Dimmer Risetime

MEASUREMENT TECHNIQUE

JANDS

INTRODUCTION

Since the introduction of Thyristor (ie Triac or SCR) dimmers in the 70's, dimmer risetime measurement has been used as a means to quantify both the amount of noise and buzz that a dimmer will inject into an adjacent sound system, and the amount of acoustic noise from lamp filament rattle. This Application Sheet shows the standard measurement technique as used by Jands for measuring dimmer risetime. Users can then make their own measurements and/or understand how values from different manufacturers using different measurement techniques can be compared.

Phase Controlled Dimmer Operation

Thyristor dimmers use SCRs or Triacs to switch the output load for a portion of every half cycle—the portion when the load is switched on defines the output power and therefore the brightness of the connected lamp. The sharp edge created by the Thyristor turning on generates a large amount of broad spectrum high frequency noise which, if left unchecked, couples into any nearby sound system. The result is the classic unwanted dimmer buzz.

A series inductor or choke is used to limit the risetime of the output and reduce the width and intensity of the interference. In general a longer risetime results in a reduced amount of interference.

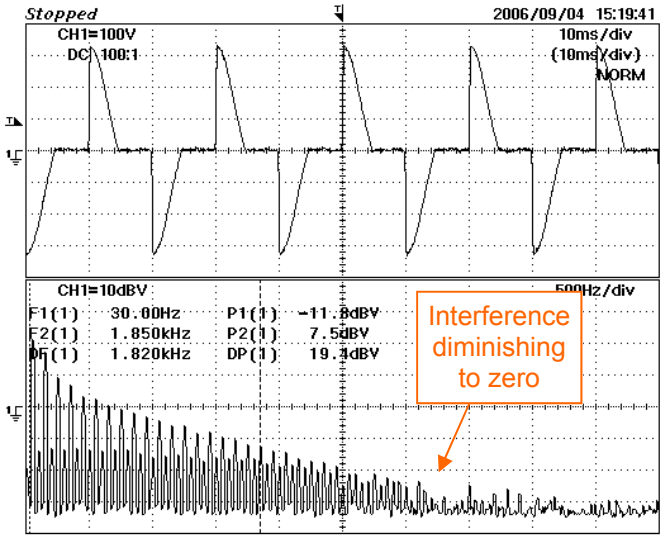

Figure 1: A typical noise spectrum from a choked thyristor dimmer source. The top trace shows the source waveform, while the bottom shows the noise spectra present in this waveform.

Figure 1 shows a noise measurement of a standard triac plus choke dimmer - in fact it's a HPX driving a 2.5KW CP91 lamp. This product is specified as having a 220us risetime. The noise indicated by the bottom trace can be seen to be approaching zero at around 3KHz.

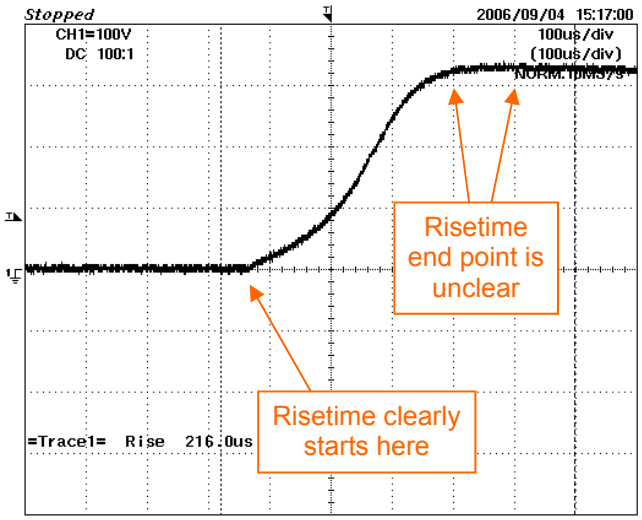

Figure 2: Expanded view of the switching event in Figure 1.

Where does the Risetime Finish?

Figure 2 shows a higher detail trace of the time around when the triac switches on. The action of the choke can be clearly seen - the output doesn't snap to full but slowly rises from 0 to the full supply voltage.

Looking closely at Figure 2, the point at which the risetime starts can be clearly seen as the instant the voltage starts to rise. However the point at which risetime completes is *very* un-clear - for this reason standard engineering practice takes risetime measurements from 10 to 90% of the final value. Most CRO's have 0, 10, 90, and 100% graduations marked on their display specifically for the purpose of risetime measurement.

The plot in Figure 2 shows a risetime as measured using the 10 - 90% technique of around 220us. However using the 0 - 100% technique the risetime could be interpreted as anything up to 400us. Be wary of dimmer specifications that include 0 - 100% values for risetime — although they look better they are vague and subjective and must not be directly compared to 10-90% risetime specifications.

Other Effects

Dimmer risetime is significantly affected by other parameters - output current / load, supply voltage and the drive level. Jands dimmers are always tested at their full rated load, at the specified supply voltage, at 50% power, using an incandescent load.

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The Test

The procedure for measuring risetime is fairly quick once you know what you're doing. Since mains voltages are involved, **the following procedure must only be attempted by only those competent in the servicing of mains equipment.**

Equipment

- Mains supply capable of delivering the expected current.
- Oscilloscope (CRO) with 0, 10, 90, and 100% graduations on the graticule
- Mains probe for the oscilloscope
- Both small and full power lamp loads
- Some way to adjust the dimmer level eg console.
- Dimmer under test

The small lamp is used during setup—the full power lamps create a lot of heat in the average workshop and are used only for the final measurement.

Set the equipment up on a clear bench with the lamp shielded by a non-flammable barrier. The power source should be protected with a RCD of no more than 30mA trip current. Test the RCD before switching anything on.

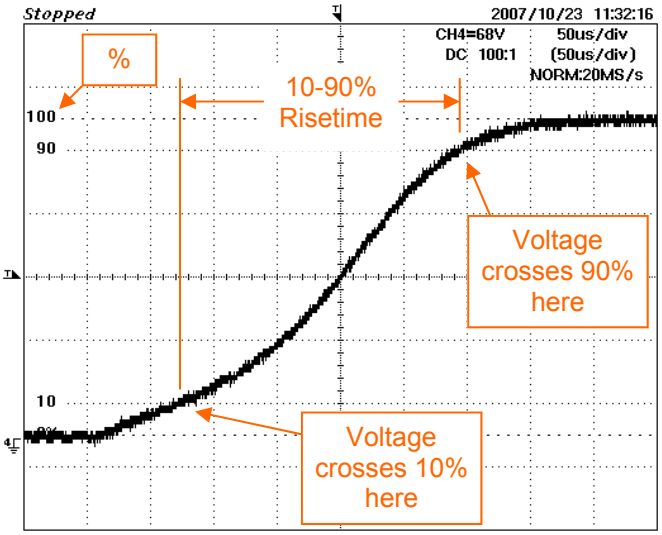

Figure 3: HPX choke plot with the voltage scaled to the 0 and 100% graduations. The 10-90 risetime is the time the voltage takes to rise from the 10% level to the 90% level. Note change of timebase from previous figures. This choke is rated by Jands at 220us, however using 0-100% technique the same choke would be rated at around 350- 400us.

Procedure

1. Plug in all of the equipment as normal. At this stage however plug only the small load into the dimmer. Connect the CRO mains probe on the dimmer channel to be measured.
2. Apply power to the system, and check that the lamp can be dimmed up and down. Adjust the drive level and the CRO triggering so that the output voltage rise finishes at the peak voltage of the supply ie around 340V for a 240VAC system.
3. The CRO graticule will normally include 0, 10, 90, and 100% graduations on the display. Adjust the **0V reference** of the trace so that it is aligned with the 0% graduation. See Figure 3.
4. Adjust the channel **variable gain** and the **sensitivity selector** on the CRO so that the peak voltage just touches the 100% graduation.
5. Turn the dimmer power off and swap over the load to the full power lamp. Put sunglasses on. Turn the power back on.
6. If necessary re-adjust the timebase on the CRO so that the complete transition from off to on is displayed. On the CRO display count the number of major divisions horizontally between where the trace crosses the 10% graduation and where the trace crosses the 90% graduation. This is the 10-90% risetime.
7. Multiply the number of graduations by the timebase to calculate the actual risetime.

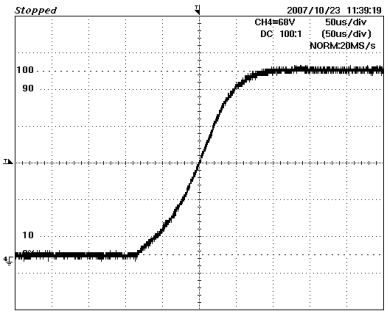

Figure 4: Risetime plot of Jands FPX with standard 120us choke. Using 0-100% technique this choke would be rated at around 175us.

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