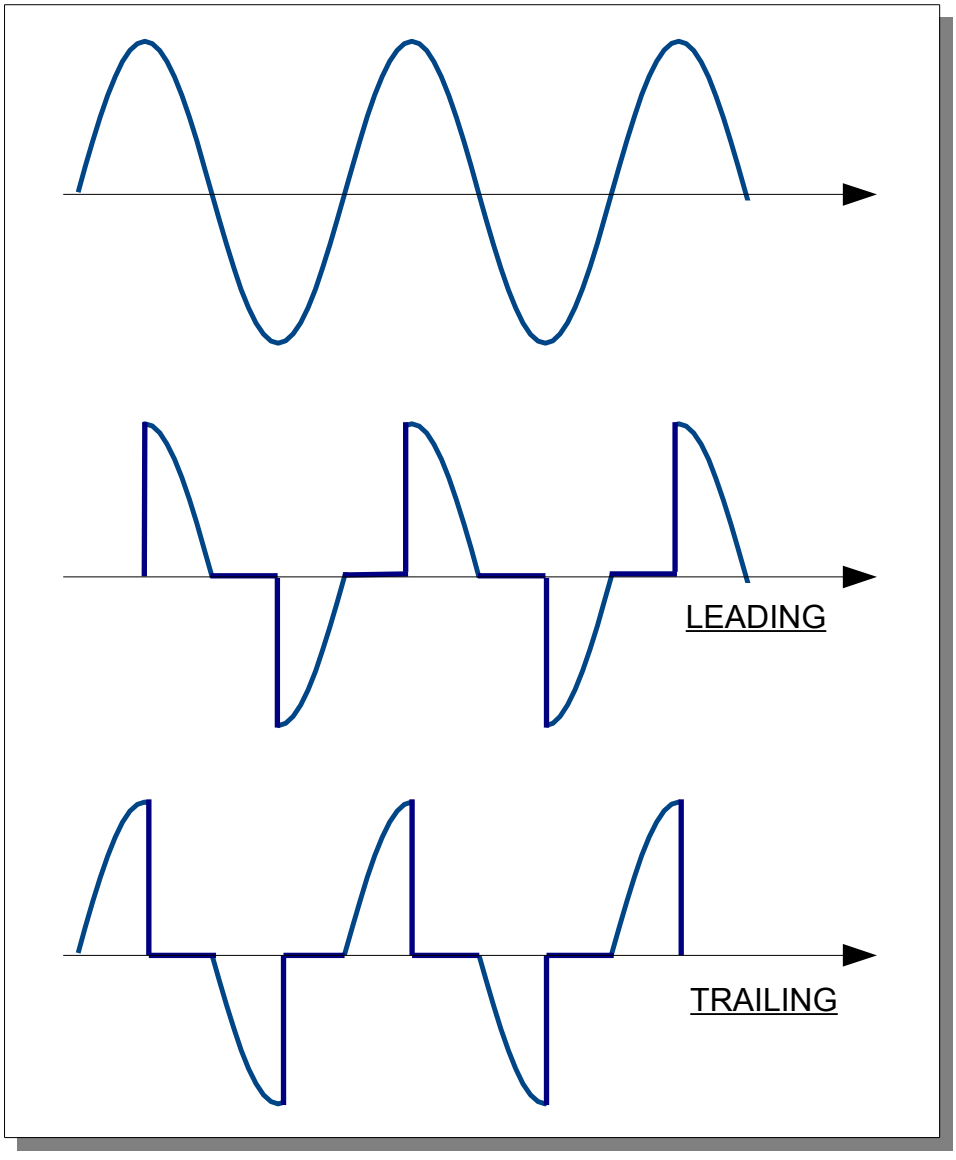
SHUTTLE DIMMER
FAULT FINDING, TIPS AND FAQ

➢ *1. DIFFERENCE BETWEEN TRAILING EDGE AND LEADING EDGE DIMMING*

The diagram below shows a normal 220VAC 50Hz cycle. If the dimmer delays the turn on of the cycle, it is a leading edge dimmer, but if the dimmer delays the turn off of the cycle, it is a trailing edge dimmer. Leading edge dimming hence produces a very quick or sharp inrush of voltage into the load during each 50Hz half cycle, which in turn causes a high inrush current into the lamp filaments or the electronic components of solid state lighting. Trailing edge dimming does not cause a high inrush voltage or current and is hence in general more "natural" for the load.



➢ *2. WHY DOES A DIMMER AND TRANSFORMERS BUZZ WHEN BEING DIMMED?*

Only leading edge dimmers cause a buzz in transformers and itself. When a transformer is operated on a normal non-dimmed AC cycle, it is quiet because it turns on "softly" when the AC starts off from zero volts. On leading edge dimming the transformer experiences a sudden electrical and mechanical "shock" when it receives the sudden very high voltage

and corresponding inrush current. A trailing edge dimmer and transformers being dimmed is quiet because the dimmer and transformer “thinks” it operates with a normal non-dimmed AC cycle – there is no sudden high voltage or inrush current that “shocks” the load

- *3. DOES A DIMMER SAVE ENERGY?*

Yes, because even when full on, dimmers supplied the lamp with a maximum of 92-95% of the full AC voltage and hence provides a slight energy saving. As the lamp is dimmed more, the RMS voltage across the lamp is reduced and the energy saving becomes more. As an example, an incandescent or halogen lamp which is 50% dimmed uses at least 40% less energy compared to when fully on.

- *4. CHOOSING BETWEEN TRAILING EDGE OR LEADING EDGE*

In most dimming applications it is more desirable to use a trailing edge dimmer (SDIM-T/SDIM-T-LED). Trailing edge technology ensures less EMI being generated in electronic transformers, is 100% silent, usually reduces or even completely eliminates high inrush currents into lamps or the electronics of the lamps, is generally capable of handling a larger maximum load (due to the lack of inrush current mentioned) and is in general more compatible with a majority of load types, including electronic transformers. There are however some applications or lamp types (especially some LED lamps) which specifically requires a leading edge dimming solution (SDIM-L-LED)

- *5. CHOOSING BETWEEN LOW VOLTAGE OR 230VAC HALOGEN LAMPS*

Low voltage MR16 halogen lamps have a physically much thicker and shorter filament than that of it's 230VAC counterparts. This produces a more even light distribution, generally ensures a much longer lamp lifetime and makes the low voltage lamps less prone to possible over voltage or “spikes” from the mains. The MR16 lamps are also protected from the harsh mains environment by the 230VAC to 12VAC transformer. Electronic transformers are generally well designed and features thermal protection, overload and short circuit protection and in many cases some protection against spikes from the mains. Although the initial capital outlay may be more for the MR16 halogen lamp choice, the overall performance and quality of light makes this the preferred choice.

- *6. CHOOSING BETWEEN LOW VOLTAGE OR 230VAC DIMMABLE LED LAMPS*

In the case of dimmable LED's the advantages of the direct 230VAC products makes this the preferred choice. Most often the MR16 LED lamp is not supplied with a transformer. This then not only brings compatibility of the LED and transformer into question, but also compatibility of the transformer and dimmer and in most cases the compatibility of the dimmer/LED/transformer combination. There are three very complex and physically different electronic technologies that must be optimally matched. If not matched, the lamps could flicker, dimming range be limited, lamps might not turn on at all, etc. etc. On the other hand, a 230VAC dimmable LED lamp is a complete unit which does not require additional and very much unknown electronic modules to operate. This not only makes it much easier to ensure dimmer compatibility (avoid possible MR16 flashing when turning on or off), but remove a possible weak link from the lighting system.

A good example of a maintenance issue is if the client has low voltage LED's installed and a failure occurs. The maintenance crew must have not only spare LED lamps, but also

spare electronic transformers, since they do not know which failed, LED or transformer. If the transformer failed, they should ideally ensure that the same brand and model of transformer is replaced, else the LED lamp might not react the same as the others.

- *7. CAN A DIMMABLE MR16 LED BE USED WITH A WIRE WOUND TRANSFORMER?*

Shuttle does not qualify any dimmer model to be used with wire wound transformers due to the possibility of dimmer and/or LED damage.

Unless the wattage load on the wire wound transformer is close to the VA rating of the transformer, the back EMF can be very large. If the real load is close to the VA rating, most of the back EMF is only caused by the transformer leakage inductance which is normally only about 1-4% of the total inductance (depending on the size and winding method). The problem with LED is that one would place a "replacement" lamp on the transformer – that is light output replacement, not wattage replacement. For instance, a 200VA wire-wound normally had 4x50W halogen lamps. Now the 4 halogens are for instance replaced with 4x10W LED's and the 200VA transformer only has a load of 40W which implies that the total circuit now becomes hugely inductive (same with a 1x10W LED on a 50VA) and the power factor deteriorates significantly. When not being dimmed, the much larger energy stored (causing back EMF) is simply returned to the mains without a problem, unless there is a brown-out. During a brown-out, the voltage is momentarily interrupted and it can cause a much higher back EMF to be generated. Fortunately this would generally not cause a problem since it's for a very short time. If the under-loaded wire wound transformer is however dimmed, the problem becomes significant. Essentially the voltage to the transformer is interrupted during each cycle and the EMF generated will over stress the dimmer and failure will occur unless a dimmer specifically designed for an inductive or so called "motor" load is used.

- *8. THE LIGHTS DIM DOWN TOO MUCH*

*Dim to a comfortable low light level and se*t (MINDIM^{T}) this *level as the dimmer minimum level (11 clicks)*

- *9. TWO WAY SWITCHING DOES NOT WORK*

Ensure that there are no mains live, neutral or earth connected to the two white wires

- *10. DIMMABLE LED'S FLICKER AT LOW LIGHT OUTPUT*

There are many different types of control circuits employed in dimmable LED's. Some of the circuits or control IC's might not be able stabilise the LED at very low light output, especially in areas of low supply voltage. This however usually only occur at fairly low light output

Dim to the lowest light level and then increase the light level to where the light output is stable. Set this level (MINDIM^{T}) *as the dimmer minimum level (11 clicks)*

- *11. WHEN DIMMING DOWN, THE LED'S TURN OFF*

Although the dimmer did not turn off while dimming down, the LED's, especially some MR16's with electronic transformers, do turn off. This is once again a function of the control circuit electronics as above and/or the interaction and characteristics of the MR16/transformer combination. It was found that if the dimmer's lowest light output level is adjusted to prevent certain electronic transformer and MR16 LED lamp combinations from turning off a low light output, other combinations of transformers and LED's do not dim low enough, which would limit the effective dimming range. In order to address the two extremities, the dimmer's minimum light output level was designed to allow an acceptable dynamic dimming range for most popular transformer/MR16 combinations. The disadvantage is that some combinations might turn off at low dimmer output.

Dim up and down around the point where the LED's turn off. Then increase the light output slightly and set this level (MINDIM^{T}) *as the dimmer minimum level (11 clicks)*

- *12. DIMMABLE MR16'S DO NOT TURN ON*

Most electronic transformers employ self oscillating methods which rely on the load current for oscillation, hence the characteristic minimum load requirements. Since LED lamps consumes much less power (current) than it's halogen counterparts, it could be that the lamp current is too little to initiate the transformer oscillation and hence turn on. This is especially a possibility if the supply voltage is relatively low and with a low total load on the dimmer.

Follow manufacturers recommendations for transformer compatibility and minimum number of MR16 LED lamps per transformer. If this is according to specifications, activate the MR16 LED compatibility mode of the SDIM-T-LED. Please refer to Shuttle compatibility chart..

- *13. DIMMABLE MR16 LED's DIM TOO QUICKLY AT LOW LIGHT LEVEL*

As in the case where some of the MR16 LED turn off, it was found that a number of electronic transformer and MR16 LED lamp combinations exhibit a dimming curve very similar to that of conventional halogen lamps. Some however do not and might dim very quickly at low light output.

*Activate the MR16 LED compatibility mode of the SDIM-T-LED***.**

- *14. DIMMABLE LED's FLICK OR FLASH WHEN TURNED ON AT LOW LIGHT LEVEL*

This is a function of the LED control circuit (driver) and itt was found that this is **not a function of the dimmer brand or dimming method.** If the LED lamps exhibits this characteristic, it will usually occur with any type of dimmer, whether leading edge, trailing edge, rotary or bell-press.

- *15. DIMMABLE MR16 LED's FLICK OR FLASH WHEN TURNING OFF*

This is a function of the transformer/MR16 LED interaction. Since the transformer is electrically situated between the MR16 LED lamp and the dimmer, the LED lamp does not react directly to the dimmer turning off as is the case with 230VAC LED lamps. The MR16 LED reacts to the voltage diminishing on the output of the transformer and due to possible

energy being stored in the transformer, the LED could flick when turning off or even exhibit a slower turn off than it's 230VAC LED or halogen counterpart.

It was found that this is **not a function of the dimmer brand or dimming method.** If the transformer/MR16 LED lamps exhibits this characteristic, it will usually occur with any type of dimmer, whether leading edge, trailing edge, rotary or bell-press.

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