DESIGNLIGHTS CONSORTIUM®

What is worst-case?

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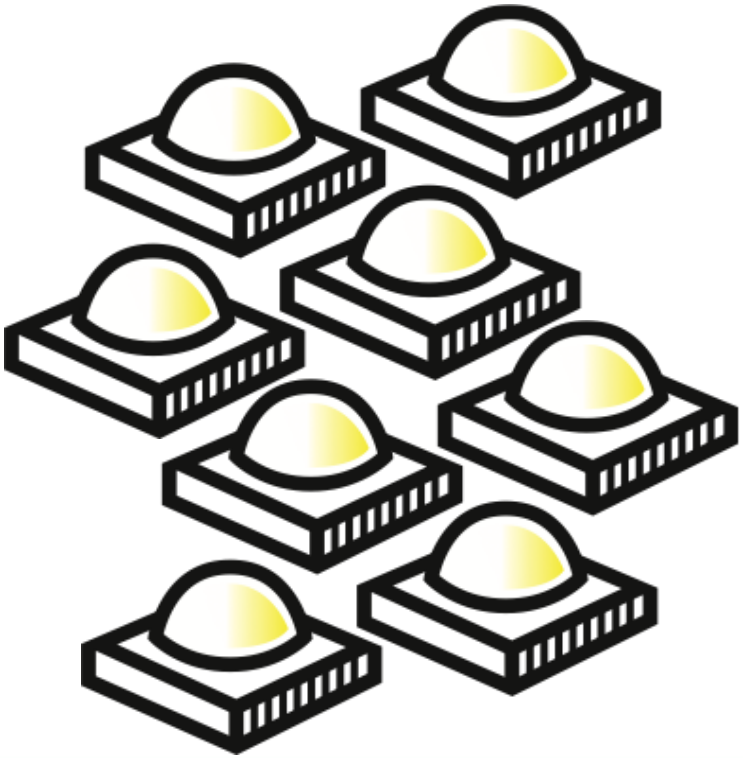
Overview



- Understand what “worst-case” means
- Understand the importance of worst-case
- Recognize which product variables affect performance
- Learn what the DLC expects to be worst-case
- Goal: Understand the DLC’s worst-case expectations to decrease processing time

What is worst-case?

- The meaning of worst-case
  - Worst-case = worst performing
  - Worst-case conditions for a particular metric (e.g., light output)
    - Ex: Under which conditions would your product produce the fewest lumens?
- The importance of worst-case information
  - For all applications, the DLC is most concerned with worst-case performance of a product in the field, and how that would compare to the DLC's minimum performance requirements

Accepted Product Variations

Single Product Application

- Correlated Color Temperature (CCT)
  - e.g., 3000K, 4000K, and 5000K
- Voltages
  - Same driver that operates at two voltage ranges
- Dimming options
- Non-performance affecting variations
  - e.g., housing color

Family Grouping Application

- CCT
- Multiple wattages
- Housing size (volume)
- Dimming options
- Number of LEDs
- Voltages
- Driver current
  - Note: drivers with programmable currents (e.g., 350mA, 530mA, and 700mA) not separate drivers

Worst-Case: Single Product

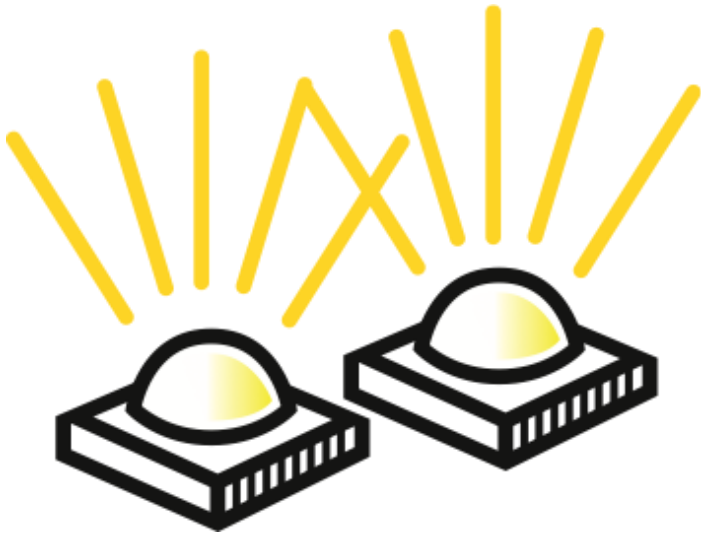
Which variables affect your single product application?

- Correlated Color Temperature (CCT)
  - Warmer color (lower CCT) → hotter → less efficient
- Input voltage
  - Universal voltage drivers (120V – 277V)
    - Operating at 120V → worst-case efficiency? → worst-case efficacy
    - Operating at 277V → worst-case THDi? worst-case power factor?
  - High voltage drivers (347V – 480V)
    - May not be able to apply universal driver logic here
- Understand your products; justify worst-case

Worst-Case: Family Grouping

Worst-Case Light Output

- Product variables that affect light output



Worst-Case: Family Grouping

Worst-Case Light Output

- Product variables that affect light output
  - Number of LEDs (lower quantity is worse)
  - Drive current (lower is worse)

Worst-Case: Family Grouping

Worst-Case Light Output

- Product variables that affect light output
  - Number of LEDs (lower quantity is worse)
  - Drive current (lower is worse)
  - CCT (lower is worse)
  - Optical efficiencies (which is least efficient?)

Worst-Case: Family Grouping

Worst-Case Light Output

- Product variables that affect light output
  - Number of LEDs (lower quantity is worse)
  - Drive current (lower is worse)
  - CCT (lower is worse)
  - Optical efficiencies (which is least efficient?)
  - Color Rendering Index (CRI) (higher is worse)
  - Thermal conditions (hotter is worse)

Worst-Case: Family Grouping

Worst-Case Efficacy

- Product variables that affect efficacy
  - CCT (lower is worse)
  - Thermal conditions (hotter is worse)
  - Optical efficiencies (which is least efficient?)
  - Drive current (higher is worse)
  - Loading conditions (lower is worse)
  - CRI (higher is worse)

Worst-Case: Family Grouping

Worst-Case Thermal Environment

- Product variables that affect the thermal environment
  - Number of LEDs (higher quantity is worse)
  - Housing size (smaller is worse)
  - Drive current (higher is worse)
  - CCT (lower is worse)
  - CRI (higher is worse)
  - Optical efficiencies (which is least efficient?)
  - Proximity of other heat sources? (e.g., driver)
- Understand your products; justify worst-case

Some Worst-Case Exceptions

- Dimmable Products
  - We are aware that dimming negatively affects performance
  - DLC will monitor progress toward standard methodology and will consider performance reporting or requirements in the future

- Ambient Air Temperature
  - Currently no testing requirements for products tested at higher ambient air temperatures (e.g., 40°C)
  - May be something the DLC will look at in the future

Worst-Case Example: Single Product

- A manufacturer submits models AB-20-3000K, AB-20-4000K, and AB-20-5000K under category X, using a universal driver
  - Provides full LM-79 test report for AB-20-3000K at 120V
  - Provides color data (section 12 of LM79) for AB-20-5000K at 120V
  - Provides electrical data (PF and THDi) at only 120V for AB-20-3000K
  - Product meets requirements, but will be qualified at 120V ONLY!

- Why the limitation?
  - Didn't provide justification for only testing PF and THDi at 120V
  - To remove the "120V ONLY" limitation, the manufacturer needs to conduct additional PF/THDi testing at 277V → delays processing time!

Worst-Case Example: Family Group

- A manufacturer submits family ABC-HHH-DDD-KK-OO under category X

- Family contains:
  - ABC = Product Family Line
  - HHH = 3 housing sizes (SML=Small, MED=Medium, LRG=Large) with varying # of LEDs
  - DDD = 3 driver currents (35=350mA, 53=530mA, and 70=700mA)
  - KK = 3 CCTs (30=3000K, 40=4000K, and 50=5000K)
  - OO = 3 optical variations (T2=Type 2, T3=Type 3, and T4=Type 4)

Family Grouping Continued

- Through various methods, the manufacturer determined the Type 2 optic to be least efficient – meaning it is the hottest, least efficacious, and lowest lumen output optic
  - "Various methods" include, but are not limited to:
    - Measured values from an Accredited Laboratory
    - In-house testing facilities
- Knowing this information, the manufacturer completes the scaled performance table while providing scaling methodology and justification
- Understand your products; justify worst-case

Family Grouping Continued

- Knowing Type 2 is the least efficient optic, the manufacturer can conclude:
  - Model ABC-SML-350-30-T2 will be the worst-case light output member
  - Model ABC-SML-700-30-T2 will also be the worst-case efficacy model, knowing that it is the hottest optic and produces the fewest lumens
  - Model ABC-LRG-700-30-T2 will be the worst-case thermal member, as it has the most LEDs, highest drive current, lowest CCT, and the least efficient, Type 2 optic

- Manufacturer determined the correct worst-case models and provided the appropriate test reports for each

Family Grouping Continued

- What the manufacturer did right!
  - The manufacturer recognized all of the performance-affecting variables in the family
  - It isolated the variables with the biggest effects and determined which models were “worst-case”
  - It conducted the appropriate tests on its selected worst-case models
  - It provided technical rationale to the DLC reviewer
  - The manufacturer decreased DLC processing time by understanding its products’ performance and providing justification

Worst-Case: Key Points

- Important performance metrics:
  - Worst-Case Light Output
  - Worst-Case Efficacy
  - Worst-Case Thermal Environment
- Recognizing worst-case will decrease processing time
- Understand your products; justify worst-case
- The DLC always reserves the right to ask for more information or justification about how worst-case was determined

Thank You!

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