Overcurrent Testing of J Series® Products

INTRODUCTION

In certain applications – namely flashlights, signal lighting, strobe lighting, and entertainment lighting – the ability to drive an LED at a current higher than the rated maximum current for a short period of time is beneficial in maximizing lumen output, intensity, or minimizing cost. Generally, LED devices are characterized with a maximum rated forward current across the p-n junction, usually coupled with a maximum junction temperature above which the probability of catastrophic failure increases considerably. Balancing the tradeoffs between fixture size, weight, cost to build, optical output, operating temperature, and environmental conditions can lead to deciding to drive the LED devices harder than their respective rated conditions.

In this white paper, the maximum current that a given LED device can repeatedly withstand (denoted "overcurrent") as a function of Tsp while providing the maximum lumens per emitting area will be explored across the J Series® device portfolio. This application note is an extension of the previously published document covering overcurrent ratings for the Cree LED XLamp® portfolio of LEDs found on the Cree LED website.

Definitions of commonly used words in this white paper:

- Tsp is the temperature measured at the LED solder point in °C.
- LumFlux is shorthand for luminous flux emitted from an LED.

THE OVERCURRENT TESTING PROCEDURE

The following procedure was followed to collect the data necessary to produce relationships between overcurrent values and Tsp/LumFlux for a given J Series LED:

1. The LED under study was soldered onto a starboard, affixed to an Arroyo Series 286 thermoelectric cooler (TEC) plate, inside of an integrating sphere.
2. A pair of wire leads were soldered onto the electrodes of the starboard along with a thermocouple wire to measure the Tsp of the device.
3. Before each measurement, the thermocouple was checked against a known standard.
4. The LED is energized in incremental steps, starting at the rated maximum current from the data sheet, and allowed to stabilize for 30 seconds at each condition after which the optical data and Tsp was recorded.
5. Three individual samples were collected for each LED product family under test and the resultant data was averaged.

The triplicate average for each product is reported in two forms:

1. Overcurrent as a function of Tsp and
2. The resultant Relative LumFlux as a function of Tsp (relative to the applicable data sheet flux at binning conditions).

The overcurrent values were de-rated as a function of power density, where applicable, based on millions of device hours of internal reliability testing.

SUMMARY OF OVERCURRENT LIMITS OF SELECT J SERIES LEDS

The following table summarizes the maximum overcurrent values (Tsp = 55 °C) and relative luminous flux scalars across the J Series line of LED products. As a reminder, please refer to the section on Overcurrent Precautions (below) before implementing any circuit where the LED is driven above its rated maximum current per the associated J Series data sheet. The Relative LumFlux column is a multiplier relative to the binning condition of the respective device, as described in the data sheet. This multiplier is valid for the LED only – any optical or electrical losses on a system level will continue to carry through (and may increase) as the drive current and system temperature are increased.

Cree LED Product	Footprint	Overcurrent (A)	Relative LumFlux
JB2835BWT-R	2835	0.750	2.85
JB2835BWT-T	2835	0.850	7.35
JB3030CWT-E	3030	1.550	17.1
JB3030CWT-F	3030	1.450	14.0
JR5050CWT-E	5050	3.600	5.35
JR5050BWT-K	5050	2.650	4.10
JR5050BWT-P	5050	1.850	3.00
JR5050AWT-Q	5050	1.550	2.80
JU7070BWT-K	7070	5.200	2.35

Data summaries for each of the above J-Series products are available in the Appendix section of this whitepaper. As these products are optimized for operating in different power regimes, a wide range of Relative LumFlux values is expected and dependent on the binning current for each individual device.

OVERCURRENT PRECAUTIONS

As the overcurrent values are substantially higher than the rated maximum currents for any of the Cree LEDs described in this document, there is no warranty of optical performance, longevity, or cyclability, or any other metric related to the LED device at any condition greater than the maximum rated condition on the data sheet.

- This white paper is a guide for designing products using J Series LEDs and driving those LEDs above the maximum rated condition. It provides overcurrent limits as a function of Tsp, which were generated in a very controlled system setup that included active cooling. Use this information with engineering caution.
- Proper heatsinking is paramount and Tsp values must be measured at the solder point, directly connected with the thermal pad of the LED device.
- The drive current for an LED at a given Tsp must never exceed the overcurrent value for that Tsp. The probability of immediate catastrophic failure of the LED device increases exponentially as the drive current increases above the overcurrent for a given Tsp.
- The LED device should never be driven continuously for more than 30 seconds at the maximum overdrive current, and a proper cooldown period (dependent on thermal load and heatsinking of the fixture) must be implemented to preserve device longevity.

- Implementation of an integrated thermal feedback circuit, or at a minimum a thermal cutoff circuit, is necessary in all overcurrent applications.

For any questions related to usage of any of the products in the Cree LED portfolio, please contact your local sales representative or visit https://cree-led.com.

APPENDIX: OVERCURRENT SUMMARIES BY PRODUCT

JB2835BWT-R

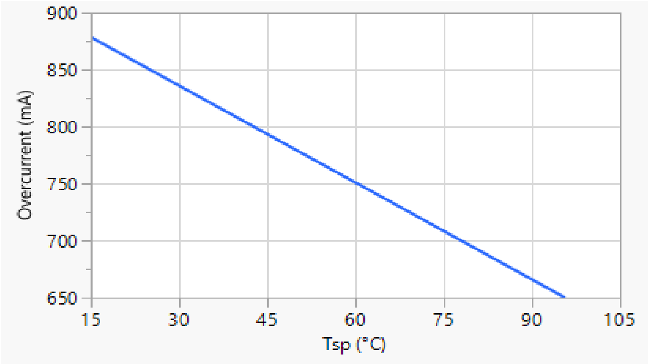

Figure 1: Overcurrent vs. Tsp

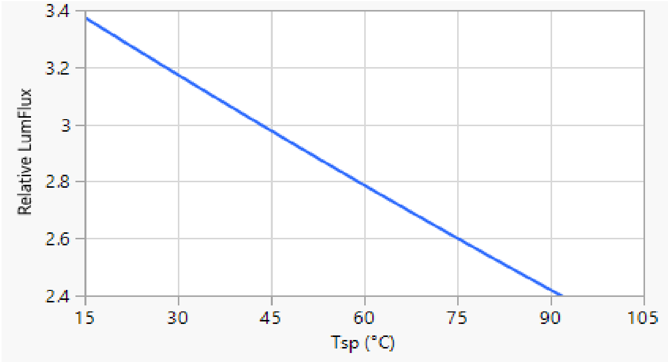

Figure 2: Relative LumFlux vs. Tsp

JB2835BWT-T

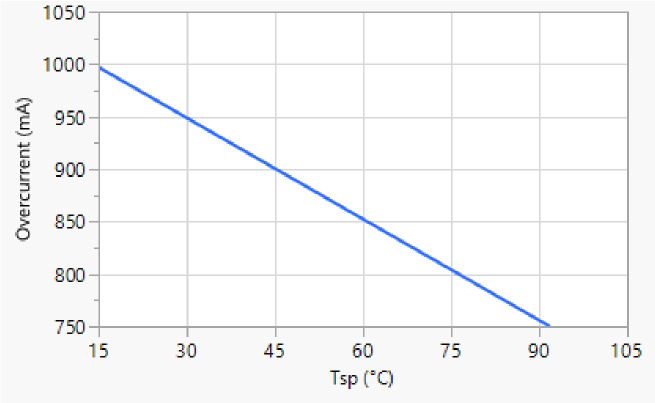

Figure 3: Overcurrent vs. Tsp

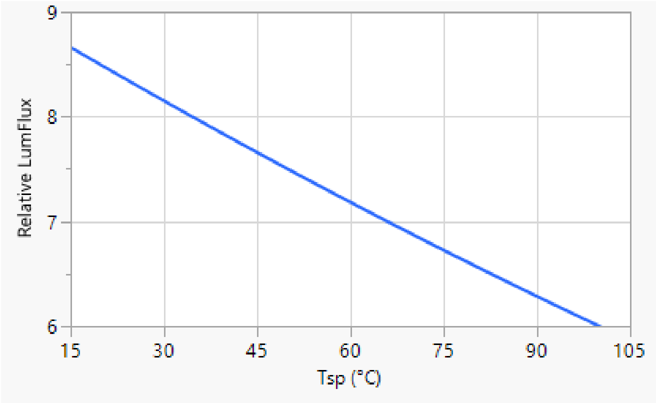

Figure 4: Relative LumFlux vs. Tsp

JB3030CWT-E

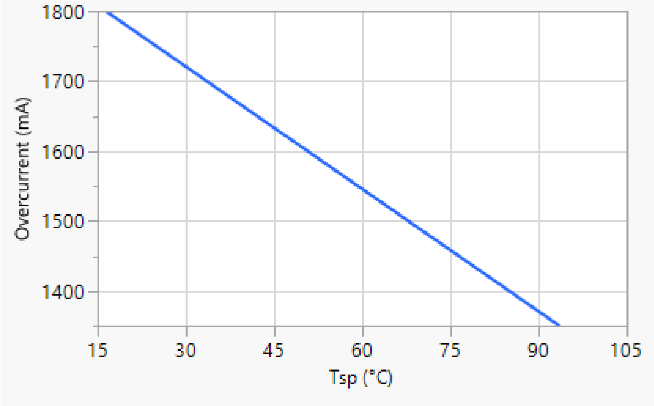

Figure 5: Overcurrent vs. Tsp

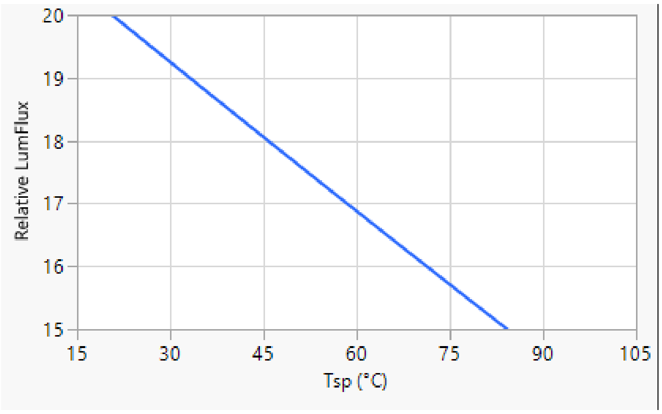

Figure 6: Relative LumFlux vs. Tsp

APPENDIX: OVERCURRENT SUMMARIES BY PRODUCT - CONTINUED

JB3030CWT-F (6 V)

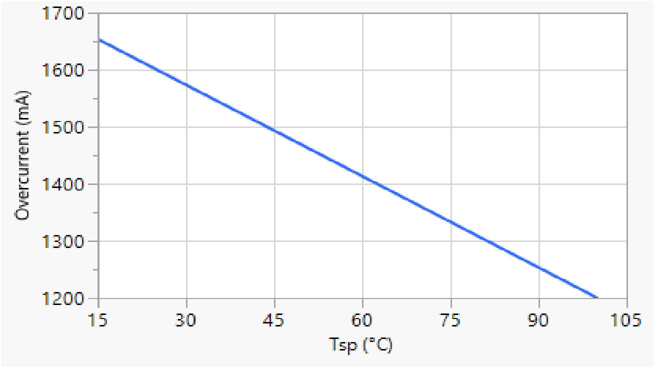

Figure 7: Overcurrent vs. Tsp

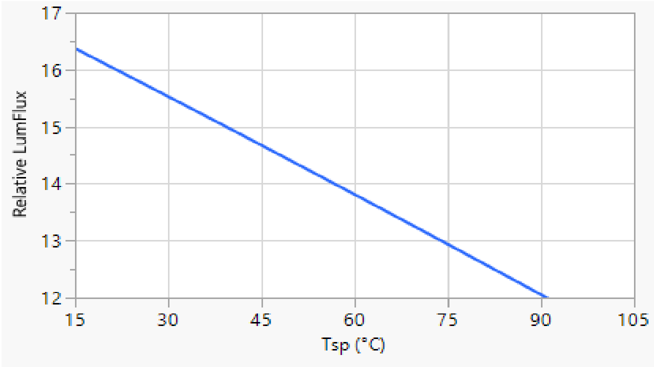

Figure 8: Relative LumFlux vs. Tsp

JR5050CWT-E (6 V)

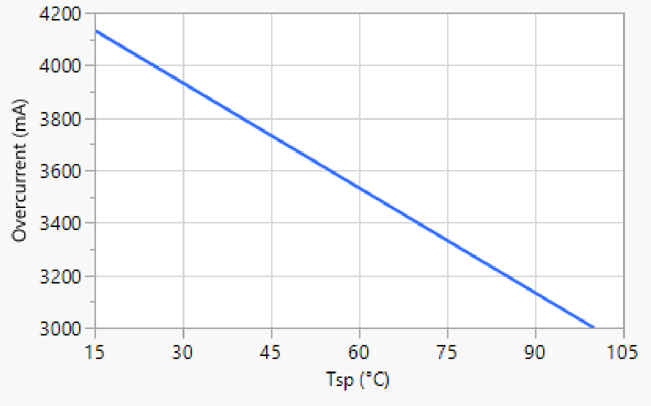

Figure 9: Overcurrent vs. Tsp

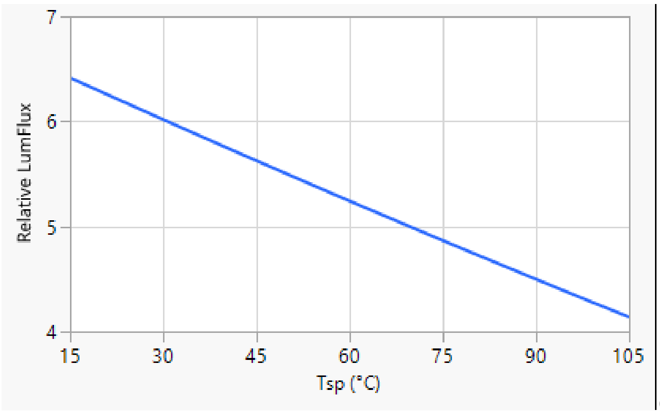

Figure 10: Relative LumFlux vs. Tsp

JR5050BWT-K (6 V)

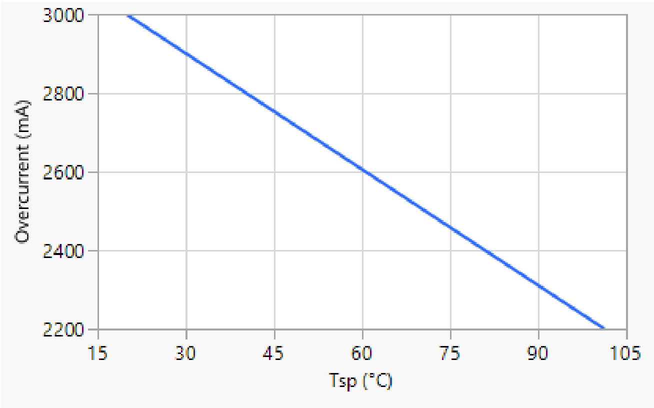

Figure 11: Overcurrent vs. Tsp

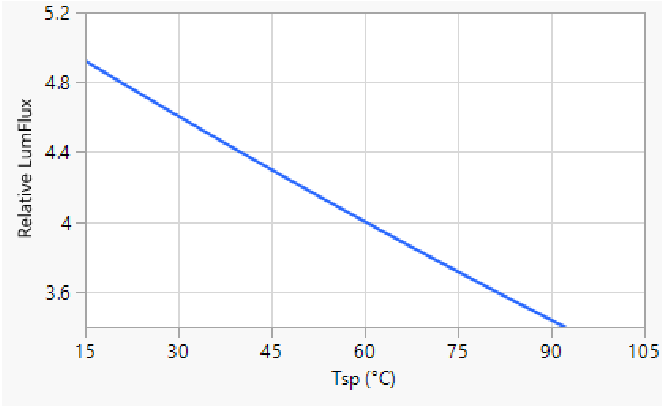

Figure 12: Relative LumFlux vs. Tsp

APPENDIX: OVERCURRENT SUMMARIES BY PRODUCT - CONTINUED

JR5050BWT-P (6 V)

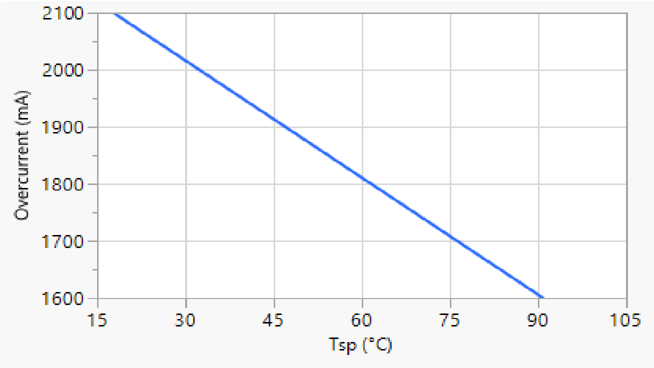

Figure 13: Overcurrent vs. Tsp

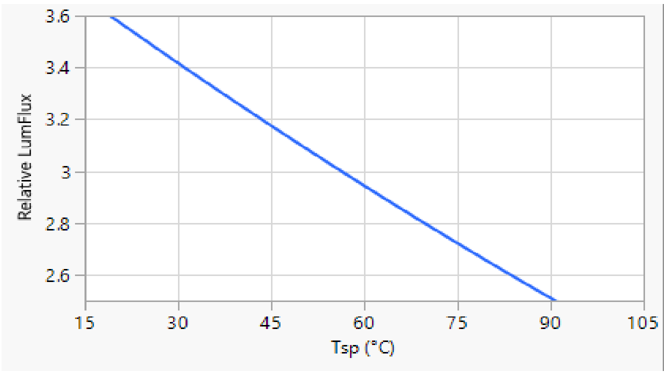

Figure 14: Relative LumFlux vs. Tsp

JR5050AWT-Q (6 V)

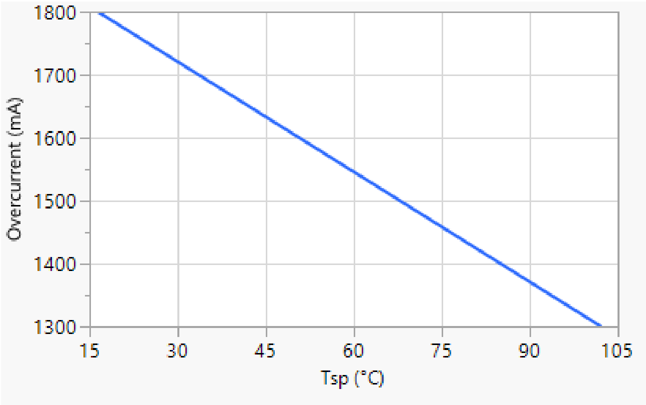

Figure 15: Overcurrent vs. Tsp

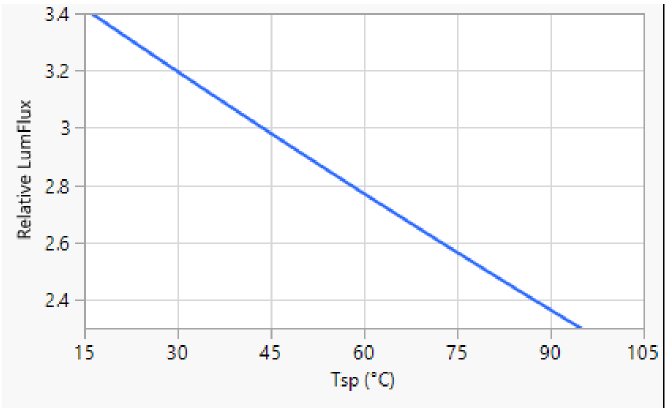

Figure 16: Relative LumFlux vs. Tsp

JU7070BWT-K (6 V)

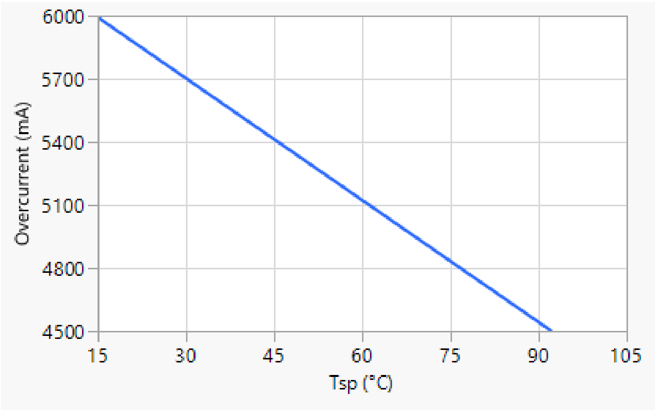

Figure 17: Overcurrent vs. Tsp

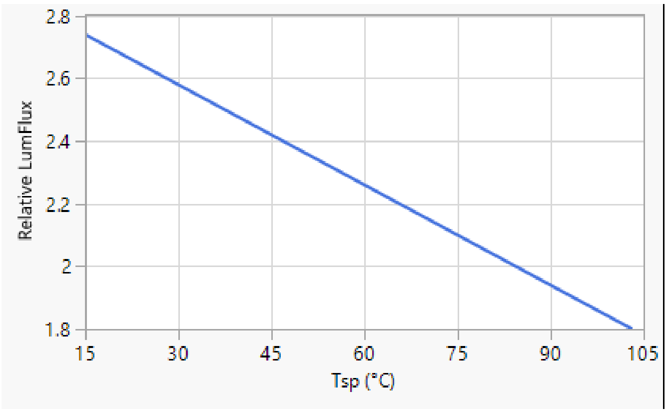

Figure 18: Relative LumFlux vs. Tsp