

SENCORE NEWS

Issue #139 July/August 1988

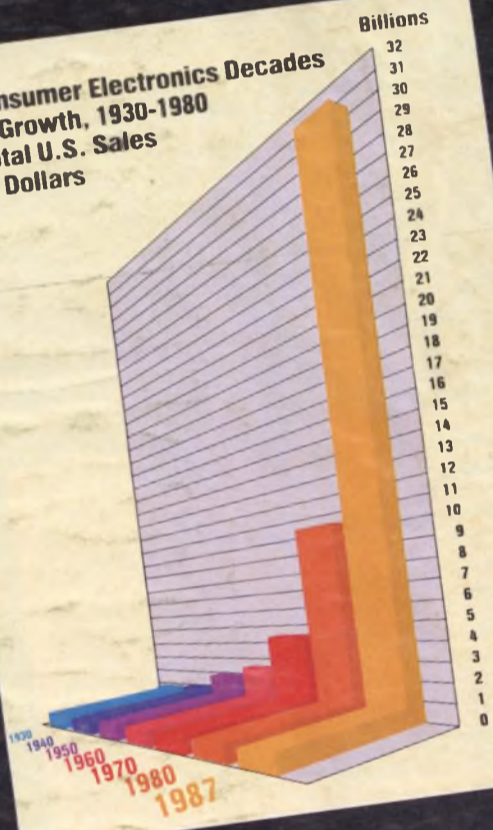
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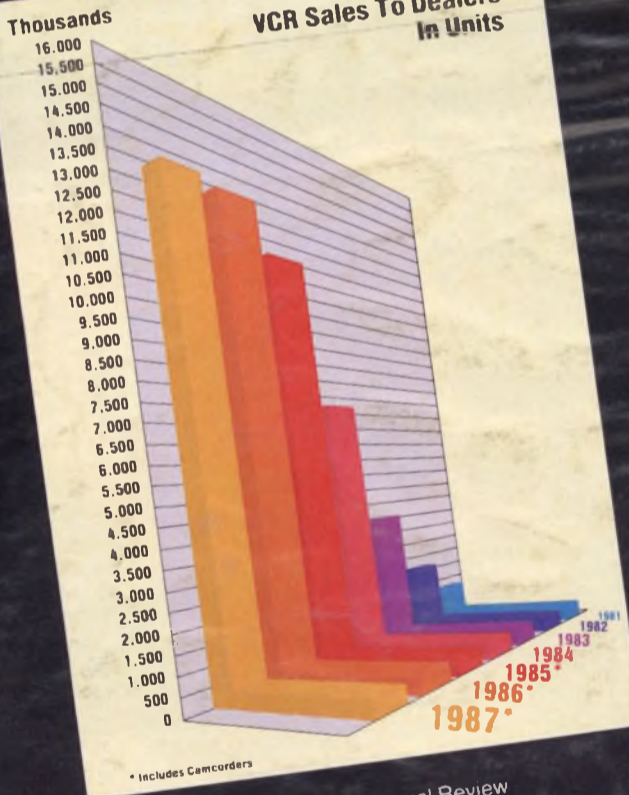
**New Technology Is
Here To Stay ...**



**Consumer Electronics Decades
Of Growth, 1930-1980
Total U.S. Sales
In Dollars**



**VCR Sales To Dealers
In Units**



From Consumer Electronics Annual Review
Courtesy Of EIA

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Introducing The Portable MTS Update Team!

Now, take your MTS troubleshooting abilities into the home with the ST66 and SR68 Portable Update Team! This NEW combination allows you to quickly and easily performance test and troubleshoot MTS problems in the home.

Find out on the spot if it's the TV or the Cable system that's causing the problems. The ST66 and SR68 team up and allow you to performance test, in the home, before committing time-consuming warranty service. Once and for all, eliminate having to bring the set into your shop to determine if there really is a problem.

Here's what the Portable MTS Update Team can do for you:

ST66 Stereo TV Analyzer™ S1395 Patent Pending

- Portable, stand alone analyzer to test MTS Stereo TV and VCR problems in the field.
- Special signals to performance test and service MTS stereo TV.
- Eliminates RF/IF sections as a source of trouble.
- Exclusive video patterns allow you to service the entire TV from audio to video!
- Surpasses all others on the market in performance, price, portability and reliability.

SR68 Stereo TV Readout™ S595

- Analyze stereo TV audio line or speakers in dB or Watts.
- Loads to 100 Watts for dynamic tests and speaker substitution.
- Measure channel separation to -40 dB without calculations.
- Battery operated - use in the shop or field!

Save \$313.90 On The Portable MTS Update Team!

When you invest in the Portable MTS Update Team, you will save \$313.90 on these two instruments. As a package deal, you'll receive the ST66 and SR68 along with two (2) battery packs and two (2) protective covers for only \$1,895.00! (List price \$2,208.90). That saves you \$313.90! (See the Update '88 Flyer for more details.)



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SENCORE



"Update 88" — You Can Be As Busy As You Want In Electronics Service

by Doug Bowden, V.P. Sales and Marketing

With the tremendous growth in consumer electronics, you're going to see greater opportunities for service profits. Play your cards right and you'll be a success; there's no doubt about it. Start by updating your shop with Sencore instruments. They save you time—the time for making more profit and the time for leisure.

Estimated Household Penetrations By Product

(as of January 1988)

Courtesy of EIA

| Product | Percent |
|-----------------------------|---------|
| All Television | 98% |
| LCD TV | 2% |
| Color TV | 94% |
| Color TV with MTS | 9% |
| Stereo Adaptable Color TV | 11% |
| Monochrome TV | 58% |
| VCR | 52% |
| Comcorders | 4% |
| Pre-recorded Videocassettes | 40% |
| Home Computers | 20% |
| Audio Systems | 89% |
| Compact | 54% |
| Component | 44% |
| Compact Disc Players | 8% |
| Telephone Answering Devices | 19% |
| Cordless Telephones | 17% |
| Home Radios | 98% |
| Home Security Alarm Systems | 10% |

You can be as busy as you want in electronics service, even in the summer. That's the opinion expressed by servicers who stopped by Sencore's booth at the recent Summer Consumer Electronics Show (CES) in Chicago. Shops that promote their business are enjoying the profits from this growing industry. Many are expanding their service operations and capabilities to take advantage of the growing demands.

The consumer electronics industry is growing fast. Your service opportunities are also growing. The graphs on the cover of this issue show the total sales for 1987—near 31 Billion. 1988 is the time to update. Everything about the consumer electronics industry says the time is right for real success in electronics service.

The Electronics Industries Association (EIA) compiles and publishes accurate and timely facts and figures about consumer electronics. We refer to this important information in the *Sencore News* because we are sure that you, the professional servicer, want to be aware of important industry trends. They help you zero in on the areas that you want to service, plus help you forecast test instrument needs. For example, did you know that color TV is in 94% of the homes in your service area, 89% have audio systems and 52% are using VCRs? The profit trend for your consumer electronics service operation is straight up.

According to servicers that stopped by to chat at CES, Color TV still tops the list of products most profitable to service, with VCRs a close second. Projection TV and the "Big Screen" models are creating more home service calls. Servicers are seeing more TVs and VCRs with stereo (Multichannel Television Sound - MTS), and audio service is in high demand.

Contents

How To Use Your VA62 Universal Video Analyzer, Step-By-Step. (This could be the key to your success in video service.)
- page 4

New VCR Performance Report Card Designed To Speed Your Service And Increase Customer Satisfaction - page 8

Learn New Ways To Save Time And Simplify VCR Service - page 10

Buyer's Guide - page 13

How To Solve TV Horizontal Circuit Problems - page 24

Servicing The New High Quality RGB Monitors - page 26

Update your skills and equipment, then claim your share of the growing service market.

Free workshops for Summer 1988:



Workshops for consumer electronics technicians in CD and VCR are given below. For specific sites and local contacts, check with NESDA/ISCET in Ft. Worth, Texas, 1-817-921-9061 or 9101.

| | | |
|--------------------|-----|------------------|
| Louisville, KY | VCR | July 5-9 |
| Goodland, KS | VCR | July 11-15 |
| Nashville, TN | CD | July 15-16 |
| Ft. Lauderdale, FL | VCR | July 18-22 |
| San Francisco, CA | VCR | July 18-22 |
| St. Charles, IL | CD | August 2-3 & 5-6 |
| Tacoma, WA | CD | July 29-30 |
| Syracuse, NY | VCR | August 22-26 |
| Jacksonville, FL | CD | May 20-21 |



Your VA62 Universal Video Analyzer Is The Key To Success In Video Servicing

by Greg Carey, Applications Engineer, CET

Why Your VA62 Universal Video Analyzer Is The Key To Success In Video Servicing

The VA62 provides universal troubleshooting answers for any circuit based on the National Television Systems Committee (NTSC) standard. The VA62 has all of the signals needed to do a complete performance test to identify every symptom associated with a problem. It then provides all the signals, measurements, and special tests needed to quickly isolate any defective stage using functional analyzing and signal substitution.

By itself, the VA62 provides more troubleshooting capabilities than any other piece of video test equipment. Optional accessories expand its capabilities even farther. These accessories are especially helpful when you

Modern video circuits are tougher to troubleshoot than those of a few years ago. Today, we have large-scale integrated circuits (LSI), unitized single-board construction, and new circuits which squeeze every last bit of quality from the NTSC television signal. Some technologies did not even exist a few years ago, such as Video Cassette Recorders (VCRs), Multichannel Television Sound (MTS stereo), and high resolution monitors with separate inputs for the red, green, and blue (RGB) signals.

“
A new Sencore video tape, “Successful Video Servicing”, is now available. The tape explains each VA62 function and shows how its exclusive features simplify video service. Call 1-800-843-3338 and ask your Area Sales Engineer about this informative video tape.”

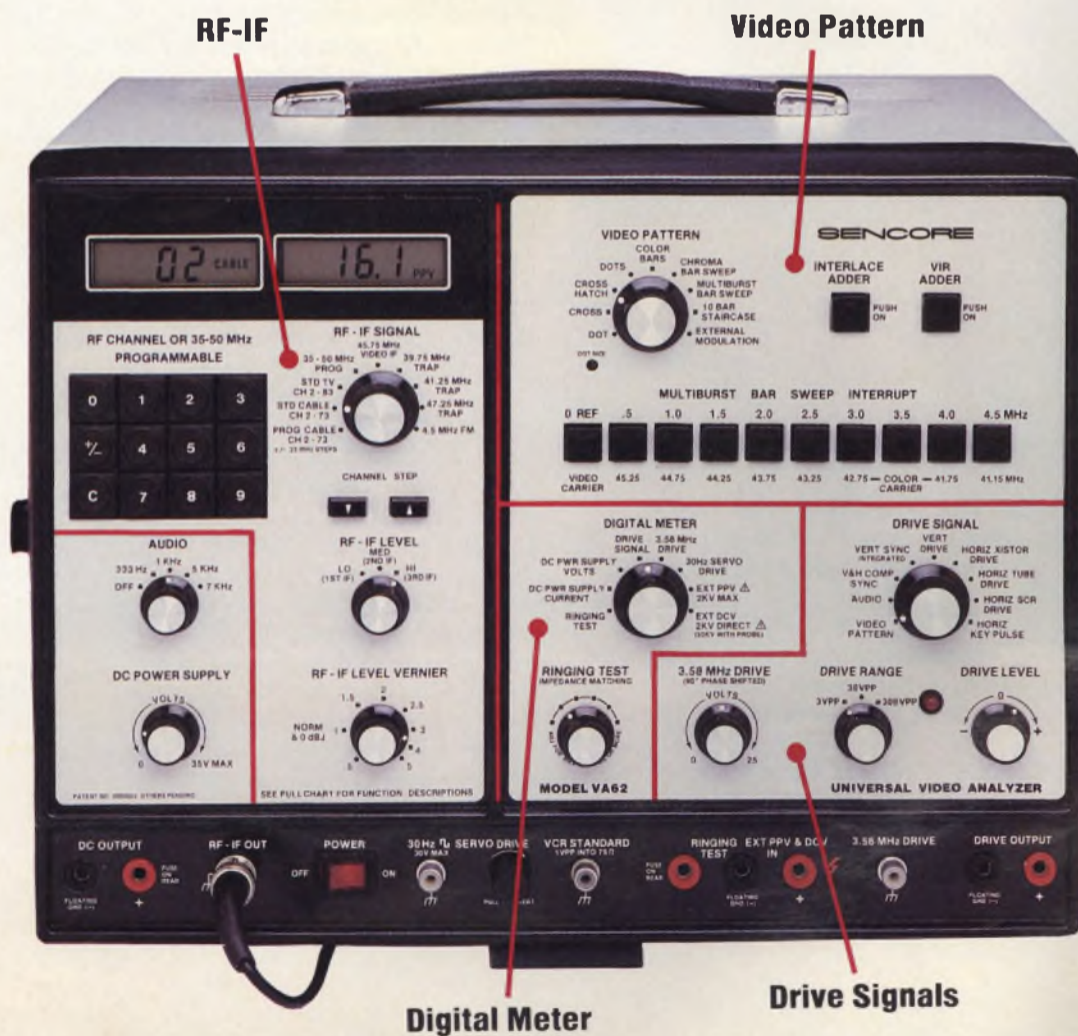


Fig. 1: The easiest way to learn to use the VA62 Universal Video Analyzer is to think in terms of its four main operating functions: RF-IF, Video Patterns, Digital Meter, and Drive Signals.

specialize in VCRs, computer monitors, or stereo receivers.

It's easier to understand the VA62 when you think of its front panel as being divided into four main sections:

1. The RF-IF generator
2. The video pattern generator
3. The drive signal section
4. The digital meter

You Can Solve Tuner And IF Troubles Faster With The VA62's RF-IF Signals

The VA62's RF signals provide two important functions:

1. You can run a complete performance test without removing the back of the set.
2. You can identify whether a front-end problem is caused by a bad tuner or by supporting circuits, such as the tuner control module, the automatic gain control (AGC) or the automatic fine tuning (AFT) circuits.

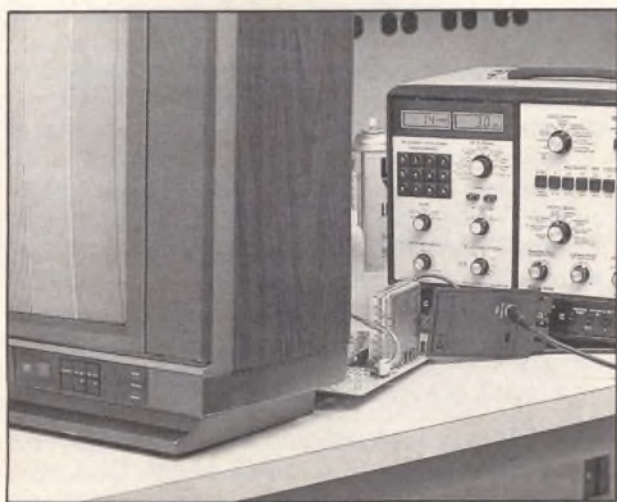


Fig. 2: The VA62's all-channel RF generator quickly tells you whether a problem is in the tuner or the tuner-control module when testing digital, cable-ready tuners.

Most TVs and VCRs now use digital tuners. Unlike conventional tuners, digital tuners can miss a single channel, or a group of channels. The only way to confirm this is to check each and every channel.

In addition, many digital tuners can receive the special channels used by cable TV systems. Here too, the ability to duplicate every channel is important to confirm that all work well.

Some cable channels are at different frequencies than used by over-the-air stations. This calls for a wider AFT tuning range. The ability to duplicate the shift found on any cable channel becomes an important factor if you want to confirm the TV or VCR will work correctly when your customer puts it back into operation.

The VA62's RF generator provides all channels, including VHF, UHF, and cable channels. It has programmable shifting to let you duplicate any cable channel.

Using The RF Generator To Solve Channel Troubles

Selecting RF channels on your VA62 is about the same as selecting channels on a digital tuner. You can randomly select channels by entering two

numbers into the digital keypad, or you can select channels in sequence with the "CHANNEL STEP" buttons.

The channel format is selected by the setting of the RF-IF SIGNAL switch. There are three RF functions:

1. Standard TV
2. Standard Cable
3. Programmable Cable

"Standard TV" provides all "over-the-air" channels. You can confirm that a tuner does not miss individual channels or bands of channels by simply stepping through all channels in succession. You might note that most newer tuners will not pick up UHF channels above channel 69, since the FCC no longer assigns stations from channels 70 through 82. The VA62, however, does produce these top channels, to let you find problems which may appear at the ends of tuning ranges.

"Standard Cable" channels 2 through 13 are exactly the same as the "Standard TV" function. The difference is in channels 14 through 73. These channels produce the midband, superband, and hyperband channels selected by "cable ready" tuners. The VA62's microprocessor automatically takes care of band switching as you move through the channels.

"Programmable Cable" provides the same channel designations as the "Standard Cable" function with one main difference. You can change the carrier frequency of the channels to agree with cable systems which use shifted carriers. This lets you confirm that the tuner's automatic fine tuning circuits are capable of tuning the cable channels.

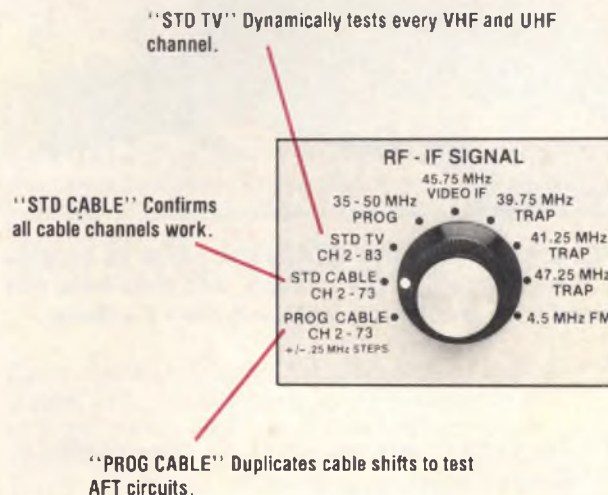


Fig. 3: The three RF generators help you quickly isolate any problem related to a tuner on tuner-control circuit.

Programming is normally done one time. Frequency shifts that you select are retained in the VA62's memory (even when power is removed). You can program the same shift in all the channels, or you can shift each channel by a different amount. You enter a shift by pressing the \pm key, and then entering three digits into the keypad to indicate the amount of shift you want. For example, entering the numbers 1, 2, and 5 will shift the frequency by 1.25 MHz from the normal carrier frequency.

Cable TV Has Made Performance Testing And Setting Traps More Important

Troubleshooting the IF

TV and VCR IF stages have always been difficult to troubleshoot. Scopes don't usually do you much good, since few are capable of locking to the 45.75 MHz, amplitude-modulated signal. Even if you get your scope to lock, you don't have schematic waveforms for comparison. Plus, many of the high frequency test points are affected by loading, so they don't really show what's happening in the circuit.

The VA62's IF generator makes all IF stages look alike, for increased troubleshooting effectiveness. When you select the "Video IF" position of the RF-IF SIGNAL switch, the VA62 produces a crystal-controlled, 45.75 MHz carrier, which is amplitude modulated with the video pattern you've selected. The signal is available at the correct amplitude for the first, second, or third IF stage, as shown on the front panel, by the setting of the RF-IF LEVEL switch.

The VA62 lets you inject "known-good" signals anywhere from the tuner output to the video detector. If you see the VA62's signal come through to the picture tube, you know that every stage from your injection point to the output works correctly.

Setting Traps

Cable TV has made trap setting more important than in the past, since nearly every channel has an adjacent sound and an adjacent video carrier which can cause interference. The VA62 uses two carriers to let you make accurate trap adjustments while watching the results on the TV screen. The first carrier has a fixed amplitude of 1000 microvolts. Video modulation on this signal causes the AGC circuits to lock to a fixed level, without the need for an external bias supply. The second signal is a crystal-referenced duplicate of the carrier that a trap should reject. The second signal amplitude is variable from less than 100 microvolts to 500,000 microvolts.

To adjust the trap, set the VA62 to the frequency for the trap you want to adjust. Then, turn the output controls to their lowest level. Slowly increase the signal level until you see a small amount of interference in the picture. Adjust the trap coil until the interference is at its lowest level. This is the best setting of the trap.

You Can Troubleshoot Video Circuits Faster With The VA62's Video Patterns

You get information about the quality of the TV or VCR circuits by examining the VA62 Video patterns on a TV screen. This speeds the troubleshooting of nearly any problem.

Two of the patterns help find problems in the luminance circuits; the others are for testing the color circuits. The video pattern generator feeds to all of the VA62 outputs, including the RF-IF generators, the drive signals, the VCR standard output, and the external accessories.

The luminance patterns dynamically test conventional video amplifiers and IF stages as well as the new, high performance circuits. For example, comb filters give expanded video bandwidth, but need properly phased video

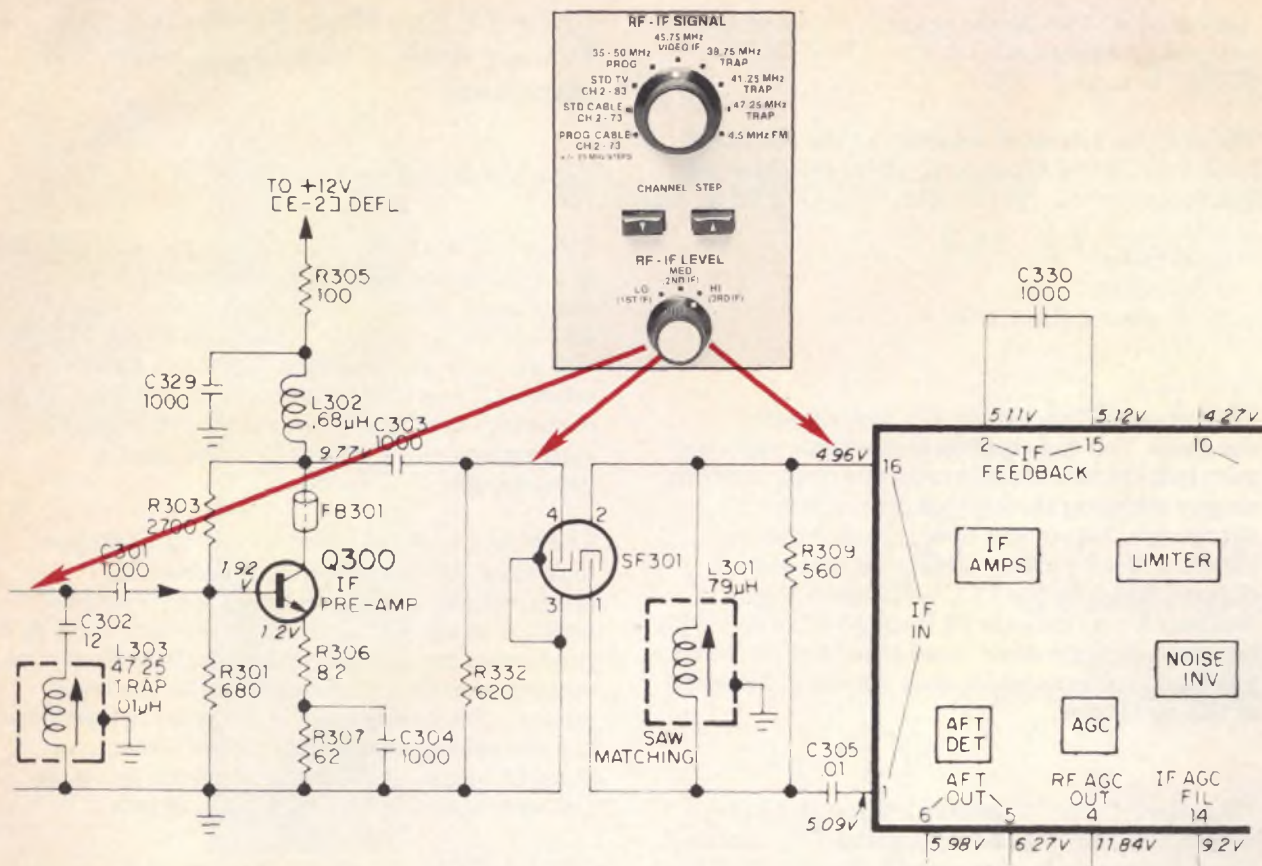


Fig. 4: You inject the VA62 IF signal into IF test points, and then watch the TV screen to see whether the circuits work correctly.

signals for testing. Synchronous video detectors also provide improved performance, but you need special video patterns to adjust them for best output. Newer VCR formats, like "HQ", Super Beta, and Super VHS, produce improved luminance resolution, and need special test patterns to confirm they are working correctly.

Testing Frequency Response:

The Multiburst Barsweep pattern tests the video circuits at ten different frequencies, ranging from one-half megahertz to 4.5 megahertz. All of the bars are produced at the same amplitude, so that any circuit which restricts bandwidth causes their relative amplitude to change. Confirm proper bandwidth by watching the TV screen to see which bars display resolution, in the form of vertical stripes, as you substitute signals into various stages.

The Multiburst Barsweep has enough bandwidth, 4.5 MHz, to test even the latest video circuits, like comb filters and high resolution VCRs.

Testing Dynamic Operating Range:

The 10-Bar Staircase tests the video circuits dynamic operating range. This pattern consists of 10 steps, ranging from pure black to 100% white. A video stage which restricts brightness or contrast will cause one or more of the different levels to blend into its neighbor. Use this pattern to define the problem, and then watch for an improvement as you substitute signals stage by stage.

Six Test Patterns Simplify Your Color Troubleshooting And Convergence Adjustments

The other six video patterns provide full testing of the color circuits.



Fig. 5: The innovative VA62 video patterns provide a complete test of the circuits, and then help you isolate the problem by watching the TV screen.

1. "Single Dot" lets you set static convergence.
2. "Single Cross" lets you center yokes.
3. "Crosshatch" lets you check linearity.
4. "Dots" let you set dynamic convergence.

These are controlled by the DOT SIZE control, so you can make the dots or lines as wide or as narrow as you like.

5. "Color Bars" pattern is an improved version of the popular 10-bar, gated-rainbow pattern invented by RCA. Three improvements bring this pattern up-to-date for the latest video technology. Increased color saturation and a true 3.58 MHz color burst make the pattern work better with VCR circuits. Proper locking between the phase of the color subcarrier and the horizontal sync pulses let the pattern pass correctly through phase-sensitive comb filters.

The "Color Bars" pattern tests two of the three parameters which affect color quality: phase and amplitude. But, no color-bar pattern does a good

job of testing for proper chroma bandwidth. That's the reason for the "Chroma Bar Sweep" pattern.

6. "Chroma Bar Sweep" has three color test bars set on a background of 100% white. The white provides the correct peak-to-peak signal levels when testing the recording circuits of VCRs. The three bars then test the chroma circuits.

The center bar is the cyan bar of the EIA RS189 color bar pattern (sometimes called the "NTSC" test pattern). The reason Sencore uses the cyan bar is that cyan is the only bar used for VCR color alignment procedures. Since the VA62 pattern exactly matches the "NTSC" pattern, you get the same results when setting adjustments.

But, this center bar has the same restriction as the bars of a conventional color-bar generator. The bar only needs about 100 kHz of chroma bandwidth, instead of the 1 MHz of bandwidth that a color chroma bandpass circuit should have. That's the reason for the other two bars.

The second bar is at 3.08 MHz, one-half megahertz below the frequency of the color subcarrier. The third bar is at 4.08 MHz, or one-half megahertz above the color subcarrier. Thus, a full megahertz of chroma bandwidth is needed to display all three of the Chroma Bar Sweep bars with the same color saturation.

Any of the video patterns can be modified by two "adders", which let you add interlace or VIR signals for special tests.

The video patterns modulate the RF and the IF signal generators to let you test or troubleshoot RF and IF problems. You inject known-good signals into any stage you think may have a problem, and then look at the TV screen to see if the original symptoms improve. The drive signals let you do exactly the same thing when the problem is in a circuit after the video or audio detector.

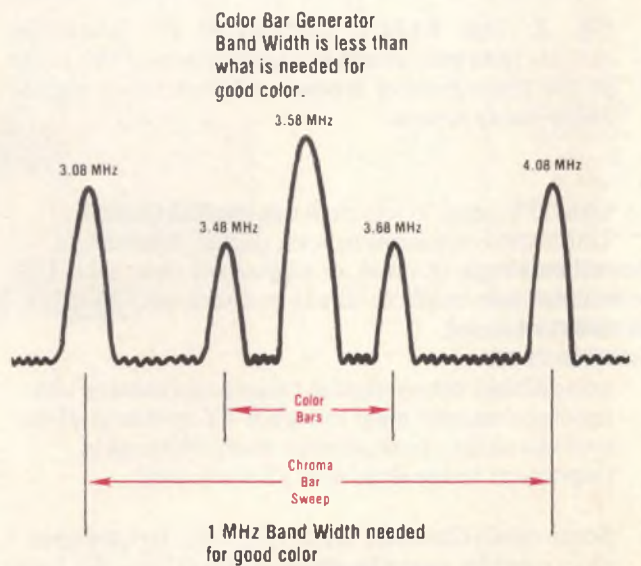


Fig. 6: The Chroma Bar Sweep tests color circuits to a full 1 MHz bandwidth, while a color-bar generator tests to only 100 kHz.

Phase Locked Drive Signals Help You Isolate Bad Stages In Minutes

Functional analyzing calls for a duplicate of every signal found in the circuits you are troubleshooting. The substitute signal needs the correct waveshape to replace the circuit signals. It must be adjustable in amplitude from a few tenths of a volt for integrated circuits, to several hundred volts to feed into a picture tube. Proper phasing is needed when feeding into sweep, sync,

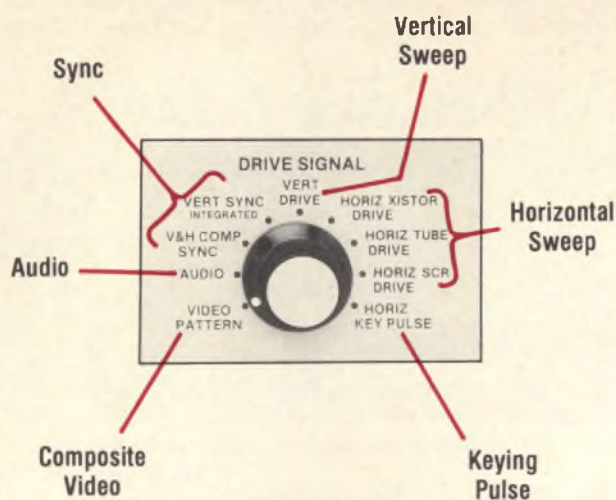


Fig. 7: You do not need to disconnect components when injecting the VA62 substitute signals into any of the stages after the detector.

or color circuits. The substitute signals should also be floating from ground, to allow injection into non-grounded test points.

The VA62 drive signals let you feed into any stage after the detector. The signals are supplied in three drive ranges: 3,30, and 300 volts peak-to-peak, with full adjustment from zero to the maximum output. Both positive and negative phases are available, letting you inject at the input and the output of an inverter stage. Each signal is phase-locked to all of the other VA62 signals, to bring back proper sync and color timing.

A unique feature of the VA62 drive signals is swamping. Swamping means you can inject the VA62 signals right over the top of the signals already in the circuit without disconnecting components. The VA62 takes control of the circuit, so all you need to do is watch the TV screen to see whether the original symptom has improved. (By the way, you must leave the VA62's RF cable connected to the antenna input to keep all of the good circuits in sync while you inject into one suspected bad stage at a time.)

Fig. 7 shows the drive controls. Notice that you have signals for video, sync, and sweep stages on the main drive signal switch. Separate drive outputs let you feed color circuits and VCR circuits for even higher effectiveness. All outputs swamp existing circuits, and all are phase-locked to each other.

The Digital Meter Makes The VA62 A Complete Analyzer By Complimenting All Of The Driving Signals.

The VA62's digital meter works directly with the drive signals, letting you monitor the true peak-to-peak levels of each of the drive outputs. The readings let you set the drive outputs for the same level normally found in the circuits. The drive monitors show a drop in level when you feed a shorted component; this often leads you right to the bad part.

Since deflection yokes and flyback transformers often fail, the second function of the digital meter is an accurate test of these components. Sencore's time-tested Ringer circuit gives direct good/bad results on flybacks and yokes. All you need to remember is the number 10, since good coils show readings larger than 10, and bad ones show number smaller than 10.

The DC function lets you quickly find power supply and bias problems. You also use the DC function to test high voltage triplers and integrated high voltage transformers (IHVTs). These components are tested by feeding a signal from the drive output into their input while monitoring the resulting DC voltage that is produced at the high voltage lead.

You can also measure high DC levels with optional probes. The TP212 takes your VA62 meter to 10,000 volts for focus voltages (you also need this probe to test triplers and IHVTs), and the HP200 extends the input range to a full 50,000 volts for second anode testing.

The digital meter lets you measure the peak-to-peak level of any signal in a TV or VCR. This lets you "gang up" on a problem by injecting signals at one point while you are monitoring the results at another.

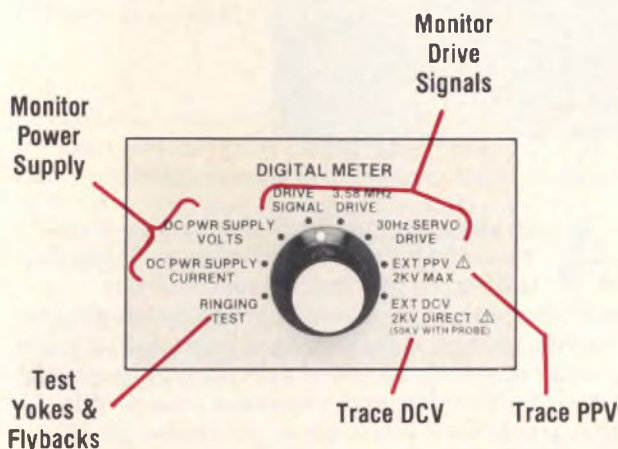


Fig. 8: The VA62's digital meter rounds it out to a complete analyzer, with both signal injection and measuring capabilities.

All of the features we've covered so far are part of the main analyzer. These features already take you farther than any other video servicing instrument. But, optional accessories let you expand the VA62 for even higher effectiveness.

Each of the optional VA62 accessories is phase-locked to the VA62 signals, so it operates just as though it were built into the main instrument. The accessories also provide swamping, so that you use the same effective procedures for each troubleshooting step.

VC63 VCR Test Accessory:

This unit provides the special FM signals needed to use signal substitution in VCR playback circuits. Its exclusive "Head Sub" test lets you quickly confirm whether poor playback is caused by bad heads or one of the other circuits in the luminance path.

NT64 "NTSC Pattern Generator"

The NT64 provides the "NTSC" patterns required by a few VCR manufacturers for warranty service authorization. The NT64

receives signals from the VA62, which means that the patterns fed back to the VA62's external modulation jack will be phase locked to all of the other VA62 signals. The NT64 provides both standard color-bar patterns; the full field and the split field pattern.

ST65 "MTS Stereo Adder"

The ST65 provides all the signals needed to test or troubleshoot MTS stereo circuits. The ST65 obtains video from the VA62, which phase-locks its output to the other VA62 signals. It has its own RF and IF signal source for isolating problems in the front end of stereo TVs or VCRs. It duplicates normal MTS companding curves, allowing dynamic testing of the MTS stereo circuits.

RG67 NTSC Video Monitor Adapter

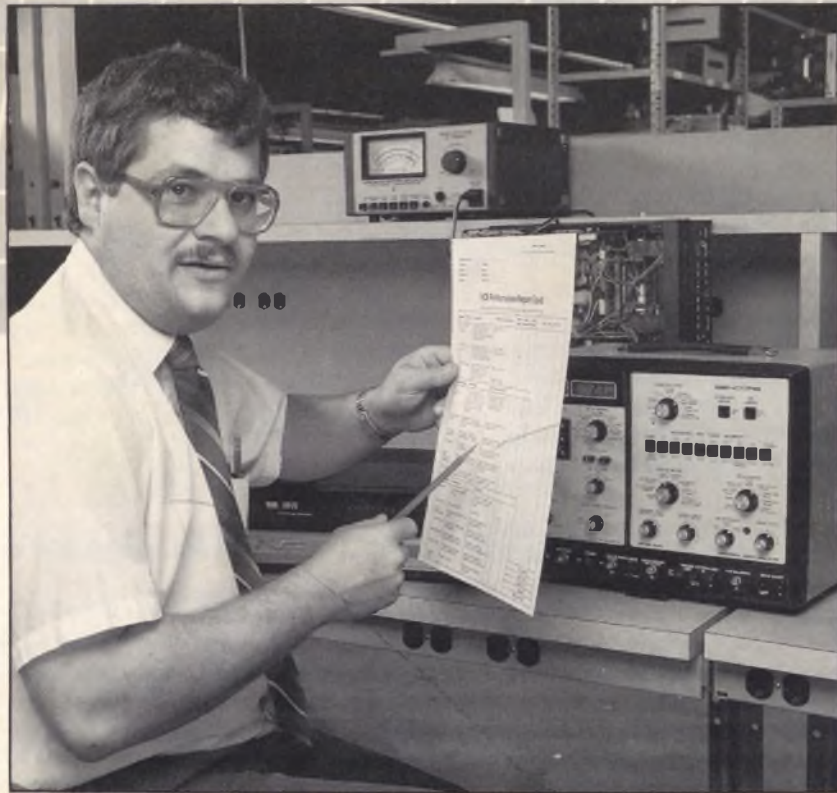
The RG67 expands the VA62 into an analyzer for testing RGB computer monitors. The RG67 drives digital or analog monitors. It provides separate outputs for the red, green, and blue video channels, and also provides all versions of sync drive. The sync may be added to any of the color signals, or supplied as composite sync, or separate vertical and horizontal sync. The polarities of any of the signals can be reversed in reference to all others to match the input of any RGB system capable of operating with a horizontal sweep frequency of 15.7 kHz.



Fig. 9: The optional, phase-locked accessories let you expand the capabilities of your VA62 for whatever video service you want.

It's Easy To Learn Video Troubleshooting With The VA62 Universal Video Analyzer

You can use the "Simplified Operating Guide" to learn the VA62 a stage at a time in TV service. The new video tape "Successful Video Servicing" gives a complete front-panel familiarization of the unit. And, Tech Tips cover many of the special tests and functions of the VA62 and its accessories. For more details, call your Telemarketing Engineer, WATS FREE 1-800-843-3338. ■



Increase Your Profits With The All-New VCR Proof Of Performance Report Card

by Paul Nies, Applications Engineer

Performance Tests Help You Know Where To Start Troubleshooting

The key to a profitable repair is analyzing the symptom quickly and accurately to get started off on the right path. But often the right path isn't obvious because a customer's complaint is vague or uncertain. Sometimes symptoms are inter-related. For example a record problem may lie within the playback circuits. Yet the customer complaint is "won't record". The performance tests listed on the VCR Performance Report Card are the first step in the process of functional analyzing. They lead you to one of the paths on the "Sencore VCR Functional Analyzing Troubleshooting Guide", Figure 2, or to another major problem area of Tuner/IFs, Video In & RF Out circuits, or interchangeability.

Ask any growing, profitable service shop what the secret to success is, and they will tell you to concentrate on customer satisfaction and work very hard to produce high-quality repairs. Anything that helps you increase customer satisfaction and provide higher-quality repairs will undoubtedly increase your profits. In this article we'll introduce to you a new profit-building aid, Sencore's VCR Performance Report Card.

“The Performance Report Card helps bring your shop more profits by increasing customer satisfaction...”

The VCR Performance Report Card helps you analyze VCRs by using many of the tests provided by your VA62 Video Analyzer. This VCR Performance Report Card can help your shop increase profits in two ways. First, it provides a means of improving your troubleshooting efficiency. As a troubleshooting aid it can help you get started on the correct path, and also tell you when the repair is complete. Secondly, and most importantly, the Performance Report Card helps bring your shop increased profits by increasing customer satisfaction. Let's see how the VCR Performance Report Card can do this for you.

| VCR Performance Report Card | | | |
|--|---|--|----------------------------------|
| All video and RF signals provided by the VA62 Video Analyzer | | | |
| Video In & RF Out | Instructions | RF Monitor Should Show: | Repairs Required: Alter Repairs: |
| TV/VCR RF Switch | Set TV/VCR switch to "TV". Inject Multiburst Bar Sweep on Ch 6 to RF INPUT. Set monitor to Ch 6. | Clear picture. | |
| VIDEO OUT Level | Set VCR for LINE input. Connect "VCR Standard" to VIDEO IN. Scope across terminated VIDEO OUT. | 1.0 ± 1 VPP All bars within 10%. | |
| RF Modulator | Set TV/VCR switch to VCR. Set modulator to Ch 3 & tune RF monitor to Ch 3. Repeat with Ch 4. | Detail to 3.0 MHz. Detail to 3.0 MHz. | |
| Tuner/IF Stages | Instructions | Monitor Should Show: | |
| Tuner operation | TUNERLINE switch to tuner. VCR TV switch to VCR RF LEVEL to "HI" & VERNIER to "1" (1000uV). Check each VHF & UHF channel. | Good picture unless over-driven by local station. Locked in sync & color. Snow free picture. | |
| Cable Ready Tuner | As above except check cable channels & HRC/ICC offsets. | Same picture quality as non-shifted channels. | |
| Low-level Sensitivity | RF LEVEL to "MED" & VERNIER to "1" (100uV). | Snowy picture. Locked in sync. Noisy color. | |
| RF/IF AGC | RF LEVEL to "HI" & VERNIER to "5" (5000uV). | No picture. | |
| RF/IF Frequency Response | Feed in Multiburst Bar Sweep. | | |

Fig. 1: Learn how this new VCR Performance Report Card can increase your profits.

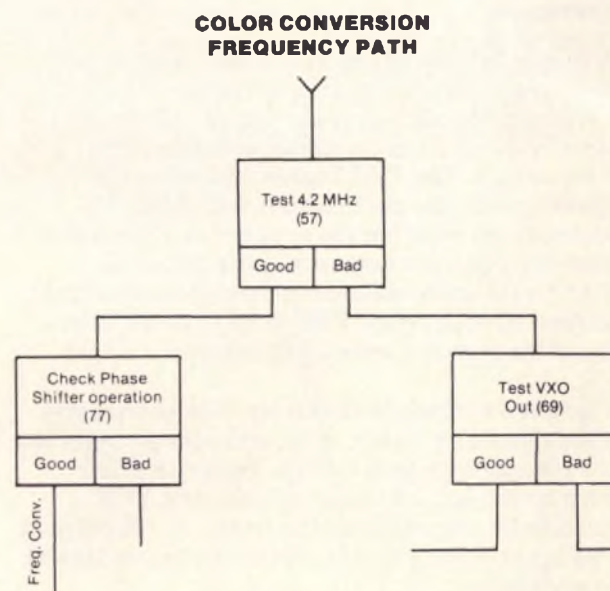


Fig. 2: The performance tests listed on the VCR Performance Report Card will lead you to one of the main symptoms listed on the Sencore VCR Functional Analyzing Troubleshooting Guide.

Performance Tests Tell You When You've Completed The Job

When servicing machines as complex as VCRs, you cannot assume that the VCR will work simply because you've found and repaired a defect. Never assume that you've fixed a VCR — always prove it. Your customer would not be too satisfied if, for example, you removed the jammed tape, but failed to performance test the machine and find the clogged video heads. The customer takes the VCR home, calls his friends over to watch a tape and then finds that it only plays back snow. Not only do you have a call back, you also have an irate customer!

A Written Performance Test Record Tells Your Customer You Care

The written record of the performance tests provided by the Report Card helps increase your profits by increasing your customer's awareness of the quality repair job you've performed. The Report Card tells your customer that you have enough confidence in your work to scrutinize it and give a written report. Your customer knows that you care enough to make sure that he gets a working VCR, and that he doesn't need to worry about a callback. The Report Card gives him all the information about his VCR on one single document, including what was wrong, the repairs that were completed, and the condition of the VCR after repair.

| VCR Performance Report Card | | | | | |
|--|--|--|------------------|--------------|-------------------|
| All video and RF signals provided by the VA62 Video Analyzer | | | | | |
| Video In & RF Out | Instructions | RF Monitor Should Show | Repairs Required | After Repair | Parts, Labor, and |
| TV/VCR RF Switch | Set TV/VCR switch to "TV". Inject "Multiburst Bar Sweep" on Ch 6 to RF INPUT. Set monitor to Ch 6. | Clear picture | | ✓ | |
| VIDEO OUT Level | Set VCR for LINE input. Connect "VCR Standard" to VIDEO IN. Scope across terminated VIDEO OUT? | 1.0 ± 1 VPP. All bars within 10%. | | ✓ | |
| RF Modulator | Set TV/VCR switch to VCR. Set modulator to Ch 3 & tune RF monitor to Ch 3. Repeat with Ch 4. | Detail to 3.0 MHz. Detail to 3.0 MHz. | | ✓ | |
| Tuner/IF Stages | | | | | |
| Tuner operation | TUNER/LINE switch to tuner. VCR/TV switch to VCR. VERNIER to "1" (1000uV). Check each VHF & UHF channel. | Good picture unless over-driven by local station. Locked on sync & color. Snow free picture. | | ✓ | |
| Cable Ready Tuner | As above except check cable channels & HRC/CC offsets. | Same picture quality as non-shifted channels. | | ✓ | |
| Low Level Sensitivity | RF LEVEL to "MED" & VERNIER to "1" (100uV). | Snowy picture. Locked in sync. | | ✓ | |

Fig. 3: The VCR Performance Report Card gives your customer complete information about his VCR.

Earn Extra Profits By Performing A Service For Your Customer

If you are like most good servicers, you may already be performance testing your repairs before they leave the shop. If so, why not check off each test on the Report Card as you complete it, then add a small charge for the service to bring in some extra profit. Many VA62 owners give their customers a "TV Performance Report Card" and charge \$12 for the service. In this way they defray the cost of test equipment.

| VCR Perf | | |
|-------------------|--|-----------------------------------|
| All video and RF | | |
| Video In & RF Out | Instructions | RF M |
| TV/VCR RF Switch | Set TV/VCR switch to "TV". Inject "Multiburst Bar Sweep" on Ch 6 to RF INPUT. Set monitor to Ch 6. | Clear |
| VIDEO OUT Level | Set VCR for LINE input. Connect "VCR Standard" to VIDEO IN. Scope across terminated VIDEO OUT? | 1.0 ± 1 VPP. All bars within 10%. |
| RF Modulator | Set TV/VCR switch to VCR. Set modulator to Ch 3 & tune RF monitor to Ch 3. Repeat with Ch 4. | Detail to 3.0 MHz. |

Fig. 4: The first group of performance tests on the VCR Performance Report Card confirm the operation of video input, and output circuits as well as the RF modulator and output. Confirm the operation of these stages before doing any other performance tests.

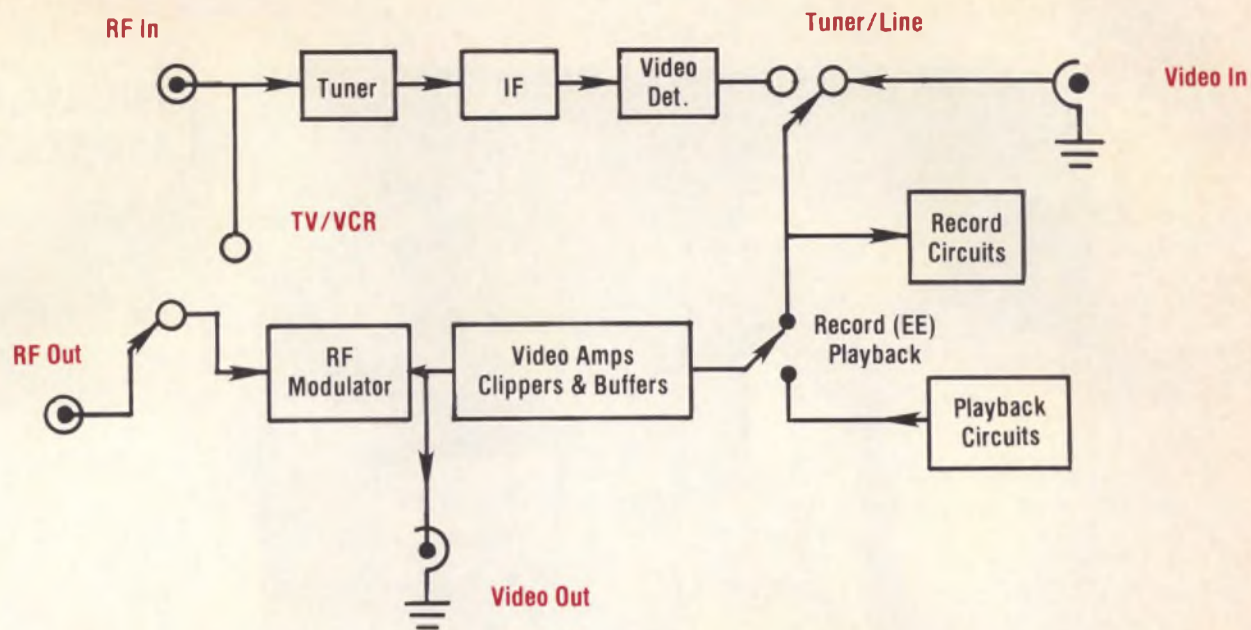


Fig. 5: The video inout and RF inout stages must function correctly before the remaining VCR circuits can be tested. The first group of performance tests on the Performance Report Card check the operation of these important stages.

If your shop experiences seasonal slow periods, why not use the VCR Performance Report Card as a promotional item to bring in more business? Whatever way you choose to use it, the VCR Performance Report Card can help your shop earn extra profits.

To help you better understand the VCR Performance Report Card, let's run through several tests using the VA62 Video Analyzer.

Isolating A Trouble With The Video/RF Output Circuit Performance Test

The first group of performance tests on the Report card (Figure 4) check the operation of the video input and output circuits (sometimes called "E to E" mode) and the RF modulator. A typical block diagram of these circuits is shown in figure 5. These tests can be an especially important first step when troubleshooting "snow on playback" problems, as the following example illustrates.

A VCR comes into your shop with the customer stating that "the machine only plays back snow". Where do you begin your troubleshooting? Possible problems with the VCR include the playback luminance circuits, an interchangeability problem, a servo problem, or a problem with the video out/RF circuits. Only one of these paths leads to the problem, the others lead to a dead end.

The first performance test checks the RF switching and the RF output jack. Failures here prevent the RF signal from getting to the monitor. To test these stages, feed a modulated RF signal from the VA62 into the VCR's RF INPUT. Connect a television monitor to the VCR's RF OUTPUT jack and tune the television monitor to the same channel as the VA62. Use a channel other than one produced by the VCR's RF modulator to insure that the RF input is being routed through the RF OUTPUT jack, rather than being received and converted to another channel by the VCR. You should see a clear picture on the television monitor. Our VCR passes this part of the test.

A performance test of the VIDEO OUT signal will confirm if the video amps are functioning properly. To test the video amps, connect the VA62 VCR STANDARD output to the VCR's VIDEO INPUT. Then monitor the signal at the VIDEO OUT jack with a scope. Look for a signal

that is 1 VPP with no distortion. Remember to connect a 75 ohm resistor across the VIDEO OUT jack, as shown in figure 7, in order to properly terminate the output. Without the terminating resistor, the output signal will be the wrong amplitude and distorted even if the circuits are working properly. In our example the signal at the VIDEO OUT jack is correct, so we can move on.

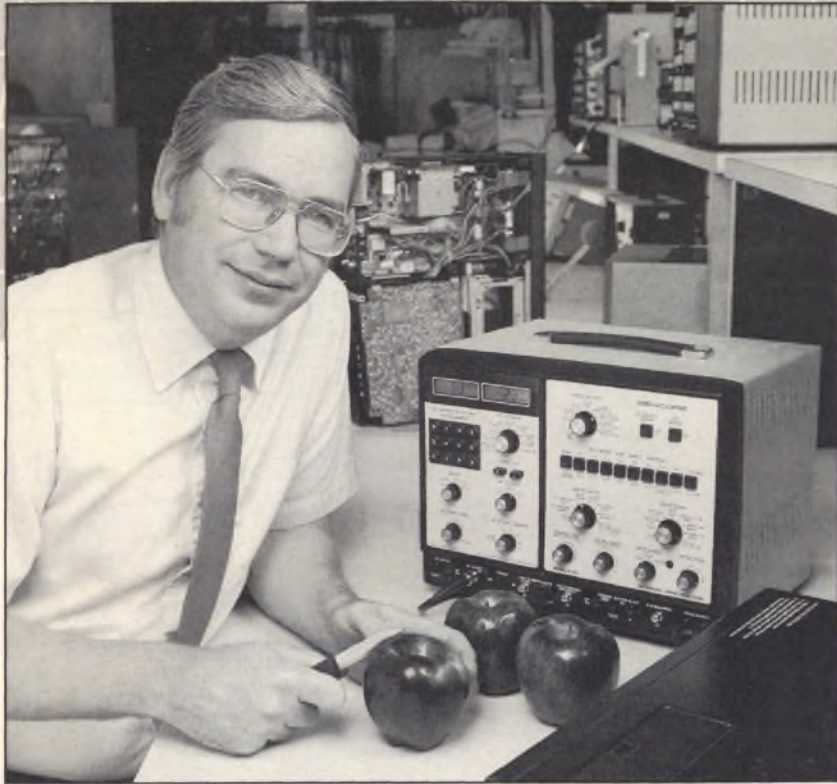
The last test in this group of tests is to performance test the RF modulator. Check the RF modulator by placing the VCR's "TV/VCR" switch to "VCR" with the VA62 VCR STANDARD connected to the VIDEO IN jack. This routes the video signal to the RF modulator, as figure 5 shows. Tune the television monitor to the same channel as the VCR's modulator output. The monitor should show the video pattern applied to the VCR's VIDEO IN jack. But, in our example VCR, the monitor continues to show snow. We've found the problem, the modulator is not producing an output.

NOTE: Be sure that the response of the television monitor is greater than 3.0 MHz. To confirm this, feed the VA62 RF signal directly into the monitor on the same channel as the RF output from the VCR's modulator.

(continued on page 12)



Fig. 6: Most VCR performance tests are done by using a television receiver connected to the VCR's output. Be sure that the television has a good tuner and frequency response.



Divide And Conquer VCRs With Your VA62 Universal Video Analyzer™

by Rick Meyer, Applications Engineer

Many Analyzing Techniques Rely On Guesswork

Popular troubleshooting methods are: signal tracing, component testing, and divide and conquer functional analyzing.

Signal tracing: Signal tracing is a valuable troubleshooting method. However, you must know exactly what the voltages and waveforms are at each test point. Unfortunately, you often don't have the schematic or the schematic doesn't show the voltage or waveform at the point you want to look at. You take a measurement and make an educated guess that the voltage or waveform is good or bad. If you guess right, your next step leads you closer to the problem. If you guess wrong, your next step turns a simple repair into a "tough dog".

Component testing: This method relies heavily on educated guesses. Based on the symptoms, you might say, "I think this is the bad part." You could be right! However, statistically there's not much chance. In theory, if you test enough components, you will eventually find the bad one.

Functional Analyzing Tests Circuits Rather Than Components

Divide and conquer functional analyzing: All systems are composed of subsystems; VCRs, as an example, have subsystems that perform specific functions (Figure 1). The luminance

“**S**tart by testing the functions of the major blocks, rather than looking at individual components. Use your VA62 to prove which stages are good. Once the good stages are confirmed, you've solved the problem.”

Whether you are an experienced television servicer or have just graduated from technical school, your training and experience in television technology has prepared you to service VCRs.

VCRs and TVs use similar circuits to process video and audio signals. This is why VCR servicing is a natural for the television servicer. The same substitute signals that you use for TV are also needed for VCRs, to service the tuner, IF, video detector, luminance, color, audio detector, audio, sync, and control circuits.

In this article, we'll show you how to use your VA62 Universal Video Analyzer's RF, video, and drive signals to speed VCR service. But first, let's look at troubleshooting methods and examine the one that is guaranteed to bring you success — divide and conquer functional analyzing.

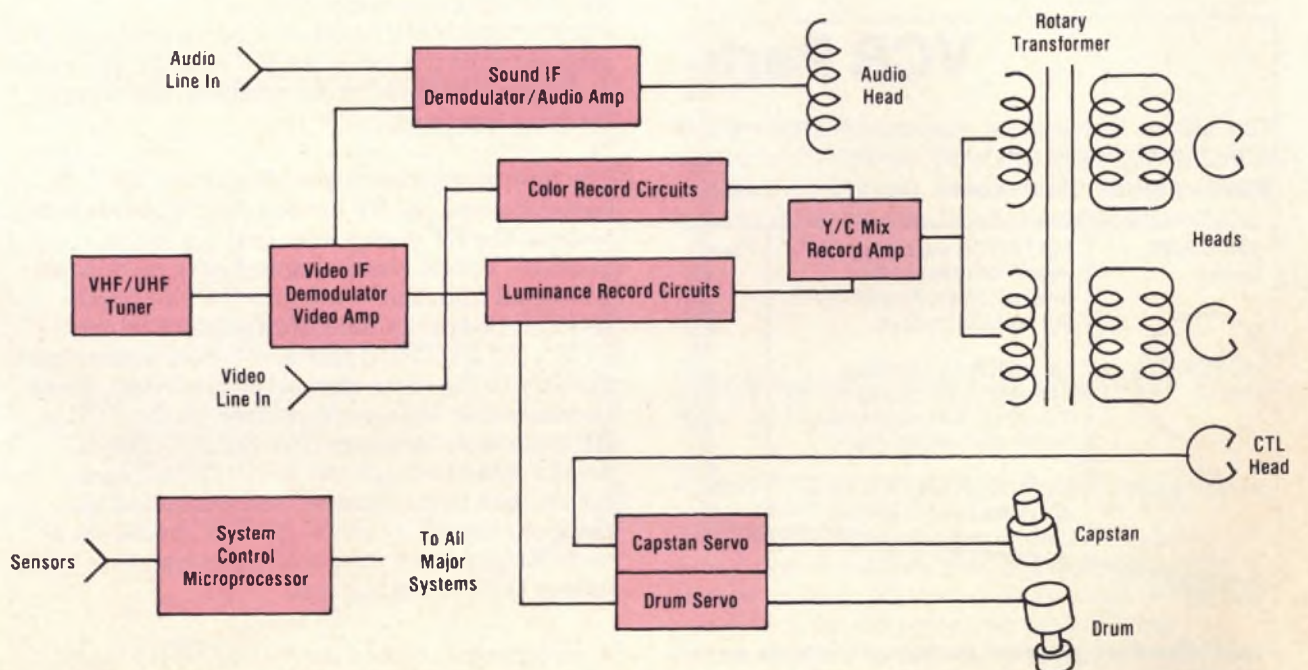


Fig. 1: A VCR uses different groups of circuits to perform specific functions. Your VA62 Universal Video Analyzer provides the signals needed to prove which circuits are good.

circuits process black and white video information, while the chrominance circuits process color. The servos control the capstan and cylinder speed. Each subsystem, or set of circuits, is designed to perform a specific function.

Functional analyzing uses a combination of signal injection, signal tracing, and component testing, all done in a logical sequence. You start by testing the *functions* of the major functional blocks, rather than looking at individual components. In this way, large numbers of components are quickly eliminated from suspicion. Functional analyzing differs from other troubleshooting methods in that the first step is not proving which stages are bad, but rather, confirming which stages are good.

Once the good stages are confirmed, they are no longer of concern. The number of questionable stages is systematically reduced until the bad stage is found. Once the bad stage is located, signal tracing and component testing quickly identifies the problem within the few remaining components.

Speed in functional analyzing is achieved when you keep the number of tests to a minimum. Divide functional circuits into various levels. For instance, you can view the VCR luminance system as extending from the tuner to the video heads or you can break it into smaller functional blocks (Figure 2).

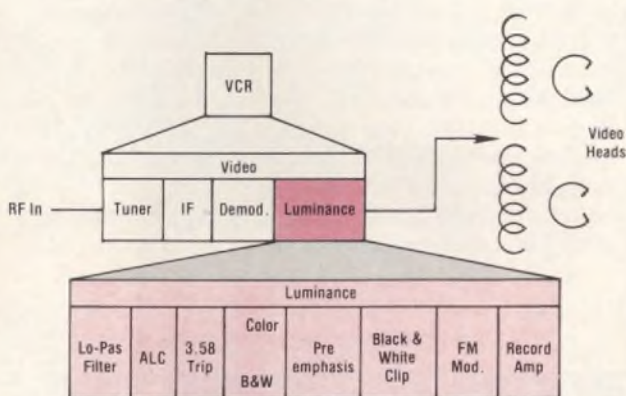


Fig. 2: You can troubleshoot faster by testing the largest functional block first - then test smaller functional circuits within the block.

Test the largest function block possible first. Each test thereafter breaks the system down into smaller functional blocks. Once you get to the smallest functional block, or circuit, only a few individual components remain to be tested.

The Divide & Conquer Technique Produces The Highest Troubleshooting Efficiency

Divide and conquer functional analyzing saves you time by minimizing the number of tests you need to make. Let's look at how the divide and conquer technique works to see why it saves troubleshooting time.

Think of the bad stage as a worm and the VCR as an apple. Your job is to locate the worm in the fewest number of steps. The "symptom" is the small hole on the outside of the apple. You don't know whether the worm turned to the left or right after it entered the apple. Did it go in only a short distance, or is it on the other side of the apple?

Using the "subtractive" method, you would start at the worm hole and slice out a small section of the apple. If the worm hole still exists in the remaining apple, you would slice out another section and continue to make slices until you

stumbled onto the worm. The number of slices needed depends on where the worm is and how small you make the slices.



Think of the bad stage . . .

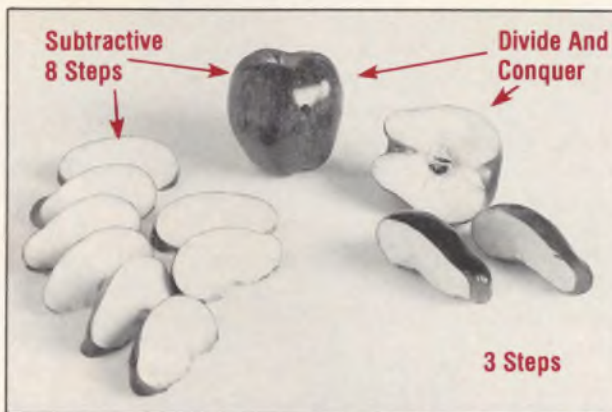


Fig. 3: The divide and conquer techniques cuts the apple in the largest possible pieces, to minimize the number of cuts needed.

The divide and conquer technique keeps your test sections as large as possible. It allows you to quickly whittle the sections down to the problem. In the example of the worm, if the worm were on the opposite side of the apple, the divide and conquer method could locate the worm in only 3 steps. The "subtractive" method, however, requires 8 steps.

In either case, of course, you could have cut the worm in half on the first try. This is just like stumbling across the circuit defect in a VCR on the first try.

Proper Tools And A Block Diagram Speed Functional Analyzing

To use divide and conquer functional analyzing to its best, you need a good functional block diagram. Some VCR manufacturers now supply functional block diagrams in their service literature. If the service literature does not have a block diagram, a universal block diagram, such as Sencore's Universal VCR Block Diagram (Form 3038), is useful. Always start with a block diagram so you stay away from checking components too early. By injecting a known good signal, you can tell if the circuits after your signal injection point are good. The individual parts are important only after you have identified the smallest bad functional stage.

TVs And VCRs Have Many Similar Signals.

Both VCRs and TVs convert a modulated RF signal into video, including color, and audio. In the case of a television, video is displayed on the CRT and audio is fed to the speakers. In a VCR, the video and audio are recorded on the video tape for future playback.

To better understand the signals needed to functional analyze a VCR, let's look at the different circuits or systems. VCRs have six major sections (Figure 4):

1. RF demodulation
2. Luminance processing
3. Chroma processing
4. Audio processing
5. Servo control of capstan and drum
6. Overall system control

VCR circuits, from the tuner to the video and sound detectors, are identical to television circuits. The VCR contains an all channel tuner which converts the RF to an IF signal. The IF section amplifies the signal and feeds it to the video detector. The detected signal is fed through filter, preemphasis, and clip circuits which prepare the signal for the FM modulator. The modulated FM is further amplified and fed to the video heads.

The signals in the luminance path, up to the FM modulator, are similar to a television receiver. Your VA62 signals allow you to functional analyze these circuits.

How To Use Divide And Conquer Functional Analyzing On A Typical VCR Problem

Let's look at a typical VCR trouble and see how divide and conquer functional analyzing with your VA62 Universal Video Analyzer saves time.

The symptom is: "doesn't record". First, do a general performance test. This verifies the customer complaint and gives you valuable information on where the problem lies. In fact, performance testing is the first test in functional analyzing. Consider the entire VCR as a functional system. Its function is to record and play back video and audio.

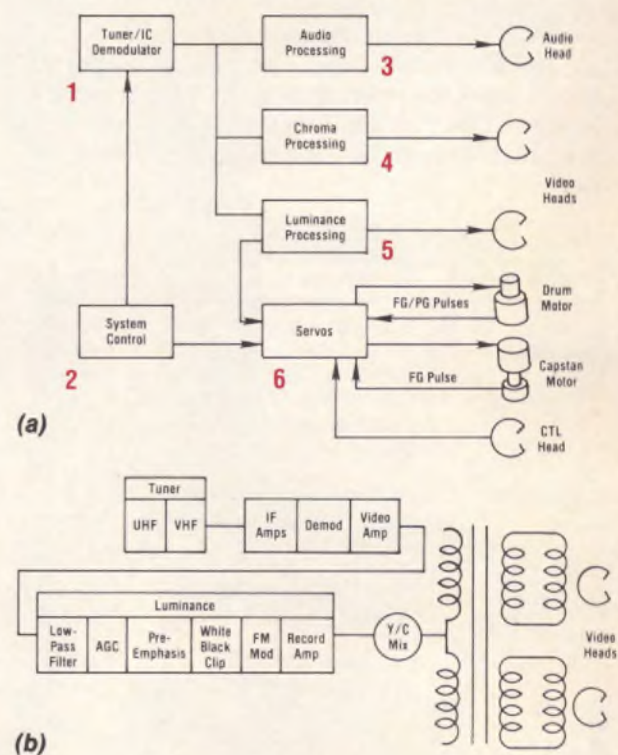


Fig. 4: (a) Six major systems make up a VCR. (b) Each major system is composed of several functional circuits.

Hook up a TV to the VCR and play a prerecorded test tape. If the VCR plays a prerecorded tape properly, a number of systems have been eliminated from your list of suspects. This VCR supplies good video, color and audio, telling us the following VCR circuits are good:

1. The system control (for playback) is working
2. The servo circuits are working
3. The video heads and rotary transformer are good
4. The video playback circuits are good
5. The audio playback circuits are good

Now, connect your VA62 to the antenna input terminals on the VCR. Select channel 3 on the

(continued on page 28)



Fig. 7: Always terminate the VIDEO OUTPUT jack with a 75 Ohm resistor. This correctly loads the signal and prevents overshoots and rolloffs.

From this short example you can see how the performance tests can be very useful for confirming and sorting out symptoms. By getting you started on the correct troubleshooting path the VCR Performance Report card can help increase your shops profits.

Performance Testing The Tuner and IF Stages

Let's look at some additional tests on the Performance Report Card. The tests shown in figure 8 check the operation of the VCR tuner and IF stages. The VA62 allows you to do a very quick and thorough performance test of these stages.

| Tuner/IF Stages | Instructions | Mon |
|--------------------------|--|----------------------------|
| Tuner operation | TUNER/LINE switch to tuner. VCR/TV switch to VCR RF LEVEL to "HI" & VERNIER to "1" (1000uV). Check each VHF & UHF channel. | Good drive Lock Snow |
| Cable Ready Tuner | As above except check cable channels & HRC/ICC offsets. | Same shift |
| Low-level Sensitivity | RF LEVEL to "MED" & VERNIER to "1" (100uV). | Snow sync |
| RF/IF AGC | RF LEVEL to "HI" & VERNIER to "5" (5000uV) | No p of pi |
| RF/IF Frequency Response | Feed in MULTIBURST BAR SWEEP pattern. Fine tune VCR | D |

Fig. 8: The VA62 allows you to quickly and thoroughly performance test a VCR's tuner and IF stages.

NOTE: A composite input video monitor may be used in place of a television monitor for this and the remaining performance tests. Composite video monitors usually have a better frequency response than television receivers. You can confirm the frequency response of the composite monitor by connecting it to the VA62 VCR STANDARD and selecting the MULTIBURST BAR SWEEP pattern.

The first performance test in this section checks basic tuner operation. If the VCR has a TUNER/LINE input select switch, begin by placing it in the "Tuner" position. VCRs without this switch automatically select the tuner input if

no connection is made to the VIDEO IN jack. Tune the television monitor to the same channel as the output of the VCR modulator (usually channel 3 or 4). Then set the VA62 RF output to 1000uV (RF/IF LEVEL "HI", RF/IF VERNIER "NORM") and the RF SIGNAL switch to "STD TV". Step through all the VHF and UHF channels on the VCR tuner and VA62, looking for a clear, snow-free picture on the television monitor.

Be sure to check the cable channels on "cable ready" VCRs. This is done by setting the VA62 RF/IF SIGNAL switch to "STD CABLE" and checking the cable channels 14 to 73 (or whatever channels the VCR tunes). Some "cable ready" VCRs have a switch which allows compatibility with HRC or ICC systems. To check HRC operation, set the VA62 to "PROG CABLE" and program a "-1.25 MHz" shift on several channels throughout the cable band. The VCR should tune those shifted channels. VCRs with "ICC" capability may also be checked by programming in the VA62 for the offsets shown in figure 9.

| Channel | ICC Frequency Shift |
|---------|--------------------------|
| | (MHz) |
| 2 | 0 |
| 3 | 0 |
| 4 | 0 |
| 4 + | 4 (+ 6.00) or 5 (- 4.00) |
| 5 | + 2.00 |
| 6 | + 2.00 |
| 7 | 0 |

Fig. 9: Program these offsets into the VA62 for checking VCRs which have ICC, cable channel tuners.

The next tuner/IF performance test checks low level sensitivity. With the VCR tuned to the VA62 RF output, reduce the VA62 RF level to 100 uV (RF/IF LEVEL "Med" & RF/IF LEVEL "NORM"). The monitor connected to the VCR RF output should continue to show a locked-in picture, although the picture may be snowy. Check sensitivity at several channels in each VHF, UHF and CATV band.

VCRs must also be able to handle very large signal levels. This is confirmed by the tuner/IF AGC test. This test is similar to the low level sensitivity test except the VA62 RF output is set to 5000uV (RF/IF LEVEL "Hi" & RF/IF VERNIER "5"). With this input level, the VCR should deliver a clear picture with no signs of tearing or overload.

The tuner and IF stages should also be checked for proper frequency response. Without sufficient tuner and IF response, recordings of off-air programs will lack detail and contrast. Unless you use a performance test to determine the true symptom, a poor off-air recording may be improperly diagnosed as a record circuit problem. This could lead to hours of wasted troubleshooting. Test the frequency response of the RF and IF stages with the VA62's MULTIBURST BAR SWEEP pattern. Feed in the MULTIBURST BAR SWEEP pattern on an RF channel. Fine tune the VCR for the best response on the monitor. If the response is less

than 3.0 MHz, the problem is in the tuner or IF stages, but not in the playback circuits.

The final performance test of the tuner and IF stages checks the AFT alignment. After you have confirmed good frequency response, simply turn the AFT "on". The detail in the MULTIBURST BAR SWEEP pattern displayed on the monitor should not change between AFT "off" and "on".

Using A Test Tape

Several of the remaining performance tests require playing back a section of "test tape". Do not confuse a "test tape" with a "manufacturers alignment tape". A test tape contains various video patterns and audio tones which you record using your VA62. It is inexpensive and ideal for testing VCRs with unknown defects. A manufacturers alignment tape is recorded under precise conditions and should only be used to make the final interchangeability adjustments. Details on recording a test tape are explained in Tech Tip #107. Contact your Sencore Sales Engineer for your free copy.

Request Your VCR Performance Report Card Today

We've walked through a few of the performance tests listed on the new VCR Performance Report Card to show you how easy they are to do using your VA62. The Report Card includes many other tests which check the operation of the playback, record, servo and audio circuits, as well as system control and interchangeability checks. When you've completed all the tests on the Performance Report Card, you can be sure that the VCR is in top working condition. You'll know you've thoroughly completed the job, your customer will be satisfied that he got a quality repair, and best of all your shop will have earned an extra profit.

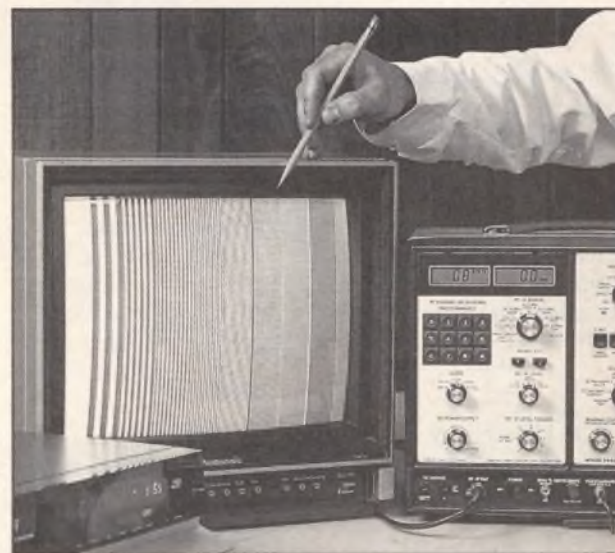


Fig. 10: Check the response of the VCR's tuner and IF's stages with the Multiburst Bar Sweep pattern. Tune the VCR to the channel generated by the VA62 and look for good response.

A complete Performance Report Card, ready to take to your printer, is available upon request from Sencore. The Report Card is designed to help you be more profitable by increasing your customer satisfaction. It includes space to list parts, labor, pricing, and customer information, as well as a section for your company name and address. To receive your complimentary copy, simply check the "Send VCR Performance Report Card" box on the enclosed Reply Card and return it postage paid to Sencore. ■

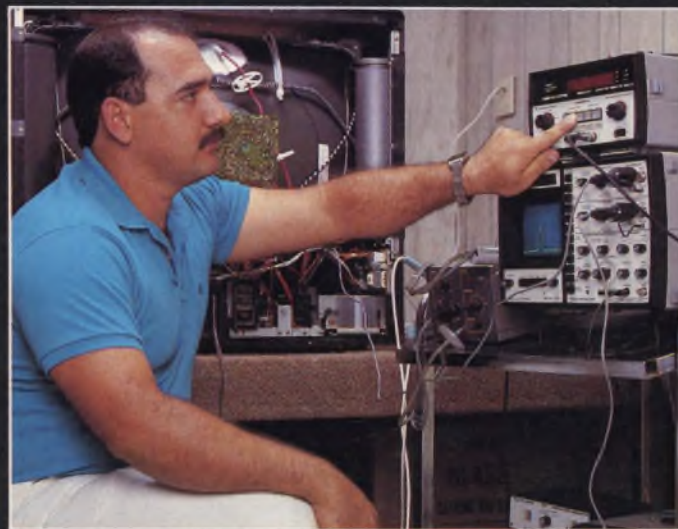
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INDEX

Capacitance and Inductor Analyzers — pg. 14
SCR/Triac Test Accessory — pg. 14
Waveform Analyzer — pg. 16
TV-RF Signal Analyzer — pg. 17
CRT Analyzer and Restorer — pg. 18

Color Bar Generator — pg. 18
Frequency Counter — pg. 19
Transistor and FET Tester — pg. 19
Video Analyzer — pg. 20
MTS TV Analyzer — pg. 21
RGB Monitor Adaptor — pg. 21

VCR Test Accessory — pg. 21
NTSC Pattern Generator Accessory — pg. 21
Stereo TV Readout — pg. 21
Isolation Transformer — pg. 22
DVMs — pg. 22

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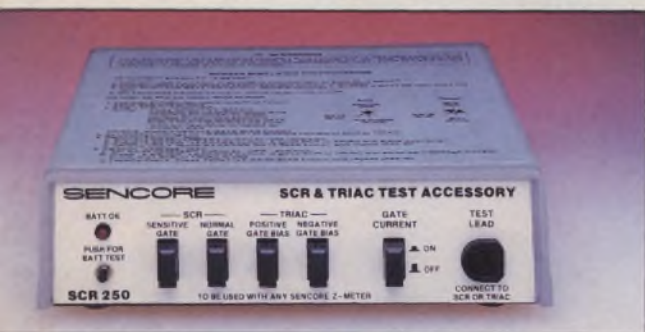
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Easy to use. The SCR250 was designed with your time in mind, to allow you to easily test SCRs and triacs. There is no complicated setup, or need to look up specifications. Just select SCR or triac and gate configuration and push the button to test. The SCR250 mounts on any Z Meter with Velcro® strips.

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A Totally Unique Battery Operated Portable, Triple Patented Capacitor/Inductor Analyzer Designed To Locate Defective Caps And Coils Other Testers Miss

Increase your troubleshooting confidence anywhere, on the bench or in the field. The LC76 PORTA-Z cap/coil analyzer gives you the time tested and proven Z tests with portability. With the LC76 PORTA-Z you get the know-how and expertise gained from Sencore's years of Z Meter experience. You also get NBS traceable accuracy on the bench or in the field.

Locate capacitor and inductor failures that all other testers can't find. Measure capacitors from 1pF to 200,000 uF and test them at voltages up to 1,000 volts. Test for value, leakage, dielectric absorption and

ESR. Test inductance values from 1 uH to 10 H. Test the effective quality of coils, yokes and flybacks with Sencore's patented ringing test.

Exclusive high potential testing to 1000 volts in a portable tester. Isolate leakage problems fast with an unheard of portable 1,000 volts. A new power circuit gives you all the power you need, yet still gives you 9 hours of portability on one battery charge.

The LC76 gives you true versatility in capacitor and inductor analyzing. The Sencore Z-METER family has

been the standard by which capacitor/inductor analyzers are measured. No other equipment performs total dynamic tests. Now with the LC76, you get the Z-METER tests anywhere, anytime and anyplace.

Locate faults in transmission lines or buried cable. The LC76's portability allows you to track down cable breaks in remote areas. Simply measure capacitance of an open line (or inductance of a shorted one), and calculate the distance to the fault.

LC75 Z METER 2™ Capacitor And Inductor Analyzer

Add These New Test Features To Your Shop In 1988

- Exclusive Capacitor Tests Analyze Value, Leakage At Rated Voltage, Dielectric Absorption (Patented), And Equivalent Series Resistance (ESR) (Patent Pending)
- Exclusive Inductor Tests Analyze True Inductance Value And Ringing (Patented)
- Finds Distance To Within Feet Of Open Or Shorted Transmission Lines
- Tests SCRs, Triacs, Hi-Voltage Rectifiers, Diodes, With SCR250 Accessory
- Checks Leakage As Low As One Microamp Up To 600 Volts In Cables, Switches, PC Boards, And Connectors

On GSA Contract
 NSN 6625-01-250-9554

LC75 Z METER 2
\$995 U.S. Funds
Exclusive Triple Patented Plus
One Patent Applied For.



Triple Patented Cap/Coil Analyzer Designed To Locate Defective Capacitors And Coils That Other Testers Miss

Solve capacitor challenges accurately and quickly. The LC75 gives you proven tests; value from 1 pF to 200,000 uF, leakage with applied voltage up to 600 volts, dielectric absorption, and ESR test. Find the other 75% of defective capacitors that "value only" testers miss. The LC75 is guaranteed to cut your troubleshooting time and boost your troubleshooting confidence.

Test inductors in or out of circuit with the time proven Z-Meter inductance tests. The LC75's double patented inductor tests check for true inductor value, and tests

the effective quality of the coil with a special ringing test, in or out of circuit. Find shorted turns and problems that "value only" testers can't find. The patented ringing test even finds just one shorted turn. Just push the button and read inductor value from 1uH to 10H and read the quality of the inductor with 100% reliability.

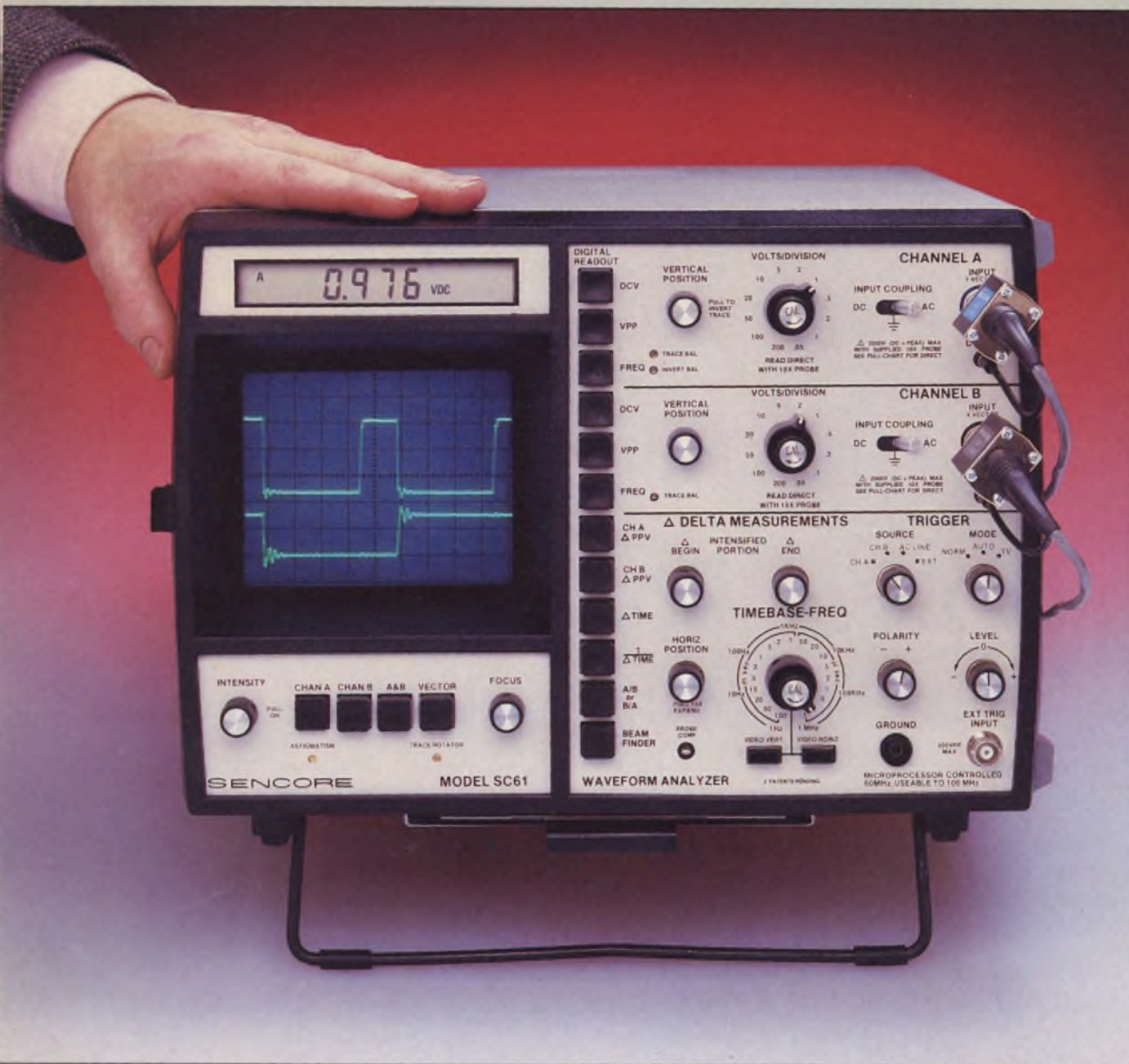
Check for insulation breakdown and troublesome leakage paths in areas where isolation is critical. The LC75 is a hi-potential leakage tester for testing switches, PC boards, connectors and contacts. Read

leakage as low as one microamp at voltages as high as 600 volts.

Eliminate costly errors. The LC75 allows you to locate potential problems that otherwise could go undetected, and cost you money down the line. The LC75 is autoranged, so it's easy to use, and has a handy pull chart to guide you in your testing. For your safety, and to keep from damaging sensitive components, the LC75 flashes a warning when 50 volts or more is applied to a device. Capacitors are automatically discharged when the leakage button is released.

SC61 Waveform Analyzer™

60 MHz (usable to 100 MHz) Dual Trace Waveform Analyzer



Analyze Any Waveform To 100 MHz, 10 Times Faster, 10 Times More Accurately, Absolutely Error Free . . . Or Your Money Back

At first glance the SC61 Waveform Analyzer may look like an ordinary conventional oscilloscope: high performance, dual trace, 60 MHz bandwidth (usable to 100 MHz). But when you pick up the probe and connect to a test point, that's when the SC61's special ECL sync circuits and auto-tracking digital readout begin working for you to save you valuable time and effort.

There are other scopes on the market that have digital readouts, but none of them have completely eliminated graticule counting, interpretation and extra lead hook ups. The SC61 was designed to integrate the features of a high performance scope with exclusive sync circuits and digital display to give you automatic, rock solid measurements through one probe. You simply hook up the probe to the circuit, then view the locked in waveform on the CRT. To read DC voltage, peak-to-peak voltage, and frequency of the waveform you simply push a button and read it directly on the auto-ranged LCD digital display — all through one probe, and without interpretation. It obsoletes other scopes like the calculator obsoleted the slide rule.

The SC61 Waveform Analyzer also gives you exclusive DELTA functions that allow you to analyze any part of a waveform in just seconds. Measure peak amplitude of part of a waveform, time of an event, or frequency of part of the waveform. Now you can easily locate the source of ripple on DC supplies, catch the frequency of a small glitch, or check the duty cycle on a digital waveform. Just lock in the waveform on the CRT, and adjust the DELTA BEGIN and DELTA END to intensify

the portion of the waveform you need to analyze. Then simply push a button and read out the corresponding peak-to-peak voltage, time or frequency. It makes troubleshooting defective waveforms easy, so you can locate the problem circuit quickly.

It's high performance. The SC61 gives you 60 MHz usable to 100 MHz bandwidth to troubleshoot even the latest digital circuits. The SC61 also gives you dual delayed signal trace so you can see the leading edge of the waveform on both channels. You can also add, subtract or view both channels separately.

It's digitally accurate. The SC61 Waveform Analyzer eliminates inaccurate and frustrating graticule counting. The internal microprocessor monitors the signal that is applied to the CRT, and digitally tracks the important parameters you need. Peak-to-peak volts, DC volts and frequency. You get measurements that are 10 times more accurate than conventional scopes.

Its waveforms are rock solid. The SC61 Waveform Analyzer, with its special circuitry, has the ability to lock quickly onto waveforms all the way to 100 MHz. This has been achieved through exclusive ECL (emitter coupled logic) circuits in the front end and noise cancelling differential amplifiers throughout the sync circuits. The SC61 Waveform Analyzer provides "rock solid" sync that allows you more time to troubleshoot, and less time fiddling with the trigger control to lock in a waveform.

Analyze Waveforms Easily

- Accurate Waveform Display — 60 MHz Bandwidth (Usable To 100 MHz) To Test The Latest Digital Circuits
- Rock-Solid Sync — ECL Logic Circuits And Differential Amplifiers Give Fiddle-Free Operation
- Four Times The Measuring Range — Measure From 5 mV To 2000 Volts (3000 Volt Protection) For Expanded Signal Handling

AUTOTRACKING™ Digital Readings Analyze The Whole Signal

- Autoranging DC Volts Through Single Probe, Even AC Coupled
- Automatic Peak-To-Peak Volts — Even If Variable Control is "Out Of Cal"
- Automatic Frequency Measurements Without Sensitivity Adjustment Or Range Switching

Delta Digital Tests Analyze Any Part Of The Signal

- Delta Peak-to-Peak Volts — Peak-to-Peak Volts Of Any Part Of The Signal
- Delta Time For Any Time Reading — Including Delay Between Traces
- 1/Delta Time — Or Frequency Of Part Of The Signal — Finds Sources Of Interference Or Ringing

Frequency Ratio Test — Tests Multiplier And Divider Circuits

Easy To Use — Human Engineered Controls And Virtually No Graticule Counting Or Calculations

SC61 Waveform Analyzer

\$3295 Patented U.S. Funds



On GSA Contract
NSN 6625-01-169-2318

It safely handles 4 times the signal level of any conventional scope. Most conventional scopes are able to handle only up to 600 volts on their input circuitry. The SC61, however, provides you with 5mV to 2000 volts (protected to 3000 volts) measuring ability to give you the extra versatility you need. Perform high voltage measurements without worrying about overloading the front end and causing you additional expense and down time.

Plus many extra high performance features. Post deflection, high intensity, blue phosphor 8 X 10 cm CRT provides easy-to-view trace, even under high ambient lighting conditions. • IEEE488 Bus Compatible. • Push button X-Y vector display with 4 MHz response for accurate phase comparisons. • Z-Axis input. • Beam finder. • TV Vertical and TV Horizontal video preset positions with sync separators.



FS74 CHANNELIZER SR.™ TV-RF Signal Analyzer

New Technological Breakthrough!



- All Channel Digital Tuner — Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel From 5 MHz - 890 MHz.
- Exclusive 5 Microvolt (–46 dB) Sensitivity With Automatic Attenuation And Ranging For Fast Hands-Off Operation
- Exclusive Automatic Tests, Even On Fully Modulated Channels:
 - Audio-to-Video Carrier Ratio Test
 - Hum Test On Any In-Use Channel
 - On-Channel Signal-to-Noise Test
 - Digital Readout Of Frequency Offset
- Exclusive Picture Quality Check With Integrated Wide Band Video Monitor — Isolates Problems Meters Can't Show
- Exclusive ACV/DCV Measurements Through RF Input Or Special DVM Input — No Need To Carry Additional Test Instruments



FS74 CHANNELIZER SR.™ TV-RF Signal Analyzer \$3495 Patented

U. S. Funds On GSA Contract

Now, locate any problem in any CATV, SMATV or RF distribution system quickly and accurately, plus test to full FCC specifications. The FS74 gives you every test you'll need to FCC specifications. RF level, Signal-to-Noise, Audio/Video separation and Hum tests are performed 100% automatically. Plus, the FS74 has an exclusive wide-band monitor that allows you to see system problems and trace them to their source.

Tune in all cable, off-air and FM channels with digital ease and accuracy. The FS74's digital tuner lets you tune in all sub-band, cable, VHF, UHF, and FM frequencies that range from 5MHz to 890MHz. The FS74 also gives you a special AFT that locks onto the exact carrier frequency and displays the amount of offset to 1kHz resolution. HRC and ICC offset lets you track cable system shifts at the flip of a switch.

Super sensitivity brings in the weakest signals with 100% automatic attenuators. The FS74 gives you 5

Thoroughly Analyze And Pinpoint Any RF Video Trouble In Any RF Video Distribution System, Accurately And Automatically, In 1/2 The Time, Or Your Money Back

microvolt sensitivity that allows you to troubleshoot back to the head-end or antenna. The RF input is fully autoranged. The FS74 automatically selects the proper attenuator range so you can measure signal level instantly, from -46 dBmV to +60 dBmV.

Microprocessor control makes all performance tests fast and simple. Exclusive microprocessor technology allows all tests to be performed on any in-use channel without removing or decreasing modulation, or adding special carriers. A patented signal-to-noise test automatically compares the signal level to the actual in-channel noise level. Making audio-to-video level tests are simple. The FS74 automatically tunes both carriers and automatically reads out the separation in dB. Hum tests are made directly also, another Sencore exclusive.

Exclusive built-in wide band monitor gives you picture quality checks anytime, anywhere. The FS74's integral

wide-band monitor lets you see tough system problems like ghosting and interference and track them quickly to their source. Just turn on the monitor and view any channel in full detail. The 4 MHz bandwidth means you can isolate problems that would go unnoticed on a portable TV.

Built-in autoranging AC/DC voltmeter and ohmmeter means you'll never be caught short. Your troubleshooting edge is enhanced with AC and DC voltage measurements and a special low range ohmmeter right at your fingertips. Plus, measure up to 200 volts AC or DC right through RF input!

We guarantee the FS74 will cut your RF distribution System servicing time, or your money back. Call 1-800-843-3338 and locate system problems faster than you imagined possible.

FS73 CHANNELIZER JR.™ TV-RF Performance Tester



Make Difficult Performance Tests In Any RF Distribution System 100% Automatically

- All Channel Digital Tuner — Tunes In Any Cable, HRC, ICC, VHF, UHF, And FM Channel
- Exclusive 5 Microvolt (–46 dB) Sensitivity With Automatic Attenuation And Ranging For Fast Hands-off Operation
- Exclusive Automatic Hum And Signal-to-Noise Tests On Any In-use Channel
- Microprocessor Controlled Fine Tuning With Readout Of Frequency Offset

FS73 CHANNELIZER JR.™ TV-RF Performance Tester \$2395 Patented

U. S. Funds On GSA Contract

New Technological Breakthrough!



Now You Can Completely Performance Test Every Single TV Channel, In Any RF Distribution System, To FCC Specifications, 100% Automatically And 100% Faster Than Ever Before.

Discover fully automated performance tests on all channels to FCC specifications. The FS73 CHANNELIZER JR. gives you the same performance tests that its big brother, the FS74, offers you. RF

level, Signal-to-Noise, Audio/Video separation and Hum tests are performed 100% automatically on any channel. No more tuning to unused carriers for your performance tests.

Super sensitivity and digital tuning make performance tests quick and easy. Measure from –46dBmV to +60dBmV with autoranged attenuators; eliminates error prone "attenuator pads." Plus, you can test all channels from 5MHz to 890MHz.

Automate your system tests. A special IEEE 488 interface allows you to computer control your performance test for remote and long-term monitoring with the optional IB72 interface accessory.

Call WATS Free 1-800-843-3338 17

CR70 "BEAM BUILDER"™

Universal CRT Analyzer and Restorer

Test Every CRT On The Market — Now And In The Future — Plus Restore 50% Of All Weak Or Shorted CRTs . . . Or Your Money Back. (Includes Color/ B & W TVs, Scopes, Computer Displays, Camera Tubes And More.)

- Test Every CRT (Old or New) — No Need To Buy Additional Sockets
- Exclusive Tests Cover CRT's Full Dynamic Range, From Cutoff To Peak Emission — For Highest Test Reliability
- Guaranteed To Safely Restore 9 Out Of 10 Weak Or Shorted CRTs — Or Your Money Back
- Guaranteed To Be Totally Protected From Damage From Charged CRTs — Keeps Your Investment Working For You

CR70 "BEAM BUILDER"™ Universal CRT Analyzer and Restorer

\$1295 Patented U.S. Funds

On GSA Contract
NSN 6625-01-187-4395

"The CR70 is a great instrument and has saved us money on camera tubes."

Eddie H. Sills
Chief Engineer (Maintenance)
Roswell, New Mexico

Stop wasting valuable time and profits by replacing CRTs. Today's electronics in the latest TVs are getting more and more reliable, but there is still one area of the TV that is guaranteed to fail, the CRT. However, most CRTs that do fail can be successfully restored with a reliable restoring system. The CR70 gives you the most reliable system anywhere that allows you to restore tubes that you would otherwise replace. The CR70 is a breakthrough in CRT restoration, here's why . . .

Test every CRT on the market. The CR70's unique selectable switches, universal adaptor and its wide restoration current range allows you to test every type of CRT in use today.

- All B & W and Color Video CRTs
- Projection CRTs
- Computer Display CRTs
- Closed Circuit Video CRTs
- Camera pickup tubes - broadcast, industrial and surveillance
- Even scope, radar and other industrial CRTs

You'll never have to buy another socket again.

There are thousands of different types of CRTs that are being used today, and with them comes a lot of different socket configurations. However, most of the CRTs use one of ten basic designs in their socket basings. The pins might change position, but the general design stays the same. The CR70 takes advantage of this fact by allowing you to select the pin configuration with switches, rather than having to buy a new socket. Simply connect the socket that fits the neck, and select the grids, filaments and cathode with the selectable switches. If you do run across an "oddball" CRT, the CR70 gives you a universal adaptor that allows you to connect and test those non-standard CRTs.

Dynamic tests you can trust. The CR70 tests the CRT over its entire operating range, from black (cutoff) to white. It's the only tester that does. The CR70 tests emission as "true beam current" (current that passes through the control grid to the screen grid). Plus, its exclusive cutoff test accurately identifies CRT problems related to bad contrast that other testers miss. A patented color tracking test gives a direct good/bad

comparison of all three guns of a color CRT or all three CRTs of a projection system to confirm they will balance properly for any color or B & W picture. The CR70 also tests for shorted elements.

Restore CRTs safely and effectively. Many technicians know what a conventional CRT rejuvenator can do to a CRT. Most of the time it's "push the button and pray." The CR70's exclusive controlled current system means you never again have to worry about losing a CRT again by zapping it too hard. The CR70 is guaranteed to restore 9 out of 10 weak or shorted CRTs. This saves you thousands of dollars by extending the life of the CRT compared to replacing the CRT, or by restoring a CRT that is no longer available. Only the CR70's progressive restoration gives you this ability.

Full protection from overload damage. Many CRT testers are damaged by the high voltages left on the CRT. The CR70 is fully protected, however, to eliminate the possibility of this with special MOVs (metal oxide varistors).

CG25 Little Huey™

Portable, Digital Color Bar Generator

Rock Solid Digital Patterns In A Small Portable, Battery Operated Package

- Built Rugged For Field Use — With Built-In Test Leads
- Big Generator Features With Variable Dot And Adjustable Channels
- Automatically Shuts Off After 20 Minutes So Your Batteries Don't Run Down

Rock-solid digital patterns: Just push the buttons for jitter-free standard color bars, horizontal and vertical lines, crosshatch, and white dot patterns.

Built rugged for field use: Lasts and lasts on the road with tough acrylic case.

Big generator features: Dot size, color level, and RF channel controls just like the deluxe generators.

CG25 Little Huey \$198 U.S. Funds
On GSA Contract



FC71 Portable 10 Hz To 1 GHz Frequency Counter™



- Five Times More Accurate Than FCC Requirements, 0.5 PPM
- Portable - 9.5 Hours Of Battery Operation
- Exclusive Microprocessor Time Base For Super Stability From -12 F to 122 F, (-25 C to 50 C)
- Measures All Signals, Even Complex And Noisy Signals, With Exclusive Sensitivity Control
- Super 5 mV Average Sensitivity Over Full Range
- .01 Hz Resolution In One Second
- Double Shielded For Interference Free Frequency Measurements Anywhere
- Automatic Crystal Check Tests The Fundamental Frequency Of Any Crystal
- Frequency Ratio Compares Two Frequencies And Displays The Ratio Directly
- Automatic Readings With IEEE488 Computer Interface, IEEE488 Bus Compatible

The Only Portable, Battery Operated Counter Especially Designed With An Exclusive Microprocessor Controlled Timebase To Measure 10 Hz To 1 GHz To 0.5 PPM Accuracy In High RF Environments

The only truly portable 1 GHz counter that makes every reading better than FCC requirements. The FC71 uses a unique, new, microprocessor-controlled timebase. This patented counter provides (0.5 ppm/yr aging) from 10 Hz to 1 GHz. With the 8 1/2 digit LCD display, you get superior accuracy on the high end while allowing .01 Hz resolution for low end and audio work.

Since there is no power robbing oven, the FC71 gives nine hours of continuous operation. Take it wherever it's needed: broadcast towers for FCC documentation, repeater sites for troubleshooting, or airplane cockpits for avionics tests.

The most sensitive frequency counter available allows you to count signals other counters miss. The FC71's 5 mV input sensitivity lets you count signals in more circuits than with any other counter - without external amplifiers. It will even measure the output of RF

generators and communications monitors that can't be tested with other counters.

The highest stability available lets you count the toughest signals. The FC71 is guaranteed to be the most stable counter you can buy. Its uniquely designed input circuits allow you to count signals that are otherwise unmeasurable. Signals like AM or FM, digital signals with ringing, or signals with noise. The FC71's stability means you never have to guess at frequencies again.

Fully RF shielded so you can measure anywhere, even in high RF fields. With most counters, you cannot make measurements near a broadcast or 2-way transmitter because the counter picks up the transmitter signal through the case. The FC71's double shielding lets you measure signals in RF fields that are impossible to measure with other counters.

FC71 Portable 10 Hz To 1 GHz Frequency Counter \$1295 Patented U.S. Funds

On GSA Contract
NSN 6625-01-076-2695



Additional tests make the FC71 more than a counter. An exclusive frequency-ratio test simplifies troubleshooting in digital and RF multiplier and divide circuits. Simply measure the input, press the frequency store button, measure the output, and push the ratio read button to find the exact ratio. The FC71 also has a unique crystal test to check any crystal at its fundamental operating frequency to eliminate guesswork in oscillator repairs.

IEEE 488 instrument bus interface automates the FC71 for extended tests. Sencore's optional universal IEEE interface, the IB72, allows you to use the FC71 with a computer for automated testing and data collection. Perform system stability tests over long periods of time, or document frequencies in quality control tests.

TF46 Portable Super Cricket™ Portable Transistor/FET Tester



Test Any Transistor Or FET With 99% Reliability In Less Than 15 Seconds — In Or Out Of Circuit

- Portable Battery Operation So You Can Completely Analyze A Transistor Or FET Anywhere
- Needs No Set-up Book Or Instructions
- Automatic Power Shut Off After 20 Minutes Use; Saves Your Batteries

On GSA Contract
NSN 6625-01-058-9564

TF46 Portable Super Cricket Portable Transistor/FET Tester \$495 Patented

U.S. Funds

Instantly test any transistor or FET without set-up books. The TF46 is the latest in a long line of "cricket" testers that gives you a patented "good" or "bad" test in or out of circuit. The TF46 is completely automatic, simply hook up the three leads in any configuration, and the TF46 tells you if the device is good or bad with an audible chirp, and on the meter. It also identifies the transistor's base, emitter and collector, or the FET's gate, drain and source.

Test for gain at the push of a button to match transistors and speed troubleshooting. The TF46 also allows you to test for leakage on transistors that show good gain, but have leaky collector-to-base or collector-to-emitter junction. Plus it has a diode test too, for more versatility.

Trademarks of Sencore, Inc.: Little Huey, Super Cricket, MICRORANGER®, POWERITE®, Waveform Analyzer, AUTOTRACKING, BEAM BUILDER, CHANNELIZER JR., CHANNELIZER SR., PORTA-Z, AUTO-Z.

Pricing Note: All prices shown are U.S. dollars. Canada must add applicable Duty, Freight, and F.S.T. Prices and specifications subject to change without notice.

Call WATS Free 1-800-843-3338

VA62 Video Analyzing Package



The Only NTSC Video Servicing System Guaranteed To Cut Your Servicing Time By 54% Or Your Money Back.*

Isolate Video Troubles In Half The Time With The Only Universal Video Analyzer.

- Identify Tuner Problems With All-Channel, VHF, UHF, And Cable RF Generator
- Pinpoint IF Troubles With Modulated Troubleshooting Signal And Exclusive Programmable IF/RF Generators
- Isolate Any Video Problem With Patented Video And Standard Color-Bar Patterns
- Find Defective Stages, Without Disconnecting Parts, Using Exclusive Phase-Locked Drive Signals
- Test Yokes And Flybacks, Plus Measure Signal Levels With Autoranged Digital Meter
- Expandable; Update For New Technology With Exclusive Phase-locked Accessories

VA62 Universal Video Analyzer

\$3495 Patented U.S. Funds

On GSA Contract
NSN 6625-01-187-5516

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

The VA62 Universal Video Analyzer is the only system that equips you for successful servicing in the expanding video market. It ends expensive parts substitution (especially when working with large-scale ICs) and eliminates embarrassing, costly callbacks by allowing you to quickly, confidently, and dynamically check every repair.

Eliminate aggravating tuner questions. The all-channel VA62 gives you the confidence of complete RF testing. The "Standard TV" generator produces every VHF and UHF channel, the "Standard Cable" generator every cable channel and "Programmable Cable" function lets you duplicate any cable carrier shift to test lock in range.

Dynamically isolate IF troubles quickly and easily. The VA62 isolates any IF trouble with a fully modulated, crystal referenced 45.75 MHz IF signal, matched to inject into any IF stage. Both video and audio modulation identify any trouble. It's a real troubleshooting confidence builder.

Patented signals let you set IF traps—a must for cable—by simply looking at the CRT. Plus, the VA62 lets you do full IF alignments without confusing cables or complicated adjustments.

Isolate troubles without disconnecting a single component with VA62 drive signals. No need to unsolder components because the VA62's output circuits automatically "swamp out" the original signal before injecting the substitute signal. These special

signals let you troubleshoot any video or sync stage, as well as vertical or horizontal circuits. Separate drive outputs allow simultaneous injection into the tricky closed-loop servo circuits or color oscillators.

Digital Meters Add Confidence:

Ringing Test: The digital meter makes the VA62 a complete analyzer. Start by testing deflection yokes and flyback transformers, in-or out-of-circuit, with Sencore's reliable (patented) good/bad ringing test.

Drive Level Monitor: Internal monitoring measures the true peak-to-peak level of any drive signal to prevent overdriving and to show when feeding into a shorted component.

Peak-to-peak and DC Meter: Autoranged external meter includes peak-to-peak and DC to a full 2 kV. Compare peak-to-peak and DC directly to the schematic.

DC Power Supply: The 0 to 35 volt DC power supply blocks confusing feedback loops in AGC, AFT, ACC or servo circuits or isolates problems in direct coupled (DC) circuits, such as vertical amplifiers.

Integrate phase-locked accessories into your video analyzing system to increase your service potential. The accessory jack and the composite video output let you add new technology as you need it. Phase-locking means the accessory signal returns to full sync when used with the other VA62 signals.

VC63 VCR Test Accessory™

Solves The VCR Service Challenge With Substitute VCR Signals. Phase-Locked To Your VA62.

Find defective heads without expensive substitution in VHS, Beta, and U-Matic VCR formats. Plus, pinpoint defective stages with exclusive substitution signal and troubleshoot color problems with special reference signal.

VC63 \$495 U.S. Funds On GSA Contract
NSN 6625-01-201-2880

NT64 NTSC Pattern Generator™

For Faster Service And Warranty Approval. Adds NTSC Full Field And Split Field Patterns To Your VA62.

Produces the EIA RS 189 standard full-field and split-field color bar patterns that meet all VCR manufacturer's requirements for a color bar generator. These two patterns are fully phase-locked to all other VA62 signals. The NT64 is one-fifth the cost of competitive stand alone NTSC generators.

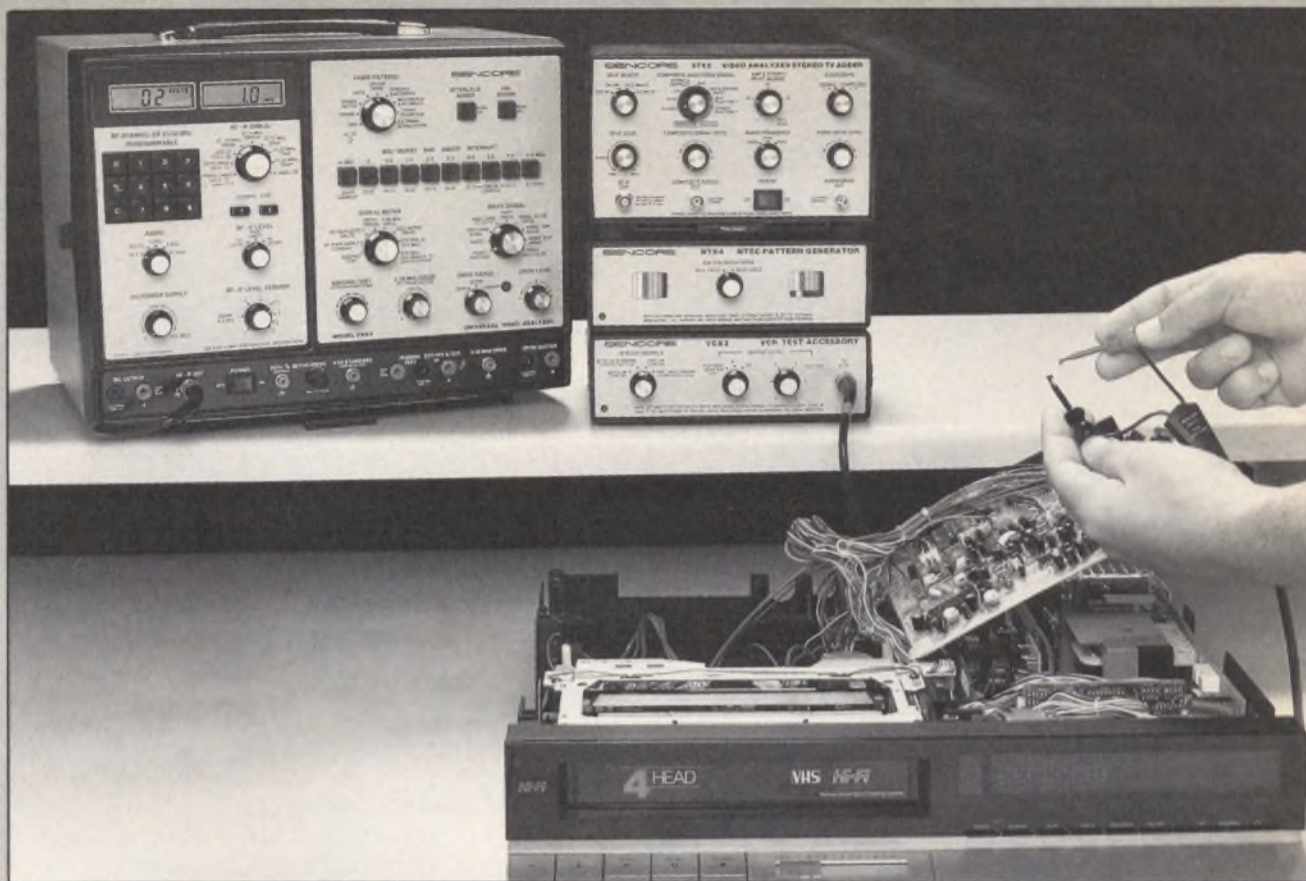
NT64 \$495 U.S. Funds
On GSA Contract

ST65 Video Analyzer Stereo TV Adder™

Test, Troubleshoot And Verify Any Mono/Stereo Sound Or SAP Channel - In 1/2 The Time, Or Your Money Back.

Update your VA48 or VA62 Video Analyzer to an integrated Multichannel Television Sound (MTS) Stereo TV analyzing system. The ST65 makes stereo and second audio program (SAP) performance tests on any MTS stereo TV system. Exclusive adjustable RF/IF, COMPOSITE SIGNAL, and AUDIO levels match and isolate troubles in any stage — including the decoder. It's the only tester guaranteed to tie troubles down to any and all stages.

ST65 Video Analyzer Stereo TV Adder \$995 Patent Pending U.S. Funds
On GSA Contract



RG67 NTSC Video Monitor Adaptor

Updates Your VA48 or VA62 Video Analyzer With Every R, G, B Combination Required For Analog/Digital Monitor Service.

The RG67 provides phase-locked R, G, B, and I signals to drive any NTSC analog or digital monitor. Match any input with selectable signal and sync polarity and adjustable amplitude to 5 VPP. Fast hookup to R, G, B and I inputs with E-Z HOOK® leads.

RG67 \$890 U.S. Funds
On GSA Contract



SR68 Stereo TV Readout™

Tests Any Stereo Output To 100 Watts, With Power, Separation, And Signal Level Measurements.

Analyze stereo TV Audio Line or speakers in dB or watts. Loads to 100 watts provide dynamic testing and speaker substitution. Automatic channel separation measurements to -40 dB without calculations. The SR68 is battery operated—use in the shop or in the field.

SR68 Stereo TV Readout \$595 U.S. Funds
On GSA Contract

ST66 Stereo TV Analyzer™

Test And Troubleshoot MTS And Cap Circuits Plus Performance Test The Entire TV - Anywhere.

The ST66 is a complete MTS stereo TV and VCR analyzer that provides all of the special signals you need to successfully service MTS stereo TV from the antenna to the speakers with one simple connection. It has exclusive video patterns for total analysis and variable pilots for threshold testing. Plus it's portable—works two hours continuous on one battery charge.

ST66 Stereo TV Analyzer \$1395 Patent Pending On GSA Contract
U.S. Funds



PR57 "POWERITE"®

Variable Isolation Transformer And Safety Analyzer

One Totally Integrated Supply That Lets You Know That Your AC Power Is Right And Safe

The PR57 "POWERITE" lets you know your AC power is right and includes a variable isolated 470 Watt power transformer to isolate your AC line and vary the output voltage from 0 to 150 volts. You'll monitor voltage, current, and wattage to prove that the equipment under test isn't drawing too much current at any voltage setting.

Variable output supply is isolated for your protection. The "POWERITE" 470 Watt AC variable output transformer provides a continuously variable output voltage from 0 to 150 volts; a must for troubleshooting shutdown circuits. It protects you and your test equipment from shocking overloads by isolating you (and the equipment under test) from the AC line.

Solve challenging shutdown problems and eliminate callbacks. Lower the line voltage to solve tough shutdown problems. Raise the line voltage to sweat out intermittents or sensitive parts. Test every

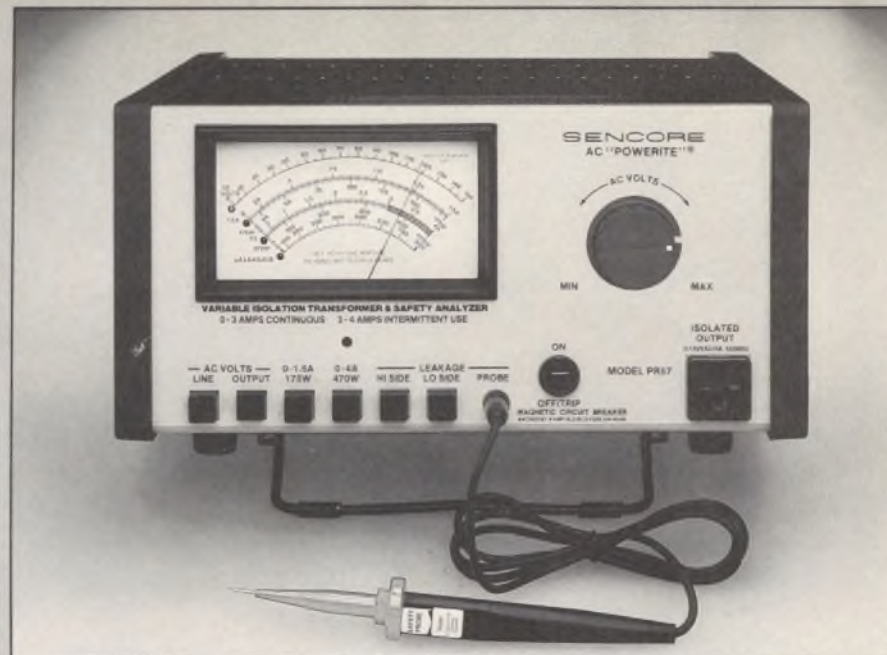
•Variable Isolated 470 Watt Power Transformer To Isolate Your AC Line And Vary Your Output Voltage From 0 To 150 Volts

•Voltage, Current, And Wattage Power Monitor To Determine That The Equipment Under Test Is Not Drawing Excessive Current (Or Wattage) At Any Voltage Setting

•AC Line Leakage Safety Tester To Assure That Excessive Leakage Current Is Not Present On Any Exposed Part On The Equipment Being Tested

PR57 "POWERITE"®
\$495 Patented U.S. Funds

NSN 6625-01-124-6296

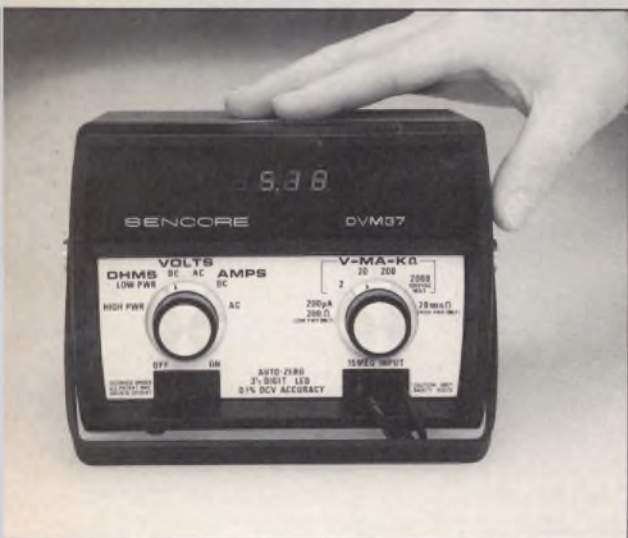


set at high or low line voltage to avoid embarrassing callbacks. Identify AC line related problems like picture width, sync, and intermittents in the customer's home or test in the shop at their line voltage.

Safety leakage test means safe repairs and additional profits. Safety checks for current leakage are

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You Can Solve Tough Horizontal Troubles Fast With Your VA62 Universal Video Analyzer

by Brian Phelps, Applications Engineer

If you were asked, what one circuit in a TV is most essential to its operation, what would you say? Many servicers would key in on the horizontal circuit. They know that with modern television technology the horizontal circuit provides the operating power supplies for the rest of the TV, as well as performing horizontal scanning. Some servicers remember the horizontal circuit from a costly troubleshooting experience. Many owners say the horizontal circuit is the "Tough Dog" problem for their shop.

Fortunately for the service industry, the number of TVs sold in the U.S. is still growing. This does, however, mean that your chances of servicing a horizontal circuit are also growing. As with other video circuits, your VA62 Universal Video Analyzer helps you quickly isolate failures in "Tough Dog" horizontal circuits. In this article, we'll look at how horizontal stages work and how you can use your VA62's drive signals to isolate horizontal failures.

Successful Troubleshooting Begins With Learning How The Circuit Works

For signal injection, work from your Sencore Universal TV Block Diagram (Figure 1). As you can see from the partial block diagram, there are four main blocks to the horizontal circuit. The following is a brief explanation of each of the four blocks.

1. HORIZ. AFC- Automatic Frequency Control (AFC) functions to control the frequency of the horizontal oscillator. The AFC section receives a signal from the sync separators and a flyback pulse from the secondary of the flyback or Integrated High Voltage Transformer (IHVT). AFC corrects the oscillator by comparing the sync pulse rate to the flyback pulse rate. This stage can be made up of several components or contained in a single integrated circuit (IC).

2. HORIZ. OSC.- The horizontal oscillator provides a 15,734 Hz square wave signal to the horizontal driver. In some TVs, the horizontal oscillator is in the horizontal/vertical IC, with the AFC circuit.

3. HORIZ. DRIVER- The horizontal driver amplifies the signal from the horizontal oscillator. The driver is typically a medium gain

transistor that feeds the primary of the horizontal drive transformer.

4. HORIZ. OUT DAMPER- This is the final amplifier for the horizontal oscillator signal. The horizontal drive transformer converts the high voltage, low current, at the primary to low voltage, high current, at the secondary for the output transistor. The horizontal output transistor (H.O.T.) drives the IHVT, the deflection yoke, and components used for convergence and timing. The horizontal output pulse, stepped-up or down by the IHVT is rectified to produce "scan derived" B+ supplies which operate most circuits in the TV.

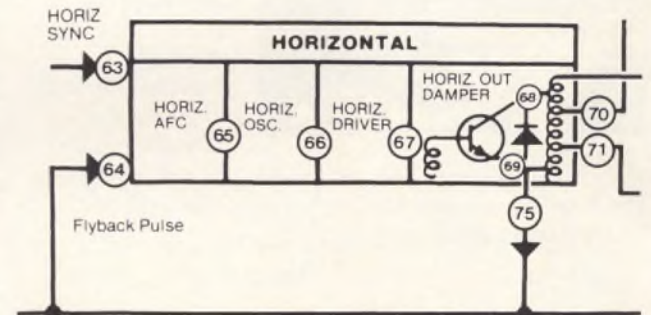


Fig. 1: A television's horizontal circuit can be simplified and troubleshot using the Universal TV Block Diagram.

Divide And Conquer With The VA62 To Isolate Horizontal Failures

The troubleshooting technique known as "divide and conquer", makes isolation of failures affecting the horizontal circuit easy to locate. Dividing and conquering a circuit using signal injection is one of the most effective and efficient troubleshooting methods. You simply inject a known-good test signal at the mid-point of the suspected circuit and watch the output on the TV screen, to tell if the trouble is between the point of injection and the output.

When you inject a good signal into a circuit and notice no significant improvement at the output, the problem lies between the point of injection and the output. However, if you do notice improvement at the output, the problem lies towards the tuner. Thus, by signal injecting, you divide a circuit in half and keep dividing in half until you isolate the defect.

Troubleshooting The Horizontal Circuit

If the horizontal circuit is not working, the trouble could be caused by:

- Any of the blocks of the horizontal stage.
- A defective flyback, yoke, tripler, or CRT.
- A problem with any of the B+ supplies.
- A defective startup or shutdown circuit.

TV Receivers Millions Of Units



The sales of television receivers is still climbing. You have a very good chance of seeing TVs with horizontal troubles on your service bench . . . some are profit robbing "Tough Dogs".



Fig. 2: By connecting an oscilloscope to the collector of the horizontal output transistor you can tell if the circuit is operating and monitor the effects of driving the circuit.

One of the main problems servicers see, when troubleshooting the horizontal circuit, is that when the horizontal circuits are shut off (for whatever reason), the B+ supplies, video, and related circuits have no signals or voltages to look at. This often leads to the "shotgun" approach to repairing the TV. There is, however, a better way.

To isolate defects in the horizontal circuit, you must get some voltages and signals to look at. You must power-up the horizontal circuit, so the

other circuits can operate. This can be done by driving the horizontal output transistor with the VA62 Universal Video Analyzer's HORIZ XISTOR DRIVE signal.

A Quick Pretest Tells Whether You Should Drive The Horizontal Output Circuit

Test to see if the horizontal circuit is working and the symptom looks like it isn't. If the horizontal circuit is not running, the scan derived B+ voltages will be missing. None of the circuits fed by these voltages will be working. If even one of the circuits is *operating properly*, the horizontal circuit is functioning and your problem lies elsewhere.

You can tell if the horizontal circuit is working by monitoring the collector of the horizontal output transistor with your SC61 Waveform Analyzer. (Your SC61 is protected to 3,000 V and easily measures the horizontal output pulse. Other scopes are easily damaged by this 900 to 1,500 VPP pulse.) You should analyze the horizontal transistor's collector waveform, because it gives you an instantaneous readout of what the circuit is doing. If you wait for the CRT filaments to warm-up, the horizontal output transistor may overheat and be destroyed.

If none of the TV's scan derive powered circuits are operating, you should test for horizontal startup. Watch the scope for a brief output of the horizontal output transistor when power is first applied to the TV. This is a clue that the horizontal circuits may be working correctly, but simply going into the shutdown mode. If the horizontal circuits aren't working, use the VA62's HORIZ XISTOR DRIVE signal to inject at the various horizontal circuit blocks, to isolate the problem.

Driving The Horizontal Output

Pretest

- Test H.O.T. for a short (if bad, ring IHVT and yoke)
- Test for shorted scan derived supplies
- Connect VA62's RF-IF OUT to TV and set to same channel as the TV
- Lower the line voltage to 90 VAC, and turn on the TV
- Monitor the horizontal collector output with your SC61
- Measure the regulated B+ to the H.O.T.

Drive

- Remove TV power
- Connect the VA62 DRIVE OUTPUT leads to the base and emitter of the H.O.T.
- Set the DRIVE LEVEL to match the schematic (+ polarity)
- Set the DRIVE SIGNAL control to HORIZ XISTOR DRIVE position
- Disconnect the horizontal drive transformer to eliminate inductive feedback
- Monitor the horizontal output transistor collector
- Apply power to the TV
- Check the scan derived B+ supplies.

Always do an accurate pretest; when necessary, drive the horizontal output transistor to isolate failures. Call your Area Sales Engineer and ask for Tech Tip #118, "How To Analyze The Horizontal Output Pulse With The SC61 Waveform Analyzer", or Tech Tip #131, "Servicing Startup And Shutdown Problems With The SC61", or ask for a VA62 "Self Demo" in your shop; WATS FREE 1-800-843-3338. ■

Tech Talk

Questions Often Asked About Driving The Horizontal Circuit

How do I connect the VA62 to the horizontal output transistor?

Connect the VA62's DRIVE OUTPUT directly across the base-to-emitter junction of the horizontal output transistor. The VA62's drive signals are isolated from chassis ground (floating ground), letting you connect directly across transistor junctions. This is especially important when servicing a hot ground output stage.

Do I have to disconnect any components before I can drive the horizontal output?

In most cases the answer is no, however, when a horizontal drive transformer is used, it places a very low impedance to ground and may produce inductive feedback. To eliminate this problem, disconnect the transformer secondary when driving the H.O.T.

How much signal, and what type of signal does it take to drive the H.O.T.?

When driving circuits with the VA62, match the signal level shown on the schematic. Use the HORIZ XISTOR DRIVE signal with positive polarity in most instances. There may be an occasion when negative drive levels should be

used. The incorrect polarity will produce an out of phase picture.

What results should I look for when driving?

It is best to use your SC61 Waveform Analyzer to monitor the collector of the output transistor. This way, you can catch defects before the CRT warms enough to give a picture. This also helps prevent damage from the horizontal output transistor overheating.

Can I blow out the H.O.T by driving it?

Yes, you can damage any semiconductor if you operate them under conditions they were not designed to withstand. But, if you operate the TV at a lower line voltage (typically 90 VAC), and test the IHVT and yoke with the VA62's RINGING TEST when you find the original H.O.T. damaged, your chance of blowing the H.O.T. are minimal.

What should I do, if when I drive the output stage I don't get any results?

In order for the transistor to function, the DC voltages must be present. If you don't get results when driving the H.O.T directly, check the

regulated B+ at the collector of the output transistor.

Are there any horizontal circuits (or situations) that I should not attempt to drive with the VA62?

There are a couple of conditions where you should use extreme prejudice before driving.

One: If the TV is in shutdown and you bypass the shutdown circuits by driving the H.O.T., you may damage the TV, or test equipment. Always troubleshoot TVs that are in shutdown at a lower (90 VAC) voltage.

Two: If the TV uses trace and retrace SCRs in the output, only drive the retrace SCR with the HORIZ SCR DRIVE signal. Do not drive the gate controlled switch used in some Sony TVs. If the TV uses a form of pulse width modulation in the horizontal output, only drive as far as the drive transistor.



You Can Walk Troubles Out Of RGB Monitors With Your VA62 Universal Video Analyzer™

by Larry Schnabel, Applications Engineer

needed to keep digital or analog RGB monitors running and in sync while you use the VA62 to analyze the trouble to a single stage . . . without disconnecting components.

What Is An RGB Monitor?

Before we start walking through RGB monitors with your VA62 and RG67, a short review is in order. An RGB monitor is similar to a TV receiver except for the lack of a tuner and an IF section. RGB monitors accept separate red, green, and blue video components for display on the screen. The advantage of RGB monitors is greater resolution. The challenge is to supply the necessary signals for operation and troubleshooting.

The last part hit the bottom of the plastic bag; you're ready to junk the parts, RGB monitor, schematic and all. Just then, a customer walks in carrying a 13 inch TV, or so you think. As he gets closer to the counter, however, you can see that this 13 inch TV is not actually a TV. It's another RGB monitor . . .

RGB monitors are especially tough for servicers. They're a special challenge — actually, they're the first consumer product you've seen that uses up to six input signals: red, blue, and green video, horizontal and vertical sync, and an intensity line. Your VA62 can drive one or two inputs, but it can't drive them all at the same time and still let you troubleshoot — unless you have the RG67 NTSC Video Monitor Adapter. That's why some RGB monitors sit on the shelf . . . waiting to be serviced.

If you could just get them up and running long enough to inject your VA62 drive signals and watch for improvements on the CRT, you could repair them in no time. You'd troubleshoot the power supplies, high voltage circuits, focus supply, sweep, video, audio, and sync just like you do with TVs.

RGB monitors *are* different. That's why we built the RG67, so you could update your VA48 or VA62 Video Analyzer and expand into monitor service. The RG67 gives you all the signals



Fig. 2: The RG67 NTSC Video Monitor Adapter keeps digital or analog RGB monitors running and in sync while you troubleshoot with your VA62.

“The RG67 NTSC Video Monitor Adaptor keeps digital or analog RGB monitors running while you use your VA62 Universal Video Analyzer to troubleshoot . . .”

Your VA62 solves RGB monitor analyzing problems by letting you test the monitor during full operation. Simply hold the RGB monitor's circuits in sync with the RG67 while you functionally analyze the problem down to a single stage with your VA62.

The only input the RG67 needs is composite video from the VA62's VCR STANDARD jack. With the RG67 supplying signals to the RGB monitor's input jacks, your VA62 is free to divide and conquer any problem in any stage of the monitor.

Dividing And Conquering RGB Monitors

Troubleshooting RGB monitors is similar to troubleshooting TV receivers. The basic circuits are the same. These include power supplies, high voltage circuits, focus supplies, sweep circuits, video circuits, audio circuits, and sync. Let's look at RGB servicing by walking through an example.



Fig. 1: A special adapter cable such as the 39G206 D 9-pin test lead lets you hook up directly to the RGB monitor.

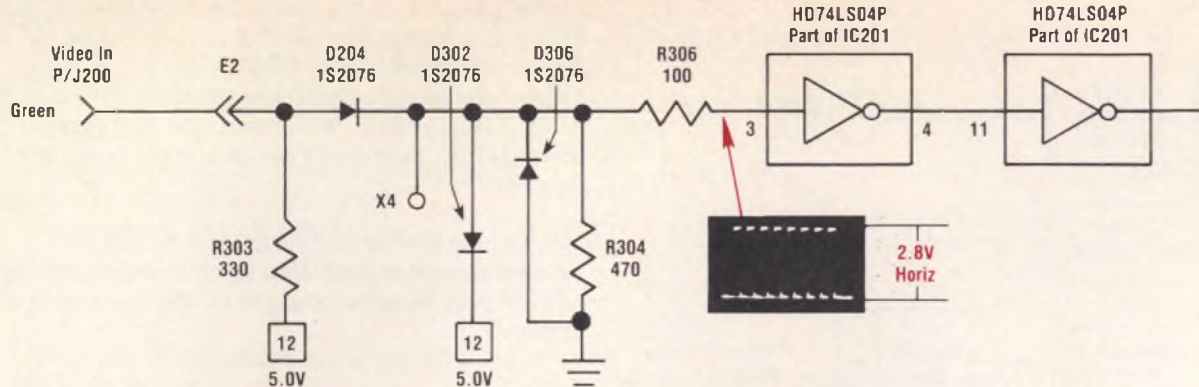


Fig. 3: The video input level shown on the schematic is 2.8 VPP. Simply adjust the RG67's OUTPUT LEVEL knob for the correct level.

The first thing you have to do is give the RGB monitor a performance test and confirm the symptoms. In our example, the customer said the picture is blurred and at times the color isn't quite right. This sounds like a problem that could be practically anywhere, right?

A look at the monitor's back panel reveals that the input jack is the "D 9-pin" type. You'll use the optional "D 9-pin" test cable to hook the RG67 to this monitor.

A quick check of the service literature shows that this monitor needs positive video and negative composite sync. You simply set the RG67 POLARITY SELECT buttons for positive video and negative composite sync.

The video input level shown on the schematic is 2.8 VPP. Simply adjust the RG67's OUTPUT LEVEL knob for the correct level.

Since this is a digital monitor, it might use the special intensity line. A look at the schematic confirms your thoughts, so you turn the RG67's INTENSITY line on to match the monitor's normal operation and you're ready to test.

Wait a minute, what about the VA62? Choose the video pattern and hook the VA62's VCR STANDARD jack to the RG67's COMPOSITE VIDEO IN jack; the RG67 does the rest. Your VA62 is free to use for signal injection while the RG67 keeps the monitor's good stages in sync.

A quick performance test gives you some interesting results. With the VA62's MULTIBURST BARSWEEP pattern chosen, you see that the monitor's picture is indeed blurred, but not as bad as you thought it would be. The gray scale looks like it may be off, though.

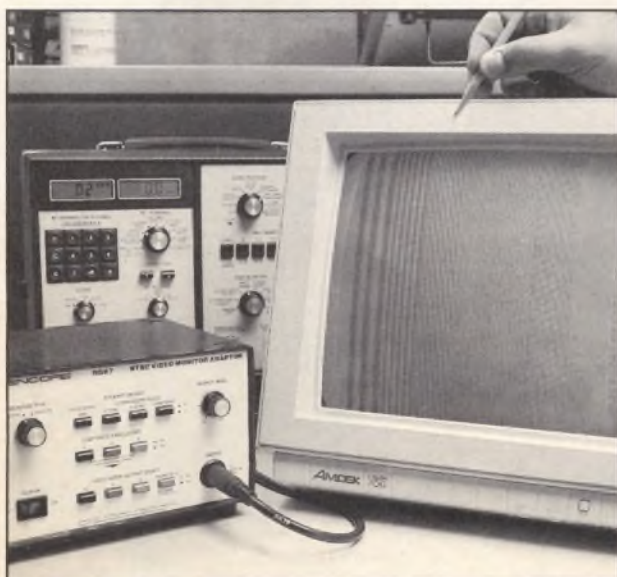


Fig. 4: Injecting at the emitter of Q852 brought the green video back, so you need to move back a stage.

Perhaps testing one color at a time will help. Sure enough! Testing the red and blue individually (the RG67 lets you this by pushing a button) shows good sharp video. But, when you test the green alone, the little video that is there is

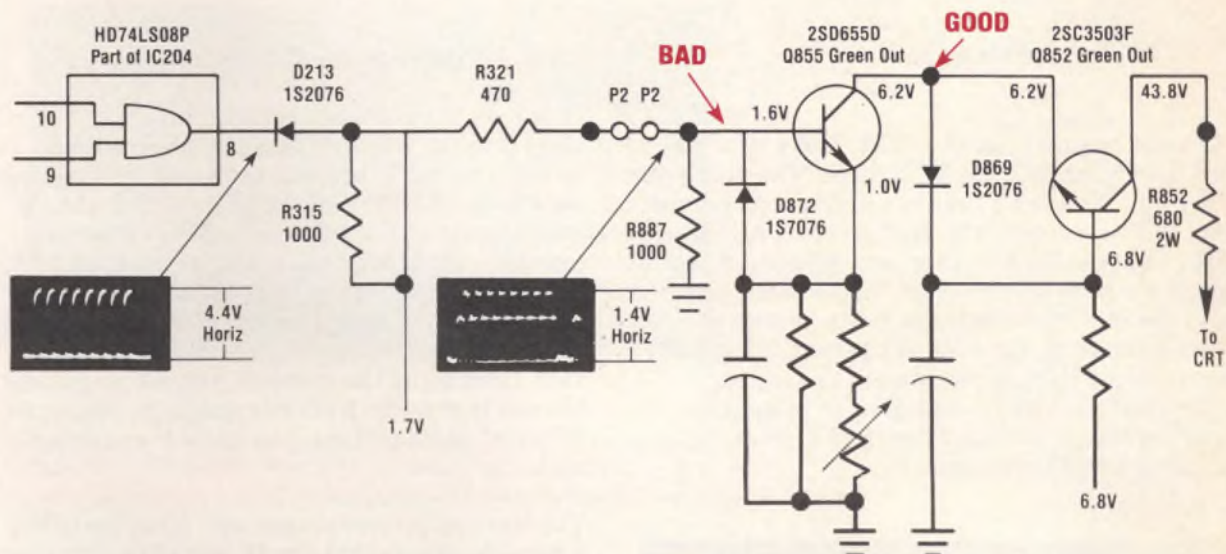


Fig. 5: Injecting at the collector of Q855 brought the green back. But, injecting at the base didn't. Is this transistor bad?

blurred. The customer's symptom agrees closely with the performance test.

With the symptom firmly in mind, take the case off and make a thorough visual inspection. Check the power supplies with the VA62's digital DC voltmeter. They check good, so it's time to divide and conquer the problem with your VA62.

Pin 8 of IC204 seems to be the midpoint in the green video path. This is the logical point to inject the VA62 drive signal. All you need to do is replace the in-circuit signal with a known good signal of the normal level, 4.4 VPP in this case, and watch the CRT for improvement. Injecting the VIDEO PATTERN drive at the green output of this chip shows no improvement in the symptom. That means the problem must lie between the green output and the CRT.

Next, inject a signal at the base of the green output driver transistor, Q852. Injecting at this point brings the green back to the CRT. Is the problem between Q852's base and IC204 pin 8?

Moving a stage back, inject at the base of Q855. No improvement? Move to the collector of Q855 and inject there. The green pops back on the screen.

Ah-ha. You're pretty proud of yourself thinking you found the problem this fast. You check the transistor, Q855, in circuit with your TF46 Super Cricket and hear no chirping. Time to replace the transistor, right? Well, upon removal you discover that the transistor checks good out of the circuit.

Now what? The green video signals are not

getting through Q855. If the transistor tests good, what else could it be?

After you put the transistor back in the circuit, you do a DC bias check on the transistor. The VA62's digital DC meter shows the transistor is biased off. Now what could be causing this problem?

A close check of the schematic shows a diode across the base-emitter junction. An in-circuit ohmmeter test across this diode shows a resistance of 12 ohms in both directions.

Pulling one side of the diode out of the circuit lets you test it "proof-positive" with your TF46 Super Cricket. Whew! The Super Cricket showed leakage in both directions — a bad diode indeed.

There's only one more step: Replace the defective diode. After replacing the diode, you breathe a sigh of relief. It brought back the green as sharp and bright as new.

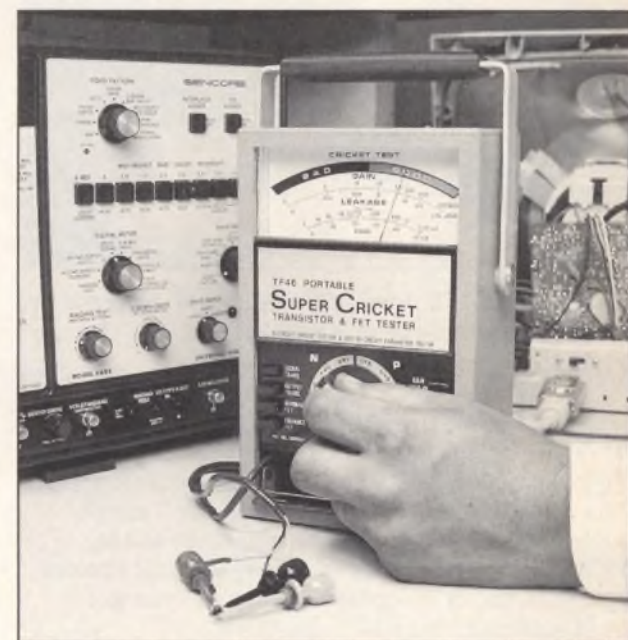


Fig. 6: A leaky diode caused the transistor to shut off, not allowing the green signal to pass through the stage.

Prove It To Yourself

The best way to become familiar with divide and conquer and signal substitution in RGB monitors (and TVs as well) is to begin by injecting substitute signals into various circuits of an RGB monitor that you know is working.

Have questions about this article, your VA62, or RG67? Call 1-800-843-3338 and ask for your Area Sales Engineer; he'll be glad to help. ■

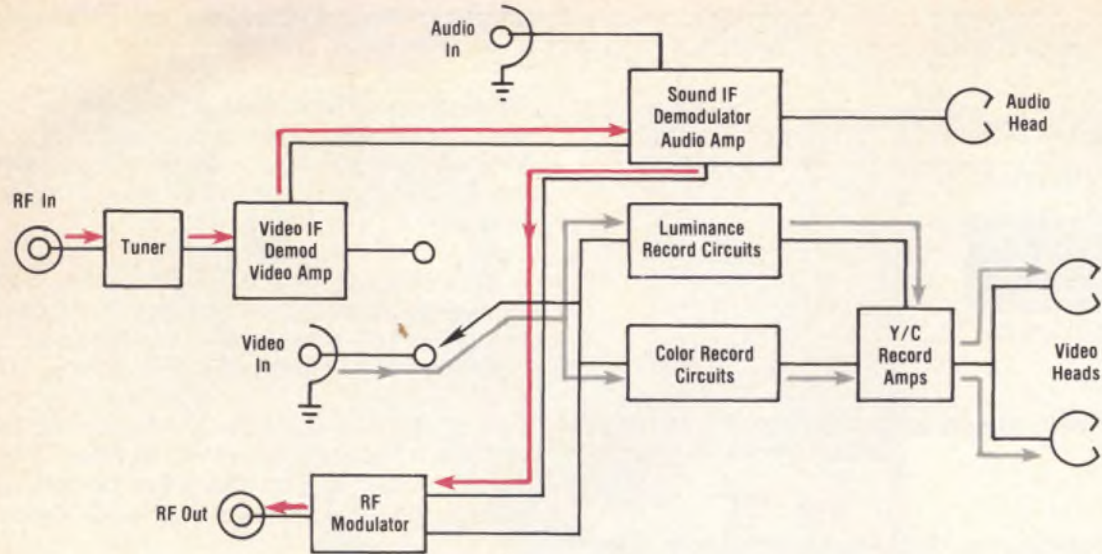


Fig. 5: An audio tone from the speaker verifies that the sound signal path is working, including the tuner and part of the IF signal path.

(continued from page 11)

VA62 and channel 3 on the VCR. Make sure the TV/VCR switch is in the VCR mode. The problem shows up: "You can't tune in a picture on channel 3 on the VCR tuner." You turn on the VA62's audio, tune the VCR's tuner, and get a good audio tone. What does this tell you? Apparently, the audio channel from the tuner to the output is working properly. Looking at the block diagram (Figure 5), notice that the presence of audio proves that the tuner is on the right frequency and at least a part of the IF section is working. You have a video problem.



Fig. 6: The VA62 provides a series of patterns to test the performance of a VCR.

Connect a cable from the VA62's VCR STANDARD jack to the VCR's video input jack. You already know that you can get audio through part of the circuit. However, to be sure, simply connect the VA62's audio drive signal to the VCR's audio input jack (with the TV still hooked up). Turn the drive control up so that you get good audio out of the TV speakers.

Now, using the 1 VPP video signal, you get video on the monitor and audio from the speaker. Are the recording circuits working? Place a blank tape in the VCR and press the record and play buttons. After recording a short length of tape, rewind it and play it back. Now, you get good video and audio from the tape. Can you see that you have proved that the record circuits from the video and audio input jacks to the tape are working properly?

You have learned that a signal fed into the Video input jack can be recorded. A signal fed into the tuner, can not. The block diagram (Figure 7) shows that the problem is between the RF input and the VCR input jacks. The bad stage is in the

tuner, IF amplifiers, video detector, or video amplifiers...

Let's find out which of these remaining four sections is bad. Eliminate the tuner by injecting a signal into the input of the IF amplifier section. Disconnect the tuner from the IF section and connect a cable from the VA62's RF/IF OUTPUT jack to the input of the VCR IF section. Next, place the RF/IF signal switch on the VA62 to the 45.75 MHz position and the audio switch to 1 kHz. Looking at the monitor, you see no picture but can hear audio from the speakers. Since you still can't get a picture, you know the problem is not in the tuner.

You have only three stages left. A review of the schematic shows that the IF and video detector are in one chip. You might suspect the IC and go ahead and replace it. But, let's check this out a little closer. Notice that pin 16, on this particular IC, is the video output. Inject a video signal at pin 16 and see what you get. You still don't get a picture on the monitor? The problem is after pin 16.

Looking again at the schematic, you see a video amplifier transistor, Q703, and a 4.5 MHz trap between the IC video output and the video output

on the board. Inject a video signal at the collector of Q703. Finally, you see video on the monitor. When you inject at the Q703's base, there's no video. You have isolated the problem to the bad stage. Grab your TF46 Transistor Tester and check Q703. No gain? Then you have found the culprit!

Notice how divide and conquer functional analyzing systematically cut this problem down to size, just like the example of the worm in the apple.

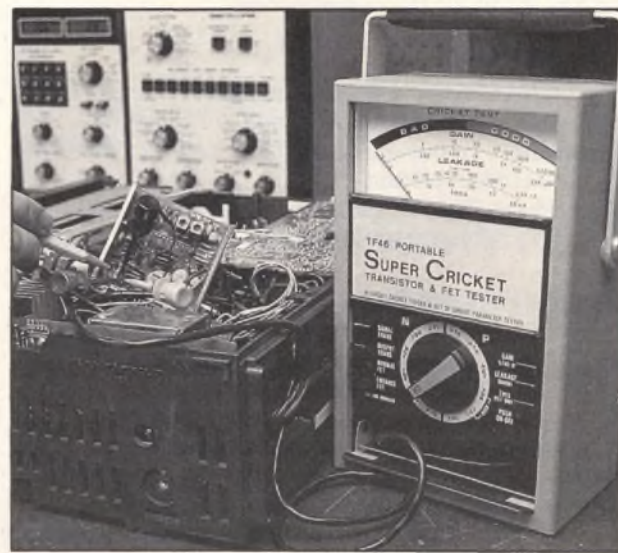


Fig. 8: The final stage of divide and conquer functional analyzing is to check the few remaining components of the identified bad circuit.

If you haven't tried your VA62 on VCRs, take a little time and try it. To get used to the divide and conquer functional analyzing technique, use a good VCR and inject the VA62's signals into various stages. This will help you recognize the signals that you should see at each test point. Once you have a little divide and conquer experience, try it on the next VCR that comes in for service. Have questions? Need more information? Call your Area Sales Engineer 1-800-843-3338.

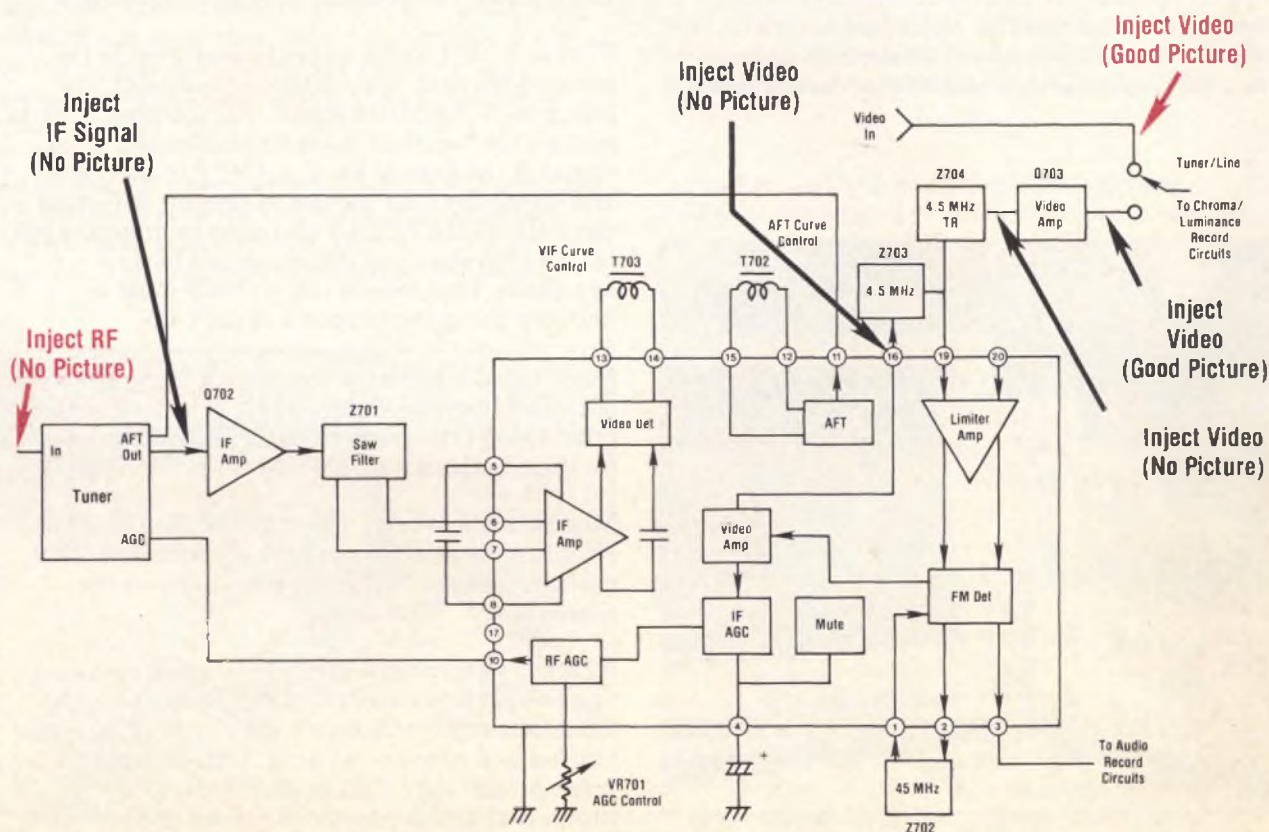


Fig. 7: A few final signal injections locates the smallest defective stage.

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- **How to isolate frustrating shutdown problems in 5 steps or less:** See how you can locate tough shutdown problems with pin-point accuracy. Exclusive troubleshooting techniques will bring any chassis out of shutdown and turn those "tough to find" shutdown problems into a quick servicing job.
- **How to dynamically analyze any VCR head or head circuit problem with 100% reliability:** See how special substitution signals isolate VHS, BETA, or U-Matic problems with 100% proof positive results.
- **How to walk through any VCR system control problem with a simple 5 step micro-processor troubleshooting technique.**
- **How to determine if a cap or coil is simply good or bad, easily and with 100% reliability:** See how the NEW triple-patented, microprocessor controlled LC77 "AUTO-Z" locates bad caps or coils at just the push of a button.

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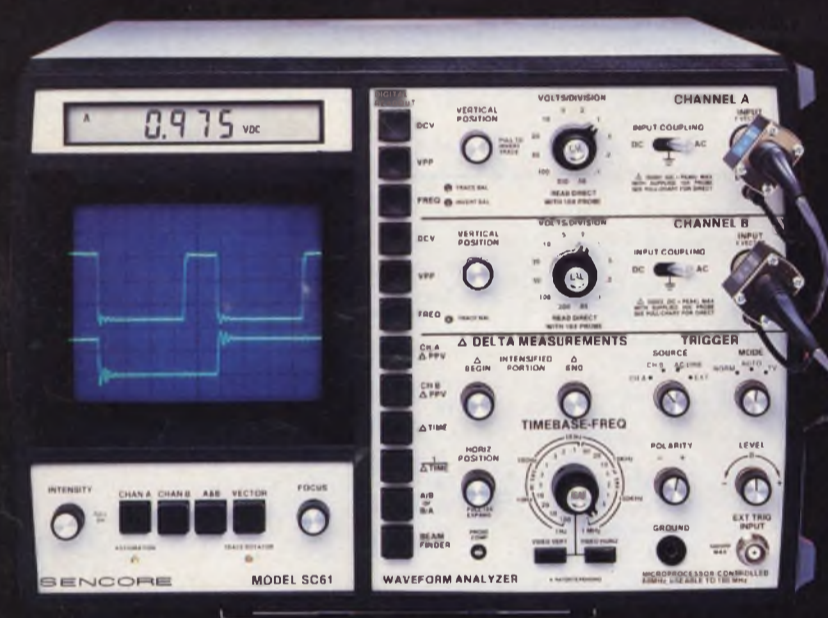


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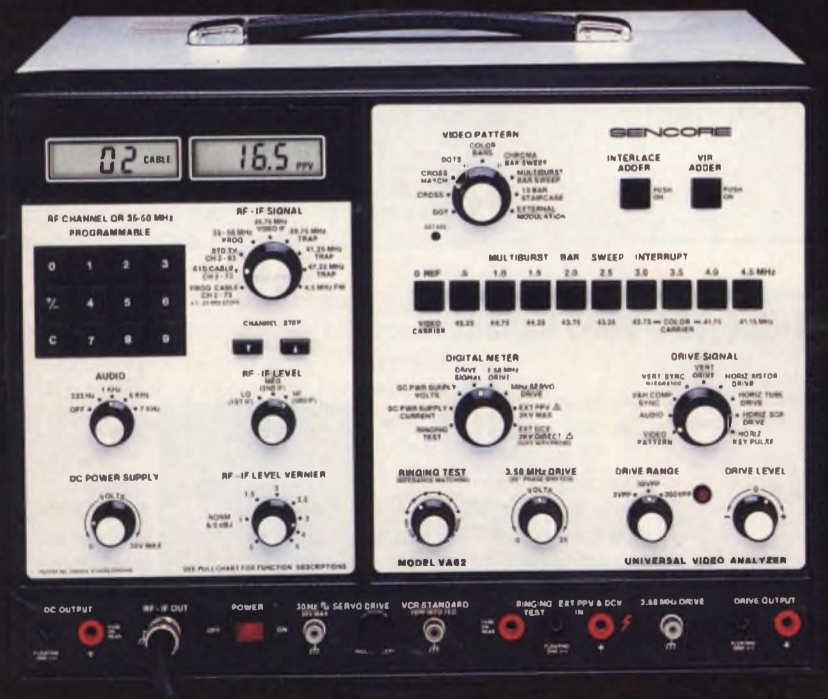
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MONDAY AFTERNOON
5:30 AM...



SENCORE

Discover The Power Of The Ultimate Troubleshooting Team!

The SC61 Waveform Analyzer and VA62 Universal NTSC Video Analyzing System, team up to conquer tough service jobs, and speed up routine troubleshooting and alignment jobs. These powerful instruments allow you to double your troubleshooting productivity and double your servicing profits.

The SC61 gives you high performance bandwidth, useable to 100 MHz, so you can troubleshoot all of today's circuits, plus circuits that will be introduced in the future. Hi-voltage protection allows you to connect to the output of the horizontal output transistor with confidence to track down hard-to-find high voltage problems. Plus, the SC61 features rock-solid sync readout of every circuit measurement you need to make.

The VA62 Universal NTSC Video Analyzing System, provides you with a proven method of signal injection to track down the defective stage . . . fast. Using the concept of divide and conquer, you can isolate a defective circuit in less than half the time you now spend. Plus, the VA62 provides you with patented signals that allow you to thoroughly performance test and align today's tough video circuits.

Discover the power of the Ultimate Troubleshooting Team, Call WATS Free 1-800-843-3338, and ask for additional information.

Or, request additional information on the Update '88 Response Card on page 28.

The Ultimate Troubleshooting Team is backed by our no nonsense 30 day "Proof Of Performance" Guarantee.

"If you're not 100% satisfied with the performance of your Sencore instrument, return it within the first 30 days for a full refund, including freight both ways, and you'll own nothing."

You're always assured that you've made the right decision when you say "Yes" to a Sencore Investment.

ADDED BONUS! Save up to \$1,814 when you invest in the Complete Video Update Bench! See the update '88 Flyer on page 16 for more details.

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The Z Team Offers You Three Choices To Conquer Your Tough Cap/Coil Problems



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\$995 Exclusive Triple Patented
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No matter what the problem or where the problem, the Z team gets the job done - fast!

LC75 Z METER 2™

The LC75 gives you cap/coil and special component problem solving capability at a bargain price.

The LC75 tests capacitors for the four ways they fail. Test **Value** from 1 pF to 200,000 uF and test **Leakage** at rated voltage up to 600 Volts. Plus, test for **Dielectric Absorption** and **Equivalent Series Resistance (ESR)** . . . all at the push of a button.

Pinpoint a defective inductor (even with a single shorted turn) with the inductance value test and the patented Sencore "Ringing Test."

Zero in on leakage in switches, PC boards, and connectors all the way down to one microamp. Plus, test SCRs and Triacs, and locate shorts or opens to within feet in transmission lines.

Save \$168 with a FREE SCR250 Accessory!
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If the person on the label is no longer with your organization, this should be routed to his replacement or superior.

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LC77 AUTO-Z™

The top of the line! Why guess if a capacitor or coil is good or bad, let the LC77 make the decision for you! Enter in the parameters printed on the side of the component (or on the schematic) and simply press the button. The LC77 automatically reads the value and displays "good" or "bad"; no more guesswork!

Test capacitors from 1 pf to 20 F and inductors from 1 uH to 20 H. Measure resistance up to 1,000 megohms with up to 1,000 volts applied and leakage current down to 1 microamp. Plus, test Dielectric Absorption and ESR. The LC77 is both battery and AC operated so you can test caps, coils and special components wherever you do component testing.

Save \$524.95 on the LC77 AUTO-Z!
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Take your cap/coil analyzing abilities into the field to fully test those tough-to-find problems, anywhere!

The LC76 gives you the same exclusive tests as the LC75 wherever you do cap and coil testing with portable, battery/AC operation. An extra applied voltage range lets you test for leakage all the way up to 1,000 volts applied.

Save \$326.95 on the LC76 PORTA-Z!
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