VCR HEAD AMP TESTER

This inexpensive piece of equipment can turn a second VCR into a valuable troubleshooting tool.

ED BATHGATE

THE MAJORITY OF PROBLEMS THAT OCCUR in a VCR are mechanical in nature. Problems caused by dirty heads, worn idlers, stretched belts, and jammed gears are perhaps most common, but VCR's also have their share of electrical problems. Such problems may be bad end sensors, burned out motors, power-supply problems, etc.

A good oscilloscope and a digital voltmeter can get you through the majority of VCR problems quickly and easily. However, problems involving the video heads, rotary transformer, head pre-amps, and head-switching circuits can be tough to troubleshoot. There are low-cost ($60) video-head testers, but they won't indicate if a head is contaminated or if the gap is clogged; in either case the output will seriously be degraded.

You could replace the video head in question, but that requires that you have a spare head for every make and model of VCR you service. Changing heads is time consuming, and keeping lots of heads in stock is expensive. What's really needed is an instrument that can generate a known-to-be-good video-head playback signal, and one inexpensive source for such a signal is another VCR. A VCR creates that signal whenever it plays a tape, so a working VCR can be used to troubleshoot a broken VCR (see Fig. 1).

If you are repairing VCR's as part of a service business, you probably have more than one working VCR in the shop at any given time. What's needed is a video jumper cable to take the signal from the source VCR and inject it into the VCR being repaired. This project makes it possible to do just that, with no modifications to either VCR.

VCR operation

There are several signals that a video head generates during playback. The luminance and sync is a signal from 3.4 to 4.4 MHz, frequency-modulated by video luminance and sync information. The chroma, or color information, is a 629.371-kHz signal recorded by amplitude modulating the 3.4 MHz FM carrier. The combined signals are usually referred to as video-head RF or RF envelope.

Two video heads are needed to "read" the information from a standard VHS videocassette (see Fig. 2). The two heads are mounted 180 degrees apart on a polished aluminum cylinder that spins counter-clockwise at 30 rpm. When one head completes a scan of the tape, the other head is ready to start its scan. In one scan, one video head generates a "field," a full top-to-bottom picture on the TV screen. The second video head also generates a field, but it is interlaced with the field from the first head. The two interlaced fields make one frame.

A standard four-head VCR uses only two heads at a time, one pair for "SP" (two-hour standard play), and one pair for "EP" (six-hour extended play). If one of the video heads is bad, the VCR will send a full-size picture to the TV, but with only half the picture information, with every other field composed of "snow."

Each head has its own pre-amp, and the output of each one goes to an

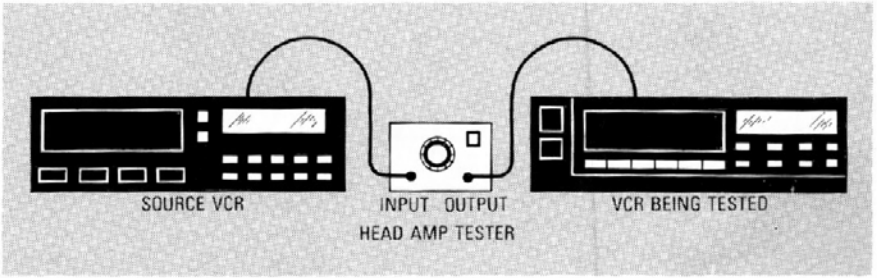


FIG. 1—THE VIDEO HEAD-AMP TESTER enables you to use a good signal from a working VCR to test a VCR with possible head problems.

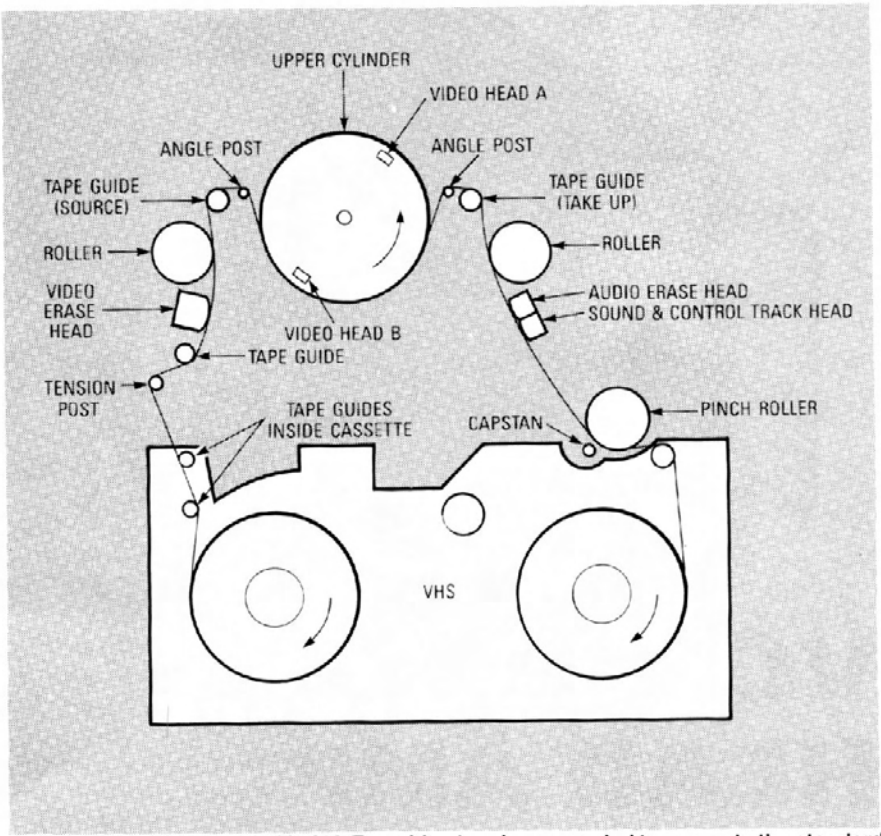


FIG. 2—VHS BASIC MECHANISM. Two video heads are needed to generate the standard VHS format. The two heads are mounted 180 degrees apart on a polished aluminum cylinder that spins counter-clockwise at 30 rpm.

electronic head switch (see Fig. 3). The head-switching circuit combines the outputs from each head pre-amp, by switching to the head which is in contact with the tape at that time. The head-switching control pulse is a 30-Hz square wave derived from the rotation of the head-cylinder motor. The output envelope (waveform *d*) is the sum of the two individual head pre-amp envelopes (waveforms *a* and *b*).

If the head-switching pulse is not present, or if it's distorted or inverted in phase, the symptoms will be similar to bad heads or a bad pre-amp. Some examples of bad waveforms are shown in Fig. 4. Waveforms *a* to *d* are caused by mechanical misalignment of the tape guides, and the waveforms in *e* and *f* indicate proper alignment, but show a problem with the video heads, pre-amps, or head switcher.

PARTS LIST

All resistors are ¼-watt, 5%, unless otherwise indicated.
R1, R4—100,000 ohms
R2—220,000 ohms
R3—10,000 ohms, audio-taper potentiometer
R5—150,000 ohms
R6—2200 ohms
R7—1000 ohms
Capacitors
C1, C3, C4—0.001 μF, ceramic disc
C2—39 pF, ceramic disc
Semiconductors
LED1—red light-emitting diode
Q1, Q2—2N2222 NPN transistor
Other components
J1, J2—RCA-type jack
S1—SPST on/off switch
Miscellaneous: Coaxial cable, PC board, metal case, solder, etc.

Head-amp tester circuitry

The schematic for the tester is shown in Fig. 5. The input is an RF envelope from a working VCR, applied to Q1 through coupling-capacitor C1. Q1 is connected as an emitter follower, with a high-impedance input and a low-impedance output, and a voltage gain of 1.

Potentiometer R3 is used as the emitter load for Q1 and level control for the signal applied to Q2. Capacitor C2 is for improving the frequency response of R3. Transistor Q2 is also a 2N2222, wired in the same configuration as Q1, but with a lower output impedance in order to drive circuits in the VCR under test. The circuit draws only 12 mA, so a 9-volt battery is well suited for the project.

Construction

The circuit should be built on a PC board, because RF as high as 4.5 MHz will be present. A single-sided board was used in the author's prototype with no problems. The board layout is very simple and can be drawn by hand directly on the copper with an etch-resist pen. See Fig. 6 for a parts-placement diagram; a foil pattern is provided in PC Service.

The assembled circuit should be mounted in a shielded box and coaxial leads should be used for input and output. Keep the lead length as short as possible (2-foot leads were used on the prototype with no problems).

Checkout

After assembly, check the voltages on Q1 and Q2, and the current draw, to verify proper circuit operation. Connect the VCR to be used as the signal

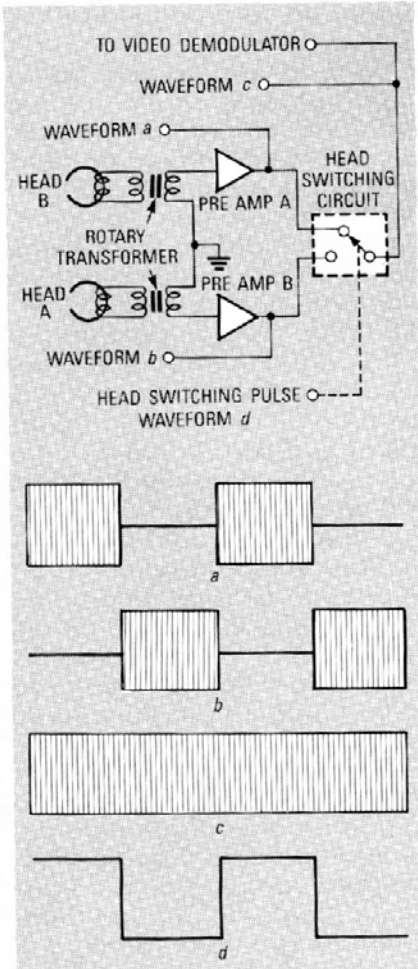


FIG. 3—EACH HEAD HAS ITS OWN PRE-amp, and the output of each one goes to an electronic switch that combines the outputs from each head pre-amp.

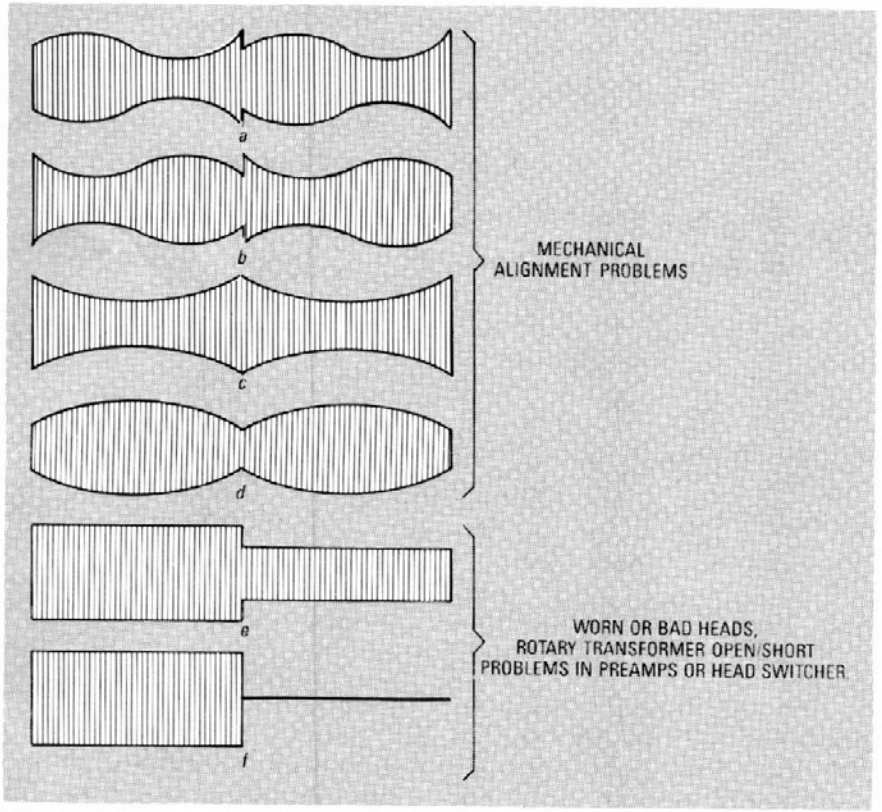


FIG. 4—IMPROPER WAVEFORMS. Waveforms *a–d* are caused by mechanical misalignment of the tape guides. The waveforms in *e and f* indicate proper alignment, but show that there's a problem with either the video heads, pre-amps, or head switcher.

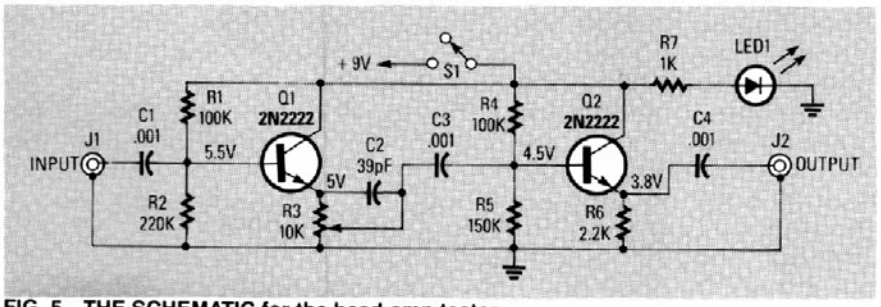


FIG. 5—THE SCHEMATIC for the head-amp tester.

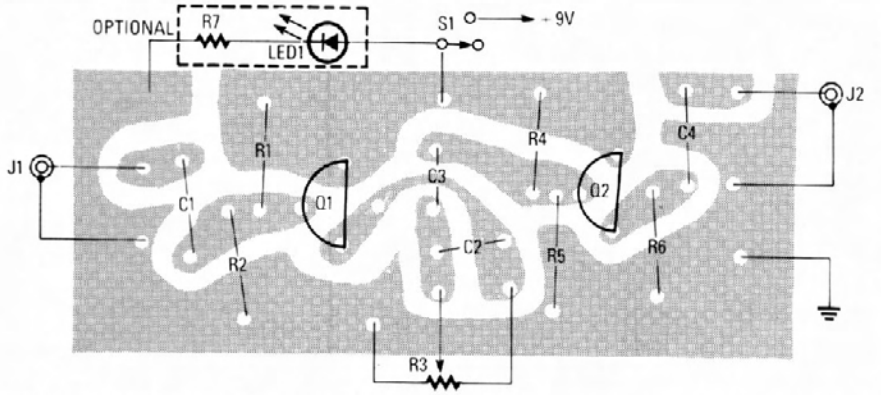


FIG. 6—PARTS-PLACEMENT DIAGRAM. Use the foil pattern provided in PC Service to make your own board.

source to a TV or monitor, and play a tape to use as the test signal; it can be a test pattern, or a home-made recording of the news or some other show. Use an oscilloscope to check out the head RF envelope (Fig. 3-*c*), from the source VCR for proper flatness. The RF envelope should be between 100- and 500-mV p-p in most VCR's.

Now turn on and connect the head-amp tester to the source VCR at the same point in the circuit that you measured the RF envelope (Fig. 3-*c*) with the oscilloscope. There may be a slight amount of signal degradation but if the entire picture disappears, it is loading down the source and the output signal will be unusable.

Check the output signal of the head-amp tester with the oscilloscope; it should be the same amplitude as the input signal with the level control at maximum. The output should be 0-V with the level control at minimum.

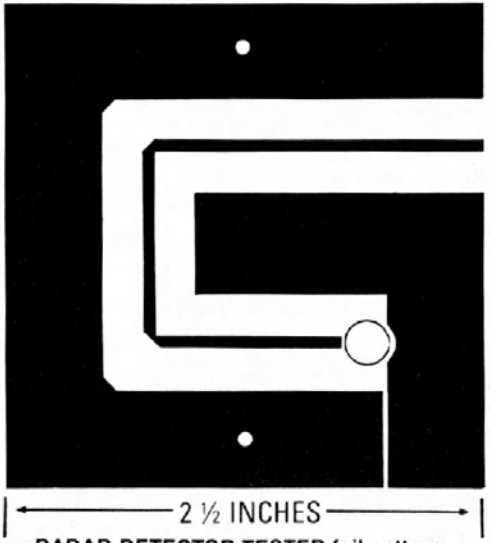
Using the tester

To substitute a signal in place of bad or questionable video heads, first put the source VCR into play, connect the head-amp tester, and adjust the output for 5–10-mV p-p. Put the VCR to be tested into play with a blank tape, and connect the output of the tester to the input of one of the head amps. That may be done at the connector end of the cable between the rotary transformer and the head amps. You can also capacitively inject the signal by clipping the output lead over the insulation of a non-shielded wire (no electrical connection), and increasing the output level to about ½ to ¾ of maximum. Signals can also be injected into the input and output of the head switcher. The output level should be high and direct electrical connections should be made.

The rotary transformer (one that can couple a signal from a rotating drum to the rest of the circuitry) can be tested with the VCR under test in "stop" mode, but the source VCR must be in "play" to supply a signal. Connect the output lead directly across one head at a time, and measure the output at the pre-amp input connector. You should disconnect the pre-amp connector from the pre-amps if possible. The signal from the rotary transformer should be equal or greater in voltage than the applied signal voltage. Test each head and the corresponding transformer winding.

The head-amp tester is not going to replace any major test equipment, but it does help you to troubleshoot some problems. And, after all, why wouldn't you want all the help you can get? **R-E**

HEAD-AMP TESTER foil pattern.



RADAR-DETECTOR TESTER foil pattern.