

VIDEO GAME MONITOR REPAIR

Troubleshooting Horizontal Deflection Failures

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Most video game monitor failures are pretty straightforward. A quick glance at the screen will usually point you to the general area of the problem. A missing color will lead you to the video amplifier circuits while a horizontal line will point to a loss of vertical deflection.

But a failure in the horizontal deflection circuit can be a bit more difficult to figure out because the monitor will appear to be completely dead. The characteristic high pitched squeal of a functioning monitor will be missing and there will be no picture or brightness of any kind on the screen. That's because the horizontal deflection circuit is used to drive the high voltage unit (see RePlay, June 1990 for more on high voltage units.) Without high voltage, there is no picture at all.

The Horizontal Deflection Circuit

The horizontal deflection circuit is similar in most monitors; in fact, it is almost identical in just about every video game monitor in use today. Inside an IC on the monitor's printed circuit board, a circuit known as the "horizontal oscillator" is used to generate an alternating current signal of approximately 15,750 Hertz. Although this signal will eventually be used to power the horizontal deflection coil in the yoke (as well as the high voltage unit) it is still very weak at this point (only about 1.5 VAC); it has to be amplified.

The output of the horizontal oscillator is connected to the input of the horizontal drive transistor where it is amplified to obtain an output of around 100 VAC. A small transformer (appropriately called the horizontal drive transformer) is used to change this output into a high current AC signal. This is used to drive the horizontal output transistor.

The horizontal output transistor is the hardest working transistor in monitor. All the current for the horizontal deflection coil in the yoke and the flyback transformer in the high voltage unit passes through the horizontal output transistor. In fact, approximately 80% of the power consumed by a video game monitor is controlled by the horizontal output transistor.

Troubleshooting Horizontal Failures

If the monitor has a blown fuse, chances are excellent that the horizontal output transistor has shorted. You can check it with your digital multimeter. Set the meter to the diode test setting. If your meter does not have a diode test, use a low resistance scale. Remove the power to the monitor. Ground the black meter lead to the chassis and touch the red meter lead to the collector of the horizontal output transistor. If the meter displays a low resistance or short circuit, you've found the culprit. A bad high voltage unit also may cause the fuse to blow. In fact, the horizontal output transistor and high voltage unit will often fail together (the bad high voltage unit having caused the transistor to fail.)

Horizontal deflection problems that do not blow the fuse are somewhat more difficult to troubleshoot. There are a few things that can cause the horizontal deflection to become inoperative. One may have nothing to do with a horizontal failure at all!

Most monitors include a circuit known as an "X-ray protector" or "high voltage shut-down." The purpose of this circuit is to shut down the high voltage if it becomes excessively high in voltage. It does this by killing the horizontal oscillator circuit. This prevents the monitor from emitting excessive X-rays.

To figure out if the horizontal deflection circuit is really defective or if it has been shut down by the X-ray protector, you should start your troubleshooting by disabling the shut-down circuit. This will be different in each type of monitor, so here are some commonly used video game monitors and the method of disabling the X-ray protector:

Electrohome	- Remove transistor X701.
Hantarex MTC 900	- Unsolder and lift one end of resistor R152.
Hantarex MTC 9000	- Unsolder and lift one end of diode D10.
Orion	- Unsolder and lift one end of diode D401.
Sharp Image	- Unsolder and lift one end of diode D410.
Wells-Gardner K4600 series	- Remove transistor TR353.
Wells-Gardner K7000 series	- Unsolder and lift one end of diode D12.

Note: Quite a few of the monitors use an HA-11235 integrated circuit for the horizontal oscillator. Pin 9 of this IC is used for the shut-down input. If you see a zener diode connected to this pin, lifting either end of the diode off the board will disable the shut-down circuit.

With the shut-down circuit disabled, apply power to the monitor. If the monitor now gives you a picture, the horizontal circuit is working. Your problem lies elsewhere (probably in the voltage regulator circuit.)

If the monitor is still dead, you need to make a few more tests. Measure the voltage at the collector of the horizontal output transistor. It should be around +110 to +130 VDC. **WARNING: NEVER TEST THE VOLTAGE AT THE COLLECTOR OF THE HORIZONTAL OUTPUT TRANSISTOR IF THE HORIZONTAL DEFLECTION CIRCUIT IS WORKING PROPERLY!** This test should only be performed if the monitor is dead. If you hear the high pitched squeal, or if a neon lamp glows when held near the flyback transformer (see RePlay, June 1990) measuring the collector voltage can damage your meter.

If the collector voltage is missing, there are only a few things that can be wrong. The most likely is a crack in the printed circuit board. Also, examine the solder joints around the high voltage unit. You may find some cracks or fractured solder joints. There is a highly remote possibility that the high voltage unit may be bad.

The Wells-Gardner K4900 series has a common problem with the jumpers that carry the +130 VDC power supply around the perimeter of the board. One of the jumpers is located in the position on the board that is subjected to stress from the plastic clip that holds the board in place on the chassis. Removal and replacement of the board can cause this jumper to break, cutting off the voltage to the horizontal output circuit.

If the collector voltage of the horizontal output transistor is good, test the voltage at the collector of the horizontal drive transistor. If this voltage is missing, the primary winding of the horizontal drive transformer or the resistor that is in series with it may be open. The resistor will generally be 5 watts at 2.2K to 3.8K ohms. Check these with the power turned off. Naturally, you want to check for bad solder joints here as well.

If the collector voltage measures at around 50 VDC, switch your meter to read AC volts and measure it again. If you read approximately 50 VAC, the horizontal drive circuit is probably working properly. Your problem is most likely an open secondary winding in the horizontal drive transformer or broken traces and/or bad solder joints between the output of the horizontal drive transformer and the base of the horizontal output transistor. There is a remote possibility that the horizontal output transistor is bad but this is highly unlikely. As the horizontal output transistor is often a specialized one (with an internal resistor and diode) the best test here is substitution with a known good component.

If the collector voltage of the horizontal drive transistor measures at +110 to +130 VDC, turn off the monitor and test the horizontal drive transistor. You must unsolder and remove the transistor from the printed circuit board to test it properly. Horizontal drive transistor failure is not too common, so don't be too hopeful.

If the drive transistor tests good, re-install it, apply power to the monitor and measure the voltage at the base of the horizontal drive transistor. It should measure at around .4 VDC and 1 VAC. If you have performed all the previous tests and still haven't found the problem, it probably won't. You probably will measure 0 VAC. This means that you do not have an output from the horizontal oscillator in the integrated circuit. Before you declare the IC to be defective, you should test to make sure that the IC has power (Vcc) to it. Most of the time this will be around 12 VDC. As before, this connection will vary from monitor to monitor. Here are some common monitors and the Vcc connection for each:

Electrohome	- IC501 Pin 6.
Hantarex MTC 900	- IC2 Pin 2.
Hantarex MTC 9000	- IC2 Pin 15.
Orion - IC401	- Pin 11.
Sharp Image	- IC401 - Pin 11.
Wells-Gardner K7000 series	- IC2 Pin 16.

Of course, any monitor that uses the same IC as those listed above, will use the same pin number for the Vcc input.

If the input voltage to the integrated circuit is okay, the IC itself may be defective. This is not a very common problem but at this point the IC should be replaced as you have all but eliminated everything else. If the Vcc power input to the integrated circuit is missing, trace the circuit back to see where it comes from. In general, the Vcc power for the IC comes from a 6.8K to 7.5K, 3 watt resistor that is connected to the +110 to +130 VDC power supply. If this resistor opens, it will cut off the power to the IC.

Author's note: Following these procedures should help you locate most horizontal deflection failures. As always, if you need any assistance, feel free to give me a call at 619.593.6131 and I'll try to help you out over the phone. Have your schematic ready, and be prepared to make some tests on the monitor as we discuss it. - Randy