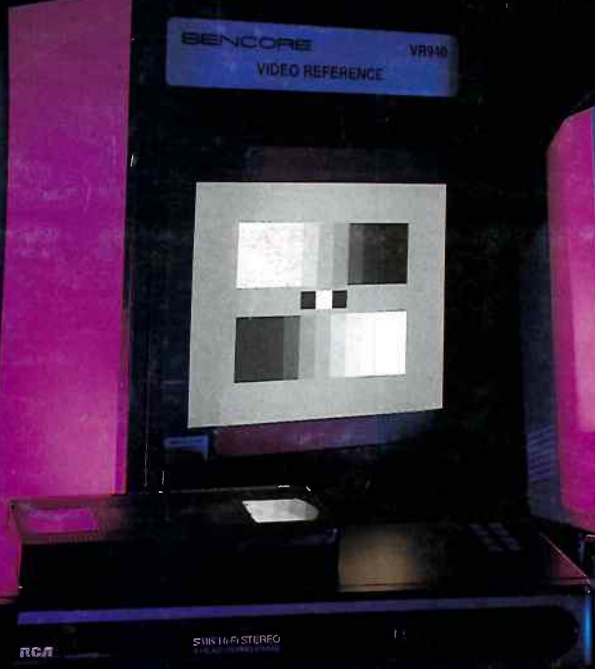


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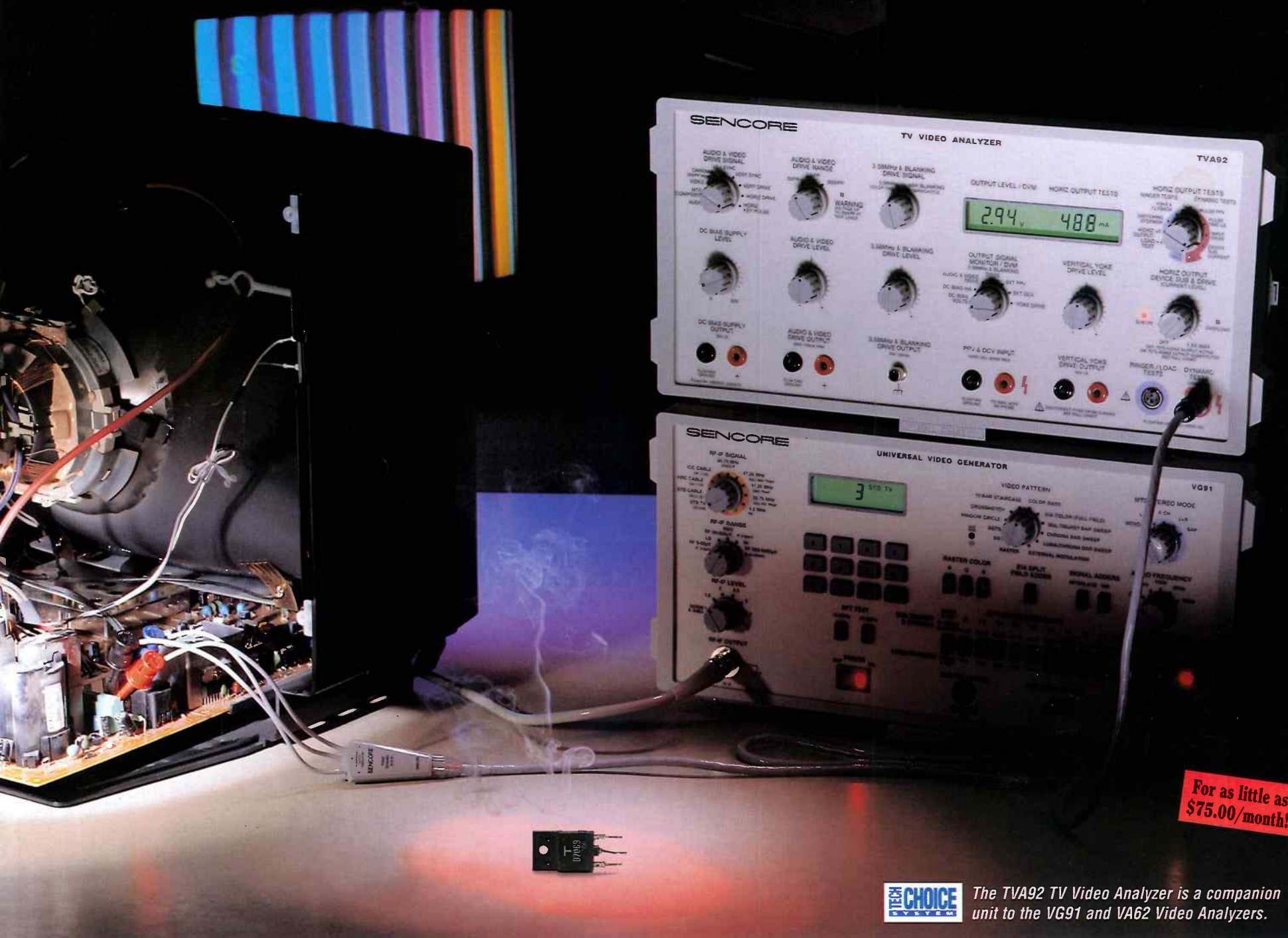
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Center Prepare For The Future*

*Profit From New Opportunities With Technical  
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# Have You Ever Powered Up A Set To Full High Voltage... Without The Horizontal Output Transistor?



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SYSTEM

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or accurate way of analyzing a defective chassis. By determining if the problem goes beyond the HOT into more expensive parts (such as the fly-back), you'll be able to give faster, more accurate estimates. You'll have more satisfied customers and more profits in your pocket. When that next dead chassis comes in your door, your first reach will be for the patented TVA92.

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# From The Editor's Desk



**T**he electronic service industry is in a state of transition. We see several issues pertaining to the service center that are paramount to its success. One is, of course, profitability. If a service center can't run itself profitably, it probably won't be running very long. You can cut a lot of wood to keep yourself warm during the winter months, but if

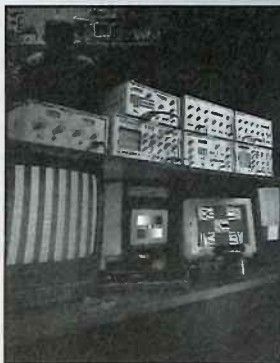
you don't have a fireplace, that effort is wasted. The same holds true for the service center. If you solicit all types of electronic repairs, but can't turn them into profits, maybe you should be adjusting some of your business policies. The Sencore News is one source for you to find answers to these questions. Each issue contains articles about turning opportunities into profits. We don't pretend to have all the answers. But we'd like to get you thinking about all aspects of your business. Maybe we can at least point you in the right direction.

Training is also a key issue for many service centers. The technician that has the knowledge and hands-on experience is the one that will succeed in today's troubleshooting arena. Understanding how a camcorder or switched mode power supply works is the first step. Then putting that knowledge into a hands-on setting will help lower the time spent on repairs. Sencore is an industry leader in technical training. Our exclusive Tech Schools and seminars are loaded with useful, practical information. You'll see current information on offerings and schedules in each Sencore News.

Another key area is efficiency. Does it make sense to use a hand screwdriver for inserting and removing screws when there's a power screwdriver on the shelf? Efficiency should be examined in every part of your business. Every television repair (or almost every) that comes in your front door leaves in the hands of a satisfied customer. But what happens to the TV while it's in your service center has become more key than ever. For example, if you ordered a \$65 flyback for a problem that a 50 cent capacitor could have fixed, how does that affect your efficiency? Assuming you eat the cost of the flyback, the end result to the customer may be the same, but how does it affect your profits? That's the very reason every service center needs good test equipment they can trust on every job. You'll find almost every article in the Sencore News deals with efficiency and saving time on every repair job. Our test equipment is designed around that central goal.

Sencore is committed to the success of your service center. In fact, our success depends on your success, so we're doing everything we can to help. You won't find another test equipment company that offers all the added services that Sencore provides. From innovative test equipment to technical support to investment financing to training, one toll-free call is all you need to make. **We're in this business together, let's team up for success.**

## On The Cover...



*New servicing opportunities are on the horizon for the service center prepared for the future. And if you're ready to tackle these challenges as they develop, you'll be ahead of your competition. If you're prepared for these opportunities when they come across your bench, you'll have more opportunities to enjoy your life – at the service center and away! Enjoy this issue of the Sencore News as we continue to "Share Your Vision For Success!"*

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**Call 1-800-SENCORE!**



# TV Troubleshooting Advantages You'll Find Only With The TVA92 Video Analyzer

Plus...It's Compatible With Your VA62 Video Analyzing System!

**O**ne of the most popular questions asked about the Sencore TVA92 TV Video Analyzer is just how it can help troubleshoot TVs compared to present methods. This question is admirable because it shows how most technicians continue to search for faster, easier ways to isolate TV defects and eliminate costly errors on repair estimates.

Whether you are using the Sencore VG91 Universal Video Generator or the earlier VA62(A) Video Analyzer as a companion unit, the TVA92 TV Video Analyzer offers you many TV analyzing advantages. This article examines several difficult TV troubleshooting challenges and shows you the advantages of using the TVA92's exclusive tests compared to your current methods.

## Pinpoint B+ Power Supply Loading Problems With The TV "Off"

The TV's B+ supply and horizontal output stage depend on one another for normal operation. The B+ power supply delivers voltage and current (power) to an operating horizontal output stage. A problem in the B+ power supply changes the B+ output and the operation of the horizontal output stage. Likewise, a problem in the horizontal output stage or a flyback secondary typically increases the current draw from the B+ power supply. A substantial increase in load current reduces the B+ output voltage and/or produces heat in power supply components. Often components heat quickly and are damaged leaving little or no time for circuit measurements.

An ohmmeter may be able to help you find shorts on the B+ output such as a shorted horizontal output transistor. But high current problems of a lesser degree leave

you trying to determine if the reduced B+ output voltage and/or damaged power supply components are from a power supply, horizontal output stage, or flyback secondary circuit defect.

A common troubleshooting practice is to open the B+ current path to the horizontal output stage and measure the B+ output voltage. If the B+ returns to near normal, you may think the power supply is OK, when in fact it may not be. A switching power supply problem can produce a normal B+ voltage output when the load is removed, but cause the output voltage to drop with normal load current. Furthermore, some linear regulating power supplies have a higher than normal B+ output when the load is removed, leading you to suspect the power supply is in error.

To determine if the B+ supply regulates the output properly with a normal load current, you can substitute a suitable light bulb or power resistor in place of the horizontal circuit load. If the output voltage regulates properly, the B+ supply is probably working normally. But finding a suitable load is not always easy and these added troubleshooting steps take time. Especially considering how often technicians run into horizontal problems.

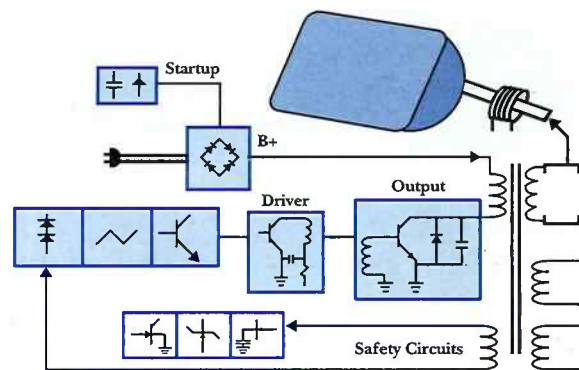
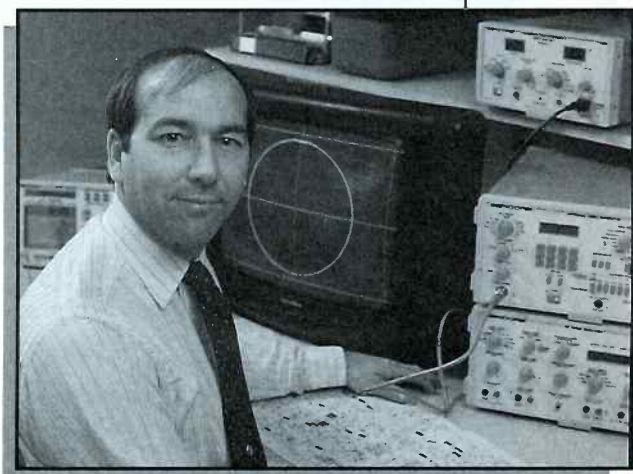


Fig. 1: The startup, B+ power supply, and safety circuits can interact with the horizontal stages to cause confusing defect symptoms.

Another troubleshooting alternative with reduced B+ voltages is to measure voltages and waveforms in the horizontal output stage. But with reduced B+ voltage, you'll find all the voltages and waveforms reduced from normal, making any troubleshooting conclusions a good guess at best. And as you make measurements, components may be overheating – one step from smoke and expensive damage.

The TVA92's Horizontal Output Load Test



By Glen Kropuenske  
Application Engineer

Sencore Electronics



easily determines if there is a problem in the horizontal output stage that is loading the B+ supply output. It shows you the severity of the loading problem and helps you isolate the cause. The Horizontal Output Load Test is performed with the TV "off" eliminating any risk to B+ power supply components.

The Horizontal Output Load Test is performed with connections to the B+ supply output and the emitter and collector of the horizontal output transistor. The test supplies a reduced B+ voltage (15V) and simulates the operation of the horizontal output stage. Alternating currents are produced in the horizontal output stage duplicating its operation, but at reduced voltage and current levels. Flyback pulses are produced at the collector and power is transferred to the flyback secondary circuits.

During the Horizontal Output Load Test, a current (mA) readout indicates the TVA92's B+ supply current flowing to the horizontal output stage. Because the horizontal output stage is mirroring its full power operation, the current (mA) indication is approximately 1/10 of the load current that would be needed for normal operation. Current readouts from 5 to 80 mA represent a normal range of current for good horizontal output stages. Current readouts exceeding 80 mA indicate a high current demand from the power supply.

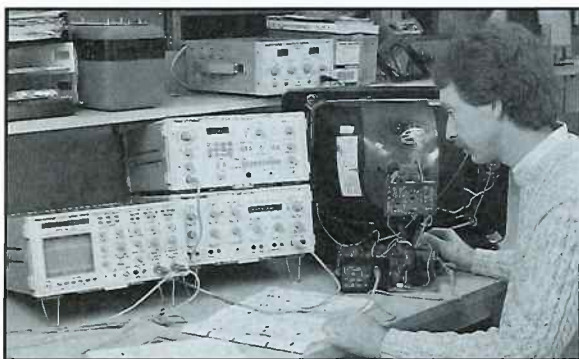


Fig. 2: The Horizontal Output Load Test isolates B+ supply loading problems without risking component damage.

Horizontal output stage problems that load the B+ supply indicate mA readouts typically greater than 100 mA up to 250 mA, the maximum current permitted during the test. Loading problems may be either AC or DC leakage paths in the output stage. Examples of DC leakage include a leaky output transistor, damper diode, or retrace capacitor in which direct current flows to ground. Examples of AC leakage problems include a shorted turn in the yoke or flyback, leaky secondary diode, filter capacitor, or other secondary component. These problems can only be detected when the horizontal output stage is producing alternating currents.

An AC short or leakage can be identified

by removing the Horizontal Output Load Test's yellow (C/Ring) test clip and noting the current readout. If the short is AC, the reading will switch back to a normal range or "—" display, while a DC leakage path will continue to show a high mA readout with the yellow clip disconnected.

You can troubleshoot AC leakage problems and other horizontal stage problems by measuring voltages and viewing scope waveforms during the Horizontal Output Load Test. Since the TVA92's Load Test duplicates the horizontal output stage's normal operation at approximately 1/10 of normal, the voltages and waveforms should be 1/10 of the amplitude shown in the service schematic. A waveform or DC voltage that is missing or considerably lower than a 1/10 level indicates a problem associated with the flyback winding or secondary circuit.

### Isolate Horizontal Timing (HV Shutdown Problems) With The TV "Off"

A timing problem in the horizontal output stage is one cause of excessive high voltage. If the capacitance of the timing capacitor in the stage decreases, the duration or timing of the flyback pulse at the collector of the horizontal output transistor decreases. Also, the amplitude of the pulse increases, threatening damage to the horizontal output transistor and increasing high voltage to the CRT anode. This unwanted, excessive high voltage condition is prevented with the high voltage protect or X-ray shutdown

circuit in the television. The shutdown circuit quickly disables the operation of the horizontal output stage.

Troubleshooting a timing defect that results in a high voltage shutdown symptom is complicated by the shutdown method and the type of B+ power supply. The two most common methods for shutdown use a transistor or SCR latch to switch off the horizontal drive signal or B+ supply voltage to the horizontal output stage. Removing B+ or horizontal drive stops the operation of the horizontal output stage reducing the high voltage to 0. Shutdown is almost instantaneous leaving little time for voltage and waveform measurements.

Since voltages appear only momentarily, it is difficult to isolate the cause of a horizontal timing shutdown symptom. One solution to avoid shutdown is to lower the AC voltage to the TV. On some B+ supplies, this reduces the B+ voltage to the horizontal output stage reducing the flyback pulse amplitude and the high voltage to a level below shutdown. While this works on TVs using a linear regulating power supply, it is not effective on those with switching power supplies. Reducing the AC input voltage to a switching power supply does not lower the output B+ voltage to prevent shutdown. Furthermore, reducing the AC input voltage to loaded switching power supplies can result in power supply damage.

The TVA92's Horizontal Output Load Test checks the timing of the horizontal output stage without applying AC power to the

Guide To Horiz Output Tests		
HORIZ OUTPUT TEST	WHEN TO USE	WHAT IT TELLS YOU
<b>Horiz Output Load Test</b>	<ul style="list-style-type: none"> <li>Full AC volts cannot be applied because:               <ul style="list-style-type: none"> <li>- Draws hi current.</li> <li>- Burns-up components.</li> <li>- Safety shutdown.</li> <li>- HOT gets hot.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Output stage functions.</li> <li>Short or loading on B+.</li> <li>Timing of Horiz Output</li> <li>Stage normal or abnormal.</li> </ul>
<b>Ringer Tests</b>	<ul style="list-style-type: none"> <li>Horiz Output Load Test Readout "BAD".</li> <li>Suspect bad flyback, yoke or transformer.</li> </ul>	<ul style="list-style-type: none"> <li>If component bad from shorted turn(s).</li> </ul>
<b>Dynamic Tests (DCV, PULSE PPV PULSE TIME μS, INPUT DRIVE)</b>	<ul style="list-style-type: none"> <li>Horiz Output Load Test Readout "GOOD".</li> <li>Test parameters at Horiz Output.</li> </ul>	<ul style="list-style-type: none"> <li>B+ supply volts.</li> <li>Flyback pulse PPV &amp; Time</li> <li>Input drive status to HOT</li> </ul>
<b>Horiz Output Device Sub &amp; Drive (DEVICE CURRENT)</b>	<ul style="list-style-type: none"> <li>Test horiz output HV circuits when HOT is bad and Horiz Output Load Test Readout "GOOD".</li> </ul>	<ul style="list-style-type: none"> <li>If HV components good.</li> <li>If HOT can be replaced.</li> <li>Accurate repair estimate.</li> </ul>
<small>HOT=Horizontal Output Transistor HV=High Voltage</small>		

Fig. 3: Use this guide to help use the TVA92's horizontal/HV circuit tests.



TV. The flyback pulses produced during the tests accurately reflect the pulse width of the flyback pulse and timing of the horizontal output stage. The Horizontal Output Load Test uS readout provides an indication of the flyback pulse width reflecting the horizontal output stage timing. Normal horizontal output stage timing results in uS readings ranging from 11.3 uS to 16 uS. Readings considerably below 11.3 uS indicate a timing problem that is causing a shut-down symptom.

### Identify Horiz/HV Defects With The TV's Defective H.O.T. Removed!

Is it safe to solder in a new horizontal output transistor after you've removed the shorted one? This is a common troubleshooting dilemma for technicians. What if the horizontal output transistor breaks down and fails again because of a horizontal output or horizontal driver stage defect? It is essential to detect remaining circuit problems before soldering in a new horizontal output transistor or before quoting a repair estimate.

Horizontal output transistors often fail from horizontal output or horizontal driver circuit problems. A timing defect increases the flyback pulse amplitude often exceeding the 1500 volt collector-to-emitter breakdown potential of the transistor. High voltage component breakdown or leakage in the horizontal stage, flyback, or flyback secondary circuits cause excessive current to flow in the horizontal output transistor. These defects increase the conduction current producing heat which can quickly and permanently damage the transistor. One example of this would be a flyback transformer that breaks down internally and conducts between isolated secondary windings at high voltage potentials.

A more difficult problem that often leads to a horizontal output transistor failure is a defect in the horizontal driver stage. A driver stage problem can reduce the base drive current to the horizontal output or cause intermittent drive resulting in transistor failure.

The TVA92's Dynamic Tests along with the Horizontal Output Device Sub & Drive are designed to analyze the horizontal output stage and flyback secondaries. It is designed to operate the horizontal output stage from about 1/2 the normal to full operating voltages all without a horizontal output transistor installed in the chassis and regardless of the B+ supply type. The TVA92's Dynamic Tests and Sub & Drive help you isolate difficult horizontal problems and show you hidden problems before preparing service estimates.

The TVA92's Horizontal Output Device Sub & Drive provides a substitute horizontal output transistor fully protected inside the TVA92. A horizontal drive signal generated by the TVA92 and synced to the video signal is applied to the base of the



*Fig. 4: Horizontal output transistors often fail from surrounding circuit defects. The TVA92's Dynamic Tests and Horizontal Output Device Sub & Drive help you isolate these problems.*

subbing transistor. The TVA92's Horizontal Output Device Sub & Drive control switches "on" the horizontal drive signal and varies the duty cycle of the drive signal to the base of the subbing transistor. The duty cycle is varied so as to change the conduction time of the subbing transistor from approximately 10 uS to 35 uS. This permits operation of the TV's horizontal output stage at a reduced current level up to the normal current level in the flyback and yoke.

With the TV's horizontal output transistor removed, connect the TVA92's Dynamic Test leads to the circuit points equivalent to the emitter, base, and collector of the H.O.T. Start with the Horizontal Output Sub & Drive control "off", and apply power to the TV chassis. Confirm that proper B+ is applied to the horizontal output stage by measuring the DCV to the collector. This is measured automatically by the "DCV" Dynamic Test readout.

When troubleshooting, move the Horizontal Output Device Sub & Drive control clockwise until the "Sub On" light illuminates. At this position, the TVA92's subbing transistor and drive is operating the horizontal output stage but limiting the flyback and yoke currents to approximately 1/2 of normal. At this reduced level, use the TVA92's "Device Sub Current" readout to detect abnormally high flyback and/or yoke currents in the TV's output stage. The Device Sub Current readout indicates the collector current of the TVA92's subbing transistor which is determined by the TV's horizontal output stage. Currents typically range below 500 mA at this reduced current setting. Readings exceeding 500 mA indicate excessive currents in the horizontal output stage indicating a likely component leakage or breakdown.

If the Device Sub Current readout is normal at the reduced setting, increase the Sub & Drive control to mid range or slightly higher while monitoring the Device Sub Current readout. The Device Sub Current readout should read between 500 mA and 1.2 amps depending on the chassis design and CRT size. Use the TVA92's Dynamic Tests to measure the collector flyback pulse amplitude (Pulse PPV) and time (Pulse Time uS). The PPV should range from 800 to 1200 VPP for a full-size color chassis and the Pulse Time uS typically from 11.3 uS to 13 uS.

After a slight delay for the CRT filament to heat, you should see the VG91's or VA62's video pattern on the CRT. This lets you evaluate the TV's high voltage, video, color, tuner/IF, and deflection stages for defects. If you hear arcing as you increase the Device Sub & Drive control or the Device Sub Current readout begins flashing 1.5 mA and /or the "overload" light illuminates, a breakdown problem causing abnormally high current is indicated.

### Analyzing Advantages Await You!

The TV analyzing advantages of the TVA92 can be realized by combining it with the Sencore VG91 or VA62. Either of these Sencore RF/Video Generators provides the voltages and synchronizing signals needed by the TVA92. If you are using a VA62, it's as easy as connecting the TVA92 to the Accessories Jack or EX231 Expander. If you're using a VG91 Universal Video Generator, the TVA92 connects to the rear Synchronizing Signal Output.

The TVA92 advantages are ready to make your TV troubleshooting faster, easier and more enjoyable. Don't wait another day. Call Sencore at **1-800-736-2673** for a no-obligation evaluation of the TVA92. There's nothing else like it on the market. **SN**

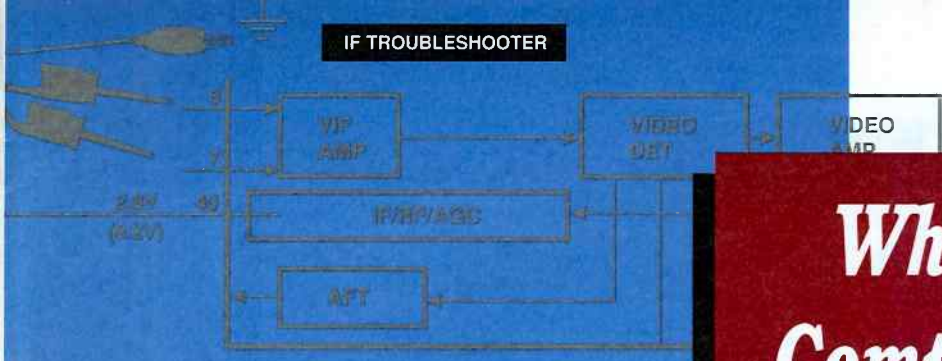
**Reduce Your TV Troubleshooting Time!**

Our new technical guide on horizontal theory and troubleshooting is what you need to build your confidence in these challenging circuits. The TV300, Understanding TV Horizontal Stages, covers the theory behind TV horizontal stages in a 46 page book and includes a videotape so you can better understand these troublesome stages.

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IF TROUBLESHOOTER



# What You Don't See Makes It A Complete Video Analyzing System

EXPANDABLE

Synchronizing Signal Output



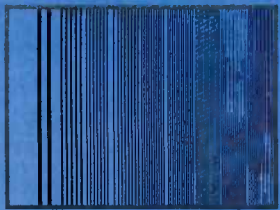
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STD Y/C OUTPUT



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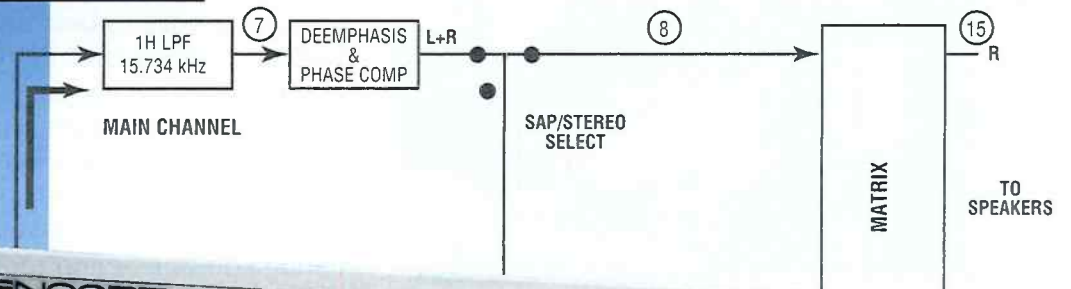
EASY-TO-USE



ALL CHANNEL CAPABLE

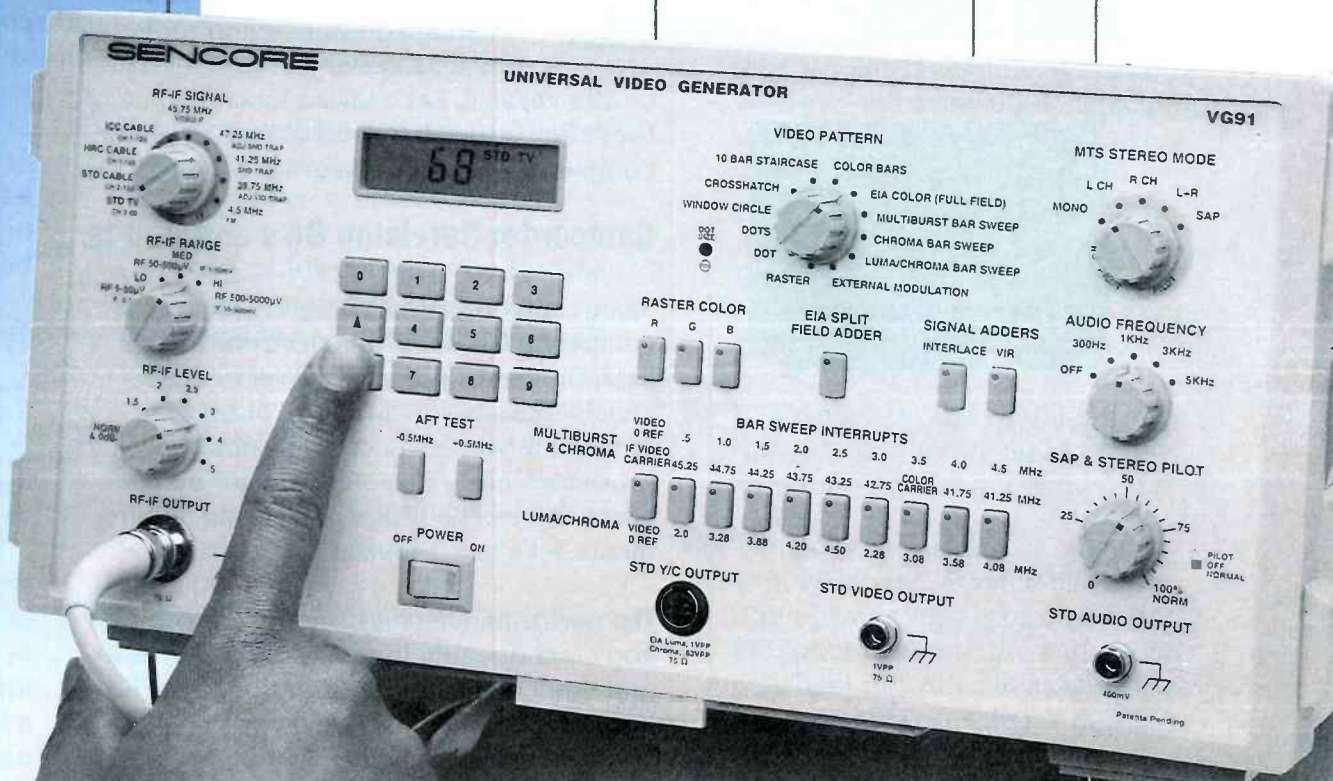


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Sometimes what you see is only a part of the picture. The VG91 Universal Video Generator is the only instrument that provides all the TV-RF-IF and innovative NTSC video tests and signals in one expandable instrument that covers all your servicing and alignment needs. It's a powerful way to help build your business.

The VG91 is part of the "Tech Choice System," call your Sencore Area Sales Representative today at **1-800-SENOCORE (736-2673)** for more details.



VG91 Universal Video Generator Patented





# Getting Started In Camcorder Service

## Some Do's And Don'ts In The Basics Of Camcorder Servicing

**A**re you searching for ways to add to your revenue and service potential? Are you wondering whether complete camcorder service might be one answer? You may already service the VCR section of camcorders and want to tackle the camera problems you see as well, instead of sending them off to another service center. Or, you may not be presently servicing camcorders at all, but are considering doing so. In either case, you're probably wondering what the additional service requirements are.

There are some special camcorder service considerations you want to be aware of to decrease your service time and increase your service quality. You also need a basic understanding of VCR and camera operation theory to best understand the performance and troubleshooting tests you'll use to isolate camcorder problems. You may need to obtain some specialized tools and test equipment, although much of your existing equipment and tools will also serve you well for camcorder service. Let's take a look at some of these key issues involved in setting up for complete, efficient camcorder service.

### Camcorder Servicing Do's and Don'ts

Since camcorders are so tightly packaged compared to most other electronic products, there are some special servicing considerations you'll want to observe to streamline your camcorder troubleshooting processes. Since these "do's" and "don'ts" affect some of your other servicing requirements, let's take a look at them first.

**Do** performance test camcorders before you start opening them up. This will verify and determine the full extent of any problems and help localize those problems to a general section of the VCR or camera. If you open and start troubleshooting the

camcorder based solely on the stated symptom, you may be missing some valuable troubleshooting clues. You could erroneously start testing the wrong camcorder section, or you may even be troubleshooting the wrong problem which wastes your valuable time.

**Don't** open up the camcorder until you're sure there is a problem inside the camcorder. When troubleshooting an intermittent shutdown complaint, for example, you don't want to open the camcorder to troubleshoot the power supply or system control circuits if the problem is simply a weak battery. Also, when you receive a complaint of wrong colors in a recorded scene, you don't want to open the camcorder to troubleshoot the camera automatic white balance circuits if the problem is simply that the owner didn't realize that the white balance switch had been moved from the "auto" to the "outdoor" position.

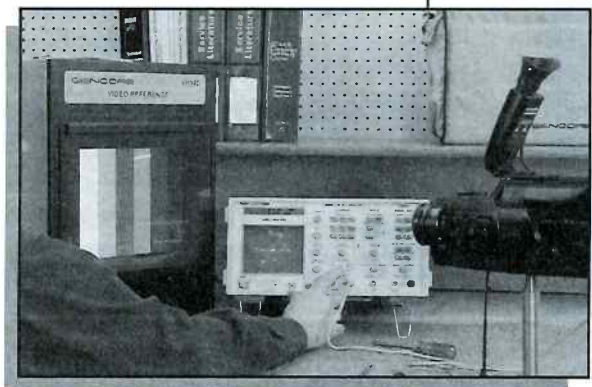
**Don't** disconnect or extend circuit boards until you're very confident which area of the circuit you should be troubleshooting. Use a proper combination of performance tests and functional analyzing, with the test points accessible to you, to first narrow the problem down to a major block of circuits contained on one circuit board.

**Do** have the correct tools available to work efficiently with the smaller mechanical and electronic components used in camcorders. Something as simple as using the wrong screwdriver to remove a camcorder's case screws can leave both the screws and your technical competence looking mangled from your customer's perspective. The correct tool for each part of the job makes repairs go faster and leads to fewer additional failures due to broken mechanical parts, damaged circuit boards, etc.

### Typical Camcorder Problems

Camcorder problems typically fall into two general categories; circuit failures caused by heat or voltage stress, and failures caused by mechanical wear or breakage.

Weak batteries frequently cause short record time or cause a camcorder to not operate. These problems can often be identified by operating the camcorder on a known-good AC adapter/charger or battery to identify whether the camcorder itself operates properly.



**By Tom Schulte**  
Application Engineer, CET

*Sencore Electronics*



The camcorder power supply, often called a DC to DC converter, is a frequent source of problems. This power supply doesn't use a rectifier circuit to convert from AC line voltage to DC circuit voltages, as is typical for most electronic equipment. Instead, the AC adapter/charger or the camcorder's battery supplies a steady DC voltage in the range of 6-12 volts. Inside the camcorder, either a switching power supply acts as a DC to DC converter to provide DC circuit voltages, or series pass regulators drop the battery DC voltage down to typical DC circuit voltages of 5, 9, or 12 volts.

The camera electronic viewfinder (EVF) is simply a miniature video monitor which receives composite video from the camcorder. Since it generates sweep voltages and high voltage for the viewfinder CRT, the EVF also has a fairly high failure rate.

The driver ICs which control the cylinder and capstan motors (plus loading motor, if used) produce a significant amount of heat while controlling the motor currents. This, of course, leads to reduced reliability for the driver ICs and their nearby support circuits.

Moving mechanical parts in the camcorder, especially in the VCR section, account for perhaps the largest number of camcorder failures. These failures are very similar to those found in standard VCRs, but are even more common due to the smaller size of the parts in the camcorder tape transport. The camera lens assembly has its share of breakage due to rough handling or dropping of the camcorder. The gears and motors in the lens assembly, as well as the lens mounting parts, tend to be damaged. Another common mechanical failure due to rough camcorder handling is cracked circuit boards in both the VCR and camera section.

## Camcorder Service Tools And Supplies

A small tripod mount is very convenient for holding camcorders during testing. These are approximately 6" high and can be obtained in the camera department of most discount department stores for under \$10. A properly grounded static control mat on the bench surface is important for repairing most of today's electronics and should be used when servicing camcorders.

An assortment of small hand tools is valuable for disassembling and adjusting the small parts found in camcorders. These should include a set of small metric Allen wrenches, a set of metric Phillips screwdrivers (shaped differently than standard

Phillips), and several small picks and spring adjustment tools. A low wattage, fine tip soldering iron (best if temperature regulated) and a magnifying light are also helpful when working on small parts. Extension cables are helpful, and in some cases necessary when servicing camcorders. These are available directly from the camera manufacturers. The lens and camera circuits are usually packaged as a single camera head assembly which can be disconnected from the VCR assembly by removing a few screws and one cable plug. The camera head can then be mounted on a small tripod and reconnected to the VCR assembly with a camera head extension cable. This gives you easy access to camera circuit test points and adjustments. Extension cables may also be needed at times to gain better access to single circuit boards for final troubleshooting to the defective component.

## Camcorder Service Test Equipment

Some general purpose and specialized test equipment will help you become more efficient servicing camcorders. Following is a listing and discussion of the test equipment which will be most useful.

You should have a variable power supply or standard power adapter/chargers available to supply each of the standard camcorder supply voltages of 6, 7.2, 9.6, and 12 volts. A power supply used to power camcorders should be capable of supplying up to 3 amps of current, especially at the lower voltages.



*Fig. 1: Setting up for camcorder service involves much of your existing equipment. You'll also want a tripod, small hand tools, and good test equipment.*

The oscilloscope and voltmeter (or SC3100 "AUTO TRACKER" Waveform Analyzer) already in use on your video service bench will serve well for camcorder service, provided the scope has a solid TV trigger mode and enough bandwidth to accurately display squarewave clock and control signals (60-100 MHz). The Waveform Analyzer will be used especially when signal tracing problems in the camcorder power supply and system control circuits.

Most camcorder repairs are mechanical, especially in the VCR section and in the

camera lens assembly. Once the obvious VCR mechanical defects are corrected, you need a method of isolating any remaining (hidden) mechanical problems from signal processing (including heads) and servo control problems.



Learn More About Camcorders!

To help you with an understanding of camcorder operation theory plus testing and troubleshooting techniques, Sencore offers a one-day Camcorder Tech School, scheduled at locations across the United States and Canada. These Tech Schools cover simplified camera operation theory, camera testing/troubleshooting techniques, and VCR testing/troubleshooting techniques. This knowledge is reinforced with hands-on practice of test and alignment techniques. These Tech Schools are designed to help you understand and troubleshoot all brands of camcorders more effectively.

**Call your Area Sales Representative at 1-800-SENCORE for more details.**

The Sencore VC93 All Format VCR Analyzer helps you quickly separate problems which allow the VCR to play the tape, but produce a defective picture or audio (see article on page 32). It allows you to quickly identify and localize signal processing and servo control problems or to identify the problem as a tape path mechanical problem. The VC93 covers standard and Super VHS as well as the VHS-C and 8mm formats found in camcorders.

A camera needs to automatically adjust to many operating conditions (different light levels, different illuminating light color, different distances, etc.) and needs to be compatible with all TV receivers. Because of this, camera problems experienced by the owner aren't always obvious in a simple point and shoot camera checkout. A method of quickly analyzing the camera for all its important performance characteristics, without guesswork, will speed up your camera troubleshooting and minimize callbacks. You can quickly identify camera defects and localize the defect to an area of the camera circuit with the Sencore VR940 Video Reference and the CVA94 "Video Tracker" Camera Video Analyzer. The VR940 Video Reference provides the camera with controlled video input signals designed to test all aspects of camera operation, while the CVA94 "Video Tracker" provides a complete analysis of the camera's operation. Together, they make quick work of performance testing and troubleshooting video cameras.



## Troubleshooting A Typical Camcorder Problem

Let's now look at a typical camcorder repair. The customer complained that all tapes played back on the camcorder showed noise streaks in the picture, but the audio sounded pretty good. The "defective picture" symptom indicated a problem in either the signal processing circuits, the servo control circuits, or the mechanical tape path. A quick visual check of the tape path components through the tape door didn't show any obvious mechanical problems. Since the VC93 VCR Servo Performance Tests would be the easiest next step, those tests were performed next (from the camcorder's video and audio out jacks). The Performance Tests showed a "Bad" Servos Locked result, indicating a definite problem in the servo circuits.

In order to localize the problem to the exact area of the servo circuit, the camcorder side cover was removed. The Servo Troubleshooting Tests were performed with the Servo Troubleshooting Test Leads connected to the CTL and SW30 test points on the camcorder VCR board. The Servos Locked test showed "Bad," while the capstan and drum speed tests all showed "Good." This localized the problem to either a capstan phase loop defect or a drum phase loop defect. The next step was to isolate the problem to the defective loop and component.

Since the drum circuit seemed the most likely problem area, the Waveform Analyzer was used to view the drum phase PWM output while lightly touching the upper edge of the drum to slow it down (Fig. 2). The drum phase PWM signal immediately changed its duty cycle, indicating the drum feedback and phase detect circuits were operating normally. A check of the DC correction voltage at the drum phase low pass filter output also showed an immediate response to changes in the drum speed. This indicated that the drum phase loop was operating normally, so the capstan phase loop was checked next.

The Waveform Analyzer was used to view the capstan phase PWM output (Fig. 2) while lightly loading down the capstan pinch roller. The capstan phase PWM signal immediately changed its duty cycle, indicating the CTL feedback and phase detect circuits were operating normally. A check of the DC correction voltage at the capstan phase low pass filter output, however, showed unfiltered PWM signal instead of filtered DC. A quick check of the LPF capacitor with the LC102 "AUTO-Z" Capacitor/Inductor Analyzer showed that the 2.2 uF LPF cap had over 300 ohms

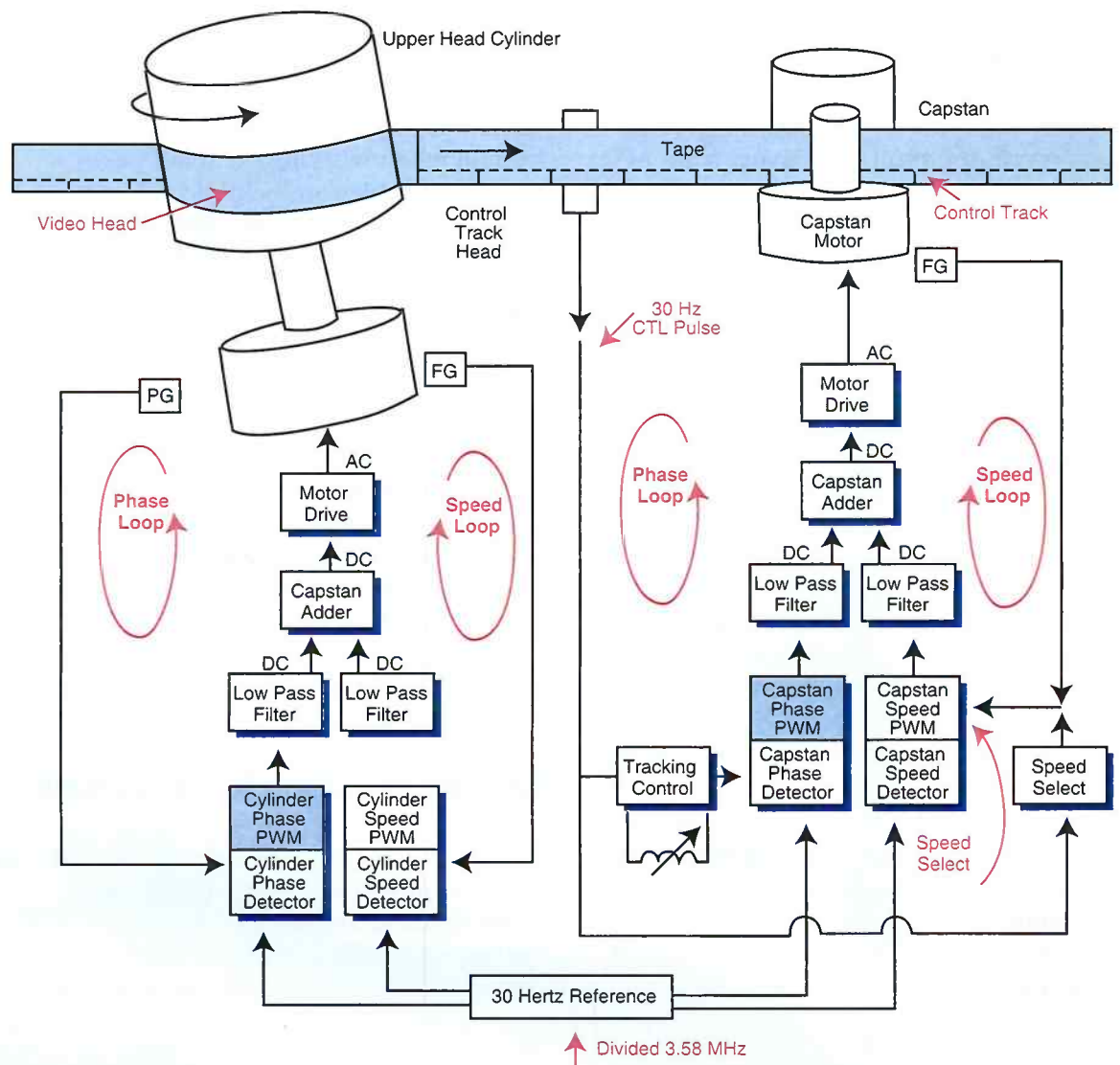


Fig. 2: Use your VC93 All Format VCR Analyzer and Waveform Analyzer to track down problems in both the drum and capstan servo circuits.

of ESR (equivalent series resistance), much more than its normal value. With a new phase loop filter capacitor installed, playback returned to normal with good video and audio. A quick last check with the VC93 VCR Servo Performance Tests showed all "Good" test results, indicating that the electro-mechanical servo control and motor circuits were now all working properly.

The CVA94 Camera Performance tests were then performed on the camera section of the camcorder to insure that the complete camcorder would function properly for the customer upon return. These tests take just a few minutes, but provide a complete 10 point analysis of camera operation (Fig. 3). The tests showed that black setup, rather than being at 7.5 IRE above blanking, was about

Video Camera 10 Point Dynamic Test Procedure				
VIDEO CAMERA TEST	CAMERA SECTION TESTED	CHARTS USED	RESULTS EXPECTED	TEST RESULTS/RECOMMENDATIONS
1. Burst Reference Frequency	Master Oscillator, Sync. Generator Power Supply	None	3.57545 MHz ±100 Hz ±3%	
2. Focus	Mechanical Lens Auto Focus Circuit	Focus Check/ND Filter Paper Focus Chart	Focus/Zoom Tracking, Uniform Focus/Response Over Distance	
3. Black Level	Automatic Chroma Process	Automatic Chart	Minimum Signal/Black No Color Level	
4. White Balance Control	Color Map System Lens, Auto Compensation	Color Chart/Color Balance Chart	7.5 IRE White Signal/100 IRE Black Signal	

Fig. 3: Call your Area Sales Representative for a copy of the "Video Camera 10 Point Test Procedure" to help you profitably service, estimate, and troubleshoot cameras and camcorders (first 100 copies are free).

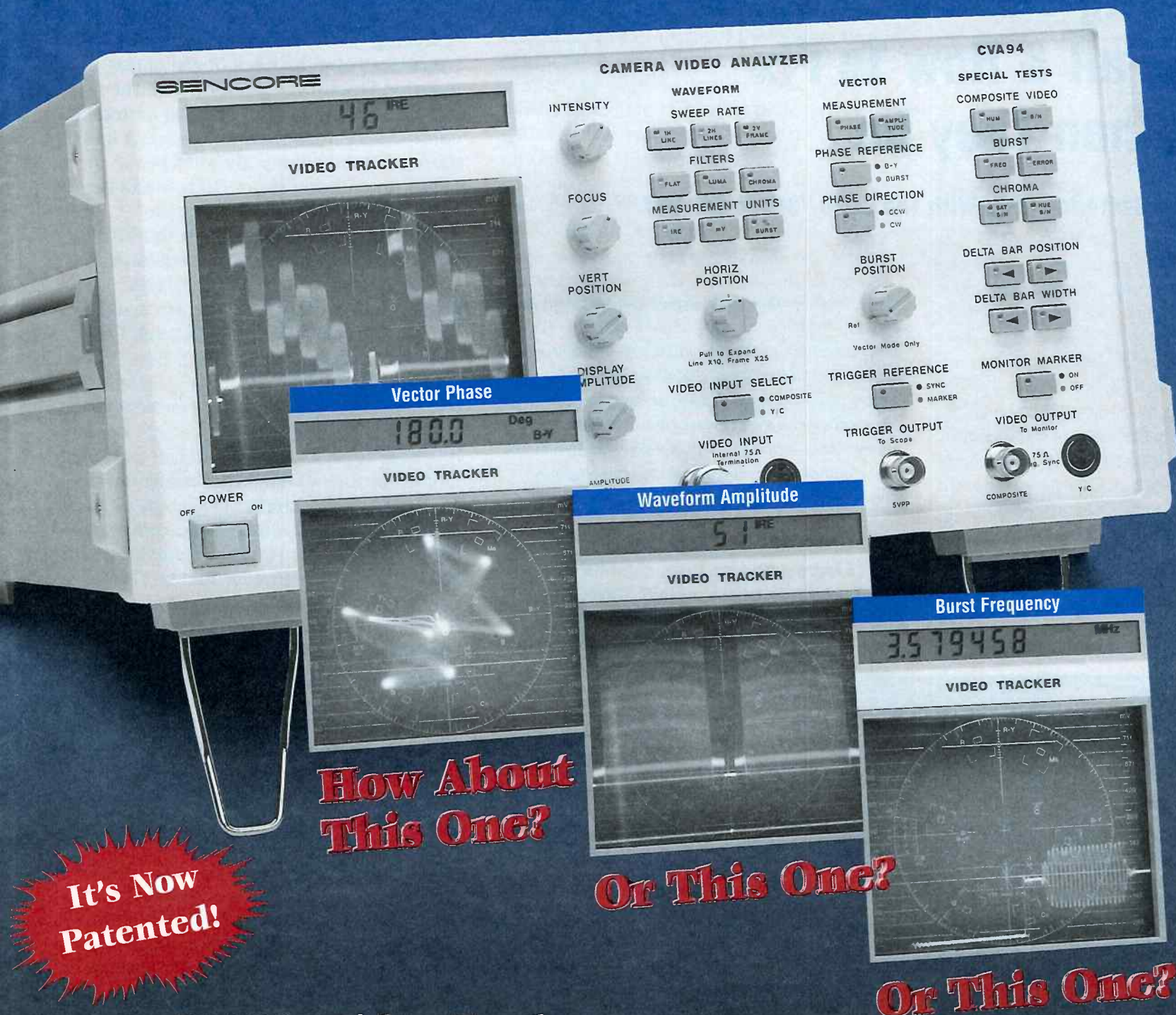
17 IRE above blanking. Excessive black setup produces compressed video, resulting in low contrast pictures. Also, the outdoor white balance test, rather than indicating a balanced white picture, indicated an overall red picture tint. This results in wrong colors under outdoor lighting conditions. A quick check of the camera setup and white balance adjustments showed that both the setup and white balance problems were easily corrected with minor readjustments.

After this complete analysis of both the VCR and camera sections of the camcorder had been performed, the camcorder was confidently returned to the customer, knowing that the customer would be well satisfied with the camcorder operation under all different operating conditions.

If you'd like to learn more about camcorder analyzing, and the equipment and support Sencore can provide, call your Area Sales Representative at **1-800-SENCORE**. Even if you've never touched a camcorder, we can help you get started. Just give us a call. **SN**



# If You Don't Like This Camcorder Answer...



**It's Now  
Patented!**

**How About  
This One?**

**Or This One?**

**Or This One?**

## CVA94 "Video Tracker" Camera Video Analyzer Patented

When you need another opinion on a camcorder signal, now all you have to do is push a button. The CVA94 "Video Tracker" provides a complete vectorscope and waveform monitor, plus digital waveform measurements for fast signal troubleshooting. It is the only instrument designed specifically for camera analyzing,

saving time, and building customer trust. The confidence you gain is what makes the "Video Tracker" such a powerful tool. From the first time you use it, you'll positively identify and localize camcorder problems for fast service and alignment. Need another opinion? Ask the CVA94 "Video Tracker."

*But don't take our word for it. See it for yourself on your bench with our no-obligation trial. Call 1-800-SENCORE (736-2673) ext #516 for details!*





# Shooting The Tube: Why CRTs Fail & How To Fix 'Em When They Do

Testing And Restoring CRTs With The CR70 "BEAM BUILDER"®

*The following article has been reprinted courtesy of RePlay Magazine, a trade journal for the coin-operated amusement industry including jukeboxes, pool tables, pinball machines, and video games. The article's author, Randy Fromm, writes a monthly technical column on the subject of amusement game repair. He also holds technical training seminars and is the author of a textbook and videotape training series on the subject of arcade game repair.*

**I**f I have a bad picture, can I fix it? I get asked this question just above every time I teach a class on video game monitor repair. It's a good question! As video games get converted and reconverted, the monitors can easily log tens of thousands of hours of operation. As a result, picture tube or CRT (cathode ray tube) failure has become increasingly more common.

Anyway, the answer to the question is yes. Sometimes. Kinda. Sorta. Maybe. But before we get into repairing picture tubes, let's take a look at some different types of picture tube failures. More specifically, we're going to look at the electron gun assembly that's located in the neck of the picture tube.

Each of the three electron guns in the electron gun assembly uses a heated cathode as a source of electrons. The heater is the element that you see glowing when you look at the neck of a picture tube. The heater must fit closely inside the metal cathode, but it must not touch it. If the heater shorts to the cathode, the gun will be stuck "ON" and the screen will appear a super bright color (red, green, or blue depending on which of the three guns is affected) with vertical retrace lines visible throughout the screen. Vertical retrace lines appear as diagonal lines that run from lower left to upper right across the screen.

If you believe you might have a heater-to-cathode short, try unsoldering and removing the associated video output transistor from the neck board of the monitor. Fire up the monitor with the transistor removed. If you still have a brightly colored screen with vertical retrace lines, there's a good chance the CRT has a heater-to-cathode short. You should be able to verify this with an ohmmeter. With the neck board removed from the CRT, you should have an infinite resistance between heater and cathode of the picture tube. Although there are many different types of CRTs, you will often find the red cathode at pin 8, the green cathode at pin 6, and the blue cathode at pin 11. Pins 9 and 10 are for the heater.

It is also possible that one of the cathodes might become shorted to a control grid. This can cause a similar symptom as a heater-to-cathode short. If the cathode is shorted to the control grid, you should be able to verify it with your meter. The control grid will often be found at pin 5. If the cathode has become damaged due to a buildup of oxides and other crud, you will experience a loss of one color (partial or total). Try grounding the collector of the associated video output transistor. If the color comes on clear and bright (a brightly colored screen with vertical retrace line), the CRT is okay. If the color does not come on or is not as bright as the other two colors, the picture tube is bad. (**Caution:** Don't do this on a Hantarex MTC 900. You will smoke a resistor.)

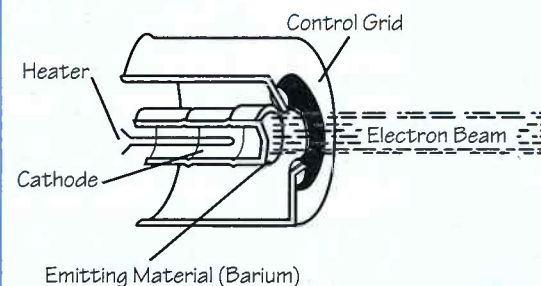
Another type of electron gun failure is a short between the control grid and the screen grid. This will cause an extremely dark picture (even with the screen control at maximum) or no picture at all. Measure the voltage at the screen grid (often pin 7) of the CRT. You should be able to run it through a range of 250 to 750 volts DC



By Randy Fromm  
Reprinted From  
Replay Magazine

January 1996 Issue

FIGURE 1



The heater, cathode, and control grid (G1) of a typical electron gun.

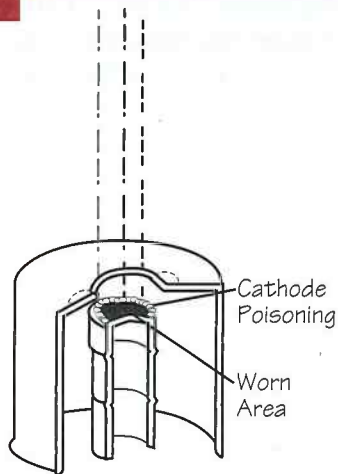


using the screen potentiometer. If the voltage is not high enough, pull the neck board off the CRT and measure the voltage at the CRT socket again. If the voltage is now normal, you probably have a short between the control grid and the screen grid. Use your ohmmeter to verify.

## Fixing Bad Tubes

Is it really possible to fix a bad CRT? I have had a fair bit of success using some simple techniques. Shorted electron guns are often caused by small flakes of cathode material that have sloughed off and found their way into the electron gun. This type of failure is common in games with face-up mounted monitors (table games, gun games that use mirrors, etc.) because any crud in the CRT will naturally fall right into the electron gun. By turning the picture tube face down and tapping lightly and repeatedly on the neck with the plastic handle of a screwdriver, the flakes can sometimes be dislodged. Do not hit the convergence ring assembly and for goodness sake, don't hit the glass neck hard enough to break it! Naturally, if you manage to shake the shorting particle out of the neck of the CRT, you do not want to use this picture tube for a table game again, EVER!

FIGURE 2



Low white-level beam current is usually caused by a poisoning ion layer that prevents electron emission.

There is another trick that you can use to save a shorted CRT. Commercial CRT service equipment uses a technique known as "rejuvenation" to remove shorts from electron guns. The rejuvenation circuit uses a capacitive discharge to blow away any little shorting particle. We'll look at the CRT rejuvenator in just a second, but here's a cheap and dirty way to repair some shorted CRTs using just a clip lead or small piece of wire.

**CAUTION:** The procedures described herein involve potentially lethal voltages and must be performed by qualified personnel or at the very least by a mechanic with a decent sense of self-preservation.

1. Remove the video output transistor associated with the bad color. If in doubt, remove all three video output transistors. I usually remove all three just to be sure.
2. Locate the screen voltage pin of the CRT socket (often pin 7, but check schematic to be sure). This pin is often labeled "G2".
3. With the neck board installed on the CRT (without the video output transistors installed,) turn on the monitor and adjust the screen potentiometer fully clockwise in order to obtain maximum screen voltage.
4. Touch one end of a wire or clip lead to the screen voltage pin of the CRT socket.
5. Momentarily touch the other end of the wire to the shorted cathode pin (red, green or blue) of the picture tube. With luck, you will see a small blue arc in the neck of the CRT as the short is blown away.
6. Use your digital multimeter to verify that the short is gone. You should now read an infinite resistance. If not, repeat steps 1-6.

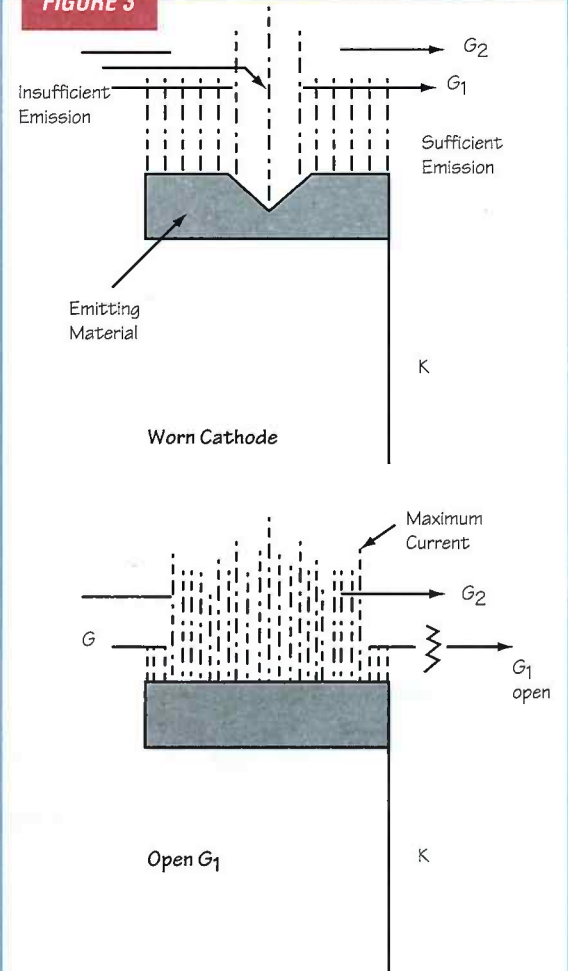
Cathode to grid shorts and grid to grid shorts can usually be removed with this technique. Heater to cathode shorts are another story as the thin filament of the heater will often blow out before the short circuit does. I have had about 50% success removing heater to cathode shorts this way.

## The Right Way To Test And Restore CRTs

Now let's look at the "correct" way to test and restore CRTs using a remarkable piece of equipment from Sencore called the CR70 "BEAM BUILDER" Universal CRT Analyzer & Restorer. Before I begin to describe what the "BEAM BUILDER" does and how it works, let me say that I have repaired and restored dozens of bad video game picture tubes using the CR70. I have taken old CRTs that were dim and virtually unusable and turned them into beautiful, bright displays that look as good as the day they were manufactured. In the process, I have saved my boss at Area Amusements and my Arcade School students hundreds of dollars in CRT replacement costs. I saved \$400 just by restoring one high resolution CRT!

A good cathode produces more than enough electrons than needed for adequate beam current, but when the cathode becomes encrusted, no beam current can flow. Emission that drops off when the LIFE test button is depressed is

FIGURE 3



Bad cutoff is caused by either a worn cathode or open G1. A CRT that has a worn cathode will produce insufficient beam current for gray picture elements, but since the edges of the cathode are good, sufficient emission is available when G1 opens up for bright picture elements. An open G1 results in no beam control, much like an H-K short.

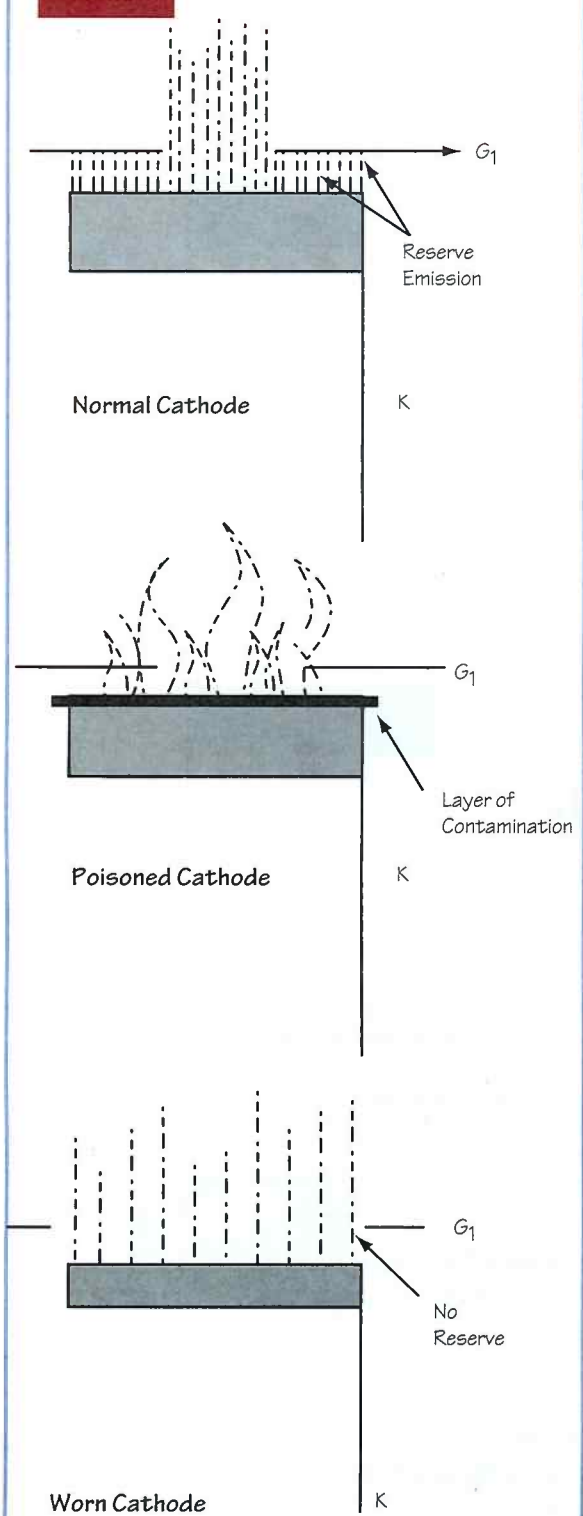
caused by a weak cathode that has no reserve electrons.

Since most operators simply purchase new monitors instead of replacing the picture tube, the actual savings are even greater. At \$1,495.00, the CR70 "BEAM BUILDER" is priced about the same as four 27-inch replacement monitors. Even if you're a medium-sized operator, there's almost no way the CR70 cannot pay for itself in just a year or two of occasional use.

What is it? First of all, Sencore's CR70 "BEAM BUILDER" will test all types of picture tubes. Individual tests are made for short circuits in each of the three electron guns. Tests are made for heater-to-cathode (H-K) shorts and cathode-to-grid (G1) shorts as well. The electron guns are also tested for proper cutoff (the level at which the gun stops emitting electrons, producing black on the screen) and "emission" (sufficient beam current to produce a bright color on the screen). Each of the tests closely duplicates the normal operation of the CRT so you're testing it under typical operating conditions. By the way, you do not need the entire monitor in order to test the picture tube. The CR70 will test any CRT as a stand-alone unit. Naturally, you do not need to remove the



**FIGURE 4**



*A good cathode produces more than enough electrons than needed for adequate beam current (top) but when the cathode becomes encrusted (center), no beam current can flow. Emission that drops off when the LIFE test button is depressed is caused by a weak cathode that has no reserve electrons (bottom).*

restored by the “BEAM BUILDER” as we’ll see later. The CR70 “BEAM BUILDER” even has a “life test.” The life test will tell you how much usable life you can expect from your picture tube.

### Removing Shorts

Heater-to-cathode shorts are caused by contact between the CRT heater and the cathode. The CR70 is not designed to correct this fault as the surge current provided by the “BEAM BUILDER” will often blow out the filament completely. Control grid (G1) shorts are often caused by flakes of material that have become lodged between the cathode and the control grid. A G1 short can cause loss of control of the CRT beam, resulting in a bright screen with visible retrace lines. G1 shorts also result in CRTs that cannot be controlled by the brightness control or the incoming video or blanking signals. The CR70 “REMOVE G1 SHORT” function will vaporize most shorting particles, resulting in normal CRT operation.

### Cutoff Related Failures

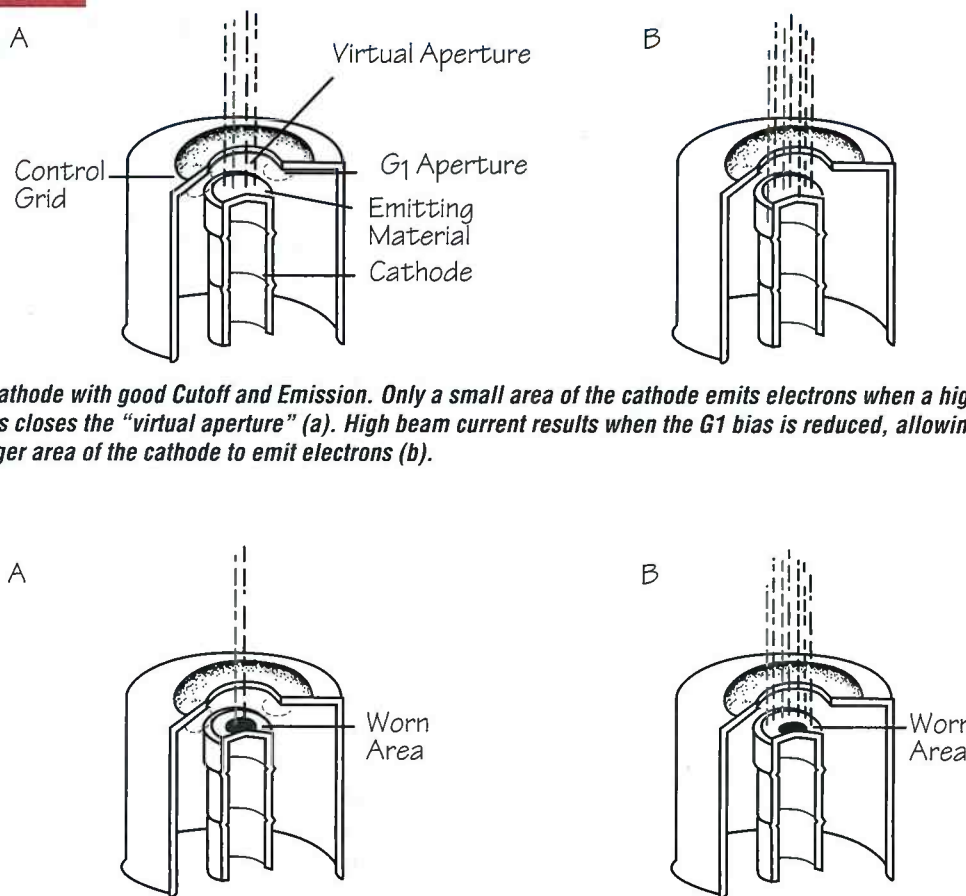
In order to understand the cutoff test, let’s take a closer look at the way the cathode works. The cathode is the source of the electron beam. It is coated with a material (such as barium or thorium) which gives off large numbers of electrons when it is heated by a filament. Believe it or not, there is a finite amount of this electron emitting material and it gets used up

or “stripped” after years of extended use. Once the barium is used up, the picture tube cannot be completely restored. The hot cathode emits electrons which form a cloud around the cathode until they’re attracted toward the front of the screen by a positive voltage on the screen by a positive voltage on the screen grid of the electron gun assembly. Between the cathode and the screen grid lies the control grid. In most video game monitors, the control grid is grounded, giving the control grid a negative bias with respect to the cathode. The video signal modulates (changes) the voltage of the cathode. It is the voltage difference between the cathode and the control grid that controls the beam current and the brightness of the color.

The entire surface of the cathode is not always used to supply the electrons that make up the electron beam. When the electron gun is only partially turned on, just the center part of the cathode is used. This means that the emitting material at the center of the cathode is used up faster than the material at the edges. The outer areas only supply electrons during the peak brightness periods.

When the center part becomes worn, the CRT screen still lights brightly during peak brightness, but the beam cuts off too soon because the brightness drops and the worn-out center of the cathode is the only part being used. This results in a picture that’s a combination of over-

**FIGURE 5**



*A cathode with good Cutoff and Emission. Only a small area of the cathode emits electrons when a high G1 bias closes the “virtual aperture” (a). High beam current results when the G1 bias is reduced, allowing a larger area of the cathode to emit electrons (b).*

*A cathode with bad Cutoff and good Emission. The CRT cuts off too soon when the center of the cathode wears, causing gray images to be too dark (a). The CRT with a cathode worn in the center produces bright highlights because the outer edges are still good (b).*

picture tube from the monitor to test it. You simply remove the CRT socket (the neck board) from the monitor in order to connect the picture tube to the “BEAM BUILDER.” The CR70 comes with adapter sockets for testing all types of picture tubes. Notice I didn’t say “most picture tubes” or “all popular tubes.” The “BEAM BUILDER” tests ‘em all! Another test checks the “tracking” of the three color guns. In order to produce a picture that is properly color balanced, all three electron guns are compared by the CR70, which measures the ratio between the strongest and weakest gun. If the difference is more than 55 percent, the gun will show as “bad.” Don’t worry! Bad guns can be



driven, smearing color and black, with no intermediate shades of color. Many technicians call this a "gassy" tube. Actually, the tube is exhibiting poor gamma; the ability to correctly reproduce shades of gray or color.

The CR70 tests for proper cutoff. The cutoff test, combined with the emission test that follows, indicate the next steps to be taken in the restoration process.

### Emission Test

The emission test indicates if the edges of the cathode are poisoned. Poisoning occurs when positive ions coat the emitting material on the cathode. The ions are a result of a minute amount of air that's left inside the CRT during manufacturing. These ions react with the hot cathode surface over a period of time and reduce (in some cases completely shut off) the number of electrons emitted by the CRT. Cathode poisoning is similar to rust on a piece of steel.

If the tube fails both the emission test and the cutoff test, the entire surface is poisoned or stripped of emitting material. An emission life test reduces the filament voltage to detect cathodes that are overly temperature dependent, indicating short life expectancy.

### CRT Rejuvenation And Restoration

The CR70 uses a number of different methods to fix picture tubes. The method used varies from tube to tube, depending on the nature of the CRT failure. The "BEAM BUILDER" uses a "progressive restoration" technique that allows you to carry out CRT restoration one step at a time, using just the right combination of voltage, current, and heater voltage to get the job done while avoiding the tendency to "overdo it" that many technicians have when restoring a CRT. The process of restoring a CRT is often referred to as "shooting the tube."

After removing any shorts and testing each gun for cutoff and emission, you're ready to try restoring any weak guns. The CR70 does this by boosting the CRT heater voltage. This makes the cathode super hot. Then, a 100 or 150 milliamp current is passed through the cathode. The combination of high temperature and high cathode current removes the cathode poisoning, exposing fresh cathode material.

There are three levels of restoration available: AUTO, MANUAL 1 and MANUAL 2. Each is progressively more severe. Naturally, you begin with the AUTO restore function. It's as simple as holding down a button and watching the meter on

## Restore Your CRTs - With Confidence.



### CR70 "BEAM BUILDER"® Universal CRT Analyzer & Restorer Patented

Safe and effective. These are the words to describe how the CR70 "BEAM BUILDER" restores CRTs. First, the CR70 tests the CRT over its entire dynamic range from black to white with several reliable "GOOD/BAD" tests. If the tube shows any kind of defect, the CR70's "progressive restoration" system starts with the lowest (and safest) restoring level necessary. Since you control the restoring level, you control the outcome. Nothing on the market is safer or more effective at restoring CRTs.

**Call 1-800-SENCORE (736-2673)**

- Guaranteed to test virtually every CRT (old, new, projection, camera, scope, video monitor, and more)
- Guaranteed dynamic tests you can trust
- Guaranteed to safely restore 9 out of 10 weak or shorted CRTs
- Guaranteed to be totally protected from damage by charged CRTs


the CR70. When the meter completes three cycles of restoration, you let go of the button. This has worked like a charm every time I've used it.

If the auto restore doesn't work to brighten a weak gun, there are the two manual restoration functions. These provide continuous cathode currents of 100 to 150 milliamps, respectively, for as long as you hold down the restore button. The meter on the CR70 monitors the current and lets you know how the restoration is proceeding. If you cannot get any cathode current to flow due to complete poisoning of the cathode, the CR70 has a "rejuvenate" function. The rejuvenate function is used when the CRT cathode is so totally encrusted that no restore current can be drawn by any of the other restore functions.

In the rejuvenate function, a charged capacitor is connected between the

cathode and the control grid (G1). When the sudden positive voltage from the capacitor is applied to G1, the electrons under the poison crust break free, essentially cracking the layer of contamination. Once the layer of contamination has been cracked, the auto restore function can be used successfully.

### Free Video Tape And Technical Newsletter

A very informative videotape on CRT failures is available from Sencore. Sencore's toll-free phone number is (800) SENCORE. Ask for Tech Tape #861A. The tape is free. Please tell them Randy Fromm at RePlay Magazine recommended you call. 

[Readers can contact Randy at 1944 Falmouth Dr., El Cajon, CA 92020-2827. Phone is 619.593.6131; fax is 619.593.6132. Copyright 1996 by Randy Fromm.]



# Looking At A Bright Future With JOB ELECTRONICS

**T**his issue's Service Center Profile features JOB ELECTRONICS of Williamsport, MD. Alan Williams (President) tells us his service operation is in the process of making a major expansion. With business picking up, and space getting tight, JOB ELECTRONICS is preparing to expand its service and move to a new location. Read through the profile and I think you'll understand why their service business has a bright future.

**How did you get started in the service industry?**

"While repairing VCRs for a local dub center, I learned of the potential in the electronic service industry. I worked part time at that for a year, then Jack and I became partners in our service business. Getting started was scary, but we invested in Sencore equipment, became incorporated, and our business has just grown ever since. We're preparing to move into a larger facility with more of a store front to draw even more business."

**What was the first product you worked on?**

"I started working on VCRs. The transition into camcorders came very easy for me, and since nobody else around was doing them, I felt like that was the best choice."

**What products do you presently service?**

"We're taking in VCRs, camcorders, audio products, CBs, scanners, and TVs. Right now our space limits us from taking larger

items like big screen TVs, but our new location will fix that."

**What kind of advertising do you do?**

"Our quality work and word-of-mouth plus a yellow page ad has kept us busy enough. This month, we also placed our first local newspaper ad and we bought some ad space at a local bowling alley."



Fig. 1: Alan Williams (right), Jack Myers, and Job Electronics are preparing to expand their service and move to a larger location.

**How has location affected your business?**

"Up until recently, we've pushed our commercial business accounts harder and not so much the walk-in business. This has worked for us, but we find ourselves working on the units that have been worked on by somebody else before, and many of these turn out to be tough dogs. Now we're getting more walk-ins and first time repairs which seem to be more profitable. When we move to our new location, we'll offer drop-off and pick-up from 6 AM to 9 PM on weekdays and Saturday, and noon to 5 PM on Sundays."

**How do you handle estimates?**

"We get a \$10 deposit on phones, scanners, CBs, etc., \$15 on VCRs and audio, and \$25 deposit on camcorders and TV. Our estimate fee is treated as a deposit on approved work. With our Sencore equipment, we have a super ratio on hitting our estimates right the first time. We're also up-front about not repairing items that aren't worth the effort."



By Larry Schnabel  
Sencore News Editor

Sencore Electronics

**Owner's Name:** Alan Williams (Pres.), Jack Myers (VP), Ron Williams (Office Manager)

**Business Name:** JOB ELECTRONICS, Inc.

**City:** Williamsport **State:** MD

**Years In Business:** 5

**Products Serviced:** Camcorder, VCR, Audio, TV, CB, Scanners, etc.

**Number Of Employees:** 3

**Sencore Instruments Owned:** VR940, CVA94, SC3100, VC93, LC102, SCR250, TF46, PR570, SM2001 Service Center Manager



**How do you handle customers who want to "buy new" vs. repair?**

"Our equipment gives us the confidence to give good advice to our customers. We discuss options and help any way we can. Our estimate fee is for our time to give a good estimate, which includes this type of advice."

**How do you prevent callbacks?**

"What callbacks? We are constantly developing our QC process by integrating Sencore's special tests with our own routines. Jack and I constantly double check each other's work. When we do have a callback, we let our customer know that we appreciate their patience. If someone takes the time to bring something back, it's your last chance to make a loyal customer."

**How does competition affect your business?**

"This was another reason for getting into the business. There just aren't enough repair shops in this area. The ones that are here farm out most of their work. We're emphasizing in our ads now that we repair first-time items only."

**How do you get new business?**

"Word-of-mouth has been our best source. To get the commercial customers that we have now, we set up appointments and went to talk to them. We've also done some door-to-door sales to businesses to drum up revenue."



Fig. 2: JOB ELECTRONICS specializes in camcorder repair with the Sencore CVA94 "Video Tracker" and VR940 Video Reference.

**What product have you most recently started repairing and why?**

"TVs. Our space is tight right now, but there's too much money to be made in TV service. Plus, we want to start to provide a complete service to our customers. Without the TV service end, we wouldn't be able to make good on that claim. We're also going to start computer monitor repair with our new Sencore monitor analyzer (CM2125) as soon as we move. I know there are profits to be made there."

**Why did you first start buying Sencore equipment?**

"I first used Sencore equipment at a Philips hands-on training session. That gave me my first look at what you had to offer. After some time, and with the help

of Cory Sanders (Sencore's Area Sales Representative), we determined what I really needed on my bench to get started. The quality of Sencore equipment was the deciding factor for my benches. I feel if you work with the best equipment, you can be the best at what you do."

**What has made you remain a Sencore customer?**

"Sencore treats us with quality and high standards. That's what we want to project to our customers with our own business. We always receive the support we need from Sencore, and Cory has been a great help with sources and advice, plus he knows the Sencore equipment and how it works."

**How has Sencore equipment helped your business?**

"To put it simply, the equipment has saved us time and lots of it. As our repair flow increases, it will save us more and more time. If I listed all the ways Sencore equipment helped us, this article would never make your deadline. Somehow the equipment reaches into other facets of business that I am still discovering every day."

**How would you rate the support you've received from Sencore?**

"Your salesman (Cory Sanders) is always contacting us and helping in any way he can. I should also mention how your financing has worked with us. Sencore is really helping us grow. Thanks."

**Why has your business been successful?**

"Customer satisfaction is the key to repeat business. Our business philosophy is the same as Sencore's - we do it right the first time."

**How does the Sencore equipment specifically help you with camcorder service?**

"The VC93, CVA94, VR940, and SC3100 has to be the most efficient way to troubleshoot any camcorder. The Hum test has been especially valuable. When people find themselves buying multiple batteries and then come to us, we can fix them right up. Usually they've had the camcorder in for service somewhere else, so this makes for great word-of-mouth advertising. We're up to an average of four or five camcorder repairs a week, with an

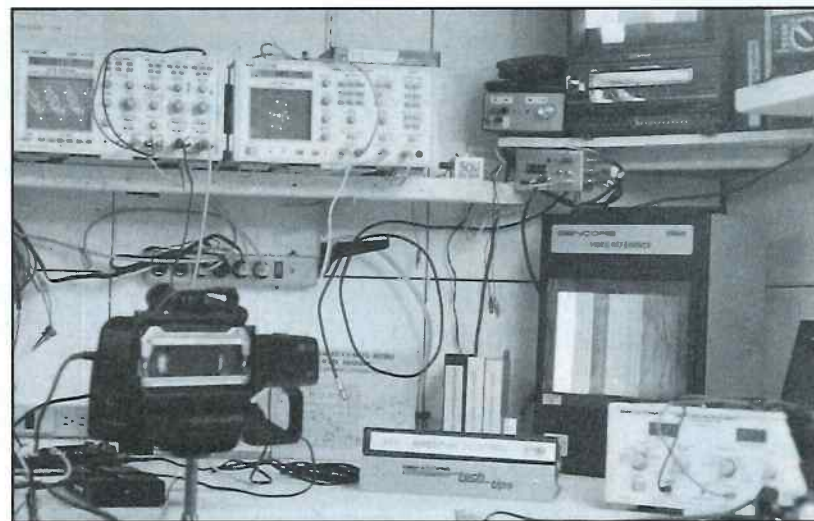


Fig. 3: With specialized Sencore equipment on the bench, JOB ELECTRONICS is able to fix repairs right the first time. Customer satisfaction is their key to repeat business.

average invoice of over \$100. We have also calibrated production cameras for some local television stations and are always looking for that type of work."

**How do you keep up with new circuits and technology?**

"Read, read, read. We believe a broad base in fundamental theory and hands-on experience is the key. We are believers of training seminars as well. Much can be learned from someone with years of experience. Otherwise, the learning could take years."

**How did you get started in camcorder repair?**

"It was the main reason for starting our business. There seemed to be a lot of opportunity in camcorder repair, and there wasn't much competition. When I was ordering parts at my last job, I saw a quote that stuck with me. It said, 'Camcorders, The Repair Gig Of The Nineties.' That quote hit the nail on the head."

**What does the future hold for JOB ELECTRONICS?**

"We have recently acquired the SM2001 (Service Center Manager) program and are shopping for a computer system that will meet our needs after we move to the new location. We have a pretty big corner on the repair market in this area. We look for JOB ELECTRONICS to become one of the fastest growing businesses around."

For more information on the Sencore equipment mentioned in this article, call your Area Sales Representative at **1-800-SENCORE**. We'll listen to your needs and help determine the best solutions, based on your service center and the items you service. **SN**

**"If someone takes the time to bring something back, it's your last chance to make a loyal customer."**



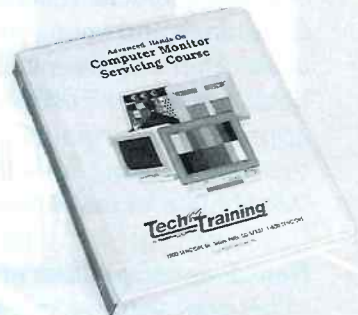
**“Sharing Your Vision For Success”**

**T**oday more than ever, a basic functional understanding, combined with proven effective troubleshooting techniques is essential to your success. But where do you get solid, well-rounded training? To meet the growing demand for fundamental, practical training, Sencore introduces “Tech Training” – by technicians... for technicians.

### **Computer Monitor Servicing Course – TC100**

(Approved for CEU credit) This hands-on self study course teaches you how to efficiently test and troubleshoot as you work through the activities and self tests. You'll learn:

- How to quickly determine monitor types
- How to make all monitors look alike
- What video patterns to use to accurately identify failures



### **Understanding Television Horizontal Stages – TV300**

Knowing how horizontal stages work, how they fail, and how they interact with other circuits will help you conquer these difficult servicing problems. This training package includes a self-study workbook and a 45 minute video.



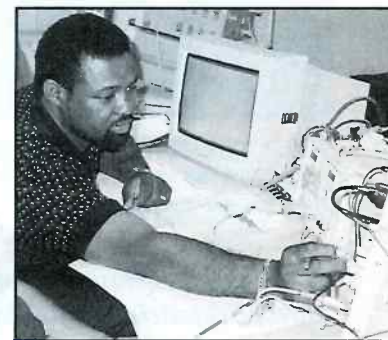
### **Computer Monitor Servicing Class – TC100T**

(Approved for CEU credit) This 3 1/2 day class provides hands-on experience on actual chassis. You'll learn how computer monitors work, typical circuit operation, how to make adjustments, and gain lots of practical troubleshooting experience.

### **Tech Choice Technical Troubleshooting Demonstrations**

Do you need a quick servicing refresher? No matter how you service, you'll gain valuable tips that you'll put into practice immediately. Choose from these practical demonstrations:

- Computer Monitor Troubleshooting
- Profitable TV Troubleshooting
- Simplified VCR Servicing
- Camera/Camcorder Testing & Troubleshooting



**Tech Training**<sup>TM</sup>  
by SENCORE

**Call 1-800-SENCORE (736-2673) and ask your Area Sales Representative about dates and locations!**



# Sencore Takes The Fear Out Of Training For New Technology!

Don't Let Fear Of The Unknown Hold You Back



**A**lmost everybody has been intimidated by new technology at some time or another. For example, not everybody has grown up "surfing the net" experimenting with computer technology. But in reality, we'd better learn all we can about bytes, websites, floppies, RAM, monitors, etc., or we could be watching from the sidelines.

It's never easy to dive into something unfamiliar, and always easier to stay where you are, but keeping up with changing technology is crucial. Whether you're a part-time or full time servicer, a vo-tech instructor, or a maintenance professional, one of the most rewarding experiences you can have is successfully completing a program such as a Sencore Tech School. Sencore has made training for new servicing technology as easy and interesting as possible by creating hands-on servicing courses in several servicing fields.



## Sencore Training Offered In Various Formats To Fit Your Needs

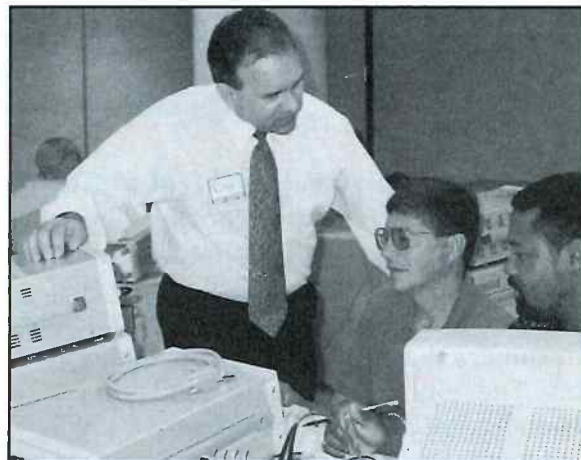
Servicing training from camcorder troubleshooting to computer monitor repair is being offered in three formats: one-day hands-on workshops, three hour "Tech Choice" demonstrations, and a 3 1/2 day hands-on computer monitor servicing workshop. One-day Tech Schools are a great way to pick up on new troubleshooting techniques in many different areas of servicing including VCR, TV, and switched mode power supplies. Sencore's three hour product demonstration seminars spotlight Sencore test equipment in real troubleshooting scenarios leaving no doubt to their value as test equipment. Take a look at the programs to see where you or your co-workers could benefit from some practical, hands-on experience.

**By Don Multerer**  
Application Engineer

Sencore Electronics

## 3 1/2 Day Hands-On Computer Monitor Servicing Class CEU Approved (\$1,390)

This 3 1/2 day course gives the servicer a complete comprehensive class where you'll leave knowing the ins and outs of computer monitor repair. The TC100T Computer Monitor Servicing Class covers subjects such as: Servicing Safety; Scan Frequencies, Pixels, Blanking Times, Horizontal Deflection/High Voltage, Sync, Multimode, and Multiscan. During the hands-on portions of the class, Sencore Applications Engineers move through the room helping students better understand the procedures and troubleshooting techniques outlined in the TC100 book. With a universal computer monitor block diagram for a guide and the CM2125 Computer Monitor Analyzer as the tool, stepping through the course exercises is easy. Included with the 3 1/2 day class is a 13 chapter, full color coursebook (TC100).



*Fig. 1: Sencore's TC100T 3 1/2 day course on servicing computer monitors is a hands-on, comprehensive workshop designed to turn opportunity into profits.*

## One Day Tech Schools

One day Tech Schools offer a condensed, comprehensive format where participants, who just can't get away for a whole week, can get hands-on individualized training in servicing areas such as switched mode power supplies, camcorders, and computer monitors. Instructional repair-workstations for SMPS, camcorder, and computer monitor servicing offer a realistic classroom setting for actual troubleshooting training. The repair of these products will never catch you off-guard again. One day hands-on tech schools are an excellent way to get the intense, to-the-point training you need to boost your profits.



**TS400 SMPS One Day Tech School (\$169)** – With Switched Mode Power Supplies being one of the most difficult circuits to troubleshoot in TVs, computer monitors, and many electronic products, additional training is a must. With Sencore's TS400 SMPS One Day Tech School, you will come away with a working knowledge of these troublesome sections. Emphasis on feedback, control, and high frequency transformer circuits is stressed. If you have felt uncomfortable with the repair of these "switchers," this course will give you the confidence you need. Two to three technicians per workstation and individual instructor assistance give you the opportunity to learn at an accelerated pace.



Fig. 2: Sencore's one-day Tech Schools give you the opportunity to concentrate and absorb important information in a controlled environment free of interruptions and phone calls.

**TS200 Camcorder Troubleshooting One Day Tech School (\$99)** – The TS200 Camcorder Troubleshooting Tech School is a one day Tech School offering you the chance to become more proficient in camera diagnostics and troubleshooting. The course features 10 hands-on training stations and features the CVA94 "Video Tracker" Camera Video Analyzer in its specialized camera troubleshooting role. Emphasis is placed on the camera portion of the camcorder, where there seems to be the most questions among servicers. With this Tech School under your belt, you can venture further into profitable camcorder servicing.

**TS100 Computer Monitor Troubleshooting One Day Tech School (\$99)** – Computer monitor one day Tech Schools like the TS100 offer another choice for updating your technical skills. Computer monitor servicing is a fast growing area of repair, and to maintain the edge, you need to be updated on new types of monitors and troubleshooting techniques. Here, the most important sections of the universal block diagram are discussed and students work through classroom exercises in horizontal deflection/high voltage and other important topics.

## Three-Hour Technical Demonstrations (FREE)

Whether you purchase a piece of Sencore test equipment or just want to know more about the servicing associated with a particular piece of consumer electronics, these three-hour equipment demonstrations are a great way to become more familiar with troubleshooting techniques, and to learn how the equipment can speed up your troubleshooting and lead to increased profits.

**TD200 Camcorder Servicing Demonstrations** – Camcorders have been around a while but have become more and more sophisticated with 8mm and S-VHS formats. While these tape formats may change, the nuts and bolts of the camera itself still remain fairly constant. The need for diagnostic troubleshooting of these sections is still in high demand. Consumers are consistent – they want their camera to be tweaked to perfection to record the best possible picture during their various special occasions.

The TD200 Simplified Camera/Camcorder Performance Analyzing Techniques Course instructs the servicer on how to troubleshoot the recording section of these camcorders and diagnose and adjust the camera portion of these devices using the CVA94 "Video Tracker" Camera Video Analyzer. Although many servicers may be unfamiliar with camera sections of camcorders, hands-on camcorder training gives you the knowledge and takes the guesswork out of troubleshooting.

**TD201 VCR Servicing Demonstrations** – Simplifying VCR repair is what the TD201 is all about. New techniques leading to faster repairs are covered in this technical demonstration. You'll learn to look at all VCRs from a block diagram format and find where signal tracing and signal injection work the best. This class covers mechanical problems, diagnosing head symptoms, troubleshooting luma/chroma problems, and how to determine if a problem is mechanical or electrical. Sencore's VC93 All Format VCR Analyzer is the featured test piece in this informative demonstration offering a patented method of testing VCRs without removing the cover. If misdiagnosed repairs have set you back, this demonstration will set you straight.

**TD300 TV Servicing Demonstrations** – Today's televisions can offer a unique challenge to the servicer with SMPS and integrated circuits invading the scene. The TD300 Profitable Television Technical Demonstration shows you the newest in

troubleshooting technology of these latest circuit versions. Also covered in the TD300 demonstration are: Digital Tuners, IF Circuits, Vertical Circuits, Yokes, AFT Circuits, Video, IHVTs, and Horizontal Circuits. Sencore's dynamic duo, the VG91 Universal Video Generator and TVA92 TV Video Analyzer are featured as troubleshooting profit-makers.

**TD100 Computer Monitor Servicing Demonstrations** – As more and more computers are purchased in this country, the need increases for accurate repair of the visual portion of these PCs – the computer monitor. The TD100 Basic Computer Monitor Troubleshooting Techniques Demonstration covers the most common failures in monitors from the SMPS to the horizontal section. Again, the universal block diagram is at the heart of the demonstration showing you how to make all monitors look alike, and you will also learn what equipment is required to properly diagnose and troubleshoot today's multi-sync/multimode computer monitors.



Fig. 3: You'll become more familiar with equipment and techniques at Sencore's three-hour technical demonstrations while learning how to speed up your daily troubleshooting.

The idea of going to a class or seminar to learn a new servicing technology or method may seem uncomfortable or even intimidating at first. But we guarantee you'll feel differently in your first hour of a Sencore training session. You'll feel a part of the new-technology-team and learning will come easy. Just give your Area Sales Representative a call at **1-800-SENCORE** and we'll register you for the class that fits your needs. Or complete and return the card (between pages 18 and 19) and we'll send you more information about dates, times and locations. **SN**

### Register Now!

Call today for your early registration discount. Class sizes are limited, so call early to reserve your seat.





# The Easiest Way In The World To Analyze Circuits And Waveforms

The SC3100 "AUTO TRACKER"<sup>™</sup> Simplifies Waveform Analyzing With "Touch 'N Test"

**T**echnicians typically are an honest bunch. According to most technicians we talk to, they claim their oscilloscope is the most important instrument they use on a day-to-day basis. If they could keep only one instrument on their bench, most technicians would choose their oscilloscope because it's the instrument they turn to first for most repairs (and last).

Since the oscilloscope is such an important instrument, technicians are also very picky about which one occupies their bench. In the past, most oscilloscopes were hard to use and needed to be adjusted for every measurement. Technicians often had to untangle scope/DVM/ohmmeter probes in the middle of a repair, causing wasted time and adding the chance of shorting out components. Technicians said these were just two of the frustrating traits of oscilloscopes, yet they didn't have an alternative option.

The SC3100 "AUTO TRACKER"<sup>™</sup> changes all that. You connect the probe to the circuit and let the SC3100 "AUTO TRACKER" Automatic 100 MHz Waveform & Circuit

Analyzer do the measuring for you with its Auto-Tracking and autoranging digital measurements. First, you set the controls to "AUTO", and two cycles of the waveform pop up on the CRT without making a single adjustment. Then, you simply push a button and read the desired signal parameter in the digital readout: DC voltage, peak-to-peak voltage, frequency, or AC voltage. If there's an easier way to analyze waveforms in this world, we would like to know about it.

## Analyze Waveforms Without Making A Single Adjustment

There are times when you need more than a digital measurement of signal parame-

ters. Often times you need to view the waveform to make sure that it's correct—that it has the proper shape; that there's no distortion or noise; and that the timing of the signal is correct.

That's why, in addition to the Auto-Tracking digital parameter measurements, we've autoranged the SC3100's timebase and attenuator controls. You simply set the SC3100's VOLTS/DIV and TIME/DIV controls to their "AUTO" positions, and the "AUTO TRACKER" automatically sets these controls to the appropriate range to show a precise waveform display on the CRT. Because the circuits are fully autoranged, you get a proper waveform every time as you move from test point to test point — or "Touch 'N Test."

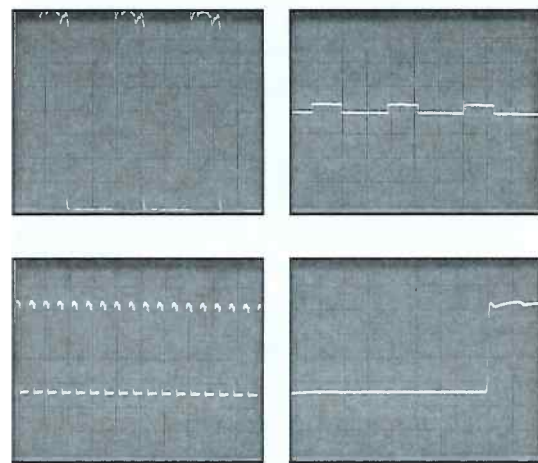
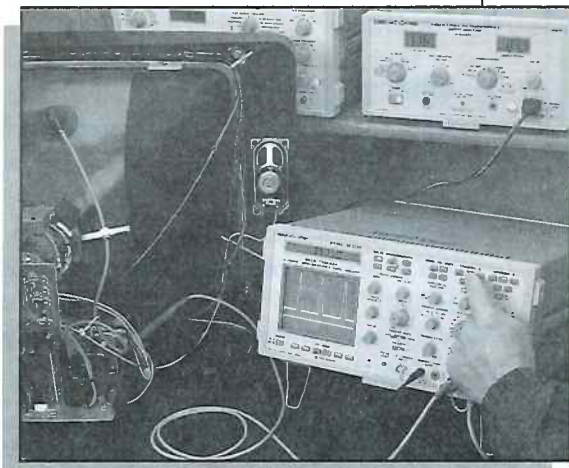


Fig. 1: Each of these waveform displays is the result of one mis-adjusted oscilloscope control. What control should be adjusted to correct the display?

The waveform displays in Fig. 1 don't look quite right, do they? That's because in each example, one of the oscilloscope's controls is misadjusted. In these examples, it's difficult or impossible to analyze the waveform. All that's needed to correct these displays is to simply adjust the TIME/DIV or VOLTS/DIV control, but unless you're using the SC3100 "AUTO TRACKER", you'll see similar displays all too frequently as you probe from test point to test point.

Have you ever considered how much it costs you while you're fiddling with your conventional oscilloscope's controls?

1. First you need to think about which channel to adjust. Is the top trace channel A, or channel B?
2. Next you need to think about where to set the controls. Does turning the



By Brad Johnson  
Product Marketing  
Manager

Sencore Electronics



vertical attenuator clockwise make the display bigger or smaller? Do you need to turn the timebase up or down?

- Now you need to take your eyes off the circuit and locate the control(s) on the scope's front panel. (Be careful not to let the probe slip off the test point.)
- Finally, you set the control and refocus on the scope's CRT and hope you don't have to tweak any more knobs.

If you are an experienced oscilloscope user who is familiar with your unit, the steps above may take only a couple of seconds each time you connect to a different test point. But don't forget step 5:

- Refocus your attention back on the circuit. Now, can you remember what the signal at the last test point looks like again?

When you're thinking about how to set the oscilloscope controls, your mind is not on the circuit, and if your mind is not on the circuit, your troubleshooting is not effective.

Wouldn't it be great if your oscilloscope automatically adjusted itself and showed the proper waveform without needing to adjust the oscilloscope controls such as the timebase and vertical attenuator? Sure it would, and that's what the SC3100 "AUTO TRACKER" does for you. Let's take a look inside the SC3100 and see how the "AUTO TRACKER" increases your troubleshooting efficiency.

## Autoranging – The Big Timesaver

Figure 2 shows a simplified functional block diagram of the "AUTO TRACKER's" autoranging circuitry. Notice that the key to the SC3100's autoranging lies in its Auto-Tracking digital measurement circuits.

The SC3100's digital measuring circuits were designed to provide accurate readings of the waveform's parameters – no matter how you set the CRT display, TIME/DIV, VOLTS/DIV, Input Coupling, and variable vernier controls. The digital readout and CRT display share a few input circuits, but then separate into different paths as shown in Fig. 2. Both paths use the same probe, input connection, and input vertical amp.

The digital readings remain independent, however, because the signals for the digital measurements (shown in Fig. 2) are routed to the microprocessor before the vertical and timebase vernier controls

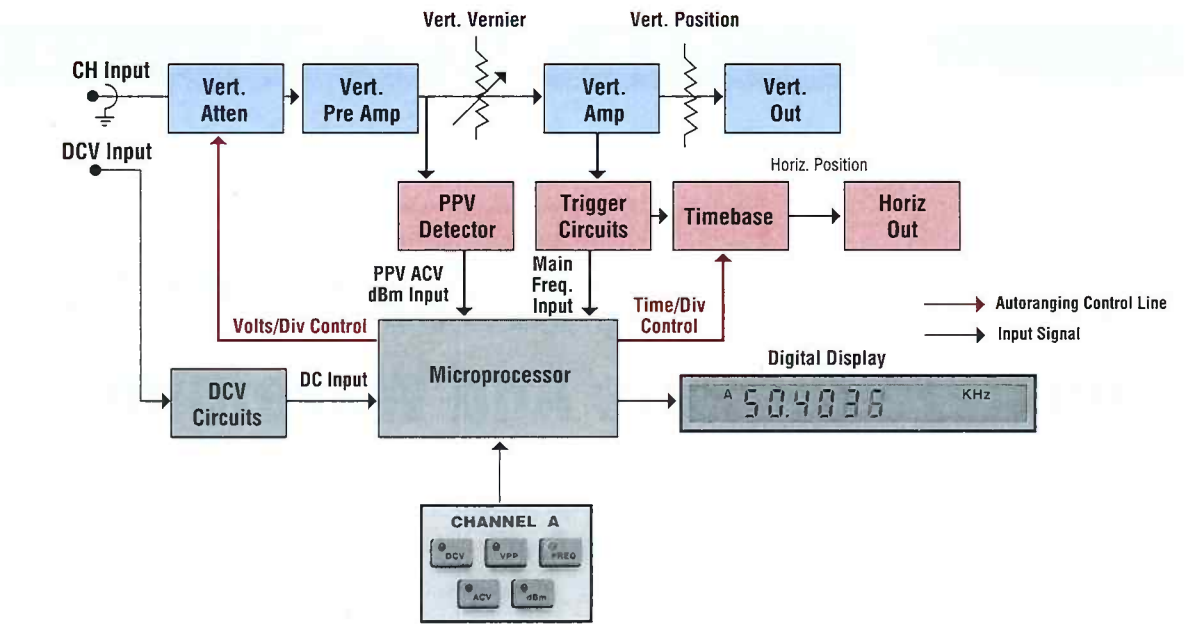


Fig. 2: The input signal is routed to the SC3100's digital measuring circuits ahead of the CRT controls where the vertical attenuator and horizontal timebase are set automatically eliminating setup time and confusion.

and deflection amplifiers. The DC voltage function uses a separate connection to completely bypass the input coupling switch and vertical circuits. This allows you to measure signals that have a large DC component and a small AC signal.

As you can see, these inputs to the microprocessor provide the Auto-Tracking digital readings of the waveform's DC voltage, PP voltage, frequency, and AC voltage. But notice the control lines going from the microprocessor to the vertical attenuator and timebase (shown in Fig. 2). These control lines allow the microprocessor to automatically select the setting of the vertical attenuator and timebase.

When any of the VOLTS/DIV or TIME/DIV switches are set to "AUTO", the microprocessor uses the digital peak-to-peak reading or frequency to determine where to set the CRT controls for the best waveform display. The switch settings, which the microprocessor automatically selects,

attenuators and the timebase autorange independently of each other. You can choose to autorange just one control, or set all three to "AUTO" for hands-off, error-free automation as you "Touch 'N Test" from test point to test point.

Our goal for the "AUTO TRACKER" was to automate the tedious control settings, but to keep you in full control. The SC3100 won't go off on its own and set controls or make adjustments that you aren't aware of. That's because there are three conditions where you'll want to manually set the timebase:

- "TV" Trigger Mode** - When viewing composite video, you may wish to view the video at either the horizontal or vertical rate. That's why we've included special video presets to set up these waveforms automatically. Select TVV to see two fields or TVH to view two horizontal lines, as shown in Fig. 4.

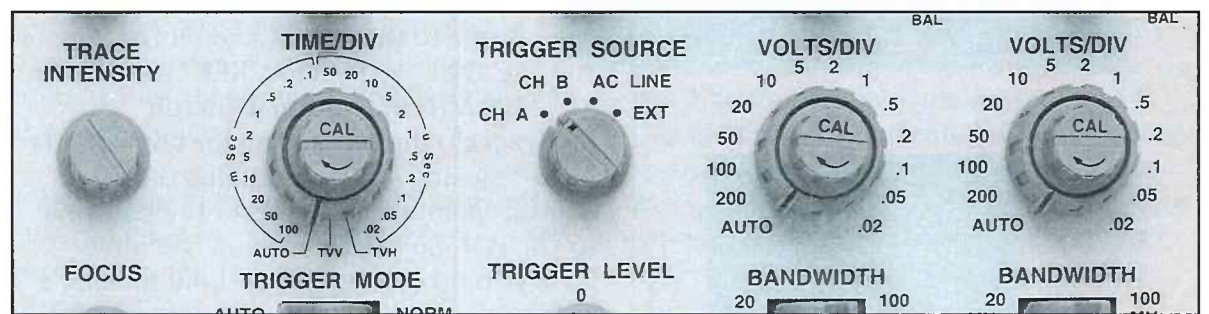


Fig. 3: The channel A and channel B attenuators and the timebase autorange independently of each other for added flexibility.

are the same as those which you can manually select from the front panel.

Because the signal to the microprocessor is taken off ahead of the vernier controls, you can use the verniers to "fine tune" the waveform display without affecting the autoranging or the accuracy of the digital readings. The channel A and channel B

- Complex signals** - Complex signals such as composite video and FM waveforms contain many different and changing frequencies. You may need to analyze the waveform at several oscilloscope settings. The SC3100 gives you the ability to take the timebase out of autorange while the vertical input still fully autoranges.



**3. Trigger circuits not locked** - The SC3100's frequency counter and autoranging timebase circuits lock to the digital pulses produced by the trigger circuits. This insures that you get an accurate frequency reading and waveform display, rather than some random or incorrect reading caused by an unseen signal. So, if the Trigger Level or Source control is not set, the frequency display simply reads "0000." The timebase then remains set, rather than randomly autoranging.

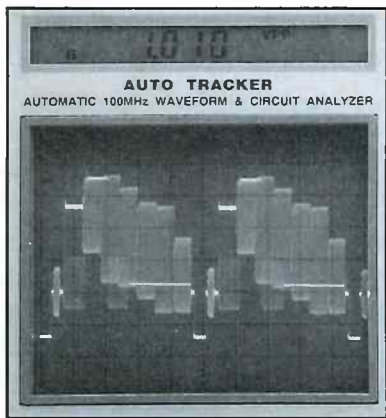


Fig. 4: Set the timebase control to TVV to automatically view two vertical fields of video information, or to TVH to view two horizontal lines as shown here.

### Quickly Lock Onto Any Signal

If you have used an oscilloscope for any length of time, you know that good trigger circuits are critical to waveform viewing. That's why we've given the SC3100 the most user friendly trigger circuits possible. The SC3100 has just four trigger controls, but these four controls allow you to quickly and easily lock in the signals that you encounter.

The Trigger Source control selects which input is directed to the trigger circuits. Set it to either "A" or "B" to match the input.

The Trigger Level and Polarity controls set the waveform point that triggers the circuits. You simply adjust the Level control close to "0" until the waveform locks in. Once it's set, you shouldn't need to reset it. Most signals lock equally well in either the "+" or "-" polarity, except composite video. With video signals, you'll need to set the Polarity control to match the sync polarity.

The Trigger Mode switch determines how the trigger circuits operate. In the "AUTO" mode, the sweep circuits always provide a trace, even if the trigger circuits are not locked. This is the trigger mode you will use most of the time, since it allows you to quickly view the waveform size and frequency. If the trace is not locked, simply adjust the Level control.

The "TV" position of the Trigger Mode switch selects the "AUTO TRACKER's" internal sync separators. This provides a stable display when viewing composite video signals. As you change the setting of the timebase control, you'll see the vertical portion of the signal ("mSec" positions) or the horizontal portion ("uSec" positions) in more detail.

### There's Only One "AUTO TRACKER"

There are several other digital reading oscilloscopes on the market. But don't be mistaken - there's only one "AUTO TRACKER". Only the SC3100 "AUTO TRACKER" gives you fast, error-free measurements at the push of a button, plus a hands-free waveform display.

With conventional oscilloscopes, you can't just push a button and take a reading - you've got to select the measurement channel; (and go through a 3-step menu process to select the other channel); make sure you are DC (or AC) coupled; make sure the variable verniers are set to "CAL" (and never uncal them); set the timebase control; set the vertical controls; and more. By the time you've got your scope adjusted, your mind is completely off the circuit!

And what about those "Auto Setup" buttons that a couple other competitive models have? Well, Auto Setup is great to get a waveform display when you first turn on your scope, or if you're in a production environment looking at the same sequence of test points over and over. But if you're moving from test point to test point troubleshooting a circuit, you simply can't afford the time (or patience) to use Auto Setup. You need the SC3100's Auto-Tracking, autoranged performance. Here's why:

We'll connect the Channel A input of the "AUTO TRACKER" and a conventional oscilloscope having Auto Setup to a test point. While the "AUTO TRACKER" instantly locks onto the waveform, you have to push "Auto-Setup" to lock in the waveform on the conventional oscilloscope. As the photos in 5a show, both units now display a locked-in waveform.

So far it looks like the SC3100's autoranging and the competitor's Auto Setup are fairly similar. But let's now move the probes to a different test point. The photos in Fig. 5b show you what happens.

The SC3100 automatically autoranges and continues to display the new waveform. The competitor? Well, it looks like we'll need to push Auto Setup again. (Oh, by the way, you'll need to reselect the measurement all over again for every test point with the conventional oscilloscope).

When we move to a third test point in Fig. 5c, the "AUTO TRACKER" autoranges again while the competitive unit remains in a state of confusion. The SC3100 is able to autorange itself to any waveform so you can troubleshoot faster and concentrate on the circuit.

As you can see, there's only one Automatic Waveform And Circuit Analyzer - the SC3100 "AUTO TRACKER." If you'd like to learn more about the "AUTO TRACKER", call your Area Sales Representative toll-free at **1-800-SENCORE**. Easy investment terms and easy-to-use features guarantee increased bottom-line profit.

Call us today. We'll help put the SC3100 "AUTO TRACKER" on your bench. The best way to learn is to try it for yourself. **SN**

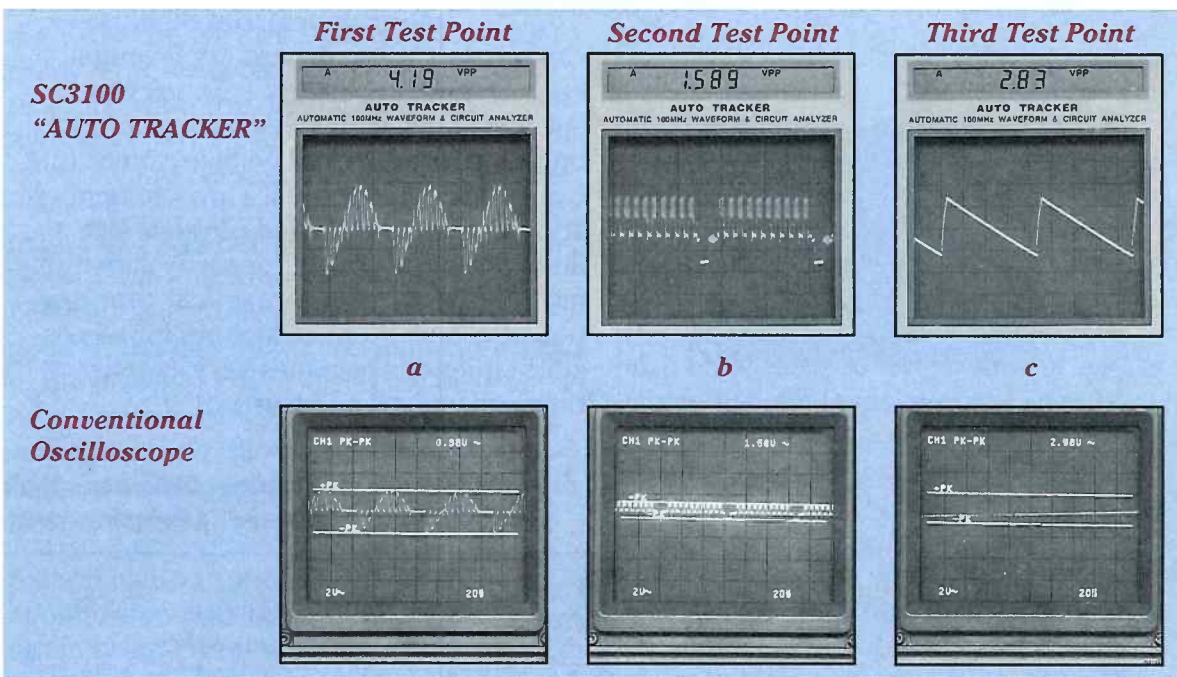


Fig. 5: These waveforms show the difference between Auto Setup and the SC3100's autoranging as you move from test point to test point.

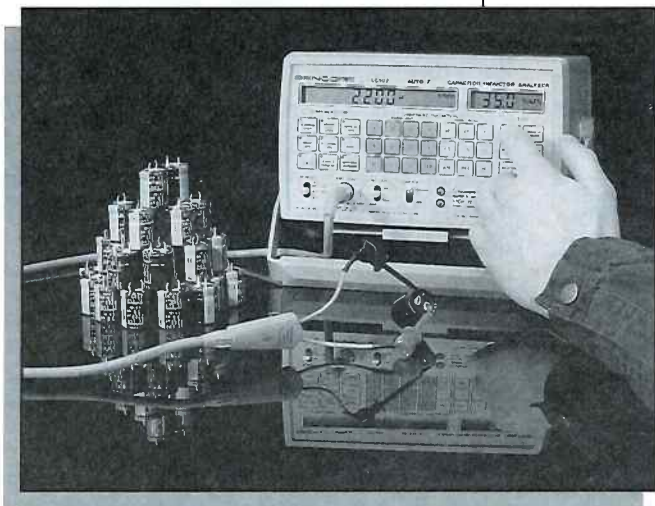


# The Capacitor – How It Works, How It Fails, And How It Affects Your Life

**T**he capacitor still plays a major role in modern electronic circuits. Whether the application is filtering, coupling, timing, etc., the capacitor is a very important component in almost all electronic circuits.

As important as the capacitor is in today's circuits, many technicians still don't have a dynamic method to test these parts. One method used in the past to locate defective capacitors was the substitution method. Before the development of practical capacitor test equipment, it was the only method available to troubleshoot capacitor related problems. In addition, the circuits used in the past were not as critical on part values and performance characteristics as some present day circuits.

If you look at a typical TV or VCR chassis in use today, you'll still see hundreds of capacitors in use. There are several types of capacitors used most commonly, (ceramics, poly, and electrolytics), but other types can be used in specialized applications. Each of these capacitors have varying specifications, with value from picofarads up into the Farads and voltage ratings that can run over 1,000 volts. Throw in temperature characteristics and physical size limitations and you can see why substituting for capacitors is impractical. Stocking potential substitute capacitors for all possible situations becomes very expensive, time-consuming, and frustrating.



By Larry Schnabel  
Sencore News Editor

Sencore Electronics

Capacitor Type	Value Change	Excessive Leakage	Dielectric Absorption	High ESR
Paper	x			x
Film	x			x
Ceramic	x			x
Electrolytic	x	x	x	x

Fig. 1: The common failure modes for the most popular types of capacitors.

Value-only testers and ohmmeters aren't reliable methods of testing capacitors either, as you'll learn in the following sections. Capacitors can fail in four different ways, (see Fig.1) and you need a way to dynamically test for each defect. Since the aluminum electrolytic capacitor can fail in all four categories, let's examine it closer before we explore capacitor testing.

## Inside The Aluminum Electrolytic Capacitor

An aluminum electrolytic capacitor is composed of aluminum plates separated by a spacer which is soaked with an electrolytic solution (see Fig. 2). The dielectric

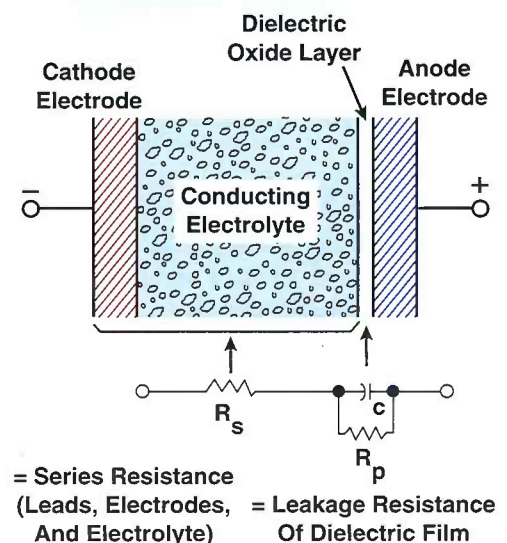


Fig. 2: Construction of an electrolytic capacitor and its equivalent circuit.

inside the capacitor is created when the water in the electrolyte reacts with the aluminum in the plates to form a thin layer of aluminum oxide and hydrated aluminum oxide. Remember the formula for capacitance:  $C = kA/D$ , where C is the capacitance, k is the dielectric constant, A is the area of the plates, and D is the distance between the plates. In an aluminum electrolytic capacitor, the aluminum oxide layer is extremely thin. If the distance between the plates is made very small, then a large capacitance is possible for a given size of plate. Since the dielectric layer in an electrolytic capacitor is very small, large capacitance values are possible in relatively small packages. This is one of the reasons electrolytic capacitors are used so often in electronic circuits.

Another advantage of an aluminum electrolytic capacitor is its ability to heal itself. If an electric current, such as a



voltage spike, passes through the aluminum oxide layer, the water in the electrolyte will react with the aluminum in the plates and form a new dielectric layer. This effectively heels the dielectric, allowing the capacitor to continue to operate in the circuit.

All aluminum electrolytic capacitors have some leakage current flowing through them. Thus, the healing process occurs continually. As long as there is sufficient water in the electrolyte to react with the aluminum in the plates, everything is fine. When the water is used up, however, the capacitor can no longer heal itself and the capacitor will fail.

Heat can affect the chemical reaction that occurs within an electrolytic capacitor. Capacitor manufacturers have long known that heat is an enemy to electrolytic capacitors. The chemical processes are accelerated in a "hot" capacitor, and the life of the capacitor is reduced. A general rule of thumb states that the life of an aluminum electrolytic capacitor will be cut in half for every 10 degrees Centigrade temperature rise in the capacitor. Thus, any defect that causes the temperature of the capacitor to rise will also cause that capacitor to fail sooner than it normally would.

There are several things that can cause a capacitor to get hot. Looking back at the capacitor model in Fig. 2, we can see that heat can be generated if a current flows through either of the two resistances,  $R_p$  and  $R_s$ . Let's look at each of these resistances and see what effect they have.

### Leakage Current

When a DC voltage is applied to a capacitor, a certain amount of current will flow through the capacitor. This current is called the leakage current and is the result of imperfections in the dielectric. Whenever this leakage current flows through an electrolytic capacitor, normal chemical processes take place to repair the damage done by the current flow. Heat will be generated from the leakage current flowing through the capacitor and will speed up the chemical repair process.

As the capacitor ages, the amount of water remaining in the electrolyte will decrease, and the capacitor will be less capable of healing the damage done by the various leakage paths through the dielectric. Thus, as the amount of water in the electrolyte decreases, the capacitor will be less capable of healing the leakage paths and the overall leakage current in the capacitor will ultimately increase. The increase in leakage current will generate additional heat, which will speed up the chemical processes in the capacitor. This

process, of course, will use up more water and the capacitor will eventually go into a run-away mode.

### Effective Series Resistance

All of the internal series resistances in a capacitor can be lumped together into a single term called the Effective Series Resistance or ESR for short. ESR is the combined resistances of the connecting leads, the electrode plates, the resistance of the lead to plate connections, and the losses associated with the dielectric. All capacitors have some ESR. Normal amounts of ESR are tolerated by the capacitor and the circuit it is used in. Defects can occur, however, in the capacitor which will increase the ESR in the capacitor. Any increase in ESR can affect the circuit in which the capacitor is used, as well as the capacitor itself.

To understand what effect excessive ESR has, let's look at what goes on inside a capacitor in a circuit. First, let's consider a DC voltage applied to a capacitor, as shown in Fig. 3.

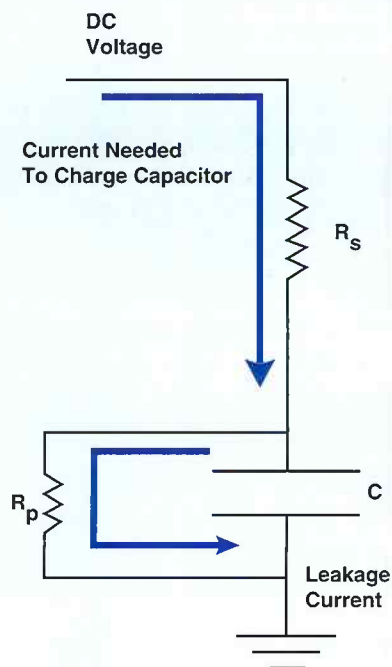


Fig. 3: Effect of a DC voltage being applied to a capacitor.

When a DC voltage is first applied to a capacitor, a current will flow through the series resistance ( $R_s$ ) and will charge the capacitor. Once the capacitor is charged, however, the only current that will flow through the series resistance ( $R_s$ ) is the leakage current. Under normal conditions, this current is relatively low, and thus the series resistance will have little effect on the capacitor or on the circuit.

If an AC voltage is applied to this capacitor, the series resistance becomes more important. Let's consider the simple example of a power supply as shown in Fig. 4.

When the power supply diodes conduct, some current will flow to the load and the

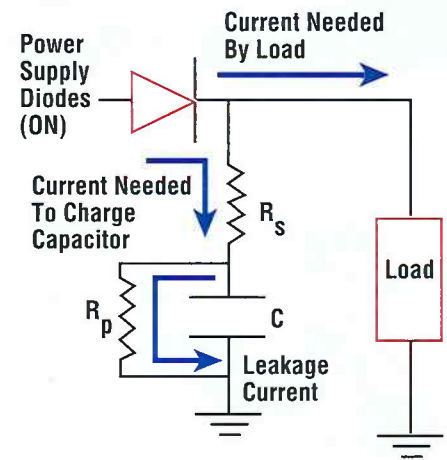


Fig. 4: Current flow in a filter circuit while power supply diodes are conducting.

rest of the current will flow into the capacitor. The current which flows into the capacitor will charge the capacitor. Of importance here, is the fact that all of the current that goes into charging the capacitor will flow through the series resistance and generate heat. When the AC voltage applied to the power supply diodes swings towards zero volts, the current supplied to the load by the diodes will decrease and the energy stored in the capacitor must be used to supply the current needed by the load.

The current needed by the load will flow out of the capacitor and through the internal series resistances (ESR). This current flow will again produce heat inside the capacitor. Thus, as the capacitor alternately stores and supplies energy, current will flow through the ESR and heat up the capacitor. In the case of an aluminum electrolytic capacitor, this heat will speed up the chemical processes inside the capacitor and cause it to fail.

In the past, most power supplies operated at the AC power line frequency. In these power supplies, the current flow into and out of the capacitor occurred at a rate of 60 to 120 cycles per second. At these frequencies, capacitors would tolerate a fair amount of heat. Today, however, we are seeing the rapid increase in the use of switching power supplies which operate at significantly higher frequencies.

Capacitors used in switching power supplies have currents flowing in and out at very high rates, and any increase in the capacitor's ESR will result in a rapid increase in temperature.

### Only One Meter Tests For All Four Capacitor Failures – The LC102 "AUTO-Z"

The Sencore LC102 "AUTO-Z" Capacitor/Inductor Analyzer tests capacitors for all capacitor failures – something "value-only" testers can't do. The portable



# Test For All Four Capacitor Defects!



## LC102 "AUTO-Z" Capacitor & Inductor Analyzer Five Patents - Only From Sencore!

If you have to guess if a capacitor is good or bad, you're in trouble. With the push of a button, the LC102 "AUTO-Z" tells you if a capacitor is "GOOD" or "BAD" - no interpretations, no calculations, and no guessing. You get exact readings for all four capacitor defects: value, leakage, dielectric absorption, and ESR. The LC102 "AUTO-Z" gives you dynamic tests with results you can trust to build confidence in your everyday troubleshooting. Now, when you need to know if a capacitor is good or bad, you'll have an answer you can trust in seconds.

**Call 1-800-SENCORE (736-2673)**

- Analyzes capacitors for:
  - Value from 1 pF to 20 F
  - Leakage with up to 1 kV applied
  - Dielectric absorption
  - Equivalent series resistance (ESR)
- Analyzes inductors from 1 uH to 20 H for opens, shorts, value, and even one shorted turn
- Analyzes SCRs and triacs (with accessory), high-voltage resistors, and transmission lines
- Makes all tests, compares results to EIA standards, and tells you "GOOD" or "BAD" - automatically
- Portable; 9-hour battery operation for remote sites - AC operation for your bench

"AUTO-Z" lets you test capacitors automatically so you can't miss even a single hidden defect.

The "AUTO-Z" is a troubleshooting breakthrough assuring your tests are accurate without interpretation errors or "look-up" time. Yet the tests are kept simple enough



Fig. 5: The LC102 "AUTO-Z" tests for all capacitor failures and automatically tells you if the capacitor is "GOOD" or "BAD."

for anyone to use. You simply enter value, tolerance, and working voltage (up to 1,000 volts) and push a button. The LC102 "AUTO-Z" does the rest as you select the tests you want. All readings are automatic for all four failure modes, plus you get a "GOOD" or "BAD" indication telling you if the capacitor meets Electronic Industry Association (EIA) and industry specifications.

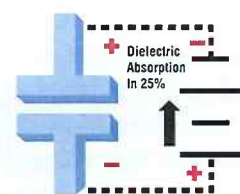


**Value:** The LC102 checks for capacitor value from 1 pF up to 20 Farads with no decimal moving or interpretation. The microcomputer in the LC102 compares the capacitor's measured value with the tolerances you've entered. If the capacitor measures within tolerance, the "AUTO-Z's"

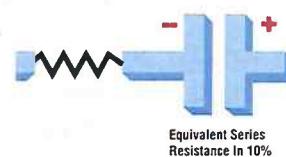
display will read "GOOD." If the capacitor falls out of tolerance, the display will show "BAD." That's a Sencore exclusive - you won't find this feature anywhere else.



**Leakage:** The LC102 "AUTO-Z" tests capacitors under full load with up to 1,000 volts applied. The "AUTO-Z's" internal computer tells you if the capacitor's dielectric leakage is within the limits as defined by the EIA. The leakage test catches the capacitors that are already in the failure mode, plus it finds the capacitors that are just starting to show signs of excessive leakage. Capacitors are automatically discharged when the LEAKAGE button is released, protecting the operator from shock hazard. The current limited leakage voltage is also excellent for reforming those leaky electrolytics that go bad setting on the shelf.



**Dielectric Absorption:** To test DA, the "AUTO-Z" charges the capacitor, discharges it, then measures the remaining voltage on the capacitor. This patented test is done automatically by pushing one button. The DA is calculated and displayed as a percentage change with the "GOOD" or "BAD" interpretation automatically made for you.

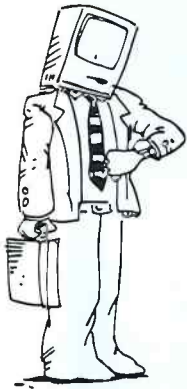


**Equivalent Series Resistance:** You can analyze capacitor ESR simply by pushing a button and reading the LCD display. This patented test is impossible to perform with an ohmmeter because the resistance is inside the capacitor. The LC102 measures the ESR, compares the reading to its internal memory of EIA standards, and displays the results as "GOOD" or "BAD."

We believe the LC102 "AUTO-Z" is a must for every bench. If you'd like to see how the "AUTO-Z" fits your needs, call toll-free (1-800-SENCORE) and talk to your Area Sales Representative. We'll help set you up with a no-obligation trial so you can use it on your bench under your applications. We know the true test of any instrument is how it works for you. That's why we invite you try the LC102 "AUTO-Z" risk-free. **SN**



# Tips And Techniques to Computer Monitor Repair



*Editor's Note: We recently received the following letter and article from Kim Armstrong of Elite Computer Monitor Repair Services in Lawrenceville, Georgia. It's a good "nuts and bolts" article about the common sense of computer monitor repair. I think you'll find the information helpful.*

**C**omputer monitors have come into their own as a viable repair item. If you haven't had a request for a computer monitor repair, just wait, you will.

*Dear Sencore,*

*My name is Kim Armstrong. Because of the Sencore Tech Tips, Technical Seminars, and a complete monitor equipment bench, I've become rather proficient analyzing computer monitors.*

*Because of Don Multerer, Stan Warner, and my Sales Representative, I've drummed up enough confidence to submit an article to you for your "Sencore News" publication. I hope it is in compliance and suitable.*

*Anyway, enjoy "Tips And Techniques To Computer Monitor Repair" and feel free to call me anytime. Like my alma mater, DeVry Institute, Sencore "is serious about success."*

*Best Regards,  
Kim Eugene Armstrong*

**By Kim Eugene Armstrong**  
ASE, CET

*Elite Computer Monitor  
Repair Services*

Consumers are keeping their monitors longer, refurbishing used monitors, and demanding faster service turnover on them. Businesses are revolving their shelf inventories and repairing serviceable monitors instead of purchasing new monitors. In addition, application requests from computer monitor specialty repair firms to monitor manufacturers asking to be certified as their regional authorized monitor service centers are increasing.

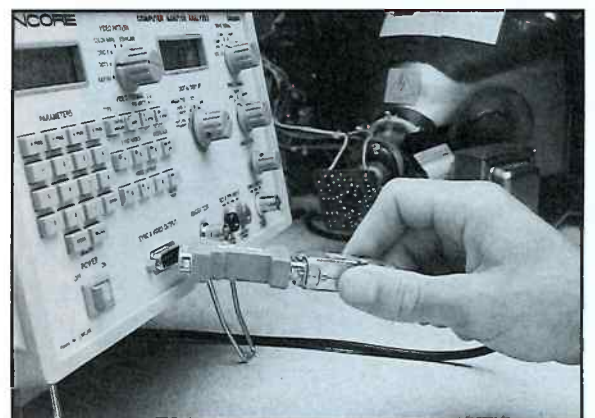
The computer monitor repair industry is specializing to a point where service managers are coveting their repair technicians and treating service techniques as guarded trade secrets. Training

seminars are springing up all over the United States with costs ranging from \$79 to \$1,800. Video tapes offering service instruction are ranging from \$149 to \$315. Even the computer software and internet industry has gotten into the act, with prices starting from \$29 to \$299. We're talking serious money, folks.

I will point out a few very simple trade techniques and tools that will aid you in diagnosing those monitor repair requests that come onto your bench. I call them "The Two-Minute Malady Tests." These preliminary checks do not need equipment and are applied while the case is still on. Physically, utilize your eyes to assess the image condition. Use your ears to hear the high voltage charge crackle,

faulty flyback tic-tic-tic, or pops from cold solder joints. The hair on your hand and/or arm will feel the pull of a developing electro-magnetic high voltage surge on the CRT screen.

- Turn the unit on, feel for the high voltage surge.
- If there is no high voltage or screen image, look at the low-voltage region LED indicator light at the on/off switch to see if it is lit.
- Listen for any kind of squealing, sparks, snap, crackle, or pops. This indicates poor solder connections.
- Examine the screen's image closely, if there is one, for loss of a color gun, sync control, and flickering.
- Flex the signal cable at the pin input connector. If the monitor image intermittently comes and goes or clears up and goes bad by touch, suspect wiring shorts and bent pins.
- Be careful. Safety is always first. You won't die from a monitor's electrical shock, but you will definitely wait awhile before resuming your work.
- Smell for burned/burning circuit board components.

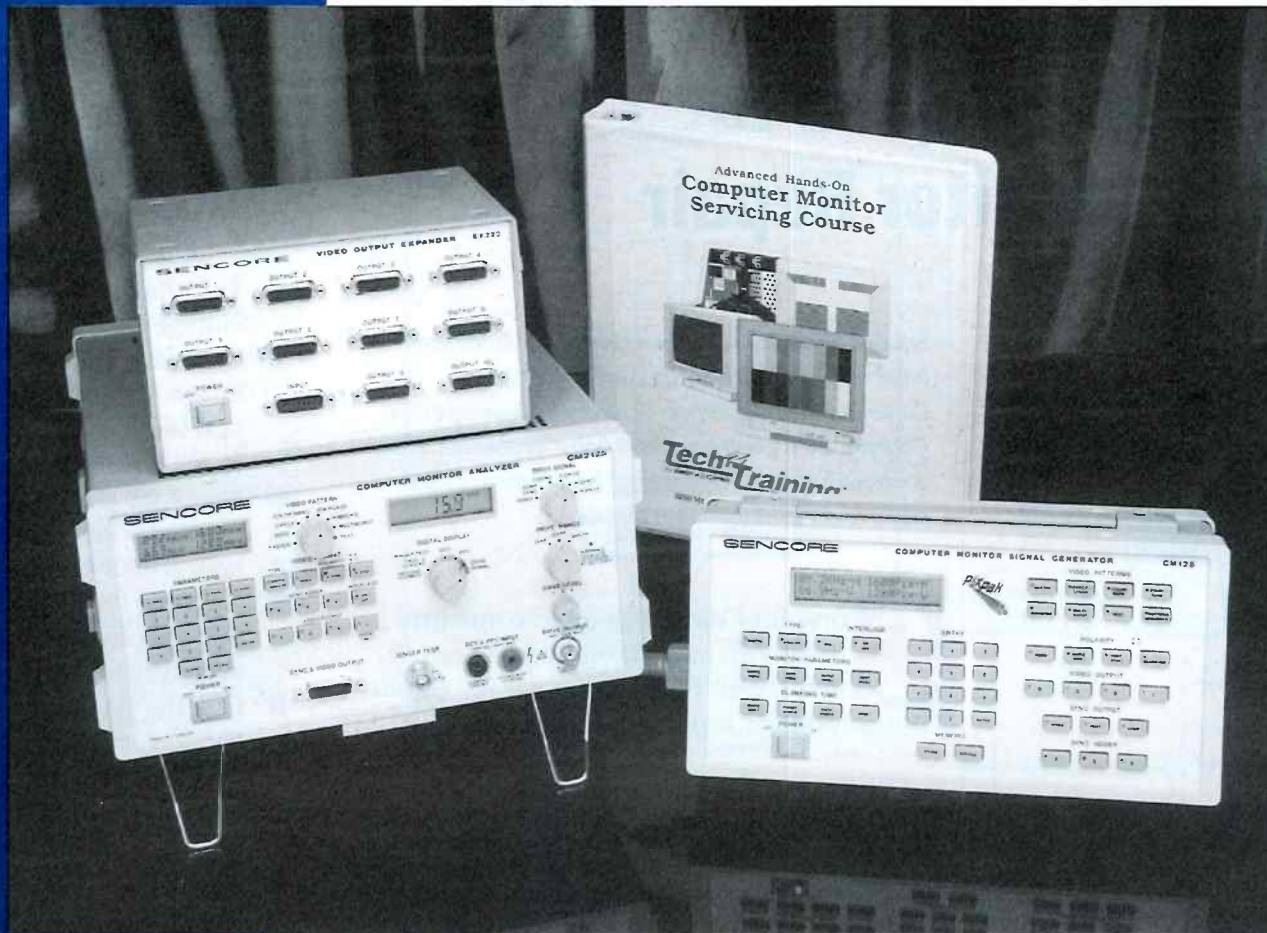


*Fig. 1: Monitor testing diagnostic equipment should include a pattern generator/analyzer such as the Sencore CM2125 Computer Monitor Analyzer.*

Diagnostic equipment is a must, nothing elaborate, just functional. You'll, of course, need the essential tools such as pliers, screwdrivers, probe lighting, and other accessories. Some of the larger equipment you'll need includes (1) image signal pattern generator is essential to monitor the screen image for tweaking, tuning, and burn-in purposes. Prices range from \$99.95 to \$4,000.00. Remember, be practical, but think of it as an investment for the future. (*Elite Computers owns the Sencore CM2125 Computer Monitor Analyzer.*)



# Envision Your Future



**A few will lead – while others may follow!**

From the beginning, Sencore has been with the service industry offering solutions to your servicing challenges – in fact our first product was built over 45 years ago. Now, we're supplying the industry with the best technical analyzing solutions for the newest technology in computer monitors.

At Sencore, we share your challenges and we're dedicated to your success with solutions as the future unfolds. Our line of computer monitor analyzing instruments provides the competitive edge you need to survive in the new technology computer monitor servicing industry.

### ***Our Instruments Offer:***

- Full Programmability
- 2048 x 2048 Pixels
- 125 MHz Bandwidth
- Certified Information & Training
- Innovative Test Patterns
- Patented Features
- TTL/Analog & ECL Compatible
- Preset And Programmable Setups With Adapters

***Sencore – 45 years of sharing  
your vision for success.***

**Call 1-800-SENCORE (736-2673)**

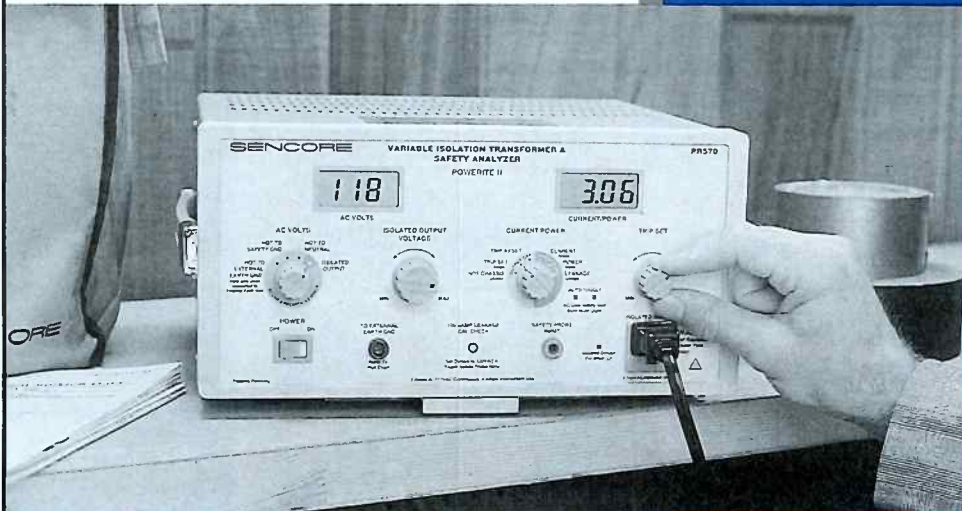


Of course, (2) a multimeter is also a must. If a unit has many different measuring apparatus (diode, transistor, resistor, voltage, current, continuity) on it, get it, especially if it's within budget. A (3) soldering station (solder, soldering iron, solder-sucker, iron holder, solder maneuvering tools) is essential for component replacement and circuit board routing. A (4) variable isolation transformer will aid you by reading-out and gauging the current/power being consumed by the monitor, whether an image is projected or not. It also protects the bench's circuit breaker from being blown when a monitor blows its fuses without blowing the entire company's circuit breaker panel. (*Elite Computers owns the Sencore PR570 "POWERITE II" Variable Isolation Transformer & Safety Analyzer.*)

You should also have a good (5) oscilloscope on your bench to trace problems through to the bad component. Make sure you buy one that's easy to use or you'll be more likely to push it in the corner where it gathers dust. Your equipment isn't any good if you don't feel comfortable using it. (*Elite Computers owns a Sencore SC3100 "AUTO TRACKER."*)

When opening up the case, keep an idea of what seemed to be wrong from the two-minute check symptoms in mind when searching for the specific malady. Beginning the process, connect the monitor's AC input cord to a variable isolation transformer and connect a

## Monitor Voltage And Current Draw!



### PR570 "POWERITE II"™ Variable Isolation Transformer & Safety Analyzer

Now you get all the information you need with the PR570 "POWERITE II" for full control of your AC troubleshooting. Simultaneous digital displays of voltage and current draw help prevent parts damage and wasted time. The PR570's isolated output reduces shock hazards and prevents damage to the chassis and your test equipment. Plus, the safety leakage test builds additional profits while protecting your customer's safety, thus reducing the chance of lawsuits.

- Insure your safety and the safety of your test instruments
- Conquer AC power source problems plus startup, shutdown, and regulator failures with a variable 0-140 volt AC supply
- Have confidence your AC line is right with the AC line monitor
- An adjustable current trip feature minimizes parts damage
- Watch voltage and current draw with simultaneous digital displays
- Protect your customers from electrical shock and protect your business from lawsuit with an automatic safety leakage test

**Call 1-800-SENCORE (736-2673)**

## Computer Monitor Hands-On Training!

Sencore has developed a 3 1/2 day hands-on training course (TC100T) designed to familiarize you with every phase of computer monitor servicing from the theory of operation to repairing those tough dog monitor problems. The TC100T is 3 1/2 days of intense hands-on training, plus you receive the TC100 full color self-study course book that is yours to keep.

### Here's a sample of what you'll learn:

- Computer Monitor Basics & Background
- Servicing Safety & Hot Chassis
- Scan Frequencies, Pixels, And Blanking Times
- Troubleshooting Techniques
- Troubleshooting Switch Mode Power Supplies
- Horizontal Deflection/High Voltage
- Sync, Multimode, & Multiscan

### TC100T Computer Monitor Servicing Course Schedule (Course Hours - 8:00 AM to 5:00 PM)

Location	Date
Dallas, TX	April 22-25, 1996
Chicago, IL	May 13-16, 1996
Toronto, ON	June 10-13, 1996
New York City, NY	July 22-25, 1996

Call your Area Sales Representative at **1-800-SENCORE** for details on registering. Be sure to ask about early-bird registering discounts.

signal image pattern generator to the unit's signal cable. Power up the unit:

- If there is no high voltage, check the high voltage region. Meter the transistors, diodes, and resistors by switch/crossing the multimeter's (pos/neg) leads between the transistor's base/emitter, the diode's anode/cathode, and measuring the resistor's value reading.
- If the on/off LED is off, check the low-voltage region's fuse, diodes, transistors, AC input plug's board terminal, and resistors.
- If there is high voltage but no image, look inside the CRT neck for light, check the CRT color gun board for broken solder joints, and check the signal cable for continuity.

- Signal cables are often culprits for loss of color, faulty horizontal/vertical sync, and many other defects. It is a very tedious soldering process working on a signal cable's pin configuration, especially without schematics. If you've pinpointed the problem and pins, swell. If not, replacing it with a cross-match from a parts supplier is the best way to go.
- Remember to smell and look for burned, discolored, and burning circuit board components.
- The power transformer power supply can be serviced like any other power supply circuit. If the LED pilot light and the end of the CRT light up, you can assume that the power transformer is all right.



# Earn More Profits And Save Time!



## SM2001 Service Center Manager Only From Sencore

Most service centers can handle the technical side of their business, but there's more to making a business profitable. The SM2001 Service Center Manager is guaranteed to be the most complete and easiest-to-use business management program on the market. The SM2001 is designed specifically to help you manage all aspects of your business more efficiently, effectively, and profitably. The SM2001's new modular design allows you to build a solution to fit your business.

**Call 1-800-SENCORE (736-2673)**

- Manage invoicing and work flow automatically
- Generate, track, and control parts orders to save time and money
- Gain control of your inventory to reduce costs
- Automate your accounts receivable with just a few keystrokes
- Electronically file warranty claims
- And much more...

for parts and professional service information, including 1-800 support numbers.

- ➔ Make applications for certifications - C.E.T., service seminars, and authorized service centering.
- ➔ Advertise what you do and get the word out. Also mention that you will make concessions for regular/volume accounts.
- ➔ Turnovers make your shop the "one-stop" place to be. When the unit comes in and is placed on your counter, have your customer think the monitor is fixed already. No matter what, get the unit processed quick and back to the customer.
- ➔ Technicians don't have to write like doctors. When filling out your service forms, write legibly. This is your opportunity to show-off and share with the customer what actually went wrong and how "you" repaired it. They'll appreciate the information and it'll add credibility to your shop fees serving as icing on the monitor repair cake.

If you're interested in reference material, these sources offer help:

- ◆ Troubleshooting And Repairing Solid-State TVs. By Homer L. Davidson; Tab Books Publishing; 1-717-794-2191
- ◆ Sencore Electronics; Sioux Falls, South Dakota; Technical Support Division; 1-800-736-2673.
- ◆ Elite Computer Services, Inc.; Lawrenceville, Georgia; 1-404-923-9291. **SN**

- Check the fuse when no power/no image symptoms occur and be sure to turn the brightness/contrast controls up.

Occasionally, you will come across a "tough-dog" monitor. Think about referring it to a specialty repair firm. There is no reason to have a customer's unit worry you to death or sit on your holding shelf. Your customer will appreciate the extra effort and the time will be less of a headache for you. As an extra incentive, you'll have the specialty firm's service warranty on the monitor, a surcharge from the referral in your fee, and a satisfied (repeat) customer.

Speaking on pricing for a moment, the quickest way to lose repeat business is to overcharge. The practice of charging a customer double the fee charged by the

referred specialty company is bad business. Double-dipping is criminal. How can you save the customer money by digging deeper into their pockets and expect to be competitive with the other shops who aren't double-dipping? Applying a flat surcharge or charging 1/8 or 1/4 of the specialty firm's charge is enough cushion.

The monitor repair business is profitable. You can succeed in it without lying or cheating and build a faithful clientele. If you're really interested in pursuing this type of servicing, here is what you should do:

- ➔ Join trade affiliations - local, regionally, and nationally. They offer lots of ideas and support.
- ➔ Build a research library of books, magazines, and devise an ongoing list



## Sweepstakes Pennsylvania CET Wins ES&T Grand Prize!

*Jeffrey A. Hollinshead of Greencastle, Pennsylvania won ES&T magazine's grand prize in their February giveaway. The Certified Electronic Technician at Miller's TV & Appliance won Sencore's SM2001 Service Center Manager, a business management software package.*

**Congratulations to  
Jeff Hollinshead!**



## Planning Continues For NPSC-96

The 1996 National Professional Service Convention, otherwise known as NPSC-96, is well into the planning stages, held this year in St. Louis, MO on August 5-8. Registrations have already started coming in, with the early birds receiving discounts on registration fees.

In addition to participation by manufacturers and industry suppliers, NPSC-96 offers a tremendous opportunity to network, learn, and meet industry leaders. You'll also learn from the many different management seminars that will be presented by knowledgeable service company operators who are anxious to

share their success with you. Parts and equipment suppliers are invited to participate in the two day trade show to demonstrate their products and services directly to you.

This is your chance to learn the necessary survival skills for the '90s and beyond. Mark your calendar now and make your reservations for NPSC-96. St. Louis is waiting for you this August.

Source: NPSC



## "V-Chip" Becomes Reality As Telecom Bill Is Signed

The Telecom Act of 1996 became law Feb. 8 as President Clinton signed the bill amid one of the most sweeping legislations in recent years. The passing of this bill makes mandated use of the "V-Chip" constitutional according to proponents of the bill.

The V-Chip provision of the bill requires mandatory use of the special chip in all TVs 13" and larger to block out inappropriate programming to children. Supporters of the bill are urging

industry to adopt standards on obscenity and violence in programming. If that doesn't happen, law now directs government to do so. Clinton praised the V-Chip, saying it would "make a big difference in the lives of families all over America."

Source: Television Digest



## HDTV: Beyond The Hype

High definition TV offers an improved picture over today's standard NTSC video by increasing the amount of information that is transmitted for each image. Compared to NTSC, HDTV offers six times the amount of picture information and twice the number of scan lines, so that the picture is clearer and colors are sharper.

HDTV was widely hyped in the late 1980s as the television of the future, but it has failed to win the hearts of U.S. broadcasters. There is an HDTV standard being developed in the U.S. by a group of companies known as the Grand

Alliance, but the initiative isn't expected to impact TV in the home before the year 2000.

The problem, according to industry observers, is that while HDTV will cost broadcasters more to produce, it isn't likely to generate substantial new revenues. On smaller screens such as a standard TV set, the improvement in picture quality is less noticeable, and isn't considered enough of an incentive to prompt viewers to replace their existing TV sets with more expensive HDTV models. In Japan, where HDTV has been commercially available for three years, only 25,000 people have purchased the more expensive HDTV sets.

Source: Interactive Week

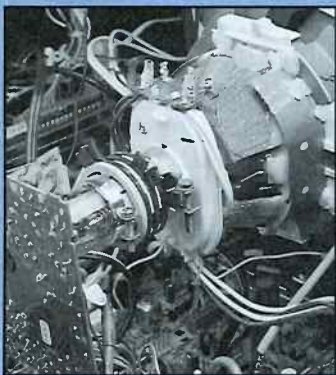
## Sony To Make 35" TVs In Pennsylvania

Jim Palumbo, senior vice president for Sony consumer TV products says their new 35" TV set is truly a product of the United States – conceived, designed, and manufactured for the U.S. and North American markets.

The firm will manufacture their new 35" TV sets in a portion of its 2.8 million sq. ft. facility near Pittsburgh. The site, which is used to make projection TV sets and 7" projection TV CRTs, was formerly used to make Volkswagen automobiles. It is now also home to American Video, a joint venture of Sony with Corning and Corning Asahi to make glass envelopes for TV picture tubes. Sometime in 1997, Sony expects to have a completely integrated process to make the entire 35" TV set there, using the 35" CRTs right as they come off the line to feed the set manufacturing line.

Palumbo says the market is ripe for Sony's large-screen products because "Big-Screen" TV is becoming more than just a cyclical sales spike with football season, and projected 27" & larger direct view sales for 1996 at 7-million plus.

Source: The Word



## Zenith To Produce Display Tubes

In a move designed to boost revenues, Zenith Electronics Corporation plans to produce high-resolution color picture tubes for computer monitors. The \$45.6 million program will include a new production line for the high-margin tubes at the Zenith color picture tube plant in Melrose Park, IL. The new line, with a production capacity of more than a million 17 inch display tubes annually, is expected to start production in the second quarter of 1997. One of Zenith's major customers is expected to be South Korea's LG Electronics, Inc., its majority stockholder. LGE purchased about 58 percent of Zenith's outstanding shares of common stock last year.

Source: Appliance News

## Calendar Update

**April 15-18** – National Association Of Broadcasters (NAB) Show, Las Vegas, NV

**April 19-21** – Mobile Electronics Show, Orlando, FL

**May 23-25** – CES Orlando '96, "The Digital Destination", Orlando, FL

**June 13-16** – National Appliance Service Association, New Orleans Hilton Riverside, New Orleans, LA. Contact: NASA, 9247 N. Meridian Street, Suite 216, Indianapolis, IN 46260; phone (317)844-1602; fax (317)844-4745.

**June 14-16** – Heartland Conference '96 (sponsored by NESAs), Old Mill Holiday Inn, Omaha, NE. Contact: Myron Sahs, J & M Electronics, 2332 Cornhusker, Omaha, NE 68123

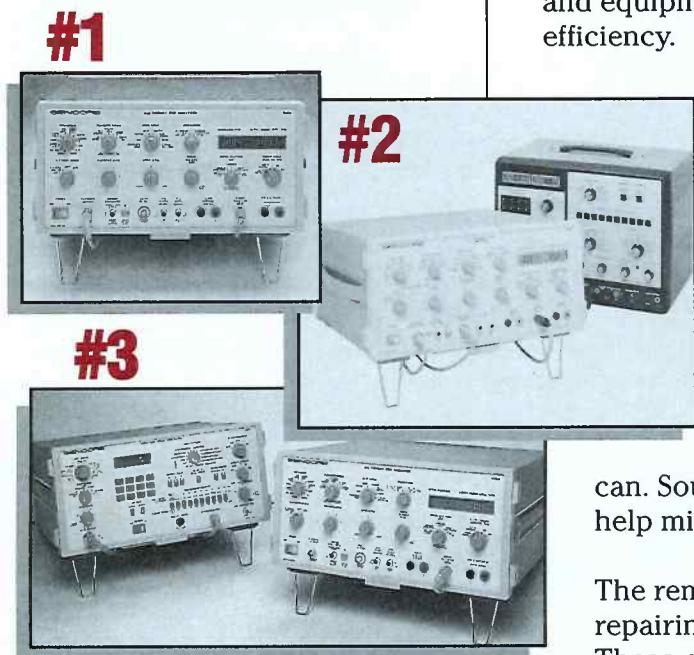
**August 5-8** – National Professional Service Convention, Hyatt Regency at Union Station, St. Louis, MO. Contact: NPSC 1996, 2708 West Berry St., Fort Worth, TX 76109, phone (817)921-9061; fax (817)921-3741.



# Three Ways To More Effective VCR Troubleshooting

**Attention VA62 Owners: The VC93 All Format VCR Analyzer Is Also Compatible With Your VA62!**

**L**et's face it; with the continued decrease in the price of new VCRs, it's getting more difficult to persuade customers to fix their defective VCRs rather than buy a new one. Customer satisfaction and profitability are the keys to any successful business. Customer satisfaction occurs when VCRs are repaired quickly and at prices the customer can afford. In order to be profitable, VCR servicers need to develop techniques and use the tools and equipment that will provide maximum efficiency.



by Rick Meyer, MSEP  
Application Engineer  
Sencore Electronics

What constitutes the cost of a VCR repair? The cost of a repair includes the price of parts, the cost of labor, and the basic overhead costs of doing business. We can't do much about the price of the parts needed to repair a VCR other than to shop around and use the best purchasing methods we can. Sound business practices also help minimize basic overhead costs.

The remaining factor in the cost of repairing a VCR is the labor costs. These costs can have a significant impact on the price of a repair. The cost of labor is the one area we have the most potential of saving money. This comes in the efficient use of time in the repair process. Labor efficiency relates directly to whether a customer will elect to repair a VCR – or throw it away.

In some cases, the cost of the parts alone makes a VCR too expensive to repair. Service efficiency, however, relates directly to how quickly and accurately symptoms can be diagnosed and the estimated cost of the repair determined. The time taken to diagnose the problem and the accuracy at which the diagnosis is performed affect profitability. One of the best ways to increase our servicing efficiency is to have a set of signals and tests that quickly isolate the cause of any VCR symptom.

## #1 Substitution Signals Quickly Isolate Defective Components

By injecting known good signals into a VCR, the circuits after the injection point can be tested to determine if they work or not. Signal injection speeds troubleshooting by quickly determining what is working. By the process of elimination, the defective circuit or stage can be isolated. The VC93 All Format VCR Analyzer provides all the troubleshooting signals needed to completely analyze any VCR problem. The following key troubleshooting signals are provided by the VC93.

**Head Substitution Signals:** The VC93 generates FM modulated signals identical to those produced by the video heads. By injecting these signals anywhere between the VCR's rotary transformer and the FM demodulator, you'll know if the circuits after the injection point are working or not. If they are, then the problem is before the injection point. The VC93 provides the precisely modulated FM signals to inject into VHS, Beta, U-Matic, and 8mm VCRs. In addition, properly encoded stereo audio signals are also provided by the VC93 to verify the operation of the hi-fi stereo circuits after the heads. Specific stereo audio signals are provided for troubleshooting VHS, Beta, and 8mm hi-fi stereo VCRs.

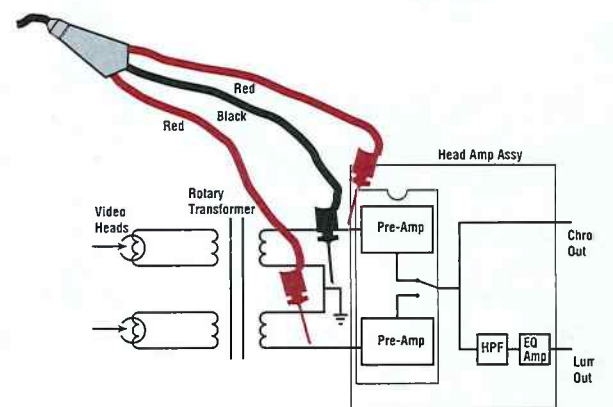


Fig. 1: The VC93 All Format VCR Analyzer signals let you inject known good signals into a VCR to identify video head and other problems.

**Baseband Video, Chroma, and Audio Drive Signals:** If you don't see or hear a video or audio signal by injecting the FM modulated head substitution signal of the VC93 into the VCR, then the problem is proven to exist somewhere in the baseband video, chroma, or audio circuits. The VC93 provides baseband video, chroma, and audio signals, all appropriately phased to inject into the circuits after the FM demodulator. Injection of the VC93's



baseband signals into these circuits narrows the problem down to the specific faulty circuit, saving valuable troubleshooting time.

## Patented Tests Speed Servo Troubleshooting

In addition to the injection signals supplied with the VC93, a series of servo tests help identify and isolate VCR servo problems. Symptoms of bad video can be caused by bad video heads, a problem in the video processing circuits, or a problem in one or more of the servo circuits. The exclusive, patented servo tests on the VC93 quickly identify servo problems, isolating them to either the capstan or drum servo circuits.

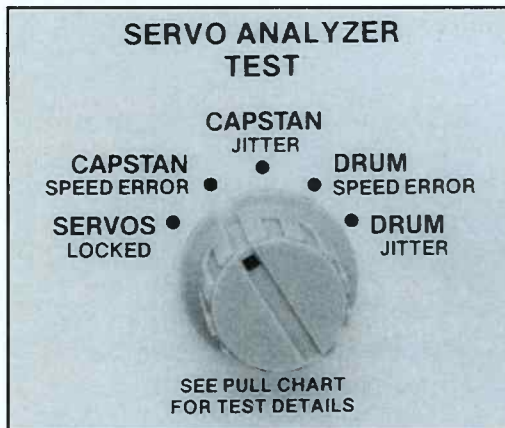


Fig. 2: The patented servo analyzing tests on the VC93 quickly isolate servo problems in VCRs.

**Servos Locked Test:** The servos locked test quickly determines if there is a problem in either the capstan or drum servo circuits. By using the supplied servo test tape, the servos locked test determines if the capstan and drum servos are locked to each other as they should be. If the video or audio signal is too bad to use the servo test lead, the supplied servo troubleshooting leads can be used to make a more exacting test of the servo circuits. By hooking up to two common VCR test points (CTL and SW30), the Servos Locked test determines if the capstan and drum servos are locked to each other, even without video or audio signals. If the Servos Locked test indicates that the servos are not locked, four easy to use servo tests quickly isolate the servo problem down to the capstan or drum servo circuits.

**Capstan Servo Tests:** The VC93 provides two patented capstan servo tests to determine if there is a defect in the capstan servo. If the servo test leads are used, these tests analyze the audio from the servo test tape to determine if the capstan servo circuits are pulling the video tape through at the correct average speed (Capstan Speed Error test) and if the speed is constant (Capstan Jitter test). If the servo troubleshooting test

lead is used, the VC93 capstan servo tests analyze the CTL pulses to determine if the capstan is running at the correct and constant speed.

**Drum Servo Tests:** If the Capstan Servo tests determine that the capstan is running properly, two Drum Servo tests analyze the drum servos to determine if they are working properly. If the servo performance test leads are used, the drum servo test checks the frequency of the vertical sync pulses contained in the playback video to determine if the drum is turning at the correct average speed (Drum Speed Error test) and at a constant speed (Drum Jitter test). If the servo troubleshooting test lead is used, the VCR headswitching pulse is analyzed to determine if the VCR head drum assembly is running at the correct and constant speed for proper operation.

The results of all five servo tests determine if the servos are defective and, if so, which servo circuit is at fault. The best part is every test gives you a GOOD/BAD result to eliminate guesswork and calculations.

## #2 Team Up Your Sencore Equipment For Enhanced Troubleshooting Capabilities

We know that thousands of you own the VA62 video analyzing system. Here's your chance to make that system even more complete. If you own the VC63 VCR Test Accessory for the VA62, you can replace it with the VC93 and gain many extra benefits. The VC93 All Format VCR Analyzer connects directly to the VA62 Video Analyzer just like the VC63 to provide enhanced troubleshooting capabilities. The combination of the VC93 and VA62 adds the following capabilities over the VA62/VC63 combination:

- 8mm VCR Head Substitution
- VHS, Beta, and 8mm Hi-Fi Stereo Audio Signal Substitution
- Complete Servo Troubleshooting Capabilities

### VC63 Trade-In Offer!

For a limited time, we're giving full retail price (\$495) of the VC63 VCR Test Accessory if you trade it in for the VC93 All Format VCR Analyzer. We won't even ask you the condition of the VC63 - we'll give you the \$495 on any trade-in of this accessory. So if you're ready to turn your VCR bench into a complete, dynamic analyzing system and save \$495 in the process, call your Area Sales Representative at 1-800-SENCORE and we'll set up the details.

By turning the Modulation switch on the VC93 to external, the video and audio signals from the VA62 are fed directly to the VC93. That makes all of the VA62 patterns available in the VC93 so you can solve those truly "tough dog" VCR problems. In addition, the VA62 adds phase locked RF and IF signals to troubleshoot the tuner and IF sections of VCRs. Combining the VC93 All Format VCR Analyzer with the VA62 provides the following additional troubleshooting capabilities:

**Helps Isolate Worn Head Problems:** Truly "tough dog" VCR problems include symptoms of smeared pictures. This can be caused by worn heads or by a frequency response problem in any circuit after the heads. The Multiburst Bar Sweep pattern on the VA62 is a key in identifying worn head problems and eliminates the guesswork. Simply select the Multiburst Bar pattern on the VA62 and use the head substitution signals on the VC93 to inject into the VCR after the rotary transformer. Look at all of the Multiburst bars produced by the VCR. If little or no smearing is present (even on the wide, low frequency bars), then the heads are suspect. If smearing is present on the lower bars, then suspect a frequency response problem after the injection point. Use the VC93's head substitution and baseband injection signals to isolate the video response problem further.



Fig. 3: The VC93 can be connected directly to the VA62 or VA62A for enhanced troubleshooting capabilities.

**Check FM Deviation:** The FM deviation of the record circuits determines the ultimate condition of the contrast of the video played back. Use the 10 Bar Staircase pattern on the VA62 to check the condition of the record and playback circuits. Simply select the 10 Bar Staircase pattern on the VA62 and connect the VCR up to the video and audio jacks on the VC93. Record several minutes of the 10 Bar Staircase pattern, then play it back. Observe the shape of the 10 Bar Staircase pattern at the VCR video output with an oscilloscope to determine if the stairs are equally spaced. If they are not equally spaced or if the upper steps are highly compressed, then the FM deviation is incorrect and needs to be adjusted.



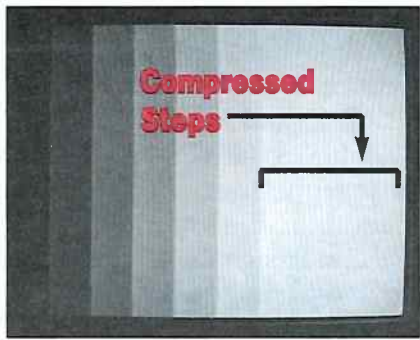


Fig. 5: The 10 Bar Staircase pattern quickly identifies VCRs needing FM modulator adjustments.

### Makes Head Substitution Even Simpler:

The VA62 Crosshatch pattern provides even simpler observation of head substitution results. Due to the wide change in video from the gray background to white lines, the injected signal can be easily seen over whatever signal is recorded on the video tape.

### Your VA62 Adds RF/IF Troubleshooting Capabilities

Teaming up the VA62 with the VC93 adds additional troubleshooting capabilities in the tuner and IF sections of VCRs. The VA62 provides RF signals on all channel bands to check the tuner for operation and correct tuning. The direct access and stepping feature of the VA62 channel programming permits quick setups of custom programmed tuners.

The IF signal injection capabilities of the VA62 serves as a tuner subber. It also provides a signal source to inject throughout the video and sound IF to locate defects in these stages.

## #3 Added Capabilities Of The VG91/VC93 Combination

The VG91 and VC93 are the ultimate VCR troubleshooting pair. The VG91 and VC93

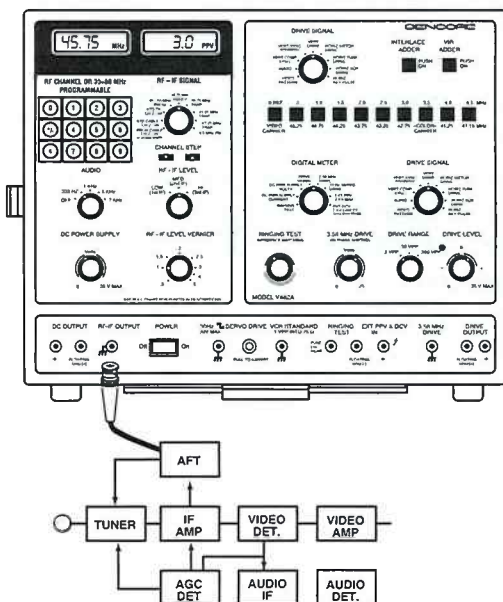
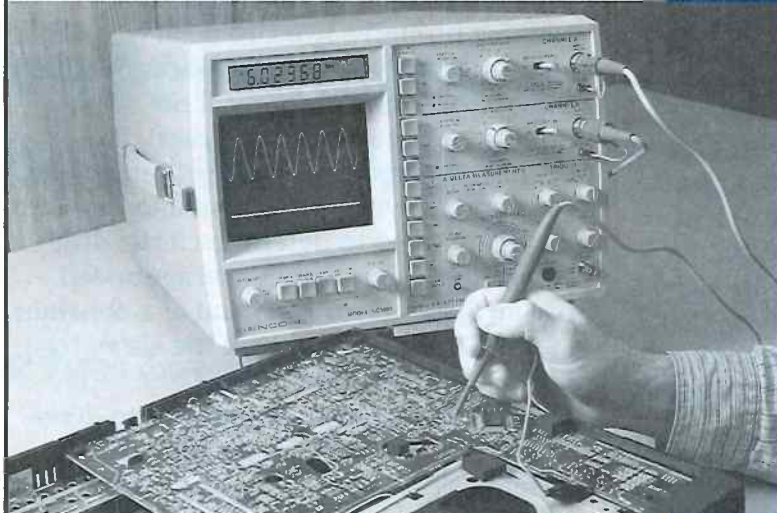


Fig. 6: The VA62 and VA62A provide added signals to troubleshoot the RF and IF sections of a VCR.

## Analyze Waveforms With Confidence!



### SC3080 Waveform Analyzer 80 MHz Dual Trace Oscilloscope

Triple Patented

Just pick up the probe and connect it to the circuit. The SC3080 Waveform Analyzer does the rest for you. Its patented, timesaving analyzing features give you a head start on any troubleshooting repair. Now you can do much more than look at the waveform. The SC3080 lets you safely analyze any waveform (up to 2,000 VPP) with digital accuracy and fiddle-free sync. You gain troubleshooting efficiency, you save time, and best of all – you build confidence. And only you know how confidence affects your troubleshooting.

**Call 1-800-SENCORE (736-2673)**

- Auto-Tracking digital readout of DCV, VPP, and frequency provides 100% automatic digital readings through one probe
- Dual trace with rock solid sync (including video) eliminates frustrating fiddling with controls
- Five times the measuring capability of any conventional scope allows you to analyze without fear of damage
- 80 MHz (usable to 100 MHz) high performance puts confidence back into your waveform analyzing
- Plus many extra, exclusive features designed to save your waveform analyzing time

used as a pair provide the same troubleshooting capabilities as the VA62/VC93 combination but with these added benefits:

- Chroma Lock
- Y/C Video Signals

**Chroma Lock:** VCRs use signal phase shifting to minimize crosstalk between tracks of recorded information on the tape. The phase shifting is related to the 30 Hz switching signal and horizontal sync signal. Signal injection using the VA62 and VC93 is similar to the VA62/VC63 injection methods. When the vertical sync of the injected signal gets out of step with the 30 Hz of the VCR, color will momentarily be lost. This has been eliminated by the Chroma Lock feature of the VC93 and VG91. The VG91 has been specifically designed to receive a locking signal from the VC93 to lock the

vertical sync of the signal generator to the 30 Hz signal of the VCR. This improves the chroma signal injection capabilities and gives clearer, more easily interpreted injection results.

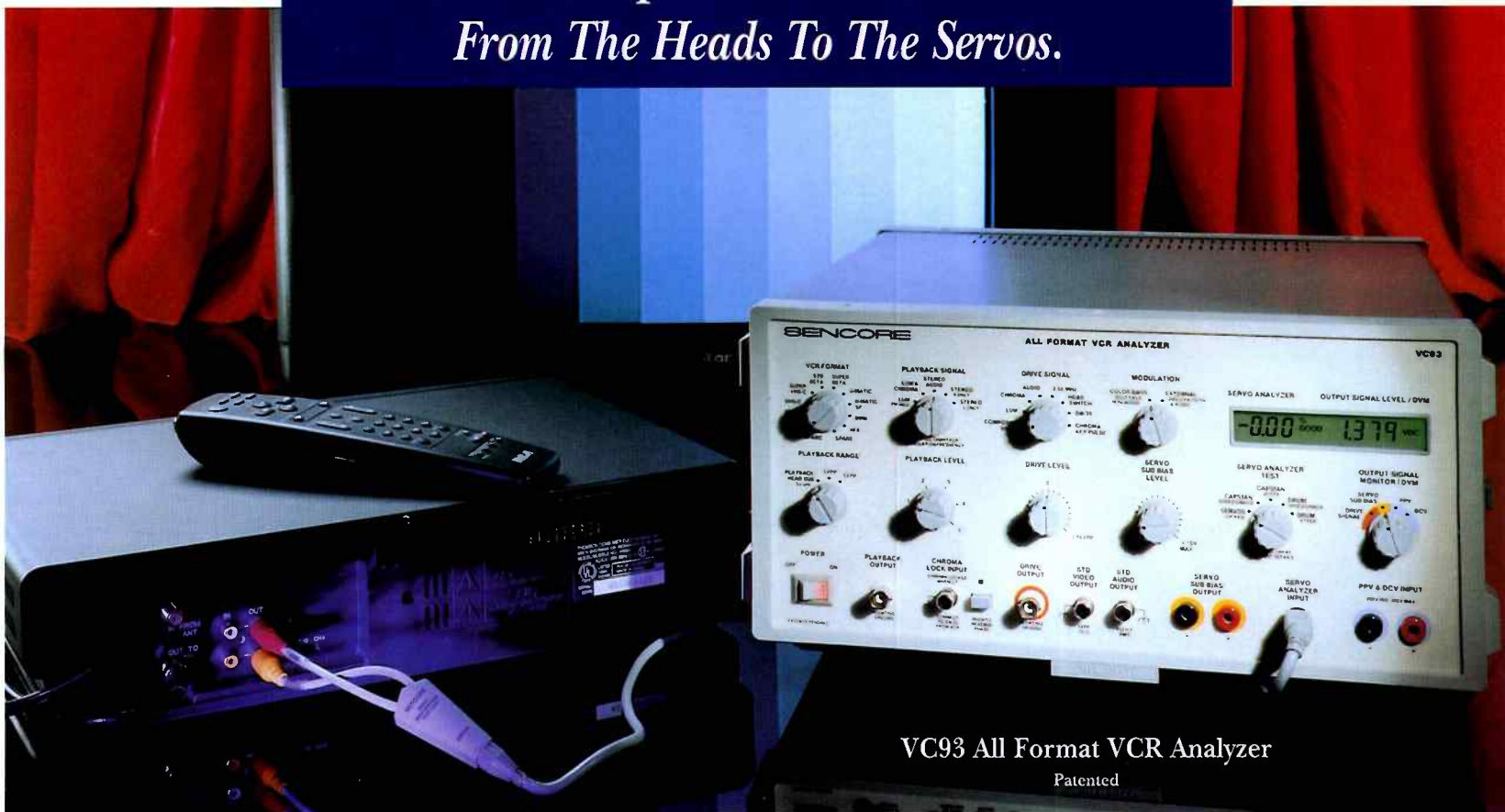
**Y/C Signals:** Many new VCRs, especially the higher end units, also include Y/C inputs. These inputs provide better bandwidth characteristics and less chroma to luma leakage that the conventional composite video. The VG91 provides all video patterns in the Y/C format to test the Y/C inputs of these higher end VCRs.

Your Sencore Area Representative can provide you with the details on adding the VC93 to your troubleshooting team. Simply give us a call at **1-800-SENCORE** and tell him/her you'd like to discuss which system would best fit your bench. **SN**



# The Easiest Tests You'll Ever Make!

Two Simple Connections Give You Complete VCR Answers...  
*From The Heads To The Servos.*



VC93 All Format VCR Analyzer  
Patented

**TECH CHOICE SYSTEM**

All you need are two connections to the video and audio output jacks to dynamically analyze VCR servo performance. Now, you can guarantee the operation of every VCR you service or clean with the VC93 All Format VCR Analyzer's patented "GOOD/BAD" servo analyzing tests. You'll save time, gain confidence, reduce callbacks, and build profits.

*Two simple connections and you'll:*

- Verify the VCR servos are operating correctly
- Ensure the video and audio signals are good
- Lock-in repeat business the next time the VCR fails or needs cleaning
- Add an additional \$2 - \$5 in extra income per VCR
- Rest easy by knowing the VCR will work when your customer gets home



*This same troubleshooting technique applies throughout the VCR. Now you can prove the condition of the video and audio heads and the other VCR circuits with two simple connections. It's that easy!*

• **Attention** •  
**VCR Servicers!**

*Trade in your Sencore VC63 VCR Test Accessory on a VC93, and we'll give you the full price you paid for the VC63 when it was new. Or - receive \$395 for any piece of VCR testing equipment or tools.*

**SENCORE**  
3200 Sencore Drive, Sioux Falls, SD 57107  
Direct: (605)339-0100 Fax: (605)339-0317

**Call 1-800-SENCORE ext. #515**  
**(736-2673)**



# Escape The Duct-Tape!

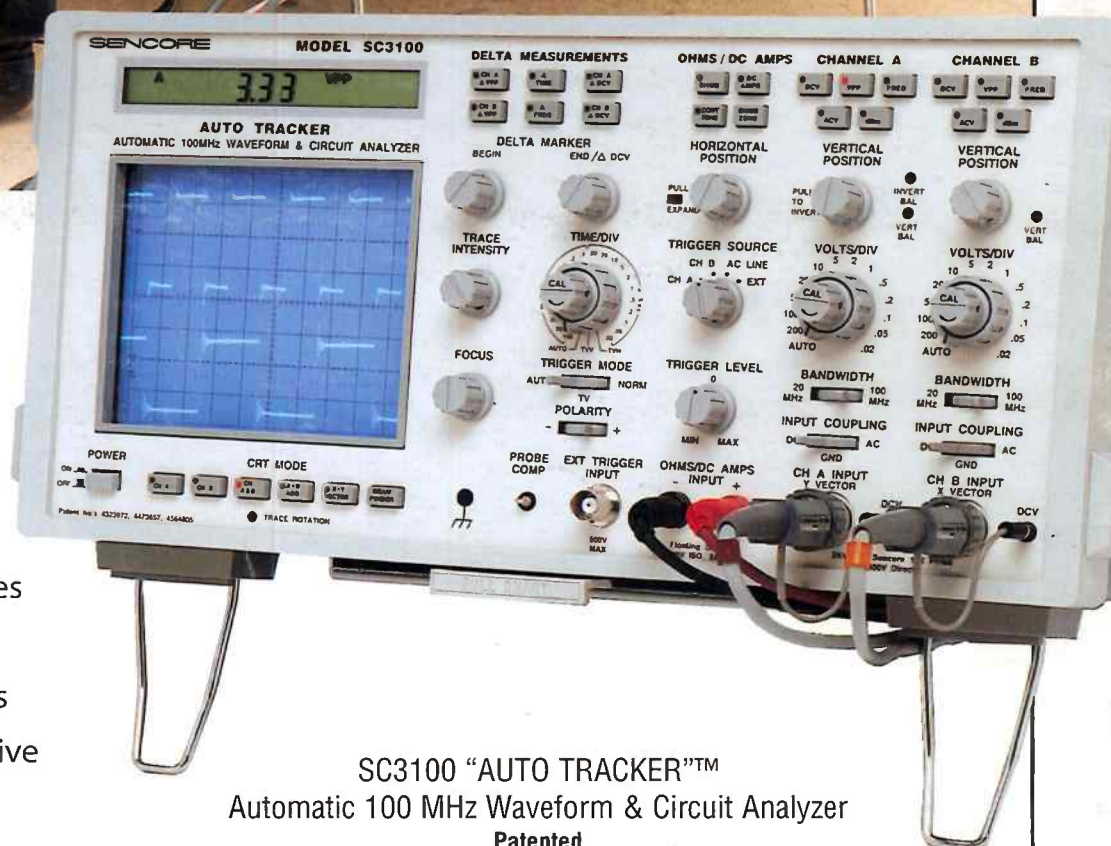
*The 3 Best Reasons  
In The World You  
Need An SC3100  
"AUTO TRACKER"™*

- 1. Save Time**
- 2. Reduce Hassles**
- 3. Save On Duct-Tape**

When the clock is ticking and the profits are burning, you can't afford to break your concentration to untangle probes and adjust knobs on three or four different meters. The user-friendly SC3100 "AUTO TRACKER" eliminates all these hassles with time-reducing, profit boosting, features. Its integrated measurements and autoranged "Touch and Test" capabilities give you a complete troubleshooting center.

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- waveform analysis (100 MHz)
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- VPP (up to 2,000 volts)
- frequency (with no calculations)
- delta measurements
- AC RMS (no graticule counting)
- dBm (automatically)
- continuity (audible beep)
- current (measures loads)
- ohms (troubleshooting time-saver)



SC3100 "AUTO TRACKER"™  
Automatic 100 MHz Waveform & Circuit Analyzer  
Patented

**Yours today  
for as low as  
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