SENCORE NEWS

Issue #161 June/July 1993

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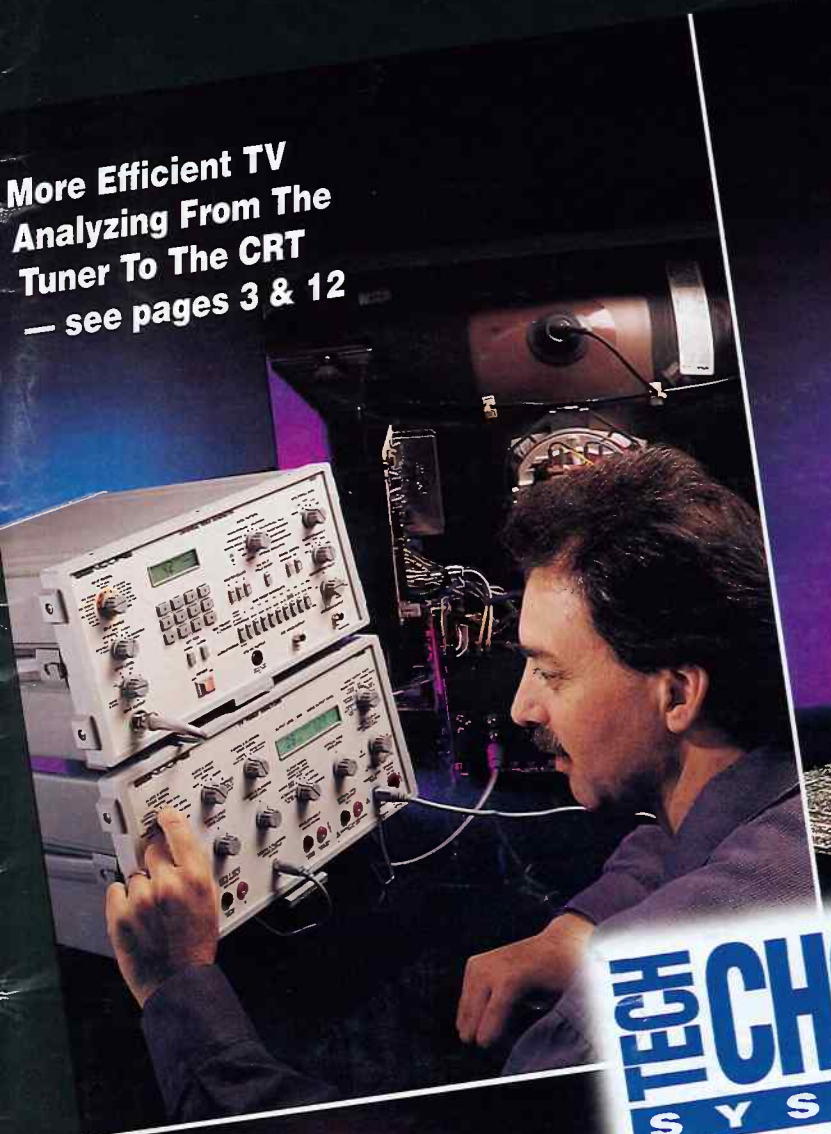

TECH CHOICE SYSTEM

Track Down Computer Monitor Horizontal Problems Faster
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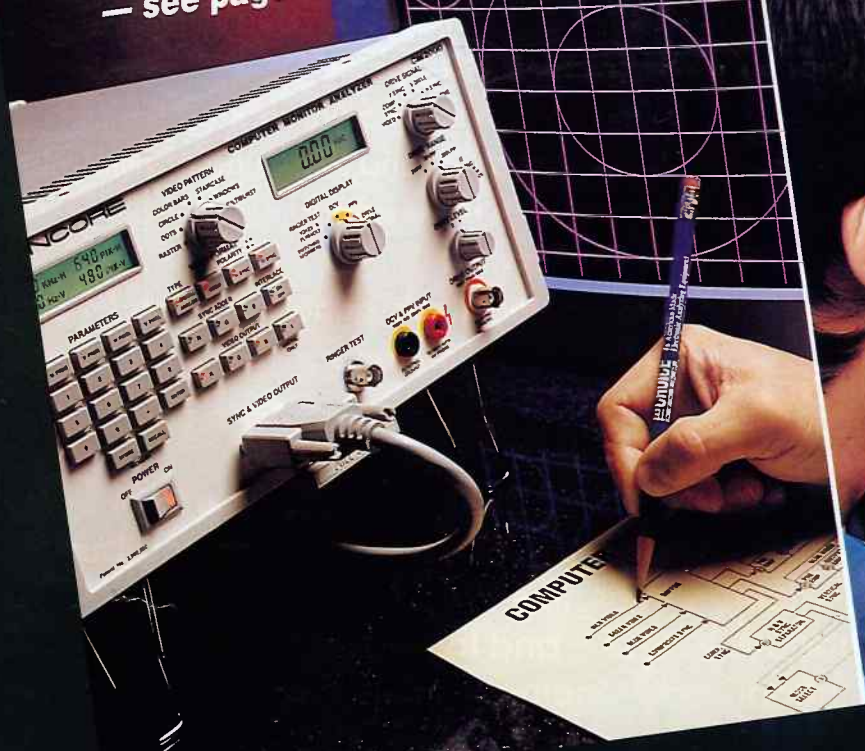

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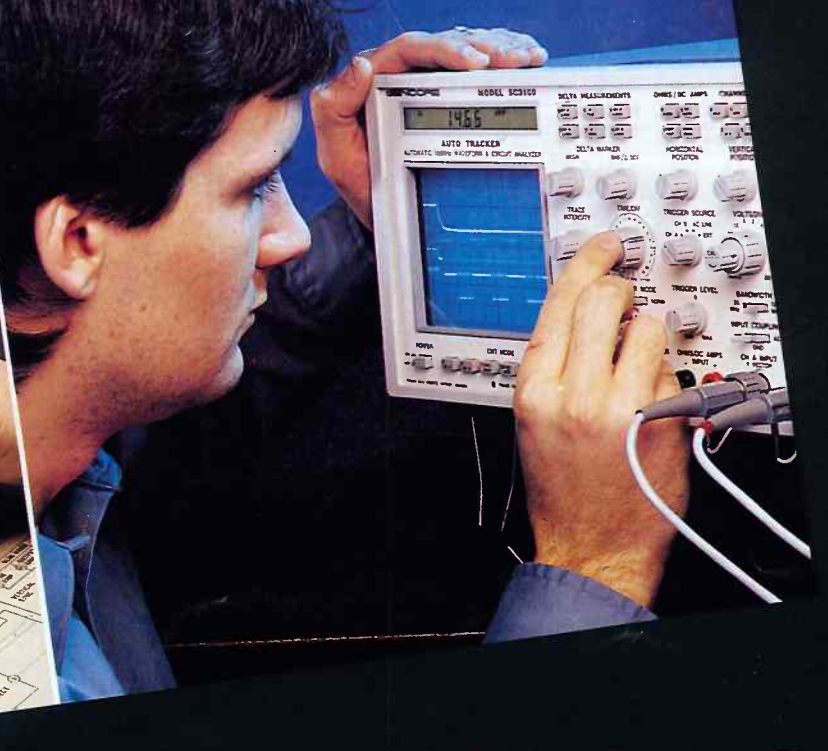

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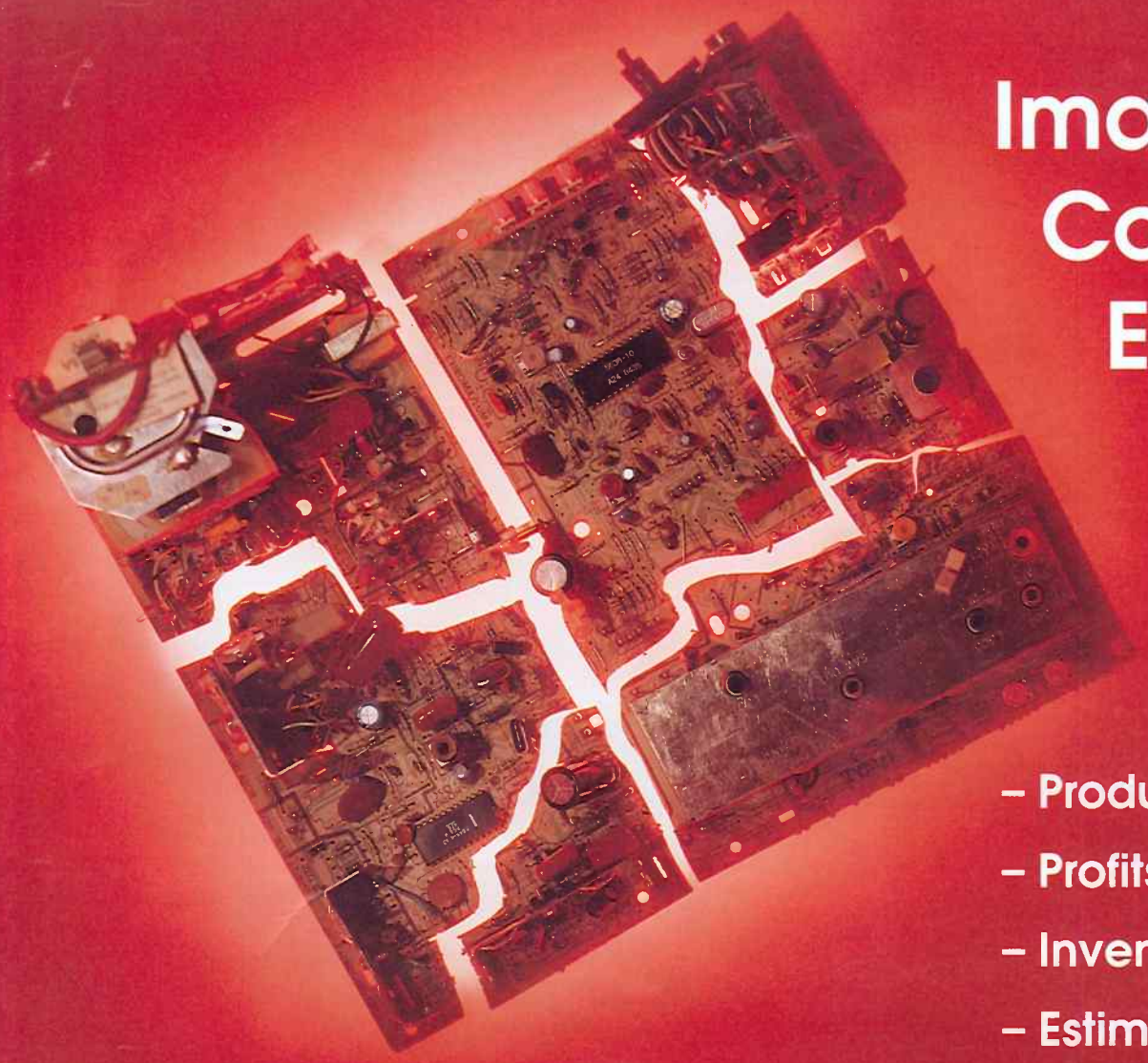

Imagine If You Could Divide Every TV Into Its Functional Blocks!

- Productivity would rise.
- Profits would increase.
- Inventory would decrease.
- Estimates would be more accurate.

Physically cutting the TV chassis into the functional blocks isn't practical, but there is a way you can electrically isolate them. There's a way that will help you determine defects by simply watching the CRT. And there's a way to isolate horizontal circuit (startup/shutdown) faults without risking damage to replacement components – or your pride.

Sencore has been designing instruments that allow servicers to use signal injection for troubleshooting for many years. Now, with the new TVA92 TV Video Analyzer, TV servicing actually pulls the entire TV together while isolating individual stages.

Now you can isolate TV defects, troubleshoot startup/shutdown problems, test expensive TV components, plus accurately estimate TV repair costs in minutes with:

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- Dynamic tests through a simple 3 lead hook-up to the H.O.T.
- Horizontal output transistor sub and drive
- Universal substitute TV signals
- Patented ringer test to pinpoint shorted turns in flybacks, IHVTs, yokes, and switching transformers
- An exclusive yoke drive signal
- DC biasing supply
- Built-in monitor for all sub-signal results and making DCV and PPV measurements

TVA92 TV Video Analyzer
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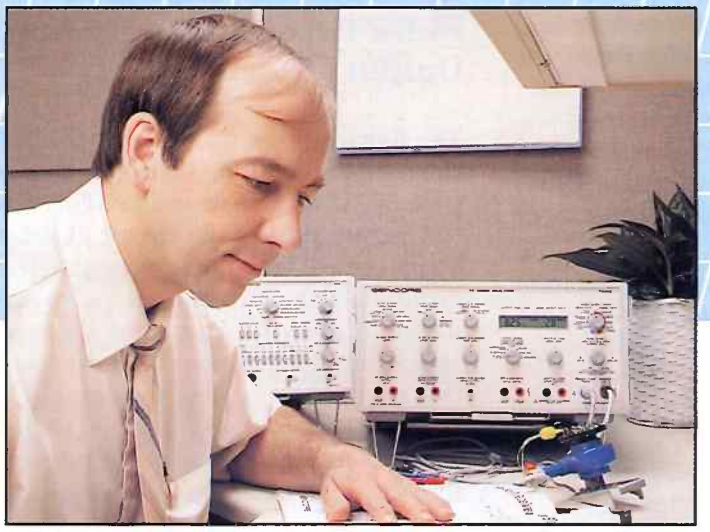


Analyzing TV Startup/Shutdown And Horizontal Problems With The TVA92 TV Video Analyzer's "Dynamic Tests"

By Glen Kropuenske, Application Engineer

On The Cover

Only Sencore lets you build your business with the New "Tech Choice System." Innovative products and exclusive tests save you precious time and help manage your service center more efficiently. Read on for details.

In This Issue

It seems nothing happens in a TV chassis until the horizontal output stage operates. In many ways, this stage is the heart of the TV receiver. It is directly responsible for horizontal scanning, CRT high voltage & focus, scan-derived power supplies, and flyback gating signals. Defects in other TV circuits commonly alter the normal operation of the horizontal output stage, in turn affecting many other circuits.

The horizontal output stage, more than any other stage of the TV, provides a wealth of servicing information. You can quickly diagnose power supply, horizontal output/high voltage, startup/shutdown, or horizontal drive problems with only a few measurements. Yet, many servicers avoid making measurements in the horizontal output stage because of the difficulty of interpreting measurements and for the fear of damaging their test equipment.

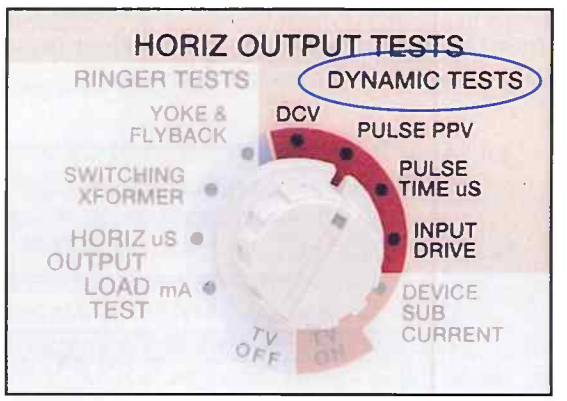


Fig. 1: The Dynamic Tests of the TVA92 are designed to analyze the TV's horizontal output/flyback circuits when the TV is "ON" guiding you to suspect circuits or components.

The Sencore TVA92 TV Video Analyzer is specially designed to provide fast, automatic voltage and waveform measurements in the horizontal output stage. These measurements can quickly guide you to a suspect circuit or component to speed your repair process. In this article, we'll show you how to use the TVA92's "TV ON" measurements, including the DCV, Pulse PPV, Pulse Time µS, and Input Drive "Dynamic Tests" to speed up your TV servicing. In a future article, we'll show you how you can use these measurements while using the TVA92's horizontal output substitute transistor. Lets get started!

Simple Three Lead Hookup To Any TV Chassis

The Dynamic Tests of the TVA92 are designed to analyze the TV's horizontal output/flyback circuits when the TV is "ON." All of the TVA92's Horizontal Output Dynamic Tests are made through a simple three lead hookup to the TV's horizontal output transistor. The colored connectors of the Dynamic Tests lead attach to the collector, base, and emitter lead ground of the chassis horizontal output transistor. This specially constructed lead is designed to withstand the high voltages present in the TV's horizontal output stage providing you with maximum equipment protection.

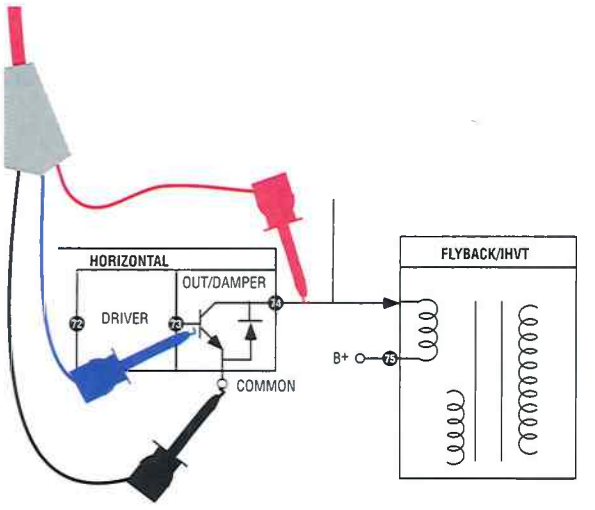


Fig. 2: All the DYNAMIC TESTS are made with a simple three lead hookup to the collector, base, and emitter ground of the TV's horizontal output transistor or equivalent circuit points.

Identifying B+ Supply Problems

The horizontal output stage requires a DC power supply voltage at the primary winding of the flyback transformer. This B+ voltage ranges from approximately 12 volts in small B&W displays to 160 volts in larger color displays. The power supply voltage directly determines the flyback and yoke current levels in the horizontal output stage which in turn determine the high voltage and CRT beam deflection. Therefore, the power supply voltage must be normal for proper high voltage and deflection.

If the B+ voltage is missing, the horizontal output stage will not produce flyback or yoke

current. If the B+ voltage is lower than normal, the flyback and yoke currents are reduced resulting in reduced high voltage and horizontal deflection. If the B+ voltage is higher than normal, the flyback and yoke currents will be excessive, resulting in increased deflection and high voltage. If the resultant high voltage is much higher than normal, the safety shutdown circuits will "shut down" the horizontal output stage.

The TVA92 measures the B+ voltage at the horizontal output transistor and displays the value in its digital readout. The voltage measurement is taken at the collector test point in the TV's horizontal output stage with respect to ground. The DCV may be metered when the TV is operating with its own horizontal output transistor, when the transistor is removed, or when the TVA92's subbing transistor is used. The DCV measurement works on any horizontal output stages using positive B+ voltages ranging from 0-200 volts.

The DCV readout alerts you to B+ power supply problems. The DCV readout should closely agree with the B+ power supply voltage indicated by the schematic. A reading that varies considerably from normal indicates a change in the normal current load on the B+ supply or a problem with the B+ supply itself.

If the DCV is low or missing, it indicates a problem with the B+ power supply or possibly a direct short to ground. Use the TVA92's Horiz Output Load Test to identify and isolate the short or excessive load on the B+ supply. If the Horiz Output Load Test indicates a normal load, analyze the B+ power supply for defects. A higher than normal B+ voltage usually indicates a power supply regulator problem.

Automatically Analyze Flyback Pulse Amplitude To Identify Horizontal Output Defects

A high voltage pulse is produced at the collector of the horizontal output transistor each horizontal cycle when the magnetic field of the flyback collapses. This "flyback" pulse provides important information regarding the operation of the horizontal output stage. Just the presence of a flyback pulse indicates horizontal output transistor switching, the presence of B+ voltage, and a complete flyback current path. Missing flyback pulses indicate a missing drive, missing B+, or complete short or open in the horizontal output stage.

The amplitude of the flyback pulse is important because it reflects the levels of flyback current and resonant timing of the stage. This amplitude is safely metered and displayed by the TVA92 using the "PULSE PPV" position of the Horiz Output "DYNAMIC TESTS" switch. You can make this measurement when the TV is operating with its own active horizontal output transistor, or when you use the TVA92's subbing transistor.

The PPV readout should agree closely with the schematic which typically range from 500-1100 PPV. It is not unusual for PPV levels to vary 50 VPP between chassis of the same model. These inconsistent readings indicate a change in the flyback primary current, resonant timing change of the horizontal output stage, or a leaky component or loading of the circuit.

Absent flyback pulses cause the TVA92 readout to read "0.0." This tells you the horizontal output stage is not providing a path for flyback current or there is no B+ voltage. If a test of the B+ supply using the "DCV" Dynamic Test of the TVA92 shows good, the problem is an open horizontal output transistor or lack of drive at the base of the horizontal output transistor. Use the "INPUT DRIVE" Dynamic Test to verify the presence of drive to the base.

If the flyback pulse PPV readout is considerably lower than normal, the most likely cause is a decrease in flyback primary current. This can result from reduced B+ voltage, insufficient horizontal output transistor gain (beta), or insufficient base drive current. An increase in the flyback pulse duration, determined by the resonant timing of the horizontal output stage, can also cause a substantial reduction in the PPV readout. Use the "PULSE TIME μS" readout to verify if the timing of the stage is normal.

A higher than normal pulse PPV indicates the charging current to the retrace timing capacitor is higher than normal (assuming normal charge time). This may be due to an increase in B+ supply voltage which increases the flyback primary current. An increase in pulse amplitude also results if the resonant timing of retrace is shortened. This occurs if either the inductance of the transformer or retrace capacitor values are decreased.

Automatically Analyze Flyback Pulse Time To Identify Horizontal Output Defects

The flyback pulse time (duration) is actually the rising and falling (charging/discharging) time of the retrace capacitor. This duration is the retrace time of the circuit as determined by its critical timing components. The duration of the TV's flyback pulse provides useful information regarding the resonant operation of the horizontal output stage. If this timing has varied considerably from normal (11.3-16.0 μS), it would indicate a problem in the horizontal output circuit, flyback, or flyback secondaries.

The duration of the flyback pulse is metered and displayed automatically with the TVA92's Dynamic Tests. Just use the "PULSE TIME μS" position of the HORIZ OUTPUT TESTS switch. The flyback pulse time is measured at the collector of the TV's horizontal output device with respect to ground. The TVA92 lets you make this measurement when the TV is operating with its own active horizontal output transistor, or when you use the TVA92's subbing transistor.

The μS readout of the TVA92 is designed to provide accurate, automatic flyback pulse time readouts in horizontal output stages with positive B+ voltages. The time readout is automatically calculated from measurements at approximately the 10% amplitude point. The μS readout of the TVA92 is optimized for flyback pulses ranging in amplitude from 500-1100 VPP which is typical of most color TV receivers. Receivers with normal flyback pulses of less than 500 VPP may read less than 11.3 μS.

A flyback pulse time of greater than 16 μS or several μS longer than normal indicates an

Fig. 3: The TVA92 provides four automatic and dynamic test measurements at the HOT through a simple three lead hookup.

open yoke circuit, or reduction in yoke inductance or series capacitance values. Check for an open in the yoke series circuit path or yoke itself with the TVA92's patented Ringer test. Also check the yoke series capacitor with a Sencore Z Meter for all capacitor defects: value, leakage, dielectric absorption, and equivalent series resistance.

A flyback pulse time of less than 11.3 μS, or several μS less than normal indicates a reduction in effective values of the flyback inductance or retrace timing capacitance. Reduced timing may be caused by a flyback shorted turn, yoke shorted turn, or reduction in retrace timing capacitor values. Loading on the secondary of the flyback transformer will also effectively reduce the inductance of the flyback transformer, reducing the flyback pulse time.

Identifying Shutdown, Startup Pulses, Or Intermittent Drive

The TV's horizontal output transistor acts as a switch providing a path for flyback and yoke currents. The horizontal output stage cannot operate if the horizontal output transistor is not being switched on and off by a drive signal to its base.

The "INPUT DRIVE" position of the TVA92's HORIZ OUTPUT TESTS switch monitors the presence of drive to the base of the horizontal output transistor. An "ON" indication in the TVA92's digital display indicates a drive signal is present to the base of the horizontal output transistor. An "OFF" indication indicates that a base drive signal is not present.

The "INPUT DRIVE" readout of the TVA92 is designed to assist you in isolating startup, shutdown, or intermittent TV symptoms. The "INPUT DRIVE" readout detects even a momentary change in the status of the input drive signal. If initial startup pulses are present for only a moment, the digital readout of the TVA92 indicates a brief "ON" display, followed by an "OFF" readout. The "ON/OFF" display will alternate if the drive is interrupted briefly by an intermittent in the horizontal oscillator or driver stages.

Dynamic Tests Quickly Diagnose TV Problem Symptoms

The best time to use the TVA92's TV Video Analyzer's Dynamic Tests is when a TV performance check indicates a blank raster, low or missing high voltage, and/or startup or shutdown symptoms. Before performing the Dynamic Tests, however, use the TVA92's Horiz Output Load Test to identify and troubleshoot severe loading or timing problems in the horizontal output stage. This lets you isolate severe problems which could stress TV circuits and individual components (see article in *Sencore News* #160, page 7).

If the TV's horizontal output transistor was found defective and removed from the circuit during initial testing, you do not need to replace the transistor before using the TVA92's Dynamic Tests. With the transistor removed, you may still use the Dynamic Tests of the TVA92 to check the B+ voltage and presence of horizontal drive. Simply connect the Dynamic Test Leads to the circuit board paths or components equivalent to the elements of the horizontal output transistor. With the TV's horizontal output transistor removed, no flyback pulse will be produced, resulting in "0.0" readouts in the Pulse PPV and Pulse Time μS Dynamic Tests.

To test the horizontal output and high voltage stages with the TV's horizontal output transistor removed, you can use the Horiz Output Device Sub & Drive capability of the TVA92. The Horiz Output Device Sub & Drive of the TVA92 lets you substitute for the TV's horizontal output transistor and replaces the TV's drive with a known good horizontal drive signal from the TVA92. The DCV, Pulse PPV, and Pulse Time μS tests can all be used while subbing for the horizontal output transistor.

For most TV symptoms, you will want to use the Dynamic Tests of the TVA92 in the order they appear on the HORIZ OUTPUT TESTS switch. First check for proper DCV to check the B+ supply. Then measure the flyback Pulse PPV and Pulse Time μS to check for the presence of flyback pulses and pulse parameters. If these measurements compare closely with the schematic values, the horizontal output stage is functioning near normal. If the measurements are considerably different, use Table 1 in Tech Tip #208 to help pinpoint the defect. (Call your Sencore Area Sales Representative for a copy.)

The TVA92 TV Video Analyzer provides you with many other exclusive TV analyzing features. Let the TVA92 boost your TV servicing confidence and increase your profits. For complete information on the TVA92 TV Video Analyzer, call your Sencore Area Sales Representative at **1-800-SENCORE** (736-2673) today. ■

Recognizing And Correcting Service Center Bottlenecks

By Al Bowden, Owner and President, Sencore, Inc.

In the last two editions of the *Sencore News* (#159 and #160), we addressed the issues involving the reduction of operating expenses and inventory. We also discussed various methods of increasing revenue providing the perfect ingredients for growth. Here's a quick reminder of the terms we've discussed.

Inventory: All of the money spent on goods and services that a business buys in order to provide value added goods and services to their customers (i.e., solder, parts.... anything that makes it back to the customer's hands).

Revenue: The amount of money a business collects from selling the goods and services the business produces/provides.

Operating Expenses: The amount of money a business spends to turn inventory into revenue (i.e., solder wick, benches, tools, rent, etc.).

We talked about the benefits and the detriments of fast and uncontrolled growth. Sudden growth, if not managed properly, can cripple a business. But, what about the predictable growth that we discussed in the last article? Can it also have detrimental effects? How can a service center, or any business prepare for growth so as to minimize growing pains?

Capacity And Bottlenecks

As explained in the article in *Sencore News* #160, increasing revenue is easy, but it is not painless. It is riddled with capacity problems often referred to as "bottlenecks." Bottlenecks and growth are inter-related and affect one another. Too many bottlenecks in an operation restrict growth and are an indicator of poor investment practices. Lack of bottlenecks in a healthy operation, however, could indicate frivolous, uncontrolled spending and excessive capacity that is not being utilized.

Let's first define capacity and what it means:

Capacity: The maximum amount of revenue an operation can earn without an increase in operating expenses.

In other words, your capacity is the amount of service income you can generate without adding any more employees or any more space (without additional investment). This capacity is a resource – possibly the most valuable resource you possess. The way you utilize your capacity dictates not only your revenue, but ultimately your level of profitability.

For example, to keep the numbers simple, say your company repairs (as a maximum) 10 television sets per day. Ten sets is your capacity but you're getting 12 in the door per day. What choices do you have? Do you increase capacity (pay overtime or hire extra help), or do you restrain the number of repairs you take in? And, think about why you can only repair 10 sets per day? What's holding you back? Where is the bottleneck?

A restriction in capacity that limits the amount of revenue an operation can earn is a bottleneck. Bottlenecks exist in every type of business and every type of process. As management strives to increase individual productivity, reduce costs, and increase revenue, bottlenecks appear throughout the operation. Surprisingly, the answer to resolving bottlenecks is not to eliminate them. The answer is to position your bottlenecks in strategic places within your process that can help you control the flow of your production. In this manner, you can use a bottleneck as an opening or closing valve to control bottlenecks in all other areas. It sounds complicated, but really is quite simple.... read on.

Managing Capacity And Bottlenecks

In order to manage bottlenecks and use them to our advantage, you need to segment your work into its individual stages. Let's take a look at the steps that a service center uses to process their work (see Fig. 1).

As you can see, the process that a service center goes through in order to repair a set is serial (much like a series resistive network from ET101). The work (unit being repaired) has to go through a series of individual processes and can get "stuck" (or

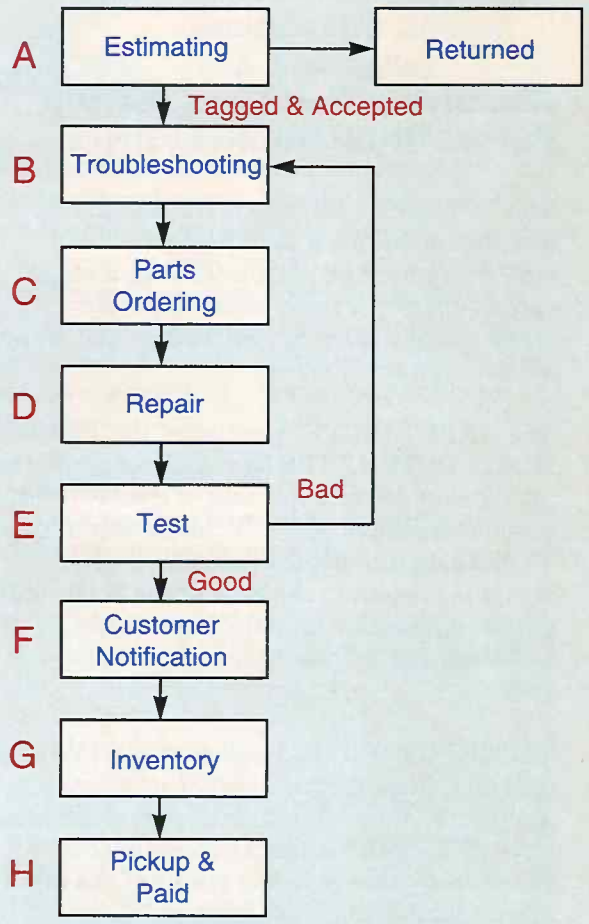


Fig. 1: Bottlenecks can occur in any of these steps of the repair process.

bottlenecked) in any of these individual processes. Now, imagine that every set that you process through your service operation must go through the same steps and you have all of the work you can possibly get coming in your shop. Where do you think most of the units will be bottlenecked? Which area in your operation do you feel will experience a backlog? This will be your first bottleneck.

For example, are your units getting bottlenecked at the troubleshooting process (Fig. 1B)? If so, how many units are we talking about, and how often does it occur? You certainly do not want to hire more people to resolve the troubleshooting bottleneck (increase troubleshooting capacity) if this is not a regular occurrence. On the other hand, you do not want to restrict your business growth (and restrict the activities of all the processes that follow) by not opening up the bottleneck.

The other consideration you need to take into account is the capacity of your system after the troubleshooting process. Once you increase your troubleshooting capacity, can your parts ordering, repair, and test processes handle the additional work? Or will you be forcing yourself to experience the next bottleneck? If your system following the bottlenecked area cannot support the additional work, you will run into the danger of making an investment in capacity in one area while creating bottlenecks in the next.

The change may be good for improvement, but what if the work is still not getting out any faster? This means you made an investment that cannot pay off until you "walk" the bottlenecks out of your system one process at a time. And, if you do not plan it out right, you could be spending your money in increasing capacity in each area, but not seeing the return on your investment (because you will have inventory sitting bottlenecked in some area that is "next" on your list to improve on).

So, how do you resolve this bottleneck problem? By controlling the input. If you are experiencing bottlenecks in your operation, the first thing to do is to identify a "traffic" controller. For instance, if you are having bottlenecks in the troubleshooting area, start cutting back on the repairs you accept in the estimating area (Fig. 1A) – try to accept high profit items (and turn down low profit jobs) for a while to maximize the profitability of your limited capacity.

By controlling the input, you can control the bottleneck long enough to rectify it without negative effects. And if you control it properly (by being selective about the repairs you accept), you could find yourself making more money – money that will help fix the bottleneck by increasing the area's capacity. Word of caution, though, this is only a temporary fix to give you room to breathe and think about what is happening in the organization in order to take corrective action. You do not want to start refusing business as a method of controlling bottlenecks, because this can run you out of business.

If you are experiencing a bottleneck in stage B, and you are certain that all of the subsequent areas have the capacity to handle the increase in workload, then you simply increase the capacity in stage B until you discover the next bottleneck (possibly in the repair area, D). Then, you use the same method to control and fix the repair area bottleneck, and so on. Basically, you are constantly looking for bottlenecks and their effect on your throughput. The more bottlenecks you identify, and capacity you add, the more money your business can make.

The Ideal Setup

Some areas of your operation will be working at 100% of their capacity, and others at 80% capacity. Does this mean that you should make sure every single area is at 100%? Absolutely not! Instead, you should be decreasing the capacity of your 100% area so that it comes down to around 90%. Excessive capacity is a necessary evil and it is required for healthy growth. If all of your areas are at 100% capacity, then your business cannot grow any further – being at 100% capacity means that you are stressing several areas of your operation and if your work increases (more walk-ins, a service contract, etc.) you'll find yourself refusing work or rushing your people resulting in employee turnover or poor quality work.

This does not mean that you need to go out and spend money to increase your capacities just to be sure that you can provide service for your future customers. It does mean that when you institute a revenue increase program, you need to be prepared for bottlenecks and you need to budget for a capacity increase to support the revenue increase. In other words, when you take out an ad in the paper, the cost of advertising is

Fig. 2: A bottleneck in your repair area affects every process after that stage in your repair process.

not the only cost of this revenue increase program – you must also take into consideration any costs that you might incur as a result of increasing your capacity.

In an ideal setup, the capacity of your processes should have a funnelling effect. For example, process H should have the lowest

capacity with process A having the highest capacity. The reason is simple. You want to set up your business in a way that an increase in workload causes a bottleneck as close to the "finish line" as possible. In this manner, resolving the bottleneck becomes a much simpler issue (since you only have to "walk" the bottleneck out of the last process).

When you first start thinking about bottlenecks in your organization, you need to look at each process from A to H. Once your capacity problems are fixed and you have your "funnel" set up (A highest capacity to H being the lowest), you'll want to work out bottlenecks the reverse way – constantly opening up the funnel from the narrow end (from H to A). Then as you open up the "narrow end", make sure you are also providing additional contingencies for the initial processes.

Setting Up A Warning System

So, when you implement these theories, how do you set up a system that will warn you in the event of a bottleneck? In order to set up a warning system, you need to segment your operation into its basic functions – much like on Fig. 1. Then, you need to take each function and measure its input and its output (see Fig. 3). This measurement needs to use two standards, a unit standard and a dollar value standard. In other words, you'll be measuring each area to determine how many repairs each area contributes and how many dollars (based on the estimate given to the customer) it is helping generate. Since every repair has to go through this process, in theory, every one of your processes should be generating the same amount of repairs and the same amount of dollar volume (potential earnings). Let's look at an example of a tracking form:

Column A : The amount (in estimate dollars) of work received (input) during a period of time.
Column B : The amount of work (in units) received (input) during a period of time.
Column C : The amount of work (in estimate dollars) completed during a period of time.
Column D : The amount of work (in units) completed during a period of time.
Column E : This is a formula (Column C/Column A) and depicts the percentage of estimate dollars processed through.
Column F : This is a formula (Column D/Column B) and depicts the percentage of units processed through.
Row 9 (Overall): Records the input and output for the entire operation.

Keeping this information on a daily basis is probably a good practice (but time consuming) and provides information that is based on too short of a time frame to be meaningful. This information needs to be tracked and kept for a long period of time in order to be accurate and useful. Filling out the form on a weekly and monthly basis will provide more accurate data that you can use to identify troubled areas. Let's take a look at what is happening in a fictional service center depicted in the tracking form above.

COLUMN	A	B	C	D	E	F
Average Repair = $65.00	INPUT ESTIMATED DOLLARS	INPUT UNITS	OUTPUT ESTIMATED DOLLARS	OUTPUT UNITS	% DIFF ESTIMATED DOLLARS	% DIFF UNITS
1. Accepted Units	N/A	100	$5,200	80	N/A	80%
2. Troubleshooting	$5,720	88	$4,875	75	85%	85%
3. Parts Ordering	$4,875	75	$4,550	70	93%	93%
4. Repair	$4,550	70	$3,575	55	79%	79%
5. Test	$3,575	55	$3,055	47	85%	85%
6. Notification	$3,055	47	$3,055	47	100%	100%
7. Inventory	$3,055	47	$1,950	30	64%	64%
8. Pick Up/Paid	$1,950	30	$1,950	30	100%	100%
9. Overall	$5,200	80	$1,950	30	38%	38%

Fig. 3: This typical tracking form can help you pinpoint bottleneck areas quickly so you can correct the biggest problem first.

It seems that we are accepting 80% of the units that come in for repair and we pass those on to our troubleshooting process. We were supposed to have had 80 units to repair (from line 1 output) but the input for troubleshooting (line 2) is more: 88 units. These extra units come from two places:

1) Backlog from the previous measurement period, or

2) Units that failed test (line 5) and were returned for further troubleshooting.

Going further, we see that our parts ordering fell short of completing their task by five units (so there are five units sitting waiting for parts). We find a bigger problem though (look at the percentages line 4, column F) in the repair area. Troubleshooting (line 2) and parts ordering (line 3) have passed on 70 units to the repair area (line #4) but this area only processed 55 out of 70 units (79%). This area is holding onto 15 units that are waiting to be processed.

Let's move on to our largest problem, line #7, repaired inventory. Here, we have only gotten 64% (30 out of 47 units) delivered. In reality though, if our operation was running smoothly, we would be able to deliver 80 units (the amount of units we accepted in line 1) instead of a mere 30 units (see line 9 for overall performance).

Where would you start your bottleneck elimination process? Here's some ideas :

1. Temporarily start limiting the amount of units coming in and only accept profitable jobs from customers that you know will pick up the product. This should help areas 2 through 5 to catch up with their backlog of units.

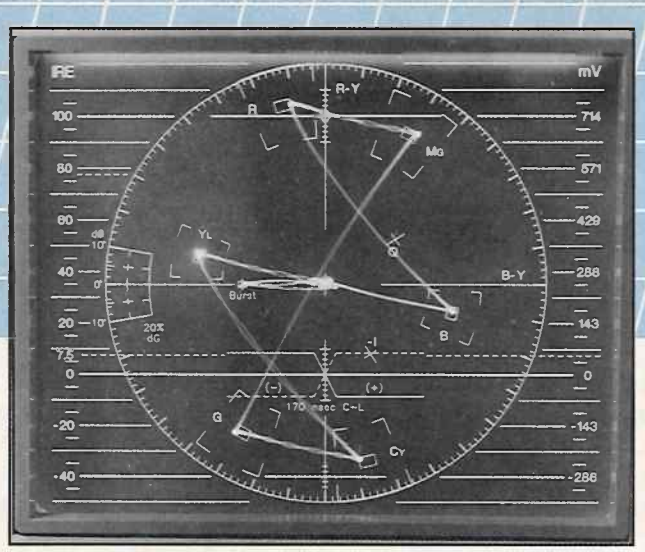
2. Institute an inventory reduction program (see article in *Sencore News* #159 and #160) in order to increase your capacity on line item #7. Inventory sitting unrepaired is opportunity not being explored, but repaired inventory is investment going to waste.

3. Once the inventory problem is eliminated, you need to start opening up the flood gates again and accepting product for repair as you were before. The next time you look at the report, you will find bottlenecks possibly in the repair stage (stage #4). You know this by looking at the percentages of difference and prioritizing them (first line #7 at 64%, then line number 4 at 79%).

On our chart, you will notice that the dollar amounts are simple multipliers of the number of units times $65. If your average invoice is $85, then most of your dollar amounts are going to be multiples of your average invoice ($85) times the number of units. Serious deviations from your average invoice (per process), indicate problems in estimating or indicate problems of "preference" within your processes (i.e., is the repair tech working on the less expensive or more expensive repairs, or is he using a good balance that supports your average invoice and keeps all customers happy?)

In the next *Sencore News* we will be exploring this form and the various conclusions that a business owner can draw from it. We'll also discuss ways of measuring technician efficiency and effectiveness.

If you have any special needs or concerns in your service center, please give us a call. For copies of previous articles in this series, please call your Area Sales Representative at **1-800-SENCORE** (736-2673). ■



Camera Service - Understanding Video Camera Output Signals

By Tom Schulte, Application Engineer, CET

- **Learn how the camera video signal is created.**
- **Camera and camcorder service opportunities continue to grow with camera sales.**
- **Don't risk your customers' present and future business by turning away camcorder repairs.**

Now is the time to take advantage of the profitable opportunities in video camera servicing! It's an opportunity for you to expand your service business into a growing segment of the service market and tap into the profitable fields of business, industrial, medical, and school camera servicing as well as the consumer camcorder service market. The profit opportunities are there for those willing to take advantage of them.

Perhaps you've been reluctant to begin servicing cameras on a full-time basis because you don't feel you understand camera operation as well as you should. Maybe you aren't experienced at relating camera signal problems to the defective circuits causing those problems. Let's take a few minutes to see if we can help you in these areas. We'll take a look at how a camera creates its composite video output signal, and also discover how circuit problems can cause various output signal defects.

How Does A Camera Create A Video Output Signal?

A video camera's operation begins at the lens assembly, where the lens focuses reflected light from the scene onto the light sensitive surface of the imaging pick-up device. Here's how everything comes together to produce the video image seen eventually on some form of monitoring device:

Signal Sampling: The pick-up device uses a scanning technique of sampling the brightness at small, individual points across the pick-up surface, then develops voltage samples which correspond to the brightness level at each of the points. These small picture sampling points are called picture elements or pixels.

Horizontal Scan: Starting at the upper left corner and moving horizontally across the scene along is a thin scan line. This thin scan line consists of voltage samples assembled into a continuous signal called video. The voltage changes in this video signal correspond to the scene's brightness level changes along the scan line. When the scanning process reaches the right edge of the scene, the camera generates a sync pulse and a blanking pulse (Fig. 1). A horizontal line of video with sync and blanking at the end takes slightly over 63.5 microseconds to complete.

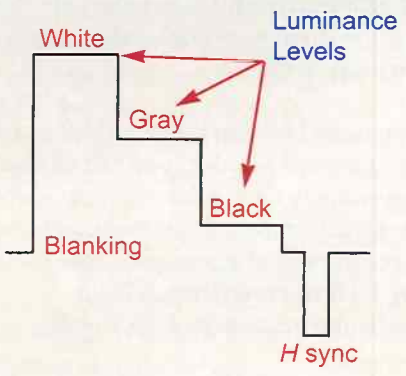


Fig. 1: One horizontal line of video with sync, blanking, and video levels.

The camera then resets its horizontal scanning process to the left edge of the scene, slightly below its original starting point, and the process repeats itself. Again, sync and blanking pulses are added after the scanning process reaches the right edge of the scene. These pulses produced at the end of each horizontal scan line are called horizontal sync and horizontal blanking pulses.

Vertical Scan: The scanning process continues down the scene, with each horizontal scan line sampling the scene slightly lower than the previous line. The 241st horizontal scan line occurs at the bottom of the scene. When it is completed, the camera generates a blanking pulse and a sync pulse which are much longer than the pulses at the end of the previous horizontal lines. In fact, this blanking pulse at the bottom of the scene lasts for a period of time equal to 21 horizontal scan lines (Fig. 2). These longer pulses produced at the bottom of the scene, after the entire scene has been scanned vertically from top to bottom, are called vertical sync and vertical blanking pulses.

This complete set of 241 horizontal scan lines plus vertical sync and blanking is known as one vertical field. Each field, which scans 241 lines from the top to the bottom of the scene, occurs in approximately 1/60th of a second. After vertical blanking, the camera resets its scanning process to the upper left corner of the scene and a second field of 241 lines is scanned, again ending with vertical sync and blanking.

Interlaced Scan: Although each field scans the entire scene from top to bottom, the adjacent scan lines in each field are spaced far enough apart that another scan line would fit between each pair of lines. In fact, each of the 241 lines in the second field scan the open spaces between the scan lines of the first field (Fig. 3). This is called interlaced scan. Once the second field is scanned, the entire area of the scene has been sampled. This set of two fields of scan lines, which cover the entire scene, is known as one frame. Since one frame consists of two fields, each frame takes place in 2/60ths (1/30th) of a second.

But why not just scan out the entire set of 482 scan lines in one pass in 1/30th of a second? If that were done, a viewer would see the screen brightness start to drop before

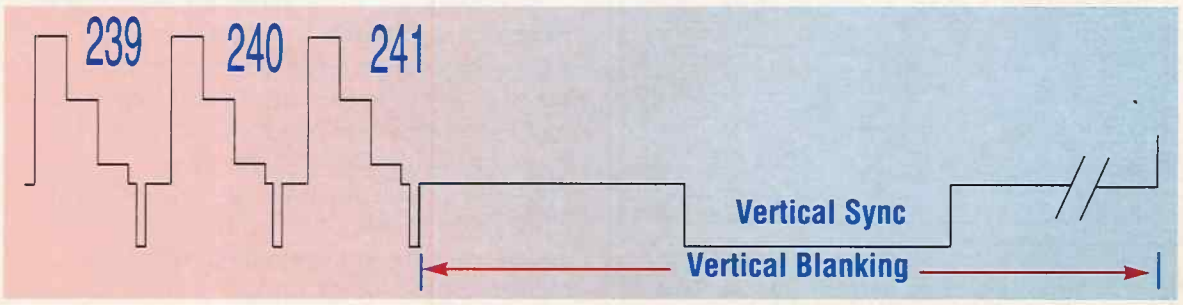


Fig. 2: The camera generates a blanking pulse after line 241 that lasts for 21 lines at the bottom of the screen.

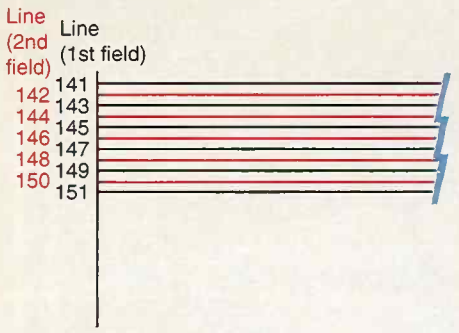


Fig. 3: During interlaced scan, the second field of 241 scan lines fill in the open spaces between the first field's 241 scan lines.

the next scan. This would appear as a flickering effect in the picture. Or, if the scanning speed were simply increased to scan all 482 lines in one pass in 1/60th of a second to eliminate flicker, the video bandwidth would be greater than the maximum allowed for the NTSC system.

Instead, the camera splits the scene (frame) into two parts (fields). The first field (the odd field) scans out lines 1, 3, 5, etc. in 1/60th of a second, while the second field (the even field) goes back and scans out lines 2, 4, 6, etc. in the next 1/60th of a second. This causes the brightness in every area of the picture to be refreshed every 1/60th, instead of 1/30th, of a second. Since the human eye cannot detect brightness variations which occur this quickly, the picture appears flicker-free. Also, the video bandwidth is held to the designated maximum of 4.2 MHz.

One result of this method of interlaced scan is that, due to timing requirements, each field of scan lines needs to include an extra half scan line. The first field adds the extra half line at the end of the field, while the second field adds the extra half line at the beginning of the field (Fig. 4). That means that each field contains 241.5 scan lines plus vertical sync and blanking time (equivalent to another 21 scan lines), for a total time in each field equivalent to 262.5 scan lines. Each frame, then, includes 483 active scan lines (241.5 times 2), plus vertical sync and blanking (21 times 2), for a total time equivalent to 525 horizontal scan lines.

Also, some extra signals are added during the vertical sync and blanking pulses to prevent a horizontal sync problem. If the horizontal oscillator in a TV or monitor was left without sync for the entire vertical sync and blanking

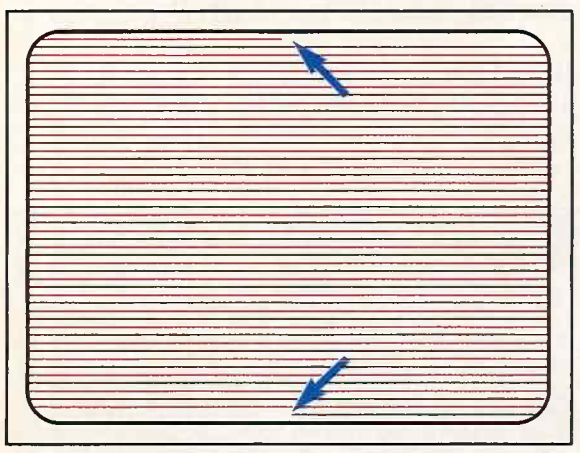


Fig. 4: Because of timing requirements, interlaced scan adds a half line at the end of the first field and a half line at the start of the second field.

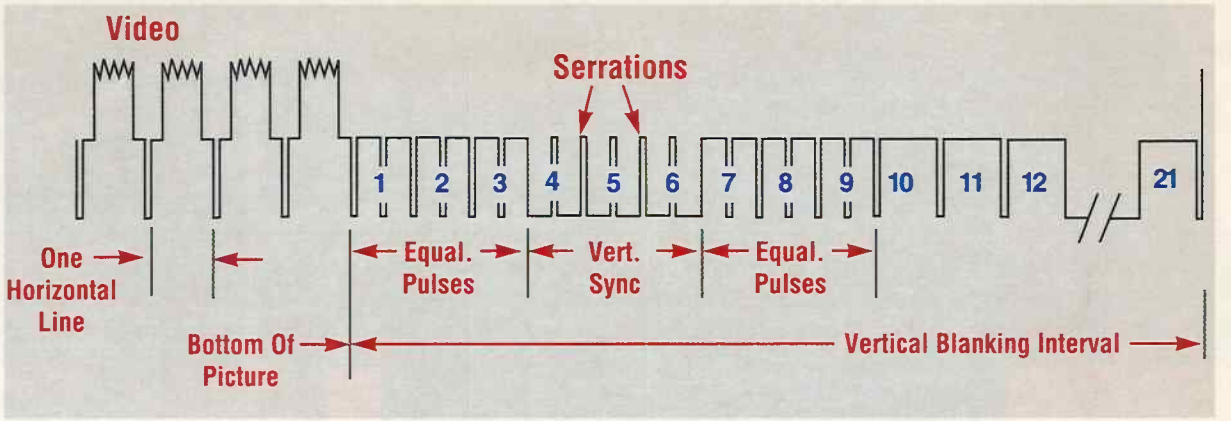


Fig. 5: Equalizing pulses and serrations are added during the vertical blanking interval to insure proper timing for both fields.

time, the oscillator would have a chance to drift off frequency before the next horizontal sync pulse arrived. To prevent this problem, "extra" horizontal sync pulses are inserted during the vertical sync and blanking periods. These substitute horizontal sync pulses which occur during the vertical blanking interval are called equalizing pulses, and those during the vertical sync interval are called serrations. Since the odd field ends with a half line of video before vertical blanking and the even field ends with a full line of video before vertical blanking, the equalizing pulses and serrations are spaced at half horizontal line intervals (Fig. 5) in order for them to occur at the proper timing for both fields.

Scan Frequencies: Each horizontal scan line, with sync and blanking added at the end, takes slightly over 63.5 microseconds to complete. At this rate, 15,734 horizontal scan lines are completed every second (one second divided by 63.5 microseconds), for a horizontal scan frequency of 15,734 Hz.

Each vertical scan of the scene from top to bottom, plus vertical sync and blanking, takes 1/60th of a second to complete. At this rate, 60 vertical scan cycles are completed every second, for a vertical scan frequency of 60 Hz. This is also referred to as the vertical field rate.

Composite Video: The total combined signal created by the camera is called composite video and is made up of three major types of signals. First, the video signal (1) is assembled from voltage samples corresponding to the brightness level at each pixel. Then the horizontal sync and horizontal blanking pulses (2) are repeated at the end of each horizontal scan line (15,734 Hz rate). Finally the vertical sync and vertical blanking pulses (3) are repeated at the end of each field of 241.5 horizontal lines (60 Hz rate).

Signal Amplitude: The blanking signals which the camera adds to the video signal serve as the reference level for voltages in the rest of the signal. When black areas of the scene are being scanned, the camera produces a black level voltage 54 millivolts more positive than the blanking level. This difference in level between blanking and black is called "black setup." When white areas of the scene are being scanned, the camera produces a voltage 714 millivolts more positive than the blanking level (Fig. 6). Gray areas of the scene result in voltage levels somewhere between the black and white levels.

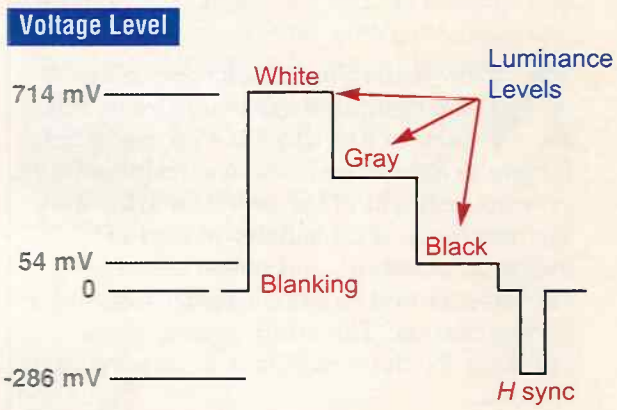


Fig. 6: Blanking provides a reference level for the video signal with a white signal being 714 millivolts more positive than blanking and sync signals being 286 millivolts more negative than blanking.

The horizontal and vertical sync pulses, which serve as the reference signals for the scan oscillators in a TV or monitor, are produced at a level 286 millivolts more negative than the blanking level (Fig. 6). The peak-to-peak amplitude of the composite video signal, when white is included in the picture, amounts to one volt from the negative peaks of the sync pulses to the positive peaks of the white signals.

IRE Measurement Scale: The Institute Of Radio Engineers (IRE) developed a more convenient video measurement scale, which is often used instead of millivolts. This measurement scale extends 100 IRE units up from blanking to peak white and 40 IRE units down from blanking to sync tips (Fig. 7). Black setup is 7.5 IRE units above the

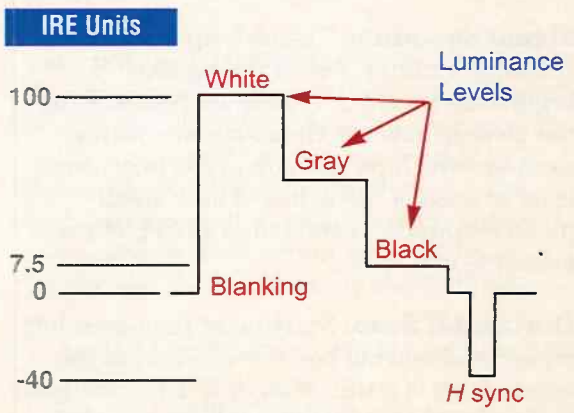


Fig. 7: The IRE scale provides a convenient method of measuring video, blanking, and sync levels.

blanking level. Since 140 IRE units correspond to the one volt peak-to-peak video signal, one IRE unit equals 7.14 millivolts.

Video Noise: Ideally, the camera circuits which produce the video signal don't add any noise to the signal. However, the circuits do add both amplitude and phase noise, at least in small quantities. Since the phase of the video signal carries little information, only the amplitude noise causes problems. This amplitude noise adds changes to the video signal which aren't related to the brightness level changes in the original scene (Fig. 8).

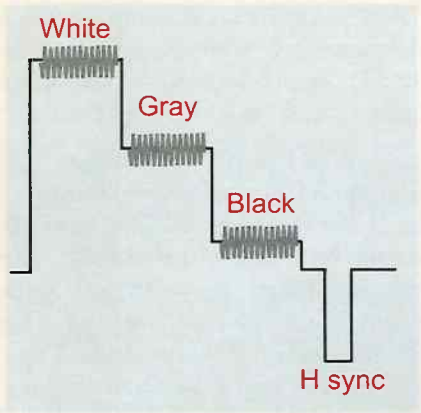


Fig. 8: Amplitude noise in the video signal adds non-brightness related changes to the original scene.

When the video signal is sent to a TV or monitor, the video noise causes brightness variations to occur in areas of the picture which should be at constant brightness levels. This shows up as a "grainy" or "snowy" picture (Fig. 9). This same effect is seen when the camera circuits are forced to operate at maximum gain for a very dark scene. Video noise is usually measured in comparison to the normal video signal level.

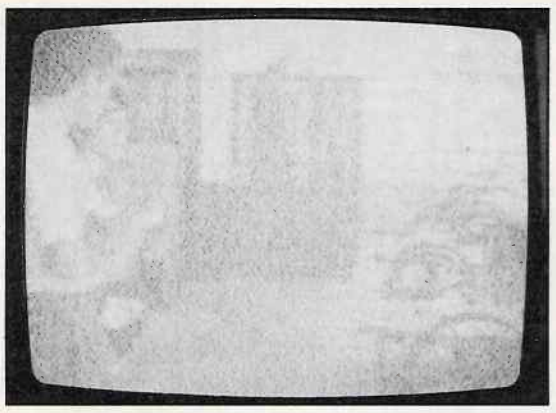


Fig. 9: A "grainy" or "snowy" picture can be the result of video signals with amplitude noise.

The measurement is called signal-to-noise ratio, or more simply S/N, and the normal unit of measurement is the decibel (dB). When the noise amplitude is 40 dB lower than the video signal amplitude (1/100th), the S/N ratio is 40 dB.

Chroma: Some video cameras produce only a monochrome (B/W) video signal. The monochrome video signal corresponds only to brightness changes in the scene. This portion of the video signal is known as the luminance, or simply luma signal. However, most modern cameras also produce a chroma signal which contains information about the color present at each of the points in the scene. There are two color properties of any colored object. The amount of color is the color saturation. The "tint" of the color is the color hue. Information on both these color properties is contained in the camera's chroma output signal.

A video camera creates this chroma signal by placing a multicolored filter in front of the imaging pick-up device. This allows the pick-up device to sample the amount of yellow, cyan, magenta, and green light present in each area of the picture. The process of scanning across the multicolored segments of the filter creates a high frequency chroma signal (higher frequency than the luminance signal, the exact frequency depends on the camera design) which carries all the information needed about colored portions of the scene.

Even though all the needed color information is present at the output of the color imaging pick-up device, the signal isn't in the NTSC standard chroma format required by standard color receivers. The remainder of the camera's chroma processing circuits are required to separate the red and blue components of the color signal (less luma) and modulate them onto individual 3.58 MHz subcarriers which are 90 degrees out of phase with each other. These two modulated subcarriers are then added together, producing a final modulated 3.58 MHz chroma output signal which changes in both phase and amplitude according to colors scanned in the scene. The amplitude of the chroma signal corresponds to the saturation of the color being scanned. The phase of the chroma signal corresponds to the hue of the color being scanned. A video camera adds

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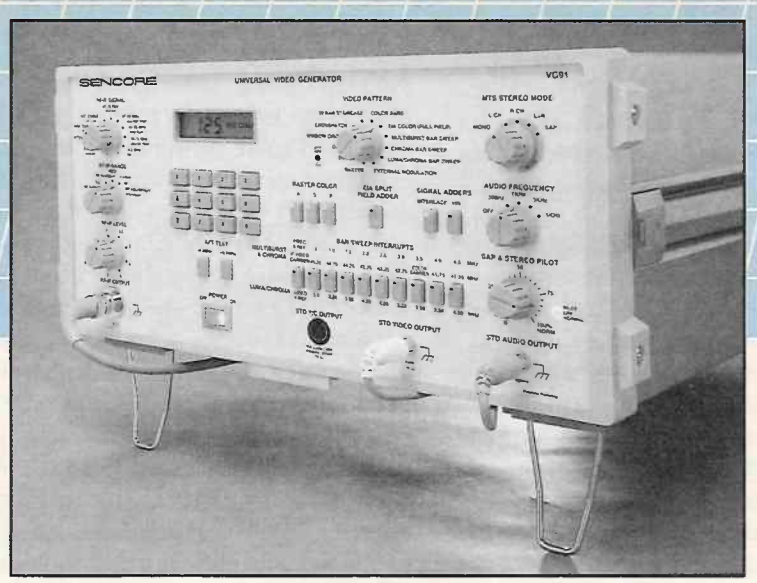

Analyzing TV Tuning Systems With The VG91 Universal Video Generator

By Glen Kropuenske, Application Engineer

** This article is the second of a two-part article on troubleshooting tuners using the VG91 Universal Video Generator.*

How many times have you found yourself struggling with a tuning problem? Was the problem in the tuner, tuner control microprocessor, or IF/AFT? How many times have you gambled on a tuner swap – and lost?

Today's sophisticated TV (and VCR) tuning systems combine several new and exciting technologies that can challenge your troubleshooting skills. This article will show you how to use the VG91 Universal Video Generator to help you troubleshoot tuning or RF/IF gain problems.

"Time Out" To Analyze Symptoms

Modern TV channel varactor tuners are influenced by the AGC, IF, AFC, video detector, and frequency synthesis (PLL) circuits. A problem in any of these circuits can cause reception or tuning problems. An important first step in troubleshooting these problems is performance testing with an accurate all-channel TV generator. This lets you clearly understand the symptoms, saving you time and money in the long run. You should performance test VHF/UHF reception, cable reception, tuner sensitivity or gain, AFT operation, and AGC operation. For a complete explanation on performance testing tuning systems, see the article in *Sencore News* #160 entitled "Analyzing TV Tuning Systems With The VG91 Universal Video Generator."

Once you have fully analyzed all symptoms, you are ready to begin troubleshooting. The symptoms will place the problem in one of three categories:

1. System control problems (microprocessor or RAM memory)
2. RF-IF gain problems (signal loss or reduced gain in RF-IF path)
3. Improper tuning (tuner's oscillator frequency error)

Troubleshooting System Control Problems

Problems with the system control (microprocessor) usually alter many control functions. To identify system control problems, first analyze all the control functions. Check volume, video adjustments, interface selections, and all other operations first. If the microprocessor selects channels, displays channel numbers, performs other operations, and has digital activity to tuning control/synthesis circuits, the microprocessor and its memory are likely to be okay.

Finally, you can look for bandswitching voltage changes between VHF channel 6 to 7 and channel 13 to UHF channel 14. An abrupt voltage change shows the microprocessor is likely providing the proper tuning instructions to the frequency synthesis circuits. If control problems are noted, use the Sencore SC3100 "AUTO TRACKER" to troubleshoot the microprocessor. (Call your Area Sales Representative for a copy of Tech Tip #109 on testing microprocessors.)

Gain problems in the RF or IF stages should be distinguished from improper tuning problems. If the receiver properly tunes to each channel, but the picture is noisy, the microprocessor, frequency synthesis system (PLL), and AFT circuits are working. There is no need to test tuning control circuits or voltages. The problem is a lack of signal gain or excessive signal loss in the RF and/or IF signal paths.

The inability to tune to all or some of the TV channels indicates a problem in the tuner, frequency synthesis, or video IF/AFT stages. These problems are the most difficult to isolate because you must check IF, sync, and AFT circuits. You will need to substitute accurate RF-IF signals with the VG91 Universal Video Generator and use conventional troubleshooting techniques to isolate the defect. RF-IF troubleshooting has never been this easy.

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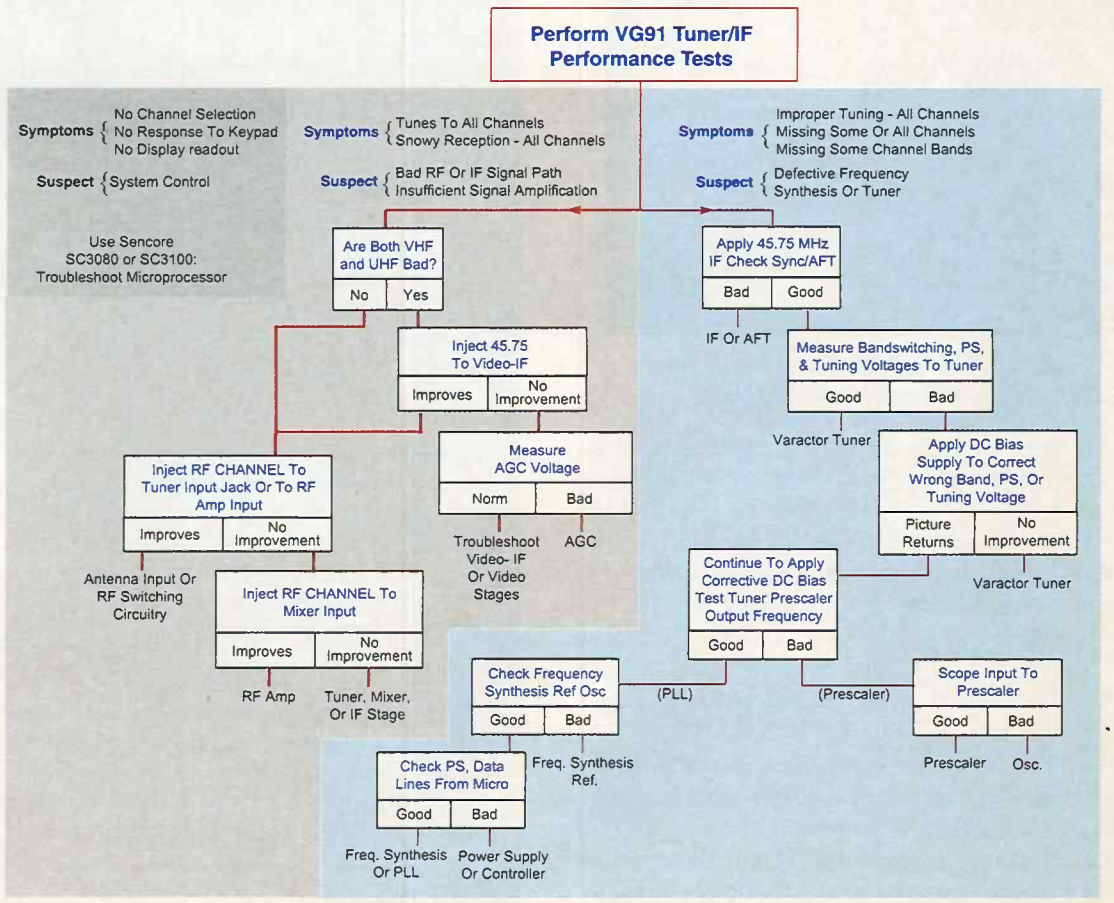

Fig. 1: Guide to troubleshooting TV tuning systems with the VG91 Universal Video Generator.

VIDEO

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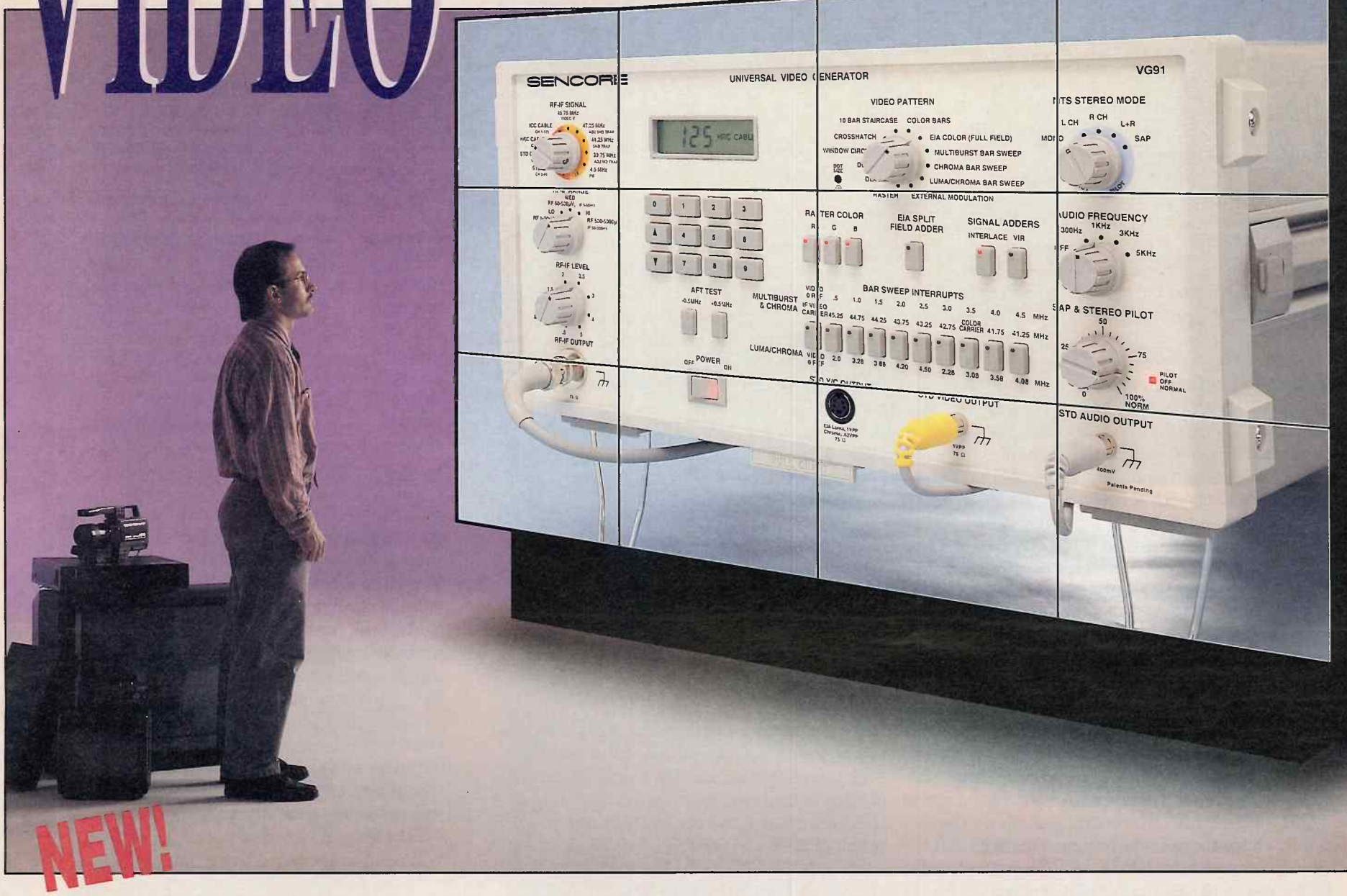

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Troubleshooting RF-IF Gain Problems

The VHF and UHF sections of the varactor tuner use separate RF amps, oscillators, and mixer stages. Before troubleshooting RF-IF gain problems, consider if both VHF and UHF reception are affected. Be sure to connect the RF cable to the proper input if the receiver has separate UHF and VHF inputs. If either the VHF or UHF reception is good while the other is poor, you have isolated the problem to one tuner section and at the same time determined the IF and AGC circuits are good. If both have snowy reception, the problem is common to both sections. The problem could then be in the video IF, AGC, antenna input, or tuner-IF pre-amp stage.

To isolate gain problems, start by injecting your VG91's 45.75 MHz Video IF signal at the IF output of the tuner module. The normal IF level to the first IF amplifier transistor is approximately 1,500 μV and 20,000 μV to the SAW filter. Set the VG91's IF output to match these normal circuit levels when injecting into these circuit points. If good video returns, you have confirmed the problem is either the antenna input or varactor tuner. If there is no improvement, a gain problem exists in the video-IF or video stages.

The AGC voltage commonly controls the gain of an IF stage and the tuner's RF amplifier. While substituting the 45.75 MHz Video-IF, use a DCV meter to check the AGC voltage and verify proper operation. Adjust the VG91's RF-IF LEVEL control just above the point where the picture becomes snowy. Slowly increase the RF-IF LEVEL control and observe the changing AGC voltage.

Compare the AGC voltages to your schematic. Most tuning systems have AGC voltages of five to eight volts at low input signal levels (full gain). AGC voltages fall to approximately one volt to reduce gain of RF and IF amplifiers as signal levels increase. A voltage which does not change or is continually low indicates an AGC problem.

If the IF and AGC circuits test good, the next step is to determine if the problem is in the varactor tuner or antenna input signal paths. Apply the VG91's RF channel signal at 1000 μV directly to the input connector on the varactor tuner. You may need to use the RCA Adapter Cable supplied with your VG91 to adapt the RF-IF Test Cable to the tuner's RCA input jack. If a noise free picture returns, the problem is in the antenna input connections, circuits, or cable.

If this injection does not restore good video, you have isolated the gain problem to the varactor tuner. You may elect to have the tuner repaired by a tuner repair service or you can use your VG91 to further isolate the problem.

In many instances you can pinpoint the problem within the tuner and make the repair. To isolate the defective tuner stage, use your VG91's RF output and RF-IF Troubleshooting Balun to inject an RF channel signal at the mixer input. Use the "Lo" position of the RF-IF RANGE switch. If good video returns, the problem is in the RF amp or tuned circuits. If you see no improvement, the problem is in the mixer or IF preamp stage.

Troubleshooting Tuning Problems

The first step in isolating tuning symptoms is to isolate the problem to the tuner/tuner control circuits or IF/AFT/sync stage. Since IF/AFT/sync circuit problems can alter tuning operation, you must first check these stages. Use the process of elimination to prove the IF circuits plus the AFT, AGC, and sync feedbacks to the tuning system are not causing the PLL to mistune. The last step is to use the accurate TV RF signals of your VG91 Universal Video Analyzer along with conventional troubleshooting methods to isolate the defect.

Start by injecting your VG91's 45.75 MHz Video-IF signal at the video-IF output of the tuner module. If good video returns, you have confirmed the problem is tuning related. If the video does not improve, a problem exists in the video-IF, AFT, or video stages – but not the tuner.

Once you have confirmed the symptoms are tuning related, the next step is to test the sync and AFT circuits. By using the process of elimination, you can determine if any of these stages are the cause of tuning problems.

Continue to substitute the 45.75 MHz Video-IF signal with your VG91 while using an oscilloscope to check for proper vertical and horizontal sync to the tuner control circuits. Do not assume that because the receiver produces a good video picture, the tuner is receiving proper sync. Some receivers use separate sync detection circuits to feed the microprocessor.

Next, connect a DCV meter to measure the voltage present at the AFT test point. Compare the AFT voltage to your schematic. The AFT voltage typically centers at 3.5 to 4.5 volts. Alternately push and hold your VG91's AFT TEST buttons and note the AFT voltage change. You should see near equal, but opposite changes in the AFT voltage as you alternate between the AFT TEST buttons. The AFT voltage typically falls to about 0.1 to 1.5 volts or rises to 6 to 8 volts as the AFT TEST buttons are pushed. If the voltage is not centered, does not change, or changes in only one direction, an AFT problem or misalignment is probable.

Many modern tuning systems use a comparator circuit to interface the AFT voltage to the tuning control microprocessor. You should make a final check of the AFT voltage change at the input to the tuner control microprocessor. This can find problems with AFT voltage paths or components which interface the AFT voltage to the tuner control microprocessor.

Once you have tested the video-IF stages and determined voltages and signals returned to the tuner control microprocessor are proper, you are ready to analyze the frequency synthesis and varactor tuner. To do this, you will need to measure power supply,

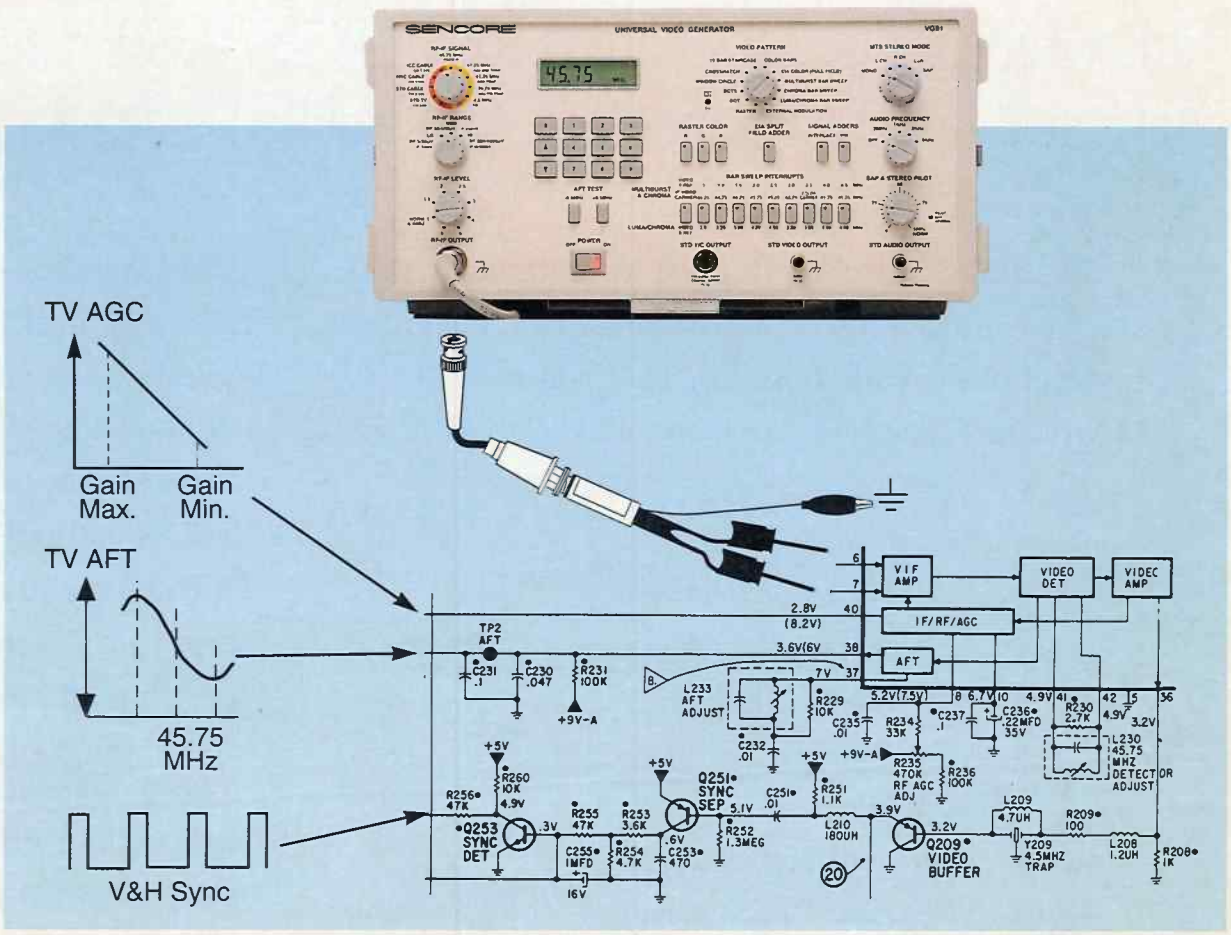


Fig. 2: To isolate tuning symptoms, substitute the accurate 45.75 MHz Video-IF signal of the VG91 and test for proper IF, sync, AFT, and AGC operation.

bandswitching, and tuning voltages applied to the varactor tuner and analyze the tuner's "prescaler" output.

You will find two common variations to the location of the frequency synthesis (PLL) circuits. Many tuner control microprocessors ICs have the frequency synthesis stages inside the IC. In these tuning systems, bandswitching and tuning voltages are available at the input pins to the varactor tuner. The varactor tuner contains a frequency divider prescaler which divides down the frequency of the tuner's oscillator. The prescaler output is returned to the frequency synthesis circuits and is available on an output of the varactor tuner.

In some tuning systems, frequency synthesis is contained inside the varactor tuner enclosure. The microprocessor or tuner control IC inputs data and control signals which are decoded by the frequency synthesis IC inside the varactor tuner. In this system, bandswitching voltages are internal to the varactor tuner, but a test pin is provided for measuring the tuning voltage. To measure bandswitching and prescaler frequencies, you must remove the tuner's metal enclosure. If you do not, you are limited to checking enable and data inputs for digital activity and monitoring the tuning voltage test point.

Once you have found the frequency synthesis circuits and voltage test points, you are ready to analyze tuning problems. Set the receiver to the "Normal TV" tuning mode (if symptoms permit). In this mode, tuning systems synthesize the center channel frequency – then implement AFT action. This lets you analyze frequency synthesis operation without cable channel searching which alters symptoms and measurements.

Apply an RF channel signal from the VG91 to the antenna input. Set the receiver and VG91 to channel 2 (if symptoms permit). This channel permits you to compare readings

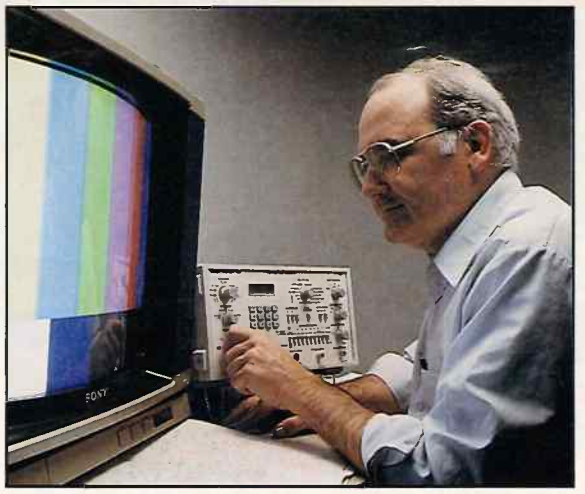


Fig. 3: The VG91 Universal Video Generator lets you troubleshoot tuning problems with exclusive and dynamic signals.

to voltage charts in service literature and make waveform measurements with the Sencore SC3100 "AUTO TRACKER." You can also use the "AUTO TRACKER" to measure DC power supply, bandswitching, and tuning voltages applied to the varactor tuner. If the voltages are normal, you have a problem with the varactor tuner.

If voltages are improper, test the tuner module by using a DC bias supply to substitute for any improper DC voltages. If proper tuning is restored, the problem is in the frequency synthesis circuit loop. The problem could be in the tuner's oscillator or prescaler or in the frequency synthesis stages.

The first step in troubleshooting the frequency synthesis circuits is to test the tuner's oscillator and prescaler output. This determines if the PLL problem is in the varactor tuner. Since the PLL is a closed circuit loop, a problem here can cause all the frequencies and voltages in the frequency synthesis to be defective, including the tuner's oscillator and prescaler output. You will need to correct the defective tuning voltage with a DC bias supply to analyze the tuner's oscillator and prescaler.

To test the prescaler inside the varactor tuner, substitute with the DC bias supply to restore proper tuning. Use the SC3100 "AUTO TRACKER" to test for an output with the proper frequency from the prescaler. A missing or improper output indicates a problem with the tuner's prescaler or oscillator. A proper output indicates these stages are good and that the problem is elsewhere in the frequency synthesis.

Since the frequency synthesis circuits are usually part of a microprocessor or IC in the varactor tuner, the number of discrete stages, components, and test points is minimal. To isolate PLL problems, first check the presence and frequency of the reference PLL oscillator. This may be the main clock crystal of the microprocessor or tuner control IC. Also check for proper voltages to the PLL circuits and digital data or clock input.

If the varactor tuner signals are normal, or applying proper DC voltages to the varactor tuner fails to restore proper tuning, the tuner is defective. You must decide if you are going to attempt to repair the tuner, or send it to a tuner repair specialist.

The VG91 Will Help You

Don't delay any longer. Let the VG91 Universal Video Generator take the frustration out of analyzing and troubleshooting modern tuning system problems. Service calls? Take your VG91 with you and solve tuning or cable channel performance questions right at the job site or your customer's home and avoid costly mistakes or transporting expenses. For complete information on the VG91 Universal Video Generator, call your Sencore Area Sales Representative at **1-800-SENCORE** (736-2673) today. ■

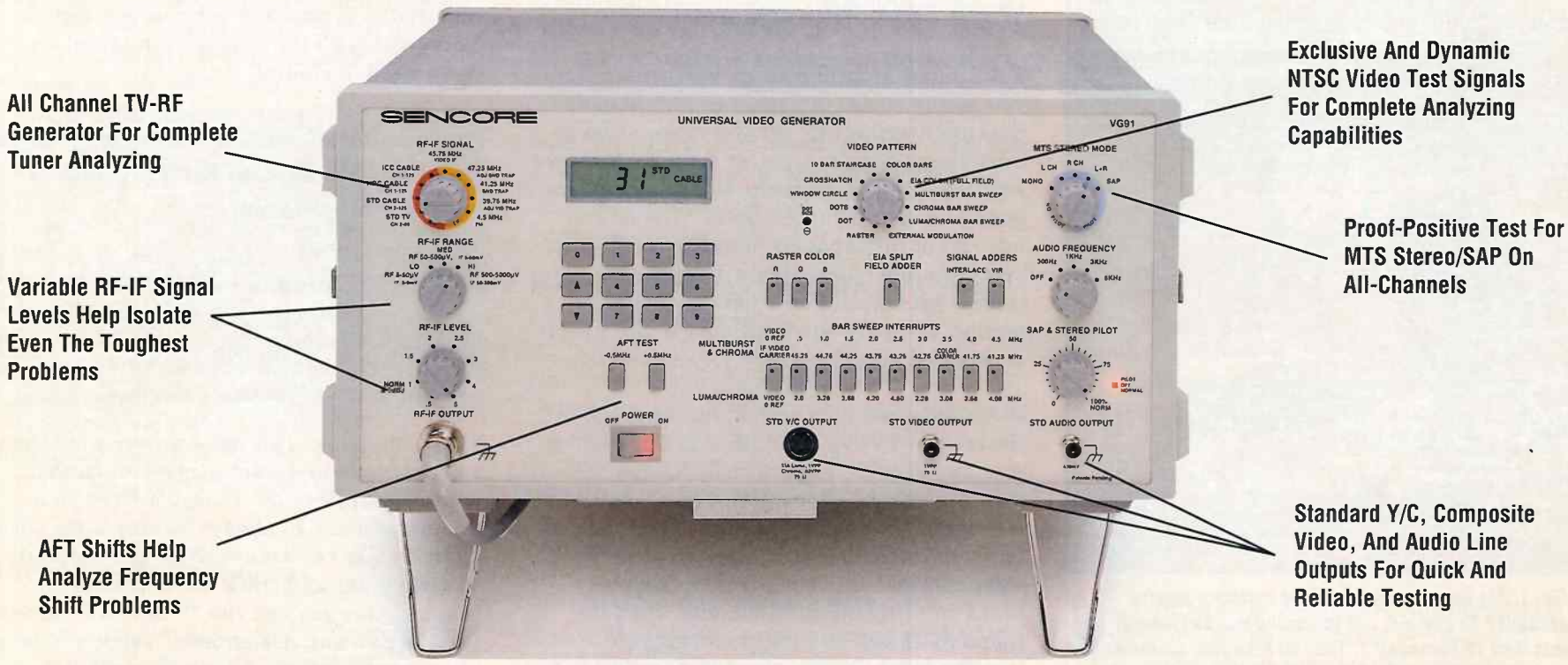
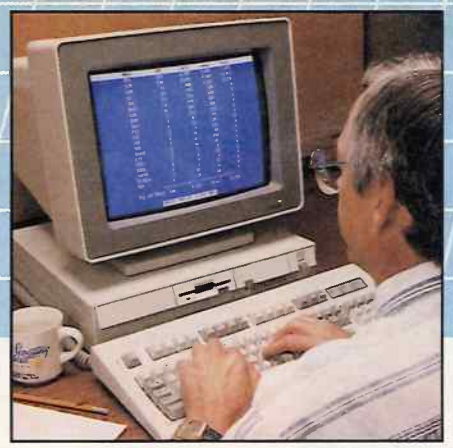


Fig. 4: The exclusive, dynamic features of the VG91 Universal Video Generator let you performance test and troubleshoot tuner problems with confidence.



Improve Your Customer Service By Automating Your Business

By David Olps, Product Manager, Business Management Group

Editor's Note: This is the first part in a series on the SM2001 Service Center Manager. This article takes you through how you can improve your customer service through better business management. We will be showing you how to streamline and improve your business controls with the SM2001 in upcoming Sencore News articles during 1993. Please, give us a call at ***1-800-SENCORE*** *and let us know if we're on track with your business management needs.*

Do you remember when you started your business and how you'd spend extra time on a TV or VCR to make your customer happy – insuring that the word of mouth advertising was good? If you're like most service centers, you originally built your business on customer service with honest service and dependable repairs. Yet, have you truly looked at your business through your customer's eyes?

Many service centers are trying to get new business to come in their doors through newspapers, yellow pages, or radio commercials each and every day. And this is great – it definitely is a step in the right direction. But, how well are you handling your increasing business and the growing demands placed on your service center? Are you confident you're keeping your customers happy and presenting a professional image to them? Imagine how nice it would be if your business was using the most advanced and state-of-the-art business management system allowing you to process and track your customers' broken (but highly valued) TVs, VCRs, etc.

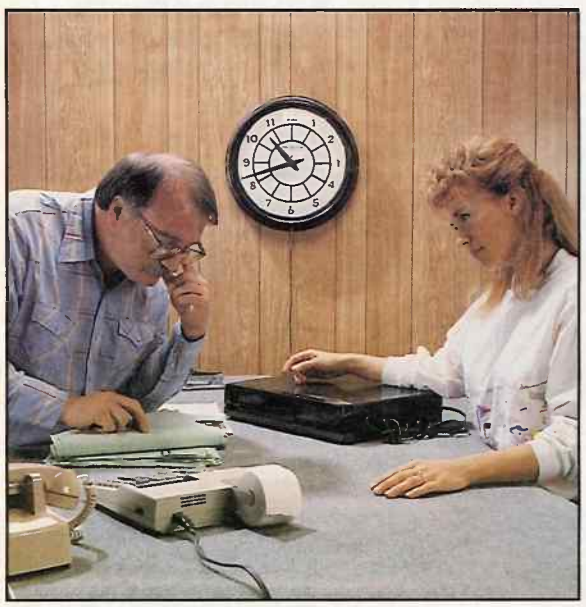


Fig. 1: Are you providing the best customer service possible? To find out, ask yourself if you can identify (in less then 10 seconds): 1. The last time your customer had a product in for service? 2. What was the customer's complaint? 3. What fixed the defect?

Sencore's New SM2001 Service Center Manager Is Truly A Customer Service Tool For Your Service Center!

The SM2001 Service Center Manager is the only complete, customized, and easy to use software system that is designed specifically to help you manage all aspects of your business. The SM2001 guarantees your business will run more efficiently, effectively, and profitably, while improving customer service. This article will show specific ways the SM2001 enhances your customer service through better work flow management, customer history files, business management, and extra features to expedite your customer services. Read on and let's get started toward the future of your service center.

Work Flow Management

Take a look around your service center. Are you seeing stacks of papers or file cabinets that are overflowing, yet you never seem to have the papers, reports, or service literature you need? If you see them, then chances are your customer also sees them. Why do you have all of these papers stored around your service center? Most likely it helps you control your work flow from the time a product comes in the front door to the time it is repaired and given back to your customer.

Work flow management is much more than the steps a TV, VCR, or other product being repaired goes through. It includes the detailing of customer information, identifying if the product has been in for service before and what was done to it, knowing the warranty status of the product, tracking parts ordering information, and when it's taken in. It also includes knowing the location of the repair, who's working on it, and being able to keep special notes on the repair for future reference. Yet, all of this information should be kept in one convenient location for quick, easy access to show your customer that you're running a modernized, high-tech service center they can trust with the repair of their product.

SM2001
Service Center Manager

There is a better way of managing the work flow in your business – the SM2001 Service Center Manager. With the SM2001, you have all the information needed when the repair comes in or you're answering customer inquiries. The SM2001 allows you to know exactly what's happening in your business. Electronic automation is the way of the future and many service centers are already progressing with the SM2001 system.

You start with the invoice screen by simply entering the information on the product to be repaired as it comes in your service center. This creates all the reference information you'll need, including:

- **Customer Name, Address, and Phone**
- **Make, Model, and Serial Numbers**
- **Warranty Status**
- **Defect Code**
- **Invoice Number**
- **Date In For Repair**
- **Billing Information**
- **And Much More...**

This is probably a lot more information than you're able to maintain using your current paperwork processes. Plus, it's all at your fingertips and will always be accessible with a few simple keystrokes. With the SM2001, you can enter and track the entire repair process, plus you can run "Work In Progress" and "Technician Assignment" reports to help you manage and expedite your work flow.

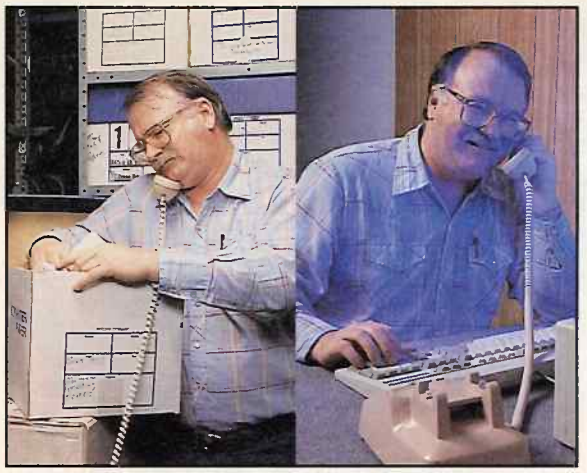


Fig. 2: Can you currently tell within 10 seconds, the exact status of a repair in your service center? Only the SM2001 will identify the status of parts orders, if you're waiting for the estimate to be approved, or if it's currently being worked on by the technician.

Only the SM2001 is guaranteed to help you improve your customer relations through better work flow management. You'll know exactly what is happening with your customer's product instantly – regardless if your customer is in the shop or on the phone.

Customer History Management

Many service centers currently use rows of file cabinets to retain information for past and future reference. Can you imagine how it looks to the customer when they ask you to check on a repair that they claim was done two months ago and you can't find it? (Remember the instances when the customer said a few months and it was actually a year ago?) There is a better way of tracking repairs and filing information that makes it convenient for you to search for customer names and products they've had in for previous service.

Remember entering the customer information and their product as it came in? You can use this information to automatically display the customer's previous repair history with the Service Center Manager. The SM2001 lets you automatically search your history files by serial number, customer name, and model number to see the customer's complaint, when it was last in for service, and what repair work was performed in just seconds – all while your customer is standing in front of you.

With the SM2001, you'll improve your history management on repaired products, parts ordering processing, and inventory control (especially with searching, cross referencing, automatic pricing levels, and ordering advice). You'll also accurately control your accounts receivables and be able to customize business reports so you'll know exactly where, when, and why your business is making a profit. You can even better manage your warranty claim processing.

Business Management

As a business manager, your responsibilities may sometimes seem overwhelming. You're responsible for the success and profitability of the business, the jobs of your employees, and customers' products in your service center, to mention just a few. You need the best management tools available to help control inventory dollars, parts orders, accounts receivables, and to help manage the work being done. (Whether you realize it or not, all of these areas ultimately affect your customer service.)

Let's look at inventory as an example of how business management impacts customer service. Do you have the parts you frequently use in stock that can help speed your customer's repair? Can you get a better deal from specific vendors (or order multiple parts from one vendor and save on freight charges), saving you money and helping keep your customer's repair bill down? Do you have needless inventory that should be cleared out of your business to make room for products to be serviced or other more frequently needed and used parts?

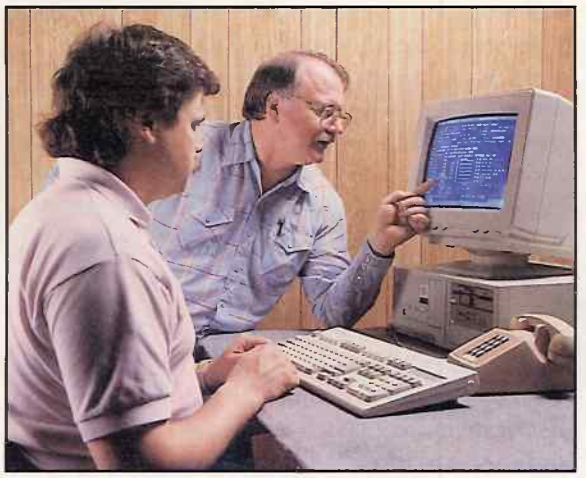


Fig. 3: With Sencore's New SM2001 Service Center Manager, you'll improve your business through better customer relations. This means more repeat business, easier justification of the repair fees, and better peace of mind for both you and your employees.

The SM2001 Service Center Manager is designed to help you manage and control your entire business. You can control inventory and parts ordering with ease. You can insure your accounts receivable information is accurate. "Work In Process", "Technician Assignment", and other detailed reports help you manage the work being done by your technicians, secretaries, accounting personnel, etc. The SM2001 provides standardization of processes yet is flexible enough to allow your business to function like a well oiled machine geared to properly handle even your heaviest workload.

Extra Features To Improve Your Customer Service

Have you ever wished you could let your technician communicate with the customer, yet still keep him/her on the bench? Remember the times when the customer would ask about warranty repair and you either guessed or pulled out the literature from the manufacturer? Along with the manufacturer's warranty requirements, you need to know the product's warranty time frame. This calls for an automatic method of calculating the product's age (or purchase date) – sometimes with the customer standing in front of you.

The SM2001 Service Center Manager assists you in managing and controlling your business functions with extra features other software programs haven't even considered. The SM2001 goes the distance to provide the absolute best business management and customer service possible. The SM2001 gives you these extra features:

1. Literature File – Check to verify that you have the SAMS, microfiche, or manuals, by manufacturer model and chassis number – while your customer is in your service center.
2. Blinking Messages – Now you can emphasize specialized and important messages that need your attention or simply as a reminder notice to relay information from the technician to your customer.
3. General Ledger Codes – Customized to fit your business.
4. Automatic Pricing on Parts – You'll instantly know how much to charge for parts allowing you to streamline your parts pricing and insure profits.
5. Memo Pad – This feature allows you to enter additional notes about the repair or messages that should be given to the customer.
6. Warranty Look-up Table – Automatically displays manufacturer warranty rates and parts mark up percentages on the product to be serviced.
7. Automatically Calculates Product Age from the date of purchase. You'll know instantly if the unit is in or out of warranty.
8. Auto Search On Serial # – When you enter a product for service, the SM2001 automatically scans the entire database of past repairs to see if the product was previously in for service, and you can tell what work was done and see if it is a rework or a different defect – again, all while the customer is standing in front of you.
9. Repeat Key – Provides fast operation and unparalleled ease-of-use when dealing with repetitive operations so you can spend as little time as possible entering information and more time with your customers.
10. Servicer Defined Service Codes – Customize your business defect codes, and enter the symptoms as the customer states them and in logical terms for your business.

The SM2001 Can Help Build Your Business In 1993!

We're confident the SM2001 Service Center Manager is absolutely the best business management program available. It's specifically designed for the service industry by the service industry and it's available exclusively from Sencore – the leader in American-Made Electronic Analyzing Equipment, and now Business Management Software.

For a limited time, Sencore is offering special introductory package pricing. For detailed information or a demonstration package on the SM2001 Service Center Manager, call **1-800-SENCORE, ext. 238.** ■

Profitable VCR Servicing With The VC93 All Format VCR Analyzer

By Brad Johnson, Marketing Communications Specialist

Electronic servicing, like many other businesses, is a win or lose proposition. Every day, you as a business owner are required to make decisions that will affect the bottom line of your business. How can you protect yourself against coming out on the losing end?

Today's consumers are smarter than ever and expect you to be able to quickly diagnose and give them an accurate estimate of what it will cost to repair their electronic products. What complicates this matter is the decreasing cost of consumer electronic products, so now you have to balance your repair costs to the price of a replacement unit. You'll probably find this phenomenon more prevalent in VCR servicing than any other service market.

Accurately estimating a VCR repair can be a tricky situation. First you have to ask yourself, "Is it a mechanical problem or an electronic problem, and do I have the parts in stock?" Here is where the real problems come into play. What if you make a wrong diagnosis? You could run the risk of undercharging the customer and having to boost the final charges to cover your expenses. Or do you play the odds and overestimate the costs and run the risk of losing the job and any future business from that customer?

There are ways of protecting yourself against these kinds of risks, yet run your service center profitably. Sencore wants to help you. That's why we designed the VC93 All Format VCR Analyzer. The VC93 will take the risks out of diagnosing "tough dog" type VCR problems and helps make VCR servicing more profitable than ever before. Let's take a look at the ways the VC93 can make a difference in diagnosing, analyzing, and troubleshooting common problems.

Heads Or Tails? There's No Question With The VC93 All Format VCR Analyzer

According to VCR manufacturers, over 50% of the video heads that are returned under warranty are good. That's a staggering figure if you consider there are VCRs in three of every four American homes and almost every one of these VCRs will at one point or another need to have the video heads cleaned and/or tested. The Sencore VC93 All Format VCR Analyzer can insure you'll never install another set of video heads without being 100% positive they are defective.

How many times have you had a VCR come in the door when you've felt certain the video heads were the problem? The symptoms were all there: snowy picture or weak video, good audio, the works. The first thing you probably did was clean the head assembly, look at the heads through a magnifying glass to make sure they're clean, then re-test the picture quality. What if the picture looks the same as before? Do you have positive proof the heads are good or bad? Could there be a problem in the servo circuitry? Or could the problem be somewhere else?

The VC93 All Format VCR Analyzer can answer these types of questions. The VC93 saves you time and money by providing you with a proven method of testing video heads and analyzing the servo circuits. The VC93 features an exclusive video head signal substituter that dynamically isolates video head defects from all other circuit failures. Think of the number of times a VCR or camcorder came into your service center and you didn't know if the heads were the true problem, or if the problem was somewhere else. You're not alone.

Mechanical Or Electrical? Only The VC93 Knows For Sure

There are many ways a VCR can fail, both mechanically and electrically. How do you diagnose between an electrical failure or mechanical problem? Some mechanical problems are easy to diagnose like worn belts, wheels, idlers etc., but what about those that could be either electrical or mechanical problems? How can you know for sure? For example, many VCRs that exhibit what seems like a mechanical failure may actually have a problem in one of the servo circuits. Your job as a professional servicer is

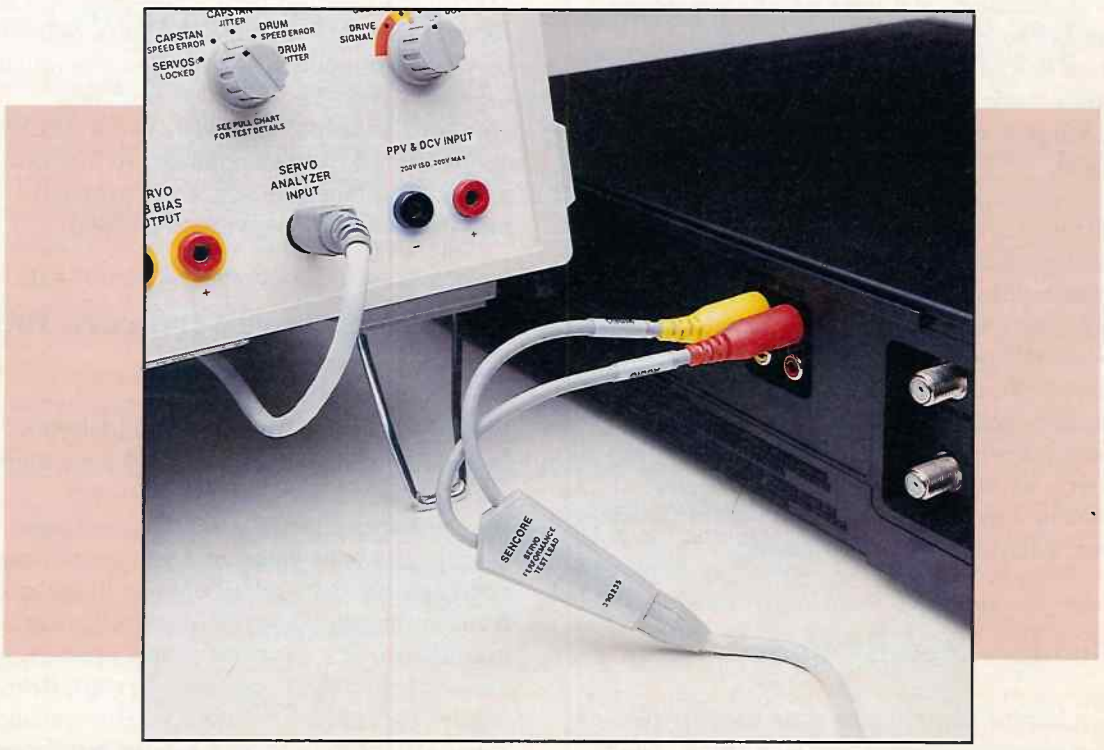


Fig. 1: The VC93 All Format VCR Analyzer lets you test the servo circuits by connecting just two leads, and without taking the cover off the VCR.

to find out which servo circuit is defective and why it is causing a problem.

These are the VCRs that typically find a home in the corner of your bench or on the shelf. You know the ones. Look around the shop and take a count. Then look at your average repair bill and ask yourself if you have a place you could use that extra money that is sitting as potential on the shelf. Most servicers would like to avoid these situations, but for one reason or another, those VCRs are still eating away profits.

How can you prevent this type of situation? You could refuse to repair the "tough dog" VCRs, but that can cause other problems such as limiting your customer base and potential earnings. The better answer is to have the VC93 All Format VCR Analyzer on your bench. The VC93, with its patented servo analyzing tests, will automatically determine if the VCR has a capstan servo, cylinder servo, or luminance/chrominance circuit defect. And it only takes the same amount of time as connecting two test leads.

Isolating Defects In The Overall VCR System

A VCR contains five major sections: luminance, chroma, audio, servo, and system control. The VC93 All Format VCR Analyzer is designed to analyze and troubleshoot each of these major sections. The luminance section receives the recorded information from the tape and processes it into a form that can be displayed by a TV or monitor.

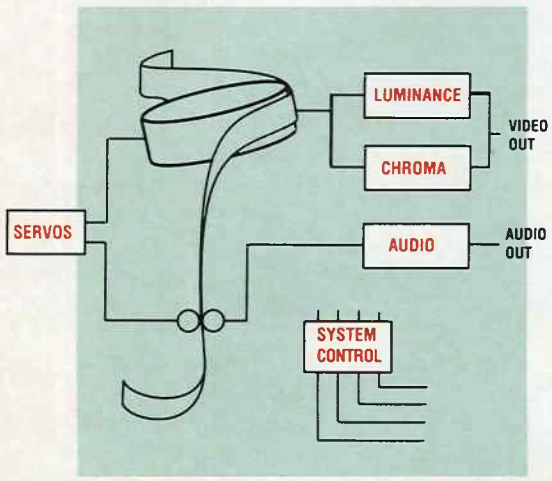


Fig. 2: All VCRs include five different sections. The VC93 helps you diagnose where to start troubleshooting.

This is where the VC93 begins to earn its place on your bench. The VC93 lets you inject the FM modulated video signals into all the circuits between the video heads and the FM detector. Then the VC93's exclusive drive signals help diagnose problems between the FM detector and the video output.

The VC93 also contains a down-converted chroma signal and other key signals that make servicing chroma problems a snap. It allows you to identify whether the problem is in the chroma processor or somewhere else in the chroma circuitry. You no longer have to take the chance of ordering the wrong part or spending extra time trying to signal trace the problem.

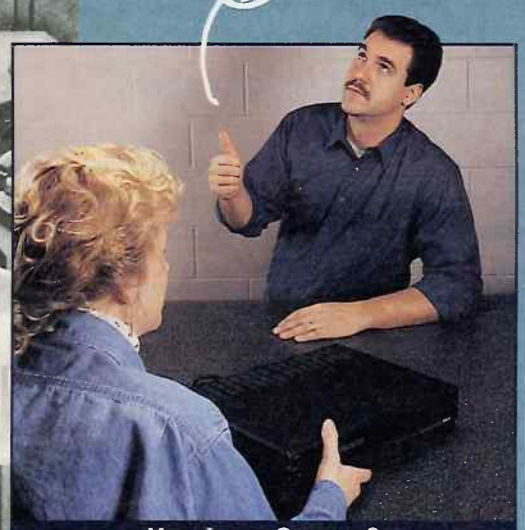
The audio section is typically overlooked as a potential problem area, but what about Hi-Fi stereo problems? Most of the VCRs being produced now have stereo capabilities and your customers expect to hear stereo sound. Troubleshooting Hi-Fi stereo problems can be difficult if you are not equipped to handle them.

The VC93 was designed to give you full audio troubleshooting capabilities – whether it's Hi-Fi stereo or linear audio. You simply use the VC93's exclusive Playback Stereo signals to troubleshoot the Hi-Fi stereo section, or use the Audio Drive Signal to troubleshoot the linear audio section of the VCR.

The servo section of a VCR can be difficult to analyze and troubleshoot. It controls and adjusts the tape speed as well as the phase relationship of the heads with respect to the information recorded on the tape. The VC93 features five exclusive servo analyzing tests, each designed to help you quickly diagnose servo problems and determine where to begin

Fig. 3: The VC93 is part of the new "Tech Choice System" that is designed to simplify VCR troubleshooting with exclusive and dynamic tests.

Business Is Not A Game Of Chance!



Heads → Servos?
Tails → Video?

You Either Win Or You Lose - There's No Two Out Of Three!

All too often a servicer is forced to place the profits on the line based solely on the flip of a coin or an educated guess. What happens to your productivity when you go down the wrong circuit, or spend time diagnosing the heads when the servos aren't tracking correctly? You lose the gamble, right?

Don't take that chance! Here's the answer . . .

TECH CHOICE SYSTEM

Thousands of satisfied customers have invested in the VC93 All Format VCR Analyzer for various reasons: servo analyzing, head checking, luminance/chrominance circuit troubleshooting, audio and Hi-Fi circuit analyzing, plus the simple ability to add an additional $2-$5 of profit on each VCR coming through their service center.

And they can do all of these things because the VC93 provides:

- Dynamic VCR head signal substitution
- Exclusive Hi-Fi Stereo head substitution
- Innovative VCR luminance, chrominance, and audio circuit analyzing
- Automatic servo analyzer
- Stand-alone ability or can be integrated with the new "Tech Choice System" instruments
- Complete all-format troubleshooting, including:
  - Servo bias supply
  - Standard video & audio line outputs
  - Autoranging DCV and PPV meter
  - Output signal monitor

New!

If you'd like to learn more about the VC93, call your Sencore Area Sales Representative today, and find out why the VC93 is one of the best investments you'll make in your 1993 VCR servicing.

VC93 All Format VCR Analyzer

Patented - Exclusively From Sencore

Call 1-800-SENCORE Ext. 636
(736-2673)

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

troubleshooting. A common problem such as noise bars running through the picture can be caused by one of several defects. But the VC93's special servo analyzing capabilities allow you to determine if the defect is in the servo circuits or somewhere else in the VCR.

The VC93 can simplify all your VCR servo troubleshooting. For more information on how the VC93's exclusive tests can help you quickly diagnose VCR problems, call **1-800-SENCORE** and ask your Area Sales Representative about valuable Tech Tip troubleshooting information

The last section is the system control. This section usually has one or more microprocessors that monitor and control the entire operation of the VCR. The VCR's different types of sensors are typically tied into the system control section so the microprocessor knows what conditions or modes exist in the VCR.

The microprocessor is usually unique to each VCR model and requires you to use the VC93 along with an oscilloscope to determine where the problem exists. Sencore offers several informative Tech Tips on the topic of system control troubleshooting to help you better understand and troubleshoot these types of problems. Again, for more information, just call **1-800-SENCORE**

Adding Profits And Protecting The Bottom Line

So what does all this mean for you, the servicer. Well, the VC93 All Format VCR Analyzer was designed to make one big difference for you – increase the profits of your business. The VC93 can and will provide several ways for you to add more profits to your VCR servicing. In addition to providing you with all the troubleshooting and analyzing signals that will make servicing easier and faster, the VC93 provides an "insurance policy" for both you and your customer. Here's how:

As we discussed earlier, today's consumers are protecting themselves by knowing more about the costs of repairing their products. This includes their automobiles, homes, boats, and now their electronic products. That's why they are always asking "what will this cost to repair?" Why do they ask? Because they want to know if buying new would be more economical than repairing the old one. And many consumers are concerned about the dishonest servicers which have received some media exposure recently.

Here's where the VC93 really provides you some reliable "insurance." Before you give the customer an estimate of what it will cost to repair the unit, use the VC93 All Format VCR Analyzer to run a complete "performance test." This gives you full confidence in your estimate. You'll know if the defect is an expensive microprocessor or a less expensive component such as a capacitor. You'll know if the servo and control sections are good, and the condition of the video heads. The VC93 will provide the answers you need to make an accurate, educated estimate and prevent the possibilities of "buying" the VCR.

Secondly, the VC93 provides your customer with an estimate on which they can rely, and establishes you as a servicer that they can trust. In today's society, this is a must for any servicer to increase their customer base as well as their profits. To provide proof to your customers, give them a copy of the performance test results, and tell them it is part of the service that your business provides as part of your customer service program. This test will provide insurance for your customer and can be an extra income generator for your service center.

We want to help you become more profitable in your service business. That is why we've created the VCR Performance Report Card for you. The VCR Performance Report Card is designed so that you can use it as an estimating tool as well as a tool for your final tests. If you would like to know more about performance testing and the Performance Report Card, call your Sencore Area Sales Representative at **1-800-SENCORE** for more details.

The VC93 will also save you time and money by decreasing your callbacks and service warranties. Callbacks can eat your profits faster than anything else, because they are generally done at no charge. Sure, the customer ends up being happy that you covered the additional service call, but how did your business do?

Why not protect yourself against this type of situation by completely testing the VCR and providing proof with the VC93? The customer will know the test was performed and will know the condition of his/her unit. If something else fails, you can't be expected to cover it since they have proof that the machine performed to specifications when it left your service center. Plus, it gives you the opportunity to suggest they bring the machine back in for regular cleaning insuring continued top performance from the VCR.

The possibilities can just keep growing from there. If you keep records of the performance tests you complete, you'll have a database you can send reminder cards for cleanings and yearly performance testing. This can mean repeat customers and it keeps your business name in front of them.

This is just a sample of the possibilities that exist for servicers. VCR servicing involves more than simple cleanings and adjustments. Those aspects are just part of your customer's overall service needs. They rely on you to repair the VCR that they have come to depend on as entertainment for the kids, important business meetings, sales presentations, instructional teaching methods, and the list goes on and on.

If you would like to find out more about how the VC93 can put profit back into every VCR your service, call your Area Sales Representative at **1-800-SENCORE**. We'll be glad to show you how VCR servicing can be easier than ever before. ■

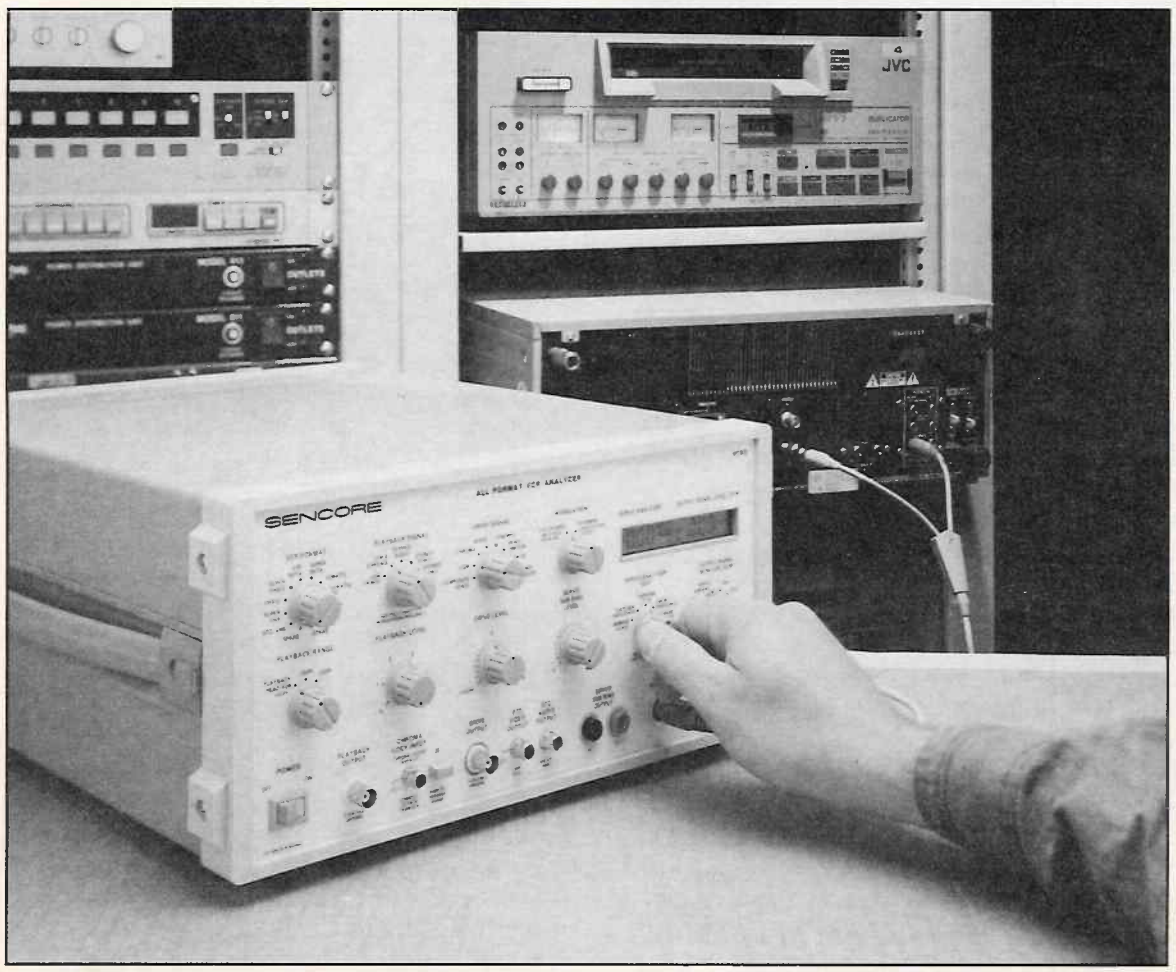


Fig. 4: Use the VC93 All Format VCR Analyzer to performance test every VCR.

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this chroma signal to the luma, blanking, and sync signals at the camera output (Fig. 10).

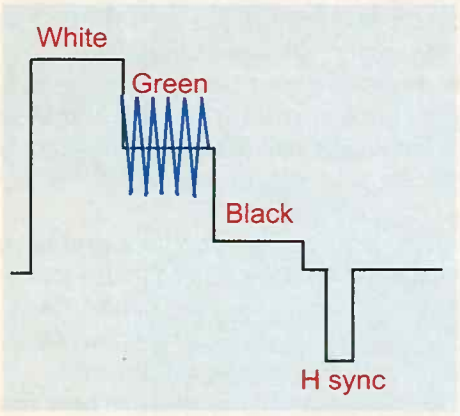


Fig. 10: A video camera adds the chroma information to the luma, blanking, and video signals at the camera output.

Burst: NTSC standard color receivers require a sample of the camera's 3.58 MHz chroma reference signal in order to properly display the camera's chroma output signal. The camera inserts a sample of its 3.58 MHz reference signal during horizontal blanking time, just after each horizontal sync pulse (Fig. 11). This short sample of the camera's reference signal is called chroma burst.

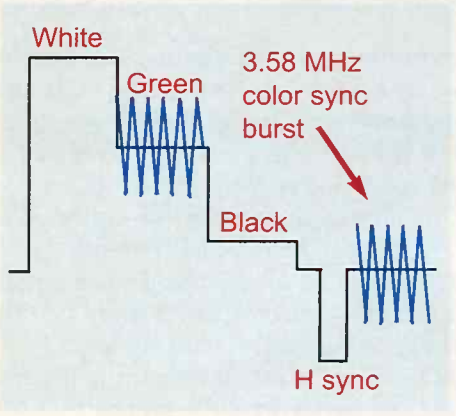


Fig. 11: Burst is a sample of the 3.58 MHz reference signal inserted just after each horizontal sync pulse.

Every color receiver uses the chroma burst to lock in its own reference oscillator. It is important that the camera's chroma burst be at the correct frequency to insure compatibility with all color receivers. Although chroma burst is commonly referred to as 3.58 MHz, the actual frequency is 3.579545 MHz. The camera's sync generator should generate this signal to within at least 100 Hz (preferably 50 Hz) to be sure that color will be produced on all receivers. The amplitude of the camera's chroma burst is also important, and should be 40 IRE units peak-to-peak, centered on the blanking level.

Chroma Amplitude: The amplitude of chroma signals developed while scanning a normal scene extends to over 140 IRE units peak-to-peak. The normal amplitude of camera test signals isn't that high, however. Red and cyan are the highest amplitude color test signals at 88 IRE. The other four test colors typically used; green, yellow, magenta, and blue are at lower amplitudes. Often though, rather than expressing chroma amplitude in IRE or millivolts, manufacturers state the desired chroma amplitude as a percentage of the burst signal's normal amplitude.

Chroma Phase: Each chroma hue scanned by a video camera produces a different phase 3.58 MHz chroma output signal. Chroma signal phase angles are normally measured on a vector display (Fig. 12). This type of display compares the phase of the burst reference signal (on the left display axis) to any other colors which are produced. For the entire time that a camera is scanning a colored object with uniform saturation and hue, it should be producing a chroma output signal with constant amplitude and phase. If it does, the vector display will show a single small dot representing the entire colored object.

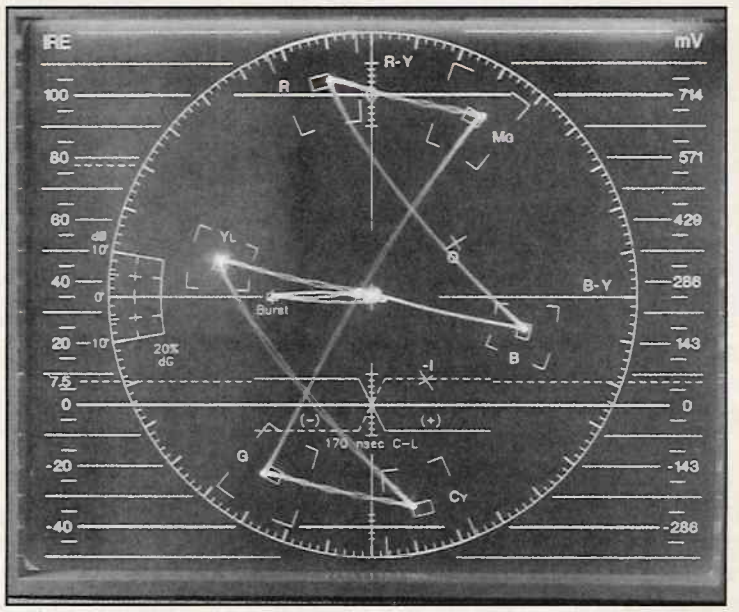


Fig. 12: A vector display compares the phase of the burst signal to any other colors produced.

When a video camera scans the three primary and the three secondary colors, it would ideally produce chroma signals with the phase angles shown in Fig. 12. The chroma phase angles are usually measured counterclockwise from the right-hand, positive B-Y axis, although various camera manufacturers have used other measurement methods. Since pinkish to orange flesh tones fall between yellow and red, camera manufacturers strive to produce those colors most accurately.

Chroma Noise: As with the video circuits, the chroma processing circuits ideally should add no noise to the chroma signal. Actually, they do add both amplitude and phase noise to the chroma signal. Since both chroma amplitude and chroma phase carry color information, both types of noise affect the chroma signal. Chroma amplitude noise shows up in the picture very similarly to video amplitude noise. With chroma amplitude noise, highly saturated color areas of the picture show a "grainy" effect. When a chroma signal with amplitude noise is shown on a vector display, the vector dots spread out in a line toward and away from the center of the display.

Chroma phase noise shows up differently, with highly saturated color areas of the picture showing a "smeary" effect. When a chroma signal with phase noise is shown on a vector display, the vector dots spread out in a line at a right angle to a line drawn to the center of the display.

Chroma amplitude and phase noise are measured almost the same as video amplitude noise. The noise in the 3.58 MHz signal is compared to the normal signal level, and the S/N ratio is expressed in dB.

What Do Camera Video Output Signals Tell Us About Camera Circuit Problems?

Luminance: A video camera should maintain a constant video output signal amplitude when it is moved from high brightness to low brightness scenes and vice versa. Opening and closing of the iris within the lens assembly regulates the signal level at high brightness levels. When the light level drops low enough that the iris isn't able to open further, AGC then starts increasing the camera gain to hold the output signal constant.

Following are some camera signal amplitude problems and likely circuit problems causing them:

Signal amplitude:	• Too large at all brightness levels.
Likely problem:	• AGC causing excessive gain.
Signal amplitude:	• Too small at all brightness levels.
Likely problem:	• AGC causing insufficient gain.
Signal amplitude:	• Okay at high brightness levels, but too small at low brightness levels.
Likely problem:	• AGC not increasing gain sufficiently.
Signal amplitude:	• Okay at low brightness levels, but too large at high brightness levels.
Likely problem:	• Iris not closing sufficiently.
Signal amplitude:	• Okay over only a small range of brightness levels.
Likely problem:	• Iris stuck in one position.

Sync: The amplitude of the horizontal and vertical sync pulses at the camera output should always be 40 IRE (286 mV) measured from the blanking level, regardless of the video signal present. If the amplitude isn't correct, poor sync may result in some receivers. Only a couple of stages need to be checked when improper sync levels are found. The sync adder stage includes an adjustment for setting the sync level. If that adjustment doesn't correct the sync level, the sync generator should be checked for improper operation.

If you find a low frequency variation in the DC level of the sync pulses (hum), you should suspect the power supply circuit. You probably won't see any hum riding on the video signal when you are using most waveform monitors. Usually a blanking clamp circuit is included which clamps the sync and blanking pulses to a constant DC level, disguising the effects of any low frequency interference in the video signal. Unless the waveform monitor includes a switch to disable the clamp circuit, you won't see the hum, much less be able to measure it.

Chroma: The amplitude of the chroma portion of the camera output signal should correspond to the saturation of colors scanned in the scene. If the chroma signal amplitude is wrong, colors in the reproduced picture will have incorrect saturation. Check the camera's chroma saturation accuracy by scanning a reference test pattern with known saturation colors. Then check the amplitude of the camera's chroma signals on a vectorscope or waveform monitor. If the chroma amplitudes don't match the manufacturer's specs, check the adjustment of the chroma gain. If the adjustment doesn't correct the problem, but the video signals have proper amplitude, check the operation of the chroma AGC amplifier as well as other amplifiers in the chroma process section.

Making matters more difficult, as stated above, manufacturers often specify the desired chroma amplitude as a percentage of the burst signal's normal amplitude. Since measuring instruments aren't calibrated in % of burst units, you'll need to measure both burst and the chroma signal on a linear scale (perhaps a small ruler) and divide the measurements to obtain a percentage measurement.

Burst: The amplitude of the chroma burst at the camera output should always be 40 IRE (286 mV) peak-to-peak, regardless of the type of video signal present. If the burst amplitude isn't correct, improper chroma operation may result in some receivers. Only a couple of stages need be checked when a wrong burst level is found. The burst adder stage includes an adjustment for setting the burst level. If that adjustment doesn't correct the burst level, the sync generator should be checked for proper operation.

The frequency of the chroma burst at the camera output should be very close to 3.579545 MHz to insure proper color operation on all receivers. If the burst isn't within at least 100 Hz, it should be adjusted to center frequency with the master oscillator adjustment. The burst frequency can't be measured at the camera output with a standard frequency counter, though, since a counter can't separate the burst signal from the rest of the composite video signal. To measure the burst frequency, the camera needs to be opened and the frequency counter attached to the master oscillator test point.

Video and Chroma Noise: A camera's signal circuits should normally add only a small amount of noise to the video signal. This results in a high quality picture which doesn't have noticeable levels of noise in the picture. Under the lowest brightness lighting conditions, the camera's AGC circuit increases amplifier gain to maximum in attempt to maintain normal output signal level. Due to the maximum amplifier gain, extra noise is generated and the picture becomes grainy. This is normal, and should be expected at very low light levels.

The difficulty is accurately measuring noise levels and deciding whether the noise is present in just the luma, just the chroma, or in both the luma and the chroma signals. If the luma noise is higher than it should be, but the chroma noise is okay, the camera's luma process circuits are likely at fault. If the chroma noise is higher than it should be, but the luma noise is okay, the camera's chroma process circuits are likely at fault. If only the chroma hue noise is excessive, the camera's chroma balance may simply be misadjusted. If both the luma noise and the chroma noise are higher than they should be, one of the camera stages common to both the luma and the chroma signals is likely at fault. This includes the pick-up device, iris control, prevideo process circuits, and AGC control circuits.

Business Opportunities

Camera sales and service are increasing in a number of markets. Business and industrial users are increasingly using cameras for monitoring plant operations and for security purposes. These cameras can be important to the day-to-day operations of the company, and when a camera isn't functioning properly, it's important to get it serviced properly and quickly.

The sales of camcorders are also on the rise, after level growth in the last couple of years. Camcorders are an upscale product and manufacturers are striving to maintain profitable sales margins. That means consumers aren't seeing the deep discounts on camcorders that they have on TVs and VCRs. So, when their camcorder needs service, they are more likely to have it repaired rather than purchase a new one.

That means good service profits are possible for servicers expanding into this growing field of camera service. Complete camera service on camcorders makes excellent business sense, especially for consumer servicers already servicing VCRs. If you don't service the complete camcorder, you are left with two choices. You can send your customer to your competitor and risk losing all your customer's future business. Or, you can send your customer's camera to a camera service depot and risk your customer's satisfaction with extended service times and higher service charges.

Whether you are a self-servicer in a company which uses cameras, or if you are an independent servicer, complete camera service makes good economic sense. Cameras aren't any more complicated than other consumer or industrial electronics. As this article and articles in the past two issues of the *Sencore News* have shown, what you need for profitable camera service is a basic understanding of camera operation and the right equipment to help you quickly service all camera problems. ■

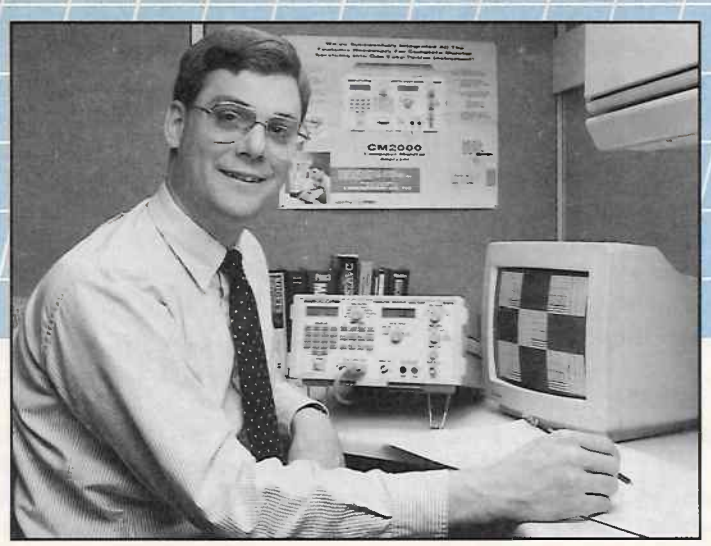
Service Department Notes

Rebuilt SC61 Probes

Sencore's Service Department has rebuilt probes available for the SC61 Waveform Analyzer. These probes have been completely rebuilt and come with a full 90 day warranty. The part number of the probe is 39G183 and the cost is $99.00 each. But hurry, we have a limited quantity. To order your probe(s), just call **1-800-SENCORE (736-2673)**, ext. 635.

New CR70 "BEAM BUILDER" Setup Books

The New 1993 CR70 "BEAM BUILDER" Setup Books (form #5245) are now available for a price of $20. This year's edition contains over 370 new CRT listings that will help you test and restore all CRTs. Just call **1-800-SENCORE (736-2673)** and ask for ext. 635. The Setup Book for older Sencore CRT testers is also available for $15 (form #5244).



Analyzing Horizontal And High Voltage Problems With The CM2000 Computer Monitor Analyzer

By Stan Warner, Application Engineer

Editor's Note: We know many of you have just started servicing computer monitors or are ready to start. This article gives you an example of some step-by-step troubleshooting procedures and the type of support you can expect from Sencore when you invest in the CM2000 Computer Monitor Analyzer. Remember, when you invest in Sencore equipment, you get more than just a product. You also gain maximum productivity on the easiest to use equipment in the industry.

Problems in a computer monitor's horizontal drive and output circuits pose serious concerns for servicers and can endanger profits on many repair jobs. The components in these circuits interact closely, creating confusing symptoms (often a dead monitor). Plus, the parts are expensive (flybacks and regulators); and because of the high voltage and currents involved, a mis-diagnosed problem can quickly destroy newly replaced parts.

In the last issue (*Sencore News* #160), we covered flyback transformer analyzing, high voltage diode testing, and measuring the pulse at the collector of the output transistor using the CM2000 Computer Monitor Analyzer. This article features how the CM2000 gives you the power to analyze horizontal drive circuits, measure second anode high voltage, and test the power supply regulation in computer monitors.

Troubleshooting Horizontal Drive Circuits With Confidence

The horizontal circuit basically consists of an oscillator, a driver, an output, and a yoke. The horizontal oscillator synchronizes to the incoming video signal and develops a horizontal drive signal. The horizontal drive circuit amplifies the drive signal and converts it to a current waveform. The output stage then provides sufficient current to drive the deflection yoke. The horizontal output stage also provides the drive signal to the flyback transformer that creates the focus and high voltage. The flyback is also responsible for generating other scan derived power supply voltages which power other circuits.

If the monitor under test has no deflection or high voltage even after you have tested the horizontal yoke, flyback, multiplier, horizontal output transistor, and B+ supply, 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.

Note: *Always plug a hot chassis monitor into an isolation transformer such as the Sencore PR57 AC "POWERITE" before you begin troubleshooting with any test equipment. Important: When injecting the H DRIVE signal into the horizontal drive circuit, always lower the line voltage to 85 volts AC (see step 5).*

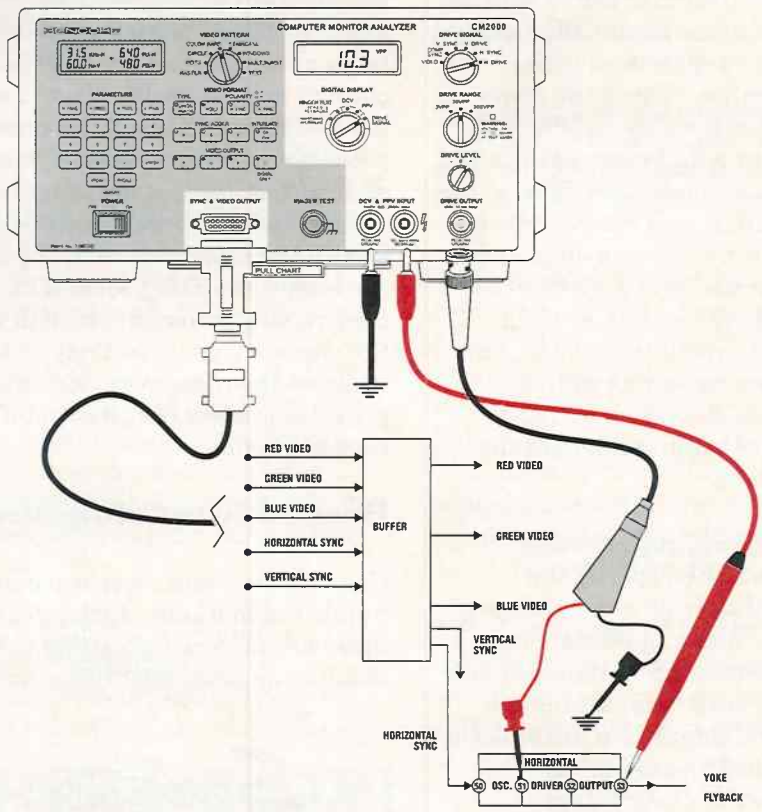


Fig. 1: The CM2000 Computer Monitor Analyzer's exclusive drive signals let you troubleshoot problems in horizontal drive and high power output circuits.

The CM2000 Computer Monitor Analyzer lets you inject a "known good" signal into the horizontal drive circuit to replace the existing signal. The low impedance of the CM2000's Drive Signal Output "swamps out" the signal present at the injection point and replaces it with a good horizontal drive signal.

While driving the suspect circuit with the CM2000, watch the CRT (or monitor the voltage at the collector of the horizontal output transistor) to see if the monitor develops deflection. If deflection returns, you can be confident that all the circuits between the injection point and the output are good.

Let's put the CM2000 Computer Monitor Analyzer to work with the following example. We'll assume we're troubleshooting a monitor with no high voltage or a horizontal deflection problem, and the flyback, yoke, high voltage multiplier, horizontal output transistor, and B+ supply have all been tested. Here's how to set up the CM2000:

1. Set the CM2000 to match the monitor type under service.
2. Set the CM2000 controls as follows:
   a. VIDEO PATTERN control to RASTER.
   b. DIGITAL DISPLAY control to DRIVE SIGNAL.

c. DRIVE SIGNAL control to H DRIVE.
d. DRIVE RANGE control to the range closest to the normal circuit signal level.
e. Adjust the DRIVE LEVEL control to match the signal level normally found in the circuit.

3. Connect the CM2000 to the monitor as follows:
   a. DIRECT TEST LEAD to base of the driver transistor
   b. Black DVM TEST LEAD to circuit ground.
   c. Red DVM TEST LEAD to the collector of the horizontal output transistor.
4. Set the DIGITAL DISPLAY control to PPV.
5. Set the AC line voltage to 85 VAC and turn on the computer monitor.
6. Monitor the PPV level on the DIGITAL DISPLAY readout as you adjust the DRIVE LEVEL control.

What to expect: Watch for horizontal pulses on the CM2000's PPV meter and/or for horizontal deflection on the CRT. If voltage and CRT deflection return, you are injecting after the defective stage. If horizontal pulses do not occur at the collector monitoring point, inject the CM2000 Drive Signal at the base of the horizontal output transistor. If the horizontal pulses now return, you know the defect is between the last two injection points. Use signal tracing and conventional troubleshooting techniques to narrow the problem to a single component.

Note: When injecting at the horizontal output transistor, disconnect the low impedance secondary winding of the driver transformer from the base.

How To Troubleshoot Split Horizontal Sweep And Horizontal High Voltage Monitor Circuits

Some multi-sync computer monitors (monitors that lock to multiple formats with different scan frequencies) have split horizontal circuits. The signal divides at the output of the horizontal oscillator. One circuit drives the yoke for horizontal sweep and the other drives the flyback transformer for high voltage generation (see Fig. 2).

Troubleshooting split horizontal circuits with the CM2000 involves the same tests and signals as with the normal horizontal circuit reviewed earlier. If the computer monitor lacks high voltage – and the flyback, output transistor, and B+ supply have tested good, inject the CM2000's horizontal drive signal into the horizontal drive high voltage circuit and monitor the results.

If the monitor has high voltage but no horizontal sweep (a thin vertical line down the middle of the display), inject the CM2000's horizontal drive signal into the horizontal drive sweep circuit. Then watch the CRT for results and troubleshoot as explained earlier. It is not necessary to troubleshoot the horizontal sweep circuit if the monitor has no high voltage.

Safely Measuring High Voltage With The CM2000

The CRT of a computer requires a very high-level DC voltage to accelerate the electrons toward the screen. The secondary winding of the flyback transformer develops this high voltage. The integrated diodes in the flyback or a separate multiplier circuit amplifies and rectifies the voltage.

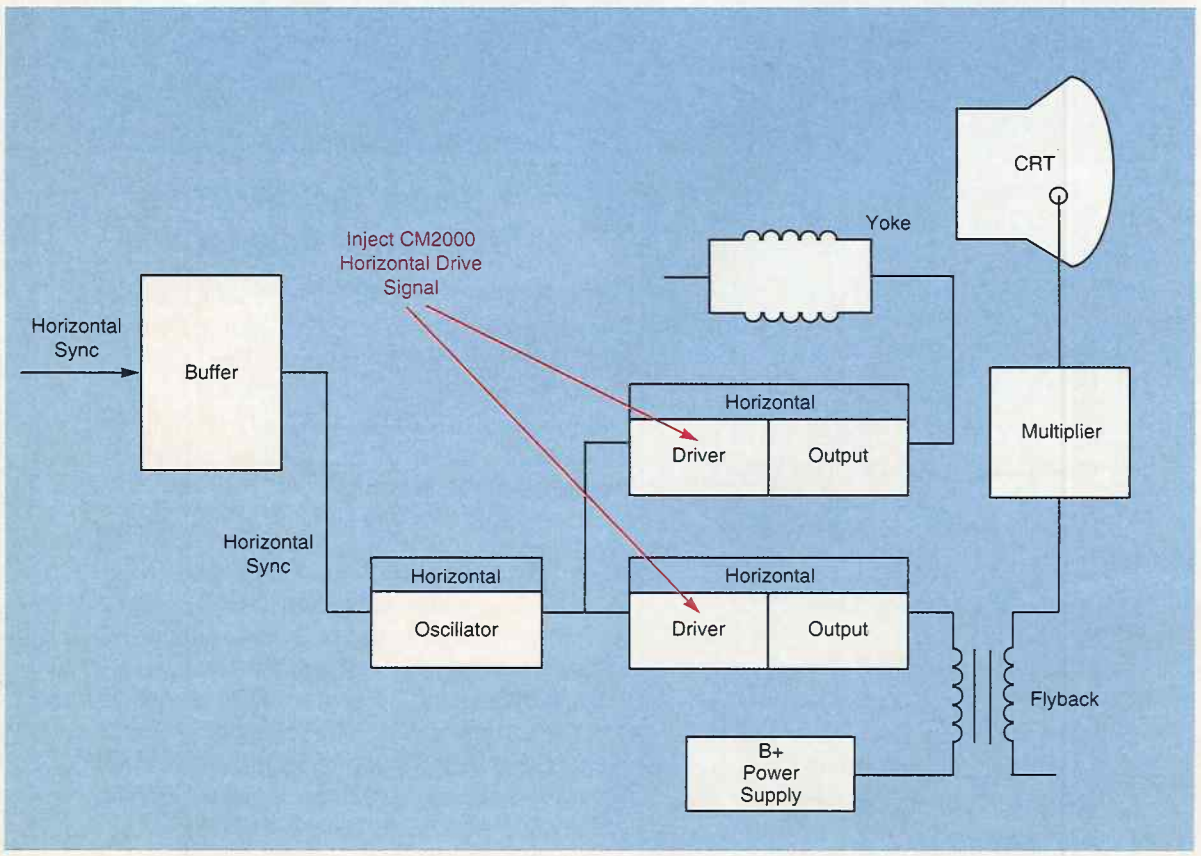


Fig. 2: The CM2000 lets you analyze computer monitors with split horizontal circuits. One circuit creates horizontal sweep and the other creates high voltage.

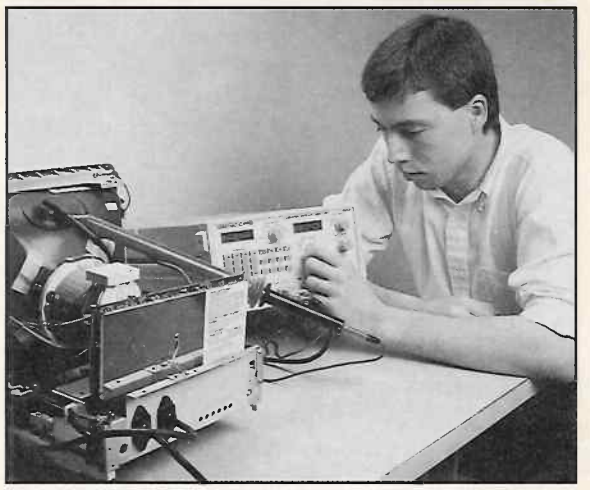


Fig. 3: Measuring the CRT's high voltage is safe and easy with the CM2000 Computer Monitor Analyzer and HP200 high voltage probe.

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/or focus voltage.

WARNING

Measuring high voltage exposes you to the possibility of a severe shock hazard if you do not follow careful test methods. Do not perform the high voltage test until you completely read and understand all the warnings included with this test found in the CM2000 Computer Monitor Analyzer Operations and Applications Manual.

But measuring CRT high voltage is no easy (or safe) task without the proper test equipment. The CM2000 lets you safely measure high voltage up to 50,000 volts with its DCV meter and the optional HP200 accessory probe. Here's the proper procedure to measure CRT high voltage with the CM2000:

1. Turn "OFF" the power to the computer monitor.
2. Set the CM2000 DIGITAL DISPLAY switch to "DCV."
3. Slip the red CM2000 DVM TEST LEAD into the HP200 High Voltage Probe.
4. Connect the black DVM TEST LEAD to the HV ground point on the monitor chassis.
5. Connect the HP200 probe to the test point so it does not need to be held during the measurement.
6. Turn the monitor "ON" and note the voltage reading on the CM2000 digital display.
7. Multiply the reading by 100 for the actual voltage present at the test point.

What to expect: Compare the high voltage reading to the voltage shown on the schematic. If the reading is high, check for a timing problem in the horizontal output circuit, or for a B+ regulation problem. If the reading is low or missing, check for a low or missing B+ supply or a faulty component such as the IHVT or high voltage multiplier.

Testing High Voltage Regulation

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

Use the CM2000's Raster pattern to dynamically test a monitor's high voltage regulation circuit. Quickly switching the VIDEO POLARITY button between "+" and "-" causes the display to alternate between white (maximum load) and black (minimum load). Here's an example of how to test a monitor's high voltage regulation.

1. Set the CM2000 to match the monitor type under service.
2. Set the VIDEO PATTERN switch to RASTER.
3. Press the "R", "G", and "B" VIDEO OUTPUT buttons to "ON."
4. Set the monitor's brightness to maximum.
5. Quickly toggle the VIDEO POLARITY switch from "+" to "-."

What to expect: The CRT display should remain stable as you switch between the white raster and black raster. The border line on each raster should remain stable with no signs of bowing or blooming.

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

Try A CM2000 Computer Monitor Analyzer On Your Bench With No Obligation

The CM2000 Computer Monitor Analyzer gives you all the features and tests necessary for computer monitor servicing in one complete, easy to use instrument. Give your Area Sales Representative a call today at **1-800-SENCORE** (736-2673) to set up a no obligation trial of the CM2000. Then see for yourself how the CM2000 fits your computer monitor servicing needs. ■

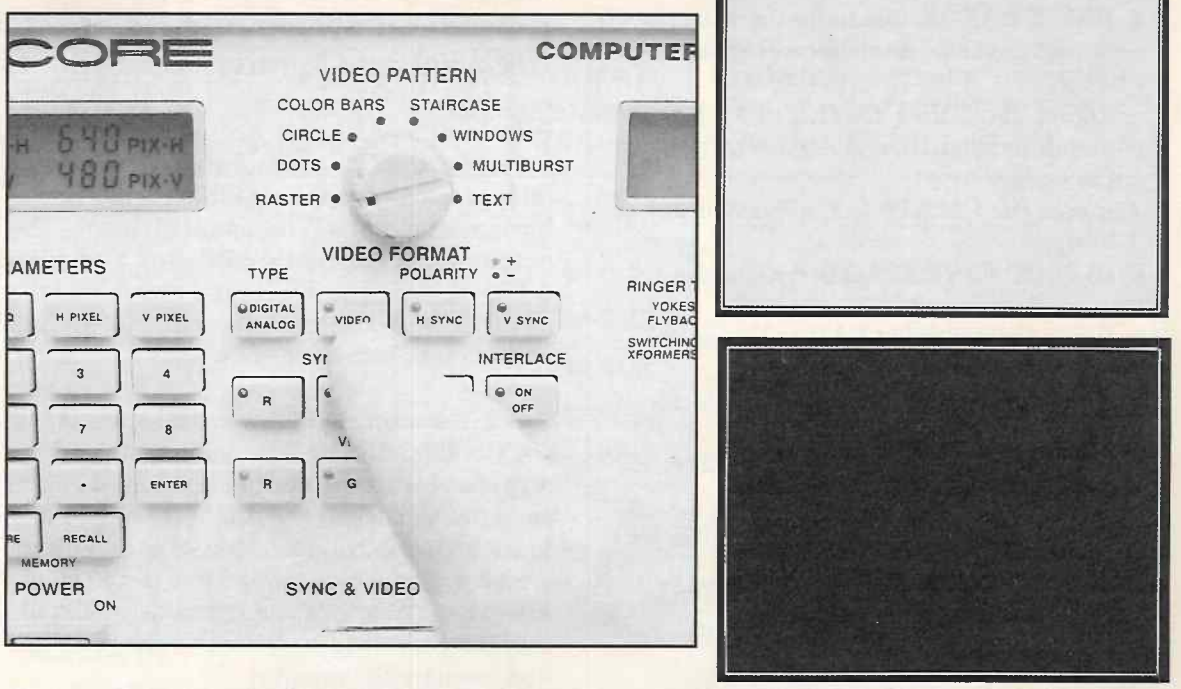
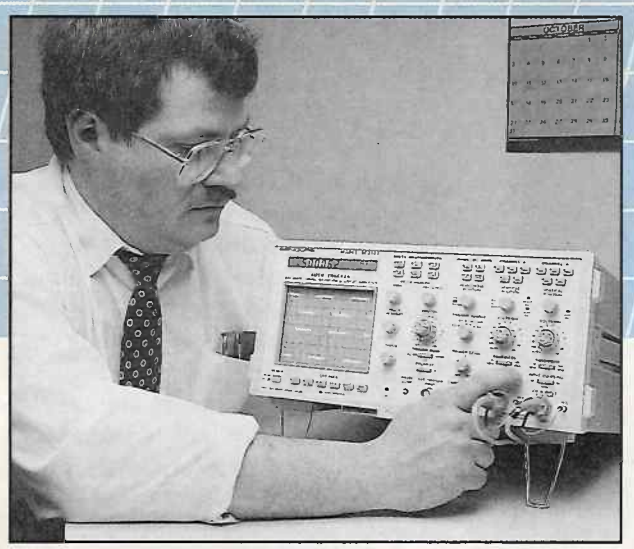


Fig 4: The CM2000 lets you test computer monitor high voltage regulation by simply changing the polarity of the Raster pattern.



Analyzing Signals Faster And Easier With The SC3100 "AUTO TRACKER"™

By Paul Nies, Application Engineer

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

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

But enough talk. It's time to put the SC3100 "AUTO TRACKER" to work in real-life situations. In this article, we'll show you how to analyze and/or align these five key troubleshooting and analyzing waveforms:

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

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

1 Analyzing The Horizontal Output Pulse

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

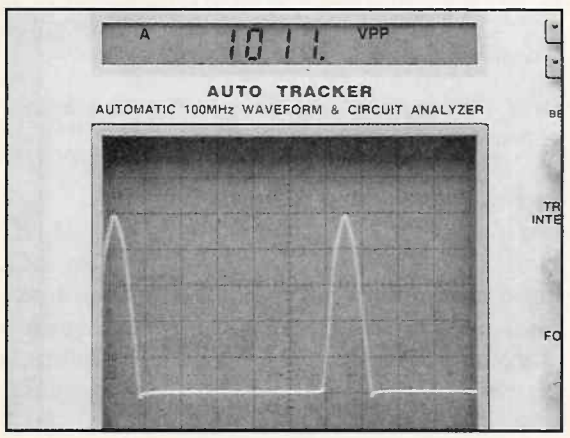


Fig. 1: Only the SC3100 "AUTO TRACKER" lets you safely view the horizontal output pulse.

But an important element prevents competitive oscilloscopes from analyzing the horizontal output collector pulse – the amplitude of the pulse. The horizontal output pulse ranges from 500 to 1,500 volts peak-to-peak. This pulse can cause serious front-end damage since the amplitude is several times greater than the input rating of most oscilloscopes (typically 200-500 volts).

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

NOTE: Always plug a hot chassis TV or monitor into an isolation transformer such as the Sencore PR57 AC "POWERITE" before you begin troubleshooting with any test equipment.

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

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

Now, you just press the "DCV" button and read the LCD. The displayed voltage should agree with the amount shown on the schematic (usually 110-130 VDC). Then press the "VPP" button and read the LCD. The measured voltage should be within 50 volts of the amount shown on the schematic (range: 500-1500 VPP).

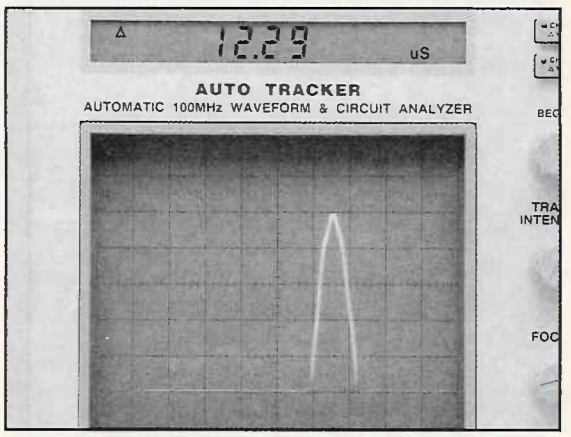


Fig. 2: The "AUTO TRACKER" lets you measure the horizontal output pulse's width to check for proper timing.

It's also very important to measure the retrace time of the horizontal pulse with the SC3100 "AUTO TRACKER" (refer to Fig. 2). To measure the retrace time, simply press the Delta Time button, adjust the Delta Begin and Delta End controls, and read the LCD display. The normal range for horizontal

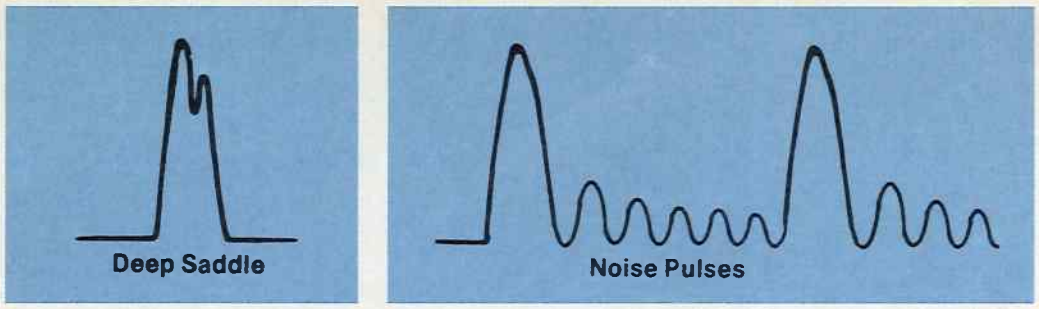


Fig. 3: The output waveform should be free of extra ringing pulses and should not include a deep saddle.

retrace time is 11.3 to 16.0 µS. Anything below or above this range indicates a problem. Here's what to look for in a horizontal output pulse:

Waveshape – The horizontal output waveform should look like Fig. 1. It should be symmetrical, free from extra ringing pulses, and should not contain a deep saddle, as Fig. 3 shows. A deep saddle indicates an excessive load, possibly a shorted turn in the flyback. Extra ringing pulses indicate a cracked core in the flyback, bad damper, or drive signal problems.

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

Pulse Amplitude – The amplitude of the output pulse ranges from 500 to 1,500 volts, depending on the chassis. The measured PPV amplitude should be within about 50 volts of the amplitude shown on the schematic.

Readings that are considerably different from the schematic value indicate problems with the flyback, load, or drive signal.

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

2 Analyzing The Sandcastle Signal The Right Way

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

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

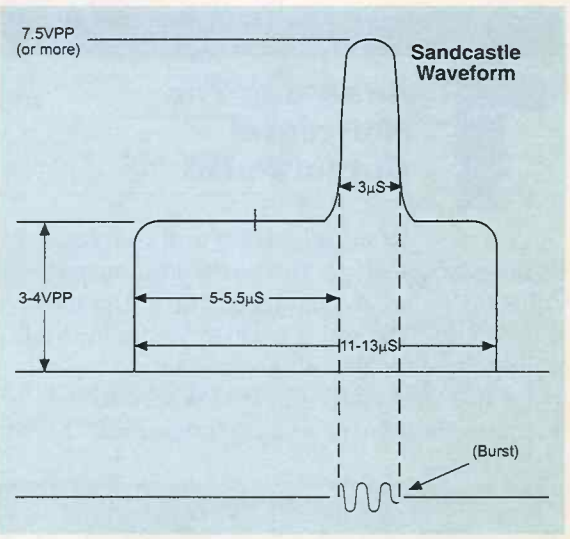


Fig. 4: The complex sandcastle signal must meet exact parameters.

As Fig. 4 shows, the manufacturer has established precise parameters for the sandcastle waveform. Deviation from any of these parameters can result in the symptoms described earlier. You can use the following procedure to analyze a sandcastle waveform with the "AUTO TRACKER":

1. Connect the channel A probe to the sandcastle signal and the channel B probe to the output of the video detector (set TRIGGER SOURCE to "CH B").

2. Set the SC3100 TIME/DIV switch to "TVH", leave the VOLT/DIV switch on "AUTO", and analyze the waveform.

Pressing the SC3100's "VPP" button tells you the amplitude of the sandcastle waveform. The waveform should be at least 7.5 volts peak-to-peak on this chassis (see Fig. 4). If this amplitude is incorrect, check the circuitry that processes the flyback (key) pulse.

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

To analyze the portions of the waveform, adjust the Delta Begin and End controls to measure the level between the base and the top of horizontal blanking, as shown in Figure 5a. If this level is incorrect, check the circuitry that processes the blanking pulses.

Now press Delta Time on the SC3100 and adjust the Delta Begin and End controls to measure the time from the start of the blanking pulse to the start of the burst key pulse, as shown in Figure 5b. If this time is incorrect, check the circuity that processes the horizontal blanking pulse. You should also measure the width of the burst key pulse with the "AUTO TRACKER's" Delta Time function. If this time is incorrect, check the circuitry that processes the flyback (key) pulse.

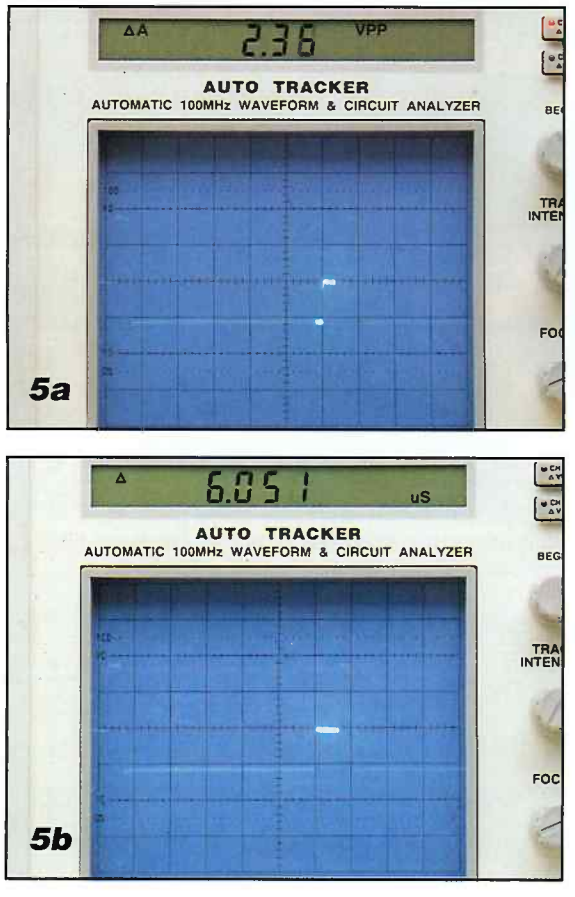


Fig. 5a: Use the SC3100's Delta VPP function to measure the amplitude of the horizontal blanking. 5b: Use the Delta time function to measure the pulse width parameters. Are these readings within tolerance?

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

One, two, three, and you're done. The SC3100 "AUTO TRACKER" has confirmed whether all parameters of this signal meet manufacturer requirements. Just think about how this could help get those "tough dog" sets off your bench.

3 VCR Headswitching Made Easy

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

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

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

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

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

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

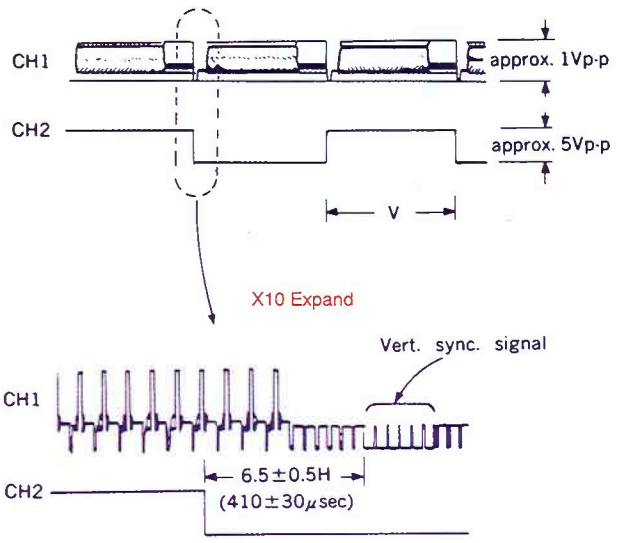


Fig. 6: The headswitching adjustment requires you to expand the waveform. The "AUTO TRACKER" lets you expand the waveform by a factor of 10 with plenty of detail.

When you play back the VCR alignment tape, the CRT display will look like the drawing in Fig. 6. Notice that you can clearly see the horizontal sync pulses ahead of the vertical sync interval. Set the VCR's PG adjustment so there are 3 1/2 horizontal lines before the start of vertical blanking, or 6 1/2 lines before vertical sync. If the video signal contains equalizing pulses, be sure to count only every second pulse. For a more detailed explanation, call your Area Sales Representative for a copy of the Tech Tip explaining VCR headswitching.

4 Setting VCR Tracking Fix Helps Insure A Quality Repair

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

3-1-2. Tracking Fix Adjustment

TP	ADJ.	MODE	INPUT
TP2005 TP2006	R2022	SP SELF-RECORDING AND PLAYBACK	(VIDEO IN) VIDEO SIGNAL

TAPE	M. EQ.	SPEC.
BLANK TAPE	OSCILLOSCOPE	T = 7.3 ± 0.5msec.

Note:
TP2005, TP2006, R2022 : Servo Section on the Main C.B.A.

Confirm that the Tracking Control on the front panel is in the center position.

Fig. 7: The typical Tracking Fix procedure specifies the time delay between two signals.

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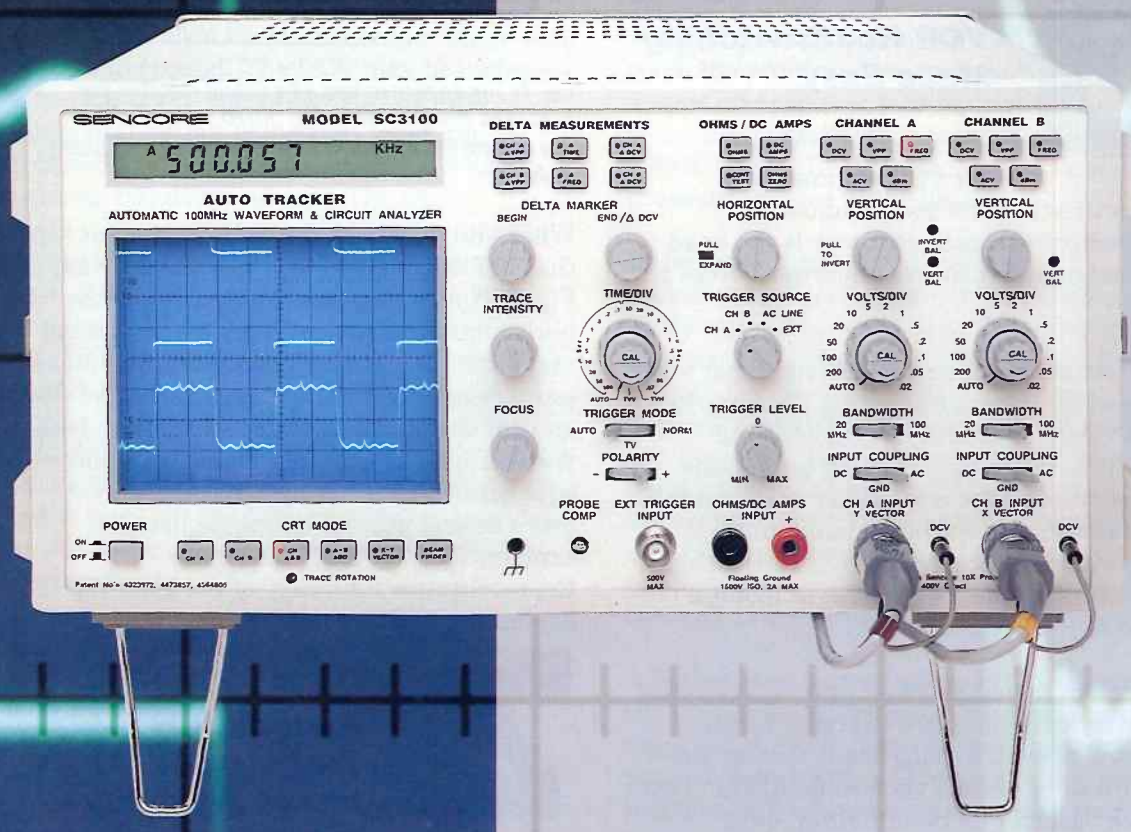

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Exclusive:

- ***Autoranging timebase***
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- ***Integrated current & ohms measurements***

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Figure 7 shows an example of a typical manufacturer's Tracking Fix alignment procedure. Notice the procedure calls for setting a specified amount of time delay between the signals. The amount of delay and the specific test points will vary somewhat between VCRs. Most procedures call for setting the time delay between the 30 Hz switching signal and the CTL pulse when the front panel tracking control is in the center detent position.

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

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

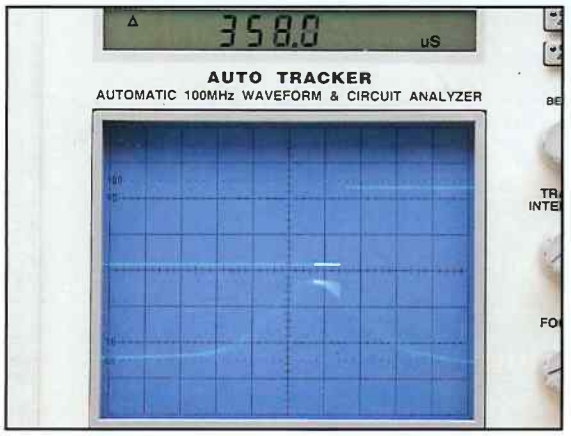

Fig. 8: The SC3100's Delta Bar quickly measures the Tracking Fix adjustment time delay between the two signals.

Play back the VCR alignment tape and adjust the Delta Begin and Delta End controls until the highlighted Delta bar just covers the delay between the two waveforms, as shown in Fig. 8. Now, read and note the time delay in the SC3100's digital readout. If the time delay is not correct, adjust the Tracking Fix Adjustment and watch the "AUTO TRACKER's" digital display until the delay is correct. For more details on setting the Tracking Fix Adjustment, call your Area Sales Representative for Tech Tip information.

5 Analyzing Logic Levels In Modern Circuits

Almost every electronic device today uses digital logic levels that must be correct for proper operation. VCRs, for example, contain a dozen or more logic sensors (dew, tape end, cassette in, take up reel, etc.) that must be correct for the machine to operate. The input and output data lines from microprocessors in television receivers, CD players, tape decks, etc., must be at the proper logic level . . . the list goes on and on.

In order for a logic level to be properly recognized, the "low" and "high" voltage levels must fall within a standard range. A questionable area exists when the digital circuits cannot decide if the level is "high" or "low." Figure 9 shows the range of logic highs and lows, and the questionable area for the two most commonly used logic families.

TTL circuits operate with a supply of 5 volts and have a questionable area from 0.8 to 2.0 volts. CMOS devices operate over a wider range of power supply voltages. Because of this, the questionable area for CMOS logic is a percentage of the power supply voltage. The questionable area for CMOS is between 20% and 70% of the supply voltage.

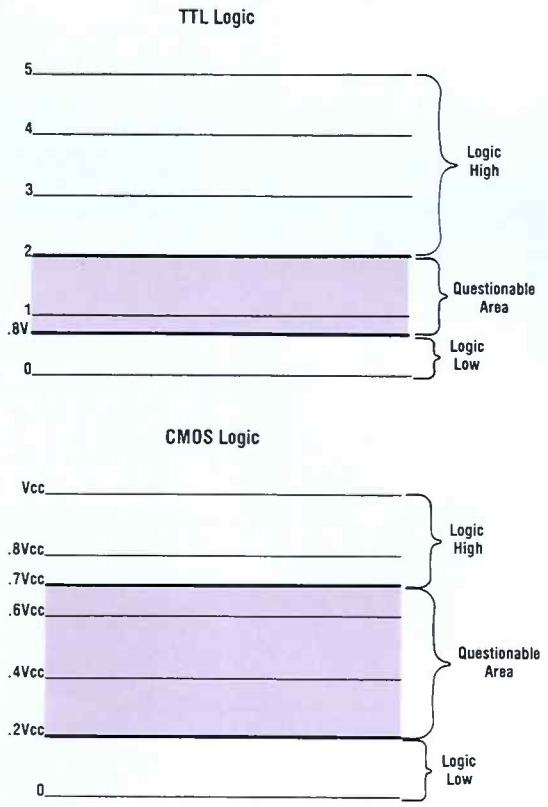

Fig. 9: Logic levels must fall within the accepted high or low range for digital circuits to operate properly.

The SC3100's exclusive Delta DC test allows you to determine the logic level without counting graticules or even selecting DC coupling on the front panel. Here's how you set up the "AUTO TRACKER":

1. Connect the SC3100's CH A probe to the test point.
2. Push the Delta DCV button.
3. Set the VOLT/DIV and TIME/DIV switches to "AUTO."

Now, adjust the DELTA MARKER control to position the DC marker at the logic low or logic high point on the waveform you are analyzing. Compare the DCV reading on the SC3100's digital display to the logic levels shown in Fig. 9, and you're done.

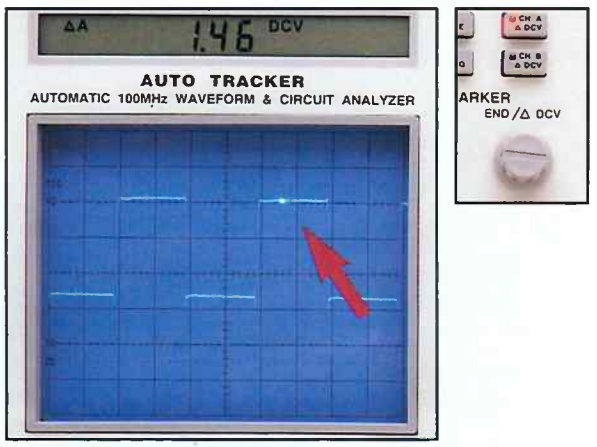

Fig. 10: The SC3100 automatically measures the instantaneous voltage at the point on the waveform indicated by the Delta DC Marker.

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

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