

VCR APPLICATIONS

Introduction

The VA62 provides video patterns and test signals that simplify servicing of video cassette recorders (VCRs). Optional accessories add to these basic capabilities. These accessories add new video patterns or special phase-locked drive signals needed for particular tape formats or special tests. *This section of the manual covers the applications of the VA62 when used without these optional accessories.* The instructions accompanying the accessories explain their added capabilities and applications.

Performance Testing

The first step in servicing a VCR is performing a complete operational check of the record and playback circuits. The "10 Bar Staircase", MULTIBURST BAR SWEEP, and CHROMA BAR SWEEP video patterns provide all the information you need for a complete performance test.

First, you test the playback circuits with a pre-recorded test tape. You should repair any problems in the playback circuits before moving on. After you are satisfied that the playback circuits work properly, you test the recording circuits by feeding signals from the VA62 VCR STANDARD output jack to the VCR's direct video input. You record samples of the three VA62 patterns and then analyze them as you play them back. Finally, if you suspect a problem in the tuner or IF stages, you feed the VA62 signal into the antenna terminals. You do not need to record and play back the signals this time because you have already confirmed the recording circuits work with the direct-video test. You simply set the VCR to the "e-e" (electronic-to-electronic) mode and observe the VCR output as you inject the VA62 signal.

Interpreting the Results

A VCR has normal frequency losses in both the luminance and chroma channels. The waveforms in Fig. 101 show typical results. A pair of waveforms is shown for each of the three speeds of the VHS and Beta formats. Each waveform has been double-exposed to show the MULTIBURST BAR SWEEP and the CHROMA BAR SWEEP. In real life, of course, you will look at the patterns one at a time.

Connect a 75 ohm resistor across the video output jack, and then connect your scope across the jack. The first thing to check is the amplitude of the lower frequency MULTIBURST BAR SWEEP bars (2.0 MHz and lower). They should read within 20% of the ideal value of 1 volt peak-to-peak.

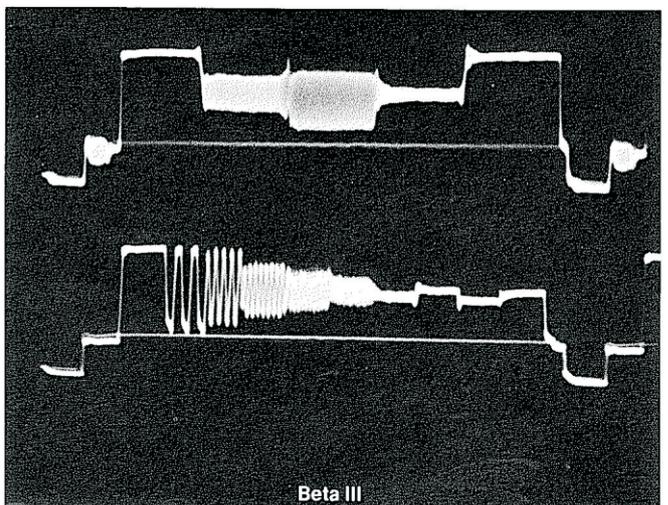
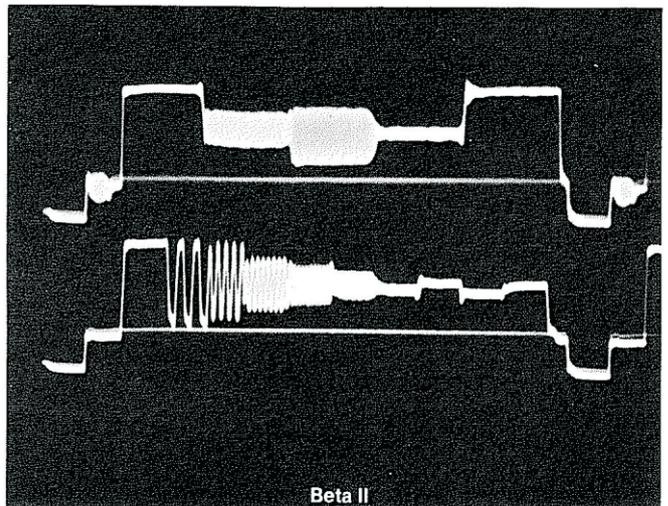
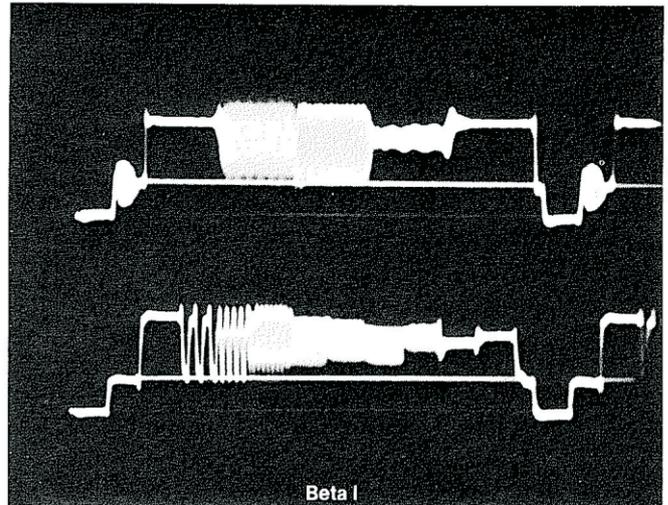


Fig. 101 — Typical outputs for each tape speed in the VHS and Beta formats. The top trace in each waveform is the Chroma Bar Sweep and the bottom trace is the Multiburst Bar Sweep. Notice the normal loss of high frequency detail.

The higher frequency bars of the MULTIBURST BAR SWEEP (the 2.5 MHz bars and higher) usually show a rolloff, as shown in the waveforms. The amount of rolloff may vary by as much as 50% from one machine to the next. Proper alignment of the video circuits keeps the losses on these bars to a minimum for best video detail.

The CHROMA BAR SWEEP pattern also shows normal losses of the sideband detail. The 4.0 MHz bar shows the largest loss because of the way the color frequencies are converted in the record and playback processes. The losses should be within 20% of the typical examples shown.

Test/Alignment Tape

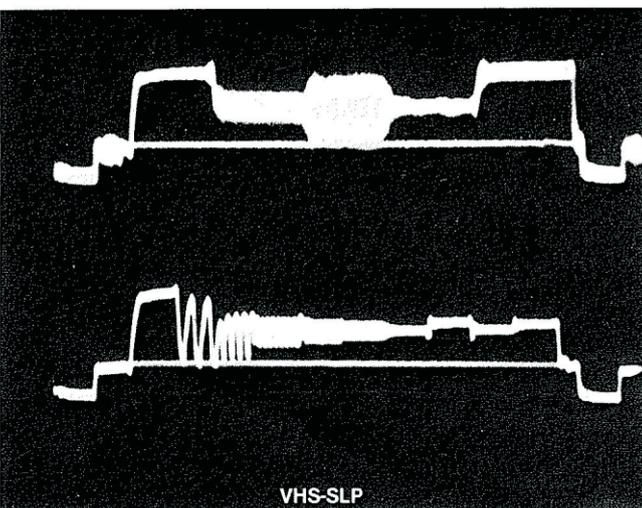
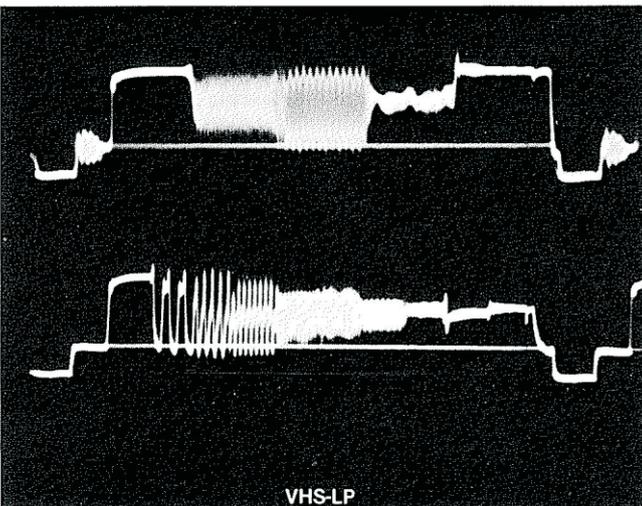
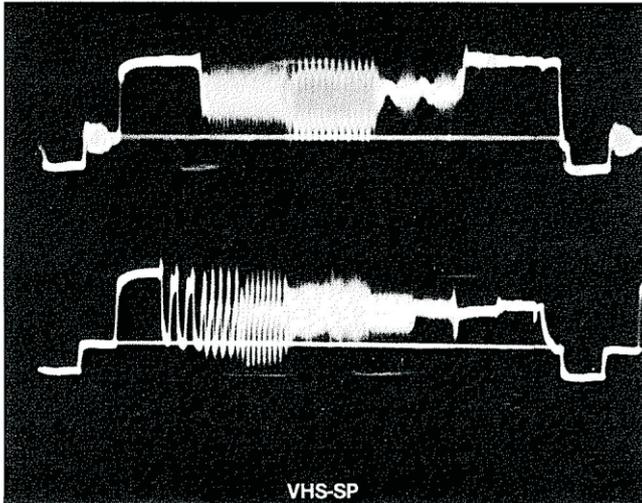
A test tape is essential for testing and aligning VCRs. Sencore recommends that you use two different types of tapes; the manufacturer's alignment tape and one that you have recorded yourself. You need both because each plays a different role in servicing.

The purchased tape insures that every VCR you service meets the manufacturer's standards for machine-to-machine compatibility; it insures that a tape recorded on one machine plays back correctly on another machine. However, there are two problems with using the manufacturer's tape as your only standard. First, they are expensive and easily damaged. Second, they do not have the VA62 video patterns, which provide more detailed troubleshooting information than the general test patterns on a purchased tape.

The best answer is to record your own tape on a machine you know works properly. You use the VA62 tape for troubleshooting and alignment, while you save the manufacturer's tape for the few times you need to check compatibility. If something should happen to your VA62 tape, you are only out the cost of a blank tape, rather than the several hundred dollars needed to replace a manufacturer's tape.

It's best if you record a separate tape for each tape speed within a tape format. There are two reasons for this: 1. It saves time, and 2. It provides better results. In the first case, you will not have to fast forward over long stretches of the tape to get to the desired tape speed when troubleshooting a tape speed problem. In the second case, you will find subtle differences in the tape, depending on which machine you use to make the recording. Here's why.

Each tape speed has an optimum video head width. A machine that only plays the fastest speed, for example, uses heads that are much wider than heads used to record the slowest tape speed. The narrower heads cause wide blank spaces between each stripe of video information when recording at higher speeds. These "guard bands" cause increased noise when picked up by a wider head. Therefore, your test tapes match the VCR better if you use a 4-head VCR (which has heads of the correct width for each tape speed) or if you use a different machine to record the test tape for each tape speed.



Record three different sets of patterns on your test tape: 1. A short segment using each recording speed to test the automatic playback speed selection circuits, 2. A medium length of each of the video patterns using a single tape speed for performance testing and 3. A longer length of each pattern for troubleshooting and alignment. You can repeat this sequence several times on the tape so you have a backup in case the first sequence of patterns is damaged by a defective machine.

Each of the patterns in the second (performance testing) section should be just long enough to let you observe the response on a monitor and scope connected to the VCR's output. Each of the patterns in the final (troubleshooting) section, on the other hand, should be long enough to let you carefully troubleshoot a circuit or align a control without running out of the pattern in the middle of a procedure.

Record audio at the same time. Feed a different audio frequency into the VCR with each video pattern so you can tell which audio frequency is on the tape by looking at the test pattern. Feed the audio and the video signals to the direct audio and video input jacks (not the antenna terminals) to prevent possible distortion due to fine tuning or alignment errors.

Fig. 102 shows a typical plan for a test tape.

| Length | Video Pattern | Audio |
|---------|-----------------------------------|--------|
| 10 sec. | Multiburst Bar Sweep (Fast Speed) | 1 KHz |
| 10 sec. | Multiburst Bar Sweep (Med Speed) | 1 KHz |
| 10 sec. | Multiburst Bar Sweep (Slow Speed) | 1 KHz |
| 20 sec. | Color Bars | 333 Hz |
| 20 sec. | Chroma Bar Sweep | 1 KHz |
| 20 sec. | Multiburst Bar Sweep | 5 KHz |
| 20 sec. | 10 Bar Staircase | 7 KHz |
| 2 min. | Color Bars | 333 Hz |
| 2 min. | Chroma Bar Sweep | 1 KHz |
| 2 min. | Multiburst Bar Sweep | 5 KHz |
| 2 min. | 10 Bar Staircase | 7 KHz |

Fig. 102 — Typical setup of VA62 test tape.

Universal Block Diagrams

Your job of servicing different makes and models of VCRs is greatly simplified if you have a single set of block diagrams that applies to all VCRs. The block diagrams in Fig. 104 and Fig. 105 are the universal block diagrams for the luminance and chroma circuits of all VCRs. These block diagrams include all of the main VCR circuits except for the servos and the system control circuits. The servos are covered in separate block diagrams. We will not cover system control circuits, since each make and model of VCR uses different control circuits. Refer to the manufacturer's service literature if there is a question involving system control.

Waveform Comparison at Key Test Points

You may wish to compare the waveform at a test point in a defective VCR with a typical waveform. The scope waveforms that accompany the block diagrams in Fig. 104 and Fig. 105 show typical waveforms at key test points in VHS and Beta VCRs. These waveforms are shown for a waveshape comparison only. The waveforms do not show a peak-to-peak amplitude because the amplitude of each signal agrees with the amplitude shown on the schematic of the particular VCR you are servicing.

Each waveform photo shows two signals for comparison. The luminance circuits show the MULTIBURST BAR SWEEP and the "10 Bar Staircase" patterns. The chroma circuits show the CHROMA BAR SWEEP and the NTSC GATED RAINBOW color patterns. The waveforms in the playback circuit were made using a VA62 test tape, as explained in the previous section. These waveform pairs were shot as double exposures. Keep in mind that you will only be able to view one waveform at a time as you switch in a particular video pattern.

Waveform Interpretation

Conventional troubleshooting of VCR circuits is based on signal tracing with an oscilloscope. Most VCR schematics show the "NTSC" color patterns. An optional accessory is available that supplies the "NTSC" pattern to the EXTERNAL MODULATION input jack if you have a real need for this pattern. The special design of the VA62 patterns, however, eliminate the need for the "NTSC" pattern for most applications.

Except for slight differences in waveshape, the VA62 video patterns produce waveforms that closely match the waveforms shown on VCR schematics. The "10 Bar Staircase" and the MULTIBURST BAR SWEEP patterns produce peak white signals that agree directly with the level of the white bar of the "split-field NTSC" color bar pattern when tracing signals through the luminance circuits.

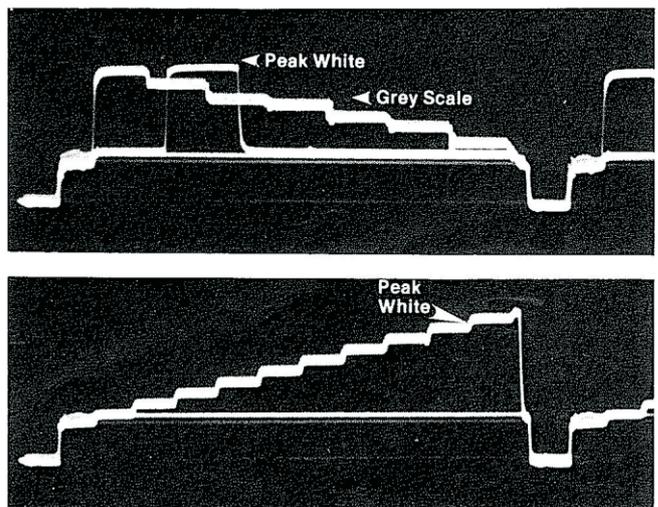
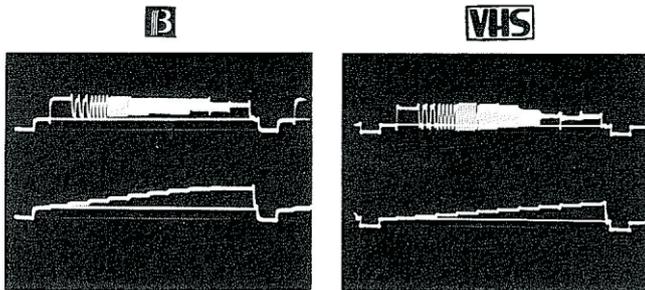
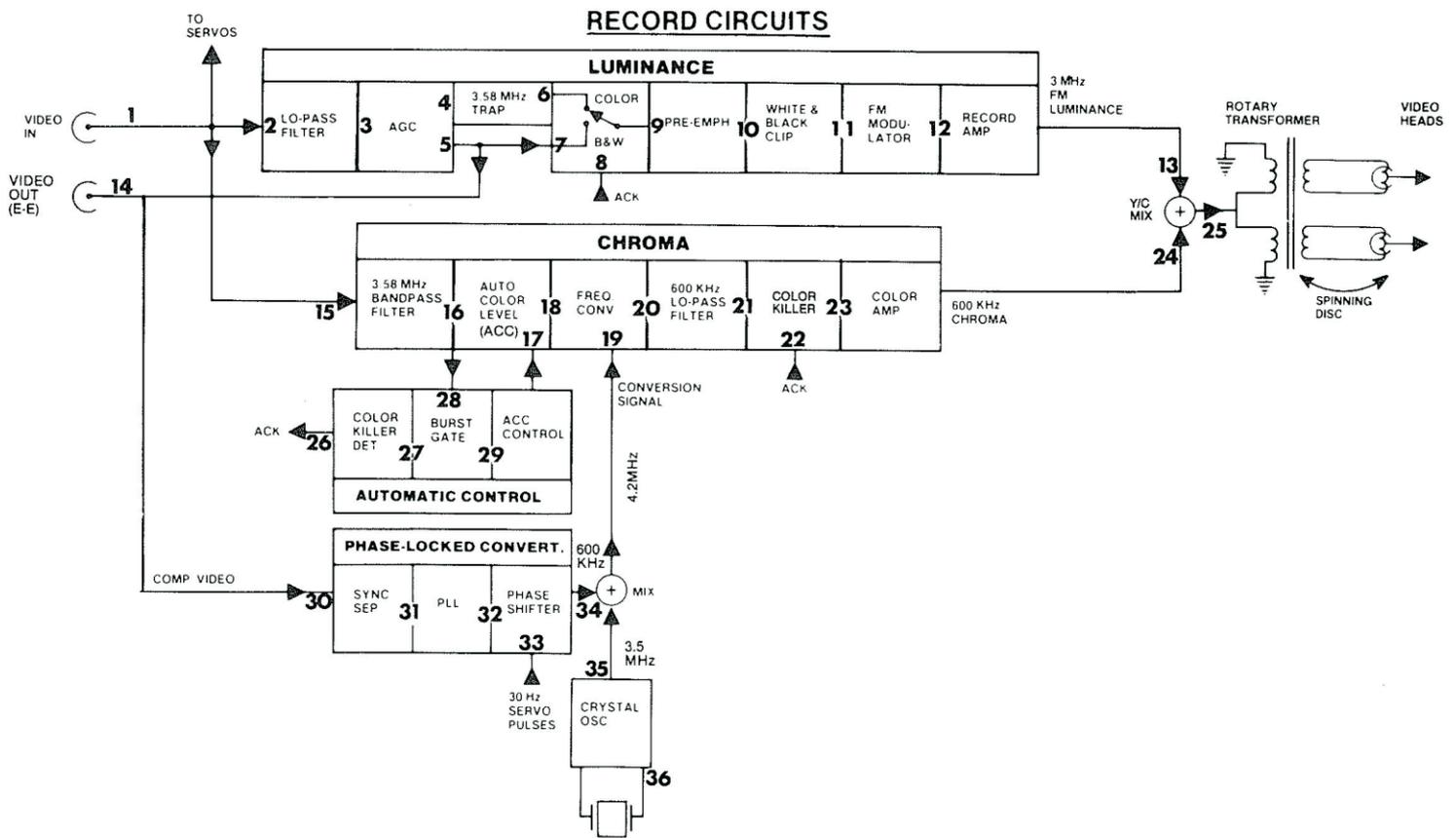
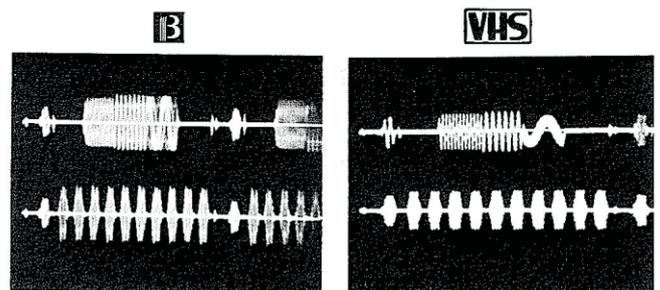


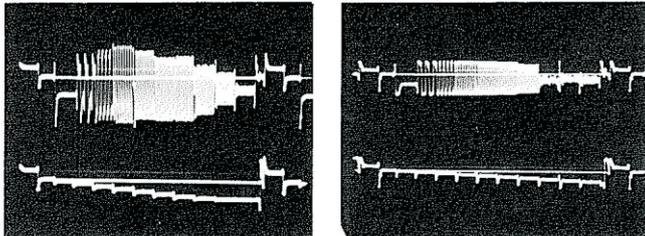
Fig. 103 — The "10 Bar Staircase" video pattern provides the same information in the luminance circuits as the luminance portion of the "NTSC" split field pattern.



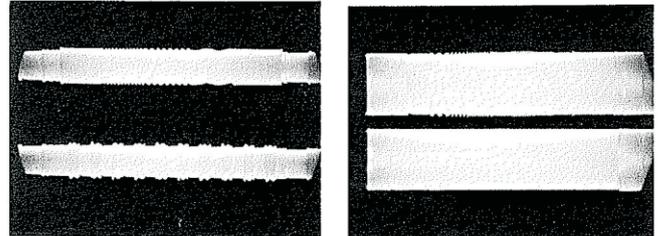
9. Trap Switch Out



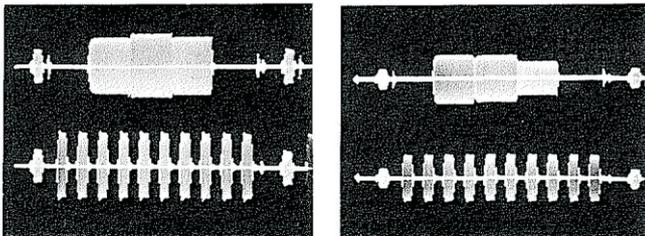
20. Color Down-Converting Frequency Converter Output



11. White and Black Clipper Out



25. Video Head Signal



16. 3.58 MHz Bandpass Filter Output

Fig. 104 — This block diagram applies to the recording circuits of VHS and Beta VCRs. The waveforms at marked test points are typical of the waveforms from the appropriate format. Use the service literature for the particular VCR to determine the correct amplitude.

PLAYBACK CIRCUITS

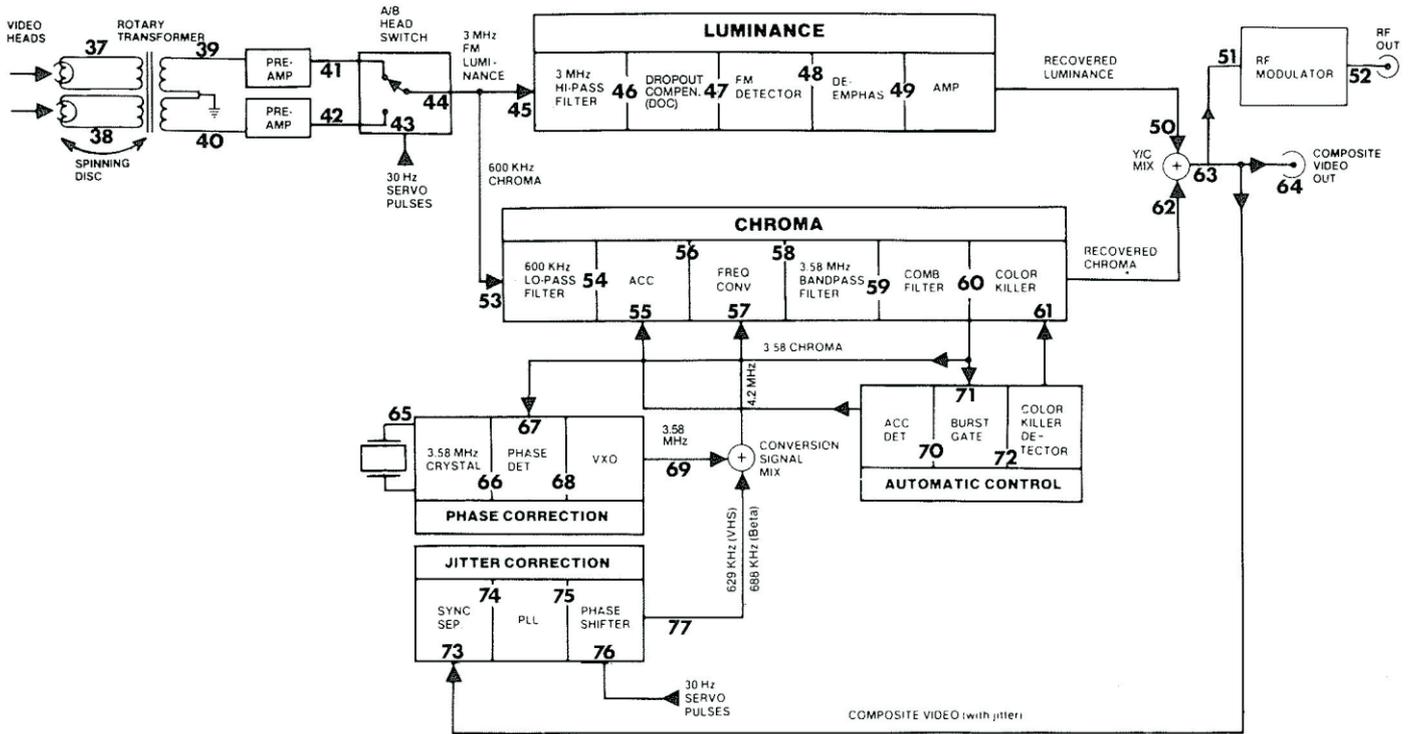
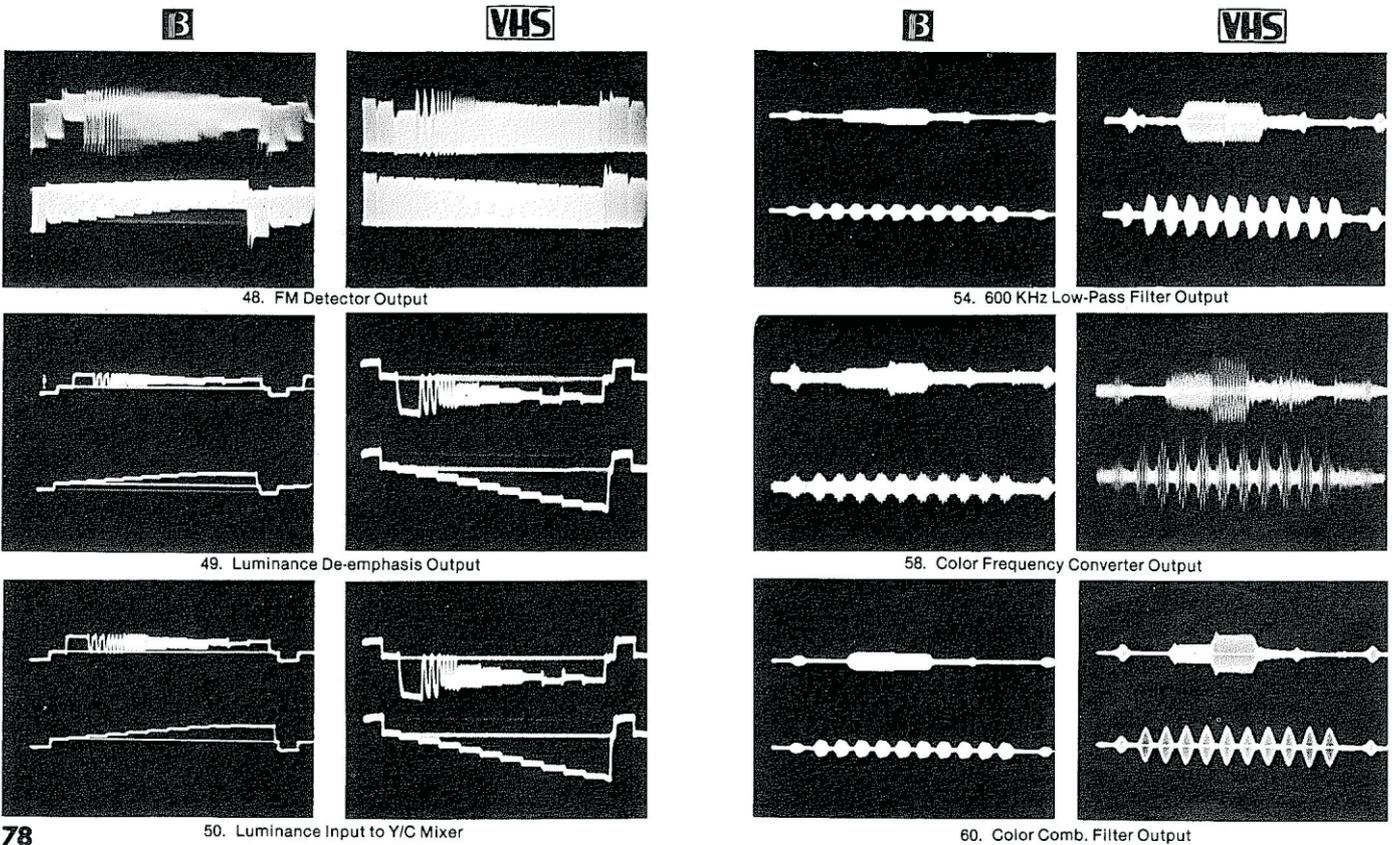


Fig. 105 — The block diagram for VHS and Beta playback circuits. Notice the typical losses at test points in the circuits shown by the special VA62 test patterns.



The CHROMA BAR SWEEP pattern provides the information needed to trace signals through the chroma circuits. The CHROMA BAR SWEEP has two features that allow direct comparison to the "NTSC" video pattern: 1. It has peak-white content, and 2. Its center bar is identical to the cyan bar of the "NTSC" video pattern.

The peak-white content is important when servicing VHS VCRs, since they usually use an average detecting AGC circuit instead of a keyed circuit that is referenced to sync. The white edges of the CHROMA BAR SWEEP cause the gain of the AGC circuits to be the same as for the "split-field NTSC" pattern, which also includes a pure white bar.

Some color alignment procedures use the cyan bar of the "NTSC" pattern as a reference because the cyan bar contains the highest peak-to-peak chroma level. The VA62 CHROMA BAR SWEEP's cyan bar matches the "NTSC" cyan bar, so the results come out the same for either pattern.

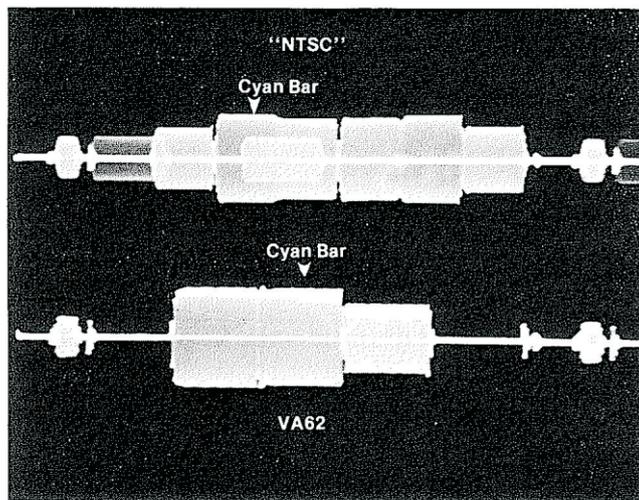


Fig. 106 — The Chroma Bar Sweep provides the same information as the chroma portion of the "NTSC" signal in the color circuits.

Lines of Resolution

Some VCR literature may reference the video frequency response as so many "lines of resolution". A line of resolution is a measure of the smallest horizontal detail that can be recorded and played back compared to the thickness of a vertical scanning line, or $1/525$ th the height of the screen on a monitor. For example, 525 lines of resolution means the CRT will show detail horizontally that is the same size as a scanning line. 1050 lines of resolution means that the smallest horizontal detail that can be shown is $1/2$ the size of a scanning line.

You convert frequency (in MHz) to lines of resolution by multiplying the frequency marked next to the MULTIBURST BAR SWEEP INTERRUPT buttons on the VA62 panel by 80. For example, the 1 MHz bar is the same as 80 lines of resolution, the 2 MHz bar is equal to 160 lines of resolution, etc. Fig. 107 shows the lines of resolution represented by each of the VA62 MULTIBURST BAR SWEEP bars.

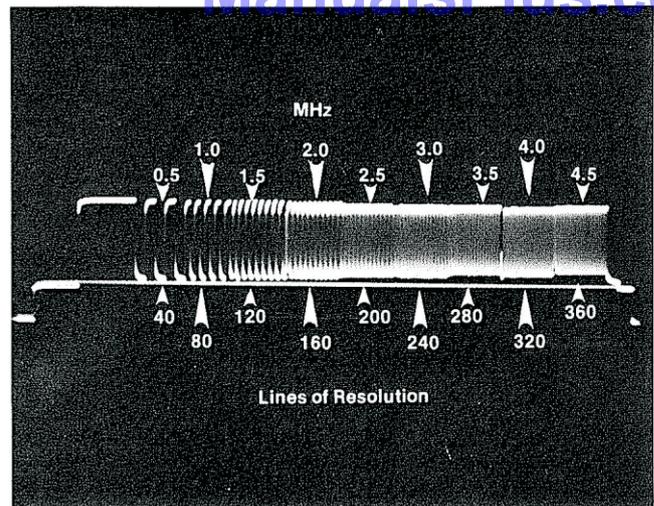


Fig. 107 — The "lines of resolution" represented by each bar of the Multiburst Bar Sweep video patterns.

Troubleshooting Sequence

The operation of most VCR circuits depends on signals coming from several other circuits. This can lead to problems if you troubleshoot the circuits in the wrong sequence. For example, a color symptom may actually be caused by troubles in the luminance circuits. Or, a servo problem may cause multiple symptoms in the luminance and chroma stages. Avoid getting confused by this interaction by using the following sequence when troubleshooting:

1. System Control
2. Servos
3. Luminance
4. Chroma
5. Audio

Always isolate playback problems before recording problems. Having the playback circuits working first allows you to do the recording tests on the same VCR you are servicing, rather than having to use a second VCR. In addition, repairing a playback problem often corrects a recording problem because many circuits are shared between the recording and playback functions.

IF and Tuner Systems

Most VCRs are designed to record programs off the air. The tuners and IF stages in these units are almost identical to the tuners and IF stages in a video receiver. The main difference is that the AGC circuits must develop their own keying pulse because there is no flyback transformer providing properly timed pulses.

Service and alignment of the tuner/IF strip is virtually the same for VCR service as for television service. When setting traps, however, connect your scope to the video detector output. Use the "10 Bar Staircase" signal with *no audio modulation on the trap signal*. Adjust the trap for the least thickness of each of the steps. Follow the instructions for

aligning the other IF adjustments covered in the "Receiver and Monitor Applications" section of this manual.

Testing Luminance 3.58 MHz Trap

Most VCRs have a special 3.58 MHz trap in the luminance recording circuits. This trap switches into the circuit when recording a color signal (as indicated by the presence of color burst) to prevent interference between color signals in the luminance channel and the processed color signals in the 600 KHz "color-under" stages. The trap switches out of the circuit during black and white programs (as indicated by the lack of a color burst) in order to provide better frequency response during B & W programs. Some low-cost VCRs do not have this feature. Check the schematic to confirm whether or not the VCR you are servicing uses the 3.58 MHz trap switcher.

The VA62 video patterns provide a quick and effective way to test the trap switcher and the trap action. The MULTIBURST BAR SWEEP pattern is a full B & W pattern with no color burst. The CHROMA BAR SWEEP, on the other hand, does have a color burst. Thus, the trap switcher should switch to the B & W mode (trap out of the circuit) for the MULTIBURST BAR SWEEP pattern, and to the color mode (trap in the circuit) for the CHROMA BAR SWEEP. This is easily confirmed by connecting your scope to the trap switcher output. Then, observe the 3.5 MHz "Color Carrier" bar as you switch between the two patterns. The 3.5 MHz should be present in the MULTIBURST BAR SWEEP pattern, but not for the CHROMA BAR SWEEP. If the trap is adjustable, set it for the least amplitude on the 3.5 MHz bar of the CHROMA BAR SWEEP video pattern.

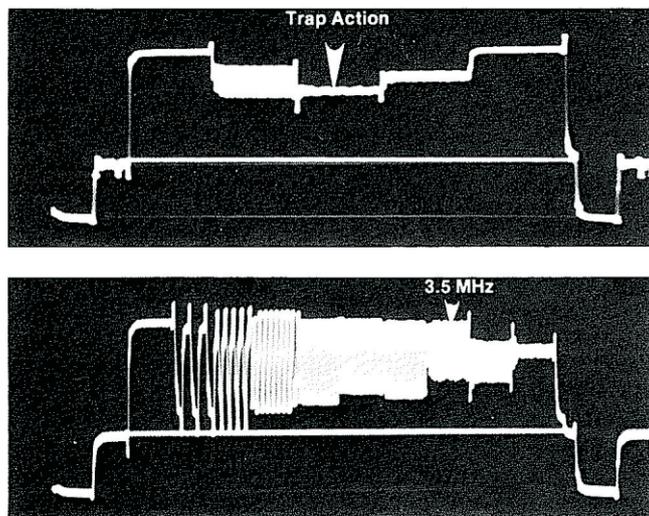


Fig. 108 — The VA62 patterns dynamically test the 3.58 MHz trap in the recording circuits: (top) the trap removes the 3.5 MHz bar from the Chroma Bar Sweep, (bottom) the trap switches out of the circuit during B&W signals, allowing the 3.5 MHz bar to come through.

The servos are the interface between the electronic circuits and the mechanical parts. The most common symptom of servo problems is a tearing picture. Some VCRs have muting circuits that blank the audio and video outputs when the servos are not locked, however, resulting in a symptom of no picture/no sound. Therefore, the first thing you should do when working with a "no output" condition is bypass the muting circuits to see whether the problem is in the video circuits or the servo circuits.

The VCR has two servo systems: the capstan (tape speed) servo and the drum (video head) servo. As Fig. 109 and Fig. 110 show, the two servos are fairly independent from each other, but they do have some common circuits. They also produce similar video symptoms; a tearing picture.

The audio gives an indication of servo problems related to tape speed (which is controlled by the capstan servo). The audio tones on the test tape should have a constant pitch when played back on the deck. (Remember that you may need to unmute the audio circuits to hear the tone.) If the tone has a constant pitch, you know the tape is moving at a constant speed. Tearing in the picture must, therefore, be caused by errors in the drum servo.

Once you confirm which servo has the problem, refer to the trouble tree in Fig. 111 and the appropriate block diagram. Notice that there is only one trouble tree for all four of the servos (record and playback for the capstan and drum servos). In each case, you are injecting the 30 Hz Servo Drive signal or a DC voltage from the VA62 DC power supply to identify which part of the servo is defective.

Signal substitution works a little differently here than for other video circuits. You are feeding a signal into a feedback loop. Therefore, the circuit does not return to perfect operation because you are replacing the signal containing the error information with one that has no error. You are looking for a noticeable *change* in the operation of the circuit instead of a return to near-normal operation.

Recording Servos

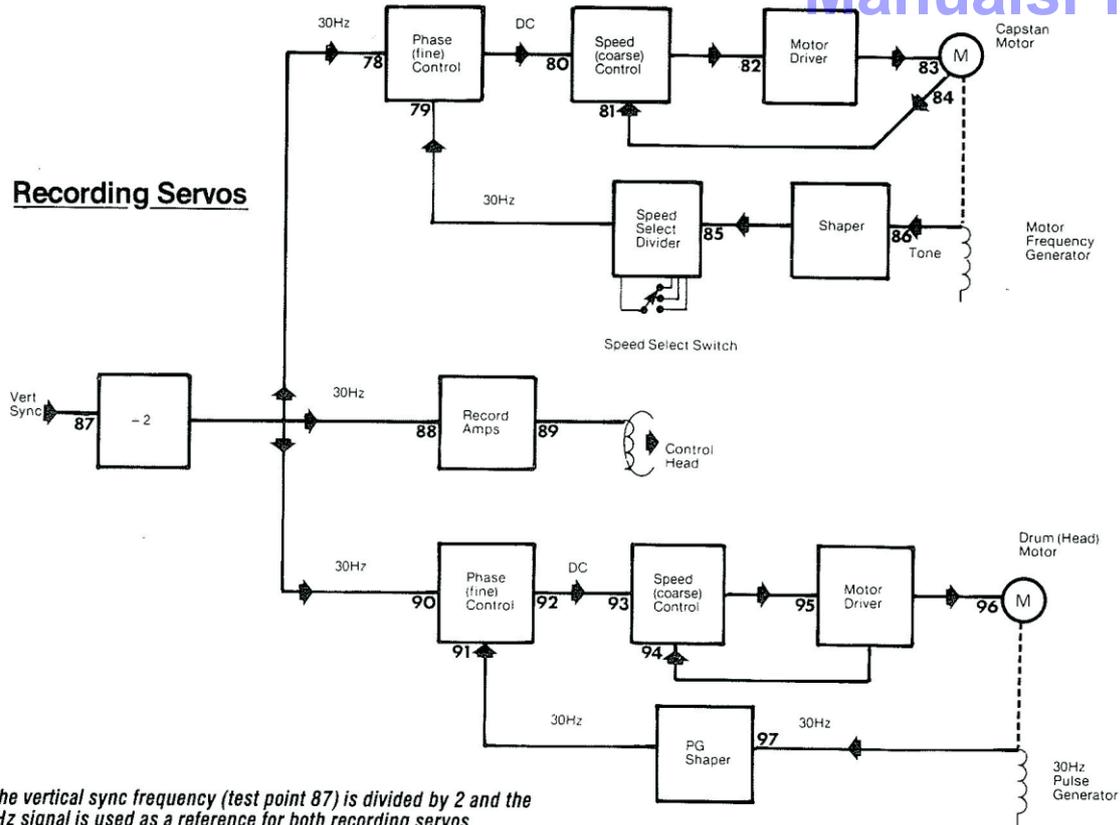


Fig. 109 — The vertical sync frequency (test point 87) is divided by 2 and the resulting 30 Hz signal is used as a reference for both recording servos.

Playback Servos

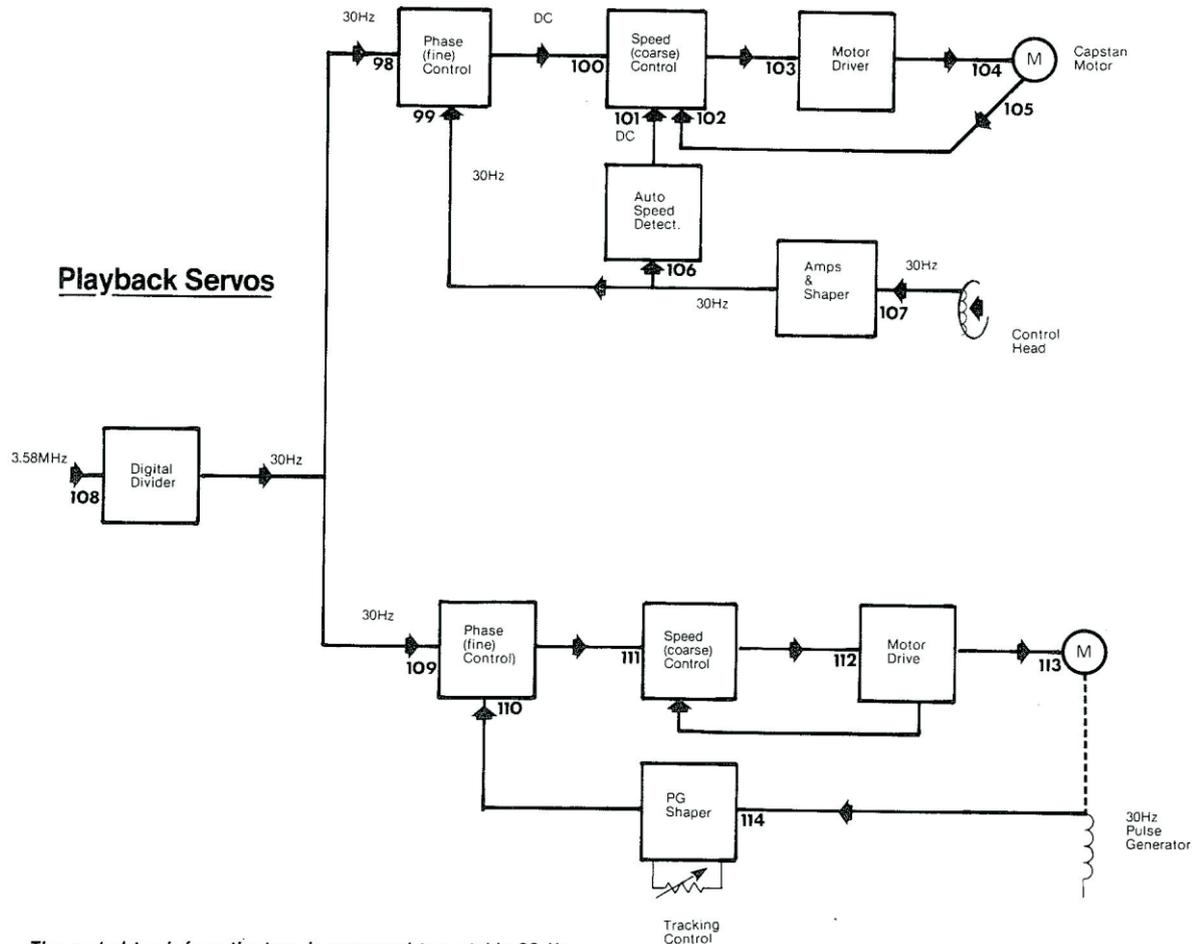


Fig. 110 — The control track from the tape is compared to a stable 30 Hz reference (derived from a crystal oscillator in most decks) to properly reference the playback circuits.

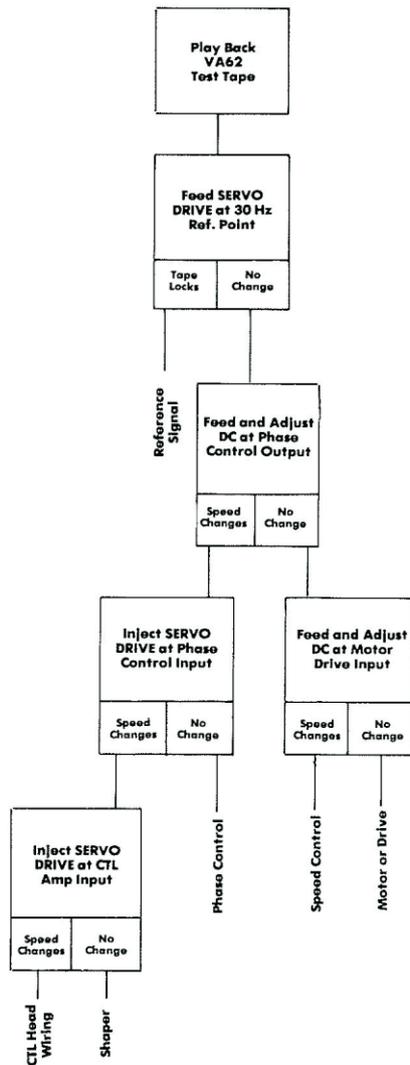


Fig. 111 — The same troubleshooting procedures apply to either of the servo circuits for recording or playback. Use your scope to monitor the resulting output because the injected signals cause the operation to change but do not cause the operation to return to normal.

Speed Select Circuit

Some servo problems only show up on certain tape speeds, or when playing a tape with segments recorded at different speeds. Use the first part of your VA62 test tape, with samples of all three tape speeds, to test every VCR you service. Confirm that the picture locks in properly at each speed transition and that the audio tone plays back, indicating that the audio circuits are not muted. If one of the speeds fails to lock, insert the test tape for that tape speed and troubleshoot the speed-changing circuits.

In some cases, you may find that the deck locks up after playing the test tape for several seconds. This indicates the problem is only present when a *change* in tape speed is encountered, rather than when a tape is recorded at the same speed from end to end. Troubleshoot the speed detector and the servo motors when you see this symptom.

Most alignment is done using the manufacturer's procedures directly. Sencore has developed several procedures that produce better results or that are easier to perform than conventional procedures. In most cases, these procedures are based on the added detail provided by the VA62 test patterns compared to other video pattern generators.

Video Head Response

Some VCRs have a number of adjustments that affect the frequency response of the video head amplifiers. The number of adjustments in newer decks (especially low-priced models) has been reduced. The following instructions apply to VCRs with a full set of adjustments. Decks with fewer controls should be adjusted for best overall MULTIBURST BAR SWEEP response.

Most alignment instructions require the use of a test tape containing a special sweep signal to adjust the frequency response of the video head amplifiers. The MULTIBURST BAR SWEEP signal on the VA62 test tape allows you to adjust these controls using the frequency response of the detected video instead of the frequency response of the FM carrier. This results in an improved video response.

You monitor the results on an oscilloscope connected to the composite video output. Align the head amplifiers for the best overall frequency response without peaking or ringing on the low frequency square waves. Then, adjust each of the head amplifiers individually for the best overall response. Finally, balance the adjustments for equal response.

For the sake of clarity, we will call one of the video heads channel "A", and the other "B". We will also refer to a control that some manufacturers call the "damping" control and others call the "dump" control. We will use the term "damping". There is a damping control for channel A and a second one for channel B.

You play back the MULTIBURST BAR SWEEP pattern from the VA62 test tape. Then, you view channel A's output by turning the channel B damping control until channel B's signal cuts off. With one head turned off, the picture on the monitor and the waveform on your oscilloscope will flicker (as a result of skipping every other video field of information). You will learn to ignore the flicker and observe the video information coming through from the second video head.

With the signal from channel B turned off, adjust the frequency compensation adjustments for channel A (except for the damping control) for the best overall response. Be especially watchful of the 2.5 and 3.0 MHz bars, keeping them as large as possible. Do not boost the response of these bars so much, however, that you cause overshoot on the "0 Ref" or 0.5 MHz bars.

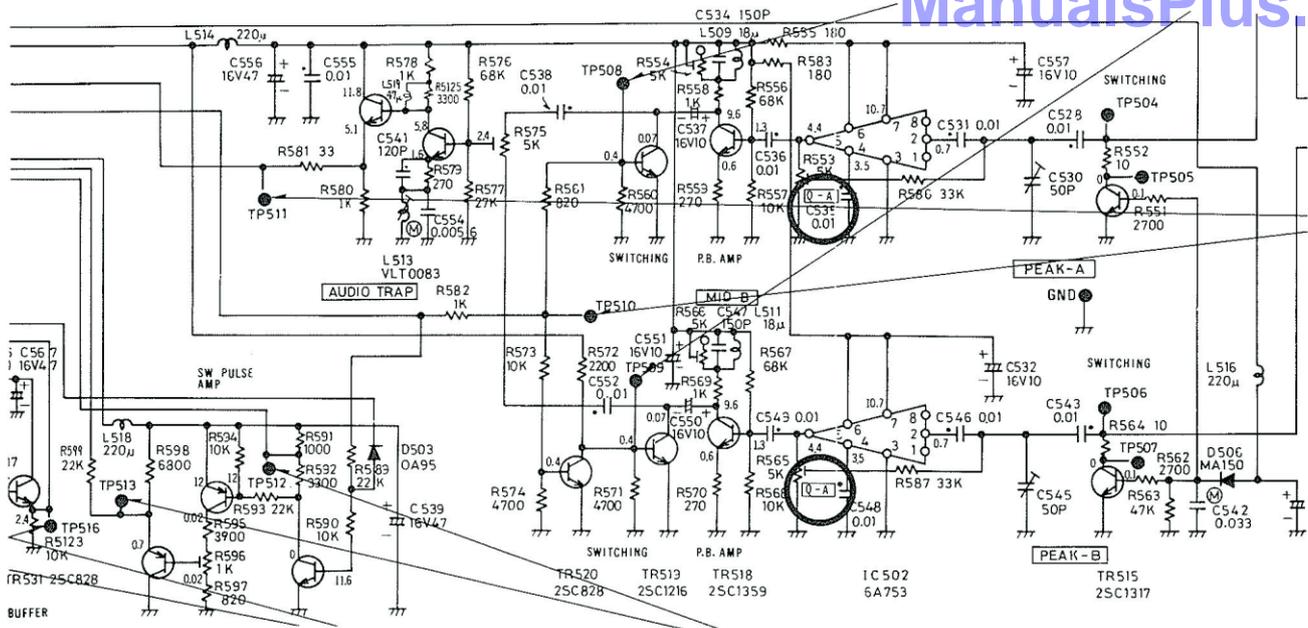


Fig. 112 — Use the schematic of the VCR to locate the "dump" or "damp" controls. These are used to control the output of each head as the frequency adjustments for the other head are aligned.

Then, turn the damping control for channel B until the flicker stops, indicating that the signal from channel B has returned. Turn the damping control for channel A until it causes the signal to flicker again and adjust the frequency compensation controls for channel B for best response. Then, return the channel A damping control until the signal returns.

Finally, balance the two damping controls for the best overall response. You will have to watch the "0 Ref" and 0.5 MHz bars carefully because the two head signals will be superimposed on top of each other. You should, however, be able to see changes in the "0 Ref" and 0.5 MHz bars. Adjust each damping control until the waveforms superimpose. You may have to reduce the overall response of one of the heads slightly to get the two patterns to mesh properly. Generally, you will see the best response just before the control causes the output of the related video head to be lost. Adjust for the best balance between flat response and reduced output.

Four-head systems may require this procedure to be repeated twice, as there are often tuning adjustments for each pair of video heads. Each pair of heads is activated for a different tape speed. Usually, one pair matches the fastest tape speed and the second pair matches the slowest tape speed. The middle speed usually uses the same heads as the slowest speed, but the heads are designed for best results on the slowest speed.

Record Bandpass Amplifiers

Some VCRs have adjustable bandpass amplifiers in the first chroma stage which should be adjusted for flat response across the color frequency band. The CHROMA BAR SWEEP pattern provides a reference that allows you to adjust these stages for the best chroma response.

Feed the CHROMA BAR SWEEP into the direct video input. Connect one channel of your scope to the output of the bandpass amplifier. Externally trigger the scope from the composite video output or from a horizontal drive signal from the VA62. Then adjust the bandpass coil until the center (color carrier) bar is the largest of the three bars and the left hand bar (3.0 MHz) has the same amplitude as the right hand bar (4.0 MHz).

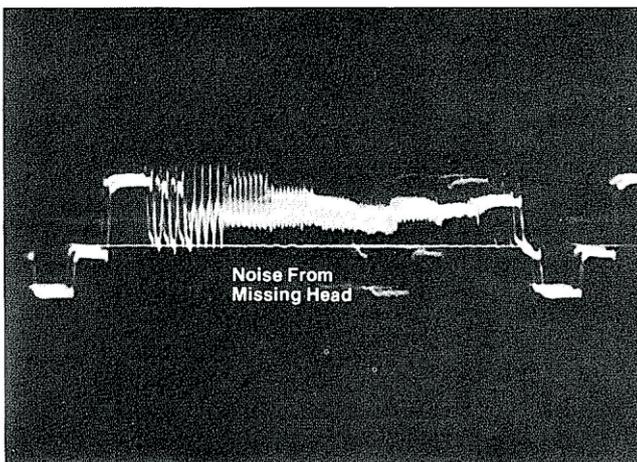


Fig. 113 — It is normal for the scope waveform to flicker, with one of the video heads turned off, because the signal is missing half of the time. Ignore the flicker as you view the changes in the Multiburst Bar Sweep.

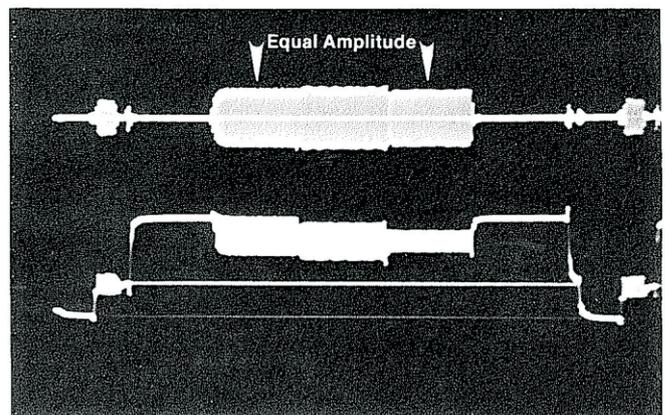


Fig. 114 — Use the Chroma Bar Sweep as a reference if the recording chroma bandpass amplifier is adjustable. Make sure the left and right hand bars have approximately the same amplitude, as shown here.

Comb Filters

The VA62 color signals work correctly when used with a comb filter because the color carrier is properly phase-locked to horizontal sync. VCRs use a comb filter to reduce color crosstalk during playback. Some VCRs also use this same comb filter to separate the luminance signal from the chroma signal during recording.

Comb filters always have two outputs; one for luminance and one for chroma. Only the chroma output is used in crosstalk cancellation. The second (unused) output, however, is easier to use when adjusting the comb filter because it is usually easier to null the chroma signal at the luminance output than it is to peak the same signal at the chroma output. Nulling the chroma also results in better performance, since the main use of the comb filter is to cancel unwanted crosstalk. Thus, the procedure duplicates the operation of the comb filter when playing an actual tape.

Find the correct test point by locating the comb filter delay line. One junction of the delay line feeds the color playback circuits. You want to connect to the *second* delay line output. If the VCR uses the comb filter to separate luminance from chroma during recording, the correct test point connects to the luminance recording circuits.

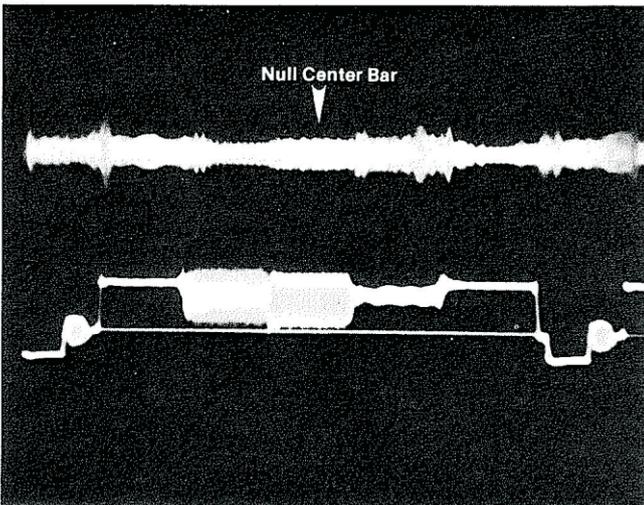


Fig. 115 — Use dual trace to compare the composite video output to the comb filter output. Null the center bar.

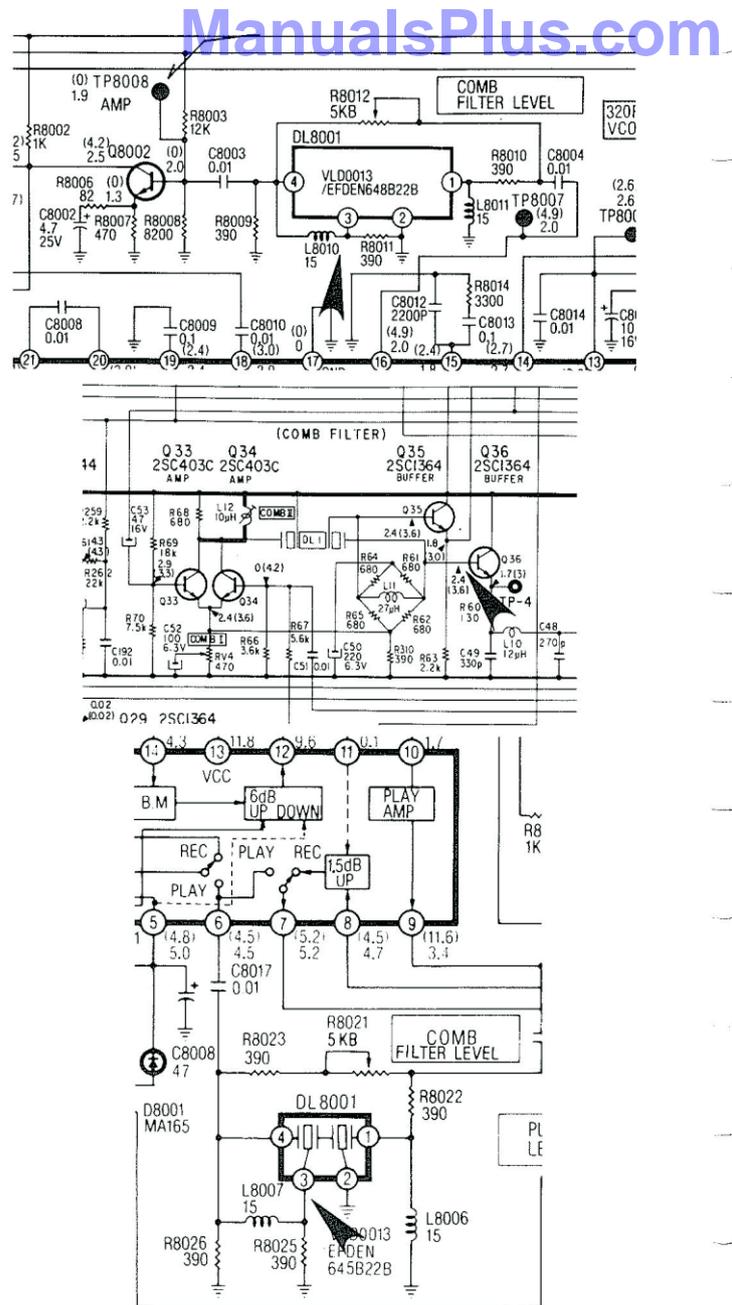


Fig. 116 — The best place to monitor the comb filter output is the luminance output port. This port is the one that does not connect to the chroma circuits.

You need the VA62 test tape to adjust the comb filter. Play back the CHROMA BAR SWEEP pattern while monitoring the correct comb filter output with your scope. Then adjust the comb filter until the center (color carrier) bar has the lowest possible amplitude.

It will be difficult to trigger your scope from the comb filter output because the signal has no sync pulses. In addition, it helps to have a composite reference to make sure you are nulling the correct bar. You could make a mistake as normal losses in the record/playback processes cause the 4.0 MHz bar to reduce in amplitude and adjustment of the comb filter causes the amplitude of the remaining signals to vary. Therefore, use the composite video output of the VCR to trigger your scope. Use a dual-trace scope to compare the comb filter output to the composite video output so you are sure you are nulling the correct (center) bar.