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tech tips

How to Troubleshoot VCR Sensors with the Waveform Analyzer

Servicers are finding that the VCR sensors are often the cause of a dead or non-functioning VCR. Many of these sensors fail entirely or become intermittent. In this Tech Tip, we will look at sensors and how to troubleshoot them using the Waveform Analyzer.

Sensors Must provide a Signal of Proper Levels

Digital circuits, including microprocessors, operate with logic high and logic low signal levels. These logic levels must be distinct or the microprocessor will confuse one for the other. If the voltage input to a data pin on the microprocessor from a sensor is between 0.8 volts and 2 volts DC for TTL circuits, the questionable area, the microprocessor cannot determine if the signal is a high or a low.

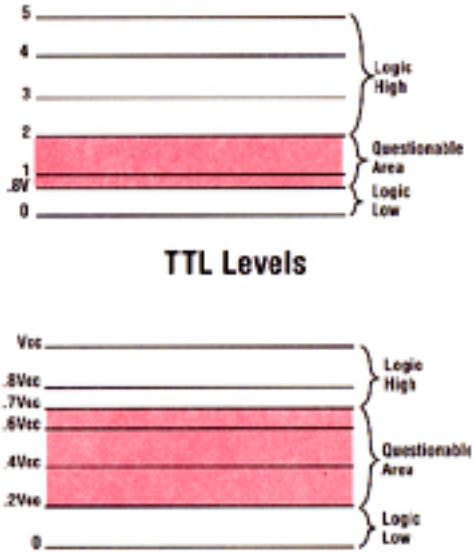

Fig. 1: Signal levels should not fall within the questionable area for correct operation.

The characteristics of a defective sensor can often result in an output that is in this questionable voltage area. Mechanical switch sensors can develop high contact resistance causing a voltage to either not go to ground or not come completely to the power supply voltage. Photo-coupler and hall-effect sensors can have a low power supply voltage, leakage, or not completely turn on, giving output voltages that cannot be properly interpreted by the microprocessor.

The sensors' output must be carefully measured to determine if they are operating properly. You need to know that the signal is occurring, and that the signal level is correct. This is best done with the Waveform Analyzer.

To analyze digital waveforms for proper using the CRT display:

1. Set the TIMEBASE and VOLTS/DIVISION control to display both the high and low levels of the waveform.
2. Move the INPUT COUPLING switch to the ground position, and adjust the VERTICLE POSITION control so the line on the CRT is set to the bottom graticule on the CRT.
3. Set the INPUT COUPLING switch to the DC position. Count the number of divisions the logic low level is above the ground reference set in step 2 above. Multiply the number of graticules by the VOLT/DIVISION setting. The level should be less than 0.8 volts.
4. Press the DIGITAL READOUT VPP button. Add the displayed reading to the answer found in step 3 above. The level should be greater than 2.0 volts.
5. The logic low (step 3) should be less than 0.8 volts, and the logic high (step 4) should be greater than 2.0 volts.

To determine logic levels using the Delta DC function:

1. Properly lock the waveform on the CRT display.
2. Set the TIME/DIV and VOLTS/DIV controls to display the entire waveform. Use the "Auto" positions if desired.
3. Press the Delta DCV button of the channel corresponding to the signal to be measured.
4. Adjust the "ΔDCV" DELTA MARKER control to position the DC marker at the logic low or logic high point on the waveform.
5. Confirm that the voltage displayed on the digital readout matches the logic level shown in Figure 1.

VCR Sensors Can Be Split into Two Categories for Troubleshooting

Seven basic sensors monitor the operation of VCRs. These sensors can be broken into two categories: 1) Single logic change and 2) variable output. The following sections take a look at these sensors, and how to troubleshoot them with the Waveform Analyzer.

Single Logic Change Sensors

Cassette IN and UP/DOWN Switches: The video tape cannot be loaded around the video drum until the tape cassette is in the proper position. In top loading VCRs, the tape is inserted into the cassette basket and manually pushed down. When the cassette is properly seated, a switch activates to tell the microprocessor that the cassette is ready to play.

In front loading VCRs the process is more complex. One switch, the cassette in, tells

the microprocessor that the cassette is ready to load. A second switch, the up switch, verifies that the basket is in the up position. A third switch, cassette down, notifies the microprocessor of the status of the loaded cassette. Usually the cassette in, up, and down switches are mechanical contact types of switches.

End Sensors and Light Tower:
To prevent tape damage, end sensors detect the end of the tape and tell the microprocessor when either end of the tape is reached. End sensors in VHS VCRs use a light beam to operate. The light beam is supplied by a light tower and may be either in the visible spectrum or in the infrared portion of the light spectrum.

Fig. 2: The end sensors change output level when light activates the phototransistor.

The end sensors are phototransistors that conduct when light strikes them. A clear length of tape exists at each end of the video tape. When the tape approaches the end, light shines through the clear tape and onto the end sensors. The microprocessor recognizes this and stops the movement of the tape.

Mode Switch: A mechanical "mode switch" monitors the loading arms. Contacts in the mode switch open and close as the mode switch changes position. This activates different data lines to the microprocessor. When the mechanical arms are in their correct position, the microprocessor recognizes the correct combination of signals from the mode switch and the VCR starts the next operation.

Record Safety Switch: Video tape cartridges have a small tab that can be broken out if the customer does not want his favorite program to be recorded over. A small lever and switch detects the presence or absence of this tab. The microprocessor checks the status of this switch before it allows the VCR to go into the record mode.

To test a single logic change sensor with the Waveform Analyzer:
1. Connect the Waveform Analyzer to the input of the sensor, and press the DIGITAL READOUT DCV button.
2. Read the digital display. The level should be greater than the minimum logic high level used by the VCR.
3. Connect the Waveform Analyzer to the output of the sensor.
4. Activate the switch either manually or by normal operation of the VCR.
5. Read the level on the digital display and note if the level is above or below the questionable area, described earlier.

Variable Output Sensors

Reel Sensors: Sensors detect the turning of the take-up reel, and sometimes, the rewind reel. Two different types of sensors are used; the phototransistor sensor and the hall-effect sensor. As the take-up reel turns, the output of the sensor produces pulses. These pulses are either sent directly to the microprocessor or to a detection circuit that supplies a logic signal telling the microprocessor that the reel sensor is turning.

Dew Sensor: Several problems can be caused by moisture on the tape and/or the VCR. If the moisture level (dew) is high, the tape sticks to the rotating video drum. Since this drum is traveling at 1800 rpm, a large quantity of tape can be wrapped up inside the VCR in a matter of seconds. Often, the tape will not stick, but the video heads scrape the oxide coating off the tape and deposit the residue on the heads and video drum assembly.

Dew sensors change their resistance in relation to how moist they are. The sensor is placed in series with a power supply and the voltage at a given point is monitored. When the resistance changes beyond a predetermined amount, a circuit sends a logic signal to the microprocessor telling it to shut off.

Cylinder Lock Sensor: In a correctly operating VCR, the cylinder begins to rotate immediately after the play switch is selected. A signal is sent from the cylinder servo circuit to the microprocessor telling it that the cylinder is operating. This signal is often derived from the FG or PG sensor on the cylinder drum.

To test variable output sensors with the Waveform Analyzer:
1. Connect the Waveform Analyzer to the input of the sensor, and press the DIGITAL READOUT DCV button.
2. Read the digital display, and note if the reading is above or below the questionable area.
3. Connect the Waveform Analyzer to the output of the sensor. Either manually or automatically cause the sensor to operate.
4. Read the digital display, or compare the waveform on the CRT to the schematic for the VCR. The output levels should not be within the questionable area discussed earlier.

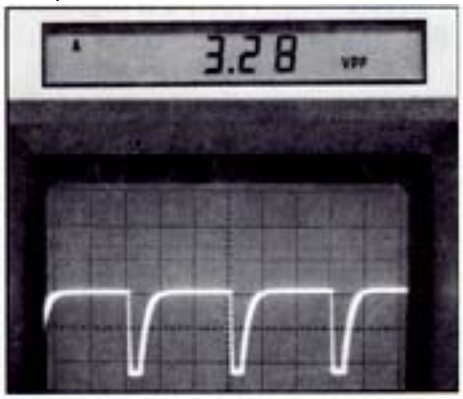

Fig. 3: Use the Waveform Analyzer's DIGITAL READOUT functions and the CRT to isolate defective sensors.