THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

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New technology update

Some general software packages

VCR service centers: Tips on remaining profitable

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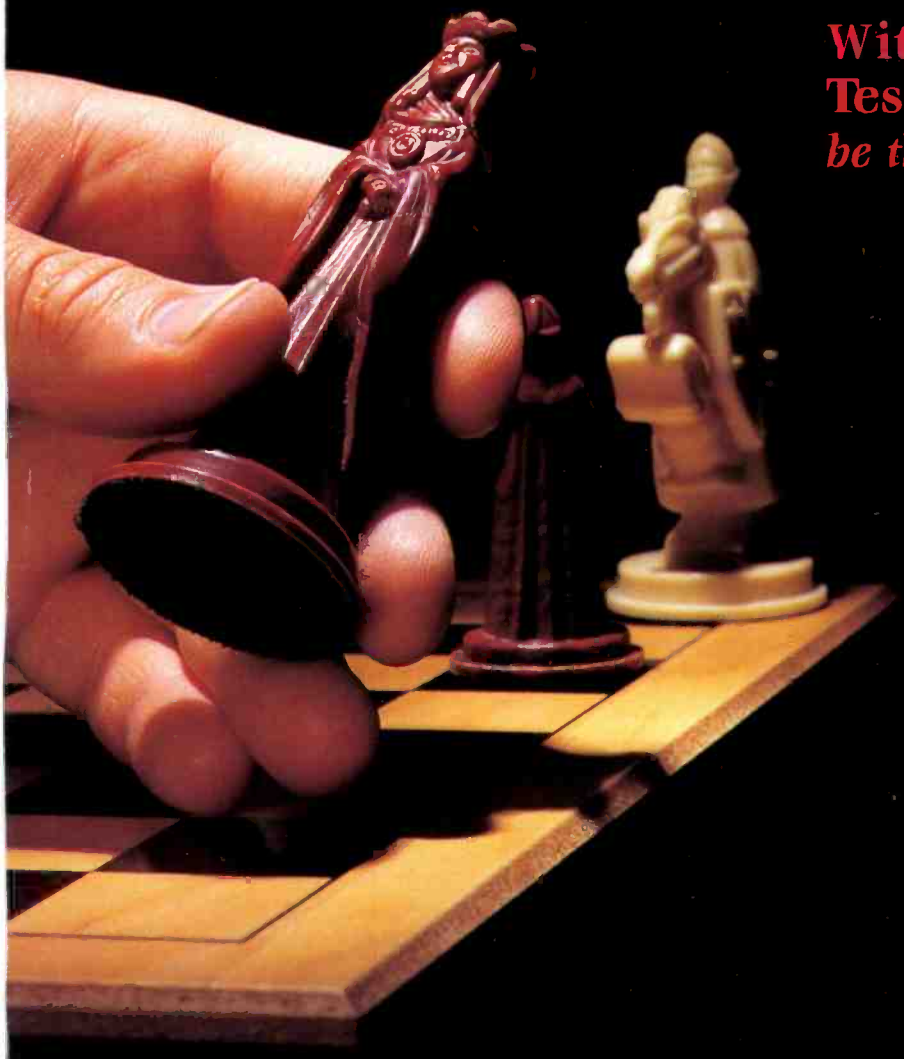

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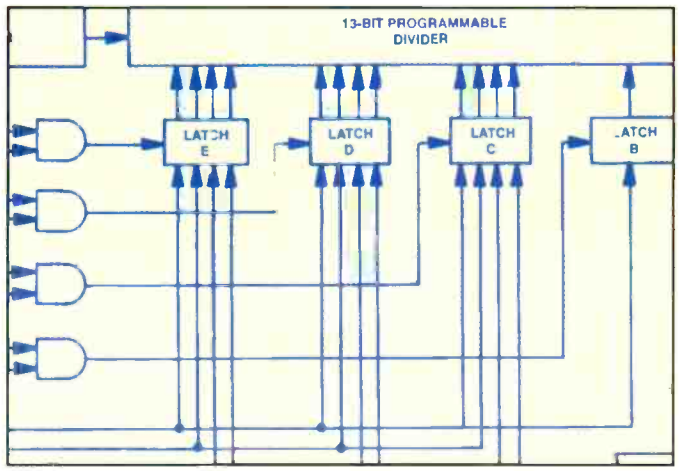

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ON THE COVER

It is a lot tougher these days for service centers to make money servicing VCRs. Many service centers may not survive the transition caused by the low-priced new units available on the market. There are some things a service center can do to increase the likelihood of survival. (Photo courtesy of Tentel)

Computers and software

When the first computer was built, it had a very limited and specific purpose: to calculate the trajectories of artillery projectiles to be fired during World War II. By today's standards, it really wasn't much of a computer. Even though it was huge, and took kilowatts of electricity to operate it, it had limited computing power, and was programmed by the paths of wires in a wiring patch panel.

Since those early days, computers have evolved from vacuum tubes to transistors, then to integrated circuits, and have shrunk in size from something that would fill several rooms to something that will fit into a shoe box.

Every bit as important as the evolution of the hardware is the evolution of the software. In those early days, and for many years since, the user of any computer had to pretty much program it for himself, or hire someone to program it. As with any technology, that meant that only people who were computer professionals were using computers, or people who could afford to hire a computer professional to program their computers.

Over the years, computer software has been written to be easier to use, and software manufacturing companies have churned out huge numbers of software programs that cover a broad range of interests that are extremely comprehensive, and that are easier and easier to use.

The first general-purpose software package that really caught on with personal computer users was the word processor. Early versions of this software were really a huge improvement over the venerable typewriter. The most obvious advance was that now a writer or typist could type a document into the computer, check it over, make corrections on the screen, rearrange words, sentences, and paragraphs, and turn out a perfect document without doing any major retyping.

Over the relatively few years during which word processing software has existed it has undergone major improvements. In those early days, a word processor could turn out a pretty good looking letter. Today, a word processor with page layout capabilities can turn out a letter, a newsletter, or even a camera-ready magazine page, complete with photos and line art.

Other software has undergone similar evolution. Spread sheet and database software have evolved from relatively simple programs that could crunch numbers or store and retrieve data to full-featured programs that include word processing and graphic capability. Specific application software based on database programs, such as contact management software, allow someone who has only a rudimentary knowledge of computers to use all of the power that a computer offers.

Specific applications software has even made computer users and enthusiasts of people who really weren't interested in computers in the abstract. For example, I know one man, Jack, who got involved in computers because of his love of flying.

I met Jack at an electronics association convention. He was selling an on-line troubleshooting tips database service. He was not a computer professional or an electronics professional, so I asked him how he came to be involved with both.

Jack's reply was that he loves to fly, but can't do so as often as he'd like, so when he became aware of a personal computer based flight simulation program, he bought a computer and a copy of the program. He then became a computer enthusiast and that led to his employment with the database service company.

Because they're such general-purpose information-processing machines, and because they have become so much easier to use, computers are being used by people who have no interest in "computers" as such. Artists paint and draw using the computer. Graphic designers lay out newspaper and magazine pages using the computer. Sales people manage their lists of customers and contacts using computers. In their homes, people store and retrieve recipes, keep inventories, design and produce cards and banners using computers.

The computer has also been a boon to consumer electronics service. Not only do service centers use computers to help manage the business and to store and retrieve troubleshooting information, but they are also products that service centers can make a profit on servicing. And as the continuing evolution of software makes computers more general in purpose and easier to use, more consumers will have computers that need to be serviced.

Nils Conrad Persson

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SmarTips

Locate Philips Service Tips on TVs, tuners, VCRs, camcorders, CD-audio and video players, monitors, etc. right in your computer! Just a few keystrokes, and you have a list of tips on Philips, Magnavox, Sylvania, and Philco products to help solve some of the difficult repairs encountered every day. Tips are taken from Service Reporters and from reports called in to our Technical Assistance Department–you can even add your own tips to the list!

Update #1 and #2 for Thomson's FixFinder Program

If you have Thomson's Fixfinder Program, and you service Philips, Magnavox, Sylvania, or Philco TVs, VCRs, and camcorders, you shouldn't be without these updates! Tips from Service Reporters, Service Bulletins, and from reports called in to our Technical Assistance Department are incorporated into the program to make servicing easier.

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News

California State Electronics Association becomes Professional Servicers Organization of California

The California State Electronics Association became known as the Professional Servicers Organization of California effective January 1, 1995. After a complete reorganization that took almost three years to accomplish, the members voted in the new name at a meeting held on November 11 to 13, 1994.

The new system will allow the unification of all industries that are in service and finally be the voice for all. It intends to work together with all to provide a better future for the organization, its members and the service industry.

Video sales set new standards for October

The video market continued to set new sales standards in October 1994. According to the Electronic Industries Association, all-time October bests were recorded for direct view color TVs, projection TVs, camcorders, and TV/VCR combinations.

"Despite consumer uncertainty about the future of the economy, we're still experiencing considerable growth in the video market," stated Jack Osborn, president and chief operating officer of Mitsubishi Consumer Electronics America, Inc. "Our research indicates that there is a significant amount of replacement buying underway and the home rebuilding cycle is finally beginning to affect television sales. Addi-tionally, consumers have plenty of disposable income and manufacturers have introduced aggressive credit promotions to provide incentives for other groups of consumers.

Combined sales of all video products were up 10 percent over October 1993, and are up 8 percent for the year to date. Video sales are benefitting from a strong domestic economy (3.5 percent growth in the third quarter), although consumer purchases of these products are in stark contrast to their perceptions on the economy as a whole. In a recent poll of 708 adult consumers conducted by the Bloomberg Business Report, 59 percent believe the U.S. economy is still in a recession. Another study of 1,000 adults by ABC News reported only 32 percent of those surveyed feel the economy is improving. But that broad pessimism about the economy hasn't dampened buying expectation for video products. Buying intentions for color TVs, VCR decks, and camcorders were up fractionally in October from the previous month.

Color TV sales rose a solid 6 percent in October and are up 8 percent for the year to date. Shipments of 25-inch sets were particularly strong rising 13 percent in October. Additionally, projection TVs were up 40 percent in October, helping the projection market to average monthly growth of 39 percent through the first 10 months of 1994. It has had only one month where growth was less than 21 percent (14 percent in January 1994).

Sales of VCR decks set an all-time October high with volume of over 1.5 million units (up 16 percent over 1993). Monaural decks outperformed stereo models by a small margin. Additionally, camcorder sales were up 4 percent in the month and are up an additional 4 percent in the year to date.

Osborn says that when all the 1994 numbers are in, "I believe we'll see record sales." Clearly the growth is in the home theater market and large screen TVs are the driving force for the video market. But other video categories are showing strength as well, and should remain healthy well into 1995. Camcorder sales are up, and VCR decks continue to be a strong seller in the market. In the end, consumers will benefit tremendously from the vitality of this segment of the market. It all comes down to a few basic concepts for our industry; value, quality, and the availability of cash by the consumers or reasonable credit terms. When they've got the cash, they want to buy something that lasts, and that means our products," concluded Osborn.

EIA is the 70-year-old Washington, D.C.-based trade association representing all facets of electronic manufacturing. EIA's Consumer Electronics Group represents U.S. manufacturers of audio, video, home office, home automation, mobile electronics, and accessories products, as well as assistive devices for people with disabilities.

Mobile Electronics Show targets success in Philadelphia

The 1995 Mobile Electronics Show (MES), the "Spring Break '95" event for the 12-volt industry will be rolling into Philadelphia's Pennsylvania Convention Center April 7 through April 9, 1995. Each year the success of MES reflects the growing interest of consumers in purchasing mobile electronics products. Products featured at MES include autosound and security, as well as pagers, cellular, vehicle navigation products and mobile electronics accessories.

MES has signed more than 83 exhibitors and allocated more than 57,000 square feet of exhibit space.

"Considering that we have already sold more than half of last year's total exhibit space and we are six months out from the Show, we expect a very successful turnout in 1995," said Robbi Lycett, MES show manager. "Our goal is to exceed last year's record show in terms of size. We expect to sell out the show after the Winter CES in January."

Lycett added that exhibitors are excited about the new Philadelphia location for the show which has taken place in Atlanta in 1993 and 1994. In 1994 the Electronic Industries Association (EIA) co-sponsored the MES with Bobit Publishing, the Show founder. EIA assumed the role of sole manager of MES beginning with the 1995 Show. All profits from the Show are reinvested into the programs and activities of the EIA, including the Mobile Electronics Certification Program (MECP) and other services for the mobile electronics industry which are offered by EIA/CEG's Mobile Electronics Division.

Mobile Electronics, otherwise referred to as the 12-volt industry, is one of the fastest growing segments of the consumer electronics industry. According to the Electronic Industries Association, the mobile electronics industry—including aftermarket autosound, cellular telephones, pagers and aftermarket vehicle security—will grow an estimated nine percent in 1994, and five percent in 1995.

The 1996 Mobile Electronics Show will take place in Orlando, April 19 through 21, 1996.

EDS offers travel and housing discounts

The Electronic Distribution Show and Conference (EDS) has made it even easier to travel to Las Vegas for EDS '95. EDS has negotiated a number of travel

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General software for the service center

By The ES&T Staff

The introduction of the personal computer into our daily lives, both business and personal, has wrought many profound changes; so many that most of us can't really begin to appreciate them. Almost all small businesses now have at least one personal computer to handle customer contact information, keep track of inventory, perform accounting chores, and more. Organizations such as churches use the personal computer to perform many of these same types of functions, as well as to publish the weekly bulletin. At home, people are using their computers to track their family finances, store and retrieve recipes, play video games, write term papers, and even to keep track of Junior's Little League batting average.

The computer is a general-purpose machine

The computer is able to perform all of these functions because it is truly a general-purpose information processing machine. Its ability to handle information is limited only by the power of the processor, the size of both temporary and permanent memory, and the skill and imagination of the programmers who write the computer software.

In several past issues we have published articles about specific types of software. In one issue, for example, we talked about service center management software. In another issue we reported on diagnostic software.

The utility of the personal computer to the consumer electronics service business is not limited to those two types of software. There is a host of personal computer software, much of which was written without regard to the needs of electronics service, that nevertheless can be very useful in the service business. This article will look at a few of those products. We'll briefly mention such software as word processing, database and spreadsheet, but then place emphasis on products like electronics circuit diagnosis and design and computer-aided drafting (CAD).

The big three

Most individuals as well as businesses have a need to communicate on paper, to store and retrieve data, and to perform mathematical calculations. The personal computer is ideally suited to do all of these things, and programmers have designed many types of software to make it relatively easy for computer users to do them. Many companies have huge resources dedicated to devising and improving these types of programs.

Word processing

Perhaps the single most popular application of the personal computer is word processing. These programs allow the user to type up letters and other correspondence on the computer and save them in memory until it's time to print them. It also allows the individual to make corrections to the material before the page is ever printed, so even the least adept typist can turn out perfect looking material.

But that's only part of what a word processor can do. Because the software manufacturers employ a wide variety of talent, many word processor software packages have a broad array of features, such as pre-formatted pages, graphics capability, type available in a variety of sizes and styles. So the user can call up a certificate, design a letterhead or format a newsletter.

Some of the more popular examples of word processor software are Word Perfect, Word Star, and Word.

Spread sheet

Spread sheet programs, such as Lotus 123, Microsoft Excel and Quattro Pro, are extremely useful for anyone who needs to perform calculations in columnar fashion. The screen representation of the program consists of an array of horizontal rows and vertical columns. The intersection of a row and a column is a "cell." You can enter numbers in cells, and then use the program's functions to operate on the contents of the cells.

For example, if you enter several numbers that you want to add together, such as household expenses, then you can enter a formula into another cell that will give the sum of those numbers. If you wanted to, you could also take the mean, the mode or the average of the numbers.

A spread sheet is particularly useful for doing what accountants call "what if" types of calculations. For example, let's say you work out a business plan for next year based on increasing your volume by some percentage, and assuming a particular inflation rate, you can then go in and change those percentages and all calculations based on those rates will change.

Data base

Data base programs, such as dBase, Paradox, and Lotus Approach allow the user to store data and manipulate it in any of a number of ways, depending on the experience and skill of the user. Many database applications, such as service center software management programs, are based on one of these software packages.

Electronic circuit simulation

Some computer software programs allow the user to actually design a circuit on the computer screen and test it to see how it works. For example, there's a program called Electronics Workbench by Interactive Image Technologies that contains not only symbols for typical electronics components that can be hooked together, but it also has simulated test equipment on the monitor screen that can be connected to various points in the simulated circuit to read parameter values.

To start building the circuit, the user moves the mouse over to the "parts" section of the screen, clicks on the resistor, capacitor, or whatever, and drags it to the workspace on the screen, then drops it and runs "wires" to it. If the circuit gets too big for the screen, simply scroll and keep building. Because the wires are routed automatically, and a grid is available, even complex circuits are readable.

All commands can be issued from simple menus with a mouse, and common operations have keyboard shortcuts. You can cut, copy and paste groups of components, or put components into a subcircuit, a kind of "black box." It's even possible to put one subcircuit inside another to simplify complex circuits. Subcircuits can be used simultaneously in many places in a circuit and stored for later use.

Parts

Simulated ideal and real-world circuit components, available from a "bottomless" bin include resistors, capacitors, inductors, relays and transformers. The user has precise control over their values. Active components include diodes, Zener diodes, NPN and PNP BJTs, op amps, JFETs and MOSFETs. Voltage controlled and current controlled as well as independent sources are included. The parts bin also contains voltage and current controlled manual and time delay switches.

Ideal and real-world models

For each active component, you can use either an ideal or real-world model similar to those found in data books. An ideal op amp, for example, has a near-infinite, open-loop gain and slew rate. The parts bin also provides a selection of real-world op amps that take into account the unity-gain bandwidth, input-bias and offset currents, etc.

Instead of an ideal op amp, you can select, for example, an LM741 from the model list. The analog module also includes an editor to investigate or alter any of the models, or to create your own. Edit or create your own models for op amps, BJTs, diodes, JFETS and MOSFETS.

Test equipment

The program has a function generator that produces square, triangular or sinusoidal waves. The user controls the frequency from 1Hz to 999MHz, the duty cycle, amplitude and dc offset.

A simulated dual-trace oscilloscope behaves like the real instrument. It supports internal or external triggering on either the positive or negative edge, and the time base is adjustable from seconds to nanoseconds. You can even study hysteresis by plotting the signal amplitude on the axes.

The simulated autoranging multimeter measures current, voltage, resistance and dB loss. You can measure a signal's dc or ac component.

SPICE simulation

Once you have designed the circuit, you can switch on the "power" and the program simulates the response of the circuit, using the international standard SPICE algorithm. The user has complete control over all parts of the circuit, as well as over SPICE models used to simulate active components. When a signal is first applied to a real circuit, there is a short-lived transient state before the circuit settles down to its final response. This software can be configured to present either the transient or the steady state.

Digital module

This program also offers a digital module with which you can design digital circuits. The parts bin contains an endless supply of ideal components. The selection of logic gates includes AND, OR, XOR, NOT, NAND and NOR. The selection of flip-flops includes RS, JK (clocked, negative-edge-triggered) and D

(positive-edge-triggered). There are also half-adders, seven-segment displays, switches and LED probes.

The test functions for the digital module include a word generator that drives a digital circuit by producing streams of 16-bit words and a logic analyzer.

Educational features

A service center could use this type of software for educational purposes. For example, if one of the technicians should need training or a refresher on any type of circuitry, the service manager could set him up with a computer with this software on it and let him study on his own.

Another feature of the software, however, is that the individual who controls the computer; instructor, service manager, or whoever, can introduce real world faults. For example, any component can be open-circuited or short-circuited, in a manner that's hidden from the student to give him troubleshooting experience.

Drafting

Another type of software that may be of value to service centers is drafting software. Every service center uses schematic diagrams in one form or another, and from time to time may have a need to draw partial diagrams of a TV or VCR or other consumer product.

Many times, such hand drawings do not very well convey the desired information because they're not clear and sharp. A drafting software package allows anyone who owns a personal computer to produce first class drawings, and not only of schematic diagrams, but of buildings, floor plans, and anything else that lends itself to drafting techniques.

There are a number of drafting programs available: Drafix, AutoCAD, CADKey and many more. We will use Drafix, one familiar drafting program , to present an idea of what can be done with one of these drawing packages.

The screen for Drafix for Windows contains a workspace on which to draw, and a number of items that you can draw, including lines, double lines, curves, polygons, ellipses, arcs and circles, and a huge set of symbols. The program contains symbols for use in all kinds of drawings: architectural, mechanical, landscape design, network layout and electrical/electronic. It would be impossible to do justice to a program like this in just a few pages in a magazine, so we won't even try. We'll just try to give an idea of how it's used.

Creating a drawing

To draw a line for example, once the program has been run, the user moves the mouse to point to the "Draw" menu item. This causes a submenu to drop down showing a number of choices. In this case, the user selects "Line," which causes a further submenu to open, allowing the user to select from among "Single," "Double," and a number of other choices.

If the user wants a single line, he chooses "Single." Now when the user moves the mouse, a cursor appears on the workspace that shows the location where the line will start. The user chooses a spot to begin the line and presses the left mouse button. Then the user moves the mouse to the point where he wants to end the line. As the mouse is moved, a "rubber band" line follows the mouse from the starting point to show what the finished line will look like once the button is pressed. When the mouse is at the desired point, pressing the left button again finishes the line.

To draw a symbol, the user chooses a library of symbols, then using a series of menu choices places the symbol such as a resistor, capacitor, inductor, transformer, transistor, or whatever, in the drawing. If the symbol library doesn't have the symbol you need, you can draw your own.

The program also provides for typing in callouts to identify the components in the drawing. Large drawings can be spread across a number of screens. Complex drawings such as building drawings that contain architectural features, plumbing/piping information and electrical layouts can be drawn in a number of layers so that the user can look at any one of the layers, or any combination of layers.

The computer can help

Computers and their software have definitely changed the way people do their jobs. They provide a number of features and functions that allow people to automate the work to be done and to look at the information they need to process in a variety of new ways. Consumer electronics service centers have such a broad variety of information processing needs that service center owners and managers should be constantly on the lookout for software such as that mentioned here that can help them do their difficult jobs. ■

Products

CAD for Windows

Foresight Resources Corporation announces Drafix CAD Professional version 3.0 computer-aided drafting software, designed to exploit the multiple document interface, object linking, built-in help and other features available in the latest version of Microsoft Windows.

This package includes the entire collection of symbol libraries as well as hundreds of sample designs and drawings.

The software improves both performance and the ease of user interaction by exploiting new features that are available in the latest release of Windows, including OLE 1.0 server technology, DDE, Windows Clipboard and support for right mouse button functions. By clicking the right mouse button special menus appear that intuitively anticipate what functions the user is most likely to need next. In addition, as the cursor passes over a tool, new pop-balloons appear to assist users by announcing its functionality.

Circle (71) on Reply Card

PC diagnostic and POST reader

Micro-Scope, from *Micro 2000*, is a complete diagnostic tool for testing memory (base, extended, expanded, and cache), fixed drives (MFM, RLL, SCSI, ESDI, and IDE), floppy drives, serial and parallel ports, system board, and more.

Version 6.0 adds more than one hundred tests and enhancements to the previous version. New features include: identification of exact processor (I80486 Rev. 08, etc.); identification of exact manufacturer of components; enhanced IRQ and DMA testing; testing of specific segments of memory; generic FIFO tests for serial devices; video memory test of up to 4 megabytes; string search option for memory, floppy, and hard disks; accurate benchmarks for processor, coprocessor, memory access time, hard disk seek time, and video transfer rate; enhanced parallel device tests; real time clock tests; expanded IDE drive tests; keyboard tests; mouse tests; Soundblaster and Adlib tests; speaker tests; CD ROM tests; joystick tests; printer tests; and more.

The POST-Probe reader card, along with its MCA adapter, will fit into any ISA, EISA, or Micro-Channel slot and monitor the system as it's trying to boot. It displays all the diagnostic signals simultaneously. You can watch all computer functions as they occur, allowing the user to isolate problems even if the system BIOS does not emit POST codes. The manual includes all the POST codes on the market, lists the code, the test that is failing, and what chip or device is causing that test to fail. The card features a tri-state logic probe built in, making determination of specific chip failure possible.

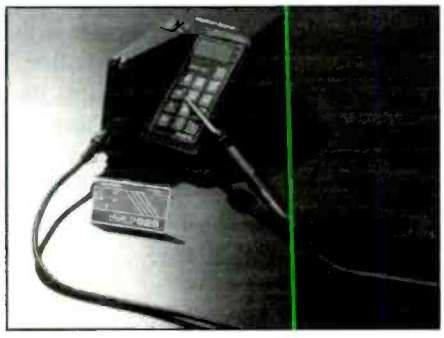
The Universal Diagnostic Toolkit includes both the Micro-Scope and POST-Probe diagnostic tools.

Circle (72) on Reply Card

Fast recovery soldering station

American Hakko's Model 929-2 soldering iron was especially developed to provide fast recovery of heat to soldering tips as well as reducing the necessity for their frequent replacement. Both features provide greater control.

The unit has an integrated tip/sensor



heating element that directly transfers heat to the tip, permitting faster response to temperature fluctuations, thus creating better solder joint quality and improved start-up time.

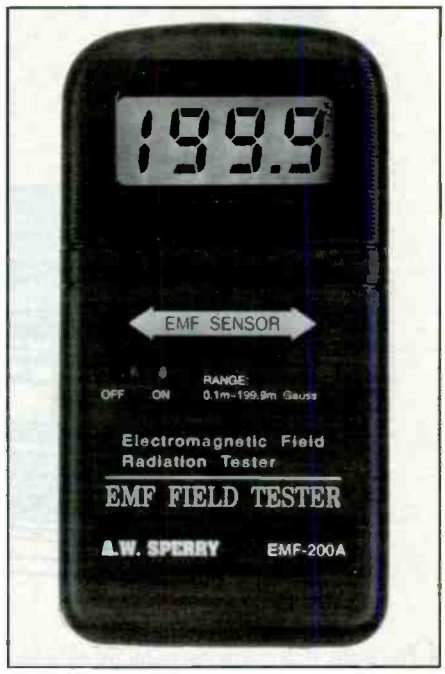
The station uses tips that last longer than most high performance irons on the market, according to the manufacturer. Tips are available for applications ranging from fine pitch to heavy ground plane. The new tip design also makes tip changing safe, quick and easy.

Circle (73) on Reply Card

Electromagnetic field tester

A.W. Sperry Instruments, Inc., a leading national marketer of portable electrical and electronic test equipment, announces the introduction of their Electromagnetic Field Tester, EMF-200A.

The tester uses a state-of-the-art digital



display. Measurements are precise and easy to read.

Circle (74) on Reply Card

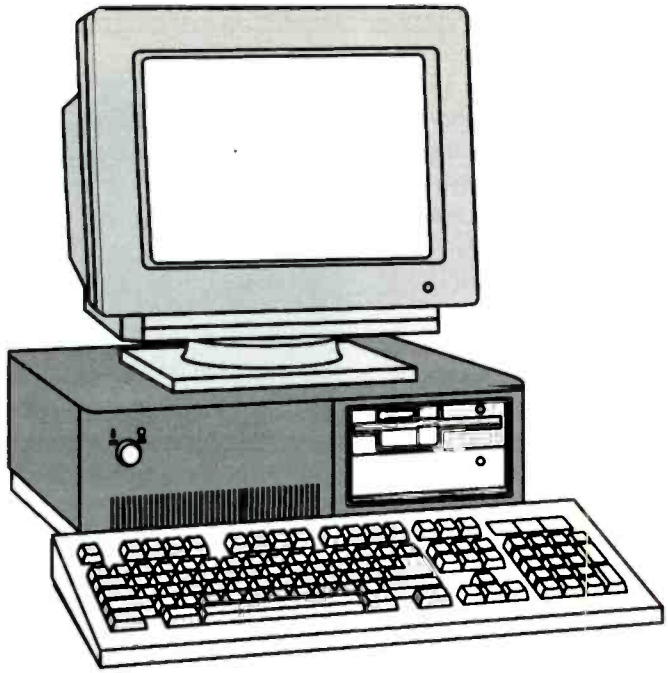
On-line service helps locate computer equipment

MicroLine, Inc., has developed an electronic information service dedicated to companies in the computer service industry. The company's on-line databases assist computer resellers, MIS maintenance managers, and corporate purchasing agents in quickly locating the most cost-effective sources for computer equipment, repairs, exchanges, and spare parts.

These databases contain information on over 1000 vendors and 100,000 parts nationwide. Users call into the company's host computer through their modems and perform product specific searches based on a keyword description, manufacturer's name, or model number. They instantly receive up-to-date and accurate information on vendor pricing, warranties, turnaround times, addresses, contact names, phone numbers, detailed vendor information and terms and conditions.

The company's other services include classified ads for buying and selling computer equipment and services, repair specials, user networking/support conferences, electronic mail, and internet mail. There is a flat yearly fee to use all the services on the system. New subscribers get a free 14-day trial of all these services.

Circle (75) on Reply Card



New technology update

By The ES&T Staff

One thing that consumer electronics servicing technicians can always count on is that engineers and manufacturers will constantly be improving the electronics products that consumers buy and that will appear on the service bench. In addition, the manufacturers can be counted on to continue to come up with new electronics products, and to continue to add electronic features to otherwise non-electronic products.

Here are some technological innovations that readers might be interested in reading about.

Optimizing tape recording

Higher grade tapes are capable of producing a sharper picture than are lower grade tapes. High grade tapes are capable of recording and playing back small amplitude changes resulting in an improved picture. This increase in detail is not possible on lower-grade tapes.

On most VCRs the difference in picture between low and high grade tape is not apparent. The operating parameters on most VCRs are designed to produce an acceptable picture on low-grade tapes. Therefore the picture improvement possible on higher-grade tapes is not used.

Four VCRs in Mitsubishi's new product line incorporate a new feature called PerfecTape. The PerfecTape feature determines the quality of the tape and adjusts the internal circuitry to produce the best possible picture.

There are two operational modes for the PerfecTape feature: automatic and manual; selectable from the Option Menu.

In the automatic mode, the evaluation of the tape quality is activated when a cassette is first inserted in the VCR. In the manual mode, evaluation of the tape quality may be activated after a tape is in the unit by pressing the PerfecTape button.

The evaluation process requires momentary recording. To preserve any previously recorded information, the VCR automatically prechecks the tape for previously recorded CTL pulses before the evaluation process begins.

Ghost cancellation

Spurred by the growing acceptance among broadcasters of the Philips television ghost cancellation system, Philips Consumer Electronics Company has formed a new unit responsible for worldwide marketing and manufacturing for the industry's first consumer and professional products in a new category.

The specialty Television Products Group, based in Knoxville, TN, is responsible for continuing the rapid implementation by broadcasters of Philips Ghost Cancellation Reference (GCR) signal technology, including sale and installation assistance to terrestrial and cable networks and local stations. Last July, the FCC designated Line 19 of the vertical blanking interval solely for broadcasting of this GCR signal. The signal, invented at Philips Laboratories, Briarcliff Manor, NY, has also been recommended as the world standard by the International Telecommunications Union, while the European Broadcast Union has agreed to address specific standards for application later this year.

In addition to ensuring full acceptance by broadcasters of Philips GCR technology, the Specialty Television Products Group is responsible for the manufacture of several planned products, including a set-top GCR signal decoder with built-in tuner, a similar decoder without tuner for use with virtually any brand of VCR or cable box; a set-back decoder for use with the company's projection televisions already available with dedicated GCR jacks; a low-cost GCR inserter, and various accessories. Philips plans to market the set-top, ghost-canceling decoders to consumers in early 1995.

In addition to ridding NTSC television broadcasts of the annoying ghosts that have plagued color TV signals since the advent of the medium, the GCR technology offers additional improvements to solving multi-path problems such as color fading and mis-registration.

Computer networking via cable TV

Education takes a major step toward the 21st Century through an innovative effort involving Zenith Electronics Corporation and Tele-Communications Inc. (TCI), linking an entire Indiana school district to a new networking system that offers high-speed, low-cost data access throughout the district on the cable TV system.

The new communications link serving the Evansville-Vanderburgh School Corporation in southern Indiana, eventually

could lead to an interactive educational network with creative applications such as work-at-home and distance learning.

"In addition to increased access speed, our long-range vision is to move information and video between schools. This technology lends itself to that," said Mike Russ, director of technology for Evansville-Vanderburgh. "We needed and found a system set up to help us tap into new and unexplored possibilities for education in the future."

Using existing TCI cable TV lines and Zenith's Channel Mizer, a premises device that connects baseband Local Area Networks (LANs) to cable systems, all 40 Evansville-Vanderburgh sites (37 elementary schools, high schools and administrative facilities) were linked in August, making it the largest school-wide network in the country.

The system currently offers school administrators and teachers such applications as sharing district-wide information and reports, grade transferring and sending E-mail. Ultimately, this network can be expanded to include a computer-based, educational network that can link students through a PC, a modem and a regular cable TV in their home. The network effectively eliminates telephone lines from being tied up and splitting in-home TV channel use.

"Interactive services such as distance-learning and work-at-home can introduce a more collaborative, cooperative form of education. That may mean a major change in the way we think of school and how to teach students, but this emphasis can better prepare students for the real world, where we all have to work effectively with other people," Russ explained.

"Also, this technology allows us to bring more of what students are exposed to outside of the classroom back into the classroom, which hopefully can raise the enthusiasm for education. It can make school a fun place to be," he added.

Rich Killmar, manager of showcase/model school for TCI, said, "the potential of this network is only limited by the creativity and imagination of the school district using it. Because it is so flexible and expandable, access such as teacher-to-student, student-to-student, or student-to-school opens a wide range of uses."

Applications such as access to school resources like the library, encyclopedias and other reference materials, linking into specific classes not offered at an individual school, the addition of more advanced classes for gifted students and after-school access to the teacher, are just a few possibilities this type of network makes available, he said.

These and other programs can easily be added to the overall district curriculum by utilizing a variety of Zenith gateway products, including HomeWorks, a low-cost PC LAN interface and CATV data modem that provides LAN connectivity through standard home subscriber cable TV facilities.

Microwave clothes dryer

In November, the Electric Power Research Institute (EPRI) announced the development of a microwave clothes dryer, one that keeps pace with the washer so that people spend less time doing laundry. Actually, the dryer has two designs: one for residential use and another for commercial application. The prototypes recently completed nine demonstrations hosted by EPRI member utilities.

"A survey of 220 people at one of the demonstrations of the residential unit showed that 81 percent thought that the shorter drying time was the most attractive feature of the dryer. Eighty-six per-

cent said that they would be interested in buying the dryer, if it were available today, even if it cost 20 percent more than conventional dryers," said John Kesselring, manager, residential systems, of EPRI. Commercial availability is not expected for several years.

The residential dryer dries clothes one-sixth faster than conventional dryers. Because more power is availabe at commercial sites, the commercial dryer works two-thirds faster. Both dryers are approximately 15 percent more energy efficient.

About 40 percent of the clothes that require dry cleaning could be dried in the microwave dryer without shrinkage or damage. The microwave clothes dryer is gentler on fabrics because it targets water molecules, rather than the molecules of the clothes fabrics. Moisture is removed more quickly, gently and at cooler temperatures than in conventional dryers.

Because of the design of zippers and metal buttons they are not susceptible to heating. To avoid any possible hazards, Thermo Energy Corporation, EPRI's contractor, is developing a safety system to automatically shut the machine off and notify the user if something heats the fabrics or starts to degrade.

Kesselring hopes to first enter the on-premises laundry markets, such as in nursing homes, hotels, etc., where a full-time operator checks for extraneous objects. In the commercial sector, the availability of sufficient electric service allows for a dryer with larger magnetrons for faster operation. Also, loads of similar fabrics, such as sheets and pillowcases, are easier to dry.

The commercial sector could also benefit from using microwave clothes dryers by avoiding the use of dry cleaning fluid, which has suspected environmental and health impacts," Kesselring said.

The microwave clothes dryer operates in three drying modes: cooler, faster, and more efficient. With cooler drying, only microwave heating is used with not waste heat recovery. This is the mode that allows woolens and delicates to be dried. Faster drying combines microwave heating with conventional electric resistance heating. More efficient drying combines microwave heating and recovery of magnetron waste heat.

"It's clear that the microwave clothes dryer will be a winner because of user convenience, environmental benefits and efficiency," said Kesselring.

EPRI, founded in 1972 and headquartered in Palo Alto, CA, manages technology research and development programs for the electric utility industry to improve electricity production, distribution and use. Some 700 utilities are members of the Institute.

Implications for service

Every technological advance in the area of electronics has potential implications for service centers. Improvements such as PerfecTape and the ghost cancellation reference signal introduce new circuitry that service technicians need to be aware of in servicing the products. Innovations such as networking via cable TV introduce entire new technologies that technicians may one day encounter.

Many consumer electronics service centers began servicing what was essentially an appliance when microwave ovens were introduced. Microwave clothes driers might become another similar opportunity when they become available.

Keeping abreast of these technological advances can help a successful service center remain that way or become even more successful. ■

Ten steps to successful servicing

By Brian Phelps

If you break servicing down into steps, you'll see that most service jobs require the same steps. You might try to skip a step or two, but doing so often leads to more work later, as you have to back up and re-do the skipped steps.

You can follow these steps without the video test instruments, but they will be more difficult, will call for more component-level testing, and will often cause you to backtrack because you followed the wrong circuit path.

Here are the 10 steps used by successful servicers:

1. Ask customer for symptoms and history of item being repaired
2. Do performance test with customer
3. Determine all related symptoms
4. Check for obvious defects
5. Narrow problem to functional block/defective stage
6. Pinpoint bad components
7. Replace bad components
8. Re-test to confirm operation restored
9. Repair secondary symptoms
10. Run complete performance test

Let's look at these steps, so that you can understand why each is important.

Ask the customer for symptoms and history

Many servicers get a chuckle about this step. Often times, they explain, the only clue they get from a customer is, "It quit working." While this is all they get from some customers, the set's owner can often fill some gaps in the diagnosis process.

Notice that this step asks for two kinds of information, symptoms and history. If the customer can explain the exact symptom, such as, "The picture went first, then the sound," you can get an important clue about the mode of the failure. Modern television receivers often appear to work fine one moment, and then fail to start the next time, so "It doesn't work" might be all the customer knows.

Phelps is the Electronic Service Center Product Marketing Specialist and Business Management Solutions (software) Manager for Sencore Electronics.

Don't forget to ask about the set's history. Did it do this before? Has it been fixed by another shop? If so when and where? Were there any unusual symptoms in the week or month before the failure, such as popping in the audio or sparks in the picture? Was there a thunderstorm in the area recently? All these clues can be especially helpful when tracing an intermittent or unusual failure.

Do a performance test with your customer

Few technicians bother with this step, yet some of the most successful service centers tell us that it's the most important. With the customer watching, plug the set into a live outlet and run through every function to see what works and what does not. Sometimes, you'll find there's really nothing wrong - the problem is a dead ac outlet, a bad antenna, or a disconnected cable-TV tap.

But there's an even more important reason to run through a complete performance test. The set may have more than one problem and the customer has only mentioned the most recent one. For example, they may be complaining about the loss of horizontal sync, but your test shows that audio is also weak. Or, they may not have noticed the low brightness caused by a weak picture tube, and may be glad to learn that you can restore the picture tube with both a quality CRT tester and restorer.

Video test instruments let you test the performance of every TV circuit by connecting to the antenna terminals. You don't even need to take the back off the set to do these tests.

Most importantly, doing this performance test shows the customer that you are concerned about doing the job correctly. You've taken the time to show that you want to do a complete job.

Before the customer leaves your shop (or before they leave the room if you're doing home service), have them agree with you on what they want fixed. You and your customer come to an agreement on such questions as whether they want the picture tube restored, or whether there are some other, secondary problems they want you to look at. By pointing out that there are several, unrelated problems, it's easier to itemize the bill. Otherwise, they may think that all your work was to find only one problem, and may feel you are overcharging them when the final bill is presented to them.

Determine all related symptoms

Here's one of the steps where many technicians build in their own inefficiency. Instead of identifying all the symptoms, they find one symptom and begin tracing it. But, this symptom may be a secondary symptom of an even larger problem. If they had taken a few more moments, they might have noticed that two or three symptoms all point to the same source, such as a bad tuner, or poorly regulated power supply.

If you use all the features of your test instruments, this step becomes easy. The information gained from the performance test in step 2 already has identified the main symptoms. Now, it's a matter of refining these symptoms, by making a more detailed test, or by using some of your instrument's functions not used when doing the simple performance test.

If you confirm several symptoms, you need to decide which one to troubleshoot first. You should not try to follow more than one at a time, because it is too easy to get crossed up as one affects the other. Since one problem may cause multiple symptoms, finding one bad component often clears up all the symptoms. Always repair circuit problems in the following order, to find the problems most likely to affect other circuits:

1. High Voltage
2. Sweep
3. Sync
4. Luminance (video)
5. Color
6. Audio

Figure 1. Checking for obvious defects can save troubleshooting time.

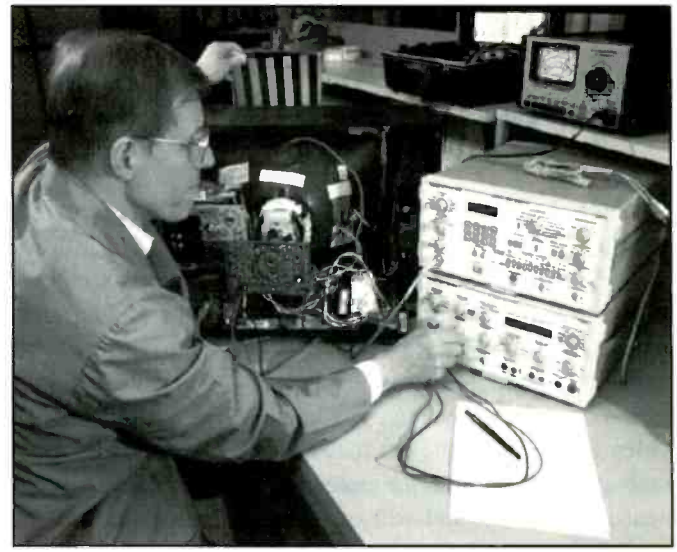


Figure 2. Injecting a vido signal can help narrow the problem to a single defective functional block.

Each of these general symptoms directs you to one of the areas of the "trouble tree" troubleshooting guide (available from Sencore). They, in turn, let you isolate the defective stage for troubleshooting in three steps or less.

Check for obvious defects

This step relies on your senses of observation and your own practical experience. If, for example, you see a burned resistor, or smell smoke, you should attend to these obvious defects, even before making a measurement. Sometimes repairing the burned part solves the problem. But, even if it doesn't, you have fixed something you know must be corrected before the service job is done.

You may also know that a particular chassis has a manufacturing defect which causes a particular symptom. Service literature, for example, may instruct you to resolder certain connections, or to replace certain components with improved ones. Here again, checking for these obvious defects first, ensures that they won't mislead you in your final troubleshooting.

Narrow the problem to one functional block

Up to this step, the video test instruments have been used to make general tests. Now, it's time to put their full analyzing capabilities to work with functional analyzing. Functional analyzing means that you base your troubleshooting on the function of a circuit, instead of the specific parameters of each component in the circuit.

Functional analyzing calls for a duplicate of the normal signal into each of the stages you think might cause the symptom identified earlier. You know that these substitute signals are good, so you know that injecting them into a good circuit causes it to operate normally.

If you inject a signal into a test point, and the symptoms improve, you know that all the circuits from there to the output are working correctly. If, by comparison, the symptoms remain, you know that the bad circuit is affecting the substituted signal, and the problem is found to be somewhere between the injection point and the output.

If you use the "divide and conquer" troubleshooting method, you'll find the bad stage in four troubleshooting stages or less (steps 3-6 above).

The principles of divide and conquer instruct you to substitute into a test point about half-way through the circuits related to the symptoms. If the symptom improves, you have proven that all the circuits to the output are good, so you move toward the input. If the symptom remains, you are ahead of the bad stage, so you are instructed to move toward the output.

In either case, the troubleshooting steps divide the remaining stages in half again. This halving process repeats until you have found the bad stage. You know you have the bad stage when you get an improvement in the symptom when injecting at its output and the original symptom when injecting at its input. The isolated stage has only a few parts that might be bad. These are tested with conventional testing methods.

Pinpoint bad components

After you have isolated the problem to a single stage, bring in your conventional testers. You might use a scope or waveform analyzer to look at a signal. You might use your volt/ohmmeter to measure a resistor or to test a power supply. You can use a Z Meter to test a capacitor or an inductor, or you can use a transistor checker to test a transistor.

Whichever test method you use will be more effective, since your video test instruments have narrowed the suspect parts to a dozen or less. Functional analyzing has isolated the problem stage so that your conventional tests are more effective than ever before.

Replace bad components

This step doesn't directly involve test instruments. It is a good idea, however, to use your component testing methods to check parts associated with the bad part you found. For example, don't forget to check emitter resistors if a transistor was bad. Also, look for shorted PC boards, bad solder connections, and other mechanical problems.

Re-test to confirm operation restored

Changing a part may only partly return normal operation. Double check your work by feeding in the video test instrument signals which dynamically test the circuit associated with the original problem. The video patterns produced by some video test instruments provide dynamic tests you can interpret right on the screen of the TV you are testing.

If your tests show there is still a problem, use signal substitution to find its cause. This time, start at the input of the output of the circuit you just repaired to learn whether another part in the same circuit might be defective.

Repair secondary symptoms

If repairing the first problem did not clear up secondary problems, you now turn your attention to them. Move back to step number 3, and follow the troubleshooting sequence to find each remaining problem, one at a time.

Run complete performance test

When you have found all the problems, repeat all the steps of the performance test used at the beginning of the process. ■

VCR service centers: Some tips on remaining profitable

By Wayne B. Graham

Making money in the electronics servicing business has required many changes since the TV repair/tube tester days of the 50's, 60's and early 70's. Even the early days of $750 to $1,000 VCRs were good for the electronics service business. Repair quotes of $75 or $150 were thought to be a good deal, and these older machines were designed to be repaired; so, it wasn't a frustrating experience for the technician. But now many consumers are thinking of the VCR as a disposable appliance, like an alarm clock or telephone.

The arithmetic of VCR servicing

Are service centers still able to make money servicing VCRs? Yes, but it is a lot tougher these days and many service centers won't survive the transition caused by the low-priced new units available on the market. We've talked with thousands of servicers over the years, and it's been interesting to note the differences between service centers that make money, grow, and stay in business, versus those that don't make money, dwindle, and end up with disconnected phone lines leaving "no new number."

From the thousands of technicians and service center owners we've talked with over the past few years, here's our outline for a profitable VCR service business.

Charge for estimates

Charge $20 to $30, depending upon the area of the country and local cost of living. If you do free estimates, the customer may continue to shop around for the lowest repair cost and the machine may not make it back to your service center, even if you were the low bidder.

Unfortunately, those who don't charge for estimates often don't have a very well equipped service area, and you may lose out to someone with not much more test equipment than a multimeter and needle nose pliers. Charging for the estimate also provides a source of repairable VCRs, since the customer often chooses to abandon his VCR instead of going ahead with repairs. You either get the estimate fee, the repair job, or the VCR, so at least you aren't working for free.

Provide a knowledgeable accurate estimate

You might call this a "technical evaluation" rather than an estimate, because

Graham is Sales Manager of Tentel

that's really what it is. The fact is the mechanical parts of the VCR do wear out. If you review any factory service manual, you'll see that such mechanical parameters as hold back tape tension, take-up torque, FF torque, rewind torque, reel table heights, guide heights and other similar measurements represent the basics for mechanical performance of a transport.

If you're using a "trial and error" method, it will prove to be too prone to errors and too time consuming. Often there are several marginal problems along with the obvious problem. Conscientious as you may think you are, the guessing that is necessary without proper test equipment will help assure failure.

Test equipment will allow an accurate, true estimate in the least amount of time, plus this same test equipment can be used to help perform the actual repairs.

The ability to measure the actual amount of video head tip protrusion (wear) has proven to be one of the most important parameters for determining not only how much use the machine has already had, but more importantly how much longer it's likely to last. Accurately knowing video head wear allows you to honestly advise a potential customer that; "even though the machine is six (or whatever) years old, the heads are still in very good shape and should last for six (or whatever) more years, once these 'other' problems are corrected."

Having information like this helps assure the customer that you know what you're doing and that his machine will be fixed correctly by an expert. We recommend the use of a check out form to com pile findings regarding these critical electronic and mechanical tests. The form provides an excellent method of showing expertise to the customer, and helps to fully explain and justify repair estimates. It can also be maintained as a history as future machine problems arise. This leads us directly to the warranty on your work.

Provide a six-month to one-year warranty on VCRs you service

I'm always amazed at how many technicians tell me that they only offer a 30-day warranty, just on their work, but then complain about lack of business. Should it really be a surprise? New machines offer a one-year warranty, even longer when purchased on a number of different major gold credit cards. The customer has to weigh the cost of $150 for a new machine with a one or two year warranty versus $65 (national average) for a "how many day warranty?"

If you are able to quickly and accurately measure all of the normal wear items in a transport, including video heads, tape tension, torques, etc., why couldn't you offer a six-month warranty, or as you discover your repairs getting better, a one-year warranty on the VCR? (Exclude lightning, small kids, fire and problems outside of the normal wear and tear category).

Even if you see 5 or 10 percent of these machines back within the one-year time limit, the extra business will more than offset the extra work required to correct the problems in these few machines. You may be pleasantly surprised to find the return percentage to be far less than 5 percent when you eliminate guessing about mechanical wear and think about the good will you will reap.

Make money on abandoned VCRs

A fair percentage of customers will choose to abandon their VCR after they hear the repair estimate. This may actual-

ly be good news. You may make more money on these VCRs than if you had repaired it for the customer. By repairing the VCR, and again offering a one-year warranty, you will find that selling these machines for $95 ($75 low-end to $150 for a high-end 4-head Hi-Fi unit) to customers who bring in their broken VCRs may help both your customers and your bottom line.

If you sell a reconditioned VCR for $95 that would have brought $65 for repair, you make an additional $30 (plus you may pick up his broken unit for free, since the customer now has a working unit and may not want to pay to have his unit serviced). Being able to accurately measure remaining video head tip protrusion on these reconditioned units will help to determine how much *use* they've already had, and thus how much more they're likely to endure.

New heads typically protrude 40 microns. When the heads are worn out they're down in the 10 micron range. A used machine with 25 microns remaining is in a totally different category than one with only 15 microns. The warranty and price may both be based on this number.

Find more business

You may be doing lots of things right, but if you don't have enough VCRs to service, you won't be profitable. Coupons in local TV program listings, although fairly expensive, have proven to be an excellent method to reach your target audience. Other good programs we've heard of are flyers posted at video tape rental stores.

No one is more interested in proper mechanical repairs than these store owners, since tape tensions, torques, guide heights, carriage latching problems, and similar problems, cause the vast majority of their ruined tapes. Rental stores need to have access to a reliable repair shop since they lose many tapes due to defective VCRs.

You might want to offer a Saturday "clinic," where you set up in their store and for $15 (or some nominal fee) clean the head (proper method, not just a cleaning tape), measure hold back tension, a few critical torques, reel heights, guide heights, RF envelope, and for $5 more you can even measure their remaining head wear. Even if their VCR is perfect, they'll know who to bring it to if they experience a problem.

If their VCR *is* in need of repair, you'll probably be able to write up a ticket to take it back to your service center. Often you can stay fairly busy just from word of mouth of these "customers," since they can now inform friends and family of an "expert" they know—you.

Another low-cost method of finding more business is "discount" coupons placed under windshield wipers at malls, baseball games, or anywhere there are a lot of automobiles. Have coupons printed 3 or 4 up on an 8½ x 11 sheet. This reduces cost and it appears more like a discount coupon. Remember, almost everyone has at least one VCR and may know others who are having problems.

Expensive products will be serviced

Doing repairs properly, providing a worthwhile warranty, and generating new business is the only way you can remain profitable in the current low-price VCR service market. There are a growing number of more expensive four-head and Hi-Fi VCRs and camcorders that will not be viewed as disposable, and most customers who pay even $150 for a low-end machine will look favorably at a $65 repair rather than another $150. The consumer electronics service business should improve very soon with the new technologies of wireless cable, flat-screen TV, projection TV, and other high dollar consumer products that will help support the independent servicer.

VCRs will certainly be with us for many years. There is no other method that can provide six hours of video recording for $2 or $3 even dreamed of at this time. The VHS format is also being used for time-lapse recorders in convenience stores, banks, etc., and due to the high data memory, companies are also using it for digital audio recording, and computer data backup. Don't give up on VHS, but if you're going to be profitable doing service, perform the service correctly, and stand behind your work. ■

Test Your Electronics Knowledge

Terms defined

By Sam Wilson

(Answers on page 59)

1. To deliver data to a medium such as storage
   W_____
2. Another way of saying "the voltage between two points."
   D_____
3. A coil assembly that is used to produce electromagnetic deflection of the electron beam in a CRT.
   Y_____
4. A temperature scale equal to the Celsius scale— 273.18 degrees.
   K_____
5. A wire used for transmitting and receiving radio waves.
   A_____
6. An expression relating the output of a linear system to its input.
   T_____
7. Another name for the television luminance signal.
   Y_____
8. A solution that conducts an electric current.
   E_____
9. A unit of *energy* equal to a thousand watts dissipated for one hour.
   K_____
10. Another name for a star-connected transformer secondary in a three-phase system.
    Y_____

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

Magnetic recording principles: Video

By Lamar Ritchie

An article in the January issue described in general the principles of magnetic recording, and provided specific details on audio recording. This article provides information on recording of video, with detail on each of the popular consumer video formats: VHS, Beta and 8-mm.

Video recording

The writing speed for video recording must be far greater than that for audio. To record the higher frequencies using the same tape velocity that is used for audio would produce far too short a recorded wavelength. For one thing, it would be impossible to manufacture tape heads with a gap small enough.

Moreover, there is a problem because of the broad frequency range needed: 30Hz to 4.5MHz, or about 18 octaves. A recording across this number of octaves would result in a recorded dynamic range of 110dB, far too much to equalize.

Frequency translation

The first thing that must be done to record video is to translate all frequencies upward. If all video frequencies are moved upward by 4MHz, this would give a band for the video frequencies of approximately 4MHz to 8MHz. This would be only one octave.

Since the frequencies must be moved up, it was decided to record the video as an FM signal. The video is not recorded directly, but modulates an FM carrier. Using this method helps to prevent amplitude variations in the record/playback process from degrading the video.

Another problem is achieving the writing speed required to increase the recorded wavelength to manageable levels. Longitudinal recording, such as used for audio, is not feasible; it would consume tape too fast. For example, the writing speed for the present VHS format is approximately 6m/sec, and for Beta it is approximately 7m/sec. All video machines, therefore, provide the high writing speed by "scanning" the tape (moving the heads past the tape) at high speed. The tape moves at all only to present a new surface for this process

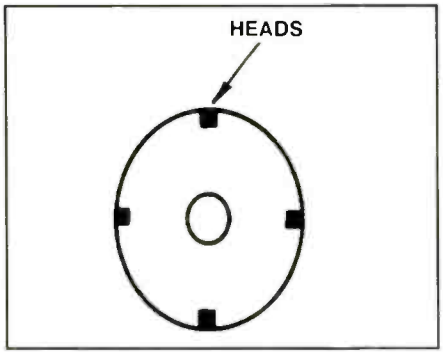


Figure 1. The video heads are arranged in this fashion on the quad scanner cylinder. Tape motion is perpendicular to the plane of the cylinder.

Recording the audio

On most VCRs the audio is not recorded along with the video, but uses separate audio heads and conventional audio circuits. A narrow strip of the tape is used for the audio tracks. Some newer consumer machines, however, do place the audio on an FM carrier also and place the audio heads alongside the video heads to scan the tape. Hi-Fi recordings with excellent quality can be produced this way. Our discussion, for now, will be centered on recording and playback of video signal.

The technology

The technical sophistication required for the magnetic recording and playback of a video signal, particularly a color signal, is immense.

It is little more than a decade that color video recorders have been available for the consumer, at least at a reasonable price and performance. The actual principles have changed little with time. Mainly the quality and manufacturing improvements have created improvements in the performance of these machines.

All video tape recorders, from the most advanced professional models to the bottom-line consumer models have some things in common:

- A rotating "scanner" to move the heads past the tape to obtain a high writing speed.
- Servo control to put the heads in the exact position required as they scan the tape. To do this either the scanner motor, capstan motor, or both can be servo controlled. To obtain high enough quality for color pictures, usually both must be.
- An FM modulator (record) and an FM demodulator (playback) for the video.
- A conventional audio system using space on the same tape.
- A system to record a "control track" longitudinally (like the audio) to use as a reference in positioning the scanner at the correct place at all times.

Professional video recording

The highest quality video recorder, used for TV broadcasting, is the Quadruplex, or "quad" video recorder. It uses

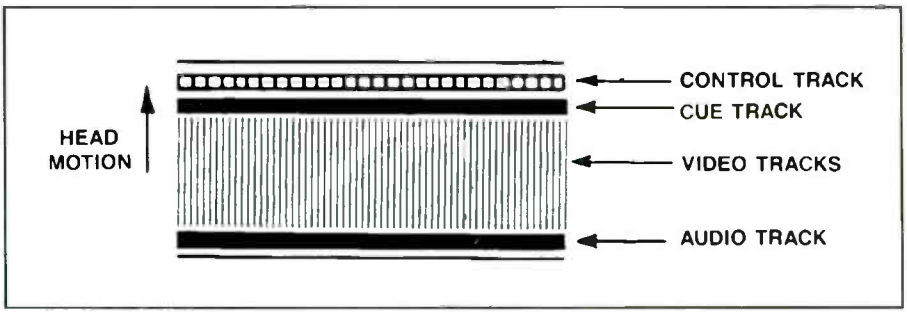


Figure 2. The information is recorded in this scheme in the quad videotape format.

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two-inch video tape (reel-to-reel in most) and a scanner with four heads, as indicated in Figure 1.

The scanner rotates at 14,400RPM and uses a vacuum to form the tape into a bowed shape around it. Because 14,400-RPM is 240 revolutions per second, the scanner rotates 4 times per field. This means there are 16 passes of a video head to record one field.

The tape speeds used are $7^1/_2$ inches per second and 15 inches per second, selectable. There are two versions, depending on the frequency of the FM carrier used: high band and low band. The recording format, the manner in which the various signals are placed on the tape, is shown in Figure 2.

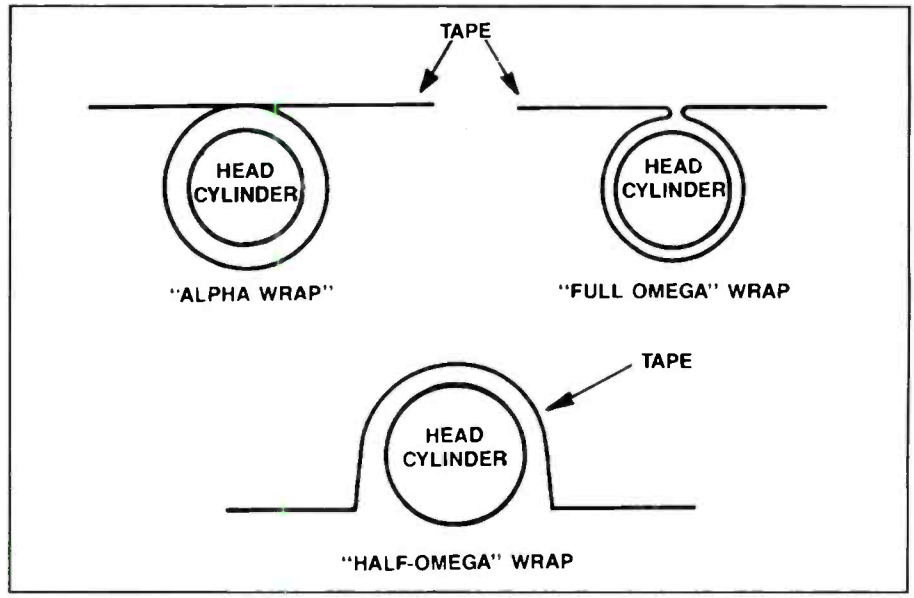

Figure 3. The scanner in VCRs that employ "alpha" wrap and the full "omega: wrap, each so called because the arrangement of the tape resembles the respective Greek letter, uses only a single video head. All modern VCRs use the "half-omega" wrap scheme, which requires two video heads spaced 180 degrees apart on the scanner.

Helical scan

A simpler, less expensive way of scanning the tape is to use a "helical scan." All modern consumer VCRs use this method. Improvements have been made so that many professional recorders also use it.

In this method, the video head describes a helix as it rotates, which creates a recorded track that is a series of diagonal stripes across the tape. To accomplish this using one head, the tape would have to be wrapped entirely around the scanner. In practical VCRs, the tape is wrapped 180 degrees and two video heads on opposite sides of the cylinder are alternately switched on, to insure head to tape contact at all times. One diagonally recorded track can contain a complete field.

Two earlier methods that were used to provide a 360 degree wrap of the tape for machines using a single video head were the alpha wrap and the full omega wrap. These systems were so named because the pattern of wrapping of the tape resembled the respective letter in the Greek alphabet. The alpha wrap looked like the Greek letter α and the omega wrap looked like the Greek letter Ω.

The 360 degree wrap had an inherent problem: it was difficult to insure that the single head stayed in contact with the tape at all times. It also made threading the tape difficult. All modern VCRs use a switching system with two video heads. Tape wrap is for a little more than 180 degrees. This insures that one head, at least, is always in contact with the tape.

One of the earliest methods, used with reel-to-reel type recorders was the half-omega wrap. Modern VCRs use a threading method that is similar to the half-omega wrap. Figure 3 shows roughly how the tape was wrapped, or threaded, around the video heads for these machines.

To form the helix, the tape has to cross the scanner at an angle. This can be done one of two ways. Earlier, reel-to-reel machines tilted the tape path by mounting one reel higher than the other. Usually the supply reel was mounted above the take-up reel so that the tape had to move downward as it crossed the head. This formed the helical tracks. The actual tracks on a straight piece of tape are long lines slanted at an angle, and these machines were sometimes called "slant track" machines.

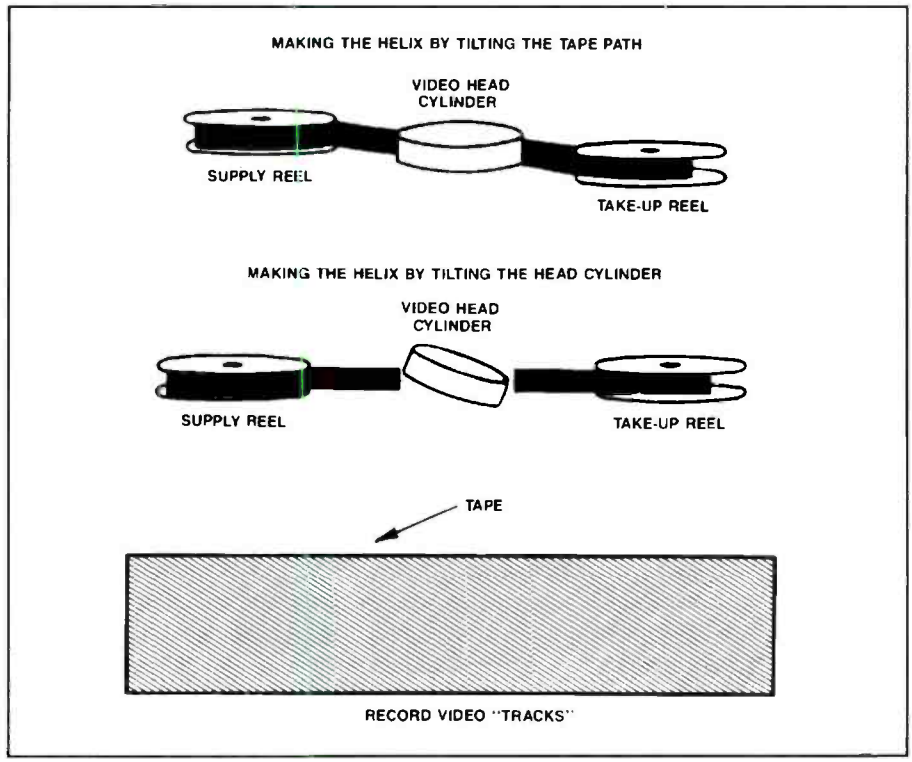

Figure 4. One of two methods can be used to create the helical scan pattern of the video signal on the video tape: tilt the tape path or tilt the head cylinder. Modern VCRs tilt the head cylinder because this method can use a smaller, less expensive, cassette. A general idea of the physical arrangement of the video tracks on the tape is shown at the bottom of the figure.

Modern VCRs do not use this method of producing the slant tracks because it would make the cassette larger and more expensive. Instead, the head is tilted. This produces the slant video tracks on the tape as the head scans the tape moving straight across from supply to take-up reel. Figure 4 illustrates these concepts and the shape of the recorded video tracks that result.

Most modern VCRs use one of the two basic formats; Beta and VHS (VHS stands for "Video Home System," or "Vertical Helical Scan," depending on who is talking). They are similar, but enough differences exist to make them incompatible with each other. Table 1 shows the tape formats for Beta and VHS.

Note that the formats are similar, and both formats use 1/2 inch tape, but the threading method and hence, the cassette cases, are different. They are not similar enough, however, to allow a Beta machine to play a VHS recording even if you removed the tape and put it in the correct type of cassette.

The Beta format is actually somewhat better in picture quality than the VHS format because of the longer track length. The VHS format, however, has become much more popular because it allows for a longer recording time.

In both VHS and Beta machines, the scanner is most often referred to as the cylinder. It may also be referred to, in some service manuals, as the "upper cylinder," the "lower cylinder" being the motor that rotates the scanner. In older machines it was called the "drum" and is sometimes called this in newer machines.

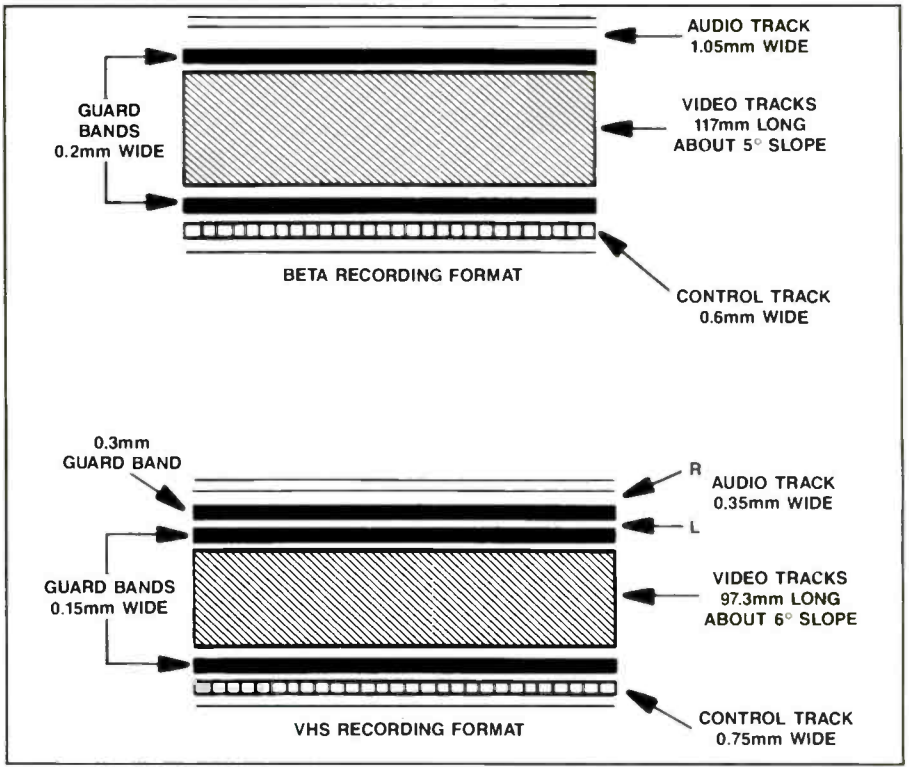

Figure 5. The recording scheme for VHS is similar to that of Beta, but the threading and hence the cassettes are different. Even if you put a VHS tape in a Beta cassette, or vice versa, however, it would not play.

U-Matic

Another type of cassette recorder that came into common use as a commercial video cassette recorder was the U-Matic format. The U-Matic machines are still used in industry and are popular at TV broadcast facilities. It is a format that uses larger tape ($^3/_4$-inch) and a larger cartridge. The scanner is much larger producing longer tracks, and a faster tape speed is used so better, more stable pictures are possible. This machine was the forerunner of the Beta machine and, mechanically, the Beta machine is a miniaturized version of it.

As for consumer VCRs (Beta and VHS), FM is still used to record the luminance video. In the Quad recorder, the complete video (Y and C signals) modulates the FM carrier. This is possible with the Quad machine because of its quality.

The head in a Quad machine alone may cost several thousand dollars and the complete recorder almost $100,000 dollars. It is still not feasible, however, to record the color signal along with the luminance for the consumer VCR.

Recording chroma and luma

To see why the color (chroma) and luminance (luma) can't be used together to modulate the FM carrier in consumer VCRs, consider these facts. The head cylinder, only two to three inches in diameter, scans the tape producing tracks that are roughly five inches long. A single track contains one complete field of video. Thus each horizontal line of video is recorded on a length of tape that is 5/262.5 of an inch, or about 0.02 inches long.

Remember now about head gap width, writing speed, and recorded wavelength.

If the signal has color on it, a 3.58MHz signal produces about 227 cycles per horizontal line, so each cycle of the color occupies about 0.02/227 inches, or about 8.8 millionths of an inch. There will be vast errors if the heads are only millionths of an inch in the wrong place at any time. A change in phase of only a few degrees from one rotation of the head to the next is intolerable—color oscillators in TV sets could not follow it.

Overcoming the problems

Before video can be recorded suitably, there are many problems to overcome:

- Variations in tape tension
- Tape stretch
- Dropouts (oxide bad or missing)
- Head to tape contact at the high writing speed
- Variations in capstan speed and rotation speed of cylinder
- Providing electrical contact to rotating heads
- Crosstalk between adjacent tracks
- Switching between the two video heads at the correct time.

The tension regulator

To correct for variations in tape tension, a *tension regulator* is used. This is a mechanical device that will be the first component in the tape path. It usually is a metal band with a felt strip on the inside that provides variable "braking" for the supply reel. If the tape has too much tension, a loop in the tape will tighten, pulling on the band to release it slightly and

allow the supply reel to turn easier, lowering the tension. If there's too little tape tension, the tension regulator compensates to increase it.

The dropout compensator

To make dropouts less objectionable, all VCR's have a *dropout compensator*, or DOC. This is a circuit that delays the video for 63.5µsec, and thus always has the previous horizontal line output from it. The circuit senses if the video signal disappears (there is a dropout) and, if so, switches in the video from the previous line. The eye cannot detect momentary dropouts of only one or two lines because adjacent lines are very similar.

Head-to-tape contact

As for head-to-tape contact, the heads are made to protrude very slightly into the tape, that is, they project slightly from the surface of the cylinder they are mounted on. The biggest problem here is tape contact with the cylinder itself, which must rotate at 1800 RPM. Actual contact with the cylinder would destroy tape and cylinder in a short time. Lubricants cannot be used, as they would destroy the tape.

What is done is to put fine grooves in the cylinder. Before the tape is pulled to the cylinder in the thread operation, the cylinder is started to rotate. This creates an air cushion because the grooves and the tape actually do not touch the cylinder, but ride just above its surface on the air cushion. If anything were to fill up these grooves, even a tiny amount of oil, the cylinder and tape would seize, possibly destroying the heads and the tape.

The use of an FM carrier for the luminance video also helps to minimize variations in head to tape contact because the FM demodulator is not sensitive to amplitude variations.

Getting the signal to and from the heads

To couple the video signal to and from the rotating heads, older machines used slip rings and brushes. These gave many problems because of dirty, bent or worn contacts. All VCRs now use rotary transformers to couple the energy to and from the heads. One circular winding is in the rotating upper cylinder, the other is in the stationary lower cylinder. The circular windings are precision wound with primary and secondary windings that keep a constant relative position to each other.

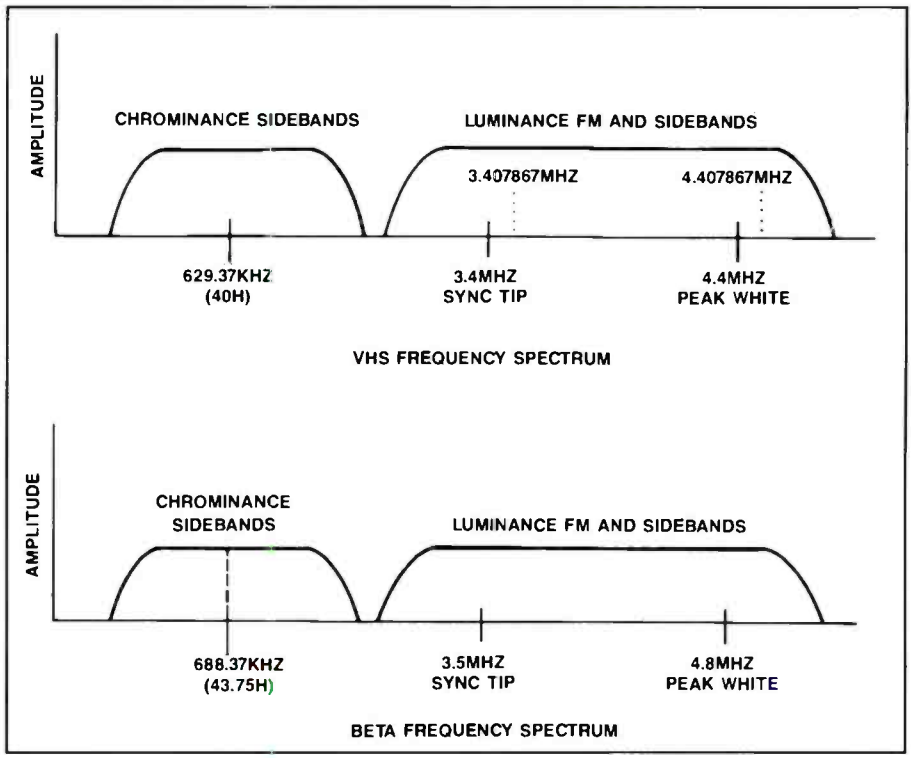

Figure 6. The VHS frequency spectrum is somewhat different from the frequency spectrum for Beta.

Speed control

To minimize speed irregularities, the cylinder and capstan motors are servo controlled. Switching between the heads is accomplished at the proper time by generating a reference pulse from a pulse generator in the rotating cylinder and comparing this pulse to the vertical sync pulse.

Still, the heads cannot be positioned accurately enough to allow the color to be demodulated and used "as is," even in the expensive Quad machines.

The phase and frequency variations that remain, caused by the small short term changes in writing speed, are called "jitter" components of the signal. These timing irregularities are very harmful to the color signal because this signal is so phase dependent.

All video recorders that use color must have a type of "velocity compensation" whereby two signals are created with the same jitter components and heterodyned together to produce a stable difference signal. For broadcast use, a *time base corrector* is used to stabilize the longer term variations in the signal frequencies.

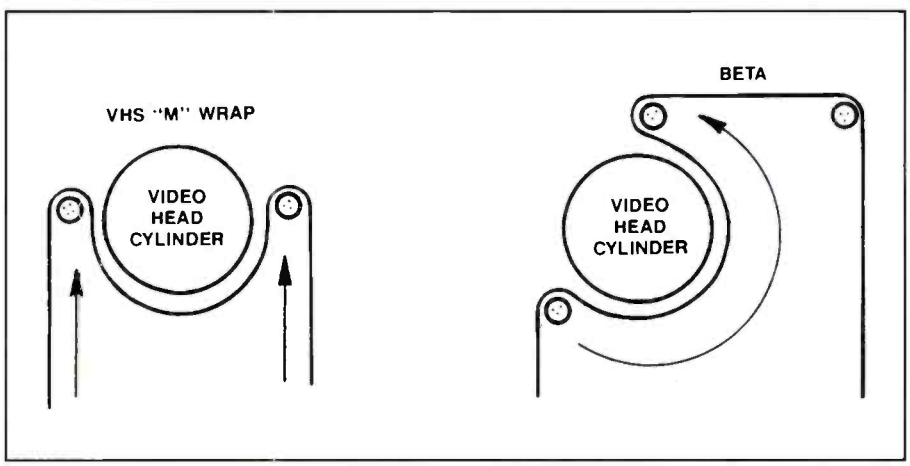

Figure 7. The tape wrap schemes are different in the VHS and in the Beta VCRs.

Modulation and demodulation

VCRs are not capable of recording the color in the same band of FM frequencies in which the luminance is recorded. The FM modulation and demodulation would create beat interference because 3.58-MHz is within the band of FM frequencies used. Quad machines can do it because their FM carriers are up in the range of 8MHz to 12MHz.

The cost would prohibit consumer equipment from using this method. Instead, the color is moved out of the way. It is moved down in frequency, below the FM luminance frequencies. This used to be referred to as the "color under" or "heterodyne" color system. This enables the limited bandwidth of present VCRs to record color separate from the luminance, preventing interference between the two. It does, however, limit the bandwidth of the color that is recorded. The actual frequencies that are used for the two systems are shown in Figure 6.

The two sets of frequencies given for the VHS luminance signal have to do with a method of preventing crosstalk and will be discussed later.

Another Beta version called "Super beta" centers the FM luminance at 5.17-MHz for greater picture detail.

Mechanical differences

In addition to the electrical differences, there are mechanical differences between VHS and Beta machines. To get the minimum 180-degree wrap around the head cylinder, the tape must be pulled from the cartridge and "threaded." These machines use different methods, as shown in Figure 7.

Other differences, in comparing Beta to VHS are:

- Beta uses a smaller cassette. This is an advantage in that it is more compact, but it holds a shorter spool of tape so there is less record time.
- The thread operation occurs as soon as the cassette is inserted in the Beta machine, and stays threaded at all times when the cassette is in the machine. This gives better control over tape movement and allows faster operation between modes, such as from stop mode to play mode. It is, however, a little more damaging to the tape during FF and REW operations. (A few "instant play" VHS machines are now doing this also.)

Table 1. Beta and VHS tape parameters

FORMAT	SPEED	TRACK WIDTH	TRACK LENGTH
Beta 1	1.6 in/sec(40 mm/sec)	58 microns	117 mm
Beta 2	0.8 in/sec(20 mm/sec)	29.2 microns	117 mm
Beta 3	0.53 in/sec(13.3 mm/sec)	19.5 microns	117 mm
VHS—SP	1-5/16 in/sec(33.35 mm/sec)	58 microns	97.3 mm
VHS—LP	21/32 in/sec(16.67 mm/sec)	38.5 microns	97.3 mm
VHS—EP	7/16 in/sec(11.12 mm/sec)	19.2 microns	97.3 mm

- Beta video tracks are a little longer, as mentioned earlier. This allows for a little wider FM bandwidth for the luminance, and therefore resolution that is a little better.

Improved formats

Recently, new formats for both VHS and Beta have been developed that provide better picture detail (better resolution). As a comparison, broadcast TV signals have a resolution of about 330 lines. VHS VCRs use a chrominance signal at approximately 629KHz that trails off at about 1.13MHz. The luminance extends from there, up to about 4MHz, giving a bandwidth of about 2.9MHz. This produces about 250 lines of resolution.

Beta resolution is slightly better, at about 260 lines of resolution. The newer Super beta has a bandwidth of about 3.2MHz. that gives a resolution of just under 300 lines.

As mentioned, recent advances have created new formats that are superior in resolution, but unfortunately incompatible with the old formats. The two new formats are Super VHS and Extended Definition BETA (ED BETA).

Actually, there are three basic formats, but the third, 8-mm, is not yet in common use for VCRs, although it may be in the near future.

The newer Super VHS has a color signal identical to the signal used in the old system. The difference is in the FM luminance. It uses a higher band of frequencies, allowing a wider bandwidth and thus better picture detail.

The sync tip and peak white frequencies for Super VHS are 5.4MHz and 7MHz. This produces a resolution capability that exceeds 400 lines. This is much better resolution than a broadcast TV signal, and better than most TV receivers are capable of displaying. To see the picture with full quality requires the use of a color monitor with a special S-VHS input jack. The S-VHS connector has separate cables for the luminance video, color signal, and the audio channels. This provides much better quality because the Y and C signals are separate and the high frequency luminance cannot beat with the C signal and produce beat interference. These monitors are capable of displaying typically 400 to 500 lines of resolution.

Compatibility considerations

To provide compatibility, S-VHS VCR's have built in record and playback circuits for standard VHS. For recording, a switch can select the desired format. For playback, the circuits automatically detect whether the signal is VHS or S-VHS. The use of S-VHS requires special higher quality tape that is capable of recording the S-VHS signal. The signal-to-noise ratio for the luminance in standard VHS is a little better than 40dB, and can be a few dB higher for S-VHS. The color signal is, however, improved only slightly. It is recorded exactly the same and what improvement is noted is because of the higher quality tape.

The newer ED Beta provides much more resolution than even S-VHS; over 500 lines. As with S-VHS, the color signal is recorded the same and the luminance FM band is much higher. The sync tip and peak white frequencies for ED Beta are 6.8MHz and 8.6MHz. Moreover, ED Beta uses a special tape, that is even more demanding than S-VHS, that uses extremely fine metal particles instead of oxide particles.

The favorite

At present, the clear favorite standard is VHS. The main reason that VHS be-

came the favorite was the decision to use a little larger cassette and thus more tape, to provide a longer play/record time. It is difficult to predict what the future will be, but S-VHS will probably become the most popular standard in the next few years. Although S-VHS is not the superior format for picture quality, it still provides the longest play/record time and S-VHS VCR's are being built that will play standard VHS recordings. This insures that the consumer's tape library will still be usable with the purchase of the S-VHS video cassette recorder.

The 8-mm format

As mentioned earlier, there is a third basic tape format, but it is not as popular and is used primarily (at present) for camcorders. This is the 8-mm format. The original 8-mm format provides better picture quality than either VHS or Beta, including the color signal. The 8-mm format was developed to provide a much smaller tape cassette for use in camcorders. 8-mm tape is about one-third of an inch wide, only slightly larger than reel-to-reel and 8-track audio tape, but of a much higher quality, using metal particles like the ED Beta tape.

The 8-mm cassette is not much larger than the standard audio cassette. The format uses a color signal at 743KHz, and a luminance signal with sync tip and white peak frequencies of 4.2MHz and 5.4-MHz. Picture resolution is between that of VHS and S-VHS.

Recently, a new 8-mm format called Hi-Band 8-mm, or "Hi–8," was developed. The color is the same and improvement was provided by moving the luminance FM frequencies up, as it was for the others. For Hi-Band 8-mm, the sync tip and peak white frequencies are 5.7MHz and 7.7MHz and provides roughly the same resolution as ED Beta.

8-mm does not use an audio track. Instead, all 8-mm machines use the hi-fi sound system in which the sound modulates an FM carrier and is recorded by heads mounted on the rotating head cylinder. This FM carrier is located in the gap between the chroma frequencies and the luminance FM frequencies. This applies to the hi-fi machines in the other formats as well. This provides for sound that has as wide a frequency response and almost as good a dynamic range as CD players.

It can be argued that the 8-mm format is the best of all, but its popularity at present is limited. It could be that the choice of the name is part of its problem. There was an 8-mm film format that was the standard for home movies before the advent of VCRs and camcorders, and some of the public may be confusing the two, believing the 8-mm camcorder to be a film camera. Of course, the lack of prerecorded tapes in the 8-mm tape format is a definite handicap.

Coming attractions

A future article will cover some of the circuits in VHS and Beta VCRs and describe in more detail how they work. ■

Coping with hard disk problems—Part II

By Stephen J. Bigelow

Part I of this three-part article, published in the January issue of **ES&T**, described the various parts of a hard drive system, and detailed the similarities and differences among the different types of hard disk drives. This part lists some of the hard drive hardware error messages that a technician may encounter and suggests a course of action to take when they are encountered.

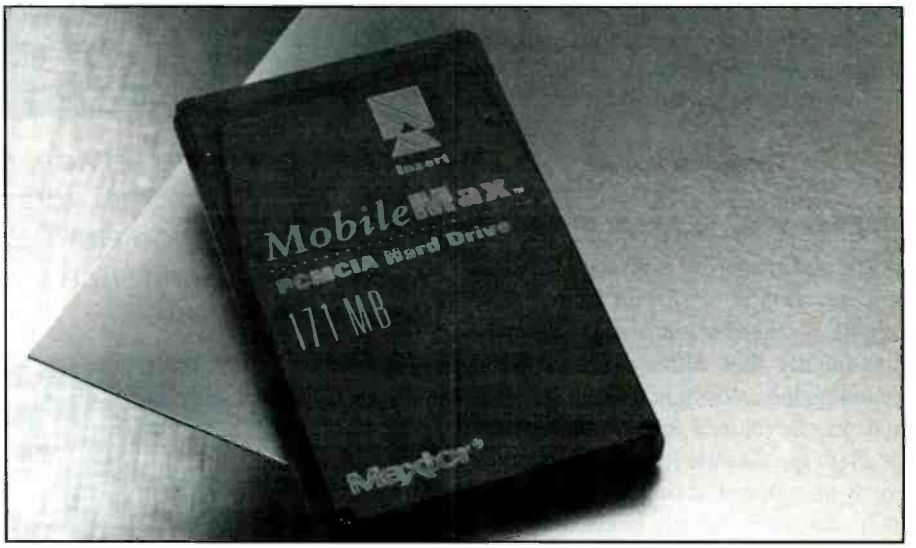

Figure 1. Hard disk drives have long been a focal point of PC technology.

Pre-service checkout

When you encounter a hard drive error message, take a minute to consider the following installation points. First, make sure that the drive controller board (and every board in the PC) is seated firmly and evenly into its expansion slot. Also make a careful inspection of the drive's power and signal cable(s) to ensure that they are intact and inserted properly into their corresponding connectors.

Refer to the documentation for the drive and controller board. Inspect any jumpers or DIP switches that are used to set address settings, drive numbers, interrupt lines, or DMA configurations. An incorrect selection on the drive or controller can render the drive inoperative.

Next, measure the power supply output serving the drive. Most drives use a 4-pin mate-n-lok connector for power. The two middle pins are ground (or return) lines. One side of the connector supplies +12Vdc, and the opposite side of the connector supplies +5Vdc. If one or both of these voltages is low or absent, the drive may function erratically (or not at all). You may need to either troubleshoot the power supply or upgrade it to a higher-capacity supply.

When you are confident that the drive and controller are configured properly, inserted correctly, and have adequate power, you can go on to specific troubleshooting steps.

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

Hardware initialization troubleshooting

Initialization problems are surprisingly common. They can occur when the drive or controller fails, but initialization problems can also occur when a new drive is installed improperly, or is incompatible with the existing system setup.

Following are a number of symptoms, along with some recommended corrective actions.

The screen goes blank when the system is powered up

This is a problem encountered during new drive installation. If the display does not appear after power up (you should initially see a BIOS ROM copyright notice and the memory test), there is likely a hardware conflict between the drive controller board and the system.

Make a quick check of the monitor to be sure its power cord or video cable has not worked loose during the hard drive installation process. Power down the computer and remove the new controller board. If the problem disappears, check the I/O address, DMA, and IRQ settings on the drive controller board.

However, if the controller board settings check properly, reinstall the drive and controller board, power up the system again, and measure each output from the power supply. If one or more supply outputs becomes low or absent, the supply may be undersized, or there may be a serious short circuit somewhere in the controller or drive. Try a new or similar controller. If the problem persists, try a larger power supply, or remove other expansion boards from the system to reduce loading on the supply.

The IDE drive fails to spin-up properly after power is applied

This problem usually occurs when a new drive or controller board is installed or upgraded. One end of a signal cable between the drive and controller board is probably reversed. Check the signal cable alignments and ensure that both ends of the cable(s) are inserted properly.

In an AT system, the drive light stays on continuously

A continuous LED indication is not necessarily a problem as long as the drive seems to be operating properly. Refer to

the documentation for the controller board—there may be a jumper available to switch the LED display between a "latched" mode (the LED is always on) and an "activity" mode (the LED is only on during drive access). If such a jumper exists on the drive, set the jumper to the "activity" mode.

If the drive does not operate, power down the computer and check the signal cable(s) between the drive and controller board. One end of a signal cable is probably inserted upside-down. Reinstall the signal cable(s) correctly and retest.

A "No Fixed Disk Present" error message is displayed on the monitor

This kind of problem can occur during installation, or at any point in the PC's working life. If you are installing/upgrading a drive system (or installing a new board in the system), there may be an address or IRQ conflict with other boards in the system—a common difficulty. Since it is very difficult to know the address and IRQ layout of each board in the system, your best strategy is to remove all expansion boards in the system other than the drive controller.

Try the system again. If the drive operates, there is a conflict with one of the boards you removed. Replace one board at a time. When the problem returns, you know that the board you just installed is the problem. It is then your choice whether to change the settings of the drive controller, or of the "other" board.

It is usually a better idea to adjust the controller board because you probably have the documentation for it right on hand. It would also be a serious hassle to find and alter the customer's existing utility configurations after making changes to "other" boards. Make the new controller fit the old system—not vice versa.

Refer to the system's setup routine and ensure that the correct drive type and drive parameters are entered in the CMOS setup screen. One or more faulty parameters can disable the drive. You may have to check the drive's parameters (cylinders, heads, sectors, landing zone, and write pre-compensation) against parameter data from the drive manufacturer.

If you cannot find a prefabricated drive "type" with the appropriate parameters, you can usually enter the proper parameters manually as a "custom" drive type. If CMOS RAM has failed, replace the backup battery and re-enter each setting. Be sure to write down each setting and tape the notes inside the PC cover.

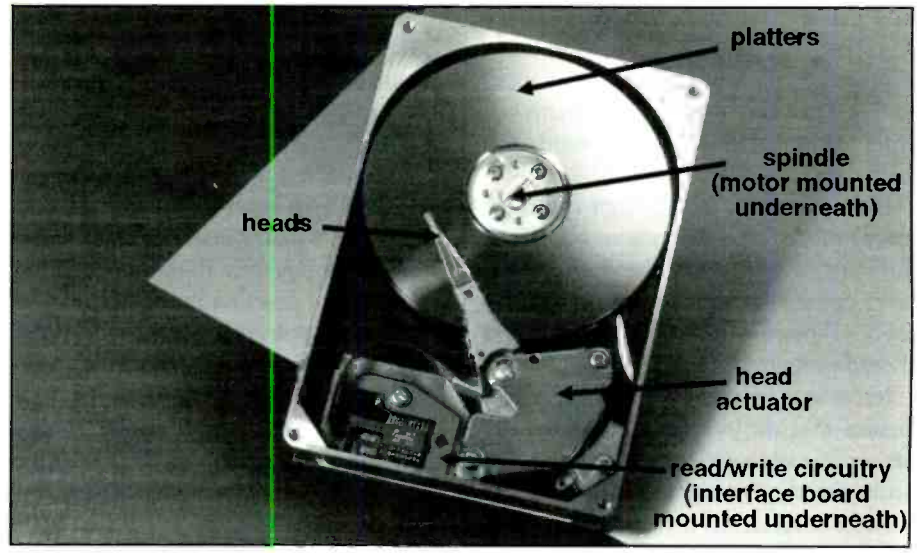

Figure 2. In last month's issue we mentioned the five critical elements of a current hard drive assembly that are shown here.

Check for any loose power and signal cables. In a multi-drive system, make sure that any drive jumpers or DIP switches for each drive are configured properly for multi-drive operation (master/slave settings). If any terminator resistors are needed, make sure that the terminators are installed in the correct locations. You may try low-level formatting the drive again.

The system fails to recognize the presence of the drive

The computer may flag this as a "hard-disk error" or "hard-disk controller failure" during system initialization. Begin your inspection by checking the drive's signal cable orientation. When installing or upgrading a drive, be sure that the red lead of the ribbon cable (pin 1) is oriented toward connector pin 1 at both ends. If the cable is reversed at either side, the controller board will not recognize the presence of a drive.

Double check any jumpers used to configure the drive or drive controller board. Drive configuration jumper settings are even more critical when there is more than one drive in the system. Each drive must have unique identifying settings, otherwise a communication conflict will occur that can temporarily disable all the drives.

If the drive still fails to operate after installation or upgrade, there may be an address or IRQ conflict with other boards in the system—a common difficulty. Since it is very difficult to know the address and IRQ layout of each board in the system, your best strategy is to remove all expansion boards in the system other than the drive controller.

Try the system again. If the drive operates, there is a conflict with one of the boards you removed. Replace one board at a time until the conflict resurfaces—the board you reinstalled when the conflict returned is the source of the problem. It is then your choice whether to change the settings of the drive controller, or of the "other" board.

It is often a better idea to adjust the controller board because you probably have the documentation for it right on hand. It would also be a serious hassle to find and alter your customer's existing utility configurations after making changes to "other" boards. Make the new controller fit the old system—not vice versa.

Next, be sure the drive actually spins up when power is turned on. You should be able to hear this, but some hard drives are extremely quiet. If the drive fails to spin up, check the power supplied through the 4-pin mate-n-lok connector as described in the "Pre-Service Checkout" section. If one or more supply voltages is low or absent, the drive will certainly not function. Troubleshoot or replace the power supply.

Double-check the controller board to be sure that it is compatible with the drive you are using (not a problem with IDE drives). While instances of incompatibility between drives and controllers that share the same signal interface is rare, it may happen under some unusual circumstances. Remember, not all SCSI devices are compatible with every host controller.

One test of controller incompatibility

for ST506/412 and ESDI drives is the system speed test; older PC expansion boards expected the ISA bus to operate at about 8MHz, but today's powerful systems operate so fast that the controller board can't keep up.

If the computer is in a high-speed (or turbo) mode, take the system out of the turbo mode and re-try the drive. If the drive operates when a lower bus speed is used, a more sophisticated controller should probably be used.

Refer to the system's setup routine and ensure that the correct drive type and drive parameters are entered in the CMOS setup screen. One or more faulty parameters can disable the drive. You may have to check the drive's parameters (cylinders, heads, sectors, landing zone, and write pre- compensation) against parameter data from the drive manufacturer. If you can't find a prefabricated drive "type" with the appropriate parameters, you can usually enter the proper parameters manually as a "Custom" drive type.

A "Drive not Ready" error message is displayed on the monitor

This problem is typically encountered during installations and upgrades. The system does not recognize the drive. Begin your inspection by checking the signal cable between the controller and drive. One end of the cable may be reversed.

Inspect outputs from the power supply next. Power is typically through a 4-pin mate-n-lok connector. The middle two pins are ground. One end provides +5Vdc and the other end provides +12Vdc.

If one or both of the supply voltages is low or absent, the supply may be undersized for the power load demanded by the system. You could try a larger supply. If power is adequate, make sure that the drive spins up.

Inspect any jumpers or DIP switches and make sure the drive is set properly for the type of controller being used. If the drive is not configured properly, the system will not recognize the drive. The drive may be low-level formatted improperly. Check the low-level drive parameters used in low-level formatting. If any of the parameters are incorrect, correct the parameters and try reformatting the drive again.

A drive formatted by a dealer does not operate after installation

Start by checking the controller and cable installation. Also check the system CMOS to be sure that the proper parameters are entered for the drive being used. This is especially important when using an IDE drive in "translation mode."

Find out if the DOS version used to partition and high-level format the drive is compatible with the system. A hard drive with an incompatible format or partition table will not function in the system.

Make sure you are using the same drive controller board used by the dealer who prepared the drive. Also check that you are using the same type of cables. It may be necessary to re-partition the hard drive from scratch to ensure compatibility.

The IDE spins up when powered, then rapidly down again

If the drive is not communicating properly with its host system, try a new signal cable between the drive and its controller board. If a new cable fails to restore the drive, there may be an incompatibility between the drive and the system's BIOS. To confirm this, try the drive and "controller board" on another system using a newer BIOS, or a BIOS from a different manufacturer. If the problem does not occur on another machine, you may need to upgrade the BIOS ROM(s) on the original system.

A "Sector not found" error message is displayed on the monitor

This problem usually occurs after the drive has been in operation for quite some time. Inspect the signal cable(s) between the drive and controller. Try using new cables. If the cables are intact, there may be a media fault on the drive—the drive itself may be defective.

If you had just replaced the drive controller with another model, there may be an incompatibility in the low-level format. Try another controller board of the same model.

If the problem persists (or an appropriate controller board is not available), try backing up as much of the drive as possible, and re-work the drive (try to perform a new low-level format, repartition the drive, and reformat the drive).

A "1780 or 1781 ERROR" is displayed on the monitor

The classic 1780 error code indicates a "Hard Disk 0 Failure," while the 1781 error code marks a "Hard Disk 1 Failure." The term Failure is used to suggest that a hardware fault has occurred. In a new installation or upgrade, make sure that the controller is compatible with the drive. When this fault occurs in an established system, your best course is simply to replace the hard drive. If the error code disappears when another hard drive is used, the original drive can be returned for repair or replacement.

A "1790 or 1791 ERROR" is displayed on the monitor

The classic 1790 error code indicates a "Hard Disk 0 Error," while the 1791 error code marks a "Hard Disk 1 Error." The term Error is used to suggest that a logical or operational fault has occurred (as opposed to a hardware failure). In many cases, this error is generated when a drive is brand new and needs to be low-level formatted, partitioned, and DOS formatted.

Because 1790-type errors are logical in nature, a signal interruption may be occurring between the drive and controller. If the drive has already been prepared by a dealer, try a new signal cable between the controller and drive before you consider re-partitioning and reformatting.

A "1701 ERROR" is displayed on the monitor

The 1701 error code indicates a hard drive POST (power-on self test) error: the drive did not pass its POST test. Check the drive setup data entered in the system CMOS. Also check that the drive's signal and power cables are connected properly. If you are installing a hard drive in an older PC/XT system, you should perform a low-level format on the drive (if that is appropriate).

The system reports random data, seek, or format errors

Random errors rarely indicate a permanent problem, but identifying the problem source can be a time-consuming task. Start by checking the drive power as described in the "Pre- Service Checkout." Marginal power supply levels (especially in fully-loaded systems) can result in strange, random faults. Electrical noise in the system can also interfere with normal drive operation.

Try re-routing the signal cable away from the power supply and other expan sion boards. You may also try placing expansion boards in other slots which are farther away from the drive signal cable.

(Continued on page 41)

Hard Disk Problems

(from page 28)

Electrical noise can also affect the drive controller board. Install the controller board away from the power supply, and try to keep it away from the video adapter board if that's possible.

There may be a problem with the system speed. Although most ISA bus systems are designed to run at 8MHz, some new machines run so fast that communications between the system and drive adapter is marginal. Try taking the PC out of its "turbo" mode. If the problem disappears, replace the drive controller board with a newer, faster board.

Try the drive and controller in another system. If the drive and controller work in another system, there is probably excessive noise or a grounding problem in the original system. Reinstall the drive and controller in the original system and remove all extra expansion boards (except the video adapter).

If the problem goes away, replace one board at a time and retest the system until the problem returns. The last board you inserted when the problem returned is probably the culprit. If the problem persists, there may be a ground problem on the motherboard. Try replacing it.

There may be a marginal area on the drive. Back up as much of the hard drive as possible and use a third-party hard drive utility such as PC Tools or Norton Utilities to perform a thorough scan of the hard drive media. Use such tools to mark out any media errors, then reformat.

There are problems when installing a new hard drive using a second disk controller

The system may also not boot after a second controller is installed. System conflicts will almost invariably result when two drive controllers are present in the system. Make sure that the new controller is correct for the drive being installed. The controller should also have its own on-board BIOS that can be used in a system without having to specify a CMOS drive type.

Check the I/O address of each controller BIOS. Make sure that the BIOS I/O address of each controller is set differently. If addresses overlap, a hardware conflict will result. Since many drive controllers also offer floppy drive controllers, make sure that all unused floppy drive controller circuits are disabled.

A "Bad or Missing Command Interpreter" error message is displayed

This is a typical error that appears when a drive is formatted in one DOS version but loaded with another. Compatibility problems occur when you mix DOS versions. Make sure that the drive is formatted with the DOS version you intend to use, and that the /S option is used with FORMAT in order to transfer the proper system files to the boot device.

If this is a new problem on an existing system, you should strongly suspect the presence of a computer virus. Use a clean virus checking disk to examine the hard drive and eliminate the virus if possible (once checking is complete, discard the anti-virus work disk). You may need to recopy COMMAND.COM to the hard drive. If you need to reformat the drive again, back up as much of the drive as possible before proceeding.

An "Error reading drive C:" error message is displayed

Read errors in a hard drive typically indicate problems with the disk media, but it is always worthwhile to check the drive's signal and power cables first to ensure that each is secure. If faulty cabling is not the problem, use some good anti-virus software and scan the drive for a computer virus. Remove any infected files. If a computer virus is detected, you should also check every floppy disk that you have available since any disks used in an infected system may also be infected (and can re-infect the hard drive or other PCs).

Use a commercial PC utility such as PC Tools or Norton Utilities to scan the hard drive for defects. If defects are detected, try mapping out such defects as dictated by the particular utilities. If the problem persists, it may indicate failing sector and track ID information. This may also be a factor if the drive's orientation has changed (i.e. you re-mount the drive vertically where before it was horizontal).

Back up as much of the drive as possible, and perform a new low-level format of the drive (if possible). Establish a new DOS partition, and run a new DOS format. Restore the backup and recreate any files that were lost due to original error.

A "Track 0 not found" error message is displayed

Start by checking the interconnecting cables between the drive and controller. Try a new cable. Also check to be sure that you are using DOS 3.3 or later (if you do upgrade, move to MS-DOS 6.2 or later). If cabling and DOS versions are right, the problem is likely on the drive itself.

A fault on track 00 can disable the entire drive since track 00 contains the drive's File Allocation Table (FAT). Back up as much of the drive as you can (this may be impossible with a track 00 problem) and perform a low-level format of the drive (if possible). You will then need to repartition the drive and perform a new DOS format. If this procedure fails to restore track 00, you will have to replace the hard drive outright.

Software diagnostics indicate a longer average access time than is specified

The average access time is the average amount of time needed for a drive to reach the track and sector where a needed file begins. Verify the specifications for the particular drive. Keep in mind that different software packages measure access time differently. Make sure that the diagnostic subtracts system overhead processing from the access time calculation. Try one or two other diagnostics to confirm the measurement.

If different software tools confirm the measurement, test several identical drives. If all drives measure the same way and work properly, check with the drive manufacturer for a technical explanation. If only the suspect drive measures incorrectly, consider replacing the drive—or at least warn the user to perform a full drive backup.

Software diagnostics indicate a slower data transfer rate than specified

Verify the specifications for the particular drive and controller. Keep in mind that different software packages measure access time differently. Try several different software diagnostics to confirm the measurements.

If the drive is an IDE type, make sure that the original user did not perform a low-level format—this may remove head and cylinder skewing optimization and result in a degradation of data transfer. If no low-level formatting was performed, the drive may be failing. Either replace the drive or perform a full drive backup.

Next time

The next, and final, installment will describe software-related hard-disk problems and will suggest various ways of coping with them. ■

Electronic tuner theory and troubleshooting—Part I

Theory

By Steve Babbert

The advent of the electronic tuner for television sets marked a radical departure from the existing technology. It eliminated the need for most of the moving parts used in the mechanical tuner. Numerous switch contacts, shafts and gears, as well as many of the inductors and capacitors, were replaced with microprocessors, PLLs (phase lock loops), prescalers and varactor diodes.

The mechanical tuners often developed problems due to failure of one or more switch contacts. Sometimes these problems could be solved by cleaning. Other times rebuilding or replacement of the tuner was the only solution. In any event, the problems were usually easy to diagnose and understand.

When troubleshooting the electronic tuner, which bears very little resemblance to the mechanical tuner, many technicians find it difficult to pinpoint the source of a problem. This article will attempt to demystify the electronic tuner and outline some basic troubleshooting procedures. But first, let's look at exactly how a typical tuner operates.

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The purpose of the tuner

The purpose of the tuner is to select a single radio frequency (RF) channel from the many channels that make up the UHF or VHF band, and convert it to an intermediate frequency (IF). While the RF frequency is different for every channel, the IF frequency is always the same. Using this method, all stages of amplification following the tuner won't need to be retuned during channel selection. Conversion of RF to IF is made possible by a process known as *heterodyning*.

In the heterodyning process, the signal from a local oscillator (LO) in the set is mixed with or "beat" against the incoming RF signal in a stage known as a mixer (see Figure 1). The actual mixing takes place in a non-linear device. In a linear device such as a resistor, changes in voltage across the device are accompanied by directly proportionate changes in current through the device, so no heterodyning can take place.

Most semiconductors are non-linear. In modern VHF tuners the mixer is often a MOSFET while UHF tuners generally use a Schottky Barrier Diode. In the early days of radio this stage was often referred to as the "first detector." This term was supplanted by the commonly used "mixer" many years ago reserving the use of the term "detector" for the stage that extracts the so-called intelligence or baseband audio, video or both from the carrier after amplification in the IF stages.

Mixer output

The output of the mixer contains the sum and the difference of the two input frequencies and in some cases the two input frequencies as well (this is determined by what type of mixer is used). Mixing 113MHz (the channel 4 LO frequency) with 69MHz (the center of the channel 4 RF frequency) will result in a 44MHz and a 182MHz output.

An in depth discussion of the various types of oscillators and mixers is beyond the scope of this article. Suffice it to say that after the filtering of any undesired remnants at the output of the mixer, only the IF frequency will remain.

In the NTSC system, the difference frequency, which is centered at 44MHz, is used for the IF. The actual frequencies of the sound and video carriers are 41.25-MHz and 45.75MHz respectively.

Any channel in the UHF or VHF band can be converted to the IF frequency by

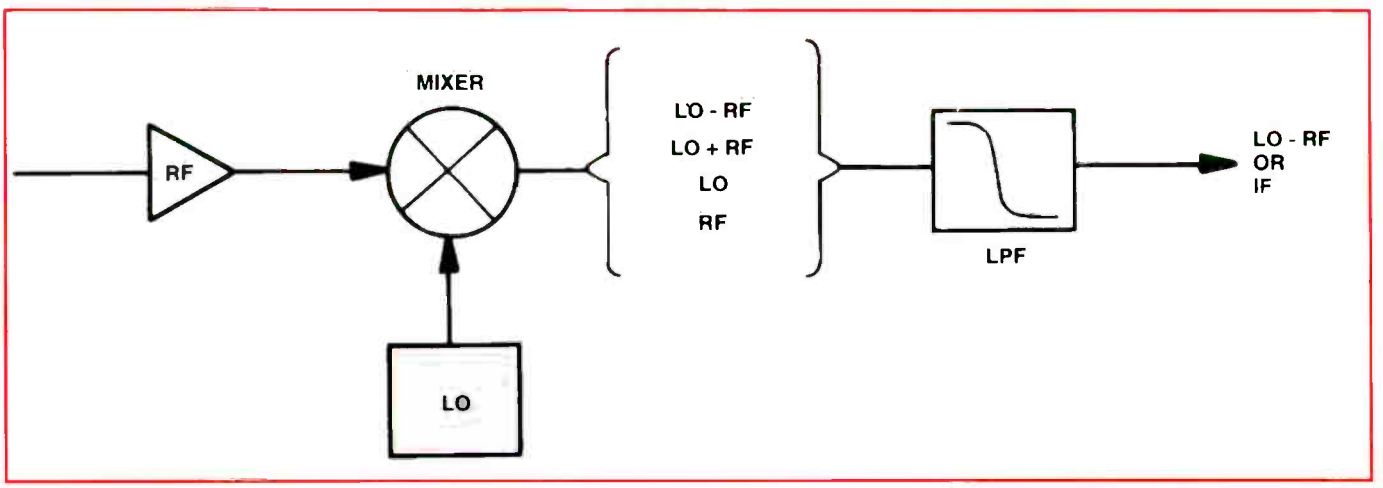

Figure 1: In the heterodyning process, the RF signal is mixed with a signal from a local oscillator in a non-linear device to produce the IF frequency.

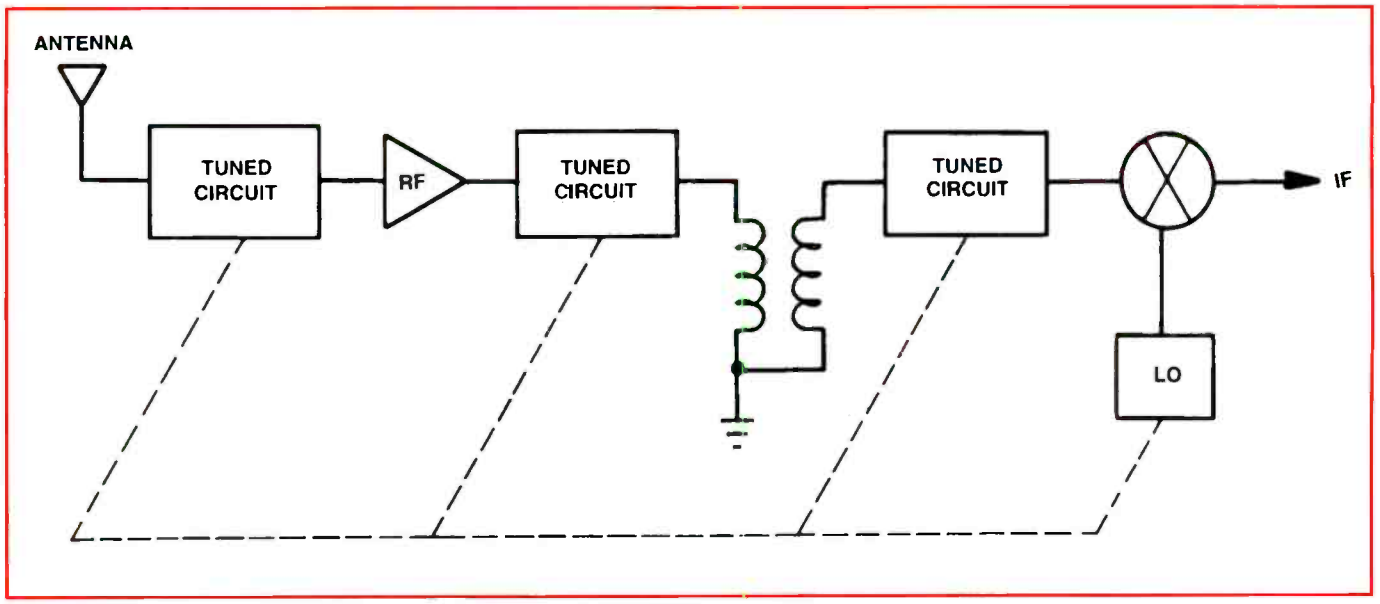

Figure 2: In the VHF tuner four circuits are tuned simultaneously. These circuits can be tuned mechanically by changing component values, or electronically by using varactor diodes in conjunction with a variable voltage source.

selection of the appropriate LO frequency. In the most common mechanical VHF tuners (rotary style), when the channel is changed, a different set of inductors and/or capacitors is switched into the LO circuit. These are frequency determining components and therefore change the LO frequency. The UHF tuner generally uses a set of continuously variable capacitors for tuning.

The first RF amp, which is often referred to as a *preselector* since it is ahead of the mixer, is also tuned at its input and output by this method to select a channel. The input to the mixer also uses this tuning method. The electronic tuner achieves the same results by varying the dc voltage on a series of reverse-biased varactor diodes that are used as frequency determining components in the above mentioned stages (see Figure 2).

The varactor diode

A reverse-biased varactor (variable reactance) diode exhibits capacitance that is inversely proportional to the voltage across its P-N junction. The greater the reverse bias, the lower the capacitance; hence the higher tuned-circuit resonant frequency (see Figure 3a). Physically, the change in capacitance is attributable to change in the width of the depletion region under varying reverse bias conditions.

In semiconductor diodes, a depletion region or space-charge layer exists at the junction of the P and N type semiconductor layers. This is a result of mobile charge carriers drifting from the P layer to the N layer and vice-versa. Under no-bias conditions, this diffusion flow reaches equilibrium at some point. Since the depletion region is devoid of charge carriers it acts as a dielectric (in this case the insulating material between the two plates of a capacitor).

The opposing surfaces of the P and N layers effectively act as the plates of the capacitance. As the reverse bias is increased, the depletion region widens, which reduces the capacitance (capacitance is inversely proportional to the distance between the plates). Though many kinds of diodes exhibit this effect, by controlling the doping profile at the junction during manufacturing, the varactor diode

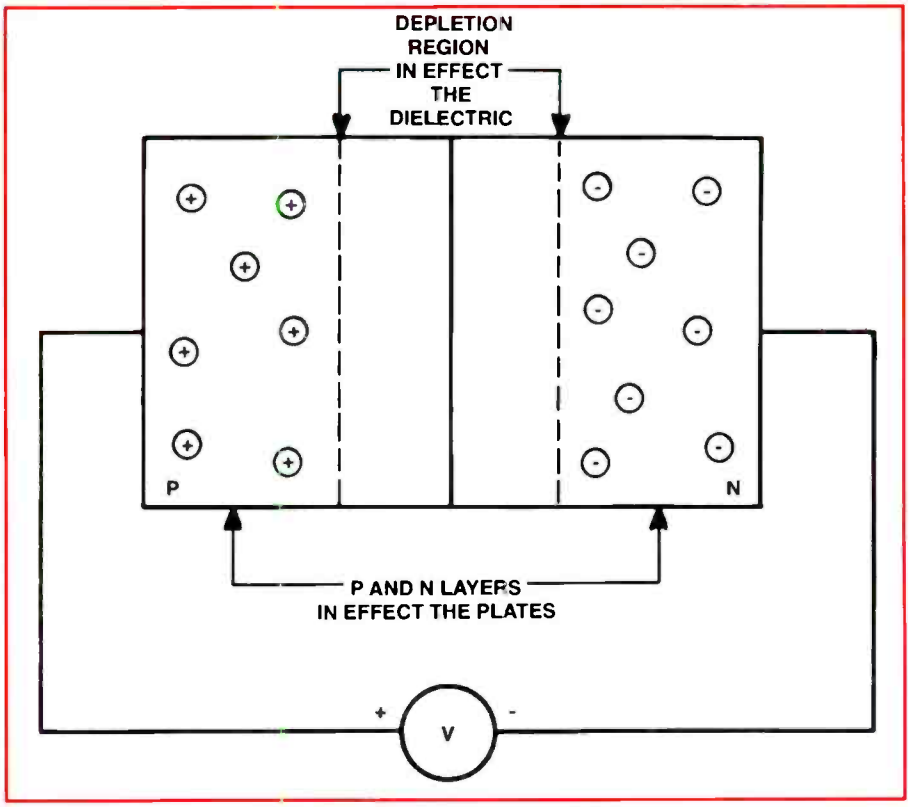

Figure 3a: When the reverse bias is increased, the depletion region is widened, effectively ncreasing the distance between the "plates" hence decreasing the capacitance.

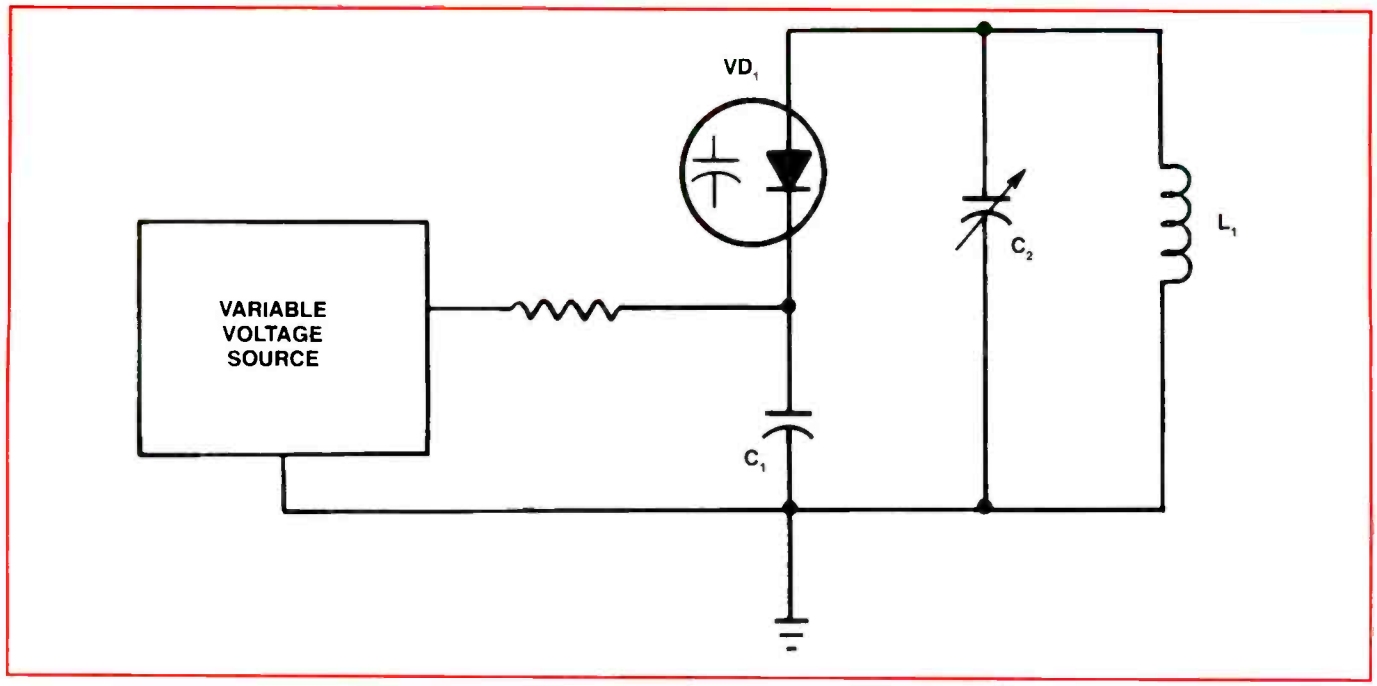

Figure 3b: C1 acts as a short to the frequency of interest while isolating the tune voltage from ground. This places the capacitance of VD1 in parallel with C2 and L1. By varying the voltage on VD1, the resonant frequency of the tuned circuit can be changed.

can be tailored to a specific application. Varicap and Selicap are two tradenames for the varactor.

Adjusting the tuning voltage

The simplest electronic tuners that are often found in older TVs and VCRs, use a series of potentiometers (presets) to adjust the "tune voltage". A different potentiometer and band selector switch combination is connected into the circuit each time a new channel is selected via a pushbutton. Some battery operated TVs use a single potentiometer that is adjusted to select a particular channel. This design still uses a band selection switch. Most TVs and VCRs, however, use some form of voltage synthesizer to supply the tune voltage (see Figure 3b).

In newer electronic tuners, one or more of the components that comprise the voltage synthesizer may be contained within the tuner housing (the prescaler is often part of the tuner assembly). This can place some constraints on what the technician can do.

This isn't to say that it is impossible to troubleshoot inside of the tuner housing. However, if the electronic tuner itself develops a problem it is generally replaced as a unit. The ancillary circuits, however, often can be serviced by the technician.

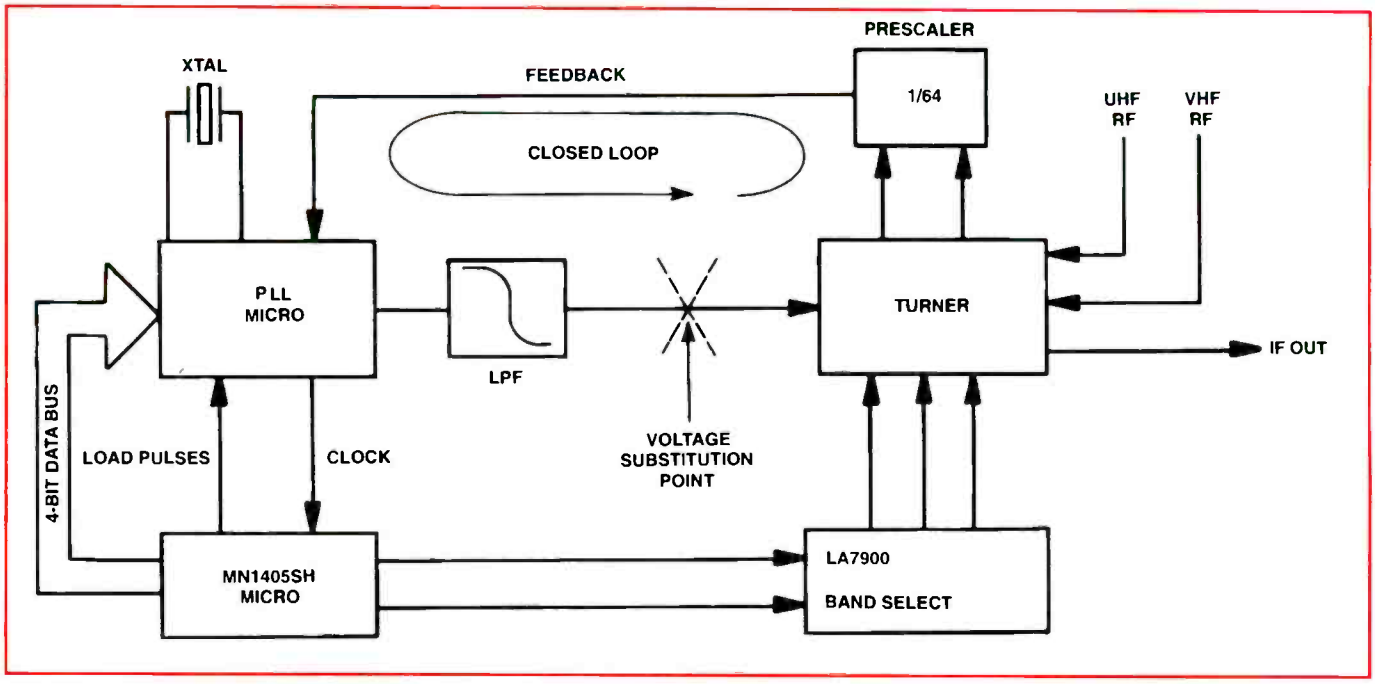

Figure 4: In the Sanyo Model 91C94N, all components related to voltage synthesis are located outside of the tuner.

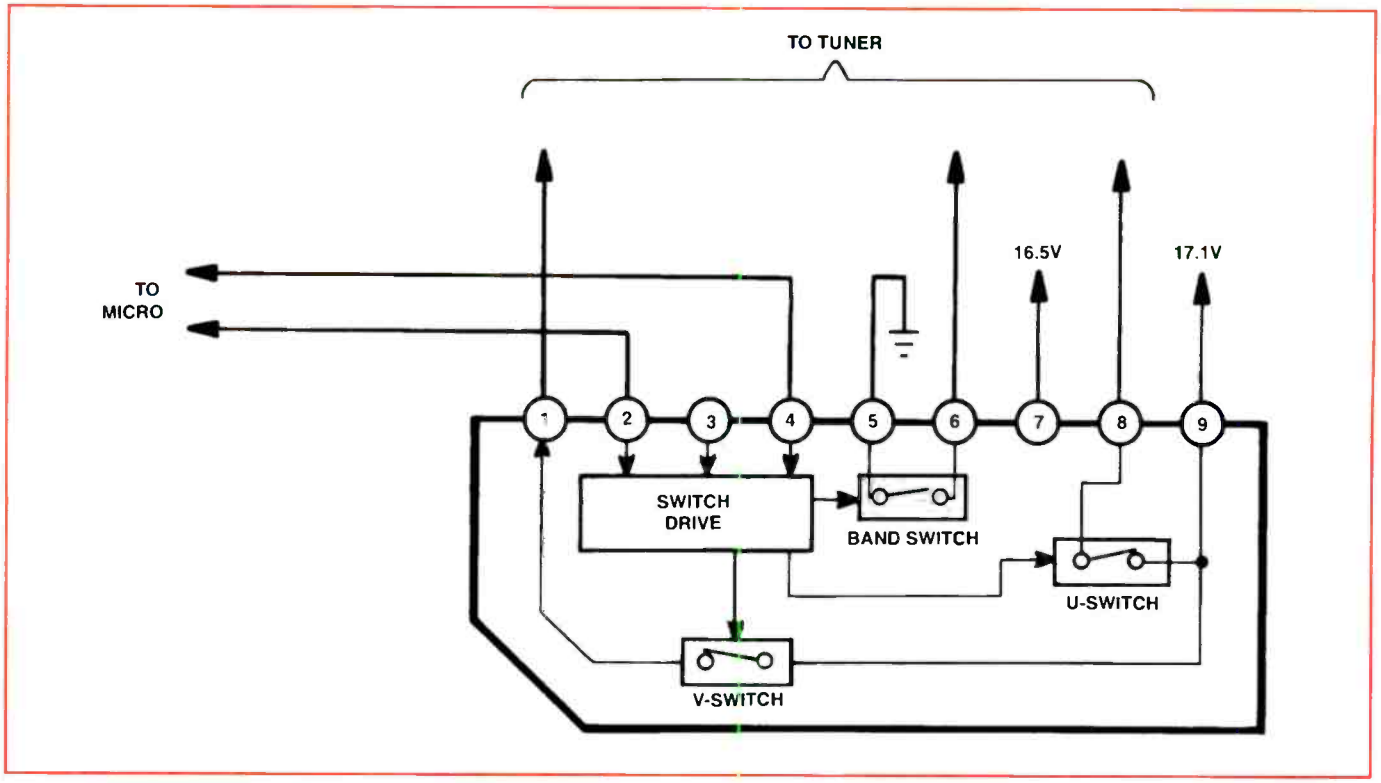

Figure 5: The band selector switch activates or deactivates sections of the tuner in response to signals from the control micro.

The voltage synthesizer

I recently repaired the synthesizer board and varactor tuner in a Sanyo Model 91C94N. In this chassis, all components related to voltage synthesis are located outside of the tuner. The main blocks that will be covered are the prescaler, the PLL, the microprocessor, the tuner band selector switch and the low-pass filter (Figure 4).

The band selector switch

In the electronic tuner, some sections are common to VL (low band VHF), VH (high band VHF) and UHF while other sections are used exclusively for one of these bands. Tuners incorporating a superband section follow this rule as well. Tuning of these bands is done separately because the varactor diode has a limited capacitance range and therefore cannot cover the entire tuning range of the VHF band (54 to 216MHz which is a 4:1 tuning ratio) much less the combined UHF and VHF band.

The purpose of the band selector switch is to enable the appropriate sections of the tuner as needed when a channel is selected. In this chassis, the band selector switch IC, an LA7900, is controlled by the microprocessor, an MN1405SH, via two lines. The tuner is controlled by the band selector switch via three lines.

When a channel is selected, the microprocessor, in response to an internal program, instructs the band selector switch to open or close one or more of its three internal switches. Switching diodes within the tuner either pass or block signals depending on whether they are forward

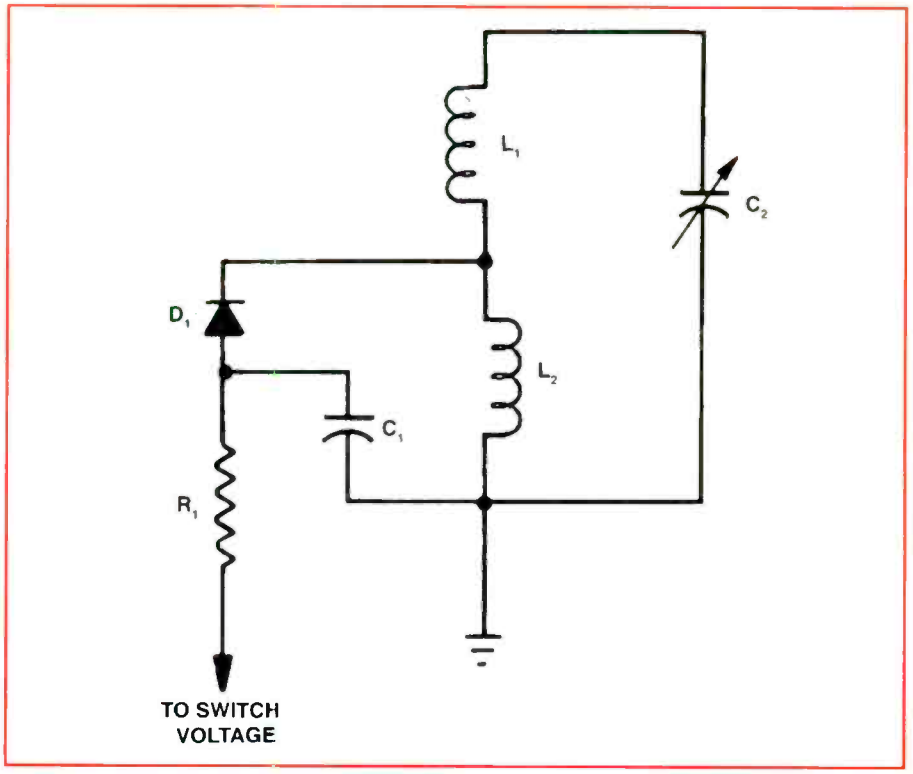

Figure 6: C1 acts as a short at the frequency of interest while isolating the switching voltage from ground. When D1 is forward biased, the lower side of L1 is pulled to ground bypassing L2. This lowers the inductance of the tuned circuit raising the resonant frequency.

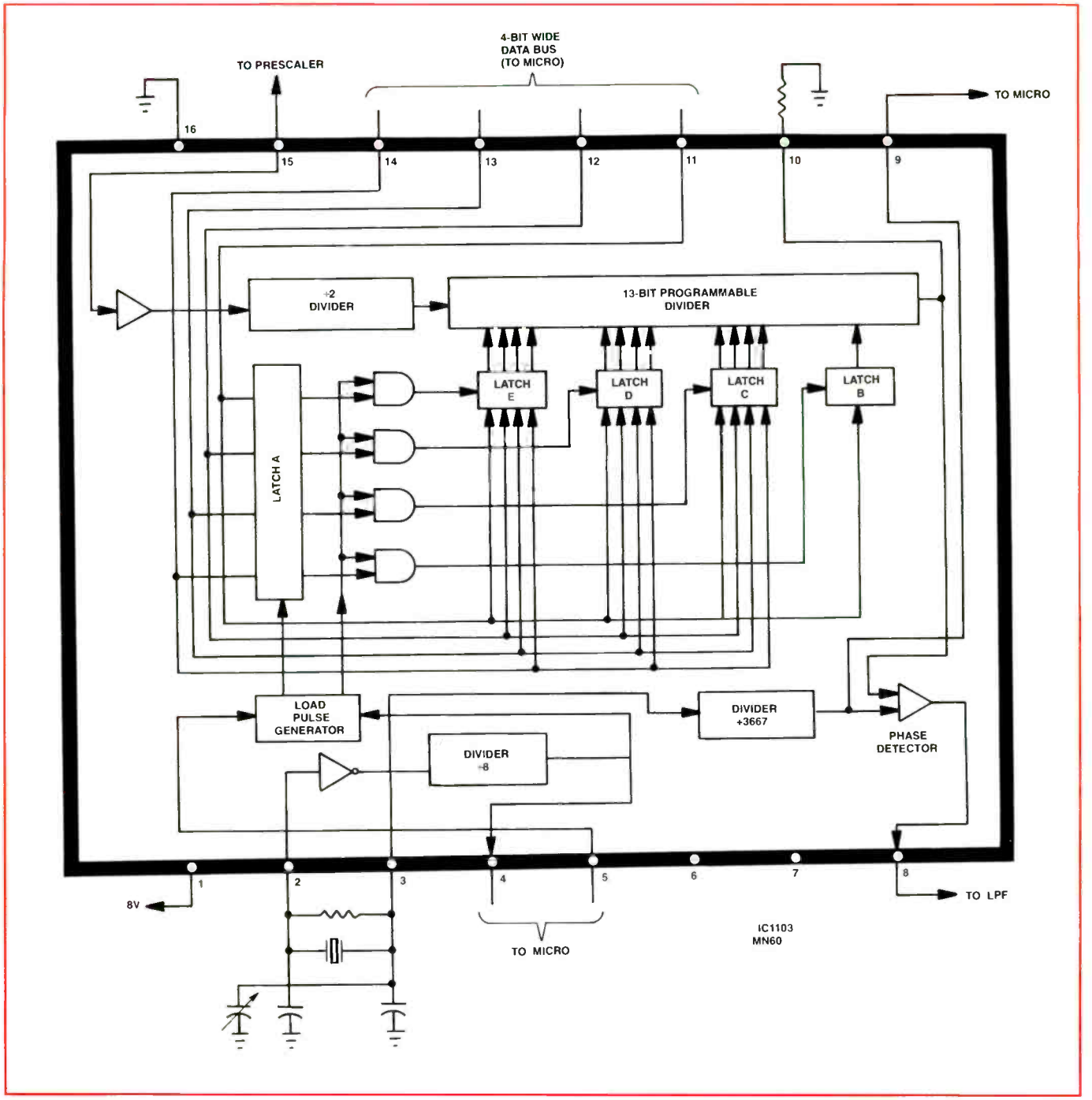

Figure 7: One of the more complex blocks in the voltage synthesizer system is the PLL. In this case the internal block diagram of the PLL was shown on the schematic and proved very helpful in troubleshooting.

or reverse biased by voltages from the band selector switch. The result of this switching scheme is that only the sections of the tuner that were designed to accommodate a given band will be activated. In this band selector switch, one switch places the tuner into the UHF mode, one places it into the VHF mode and the remaining switch selects between VL and VH when the tuner is in the VHF mode (see Figure 5).

The tuning circuits must make a relatively far jump between channel 6 (VL's highest) and channel 7 (VH's lowest). The center frequency of channel 6 is 85-MHz and that of channel 7 is 177MHz. The difference is 92MHz. Most channels differ by 6MHz. The reason for this gap is that those frequencies were allotted for other services. For example the FM broadcast band uses 88 to 108MHz.

The tuned circuits are shifted to a higher frequency by forward biasing a switching diode which shunts a portion of an inductor to ground (see Figure 6). This reduces the inductance which raises the resonant frequency. The reactance of C1 is negligible at the frequency of interest so it acts as a short. Its purpose is to isolate the switching voltage from ground.

Since the UHF band is so far removed from the VHF band, it isn't practical to try to tune it on a tuner designed for VHF. As frequencies increase, the problems of RF design become greater. For this reason, most of the UHF stages in the tuner are completely different and separated from the VHF stages. Switching diodes are used to activate or deactivate stages

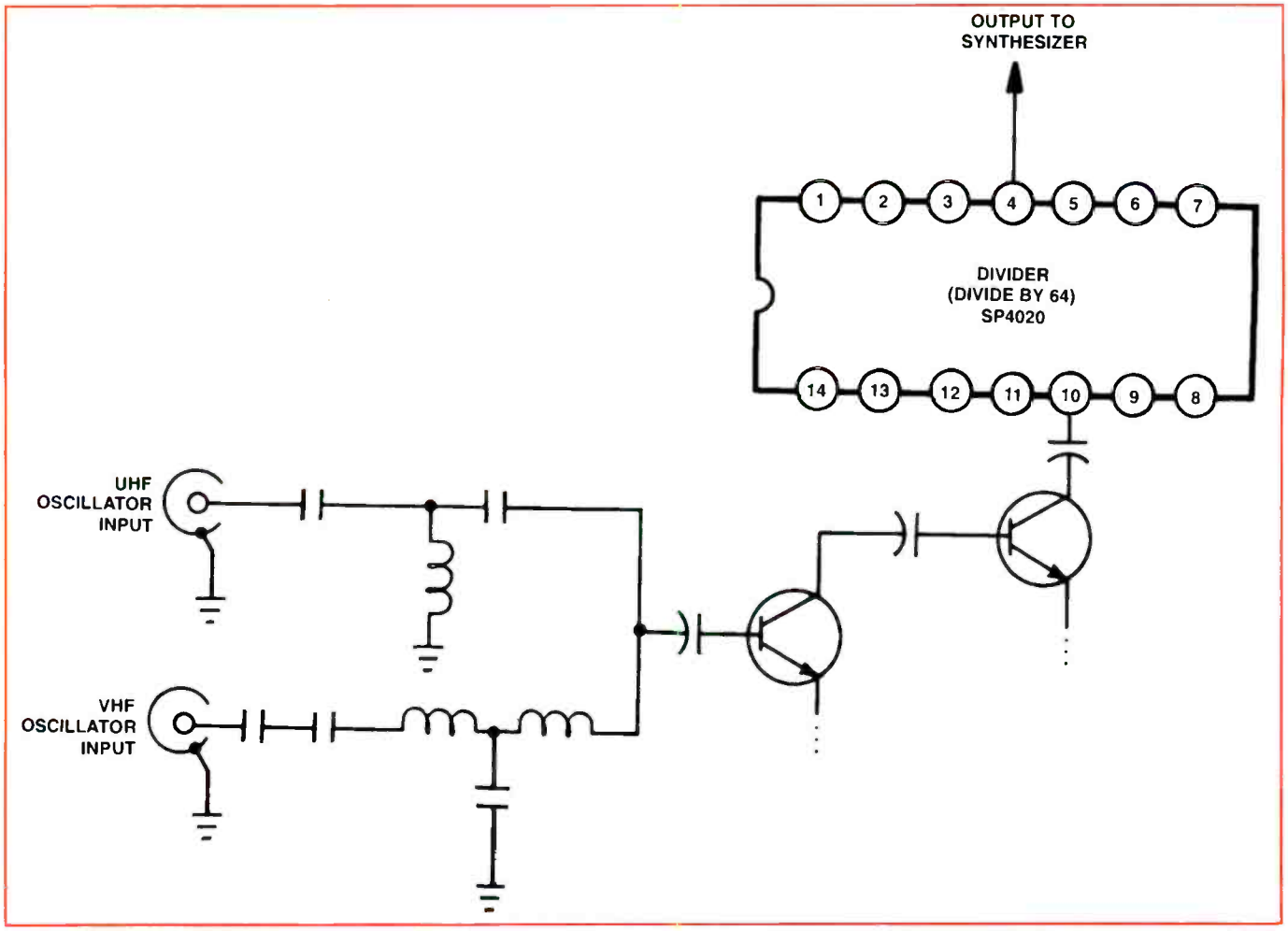

Figure 8: The prescaler circuit divides the frequency of the UHF or VHF oscillator by 64 before application to the PLL. This lower frequency, while still related to the original frequency, will simplify the task of the PLL.

as needed. The main stage, which is shared by the UHF and VHF sections, is the VHF mixer. Once the UHF frequency is converted to the IF it is passed through the VHF mixer which in this case acts as an IF amp.

The tune voltage

Now that band selection has been covered, let's look at individual channel tuning. The tune voltage measured at the output of the low-pass filter (LPF) ranges from a little over 1V to about 24V. There is some overlapping of voltages between bands. The tune voltage when in the VL band will range from 2V to about 20V. In the VH band the range will be from about 7V to 20V. In the UHF band it will range from about 2V to 24V. These ranges may be different for other tuners. Generally, the tune voltage will not exceed 28V.

If the tune voltage line (which will be referred to as VT in this article) is monitored, it can be seen that the voltage will increase each time a higher channel is selected. Once a higher band is passed into, VT will drop to the floor of that band. Passing into a different band causes different tuner sections to be activated so a specific value of VT won't tune the same frequency in different bands. If VT is monitored ahead of the LPF (which in this case provides inversion and amplification) the voltage increments will be smaller while stepping through channels.

The PLL

One of the most important and complex blocks in the voltage synthesis circuit is the phase lock loop (PLL). Basic PLL theory won't be covered here as it has been outlined thoroughly in recent issues of ES&T. The PLL receives instructions from the microprocessor and feedback from the tuner itself and outputs an error voltage which becomes the tune voltage. The PLL IC in this chassis, is an MN6049 (see Figure 7). One of the blocks in this IC is a 13-bit programmable divider. This divider receives an input signal from the UHF or VHF LO in the tuner after having been passed through a prescaler and an on-board divide-by-2 counter.

The prescaler

The prescaler in this chassis is a separate shielded module mounted beside the tuner. It consists basically of a 4020 CMOS 12-stage binary counter IC configured to divide by 64 (see Figure 8). Its input comes from the VHF LO or the UHF LO (depending on which is active).

The LO signal is buffered and amplified by a two-stage amp once inside the prescaler module before application to the divider. Since the UHF/VHF LO frequencies are related to the tuned frequency, they can be used as feedback by the PLL to determine to which frequency the tuner is tuned. This feedback signal is essential for proper operation.

Once the feedback signal is divided further by the divide-by-2 block and the programmable divider, it is compared to a stable reference at the phase detector. If

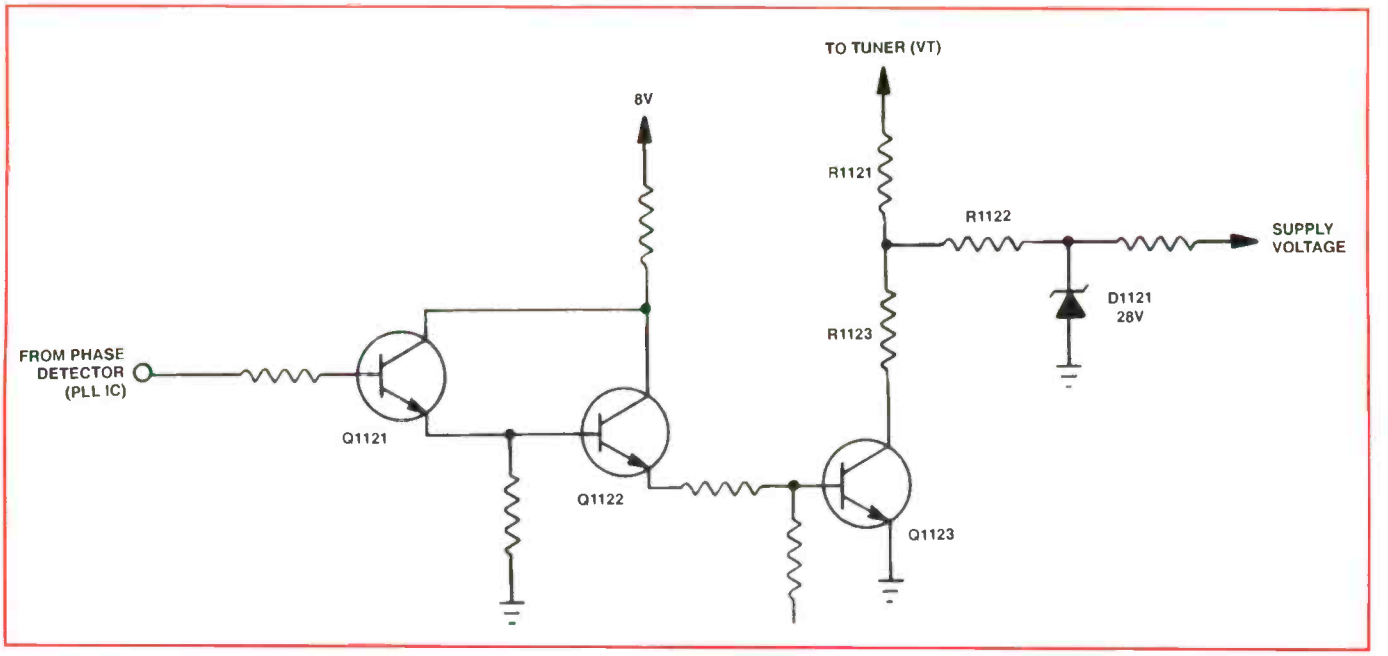

Figure 9: The low pass filter amplifies, filters and inverts the tune voltage from the PLL before application to the tuner. The output of the LPF is a good place to open the loop.

the two frequencies don't match, the output of the phase detector, which is basically a voltage comparator, will toggle high or low as needed in an attempt to bring the tuner frequency in line.

Actual locking between the two frequencies never takes place. Instead, the output of the phase detector responds quickly each time the tuned frequency overshoots or undershoots the reference. This holds the tuner frequency within an acceptable tolerance.

The programmable divider

The programmable divider receives a specific set of data from the microprocessor for each channel. By selecting the correct divide modulus or division factor, the divider can convert any incoming divided down LO frequency to the reference. This way, no matter what frequency is tuned by the tuner, once the LO frequency for that channel is divided it will be suitable for comparison. Since this

system uses feedback from the tuner to create the tune voltage, it must be viewed as a closed loop. As in any loop system, a problem in one section will upset measurements in all sections.

This PLL has an on-board oscillator that uses an external 3.581055MHz crystal. This signal is divided by 8 before being passed to the load pulse generator. It is also applied to the microprocessor where it is used as a clock signal. This way the microprocessor will be locked to the PLL. Another divider in the PLL divides the signal by 3667, giving 976.5625-Hz before it is applied to the phase detector where it is used as the stable reference.

The load pulse generator

The input to the load pulse generator, at pin 5 of the PLL, which is derived from the microprocessor, provides timing information for the loading routine. At first glance with an oscilloscope, the signal looks like a narrow positive-going pulse with a frequency of about 57Hz. If the timebase of the scope is adjusted to expand this pulse on the display, it can be seen that the pulse is actually a cluster of four pulses.

Though the PLL uses a 13-bit divider, there are only four data lines coming from the microprocessor to the PLL. The load pulse generator, which receives a signal from the microprocessor as well as a signal from the divide-by-8 divider, working in conjunction with data latch A and four AND gates, provides a means for sequentially loading latches B through E. If any one of the four data lines is scoped at the same time as the load pulse, it can be seen that a 4-bit data burst is present for the duration of the load pulse cluster.

The data burst is different on each of the four data lines. The data will change each time a new channel is selected. Each latch will maintain its status after it is loaded thus acting as a data retainer (or memory). This way the 13-bit word will be available at the data input of the divider during the interval between load pulses.

The division factor

The following example will show how the division factor of the programmable divider is established. The LO frequency for channel 4 is 113MHz. Once this is divided by 64 in the prescaler and 2 in the PLL's on-board counter, the result will be 882,812.5Hz. We know that after division in the programmable divider it must equal 976.5625Hz to be equal to the reference. We can find the division factor by dividing the last number into the first which gives 904.

Therefore, in order to tune channel 4, the programmable divider must divide by 904. The binary equivalent of this number is 1110001000. This number is stored in the microprocessor's built-in memory at the "channel 4" address. This is only a 10-bit number and could be handled by a 10-bit divider. However, channel 83, which uses an LO of 971MHz, requires a divide modulus of 7768 which translates to 1111001011000 (13 bits).

The phase detector

The output of the programmable divider, which provides one of the inputs to the phase detector, is available at pin 10. The divided-down reference, which is the other input to the phase detector, is available at pin 9. By scoping these two signals simultaneously, it can be seen if they share the same frequency and phase (which incidentally is the job of the phase detector). In a properly working tuner, this will be the case when any channel is selected. It makes no difference whether the channel is active or inactive.

The most important parameter of the phase detector output at pin 8 is the average dc value. This value is dependent on which channel has been selected. This voltage is applied to the input of a low-pass filter. The low pass filter removes any ac components that were generated by the phase detector.

The raw tune voltage is taken from a 28V Zener diode D1121. This voltage is applied to a voltage divider consisting of R1122, R1123, and Q1123 (see Figure 9). The voltage that is routed to the tuner control input is tapped from this divider by R1121. Transistor Q1123 serves as a variable resistance. It is also an inverter.

When it is turned fully on, VT will be at its lowest point. When it is fully off, VT will be at its maximum. Normally, it will be partially on, holding VT somewhere in between. Notice that the LPF is active and uses a Darlington configuration hence it has a high gain. A change of only a fraction of a volt at the input results in a change of several volts at its output.

Troubleshooting secondary voltage circuits

By Homer L. Davidson

Determining the cause of chassis shut-down, or overloaded power supply circuits, or isolating defective components in the secondary circuits of the horizontal output transformer can consume a great deal of a technician's valuable servicing time. Overloaded circuits in any of the scan-derived voltage sources can cause chassis shut-down, which frequently makes the job of diagnosing a problem more difficult.

A shorted or leaky component in any of the circuits in a TV set can result in failure of another circuit. A defective silicon diode rectifier or electrolytic capacitor in any of the voltage sources supplied from a secondary winding of the horizontal output transformer can cause shut-down or improper circuit operation.

The secondary winding of the horizontal output transformer provides power to the horizontal output and driver circuits. In many sets, the low voltage power supply circuits may operate off of a secondary winding of the flyback as well (Figure 1).

Davidson is a TV servicing consultant for ES&T.

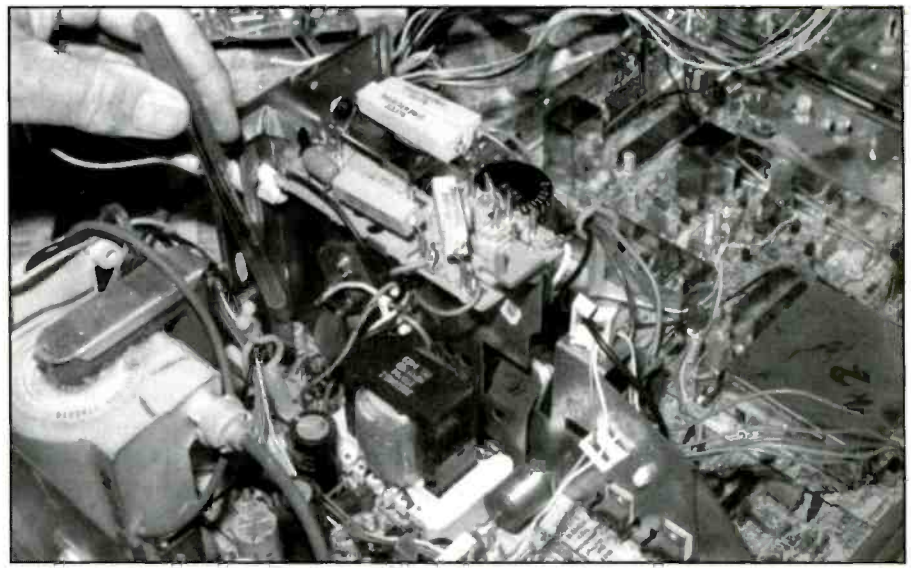

Figure 1. The secondary voltage sources are derived from several windings upon the IHVT flyback.

These various supply voltage circuits may be derived from separate transformer windings, and may be regulated and filtered by silicon diodes and electrolytic filter capacitors. Transistor or zener diode voltage regulation, or a combination of transistor and zener diode regulation, can be used in the critical voltage circuits. In

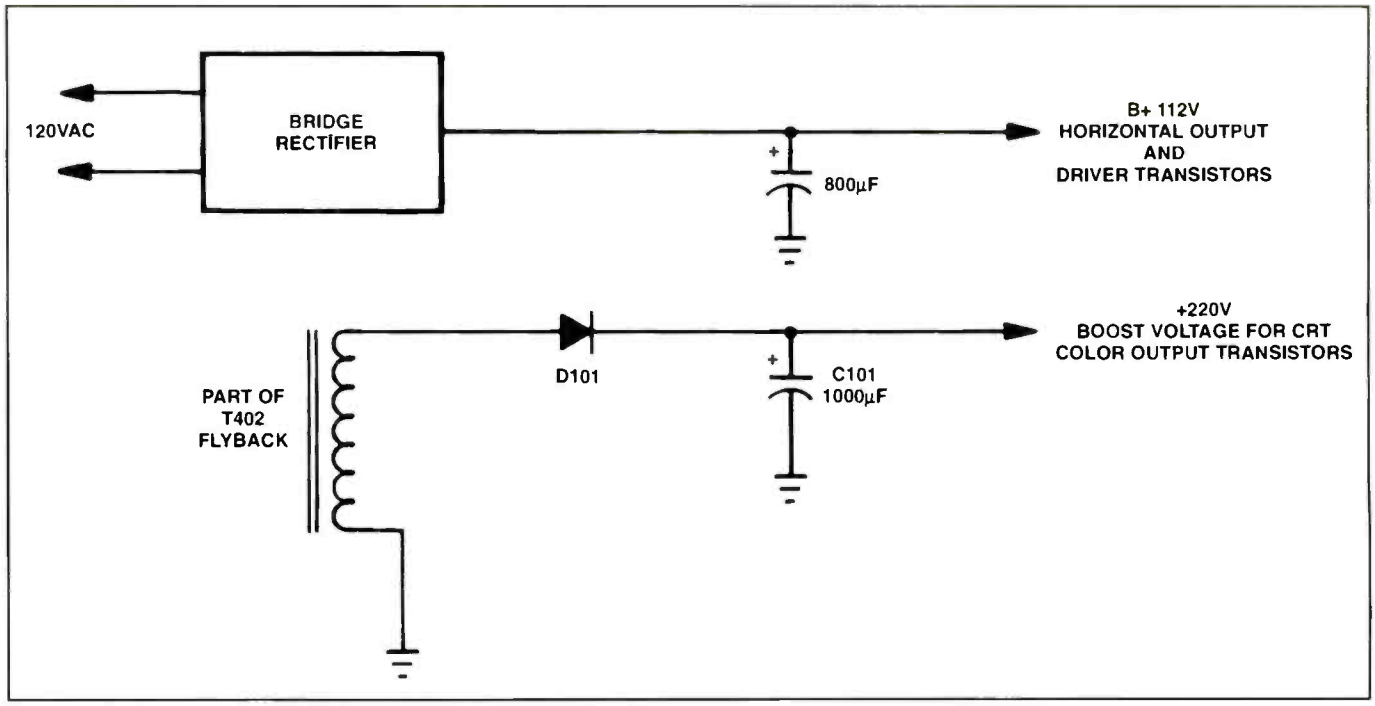

Figure 2. The boost voltage (+220V) in this circuit was taken from a secondary winding of the horizontal output transformer T402.

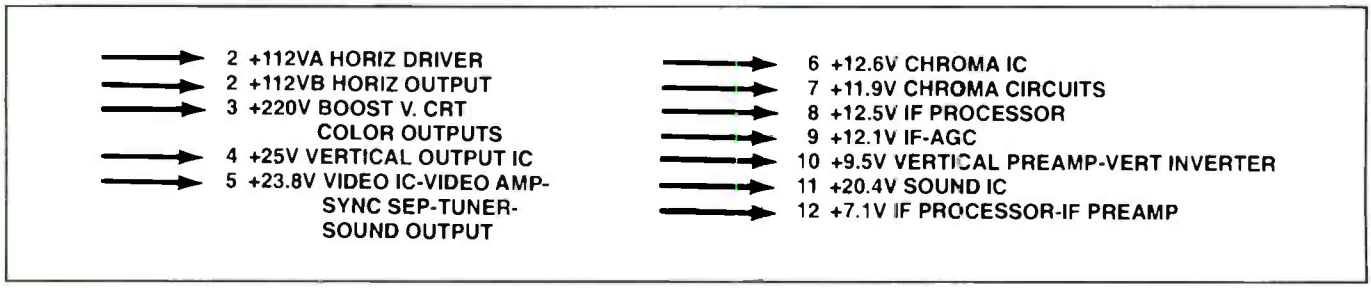

Figure 3. The voltage sources shown here numbered, are powered by the flyback secondary. These sources provide power to most of the circuits in this set.

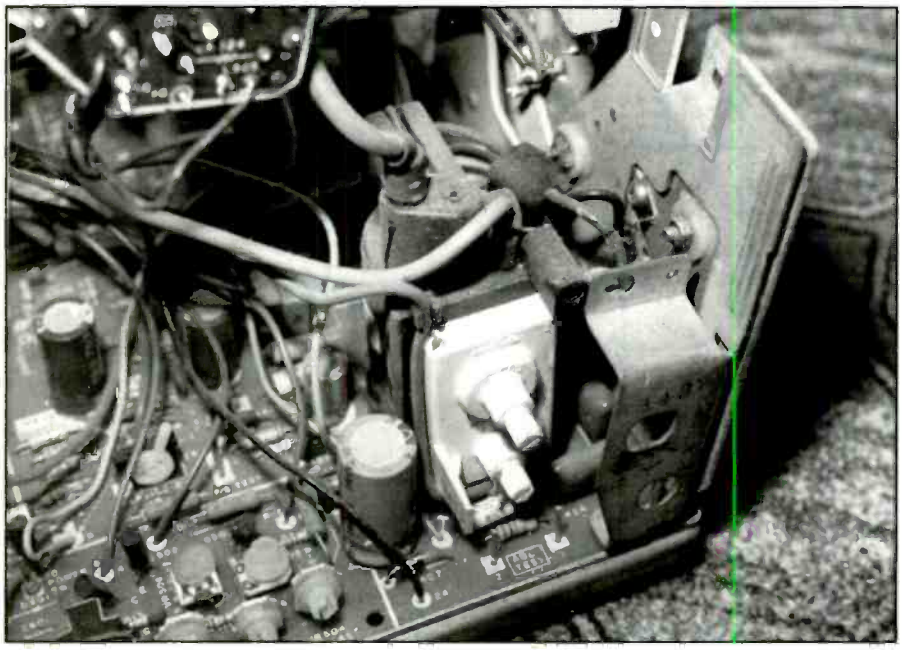

Figure 4. Older flybacks provided high voltage, screen and focus voltages from their secondary windings.

some cases regulation of voltage sources is achieved using only zener diodes.

The various voltage sources

In many sets the low-voltage power supply circuit consists of a bridge rectifier network, a high voltage filter capacitor, and dc voltage fed to the horizontal output transistor and driver circuits. The voltage source feeding these two circuits may be raw dc taken directly from the dc power supply, or it may be regulated by an IC voltage regulator. Usually the voltage supplied to the horizontal output transistor circuits is the highest dc voltage found in the set, except for boost voltage.

A typical flyback transformer secondary circuit supplies many different voltage sources. In the circuit shown in Figure 2, a 220V boost voltage feeds the CRT, color outputs and HV shutdown return circuits. A separate secondary winding supplies ac voltage to a silicon diode and a 47µF, 180V electrolytic capacitor. Note that the working voltage of the filter capacitor is far higher than those found in the rest of the dc sources.

Another secondary winding supplies flyback voltage to a silicon rectifier. The output of this source is used to provide several different voltages via regulation employing transistors and zener diodes, and filtered using electrolytic capacitors. Most secondary circuits employ silicon diodes for half-wave rectification. In Sams Photofacts, the various voltage sources are identified by number and can easily be located on the main schematic by the number (Figure 3).

If, for example, you are servicing a TV set with a good picture but no sound, you would check the secondary power supply list and see what number circuit supplies voltage to the audio output circuits. You would then locate that number on the schematic to locate the point where the output of the supply appears.

The next step would be to check the voltage at that point. If the voltage is incorrect, the problem might be a defect in the supply, or a defect in the circuit that is supplied by that voltage that is causing an overload.

If the voltage is correct, the cause of the problem is not the supply. Keep in mind that when one voltage source is missing several different stages or circuits may be inoperative.

Older flyback circuits

In older horizontal output transformer circuits, very high HV, focus, screen and boost voltages were found in the secondary circuits. In some TV chassis, high voltage was developed from the large flyback winding with a tripler unit supplying HV to the CRT.

The focus and screen voltages are developed from a high resistance network supplied by the high voltage source. Another secondary winding, or a tap off of the bottom leg of the horizontal output transformer, supplied boost voltage to the picture tube circuits (Figure 4).

In later model TV sets, the integrated high voltage transformer (IHVT) was introduced. This unit comes with HV diodes and capacitors mounted inside the flyback to develop high voltage for the picture tube. The high voltage resistor network from the HV output supplies both focus and screen voltages for the CRT. Still later, several different secondary windings were added to the horizontal output transformer to supply voltages to other circuits in the TV chassis.

Overloaded circuits

Today, the IHVT transformer provides many different voltage sources derived

from the secondary winding. These coils are wound on the same transformer core as the high voltage winding. If a chassis starts up and then shuts down, a likely cause is a leaky silicon diode in the secondary circuits.

Sometimes by carefully observing the screen as you turn the set on you can determine what circuit the trouble exists in. An overload in the secondary voltage circuits or in a circuit that is supplied by the secondary can cause the chassis to shut down at once.

For example, if a 25V source feeds the vertical output IC, a leaky output transistor or IC can cause an overload on that 25V source. A direct short or low resistance may damage the connecting silicon diode and isolation resistor before chassis shut-down occurs. Often, the chassis will shut down if a component in the vertical circuit is causing an overload.

In the circuit shown in Figure 5, if capacitor C322 (1000µF) had a direct short, D522 might become damaged, or the chassis might shut down before D522 incurs any damage. A leaky C335 (1000µf) electrolytic capacitor in the output yoke return circuit may delay the shut down of the chassis and cause a horizontal white line on the raster.

The sound was weak and distorted in a Panasonic AGP159 chassis. The picture was normal. The voltage at pin 9 (V_{CC}) of the sound output IC, IC201 was only 5.4V. The voltages on both sides of R210 were low. I traced the low voltage source back to the flyback secondary 15V source. Diode D507 and capacitor C516 checked out normal. I concluded that IC201 was leaky. All of these tests were made by monitoring voltages during turn-on and shut-down operations.

I unsoldered one end of R210 to isolate this supply from the circuit it supplies, to see if the voltage source was the problem or if the IC was defective. When I again applied power to the set, the secondary 15V voltage source measured 15V (Figure 6). A resistance measurement from pin 9 to ground verified that IC201 was leaky. IC201 was replaced with an ECG-1789 universal IC replacement.

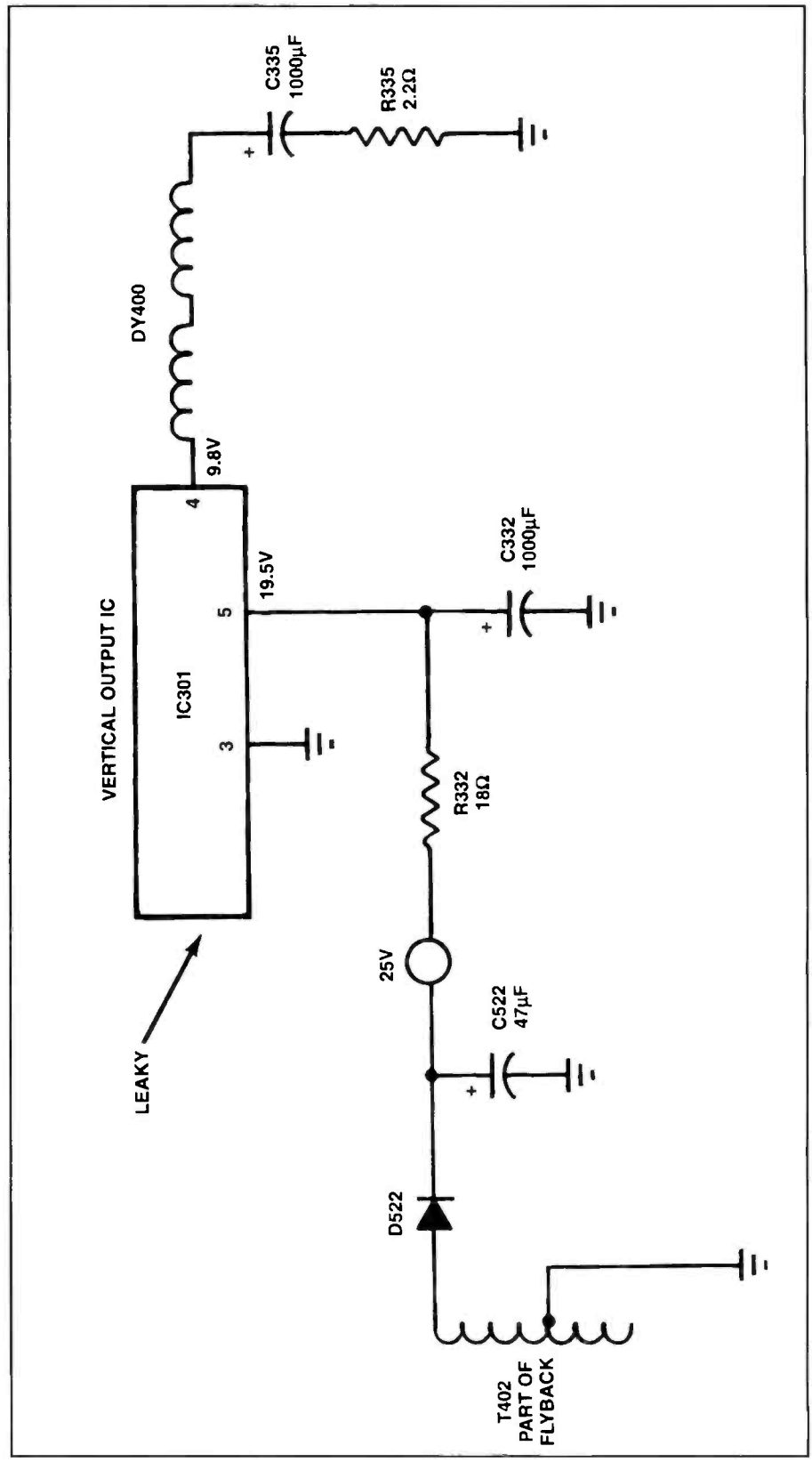

Figure 5. A leaky vertical output IC, IC301, may load down the 25V secondary source, causing shut-down.

Chassis shut-down

A low resistance leakage loading down one of the voltage sources powered by the flyback secondary may cause chassis shut-down in sets that have the latest IHVT flybacks (Figure 7). The chassis will shut down if a horizontal deflection IC that derives its power from the flyback secondary becomes faulty.

The same type of horizontal deflection IC fault might not cause shut-down if its supply voltage comes directly from the ac-line-powered low voltage power supply. When faced with a set that is inoperative because of shut-down, try to deter-

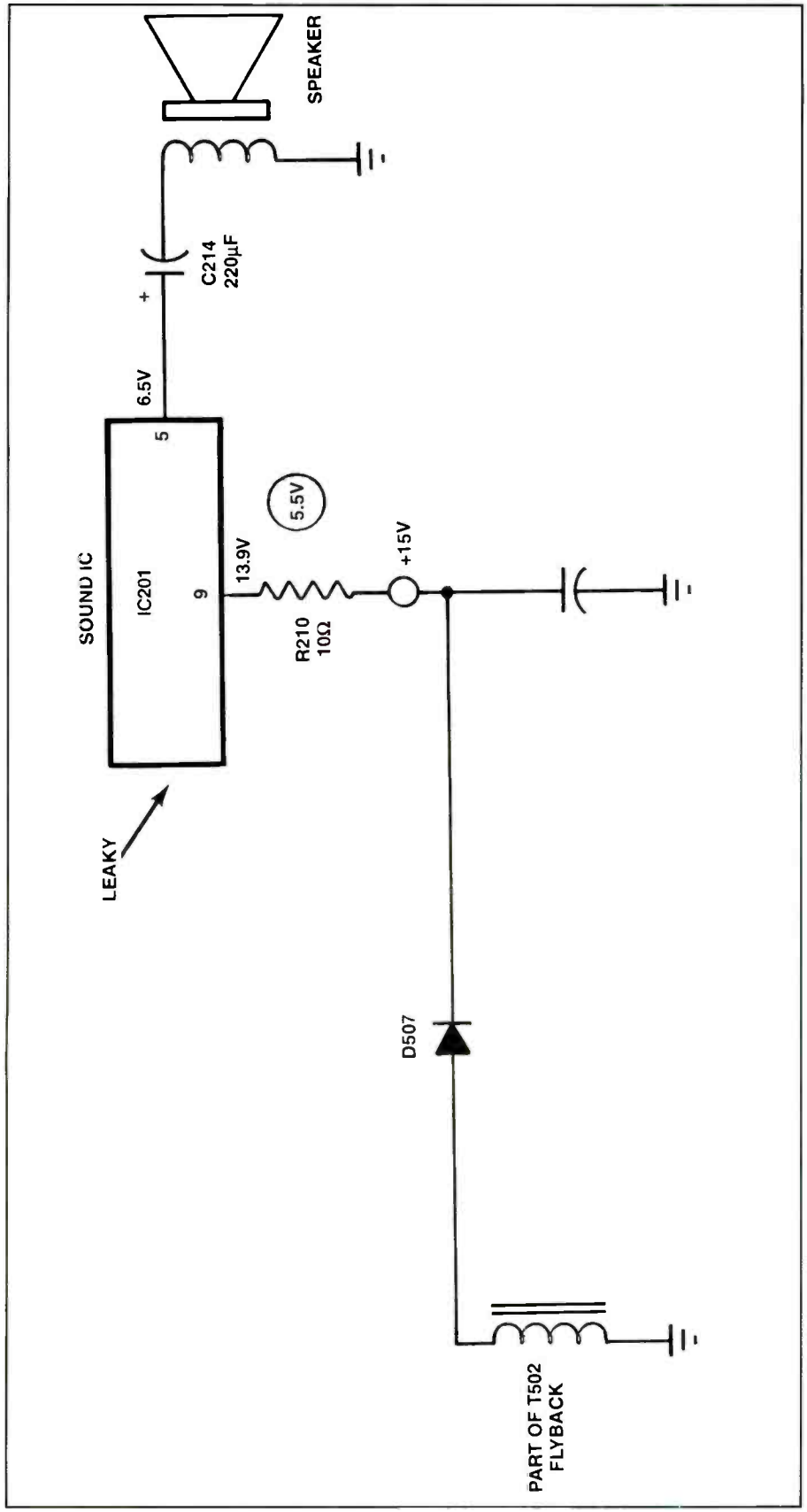

Figure 6. When one end of R210 was disconnected from the circuit in this set, the secondary voltage source returned to normal. The problem was found to be a leaky sound output IC, IC201.

mine what circuit might cause chassis shut-down if it becomes overloaded. Check to see what type of voltage source is feeding the horizontal deflection IC.

For instance, if you see a horizontal white line on the screen before chassis shut-down, it's a good bet that a malfunction in the vertical circuits caused the shut-down. In such a case, go directly to the vertical circuits and isolate the voltage source feeding the vertical output transistors or IC. Desolder the vertical IC voltage supply pin to isolate the supply from the IC. Likewise disconnect the isolation resistor between output transistors and the voltage source.

If the chassis starts-up and remains operating (or it may shut down after a few minutes) check for a leaky diode in the secondary voltage source. Refer to the schematic to locate the isolation resistor and filter capacitor. The resistor may show signs of overheating and burned marks. An open electrolytic filter capacitor will have very low voltage at the voltage source.

The causes of shut-down are difficult to locate if the horizontal deflection IC circuits are fed from the secondary voltage source. The horizontal circuits must operate in order to generate the secondary flyback voltage sources. When the set goes into shut-down, you must determine if the secondary voltage sources are causing the shut-down or if the problem is caused by defective horizontal circuits.

The horizontal oscillator, count-down circuits and horizontal deflection IC can be checked by supplying a voltage from an external power supply or batteries to the horizontal circuits. With the external power source connected, use the oscilloscope to see if there is a horizontal output waveform at the deflection IC. Proceed to the rest of the horizontal circuits to determine if they are working.

Secondary current tests

If the set has shut-down and you don't know if the problem is a faulty voltage source that derives its power from the flyback secondary or a faulty circuit that's loading down the supply, disconnect one end of the silicon diode that provides voltage to the secondary voltage source. Disconnect only one end of the diode and check to see if the set will stay on.

All secondary voltage sources can be isolated using this method. Of course, if you disconnect the voltage source that feeds the horizontal deflection circuits, the chassis will remain in shut-down. Remember this same voltage source may

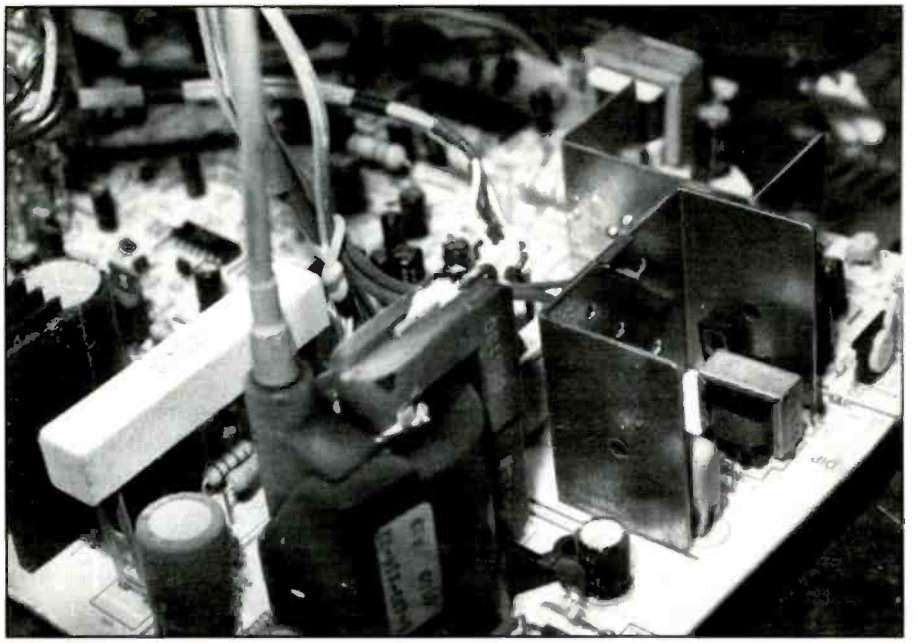

Figure 7. Chassis shut-down may occur when one of the circuits supplied by the secondary of the flyback transformer becomes leaky and loads down the supply.

supply voltage to several different circuits. By removing one end of each silicon diode in turn, you may be able to identify the overloaded circuit. Determine which components are causing the defective circuit using resistance and transistor-diode tests.

Another method of determining if there is an overload is to insert a current meter in series with the voltage source or silicon diode. Disconnect the positive end of the diode rectifier and insert the milliammeter. Some schematics have the total current draw marked on the various voltage sources. If the current is high on any given circuit, check to see if a faulty component is causing an overload (Figure 8). If the total current was specified to be 20mA and you measured 30mA or more, suspect a leaky component in the circuit supplied by that voltage source.

Voltage and resistance tests

Voltage measurements in the secondary circuits can determine if a component in the voltage source is faulty, or if circuits external to the power supply are leaky or shorted. Extremely low voltages may indicate an overloaded circuit or an open filter capacitor. A leaky filter capacitor in the voltage source can shut the chassis down. Leaky transistors or zener diode regulators can cause chassis shutdown as well.

Resistance measurements across the low-voltage sources may turn up a leaky component or voltage source. If voltage and resistance measurements at the terminals of a voltage source reveal low volt-

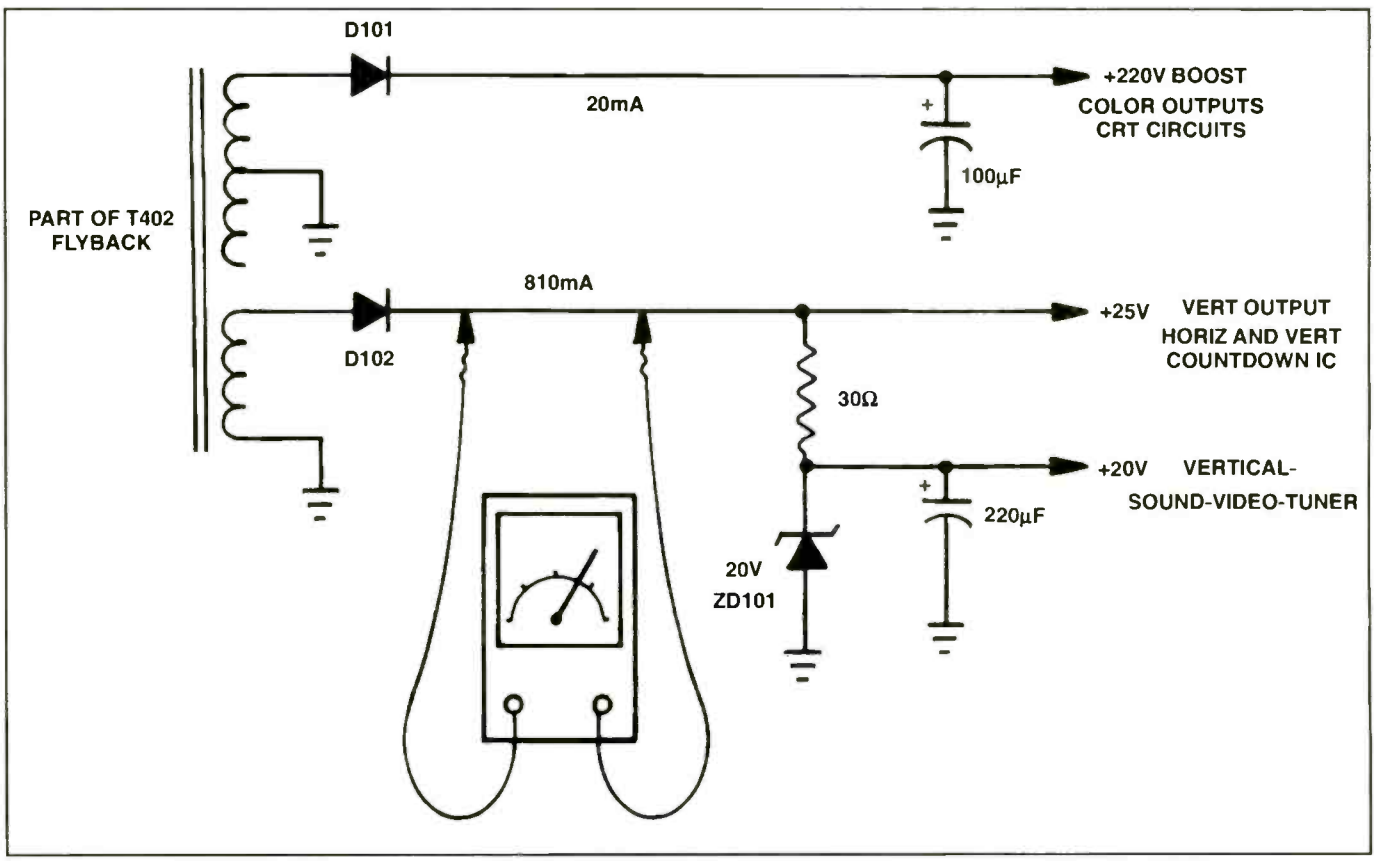

Figure 8. You can check to see if a circuit is causing an overload by disconnecting the positive terminal of the silicon diode that's used as a rectifier for that source and inserting a current meter in series with the output voltage source.

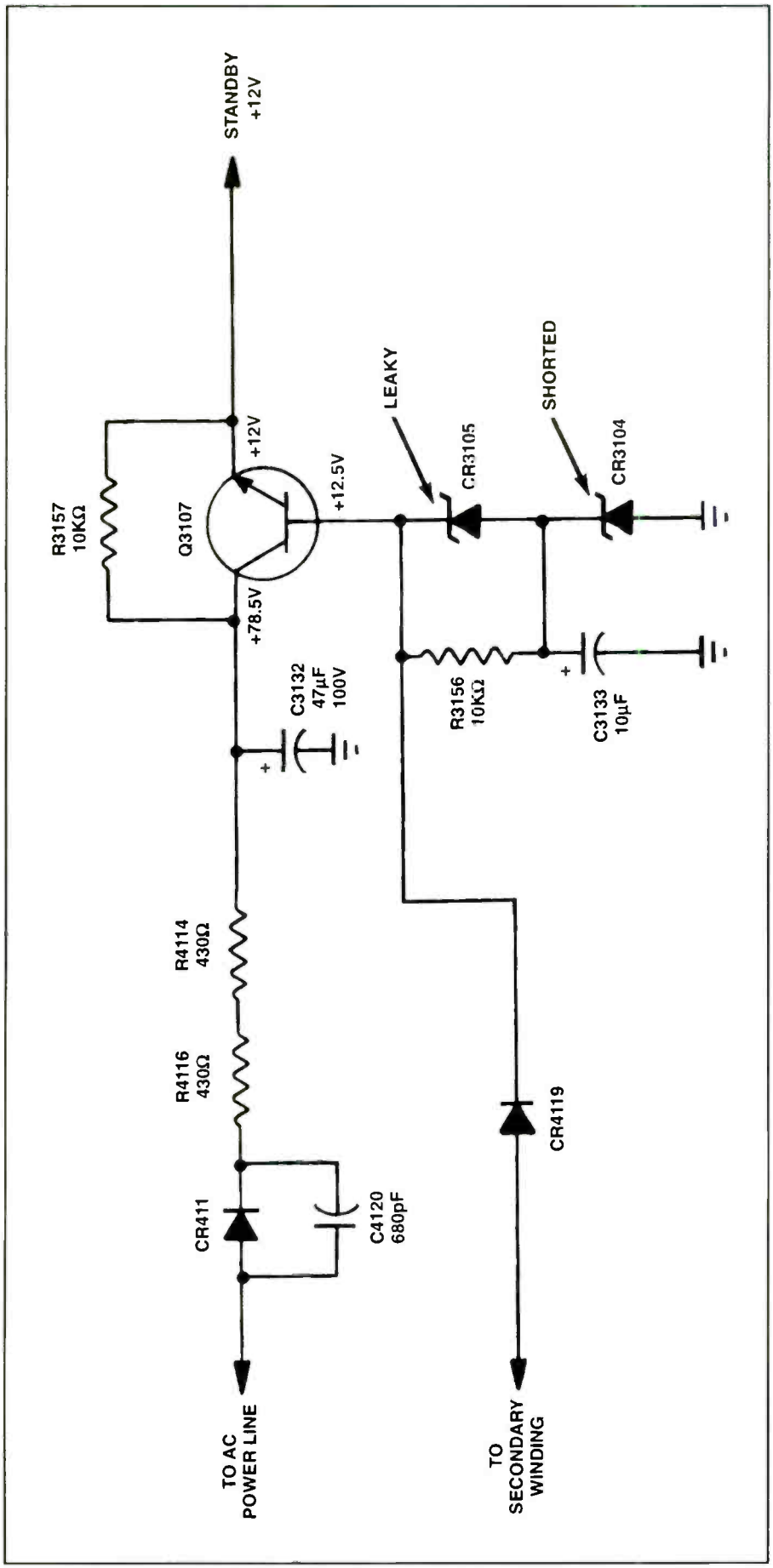

Figure 9. Shorted CR3104 and leaky CR3105 caused the RCA CTC146 chassis to shut-down at once.

age and resistance to common ground, disconnect one end of the diode to determine if the voltage source is defective or if the connected circuits are defective. Monitor the suspected voltage source when the problem is chassis shut-down. Note if the correct voltage is there before shut-down. Most likely the voltage source is normal if correct voltage is found before shut-down. Suspect leaky components in the voltage source circuits when the voltage at the source terminals remains at 0V.

A diode test of silicon diodes, regulator transistors and zener diodes may turn up the defective component. Measure the resistance across the secondary electrolytic capacitor to see if there is leakage or low resistance. When low resistance is found across the secondary voltage source, disconnect the external circuit or check it for leaky or shorted components.

In an RCA CTC146 chassis, the TV set would come up and immediately shut-down. The 140V, 160V, and 185V sources were fairly normal. The standby voltage was very low. It should be around 12V. According to the schematic, the standby regulator (Q3107) had sufficient input voltage to the collector terminal. At first I suspected that the regulator transistor was open, but it tested normal in and out of the circuit.

Resistance across CR3105 and CR-3104 in the base circuit of the 12V regulator measured below 27Ω. Further checking of these components out of circuit revealed that CR3104 had a direct short across its terminals and CR3105 was leaky (Figure 9). Replacing both the 6.8V and 5.6V zener diode regulators solved the chassis shut-down symptom.

Secondary open filter capacitors

Very low secondary voltage sources can be caused by a leaky silicon diode, burned isolation resistor, or open filter capacitor. Check the suspected diode and resistor with a resistance test. The dried-up or open filter capacitor in the secondary circuits may be a little more difficult to locate. You could try an in-circuit capacitor test, but this measurement is fruitless, since the surrounding resistances in the output voltage source are low.

When the voltage of a source is low, and the chassis is not in shut-down, turn off the set, disconnect the line cord and shunt a known good electrolytic capacitor with correct working voltage across

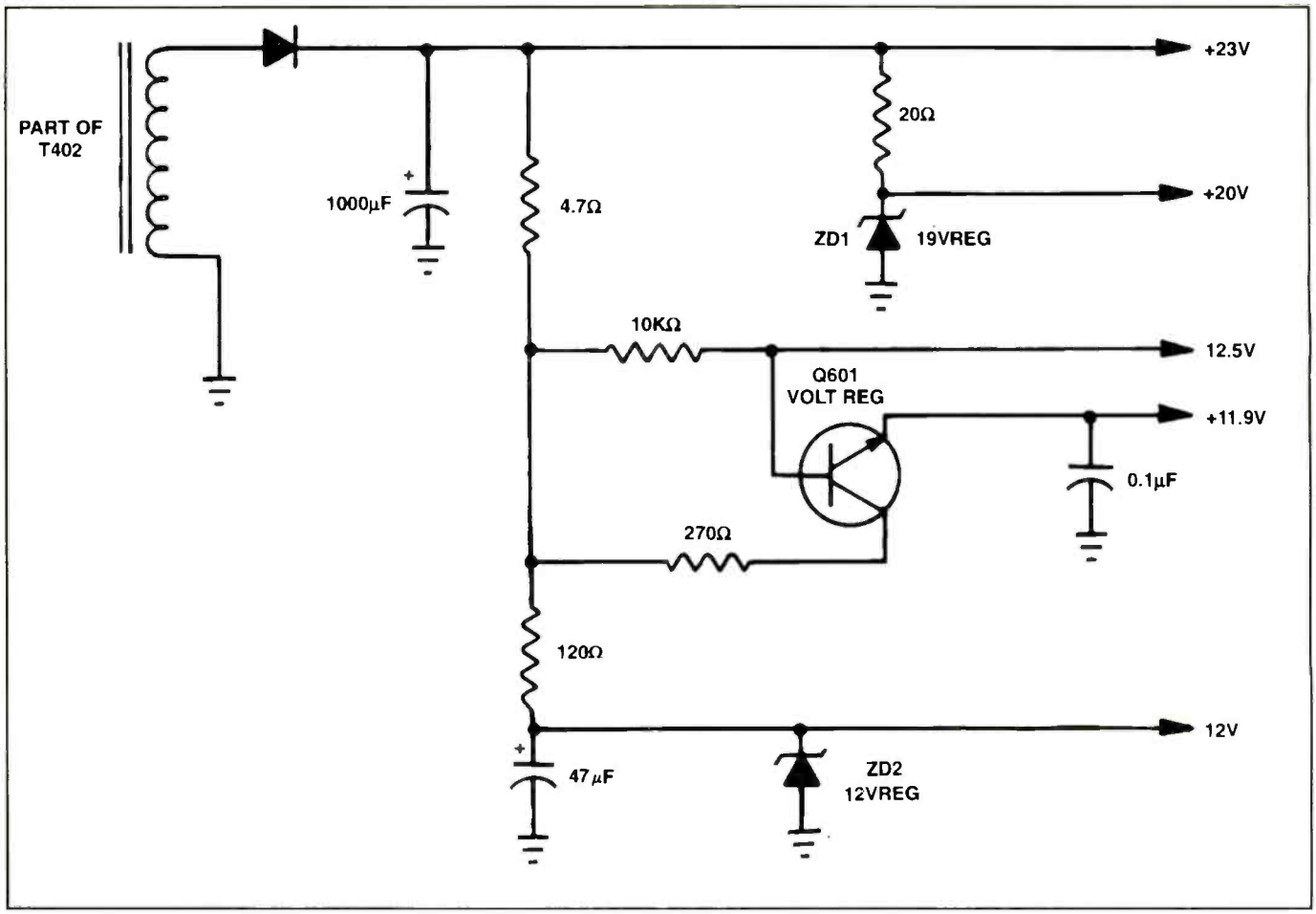

Figure 10. Check for leaky or open voltage regulator transistors and zener diodes in the defective scan-derived voltage sources.

the suspected one. Apply power to the set and check to see if the voltage returns to normal. If so, remove the open capacitor and test it out of the circuit. If this test confirms that it's bad, replace it.

Although you can remove the suspected capacitor and test it out of the circuit, this test may indicate that the capacitor is normal, even if there's a broken internal connection. The broken connection may be temporarily restored by the jostling experienced by the capacitor as it's being removed from the board. Shunting the capacitor in the circuit is much quicker and accurate, because it doesn't disturb the condition of the electrolytic capacitor.

Identifying secondary voltage sources

It can be very difficult to service secondary voltage sources without a schematic. In some sets, the voltages of the sources are stamped on the printed circuit board, making things a little easier. Sams Photofacts list the various voltage sources by number. By locating the correct silicon diode in the secondary voltage sources, you can locate the diode on a chassis layout chart.

Critical voltage sources can be measured or monitored from the positive terminal of the silicon diode. Look for these secondary components on the printed circuit board near the flyback transformer. If the schematic is not available, it may be possible to trace out the various secondary windings from the transformer to the corresponding silicon rectifier, and create a rough schematic of your own.

Secondary voltage regulators

You may find several transistors and zener diode regulators in the various secondary low voltage circuits. In the 20V source of the circuit of Figure 10, a 19V zener diode regulates the 20V source. This voltage source is fed to the first and second video amp, sync, tuner, and sound output circuits. The 11.9V source has a transistor as voltage regulator (Q601). The 11.9V source feeds the chroma IC circuits. The 12V source is regulated with a 12V zener diode. Do not overlook the possibility that the problem is an open or leaky transistor or zener diode regulator if the voltage from a particular secondary voltage source is low.

Conclusion

When servicing voltage supply circuits that derive their power from a horizontal output transformer, determine if the horizontal oscillator or deflection IC is powered directly from the low voltage power supply or if they're powered by the secondary voltage source. Chassis shut-down problems are easier to service if the supply voltage for the deflection IC comes from the low-voltage power supply.

The horizontal circuits must be fully operational if the supply voltage of deflection IC is taken from the secondary voltage sources. Check for leaky components in the secondary voltage sources and overloaded components in the connecting TV circuits. ■

Photofacts

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

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CTC-136D 3436
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VG7720 ..... VCR-260
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PV-4800-K ..... (sim to) VCR-260

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SP2000K 3438
SP2026K 3438
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SHARP
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ZENITH
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SMS2504EW 3439
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Networking basics

By David F. Norman

Even experienced personal computer users often feel that computer networking is a real mystery. Networks can be incredibly complex, but the basic concept is simple. Let's take a look at what networks are and what they can do for you and your customers.

For the small electronics service center, selling, installing and servicing local area networks (LANs) can add some to the bottom line, even if you service a small market area. Frequently, computer expertise, defined as staying one page ahead of the client, is hard to come by in small towns and rural areas. The dealer who is already selling or planning to handle a few computer accessories will find that networks are one area where mail order is weak. If you are already competent at setting up computers for new users, networks will be a natural for you.

However, before you start selling them, you need to set up your own LAN. If you currently use more than one computer in your business, you already have most of what you need.

Actually, you may be already doing some simple networking and not even realize it. Networking is connecting computers together in order to share files and resources. If you use a modem to access a bulletin board or an on-line service such as Compuserve or Prodigy, you are engaging in a type of limited networking. When you take a file from home to the office or take a disk to another desk just to use the laser printer, you are using a type of network often called "Sneakernet." As long as this doesn't become a hassle, this may be all the networking you ever do or ever need. However, there are many circumstances that require more efficient connections between computers.

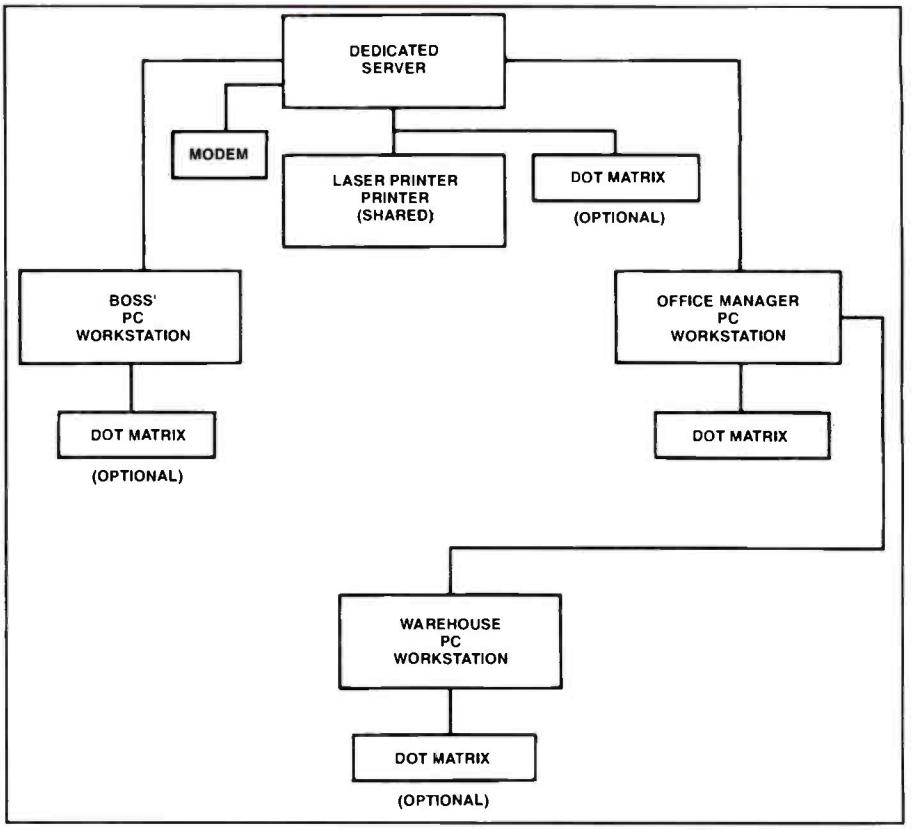

Figure 1. A simple network such as this one can help a business keep computer information flowing smoothly.

A small network system

Let's consider the owner of a small business with three computers in his office. He uses a computer to track his clients, run spreadsheets for projections, and writes business correspondence. The office manager keeps the books, does invoicing, figures the payroll, and polishes the letters written by the boss. The warehouseman uses a computer for inventory control and to transmit orders to vendors.

Obviously, the boss needs to know what is going on with the inventory, billing and payroll. The office manager needs up to date information on what has been ordered and sold, and also needs easy access to the correspondence requiring editing. The warehouseman must be able to access customer account status or the office manager has even more work to do deciding whether to ship to a questionable account.

Each of the departments needs information from the others or efficiency suffers and so does profitability. Believe it or not, there are businesses being operated in just this manner. If not for sneakernetting, the computers would almost be more trouble than they are worth. There is a simple solution.

Networking the computers

The owner looks around and decides to add one more computer. This computer sits in a corner and does nothing except act as an administrator of the other computer resources. Wasteful, you say? Not at all. While it is possible for a *server* to be *non-dedicated*, meaning it can be used for computing as well as managing network resources, a *dedicated* configuration is more efficient (see Figure 1).

While there are many different network *topologies*, or ways of connecting the hardware, Figure 1 uses the *bus topology* for simplicity.

At one end of the bus, sits the computer in the owner's office. Next down the line is the server. Then comes the office manager's computer and at the end of the line is the warehouse.

Norman is an independent servicing technician and a computer and security consultant.

In the simplest of all configurations, which many experts believe is the best way to run a network,each *workstation* has its own hard drive. Program files (the files necessary to run an application) are installed on each workstation and only data files (those that contain information added by operators) are stored on the server. Generally speaking, this configuration lessens network traffic and speeds operation. In a small office, there might be little advantage to keeping program files off the network, but having more than one set of program files can keep things going in case of a breakdown of the server. This assumes that proper backups of data files are made frequently.

Okay, how does all this tie together?

Network hardware and software

A network consists of two parts: hardware and software. The hardware consists of the computers, printers, network adapters, and cable which tie it all together. The software is what makes it all work.

After the adapters are all tied together with cabling, the network software might be considered the language and the rules the computers use to get things done.

If two workstations try to do the same thing at the same time, the network software must resolve the conflict without "locking up." If a file is already in use and another computer tries to access it, there must be something to lock a file so that the information added doesn't conflict with simultaneous entries. When a printer is shared by several computers, a *print queue* must be formed to keep each computer free to do other work while printing is in progress.

Network software also makes provisions for security. If the boss has files he wants to keep secret, the network limits access. Employee records are often confidential; casual access could cause all sorts of problems. Most networks allow tracking of users by file and time. Thus, who does what is a matter of record. Wise employers seldom use all of the information that can be gleaned from network records, but the controls allow abuses to be documented and controlled.

Additional network features

Depending on the network, there are many other bells and whistles which can be used as necessary. Most networks allow sending "live" messages, electronic mail or both. It is a relatively simple matter to set up a network for remote access.

A salesman on the road can access the system via telephone modem to place orders, check availability or status of an account, leave a message for later retrieval, or check his own mail. The possibilities are almost unlimited—even with an inexpensive network.

Tying it all together

Here's a description of a business process that can be handled easily using the networked computers. The owner wants to send a letter offering a new service to all accounts which are over a certain level of purchases with good credit records.

He composes a letter and saves it in a directory for later editing and leaves a message to the office manager requesting that the letter be merged with the appropriate customer data base.

When time permits, the office manager executes the request and sends a message to the warehouse advising of this new service being offered.

At the same time, an order is received by telephone and routed to the warehouse. The warehouseman checks to see that the account meets automatic shipping guidelines and checks for any special shipping requirements noted on the account's information sheet. Finally, he makes an order entry, which removes the items sold from the perpetual inventory, and generates a shipping invoice on the printer.

Since this business is tightly run and billing is done daily offering discounts for early payment, the office manager uses the information from the order to send a statement to the customer.

At the end of the day, the office manager develops a sales and inventory report and prints it on the office laser printer which can be shared by any station that is on the network.

That's how it works. There is no lost motion in this system. The flow of information goes smoothly and is instantly available to all who need it.

A network

So what does all this efficiency cost? Less than you would think.

A network consisting of a server and three workstations could cost as little as $1000 or thereabouts for the network cards, cabling, and software. This, of course, doesn't count the costs of the computers, monitors, and printers. It could also cost a lot more. There are even some "poor boy" networks which use serial or parallel ports and are quite inexpensive. Unfortunately, there are usually deadly limits and drawbacks to such systems. The last thing you need when you are in search of efficiency is a balky, crash-prone, slow, and limited-function network. The real thing is always better.

The businessman using several computers for simple processes such as word processing, accounting, and inventory tracking, may find that networking can actually save money by using slower, and cheaper, computers for these mundane chores and put his money into the shared peripherals such as laser printers and high-speed modems. Not everyone needs a 386 or higher machine.

In a future article we will get into the nuts and bolts of setting up an actual system, using typical software and hardware.

Test Your Electronics Knowledge

Answers to the quiz

(*from page 19*)

1. Write (What)
2. Difference of potential (Do)
3. Yoke (You)
4. Kelvin (Know?)
5. Antenna (And)
6. Transfer Function (Test)
7. Y Signal (Your)
8. Electrolyte (Electronics)
9. Kilowatt Hour (Knowledge)
10. Y Connection (Yes!)

What Do You Know About Electronics?
Working with fractions

By Sam Wilson

The word "cancel," as used in this article, means division of one quantity by another. When I was in school one of my teachers would get very upset at the mention of the word in relation to fractions. I have forgotten why it is supposed to be so bad, but, I remember the message.

I guess I can get away with it here by defining "cancel" as a form of division in working with fractions.

As shown in Figure 1, fractions can be represented two different ways: *shilling* and *case*.

When you do work for a book publisher you are usually constrained to use shilling fractions. That makes it difficult to show unit conversions. It also makes it difficult to rationize units in equations.

For a very simple example consider the calculation of earnings for a worker who is paid by the hour.

Example:

A worker earns $8.36 an hour. If he works 27.5 hours in one week, how much does he earn?

Solution:

Earnings = hourly wage x number of hours worked.

I have shown the solution two ways in Figure 2.

There is a certain amount of opinion in what I say here. I believe the solution with a case fraction to be the better way of showing the calculation. It is a better way of showing how the units can be cancelled compared to the method that uses the shilling fractions.

That is especially true with more complicated calculations.

There are good reasons for using shilling fractions in books: they are easier to typeset and they do not goof up the line spacing. In most cases that is acceptable, but, they do not do the job when you want to show certain math solutions. (If you have an opinion about this be sure to write and cast your vote.)

Note how the units (hours) are cancelled in both solutions.

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

SHILLING FRACTION: 3/4

CASE FRACTION: $\frac{3}{4}$

Figure 1

Figure 2

WITH SHILLING FRACTION:

EARNINGS = 8.36 *DOLLARS/HOUR* X 29.5 *HOURS* = 246.62 *DOLLARS*

WITH CASE FRACTION:

$$EARNINGS = 8.36 \frac{DOLLARS}{HOUR} \times 29.5\ HOURS = 246.62\ DOLLARS$$

$$70 \frac{MILES}{HOUR} \times 1\ \frac{HOUR}{60\ MIN} \times 1 \frac{MIN}{60\ SEC} \times 5280 \frac{FEET}{MILE} = 102.67 \frac{FEET}{SEC}$$

Figure 3

$$SPEED = \frac{X\ MILES}{HOUR} \times \frac{HOUR}{60\ MIN} \times \frac{MIN}{60\ SEC} \times \frac{5280\ ft}{MILE}$$

$$SO: \frac{MILES}{HOUR} \times 1.467 = \frac{FEET}{SECOND}$$

TO CHECK THIS EQUATION –
30 MPH X 1.467 = 44 fps

Figure 4

After cancelling the hours the only unit left is the dollars and that is what you are looking for in the solution.

In some books—and in this article—that is called "rationalizing units."

Of course, with the sample problem the solution is very easy. Let's look at a more complicated example.

Example:

How many feet per second does a car go when it is moving at a speed of seventy miles per hour?

Solution:

From this point on I will abandon solutions with shilling fractions. To solve this problem you need to remember that there are 5280 feet in one mile. Also, you need to remember that there are 60 minutes in an hour and 60 seconds in a minute.

I have shown the solution in Figure 3. Again, take note of the method used to cancel units.

The word "per" means to divide. It is important to observe that the speed is not

$$\frac{A}{B} = \frac{C}{D}$$

Figure 5

Figure 6

$$\frac{30\ MPH}{44\ fps} = \frac{70\ MPH}{X}$$

$$30\ (MPH)\ TIMES\ X = 70\ (MPH)\ TIMES\ 44\ (fps)$$

$$X = \frac{70\ MPH \times 44\ fps}{30\ MPH}$$

$$X = 102.67\ fps$$

written as 70 miles/hour. In the solution it is written as 70 miles divided by hours. It makes the cancellation of equal units easier to locate in the equation.

You don't have to remember whether you need to multiply or divide with this method. If you perform the calculation wrong you won't come out with the correct units in the solution.

There are other applications where case fractions do a better job. When you derive an equation it is a quick method of checking to see if you got it right. I can show that with the same type of problem that was just worked.

Example:

Derive a general equation showing how speed in miles per hour can be converted to feet per second.

Solution:

Refer to Figure 4. In the equation, MPH is miles per hour and fps is feet per second. The resulting equation is correct because it gives the answer in feet per second. The solution gives a general-case equation that can be used with any speed in MPH.

Having reviewed the method of rationalizing units I will use the technique for working problems in electronics. That will have to wait for a near-future article.

Working with ratios and proportions

This is another example of an application where case fractions do a better job.

A number divided by another number is a ratio. A proportion looks like this with shilling fractions: A/B = C/D. It is sometimes shown as A:B = C:D where A and D are called the "extremes," and, B and C are called the "means."

Figure 5 shows the same proportion with case fractions. Read the equation this way: "A is to B as C is to D."

It will not work unless there is a direct connection between the quantities that are represented by the letters. For example, you can't say that pigs are to chickens as possums are to Broadway plays.

People who write entrance tests for college feel that there is something deep and special in a proportional kind of relationship. The *theory* is that highly-intelligent people can quickly discern relationships better than those less gifted. For some reason—never fully explained to me—there are people who do not do well on any kind of test who are often able to command very high salaries.

Here is an example of the type of question used on those tests:

Pen is to ink as pencil is to:

A. Bauxite

B. Graphite*

C. Water

D. Wine

E. lead

(The answer is not lead.)

In science and related subjects—like electronics—the use of proportions serves a practical purpose. You can solve many problems with it.

In the last problem it was necessary to find a relationship between miles per hour and feet per second. To solve the problem you need to know that there is some direct relationship between the two. One of the first relationships I was required to learn in school was: "30 miles per hour equals 44 feet per second."

Armed with that you can work the problem as shown in Figure 6 by setting up the proportion: 30MPH is to 44 fps as 70 MPH is to x fps. The product of the means is set equal to the product of the extremes and the equation is solved for x. ■

***Surface Mount Technology*, By Rudolf Strauss, Butterworth Heinemann, 364 pages, $69.95 hardcover.**

Surface Mount Technology has had a profound influence on the electronics industry. Change has involved the use of new materials, techniques and manufacturing processes, and has resulted in a significantly new approach to electronics assembly. This is a wide-ranging guide to the subject by one of the founders of the technology and covers SMDs, soldering (including reflow- and wave-soldering), component placement, cleaning and quality control.

The author, Rudolf Strauss, was responsible during a lifetime at Fry Group of Companies for a number of the key innovations that contributed to surface mount technology, including the wave-soldering principle, the first wavesoldering machine, and a number of soldering fluxes and preparations.

Strauss' book aims to explain the principles of surface mount technology for practical application, rather than dwelling on theory, and so should find use in any facility employing SMT as well as those considering switching to it.

Book topics include: Why SMDs?, The SMD Family, Soldering, Wavesoldering, Reflow soldering, The Circuit Board, Component Placement, Cleaning Quality Control and Inspection, and Rework.

Butterworth Heinemann, Newton, MA 02158-1626

***The Technical Career Navigator*, By Ray Weiss, Prentice Hall PTR, 270 pages, $19.95 paperback.**

Ray Weiss helps technical professionals find a job, keep a job and advance their careers in his new book, *The Technical Career Navigator*.

The Technical Career Navigator shows technical professionals how to take control of their careers. Using an easy-to-read, informal and entertaining style, Weiss offers vital information that mentors used to give. Weiss, a technical professional himself, addresses anxieties found in today's technical industries. *The Technical Career Navigator* features 138 keys to success—straightforward advice, insights, unwritten rules, conceptual views. Some of the topics covered include: Be Noticed—do your work and make sure you're noticed; Burnout—Don't burn out, grow; Creativity Is Not Enough—ideas need to be implemented; Pat yourself on the Back—know your worth; Your Worst Enemy—Know your weaknesses and bypass them.

Ray Weiss is a former computer and logic designer, a former programmer and project manager. He spent the last 10 years in the electronics trade press as a technical editor. Weiss has a BSEE from the University of Southern California. He has also worked as a technical headhunter learning the ins and outs of technical employment.

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

***The Internet Book*, By Douglas E. Comer, Prentice Hall PTR, 336 pages, $24.95 paperback.**

Prentice Hall announces the publication of *The Internet Book: Everything You Need to Know About Computer Networking* and *How the Internet Works* by Donald E. Comer.

The Internet Book puts the whole networking story together. Comer, an Internet expert and educator, examines computer networking and the Internet from a nontechnical perspective and puts it in terms that anyone can understand. Comer focuses on fundamentals of networking. The book explains how computers communicate, what the Internet is, how the Internet works, and what the Internet can do for you. By the time you finish reading, you will know what the Internet is, how it can be used and why people find it so exciting. You will also understand the origins of the Internet and why it continues to grow so rapidly. Most important, you will understand the potential ways in which the Internet can change your life.

The Internet Book answers the question "What is the Internet?" in the broadest sense. The book examines the origins of computer networking and its application to everyday problems. It focuses on the services that the Internet provides and helps you understand their importance. The book doesn't overwhelm you with details. Using easy-to-understand analogies, examples and nontechnical language, Comer builds a foundation for understanding computer networking in terms of your everyday experiences.

The Internet Book is organized into four sections. The first section introduces communication system concepts and terminology such as digital and analog communication, universal service, and binary data encoding. The second section reviews the history of the Internet and its incredible growth. The third section describes basic Internet technology and capabilities. It examines how Internet hardware is organized and how software provides communication. The final section describes services currently available on the Internet. For each service the book explains how the services work and how each service can be used.

Douglas E. Comer is a professor at Purdue University, where he teaches popular courses on computer networking.

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

***Practice Tests for Communications Licensing and Certification Examinations: The Complete TAB Reference*, By Sam Wilson and Joseph A. Risse, TAB/McGraw Hill Inc., 400 pages, $24.95 paperback.**

The new TAB/McGraw-Hill release, *Practice Tests for Communications Licensing and Certification Examinations: The Complete TAB Reference*, is a study guide to passing all of the important licensing and certifications tests in the field of communications.

Authors Sam Wilson and Joseph A. Risse include full-length practice exams, along with answers and mathematical solutions, for: General Radio Operator License; Amateur Radio Technical Class License; Marine Radio Operator Permit; ISCET Associate-Level Certification; ISCET and ETA Journeyman Communications certifications; GMDSS; Radio Telegraph Certification; Radar Endorsement; ETA Associate-Level Certification; SBE and NICET Certifications.

Both authors of actual CET exam questions, Sam Wilson and Joseph A. Risse have collaborated on a companion volume, the February 1995 TAB/McGraw-

Hill release, *Communications Licensing and Certification Examininations: The Complete TAB Reference*. Wilson, a resident of Melbourne, Florida, is a former CET Test Consultant for ISCET. Risse, a resident of Dunsmore, Pennsylvania, is an electrical engineer.

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

***Communications Licensing and Certification Examinations: The Complete TAB Reference*, By Sam Wilson and Joseph A. Risse, TAB/McGraw, Inc., 480 pages, $44.50 paperback.**

Communications Licensing and Certification Examinations: The Complete TAB Reference provides electronics technicians with expert advice and information they need to pass the various communications exams given by the Federal Communications Commission and other sponsoring organizations.

Authors Sam Wilson and Joseph A. Risse include important information on dc and ac circuits and components, power equipment, transmitters and receivers, digital basics, television systems, electronic circuits and components, and many other topics.

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

***Auto Audio: Choosing, Installing, Maintaining, and Repairing Car Stereo Systems*, By Andrew Yoder, McGraw-Hill, 352 pages, 200 illus., $34.95 hardcover, $24.95 paperback.**

Recent advances in automotive audio equipment have made an already complex subject even more mind-boggling. Today's components are far ahead of those available in the mid-1980s. With so many choices and options available, the average music-lover who just wants a quality car stereo system is often left confused about what to buy, and from whom. The first book to examine this subject thoroughly, *Auto Audio* comes to the rescue. This information-filled guide contains practical, straightforward advice on how to select and install audio systems, and provides tips and techniques for maintaining and repairing them.

Author Andrew Yoder begins by telling readers how to select an audio system that suits their individual needs. He covers installation procedures such as soldering, grounding, making electrical connections, and running cables; and provides useful tips for keeping a system in top condition. Readers also will learn how to identify and locate problems, and make simple repairs. Other topics discussed in detail include: speakers and speaker enclosures, amplifiers, antennas, filters and crossovers, wire, cabling, connectors, and transmission systems.

Technological breakthroughs in CD players, MiniDisc changers, DCC decks, and shortwave radio are also discussed. Finally, there is a lengthy compilation of sources from which readers can purchase products, supplies, and tools.

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

Literature

Catalog of advanced soldering material

ESP Inc. has published a new 16-page, full-color catalog describing its new Solder Plus soldering material, an advanced soldering material designed to replace fluxcored wire, preforms and cut solder.

The catalog explains the material and details the benefits of this material in many different applications, as well as cost advantages over solid solder. It also includes pricing, technical data, ordering information, and full illustrations.

The material consists of microsized particles of solder alloy coated with flux. The outer flux coating helps it stick to wherever it is applied, even on vertical surfaces, and ensures proper fluxing action for reliable solder joints.

The solder is prepackaged in special no-ooze syringes for manual or air powered dispensing. The material allows exact deposit control, thereby reducing by up to 80% the amount of solder used.

Low-cost evaluation kits, also described in the catalog, are available that include five 35 gram syringes, a reusable hand dispenser and various dispensing needles. Five alloys in four flux systems cover most electronic and electrical soldering applications. The product is safe and easy to handle, offers faster application and greater heating flexibility than solid solder, and results in lower production costs.

Circle (53) on Reply Card

Book catalog

Butterworth-Heinemann announces the publication of its 1995 Electronics Book Catalog featuring new books in the EDN Series of Design Engineers, the Test and Measurement Series, and more.

The catalog includes something for everyone. Whether you're looking for a handy guide to the design of power supply systems or a comprehensive handbook on the ISO9000 requirements, you'll find what you want in the catalog.

Books from the EDN Series include *Simplified Design of Linear Power Supplies* by John D. Lenk, *Power Supply Cookbook* by Marty Brown, and *Electronic Circuit Design Ideas* by Venkataraman Lakshminarayanan. From the Test & Measurement Series comes *Building a Successful Board-Test Strategy* by Stephen F. Scheiber.

Circle (54) on Reply Card

Replacement components catalog

The latest issue of the Electronics Warehouse Corporation's 188-page quarterly catalog, featuring more than 20,000 electronic components, is now available. The company supplies replacement parts to consumer product maintenance organizations and includes comprehensive cross-reference information for converting original manufacturers' part numbers into replacement types currently available.

Some of the major categories of products offered include VCR belts, wheels, idler assemblies and tires, a section on semiconductors, video game parts for Nintendo and Sega/Genesis, and instructional videotapes. Microwave parts, tools and test equipment are also included in addition to a commercial sound and security product section.

Circle (55) on Reply Card

and housing discounts for people attending the 1995 Electronic Distribution Show and Conference, April 19 through 21 at the Las Vegas Hilton.

The Las Vegas Hilton is offering housing for EDS attendees at a rate that is 15% lower than last year, $85.00 per night, single or double. For reservations, contact the Las Vegas Hilton at 800-732-7117. Additional accommodations for EDS attendees are also available at Caesars Palace. For reservations, contact Caesars at 800-634-6661.

The Show Corporation has appointed Delta and United Airlines as official EDS carriers. Both Delta and United are offering EDS attendees a 10% discount on unrestricted coach fares, and a 5% discount on any published fare. United, Delta, and most commercial airlines serving Las Vegas, do not require a Saturday stay over to qualify for discounted fares.

To make reservations on United Airlines, call 800-521-4041, and indicate EDS '95 ID Number 591 WU. To make reservations on Delta Airlines, call 800-241-6760, and indicate EDS '95 File Number E0246.

In addition, Avis Rent-A-Car has been selected as the official car rental agency for EDS '95. Contact Avis at 800-367-2847, and use Group Number A/B 622928 to obtain special EDS rates and any information.

The not for profit Electronic Dis-tribution Show and Conference has been operating since 1937, as the main event of the year for the electronic distribution community—distributors, their manufacturer suppliers, and the representatives who provide the year-round interface. EDS is sponsored by the three major electronic trade associations focussing on distribution: The Electronic Industries Association Components Group (EIA); The National Electronic Distribution Association (NEDA); and the Electronic Representatives Association (ERA).

For more information on EDS '95, contact the Electronic Industry Show Corporation, 222 S. Riverside Plaza, Suite 2710, Chicago, IL 60606. Telephone: 312-648-1140, Fax: 312-648-4282.

High-security system for 'Media Access' digital set-top boxes

Zenith Electronics Corporation and Teledyne are jointly developing a military-grade "crypto-graphic" security system for advanced cable and telephone networks deploying video-on-demand, home shopping, video games and other digital services.

Teledyne, through its electronic systems businesses, designs and implements advanced military identification systems. The agreement with Zenith is Teledyne's first commercial venture involving military encryption technology. "We are pleased to forge this alliance with Zenith," said Hudson B. Drake, senior vice president of Teledyne. "We view this as an important step in establishing Teledyne as a provider of security technology to the emerging interactive multimedia market."

Using its patented cryptographic technology, known as Dynamic Substitution Devices, Teledyne will create the Zenith Digital Conditional Access Module (DCAM) integrated circuit for use in the "Media Access" digital set-top decoders offered by Zenith, Philips Consumer Electronics and Compression Labs Inc.

"Teledyne's advanced encryption capabilities give Zenith set-top boxes a military-level security system that greatly reduces the opportunities for piracy, which is a primary concern for cable operators," said John W. Bowler, Zenith vice president, corporate R&D and network systems engineering.

The Zenith-Teledyne DCAM integrated circuit is a flexible, robust application specific integrated circuit that will allow operators system-wide control over service authorization to individual set-top boxes. It is also resistant to the most powerful cryptanalysis decoding to date and introduces a new level of renewable set-top security to network operators.

"Our system should be as secure as those Teledyne has designed for military application. As set-top decoders play a significant role in the wide range of programming choices being developed, a high-level, tamper-proof security system is essential. "Our Media-Access system will be the most secure on the market."

Teledyne's CDAM security cryptology is compatible with the MPEG-2 world-standard decoder technology by Philips and CLI, and Zenith's 16-level Vesitigial Sideband (16-VSB) transmission, used in the new Media Access set-top box. Media Access products will offer cable operators a simplified interactive network operation and an enhanced ability to extend the services of third-party information providers into the network.

MPEG-2 and VSB are also key features of the Digital HDTV Grand Alliance high-definition television system. ■

ES&T Calendar of Events

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

April 19-21, 1995
Electronic Distribution Show & conference
Las Vegas Hilton Hotel
Las Vegas, NV

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

May 19-20, 1995
Electronics Technicians
Association annual convention
Philadelphia Wireless Technical Institute
Philadelpha, PA

June 17-June 19, 1995
CES Specialty Audio &
Home Theater trade show
The Electronic Industries Association's
Consumer Electronics Group
Chicago, IL

July 7-9, 1995
The Fiber Optic Installers'
Conference
Royal Plaza Hotel
Marlboro, MA
1-800-50-FIBER,
Fax 1-617-241-8616

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

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

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

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******SERVICE TIPS 1995 Version 3.02 IS HERE**** Simple to use and not complicated, it organizes 16,068 SERVICE TIPS in ALPHABETICAL ORDER** by Brand Model/Chassis & Symptom with 3 lines for Symptom and 8 for Solution. **NOT ONLY CAN YOU REVISE** and **EDIT** or **PRINT** any service tip in our database, but **YOU CAN ADD YOUR OWN INFORMATION** and it will automatically be alphabetized and sorted. Our program contains information from TECHNICIANS like YOURSELF on TVs, Projection TVs, VCRs, Camcorders and other consumer electronic equipment. UNLIKE SOME OTHER PROGRAMS, WE HAVE NO GIMMICKS. SERVICE TIPS was designed and created by 2 CETs who are technicians/owners of their own service centers and a full-time programmer. **SERVICE TIPS is available for $129.95** plus s&h. For more information **CALL US at 1-800-621-TIPS (621-8477)** (from US & Canada). Demo Disk and Quarterly Updates available. **IF YOU USE WINDOWS, WE NOW HAVE AVAILABLE A SERVICE TIPS PROGRAM JUST FOR YOU. CALL US FOR MORE INFORMATION.**

VHS-VCR Repair Solutions Sets I - IX. Each contains 150 symptoms and cures, free assistance, $19.95 each, all nine $49.95. Visa/MC. FAX (219) 272-6612. **Eagle Electronics**, 52053 Locks Lane, Granger, IN 46530.

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SENCORE VG-91, TVA-92, SC3100, PR-57, CR-70. LIKE NEW. ALL LEADS AND MANUALS. 10KV AND 50KV PROBES, $7,000. 901-986-0410 after 5:00 pm.

MISCELLANEOUS

Wanted to do service center business part time. CET qualified. Ship to me UPS. Consumer Electronics, 812-295-4240.

BUSINESS OPPORTUNITIES

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

TV-VCR Repair. St. Pete Florida, close to Beaches. Sencore equipment; parts and inventory, turn key operation, $15K. 813-546-8323.

Pacific Northwest repair shop for 30 years, same location. Licensed TV, stereo, microwaves, VCR, and computers. Completely equipped. Owner retiring. Susan Howard, IBA (503) 245-4464.

Readers' Exchange

Readers' Exchange has been reinstated as a free service.

The following restrictions apply to Readers' Exchange:

• Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.

• Readers' Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

• All submissions must be typed or printed clearly!

Send your Readers' Exchange submissions to:

Readers' Exchange
Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801

WANTED

Tentel HPG-1 head protrusion gauge with S1 stand. Also 23 and 40 channel CB radio performance test equipment. *Contact: Pete, 701-663-5331 evenings.*

Green Yoke part number 330P09003 for Mitsubishi projection TV Model VS-403R. *Contact: W.C. Myre, 7306 Aztec Rd., Albuquerque, NM 87110.*

Looking for schematic for TMK Model number 1933 RC color TV Lafayette number LA84 amp. Precise Model 660 color generator Will copy and return or pay for copy. *Contact: Gerard O'Gara, 11 Crag La., Levittown, NY 11756, 516-PE1-4075.*

Service manual for Hitachi VHS Camcorder Model number VM-1300A. This is a 9.6V model that Hitachi claims to have no knowledge of. *Contact: Craig Rogers at Gunnison Electronic Repair, PO Box 344, Gunnison, CO 81230. Phone/Fax/message at 970-641-1669.*

Power transformer JVC part number A39982AYD. *Contact: Bob Green, R.R. 1, Ridgetown, Ont. N0P2C0, Canada.*

Knight, KG-688 audio generator, KG-686 RF generator, and KG-687 sweep generator. All with manuals. *Contact: Charles T. Huth, 229 Melmore St., Tiffin, OH 44883, 419-448-0007.*

I need the operation manual and schematic for an Olson CRT analyzer Model TE-189. Will pay for copy and postage. *Call collect after 6PM EST 809-842-0019.*

Service manual (used) for RCA CTC117 chassis, or Feb. 1986 issue of ES&T with CTC117 profax. Must be under $10.00. *Contact: Craig at Gunnison Electronic Repair, Box 344, Gunnison, CO 81230, 303-641-1669.*

Power supply circuit board (stock number 01243602) for Sansui VCR Model number S-V7. *Contact: J. Powell, 299 Charleston Rd., Willingboro, NJ 08046, 609-877-9143.*

Service manual for Fisher FVH-830 VCR. *Contact: Don Nitkin, 123 Coolidge Hwy., Birmingham, MI 48009, 810-649-5012.*

In need of schematic for BMC color monitor Model Number BM-AU9191U. *Contact: William Shiner, 1608 Styer Dr., New Carlisle, OH 45344, 513-849-0577.*

Need for parts radio clock Panasonic Model RC6900C. *Contact: Danny at 708-662-0165.*

Schematic or service manual for Broksonic 5 inch color TV, AM/FM radio. Model Number CCRT 3609. *Contact: Paul Lombardi, 501 Jefferson Blvd., Warwick, RI 02886, 1-800-437-3282.*

Service manual or schematic wanted for a Layfayette Neutrodine radio, Model K60. It was made around 1925-26. *Contact: Chuck McGuire, PO Box 555, Jefferson City, TN 37760, or call 615-475-0335.*

Sharp TV Yoke Number KYS-60159, Fisher motor assembly number 143-0-3404-03700, schematic for Magnavox TV 13C202. *Contact: Ed Herbert, 410 N. 3rd St., Minersville, PA 17954.*

Top, control panel glass for Frigidaire Flair range, Model Number RC1B6452. *Contact: Warren Shukis, 1479 Prince Edward Way, Sunnyvale, CA 94087, or call (days) 510-651-5112, (eves.) 408-739-2709.*

Flyback transformer for RCA Model TC-127, chassis KCS34B, drawing No. 970975-1, part number 274950. Will accept used, working unit. *Contact: Mike Pickels, Sunset TV, 3131 Davie Blvd., Ft. Lauderdale, FL 33312, 305-583-5110 or Fax 305-581-8414.*

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Heathkit, model AD-1013, audio oscilloscope with assembly maunual, $120.00. *Contact Fred Stavans, 142-11 248th Street, Rosedale, NY 11422 (718) 528-9152.*

Sentinel flutter meter, model FL-3D-1, $75.00; Leader AC microvolt meter, model LMV-89, $200.00; Sencore AM/FM stereo analyzer, model SG165, $750.00. *Contact: Mark (503) 888-4601 home; (503) 267-0628 work.*

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Computer monitor schematics, all brands, also parts. Test equipment and parts. *Contact: R.C.E., P.O. Box 72882, Chattanooga, TN 37407, (706) 866-3184.*

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NRI VCR training course with video, $45.00; C-MOS IC tester, B&K, model 552, like new, $85.00. Also electronic books. *Contact: Ralph Bianco, Boulevard TV & VCR Service, 1431 Robinson Ave., Havertown, PA 19083, (610) 446-4519.*

Proton HVT, model KF5897, new, never used, $35.00 (postage paid); RCA Marker generator WR-99A, good condition, $30.00 (postage paid). *Contact: Samuel M. Pearlman, 7513 D. Camino De Querabi, Tucson, AZ 85715.*

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B&K misc. pix-tube checkers, $50.00–$200.00; misc. high voltage probes, $20.00; B&K 10 meg dual trace oscilloscope, model 1476, $150.00. *Contact: Bill (503) 267-0628 work; (503) 756-1725 home.*

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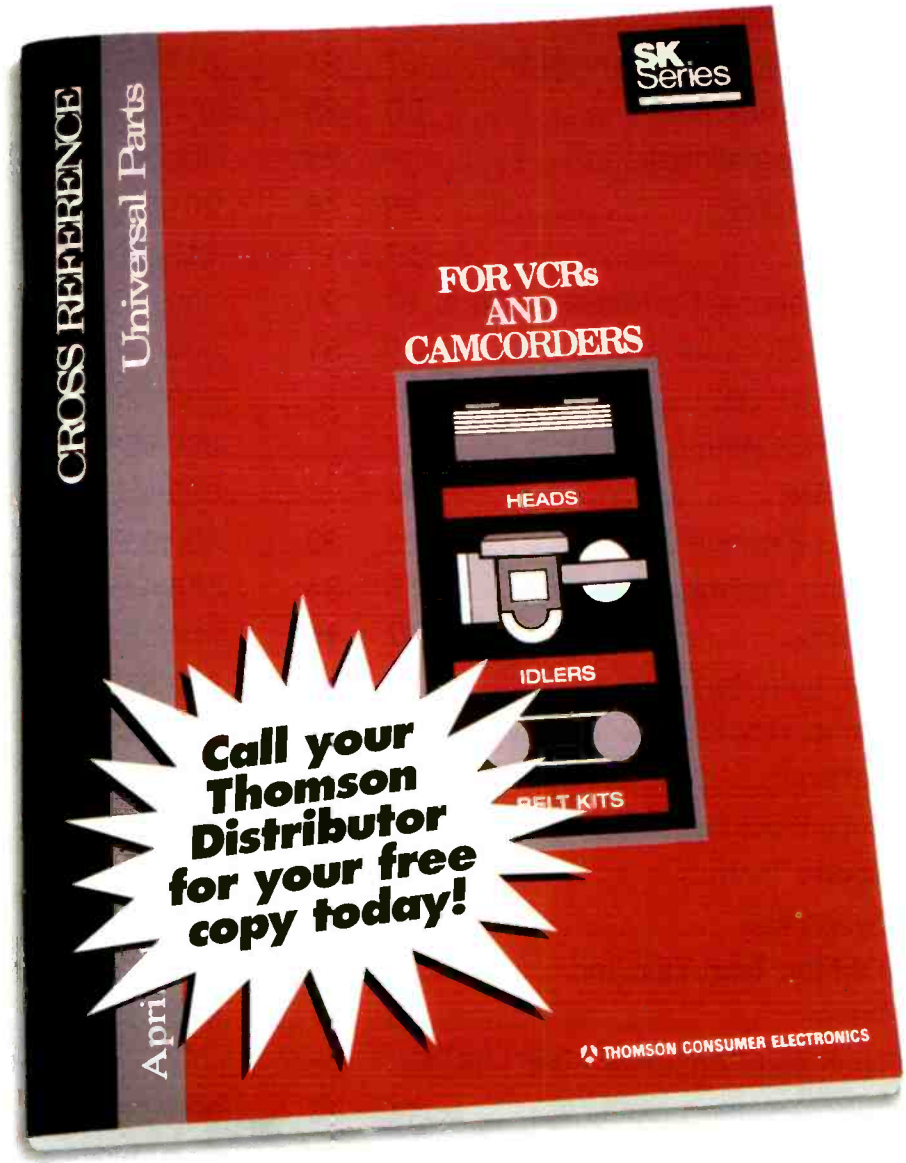

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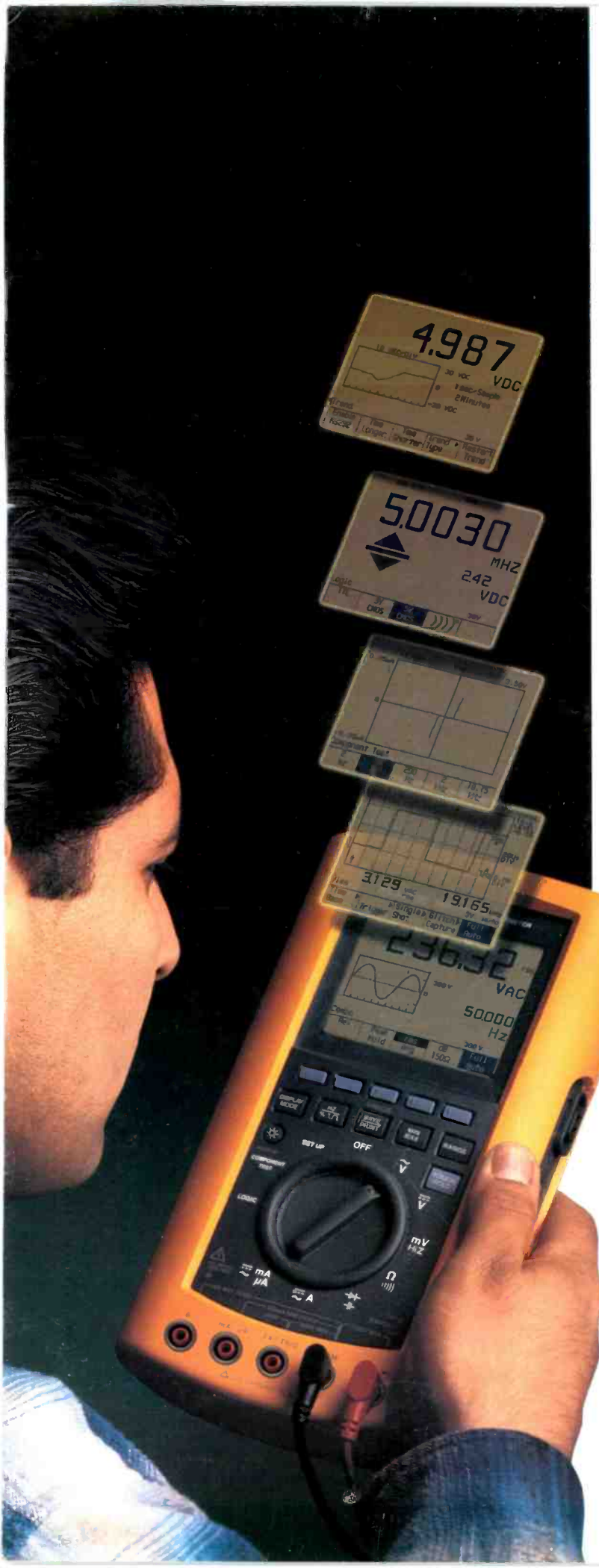

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