

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

# ELECTRONIC<sup>T.M.</sup>

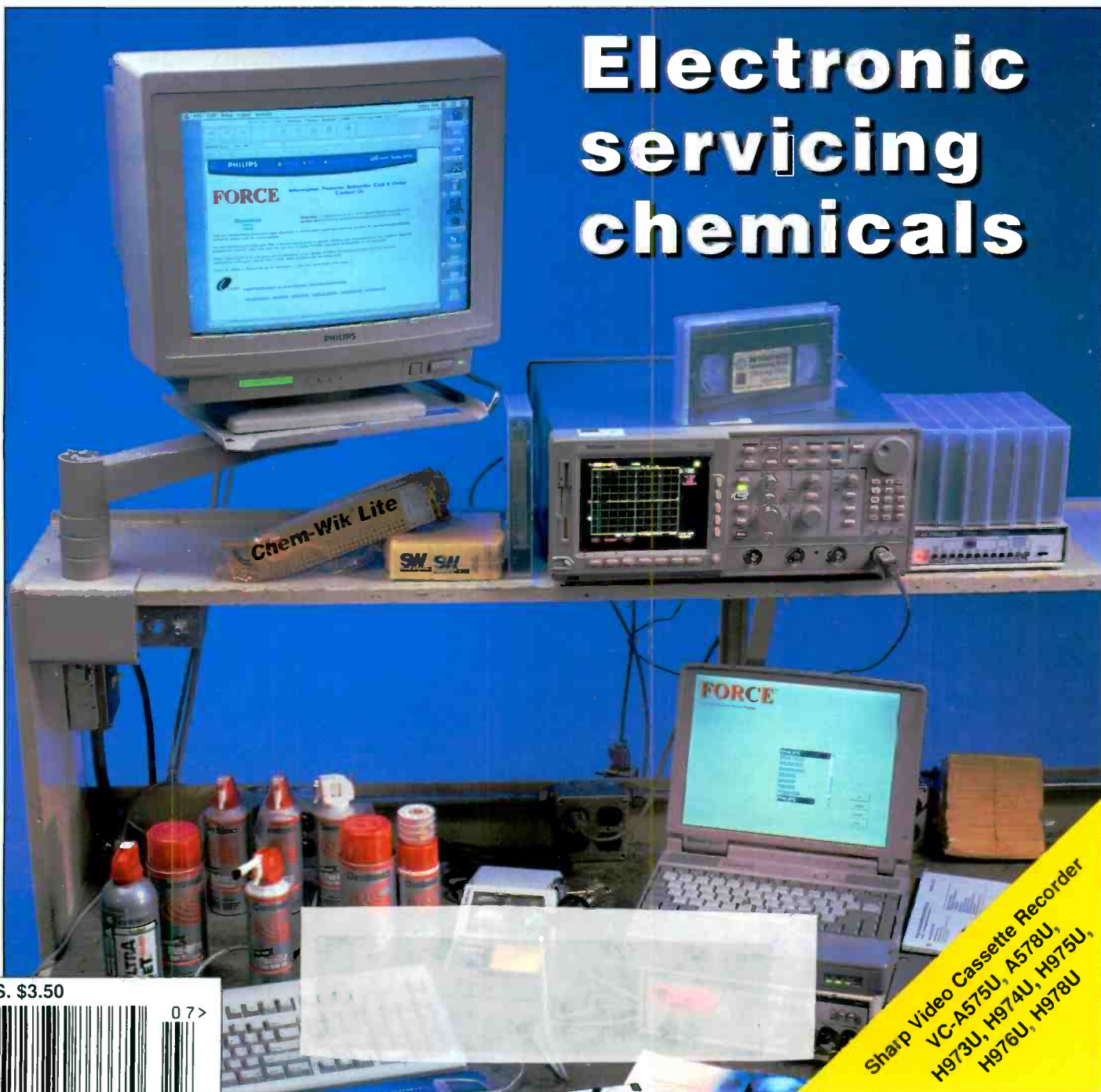
## Servicing & Technology

July 1998

How to start a computer repair job

High-definition television

# Electronic servicing chemicals



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# ELECTRONIC

Servicing & Technology

Volume 19, No.7 July, 1998

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A camcorder contains an impressive amount of mechanical and electronic hardware packed into a small amount of space. In order to make camcorder servicing profitable, the technician must be able to determine the cause of the problem quickly before dismantling the unit.

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*by John A. Ross*

When we combine the continuing convergence of technologies with sales and

the need for maintaining older systems, it becomes apparent that satellite television still provides opportunities for growth. This article gives helpful information on the different types of satellite television systems.

**50 VCR Service**

*by Ken Simmons*

A lot of us look at the VCR as one big mechanical monster. But in reality, it is just a combination of circuitry that we should already be familiar with. This article presents an overview of a VCR and how to troubleshoot and service problems that arise in each area of the unit.



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### ON THE COVER

Electronics servicing chemicals can help the technician during a service procedure in a number of ways: cleaning/degreasing dirty areas of the product, lubricating moving parts, restoring hardened, cracked, glazed rubber parts, cooling suspected defective components. It's important, however, when using servicing chemicals, to follow all of the manufacturers' directions concerning product, personal and environmental safety. (Photo courtesy Philips Software Development)



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are you  
**ready**  
to define the  
future of  
**HDTV**  
**repair**  
management



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## EDITORIAL

# Whither HDTV?

As with all new technology, the development of high-definition TV has progressed, at least to some extent, by fits and starts, and has had many detractors as well as champions. The technological developments that have led up to the HDTV system that will be used in the United States have been interesting to follow. For some time there were a number of high-tech companies working independently on HDTV, each having some success. Then at some point these companies banded together to form the so called "Grand Alliance." The HDTV system that these companies developed in concert is the one that will soon be delivering pictures to the homes of some citizens of the U.S.

Some detractors have said, in essence, that we don't need HDTV. For one thing, there's so little quality television programming available that almost none of it cries out for sharper visual images. No argument here. Of course we don't *need* HDTV. For the most part, we don't really *need* TV at all. Except for news and certain public information programs, TV isn't terribly informative or uplifting. But it's there, and millions of us watch it.

Other detractors have argued that there has been no general demand by the public for higher quality TV images, so why is HDTV being developed. I must admit that I don't quite understand that argument myself. Consumer electronics entertainment technology has never been particularly demand driven. At least that doesn't seem to me to be the case. When radio was introduced it wasn't because the public had noted a general lack of instant information delivery and had been clamoring for it. I suspect that the public had no idea that such things were even possible. Science and technology developed the ability to send sound over long distances via radio waves, and some enterprising people recognized that this was a way to reach lots of people, and the whole thing just sorta happened.

Similarly, when color television was developed, huge numbers of people saw no need for color. Oh, color was nice, of course, but why would anyone spend the extra money for a TV set that would receive pictures in color when black and white images are perfectly adequate? When was the last time you even contemplated buying a monochrome TV set; or serviced one?

High definition television is being introduced whether any of us, the viewing public, or the consumer electronics product service community likes it or not. Whether any of us thinks it's necessary or not. And programming for HDTV will be available before we know it. "If cable operators adhere to these standards and receivers are designed to support them,



all non-scrambled cable programs would be accessible by commercially available digital receivers without the need of a set-top box," said George Hanover, vice president of engineering for CEMA.

Moreover, according to at least some consumer research, consumers *are* demanding HDTV. The demand for digital high-definition television — and the variety of features it offers consumers — is real, according to recent focus group research conducted by the Verity Group and sponsored by the Consumer Electronics Manufacturers Association. Highlights of the study were released at the 1998 International CES, where manufacturers introduced commercial HDTV receivers for the very first time.

The focus groups targeted a broad base of opinions concentrating on consumers in two categories: 1. early adopters - those with a high awareness level of Digital and HDTV and enthusiasm about the digital TV transition, and 2. mainstream adopters — those with little knowledge or initial interest in the technology who own a wide variety of other consumer electronics. Together, these groups represent approximately 50 percent of the purchasers in the potential DTV market. Participants were shown a video and audio demonstration of the improvements offered by digital and high-definition television. When participants were shown an HDTV picture, the reaction was unanimously positive among all consumers, and virtually all strongly preferred HDTV to any lower-resolution digital sets. Early adopters especially preferred the wide screen presentation format of HDTV over today's sets.

Further evidence that HDTV is getting close comes from the manufacturers. Many manufacturers do in fact have HDTV sets, at least in prototype. Many HDTV sets were shown at the Consumer Electronics Show in Las Vegas in January.

And for those of us who aren't ready to spend \$5,000 to \$7,000 for an HDTV set in the short run, while the technology is still new and development costs have to be amortized, the manufacturers have promised set top boxes for a few hundred bucks that will convert the digital signal to an analog signal that a standard NTSC set will be able to display.

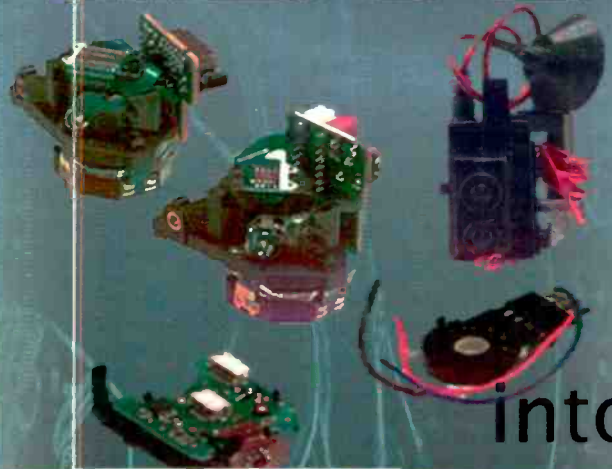
And in the long run, again for those of us who are unable, or unwilling to spend several thousand dollars for HDTV, there's time, during which the prices of HDTV sets will no doubt gradually come down to reasonable levels.

*Nile Conrad Penner*

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### Antennas go through the roof

*CEMA Group Focuses on Critical Link to our Digital Future*

Consider one of the most valuable consumer viewing investments, now and in the future. You may be surprised that it is an inexpensive, familiar piece of technology—the antenna. Antennas are making a modern comeback, increasingly used to receive terrestrial off-air local signals in conjunction with digital satellite TV systems, such as the Digital Satellite System (DSS), and may be the only way to receive a high-definition television (HDTV) signal when broadcasters begin transmitting HDTV signals.

Gary Shapiro, president of the Consumer Electronics Manufacturers Association stated, “Consumers are very comfortable with antennas. They have used them for decades, and more recently, with DSS. Now, the use of a simple indoor or outdoor antenna will allow almost every consumer in the U. S. to receive the full, rich HDTV signal. Until cable companies pass through a full HDTV signal, antennas may be the *only* way for consumers to experience the almost three-dimensional picture quality and digital surround-sound that HDTV offers and our research shows consumers want. And today’s antenna technology brings new, sleek, innovative designs that, in most cases, provide remarkable reception if the correct type of antenna is being used.”

The consumer’s option of receiving free TV via antennas is one of the primary reasons the CEMA recently organized an Antenna Subdivision of the CEMA Accessories Division. The group, formed out of an increasing need for industry consistency in this burgeoning business, is dedicated to promoting the growth of the antenna market by coordinating and energizing the technical and market development activities of broadcasters and receiver/reception systems manufacturers and distributors. One of the immediate missions of the subdivision is to develop industry solutions for effective merchandising of satellite and local reception antenna systems. A key element of this program is to teach consumer electronics retail salespeople how to use

new, voluntary antenna specification standards, and a corresponding color-coded local reception map that is currently under development.

The map, being created for 211 U.S. demographic market areas, is a tool to help consumers select the appropriate category of antenna for their reception area. Other training materials, such as an antenna selector guide and store display materials, are under development as well, and it is expected that prototype materials may be rolled out to select retailers shortly.

Virtually all segments of the industry are represented in the Antenna Subdivision, including antenna manufacturers and even content programmers. This is the first time this industry has come together in this type of cooperative effort, and members include: Channel Master, DirecTV, Gemini Industries, Jasco Products, RDI Electronics, Recoton Corporation, Sony Electronics, Tandy Corporation, Terk Technologies, Thomson Consumer Electronics, U.S. Satellite Broadcasting, Winegard, and Zenith Electronics. The National Association of Broadcasters (NAB) and the Satellite Broadcasting and Communications Association (SBCA) have also provided technical assistance in support of the new antenna group.

### CEMA publishes common application language standard for home consumer electronics networks

By making the common application language (CAL) independent of its original use as the CEBus® command language, the CEBus Technical Steering Committee opened the door for the Consumer Electronics Manufacturers Association’s (CEMA) non-proprietary standard (now named EIA-721) to be used with important transport standards such as IEEE 1394. Divided into three parts, EIA-721 describes the basic framework of CAL (EIA-721.1), the contexts or main subsystems within a device supported by CAL (EIA-721.2), and the application layer for CAL (EIA-721.3).

Designed as a robust, general purpose command language not dedicated to any

particular function within the application layer, CAL provides for controlling network devices and allocating resources.

CEMA and its members developed the specifications for CAL while creating the CEBus home automation standard. EIA-721 now provides the framework for extending CAL to other home networking systems separate from the CEBus system.

### CEMA publishes AVBus standard for enhanced home theater networking

The Consumer Electronics Manufacturers Association (CEMA) has published ANSI/EIA-693, the Audio/Video Bus (AVBus) Physical Layer and Media Specification standard. The standard will provide consumers with: A simple way to interconnect audio, video and home theater products; the ability to carry all the common control messages needed to set up a home theater or multimedia system, and; an easy way for all the interconnected units to share the audio, video and data on the system.

For example, with one keystroke (or by simply inserting a videocassette or DVD), the system can configure itself to turn on the TV and adjust the audio and video components to receive their signals in the proper formats.

“Completion of the AVBus standard represents a significant milestone in the TV, VCR and cable industries. It marks the first application of the powerful CEBus® standard in these industries,” commented Bill Lagoni, chair of the CEMA engineering group R.4 and manager of product reliability at Thomson Consumer Electronics. “With the versatile Common Application Language (CAL), analog connectivity and interoperability are supported, and a model has been set for digital audio and video buses. The AVBus already has been used by CEMA and the NCTA (National Cable Television Association) in their development of a decoder interface, which is part of the cable-ready definition proposed to the FCC.”

The purpose of EIA-693 is to present all of the information necessary to an AV

*(Continued on page 60)*

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

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# LITERATURE



## Test and measurement instrument guide

Herman H. Sticht Company has issued their latest purchasing guide. The guide contains 80 pages with information and specifications on the company's complete line of hand held and stationary tachometers, frequency meters, running time meters, insulation testers, stroboscopes, controllers, static eliminators and more. In addition the catalog presents information on multimeters and test instruments by manufacturers worldwide.

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## Books catalog

Howard W. Sams & Company announces the release of its 1998 PROMPT Publications book catalog. This 48-page offering features titles from PROMPT Publications, Butterworth-Heinemann, Macmillan Computer Publishing, and UCANDO Educational Videos.

Along with many new books, the 1998 catalog features new editions of some well-established classics available for all electronics hobbyists, students, and professional technicians. Updated titles include the second editions of *Real-World Interfacing with Your PC*, *Power Supplies*, and *The Phone Book*, along with the sixth edition of the *Modern Dictionary of Electronics* and the eighth edition of *Upgrading and Repairing PCs*.

Besides the catalog and its updates, you can stay in touch with the publisher's happenings through our Web site at <http://www.hsams.com>. This fully interactive site provides guests with complete book summaries, new release dates, product updates, and order information.

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## Instrument and software catalog

Fluke is now offering its 1997/1998 Instrumentation Catalog. The new 240-page catalog presents Fluke's full range of instruments, accessories and software for test and measurement, calibration, data acquisition, network testing, and many other application areas.

The catalog offers a variety of new products and made improvements to several others. A brief overview of the latest and most popular products is featured in the Product Highlights section at the beginning of the catalog. The remainder of the catalog is subdivided into application-related categories, making it easy for users to find what they need.

In addition to the catalog, the company also has dedicated product catalogs, such as Test Tools, Electrical/HVAC/R, Data Acquisition, and Network Test Tools catalogs that offer detailed information about the tools for specific applications.

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## Product information on CD-ROM

Micronas Intermetall, a European supplier of highly integrated circuits for

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# Electronics servicing chemicals

by the ES&T Staff

One of the delights of being a consumer electronics servicing technician is the variety of problems that a product can experience, and the almost infinite variety of possible ways to attack and solve the problem. Where a production line worker may stand or sit in one place, hour after hour, assembling one segment of a product, over and over again, the service technician will most likely work on several different brands, types, and models of product. Moreover, the type of problem that requires service will, in most cases, be different from unit to unit, and the service procedure will be different in each case. The service technician ordinarily gets to exercise a great amount of creativity in getting the job done.

## How do consumer electronics products fail?

Consumer electronics products such as TVs, VCRs, compact disc players and personal computers, fail for a variety of reasons. In some cases, some component that may have been weak, or slightly damaged, during manufacture fails and has to be replaced. A power surge or spike, perhaps caused by a lightning strike on the power line, antenna or cable, might have caused damage to connected components. In some cases the problem is a part that no longer rotates freely because of lubricant that has gotten old and stiff, or contaminated with dirt and/or dust. In still other cases, a mechanism may fail to operate properly because a rubber part has gotten old and stiff or glazed.

Of course, the technician's job is to somehow determine exactly what it is that has caused a particular product to fail, or to operate improperly, and to correct the cause of the problem thus restoring proper operation. Sometimes this is a simple procedure, and sometimes it is anything but simple. Fortunately, the technician has a vast and growing arsenal of weapons with which to diagnose and repair problems in consumer electronics products: oscilloscopes, DMMs, signal generators, variable transformers, isolation transformers, logic pulsers and probes, to name just a few pieces of test equipment. And

when the problem turns out to be a bearing that's dirty or needs lubricant, or a dirty video or audio head, or even an intermittent, thermally-dependent, component failure, chemical companies offer a host of chemical weapons that a technician can turn to, to help get the job done.

## Consumer electronics servicing chemicals

There are so many areas in consumer electronics products where a spray of cleaner here, a drop of oil there, or application of rubber restorer, can restore a useless unit back to the provider of entertainment that it once was for the owner, that a number of companies specialize just in this type of chemical product. Many of these products are available in a number of forms, depending on the particular application. For example, some cleaners may be available in bulk form to be used by the technician with applicators he provides, or in aerosol spray form, or even in presaturated swabs and/or wipes.

The form of any of these products that would be most useful to a particular service center would depend on how that company goes about product service. For example, in a large service center that performs a great deal of service on products such as VCRs, camcorders, CD players and other electromechanical products, it might make sense to have one or two technicians armed with bulk chemical products who do nothing but clean and lubricate the mechanisms in these products. In a smaller service center that does far fewer of these units, it might make sense to have on hand presaturated wipes or swabs that can be opened and used quickly and then discarded.

## Uses of the chemicals

Following is a partial list of the chemicals offered by most of the major suppliers of chemicals to consumer electronics service centers:

- Cleaners/degreasers
- Defluxers
- Dusters
- Freeze spray
- Static control products

---

*“Most of those chemicals used frequently in the service center look pretty innocuous in their brightly colored cans, and used properly pose no threat to the materials they're used on....”*

---

- Solder
- Desoldering braid
- Swabs and wipes
- Lubricants
- Adhesives
- Rubber/platen restorers
- Flexible keypad contact restorers
- Non-contaminating hand lotions

## Precautions

Most of those chemicals used frequently in the service center look pretty innocuous in their brightly colored cans, and used properly pose no threat to the materials they're used on, the people using the product, or the environment. But a service technician should never lose sight of the fact that some of those chemicals can be quite hazardous if used improperly.

Some of the chemicals are quite flammable, and could lead to burns, or even start a fire if used improperly. Some of the chemicals, even if they're pretty much inert, can displace air if released in large enough quantities, leading to unconsciousness or even death.

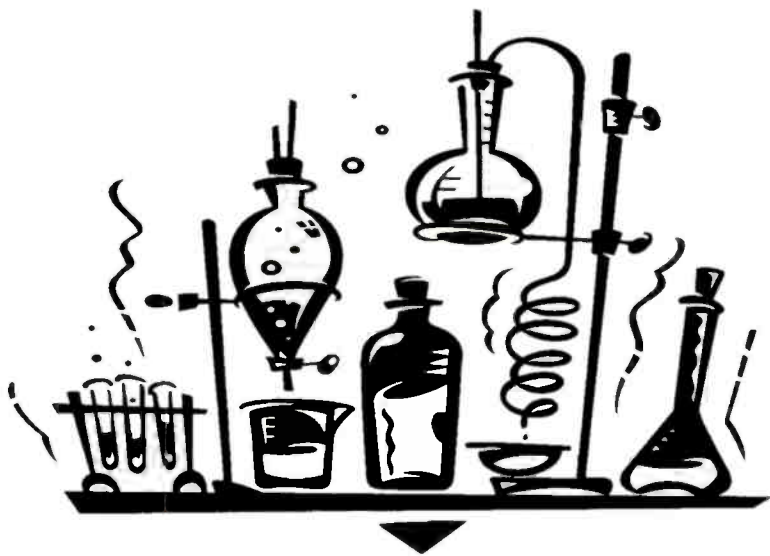
Here are some quotes on personal hazards from a material safety data sheet provided by a manufacturer of chemicals for one of their cleaning products. The product is a liquid that is a mixture of a number of organic compounds:

**Emergency Overview:** Clear, colorless liquid with mild hydrocarbon odor. This product is extremely flammable. Liquid will irritate eyes and skin under repeated or prolonged exposure. Breathing high concentrations of product may produce drowsiness and a headache.

### Potential Health Effects:

**Eyes:** Liquid and vapors of this product are irritating and can cause pain, tearing, reddening and swelling accompanied by a stinging sensation.





*"The key to using chemicals successfully, as with any other of the products used in product service, is to understand their benefits, their limitations and their hazards and apply them accordingly."*

**Skin:** Contact causes skin irritation.  
**Ingestion:** Harmful if swallowed. Irritating to the mouth, throat and stomach. May cause vomiting.  
**Inhalation:** Harmful if inhaled. High concentrations in immediate area can displace oxygen and cause dizziness, unconsciousness and even death, with longer exposure. Keep people away from such vapors without self-contained breathing apparatus. Pre-existing medical conditions aggravated by exposure: Heart, lung, skin, eye.  
**Handling and storage:** Avoid prolonged or repeated contact with skin, eyes or clothing. Wash hands before eating. Use with adequate ventilation. Avoid breathing product vapor. Do not reuse this container. Store in a cool dry place, away from heat, sparks or flames. Keep container tightly closed when not in use. Do not store in direct sunlight. Keep out of reach of children.

ness to the technician, damage to products or problems to the environment is to take the time to read the information provided by the manufacturer on any of these chemical products. This information is available in two forms: the technical data sheet (TDS) and the material safety data sheet (MSDS). The technical data sheet provides general information about the product, including compatibility with other materials, usage instructions, availability and environmental impact data. The material safety data sheet provides details on human safety including health effects, other safety data including flammability, and handling and storage.  
 When you buy one of these products, if they don't come with one or both of these data sheets, ask for them and read them carefully. If you are thinking about

using one of these products, but you're not sure what it can do, you can request this data from the manufacturer in advance. Some manufacturers provide a fax-back service such that you can call and, using the touch-tone keypad of the telephone request information on certain products. The documentation will be directed to a fax number that you specify.

The internet has also become a source of a great deal of information on manufacturers' products. As an example, during the research for this article, we found one chemical manufacturer's internet site on which it was possible to download individual MSDSs, or even, if preferred, to download a .zip file containing all of that manufacturer's MSDSs.

Chemicals provide the service technician with a lot of options for service. Used with care they can restore a dead product to life. The key to using chemicals successfully, as with any other of the products used in product service, is to understand their benefits, their limitations and their hazards and apply them accordingly. ■

And here's a quote from the technical data sheet for a cleaner degreaser that describes the adverse effects that might occur to certain materials when exposed to the product:

*Name of product* is generally compatible with most materials used in printed circuit board fabrication, except acrylics, ABS, polycarbonates and polystyrenes. With any cleaning agent, solvent/component compatibility must be determined on a non-critical area prior to use.

If a technician doesn't use this product carefully, he might wind up replacing some plastic parts on a TV or VCR.

**Manufacturers' data sheets**

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# How to start a computer repair job

by Victor Meeldjick  
Components Consultant for ES&T

If you have been repairing computers for a while, you automatically know what to do when confronted with a malfunctioning unit. However, for those of you without much experience here are some typical steps to begin to troubleshoot a computer problem.

In a previous article we discussed the steps to start a general repair. In this article we tailor that advice for computers. As with any repair, the first thing to do is to listen to the user.

## Initial symptom analysis

1. Was the computer operating normally and just failed, or there was a sequence of key steps entered and the computer locked up? If the latter, suspect some software interaction, especially if new software was just recently loaded into the computer and the problem never occurred before this installation.

2. Has this happened before and were the circumstances the same? If a program does not run properly after a different application has been used, System RAM memory may have stored material from the previous program, not allowing enough memory for the next program to operate. Turn the computer off and then on and run the application again.

3. Is the problem temperature related, does the computer act erratically until it warms up, or does it malfunction after it is warmed up? What is the room ambient temperature when the problem occurs; cold or hot? If the computer malfunctions after warm-up and the room is hot, suspect poor ventilation. Otherwise this problem may be caused by an intermittent connection.

4. Does the problem relate to the monitor or a peripheral; i.e., the printer or an external modem? Check all the cables at the back of each unit to see that they are properly connected, and that they do not appear frayed or worn. If any cable can be, or is, frequently flexed, especially

near the connector ends, wires may be broken. Make sure each peripheral is switched on if your system is connected to a master power controller.

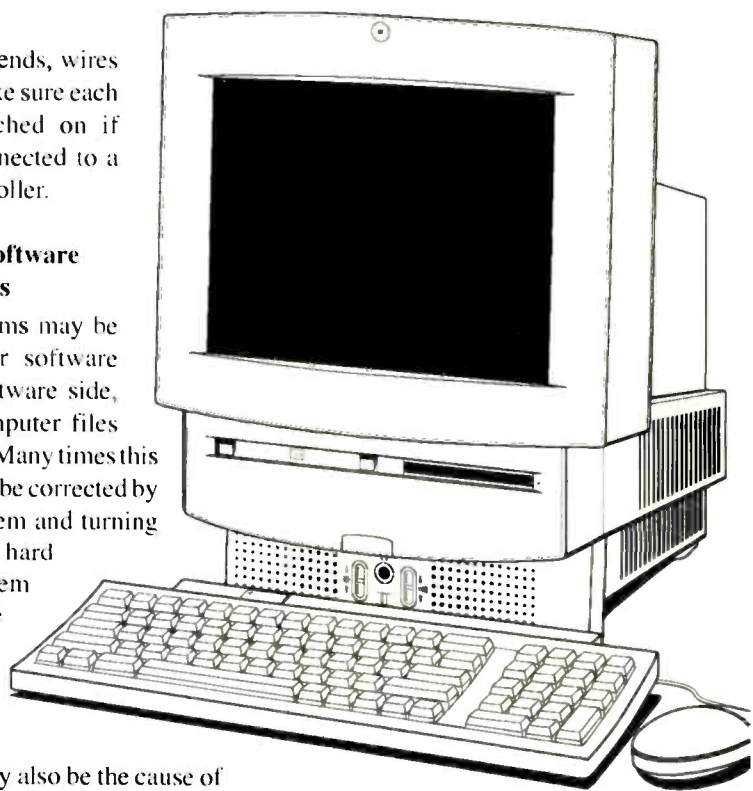
## Hardware vs software problems

Computer problems may be either hardware or software related. On the software side, sometimes the computer files become corrupted. Many times this type of problem can be corrected by turning off the system and turning it on again (a hard reboot). If the system still does not come up, try rebooting the system from a known good set of DOS disks.

New software may also be the cause of problems. Memory resident programs may be causing contention problems or new software requirements may disclose previously undetected system problems.

Note: some forms of DOS, such as the older NEC DOS 3.2, do not recognize the hard drive when you boot from the A drive. Use the newer Microsoft version of DOS (use the command VER to display the version of DOS used in the computer). Terminate and stay resident (TSR) programs may also conflict with some other existing software programs. If a TSR problem is suspected, try booting up the computer from a system floppy disk and try the program that previously worked before the TSR program was installed. If the computer again functions properly, edit out the new program from the AUTOEXEC.BAT file.

When new software is installed, the install program may also alter or erase the AUTOEXEC.BAT or CONFIG.SYS files (for DOS) or WIN.INI files for Windows. (If your system is working fine today make a copy of these files). The new software may also change the DOS PROMPT and PATH commands. If this happens, pro-



grams that worked before new software was installed may not work. Check the computer for AUTOEXEC.BAK and CONFIG.BAK files (or use stored floppy or tape back ups) which can be used to restore the original configuration of your computer. New software may not install because of an error in installation information on the setup directory. For example, one version of Microsoft Bob™ would not install from the CD-ROM because the setup file was not in the main directory but in the subdirectory MSBOB.

## Internal computer tests

When the computer is first turned on, an internal POST (Power-On Self Test) is automatically performed. The POST, located in the system BIOS ROM, runs numerous tests on the system including the system board (and microprocessor), RAM memory, floppy and hard drives, the keyboard, COM port and the video adaptor (and for the IBM XT the expansion unit). As the memory is being tested the memory size is displayed in the upper left hand corner of the screen. After

Meeldjick has been employed in the electronics industry for over 20 years.

the memory is tested you will see the floppy and hard drive lights briefly illuminate and drive noises will be heard. If the POST successfully completes, a short beep will be heard (some computers have two beep tones, an initial one to indicate if there are any major faults followed by a beep after POST has run).

If the computer seems to be operating properly, but there were no beep tones, the loudspeaker may be disconnected or damaged. If the POST fails, you will get either a blank screen, no beep or more than one beep, or an error message on the screen.

Usually after an error message is displayed the next line will show "ERROR (Resume = "F1" Key)". Some machines will display an error code while others will print out a plain language error message (such as Keyboard Error) if a key is depressed or the keyboard is unplugged or failed. If a code word is shown, consult your owners manual to see if there is a list that explains the codes. Pressing the F1 key will cause the computer to try to bypass the error and complete POST testing. If the POST completes you can run advanced diagnostics with a disk usually provided by the computer manufacturer.

### Common problems/solutions

If there is response when the computer is turned on, check the ac power-on light. If this light is not illuminated, check the system circuit breaker (if using a master controller to turn on the system), verify that the ac power cord is in place and that there is ac power available (try another appliance in the same outlet). If the problem has occurred after a power brownout, turn the computer off and then back on again to reset the power supply.

In IBM PC or PC/XT's the system will appear dead if the fault is in one of the first 11 POST tests; including a failed 16K RAM IC, which is in the critical bank of RAM (this type of software accounts for a reported 50% of all system dead mother board problems).

If the problem is a failed power supply, microprocessor, microprocessor support circuits, low memory, or a loaded down bus, there will not be a display. If the power supply fan is running, there is a chance that the power supply may be operational (the fan generally runs off a dc voltage generated by the power supply) and that the fault lies in the system mother board or plug-in cards.

If the fan is not running, look for a fuse and check it. If there is no visible fuse, it is located inside the power supply case. If you are mechanically inclined, after we discuss how to open the case you can remove the power supply and open it. The fuse is usually in a clip mounted on the power supply printed circuit board. If the fuse is open, and you note any burned components (or a burned smell) the supply has to be either repaired or replaced. If just the fuse is open, try replacing it with one of the same rating and type (do not use a larger one or a slow blowing model versus a fast blowing fuse).

### Beep tone but no screen display

If you hear a beep tone but there is no screen display, check the following:

- Connection to the video output card
- AC power to the monitor
- Monitor brightness control
- Monitor fuse
- Video output card

### Beep tone but no "C:\>" prompt

If you hear a beep tone, but there is no "C:\>:" prompt on the screen (that is if running DOS), try booting the system from the DOS disk in the A drive. After the hardware self-test and equipment checks, the computer looks for a boot record on the A drive, then the C drive. Thus even if the hard drive, or the DOS file on the hard drive, has been corrupted, the system can be booted from the A drive.

### No beep tone, or two beep tones and error messages

If you hear no beep tone, or two beep tones, and error messages appear on the screen, check:

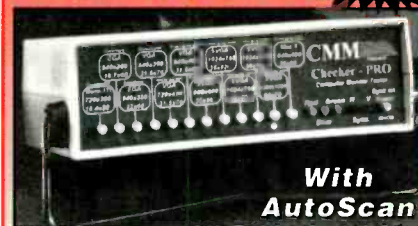
- connections to the area that has been identified as faulty (unplug and remate each connector).
- system jumper settings

### Computer, or peripherals act erratic

If the computer performs erratically, check that there are no other heavy electrical equipment items operating on the same line that may be a source of electrical noise in the circuit. Verify that the ground wire connection is good and that the area where the computer is not excessively hot (greater than 90° F or 32° C). Make sure that static electricity is not a problem around the computer.

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**Checker TV Pro...PRICE: \$499.95**

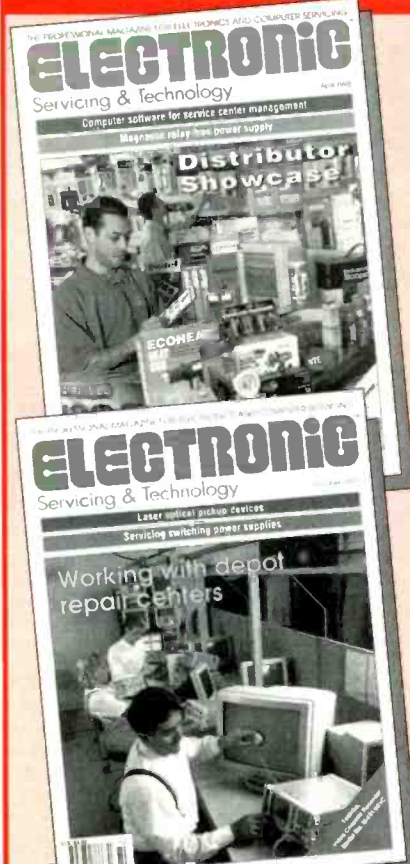
The TV Jr. is a small NTSC video generator, with colorbars, crosshatch with dots, white, red, blue, green, and black screens. Small enough to fit in your pocket, powerful enough to drive the largest projection TV!

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**Maintenance, Inc.**  
1-800-466-4411 • 770-662-5633  
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Consult the user manual on running system diagnostic tests. Systems usually have a set-up/diagnostic routine activated either by simultaneously pressing the CTRL-ALT-ESC keys (some computers such as Zenith microcomputers have a monitor diagnostic routine exercised by pressing the CTRL, ALT and INSERT keys), or by inserting a special disk into the A drive (such as with the IBM XT, AT and PS/2). These tests can be used to check the system board (BIOS, timer controller, etc), memory, hard and floppy drives, keyboard, video card, sound, ports, and math coprocessor.

## Opening the computer

If the system has a major fault and does not pass POST testing (no beep tone), or have a display, you need to open the computer. Record where all the cables are connected, turn off power, disconnect the power cable, printer or other peripheral cables and take the computer to a work area (Note: If your system is part of a network do not move it unless you are signed off the network and do not move the computer unless the hard drive has been parked using a software utility [the PC/XT diagnostic disk uses a SHIP-DISK.COM command] or by a automatic head parking system, which is on systems today. Consult your owner's manual to be sure about head parking).

## Once inside

As with any other repair, visually examine the inside of the unit looking for burned parts (or observe a burning smell). Check that all cables are secure. You may want to unmate and remate all connectors. Make sure all boards are seated properly. The easiest way to troubleshoot a system is by replacement of subassemblies. If the computer is totally inoperative (i.e., not even the fan is running), try operating the computer with either an external power source or swap in a new power supply. If the computer seems to be running, but there is no display or the display is distorted, connect a known good monitor, or swap the video card (Note: some computers may have the video circuitry on the mother board).

## Keyboard problems

If the system locks up and does not respond to the keyboard, try a reboot by pressing the CTRL-ALT-DEL keys

simultaneously. If this does not work, turn the computer power off and then on.

If a key is stuck, or something is pressing on a key during power up testing, a keyboard error message will be displayed on the screen. A key may be stuck down as a result of dropping the keyboard.

Other problems may be due to:

- loose keyboard connector
- broken wire in the keyboard cable (wiggle the wire and see if the symptoms change)

- incorrect keyboard switch setting (usually on the bottom of the keyboard AT vs XT settings or U.S. versus a foreign language setting)

- worn-out or dirty switches (vacuum the keyboard to remove loose dust/dirt)

- a blown fuse in the keyboard
- a failed component in the keyboard electronics

- foreign objects jamming keys
- spilled liquids

When replacing the keyboard, make sure the connector of the new one matches the one on the present keyboard.

### Floppy drive problems

If the floppy disk drive light does not illuminate, or illuminates but no activity noise is heard from the drive, open the computer and check cables going to the floppy drive. If a new or additional drive has just been installed make sure that the system configuration file (CONFIG.-SYS) has been changed to reflect this.

If you get a "General Failure" message verify that the density of the disk matches that of the drive (errors may also occur if a lower density disk was formatted to a higher density. For example, some floppy drives will allow a 720K, 3.5-inch, disk to be formatted to a 1.44M format. Since the disk will not have an index hole on the lower left corner, this disk may not be accepted by another machine). If using a new disk that is not formatted, this message will also occur.

High density drives can also be set to format at lower densities (for example a 1.2M drive can format disks to 360K). These disks may experience interchangeability problems because the physical head size of the 1.2M drive is much smaller

than the older 360K head. Many older 360K heads are not sensitive enough to read the information.

Finally, check to see that the disk is properly inserted into the drive. (Note: high capacity drives can format more than one type of disk. For example, a 1.44M drive can format to a 720K format. Use the size switch a:/F:720).

If you see the message "Error Writing to Disk" (or a "Can Not Create File" error), check to see that there is sufficient room on the disk to store files. In DOS you can use the CHKDSK command to do this. Also check and make certain that the write protect tab is up (hole covered) or the disk will be read only.

Some errors may occur because the disk drive heads are dirty. While some manufacturers recommend that the driveheads be cleaned after 100 hours of continuous use, this time frame is hard to estimate accurately, since the drives are not constantly used. Clean the heads when you have a problem. There are various disk cleaning products available. Check your local computer store.

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## Hardware and software diagnostic materials

There are various hardware and software packages that can be used to help diagnose computer problems. Some of the materials available are:

### Hardware:

Used when the system is dead or there is no monitor display. Passive hardware testers (or POST Cards) read and display the codes put out by the system BIOS ROM.

### Corporate Systems Center

Hammerwood Avenue  
Sunnyvale, CA 94089  
408-743-8750  
Fax: 408-745-1816  
<http://www.corpsys.com>  
Technician Support:  
FTP.corpsys.com  
techsupp@corpsys.com  
same phone/fax numbers as above.

- Hard Drive Bible with 1294 installation instructions, drive parameter tables, set-up information for hard, optical and tape drives. Data on jumper settings, controller card compatibility and driver software is also included. They also have a CDROM of major brand hard drive manufacturer technical manuals.

### Data Depot, Inc.

1710 Drew Street  
Clearwater, FL 34615-6213  
800-767-3424  
813-446-3402  
Fax: 813-443-4377  
<http://www.datadepo.com/home.sht>

- PocketPOST, FloppyTune, PC Check Diagnostic s/w, Printer Technician s/w, WhatCOM Modem installer, etc. (prices from \$34-\$299 for PocketPOST V2 card). PC clinic for OEMs. Company has free s/w downloads.

### ForeFront™ Direct

Post Oak Blvd, Suite 2050  
Houston, TX 77056  
800-475-5831  
713-961-1101  
<http://www.ffg.com>  
(formerly AllMicro, Inc.)

- PocketPost™ (XT, AT, 1360 ISA and EISA computers), Discovery Card™ resolves IRQ and DMA conflicts. The Troubleshooter, a self booting program. They also have

WebWhacker™ that speeds up Web browsers, GrabNet™ that drags and drops graphics and text from the web, WebSeeker™ a web search tool, ClickBook™ automatically reduces, rotates and paginates pages to make double sided documents on your printer.

### Landmark Research International Corp.

703 Grand Central St.  
Clearwater, FL 34616  
Sales: 800-683-6696  
Technical Support: 800-683-6854  
813-443-1331  
Fax: 813-443-6603  
(formerly Performance Computer Diagnostics)

- Kickstart, a power on 703 self test diagnostic card. Quarterdeck Direct.

### Micro 2000

1100 E. Broadway, Suite 301  
Glendale, CA 91205-1316  
818-547-0125  
1-800-864-8008  
<http://www.micro2000.com>

- POST PROBE diagnostic card with built in logic probe (list \$399).

### Tech-Assist, Inc.

11350 66th St., Suite 105  
Largo, FL 34643  
800-274-3785  
813-547-0499  
Fax: 800-226-5404  
Disk Fax: 813-547-0768  
[www.toolsthatwork.com](http://www.toolsthatwork.com)  
[info@toolsthatwork.com](mailto:info@toolsthatwork.com)

- (V 2.1) used by DoD to clean heads and recover data. Designed by Computer Peripheral Repair and Data Recovery Services, Inc. (\$299) Hard Disk Tech Specs (4.0) details on hard drives from over 90 mfrs includes controller card data. (\$299) Amnesia (3.0) puts hard drive specs on hard drive in case of battery/cmos failure. (\$229) PrinTrace a printer diagnostic program for over 600 printers with 11 standard tests. For DOS, Windows, OS/2. (\$129). Ramanalyzer (\$159).

### Track Mate

5209 Davis Blvd.  
Fort Worth, TX 76180  
817-281-1694, 8502, 1694

## Hard drive problems

A hard drive consists of an enclosed chamber that contains a head riding on a cushion of air about 4 microns over a disk platter coated with a magnetic oxide material (4 microns is very small, a human hair is 80 microns thick). Approximately 60%

to 70% of hard drive failures are electronic problems, about 25% of hard drive problems are mechanical and electrical problems and 6% to 7% of hard drive problems are caused by poor connections to the drive (and the drive is operating normally). Head crashes are relatively rare and are

usually caused by mishandling of the drive, dropping it to a hard surface or by a severe mechanical shock. Sometimes the drive head support may fail allowing the head to contact the platters.

Hard drive noises are usually caused by worn drive bearings (drive service life is

• Maintenance products for disk drives, etc. Tests disk drive heads and rotational speed. Cleans drive and reports the results (\$25-\$75).

**Ultra-X, Inc.**

P.O. Box 730010  
San Jose, CA 95173-0010  
800-722-3789  
408-988-4721  
Fax: 408-261-7077  
<http://www.ultra-x.com>

• Plug-In diagnostic cards, including POST cards (R.A.C.E.R. card).

**Vista Microsystems, Inc.**

6 Whipple Street  
N. Attleboro, MA 02760  
508-695-8459

• Plug in diagnostic hardware for motherboard trouble shooting V-ATE (variations list from \$995-\$1995).

**Windsor Technologies, Inc.**

130 Alto Street  
San Rafael, CA 94901-4768  
415-456-2200  
Fax: 415-456-2244  
<http://www.windsortech.com>  
[sales@windsortech.com](mailto:sales@windsortech.com)

• PC Technician, diagnostic software, Printer Technician printer test software, and Windsor Post, a diagnostic ROM module. List prices are \$395 for PC Technician, \$145 for Printer Technician and \$295 for Windsor POST.

**Software:**

**ForeFront™ Direct**

AT, 25400 US Highway 19N. #285  
Clearwater, FL 34623  
800-653-4933  
813-724-8994  
Fax: 813-726-6922  
(formerly AllMicro, Inc.)

• PocketPost™ (for XT, ISA and EISA computers, Discovery Card™, resolves IRQ and DMA conflicts, The Troubleshooter™ a self booting program. They also have WebWhacker™ that speeds up Web browsers, GrabNet™ that drags and drops graphics and text from the web, WebSeeker™ a web search tool, ClickBook™ automatically reduces, rotates

and paginates pages to make double sided documents on your printer.

**Landmark Research International Corp.**

703 Grand Central St.  
Clearwater, FL 34616  
800-683-6696  
813-443-1331  
Fax: 813-443-6603

• PC Certify, tests motherboard, memory, drives, ports, keyboard, video card, printer DOS Utils, (list \$228 with Disk Mgr) drive data recovery and hard drive diagnostics. PC Probe, does PC diagnostics, identifies weak RAM memory, and has virus protection. (prices range from \$249-\$585) WinProbe does diagnostics, automatic system optimizing (Price is \$99.00).

**Micro 2000**

1100 E. Broadway, Suite 301  
Glendale, CA 91205  
1-800-864-8008  
818-547-0125

• "Micro-Scope" software does low level formats, checks memory, hard drive, floppy drive, video card, etc. Can erase viruses. Micro-Scope is operating system independent.

**Sykes Enterprises, Inc.**

100 North Tampa St., Suite 3900  
Tampa, FL 33602  
800tosykes  
800-867-9537  
813-274-1000

<http://www.sykes.com/sa/diagsoft.html>  
(this company acquired Diagsoft in September 1996)  
• QApus/FE software tests all computer components.

**Symantec Corporation**

10201 Torre Avenue  
Cupertino, CA 95014-2132  
800-441-7234  
408-252-3570  
<http://www.symantec.com>

• Norton Utilities data recovery utility, etc. (list price \$179)  
Norton Antivirus (virus prevention, cures)  
(list price \$120) <http://www.norton.com>.

usually quoted to be 5 years), or a loose internal grounding spring. Both of these problems produce a chirping like noise. If you hear such a noise, the drive can generally be used long enough to back up all the information on it (use DOS XCOPY if you only have a few files on the drive,

or DOS BACKUP (and RESTORE) commands, or use a commercially available harddrive backup program).

The appearance of the message "Disk Boot Failure" or "Fixed Disk Failure" may be the symptom of either a hard drive or hard drive controller card failure. A

related problem, which can occur after a new drive has been installed, is the system requesting power up status faster than the drive can complete internal checks. The computer POST BIOS may only request status once or twice, and when no response is received, it will display an

error message. You will then be prompted to press a key to continue. A solution to this is to change the system from a fast boot mode, which does not give the drive enough time to do power-up diagnostics, to a standard boot mode.

Another problem with new drives, is failure of the system to boot when it is first turned on, followed by proper operation after a reset. This problem may occur because the power supply may not have enough power to spin the disk up to proper speed before a time out fault occurs.

If you get a "Sector Not Found," message, it may be because low-level formatting data is never rewritten and the magnetic field has faded until the disk controller can not find the sector. There are computer programs (such as SpinRite from Gibson Research Corporation in Laguna Hills, CA) that can non-destructively rewrite the low level format. It does this by temporarily storing the disk data in RAM memory while the hard drive is being formatted. The data is then put back on the drive. (Note: there are also software utilities, such as Norton Utilities (Symantec Corporation of Cupertino, CA), PC Tools (from Central Point Software Inc. in Beaverton OR), Symantec Utilities (by Symantec Corporation of Cupertino CA), or Delux First Aid Kit (from 1st Aid Software of Boston MA) that can restore files accidentally lost by high level formatting of your hard drive).

If the system does not boot from the hard drive but will boot from a floppy, and the hard drive is accessible the boot track needs to be restored. Use the DOS command SYS C:. If this does not work, back up the hard drive and do a FORMAT/S. (Note: To make a bootable DOS floppy disk use the command a:/S, also copy CONFIG.SYS and AUTOEXEC.BAT files (but call it AUTOEXEC.SAV as the hard drive file includes PATH commands that only work from a hard drive.)

### Monitor problems

If there appears to be some kind of monitor problem, but the beep tone was not heard at turn on, see "Opening the computer," above for possible solutions.

Monitor-related problems may be a result of the monitor or the video card. If there is no display, perform the following checks:

- Check for the presence of ac power to the monitor.

- Verify that the brightness and contrast controls seem to be properly set (not turned all the way down). Check all cables going to the monitor and the computer to see that they are properly connected.

- If either the monitor or the video card was replaced before the problem occurred, verify that the monitor and the card are compatible. For example. VGA card and VGA monitor) and that the card jumper settings are correct.

- If using a multisync monitor, verify that the monitor setting are correct. Check the monitor and video card.

If there is no display, and the monitor controls are set properly, try these diagnostic steps:

- Turn the brightness control all the way up, you should see a raster (faint sloping lines). If not, check for the presence of an external fuse. If there is none, the fuse is mounted inside the monitor.

- Turn the monitor off. Open the case (look for screws under decorative buttons, rubber plugs or under the monitor rubber feet). With the monitor open look for charred components or a burned smell.

- If the monitor-on light comes on momentarily when the computer is turned on, a short in the flyback is probably pulling down the monitor power supply which causes the supply to shut down. A major cause of failure of VGA and multisync monitors has been failure of the flyback transformer. On systems used without some sort of power conditioner, it is common to find a blown fuse and a failed voltage regulator due to power line transients (especially after a lightning storm).

- If you do see a raster, check the video card first and then the monitor.

- If the screen is blank when running a particular application program check to make sure that the program is set for the type of display you are using and the screen colors are such that text and background colors are not the same.

- If there is noise in the display, try rotating the brightness and contrast controls. If this affects the problem, the controls are dirty and need to be cleaned with some type of contact cleaner.

### Printers

If the printer does not turn on, and you

are using a master power controller, check the line cord, printer power switch, and the master controller switch for the printer. Check the printer fuse. If there is no external fuse, disconnect the power cable, remove the cover screws, open the printer and check the fuse. Look for burned parts or a burned smell.

If the printer does not print but it is on, displays no error messages and lights are illuminated, make sure that the printer has paper (the paper-out light should be off) and it is on-line (on-line light illuminated). For ribbon printers, check the ribbon and make sure it is not binding the print head (for a laser printer check for a low toner display). Check your printer manual on running diagnostic tests and verify that the program printer settings match the printer that is being used. Check all cables and printer configuration switch settings. Make sure that the printer port is the one being used by the software program (if this is a new printer installation make sure it is connected to the right port for a serial or parallel printer. Check the printer manual on setting up DOS MODE commands for serial printers).

With the computer at a C:\> or A:\> prompt, press the CTRL-P keys. This will slave the printer to the computer. Type a sentence on the computer and then press ENTER. The printer should print this sentence followed by "Bad Command or File Name". If this works, press CTRL-P keys again to unslave the printer (alternatively enter at the A:\> or C:\> LPT1 if the printer is connected to port 1 (or LTP2, LTP3 for the other ports). If this works, the cables are OK and the printer operates so the problem is program software related.

If this test does not work unplug and remate the printer connector that goes to the computer (do this on the computer end as well). If this still does not work, try a known good cable. If there are still problems, at the C:\> or A:\> prompt print a small file, type PRINT CONFIG.SYS. If this works, the problem is probably in the software you are using.

If the print quality is poor, check the ribbon, look for worn or broken ribbon drive gears, worn or loose belts, check for a dirty print head or damaged print head wires. On dot matrix printers, check the position of the print lever. If the paper feeds improperly, check that the paper



feed levers are in the proper position (check traction vs friction feed levers) and that there are no small bits of paper jamming the mechanism.

Check to make sure that the software in use is set for the printer being used and that all printer configuration switches are in their proper positions.

If your laser printer only prints half page of graphics the printer does not have enough memory to contain the whole image that has to be printed out. If the laser print quality is light, check for a low toner message. Remove the toner cartridge and tilt it from side to side. This will even out the toner in the cartridge and you can get some more use out of it. If there is a dark line running the length of page on all copies the laser printer drum is probably scratched and needs to be replaced (Note, in HP printers the drum is in the toner cartridge, just put in a new toner cartridge).

Printers generally have their own internal diagnostic routine, check the printer manual for details of how to use it.

### Modem Problems

Modem problems are generally related to one of three things:

- power problems
- the telephone line
- the serial port.

If you have just installed a new modem, and it dials out but does not respond to the incoming data, check the computer user manual to see if an internal DIP switch has to be reset. If cards are plugged into a bus that also has a COM port (some older NEC computers had preassigned COM1 and COM2 ports), the internal COM1 port has to be disabled if the modem card uses COM1.

For modem related problems check the following factors:

- Connections (make sure connectors mated properly)
- Power (if an external modem is used)
- The telephone line (make sure the line jack is connected to the line input)
- Volume control of the modem (may be set only by software commands, check the user manual).

If you have an external modem and have visual LED's if you do not get a dial tone but the RD (receive data) and SD (send data) lights flash, check the phone line and the phone jack contacts. If no

lights flash on the modem, check the connector on the modem.

### Virus problems

Virus problems came to national attention when in 1988 Robert Morris, a Cornell University student, infected Darpanet, the DOD's computer network with a software virus.

There are two types of viruses: boot-sector viruses and executable-file viruses. Boot sector viruses account for less than 10% of all known viruses, but are responsible for 90% of virus problems. Of the viruses in the office, 43% come from disks brought from home, 6% come from sales demos, 6% come from repair/service people and 3% come from new purchased software. The most common computer viruses are the Stoned Virus (42% of all virus problems) and the Jerusalem viruses (32%). The latter activates on Friday the 13th when it deletes files. There is also the Michelangelo virus, which received a lot of publicity in the early 1990's, and activates on Michelangelo's birthday, March 6. Most viruses take about 2 to 3 hours to recover from, but some especially malicious ones can keep your system down for as long as 60 hours while the virus is eradicated and data is reloaded.

At the IBM Anti-Virus Development Group at Yorktown Heights, NY, a Neural based IBM AntiVirus was created in 1994 that is an artificial immune system for computers. This program concentrates on boot-sector viruses where the network learns what bad things (i.e., the appearance of suspect code sectors) in the boot sector occur when a virus attacks. If when the suspect code sectors are counted and numerically weighted they exceed a certain threshold value of the neural net concludes that a virus is present on the disk. Viruses can then be eradicated before they do damage to system files.

To prevent virus problems, scan all software before using it to verify it is virus free and purchase new packages software vs used software. Be wary of software downloaded from shall private electronic bulletin boards. CompuServe, Prodigy, America Online and other major online services screen software for viruses. You should also have your virus program check your machine for viruses each time you turn on the computer. ■

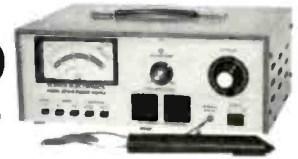
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# High-definition television

by John A. Ross

By 2006, the traditional method for transmitting and receiving television signals will give way to digital television. While 2006 may seem years away, several television stations in the United States have already begun digital broadcast tests. In November 1998, the four major commercial networks and the Public Broadcasting Service will transmit digital programs.

As high definition television has moved from concept to reality, analysts have said that the new format is the next great leap for television. Indeed, many of those analysts continue by saying that the size of the technological leap represented by the soon-to-happen introduction of the new technology equals or surpasses that of the initial introduction of television. A recent issue of *U.S. News and World Report* illustrates this by describing how high definition television can pick out the individual blades of grass from a lawn or show the individual seams of a football—as it moves through the air.

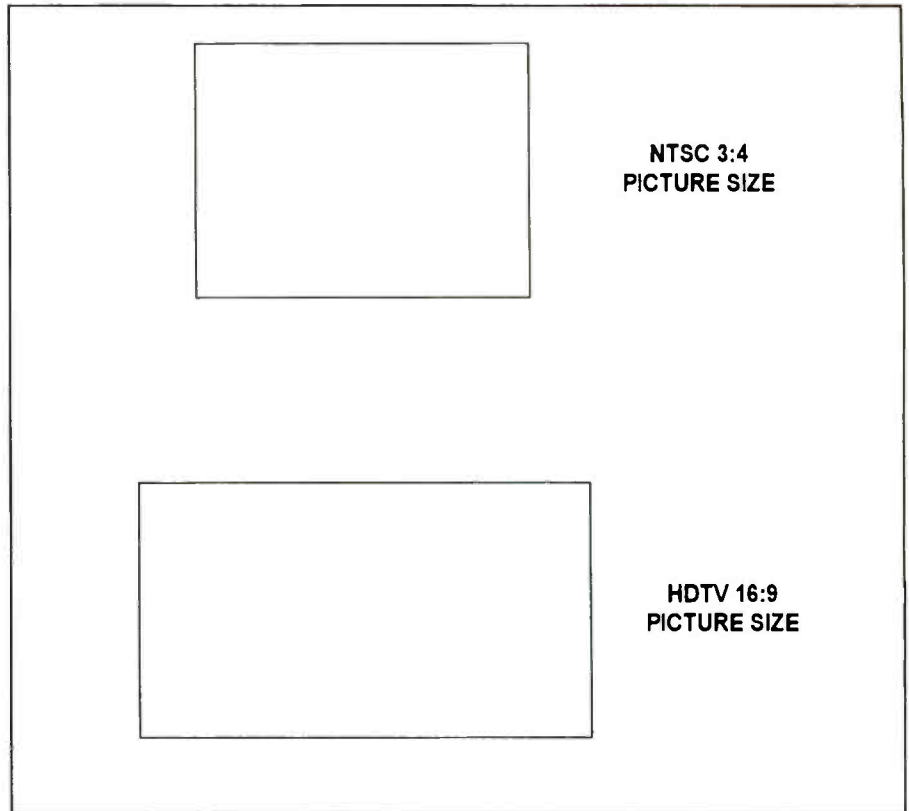
However, the promise of the new technology is dampened by higher consumer prices for high definition televisions, concerns about the possible degradation of digital signals in current cable systems, and internal industry conflicts over the formats used to transmit the signals.

When we consider that the present-day prices for a high definition television including a Dolby sound system range from \$7,000 to \$15,000, there is good reason to wonder about the future of the new technology. The potential for a slow start heightens when we find that current cable system technologies may not be able to pass the complete high-definition signal. In addition, the capability of HDTV to display not only television signals but also to provide access to digital information services and the World-Wide-Web hinges on the use of compatible scanning formats.

## Pixels and refresh rates

All this leads us to some basic discussions. When we talk about video displays,

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**Figure 1.** The NTSC standard picture has an aspect ratio, (the ratio of picture width to picture height) of 4:3, while the HDTV system establishes an aspect ratio of 16:9. Because of this, the viewer gains the capability to receive almost six times as much information. Moreover, the 16:9 HDTV aspect ratio is the same format that most moving pictures are filmed in, so films will be able to broadcast directly in HDTV, eliminating the need for "letterboxing," (reducing the picture height so the entire width fits the TV screen) or "pan and zoom" (selecting portions of the complete picture width of each scene during editing for TV so that it fits the NTSC screen format).

the ability of the display to show a clear image is defined through a constant called *dot pitch*. In any display, a *pixel* (picture element) consists of three individual red, blue and green dots. Dot pitch is the distance between the center points of adjacent horizontal pixels on the CRT screen. Most advertisements for video display monitors will list the dot pitch measurement in millimeters. Any video display that has a smaller distance between pixels will have a higher possible resolution. A lower dot pitch number, such as 0.28, shows that the dots are closer together than those seen with a 0.31 dot pitch.

Each line that results from the vertical and horizontal scanning of the CRT electron beam yields a set number of pixels. The longer horizontal lines will have more pixels than the shorter vertical lines. If the

specifications of a monitor list a resolution of 640 x 480 pixels, the horizontal scan lines show 640 pixels while the vertical line shows 480 pixels. Multiplying the two figures together gives us the total number of pixels that the raster will display. In this case, the total number of pixels that will be displayed is 307200. Since the number of pixels that can be displayed depends on the deflection signals, varying the horizontal scan rate also varies the number of displayable pixels.

Televisions and older computer monitor designs have a horizontal frequency of 15,734kHz. Newer computer monitor standards and the new high definition television standards use horizontal sync signals of 21.80kHz, 31.50kHz and 35kHz. By retaining the 60Hz vertical scan rate and increasing the horizontal scan rate,

Table One: Pixels, Bandwidth, and Horizontal Sync Rates 60Hz Refresh Rate

| Resolution        | # of Pixels per Screen | Bandwidth | Horizontal Sync Rate |
|-------------------|------------------------|-----------|----------------------|
| 800 x 600         | 480000                 | 28.8MHz   | 36kHz                |
| 1024 x 768        | 786432                 | 47.2MHz   | 46.1kHz              |
| 1152 x 900        | 1036800                | 62.2MHz   | 54kHz                |
| 1280 x 1024       | 1310720                | 78.6MHz   | 61.4kHz              |
| 66Hz Refresh Rate |                        |           |                      |
| 800 x 600         | 480000                 | 31.7MHz   | 39kHz                |
| 1024 x 768        | 786432                 | 51.9MHz   | 50.7kHz              |
| 1152 x 900        | 1036800                | 68.4MHz   | 59.4kHz              |
| 1280 x 1024       | 1310720                | 86.5MHz   | 67.6kHz              |
| 72Hz Refresh Rate |                        |           |                      |
| 800 x 600         | 480000                 | 34.6MHz   | 43.2kHz              |
| 1024 x 768        | 786432                 | 56.6MHz   | 55.3kHz              |
| 1152 x 900        | 1036800                | 74.7MHz   | 64.8kHz              |
| 1280 x 1024       | 1310720                | 94.4MHz   | 73.7kHz              |

more horizontal lines become squeezed into the vertical cycle.

An increased number of horizontal lines further improves the clarity produced by the video monitor. Information display monitors also use higher picture bandwidths than do television receivers. In other words, the monitor turns its display pixels off and on more rapidly than a television receiver does. We know that television receivers have a bandwidth of 4.5Mhz. Information display monitors have a bandwidth of 35Mhz or higher. The higher bandwidth allows the monitor to display more pixels during one horizontal scan. Without the needed bandwidth, a monitor is limited in the resolution that it can provide.

*Refresh rate* defines the rate at which a screen image is redrawn, shows how many frames are scanned per second, and is the vertical scanning rate. Because CRTs form images in frames, the refresh rate correlates with the amount of flickering seen on the screen. Refresh rates are generally between 60Hz and 75Hz with a refresh rate of 75Hz becoming common. Table 1 lists bandwidth measurements in combination with resolution, the number of pixels, and horizontal sync rates.

### Interlaced scanning

When television was first introduced, the *NTSC*, or *National Television Systems Committee*, selected interlaced scanning as a standard for broadcast signals

because of the limited bandwidth available for delivering picture information. *Interlaced scanning* is a process in which the CRT's electron guns draw only half the horizontal lines with each pass. During the first pass, the electron guns draw all odd lines, leaving one line space between each pair of odd lines. During the second pass, the electron guns draw all even lines in those spaces left between the odd lines. As a result, one complete frame of picture information is created for every two fields scanned.

If interlace scanning were not used in the NTSC system, the top of the television picture would become significantly reduced in brightness by the time the electron guns were scanning the bottom of the picture, resulting in annoying flicker. Interlace scanning reduces this annoying flicker by cutting in half the amount of time it takes the electron beam to scan from the top to the bottom of the picture. With one field generated every 1/60th of a second, the human eye cannot discern the scanning motion. To compensate for any possible flicker that might remain, manufacturers of interlaced scanning displays choose phosphors for the CRT screen that have a longer decay time.

Because interlaced scanning refreshes only half the lines at one time, it can display twice as many lines per cycle. Thus, the display technique provides an inexpensive method for yielding greater resolution. Interlaced scanning has a relatively slow trace and retrace time, which

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affects the ability of a display to show animations and video graphics.

### Non-interlaced scanning

Interlaced scanning has two problems. Because of the higher resolution, any amount of flicker caused by screen phosphor decay would be noticeable and distracting. With all the individual dots displayed, some will dim as others become illuminated. In addition, the scanning lines in an interlaced scanning display are visible. If a person stands too close to a display device, each line of information can be seen as it displays on the screen. For that reason, the optimal viewing distance for an interlaced display is always listed as 4.5 times or 6 times the height of the display screen. At this distance, scanning lines seem to merge together and create the illusion that one complete image is displayed. However, with larger display devices, such as projection televisions, the scanning lines are more noticeable.

To counter the flicker and scanning line problems, computer displays and the new HDTV standard use *non-interlaced refresh* or *progressive scanning*. With progressive scanning, every line of information on the display is scanned by the electron gun at each pass across the panel. The technique enhances the vertical resolution of the display while allowing the viewer to sit closer to the display. Viewing distances with progressive scanning, shortens to 2.5 times the height of the display.

### Evolution of the HDTV standard

The current television broadcasting and reception standard was established by the NTSC in 1940. That standard utilizes 525 horizontal scanning lines, interlaced scanning, the transmission of separate luminance and chrominance signals, and relies on a 60Hz frame rate. Of the 525 scanning lines, only 483 are visible while the remaining lines are used for interval timing or other functions. The bandwidth for those signals covers 4.2MHz.

Although many nations use the NTSC standard, most European nations rely on another standard called Phase Alternate Lines, or PAL, a signal that relies on a 50Hz frame rate; uses a color subcarrier frequency of 4.43MHz; and has 626 scanning lines. The alternate standard surfaced because of detectable shifts in the color sub-carrier phase of the NTSC.

Still another television broadcast stan-

dard—developed by the French and known as SECAM, or Sequential Couleur Avec Memoire, is used in the former East Bloc European countries. The introduction of each broadcast standard also introduced incompatibilities between each system. For example, a SECAM system cannot display a PAL broadcast image because of differences between broadcast equipment. NTSC systems cannot display PAL broadcasts because of the difference in the frame frequencies.

In the early 1980's, the Japan Broadcasting Corporation, or NHK, proposed the MUSE HDTV interlaced system that would use 1,125 scan lines and introduced it as a possible world standard. With this proposal, NHK established a goal of high-definition television playing on a wide screen format. At the request of broadcasters concerned about America's role in establishing the new technology, the FCC established a rule making committee called the Advisory Committee on Advanced Television Service, or ACATS. In addition, the FCC decided that new HDTV signals would be broadcast on currently unusable channels and that broadcasters would be temporarily assigned a second channel for the transition to HDTV.

During the early 1990's, three competing high-definition television design teams agreed to combine their efforts and produce a standard, high-quality product. The three design teams, working under the direction of AT&T and Zenith Electronics; the General Instrument Corporation and the Massachusetts Institute of Technology; and Philips Consumer Electronics, Thomson Consumer Electronics and the David Sarnoff Research Center—have formed the *Digital HDTV Grand Alliance*. The high definition television standard produced by the Grand Alliance establishes a technological framework for the merging of broadcast, cable, telecommunications, and computer technologies. Not surprisingly, the introduction of a high definition television standard affects both the transmission system and the receiver design for modern video receivers.

With HDTV, the amount of luminance definition doubles both horizontally and vertically. An HDTV system provides four times as many pixels as the older NTSC system. In addition, the wider aspect ratio given by HDTV systems establishes more visual information for the viewer. Specifically, the high definition system yields increased vertical def-

inition through the use of 1125 lines in the scanning pattern. The system provides additional video detail through the application of video bandwidth five times that seen with the conventional NTSC system.

While the NTSC system offers an *aspect ratio*, or the ratio of picture width to picture height, of 4:3, the increased picture width given by the HDTV system establishes an aspect ratio of 16:9. Because of this, the viewer gains the capability to receive almost six times as much information. Therefore, high-definition televisions have a place in industrial applications; information capture, storage and retrieval applications; and educational, medical, and cultural applications. With each of those applications, HDTV provides the picture quality needed for teleconferencing, training, and product promotion. Figure 1 compares the NTSC standard picture size with the HDTV picture size.

### The HDTV 1125/60 standard

During the planning and development of the HDTV system, the design team chose to use 1125 scanning lines with a picture refresh rate of 60Hz. This *1125/60 standard* compares with the type of resolution given by projecting a 35mm formatted film onto a large screen and establishes 1035 scanning lines in the active picture display. Also, as an international standard, the 1125/60 systems fits within the need to convert from older systems that have 525 and 625 scanning lines.

Thus, the 1125/60 standard allows existing television signal distributors to convert from the NTSC 525/59.4 standard through readily available large-scale integrated circuits and establishes a format for the global distribution of video information. Currently, the HDTV broadcast system shares television bands with existing services and utilizes unused channels. As a result of this arrangement, television signal broadcasters are temporarily assigned a second channel to accomplish the transition from the NTSC format to the HDTV format.

### Other HDTV standards

Along with the 16:9 aspect ratio and the 1125/60 scanning refresh standard, the HDTV design team also determined that the new system should have:

- 2:1 interlaced scanning combined with non-interlaced scanning;

- A luminance bandwidth of 30Hz;
- Two color difference signals with bandwidths of 15MHz;
- An active horizontal picture duration of 29.63µsec;
- A horizontal blanking duration of 3.77µsec; and
- A new sync waveform.

The HDTV standard assembled by the Grand Alliance takes advantage of the interlaced scanning used for television transmission and reception and the non-interlaced scanning commonly seen with computer monitors.

With non-interlaced, or progressive scanning, the HDTV system provides a choice of 24-, 30-, and 60-frame-per-second scanning with a 1280 x 720 pixel dot resolution and a 24- and 30-frame-per-second scan with a 1920 x 1080 pixel dot resolution. As a whole, HDTV supports the following spatial formats:

1280 x 720:  
 23.976/24Hz Progressive  
 29.97/30Hz Progressive  
 59.94/60Hz Progressive

1920 x 1080:  
 23.976/24Hz Progressive  
 29.97/30Hz Progressive  
 59.94/60Hz Interlaced  
 59.94/60Hz Interlaced

By using these formats, the HDTV system provides direct compatibility with computing systems. In addition to the non-interlaced scanning formats, the system also offers 60-frame-per-second interlaced scanning at a resolution of 1920 x 1080. The use of interlaced scanning becomes necessary for the two 1920 x 1080 x 60 formats because of the lack of a method for compressing the formats into a 6MHz channel. Each of the formats features square pixels, a 16:9 aspect ratio, and 4:2:0 chrominance sampling.

### The HDTV sync waveform

The new horizontal blanking interval accommodates the new sync waveform. By using an improved sync waveform, the design team ensured compatibility across all systems, achieved precise synchronization, and constructed a sync structure that would continue to have noise immunity in the future. The new HDTV sync signal eliminates jitter by placing the horizontal timing edge at the

center of the video signal dynamic range. Moreover, the timing edge has a defined mid-point centered on the video blanking level.

In addition to improving the sync waveform, the design team also moved to improve the capability of the HDTV system to reproduce colors through the use of 4:2:0 chrominance sampling. When compared to the NTSC standard, HDTV provides a broader choice of colors that aligns with newer film technologies, computer graphics technologies, and print media. As you may suspect, the capability of the HDTV standard to reproduce a broader spectrum of colors affects both camera and display technology.

The system achieves many of the improvements in resolution and color reproduction through the decision to establish a 30MHz luminance bandwidth and two color difference signals with a bandwidth of 15MHz each. In effect, the decision to use the 30MHz and 15MHz bandwidths depended on the decision to use 1125 scanning lines. Because of that decision, the system required a bandwidth of at least 25MHz.

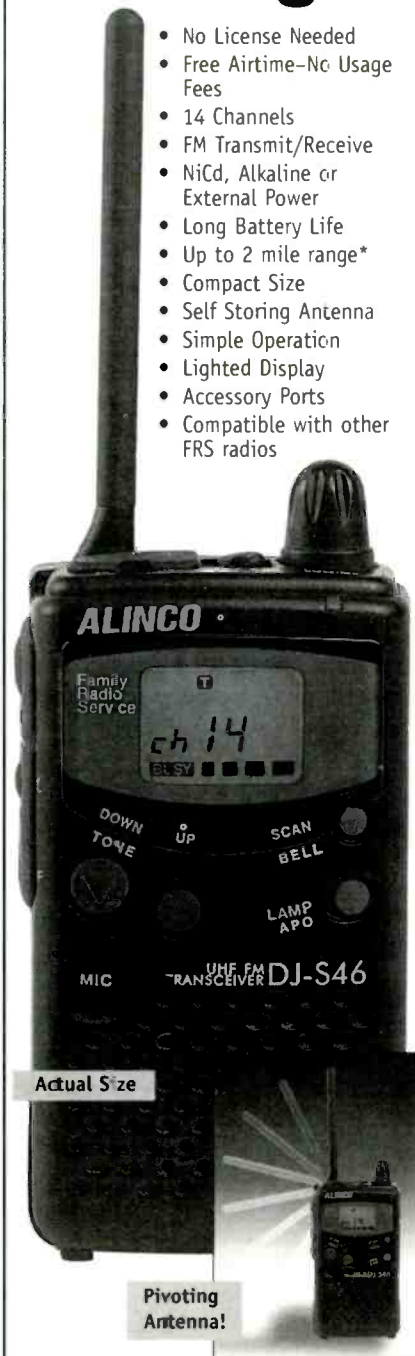
From an overall perspective, the combining of increased horizontal and vertical resolution with wider luminance and chrominance bandwidths yielded a larger number of viewable pixels. Given 1920 horizontal pixels, the HDTV system becomes a platform for different applications of computer display technologies ranging from computer-aided design and manufacturing to medical imaging.

The HDTV broadband, 20Mbit-per-second digital transmission system enables the convergence of the entertainment, industrial, medical, and educational technologies by using a packetized data transport structure based on the MPEG-2 compression format. Each data packet is 188 bytes long with 4 bytes designated as the header or descriptor and 184 bytes designated as an information payload. With this type of high compression data transportation, the HDTV system can deliver a wide variety of video, audio, voice, data or multimedia services and can interoperate with other delivery or imaging systems.

While the digital transmission system may allow the simultaneous transmission and reception of those services, viewers could select services that would substitute for the normal daily programming.

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For example, a local PBS station could broadcast HDTV programs such as National Geographic specials or ballet during the evening prime time hours while also broadcasting data services such as weather forecasts or stock market information. The weather and stock information would be apparent to viewers who had requested the service. During school hours, the same station could deliver five simultaneous education programs to participating local schools and homes.

Over-the-air broadcasts of HDTV signals will rely on a 8-VSB vestigial sideband broadcast system while cable transmissions of HDTV signals will use a 16-VSB vestigial sideband system. This system minimizes any potential interference between the HDTV broadcasts and conventional NTSC transmissions. Each of the standards uses digital technology to provide a high-data-rate transmission and ensure a broad coverage area. The higher-data-rate transmission for the HDTV cable signals allows the transmission of two full HDTV signals in a single 6MHz cable channel.

### MPEG-2 video

The HDTV system uses a video com-

pression system based on the MPEG-2 video compression standard while the audio system relies on the Dolby AC-3 five-channel sound system. Established by the Motion Picture Experts Groups, MPEG-2 source pictures consist of a luminance matrix and two chrominance matrices and ensure synchronization between the audio and video playback. In the 4:2:0 format used in HDTV, the chrominance matrices are one-half the size of the luminance matrixes in both the vertical and horizontal planes of the picture. While the bi-directional frame motion compensation, or B-Frame, used in MPEG-2, improves picture quality, the MPEG format supports interlaced and progressive scanning.

### Dolby AC-3 Sound

The *Dolby AC-3 sound format* encodes multiple channels as a single channel. As a result, the format can operate at data rates as low as 320kbps. The Dolby AC-3 algorithm represents five full bandwidth channels representing 1) left; 2) center; 3) right; 4) left-surround; and 5) right-surround along with a limited-bandwidth low-frequency sub-woofer channel. The audio format is designed to

take advantage of the characteristics of the human ear and to permit the noise-free reproduction of the transmitted sound.

### Summary

As with all new technologies, it is difficult to gauge the initial impact of high definition television on the consumer market. In addition, it is also difficult to forecast the impact of the new technology on the service arena. We do know, however, that the inevitable use of digital signals and high definition television formats will push us to increase our knowledge. As this article points out, HDTV requires a different set of sync signals and that the new standard takes advantage of the MPEG video compression and Dolby audio compression formats.

Moreover, the new television standard takes advantage of standards and technologies previously assigned only to computer displays. Because of this convergence, HDTV has many applications including entertainment, healthcare, and the simulcasting of broadcast channels. The convergence between technologies places more emphasis on the need for service technicians who have diversified and broadened their skills and knowledge. ■



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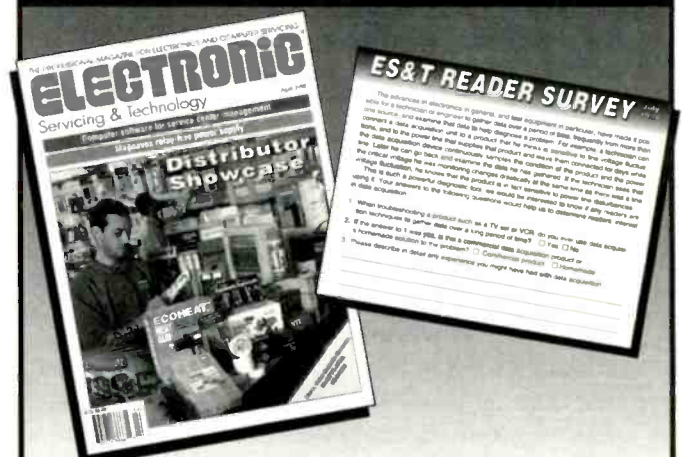
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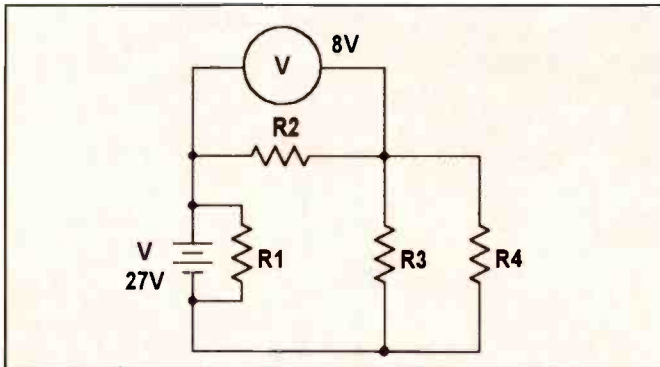
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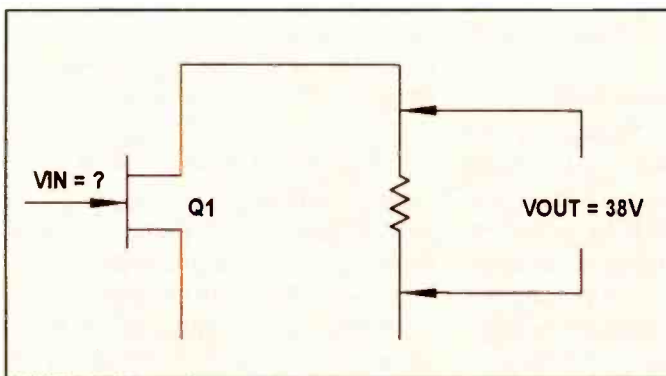
by J. A. Sam Wilson

1. What do the letters HDTV stand for?
2. An eight-bit microprocessor has eight
  - A. data lines.
  - B. address lines
3. If one transistor costs \$1.36, how much do 27 transistors (of the same type) cost?



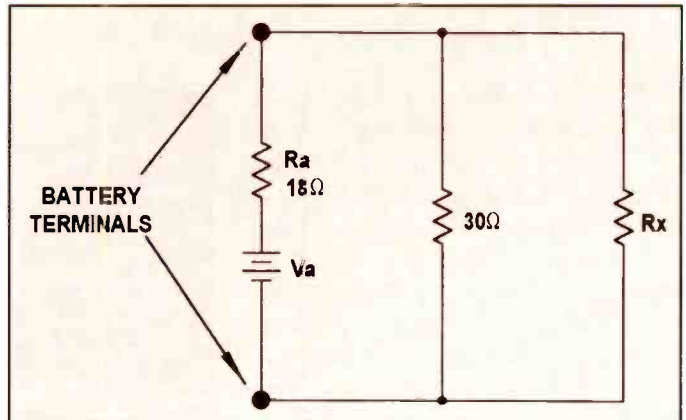
**Figure 1.** If the voltage drop across  $R_2$  is 8V, calculate the voltage drop across  $R_4$ .

4. See Figure 1. If the voltage drop across  $R_2$  is 8V, calculate the voltage drop across  $R_4$ .
5. See Figure 2. If the voltage gain of  $Q_1$  is 38, what voltage is being applied to  $V_{in}$ ?



**Figure 2.** If the voltage gain of  $Q_1$  is 38, what voltage is being applied to  $V_{in}$ ?

6. In the circuit of Figure 3, what is the ohmic value of  $R_x$  needed so that the battery is delivering its maximum power?
7. My subscription bottle says "take one pill twice a day". How many pills do I take in the morning?



**Figure 3.** What is the value of  $R_x$  needed in this circuit so that the battery is delivering its maximum power?

8. Astronomers tell us that alpha centuri, beta centuri and proxima centuri are our three closest stars. Which star is closest to the earth? (Caution: This is a trick question.)
  9. Conductance is measured in \_\_\_\_\_.
  10. Reactance is measured in \_\_\_\_\_.
- (Answers on page 60)



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Wilson is the electronics theory consultant for ES&T.

# Camcorder servicing: Diagnosing audio problems

by Philip M. Zorian

A camcorder contains an impressive amount of mechanical and electronic hardware packed into a small amount of space; miniaturization is a key element of camcorder design. This is a benefit for the consumer, since the camcorder comes bundled with plenty of features. But for the technician, the mere size and density of the camcorder makes it difficult to diagnose and repair problems.

## Recording audio

Of the three video formats, (each with its own unique method of recording audio), the popular VHS-family offers the lowest level of audio quality with its linear analog sound track, and low quality built-in microphone. Audio frequency response is limited to about 9kHz, and the S/N ratio is about 43dB. Most of these camcorders will also pick up some amount of internal motor noise.

Signal to noise is the ratio between the desired audio signal and the recorded noise. Magnetic recording tape is prone to problems with "noise". Although various noise reduction techniques have helped to reduce the level of "tape hiss", none has entirely solved the problem. The S/N ratio of the VHS format can be as low as 40dB. A rating of 70dB or greater is acceptable, meaning that noise will not be a problem, but a ratio of 50dB or less indicates that the audio will contain a noticeable amount of noise.

The best option for improving the audio is to add a high quality external microphone. This has the effect of increasing the upper frequencies. With this in mind, we can proceed to diagnose audio recording problems that are not inherent in the design of the camcorder.

The following symptoms are indicative of a malfunction in the audio recording capability of a camcorder, especially when video is assumed to be good:

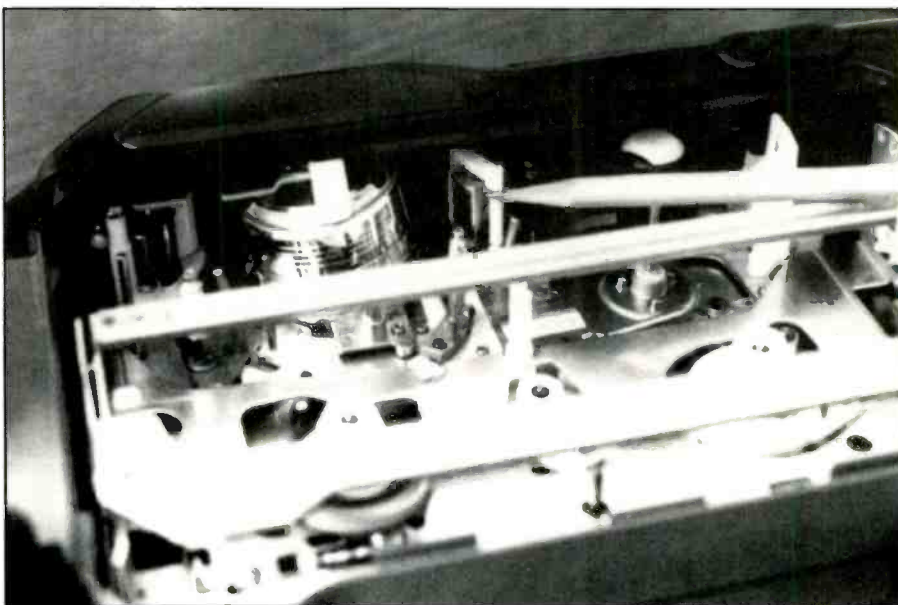


Figure 1. The audio/control head in the camcorder ("A/C" head) is located between the video-heads and the pinch roller.

- hum or other distortion accompanying the sound, or on top of the sound,
- wow or flutter,
- too-fast, Donald Duck sound in the voices on the tape
- sound is out of sync with the picture

## The audio/control head

Figure 1 shows the location of the audio/control head ("A/C" head) inside the camcorder, between the videoheads and the pinch roller. This component is responsible for recording the audio signal onto the videotape, and for reading the audio signal from the tape during playback. It is also responsible for reading and writing a 30Hz control signal onto the videotape. The audio track is located at the top of the tape, while the control track is located at the bottom of the tape. When confronted with poor or non-existent audio, the audio/control head is the component that a technician should look at.

Is the audio head dirty, out of alignment, or faulty? Always try to clean this component as your first step when confronted with poor audio. Just as is the case

with the video heads, the audio head can become coated with a build up of videotape oxide, dust and debris.

If cleaning the audio head does not improve the quality of the audio, then suspect a faulty A/C head. However, if the improvement is slight but apparent, try cleaning the A/C head again.

## Checking the audio head

Occasionally, the A/C head is defective and the camcorder is unable to record audio. But is the camcorder able to playback audio? This is an important consideration. You can determine this by inserting a known-good tape and putting the camcorder into playback mode. On some camcorders you can simply connect a set of headphones into an earphone jack to listen for audio, while others provide an *audio line out* jack on the camcorder or on the power supply. The line out will have to be connected to a monitor to perform this check for sound.

Assuming that the camcorder is unable to record audio or playback audio, it is time to isolate the A/C head from the

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audio circuits. Is it the audio head that is defective, or is it the audio circuits? With the camcorder connected as described above so that you can hear audio:

- insert a known good tape,
- put the camcorder into Play mode,
- using the tip of a flat head screwdriver, tap on the face of the A/C head very lightly in the upper right hand corner. You are listening for a sharp popping sound. The presence of the popping sound is an indication that the audio head is ok and that the audio circuits are OK.

If there is no popping sound, it is then necessary to determine if the fault is with the head or with the audio circuits. Proceed to the small circuit board on the back of the A/C head. Touch each connector directly behind the audio head with the tip of a screwdriver. Be careful not to short any of these. (Always place one finger on the shaft of the screwdriver).

You should detect a noticeable buzz when you touch the correct contact. This will verify that the audio circuits are functioning. If you are able to create the buzz but unable to create the popping sound, the problem is a defective audio head and replacement is required. A follow up article will explain the procedure for replacing an audio/control head in a camcorder.

### Checking the A/C head for poor alignment

Typically, a weak or distorted audio signal is the result of dirty audio heads, but the audio heads can also be out of alignment. You can visually inspect the alignment by checking to see that the tape lines up according to Figure 2. The top edge of the videotape should land just inside the center of the audio head. The re-alignment procedure will be in a follow-up article on replacing the A/C head.

If the audio control head and the audio circuits are found to be working properly, the other part to consider is the microphone. This is a fairly simple component to test since most camcorders offer the option of connecting a remote microphone to the camcorder. When using a remote microphone, the design of the camcorder is such that we have effectively disconnected the built-in mic and substituted it with a good mic. If the audio is still acting improperly, we have gained further evidence that the audio circuits are the problem. However, if the audio comes

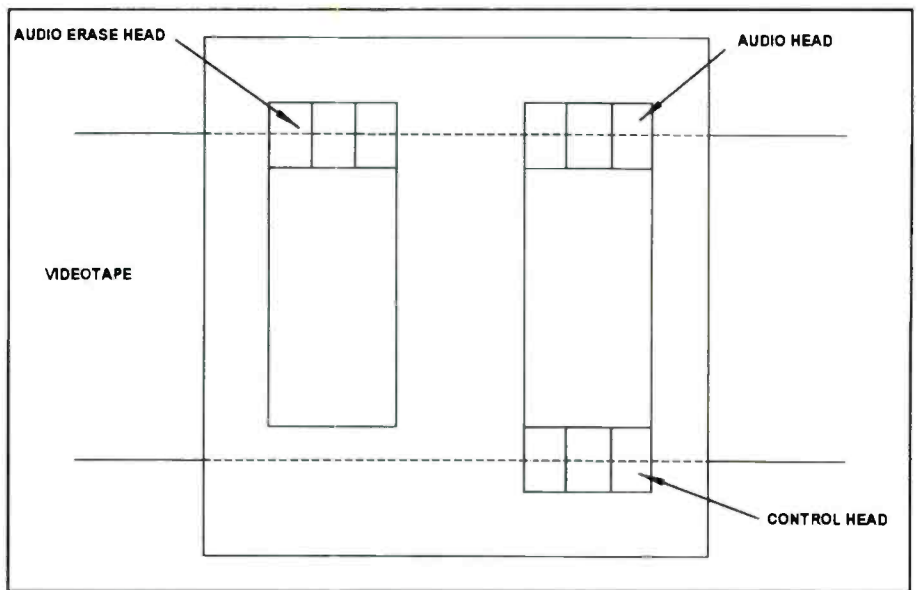


Figure 2. You can visually inspect the videotape alignment on the A/C head.

bouncing back to normal, we can safely conclude that the microphone is faulty.

### Replacing a faulty microphone

The last section of this article will explain the procedure for replacing a microphone in a Panasonic Model AG-187 and 188 Camcorder. This model is unique in that the built-in microphone has been integrated into the viewfinder as shown in Figure 3. This makes it necessary to dismantle the camcorder and the viewfinder in order to replace the microphone. The replacement mic is part No VXMW0081.

Before you begin replacement here are a few words of caution:

- This is a difficult repair, be prepared.
- When removing the side case, work carefully to avoid breaking the Locking Portions of the case.
- Do not supply power to the unit during disassembly.
- Use a grounding wrist strap to provide electrostatic damage protection to vulnerable components.

This repair requires the removal of the right case unit, followed by the removal and opening of the electronic viewfinder, and replacing the faulty microphone.

### Removing the right case unit

To begin removing the right case unit, open the cassette cover unit, remove the two screws and cover.

1. Facing the left side of the camcorder

(cassette side), remove the two screws located just below the mic.

2. Going clockwise around the camcorder, remove the screw just above the lens.
3. Remove the two screws below the lens.
4. Remove all screws on the bottom including the rubber caution plate.
5. Resist the temptation to remove the gold screw located under this plate.
6. Remove the two screws from the back.
7. Inside of the camcorder just beneath the handle, locate and remove the four screws.
8. It is now safe to gently open and remove the right side case unit only.

### Removing the electronic viewfinder

To remove the electronic viewfinder, perform the following steps:

1. Locate and remove the two red screws just below the viewfinder.
2. Gently work the viewfinder free and remove.
3. Looking at the bottom of the viewfinder, locate the two screws and the three metal plates.
4. Using a marking pen, draw a line across the plates; use this line as a reference to find the correct position of the plates for re-assembly.
5. Carefully remove the two screws. One is short, the other long. The short one holds down the top plate, as this



screw is removed the ball bearing will become free.

6. The second, long screw will free up the other plates. Gently slide the plates. The circles will spring up onto the cables.

7. Remove the grey plastic EVF ring by unscrewing.

8. It is now safe to gently open the viewfinder. Once the EVF is open, be careful not to allow the CRT assembly to fall out.

9. Locate the microphone and remove the tiny ground screw at the end of the black ground cable.

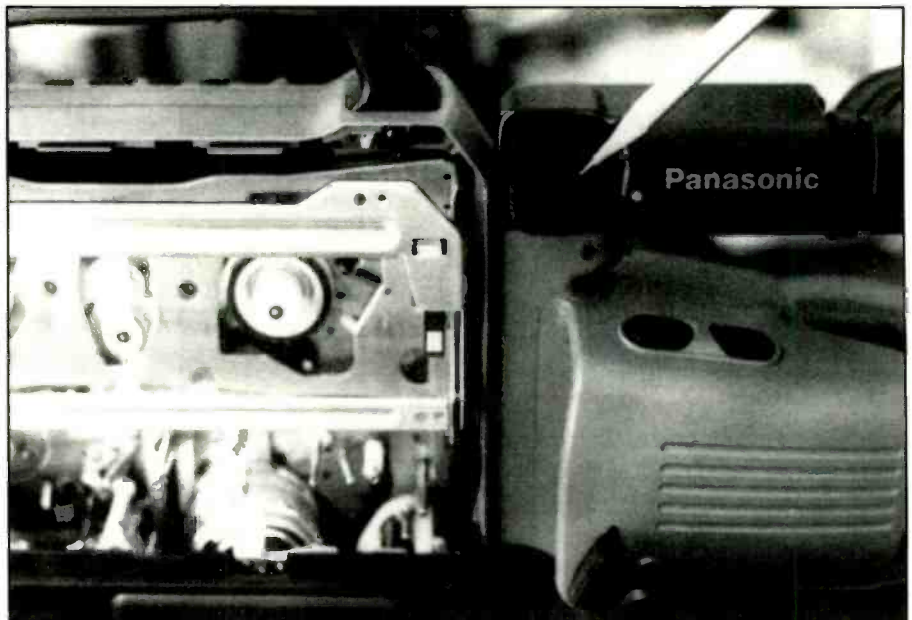
10. Wiggle the microphone free; carefully remove the connector from the base of the microphone.

11. Replace the microphone and reassemble the camcorder.

Be sure to move the power switch forward before putting the right side case unit back on.

### Conclusion

As with all electronic repairs, economics is an important consideration. In order to continue to provide this valuable ser-



**Figure 3.** This camcorder design is unique in that the built-in microphone has been integrated into the viewfinder.

vice, the technician must find ways to cut down on the time and the cost of the diagnosis. As the price of camcorders continue to decrease, this becomes more and more critical. With a camcorder, it is no

simple task to simply "pop the hood" and have a look. Therefore, the technician must be able to determine the cause of the problem as quickly as possible before dismantling the unit. ■

## ES&T Calendar

NESDA 48th/ISCET 28th/NIAS 6th Annual

August 10-15, 1998  
Kissimmee, FL  
817-921-9061

CeBit Home Electronics '98  
August 26-30, 1998  
Hanover Germany  
609-987-1202

PCS 98  
September 23-25, 1998  
Orlando, FL  
703-739-0300

Personal Computer & Electronics Expo  
October 15-18, 1998  
Uniondale L.I., NY  
800-886-8000

PCS 99  
September 22-24, 1999  
New Orleans, LA  
703-739-0300

### Literature (from page 5)

mixed-signal applications and Hall effect sensors, now offers a new edition of its product documentation on CD-ROM.

In addition to brief descriptions of the product range and the current data sheets, the CD-ROM provides information on applications ("System Solutions") and product families ("IC Family Information"). Users have access to more than 2,000 pages of product documentation in PDF format; the display software, Adobe Acrobat Reader 3.0, is appended.

Circle (93) on Reply Card

### Test equipment, tools, supplies catalog

A 64-page update catalog from Contact East lists the latest in test instruments and tools offered by the company for engineers and technicians. Featured are quality products from brand name manufacturers for testing, repairing and assembling electrical and electronic equipment. New product highlights include Fluke's T5 Electrical Testers, Tektronix' Huntron Tracker TR210, and the CEK74 Complete Electronics Tool Kit.

Other products displayed are DMM's,

oscilloscopes, soldering/desoldering tools, clamp meters, power supplies, ESD protection products, aerosol cleaners, adhesives, and a complete selection of precision hand tools. Choose from quality brand names like Fluke, Tektronix, Hewlett Packard, Xcelite, Xuron, Ideal, Weller, OK/Metcal, Pace, 3M, Chemtronics, and Microcare.

Circle (94) on Reply Card

### Test equipment catalog

Triplett introduces its new test equipment catalog. This full color, 36-page catalog features the company's standard test equipment along with several new products. The newly improved VisualEYEzer Heads-Up Digital VOM now features a rugged, hinged eyepiece and voltage ranges to 600V. The new 9000 Series includes 5 low-cost digital multimeters and 3 clamp-on testers. The new catalog also introduces the "Sniff-It" non-contact ac voltage detector. Also included are the company's standard analog and digital testers, telecommunications testers, LAN cable testers, the Fox & Hound wire tracers, battery testers, capacitance meter, carrying cases, and replacement test leads.

Circle (95) on Reply Card

# Servicing satellite television systems

by John A. Ross

Almost fifteen years ago, I entered the world of satellite television by selling and installing C-band satellite reception systems. Those systems featured either an eight-foot or ten-foot diameter dish, 120 degree LNA's, block down converters, and, for the most part, integrated receivers that enclosed both the receiver and motor controls. At that time, the broad-based scrambling of satellite-transmitted signals was just beginning and C-band system sales were hot.

Today, sales of small dish Direct Broadcast Satellite (DBS) systems have skyrocketed and have supplanted the larger C-band systems. In a recent interview with a major satellite system supplier, I learned that their sales of complete large-dish systems had dropped to perhaps one or two per year. At the same time, their warehouse contained pallets loaded with the small-dish systems.

## C- and Ku-band systems

Despite the trend towards smaller dishes, opportunities still exist in both markets. Even though the sales of large dish systems have dropped, a large customer base remains. The C-band systems provide benefits not available with the DBS systems. Some of those benefits are:

- The ability to select satellites from across the band: Any C-band system can move back and forth across the satellite band through the use of an actuator motor.
- Extensive programming choices: Because the dish can move across the band, the system is not limited to the programming choices found on any one satellite.
- The capability to pick up special feeds
- Reliability in all types of weather
- The capability to receive Ku-band and 4DTV transmissions

Given these benefits, many people will opt to maintain the C-Band systems. As

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

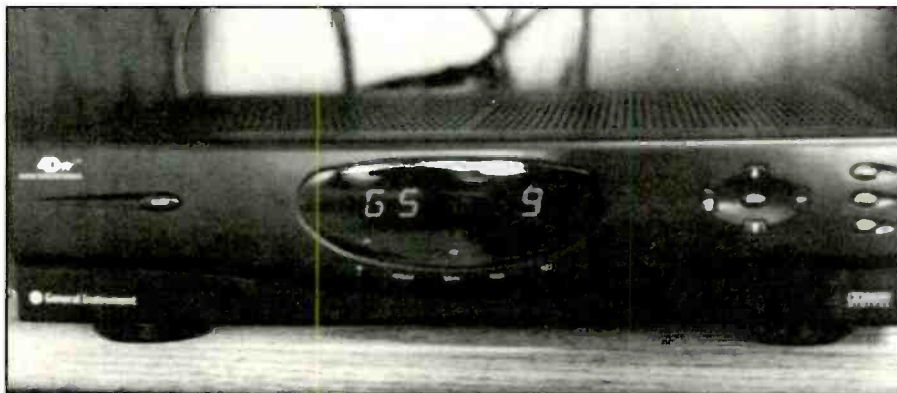


Figure 1. A receiver, such as this one by General Instruments, allows the viewer to select one channel from the many received by the satellite antenna for viewing.

a result, providing service for C-band systems can remain a viable niche. When those systems age, routine maintenance may require the replacement of the polarotor assembly; the upgrade of the LNB to a lower temperature unit; the replacement of cables or cable connectors; or the replacement of actuator motors. Along with these possibilities, service may also include re-aligning the dish or installing interference filters.

In addition, some satellite dish owners may also decide to replace their current receivers with a model that offers more features for a lower price. As an example, a Uniden Ultra receiver offers basic features such as favorite video channel memory; satellite position memory; C/Ku-band capability; on-screen display; parental lock-out; picture-in-picture; and a VCRS decoder module for a retail price of around \$350.00.

On the high end, the new General Instruments 4DTV digital satellite receivers offer the same features along with high-speed data ports; the capability to receive MPEG-2 audio signals; an interactive program guide, instant pay-per-view; and program timers. Because the receiver works with digital as well as analog signals, it also offers compatibility with the HDTV transmissions that will become a standard part of the television

broadcast world. A 4DTV receiver may have a list price as high as \$1,000.00 and as low as \$675.00. Figure 1 is a photograph of the General Instruments receiver.

## Polarotor Basics

On any dish-type of antenna, there is one optimum location for the feedhorn. The placement of the feedhorn must allow the focal point of the dish to land 0.25" inside the throat of the feed. Moreover, the feedhorn must remain flat relative to the dish surface. Referring to the Chaparral Corotor shown in Figure 2, a prop-

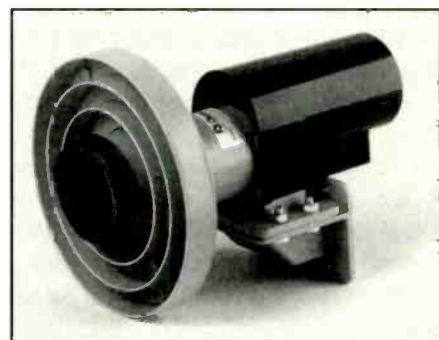
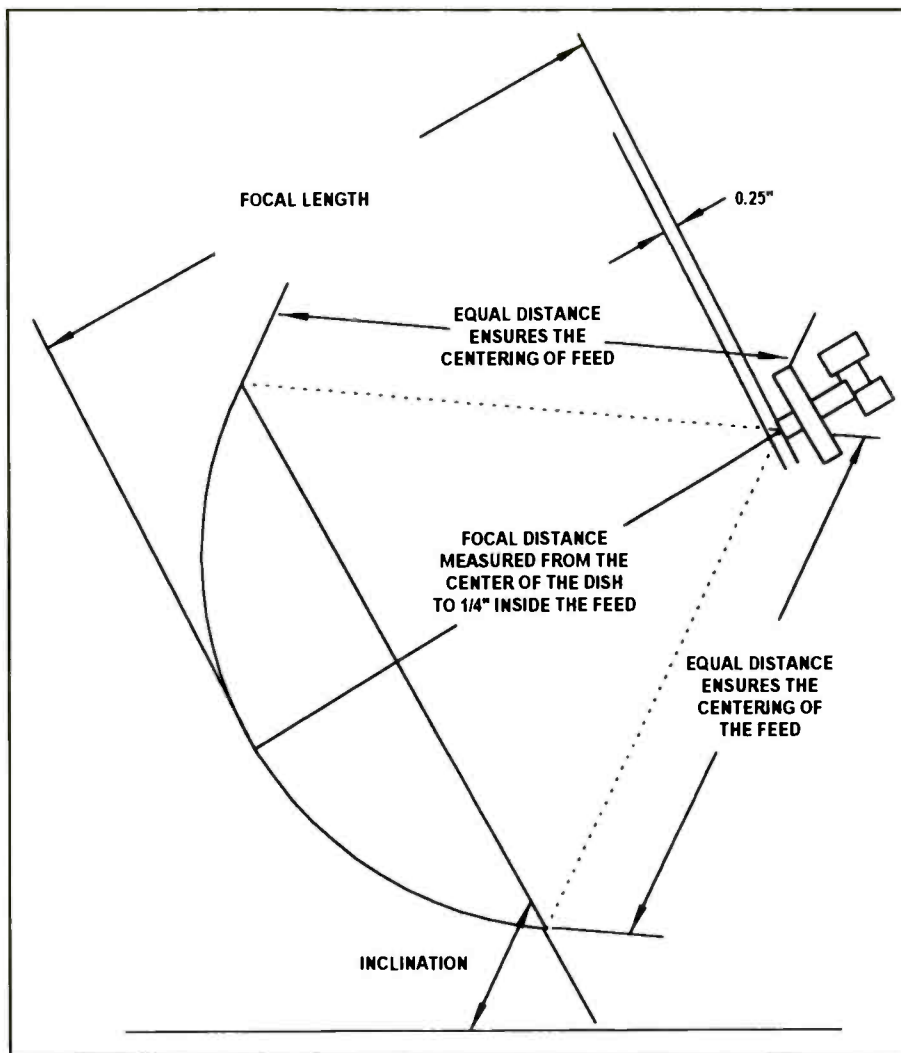


Figure 2. The polarotor, such as this Chaparral Corotor, allows the satellite reception system to switch to either the group of satellite signals that are horizontally polarized, or the group of signals that are vertically polarized. If the polarotor fails, the viewer will be limited to programs that are polarized in the same direction as the programs he was watching when the polarotor failed.



**Figure 3.** Proper alignment of the polarotor requires the setting of the focal length as accurately as possible. See the text for details of this procedure.

erly installed feedhorn assembly can improve the reception of a C-band system by as much as 2dB.

When positioning the feedhorn, ensure that the unit has full skew and polarity switching. To do this, position the LNB flange opening of the feed at a 45° angle from the polar axis of the dish. As you know, the polar axis is the line on which the dish pivots on the mount. Rotating the feed to a 45° angle from the polar axis aligns the antenna probe so that neither the horizontal nor vertical limits are at the physical limits of the motor. Figure 3 shows a diagram for centering the feed on a C-band system.

Proper alignment of the polarotor requires the setting of the focal length as accurately as possible. Generally, the manufacturer will list a focal length specification. After adjusting the focal length, measure from three roughly equidistant

points on the perimeter of the dish to the edge of the feedhorn. To find the correct measurement, simply find the average of the three measurements. Once the feed is centered, check to ensure that the face of the feed parallels the face of the dish.

You can check this by measuring from three equidistant spots on the feedhorn to the center of the dish. Each of these measurements must equal the focal length of the antenna. Without equal measurements at these points, the feedhorn will skew slightly, which will result in uneven illumination of the dish.

#### Polarotor wiring

Polarotor motors connect back to the receiver through three cable connections: ground, pulse, and +5V. When servicing an older C-band system, always check for the proper voltages at both the receiver and the polarotor. Because 20 gauge or

smaller cables usually connect the receiver and motor, breaks can occur.

The most common reason for replacing Polarotor servo motors involves susceptibility of the motors to cold weather conditions. In many cases, extreme cold conditions will cause the small servo motor to lock into place. When this occurs, the consumer will be limited to one set of either vertical or horizontal channels. Replacement motors for the polarotors are available from most satellite television supply houses and range in cost from \$14.95 to \$25.00.

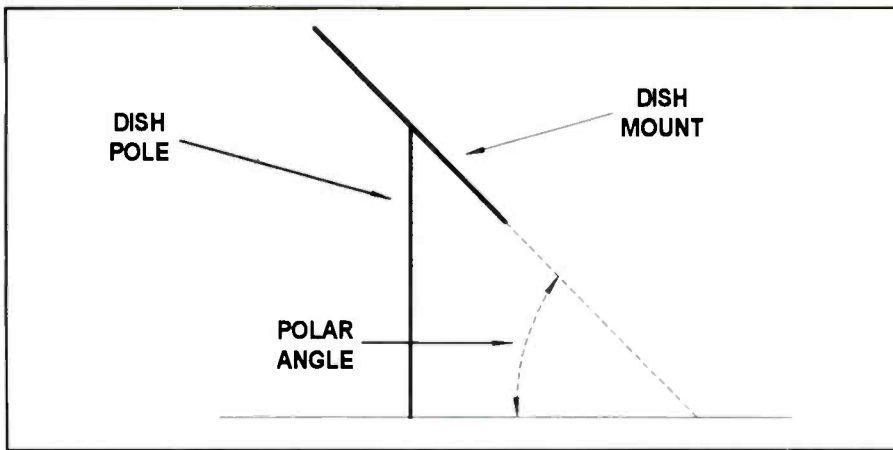
#### Aligning the dish: polar and offset angles

The polar angle of a satellite dish is equal to the latitude in degrees of your location. When working with a C-band system, you can measure the polar angle by placing an inclinometer on the back of the mount. In short, the setting of the polar angle causes the rotational axis to parallel the north/south axis of the earth and allows the antenna to symmetrically track the satellites orbiting in the Clarke Belt. Figure 4 illustrates the setting of the polar angle.

Depending on your location, the dish will need to tilt either up or down to coincide with the Clark Belt. Setting the offset angle to 0.5° accuracy ensures that the dish will properly track the satellites. The amount of offset angle is determined by the latitude of your location. At the equator, a 0° offset angle is required while an antenna located at the Artic Circle would require an offset angle of 8.80°.

Generally, dish manufacturers will include offset angle charts and conversion factors with the dish. As an example, an antenna site located at 35° latitude will have an offset angle of 5.70° and a conversion factor of 0.0998. Measuring the distance between the upper and lower pivots of the dish mount and multiplying that distance by the conversion factor provides the offset adjustment in inches. As an example, if you find that the distance between the pivots is 28 inches, the offset adjustment equals 28 x 0.0998 or 2.79 inches. To set the offset angle, adjust the upper bracket so that it equals 2.79 inches plus the length of the lower bracket.

After verifying the polar and offset angles, the polar axis (the part of the mount that forms the polar angle) and the



**Figure 4.** The polar angle of a dish is equal to the latitude in degrees of your location. When working with a C-band system, you can measure this angle by placing an inclinometer on the back of the mount. In short, the setting of the polar angle causes the rotational axis to parallel the north/south axis of the earth and allows the antenna to symmetrically track the satellites orbiting in the Clarke Belt.

mounting point for the antenna pivots, should be oriented in a true North/South direction. While some texts recommend using either a compass or the location of the North Star for the North/South alignment, the best method is to rotate the antenna to the correct elevation for satellites at each end and at the highest point of the Clarke Belt. Correctly setting the elevation of the dish for each of the three satellites should align the mount with true North. Table 1 shows common symptoms associated with C-band satellite antenna alignment problems.

#### LNAs, LNBs, and LNBFs

In the early days of satellite television, the LNA, or low noise amplifier, and the frequency downconverter were two different devices. The earliest systems relied on a 70MHz down conversion system and were characterized by the large type N connector on the LNA housing and the use of a heavy RG213 cable for the con-

nection between the LNA and the converter. Later satellite antenna series utilized either a 950MHz to 150MHz or 45MHz to 950MHz block downconverter. With the change in the frequency down conversion format, the LNA featured a smaller type F connector and used either an RG6 or RG59 cable.

An LNB, or low noise block, is a device that houses two components in one casing: the LNA and the block downconverter. In this type of system the unit is the heart of any satellite system because it handles the amplification of an extremely weak signal. Combining the two devices into a single package offers higher gain. The LNBFs commonly seen in DBS systems are low noise block feeds that fuse the LNB to the polarizer.

#### Block downconversion

Block down conversion of the high frequency signals gained popularity in the mid-1980's. Early block downconversion

schemes had problems with frequency drift and required the matching of each block downconverter to a particular receiver. Matching the two devices required a stable working temperature; adjustment of the tuning ramp in the receiver; and the setting of the AFC.

The introduction of DROs (dielectrically resonated oscillators) provided the necessary oscillator stability and eliminated the need for matching the block downconverter to the receiver. A DRO encloses the oscillator in a cavity that is resonant at the fixed local oscillator frequency. Because of this, the downconverter remains stable throughout a wide range of temperature variations.

#### Noise factor and sparklies

Every C-band LNB has specifications such as noise factor, which is given in degrees Kelvin. Ku-band LNBs are measured in decibels. In either case, a lower value for this noise factor indicates a higher quality amplifier. For the sake of comparison, early 120° LNA's were considered as Cadillacs for the fledgling industry. Today, the noise factor for modern C-band LNBs ranges from 6° to 30°. Modern Ku-band LNBs have a low range of 0.5dB to a high range of 0.9dB.

Most LNBs use three to four stages of gain with GaAsFET (Gallium Arsenide Field Effect Transistors) used for each stage. In most cases, a GaAsFET will draw, approximately 25mA of current. If a suspected bad LNB had zero current draw either an open connection or a problem with voltage regulation has occurred. A current draw above 150mA usually indicates that a short has occurred within the voltage regulator. Current draw measurements in the 75mA range and spark-

**Table 1 — C-band Alignment Problems and Solutions**

| Symptom  | Solution  |
|--|---|
| Poor reception from satellites at the lower end of the Clarke Belt.<br>Good reception from satellites at the high end. | Excessive Offset Angle  |
| Poor reception from satellites at the high end of the Clarke Belt.<br>Good reception from satellites at the low end.   | Insufficient Offset Angle   |
| Reception from all satellites improves when the front edge of the reflector is lifted.                                 | Rotate the mount on the slightly to the right (viewed from the rear of the reflector) |
| Reception from all satellites improves when the front edge of the reflector is pushed down.                            | Rotate the mount on the pole slightly to the left.                                    |

**Table 1.** Some typical C-band Alignment Problems and causes

lies in the picture indicate that one of the stages has failed.

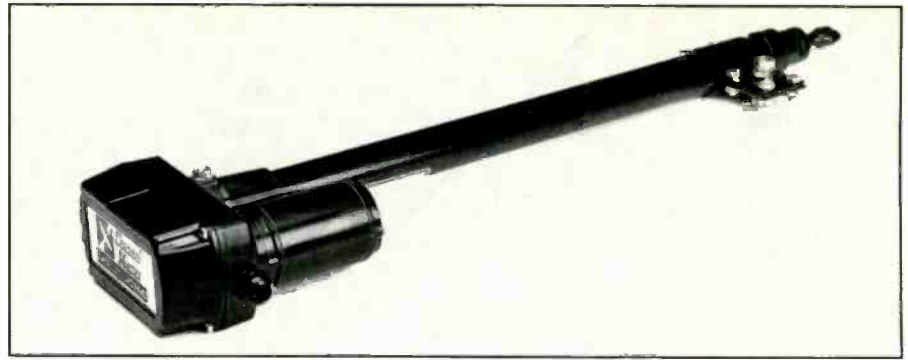
One of the key and most common indicators of a failing LNB is the degradation of a signal referred to as *sparklies*. Generally, this snow-like interference on all channels points towards the need for a new LNB. However, it is always wise to check the cables, the cable connections, and the alignment of the dish. Replacing the LNB simply involves removing four bolts and the coaxial cable; verifying the position of the antenna inside the assembly; and attaching the new unit. Prices for new C-band LNBs range from \$35.00 to \$85.00 and depend on the noise factor.

### Cables and connectors

When wiring a satellite reception system, always consider the type and quantity of the installed equipment; the distance between equipment; the elements; and the type of wire and connections. Depending on the type of system, the wiring may be limited to a simple coaxial cable or, in the case of an SMATV (satellite master antenna television) system, may involve a number of cables. Modern satellite systems utilize an all-in-one cable that includes all necessary feeder and motor cables and is suited for direct burial.

Because the LNB lowers the signal frequency at the antenna, satellite systems rely on RG-6 coaxial cables for feeder lines. Lowering the frequency also lowers the attenuation per foot of cable. As a result, the lower frequencies may be boosted through the use of line amplifiers.

Although the RG-6 cable works with common F fittings and is easily installed, a few general precautions come to mind. When stripping the insulation from the center conductor, do not score the con-



**Figure 5.** C-band satellite television reception systems use actuators, such as the one shown here, to move the direction in which the dish is aimed across the arc of satellites. An actuator must perform in all weather conditions and must provide accuracy in movement.

ductor. If there is any question about moisture becoming a factor in your installation, always use rubber boots and silicone grease. A small amount of silicone grease placed on the boot and the conductor will prevent moisture from causing a chemical reaction within the connector.

Moisture in an LNB feeder cable will cause an excess current draw and the lowering of the power supply voltage for the LNB. Water and the resulting corrosion in the line can form a resistance between the center conductor and shield which will act as a voltage divider. As a result, some of the power supply voltage will shunt to ground. To check for this problem, perform a resistance check on both ends of the cable. Any resistance reading indicates that the cable requires replacement.

Most satellite antenna wiring is either copper or aluminum. When subjected to air and moisture, oxidation will occur. Aluminum wires, such as those used for the grounding connections, may turn to powder while copper conductors will turn green. In either case, the connector will lose all continuity.

As mentioned, the all-in-one direct bur-

ial cable contains all the cables needed to install a satellite system. Given the color coding of the cables, the connection of the receiver to the actuator and polarotor should be reasonably easy. The actuator motor requires the connection of two 14 gauge voltage cables and two to three 22 gauge sensor cables. The polarotor sensor motor requires the connection of three 18 gauge cables.

### Actuator motors

C-band satellite television reception systems use actuators to move the dish across the arc of satellites. Figure 5 shows a typical actuator motor and drive assembly. In brief, an actuator must perform in all weather conditions and must provide accuracy in movement. While older satellite receivers utilized a separate actuator control box, all modern receivers enclose the actuator control within the same case as the receiver. The programming of satellite names and positions into the microprocessor-based controller synchronizes the receiver/actuator control with the actuator.

As Figure 5 shows, the actuator is made

**Table 2 — DBS Service Providers**

| Type of Service | Owner                                 | Satellites                 | Satellite Location    | Number of Households |
|-----------------|---------------------------------------|----------------------------|-----------------------|----------------------|
| DSS             | GM Hughes/USSB                        | GM Hughes DBS1, DBS2, DBS3 | 100, 101 Degrees West | 3.54 Million         |
| DISH            | Echosphere Communications Corporation | Echo 1, Echo 2             | 119 Degrees West      | 1.23 Million         |
| PrimeStar       | TCI/Comcast Continental/GE Americom   | 3.54 Million               | 85 Degrees West       | 2.05 Million         |

**Table 2.** DBS service providers by category, showing the approximate number of households using the particular services. Also shown are the satellite locations for each service and the satellite names.



**Figure 6.** This is what a typical direct broadcast system (DBS) looks like. This particular unit was manufactured by Thomson Consumer Electronics/RCA. The antenna has a gain of 34dB and a half-power beamwidth of 3.5°

up of a motor and an arm. Most arms use an acme thread arrangement that offers dependable mechanical pushing and pulling of the dish. This type of arm works well for 6ft, 8ft, and 10ft diameter dishes. Owners of larger diameter dishes may opt for a ball screw arm that supplements the nut moving on the threaded shaft with ball bearings.

### Direct broadcast systems

A direct broadcast system uses the same principles as do the C-band and Ku-band systems, in that many channels of programming are delivered directly from the satellite to a dish and receiver located at an individual house or business. Direct broadcast satellite signals are broadcast in the microwave Ku band; have a frequency of 12.5GHz; and utilize encoded digital signals. Figure 6 shows a typical direct broadcast system manufactured by Thomson Consumer Electronics/RCA. The antenna has a gain of 34dB and a half-power beamwidth of 3.5°.

Each DBS satellite has 16 transponders which operate at 40Mbps per second. Because direct broadcast systems utilize compressed digital signals rather than analog signals, a DBS system does not move from satellite to satellite. Instead, the 18" dish is fixed to one satellite location. The use of digital signals allows each transponder to send several channels. As

a result, the owner of a DBS system may choose from 120 to 200 channels of popular programming.

### Forward error correction

Of the available 40Mbps (million bits per second) of signal found at each transponder, only 23Mbps are used for the actual video and audio signals. The remaining 17Mbps contains *forward error correction* (FEC) information. Because the smaller DBS dishes rely on the short wavelength of the Ku band microwave signals, the systems are susceptible to signal blockage during heavy rainstorms. Each raindrop absorbs part of the transmitted signal.

With the FEC signals generated during the transmission of the television signals to the satellites, a set of mathematical calculations derive information about the television data signal. At the receiver, the process of receiving the signals also involves using the mathematical calculations to recreate any lost signals. In addition, the set of calculations, called a syndrome, includes the information needed to correct and recover the correction information. When a rainstorm or other phenomenon causes a signal blockage and introduces digital signal bits in error, the FEC allows the receiver to compensate for the blockage and to reproduce a clear television picture.

If a heavy downpour causes a high bit-error rate, the FEC automatic error correction will fail. In this eventuality, the viewer may see out-of-place picture blocks, blocks of colored snow, rainbow-like displays, or a frozen image on the screen. All of this occurs because of the lack of synchronization.

### Compressed video signals

Each transponder found on a DBS satellite is controlled by a special type of multiplexer called a statistical multiplexer. During operation, the statistical multiplexer connects to several video CODECs or COder-DECOders that comply with the MPEG-2 standard and accommodate a number of digital signals at the same time. Each CODEC converts uncompressed analog audio and video signals to a 140Mbps digital signal and then reduces the bit rate to between the 1.5Mbps and 15Mbps required for DBS operations.

All the compression occurs at a single,

expensive encoder located at the transmission point. Because of this, the decoder found within the DBS receiver is both simple and inexpensive. As an example, the DirecTV Castle Rock, Colorado broadcast center operates with more than 200 Compression Labs, Inc. Magnitude MPEG-2 encoders that use an array of encoder chips. The dynamic statistical multiplexer allows the transmission point to efficiently use the bandwidth and to optimize video quality.

The use of the MPEG-2 video compression standard allows the DBS system to provide high quality audio and video transmissions at a variety of bit rates. Given these variable bit rates, the system makes the most efficient use of bandwidth. As an example, a high-motion program, such as the NBA championships, use a nominal bit rate of 7.5Mbps. A more stationary program, such as a talk show, is allocated 3Mbps.

From this, we can deduce that the greater amount of motion requires a higher bit rate. Moreover, fine picture detail, especially in moving objects, also

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| AV-32820 ..... | 4006 |
| C-13810 .....  | 4010 |
| C-13811 .....  | 4010 |

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| VRX462AT01 ..... | VCR-299 |

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| <b>MITSUBISHI</b> |      |
| CS-27209 .....    | 4008 |

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requires more generated data. In the world of DBS, a compromise occurs because the limited bandwidth is shared among the group of CODECs that belong to any particular transponder. Because of this arrangement, a CODEC using only a portion of its assigned bandwidth will allow another unit to borrow the remaining bandwidth. Because of this dynamic bandwidth switching, the system maximizes its uses of the available 23Mbps. Of course, the allocation of all channels on a given transponder to high-motion events can defeat the bandwidth optimization and cause some signal degradation.

## DSS, DirecTV, USSB, DISH, and Primestar

Depending on the source, DSS may represent either *digital satellite system* or *direct satellite system*. Developed by GM/Hughes Electronics for DirecTV and Thomson Consumer Electronics, DSS is a method for delivering original programming from the transmission point to the receiver. DISH stands for *digital information sky highway* and is a product of Echosphere Communications.

When considering programming options, DirecTV and USSB, or United States Satellite Broadcasting, Inc., and DISH provide a variety of options while relying on digital signal formats. With the first two systems relying on the DSS format, the system allows consumers to choose from a large number of premium channel feeds, superstations, news channels, major networks, pay-per-view channels, and 30 channels of CD quality music. Among others, RCA, Sony, Uniden, Hitachi, Memorex, ProScan, GE, and Toshiba manufacture DSS products.

The DISH system operates from two satellites owned by Echostar Communications and provides the same type of television services along with 31 channels of CD-quality music. Echostar, Houston Tracker Systems, and JVC manufacture the hardware used in the DISH satellite TV systems.

In a slightly different category, TCI-owned Primestar system relies on a medium powered satellite, utilizes 27-inch dishes, and is available on a lease basis only. As with the other program services, Primestar offers a wide variety of subscription-only services. Using dishes manufactured by ChannelMaster, Prime-

star provides nearly 150 channels of programming. Regardless of the type of satellite service desired, a consumer must subscribe to at least one service before the system becomes operational.

Figure 2 divides the service providers into categories and shows the approximate number of households using the particular services. In addition, the chart shows the satellite locations for each service and the satellite names.

## Convergence

If you refer to the article about HDTV in this issue, you will find that many of the transmission standards set for HDTV match those used for Direct Broadcast Satellite systems. Each uses the MPEG-2 video compression standard. However, the addition of the Dolby AC-3 standard for audio reproduction to HDTV may cause additional crowding of the bandwidth needed to transmit DBS signals.

Convergence also exists through the use of both platforms for the transmission and reproduction of data. In part, the delay in the introduction of HDTV stems from the desire to use the transmission standard for both television signals and access to the worldwide web. From the DBS vantage point, a solution for high speed 400Kbps web access exists with the DirecPC system that includes a 21-inch dish, and a 16-bit adapter for the computer, and software. The DirecDuo package takes convergence a step further by combining the DirecPC system with the ability to deliver two DSS signals. All this occurs through a dedicated LNBF for DirecPC and a dedicated dual LNBF for DirecTV and USSB programming.

When we combine this continuing convergence of technologies with sales and the need for maintaining older systems, it becomes apparent that satellite television still provides opportunities for growth. Although many experts have predicted the death of the C-band industry, consumers continue to buy the larger systems because of their flexibility. In many cases, consumers will decide to maintain or upgrade an older system. Because DBS installations have existed for several years, service and upgrade opportunities will also increase in this area. Continued growth of the DBS industry and increased capabilities should open new doors for service and installation. ■





### Universal horizontal analyzer

The HA2500 Universal Horizontal Analyzer from *Sencore* provides a frequency lock and variable horizontal frequency system that allows the user to quickly service all horizontal circuits no matter the frequency (15 kHz - 125 kHz), allowing this one instrument to be used for servicing computer monitors, big screen TVs, and special application video display devices.

The analyzer also provides a "Horizontal Output Load Test" that makes setup and testing a snap, according to the manufacturer. The unit allows the user to test the circuit even without applying ac power. This feature is designed to help provide more accurate estimates, reduce the number of damaged replacement parts, and speed the technician's

diagnosis and repair. The product also incorporates the patented "Ringer" test for analyzing IHVTs, flybacks, and yokes in seconds.

The new "Dynamic Tests" assist in analysis of horizontal circuits in a powered-up condition to catch even subtle defects in the power supply and drive signal. This test can help eliminate call-backs and reworks associated with horizontal circuits.

The tester incorporates a special variable-current limited and protected B+ substitute supply. This feature allows the technician to test and troubleshoot even when the power supply is dead. The unit is portable and field rugged to go on location when bringing the defective product to the bench isn't feasible.

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### Soldering system

*PACE* launches the new ST 40A-SP Soldering System with SensaTemp Control, delivering high capacity heating for demanding production soldering at safer, lower tip temperatures. The unit incorporates user-friendly intelligent electronics to make its features easy to operate including a large LCD digital display and key pad, an Auto-Off safety system, continuous temperature calibration, and auto tip temperature compensation. A password lock prevents unauthorized adjustment of temperature settings. SensaTemp Control also lets you change handpieces or tips instantly without recalibration.

Circle (102) on Reply Card



### GPIB-programmable bench top power supplies

*B&K Precision* introduces three new benchtop programmable power supplies, configured in compact half-rack size, that can be regulated via the IEEE488.1 GPIB programming interface, or the front panel keypad. This is useful for lab, ATE and R&D applications. Three new models feature a selection of popular voltage ranges from 0V-35V, and 0A-6A current output, depending on performance functions required.

Internal software enables the power

(Continued on page 45)

### HDTV digital waveform monitor

A new monitoring unit from *Leader Instruments*, the LV 5150D, handles both serial digital and analog components for HDTV signals in the 1125/60 (59.94) format. It provides full waveform monitoring functions including line select, cursors and memory presets of test setups. Picture display of the Y or G component, with a line select strobe, is also provided. The unit offers a vector display of chroma component as well as a Lissajous display for stereo audio.

Two SDI inputs are accommodated



with an active output of the channel selected for observation. Waveform display and decoded picture monitor outputs may be set to GBR or YPbPr form.

Circle (101) on Reply Card

# What Do You Know About Electronics?

## My 15 minutes of fame

by J. A. Sam Wilson

The International Society of Electronics Technicians includes with their monthly mailing to members a paper called "Information Available for IS CET Members". I was pleased to see that my article from the February 1998 issue of *ES&T* was offered. It included the design of a minimum-loss pad using hyperbolic functions.

I looked up the article and learned that kind of fame wasn't anything I really wanted. Unfortunately, when I transformed the article from my notes I carelessly miscopied the first equation. Here is the way the equation appeared:

$$\epsilon^x + I + \sqrt{\frac{R_L}{R_O}} = I + \sqrt{\frac{200}{100}} + 2.414$$

The equation should be as follows:

$$\epsilon^x = I + \sqrt{\frac{R_L}{R_O}} = I + \frac{200}{100} = 2.414$$

All of the material that followed used the 2.414 value, so, everything else that appeared in the article was correct.

Confucius say: "He who makes too many mistakes does nothing, but, he who makes no mistakes also does nothing."

### The uncertainty principle

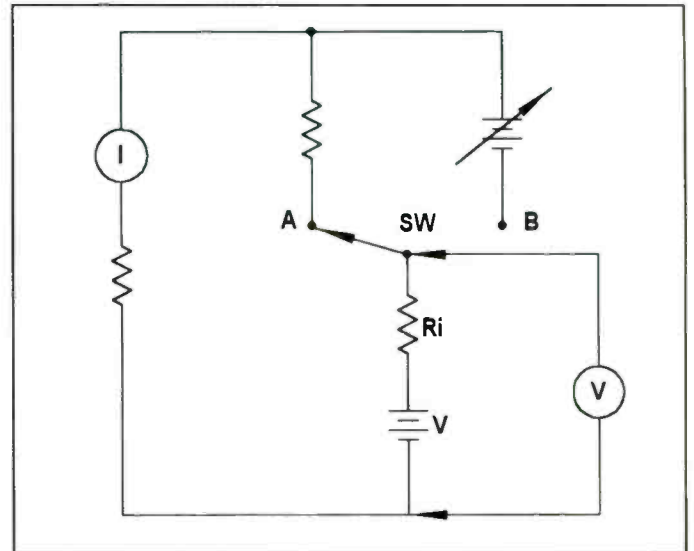
In the previous issue I promised I would go into the uncertainty principle in greater detail. Heisenberg, an early theoretical physicist, proposed that it is impossible to determine whether an electron is a particle or a small bundle of energy. His reasoning was that anything you do to measure it changes it. Well, that is the gist of his principle and it had far-reaching effects on early theoretical physics.

Many years ago I was discussing the effect of the internal resistance of a battery's ability to deliver power. I got an astonishing letter from a professor of physics in Texas. He said that a battery has no voltage across its terminals "unless it is delivering current".

I had never heard that before and I asked for our readers' help. A very alert reader responded. (If I ever get these boxes emptied I am sure I can find his name and put it in this column.) He proposed the circuit in Figure 1.

Here's how it works. When the switch is in position A, the battery (V) is supplying current through  $R_L$ . There is a voltage drop across the internal resistance, so the true battery (V) voltage cannot be measured in this manner.

When the switch is in position B, the variable-voltage power supply is adjusted so that there is no current in the ammeter. At that point the battery is not delivering current and the battery



**Figure 1.** When the switch is in position A, the battery (V) is supplying current through  $R_L$ . There is a voltage drop across the internal resistance, so, the true battery (V) voltage cannot be measured. When the switch is in position B the variable-voltage power supply is adjusted so that there is no current in the ammeter. At that point the battery is not delivering current and the battery voltage is equal to the output voltage of the variable-voltage power supply.

voltage is equal to the output voltage of the variable-voltage power supply.

Now, back to the uncertainty principle.

There have been many attempts to apply it to many different measurements in electronics. An example is shown in Figure 2. A basic voltmeter is used to measure the voltage across R. The resistance of the voltmeter shunts the resistance of R so that the actual voltage being measured is no longer the voltage across the one  $M\Omega$  resistor. Clearly, the voltmeter shows a voltage of 25V but the actual voltage (without the voltmeter) is 50V. That is called voltmeter loading.

Examples like the one just shown have been used to show that voltmeter loading makes it impossible to get an exact measurement of the voltage across points 'X' and 'Y' and has been attributed to the uncertainty principle. (It doesn't matter how high the resistance of the voltmeter is, it will still disturb the measurement of the actual voltage across points 'X' and 'Y' somewhat.)

However, using the technique from a very alert reader, we can set up a measurement like the one shown in Figure 1. That type of measurement has been called "slide-back voltage measurement".

Now, Mr./Ms. Alert Reader - whoever you are, have we disproved Heisenberg's Uncertainty Principle? Send me letter(s). I'll collect and save the letters so I won't lose them. Then, we will discuss this again in a near-future issue of *ES&T*.

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

## SPIN talk

In the previous issue I noted that electrons and protons spin on their axes. The question arises: If no person has ever seen an electron, how does anyone know they spin? I asked that same question in a conversation with a physics professor many years ago and he described an experiment that has been conducted in the lab. It is illustrated in Figure 3.

As illustrated, an electron gun shoots electrons onto a neutral reflecting surface. They bounce off the surface at an angle onto three positive plates. The reflected electrons strike the positive plates in three ways. The plate currents are an indication of electron strikes.

Plates A and C receive almost all of the current indicating clockwise and counterclockwise spins. Think of them as spinning tennis balls that are spinning as they hit the surface and bounce. Very few electrons strike the center plate. They can be thought of as electrons in transition between particle and energy.

In another experiment, a photographic plate is used in place of the metal plates to display the bounced electrons.

### More (or less) about HDTV

The digital TV picture will be scanned with continuous lines, not digitized lines. At least, that is the present scheme. However, as of this writing they can't make up their minds. Should the lines be interlaced as in the present system, or, should a single scan be used for each frame. Broadcast systems seem to prefer the interlaced system and computer people prefer the single-

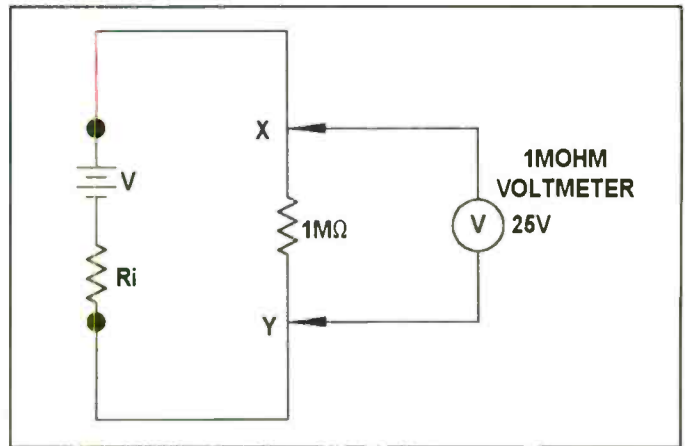


Figure 2. A basic voltmeter is used to measure the voltage across R. The resistance of the voltmeter shunts the resistance of R so that the actual voltage being measured is no longer the voltage across the one M (resistor). Clearly, the voltmeter shows a voltage of 25V but the actual voltage (without the voltmeter) is 50V. That is called voltmeter loading.

scan per frame method. If either method is used, each line will carry pixel information. (However, I wouldn't bet on that.)

I am watching this circus very carefully. One thing that could change the whole outlook is cable TV. There are rumors that cable TV companies, if allowed, may convert HDTV to the analog system now on your present TV.

Did you vote for replacing the present analog TV system with DTV and HDTV? (The answer is yes. When you voted for your

# Howard W. Sams & Company

The collage features several book covers:
 

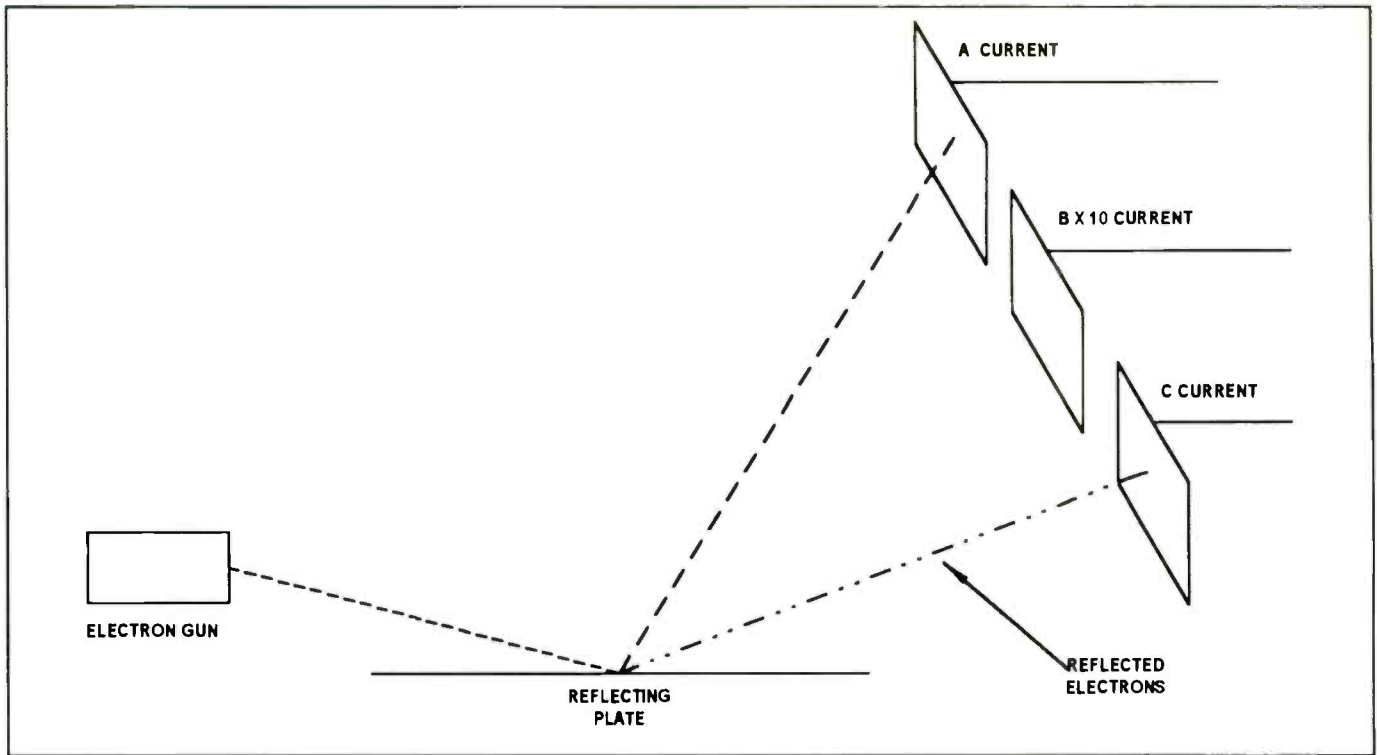
- 1998 Annual Index**: Same Helps You Master Technology.
- VT 102**: Building Your 80 MHz.
- INTRODUCTION TO VCR REPAIR**: This video step is designed for the technician with a good basic understanding of TV circuitry.
- Troubleshooting & Repair Guide to TV**: Learn How to Troubleshoot PPM, Learn How to Use Test Equipment For Servicing, Troubleshoot Self-Made Pioneer Supply Extension, Troubleshoot Microprocessor With Control Circuitry.
- VCR Troubleshooting & Repair**: \$14.95. Video & 60mm audio & 1998.
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- Complete VCR Troubleshooting and Repair**: Includes a photo of a VCR.
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**Figure 3.** If no one has ever seen an electron, how does anyone know they spin? In this experiment, an electron gun shoots electrons onto a neutral reflecting surface. They bounce off at an angle onto three positive plates. The electrons strike the positive plates in three ways. The plate currents are an indication of electron strikes. Plates A and C receive almost all of the current indicating clockwise and counterclockwise spins.

favorite Congress person you voted for the people who are the major instigators of the digital TV requirement.)

Here are a few questions:

- Will DTV and HDTV use 1080 scanning lines?
- Will cable TV be required to carry DTV or HDTV? (Cable TV carries programs to over 60% of the TV viewers.) Or, will “set top boxes” be allowed to convert digital TV programs to the present analog TV sets?
- Have you received literature on the design of digital TV so you will be able to repair the new DTV sets? (They haven’t even finalized the set designs.)
- Are families currently watching sitcoms on TV anxiously waiting for better definition for these programs.
- For receivers connected to outside antennas, how will the antenna design differ from what is already being used?

### Does Anyone Read This Stuff?

There is a writer for another publication who criticizes my writings in **ES&T** and other magazines. The first time I heard from this individual was a response to my article called “Why Johnny Can’t Understand Capacitors.” In that article I emphasized the importance of the capacitor dielectric.

In response to that article this is what he said (in his column). “A capacitor doesn’t even need a dielectric. It could be a vacuum (between the plates).”

The editor of the publication in which that column ran was kind enough to let me respond (in letters to the editor) that the vacuum, in that case, *is* the dielectric.

His most recent correspondence was a very unprofessional letter to the noble editor of **ES&T**. He queried: “Doesn’t anyone read this stuff?” He was questioning the fact that I insert-

ed a low resistance across a transformer and I said that the secondary current of a transformer is determined by Ohm’s law, *not* by a reckless application of the equation  $V_p/V_s = I_s/I_p$ . In that article I showed the difference in secondary current between connecting a 4Ω resistor and then a 2Ω resistor across an energized power transformer.

Basically, this individual argued that connecting the 2Ω resistor across the transformer as described would lead to a disaster for that transformer. It was an obvious attempt to get me in trouble.

Normally, Norma filters out unprofessional letters and throws them away. However, in this case the letter was addressed to the editor of this magazine, so, she suggested I answer it.

It is no surprise to me that many technicians wrote that the low resistance across the transformer secondary would produce bad effects. You won’t find this subject in most books written for technicians.

Many different short-circuit tests are used by engineers to evaluate transformer designs. I quote from the *Standard Handbook for Electrical Engineers* by Fink and Carroll, tenth edition:

“**Temperature Test.** The temperature test is usually made by the short-circuit method. One winding is short-circuited (usually the low-voltage winding), and suitable voltage is applied to another winding to generate a loss equal to the desired total loss (load loss corrected to standard reference temperature plus no-load loss).”

If a short circuit across a transformer secondary doesn’t destroy the transformer then surely connecting a 2Ω resistor across it won’t destroy it!

Again, thanks to the many technicians who wrote about this.

***Internet Guide to the Electronics Industry*, by John Adams, PROMPT Publications, 192 pages, paperback \$16.95**

Although the Internet pervades our lives, it would not have been possible without the growth of electronics. It is very fitting then that technical subjects, data sheets, parts houses, and of course manufacturers, are developing new and innovative ways to ride along the Information Superhighway. Whether it's programs that calculate Ohm's Law or a schematic of a satellite system, electronics hobbyists and technicians can find a wealth of knowledge and information on the Internet.

In fact, soon electronics hobbyists and professionals will be able to access on-line catalogs from manufacturers and distributors all over the world, and then order parts, schematics, and other merchandise without leaving home. *The Internet Guide to the Electronics Industry* serves mainly as a directory to the resources available to electronics professionals and hobbyists. Author John Adams is co-owner of InfiNet-FX, an Internet consulting service for businesses specializing in the electronics industry on the Web.

PROMPT Publications, 2647 Waterfront Parkway E. Drive, Indianapolis, IN 46214-2041

***Setting Up and Troubleshooting Windows PCs*, by Michael Hordeski, Butterworth-Heinemann, 439 pages, paperback \$34.95**

*Setting Up and Troubleshooting Windows PCs* will make your life as a Windows user easier whether you are using Windows 3.1, Windows 95, or Windows NT. It contains the information you need on Windows applications, multimedia cards and configuration files so you can detect and fix PC problems quickly. It is also a ready source of useful mailing addresses, phone numbers, BBSs and CompuServe Forum locations for Microsoft sources where you can obtain additional information.

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

***Understanding & Servicing CD Players*, by Ken Clements, Butterworth-Heinemann, 202 pages, hardcover \$52.95**

Written specifically with service technicians and engineers in mind, this book is designed as a bench-side companion and guide to principles involved in repairing and adjusting CD players. With a problem-solving approach and numerous examples, *Understanding & Servicing CD Players* is a helpful companion to the service manuals.

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

***IC Projects*, by Curt Reeder, PROMPT Publications, 212 pages, paperback \$21.95**

*IC Projects* was written for electronics hobbyists and technicians who are interested in projects that you will be able to breadboard quickly and test easily. Designed to be fun and user-friendly, all of the projects employ integrated circuits and transistors. The book presents the experienced electronics enthusiast with instructions on how to construct such interesting projects as an LED VU meter and an infrared circuit.

This book covers the entire circuit construction of the following: electronic memo pad, digital thermometer, digital stopwatch, Johnson counter, electronic bug detector, TTL counter, wireless microphone, A/D converter, logic probe, laser pointer, sound effects generator, function generator, digital clock, and many more. All the projects utilize commonly available ICs,

thus you will be able to find the chips in this book. Also, attention was given to keeping projects costs down, so the projects can be built at a cost within the "hobby" range.

PROMPT Publications, 2647 Waterfront Parkway E. Drive, Indianapolis, IN 46214-2041

***Oscillator Circuits & Projects*, by Stephen Kamichik, PROMPT Publications, 249 pages, paperback \$19.95**

*Oscillator Circuits & Projects* was written as a textbook and project book for individuals who need to know more about oscillator circuits. Students, technicians, and electronics hobbyists can build and enjoy the informative and entertaining projects described at the end of this book. Complete information about oscillator circuits is presented in an easy-to-follow manner with many illustrations to help guide you through the theory stage and on to the hands-on stage.

Some of the topics covered include feedback, saturation, bistable multivibrators, negative-resistance oscillators, solar powered generators, sinusoidal oscillators, blocking oscillators, and more. Author Stephen Kamichik is an electronics consultant who has developed dozens of electronic products and received patents in both the U.S. and Canada. His other books include *Advanced Electronic Projects*, *Semiconductor Essentials* and *Digital Electronics*, all published by PROMPT Publications.

PROMPT Publications, 2647 Waterfront Parkway E. Drive, Indianapolis, IN 46214-2041

***Power Supplies Second Edition*, by David Lines, PROMPT Publications, 124 pages, paperback \$14.95**

Power supplies, the basic sources of energy in all electronic equipment, are essential to electronic design and construction. *Power Supplies: Projects for the Hobbyist and Technician* guides you from the fundamentals of power supply components and their functions to the design and construction of a power supply system. The comprehensive coverage includes the basics of ac and dc energy sources, regulated and unregulated power supply systems, linear and switching power supply projects, measurements, calibration, and troubleshooting.

PROMPT Publications, 2647 Waterfront Parkway E. Drive, Indianapolis, IN 46214-2041

***Complete Guide to Audio*, by John Adams, PROMPT Publications, 336 pages, paperback \$24.95**

In today's typical home there is a main home entertainment center as well as other mini-entertainment centers throughout the house. There are the common components such as AM/FM stereo receivers, CD players, tape cassette decks, speakers, and equalizers. Now there are newer devices such as DATs, subwoofers, satellite radio and surround sound, to name just a few. It all comes together to form 10%-25% of our time during the day and night.

The *Complete Guide to Audio* explains audio systems. It outlines the common components of modern audio equipment and gives details and features of the newest gadgets. Audiophiles will also be interested in learning of the newest updates to established equipment, features that were previously only realized on audio equipment costing thousands of dollars. Topics covered include audio recording basics, speakers, stereo receivers, antenna basics, and troubleshooting.

PROMPT Publications, 2647 Waterfront Parkway E. Drive, Indianapolis, IN 46214-2041

# VCR service

by Ken Simmons

A lot of us look at the VCR as one big mechanical monster. But in reality, it is just a combination of circuitry that we should already be familiar with. I'm sure you have serviced many audio units, as well as tape transport assemblies, and color TV's.

I will admit that a VCR does contain more mechanics, (belts, cams, tires, rollers, and levers [see Figure 1]), but if you can follow the operation of the unit, you are half-way home. Add some audio, color, and video circuits, and there you have it, a VCR.

Lets start out with the basic functions, add some electronic theory, and see how we come out.

The fast-forward, rewind, play and record switches in a VCR usually have one side at ground potential, while the other side is a dc voltage of 5V to 10V.

When a panel switch is depressed, play for example, a connection is made between ground and a dc voltage. This voltage level change is then sent to a microprocessor via circuitry in the VCR.

The microprocessor in turn, transmits this output signal to an LED associated with the depressed switch.

## Cassette-in switch

When a tape (Figure 2) is inserted into a VCR, the cassettes in switch is made, and if the microprocessor detects no faulty circuit, the unit is ready to receive information from the video viewer to the VCR front switch panel.

## Tape loading motor

As the play switch is activated, a signal is sent from the microprocessor to turn on the load motor (Figure 3). The necessary voltage and current for this motor is usually stepped up by an IC amplifier located between the motor and processor.

Once the load motor turns on, it either drives a pulley-belt assembly, or worm gear, which in turn drives some type of gear train, normally located below the VCR deck assembly.

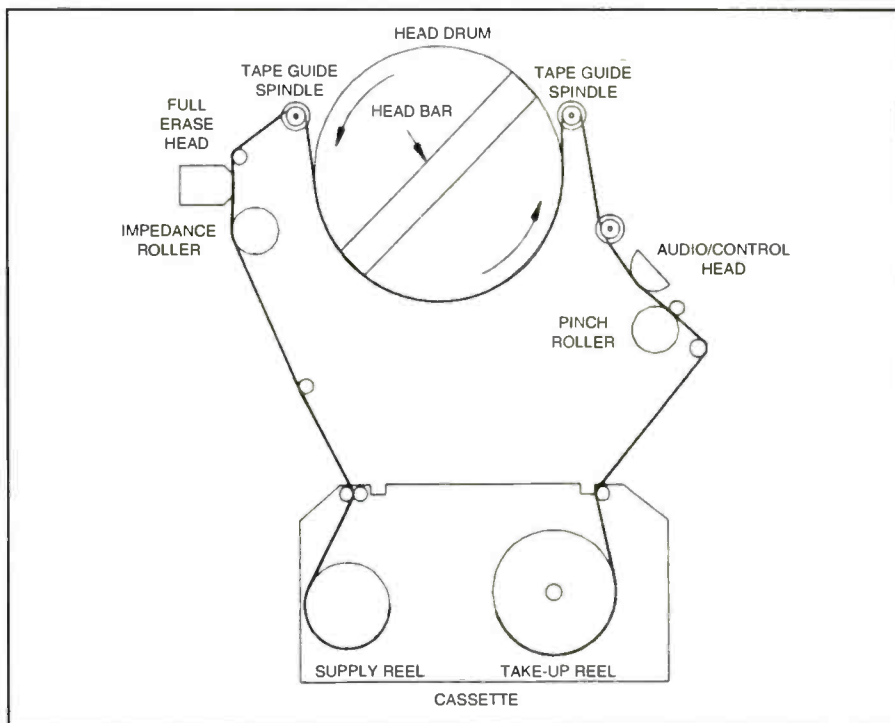


Figure 1. The tape path of a VCR contains belts, cams, tires, rollers, and levers.

Usually after two or three seconds, the tape has been extracted from the cassette, and the machine has then completed the loading process (Figure 4).

(Note: keep in mind, that if the microprocessor senses a problem in the loading function or associated circuitry, the unit

will most likely kick the cassette tape back out of the VCR.)

## Mode switch, cam switch, or function switch

The mode switch (Figure 5) sends information on the gear train position

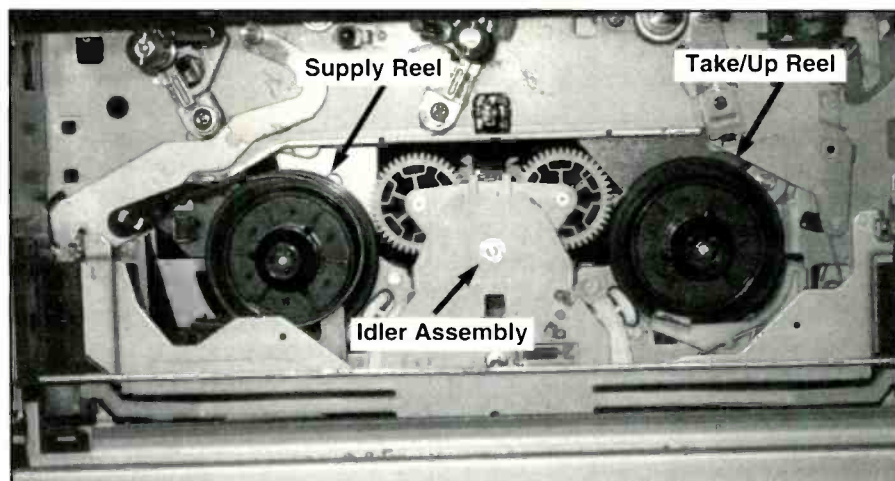
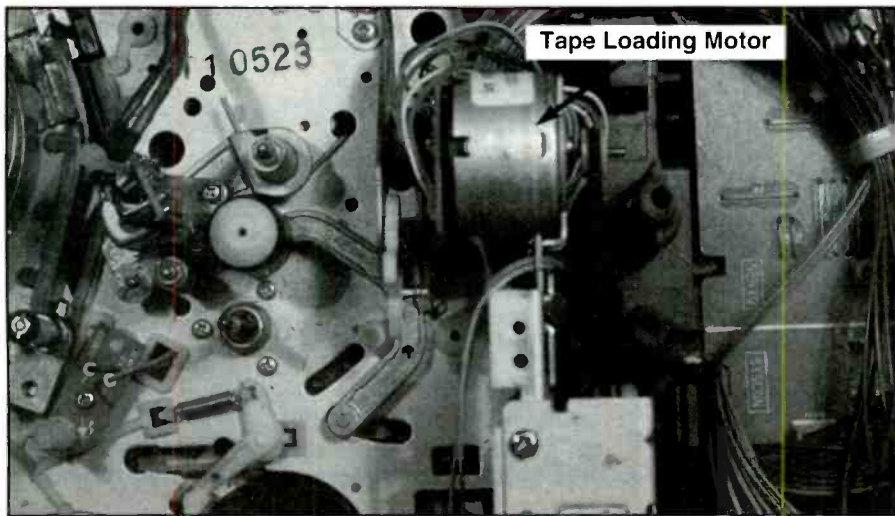


Figure 2. This photograph of the underside of a videocassette shows the moving parts: Supply reel, the take-up reel and the idler assembly.

Simmons is an independent electronic service center owner and technician.



**Figure 3.** As the play switch is activated, a signal is sent from the microprocessor to turn on the load motor, thus causing the tape to be loaded.

back to the microprocessor. This in turn, lets the processor know that the loading function is complete, thus turning off the load motor dc voltage.

A microswitch located usually in the cassette housing mechanism, changes positions when a tape is inserted, causing a voltage to change state, and thus be sent to the control system microprocessor. This processor sends a signal that will turn on the cassette motor. Here again, an IC amplifier or transistor is placed ahead of this turn-on signal.

#### Video drum motor

Unlike the tape load or cassette load motor, the video drum motor (Figure 6) is usually a dc direct drive type. Precision circuits drive this motor, and supply feedback to the servo control circuitry.

The only function that occurs between the microprocessor and drum motor is the

turn-on, turn-off signal sent via the play/record or stop switch.

#### Capstan motor

The servo circuitry also controls the capstan motor, continually monitoring and correcting its speed. Again, the only function of the microprocessor is for the turn-on, turn-off of the capstan motor.

#### Sensors

VCRs are equipped with a number of sensors that control operation and prevent damage to the unit (Figure 7).

#### Dew sensor

This sensor is a safety protection feature that monitors humidity in the air. It works with the microprocessor, and will send a voltage change if higher than normal humidity is detected. This will result

in a power-down signal to the VCR, preventing damage to the tape.

#### Start sensor

After a tape is rewound, a clear leader section on the tape allows light from the infrared detector, or bulb sensor to pass through, causing a transistor circuit to send the microprocessor a signal to shut the tape drive system off.

#### End sensor

At the end of the cassette tape, this sensor operates in much the same way as the start sensor, via the clear leader on the end of the tape. It also shuts the drive off.

#### Take-up reel sensor

Located beneath the take-up reel, this sensor will also cause a shut down to occur if there is a mechanical malfunction with the tape movement. When the reel is moving, a pulse signal usually amplified by a separate amplifier circuit, is sent from this sensor to the microprocessor.

#### Record safety switch

Similar to the provision on an audio cassette tape, a tab of the cassette case serves as the record safety switch function. When the tab is intact, the unit will record input signal information. If the tab is removed, the microprocessor will detect its absence, and prevent recording.

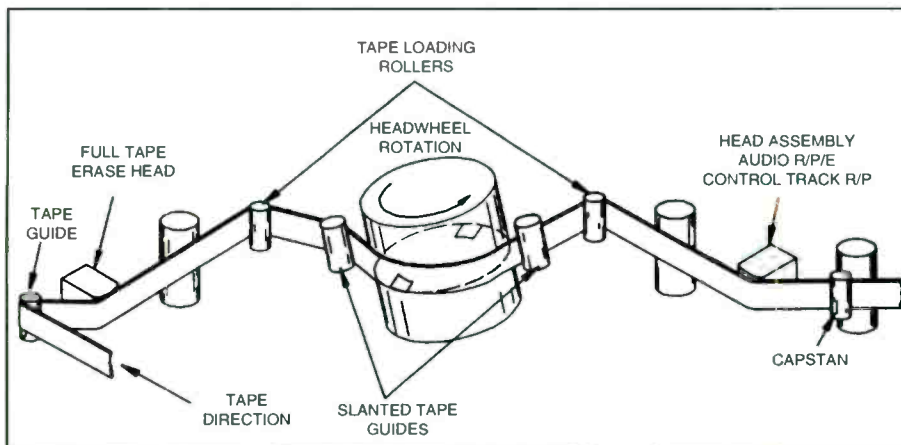
#### VCR power supplies

I won't go into the switching power supplies here, as Bob Rose did an excellent article on these in the November, 1997 issue of this magazine.

The power supplies that I will cover are straightforward in design, and if you can service TV and other supplies you should have no problem with the VCR supplies.

A lot of VCR's use a power transformer to step the 115Vac down to a lower and usable level for the VCR circuitry. These voltages are then fused, filtered and regulated by the appropriate components.

The power transformers are very reliable, and seldom need replacing. The more common power supply failures are usually from a blown fuse, ( sometimes caused by a power line surge ), but more times than not from a defective circuit component. Power diodes or bridge rectifiers can short or get leaky, regulators will short out, destroying resistors and opening a voltage source completely. The



**Figure 4.** Usually two or three seconds after the signal is sent to the tape loading motor, the tape has been extracted from the cassette, and the machine has completed loading.

power supply filters can also become leaky with age, and cause problems.

Occasionally, you will find some small metal object that has been inserted in through the cassette door, eventually finding its way on top of a printed circuit board causing a B+ short. Also, you may encounter a VCR that has had some type of liquid spilled on top that finds its way inside to the circuit boards, causing one circuit to short across to another one.

When a VCR comes in to your service center with a power supply problem, a few quick measurements using your DMM, scope or capacitor tester should make for a relatively fast repair.

### Video drum and servo operation

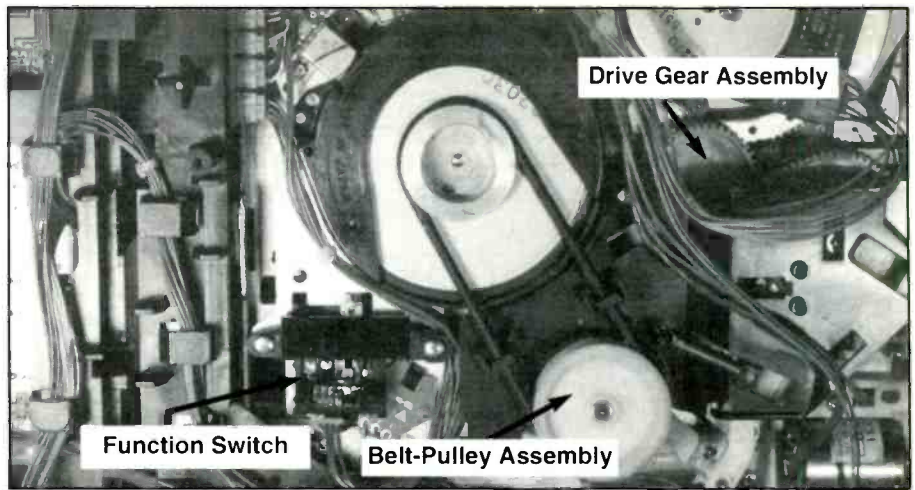
On two-head VCR's, the heads are located in the top cylinder area, placed 180 degrees apart (Figures 8 and 9). The drum assembly starts spinning the minute the loading of the tape begins. It then reaches a speed of 30 cycles per second, (actually 29.94 Hertz). The tape will now be wrapped 180 degrees around the video drum. One tape head is in contact with the tape every 1/60th of a second. One video frame consists of two fields. One frame is completed 60 times a second, each field, 30 times a second.

A "swipe" is performed each time the heads come in contact with the tape (Figure 10). During this time, video information is either read, (during playback), or in the case of record, written. There are 262.5 lines of video for each swipe of the heads. In record, the odd lines are put on the tape first, followed by the even lines. One complete screen scan is the result, which we know as interlace scanning.

During the play back mode, one head prints one field, while the remaining head produces the other field of video information. Each head "swipe" is equal to 1/60th of a second.

In the VCR, there are counter circuits that are synchronized to the incoming 60Hz signal made up of the video, color, sync and audio information. Every 1/60th of a second during record, the VCR actually divides the signal in half. And every 1/30th of a second, one field is recorded onto the video tape, which means one field will be recorded every 1/60th of a second.

The VCR control head and servo feedback circuits constantly control the tape speed through the unit. The 60 cycle sync



**Figure 5.** The mode switch (functions switch) sends information on the gear train position back to the microprocessor. This in turn, lets the processor know that loading is complete, thus turning off the load motor dc voltage.

signal received during the record function is split in two, amplified and then carried to the control head, which is part of the audio-control-erase head (A.C.E.) assembly (Figure 11).

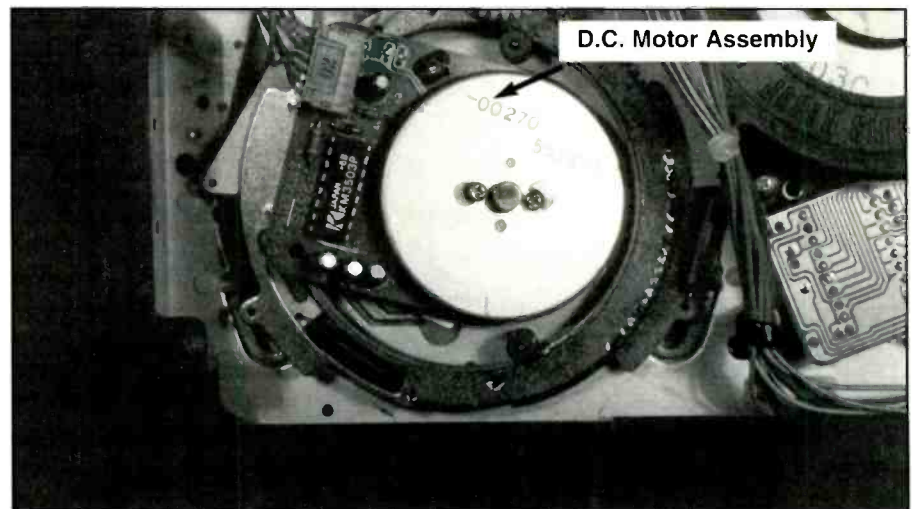
The control head then records these 30Hz pulses onto the video tape. These pulses are read back during playback by this same control head, which will compare these pulses to the ones developed from the VCR's feed back circuit, which is part of the capstan servo and lower drum assembly.

These pulses from the control track are what controls the capstan speed. In the upper drum, coils are turning at 30Hz, in close proximity to coils which are mounted stationary in the lower drum. The magnetic pulses derived from this process are

constantly monitored and compared to the pulses from the control track.

### Servo/capstan operation

There are two servos in a VCR. The speed of the upper drum servo is controlled by the drum servo. The tape speed as it travels through the VCR is controlled by the capstan servo. Tape travel in play and record (from left to right) is accomplished by the capstan motor. At normal or S.P., the speed of the tape is about 33.4 millimeters per second. This tape speed is critical, and if it is not constantly controlled and corrected you will experience several tape problems, such as video jitter, slow audio, wow and flutter in the audio, and also fast audio. Feedback signals, (pulses) are sent out by the capstan



**Figure 6.** The video drum motor is usually a dc direct drive type. Precision circuits drive this motor, and supply continuous feedback to the servo control circuitry.



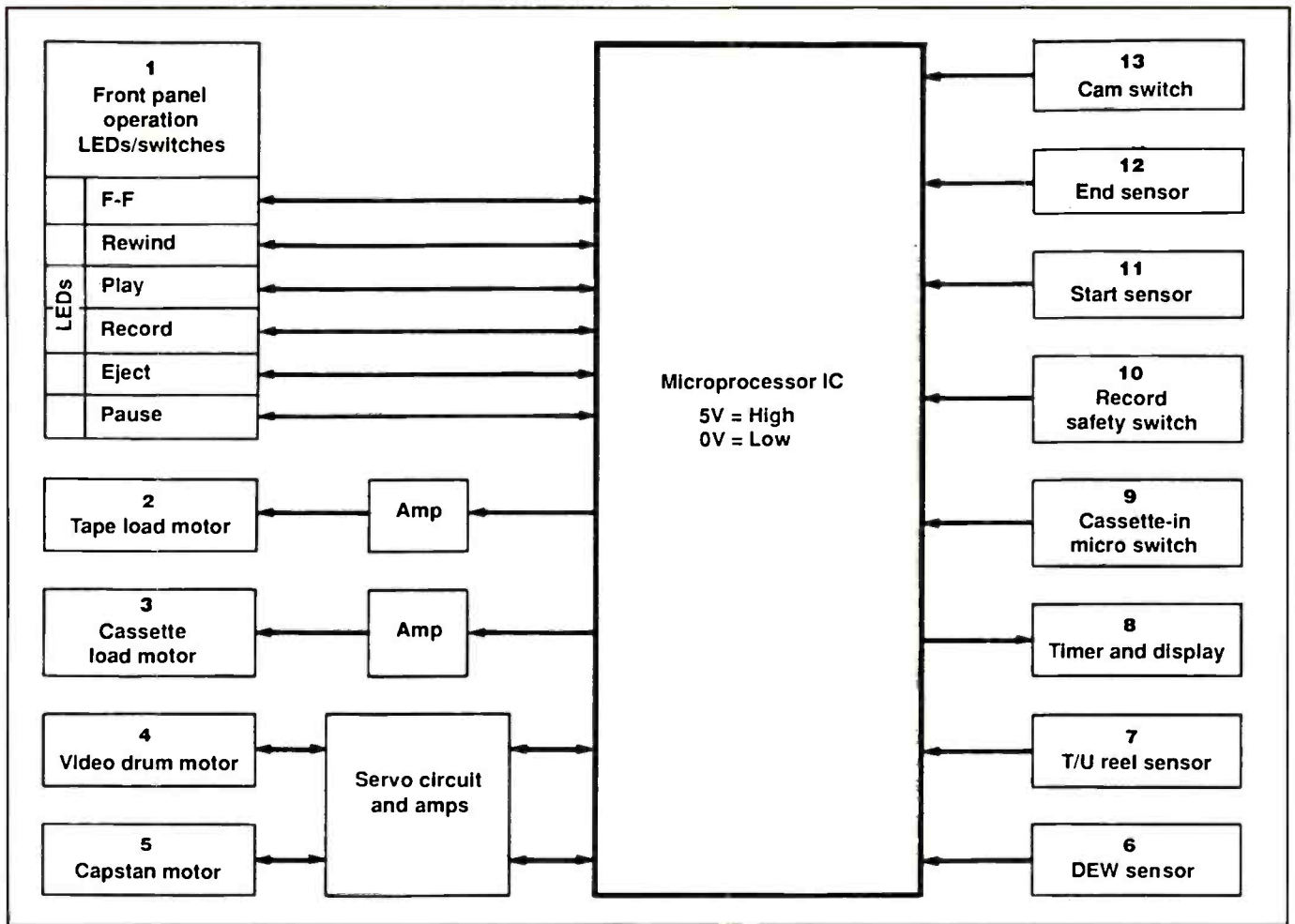


Figure 7. VCRs are equipped with a number of sensors that control operation and prevent damage to the unit.

motor, in much the same way as the drum motor pulses are generated.

Hall effect, or fixed coil mechanisms are what develops these feedback signals. In the L.P. mode, the frequency of the pulses is 360Hz, in S.P. approximately 720Hz, and 240Hz in the E.P. mode.

A coarse speed control, developed by the frequency-generated pulses keep the speed of the capstan correct and at the same time compares them to the reference signal of 3.58MHz, (divided down to about 30Hz).

Amplified pulses are sent to another VCR circuit. These are interpreted from the control track of previously recorded material on the tape. A very fine capstan speed control is developed in this manner. (phase comparison of the reference signal of 30Hz from the 3.58MHz signal previously divided down). This error signal which is also a dc pulse or signal, (the comparison result), then gets fed to the drive circuit of the capstan and drives the tape and shaft of the capstan.

In record, the speed of the capstan

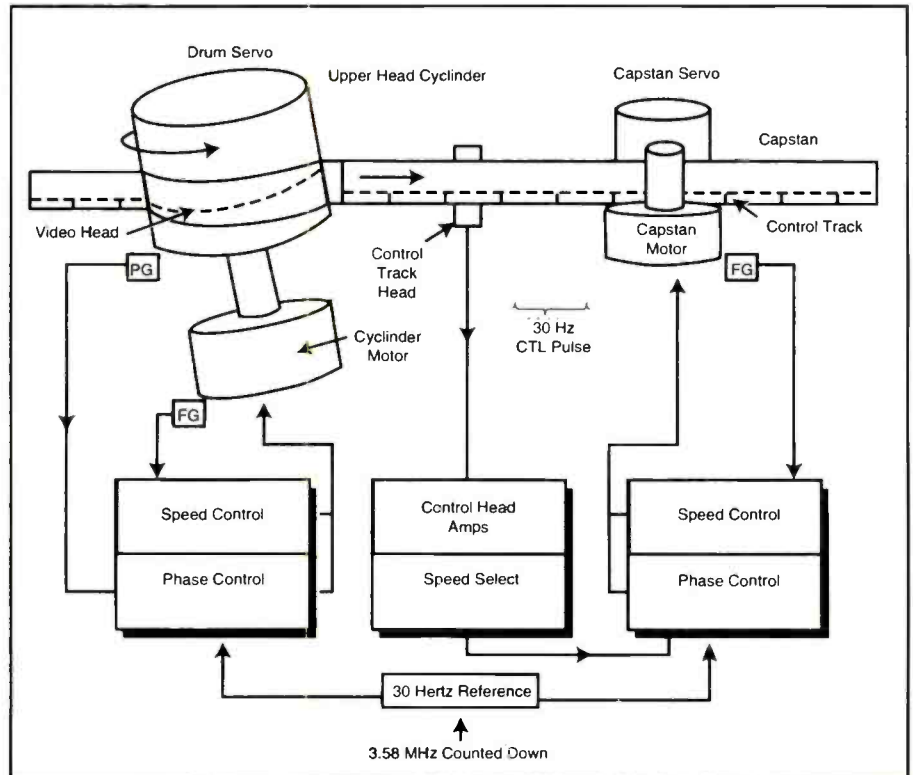


Figure 8. On two-head VCR's, the heads are located in the top cylinder area.

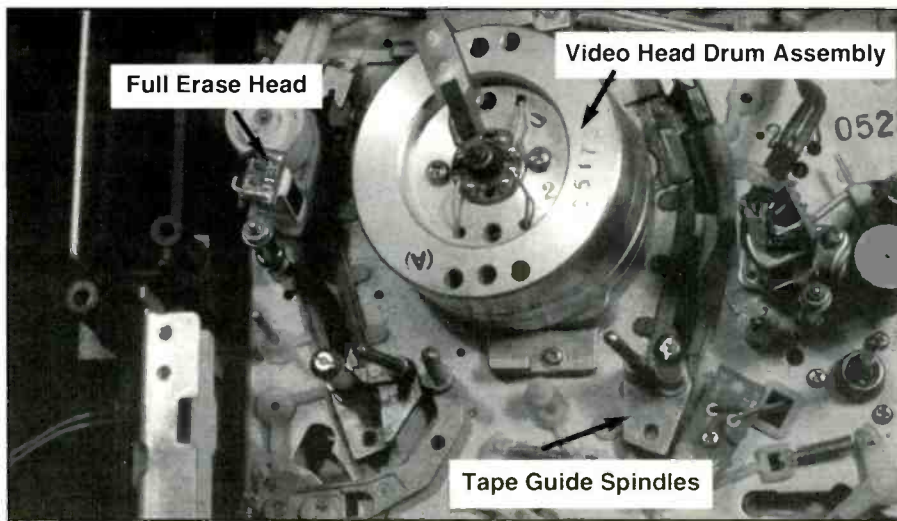


Figure 9. The heads on two-head VCRs are placed 180 degrees apart on the drum.

results from the 30Hz reference signal being compared to the 720Hz signal from the capstan. What keeps the motor at the correct and constant speed, is the result of this comparison or error signal.

The vertical sync signal develops the 30Hz control signal or pulse which is recorded on to the cassette tape control track. The automatic selection of what speed was used during record is the direct function of the control pulses on the control track being compared by the capstan servo, resulting in the same speed during playback, as during record.

The tracking control process is derived from the divided reference signal of 3.58MHz. This result will usually correct for differences in tracking from tapes recorded on different VCR units.

### Overview

At the heads, the signal from the fm luminance starts (Figure 12). The signal is picked up by the turning heads, electronically induced through the windings of the rotary transformer, and then sent to the pre-amplifiers in the heads.

The a/b head switcher selects the output signal from the head preamps (Figure 13). The signal sent to the other circuits in the VCR, is from the head that touches, or is in contact with the VCR cassette tape. This prevents noise or interference from the head not in contact with the cassette tape from showing up as trash in the reproduced picture.

Separation of the fm luminance signal from the chroma, which was down-converted, takes place after the a/b head switcher. Separate processing of the lumi-

nance and color signals occurs, then they are recombined at the Y/C mixer. This output signal is the composite video, and is sent to the rf modulator and video output jack on the VCR unit. (note: remember that the processed fm luminance signal will be different for the 8mm, VHS, U-matic and Beta formats.)

### VCR test equipment

Most of the standard equipment used for color TV servicing will work nicely for VCR troubleshooting. Personally, I like the following.

A good DMM, digital voltmeter, frequency counter, video/audio signal generator, logic probe, and a good 100MHz dual-trace scope.

### Tools and service aids

Good quality hand tools are a must for VCR service. Four-inch miniature cut-

ters, 4" long nose, curved tip long nose, a set of jeweler's screw drivers, set of assorted steel picks, (for hooking, unhooking springs especially), screw drivers, plain and Phillips, pliers, etc.

First and foremost, "safety first". Do not attempt a VCR repair without using an isolation transformer. Secondly, use a low power soldering iron, (grounded tip), or temperature controlled solder station. You will also need a vacuum type solder sucker, desoldering wick, or both.

Various chemicals and cleaning supplies are also needed to perform expert VCR service. For cleaning the video heads, a good liquid head cleaner, and special 4" x 4" cleaning cloths. I prefer the cloths to the chamois-tip cleaning swabs, because they are less likely to hang up on the heads. Use a horizontal swipe, side to side on the heads rather than up and down, which can break or bend the heads.

For the full erase and A.C.E. head, the foam-tipped cleaning swabs do a good cleaning job. They are also good for cleaning the tape guides, spindles, impedance roller, idler tires, pinch roller and capstan shaft.

For very dirty or corroded video heads, that regular cleaner won't work on, use a *little* acetone on a cloth. This will usually take care of the problem. Don't let the acetone get on anything plastic, as it will eat right through it. Having to replace a cabinet, etc., when all the unit needed was a good cleaning and adjustment, can be expensive for the service center.

If you don't have a VCR test jig cassette body (Figure 14), I suggest that you get a couple of these devices. They are not that expensive, and they will allow you to see

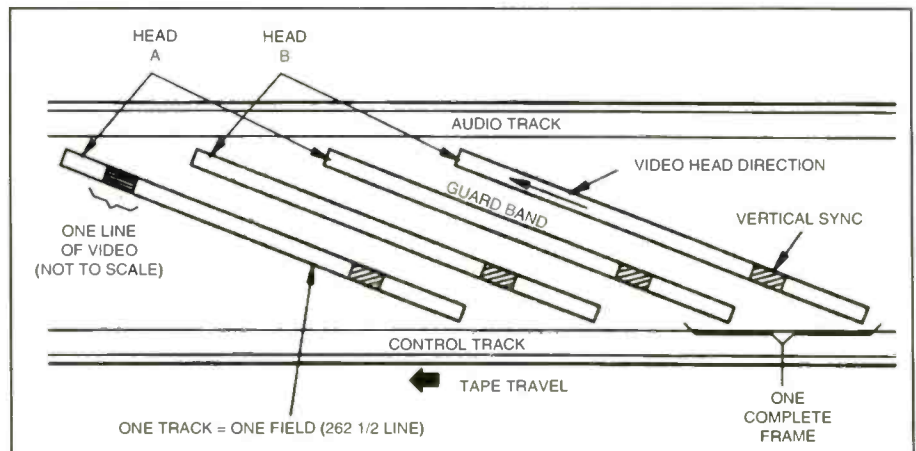
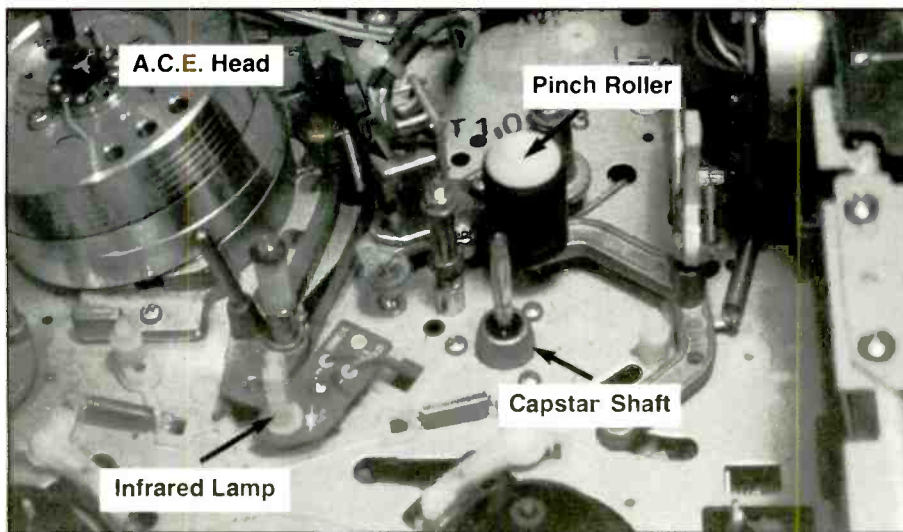


Figure 10. A "swipe" is performed each time the heads come in contact with the video tape. During this time or "swipe", video information is either read, (during playback), or in the case of record, it is written onto the videotape.



**Figure 11.** The 60 cycle per second sync signal received during the record function is split in two, amplified and then carried to the control head, which is part of the audio-control-erase head (A.C.E.) assembly. The control head then records these 30Hz pulses onto the video tape. These pulses are read back during playback of the tape by this same control head, which will compare these recorded pulses to the ones developed from the VCR's feed back circuit, which is part of the capstan servo and lower drum assembly.

the mechanical operation as you run the VCR through its cycle.

A bottle of rubber re-grip is very helpful for re-dressing those rubber tires, belts, etc. Over a period of time rubber

drive components get slick and shiny, and no longer grip as they should. If the rubber is cracked and dried out, all you can do is replace the part. You will also need some VCR grease, and an injection-type

dispenser of light lubricating oil. Use these items sparingly, as it doesn't take much to do the job. Cans of compressed air are handy for blowing away dust, and drying damp parts you have cleaned.

### VCR replacement parts

Stock your service department with a good selection of fuses, resistors, capacitors, filters, bridge rectifiers and power diodes. Also keep a supply of the most popular idlers, tires and belts. I buy these individually, as well as in kit form for a particular brand of VCR. You will find that what fits one brand of VCR may also fit another brand.

The tape transport and mechanism can be the same in a variety of VCR's. I also carry a pretty good supply of the most popular transistors and IC's.

How many replacement video heads to carry in stock is up to you. I don't carry that many, as it doesn't take that long to order them and have them delivered.

Spare screws, springs, etc. are also a good stock item. More than once have I misplaced a vital screw, or had a spring fly off, never to be seen again. This brings

## Cable/CE joint engineering group defines basics for cable ready DTV receivers

Activity is taking place on many fronts to make digital TV a reality. Recently, a working group of the Joint Engineering Committee (JEC) of the Consumer Electronics Manufacturers Association (CEMA) and the National Cable Television Association (NCTA) identified eight essential elements of all cable-ready digital TVs. These building blocks are fundamental to the reception of DTV programming which use the transmission standards developed by the Society of Cable Telecommunications Engineers (SCTE).

"If cable operators adhere to these standards and receivers are designed to support them, all non-scrambled cable programs would be accessible by commercially available digital receivers without the need of a set-top box," said George Hanover, vice president of engineering for CEMA.

The JEC concluded that, while these components are needed, they will consider additional functions before recommending the final definition of a cable-ready digital receiver. Other important aspects include if and how the receiver will descramble premium programs and link to external products and services which may not be supported in the receiver itself.

For example, the group is considering the plug-in descrambler defined by another JEC committee and standardized under

EIA-679, the National Renewable Security Standard. "If a descrambling function can be added to the elements of the cable-ready receiver, a majority of the needs of cable subscribers will be served with the receiver only," said Hanover. Also, for example, to add extra functionality, a high-speed digital interface based on the IEEE 1394 can be included.

According to the working group, cable-ready receivers and cable operators should:

1. Support ATSC Digital Television Standard A/53, which describes the overall system characteristics of the U.S. ATV system.

2. Follow RF performance recommendations per draft EIA-23 (RF Interface Specification for Television Receiving Devices and Cable Television Systems) which defines tuner and corresponding cable signal characteristics,

3. Tune cable channels per EIA-542 (Cable Television Channel Identification Plan) which lists the frequencies to be used for each cable channel,

4. Use only 64/256 QAM modulation as specified in SCTE standard DVS-031 (Digital Transmission Standard for Cable Television) or 8VSB and possibly 16VSB modulation, as defined in ATSC A/53,

5. Support draft standard SCTE DVS-093 (Digital Video Service Multiplex and Transport System Standard for Cable

Television), which defines the MPEG-2 packetization of program material.

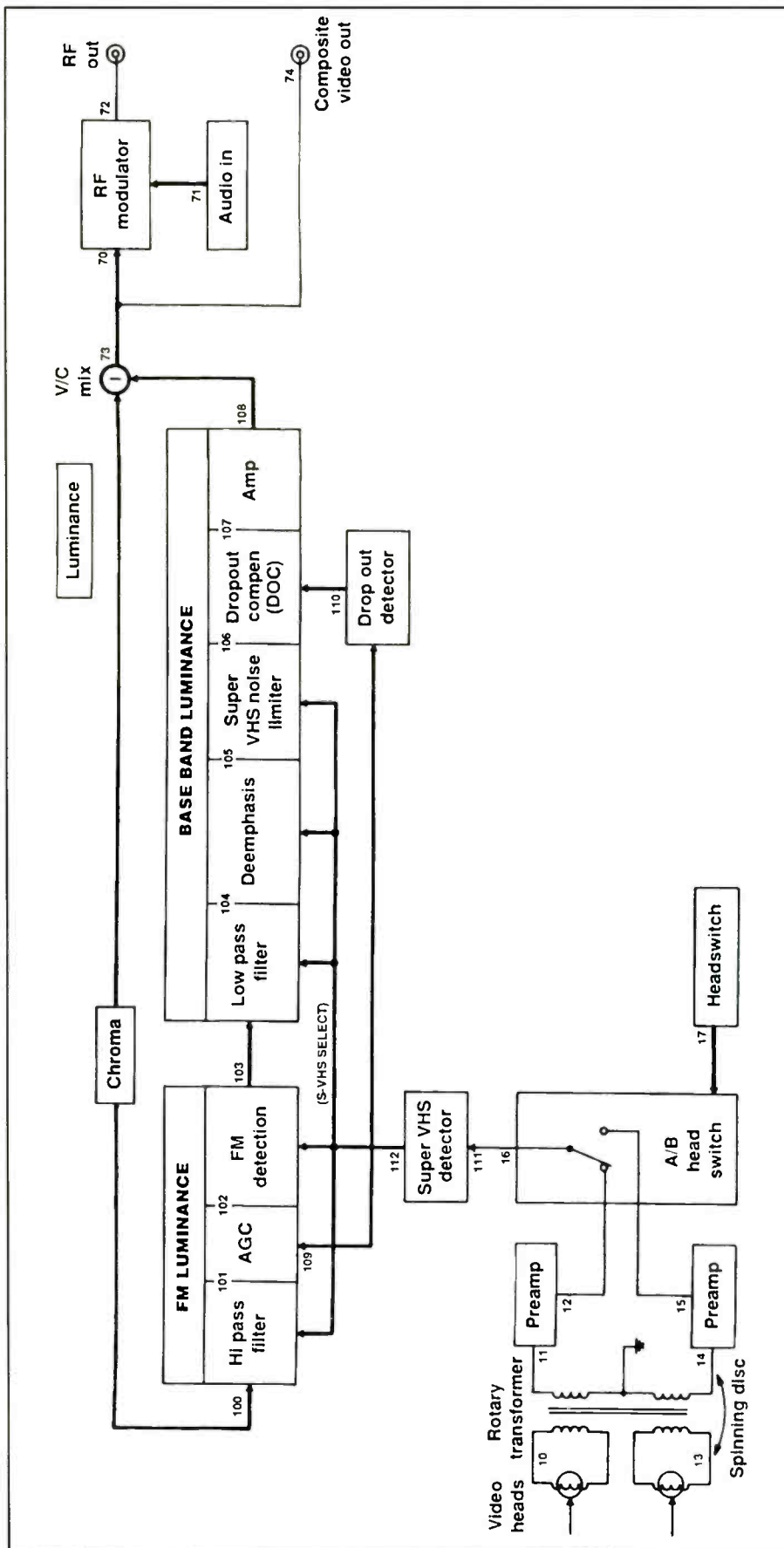
6. Use only the transmission video display formats defined in ATSC standard A/53 table 3 and in table 2 of SCTE standard DVS-033 (Submission on "Class A" Issues-Profiles, Levels and Formats),

7. Use the in-band Program and System Information Protocol for Terrestrial Broadcast and Cable, SCTE standard DVS-097, which defines the data format for tuning parameters, v-chip information and on screen program guides, and

8. Support emergency messaging.

The JEC, in part, advises the Cable/Consumer Electronics Compatibility Advisory Group (C3AG) on technical matters. The C3AG is expected to take the JEC's recommendations to the Federal Communications Commission (FCC).

CEMA is a sector of the Electronic Industries Alliance (EIA), the 74-year-old Arlington, Virginia-based trade organization 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. CEMA also sponsors the International CES, the world's largest annual trade event for consumer technology. The 1999 show will sponsor a wide variety of new DTV products.



**Figure 12.** At the video heads, the signal from the fm luminance starts. The signal is picked up by the turning heads, electronically induced through the windings of the rotary transformer, and then sent to the pre-amplifiers in the heads.

up another point. Obtain several small plastic cups or trays. These will keep parts removed from the VCR in order, and also keep them from getting misplaced.

As far as service information goes, it's entirely up to your pocket book. Some of it is quite expensive. Howard W. Sams is a pretty good bet here. Factory service information may be more expensive. Sams is very good about showing parts lay-out and placement.

One more thing; a VCR cross-reference manual will be worth every cent you pay for it. As mentioned earlier, different brands of VCR's contain the same mechanism and circuitry. This will aid you in not duplicating service information.

Keep in mind also about 80% of all VCR problems are mechanical in nature. As you become more familiar with the various VCR problems, you will find yourself correcting defects that run common to several brands of VCR's.

There are also other service publications available relating to VCR service, as well as some good video instruction tapes.

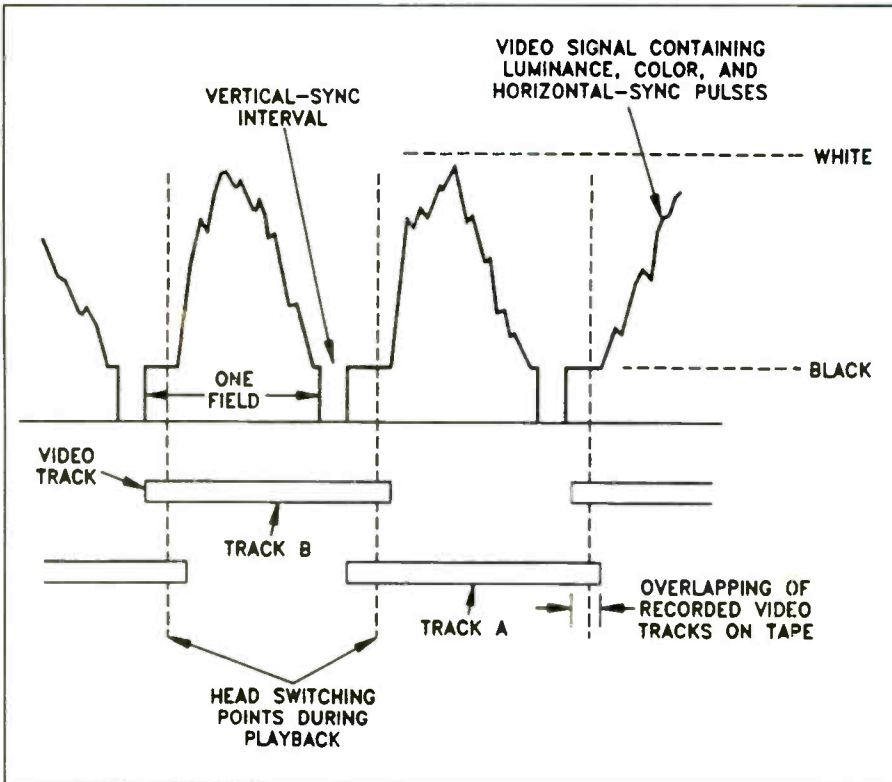
The following will make your job a little easier. Purchase a good VCR test tape. You will be surprised how it can help you pinpoint an audio or video problem.

You will also want to keep some inexpensive videotapes that won't cost you a fortune if the machine happens to eat one up. Buy some of the more expensive videos to use for the final play-out. Also, have on hand some blank videos for making your own test tapes, or for checking out the record functions.

What I usually do after the preliminary checks have been made of the power circuits is to insert one of the cassette test jigs mentioned earlier. This lets me go through the operation of tape-in, loading, and tape transport operation, as well as observing how the idlers and belts are working. I then use one of the inexpensive pre-recorded video tapes and check the audio, color, video, sync, etc. This also gives me a pretty good clue of how much cleaning and adjustment will be involved. After a complete cleaning of the VCR, I put in a test tape and checked the quality, and then perform the final tune up.

When I'm satisfied that the unit is ready, I put it on the play-out shelf and play a complete movie through it.

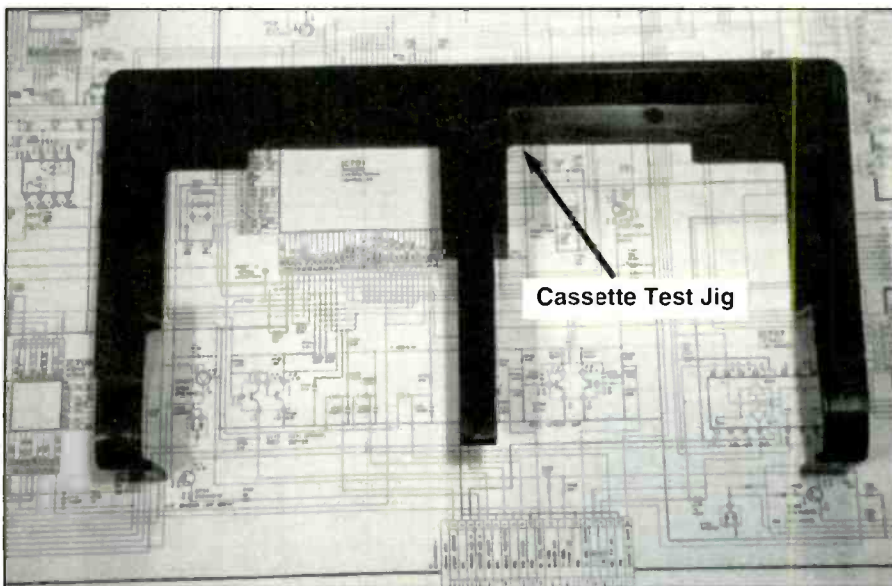
A good solution to a problem with having several VCR's on the play-out shelf



**Figure 13.** The a/b head switcher selects the output signal from the head preamps. The signal sent to the other circuits in the VCR, is from the head that touches, or is in contact with the VCR cassette tape. This prevents noise or interference from the head not in contact with the cassette tape from showing up as trash in the reproduced picture.

at once, is to use an electronic video switcher. This allows me to play test four VCR's at the same time. All VCR's are hooked to the switcher, and its output goes to one monitor. It will flip flop back and forth from VCR to VCR, and the time on

is adjustable so you can keep an eye on all of them, in case an unexpected problem pops up, or one of the VCR's develops a problem that doesn't show up it has played for some time. (especially an intermittent or heat problem). ■



**Figure 14.** A VCR test jig cassette body is not very expensive, and will allow you to see the mechanical operation as you run the VCR through its cycle.

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supplies to be calibrated in the case, eliminating the time and expense of sending the power supply to a third party for adjustment or repair. The software sends calibrated constants for output voltage and current to the supply via the front panel keys. The supplies can then be calibrated using a shunt resistor, accurate voltage meter and the front panel. A large character, "understandable" LCD display offers fast, simple readings.

The model 1780 offers dual output, with popular ranges, from 0Vdc to 18Vdc voltage and 0A to 4A dc current, and total power of 144W. The 1775 also offers dual output, with dc voltage ranges from 0Vdc to 35Vdc, dc current 0A to 2A, and total power of 140W. The 1770 offers dual range, with dc voltage selection from 0V to 17.5V or 0V to 35V, and available dc current from 0A to 6A or 0A to 3A, with total power of 105W. All units provide 12-bit D/A converter accuracy.

Circle (103) on Reply Card

### RF field analyzer

AW. Sperry Instruments announces their new RF Field Analyzer Model 3200.

The RF-3200 offers a wide band reception ranging from 100KHz to 2060MHz. The RF-3200 is designed to fill the maintenance and installation needs of the mobile telecommunications market including cellular telephones, cordless telephones, CB radios, and paging systems, as well as cable/ TV, and satellite receiving equipment applications.

Features include the ability to analyze Narrow Band FM (N-FM), Wide Band FM (F-FM), AM and Single Side Bands (SSB) modulated signals. PLL Tuning Systems, up to 160 channels displayed simultaneously, built-in frequency counter, and built-in speaker, as well as RS 232C Interface.

Circle (104) on Reply Card

### Hands-free dual lens magnifier

The MagEyes hands-free dual lens magnifier from Jensen Tools offers clear distortion-free magnified viewing in a comfortable, ultra-lightweight (1-3/4oz) head-mounted unit. Binocular lenses change power from 2.5X to 4X power. The magnifier has a cushioned headband.



The visor swings out of the way when not in use. The product may be worn with or without glasses.

Circle (105) on Reply Card

### Portable flameless heat gun

The Micro-Therm portable flameless heat gun from Wahl Electronics is powered by a replaceable butane cartridge that is readily available and economically priced. The unit reaches an operating temperature of up to 1200F within 10 seconds to perform a wide variety of heating tasks. A single cartridge provides approximately 20 minutes of continuous use. The heat gun's small, lightweight design makes it a useful portable replacement for many jobs previously performed by a heavy, corded heat gun. Applications include shrinking tubing, activating adhesives and potting compounds, forming plastics and laminates, bending PVC, pre-heating flux, stretching and repairing vinyl, and general heating and drying.

A heat deflector is included to allow the unit to achieve higher heat efficiency in certain applications and to provide additional protection from the heat for surrounding components.

Circle (106) on Reply Card



physical network as well as the devices to communicate and share information over that network. The standard covers the complete physical layer (OSI Layer 1), including the interface to the medium access control (MAC) layer and the interface to the medium. Additionally, the standard provides a set of physical and electrical specifications for the connecting cable and the specification for a number of data channels on the medium.

Interested parties can order EIA/CEMA standards through Global Engineering Documents, 1-800-854-7179 or <http://global.ihs.com>. CEMA engineering information can be found on CEMA's Website, [www.cemacity.org](http://www.cemacity.org).

CEMA is a sector of the Electronic Industries Alliance (EIA), the 74-year-old Arlington, Virginia-based trade organization 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. ■

## Answers to TYEK

(from page 23)

1. High Definition TV

2. A

3.  $27 \times 1.36 = \$36.72$

4.  $27 - 8 = 19V$

5. 1V

6. 
$$\frac{30 R_x}{30 + R_x} = 18 \text{ So, } R_x = 45$$

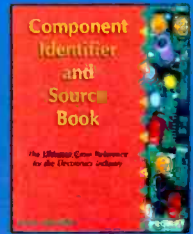
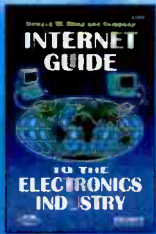
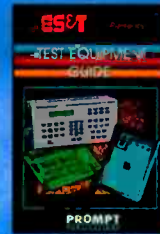
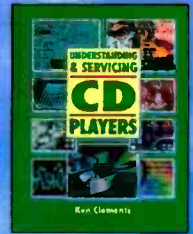
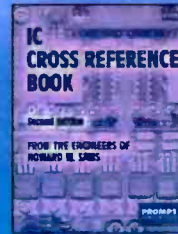
7. One-half of a pill. Doctors don't seem to realize that!

8. The sun

9. Siemens

10. Ohms

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Emerson radio model 5-38, music cone and 90V B+ battery and 16 to 45V B+ batteries. *Contact: Apple Electronics, 3428 E. Bankhead Highway, Lithia Springs, GA 30122, 770-948-9895.*

Sony 1040 series projector tubes part number SD-187G, B or R. *Contact: D. McNggly, 562-924-2666.*

Hitachi schematic for SR2004 stereo receiver. Sony KV-1370R VIF IC module. Motorola MRF309 RF power transistors. *Contact: C. Ellis, 9419 Wallre Rd. E., Tacoma, WA 98446, 253-531-8142, e-mail: rminc@wolfenet.com.*

Dell color monitor display GPID-16C schematic. Northern transceiver model N550. *Contact: Joe Syczyle, 208-865-2216.*

Fisher VCR service manuals. *Contact: Ed Herbert, 410 N. Third Street, Minersville, PA 17954.*

Tektronix oscilloscope model 2215 with owner's manual. *Contact: Winston Bennett, 905-279-5340.*

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| 2SC1730   | 2SC2362  | 2SC3203  | 2SC380 |
| 2SC1740   | 2SC2362  | 2SC3203  | 2SC380 |
| 2SC1740S  | 2SC2362  | 2SC3203  | 2SC384 |
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