INTRODUCTION

360° Test Labs has been retained to perform a failure investigation and analysis of Branded Model T8 LEDs that have exhibited a high rate of failures. For this purpose twenty-four failed, and twenty-four new Branded T8 LEDs were supplied (pictured right). The Branded Model is a direct voltage five foot lamp designed to retrofit a florescent fixture after removal of the ballast.

Investigation

The Branded Model lamp consists of a polycarbonate tube containing a LED strip with caps at each end contain printed circuit boards. At the power inlet end, the PCB converts the AC mains voltage to DC (described as the power supply for purposes of this report). At the opposite end is another PCB controlling current to the LEDs, described as the driver.

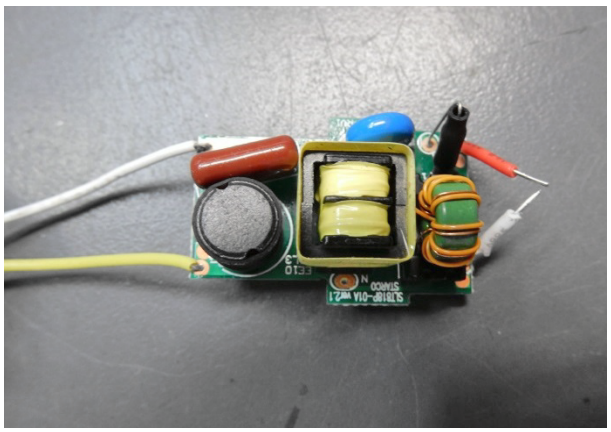


Figure 1: Power supply board

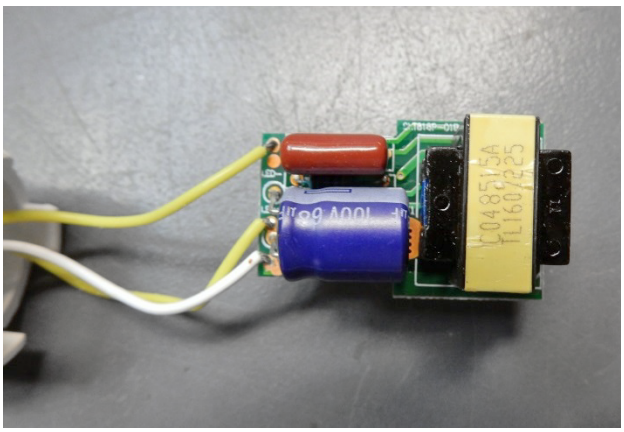


Figure 2: Driver board

During investigation it was found that the power supply board of the failed lamps was functional and suppling DC voltage, thus the driver board of a failed lamp was replaced with a known operational board, which restored lamp functionality.

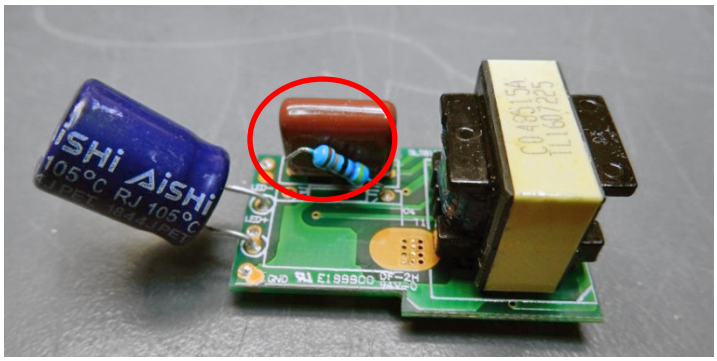
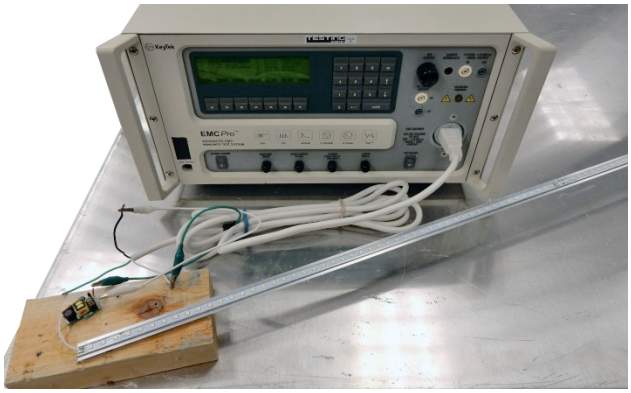


Figure 3: Driver board with R4 circled

Closer examination of the failed driver board found that a resistor on the board (R4) was open. Substituting the 470K& R4 resistor of a non-functional board with a known good resistor restored operation to the driver board and the lamp. Subsequently, a good 470K& resistor was jumpered across R4 of each of the failed lamps restoring proper operation to all of the failed lamps.

Figure 4: Lamps restored to proper operation

In an attempt to reproduce the failure of R4, 360° utilized a Thermo Fisher Scientific EMCPro Test System to stress a repaired lamp with various power line disturbances: (**https://youtu.be/lqaBCO3oLWg**)



- *IEC waveform Electrical Fast Transient (Burst) class 3, coupled to L1, L2 & PE.*
- *Surge with IEC 1.2/50uS combination waveform class 3, applied line-to-line and line-to-earth.*
- *Surge 500A IEC/ANSI 100kHz ringwave to level 3 applied line-to-line and line-to-earth.*
- *Power Quality Failure (dips and interrupts) with IEC voltage levels (0%, 40% & 70%) and phase angles.*

One lamp failed the IEC 1.2/50uS combination waveform class 3; however, the failure was not due to the R4 resistor. The failed part appears to be a MOSFET driver (exact identification was not pursued since such was not essential to the analysis). Other lamps subjected to the same stress multiple times successfully withstood the stress without failure.

A lamp was also placed within an environmental chamber and operated at maximum specified ambient temperature (45°C / 113°F) for an extended time period. Significant heat was generated by the transformer on the driver board, which is adjacent to the R4 resistor. 166°F (75°C), high enough that derating of the resistor is appropriate.

Figure 5: Lamp placed within environmental chamber

A voltage measurement across the R4 resistor with the lamp powered by 120 VAC found an acceptable voltage drop of approximately 92 VDC. Conversely, **when powered by 277 VAC this voltage drop increased to approximately 240 VDC; extremely close to the typical 250 volt maximum working voltage of a ¼ watt metal film resistor.**

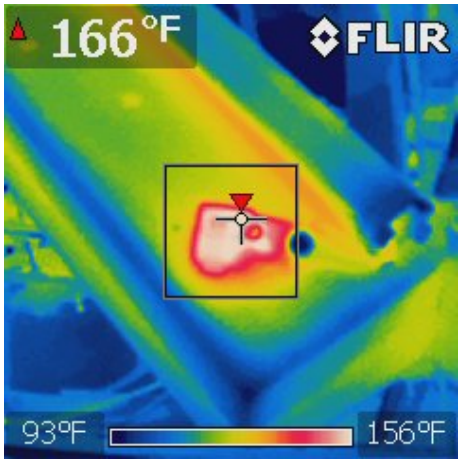


Figure 6: Driver board Temperature

Figure 7: Power source suppling ~277 VAC

Neither a BOM nor a schematic were provided; however, R4 appears to be a ¼ watt resistor likely of metal film composition. At 120 and 208 VAC power dissipation is minimal, however at 277 VAC power dissipation increases to just over 0.12 watt, roughly 50% of a ¼ watt.

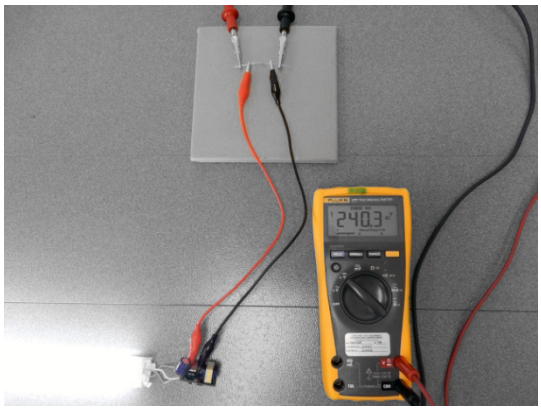


Figure 8: Voltage measurement across R4

Conclusion

The resistor R4 appears to be under specified for use with a 277 VAC line voltage; this is true without a high-heat derating that is likely appropriate based on temperature chamber test data.

While power dissipation is reasonable, the temperature stress is moderate and the voltage stress is high.

Reviewed by: ATL OCE PAG