# SENCORE NEWS

Issue #168 Jan./Feb.1995

# *Plan Your Strategy...*

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**An entire issue full of time saving, profit building strategies!**

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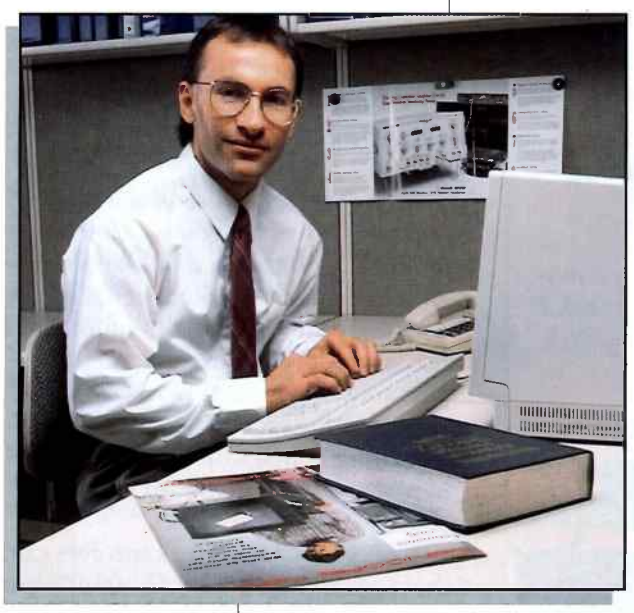
# NOR-COM – Playing In The Big Leagues

Dan Van Meter is a man who chose a path in the electronic service industry, and has followed it successfully – all the way to the big leagues.

Van Meter is the owner and founder of NOR-COM, a 24-year old full sales and service organization servicing consumer, education, hospital, and industry markets. The business is based in Hebron, Kentucky – just across the border from Cincinnati, Ohio.

He started the company as a part-time television repair business while attending evening classes in electronic engineering for 3 ½ years at the University of Cincinnati. The business slowly progressed and eventually added small intercom and paging system installation, all while working out of the basement.



But after Van Meter installed more and more high quality systems, word spread, and he found himself with more work than he could handle. He needed to expand his operation base, so he moved into the rear office of a real estate building and hired his first three employees.

"I credit most of that early success to the people that surrounded me in those early years," Van Meter said of those three employees, who helped to further expand his young business and continue to form the backbone of "NOR-COM", officially born in 1985.

But not everyone gives the same credit lines. Sales Manager Karl Snider says Van Meter's desire to perform only the highest quality work while emphasizing ongoing education was certainly a key to NOR-COM's success. "Dan puts the most emphasis on the ongoing learning process," Snider said. "He keeps technicians totally up-to-date. He takes seminars, classes and the like very seriously and always thrives for his technicians to continually update their knowledge and skills."

Using this philosophy, Van Meter is always looking for new opportunities in his business.

*Fig. 1: Dan Van Meter, owner of NOR-COM in Hebron, Kentucky, keeps up-to-date on technology and is always looking for new opportunities.*

When he saw an increasingly expanding market for business teleconferencing, for example, he continued to gain education on the market and started to capture part of the market in his area. As NOR-COM began to make a name for itself in the community, word-of-mouth led to more challenges – and a trip to the White House.

In 1980, after moving into NOR-COM's new headquarters, he received a surprising call from Washington, D.C. asking him to bid on a teleconferencing system for the office of President Reagan's personal attorneys in Los Angeles. The facilities were to be used when the President was in town and needed to make audio teleconferencing calls.

NOR-COM landed the job, and after it was successfully completed, the company's notoriety increased, as did the demand for NOR-COM's services. They have since installed and serviced large teleconferencing, audio visual, and training rooms for companies such as IBM, General Electric, Procter and Gamble, Coca-Cola, and Toyota.

Van Meter did not have any sales numbers available, but he says all of it happens without the benefit of advertising. "Our business is strictly referral," he said. "We haven't found the need to advertise. There are limitless markets in this field, and we're one of the very few companies to get into them."

**By Larry Schnabel**
Sencore News Editor
*Sencore Electronics*

## On The Cover

*Planning your strategy in electronic servicing is an important step to your success. The articles is this issue show you some of the strategies to stay competitive while earning profits.*

## In This Issue

With 18 employees, NOR-COM handles two types of audio/visual installations: industry and local business. For instance, they installed training facilities in eight locations for Toyota Motor Corp. which felt it needed to provide special education to its sales force on the upscale Lexus car line.

"We also started out with IBM (Corp.) in their local Cincinnati office and designed two executive briefing rooms that enabled their representatives to cut two to three outside sales calls from their schedule by bringing clients in-house for presentations," said Van Meter.

## Servicing Riverfront Stadium's JumboTron

When the firm that provided ongoing maintenance and servicing for the JumboTron at Cincinnati's Riverfront Stadium liquidated its operations, Van Meter saw an opportunity. After a three month search and lengthy contract negotiations, NOR-COM was selected to provide service, maintenance, and operation to the giant video scoreboard.

"We landed the job because of our wide range of skills and expertise," said Van Meter. "We weren't the biggest firm to bid the job, but our commitment to quality and ability to get the job done were the determining factors."

NOR-COM technicians have needed – and used – all those skills to help Sony and Riverfront tear down and replace the insides of the giant JumboTron. "It's like being in the back of a television," Van Meter said, "and not knowing if work behind the screen will fix what's in front." The back of a television might actually be more convenient. Most of the work that takes place is up among the upper seats, across a metal catwalk, or inside a sign about the width of a man's arm span.

One of the maintenance tasks performed by NOR-COM is locating and replacing burnt out bulbs or "cells" on the JumboTron. The process begins across the stadium as workers in a control room scan the lit-up board with binoculars. When they spy a spent cell, they describe its general location to workers inside the JumboTron. With cells that can be seen only from the front – and 13,824 to choose from – the replacement process requires more than guesswork. Workers have to pull out entire 16-cell units when looking for one dead cell.

The cell check was the final step in what was essentially, a gutting of the JumboTron. NOR-COM replaced traditional copper cables, which link the control room board, with fiber optic cables. With copper, information travels via electronic pulse and is subject to frequent interference. With fiber optics, information turns into a light wave, moves on a glass highway, and is less susceptible to interference. "You can run the signals thousands and thousands of feet with minimal loss," Van Meter said.

"We find ourselves confronted on a daily basis with numerous service problems," said Van Meter. "Cincinnati Riverfront Stadium is a prime example of the multitudes of equipment, literally miles of audio, video, and control cables, plus numerous other equipment feeds which interface the Sony large screen JumboTron projection system."

## NOR-COM And Sencore – A Winning Combination

Van Meter and NOR-COM made their first purchase of Sencore equipment in 1985. He said, "I liked the way Sencore equipment gave me and my business benefits, instead of just features, like some other companies. My technicians liked the Sencore equipment right away, and I could see the results almost instantly."

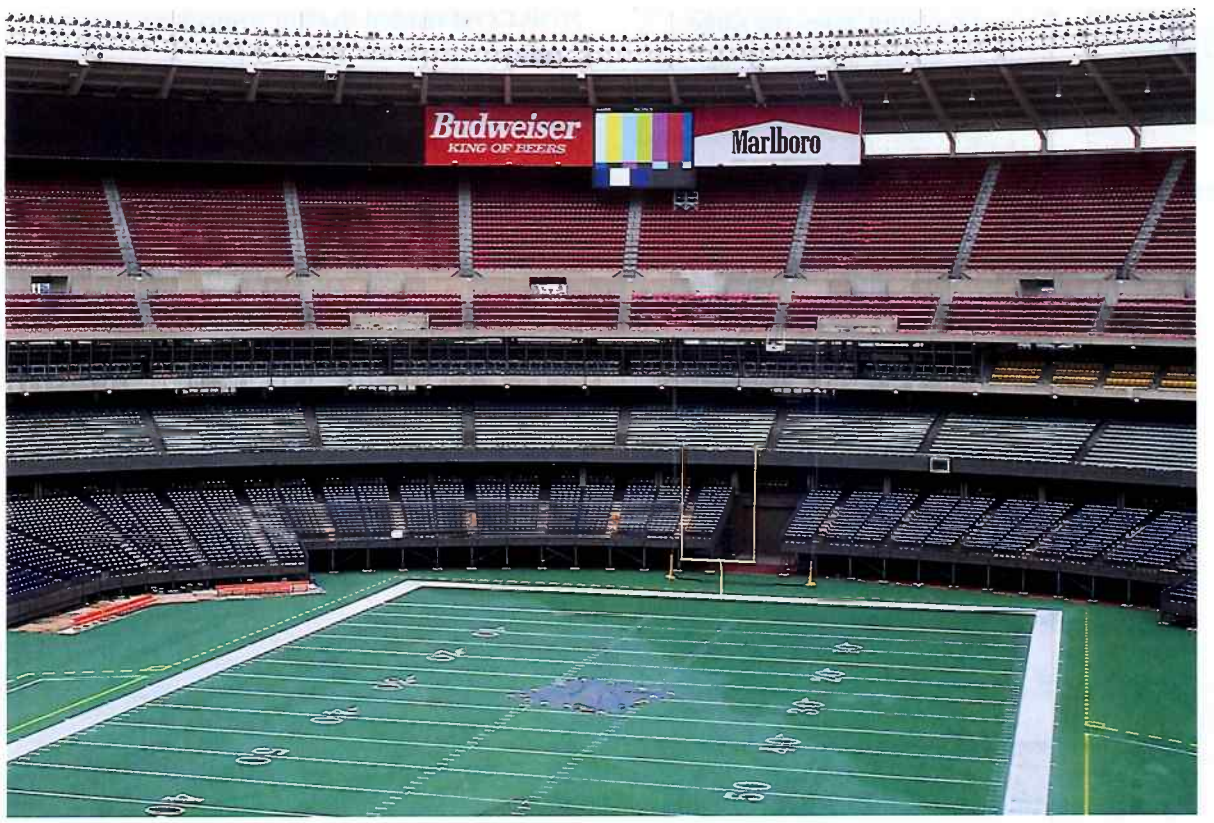



*Fig. 2: NOR-COM's technical expertise and attention to quality were important factors in landing the job of maintaining the JumboTron at Riverfront Stadium.*

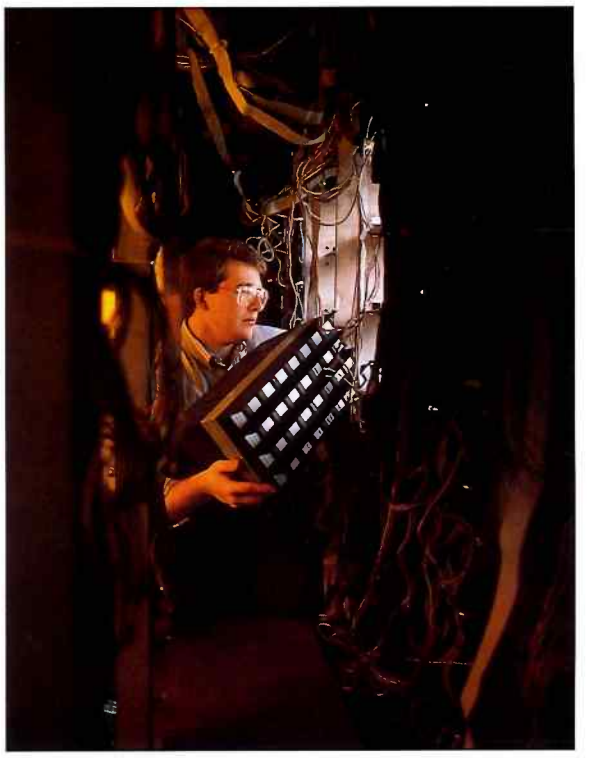


*Fig. 3: Working behind the JumboTron is like working, "Behind a TV without seeing the screen."*

Now NOR-COM has acquired most of the Sencore instrument line. Along with consumer electronic repair of camcorders, VCRs, televisions, etc., NOR-COM uses much of its Sencore equipment on audio/visual installations, including Riverfront stadium.

Van Meter says, "The use of our Sencore test equipment insures that service, maintenance, and repair is done in a timely and efficient manner and also pinpoints signal problems from other vendors and/or equipment which cause symptoms on our equipment, whereas our equipment is operating perfectly." NOR-COM recently set up a second complete video troubleshooting bench with Sencore equipment, and is always looking toward the future.

Much of NOR-COM's work involves camera signal processing and display equipment both on the bench and at work sites. As NOR-COM became more involved with this type of work, Van Meter made the decision to purchase the Sencore CVA94 "Video Tracker" Camera Video Analyzer and VR940 Video Reference light box.

As Van Meter put it, "We simply cannot afford to have a camera or video source mis-aligned and think the problem is in our display or processing equipment. The camera equipment from Sencore has helped us tremendously in that respect."

For example, NOR-COM keeps a staff at Riverfront before and during games to handle the problems that arise when networks and local feeds start hooking up cables and video equipment. With literally miles of cable being used at the stadium, signal loss, noise, and hum problems occur on a regular basis and need to be rectified in a finite period of time, usually a few hours. "On gameday, the 'Video Tracker' is

*Fig. 4: The control room at Riverfront must be operating perfectly on gameday, certainly a challenge considering the miles of cables and network feeds.*

invaluable in diagnosing signal defects and determining the source of the problem," Van Meter said. "Without the Sencore equipment, we'd be at a serious disadvantage."

He told us of a situation that happened at a $50,000 closed-circuit camera install job at a local college. As two new buildings were being constructed side-by-side, NOR-COM was having trouble obtaining good video signals on the monitors. NOR-COM checked their connections and installs, but everything checked out OK.

That left something external to the install, maybe an electrical or grounding problem. But NOR-COM had to prove there was a problem to the contractors before any corrective action would happen. That's where the CVA94 "Video Tracker" saved the day. The "Video Tracker" Hum test showed the signal had about 28% hum, which was much higher than acceptable.

This was proof enough for the electrical contractors to take a closer look at the wiring between the two buildings. They found that the coaxial shielding in one building was at a different potential than the other. The difference in potential was causing a ground loop which eventually showed up as hum on the closed-circuit video monitors. "The Sencore Camera Analyzer gave us the proof to go the contractor so they could fix the problem," said Van Meter. "The Hum Test saved us a lot of wasted time on just this one job."

Over the years, customers have come to expect quality products and services from NOR-COM. "If we have a calling card, it is our commitment to quality and our ability to modify or change equipment so that it will perform certain functions to benefit our clients," explained Van Meter. "And our Sencore equipment has helped us deliver that quality without sacrificing time or profits."

*Sencore now offers a complete, integrated set of test instruments designed especially to make your camera and camcorder servicing easier and more profitable. These instruments are part of the "Tech Choice System" and work together to offer a complete answer to your camera video testing and troubleshooting needs. This exclusive system saves time, reduces parts inventory, and increases customer satisfaction. If you'd like to see how your business will benefit from having a new camera video analyzing system, give your Area Sales Representative a call at* ***1-800-SENCORE.*** ■

*Figure 5: The CVA94 "Video Tracker" and other Sencore equipment give NOR-COM the technical ability to stay ahead of the competition.*

## Business Tip

### Managing Accounts Receivable

Your accounts receivable practices are the lifeline of your business. Each day your customer has your money in his/her pockets, it costs you. Don't ignore these accounts and hope they get paid. Instead, used the following methods.

**Develop a written policy.** The best thing you can do to protect your valuable assets is to develop a written policy regarding collections and follow it.

**Start your collection efforts promptly.** Start your efforts no later than ten (10) days after the due date. Remember, each day costs you money.

**Give the customer a call.** The telephone is by far the most efficient and cost effective tool you can use in collecting your past due receivables.

**Overcome the customer's objections.** To overcome objections for payment, you must:

1. Get the customer to agree that the debt is justified and that it is his/her obligation.
2. Identify the real reason(s) for delinquency by asking fact finding questions. Lead with who, what, when, where, and why.
3. Explain the positive benefits for meeting the obligation, i.e., positive credit report, future credit transactions, no late fees, reduced interest payments, etc.
4. Propose a payment plan.
5. Upon agreement, firm up the plan with warning statements, i.e., point out what will happen if the agreement is broken.
6. If there is no agreement:
   a. Identify the part(s) of the plan the customer does agree to.
   b. Identify the specific objection(s).

**Work with your customer to find a solution.** If you know specifically what the objection is, hopefully the problem can be worked out, and both you and your customer will experience the positive benefits.

## Big News...

**From The Sencore Service Department**

NEW YEAR'S CALIBRATION

***Special 15% Calibration Discount***

Now is the best time for you to have your current-line Sencore instrument(s) tuned to top working condition. For a limited time, the Sencore Factory Service Department is offering a 15% discount on the calibration of current-line Sencore instruments. Send in your Sencore instrument for calibration-only before January 31, 1995, and we'll give you 15% discount right off the top.

# Earn More Profit With Value Added Services And Strategies

**By Larry Schnabel**
Sencore News Editor
*Sencore Electronics*

Many servicers are reluctant to charge for extra services that they perform on TVs, VCRs, etc. They either don't perform any extra services, or include those extra services with the repair job at no extra charge. I've seen many invoices that just include the cost of the part and the labor associated with that part. There's no charge for alignments. There's no charge for safety testing. Some service centers don't charge for estimates. These value-added services can increase a service center's income while providing the customer with a better quality product, peace of mind, and greater satisfaction.

When was the last time you went to a medical doctor who didn't charge you for a flu shot or an X-Ray? Patients have grown to expect laboratory fees and separate charges for blood tests. If the doctor didn't charge for every service incurred, medical bills would be much smaller.

Attorneys would have an even tougher time at billing customers. If you think about it, they don't often provide a specific service or product you can carry into your home. If attorneys were like some servicers, they would only feel justified billing a customer when they filled out a form or wrote up a contract. They wouldn't feel comfortable charging for advice and 90% of their time would be non-billable. Do you think attorneys charge less for a court case they lost?

Then there's the automobile repair industry. Mechanics certainly charge more than the parts installed and a little labor to install them. They charge to "scope" an engine, to set the timing, rotate tires, etc. I was even charged an $18 standard "chemical" charge at one auto shop.

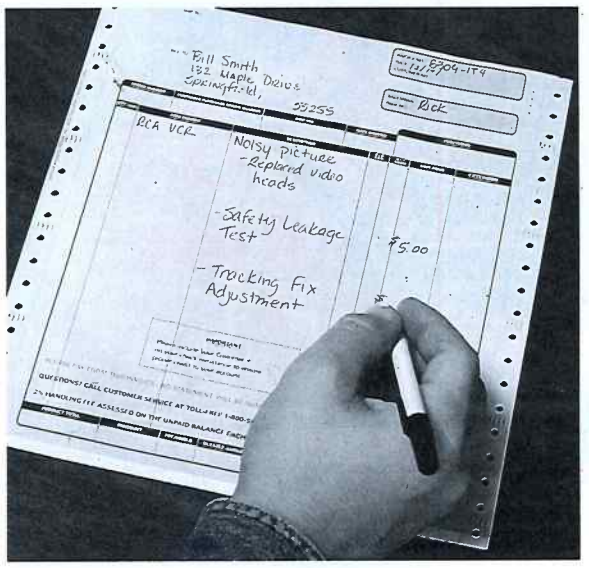



***Fig. 1: Don't forget to add extra charges for the value added services you provide.***

*Here's my point.* Each of these people are not that different than yourself. They sell a few parts and charge for their time, just like we do. But the main thing we're buying is training, experience, and good judgment at their respective position or business. That's why doctors and attorneys have such high fees. That's why automobile service centers are always busy. And that's exactly why you should charge for your value added services. You have the skill and expertise that's been acquired over many years. The average consumer doesn't know how to set VCR head switching and adjust the gray scale on a TV. Those skills are worth those small extra charges on any invoice – and more.

## Learn The Secret To Proper Billing

The secret to billing is charging a fair price for services which the customer sees as a value. This doesn't mean overcharging the customer. It means charging the customer according to the amount of experience and equipment needed to do the job correctly. In some cases, that includes a separate charge for value you've added through extra services that the customer may not get elsewhere. By separating these charges on your invoice, you're reminding your customer that you've provided these extras.

You may get questioned on the charges for some of these services. It's your job to show your customer the benefit of this extra service. For example, you can describe why you perform a safety leakage test and how it protects everyone in the family, including the children. And it shouldn't be too hard to justify why you cleaned a noisy volume control on a TV when the customer hears the clear sound.

Investing in test equipment with value-added capabilities also lets you improve profits. Some test equipment comes with tests or features that let you perform value added services. Two of these value added services are AC safety leakage testing and CRT restoring. Let's see how each of these value added services helps improve your bottom line and your customer's peace of mind.

## Safety Leakage Testing Protects Your Customers And Builds Profits

Imagine the thoughts that run through one of your customer's minds when she reads a story about a child who was shocked and injured by a television which was recently repaired. Even though the accident happened hundreds of miles away, it hits home. Imagine the same customer looking at her TV set you just fixed two weeks ago. Do you think she's wondering if her child could be in danger?

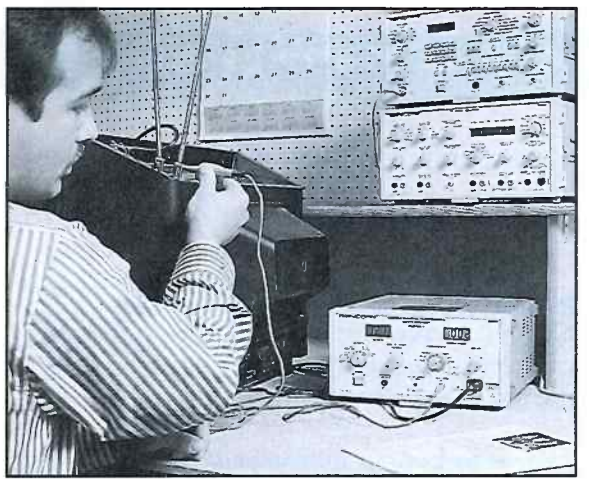


*Fig. 2: The value added to your service with the PR570's AC safety leakage test takes only seconds, but gives your customer peace of mind and improves your profits.*

Now imagine the peace of mind she would have if you had "safety certified" the set as part of that repair. How much is that added peace of mind worth?

Most service centers I talk to charge between $2 and $5 per repair for performing this all important safety leakage test. The service charge covers your time and the added equipment needed to do the job right. (Some states even require this test.)

But to perform this AC safety leakage test fast and accurately, you need the proper test equipment. The new PR570 "POWERITE II" Isolation Transformer & Safety Analyzer provides a patented test to check the AC leakage between the AC line and the exposed metal on an AC operated device. This easy and simple safety leakage test lets you confirm the safety of every repaired set quickly and easily.

For your safety and convenience, the PR570 "POWERITE II" lets you make the test while the set you are testing is connected to the isolated output. You just touch the PR570's Safety Leakage Probe to the exposed metal on the repaired set, and read the large LCD display. There are no calculations, no circuits to assemble, and no nightmares about lawsuits. The PR570 is just one strategy to add profits to your business, let's look at another.

The safety leakage test applies to every television, VCR, stereo, microwave, and AC operated unit that you service. If you finish an average of 5 products each day, and you charge $5 for the safety leakage test, you would be adding $25 income each day. Multiplying $25 times 5 days per week yields $125 each week added income. Take that times 52 weeks per year and you have increased your shop income by $6,500!

## Add Extra Profits With CRT Restoration – Often From "Throw Away" Products

A second profit opportunity to consider is CRT restoration. Today, many service centers find that it provides income from TV receivers that are too old for a new CRT, but too good to throw away. Others find that projection TVs are creating a growing CRT service market, especially when you consider the price of these units.

The popularity of restoring and rejuvenating has gone through several cycles through the years. Today, restoring a CRT may give the customer the added time they need to fit a new set into their budget. Or, restoring the tube may give them a 19" second set to use in the basement or the kid's room, while a new 27" model gets priority in the entertainment center.

Restoration is also important when you've finished a major repair, such as a flyback replacement, and find out the picture is weak because of the CRT. Now, the customer has a relatively expensive parts and labor bill, but sees a poor picture on his TV (the picture may have been bad even before the flyback failed). Restoring the CRT produces a much better picture than before the flyback went bad. This value added service brings extra income, and a happier customer as well.

Projection sets give even more reason for restoration. Often, one of the three CRTs becomes weak before the other two. Normally, changing one CRT means changing all three tubes, since the two stronger tubes will not provide the same output light level as the single replacement. So, the question for the customer is one of changing all three tubes, or continuing to run with one weak tube. Restoration of the weak tube lets you balance it with the other two and return an acceptable picture.

## Restore CRTs To Build Profits And Customer Confidence

Older CRT rejuvenators often don't have enough power to improve the picture. If they do have the power, it can't be harnessed and often damages the CRT. In either case, you cannot depend on this type of restoration to satisfy your customer or to generate added income. That's where "Progressive Restoration" with the CR70 "BEAM BUILDER" CRT Analyzer & Restorer makes all the difference. It gives you the balance between safety and effectiveness needed to profit from CRT restoration.

Only the CR70 "BEAM BUILDER" gives you choice of restoration levels. Progressive restoration starts with the lowest, safest restoring level. If it improves the CRT, stop. You've done the job with the least risk to the CRT possible. If it doesn't improve the CRT, just step up to the next restoring level (see Tech Tip #156).

*Fig. 3: Restoring a CRT with one of the five levels of the CR70's Progressive Restoration lets your customer keep an older set running, while generating value added billing for you.*

Unlike safety testing, you cannot apply a restoration bill to every unit you service – most TVs don't need it. But since the charge is higher, your profits still add quickly.

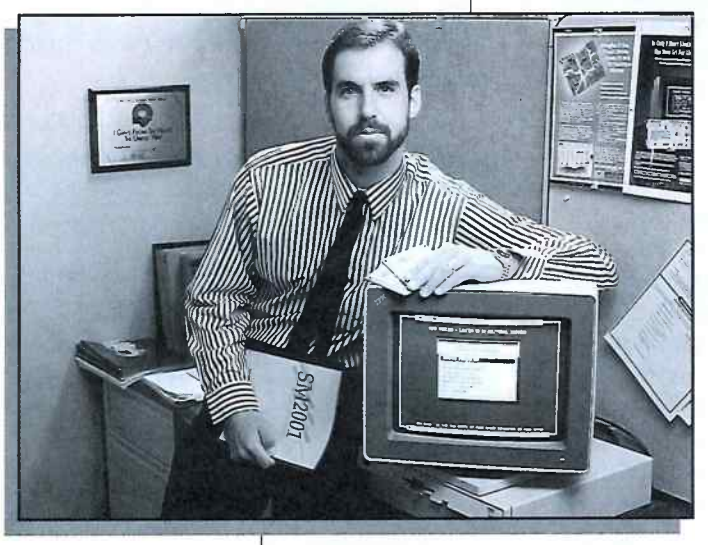
As you can see, it only takes a few of these added services to bring your business' profits up by a measurable amount. Most Sencore products have similar value-added tests which can help in other areas. For example, many servicers charge to do a VCR performance test with their VC93 All Format VCR Analyzer.

Let's say you restore two CRTs per week, at a charge of $35 each. Multiplying $35 by 2 is $70 per week added income. Take $70 times 52 weeks per year, and you're earning $3,640 per year in additional income. Many service centers use that extra income to finance future test equipment purchases.

You can improve your success by billing for the services you provide – even if they didn't involve soldering in a part. This extra income from service can pay for all kinds of improvements for your business – new test equipment, a new sign, improved tools, or a well-deserved vacation. Just call us at **1-800-SENCORE** and we'll show you how to get started. ■

# Business Management Solutions For The '90s

Business Management Solutions




**By Brian Phelps**
Product Marketing Specialist,
Business Management Solutions Manager

*Sencore Electronics*

Managing your business towards success isn't like it used to be. Anyone who's been in the service industry for a number of years knows that the products have changed, the customer has changed, and the revolutions in electronic capabilities has changed almost every aspect of our businesses. To survive in these changing times, many service centers have developed a new strategy of business management.

Today's successful service centers are using the new tools available to them. They're using the marvels of the electronic era as their business partner, and they're ending up on top. Thousands of software users throughout the country have taken the necessary step to incorporate the newer business management solution into their business.

## Sencore Has Moved Toward A New "Business Management Solutions" Strategy To Ensure Your Success

Sencore is also making the move to provide solutions to your business management needs. We're taking our "Tech Choice" test instrument concepts and applying them to business management solutions. Now you have the choice of several solutions to your management needs - our line is expanding to fit your strategy.

Sencore is making our current SM2001 Service Center Manager more flexible and affordable based on input from you - the customer and end-user. We've been surveying service center business owners over the past year and we're happy to say that based on your input, we've made some changes. Our current premier software system (SM2001) is opening up to fit more service center needs by offering a unique and custom-built solution.

We're maintaining the SM2001's "Base System" which provides the complete invoice, parts ordering, inventory control, business reports, file scanning and searching, transaction register, and many other key features. And now we're offering the "Base System" at a new, reduced price (see Fig. 2).

## Added Flexibility And Option Packages Add To Your SM2001 Business Management Solution

The module options we've selected are developed to solve specific/unique needs of an individual service center. Each module is fully detailed and adds a specific feature to the SM2001 "Base System." Some modules may be purchased and used separately from the SM2001, however, you'll quickly learn that the complete system is much more powerful than the individual elements.

Also, as part of our unmatched technical support, all SM2001 owners will be receiving a quarterly newsletter. This newsletter will highlight product enhancements, user tips and shortcuts, and provide ideas and information that will help you to better use your business management system (look for the newsletter in February, 1995).

*Here's a brief explanation of the solutions available to help you manage your service center towards success:*

### *Electronic Filing Option*

We all agree that the "Base System" is a must for a service center to survive these days, yet other features may fall into the category of "customized to my individual business". That's why, now when you invest in the SM2001 (single user) or SM2002 (multi-user) system, you have the option of which module(s) you'd like to add. For example, if you do a large warranty repair volume and/or want to speed your claim filing – add the Electronic Filing Option to your "Base System."

This option allows you to file all your warranty claims through KeyPrestige – the nation's largest independent warranty claims processor. You'll have an automated link to many electronic manufacturers and you'll be receiving your warranty claims much faster. You'll be keeping the profits where they belong – in your bank account.

## These Service Centers Are Using The SM2001 — The New Strategy In Business Management Solutions

See what people in the field have to say. If you'd like to talk with a user of the SM2001, contact your SM2001 Technical Support Specialist, Michael Burakiewicz at **1-800-SENCORE.** He'll put you in touch with users throughout the country – perhaps even one in your area.

**ABM VCR Repair**
*"We save 10-20 minutes on every invoice."*

**Garrett Electronics**
*"It does the work of three people."*

**Wilson Enterprises Of Maine**
*"We spend about 1/10th of the time used previously to invoice customers and track history."*

**Stereo Video Craft**
*"My techs love it."*

***More To Come Later!***

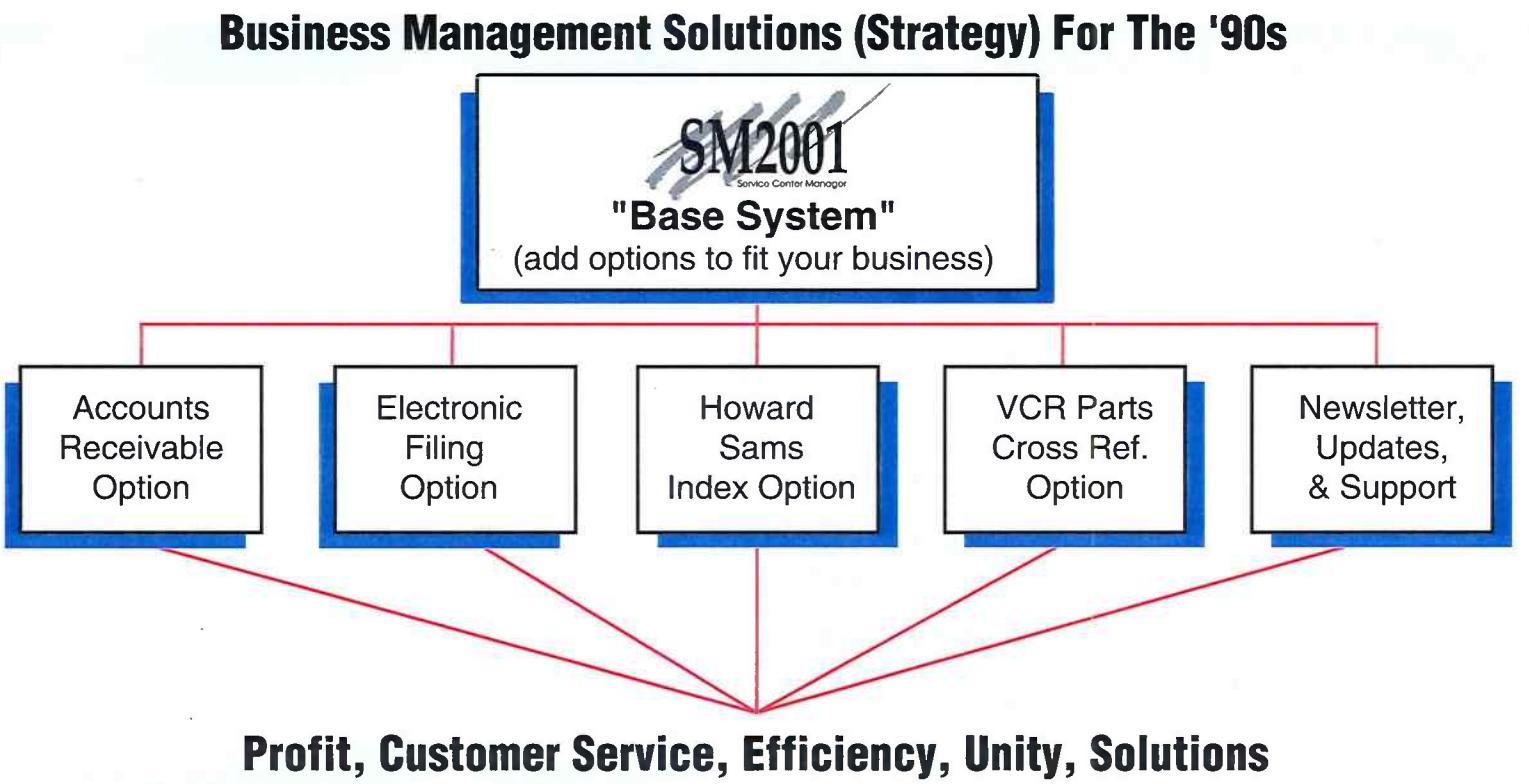



***Fig. 1: Only the SM2001 Service Center Manager pulls everything together into one complete system specifically designed to improve your management efficiency with a solid solution.***

### *Accounts Receivable Option*

If you are needing to know exactly where your money is and how customers are paying you - the SM2001's Accounts Receivable Option is there to help. This module will take care of posting payments and credits, invoice aging, month end processing, and more. The Accounts Receivable Option works hand in hand with invoice processing to make managing your accounts quick, easy, and accurate.

### *Howard Sams Index*

One of the leading challenges faced by service centers lies in the area of service literature. Do you have it on hand? Is there one close enough to use? Are you going to have to order the manufacturer's literature or is there something more affordable available? The Howard Sams Index Option solves many of the service literature questions you may be running into. Access to the index is quick and easy while in the SM2001 Service Center Manager.

Now you can check on the service literature while the customer is checking-in their product. You'll be able to quickly scroll by manufacturer and model/chassis number to locate the schematic you need. This allows you to identify if you'll be needing to order the literature and accurately predict your repair timeframe and your business' image, in your customer's eyes, will improve.

### *VCR Cross Reference Option*

Finally, through the seemingly infinite list of pulleys, gears, belts, video heads, idler assemblies, etc., comes the first user-friendly VCR parts cross-reference solution. Never again will you need to consult volumes of supplier's parts catalogs to search for the common high-failure parts that you need in order to quickly and profitably repair your customer's VCR.

The VCR Cross Reference Option covers more than 5,800 VCR and camcorder models. The common high-failure parts are crossed to 17 parts distributors, complete with the part numbers for each part. This option is updated yearly to include new models and manufacturer's parts data.

### Sum It All Into The Only Complete Business Management Solution

Are you starting to see the full power behind our new business management solution? You're not just adding the best invoice processing, parts order processing, inventory management, and business control system. You're integrating an entirely new business strategy that's proven to work. There's an old saying that a manager is only as good as his/her employees. Now (with the SM2001 Service Center Manager) you have the opportunity to be the best you can be.

The actual power to improve your business from a management, profitability, and customer service organization standpoint grows exponentially, especially when you've integrated the full system. Give it a try.

The SM2001 is available in a **FREE** demonstration package. We'll provide this package and include samples of the options available by calling **1-800-SENCORE (736-2673)**. Join the new strategy for the '90s. Sencore will be with you through every repair.

The SM2001 currently has thousands of satisfied users. Please contact your Area Sales Representative at **1-800-SENCORE** for a detailed information package, including sample reports, files, and other valuable information. ■

**SM2001 Service Center Manager Option Chart**

| System | Price | w/Base |
|---|---|---|
| **SM2001 Base System** | $995 | ***** |
| *Quarterly User Tips Newsletter* | FREE to owners | ***** |
| *Accounts Receivable Option* | $349 | $325 |
| *Electronic Filing Option* | $495 | $475 |
| *Howard Sams Index Option* | $159 | $125 |
| *VCR Parts Cross Reference* | $199 | $175 |
| **SM2002 Multi-User Base System** (additional modules at price above) | $1,395 | ***** |
| **Upgrade Single-User To Multi-User** | $425 | ***** |
| **Updates - SM2001 Base & Multi-User** | 1 yr. Free - then $125 per year (2 updates) | ***** |
| **Technical Support** | Unlimited - FREE | ***** |

***Fig. 2: Only the SM2001 provides a complete list of options to ensure the flexibility and affordability you need for a complete business management solution.***

# Strategies To Reduce Computer Monitor Callbacks

**By Stan Warner**
Application Engineer

*Sencore Electronics*

After you've repaired a computer monitor, you'll need to do a final test and alignment on the unit before you "burn in" the unit and send it back to the customer. This quality check strategy assures customer satisfaction with your services and it greatly reduces the risk of callbacks. The new CM125 "Pix Pak" Computer Monitor Signal Generator works perfectly for this customer service quality check.

The CM125 is small in size and weighs less than five pounds so it fits nicely on your test bench. The "Pix Pak" is a high performance (video bandwidth of 125 MHz and 2048 x 2048 pixel output) computer monitor signal generator so your monitors will be tested to their full capabilities. The CM125's programmability and computer monitor storage locations let you recall stored computer monitor video formats so you can quickly get a pattern on the display. The CM125's dynamic video patterns let you test every circuit in the monitor.


This article takes you through several of the quality checks you'll want to complete before you send the repaired monitor back to your customer. Future articles will contain other final quality checks you can complete using your CM125 Computer Monitor Signal Generator.

## Testing Sync Lock Phasing And Linearity

After you've completed a repair, the first step of your quality test will be to make certain the computer monitor displays a locked-in and centered picture when you feed it the correct video format. Pictures that are shifted to the left or right or that are sized too large or small are one of the most common sources of customer callbacks on computer monitors.

With programmable control of the scan frequencies and pixels, the CM125 "Pix Pak" generates the signals that match the output of your customer's video card and that match the input requirements of the computer monitor under test. The CM125's CIRCLE/CROSS pattern lets you test that the picture is sized properly on the display and that it's not shifted left or right.

The following procedure shows you how to test sync lock, phasing, and linearity with the CM125 "Pix Pak". If the computer format matches any of the "Pix Pak's" 43 preprogrammed storage locations, it takes just three steps. If the computer format does not match any of the 43 setups, you can enter in the sync frequencies, pixels, and sync times to match the monitor format.

**Testing sync lock, phasing, and linearity with the CM125 (if the computer monitor format is contained in one of the 43 preprogrammed storage locations).**

1. Press RECALL, enter "storage location #", ENTER
2. Connect the CM125 to the computer monitor under test.
3. Press •CIRCLE/ CROSS

**If the computer monitor format is not preprogrammed.**

1. Press HORIZ FREQ, enter horizontal frequency, ENTER
2. Press VERT FREQ, enter vertical frequency, ENTER
3. Press HORIZ PIXEL, enter horizontal pixels, ENTER
4. Press VERT PIXEL, enter vertical pixels, ENTER
5. Press FRONT PORCH, enter front porch time, ENTER
6. Press BACK PORCH, enter back porch time, ENTER
7. Press SYNC, enter sync time, ENTER

*Note: You need to enter front porch, back porch, and sync times for both the horizontal and vertical blanking pulses.*

8. Connect the CM125 to the computer monitor under test.
9. Press • CIRCLE/ CROSS

***What to expect:***
The picture should be locked-in and centered on the display. Check that each line is straight and that each box is square and uniform throughout the raster (except for the row of squares on the outside of the display). Also check that each circle is round with no visible distortion.

If the circles are egg shaped, check the horizontal and vertical linearity adjustments. If the picture is shifted up or down, left or right, or folded over, check the horizontal and vertical phasing adjustments.

If a computer monitor's format is not one of the CM125's preprogrammed storage locations and you do not know the exact timing parameters (scan frequencies, pixels, and blanking times), do not adjust the monitor's internal sync and phasing controls for a locked-in, centered picture. The computer monitor display may look nice leaving your service center, but it will almost certainly result in a customer callback. If you do not know the format, don't perform any phasing adjustments in the monitor. You stand a far better chance of returning a properly aligned computer monitor than if you try to adjust to the wrong monitor parameters. This especially holds true if the repair you've performed was not in one of the critical timing circuits.

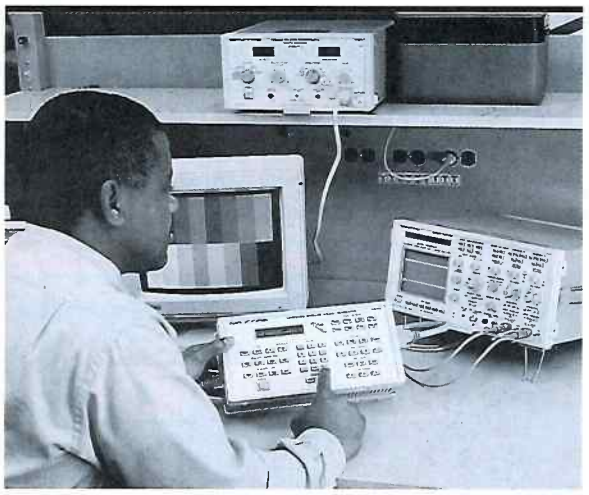


*Fig. 1: Use the CM125 "Pix Pak" to perform a final quality test before you send the computer monitor back to the customer.*

## Testing A Computer Monitor's Mode Select Circuits

Several monitor standards have different graphics modes. The VGA standard, for example, has three modes as Fig. 3 shows. The horizontal sync frequencies are the same for each mode, but the vertical sync and pixels are different. With no adjustments made in the vertical sweep circuits, the picture that looks okay in one mode could be too tall or scrunched in one of the other two.

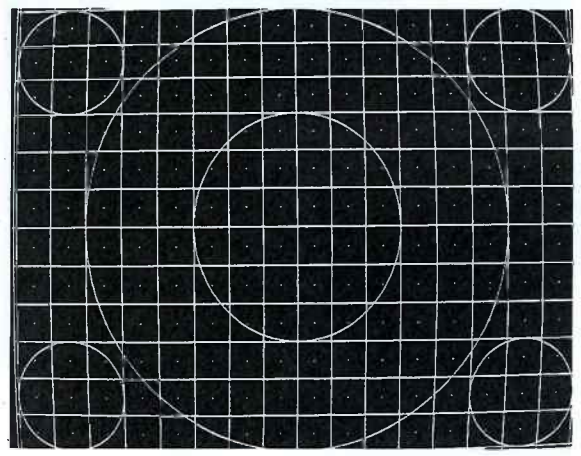


*Fig. 2: Use the CM125's CIRCLE/CROSS pattern for testing a computer monitor's display centering and linearity.*

A mode select circuit, used in some monitors, compensates for the compressed or stretched display that results from these different graphic modes (different vertical sync frequency and vertical pixels). The mode select senses the input and tells the vertical driver to adjust the drive output to produce a full raster for each of the modes. The polarity of the horizontal and vertical sync pulses forms a code that tells the mode select circuit what graphics mode is applied. Figure 3 also shows the polarity code. A faulty mode select circuit will cause the display to be too compressed or spread out. The display may look okay in one of the modes but not another.

You should always test each of the modes before you send a computer monitor back to a customer. If you don't, a monitor may look good in the mode you've tested, but may be misaligned in the customer's mode.

Testing the mode select circuits with the CM125 "Pix Pak" is an easy task, especially if each of the monitor's modes are already stored in preprogrammed storage locations. Just recall each of the modes from the CM125 and test for proper alignment in each mode.

**Testing the mode select circuit on a VGA monitor.**

1. Press RECALL 5 ENTER
   *(this is VGA mode 1)*
2. Connect the CM125 to the computer monitor under test
3. Press RECALL 6 ENTER
   *(this is VGA mode 2)*
4. Press RECALL 7 ENTER
   *(this VGA mode 3)*

***What to expect:***
For each mode, make sure the display is not distorted. If necessary, adjust the monitor's raster size and linearity controls. The computer monitor should produce a full display in each mode. If it does not, troubleshoot the mode select circuit or the vertical or horizontal driver stage. *Note: You can test the modes for standards that not stored in the CM125's memory by entering the parameters directly.*

## Testing A Computer Monitor's Multiscan Circuits

Multiscan monitors lock to any applied horizontal and vertical sync frequency within a set range. A common problem in multiscan monitors is they will lock to small frequency range, either horizontal or vertical, but are unable to lock over the entire range of input sync frequencies. Before you return a multiscan computer monitor to a customer, you must make certain the monitor is able to lock in each of the formats in its frequency range.

You can easily do a quality test on multiscan computer monitors using the CM125 "Pix Pak". Simply recall each of the formats the computer monitor can lock to within its frequency range. The monitor should produce a locked-in display

| 3 VGA Modes | | | | | | |
|---|---|---|---|---|---|---|
| VGA Mode | Horizontal Frequency (kHz) | Vertical Frequency (Hz) | Horizontal Resolution (Pixels) | Vertical Resolution (Pixels) | Horizontal Sync Polarity | Vertical Sync Polarity |
| 1 | 31.5 | 70.1 | 640 | 350 | (+) | (-) |
| 2 | 31.5 | 70.1 | 720 | 400 | (-) | (+) |
| 3 | 31.5 | 64.0 | 640 | 480 | (-) | (-) |

*Fig. 3: VGA monitors only sync to a 31.5 kHz horizontal sync frequency but can display three modes.*

with all formats. If the monitor doesn't lock, there may be a problem in the multiscan or sweep circuits. If the monitor shifts or distorts the pattern, the monitor may simply need to be aligned.

**Testing a computer monitor that can sync to VGA, SVGA, MAC II, 8514 and 1024 x 768.**

1. Press RECALL 5 ENTER
   *(this is VGA mode 1)*
2. Connect the CM125 to the computer monitor under test
3. Press RECALL 6 ENTER
   *(this is VGA mode 2)*
4. Press RECALL 7 ENTER
   *(this is VGA mode 3)*
5. Press RECALL 8 ENTER
   *(this is SVGA)*
6. Press RECALL 9 ENTER
   *(this is 8514)*
7. Press RECALL 10 ENTER
   *(this is MAC)*
8. Press RECALL 11 ENTER
   *(this is 1024 x 768)*

***What to expect:***
The computer monitor should have a locked-in display for each of the computer monitor formats. If the computer monitor doesn't sync to any one of the standards, you need to troubleshoot either the automatic synchronizing circuits or the horizontal or vertical sweep circuits (depending on which circuit has lost sync), or align the computer monitor for that particular format.

## Testing The Power Supply Regulation Circuits

The high voltage regulator circuit is responsible for maintaining a constant high voltage at the CRT as the HV load varies. A black raster turns the guns off, so there is minimum beam current and minimum load. The heaviest load is produced by a white raster. Without regulation, the high voltage would vary with the displayed image. Poor high voltage regulation creates problems such as blooming, improper brightness variations, poor focus, poor color, and a jumpy display.

A computer monitor you've repaired may perform well under low current conditions but may lose regulation as the monitor is switched between high and low beam currents. Use the CM125's RASTER pattern to dynamically test a monitor's high voltage regulation circuit. Quickly switching the VIDEO polarity button between "+" and "-" causes the display to alternate between white (maximum load) and black (minimum load).

**Testing a monitor's high voltage regulation.**

1. Connect the CM125 to the computer monitor under test.
2. Press RASTER
3. Press R G B all to "on"
4. Set the monitor's brightness to maximum.
5. Quickly toggle VIDEO polarity from "+" to "-"

***What to expect:***
The display should remain stable as the pattern is switched between the white raster and black raster. The white border line should remain stable with no signs of bowing or blooming.

If the display shows a regulation problem, measure the peak-to-peak voltage at the collector of the horizontal output transistor while repeating step 5. If the PPV voltage changes widely with the changing video pattern, troubleshoot the B+ regulator circuit. If the PPV voltage remains stable, check the video or sync circuits for changing levels.

## Testing The Power Management Circuits

Many of the new computer monitors on the market contain a "display power management" feature that aides in cutting energy costs. This feature shuts down the monitor if the computer hasn't been used for a preset period.

The shutdown occurs in three stages: (1) video is interrupted (similar to a screen saver); (2) horizontal sync is interrupted, and (3) vertical sync is interrupted. At each stage the computer monitor consumes less power. Before you send a computer monitor back to your customer, you should test that the power management circuits can properly power down the monitor and then power it back up.

The CM125 effectively tests the power management stages with the VIDEO OUTPUT and SYNC OUTPUT on/off buttons by simulating the step-by-step shutdown action carried out by the video card in the computer. To completely test the power management circuits, you should take the computer monitor through both the "shutdown" stages as well as the "power-up" stages.

**Testing a computer monitor's power management circuits (shutdown):**

1. Press R G B (LED off) to turn off video lines
2. Press HORIZ SYNC (LED off) to turn off horizontal sync
3. Press VERT SYNC (LED off) to turn of vertical sync

***Note:*** *Power management methods may vary between computer monitor manufacturers. Check the service literature to verify that the computer monitor shuts down in the same sequence.*

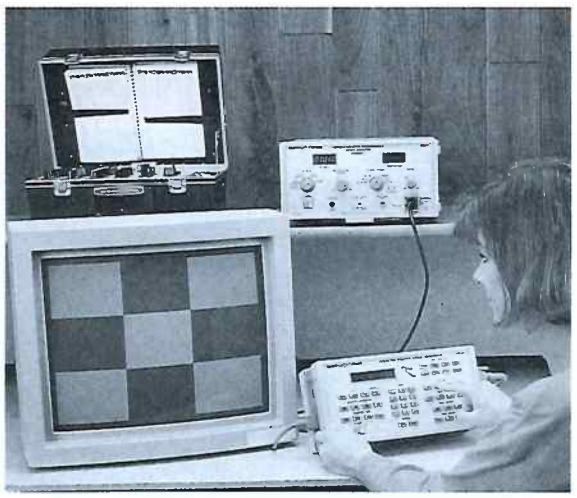


*Fig. 4: Use the Sencore PR570 "POWERITE II" to monitor the current draw as you exercise the power management circuits*

If your computer monitor is powered by a Sencore PR570 "POWERITE II" Variable Isolation Transformer & Safety Analyzer, you can monitor the current draw as you turn off the different stages. If the current draw doesn't decrease as each stage is turned off, the power management circuits are probably defective. Again, if you are using a Sencore PR570, note that the current draw of the computer monitor increases as each stage is turned on.

**Testing a computer monitor's power management circuits (power-up):**

1. Press VERT SYNC (LED on) to turn on vertical sync
2. Press HORIZ SYNC (LED on) to turn on horizontal sync
3. Press R G B (LED on) to turn on video lines

See for yourself how the CM125 fits your computer monitor analyzing needs. Just give us a call to set up a no-obligation trial. For more ideas and strategies, call us today at **1-800-SENCORE.** ■

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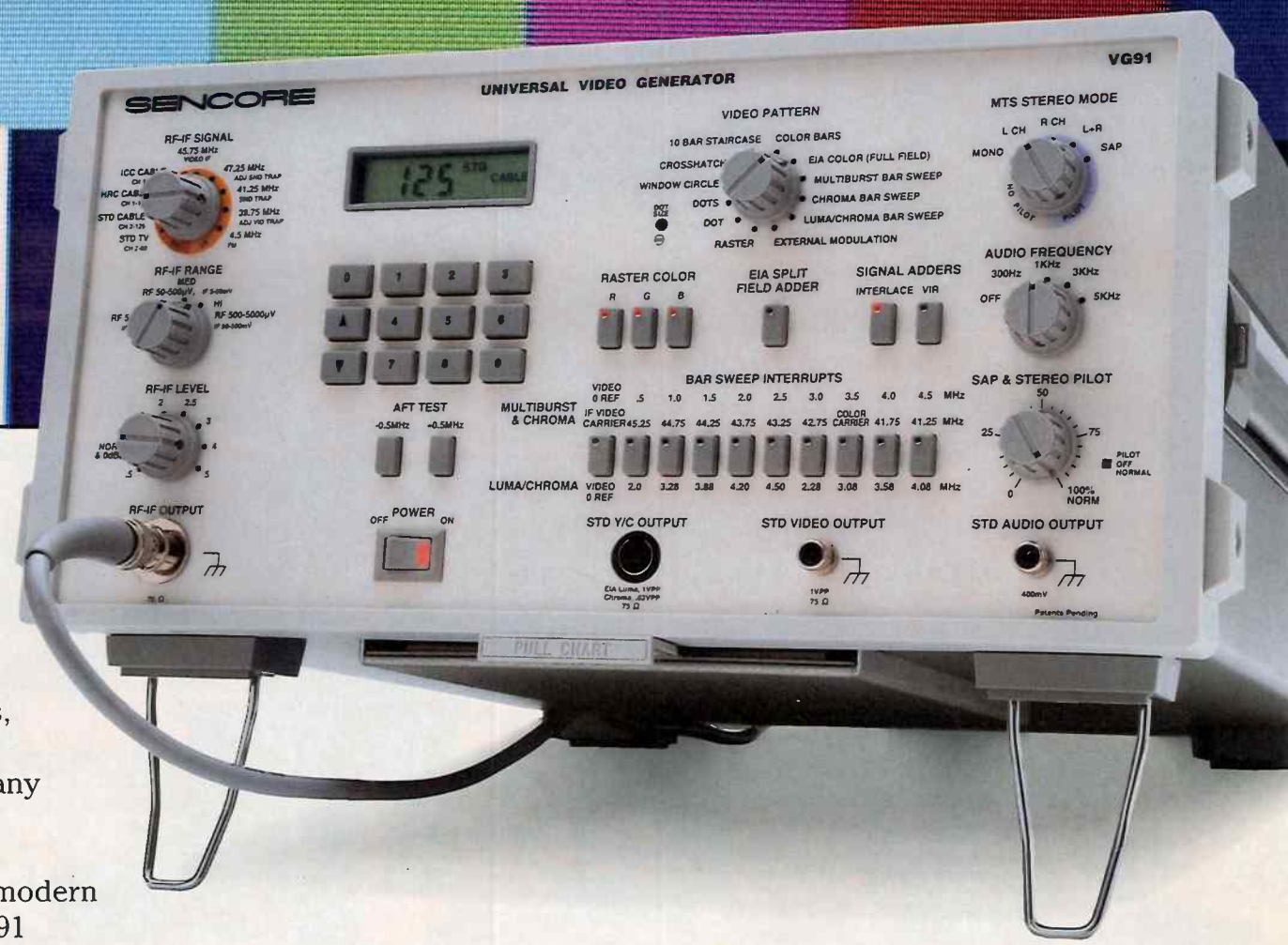


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# Understanding & Aligning TV/VCR Automatic Fine Tuning (AFT) Circuits

**By Glen Kropuenske**
Application Engineer
*Sencore Electronics*

What happens on today's modern televisions when the picture doesn't quite tune in like it's supposed to? On most modern sets, you can't turn off the AFT anymore and fine tune the channel. So is the tuner defective, is it the tuner control circuitry, or is there an AFT problem? Chances are you've asked yourself this question a few times.

Remember the "good old days" when your troubleshooting strategy was to turn off the AFT switch and manually turn the fine tuning knob or buttons. Like it or not, those days are long gone and a new strategy for analyzing tuning and AFT problems is needed.

In this article, we will examine the role of the Automatic Fine Tuning (AFT or AFC) circuits found in modern digital tuning systems. We'll examine the operation of a typical AFT circuit and cover how you can easily test and align the AFT circuit using the VG91 Universal Video Generator and SC3100 "AUTO TRACKER".

## Understanding How AFT Circuits Work

The AFT circuit consists of a tuned discriminator and a DC voltage amplifier. The output of the AFT circuit is a DC voltage.

The AFT circuit receives the video-IF carrier which is fed into a tuned FM detector or discriminator. The FM discriminator is tuned to 45.75 MHz. As the 45.75 MHz carrier shifts above and below this frequency, the output AFT voltage increases or decreases. In this manner, video IF frequency changes of the 45.75 MHz carrier are converted to DC voltage changes. Figure 2 shows the basic blocks and output DC voltage curve of an AFT circuit.

A properly working AFT discriminator produces an "S-curve" DCV output vs. frequency characteristics. This means the DC voltage increases and decreases in equal but opposite polarities as the 45.75 MHz IF carrier varies above and below 45.75 MHz.

When the tuner's oscillator is set correctly, the AFT detector outputs a DC voltage which represents "zero correction" (usually not 0 volts, however). If the tuner's oscillator changes in frequency, the IF carrier shifts and is no longer at 45.75 MHz. The IF frequency change causes the voltage at the AFT detector output to change. The correction voltage is fed back to the tuner or control circuits to change the tuner's oscillator, returning the IF carrier to 45.75 MHz. If the AFT detector is improperly aligned, an AFT voltage error pulls the tuner's oscillator to the improper frequency and mistunes the incoming TV channels.

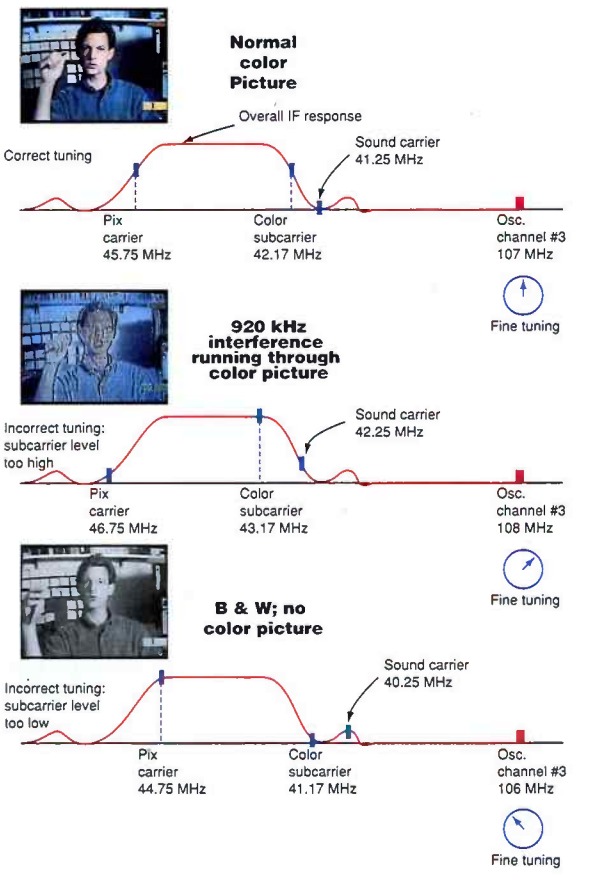


*Fig. 1: Changes in fine tuning dramatically affects the picture and IF response.*

## A Practical Look At A Modern AFT Circuit

In modern digital tuning systems, the AFT voltage is input to the microprocessor. The microprocessor relies on the AFT voltage as the final indicator as to when the tuner's oscillator is set properly. The microprocessor increments the tuner's oscillator until the AFT voltage indicates a precise 45.75 MHz carrier is being input to the video IF.

In most "digital" tuning systems, the AFT on/off switch has been eliminated, creating a closed circuit loop. This closed-loop between the tuner and AFT circuit causes several problems. First when a tuning error occurs, the IF frequency and AFT voltages all change. Secondly, any attempt to align the AFT detector with TV signals applied to the tuner results in misalignment.

To better understand the AFT stage and its role in a modern tuning system, we will analyze the AFT circuit in an NAP R1 chassis. See the simplified schematic diagram in Fig. 3 on page 17.

As in most TV chassis, a tuned AFT detector is part of the IF/Processor IC. The AFT detector block receives a video-IF carrier input from within the IC. An LC tuned circuit is external to the IC and adjustable with L233 to tune the AFT detector. The DC output voltage from the AFT detector is output from the IC at pin 38, or test point 2. The voltage at this point during normal operation (properly tuned channel) of the receiver is just below 4 volts as indicated on the

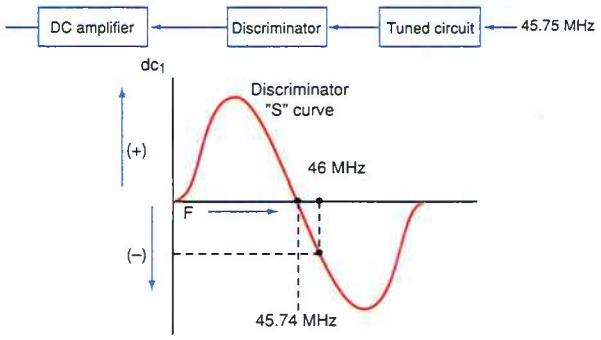


***Fig. 2: AFT block diagram and "S-curve" DC voltage output with changes in IF input frequency.***

schematic. The AFT voltage at test point 2 ranges from approximately 0.5 volts to 8 volts during tuning operations.

The AFT voltage is divided by resistors R394 and R393 and applied to pins 6 and 2 of the comparitors in IC390. When properly tuned, pin 7 of the comparator feeds a logic high of 4.5 volts to the microprocessor, and pin 1 a logic low of .04 volts.

The microprocessor uses the AFT inputs to know when it has accurately set the tuner's oscillator to produce the 45.75 MHz IF carrier. If the IF carrier drifts above 45.75 MHz (tuner oscillator frequency increase), the AFT voltage decreases causing the comparator output at pin 7 to go high. If the IF carrier drifts low (tuner oscillator frequency decrease), the comparator output at pin 1 goes low. When the microprocessor sees the AFT inputs change, it takes corrective action to move the tuner's oscillator back on frequency.

The role of the AFT circuit is especially critical in "cable ready" tuning systems. During a cable search routine in the NAP R1 chassis, the microprocessor steps the tuner's oscillator (part of the PLL circuit) up or down. When the changing oscillator mixes with the incoming TV channel carrier, the resulting IF carrier moves through 45.75 MHz. When the carrier passes through 45.75 MHz, the AFT voltage changes from minimum to maximum. The comparitor stage causes the voltages to toggle at the AFT inputs to the microprocessor. If the AFT detector is properly adjusted, the precise point the logic change occurs should be when a 45.75 MHz IF carrier results. The microprocessor locks the tuner's oscillator to this spot.

## How To Test & Align The AFT Circuit With The VG91 And SC3100

Testing and adjusting the AFT circuit involves four steps: 1) Connecting the VG91 and SC3100 "AUTO TRACKER" to the IF/AFT circuits, 2) Quick checking the AFT circuit operation, 3) Determining the ideal "zero correction" voltage, and 4) Adjusting the AFT detector coil and centering potentiometers for maximum or best corrective AFT action.

### *1. Connect the SC3100*

The first step involves applying a known good substitute IF video carrier at 45.75 MHz to the IF stage and connecting a scope to monitor the AFT voltage. Use the following steps to establish the connections and settings using the VG91 and SC3100.

a. Connect the SC3100 Channel A Input probe to the AFT test point.
b. Set the INPUT COUPLING switch to "DC" and adjust the CRT controls until the CH A trace is on the middle division.
c. Set the CH A VOLTS/DIV switch to 2V per division.
d. Push the Channel A "DCV" readout button.

### *Connect the VG91*

a. If there is a tuner/IF link cable, unplug it from the IF input and connect the VG91's RF-IF Cable using the supplied Adapter Cable.
b. If there is no link cable, use the VG91's RF-IF Troubleshooting Balun to connect to the IF input.
c. Set the VG91's output for 10 mV (Lo and Norm), 100 mV for SAW filter inputs when the tuner includes an IF preamp (1st IF). Increase the output level until the snow disappears from the raster.
d. Set the VIDEO PATTERN switch to "Raster."
e. Release the RASTER COLOR switches for a black raster.

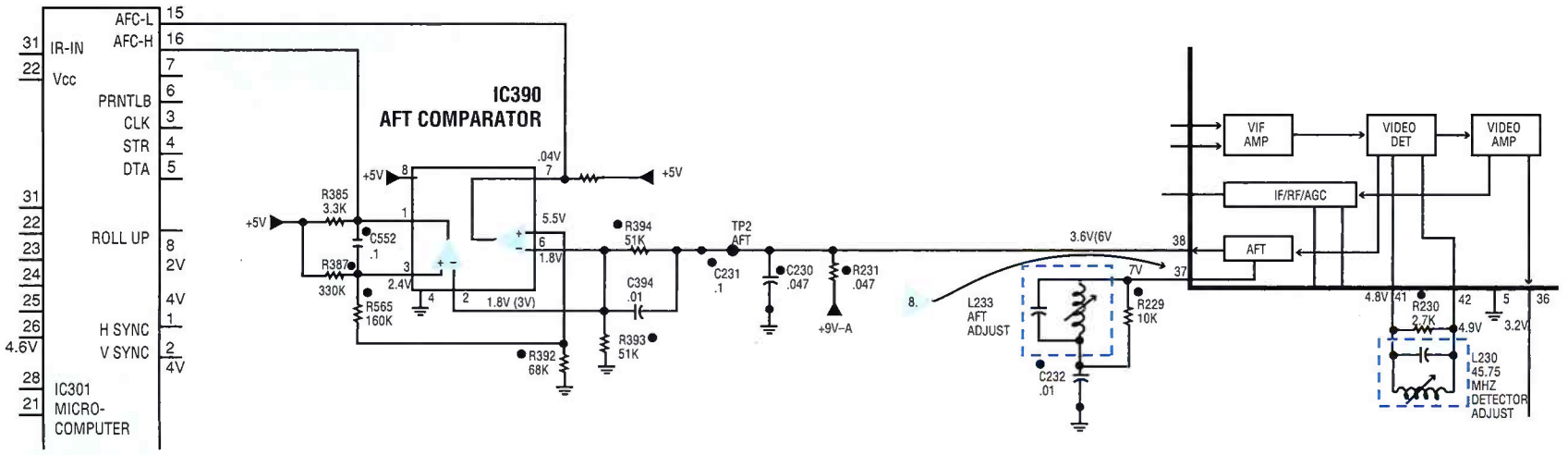


*Fig. 3: Simplified schematic of NAP R1 AFT circuits.*

You are now set up to test and align the AFT output voltage with an accurate 45.75 MHz Video IF (sync modulated only) carrier.

### *2. Quick Checking The AFT Circuit*

The 45.75 MHz Video-IF carrier from the VG91 represents an ideal output which would exist from the tuner if properly tuned to a channel. With this input, the AFT voltage should be near the voltage indicated by the schematic for a normal signal condition. If no voltage is shown on the schematic, check the alignment instructions for the normal AFT voltage with 45.75 MHz applied to the IF. The voltage at the AFT test point should be near the middle of the AFT voltage minimum to maximum range.

The AFT TEST buttons of the VG91 let you "quick check" the AFT circuit. Pushing the VG91's AFT TEST buttons shift the 45.75 MHz up or down by 0.5 MHz.

You should observe the trace on the SC3100 move upward or downward indicating the AFT voltage change as you hold in the AFT TEST buttons. When you release the AFT TEST button, the trace should return to the center of the display.

If the trace shifts an equal amount up and down as you press the AFT TEST buttons and returns to a median voltage level, the AFT circuits are working properly. No alignment should be necessary. Make an additional voltage check at the input(s) to the microprocessor to make sure the comparator or voltage amplifier is passing the AFT voltage properly to the microprocessor. If you observe no voltage change, a change in only one direction, or an unequal upward/downward voltage change, further testing of the AFT circuit is needed.

### *3. Determining The AFT "Zero Correction" Voltage*

To further test and align the AFT circuit requires that you adjust the AFT detector coil. Observe the SC3100 trace and monitor the AFT voltage on the digital display as you mis-adjust the AFT detector coil through its 45.75 MHz tuning spot. If working properly, the output voltage at the AFT test point should swing through a tuning output voltage range. Based on this output voltage change, you can determine the range and mid-point setting for the proper AFT adjustment. *Hint: If the service literature gives a voltage for AFT alignment based on 45.75 MHz, use it.*

Service literature often specifies a voltage at the AFT test point during alignment of the AFT detector using a 45.75 MHz carrier. If not, adjust the AFT detector or tuning coil (usually a coil near the IF integrated circuit) through its full DC output voltage range as measured and viewed on the SC3100. Note the highest and lowest voltages. Calculate the midpoint voltage using the following formula:

$$\text{AFT zero correction} = \frac{\text{V min + (V max - V min)voltage}}{2}$$

Notice from the formula that the "zero correction" point may not be the voltage which is one-half the highest correction voltage. The AFT voltage curve varies between two DC levels. Subtract the highest voltage from the lowest one to calculate the voltage swing. Then divide the voltage swing by two and add this value back to the lowest AFT voltage. The result is the mid-point of the AFT correction range. This serves as a good value to use for the "zero correction" during alignment.

### *4. Setting the AFT Detector Coil*

The final step is locating and setting the AFT detector tuning coil to produce the best AFT correction voltage. You may find that the AFT coil produces what seems to be the "zero correction" voltage at three different points, but that only one of these points is the desired setting. If you look at the "S" voltage curve in Fig. 2, you see that beyond the center part of the curve, the voltage may decrease again toward the center.

Only one point provides normal AFT operation. If you set the AFT circuits to the wrong point, the circuit will work in some cases, but not in others. In fact, the AFT circuits may sometimes pull the tuning of one or more channels off instead of tuning for best reception.

The easiest way to find the correct setting is to observe the SC3100's CRT trace as you slowly tune the AFT coil through its range. If the AFT circuits are working correctly, there should be one part of the coil's rotation which produces the fastest and largest AFT voltage change. The other (incorrect) settings approach the "zero correction" voltage more slowly. In addition, the wrong settings usually do not reach as far in the positive or negative direction as the correct one.

1. Find the range of the AFT adjustment which causes a sudden change between the highest and lowest AFT correction voltage. (This is the correct range of the adjustment.)
2. Slowly adjust the detector until the voltage is at the "zero correction" calculated voltage.
3. If the AFT circuits have a DC bias or centering potentiometer in addition to the tuning coil, adjust the potentiometer for the DC voltages called for in the service literature. Repeat the AFT detector alignment until the maximum AFT voltage change (range) and proper centering is achieved.

*Fig. 4: Testing and aligning the AFT circuit using the VG91 Universal Video Generator is a critical part of troubleshooting a tuning problem.*

After setting the AFT circuits, check the operation of the receiver through the antenna input. You may monitor the AFT voltage and compare values to the max, min, and "zero correction" value determined with the 45.75 MHz substitution signal. For direct comparison, use a black raster. Any difference between the AFT voltages indicates a slight error in the centering adjustment. If the error is significant, apply the IF signal once again and repeat the AFT alignment. Slightly increase or decrease the "zero correction" voltage. Again, check the operations through the antenna input.

## A Strategy That Works

When isolating tuning problems, analyzing the operation of the IF stages and the AFT circuit becomes an important first step. This strategy can save you valuable time in isolating tuning problems and avoid the mistake of ordering unneeded tuner modules. Give your Area Sales Representative a call today at **1-800-SENCORE** to set up a no-obligation trial. Now's the time to setup your AFT troubleshooting strategy. ■

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# How many times have you found yourself in this kind of situation?

A customer calls complaining of a poor picture on a television that you just repaired. You remember the set well, it was a dog and you test-ran it for two days just to be sure it was repaired and would stay that way. Now, the customer is on the phone complaining of a bad picture.

Before you jump to any conclusions, how do you know the customer's signal source is good? Is it the cable? Is it an antenna problem? Could the signal be weak? Maybe you never thought about it, but a quick test could save the time of bringing the set back to the shop only to find there was no problem with the TV receiver.

That's the type of problem the easy-to-use SL750I "CHANNELIZER" is designed to eliminate. You can quickly test the quality and quantity of the signal being delivered to the television or VCR on every channel – VHF, UHF, or cable.

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# Cable Problems?

One of the many frustrations experienced by technicians is tracking down cable shorts, opens, or damaged cable in systems that deliver signals to your customer. An ohmmeter finds some of the problems, but what if you have several cables bundled together over hundreds of feet long? Cabling has grown beyond just RF distribution systems, it now includes computer networks, telephone systems, etc., the list goes on and on.

What you really need is a proven method of isolating the problem down to the defective area so you can repair it fast. The CA780 "Cableizer" is designed to help you find the problem quickly, accurately, and as easily as possible.

Find out how to track down all of your cabling problems with the CA780 "Cableizer", call **1-800-SENCORE** (736-2673) today!

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3200 Sencore Drive, Sioux Falls, SD 57107
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# Sencore "Tech Choice" Technical Troubleshooting Demonstrations

Sencore has announced it will begin holding six new troubleshooting Tech Schools and seminars starting this fall at various locations around the U.S. and Canada. Each Tech School and seminar concentrates on a special subject providing technical troubleshooting information with demonstrations and/or hands-on activities.

Each seminar provides servicers with a better understanding and practical troubleshooting experience on each topic. Many valuable troubleshooting tips are demonstrated that help eliminate guesswork and reduce repair time. Plus, learn how the Sencore "Tech Choice" instruments will improve troubleshooting skills on today's modern circuits.

## Hands-On Camcorder Troubleshooting - $79

*(Attendance limited to first 20 registrants)*

This full-day Tech School gives hands-on experience and techniques for troubleshooting and repairing camcorders. There's only one way to gain experience with camcorder troubleshooting - and that's by troubleshooting camcorders. Learn how to diagnose and isolate camcorder problems by using dynamic and exclusive tests in a bench setting.

*The program includes:*

- A 10 point dynamic camera video test procedure without taking the camera apart.
- How to accurately diagnose any camera video problem using IRE, millivolt, or percentage of burst.
- How to use the nine video reference charts to test, troubleshoot, and align cameras quickly and more profitably.
- How to quickly isolate camcorder servo problems using an exclusive two lead hookup test...without removing the camera case.
- A certificate of camcorder troubleshooting achievement.

## Hands-On Computer Monitor Troubleshooting - $79

*(Attendance limited to first 20 registrants)*

Discover the technology of computer monitor troubleshooting at this full-day, hands-on Tech School. Learn to troubleshoot any computer monitor format and pinpoint defects with quick and easy tests. Be ready to troubleshoot real problems on real computer monitors.

*The program includes:*

- Dynamically troubleshoot any computer format from CGA to hi-resolution in three easy steps.
- Pinpoint circuit defects with special sync locked substitution signals without disconnecting any components.
- Dynamically analyze yokes, flybacks, IHVTs, and switching transformers.
- Troubleshoot any switch mode supply, using the 4-M.I.C.s (most important circuits).
- A certificate of computer troubleshooting achievement.

***Learn how to diagnose and troubleshoot camcorder problems in a bench setting.***

## Profitable TV Troubleshooting Demonstration - Free

Exclusive dynamic high voltage, horizontal, shutdown troubleshooting techniques, plus more. This evening seminar is all about troubleshooting the latest "tough dog" television circuits.

*Learn how to:*

- Isolate UHF, VHF, cable, IF, and video problems in seconds.
- Dynamically check and accurately set any TV AFT system.
- Exclusively test H.O.T. circuits with the set off!
- Substitute H.O.T. to dynamically analyze any horizontal output circuit problem.
- Test flybacks, IHVTs, and SMPS transformers using patented ringing tests.

## VCR Troubleshooting Demonstration - Free

Latest "head to servo" troubleshooting techniques that are guaranteed to turn estimates into revenue.

*Learn how to:*

- Accurately troubleshoot/test for bad heads fast.
- Dynamically isolate any luminance, chroma, or audio problem.
- Isolate any servo problem with exclusive two lead hook-up... without removing the VCR cover.
- Turn tough dogs into cash hounds.

## Testing and Diagnosing Camcorders - Free

Want to get started in camcorder service? Then this afternoon demonstration is just the ticket.

*Learn how to:*

- Test camcorders and know what to look for.
- Take in the latest information on camera test procedures and diagnosing problems.
- See how to distinguish camera signal defects and isolate camcorder servo problems more profitably than ever before.

***See how to test and diagnose camcorder problems.***

## Basic Computer Monitor Troubleshooting - Free

A secret servicing opportunity for a few good techs! This one night seminar gives all the basics needed to start troubleshooting computer monitors.

*Learn how to:*

- Troubleshoot different computer monitor problems using exclusive video patterns and dynamic drive signals.
- Diagnose the most expensive parts of a computer monitor - flybacks, yokes, and CRTs.
- Get a troubleshooting pattern on any monitor, CGA to the latest hi-resolution multi-sync.

**Following is a partial list of the seminar sites scheduled for the near future. To find out if one of these fact-filled demonstrations or hands-on seminars is coming to your part of the country, give us a call at 1-800-SENCORE and ask for your Area Sales Representative.**

### Tech School Cities

| | |
|---|---|
| Cleveland, OH | Raleigh, NC |
| Denver, CO | Seattle, WA |
| Las Vegas, NV | Nashville, TN |
| Los Angeles, CA | Canada (call for locations) |
| New York, NY | |
| San Francisco, CA | Atlanta, GA |
| Philadelphia, PA | Orlando, FL |
| Portland, OR | Salt Lake City, UT |

***Class sizes are limited. Call now to reserve your seat.***

tech school
TECH CHOICE SYSTEM

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

# Frustrated With Servicing The Tough Dog VCRs?

*Would you be interested in servicing all types and formats of VCRs? Have you ever thought it would be possible to analyze a VCR problem without even taking off the VCR cover?*

## Take on all VCRs with the VC93 All Format VCR Analyzer!

Now, with the VC93, you'll have everything you need to completely analyze all VCR video, audio, tuner, and servo problems.

The VC93 All Format VCR Analyzer brings new, innovative solutions to VCR analyzing by providing:

**#1: An Automatic Servo Analyzer**

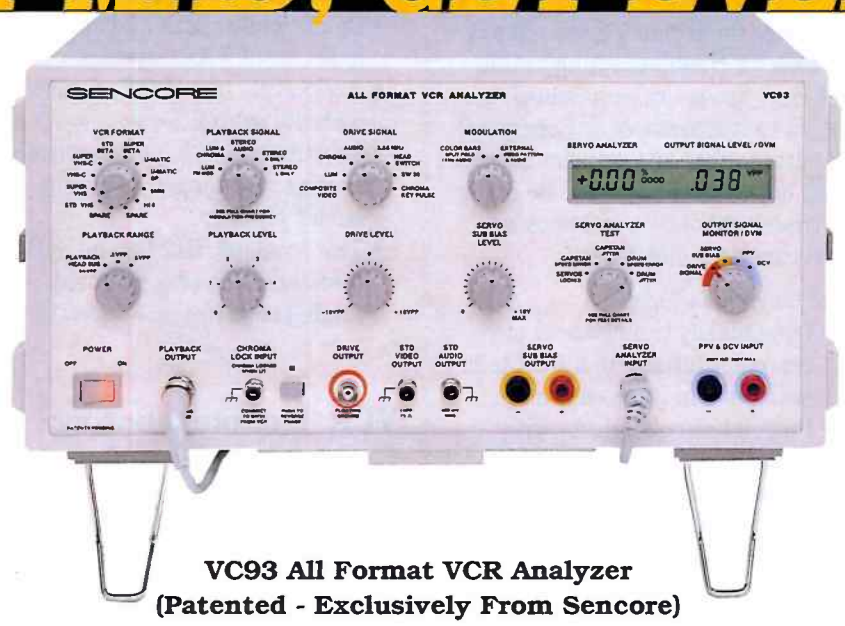
**#2: A Video Head Signal Substituter**

**#3: A Hi-Fi Stereo Signal Substituter**

**#4: A Luminance/Chroma/Audio Troubleshooter**

Broken VCRs don't have a chance with the VC93 All Format VCR Analyzer on your bench. It's the latest and most advanced VCR analyzing instrument of the decade. To find out more about this revolutionary VCR analyzing instrument, simply call **1-800-SENCORE** and talk to your Area Sales Representative.

## DON'T GET MAD, GET EVEN!




**VC93 All Format VCR Analyzer**
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## Call 1-800-SENCORE (736-2673)

# Isolating Confusing VCR Picture Problems With A Three Step Strategy

**By Lisa Kunkle**
Application Engineer

*Sencore Electronics*

One of your first steps in the strategy of troubleshooting a VCR is to verify the customer's complaint. You first observe the operation of the VCR to determine what symptom or symptoms are apparent. Many times, this leads you to the problem, although several problems can produce similar symptoms. You can often waste valuable time trying to locate the true cause of these symptoms. This lost time cuts into the profits you make on other repair jobs.

Problems in the tape movement (capstan servos), head positioning (drum servos), tape path alignment, video head circuitry, or FM luminance circuits can produce almost identical symptoms. What we plan to accomplish in this article is to show you how the VC93 All Format VCR Analyzer can isolate these confusing picture problems using a simple three step strategy. By using this quick process, you will quickly determine which repairs are profitable.

## Identifying The Symptom

Imagine a typical VCR that comes in with the complaint of a bad picture. To confirm the symptom, you hook up the VCR to a monitor and insert a work tape. The tape loads properly and the VCR begins to play. The picture is exactly as the customer described – noise throughout the entire picture. You move the VCR's tracking control, but the noise remains unchanged. It looks like dirty or defective video heads.

You clean the video heads and try the work tape again. There is no improvement. You clean the heads one more time to be sure, but you find the noise remains unchanged. This virtually eliminates the chances of dirty video heads. You realize that this will not be a routine repair.

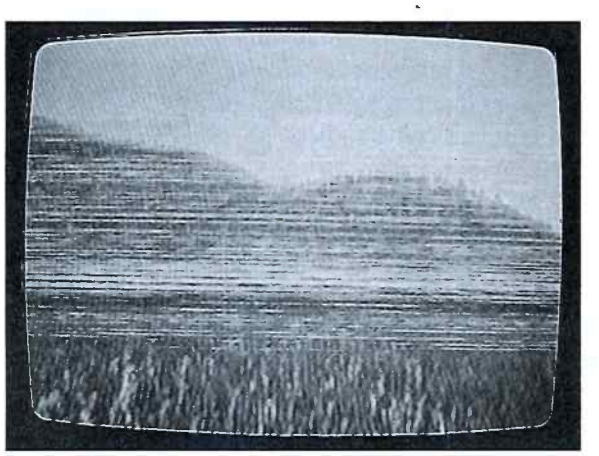


*Fig 1: A noisy playback picture can mean a problem in the video head circuitry, servos, and even tape path alignment. With the right test equipment, you can isolate these tough dogs quickly.*

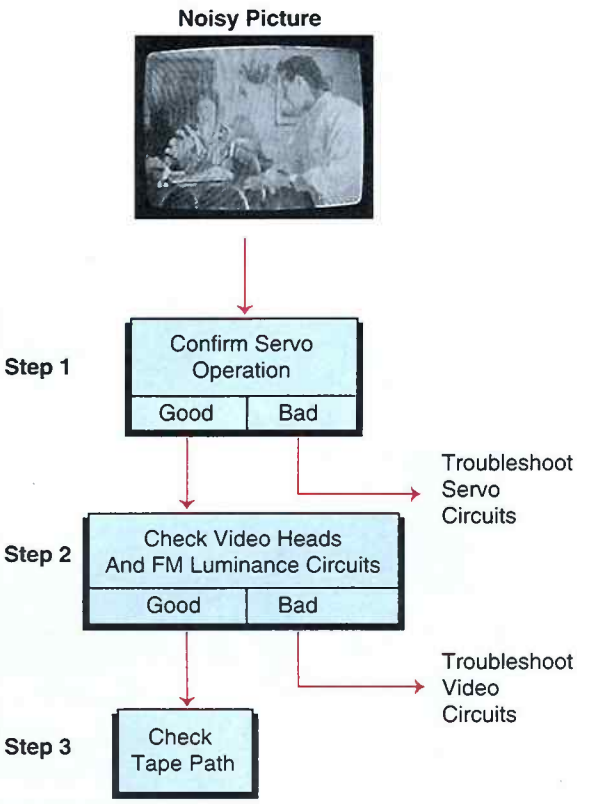



*Fig 2: Using the three step strategy isolates confusing noisy VCR picture problems in the least amount of time.*

From experience, you realize that the noisy video can be a problem in the video head circuitry, luminance processing circuits, servos, or even tape path alignment. But, how do you find out immediately which one of these circuits is causing the defect so you can effectively determine if there is a profit to be made?

With the VC93 All Format VCR Analyzer and the three step procedure, you will quickly isolate where the defective stage is. Using the three step procedure, you first confirm proper servo operation. Second you check the video heads and corresponding luminance circuitry. And finally, if these check out, you know you have a tape path alignment problem.

## Confirming Proper Servo Operation

The servo section commonly fails because it is a combination of mechanical and electrical components. The servos must line up a video head that is spinning at 1,800 RPM with a moving recorded track that is only a few thousandths of an inch wide (refer to Fig. 3). Even minor servo problems can cause partial or complete loss of video and/or audio.

With the VC93, you can confirm servo operation with either of two test leads – the Servo Performance Test Lead or Servo Troubleshooting Test Lead. The Servo Performance Lead uses the standard video and audio output signals present at the VCRs external jacks to analyze the servos. This lead analyzes the vertical sync pulses of the video signal and

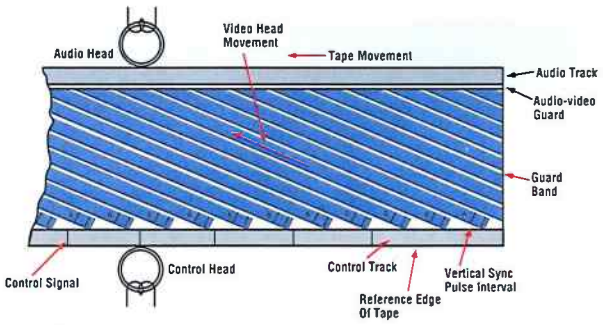



*Fig. 3: The video heads traveling at approximately 1,800 RPM must follow a track on the video tape that is only a few thousandths of an inch wide.*

the linear audio tone from the Sencore Servo Performance Test Tape.

If the VCR's video is bad or missing, you will use a different strategy. The Servo Troubleshooting Test Lead analyzes the internal servo reference signals instead of the video and audio output signals. Hook this test lead to the SW30 signal of the drum circuit and the CTL signal of the capstan circuit. Then all you have to do is rotate the Servo Analyzer Tests switch through the five servo tests. Following is a brief discussion on what these tests are checking.

***Servos Locked Test:*** This test quickly determines whether the capstan and cylinder phase loops are locked to the VCR's internal reference source. If the servos are not locked, use the remaining servo tests to help track down the defective phase servo loop. If the test shows "GOOD", then you know the servos are locked together.

***Capstan Speed Test:*** This test tells you if the tape is being pulled through the VCR at the correct speed. This identifies capstan servo defects such as speed detect problems. The percentage reading tells you whether the capstan is turning too fast or too slow.

***Capstan Jitter Test:*** This test checks for minor capstan speed variations. These variations can be caused by problems such as a bad capstan motor bearings, slipping belts, or worn idlers. Use this test to isolate mechanical or phase loop problems within the capstan.

***Drum Speed Test:*** This test quickly determines if the drum is turning too fast or too slow. It eliminates false starts and wrong conclusions so you can spend your time troubleshooting defective circuits. Use the GOOD/BAD percentage reading to determine if the drum is running too fast or too slow.

***Drum Jitter Test:*** This test checks for short term variations in the speed of the drum. Excessive drum jitter is most often caused by problems such as bad drum motor bearings, excessive oxide buildup on the drum, a missing drum PG signal, or a defective drum servo control loop.

Once you have verified that you have a servo problem, refer to Tech Tip 187 (Testing Capstan Servos With The VC93) and Tech Tip 188 (Testing Drum Servos With The VC93). If the Servo Tests show no defects, you have quickly determined that the drum and capstan servo circuits are working properly electrically. Then the next step of the procedure is to check the video head and luminance circuitry. (Call **1-800-SENCORE** for a copy of the Tech Tips.)

## Isolating Video Head And FM Luminance Circuit Defects

One of the most expensive parts in a VCR is the video head assembly. Your customer's decision to have his/her VCR fixed often depends on whether the video heads are good or bad. For efficient servicing and reliable estimates, you need a system that can quickly determine if a video problem is in the video heads or the luminance circuit.

The VC93 All Format VCR Analyzer gives you the capability to inject the "FM Lum" signal into the input of the preamps. If you get a good, locked-in color bar picture (with or without color) on your TV/monitor, you know everything from the point of injection to the video output jacks can process a known good signal.

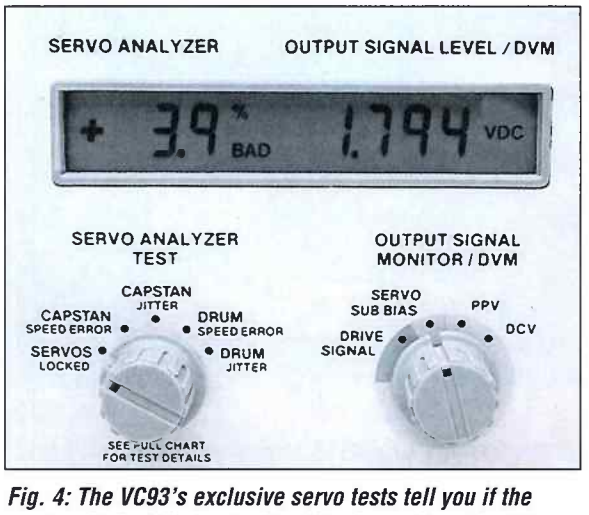



*Fig. 4: The VC93's exclusive servo tests tell you if the servos are working correctly with a percentage reading and a "GOOD" or "BAD" indication.*

To further isolate defective heads, remove one lead while injecting into the preamp. You should see one field of VC93 Color Bars and one field of the tape you are playing. If you see one field of VC93 Color Bars and one field of snow, then the channel you are not injecting into is the defective head or rotary transformer. Repeat this test for the other video head channel.

If the injection doesn't give a clear locked in picture, then you have to start breaking the luminance circuits into functional blocks. Follow Tech Tip 193 (Troubleshooting VCR Luminance Circuits) for additional troubleshooting assistance.

So far, we have determined how to isolate servo problems and video head or luminance defects – two of the most time consuming repairs to isolate. By quickly locating where the problem is, you have pinpointed the extent of the problem so you can provide an accurate estimate – in a matter of minutes.

We've talked about how to isolate the servos, video heads, and luminance circuitry defects. But we need to discuss one more section in the VCR that causes the same symptoms as these problems – the tape path circuitry.

## Checking The Tape Path

There are many components that are instrumental in pulling the tape smoothly across the video and audio heads without jerky movements, noise lines, or warbly sound. Any of the mechanical components that experience normal wear can cause the same symptom as a defective servo or a video head. If you isolate the servos, video heads, and FM luminance circuitry, then there is only one thing left to check – the tape path. Following are some of the components that are likely suspects.

The drum mechanical components are responsible for the proper position of the tape with respect to the video heads. Anything that is slightly off or worn may cause a snowy picture or noise lines through the video.

Make it strict routine to check the guide rollers (P-Posts). Make sure the tape is riding on the air cushion and the rollers are fairly stable,

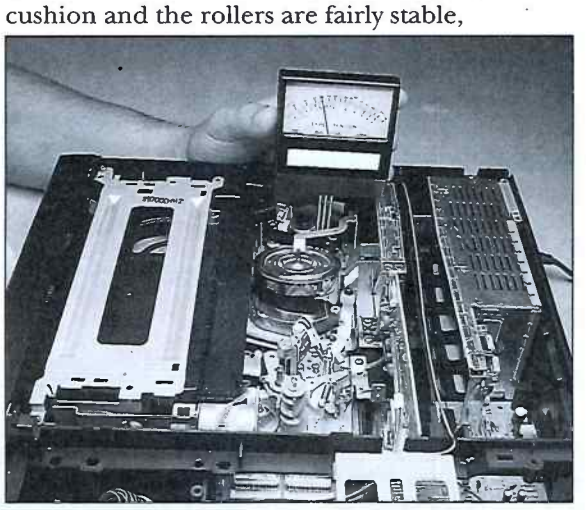


***Fig. 5: Be sure to check the alignment of the entire tape path, including the tape tension.***

although some movement is normal. Check that the guide rollers are against the V-blocks. If they are not, the tape will not be positioned on the heads properly. Check the slant posts for proper position, also. If they are bent, the tape will no longer ride on the heads properly.

If the tape tension is misadjusted, the tape will be stretched or too loose across the heads. Check the adjustment of the tension arm and the alignment of the post. Often if you have oxide flakes on the lower drum assembly or in the grooves of the upper drum, you may see some noise lines or jitter in the picture. To identify this problem, take a magnifying glass and inspect the drum itself. Also check for dings or scratches on the drum when inspecting with the magnifying glass.

The capstan circuitry is responsible for pulling the tape through at the proper speed. Any variations will affect the tape speed which affects the video and audio both. Make sure that the control and audio head are cleaned and positioned properly.

Since the take-up reel is not driven directly, make sure the clutch assembly is positioned properly. If it is not, you may hear some audio warble in the tape. Also, if the capstan pinch roller is glazed, then the tape may start to slip. Replace the pinch roller or use sandpaper to rough up the smooth surface (be sure not to leave flat spots).

These are some of the main mechanical components you should check, although there are other components and adjustments that will need to be done. Refer to your manufacturer's literature for the proper procedures.

You can save time and money in isolating your picture problems with this three step procedure using the VC93 All Format VCR Analyzer. You'll quickly know if the VCR you're servicing is going to return profit in the least amount of time. Give your Area Sales Representative a call today at **1-800-SENCORE**. We can help set up a VC93 no-obligation trial so you can develop a VCR analyzing strategy for the future. ■

# Tech Talk

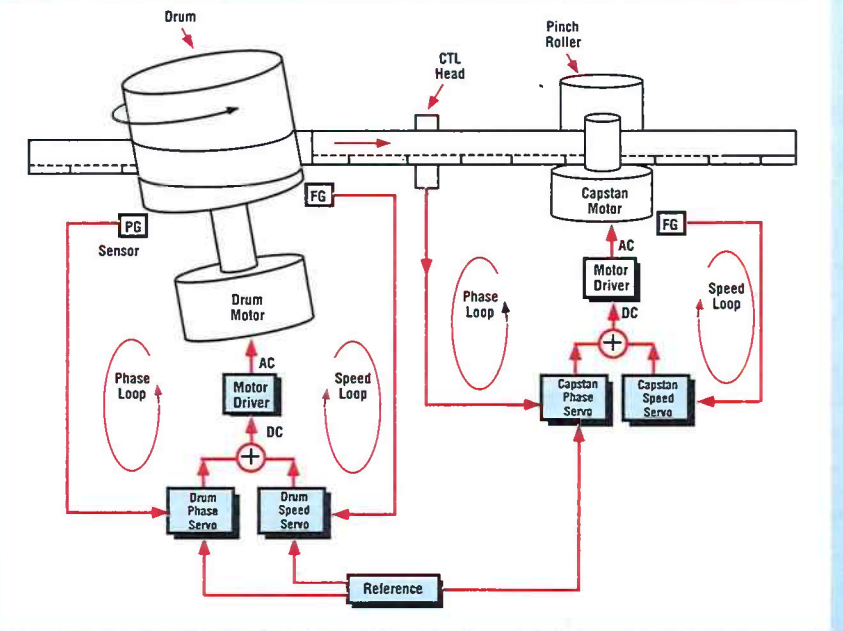
## The Basics Of Servos

VCR servos control the movement of both the video tape and the video heads. Servos are a combination of mechanical devices and electronic circuits. The capstan servo controls the movement of the video tape through the VCR, while the drum servo controls the movement of the video heads. Together, they ensure that the correct video head is positioned exactly over the corresponding video track on the magnetic tape. Since the video heads spin close to 1800 RPM, and the recorded track is only a few thousandths of an inch wide, servo operation must be exact.

The capstan servo uses a motor and pinch roller to pull the video tape through the VCR. An electric motor driver supplies the current to run the motor. In order for the motor to run at the correct speed, a servo control "loop" monitors the motor rotation and another loop monitors the tape position. They supply correction signals to the motor driver to correctly position the video heads to pick up a signal.

A frequency generator (FG) sensor, located next to the motor, develops a signal for the servo speed control loop to tell it how fast the motor is turning. The speed servo loop compares this signal to a reference signal and sends a correction voltage to the motor driver to correct for any motor speed variations.

A second signal, called the control track logic (CTL) signal, is obtained from the video tape using a CTL head. It tells the capstan phase loop where the tape is at any instant in time. The CTL signal is compared to the reference signal and a correction signal is sent to the motor driver to speed up or slow down the motor to get the tape in the correct position at the correct time.



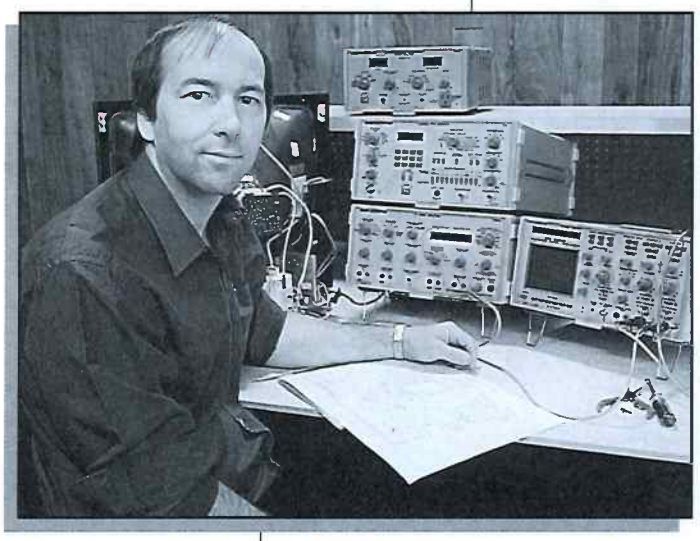

The drum servo controls the speed of the drum motor which rotates the video heads at a rate of approximately 1800 RPM. A similar electronic motor driver supplies the current to run the drum motor. In order for the drum motor to run at the correct speed, two control "loops" are again used to monitor the speed of the spinning heads and their position.

Like the capstan servo, the drum servo uses an FG sensor to create a signal that indicates how fast the drum is turning. This signal is monitored by the drum speed loop and a correction voltage is created to speed up or slow down the motor.

The drum servo uses a pulse generator (PG) signal to tell the drum servo phase loop where the video heads are in their rotation. The PG signal is compared to the same reference signal used by the capstan circuit to create a correction voltage that places the video heads at the correct position at any instant of time.

*For more information, refer to Sencore Tech Tips #186 and #187.*

# Take The Guesswork Out Of Testing TV Vertical Yokes.



**By Glen Kropuenske**
Application Engineer

*Sencore Electronics*

Have you ever spent hours testing or replacing parts in the vertical circuits, leaving you guessing that the yoke was bad? Or have you concluded the yoke was bad, only to discover a new yoke didn't solve the problem, but a $2 component did?

Technicians rate vertical circuits among the most difficult circuits in a TV receiver to troubleshoot. Even the most subtle change in component parameters can cause reduced deflection, non-linear deflection, or picture foldovers. These symptoms can be due to a $2 circuit component or an expensive vertical yoke. A carefully planned strategy is needed to reduce the guesswork when it comes to isolating vertical problems.

This article looks at the theory of vertical stages and examines why they are so difficult to troubleshoot. It further explains the strategy how to quickly determine if the problem is in the yoke or in the vertical circuits using the TVA92 TV Video Analyzer's Vertical Yoke Drive Output. When it comes to vertical circuits, the strategy you use could be the difference between a profit and a long journey down the wrong road.

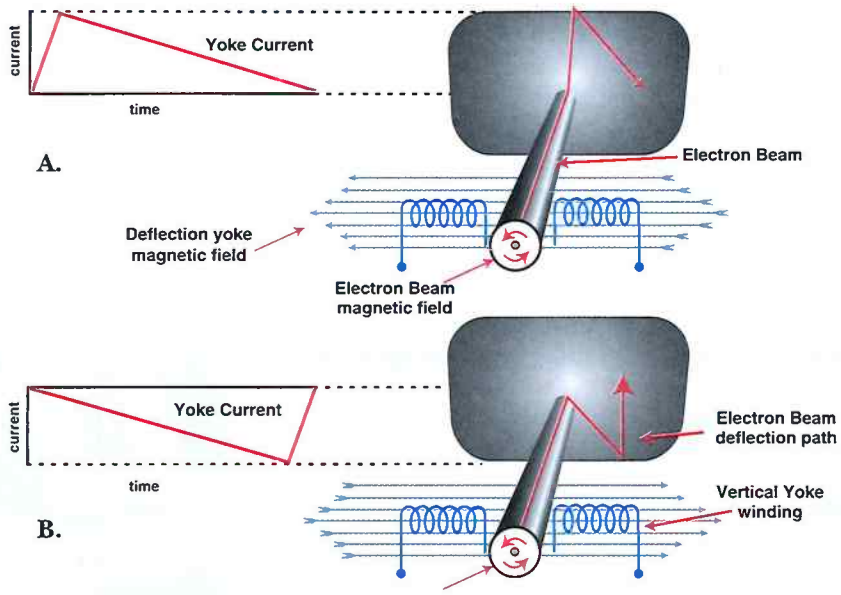



*Fig. 1: The yoke mounted on the CRT neck produces the magnetic field resulting in electron deflection.*

## How The Vertical Yoke Produces CRT Beam Deflection

Understanding vertical stages requires an understanding of cathode ray tube (CRT) beam deflection. Inside the CRT, an electron gun emits a stream of electrons. These electrons travel to the face of the CRT striking the phosphor surface to produce light.

If the stream of electrons travel to the CRT face without influence from any magnetic or electrostatic field, the electrons strike the center of the CRT producing a white dot. To move the dot across the face of the CRT face requires that the electrons be influenced by an electrostatic or magnetic field.

In video display CRTs, a magnetic field is produced by the vertical coils of a yoke mounted around the neck of the CRT. The yoke is constructed with coils wound around a magnetic core material.

When current flows in the vertical yoke coils, a magnetic field is produced. The yoke's core concentrates the magnetic field inward through the neck of the CRT. As the electrons pass through the magnetic field on the way to the CRT face, they are "deflected" or pulled upward or downward by the yoke. This causes the electrons to strike the CRT face at points above or below the center.

To understand how electrons are "deflected" requires a review of the interaction of magnetic fields (refer to Fig. 1). You will recall that an individual electron in motion is surrounded by a magnetic field. The magnetic field is in a circular motion surrounding the electron. As electrons travel through the magnetic field of the yoke, the magnetic fields interact. Magnetic lines of force in the same direction create a stronger field while magnetic lines in opposite directions produce a weaker field. The electron is pulled toward the weaker field.

The direction of the current in the yoke coil determines the polarity of the yoke's magnetic field. This determines if the electron beam is deflected upward or downward. Current flow in the direction shown in Fig. 1A causes the electron beam to deflect upward. Current flow in the opposite direction through the yoke coils (Fig. 1B) reverses the magnetic field causing the beam to deflect downward.

How far the electrons are repelled when passing through the yoke's magnetic field is determined by the yoke and the level of current flowing in the vertical coils. The higher the current, the stronger the magnetic field and resulting electron deflection.

A requirement of vertical deflection in a TV or monitor is that the current in the coils of the vertical yoke increase an equal amount for specific time intervals. This linear current change causes the deflection of the electron beam to

make a uniform or smooth movement from the top to center and from the center to the bottom of the CRT face.

During normal TV or monitor operation, the yoke current increases and decreases as illustrated in waveforms 1A and 1B. The current changes directions alternating between illustration 1A and 1B approximately 60 times a second. The alternating current moves the electron beam from the top of the CRT face to the bottom and then quickly back to the top.

## How The Vertical Drive Signal Is Produced

The vertical section consists of four basic circuits or blocks as shown in Fig. 2. They include 1) Oscillator or Digital Divider, 2) Buffer/Predriver Amp 3) Driver Amp and 4) Output Amplifier. The circuitry for these stages may be discrete components on the circuit board or may be included as part of an integrated circuit(s).

The vertical oscillator generates the vertical signal. The signal is output to the amplifiers and drives the yoke to produce deflection. Vertical oscillators may be free-running circuit oscillators or more modern digital divider generators.

The output of a vertical oscillator must be a sawtooth shaped waveform. A ramp generator is often used to shape the output waveform of a freerunning oscillator or digital divider. A ramp generator switches a transistor on and off, alternately charging and discharging a capacitor. When the transistor is off, the capacitor charges to the supply voltage through a resistor. When the transistor is switched on, the capacitor is discharged.

The vertical oscillator must be synchronized with the video signal so a stationary picture can be viewed on the CRT display. The oscillator frequency is controlled in two ways. A vertical hold control may be used to set the free-running oscillator close to the vertical frequency. Vertical sync pulses, removed from the video signal, are applied to the vertical oscillator locking it to the proper frequency and phase. If the oscillator is not synced, the CRT picture rolls vertically. The picture rolls upward when the oscillator frequency is too low, and downward when the frequency is too high.

There are several intermediate amplifier stages between the output of the vertical oscillator and output amplifier stage. Some common stages are the "buffer", "predriver" and/or "driver." The purpose of the buffer amplifier stage is to prevent loading of the oscillator which may cause frequency instability or waveshape changes.

The predriver and/or driver stages shape and amplify the signal to provide sufficient base drive current to the output amplifier stage. This permits the output stage transistors to produce the yoke current needed for full and linear deflection.

The predriver and/or driver amplifier stages are commonly DC coupled and use AC and DC feedback much like audio amplifier stages. Feedback maintains the proper DC bias and

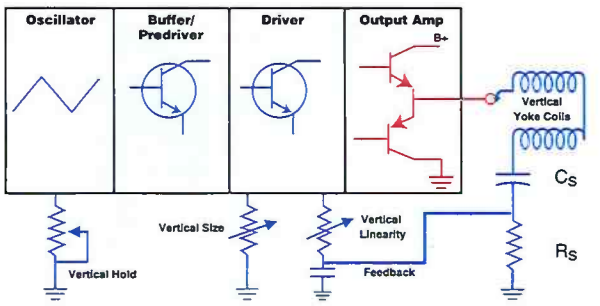



*Fig. 2: The vertical section of a TV consists of an oscillator, buffer, driver, and output amplifier.*

waveshape to insure the current drive to the yoke remains constant as components, temperature, and power supply voltages drift.

AC feedback in most vertical circuits is obtained by a voltage waveform derived from a resistor placed in series with the yoke. The small resistor is typically placed from one side of the yoke to ground. A sawtooth waveform is developed across the resistor as yoke current alternates through it. This resistor provides feedback to widen the frequency response, reduce distortion, and stabilize the output current drive to the yoke. The feedback is often adjusted with gain or shaping controls known as the Vertical Height or Size and Vertical Linearity controls.

DC feedback is used to stabilize the DC voltages in the vertical output amplifiers. DC voltage from the output amplifier stage is used as feedback to an earlier amplifier stage. Any slight increase or decrease in the balance of the output amplifiers is offset by slightly changing the bias. Since the amplifiers are direct coupled, the bias change slightly shifts the bias on the output transistors bringing the stage back into balance.

Much of the difficulty in troubleshooting vertical stages is due to the feedback and DC coupling between stages. A problem in any amplifier stage, yoke, or its series components alters all the waveforms and/or DC voltages making it difficult to trace the problem.

## How The Vertical Output Stage Produces Yoke Current

The vertical yoke may require up to 500 mA of alternating current to produce full deflection. A power output stage is required to produce this level of current.

A vertical output stage commonly consists of a complementary symmetry circuit with two matched power transistors (see Fig. 3). The transistors conduct alternately in a push-pull fashion. The top transistor conducts to produce current in one direction to scan the top half of the picture. The bottom transistor conducts to produce current in the opposite direction to scan the bottom of the picture.

To better understand the typical vertical output stage, we will analyze the current paths at four times during the vertical cycle (refer to Fig. 3). Starting with time "a", the top transistor, Qt, is turned on by the drive signal to its base. The transistor is biased "on" resulting in a low conduction resistance from collector to emitter which provides a high level of collector current. This puts a high +V potential at the top of the yoke resulting in a fast rising current.

During time "a", capacitor Cs charges toward +V and current flows through the yoke and the top transistor, Qt. This pulls the CRT's electron beam from the center of the CRT quickly to the

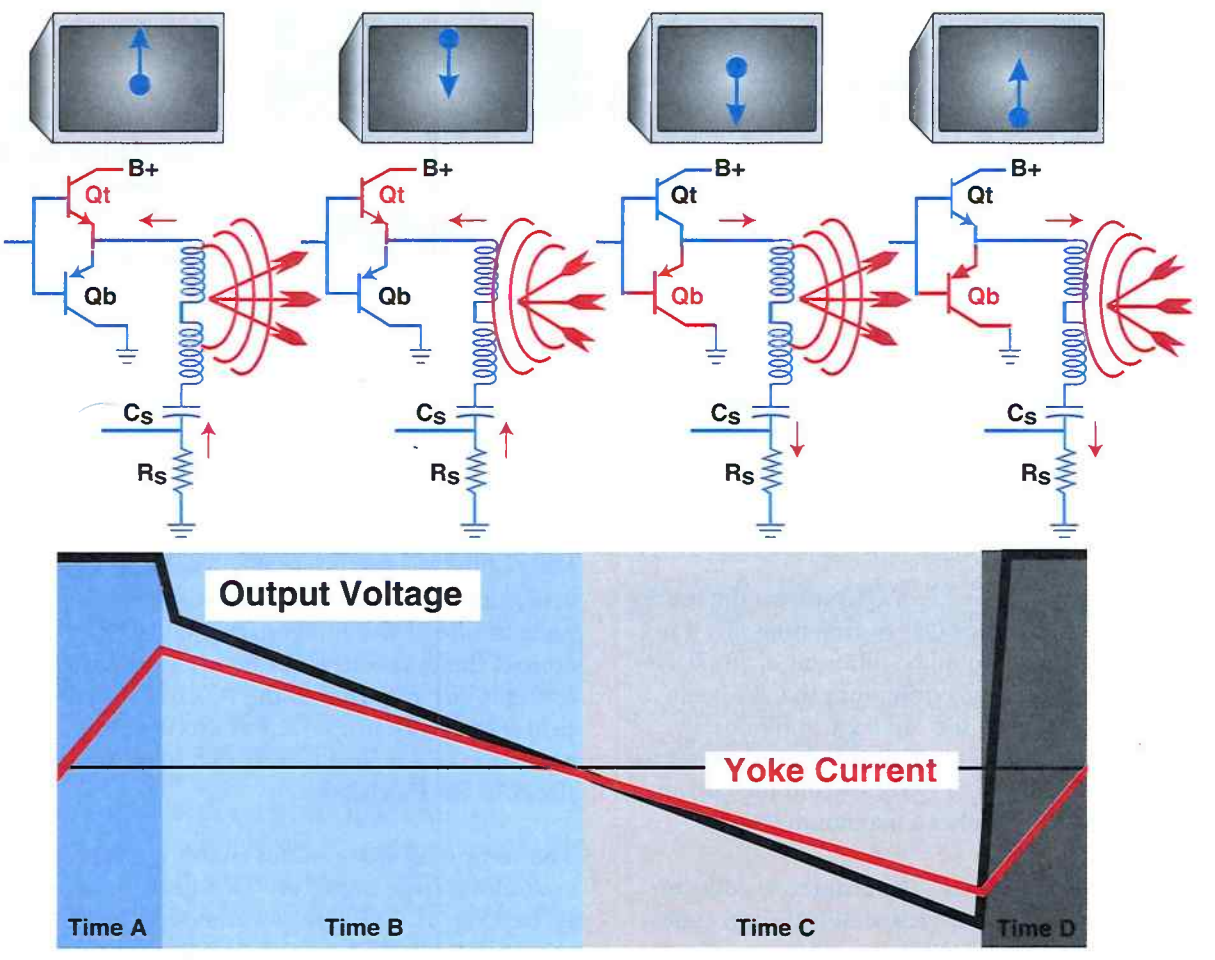



*Fig. 3: The deflection, currents, and waveforms during four periods of vertical cycle.*

top. During time "a", an oscilloscope connected at the emitter junction displays a voltage peak as shown in the V Output waveform. The inductive voltage from the fast changing current in the yoke along with retrace "speedup" components cause the voltage peak to be higher than +V.

The current flowing in the yoke during time "a" produces a waveform as viewed from the bottom of the yoke to ground. This is the voltage drop across Rs which is a reflection of the current flowing through the yoke.

During time "b", the drive signal to Qt slowly increases the transistor's emitter to collector resistance. Current in the yoke steadily decreases as the transistor increases its E-C resistance and reduces its collector current. The voltage at the emitter junction falls during this time and capacitor Cs discharges. A decreasing current through the yoke causes the CRT's electron beam to move from the top to the center of the screen.

To produce a linear fall in current through the yoke during time "b" demands a critically shaped drive waveform to the base of Qt to meet its linear transistor operating characteristics. The drive waveform must decrease the transistor's base current at a constant rate. Furthermore, the transistor must operate with linear base-to-collector current characteristics. Reductions in base current must result in proportional changes in collector current. The linear decrease in the yoke current is shown by the I Yoke or Vrs waveform.

At the end of time "b", transistor Qt's emitter-to-collector resistance is high and the transistor is approaching the same emitter-to-collector resistance as the bottom transistor Qb. The capacitor Cs has been slowly discharging to the falling voltage at the emitter junction of the output transistors. Just as the voltage at the emitter junction approaches 1/2 +V, the bottom transistor begins to be biased "on" to begin time "c". This transition requires that the conduction of Qt and Qb at this point be balanced to avoid distortion in the center of the CRT.

During time "c", the resistance from the c ollector to emitter of transistor Qb is slowly decreased by the base drive signal and the collector current increased. Capacitor Cs begins to discharge producing current through the yoke and through Qb. As Qb's resistance decreases and its collector current increases, the voltage at the emitter junction decreases. This can be seen on the V Output waveform as it goes from 1/2 +V towards ground during time "c". The current increases at a linear rate through the yoke as shown in the I Yoke or Vrs waveform.

The resistance decrease of Qb must be the mirror opposite of transistor Qt's during time "b". If not, the yoke current would be different in amplitude and/or rate causing a difference in CRT beam deflection between the top trace and bottom trace times. At the end of time "c", the emitter to collector resistance of Qb is low and the current in the yoke approaches a maximum level.

At the start of time "d", the emitter to collector resistance of Qb is increased quickly and collector current decreased. This quickly slows the discharging current from capacitor Cs through the yoke and transistor. As the current is reduced, the trace is pulled quickly from the bottom back to the center. Time "a" begins once again, and the cycle repeats.



## Understanding Today's Vertical ICs

Most of the vertical stages discussed in this article are found in today's television receivers as parts of one or two integrated circuits. Of course, the yoke and other components external to the IC are required so the IC's individual vertical stages work properly. Let's look at the operation of a typical IC vertical circuit found in the NAP R1 TV chassis.

The vertical oscillator in this chassis is a vertical countdown stage within the TV Signal Processor IC (see Fig. 4). The vertical countdown block receives an input from the horizontal oscillator, divides it by 262, and is gated by vertical sync. The output is a synchronized vertical pulse on pin 27.

The vertical signal is buffered by a transistor and applied simultaneously to the microprocessor and character generator to synchronize on-screen display graphics. The signal is also routed to pin 3 of IC550. IC550 contains a ramp generator, buffer amplifier, and the vertical amplifier stage.

The vertical signal to the ramp generator charges and discharges C558 producing a sawtooth or ramp signal at pin 7. The amplitude of the ramp signal is adjustable with the vertical size control. The lack of an input to the ramp generator would result in no output and no vertical yoke deflection.

The output of the ramp generator feeds the buffer amplifier and then the output amplifier at pin 9. DC voltage at pin 9, developed by the voltage divider networks, sets the bias to the amplifier and provides DC feedback to stabilize the gain of the amplifier and center the deflection.

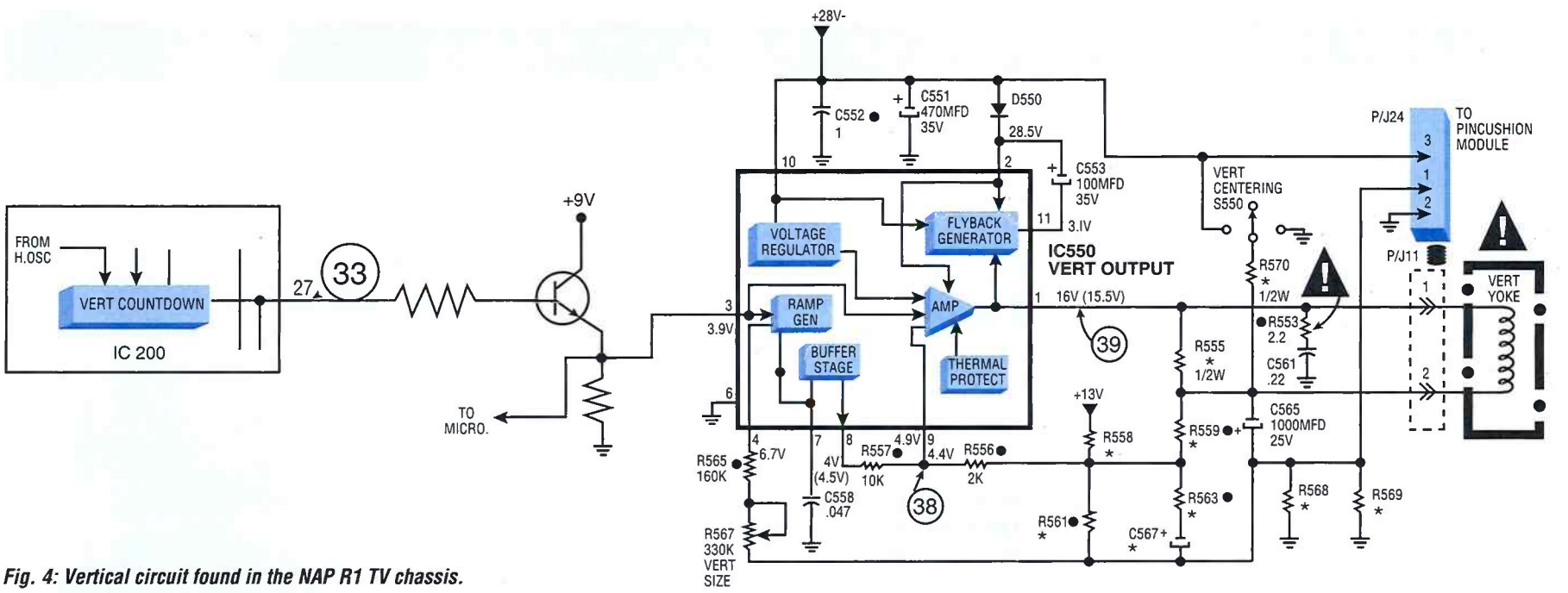



***Fig. 4: Vertical circuit found in the NAP R1 TV chassis.***

The output amp of IC550 contains the complementary output amplifier transistor stage as explained in this article. The output amplifier causes current to alternate through the yoke by conduction through the parallel resistors R568 and R569 charging and discharging capacitor C565. During retrace time, the flyback generator block switches-in capacitor C553, which was charged to 28 volts during trace time. The capacitor and D550 conduct, doubling the supply voltage to the output producing a waveform amplitude of 58 volts peak during retrace at pin 1. The added voltage works to increase the rate of current and speed up retrace time.

A portion of the signal across the yoke series capacitor, C565, is shaped by R563/C567 and added to the DC at pin 9. This AC feedback shapes the drive signal and maintains proper drive linearity. Problems associated with IC550 or components surrounding it all can cause reduced or improper deflection due to the DC and AC signal feedback. A quick method to accurately prove the yoke is good at full operational current lets you know the circuit has a relatively inexpensive part causing the problem.

## Understanding The TVA92's Vertical Yoke Drive Output

The TVA92 TV Video Analyzer dynamically tests the vertical yoke by subbing for the drive signal which normally drives the yoke. This lets you analyze the yoke's ability to produce a full linear deflection.

The TVA92's Vertical Yoke Drive Output signal is produced by circuits similar to the vertical stages of a TV receiver. Vertical sync pulses originating in the TVA92's video generator are input to the TVA92's vertical ramp generator to sync lock the yoke drive. Since the Vertical Yoke Drive signal is locked to the video, you can simply watch the CRT of the receiver to determine if the vertical yoke coils produce proper vertical deflection

The TVA92's Vertical Yoke Drive Level control lets you increase the output signal (AC current) to the yoke being tested. The control varies the output from approximately 0-40 VPP and deflection current from 0-1.5 amp peak. When the TVA92's Output Signal Monitor DVM switch is set to "Yoke Drive", the digital LCD display indicates the output peak-to-peak signal level.

## Connecting The TVA92 To The Vertical Yoke

The TVA92 Vertical Yoke Drive signal is present on a separate jack – a jack different than the other TVA92 substitution signals. The Vertical Yoke Drive is unlike the other TVA92 substitution signals, so it is applied to the circuit differently.

The vertical output amplifier in a TV receiver is a power output amplifier. It drives current into a low impedance load (yoke). Attempting to swamp out the output current drive of the amplifier and substituting for it at the same time would not be effective and would likely cause component damage. Therefore the yoke must be disconnected from the circuit before applying the TVA92's Vertical Yoke Drive.

There are two ways to disconnect the vertical yoke from the circuit. The easiest is simply to remove the plug that connects the vertical yoke to the circuit board. You may find a single plug connecting the vertical and horizontal yoke to the circuit board or separate vertical and horizontal plugs. Another method of disconnecting the yoke is unsoldering the wires from the yoke windings. Most yokes have mounted terminals on the yoke assembly that can be accessed by removing a plastic cover.

## How To Test The Vertical Yoke With The TVA92

To test the vertical yoke, start with the TVA92 Vertical Yoke Drive control set to "0" and the Output Signal Monitor/DVM switch set to "Yoke Drive." Connect the VG91 or VA62A RF/IF Output to the antenna input on the TV receiver. Set the VG91 or VA62's RF-IF controls to generate a cable channel at 1000 uV. Select the "Crosshatch" video pattern.

Now apply power to the TV chassis and turn it on. Select the channel on the TV receiver to agree with the number of the RF channel indicated by the VG91 or VA62. Observe the CRT of the receiver for an illuminated horizontal line across the middle of the screen.

Increase the Vertical Yoke Drive Level control while looking at the CRT. Adjust the control in either the positive or negative direction until the Crosshatch pattern nears the top and bottom of the display. If the vertical yoke is good, you will see a full and near-linear deflection. The Crosshatch pattern boxes should be near squares from the top to the bottom of the screen if the yoke is good.

If the yoke is bad, the results will be similar to the problem seen when the chassis vertical circuits are driving the yoke. To achieve full deflection may require an increase in the TVA92 drive level control resulting in foldovers or nonlinearities in the Crosshatch video pattern seen on the display.

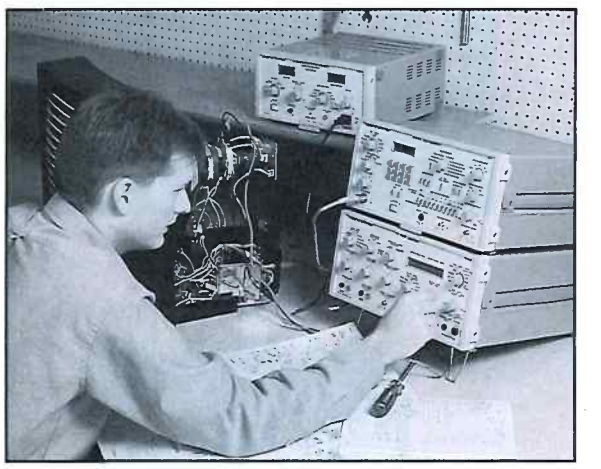
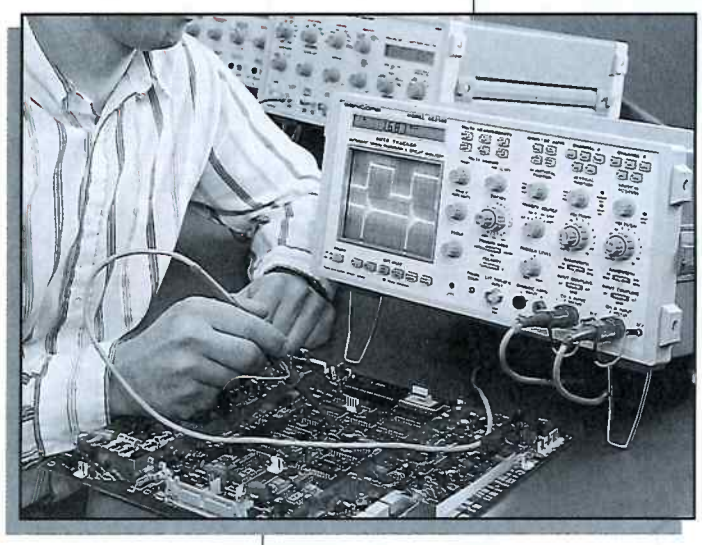


***Fig. 6: A full linear display indicates a good vertical yoke while nonlinearities or foldovers similar to the chassis symptoms indicate a yoke defect.***

## Another TVA92 Testing Strategy Advantage

What's your strategy when it comes to isolating vertical problems and testing suspect yokes? Stop guessing! The Vertical Yoke Drive and Horizontal Output tests give you the advantage you need to eliminate frustration and save you valuable troubleshooting time and money. Give your Area Sales Representative a call today at **1-800-SENCORE** (736-2673) to set up a no-obligation trial. ■

# Waveform Analyzing Strategies Using The SC3100 "AUTO TRACKER"™



**By Larry Schnabel**
Sencore News Editor

*Sencore Electronics*

We've already introduced you to the SC3100 "AUTO TRACKER" Automatic 100 MHz Waveform & Circuit Analyzer and its features in the last several issues of the Sencore News. The "AUTO TRACKER" lets you touch and test any circuit test point and make autoranged error free measurements in a fraction of the time.

We've told you about the dynamic Auto-Tracking™ and Delta Digital tests. By now, you've probably seen or heard how the SC3100's exclusive autoranging functions can save you a lot of precious time. And we've told you about the SC3100's features like 2 mV volt sensitivity, TV triggering, and 100 MHz bandwidth.

Now we're going to show you how to put the SC3100 "AUTO TRACKER" to work in real-life situations. In this article, we'll show you the strategy how to analyze and/or align these four key troubleshooting and analyzing waveforms:

1. **Horizontal Output Pulse**
2. **Sandcastle Signal**
3. **VCR Headswitching**
4. **VCR Tracking Fix**

Our strategy in this article is to show you how the SC3100 "AUTO TRACKER" can make your analyzing faster and more accurate. We've chosen these four signals because they are common signals that you may have already tried to analyze using a conventional oscilloscope. And since these signals are common signals to many servicers, you've probably experienced some of the time consuming problems they present. So while reading this article, reflect back to your current waveform analyzing strategies, then think about the time you could save with an SC3100 "AUTO TRACKER."

## #1 Analyzing The Horizontal Output Pulse

Of all television and computer monitor waveforms, the horizontal output collector pulse is considered one of the most important. This pulse is responsible for high voltage and focus voltage production, blanking, and often a host of scan derived voltages, besides providing horizontal deflection.

But one problem prevents competitive oscilloscopes from analyzing the horizontal output collector pulse – the amplitude of the pulse. The horizontal output pulse ranges from 500 to 1,500 volts peak-to-peak. This pulse can cause serious front-end damage to a scope since the

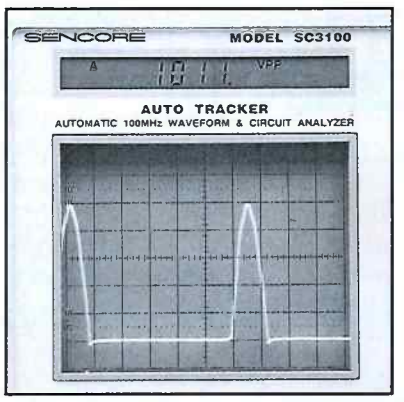



***Fig. 1: Only the SC3100 "AUTO TRACKER" lets you safely view the typical horizontal output pulse up to 2000 VPP.***

amplitude is several times greater than the input rating of most scopes (typically 200-500 volts).

The SC3100's exclusive 2,000 volt measuring range allows you to view and analyze the 500 to 1,500 volt peak-to-peak signal produced by these horizontal output stages. Only the SC3100 allows you to safely measure this pulse, while other scopes would likely be damaged by this high-powered signal. Even if you should happen to leave the SC3100's VOLTS/DIV control in the .02 V position, no damage will result. Here's how to analyze the horizontal output pulse with the SC3100 "AUTO TRACKER":

***NOTE:*** *Always plug a hot chassis TV or monitor into an isolation transformer such as the Sencore PR570 "POWERITE II" before you begin troubleshooting.*

1. Connect the SC3100's channel A probe to the collector of the horizontal output transistor and ground to circuit ground.
2. Set the TIME/DIV and VOLT/DIV switches on the SC3100 to "AUTO" and observe the waveform.

It's that simple – and you'll be looking at two crisp, clear cycles of the signal. You'll want to carefully examine these waveforms for symmetry, extra ringing pulses, or the presence of a deep saddle. Any one of these symptoms could be the cause of present or future problems in the chassis. But the "AUTO TRACKER" doesn't stop analyzing with just waveshape, and neither should you.

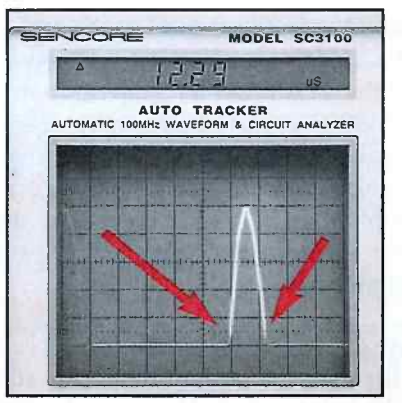



***Fig. 2: The "AUTO TRACKER" lets you measure the pulse width between the 10% amplitude points to check for proper timing.***

**Waveshape** - The horizontal output waveform should look like Fig. 1 on page 28. It should be symmetrical, free from extra ringing pulses, and should not contain a deep saddle. A deep saddle indicates an excessive load, possibly a shorted turn in the flyback. Extra ringing pulses indicate a cracked core in the flyback, bad damper, or drive signal problems.

**DCV** - The DC voltage is normally between 110 to 130 volts, but be sure to check the schematic for the exact amount. If this voltage measures incorrect, check the B+ regulator circuit or possible loading of the supply.

**Pulse Amplitude** - The amplitude of the output pulse ranges from 500 to 1,500 volts, depending on the chassis. The measured PPV amplitude should be within about 50 volts of the amplitude shown on the schematic. Readings that are considerably different from the schematic value indicate problems with the flyback, load, or drive signal.

**Pulse Width** - The duty cycle measurement can be considered one of the most important parameters. A normal pulse width (which is the output stage retrace time) varies from approximately 11.3 to 16 microseconds. A retrace time less than 11 microseconds indicates excessive loading such as a shorted flyback turn, excessive flyback load, or a retrace capacitor that has decreased in value. A pulse width longer than 16 microseconds indicates a problem yoke circuit.

## #2 Analyzing The Sandcastle Signal The Right Way

A key signal in many of today's color television receivers is the sandcastle waveform. Problems with the sandcastle signal can cause several symptoms: no color, wrong or unlocked color, blank raster, or retrace lines. Note that a defect other than a sandcastle problem can also cause these same symptoms.

The sandcastle signal is a combination of three signals:

1. Flyback pulse
2. Delayed horizontal sync pulse
3. Vertical blanking pulse

As Fig. 3 shows, the manufacturer has established precise parameters for the sandcastle waveform. Deviation from any of these parameters can result in the symptoms described earlier. You can use the following procedure to analyze a sandcastle waveform with the "AUTO TRACKER":

1. Connect the channel A probe to the sandcastle signal and the channel B probe to the output of the video detector (set TRIGGER SOURCE to "CH B").
2. Set the SC3100 TIME/DIV switch to "TVH", leave the VOLT/DIV switch on "AUTO", and analyze the waveform.

Pressing the SC3100's "VPP" button tells you the amplitude of the sandcastle waveform. The waveform should be at least 7.5 volts peak-to-peak on this chassis (see Fig. 3). If this amplitude is incorrect, check the circuitry that processes the flyback (key) pulse.



To fully analyze the sandcastle signal, you must be able to measure individual portions of it. The SC3100's Delta functions allow you to precisely measure these parameters. The "AUTO TRACKER's" exclusive Delta Bar lets you highlight any part of the waveform and analyze the amplitude, absolute DC, time, or frequency. Plus, if you want even more detail of the waveform for more accurate Delta measurements, just pull the HORIZONTAL POSITION control to expand the waveform by a factor of ten.

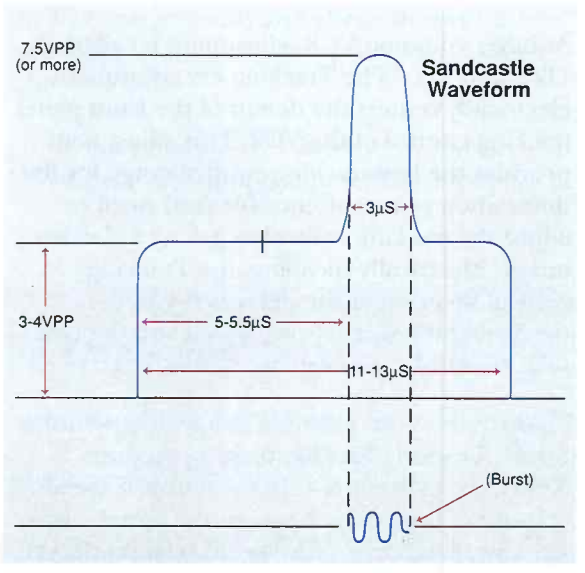



***Fig. 3 : The complex sandcastle signal must meet exact parameters.***

To analyze the portions of the waveform, adjust the Delta Begin and End controls to measure the level between the base and the top of horizontal blanking, as shown in Figure 4a on page 30. If this level is incorrect, check the circuitry that processes the blanking pulses.

Now press Delta Time on the SC3100 and adjust the Delta Begin and End controls to measure the time from the start of the blanking pulse to the start of the burst key pulse, as shown in Figure 4b. If this time is incorrect, check the circuitry that processes the horizontal blanking pulse. You should also measure the width of the burst key pulse with the "AUTO TRACKER's" Delta Time function. If this time is incorrect, check the circuitry that processes the flyback pulse.

a.

b.

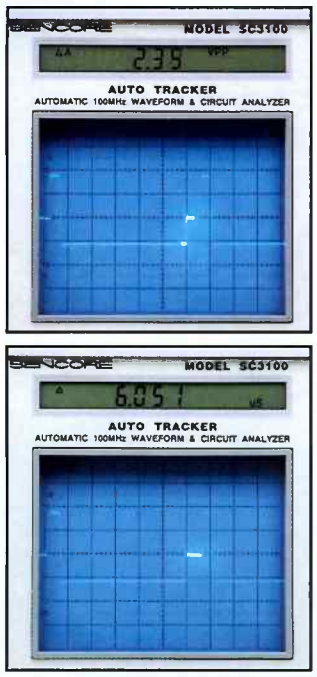



***Fig. 4: Use the SC3100's Delta VPP function to measure the amplitude of the horizontal blanking (a). Use the SC3100 Delta time function to measure the pulse width parameters (b).***

As a final check, adjust the SC3100's vertical position control to place the video signal over the sandcastle signal. Note that most of the color burst should fall within the key pulse portion of the sandcastle.

One, two, three, and you're done. The "AUTO TRACKER" has confirmed whether all parameters of this signal meets manufacturer requirements. Just think about how this could help get those "tough dog" sets off your bench.

## #3 VCR Headswitching Made Easy

All VCR alignment instructions require you to adjust the headswitching signal. But why is the head-switching adjustment so important? Here's why:

VCR circuits produce a visible noise bar when they switch from one spinning playback head to the other. If headswitching occurred halfway between vertical sync pulses, the picture would have a noise bar in the middle of the screen. On the other hand, if headswitching occurred during vertical sync, the picture on the TV receiver or monitor connected to the output would roll or jitter vertically.

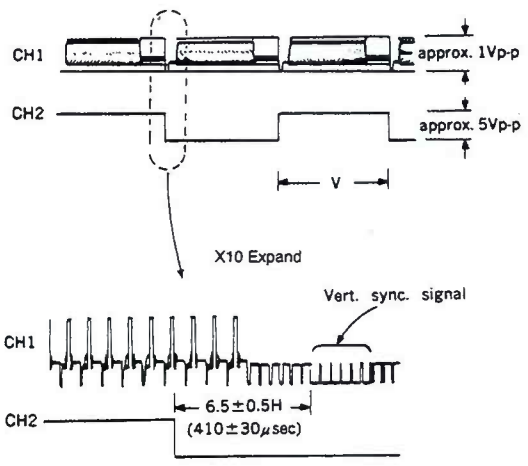



***Fig. 5: The "AUTO TRACKER" expands the waveform with plenty of detail to follow headswitching alignment instructions easily.***

To prevent a visible noise bar or interference with vertical sync, the VCR circuits are adjusted to switch video heads during the last few lines of each vertical field. The "Head Switch" (Head PG, Head Shifter, etc.) adjustment changes the timing of the head switch squarewave signal relative to the vertical sync pulses - placing the noise bar at the very bottom of the screen, below the viewable picture.

The SC3100 "AUTO TRACKER" provides stable triggering and a sharp, detailed waveform to view the headswitching waveforms with ease. The SC3100's fiddle-free sync circuits let you view the waveforms and make the VCR adjustment without worrying about adjusting the "AUTO TRACKER's" controls. Here's how you set up your "AUTO TRACKER" to perform the headswitching adjustment:

1. Connect the SC3100 probes to the test points specified in the VCR's service literature (usually the SW30 and Video Out).
2. Set the TRIGGER SOURCE control to the channel connected to the 30 Hz signal.
3. Set the TIME/DIV switch to "1 mS", leave the VOLT/DIV switch on "AUTO", and observe the waveforms.

Turn the Horizontal Vernier control counter-clockwise until the transition in the SW30 signal just becomes visible. Now, adjust the HORIZONTAL POSITION control to place the square wave transition on the CRT's center graticule. Then pull the HORIZONTAL POSITION control outward to expand the waveforms by a factor of ten.

When you play back the VCR alignment tape, the CRT display will look like the drawing in Fig. 5. Notice that you can clearly see the horizontal sync pulses ahead of the vertical sync interval. Set the VCR's PG adjustment so there are $3\frac{1}{2}$ horizontal lines before the start of vertical blanking, or $7\frac{1}{2}$ lines before vertical sync. If the video signal contains equalizing pulses, be sure to only count every second pulse. For a more detailed explanation, call your Area Sales Representative for a copy of the Tech Tip explaining VCR headswitching.

## #4 Setting VCR Tracking Fix Helps Insure A Quality Repair

Another common VCR adjustment is called "Tracking Fix." The Tracking Fix adjustment electrically centers the detent of the front panel tracking control of the VCR. This adjustment provides the best tracking control range for the times when your customer (or you) need to adjust the tracking control to get a good video image. Electrically speaking, the Tracking control determines the delay between the headswitching square wave signal and the tape's CTL (control track) signal.

Figure 6 shows an example of a typical manufacturer's Tracking Fix alignment procedure. Notice the procedure calls for setting a specified amount of time delay between the signals. The amount of delay and the specific test points will vary somewhat between VCRs. Most procedures call for setting the time delay between the 30 Hz

| 3-2-1. Tracking Fix Adjustment | | | |
|---|---|---|---|
| TP<br>TP2005<br>TP2006 | AF<br>R2022 | MODE<br>SP SELF-RECORDING AND PLAYBACK | INPUT<br>(VIDEO IN) VIDEO SIGNAL |
| Tape | M. EQ. | Spec. | |
| Blank Tape | Oscilloscope | T - 7.3 ± 0.5 msec. | |

***Fig. 6: The typical Tracking Fix procedure specifies the time delay between two signals.***

switching signal and the CTL pulse when the front panel Tracking control is in the center detent position.

The SC3100 "AUTO TRACKER's" Delta functions simplify the measurement and greatly reduce the chance of errors associated with determining the time of the signals. Here's how you set up the "AUTO TRACKER":

1. Connect the SC3100 probes to the test points specified in the VCR's service literature (usually the SW30 and the CTL pulse).
2. Leave the SC3100 controls set the same as earlier for the headswitching adjustment.
3. Press the Delta Time button (make sure the HORIZONTAL POSITION is pushed in for a non-expanded display).


***Fig. 7: The SC3100's Delta Bar quickly measures the Tracking Fix adjustment time delay between the two signals.***

Play back the VCR alignment tape and adjust the Delta Begin and Delta End controls until the highlighted Delta bar just covers the delay between the two waveforms, as shown in Fig. 7. Now, read the time delay in the SC3100's digital readout. If the delay is not correct, adjust the Tracking Fix Adjustment and watch the "AUTO TRACKER's" digital display until the delay is correct. For more details, call your Area Sales Representative for free Tech Tip information.

As you've just read, the SC3100 analyzes waveforms quickly, typically in three steps or less. If you'd like to learn more about the SC3100 "AUTO TRACKER" Automatic 100 MHz Waveform & Circuit Analyzer, call your Area Sales Representative today toll-free at **1-800-SENCORE** (736-2673). We'll help put one on your own bench, risk-free, to prove to yourself how much the "AUTO TRACKER" can speed up your troubleshooting. And with our easy investment terms and special package deals, the opportunity is even better. Just give us a call. We'll help plan a strategy. ■

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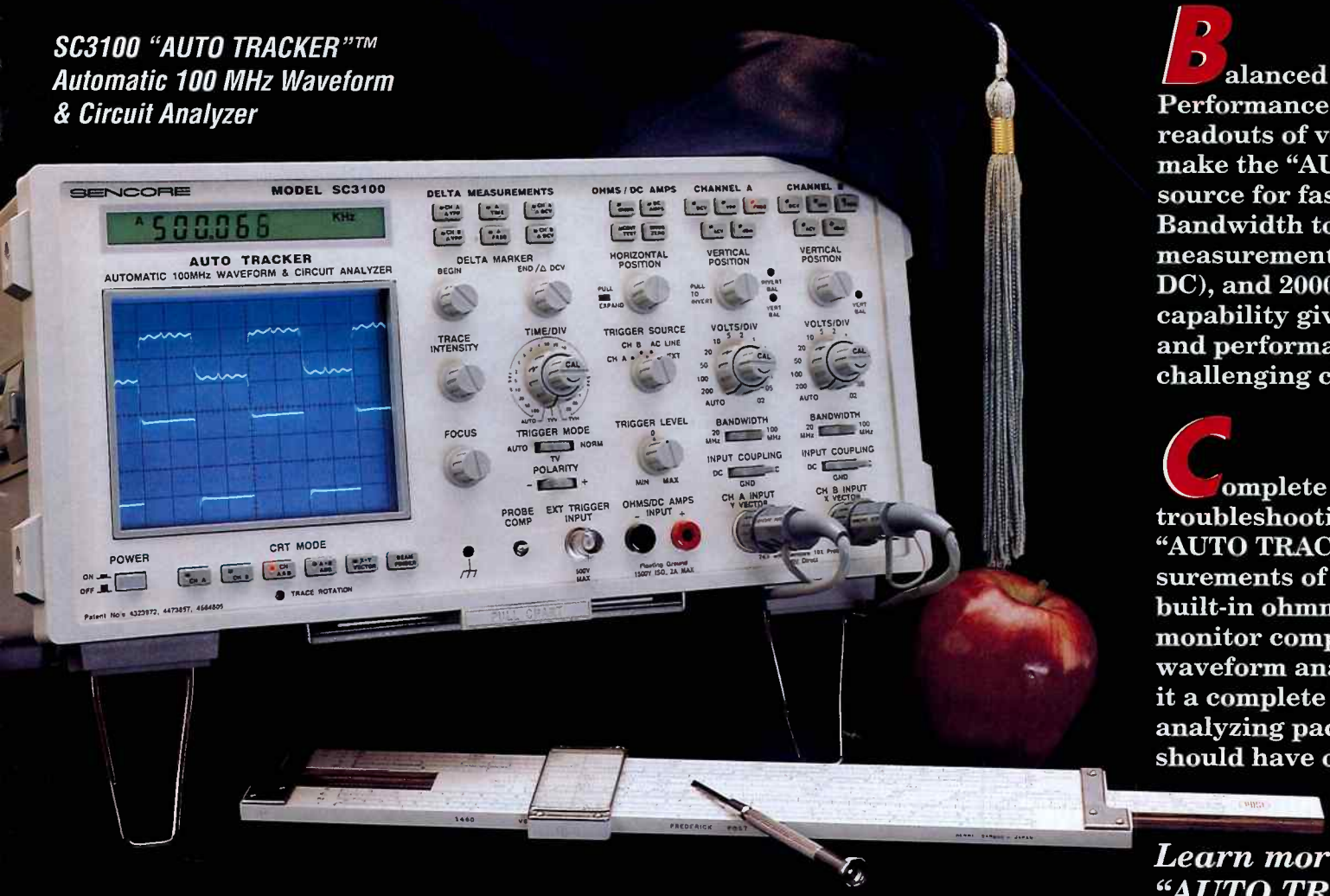


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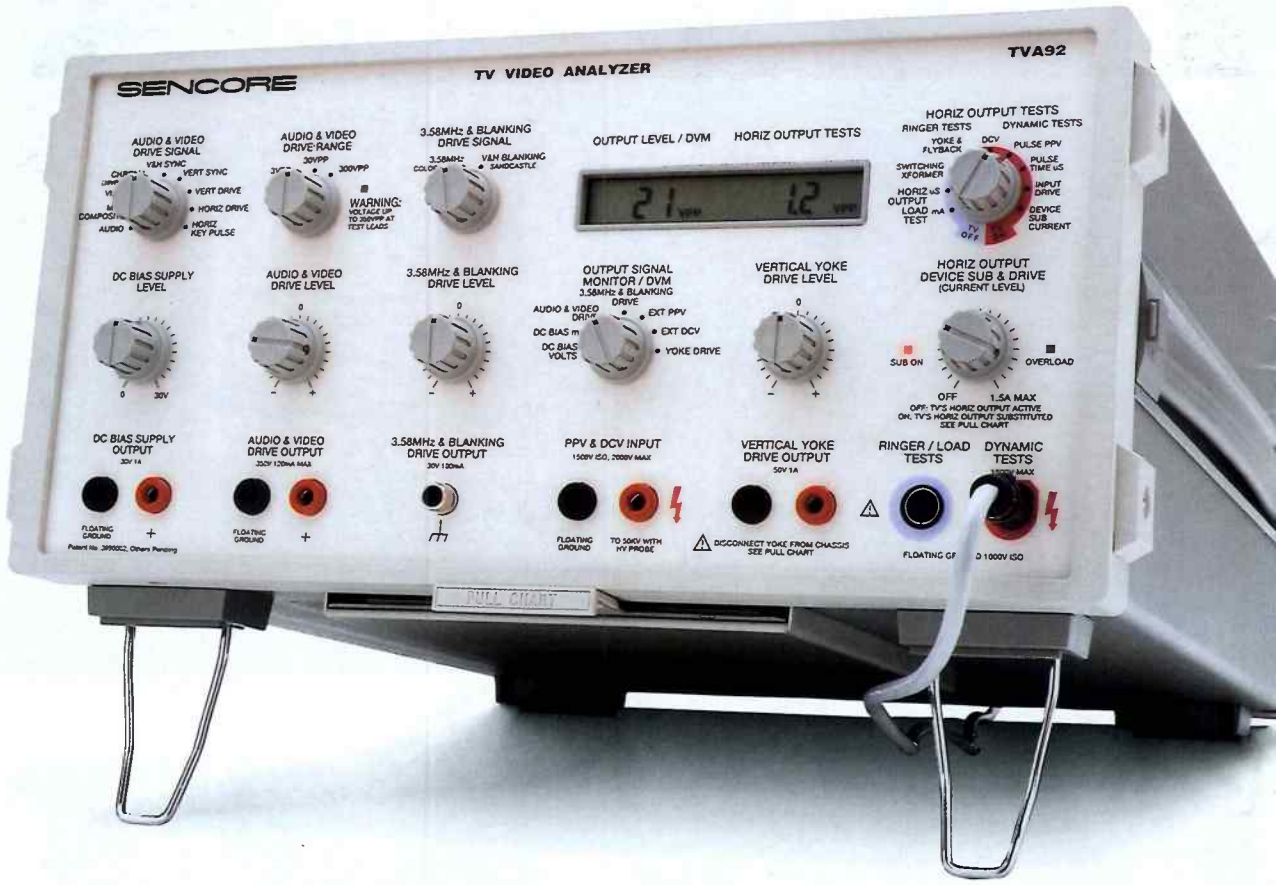


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