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tech tips

Troubleshooting VCR Chroma Circuits Using The VC93

Troubleshooting color problems in VCRs can be greatly simplified through the use of a systematic approach and the aid of your VC93 All Format VCR Analyzer and a Sencore Waveform Analyzer, such as the SC61 or SC3080. Symptoms of problems in the chroma circuits include: no color, wrong tint, weak color, won't record color, or won't playback with color on another VCR. This Tech Tip will help you better understand VCR chroma signal processing and how to quickly isolate chroma circuit defects.

NOTE: This Tech Tip applies to VCR formats that use a color-under scheme to record color.

Understanding The Color-Under Chroma Signal

The main function of the VCR chroma circuits is to maintain useable color during record and playback. In order for the playback picture to have good color, the phase, frequency, and amplitude of the chroma information must be carefully maintained throughout the entire record/playback process. Constantly changing head and tape speeds due to changing tape tension, friction, and inherent imperfections in the servos, plus changes in the video tape due to humidity and temperature, all add to cause relatively high amounts of frequency and phase instability. Compared to the chroma signal, the luminance signal is relatively unaffected by these problems.

VCR circuits minimize the effects of these problems by recording the chroma signal in a color-under format, as shown in Figure 1. (Because the color information is recorded at a lower frequency than the luminance, it is called color under.) Moving the color portion of the NTSC signal to a lower frequency prior to recording offers four major advantages: 1) reduced bandwidth; 2) the lower frequency inherently has reduced frequency error; 3) the luminance can be recorded as FM; and 4) in the conversion process, the color information can be referenced to other signals for near-perfect phase and frequency reproduction.

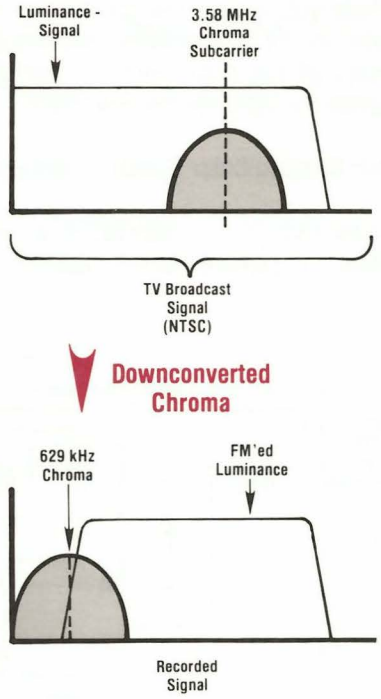

Fig. 1 - The chroma information is converted to a lower frequency so that it can be better handled by the VCR circuits.

During record, the 3.58 MHz color information is separated from the NTSC composite video signal by a 3.58 MHz bandpass filter or comb filter. This color-only signal is heterodyned with a conversion signal to produce the color-under signal. In addition to producing the color-under frequency, the frequency convertor shifts the phase of the chroma signal to give each field an identifiable pattern that is used to minimize crosstalk during playback. A low pass filter after the frequency convertor passes only the difference, or color-under signal. This phase rotated, down converted chroma is mixed with the FM luminance in the Y/C mixer and recorded onto the tape.

NOTE: The U-Matic format does not use chroma phase rotation. Instead, guards bands exist between tracks to minimize crosstalk.

During playback the process is reversed. The color-under signal is separated from the FM luminance and then heterodyned back up to its original 3.58 MHz frequency. The phase rotation that was added during record is also canceled in this process. Lastly, the 3.58 MHz chroma is added to the baseband luminance to restoring the signal back to its original NTSC form. The block diagram in Figure 2 is an example of the chroma conversion process. Notice that in the conversion process, the color conversion signal is referenced to a stable 3.58 MHz oscillator, horizontal sync, with jitter, and 30 Hz headswitching.

Four Key Signals Needed For Proper VCR Color Operation

All VCR color circuits contain four key signals, as shown in Figure 2. Understanding these signals will help you quickly isolate most color problems.

1. Converted Chroma: The color circuits require a signal that contains the color information. In the playback mode this signal is

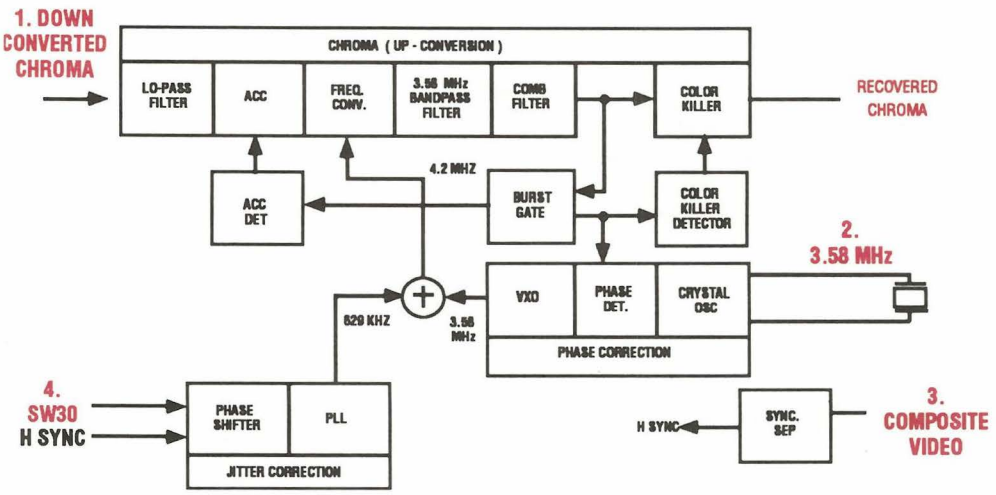

Fig. 2 - The chroma playback section of a VCR. Four key signals are required for proper operation.

the low frequency chroma signal picked up from the tape. It is separated from the luminance information after the A/B headswitcher using a lowpass filter. In the record mode this signal consists of the color burst and chroma sideband signals stripped from the composite video.

2. 3.58 MHz Reference Signal: The 3.58 MHz signal is required to sync the various burst gates and control the ACC and ACK circuits. In the record mode it establishes the down converted chroma signal. During playback this signal is needed to re-establish the correct NTSC standard video signal.

3. Composite Video (With Jitter): The horizontal sync pulses are separated from the composite video either before the chroma circuits, or inside the chroma IC. During playback they have jitter (fast frequency changes) caused by the mechanical instabilities of the VCR. These pulses are used to correct the jitter. During both playback and record the horizontal sync pulses reference the timing of the phase shift circuits.

4. 30 Hz Switching Pulse: Color-under formats use phase shifting to minimize chroma crosstalk by rotating the color phase for each horizontal line. During record and playback, the 30 Hz switching pulse controls the direction of the phase rotation of the down-converted chroma signal.

Troubleshooting Color Playback Problems

Typical playback problems are no color, weak color, or wrong tint. The following seven-step procedure summarized in Figure 3, will help you isolate the problem to the chroma circuits or other associated circuits. For each of the steps, insert a test tape and place the VCR into the play mode.

Step 1: Confirm Color Circuit Operation

The first step in troubleshooting a color problem is to confirm that the trouble is not caused by dirty or bad video heads, or by a luminance problem. Because the color circuits require composite video from the luminance circuits, you must inject the signal before the point where the luma and chroma signals separate. This is accomplished by substituting the LUM & CHROMA Playback Signal right after the A/B headswitcher. You must also phase-lock the VC93 to the VCR so that the chroma phases match. This is done using the Chroma Lock Test Leads.

1. Insert a blank tape in the VCR and press "Play".
2. Set the VC93 as follows:
   a. FORMAT to format being serviced.
   b. MODULATION to "Color Bars" or "External."
   c. PLAYBACK RANGE to ".5VPP".
   d. PLAYBACK LEVEL to midrange.
   e. PLAYBACK SIGNAL to "Lum & Chroma".
3. Connect the HEAD SUBSTITUTION TEST LEAD to the PLAYBACK OUTPUT Jack.
4. Connect the HEAD SUBSTITUTION TEST LEAD to the output of the A/B headswitcher.
5. Connect the CHROMA LOCK TEST LEAD to the CHROMA LOCK INPUT Jack.
6. Connect the CHROMA LOCK TEST LEAD to the SW30 test point in the VCR.

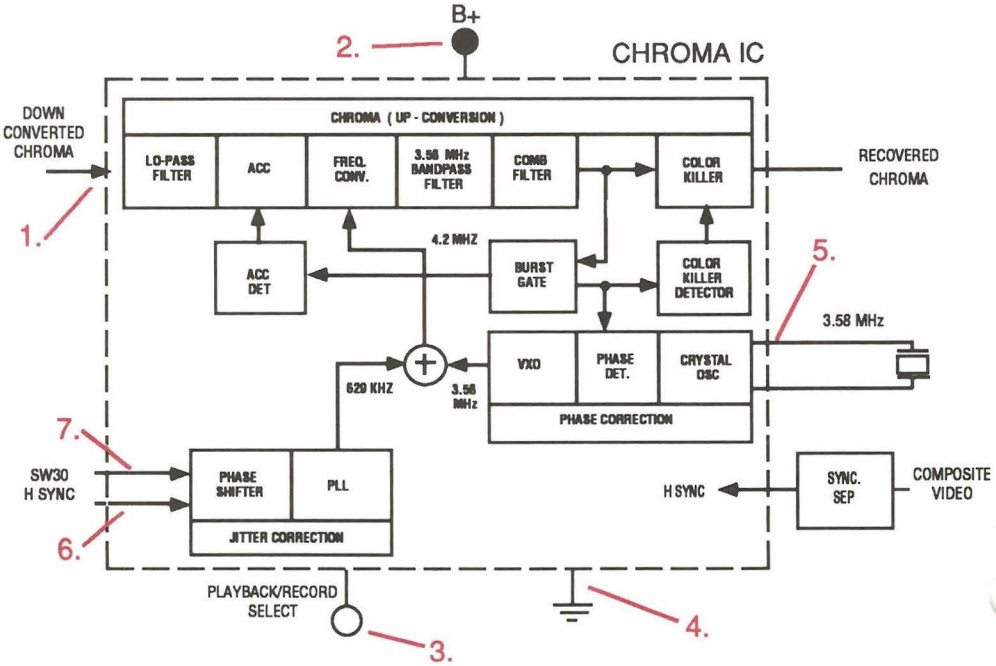

Fig. 3 - Follow these seven steps to determine if a color playback problem is caused by the chroma circuits or associated circuits.

NOTE: The CHROMA LOCK INDICATOR will light if you are connected to the correct test point.

7. Observe the playback monitor for a color picture.
8. If you don't see color, press the CHROMA LOCK PHASE BUTTON to select the other SW30 phase.
9. Adjust the PLAYBACK LEVEL control for best color.

NOTE: Some VCRs separate the chroma and luminance signals inside the enclosure containing the head preamps. These VCRs have separate luminance and chroma signal output pins. Connect one of the "red" HEAD SUBSTITUTION TEST leads to the luminance pin and the other "red" lead to the chroma pin in these VCRs.

If you see a color pattern on the playback monitor, all of the chroma circuits are working properly and the cause of the color problem is in a stage before the headswitcher; the preamps, rotary transformer, or video heads are the most likely cause. Continue your troubleshooting by moving your injection back towards the heads one stage at a time until you have isolated the problem.

If you do not obtain color, either the color circuits are defective or one of the chroma signals is missing or incorrect. Continue with the following steps until you locate the problem.

Step 2: Check The Power Supply

Use a Waveform Analyzer to check for voltage on the power supply pin of the chroma IC. Compare this reading with the voltage shown on the schematic. Look at the CRT on the Waveform Analyzer to be sure that there is no ripple on the power supply line which would indicate a power supply filter problem.

Step 3: Check For Proper System Control Signals

A control signal is sent from the VCR's microprocessor to the chroma IC. This signal turns on either the record or the playback circuits in the chroma IC. Compare this voltage to the control volt-

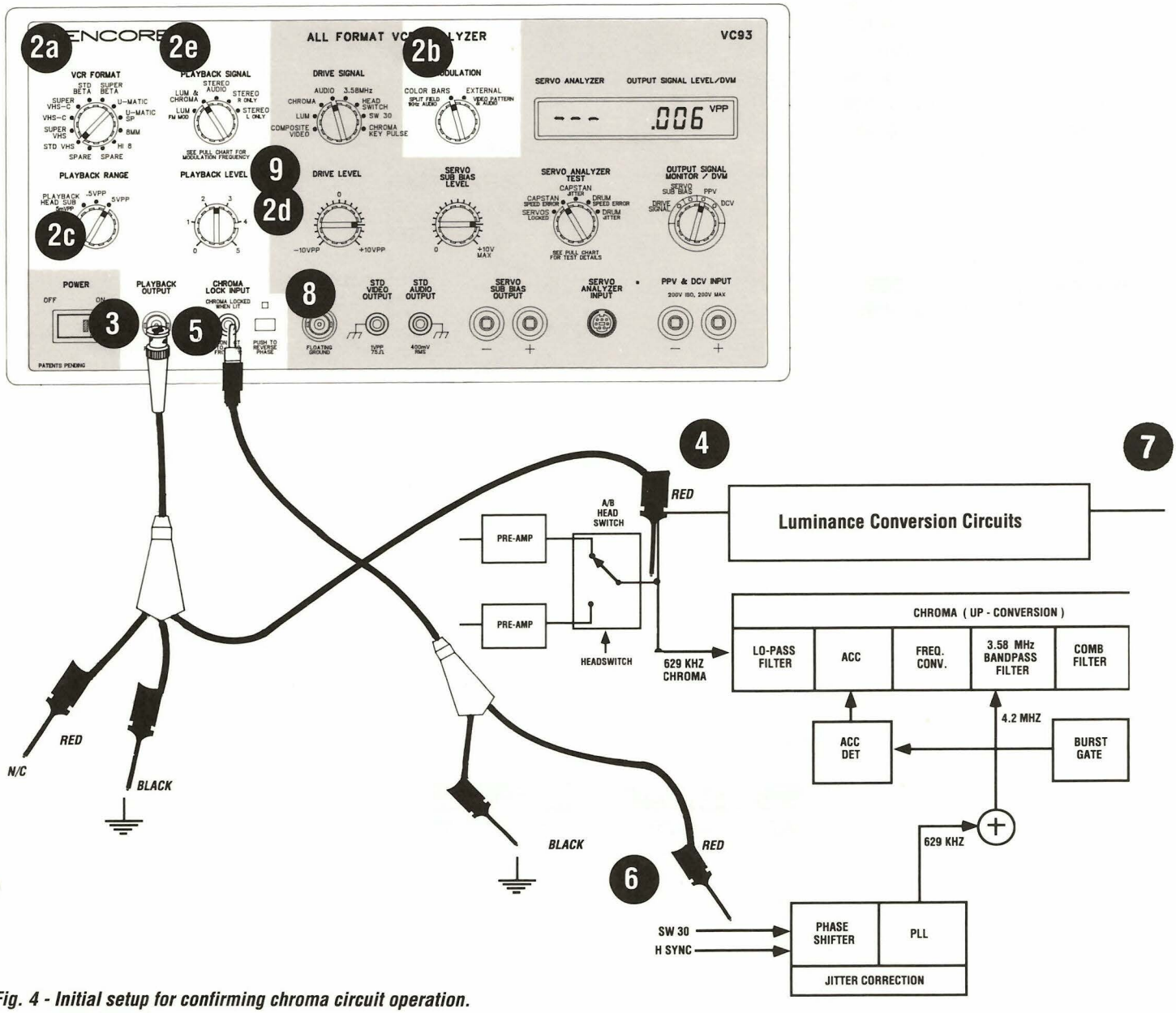

Fig. 4 - Initial setup for confirming chroma circuit operation.

age shown on the VCR schematic. An incorrect voltage indicates a problem in the system control circuits instead of the chroma circuits.

Step 4: Check For Proper Grounding

Check each grounded pin. Each should show zero volts DC and zero volts AC. A signal on any ground pin will cause improper signal processing.

Step 5: Substitute For The 3.58 MHz Reference

A missing or off-frequency 3.58 MHz reference will cause no or wrong playback color. Some VCRs use the color 3.58 MHz signal to control the servos and a missing or wrong 3.58 MHz reference will not allow these VCRs to function. Substituting the 3.58 MHz signal into the chroma section will return the machine to operation.

1. Set the VC93 as described in step 1, "Confirm Color Circuit Operation."
2. Set the DRIVE SIGNAL switch to "3.58 MHz".
3. Connect the DIRECT TEST LEAD to the DRIVE OUTPUT Jack.
4. Connect the DIRECT TEST LEAD to the VCR's 3.58 MHz oscillator.
5. Adjust the DRIVE LEVEL control while watching the playback monitor for color.
6. If you don't see color, press the CHROMA LOCK PHASE BUTTON to select the other SW30 phase.

If color returns, the 3.58 MHz signal in the VCR is either missing or defective. If color does not return, remove the 3.58 MHz Drive Signal and substitute for the horizontal sync (key) pulse, as explained in the next step.

Step 6: Substituting The Horizontal Sync

1. Set the VC93 as described in step 1, "Confirm Color Circuit Operation."
2. a. If the sync separator is external to the color IC, set the DRIVE SIGNAL Switch to "Chroma Key Pulse".
   b. If the sync separator is internal to the color IC, set the DRIVE SIGNAL Switch to "Composite Video".
3. Connect the DIRECT TEST LEAD to the chroma IC's horizontal sync input.
4. Adjust the DRIVE LEVEL control clockwise ("+" polarity) while watching the playback monitor for color.
5. If color doesn't return, rotate the DRIVE LEVEL control counterclockwise ("–" polarity).
6. If you don't see color, press the CHROMA LOCK PHASE BUTTON to select the other SW30 phase and repeat steps 4 and 5.

If color returns, troubleshoot the cause of the bad or missing sync pulse. If color does not return, remove your substitution signal and substitute the 30Hz switching signal, as explained in the next step.

Step 7: Substituting The 30Hz Phase Switching Signal

1. Set the VC93 as described in step 1, "Confirm Color Circuit Operation."
2. Set the DRIVE SIGNAL Switch to "SW30".
3. Connect the DIRECT TEST LEAD to the SW30 input on the chroma IC.
4. Adjust the DRIVE LEVEL Control clockwise ("+"polarity) while watching the playback monitor for color.
5. If no color is seen, rotate the DRIVE LEVEL Control counterclockwise ("–"polarity).

NOTE: The SW30 signal is used throughout the VCR. Substituting for the SW30 signal may cause the VCR to shut down. This is normal. Simply remove your injection signal and press the "PLAY" button on the VCR.

If color returns, locate the cause of the missing SW30 signal.

Troubleshooting Color Record Problems

The majority of VCR color problems affect both playback and record. A few problems, however, only show up during record. Typical color record problems are: won't record color, weak color, and won't playback color on another machine. Always confirm that the VCR plays back in color (and repair if necessary) before troubleshooting the record circuits.

Most of the record troubleshooting procedures involve signal tracing. Using a systematic approach and knowing the key signals to look for will save time spent on unnecessary troubleshooting. The block diagram in Figure 5 on the next page, shows these key signal inputs. Use the following steps to isolate color record problems.

Step 1: Check The Tuner/IF Section

Many VCRs are used to record programs directly from an antenna. A problem in the tuner or IF section can eliminate the color information, but allow the black and white signal to pass. Before you suspect the VCR color record circuits, bypass the tuner and IF section by feeding a signal from the VC93's STD VIDEO OUTPUT Jack in to the VCR's video input jack. If the VCR now records color, the problem is in the tuner or IF section.

Step 2: Check The Power Supply

A bad power supply can cause problems in the playback circuits as well as in the record circuits. Confirm that the playback circuits work before proceeding to service the record circuits. Check the voltage on the power supply pin of the chroma IC and compare it with the voltage shown on the schematic.

Step 3: Check The Record Status Line

The system control microprocessor sends a control signal to the chroma circuits to select the record circuits. This control line should be at either a logic high or a logic low level. Place the VCR in the record mode and compare the DC voltage on the

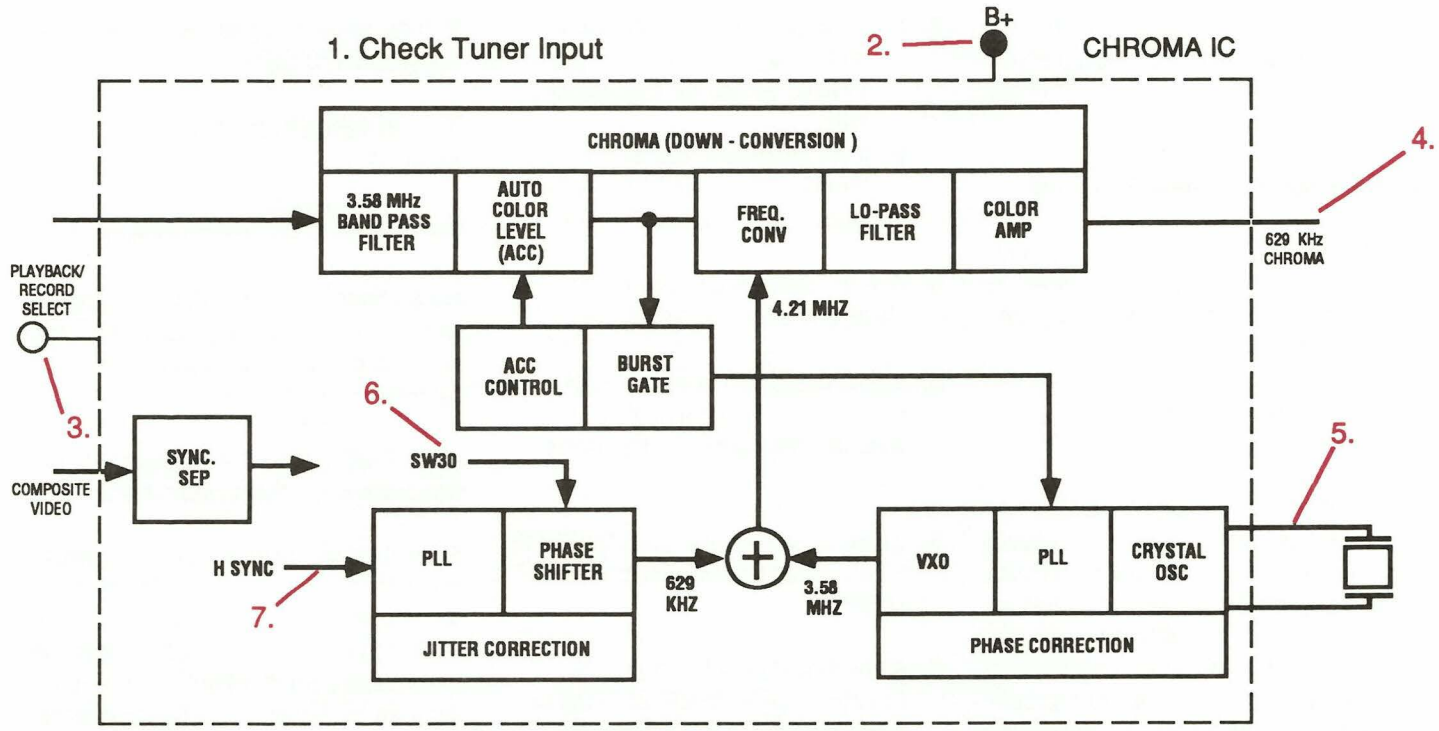

Fig. 5 - Follow these seven steps to determine if a color record problem is caused by the chroma circuits or associated circuits.

control line with the voltages specified in the schematic. If the control line voltage is incorrect, troubleshoot the system control circuits.

Step 4: Check For The Down Converted Chroma Signal

The chroma information is down converted before it is recorded onto the video tape. Check to be sure that a down converted signal is present. Use a Waveform Analyzer to perform the following procedure to check for the presence of the down converted chroma signal:

1. Insert a video signal to the RF or line input of the VCR.
2. Put a blank tape into the VCR and place the VCR in the record mode.
3. 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 level to their proper level.

4. Connect the Waveform Analyzer probe to the chroma input of the record Y/C mixer.
5. Set the TRIGGER controls: SOURCE to "CH A", MODE to "Auto", and POLARITY to "–".
6. Set the TIMEBASE to "5 usec".
7. Adjust the TRIGGER LEVEL control to lock in the trace. You should see a modulated signal around 629 kHz for VHS, and 688 kHz for Beta, U-Matic and 8 MM.
8. Pull HORIZ POSITION control to expand the trace X10.
9. Press the 1/DELTA TIME button and adjust the DELTA BEGIN and DELTA END control to intensify one complete cycle of the waveform.
10. Read the chroma frequency on the digital meter of the Waveform Analyzer. The frequency read should be close to 629 kHz or 688 kHz.

NOTE: The frequency shown on the digital meter may not be exactly 629 kHz or 688 kHz. This is due to the inability to exactly set the DELTA BEGIN and DELTA END controls for one complete cycle. The frequency should be close, however.

Step 5: Check The 3.58 MHz Local Oscillator Frequency

If the down converted signal is missing or at the wrong frequency, check if the 3.58 MHz signal is present and at the correct frequency. Use the digital frequency counter on the Waveform Analyzer to check the oscillator frequency. If it is at the wrong frequency, the tape may playback correctly on the VCR, but will not playback on another VCR.

Step 6: Check For A 30 Hz Switching Pulse

The 30 Hz switching pulse is used to select the correct sequence of the chroma phase shifting. A missing 30 Hz switching pulse will cause missing color or intermittent bursts of color when the tape is played back on a different machine. Check for the presence of a 30 Hz switching pulse using the Waveform Analyzer. Hook the test probe to the chroma IC pin that normally has a 30 Hz pulse and place the recorder in the play mode.

Step 7: Check For A Horizontal Sync Pulse

The horizontal sync pulse turns on the various burst gates and times the phase

shifting of the chroma down converted signal. Use the Waveform Analyzer to check for the presence of either a composite video signal or a sync pulse at the horizontal rate.

Weak Color When Recording

Weak color recordings are often caused by a misadjustment of the chroma record current. Perform the chroma record current adjustment explained in the VCR's Service Manual. If the color is still weak, check the key inputs into the chroma IC listed above. If they are all present, suspect a defective automatic color circuit. This circuit is normally contained within the chroma IC and the entire IC will need to be replaced.

An understanding of color VCR circuits and efficient servicing tools like the VC93, and SC61 or SC3080 Waveform Analyzer will help you quickly walk out color problems in VCRs. Use the VC93 to substitute for the down converted chroma information. Use the Waveform Analyzer to check the conversion frequencies and key signals.

For More Information,
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