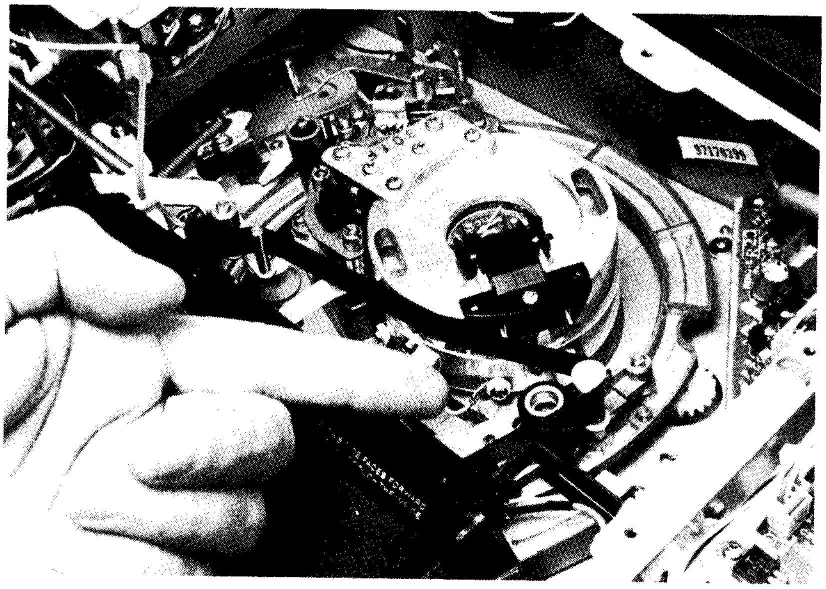
VCR



REPAIRS AND ADJUSTMENTS THAT YOU CAN DO

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Repairing and aligning VCR's isn't easy, but it is possible to do some of the work yourself if you know how! In this article we'll tell you what repairs and adjustments you can make using standard test equipment.

Part 3 IN THIS MONTH'S ARTICLE we'll be looking at some VCR symptoms, and their likely causes. We'll also look at the steps that should be followed to be sure that your VCR is properly aligned.

Precautions when installing a VCR

In addition to all precautions described in the service or operating literature for the VCR, keep the following points in mind. Avoid placing the VCR in areas of high temperature or high humidity. Exposure to those environmental factors can harm the VCR and (especially) the cassette tape. The rear of the VCR should be at least 4 inches from the wall to maintain adequate heat dissipation. Make certain that the TV fine-tuning has been properly adjusted for either channel 3 or 4. The VCR output is displayed on the selected channel, but since that channel is not ordinarily used the fine tuning may not be precisely adjusted. Play back a tape that you know to be good, and adjust the TV fine tuning to get the best picture. Also make sure that the VCR fine tuning is properly adjusted.

If you have the job of demonstrating use of the VCR to someone, go over the operating instructions of the instruction manual in boring detail. Although operation of a VCR is simple to those familiar with electronic equipment, it may not be so to the general public, especially since a VCR has many more capabilities, and controls, than a TV. As a minimum, describe how to do the following: watch the TV, record a TV program, record one program on the VCR while watching another on the TV set, use the automatic recording timer to record while away from home, play back a recorded tape. If you can not do any of those yourself, do not attempt to service that VCR until you have studied the instructions, please!

One point often confused by those familiar with Beta or VHS, but not both, is in loading and unloading the cassette. With Beta, when the cassette compartment lid is closed, the tape is automatically loaded. For VHS, tape loading occurs after the lid is closed and the PLAY button is pressed.

To remove a Beta cassette, make sure that the power is turned on, and that the VCR is in the STOP mode. Press EJECT, remove the cassette, and close the lid. When a Beta compartment lid is raised by pressing the EJECT button, the tape is automatically unloaded, and the cassette supply and take-up reels disengage from the tape drive motors. (On some Beta VCR's, the EJECT button cannot be pressed except in the STOP mode. In other Beta VCR's, the EJECT button can be pressed, but does not actuate the circuit unless the VCR is in STOP.)

For VHS, when the STOP button is pressed, the tape is unloaded. The cassette can then be removed by pressing the EJECT button to release the cassette holder.

Checkout procedures for a VCR

Before we get into the detailed service notes where we discuss specific problems related to the major functional sections of a VCR, let us go over some simple, obvious steps to be performed before you start any service (and long before you tear into the VCR).

If the video playback or the TV picture is bad, set the program select switch to TV and check picture quality for each TV channel (using the TV channel selector). If the picture quality is still bad, check for defective antenna connections (or a faulty TV). Also check the TV fine tuning.

If the TV picture is good when the program select switch is set to TV, but the video playback is not good, set the program select switch to VCR, turn the TV to the inactive channel (3 or 4), and check reception on each channel by changing the setting on the VCR channel selector. If picture quality is bad, or there is no picture on all channels, it is possible that the TV fine tuning is not properly adjusted. If the problem appears only on certain channels, the VCR fine tuning is suspect (as is the VCR tuner).

If picture quality is good when viewing a TV broadcast through the VCR, try recording and playing back the program.

If noise is apparent (resulting in poor picture quality on playback but not when viewing through the VCR) it is possible that the video heads are dirty (head gaps are slightly clogged). If there is sound but no picture, the video head gaps may be badly clogged. If the playback picture is unstable with a new TV set (never previously used with the VCR), it is possible that the TV's AFC circuits are not compatible with the VCR. (We'll discuss that problem latter on.) If there is color beat (rainbow-like stripes on the screen) the problem may be interference rather than a failure in the VCR or TV.

Let's now go over specific symptoms and possible causes for some basic VCR troubles.

Record button cannot be pressed

Check that there is a cassette installed and that the safety tab has not been removed from the cassette. If necessary, cover the safety tab hole with tape. (The safety tab engages a plunger rod or switch when the cassette is inserted and the lid closed.) In most Beta systems, the RECORD button cannot be pressed unless the rod is pushed down by the tape. In VHS, the tab prevents a switch from closing. Closing the switch disables the record operation. If you want to keep a recorded program from being accidentally erased, you break off the tab so that the plunger is not pushed down, for Beta, or the switch can close, for VHS, and the record function is disabled. If you want to record on a cassette with the tab removed, cover the tab hole with vinyl tape.

No E-E picture.

If there is no E-E picture, check that the VCR program select switch is in the correct position. Also check the fine tuning on the TV. (The term E-E, or *E*lectric-to-*E*lectric, can be explained as follows. When the VCR is in the record mode, the record output circuit is also connected to the playback input circuit so that the video signal to be recorded can be monitored on the TV. Since the magnetic components (head, tape, etc.) have nothing to do with that signal, and the signal is passed directly from one electrical circuit to another, the function is called the E-E mode. When the heads and tape are involved in the normal record/playback cycle, the term V-V, or *V*ideo-to-*V*ideo is sometimes used.)

No color, or very poor color

If there is no color on playback, check the fine tuning on the TV. If the VCR fine tuning is misadjusted during record, color may appear while recording, but may not appear during playback. Always check the fine tuning of both the VCR and TV as a first step when there are color problems.

Playback picture is unstable

If you have periodic problems of picture instability, check the following: Has the VCR been operated in an area having a different AC line frequency? While recording, it is possible that a fringe-area signal was weak (intermittently) so that the video sync signal was not properly recorded? During recording, could there have been some interference or large fluctuations in the power supply voltage? Could the cassette tape be defective. Could the tracking control be improperly adjusted.

Both Beta and VHS machines have some form of tracking control that adjusts for minor variations between tapes recorded on one machine and played back on another machine. If the physical distance between the control head and video heads is different for the two machines, the playback signals are not synchronized, even though the servo is locked to the CTL signal. That condition can be corrected by physically moving the control/audio head stack in relation to the scanner. (That is one of the recommended service adjustment procedures for some VCR's.) But it is more practical to use the front panel tracking control, which shifts the relationship of CTL signal to the video tracks electrically.

Snow or noise during playback only

Check the tracking control!

Sound but no picture

Check for very dirty video heads. The same holds true for excessive black-and-white snow.

Tape stops during rewind

If the VCR has a memory counter, is the counter switch on? If the memory switch is on, the tape stops automatically at 999 during rewind (on most VCR's).

Rewind and fast-forward problems

If the rewind and fast-forward buttons can not be locked or operated, check to see if the cassette tape is at either end of its travel If the tape is at the beginning, rewind does not function. Fast forward does not function if the tape is at the end.

Cassette will not eject

Is the power on?

Feedback when using a microphone

Keep the microphone away from the TV. Turn down the TV volume.

Tape-speed-related problems

Those include such things as a noise band in the playback picture and picture instability with too high or too low pitched sound.

In some VCR's, the tape is automatically locked to the correct speed by the servo. However, many VCR's also require some manual switching. For example, certain Beta VCR's have a front-panel switch to select between Beta II and Beta III, as well as a rear panel switch for Beta I.

Some VCR service suggestions

The following points summarize some practical suggestions for servicing any VCR.

Initial setup

When a VCR is first connected to a TV, it is likely that the unused channel (3 or 4) of the TV is not properly fine tuned. When fine tuning the TV, operate the VCR in the playback mode using a known good cassette, preferably with a color program. If you try to fine tune the TV in the record or E-E mode, both the VCR and TV tuners are connected in the circuit, and the picture is affected by either or both tuners. With playback, the picture depends only on the TV tuner. Once the normally unused channel of the TV is fine tuned for best picture, the VCR tuner can be fine tuned as necessary.

Replacing a tuner

In many VCR's, the entire tuner is replaced as a unit in the event of failure, although some manufacturers supply replacement parts for their tuners, and include adjustment procedures for the tuner in the service literature. As a point of reference, a typical VCR tuner (including the IF) produces 1 volt P-P of video into a 75-ohm load. Typically, the audio output from the tuner is in the −10- to −20-dB range.

Replacing an RF modulator

In most VCR's, the RF modulator must be replaced as a package in the event of failure. No adjustments or parts replacement are possible. If you have proper audio and video inputs (and power) to the modulator, but there is no output (or low output), the modulator is most likely defective. As a point of reference, a typical RF modulator produces 1000 microvolts into a 75-ohm load (or 2000 microvolts into a 300-ohm load) on the selected channel.

Black-and-white picture circuits

Although the black-and-white (or luminance) circuits of any VCR are very complex, they are not the major cause of trouble. Mechanical problems are on top of the list, closely followed by servo and system control troubles. Also, although many circuits are involved, all of the circuits are found in three or four IC's. If all else fails, you can replace the few IC's, one at a time, until the problem is solved. (If only mechanical problems were that simple!)

The first step in servicing luminance circuits is to play back a known good tape, or an alignment tape. That will pinpoint the problem to playback or record circuits, or both. Then run through the electrical adjustments that apply to luminance, or picture, using the manufacturer's procedures.

If playback from a known good tape has poor resolution (picture lacks sharpness) look for an improperly adjusted noise canceler circuit, and for bad response in the video-head preamps. When making the manufacturer's adjustments, study the stairstep or color-bar signals for any transients at the leading edges of the white bars.

If the playback has excessive snow, try adjusting the tracking control, since mistracking can cause snow. Then try cleaning the video heads before making any extensive adjustments. (Cleaning the video heads clears up about 50% of all noise or snow problems.) If neither of those do the trick, then try electrical and mechanical adjustments. Make mechanical adjustments only as a last resort (even though snow and mistracking can be caused by mechanical problems).

If playback of a known good tape produces smudges on the leading edge of the white parts of a test pattern (from an alignment tape) or a picture, the problem is usually in the preamps, or in adjustments that match the heads to the preamps. The head/preamp combination is not reproducing the high end (5 MHz) of the video signals. The adjustment procedures usually show the head/preamp response characteristics.

If you see a herringbone (beat) pattern in the playback of a known good tape, look for carrier leak. There is probably some unbalance condition in the FM demodulators or limiters, allowing the original carrier to pass through the demodulation process. If very excessive carrier passes through the demodulator, you may get a negative picture. Recheck all carrier lead adjustments.

Most adjustment procedures include a check of the video output level (typically 1 volt P-P). If the VCR produces the correct output level when playing back an alignment tape, but not from a tape recorded on the VCR, you probably have a problem in the record circuits. The record current may be low (one symptom of low record current is snow), or the white-clip adjustment may be off. Look for details of those two adjustments in the manufacturer's literature.

Servicing color circuits

As in the case of black-and-white, the color (or chroma) circuits of a VCR are very complex, but not necessarily difficult to service (nor do they fail as frequently as the mechanical section). Again, the first step in color-circuit service is to play back an alignment tape, followed by a check of all adjustments pertaining to color. As in the black-and-white circuits, when performing adjustments, you are tracing the signal through the color circuits. (At least that is the case in most well-written VCR service literature.)

There are two main points to remember in regard to VCR color circuits. First, most color circuits are contained within IC's, possibly the same IC's as the black-and-white circuits. Also, both circuits are interrelated. If you find correct inputs and power to an IC, but an absent or abnormal output, you must replace the IC. A possible exception in the color circuits are the various filters and traps located outside the IC.

Second, in most VCR's, the reference signal input to the color converters comes from the same source for both playback and record (from crystal-controlled oscillators). If you get good color on playback, but not on record, the problem is definitely in the record circuits. However, if you get no color on playback of a known good tape, the problem can be in the color playback circuits or in the common reference signal. A good place to start color circuit signal tracing is to check any common source reference signals. Then check the AFC signals. If any of those signals are missing (or abnormal), the color will be absent or abnormal.

The following describes a few VCR color circuit failure symptoms, together with some possible causes.

If you get a "barber pole" effect, indicating a loss of color lock, the AFC circuits are probably at fault. Check that the AFC circuit is receiving the horizontal-sync pulses, and that the AFC voltage-controlled oscillator (VCO) is nearly on-frequency, even without the correction circuit. (Most electrical adjustments include such a procedu[illegible]

If the hue control [illegible] reset when playing back a tape that [illegible] just been recorded, check the color subcarrier frequency using a frequency counter.

If you get bands of color several lines wide on saturated colors (such as alternate blue and magenta bands on the magenta bar of a color-bar signal), check the automatic phase-control circuits, as well as the 3.58-MHz oscillator frequency.

If you get the herringbone (beat) pattern during a color playback, try turning the color control of the TV down to produce a black-and-white picture. If the herringbone is removed on black and white, but reappears when the color control is turned back up, look for leakage in both the color and luminance circuits.

If you get flickering of the color during playback, look for failure of the automatic color-control system. It is also possible that one video head is bad (or that the preamps are not balanced), but such conditions show up as a problem in black-and-white operation.

If you have what appears to be very severe color flicker on a Beta VCR, you may be losing color on every other field. That can occur if the phase of signal is not shifted 180° at the horizontal-sync rate when one head is making its pass. The opposite head works normally, making the picture appear at a 30-Hz rate.

If you lose color after a noticeable dropout, look for problems in the dropout-compensation circuit. Most VCR's have some form of dropout compensation circuit to sense any dropout of recorded signal. Those circuits compensate for dropout by using the preceding horizontal line signal. It is possible that the phase reversal circuits have locked up on the wrong mode after a dropout. In that case, the color signals have the wrong phase relation from line to line, and the comb filter is canceling all color signals.

It's usually easy to spot total failures in the servo system. If a servo motor fails to operate, check that the power is applied to the motor at the appropriate time. If power is there, but the motor does not operate, the motor is at fault (burned out, open windings, etc.). If the power is absent, trace the power-supply line back to its source. See if the system control circuits (usually a microprocessor) are delivering the necessary control signals.

The problem is not so easy to locate when the servo fails to lock on either (or both) record and playback. If the control signal is not recorded (or is improperly recorded) on the control track during record, the servo cannot lock properly during playback. So your first step is to see if the servo can play back a properly recorded tape.

There are usually some obvious symptoms when the servo is not locking prop-

... a horizontal band of er... moves vertically through the ...cture if the servo is out of sync during playback. The picture may appear normal at times, possibly leading you to think that it is an intermittent condition. With a true out-of-sync condition, the noise band appears regularly (even though moving) and may cover the entire screen at times.

The symptoms for failure of the servo to lock during record are about the same as during playback, with one major difference. During record, the head-switching point (the point where head A is switched off and head B switched on, usually appearing as a break in the horizontal noise band) appears to move vertically through the picture in a random fashion.

Another way to check if the servo is locking on either record or playback involves looking at some point in the rotating scanner or video-head assembly under fluorescent light. When the servo is locked, the fluorescent light produces a blurred pattern on the scanner that appears almost stationary. When the servo is not locked, the pattern appears to spin. Try observing the scanner of a known-good VCR under fluorescent light. Stop and start the VCR in the record mode. Note that the blurred pattern spins when the scanner first starts, but settles down to almost stationary when the servo locks.

Once you have studied the symptoms and checked the servo playback with a known good tape, you can use the results to localize the trouble in the servo. For example, if the servo remains locked during playback of a good tape, you can assume that the circuits between the control head and servo motors are good.

Keep in mind that servo troubles may be either mechanical or electrical, and may be the result of either improper adjustment or component failure (or both). As a general guideline, if you suspect a servo problem, start by making the electrical adjustments that apply to the servo. That may cure the servo problem. If not, you will at least see if all of the servo-control signals are available. A block diagram of a servo-control system is shown in Fig. 16. That diagram shows where in the servo system the control signals are found. If one or more of the signals are missing or abnormal, you have a good starting point for servo troubleshooting.

If the VCR has rubber belts to drive servo motors, the belts may stretch (or be otherwise damaged) and cause servo problems. If you have replacement belts available, compare the used VCR belts for size. Hold a new and used belt on your finger under no strain. If the used belt is larger, or does not conform to the new belt, install the new belt and recheck the servo for proper locking.

Keep in mind that the servo adjustments may be so far from normal that the servo simply cannot lock up. The only sure way to check that is to run through the servo adjustments.

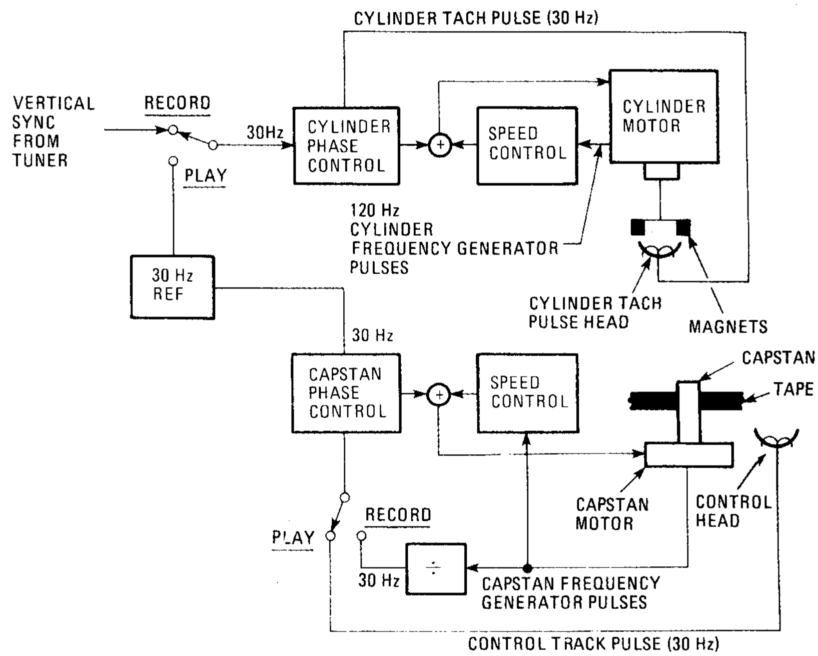

FIG. 16—BLOCK DIAGRAM of a VHS servo system. This diagram shows the location of all of the typical servo control signals.

Interchange operation

When a VCR plays back its own recordings with good quality, but the playback of tapes recorded on other machines is poor, the VCR is said to have *interchange* problems. Such problems are almost always located in the mechanical section of the VCR (usually in the tape path) and are often the result of improper adjustment. The simplest way to make interchange adjustments is to monitor the RF output from the video heads during playback and adjust elements of the tape path to produce a maximum, uniform RF output from a factory alignment-tape. Generally, the output is measured at a point after head switching so that both heads are monitored. But always follow the manufacturer's alignment procedures.

Wow and flutter

As is the case with audio recorders, wow and flutter are almost always present in all VCR's. To find out how much wow and flutter are present, use the low-frequency tone recorded on the alignment tape and a frequency counter connected to the audio line at some convenient point. Typically, the low-frequency tone is on the order of 333 Hz, and an acceptable tolerance is $\pm 0.03\%$. You will probably use the period mode of the frequency counter to make that measurement. You can also use the special wow-and-flutter test equipment found in audio and hi-fi shops, but it is not really necessary. Any wow and flutter that does not show up when using the alignment tape and frequency counter is most probably not objectionable. The cause of wow and flutter can be either electrical or mechanical in origin.

Servicing systems-control circuits

Each VCR has its own system-control functions, and you must learn those functions to properly service any VCR. However, all system-control circuits have elements in common. In most VCR's, microprocessors accept logic-level control-signals from the VCR operating controls, and from various tape sensors. In turn, the microprocessor sends control signals to the various circuits, as well as drive signals to solenoids and motors. We will concentrate on the stop control-functions here, since those stop (or failure) functions are most likely to confuse those not familiar with VCR's.

Figure 17 shows the basic circuits of a VHS-system stop control. The VCR is stopped when the STOP button is pressed, when the tape runs to either end (forward and reverse), or when there is mechanical trouble.

Both ends of a VHS tape are transparent. The tape passes between an end-sensor lamp and two end-sensor phototransistors. When the tape reaches either end (supply or take-up), the light passes through the transparent portion of the tape onto one of the phototransistors. When either phototransistor receives light, it applies a signal to the IC, which stops and unloads the VCR. The VCR also stops should the end-sensor lamp fail. Without that feature, the tape could break at either end. If the lamp burns out, the cathode voltage of the Zener diode increases, and the increase is applied to

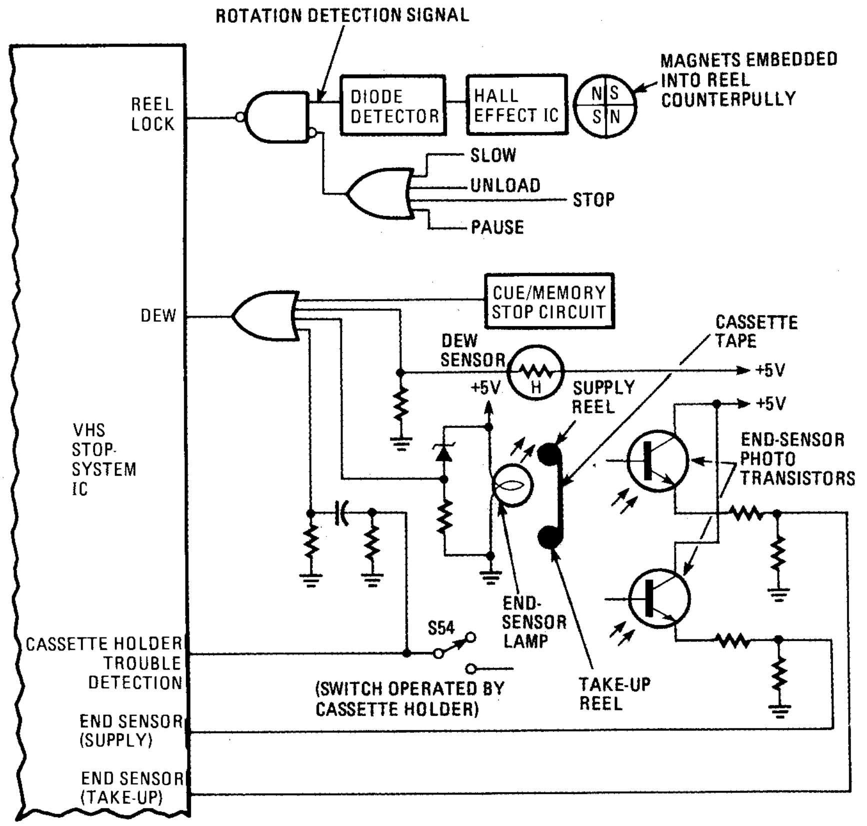

FIG. 17—THE STOP SYSTEM used in a typical VHS recorder. Its functions include sensing end-of-tape and excess humidity conditions.

the stop-system IC through the OR gate. The end-of-tape condition can be simulated by exposing the phototransistors to light; that should result in an immediate stop and unload. The end-of-tape function can be disabled (for service) by covering the phototransistor with opaque tape or a cap. Do not remove the light source for the end-of-tape sensor on a VHS machine! That is sensed as a lamp-failure condition by most VHS units.

When changes of temperature and humidity cause condensation of dew on the surface of the video scanner, that is detected by the dew sensor; and the stop mode is produced to prevent damage to the tape and mechanism. In Fig. 17, the dew-sensor output is applied to the IC through the OR gate. When relative humidity is less than about 80%, the resistance of the dew sensor is about 100 megohms. When humidity increases above about 80% the resistance drops to about 3 megohms, and the voltage at the junction of the sensor and the resistor increases. That increase is applied to the IC through the OR gate, and stops the VCR.

The reel-lock circuit detects when the reel motor has stopped rotating, except when the tape should not be running at the normal speed (unloading, loading, pause, step slow, etc.). The NAND-gate output is high when the reel disk is rotating, or when operating mode signals are applied to the OR gate. When reel rotation stops, the NAND-gate output goes low, and the IC causes the VCR to unload and stop. That can be prevented by applying an override signal to the OR gate. The rotation-detection signal is developed by diode detectors, a Hall-effect element, and magnets (usually embedded into the reel counterpully). When the reel is rotating, the magnetic field also rotates, and causes the Hall element to produce a current. That current is rectified and doubled by the detector to become the rotation-detection signal. If rotation stops, the alternating current stops, as does the detection signal, and the IC removes power to the tape-drive motor, preventing damage to the tape. The detector can be checked by holding the take-up reel. That causes the take-up clutch to slip (to prevent damage) but the detector senses that the reel is not turning, and produces an automatic stop.

The cassette-holder trouble-detection circuit detects if the cassette holder is in the eject condition (by sensing a switch that is operated by the holder). If the eject button has been pushed, the VCR is placed in the stop mode by the switch. To disable the cassette-holder-trouble function (that is often necessary to do during service), locate the mechanism that actuates the switch and hold the mechanism in place with cellophane tape. In many cases, it is possible to operate the VCR through all its modes without a cassette installed if the switch can be actuated manually. Always check that all automatic-stop functions work, and that all bypasses and simulations (covers on lamps, tape on switches, etc.) are removed after service!

Beta VCR's have similar stop functions (in the event of trouble) but the circuits are different. The two major differences are in the end-of-tape and reel sensors. Both ends of Beta tape are covered with foil. When the foil at the start of the tape approaches a forward sensor coil (the coil of an oscillator), the Q of the sensor coil decreases, as does the oscillator output (indicating that the tape is at the start position). The rewind sensor operates the same way, except that the rewind-circuit oscillator-signal output drops when the foil at the end of the tape passes the oscillator coil (placing the VCR in the stop mode, and indicating that the tape must be rewound). For Beta, the end-of-tape foil can be simulated by placing a piece of foil near the coil of either sensor.

The reel-sensor circuit of a Beta VCR usually consists of a phototransistor and an LED, arranged around the base of a take-up reel as shown in Fig. 18. The phototransistor receives light from the LED; the light passes through the slots at the bottom rim of the take-up reel base while the reel is in motion. When the take-up reel stops rotating, the light is blocked off from the phototransistor. When that happens, the sensor circuit produces a signal that places the VCR in its automatic-stop mode to prevent the damage to the tape.

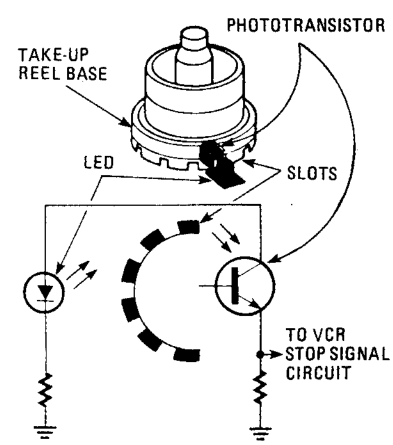

FIG. 18—THIS REEL-MOTION sensor circuit is used in Beta VCR's.

Most VCR's have some form of tape-slack sensor. Slack tape can cause damage (as can condensation, belt rupture, a sudden stop of the reel motor, etc.). Tape-slack sensors can be checked by visual inspection and by pressing on the switch with your fingers to simulate slack tape. If the tape-slack sensors include a micro-switch (as is the case with most Beta VCR's), the sensor circuit can be disabled by forcing something like a match against the sensor to keep the switch from triggering. (That is useful if you want to run the VCR without a tape.)

Video-camera sync

If you have trouble using a video camera (perhaps one not designed for the VCR, possibly an inexpensive surveillance camera) you may have an interlace problem. Most cameras designed for use with VCR's—even those from different manufacturers—are compatible with any VCR. That's because such cameras have a 2:1 interlace. Some inexpensive cameras have a random-interlace, where the horizontal and vertical sync are not locked together. The playback of a recording made with a random interlace camera usually has a strong beat pattern (herringbone effect). One way to confirm a random-interlace condition is to watch the playback while observing the last horizontal line above the vertical-blanking bar. Operate the TV's vertical-hold control as necessary to roll the picture so that the blanking bar is visible. If the end of the last horizontal line is stationary, the camera has a 2:1 interlace and should be compatible. If the end of the last horizontal line is moving on a camera playback, the camera is not providing the necessary sync and probably has random interlace.

TV AFC compatibility

If the AFC circuits of a TV are not compatible with a VCR, skewing may result. In most VCR literature, the term "skew" or "skewing" is used to indicate that the upper part of the reproduced picture is being bent or distorted by incorrect back-tension on the tape (caused by improper mechanical adjustment). However, you can get that same effect if the TV's AFC circuits can not follow the VCR playback output. That condition is very rare in newer TV sets (designed for VCR's and videodiscs), and appears only in about 1% of older TV sets (and almost never when the TV and VCR are made by the same manufacturer). So do not go into the TV's AFC unless you are absolutely certain that there is a problem. First try the VCR with a different TV, then try the TV with a different VCR.

Once you are convinced that there is a compatibility problem, the easiest cure is to reduce the time constant of the integrating circuit of the TV's AFC (see Fig. 19); that's done by changing the circuit values.

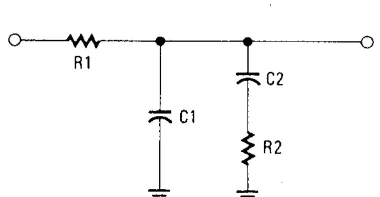

FIG. 19—COMPATIBILITY PROBLEMS can sometimes be solved by making changes in the TV AFC's integrating circuit.

To reduce the time constant, reduce the values of either or both capacitors C1 and C2, reduce the value of R1, or increase the value of R2. It is generally not necessary to change all four values. Be sure to check the stability of the TV's horizontal sync after changing any of the values in the AFC circuit.

Maintenance

We'll end this article by describing some typical maintenance procedures for VCR's. Keep in mind that those procedures do not necessarily apply to your specific VCR. When servicing VCR's, *be sure that you follow the manufacturer's instructions exactly*. Also, the procedures here are only the highlights, and only cover those areas common to most VCR's. All VCR's have many special-purpose adjustments that apply to their particular circuits. However, by studying the examples here, you should be able to relate the procedures to a similar set of adjustment points on any VCR, and to identify typical signals found in most VCR's (even though the signals may appear at different points in your particular unit).

Cleaning and lubrication

Table 1 shows the recommended maintenance intervals for most VCR's. However, never lubricate or clean any part not recommended by the manufacturer. Most VCR's use sealed bearings that do not require lubrication. A drop or two of oil in the wrong places can cause damage!

TABLE 1—SUGGESTED MAINTENANCE

Component	Operation
Video Heads	Clean every 500 hours
Audio/Control Heads	Clean every 500 hours
Pinch Head	Clean every 500 hours
Erase Head	Clean every 500 hours
Supply Head	Clean and lubricate every 2000 hours
Take-up Reel	Clean and lubricate every 2000 hours
Fast-Forward Roller	Clean and lubricate every 1000 hours
Clutch Pully	Lubricate at 2000 hours, then every 1000 hours
Rewind Idler	Lubricate at 1000 hours, then clean and lubricate every 1000 hours
Capstan Assembly	Clean every 1000 hours
Loading Gear	Clean and lubricate every 1000 hours

Clean off any excess, or spilled, oil. In the absence of a specific recommendation, use a light machine oil, such as sewing-machine oil. Although there are spray cans of head cleaner, most manufacturers recommend alcohol and cleaning sticks or wands for all cleaning. Methyl alcohol does the best cleaning job but can be a health hazard. Isotropyl alcohol is usually satisfactory for most cleaning.

Video-head cleaning

Turn the power switch off, and pull out the power cord. Rotate the video-head disk by hand to a position convenient for cleaning the video heads, as shown in Fig. 20. Moisten a cleaner stick with alcohol, lightly press the buckskin portion of the stick against the head drum, and move the head disk by turning the motor back and forth. Clean both heads (on opposite sides of the drum) following the same procedure. **CAUTION:** Do *not* move the cleaner stick vertically while in contact with the heads. Always clean the heads in the same direction as the tape path. Cleaning across the tape path can damage the heads.

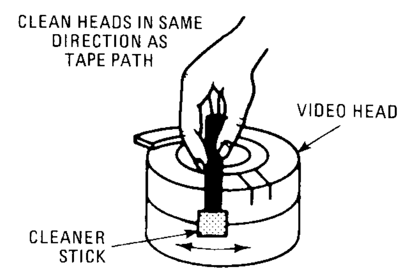

FIG. 20—CLEANING THE VIDEO HEADS. Be sure to always clean in the same direction as the tape path.

Audio/control and erase-head

Moisten the cleaner stick with alcohol, press the stick against each head surface, and clean the heads by moving the stick horizontally, as shown in Fig. 21.

Tape-path cleaning

Figure 22 shows the tape path for a typical Beta VCR. Clean the drum surface and each tape-guide surface with a soft cloth moistened with alcohol. When cleaning the drum surface, be careful not to touch the video heads with the cleaning cloth. Rotate the video-head disk by hand

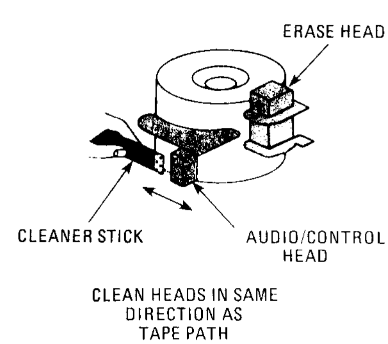

FIG. 21—WHEN CLEANING the audio/control and erase heads, move the cleaning stick horizontally as shown.

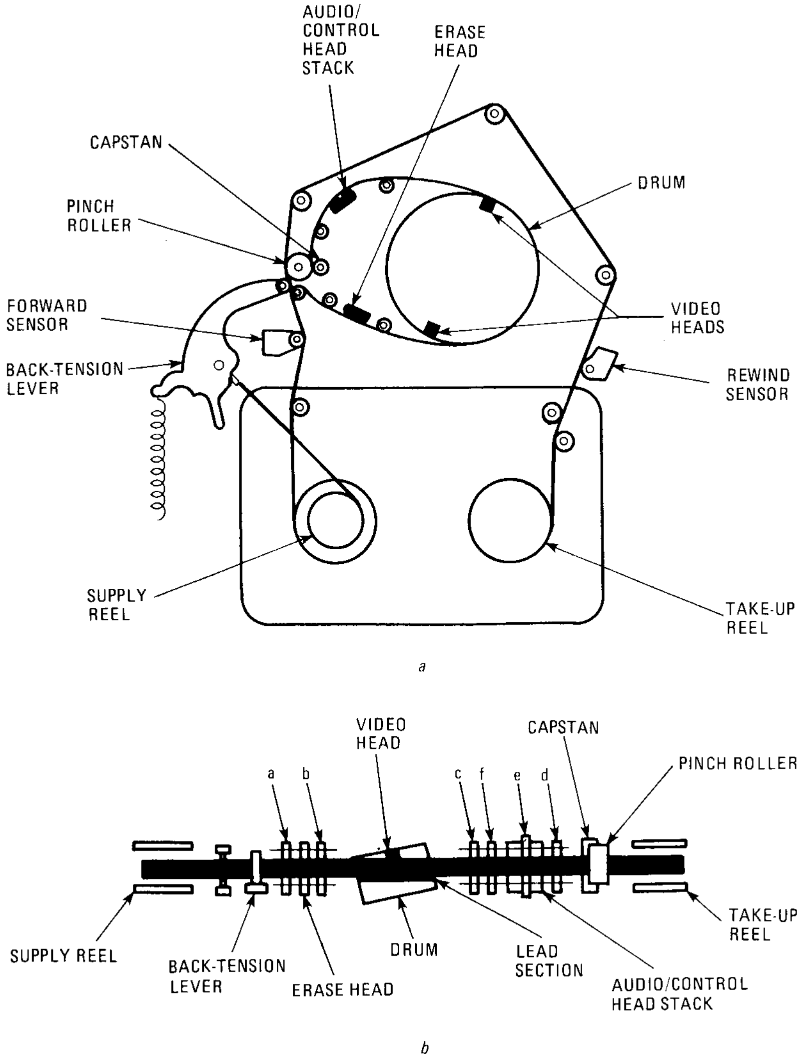

FIG. 22—TAPE PATH for a Beta VCR. Note that the location of the screw adjustments mentioned in the text are shown in *b*.

to move the head away from the spot to be cleaned.

Tape-path adjustments

The tape path for most VCR's is critical to proper operation. For that reason, the position and height of the tape guides and heads are precisely adjusted at the factory. Since those components greatly affect normal tape running, never touch the them unless necessary. First check operation of the VCR using an alignment tape and a known good monitor or TV. If the playback is good, quit while you are ahead. If you have playback problems, then (and only then) make the following adjustments (which are typical for VCR's with a tape path similar to that shown in Fig. 22).

1. Connect a good monitor or TV to the VCR, and an oscilloscope to a test point that monitors the video-color signal output of the playback amplifier circuits.

2. Play back an alignment tape (video portion) and observe the waveform (envelope) on the scope. Figures 23 and 24 show some typical envelopes.

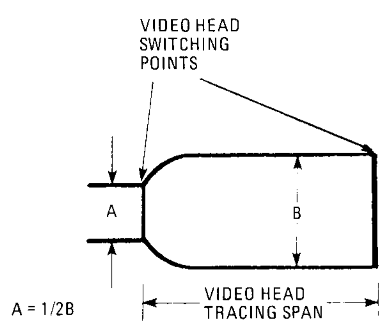

FIG. 23—ADJUST THE WAVEFORM so that the amplitude at A is equal to one half that at B. Note that only one period of the waveform is shown here for simplicity.

3. Adjust the VCR tracking control for the maximum waveform amplitude on the scope.

4. Observe the running state of the tape around the back-tension lever (Fig. 22). If you see any slack at the top or bottom edges, slightly bend the back-tension lever (with the appropriate tool) to eliminate the slack.

5. Adjust screw B (see Fig. 22-b) so that the top edge of the tape does not hit against the guide at the side below the screw.

6. Observe the waveform on the oscilloscope, and adjust screws A and B so that the amplitude at A is equal to one-half of the amplitude at B, as shown in Fig. 23. Note that A is measured at the video-head-switching point, and B is measured at 40% of the video-head-tracing span. Check that slack does not develop along screw A, screw B, or the lead section during those or any other adjustments.

7. Adjust screw C so that the tape top edge does not hit against the guide below. Then adjust screw C and D to make the waveform amplitude at C equal to one-half that at B, as shown in Fig. 24. While doing that adjustment, check that the tape-bottom edge is steadily in contact with the flange shoulder below screw D. Also, use an inspection mirror to check for slack along screws C, D and the lead section. The type of mirror used by dentists is very handy for checking tape slack at inaccessible points. The proper adjustment of screw C will give you the optimum waveform as described with no slack.

8. Ideally, the center portion of the video-head waveform should be flat after all the adjustments are complete. For acceptable performance, the minimum amplitude should be no less than 60% of the maximum amplitude at the center portion of the waveform.

9. Switch the scope from the video-head test point to the audio-output test point.

10. Play back the alignment tape (audio portion) and monitor the audio-signal output waveform. Adjust screw E for maximum amplitude.

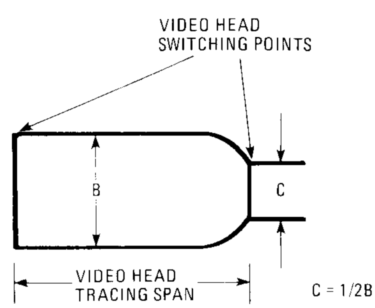

FIG. 24—WHEN THE NEXT SET of adjustments is completed, the amplitude at C should be one half that at B.

11. Switch the scope back to the video-head test point. Set the tracking control at the center position (at the click stop).

12. Adjust screw F for maximum video-signal amplitude.

13. Turn the tracking control to the right and left, and make sure that the waveform changes symmetrically.

14. Check operation of the VCR by recording and playing back a program. If the playback is good, you have made all of the adjustments correctly. Either that or you have fantastic luck!

Video-head-switching adjustments

Most VCR's have some form of video-head-switching adjustments. Before we get into some typical adjustments, let us consider how the switching circuits operate. The playback signals from the video heads are amplified and mixed to produce a continuous noise-free signal as shown in Fig. 25. Note that the overlap of the signals from channel 1 (head A) and channel 2 (head B) at the heads is eliminated by pulses that switch the channel 1 and 2 outputs so that channel 1 is off at the instant channel 2 is on (and vice versa). The switching pulses are called by various names (RF switching pulses, drum FF pulses, etc.) and originate in the servo system.

The video-head-switching adjustments for Beta and VHS are essentially the same, but with minor variations. In both cases you connect a scope to the video output of the VCR, and trigger the scope with pulses from the servo. Then you insert an alignment tape, and play back a color-bar signal. For VHS, the display is something like that shown in Fig. 26 on both channels, except that the switching pulse is inverted on one channel. (Generally, it is necessary to set the scope's trigger slope to " + " for one channel, and to " – " for the other channel.) With VHS, you set the switching adjustment so that head switching occurs 6.5 horizontal lines (6.5 H) before the start of the vertical sync pulse, as shown in Fig. 26. (If you don't know the difference between the vertical-sync pulse and the equalizing

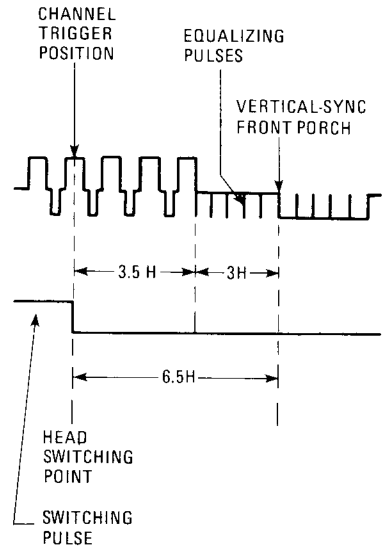

FIG. 26—VIDEO-HEAD-switching-point adjustments are made while observing the video output of a recorder. The output waveform shown here is for a VHS VCR.

pulses of a TV signal, please stay away from my VCR!) Because it is difficult to measure 6.5 H, you may want to measure for about 220 microseconds between the start of the scope triggering and the equalizing pulses instead.

Most Beta service literature recommends that the switching pulse occurs so that there is a 7-H (± 0.5 H) difference between the edge of the switching pulse and the front edge of the vertical-sync signal, as shown in Fig. 27. Often, there are two adjustments (one for trailing and one for leading edge of the switching pulse).

No matter what is recommended by the VCR service literature, keep the following in mind when you make the head-

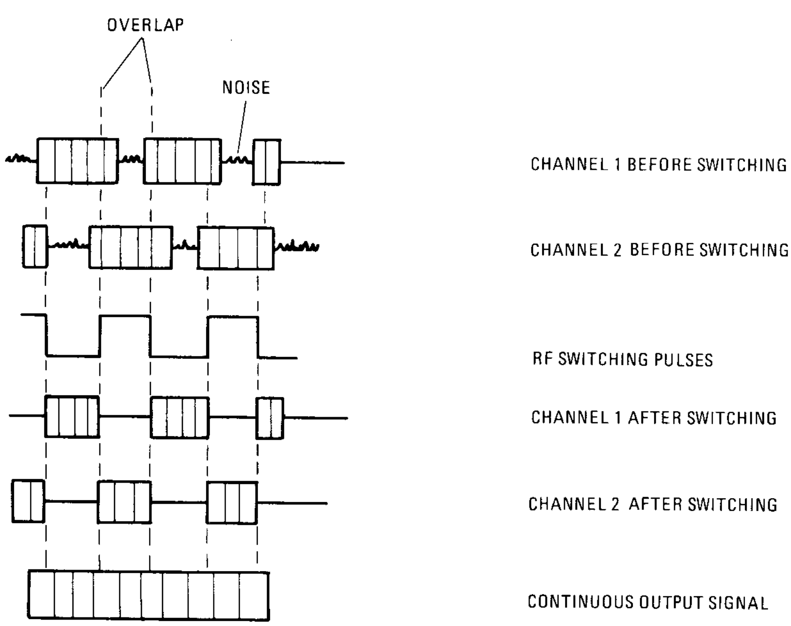

FIG. 25—THE SWITCHING PROCESS shown here produces a continuous output signal from the two video heads.

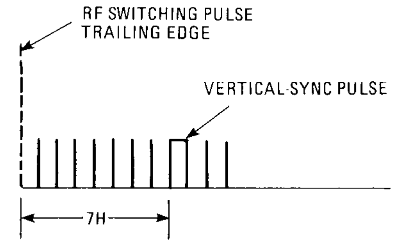

FIG. 27—FOR A BETA VCR, most literature recommends a 7 horizontal-line difference between the trailing edge of the switching pulse and the front edge of the vertical-sync pulse.

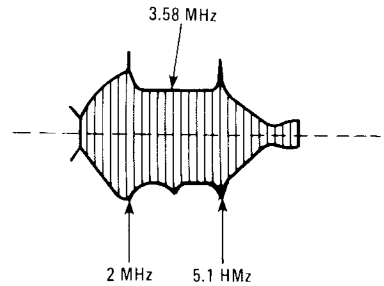

FIG. 28—THE RESPONSE OF a typical playback preamp.

switching adjustments: If head switching occurs too soon, a narrow band of noise may appear at the bottom of the picture on the TV being used to monitor the VCR. If the head-switching pulse is late, noise can be introduced during vertical sync, possibly resulting in vertical-sync problems.

Video-head resonance adjustments

Since the playback signal from the video heads is on the order of a few millivolts, their output is amplified by one or more preamps. The preamp circuits are provided with controls that make it possible to adjust video-head resonance and Q to produce an overall flat response (or some particular response). Figure 28 shows the response of a typical preamp. It was obtained by playing back the RF-sweep portion of an alignment tape. Typically, you set the adjustments so that the response is flat between about 2 and 5 MHz, and so that the signal levels on channels 1 and 2 (heads A and B) are equal. In some VCR's, you need to set the controls to get a peak response at one frequency.

Other adjustments

Although we have been through the major adjustments found on all VCR's, you will find many more adjustments in VCR literature. We will not cover those since they are unique to each model of VCR, or are similar to adjustments in other equipment. For example, all VCR's have power-supply adjustments where you set the various outputs to given voltage levels, and all VCR's have tuner/IF adjustments that are usually quite similar to those of a TV set. Both Beta and VHF

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