

Technical Write-Up on LED Lamp performance during use with Dimmers

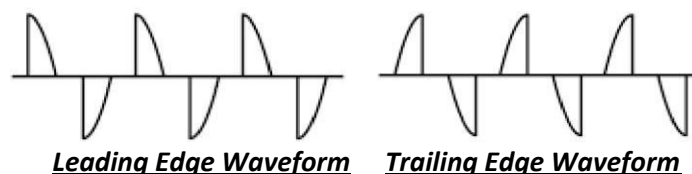
BACKGROUND: Controlled lighting environments have helped the poultry industry to improve production. The journey of controlled lighting environments by way of dimming was initiated by using incandescent lamps and later on to cold cathode fluorescent lamps which were dimmed through TRIAC Dimmers.

Subsequently LED technologies were introduced to the poultry industry over the last 7 years offering extremely good ROI's. Since most of the houses were equipped with the older TRIAC dimmers many companies designed new dimmers to control the variation of different kinds of light bulbs (CFL, CCFL, Incand. and LED).

TYPE OF DIMMING TECHNOLOGIES: Dimming was achieved by 'chopping of the phase angle' of the AC Sine Wave. Primarily two methods of dimming technology were used for general lighting purposes as per details below:

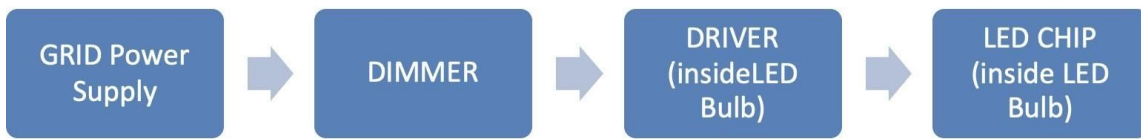
Leading Edge Dimming: Leading edge dimming cuts the front edge of each wave's half cycle. Leading Edge Dimming produces a rush of voltage every half cycle, resulting in a rush of current to the light source. Leading-edge dimmer switches are cheaper and simpler than trailing-edge, and were used originally to dim incandescent and halogen bulbs or wire-wound magnetic transformers. They use a 'TRIAC' (Triode for Alternating Current) switch to control power, and are sometimes called TRIAC dimmers."

Trailing Edge Dimming: Trailing Edge Dimming (electronic dimming) utilizes a current that is turned off as the AC waveform ends, right before it crosses zero. These more modern dimmers have many benefits over the leading edge type. These improvements include smoother dimming with less interference. Trailing edge dimmers have a much lower minimum load than the leading edge, making them far more suitable for powering LEDs.



There were many limitations for development of one common dimmer which can operate many kinds of light bulbs (incand. CCFL, CFL and LED). Some companies tried to make a common dimmer to dim various types of light sources/bulbs.

LED lights are far different from incandescent lamps. LED lights rely on driver circuits to provide constant DC current to the LED chips for proper performance. The driver circuit is housed inside the light bulb itself. LED chips are current sensitive devices and require good quality constant DC current for stable life and lumens over its' life time.



The dimmer selection and its interface with the LED driver require the following precautions to ensure life hours and proper lumen maintenance:

1. Avoid use of 'Leading Edge' dimmers, as these could generate high peak pulsating currents from the driver to the LED chip which would be harmful for LED life/lumens.
2. Every LED manufacturer suggests NEVER exceed specified "Maximum Peak Pulsed Forward Current". It can have catastrophic impacts on the LED chip performance. They suggest that the lower the pulsating DC current and Peak the better the LED would perform.
3. Lowest level of pulsating current spikes are desired to ensure proper life/lumen from the LED.

Internal Observations and recommendations based on Testing of various Dimmers

Overdrive R&D engineers tested various dimmers to check their impact on LED lamp performance and some important findings are listed below:

- 1 Found that many dimmers are using conventional technology like TRIAC/Leading Edge Dimmers. Poultry Industry dimming demands are quite harsh in terms "Low 1%-3% Dimming Levels" and "Continuous long usage hours". When this low dim level is used with "Leading Edge type dimmers" the Peak Pulsating Current spike increases and many times exceeds the specified limits established by the LED chip makers. BridgeLux/Seoul Semi are 2 chip makers that have commented and reviewed test data supporting the above situations.
- 2 Some dimmers were designed with options of providing both Leading and Trailing Edge dimming. We found that these dimmers can cause severe damages to the LED chips if operated on Leading Edge dimming options as Peak Current exceeds the limits.
- 3 The peak current fed to the LED chip is generated by LED Bulb Driver and depends substantially on the quality of power fed from the dimmer output. The pattern of the peak current can vary from driver design and topology.
- 4 These tests were carried out under laboratory conditions and it is expected that under actual field conditions it would show worse results with Leading Edge dimmers.
- 5 Overdrive ODMR uses Trailing Edge dimming technology based on MOSFET circuitry and was found to have minimal/lowest peak current generation when compared against any dimmer that was tested internally and externally at Intertek lab.