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Issue #138 May/June 1988

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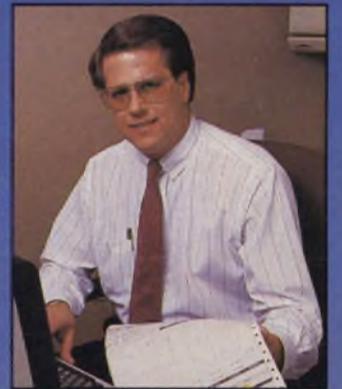
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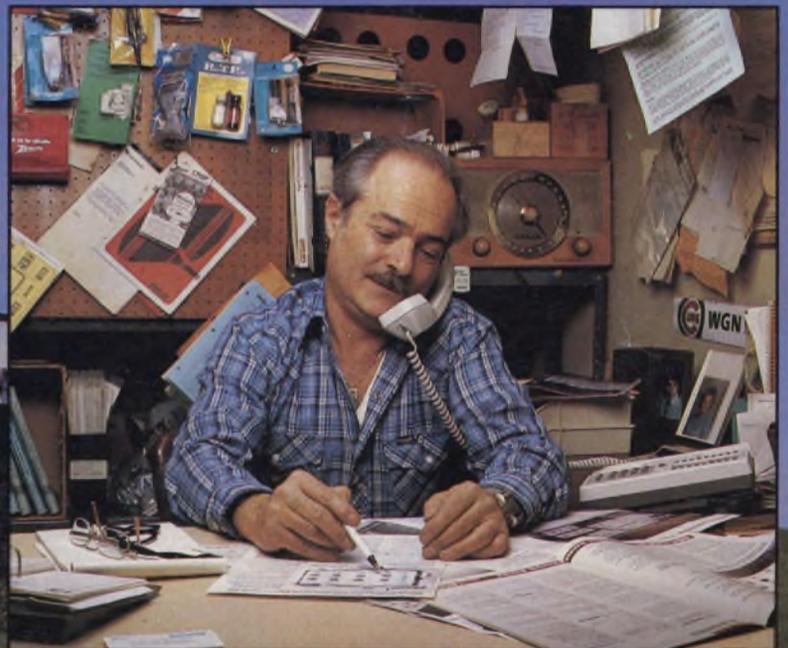
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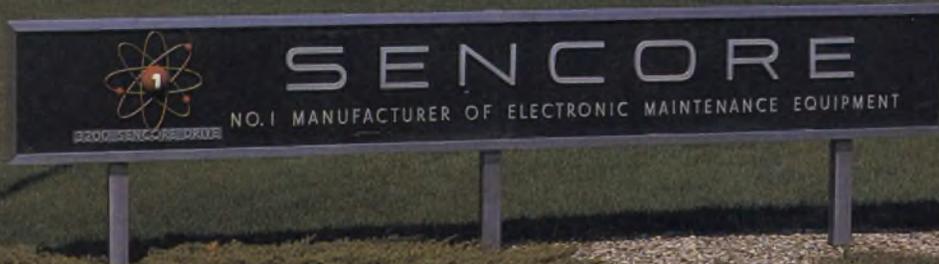
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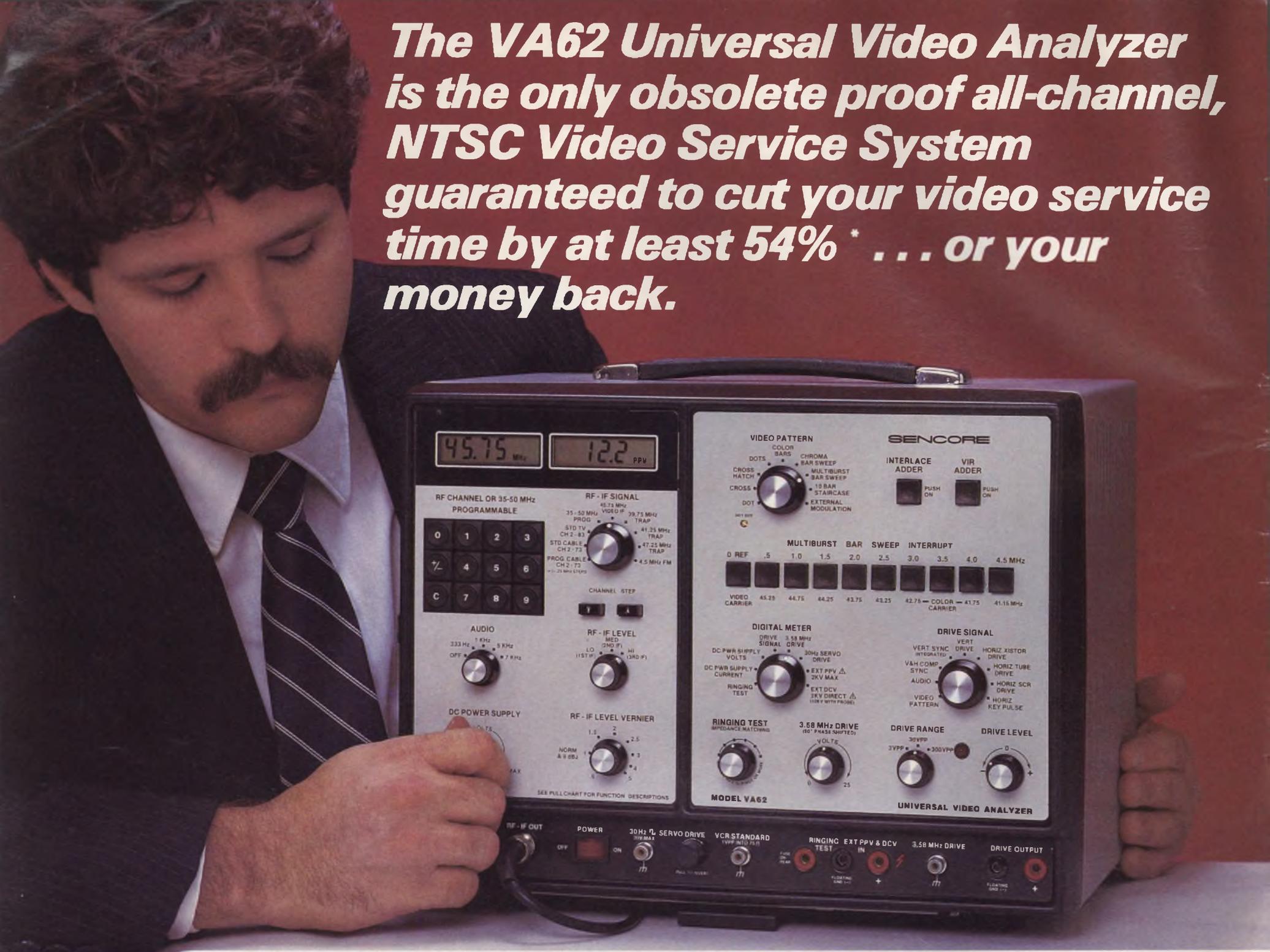
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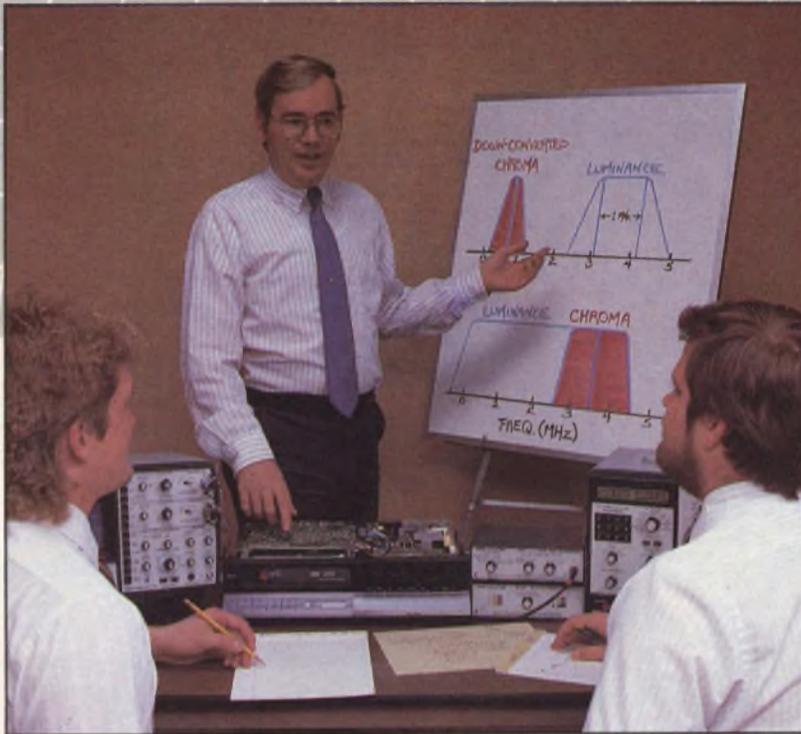
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* Based on a survey of servicers using the VA62 Universal Video Analyzer techniques over previous methods.

You Can Service VCR Color Circuits Faster With Your VA62 Video Analyzer And SC61 Waveform Analyzer

by Rick Meyer, Application Engineer



Limited bandwidth and unstable playback create a special concern for designers of VCRs. These two areas in a VCR pose unique problems that could easily eliminate or severely degrade color quality.

In this article we'll look at the circuits that solve these color problems, and discuss what goes wrong and see how to locate defective stages. You'll learn how color is recorded and played back, plus you'll see how to service VCR color with your VA62 Video Analyzer, VC63 VCR Test Accessory and SC61 Waveform Analyzer.

How The Color Information Is Recorded On A Video Tape

In the NTSC format (Figure 1a), video extends from 0 Hz (DC) to about 4.2 MHz. Color information is located at 3.58 MHz, which is within the luminance bandpass. Video tape frequency response, however, does not permit recording the NTSC signal as is. Instead, luminance is FM modulated on a 3.9 MHz carrier. Deviation is adjusted so that the video sync tips occur at 3.4 MHz and peak white occurs at 4.4 MHz (Figure 1b). Since luminance and chroma cannot be recorded at the same frequency, the chroma information is converted to a lower frequency (629 kHz for VHS and 688 kHz for Beta).

To service color circuits, we must first understand how the VCR converts the 3.58 MHz chroma information to a downconverted 629 kHz signal and back again. Let's see how the chroma information is placed on the video tape (Figure 2).

First, a bandpass filter separates the 3.58 MHz chroma information from the luminance. The

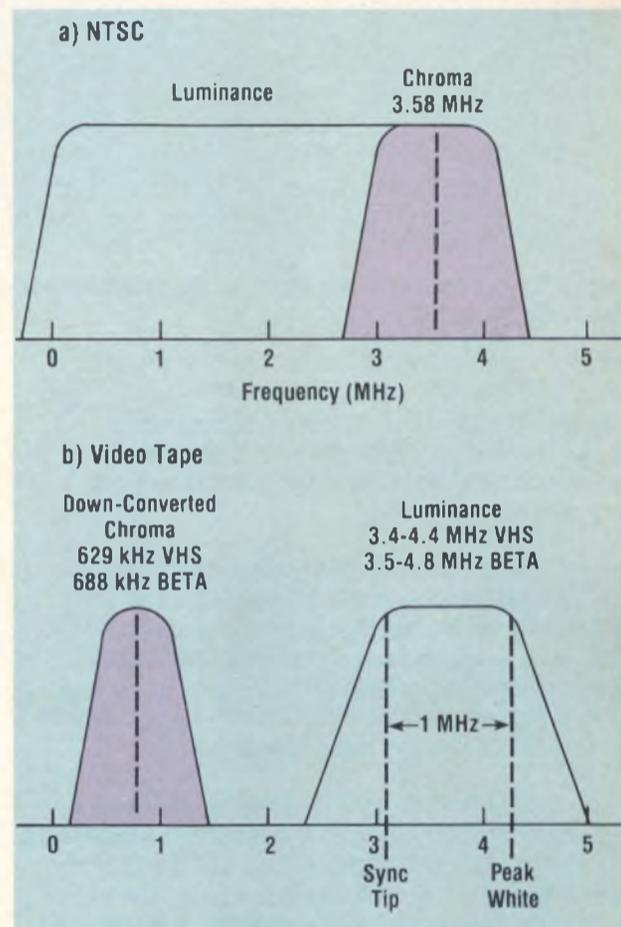


Fig. 1: (a) shows how the chroma and luminance signals overlap in the NTSC format; for video tape (b) the chroma information is "down-converted" and recorded separate from luminance.

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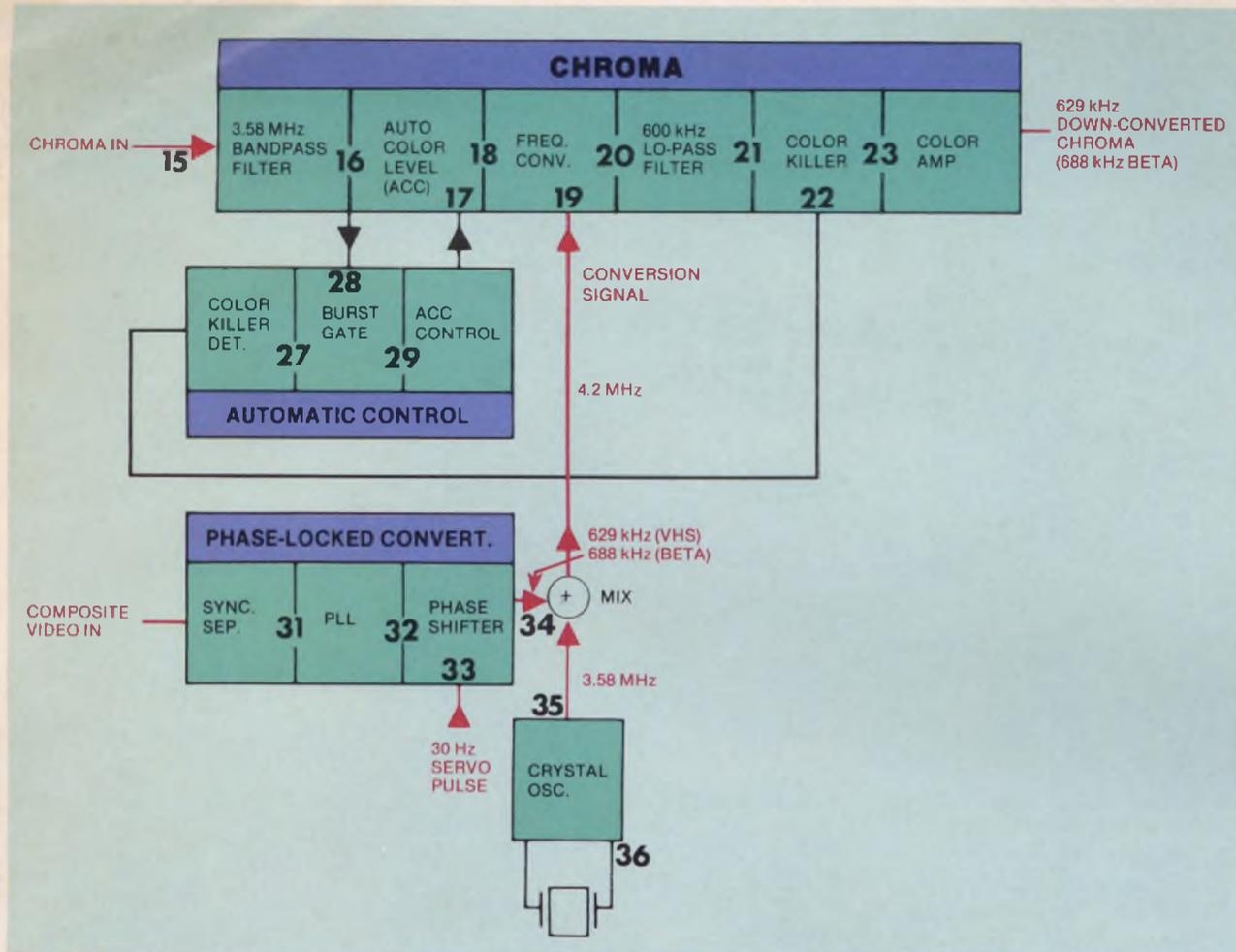


Fig. 2: The record circuits perform the function of converting the chroma information down to 629 kHz (688 kHz for Beta).

separated chroma is then sent through an automatic color leveling circuit that works somewhat like an AGC amplifier to level out amplitude variations.

Next, the 3.58 MHz chroma signal is fed to a frequency converter (mixer) where it is mixed with a 4.2 MHz signal generated inside the VCR. The mixer output includes the original signals and the mixing products. This signal is fed to a 600 kHz lowpass filter which allows only the 629 kHz downconverted signal to pass.

The 629 kHz color signal is then fed through a color killer, one or more color amplifier stages and finally to the luminance/chroma (Y/C) mixer. In the Y/C mixer, the FM luminance signal and the 629 kHz chroma signal are combined and routed to the video heads.

The process appears simple, however, there are several additional circuits. The 4.2 MHz local oscillator, used to create the downconverted chroma signal, is particularly important. This signal is derived from two other signals: a stable 3.58 MHz local oscillator signal and a phase locked 629 kHz signal.

The 3.58 MHz local oscillator is either a crystal oscillator or an accurate voltage controlled oscillator (VCO). The 629 kHz signal is generated by a phase locked loop oscillator (PLL). The PLL operates by dividing the 629 kHz signal (actually 629.36 kHz) by 40 to create a 15,734 kHz signal. The divided down signal (15,734 kHz) is then compared to the incoming horizontal sync pulses. Variations in the 629 kHz signal result in correction voltages that bring the PLL back to the correct frequency.

Since the video tracks are laid down next to each other, signal from one track may affect an adjacent track (crosstalk). Color crosstalk causes objectionable interference in the color picture. Crosstalk is eliminated by systematically shifting the phase of the recorded color signal — by changing the 629 kHz signal's phase for each horizontal line.

In a VHS VCR this phase shift is 90 degrees and occurs on each horizontal line. In a Beta VCR, the phase shift (180 degrees) occurs on every other line (Figure 4). Each arrow direction represents a different phase. VCR playback circuits remove the phase shift, thus canceling crosstalk.

Two external signals, the 30 Hz head switching pulse and a horizontal sync pulse, are used by the phase shifting circuits. The 30 Hertz pulse switches the video heads and ensures that the correct phase sequence occurs for each video head. The horizontal sync pulse selects the appropriate phase shift for each horizontal line.

If all the above circuits, plus the luminance record circuits, are working, a properly formatted signal will be recorded onto the video tape. Now, let's see how this information is taken off the tape and converted back to a TV signal.

How The Color Information Is Converted Back To An NTSC Signal

In playback, the recovered video signal includes the FM luminance and chroma information (Figure 5). *Note: In Hi-Fi VCRs, a Hi-Fi audio signal is also present.*

The 629 kHz chroma signal is separated from the luminance signal by a lowpass filter and fed to an automatic color leveling circuit. A frequency converter (mixer) converts the 629 kHz chroma signal back into a 3.58 MHz chroma signal. The 3.58 MHz chroma bandpass filter, at the



"All the color and luminance circuits must work properly to record signals on the tape that can be recovered in playback. The process appears simple . . ."

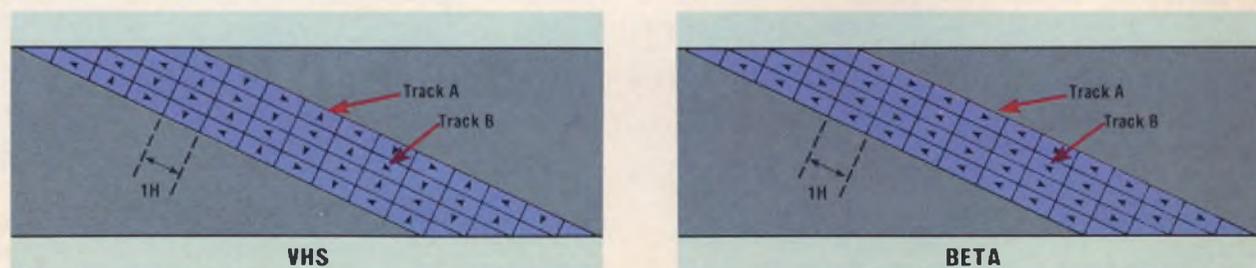


Fig. 4: The chroma phase shifting circuits ensure that any crosstalk between tracks can be taken out during the playback process. The direction of the arrows indicate the phase of the color signal.

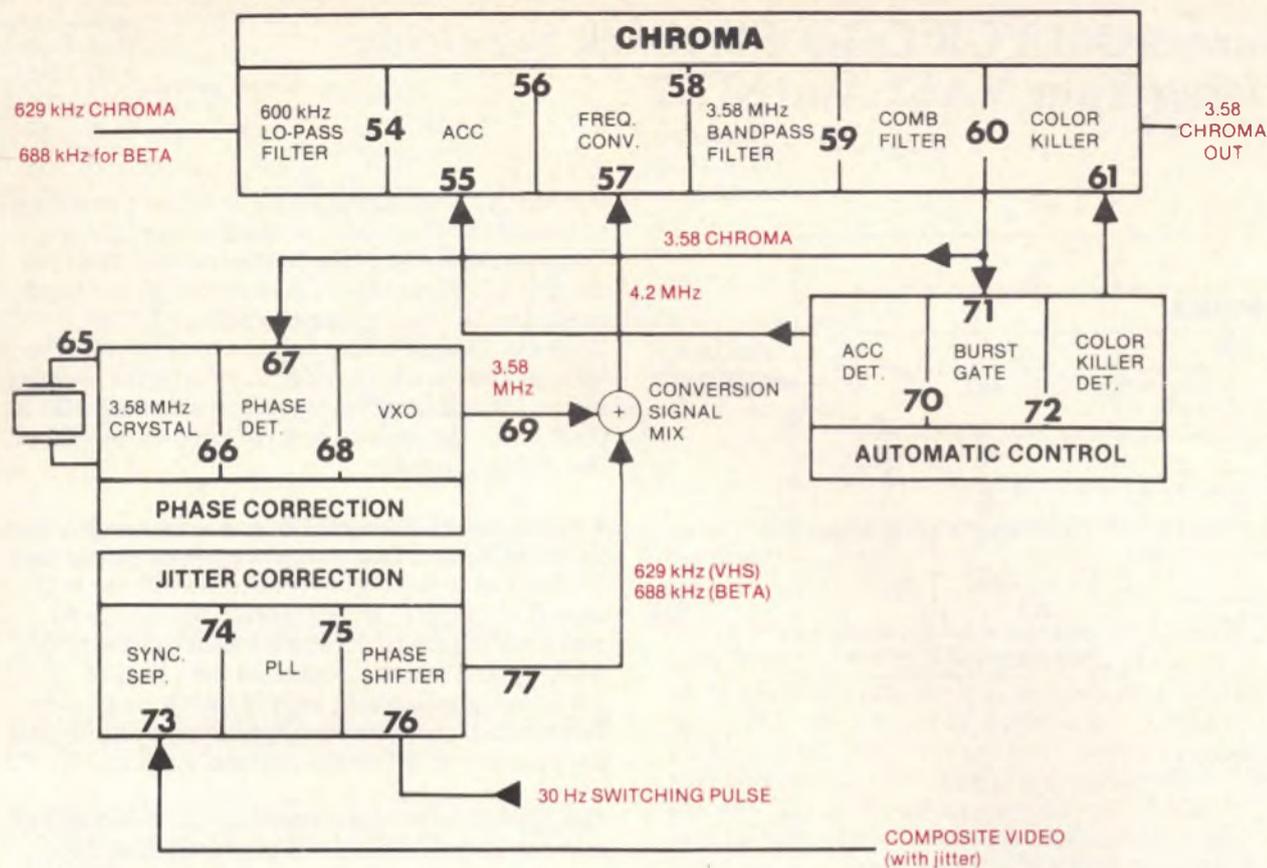


Fig. 5: The playback circuits perform the process of converting the chroma information back to a signal that can be received by a television receiver.

converter output, passes only the chroma information. The 3.58 MHz color signal is further filtered in a comb filter and run through color killer and amplifier circuits. It is finally fed to the playback Y/C mixer. This mixer combines the 3.58 MHz chroma information with the reprocessed luminance information, producing a video signal that matches the original NTSC picture.

Correcting For Tape Variations And Jitter

The 629 kHz chroma signal, from the tape, is not exactly at 629 kHz. It can vary as much as 2000 Hz as the head and capstan servos adjust to keep the video heads and tape moving at a relatively constant rate. In addition, temperature and humidity cause the video tape length to change. Direct conversion of the varying 629 kHz chroma signal would result in the same variations in the final 3.58 MHz chroma signal. This is unacceptable, since the TV's color circuits have a tight tolerance range.

The 629 kHz chroma signal conversion, from the tape to the 3.58 MHz signal needed by the receiver, is accomplished by mixing the low frequency chroma information with a 4.2 MHz signal. The 4.2 MHz signal is a combination of two signals: a jitter corrected 629 kHz signal and a phase corrected 3.58 MHz local oscillator signal. Lets look at these correction signals.

Jitter corrected 629 kHz: Variations in the speed of the tape or video heads cause the video output's horizontal sync pulses to occur sooner or later than they should. These horizontal sync pulses are used to create a jitter corrected 629 kHz signal. The 629 kHz local oscillator signal is created in the same way as in record, except that the jittery video sync signals from the luminance signal are used for a reference. The result is a jittery 629 kHz signal that cancels jitter in the 629 kHz chroma signal coming from the tape. The jitter correction circuit also contains a phase shifting circuit to cancel the phase shifts created in the signal during record, effectively cancelling crosstalk between the recorded chroma signal tracks.

Phase correction signal: The phase correction signal eliminates the small phase errors that cause a color tint problem or a total loss of color. The phase correction circuit takes a sample of the resultant 3.58 MHz chroma output signal and compares it to the VCR's internal 3.58 MHz local oscillator. Variations in the outgoing 3.58 MHz signal cause a corrective phase shift in the reference 3.58 MHz signal.

Both the jitter corrected 629 kHz signal and the phase corrected 3.58 MHz signal (Figure 5) are combined to create a jitter and phase compensated 4.2 MHz signal. This signal combines with the jittery 629 kHz chroma signal coming from the tape. The resultant 3.58 MHz signal is at the correct frequency and phase to faithfully recreate the color picture.

Four Signals Are Needed For Proper VCR Color Operation

Regardless of how simple or how complex a VCR chroma IC is, 4 basic signals are required for proper color recording and playback. These signals are:

- 1. The chroma signal:** Color circuits require a signal that contains the color information. In record, this signal includes the color burst and chroma sideband signals that are stripped from the composite video signal. In playback, this signal is the downconverted 629 kHz (688 kHz in Beta) chroma signal taken from the video tape.
- 2. The horizontal sync signal:** This signal is required to sync the various burst gates, automatic color control circuits, color killer circuits and phase shifting circuits. In record, the sync signal comes from the incoming video. In playback, it is obtained from the recorded luminance signal.
- 3. The 30 Hz switching pulse:** In record, color information is changed in phase each horizontal line. The 30 Hz switching pulse keys in a different phase sequence for each video head. This minimizes crosstalk between recorded tracks. In playback, the 30 Hz switching pulse reverses the record process.
- 4. The local 3.58 MHz oscillator signal:** This signal, in combination with other internally generated signals, is used as a reference in the color conversion process. It is part of the 4.2 MHz signal used to create the 629 kHz (688 kHz for Beta) color under signal. It is also a major part of the signal that converts the color under signal back to the 3.58 MHz chroma signal used by the television receiver.

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Six Steps To Successful VCR Color Playback Servicing Using Your VA62 And SC61

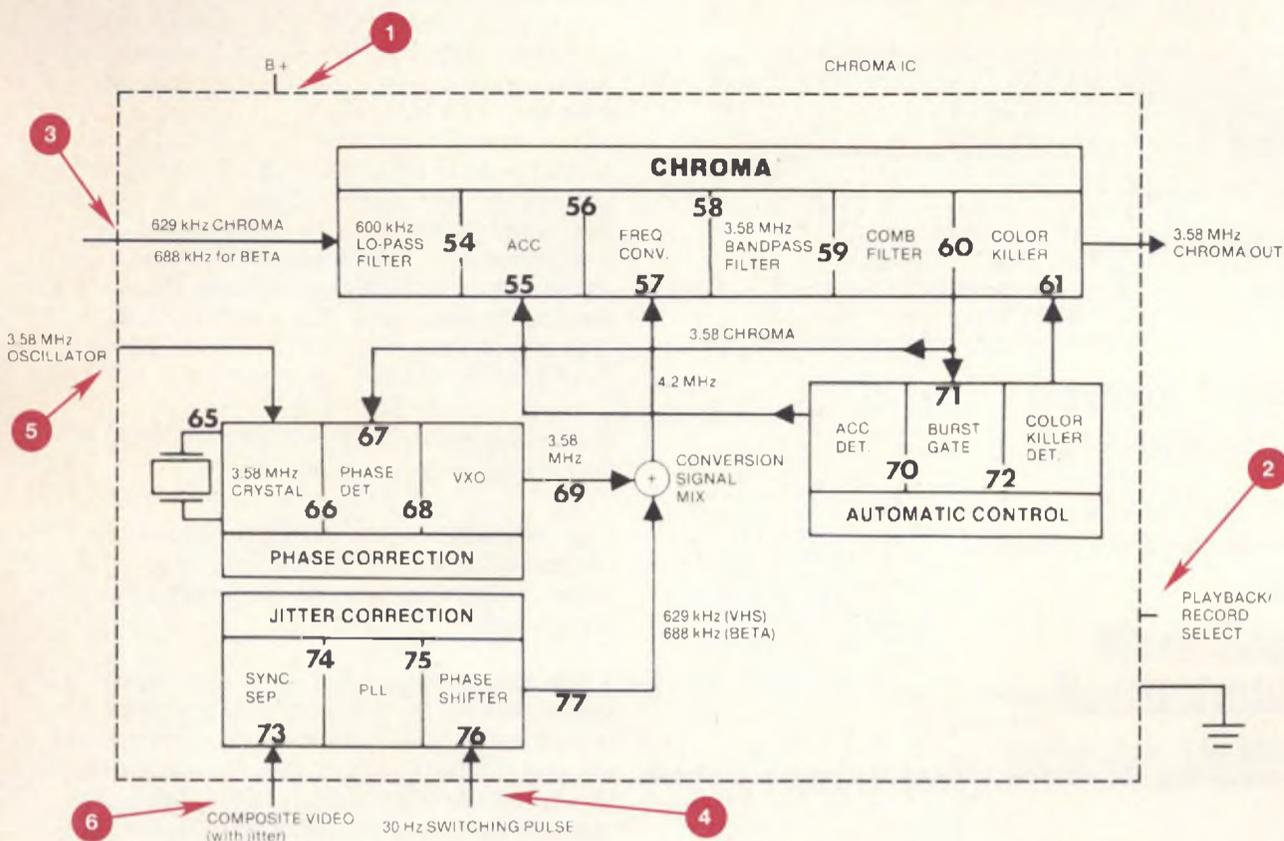


Fig. 6: Modern VCR chroma playback circuits are typically all located in one or more ICs. There are six key signals that need to be checked to determine if the IC is operating correctly.

In early VCRs, each functional circuit was built with discrete parts. You could troubleshoot those VCRs by following the signal through each stage, one stage at a time. Today, many of the functional circuits are located within one or more ICs (Figure 6). You must service these VCRs using the IC's available input and output signals. This does not, however, eliminate functional analyzing. In fact, functional analyzing is more important.

Make Sure The Problem Is Actually In The Color Circuits

Before you suspect a problem in the color circuits, check the VCR to be sure that the servo and luminance circuits are working properly. Play a pre-recorded tape in the VCR. Make sure that the tape is running at the correct speed and that you are getting a good luminance signal (B&W picture). If the VCR has a dirty or defective head, for instance, you will often see flashing color. This problem can be easily identified, since the luminance signal will also be flashing or have a lot of noise in it. Repair any problems that affect the luminance signal before suspecting color circuits.

A servo problem can also give symptoms that are easily mistaken for a color problem. Servo problems can also be identified by looking at the luminance signal. If the picture has poor video, or is jittery, check the servo circuits. Check the tracking control to see if it operates correctly. Repair any servo problem before suspecting a color problem.

Once you are sure that the VCR servos, video heads, and luminance circuits are working properly, check the color picture quality. Make sure that the VCR gives a good color picture from a prerecorded tape. Some color problems allow a tape, recorded with the VCR, to play back properly on that VCR, but not play back on another VCR. In addition, if a problem is found and repaired in the playback circuits, it will often also correct a color playback problem.

Six Steps To Faster VCR Color Playback Troubleshooting With Your VA62 And SC61

Typical playback problems are: no color, weak color, and wrong tint. A simple six step procedure will help you isolate the problem to the chroma circuits or other associated circuits. For the six steps, insert a test tape in the VCR and place it in the play mode. Refer to figure 6 for these test points.

1. Check the power supply: Always test the power supply first. Use the SC61 Waveform Analyzer to check for the proper voltage on the chroma IC power supply pin. Press the SC61'S CHANNEL A DCV button and touch the SC61 probe to the IC's power supply pin. The SC61's digital meter will display the DC voltage at this point. Compare this reading with the voltage shown on the VCR schematic. Look at the SC61's CRT to be sure that there is no ripple on the power supply line which would indicate a power supply filter problem.

2. Check for proper system control signals: A microprocessor control signal is sent to the

chroma IC. This signal turns on either the record or the playback circuits in the chroma IC. Connect the SC61 probe to the control pin of the chroma IC. Place the VCR in the play mode and check the DC level using the SC61's DCV function. Compare this voltage to the control voltage shown on the VCR schematic for the play mode. If the voltage is incorrect, this indicates a problem in the system control circuits instead of the chroma circuits.

3. Inject the VC63 signal into the chroma IC: The VC63 VCR Test Accessory supplies a signal that is identical to the signal that comes off the video tape. This signal can be injected into the early playback stages to determine which circuits are working and which circuits are not. In this particular application, we will use this signal to determine if the chroma circuits are working or if the problem is before the chroma stages.

The best place to start injecting the VC63 signal is at the output of the A/B headswitcher. This point allows the VC63 to supply a correctly phased signal to both the chroma and the luminance circuits. The VC63 can be used for VHS, Beta, or U-Matic VCRs. In a VHS machine, select the VHS LUM & CHROMA signal. You will need to use a fairly large signal, since the injection point is after the head preamps. Set the OUTPUT LEVEL on the VC63 to the X.1 range and the VOLTS PP to the midrange position. This is a good starting range.

Place the VCR in the play mode and watch the picture on the television monitor. If the black and white signal is weak or has a lot of noise in it, turn up the VOLTS PP control on the VC63. If the color circuits are operating, you should see color on the television screen. The color may flash on and off. This is because the VCR and the VC63 are not synced up to each other.

4. Sync up the VC63 signal using the VA62 30 Hz SERVO signal: You must also feed the VA62 30 HZ SERVO DRIVE signal into the VCR color circuits in order to get good color. The 30 HZ SERVO DRIVE signal, from the VA62, is phase locked to the signal being supplied by the VC63.

The 30 Hz servo line normally has a very low impedance. Many, but not all, VCR 30 Hz servo lines can be driven directly using the 30 HZ SERVO DRIVE signal on the VA62 see note page 7. To determine if the servo line can be directly driven, use the following procedure:

- Connect up a set of test leads to the VA62's SERVO DRIVE jack.

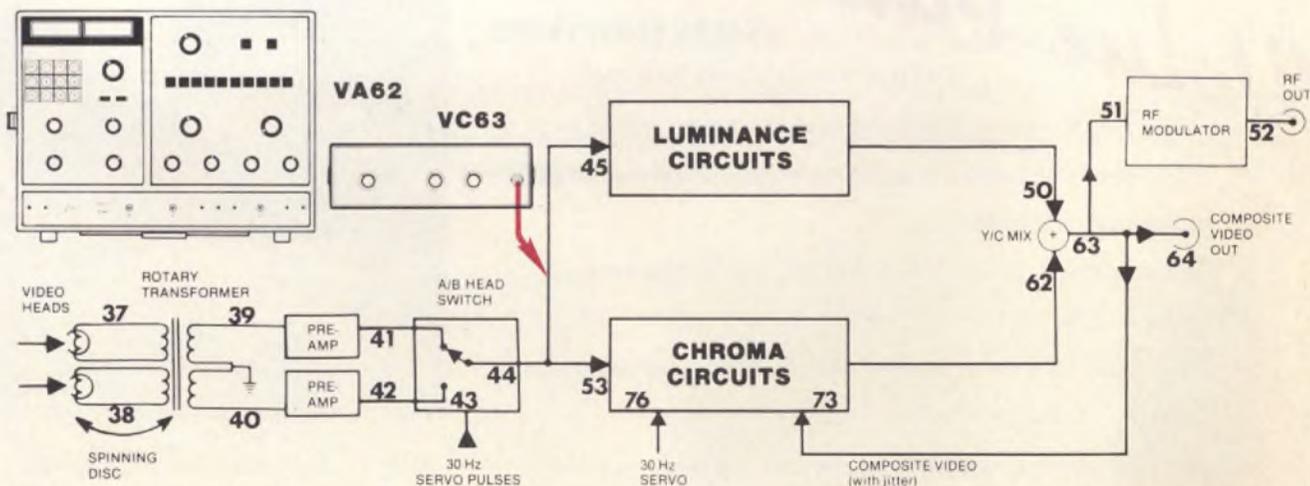


Fig. 7: The best place to inject the VC63 VCR Test Accessory for locating chroma problems is at the output of the A/B headswitcher. This supplies both the necessary chroma and luminance signals to the VCR.

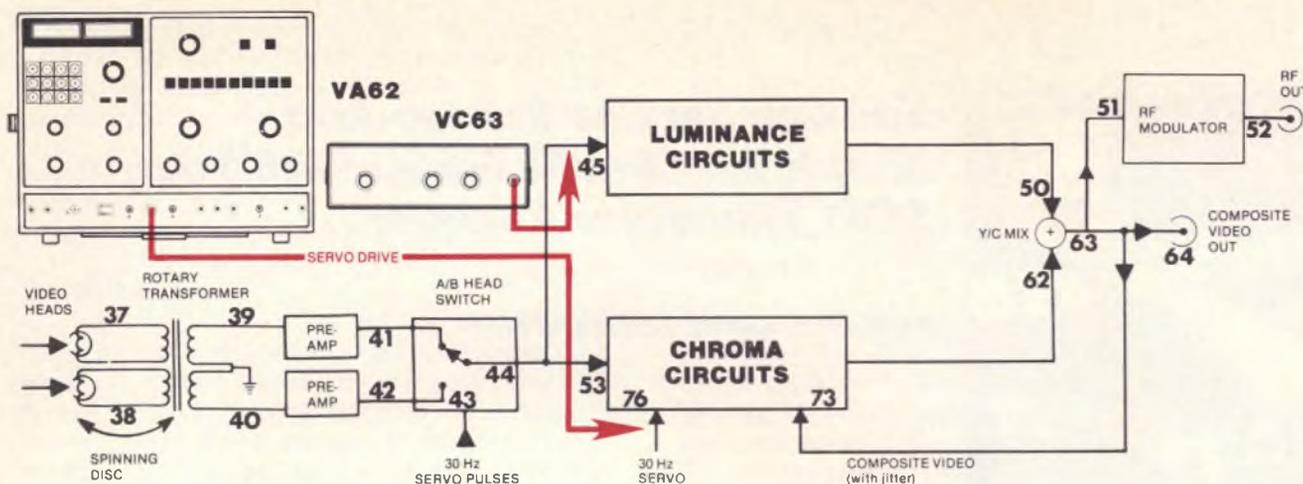


Fig. 8: Connect the VC63 Test Accessory to the output of the A/B headswitcher and the VA62 30 Hz servo drive signal to the chroma IC 30 Hz servo pin to lock in the color.

- Turn the VA62's SERVO DRIVE control to zero.
- Move the VA62's DIGITAL METER switch to the 30 HZ SERVO DRIVE position.
- Connect the 30 HZ SERVO DRIVE signal to the 30 Hz servo pin on the VCR's chroma IC.
- Put the VCR into the play mode. Note: Leave the VA62 30 HZ SERVO DRIVE control at zero.
- Note the reading on the VA62 digital meter. This reading is the amount of 30 Hz signal being applied to the chroma IC without any VA62 drive signal applied.
- Carefully increase the setting of the VA62 30 HZ SERVO DRIVE control until the VA62 digital meter reads 0.5 to 1 volt higher than the voltage reading obtained in step 5. This is the maximum signal you should apply to the chroma 30 Hz drive pin.

If the color circuits are operating, the color will now lock up. If you do not get color, try the opposite phase 30 HZ SERVO DRIVE signal. Simply pull out or push in on the VA62 30 HZ SERVO DRIVE control. There is no practical way to predict which phase is needed for a given VCR since it depends on the design of the chroma IC. Therefore, simply try both polarities and watch for color. If the color circuits are working, you will either see colors that alternately change position at a rapid rate, or the colors will lock in.

NOTE: Some VCRs can't be directly driven with the 30 HZ SERVO DRIVE signal. They will shut down when you attempt to sync up the 30 Hz drive signal. If this happens, disconnect the VCR

30 Hz drive circuits from the chroma IC. Trace back from the 30 Hz input pin on the chroma IC until you find a jumper wire or resistor. Unsolder one side of the jumper wire or resistor to isolate the rest of the 30 Hz servo circuits. If no jumper wires are found, then carefully unsolder the chroma IC's 30 Hz input pin. Once the 30 Hz input pin has been isolated from the rest of the VCR, connect the VA62 30 HZ SERVO DRIVE signal to the chroma IC's 30 Hz input pin and drive the IC.

If you see good color on the television monitor, the chroma IC and associated circuitry are good. If not, try the other phase of 30 HZ SERVO DRIVE signal. If you see good color, you have confirmed that the chroma circuits are good and have isolated the problem to the video heads, rotary transformer, head preamps, or A/B headswitchers. Generally, however, a problem in these areas will also show up as bad luminance.

5. Check the 3.58 MHz local oscillator: A local 3.58 MHz oscillator signal is used to mix the downconverted chroma information back up to the 3.58 MHz signal needed by the television receiver. A missing 3.58 MHz local oscillator signal will result in no chroma information on the video signal. An incorrect 3.58 MHz oscillator signal may provide chroma information on the video, but the frequency will be outside the range of the color circuits in the television receiver and no color will be observed.

Check the frequency of the 3.58 MHz local oscillator using your SC61's digital frequency counter. The 3.58 MHz local oscillator is often located immediately next to or inside the chroma IC. If it is located inside the IC, look for a 3.58 MHz reference pin on the chroma IC. Press the SC61's CHANNEL A FREQ button and connect

the SC61 probe to the chroma IC's 3.58 MHz local oscillator pin. If the 3.58 MHz signal is missing or incorrect, determine the reason before proceeding. In the case of a 3.58 MHz oscillator located inside the IC, the IC will need to be replaced. If the 3.58 MHz oscillator is separate, trace back to the oscillator and correct the problem.

6. Check the horizontal sync pulse: A horizontal sync pulse triggers the various burst gates, color killers, and chroma phase shifting circuits. Some chroma ICs contain sync separators. For these ICs, a composite video signal is fed into the IC. In other chroma ICs, an external sync signal is supplied to the IC.

Again, use the SC61 to check for the presence of either a composite video signal or for externally generated sync pulses. Since this video is coming off the tape, some frequency and phase instability will exist. The important thing is to be sure that the video or horizontal sync signal is getting to the chroma IC.

If you have performed the above six steps and all signals are present, it is time to replace the chroma IC. The remaining circuits that convert the color information up to the proper 3.58 MHz color information are contained inside the IC.

Troubleshooting A Poor Color Tint Problem On Playback

Color tint problems can occur because of a problem in one of the four key signals or due to a problem in the chroma IC itself. Tint problems are normally caused by problems in the color phase correction circuits. These circuits are often located inside the chroma IC. If the VCR has a color tint problem, first check to be sure the 4 key signals are present using the six step procedure given above. If all signals are present, then replace the chroma IC.

Troubleshooting A Weak Color Symptom On Playback

Weak color on playback is often caused by problems in the automatic color circuits. This problem can be caused by one of the 4 key signals being missing or by a problem in the automatic color circuits. Again use the six step procedure given above to ensure that all 4 key signals are going into the chroma IC. If the signals are present and the color is still weak, then replace the chroma IC. The automatic color circuits are located inside this IC.

(continued on page 12)

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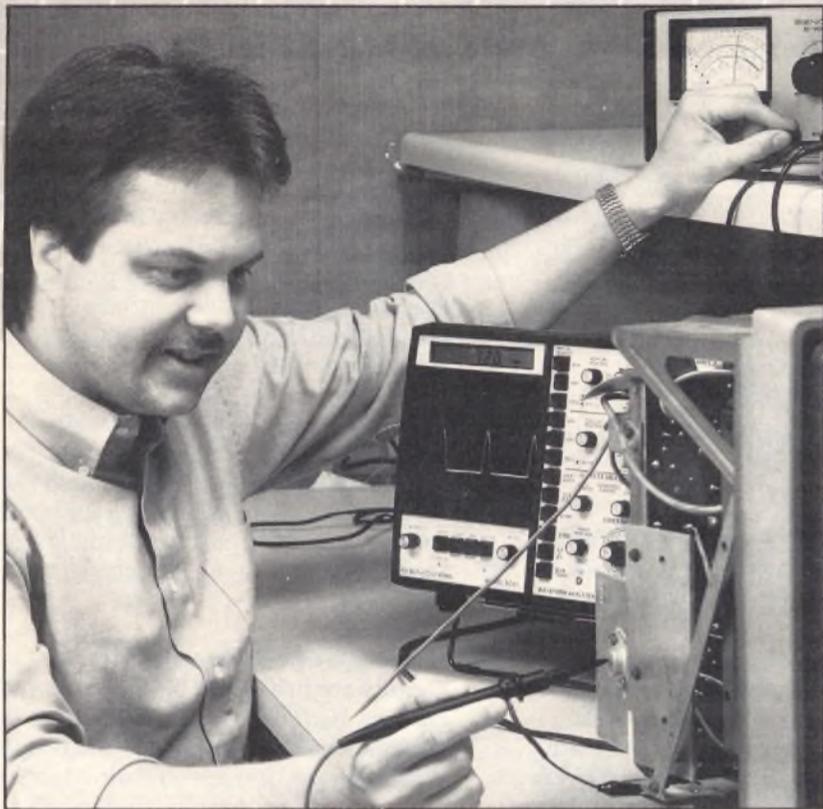
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You Can Service Startup And Shutdown Circuits Faster With Your SC61 Waveform Analyzer . . .

by Wayne Smith, CET/WA4WZP

Before a set can shut down, it must first start up. Refer to Figure 1 as we discuss the start up and run circuits.

Main Power Supply & Horizontal Output Transistor (H.O.T.)

Unregulated B+, at approximately 150 volts, is supplied to a regulator circuit that maintains an output of about 120 V. This regulated 120 V is fed through the HV transformer to the horizontal output transistor collector, which converts the DC to an AC signal which can be stepped up or down by the flyback transformer. Of course, something has to turn the H.O.T. on and off — just B+ on the collector won't do it. Until a base drive signal is applied, the H.O.T. looks like an open circuit. The base drive signal is generated by the horizontal oscillator and is amplified by the horizontal driver. The base of the H.O.T., TP67, has a square wave applied to turn the H.O.T. off and on 15,734 times per second.

Once Started, Scan Derived B+ Keeps The Set Going

Many sets use "scan derived" B+, produced by the secondary of the flyback, to run the horizontal oscillator and/or the horizontal driver



Wayne Smith
Field Representative

When servicers are asked "What circuits give you the most problems?" Start Up and Shut Down (SUSD) circuits rate in the top 3 answers. In this article, we'll show you how to use your Sencore SC61 Waveform Analyzer, VA62 Universal Video Analyzer & PR57 "POWERITE"® Variable Isolation Transformer and Safety Ana-

lyzer to successfully troubleshoot startup and shutdown circuits.

Why are SUSD circuits a problem today, but not 10 years ago? SUSD circuits are a by-product of the modern, efficient power supply. Why did the manufacturers have to change from the old brute force power supply that we all loved?

One reason is energy consumption. Can you imagine what the electric bill would be if every TV & VCR still used the old inefficient power transformer - brute force type of power supply? We'd probably need twice as many power generating plants! Older TVs consumed around 400 watts while newer ones use less than 100 watts. Multiply this times the number of TVs/VCRs in use today, 130 million, and you'll see why a better power supply was needed.

Transformerless Power Supplies:

1. Less Weight
2. Less Heat
3. Less Current
4. Less Cost

Disadvantages:

1. Less safe - "Hot" chassis
2. More extensive lightning or power surge damage
3. More circuits needed to control high voltage
4. More of the set is shut down when a power supply fails
5. More difficult (it seems) to troubleshoot

These disadvantages keep electronic service shops successful and profitable — if you know how to service them properly and have the proper test equipment.

You can service SUSD circuits knowledgeably, or use "swapaholic" methods. Swapaholics just keep changing parts until something fixes the set, or until they realize it can't be fixed. If you are going to be a swapaholic, you'll need a good stock of the special, expensive parts — since many are safety related.

Successful servicers prefer a more efficient method of servicing. That is, *analyze the circuit first; replace parts last.* Let's see how your Sencore test equipment helps you analyze SUSD circuits.

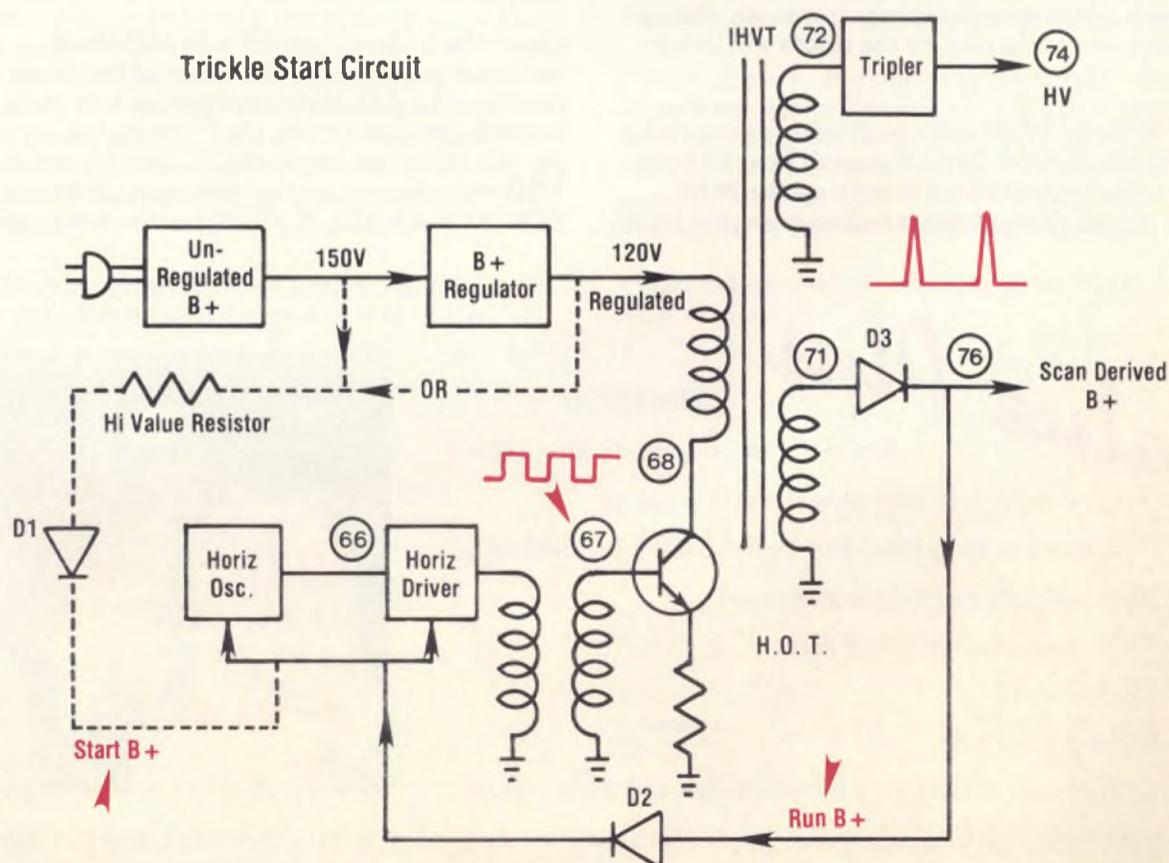


Fig. 1: Before a set "shuts down" it must first start up. Start B+ (trickle start) gets the horizontal oscillator started, and the scan derived run B+ keeps it running.

circuits. How are these scan derived voltages created? Look at TP71 with your scope and you'll see pulses. These pulses are rectified by D3 (fast switching diode - regular power supply diodes won't work here), filtered and applied to the horizontal oscillator/driver as "run B+" (Fig. 1).

Trickle Start

Scan derived voltage keeps the set running, but what gets the oscillator/driver started? See figure 1; the 150 V unregulated B+ (some sets use regulated B+) is dropped by a high value resistor and forward biases diode D1, supplying voltage to the oscillator/driver. This "Start B+" gets the set started. The same voltage reverse biases D2 so that other circuits connected to the scan derived B+ cannot load the very small trickle current supply. When D3 produces voltage, D1 becomes reverse biased and the trickle start supply is virtually disconnected. The horizontal oscillator/driver continues to operate using power supplied from the scan derived B+.

Kick Start

Figure 2 shows the "Kick Start" method of starting the horizontal oscillator/driver. The key components here are T1 and C1. With the set off, C1 is discharged. When the set is turned on, C1 charges through T1. As B+ starts to build, a heavy current flows through the primary of T1 giving us an induced current in the secondary.

This secondary current is rectified by D1, producing the "Start B+" to start the horizontal oscillator/driver — just like the trickle start. When C1 is fully charged, the current reaches a peak and does not change appreciably. Transformer action ceases. The horizontal oscillator/driver has started and you have scan derived B+ at TP76.

This scan derived B+ reverse biases D1, making it an open switch so that scan derived B+ is not grounded through T1. Now that you understand how "Trickle Start" and "Kick Start" circuits start the set and keep it running, let's look at how shutdown circuits work.

Understanding Shutdown Circuits

Shutdown circuits were not used in older TVs because the power supplies could barely generate the HV needed to operate the set, let alone anything extra. However, modern efficient supplies can easily generate 40 to 50 KV. When the circuit is operating normally, these voltages are held to the manufacturers' specifications by circuit design. Shutdown circuits are designed to disable the TV when a component fails that could cause excessive HV, X-Rays, or other unsafe condition. Shutdown circuits tend to have a small number of highly reliable components; if the set is in shutdown, you can be fairly sure that the shutdown circuit is doing its job and the problem is elsewhere.

Shutdown is accomplished in most TVs by removing the H.O.T. base drive signal when an unsafe condition is sensed. Several methods are used to remove the base drive; one method is shown in Figure 3. An SCR, when gated on, effectively shorts the horizontal oscillator signal to ground. Another method, used by RCA in the CTC93 chassis (and others), pulls the horizontal oscillator way off frequency. (The horizontal output circuit is tuned to 15 kHz, therefore changing the drive frequency reduces the circuit efficiency and limits the output voltage.) Another method, in the NAP C9 chassis, uses an SCR to ground the B+ going to the horizontal oscillator and driver transistors.

Whatever method is used, the end result is removal or reduction of the H.O.T. base drive signal. Your analysis of what's causing the shutdown will be concerned with the "feedback" path that is gating on the shutdown SCR. Figure 3 shows three often used shutdown methods. (Of course shutdown can also be caused by failure in the shutdown circuit itself.)

Monitoring the B+ regulator: If the B+ regulator should fail and allow raw B+ (See Figure 3) to be fed to the H.O.T., the result would be excessive HV. Shutdown circuit (1) uses a zener diode that is just a few volts above the normal B+. If B+ goes above the zener level, the zener turns on and feeds B+ to the shutdown SCR gate. The SCR conducts, base drive is removed and shutdown occurs.

Monitoring the scan derived voltages: If the safety capacitor failed, for example, all flyback secondary voltages would increase, including the scan derived supplies. Shutdown circuit (3) shows us that an increase in voltage at TP76 would gate on Z3 and cause SCR1 to conduct, killing the base drive (here again, zener voltage is just a few volts above what is expected).

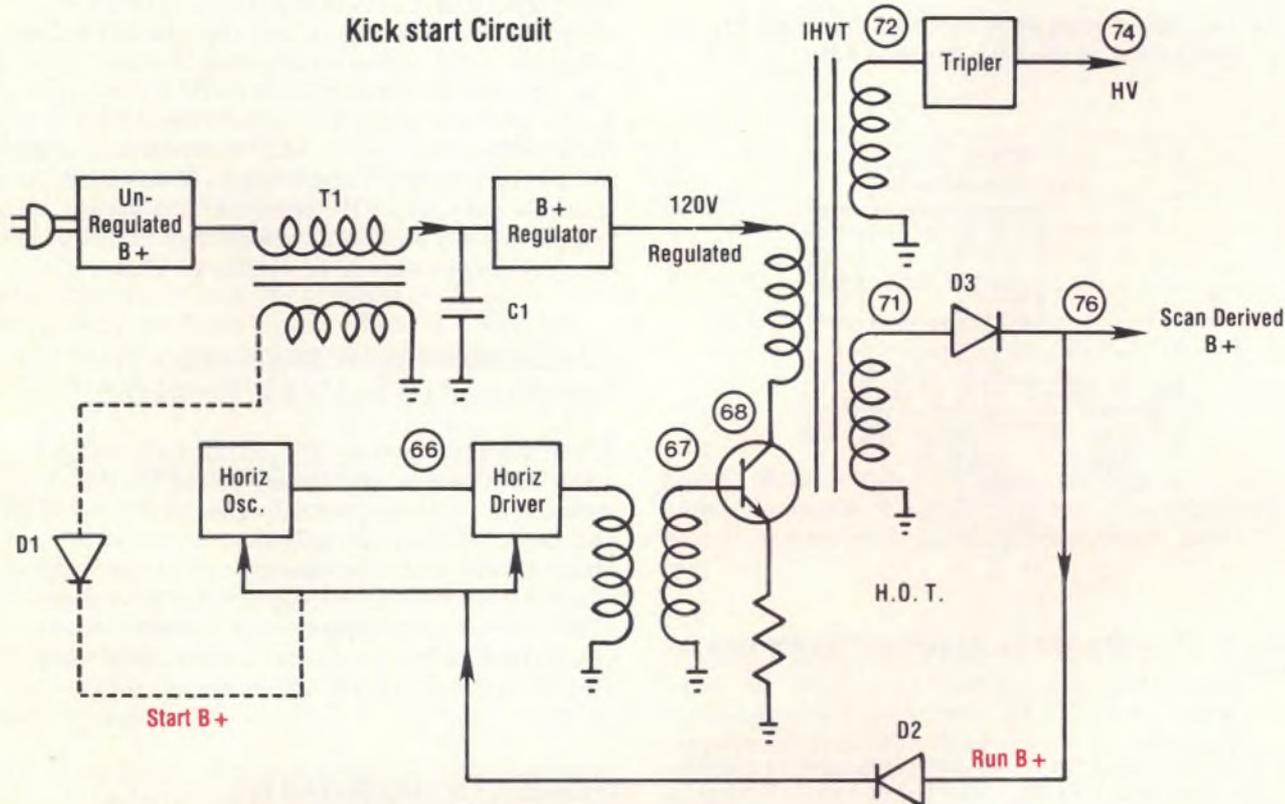


Fig. 2: In the "kick start" and run circuit, start B+ drives the horizontal oscillator while C1 is charging. Scan derived run B+ must keep the oscillator running.

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HV Shutdown Or X-ray Protection Circuit

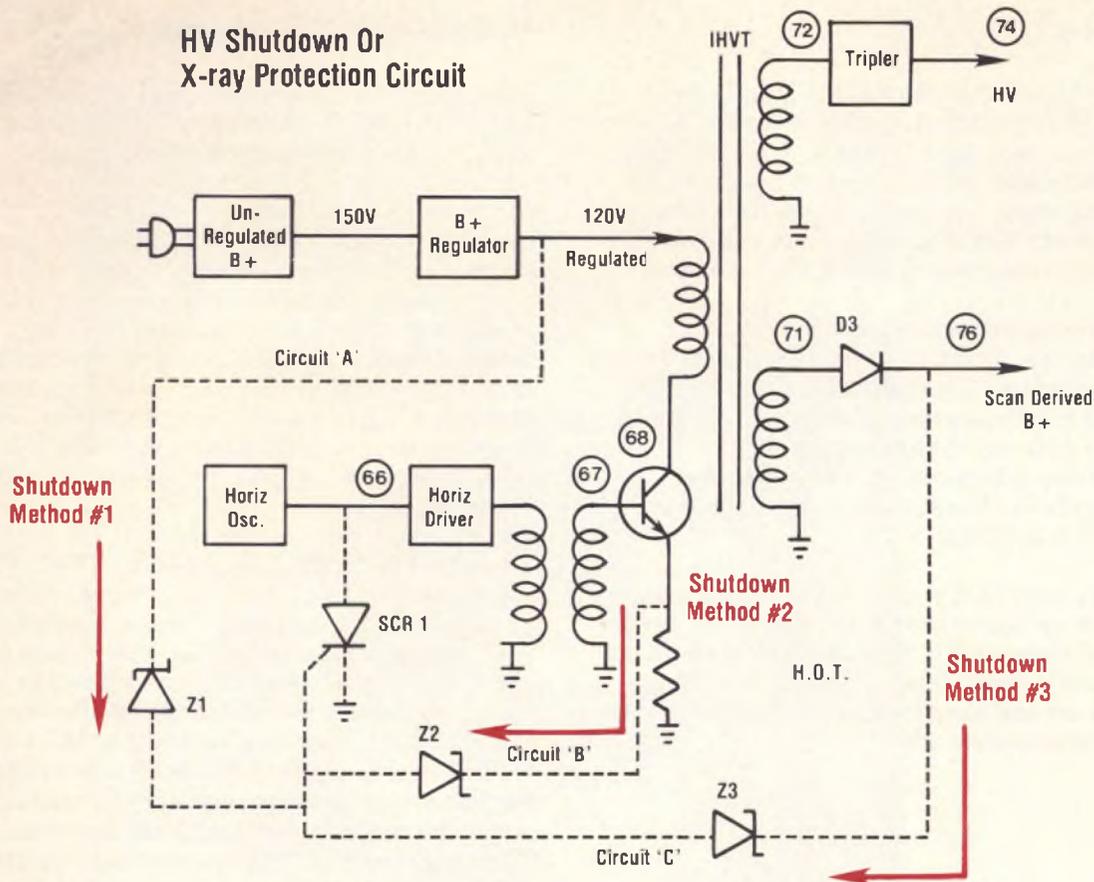


Fig. 3: Once the set has started, it will shut down if the regulated voltage is too high (method #1), the horizontal output current rises (method #2), or if the scan derived B+ is too high (method #3).

Monitoring the horizontal output transistor: Some sets also monitor the H.O.T. current (circuit 2); if the current goes up, Z2 conducts gating on SCR1 and killing the base drive.

Figure 3 shows zener diodes used as sensing devices, but many sets use simple voltage divider networks. Some sets use all three methods of activating the shutdown circuits (monitoring the regulated B+, scan derived voltages, and the horizontal output transistor current). Others simply use the voltage from the scan derived supply (TP76).

Is The Set In Shutdown . . . Or Didn't It Start Up?

As a successful servicer, you must decide if the set is really in shutdown. How? You can use the Sencore PR57 Variable Isolation Transformer And Safety Tester to lower the AC line voltage to 80 or 90 volts. This reduces the HV to a safe level where the shutdown circuits aren't activated. Turn on the set. Does it come on? If it comes on, even with reduced width, height, or other indications of trouble, you have proven that the set will start up. The problem is a shutdown condition. If the set didn't come on, you might still have a shutdown problem to service, but first you have to make it start up. Let's see how your SC61 Waveform Analyzer can help.

Your SC61 Can Help You Isolate Startup Troubles

The best way to find startup troubles is to monitor the horizontal output transistor's collector with your SC61. Select the CHANNEL A display. Set the CHANNEL A VOLTS/DIVISION switch to the 200 Volt range. Set the TRIGGER SOURCE and MODE to CH A, TV TRIGGER, LEVEL TO 0, "+" Polarity. Set the TIMEBASE-FREQ preset to the VIDEO HORIZ position. Connect the CHANNEL A probe to the horizontal output transistor collector. Now you're ready to turn on the set and watch for startup. By the way, you can do this test with your older scope — if startup doesn't occur. If startup occurs, you won't be able to

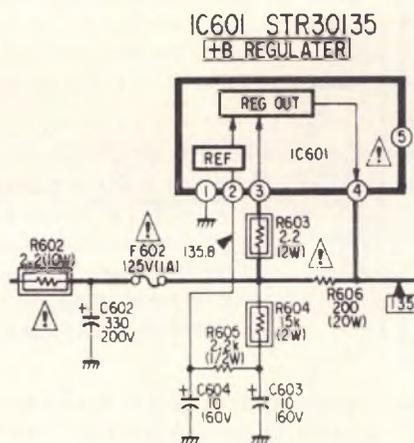


Fig. 4: TVs often use IC regulators that are easy to test.

make this test again, because most scopes smoke when connected to the collector of a H.O.T. that's working! (Your SC61's inputs are protected to 3,000 volts.)

Set turned on, but nothing happened . . . wait, your SC61 is indicating something. Can we gain any info by what's on the SC61 display? Sure:

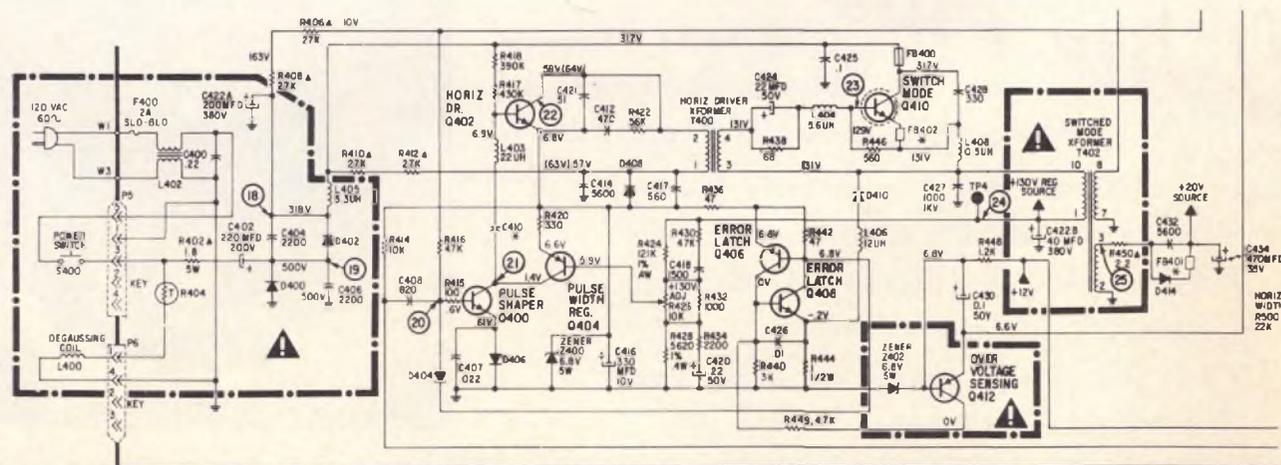


Fig. 5: In many TVs, the B+ regulator is made up of discrete components in a complex circuit. You'll need your SC61 here, to measure peak-to-peak, DCV, and frequency, with just one probe hooked up.

(1) If no B+ is indicated (even momentarily), this points to a main power supply problem or shorted horizontal output transistor.

(2) Momentary B+ indicates a startup with an immediate shutdown. Some sets disable the B+ when in shutdown and others disable the horizontal oscillator and/or driver circuits. This momentary B+ indicates a shutdown problem.

(3) Either raw B+ or regulated B+ (DC only with no waveform) on the H.O.T collector indicates that the set did not start up at all. Some sets, such as the RCA CTC108, use horizontal pulses to synchronize regulation in the main B+ supply. With no horizontal pulses, raw B+ is fed through the regulator to the collector of the horizontal output transistor.

Troubleshooting The Symptom Of No B+ At The H.O.T. Collector

If no B+ is your symptom, start checking the main B+ supply. Is raw B+ present at the input to the regulator? Two common B+ regulators are the "IC" type (Figure 4), and the more complicated "discrete component" type (Figure 5). Remember, some sets use a horizontal output waveform to operate the regulator, so raw B+ where you would expect to see regulated B+ does not necessarily indicate a problem in the regulator circuit. You will use your SC61 frequently in troubleshooting startup and shutdown problems. The DCV meter for checking the voltages which range from 0.1 V to several hundred volts. The PPV meter for measuring the "ripple" of the waveform, which may indicate bad filter capacitors or shorted transistors.

Troubleshooting A Momentary B+ Symptom At The H.O.T. Collector

If you see a momentary B+ on the horiz output collector or hear a momentary sound through the speaker, the set has probably gone into shutdown. Reduce the AC input to the set to about 80/90 volts. Turn the set off (to reset any circuits that are still on) and now back on again. If the set starts to operate, or if the SC61 shows you a pulse on the horizontal output collector, you know the set was in shutdown.

Raw B+ Or Regulated B+

If the set has an "IC" regulator, raw B+ would indicate a power supply failure. Regulated B+ indicates the power supply is probably operating normally. Raw B+, if the set has a "discrete" power supply, would indicate that

startup did not occur. Since the horizontal signal is used to synchronize the B+ regulator, you should try to get the horizontal stages operating first. B+ on the H.O.T. collector indicates that it might work if a base drive signal was present. Your VA62 will provide this signal.

How To Drive The Horizontal Output With Your VA62

A Word Of Caution First: *Make sure your TV is connected to the PR57 and the output voltage is no higher than 90 volts!* Driving the base of the horizontal output transistor can bypass the shutdown circuit. Excessive high voltage can result with damage to the set and/or you!

Refer to the schematic for the level of the PPV drive signal at the base of the H.O.T. *Open one lead of the horizontal driver transformer and drive the base directly.* Select HORIZ BASE drive, adjust your VA62 DRIVE SIGNAL output to match the schematic, connect the H.O.T. base (TP67), and turn the set on. If the H.O.T. and all other circuits are good, you'll see video, color, and sync. Video OK? Color OK? Sync OK? This procedure is especially helpful if you have to give an estimate before the repair.

HV indicates that all circuits after the H.O.T. are good. Now would be a good time to check your scan derived run voltages for the horizontal oscillator and driver. Remember, to make things easy for yourself, use the DCV function of your SC61. Collector voltages OK? Move your drive signal to the base of the horizontal driver transistor (TP66). Is HV OK? You know that the driver is OK and the problem should be in the horizontal oscillator circuit. If the HV didn't come on, you would know to troubleshoot the horizontal driver stage.

How To Tell Which Circuit Is Causing Shutdown

You learned earlier that shutdown disables the HV in case of circuit failure. Figure 3 shows the 3 most common methods used to detect excessive voltage and current. To service shutdown successfully, you must determine which circuit is causing shutdown — in the least amount of time.

The B+ regulator, not regulating, is the cause of most shutdown symptoms. You might want to verify the correct B+ regulation first. Figure 6 shows you how a B+ regulator circuit should act. As AC input voltage is increased, the output DC

voltage also increases until you reach the point of regulation. After this point, a further increase in the AC input will not cause the DC output to rise. Notice the graph "flattens out" at the regulation point.

B+ Regulator Test

You can test for proper B+ regulation by connecting the TV to your PR57. Set the AC output voltage at 80-90 volts (this is enough voltage to make the set operate). Connect your SC61 to the output of the B+ regulator. Push the DCV button. Watch the DC output voltage as you *slowly* increase the PR57 output voltage. You should see the regulator output voltage increase as the input voltage is increased. When the regulation point is reached, the DC output voltage will stop increasing even though the AC input is increased. This would indicate that the regulator circuit is good. Of course, if the regulator is causing the problem the DC output will continue to rise and cause the set to shut down. Sometimes you have a very narrow margin between the regulated B+ and the voltage that causes the set to shut down. You may have to disconnect the B+ between the regulator and the circuit.

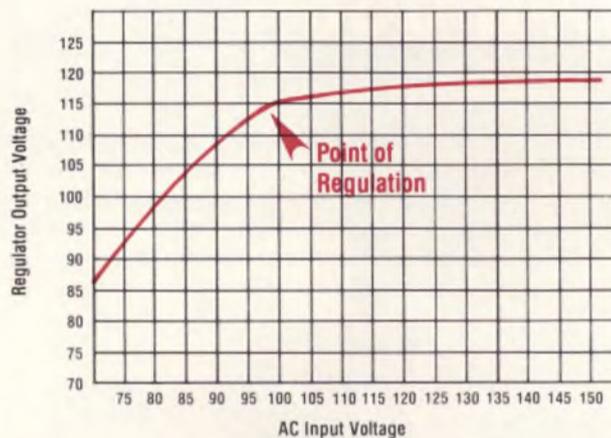


Fig. 6: Monitor the TV's regulator output as you slowly increase the PR57 output. The regulator output should rise until the regulation point is reached.

If the B+ regulator proves to be good, determine what the "trip" voltages are for the other shutdown circuits. Using your SC61 DCV function, you should be able to determine which circuit is causing shutdown. The voltage difference between shutdown and normal operation is sometimes 1 volt or less. Some manufacturers suggest disconnecting the shutdown SCR or circuit *for testing purposes only*. If you have to do

this, *make absolutely sure that you can monitor the HV and don't exceed the maximum shown on the TV schematic.* Damage to the TV, test equipment, or you can be caused by excessive high voltage.

Make absolutely sure that you reconnect the shut down circuit and do the shut down test as ordered in the manufacturers' service manual.

After The Repair, Make A Safety Test

Virtually all TVs and some VCRs have a "hot chassis". The manufacturer designs each unit to prevent AC from getting outside. Your responsibility is to determine that the unit is still safe after your repair. Before the Sencore PR57 "POWERITE", this test was difficult and most shops didn't bother with it.

Today, manufacturers print a long list of procedures for making leakage tests in the front of their service manuals. This "manufacturer's safety procedure" serves two important purposes. 1.) Ensures that servicers are told how to test for leakage. 2.) Helps transfer the responsibility for making leakage tests (after completing repairs) to the servicer.

With the PR57 "POWERITE", leakage tests take about 2 minutes! Would you invest this amount of time to protect your customers and have peace of mind?

How To Make A Safety Leakage Test With Your PR57

Connect your TV/VCR to the PR57 ISOLATED OUTPUT. Connect the test probe to the LEAKAGE PROBE jack. Push the LEAKAGE HI SIDE button. Using the probe, touch all metal surfaces the customer can touch. If no leakage is found, push the LEAKAGE LO SIDE button and repeat the leakage test on all metal parts. For consumer products, equipment that has leakage greater than 500 uA on any part the customer can touch is unsafe.

The PR57 "POWERITE" Can Pay For Your Sencore Success Shop

Many shops are adding an extra \$5.00 to each invoice for performing the "Safety Leakage Test". Customers are concerned about the safety of their electronic devices. They will pay the extra costs with very little complaint. Use this extra income to pay for your Sencore Success Shop. ■

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Seven Steps To Successful VCR Color Record Troubleshooting Using Your VA62 And SC61

You'll see VCRs that have weak color, won't record color, or record tapes that don't playback in color on another machine. VCR color record circuits require 4 key signals for proper operation (Figure 9); use the following procedure to troubleshoot these VCRs.

1. Check the Tuner/IF section: When VCRs are used to record programs off the air, trouble in the tuner or IF may reject color but pass the luminance (B & W) signal. Before you suspect the VCR color record circuits, bypass the tuner and IF by feeding your VA62's VCR STANDARD output into the VCR's video input jack. Select the CHROMA BAR SWEEP pattern on the VA62. If the VCR now records color, the problem is in the tuner or IF section.

2. Check the power supply: A bad power supply can cause problems in playback and record circuits. Be sure the playback circuits are working and check the power supply before servicing the record circuits.

3. Check the record status line: A microprocessor control signal selects the playback or record circuits. Use your SC61's DCV function to check this control line. Place the VCR in record and compare the DC voltage on the control line with the voltages specified in the schematic. If the control line voltage is incorrect, check the system control circuits.

4. Check for the downconverted chroma signal: Chroma information is downconverted to a 629 kHz (688 kHz for Beta) signal before it is recorded on the video tape. Use your SC61 to check for downconverted chroma:

- Put a blank tape in the VCR and select record.

- Locate the record luminance level control and turn it all the way down. *Note: Once the VCR is repaired, you will need to perform the record current adjustments to set the luminance and chrominance record levels.*

- Connect the SC61's test probe to the record Y/C mixer's chroma input. Select CHANNEL A on the SC61, set TRIGGER SOURCE to CH A, MODE to AUTO, POLARITY to "-" and TIMEBASE - FREQ to 5 usec.

- Adjust the TRIGGER LEVEL control to lock in a trace. You should see a modulated signal around 629 kHz (688 kHz for Beta).

- Pull out on the HORIZ POSITION control on the SC61 to expand the trace by 10 times.

- Press 1/DELTA TIME and adjust the DELTA BEGIN and DELTA END controls until one complete cycle of the waveform is intensified.

- Read the chroma frequency on the SC61's

digital meter. It should read close to 629 kHz. *Note: You usually won't set the DELTA BEGIN and DELTA END controls for exactly one complete cycle. The frequency should be close, however.*

5. Check the 3.58 MHz local oscillator frequency: If the 629 kHz (688 kHz for Beta) signal is either missing or at the wrong frequency, see if the 3.58 MHz signal is present and at the correct frequency. Use your SC61's digital frequency



Fig. 10: The delta feature of the SC61 lets you measure the frequency of the downconverted chroma signal.

counter to check the 3.58 MHz local oscillator. A missing oscillator signal or a signal that is off frequency will cause the downconverted color signal to be either missing or off frequency. If the oscillator is off frequency, the tape may playback correctly on the VCR, but not playback on another VCR.

6. Check for a 30 Hz switching pulse: The 30 Hz switching pulse selects the correct sequence of phase shifting of the chroma information. A missing 30 Hz switching pulse will cause either missing color or intermittent bursts of color when the tape is played back on another machine. Connect your SC61 probe to the chroma IC pin that normally has a 30 Hz pulse. Place the recorder in play and check for the presence of the 30 Hz pulse.

7. Check for a horizontal sync pulse: The horizontal sync pulse turns on the various burst gates as well as the correct phase shifting of the chroma downconverted signal. Use the SC61 to check for the presence of either a composite video signal or a sync pulse at the horizontal rate.

Troubleshooting A Weak Color Symptom On Record

Weak recorded color is often caused by a misadjustment of the chroma record current. Perform the chroma record current adjustment. If the color is still weak, check the 4 key signal inputs into the chroma IC. If they are all present, then suspect a defective chroma IC. ■

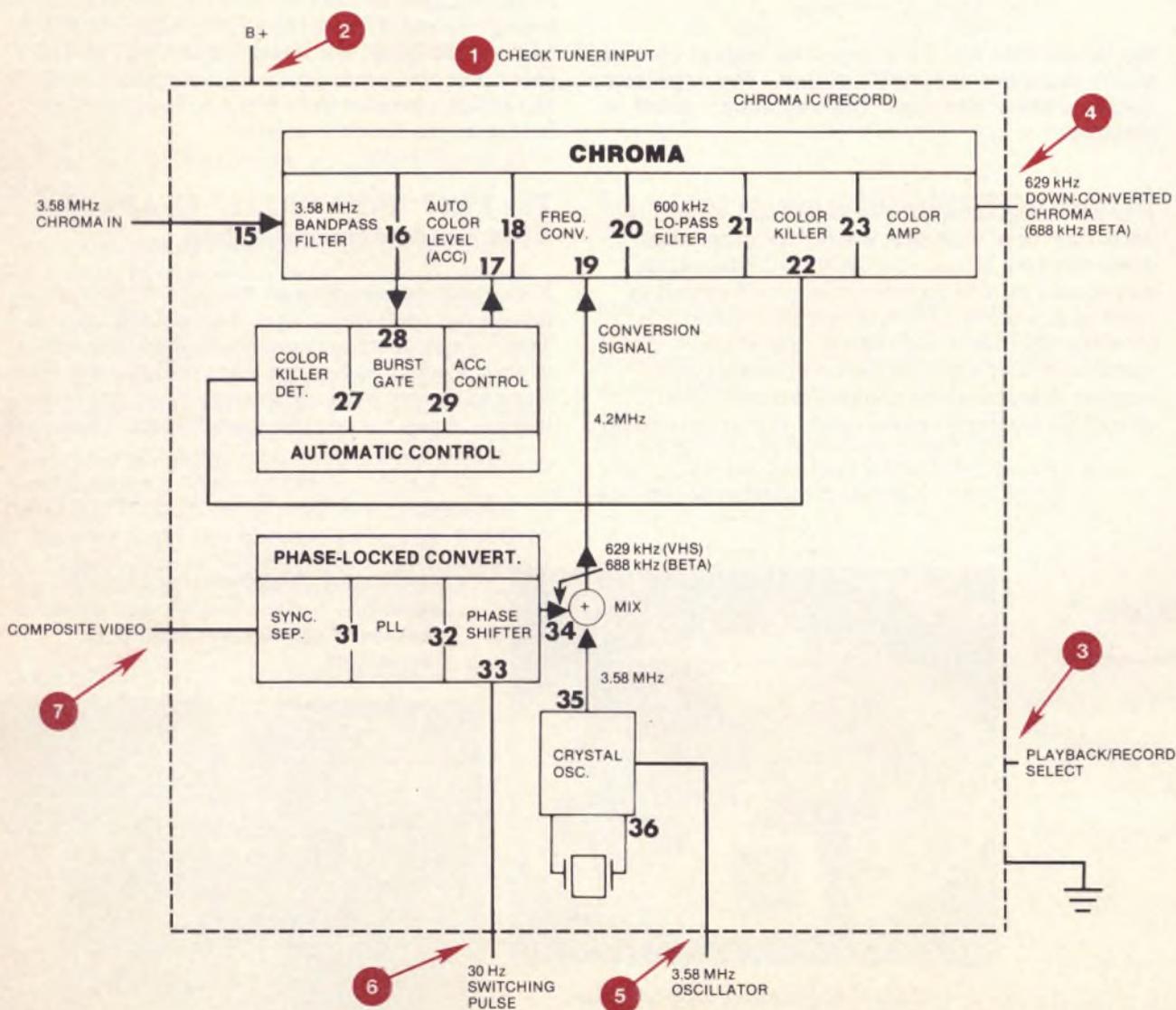


Fig. 9: There are 7 key points to check when troubleshooting VCR chroma record problems.

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

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

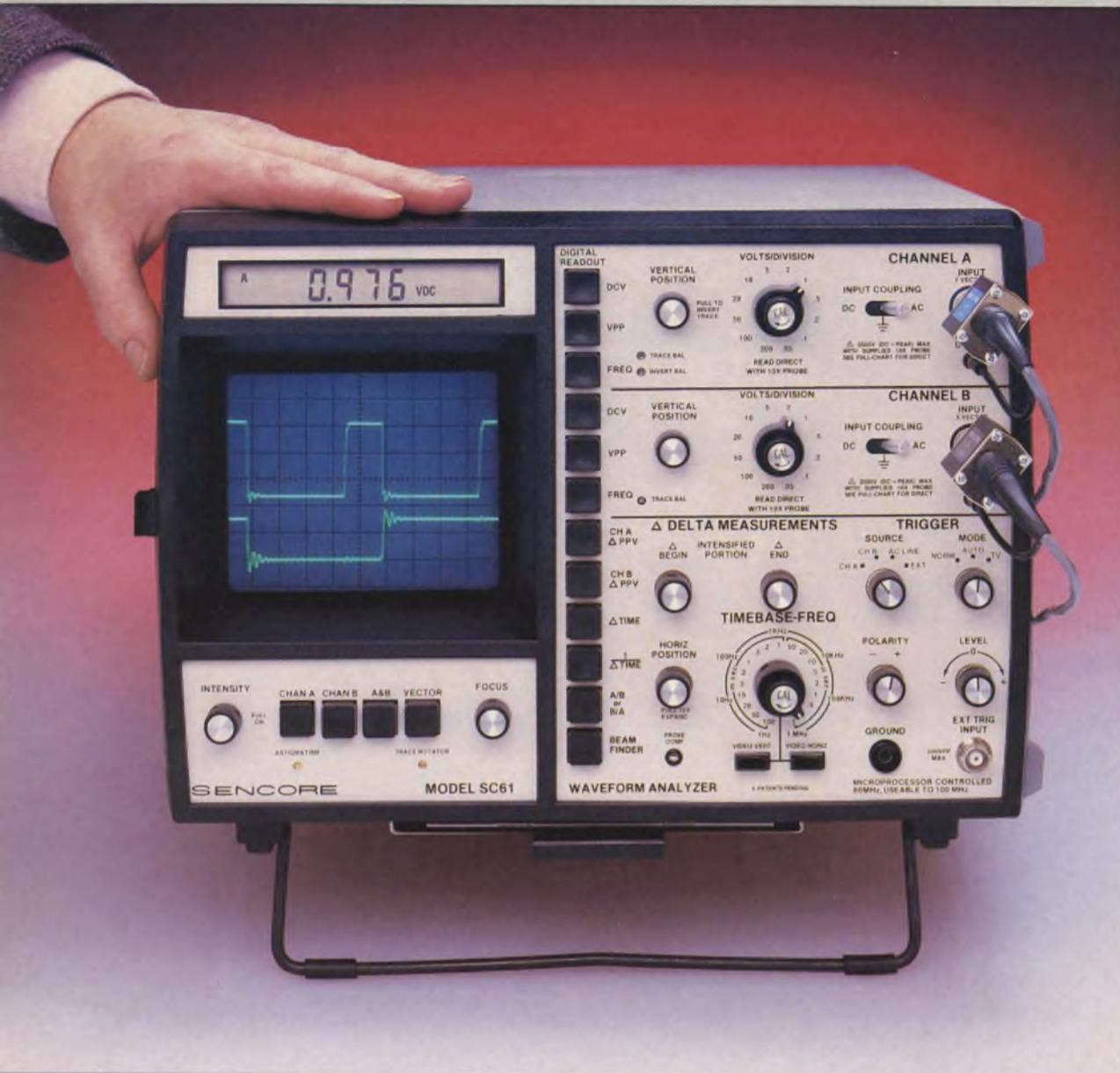
leakage as low as one microamp at voltages as high as 600 volts.

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



SC61 Waveform Analyzer™

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



Analyze Waveforms Easily

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

AUTOTRACKING™ Digital Readings Analyze The Whole Signal

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

Delta Digital Tests Analyze Any Part Of The Signal

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

Frequency Ratio Test — Tests Multiplier And Divider Circuits

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

SC61 Waveform Analyzer

\$3295 Patented U.S. Funds



On GSA Contract
NSN 6625-01-169-2318

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

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

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

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

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

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

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

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

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

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



FS74 CHANNELIZER SR.™ TV-RF Signal Analyzer

New Technological Breakthrough!



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



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

U.S. Funds On GSA Contract

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

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

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

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

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

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

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

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

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

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

FS73 CHANNELIZER JR.™ TV-RF Performance Tester



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

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

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

U.S. Funds On GSA Contract

New Technological Breakthrough!



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

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

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

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

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

Call WATS Free 1-800-843-3338 17

CR70 "BEAM BUILDER"™ Universal CRT Analyzer and Restorer

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

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

CR70 "BEAM BUILDER"™ Universal CRT Analyzer and Restorer

\$1295 Patented U.S. Funds NSN 6625-01-187-4395

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

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



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

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

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

You'll never have to buy another socket again.

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

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

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

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

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

CG25 Little Huey™ Portable, Digital Color Bar Generator

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

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

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

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

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

CG25 Little Huey \$198 U.S. Funds



FC71 Portable 10 Hz To 1 GHz Frequency Counter™



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

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

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

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

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

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

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

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

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

NSN 6625-01-076-2695



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

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

TF46 Portable Super Cricket™ Portable Transistor/FET Tester



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

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

NSN 6625-01-058-9564

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

U.S. Funds

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

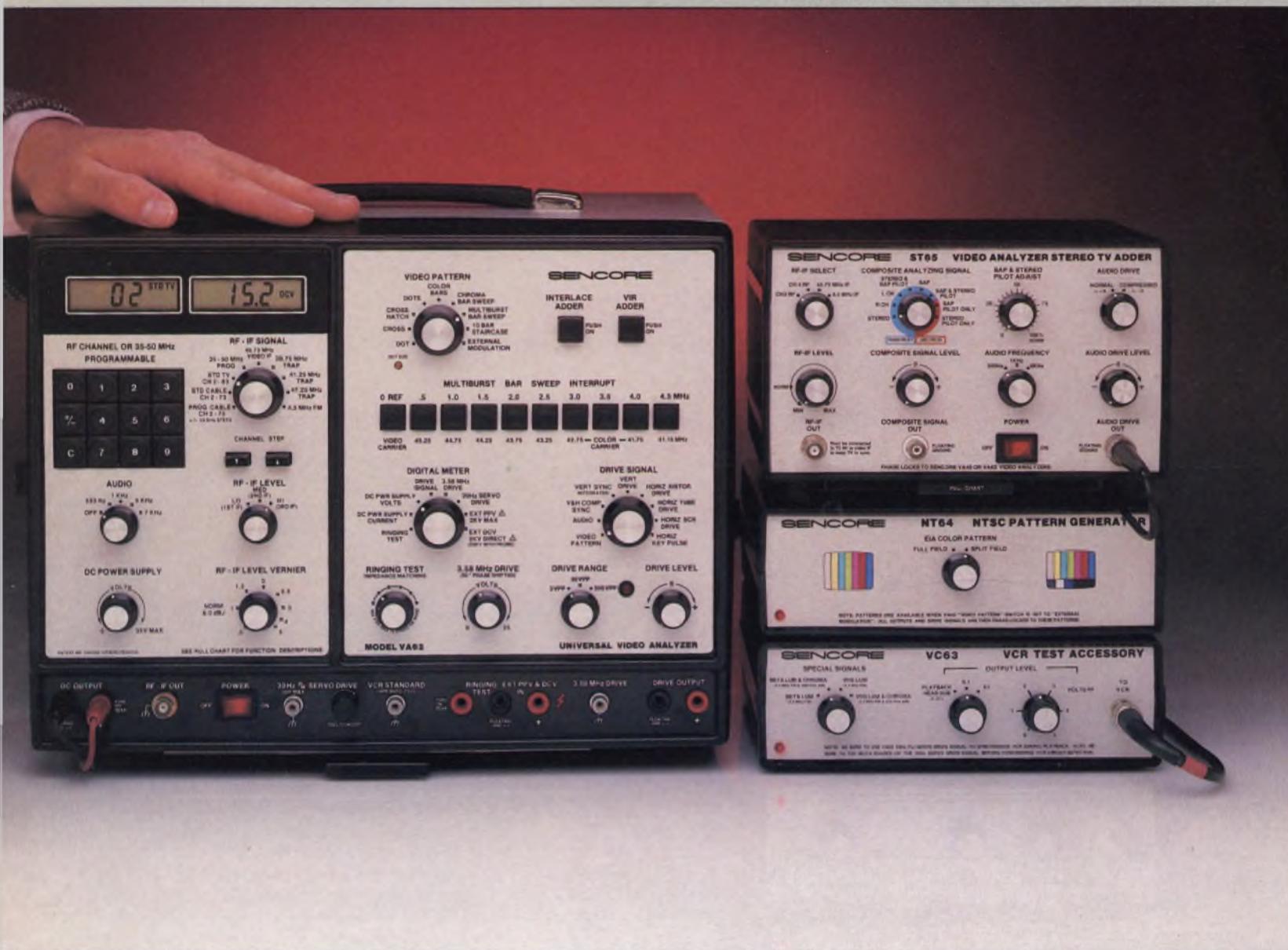
Test for gain at the push of a button to match transistors and speed troubleshooting. The TF46 also allows you to test for leakage on transistors that show good gain, but have leaky collector-to-base or collector-to-emitter junction. Plus it has a diode test too, for more versatility.

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

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

Call WATS Free 1-800-843-3338

VA62 Video Analyzing Package



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

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

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

VA62 Universal Video Analyzer

\$3495 Patented U.S. Funds

On GSA Contract
NSN 6625-01-187-5516

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.

* 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™

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

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

VC63 \$495 U.S. Funds

NT64 NTSC Pattern Generator™

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

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

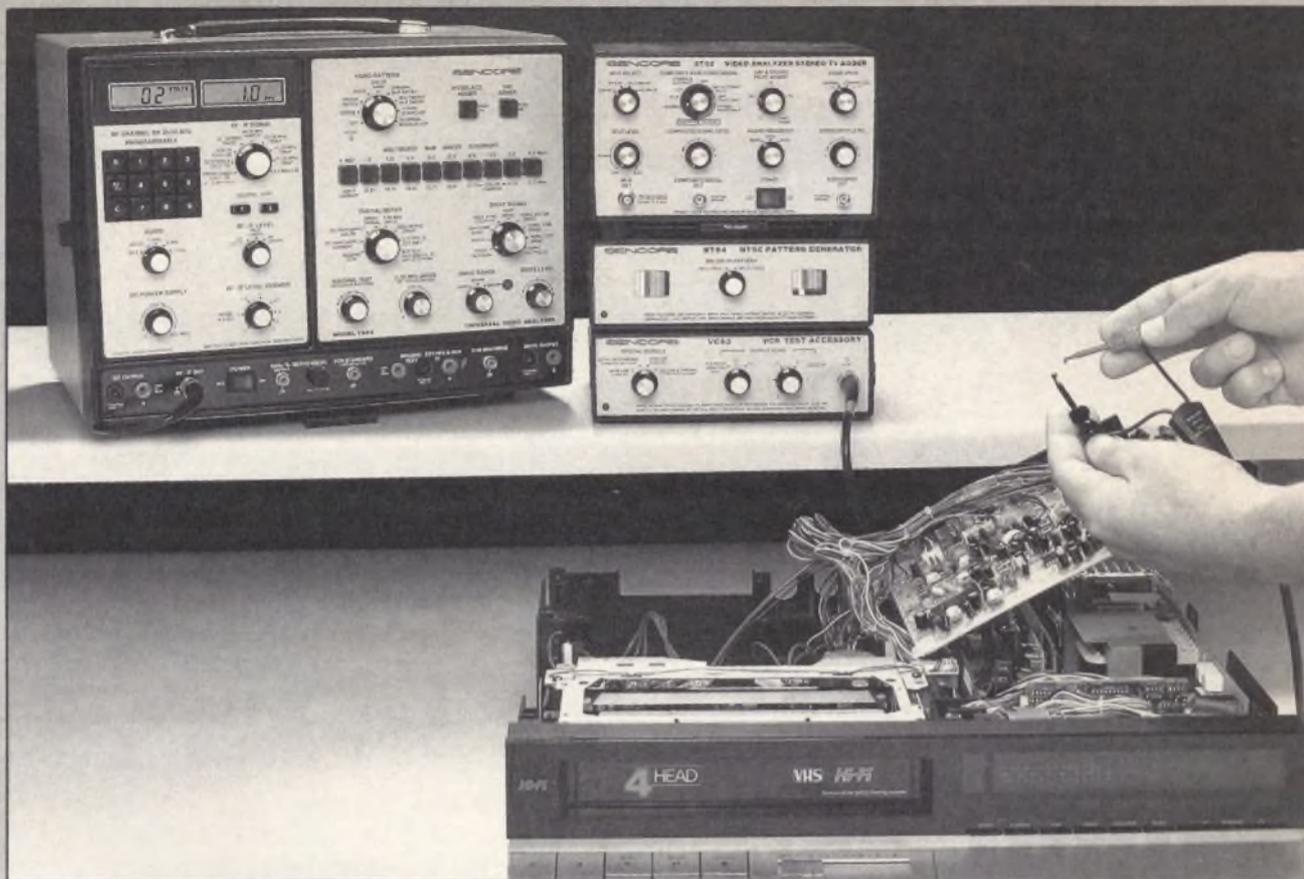
NT64 \$495 U.S. Funds

ST65 Video Analyzer Stereo TV Adder™

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

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

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



RG67 NTSC Video Monitor Adaptor

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

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

RG67 \$890 U.S. Funds



SR68 Stereo TV Readout™

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

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

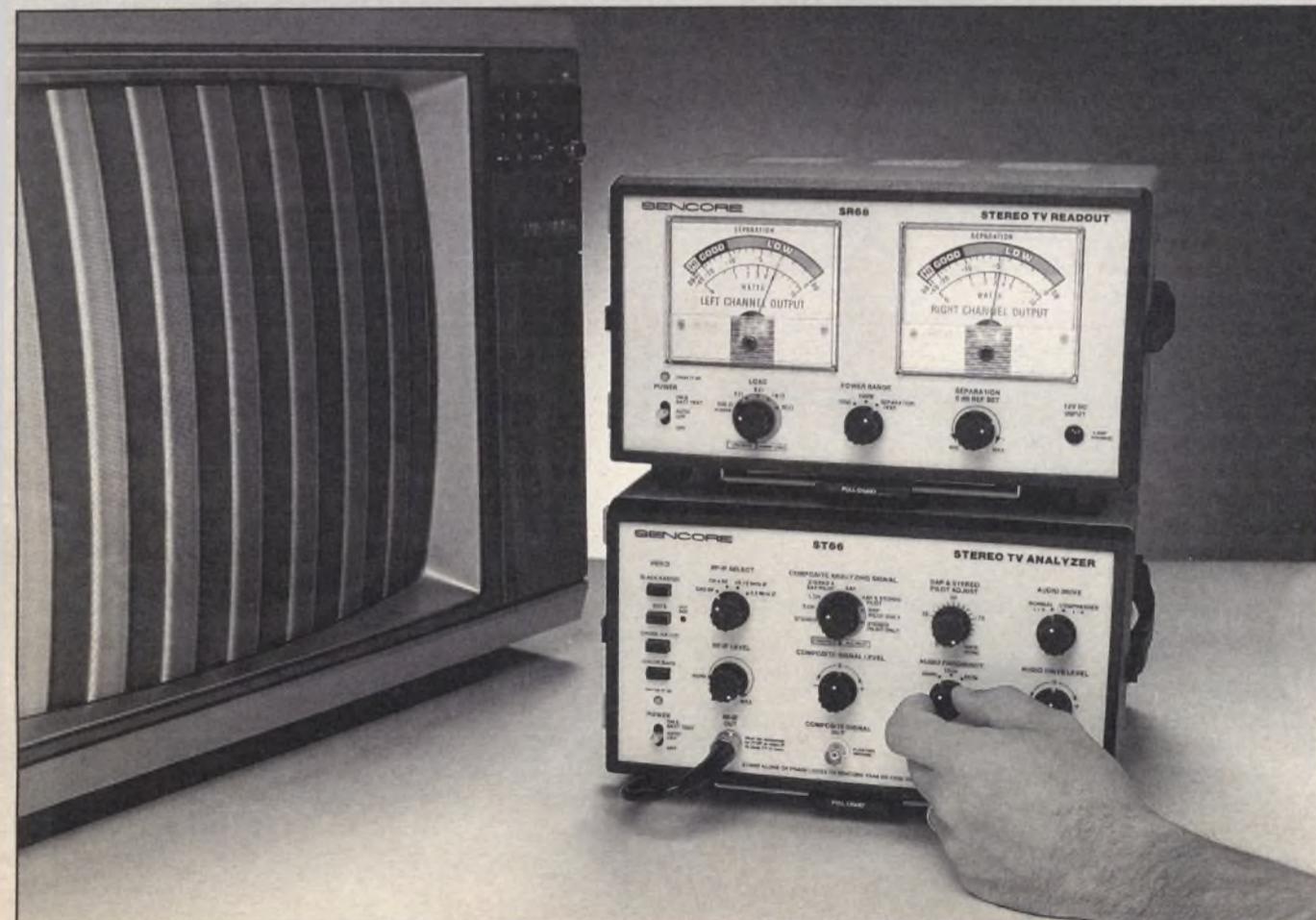
SR68 Stereo TV Readout \$595 U.S. Funds

ST66 Stereo TV Analyzer™

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

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

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



PR57 "POWERITE"

Variable Isolation Transformer And Safety Analyzer

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

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

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

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

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

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

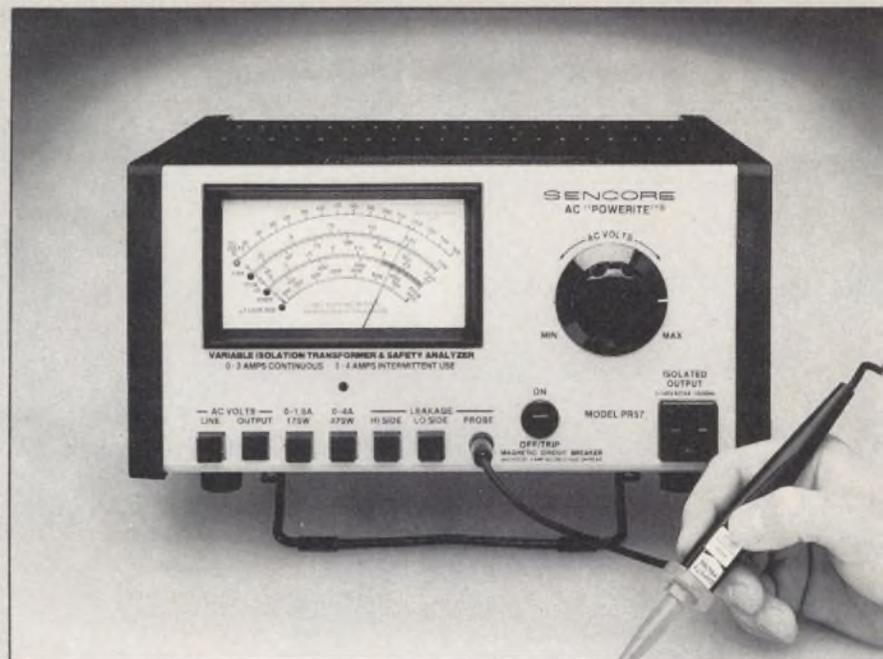
•AC Line Leakage Safety Tester To Assure That Excessive Leakage Current Is Not Present On Any Exposed Part On The Equipment Being Tested

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

NSN 6625-01-124-6296

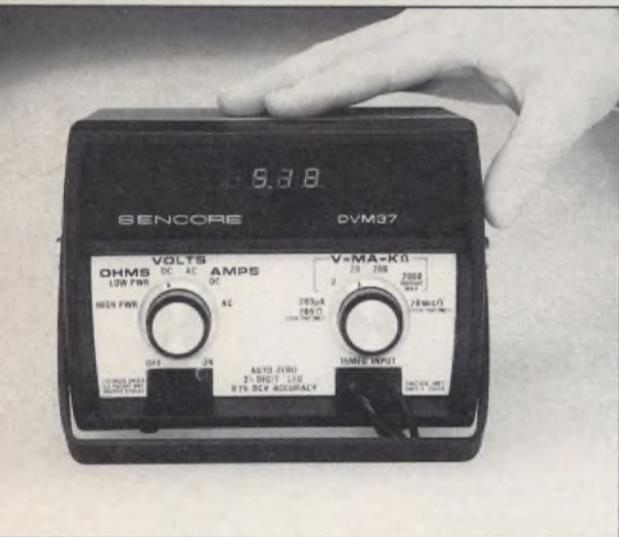
set at high or low line voltage to avoid embarrassing callbacks. Identify AC line related problems like picture width, sync, and intermittents in the customer's home or test in the shop at their line voltage.

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



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.

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



Fully Protected, Super Rugged Digital Multimeter You Can Use Anywhere

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.

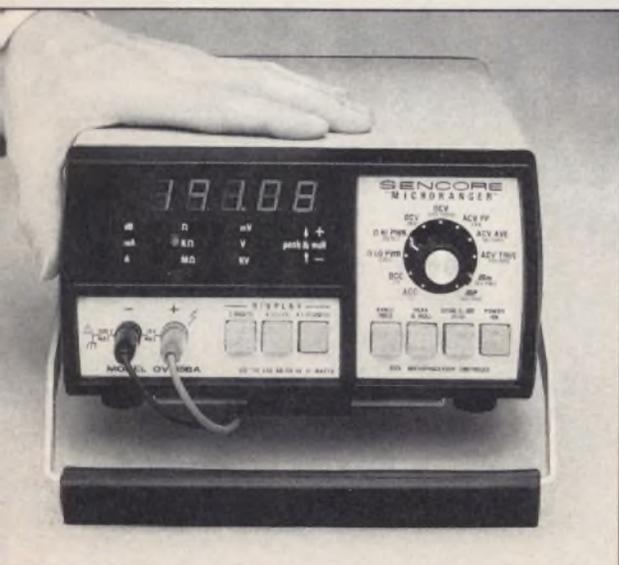
Fully protected inside. Unheard of 8 kV transient protection on every function and range, including ohms means unmatched internal protection.

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.

- An Indestructible DVM For Both Bench And Field
- 0.1% Lab Accuracy In A Portable Meter For Measurements You Can Count On
- 15 Megohm Input Impedance For Least Loading 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

DVM37 3 1/2 Digit, 0.1%
Bench/ Portable Digital Multimeter
\$395 U.S. Funds

DVM56A "MICRORANGER" Digital Voltmeter



A 100% Automatic, Microprocessor Controlled, Speed & Accuracy, 3, 4 or 4 1/2 Digit DVM, Designed to Save You Time.

- 100% Error Proof. You Can't Make A Mistake, Even If You Operate Everything Backwards
- The DVM56A Makes Tests For You That No Other Single Meter Can Make
- Tough, Fully Protected To 10 kV, Better Than Any DVM On The Market

DVM56A "MICRORANGER"®
Digital Voltmeter \$995 Patented U.S. Funds

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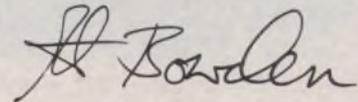
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Al Bowden/President

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You Can Have PR57 "POWERITE"® Protection, Plus Earn Over 1000% On Your Investment The First Year . . .

by Don Multerer, Special Accounts Manager,
Director of Sencore Seminars

If your banker called today and told you about a \$495 investment where you were guaranteed to earn a minimum of 1040% return the very first year, you would be most interested wouldn't you? In fact, you would probably say "this sounds too good to be true, tell me what to do!" The PR57 "POWERITE" not only is guaranteed to provide more than 1000% return on your investment the very first year, but this amazing benefit is just one of the five ways the PR57 is guaranteed to put even more profits right back into your business. Here's how:

The "POWERITE" Is A Safety Leakage Tester

The "POWERITE" safety leakage test protects you, your instruments, and your customer. It's the best profit builder of all. Safety engineers from the TV manufacturers we have interviewed all tell the same story — "too many servicers still do not make the safety leakage tests."

One reason for not making the test is that the present procedure is too complicated. It requires a good ground, a resistor/capacitor combination "made up" or located among the multitude of shop parts, and the chassis disconnected from the bench isolation. The "POWERITE" Safety Leakage test eliminates this time consuming procedure. Simply plug the chassis under test into the "POWERITE" and use the supplied safety probe to touch and test all exposed (through the cabinet) metal parts. Any leakage in excess of 500 microamps is a hot chassis problem that you should correct before the set is returned to the customer.

It Only Takes One

Many servicers confess that they feel guilty about not performing a leakage test on every chassis that leaves their shop. One technician told us "I can't justify the time of testing every set when only one out of a hundred will have a shock hazard." But that's the very reason you need to safety test every chassis that leaves your shop. It only takes one to put you out of commission so you are unable to work. It only takes one to zap your expensive test instruments or the customer's unit before you realize that it costs you more *not* to make the leakage test on every chassis.

The "POWERITE" is an Isolation Transformer to 470 Watts peak

An Isolation Transformer puts profits into your business by eliminating down time. Down time of your test instruments or the customer's set, damaged because they were not properly isolated from the chassis under test. Damaged sets and instruments have to be replaced or repaired. That takes profits right out of your profit till. Why can lack of isolation cause damage?

Today, most TV chassis use transformerless or "Hot chassis" for energy savings and lower



Fig. 1: To make a safety leakage test with the PR57, simply plug the chassis into the POWERITE and touch the probes to any exposed metal surfaces.

prices. The three types of transformerless chassis illustrated below require isolation transformer protection:

The half wave rectifier chassis: One side of the AC line is connected directly to the chassis in a half-wave, hot ground power supply.

Bridge rectifier chassis: There is a 67 volt potential between the TV chassis and earth ground in today's bridge rectifier power supplies.

Switching power supply: Similar to a bridge rectifier chassis; the switching transistor converts the bridge's DC output into a square wave which is in turn filtered for a DC output. Switching power supplies are found in many new TV and VCR chassis.

There's no problem with connecting grounded test equipment to the half wave rectifier chassis (Figure 2A). Many servicers make the proper

connection by measuring the voltage between the chassis and the grounded test equipment. A high AC voltage reading shows the "Hot" side of the line is feeding the chassis. If so, they simply reverse the AC plug.

Unfortunately this approach doesn't work with bridge power supplies (Figure 2B). In these power supplies the metal chassis is at half the AC line, no matter how the AC plug is connected. Here is where costly damage affects your test equipment and the customer's set. Connecting your scope, or any other grounded test instrument to the television receiver or VCR chassis shorts out half of the power supply (Figure 3). Damage results from excessive current flowing through the power supply's input choke and rectifier diodes. Chances are the high current will "fry" your common test lead or scope probe, too.

An answer would seem to be to break the ground path that causes the short circuit. But breaking the test instruments third wire safety ground by cutting off the AC plug ground pin, or using a 3 wire adapter plug, leads to two other problems. First, the instrument's 3rd wire ground return is often necessary to properly shield sensitive circuits such as microprocessors and high impedance amps to prevent erroneous readings. Defeating the shield causes you to spend profitless time chasing electrons up the wrong path.

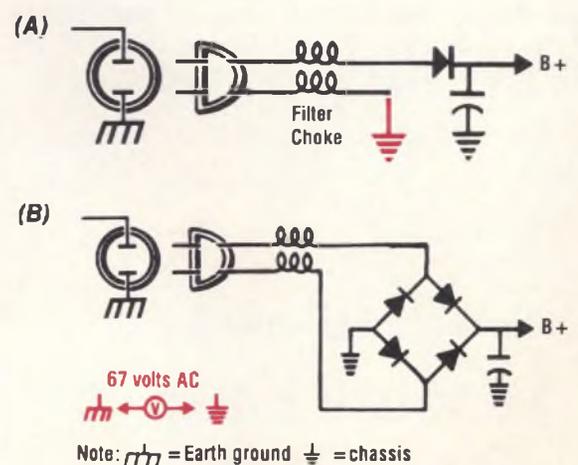


Fig. 2: (A). One side of the AC line is connected directly to the chassis in the half wave supply. (B). There is always 67 volts between the chassis and earth ground in a bridge rectifier supply.

The second problem, with defeating the 3rd wire ground, is that a serious shock hazard is formed between the instrument's metal case and any metal object connected to earth ground. Accidentally getting your body between these two AC points can cause more downtime.

Both of these problems can be eliminated if you make it a Golden Rule to ALWAYS plug every television, VCR, or any other chassis into the "POWERITE" isolation transformer before servicing it.

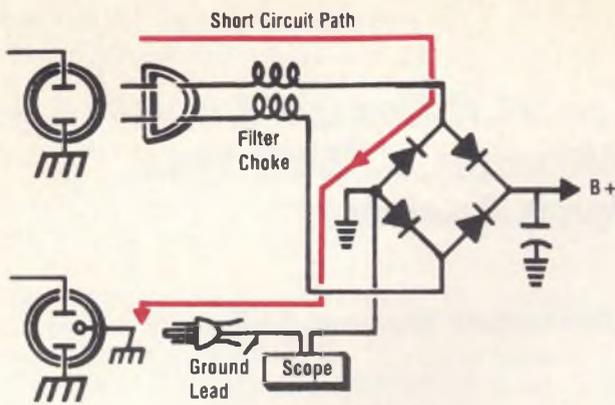


Fig. 3: Connecting a ground lead to a bridge rectifier chassis without using an isolation transformer will short out half the power supply.

The "POWERITE" is An AC Supply Continuously Variable from 0-140 VAC

How can a variable AC supply add profits to your business? An adjustable AC supply is a tremendous *timesaver* and a "must have" piece of equipment.

Manufacturers tell us that problems in TV regulator or shutdown safety circuits are the most time-consuming problems to troubleshoot. Service literature recommends a variable AC power supply as the only way to effectively service shutdown problems. Why? Because lowering the AC line voltage to about 90 VAC keeps the chassis from going into shutdown, letting you make waveform and voltage measurements to quickly find the circuit or component causing the shutdown condition.

The "POWERITE" Is An AC Line Voltage Monitor

The AC line monitor is another "POWERITE" feature and profit builder. It eliminates those phantom problems that send you off on a wild goose chase, tracking down problems that often do not exist. Low line voltages can cause picture width, sync, and intermittent problems. High line voltages may cause excessive 2nd anode high voltage, shutdown problems, or intermittent operation. You need to know what voltage is being supplied to your service bench at all times. With the PR57 it's easy, just reach up and push the AC VOLTS - OUTPUT button. The "POWERITE" voltage monitor swings into action to measure from 0-150 VAC and has a calibrated 117 VAC meter mark. At the push of a button, you can build your shop's profits.

The "POWERITE" has a built in Power Monitor to 4 amps and 470 watts — the best parts saver money can buy

How often have you replaced the horizontal output transistor, the driver transistor and the power supply regulator . . . and powered up the chassis, only to have all those parts self destruct because you couldn't monitor the current drawn by the chassis?

Replacing horizontal output transistors can be an expensive experience, because you can only charge the customer for the first one, not the one

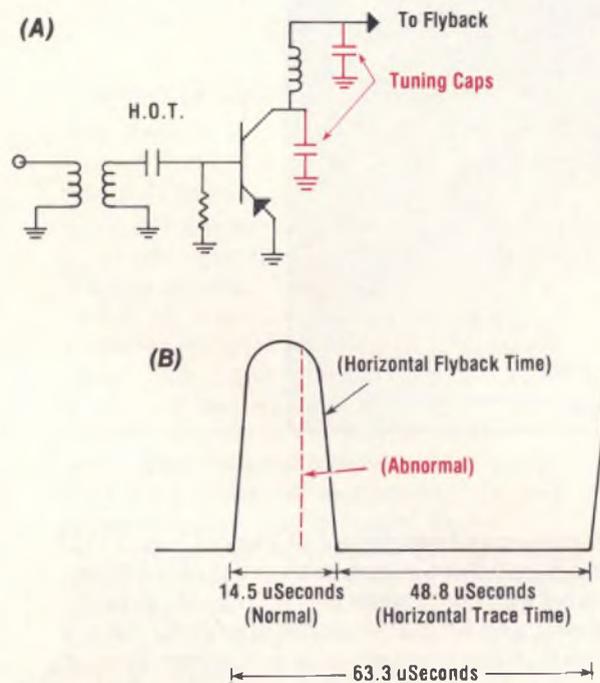


Fig. 4: Tuning capacitors (A) determine the horizontal flyback pulse timing. A shorter flyback pulse, (B) allows the horizontal output transistor to overheat.

you blew up. The next replacement transistors come out of your own pocket. If the chassis fails after a few days or few weeks of operation, it becomes an even more expensive repair as you now have the extra parts expense plus a costly and time consuming needless callback expense.

It only takes one of the horizontal output transistor's tuned capacitors to change value and change the timing of the horizontal flyback pulse. A shortened flyback time means increased horizontal trace time, increased duty cycle, and increased current drawn. More current for a longer period of time means that more heat is generated than the horizontal output transistor is designed to dissipate. Result: thermal run away

and eventual part failure. The "POWERITE" can be your "horizontal output parts saver" by letting you monitor current to 4 amps and wattage to 470 watts, at the push of a button.

The "POWERITE", Your Best Profit Builder of All

By now you are beginning see how the PR57 can be one of the best profit builders for your business. Let's review the five ways that the "POWERITE" can put profits back into your business:

1. Safety Leakage Test; your "business protector"
2. Isolation Transformer; your "down time" eliminator
3. Variable AC Source; your "time saver"
4. AC Line Monitor; your "phantom problem" eliminator
5. Power Monitor; your "parts saver"

How do you get that 1040% return for the \$495.00 investment? Once you decide to safety test every chassis that leaves your shop, simply add a service charge for the "Safety Leakage Test." Surveys taken by Sencore Field Sales Engineers at recent VCR clinics found service shops charge \$4.00 to \$6.00 for the PR57 Safety Leakage test. Our same survey showed that not one service technician got any "flack" for adding the safety check and others who worded the charge as a benefit to the customer's family, received thank you letters and phone calls. Let's see how fast a simple \$4.95 safety check adds up.

The National Electronics Sales and Service Dealers Association reports that nationally, the average shop repairs 4 TV sets a day per technician. Using a little math we find that:

4 sets per day x 5 days a week = 20 sets per week
x 4.95 per set = \$99.00 extra service income per week.

\$99.00 x 52 weeks = \$5,148.00 EXTRA SERVICE INCOME PER YEAR!

\$5,148.00 divided by \$495.00 (cost of PR57) = 1040% return on investment.

In fact, the PR57 almost pays for itself the very first month you own it if you join your technician friends and start making this all important safety charge. Then, after the first month, the "POWERITE" becomes an income producing source . . . a Business Builder. Many servicers set aside the safety charge money and use it to purchase all of their test equipment. ■

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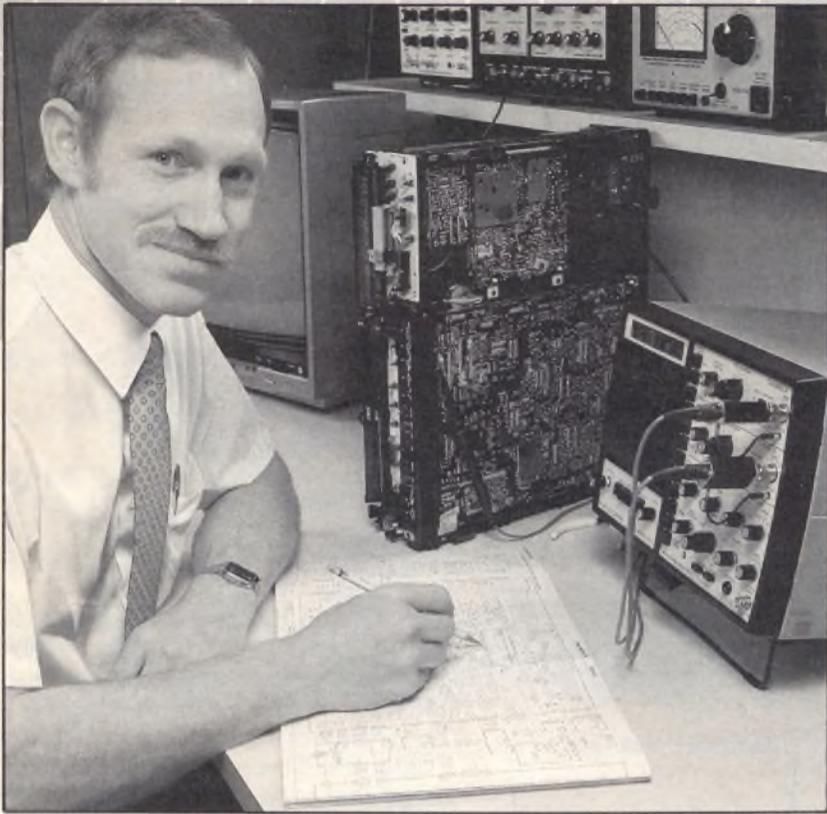
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You Can Solve VCR Control Circuit Troubles In Minutes . . . With Your SC61 Waveform Analyzer

by Tom Schulte, Applications Engineer, CET

responding to the front panel keys. Could the serial "op code" data or the data path itself be the problem? That path includes the key encoder, remote infrared receiver, and comparator ICs.

Have you recently added VCR service? Are many of the problems that you see easy to troubleshoot? That's what a few servicers have told us. But, most say they routinely run into tough problems and need a way to pin them down fast. You see, the key to successful VCR service is to get every VCR repaired quickly. Tough dogs eat up profits and drive customers to the competition.

Our seminar holders tell us that many servicers find control circuit problems particularly difficult. The majority talk about replacing the microprocessor and then discovering that it wasn't the trouble. In this article, we'll examine a typical control circuit problem that was found after the microprocessor was replaced. You'll see how a few logical troubleshooting steps with the SC61 Waveform Analyzer could have saved time and frustration . . . we'll call our servicer Tom, since I could have easily made the same mistake.

A customer brought a JVC model HR-D555U VCR into Tom's shop with most of the front panel switches inoperative. Only the power, timer, and SP/EP switches operated. After a check of the microprocessor's power, ground, reset pulse, clock and data lines, Tom figured it had to be bad. You can guess what happened. About a week later, Tom installed the replacement microprocessor chip. The VCR still didn't work; that proved the old micro was good. Now what?

Tom searched through the service manual again, looking for the system control circuits. The power, timer, and SP/EP switches fed directly to the system control microprocessor (IC 203 pins 39, 40, and 41; See Figure 1). The remaining front panel switches went to a key encoder. See *Tech Talk* page 27. The key encoder develops serial data to feed a single "op code" input on the micro, IC 203, pin 18. The micro simply wasn't

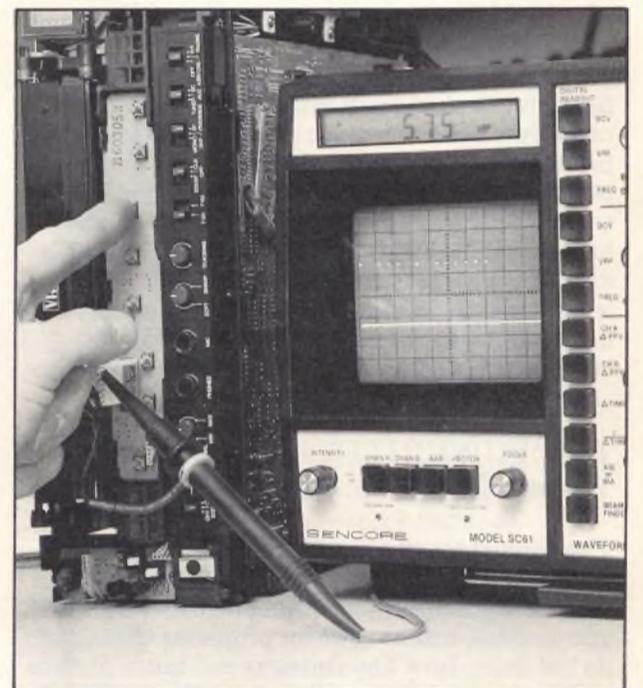


Fig. 2: Serial data output from the encoder changes when different buttons are pushed. This shows that the encoder is working.

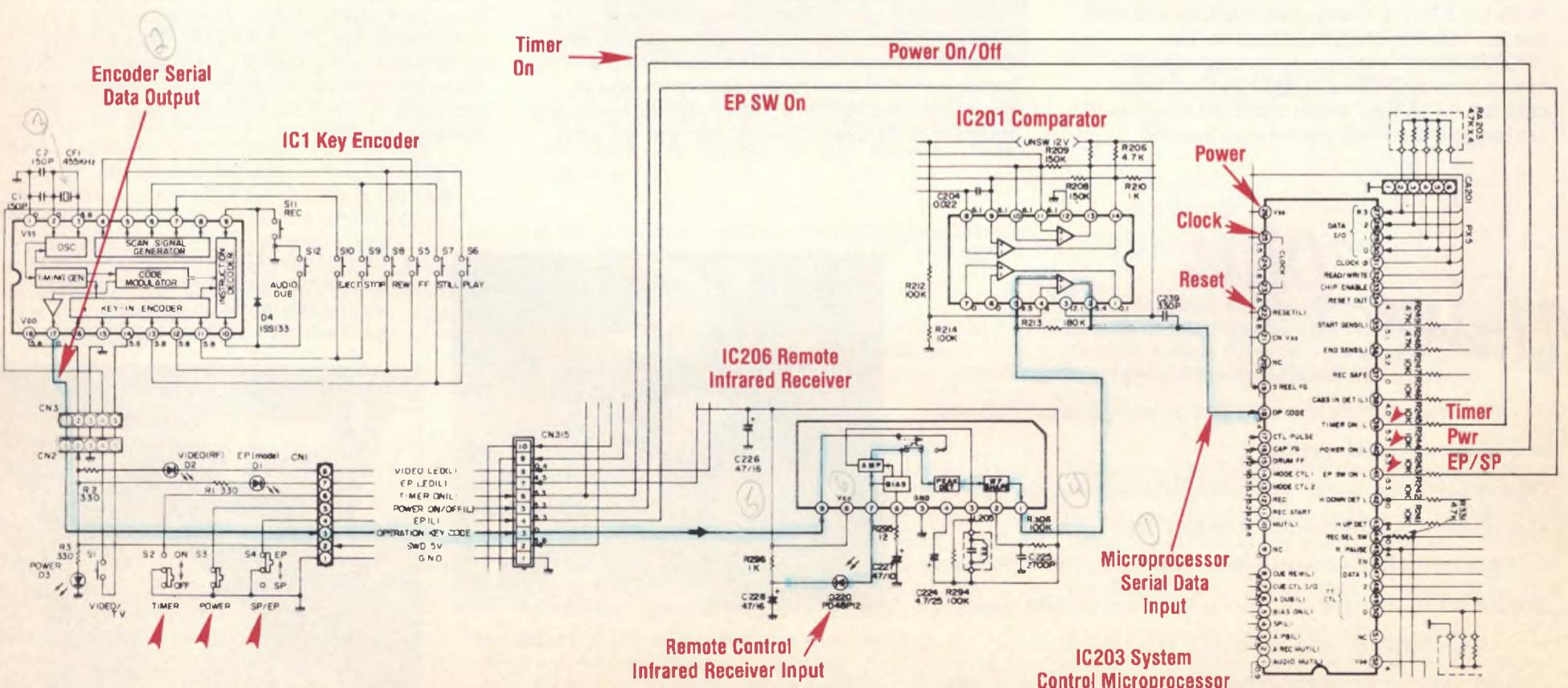


Fig. 1: Use the schematic to determine the path for data input to the microprocessor. Use your SC61 to isolate the defective part in the data path.

The SC61 Simplifies Digital Troubleshooting, Builds Confidence Too

When troubleshooting digital circuits, use your SC61 Waveform Analyzer; with just one probe hooked up you can check for DC voltage, peak-to-peak voltage and frequency — all at the push of a button.

Tom hooked the SC61 probe to the micro's op code input, IC203 pin 18, and pushed the front panel switches one at a time. There was no data. Was the input circuit generating serial data? Tom moved the probe to the key encoder serial output (IC1 pin 17). The SC61 locked onto the output pulses as Tom pushed the front panel switches (Figure 2). Peak-to-peak voltage was right on and the data pattern changed as each switch was depressed.

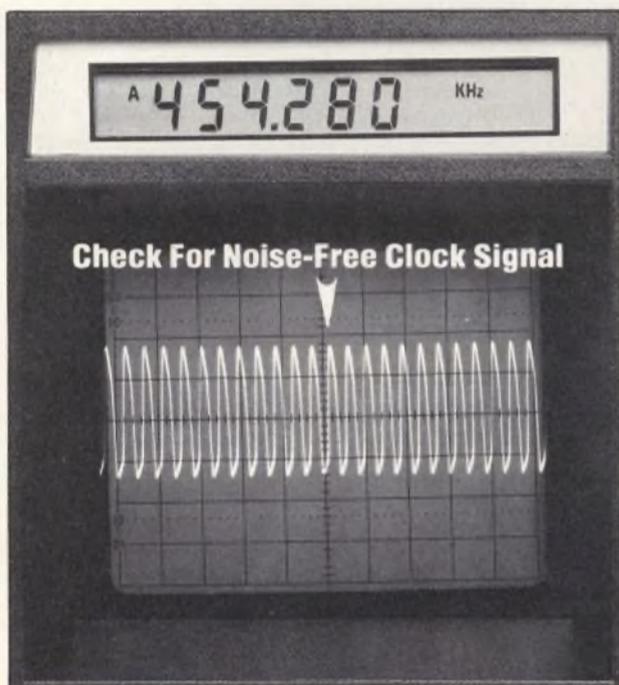


Fig. 3: The SC61 allows you to easily check the clock waveform and frequency.

The data looked good. Tom moved the SC61 probe to the encoder's clock input (IC1 pin 3) and pushed the **FREQ** button. The correct clock frequency, 455 kHz, popped up on the SC61's digital display (Figure 3). The data was right and the clock was on frequency . . . nothing to keep the panel switches from working if he could only get the data to the microprocessor. The trouble

had to be between the encoder output, IC1 pin 17, and the microprocessor input, IC203 pin 18.

Moving the SC61's probe to the remote receiver output, pin 1 of IC206, Tom verified the troublesome stage. The remote infrared receiver IC wasn't passing the data. A quick check at the input, pin 9, verified the chip was receiving data. Tom pushed the SC61's **DCA** button and moved the **CHANNEL A** probe to IC206 pin 8 (VCC).

DC supply voltage was reaching the IC. The remote infrared receiver IC was definitely bad. Replacing the IC restored the VCR to normal.

What lesson should you learn from Tom's experience? Before replacing a microprocessor chip, always use your SC61 to verify every input as well as the power, ground, clock, reset pulse, and data lines. ■

Tech Talk

Understanding Key Matrix Encoders

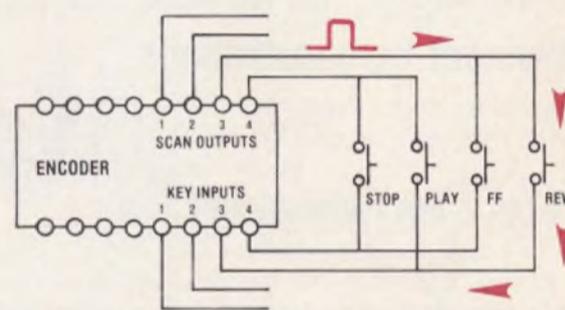
Most VCRs use some method of allowing several front panel switches (keys) to share a common input line to the system control microprocessor. One method used is the key matrix encoder. This is also a common method for computer keyboard input. The encoder continually checks for a depressed key. When it detects one, it determines which key is pushed and develops a series of output pulses (series data string) that corresponds to that key. The series data string is sent to the microprocessor (sometimes through other ICs that shape the pulses or combine them with yet other signals). The microprocessor reads the data string to decide which of the keys is depressed, and responds according to its built-in program. The major difference with computer keyboards is that the encoder output is generally parallel data in ASCII format.

The key matrix encoder works by sending out pulses on its scan output lines. First one scan line is pulsed, then the next, and so on until the pulse cycles back to the first line. Each scan output line is connected to a number of front panel switches. The other side of each switch is connected to one of the encoder input lines.

Referring to the simplified circuit, you see that if the **REW** button is pushed, **INPUT 3** will be pulsed during **SCAN 3** time. The encoder knows that if a pulse appears on **INPUT 3** during **SCAN 3** time the **REW**

button is pushed. It develops a series of output pulses that corresponds to the **REW** button.

If the **PLAY** button is pushed, input 3 will be pulsed during **SCAN 4** time. The encoder knows that if a pulse appears on **INPUT 3** during **SCAN 4** time the **PLAY** button is pushed. It now develops a series of output pulses that corresponds to the **PLAY** button.



Once you understand how a key matrix encoder works, troubleshooting one is easy. For example, if the VCR won't go into **Fast Forward** but the other functions work, see which scan line is connected to the **Fast Forward** switch and scope that scan line. If pulses are present, check the input line connected to the **Fast Forward** switch. If input pulses are present, the encoder IC isn't working properly. Check its supply voltage, clock, and ground as well as associated components before replacing the IC. If pulses aren't present, trace the lines leading to and from the **Fast Forward** switch to see where the pulses are stopping.

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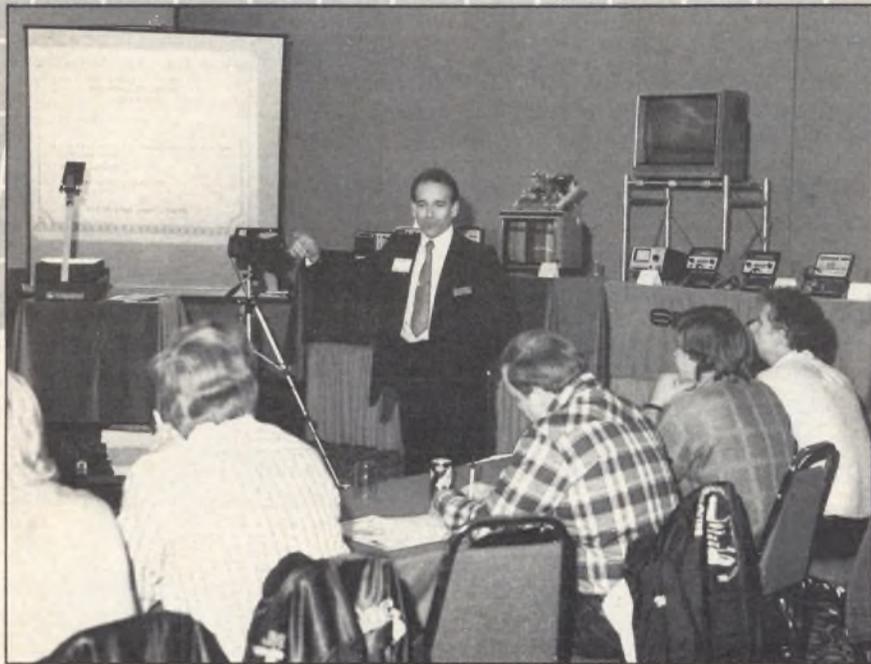
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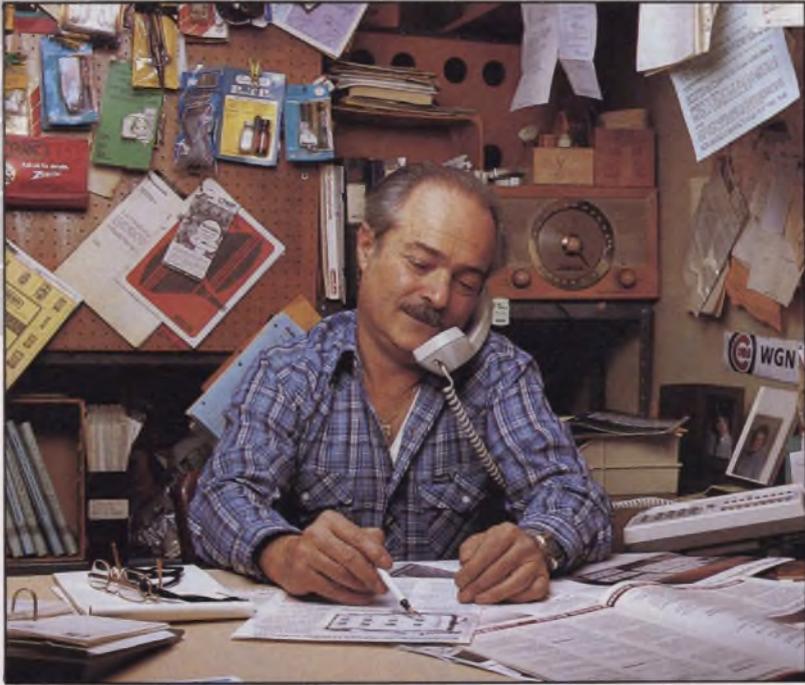


3 Next mark your calendar so you don't forget. Even if you do, we'll remind you a few days before your scheduled workshop. (P.S. Bring a technical friend.)



4 Then be sure to attend to receive your Free Sencore Workshop attendance gift — two specially prepared Video Servicing Workbook Study Guides. A \$40.00 value.

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"If I Didn't Have A Manufacturer Like You With The Support And Backup Like Yours, I Might As Well Pack . . ."

Lou Edelstein, Lou's TV And Electronics, Chicago

were 110 volts on one side of the antenna. When the customers found out, they were simply amazed. So I certify that each unit is shock free and it protects me too."

What do you think about Sencore's seminars and how do they help you?

"The seminars are absolutely phenomenal. They are very, very useful. Maybe the genius doesn't have to go, but I'm not that smart and I can learn something every time I go there."

I think you're just about the only one left that gives seminars on test equipment. B&K used to give seminars twice a year through their distributors."

The electronic servicing industry is changing. What role will Sencore play for you in the future to meet new challenges?

"Technology is getting more complex today than it has ever been. And it's going to get more sophisticated. The person that stays up with it is going to become very successful."

See, I'm in business to stay in business. And anyone in this business has to be determined. You have to fight, you have to educate yourself."

Sencore is an integral part of my business. If I didn't have a manufacturer like you with the support and backup like yours I might as well pack my stuff and go home."

You have moved with technology and the only way a small guy can survive is to move with technology also. If anyone would call me and say, 'I don't believe that stuff I read in the Sencore News.' I'd say, 'No, you're wrong. If you spend the money for it, you get every penny that you invest.' There isn't one piece of test equipment that I bought from you that I haven't used to the nth degree. I'm very, very, pleased with Sencore—really!"

Value added services are extra benefits that come without cost. They don't appear on the price tag and they aren't itemized on the invoice. They're a service to valued customers.

How does "value added" benefit you and your business? Here are the answers, given by Lou Edelstein, Lou's TV & Electronics.

Lou operates a shop in Chicago; he's been a Sencore customer since about 1952. Over the years Lou has used Sencore instruments and Sencore's value added services as a means to improve the service he delivers his customers.

Lou, how do you like working with the people at Sencore?

"Outstanding! I have backup from everybody at Sencore. They are all super nice. If I have a question I call into my Area Phone Sales Engineer. If he can't help me out with a technical question he finds someone who can. Everyone is very supportive."

Have you taken advantage of our "Pay As You Grow" finance program?

"I used the finance package for the VA62. In fact I'm just about paid off with that. The Sencore people were very nice about it."

For a small shop, if you want to build test equipment up, this "Pay As You Grow" finance program that you talk about does work. But you have to put the equipment to good use. As for the VA62, I charge the customer \$12 for a performance test. It's the performance check list that you came out with. I return it to the customer so they know they are being charged \$12 for a performance test. This helps me defray the cost of the new equipment.

I do the same with the PR57. I charge \$5 for a leakage test. I have found a couple of units that



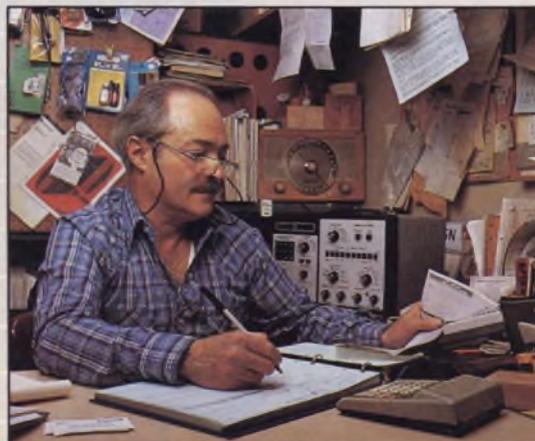
My specialty is television, VCR, microwave and audio . . .

Value Plus

CUSTOMER SATISFACTION

Only Sencore offers you a 100% Made-Right Lifetime Guarantee. This exclusive Buyer Protection Plan assures you that your unit was engineered and manufactured right - or we'll make it right - for the lifetime of the instrument, at no cost to you.

You can't make a wrong buying decision when you say "yes" to investing in Sencore. You're not investing in just an instrument, you're investing in your own piece of an entire organization dedicated to making you more successful. You get more with Sencore, we like to call it value plus . . .



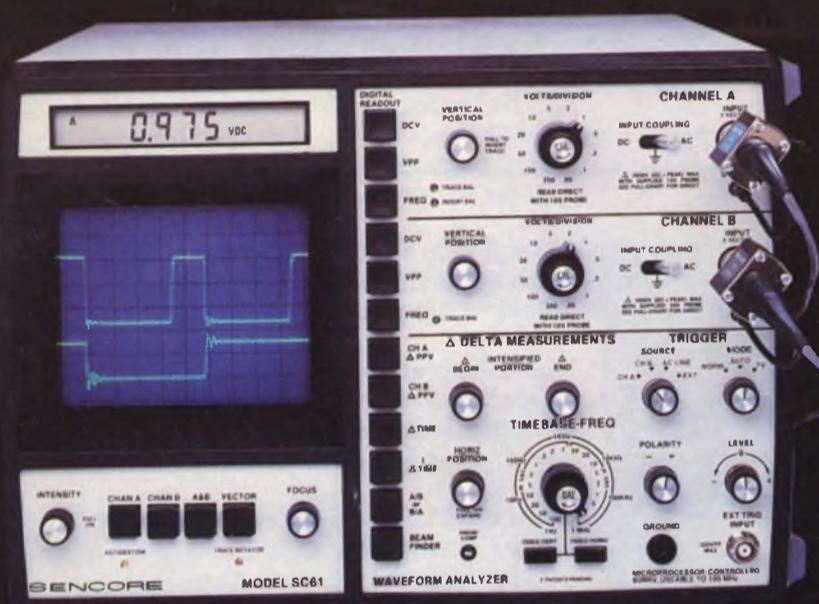
▲ I used the finance package for the VA62 . . . this "Pay As You Grow" that you speak about. It does work . . .

▼ I have found a couple of units that had 110 on the antenna; the customer never knew . . . The PR57 protects me, too.

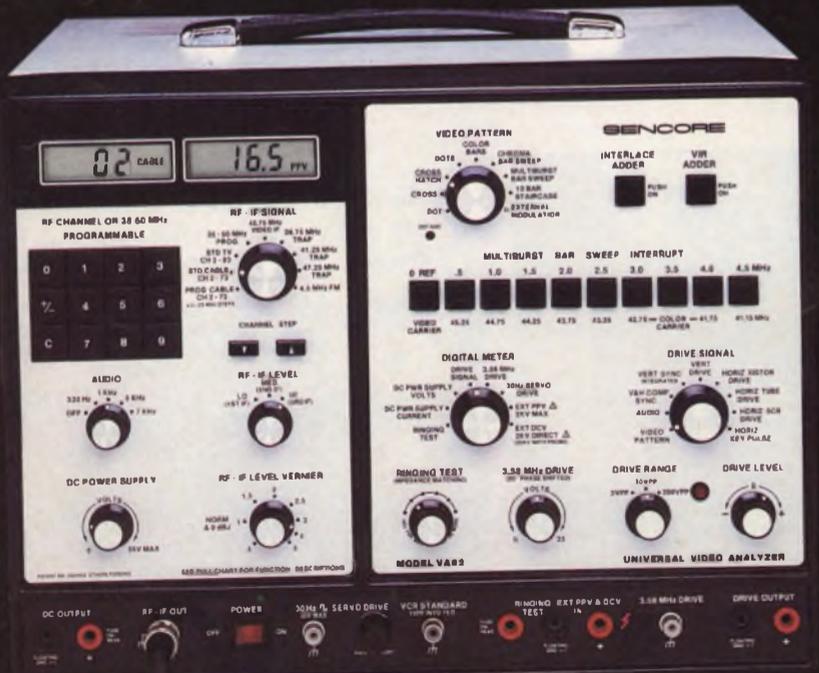


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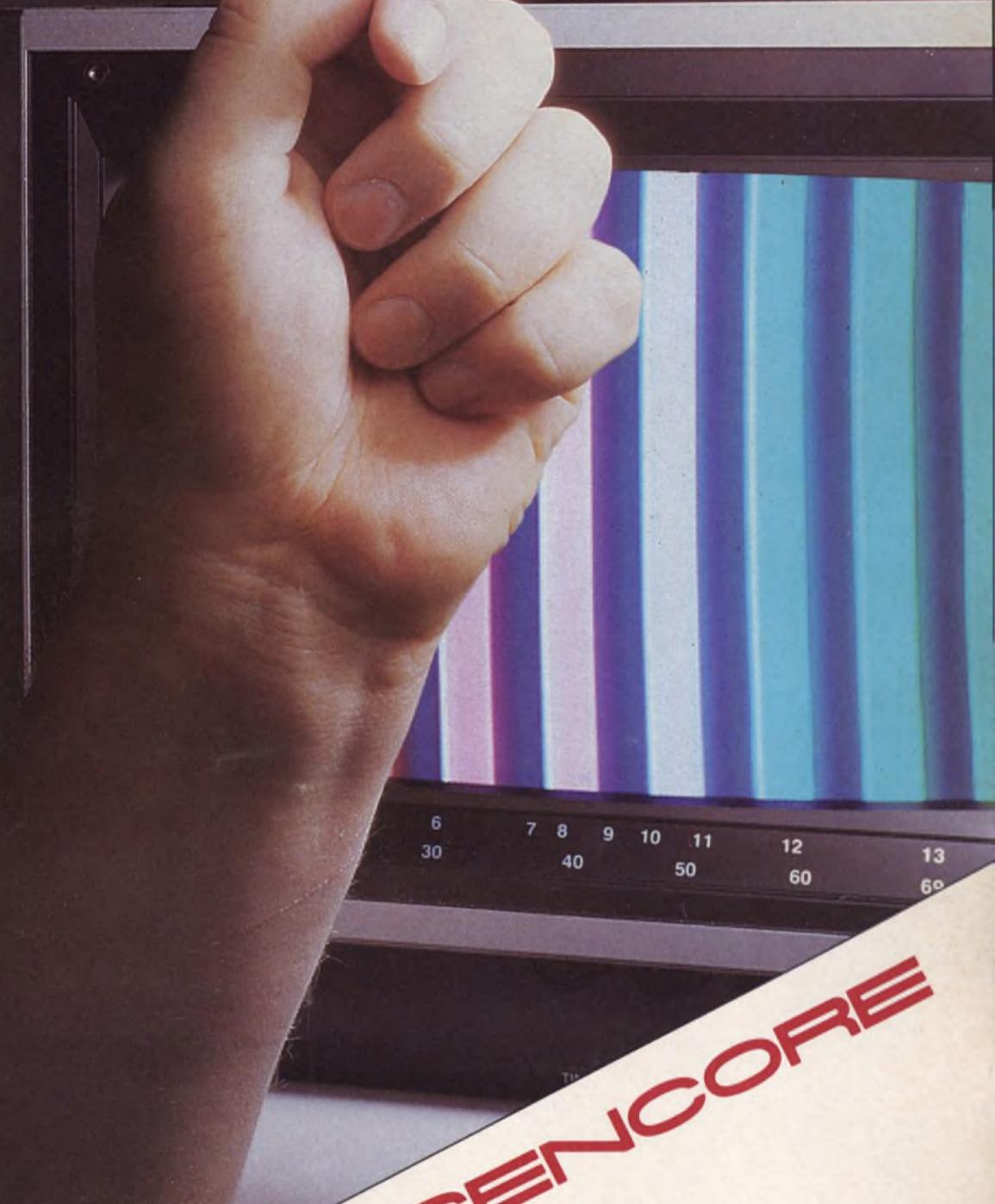
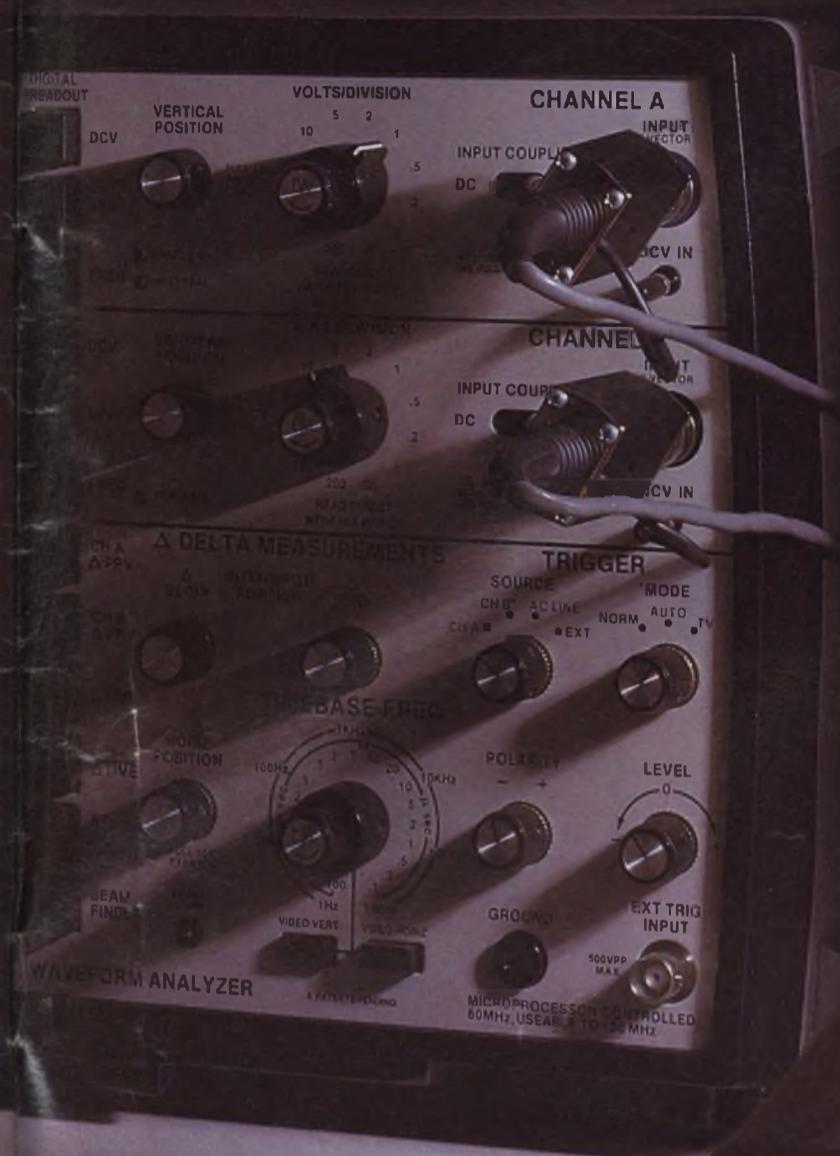
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MONDAY AFTERNOON, 5:30 PM



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

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