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Interpreting The HA2500 Horizontal Output Load Test Readouts

The HA2500's LOAD TESTS and its readouts analyze the chassis horizontal output stage to identify defects or confirm normal operations. This Tech Tip explains how to interpret the LOAD TESTS.

Interpreting The Load Tests mA Readout

Load Test mA readings vary between high voltage only, deflection only or combination horizontal output stages. They also vary depend on the CRT size. Larger CRT sizes require increased yoke current and high voltage resulting in greater horizontal output stage power demands.

A high voltage only horizontal output stage typically demands 5 to 20 watts of power. If the chassis B+ voltage is 100 volts, the B+ supply delivers 200 mA to the horizontal output for 20 watts. This corresponds to a Load Test mA reading of near 20 mA. If another chassis requiring 20 watts uses a B+ voltage of 125 volts, the power supply current is 160 mA corresponding to a Load Test mA reading of 16 mA. Considering a power range of 5 to 20 watts and a typical B+ voltage range, Load Test mA readings ranging from 10 to 30 mA are typical in high voltage only horizontal output stages. Slightly higher mA readings may be encountered if the output stage operates at B+ voltages below 70 volts and/or has power demands exceeding 20 watts.

Deflection only and combination horizontal output stages require more power and subsequently more B+ power supply current (see Chart 1). The added power demand increases typical mA readings during the Load Test. Combination horizontal output stages in TVs with CRT sizes less than 27 inch or multi-frequency monitors with CRT sizes less than 18 inch, typically have Load Test mA readings from 10 to 50 mA. Deflection only horizontal output stages among multi-frequency monitors with larger CRT sizes, typically have Load Test mA readings from 10 to 70 mA. This range is also typical of combination horizontal output stages in TVs with CRT sizes exceeding 26 inches and multi-frequency monitors with CRT sizes exceeding 17 inches.

Load Test mA readings in the typical range indicate a normal current load on the B+ power supply. Check the µS and Efficiency % reading to confirm that the horizontal output stage has no other defects. Load Test mA readings below 5 mA in high voltage only horizontal output stages or below 10 mA in other horizontal output stage types are unusually low. Unusually low mA readings may indicate an improper Load Test Setup or an improper circuit connection.

Load Test mA readings greatly exceeding the typical current range for the horizontal output stage type and CRT size indicate a heavy current demand in the horizontal output stage or flyback secondary. A heavy current demand loads the high voltage or deflection regulator and B+ power supply stressing components when AC voltage is applied. Isolate the problem and confirm normal Load Test results before applying AC voltage.

Load Test mA readings that are slightly above the typical current range are questionable. It may be normal for a chassis to slightly exceed the typical mA range if its B+ voltage is lower than the norm or its power requirements are slightly higher. Current readings exceeding the typical range may indicate a subtle horizontal output stage problem or result from using a slightly higher than normal Load Test B+ voltage or lower than normal test frequency.

When a mA reading is questionable, check the VPP reading in the LOAD TEST SETUP position of the LOAD & RINGER TEST switch. A B+ voltage higher than the 1/10 level causes an increase in output stage power demand and load on the B+ supply. Reduce the B+ voltage until the VPP is approximately 1/10 of the chassis normal.

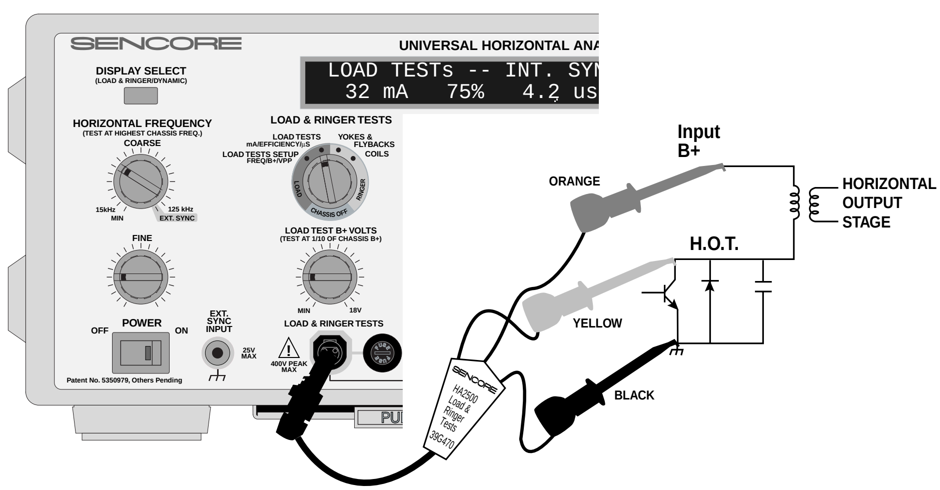

Fig. 1: The three LOAD TESTS readouts determine if the horizontal output stage is normal or contains a defect.

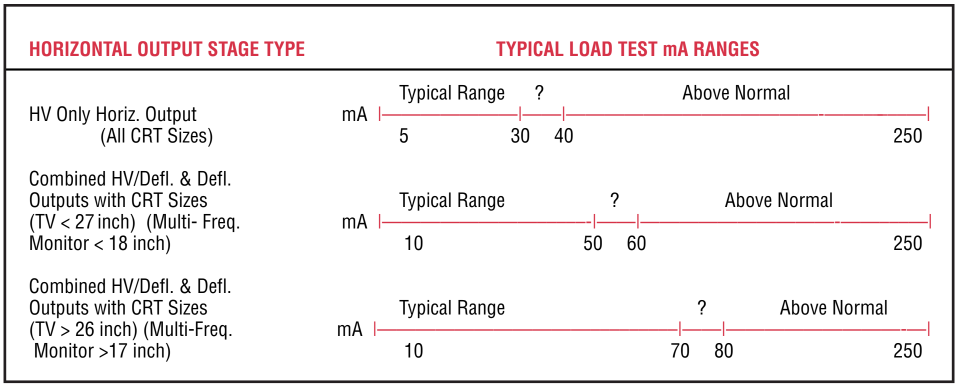

Chart 1: Typical Load Test mA ranges of horizontal output stages.

This may reduce the mA reading into the typical range. Check the Load Test µS and Efficiency % readouts. If either or both tests indicate unusual readings, a horizontal output stage defect is likely. If both tests indicate normal, the horizontal output stage does not have a severe defect and AC power may be applied for further testing.

Interpreting The Load Tests Efficiency % Readout

The "%" readout measures what percentage of the input energy returns to the B+ power supply at the end of the horizontal output stage cycle. Horizontal output stages are tuned circuits which return a share of the input energy back to the power supply at the end of each cycle. Defects add power losses, greatly reducing the efficiency of the horizontal output stage and the % of energy returned at the end of each cycle.

The % readout is based upon the ratio of two current measurements reflecting the efficiency of the horizontal output stage under test. The measurements include a gated conduction current measurement of the Load Test's horizontal output transistor and secondly the Load Test's "mA" or B+ power supply current. The gated current measurement captures the horizontal output transistor conduction current representing the total input of energy to the components of the horizontal output stage. The B+ supply current represents the current needed to replenish the output stage to satisfy its current demand each cycle. The supply current represents the energy or current consumption of the output stage and transformer secondaries.

The ratio of these currents represent what % of the input energy or current is returned to the output stage during each horizontal cycle. If all the input energy to the horizontal output stage was returned at the end of the cycle, it would be 100% efficient. But all horizontal output stages have some inefficiencies or losses. Power is induced into the flyback transformer secondaries and used to produce CRT currents and gating pulses to other stages. Other energy is dissipated in the inherent losses of the components in the horizontal output stage. For this reason, the efficiency % readout is less than 100% and typically less than 90%. High voltage only horizontal output stages typically are 60 - 90% efficient. Deflection only and combination horizontal output stages typically range from 55 - 90% efficient.

A % readout in the typical range indicates the horizontal output stage and transformer secondary circuits are exhibiting a normal range of energy losses and transfer. Efficiency % readouts considerably below the typical range for the horizontal output stage configuration indicates a substantial increase in losses or power transfer to a secondary. Low efficiency % readouts usually accompany high mA readouts when severe horizontal output stage problems exist.

The % readout is especially useful when testing multi-frequency monitors. An error in setting the Load Test B+ voltage and/or test frequency may cause the "mA" readout to be above the typical range when the chassis is good or in the typical range when the chassis has a defect. The % readout provides an additional test of the horizontal output stage to identify if excessive circuit losses exist. The % readout is influenced only by extreme B+ or test frequency errors. If the % readout is in a normal range, a higher than normal "mA" readout is likely a result of too much applied B+ voltage and/or an improper test frequency. A high mA readout accompanied by a lower than normal % readout confirms a horizontal output stage defect.

Interpreting The Load Tests µS Readout

The Load Tests "µS" readout measures the time duration of the voltage or "flyback" pulse at the collector or drain of the horizontal output transistor during the Load Test. The measurement is taken between the 5% levels of the voltage pulse for pulses exceeding 10 VPP. The µS measurement closely agrees with the pulse time of the chassis when powered to its full B+ voltage.

The timing of the flyback pulse influences the level of energy induced to the yoke to produce deflection and into the flyback transformer to produce high voltage. The time of the pulse determines the time for yoke retrace in which the video is blanked. The pulse time is determined by the inductance and capacitance values in the horizontal output stage.

The normal µS pulse time among CRT displays varies among horizontal output stages depending on the display's horizontal scanning frequency or frequency range. It further depends on the horizontal blanking time of the video to be displayed. The pulse time must begin and end relative to the video's horizontal blanking interval. If

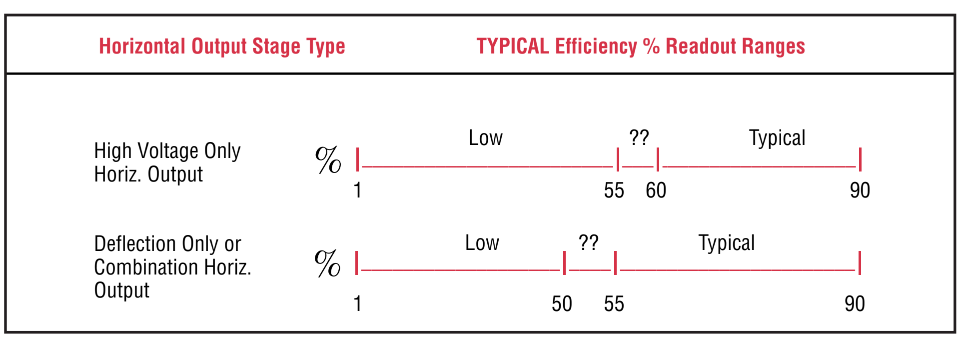

Chart 2: Typical efficiency "%" ranges among horizontal output stages.

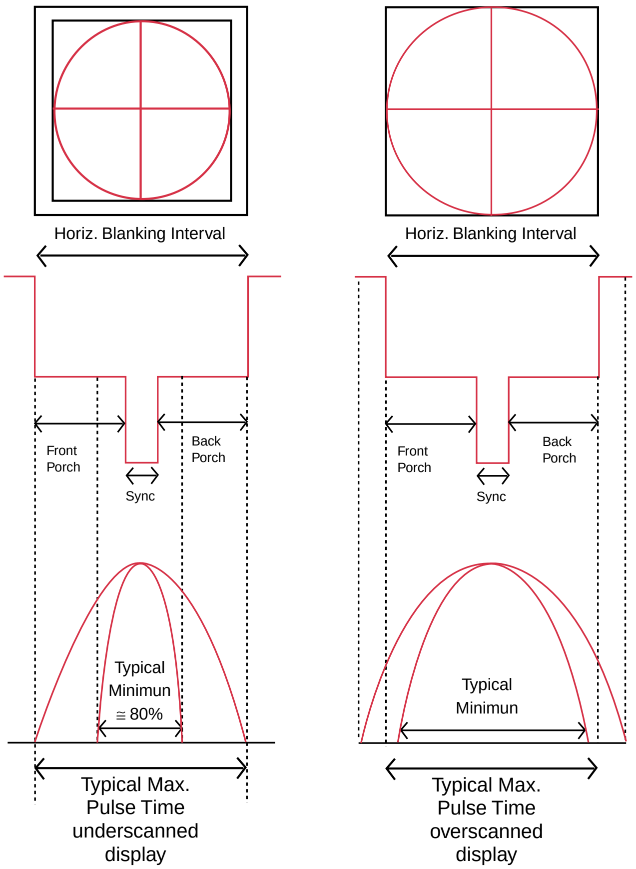

Fig. 2: Typical pulse µS times relate to the horizontal blanking interval and overscan or underscanned characteristics of the display.

the picture is overscanned, such as in NTSC television, the pulse duration is typically 0-30% greater than the approximately 11 µS blanking interval (see Fig. 2). Since the video is overscanned on the CRT, the voltage pulse begins just before the start of the horizontal interval and ends slightly after the horizontal interval. This produces typical µS pulse duration's of 11 to 15 µS on NTSC compatible television displays.

On underscanned video displays, the voltage pulse does not begin until the start of the blanking interval and ends before active video begins at the end of the horizontal interval. This is because video blanking and retrace cannot occur during active video which is visible on the CRT edges. Therefore, the video's horizontal blanking time serves as an approximate maximum µS pulse time in multi-frequency displays. The minimum µS time in an underscanned display is typically not less than 80% of the blanking interval time. This produces typical µS pulse durations from 80-100% of the horizontal blanking time. This range applies to deflection only and combination horizontal output stages and most high voltage only horizontal output stages.

For example, several monitor video format frequencies and their corresponding horizontal blanking intervals are shown in Chart 3. VGA computer monitor operating at 31.5 kHz display a video format with a horizontal blanking time of 6.35 microseconds. The typical range of horizontal pulse time among VGA monitors ranges from approximately 5.0 µS (approx. 80% of 6.35 µS) to 7.0 µS. A monitor designed to display a higher resolution VESA format at 60 kHz displays a video with a horizontal blanking interval of 3.56 µS. Monitors designed to display up to a 60 kHz video format would have horizontal stage pulse times ranging from approximately 3.0 to 4.5 µS.

Chart 3 shows that as a CRT video display's horizontal scanning frequency increases, the video's horizontal blanking time decreases. As the horizontal blanking interval decreases, so does the normal range of horizontal pulse or µS readings. To determine the typical µS range for a particular chassis, reference a horizontal scanning frequency and/or horizontal blanking interval that matches the monitor's highest horizontal frequency or resolution capability.

A multi-frequency monitor has the ability to display different video formats with various horizontal scanning frequencies and blanking intervals. The horizontal voltage pulse or µS timing is limited by the video format containing the shortest horizontal blanking interval. This is usually its highest

Scan Format	Horiz. Frequency	Horiz. Blanking Time	Typical µS Range
TV- NTSC	15.7 kHz	11 µS	11.0 - 15 µS
CGA	15.7 kHz	18 µS	11.0 - 18.5 µS
MDA, Hercules	18.4 kHz	10 µS	7.0 - 10.5 µS
VGA	31.5 kHz	6.35 µS	5.0 - 7.0 µS
VESA	38 kHz	6.1 µS	4.8 - 7.0 µS
XGA	35.5 kHz	5.3 µS	4.2 - 6.0 µS
VESA	46.88 kHz	5.17 µS	4.1 - 5.5 µS
XGA-2	39 kHz	4.57 µS	3.6 - 5.0 µS
Generic	48 kHz	4.35 µS	3.5 - 5.0 µS
DEC	54 kHz	3.6 µS	2.8 - 4.5 µS
VESA	60.02 kHz	3.56 µS	2.8 - 4.5 µS
VESA	63.98 kHz	3.78 µS	3.0 - 4.5 µS
VESA	75.0 kHz	3.46 µS	2.8 - 4.0 µS
VESA	79.98 kHz	3.0 µS	2.4 - 3.5 µS
VESA	81.25 kHz	3.2 µS	2.5 - 3.5 µS
VESA	93.75 kHz	2.765 µS	2.2 - 3.5 µS
VESA	106.25 kHz	2.44 µS	2.0 - 3.5 µS

Chart 3: The typical µS horizontal pulse time range for video displays of different frequency and horizontal blanking times.

horizontal scan frequency. To approximate the horizontal output stage μS pulse time in a multi-frequency display, reference the display's highest horizontal frequency capability and the corresponding video format's blanking time. The horizontal voltage pulse time should be equal or shorter than the horizontal blanking interval, but typically not less than 80% of the blanking time.

A horizontal output stage pulse time that is in the range shown in Chart 3 for the video display's frequency and blanking capabilities indicates proper horizontal output stage timing. A pulse time outside of the typical range indicates questionable timing or a horizontal output stage defect.

Readings slightly below the anticipated range may indicate the monitor is capable of a higher resolution. Readings below the typical range for the monitor's known highest frequency capability and its video blanking time indicate a likely problem in the horizontal output stage. Readings below the typical μS range may result in high voltage shutdown, horizontal output transistor failures, or possible B+ power supply loading.

For More Information,
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Form #6657
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