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tech tips

Troubleshooting With The TVA92'S Horizontal Output Load Test

Problems that cause excessive loading on the B^+ power supply or flyback, or that affect the critical timing of the horizontal output stage often strain or damage output components when AC power is applied to the defective chassis. Timing problems can also cause the safety shutdown circuits to shutdown the chassis. In either case the "dead" horizontal output stage leaves the technician with no way to determine if circuits are working and no way to easily to pinpoint the problem.

The TVA92's Horizontal Output Load Test is specifically designed to troubleshoot these difficult horizontal output stage loading and timing problems. This Tech Tip covers how to use the Horizontal Output Load Test to troubleshoot B^+, horizontal output, and flyback secondary circuits with the chassis power turned off. Refer to Tech Tip #209, "Understanding the TVA92 Horizontal Output Load Test" for more information on how the test works.

When To Use The Horizontal Output Load Test

The most effective time to use the Horizontal Output Load test is when you are troubleshooting startup or shutdown symptoms. These symptoms may be caused by the switched mode power supply (SMPS), B^+ power supply, horizontal output circuit or safety shutdown circuits. But, because the chassis is dead, the actual cause is difficult to determine

The Horizontal Output Load test allows you to quickly check the B^+ load current and the resonant action horizontal output and flyback circuits without AC power applied to the circuit. If the Horizontal Output Load Test "mA" and "µS" readouts indicate "Good" you know the B^+ power supply is not severely loaded and the operation and resonant timing of the horizontal output circuits is OK. You can then use the DYNAMIC TESTS to further isolate the problem with the chassis AC power applied.

If either of the Horiz Output Load Test readouts indicate "BAD", you know there is a problem somewhere in the output stage. You can use the Output Load Test to help further isolate the defect.

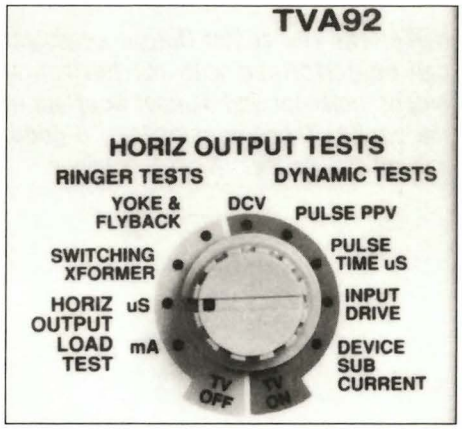

Fig. 1 - Use the Horizontal Output Load Tests to locate excessive B^+ loading or output timing problems.

Understanding The mA Readout

The Horizontal Output Load Test applies 15 volts to the chassis B^+ test point while it simulates the normal switching action of the horizontal output stage. The mA readout indicates the total current that is being delivered by the 15 volt supply to the output stage.

The 15 volt supply is approximately 1/10 of the normal B^+ voltage that is found in most full size color television receivers. Therefore the mA reading can be used to determine the approximate current load on the chassis B^+ supply. The circuits operate as they would if the full B^+ voltage were applied, but they draw approximately 1/10 of the current. To approximate what the actual load current would be at full voltage simply multiply the mA reading by 10.

In most receivers the actual B^+ current load will be slightly higher than this due to CRT beam current. A resistance check with an ohmmeter at the chassis B^+ test point, on the other hand, will only show DC shorts or leakage resistances. Readings greater than 80 mA indicate an excessive current load on the chassis B^+ power supply that is approaching 1 Amp or more.

NOTE: Some older televisions use a normal B^+ supply voltage less than 100 volts. These receivers may show more than 80 mA when tested with the Output Load Test. Use the DC Bias Supply to provide a voltage that is 1/10 of the chassis B^+ supply when testing or troubleshooting these receivers. See the section "Using The DC Bias Supply With The Horizontal Output Load Test" at the end of this Tech Tip.

Isolating DC Loading Problems

There are 3 common types of short and leakage problems that cause excessive B+ supply current.

1. A low resistance path for direct current (DC short to ground).
2. A DC leakage (higher resistance short).
3. An AC short or leakage path.

Use the Horizontal Output Load Test "mA" reading as a an indication of the severity

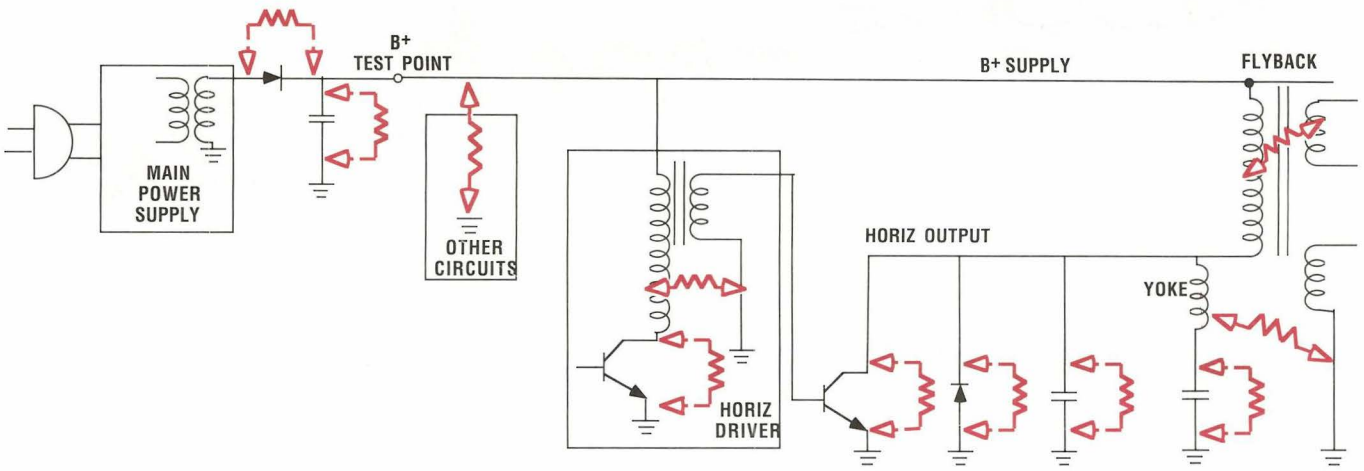

Fig. 2 - Possible DC short or leakage paths which can load down the B+ power supply

of the loading and to monitor the current as you troubleshoot the problem.

The B^+ current supplied by the Horizontal Output Load Test to the chassis is limited to 250 mA. Therefore a current reading of approximately 250 mA indicates a low resistance DC short from the B^+ power supply to ground. Before you assume a short however, confirm that you have connected the test leads to the proper B^+ and ground test points in the chassis.

The most likely cause of a DC short on the B^+ supply is a shorted horizontal output transistor. Disconnect the "B^+" (orange) Ringer/Load Test lead from the chassis and remove the horizontal output transistor. Then reconnect the "B^+" Ringer/Load Test lead and note the mA reading. If the mA readout is 10 mA or less, you have confirmed that the horizontal output transistor is shorted. If opening the horizontal output transistor does not remove the short, continue opening the possible DC short circuit paths shown in Figure 2 until you have isolated the defective component.

NOTE: The Horizontal Output Load test can be performed with the horizontal output transistor and damper in or out of the circuit. These components, if good, will not change the mA or μS readings.

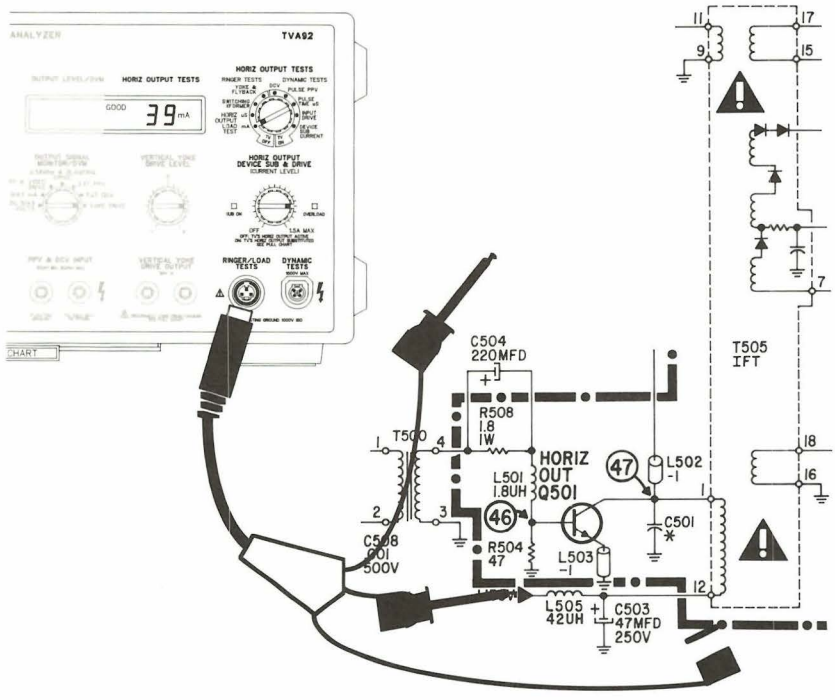

Fig. 3 - To determine if the loading is caused by DC or AC leakage, disconnect the "collector" (yellow) test lead. If the current drops below 10 mA the loading is caused by AC leakage.

Loading problems other than a low resistance short produce current readings ranging from 80 mA to 200 mA. The first step in isolating these loading problems is to determine if the added current is caused by a DC load or by an AC load. Do so by disconnecting the "collector" or yellow RINGER/LOAD Test lead from the horizontal output stage, as shown in Figure 3. Removing the collector lead stops the switching action of the output stage and removes all of the AC currents in the flyback and yoke. All power transfer to the flyback secondary circuits also stops.

Check the mA readout with the collector lead disconnected. The current now is only the DC current to circuits that are powered by the B^+ supply. This includes the horizontal output stage and perhaps the horizontal driver stage and oscillator. These stages typically draw less than 10 mA during the Output Load Test. If the current is much higher than this, suspect a DC short or leakage path on the B^+ power supply. If the current drops to normal, the excessive load is caused by AC leakage.

There are many possible DC leakage paths as shown in Figure 2. A DC short or leakage path can be caused by a leaky filter capacitor or diode in the B^+ supply itself, or by shorts or leakage paths in the horizontal output stage or other stages connected to the B^+ power supply. To isolate a DC short or leakage path, open the B^+ supply circuit path and hook the "B^+" (orange) test lead directly to the B^+ side of the flyback transformer. Leave the "collector" (yellow) lead open. A current

reading greater than 5 mA indicates a DC leakage or short in the horizontal output stage.

NOTE: Some televisions use a small DC current for horizontal yoke centering which may be seen during this test. Current in excess of 5 mA indicates a DC short or leakage path in the horizontal output stage components.

Isolating AC Loading Problems

If the current reading is between 80 mA to 200 mA during the Horizontal Output Load Test but drops to normal when the "collector" (yellow) lead is removed, the excessive load is the result of a severe AC load in the output stage. The extra current demand may be caused by shorted turns in the flyback or yoke, by a short or leakage in any of the secondary circuits of the flyback, or by the horizontal output transistor or damper diode breaking down. Some possible AC leakage paths are shown in Figure 4.

The best way to isolate AC loading problems is through a process of elimination: disconnect each possible leakage path while you monitor the current. Begin by removing the horizontal output transistor and damper diode. Repeat the Horizontal Output Load Test and compare the mA readout to the previous reading. If the mA reading decreased, the transistor or damper diode is leaky.

To isolate shorts on the flyback secondaries of the TVA92 use the EXT PPV & DCV INPUT to measure the DC voltages and Peak-to-Peak flyback pulse amplitudes on the secondary windings of the flyback. Remember that the load test simulates the chassis normal horizontal output circuit operation at approximately 1/10 of normal. Therefore the voltages will be approximately 1/10 of the normal values that are shown on the schematic.

AC or DC voltages that are considerably lower than 1/10 of normal, or that are completely missing, indicate a shorted component or scan derived circuit associated with that flyback winding. If you suspect a short circuit, open the current path. Then repeat the Load Test and compare mA readout. If the current decreased substantially the load on that flyback winding is excessive.

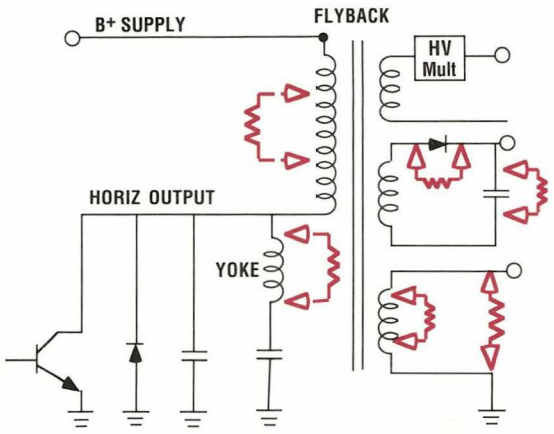

Fig. 4 - Possible AC shorts or leakage paths which can load down the B+ power supply.

NOTE: Use a voltage multiplier probe such as the Sencore TP212 when measuring the output of voltage multipliers or focus dividers.

If all of the secondary voltages appear normal, the load is likely caused by a shorted turn in the flyback or yoke, or by a component that is breaking down. Use the Ringer test to check the flyback and yoke for a shorted turn and use the Sencore Z-Meter to check capacitors and other components for breakdown at their full rated voltage

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Understanding The µS Readout

The Horizontal Output Load Test accurately simulates the normal switching action of the horizontal output stage. During the test a pulse is produced at the collector of the horizontal output transistor. The shape and width of this flyback pulse reflects the chassis normal resonant timing. Normal flyback pulse durations (time in µS) vary from about 11.3 µS to as long as 16 µS. Any stable microsecond reading in this range indicates normal output stage timing, and is accompanied by a "GOOD" indication. If the readout indicates "GOOD" you know that the horizontal output stage is developing normal flyback pulses of the proper duration and that it is not the cause of a dead or shutdown symptom.

A "BAD" readout however, indicates there is a timing or minor loading problem associated with the horizontal output circuits. You can use the Horizontal Output Load Test to further isolate the problem.

Isolating Timing Problems

There are 3 common types of problems in the horizontal output and flyback circuits that will cause the timing to be incorrect. Each of these problems produces a different µS reading.

"—-" readout - A reading of dashes during the Horizontal Output Load Test indicates that no flyback pulses are being produced. This is caused by an open in the B^+ supply path, flyback primary, or ground path or by a defective component in output stage that results in no flyback primary current.

Be sure and double check to be sure the RING/LOAD test leads are connected to the proper circuit test points. If they are this readout indicates an open circuit path. Use an ohmmeter to isolate the open.

Stable µS reading outside of the normal range - Stable pulse widths that are too long or too short are caused by a value change in one of the critical timing components in the horizontal output stage.

If the pulse width is longer than 16 µS, check the yoke and yoke series capacitor values. If the time is shorter than 11.3 µS, check the retrace timing capacitors and use the Ringer test to check the flyback and yoke. In some cases a short on the flyback secondary will effectively decrease

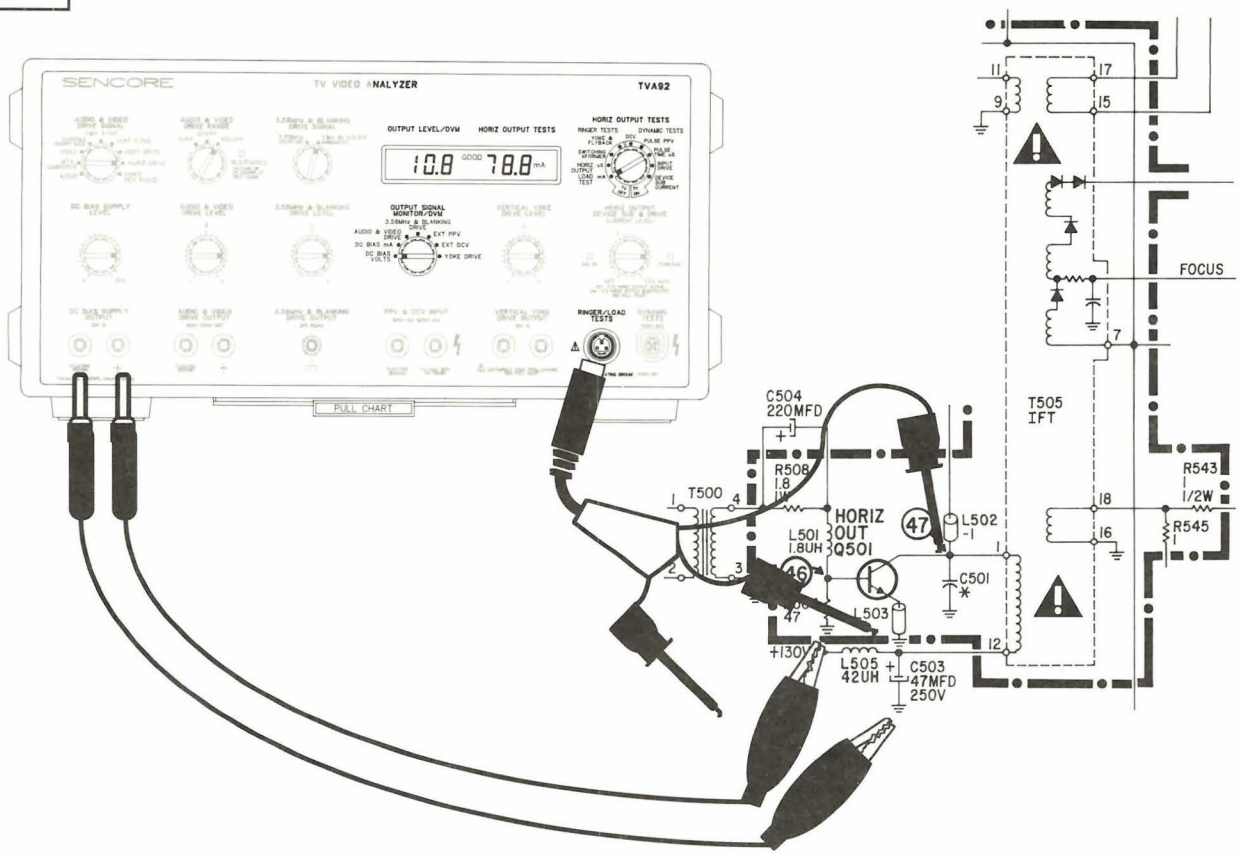

Fig. 5 - The DC BIAS SUPPLY may be used with the HORIZ OUTPUT LOAD TEST to simulate a B+ voltage that is exactly 1/10 of the normal chassis B+ voltage.

the inductance value of the flyback transformer and cause the pulse width to fall below 11.3 µS. Also check for abnormal loading of the flyback secondaries.

Fluctuating µS readings - Pulse times that randomly change within or outside of the normal time range indicate a short or leakage in the horizontal output stage or flyback secondaries. They are often accompanied by higher than normal mA readings.

Pulse times that vary by several µS or more indicate that the waveshape of the flyback pulse is abnormal. The waveshape may be multiple pulses or have abnormal ringing. This symptom is typically caused by loading problems in the flyback secondary or horizontal output stage. Test horizontal output components and flyback secondary circuits to isolate the problem.

Using The DC Bias Supply With The Output Load Test

The Horizontal Output Load Test energizes the horizontal output stages with a 15 volt B^+ supply. This voltage is approximately 1/10 of the normal B^+ voltage used in most modern full-size color television receivers. Some older chassis however, operate with a normal B^+ voltage that is lower than 100 volts. Many of these chassis will indicate greater than 80 mA when tested with the Load Test, even though the horizontal output stage is working properly.

You can accurately test these chassis by using the TVA92's DC BIAS SUPPLY to provide a lower B^+ test voltage. Disconnect the orange (B^+/15V) lead RINGER/LOAD TEST LEAD from the chassis. Then use the TVA92's DC BIAS SUPPLY to apply a DC voltage that is 1/10 of the chassis normal B^+ voltage. Monitor the DC Bias Supply current with the OUTPUT SIGNAL MONITOR/DVM, instead of with the HORIZONTAL LOAD TEST Readout. It should be less than 80 mA.

NOTE: You still use the HORIZONTAL LOAD TEST Readout to measure the µS pulse time.

You may wish to use the DC BIAS SUPPLY to supply a B^+ test voltage that is exactly 1/10 of the normal chassis B+ supply voltage when testing other chassis as well. This will make the voltages in the output and high voltage circuits very close to 1/10 of normal, compared to the 15 volts supplied by the HORIZONTAL LOAD TEST (unless the normal chassis B^+ is 150 volts).

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