because the coupling capacitor is relatively large (10μF), it looks like a low resistance to all but the lowest frequencies. This has the effect of connecting that input to ground through the 680Ω resistor, creating a non-inverting configuration. The gain of this configuration works out to be about 90.

A switching jack changes the input amp into a "virtual" buffer amp (unity gain) when a high impedance microphone is plugged in. I say virtual because it connects 10μF into the feedback loop which, again, is a very low resistance for all but the lowest audio frequencies. The reason for this is the high-impedance microphone doesn't require as much gain as the low-impedance one.

The public address amp

Before we talk about the output stage, let's see how the amp itself is laid out and discuss a few other features.

Figure 6 shows the block diagram of the Rotel amp. The tuner module has a terminal block that allows the connection of an antenna or cable. The output of the tuner is connected to the preamplifier but is also brought out to an RCA jack so you could connect it to another amp or other device. In addition to the microphone inputs to the preamp module, an auxiliary

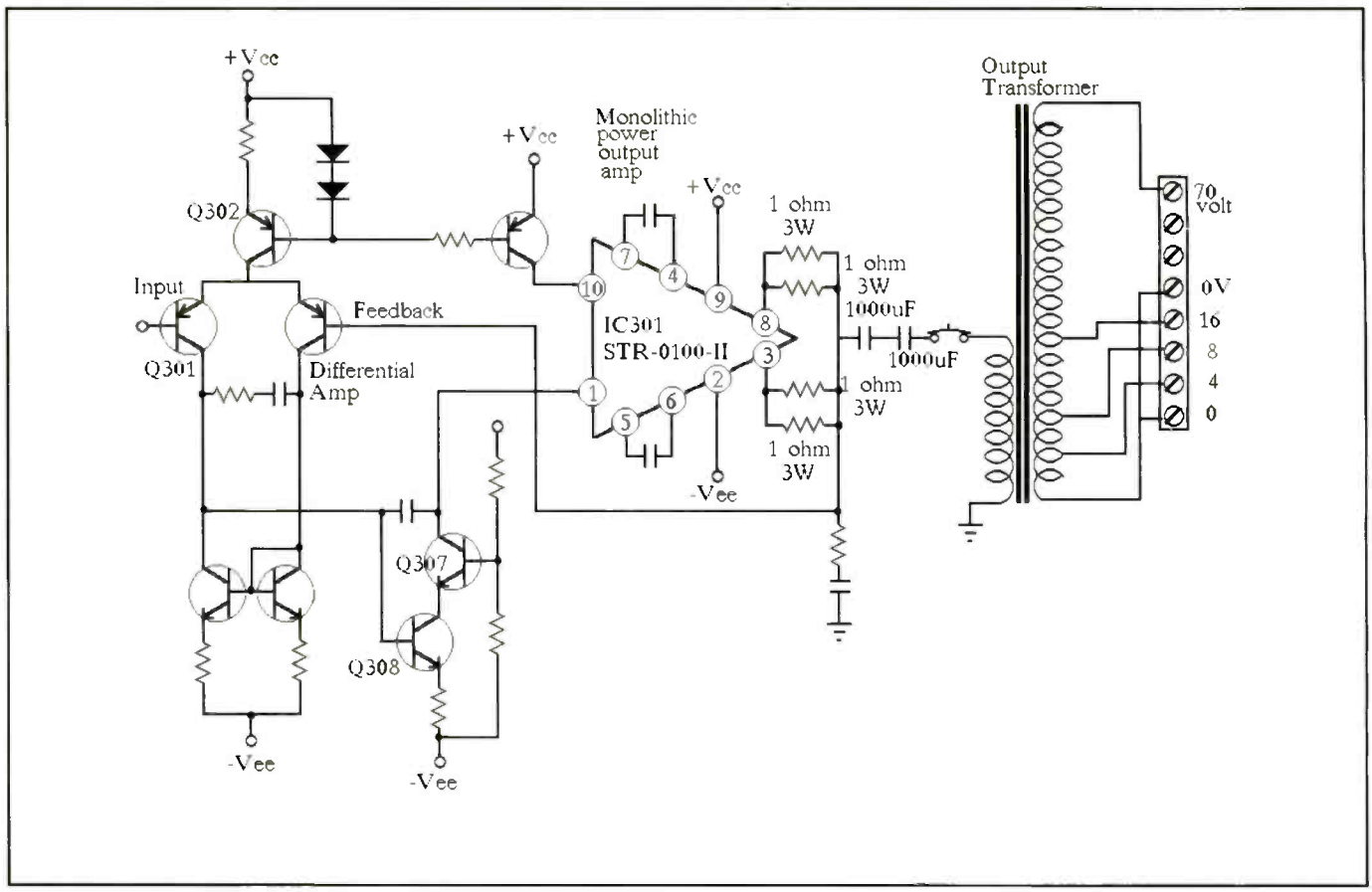


Figure 7. Simplified diagram of the output of a public address amplifier.

input and a phono input can be plugged into RCA jacks. The phono input accepts magnetic cartridge output levels and performs the standard RIAA equalization on the signal.

All of these signals are mixed together through resistors onto a bus before being applied to the next stage which incorporates the bass and treble controls. A muting circuit, consisting of a couple of NPN transistor switches, is connected to the point where the tuner, aux and phono signals come together. A contact closure across the muting input terminals effectively shorts these program signals to ground through one of these transistors. The microphones are unaffected by the muting function. By connecting a momentary switch on the paging mic to the muting input, paging can be accomplished.

This amp also has the output of the preamp and the input to the power amp brought out to RCA jacks. The unite/separate switch allows you to disconnect the preamp from the power amp and use the jacks to insert an equalizer or other device. You could also mix in signals from other sources. This feature makes troubleshooting the amp easier because you can check for preamp output, and inject a signal into the power amp at this point.

The power amp

This amp, being a fairly new design, uses a monolithic power amp module in its output. The rated power output is 100WRMS, a respectable figure as public address amplifiers go. Figure 7 shows a somewhat simplified diagram of the output stage, including the differential input stage made up of discrete transistors and the output transformer used to drive the speaker load. In past articles I've discussed quasi-complimentary transistor power amps and push-pull tube amps. This one really isn't all that much different in concept, just simpler because of the use of a chip.

The input signal is fed into Q301 which is one side of the differential input stage. The other side of the amp comes from the output of the power chip and gives the negative feedback necessary to minimize noise and distortion, and maintain stability in the amplifier. Q302 is basically a constant current source to the emitters of the difference amplifier (diff amp). Its emitter current is set by the voltage across the two diodes connected to its base. The output of the diff amp goes through Q308 and Q307 before driving the chip.

Notice the two 1000µF capacitors in series with the output load (the transformer). These are good suspects if you're having trouble with an amp like this. Also keep an eye on the output resistors. They are 1Ω, 3W resistors and could go open in the event of a catastrophic failure. This amp is pretty forgiving (partly because of the transformer in the output), but nothing is indestructible.

The 70V output

The final aspect of this system that I want to look at is the 70V output. This is probably the most characteristic—and least understood—aspect of commercial sound systems.

Seventy-volt lines are used in sound systems for the same reason high-voltage lines are used in power distribution systems. When you have to put in long speaker wire runs, losses in the wire become a problem. You want to deliver the same power to a speaker some distance away but you don't want high levels of current in your speaker lines. By increasing the voltage, the same amount of power can be delivered using less current. This means lighter gauge wire can be used.

But there is another advantage to 70V outputs on public address amplifiers. With a typical consumer or sound reinforcement amplifier the speaker load is usually pretty standard. The amp is rated to deliver some specified power into a specified load such as 16Ω, 8Ω, or 4Ω. If you make the load too small, the amplifier will exceed its maximum power output. The load is determined by the type of speakers and the arrangement in which they are connected.

These arrangements are standard (because you don't usually have very many speakers), but they're not very flexible. It doesn't take many 8Ω speakers connected in parallel to bring the load impedance below the minimum value. Series-parallel networks can be used but don't lend themselves very well to the physical layout of typical public address systems.

With public address systems—especially distributed, or ceiling speaker systems—you may want to connect many speakers to the system in a variety of locations. Usually you don't need more than a few watts out of each speaker because they are relatively close to the listener but twenty or thirty speakers wouldn't be uncommon in a medium-sized grocery store. The maximum output power of the amplifier is still the limiting factor in what you connect to the output but you need a way of doing it that doesn't cause problems for the amp.

The answer is to use standard 8Ω speakers with small impedance matching transformers which allow them to be connected to the 70 volt, high impedance speaker line. All speaker transformers in the system are connected in parallel across the 70V line making it simple to add speakers to the system. To control the output level of the speakers, the transformers have various taps to which to connect the speaker. The taps are labeled in terms of watts. In its simplest form, the procedure is to total up the watts of all the speakers connected. The total should not exceed the power rating of the amplifier.

Some drawbacks

There is more to the determination of actual output and input impedances than I have mentioned but I've tried to concentrate on the practical side of it. In reality, 70V systems have some drawbacks. Often the quality of the transformers used degrades the frequency response out of the speakers. Inexpensive transformers also add insertion losses because they dissipate power themselves.

Older tube amps, which have inherently high output impedances, could often drive 70V lines directly. Semiconductor outputs are low-impedance, so a step-up transformer is generally used to create the 70V output. The transformer on the Rotel amp we've been looking at has multiple taps on its output. The lower taps match 4Ω, 8Ω and 16Ω speaker systems while the highest tap on the transformer drives the 70V line. Keep in mind, though, that only one output can be used at a time; either 70V or one of the others.

The other important thing to remember is that, when using the 70V line, all speakers must have impedance matching transformers. If you connect a standard 8Ω speaker to the 70V line the least you can expect is loud, distorted sound. The worst case scenario involves smoke billowing out of your amplifier. Rotel, in its wisdom, installed a circuit breaker between the power output and the transformer.

Well, there is so much more about public address that could be said. I couldn't hope to do it justice here but maybe this will help you decide whether you're interested in getting involved. Really, it's a field unto itself, related to other areas of electronics but with its own foibles and interesting technologies. ■

Test your electronics knowledge

Try this tough quiz

By J.A. Sam Wilson

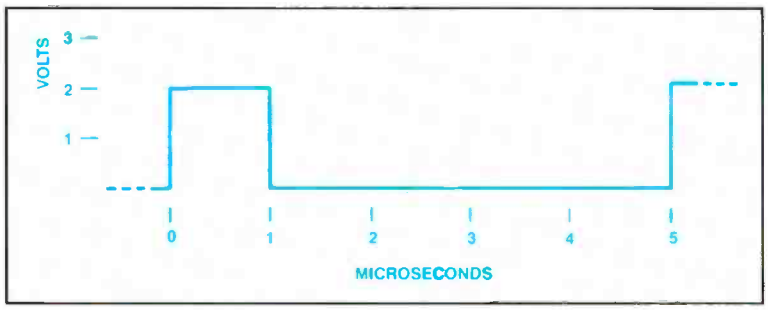


Figure 1.

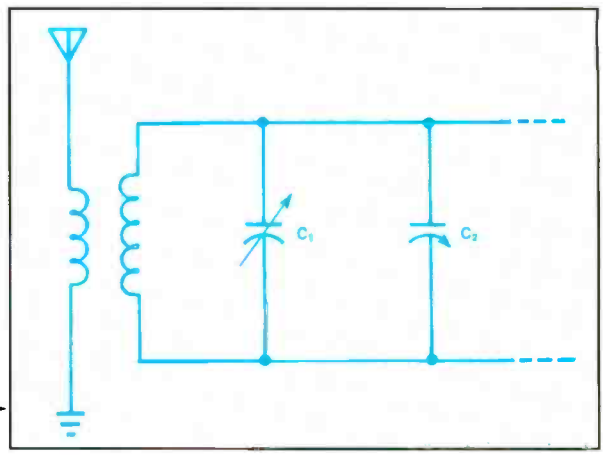


Figure 2.

We haven't had a tough TYEK test for a long time. At least that's what some readers tell me. OK. If you can get seven correct answers on this test you're a supertech! But, then, if you read ES&T you're a supertech even if you don't get seven right!

1. What is the percent duty cycle for the waveform shown in Figure 1?_____

2. Tune the resonant circuit in Figure 2 to a lower frequency by moving the plates of C2
   A. closer together.
   B. further apart.

3. Which of the following is used to remove parasitic oscillations in amplifiers?
   A. Bead ledge
   B. Elastomer
   C. Ferrite core
   D. None of the choices is correct.

4. The voltage (V_c) across a certain charging capacitor is calculated by the equation
   $V_C = 15\ [\ 1\text{-}1/(\epsilon^{\ t/0.06})]$
   How long does it take the voltage across the capacitor to reach 10V?

5. What is the power factor of the circuit in Figure 3?_____

6. A certain transmission line has a characteristic impedance of 300Ω. When connected to a source having an internal impedance of 375Ω and a load impedance of 220Ω, what is the surge impedance of the transmission line?_____

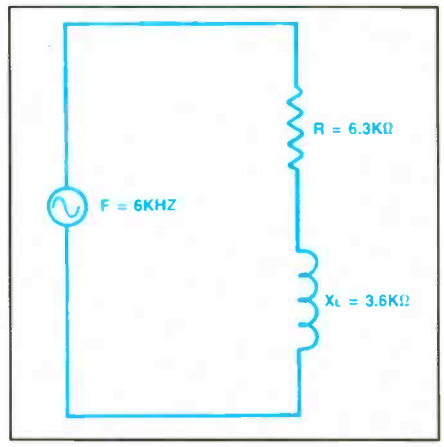


Figure 3.

7. A diversity antenna system is effective against
   A. adjacent channel interference.
   B. co-channel interference.

Wilson is the electronics theory consultant for ES&T.

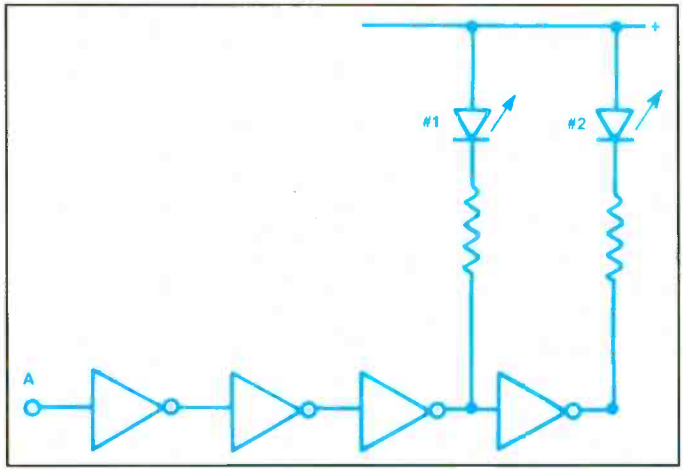
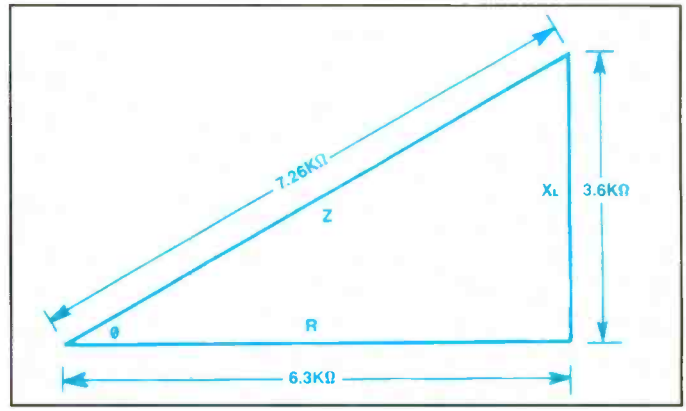


Figure 4.

Figure 5.



C. re-radiation.
D.(none of these choices is correct.)

8. Your frequency counter cannot count to a value sufficiently high for your application. You can use your frequency counter if you use a _____.

9. Which of the following can be used to measure a voltage?
A. Capacitor
B. Inductor
C. Potentiometer
D. None of these choices is correct.

10. What is the third harmonic of a 1.277kHz sinewave signal?
A. 0.426kHz
B. 3.831kHz
C. Neither choice is correct.

Bonus Question (10 points)

Refer to Figure 4. A logic 0 is delivered to A. Which (if any) of the LEDs will be ON?
A. LED #1
B. LED #2
C. Both LEDs
D. Neither LED

(Answers on page 52)

Literature

Catalog of test and measurement products

Analogic Corporation announces a new test and measurement catalog featuring its complete line of high precision instrumentation products. This catalog presents 72 pages of instruments and is intended to help design and test engineers solve their complex application problems. Featured in the catalog is the company's complete family of waveform generators and synthesizers, waveform analyzers, and general purpose instrumentation.

The catalog showcases high-precision arbitrary waveform synthesizers, which offer performance up to 800 Ms/s. Ten recently introduced waveform generators extend the product line to offer features and a price to suit almost every application. The new products include both standard and programmable function generators, arbitrary function generators, high-bandwidth arbitrary waveform generators, and a flexible pulse generator useful for comparator and device testing, telecommunications, and ATE.

Also featured are waveform analyzers, including the recently introduced Model 6500. This DSP-based analyzer performs real-time analysis in both the time and frequency domains. Six plug-in modules complement the analyzers for use in applications such as radar, vibration, medical research, wideband video, component and circuit testing, acoustics, audio, and communications. Completing the product line are general purpose instruments, including digital multimeters, dc voltage standards, electronic loads, and a PC-compatible waveform digitizer.

Circle (100) on Reply Card

Brochure details UPS products

Tripp Lite's new UPS systems brochure showcases the company's battery backup model line. Included in the full-color, 12-page brochure are complete specifications and benefits of the company's standby UPS systems and on-line, sine wave UPS systems.

New products, like the company's adapter for UPS, software for automatic, unattended shutdown of any network and a complete line of international 230 UPS models are also described.

The brochure also discusses why network power protection is a crucial requirement for today's network installations, details the various waveform outputs available in current UPS designs and lists various options, like extended battery capability, rack mount kits and remote turn-on.

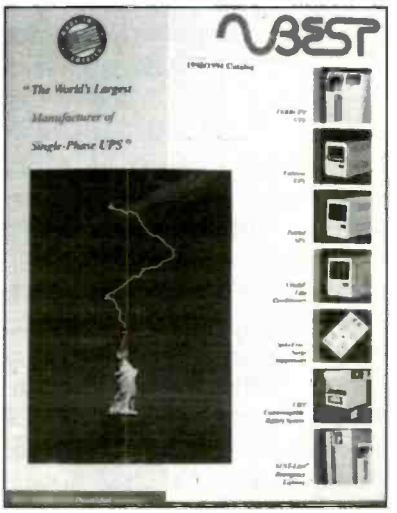
Circle (101) on Reply Card

Power protection catalog

A power protection catalog, from Best Power Technology, Inc., helps users of sensitive electronics products define and solve power problems. It shows how to save money by protecting equipment from power problems such as surges, sags, spikes, noise, brownouts, blackouts, and lightning.

The catalog is a power protection reference manual. Colorful, easy-to-read, tabbed sections move readers from section to section. Along with brief descriptions and specifications of the company's products, the catalog offers these handy sections:

The power problem analysis and solutions section gives a brief review of many common power problems, symptoms that make their identification simple, and a brief discussion of which type of power protection technology will best solve the problem and why.



The how-to-buy a UPS/SPS section makes selecting the right power protection as easy as asking a few very basic questions about the system that needs protection. Readers then select the appropriate level of power protection based on their answers.

The latest advances in UPS communication software section explains how, with communications software, UPS users need never worry that their system will crash because of unattended operation during long outages.

Circle (102) on Reply Card

Instant bonding kit

Planned Products introduces the 4300 Circuit Works Quick-Bond Gel Kit to provide rugged, instant bonding of metals, rubbers and plastics. The kit includes an accelerator that can be applied directly over the adhesive to assure instant bonding results.

Developed for design, prototype and repair applications, the kit provides a one part, cyanoacrylate gel that will not

migrate to unwanted areas after application. Useful for filling gaps, wide tolerances, and bonding dissimilar materials, the gel can be used alone or with the supplied accelerator for instant bonding. The accelerator can be brushed on difficult to reach areas, or applied directly over the gel adhesive. Bonding is instantaneous as the accelerator contacts the adhesive, assuring reliable results in any environment regardless of temperature or humidity. The accelerator is applied using the kit's poly brush or pipette.

The cured gel is a colorless solid that resists shock, impact and temperature cycling. Cured adhesive provides an aluminum to aluminum tensile strength of 3770 psi and a working temperature range of –65F to 200F (–54C to 93C). Softening begins at 329F (165C). The dielectric strength of the cured adhesive is 11.6KV/mm.

Applications include bonding jumper wires to circuit boards, fixturing surface mount components, component mounting, strain relief, shallow potting, and general instant bonding.

Each kit includes the gel adhesive, accelerator, with an applicator brush and pipette for applying the accelerator.

Circle (50) on Reply Card

Surface mount and thru-hole soldering system

PACE announces the introduction of

the ST 20, designed specifically for production soldering of thru-hole and surface mount components.

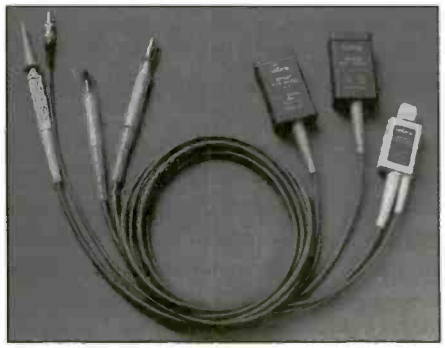
The system incorporates SensaTemp technology providing the high capacity/low temperature heating required to safely handle all production applications. While the unit permits setting accurate honest tip temperatures between 200F and 900F, most routine surface mount soldering tasks, even on high pin count packages, are performed at temperatures as low as 525F. If desired, a specific temperature can be locked in to prevent unauthorized tampering.

The product's electronics incorporate an auto-off safety system which powers off the unit automatically after 90 minutes of inactivity. This feature increases tip/heater life and saves energy.

Circle (51) on Reply Card

Intelligent FET probes

LeCroy introduces a new line of active FET probes, together with the Probus Interface. This interface system is a complete measurement solution from probe tip to oscilloscope display. The interface supplies power to active probes and automatic attenuation sensing, and also enables direct control of the probe offset and input coupling from the instrument's



front panel. In addition, it automatically calibrates the gain and offset at the probe tip—it can even compensate for non-linearities—providing the most accurate measurements.

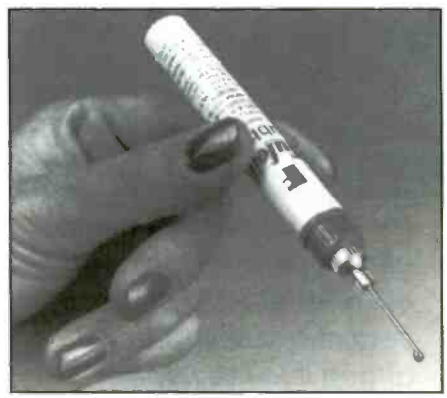
Two FET probes are already equipped with the system: Models AP020 and AP021 offer 1GHz and 800MHz bandwidth respectively. AP020 features a x10 signal attenuation. The AP021 offers a x5 attenuation. The AP003 1GHz FET probe is equipped with a standard BNC connector and can be used with any oscilloscope with a 50Ω input.

FET probes provide the oscilloscope user with a higher level of measurement capability. Compared with passive probes, they offer low circuit loading, low capacitance and high bandwidth.

Circle (52) on Reply Card

Needle-tip pen oiler

A new pen oiler filled with a lubricant containing Teflon that is ideal for maintaining a wide-variety of products ranging from scientific instruments to cameras, guns, and fishing tackle is being introduced by *Syon Corporation* of Ashland, MA.



The Lubit-8 Pen Oiler is filled with a blend of natural and synthetic oils containing microminiature particles of Teflon and Fluon held in permanent suspension. Featuring a needle-tip which precisely dispenses the lubricant, one drop at a time, this oiler is for use where sprays and oil cans are impractical.

Designed to be clipped to a shirt pocket or carried in a field service kit or other small tool box, the oiler is about the size of a fountain pen. The lubricant is unaffected by -60F to +500F temperatures, is

very slippery, resists dust, does not coagulate, and leaves no oily residue.

Circle (53) on Reply Card

DMM/thermometer/relative humidity meter

Newport Electronics introduces the Model HHM25, a portable handheld DMM which features true RMS functions, with the capability of measuring up to 3 type K thermocouples using the included adaptor. The DMM measures

voltage from 0.01mV to 1000Vdc or 1000Vac, current from 0.01mA to 10A for ac and dc, frequency from 1Hz to 19.99kHz, capacitance from 0.001nF to 99.99µF, resistance values from 400Ω to 40MΩ. The temperature measurements will allow for up to three type K thermocouple inputs for measurements of either T1, T2, T3 or T1-T2 with a temperature range of –346F to 2498F (–200C to 1370C).

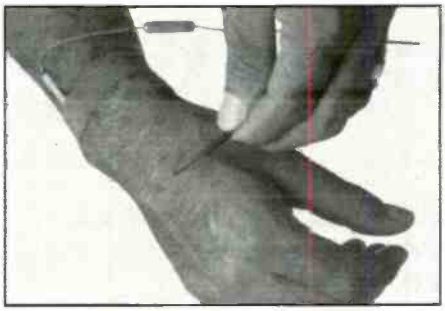
Standard features include a $4^1/_2$ digit display which indicates the measurement functions, measurement units, thermocouple or relative humidity probe, display hold, overrange and low battery warning and a bar graph display.

The meter is supplied with 3 type K beaded wire thermocouples, thermocouple adaptor, heavy duty rubber protective boot, rugged carrying case, 9V battery and operator's manual. An optional humidity probe may be used allowing the user to measure relative humidity over the range of 15% to 95%.

Circle (54) on Reply Card

Disposable wrist band

Dispos-A-Strap from *Richmond Static Control Services*, is a new, one-piece grounding strap designed to be thrown away after one use. The design includes a sturdy elastic strap containing conductive filaments positioned above the inner layer for maximum skin contact and conductivity for protection against ESD. The convenient five-foot straight wire features a built-in 1MΩ resistor and an easy-to-adapt banana configuration plug for easy, yet solid grounding. The wrist strap and straight wire are yellow.



The strap is useful for inclusion in the factory packaging of personal computers and other electronic equipment that may require elementary service or repair by the end user. It is also designed for use by field service technicians when making repair and service calls on electronic equipment containing PC boards, such as computers, copiers, printers and fax machines, to insure protection from electrostatic damage to sensitive integrated circuits.

Circle (55) on Reply Card

Digital scopes

Tektronix announces two new oscilloscopes: the 50MHz TDS 310 and the 200MHz TDS 350 digital, real time oscilloscopes featuring high-speed oversampling. The digital scopes acquire and display signals similar to analog scopes, eliminating the potential for aliasing of the waveform. The TDS 310's two channels digitize at a rate of 200 megasamples per second and the TDS 350 at one gigasample per second, providing accurate representations of waveforms at the full bandwidth of each scope, even for single-shot events.

The series communication option includes GPIB, RS232 and Centronics-type interfaces for hard copies. In addition to over 20 waveform measurements, the oscilloscope offers four acquisition modes: sample, envelope, average and peak detect.

Circle (56) on Reply Card

What Do You Know About Electronics?

Tunnel diodes are alive and well

By J.A. Sam Wilson

Announcement

For those of you who need information about or from any technician organization such as the CET programs, CET testing, activities of technicians, etc., I would like to inform you that I am no longer a member of any of these groups. Therefore, you may want to try contacting the following memberships that are involved with CET testing (in alphabetical order):

Electronics Technicians Association—ETA
604 N. Jackson Street
Greencastle, IN 46135

International Society of Certified Electronics Technicians—ISCET
2708 West Berry Street
Ft. Worth, TX 76109

For those of you who are not aware of it, the following entry is your contact for buying tunnel diodes:

Germanium Power Devices Corp.
300 Brickstone Square
P.O. Box 3065
Andover, MA 01810
Sales Manager: Rick Kassiotis

Apparently, the big companies have abandoned all germanium devices. The tunnel diode is just one example. I suppose this means that someday they will abandon all silicon devices in favor of the gallium arsenide devices. That is what is known as progress. (?)

Letters

I have received two letters I want to share with you. The first is from FM in Darien, IL.:

Mr. Wilson:

I believe the answer to problem 3 in Test Your Electronics Knowledge is wrong and should have been 151 instead of 97. The problem was to decode BCD number 10010111.

The first four digits to the left are 144 in decimal and to the right the last four digits are 7 in decimal. This brings the total to 151 decimal.

Thank you.

Sam Says:

If you have been following WDYKAE? you already know that the BCD number is divided into groups of four binary numbers. Each four-bit binary number is then decoded into a decimal number between 0 and 9. So, 97 is the correct answer.

I want to thank FM for his very professional letter. There are two important lessons to be learned from this. The first is that it can take an awful long time to get an answer. The second is that sometimes something seems to be wrong, but, it turns out to be right. Note that Frank Massi did not jump all over me with insults. Maybe by printing his letter as a model we can all learn a better way to correspond.

The second letter is from Erich Hollingswood. He says he and the Chief Tech

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

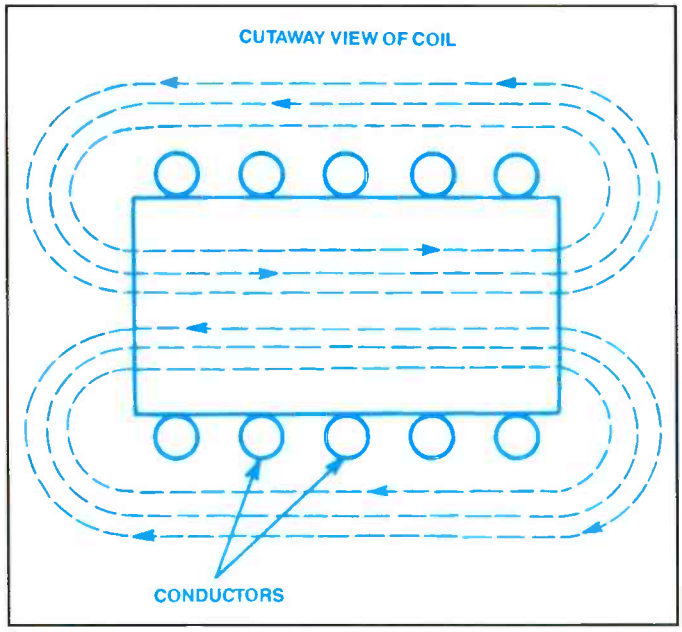


Figure 1. A voltage is induced in a conductor anytime there is a change in the magnetic field around the conductor.

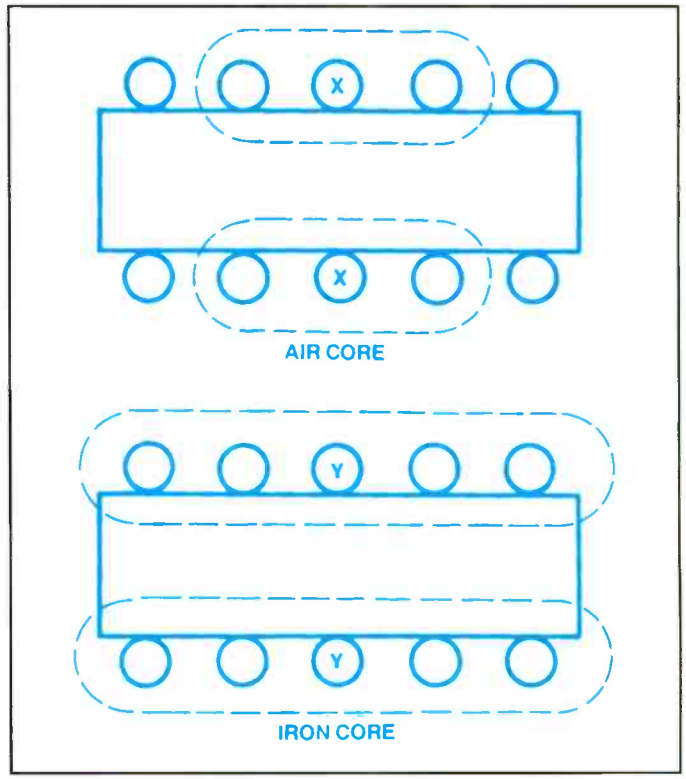


Figure 2. The voltage induced in a coil with an iron core will be greater than the voltage induced in the same coil with an air core because of the lower magnetic reluctance of the iron core.

of Halls TV in Prentiss, MS really enjoy our articles. He adds—Keep up the good work, gentlemen!!!

I don't have room to print the complete (very professional) letter, but, this is the idea he proposes. He says that the method of decoding the BCD number couldn't work because 01111111 would decode as 7F and that is not a decimal number.

He proposes that the method of decoding that I gave would really convert the binary string to a hexadecimal number.

Actually, he makes an important point. In the BCD decoding no four-digit number can be greater than 1001—that is to say, none of the four-digit numbers can be greater than decimal 9. I should have made that clear.

Of course, BCD stands for binary-coded decimal. It does not mean binary-coded hexadecimal.

Many, many thanks to the writers of the above letters.

Inductance as determined by magnetism

I have had a discussion with a very intelligent person. He likes to give me ideas about basics that I can write about. In this case it is about the way the magnetic field is represented in electromagnetic devices. I'll use an inductor as an example.

Faraday's Law states that any time there is relative motion between a magnetic field and a conductor, a voltage is generated. The mathematical expression for Faraday's Law is expressed in two different ways, but both are saying the same thing in different ways.

$$V = -N\left(\frac{d\phi}{dt}\right) \text{ and } V = -L\left(\frac{di}{dt}\right)$$

In these equations, V is the induced voltage or counter voltage, N is the number of turns in the coil, and, L is the inductance of the coil. The mathematical expression $\frac{d\phi}{dt}$ means the rate of change of flux, and, $\frac{di}{dt}$ means the rate of change of current that produces the changing flux.

It doesn't matter whether the flux is moving and the conductors are motionless, or, the conductor is moving and the flux is motionless.

Refer to Figure 1. Note that the flux is shown in the center of the coil and that flux, represented by broken lines, is shown with arrows. This illustration is sometimes accompanied with a statement like "the greater the flux the greater the induced voltage.

You *might* get the idea that a voltage is induced in the coil by the flux lines in the core. Also, from the arrows on the flux lines you *might* get the idea that the flux lines are moving.

There is no physical law or effect that relates the flux in the center of a coil to the voltage induced in the coil. To explain what is being illustrated I have provided the illustrations in Figure 2. Note that there are two cases being shown. In the first case, the core of the coil is air. In the second case, it is iron.

At the peak of one-half cycle the flux around the conductor marked with an X reaches across only two adjacent conductors. That means an induced voltage will occur only in those conductors. The same thing happens with all of the other conductors. Therefore, there is not much total induced voltage.

In the case of the coil with the iron core, the low reluctance of the iron results in the peak flux reaching across all of the turns of wire. So, the peak flux around conductor Y induces a voltage in all of the other conductors. Observe in Figure

l that the flux lines in the center of the coil will add to produce a good healthy flux density in the core.

The arrows on flux lines do not indicate flux motion. Instead, they show the path that a unit north pole would move if there was such a thing. A unit north pole is a very small magnet that has a north magnetic pole but no south magnetic pole. People are spending lifetimes looking for those things but none has ever been found. If they do find one you will hear the sound of one hand clapping.

To summarize, the flux in the center of the core is the result of adding the fluxes around each turn. However, the counter-voltage induced in the coil is the sum of the voltages induced in each winding by adjacent windings.

Frone Smix has passed his first quarter in his post-high course in electronics. His study of magnetism has given him an idea he believes he can patent. Since the flux passing through the center of the core does not produce the counter voltage characteristic of inductance, then, why not make the core hollow? According to Frone, that would give us much lighter inductors and transformers.

Of course, it will not work because decreasing the cross section of the iron core causes an increase in the core reluctance. That, in turn, will reduce the number of flux linkages.

Calculator practice

Nothing clears the air better than an arithmetic problem that everyone understands. Here is one you can pass around.

Enter any three-digit number on your calculator. Without clearing, repeat the same three numbers. For example, if you chose 432 for the first 3-digit number you would now have 432432 displayed.

Divide that number by 11. Divide the result by 7.

Divide that result by 13. You should have the original number.

Technician hazards

I have warned technicians many times in WDYKAE? about the hazards of lead and lead solder. In some cases, technicians have picked up the very dangerous hazard of holding solder in their mouth during the soldering process. In other words, they are using their mouth as a third hand. Do that for a little while and the result is Big Casino! In other words, the technician assumes room temperature. (In electronics we never say die.)

The first sign of lead poisoning is loss of memory. Also, there is a reduction of math skills. These things make it very difficult to diagnose in some students.

Another symptom is loss of circulation. A tingling sensation in the fingers is a warning sign.

According to an Associated Press release, a technician in Ohio began to notice all of those symptoms. He was diagnosed as having 10 times the lead level in normal humans.

People who knew him gave this clue: He was fond of chewing on the insulation scraped off wires. That plastic coating has a high level of lead! It was the cause of the high level of lead in the technician.

Understand this important point: Once the lead gets into you it is nearly impossible to get out. ■

Test your electronics knowledge

Answers to the quiz

(from page 46)

1. 20%. Percent duty cycle is equal to the ON time divided by the time for one cycle multiplied by 100.

2. A. Moving the plates closer gives a higher capacitance and a lower resonant frequency.

3. D. The correct answer is ferrite bead. Resistors have also been used.

4. About 66ms. This type of problem was worked in last month's "WDYKAE?".

5. See Figure A.

6. 300Ω. The surge impedance is the same as the characteristic impedance.

7. D. The diversity antenna system is effective against fading. This antenna system consists of a receiver and a number of antennas spaced a wavelength (or, two wavelengths) apart.

8. Prescaler. That is what a prescaler does.

9. C. Potentiometer is a name used for a variable resistor. It is also a name used for an instrument that measures voltage.

10. C. Sinewaves have no harmonics.

Solution To Bonus Question (10 points)

The answer is B. LED #2.

Books

Electronic Troubleshooting, by Daniel R. Tomal and Neal S. Widmer, TAB Books, 384 pages, 317 illus., $24.95 paper, $34.95 hardcover.

A full revision and update of Daniel Tomal's *Principles and Practice of Electrical and Electronic Troubleshooting*, this compact reference puts state-of-the-art troubleshooting techniques at the fingertips of electronics technicians, students, and hobbyists.

Included in this book is an ample supply of time-saving diagnostic tables and charts that make pinpointing problems with electronic equipment quick and easy. Authors Tomal and Widmer show readers how to troubleshoot and repair electric motors and generators, residential and industrial wiring, digital circuits, microprocessor-based systems, industrial controls, radios and televisions, sequential digital circuits, and biomedical equipment. Also included at the end of each chapter are examination questions/problems.

Tomal is an assistant professor in the technology and engineering department at Purdue University, North Central. Neal S. Widmer is an associate professor of electrical engineering technology at Purdue University.

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

Practical Filter Design, By Jack Middlehurst, Prentice Hall, 259 pages, includes 3½ inch DOS disk, $35.00, paper.

Although filters are basically easy to understand, you don't get this impression from most books. This is a non-mathematical treatment for electronics hobbyists and technicians. This book looks at the circumstances where filters are needed, indicates which ones to choose for specific applications, and discusses their limitations. Details are given of the circuits, construction and tuning of LC filters, as well as simple active filters. Butterworth, Chebychev and elliptic forms of low-pass, high-pass, band-pass and band-reject filters are described, as well as active and passive crossover and notch filters. To truly remove any difficulties with mathematics, computer programs in GW BASIC are provided on disk so that filters and their properties can be easily designed and predicted.

Prentice Hall, Englewood Cliffs, NJ 07632

Build Your Own 386/386SX and Save a Bundle, 2nd Edition, By Aubrey Pilgrim, TAB Books, 248 pages, $18.95, paper.

Windcrest has two words for people who think they can't afford high-power personal computing—Aubrey Pilgrim. He wrote the book on how to build a state-of-the-art PC at home for a fraction of the cost of a new store-bought system. *Build Your Own 386/386SX and Save a Bundle, 2nd Edition*, the latest in Pilgrim's bestselling *Save a Bundle* series, shows how anyone, regardless of their level of computer or electronics skill, can assemble their very own 80386-based microcomputer using inexpensive mail-order parts.

Pilgrim's clear, step-by-step instructions and close-up photographs lead do-it-yourself PC builders through each phase of the assembly process, explaining not only where each component goes, but also what it does and how it does it. A revised edition of the national best-seller *Build Your Own 80386 IBM Compatible and Save a Bundle*, this volume now includes material on the new 386SX and 486SX microprocessors, as well as expert advice on how-to-build a computer that takes full advantage of DOS 5 and Windows 3.1. Pilgrim also furnishes complete, up-to-date information on component prices and availability, parts suppli- ers, troubleshooting techniques, peripherals, and software.

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

Professional Photocopier Troubleshooting and Repair, By Eric Kuaimoku, TAB Books, 352 pages, 240 illus., $29.95, hardcover.

For licensed technicians and apprentices who want to add photocopier repair expertise to their resumes, *Professional Photocopier Troubleshooting and Repair* provides a comprehensive course in the tools and techniques employed by working professionals.

Eric Kuaimoku takes an in-depth look at each photocopier component and subsystem—including optical devices, developer drums and sensors, fusing mechanisms, and paper transfer rollers and belts—pinpointing the sources and solutions to problems that typically arise through extended use. This hardcover edition will give technicians and students all the background information and practical know-how they need to service and repair a full line of personal and business photocopiers.

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

Zen and the Art of the Internet: A Beginner's Guide, By Brendan Kehoe, Prentice Hall, 112 pages, $22.00, paperback.

Are you lost in the Internet? If you have ever had any questions about the Internet, this new book is for you. Prentice Hall proudly announces the publication of *Zen and the Art of the Internet: A Beginner's Guide* by Brendan Kehoe, a guide to navigating through the Internet.

Zen and the Art of the Internet is the first easy-to-read introduction to the Internet for both computing novices and experts. Readers will find a practical and complete guide to navigating through the Internet and using the network to the fullest extent. The book is operating system neutral, and can be used as a quick reference readers can use at a minute's notice. It covers topics such as the Internet, UUCP, bitnet, Electronic Mail, FTP, and Commercial Services (eg. electronic journals, newsletters, and Clarinet News).

Contents: Foreword: Preface; Acknowledgements; Chapter 1, Network Basics; Chapter 2, Electronic Mail; Chapter 3, Anonymous FTP; Chapter 4, Usenet News; Chapter 5, Telnet; Chapter 6, Various Tools; Chapter 7, Commercial Services; Chapter 8, Things You'll Hear About; Chapter 9, Finding Out More; Conclusion; Appendix A—Getting to Other Networks; Appendix B—Retrieving Files Via Email; Appendix C—Newsgroup Creation; Appendix D—Items Available for FTP; Appendix E—Country Codes; Glossary; Bibliography; and Index.

Prentice Hall, Simon & Schuster Education Group,
Englewood Cliffs, NJ 07632

Digital Oscilloscope Handbook, Test & Measurement Series, By Charles G. Masi, Butterworth/Heinemann, 250 pages, $29.95, hardcover.

The *Digital Oscilloscope Handbook* provides a complete reference for what you need to know about using digital scopes. It covers the essentials, starting at a level comprehensible to anyone with an electronics background and is broad enough to cover offerings from all major vendors as well as most classes of applications.

This Handbook serves as an introduction to digital oscilloscopes as well as a treasury of information for experienced digital scope users seeking a deeper understanding of these powerful instruments. This new book brings together in one place information that has been available only in scattered trade magazine articles or manufacturer application notes. It covers everything from basic principles to a detailed look at the circuitry that makes digital scopes work. The book also demonstrates real-world applications for novices as well as users who are already familiar with the use of digital scopes.

Contents include hardware fundamentals, an introduction to digital oscilloscopes, digital oscilloscope circuitry, basic measurement applications, data acqui- sition and time domain reflectometry.

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1992/1993 Profax Schematics Special Issue:
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Hitachi Camcorder Model UM-E2A
Memorex Pocketvision 26, Catalog Number 16-163
Mitsubishi VCR Model HS-U55
Panasonic Color TV Model SR400EK
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Curtis Mathes VCR/Model GV730/740
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Memorex VCR/Model 29
Mitsubishi TV/Model CS-3535R/CK-3536R, CS3135R/CK-3136R
Panasonic CTM1353R
JC Penney TV/Model 2003
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2060-2061	Mar	85
2062-2063	Apr	85
2064-2065	May	85
2066	Jun	85
2067	Jul	85
2068	Aug	85
2069-2070	Sep	85
2071-2072	Oct	85
2073-2074	Nov	85
2075-2076	Dec	85
2077-2078	Jan	86
2079-2080	Feb	86
2081	Mar	86
2082-2083	Apr	86
2084A-2084B	May	86
2085-2086	Jun	86
2087-2088	Jul	86
2089	Aug	86
2090	Sep	86
2091-2092	Oct	86
2093-2094	Nov	86
2095-2096	Dec	86
2097	Jan	87
2098-2099	Feb	87
(Note: numbers 2100-2999 were skipped)		
3000	Apr	87
3002-3003	May	87
3005-3006	Jun	87
3007-3008	Jul	87
3009-3010	Aug	87
3011-3012	Sep	87
3013	Oct	87
3014	Nov	87
3015-3016	Dec	87
3017-3018	Jan	88
3019	Feb	88
3020	Mar	88
3021-3022	Apr	88
3023-3024	May	88
3025-3026	Jun	88
3027-3028	Jul	88
3029-3030	Aug	88
3031-3032	Sep	88
3033-3034	Oct	88
3035-3036	Nov	88
3037	Dec	88

Profax #	Month	Year
3038-3039	Jan	89
3040-3041	Feb	89
3042-3043	Mar	89
3044-3045	Apr	89
3046-3047	May	89
3048-3049	Jun	89
3050-3051	Jul	89
3052-3053	Aug	89
3054	Sep	89
3055-3056	Oct	89
3057-3058	Nov	89
3059	Dec	89
3060	Jan	90
3061	Feb	90
3062	Mar	90
3063	Apr	90
3064	May	90
3065	Jun	90
3066	Jul	90
3067	Aug	90
3068	Sep	90
3069	Oct	90
3070	Nov	90
3071	Dec	90
3072	Jan	91
3073	Feb	91
3074	Mar	91
3075	Apr	91
3076	May	91
3077	Jun	91
3078	Jul	91
3079	Aug	91
3080	Sep	91
3081	Oct	91
3082	Nov	91
3083	Dec	91
3084	Jan	92
3085	Feb	92
3086	Mar	92
3087	Apr	92
3088	May	92
3089	Jun	92
3090	Jul	92
3091	Aug	92
3092	Sep	92
3093	Oct	92
3094	Nov	92
3095	Dec	92
3096	Jan	93
3097	Feb	93
3098	Feb	93
3099	Mar	93
3100	Mar	93
3101	Apr	93
3103	May	93
3103	May	93
3104	Jun	93
3105	Jul	93

Profax #	Month	Year
3106	Aug	93
3107	Sep	93
3108	Oct	93
3109	Nov	93
3110	Dec	93

Company index—1984-1993

	Profax #	Month/Year
CURTIS MATHES		
Projection TV Set: Models SMP 4100, 4600, 5210	Special	1992/93
VCR Model GV 730/740	Special	1993/94
GENERAL ELECTRIC		
AF/C chassis	2037	Mar 84
GL/X chassis	2038	Apr 84
XK B&W chassis	2039	Apr 84
XJ B&W chassis	2042	Jun 84
EC/K chassis	2044	Jul 84
XE B&W chassis	2049	Sep 84
AB/AC chassis	2051	Nov 84
CM chassis	2055	Jan 85
XM-E chassis	2057	Jan 85
PC-A chassis	2058	Feb 85
GK chassis	2060	Mar 85
EC-A chassis	2064	May 85
EP-B chassis	2066	Jun 85
19PC-F/H chassis	2067	Jul 85
PM-B chassis	2068	Aug 85
BC-N chassis	2073	Nov 85
EP chassis	2074	Nov 85
PC-J chassis	2075	Dec 85
PM-A chassis	2078	Jan 86
BC-A chassis	2079	Feb 86
25 PC(J) chassis	2082	Apr 86
HP chassis, tuning and control systems	2084A	May 86
HP chassis, chroma	2084B	May 86
NF chassis	2087	Jul 86
PM-C chassis	2088	Jul 86
X110 chassis, B&W TV	2091	Oct 86
TV/AM/FM clock radio	2092	Oct 86
14-inch portable color TV	2094	Nov 86
X110 chassis (cont.)	2095	Dec 86
CTC140 chassis, color TV	3014	Nov 87
MK-1 chassis, model 8-1938	3008	Jul 87
MK-1 chassis	2099	Feb 87
MK-2 chassis	2097	Jan 87
NF chassis update, color TV	3003	May 87
7-7130A chassis, 5-inch B&W	3004	May 87
1VCR2006W model, VCR	3027	Jul 88
1VCR2018W model, VCR	3019	Feb 88
NC-05X3/06X1 chassis, color TV	3032	Sep 88
Projection TV 8-4500	3020	Mar 88
PW chassis, model 40PW3000KA01 projection TV	3037	Dec 88
VHS VCR, model 1VCR2002X	3044	Apr 89
Color TV, 1987 CTC136	3047	May 89
CTC135-S1 color TV	3052	Aug 89
1987 8-4500 projection color TV	3057	Nov 89
HITACHI		
Projection Color TV, Models 55EX7K, 50EX6K, 46EX3B/4K, 50ES1B/K, 46EX3BS/4KS	3109	Nov 93
Camcorder Model UM-E2A	Special	1992/93
Color TV, Chassis AP13	3085	Feb 92
NP81X chassis	2054	Dec 84
CT2516 chassis	2059	Feb 85
CQ4X chassis	2061	Mar 85
CT1358 chassis, color TV	3005	Jun 87
CT2020W, CT2020B chassis	3010	Aug 87
CT2250B, CT2250W chassis	3000	Apr 87
CT2250B, CT2250W chassis	3012	Sep 87
CT1344 chassis color TV	3029	Aug 88
CT1358 chassis color TV	3018	Jan 88
CT2647/CT2648/CT2649 chassis color TVs	3025	Jun 88
CT2652, CT2653 color TVs	3024	May 88
CT3020W/CT3020B	3033	Oct 88
VHS VCR, model VT-63A	3035	Nov 88
CT1955 color TV, NP85XA chassis	3038	Jan 89
Color TV, chassis CT1941/CT19A2, NP83X chassis	3043	Mar 89
CT1955 color TV	3045	Apr 89
CT2066 color TV	3050	Jul 89
CT2086 B/W chassis G7NU3 color TV	3055	Oct 89
CT1395W G7NSU2 color TV	3060	Jan 90
G7XU2/3 chassis color TV	3063	Apr 90
G7XU2 - models CT2087B/W, A087 (MT2870 through MT2878)		
G7XU3 - models CT2088B/W, A088 (MT2880, MT2886, MT2887)		
CT4580K, VP7X2 chassis proj. TV	3065	Jun 90
NP 83LX Color TV	Special	1993/94
VP9X1 chassis color TV	3069	Oct 90
CT1947/CT19A7 chassis color TV	3079	Aug 91
CT2541/2542 chassis color TV	3080	Sep 91
VCR Model 3267E 3087	3087	Apr 92
VCR Model VT-F551A	3090	Jul 92
VCR Model VT-M40A	3086	Mar 92
VCR Model VT-150A	3095	Dec 92
VCR Model VT-M231A		
IBM		
Model 8503 Monochrome Display	Special	1993/94
MAGNAVOX		
Model RD0945C101, RD0946T101 Color TV	Special	1993/94

	Profax #	Month/Year
MEMOREX		
Pocketvision 26 TV, Catalog Number 16-163	Special	1992/93
Model CD-3360 Portable Compact Disc Player	Special	1992/93
Model 29 VCR	Special	1992/93
MITSUBISHI		
Model CS-3535R/CK-3535R CS3135R/CK3136R Color TV	Special	1992/93
VCR Model HS-U55	Special	1992/93
NAP		
E34 chassis	2034	Jan 84
19C2 chassis	2035	Feb 84
E32 chassis	2040	Apr 84
E32-58, -59 chassis	2043	Jun 84
K10 chassis	2045	Jul 84
RD 425S1 & RXC 192SL chassis	2047	Aug 84
E53-45, -46, -47, -48 chassis	2048	Sep 84
BD3911 SL01 B&W chassis	2051	Nov 84
UXC chassis	2063	Apr 85
EC-31-52, -56 & -58 chassis	2069	Sep 85
E-34-18, -32 & -33 chassis	2071	Oct 85
E51-56 chassis, color TV	3030	Aug 88
E54-10 chassis, projection TV	3021	Apr 88
E54-15 chassis, projection TV	3026	Jun 88
RD4502SL/RLC312SL color TV monitors	3036	Nov 88
Color TV, series 19C2 chassis (Magnavox)	3039	Jan 89
Color TV, chassis E34-11	3042	Mar 89
Color TV, chassis E54-15 (Magnavox RD8518 and RD8520; Philco model P8190S; Sylvania PSC410 and PSC420)	3049	Jun 89
NEC		
C13-304A chassis	2056	Jan 85
DJ-60EN(R) chassis	2065	May 85
PANASONIC		
Model CTM1353R Color TV	Special	1993/4
Model SR400EK Color TV	Special	1992/93
JC PENNEY		
Model 2003 Color TV	Special	1993/94
RCA		
KCS206 B&W	2033	Jan 84
KCS213 B&W	2036	Feb 84
CTC111 series	2041	Mar 84
CTC123 series	2046	Apr 84
CTC131/132 series	2050	Oct 84
KCS B&W AM/FM clock	2053	Dec 84
CTC117 chassis	2062	Apr 85
CTC118 chassis	2070	Sep 85
CTC121 chassis	2072	Oct 85
CTC126 chassis	2076	Dec 85
MMC100, video monitor	2077	Jan 86
CTC117 chassis	2080	Feb 86
CTC133 chassis	2081	Mar 86
CTC120 chassis	2083	Apr 86
CTC125 chassis	2085	Jun 86
207 series weather clock	2086	Jun 86
CTC136 chassis	2089	Aug 86
CTC130-S1 chassis	2090	Sep 86
B&W TV basic service data	2093	Nov 86
UWJ chassis	2096	Dec 86
CTC117-S2 color TV supplement	2098	Feb 87
CTC134 chassis, color TV	3013	Oct 87
CTC135 chassis, color TV	3006	Jun 87
VDM140 chassis, color TV	3002	May 87
PVM035 chassis color TV	3031	Sep 88
PVM050 color TV	3023	May 88
P42000-S1 projection TV (additional models: RVM46700, 46GW700, P46000)	3048	Jun 89
CTC135 color TV	3051	Jul 89
CSM055 color TV/AM/FM/clock radio	3054	Sep 89
CTC91 chassis color TV	3071	Dec 90
CTC99 chassis color TV	3072	Jan 91
CTC107 chassis color TV	3073	Feb 91
CTC96 chassis color TV	3077	Jun 91
CTC107 chassis color TV	3078	Jul 91
CTC175 Chassis Color TV	Special	1993/94
CTC176 Chassis Color TV	3108	Oct 93
RCA/GE (Thomson Consumer Electronics)		
Color TV, Model 7-7800A	3091	Aug 92
Color TV, CTC145/146 chassis	3040	Feb 89
CTC145/146 color TV	3058	Nov 89
CTC148/149-S2 chassis color TV	3062	Mar 90
CTC156 chassis color TV	3068	Sep 90
CTC169 (PV) chassis Color TV	3070	Nov 90
CTC168 chassis color TV	3074	Mar 91
CTC86 chassis color TV	3075	Apr 91
KCS203 chassis B&W TV	3076	May 91
CTC167 chassis color TV	3081	Oct 91
CTC166 chassis color TV	3082	Nov 91
CTC168 chassis color TV	3084	Jan 92
CTC168-53 chassis color TV	3088	May 92
CTC169 chassis color TV	3083	Dec 91
TX81 chassis color TV	3067	Aug 90
TX82 chassis color TV	3092	Sep 92
VCR Model VG4202	Special	1992/93
SHARP		
Model 13C-M100 Color TV	3093	Oct 92
Model 19E-M50	3110	Dec 93
Model 19E-M40R, 19E-M50R Color TV	3107	Sep 93
Model 20C-5300 Color TV	3096	Jan 93
Model 20C-S200 Color TV	3099	Mar 93

	Profax #	Month/Year
Model 20SB65 Color TV	3103	May 93
25S1 Chassis Color TV	3097	Feb 93
Model 27C-5200 Color TV	3094	Nov 92
Model 27SV65 Color TV	Special	1992/93
Model 27SV70	3101	Apr 93
Sigma 9700 Chassis Color TV	Special	1993/94
VCR Model VC-A45U	3098	Feb 93
VCR Model VC-A504U/C	3104	Jun 93
VCR Model VC-H86U/C	3100	Mar 93
VCR Model VC-H87U/C	3106	Aug 93
VCR Model VC-H870U/C, VC-8870U/C	3102	May 93
VCR Model VC-H903U/C, VC-H904U/C	3105	Jul 93
TOSHIBA		
Color TV Model CF2077A: CX21772,	Special	1992/93
VCR Model M222, M222C, M227C, M227L	Special	1993/94
ZENITH		
D2500W chassis, color TV	3009	Aug 87
D13085/D1910B chassis, color TV	3007	Jul 87
SD2501W chassis, color TV	3011	Sep 87
CM-139/B-0 (B) chassis color TV	3028	Jul 88
CM-139/B-3 (I) SD2511G/SD2581H	3034	Oct 88
C2020H chassis color TV	3022	Apr 88
PV800 color monitor	3017	Jan 88
Color TV, CM-140/b-2(G) chassis	3041	Feb 89
CM-14-0/B-3(1) color TV (models SE2721H/SE2725R/SE2727H)	3046	May 89
CM-140/B-2(I) color TV	3053	Aug 89
PV4661H rear-projector color TV	3056	Oct 89
CM-139/B2 Models SD5515, SD5535, SD555G	Special	1992/93
CM-140/DIGITAL(C) chassis color TV (Models SE3135P/SE3191H/ SE3535H/ZB2771H/ZB2771H2/ ZB2777H/ZB2777H2/ZB2797P/ ZB2797P2/ZB2797Y/ZB2797Y2/ ZB3193H/ZB3193Y/ZB3539T /ZB3539Y)	3059	Dec 89
CM-139/B1 (Y) and (K) Color TV Recievers Models SD2097S (Y) and SD1327W3, SD1327Y, SD1327Y3(K)	3061	Feb 90
PV-140/Digital (G) Rear Proj. digital TV receiver, Zenith surround stereo system	3064	May 90
PV454-1P chassis color TV	3066	Jul 90

puters 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.

NESDA recognizes that if this ruling is allowed to stand, all manufacturers of computers, automobiles, office products, and eventually almost every type of product manufactured—including appliance, radios, TV sets, heating and air-conditioning controls, etc.—could claim a similar "right" to its "intellectual property." NESDA Executive Director, Clyde Nabors, said that, "NESDA has no choice but to oppose this lower-court ruling as forcefully as legally possible. MAI did this," he said, "because they could not stand up to their service competitors on a level playing field." He sees this as "another of a long string of thinly-veiled attempts by some manufacturers to eliminate competition from independent service."

The NESDA brief will challenge the ruling on several points of law as well as other issues. The other issues include its impact upon the independent service industry and the fact that it counters a recent decision of the Supreme Court in the Kodak case. In that Kodak case, NESDA had also filed a brief that was instrumental in influencing a favorable ruling. There, the Supreme Court ruled that manufacturers may not be allowed to make the sale of a product or repair part conditional upon the factory service of that product. The cited brief along with the other service organization briefs as proof that a market for the service of a product does exist beyond the sale of the product. They used this to state that a manufacturer that does not have a monopoly in the market for the sale of its products may still be charged with illegally trying to monopolize the service of those products.

This brief, dubbed the "Service Industry Signal," is being filed on behalf of NESDA/ISCET/NIAS and their Associate organizations by noted antitrust attorney, Ron Katz, of the San Francisco law office of New York-based Coudert Brothers. Coudert also has offices throughout the world.

Joining the NESDA brief were these associate organizations: (1) Arizona State Electronics Association (Phoenix AZ); (2) Chesapeake Electronics Association (Abingdon MD); (3) Electronic Technicians Guild of Massachusetts (Arlington MA); (4) Florida Electronics Sales & Service Association (Jacksonville FL); (5) Missouri Electronics Service Dealers Association (St. Louis MO); (6) Nebraska Electronics Service Association (Coleridge NE); (7) NESDA of New York State (Oceanside NY); (8) NESDA of Ohio (Willoughby Hills OH); (9) Oregon Professional Electronics Association (Portland OR); (10) Professional Electronics Association of Florida (Ft. Lauderdale FL); (11) The Electronics Service Association of Connecticut (Ledyard CT); (12) Tennessee Electronics Service Dealers Association (Soddy Daisy TN); (13) Virginia Electronics Association (Virginia Beach VA); and (14) Wisconsin Electronics Sales/Service Dealers Association(Milwaukee WI).

To recover the costs of this brief—and to be prepared to send future such "signals" from the service industry—NESDA is asking all affected service dealers and technicians and their associations to contribute to the "S.I.S." legal defense fund. Contributions may be sent to: SIS Fund, c/o NESDA, 2708 W. Berry St., Fort Worth TX 76109. For more information, call 817-921-9061.

Video product sales up

Unit sales of video products rose six percent in October, and 11 percent in the first two months of the 1994 holiday selling season, according to the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Four of the six video product categories posted gains in October, led by color televisions, which rose 16 percent for an all-time record on the strength of the first one million unit week in history in the last week of the month. Sales in the year-to-date were up 11 percent. Large-screen sets with screens of 27 inches and over led the market with sales of about 497,000 units, a gain of 51 percent.

"The sales momentum in our industry's core product—color television—continues to build," says Gerald M. McCarthy, president of Zenith Sales Company. "The record October sales to dealers performance means we're off to a very strong fourth quarter and, based on the overall sales rates this year, we expect to see an all-time unit sales record for 1993.

"We also have every indication that sales from retailers to consumers are continuing at a very strong rate."

Projection TV sales rose 12 percent in October, and have risen 12 percent in the year-to-date. The continuing good news for the projection TV market is the strength of sets 50 inches and over. Volume of these models totaled just over 26,600 units, up 19 percent from the month of October 1992.

Camcorder sales rose two percent in October, and are up 12 percent in the year-to-date. The two percent overall gain was buoyed by a five percent gain in sales of full-size models and a one percent gain in sales of compact units.

TV/VCR combination units rose 88 percent in October, and have posted a gain of 65 percent in the year-to-date. VCR deck sales fell 13 percent in October, with stereo deck sales virtually unchanged from last year. Laserdisc players declined six percent, compared to October 1992, although in the year-to-date, sales are up two percent.

Second annual fiber optic installers' conference to be held in Long Beach, CA, July 25-28, 1994

The second annual Fiber Optic Installers' Conference has been scheduled for next summer in Long Beach, CA. The conference will include a combination of classroom seminars and hands-on workshops like the inaugural conference in Nashville last summer, but is expanding to include the building of a demonstration fiber optic cable network as part of the training program.

The Fiber Optic Installers' Conference is the only hands-on training conference for fiber optics. It began with the 1993

meeting as a way to offer fiber optic installers an opportunity to get hands-on training from a large number of vendors during a short period of time and at a reasonable cost. Two hundred attendees came to Nashville and participated in 18 seminars and 90 hands-on workshops.

For the Long Beach meeting in 1994, several changes will be made based on participant feedback from Nashville. First, there will be a "novice track" for those just getting started in fiber optics. There will be more seminars specifically for the novice, starting with the basics of fiber optics, and hands-on sessions to make certain they are familiar with the fundamentals of pulling, splicing and terminating cables. For the more experienced attendees, there will be more time to get hands-on training from an expanded list of vendors and more advanced seminars about LANs, CATV, and telco fiber optics.

The demo cable plant is an expansion of the "demo area" in Nashville, where the vendors displayed tools, components and test equipment and showed attendees how to prepare and pull cable. At the Long Beach Conference, a complete fiber optic network will be built, with virtually every type of fiber optic component.

The network will be big, using a 5,000 square foot ballroom indoors and a 4,000 square foot tent outdoors to simulate the typical environments of a fiber optic network. It will be built during the conference by vendor personnel and attendees as part of their training. Attendees will be trained on pulling cable through the conduit in the network, splicing and terminating cables and testing installed cables in a realistic setting.

The conference is sponsored by a group of fiber optic vendors which includes almost all the top companies in the field. The conference coordination is provided by Fotec, Inc., the fiber optic test equipment company, who originated the idea for the conference last year.

For more information on the conference, contact Jim Hayes, Conference Chairman, at Fotec, Inc. 800-537-8254, Fax 617-241-8616 or email @ MCImail: JHAYES ID# 541-0037. ■

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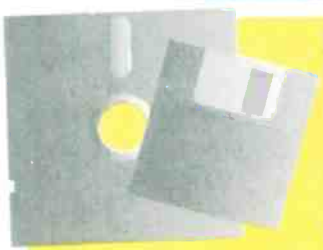

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Hz

Frequency: The Fluke 79's built-in frequency counter lets you measure from below 1 Hz to over 20 kHz. And while you view frequency on the digital display, the analog bar graph shows you AC voltage. So you can see if potentially hazardous voltage is present.

Fast 63-segment analog bar graph: The Fluke 79's bargraph moves as fast as the eye can see, updating at a rate of 40 times per second to simulate the functionality of an analog needle. You get the high speed *and* high resolution you need to detect peaking, nulling and trending.

Capacitance: No need to carry a separate dedicated capacitance tester; the Fluke 79 measures capacitance from 10 pF to 9999 µF.

Actual Size

40Ω

Lo-Ohms range: Our proprietary Lo-Ohms function lets you measure resistance as low as 0.01 ohms. High noise rejection and a test lead Zero Calibration function make the Fluke 79 ideal for detecting small resistance changes.

SMOOTHING

Smoothing™: Our exclusive new Smoothing mode gives you a stable digital readout for unstable signals — by displaying the running average of eight readings. No more jitter or "digit rattle" due to noisy signals.

Get a good thing going: To put more meter to work for you — at a price that works for you, too — head for you nearest Fluke distributor. For the name of your nearest distributor, or for more product information, call **1-800-87-FLUKE.**

The Fluke 79 comes with a yellow holster and patented Flex-Stand™ — easy to hang from a door or pipe, clip onto a belt or tool kit, or stand at virtually any viewing angle. There's even storage space for test leads.

Fluke 79 Series II
$199*
4000 Count Digital Display (9999 in Hz, capacitance, and Lo-Ohms)
63-segment Analog Bar Graph
0.3% Basic DC Voltage Accuracy
Automatic Touch Hold
Diode Test, Audible Continuity Beeper
Autoranging, Manual Ranging
Holster with Flex-Stand
Frequency Counter to over 20 kHz
Capacitance, 10 pF to 9999 µF
Lo-Ohms Range with Zero Calibration
Smoothing
700 Hours Battery Life (alkaline)
3-Year Warranty

** Suggested U.S. list price*

FLUKE®

Circle (34) on Reply Card