TRIDONIC

Design In Guide

1. Introduction

1.1 Scope of this Guide

This Design-in Guide is dedicated to the electrical, thermal, and mechanical integration of the Tridonic 600W/800W high-power outdoor LED drivers. It provides technical insights and best practices for luminaire designers, electrical engineers, and system integrators to ensure the safe, reliable, and optimized performance of the following specific models:

- LCO 600/600-2800/286 NF C PRE (600W | DALI-2 | NFC)
- LCO 800/850-4200/286 NF C PRE (800W | DALI-2 | NFC)

Purpose of the Document:

While the product datasheet provides specific performance data (e.g., efficiency, PF, THD), this guide focuses on the application level. It covers critical topics such as:

- Electrical Design-in: Inrush current handling, circuit breaker calculation, and surge protection strategies.
- Thermal Design-in: T_c point definition, heat dissipation requirements, and lifetime estimation.
- Configuration: Detailed instructions on NFC programming, DALI integration, and timer dimming profiles.

- Safety & Compliance: Insulation requirements for Non-SELV high-voltage outputs.

Intended Audience:

This document is intended for professional lighting engineers and technical staff familiar with LED driver terminology and electrical safety standards (IEC 61347).

1.2 Product Description

The outdoor 600W/800W driver represents Tridonic's flagship solution for ultra-high-power outdoor lighting. As part of the PREMIUM (PRE) portfolio, these drivers are engineered to deliver industry-leading power density and reliability for demanding applications such as stadium floodlighting (High Mast), airport aprons, harbor terminals, and large-scale industrial facilities.

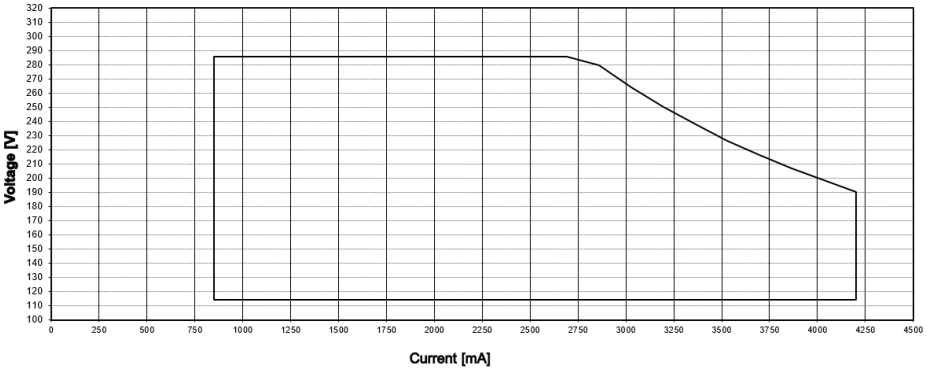
Advanced Architecture & Rugged Design

- Dual-Stage Topology: The driver utilizes a sophisticated dual-stage circuit design (independent PFC + DC-DC stages). This architecture ensures high electrical efficiency and provides a stable, low-ripple output current essential for flicker-free lighting in HDTV broadcasting environments.
- IP67 Protection: Encased in a robust die-cast aluminum housing and fully potted with high-thermal-conductivity silicone, the driver achieves an IP67 rating. This construction provides complete protection against moisture, dust, and vibration, ensuring maintenance-free operation in harsh outdoor conditions.

Smart Constant Power Technology

Unlike traditional fixed-current drivers, The outdoor 600W/800W driver features a wide "Constant Power Operating Window."

- Flexibility: Through NFC (Near Field Communication) programming, the output current can be adjusted over a broad range (e.g., 2.80 A to 4.20 A for the 800W model) while automatically boosting the voltage to maintain full wattage.
- Inventory Optimization: This flexibility allows a single driver SKU to drive various LED module configurations, significantly simplifying inventory management for luminaire manufacturers.



Connectivity & Expansion

- DALI-2 Certified: Equipped with a standardized DALI-2 interface (IEC 62386), the driver supports bi-directional communication for seamless integration into smart city or building management systems.

1.3 Key Features & Benefits

The outdoor 600W/800W driver distinguishes itself through a balanced combination of industrial-grade ruggedness and advanced digital control capabilities.

Robustness & Reliability

- Extreme Surge Immunity: Engineered to withstand harsh electrical grid environments, the driver features built-in surge protection tested to 10 kV (Line-to-Earth) and 6 kV (Line-to-Line) according to IEC 61000-4-5. This often eliminates the need for external Surge Protection Devices (SPDs) in the pole.
- Superior Lifetime: Designed for a service life of 100,000 hours at a case temperature (Tc) of 70°C. This is supported by a 7-year warranty, ensuring the luminaire matches the lifespan of the LED source.
- IP67 Ingress Protection: The fully potted aluminum enclosure ensures complete protection against dust entry and water immersion, making it suitable for wet and humid environments.

High Performance

- Industry-Leading Efficiency: Achieving up to 95% electrical efficiency. This ultra-high efficiency significantly reduces internal heat generation, lowering the thermal load on the luminaire system.
- Flicker-Free Output: The dual-stage topology ensures low output ripple, compliant with IEEE 1789 standards. This is critical for high-definition (HD) TV broadcasting requirements in sports arenas, ensuring no stroboscopic effects during slow-motion replays.

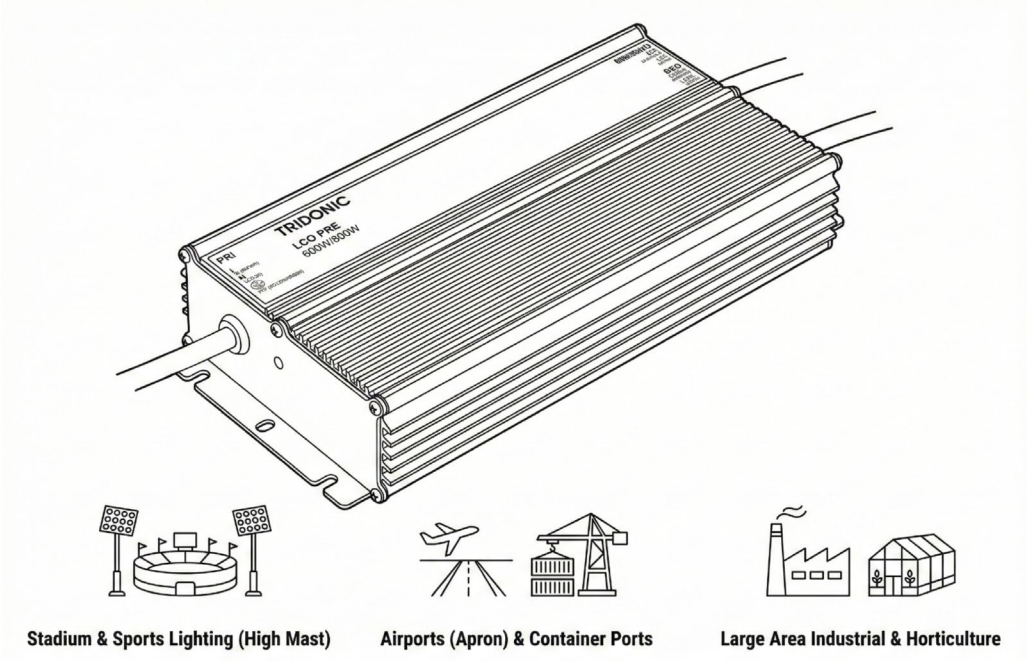
- Wide Operating Window: The "Constant Power" technology allows the driver to deliver full wattage across a wide current range, providing maximum flexibility for LED module selection.

Intelligence & Control

- NFC Wireless Programming: Supports rapid configuration of output current, dimming curves, and thermal protection parameters via the Tridonic NFC interface, without connecting the driver to mains power.
- DALI-2 Connectivity: Fully certified DALI-2 interface (IEC 62386 Parts 101, 102, 207) ensures seamless interoperability with standard lighting management systems (LMS).
- Integrated Timer Dimming: Features an automatic "Virtual Midnight" calculation logic, allowing for pre-programmed multi-step dimming profiles to save energy during off-peak hours without external controllers.

1.4 Target Applications

These drivers are specifically optimized for high-power outdoor and heavy industrial lighting scenarios.



1.4.1 Stadium & Sports Lighting (High Mast)

- Requirement: High lumen output, HD broadcasting compliance, and reliability at great heights (hard to replace).

- Solution: The outdoor 600W/800W driver delivers 600W/800W per node with low ripple (Flicker-Free). The 100,000-hour lifetime minimizes maintenance costs associated with hiring cranes or climbers for replacement.

1.4.2 Airports (Apron) & Container Ports

- Requirement: High poles (30m+), exposure to sea salt/mist, and high risk of lightning strikes on open ground.
- Solution: The IP67 potting protects against corrosion, while the 10kV surge protection safeguards the luminaire against grid transients common in large terminals.

1.4.3 Large Area Industrial & Horticulture

- Requirement: High ambient temperatures and dirty power grids.
- Solution: The high efficiency (95%) ensures the driver runs cool even in hot environments. The "Constant Power" feature allows horticultural fixture designers to easily tune the photon flux (PPF) by adjusting current without changing the driver hardware.

2. Electrical Design-in

2.1 Operating Window & Load Matching

The LCO 600/800 NF C PRE drivers utilize a programmable "Constant Power" architecture. Unlike traditional "Constant Current" drivers that only operate at a single fixed current, these drivers automatically adjust their output voltage (V_out) inversely to the programmed current (I_set) to maintain the rated wattage (P_rated).

$$V_{out} = P_{rated}/I_{set}$$

This flexibility allows a single driver SKU to power a wide variety of LED boards, ranging from high-voltage/low-current to low-voltage/high-current designs.

2.1.1 Specific Operating Areas

To utilize the full power of the driver, the output current must be programmed within the designated Constant Power Region.

A. LCO 600/600-2800/286 NF C PRE (600W)

- Max. Output Power: 600 W
- Programmable Current (I_set): 0.6A – 2.8A(Operation Region) 2.1 A – 2.8 A (Constant Power Region)
- Output Voltage Range (V_out): 129 Vdc – 286 Vdc

- At 2.8 A: Output Voltage can be up to 214 Vdc.
- At 2.1 A: Output Voltage can go up to 286 Vdc.
- Below 2.1A: Max. Output Voltage is 286Vdc.

B. LCO 800/850-4200/286 NF C PRE (800W)

- Max. Output Power: 800 W
- Programmable Current (I_set): 0.85A – 4.2A (Operation Region). 2.8 A – 4.2 A (Constant Power Region)
- Output Voltage Range (V_out): 114 Vdc – 286 Vdc
  - At 4.2 A: Output Voltage can be up to 190 Vdc.
  - At 2.8 A: Output Voltage can go up to 286 Vdc.
  - Below 2.8A: Max. Output Voltage is 286Vdc.

2.1.2 Design Calculation Example

Scenario: A designer needs to power a 600W LED engine for a stadium light.

- LED Module Specs: The LED board has a nominal forward voltage (Vf) of 230 V.
- Driver Selection:
  1. Calculate Required Current: I = P / V = 600W / 230V = 2.61 A.
  2. Check LCO 600 Specifications:
     - Is 2.61 A within the programmable range (2.10 – 2.80 A)? Yes.
     - Is 230 V within the voltage limit (< 286 V)? Yes.
  3. Result: The LCO 600 driver is a valid match. The user should program the output current to 2610 mA via NFC.

Design Tip (Headroom): Always allow a ±10% voltage margin. LED forward voltage (Vf) rises as temperature drops. Ensure that at the coldest ambient temperature (e.g., -40°C), the total string voltage does not exceed the driver's maximum voltage limit.

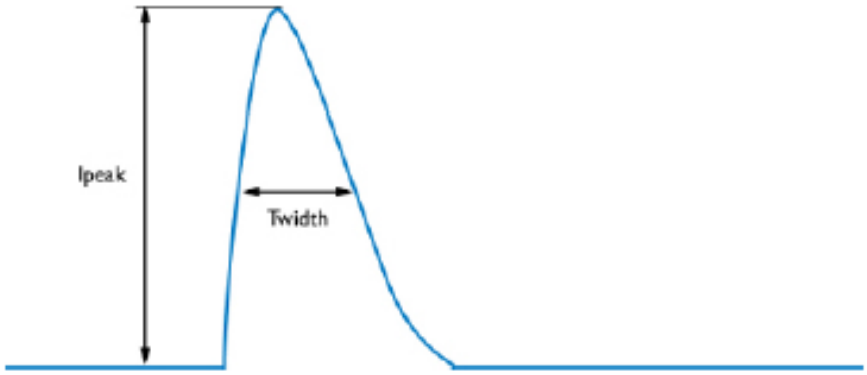
2.2 Input Characteristics & Power Quality

The outdoor 600W/800W driver is equipped with a wide-voltage, universal AC input stage designed to operate reliably across global power grids.

- Nominal Input Voltage: 120-277 Vac
- Operational Input Voltage: 108-305 Vac (Allowed fluctuation range)
- Input Frequency: 47-63 Hz
- Power Factor(PF): > 0.95 (at Full Load, 230Vac)
- Total Harmonic Distortion (THD): < 10% (at Full Load, 230Vac)

2.3 Inrush Current & Circuit Breaker (MCB) Selection

High-power LED drivers typically generate a high "Inrush Current" spike when first powered on, which can trip standard Circuit Breakers (MCBs). The outdoor 600W/800W driver utilizes Active Inrush Limiting technology to reduce this issue.



2.3.1 Inrush Data

Unlike low-cost drivers that rely on NTCs (which are ineffective during hot-restrikes), the LCO PRE uses an active circuit to limit the surge.

2.3.2 Maximum Loading of Automatic Circuit Breakers

The table below specifies the maximum number of drivers that can be connected to a single MCB. Exceeding these values may cause nuisance tripping during switch-on.

Table: Max. Drivers per MCB

	Automatic circuit breaker type	B10	B13	B16	B20	B25	B32	C10	C13	C16	C20	C25	C32	D10	D16	D25	D32
600W	120V input	1	1	1	2	2	3	1	1	2	2	3	4	1	2	3	4
	220V input	2	2	3	4	5	6	2	3	3	4	6	7	2	4	6	8
	277V input	2	3	4	5	6	8	3	3	4	6	7	9	3	5	8	11
800W	120V input	0	1	1	1	2	2	0	1	1	1	2	3	1	1	2	3
	220V input	1	1	2	3	3	4	1	2	2	3	4	5	2	3	5	6
	277V input	1	2	3	3	4	6	2	2	3	4	5	7	2	4	6	8

Design Notes:

- Type C Breakers Recommended: For outdoor lighting, Type C breakers (slower tripping curve) are generally recommended over Type B to handle startup transients.

- 3-Phase Systems: Ensure drivers are balanced evenly across phases (L1, L2, L3) to prevent neutral wire overload.

2.4 Surge Protection & Grounding

The outdoor 600W/800W driver is engineered with robust, industrial-grade surge protection to withstand electrical transients common in outdoor environments, such as lightning-induced surges and grid switching spikes.

2.4.1 Integrated Surge Capability

The driver complies with IEC 61000-4-5 standards and offers the following built-in protection levels:

- Line-to-Line (Differential Mode): 6 kV (L vs. N)
- Line-to-Earth (Common Mode): 10 kV (L/N vs. PE)

2.4.2 The Necessity of Grounding (Class I)

These drivers are classified as Class I equipment. A low-impedance connection to the Protective Earth (PE) is MANDATORY for the surge protection to function.

- How it works: The internal Metal Oxide Varistors (MOVs) and Gas Discharge Tubes (GDTs) are designed to divert excess surge energy to the ground.
- Warning: If the driver case or the PE wire is not properly grounded (floating), the surge energy has no path to dissipate. This makes the 10kV protection ineffective and puts the LED module and driver internal components at high risk of destruction.
- Requirement: Ensure the luminaire housing is effectively grounded and the PE connection resistance is minimized.

2.4.3 External SPD Recommendation

While the driver's internal protection is sufficient for most street lighting applications, additional protection is recommended for high-risk scenarios:

- High-Risk Applications: High mast poles (> 20m), open fields, mountain tops, or areas with frequent thunderstorms.
- Recommendation: Install an additional 10kA or 20kA external Surge Protection Device (SPD) in the distribution panel or at the base of the pole to provide a primary line of defense.

2.5 Safety Isolation (Non-SELV Output)

⚠ CRITICAL SAFETY WARNING: High Voltage Output

The LCO 600/800 PRE drivers produce output voltages ranging from 114 Vdc up to 286 Vdc.

2.5.1 Classification

- Output Category: Non-SELV (Hazardous Voltage).
- Definition: According to IEC standards, any DC voltage exceeding 120 Vdc is considered hazardous. Therefore, the output terminals and connected LED wires are classified as "Hazardous Live".

2.5.2 Luminaire Design Requirements

Luminaire designers must strictly adhere to the following isolation requirements to ensure user safety and pass certification:

1. Insulation Barrier:
    - Since the output is not SELV, there must be Double or Reinforced Insulation between the LED circuit (including PCB tracks, cables, and connectors) and any user-accessible metal parts of the luminaire housing.
    - Example: If the LED PCB is mounted directly on a grounded metal heatsink, the PCB material and the thermal interface material must provide sufficient dielectric strength (Basic Insulation is not enough if the heatsink is accessible, unless the heatsink is reliably earthed and the lens provides the second layer of protection).
2. Touch Protection:
    - The LED module must be enclosed (e.g., behind a glass or Polycarbonate lens) so that it cannot be touched by hand during normal operation or maintenance.
    - Internal wiring must be secured to prevent contact with sharp metal edges.
3. Creepage & Clearance:
    - The PCB layout of the LED board must meet the creepage and clearance distances for working voltages > 250 Vdc.
    - Recommendation: Maintain correct creepage distance between LED pads and the edge of the metal-core PCB (MCPCB) or mounting screws.
4. Output Safety:

- Furthermore, surge voltage at the output side(against PE) below 2 kV, assuring safe interfacing with LED strings even during significant power disturbances. This parameter shall be considered when selecting outdoor LED modules in the design; meanwhile, the impact of the harsh operating conditions on dielectric strength shall be taken into account to prevent field failure.

2.5.3 Dielectric Strength (Hi-Pot Testing)

The driver meets the following isolation standards:

- Input to Output: 3750 Vac (Reinforced)
- Input to Case (PE): 1600 Vac (Basic)
- Output to Case (PE): 1600 Vac (Basic)

2.6 Leakage Current & RCD Selection

The outdoor 600W/800W driver is designed with a low leakage current filter to maximize compatibility with modern electrical distribution systems while maintaining high EMI suppression.

2.6.1 Leakage Specification

- Earth Leakage Current: < 0.70 mA (measured at 230 Vac, 50Hz, according to IEC 61347-1).
- Significance: This low value ensures compliance with strict personal safety standards and reduces the risk of unintended tripping of the branch circuit protection.

2.6.2 RCD (Residual Current Device) Selection Guide

When connecting multiple drivers to a single RCD (also known as ELCB or GFCI), the cumulative leakage current of all drivers—plus the leakage existing in the long cables—must not exceed the RCD's trip threshold.

1. Recommended RCD Type:

- Type B or Type C (Pulse Sensitive): Highly recommended.
  - Reason: LED drivers can generate short, high-frequency current pulses during switching. Standard "AC only" (Type AC) RCDs may react too sensitively to these pulses, causing false tripping.

2. Max Quantity Calculation (Rule of Thumb):

For a standard 30 mA RCD:

- Theoretical Limit: 30mA / 0.70 mA = 42 drivers.
- Practical Engineering Limit:
    - In real-world installations, the AC cabling itself acts as a capacitor (Line-to-Earth), adding significant leakage current (approx. 1–2 mA per 100 meters).
    - Recommendation: Load the RCD to a maximum of 50%-60% of its rated trip current.
    - Safe Design Target: Connect no more than 10-15 drivers per 30 mA RCD phase.

System Tip: If "Nuisance Tripping" occurs, check if the Neutral wire is properly grounded at the transformer and if there are excessive cable lengths contributing to parasitic capacitance.

3. Thermal Design-in

3.1 Thermal Considerations & Heat Load

The outdoor 600W/800W driver utilizes a high-efficiency topology (up to 96%) to minimize power loss. However, at such high power levels, the remaining dissipated power is significant and must be effectively managed.

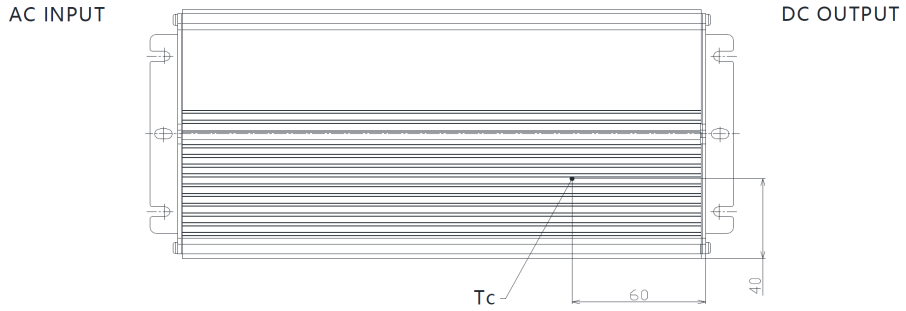
- Design Implication: The luminaire housing must be capable of dissipating this thermal load purely through conduction and convection to keep the driver cool.

3.2 Tc Point: Definition & Measurement

To confirm the thermal design, the engineer must measure the Case Temperature (Tc) at the specific reference point defined by Tridonic.

3.2.1 Location

- The Tc Point is indicated by a specific symbol on the product label (usually located on the top surface of the aluminum case).
- This point corresponds to the internal "Hot Spot" of the driver (typically the hottest electrolytic capacitor or power semiconductor).



3.2.2 Measurement Procedure

Accurate measurement is required for warranty validation and safety certification.

1. Sensor Type: Use a fine-gauge thermocouple (Type K or Type T).
2. Attachment: The sensor tip must be firmly attached to the Tc point using high-thermal-conductivity epoxy or aluminum foil tape. Do not use standard electrical tape as it insulates the sensor.
3. Test Condition:
    - Mount the driver inside the final luminaire assembly.
    - Operate at 100% Load (Max Current).
    - Allow the system to stabilize for at least 3 – 4 hours until the temperature variation is less than 1°C per hour.
4. Verdict: The measured Tc must not exceed the limits below under the maximum rated ambient temperature (Ta_max) of the application.

3.2.3 Temperature Limits

- Nominal Tc: 70°C (Target for 100,000 hrs lifetime).
- Maximum Tc: 90°C (Absolute safety limit; exceeding this triggers internal protection).

3.3 Lifetime vs. Case Temperature (Tc)

The operational lifetime of the LCO PRE driver is primarily determined by the aging characteristics of its internal electrolytic capacitors. This aging process follows the Arrhenius Law, meaning the expected lifetime is exponentially dependent on the operating temperature.

3.3.1 Nominal Lifetime Specification

- Standard Rating: 100,000 hours @ Tc = 70C.
- Definition: This implies that at a constant case temperature of 70°C, the B10 lifetime (the point where 10% of drivers may fail) is 100,000 hours.

3.3.2 The "10°C Rule" (Rule of Thumb)

Designers can estimate the lifetime at different temperatures using the following approximation:

- For every 10°C decrease in Tc, the expected lifetime doubles.
- For every 10°C increase in Tc, the expected lifetime is halved.

Lifetime Estimation Table(800W Example):

Vac/V	Load	Lifetime/Khrs			
		65℃ Tc	70℃ Tc	80℃ Tc	90℃ Tc
120	Full load	\	60	30	15
230	Full load	100	75	38	19
277	Full load	\	100	50	25

Warranty Note: The standard 7-year warranty is valid provided that the driver operates within the nominal Tc limits (typically Tc<70C on average). Continuous operation at Tc>90C may void the warranty.

3.4 Internal Over-Temperature Protection (Driver OTP)

The LCO PRE driver is equipped with an intelligent, self-regulating thermal protection mechanism designed to prevent serious failure while maintaining public safety.

3.4.1 Thermal Foldback (Derating) Strategy

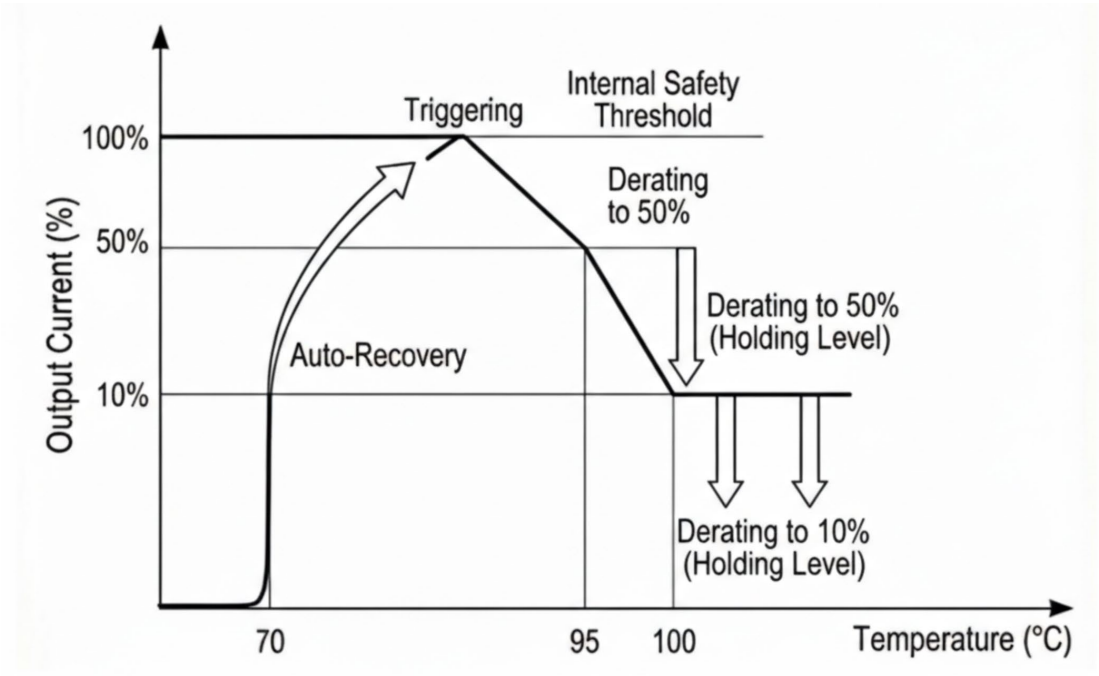
Unlike basic drivers that trigger a "Thermal Shutdown" (turning off completely) when overheated, The outdoor 600W/800W driver employs a "Thermal Foldback" strategy.

- Objective: To reduce internal heat generation without leaving the area in total darkness.
- Mechanism: When the internal temperature sensors detect a critical level (corresponding to a Case Temperature of approximately Tc>90C), the driver will automatically and smoothly reduce the output current.

3.4.2 Protection Behavior

1. Triggering: The dimming process begins when the internal safety threshold is exceeded

2. Derating Level: The current typically drops to a safe holding level, effectively reducing the thermal load on the components. When temperature hits 95°C, output current drops to 50%. At 100°C, it drops to 10%.
3. Auto-Recovery: The driver continuously monitors the temperature. Once the luminaire cools down (70°C), the output current automatically ramps back up to the original set point.



Application Benefit: This feature is critical for street and tunnel lighting, ensuring that a "lights out" situation does not occur during heatwaves or daytime accidental switching.

3.5 Mechanical Mounting & Heat Dissipation

The outdoor 600W/800W driver features a rugged aluminum enclosure with integrated cooling fins. This design supports versatile thermal integration strategies, allowing the driver to operate reliably using either natural convection or conduction cooling.

3.5.1 Cooling Methods

- Natural Convection (Air Cooling):

  The driver is capable of operating efficiently via free air convection.

  - Requirement: Ensure there is sufficient clearance around the driver (at least 25mm) to allow air to flow freely through the cooling fins.

- Note: When relying solely on air cooling, ensure the ambient temperature inside the luminaire housing does not exceed the maximum rated Ta (typically 50°C or 55°C at full load).

- Conduction Cooling (Recommended for Lifetime):

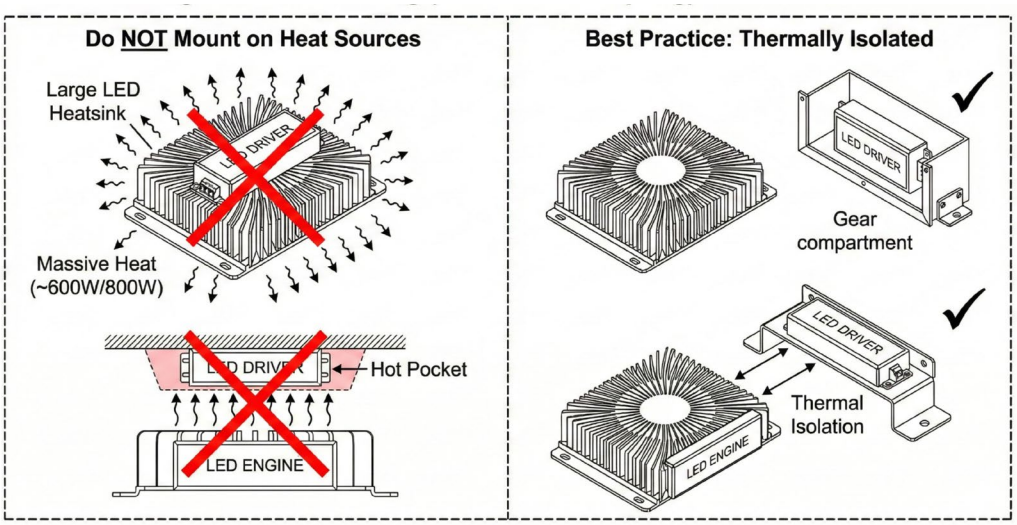
  While not strictly mandatory, mounting the driver essentially flat against the metal luminaire body is highly recommended.

  - Benefit: The luminaire casing acts as an extended heatsink, significantly lowering the driver's Case Temperature (Tc). As per the "10°C Rule," a lower Tc directly translates to a longer service life.
  - Thermal Interface: For effective conduction, apply Thermal Paste or use a Thermal Pad between the driver base and the mounting surface to eliminate air gaps.

3.5.2 Mounting Location Warning (Thermal Decoupling)

A critical design mistake is to thermally couple the driver with the LED heat source.

- Do NOT Mount on Heat Sources:
  - Avoid: Do not mount the driver directly onto the main LED heatsink or the back of the LED module, as this will transfer the massive heat generated by the LEDs (~600W/800W) into the driver.
  - Avoid: Do not mount the driver directly above the LED engine where hot air rises and accumulates ("Hot Pocket").
- Best Practice: Mount the driver in a separate luminaire housing or on a dedicated bracket that is thermally isolated from the LED light engine.



3.5.3 Installation Spacing

- Side-by-Side: When installing multiple drivers, maintain a minimum distance of 25 mm between units to prevent thermal stacking.
- Orientation: Mount the driver with the fins oriented vertically (if possible) to maximize the chimney effect for airflow.

4. Control Interfaces

4.1 DALI-2 Interface

The outdoor 600W/800W driver features a standardized digital interface compliant with the DALI-2 (Digital Addressable Lighting Interface) standard. This ensures robust, bi-directional communication and guaranteed interoperability with DALI-2 certified controllers, sensors, and gateways from any manufacturer.

4.1.1 Standards Compliance

The driver is certified according to IEC 62386 and supports the following parts:

- Part 101: General requirements – System components.
- Part 102: General requirements – Control gear.
- Part 207: Particular requirements – LED modules (Device Type 6).

4.1.2 Wiring & Connection

- Terminals: The control wires are typically labeled as DA and DA (or DA/L, DA/N).
- Polarity: The DALI interface is polarity insensitive. Installers can connect the two DALI bus wires without worrying about positive (+) or negative (-) polarity, reducing installation errors.
- Cable Type: Standard installation material (e.g., 1.5 mm^2 or 16 AWG) can be used.
- Topology: Supports Star, Tree, or Linear topologies (Ring topology is NOT allowed).
- Max. Cable Length: The voltage drop along the DALI line must not exceed 2V. Typically, the maximum cable length is 300 meters (using 1.5mm^2 copper cable).

4.1.3 Electrical Insulation (Safety)

- Isolation: The DALI terminals are basic insulated from the mains input and reinforced insulated from the driver output (LED).
- Installation: Because the DALI interface is mains-voltage rated, the DALI control cables can be run alongside the AC mains power cables (e.g., inside the same 5-core cable) without requiring extra separation.

4.1.4 Power Consumption (Bus Load)

- Role: The driver acts as a DALI "Consumer". It does not supply power to the bus.
- Current Draw: < 2 mA.
- System Design: An external DALI Power Supply Unit (PSU) is required to power the DALI bus (max. 250mA per bus).
    - Calculation: A standard 250mA DALI PSU can theoretically support up to 64 drivers (64 X 2mA = 128mA), leaving enough headroom for sensors and controllers.

4.1. DALI Device Type 6 (DT6) Compatibility

The outdoor 600W/800W driver are fully compliant with the DALI Device Type 6 (DT6) standard (IEC 62386-207), which specifically defines the control gear for LED modules.

As a standard DT6 device, the driver occupies a single DALI short address on the network and is designed to provide precise, reliable control over the brightness intensity of a single output channel. This ensures seamless integration, plug-and-play interoperability, and smooth dimming performance when connected to any certified DALI or DALI-2 master control system.

4.2 Integrated Timer Dimming

The LCO PRE driver features an advanced internal timer capable of automatic dimming control. This eliminates the need for external controllers or control lines, making it ideal for street and area lighting retrofits.

Based on the programming flexibility, the driver supports three distinct timing modes:

4.2.1 Mode 1: Traditional Timer (Fixed Duration)

In this mode, the dimming schedule is triggered strictly by the Power-On event.

- Logic: The internal clock starts counting from 00:00 when the driver is powered up. The dimming steps occur after fixed durations (e.g., "Run at 100% for 4 hours, then dim to 50%").
- Application: Best suited for applications with fixed operating hours, such as Billboards or Signage (where the light is controlled by an external time switch with a fixed schedule).
- Limitation: It does not adapt to seasonal changes (sunset/sunrise times).

4.2.2 Mode 2: Virtual Midnight (Adaptive / chronoSTEP)

This is the most recommended mode for Street Lighting. The driver automatically identifies the "Virtual Midnight" (the midpoint of the night) and shifts the dimming curve to align with it.

- Operating Principle:
  - The driver monitors the "On-Time" duration (from AC On to AC Off) for the past 2 operational cycles (nights).
  - It calculates the midpoint of the night and references all dimming steps to this virtual midnight (Tmid).
  - Adaptation: As seasons change (e.g., winter nights are longer), the driver automatically stretches the "On-Time" assumption, ensuring that the deep-dimming period (e.g., 00:00 – 04:00) always stays in the middle of the night.
- Profile Settings (Example):
  - Step 1: Start > Tmid - 3hrs @ 100% (Early Evening)
  - Step 2: Tmid - 3hrs > Tmid + 4hrs @ 50% (Late Night Save)
  - Step 3: Tmid + 4hrs > Off @ 70% (Early Morning)

Learning Period: When first installed, the driver requires 2 nights of continuous operation to learn the grid schedule. During these first 2 nights, the driver will run based on default setting before applying the dimming curve.

4.2.3 Mode 3: Self-Adapt Percentage

This mode scales the entire dimming curve proportionally based on the total night duration.

- Logic: Instead of defining fixed hours, the steps are defined as a percentage of the total night.
  - Example: "Spend the first 20% of the night at 100% brightness, then the next 50% of the night at 40% brightness..."
- Application: Useful for street lighting or specific industrial processes where proportional control is preferred over time-based control.

4.2.4 Fade Time (Soft Transition)

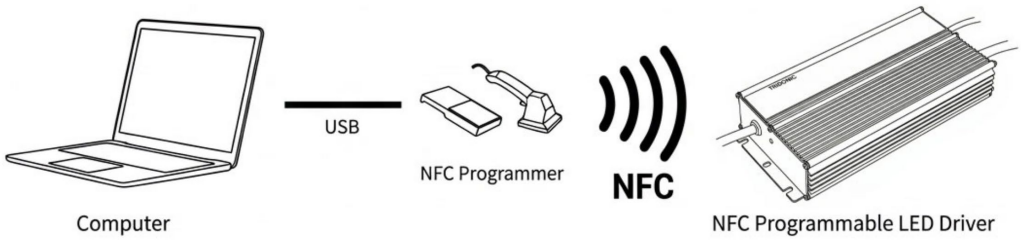
To avoid sudden changes in brightness that might distract drivers or pedestrians, the driver supports a programmable Fade Time.

- Function: When switching between dimming levels (e.g., from 100% to 50%), the driver smooths the transition.
- Range: Programmable from 0s (Instant) to 300s (Very Slow).
- Recommendation: A fade time of 10s – 60s is recommended for street lighting to make the change invisible to the human eye.

5. Configuration & Programming

5.1 NFC Interface Overview

The outdoor 600W/800W driver is equipped with a contactless NFC (Near Field Communication) interface. This technology enables rapid, wireless configuration of the driver's operating parameters without the need to apply mains power or connect control wires.



5.1.1 Key Benefits

- Zero-Power Programming: Drivers can be read or configured while completely unpowered, ensuring safety and energy efficiency on the production line.
- Efficiency: Configuration takes only a few seconds per unit, significantly reducing production cycle time compared to traditional wired interfaces.

Note: This Design-in Guide covers the functions available for configuration. For detailed step-by-step instructions on software installation, wiring, and reading/writing operations, please strictly refer to the separate Tridonic Programming Guide.

5.2 Required Tools

To successfully configure the LCO PRE drivers, the following equipment is required. Please refer to the Tridonic Programming Guide for detailed software installation instructions and driver setup.

5.2.1 Hardware (NFC Programmer)

A compatible NFC reader is required to communicate with the driver. The following models are recommended and fully supported:

- Feig ID CPR30/30+: Standard desktop reader for production environments.
- Feig ID ISC.PRH101: Handheld reader suitable for flexible use.

Note: Ensure the NFC programmer is connected to the computer via USB.

5.2.2 Software

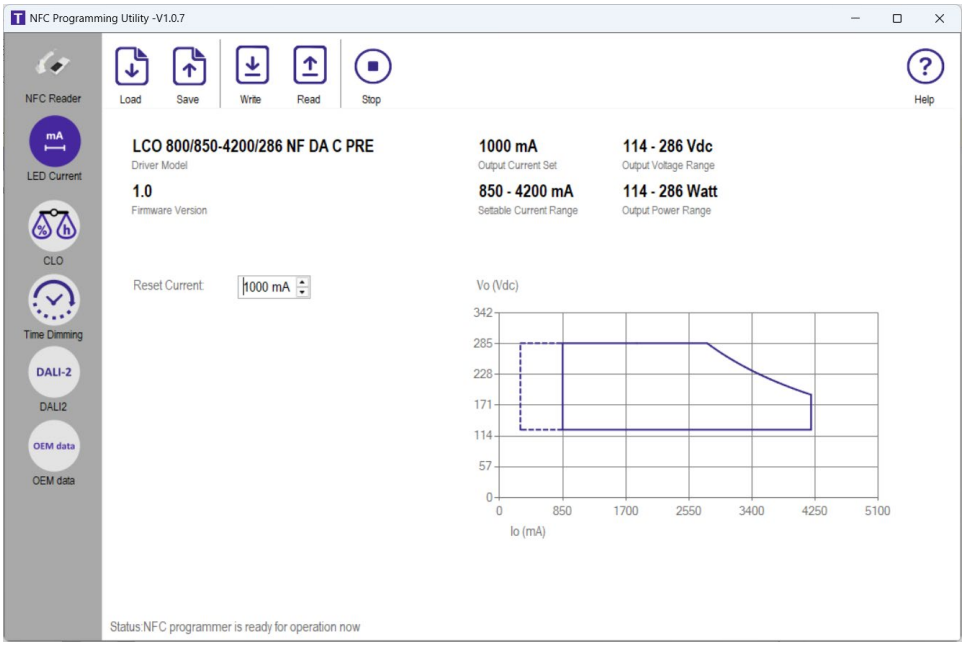
- Tridonic NFC Programming Utility: The dedicated configuration software required to define and write parameters.
- System Requirements: The software is compatible with Windows 7, 8, 10, and 11 (supporting both 32-bit and 64-bit architectures).

5.3 Settable Parameters Overview

Using the configuration software, manufacturers can customize specific behaviors of the driver to suit the luminaire's application. The available parameters include:

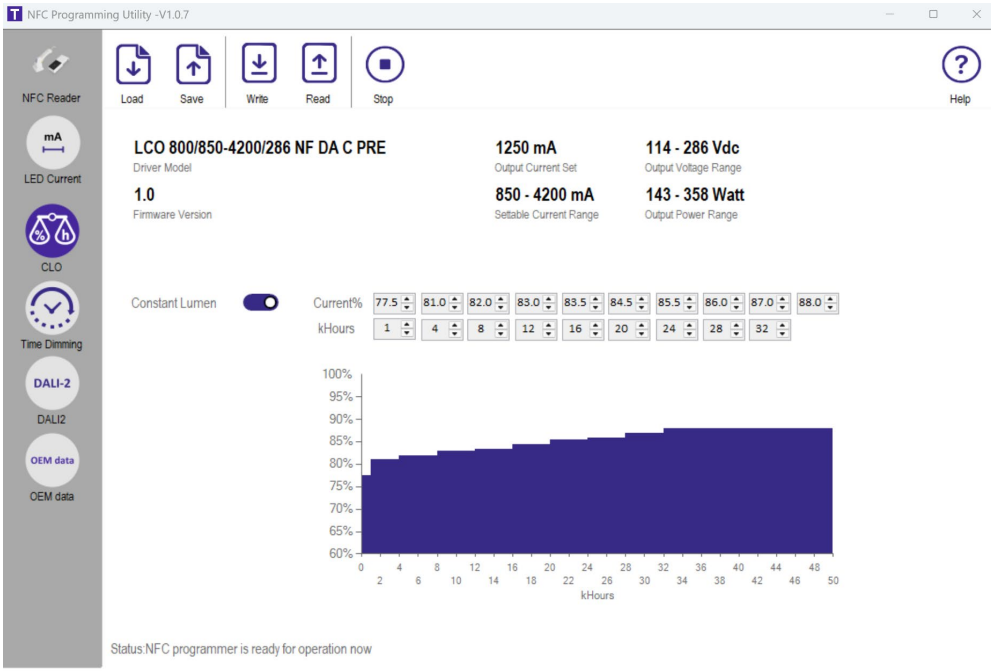
- Output Current:

  Precise adjustment of the driving current (in 1mA steps) to match the connected LED module's power and thermal requirements.



- Constant Lumen Output (CLO):

  A feature that gradually increases the output current over the product's lifetime. This compensates for the natural depreciation of LED luminous flux, ensuring consistent brightness levels.



- Timer Dimming Profiles:

To begin, ensure the Timer Mode Enable toggle is switched to ON in the software interface.

Traditional Mode

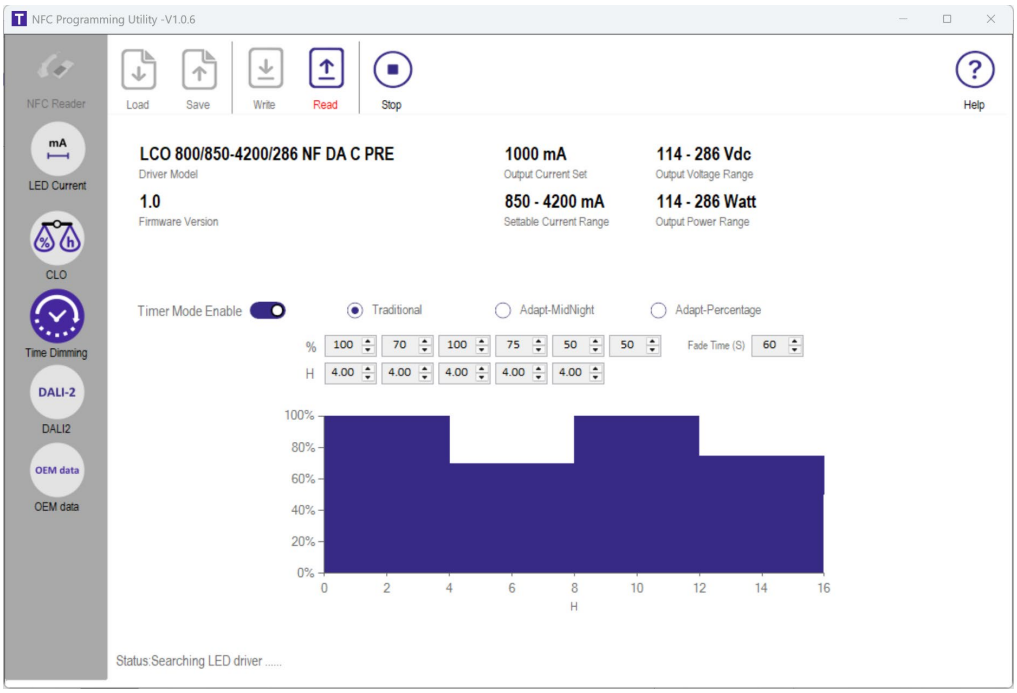
Configuration Steps: Select the Traditional button. You can configure multiple steps in the timeline:

% Row (Dimming Level): Set the desired output current percentage for each step (e.g., 100%, 70%, 50%).

H Row (Duration): Set the duration in hours for each step to remain active.

Fade Time (S): Define the transition time (in seconds) between different dimming levels to ensure smooth changes.

Note: If the driver operates longer than the total programmed time (max 16 hours), it will maintain the dimming level of the last programmed step until power is cycled.



Adapt-MidNight Mode

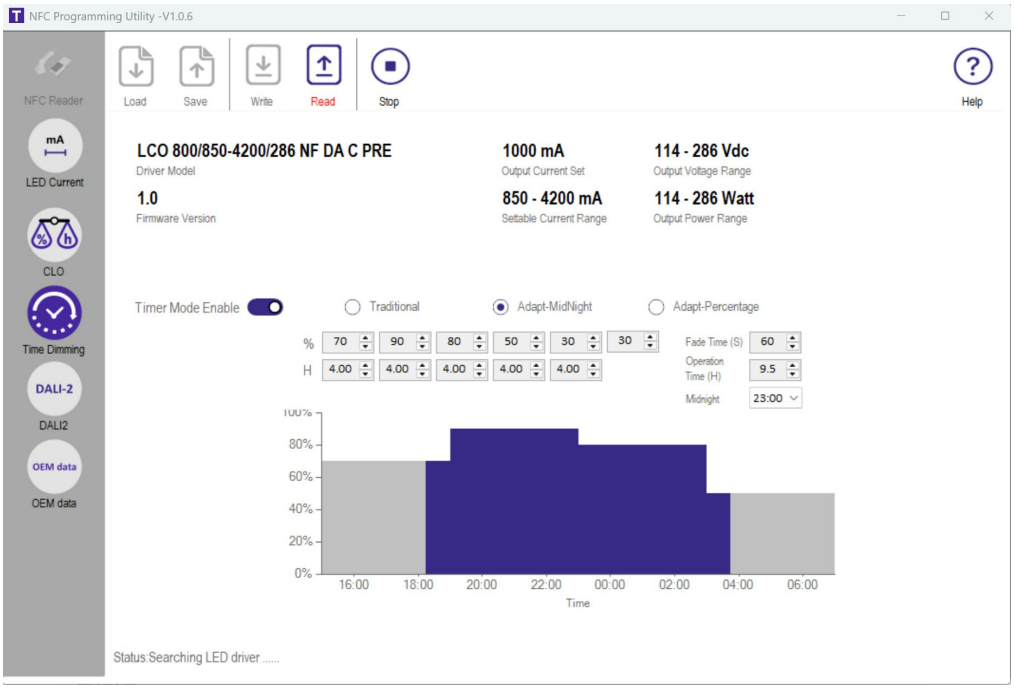
Configuration Steps: Select the Adapt-MidNight button:

% / H Setup: Similar to Traditional mode, define the target curve using brightness percentages and duration hours. The curve will be expanded or trimmed symmetrically around the calculated midnight point.

Operation Time (H): Set the estimated initial night length (e.g., 10.0 H). This value is used for the very first night of operation before historical data is available.

Midnight: Set the reference midnight time (e.g., 23:00 or 00:00) to align the midpoint of the curve.

Note: If the driver operates longer than the operation time, it will follow the unfinished dimming curve.



Adapt-Percentage Mode

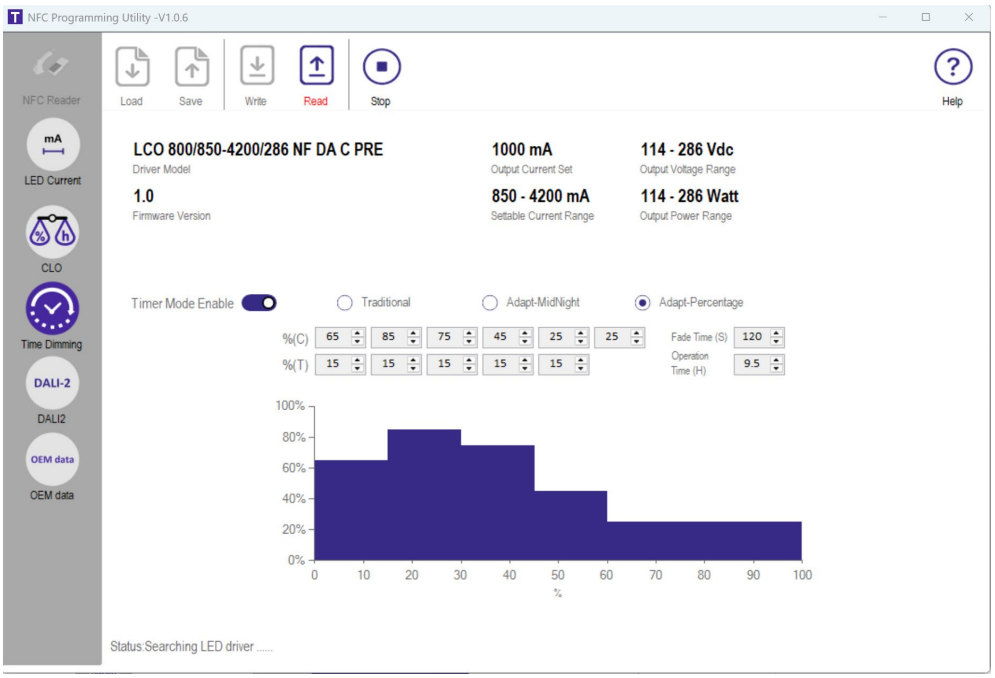
Configuration Steps: Select the Adapt-Percentage button. Note the interface change for the step columns:

%(C) (Current): Set the Output Current percentage for each stage.

%(T) (Time): Set the duration of each stage as a percentage of the total operation time. (e.g., If the total night is 10 hours, a setting of 15% equals 1.5 hours).

Operation Time (H): Set the baseline total time used for the initial calculation.

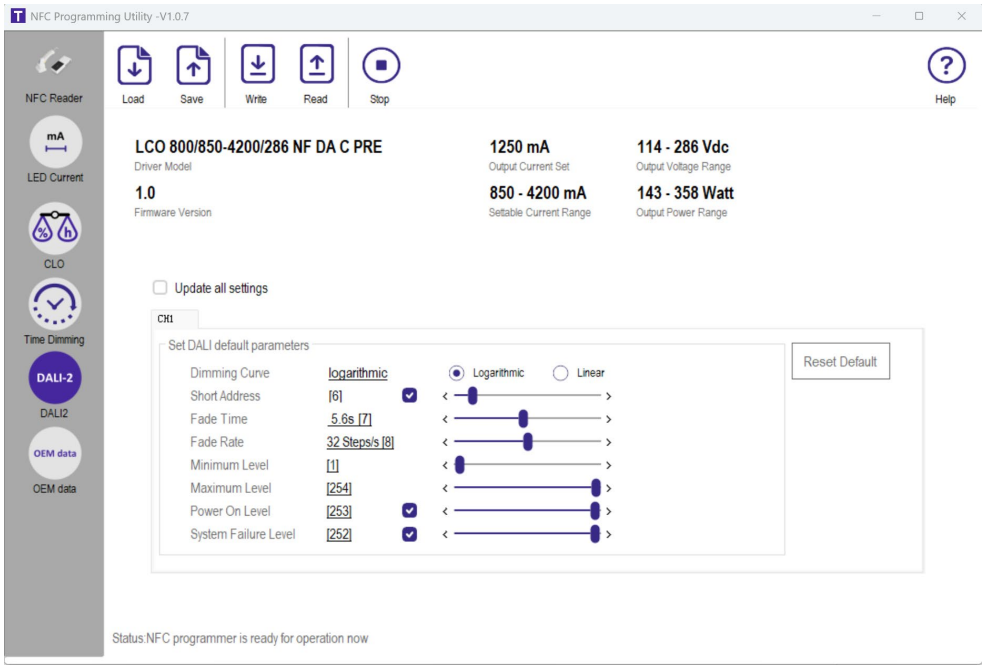
Note: If the driver operates longer than the operation time, it will maintain the last step dimming level.



- DALI-2 Configuration:

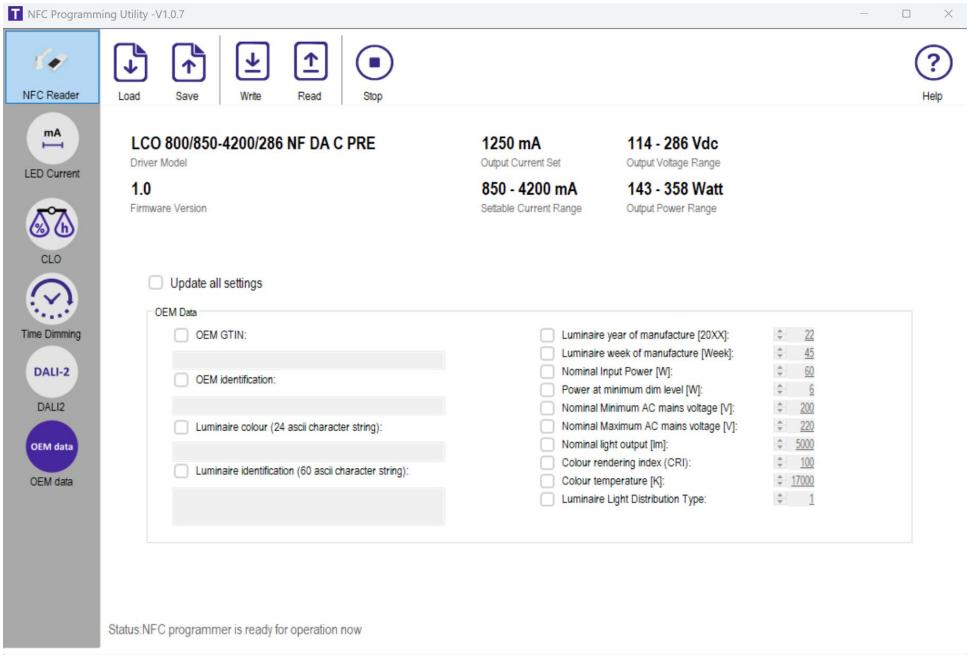
  Pre-programming of standard DALI parameters to speed up on-site commissioning. This includes:

  - Short Address: Assigning a unique ID (0-63).
  - Fade Time / Fade Rate: Defining the transition speed between dimming levels. Fade time setting range 0-15, Fade rate setting range 1-15.
  - Power On Level: Setting the brightness level when AC power is applied.
  - System Failure Level: Defining the light output in case of DALI bus failure.



- OEM Data (Asset Management):

  Storage of luminaire-specific data into the driver's memory for identification purposes, such as GTIN, Manufacturing Date, and Luminaire Identification strings.



6. Conclusion

The outdoor 600W/800W driver stands as a robust, intelligent, and highly configurable core component for high-power outdoor lighting. It combines

industrial-grade durability with advanced digital control to meet the most demanding application requirements.

By strictly adhering to the Electrical, Thermal, and Configuration guidelines outlined in this document, luminaire designers and system integrators can ensure a safe, compliant integration. Proper implementation of these design-in practices is the key to unlocking the full potential of the driver and guaranteeing the projected 100,000-hour service life in the field.