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tech tips

Testing a Mitsubishi Projection TV with the Sencore HA325 Load Tests

The Sencore HA325 Horizontal Output & Flyback Analyzer identifies defects in the horizontal output stages of projection TVs and HD ready projection TVs without applying AC power to the chassis. It further analyzes the integrated high voltage transformer (IHVT) for defects.

This Tech Tip familiarizes you with the HA325's Horiz. Output Load Test and Flyback & IHVT Load Test by showing typical use and test readings on an actual projection TV. The operation of the horizontal output stages found in a Mitsubishi projection chassis (V18) are covered in this Tech Tip along with how to connect and test these stages with the HA325 Load Tests. This Tech Tip further shows how to test the integrated high voltage transformer (IHVT) found in this chassis with the HA325 Flyback & IHVT Load Test.

Deflection Horizontal Output - Mitsubishi Projection TV

The deflection horizontal output stage of a Mitsubishi HD ready projection TV is shown in figure 1. This stage produces alternating current in the horizontal deflection yokes. The parts are numbered as found in a Mitsubishi V18 chassis. However, the circuit configuration and components are similar in deflection horizontal output stages found among other Mitsubishi models and manufacturers of CRT video displays.

The main power supply delivers approximately 110 VDC to the Scan B+ regulator stage consisting of transistors Q5A02, Q5A03, Q5A01 and associated components. (Not shown in figure 1) Q5A01 serves as a series pass regulator transistor reducing the voltage to the deflection output stage to approximately 93 volts. In addition to providing deflection width regulation, the scan B+ regulator provides deflection width and side pincushion control.

Transistor Q5A31 is the horizontal output transistor. This transistor switches on and off at the horizontal frequency of approximately 33 kHz. Power supply current builds-up in the primary winding of the transformer T5A31 during the conduction time of transistor Q5A31. Voltage induced into the secondary winding of T5A31 is rectified, filtered and regulated to 6.3 VDC to power the filament windings of the CRTs.

Parallel capacitors C5A31, C5A32, and C5A33 time the horizontal output stage producing a flyback pulse voltage waveform that is approximately 1100 volts peak-to-peak and 4.5 µS wide. The flyback pulse is generated by the charge and discharge action of the capacitors. Yoke current alternates in the parallel yoke coils, linearity coil LA533 and S-shaping capacitors C5A37 and C5A38 producing beam deflection.

Testing the Deflection Horizontal Output with the HA325 Horiz. Output Load Test

The HA325's Horiz. Output Load Test simulates the operation of a horizontal output stage with the chassis power off and analyzes the stage for defects. The test substitutes a 1/10 level B+ supply voltage to the horizontal output stage and duplicates the switching action of the stage's horizontal output transistor. The horizontal output stage duplicates its normal operation but at a safe level where it can be analyzed without damaging components.

DEFLECTION HORIZ. OUTPUT IN MITSUBISHI PROJECTION TV (Example: V18 Chassis)

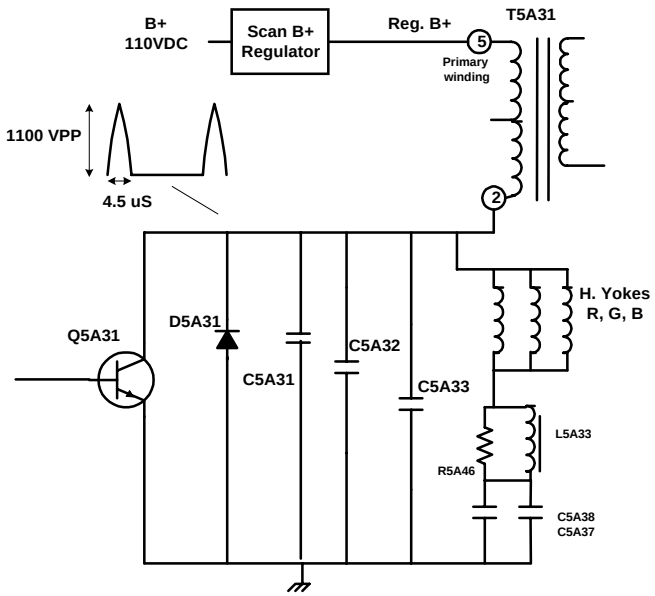

Figure 1. Defl. Horizontal Output - Mitsubishi V18 chassis.

Testing with the HA325's Horiz. Output Load Test first requires selecting the proper B+ (VDC) voltage and the proper test frequency (kHz). This "Setup" process establishes a 1/10th operational level resulting in flyback pulses of approximately 1/10th of normal.

The HA325 provides common setups or complete manual control of the VDC and test frequency applied. Once proper setup and 1/10th circuit operation is confirmed, Load Test mA, % Efficiency and µS pulse time readings analyze the horizontal output stage for defects.

The Horiz. Output Load Test connections, setup and test results on a Mitsubishi V18 chassis horizontal deflection output stage is shown in figure 2. Test lead connections include connecting the orange clip to the B+ input or pin 5 of T5A31, black clip to ground, and the yellow clip to the collector of Q5A31 or pin 2 of T5A31.

Proper setup includes setting a DCV input to the stage of approximately 9.3 VDC or 1/10th of the normal B+ voltage (93 VDC) to the horizontal output stage. A frequency reflecting a 1080I HDTV horizontal scanning frequency of approximately 33 kHz duplicates the stage's normal operating frequency. This combination of B+ and switching frequency produces a flyback pulse of approximately 100-110 VPP.

A good working Mitsubishi V18 chassis produces Horiz. Output Load Test readings of approximately 53 mA, 58% EFF and 4.2 µS. While the HA325 indicates a "?" indicator for the mA reading, normal readings on horizontal deflection output stages range to 75 mA. Load Test mA readings from 5-75mA are normal for these stages.

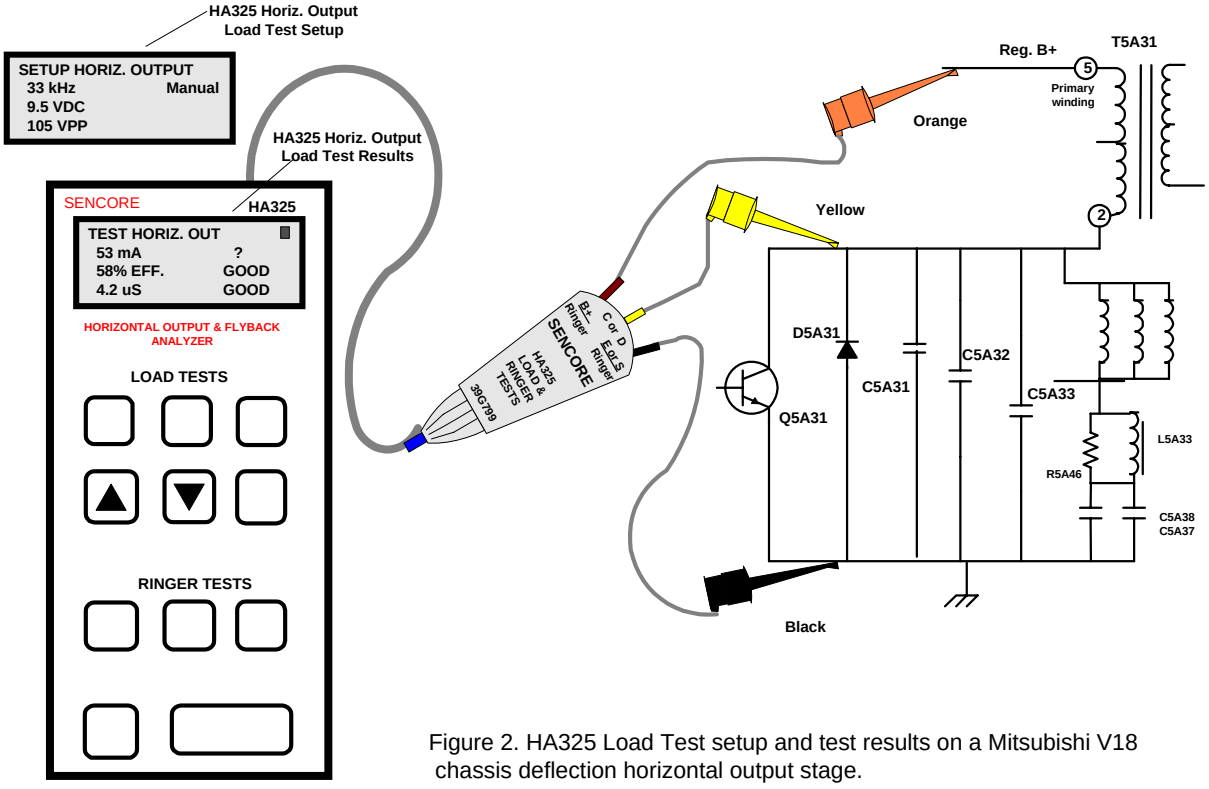

Figure 2. HA325 Load Test setup and test results on a Mitsubishi V18 chassis deflection horizontal output stage.

To Load Test the Deflection Horiz. Output Stage (Mitsubishi V18 chassis):

1. Remove Power to the Chassis – Connect test clips as shown in figure 2.
2. Press the POWER ON/OFF Pushbutton, press the HORIZ. OUTPUT Pushbutton.
3. Push Arrow Down Pushbutton to select "HDTV 1080 33kHz."
4. Press the ENTER Pushbutton.
5. Press TEST/SETUP Pushbutton to show SETUP HORIZ. OUTPUT Display.
6. Push Down Arrow Pushbutton to decrease DCV to approx. 9.5 VDC.
   (Note: VPP readings should be near 105 VPP)
7. Push TEST/SETUP Pushbutton for Load Test readings.

Normal Load Test readings are approx. 53 ma, 58% EFF, and 4.3 µS.

High Voltage Horizontal Output - Mitsubishi Projection TV

The high voltage horizontal output stage of the Mitsubishi V18 chassis is shown in figure 3. This stage produces high voltage that is fed to the high voltage divider block and to the anodes of the CRTs. The parts are numbered in figure 3 as found in the Mitsubishi V18 chassis. Many other Mitsubishi projection TV models use a similar circuit configuration.

A 110V B+ power supply voltage, filtered by capacitor C5A54, is applied to pin 2 of the flyback transformer T5A51. Transistor Q5A51 is the horizontal output transistor. It switches on and off at the horizontal rate of approximately 33 kHz.

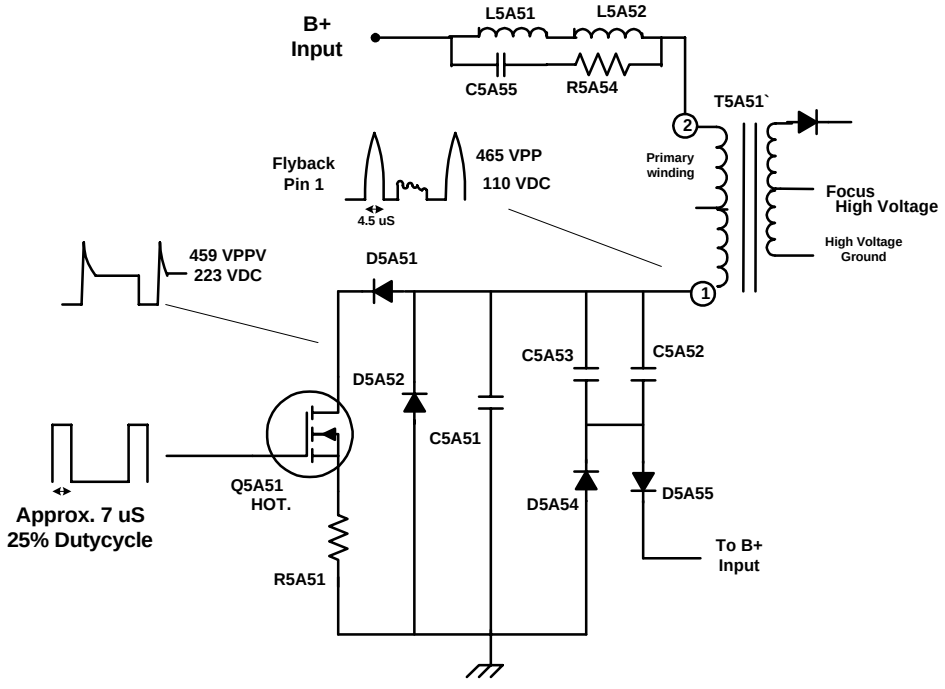

Figure: 3. HIGH VOLTAGE HORIZ. OUTPUT - MITSUBISHI PROJECTION TV (Example: V18 Chassis)

Capacitor C5A51 is the timing capacitor, and diode D5A52 is a damping diode.

The gate drive signal turns on transistor Q5A51 producing current buildup in the flyback transformer through forward biased diode D5A51. The drive signal gates off the horizontal output transistor producing alternating current in the flyback transformer. The action charges and discharges capacitor C5A51 producing a pulse waveform at pin 1 of the flyback transformer. Normal circuit operation produces a flyback pulse that is approximately 450 VPP.

IC5A00 (not shown) produces the horizontal drive applied to the gate of the output transistor Q5A54. High voltage regulation is achieved by controlling the duty-cycle of the horizontal drive signal in a manner similar to a switch mode power supply. The high voltage output of the stage is sampled from the HV block on the secondary of the flyback transformer T5A51. The voltage is divided down and input to IC5A00. The pulse width drive varies from approximately 8-12 µS. Horizontal output circuit operation produces a waveform at the drain of transistor Q5A54 that is different than at pin 1 of the flyback transformer. This is due to the action of diode D5A51. The drain waveform is shown in figure 3.

Testing the HV Horizontal Output with the HA325 Horiz. Output Load Test

The HA325's Horiz. Output Load Test can be used to analyze the operation of high voltage horizontal output stages in projection TVs. The Load Test duplicates the circuit operation and analyzes it for defects using the mA, % EFF and µS readouts. Load Test readings typically range from 3-30 mA and greater than 50% EFF. µS readings range from 3.7 – 6.0 µS in HD ready projection televisions.

The Horiz. Output Load Test connections, setup and test results on the Mitsubishi V18 HV horizontal output stage are shown in figure 4. Test lead connections include connecting the orange clip to the positive terminal of C5A54 or pin 2 of the flyback transformer. The yellow lead is connected to pin 1 of the flyback transformer. ***Do not connect the yellow test lead clip to the drain of Q5A51***. The black lead clip is connected to the ground of the circuit.

Proper HA325 Horiz. Output Load Test setup includes selecting a test frequency which matches the operating frequency of the horizontal output stage. The proper horizontal test frequency is 33 kHz for the Mitsubishi V18 chassis. Setup also includes setting a DCV voltage to simulate the circuit operation at 1/10 of the normal circuit level. A 1/10 level is indicated when the flyback pulse waveform VPP reading during the Load Test setup is approximately 1/0 of the chassis normal.

To setup the HA325 Horiz. Output Load Test to properly test the Mitsubishi V18 chassis, select the "HDTV 1080 33 kHz" setup option. You will need to decrease the normal 12 VDC used in this setup option when testing the V18 chassis. To decrease the DCV applied during the Load Test, push the TEST/SETUP pushbutton. The HA325 displays a SETUP HORIZ. OUTPUT window with the test frequency in kHz, VDC voltage and resulting flyback waveform VPP level indicated. Decrease the VDC value with the down arrow pushbutton until the VPP reads approximately 1/10 of the chassis normal or 45 VPP. This should occur at approximately 4.0 VDC.

A good working Mitsubishi V18 chassis HV horizontal output stage produces load test readings of approximately 19 mA, 50% EFF and 4.4 µS. There will be no good or bad indications with these readings as the 45 VPP setup level is below the range used by most horizontal output stages. Readings considerably different than these readings indicate a circuit defect.

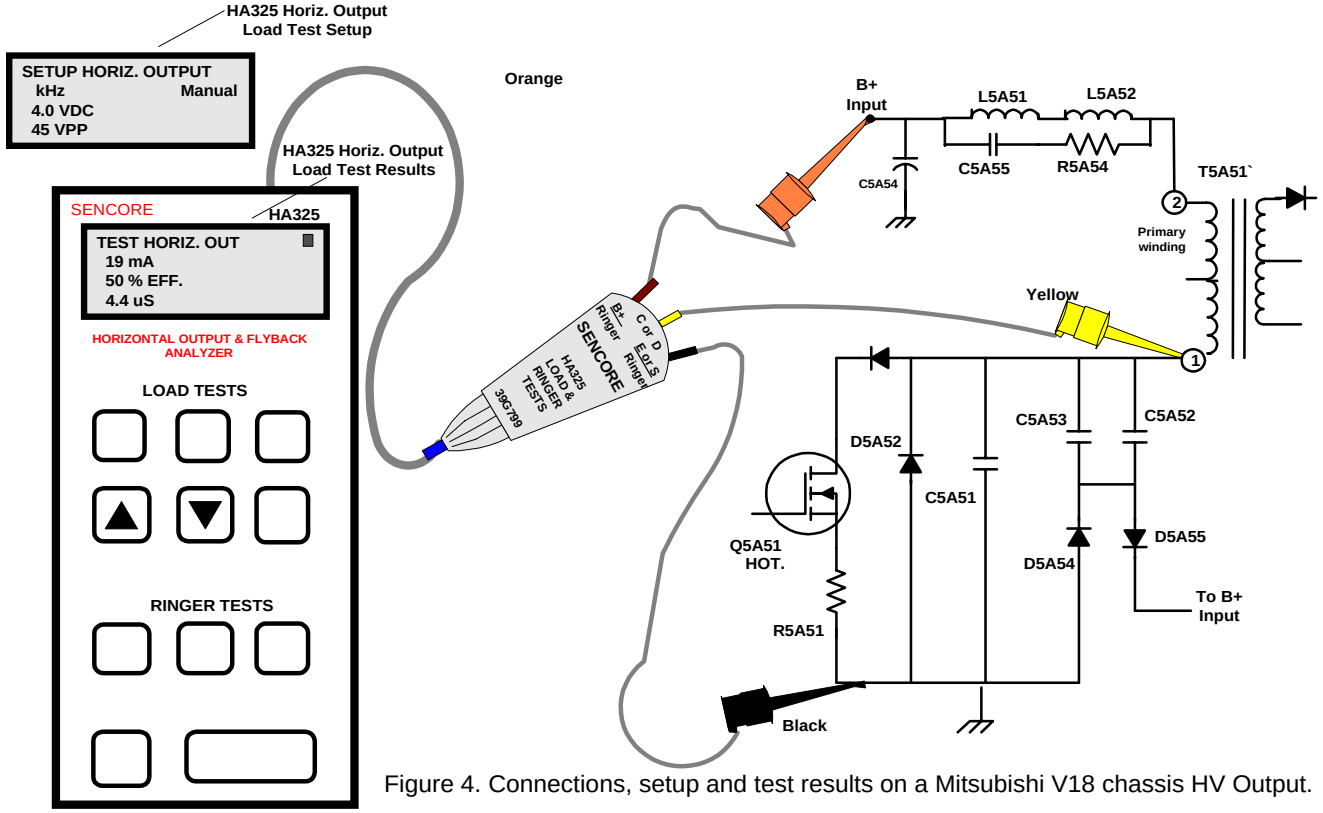

Figure 4. Connections, setup and test results on a Mitsubishi V18 chassis HV Output.

To Load Test the High Voltage Horiz. Output Stage (Mitsubishi V18 chassis):

1. Remove Power to the Chassis – Connect test clips as shown in figure 4.
2. Press the POWER ON/OFF Pushbutton, press the HORIZ. OUTPUT Pushbutton.
3. Push Arrow Down Pushbutton to select "HDTV 1080 33kHz."
4. Press the ENTER Pushbutton.
5. Press TEST/SETUP Pushbutton to show SETUP HORIZ. OUTPUT Display.
6. Push Down Arrow Pushbutton to decrease DCV to approx. 4VDC.
   (Note: VPP readings should be near 45 VPP)
7. Push TEST/SETUP Pushbutton for Load Test readings.

Normal Load Test readings are approx. 19 mA, 50% EFF, and 4.4 µS.

Testing the IHVT with the HA325 Flyback/IHVT Load Test

HA325's Flyback & IHVT Load Test analyzes the flyback or IHVT for defects. The primary winding of the flyback or IHVT being tested is tuned with a capacitor, internal to the HA325, forming a horizontal output stage. The test circuit is then setup to simulate the operation of the flyback or IHVT to a 1/10 voltage level. Flyback pulses are produced that are approximately 1/10 of normal. The Load Test mA, % EFF and µS readings analyze the flyback or IHVT for defects. Normal readings range from 3-20mA, greater than 50% EFF and 5-16 µS on good flybacks or IHVTs.

The circuit diagram of the IHVT used in the Mitsubishi V18 chassis is shown in figure 5. The primary winding is between pins 1 and 2. There are multiple ground pins on the flyback transformer at pins 3, 4, 7, 9, and 10. High voltage output feeds the secondary HV Block. A secondary winding at pin 6 feeds a secondary circuit. Pin 8 is the high voltage ground return or automatic brightness limiting (ABL) pin of the IHVT.

To test the Mitsubishi V18 chassis IHVT with the HA325, remove the flyback transformer or IHVT from the chassis. Connect the Load Test lead clips as shown in figure 5. The orange test clip connects to pin 2, the yellow clip to pin 1 and the black clip to any of the ground pins.

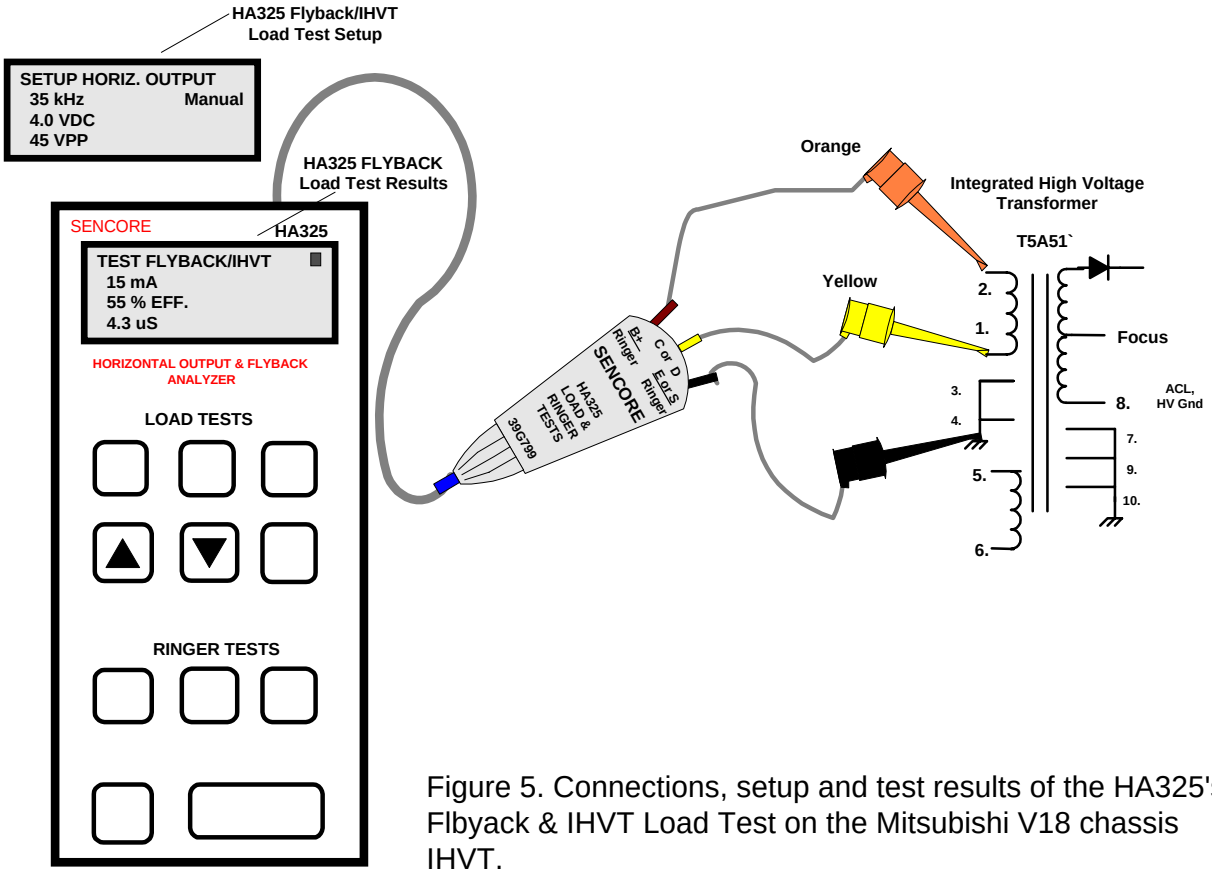

Figure 5. Connections, setup and test results of the HA325's Flbyack & IHVT Load Test on the Mitsubishi V18 chassis IHVT.

To perform the Flyback & IHVT Load Test requires set-up of a suitable test frequency and VDC voltage. A horizontal test frequency of 33 kHz or slightly higher works well when testing the Mitsubishi V18 chassis IHVT. At this frequency, a DCV test level of approximately 4 VDC produces a 45 VPP flyback pulse, which is approximately 1/10 of the circuit normal. Load Test readings of approximately 15 mA, 55% EFF and 4.4 µS are normal for the Mitsubishi IHVT.

Additional testing of the IHVT can be performed using the HA325's Flyback & IHVT Load Test. With the IHVT energized to 1/10 of normal the secondary output HV and focus voltage can be measured and tested. Use a high impedance DC voltmeter to measure from the HV output or focus leads with the meter ground connected to the ABL pin 8.

To perform the Flyback & IHVT Load Test on the Mitsubishi V18 flyback:

1. With chassis off, remove the IHVT, connect the test lead clips as shown in figure 4.
2. Press the POWER ON/OFF Pushbutton, press FLYBACK & IHVT Pushbutton.
3. Push Down Arrow Pushbutton to select MANUAL – Press ENTER Pushbutton.
4. Push ENTER Pushbutton to select kHz
5. Push Up Arrow Pushbutton to set 35 kHz – Push ENTER Pushbutton.
6. Push Up Arrow Pushbutton to set VDC to approx. 4VDC or 45 VPP.
7. Push TEST/SETUP for Load Test readings.

(Expect: Approx. 15 mA, 55% EFF, and 4.3 µS)

Testing the IHVT in-circuit with the HA325 Flyback / IHVT Load Test

The HA325's Flyback & IHVT Load Test can be used to test the flyback or IHVT while it is still mounted in the chassis. However, to perform the Flyback & IHVT Load Test in-circuit requires that the primary winding of the flyback or IHVT be isolated, or opened, from the circuitry. This can be accomplished by unsoldering the flyback pins or unsoldering and lifting circuit components.

When the HA325's Horiz. Output Load Test indicates a stage defect you can use the Flyback & IHVT Load Test to help isolate the problem. You can determine if the flyback and secondary load circuits cause the stage defect by isolating the primary winding of the flyback and performing the Flyback & IHVT Load Test.

When testing the flyback or IVHT in-circuit, expect the secondary windings and circuit loads to slightly increase the Load Test mA and decrease the % EFF readings compared to when the flyback or IHVT is fully removed from the chassis. Normal or only slightly elevated mA, % EFF and µS readings indicate the flyback and secondary load circuits are normal. Very high mA readings and low % EFF readings indicate a defective flyback or secondary circuit load or short. Opening the secondary loads one at a time can further isolate the defect to a load circuit or the flyback transformer.

With all the secondary loads of the IVHT open, expect the same results as when the IHVT is removed from the chassis. On the Mitsubishi V18 chassis you should expect the same results as shown in Figure 5 and indicated in Table 1. Table 1 further indicates the normal current increase to the Flyback & IHVT Load Test when performed in-circuit with the secondary windings connected. Note in Table 1 how the normal circuit mA readings decrease as the secondary load circuits are opened.

IHVT Secondary Conditions	*Load Test mA*	*Load Test % Eff*	*Load Test µS*
All Sec. Open	15 mA	56%	4.2 µS
Sec. Open to HV Block,	19 mA	50%	4.5 µS
All Sec. Connected	24 mA	45% EFF.	4.6 µS

*Primary winding isolated from circuitry, Flyback & IHVT Load Test Setup = 35 kHz, 4VDC, 45VPP

Table 1: Normal Flyback & IHVT Load Test results when testing the flyback in-circuit with various secondary connections on the Mitsubishi V18 chassis.