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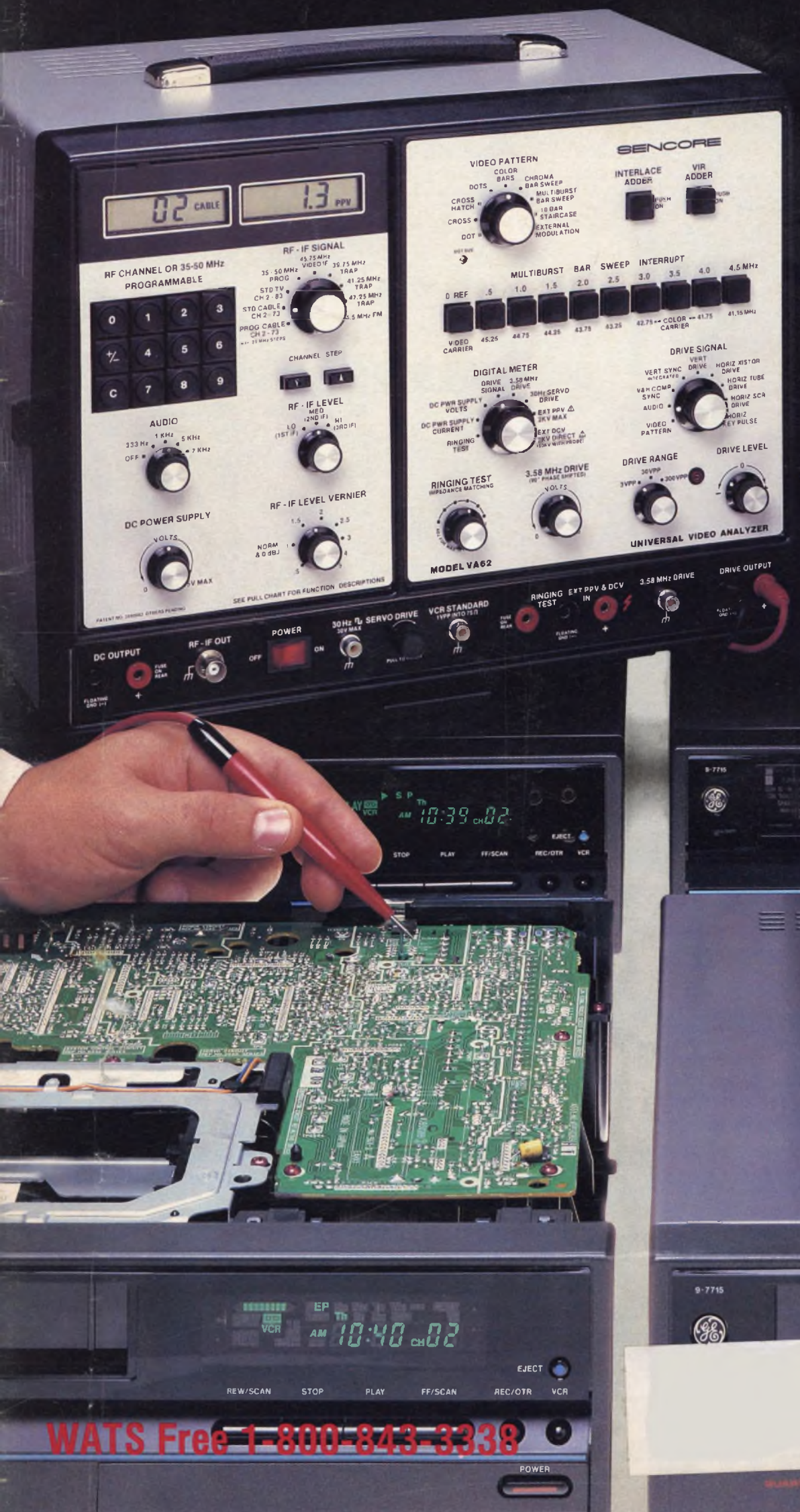

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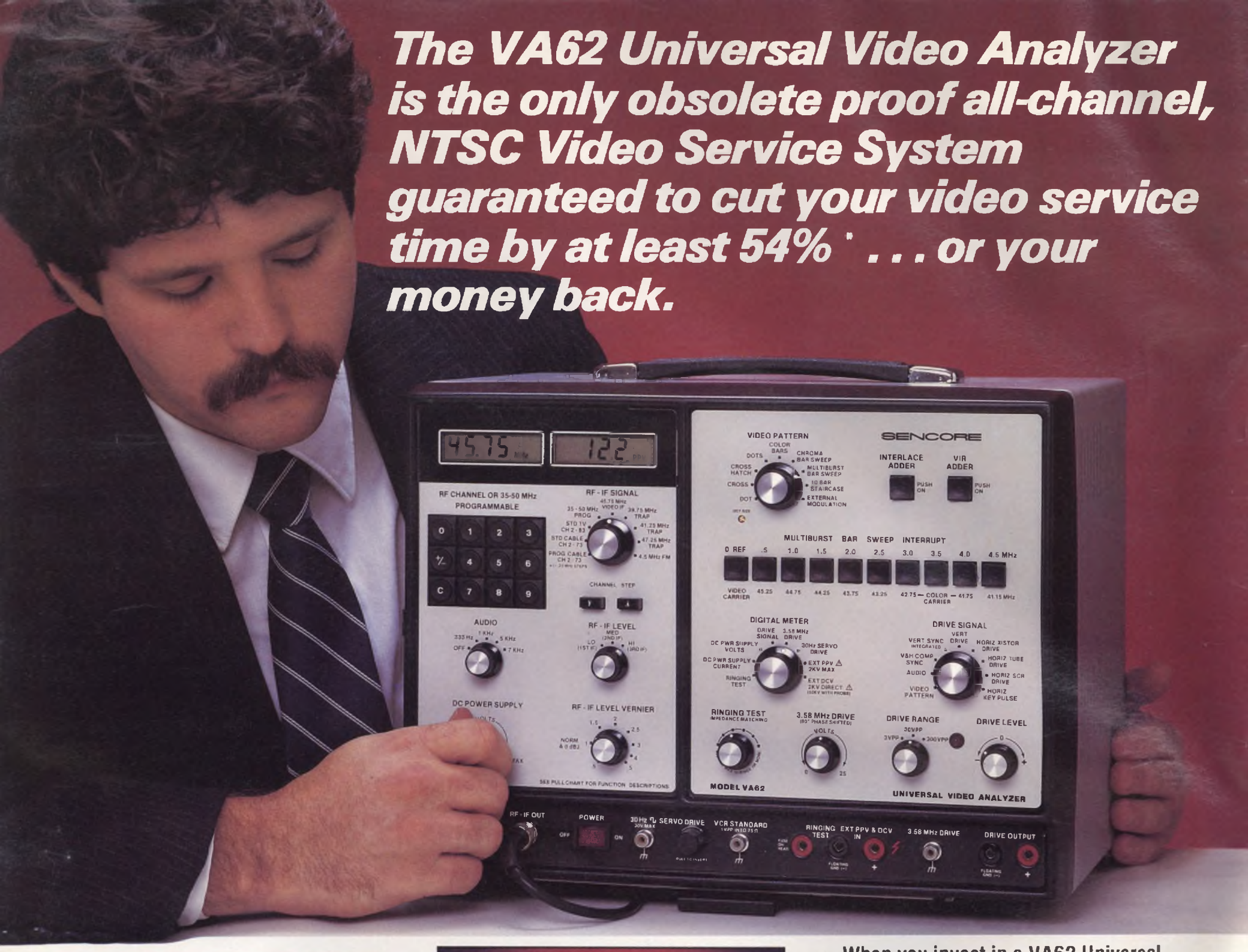

VC63 VCR Test Accessory - Update your VA62 for VCR service with phase-locked VCR substitution signals. (See page 26 for more information.)

ST65 Video Analyzer Stereo TV Adder — Update your VA62 or VA48 Video Analyzer for today's New MTS Stereo TVs and VCRs (See page 3 for more information).

NT64 NTSC Pattern Generator - Update your VA62 with full-field and split-field NTSC color patterns for VCR and warranty service.

RG67 NTSC Video Monitor Adaptor - Update your VA62 or the VA48 Video Analyzer and expand into analog/digital RGB monitor service.

When you invest in a VA62 Universal Video Analyzer, you not only cut your video troubleshooting time by at least 54%, you make an investment in your future with an obsolete proof instrument. Expand into NEW profit generating services like VCRs, Stereo TVs and VCRs, and RGB Video Monitors with easy to add accessories.

Are you encountering NEW service opportunities and already own a VA62? Expand your horizons and select the applicable accessory. Then call your Area Sales Engineer WATS FREE.

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* Based on a survey of servicers using the VA62 Universal Video Analyzer techniques over previous methods.

Expand Your VA62 Or VA48 Video Analyzer With The ST65 Video Analyzer Stereo TV Adder . . .

by Tom Schulte, Application Engineer

In March of 1987, EIA predicted that stereo TV sales would jump 60%. The networks are serious about stereo TV; you've seen the advertisements; stereo programs are even identified for the viewer. With technology advancing at such a fast pace, how can you keep up in your present service business — let alone handle *new* video service opportunities like VCRs, stereo TV, and Video Monitors?

Knowledge and efficiency are the secrets to profit in comsumer electronic service. You must continue to study, plus acquire the test instruments that can help you meet your customers' service demands. You expanded your service business when VCR sales showed rapid growth; now you have the same growth opportunity in stereo TV service.

Over 6,382 successful servicers are using the VA62 Universal Video Analyzer and its accessories to provide the special signals and test capabilities needed to expand their business. When Sencore developed the VA62 Universal Video Analyzer, our engineers made sure that it contained everything you needed, and nothing more. But, they also made sure that the VA62 could be expanded as your service opportunities grew, thus making the VA62 the only "obsolete proof" video service instrument on the market. The VA62 is really an expandable miniature TV station that provides all the basic signals that you need to service TVs, VCRs, and monitors. (Figure 1).

With so much capability in the VA62, and so much going on in our industry today, it was hard to pick the one topic to concentrate on in this article. Fortunately, your calls and concerns about updating your VA48 or VA62 for stereo TV provided the answer. Of all the new servicing opportunities, we'll discuss the one you're starting to see and hear more about; MTS Stereo TV.

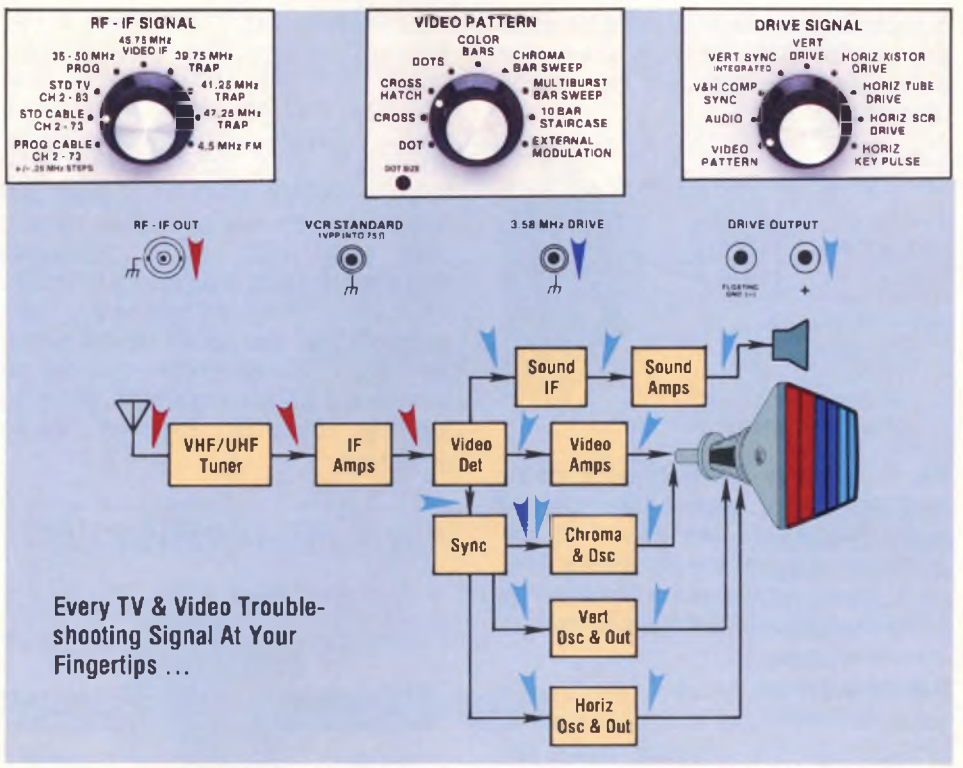


Fig. 1: The VA62 is really an expandable miniature TV station that provides all the signals you need to service TVs, VCRs, and monitors. Simply select the RF-IF SIGNAL, VIDEO PATTERN or DRIVE SIGNAL and substitute known good signals into the suspected stage.

Getting into stereo TV service means that you'll soon be unpacking your new ST65 Video Analyzer Stereo TV Adder. Let's take a look at some of the features you'll like about your new analyzer.

Now You Have All The Special Signals, Plus The Output Impedance And Modulation Needed For Successful Stereo TV Service.

Substitute signals: MTS generators should have an audio output capable of supplying substitute signals for injecting into the audio stages, including the input of the dbx® decoder or matrix (Figure 3). Phase problems in these circuits can be almost impossible to locate by probing with an oscilloscope. Only a phase-locked audio troubleshooting signal can give you the information you need to troubleshoot the Stereo TV decoder and matrix. Plus, you'll need your audio signal to prove the audio amplifiers are good.

Low impedance output: Only a specially designed low impedance output can give you the flexibility you need in signal substitution. It lets you supply the proper signal levels to any suspected circuit, including those that use composite audio (Figure 3). With the proper drive impedance, you'll find the bad circuits without suspecting and spending valuable time on the good ones.

Modulation level: What do you think happens when you test the performance of an MTS Stereo unit with other than the proper modulation? To find out, and to prove that we've provided the right signals, Sencore engineers tested every kind of MTS Stereo system they could find. They proved, beyond doubt, that only one modulation scheme lets you performance test MTS Stereo 100% of the time without error. Plus, these same engineers tested every competitive generator available against actual stereo broadcast equipment and precision demodulators; result? No other generator tested was able to fully and accurately test MTS Stereo like your new Sencore generator. Simply put, without the proper signals, output level, impedance, and modulation, you just can't trouble-shoot efficiently.

(continued on page 6)

Fig. 2: The New ST65 Video Analyzer Stereo TV Adder can update your VA48 or VA62 Video Analyzer for stereo TV and VCR service. It has the special substitute signals, outputs, and modulation needed for successful stereo service.

Learn How The SC61 Waveform Analyzer Ends VCR Servo Troubleshooting Guesswork

by Rick Meyer, Application Engineer

VCRs are now commonplace in homes, businesses, and schools. Last year, the Electronics Industries Association reported that there were over 30 million VCRs in use in the United States. The industry estimates that an additional 14.6 million VCRs will be sold in 1987, bringing the total to over 44 million by the end of the year.

For you, as a servicer, VCR servicing provides a wealth of additional income. To make money in VCR servicing, however, you need to understand how they work and develop ways to quickly repair them. Recent price decreases in the VCR market, due to efficiencies in manufacturing and marketing, make it important for the servicer to become more proficient and efficient in his servicing techniques.

As our Applications Engineers travel throughout the country presenting technical demonstration seminars, they find that VCR servo troubleshooting is giving many servicers difficulty. In the last issue of the Sencore News, Neil Graham, a seasoned VCR servicer, showed how VCR servos work. In this issue we will give you some additional servo troubleshooting techniques.

Knowing How VCR Servos Work Is The Key To Effective VCR Servicing

Let's look at how a servo system works. A servo circuit is a closed loop (Figure 1). The heart of any servo system is the motor. It is monitored, and its input signals adjusted, to ensure that it operates at precisely the correct speed. To do this, a sensor monitors the rotation of the motor. The signal from the sensor and external reference signals are fed into control circuits that provide an output correction signal. This correction signal is then fed to the motor drive circuit and the motor is either speeded-up or slowed-down. As you can see, a complete (closed) loop is formed. If any part of this loop fails, the motor either stops or does not run at the correct speed.

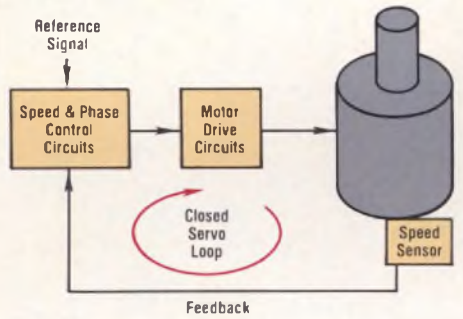


Fig. 1: A servo consists of a motor and its control circuit. The control circuits compare the speed of the motor with a reference signal and then make adjustments needed to bring the motor to the right speed.

All VCRs have two servos: a capstan servo and a cylinder servo (Figure 2). The capstan pulls the tape through the VCR and across the record/playback, audio, and CTL heads. The rate at which the tape is pulled through the machine is critical. Thus, a servo circuit is used to monitor the movement of the tape and provide correction signals to either speed-up or slow-down the capstan motor.

The video heads, and hi-fi heads in hi-fi VCRs, are located on a spinning drum, or cylinder, which must also turn at the correct speed. In addition, these heads must travel along a narrow path that is only 50 microns (0.002 inches) wide. Thus, a servo circuit is also used on the head cylinder to help it track precisely along this narrow track.

In VCRs, there are actually two closed loops for each servo: a speed loop and a phase loop. The speed loop provides the proper signal to turn the motor at the correct relative speed. The phase loop provides minute corrections to this signal to make fine corrections in the speed of the motor. A defect in either loop will cause the VCR to work incorrectly.

Proper Service Equipment (and a home-made test tape) Can Speed Your Servo Troubleshooting

In servicing, proper tools increase your troubleshooting efficiency. This is true for servicing the servo systems as well as the other circuits in VCRs. To start with, you need a good test tape. Don't use a factory alignment tape; defective VCRs have a nasty habit of "eating" tapes. Instead, record video test patterns and an audio tone (from your VA62 Universal Video Analyzer) on a good quality tape using a known good VCR that has been properly aligned. Record the test tape with short segments recorded at each tape speed (EP, LP, SLP, etc.). These segments are used to check out the speed detect servo circuits. The audio tone recorded on the tape, 1 kHz for example, helps to quickly identify capstan servo problems.

You'll need an oscilloscope to look at waveforms, a DC voltmeter for checking DC servo voltages, and a frequency counter. Your Sencore SC61 Waveform Analyzer includes all of these instruments in one package. Plus, it lets you make digitally accurate DC voltage, peak-to-peak voltage, and frequency measurements at the touch of a button, and *with only one probe hooked up.* The SC61 is designed for video work and quickly locks-on any signal you may need to look at when servicing VCRs.

Reduce False Starts By Quickly Identifying Which Servo Is At Fault

To start with, you must determine if the VCR will operate in the play mode. The VCR must be able to play a prerecorded tape. If it will not *play* a prerecorded tape it won't properly *record* a tape either.

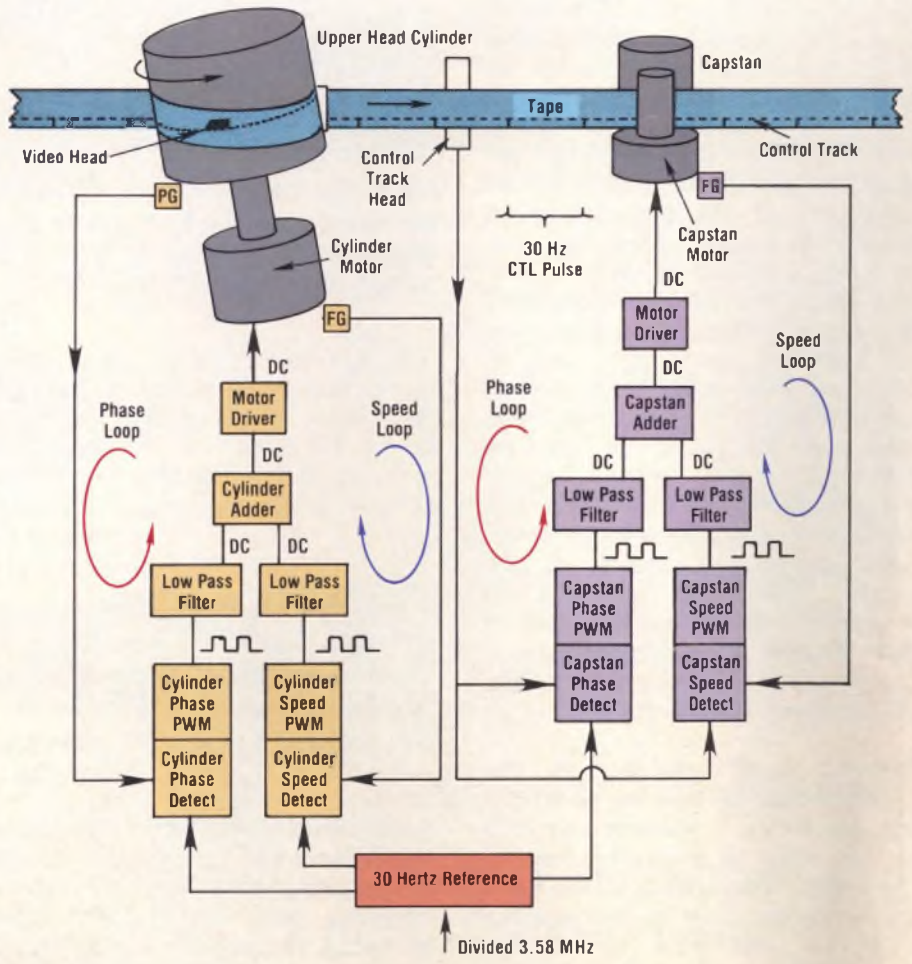


Fig. 2: A VCR has two servos; the capstan servo and the head drum servo. In addition, each servo also has two control loops; the speed control loop and the phase control loop.

SYMPTOM	POSSIBLE SERVO LOOP
Horizontal Flicker	Cylinder Phase Servo Loop
No Horizontal Sync	Cylinder Speed Servo Loop
Audio Wow & Flutter	Capstan Speed Servo Loop
Slow Sound	Capstan Speed Servo Loop
Fast Sound	Capstan Speed Servo Loop

Fig. 3: Learning these typical servo symptoms and their probable causes will help you identify VCR servo troubles faster.

Figure 3 shows typical symptoms of servo problems and shows which servos could be causing those symptoms. Let's look at how to troubleshoot a servo circuit.

With the VCR connected to a TV, play your prerecorded test tape and watch the picture as the different segments of the tape are played. If the VCR has a defective speed detect circuit, it will only play at one speed or not at all. As you watch the picture, also listen to the audio. The audio tone, recorded on the tape, should be heard from the speaker on the television and be at the correct frequency. The tone gives you a good indication of how well the capstan servo circuits are working. If the audio sounds good and is at the right frequency, you know that the capstan is pulling the tape through the VCR at the correct speed. If the tone sounds too low or high in frequency, then the capstan servos need to be looked at.

NOTE

For the procedure below, you are observing the video coming directly off the video heads. VCRs that use digital freeze frame effects, however, display the information stored in *memory* when pause is selected. In these VCRs you do not see the information coming from the video heads. Therefore, the procedure will not work. The other troubleshooting tips described in this article can still be used with digital VCRs, however.

Next, place the VCR in the pause mode. This stops the capstan and, therefore, the movement of the tape through the machine. This step checks the operation of the cylinder servos. In a properly working VCR, the picture will lock up. You may see noise bars and the color may not be present, but the picture should be in sync.

For Important Troubleshooting Clues, Watch How The VCR Loads Your Test Tape

One common symptom, is the VCR that loads the tape and then unloads it again. This may be caused by a system control problem or by a servo problem. If the VCR you are working on exhibits this condition, watch what happens as the tape loads. In a properly operating VCR, the cylinder motor should start to rotate as soon as the tape starts to load. If the cylinder motor does not turn, safety circuits in the system control will unload the tape and return the VCR to the stop mode. If the cylinder motor does turn, and the VCR unloads the tape, suspect a system control problem or a bad safety switch.

Key Measurements Help You Troubleshoot Capstan Problems Quickly

The capstan servo controls how fast the tape travels across the heads. Six different types of signals are needed for proper capstan operation:

1. System control signals (Pause, FF, REW, Slow).
2. CTL Pulse to define the location of the tape.
3. FG Pulse to define the rotation of the capstan.
4. 3.58 MHz clock divided down to a 30 Hz reference.
5. Speed and Phase Pulse Width Modulated (PWM) signals.
6. DC servo control voltage to the motor.

If any one of these signals is incorrect or missing, the capstan servo will not operate properly. You can quickly and accurately analyze all of these signals for DCV, PPV, and Frequency with your SC61 using only one probe hookup. Lets look at an actual VCR repair problem to see how to troubleshoot the capstan servo system.

How To Troubleshoot The Symptom Of A Pulsating Picture

The customer brought this VCR in with the complaint that the picture pulsed on and off. Slipping the test tape in and pressing play brought the VCR to life. The tape loaded properly and a picture came on the TV. But, just as the customer indicated, the picture slowly pulsed in and out. It looked good for approximately 10 seconds and then a noise bar moved through the picture. The audio, however, sounded close to the correct pitch.

Putting the VCR in the pause mode produced a locked-in picture with a noise bar part way through it (Figure 4). Except for the noise bar, the picture no longer pulsed in and out.

What do these initial observations tell you? First, the audio tone indicates that the capstan is turning at the correct relative speed. Second, the ability to see a clear picture for several seconds proves that the heads, luminance and color circuits are working properly. Third, placing the VCR in the pause mode eliminated the pulsing in the picture. This tells you that the problem is in the capstan servo.

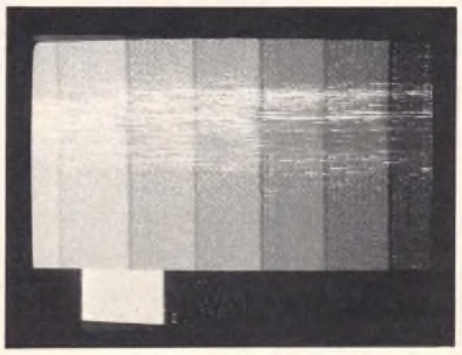


Fig. 4: If a clear picture is observed on part of the screen, suspect a servo problem. If the picture clears up (except for a noise bar) when the VCR is placed in the pause mode, suspect a capstan servo problem.

But wait! Didn't you hear an audio tone from the speakers of the television? Yes, this confirmed that the capstan was operating at the correct *relative* speed but it did not verify that the capstan *phase* circuit was working.

The capstan phase circuit uses several signals to reference the position of the tape to the rest of the system. The two main signals are the CTL pulse and the 30 Hz reference signal. When a VCR tape is recorded, a 30 Hz reference signal is recorded along the lower edge of the tape. The CTL head picks up this signal and tells the VCR where the tape is at any instant of time. As Neil Graham emphasized, in his article in the last Sencore News, *tape buildup on the CTL head can reduce the size of this signal and cause servo problems.* The second signal that the capstan phase circuit needs, is an internal 30 Hz reference signal. During playback, this signal is derived from the 3.58 MHz reference signal.

Before troubleshooting, a good cleaning ensured that there was no tape buildup on heads or guideposts in our troublesome VCR. This residue could cause increased drag on the tape resulting in the VCR's inability to run properly. After cleaning, there was no difference in the VCR's performance.

How Were The Troubles Discovered In This VCR?

A quick check of the capstan servo circuit was needed. Connecting the SC61 Waveform Analyzer probe to analyze the CTL pulse resulted in the waveform shown (Figure 5). The pulse proved to be good. A check of the voltages coming into the capstan adder with the SC61's digital meter found it to be near zero volts. The source of this voltage is the capstan phase pulse width modulator, and that signal was changing wildly (Figure 6). This showed that the capstan phase circuit was trying to compensate but, for some reason, could not.

Look at the simplified schematic (Figure 2); notice that the output of the pulse width modulator passes through a low pass filter circuit which converts the varying duty cycle square wave signal into a DC voltage. Since no voltage was present at the output of the filter circuit, and activity was present at the output of the pulse width modulator, the problem had to be in the circuitry between.

One of the capacitors in the filter circuit was shorted. After replacing the capacitor, the VCR operated correctly.

(Continued on page 28.)

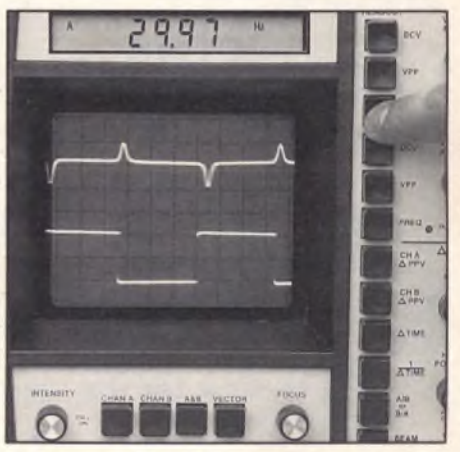


Fig. 5: Two important capstan servicing waveforms are the CTL pulse (on top trace) and the 30 Hertz reference pulse (bottom trace). The digital meter on the SC61 helps you quickly analyze these important waveforms with a simple press of a button.

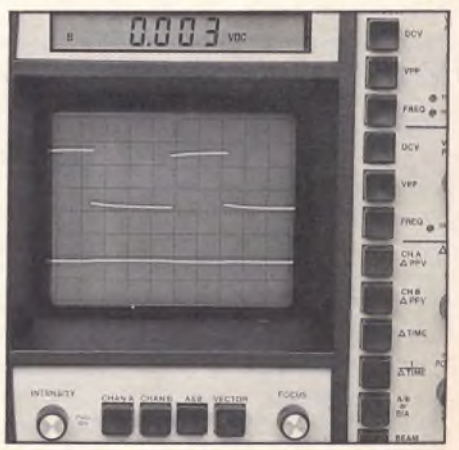


Fig. 6: Use the SC61 to quickly analyze the operation of the phase pulse width modulator (top trace) and the resultant DC control voltage (bottom trace and digital display).

Of the MTS Stereo TV generators that our engineers tested, only Sencore's ST65 and ST66 have the signals, modulation, output level, and low enough output impedance to successfully drive the main channel, difference channel, or SAP channel in any MTS Stereo system. Other generators simply couldn't prove whether a problem was caused by the generator or was actually in the circuits.

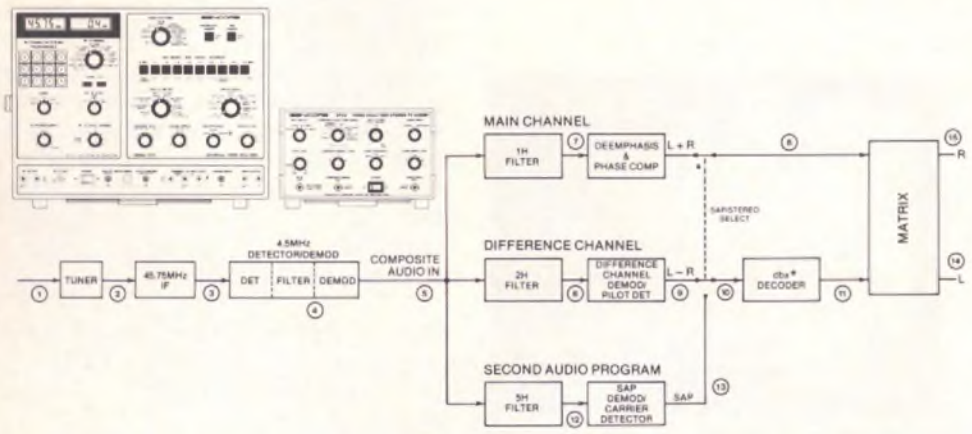


Fig. 3: Use your VA48 or VA62 Video Analyzer's special signals to troubleshoot the common circuits in TVs and VCRs. Your ST65 solves the remaining stereo circuits.

Putting Your VA62 And ST65 Video Service System To Work

Once you've unpacked your new ST65 Video Analyzer Stereo TV Adder and placed it on your bench with your VA62, you're ready to begin. Adding a new accessory is a big step and there are sure to be questions. Here's a few that other servicers have asked:

"Do I get everything I need to service the entire Stereo?"

"Will I have all the signals I need for complete performance testing?"

"Will I be able to troubleshoot all the Stereo TV circuits I run into?"

Would a simple "yes" answer those questions for you? Probably not; we need to look at how your VA62 Universal Video Analyzer works with the ST65 to form a complete video servicing system (Figure 3). Your "hands on" experience with the VA62 will make your move to total video service easy. But, instead of servicing sets that have the familiar tuner, IF, video, sync and color, you'll be seeing sets that include a stereo main channel, stereo subchannel, pilot, stereo decoder, second audio program, a stereo matrix, two audio amps, and two speakers.

How can you completely performance test any Stereo system? Simply select channel 3 or 4 on your ST65 and connect the RF-IF OUT to the antenna input of the TV or VCR you are testing and you're ready to make these important performance tests (covered step-by-step in the ST65 manual):

Stereo separation: This test proves that your customer is getting left and right stereo with good separation and that the dbx and stereo decoders, matrix, and audio circuits are working (Figure 4).

SAP and stereo signal-to-noise: A good signal-to-noise ratio shows that the Stereo TV can produce clean, noise free SAP and stereo programs on weak or strong channels. Reduce the signal input with the RF-IF control to dynamically test for weak/strong signal performance (Figure 5).

SAP/stereo and stereo/SAP crosstalk: Check crosstalk to assure that the SAP and stereo signals do not interfere with each other or with the composite stereo signal, SAP signal and stereo/SAP pilot settings. Check the SAP - stereo audio-to-video interference to assure correct IF alignment and trap settings.

SAP and stereo threshold: Make the pilot threshold test to confirm the adjustment of the stereo and SAP pilot signal circuits. Proper adjustment prevents false stereo triggering or no triggering at all when stereo or SAP is present.

Audio interference to color: Notice that the Stereo/SAP carriers are near the color subcarrier (Figure 6). Improper adjustment and/or failure of the IF can cause unusual symptoms, including Stereo/SAP interfere with color. Such interference can only be isolated by making performance tests with a color pattern on the screen.

Your guarantee to the customer that his Stereo TV or Stereo VCR is working properly, is assured by getting satisfactory answers to these important performance tests. Now, let's see how to handle those MTS circuits that aren't working!

Signal Substitution Provides The Troubleshooting Edge You Are Looking For.

How do you test these new circuits? You'll use the same successful "divide and conquer" and "signal substitution" methods you've been using with your VA62. The VA62 "phase-locks" the ST65 signals to its internal standard. Now you can choose the VA62's video troubleshooting signals, or the ST65's special stereo signals to completely analyze the TV, Stereo TV, VCR, or Stereo VCR that you are troubleshooting.

Stereo problems, especially the SAP problems, can easily happen in the RF, coupling, video IF, or the audio IF because these signals are right at the top of the channel (Figure 6). Your ST65 lets you make signal injection into each suspected stage to tie down troubles or prove the circuit works correctly (Figure 5).

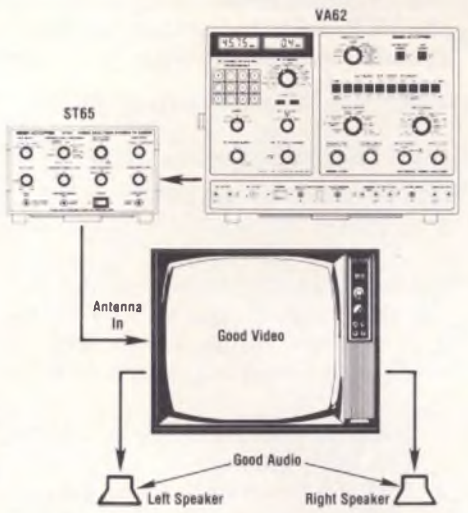


Fig. 4: You'll want to be sure your customer is receiving good video and audio.

Performance testing: If you get a good picture on the screen, you know that all the video circuits are working from the antenna input to the CRT. When you get good audio with proper separation, you know that all the stereo circuits are working from the antenna input to the speakers.

Troubleshooting: To locate a defective stage, simply move back stage by stage until the defect appears. You then know that you are injecting into the defective stage. With your experience in the "Divide and Conquer" method of troubleshooting, decreasing the number of steps required to find the bad stage is a snap. Use the ST65's 45.75 MHz IF signals to inject directly into the IF input. Inject into each IF stage before the 4.5 MHz take-off coupling point, as it too can be restrictive.

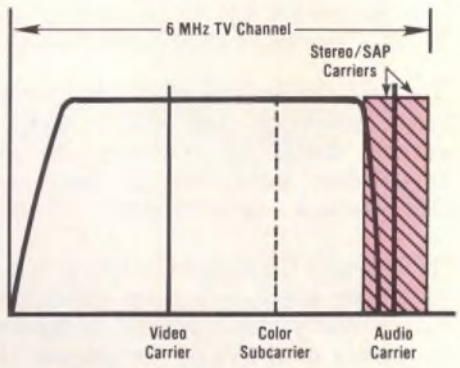


Fig. 6: Improper IF alignment trap settings, and stereo/SAP pilot adjustments can cause interference between the audio carrier, stereo/ SAP carriers and color sub carrier. These problems can only be isolated with a color pattern on the screen.

Learning How To Troubleshoot Stereo Receivers By Fixing A Defective Stereo VCR

Troubleshooting for real is, of course, a bit different than studying sample problems in the News, however, you can save yourself time and troubleshooting grief later by paying close attention to this Stereo VCR problem:

Customer complaint? There was no stereo separation or SAP output from her Magnavox VCR model VR970AT01.

Confirm The Symptoms: Well, the customer was right; the VCR's stereo light was on; it had plenty of audio, but there was no separation. And, the broadcast was known to be in stereo.

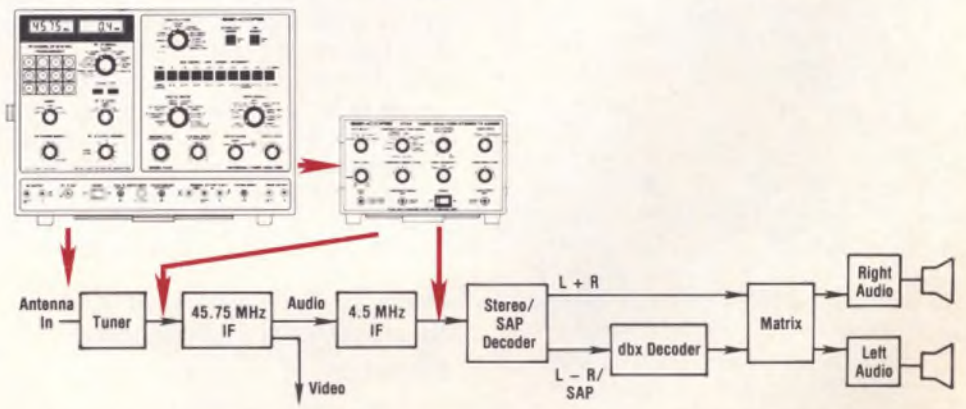


Fig. 5: Check for proper stereo performance from the antenna input to the speakers or substitute signals into any suspected stage.

Do A Performance Test To Identify The Problem: Using the ST65, supply an RF signal on Channel 3 or 4 to the VCR's antenna input,

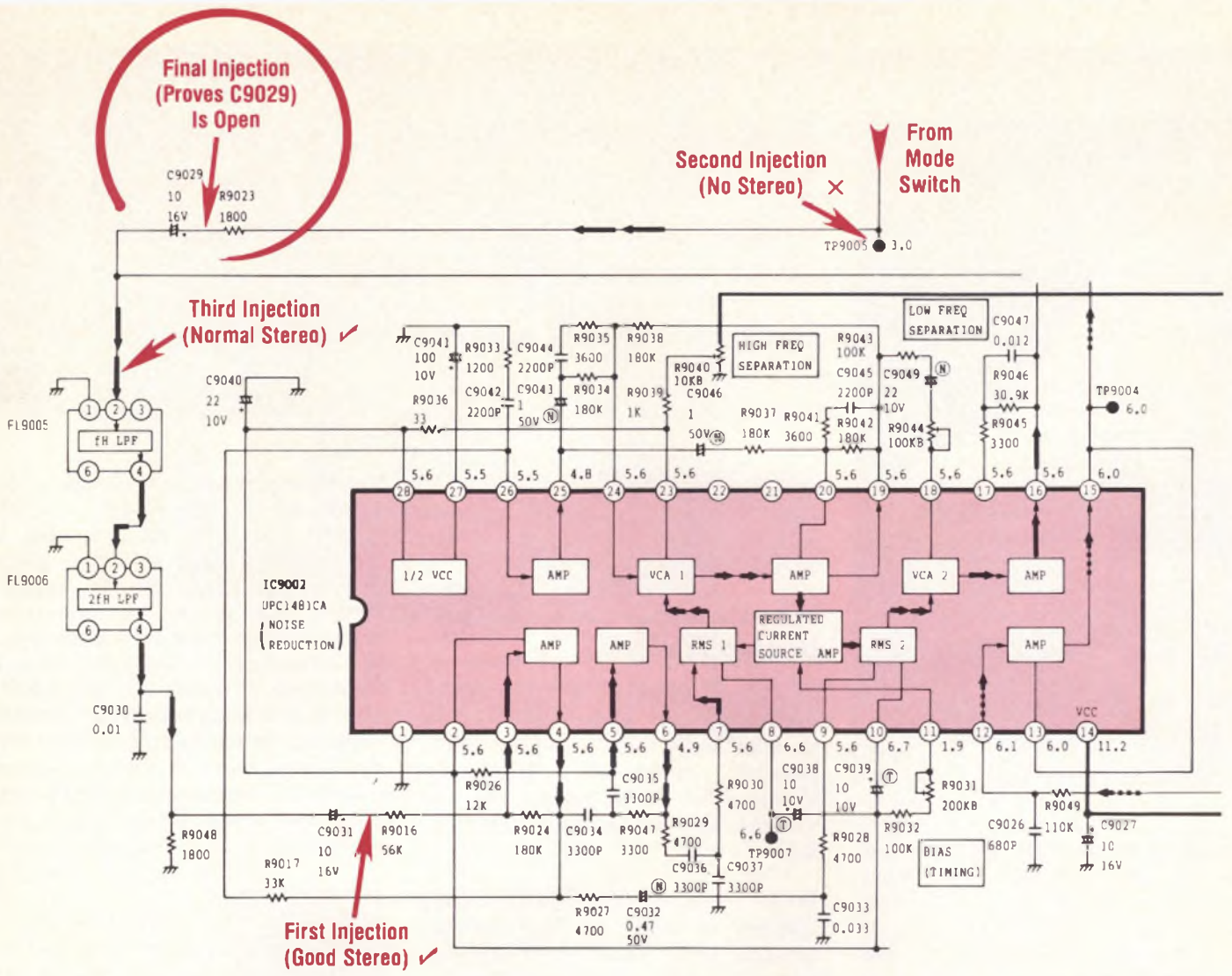


Fig. 7: Troubleshooting new MTS Stereo circuits is simplified when you can inject the proper signal to prove which circuits are good.

Monitor the VCR audio line outputs, and step through a quick performance check. Results?

- Stereo light . . . lit ✓
- Stereo threshold . . . good ✓
- Stereo (L+R) audio output . . . same for both speakers — normal ✓
- Stereo L or R only . . . 6 dB audio reduction on both channels . . . no stereo separation ✗

Troubleshoot to locate the problem: To confirm that the problem is not caused by bandpass restriction in the front end, inject a composite signal at the input of the stereo decoder board. Repeat the performance tests. Results? The same as before. Do you agree that the problem is definitely on the stereo decoder board.

Since there is audio output, the main audio channel is okay. Both stereo and SAP are affected, so we can probably eliminate the mode switch. Looking at the block diagram (Figure 3), wouldn't you agree that the dbx decoder IC is a good suspect? It is the major component that's common to Stereo and SAP. Without the ST65, we might be tempted to try to fix this problem by simply changing the chip. That decision could prove costly, so, let's make a few more tests to be absolutely certain.

Inject the ST65's compressed audio with R CH only output, to the input of the dbx decoder IC (the + lead of C9031, Figure 7), to check the operation of the IC and following circuits. Result? Normal stereo separation! The dbx decoder IC is proven good. The problem has to be before this point, but after the mode switch, since both stereo and SAP are affected.

Next, inject the same compressed audio with R CH only output to the output of the mode switch (TP9005, Figure 12). Result? No stereo separation.

Let's inject the same ST65 signal at the input of the 1H filter (FL9005, Figure 12). Result? Normal stereo separation. Move the signal to the junction of C9029 and R9023. Again, there's no stereo! Do you see the problem now? C9029 is open . . . replacing C9029 restored this VCR's stereo and SAP operation to normal.

You can expand your VA62 to take advantage of new opportunities when you are ready. Do you need more information or servicing tips? Give your Sales Engineer a call, 1-800-843-3338 and ask about expanding into VCR, Stereo TV, and digital/analog monitor service. ■

COMPARE THE DIVIDE AND CONQUER APPROACH OF SENCORE'S ST65 AND ST66 MTS ANALYZERS TO ANY MTS GENERATOR

Troubleshooting Performance	SENCORE ST65 VIDEO ANALYZER STEREO TV ADDER *	SENCORE ST66 STEREO TV ANALYZER	B & K 2009 MTS STEREO GENERATOR	LEADER LM238 TV MULTICHANNEL SOUND GENERATOR.
Modulated RF output allows you to dynamically check stereo and SAP operation.	•	•	•	•
Compressed audio lets you positively identify defective dbx decoders.	•	•		
Audio drive signals let you find problems in audio output stages.	•	•		
Low output impedance lets you troubleshoot every stereo circuit without disconnecting parts.	•	•		
Adjustable RF level lets you match signal levels for sensitivity testing.	•	•		
Audio output lets you drive any MTS circuit without a second generator.	•	•		
Pilot only and modulated carriers allow you to test stereo or SAP signal-to-noise.	•	•	**	**
Simultaneous SAP and stereo signals allow you to detect crosstalk between circuits.	•	•		**
Color video patterns let you find stereo beat interference to color.	•	•		
Isolated drive outputs allow you to signal inject into non-isolated circuits.	•	•		
Audio signals allow you to test over a wide band of frequencies.	•	•	•	•
Portability lets you analyze in the field.		•		
Adjustable pilot level lets you find faulty threshold levels.	•	•		***
Price.	$995	$1395	$495	$600

All information taken from manufacturer's published specifications. No claim is made to their accuracy. Specifications subject to change by individual manufacturers.

* The ST65 is an accessory of the VA48 and VA62.

** Results are not useable since modulation level is less than the test requires.

*** Level is adjustable but not calibrated.

You Can Take The Numbers Right Off The Capacitor, And Test To EIA And Industry Standards . . . Automatically With Your LC77 AUTO-Z.

by Cherlan Coffman, Application Engineer/Editor

Finally, there's an end to the hours wasted trying to prove good circuits good, and an end to replacing unnecessary parts or waiting on parts or waiting on parts delivery. You've experienced the real profit killer in the service business, haven't you? Would you agree that it's the wasted troubleshooting time and the pain of waiting on parts only to find they're not available, or worse . . . that you've waited on the wrong part?

It's a great feeling to be able to prove beyond a doubt, whether a capacitor, coil, high value resistor, or transmission line is good or bad. That's the one reason you must have the LC77. From the first time you use your new AUTO-Z, you begin to see it as a troubleshooter — usable in all of your electronics applications. As you enter a capacitor's value, tolerance, and voltage into the LC77's keypad, you remember the problems you had with that tough dog circuit — knowing that a positive component test would have saved the day. Since stubborn failures burn up your troubleshooting time, let's review how capacitors fail, see how the AUTO-Z was designed, and learn about coil, cable, and SCR/triac testing.

What Causes Capacitor Failures?

Capacitors have become so common in electronics products, that we often overlook their wide value range, operating voltage, type, and applications when selecting test instruments. Boiling all of these factors down into a "generic" capacitor test, however, can lead you astray when troubleshooting (Figure 1).

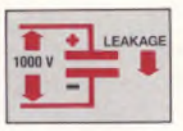
Only about 25% of the problems associated with capacitors are related to value, three out of four failures are caused by other problems. Knowing about capacitors and how they fail is important to understanding the kind of problems capacitors cause in the circuits you are servicing, and is the key to thoroughly testing them.

Dielectric	Common Values	Voltage	Use
Vacuum	5 - 2500 pF	2 - 50 kV	Transmitters
Air	.25 pF - 400 pF	80 - 200 V	Tuning
Mica	1.5 pF - 0.1 uF	350 - 2500 V	RF to 500 MHz
Ceramic	1.5 pF - 2.2 uF	3 - 6000 V	RF to 300 MHz
Paper/plastic	10 pF - 50 uF	to 1000 V	RF to 2 MHz
Mylar	.001 uF - 100 uF	to 1500 V	RF to 2 + MHz
Aluminum Lytic	1 uF - 220,000 uF	to 700 V	DC to 20 kHz
Tantalum Lytic	.001 uF - 1000 uF	6 - 120 V	DC to 200 kHz
Double Layer Lytic	0.2 F - 10 F	to 10 V	DC

Fig. 1: The type, value range, operating voltage, and application are often overlooked when selecting test instruments or troubleshooting circuits.

Understanding How Capacitor Value Changes

All capacitors can change value over time; some types are just more prone to change than others. Ceramic capacitors change value as much as 20% in 10 years as the ceramic material relaxes, or as stress causes the plates to crack. Electrolytics change value as the electrolyte dries out from sitting on the shelf, or from heat while operating in the circuit. Some circuits that are easily affected by small value changes include oscillators, RF amplifiers, filters, and traps. Large changes in value cause troubles that are easier to recognize, but that are often just as hard to find. *You really need to be equipped to test any capacitor value from < 1pF to over 10 Farads.*



Why Capacitor Leakage Can Be Hard To Find

Capacitor leakage is basically a low-resistance path directly in parallel with the capacitor. This parallel resistance effectively changes the value, upsets the DC voltage, and causes the circuit to fail.

What makes capacitors with leakage so hard to find is that leakage isn't linear with applied voltage. Leaky capacitors have a threshold effect, similar to a zener diode. A capacitor rated at 300 V, for example, may show no leakage at 50 V, but will conduct heavily when normal circuit voltage (250V) is applied. That's one reason you find only a few leaky capacitors with your ohmmeter. *The only sure way to tell if a capacitor has leakage is to measure the current through it with rated voltage applied.*

How Dielectric Absorption Indicates Which Capacitors Will Fail

Dielectric absorption (D/A) is the inability of a capacitor to fully discharge before a new charge cycle begins. A capacitor with excessive D/A causes many circuits to operate improperly. Circuits that are easily upset by excessive D/A include sample and hold, AGC, analog to digital converters, series coupling, decoupling, and power supply filters. D/A is also an important capacitor check, because it gives you an indication of the reliability of electrolytic capacitors. Excessive D/A is the first indication that the capacitor is at the end of its useful life. *Today, more than ever, you need a way to measure and prove that D/A is not excessive.*

Why High Equivalent Series Resistance (ESR) Causes Tough Dog Problems

In high current - high frequency circuits (switching or scan derived power sources, etc.) excessive ESR causes high internal heat which in turn dries out the capacitor's dielectric, causing even higher ESR. That's why ESR is a common problem with electrolytics. Although history shows that ESR was proven the culprit in fewer than ten percent of all capacitor defects, the associated dynamic value change causes severe problems in modern high current, low ripple power supplies, AGC circuits and scan derived power sources. To make matters worse, replacement capacitors often develop high ESR while sitting on the shelf.*Only a couple of ohms of ESR can be excessive, depending upon the type, value, and voltage rating of the capacitor — and the circuit it is used in.*

How The LC77 AUTO-Z Design Meets Your Servicing Needs

Sencore received many letters and phone calls emphasizing that what is needed, is an instrument designed especially for testing capacitors AND it should be automatic AND cover every type and circuit application AND . . . you are having the same difficulty finding bad coils, yokes, flybacks and high value resistors. So, it should test them automatically, too. How was the AUTO-Z designed? Sencore engineers simply reviewed the input from the field, did a lot of research,

Fig. 2: The LC77 AUTO-Z design team reviewed input from customers and performed the research needed to program the entire range of EIA and industry capacitor standards into the LC77's memory. This accomplishment helped earn the coveted award for business excellence (Abex) for 1987.

and designed the LC77 AUTO-Z to meet your servicing needs. Let's look at a few of the challenges these engineers had to overcome.

• Manufacturers are using capacitors and coils that exceed the range of available testers — Challenge: Design a test instrument that exceeds current test requirements to equip you for the future. You can totally analyze caps from 1 pF to 20 F and coils from 1 uH to 20 H with the LC77 AUTO-Z.

• Capacitors have different positive and negative tolerances; for example a common spec is +80%, -20% — Challenge: Make sure the instrument can test any capacitor to any percentage of tolerance, positive or negative. You can enter the capacitors type, value, tolerances, and operating voltage ... and your LC77 automatically determines if the cap is "GOOD" or "BAD" to EIA and industry standards.

• Many capacitors fail while sitting on the shelf and others fail in the circuit — Challenge: Build in every test necessary to positively prove whether a capacitor is good or bad, even if it is brand new. Your LC77 lets you test all the important capacitor parameters and get the answer, "GOOD" or "BAD", automatically — including value, leakage, dielectric absorption and equivalent series resistance, to find bad caps and prove why they failed.

• Leakage tests should be made at the capacitor's operating voltage; no tester had ever done that — Challenge: Include a power supply and current measurement. Your LC77's internal power supply lets you select operating voltage in 0.1 volt steps to 1,000 Volts and displays leakage in uA or ohms to 1,000 megohms. Now, for the first time in electronic servicing history, you can routinely test capacitors at any operating voltage to 1,000 V, plus perform Hi-Pot tests on insulation and higher voltage capacitors.

• One reading doesn't fit all capacitors; failures vary with the type capacitor and operating voltage. What's bad for one is often good for another — Challenge: Program the entire range of capacitor standards in memory. Your LC77's microprocessor analyzes the capacitor against the parameters you enter, and compares the results to EIA and industry standards stored in memory. You get digitally accurate answers and the LC77 tells you if the part is "GOOD" or "BAD".

• Customers have trouble proving whether coils, yokes, flybacks and transmission lines are good or bad. Challenge: Include Sencore's patented Ringer test and the necessary ranges and accuracy to test every inductor, now and in the future, without error. Your LC77 lets you test any coil, yoke, or flyback, and provides the range, accuracy, and resolution to test any inductor, including finding the distance to shorts in transmission lines.

Why is the LC77 such a good troubleshooter? Because it's the one instrument that takes all the guesswork out of cap, coil, and high voltage component testing. For the first time in electronics servicing history, you can prove beyond doubt, once and for all, that the part is "GOOD" or "BAD", to industry and EIA standards, automatically — anywhere, anytime, without look ups, calculations, or error.

Patented Ringer ™ Test Lets You Find Bad Coils

Sure you can find open coils with an ohmmeter, and measure inductance with an inductance checker, but can you find a coil with a single shorted turn that way? No, the resistance changes such a small amount in a coil with a shorted turn, that an ohm check can't tell a good coil from a bad one. Inductor value doesn't always change enough to indicate problems either, even when the coil has a number of shorted turns. Only Sencore's patented Ringer test adds the troubleshooting power you need to completely analyze inductors. Good coils show "GOOD" and ten or more rings on the LCD display. Coils with shorted turns have less quality "Q", and show "BAD" and less than ten rings on the display.

You Can Easily And Accurately Locate Transmission Line Faults With the LC77 AUTO-Z.

Wouldn't it be nice if transmission line breaks occurred only at the end near the connector? Typically, however, transmission lines break where you least expect; in the middle of a 200 foot run, under 10 feet of dirt, or in walls, elevator shafts, etc. Finding and repairing the break - without digging up or tearing out the entire cable can be a real challenge. With the LC77, it's as simple as pushing a button, reading the display, and dividing the reading by the cable's capacitance or inductance per foot to find the distance to the fault.

Fig. 3: Your LC77 AUTO-Z lets you pinpoint the distance to cable shorts or opens, saving you the time and cost of digging up an entire cable run.

You Can Measure The Capacitance Between The Center Conductor And The Shield And Calculate The Distance To The Break

Coaxial cable is essentially a long capacitor (Figure 4). The total capacitance is closely related to the length of the cable. Therefore, when a cable breaks, the capacitance measured at either end is an accurate indication of the location of the break. To find the distance to the break, first check the manufacturers spec for capacitance per foot, or measure a sample length of the same type cable. Then measure the capacitance of the suspected cable and divide the measured capacity by the capacitance per foot value. This gives the distance to the break in feet.

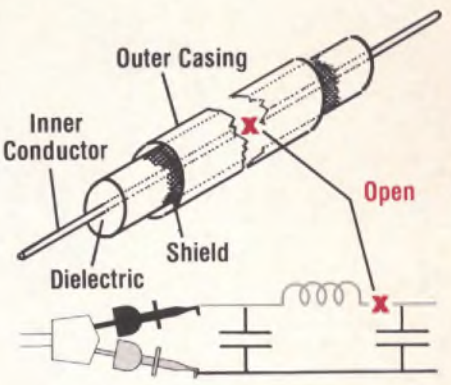


Fig. 4: Coaxial cable is essentially a long capacitor; measuring the value from either end gives you the ability to accurately determine where the break is.

You Can Measure The Inductance Per Foot Of Cable And Calculate The Distance To A Short

Unfortunately, breaks are not the only type of cable failure. One common cable problem is caused by the cable shorting, especially when someone drives a nail, staple, or tack into it. A coaxial cable that has a short is like a long inductor. If you know the total inductance and the inductance per foot, you can calculate the distance to the short (Figure 5).

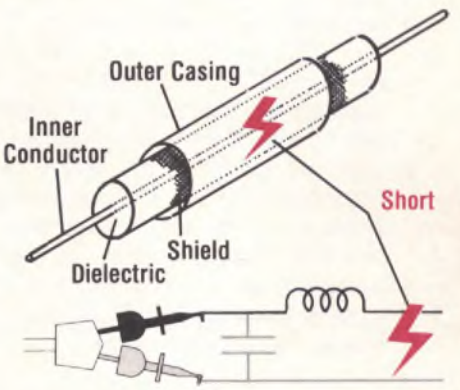


Fig. 5: A coaxial cable that has a short acts like a long inductor. Measuring the inductance value from either end lets you calculate the distance to the short.

Measure Leakage In Microamps Or Ohms For Hi-Pot Testing

The same leakage supply that allows you to dynamically test capacitors at their rated voltage also lets you test other high-voltage components. These include high-voltage diodes, transistors, SCRs and triacs, transmission lines, transformers, etc. The leakage rating for parts

(continued on page 28)

Earn Extra Profits And Save Valuable Time By Confidently Restoring Worn Out CRTs With Your CR70 "BEAM BUILDER"™

by Paul Nies, Application Engineer

It may seem hard to believe with today's technology, but every television receiver, every video monitor, and every computer display (with few exceptions) contains a component which is guaranteed to wear out. That component is the cathode ray tube (CRT). A CRT wears out because like all tubes, it uses a hot cathode to produce electrons, which in turn produce the picture. At some point in the tube's lifetime, the cathode's ability to produce electrons will diminish. Emission becomes weak or totally ceases, and the picture becomes "washed out" or goes completely dark. It's sad to say, but often a weak CRT spells death to an otherwise good television receiver or monitor, because "it's just too costly to replace the CRT."

Most weak CRTs, however, have months and even years of useful life remaining, if only they are properly restored. Why don't more service professionals use CRT restoration? Because they are either unaware that CRTs can be successfully restored, or they have had a bad experience with a CRT restorer that was not safe or effective.

Before we jump right into restoring a CRT with the CR70 "BEAM BUILDER" Universal CRT Analyzer and Restorer, let's review the basics of how a CRT works so that we can better understand what causes them to fail.

How Does A CRT Make Light?

A CRT has three major sections; 1) the electron gun, 2) the accelerator grids and 3) the phosphor screen. The electron gun forms and controls an electron beam, which is accelerated by the high voltage on the accelerator grids. The electron beam strikes the phosphor with such velocity, that the phosphor gives off light. The light produced by the phosphor depends on the amount of beam current striking it at any given instant - more beam current produces more light; less beam current produces less light.

The heart of a CRT's operation, and the section acted on by restoration, is the electron gun. The four major parts of an electron gun are the: filament (F), cathode (K), control grid (G1), and screen grid (G2).

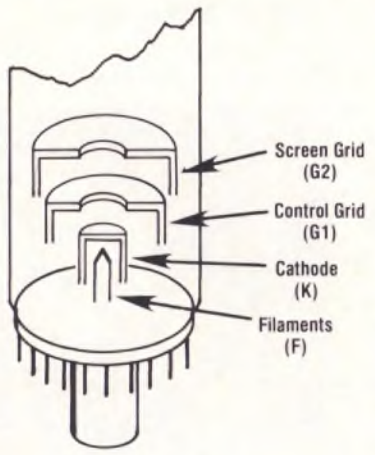


Fig. 1: The heart of a CRT is the electron gun made up of the filaments, cathode, control grid and screen grid.

The filaments heat the cathode, causing it to give up electrons. These electrons leave the cathode, strike the screen, and return through the high voltage power supply. Thus, the cathode is sort of a "launching pad" for the electron beam.

The electrons surround the hot cathode, forming a "cloud". If it weren't for the grids, G1 and G2, the electrons would simply be a big "glob" hurdling toward the screen. The G1 and G2 grids have a tiny hole in them which funnels the electron cloud into a fine beam.

The control grid (G1) regulates the electron beam's intensity. For dark picture portions, or low brightness settings, the hole in G1 is made to appear smaller by making G1 more negative than the cathode (increasing the negative bias). The negative potential on G1 repels the electrons, lowers the beam current, and makes the picture darker. When no beam current is allowed through, the tube is "cutoff". For white picture scenes or high brightness settings, the negative bias is reduced allowing more electrons through G1. The potential on G1, however, always remains negative compared to the cathode.

What Goes Wrong When The Picture Gets Weak?

Anything that affects beam current affects the picture. Nearly all CRT failures involve the electron gun. This is because the accelerator and screen sections of a CRT mainly involve static voltages and fixed alignments, making failures in these sections uncommon. CRT electron gun failures can be grouped into one of two major categories, shorts and low emission.

Gun Shorts Cause Loss Of Beam Control

Shorts occur when one gun element touches another, or when a loose "flake" of conducting material dislodges and falls between elements. One type of gun short is a heater-to-cathode (H-K) short. Unlike older chassis, where H-K shorts caused "hum bars", newer chassis are seldom affected by the H-K short. Today's chassis use scan derived filament voltage; the filaments are DC isolated, and the G1-cathode bias is unaffected by the H-K short. Also, since the filament voltage is developed during retrace, any "hum bars" that may occur, happen during blanking.

Because the heater is delicate and may be easily burned open, CRT restorers are not used for removing H-K shorts. Problems caused by H-K shorts are easily fixed with an isolation-type filament transformer.

The most common electron gun shorts involve G1. Most G1 shorts happen when a flake of material gets into the close space between G1 and the cathode. Shorts between G1 and G2 also occur, but are less common because the spacing between G1 and G2 is much greater than between G1 and the cathode.

Either type of G1 short causes loss of beam control. Visible retrace lines may appear because the beam cannot be cut off. Or, the short could cause the electron beam to run wide open and produce an extremely bright, all-white, red, green, or blue picture.

Cathode Failures Result In Weak Output

Shorts affect the beam after it has been produced by the cathode. Emission-related failures, however, never allow the tube to produce a sufficient beam. Low cathode emission causes different failure symptoms.

"Gassy Picture"

Chances are you've seen this failure before. The white picture areas are bright and "shimmery", the blacks are very deep, and there are few grays in between. Lacking a better term, most servicers call this a "gassy" tube. This problem is not caused by gas inside the tube, but by a cathode that is heavily worn in the center.

Fig. 2: A cathode worn only in the center causes the deep blacks and silvery whites that most technicians call a "gassy" tube.

Why does the cathode wear unevenly? Because as the picture changes, the area of the cathode's surface which emits electrons changes. For a white screen the entire surface contributes; for gray, a smaller area contributes; and for near-black, only the very center contributes. Note that the cathode's center ALWAYS contributes electrons. How does this cause the symptom of a "gassy" picture? Since the center of the cathode is worn, signals that should produce grays, instead produce near-black levels. The cathode is still able to provide sufficient beam current for white levels, but now the whites are too bright in contrast to the grays. Turning up the brightness and contrast controls exaggerates the misproportions.

(Continued on page 24)

SENCORE

Buyer's Guide

Are you looking for success in Electronic Servicing? Then welcome to the Sencore Buyer's Guide.

For over 37 years, Sencore has been dedicated to just one goal - making you more successful in Electronic Servicing. You see, we realize that your success truly will mean a successful future for Sencore as well.

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Sencore's engineers know that every time you have to fiddle with a knob, connect and reconnect leads, or come up with an inconclusive or misleading test result, it costs you dearly. That's why as you review the Sencore product line, you'll notice that each Sencore instrument has a fresh, uncluttered, easy-to-use look. Computer aided design and manufacturing puts the complex electronics on the inside to help keep your operation simplified on the outside.

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Midcontinent Cable

Finally You Can Thoroughly Analyze And Pinpoint Any RF Video Trouble In Any RF Video Distribution System - Accurately And Automatically - In 1/2 The Time.

Now, locate any problem in any CATV, SMATV or RF distribution system quickly and accurately, plus test to full FCC specifications. Now you can locate elusive ghosts, signal ingress, and beat problems that all other signal level meters miss with the FS74's exclusive system troubleshooting ability. The FS74 gives you every function you need to completely test all aspects of system performance to FCC specifications, including RF level, Signal-to-Noise, Hum, and Audio/Video separation; and it does it 100% automatically. Plus, the FS74 gives you the ability to troubleshoot the system to locate the problem with it's exclusive built-in wide-band monitor that lets you actually 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 exclusive micro-processor controlled, digital PLL tuner lets you tune in all sub-band, mid-band, super-band, hyper-band, VHF, UHF and FM frequencies that range from 5 MHz to 890 MHz. Plus, the FS74 gives you a special AFT that instantly locks into the exact carrier frequency, then tells you on the LCD display if that channel is off-set in frequency to 1 kHz resolution. Cable shifts are no problem, simply select between standard FCC operation or HRC and ICC offset. The microprocessor does the rest for you automatically.

Super sensitivity brings in the weakest signals with 100% automatic attenuators. The FS74 gives you a super sensitive 5 microvolt sensitivity (−46 dBmV) on all frequencies that allows you to troubleshoot all the way back to the head-end or receiving antenna. No more switching attenuator inputs or ranges that can lead to time-consuming mistakes. The RF input is fully autoranged, simply connect the cable to the input, and the FS74's microprocessor selects the proper attenuator range for you automatically, so you can measure signals instantly, from −46 dBmV to +60 dBmV.

Microprocessor control makes all performance tests fast and simple. By using the latest microprocessor technology, time consuming tests are automated and streamlined for quick and dependable results. All tests can be made on an 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. No more tuning to a "dead spot" or unused channels for a reference. Making audio-to-video level tests are simple, the FS74 automatically tunes in both the video and audio carriers and reads out the corresponding difference automatically and on any channel. You don't have to tune each carrier individually, or make calculations. Hum tests are made directly on any in-use channel without removing modulation, a Sencore exclusive.

Exclusive built-in wide band monitor gives you picture quality checks anytime, anywhere. If you've ever hunted down picture ghosts or interferences, you'll appreciate the value of this exclusive FS74 feature. The wideband monitor is an integral part of the FS74. That means no additional cables or cords to connect or TVs to haul around. Just turn on the monitor and view any of the television channels in full detail on the CRT monitor. Its full 4 MHz bandwidth means it will help you isolate problems that affect large screen receivers, but which go unnoticed on portable televisions.

Built-in autoranging AC/DC voltmeter and ohmmeter means you'll never be caught short. Your troubleshooting capabilities are rounded out with AC and DC voltage measurements and a special low resistance ohmmeter right at your finger tips. Measure up to 200 volts AC or DC right through the RF input, or measure AC and DC volts or ohms through the external DVM input.

We guarantee the FS74 will cut your RF Distribution System servicing time, or your money back. Discover the FS74 and all it's exclusive features, call **1-800-843-3338** and locate system problems faster than you imagined possible.

Call WATS Free 1-800-843-3338

LC77 AUTO-Z™ Capacitor And Inductor Analyzer

New

Automatic Microprocessor Controlled For Accurate Error Free Cap/Coil Analysis

All New Portable Automatic Features:

- Automatic Ranging Of Capacitance And Inductance Value
- Percentage Calculator
- Auto Shutoff & Battery Test
- Lead Zero
- Leakage In Current And Ohms With Up To 1000 Volts Applied
- Dielectric Absorption And Equivalent Series Resistance (ESR)
- Inductor Ringing Test
- Good/Bad Determination

THE Z STANDARD

LC77 AUTO-Z Automatic Capacitor And Inductor Analyzer $1895 Patented

On GSA Contract

IEEE 488 BUS-COMPATIBLE

LC77 AUTO-Z - The Only Dynamic, Portable, Automatic Capacitor/Inductor Analyzer Guaranteed To Help You Quickly Find Any Defective Capacitor Or Inductor That Other Testers Miss, Anywhere, Without Calculations, Look-up Tables, Or Error.

Discover the Z Standard that eliminates the guesswork, interpretation and calculation errors in capacitor and inductor testing. The LC77 AUTO-Z makes testing any capacitor or coil simple, without having to make calculatons or pull out look-up charts to determine if the component is within standards. Its advanced digital technology completely analyzes capacitors and inductors for all the ways they can fail. You simply enter the parameters: value with the tolerance you require, the rated voltage of the device and the type of device. The LC77 AUTO-Z takes over from there and compares the actual readings to standards tables stored in its memory, and simply displays if that component is good or bad based on EIA and industry standards. It's like having a Standards Engineer with you all the time.

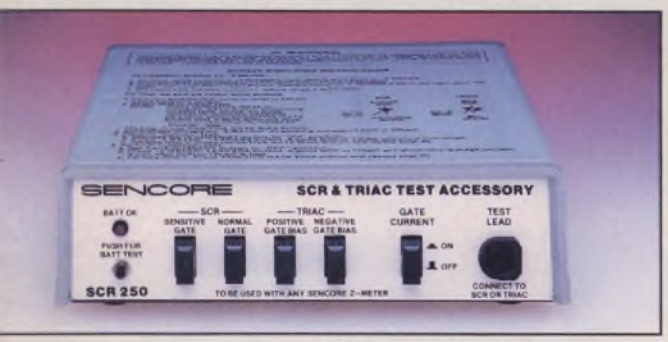
Thoroughly and automatically analyze any capacitor from 1 pF to a massive 20 farads. Only the LC77 AUTO-Z allows you to test today's high tech components. The AUTO-Z tests capacitors for every parameter in which a capacitor can fail. It reads out the capacitor's value and whether it's good or bad based on the tolerances that you want. Plus the LC77 gives tests no one else gives you. Tests for leakage, dielectric absorption and ESR, and it tells you if the cap is good or bad based on EIA and industry standards.

Finally, test inductors reliably from .1 uH to 20 henrys. The LC77 AUTO-Z tests inductors dynamically so you have a way to finally track down tough-to-find coil problems. The LC77 automatically reads out the inductor's value, and if it is good or bad based on your tolerances. It also gives you an automatic ringing test that allows you to test down to one shorted turn, and find inductor problems that other testers miss.

Portability allows you to take the AUTO-Z anywhere you need to troubleshoot. The full power and potential of the LC77 AUTO-Z is packed into a light-weight, portable (battery and AC) package. The AUTO-Z is designed with CMOS logic, LCD technology and automatic shut-off feature for low-power consumption (the LC77 operates over eight hours on one battery charge). Take the LC77 AUTO-Z wherever you check capacitors and inductors - in the field, shop or factory.

IEEE488 compatible for automated testing and data collection. Use Sencore's optional IB72 to control the AUTO-Z over the IEEE488 Bus for data collecting, incoming inspection, and quality assurance tests.

SCR250 SCR and Triac Test Accessory™



New

Now You Can Test SCRs And Triacs With Any Sencore Z Meter.

- Test All SCRs and Triacs
- Exclusive Dynamic Leakage Test
- New Sensitive Gate Test
- Easy To Use, No Setup Or Specifications Needed
- Tests Industrial And Protected Gate SCRs And Triacs, Too

SCR250 SCR And Triac Test Accessory $168

Dynamically Test All SCRs And Triacs For Leakage And Turn-on With 100% Reliability.

Tests all SCRs and triacs. The SCR250 tests all SCRs and triacs in both directions. It's completely isolated and the controlled internal battery supply protects sensitive gates while guaranteeing turn-on of the most demanding high current industrial SCRs and triacs. No more missing those triacs that check good in one direction but are leaky in the other.

Exclusive dynamic leakage test. SCRs and triacs are dynamically tested at their full working voltage. You'll never again get caught guessing whether or not an SCR or triac is good.

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.

 Call WATS Free 1-800-843-3338

LC76 PORTA-Z™ Capacitor And Inductor Analyzer

- **Rugged All Steel Construction**
- **LCD Display**
- **Full Day's Operation On Battery; Auto Shut Off After 30 Minutes**
- **Double Patented Inductor Analyzer**
- **Patented Capacitor Analyzer With Dynamic Leakage Tests To 1,000 Volts**
- **Tests L/C Components, SCRs, Triacs, Hi-Voltage Diodes, Cables And Transmission Lines**
- **NBS Traceable Accuracy; Capacitors 1.0%, Inductors 2.0%**
- **Special Test:**
  Transmission Line Distance To Open Or Short

New

On GSA Contract

LC76 PORTA-Z
Portable Capacitor And Inductor Analyzer $1395 Patented

The LC76 Brings Portability To Cap And Coil Testing - Get Lab Accuracy Anytime, Anywhere.

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 1987

- **Capacitor Tests:**
  Capacitor Value
  Capacitor Leakage
  Electrolytic Dielectric Absorption
  Electrolytic Equivalent Series Resistance (ESR)
- **Inductor Tests:**
  Inductor Value
  Inductor Ringing
- **Special Tests:**
  Leakage in Switches, PC Boards, Connectors, Etc.

New

On GSA Contract
NSN 6625-01-118-8016

LC75 Z METER 2
$995
Exclusive Triple Patented Plus One Patent Applied For.

The First Tester Designed To Solve New High Tech Cap And Coil Challenges.

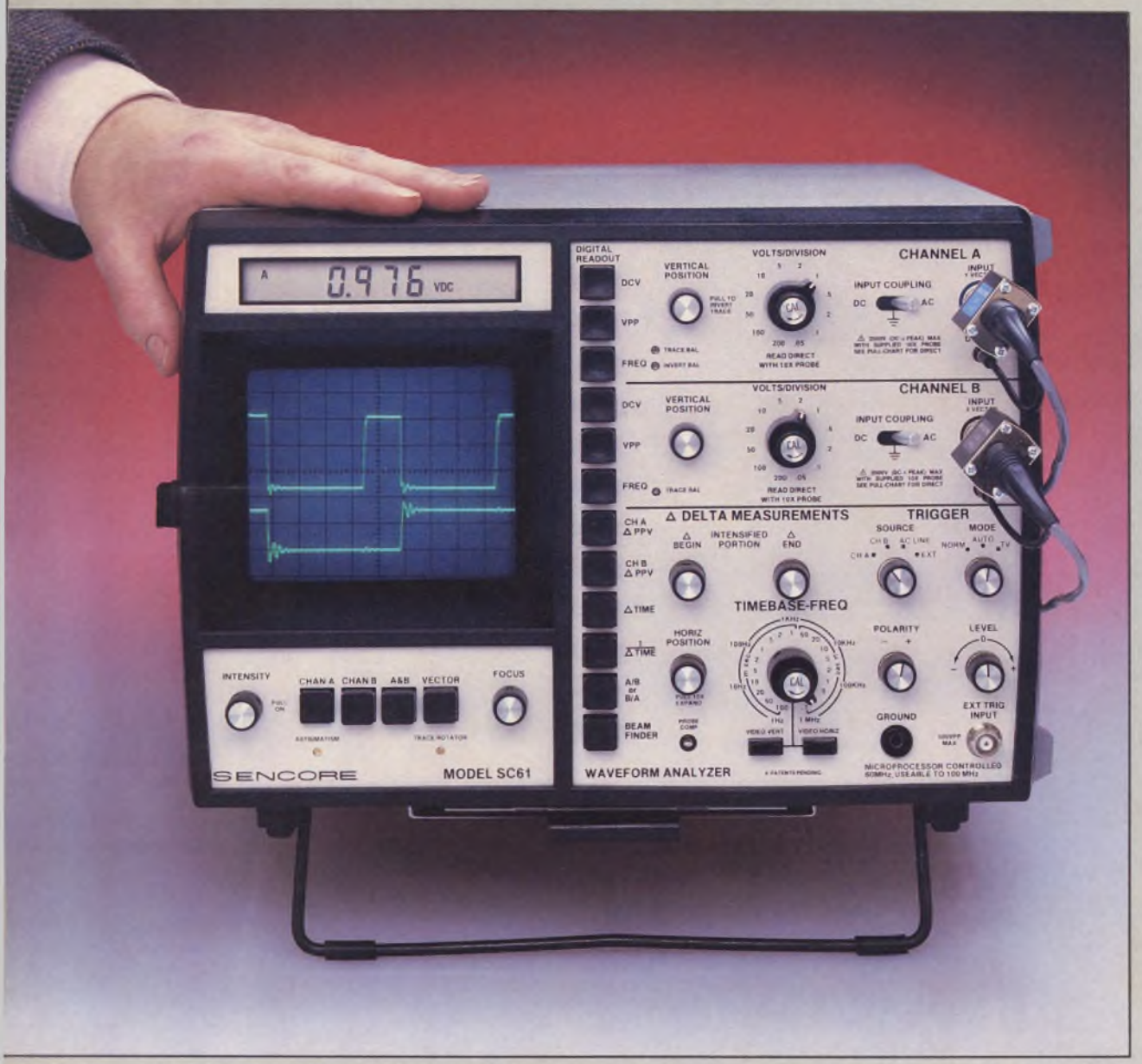
Solve capacitor challenges accurately and quickly. The LC75 gives you proven tests; value from 1 pF to 200,000 uF, leakage with applied voltage up to 600 volts, dielectric absorption, and ESR test. Find the other 75% of defective capacitors that "value only" testers miss. The LC75 is guaranteed to cut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



Meet The Triple Patented SC61 Waveform Analyzer

- 60 MHz high performance scope that will put confidence back into your waveform measuring.
- 100% automatic AUTO-TRACKING™ digital read-out of all key waveform parameters at just the push of a button.
- Faster, more accurate, easier than you ever dreamed possible.
- Rock solid sync eliminates frustrating fiddling with complicated controls.
- 4 times the measuring capability of any conventional scope for true peace of mind.
- Plus many extra, exclusive high performance features that will save you time.

SC61 Waveform Analyzer

$3295 Patented U.S. Funds

On GSA Contract
NSN 6625-01-169-2318

IEEE 488 BUS-COMPATIBLE

"I've used about every scope on the market at one time or another and I've got to say the SC61 is the easiest and fastest of them all."

Kerry L. Haught
Audio/Visual and Video Repair
Mentor, OH

Improve Your Troubleshooting Efficiency To Cut Your Troubleshooting Time And Boost Your Service Profits.

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 .he 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.

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.

 Call WATS Free 1-800-843-3338

CR70 ''BEAM BUILDER''™ Universal CRT Analyzer and Restorer

For The First Time Ever . . . Test Every CRT On The Market—Now And In The Future—Plus Restore 90% Of All Weak Or Shorted CRTs . . . Or Your Money Back. (Includes Color/B & W TVs, Scopes, Computer Displays, Camera Tubes And More.)

- Guaranteed To Test Every CRT (Old Or New)
- Guaranteed Dynamic Tests You Can Trust
- Guaranteed To Safely Restore 9 Out Of 10 Weak Or Shorted CRTs
- Guaranteed To Be Totally Protected From Damage From Charged CRTs

CR70 ''BEAM BUILDER''
Universal CRT Analyzer and Restorer

$1295 Patented

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 Patterns In A Pocket Size Generator

- Push Button Ease—Caddy Size
- Jitter Free Patterns
- Battery Saving Shutoff
- Test Leads Built In

CG25 Little Huey $198

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.

Call WATS Free 1-800-843-3338

FC71 Portable 10 Hz To 1 GHz Frequency Counter™

- 10 Hz - 1 GHz Portable Frequency Counter
- Five Times More Accurate Than FCC Requirements Even On The Toughest Job; 0.5 Parts Per Million
- Exclusive Microprocessor Time Base For Super Stability From -12°F to 122°F
- Measures All Signals, Even Complex And Noisy Signals, With Exclusive Sensitivity Control
- Super 5 mV Average Sensitivity Over Full Range
- Automatic Crystal Check Tests The Fundamental Frequency Of Any Crystal
- Frequency Ratio Compares Two Frequencies And Displays The Ratio Directly
- Double Shielded For Interference Free Frequency Measurements Anywhere
- Automatic Readings When Used With IEEE 488 Computer Interface

FC71 Portable 10 Hz To 1 GHz Frequency Counter $1295 Patented

NSN 6625-01-076-2695

IEEE 488 BUS-COMPATIBLE

FC71 Frequency Counter—The Only Portable 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. It's 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.

Additional tests make the FC71 more than a counter. An exclusive frequency-ratio test simplifies trouble-shooting 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

- Needs No Set-up Book Or Instructions
- Patented In-Circuit "go/no-go" Transistor/FET Test
- Now More Automatic Than Ever, Identifies Transistor Leads
- Portable Operation With Auto Shut Off To Save Your Batteries.
- Tests All Possible Leakage Paths
- Dynamic Gain Test

NSN 6625-01-058-9564

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

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.

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.

PR57 ''POWERITE''® Variable Isolation Transformer And Safety Analyzer

Avoid Embarrassment And Risk—Know Beyond A Doubt That Your AC Power (And The Equipment You Service) 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 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 easy with the PR57's patented tests. Leakage tests are now required from all manufacturers, and you decrease your liability and increase your profits when you perform this test. Since it's a service you offer, you can charge $3 - $5 to perform the test, and make a profit on a quick, but vital test.

Five Ways You Can Make Sure Your Power Is Right With A ''POWERITE''®

- It's an isolation transformer.
- It's a variable AC supply.
- It's a power line monitor.
- It's an amp/watt meter.
- It's a safety leakage tester.

PR57 ''POWERITE''® $495 Patented

NSN 6625-01-124-6296

DVM37 3 1/2 Digit, 0.1% Bench/Portable Digital Multimeter™

For Confidence And Success In Troubleshooting, You Need A DVM That Holds Lab Accuracy Under The Most Rugged Conditions.

One super rugged digital voltmeter for every use. If you like to use one meter and use it everywhere and anywhere, you'll want the super, reliable DVM37. You can drop it, kick it, carry it by the test leads, and it will keep right on operating at lab accuracy.

Fully protected inside. Unheard of 8 kV transient protection on every function and range, including ohms means unmatched internal protection.

0.1% DCV accuracy into 15 Megohm input. 15 Megohm input impedance means 50% less loading than other meters with 10 Megohm input impedance. Therefore, you get 50% greater accuracy than other 0.1% DVMs.

- Automatic .1% accurate DVM for bench or field for measurements you can count on.
- 15 Megohm input impedance for least loading and error, especially in high impedance circuits.
- Protected inside, too, better than any other DVM on the market, to 2 kV DC with 8 kV transient protection and to 10 kV with TP212 probe.
- An Indestructible DVM For Both Bench And Field

DVM37 3 1/2 Digit, 0.1% Bench/Portable Digital Voltmeter $395

DVM56A ''MICRORANGER''® Digital Voltmeter

DVM56A: The Most Versatile Time Saving Bench DVM You Will Ever Own.

- 100% Automatic, designed to save you time, simply touch and test and MICRORANGER® does the rest.
- Lab Accuracy - .075% 4 1/2 digit with 15 Megohm Input Impedance
- Versatile - 16 Microprocessor Controlled Measuring Ranges
- Tough - Fully protected to 7.5 kV overload and RF interference free.

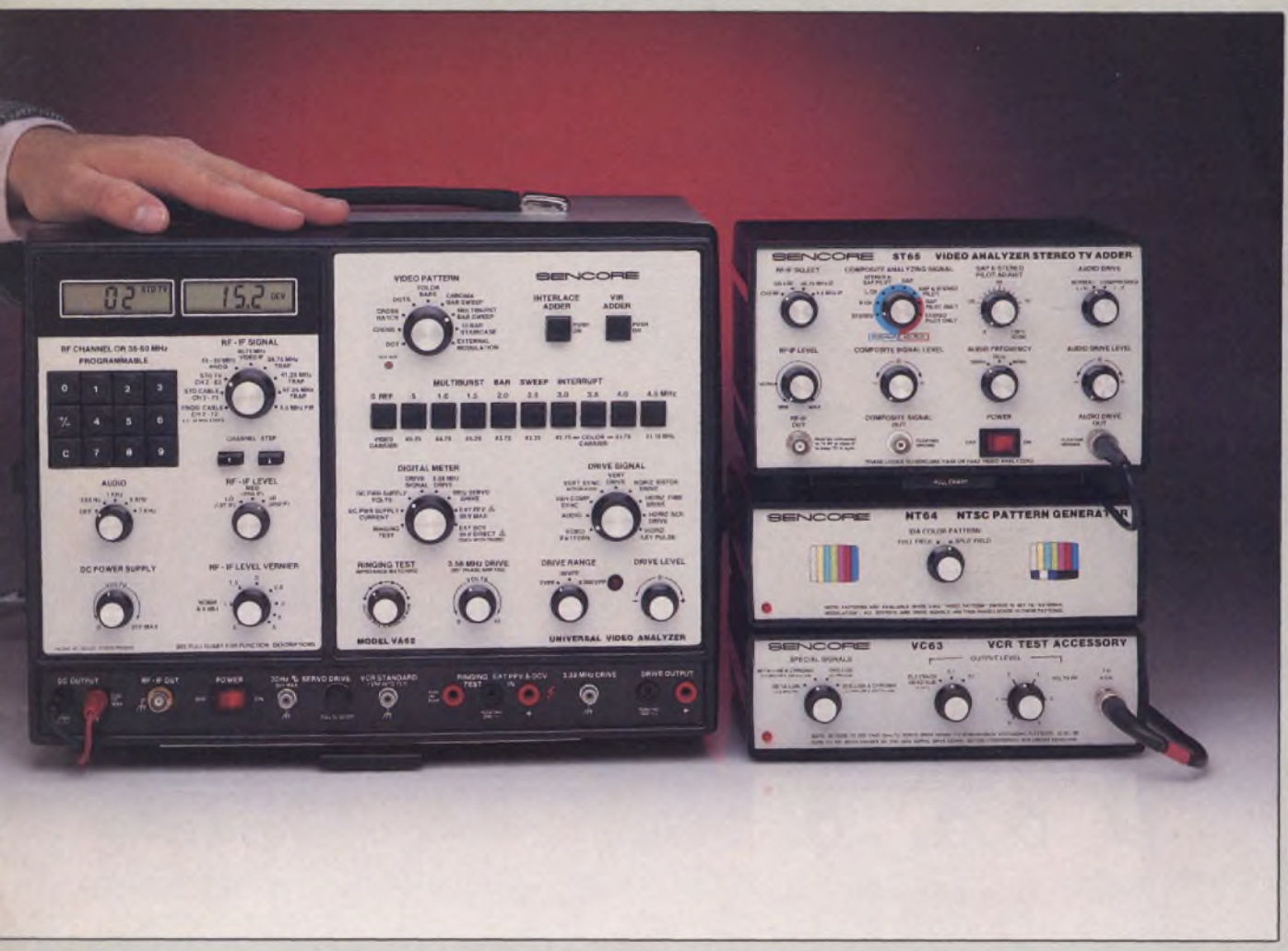
DVM56A ''MICRORANGER''® Digital Voltmeter $995 Patented

The most versatile meter on the market. If you want the best, then the DVM56A MICRORANGER is the meter for you. The DVM56A gives you all the tests you'd ever want to perform with a DVM. The internal microprocessor automatically ranges the MICRORANGER, and gives you these exclusive tests:

• AC and DC current up to 20 amps with the optional CS233 current shunt • High and low power resistance • .075% accurate DC to 10 kV • AC Volts peak-to-peak • AC Volts true RMS • AC Volts average RMS • dBm and programmable dB

Super accuracy and error free readings every time. 4 1/2 digit readout with .075% DCV accuracy. 15 Megohm input impedance means less loading and more accurate tests. Microprocessor control means no errors.

VA62 Video Analyzing Package . . . Obsolete Proof



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

- Identify tuner problems with all-channel, VHF, and cable RF generator.
- Pinpoint IF troubles with modulated trouble-shooting signal and exclusive programmable IF generator.
- Isolate any trouble with patented video and standard color-bar patterns.
- Find defective stages, without disconnecting parts, with exclusive phase-locked drive signals.
- Test yokes and flybacks plus measure signal levels with autoranged digital meter.
- It's obsolete proof; 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

VC63 VCR Test Accessory
$495 U.S. Funds
NSN 6625-01-201-2880

NT64 NTSC Pattern Generator
$495 U.S. Funds

ST65 Video Analyzer Stereo TV Adder
$995 Patent Pending U.S. Funds

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

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:

Substitute for video heads before replacing them. The VC63's exclusive "Playback Head Sub" signal lets you substitute for the tiny signal (500 microvolts or less) at the video heads. If video returns you can change the heads with confidence.

Isolate FM problems quickly. Inject the VC63's modulated signal into any FM stage. If the monitor shows the video pattern you know all the circuits after your injection point are good.

NT64 NTSC Pattern Generator:

Meets manufacturers' requirements. The NT64 produces the two high quality color bars in the two patterns specified by VCR manufacturers: the "full-field" and the "split-field" pattern.

Phase-locked to all signals. Sync and references from the VA62 generate and phase-lock the NT64 pattern to the VA62 troubleshooting signals. This makes the NT64 work just like the VA62's built-in patterns.

ST65 Video Analyzer Stereo TV Adder:

Add Profitable MTS TV Analyzing Capability To Your Sencore Video Analyzer. Add stereo TV capability to your VA62 with the ST65. It adds those special signals you need to service stereo TV and Secondary Audio Programming (SAP). You get RF and IF frequencies plus all the signals needed to perform tests of stereo separation, signal-to-noise, crosstalk, audio, pilot threshold, dbx® *, stereo decoders and more.

To cut your servicing time by 54% (or your money back), call today at **1-800-851-8866.**

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

VC63 VCR Test Accessory ™

Add The Effectiveness Of Signal Substitution To VCR Circuits.

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

NT64 NTSC Pattern Generator ™

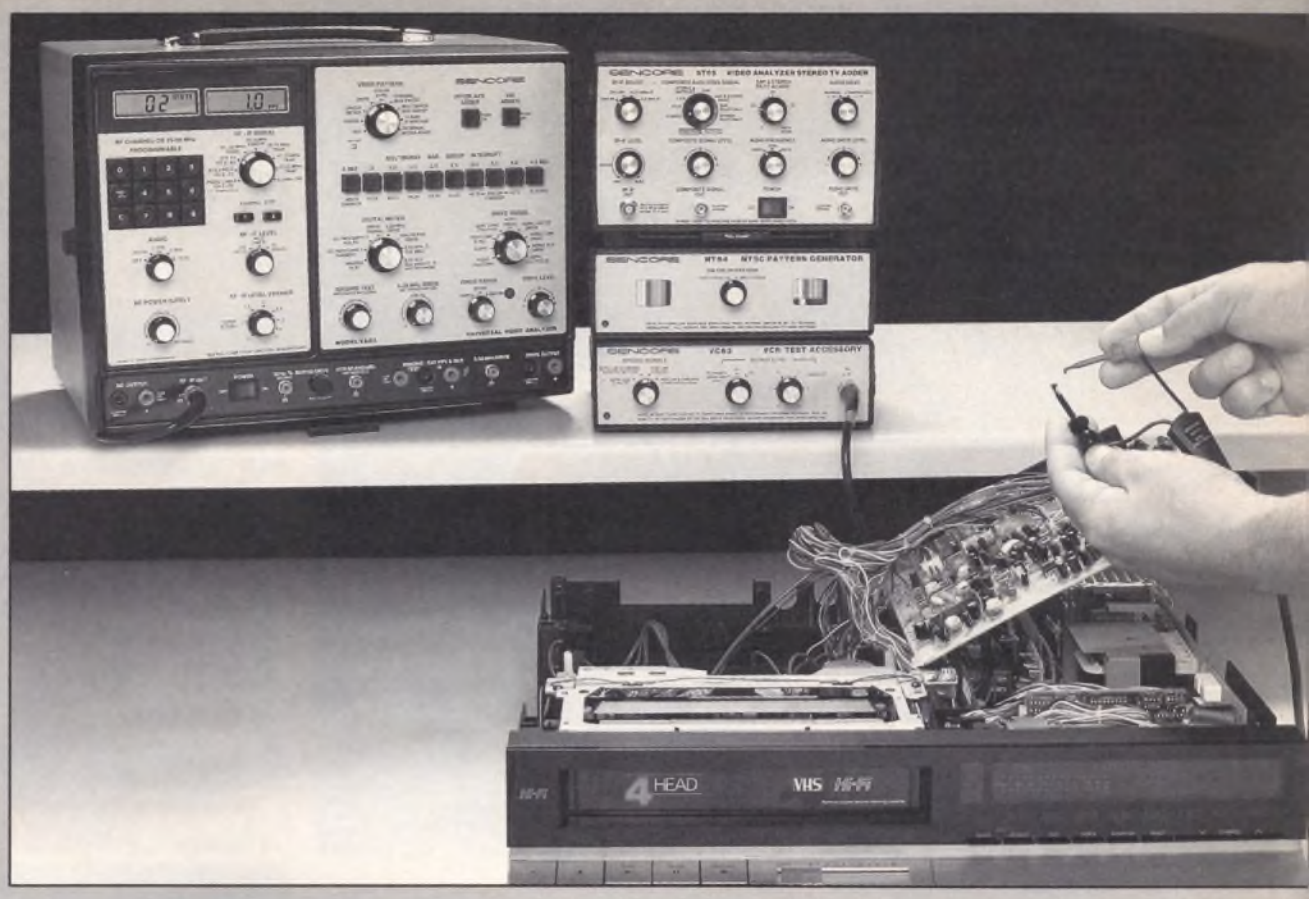
Produces the EIA RS 189 standard full-field and split-field color bar patterns that meet all VCR manufacturer's requirements for a color bar generator. These two patterns are fully phase-locked to all other VA62 signals. The NT64 is one-fifth the cost of competitive stand alone NTSC generators.

NT64 $495

ST65 Video Analyzer Stereo TV Adder ™

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



RG67 NTSC Video Monitor Adaptor

Updates Your VA48 or VA62 Video Analyzer — Helps You Expand Into 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.

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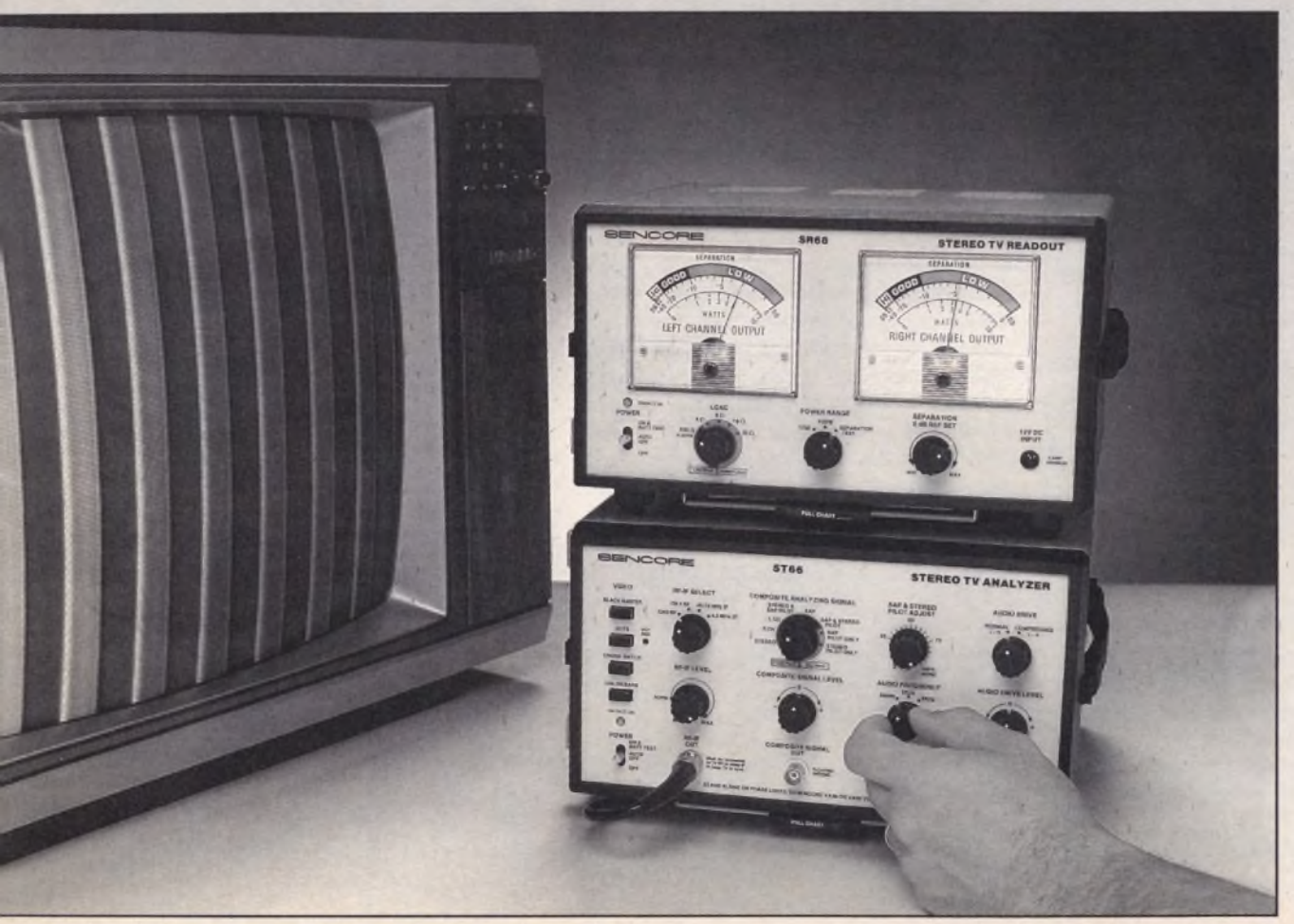

ST66 Stereo TV Analyzer ™

The Only Complete Analyzer For MTS Compatible Stereo TV.

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

SR68 Stereo TV Readout™

Dual Meters And Loads To 100 Watts Solve Stereo Servicing Challenges.

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

How The CHANNELIZERS Help You Analyze And Pinpoint Noise Troubles In MATV/CATV Systems

by Greg Carey, CET

If you work with cable TV (CATV) or master antenna (MATV) systems, you probably know how noise affects performance. You have undoubtedly struggled with conventional field strength meters to try to determine the source of noise. You may even have resorted to going from one tap to the next, looking at operating TV receivers, to try to narrow noise down to its source. We will see how the Sencore CHANNELIZERs help you quickly identify noise problems.

Three New Tests Help You Troubleshoot Noise In The Picture

TV signals are easily affected by noise in a system, because the picture carrier uses amplitude modulation. Any noise which has enough amplitude, adds to the carrier and modulates it, causing a snowy or grainy appearance.

A signal-to-noise (S/N) test lets you measure the relationship between the carrier level and background noise. The industry usually considers a ratio of 40 dB, at the subscriber tap, to be the smallest acceptable standard for S/N tests.

Noise has different effects, depending on its source. If an amplifier somewhere in the cascade (series amplifiers) begins to generate excessive noise, entire bands of channels (possibly all channels) will be affected. If the problem is in a head-end signal processor or caused by signal ingress (leakage into the system from outside), only one channel may be affected.

Other brands of field strength meters have a problem determining the cause of system noise, because they don't test the noise on each channel. They use an "offset" method where the noise is measured in a gap between channels. If, for example, a system has all VHF channels (2 through 13), a noise reference can be chosen at a frequency below channel 2 (for example 50 MHz), in the gap between the low-band and the high band VHF channels (between channels 6 and 7) and above channel 13. To further complicate matters, most competing meters cannot make this test at a subscriber's tap because they need at least a +20 dBmV (10,000 uV) signal. Special test amplifiers must be added in series with the FS meter to provide enough gain for the test.

Fig. 1: A poor signal-to-noise (S/N) ratio causes picture distortion in the form of snow or other interference.

Testing becomes even more complicated if a signal processor problem is suspected. The noise could be caused by any of several items in the chain from the antenna to the signal combiner (mixer). An MATV system, for example, may consist of an antenna, antenna amplifier, signal processor, and audio carrier filters. The output may then be combined with other processed channels in two or more steps. Some channels may even be moved to different frequencies using heterodyning converters.

S/N = Signal Level – [(Noise Reading – Test Amp Gain) + Bandwidth Correction], or S/N = S – [(N – G) + K]

When S = 23 dBmV, N = – 14 dBmV, G = 20 dB, and K = 13 dB:

S/N = 23 – [(– 14 – 20) + 13]
= 23 – [– 34 + 13]
= 23 – [– 21]
= 44 dB

Fig. 3: Conventional FS meters require you to manually calculate the signal-to-noise ratio, using the readings and two correction factors.

Conventional signal meters call for you to disable inputs of various parts of the system to measure the noise without the associated signals. To quote from the instruction manual for a popular signal strength meter: "It is necessary to remove the channel to be tested from the system . . . the input of the processor is then disconnected from the antenna and the input terminated."

To further complicate matters, other FS meters read out the signal and the noise as two separate numbers. You must mentally *subtract* these numbers if both are higher than zero (for example; +53 dBmV for signal and +4 dBmV for noise) or *add* them if they straddle zero (+22 dBmV and −14 dBmV). Then, there is the problem of identifying the cause of the noise. Without being able to view the noise, it's tough to tell if the problem is from a noisy

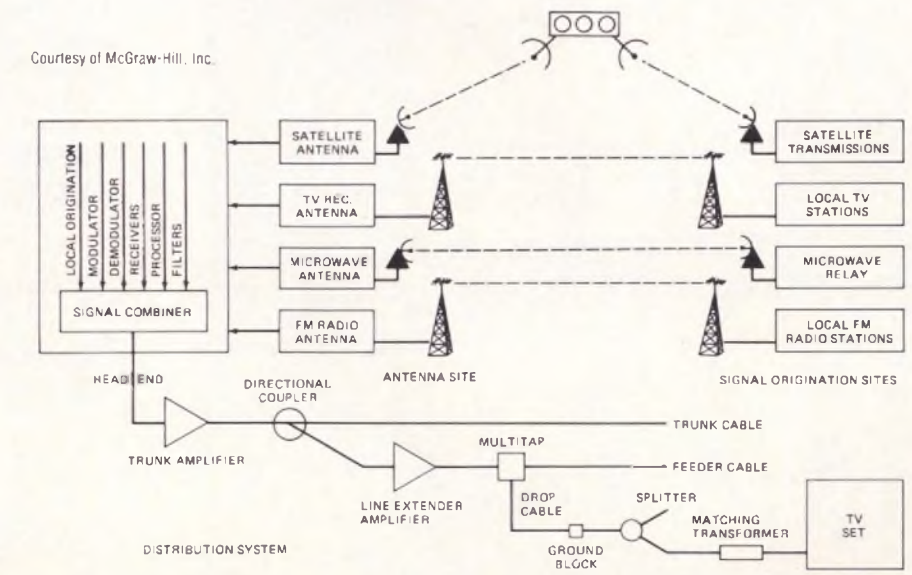

Fig. 2: Noise in a typical MATV system may be caused by amplifiers anywhere in the cascaded amplifiers or in the headend equipment. Single-channel noise usually is caused by headend problems.

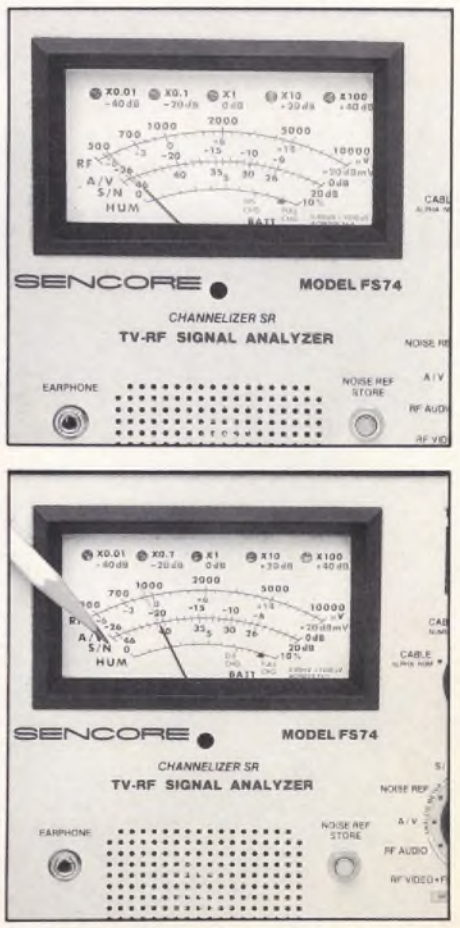

Fig. 4: The CHANNELIZERs automatically calculate the signal-to-noise ratio, and provide a direct meter reading.

amplifier, from a processor, or from co-channel interference coming in through a bad shield.

Both the FS73 "CHANNELIZER, JR." and the FS74 "CHANNELIZER, SR." simplify noise testing in three ways: 1) Automatic S/N calculations, 2) On channel, in-use testing, and 3) Keyed level test. To help isolate the cause of the interference, the FS74 CHANNELIZER SR. also has a wideband video monitor to display the noise. You use these features in different combinations, depending on the tests you want to make.

Fully Automatic Testing Eliminates Calculation And Error

The exclusive (patented) on-channel test makes the biggest difference. You have your choice of where you take your noise reference sample. If you want to capture the noise from each channel, you simply re-store the noise reference as you move through each channel. If you want to compare your S/N readings to conventional methods, you can sample the noise at some un-used part of the band and test all the channels against that single reference.

In either case, you tell the CHANNELIZER where to find the noise reference by moving FUNCTION switch to the "NOISE REF" position. You then use the TV CH-FM FREQ SELECT knob to tune to the channel you want to sample. Then, press the red NOISE REF STORE button. The CHANNELIZER stores the noise at that frequency and uses it as a comparison when you move the FUNCTION switch to the "S/N" position.

When in the S/N position, the CHANNELIZER does all calculations and displays the results on the "S/N" meter scale. The markings on scale show the dB ratio between the stored noise reference and the tuned carrier. The reading includes all needed corrections.

Exclusive Technical Breakthrough Lets You Test Channels While They're In Use

In explaining the S/N test, we mentioned that you have the option of measuring the noise on the in-use channel you are testing. This is possible because of special circuits which sample noise from a fully modulated carrier. To understand why these innovative circuits represent such a breakthrough, let's take a minute to see why conventional FS meters cannot take a noise sample from the channel under test.

An FS meter is simply a tunable RF voltmeter. The meter measures how much signal is present in a narrow band surrounding the tuned frequency. The IF stages and detector generally provide a bandwidth of under 300 kHz. The same circuits are used to measure signal or noise.

Conventional meters, however, cannot detect noise from a modulated channel, because of the video modulation products. The AM video carrier contains sidebands spaced at odd multiples of the 15,734 Hz horizontal sync frequency. This places the first sideband 15.7 kHz from the carrier. There is another signal every 31.4 kHz from the first sideband, at 47.1,

Fig. 5: Most conventional FS meters measure the video carrier incorrectly, because the carrier is only at full amplitude during the sync pulses. Horizontal sync is present only 7.5% of the time.

78.5, 109.9, etc. The 300 kHz bandwidth of the FS meter grabs about 10 sidebands, no matter where the tuning is set within the channel. These modulation products are not noise, but look like noise to the meter.

The only solution, when using a conventional FS meter, is to tune to a spot on the band which is not filled with modulation products. If all the channels contain carriers, this means sampling the noise at a point below the lowest channel or above the highest channel. If all mid-band and super-band cable channels are used, this leaves only two points where valid noise tests can be made, at the extreme ends of the filled band.

Some people think that conventional FS meters can make in-use S/N tests, because they have a special "S/N" switch. All that this switch does is add a correction factor to the meter reading, while reading the noise to correct for the narrow bandwidth of the detector. This provides a noise reading equivalent to the 4 MHz bandwidth specified by the FCC. The switch simply adds the correction to the meter reading.

The patented CHANNELIZER keyed S/N test allows in-use noise readings by measuring only during the vertical sync interval. Why does this end the problem? Because the video carrier is at a fixed amplitude during the vertical sync interval. Noise adds to the sync modulation, and causes the detected sync pulse to have noise instead of its normal flat top. To further ensure proper noise testing, the microprocessor tunes the CHANNELIZER 2 MHz above the video carrier, taking the sample points of maximum carrier power and the subcarrier used for color.

With the CHANNELIZERS' keyed test, you test the signal-to-noise ratio on each channel. This lets you quickly determine whether a noise symptom affects one channel, a band of channels, or every channel on the system.

True Signal Level Measurement Eliminates Setup Errors.

There is even more to the story. Other FS meters measure the video carrier level in error because of its amplitude modulation. The CHANNELIZER uses a keyed detector to measure true carrier level without needing mental corrections. Let's take a moment to see why other meters measure in error.

Nearly all FS meters read correctly when measuring an unmodulated carrier. This can be confirmed by measuring the output of an accurate RF generator. These meters read correctly when measuring unmodulated signals, such as the pilot carriers found on most CATV systems. The problem comes when measuring the AM video carriers.

Normal analog detectors show a lower level when measuring AM, because the carrier is at its full amplitude only during sync pulses. The horizontal sync pulses are only present for 7.5% of the time. You normally must add 1 to 3 dB to the meter reading to get the true video carrier level. (NOTE: This means that the audio-to-video carrier ratio on many systems is in error by as much as 3 dB, because an engineer set the levels using a conventional FS meter but forgot to include the correction factor!)

The CHANNELIZERS end this problem by measuring the carrier level ONLY during the vertical sync interval, when the signal is at its true carrier level. This means that the automatic signal-to-noise ratio test provides a carrier to noise ratio. The CHANNELIZERS use the same part of the signal to measure the carrier and the noise, for a true ratio.

You Can Troubleshoot Faster With The FS74's Wideband Monitor

The final feature is exclusive to the Senior CHANNELIZER only, and is designed to help identify the source of noise. The FS74 includes a special wideband TV monitor, so that you can see the type of noise present with the amount displayed on the meter. This helps track down the source of noise in a hurry.

The wide bandwidth of the monitor ensures that the noise will appear on the portable display. If the automatic meter test shows that the signal to noise ratio is less than 40 dB, turn on the monitor to see what the noise looks like.

If you see a generally snowy picture, suspect an amplifier or processor problem. If you see the herringbone pattern of co-channel interference, you know the problem is an extra carrier mixing with the original signal. Then, use the monitor as your guide as you move back through the various stages of the RF distribution system. When the picture is clear, you know that you are ahead of the noise source, and you then know where to concentrate your troubleshooting efforts.

Fig. 6: The wideband monitor on the FS74 CHANNELIZER SR. lets you find the source of the noise problem, since you can see exactly how it affects the picture.

Noise problems are tough to find when using conventional field strength meters, because they don't let you check noise on a channel-by-channel basis. The Sencore CHANNELIZERS let you sample the noise on each channel to show which channels are affected. The wideband monitor of the FS74 helps you even more, by showing what the noise looks like in the picture. Give your Sales Engineer a call, **1-800-843-3338**. He can answer your questions, plus provide additional information about the CHANNELIZERS. ■

(Continued from page 9)

Weak Emission

A CRT with weak emission produces a "dull" picture. The picture lacks brightness and contrast at all signal levels. Here the problem is a cathode that is covered with "crud". Crud buildup restricts the electrons from getting out. The cathode still emits electrons, but not enough of them can get through the crud to produce sufficient beam current.

You may think low emission results from a lack of emitting material on the cathode. This is seldom the case, since cathodes normally become covered with crud long before their emitting material wears off. Some cathodes, however, may get "stripped" of emitting material. Cathode stripping is not a result of normal CRT use, but is caused by excessive restoration. Good CRT restorers only remove the crud layer from the cathode, but some CRT restorers remove lots of good emitting material along with the crud. The result is a dead tube, or a tube with a severely shortened life.

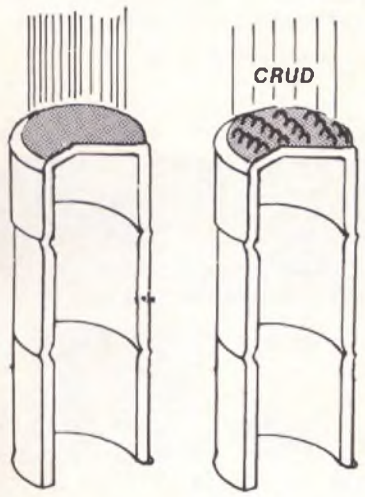

Fig. 3: Normally the hot cathode in a CRT emits enough electrons to form a strong electron beam. When the cathode becomes covered with crud, not enough electrons are emitted to produce a beam of sufficient intensity to make a bright trace.

Some CRTs have good emission at normal operation, but their emission drops off visibly with a small drop in filament voltage. A cathode always provides fewer electrons if its temperature is lowered, but a good cathode provides many more electrons than needed for beam current, so a small drop in filament voltage has no visible effect. As crud begins to develop on the cathode, however, the reserve electrons become fewer until all are needed to form the beam. These tubes may not show any symptoms unless the AC power line voltage drops, but the cathode is on a quick road to failure.

Bad Color Tracking

Only color CRTs (and 3-tube projection systems) develop bad tracking. The cathodes may have good emission, but the CRT still produces a bad picture because the colors do not balance. For the colors to balance, the electron beams from the three guns must be of the proper proportions. Normally, the guns are balanced with the Screen and Drive adjustments. But, these controls only have sufficient range if the deviation in emission from the strongest to the weakest gun is 55% or less. Bad color tracking is caused by weaker emission in one or two of the guns, which can be traced to crud buildup on the cathode.

How Can A Restorer Bring Life Back Into A CRT?

Now that we know what goes wrong with a CRT, how can we restore it? To effectively restore a CRT you must match the type of restoration to the failure. For example, removing crud from the cathode wouldn't fix a G1 short. Therefore, a CRT restorer must have different types of restoration to match the different failures. The CR70 "BEAM BUILDER" is the only CRT restorer on the market that has five levels of restoration and shorts removal, to match the failures we've just looked at. Let's quickly look at these levels so that you understand what is happening when we restore a CRT with the CR70.

Safely Remove G1 Shorts

Almost always, a G1 short is a flake of material that can be vaporized with a high, instantaneous current. In the CR70 REMOVE G1 SHORT function, the CR70 removes the filament voltage (to protect the filament and cathode) and connects the cathode and G2 together. Pushing the red REJUV OR RESTORE button applies a charged capacitor to G1, vaporizing any flake between G1 and the cathode, or between G1 and G2. When the short is gone the capacitor stops discharging. Thus, only enough current is supplied to remove the short. Many other restorers force a current between the elements, short or not.

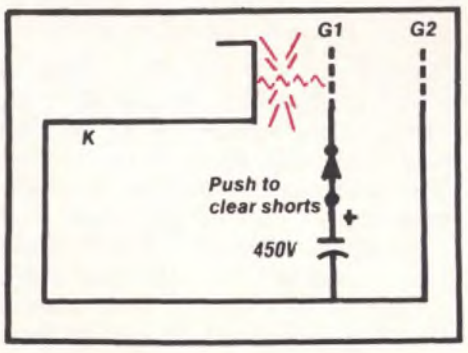

Fig. 4: G1 shorts vaporize as a 450 volt capacitor discharges through the shorting particle.

Rejuvenate Stubborn CRTs

Sometimes the crud coating the cathode is so thick that the restoring functions are not able to pull any current. The rejuvenate function of the CR70 breaks loose tubes that will not restore, with a sudden, high current surge. Once the crud has been cracked, the restore functions can draw current.

In the CR70 REJUV function the cathode and G2 are connected together and filament voltage is applied. A charged capacitor is again applied to G1. However, the current flow is limited with a resistor to prevent the hot cathode from becoming stripped. Many other CRT restorers have such a high level of rejuvenation that much of the cathode material is stripped off.

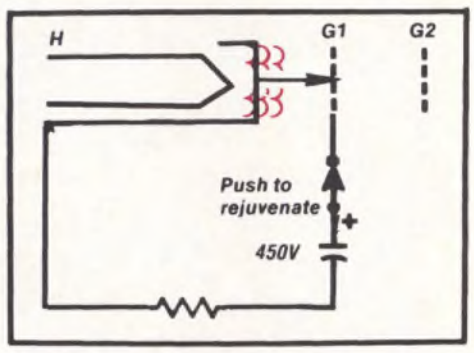

Fig. 5: The CR70 places a protective resistor in series with a 450 volt capacitor to limit cathode current during rejuvenation.

Restoring The Cathode

The CR70 AUTO RESTORE, MANUAL 1 RESTORE, and MANUAL 2 RESTORE functions are quite similar. The major difference between them, and between the CR70 restore functions and other CRT restorers, is in the amount of restoring current produced.

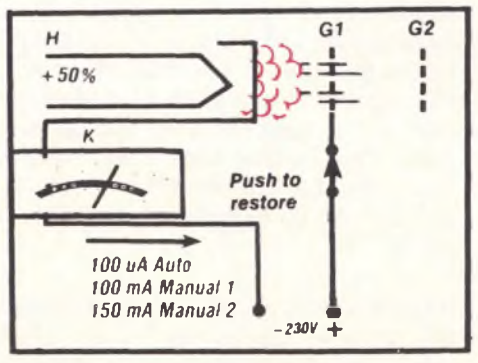

Fig. 6: Restoration increases the filament voltage and passes a 100 or 150 milliamp current through the cathode to remove cathode poisoning.

AUTO RESTORE is the lowest level of the CR70's restoration. The restoring current is limited to 100 mA, and is cycled on and off 3 times to keep the cathode from overheating. AUTO RESTORE is the first level of restoration to use on a CRT.

The next level of restoration is MANUAL 1. Restoring current is again limited to 100 mA, but is applied as long as you hold the REJUV OR RESTORE button down. Use MANUAL 1 on tubes that weren't restored by AUTO RESTORE.

The highest level of CR70 restoration is MANUAL 2. Here the restoring current is limited to 150 mA and is applied as long as the REJUV OR RESTORE button is held down. This level is about the same as the lowest level of restoration on most other CRT restorers. Only use MANUAL 2 for projection CRTs, and tubes that will not restore in AUTO or MANUAL 1.

How To Restore A CRT With The CR70

Now that we have an understanding of CRT failures and how restoration corrects those failures, we are ready to learn how to use the CR70 "BEAM BUILDER" to restore a CRT. The CRT that we will restore is shown in figure 7. Notice the dim picture, even with the contrast and brightness controls turned way up. This is typical of CRTs and television receivers which, were it not for restoration, would be discarded.

Fig. 7: Would you watch this picture? Even with the brightness and contrast controls at maximum, this picture is still dark and dull. Restoration is the only hope for this television.

Our first step is to connect the CR70 to the tube. Removing the back from the television, and checking the number on the CRT we find that this tube is a "25VETP22". Under that listing in the setup book, the following data appears: (Figure 8):

CRT NUMBER	SKT	CRT TYPE	F1	F2	FIL	NEG BIAS	GUN	K	G1	G2
25VETP22	7	VIDEO	7	8	6.3	52V	R	12	9	11
							G	10	9	11
							B	13	9	11
25VEUP22	7	VIDEO	7	8	6.3	52V	R	12	9	11
							G	10	9	11
							B	13	9	11

Fig. 8:The 1987 CR70 "BEAM BUILDER" setup book lists test data for 6,285 CRTs.

Using this data, let's do the following: First, connect socket number 7 to the tube. Then set the CR70's TYPE switch to VIDEO; F1 switch to 7; F2 to 8; FILAMENT VOLTAGE to 6; and BIAS to −52. These switches remain the same for all of the guns in this tube. The next switch settings, GUN SELECT, K, G1, and G2, however, change for each of the three guns, as each gun has unique elements. (This particular tube has a common G1 and G2 for all three guns, but many tubes have separate grids). Following the numbers in the setup books, we set the GUN SELECT to R, K to 12, G1 to 9 and G2 to 11.

Test The Tube First

First, we want to test the tube before we restore it, to confirm if it is really bad. Problems such as low anode voltage could be the cause of the poor picture. Secondly, we need to determine the tube failure so we can match the type of restoration. Lastly, we should know the tube's condition before restoration so we can determine how much restoration has improved it, or if we need to use a higher level.

Fig. 9: Before restoring a CRT, test it first so you know which restoration level to use.

To test the tube, simply follow the CR70 FUNCTION switch through the first 5 test positions. Turn the FUNCTION switch to FIL SET and the POWER to ON. Now, adjust the FIL SET control until the meter reads at the 6.3 mark on the FILAMENT VOLTAGE scale. If the voltage doesn't set, or filaments don't light, the filaments are open or shorted. This tube adjusts to 6.3 volts.

Next, move to the H-K SHORTS. All tubes should read in the green GOOD area of the meter, unless they use a directly heated cathode. A directly heated cathode tube will have the same number for F1 and K in the setup book. Our tube reads well into the GOOD portion of the meter.

Move the FUNCTION switch to G1 SHORTS. Again the tube should read in the GOOD scale. If it doesn't, use the REMOVE G1 SHORT function to remove the short before making any more tests. Once again, the tube we are working with checks good.

Fig. 10: The CRT must adjust into the cutoff box if it is going to produce an acceptable picture. A tube that won't reach cutoff has a cathode that is heavily worn in the center.

Now, move to CUTOFF. This test identifies tubes where G1 does not have proper control over the electron beam. Adjust the CUTOFF SET control so the meter reads in the CUTOFF SET box marked on the meter face. Then leave the CUTOFF SET control at this setting for the emission test.

Some technicians think that the CR70 CUTOFF test is just a setup adjustment for the emission test, as it is on other CRT testers. While CUTOFF is a setup for emission, it is also a very important test. If you can't adjust cutoff up to the box, the tube's cathode is worn heavily in the center; (the "gassy" tube we talked about earlier). Restoration is almost always successful on this tube. Occasionally, you'll encounter a tube in which the cutoff stays well above the box, or that is very erratic and won't stay set. Such tubes have a problem with G1, and may or may not be helped with restoration. The tube we are testing just adjusts into the box, with the Cutoff Set turned fully up.

Finally, move the FUNCTION switch to EMISSION. The tube should read GOOD on the meter, and it should continue to read GOOD with the EMISSION LIFE TEST button held down. Our tube tests only about midway up on the BAD scale. This indicates very low cathode emission, and corresponds with the dim picture we see.

Restore The Bad Gun

Our next step is to restore the red gun. (We could test the remaining two guns first, but with the red gun reading so low, the tube will never give an acceptable picture.) How do we restore the tube? Which of the CR70's 5 levels of restoration (the last 5 positions of FUNCTION switch) do we start with?

To use restoration successfully, remember two simple rules: 1) match the type of restoration to the failure, and 2) use only enough restoration to do the job, then stop. We know not to use REMOVE G1 SHORT on this tube, since the G1 SHORTS test read good. That means we'll start with AUTO RESTORE, since that is the lowest level of restoration.

With the FUNCTION switch set to AUTO RESTORE, you'll notice that the CRT filaments get brighter. Wait for just a few seconds for the filaments to warm the cathode a bit more, then hold the red, REJUV OR RESTORE button down.

The meter should begin to read up scale, indicating that the tube is drawing restoring current. You can read the amount on the RESTORING CURRENT scale at the bottom of the meter. After a few seconds, the meter reading drops back to zero. Keep holding the button down though, because after the tube has had a few seconds to rest, the restoring current begins again. Continue holding the button down until the CR70 completes three restoring cycles. The CR70 automatically stops after three cycles.

Fig. 11: To restore a tube with weak emission, begin with Auto Restore. Hold the Restore button down until the CR70 completes 3 cycles of restoration.

We need to stop here, and discuss what to do if the tube draws very little or no restore current. Low or no restoring current means that the crud on the cathode is so thick that the electrons can't escape. The REJUV function will be needed to crack the crud. Simply turn to the REJUV function and depress the REJUV OR RESTORE button. Nothing will appear to happen, but the current surge should have broken through the crud. Return to the AUTO RESTORE function. If the tube now draws restore current, simply continue on. If it still doesn't, repeat the REJUV procedure.

Let's check on the success of our restoration by repeating the CRT tests once again, beginning with H-K SHORT. After restoring a CRT, you may find that the H-K or G1 SHORT test reads BAD, but slowly rises into the GOOD area. This is a normal condition caused by the large electron cloud surrounding the super-heated cathode right after restoration. But in some tubes, you may find a G1 short that doesn't go away as the cathode cools to normal. This happens sometimes after restoration when a flake of the crud gets stuck between the cathode and G1. Simply go to the REMOVE G1 SHORT function, wait a few seconds for the cathode to cool and then press the REMOVE OR RESTORE button.

Most tubes will have good cutoff, emission and emission life after just one application of AUTO RESTORE. However, some tubes will still test bad, and require further restoration using the next highest level, MANUAL 1 RESTORE.

The tube we're using as an example tests good after restoring it with AUTO RESTORE. But, we are working with a color tube. So far we have tested and restored the red gun. Now, we need to do the two remaining guns. The procedure for the green and blue guns is the same as we just did for the red gun, except we need to set the CR70 GUN SELECT, K, G1 and G2 switches for the new gun as shown in the setup book (Figure 8).

After all three guns have been tested and restored, make the COLOR TRACKING test, to see if the guns track one another. Set the FUNCTION switch to COLOR TRACKING. The meter should read GOOD as you move the GUN SELECT switch to R, G, and B. A BAD reading in any one (or two) of the three GUN SELECT switch settings means that that particular electron gun (or guns) has less than 55% of the emission of the highest gun. The gun that reads bad should be restored to bring it to the level of the others.

Progressive Restoration Allows You To Restore With Confidence

The secret to successful restoration with the CR70 lies in its five levels of progressive restoration; first you match the restoration to the type of tube failure, then you use only as much restoration as needed to get the job done. Surveys of our customers tell us that over 90% of weak and shorted CRTs can be restored with the CR70, and without the worry of damaging the tube.

Do you have questions about CRT restoration? Or about this article? Call 1-800-843-3338 and ask for your Sencore Sales Engineer. ■

How To Simplify VCR Luminance And Chroma Circuit Troubleshooting With Your VA62 Universal Video Analyzer And VC63 VCR Test Accessory.

by Norm Tipton, Application Engineer

One memorable seminar night, while everyone was finding a seat and getting ready for the seminar to start, and all the equipment was getting a last minute check . . . it happened. The demonstration VCR used to simulate failures — failed. And, only a minute before the seminar. This time it was for real! Would you panic? You bet! Fortunately, a warm, empathetic voice came from the back of the room, "Why don't you use the Sencore instruments to find out what's wrong?" That voice saved the night. "Isn't this exactly what it's all about, to demonstrate the speed and ease with which Sencore instruments can isolate problems?" This seminar was going to be interesting *and memorable.*

What was wrong with the VCR? Well, during playback, the vertical bar on the TV screen was visible; it had dropped about 2 inches from the top with an intermittent noise bar above it. And, it grew worse each time the VCR was cycled from stop to play!

"What stage do you think the problem is in, according to what you see and hear on the monitor?"

The answers poured in, "Check the capstan servo", "I'd try the cylinder servo", "How about the luminance circuit?" The answers were all based on what these professional servicers saw on the screen. But, you also have to take the audio into consideration. In a moment you'll see why. Circuit analysis always starts with questions; why not let your VCR answer some of them for you?

Observing The Symptoms Can Save You Hours Of Troubleshooting

The first thing you must do, when diagnosing any playback problem, is to *look and listen for the true symptoms*. Noise in the picture can come from any source in a VCR. And, noise can cause some pretty strange things to occur in circuits. To isolate the origin of the noise, first determine where it is not coming from. These simple observations can save you hours of wasted time:

Is the linear playback audio okay? If it is, that's great! That means the capstan servo control is working properly, because the linear sound is produced by a *stationary* audio head. And since the capstan is responsible for head-to-tape velocity, any defect in the capstan motor or circuit would affect the sound quality.

Fig. 1: The first rule in VCR servicing is to look and listen for the true symptoms.

Is the FM Hi-Fi playback audio okay? If it is, then the cylinder servo, tracking, and headswitching pulse circuits are working properly. The FM Hi-Fi audio is produced by a set of audio heads on the headwheel just like the video, therefore, any defect in the cylinder motor or circuit will affect the Hi-Fi sound quality. And since the FM audio headswitching pulse is the video headswitching pulse delayed, any problem in the video headswitching pulse will also affect the audio headswitching pulse.

With these two questions (and the VCR answered them for you), you have isolated the noise to one of two places, the video heads or the luminance circuits. In our VCR, the noise and its effect on vertical sync must be coming from the heads or it is being generated in the luminance signal path.

The VCR has revealed all the information you need to make swift work of this VCR problem. What's the next step? With an instrument that can supply the special substitute signals VCRs use, you are home free! Simply substitute the luminance signal and the head signal, and you'll know which circuit the problem is in.

Use Your VA62 Universal Video Analyzer And The VC63 VCR Test Accessory To Solve Head And Luminance Problems In Minutes.

Because the symptom is one of noise, you'll need an FM black and white signal, preferably a cross-hatch, for a high white to black transition. This type of signal reveals noise more easily. Your VA62 produces this pattern (and eight others) you can use with your VC63 VCR Test Accessory to produce the FM luminance and head signals need to troubleshoot VCRs.

We're close to getting this failed VCR up and running. Now, let's set up the VC63: OUTPUT LEVEL controls to PLAYBACK HEAD SUB; 4 VOLTS PP.

Using the crosshatch pattern, inject the FM luminance signal into the luminance board input connector. This is the connector that comes from the heads. The monitor shows a beautiful crosshatch picture. There's no noise and the vertical interval is in proper sync. All the luminance circuits forward of the connector are eliminated; this leaves only the heads in suspect. A thorough cleaning is proper at this point. Cleaning the heads did the trick, now the monitor displays a beautiful picture.

Observing The Video And Sound Is Important In VCR Service

Most of the servicers agreed that they definitely would not have gone after a bad or dirty head, from the symptoms they saw on the monitor. The majority would have jumped on the servos. This VCR problem proved that: "It's not what you see, but what you see and hear that makes the difference in VCR service." Don't turn off the sound while troubleshooting a VCR; you might miss the most important clue.

The problem in the demonstration VCR was over, thanks to the VA62 Universal Video Analyzer and VC63 VCR Test Accessory. Admittedly, there was some help from the audience.

Have questions about VCR service or this article? Call **1-800-843-3338** and ask for your Sales Engineer. He'll make sure your questions are answered. ■

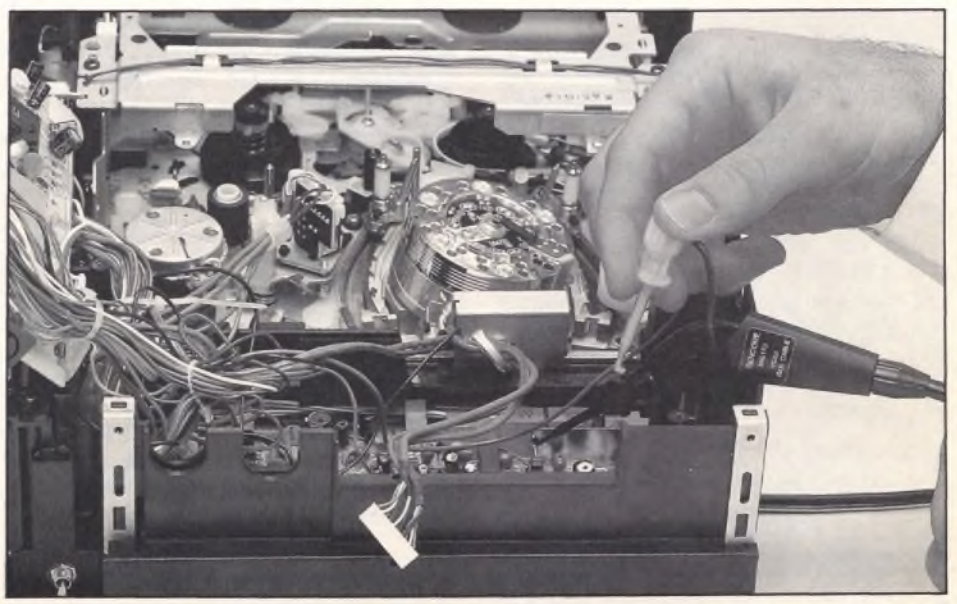

Fig. 2: Injecting the VC63's playback head sub signal proves whether there's a problem with the heads or the luminance signal path.

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- How to quickly isolate any VCR Servo lock-up problem using the Sencore VA62 Universal Analyzer and the SC61 Waveform Analyzer.
- How to accurately test and align any multiple head Hi-Fi VCR system in 3 easy steps using the SC61 Waveform Analyzer.

MTS Stereo Color Television Troubleshooting Techniques

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- How to quickly isolate any TV shutdown problem dynamically using the VA62 Video Analyzer to fire the chassis up and the SC61 Waveform Analyzer to monitor and analyze H.O.T. output.
- How to check any TV chassis for RF, IF video and chroma response in less than 60 seconds without taking the back off the set.

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- How to dynamically analyze any IHVT in circuit, in seconds, using the patented VA62 ringer test and exclusive IHVT drive test.
- How to dynamically analyze any cap or coil with 100% reliability using Sencore's all new triple-patented Z METERs.
- How to pinpoint any MATV, or cable TV-RF distribution problem with the all new Sencore FS74 CHANNELIZER SR.

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1 Ask Sue Ann Gustafson, Sencore Workshop Coordinator, to reserve a seat at your scheduled workshop.

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The SC61 Waveform Analyzer Ends The Guesswork Of VCR Servo Troubleshooting *(Continued from page 5)*

Let's review how this problem was solved. 1. Verified that the problem was a servo problem and determined which servo was at fault by using the test tape and basic knowledge of how a VCR works. 2. Analyzed the key waveforms and voltage with the SC61 Waveform Analyzer. These two steps isolated the problem to the bad stage. 3. Tested the few components in the filter circuit to locate the exact problem.

Locate Cylinder Servo Problems Too, With A Few Simple Tests

There are six important signals needed for proper cylinder operation. They are:

1. System control to turn the cylinder on.
2. The FG pulse to determine the speed of the cylinder.
3. The PG pulse to determine the exact location of the cylinder.
4. The 30 Hertz reference pulse.
5. Speed and Phase Pulse Width Modulated (PWM) signals.
6. DC control voltages for the cylinder motor.

Let's take a look at an example of a cylinder servo problem to see how to recognize the symptoms and locate the defective stage.

How Logical Troubleshooting And The SC61 Can Locate Cylinder Servo Problems.

This customer's VCR simply had a bad picture. It was promptly hooked up to a TV; the test tape was played. The tape verified that the speed detect circuits were working; you could tell by listening to the audio tone as the different sections of the tape were played. The capstan was traveling at the correct speed. No chance of a reasonable picture in *any* of the tape speeds, though. Placing the VCR in the pause mode produced video (Figure 7), but the picture would not lock up horizontally. This was the clue to a cylinder problem.

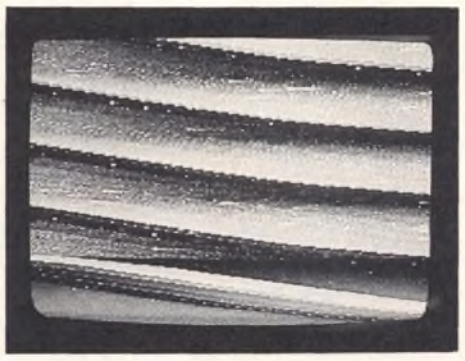

Fig. 7: One symptom of a cylinder servo problem is a picture that will not lock up horizontally.

After cleaning the VCR, a quick check proved that the problem was still present. The FG pulse from the cylinder looked pretty good on the SC61 Waveform Analyzer (Figure 8), but upon closer examination (a push of the SC61's FREQ button), the FG pulses proved to be higher in frequency than they should have been. This further verified that the cylinder servo was at fault; it was running at the wrong speed.

The next point to check? The output of the speed pulse width modulator. Again, the frequency measuring capabilities of the SC61 Waveform Analyzer were called for. Simply pressing the FREQ button and reading the display proved the frequency was correct. But, the duty cycle of the squarewave signal didn't look right; it was near 0%. A check of the DC voltages in the cylinder adder circuit found them fluctuating around their normal voltage. The servo control circuits were trying to correct the speed of the motor, but the motor was not responding.

The next logical circuit to check was the signal being fed into the motor drive IC. A varying DC voltage was present at the input of the motor driver circuit, but no correction was taking place. Replacing the motor driver IC corrected the problem.

Servo troubleshooting is simplified when you know how servos work

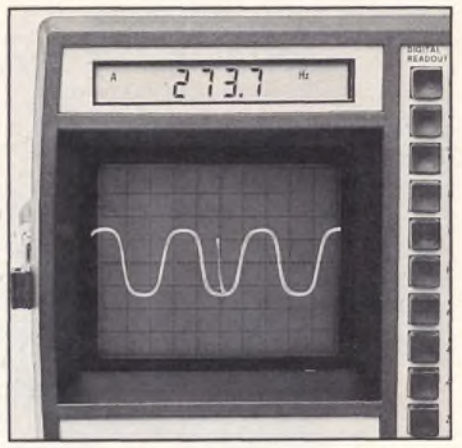

Fig. 8: The frequency of the FG pulse gives an indiction of the speed of the cylinder. The SC61 digital frequency readout gives a quick indication of this frequency without counting graticules.

and are familiar with some of the symptoms of a defective servo. But, your test instruments are the real key to successful troubleshooting. Your SC61 Waveform Analyzer will help speed your servo troubleshooting by showing you the critical waveforms, and, by helping you analyze these waveforms ten times faster and ten times more accurately than is possible with any other scope.

Do you have questions about this article? Give your Sales Engineer a call at 1-800-843-3338, and after your questions are answered, ask him about Sencore's new Tech Tips. ■

You Can Take The Numbers Right Off The Capacitor, And Test To EIA And Industry Standards . . . Automatically With Your LC77 AUTO-Z. *(continued from page 9)*

Fig. 6: With your LC77 AUTO-Z and SCR250 SCR and Triac Test Accessory, you can prove whether the SCR/triac is "GOOD" or "BAD", dynamically, at the circuit's operating voltage to 1,000 V.

other than capacitors, is often specified as a resistance (65 megohms for example). A simple flip of the switch lets you read the leakage value in microamps or ohms on your LC77.

You Should Have A Way To Test SCRs And Triacs

SCRs and triacs, are power switching devices used in applications such as TV, microwave ovens, light dimmers, industrial motor controls, welders, etc. And, of course they are high failure items. What is the worst thing about troubleshooting SCR and triac circuits? Is it having to wait for a part? No, it's getting the new SCR or triac in, and finding that it wasn't the problem! Now you have to start all over again. The bottom line is that you need a way to confidently test SCRs and triacs.

You Can Use The SCR250 With Your LC77 AUTO-Z For Dynamic SCR And Triac Testing

Checking an SCR or triac with an ohmmeter will miss all but the direct shorts. Ohmmeters don't supply enough current to trigger an SCR, and leakage tests require more voltage than the ohmmeter provides. The LC77 and SCR250 SCR and Triac Test Accessory give you a dynamic test that will do two important things: 1. Supply the current necessary to trigger the device so you can be sure the SCR actually operates. 2. Supply test voltage to 1,000 V to isolate leakage problems.

Why Is The LC77 Such A Good Troubleshooter?

Because it's the only instrument that can take all the guesswork out of component testing. Finally, you can prove beyond doubt, once and for all, that the part is good or bad, to industry and EIA standards.

Have questions or need more information? Call your Sales Engineer, 1-800-843-3338. ■

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You get direct digital readings without the confusing menus or cursors that digital readout scopes require. Readings are accurate even if the signal isn't on the CRT or knobs are left ''out of cal''.

The SC61's clean front panel and human engineered controls take the confusion out of scope operation.

Try an SC61 Waveform Analyzer. You'll quickly discover how the power at your fingertips reduces your toughest troubleshooting challenge at the push of a button.

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