Issue No. 120

HDTV. . . Are You Ready?

THE SERVICER'S ADVANTAGE

Information developed or compiled by Sencore Electronics in support of the electronic servicer.

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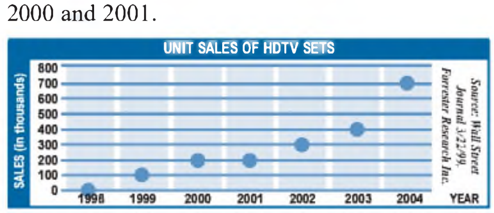
Editorial

This Servicer's Advantage features the **HA2500 Universal Horizontal Analyzer**. The following pages illustrate simplified operating procedures that demonstrate the ease of connecting the HA2500 into a defective television or computer monitor and quickly isolating the problem to a stage or even component. As you review these procedures you'll see that the HA2500 provides a powerful troubleshooting solution for you today and *in the future*.

Yes, the HA2500 not only analyzes today's TVs, computer monitors and other CRT video displays but you can anticipate using the HA2500 for the next decade or more. This is good news for the many servicers who are already familiar with the time and money saving analyzing tests offered by the HA2500 and for those preparing for HDTV servicing opportunities.

HDTV Servicing Opportunities

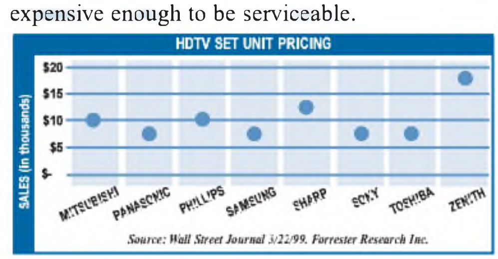
HDTV receivers went on sale in the fall of 1998 and by May of 1999 homes in the top ten television markets will receive a high definition signals. However, initial sales of HDTV sets to consumers is expected to be slow. Forrester Research Inc. as featured in the Wall Street Journal projected that only 100,000 HDTV sets would be sold in the 1999 and 200,000 in the years 2000 and 2001.



One of the main reasons for the slow sales growth is the price of the HDTV receivers. The chart below shows the current prices of HDTV receivers from a sampling of manufacturers. Today prices on these sets range from $7,000 to $18,000, far too steep for the majority of consumers.

The slow increase in HDTV sales will likely result in two waves of opportunity for consumer electronics servicers. First, many people interested in purchasing an HDTV receiver will wait until the price of the sets go down. Instead of investing in a new standard television, many consumers are expected to have their current set repaired, delaying a TV purchase until they can afford an HDTV set. This is the first wave of opportunity.

The second wave of opportunity comes when HDTV prices fall and become affordable for many consumers. Even with the price reduced enough to increase HDTV sales, set costs will still be expensive enough to be serviceable.



Are You HDTV Ready?

According to our research, HDTV receivers are similar in operation to high-resolution computer monitors and projection TVs once the signal is demodulated and decompressed in the set top converter or receiver portion of the HDTV. The 18 ATSC (Advanced Television Systems Committee) formats, which are the baseband video signals in the digital television standard, range in horizontal scan frequency from 15.7 kHz to 33.8 kHz offering varying modes of picture resolution. HDTV sets will have multi-frequency horizontal scan and drive circuits and will develop high voltage and sweep much like high resolution CRT based computer monitors and projection TVs.

It is anticipated that the HA2500's exclusive analyzing tests that isolate faults in today's high-resolution computer monitors is expected to do the same in tomorrow's HDTV sets. The HA2500's horizontal frequency range is 15 kHz all the way up to 125 kHz, covering future resolution range expansion. As you read and study the following pages, remember that the HA2500 is not only an investment to help you conquer today's service challenges, but the challenges of the future as well.

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SERVICING TECH TIP

Understanding Horizontal Stages In Multi-Frequency CRT Video Displays

Horizontal stages are part of every CRT based video display. The horizontal stages produce flyback transformer current to generate high voltages required by the CRT and horizontal yoke current to deflect the CRT beam side to side. Horizontal and related stages can be broken into six major functional areas shown in Figure 1.

CRT VIDEO DISPLAY
(Horizontal Block Diagram)

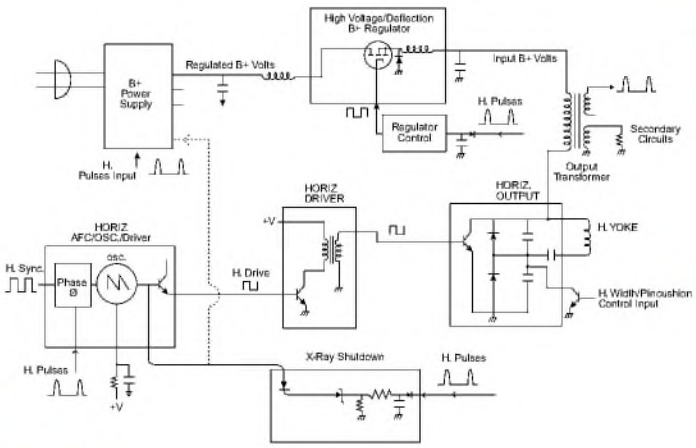


Figure 1 *Horizontal output and related stages in a multi-frequency CRT video display.*

1. **Horizontal Output** - Produces AC currents in flyback and/or yoke to produce high voltage and/or deflection.
2. **B+ Power Supply** - Provides regulated B+ power (volts X current) to power the horizontal stages.
3. **HV/Deflection B+ Regulator** - Adjusts the B+ voltage applied to the horizontal output stage keeping the high voltage and/or deflection constant with changes in scanning frequencies or modes.
4. **Horizontal AFC/OSC** - Generates a sync-locked horizontal drive signal required by the horizontal output stage.
5. **Horizontal Driver** - Amplifies the weak horizontal drive signal to a level required by the base or gate of horizontal output transistor.
6. **X-Ray Shutdown** - Disables the horizontal output stage by removing horizontal drive or B+ voltage when the high voltage is excessive.

Characteristics of horizontal stages used in Multi-Frequency CRT Video Displays:

1. The B+ Power Supply is commonly a switch mode power supply type.
2. B+ voltage varies among displays from 35 to 200 volts.
3. Horizontal scanning frequencies range from 15.7 to over 100 kHz.
4. Components (S-Shaping capacitors) are switched in or out of the horizontal output stage.
5. Width, pincushion and centering circuits effect horizontal output stage operation.
6. The horizontal output stage flyback pulse duration or timing differs among displays.
7. B+ voltage to the horizontal output stage may be switched on/off with microprocessor control.
8. Horizontal output stages differ in transistor types and circuit configurations.

Understanding Horizontal Troubleshooting Difficulties

Service technicians indicate that more than half of monitor defects are horizontal stage related. Defects cause dead monitor, switch mode power supply, start-up, shutdown, burnt part symptoms and questionable expensive components like the integrated flyback and yoke. Horizontal related symptoms are difficult to troubleshoot because the horizontal stages (see Figure 1) interact so closely. Common reasons horizontal stages are difficult to troubleshoot include:

1. A SMPS defect or abnormal increase in horizontal output stage current can decrease the B+ output voltage from the SMPS.
2. Defects resulting in excessive horizontal output stage current demand places immediate stress on the horizontal output transistor, high voltage/deflection regulator and B+ supply components.
3. A shorted flyback turn or secondary circuit short causes excessive horizontal output stage current (loading) and is not evident with ohmmeter resistance tests.
4. The high voltage/deflection regulator controls B+ to the horizontal output stage interacting with the horizontal output stage and SMPS.
5. X-Ray shutdown disables the horizontal output stage resulting in momentary voltages and wave forms with no effective means to isolate the cause.
6. Flyback pulses feed back to the AFC/Phase circuit resulting in a circuit loop that can cause unusual drive-related defects including picture interference and flyback noise.

7 Microprocessor control during resolution or mode changes, energy management or on/off powering can defeat or alter horizontal stage operation.

8 Horizontal drive problems can cause horizontal output transistor heating, leading to premature failures.

These difficulties cause replaced components to overheat or burn out when AC power is applied. Voltages or wave forms may be missing or only appear momentarily, telling you little about what stages are bad or result in no improvement to symptoms after replacing suspect components.

HA2500 Universal Horizontal Analyzer Exclusive Analyzing Tests

The Sencore HA2500 Universal Horizontal Analyzer provides exclusive analyzing tests and substitution capabilities to effectively isolate horizontal related stage defects.

Chassis Off - Horizontal Output Stage Analyzer:
Isolates horizontal output stage defects which prevent "Power On" troubleshooting (Dead or loaded SMPS, shutdown, H.O.T failures). Variable frequency and B+ voltage provide universal application.

Patented Ringer Test:
Proves if the flyback or yoke is good or bad from shorted turn(s).

Dynamic Horizontal Output Meter:
Quickly confirms normal horizontal output stage operation or identifies horizontal drive, B+ supply or output stage problems through a 3 lead H.O.T. hookup.

Exclusive Horizontal Driver Test:
Analyzes the horizontal driver stage's output current to identify weak or intermittent base drive, a common cause of horizontal output transistor failures.

Horizontal Output Transistor Base Or Gate Sub Drive:
Substitutes a missing or suspected horizontal drive to prove good or bad the horizontal output stage and its expensive components. Adjusts base drive automatically to prevent H.O.T heating while subbing.

Substitute B+ Power Supply:
Substitutes the chassis B+ power supply voltage to isolate SMPS, HV/deflection regulator, horizontal output or X-Ray shutdown symptoms. Variable output voltage and current limited to isolate horizontal output stage component breakdowns.

Ext. Sync Input:
Locks the Load Test and Base Sub Drive & Gate Sub Drive to the generator for testing of the display's signal processing stages by viewing the CRT.

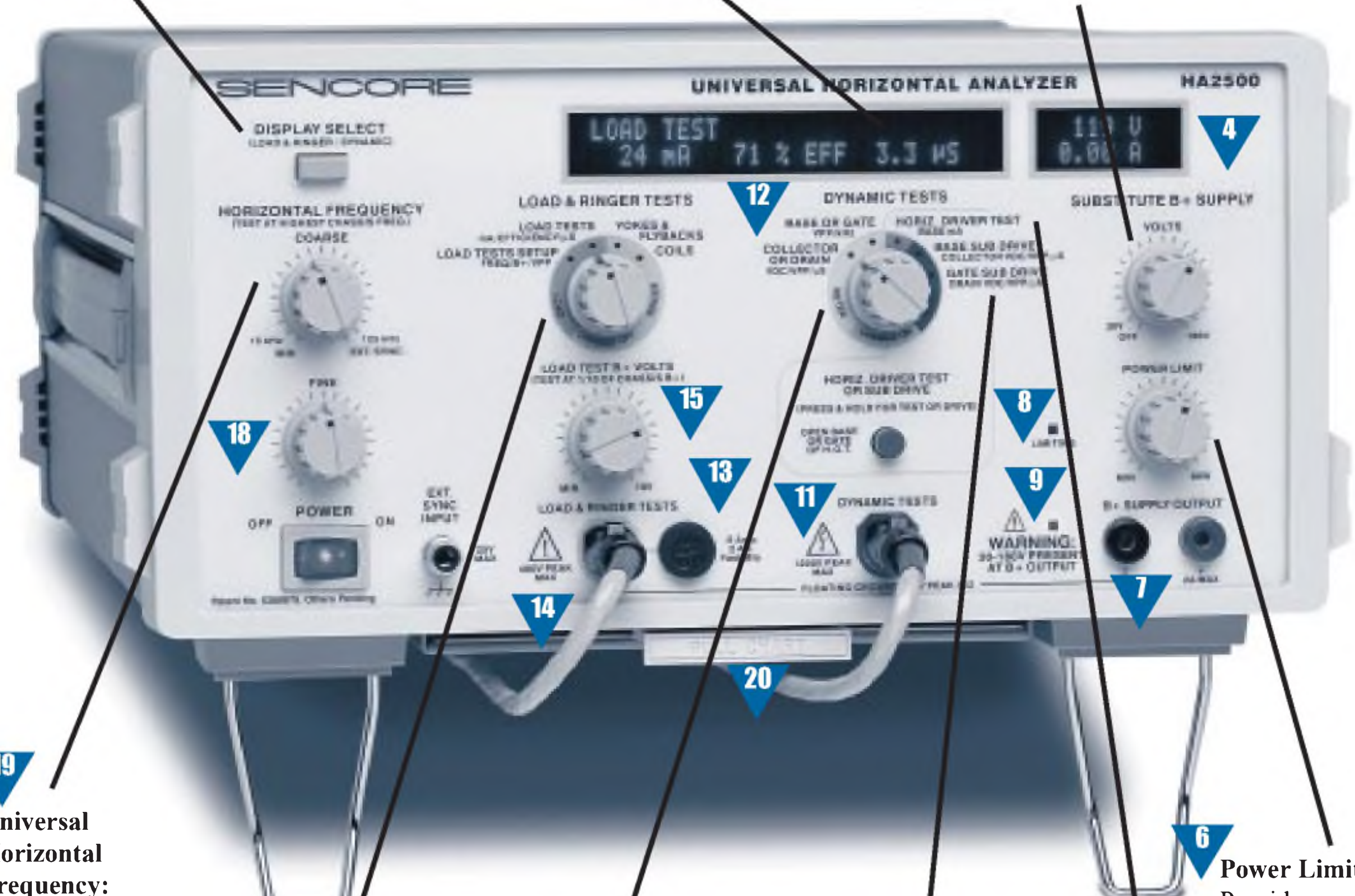
Smart Protection:
Protects the HA2500 and video display from threatening conditions or user errors.

Features & Front Panel Controls

1 **Simplified Display Select:** Allows you to switch easily between Load & Ringer and Dynamic Tests

3 **New Fluorescent Display:** Now you can clearly view all measurements – even in low light conditions

5 **Exclusive Substitute B+ Supply:** Variable 30-180 volts, so now you can take control and substitute for the B+ power supply



6 **Power Limit:** Provides power limiting for substitute B+ supply to protect the circuit and components

19 **Universal Horizontal Frequency:** Two modes of operation (internal generator or externally synced to a generator) allow the HA2500 to analyze all circuits from 15 kHz to 125 kHz

2 **Patent Pending Load & Ringer Test:** These tests will help localize horizontal circuit defects - with the chassis turned "off"

12a **Dynamic Tests "METER":** Performs automatic "chassis on" measurements through 3 lead hook-up to the horizontal output transistor to analyze the horizontal output stages for defective horizontal drive and B+ voltages

Patented With Other Patents Pending – A Sencore Exclusive–

12e **Dynamic Tests "DRIVE":** Substitutes horizontal drive to base or gate of horizontal output transistor to test horizontal output and isolate drive defects

12c **Horizontal Driver Test:** Measures current output of horizontal driver stage to detect weak or intermittent horizontal drive

Controls

1. DISPLAY SELECT Pushbutton - Selects either the LOAD & RINGER TESTS or DYNAMIC TESTS for display.

2. LOAD & RINGER TESTS Switch - Selects the LOAD TESTS or RINGER TEST to be displayed in the center display panel using the LOAD & RINGER TESTS Jack (14).

a. LOAD TEST SETUP - Displays the HORIZONTAL FREQUENCY (19) and LOAD TEST B+ (15). Simulates the operation of the chassis horizontal output stage and measures the resulting flyback pulse volts peak-to-peak.

b. LOAD TESTS - Simulates the operation of the chassis horizontal output stage and measures the B+ current, calculates the stage efficiency and measures the duration of the resulting flyback pulse.

c. YOKES & FLYBACKS - Tests for a shorted turn in a yoke or flyback using the LOAD & RINGER TESTS Jack (14).

d. COILS - Tests coils for a shorted turn using the LOAD & RINGER TESTS Jack (14).

3. CENTER FLUORESCENT DISPLAY - Displays results of tests selected by the LOAD & RINGER TESTS Switch (2) or DYNAMIC TESTS Switch (12).

4. RIGHT FLUORESCENT DISPLAY - Displays output voltage and current from the Substitute B+ Supply to the B+ SUPPLY OUTPUT Jack (7).

5. VOLTS Control - Selects the voltage output to the B+ SUPPLY OUTPUT Jack (7).

6. POWER LIMIT Control - Sets the maximum amount of voltage times current output to the B+ SUPPLY OUTPUT Jack (7).

7. B+ SUPPLY OUTPUT Jacks - Provides voltage and current output from the Substitute B+ Supply. Use the B+ SUPPLY TEST LEAD (25) to connect to the chassis.

8. LIMITING Light - Lights when the voltage times current output at the B+ SUPPLY OUTPUT Jack (7) exceeds the setting of the POWER LIMIT Control (6) setting.

9. WARNING Light - Warns of voltages present to the B+ SUPPLY OUTPUT Jack (7) that can cause a shock.

10. HORIZ. DRIVER TEST OR SUB DRIVE Pushbutton - Use to activate the HORIZ. DRIVER TEST (12c) and the SUBDRIVE (12d, 12e).

11. DYNAMIC TESTS Jack - Provides connection to the chassis for performing the Dynamic Tests. Use the DYNAMIC TESTS LEAD (24).

12. DYNAMIC TESTS Switch - Selects the Dynamic Test to be performed using the DYNAMIC TEST LEADS (24) connected to the chassis horizontal output transistor. Read results in the center phosphor panel (3).

a. COLLECTOR OR DRAIN - Measures DC volts, pulse VPP, and time at the collector or drain of the chassis horizontal output transistor with the chassis on.

b. BASE OR GATE - Measures drive signal peak-to-peak volts and frequency at the base or gate of the chassis horizontal output transistor.

c. HORIZ. DRIVER TEST - Simulates a bipolar transistor low impedance junction to test the current drive output of the horizontal driver stage. Test enabled with the HORIZ. DRIVER TEST OR SUBDRIVE Pushbutton (10).

d. BASE SUB DRIVE - Outputs a horizontal drive optimized to properly drive the base of a bipolar horizontal output transistor. Output drive is enabled with the HORIZ. DRIVER TEST OR SUBDRIVE Pushbutton (10).

e. GATE SUB DRIVE - Outputs a horizontal drive optimized to properly drive the gate of a MOSFET horizontal output transistor. Output drive is enabled with the HORIZ. DRIVER TEST OR SUBDRIVE Pushbutton (10).

13. LOAD TESTS FUSE (44G62) - Protects the Load Test from chassis voltages.

14. LOAD & RINGER TESTS Jack - Provides connection for the LOAD TESTS (2a, 2b) and the RINGER TESTS (2c, 2d) using the LOAD & RINGER TEST LEAD (23).

15. LOAD TEST B+ VOLTS Control - Adjusts the B+ voltage applied to the horizontal output stage during the LOAD TEST.

16. EXT. SYNC INPUT Jack - Used to receive horizontal sync signals that may be decoded to horizontal drive for the LOAD TEST and SUB DRIVE functions.

17. POWER Switch - Provides or removes AC power.

18. FINE Control - Provides fine frequency control of the internal horizontal frequency generator.

19. COARSE Control - Provides coarse frequency control of the internal horizontal frequency generator. Selects an Ext. Sync Input signal.

20. PULL CHART - Provides simplified operating instructions and handy reference charts.

SERVICING TECH TIP

Horizontal Output Load Test

The HA2500's Load Test analyzes the horizontal output stage for defects with no ACV to the chassis. The test simulates the operation of the output stage at its normal operating frequency and at 1/10 its normal B+ voltage. The test finds defects that burn-up replacement parts when you apply AC, cause shutdown, or don't permit start-up.

Load Test Setup

To perform the Load Tests, unplug the monitor and connect the test leads to the horizontal output stage. In the Load Tests Setup position of the Load & Ringer Tests Switch, perform the setup steps to simulate operation of the horizontal output stage near its highest operating frequency and 1/10 of its normal B+ voltage.

Figure 2

"Setup" Steps (see Figure 2):

1. Remove AC power to the chassis.
2. Set the Load Tests B+ Volts Control to "MIN."
3. Set the Horizontal Frequency near the monitors highest operating frequency.

Note: *The wrong frequency won't cause damage and you must be off 10-20 kHz before results change significantly.*

4. Connect the Load Tests lead.
5. Increase the Load Tests B+ Volts Control until the VPP readout is 1/10 of normal or near 100 VPP. Record the Load Test Setup readouts.

Load Tests Setup: Horizontal Frequency

_________ kHz _________ VDC _________ VPP

The Load Test works fine with either a good horizontal output transistor soldered in the chassis or with the horizontal output transistor removed. A shorted horizontal output transistor causes a "Current Limiting" readout during Load Tests Setup.

Load Test	Display Readout	Description of Test
B+ Current	milliamps (mA)	The current supplied by the Load Test B+ power supply to the horizontal output stage under test.
Efficiency	percent (%)	The % of the current input to the horizontal output stage at the beginning of the horizontal cycle that is returned to the power supply at the end of the cycle.
Pulse Time	microseconds (µS)	The duration of the induced voltage pulse produced by the horizontal output stage.

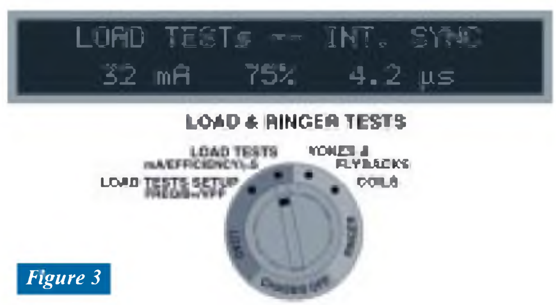


Figure 3

Load Test Steps (see Figure 3):

1. Select "Load Tests."
2. Read the "mA", "uS", and "Eff." readouts.
3. Record your readings in the spaces below.

Normal Load Tests

mA _________ Eff. % _________ uS ___________

A good horizontal output stage typically will show readings in the following ranges:

- Typical mA range: 10 - 60 mA
- Typical Eff. % range: 50 - 90 %
- Typical uS range: TV = 11.0 us - 14.0 uS
  Computer Monitor = 3.0 - 5.0 uS

Note:
For more specific information on typical Load Test mA, %, and uS ranges for various display sizes and types refer to the charts found in the HA2500's Pull Chart.

Load Tests with Simulated Bad Flyback

Horizontal output stage defects are indicated by changes to the Load Tests readings. To see this for yourself, decrease the HA2500's Load Tests B+ Volts control to minimum. Simulate a shorted flyback turn by wrapping a piece of solder around the flyback's black core material (see Figure 4).

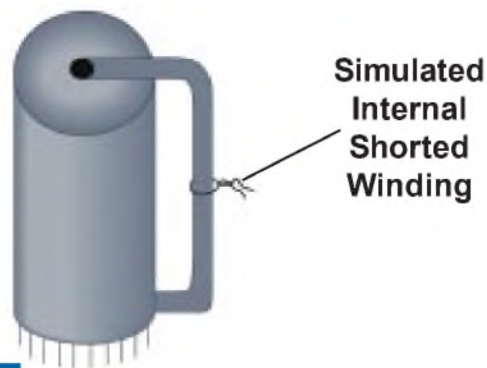


Figure 4

Figure 5

Load Test With Simulated Bad Flyback Steps (see Figure 5):

1. Set the Load Tests B+ Volts Control to "MIN."
2. Loop solder around the flyback's black core and twist the ends together.
3. Select "Load Tests Setup" - increase the Load Tests B+ Volts control for -100 VPP.
4. Select "Load Tests" and record your readings.
5. Compare your readings with the normal Load Test readings.

Defective Load Tests

mA __________ Eff. % __________ uS ___________

6. Decrease the Load Tests B+ Volts control to "MIN" and remove the solder loop from around the flyback core.

A single flyback shorted turn increases the mA reading and decreases the efficiency % reading significantly. This defect and others, such as a bad horizontal yoke and leaky secondary diodes or capacitors cannot be detected with an ohmmeter. You can further isolate these and timing defects using the HA2500 Load Test.

Load Tests Readouts mA	%	µS	Likely Causes
High mA	Very Low <6%		Improper connection. DC leakage.(See Fig. 1)
High mA	Low%		Horiz. Out Defect – Shorted inductor turn(s), secondary short, leaky or open component. (See Fig. 2)
Normal mA	Low% or low µS	Near Normal	Load Test Freq. Hi or B+ Low Horiz. Out Defect – Shorted inductor turn(s), sec. short, leaky component.(See Fig. 3)
Normal mA	Normal%	Low µS	Horiz. Out Timing – Retrace capacitor. Display runs higher resolution or frequency.
Low mA	Normal %	High µS	Yoke or series components.

The Ringer Test

Load Test mA readings above the normal range and low efficiency % readings indicate a possible shorted turn within the flyback transformer or horizontal yoke. The Ringer Test confirms if these components have a shorted turn(s). A shorted turn alters the component's function and circuit's operation but does not change the winding's resistance or inductance when measured with an ohmmeter or inductance tester.

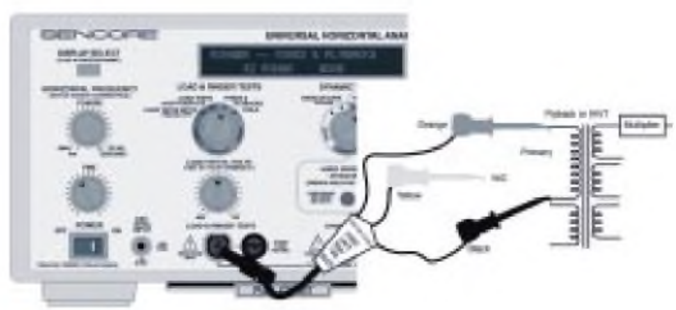


Figure 6

Ringer Test Steps (see Figure 6):

1. Remove AC to the chassis.
2. Set the Load & Ringer Tests switch to "Yokes & Flybacks."
3. Connect the Ringer/Load Test leads to the primary winding of the flyback.
4. Read the rings indicated by the display.
5. Record your reading in the space below.
   Ringer Test: _______ Rings
   Good = 10 or more rings
   Bad = less than 10 rings

Note:
A short in any of the transformer's windings reflects back to the primary. You only need to ring the primary. If in-circuit rings are less than 10, unsolder or disconnect flyback pins until the rings exceed 10 or the flyback is totally removed from the circuit.

Dynamic Tests - Meter

If the Load Tests show no serious conditions in the horizontal output stage you can apply AC power and use the HA2500's Dynamic Tests. The "Meter" tests through connections to the horizontal output transistor tell you if the horizontal output stage is operating properly or not and guides you to problem stages or components. The HA2500 can withstand the high voltages produced by this stage and multiple measurements and readouts save time compared to conventional methods.

Three automatic measurements at the collector or drain (see Figure 8) include the DC voltage, the flyback pulse duration in uS, and the peak-to-peak voltage of the flyback pulse. The base or gate measurements (see Figure 9) include the peak-to-peak voltage and frequency in kHz of the drive signal to the base or gate of the horizontal output transistor.

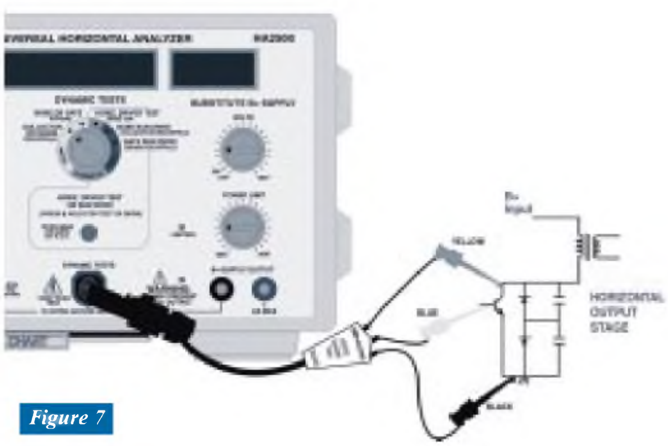


Figure 7

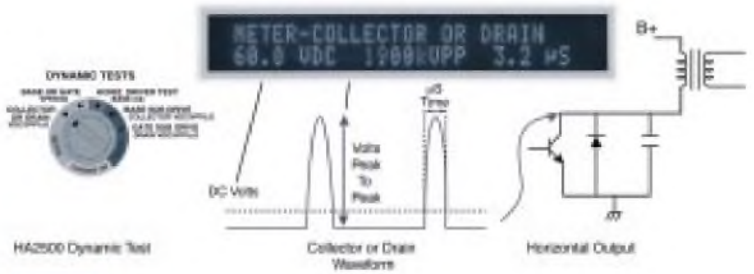


Figure 8

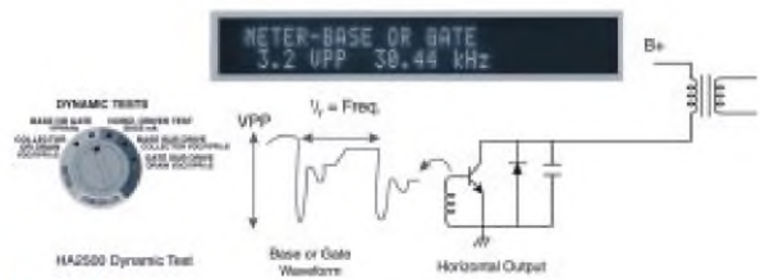


Figure 9

To Use the Dynamic Tests Meter (see Figure 7):

1. Remove AC to the chassis.
2. Connect the Dynamic Tests Leads.
3. Set the Dynamic Tests Switch to "Collector Or Drain."
4. Apply AC to the chassis.
5. Read the DCV, VPP, and uS readouts in the fluorescent panel.
6. Set the Dynamic Tests Switch to "Base Or Gate Freq/VPP."
7. Read the kHz and VPP readouts.
8. Record your readings in the spaces below.

Collector Or Drain: ______ DCV ______ VPP ______ uS

Base Or Gate: ______ VPP _______ kHz

COLLECTOR/DRAIN READOUTS	PROBABLE CAUSES
VDC = 0	No ACV, Bad B+ power supply, Open HV/Defl. regulator, Shorted H.O.T.
VDC = lower than normal	Bad HV/Defl.regulation, B+ supply defect, Severe load or short in Horiz. Output.
VDC = higher than normal	B+ Supply Regulation, shorted or bad HV/Defl. regulator, No load current to Horiz. Output.
VPP = 0.0 VPP or <5VPP	Little or no B+ volts, No Horiz. Drive, Open H.O.T. or inductor in Horiz. Output.
VPP lower than normal	Low B+, Open yoke path, Insufficient Drive, Increased value-retrace capacitor or inductor.
VPP higher than normal	High B+, reduced value-retrace capacitor or inductor, Horiz. Output stage loading.
µS = - - - µS	Little or no B+ volts, No Horiz. Drive, Open H.O.T. or inductor in Horiz. Output.
µS = lower than normal	Display capable of higher resolution? Reduced value-retrace capacitor or stage inductor. Flyback shorted turn or sec. load.
µS = higher than normal	Open yoke or its series components.

Dynamic Tests - Horiz. Driver Test

SERVICING TECH TIP

The Horizontal Driver Test analyzes the output of the horizontal driver stage to find eluding defects that cause the horizontal output transistor to fail or run excessively hot leading to premature failure. The test simulates a low impedance transistor junction and measures the current output produced by the driver stage. This test finds driver stage defects not evident on scope wave forms at the base of the horizontal output transistor.

Figure 10

Horiz. Driver Test Steps (see Figure 10):

1. Remove AC to the chassis.
2. Unsolder the Horiz. Output transistor base or open the base circuit path.
3. Connect the Dynamic Tests Leads.
4. Set the Dynamic Tests Switch to “Horiz. Driver Test”.
5. Apply AC voltage to the chassis.
6. Push and hold the Horiz. Driver Test Or Sub Drive test button.
7. Read the mA current in the display.
8. Record your measurement.

   Horiz. Driver Test mA: ________ mA

Typical Good mA range: 375 mA - 1500 mA for a combination HV/Deflection Horizontal Output)

Note:
For more specific information on typical Horiz. Driver Test mA ranges for various horizontal output stage types refer to the chart found in the HA2500’s Pull Chart.

SERVICING TECH TIP

Dynamic Tests - Base or Gate Sub Drive

The Dynamic Tests "Drive" section provides drive outputs suited to properly substitute for the chassis horizontal drive to the base or gate of either horizontal output transistor type. These drives confirm normal horizontal output stage function when the chassis horizontal drive is missing or suspect. It further isolates unusual drive related defects. While subbing drive, the three Collector Or Drain Meter tests monitor the voltages and wave forms at the collector of the horizontal output stage for easy stage analysis.

Figure 11

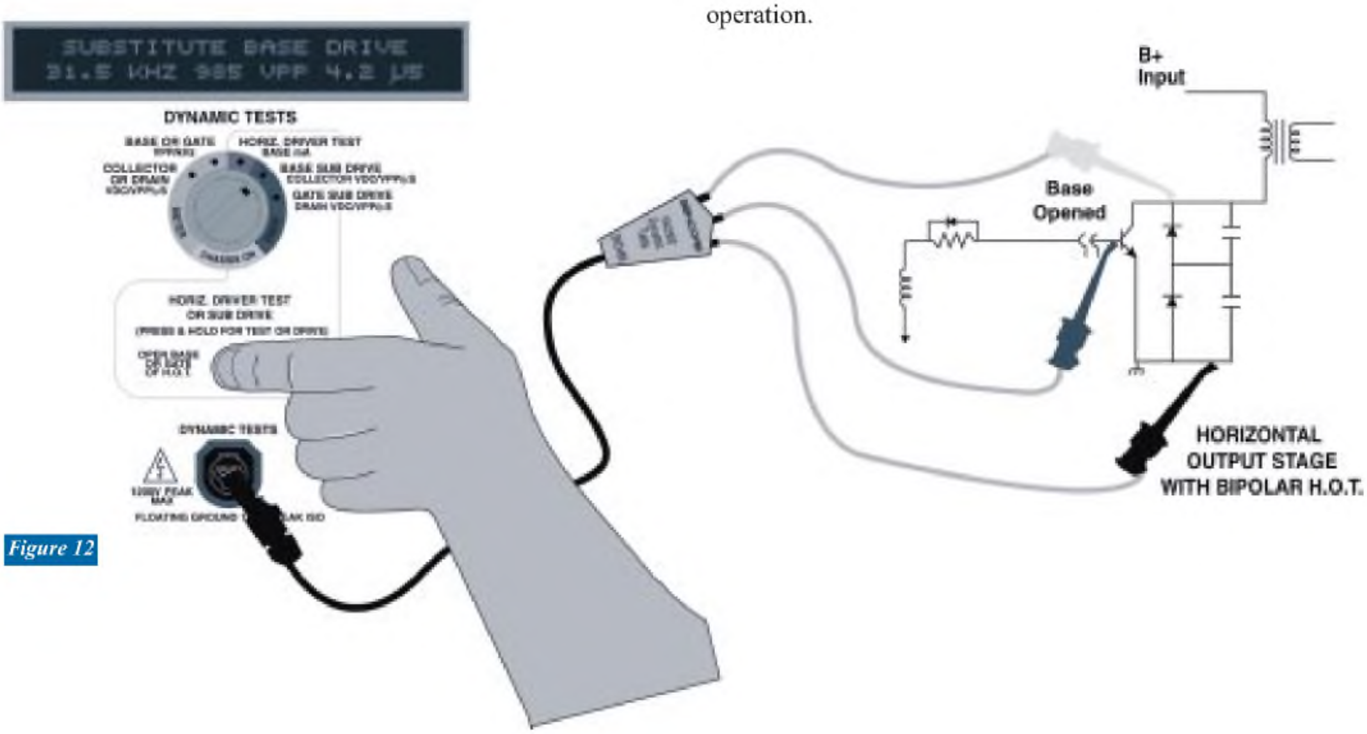


Figure 12

Substitute Base or Gate Drive to the H.O.T Steps (see Figures 11 and 12):

1. With AC power removed unsolder the Horiz. Output transistor base or open the base circuit path.
2. Connect the Dynamic Tests Leads.
   Blue - Base of H.O.T
   Yellow - Collector of H.O.T.
   Black - Horizontal circuit ground
3. Set the Dynamic Tests Switch to Base Sub Drive" (Bipolar Transistor).
4. Apply AC to the chassis and read the DCV readout to confirm proper B+ chassis voltage.
5. Read the displays kHz readout to confirm a proper test frequency.
6. Push and hold the Horiz. Driver Test Or Sub Drive test button.
7. Read the DCV, VPP, and uS readouts to test the horizontal output stage.
8. Record your readings in the spaces below.

Collector Or Drain: ______ DCV ______ VPP ______ uS

Base Or Gate: ______ VPP _______ kHz

While subbing, a properly regulated DCV, normal VPP and normal uS readings indicate normal horizontal output stage operation.

Substitute B+ Supply

SERVICING TECH TIP

The Substitute B+ Supply replaces the B+ supply voltage to a horizontal output stage powering the stage to full operation. The supply's output voltage ranges from 30 to 180 volts and output power can be limited between 3 and 80 watts. The Substitute B+ Supply can help isolate high voltage breakdown failures, X-ray shutdown, intermittent, start-up and picture noise symptoms.

Figure 13

Substitute B+ Voltage to a Horizontal Output Stage Steps (see Figure 13):

1. Remove AC voltage to the chassis and open the B+ path to the flyback - (unsolder a jumper wire, coil or resistor).
2. Set the HA2500 Volts Control to "OFF" and the Power Limit Control to 1/2 scale (40W).
3. Connect the B+ Supply Leads to the chassis.
4. Connect the Dynamic Test Leads to the chassis horizontal output transistor.
5. Set the Dynamic Tests Switch to "Collector Or Drain" Meter.
6. Apply AC power to the chassis.

Note: *The Dynamic Tests Meter should show near 0VDC if the B+ path is opened properly.*

7. Increase the Volts control to apply substitute B+ voltage to the chassis.

Note: *Increase the B+ voltage until the Collector Or Drain Meter indicates normal VPP (Typical range is from 900 - 1000 VPP)*

8. Record the Substitute B+ supply's output voltage and current readouts.

Substitute B+ Supply: _______ V ________ A

While subbing B+ voltage a picture should be seen on a working display when connected to a signal source or generator. Some irregularities may be present in the picture because the displays B+ power supply is unloaded. This can cause decreases in the other output voltages from a switch mode power supply.

Frequently Asked HA2500 Load Test Questions

1. *In a multi-scan computer monitor, what frequency do I use when performing the Load Test?*

Answer: Select a horizontal frequency that is near the frequency used by the monitor in its highest resolution mode. You can differ from this frequency by 10 kHz or more and still get accurate Load Test results.

2. *In multi-scan computer monitors, why do I need to perform the Load Test at the monitor's highest resolution mode or horizontal frequency?*

Answer: Components are switched into the horizontal output stage of these monitors depending on the horizontal frequency. When the monitor's power is "off", switched components configure the horizontal output stage to operate in its highest frequency range. Load Testing at a much lower frequency results in higher than normal current and lower than normal efficiency percentages.

3. *Can the Load Test uS readout help me estimate a computer monitor's highest operating mode and horizontal frequency?*

Answer: Yes. Perform the Load Test Setup and then note the Load Tests uS readout. Refer to the Pull Chart showing how Load Test uS readings relate to frequency. Example: A uS reading near 3.5 uS suggests a monitor with a high frequency capability near 60 kHz.

4. *Without a schematic, how can I find the test points required to use the HA2500 tests?*

Answer: Find the horizontal output transistor, a large TO-3 transistor mounted to a metal frame near the flyback. With a front top view, the center leg is the collector, left leg the base and right leg the emitter. With an ohmmeter measure from the collector to other flyback pins. Pins showing continuity to the collector are potential B+ input pins.

5. *If one of the three Load Tests readings is in the questionable area of the Typical LOAD TEST mA, % efficiency and uS ranges, how do I determine if there is a problem?*

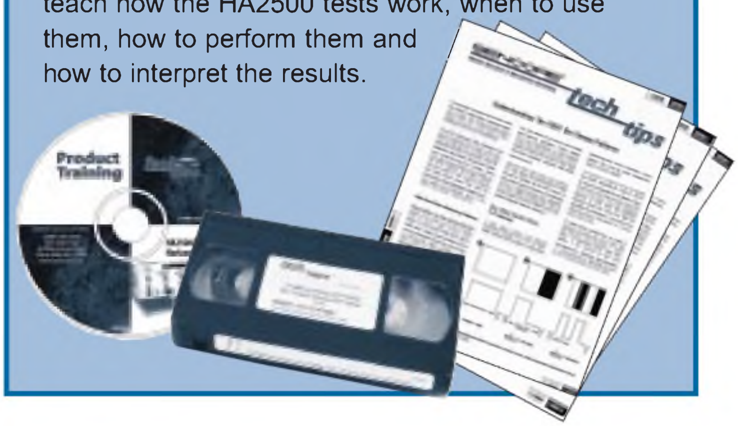
Answer: Severe defects cause dramatic changes to the Load Test readings so rarely are results questionable. The mA and efficiency % measurements are complementary. Questionable mA readings but normal efficiency % readings indicate no serious problem and vice vice versa. If both readings are questionable or in the bad area, a severe setup frequency error has been made or a defect is likely.

6. *When the Load Tests indicate a problem, how can it help isolate the defect?*

Answer: AC loading defects can be isolated by opening the flyback secondary circuit paths one at a time and noting the mA and % Load Test readings. The problem secondary circuit is indicated when the readings decrease dramatically into the typical ranges for the monitor. Remaining bad readings with all secondary paths open indicate a problem isolated to the horizontal output stage components.

Additional Learning Resources

You can learn more about the HA2500 and how to use its unique features for troubleshooting horizontal defects with the HA2500 Videotape, Training CD-ROM or Tech Tip series. The videotape explains the HA2500 analyzing tests and demonstrates how to use them. The Interactive Training CD-ROM offers comprehensive self-study training on horizontal stages, HA2500 analyzing tests and troubleshooting methods. Tech Tips teach how the HA2500 tests work, when to use them, how to perform them and how to interpret the results.



6 Ways A Horizontal Analyzer Makes You Money
Add It Up For Yourself And See!!

SERVICING TECH TIP

1. Repair Management - Less Time On Unfeasible Repairs & More Time On Profitable Repairs

a. Evaluate Quickly - ID bad expensive parts fast with Load and Ringer Tests.
b. Combine B+ Sub. Supply & Base Sub Drive - Test IHVT at full potential.

2. Save Time - Make Repairs With Less Analyzing Time Or Fix More Displays In The Same Time

a. Meter Dynamic Test - Save 2 minutes every time use them.
b. Load Test for quick diagnosis and isolation of loading and timing defects.

3. Eliminate Frustrating Guess Work - Analyze With Measurements

a. Use troubleshooting measurements to isolate shutdown symptoms.
b. Troubleshoot HV/deflection regulator circuit loops.
c. Use Base Sub Drive to isolate noisy flyback or picture symptoms.

4. More Repairs - Solve Problems That Would Have Gone Unsolved Prior To The HA2500

a. Horiz. Driver Test finds driver stage defects when you suspect the horizontal output stage.

5. Reduce Replacement Parts Usage

a. Fewer destroyed replacement parts - Use Load Test to isolate loading problems.
b. Review parts or upgrade kits usage - Analyze and replace only bad parts.
c. Swap fewer suspect parts - Use Analyzing Tests.

6. Boost Repair Quality For Fewer Burn-In Failures & Customer Returns

a. Horiz. Driver Test - check for weak drive, and drive intermittents.

Universal Horizontal Analyzer
Savings/Added Revenue Worksheet

Savings/Added Revenue Category	Estimated $ Potential
1. Repair Management	________
2. Save Time - Less Analyzing Time	________
3. Eliminate Guess Work - Analyze With Measurements	________
4. More Repairs - Solve Problems with HA2500	________
5. Reduce Replacement Parts Usage	________
6. Boost Quality - Fewer Burn-In Failures & Customer Returns	________
Total Savings & Added Revenue Potential (Add lines 1 through 6)	TOTAL ________

SERVICING TECH TIP

Tech Talk:

Split Damper Combination Horizontal Output Stages

A popular combination horizontal output stage found in multi-frequency video displays uses two damper diodes. The damper diodes are placed in series from the collector to the emitter of the H.O.T. This horizontal output stage also uses two timing capacitors placed in series between the H.O.T.'s collector and emitter. A connection in the middle of the damper diodes and timing capacitors splits the output.

The split damper diode and timing capacitor configuration provides a means to control the level of yoke deflection current while not impacting the flyback current and resulting high voltage. It furthermore provides a method of achieving pincushion correction and other dynamic modifications of the horizontal yoke current.

An understanding of the operation of a split damper horizontal output stage can be gained by analyzing the currents and resulting voltages during four segments of the horizontal cycle starting with the conduction time of the H.O.T. When the H.O.T. is switched on by base drive, current increases through the flyback primary, creating an expanding flyback magnetic field. Current is also supplied from the S-shaping capacitor charged from the previous cycle. Current flows from the S-shaping capacitor through the bottom damper (D2), H.O.T., linearity coil, and yoke. Yoke current deflects the CRT's electron beams from center to the right of the picture.

When the H.O.T. is switched off, the magnetic fields in the flyback and yoke collapse. The flyback's collapsing magnetic field produces induced voltage and charging current to timing capacitors CT1 and CT2. Values of CT1 and CT2 are chosen so approximately 80-90% of the charge is delivered to CT1 and 10-20% to CT2. The yoke's induced voltage produces charging current to CT1 and the S-shaping capacitor. The difference in capacitor values returns the greatest charge to CT1. This portion of the cycle is the first part of retrace, which quickly returns the CRT beam from the right to the center of the picture.

With the flyback and yoke magnetic fields fully collapsed, capacitors CT1 and CT2 begin to discharge. Capacitor CT1 now fully charged, supplies discharge current along with the lesser-charged S-shaping capacitor to the horizontal yoke. The yoke current moves the CRT's electron beam from the center to the left completing retrace. Capacitors CT1 and CT2 produce current through the flyback primary but in the opposite direction producing an expanding magnetic field.

When the timing capacitors are discharged, the flyback's magnetic field collapses biasing on the damper diodes. Diodes D1 and D2 conduct, providing a current path for the magnetic energy of the flyback to recharge the power supply filter capacitor. The collapsing magnetic field of the yoke charges the S-shaping capacitor with current flowing through D1. Yoke current moves the CRT electron beams from the left slowly to the center. When the yoke magnetic field is fully collapsed, the S-shaping capacitor nears full charge. The H.O.T is then switched on to repeat the horizontal cycle.

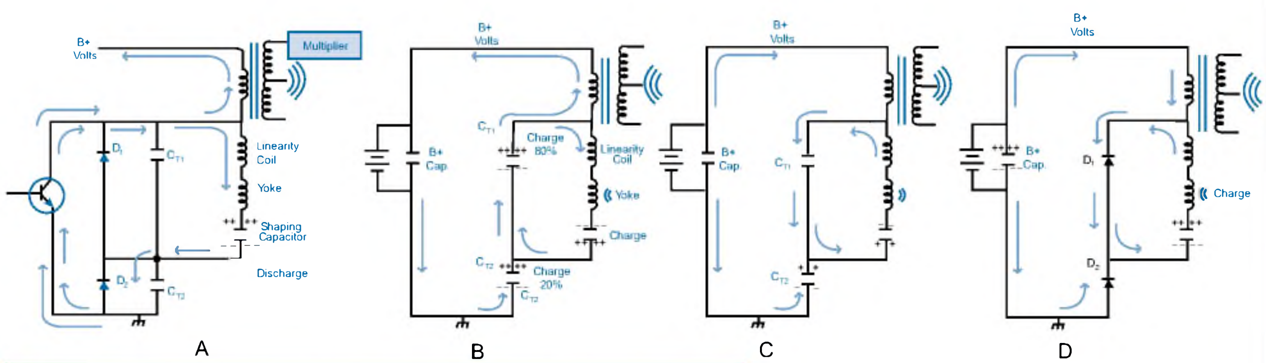


Figure 1: The operation of a split damper combination horizontal output stage.