THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

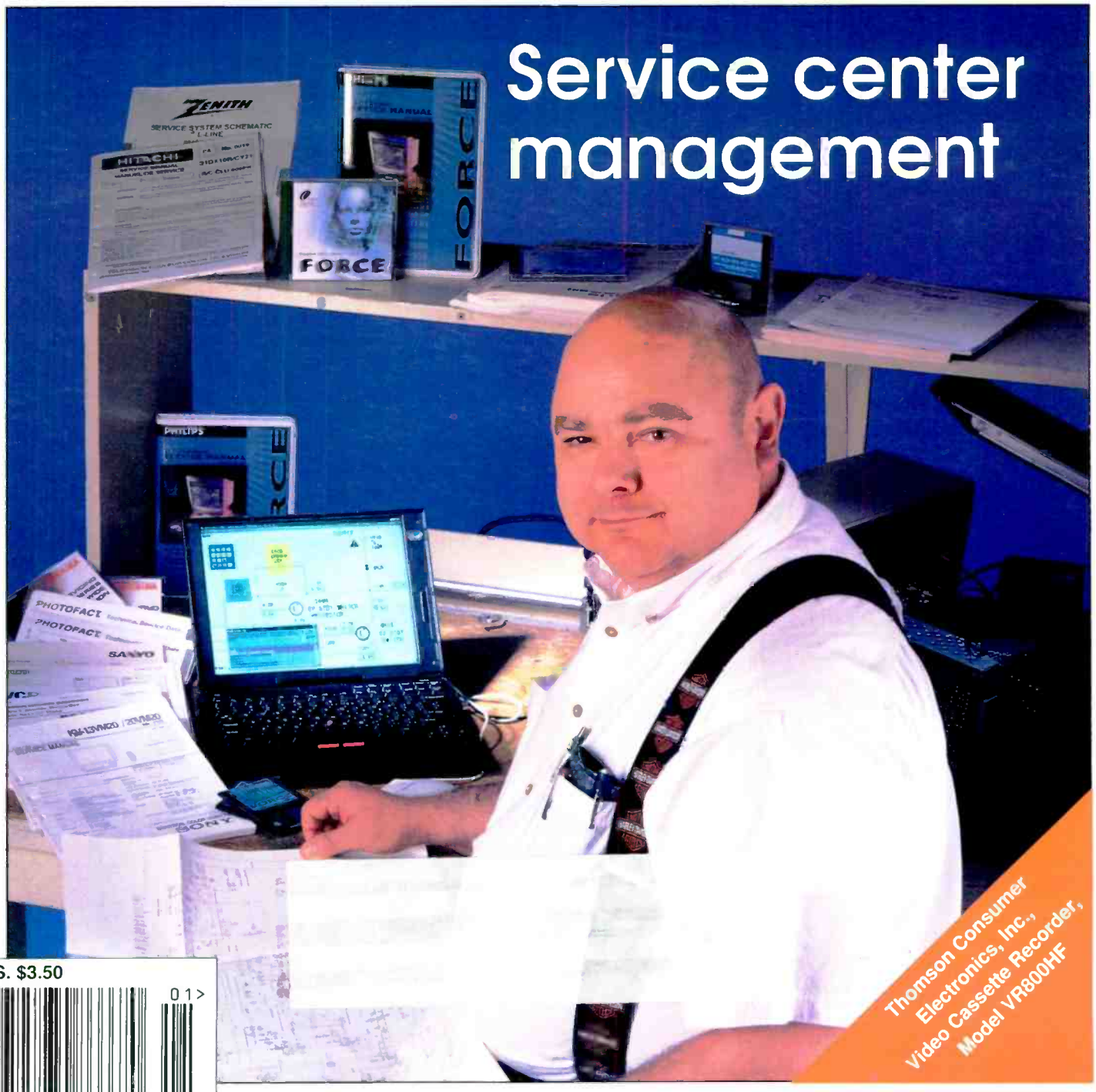
ELECTRONIC Servicing & Technology

T.M.

January 1998

Video board troubleshooting guide

Learning about PC networks



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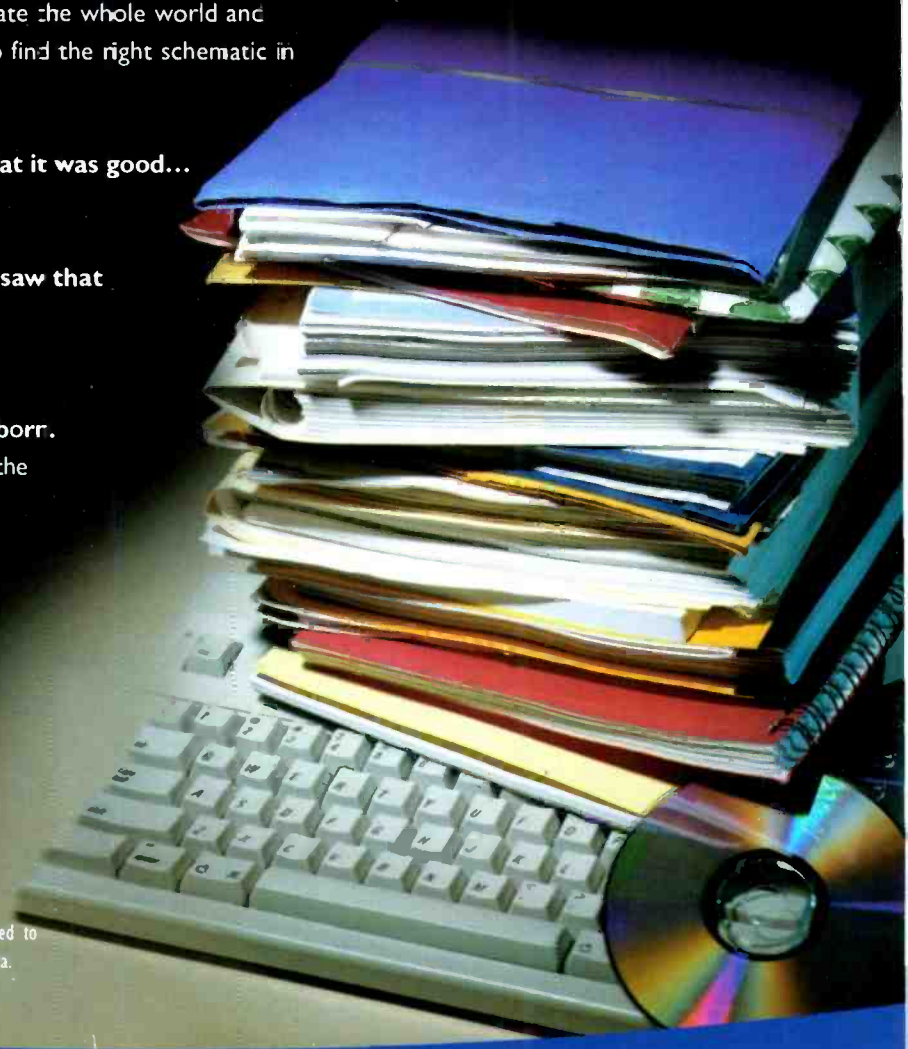

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ELECTRONIC Servicing & Technology

Volume 18, No. 1 January, 1998

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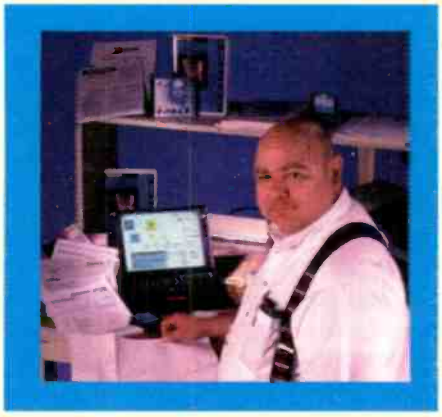

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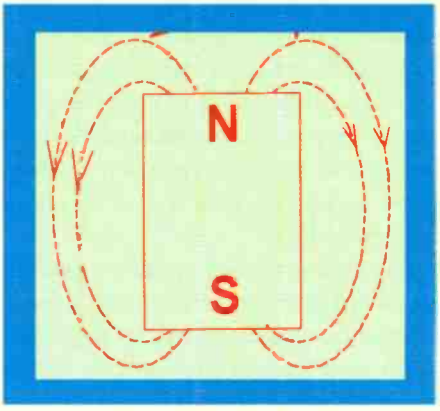

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ON THE COVER

There's a lot more to managing a consumer electronics service center than simply fixing faulty TVs and VCRs. It's also necessary to keep track of and manage a great deal of information; from the name and address of the customer to the manufacturers' service manuals. The right type of information management system, hardware and software, can help keep the task from becoming overhwelming. (Photo courtesy Philips Software Development)

The business side of consumer electronics servicing

Running a business such as consumer electronics servicing can seem like a simple task. You bring in a product that has a defect, put it on the bench, inspect the unit. If necessary, you hook the product up to a battery of test equipment, diagnose the problem, replace any defective parts, let the customer know the product is ready, then stand by to collect the fee.

Those of you who are actually in the business know that it really isn't that easy, and that there is more to the servicing business than that; a lot more. For example, people don't just walk in off the street with their defective products. You have to let them know that you're there. You have to let them know what types of products you service. You have to let them know why they should come to your service center rather than one of the many others in town.

It goes on and on

But that's just for starters. All of those choices only takes care of getting the customer into your service center. Another extremely important question that has to be asked is should your business be a sole proprietorship, a partnership, or a corporation? And if a corporation, what kind of corporation? Each business type carries with it a lot of legal ramifications. For example, if your business is a sole proprietorship or a partnership, your personal assets might be at risk if there were some kind of legal financial decision against the business, such as if someone were hurt on the premises, or by one of your vehicles.

Another important business consideration is that you are required by governments: city, state and federal to comply with licensing requirements, to collect sales taxes, to withhold income taxes, FICA and other amounts from wages.

Some important business decisions

Besides some of those more obvious tasks that any service business must perform, there are policies that the company must formulate for itself, and make sure that it is complying with all applicable local, state and federal laws when formulating those policies. Here are some of those subjects that must be considered:

- should you collect an up-front diagnosis or check-out fee?
- what do you do if a customer doesn't pick the product up (laws vary a lot here)?
- how do you determine how much to charge for your service?
- how do you price parts?
- how do you account for chemicals: cleaners, lubricants, etc.?
- how do you negotiate with the manufacturers, if you plan to become a warranty service center?

Determining how much to charge for parts and labor

Quite a few readers have called us with this question: "how do I know how much to charge my customers for performing service on a product." We have wished we could answer. Unfortunately, the answer to that question is not simple. Fortunately, however, it can be calculated. However, the amount to charge is based on the cost of doing business of a particular business, so there's no simple universal answer. So part of the answer is to determine what it costs to perform a service procedure.

One of the components of that price is the cost of labor. Because analyzing technician performance is so important to the financial health of a service business, whether the only technician employed by the business is the business owner, or there are many technicians involved, this issue includes an article entitled "Measuring the effectiveness of technicians."

The report card

As mentioned in the text, besides simply reinforcing good performance, regular measurement of technician performance can detect performance problems early so that corrective measures can be taken. For example, let's say that a technician's performance has fallen off compared with where it used to be. The manager can discuss it with the tech to find out what the problem is. It might be that the tech, who's really one of the better techs in the facility, has recently been presented with a lot of new, high-tech products for which he hasn't been adequately trained. The simple solution in this case would be to send him to school, or otherwise get him some training.

Never forget that it's a business

For many technicians who are in the service business, the challenge of diagnosing a problem in a faulty product and returning it to proper operation is exhilarating, but they'd really rather not be concerned with the business aspect of things. It can't be stressed too strongly that the business side of things is every bit as important as the technical side, and if neglected, will lead to problems. Furthermore, if looked at in the right way, working out a business problem, such as correcting a technician performance problems as alluded to above, can be every bit as exciting and enjoyable as fixing a broken TV or VCR.

Because of the importance of the business side of servicing, we will continue to publish business-related articles in **ES&T**. If there is some specific aspect of the business of servicing that you'd like to see us cover, please let us know.

Nils Conrad Persson

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SK6FR22X4	SK6FR7X8	SK6FR9M2	SK6FR23.6
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SKPR0012	SKPR0024	SKPR231	SKPR0013
SK5SC5A6	SK5SC6A7	SK5SC8B4	SK5SC5A4
SK6FR23X6	SK6FR8.2	SK6FR9M6	SK6FR23X6
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SKBK0347	SKBT.390	SKBT1.113	SKBK0347
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SK6FR7X5	SK6FR		SK6FR7X5
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SKBK0532			SKBK0532
SKPR0022		R0010	SKPR0022
SK5SC5Y2		C4X0	SK5SC5Y2
SK6FR7X7	SK6FR9.7	SK6FR21.6	SK6FR7X7

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NEWS

1998 CES Offers an education extravaganza: 1998 CES conference program grows

Attendees at the 1998 International CES - The Source for Consumer Technologies, have more than 90 targeted sessions to attend during the Show, to be held in Las Vegas, January 8-11, 1998. The conference program has been significantly expanded to appeal to the growing numbers of the diverse attendees, such as retailers, engineers, financial analysts, CEOs, information technology (IT) buyers, and custom installers.

In addition to a comprehensive schedule of consumer technologies topics, CES is offering remote access technologies, home computing mobile electronics, wireless communications, and specialty audio programs. Mobile electronics certification testing is also available.

There are several new programs that will be held at CES. "DTV: The Clear Perspective" SuperSession will be held 8:30-10:00 AM Friday, January 9, 1998. As every major TV set manufacturer plans to show HDTV at CES, this presentation and panel discussion, moderated by Joel Brinkley of the New York Times, will discuss how digital television will affect the consumer market. Panelists include: Philip Farmer, Chairman, President and CEO of Harris Corporation, Kay Koplovitz, Founder, Chairman and CEO of USA Networks, James Meyer, CEO and Executive Vice President of Thomson Consumer Electronics, and Craig Mundie, Senior Vice President of Microsoft Corporation, and a senior executive from CBS.

Another addition to the program is the Hollyweb: The Enhanced TV-TV/Web Convergence Conference. Sponsored by CreaTECH, specialists in new media marketing. This conference consists of seven sessions held January 8 and 9, 1998, that focus on the Internet/TV industry from the business perspective of the content developers, the advertisers and other leading executives and editors. Steve Perlman, President of Web TV will be giving the Hollyweb® keynote address on the Internet/TV convergence phenomenon.

Also new for the CES is the education partnership with the Satellite Broadcasting and Communications Association (SBCA). SBCA is the national trade organization representing all segments of the home satellite television industry. A recognized source, SBCA is running marketing and business sessions that provide manufacturers, retailers and press an opportunity to learn about the latest developments in the industry.

CES is also the premier conference event for the home systems marketplace. The Habitech Institute is an intensive conference program designed to train the dealers/installers/integrators involved in the broad home systems marketplace. Home systems training sessions at CES will focus on a variety of issues, including how-to installations, marketing/business tools, and technology seminars.

In 1998, Richard Brandt, Editor, *Upside* magazine will moderate two of the Emerging Technologies seminars: "*Securing Funding to Grow Your Business*" and "*New Technologies: Wall Street Picks the Winners.*" The Emerging Technologies track of eight sessions is a tailored program for the over 900 financial consultants, venture capitalists and other investors that will be at CES.

Now in its second year, the CES Retail Management Program provides retailers with the training necessary to manage their stores more effectively. These conference sessions will offer solutions and suggestions for increasing sales and driving profitability.

The Digital Engineering Conference; The Consumer Electronics Future (formerly called the Digital Audio & Video Workshop), produced annually by CEMA and the IEEE Consumer Electronics Society, will be held in conjunction with the CES, January 12-14, 1998. Geared toward engineers and product development managers, attendees will gain powerful technical insight on trends, changes and advancements in digital audio, video, computer and access technologies, plus be able to enhance professional contacts and cross engineering disciplines.

In addition to the Conference Program, CES offers an extraordinary group of visionary speakers. Barry Diller, Chairman and CEO of HSN, inc., will present the Keynote Address on Thursday,

January 8, 1998, from 8:30-10:00 AM. HSN inc. includes the Home Shopping Network, the Internet Shopping Network, Silver King Broadcasting, and SF Broadcasting. Steve Forbes, President and CEO of Forbes, Inc. and Editor-in-Chief of *Forbes* magazine, will give an Economic Outlook Address on Thursday afternoon. On Friday, January 9, from 4:00-5:00 PM, Scott McNealy, Chairman of the Board, President and CEO of Sun Microsystems will deliver the Technology Keynote. Bill Gates, President and CEO of Microsoft Corporation will also join the CES as he offers attendees his Executive Perspective on the future of technology on Saturday, January 10 from 8:30-10:00 AM.

Most of the CES sessions are free to badged attendees, however there is payment required for the Hollyweb, SBCA, Habitech Institute and Retail Management sessions. The Digital Engineering Conference must be registered for separately. All sessions (including the Digital Engineering Conference) are free to members of the press.

For information and a detailed listing of conference sessions, please see the CEMA website:<www.cemacity.org>. A comprehensive personal scheduler is also available on <www.CESweb.org>.

CEMA is a sector of the Electronic Industries Association (EIA), the 73-year-old Arlington, Virginia-based trade association representing all facets of electronics manufacturing. CEMA represents U.S. manufacturers of audio, video, accessories, mobile electronics, communication, information and multimedia products which are sold through consumer channels.

TV set makers hail ratings for V-Chip

The Consumer Electronics Manufacturers Association (CEMA) applauds Vice President Gore's endorsement of the revised television ratings proposal, the TV ParentalGuidelines, submitted to the Federal Communications Commission (FCC) by the National Association of Broadcasters, the Motion Picture Association of America and a number of education and parents groups. U.S. television set makers, who created and proposed the V-chip system, are pleased to see ratings begin.

The ratings eventually will be used in conjunction with TV sets equipped with V-chip circuitry to allow consumers to block programming. The "V-chip" was invented by an engineering committee of CEMA in 1993 while determining what additional information other than captioning could be transmitted on line 21 of the television broadcast system. After discussion with CEMA, Congressman Ed Markey (D-MA) dubbed the technology, the V-chip and proposed that it be included in every TV set.

On September 23, during an R4.3 engineering meeting in Phoenix of broadcasters, TV set manufacturers and programmers, industry engineers approved two V-chip technical proposals. The first, EIA-744, establishes a new extended data packet (XDS) standard to transport content advisory information using the vertical blanketing interval(VBI). The packet supports the movie industry's MPAA rating system and the TV Parental Guidelines. Plus, the standard allows TV set manufacturers to add a third non-U.S. analog ratings system (such as the Canadian ratings system under development).

Beyond EIA-744, engineers approved Recommended Practices for the Content Advisory XDS Packet. According to the guidelines, channel blocking should include muting the program audio, rendering the video blank or otherwise indecipherable and eliminating the program-related captions. The default state of the TV set should not block a channel until a program ratings packet is received. Once a program is blocked, the TV set should indicate to the viewer that content advisory blocking has occurred via an appropriate on-screen display message.

The FCC was notified about these engineering developments on September 24, but not in time to be incorporated into the FCC's latest Notice of Proposed Rulemaking (NPRM), adopted September 25, concerning the V-chip.

CEMA, the national trade association representing virtually all television set makers, hailed the start of ratings transmission necessary for televisions equipped with V-chip circuitry to work.

Video board troubleshooting guide

by Stephen J. Bigelow

Of all the advances in PC technology over the last 5 years, video boards have undergone some of the most dramatic and impressive improvements. The simple frame buffers of years past have been replaced by powerful video acceleration, high-resolution and color depth, high-speed, AVI, QuickTime, and MPEG playback capability, integrated TV tuners, and cutting-edge 3D rendering techniques. Along with all of these advances, however, come a myriad of problems, especially in setup and configuration under Windows 3.1x and Windows 95. This article brings you a compendium of current video board problems to consider. While many of the symptoms presented below mention particular manufacturers, virtually all of these problems can appear on any current video adapter.

" Video problems can typically arise from three areas; software, firmware, and hardware."

A quick response

Video problems can typically arise from three areas; software, firmware, and hardware. When faced with video troubles, try the following protocol to resolve the problem:

1. Check the driver(s). Video drivers are critically important in Windows 3.1x and 95. Older drivers may contain bugs, or be incompatible with certain applications. This accounts for the majority of all video problems. Obtain the latest video driver release, and make sure it is properly installed on the system. If the driver is most current, try a generic video driver (usually available from the video chipset manufacturer).

2. Check the physical installation. See that the video board is installed properly in its expansion slot, and make sure that any jumpers are set properly for the particular system.

3. Check for memory conflicts. The memory space used by video adapters is hotly-contested territory in the upper memory area. Printer drivers, sound cards, tape backups, SCSI adapters, and scanners are just some of the devices that can step all over the memory space needed by a video board. Many of today's video boards require you to exclude a range of upper memory through your memory manager (often a000 through c7ff, though your particular video board may be different). Make

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

sure that any necessary memory exclusions are made in the computer's CONFIG.SYS file. You may also have to add an EMMExclude=A000-C7FF line to the [386enh] section of your SYSTEM.INI file.

4. Suspect your memory manager. Advanced memory managers such as QEMM or Netroom use very aggressive techniques to "find" memory. Often, this interferes with video operation. Try disabling any "Stealth" or "Cloaking" mode.

5. Check your system CMOS setup. Today's motherboards sport all manner of advanced features. Try systematically disabling such attributes as; video cache, video RAM shadow, byte-merge, palette snoop, or decouple/hidden refresh. If "PCI bus bursting" is used on the video bus, try disabling that also. If the video system requires the use of an interrupt, make sure that the IRQ is not being used by another device.

Unusual hardware issues

A lot of emphasis is placed on drivers and software configurations, but there are also quite a few hardware problems that can affect your video system. Following are several of these problems and suggested remedial measures.

Clock speed and the VL bus

Video boards that use the VL bus are very sensitive to motherboard clock speeds over 40MHz. If your motherboard runs the VL bus at over 40MHz, it's quite possible that you will have trouble with VL bus video boards. The VESA specification states that one card can operate at 40MHz, or two can operate at up to 33MHz (a best-case scenario). Some manufacturers don't even guarantee that their cards will run at 40MHz - preferring to support bus speeds of 33MHz or less. So if your VL bus video board is running at over 40MHz, and it refuses to run properly, your best option is to step your bus speed down. Bus speeds can usually be controlled by a motherboard jumper, or an entry in CMOS. If you cannot change bus speed for any reason, try a different brand of VL card.

NOTE: Version 2.0 of the VESA VL-Bus specification did add support for a 50MHz bus speed. Unfortunately, VESA VL bus 2.0 is one of a few VESA specs which went largely ignored by video manufacturers. Just because the VL bus 2.0 specification exists, do not assume that any VL bus motherboard necessarily will be compatible.

"SLC" motherboards and the VL bus

If you have an older motherboard using an i486SLC-type CPU, some VL bus video boards will not operate properly when used with that particular motherboard. This is because the 32-bit VL bus was not implemented properly in conjunction with the 16-bit data path of the i486SLC - this is a problem with the motherboard's design, not the particular video boards. Later-model motherboards with the i486SLC CPU largely overcame this problem, but take care when using any VL bus video board on i486SLC motherboards.

8514/a and COM4 Conflicts

The 8514/a video adapter was designed to coexist with a VGA adapter. To achieve this, the 8514/a uses a different range of addresses. Some of these are 16-bit addresses which are located at 42E8h, 82E8h, 92E8h, A2E8h, and E2E8h. Unfortunately,

many serial controllers only decode the first 12-bits of the I/O port address, and assume that calls to x2E8 (like all of those listed above) are intended for the serial port rather than the video card. This means that COM4 cannot be used on most machines with an 8514/a compatible video card unless the address of COM4 can be changed on the serial card (usually via jumpers), or the serial controller decodes all 16-bits of the I/O port addresses. There is no other way to get COM4 and any 8514/a compatible display adapter to coexist. Keep in mind that this is an issue with the serial controller rather than the 8514/a video adapter.

ATI Mach, S3 Vision/Trio, and COM4 Conflicts

As you saw in the last section, 8514/a video adapters will often conflict with COM4 because of poor I/O address decoding. ATI's Mach chipsets and S3's chipsets are based on IBM's 8514/a standard, and frequently suffer the same problems as the 8514/a.

Video Troubleshooting

Following is a list of video related symptoms you may have encountered, or may encounter in the future, with suggested remedial measures.

You frequently encounter GPFs when using QuickTime for Windows 1.1

This is a notable problem with ATI Mach64 cards, but has been known to occur with other advanced video boards. Often, the problem can be corrected by making a change in the Windows 3.1x SYSTEM.INI file. For the ATI Mach64, you must turn DeviceBitmaps=off under the [macx] section. As an alternative, start the ATI FlexDesk, type OPT (this starts a "hidden" window), then uncheck the DeviceBitmap entry.

The video board will not boot up when used in a particular motherboard.

Generally speaking, there are noted cases of hardware incompatibility between certain video boards and motherboards. This usually causes a great deal of confusion because the video board may work just fine when tested in a different motherboard, and other video boards may work well in the original motherboard - the technician simply winds up chasing ghosts. A noted example of this problem is the Boca Research VGAXL1/2 refusing to work in a Micronics 486DX2/66 motherboard. The solution to this problem demands that U13 on the video board be a Texas Instruments TI-74F04. If U13 is a Motorola IC, you will need to send the board back for rework - strange but true. For general troubleshooting purposes, if a certain video board and motherboard refuse to work together, don't waste your time chasing ghosts - contact both the video board maker and PC (or motherboard) maker, and see if there are any reported incompatibilities.

Diagnostics refuse to show all of the available video modes for a particular board even though all video RAM was properly detected, or the board refuses to operate in some video modes

When a video board does not respond to certain video modes (usually the higher video modes), it is because there is a conflict in the upper memory area, and a memory range needs to be excluded. If there is a memory manager at work (i.e. QEMM, 386MAX, or EMM386), try disabling the memory manager in CONFIG.SYS, or boot the system from a clean floppy. Try your diagnostic(s) again - chances are that the problem has disappeared. To fix this problem on a more permanent basis, re-enable the memory manager using an exclude command. Try x=b100-b1ff as the first parameter on the memory manager's command line. If that does not work, try x=a000-bfff. Finally, try x=a000-c7ff.

The characters shown in the display appear fuzzy

This is often the result of a speed problem where the system is running too fast for the VL bus video board. In virtually all cases, you will find the VL bus to be running over 33MHz. Try slowing down the VL bus speed. This will sacrifice video performance, but should stabilize the system. Chances are also very good that the system has been locking up frequently - slowing down the video board should also correct such lock-ups.

Pixels appear "dropped" behind the mouse cursor, and graphic images appear to break up under Windows

There are two major causes for this type of problem; bad video RAM, or the system bus speed is too fast. Check the CMOS Setup for an entry in Advanced Setup such as "AT Bus Clock", "ISA Bus Speed", "AT Bus Speed". The corresponding entry should be set to 8.33MHz. Otherwise, excessive speed may result in "lost" video data. If the bus speed is set properly, run a diagnostic to check the integrity of video RAM (you may have to replace the video RAM, or replace the video board entirely).

You encounter video-related conflicts in Packard Bell systems

The system refuses to boot, or starts with "garbage" and erratic screen displays. This symptom is encountered most frequently with Boca video boards on Packard Bell systems with video circuits already on the motherboard. Even when the on-board video has been disabled, reports indicate that the video circuitry remains active, and then conflicts with the add-on video board. Packard Bell indicates that their Vxxx.16 BIOS will correct this problem, so contact Packard Bell for an appropriate BIOS upgrade.

Text appears in an odd color

When text that should be green appears black it is almost always the result of a problem with the palette decoding registers on the particular video board, and will typically appear when using higher color modes (i.e. 64k or 16M colors). Make sure that the video drivers are correct, complete, and up-to-date. If the problem persists, you may need to replace the video board outright.

When an application is started (under Windows), the opening display appears "scrambled"

While this symptom might appear to be a video memory problem at first glance, it is actually more likely to be related to a buggy video driver. Upgrade the video driver to the latest version, or try a generic video driver that is compatible with your computer's video chipset.

Display colors change when exiting from a DOS shell under Windows

This problem has been noted with video boards such as the Diamond SpeedStar Pro, and is almost always the result of a video board defect (usually a palette problem). For the Diamond board,

the product must be replaced with revision A2. For other video boards, such problems can usually be corrected by replacing the video board outright.

The computer locks up or crashes when starting an .AVI file

This problem is encountered frequently as computer users begin to experiment with multimedia applications. Rather than being a problem with the video board specifically, the trouble is often from using an outdated version of Video for Windows. Make sure to use Video for Windows 1.1E or later. Video for Windows can be downloaded from the Diamond Multimedia FTP site at: ftp://ftp.diamondmm.com/pub/misc/vfw11e.exe. You may also need to edit the [DrawDib] section of the WIN.INI file and add an entry that says: DVA=0. If no [DrawDib] section is present, you can add it. Remember to restart Windows after making any changes such as these.

The computer is running very slowly (poor performance), and the hard drive light is continuously lit

This problem is particularly apparent with Diamond Edge 3D video boards on systems with more than 16MB of RAM. The Diamond Edge 3D board comes with both 1MB and 6MB MIDI bank files. Diamond recommends that you use only the 6MB bank file on systems with over 16MB of RAM. To change the size of the MIDI bank file being used, right-click on My Computer and choose Properties. Open the System Control Panel and click on the Device Manager tab. Click on the (+) symbol beside the Sound, Video, and Game Controller line, then highlight the Diamond EDGE 3D PCI Multimedia Device, and click on Properties. Click on Settings. You will then see the 1MB and 6MB MIDI bank selection. Select the 6MB option and choose OK. Restart your computer when prompted.

You notice that .AVI files have distorted colors or "grainy" playback

This syptom usually occurs when playing 8-bit .AVI files which are not supported by DCI.The problem can usually be corrected by disabling the accelerated video playback features of the video board. For example, the Diamond ViperPro Video board is noted for this problem, and you would need to edit the COPRO.INI file located in the \windows directory. In the [VCP] area, change the VCPEnable= line to OFF. Save the .INI file and restart Windows.

The PCI video board will not work under Windows unless the system's PCI SCSI devices are disconnected

This problem occurs only on certain combinations of PCI system hardware. For example, this type of symptom has been documented using Phoenix BIOS 4.04 and a UMC8810P-AIO motherboard on systems with an NCR SCSI controller and SCSI devices. You can often correct such problems by correcting the Advanced System Setup in CMOS. Start the CMOS Setup, go to the Advanced System Setup, and select PCI Devices. Setup the PCI slot for the SCSI controller as IRQ9 and LEVEL edge select. The slot for the video board should have the IRQ set to NONE, and LEVEL edge select. Change the Base Memory Address from 0080000000 to 0081000000.

There are boot problems when a new video board is installed

Typical problems include no video or eight beeps when the system is turned on. This is usually the result of an outdated system BIOS which is not capable of detecting the particular video chipset in use - the BIOS interprets this as meaning that there is no video board in the system, and an error is generated accordingly. Contact the motherboard manufacturer (or PC maker) for an updated system BIOS. Most BIOS versions dated after the Fall of 1994 should be able to detect most modern video chipsets.

There are boot problems when a PCI video board is installed

There are two common problems that account for this. First, the system BIOS did not complete the configuration of the video board correctly, and the board has not been enabled onto the PCI bus. The video board manufacturer may have a utility available which can "remap" the video card to a new address outside of physical memory. For the Matrox Millennium, use the PCIMAP.EXE utility. Other Matrox boards use the MGABASE.EXE utility. Other PCI vid-

eo board manufacturers probably offer their own utilities.

The second problem is that the system BIOS has assigned a base memory address to the video board which is used by another device, or is reserved for use by the motherboard chipset. While the utilities mentioned above may often help to correct this problem, a more permanent fix is usually to update the system BIOS. Investigate a BIOS upgrade from the motherboard (or PC) manufacturer.

The monitor overscans when entering a DOS shell from Windows

This creates a highly distorted image, and can (if left for prolonged periods) damage the monitor circuitry. The cause of this problem is usually a bug in the video driver. For example, this type of problem is known to happen when using the Diamond SpeedStar Pro with drivers prior to version 1.06. Obtain the latest video driver from the video board maker, or try a generic video driver written by the video chipset maker.

You encounter an intermittent "Divide by Zero" error

Although there are several possible causes for this type of error, they are all related to flaws in software - in this case, problems with the video driver or video "toolkit" that is installed with the particular video board. Often, upgrading the driver or video support tools will eliminate this problem. For example, "Divide by Zero" errors can be corrected with the Diamond Stealth 64 Video 2001 series by opening the InControl Tools package, and changing a "Center to Viewport" selection to "Center to Desktop". Similarly, the "Maximize to Viewport" selection should be changed to "Maximize to Desktop".

During MPEG playback, the display flickers, shows low refresh rates, or appears to be in an interlaced mode

This is not necessarily an error. With some video boards (such as the Diamond MVP1100), MPEG files cannot play correctly at high refresh rates - typically over 72Hz. When an MPEG file is played, the driver will automatically switch to a 72Hz vertical refresh rate. This may result in an unexpected change to display quality during playback. After exiting from the MPEG player, the original (higher) refresh rate will be restored. If a vertical refresh rate lower than 72Hz was originally selected, then the vertical refresh rate will not change during MPEG playback, so you should see no difference in the appearence of the display.

You receive an error such as "There is an undetectable problem in loading the specified device driver" when starting an MPEG player or other video tool

In almost all cases, the related driver is missing, installed improperly, or corrupt. Reinstall the MPEG playback driver(s) for your particular video board, and make sure to use the latest version available. If problems persist, check for the driver under the WIN.INI or SYSTEM.INI file and see that there is only ONE load= reference to the particular driver(s) - repeated references can cause conflicts or other loading problems.

On video boards with TV tuners, the TV window is blurry or fuzzy at 1024x768 or higher resolutions

This symptom is particularly noted with the Diamond DVV1100. Unfortunately, this type of symptom is usually the result of limited bandwidth of the particular video board - specifically of the video chipset. The only real option is to reduce the resolution to 800x600 or 640x480 when running the TV, and lower the refresh rate to 60Hz. Contact your video board manufacturer - there may be an RMA or other replacement/upgrade program that might be available to correct the problem

On video boards with TV tuners, the reception does not appear as good as that of an ordinary TV

This problem has been noted in con-

junction with Matrox Media-TV boards, and is usually due to the local cable company using the HRC carrier frequency instead of the standard carrier frequency. For Matrox boards, you can correct the problem by modifying the DVMCIM-IL.INI file found in the \WINDOWS directory. Under the [Carrier] section, change the CarrierType=0 entry to CarrierType=1. Other video/TV boards may utilize different .INI entries, or allow carrier selection through the use of an onboard jumper, but poor reception is almost always the result of an unusual cable carrier.

You encounter errors such as "Insufficient video memory"

There is not enough video memory on the board to handle screen images at the resolution and color depth you have selected. In most cases, the system may crash outright. Your immediate solution should be to select a lower resolution or smaller color palette. If you are encountering such problems when attempting to play .AVI or MPEG files, you should be able to select smaller video windows and lower color depth without altering your Windows setup. As a more long-term solution, you should consider adding more video memory, or replacing the video board with one that contains more video memory.

The PCI video board is not working properly - there is a BIOS conflict with PCI interrupt 1Ah

The lower 32KB of the ROM BIOS has been redirected for high memory use. Disable this memory with your memory manager by adding an exclude command such as: x=f000-f7ff.

You encounter video corruption or sporadic system rebooting when using an SLC-type motherboard

This particular symptom has been most noted when using Number Nine video boards with Alaris SLC2 motherboards. The SLC2 microprocessor uses a 32-bit internal data bus, but the external data bus (seen by the motherboard) is 16-bit. Most of the registers on contemporary VL and PCI video boards are mapped as 32-bits, and cannot be accessed as two 16-bit registers. As a result, the video board simply cannot be used together with the particular motherboard. You will have to upgrade the motherboard, or use a different video board.

Video playback experiences long pauses while the hard drive thrashes excessively

This is a problem that appears under Windows 95, and is almost always the result of disk caching problems. Start Windows Explorer and highlight the drivers responsible for video playback (for a Motion Pixels video board, highlight MPXPLAY.EXE and MPXPLAY.PIF). Click the right mouse button and select Properties. In the Memory page, make sure that the "Protected" option has been set. Restart the video clip, or Windows 95 if necessary.

You cannot use the loop-through feature of your video board

Typical examples include the Number Nine 9FX Motion 771 VGA loop through connector with a Reel Magic board and a Number Nine driver. Unfortunately, this is often the result of a limitation with the video board's graphics processor IC (refusing to support loop-through functionality). To use loop-through, try the standard VGA driver.

Windows appears with a "black box" cursor and/or icons that fail to appear on the screen

In most cases, the problem is caused by an incompatibility with the motherboard's non-compliant PCI BIOS (the motherboard's BIOS does not comply with the PCI backward-compatibility requirement). To overcome this problem, set the video board's memory aperture manually by editing the SYSTEM.INI file located in the \WINDOWS directory. For example, when working with a Number Nine 9GXE, find the [#9GXE] section of SYSTEM.INI, then add a command line such as; APERTURE-BASE=0x8800 or APERTUR-BASE=31. Save the file and restart Windows. The actual section for your particular video board may be different.

There are video problems or the system locks up while using an anti-virus program

This error occurs frequently when using

memory-resident virus checking. Some video boards allow you to compensate for this by editing the SYSTEM.INI file. For the Number Nine 9GXE board, find the [#9GXE] area in SYSTEM.INI, then set the FastMMIO= entry to OFF. Remember to save the .INI file and restart Windows. The actual section for your particular video board may be different. As an alternative, you could also disable or remove the anti-virus program.

An error indicates that there is not enough memory for playback or re-sizing of the playback window

This type of program is directly caused by a lack of system (not video) memory in the PC. If your system uses SMARTDRV (Windows 3.1x), try reducing the memory used for caching. Try unloading various unneeded programs from memory, and consider disabling any RAM drives that may be active. Finally, consider adding more system RAM to the PC.

The video board refuses to accept a particular video mode

Mode problems are most frequent when attempting to use unusual palette sizes such as 32k or 64k colors. Try setting the video board to 256 colors. If a higher color depth is needed, it may be possible to run the video board in a palletized mode or gray-scale mode by adding command line switches to the video driver. Refer to the instructions that accompany the particular video board for detailed information. You may also consider a video BIOS upgrade, or try using an upgraded VESA driver (such as UNIVBE 5.3 from SciTech Software)

The video system cannot lock memory using QEMM and linear video memory

This is often a DOS problem with Motion Pixels video boards when using QEMM 7.04 and earlier versions. The DPMI has a bug when accessing physical memory above the DPMI's host memory. Upgrade the version of QEMM to 7.5 (or later), or play video under Windows.

The video system cannot lock memory under Windows, or the system hangs

This is also a problem noted most often with Motion Pixels video boards, and is almost always related to the use of a WINDPMI.386 DPMI driver loaded through SYSTEM.INI. WINDPMI.386 reports the wrong amount of free lockable DPMI memory. If your Windows platform is using Borland's WINDPMI.386, manually reduce the cache size with the /c option, or remove (or disable) the driver from SYSTEM.INI entirely. You might also consider upgrading WINDPMI.386 to a later version. Contact Borland technical support, or the support department of the video board maker.

Conclusion

Video systems are continuing to evolve rapidly. As they do, there are a proliferation of new problems and compatibility issues that technicians must be aware of. This article explains a suite of these new symptoms, and offers the most effective solutions for dealing with them. ■

Service center management: Measuring the effectiveness of technicians

by John Gooley

Adapted from the book "Let's Talk Service," by John Gooley.

A business can't survive, much less make a profit, without sufficient productivity. We've looked at various ways to improve productivity. There is no single measurement that will do the job. We need an array of measurements.

All too often techs are measured "by guess and by Gosh." But for the professional manager, that won't do. You have to apply positive methods, (notice the plural), not just to establish the value of the technician, but to uncover ways to improve his approach to his work, and also to discover inherent weaknesses in the system so that positive steps can be taken, and, finally, to make accurate forecasts when considering future projects.

	Technician #1	*Technician #2*	*Technician #3*
Lack Parts	13	23	4
Not Home	9	5	13
Call Back	3	4	3
Total Incompletes	25	32	20
Demand Calls	81	66	96
Warranty Calls	19	11	8
Service Agreements	1	-	4
Other	112	9	22
Total Completes	112	86	130
Grand Total	137	118	50

Figure 1. The best way to measure technician performance is by generating and using an array of measurements such as the numbers shown here.

Positive measurements lead to positive methods, which lead to positive results

How many jobs were done? They probably used this measurement when men first started walking erect. "How many saber-toothed tigers did you kill, Og?"

However, this method by itself has limited value and is suspect as to reliability. Some jobs are long and some are short. Some bring in a lot of money, some do not.

It is easy to get the feeling that all the guys in the crew always do the number of jobs that some of them did last week. There are some men who have done 20 jobs in a day; no question. But there are some who have done 7300 jobs in a year (20 times 365). If you are going to use that as a measure, make sure it is the right measure. Define the jobs, then count and record them.

I remember when some service centers started using the NARDA Service Data System (a computerized measurement system offered by the National Association of Retail Dealers of America. There were many times when the program met with some amount of resistance, or even rebellion, on the part of technicians. Much of this, of course, came from weaker crew members who knew that they were not particularly productive, but didn't want the boss to know it.

But we discovered some amount of resistance from the crew member with the best reputation. He had always made it his business to crow about his great performances. He didn't want to see a system established that might show that he was maybe only second best.

There are techs that can do 10 or 12 jobs a day fairly regularly. But they don't work on holidays, and they take their annual vacations. They get sick sometimes, and sometimes you keep them in the service center for one reason or another. Some things are largely beyond your control. Still, you must know about them and how they are affecting your business. Without complete and precise records, that is, without knowledge and awareness, it is impossible to plan effectively.

An important reason to measure productivity is to uncover losses and what is causing them, so that corrections can be made. Equally important is the fact that future decisions must be made on the basis of accurate information rather than assumptions or raw guesses. There are more ways to be wrong than to be right.

Personal problems

There are other matters that are within your power to control .

Technicians can be distracted from their normal effectiveness due to stresses of everyday problems: marital problems, illness, indebtedness, etc. If you see your techs regularly and are alert, you may sense that there is something wrong. Otherwise, the first hint of the problem may be revealed by the financial records; for example, no profit that month.

After noticing a disturbing drop in a technician's performance, you may want

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to have a private conference with him. Sit down with a cup of coffee and gently probe for the cause. If it is a money problem, perhaps you can make an advance on his wages. If it a legal problem, maybe you can get your own attorney to help. If it's a family problem, just having someone to talk to will make a difference.

Maybe it's something else around the business. It could be disgruntlement coming from failing to get a promotion that went to someone else. Sometimes a new manager with a different style is the problem, especially if the new manager is the boss's cousin. Or maybe there is the appearance of favoritism.

Equipment problems

In cold weather climates, sometimes the trucks won't start. Perhaps the trucks are old and break down frequently. Sometimes the technicians don't have the right tools, the proper training, or they don't have the right direction.

All these matters are correctable.

Substance abuse

A few years ago, the National Institute on Drug Abuse estimated that between 10 and 23 percent of all workers in the United States use dangerous drugs on the job, and that 65 percent of young persons entering the work force have used illegal drugs. NIDA says that those who habitually abuse drugs are late for work three times more often than are non-abusers; they have 2.5 times as many absences of 8 days or more, they use three times the normal level of sick benefits and are 5 times more likely to file for workman's compensation. And this is to say nothing about accidents that cause injury.

What these figures are saying is that if you employ 10 people, one of them is likely to be an alcoholic, and another one is likely to be a drug abuser.These people represent a considerable expense when it comes to your health insurance packages and your Workman's Compensation Insurance. In addition, falling down on the job (maybe literally) and decreasing your productivity. They may also be creating ill will among your customers and increasing your costs of vehicle insurance.

All of this suggests that you had better know in detail what is going on in your business, particularly in the area of technician productivity.

Completion Ratio	*Lack Parts Ratio*	*Not Home Ratio*	*Call Back Ratio*
81.7%	9.4%	6.5%	2.1%
72.8%	19.4%	4.2%	2.0%
86.6%	2.6%%	8.6%	2.0%

Figure 2. By converting the numbers of Figure 1 into percentages, you can compare the technicians to themselves and each other.

So always count those jobs and record them. There are those, too, who would advocate posting the results. The techs will see that they get their proper credit.

What is a job?

What is a job?

If the tech goes out on a job and finds nobody home, is that a job? If he can't do the job and brings it back to the service center, is that a job? If he does it wrong and has to do it over, is that a job? Or two jobs? Or how about lack of parts? It is better to count completes and incompletes.

Then is changing a bulb counted the same as a sealed system entry?

Some people adjust for this by assigning values to certain jobs. Simple jobs count 1, slightly more difficult ones, count 1-1/2, and so on.

The best way to handle this, though, is to not rely on a single system, but instead, use an array of measurements - something like the numbers in Figure 1.

Now we are getting a better picture of each man. But before we go on, let's do one more thing. Let's set up some percentages (Figure 2).

As is easily seen, not all techs are created equal. They all have some strengths and some weaknesses. And it is not a good idea to measure by only one measuring stick as - complete 10 calls a day or you're gone.It is much better to measure the various strengths and weaknesses to see what we, as professional managers, can do about them.But we still haven't gathered all the information we need. We still don't know anything about time or money.

It's about time we learn two things; how much time each tech has spent productively (working on equipment), time the customer is charged for, and how much time he is being paid for.

About money; we need to know how much money his work has generated, and what he is being paid. In both instances, we will develop the ratio. In every case, we simply divide the little figure by the big one. For time, we take the actual productive time and divide it by the time he is paid for (Figure 3). There are those, too, who make a separate calculation for travel time. This will give some insight into whether the technician is being dispatched efficiently or whether the technician is playing some games of his own.

For the next figure, we are going to reverse the procedure, simply because this is the way the industry has always looked at this material. We will take the amount of technician labor generated and divide that by the techs wages (Figure 4).

For every dollar the technician is paid he brings in $2.57 in the first case above - or $2.07 for the second technician and $2.47 for the third tech, that ratio is called the gross labor ratio.

From these figures, three types of comparisons can be made. You can compare a tech to his own past history, and to the others in the crew.

The first thing you can tell about a tech when comparing present performance with past history is whether he is making satisfactory progress. But it is also possible to spot things other than his progress.

We're not looking for little blips. A fall-off in completed jobs, when all other figures remain constant might be caused by road repair, or being sent on distant calls.

A fall off in income may be the result of the type of assignments he has been given ... too many belt changes and fewer sealed-system entries.

In the main, a high gross labor rate indicates more contribution, but this figure can be tricky. If you say, "Hey, Jack, you've been doing a great job, I'm going to give you a raise," his Gross Labor Rate is instantly going to go down.

But if you see erosion month in and month out in such things as number of jobs completed, increased time per job,

Completes	Service Time	Non-Service Time	Total Time	Avg. Time Per Complete	Productive Time Ratio
112	4645	3995	8640	41.5	53.9
86	3755	4885	8640	43.7	43.4
130	3235	5885	9120	24.9	35.5

Figure 3. Dividing the technician's productive time by the total time he is paid for yields the productive time ratio.

and more "Not Homes" you may be looking at a severe morale problem.

Mostly, though, your figures will be producing wake up calls.

Comparing techs to each other

Automatically, of course, you will be comparing the techs to each other. Joe has too many Not Homes. Does he give up too easy? Doesn't look in the back yard? Doesn't try going to the back door? The best way to handle this is for the tech to be in touch with the shop to have somebody call the customer.

Amazing as it may seem, people are often at home and just don't answer the door. But they pretty much always answer the phone. If the phone is answered, the customer can be asked to go to the door and let the tech in. If the door is not answered, a note is made of that together with the time. When the customer calls complaining about lack of service, things can be explained.

Sam has too much time per call. Is he a fuss budget? Or is he having difficulty with his troubleshooting? Does he have trouble disengaging himself from the customer? Or does he make too many trips back to the truck for a tool or a part or a look at the manual?

George has too many call backs. Is he in so much of a hurry that he doesn't check his work before he leaves. Or does his problem possibly have to do with technical understanding?

Comparing techs to a standard

Perhaps the most profitable comparison is to check the man against some kind of standard. Of course, standards are difficult to come by. Some managers use the averages that are derived from the NARDA Service Data System. Keep in mind that these are averages and you don't want to be average.

When you are at training sessions and conventions and other meetings, ask some of the better service managers what they use for standards. Ask your service rep. If he really knows his job, he can help you. In time, you will do a fine job of creating your own standards.

Always set up standards at three levels.

- 100 "You'll have to get up to this level, or I just can't afford to keep you."
- 120 "That's fine. You're doing good work. Keep it up."
- 140 "Hey guys! Look what Joe did. Why can't the rest of you guys do this?"

Labor Income	Wages Paid	Gross Labor Ratio	Income Per Job	Cost Per Job	Gross Profit Per Job
2959.90	1008.00	2.57	23.17	9.00	14.17
2395.15	1152.00	2.07	27.84	13.37	14.45
3012.55	1216.00	2.47	23.17	9.35	13.82

Figure 4. Divide the amount of technician labor dollars generated by his wages to determine his gross labor ratio. The gross labor ratio tells you how many dollars his labor produces per dollar he is paid.

	1 Additional Call
X	5 Technicians
	5
X	5 Days Per Week
	25
X	50 Weeks in the Year
	1250
X	$30 Labor Income Per Call
	$37,500 Additional Income
	(Practically All Pure Profit)

Figure 5. If a company has a crew of five technicians who average $30.00 labor income per completed call, gaining one additional call per day per man will achieve this result, as well as additional parts business.

Technician completion ratio

This tells what percentage of the time the technician completed the job with only one visit ... or in one operation on the bench. If it is your procedure to not charge for a repeat visit, then every time you make two efforts to complete one job, you are losing money, and perhaps a great deal of money.

It might be subject to some kind of argument how much money you are losing through incomplete calls, but essentially you come close to losing the full value of a complete call. On an on-site job, you lose the travel time to the home, the time it takes to get into the home and to the piece of equipment, the time it takes to open the equipment and then close it again, the time it takes to explain things to the customer and get back to the truck. Does the fact of the diagnosis on the first visit save time on the second visit? Maybe. Then again, maybe not.

You can figure, then, that the cost to your business per lost call is equal to the average income per call.

It is highly desirable, highly profitable, to keep the technician completion ratio as high as possible. At the same time, it is highly unlikely that you will be able to sustain a rate of 100 per cent. Some customers won't be home when the technician arrives, and on some occasions the required part won't be on the truck, and then the technician will be returning to a job that he thought was completed.

Conditions vary between industries, but a completion ratio of around 85 percent is considered to be attainable.

Not home ratio

The figure is derived by dividing the number of not-home calls by the total number of calls attempted. The objective is to keep this figure as low as possible.

Figures have been published showing the not home rate at two percent but there are many managers who would not find a rate this high to be acceptable. Some set a standard of one percent while others seek an even lower rate.

There are simple clerical procedures that can help reduce the not home problem. First and foremost, the firm should keep appointments as promised. If the work has been promised for Friday, the technician should arrive by Friday. If the work has been promised for morning, the technician should arrive in the morning.

Making phone calls in advance, preferably just before the technician is ready to go to that location, can do a great deal to reduce "not homes". This technique requires one-call-at-a-time dispatching. The customer is called and when she answers she is informed that the technician will arrive in ten minutes. If the customer is not reached, the technician is directed elsewhere. A 25-cent telephone call can save the expense of a $40.00 trip.

There is a difference of opinion as to who should make this call. In keeping with the proviso that a technician's time should be employed as nearly as possible to his chief attributes (analysis and repair) he would be excluded from the function of making phone calls. In such a case, the work would seem naturally to descend upon a clerk. Often it is the call takers who perform this task.

On the other hand, there are those who feel that there is a personal relationship between the technician and the customer. In this case, it is the tech who makes the calls, personally committing himself to the appointment. It is frequently true that the customer develops a reliance on an individual technician and will request him - perhaps insist upon him.

Lack-parts ratio

This figure is also a percentage, derived by dividing the number of lack-part calls by the number of calls attempted. And again, the objective is to keep this ratio as low as possible.

Lack-part calls can rise to as much as ten or fifteen percent. On the other hand, good parts management can get this figure down to around five per cent. With on-site calls, the objective is, first, to put a lot of parts on the truck, and second, to try to insure that they are the right ones.

Trying to achieve perfection might involve using an 18-wheeler to make on-site calls, so it is normal to expect a certain number of lack part calls.

The definitive method for attacking the high lack-part problem in regard to on-site calls, is for management to create a standard truck stock list which contains the parts that are most required at the particular time. By keeping track of parts used and parts available when needed, management knows when to retain the parts on the truck and when to remove them and replace them with others.

Managers of carry-in operations often presume that this subject does not apply to them. Not so. Although the cost of failure is not as painful as with on-site calls, it still exists. If the bench tech needs a part, he reaches for it where it is usually found. If it is not there, he fishes around for it. If he still can't find it, he tries to get it from the tech next to him, thus interrupting him, too. Finally, he heads off to

Technician	Number Of Jobs	Cost Per Job	Income Per Job	Gross Profit Per Job
Joe Miller	14	$114.00	$40.00	Loss of $74.00
Art Anderson	60	$23.30	$40.00	$16.70
Pat Kelly	80	$20.00	$40.00	$20.00
Bob Jones	100	$16.00	$40.00	$24.00

Figure 6. By creating a table such as this, the service manager will be able to compare the number of jobs performed by each technician, the cost per job and the income per job. Subtracting cost-per-job from income-per-job produces a figure called gross-profit-per-job.

the storeroom, and goes through the trouble of requisitioning it and taking it back to the work place. If it is not available at all, he goes back to the job, buttons up the unit, and puts it back on the rack. When he finally gets the part, he has to retrieve the unit and start his thinking processes all over again.

As many fast moving parts as possible should be located within instant reach of the bench tech, even if it means re-designing the furniture. It is also possible to put a parts cabinet on wheels. With this system, the tech simply steps over to the cabinet and rolls it to the service bench and his parts are on hand.

One service center that I know of has installed a microphone at the work site (it is not a bench). When the tech requires a part, he just asks for it and the lower-paid help delivers it to him.

Finally, if requests for service are reviewed by management in advance, the technician can be warned to seek a part that he might need. Really diligent management attention can bring the Lack parts ratio down to five percent ... or less.

Callback ratio

The callback ratio is a percentage of calls on which a return visit is required, usually because the work was not done properly on the initial visit. The figure is derived by dividing the callbacks by the number of calls attempted. Once again, the objective is to keep the rate low.

When the figure rises too high, it is usually for one of two reasons. Either the technician is not sufficiently competent on the brand or product or even the model, or the technician moves too quickly while on the job, thus failing to complete the job properly, or failing to check for additional problems before he leaves.

In the first case, additional training is called for, either in the particular product in the one case, or on-the-job procedures in the other. It is quite helpful if the record-keeping enables the manager to uncover the specific problem.

In the other case, it would be necessary to work with the man himself to establish better working habits.

Productive time ratio

The figure is read as a percentage, and is derived by dividing the number of minutes spent on revenue producing jobs by the number of minutes for which the tech receives wages.

In an ideal world, every minute of a technicians time would be productive, but from a practical point of view, this is far from the actual case.

To start with, travel time is not productive. Nor is time spent checking in each morning (not to mention the evening). Nor time spent chasing parts. Nor time spent on coffee breaks. The productive time ratio always suffers when there is not enough work to keep the technicians busy.

When productive time falls below 50 percent, it should be considered a subject requiring instant management attention.

One of the biggest challenges in management, is raising the productive time ratio. There are countless areas to be explored in this effort.

- Routing and dispatching outside technicians more effectively
- Eliminating excess paperwork
- Starting the technicians from home rather than the service center
- Eliminating chasing for parts
- Giving thought to one-call-at-a-time dispatching
- Considering two-way radio
- Motivating technicians to move more briskly
- Inaugurating an incentive plan
- Bunching calls to outlying areas
- Cross training technicians
- Making parts more easily available

Technician	*Income*	*Gross Labor Wages*	*Gross Labor Ratio*
Joe Miller	$560.00	$1600.00	Minus
Art Anderson	$2400.00	$1600.00	1.5
Pat Kelly	$3200.00	$1600.00	2.0
Bob James	$4000.00	$1600.00	2.5

Figure 7. Dividing the total of all income paid to the technician by the wages paid to him, creates what is called the gross labor ratio.

- Reducing Call Backs
- Reducing Not Homes
- Reducing Lack Parts
- Inaugurating training sessions
- Providing more and better tools

Cutting total time required per call (productive time plus travel time) by five or six minutes should enable the technician to complete one additional call per day. This improvement can increase labor income dramatically.

For instance, with a crew of five technicians who average $30.00 labor income per completed call, gaining one additional call per day per man will achieve the result shown in Figure 5.

Oh, yes, plus additional parts business which will also result.

Income per call, cost per call and gross profit per call

Income-per-call might show one of two things. This figure might rate high if the organization performs work at different price levels. Some types of jobs might call for a high degree of performance and thus command a higher price. The technician would have to make himself qualified to perform this type of work.

Thereafter, how high this figure goes depends on how much demand there is for that work (or the frequency that the individual technician is assigned to this type of work), and thus cannot be relied upon as a key to a technician's performance.

The cost-per-call figure, on the other hand, could be very revealing if the technician is on straight wages or if a significant portion of his income is from straight wages. For instance, a technician paid $1500.00 a month and doing 110 jobs a month (5 per day), would have a cost-per-job of $13.66. If he could increase this to 5.5 calls per day, it would get his cost-per-call down to $12.39.

Anything the technician does to eliminate his wasting time is likely to increase his number of calls. For instance:

- Getting to work a few minutes early
- Avoiding losing time getting out on the street - or to his bench
- Having the right tools with him
- Having the right parts with him
- Being adept at disengaging from the customer
- Being dispatched properly
- Getting quickly to his destination
- Performing his work quickly
- Doing the work right the first time
- Limiting coffee breaks, long lunches, personal errands.

Obviously, much of his accomplishment - or lack of accomplishment - is in the hands of the technician. Equally obviously, much of it is not, or could benefit with additional help from management.

It is desirable, of course, to keep cost-per-call low. The problem is in knowing how to determine what is low.

It is always well to keep in mind that the technician may not be the sole culprit. Lack of efficient management could have an effect on cost-per-call. But some matters may be beyond control of either management or technician:

- Roads repairs
- Bridges up
- Parts are not available from manufacturer
- Truck breakdowns
- Bad weather
- Long driving distance
- Accidents on the road

Income per call

As stated earlier, there are three ways to measure a technician

1. By comparing with other members of the crew
2. By comparing with past history;
3. By comparing with a standard.

None of these measurement methods are completely reliable.

In comparing other members of the crew, those other members may be particularly good. Thus, a thoroughly competent technician may come out looking bad. Heaven forbid, the present crew may be unusually bad. Then a so-so technician would take on the glow of a genius.

In comparing with past history, you can tell whether he is getting better or getting worse, but in neither case would you know what his performance really should be.

To compare with a standard, the first problem is to procure a standard. Your manufacturers may be of some help here. The next thing is to know how reliable the standard is. Does it come from a particular part of the country? Different than yours? Are the technicians who are measured by the standard doing the same type of work and on the same products as those who work for you? Are they cross-trained or not cross-trained? In other words, are washer technicians comparable to refrigeration technicians or to printing press technicians or to computer technicians? And then, how much time was spent on one product compared to another? And perhaps most of all, how old is the study?

The only thing I have ever seen that would come close to being called a standard is the set of averages derived from the participants in the NARDA Service Data System which gathered the data discussed here and created the same statistics. Careful, though. It must be realized, that averages are not standards, that averages are indications, not objectives.

Finally, the income-per-job is compared to the cost-per-job. Subtracting cost-per-job from income-per-job produces a figure called gross-profit-per-job. Thus, assuming wages of $1600.00 per month and service charge of $40.00 per job, we would be looking at the results shown in Figure 6.

From a financial point of view, gross profits would need to be compared to expenses for the month. It is easy to see why these figures are keenly scrutinized by service managers.

Finally, the total of all income for the technician can be divided by the wages paid to him, creating what is called the gross labor ratio (Figure 7).

Most service operations find that expenses exceed technician wages, and often by a significant amount. In our simulation, Joe and Art are losing the company money. And so is Pat. Bob might or might not be making money.

Another statistic that is often useful is to break time into three compartments - lost time, service time, and travel time. Why travel time? There are a number of things that this figure can tell us.

A major one is that a high figure for travel time may lead to your doing a little exploring. This investigation may discover that not many jobs are occurring near the shop, and that dispatching from the shop may not be the best tactic. It may then be found that if the technicians are dispatched from their homes, it would save a good deal of travel time.

With operations that are part of a sales organization, it may be that little by little the sales organization is extending its market farther and farther out, which means in turn that service is being extended farther and farther out. This can get very expensive for the service department and might call for payment by the sales department to the service department for insuring the after market responsibility.

What to do about it? One thing to consider is whether to bunch distant calls. Monday you take the calls that are far out north. Tuesday you go west. Thursday and Friday are for south and east. Take care though. Not responding promptly isn't going to do anything good for your customer relations.

Another possibility is to make an extra charge for calls that are out of town. There are certainly a lot of customers who would rather pay a little extra than have to wait around for a number of days

As concerns warranty work, there is nothing to do but bite the bullet.

Other uses for records

Certainly, good records are invaluable in analyzing the performance of technicians. As has been mentioned repeatedly, satisfactory profits are inescapably linked to the productivity of technicians. But all these records can call attention to other weaknesses in the organization.

One of these is the possibility of insufficient inventory, too much inventory, or inappropriate inventory.

Then again, if the technicians are functioning splendidly but profits are not satisfactory, perhaps there is a problem in pricing. Attention to pricing may be discovered by interpreting technician records. And, most important, problems with the customer can be revealed through productivity records. ■

PHOTOFACTS

EMERSON
TC1376AW (Version A) 3925
TC1376AW (Version D) 3925
TC1376AW (Version E) 3925

GATEWAY
CS1024NI 3934
PMV1448 3934
PMV1448NI 3934

GE
TX81G 3931
TX81GC 3931
TX81GT 3931
13GP234C01 3931
13GP234F01 3931
13GP234F02 3931
13GP234F03 3931
13GP236C01 3931
13GP236F01 3931
13GP236F02 3931
13GP236F03 3931

MAG iNNOVISION
CS1024NIW ..... (similar to) 3934
CS1024NIWC ..... (similar to) 3934
PMV1448 ..... (similar to) 3934
PMV1448L ..... (similar to) 3934
PMV1448NI ..... (similar to) 3934

MAGNAVOX
VRU442AT01 ..... VCR-293

PANASONIC
ADP279 3923
ANEDP275 3930
CT-13R16CV 3923
CT-13R16V 3923
CT-13R17CV 3923
CT-13R17V 3923
CT-20G32V 3930

PHILIPS
VCU442AT01 ..... (similar to) VCR-293

PROSCAN
CTC187CM 3922
PS32108FM1 3922

QUASAR
ANEDC282 3928
SP3219UV 3928
SP3219V 3928
SP3220UV 3928
SP3220V 3928

RCA
CTC169CA 3926
CTC169CA2 3926
CTC187AJ 3924
F27189ETNX1 3926
F27676BCFE1 3924
F27676BCJX1 3924
F27677BCFE1 3924
F27677BCJX1 3924

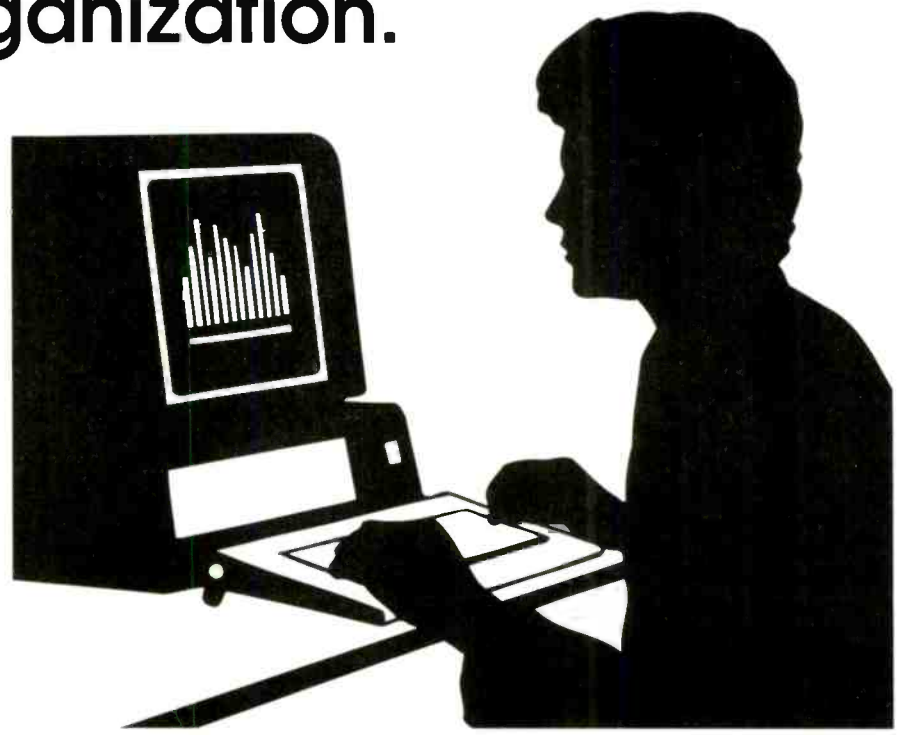
SANYO
AVM-1307 3927
AVM-1307U 3927
DS19630 3921
G6C-1307U0 3927
G6C-13070 3927
19630-00 3921
19630-01 3921
19630-02 3921
19630-03 3921

TOSHIBA
CF35F40 3932
CF36G40 3932
TAC9609 3932

ZENITH
SR1943Y 3929
SR1943YM 3929
SR2500RK 3933
SR2500RK1 3933
SR2550S 3933
SR2550S1 3933
SR2550SM 3933
SR2550SM1 3933

Business management systems: Implementing a software solution into your organization.

By Jeff Murray



Regardless of the particular type of service business we may be in, we face challenges every day managing our operations. From managing customer communications to inventory, we are forced to find better and more effective ways to remain competitive, often without the luxury of adding personnel to help track and manage our business operations. Add to this the added demands of employee productivity, vendor relationships and manufacturer warranty claims, things can seem like they get out of control very quickly.

As we speed toward the 21st century, it may do us well to stop a moment and recall how we did business in "the good old days", (and cringe when we find we still run parts of our business the exact same way we did back then).

The old way of doing business

Ahh, remember the good old days. The walk-in business, unreliable TV sets. The tube caddy? We didn't have to worry about going out and finding customers, let alone to communicate with them. No database marketing programs existed because personal computers were just a dream in the mind of Steven Jobs, founder of Apple Computer, and operating systems were used in hospitals by doctors, not computers.

But before we get too nostalgic about the good old days, let's remember that parts were hard to track and large inventories were the norm because distributors could not be easily tracked and counted on in many cases. Technicians were paid haphazardly, with no easy way of tracking productivity and time. To run a profitable business in this environment we needed a large non-technical staff to control customer contact management, distributors, parts inventory, warranty filing and tracking, not to mention payroll and accounting. (Sound familiar?).

Murray is Manager for Software Solutions at Sencore.

The current way of doing business

Technology has arrived. And so has the endless hassle of integrating big cumbersome computer systems into your paper processes. Now, besides managing everything else about our business, we now have to manage a wide array of systems, both paper and computer based. Until now, the best business management packages were custom designed, running specialized applications for the service center. These custom designed systems are extremely expensive and only work for the business they were designed for.

The dilemma is that, because the electronic service center market is relatively small, most software development companies have stayed out of the market because the return on investment is low to non-existent. Many of the canned packages that do exist are lacking in some area and are hard to modify without considerable added expense.

The new way of doing business.

To increase the profitability, and to enhance the value of your service center business you must aggressively upgrade to manage profit from operations, customer relationships, communications, employee productivity, inventory control, vendor relationships, and manufacturer warranties.

"The biggest question is 'where do I start?'"

The biggest question is "where do I start?". The first recommendation for any service operation that is interested in upgrading their business processes (notice I did not say - business software), is to determine:

- How to hire, train, and retain top-notch technicians.
- How to change with the times and

identify new equipment to service: computer monitors, computers, large screen TVs, manufacturing equipment

• How to build and maintain excellent customer relations through great service and contact management.

• How to turn equipment around quickly. What not to take in.

• How to maintain and retain relationships with vendors and distributors that enhance your business.

• How to track and reward technician productivity.

• How to know what's actually going on in your business from day to day, know where you are making money and where you are losing money and make the proper corrections.

Good management keeps service centers in business

Having recently returned from a conference of large, successful service operations, it became clear to me that the reason this group is thriving even though the industry is changing is because they're good managers and they're not afraid to think in new ways. The top three areas the group is focused on are generating new business by expanding into new markets, hiring and maintaining quality technicians, ensuring that day-to-day operations are managed, and that relationships with distributors, customers, and employees are continuously enhanced. Buying a new software package is not the answer, unless you have a handle on these business issues.

Other important areas

Granted, there are several other areas that are of equal importance when addressing business profitability: finding and retaining the right technicians, obtaining the most effective test equipment, and continually training and enhancing your technical staff to meet new and expanded opportunities. However, choosing and implementing a strong business management software package will go a long way in helping you achieve success in your business.

So, now that we've suggested that service management software can be a useful tool in managing a service center, the question becomes "how can a software package improve my business?". The answer from management and business owners is not surprising. Any package implemented must make the business easier to run, provide the proper management reports, and increase the business's profitability. If you find that you are in a position to implement a business software program, an initial assessment of business operations is necessary.

Assessing your business

In assessing your business with a view toward computerization, ask yourself:

• How many transactions are you doing manually? Do you currently print invoices and then re-enter the information into another part of your software? (warranty, or accounting for example.)

• How do you currently keep track of who owes you money: warranty companies, customers, vendor returns? How many hours do you or your employees spend tracking down warranty claims? Have you ever discovered a claim that should have been paid months ago? Have you ever lost a claim?

• How do you track the productivity of your technicians? Do you reward your top performers appropriately?

• Do you fight a trail of paperwork from customer drop off to customer pick up? Is information in your current system easily accessible? Is the status of service jobs easy to obtain (when a customer calls)?

• How do you get parts from vendors? Which vendors are your top performers? How do you track multiple/partial shipments? How do you track shipping, freight, and the dreaded *misc.* charges tacked on by vendors?

• How do you currently keep track of your inventory? Do you really know what parts to keep on hand and which are your slowest movers? How do you know when it's time to reorder parts, do you wait until the bin is empty?

• How are you pursuing and tracking customers for increased revenue generating opportunities? Are you writing and tracking custom service contracts for your customers (does your current system allow you to track them)?

• How are you scheduling and tracking technicians on service calls? Can improvements be made?

• What reports do you get from your current system? What reports do you want or need to run and improve your business?

• How are you handling accounting procedures from day to day? Do you know where you are losing the most money? Do you know where you are making the most money?

"A well designed service management software system can help a service center in handling questions from valuable customers."

Choosing a business management software package

Answer the above questions honestly and you are well on your way to choosing a business management software package. In addressing the above issues, the software package you choose should do as many functions as you do, and as "automatically" as possible.

For example, once a customer comes in and his personal information is entered it should always be available and easy to find. Complete records on all of the customers' electronics should be maintained including detailed information on previous repairs. Warranty information and service contracts should be tracked and be clearly evident to the service writer. Any other notes regarding the specific customer should also be present.

In other words, the system should work like you work. Contact management complements great service and generates return business. The system should be easy to operate (for you and your staff), and not require the assistance of a computer genius to figure it out.

In order to increase technician productivity you must be able to track it; you should be able to report what each technician invoiced, scrapped, restocked and reworked each day, week, month or year. The most effective shops maintain a minimum inventory of repair parts. Your system should tell you what parts to maintain (based on use) and which vendors are satisfying your needs.

A business management software system should tell you about your cash flow; what are the hot months, where should you focus your advertising, who are your "new" customers.

Reports and support

Your system should provide useful reports, and you should be able to create

new reports that meet your specific needs. The data in your system is yours and you should have easy access to it. You shouldn't have to input the same information twice (or three times) into the system. Warranty claims information should be automatically gathered during the repair (as much as possible) and warranties should be tracked until they are satisfied.

Make sure the product you choose has a good support package (phone support, on-line support) and will continually improve the product as the industry changes.

The bottom line is, whatever business management software package you choose, you must see increased profitability. Your business should directly benefit from increased productivity, more business, better warranty tracking, and ultimately more dollars in your pocket. Again, the software system should work the way you work!

Answering your customers' questions

A well-designed service management software system can help a service center in handling questions from valuable customers. Here is how a telephone call from a customer might be handled if the service consultant had the pertinent information at hand stored in a computer in a well-designed database.

1. Caller: "Hello, this is Francis Smith, I'm calling to check on my computer.
2. Service Writer: "Hello Ms. Smith, how are you today?"
3. Caller: "Fine, I'm calling to check on my computer"
4. Service Writer: "AST Advantage 486-66?
5. Caller: "Yes"
6. Service Writer: "Your computer had some software problems which are being resolved by our technician. He says the new program you loaded requires additional memory and hard drive space for optimal performance. Would you like our tech to add a hard drive and additional memory while the cover is still removed?"
7. Caller: "What will it cost me?"
8. Service Writer: "About $250.00 for the hard drive and $90.00 for the additional memory"
9. Caller: "Fine"
10. Service Writer: "Would you like a one year on-site service contract for your computer?"
11. Caller: "What will it cost me?"
12. Service Writer: "$89.95"
13. Caller: "That covers everything?"
14. Service Writer: "Yes, all parts and labor for one year"
15. Caller: "OK, go for it. When can I pick it up?"
16. Service Writer: "Tomorrow at 3 O'clock"
17. Caller: "Thanks"

As soon as the call was received, the service writer entered "Smith" in the search box. The service writer should be able to click on "Francis Smith" and find "Francis Smith." From that screen all information on Ms Smith's repair should be available to the service writer. She can quote exactly what the technician said was wrong and what his recommendations are. In this case the service writer was able to generate some extra business and even sell a custom service contract. Once the call was completed, the service writer should be able to enter any additional services requested and make notes about the service contract.

Once the service writer enters all the information it should be immediately available to all users on the system, including the repair bench, where the technician can complete the repairs and upgrade. Now, in some shops you may already be generating business this way, but do you do it on every call? Do your non-technical personnel do it on every call (is the information even available to them?). This is only an example, but any service center management software package you choose should allow you to handle your customers this way.

Information handling and tracking

The package you choose must track warranties until they are closed out in your system. After the initiation of a repair order the transaction should immediately be captured for warranty processing and as much information as possible should be transferred to eliminate duplication of work. Electronic filing to WTI, KPINS and manufacturers should be available in any software you choose. Information on warranties should be available and easily accessible through an easy to use front end (menu system) which has full search capabilities and tells you immediately what you have in warranty receivables.

Automatic tracking of technician productivity should be in the package you choose. Technician productivity reports should be immediately available in summary form or by individual technician. You need to see exactly what your technicians invoiced (and the parts used), the parts they scrapped and restocked, and the labor they billed. These reports should be available by the day, week, or month (or any date range), and are a valuable management tool in determining employment considerations, bonuses, pricing, and training requirements.

The program you implement should handle inventory management and transactions with vendors. The key to inventory management for improved profits is to stock what is needed immediately (and on a recurring basis) at the bench and to line up distributors that can meet your needs for other parts on an as needed basis. That way you don't stock parts you never or rarely use and you don't pay return shipping and stocking charges if you do return a part.

When you initially set up the inventory and when you receive replenishment stock, you should be able to continually track general information like description, pricing, levels, trigger, etc. In addition, some specific statistical information should be collected automatically. This statistical information should include the last price (cost) change, the latest item received, and the date the part was entered into inventory.

At a minimum the system should be able to use this information to generate reports indicating the fastest and slowest moving parts (stocked and non-stocked) and, additionally, show where the parts came from and the turn-around time from the vendor. Reports should also generate lists of suggested parts orders and recommended stock levels.

Some final thoughts

You may have noticed that I didn't mention anything about hardware requirements. The reason for this is that hardware is cheap, with complete packages available at prices well under $1000.00 and that can run the most comprehensive software packages. The key is making the hardware work for you with a service center management software package to run on it. ■

Digital multimeter

Wavetek's new digital multimeter (DMM), Model DM7 is a compact, rugged, all-trade, general purpose meter for basic electronic and electrical troubleshooting, test and measurement. Measurement capabilities include ac, dc, resistance and battery testing. Safety test leads and protective holsters are standard.

The meter with its 200-count precision digital readout has features that include ac/dc ranges to 600V, dc current to 200mA, four resistance ranges to 2MΩ, diode test and a quick tester for 1.5V and 9V batteries. Industry safety standards are also assured with the DM7's EN61010-1 approvals worldwide.

Circle (15) on Reply Card

Fiber optic kit

The *Fotec* "Fiber U Toolbox" includes a complete set of tools for installation, testing and troubleshooting fiber optic cable plants. Now it includes tools for terminating singlemode fiber optics in the field and datalogging to a notebook PC for recording testing data.

The toolbox includes tools for cable cutting, pulling and preparation, termination, splicing and testing. It's practically everything the fiber optic installer needs on the job to install fiber optic cable, splice, terminate and test it, says the manufacturer. New kits now include the tools

and instructions to terminate both multimode and singlemode fiber in the field and an option for reading the test data into a notebook computer.

Circle (16) on Reply Card

Multimeter

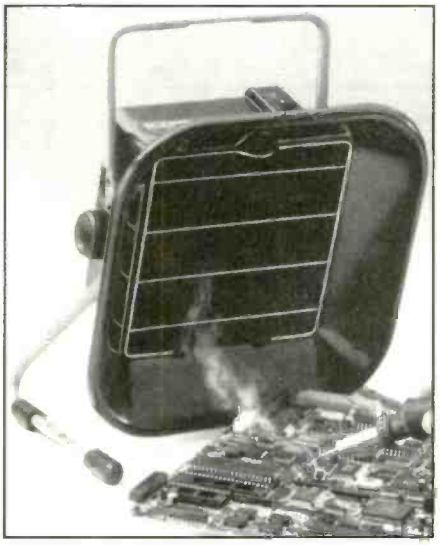
B+K Precision announces the Model 2880 RS-232 Interface multimeter. The new hand-held DMM measures true RMS values and permits datalogging on a personal computer via a built-in RS-232 interface port.

The meter incorporates a unique, easy to read, "triple" LCD display with 4000 count resolution and a fast update analog bargraph. Min, Max and Present readings can be displayed simultaneously. Furthermore, the mode can be changed to simultaneously display Min, Max and Average readings.

The triple display function can also be used in the compare mode, where high and low limits may be set and displayed, while the main display indicates pass or fail when measurements are compared to the preset limits. In the dual display mode, the LCD can display ac voltage and frequency (200Hz to 200KHz with 20,000 count display) simultaneously.

Measurement functions performed by this multimeter include ac/dcV, ac/dcA current, resistance (auto/manual ranging), continuity and diode test, capacitance (400nF to 40uF), 10MΩ input impedance and overload protection at 1000V peak (600V peak on 400mV range).

Circle (17) on Reply Card



Benchtop fume exhauster

SODRTEK announces the FX50 benchtop fume exhauster designed to remove harmful solder fumes and other airborne contaminants from the workbench. This exhauster effectively pulls the fumes from the production operator's breathing zone and filters out noxious contaminants through an activated carbon filter mat. The stand allows several mounting options with multiple height adjustments.

Circle (18) on Reply Card

Camcorder repair instructional video

An instructional video from *Electronix* is designed to assist both beginning and seasoned electronic technicians to service 8mm camcorders. With their small parts, 8mm camcorders are among the most time consuming and difficult video equipment to repair, yet the most profitable. The video teaches time saving repair techniques, common troubleshooting, and proper assembly and disassembly methods, including a thorough mechanism tear-down and reassembly.

Circle (19) on Reply Card

Test Your Electronics Knowledge

by Sam Wilson

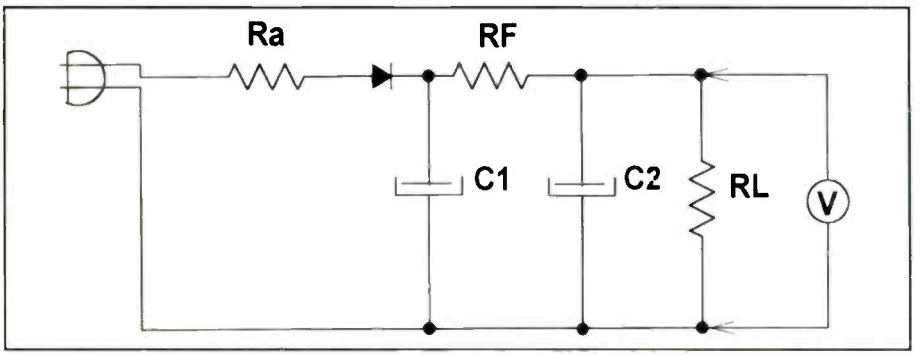


Figure 1. What is resistor Ra in this circuit called? And what will the meter indicate if capacitor C2 becomes open-circuited?

1. In Figure 1 resistor R_a is called a _____ resistor.

2. If capacitor C_2 in Figure 1 becomes open-circuited the voltmeter will indicate
   A. higher voltage.
   B. lower voltage.

3. In an NPN transistor amplifier circuit the base is
   A. negative with respect to the collector.
   B. positive with respect to the collector.

4. In the circuit of Figure 2, moving the capacitor plates closer together will
   A. raise the resonant frequency.
   B. lower the resonant frequency.

5. Which of the symbols in Figure 3 is for a P-channel MOSFET?
   A. The one marked X.
   B. The one marked Y.

6. The velocity factor of a transmission line accounts for the
   A. higher speed of radio waves on the line.
   B. lower speed of radio waves on the line.

7. Which letter of the alphabet is used to represent the speed of light? _____

8. The groove around the door frame of a microwave oven is like a quarter-wave
   A. open stub.
   B. shorted stub.

9. Unused power at the end of a transmitter transmission line creates_____.

10. For a coil, X_L/R gives the value of _____.

BONUS QUESTION: 10 points

The relative increase in the linear dimension of magnetic tape per percent increase in relative humidity is called the coefficient of _____ expansion.

(Answers to quiz on page 42)

Wilson is the electronics theory consultant for ES&T.

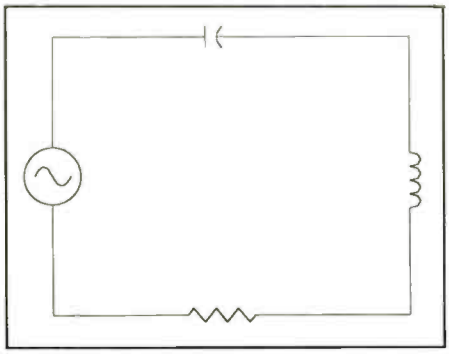


Figure 2. What will happen to the resonant frequency of this circuit if the capacitor plates are moved closer together?

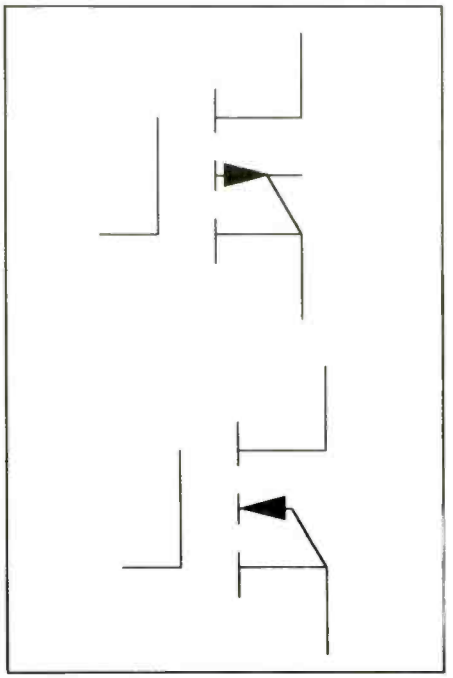


Figure 3. Which of these symbols represents a P-Channel MOSFET?

ES&T Calendar

'98 International Consumer Electronics Show
January 8-11, 1998
Las Vegas, NV
703-907-7600

The Consumer Electronics Future
January 12-14, 1998
Las Vegas, NV
703-907-7660

NESDA Board of Directors, State Representatives, and Major Committee Meetings, ISCET Board of Govenors Meeting; NIAS Board Meeting
January 11-14, 1998
Las Vegas, NV
814-921-9061

Home Automation Show & Conference
February 8-10, 1998
Orlando, FL
203-840-5482

Kansas Electronics Assn. (KEA) State Convention
February 27-March 1, 1998
Hutchinson, KS
316-662-1973

CeBit '98 - Office Info & Telecommunications Technology
March 19-25, 1998
Hannover Germany
609-987-1202

CES Habitech '98 - Home Systems
June 7-9, 1998
Atlanta, GA
703-907-7600

Learning about PC networks

by John A. Ross

A large proportion of service businesses own a personal computer that serves as a platform for word processing, database management, and accounting software. The availability of microcomputers for a reasonable cost has allowed businesses to move away from the batch processing and timesharing that was standard with mainframe computers to tailor-made applications. As a result, small businesses have gained an exceptional amount of freedom and flexibility in the management of their resources.

However, the expansion of a business also establishes the need for more computer systems, additional peripheral devices such as printers and CD-ROM readers, and additional software. Microcomputers placed in a stand-alone environment require resources for each user. Each of those requirements increases the cost of business computing.

As companies watched those costs increase, it became apparent that the type of time and resource sharing provided by the mainframe environment had some desirable consequences. Rather than move back to the mainframe applications, those small and large companies spread the cost of microcomputer applications through the use of networks. A PC network allows the sharing of data, peripherals, and software between users.

What is a network?

The term "network" covers many different types of applications and can be broken down into smaller categories such as local-area networks, metropolitan area networks, and wide area networks. Each category describes the geographic size of the network. While a local-area network, or LAN, is limited to a building or a small geographic area, a metropolitan area network, or MAN, could cover an area as large as a small city. A wide area network, or WAN, could cover a region or could stretch across world-wide boundaries.

Every personal computer network adheres to a set of standards, involves the use of specific configurations, and includes a combination of software and hardware. Networking software includes the network operating system, software embedded on network interface cards, and applications software. Modern networks offer cross-platform compatibility and services such as printing through a set of standards called protocols.

The hardware involved with a network includes the transmission media, the network interface cards, the computers attached to the network, and a selection of devices that allow either the extension of a network or the attachment of one network to another. Those connecting and controlling devices include repeaters, hubs, routers, and switches.

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

OSI LAYER	PURPOSE OF LAYER
APPLICATION	ESTABLISHES DIFFERENT TYPES OF COMMUNICATION
PRESENTATION	INCLUDES ENCRYPTION AND DATA CONVERSION
SESSION	STOPS AND STARTS A COMMUNICATIONS SESSSION
TRANSPORT	ENSURES DELIVERY OF THE ENTIRE FILE
NETWORK	DIRECTS DATA ACCORDING TO NETWORK ADDRESSES
DATA LINK	MOVES PACKETS FROM NODE TO NODE ACCORDING TO STATION ADDRESS
PHYSICAL	INVOLVES ELECTRICAL SIGNALS AND CABLING

Figure 1. With the OSI, or open system interconnection, model, a framework consisting of seven protocol layers establishes a standard for global communications, that is, communication with any other computer.

Network protocols

Protocols describe the method used by devices to communicate over a network. In the most basic sense, the use of a protocol guarantees that each device connected to the network uses the same language. A protocol establishes:

The type of error checking used for data compression, how a sending device will show that a message is complete, and how a receiving device will show that it has received the message.

With the OSI, or open system interconnection, model (Figure 1), a framework consisting of seven protocol layers establishes a standard for global communications, that is, communication with any other computer. Although the functionality given by the OSI model is seen in all networking systems, some systems may combine several layers into one. In either case, control passes from one layer to the next in a hierarchical fashion. At one node of the network, control may begin with the application layer and then move to the bottom layer, travel over the channel to the next workstation, and then move back up the hierarchical stack.

Note in Figure 1, that the OSI model has seven layers. At the bottom of the figure, the physical layer handles electrical signals and cable interfaces. The second, or data link, layer checks the validity of each node, the integrity of each transmission, and transmits packets from node to node through station addresses.

When compared to the data link layer, the network layer differs in that it routes data to different LANs and WANs while using a network address. In this regard, the action of the network layer is similar to the switching that occurs within a dial-up telephone system.

The transport layer ensures the delivery of the entire transmitted data file or message to the destination. When considering the session layer, always think of a traffic signal. As data travels throughout the network, the session layer starts and stops sessions by checking packet headers and trailers. Each packet of data contains a

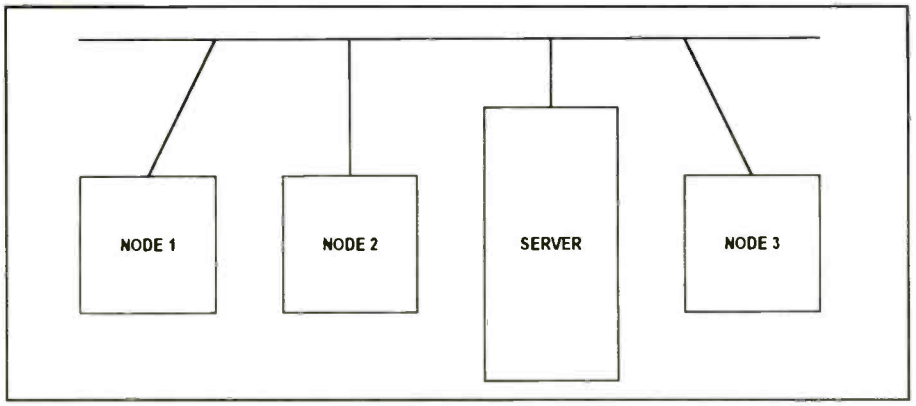


Figure 2. A bus network provides an inexpensive, easily installed, network option.

header and a trailer that indicates the beginning and end of the message.

Moving to the sixth level, the presentation layer handles encryption and the conversion of data from one format to another. For example, the conversion of BCD (binary-coded decimal) data to a binary format occurs in the presentation layer. At the top of the OSI model, the application layer covers the type of communication occurring within the network. This communication could include e-mail messages, file transfers, and the interaction between a client and a server.

Protocols may vary with the manufacturer of the network and often yield differing standards of reliability, speed, and ease-of-use. Novell networks use a protocol called IPX for Internetwork Packet Exchange while the TCP/IP, or Transmission Control Protocol/Internet Protocol, contains a suite of protocols that allow the interconnection of networks manufactured by different vendors.

Of the seven OSI layers, the first two, physical and data link, are required for every type of communications. The other layers ensure that the network model will work for different types of systems. Protocols may vary in usage from manufacturer to manufacturer and often yield differing standards of reliability, speed, and ease-of-use. Novell networks use a protocol called IPX for Internetwork Packet Exchange while the TCP/IP, or Transmission Control Protocol/Internet Protocol, contains a suite of protocols that allow the interconnection of networks manufactured by different vendors.

As an example of the cross-vendor support available through TCP/IP, Macintosh computers rely on MacTCP for the connection to the Internet and for access to other computers or networks using TCP/IP. Every device connected through TCP/IP is assigned a 4-byte identification code, or IP address, that identifies a network on the Internet and a host segment attached to a specific network. The numeric IP addresses are classified as:

Class A — an address structure supporting networks with more than 16 million nodes.

Class B — an address structure supporting networks with up to 65,536 nodes; and

Class C — an address structure supporting networks with up to 256 nodes.

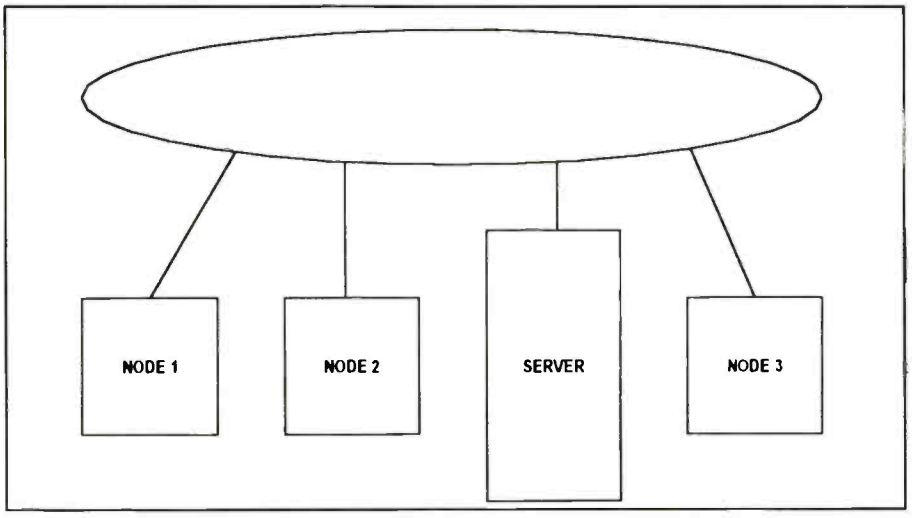


Figure 3. In a ring network, one device connects directly to two other devices, thus offering reliability in that the failure of one device usually does not affect the performance of other devices. However, the ring network is the most difficult to install and the most expensive of the three network topologies.

Other protocols

Along with the vendor-specific protocols, all networks using mail systems use the SMTP, or Simple Mail Transport Protocol. An SMTP server transfers text-only electronic mail between host servers. Complex computer networks rely on the SNMP, or Simple Network Management Protocol, for the management and control of messages.

One of the most popular protocols for file transfers is called the File Transfer Protocol, or FTP. With FTP, a worker may transfer files from the client to the server or from the server to the client. In addition to those protocols, Telnet establishes a series of terminal emulation services that allows users to access network services from remote locations. The Network File System, or NFS, protocol allows servers to share disk space and files.

Networking standards

A number of standards have been developed for interconnecting PCs among them Ethernet, Token Ring and Star. Each standard has advantages and disadvantages. A brief description of each of the standards follows.

The Ethernet Standard

During the late 1970s, a group of corporations developed the Ethernet standard as a connectivity standard that would work under the data link protocol. The Ethernet standard relies on a network access control method called Carrier Sense Multiple Access/Collision Detection, or CSMA/CD. With CSMA/CD, the workstations attached to the network detect the possibility of a data collision during simultaneous data transmissions and stop transmitting for a several milliseconds and then begin to transmit when the line clears.

Because of the chances for data collisions as an Ethernet network experiences

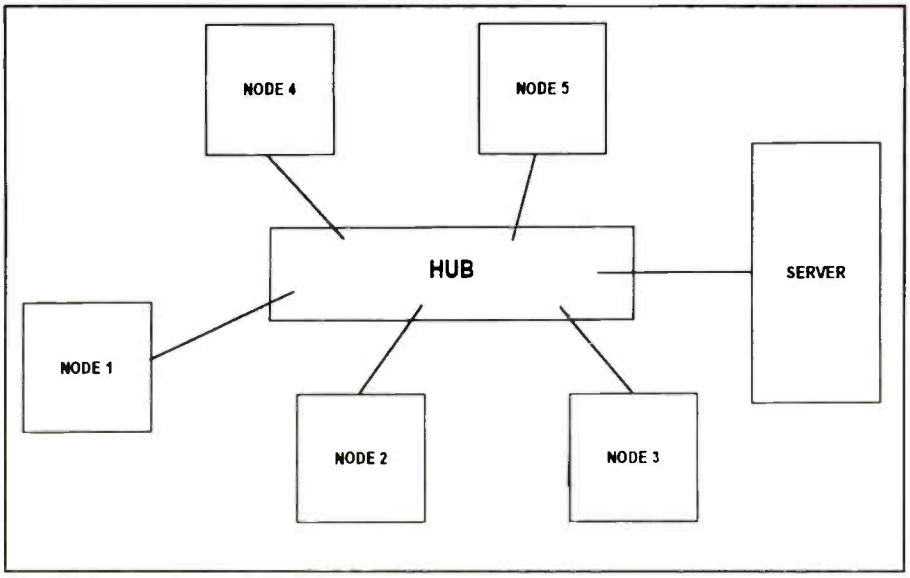


Figure 4. A network based on the star topology passes all data to each device through a centrally-located device called a hub. A star network offers easy installation and management. The drawback of a star network stems from the potential of data arriving at the hub simultaneously.

growth, limitations exist regarding cable lengths and the number of nodes attached to an Ethernet network. The limitations vary with the type of cabling used on the network. Despite those limitations, Ethernet has become a global data communications standard because of the need for flexibility and compatibility. A wide range of transmission media types and network operating systems are compatible with the Ethernet standard. The network operating systems include Novell NetWare, Microsoft Windows NT, Artisoft LAN Server, Banyan VINES, and UNIX.

Ethernet cabling standards are designated with abbreviations such as 10BaseT and 100BaseT. While the first number of the designation shows the signaling rate in megabits per second, the word "base" refers to a baseband communication. Other Ethernet cables may use broadband communication. The number or alphabetical character following the word shows the appropriate cable length or cable type. With 10BaseT, the T designates the cable type as twisted pair. With 10Base2, the 2 shows that the cable may have a length of 2 x 100 meters or 200 meters.

The Token Ring Standard

IBM developed the Token Ring standard during the mid-1980's. Stations on a token-ring network are allowed access to the network medium only when the workstation receives a specially-designed data frame called a token. The token passes from one station to the next. Although the token ring standard had an original signaling rate of 4Mbs, newer token ring networks can communicate at data rates as high as 16Mbs.

In contrast to the Ethernet standard, the Token Ring standard requires proprietary network interface cards and connecting equipment. Token Ring network interface cards contain error detection and correction circuitry not found on Ethernet cards because of the need for the exact passing of the token. In addition, a Token Ring network may use proprietary cables because of the complexity found in the network. Until recently, Token Ring networks relied on a proprietary cable type manufactured by IBM. Newer Token Ring networks operate through unshielded twisted pair cabling. As with the Ethernet standard, the type of cable determines the cable length and the number of nodes connected to the network.

Network Topologies

The term "topology" describes the shape of a local-area network. Different network standards operate using different topologies. Several common topologies are described in the following paragraphs.

Bus Networks

The bus topology allows all devices on the network to connect to a central bus or backbone. A bus network (Figure 2) provides an inexpensive, easily-installed networking option. The Ethernet standard works on the bus topology.

Ring Networks

Networks using the ring topology connect devices into a closed loop. With the very common token ring topology, each host on the network passes an electronic token which allows the device to either transmit data on the network or pass the token on to the next device. The Token Ring networks offered by IBM are examples of ring networks.

As shown in Figure 3, in a ring network one device connects directly to two adjacent devices. With this, the ring network offers reliability in that the failure of one device usually does not affect the performance of other devices. However, the ring network is the most difficult to install and the most expensive of the three network topologies.

Star Networks

A network based on the star topology (Figure 4) passes all data to each device through a centrally-located device called a hub. A star network offers easy installation and management. The drawback of a star network stems from the potential of data arriving at the hub simultaneously. In comparison with the bus and ring networks, star networks support both the Ethernet and Token Ring standards.

Network operating systems

Practical network applications involve the sharing of data, printers, fax machines, applications, and hard disk drives. Along with the transmission media and network standards, the use of a network operating system (NOS), that is, the software that makes the network operate, and allows compatibility across the network. In addition, a network operating system services the simultaneous needs of the users.

AppleTalk and LocalTalk

Included as part of the Macintosh operating system, the AppleTalk network operating system supports only Macintosh computers. The LocalTalk network interface requires that the network nodes connect either in a daisy chain or bus configuration. LocalTalk has gained widespread use because of the ease of connecting peripheral devices such as printers or scan-

TRANSMISSION MEDIA	DATA RATE	CABLE LENGTH
UTP	1MBS TO 10MBS	0.1KM
STP	16MBS	0.3KM
COAXIAL CABLE	70MBS	GREATER THAN 1KM
FIBER OPTICS	100MBS	GREATER THAN 1KM

Figure 5. The various communications media have different performance characteristics.

ners into the network. However, the limitations found with LocalTalk networks include a slow signaling rate of 230.4Kbps. In addition, LocalTalk networks are limited to a maximum of 32 nodes. Although repeaters, routers, and bridges can extend a LocalTalk network, the maximum cabling length without a repeater is 1000 feet.

Novell NetWare

Founded in 1983, the Novell Corporation offered one of the first flexible network operating systems with their Novell NetWare package. The NetWare 4.1 operating system provides file, print, directory, and drive sharing. In addition, the package includes the ability to establish administrative security and management routines. Moreover, the NetWare package can support an almost unlimited number of users.

Although much of the versatility offered by the software has become obsolete due to the widespread movement to a Windows/System 7-like graphical user interfaces, many networks continue to use versions of the NetWare operating system. In brief, the older NetWare products relied on a series of DOS-like command prompts and pull-down menus. The NetWare IPX protocol is supported by nearly all net work operating systems and by a large number of third-party vendors.

Microsoft Windows NT Server

In 1994, Microsoft introduced Windows NT Server and Client as a networking operating system. Windows NT offers the well-known Windows 95/System 7 graphical user interface, ease-of-use, and the capability for a network administrator to build security options.

In addition, Windows NT offers compatibility with other network operating systems such as NetWare, supports Macintosh connectivity, features a long file naming system, and supports protocols such as TCP/IP and IPX.

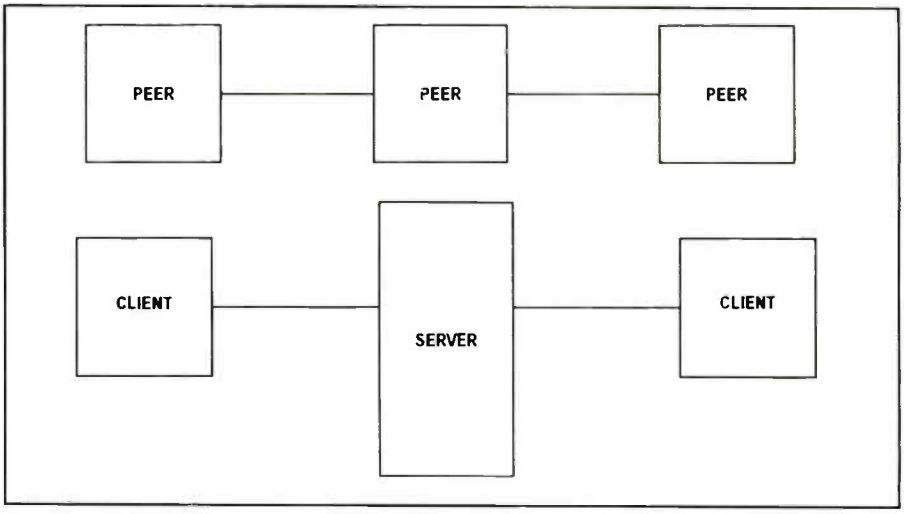


Figure 6. Peer-to-peer networks allow all the workstations or computers connected in the network to operate as servers for all users in the network. That is, each user has access to program applications or data stored on another computer disk drive. Client/server networks, on the other hand, use one or more microcomputers or workstations as clients that request data or services from a dedicated central server which operates as resource. The server shares memory, provides computing connectivity, and provides application services.

The security functions given through Windows NT allow an administrator to restrict access to floppy drives, local hard disk drives, and network drives. In addition, Windows NT uses a password logon scheme to prevent the unauthorized use of a station. Along with the security functions, the software also features several different types of logs. While the security log lists any attempts at unauthorized access, the application log lists the use of applications. A system log provides a method for cataloging any failures that occur on the system.

Network Hardware

The computer network hardware consists of the transmission media and the interface cards in each computer connected to the network, as described in the following paragraphs.

Transmission media

The transmission media for local-area networks includes several different types of media and wireless communications. One of the most popular types of transmission media is called unshielded twisted pair, or UTP, and is very similar to the cabling used for telephone connections. The twisted pair portion of the name refers to the use of two insulated wires wrapped around each other. UTP offers the benefits of low cost, easy installation, and the capability for relatively high data rates.

Other types of wired transmission media include coaxial cable and fiber optics. The coaxial cable used for data transmission has the same construction form as the cable used for television signal transmission; an insulator and braided cable surround that produces a shield for the inner conductor.

However, the differences between video and data signal transmission become apparent in terms of noise susceptibility and attenuation. Digital data is much more susceptible to noise and signal distortions. The standard coaxial cable with a single conductor is also called unbalanced transmission media. Balanced media uses two similar wires to

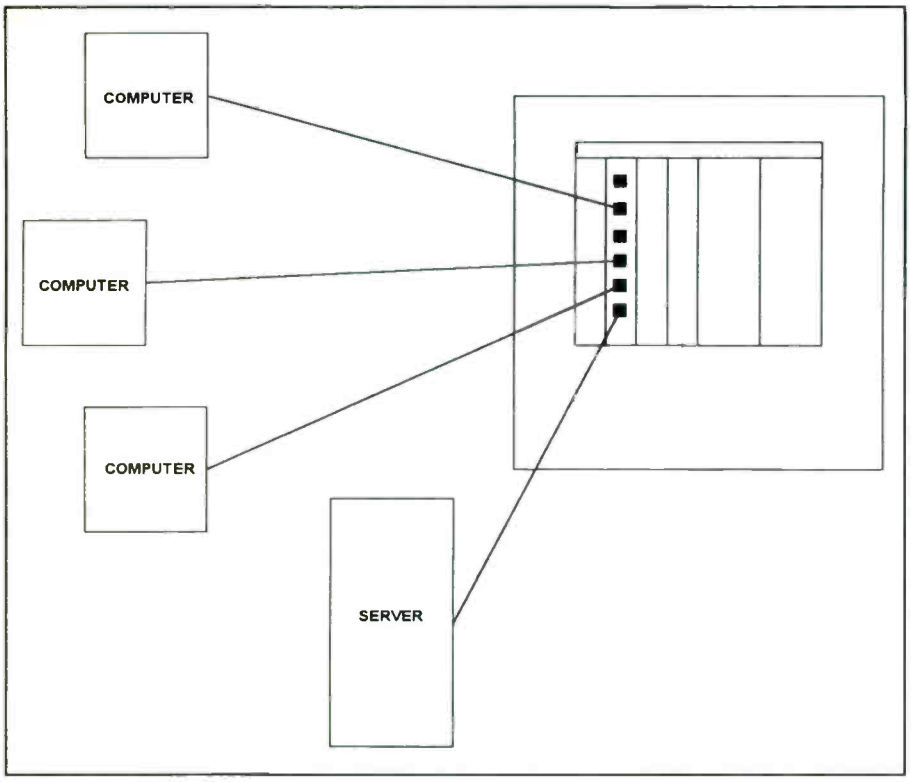


Figure 7. The use of hubs in the star network configuration allows a server to support different topologies such as Ethernet and Token Ring over different types of cabling. Without the use of a hub, a network could consist of coaxial cable running through a progression of multiple repeaters throughout a building. For example, as shown here, a hub allows the sending of signals over twisted pair copper wire and the termination of the signals at a single, central location. As a result, the hub allows the centralization and concentration of wiring connections at one location.

carry signals that have an opposite polarity and are less susceptible to noise and signal distortion.

Many building-to-building and wide-area network installations involve the use of fiber optics. With this, an insulator encloses a bundle of glass threads. Each thread can transmit information at the almost the speed of light. Along with the advantage of speed, fiber optics also offers benefits like:

Greater bandwidth or the ability to carry more data;

Less susceptibility to interference;

The ability to carry digital signals; and

Reduced size and weight.

Until recently, the use of fiber optics had not become widespread due to the installation cost and the fragile characteristics of the media. Despite those factors, fiber optics have become more popular for local-area networks and telephone networks. Nearly every telephone company in the nation has either replaced or plans to replace existing copper lines with fiber optics. Figure 5 displays the differences between the three media types.

Wireless LANs

Wireless LANs offer an attractive alternative to cabling through the use of the airwaves as a communication medium. This alternative becomes particularly beneficial when considering the networking of an older building or an installation that requires higher cable costs. Although early wireless LANs did not offer the speed or bandwidth seen with the more traditional wired systems, newer wireless networks provide 10 megabit speeds and the bandwidth needed for data and video communications.

Network interface cards

Along with the transmission media, another fundamental part of any network is the network interface card (NIC). As the name suggests, the NIC establishes a link between the transmission media of the network, workstations connected to the network, and the server.

Network interface cards are rated according to bandwidth and transmission speeds and are available for all bus types including ISA, EISA, MCA, PCI, PCM-

CIA, and the NuBus architectures. In addition to accommodating different bus types, NICS also arrive with either a standard UTP connection; a BNC connector for coaxial cable; or a combination of both jack types. A selection of software drivers ensures the compatibility of the interface cards with different operating systems.

Test Your Electronics Knowledge

(Answers to quiz from page 24)

1. surge-limiting - It protects the diode during the high-surge current when the capacitors are first charged.

2. B - The capacitor charges to the peak value of input voltage.

3. A - Although the base has a positive voltage it is less positive than the collector. In other words, it is negative with respect to the collector.

4. B - Moving the plates closer together increases its capacitance. In the equation

$f_r = 1/2(\pi \times \sqrt{\{ LC \}})$

an increase in C lowers the resonant frequency.

5. A - Remember that the arrow in semiconductors always points toward an N-type semiconductor and away from a P-type semiconductor.

6. B

7. C

8. B - Its job is to trap the microwaves and prevent them from getting out of the oven.

9. standing waves. They represent wasted power.

10. Q, or, Quality factor

BONUS QUESTION:

hygroscopic (humidity is OK for the answer)

Peer-to-Peer and Client-Server Networks

As shown in Figure 6, peer-to-peer networks allow all of the workstations or computers connected in the network to operate as servers for all users in the network. That is, each user has access to program applications or data stored on another computer disk drive. On the other hand, client/server networks use one or more microcomputers or workstations as clients that request data or services from a dedicated central server which operates as a resource. The server shares memory, provides computing connectivity, and provides application services.

Each client in the network contains a user interface and may perform all or part of the actual application processing. In today's computing environment, the user interface usually consists of a GUI, or graphical user interface. The windowing environment found with either IBM-compatible or Macintosh computers allows a client to remain involved in simultaneous word processing, spreadsheet, e-mail, and presentation graphic sessions.

Servers may take the form of high-speed microcomputers with large hard disk drives and large amounts of random-access memory, minicomputers, or mainframes. When considering server functions, an application server contains applications such as spreadsheets, computer-assisted drafting, and word processing. A database server contains only database applications and processes any requests from clients for either the removal or the updating of data.

Generally, the type of platform used as a server is different than the type of platform seen at the client level. Along with that difference, most servers use, at the very least, a slightly different type of operating system than that seen on the client. These differences become more noticeable when we begin to consider that most client-server networks include different types of personal computers and often attach IBM-compatible and Macintosh computers to the same server. The software found at the server and client levels, the transmission media, and the network protocols establish cross-platform connectivity.

Repeaters and switches

Because of the limitations on cable lengths, many local-area networks rely on repeaters as a method for extending the reach of the network. A repeater regenerates analog or digital signals that may be distorted by transmission losses caused by long cable lengths. Networks also rely on switches to filter data and forward the frames to the next location.

Hubs, bridges and routers

The use of hubs in the star network configuration allows a server to support different topologies such as Ethernet and Token Ring over different types of cabling. Without the use of a hub, a network could consist of coaxial cable running through a progression of multiple repeaters throughout a building. Shown in Figure 7, a hub allows the sending of signals over twisted pair copper wire and the termination of the signals at a single, central location. As a result, the hub allows the centralization and concentration of wiring connections at one location.

Passive hubs concentrate multiple connections into a single device and use electrical relays to connect all users. In some network installations, a number of passive hubs may connect together in a daisy chain arrangement. Intelligent hubs add management capabilities to the connections provided by the passive hubs. With this, the hub provides status reports about the connections, compiles statistics about connection usage, and supports the connection of Ethernet and Token Ring cards.

Routers and bridges provide a method for interconnecting local-area networks with other networks such as a WAN. Routers move data packets between two systems by locating and using an optimal routing path. In addition, a router usually provides a method for limiting the amount of traffic on the network.

Bridges provide another means for connecting local-area networks together and allow the network to grow beyond the limitations given by a specific topology. Because bridges operate at the data link layer of the OSI model, bridge connections are limited to either Ethernet-to-Ethernet or Token Ring-to-Token Ring connections. The key difference between bridges and routers is found within that limitation. A router operates at the network layer of the OSI model and can support data transmissions between different network topologies.

Business applications for networks

Small businesses and schools rely on the versatility provided by local-area net-

works. Depending on the application, a LAN may have a peer-to-peer configuration where a small number of computers share applications or a configuration that requires a server and workstations. In both cases, transmission media in the form of either cables or wireless transmitters and receivers connect the different parts of the network. Along with the server and workstations, a large local-area network may also include bridges, gateways, switches and routers. Both the size and the configuration of the network depend on current and future applications.

Although peer-to-peer networks are still used, most networked business applications have moved into a client-server environment. This trend continues because client/server computing offers a cost-effective user interface, the capability to store large amounts of data and the ability to access a wide variety of applications across the network. As a result, a client/server network can link personal and business applications for business-wide uses. In addition, a client/server network allows a business to save costs by allowing the connection of existing computers to the network.

Network systems based on the Windows 3.x or Macintosh System 7 operating systems allow communication with only one software application at a time. Newer operating systems such as Windows NT, OS/2, and Unix allow true multitasking, or a group of simultaneously-operating business processes. Because a client/server environment allows simultaneous software sessions, a user can cut-and-paste between different applications. As a result, the business computing environment gains versatility and functionality.

Both of these characteristics become even more important through the ability of the client to provide local editing and the entry of data for later distribution. While the server contains an application, the client controls the information. With the server capturing and holding data, a worker at a client workstation can make any necessary changes to a portion of the data without affecting the data contributed at another client. In effect, this cuts the amount of paper shuffling from desk to desk.

The independent functions found at the client also include fax, print, and e-mail services. Although different clients may utilize different network services, an individual client can output information through either a fax or printer server. This type of server allows the generation of print requests even if the printer is in the process completing a task for another client, places the print requests into a queue, and notifies each client when the print job is completed. The network extends the same type of service when e-mail messages for specific clients arrive at the server. Only the client at the specified e-mail address receives a notification that a message has arrived.

With all this occurring at the client and auxiliary server level, the network server provides and controls shared access to any resources contained on the server. This type of control prevents one application from interfering with the operation of another. In addition, the control of RAM and hard disk drive storage space by the server ensures that a single, client-initiated task does not consume all the resources offered by the server and prevent the completion of other tasks.

Aside from control, the server also establishes a number of other services. As an example, automatic file backup and recovery occurs at the server level. In addition, the server provides the automatic backing out of an application during a power, hardware, or software failure. With database servers, the reorganization of data, database management, and record locking are found at the server.

Choosing a LAN

As with any purchase, the selection of a local-area network depends on the current and projected needs of the business. For example, a small business may decide to implement a simple peer-to-peer network because of the low installation costs, the low maintenance costs, and the simplicity of the installation. However, as the business begins to grow, the simplicity offered by the peer-to-peer network may limit the uses of the network.

Because of this, most businesses opt for the client/server configuration because of the capability for expansion and the versatility offered by the ability to share applications and data. The benefits of a client/server network are offset, though, by higher maintenance costs and more difficult installations. In many cases, a business will contract with trained installers for the installation of the client/server network. ■

What Do You Know About Electronics?
Why Johnny can't understand magnetics

By J. A. Sam Wilson

This article has a several fold purpose:

- to show how difficult the study of magnetism really is,
- to explain a few magnetic facts and,
- to explain (MRI) brain scans.

It is obvious from some of the letters I have received, that many courses don't provide much training in basic magnetics.

That is not surprising. Back in the old days, when Hector was a pup, students who were studying to be technicians got a large dose of electrical theory and magnetics in their course. However, when it became necessary to include the theories of the many newly developed electronic devices, there were only two possibilities; extend the course, or take something out.Unfortunately, the latter choice was taken. I believe that is one reason technicians do not have an in-depth understanding of inductors.

In some ways that was not all bad. Looking through some of the old course outlines I found a lot of fluff. So, we will not include the fluff here.

Wilson is the electronics theory consultant for ES&T.

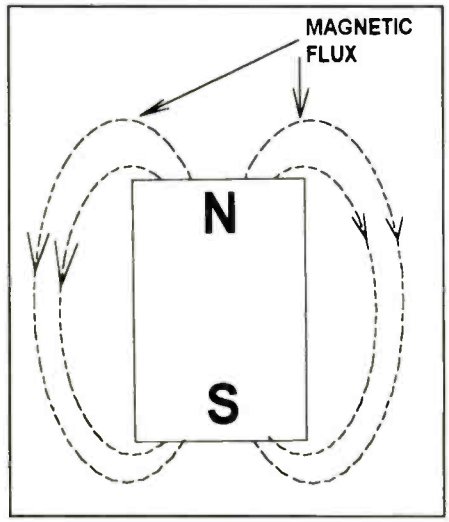


Figure 1. The flux lines surrounding this magnet show the direction in which a unit north pole (an imaginary construct) would move under the influence of the magnetic field.

Some examples of fluff

Let me give just one example of fluff. In a beginning lab course in a four-year college, students were instructed to color the bands of ten resistors to show color codes. I looked for, but did not find, instructions for the students to stay between the lines.

I think the drawing of a permanent magnet, like the one in Figure 1 gives the wrong impression. The arrows on the flux lines can give the impression that the flux lines are moving from north to south. Actually, they show the direction and path of an *imaginary* unit north pole under the influence of that field. A unit north pole is a very small north magnetic pole that has no accompanying south pole.

The unit north pole does not actually exist. It is a very important concept used to explain and design magnetic circuits. It was conceived by scientists. Once that concept was conceived, there were, and are, scientists who started looking for a unit north pole one. Many dollars are being spent on that project.

It has been suggested that a very-long, very-small diameter iron or steel rod, with a north pole at one end and a south pole

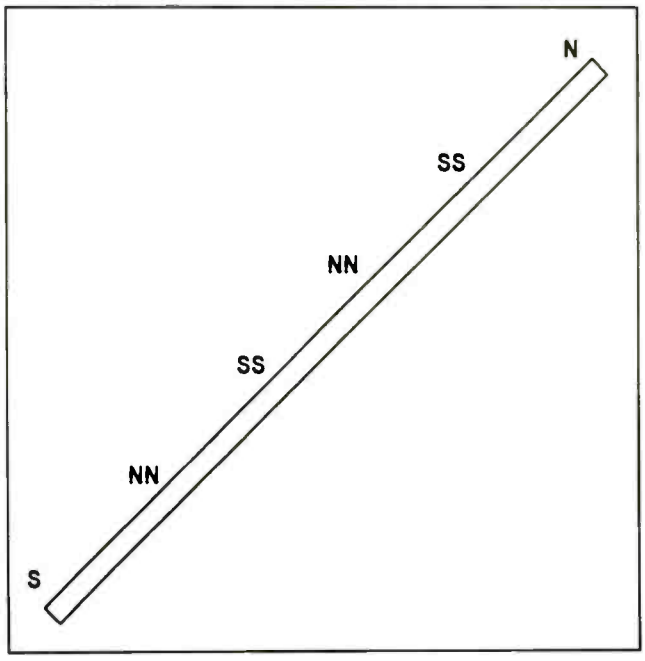
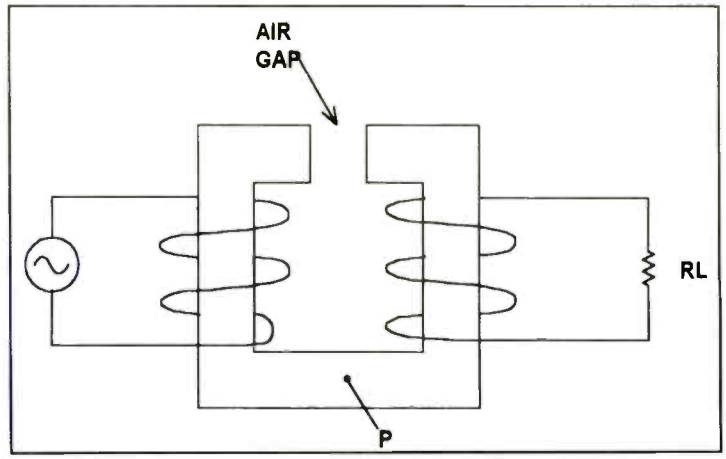


Figure 2. If you try to create the equivalent of a unit north pole by magnetizing a long iron rod, you will wind up creating a number of what are so-called consequent poles along the length of the rod.

Figure 3. It is not possible to calculate exactly the amount of flux generated by this magnetic circuit. The best that can be done for a calculation such as this is a rough approximation.



at the other end, can work like a unit north pole because its north pole is so far from its south pole. "Some would say, it acts like a unit north pole".

Don't believe it. If you try to magnetize a drill rod with a north pole at one end and a south pole at the other end you will get consequent poles. See Figure 2. You can tightly wrap a wire along the length of the rod and apply a healthy dc current along the wire. Bang on the rod to help align the domains in the steel.

When you remove the wire you will always find that the rod has consequent poles as shown in Figure 2. So much for making a unit north pole. (Note: An electromagnetic unit north pole *can* be made.)

Comparing magnetism to electricity

There have been some heroic efforts to simplify magnetism by comparing it to electricity. Electricity is neat and orderly, so we can use the equation for Ohm's law with confidence.

Here is the so-called "Ohm's Law for magnetic circuits":

magnetic flux = magnetomotive force/reluctance

That's nice and neat, but it is not true. For starters, the reluctance is a non-linear quantity. Moreover, there is magnetic flux leakage along a magnetic circuit, whereas, in electricity all of the current stays inside the wires. So, take for example the magnetic circuit shown in Figure 3. The primary coil produces the magnetomotive force, the air gap produces reluctance, and the iron core provides the flux path. We are going to calculate the amount of flux just like we calculate the current in an electric circuit like the one shown in the figure.

No we're not - because it can't be done.

Finding the strength of a magnetic field at a point

Suppose the problem is to find the exact strength of the magnetic field at point P. The authors of that problem offer "A very rough approximation can be made . . ." Let me give you a direct quote from a very authoritative book about the transformer in Figure 3. "An exact analytic solution of the problem is impossible." (From the text "University Physics" by Sears and Zemansky.)

So, in our electric circuit we can calculate the precise current at a point in the wire. Everything falls neatly into place.

The method I used to solve primary and secondary currents in a transformer (in the previous issue) is not based upon the precise calculation of a transformer magnetic circuit. Instead, it is based upon the measurable electrical parameters of the transformer plus some very basic laws of physics. (For examples, Lenz' Law, and, the Law of the Conservation of Energy.)

Now, this is my opinion - one reason the magnetic analysis of transformers is not taught is that you cannot work out organized problems and get exact answers.

Ohm's law for magnetism doesn't work

In addition, "Ohm's law" for magnetism doesn't work. You have to look at the copyright date of a book to see which magnetic units the author is using for magnetism. Take the case of magnetomotive Force (MMF). One ampere flowing in a single coil of wire produces one ampere-turn of magnetomotive force. That's simple enough. Almost anyone can understand it. However, it is apparently too simple. Try this:

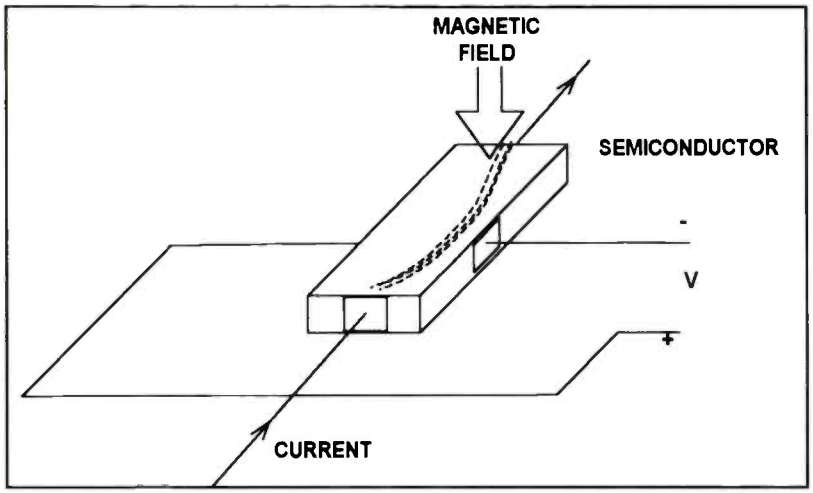


Figure 4. To measure the strength of a magnetic field you can use a Hall device. The magnetic field cuts through a small semiconductor slab. In a Hall device, electrons crowd to one side of that slab and create a voltage. The magnitude of the voltage is proportional to the strength of the magnetic field.

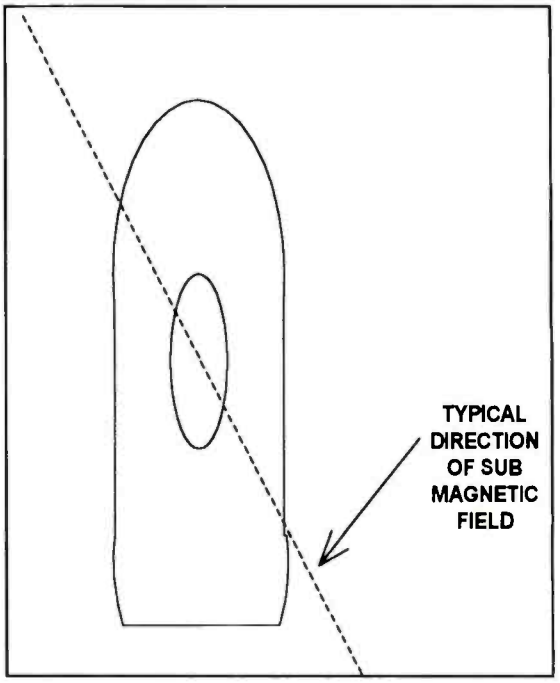


Figure 5. If the object is properly aligned relative to the earth's magnetic field, no anomaly will be detected.

1 gilbert = 1 ampere turns x 1.256637061
(often taken as 1.2566 x ampere turns)
where 1.2566 is (0.4 x π)

That is sometimes referred to as the rationalized unit. If you don't like that, maybe you would prefer the electrostatic unit:

ONE GILBERT (ESU) =

$$\frac{10}{\{4\pi\}}$$ AMPERE TURNS (RATIONALIZED MKS)

= 7.957747155 x ampere turns

If you are studying a book on magnetics, and you are taking a class in the same subject, you have to be able to convert (rapidly) from one unit to another or you can quickly get lost in a fog.

I only discussed magnetomotive force. You have the same range of units for magnetic intensity and reluctance. That's just for starters. Designers of technician courses took the easy path - just don't mention it. Is it any wonder that Johnny can't understand magnetics?

Measuring magnetism

Let's say you want to wade through all of that mess of units and you still want to study magnetism. You find a summer course is being taught in Bobo, Ohio. That course won't be worth the price of rocks in a potato patch if it doesn't have lab work that gives you experience in making measurements in magnetism.

To measure the strength of a magnetic field you will probably use a Hall device. See Figure 4. We have talked about it before. The magnetic field cuts through a small semiconductor slab. In a Hall device, electrons crowd to one side of that slab and create a voltage. The voltage is proportional to the strength of the magnetic field. You calibrate the instrument using a standard magnet.

Your next experiment is to prove that magnetic field intensity follows the "inverse square law." (Field strength decreases proportional to the square of the distance from the source.)

When you finally get through the course you decide to use your knowledge to hunt down a submarine in Lake Okeechobee by sensing the changes it makes in the earth's magnetic field. Also, you are going to measure the strength of the magnetic field using your home-built Hall instrument. You go to the surplus store and buy a Magnetic Anomaly Detector (MAD). You connect it to your friend's small plane and the two of you are off (really!) to Lake Okeechobee to hunt down a submarine.

MAD equipment measures the deflection (anomaly) in the earth's magnetic field caused by the metal in the submarine. Armed with the equipment and the inverse square law you find: nothing. For one thing, the inverse square law is not true when the length of the magnet is at least three times longer than its width. Actually, the inverse cube law applies.

Second, submarine captains know the vector of the sub's magnetic field. It is at an angle through the sub as shown in Figure 5. So, the captain aligns the sub so that it partially cancels the earth's field. Therefore, there is no anomaly.

A third possibility, and this may be a very important factor, there are no submarines in Lake Okeechobee.

The reason I'm telling you is this: even if someone is well trained in magnetism, there are so many factors in a practical application that the intense training can be nearly useless.

The nuclear precision magnetometer

Let me tell you about a better way of measuring anomalies of a magnetic field. It is called a Nuclear Precision Magnetometer. Here is how it works - the magnetic field of a gas is aligned with a known magnetic field from a coil. Then, the coil current is quickly shut off and the gas molecules align themselves to the unknown magnetic field. The time it takes for the gas molecules to align themselves to the unknown field is measured and calibrated in field strength. That device is so sensitive that it can detect the presence of an underground iron ore deposit in a forest. I'm told that was actually done in Brazil.

Well, if it is so sensitive why don't they use it for brain scans to look at the iron in people's blood?

Well, they do that - calling it Magnetic Resonance Image (MRI). They had to change the name from Nuclear Magnetic Resonance (NMR) because of people's adverse reaction to the word nuclear. (Anyway, that's my interpretation of the name change.) ■

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RCA color TV Model CTC168-S4
Sharp color TV models 20C-S100 & 20C-S120
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Sharp VCR Model VC-H946U, VC-H948U
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VCR Model VT-F350A, VT-F351A, AW	3112	Feb 94
Model 35UX80B/CZ58 35UX70B/CZ57 color TV	3146	Jan 97
Model VT-F390A/F391A VCR	3149	May 97
Model VM-2400A (U,PX), AW VCR	3115	May 94
Model VM-1700A (U,C) VCR	3120	Oct 94
Models VT-F380Z/F381A,VT-F382A/F385A VCR	3121	Nov 94
Mods. VM-2700A, VM-3700A (U,C) Vid. cam./rec.	3118	Aug 94
Model VM-1600A VCR	Special	1994/95
Model VT-F482A VCR	3125	Mar 95
Models 50UX 18B/19K projection television 46UX 16B/17K	3127	Jun 95
Model VT-UX605A VCR	3135	Feb 96
Model VM-E25A video camera	Special	1996/97
IBM		
Model 8503 Monochrome Display	Special	1993/94
MAGNAVOX		
Model RD0945C101, RD0946T101 color TV	Special	1993/94
MEMOREX		
Catalog Number 16-163 Pocketvision 26 TV	Special	1992/93
Model CD-3360 Portable CD Player	Special	1992/93
Model 29 VCR	Special	1992/93
Portavision 9-inch color VHF/UHF TV Monitor	3111	Jan 94
catalog no. 16-620 VCR	Special	1994/95
Model 127 Moviecorder	3145	Dec 96
MITSUBISHI		
Model CS-3535R/CK-3535R CS3135R/CK3136R color TV	Special	1992/93
Model HS-U55 VCR	Special	1992/93
NAP		
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
series 19C2 chassis (Magnavox) color TV	3039	Jan 89
chassis E34-11 color TV	3042	Mar 89
chassis E54-15 color TV	3049	Jun 89
(Magnavox RD8518 and RD8520; Philco Model P8190S; Sylvania PSC410 and PSC420)		
PANASONIC		
Model SR400EK color TV	Special	1992/93
Model CTM1353R color TV	Special	1993/94
Models PV-4962, PV4941-K PV4960-K VCR	Special	1994/95
Model CTM-2092S Chassis ALEDP203	Special	1995/96
VCR Model PV-4066	Special	1996/97
JC PENNEY		
Model 2003 color TV	Special	1993/94
Model 2163 TV/VCR	Special	1994/95
Model 2163 combination	3128	Jul 95
Model 1048/1049 color TV	3133	Dec 95
Model 2157 TV	Special	1995/96
Model 2294 TV	Special	1995/96
Model 2307 color TV	3140	Jul 96
Model 2158 color TV	Special	1996/97
Model 2509 color TV	Special	1996/97
RCA		
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	3048	Jun 89
(additional Models: RVM46700, 46GW700, P46000)		

	Profax #	Month/Year
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
CTC176 chassis color TV	3108	Oct 93
CTC175 chassis color TV	Special	1993/94
Model CTC 168-S4 color TV	Special	1994/95
Model VR530 VCR	3126	Apr/May 95
RCA/GE (Thomson Consumer Electronics)		
CTC145/146 chassis color TV	3040	Feb 89
CTC145/146 color TV	3058	Nov 89
CTC148/149-S2 chassis color TV	3062	Mar 90
TX81 chassis color TV	3067	Aug 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
CTC169 chassis color TV	3083	Dec 91
CTC168 chassis color TV	3084	Jan 92
CTC168-53 chassis color TV	3088	May 92
Model 7-7800A color TV	3091	Aug 92
TX82 chassis color TV	3092	Sep 92
Model VG4202 VCR	Special	1992/93
TX825 color TV	3116	Jun 94
TX825 color TV	3122	Dec 94
Model VR516 VCR	Special	1995/96
Models CC525, CPS014, CPS015 color camcorder	Special	1995/96
TV AM radio cassette combination Model 7-7800A	Special	1995/96
Model CTC187 color TV	3130	Sep 95
Model VG2030 VCR	3132	Nov 95
Model VR321 VCR	3137	Apr 96
CTC177 color TV	3143	Oct 96
Model VR520/523 VCR	3144	Nov 96
Model PTK171 projection TV	Special	1996/97
Model PTK171 VCR	3147	Feb/Mar 97
Model VR71HF VCR	3150	Jul 97
Model CC710 color camcorder	3153	Sep 97
Model CTC170 color TV	3155	Nov 97
SHARP		
Model 13C-M100 color TV	3093	Oct 92
Model 27C-5200 color TV	3094	Nov 92
Model 27SV65 color TV	Special	1992/93
Model 19E-M50	3110	Dec 93
Model 19E-M40R, 19E-M50R color TV	3107	Sep 93
Model 20C-5300 color TV	3096	Jan 93
Model 20C-S200 color TV	3099	Mar 93
Model 20SB65 color TV	3103	May 93
25S1 chassis color TV	3097	Feb 93
Model 27SV70	3101	Apr 93
Sigma 9700 chassis color TV	Special	1993/94
Model VC-A45U VCR	3098	Feb 93
Model VC-A504U/C VCR	3104	Jun 93
Model VC-H86U/C VCR	3100	Mar 93
Model VC-H87U/C VCR	3106	Aug 93
Model VC-H870U/C, VC-8870U/C VCR	3102	May 93
Model VC-H903U/C, VC-H904U/C VCR	3105	Jul 93
Model 20SB55, chassis No. 20R1 VCR	3113	Mar 94
Models 13F-M40, 13F-M50, 13F-M100, 13F-M150	3117	Jul 94
Models 25F-M40/50/100/120, chassis No SN 41	3119	Sep 94
Models 20C-S100, 20C-S120 color TV	Special	1994/95
Models VC-A502U, VC-A506U, VC-A507U VCR	3123	Jan 95
Model 19TF30, Chassis SN40a color TV	3124	Feb 95
Model VC-H925U/H927U VCR	3129	Aug 95
Model 13VT-F40/13VT-F100 Models 20VT-G60, 20VT-G100 TV/VCR combination	3131	Sep 95
20VT-G200, Chassis VN-51 TV/VCR combination	Special	1995/96
Model VC-H946U, VC-H948U VCR	Special	1995/96
Model 25E-M100, 25E-M120 color TV	3138	May 96
Model 27VS-G300 TV/VCR combination	3139	Jun 96
Models VC-A555, 556, VC-H955, 956, 958U VCR	3142	Sep 96
Model 20C-V300 TV/VCR combination	Special	1996/97
Models 27H-S200 CH27S20 color TV	3148	Apr 97
Model 25H-M100 color TV	3149	Jun 97
Models 20VT-H60, 20VT-H200 20VT-CH6 TV/VCR combination	3151	Aug 97
Models VC-A25U,C A55U, C VCR	3156	Dec 97
TATUNG		
color monitor	Special	1994/95
TOSHIBA		
Model CF2077A: CX21772 color TV	Special	1992/93
Model M222, M222C, M227C, M227L VCR	Special	1993/94
Model SV-F990 VCR	Special	1994/95
Model CF2771A TV	Special	1995/96
Models 6F35661, CX37662 color TV	Special	1996/97

	Profax #	Month/Year
Model M-651/651C VCR	3154	Oct 97
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
CM-140/b-2(G) chassis color TV	3041	Feb 89
CM-14-0/B-3(1) color TV (Models SE2721H/SE2725R/SE2727H)	3046	May 89
CM-140/B-2(I) color TV	3053	Aug 89
PV4661H rear-projector color TV	3056	Oct 89
CM-140/DIGITAL(C) chassis color TV (Models SE3135P/SE3191H/SE3535H/ ZB2771H/ZB2771H2/ZB2777H/ ZB2777H2/ZB2797P/ZB2797P2/ZB2797Y/ ZB2797Y2/ZB3193H/ ZB3193Y/ ZB3539T/ZB3539Y)	3059	Dec 89
CM-139/B1 (Y) and (K) color TV Receivers	3061	Feb 90
Models SD2097S (Y) and SD1327W3, SD1327Y, SD1327Y3(K)		
PV-140/Digital (G)	3064	May 90
Rear Proj. digital TV receiver. Zenith surround stereo system		
PV454-1P chassis color TV	3066	Jul 90
CM-139/B2 Models SD5545, SD5535, SD555G	Special	1992/93
Model CM-139/B-1 color TV	Special	1994/95
CM143/digital (A)	Special	1994/95
L-line C-8 Chassis TV	Special	1995/96
Model SD2501W, SD2509H color TV	Special	1995/96
Model PV-144 wall projector	3134	Jan 96
Model CM-142 digital direct view	3136	Mar 96
Model CM142/C-1 color TV	3141	Aug 96
J-Line Model PV-143 digital color TV	Special	1996/97
Models S1322S, SMS1324S/X, SMS1325S color TV	Special	1996/97

LITERATURE

Serial communications catalog

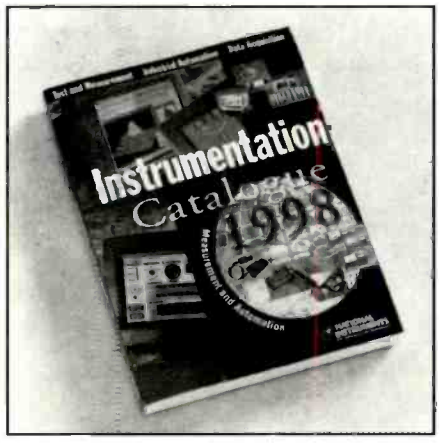
B&B Electronics announces their 48-page full color catalog #23 containing 34 new products including expanded sections of data acquisition equipment and products for fiber optic communications installation and testing.

New products include a device to allow USB port PCs to be used with existing parallel port equipment, several ultra-compact data loggers able to capture over 16,000 readings before they are downloaded and reset, and two new watchdog timers to reset locked-up PCs.

Circle (100) on Reply Card

Instrumentation catalog

National Instruments announced today its new, full-color 1998 Instrumentation Catalog. The free, 864-page catalog details more than 600 software and hardware products that engineers and scientists use to develop integrated, computer-based systems for measurement and automation applications. The catalog includes tutorials on data acquisition, GPIB, VXI, and industrial communications; product line overviews; selection guides - all designed to help readers increase productivity and save money with virtual instrumentation.



New product highlights include PXI modular instrumentation; Fieldpoint distributed I/O, computer-based instruments, and a new line of motion control products. The 1998 catalog also describes new versions of LabVIEW, LabWindows/CVI, HiQ, Lookout, and BridgeView application software products, as well as numerous new products.

The 1998 catalog features 14 sections; Instrumentation and Analysis Software, Portable Instrumentation, Data Acquisition, Signal Conditioning, Distributed I/O, Image Acquisition, Computer-Based Instruments, PXI/CompactPCI Modular Instrumentation, GPIB Instrument Control, VXI and VME, HMI/SCADA Software, Industrial Communications, and Customer Education and Support.

The catalog features comprehensive tutorials, complete with application examples to help readers learn more about using plug-in data acquisition (DAQ) systems, signal conditioning, HS488, PXI modular instrumentation, and OPC client and server products.

Circle (101) on Reply Card

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TEST EQUIPMENT. Nearly new **Tenma**: 100MHz Dual Trace Oscilloscope, $600; NTSC Generator, $150.00; Audio Generator, $100; True RMS DMM, $125; Auto Transformer, $75; RF Generator, $100. **Hakko**: 808 De-Solder Tool, $300. **B&K**: HV Probe, $75. Leader: 20MHz Oscilloscope, $200. Computer, Monitor and Printer with CDA Service Manager software: $650. All excellent condition. **Call Ron, 715-675-9878.**

Computer Monitor Service Information. Windows Tech-Tips Monitor Repair Software Program, over 800 Monitor Schematics, ESR IN-CIRCUIT capacitor tester, 8 position monitor splitter. Visa, Master Card, Amex Credit Cards Accepted. **MI Technologies Inc.** 937-335-4560, Fax: 937-339-6344, e-mail: mit335@bright.net, WEB http://www.mitechnologies.com.

TEST EQUIPMENT FOR SALE! VIEW COMPLETE LIST AT WEB SITE "a-mall.com" or call NOW to receive list by fax or mail. **AST GLOBAL ELECTRONICS.** Voice: 888-216-7159; Fax: 814-378-1176, e-mail:astmrktg@ wrench.toolcity.net.

TV CASE HISTORIES: Booklet with 2,825+ histories. Satisfaction assured. Only $56 (plus $3.00 for priority mail). **Mike's Repair Service**, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 33 years. Send SASE for samples. 410-272-4984,1-800-2-FIX TVS 11am-9pm. (or at http://www.netgsi.com/~mikesrs).

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

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FOR SALE

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

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

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Sencore VG91, like new, $1000.00, OBO. B&K Precision CRT tester, $100.00. Business closed. *Contact: Ron, 785-742-3081 (eve).*

Sencore CR70 and VA62 with NT64 signal generator. Original boxes and manuals. Large quantity of schematics/components. Going out of TV repairs. *Contact: Mike, 541-839-6609.*

Pair of Sony black and white cameras with hooded viewfinder and Sony TV zoom lens. Also, two carrying cases can be used for monitoring, video, etc, $160.00, OBO, plus shipping. *Contact: Maurer Television, 29 S. 4th Street, Lebanon, PA 17042.*

Sencore SG165 am/fm stereo analyzer, model with the power meters, new, in box, $300.00. Huge collection of old phonograph parts and adapters, inquire. *Contact: Fleischer's Service, PO Box 10744, So. Lake Tahoe, CA 96158, 916-541-5299.*

Approximately 1400 Sams PhotoFact folders (numbers below 1700) FREE to anyone who will come and get them (will not ship). Located in N.E. Texas. *Contact: 903-885-5170, e-mail: billstvs@koyote.com.*

Wideband 19" dish antenna (1.9GHz to 2.7GHz) with downconverter to TV. Includes coax cables, instructions and mounting hardware. Never used, $45.00. *Contact: J.C. Jensen, 303-733-1161.*

Sencore SC61 oscilloscope, $1200.00. VA62 with VC62, NT64 and EX231 accessories, $1200.00. CR70 CRT restorer, $800.00. PR57 Powerite, $300.00. *Contact: 505-327-2477.*

Free color consoles and table models. *Contact: Richard Gilman, PO Box 633 King City, CA 93930, 408-385-9248*

Sams photofact 100 through 1510. Make offer with or without cabinets. *Contact: Harold V. James 5903 W. Bogart Road, Castalia, OH 44824, 419-684-7622.*

Sencore SC61 scope, $900.00. Tektronix 2213 scope, $300.00 HP334A distortion analyzer $300.00. *Contact: Bud, 413-533-7566.*

Rider Radio Trouble Shooter Manuals, volumes 2 to 19, 17 manuals - 1933 to 1949. *Contact: 914-434-6232.*

Sencore SC3100 "Auto-Tracker," 100MHz oscilloscope. Still in original box, $2400.00. *Contact: Bill Ingrim, PO Box 3304 Kodiak, AK 99615, 907-486-2683.*

WANTED

Flyback transformer for RCA model PFR100 TV. Part no. 150043 or 156364. *Contact: Sam Marvosh, 702-456-9902, 702-456-9912 (fax).*

Ferrograph model RTS2 manual for wow and flutter, distortion analyzer. Will copy and return. *Contact: Bertrand Plouffe, 498 Fiset, Sorel, Quebec, Canada, J3P 3R6, 514-742-2921.*

AM/FM generator, distortion meter, variable ac supply (0V to 140V, 7.5A) laser power meter. Send information by fax. *Contact: 714-951-4703 (fax).*

MITS calculator as featured in the November 1971 issue of "Popular Electronics" magazine. Will settle for kit or assembly manual. Willing to pay decent finder's fee. *Contact: Donald Dupre, 401-737-7118, 401-886-3910, e-mail dgb@cherry-semi.com.*

Schematic for Grundig model 4670 tabletop radio. Will pay for copy and shipping. *Contact: Steve Zweifach, 9018 Greylock Street, Alexandria, VA 22308, 703-780-6708, e-mail: szweifac@apcl.com.*

Schematic diagram for Heathkit multimeter model IM-5284. Will pay. *Contact: Jens C. Jensen, 2667 S. Clayton Street, Denver, CO 80210, 303-733-1161.*

Emerson color model TS4451B, need yoke only. Yoke mounted on CRT A51EBD10X - CRT ok. No longer available from Emerson or any supplier. *Contact: Bill Risko, BRS Electronics, 1329 Twining Road, Drecher, PA 19025, 215-659-2349.*

Sharp 27G-S60 TV Chassis, chasssis number 5N-51 working or not. Board must be repairable. *Contact: Harold V. James, 5903 W. Bogart Road, Castalia, OH 44824, 419-684-7622.*

Tube technical manual. Version printed in or supplemented in the mid to late sixties, with all the "modern audio typical tubes," such as KT88, 811, 807, 6550, 300B, 5881, etc. My old Sylvania technical manual doesn't have all the supplements/pages. *Contact: Tome Jones, N5124 Highway Y, Jefferson, WI 53549, 920-699-3862 (phone/fax).*

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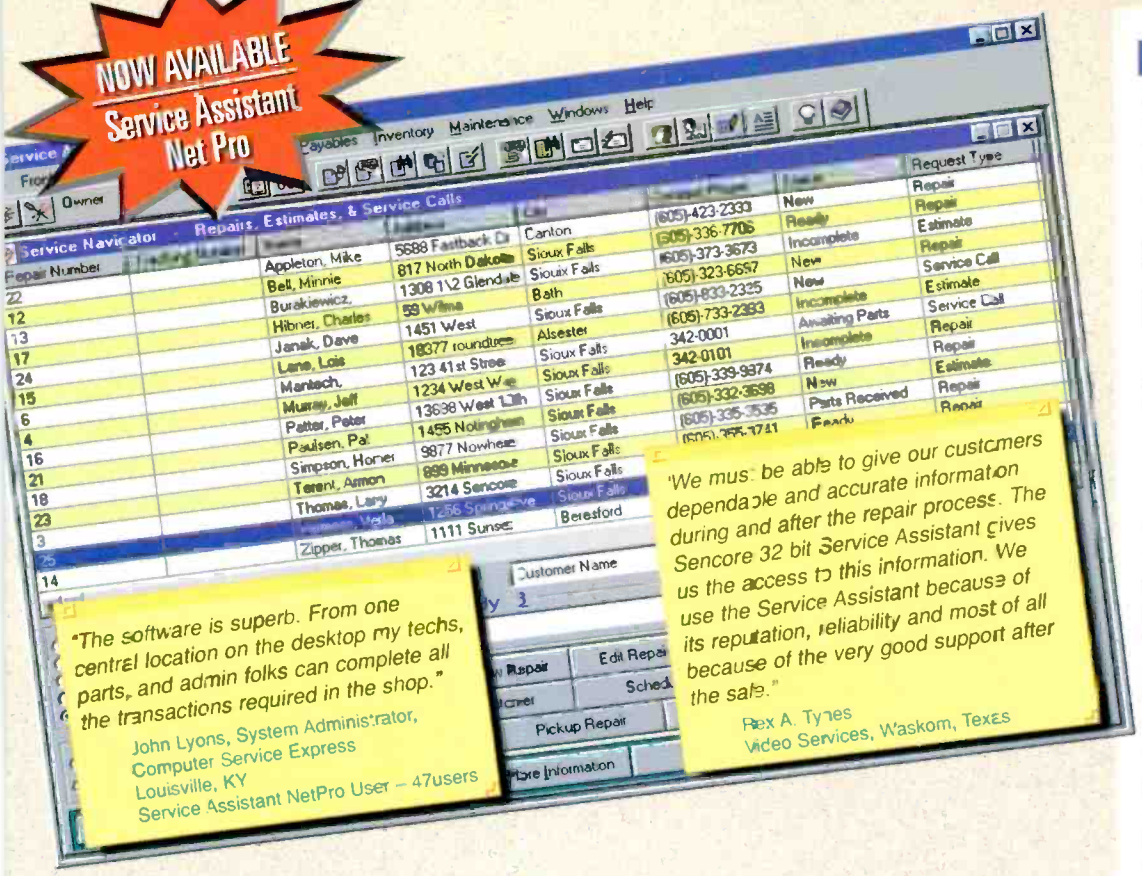

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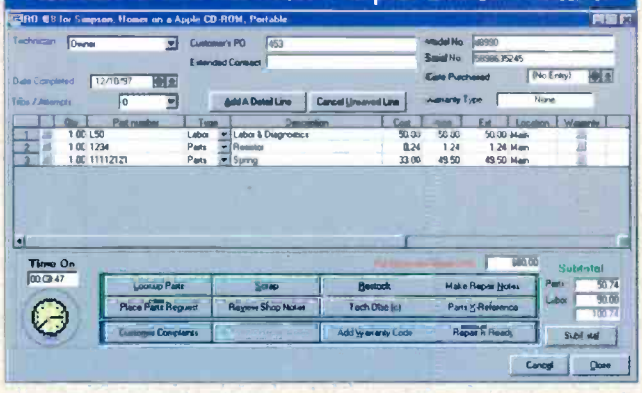

On-Site Training & Installation Available!!

Call 1-800-SENCORE or Details.

Service Assistant Net Pro by Sencore

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