

Learning To Use The VC93 All Format VCR Analyzer

The VC93 All Format VCR Analyzer provides the necessary signals to troubleshoot the luminance, chroma, and audio stages of a VCR. It allows you to inject known good signals to help isolate problems to the defective stage. The VC93 also provides special Servo Analyzer Tests to help isolate servo problems.

This Tech Tip will familiarize you with the VC93 signals and servo tests, and where to use them when servicing VCRs. Information on troubleshooting specific VCR circuits is covered in other Tech Tips.

This Tech Tip is organized according to the major features of the VC93. You should have the Universal VCR Block Diagrams provided

with your VC93 manual for reference as you read through this Tech Tip.

VCR FORMAT

There are many different VCR formats. The main difference between each is the makeup of the signals that are recorded onto the tape. These differences include luminance frequencies, the color-under signal, and the audio frequencies used for Hi-Fi Stereo. Table 1 summarizes the key characteristics of each VCR format supported by the VC93. The VC93 provides signals to troubleshoot all color-under format VCRs. Tech Tip 189, "Comparison Of VCR Formats," provides a more detailed discussion of each format.

The VC93's VCR FORMAT switch sets the signals to match the VCR format you are servicing. It determines the makeup of the luminance, chroma, and audio signals coming from the PLAYBACK OUTPUT jack, and selects the frequency of the "Head Switch" DRIVE SIGNAL. Set VCR FORMAT switch to match the type of VCR you are servicing.

PLAYBACK SIGNAL

The VC93's PLAYBACK SIGNAL switch and PLAYBACK OUTPUT jack provide the proper signals for injecting into the stages before the FM luminance detector, chroma frequency convertor, and FM audio detector. The test points that require the use of the Playback Signals are summarized in Table 2.

Note: The VCR FORMAT switch must be set to the proper format for the playback signals to be

correct at the PLAYBACK OUTPUT jack.

The PLAYBACK SIGNAL switch selects the type of signal available at the PLAYBACK OUTPUT jack. The peak-to-peak level of each signal is adjustable with the PLAYBACK RANGE and PLAYBACK LEVEL controls. Use the HEAD SUBSTITUTION TEST LEAD to inject any of the Playback Signals into the appropriate test point. Following is a summary of each Playback Signal.

Luminance And Chrominance Signals

LUM (FM Modulated): This signal duplicates the FM modulated luminance portion of the signal found in the luminance stages of a VCR or camcorder. It does not include the color information. Injecting the FM LUM signal into working VCR stages produces only the black and white portion of the video pattern. Use this signal to check the video heads, pre-amps, and other FM luminance stages.

LUM & CHROMA: This signal includes both the FM luminance and down-converted chroma. Injecting the LUM CHROMA signal into a working VCR produces the COLOR BARS pattern, or the pattern selected by the "External" position of the MODULATION control if the VC93 is phase locked to the VCR. This signal can also be injected into the FM luminance stages, but its main application is to phase lock the VCR to the VC93 while injecting into the chroma circuits.

How To Phase Lock The VC93 To A VCR For Color Troubleshooting

The chroma signal in color-under VCR formats is phase shifted each video field to minimize color crosstalk. The phase shifting is controlled by the SW30 signal. In order for the VCR to reproduce color when a signal from the VC93 is injected into it, the color phase generated by the VC93 must match the

FORMAT	A (MHz)	B (MHz)	C (MHz)	D (KHz)	E (MHz)	F (Hz)
VHS	3.4	4.4	1	629	1.3 ; 1.7	N/A
SUPER VHS	5.4	7	1.6	629	1.3 ; 1.7	N/A
VHS-C	3.4	4.4	1	629	1.3 ; 1.7	N/A
SUPER VHS-C	5.4	7	1.6	629	1.3 ; 1.7	N/A
BETA	3.5	4.8	1.2	688	1.38;1.53 1.68;1.83	N/A
SUPER BETA	4.4	5.6	1.2	688	1.38;1.53 1.68;1.83	N/A
U-MATIC	3.8	5.4	1.6	688	N/A	N/A
U-MATIC SP	5.0	6.6	1.6	688	N/A	N/A
8MM	4.2	5.4	1.2	743	1.5	102,544 118,951
HI-8	5.7	7.7	2	743	1.5 ; 1.7	165,210 148,689

Table 1 – Key VCR Format Characteristics

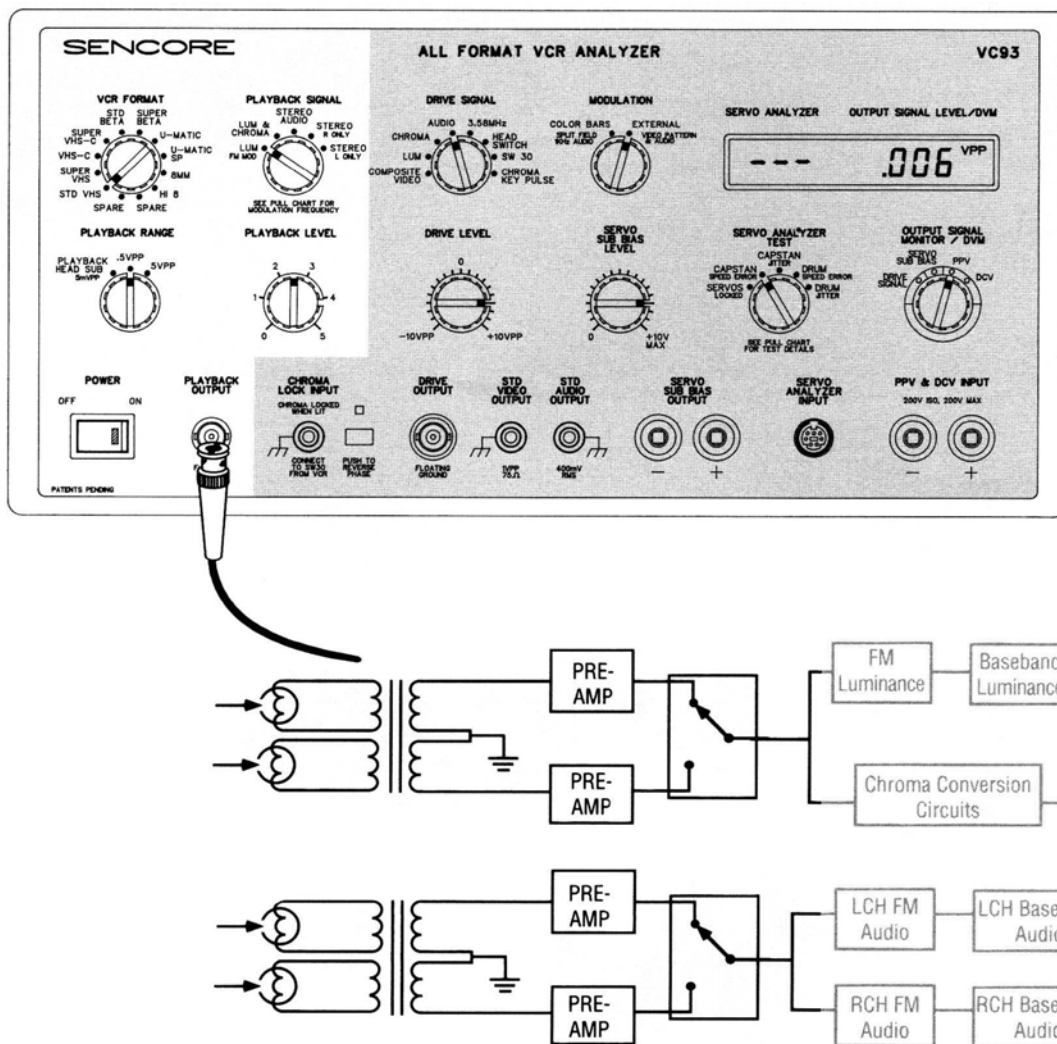


Fig. 1: The Playback Signals are used to inject before the FM detector, frequency convertor, and FM audio detector.

color phase the VCR is looking for.

For example, when the SW30 pulse in the VCR is "+", the VCR is looking for a +180° shifted chroma signal; when it goes "-" the VCR chroma circuits need a -180° shifted signal. But unless the VC93 is phase locked to the VCR's SW30, the VC93 may be producing +180° shifted chroma while the VCR is looking for the opposite phase. The result will be no color, even though both the VCR and VC93 are working correctly. (The luminance will play back fine.) The CHROMA LOCK INPUT jack on the VC93 allows you to phase-lock the VC93 to the VCR.

To Phase Lock The VC93 To A VCR:

1. Insert a blank tape in the VCR and press "PLAY".
2. Set the VC93 as follows:
 - a. VCR FORMAT to format being serviced.
 - b. MODULATION to "Color Bars".

- 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 desired test point.
 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. (The CHROMA LOCK INDICATOR lights when you are connected to the correct point.)
 7. Observe the 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 for best color.

Audio Signals

The Audio playback signals duplicate the FM audio signals found in Hi-Fi stereo VCRs. Use these signals in the Hi-Fi audio stages between the audio heads and FM detector. The VCR FORMAT switch automatically selects the proper signal makeup of the playback FM audio signal to match each format. Refer to Tech Tip #190 "How VCR Hi-Fi Stereo Works" for more information on the different Hi-Fi schemes.

To simplify troubleshooting, the audio playback signals are continuous carriers at the proper left and right frequencies so they can be injected without needing to be synchronized to the VCR. A 1 modulating tone is provided for all audio playback signals when the MODULATION switch is set to "Color Bars". Use the HEAD SUBSTITUTION TEST LEAD to inject the audio playback signals into the VCR audio circuits.

STEREO AUDIO: This signal produces equal left and right modulation. When you inject this signal into working Hi-Fi VCR circuits you should obtain equal left and right output.

STEREO R ONLY AND STEREO L ONLY: Use these signals to isolate problems in the left or right audio channels. Both channels are modulated with the same tone, selected by the MODULATION switch. When injecting into a working Hi-Fi channel, you should obtain an output only on the selected channel.

Using The Playback Signals

1. Set up the VC93 as follows:
 - a. VCR FORMAT to desired format.
 - b. MODULATION to COLOR BARS.
 - c. PLAYBACK RANGE to level necessary.
 - d. PLAYBACK SIGNAL to desired signal.
2. Connect the HEAD SUBSTITUTION LEAD.
 - a. Red lead or leads to injection point. (Both red leads have the same signal.)
 - b. Black lead to ground.
3. Adjust the PLAYBACK LEVEL control for the best picture or audio on the playback monitor.

When you inject the VC93 Playback Signals after a defective stage, the playback monitor will return to a good output. This indicates that all the circuits after the injection point are good. If you do not obtain a good picture (or audio) your injection point is before the defect stage. Continue moving your injection point to a later stage until a good output returns. The stage before the injection point that produces a good picture or audio contains the defect.

Table 2 summarizes where to inject the VC93 Playback Signals on the Universal VCR Block Diagrams. Use this table for a reference when injecting the VC93 Playback Signals. For additional troubleshooting information refer to Tech Tip #194, "Troubleshooting 'Bad Head' Symptoms with the VC93 All Format VCR Analyzer."

DRIVE SIGNAL

The VC93 DRIVE SIGNAL switch and DRIVE OUTPUT jack provide the proper signals for injecting into the stages after the FM luminance detector, chroma frequency converter or FM audio detectors. The test points that require the use of the Drive Signals are summarized in Table 3.

Except for the HEADSWITCH Drive Signal, the VCR FORMAT switch setting does not affect the Drive Signals. The HEADSWITCH Drive Signal changes from 30 Hz to 15 Hz when the VHS-C Format is selected. The detected video and audio signals are the same in all other VCR formats. For simplicity, always set the VCR FORMAT switch to match the VCR format you are servicing.

The DRIVE SIGNAL switch selects the signal available at the DRIVE OUTPUT jack. The peak-to-peak level is adjustable with the DRIVE LEVEL control, and is displayed in the right-hand LCD display when the OUTPUT SIGNAL MONITOR/DVM switch is set to "Drive Signal". The voltage is variable from -10 VPP to +10 VPP with the "-" signals being inverted from the "+" signals. Use the DIRECT TEST LEAD to inject any of the Drive Signals into the appropriate test point. Following is a summary of each Drive Signal.

COMPOSITE VIDEO: This is the standard NTSC composite video waveform including luminance, color, and sync. Use it to inject into the RF modulator, Y/C mixer output, and

other stages that normally have both luminance and color signals. The MODULATION switch determines the video pattern selected.

LUMINANCE: This signal is the luminance-only portion of the composite video signal selected by the MODULATION switch. Use it in the stages between the output of the FM luminance detector and the input of the Y/C mixer. Tech Tip #193, "Troubleshooting VCR Luminance Circuits with the VC93 All Format Analyzer," provides additional information on troubleshooting these stages.

CHROMA: This signal is the chrominance-only portion of the composite video selected by the MODULATION switch. Use it in the stages between the output of the frequency converter (color detector) and the Y/C mixer inputs. Tech Tip #198, "Troubleshooting VCR Chroma Circuits with the VC93," provides additional information on troubleshooting these stages.

AUDIO: The Audio Drive Signal is a baseband (20 Hz-15 kHz) audio signal at the frequency determined by the setting of the MODULATION switch. Inject this signal into audio stages after the FM audio detector.

3.58 MHz: This Drive Signal is a continuous sine wave that can be used to substitute for the 3.58 (3.579545) MHz color oscillator, or the 3.58 MHz reference for the servo circuits.

HEADSWITCH: This signal duplicates the square wave signal found at the playback A/B headswitcher. Most VCR formats use a 30 Hz headswitching signal. VHS-C format VCRs, however, use both 15 Hz and 30 Hz switching signals. When the VCR FORMAT switch is set to VHS-C or SUPER VHS-C the HEADSWITCH Drive Signal frequency is 15 Hz. The frequency is 30 Hz for all other formats.

SW30: This signal substitutes for the 30 Hz (29.97 Hz) input to the chroma conversion circuits. The actual frequency is the composite video frame rate, 29.97 Hz. Use the SW30 Drive Signal and the LUM & CHROMA Playback Signal when troubleshooting chroma stages.

CHROMA KEY PULSE: The CHROMA KEY PULSE Drive Signal provides a substitute for the horizontal sync input to the chroma conversion circuits. Always inject the LUM & CHROMA Playback Signal and phase VCR to the VC93 using the CHROMA LOCK

Playback Signal Injection Points		
Test Points:	Block Diagram:	Inject This Signal:
10-16 100-102 109 111	VHS Beta/U-Matic 8MM	Lum (FM MOD)
16 300-302	VHS Beta/U-Matic 8MM	Lum & Chroma
10A-12A, 10B-12B 13A-16A, 13B-16B, 100-102	VHS/VHS-C	Lum & Chroma
18 300-302	VHS/VHS-C	Lum & Chroma
50-56 500-502 510-512	VHS/VHS-C	Stereo Audio Stereo L Only Stereo R Only
50, 51 53, 54 520, 521 530, 531 540, 541 550, 551	Beta	Stereo Audio Stereo L Only Stereo R Only
50-56 570-572 560-562	8MM	Stereo Audio

Table 2: Inject the VC93 Playback Signals at these test points. Universal VCR Block Diagram.

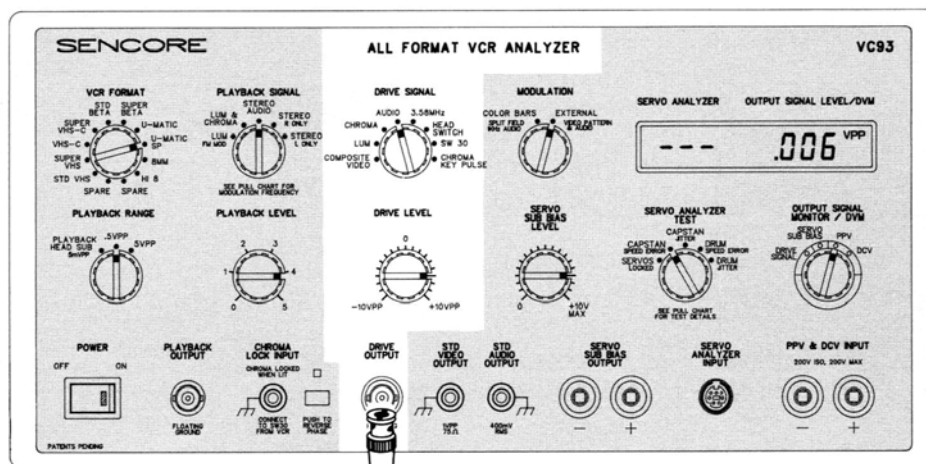


Fig. 2: Drive Signals are injected after the FM detector, frequency converter, and FM audio detector.

INPUT jack when using this signal to troubleshoot the chroma conversion circuits

Using the Drive Signals

1. Select the desired DRIVE SIGNAL.
2. Set the DRIVE LEVEL to "0".
3. Connect the DIRECT TEST LEAD to the DRIVE OUTPUT jack.
4. Connect the test lead to the circuit.
 - a. Red lead to the injection point.
 - b. Black lead to circuit ground.
5. Set the OUTPUT SIGNAL MONITOR/ DVM switch to DRIVE SIGNAL.
6. Adjust the DRIVE LEVEL control to match the level of the circuit into which you are injecting.

When you inject the VC93 Drive Signals after the defective stage, the playback monitor will show a good picture. This indicates

that all the circuits after the injection point are good. If you do not obtain a good picture, your injection point is before the defective stage. Continue moving your injection point to a later stage until a good picture returns. The stage before the injection point that produces a good picture contains the defect.

Table 3 shows where to inject the VC93 Drive Signals on the Universal VCR Block Diagrams. Use it as a reference when injecting the Drive Signals.

MODULATION

The MODULATION switch determines the video and audio modulation for the Playback and Drive Signals. It also determines the modulation of the composite video and audio signals available at the STD VIDEO OUTPUT and STD AUDIO OUTPUT jacks. **COLOR BARS:** In this position, the VC93 provides an internally generated "Split Field" color bars pattern and 1 kHz audio modulation.

EXTERNAL: In this position, external video and audio may be used to modulate the VC93. The modulation is supplied through the SYNCHRONIZING SIGNAL INPUT jack located on the rear of the unit. Connect the optional SYNCHRONIZING INTERCONNECT CABLE to the ACCESSORIES OUTPUT SIGNALS jack on the VA62 or VA62A.

STD VIDEO And STD AUDIO OUTPUT

The standard output jacks provide signals to feed into the video and audio inputs on a VCR or camcorder. Use these jacks for making "work tapes" and to check the video and audio input circuits.

Servo Analyzer Tests

The VC93 provides five servo tests which identify problems in VCR servo circuits. Each test checks out a specific servo function. Detailed information on using the servo tests is provided in Tech Tip

Drive Signal Injection Points

Test Points:	Block Diagram:	Inject VC93 Signal:
70 73, 74 315	VHS Beta/U-Matic 8MM	Composite Video
103-108	VHS Beta/U-Matic 8MM	Lum
313, 314	VHS Beta/U-Matic 8MM	3.58 MHz
17	VHS/VHS-C* Beta/U-Matic 8MM	Headswitch
19	VHS/VHS-C	SW30
320	VHS Beta/U-Matic 8MM	SW30
316, 317	VHS 8MM	Chroma Key Pulse
322	Beta/U-Matic	Chroma Key Pulse
31, 32 34, 35 77,78 503-507 513-517	VHS/VHC	Audio
31, 32 77,78 525-529 545-549 535, 536 555,556	Beta/U-Matic	Audio
77,78 563-567 573-577 580,581	8MM	Audio

* Note: When using the VHS-C format, the Headswitch drive signal is 15 Hz.

Table 3: Inject the VC93 Drive Signals at these Universal VCR **Block Diagram testpoints.**

"Testing VCR Servos with the VC93 All Format VCR Analyzer." The following information is a summary of the servo tests.

The servo tests may be performed with either the SERVO PERFORMANCE TEST LEADS or the SERVO TROUBLESHOOTING TEST LEADS. The Performance Test leads connect to the VCR's audio and video output jacks. They provide a fast, overall checkout of the servos when the VCR is producing an audio signal and at least a partial video signal. You must use the SERVO PERFORMANCE TEST TAPE when using the Performance Test Leads. An audio or video signal that has insuffi-

cient amplitude, excessive noise, or that is missing will result in a dashed line display. If this occurs, use the SERVO TROUBLESHOOTING TEST LEAD.

The SERVO TROUBLESHOOTING TEST LEAD connects to the CTL and SW30 signals inside the VCR. Use this lead to confirm any BAD test result obtained when using the Performance Test Lead, and when the audio or video signal is too poor to obtain a reading with the Performance Test Lead. The Servo Test Leads can be used to isolate servo problems to a specific servo loop.

The SERVO ANALYZER readout displays the results of the Servo Analyzer Test in a percent-of-error and a "Good/Bad" indication. The "Good/Bad" indication result is a quick way to determine servo operation, while the percent-of-error reading provides more specific troubleshooting information. The capstan and drum "Speed Error" tests also display a "+/-" indication to show if the speed is too fast or too slow.

Perform the Servo Analyzer tests starting with the "Servos Locked" test and continue clockwise through all switch positions. If you obtain a BAD result on a servo

test, continue with the remaining tests to further isolate the problem. Following is a brief summary of each of the servo tests.

SERVO LOCKED: This test determines if the servo capstan phase loop and drum phase loop are locked to the reference signal.

CAPSTAN SPEED ERROR: This test determines if the capstan servo is operating at the correct speed. It identifies speed select circuit problems and speed related problems.

CAPSTAN JITTER: This test measures how

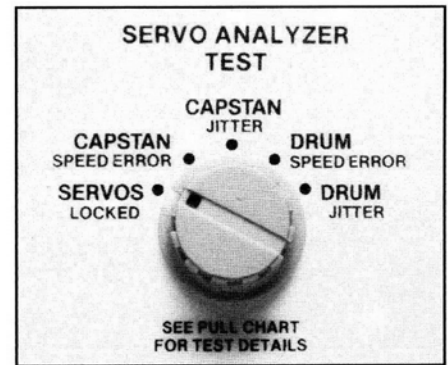


Fig 3: Perform all the Servo tests, starting with the **SERVO LOCKED** test.

constant the capstan movement is. It helps identify capstan phase problems and mechanical problems including motor bearings, bad idlers, etc.

Note: 8MM VCRs do not use a CTL pulse or linear audio. Therefore, the capstan servo tests DO NOT APPLY to 8MM VCRs.

DRUM SPEED ERROR: This test determines if the drum is operating at the correct speed.

DRUM JITTER: This test measures how constant the drum speed is. It helps identify drum related problems including bad motor bearings and a bad drum phase loop.

To use the Performance Test Lead:

1. Connect the Performance Test Lead to
2. Connect the yellow VIDEO phono plug to the VCR's "Video Out" jack.
3. Connect the red AUDIO phono plug to the VCR's "Audio Out" jack.
4. Set the SERVO ANALYZER TEST switch to SERVOS LOCKED.
5. Place the SERVO PERFORMANCE TEST TAPE into the VCR and press play.
6. Perform all five Servo Tests and note the results.

If the Servo Tests give a BAD indication on any test, or if the display shows dashes, connect the Servo Troubleshooting Test Lead to confirm the problem.

SERVO LOCKED	CAPSTAN SPEED ERROR	CAPSTAN JITTER	DRUM SPEED ERROR	DRUM JITTER	MOST LIKELY DEFECT:
GOOD	GOOD	GOOD	GOOD	GOOD	NO SERVO DEFECTS*
GOOD	GOOD	GOOD	GOOD	BAD	DRUM MECHANICAL
GOOD	GOOD	GOOD	BAD	N/A	REFERENCE FREQUENCY
GOOD	GOOD	BAD	GOOD	GOOD	CAPSTAN MECHANICAL
GOOD	BAD	N/A	GOOD	GOOD	REFERENCE FREQUENCY
GOOD	BAD	N/A	BAD	N/A	REFERENCE FREQUENCY
GOOD	BAD	N/A	GOOD	BAD	REFERENCE FREQUENCY
BAD	GOOD	GOOD	GOOD	GOOD	CAPSTAN PHASE LOOP or DRUM PHASE LOOP
BAD	BAD	N/A	GOOD	GOOD	CAPSTAN SPEED LOOP or CAPSTAN MECHANICAL
BAD	GOOD	BAD	GOOD	GOOD	CAPSTAN PHASE LOOP or CAPSTAN MECHANICAL
BAD	GOOD	GOOD	BAD	N/A	DRUM SPEED LOOP or DRUM MECHANICAL
BAD	GOOD	GOOD	GOOD	BAD	DRUM PHASE LOOP or DRUM MECHANICAL
BAD	BAD	N/A	BAD	N/A	REFERENCE FREQUENCY
BAD	BAD	N/A	GOOD	BAD	REFERENCE FREQUENCY
* NOTE: A noise bar that occurs periodically at a rate of one minute or greater could be a capstan or drum phase problem.					

Table 4: Use this table to isolate servo troubles to either a capstan or drum servo problem.

To Use the Troubleshooting Test Lead:

1. Connect the Troubleshooting Test Lead to the SERVO ANALYZER INPUT jack.
2. Connect the black GND test clip to a servo circuit ground point in the VCR.
3. Connect the red CTL test clip to the VCR CTL test point.
4. Connect the yellow SW30 test clip to the VCR SW30 test point.
5. Set the SERVO ANALYZER TEST switch to SERVOS LOCKED.
6. Place a test tape recorded at any speed into the VCR and press play.
7. Perform all five servo tests and note the results.

Compare the results with Table 4 to isolate the servo problem. If all five Servo Analyzer Tests give a GOOD indication, the servos are functioning properly.

SERVO SUB BIAS

The SERVO SUB BIAS provides a variable DC

1. Set the bias voltage to the measured circuit voltage before connecting to the circuit.

2. Never adjust the voltage more than +/- 0.5 volt from the measured circuit voltage.

To use the SERVO SUB BIAS.

- 1 Measure the voltage at the test point into which you will inject.
- 2 Set the OUTPUT SIGNAL MONITOR/DVM switch to SERVO SUB BIAS.
3. Adjust the SERVO SUB BIAS LEVEL control for the voltage measured in step 1.
4. Connect the BIAS SUPPLY TEST LEADS to the SERVO SUB BIAS OUTPUT jack.
5. Connect the test leads to the circuit test point:
 - a. Connect the black lead to circuit ground.
 - b. Connect the red lead to the injection point.
 - c. If a negative voltage is required reverse the lead connections.

voltagespeciallydesigned fortroubleshooting servo circuits. The voltage is varied with the SERVO SUB BIAS LEVEL control. The level is displayed in the OUTPUT SIGNAL LEVEL/DVM readout when the OUTPUT SIGNAL MONITOR/DVM switch is set to "Servo Sub Bias."

This DC supply provides up to 1 amp of current at 10 volts and will sink (pull down) current to 500 milliamps. These current levels are necessary to "take control" of some servo circuits, but if used incorrectly they may damage components such as the motor drive.

When using the SERVO SUB BIAS LEVEL supply, observe these precautions:

Measuring Drive Signals And External DCV And PPV

The autoranged DVM monitors the internal Drive Signals, Servo Sub Bias, and external voltages. The OUTPUT SIGNAL MONITOR/DVM switch selects the desired measurementfunction. The measurement is displayed in the right-hand, OUTPUT SIGNAL MONITOR/DVM readout.

Use the DVM TEST LEADS to connect the PPV & DCV INPUT jack to measure external PPV and DC voltages. The PPV meter has a wide, 5 MHz frequency response that allows the PPV function to accurately measurevideo signals and offers low-level sensitivity to test rotary transformers.

To measure an internal Drive Signal:

- 1 Set the OUTPUT SIGNAL MONITOR/DVM switch to DRIVE SIGNAL or SERVO SUB BIAS.
- 2 Read the level in the OUTPUT SIGNAL LEVEL/DVM readout:
 - a. DRIVE SIGNALS are measured in PPV.
 - b. SERVO SUB BIAS are measured in DCV.
- 3 Adjust the corresponding LEVEL control for the desired amount.

To measure external PPV and DCV:

1. Connect the DVM TEST LEADS to the PPV & DCV INPUT jack.
2. Connect the test lead to the circuit test point.
3. Set the OUTPUT SIGNAL switch to PPV or DCV.
4. Read the level in the OUTPUT SIGNAL LEVEL/DVM readout.
5. A flashing "888" display indicates the applied signal is greater than 199 volts.

For more information, Call Toll Free 1-800-SENCORE (1-800-736-2673)

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