SENCORE NEWS

Issue #157 May/June 1992

FRUSTRATED WITH SERVICING THE TOUGH DOGS?

Functional Analyzing Can Take The Frustration Out Of Today's Servicing Challenges!

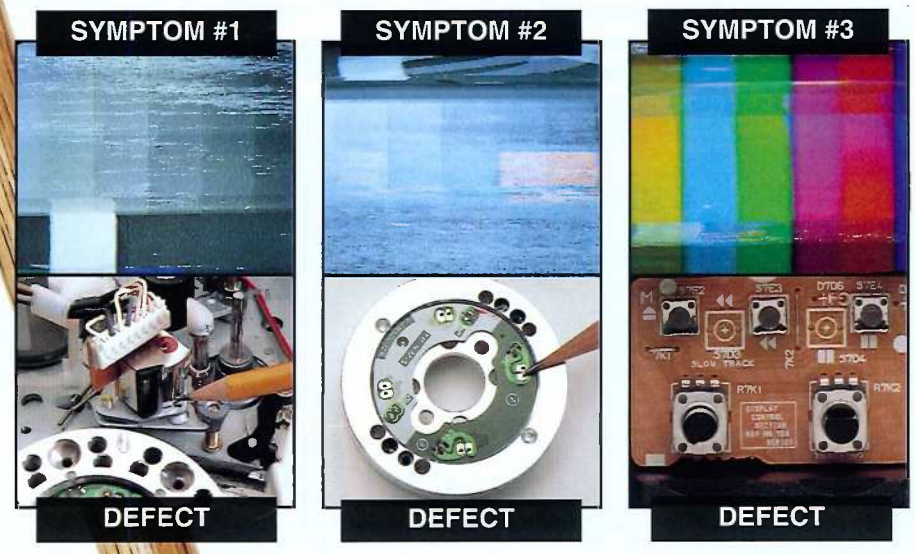
CALL 1-800-SENCORE TODAY!

(736-2673)

ANNOUNCING SENCORE'S NEW EXTENDED SERVICE AGREEMENTS - SEE PAGE 23.

Call Your Area Representative & Find Out About Our Low Interest Investment Options.

Frustrated With Servicing The "Tough Dog" VCRs?



Are You Ready For Today's VCR Challenges?

You know the scenario all too well. A customer brings in a VCR for service with the simple complaint that the picture is noisy. But down deep in the pit of your stomach you wish it would be something else, maybe "It won't load a tape, or it won't rewind". You'd even wish the customer would have said "it plays for a few seconds and then stops".

But a noisy picture, that could be anything from a problem in the servos to bad video heads, or a tape path alignment problem, to a defect almost anywhere in the luminance circuits.

What do you do after you've carefully and thoroughly cleaned the heads - several times – only to find that the same symptom has not gone away?

What would you do next if you had one of these VCRs in your shop?

- Inspect the heads further?
- Check the servos?
- Give the customer a high estimate?
- Order new heads?
- Suspect a mechanical problem?
- Other?

Are you equipped to profitably service today's VCRs and camcorders? Sencore's new VC93 All Format VCR Analyzer answers the five biggest technical troubleshooting challenges when servicing VCR/camcorder playback and record circuits.

If you'd like to see exactly how the VC93 can help you troubleshoot the three symptoms above, call 1-800-SENCORE and ask for your FREE video tape demonstration.

VC93 All Format VCR Analyzer

With the VC93 All Format VCR Analyzer...

Now, You Can Isolate Any Playback Or Record Problem In All VCRs, In Less Than Half The Time It Presently Takes!

- Equip your bench for servicing all consumer VCRs with the only all-format VCR analyzer.
- Eliminate guesswork with dynamic VCR head signal substitution for all consumer formats.
- Quickly isolate Hi-Fi stereo audio problems with exclusive Hi-Fi stereo head signal substitution.
- Pinpoint any luminance, chrominance, or audio problem with phase-locked analyzing signals.
- Automatic servo analyzer allows you to catch servo defects in a fraction of the time presently required - (patent pending)
- Built-in Split Field test pattern generator permits stand-alone operation.
- Additional test patterns and RF/IF troubleshooting capabilities are available when used in conjunction with the Sencore video analyzing system.
- Special troubleshooting features complete the VCR analyzing package:
  - Servo sub-bias supply
  - Standard video and audio line outputs
  - Autoranging DCV and PPV meter
  - Output signal monitor
- Expandable for future and increased applications.

For More Information Circle Fast Fact Card #201

Call Your Area Representative at 1-800-SENCORE And Ask About Our Free, No Obligation Evaluation Program.

"Tough Dog, Multiple Problem" VCR Tamed With The VC93 All Format VCR Analyzer

By Tom Schulte, Application Engineer, CET

In This Issue

Recently I received a call from Art, a customer who had purchased a VC93 VCR Analyzer just a few months before. Art had a "tough dog, multiple problem" VCR that he was troubleshooting with his VC93. He explained that he needed a little help to get back on the service track so he could complete the repair without losing all his profits.

We get many calls from customers who have just gotten a new piece of equipment and need a little help getting started. But this was different. Art had already used good servicing techniques to troubleshoot most of the circuit. I think it might be interesting and beneficial to share Art's story with you.

The customer's complaint on a Sharp model VC-481U VCR was no color during playback. It had already been to another service center. Art told me he had already replaced the chroma processor IC, which appeared to have been bad, but there still wasn't any color. Now he was stumped and wondered if we could help him use his VC93 to work through the remainder of what appeared to be multiple problems with the color circuit.

Progress To Date

First, I asked Art to describe the troubleshooting steps he had gone through so far. I wanted to see if he had possibly missed anything that I could catch and help put him back on track. Art had first used his VC93 to check the servos with the Servo Performance Test Tape. All the servo tests indicated good, which told him that the problem wasn't servo related. I was glad to hear that, since that quickly eliminated a major source of potential problems. Knowing that the problem wasn't due to a servo defect, he then used the VC93 Video Drive Signal to substitute at the output of the Y/C mixer (Figure 1). This returned a clear color picture and told him that the video output circuits and RF modulator were okay.

Since the frequency convertor is the dividing point between the down-converted 629 kHz chroma from the tape and baseband chroma at 3.58 MHz, Art figured that this was the best spot to substitute next with chroma signal. I had to agree that it sounded like Art had made all the right moves. When he substituted at the output of the frequency convertor, no

(Continued on pg. 18.)

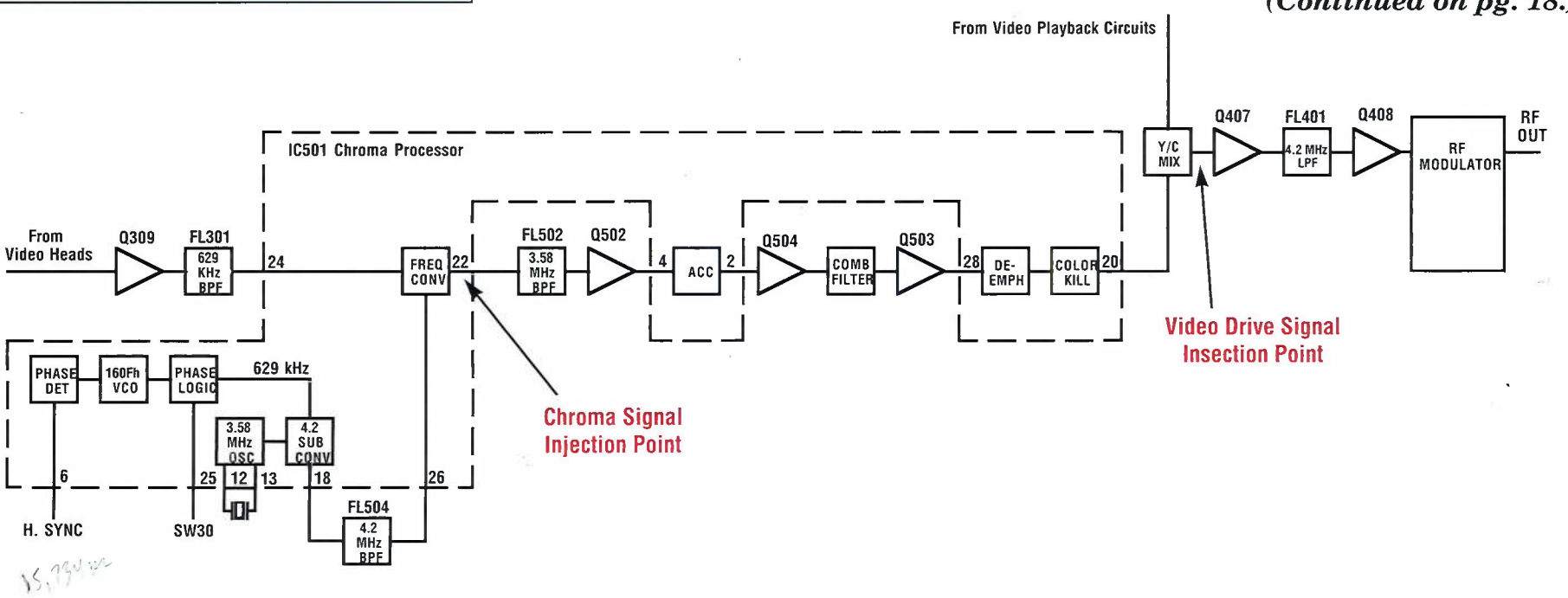
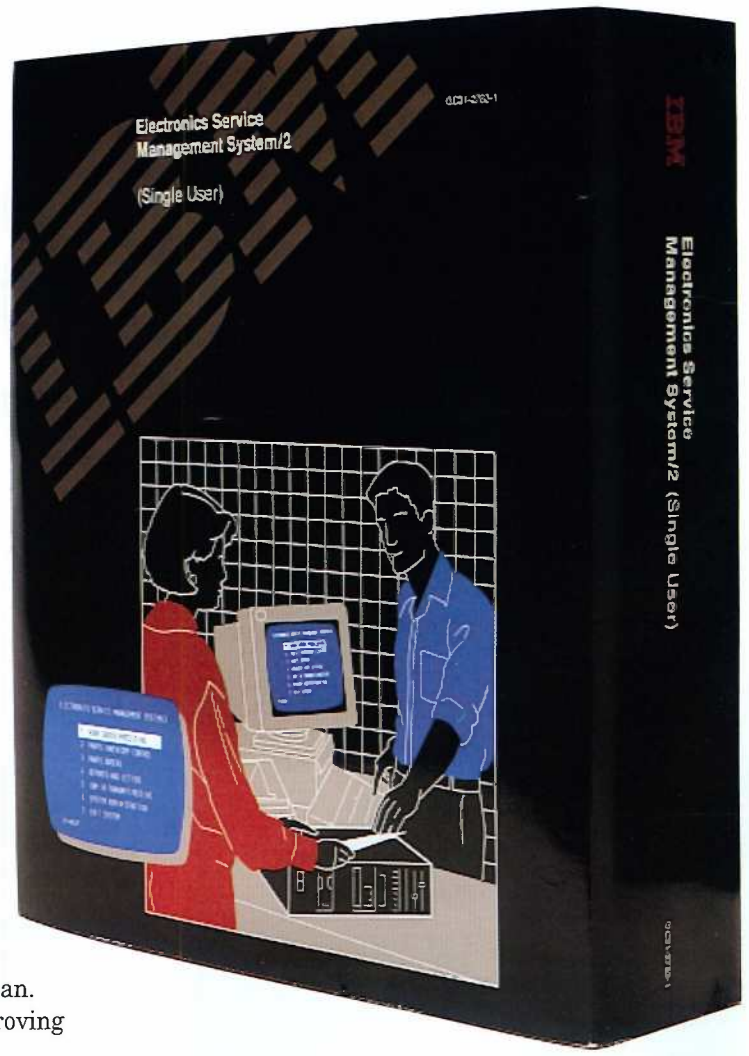


Fig. 1: Block diagram of chroma playback circuit in Sharp model VC-48IU.

Are You Having Difficulties Keeping Up With Today's Service Management Headaches?



Because Sencore is a factory direct company we hear about a lot of the problems and frustrations that servicers like you face on a day to day basis. Some of the problems that we hear about frequently go like this:

> ***"It's frustrating trying to keep both my customer and the manufacturers happy"***
>
> ***"The service management challenges of the 90's are growing and growing"***
>
> ***"I'm working hours after the rest of my employees are gone just to keep up with the paperwork"***
>
> ***"If I could get rid of the excess inventory in my shop I would probably be able to get some new equipment"***

These are some of the challenges that are faced by many service centers owners in meeting today's customer and manufacturer demands. The answer to these challenges is an automated service management system designed to take away the headaches of managing your service business. This system is called Electronic Service Management System or ESMS/2. Sencore is now offering this system with the cooperation of IBM to provide you with the most complete and easy to use service management system available today.

Study the benefits of ESMS/2 and decide for yourself if you are ready to get rid of those management headaches!

ESMS/2 Improves Work Order Handling:

No more time wasted tracking units through your service center. ESMS/2 improves work order handling through an easy to create work order system. From the work order list screen you can create a new work order, sort existing work orders, search the list for a specific work order and display existing work orders.

This allows you to locate all service work in a matter of seconds, saving you the embarrassment of ever telling your customer that you can't find their unit at the moment. Bottom line... this ensures their repeat business.

ESMS/2 Improves Parts Inventory Management:

No more worries about committing to a repair and not having the right parts on inventory. With ESMS/2's Parts Inventory Screen you can search for a specific part on the inventory list, add a part to inventory, allocate parts to a work order, disburse parts from inventory, calculate stock levels, sort parts inventory lists, cross reference substitute parts, reference dealer prices, and adjust inventory items.

The ESMS/2 Parts Inventory Management System helps you make better inventory decisions so you can have the right parts at the right time. You no longer need to worry about parts that "walk away" as all parts are assigned to a work order and documented when disbursed to a technician. All this results in saving money and improving your bottom line.

ESMS/2 Improves Parts Ordering:

No more excess parts inventory. From the ESMS/2 Parts Ordering Screen, you can search the parts list for a specific part order number and a part number supplier name. You can also add a part order, sort the part order list, receive a part order, generate stock level reports, and change parts orders.

This all leads to streamlined parts ordering. In order to ensure accurate inventory and timely ordering of parts, all parts orders tie back to inventory and work orders. This results in having only the parts you need and lowering the amount of cash tied up in un-needed inventory.

ESMS/2 Improves Service Center Management With Performance Reports:

You no longer have to wonder about how your business is performing. With ESMS/2 you can get easy access to numerous reports that assist you in making educated business decisions. Reports such as account list, history and accounts receivable statements allow you to quickly and easily access your customer's status with you. A collection summary report by account allows you to document your collection efforts. Deposits on repairs, equipment in house, parts inventory, parts order list, parts usage and repair back log reports provide a wealth of business status information that gives you an accurate picture of your business' performance. Sales register and sales tax register reports assist you in reconciling your cash register on a daily basis and help you understand where your income is coming from.

Technician analysis, assignments, performance and turn around time reports permit you to closely monitor employee performance and help you make personnel decisions. Finally, units in house for over 30 days, work order list and work orders to archive reports permit you to prioritize and distribute the workload efficiently and effectively.

ESMS/2 provides you with the information you need to make those tough decisions on employee performance, workload processing and the use of your cash. All this information leads to increased control you have over your business, which again improves the bottom line.

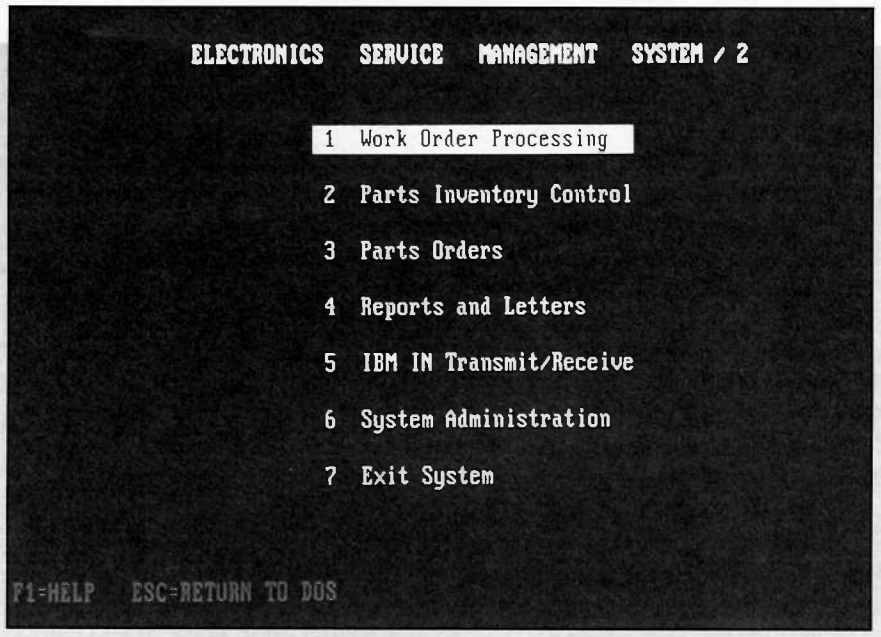
ESMS/2 Improves Communications With Your Customers And Manufacturers:

No more wasted time writing collection or other customer related letters. With ESMS/2, when you pull up the "Letters" screen, you have easy access to personal forms and custom letters such as: credit memo, customer invoice, 5 custom letters, out of warranty letter, parts order forms, revised estimate, service authorization, service delay, third party invoice, unclaimed merchandise, and warranty claim (uses NESDA/NARDA form with EIA x .12 standards). All of these common customer and manufacturer communication letters are pre-written and ready for you to print for any occasion.

You can also print labels of all customers or a selected group of your customers, or customers who have units in for repair. This allows you to send letters not only to individual customers but to any group of customers for such things as, advertising, special pricing, or any other reason. You can now have a consistent communication method with your customers and manufacturers that will lead to improved customer service and better relationships with the manufacturers.

One of the biggest advantages of th ESMS/2 is · Improved Claims Processing, no more waiting for processed warranty claims. Through ESMS/2 you can send and receive warranty claims electronically, directly to participating manufacturers. This improves accuracy, and helps your claims meet manufacturer and EIA standards, plus improves turn around time on warranty claims which guarantees less rejections and better cash flow.

IBM ESMS/2 Is The Solution!



1. Improves work order handling by reducing paperwork and improves tracking of the job as it moves through your service center. You will see improved efficiency in assigning jobs, more accurate productivity reports, and parts usage information.

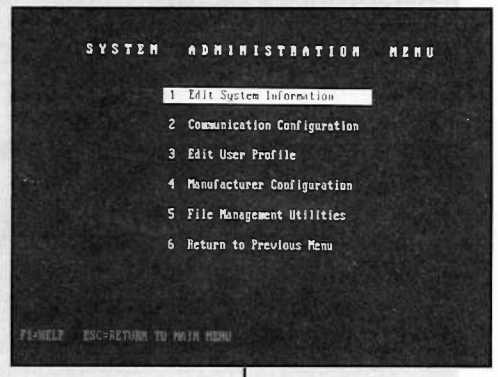
2. Improves parts inventory management. Easy-to-understand IBM ESMS/2 screens simplify parts ordering, tracking and allocation of inventory parts. Automatic stock level ordering helps you reduce your inventory costs and assures that you have the right parts on hand.

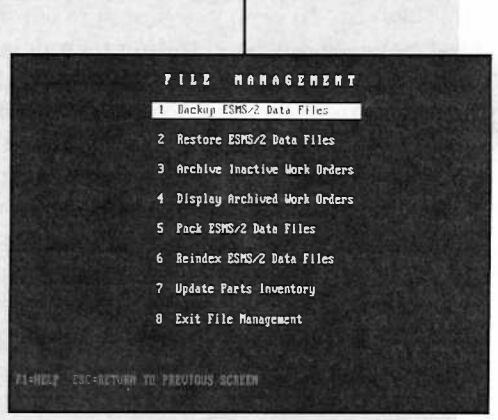
3. Gives you better quality information to manage your business. This information includes daily/weekly/monthly reports on aged accounts receivable, cash drawer deposits, parts inventory and usage, technician's performance, and sales register.

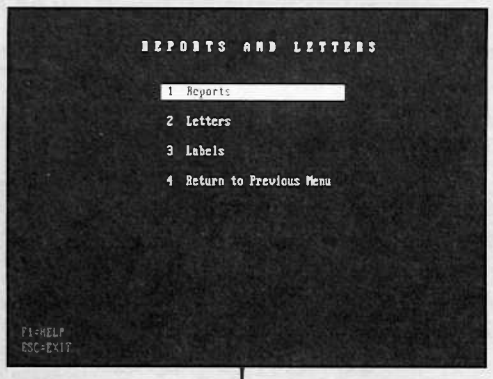
4. In addition, you can improve your customer service with customized letters for service authorization, estimates, unclaimed merchandise, repair status, not to mention mailing labels.

5. Makes processing warranty claims with manufacturers faster with increased accuracy. The system uses the work order tracking process to automatically create a warranty claim. ESMS/2 then allows you to send the information to the proper manufacturer using X12 ANS EIA standard format. Because this is all done electronically, your processing time improves greatly which results in improved cash flow.

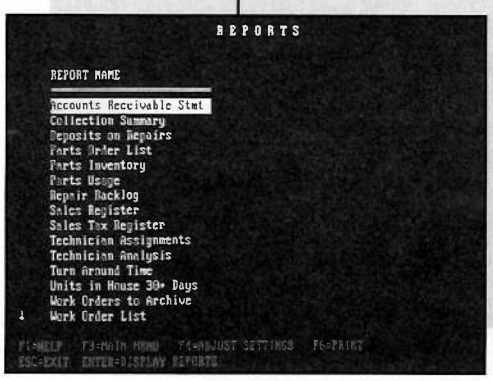
6. System Administration — Last but not least, the IBM ESMS/2 is easy and ready-to-use. The system requires virtually no computer experience and features easy-to-follow menus and help screens.

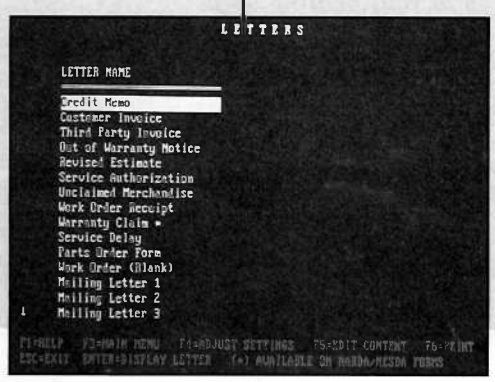


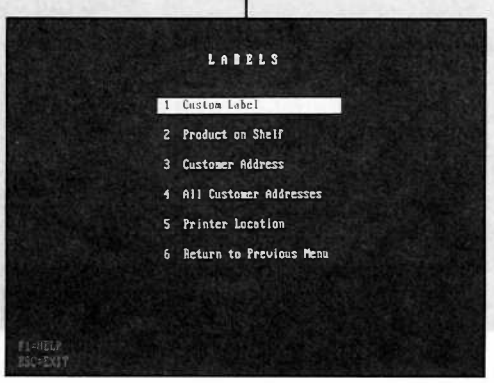




These are just a few of the advantages of using the ESMS/2 system in your service business. To find out more on how ESMS/2 can be put to work for you in your business, call 1-800-SENCORE and talk with your ESMS/2 representative. Or circle Fast Fact #212 to receive more information.







You will be taking an important step towards better managing your service business.

Call 1-800-SENCORE!

LETTERS To The Editor

Editor's Note: Thank you for your generous response to our request for letters and feedback. We've received many letters worthy of publishing, and we'll print as many as space allows.

We will continue to print viewpoints that represent the Sencore News' entire readership, not just one subject or part of the country. So read on to see what's affecting your business and the electronics industry.

Test Equipment Really Does Pay For Itself!

Dear Editor,

I just wanted to drop you a note to confirm what Sencore has been telling technicians for years, good equipment does pay for itself. I recently purchased a Sencore CR70 and have found that it has paid for itself in about a month and a half. To put it simply I am in awe of this machine and its capabilities. It has made it possible for me to make additional profits in my business that really add to the bottom line. In fact, I had a customer, who lived 250 miles away, bring his set in to be repaired in my shop, because he had heard from another customer how satisfied he was with the rejuvenation job that I had done on his set. I'm definitely sold on using good equipment, and it does make a difference.

Bill Drew

Editor's Note: That's what we've been saying for over 40 years. We're glad your seeing the difference. Thank you.

Tech Schools Provide Good Learning Experience

Dear Sencore,

Allow me to express my appreciation to you for conducting an outstanding VCR Servo workshop at TSTC/Waco. It was refreshing to have a knowledgeable individual from the industry in the classroom and the information that was covered was very beneficial to the students. The TSTC Waco-Campus has been preparing students for a career in audio/video servicing for twenty-three years and has found Sencore equipment to be durable and dependable in daily lab use. The Sencore troubleshooting philosophies and Tech Tips have become a valuable teaching tool in our program.

We appreciate the contribution that Sencore has made to vocational/technical education and look forward to hosting Sencore workshops and seminars in the future.

John Copeland
Waco, TX

Editor's Note: Thank you John. We enjoyed our visit to Texas!

Fed Up With The Unknown!

Dear Editor,

I purchased the VC93 All-Format VCR Analyzer because I was tired of not knowing the critical condition of the VCR coming into my service center. I'm finding that the VC93 is eliminating the guess work and the number of returns. It is also providing the test signals and data that are needed the most in VCR servicing.

I'd like to thank you very much for your effort, information, and advice that assisted me in the purchase of the VC93.

Sam Wong
Seattle, Wa.

Editor's Note: Sam, more and more people are discovering the real secret to VCR servicing is knowing exactly what your dealing with. Thank you.

Just What We Needed!

Dear Sencore,

Upon receiving the Sencore FS74A, Channelizer Sr. in our technical department, several benefits have been bestowed upon us.

1. To utilize a meter that is truly fully functional to the technician.
2. Provides the technician with a quality meter that will function accurately in all environments.

For field usage, the Sencore Channelizer has proved very beneficial. Being a multifunctional meter, the technicians can utilize for service work, maintenance work, and trunk alignment.

For headend testing and repair the Channelizer Sr. has several benefits:

1. Usage of a VOM in the unit.
2. S/N testing in the unit.
3. Video monitoring function that allows the technician to view the video, while selecting channels thru the meter.

Compared to our other meter, the Channelizer Sr. is the meter that the technicians selected to use on a daily basis.

Please keep me updated on equipment updates from Sencore, as your equipment has proven to be very beneficial to our company.

Dan Barger
Palo Cedro, Ca.

Editor's Note: FS74A is proof that there is a better way to test MATV and CATV system. Thank you.

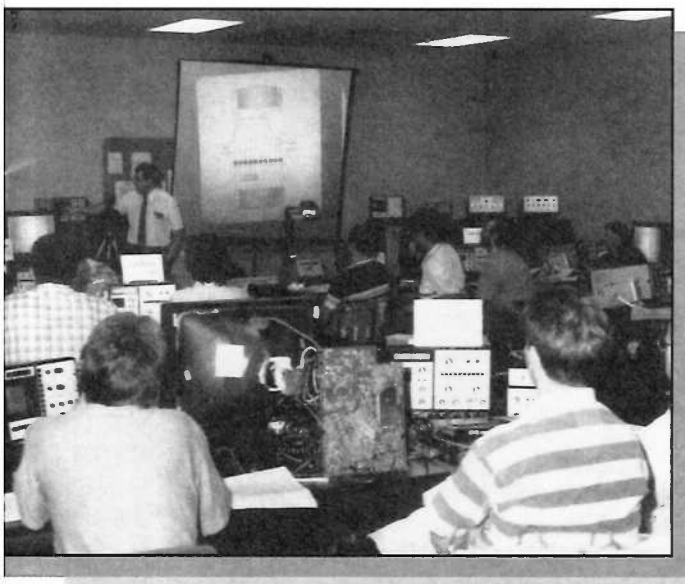
We Invite Your Letters

The Sencore News welcomes letters from its readers. We encourage mail on subjects ranging form troubleshooting tips to feedback on Sencore News articles. Address the letters to:

Letters To The Editor
Sencore
3200 Sencore Dr.
Sioux Falls, SD 57107

We reserve the right to edit letters for space and clarity. All submitted material becomes property of Sencore.

1 Day Tech Schools



Hands-On Switch Mode Power Supply Troubleshooting

June

State	City	Date
Oregon	Portland	June 2, 3, or 4th
Washington	Seattle	June 9, 10, 11, or 12th
Province	**City**	**Date**
British Columbia	Vancouver	June 15, 16, or 17th
British Columbia	Victoria	June 19th
Alberta	Calgary	June 22, 23, or 24th
Alberta	Edmonton	June 25 or 26th

July

State	City	Date
Minnesota	Minneapolis	July 28, 29, 30 or 31st
Province	**City**	**Date**
Saskatchewan	Saskatoon	July 13 or 14th
Saskatchewan	Regina	July 16 or 17th
Manitoba	Winnipeg	July 21, 22, or 23rd

August

Province	City	Date
Ontario	Toronto	August 17, 18, 19, 20, or 21st
Quebec	Montreal	August 24, 25, 26, 27, or 28th

What You Will Learn:

- The different types of SMPS, where they are used, why they are used, how they fail, and how to troubleshoot them.
- "Safe Troubleshooting Techniques" for any chassis.
- How to test switched mode supply components.
- TV kick and trickle start circuit operation and troubleshooting.
- Simplified shutdown circuit servicing.

(Your workstation will be equipped with Sencore's SC3080 Waveform Analyzer, LC102 Auto-Z, PR57 "POWERITE", and special demonstrators).

Circle Fast Fact #221 for more information on Hands-On Power Supply Troubleshooting.

What: A one day workshop on switch mode power supply or VCR "Tough Dog" troubleshooting. (Check your city and state for the Tech School in your area)

When: Each one day Tech School runs from 9:00 AM - 4:00 PM.

Who: Sponsored by Sencore.

What It Costs:

$50.00 registration fee payable in advance. VISA, MasterCard, check, or purchase orders are accepted. Maximum attendance: *30 by pre-registration only. (Cancellation policy: must call 48 hours in advance or fee is non-refundable)*

How To Register:

Call **1-800-SENCORE**. Registration is based on first-come, first-serve. Please use the 6 digit number above your name on the mailing label to speed your registration.

What You Need To Bring:

A fresh mind with room for a lot of useful information. Nothing else is required.

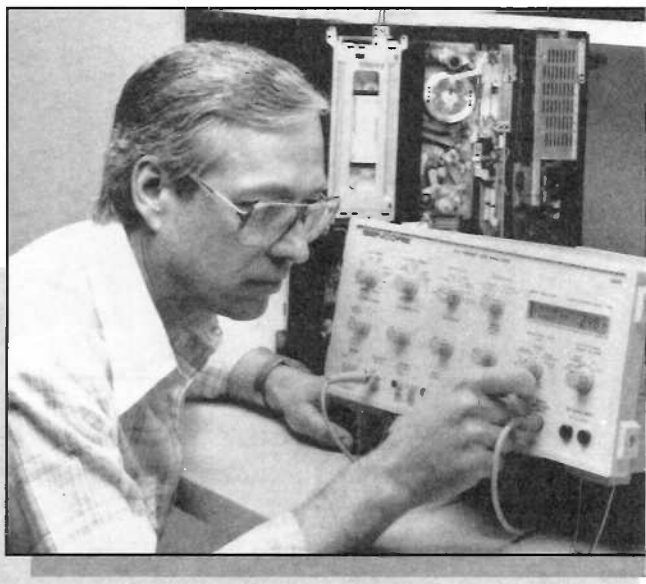
What You Will Get:

- Valuable information and troubleshooting tips that you can apply daily.
- Technical workbook (yours to keep).
- Certificate of Achievement.

(All Tech-Schools are smoke-free)

For More Details Call 1-800-SENCORE

(736-2673)



Hands-On VCR Practical Troubleshooting Techniques

with the VC93 All Format VCR Analyzer

June

State	City	Date
New York	Long Island	June 1, 2, 3, 4, or 5th
Conneticut	Hartford	June 9, 10, or 11th
Massachusetts	Boston	June 15, 16, 17, or 18th
New York	Syracuse	June 23, 24, or 25th

July

State	City	Date
New York	Buffalo	July 14, 15, 16, or 17th
Ohio	Cleveland	July 21, 22, 23, or 24th
Pennsylvannia	Pittsburg	July 28, 29, 30, or 31st

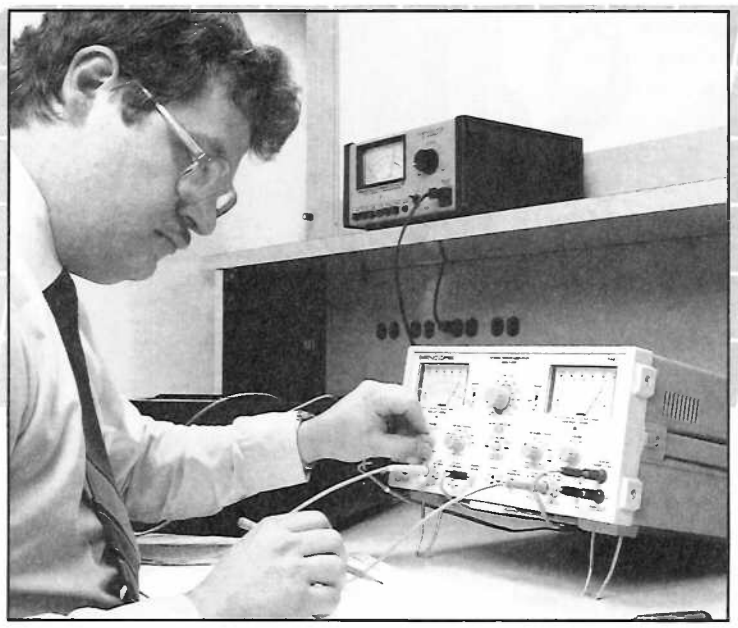
August

State	City	Date
Ohio	Columbus	Aug. 4, 5, or 6th
Indiana	Indianapolis	Aug. 11, 12, 13, or 14th
Michigan	Detroit	Aug. 18, 19, or 20th
Michigan	Grand Rapids	Aug. 25, 26, or 27th

What You Will Learn:

- How to dynamically substitute for any format VCR head: VHS, Beta, U-Matic, VHS-C, S-VHS, Super Beta, U-Matic SP, 8 MM, Hi 8.
- How to dynamically substitute any VCR Stereo Hi-Fi head for all formats.
- How to isolate any VCR luminance/chroma problem with exclusive sync-lock trouble-shooting signals.
- How to isolate any VCR Servo problem in less than 30 seconds without taking the VCR cover off.

Circle Fast Fact #222 for more information on Hands-On VCR Practical Troubleshooting Techniques.



How The PA81 Stereo Power Amplifier Analyzer™ Fills In The Missing Link For All Audio Analyzing

By Paul Nies, Application Engineer

I had seen that type of smile before. Mary, one of our secretaries, was walking toward us in the hall with a sincere, but exaggerated smile on her face. It was one of those smiles that said she wanted us to repair something for her.

I was right. She wanted somebody to take a look at her cassette deck. Seems it had started acting up the day before.

We asked her what kind of deck it was, but she didn't know exactly, although she said it was only about a year old. Then, we asked her exactly what the problem was. She didn't know that either. All she knew was that it wasn't playing her Linda Ronstadt tapes right.

The next morning, the Friday before Memorial Day, she brought it in for us to look at. It was a Panasonic deck in mint condition. Before she left it in our hands, Mary left us with this little surprise, "I brought this deck to you guys because all of the shops in town were busy. I hope you can have it ready for me by this afternoon!"

At first, we were more than a little concerned. Finding time to just work on Mary's deck was going to be hard enough. But to have it repaired by the weekend was quite a feat for a problem yet unknown.

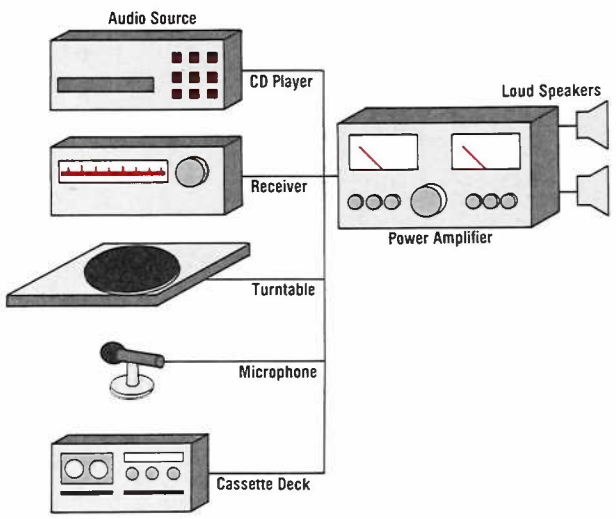


Fig. 1: The PA81 Stereo Power Amplifier Analyzer lets you pinpoint audio troubles anywhere in the system.

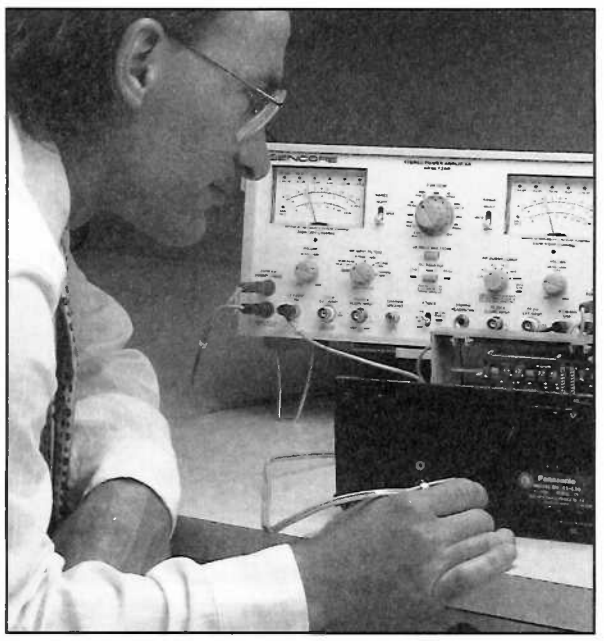


Fig. 2 You can completely analyze line outputs with the PA81.

You Can Fix Any Prpblem With The Right Test Equipment

Our only hope was a little bit of luck and the right test equipment. Luckily, our audio bench was set up with a PA81 Stereo Power Amplifier Analyzer. The PA81 fills the missing link in audio analyzing, something every servicer needs. The PA81 not only eliminates wasted time and confusion in audio amplifier analyzing, but it is the total answer for all audio amplifier analyzing, including cassette decks.

Over the lunch hour we decided we'd better look at the deck so we at least knew what the problem was. As we walked up to the audio bench with Mary's tape deck, we noticed an amplifier on the bench hooked up to the PA81.

The application engineers were doing a burn-in test of an amplifier using the PA81's IHF DUMMY LOADS. The PA81 measures audio power signals up to 250 watts per channel with all of the common load impedances.

They said they were testing for an intermittent problem with the amplifier. They had found and fixed the problem, but they were checking for possible weakened parts.

They were also monitoring the PA81's DC BALANCE LED's for a DC balance problem. If either the LT CH or RT CH LED comes on, it indicates which channel has an excessive DC voltage present.

They weren't going to work at the bench for a while, and they said we could use the PA81 if we wanted to. The dummy loads stay connected no matter which PA81 function you are using, so we were able to use any function we wanted. They were safe by leaving the amp and PA81 unattended, too, because if a DC balance problem occurs, the PA81 automatically disconnects the loads to protect the amplifier from damage.

Analyze "Line Out" Signals With The PA81 Stereo Power Amplifier Analyzer

The first thing we did was plug the LINE OUT jacks from the cassette deck into the AUDIO LINE jacks on the PA81 Stereo Power Amplifier Analyzer. The PA81 lets you completely analyze the line-level audio signals of cassette decks, CD players, VCRs, and tuners. You can even listen to the audio with the PA81's built-in high quality speakers or by hooking up a set of headphones to the STEREO HEADPHONE jack. You can also view the audio by hooking a waveform analyzer to the TO SCOPE INPUT jacks on the PA81's front panel. The waveform analyzer lets you analyze the audio waveform for further defects.

We decided to pull the Linda Ronstadt tape out of Mary's deck and use our test tape with a 1 kHz tone recorded on it. We didn't want to face the wrath of Mary if her tape would somehow get damaged.

With the line outs hooked up to the PA81 and the test tape in place, we powered the cassette deck up ready to test. The power light and indicator LED's all lit up in a normal fashion. But, when we pushed the PLAY button, nothing happened. I mean nothing happened.

The tape didn't budge. We tried the fast-forward and rewind buttons, and got the same result. The tape just wouldn't move.

We took the case off the deck and started looking for an obvious defect like a dislodged belt or a loose connector. A major failure like this is often a mechanical type of problem which can be fixed without a schematic. A thorough inspection of mechanical parts and assemblies, however, yielded no such cure. A search for the schematics for this deck also went in vain.

That left us with the PA81, our experience, and the rest of our audio bench to fix this deck. I had the feeling the PA81 would be our biggest asset.

Use The PA81's External Inputs To Track Level Problems Down

Common sense told us to measure the DC voltage getting to the motor. If there was no DC voltage present, we could trace the line back to try and pinpoint the problem. Using the DCV function of the PA81 Stereo Power Amplifier Analyzer, we hooked directly across the two leads leading to the motor. Since the grounds of the PA81's EXT INPUTs are isolated, we didn't need to worry about isolation. A quick look at the autoranged meter reading showed what we suspected, 0 volts.

Our first suspect was the power supply circuit. If the motor wasn't getting any DC voltage, either the power supply was bad or some

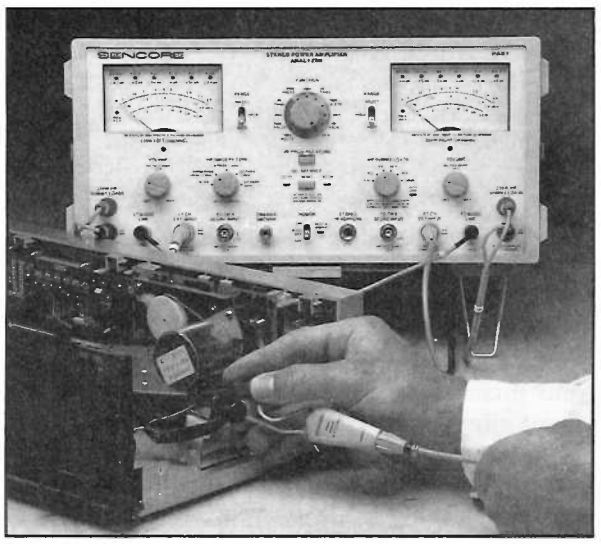


Fig. 3: Use the PA81 signal tracing meter to help pinpoint troubles down to a component. The autoranged PA81 DC meter showed 0 volts meaning there was a problem before the motor.

component between the motor and power supply was blocking the voltage. We followed the AC line cord and located the rectifier diodes on one corner of the board. Somewhere between this corner of the board and the motor laid our problem.

We followed the motor path back toward the power supply with the PA81's DC meter. It read zero volts all the way. Then we traced up to a resistor that was mounted off the board farther than the rest of the resistors. Our experience told us that this was done probably because of two reasons. One was to dissipate heat better. The other reason for the sky-mount was to make it easier to change in case it fails, as in the case of a fuseable resistor. Manufacturers occasionally do this to components that have failed more often than others.

If this resistor was a common failure point, maybe this repair wouldn't be so hard after all.

We measured the DC on the motor side of the resistor and got zero volts. Then we moved the probe to the other side of the resistor, and the PA81's autoranged meter immediately came to life. It read a full 12 volts DC.

That opened our eyes. A resistance check proved the resistor was open. The resistor's color code was yellow-violet-gold, or 4.7 ohm. We temporarily jumpered a replacement resistor in place of the open resistor and pushed the PLAY button again.

There it went! The motor was turning beautifully. We tried fast-forward and rewind to double-check the circuits and they proved to be working too. We turned up the PA81's internal autoranged speakers and listened to the audio tone. It played smoothly without any distortion.

The PA81's speakers are autoranged with the meter circuits. So it doesn't matter if you're measuring hundreds of watts of audio power or just millivolts from a line output, the speaker won't blow you away, nor will it be too quiet.

Since we didn't have any service literature or calibration procedure, about the only measurement we could do was to measure the LINE OUT voltage to be certain the deck put out enough voltage for Mary's amplifier.

I just reached up and turned the PA81's function switch to RMS VOLTS in the color-coded AUDIO LINES section. The dual-meters autoranged and showed readings of 250 mV, plenty of voltage necessary for most amplifiers.

We patted each other on the back as we put the case top back on Mary's cassette deck. We almost wished she had brought in something a little more challenging.

You Can Actually Listen To Any Audio Level With The PA81 Stereo Power Amplifier Analyzer

After lunch, Mary came back to see how we were doing. We proudly proclaimed that we had the problem already solved. We boasted how we carefully walked through the circuits with the PA81 Stereo Power Amplifier Analyzer's DC meter and found the open resistor. We also explained to her that the deck's outputs were good since we were able to measure them using the PA81's line output analyzing capabilities.

Then she decided she wanted to hear how it sounded, the ultimate test of any audio system. We had done that once before by playing the test tape and listening to the tone with the PA81 speakers, but anything to satisfy a customer.

With the deck still hooked up to the PA81's AUDIO LINE inputs, we put the Linda

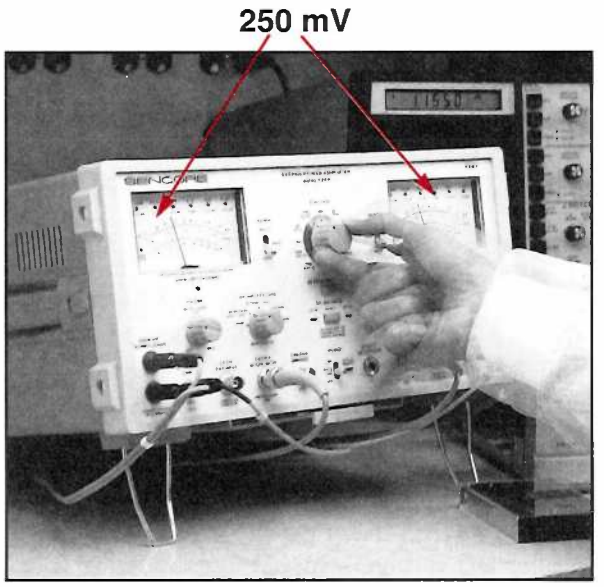


Fig. 4: Measure the RMS volts of line outputs with the PA81 Stereo Power Amplifier Analyzer to make sure the level is sufficient for an amplifier.

Ronstadt tape in and turned the power on. We watched Mary's face with great anticipation as we pushed the PLAY button.

Mary's anxious face suddenly turned to a frown, however. Either we got her tape mixed up with a Walt Disney tape, or Linda Ronstadt's voice suddenly sounded like Donald Duck. We knew that Linda Ronstadt's lark-like voice was nothing like Donald Duck, so we came to the slightly embarrassing conclusion that Mary's cassette deck still had a slight problem: the motor was running too fast.

It was a good thing we had the PA81 to listen to the actual audio that the cassette deck was putting out. Without that proof-positive test, we would have sent the deck home with Mary for the weekend, still with a problem.

We took off the case again wondering what we could do to fix this type of problem. We decided to first measure the frequency of the 1 kHz tone to see just how far off we were.

The PA81 Lets You Use Your Scope To Analyze The Audio Signal—Even Further

The PA81 Stereo Power Amplifier Analyzer provides a left channel and a right channel

Fig. 5: The PA81 lets you analyze the audio waveform even further by providing scope hookup jacks to connect to your oscilloscope.

jack to let you further analyze the audio signal with an oscilloscope for clipping, distortion, or, in this case, frequency. We hooked up the SC3080 Waveform Analyzer to the TO SCOPE INPUT jacks and pushed the channel A FREQ button to get a direct frequency readout.

We put the test tape back in the deck and turned it on. The SC3080's display came up with a reading of 1.15 kHz. That was over a 10% error in speed, certainly enough change to notice a problem on any brand of music, but difficult for the human ear to notice on a single tone.

Now all we had to do was slow the motor down. The first thing we checked for was the proper DC voltage level being supplied to the motor assembly. As long as the motor is getting a constant voltage of the correct magnitude, it should run at the right speed.

We hooked the PA81's DC meter back up to the two wires leading to the motor assembly. The analog meter reading showed a very steady 12 volts feeding the motor. That agreed with the "DC12V" printed on the back of the motor housing assembly. The PA81 DC meter eliminated the DC voltage as a problem.

We checked for and found a speed control adjustment for the motor. Perhaps a simple adjustment would take care of this untimely speed problem. Adjusting the motor speed until the tone frequency reads 1 kHz on the SC3080 should put us back in business.

As we adjusted the motor speed control, we monitored the frequency on the SC3080's LCD readout. Throughout the entire adjustment range of the control, the frequency of the tone never changed.

If the motor DC voltage was OK, and the speed adjustment didn't change a thing, that must mean there's a problem with the speed adjust circuit, we deducted. So we shut the deck down and started an investigation into the motor assembly.

The back cover of the assembly popped off rather easily and exposed a miniature PC board. Hopefully our problem would be located on this board.We unsoldered the three lugs that were holding it in place and carefully removed the board. We found three resistors, two capacitors, the speed-control pot, and a three-legged device which we assumed was the governor speed-control IC.

After a quick visual inspection, we quickly tested the capacitors with a Z Meter. They proved good so we turned our attention to the resistors and the pot. An ohmmeter proved them good leaving only the IC as suspect. The ohmmeter showed that all three legs were shorted to one another. We cautiously hoped that this was our only problem.

We crossed the number we found on the IC to one of our stock parts. After soldering the IC in place, we replaced the miniature PC board in the motor assembly ready for a preliminary test.

With the SC3080 still monitoring the audio signal through the PA81, we put our test tape in for a frequency check of the motor speed. The SC3080 read 1.05 kHz. We adjusted the speed control until the frequency read 1.00 kHz on the nose. It looked like the new IC was doing its job.

The Final Test—Customer Satisfaction

Then came the final test, the Linda Ronstadt test. We carefully inserted the tape hoping we wouldn't run across another problem. If this test worked, we would have Mary's deck back to her easily in time for the weekend.

Linda never sounded better. The internal PA81 speakers confirmed that the motor was going at the right speed as the cassette deck reproduced the music with the familiar pace and sound.

Well, I was right. The PA81 Stereo Power Amplifier Analyzer helped us get through that troubleshooting scare. We had nothing else to amplify the cassette deck's signal but the PA81. Without the AUDIO LINE inputs and the internal speakers, we would have sent this deck back to the customer improved but still unrepaired.

Most servicers run across the same thing. That's why the PA81 is called the missing link in audio analyzing. It bridges the gap in audio analyzing that most servicers just can't seem to cross.

Add portability and all the amplifier tests, and you've got a unit that is a must for all audio servicing. Mary was sure happy when she picked up her cassette deck that Friday afternoon. Your customer can be the same way.

Oh, by the way. The application engineer's amplifier worked the whole time. The DC BALANCE LEDs never came on to indicate any kind of intermittent or DC balance problem. They had achieved success with the PA81, too!

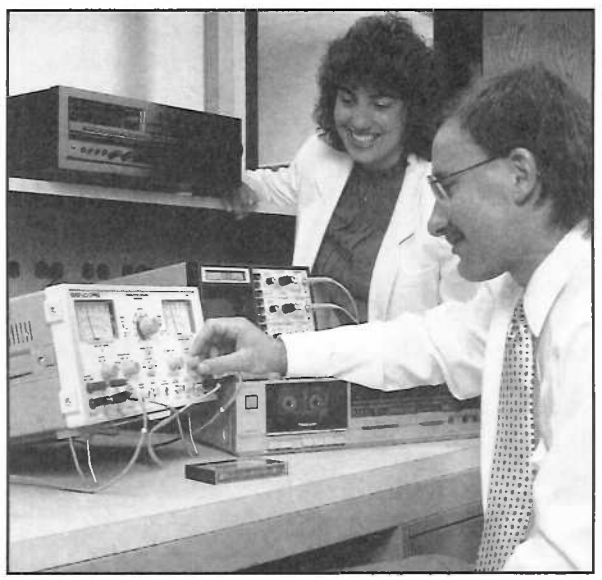


Fig. 6: Give the audio the ultimate test by listening to it with the PA81's internal speakers. Nothing else lets you listen to audio over such a wide range of levels.

Do you see how the PA81 Stereo Power Amplifier Analyzer can help you in your audio analyzing? Give Sencore a call at **1-800-SENCORE** (736-2673) and talk with your Area Sales Engineer. Let the PA81 fill in your missing link in audio analyzing. Ask about our new book, "Taking The Mystery Out Of Audio Troubleshooting."

NOTE: . For more information on the PA81's capabilities, circle fast fact card #210.

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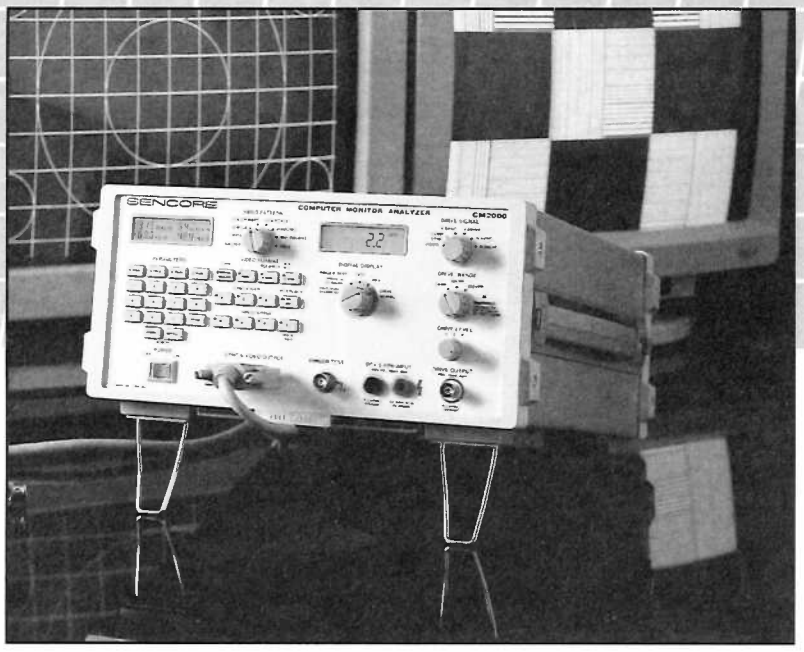


How the CM2000 Helps You Troubleshoot Every Section In A Computer Monitor

By Stan Warner, Application Engineer

Turning profits in computer monitor servicing is tough business. Yet the potential is tremendous. We use computers (and computer monitors) in nearly every facet of our daily lives. Expanding your business into computer monitor servicing, expands your service offering beyond consumer electronics repair and brings you into the profitable school, hospital and industrial markets.

The CM2000 Computer Monitor Analyzer is a new product designed exclusively for complete computer monitor servicing. It is much more than just a signal source for getting a pattern up on the CRT; it provides you with features and tests for troubleshooting in every section of the monitor.

This article starts at the input connector of a computer monitor and works to the CRT, and shows the tests that can be done to troubleshoot in each section. The descriptions below don't give the complete troubleshooting procedure (found in the CM2000 manual and Sencore Tech Tips) but a synopsis of the tests you could complete if you had a CM2000 on your bench.

Set the CM2000 to match the input parameters of the monitor under test

The CM2000 Computer Monitor Analyzer has a fully programmable sync and pixel generator that lets you match the input requirements of the computer monitor under test. Full programmability allows you to test and troubleshoot the high resolution computer monitors on the market today plus any new formats introduced in the future (new computer graphics standards come onto the market every couple of years).

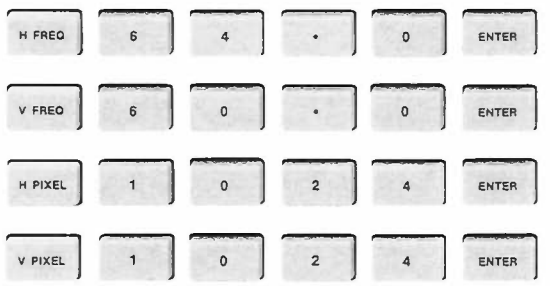


Fig. 2: The sync and pixel rates are programmable to match the monitor's input requirements.

The CM2000 generates signals for both analog and digital computer monitors. The video, horizontal and sync polarities can be set to either positive or negative. The CM2000 generates the non-interlaced signal required by most computer monitors and the interlaced signal. Composite sync can also be added to any of the video lines.

The CM2000 also has storage locations for the most common computer monitor types. So instead of having to program in each signal parameter, you can quickly recall the setup you want and start testing.

Isolate video amplifier and driver problems.

The video circuits include all the stages from the input connector to the CRT. These stages establish the correct DC for biasing the tube and amplify the applied signal to the sufficient level to drive the CRT.

Video circuit problems include a complete loss of video, missing colors, weak video, and poor frequency response. Most video problems can be effectively isolated using signal substitution. Signal substitution lets you inject a "known good" video signal into the video

Troubleshoot A Computer Monitor From The Input Connector To The CRT With The CM2000

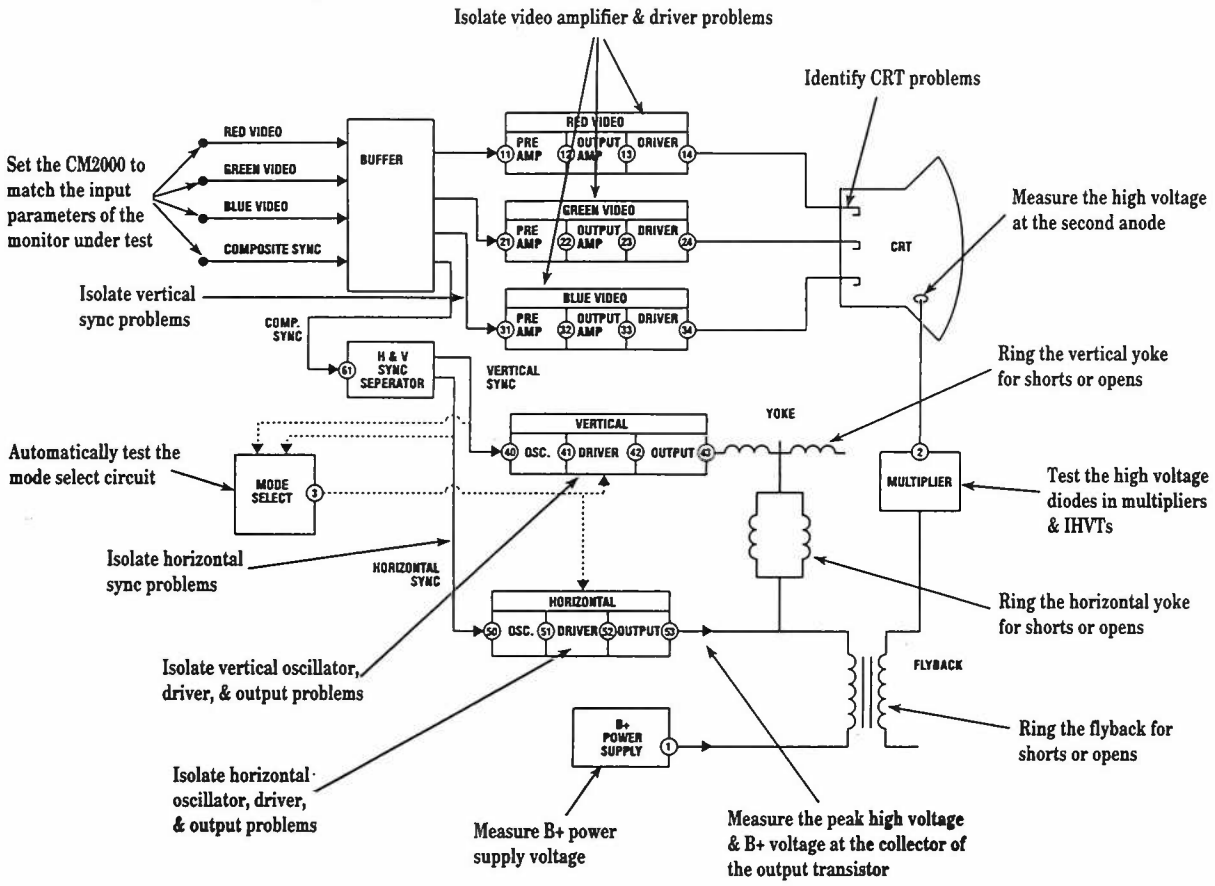


Fig. 1: The CM2000 has tests and features that help you troubleshoot computer monitors from the input connector to the CRT.

circuits from the first pre-amplifier to the CRT drivers.

Example Symptom: Missing red video

Inject the CM2000's VIDEO drive signal at the input of the red output amplifier (TP 12/Fig. 3). If the missing color returns or the output improves, you are injecting after the problem and the circuits from the injection point to the CRT are working. Move back one stage and

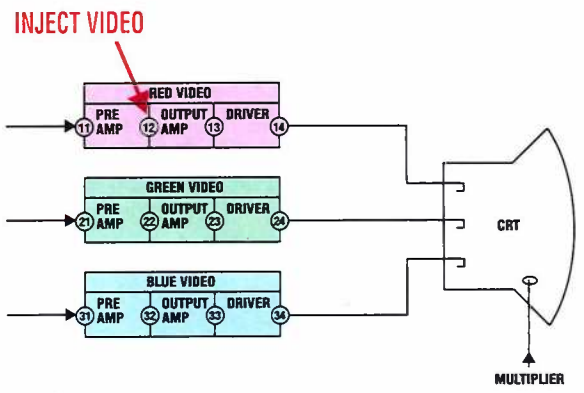


Fig. 3: Inject the VIDEO drive signal into the video circuits.

inject at the input of the red pre-amplifier (TP 11/Fig. 3).
If the same problem appears after you make the injection at TP 12/Fig. 3, you are injecting before the problem. Move forward one stage and inject into the driver input (TP 13/Fig. 3).

Automatically test the mode select circuit

Most video graphics standards have several modes.For example VGA has three (see fig. 4). The scan frequencies remain the same but the horizontal, vertical pixels and vertical scan frequencies change. Text applications use the higher resolution modes while graphics applications use the lower.

The mode select circuit controls the flow of current to the horizontal and vertical drive circuit to produce a full sized raster in all operating modes. The mode select circuit detects the operating mode by sensing the polarity of the horizontal and vertical sync pulses.

Example Symptom: The display on a VGA monitor looks okay in one mode and looks scrunched and distorted in another.

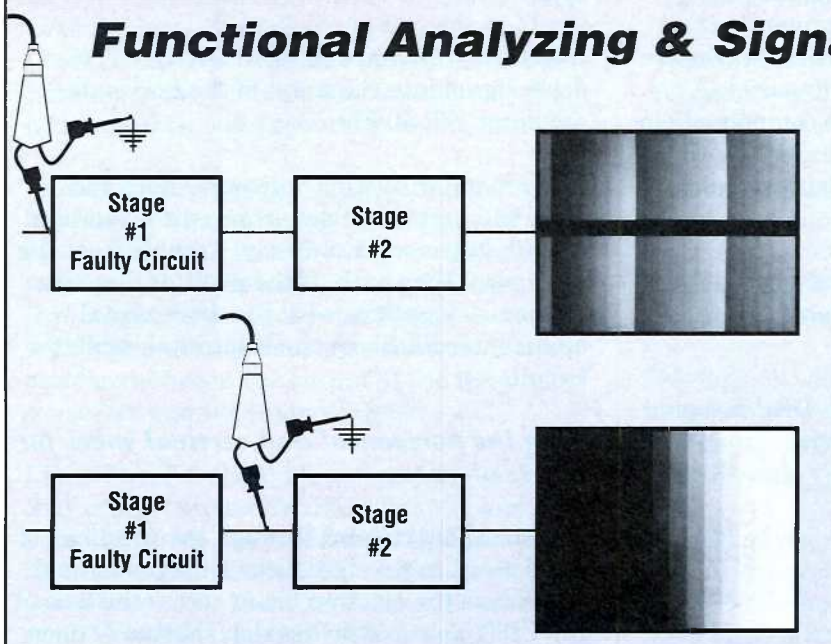
Recall each VGA mode stored in the CM2000's memory locations. Monitor the output of the

Mode	Horizontal Resolution	Vertical Resolution (Pixels)	Horiz. Sync Polarity	Vert. Sync Polarity
(1) VGA	640	350	(+)	(–)
(2) VGA	720	400	(–)	(+)
(3) VGA	640	480	(–)	(–)

Fig. 4: Standards for the three VGA modes.

Sencore Tech Talk

Functional Analyzing & Signal Injection



Use signal injection to narrow a problem down to a single stage.

The CM2000 improves troubleshooting effectiveness through a technique called "Functional Analyzing". This method consists of two parts: (1) signal injection and (2) signal tracing. Signal substitution lets you inject a "known good" signals supplied by the CM2000, into the circuits. The low impedance of the Drive Signal output "swamps out" the signal that is present at the injection point and places a known good signal in its place.

Watch the CRT to decide wether you are injecting before or after the defective stage. If the output remains bad, your injection is before the defective stage. If the output returns to normal, you can be confident that all the circuits between the injection point and the output are good.

Once you narrow the problem to a single stage, use signal tracing to find the faulty component. As you signal trace, compare the voltage levels, frequencies and waveshapes to those in the service literature. Observe the following guidelines when using signal injection:

1. The CM2000 must be connected to the input of the computer monitor before making a signal injection and the CM2000 must be programmed to match the monitor's input requirements. This ensures the injected drive signal syncs to all the other signals in the monitor.

2. Match the Drive Signal level to that shown in the Services Literature. Too much signal may cause a bad stage to operate and lead to confusing results.

3. If no level is shown, never exceed the B+ voltage of the stage.

4. Match the Drive Signal polarity to the signal in the circuit.

mode select circuit with the CM2000's DVM. Watch for the correct voltage levels as you switch between modes. If the voltage is "stuck" in one level you may have a faulty mode select circuit.

Once you have the problem repaired, adjust the monitor's raster size and linearity controls so the raster is the proper size in each mode.

Isolate vertical sync problems

Monitors have one of three sync schemes: 1) separate vertical and horizontal sync inputs; 2) vertical and horizontal composite sync input; and 3) a video line with vertical and horizontal composite sync (usually green).

The vertical sync signal fed to a monitor is responsible for synchronizing the vertical oscillator to the incoming video signal. The block diagram in this article shows a monitor block diagram with separate horizontal and vertical sync inputs. This is the most common sync scheme.

Example Symptom: Loss of vertical sync

Inject the CM2000's VERTICAL SYNC drive signal into the input of the vertical oscillator (TP 40/Fig. 5). If vertical hold returns after you've made the injection you've proven the oscillator circuit is working. Troubleshoot the vertical sync path. Also check the wiring of the monitor's connector and cable.

Isolate vertical oscillator, driver and output problems

The vertical driver and output stages amplify the oscillator signal and provide the current

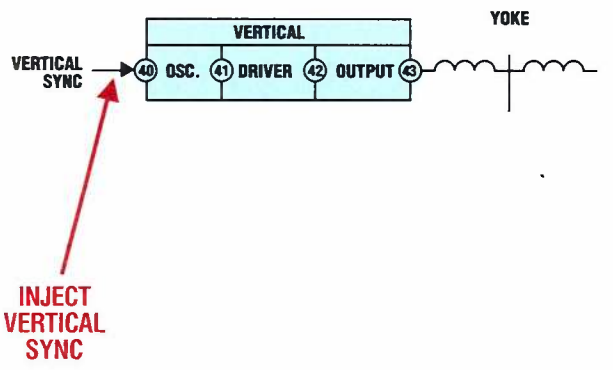


Fig. 5: Inject the VERTICAL SYNC signal into the vertical sync path. If the same symptom returns, troubleshoot the vertical oscillator, driver or output stage.

non-linearity. Before you use signal injection to troubleshoot a vertical problem, use the CM2000's DVM to confirm the proper bias on the output components. The vertical stages are usually DC coupled to get good linearity. A wrong DC voltage affects all the components in the oscillator, driver and output stages. A DC bias problem must be repaired before you can effectively use signal injection.

Example Symptom: Collapsed vertical raster (thin horizontal line across the display)

Inject the CM2000's VERTICAL DRIVE signal into the output of the vertical driver circuit (TP 42/Fig. 6).

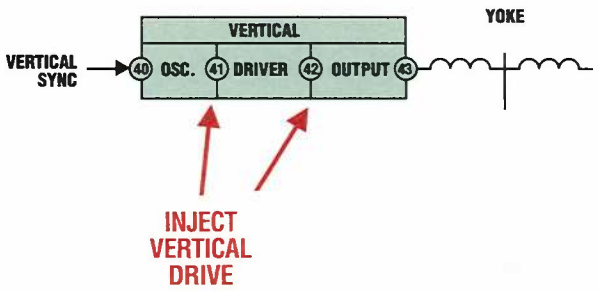


Fig. 6: Inject the VERTICAL DRIVE signal into the vertical driver and output stages.

NOTE: Injecting into the vertical stages won't always produce full vertical deflection because most of the signals are uniquely shaped by feedback loops and waveshaping circuits.

Look for the sweep to expand (remember it may not be a full raster). If the sweep expands, either partially or fully, the circuits from the injection point to the output are good. If the sweep doesn't expand, check the output components or ring the deflection yoke.

NOTE: The VERTICAL DRIVE signal does not drive the vertical yoke.

Isolate horizontal sync problems

The horizontal sync pulses control the timing of the horizontal oscillator. Many monitors receive horizontal sync directly. Other monitors have a composite sync, or "sync on video" input and require the use of sync separators. Sync pulses that are low in amplitude, the wrong frequency, or are missing cause the monitor to lose horizontal hold.

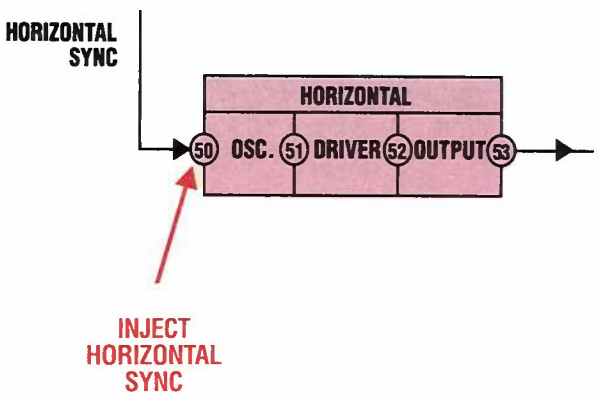


Fig. 7: Inject the HORIZONTAL SYNC signal into the horizontal sync path.

Example Symptom: Loss of horizontal sync

Inject the CM2000's HORIZONTAL SYNC drive signal into the input of the horizontal oscillator (TP 50/Fig. 7).

If the monitor regains horizontal hold and gives full horizontal deflection, the driver and output stages work properly. Troubleshoot the horizontal sync path. If the monitor displays the same symptoms with the drive signal applied, troubleshoot the horizontal oscillator circuit.

Ring the horizontal and vertical yokes for shorts or opens

The changing current through the windings of the deflection yoke produces a magnetic field that scans the electron beam across the face of the CRT. Yokes often develop shorted or open windings. An open or shorted winding may cause reduced vertical or horizontal raster size, or a complete loss of deflection.

The Ringer Test™ will find defective yokes, even if it has a single shorted turn. Readings of 10 rings or more are accompanied by a "Good" display and shows that the winding does not have a shorted turn. "Bad" readings, less than 10 rings, indicates a shorted turn.

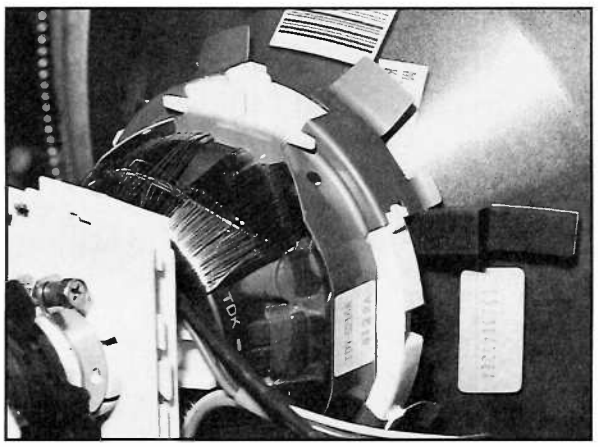


Fig. 8: The ringer test finds opened and shorted windings on horizontal and vertical yokes.

Example Symptom: Collapsed raster

Ring the horizontal and vertical yoke windings. Always unhook the yoke from the circuit and unsolder any damping resistors (leave the yoke mounted on the CRT).

If the horizontal and vertical yoke windings ring above 10 rings, the yoke is good. If any of the windings ring below 10, the yoke is bad and needs to be replaced.

Measure the peak high voltage and B+ voltage at the collector of the output transistor

A wealth of troubleshooting information can be gained about the monitor's operation by measuring the DC and peak-to-peak voltage at the collector of the horizontal output transistor. The CM2000 has a DC and peak-to-peak volt meter with the input protection needed for measuring signals at this test point. The DC reading tells you if the B+ supply is working correctly, while the peak-to-peak reading tells you if the output circuits are creating the needed high voltage.

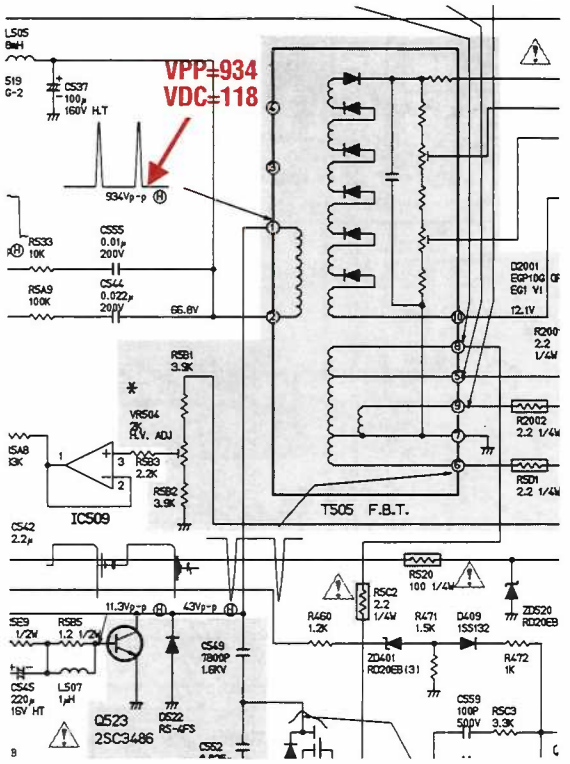


Fig. 9: The CM2000's DVM has the input protection needed to measure the pulse at the horizontal output collector.

Example Symptom: Dead monitor #1

With the CM2000 measure the DC voltage at the collector of the horizontal output transistor. If the B+ voltage is low or missing, unload the power supply by disconnecting the collector of the horizontal output transistor from the circuit. Measure the voltage at the output of the power supply regulator again. If the voltage is still low or missing, troubleshoot the power supply. If the voltage goes to it's schematic value, something is loading down the supply. Troubleshoot the output transistor, flyback, or yoke.

Ring the flyback for shorts or opens

The flyback transformer in a computer monitor is responsible for creating the focus, high voltage, and other scan derived power supply voltages. The flyback is a high failure item and it is also one of the most expensive components in the computer monitor.

While an open transformer winding is easy to identify using an ohm meter; the more common shorted transformer winding is nearly impossible to find using conventional testing methods. The CM2000 has a patented ringer test that gives you an easy to use fail-safe

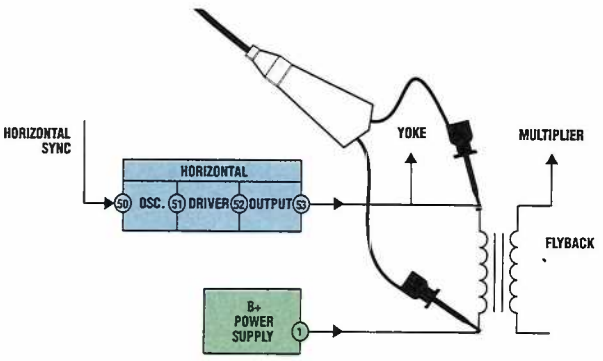


Fig. 10: The CM2000 ringer test finds shorts and opens in flyback transformer windings.

(continued on page 30)

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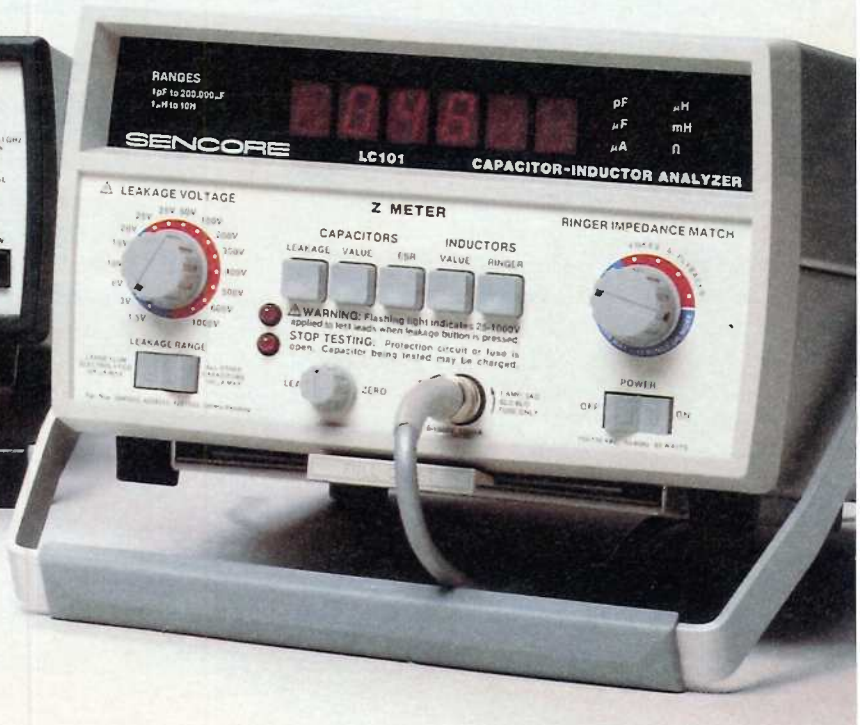


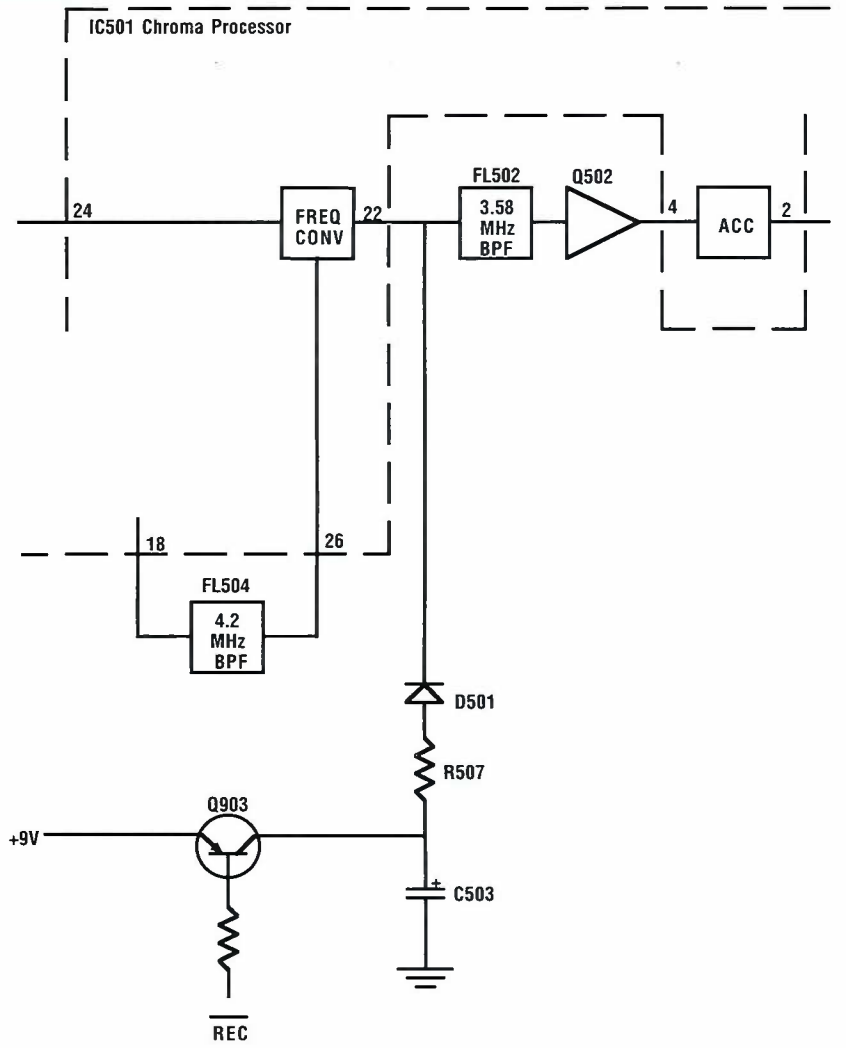


Fig. 2: Portion of record switch circuit, connected to chroma playback circuit, where problems was located.

(continued from page 3)

chroma came through to the monitor, even though he locked the VC93 to the VCR 30 Hz reference signal through the VC93 Chroma Lock Input.

Art said he knew this indicated that the chroma circuits after the frequency convertor had a problem. Art hesitated, though, after he double checked, whether the first half of the chroma circuits, before the frequency convertor, were working properly. When he scoped the output of the frequency convertor while playing a work tape, he was surprised to not see any chroma signal. Did that mean that there were multiple problems in the chroma circuit? Perhaps multiple problems were being caused by the multiple circuits of IC501, the chroma processor. Art explained that he was especially troubled at this point since he knew that the previous service center had already replaced the chroma processor IC.

Art wasn't about to make the mistake of replacing the chroma processor IC again without having solid proof that it was the culprit, so he pulled over his Waveform Analyzer and double checked the signals going into and coming from the chroma processor. He checked the horizontal sync, SW30, and 3.58 MHz reference signals — they all checked good. He explained that he also checked the DC voltages at all the IC pins, and they were good as well. But when he checked the output of the 4.2 MHz subcarrier converter at pin 18, he saw that the signal was very low in amplitude, and the Waveform Analyzer frequency test showed it was at 4.6 MHz rather than 4.2 MHz.

"Tom," Art told me, "it seemed pretty obvious that IC506 the chroma processor IC was defective, even though it had already been replaced once. When I replaced the IC, the 4.2 MHz converter signal came back to its normal amplitude and frequency. I am sure there was a problem with the IC. But Tom," Art continued somewhat disheartened, "there was still no playback color output!"

Art continued to explain that he checked pin 22 of IC501 with his Waveform Analyzer and saw that there was still no chroma signal coming through the frequency converter. Injecting signal at pin 22 with the VC93 still produced no color through the circuits following that point. Art then decided to substitute the FM playback signal coming from the video heads, just to see if that signal would be processed through the first part of the chroma circuit. He substituted the Luma & Chroma Playback Signal from his VC93 to the input of Q309 (output of head switcher) and used his Waveform Analyzer to check the output of the frequency converter at pin 22 of IC501. Still no chroma signal.

"Tom," Art asked, "I sure could use some advice on this multiple problem VCR. It's quickly becoming a tough dog."

It appeared to me that everything Art had done so far was on the right track. He had diagnosed and replaced a defective chroma processor IC, which restored the required 4.2 MHz converter signal. The IC had possibly been damaged by static or excessive heat when it was first replaced by the previous service center.

It seemed the only thing wrong now was that, due to the multiple problems showing up, Art had lost the confidence he needed to continue applying the good troubleshooting techniques he had been using so far.

Situation Recap

The first thing I did, before I tried to suggest any further troubleshooting steps for Art, was to summarize the situation back to him, to be sure I understood all he had told me. The situation so far was:

1. There is good video, but no color, during playback.

2. The servo circuits are all operating normally.

3. Signal substitution at the frequency converter output does not restore color, which indicates a problem in the circuits following that point.

4. There is no chroma signal at the frequency converter output.

5. The chroma processor IC, which wasn't producing a proper 4.2 MHz converter signal, has been replaced.

6. The new IC has restored 4.2 MHz output, but has not changed the other circuit symptoms.

I also took a minute to mentally review the six key signals the chroma circuit requires to accurately process chroma, to be sure Art had verified them all. The six signals are:

1. Playback chroma signal from heads.
2. Horizontal sync.
3. SW30 reference signal.
4. 3.58 MHz oscillator signal.
5. 629 kHz oscillator signal.
6. 4.2 MHz converter signal.

Continued Troubleshooting

I suggested to Art that he continue to use his VC93 VCR Analyzer to inject known-good substitute signals into the chroma stages after the frequency converter. This would help him identify which of those stages were still operating normally. I had Art move one stage after his previous substitution at the output of the frequency converter, and inject at the input of Q502, just following the 3.58 MHz bandpass filter. To be sure that signals would pass through the comb filter properly, I had him connect the VC93 Chroma Lock Input to the VCR SW30 test point. I could almost see Art's look of surprise as he exclaimed, "I have color now!" Already we were back on the road to progress!

Because the VC93 substitute drive signal produced color, we knew that all the chroma stages following the 3.58 MHz bandpass filter were working properly. I couldn't help but wonder though...why wouldn't a substitute signal pass through the filter...could it be that the filter was open...or was it shorted to ground? If it was shorted to ground (though I'd never seen that happen before), that would also explain why there was never a signal at the output of the frequency converter - it was being shunted to ground.

"Art," I called out, my pulse quickening, "un-solder the frequency converter output, pin 22, and allow it to float...then check for signal on the pin with your Waveform Analyzer." Sure enough, in a minute Art came back and reported that there was now chroma signal at the frequency converter output. Great! That now proved that the circuits up to that point were operating properly.

It seemed that we had narrowed the problem down to a low resistance to ground at the output of the frequency converter. Next I asked Art if there were any other components connected to the signal line between the frequency converter and 3.58 MHz bandpass filter. After a couple seconds of checking the schematic, Art said, "Yes, there is a diode, D501, which feeds through a resistor, then to a capacitor to ground."

The diode sure didn't sound like a signal path - maybe some type of switching circuit. But suspecting that possibly the diode was shorted (it sounded more likely than a shorted filter), I suggested that Art disconnect one end of the diode from the circuit and reconnect the frequency converter output pin. As soon as he did, Art really hopped for joy; the VCR was back to normal color operation!

Problem Found

I left Art at that point with his assurance that he was going to check the diode and the rest of the immediate circuit to find what was causing the low resistance to ground. Art thanked me heartily for saving him from a tough dog VCR. (Really, all I had done was to prompt him to continue with the same functional analyzing techniques he had been using before he called.)

Functional analyzing - substituting known-good input signals to analyze the proper functioning of each of the stages - had led Art to finding the first problem of a defective chroma processor IC. It also helped us isolate, with just one additional substitution, another problem between the output of the frequency converter and the input of Q502.

I heard back from Art later when he sent me a copy of the chroma circuit schematic and a note indicating the problem he had found. It turned out that diode D501, which is used as part of the record switch (Figure 2), wasn't bad at all. Instead, transistor Q903, which is supposed to supply voltage to D501 to switch it on only during record, was leaky. This was causing D501 to conduct during playback as well as record. When D501 conducts, it forms a low impedance signal path to ground through C503, shorting out the signal.

We wouldn't even have found the low resistance signal path to ground with an ohmmeter with power removed. The short only existed when the leaky Q903 caused D501 to conduct during playback. Another case where functional analyzing, using substitute signals from the VC93 VCR Analyzer, had tamed a possible tough dog and had turned it into a profitable puppy.

We'll show you more benefits of the VC93, absolutely free. Call **1-800-SENCORE** (736-2673) and your VCR servicing facts will be sent directly to your door.

NOTE: If you enjoyed this article and would like to see more articles about service problems that your fellow technicians experience in the field circle #208 on the fast fact information card.

Sencore Tech Talk

How Signal Injection Works — And Why!

Video Analyzers using substitution have been available for over thirty years. The earlier units, however did not save much time, because any signal already present at a test point had to be disabled , by disconnecting components, before the substitute signal from the analyzer could be injected. If not, the old signal mixes with the signal already in the circuit, causing a confusing combination of good and bad signals.

What is it that makes technicians using the VA62A, VC93, and the CM2000 so effective in troubleshooting? The answer is true functional analyzing using signal substitution.

Functional Analyzing is a systematic, logical approach to troubleshooting. It combines two proven troubleshooting techniques: signal substitution and signal tracing. You substitute a known good signal into the TV, VCR, or Computer Monitor and simply watch the CRT or listen to the speaker to tell which stages are working properly. You can actually restore a defective chassis to proper operation when you substitute for the defective stage.

Once you locate the defective stage with signal substitution, use signal tracing and component analyzing to isolate the bad part. By positively identifying the bad stage before you begin component testing, you narrow down the number of components that need to be tested.

Functional analyzing with the VA62A, VC93, or CM2000 is a universal troubleshooting technique that makes all TVs, VCRs, or monitors look alike by troubleshooting from the block diagram level.

You don't need to learn a new troubleshooting approach for each different chassis from every manufacturer. No matter what type of components are used, tubes, transistors, or ICs, use the same universal troubleshooting approach.

The VA62A, VC93, and CM2000 are the keys to functional analyzing. They supply all the signals needed to substitute in the circuits found in televisions, VCRs and computer monitors. But the real beauty of using functional analyzing with these units is that you don't need to disconnect any parts to substitute a signal in a circuit. Their drive signals are low impedance signals that swamp out whatever signal is present and replace it with the proper input signal for that circuit block. Simply hook up the drive leads to the circuit, select the output level, and watch for the results on the CRT.

Once you have the problem isolated to one small circuit block, use signal tracing (with your Waveform Analyzer) and your component testers (transistor tester, Z-Meter, DVM, etc.) to find the defective component(s) in minutes. The time – saving key to functional analyzing is that you quickly find the defective block, and not waste valuable servicing time checking good components or properly operating circuits.

Functional analyzing is a timesaver in any circuit. But it's a especially valuable for one of the toughest problems faced by servicers today - checking ICs. Signal substitution provides the only efficient way to confirm the function of ICs and isolate problems associated with them. The only alternative is expensive and time-consuming chip swapping.

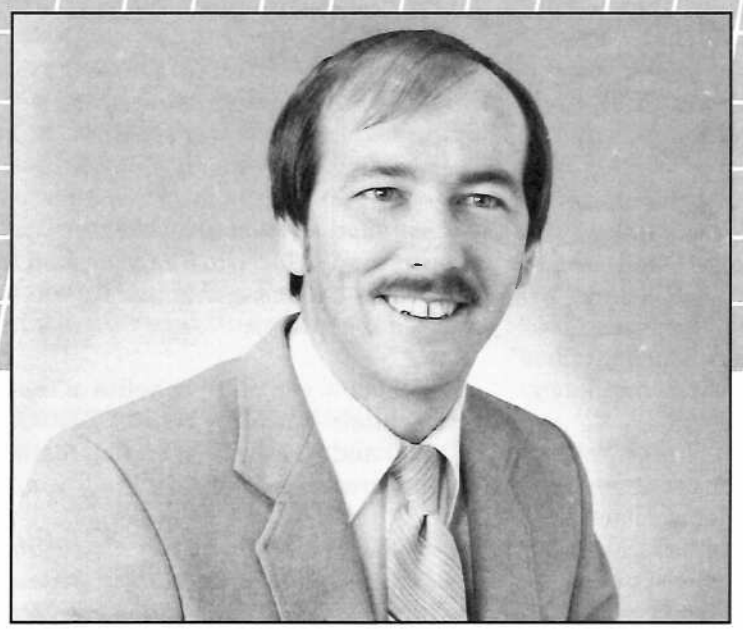
Here's why:

To confirm that a chip is good, you could measure the voltages and look at signals on the various pins. That means using a meter or scope to look at 14, 24, or even 48 pins. But what if one of the output signals isn't right? Chances are good that you'll end up having to unsolder and resolder all those pins to swap chips. How else can you be sure thaat the wrong signal isn't caused by a bad chip? But still, you have no guarantee that a new chip will fix the problem.

That's why functional analyzing using signal substitution is so important. ICs are complete circuits that perform the function of one or more of the blocks in a universal block diagram. In fact, most of the chips used in today's televisions perform the function of several blocks. Signal substitution confirms whether the IC functions properly when you substitute a known good signal at its input, without unsoldering delicate IC pins.

Imagine how much time this technique will save you, no more hunting through parts bins looking for a replacement part or ordering a part only to find out it wasn't the real problem. Functional Analyzing could be the difference you've been looking for to increase profits from your service center.

To find out how functional analyzing can work for you, call **1-800-SENCORE** and talk with your area sales representative.



Understanding The TV Horizontal Output Stage

By Glen Kropuenske, Application Engineer

One of the biggest mysteries in today's television receivers and video monitors is the operation of the horizontal output stage and flyback. The basic concept of this stage has not changed for many years. But scan derived supplies and startup and shutdown circuits have made the horizontal output stage one of the most feared of all circuits. Few technical books provide a practical explanation of how this stage operates, and literature that does explain the horizontal output stage often goes into such detail that most technicians are more confused after they read the explanation than they were before.

Many service technicians have difficulty relating horizontal output symptoms to their possible cause and are often mislead when interpreting circuit voltages and other troubleshooting clues. This article is the first in a series of articles that will help you better understand and service horizontal output stages. In this article we will begin by examining the theory of operation of the horizontal output and flyback transformer circuitry and look at the currents and voltages in the horizontal output stage.

Key Horizontal Output Stage Components

The horizontal output stages operate virtually the same regardless of make or model. All receivers and video monitors apply a sawtooth current into the primary winding of the flyback transformer. The output stage receives power from the main B+ supply, typically about 130 VDC. The B+ supply can deliver peak currents of several amps while maintaining a regulated voltage. The peak-to-peak current varies depending on the CRT size, the number of scan derived supplies, and if the chassis is color or B&W.

Figure 1 shows a simplified horizontal output stage. It consists of six key components: 1) horizontal output transistor (Q1); 2) flyback transformer; 3) retrace timing capacitor or "safety cap" (Ct); 4) damper diode (D1); 5) horizontal yoke; and 6) the yoke series capacitor (Cs). Let's take a closer look at the role that each of these components play.

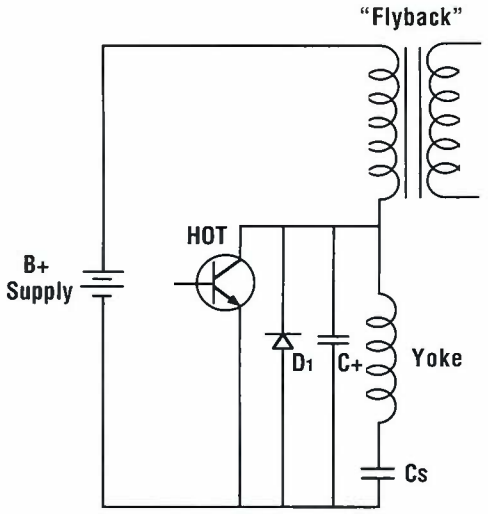


Fig. 1 - Simplified horizontal output stage.

Output Transistor

Think of the horizontal output transistor (HOT) as a switch. It provides a path for current to flow through the flyback's primary winding and horizontal yoke. The transistor is switched on and off by a signal applied to its base. Because it is a power transistor, a hefty current drive signal is needed. This drive current is supplied by the horizontal driver transistor via the driver transformer. The driver transformer steps up the current while providing impedance matching and isolation.

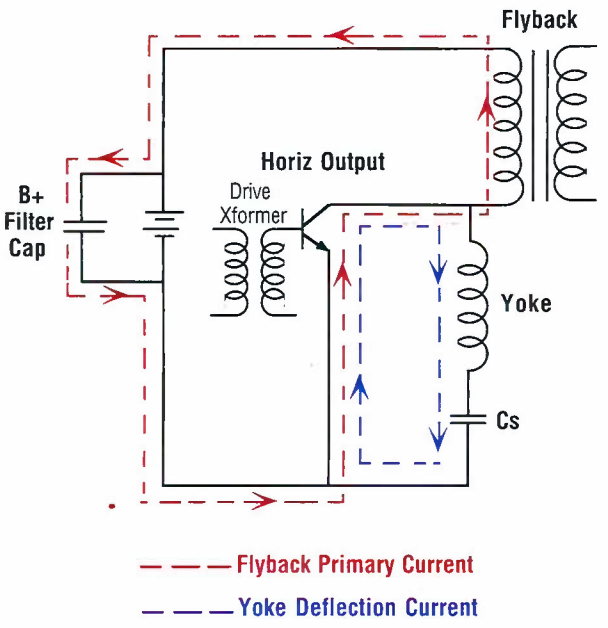


Figure 2. Horizontal output transistor conduction current paths.

The horizontal output transistor passes collector current levels which range from 200 mA in a small B&W chassis to 1.5 A in a large screen color chassis that has multiple scan derived power supplies. These are average current values as a DC current meter would display. Since the flyback and yoke are inductive, the HOT's collector current has a sawtooth rise reaching peaks of several amps.

If you remember your transistor theory you know that the collector current equals the base current multiplied by the current gain (beta) of the transistor. The base drive current must be sufficient to enable the transistor to pass the required collector currents. Base drive currents ranging from 100-300 mA are needed. Low transistor gain (beta) or reduced base current drive will prevent the transistor from passing the required flyback primary current.

The horizontal output transistor is switched on and off at the horizontal frequency of 15,734 Hz. The horizontal oscillator (which controls the driver stage) is syncronized to turn the horizontal output transistor on approximately 30-35 uS before horizontal sync. The HOT conducts until the start of horizontal sync and then is abruptly turned off. This switching action must correspond with the resonant action of the flyback and yoke circuits explained in more detail a bit latter.

The time it takes to switch the horizontal output transistor between on and off conditions is important. The drive current applied to the base of the horizontal output transistor and components in the base circuit enables fast transistor switching. As the transistor is switched, the emitter to collector resistance changes from < 5 ohms (on) to > 10 meg ohms (off). As this change occurs the current flowing through this changing resistance produces heat. The longer the transistion, the more the heat and greater the chance of transistor thermal failure.

The drive produces a waveform at the base of the horizontal output transistor similar to a squarewave. The waveform has spikes which increase the peak-to-peak values indicated on schematics from 5-30 volts. The waveform only confirms the presence of drive to the HOT, it cannot confirm if the base current drive and

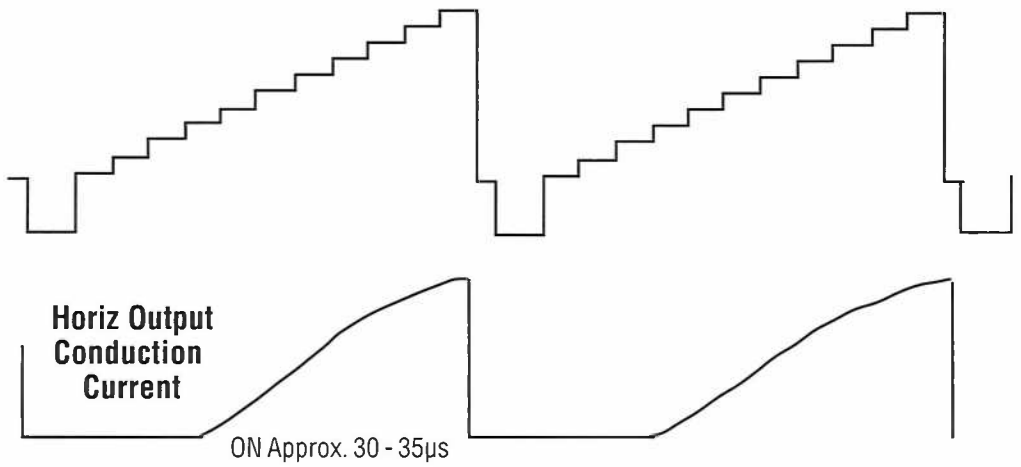


Fig. 3 - The horizontal output transistor is turned on 30-35 µSec. before horizontal sync and is turned off at horizontal sync.

switching transistions are adequate for normal horizontal output circuit operation. Improper drive can results in reduced deflection (width), picture foldover, excessive transistor heating, or shortened HOT life.

Flyback Transformer
The horizontal output transformer is often called the flyback or IHVT. (An IHVT is a flyback transformer that includes the high voltage multiplier). The flyback is primarily responsible for developing high voltage. It is constructed with a powdered iron or ceramic core which allows it to work efficiently at high frequencies.

The flyback includes one primary winding and many secondary windings. The main secondary winding supplies voltage pulses to the voltage multiplier. Other secondary windings supply CRT filament power, keying pulses, and scan-derived power supplies.

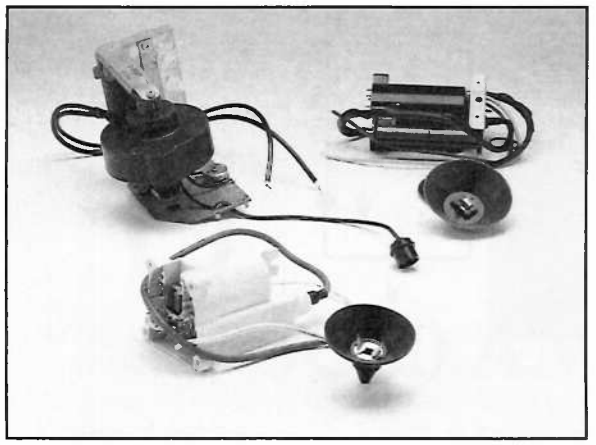


Fig. 4 - Flyback transformers are constructed with a powdered-iron or ceramic core to reduce high frequency losses and has many secondary windings.

The primary winding of the flyback is connected in series with the HOT and B+ power supply. The switching action of the horizontal output transistor energizes the flyback producing inductive voltage pulses. Even though the B+ power supply is only about 130 VDC, the "flyback" action produces voltage pluses much larger - typically 700 to 1100 VPP. To understand how this occurs you need to recall some basic inductor theory.

Inductor theory tells us that the voltage induced across an inductance is: $V = L(\Delta i/\Delta t)$. When the HOT is conducting the current in the flyback primary raises at a linear rate. This produces a constant amount of induced voltage in the flyback windings. But, when the horizontal output transistor is abruptly turned off, the magnetic field in the flyback core rapidly collapses and produces a high induced voltage into the flyback's primary and secondary windings.

The rate of the collapsing magnetic field in the output stage is controlled with timing components. If the rate was not controlled it would produce induced voltage spikes of several thousand volts across the flyback primary. These spikes would exceed the breakdown rating of the horizontal output transistor and flyback and produce excessive high voltages to all flyback windings.

Retrace Timing Capacitor
The retrace timing capacitor plays a very important role in the timing of the horizontal output stage. Its main purpose is to slow down the rate of the flyback's collapsing magnetic field.

If the retrace capacitor's value decreases, or if it opens, the flyback pulse amplitude will increase several thousand volts. To minimize this danger, several smaller value capacitors are usually connected in parallel. Safety shut-down circuits are also added to disable the horizontal output stage should the high voltage increase to unsafe levels. Because of the key role that this capacitor plays in controlling the induced voltages (and the CRT high voltage) it is often called the "safety capacitor".

Damper Diode
The damper diode serves to complete the path for resonant current for both the flyback primary and horizontal deflection yoke. The damper diode is a fast switching diode capable of withstanding the addition of the flyback and yoke currents. If the damper diode opens it forces the horizontal output transistor to operate in reverse breakdown. This adds a considerable amount of heat to the transistor and would likely lead to its failure.

Horizontal Yoke
The horizontal yoke causes the CRT electron beam to scan from left to right across the face of the CRT. Horizontal deflection is produced by a sawtooth rising and falling current to the horizontal yoke windings. The horizontal yoke is directly driven by current in the horizontal output stage. Since this component is part of the stage, it influences the retrace timing of the circuit. Problems in the yoke or it series components can alter the operation of the horizontal output circuit without being suspected.

Yoke Series Capacitor
Capacitor Cs, which is in series with the yoke has four functions. First, it is primarily

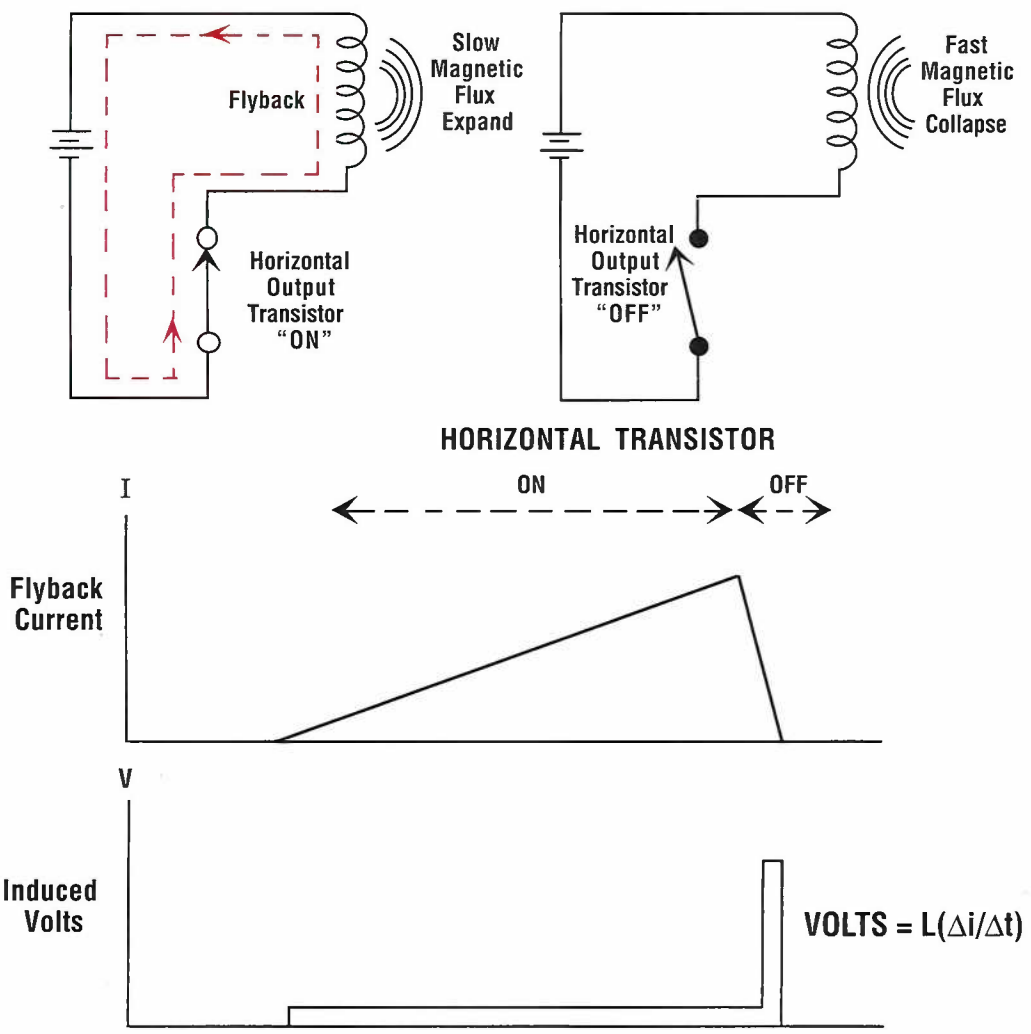


Fig. 5. The rapidly collapsing magnetic field of the flyback transformer when the horizontal output transistor is switched off produces a high voltage pulse.

responsible for matching up the resonant timing of the yoke deflection current. Secondly, as we stated earlier, it has an affect on the retrace time. Thirdly, this capacitor prevents a fixed DC bias from developing on the yoke that would cause improper picture centering. Finally, capacitor Cs shapes the sawtooth rise in deflection current to match the slight curvature of the CRT.

Understanding Output Stage Operation

Now that we have looked at each of the key components individually, we'll put them together and see how the whole circuit operates. We will analyze the output stage in two parts according to the major functions that the horizontal output stage performs: 1) Flyback primary current and retrace time, and 2) Horizontal deflection.

Although these two functions interact, discussing each separately will help you better understand the operation of the horizontal output section. The first function, flyback primary current and retrace time, is responsible for producing the CRT high voltage, focus voltage and scan derived supplies. The second function, as its name implies deals with deflecting the electron beam.

Flyback Primary Current And Retrace Time

Let's begin by looking at the current paths in the primary of the flyback transformer. Figure 6 shows the flyback action and current paths at 4 times during one output cycle, beginning with the turn on of the horizontal output transistor.

When the horizontal output transistor is turned on, current flows through the flyback's primary from the B+ power supply. All of the power needed by the output stage and flyback secondaries is delivered to the circuit from the B+ supply during this time. The current and magnetic field in the flyback's core continue to build until the transistor is turned off.

The magnetic field that was stored in the flyback's core begins to collapse immediately after the horizontal output transistor is turned off. This is the beginning of retrace time and corresponds to the start of horizontal sync. With the horizontal output transistor switched off the retrace timing capacitor is effectively placed in parallel with the flyback primary. Thus, a resonant circuit is formed as shown in Figures 5b & c. The time constant of the resonant circuit is mainly determined by the value of the retrace capacitor and the inductance of flyback's primary winding. Note that the yoke components in parallel with Ct, (the yoke and Cs) also have an affect on retrace timing.

The collapsing magnetic field causes current to flow through the low impedance of the B+ supply's filter capacitors and into Ct. This current charges Ct. The rise in voltage across Ct is the flyback pulse formed at the collector of the horizontal output transistor. (This pulse is the only voltage waveform that is available to you to help analyze the operation of the horizontal output stage).

After the magnetic field has completely collapsed Ct begins to discharge. This causes current to again flow back into the flyback's primary in the opposite direction. Again, a magnetic field rebuilds, of the opposite polarity. This action completes the 2nd part of retrace and corresponds to the falling portion of the flyback voltage pulse at the collector of the horizontal output transistor. Properly operating horizontal output stages have retrace period (flyback pulse duration) of 11.3 to 15.9 µsec..

When Ct has completely discharged the magnetic field again begins to collapse. The collapsing field induces a voltage with a polarity that forward biases the damper diode, D1. The damper diode serves as a switch and allows the magnetic energy (current) in the

(Continued on pg. 28.)

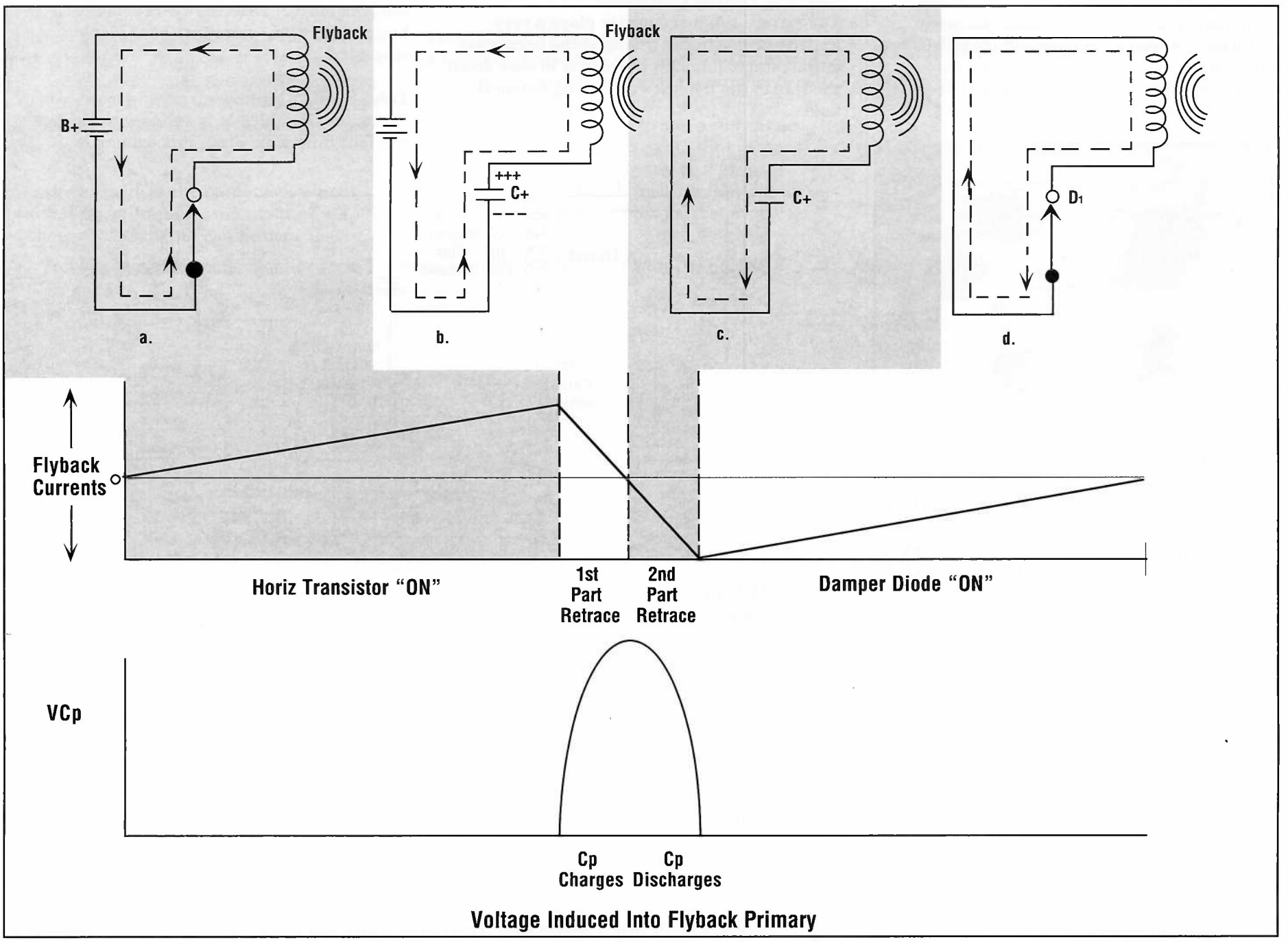
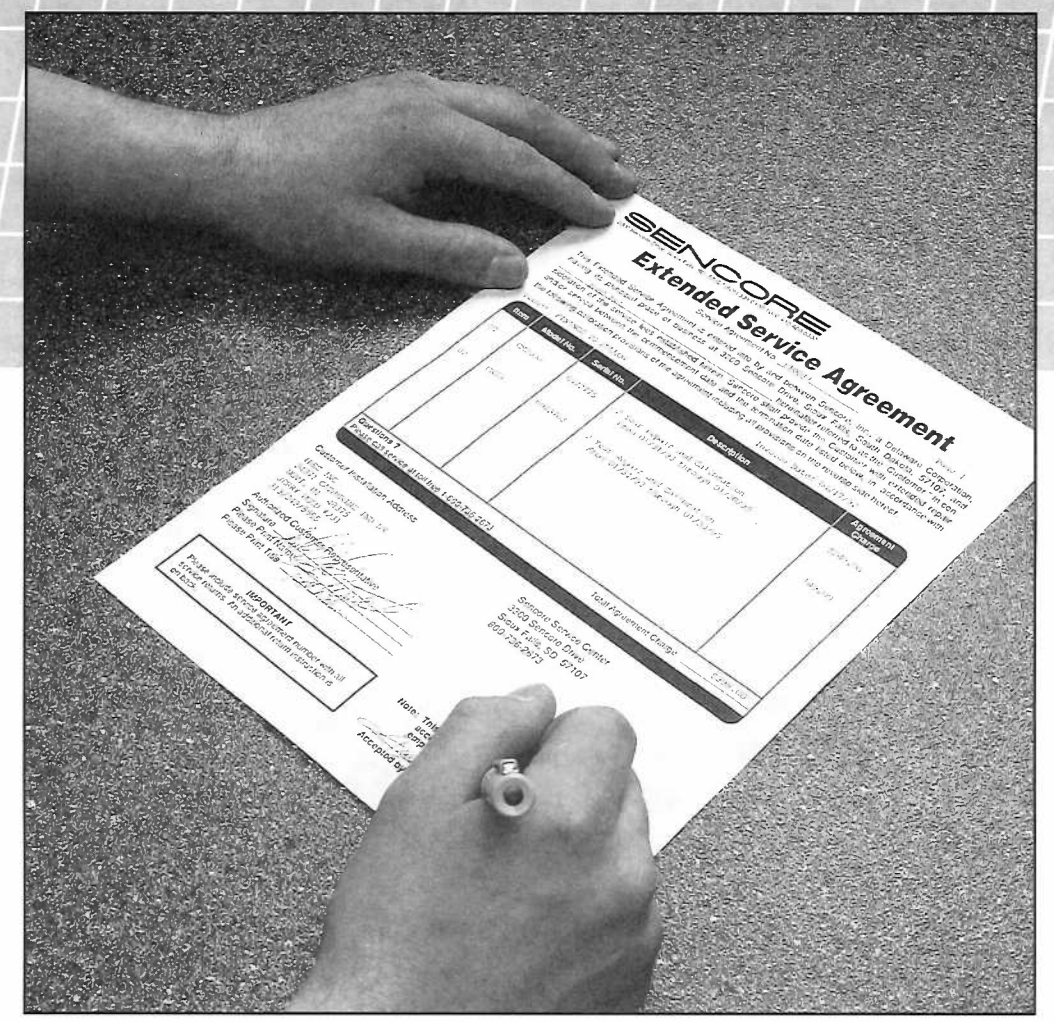


Fig. 6 These simplified circuits show the alternating flyback current, the current waveform, and the flyback voltage pulse for one complete horizontal cycle.



Sencore's All New Extended Service Agreement

By Garrett Carter, Service Department Manager

- **Product Improvements Installed At No Charge.**
- **Calibration Traceable To NIST Standards.**
- **Providing You With Tomorrow's Service At Today's Prices.**

Sencore wants to make sure that your test equipment is as reliable as the day your purchased it, so you can depend on your test equipment when you need it the most. We are proud to announce another service to our custumers—

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Sencore is offering the most effective calibration and maintenance services you can buy for your instruments to save you valuable time and money. Here are some of the advantages that you can gain by having your Sencore instrument(s) on an Extended Service Agreement.

- Sencore Extended Service Agreements (ESA) protect you against costly repair bills at an unexpected time, when you need your equipment the most but possibly don't have the funds available to get the instruments repaired immediately.
- By taking advantage of ESA, you ensure that your equipment will be at its top operating condition when you need it, with the latest product improvements installed whenever your unit comes in for regularly scheduled calibration.
- The ESA program provides you with the security of knowing what the maintenance cost will be for your instrument over the next 2 to 4 year period. In many cases, this allows you to simply put that figure into your annual budget and know that all the repair and maintenance costs are covered.
- Sencore's ESA program allows you to lock into today's prices for tomorrow's service needs. Extended Service Agreements provide you with a method of staying ahead of inflation.

And best of all, Extended Service Agreements allow you to choose the program that fits your needs. It provides calibration and repair or simply calibration.

Here is an explanation of each:

Standard Repair And Calibration Agreement:

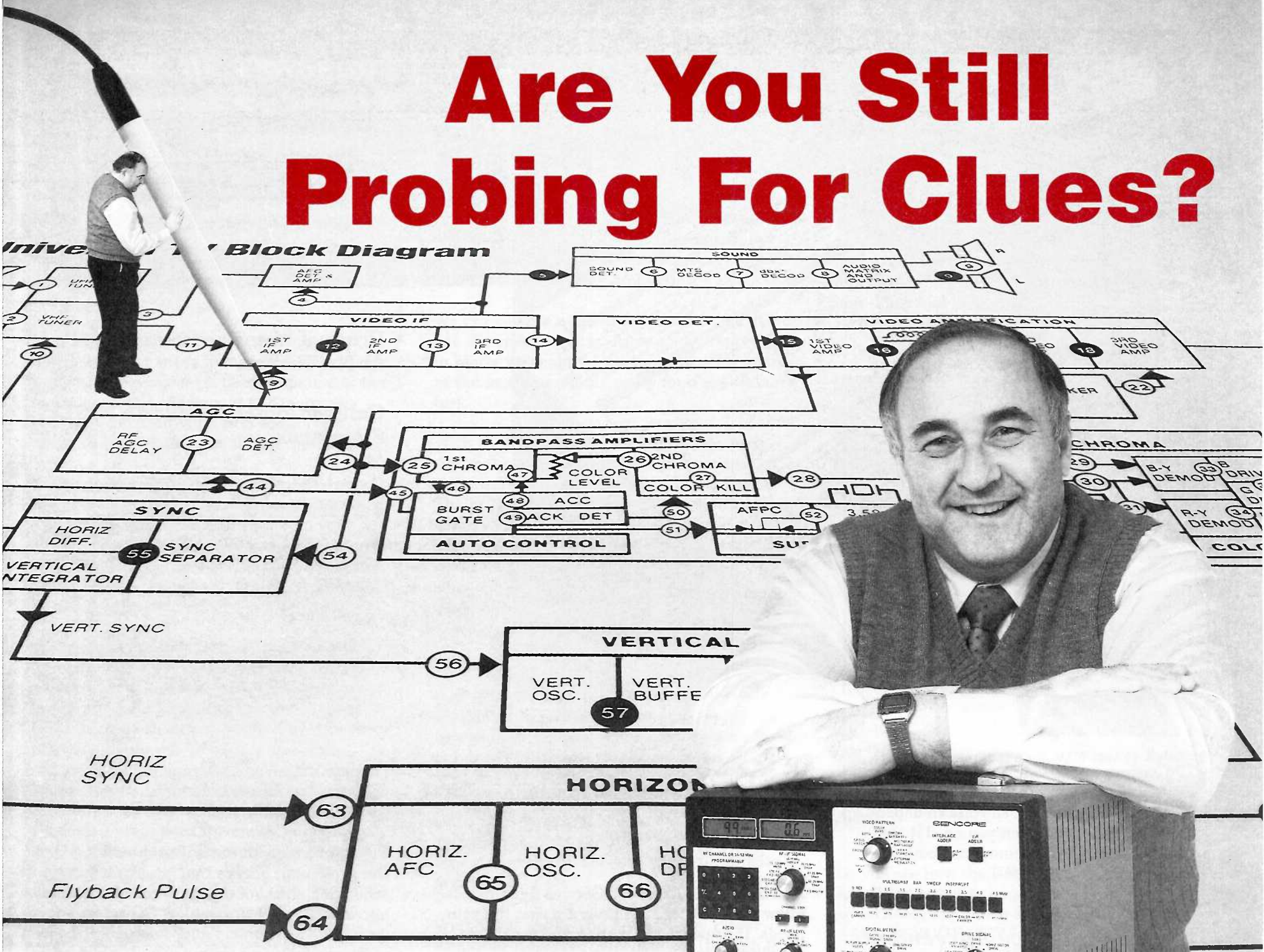
- This agreement provides repair service of your product should it ever fail during normal use, for a period of either 2 or 4 years. Terms of the agreement include:
- Response time for products serviced under the agreement will normally be shipped back to you within 3 working days.
- Repair service will cover all labor and replacement parts and any other related expenses that may be needed to get your unit back in top condition.
- Installation of product improvements will be automatically included with your unit(s). These improvements may enhance product performance and are made at no additional charge to you.
- Calibration on all products serviced are performed using standards traceable to the National Institute of Standards and Technology (NIST).
- Transportation costs to return your unit are prepaid on standard ground service.
- Documentation on each repaired and calibrated unit is included in the form of a certificate of calibration.
- Priority service for units that are covered by the agreement ensure that your unit will be scheduled ahead of units not covered by any agreement.

Calibration Only Agreement:

- This agreement is designed to provide calibration services for a period of 2 or 4 years after your normal warranty expires. With this agreement you can return your unit for calibration at any interval you select and reduce your calibration costs well below what is normally charged on a per incident basis.
- The terms of the Calibration Only Agreement are similar to those of the Repair and Calibration Agreement except it will not cover the repair charges if your unit(s) are in need of it.
- Extended Service Agreements are the ideal protection for your Sencore equipment. We're working to be your test equipment supplier. The ESA program is just another way of providing the best customer support in the industry.
- For complete details on the Extended Service Agreements, call **1-800-SENCORE**, and talk with the Sencore Service Department on how you can take advantage of this program.

NOTE: If you have resently purchased a unit and are interested in this program call the Sencore Service Dept. at 1-800-SENCORE or circle #209 on the free information card.

Are You Still Probing For Clues?



VA62A Universal Video Analyzer

Now You Can Confidently Walk Defects Out Of Any NTSC Video System In Less Than 1/2 The Time With The Industry's Only Complete Video Analyzer!

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How many times have you found yourself mentally or physically exhausted because you've spent the day probing from test point to test point, and either everything looked bad or the circuit was dead with no signals?

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2. A better and more profitable troubleshooting method compared to your present techniques.

The VA62A Universal Video Analyzer is guaranteed to cut your video troubleshooting time by 54%* or you receive a complete refund during the first 30 days.

** Based on a nationwide survey of users who reported an average time savings of 54% compared to their previous test equipment.*

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- Test yokes and flybacks (IHVTs) with the patented "Ringer" and exclusive high-voltage multiplier drive test.
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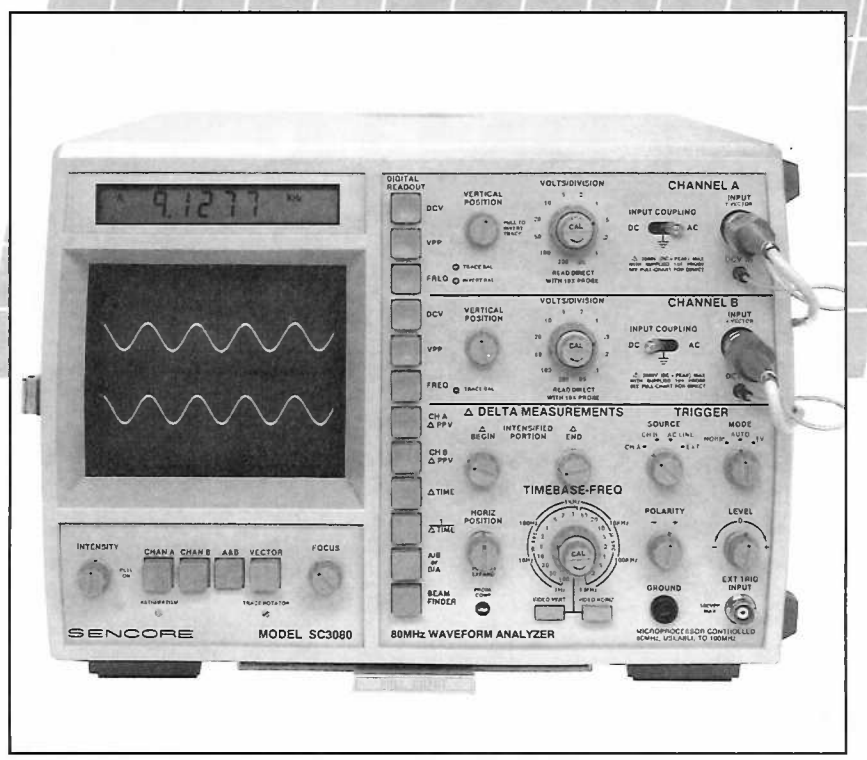
Give us a call at 1-800-SENCORE, and we'll send you a custom designed answer to your video servicing challenges!

SENCORE

For more information on how the VA62A will help you in your daily troubleshooting, circle FAST FACT #207

How To Analyze Signals; Easier, Faster, And Error-Free With The SC3080 Waveform Analyzer

By: Brian Phelps, Product Marketing Specialist



- **New Probe Design — Now easier to use.**
- **Full 80 MHz Bandwidth — Allows you to analyze more signals.**
- **Complete Push-Button Test Point Analyzing — Instantly compare to service literature for pin-point accuracy.**

As you look at Sencore's SC3080 Waveform Analyzer, it's easy to think of it as just an oscilloscope, because the CRT is the largest part of the front panel. But, we call it a waveform analyzer because its digital readout analyzes waveform parameters for you—even if you don't have the waveform displayed.

This difference might not sound like much, until you take a look at how you analyze signals. Look at Figure 1, to see what we mean.

Imagine the schematic is of a circuit you frequently service. Now, think about which troubleshooting information you use most often.

• **DCV:** What percentage of the time will the DC voltage reading tell you whether the circuit or its power supply is working?

• **PPV:** How often does peak-to-peak tell you everything you need to know about stage gain?

• **Frequency:** When will a frequency reading confirm that an oscillator or a digital divider is working correctly?

• **Waveshape:** Ask yourself how often you use a scope to look at waveshape without also needing to know one of the other parameters.

If you are like most servicers, waveshape is only used alone occasionally. The rest of the time, you either need a parameter without regard to the signal's waveshape, or you need a parameter reading with the waveform. That's why the Waveform Analyzer is designed to be used differently than an oscilloscope.

You see, other digital-readout scopes are only oscilloscopes. Most require you to have a waveform locked onto the screen every time you take a reading, because all their readings are based on the displayed waveform.

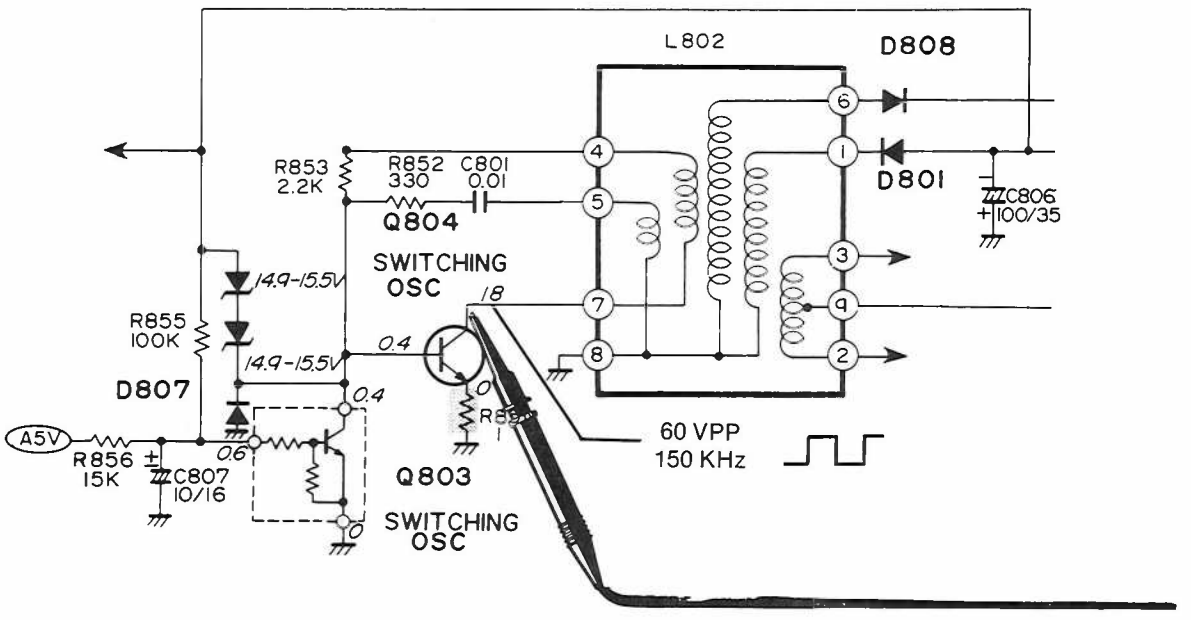


Fig. 1: Of the troubleshooting information on a typical schematic, DC voltage, peak-to-peak amplitude, and frequency are used more often than waveshape.

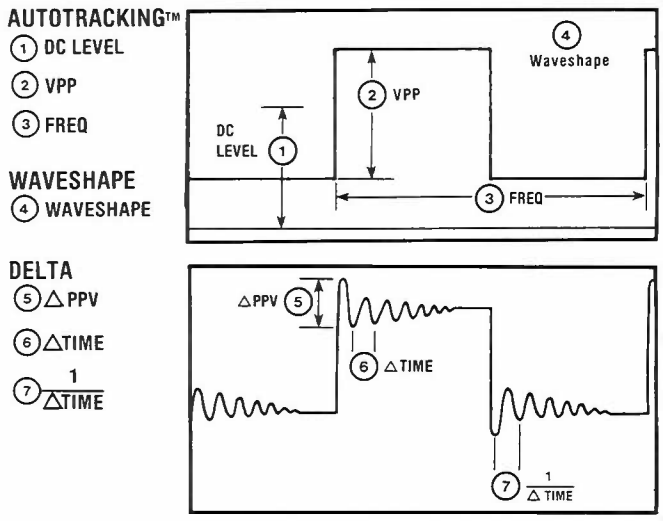


Fig. 2: The SC3080 provides three different ways to analyze a signal, depending on how much detail you want: 1. The Autotracking digital tests, 2. The easy to use CRT display, and 3. The digital Delta readings.

Every time you set up a scope display to get a simple DC or peak-to-peak value, you break your train of thought. You risk backtracking and ineffective troubleshooting. If time weren't important in your work, you probably wouldn't mind the extra steps it takes to lock the waveform every time you measure a signal. But, time is important if you want your business to generate any profit. That's why the SC3080 gives you parameter readings, even if you don't have a waveform displayed.

Just press a button and read the display. When you do want to analyze waveshape, the CRT is always ready to go—and easy to use. The rest of the time, you make the decision regarding whether you'll take the time to display the waveform, or whether you use the digital readout all alone.

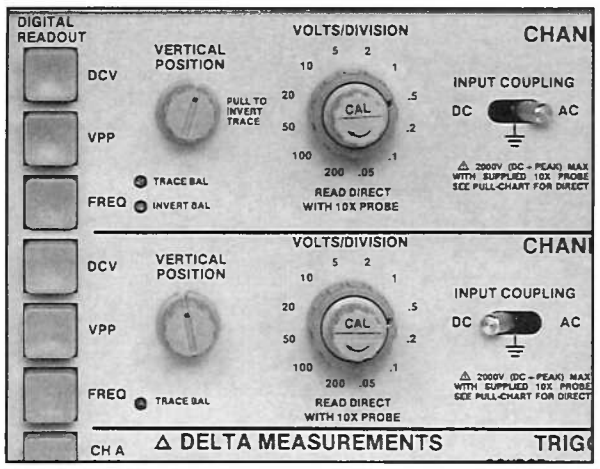


Fig. 3: Most signal tests are made with the Autotracking tests of DC volts, peak-to-peak, and frequency for channel A or B. You don't need a waveform on the CRT for any of the Autotracking tests.

Figure 2 shows how the SC3080 gives you the choice of three ways to test a signal: **1.** The "Autotracking" digital readouts, **2.** The easy to use CRT, and **3.** The "Delta" digital tests. What difference do these features make? They save you time on every signal you test. They give you measurements free from setup errors. And they make waveform analyzing as simple as using a digital meter.

The first group of tests is used similar to a meter. We call them the "Autotracking" digital tests.

The "Autotracking"™ Tests Work With or Without A Waveform Displayed

The first three digital readout functions are called the "Autotracking" tests. Autotracking means the tests automatically track with the input, but don't need a waveform on the CRT. The same probe feeds the digital circuits and the CRT. Use that same analyzing probe to fully test the signal at any test point.

The SC3080 has two matched channels, so that you can use the digital readout or the CRT to compare any two signals. The digital readout selector buttons are laid out in the sequence you use them, starting with DC volts.

Autotracking DC Volts: DC readings confirm that the power supplies are working correctly, and that stage biases are correct. Most technicians make DC voltage readings more frequently than any other. That's why the first Autotracking SC3080 test is DC volts.

To measure DC with the SC3080, just connect the analyzing probe, and press the "DCV" button for channel A or channel B. The test is fully autoranged, so that you don't have to make any adjustments to the controls for signals from 1 millivolt all the way to 2000 volts.

The SC3080 probe routes the DC around the CRT's input-coupling switch. This gives you error-free DC readings, even with the switch in the "AC" or "Ground" position. The DC readings are fully independent of other tests, so you get accurate DC readings every time you press one of the "DCV" buttons.

Autotracking Peak-to-Peak: After DC, peak-to-peak voltage is the most important parameter. Amplitude confirms that each stage is processing the signal correctly. Tracing a weak or missing signal identifies poor coupling components, bad gain stages, and so on. That's why the second Autotracking SC3080 test measures true peak-to-peak signal amplitude.

Each SC3080 channel has four ranges, chosen by the "Volts Per Division" switch. Just press the "VPP" button and turn the switch until you have as many or as few digits in the display as you want.

The peak-to-peak circuits let you measure signals as large as 2000 volts. This gives you 5 to 15 times the measuring range of basic oscilloscopes, which are limited to 200 to 600 volts maximum.

Like the DC readings, you don't need a displayed waveform to measure peak-to-peak.

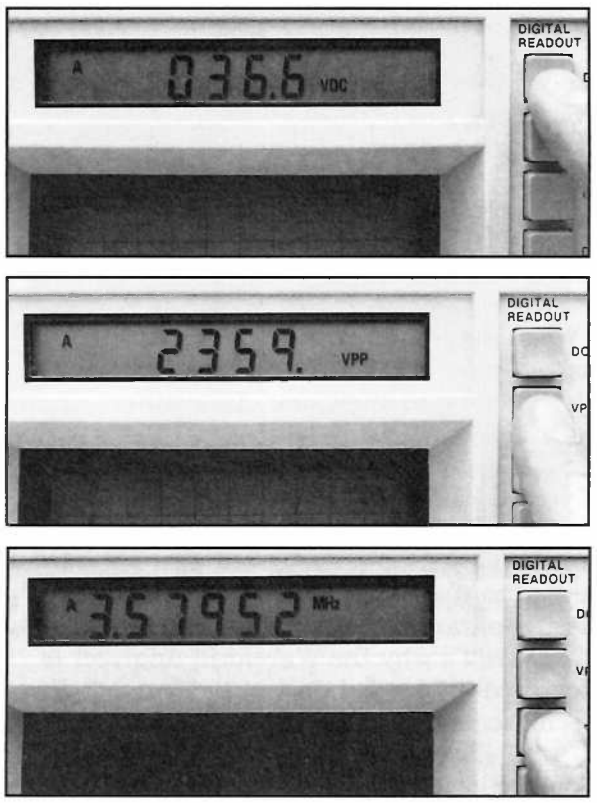


Fig. 4: The Autotracking tests work without a waveform displayed; simply push DCV, VPP or FREQ and read the digital display.

If you decide to show a waveform, the digital readings remain error-free, no matter how you set the CRT controls. The peak-to-peak circuits are not affected by the setting of the vertical vernier controls.

Autotracking Frequency: Modern digital circuits have added frequency to the list of parameters needed to track down circuit problems. Frequency confirms that oscillators, multipliers, and dividers are working the way they should. The third Autotracking SC3080 test is frequency.

When you connect the Waveform Analyzer's probe and press one of the two "frequency" buttons, the SC3080 gives a fully autoranged test. The 6-digit readout is referenced to a high accuracy crystal. This remains accurate even if you don't display the waveform or if the horizontal vernier is uncalibrated.

The three Autotracking tests of DC, peak-to-peak, and frequency, give easy-to-use, error-free readings on either channel. You can do well over half of your signal analyzing by simply connecting an SC3080 probe, pressing a button, and reading the digital display.

But, what about those times that waveshape is important? That's where the SC3080's second feature—its easy to use CRT display—comes into the picture. You have the choice of using it alone, or with any of the Autotracking tests we've just covered. We'll look at it next.

The Easiest To Use CRT Display

Sometimes waveshape is important. Waveshape shows whether the circuits have properly formed the signal. It shows whether distortion, noise, or glitches have been added to the original signal. It also shows if signals are timed correctly. The SC3080 lets you analyze the waveshape in two ways; with the CRT, and with the Delta digital tests.

Human Engineered Panel: The CRT displays the waveform like any high quality oscilloscope. It is usable all the way to 100 MHz to give accurate waveshaping. The 80 MHz bandwidth covers more than 99 percent of the circuits used today, including digital circuits.

The SC3080 makes waveform testing easy. Its highly human engineered front panel has 50 to 70 percent fewer knobs and switches than conventional oscilloscopes yet provides you with more troubleshooting power. This logical panel layout lets you make tests without needing an operating manual by your side every minute of the day. Its simplified operation eliminates the chance of making setup errors.

The spacious panel gives plenty of room to operate each control without running your knuckle into another knob. Plus, you can press the large, finger-sized pushbuttons, without using a pencil eraser, as needed with some others.

Fiddle-Free Sync: Rock-solid sync circuits provide for fiddle-free testing. In fact, the SC3080 only needs 4 setup controls. The rest of the circuits are automatic.

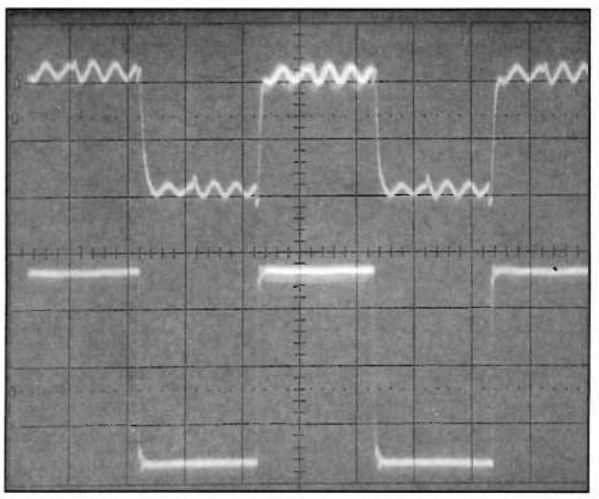


Fig. 5: The SC3080 Waveform Analyzer's CRT displays waveforms to 100 MHz, covering 99% of the circuits used today—including digital.

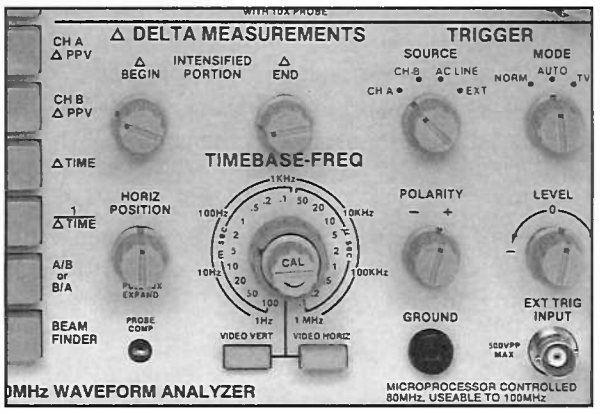


Fig. 6: The SC3080's CRT setup is error-free too, with only 2 horizontal and 4 triggering controls needed to lock in any waveform with Sencore's famous rock-solid sync.

Testing composite video signals, such as those found in computer displays, video monitors, and television equipment is also simplified with video sync separators, and with sweep speed preset buttons.

2000 Volt Measuring Range: Just like the autotracking tests, the CRT lets you measure signals as large as 2000 volts peak-to-peak. Its patented input circuit extends the 2000 volt protection to every attenuator setting. This protection lets you confidently analyze signals as extreme as the collector of the horizontal output transistor of a video monitor or TV receiver. Your SC3080 is protected from damage, preventing costly downtime.

Although the CRT works like a scope, you do not need to use the waveform when you need parameters of part of the signal. Instead, use the automatic "Delta" digital tests. These tests let you fully analyze any waveform segment you want.

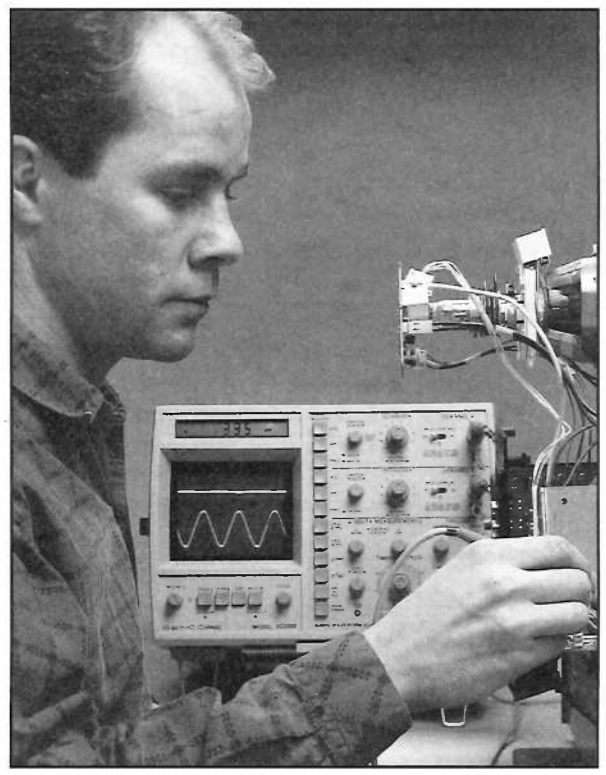


Fig. 7: The 2000 volt peak-to-peak (or 2000 volt DC) measuring range of the SC3080 lets you measure any signal; patented circuits protect the input for any attenuator setting.

Digital "Delta" Tests Analyze Waveform Segments

"Delta" means that you tell the Waveform Analyzer which part of the signal you want the digital circuits to measure. Pressing any of the four Delta buttons activates these two controls, called "Delta Begin" and "Delta End". The controls position an intensified area, called the "Delta Bar", on the waveform. The digital circuits then measure the signal in the highlighted area.

Delta Peak-to-Peak: The first Delta test is "Delta Peak-to-peak", which measures the amplitude of any part of the signal. For example, you can measure the amplitude of a color burst signal, while ignoring the rest of the composite video signal by highlighting the color burst area. Or, you can see how much noise is riding on top of a digital signal by setting the Delta Bar to only highlight the signal's on-time.

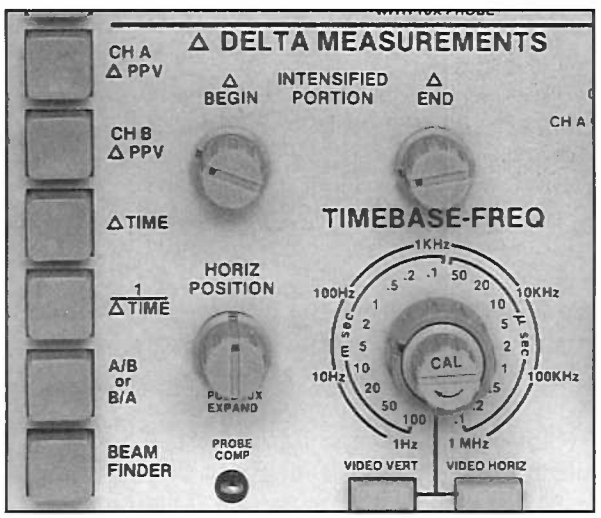


Fig. 8: The intensified portion of the waveform is the only area tested after setting the "Delta Begin" and "Delta End" controls. These controls are automatically activated when any of the four Delta buttons have been pressed.

The Delta Peak-to-peak function has the same bandwidth as the Autotracking test, so that it accurately measures any highlighted signal. And just like the Autotracking test, it measures true signal level, so that you get error-free readings with the vertical verniers set anywhere you want.

Delta Time: The second Delta test is "Delta Time". Delta Time uses a crystal oscillator to determine the time of the Delta Bar. For example, you can adjust the Delta Bar to cover the starting and stopping point of a pulse to find its on-time. Or, you can compare on-time to total time to determine duty cycle.

The Delta Time function also lets you measure the delay between two signals. Just highlight the difference between them, and read the LCD display.

Or, you can use Delta Time to adjust a circuit. Preset the SC3080 Delta controls until the digital display shows the correct amount of delay. Then adjust the circuit until the signals just touch the intensified area. Since the Delta Bar is crystal referenced, the measurements remain error-free, even when you have the horizontal vernier control uncalibrated.

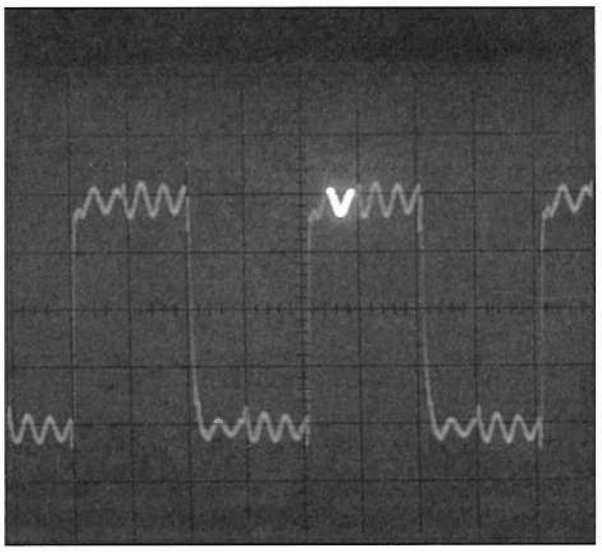


Fig. 9: The Delta Frequency test lets you find the frequency of a signal riding on top of the main signal.

Delta Frequency: The final Delta Test is Delta Frequency. This function uses time to find the equivalent frequency of any signal riding on the main signal. To calculate frequency, press the "1/ΔTime" button, and adjust the Delta Bar until it exactly covers one cycle of the signal. Then, read the display.

Incidentally, the Autotracking frequency test is more accurate than a manually adjusted "One-Over-Delta-Time" test when you want to know the precise frequency of the signal. You need both, because the "Delta" method gives you the ability to determine frequency when a signal is riding along with the main signal.

One final feature of the SC3080 is its full automation option. Connect it to any computer using the IEEE-488 general purpose interface bus, or with RS232 serial communications. Optional accessories let you add automation at any time.

Briefly, those are the SC3080's features. The Autotracking tests can be made with or without a waveform on the screen. The CRT lets you view waveshape with the easiest to use waveform display you can find. And, the Delta tests give you digital accuracy when you need to analyze any detail on a waveform, even if the CRT controls are uncalibrated.

What's the bottom line to these SC3080 features? You use a single probe to test every signal. You press a button, and get the error-free reading you want—when you want it. Only the SC3080 is so easy to use that you'll make it your main trouble-shooting tool. Try it for yourself and see if you agree.

Get The Full Story

We were unable to provide the full SC3080 story in this article. If you'd like to see exactly how the SC3080 can help you, call or write for a free brochure on the all new SC3080, which takes you through full signal analyzing. For your copy, dial (toll free) **1-800-SENCORE.** For a Risk Free, 10-day Self Demo circle Fast Fact #214.

(Continued from pg. 22.)

flyback and yoke to decay at a controlled rate. When the damper diode turns on the circuit becomes highly inductive and once again produces a slowly increasing current in the flyback's primary. Approximately 18 uS latter the horizontal output transistor is once again turned on and the cycle repeats. Note that if the horizontal output transistor could conduct current of either polarity the damper diode would not be needed.

Flyback Power Transfer

The flyback transformer essentially works like any other transformer in that the alternating current in the primary induces power (voltage and current) into the secondaries. If all of the secondary loads were open most of the power stored in the magnetic field of the transformer would return back to the primary circuit. But, the secondary circuits do draw power from the primary. Thus, as the load on the secondary windings increases, more current flows in the primary and more current is drawn from the B+ supply.

Some problems, such as a shorted secondary load circuit or a shorted flyback winding, cause such a great current demand that the circuit cannot compensate for the power demand. This may cause the horizontal output transistor to over heat and short, the flyback primary to open, or the B+ supply to fail.

Horizontal Yoke Defection

The second major function of the horizontal output stage is to provide the current needed for the deflection yoke to move the CRT electron beam from left to right cross the screen. The output transistor's collector current is split between the flyback and the horizontal yoke. Both current paths share the damper diode and retrace timing capacitor.

Figure 7 shows the yoke deflection current at 4 different times during one horizontal cycle. The four times are the same as those shown in Figure 6.

When the horizontal output transistor is turned on the bottom side of the yoke series capacitor, Cs, is connected to the top of the yoke. Because Cs is fully charged at this time, it begins to discharge through the horizontal output transistor. The resulting current produces an expanding magnetic field in the yoke which moves the electron beam from the center of the screen towards the right side.

When the horizontal output transistor opens the retrace timing capacitor is added to the circuit, as shown in Figure 7b. This increases the resonant frequency and causes the yoke's magnetic field to rapidly collapse. This is the beginning of retrace time during which the CRT beam is snapped from the right side of the screen back to the center. The induced voltage causes current to flow and returns the energy that was stored in the yoke's magnetic field to capacitors Ct and Cs. The retrace timing capacitor is replenished with charging current from the flyback transformer and becomes the current source for the yoke current.

During the 2nd part of retrace Ct and Cs discharge and force the current to flow in the opposite direction, as shown in figure 7c. The timing is identical to the first part of retrace and the CRT beam is moved quickly from the center to the left side of the screen.

When capacitors Ct and Cs are fully discharged, the yoke's magnetic field begins to collapse, as shown in figure 7d. The induced voltage forward biases the damper diode into conduction. (Notice that this occurs at the same time as it did in Figure 6).
The circuit's timing is now determined by the yoke and capacitor Cs and agrees with the timing during the right trace time. The yoke's collapsing magnetic field produces current through the damper diode which returns energy to the circuit and charges Cs.

When the yokes's magnetic field is collapsed, the damper diode stops conducting. This must coincide with the turn-on of the horizontal output transistor otherwise there will be horizontal non-linearities in the center of the raster.

The yoke current must be sufficient to achieve the needed CRT deflection (picture width). The yoke current can be changed by adding inductance in series with the yoke, or by changing the value of Ct.

Summary

To simplify our explanation of the horizontal output stage we analyzed the flyback and yoke function separately. Note that these circuits are not independent of each other: the flyback current is transferred to the yoke by the retrace timing capacitor Ct and the yoke and flyback currents share the conduction time of the horizontal output transistor, damper diode and retrace timing capacitor. Because of this interaction, most problems in the horizontal output circuits affect both the flyback and yoke currents.

Because the horizontal output circuits operate with high values of inductive currents, conventional voltage measurements are limited. One key measurement, however, is the pulse at the collector of the horizontal output transistor.

As you recall, capacitor Ct is effectively charged by the flyback and yoke currents simultaneously during retrace time. This rising and falling retrace voltage pulse can be analyzed to gain information about the operation of the horizontal output circuit. This voltage pulse may be measured at the collector of the horizontal output transistor with respect to emitter ground. The B+ power supply voltage may also be measured at this test point to confirm proper supply operation.

Caution: Before making measurements in the horizontal output stage be sure the test instrument is designed to withstand peak-peak voltage pulses >1000V.

We will see how to analyze the information at the horizontal output stage in the next article in this series.

If you enjoyed this technical article on the Horizontal Output Stage and would like additional information regarding it, circle Fast Fact #213.

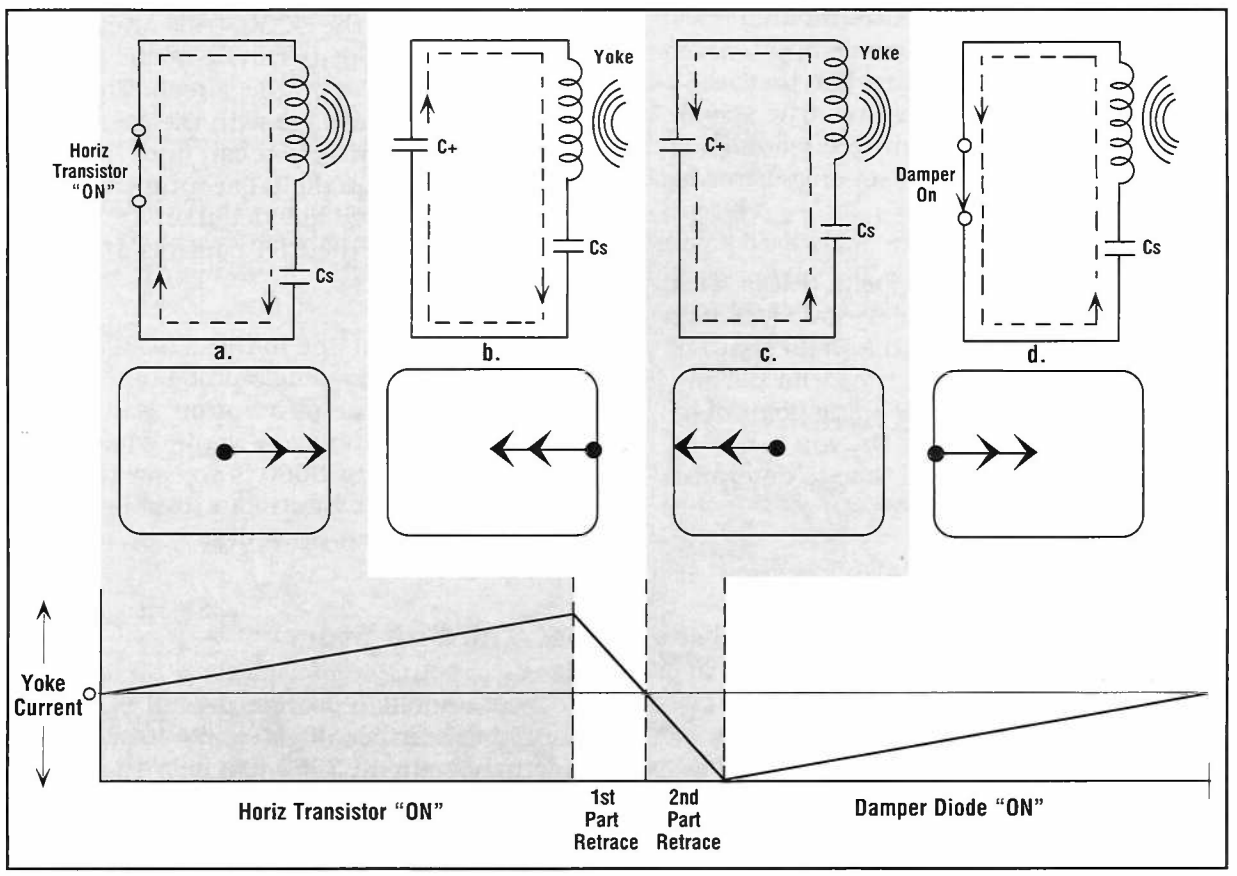


Fig. 7 - These simplified circuits show the deflection current and position of the beam for one complete horizontal cycle.

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(continued from page 14)

method of finding opens and shorts in flyback transformers.

Example Symptom: Dead monitor #2

Connect the CM2000 across the flyback's primary winding and ring the transformer. A "Good" reading of "10" rings or more mean that none of the windings in the flyback have shorts or opens. You do not need to ring any other winding. A shorted turn in any other winding will cause the primary to ring bad.

A "Bad" reading, less than 10 rings, may be caused by a circuit connected to the flyback that is loading the ringer test. Disconnect the most likely circuits in the following order: 1) Yoke; 2) CRT filament (unplug the CRT socket); 3) H.O.T collector; 4) scan derived supplies. Retest the flyback after you disconnect each circuit. If the flyback now rings "good," it does not have a shorted winding.

If the flyback still tests bad after you've disconnected each circuit, unsolder it and completely remove it from the circuit. If the flyback primary still rings less then 10, the flyback is bad and must be replaced.

Test the high voltage diode in multipliers and IHVT's

During normal monitor operation, a large pulse appears at the collector of the horizontal output transistor. The output connects to the primary of the flyback transformer and the pulses are induced into the flyback's secondary. The pulses are stepped up and rectified to produce the focus and high voltage voltages. These voltage pulses are rectified by high voltage diodes contained in the flyback or in a stand-alone multiplier package.

Because these are high voltage components, it is often difficult to determine dynamically if the diodes will break down under high voltage conditions. The CM2000 has a special test for determining if these diodes are good or bad.

Example Symptom: Low or no high voltage (monitor has an integrated high voltage transformer)

NOTE: It is only necessary to do this test if all the following conditions are met: 1)Voltage is low or missing high voltage or focus voltage 2) The B+ and PPV voltages at the horizontal output transistor are normal. 3) The flyback passes the Ringer test.

With the CM2000, feed a 25 VPP HORIZONTAL SYNC drive signal into the primary winding of the flyback transformer. The step up action of the transformer and the high voltage diodes should create a DC voltage between the second anode and high voltage re-supply pin on the flyback. Measure this voltage with the CM2000's DC volt meter. Look up this voltage on the CM2000's reference chart to decide if the high voltage diodes are good or bad.

Isolate horizontal oscillator, driver, and output problems

If the horizontal yoke, flyback, multiplier, horizontal output transistor, and B+ supply have tested good, but the monitor still lacks

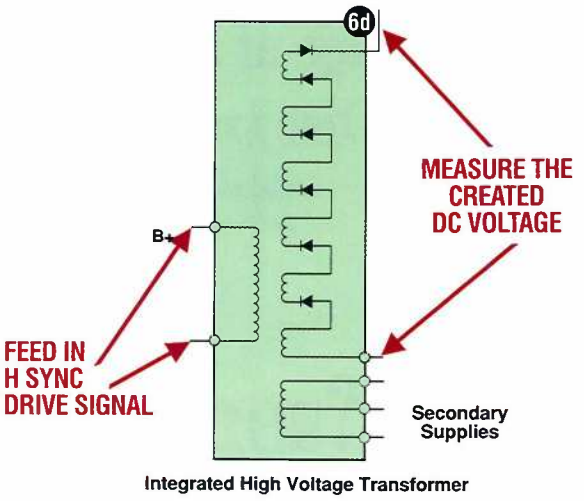

Fig. 11: To test the multiplier diodes, feed the CM2000 drive signal into the primary and monitor the DC voltage across the secondary.

deflection or high voltage, the horizontal driver circuit may be defective. A missing or reduced amplitude horizontal drive signal could prevent the computer monitor from starting up and operating properly. Use the CM2000's HORIZONTAL DRIVE signal to isolate problems in the horizontal drive circuit.

Example Symptom: The computer monitor won't start up

NOTE 1: Before injecting into the horizontal drive circuit, test the flyback and yoke, the high voltage multiplier, the horizontal output transistor, and the B+ supply.

NOTE 2: When injecting at the output transistor, disconnect the secondary winding of the driver transformer from the base.

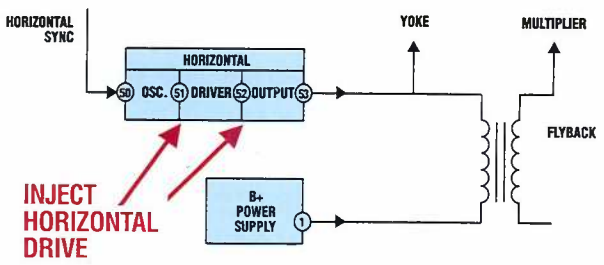

Fig. 12 Inject the HORIZONTAL DRIVE signal into the horizontal driver and output stages.

Inject the HORIZONTAL DRIVE signal into the driver circuit. Watch for horizontal deflection on the CRT. If it returns you are injecting after the defective stage. If nothing happens, inject the HORIZONTAL DRIVE signal at the base of the horizontal output transistor (TP 52/Fig. 12).

Measuring High Voltage

The CRT requires a very high DC voltage to accelerate the electrons toward the screen. This voltage develops in the secondary winding of the flyback transformer and is amplified and rectified by the integrated diodes in the flyback, or by a separate multiplier circuit.

Measuring the high voltage at the second anode of the CRT, lets you know if the output circuit, flyback, high voltage multiplier and power supply regulation circuits are working correctly. Additionally, some monitors have adjustments to set the high voltage and focus voltage.

Example Symptom: Dim, bloomed picture

Measure the high voltage with the CM2000's DC volt meter and the HP200 high voltage probe. Compare the voltage reading to that shown in the schematic.

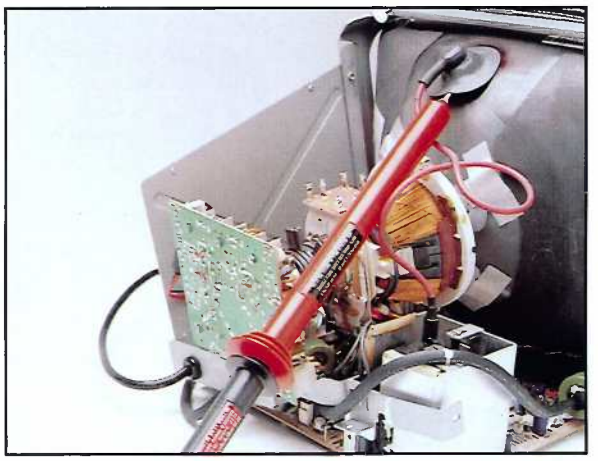

Fig. 13: Measuring high voltage with the CM2000 and the HP200 high voltage probe.

Testing switching transformers in switch mode power supplies.

Switching transformers are used in power supply circuits to step voltages up or down. They are one of the most common failure items in switch mode power supplies. Open windings are easy to find with an ohm meter but shorted turns are nearly impossible using conventional test methods. The CM2000's ringer test easily finds switching transformers with both open and shorted windings.

Example Symptom: Dead power supply

NOTE: The switching transformer must be removed from the circuit.

Connect the CM2000 ringer test across a winding on the switching transformer. A reading of 10 rings or more will show that the winding does not have a shorted turn. Readings, less than 10 rings, shows a shorted turn.

Conclusion

Turning profits in computer monitor servicing can be tough business but the potential is tremendous. With the CM2000 Computer Monitor Analyzer you'll have all the features and tests necessary for computer monitor servicing in one complete easy-to-use instrument. To find out more about how the CM2000 can help you troubleshoot today's computer monitors call 1-800-SENCORE, or circle Fast Fact #211.

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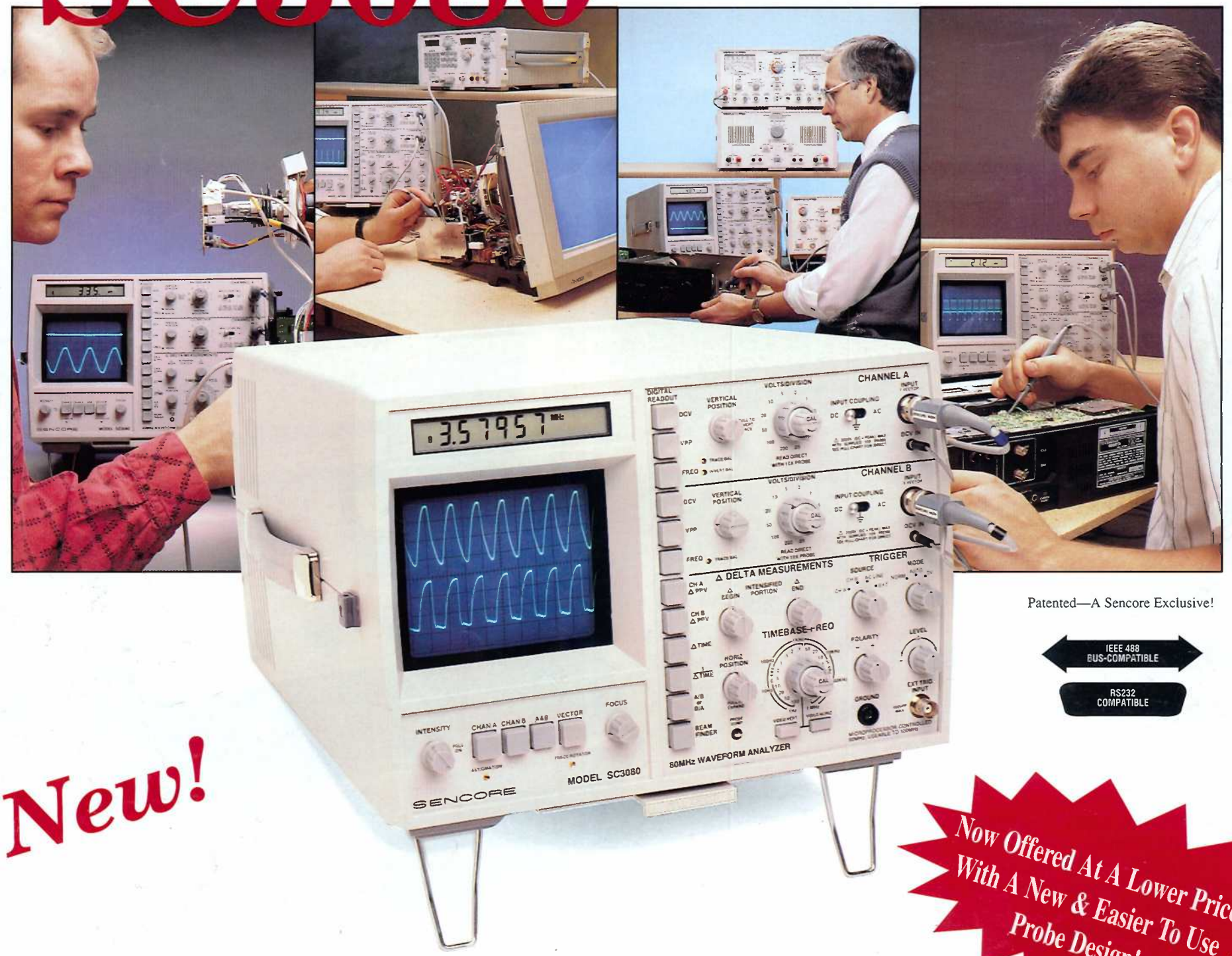

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