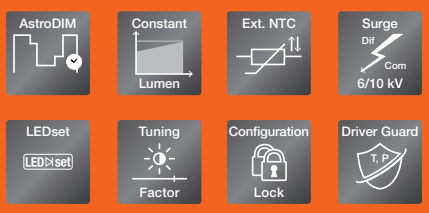
inventronics

Technical application guide

1DIM NFC G3 CE
LED drivers and T4T-C



04/2024

www.inventronicsglobal.com

Contents

Please note:
All information in this guide has been prepared with great care. Inventronics, however, does not accept liability for possible errors, changes and/or omissions. Please check www.inventronics-light.com or contact your sales partner for an updated copy of this guide. This technical application guide is for information purposes only and aims to support you in tackling the challenges and taking full advantage of all opportunities the technology has to offer. Please note that this guide is based on own measurements, tests, specific parameters and assumptions. Individual applications may not be covered and need different handling. Responsibility and testing obligations remain with the luminaire manufacturer/ OEM/application planner.

1 Introduction

1.1 OSRAM LED drivers with 1DIM functionality for outdoor and industrial applications

Long lifetime, low maintenance costs and high efficiency are very important for outdoor and industrial applications. OPTOTRONIC® LED drivers for outdoor applications meet these requirements and unlock the full potential of LED-based light sources.

Thanks to the high flexibility of the programmable OPTOTRONIC® 1DIM NFC G3 CE LED drivers, LED luminaire systems can be optimized to the on-site conditions and cost. With the integrated dimming function (1DIM), significant energy saving and a reduction of greenhouse gas emissions can be achieved.

The NFC interface implemented in the 1DIM NFC G3 CE family enables an easy and safe way of programming LED drivers during the production process and also in the field. The parameters can be transferred without the need to power the LED driver, which saves time compared to a programming process using the DALI-2 interface.

Due to several operating windows (voltage/current) of these LED drivers, both OSRAM LED modules for outdoor applications and customer-specific LED modules can be operated. This also means that the overall amount of different LED drivers on stock can be kept low and that the overall complexity of luminaire maintenance over the entire life cycle can be reduced.

With the LEDset2 interface, we have created a new path towards standardizing the communication between the LED driver and the LED modules. Without reprogramming, LEDset2 ensures optimal efficiency, a high level of reliability and the adaptability of the LED drivers to the latest LED technologies.

Finally, due to integrated overvoltage protection, LED drivers with 1DIM functionality provide a high level of protection against common mode surges of up to 10 kV for class I and II luminaires.

1.2 1DIM NFC G3 CE product family

The 1DIM NFC G3 CE product family consists of six different output power classes of up to 165 W. The new family consists of eight different types, including variants with a higher output voltage range to enable more and optimized luminaire concepts.

All types have the same dimming capabilities and the LED-set2 interface. They can be programmed via the Tuner-4TRONIC® software using NFC interface. The following overview shows the main features of these LED drivers.

Table 1: Family overview

						
Product name		OT 20/170-240/1A0 1DIM NFC G3 CE	OT 40/170-240/0A7 1DIM NFC G3 CE	OT 40/170-240/1A0 1DIM NFC G3 CE	OT 75/170-240/0A7 1DIM NFC G3 CE	OT 75/170-240/1A0 1DIM NFC G3 CE
General						
Maximum power	W	22 W	40 W	40 W	75 W	75 W
Input voltage L/N	V_{IN}	220–240 V	220–240 V	220–240 V	220–240 V	220–240 V
Nominal output voltage	V_{OUT}	10–38 V	30-77 V	15–56 V	50–150 V	35–115 V
Output current range	$I_{[mA]}$	1050 mA	700 mA	1050 mA	700 mA	1050 mA
Surge (dif/com)		6/10 kV	6/10 kV	6/10 kV	6/10 kV	6/10 kV
Insulation (primary/secondary)		SELV	SELV	SELV	Double	SELV
Insulation of casing		Double	Double	Double	Double	Double
Stand-by power		< 0.5 W	< 0.5 W	< 0.5 W	< 0.5 W	< 0.5 W

Table 2: Family overview

				
Product name		OT 110/170-240/0A7 1DIM NFC G3 CE	OT 110/170-240/1A0 1DIM NFC G3 CE	OT 165/170-240/1A0 1DIM NFC G3 CE
General				
Maximum power	W	110 W	110 W	165 W
Input voltage L/N	V_{IN}	220–240 V	220–240 V	220–240 V
Nominal output voltage	V_{OUT}	80–220 V	55–157 V	90–260 V
Output current range	$I_{[mA]}$	700 mA	1050 mA	1050 mA
Surge (dif/com)		6/10 kV	6/10 kV	6/10 kV
Insulation (primary/secondary)		Double	Double	Double
Insulation of casing		Double	Double	Double
Stand-by power		< 0.5 W	< 0.5 W	< 0.5 W

It is possible to operate the driver below the minimum nominal current through initial setting of the output current.

Warning:
When LED drivers are permanently operated below the minimum nominal current, it is necessary to ensure compliance with relevant IEC standards (for example mains current distortion and power factor). Please consider that the certificates are only valid within the nominal output current range.

Features
All types offer the same functionalities and feature-set.


AstroDIM (astro-based)


AstroDIM (time-based)

Other features


Constant Lumen function


LEDset2


External NTC


Configuration Lock


Tuning Factor


Driver Guard T, P

Programming software


Tuner4TRONIC®

AstroDIM

Automatic dimming via an integrated timer (no real-time clock): Five independent dimming levels and zones can be set with the Tuner4TRONIC® software.

CLO (constant lumen output)

The decrease in the luminous flux of an LED module can be compensated over its entire lifetime via a preprogrammed current curve. This not only ensures stable lighting but also saves energy and increases the lifetime of the LEDs.

LEDset

LEDset is an improved LED module interface for the combination of single or multiple LED modules with one LED driver via a single analog control line. This interface enables external current setting and temperature monitoring. The LEDset2 interface has no auxiliary supply and is not compatible with LEDset (Generation 1). LEDset2 has an absolute current coding, while LEDset (Generation 1) only has a relative one. In the 1DIM NFC G3, LEDset and NTC functionality share the same connection terminal. Both features are not simultaneously available.

- LEDset functionalities are limited only to the current setting (via codified resistor) and to thermal protection via PTC (5 V supply, miswiring protection, thermal protection with NTC are not available).

External temperature sensor

This feature allows the temperature protection of the LED module or the complete luminaire in hot ambient temperatures via an external sensor (e.g. NTC, negative temperature coefficient resistor). The derating can be modified via the Tuner4TRONIC® software.

Integrated overvoltage protection

The 1DIM CE drivers have an integrated overvoltage protection of up to 6 kV for differential and 10 kV for common-mode overvoltages.

Configuration Lock

This feature is an advancement of OEM Key, which allows controlling the access rights for individual features within the LED driver via Tuner4TRONIC® software and assigning different rights to the luminaire manufacturer, to the service team and to the general user. Assigning user rights also allows offering “light as a service” and still maintaining total control over who may change what within the device or luminaire.

Tuning Factor

Within limits predefined by the luminaire manufacturer, this feature allows an adjustment of the amount of light in the field or in production. Thus, one luminaire can manage different lumen packages. If the feature is combined with LEDset, other lumen packages can also be achieved, which differ in terms of resistor coding.

Driver Guard T, P

By default, the internal protection mechanisms of the LED driver are designed for maximum performance and temperature, however, not for those of the luminaire. By means of this feature, the performance and temperature derating of the LED driver can be adjusted according to the luminaire performance, maximizing the system reliability.

1.3 Nomenclature

The product name of each OPTOTRONIC® 1DIM CE LED driver is defined as shown below.

Figure 1: OT 40/170-240/1DIM NFC G3 CE

OT:	OPTOTRONIC® LED driver
40:	Power class: 40 W
170-240:	Input voltage range (L/N): 170-240 V
1A0:	Max. output current: 1050 mA
1DIM:	1DIM functionality (AstroDIM)
NFC:	NFC for LED driver programming
G3:	Generation 3
C:	Compact housing shape
E:	For exterior use under specific conditions

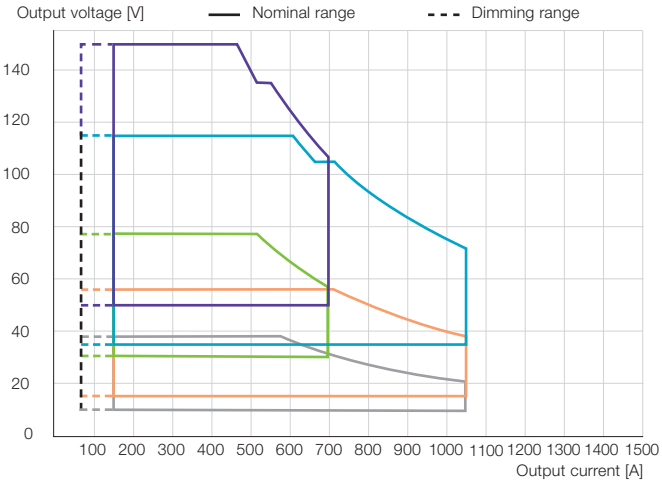
1.4 Operating windows

The OPTOTRONIC® 1DIM NFC G3 CE LED driver family is split up into five different power classes to provide the best suitable power supply for different applications. The nominal output current of 150-1050 mA is available in the following power packages.

Figure 2 gives a complete overview of the possible 1DIM NFC G3 operating windows.

Figure 2: Overview of 1DIM NFC G3 CE operating windows

OT 20/170-240/1A0 4DIM NFC G3 CE
OT 40/170-240/0A7 4DIM NFC G3 CE
OT 40/170-240/1A0 4DIM NFC G3 CE
OT 75/170-240/0A7 4DIM NFC G3 CE
OT 75/170-240/1A0 4DIM NFC G3 CE



OT 110/170-240/1A0 4DIM NFC G3 CE
OT 110/170-240/0A7 4DIM NFC G3 CE
OT 165/170-240/1A0 4DIM NFC G3 CE

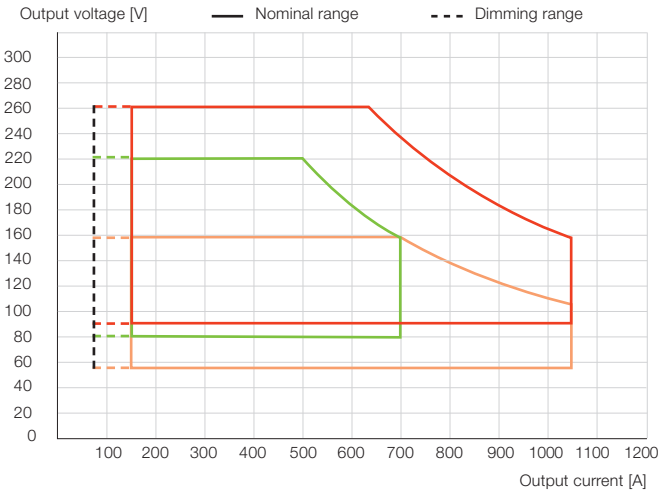


Table 3: 1DIM NFC G3 CE operating range

Type	OT 20/170-240/1A0 1DIM NFC G3 CE	OT 40/170-240/0A7 1DIM NFC G3 CE	OT 40/170-240/1A0 1DIM NFC G3 CE	OT 75/170-240/0A7 1DIM NFC G3 CE	OT 75/170-240/1A0 1DIM NFC G3 CE	OT 110/170-240/0A7 1DIM NFC G3 CE	OT 110/170-240/1A0 1DIM NFC G3 CE	OT 165/170-240/1A0 1DIM NFC G3 CE
P_{max}	22 W	40 W	40 W	75W	75 W[1)]	110 W	110 W[1)]	165 W[1)]
t_a	-40…+60 °C	-40…+60 °C	-40…+60 °C	-40…+55 °C	-40…+55 °C	-40…+55 °C	-40…+55 °C	-40…+55 °C
V_{in} (nominal)	220–240 V_{AC}	220–240 V_{AC}	220–240 V_{AC}	220–240V	220–240 V_{AC}	220–240V	220–240 V_{AC}	220–240 V_{AC}
Minimum dimming current	70 mA	70 mA	70 mA	70 mA	70 mA	70 mA	70 mA	70 mA
Minimum nominal current	150 mA	150 mA	150 mA	150 mA	150 mA	150 mA	150 mA	150 mA
Maximum nominal current	1050 mA	700 mA	1050 mA	700 mA	1050 mA	700 mA	1050 mA	1050 mA
Minimum output voltage	10 V	30 V	15 V	50 V	35 V	80 V	55 V	90 V
Maximum output voltage	38 V	77 V	56 V	150 V	115 V	220 V	157 V	260 V

1) At input voltages below 190 V, the driver protects itself as shown in figure 4.

It is possible to operate the driver below the minimum nominal current through initial setting of the output current.

Warning:
When LED drivers are permanently operated below the minimum nominal current, it is necessary to ensure compliance with relevant IEC standards (for example mains current distortion and power factor). Please consider that the certificates are only valid within the nominal output current range.

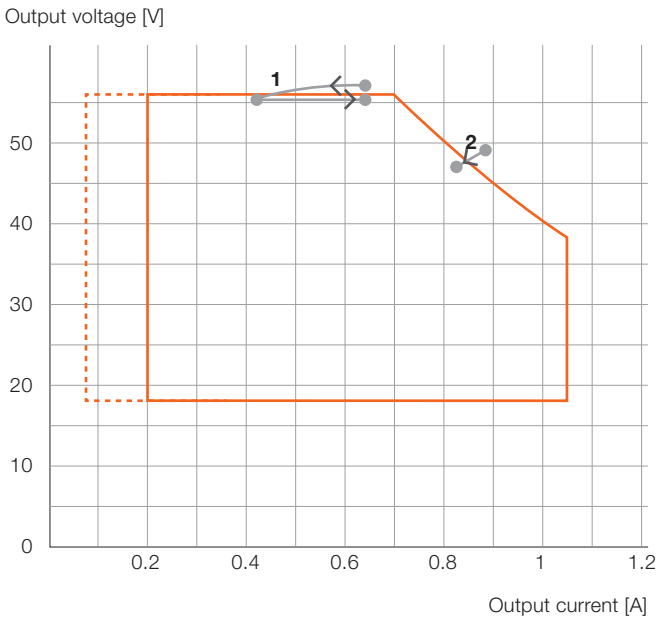
1.4.1 Current foldback

The intelligent 1DIM NFC G3 family allows a safe start-up of the system, even if the power consumption or the total forward voltage of the LED module exceeds the maximum output power or voltage of the LED driver. In this case, the unit reduces the current until the maximum output voltage [1] or power [2] is not exceeded anymore. If no stable operating point is achieved, the unit switches on and off continuously or switches off completely.

1.4.2 Low input voltage protection

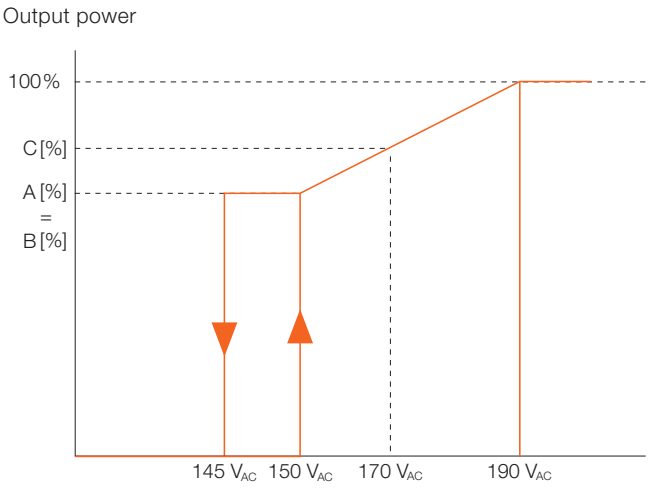
In case of a very low input voltage, the driver protects itself against being damaged by high input currents. The behavior of the driver can be seen in figure 4.

Figure 3: Current foldback (example: OT 40 1DIM NFC G3 CE)



Please note:
At ambient temperatures below -25 °C, the LED driver supplies 200 mA for a maximum of 1 minute to warm up, and after this, it supplies the programmed output current.

Figure 4: Input voltage vs. output power OT 40 1DIM NFC G3 CE driver



	A [%]	=	B [%]	C [%]
OT 20/170-240/1A0 1DIM NFC G3 CE	40		40	75
OT 40/170-240/XXX 1DIM NFC G3 CE	68		68	85
OT 75/170-240/XXX 1DIM NFC G3 CE	70		70	85
OT 110/170-240/XXX 1DIM NFC G3 CE	70		70	85
OT 165/170-240/1A0 1DIM NFC G3 CE	50		50	75

2 Features

2.1 Operating current

Flexible current setting allows taking advantage of the continuously improving LED technology and building a future-proof system. The 1DIM NFC G3 family offers two modes for current setting, which can be set via the Tuner4TRONIC® software:

- Fixed current: Current setting via programmable interface
- LEDset2: Current setting via the LEDset2 interface

Figure 5: Setting of the operating current

Without any resistor connected to the LEDset2 interface, the factory default current is 700 mA. As soon as the LED driver detects a resistor value for more than 3 seconds within the valid resistor range (see table 4), it switches to the LEDset2 mode.

2.1.1 Fixed current mode

To use the fixed current mode, it has to be selected in the Tuner4TRONIC® software. The minimum and maximum rated output currents are displayed according to the selected LED driver. The output current of the LED driver can be set by changing the value in the “Operating Current” field.

2.1.2 LEDset2 mode

The LEDset2 interface (LEDset generation 2) is a standardized LED module interface to set the right output current and establish an easy and low-cost temperature protection for the connected LED module. This multi-vendor interface is suitable for LED modules connected in parallel or in series.

Note:
In the following figures, the LED module is displayed in a simplified way. The real number of LEDs depends on the output voltage of the driver.

Figure 6: LEDset2 parallel connection

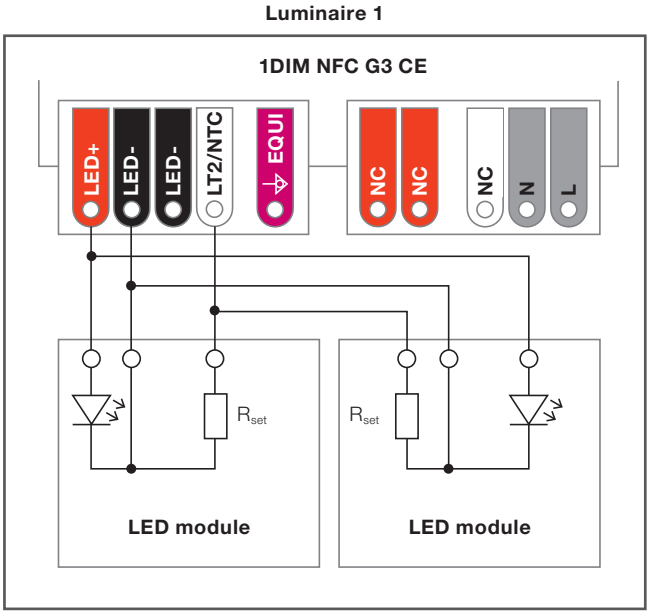
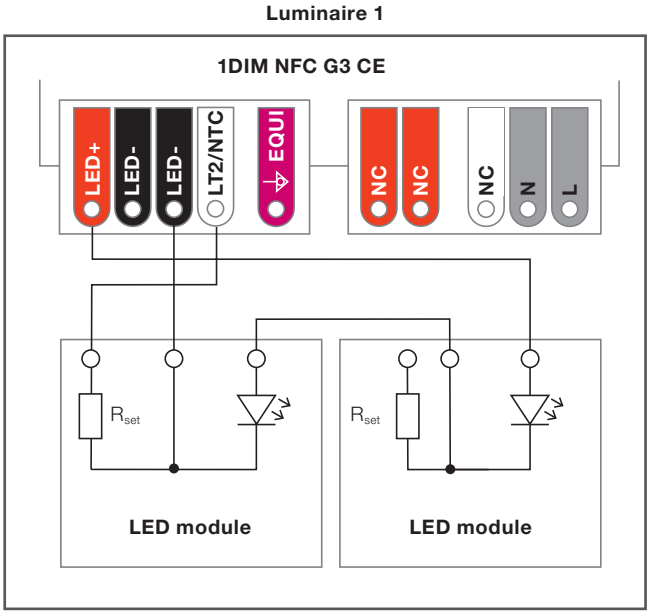
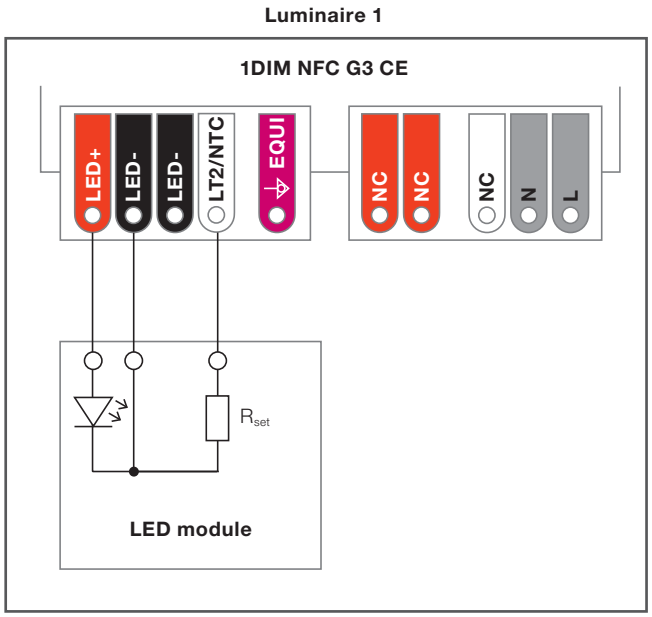


Figure 7: LEDset2 series connection



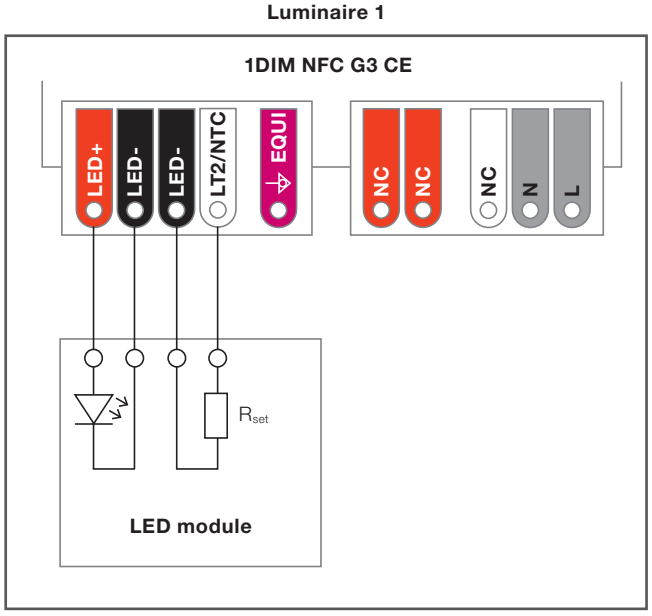
The output current of the LED driver can be set using an externally connected resistor (min. power rating 50 mW, max. tolerance 0.5 %). This provides the possibility to set the LED current manually without the need for an additional programming of the LED driver. With a resistor mounted on the LED module as shown in figure 8, the correct LED current can be set automatically. With this resistor, the desired current for the LED module is set according to the used LED bin and needed lumen output, offering a real plug-and-play solution and making the system future-proof.

Figure 8: R_{set} connection



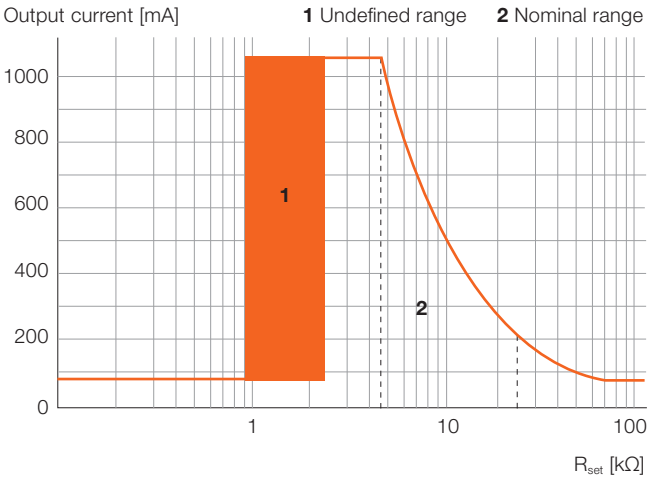
To achieve a more accurate current setting, the second LED- terminal of the LED driver can be used as shown in figure 9. This increases the accuracy by roughly 0.5 %.

Figure 9: R_{set} connection with higher accuracy



The LEDset2 coding for the 1DIM NFC G3 family is shown in the following graph.

Figure 10: LEDset2 coding



The corresponding output current can be calculated with the following formula within the valid resistor range (R_{set} = 4.75–24.9 kΩ):

$$I_{out}\,[A] = \frac{5\,V}{R_{set}\,[\Omega]} \times 1000$$

The undefined range should be avoided because the output current of the LED driver is not predictable.

Table 4 gives an overview of commonly used current values and the appropriate resistor values.

Table 4: LEDset2 resistor coding

I_{out} [mA] reference	R_{set} [kΩ] [tolerance ≤ 0.5 %]	I_{out} [mA] nominal
Open circuit	> 71	70
150	33.3	150
200	24.9	201
350	14.3 (E192)	349
500	10.0 (E192)	500
700	7.14 (E192)	699
1050	4.75 (E192)	1050
Undefined	0.9–2.37	1050/70
Short circuit	< 0.9	70

For further details, please consult the LEDset2 application guide, which can be downloaded at https://www.inventronics-light.com/application-guides.

2.1.3 Tuning Factor

Modern street lighting has a high energy saving potential as efficient LED technology allows light planners and luminaire manufacturers to perfectly adapt the behavior of the luminaire to the requirements of the illuminated street. On the other hand, this flexibility increases the complexity of maintaining the installation for cities and installers.

Our Tuning Factor feature helps to reduce this complexity to a minimum as it enables installers to adapt the settings of a luminaire according to their current needs.

Example:
A luminaire manufacturer develops a luminaire which can be operated within a range of 2,000–4,000 lm. The installer commissioned by the city can then use the Tuner4TRONIC® Field application to adjust the lumen output via the NFC programming interface to the level that is needed, while not exceeding the limits set by the luminaire manufacturer.

Figure 11: Tuner4TRONIC® user interface: Tuning Factor

Maximum limit:
This is the maximum operating current set by the luminaire manufacturer. It is equivalent to 100 %.

Minimum limit:
This is the minimum definable output current level. Valid range: 50–100 %.

Luminaire reference light output:
This value indicates a reference light output of the luminaire at 100 % output current. This enables the installer to easily adjust the light output in lumen instead of the output current.

Tuning level:
This is the current tuning level set by the installer.

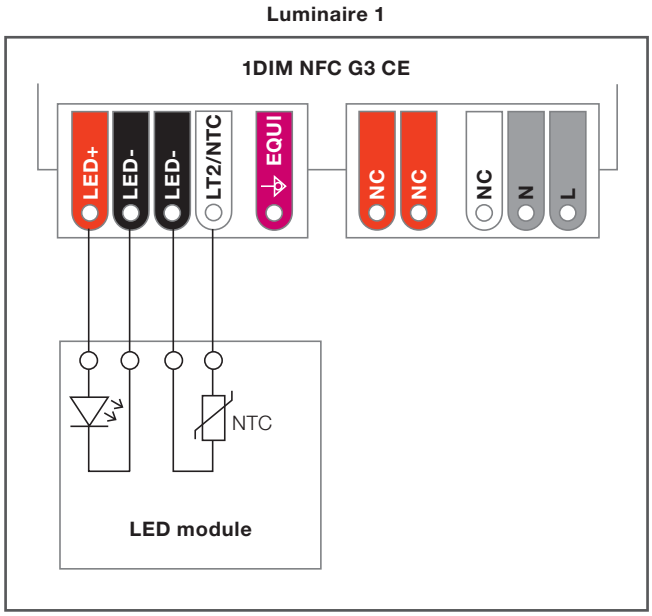
The “limits and reference lumen” can be independently protected by the Configuration Lock feature in order to avoid unauthorized usage of this feature outside the limits defined by the luminaire manufacturer.

2.2 Thermal derating and protection

2.2.1 External temperature sensor

By connecting an external temperature sensor to the NTCset port of the 1DIM NFC G3 CE LED driver, a very easy and cost-efficient temperature protection of the LED module can be realized. As an example, an NTC (negative temperature coefficient resistor) can be mounted on the LED module and connected as shown in figure 12. In case the thermal protection feature is enabled and nothing is connected to the NTCset terminal, the driver delivers 100 % light output.

Figure 12: NTC connection



Resistor-based mode
The resistor-based mode is activated by default. If the connected resistor sensor value falls in the range between 6.3 and 5.0 kΩ, the output current is continuously lowered down to 50 %. If the value falls further below 4.3 kΩ, the output is switched off completely until the sensor reaches 5.0 kΩ again. The complete switch-off can be deactivated by clicking on the “Shut Off” check box.

In this mode, a common NTC can be used to achieve a fixed thermal protection as shown in table 5. The specified temperatures can vary, depending on the used NTC component and the corresponding tolerances.

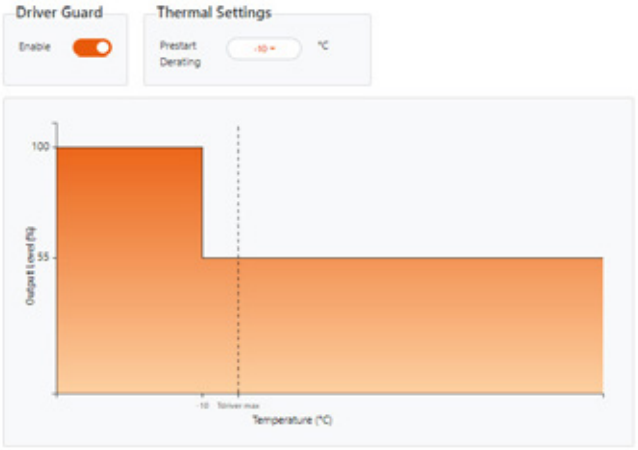
Table 5: Overview of standard NTCs

NTC type	Start derating temperature [6.3 kΩ]	End derating temperature [1] [5.0 kΩ]	Shut-off temperature [4.3 kΩ]
22 kΩ	56 °C	62 °C	67 °C
33 kΩ	66 °C	72 °C	77 °C
47 kΩ	75 °C	83 °C	87 °C
68 kΩ	85 °C	92 °C	97 °C

1) Switch-on temperature in case the temperature has reached the shut-off condition

2.2.2 Thermal management and Driver Guard feature
The 1DIM NFC G3 CE LED driver family has a reversible internal thermal protection. If the maximum allowed LED driver temperature is exceeded, the LED driver starts derating the output current down to 55 %. If the temperature keeps increasing, the LED driver switches off. It switches back on at the maximum allowed temperature.

In outdoor installations especially, the lifetime and reliability of a luminaire is very important. As the lifetime of a luminaire always depends on the operating temperature of the components, the “Driver Guard” feature helps limiting the LED driver’s temperature during its operation. The thermal behavior of the LED driver can be activated at lower temperatures using the “Prestart Derating” setting shown in the figure below.



Note:
The luminaire manufacturer is responsible for the proper thermal design of the luminaire. The temperature indicated in this feature might significantly differ from the t_c temperature mentioned on the top of the LED driver. To achieve the lifetime data of the LED driver, the luminaire manufacturer needs to ensure that the maximum t_c temperature is never exceeded.

2.3 Constant Lumen function

Over the lifetime of an LED module, the light output drops due to the aging process of the LEDs. To achieve a constant light output of the module, the LED driver stores the operating hours of the LED module and increases the output current to react to the light output drop. To set this feature according to the applied LED module, the Tuner4TRONIC® software can be used as shown, for example, in figure 14.

The output levels have to be steadily increasing from the beginning to the end.

The output level cannot fall below the minimum physical dimming level of the LED driver, even if the software displays a lower value.

Next to the table, the estimated energy savings are calculated as shown in figure 14. This value is only an estimation because it does not consider, for example, the LED V_f behavior and efficiency of the driver.

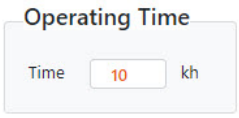
The exact values for programming the Constant Lumen function for the connected LED module need to be obtained from the corresponding LED or LED module supplier.

2.4 Lamp operating time

The LED driver monitors the operating hours of the connected LED module. In case of a fault of the LED driver or module, the lamp operating time has to be (re)set accordingly with the Tuner4TRONIC® software. The lamp operating time also has an influence on the constant lumen function and the “end of life” feature. It can be set using the Tuner4TRONIC® software as shown in figure 13.

Figure 13: Lamp operating time (10 kh)

Actual lamp operating time can be displayed and edited in the feature tab "Operating Time for ECGs without Monitoring Data".

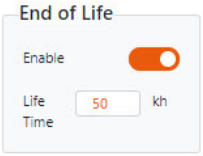


Lamp operating time allows the display and editing of the actual on-time of the LED module, which is the basis for the CLO (constant lumen output) profile.

2.5 End of life

The LED driver can indicate that a preprogrammed lifetime of the connected LED module is reached and the module should be replaced. This function has to be activated in advance via the Tuner4TRONIC® software. The “end of life” indication can be programmed as shown in figure 15.

Figure 15: “End of life” setting



If the specified lifetime is reached, the LED driver indicates this through a lower light output during the first 10 minutes of the switch-on period as shown in figure 16.

Figure 14: Constant lumen programming graph (operating time = 10 kh)

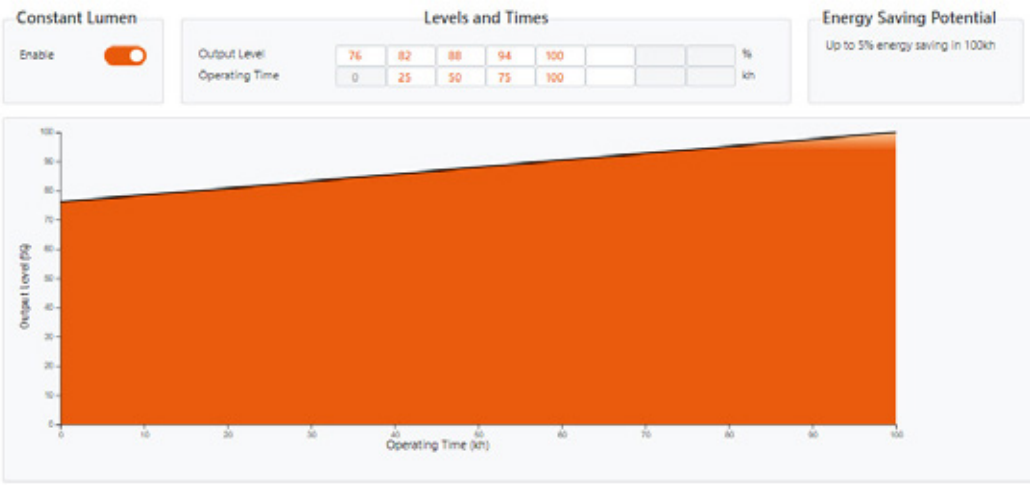
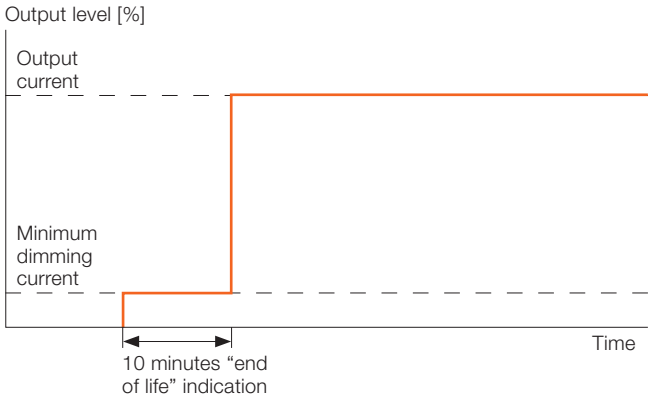
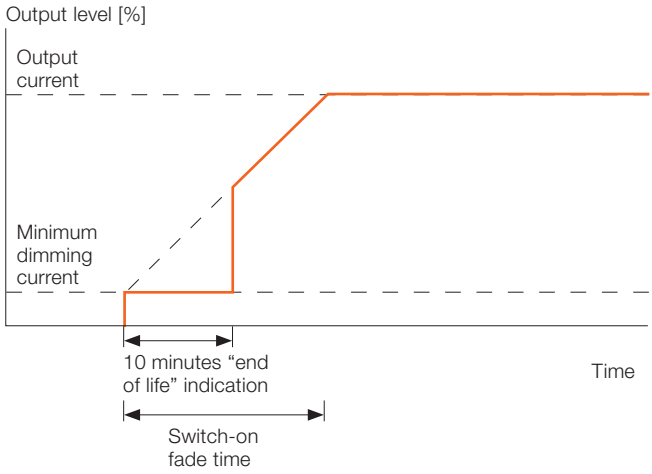


Figure 16: “End of life” behavior without switch-on fade time



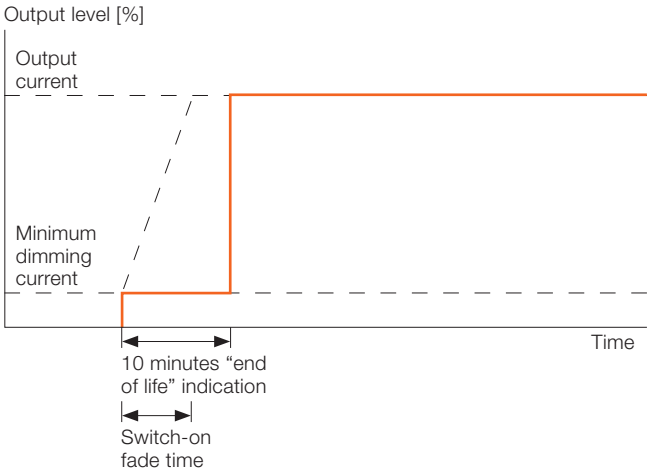
If a switch-on fade time is set, it is overriden by the “end of life” functionality as shown in figure 17. After 10 minutes, the output current is set according to the current switch-on fade time level.

Figure 17: “End of life” behavior with long switch-on fade time



If the switch-on fade time is shorter than 10 minutes, the output current is directly switched to the nominal output level after the “end of life” indication as shown in figure 18.

Figure 18 : “End of life” behavior with short switch-on fade time



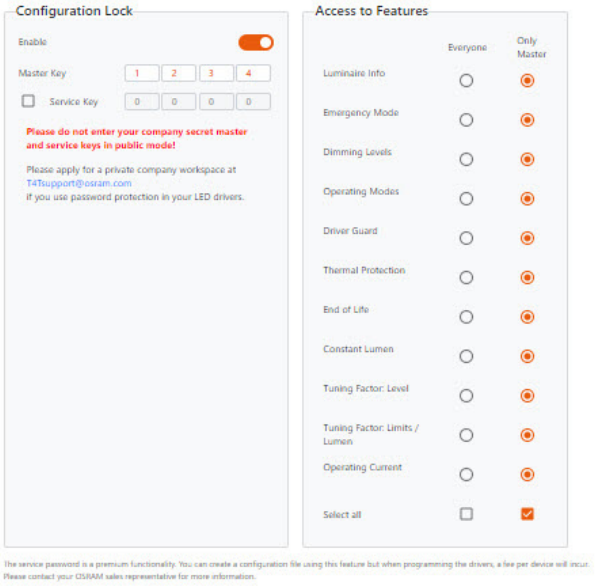
Note:
In DC operation, the “end of life” indication is deactivated until the next power-on/off cycle or DALI operation.

2.6 Configuration Lock

The protection of the LED driver settings is mandatory to guarantee a safe operation of a luminaire over its entire lifetime. In order to meet growing market demands to change settings of a luminaire in the field, we developed a new Configuration Lock, allowing a safe operation of the luminaire while also giving the end customers the possibility to adapt the settings of the luminaire in the field. With this approach, the luminaire manufacturer keeps the complete control on the boundaries defining how his product will be operated.

Example 1:
Luminaire manufacturer locks all settings, no in-field changes possible.

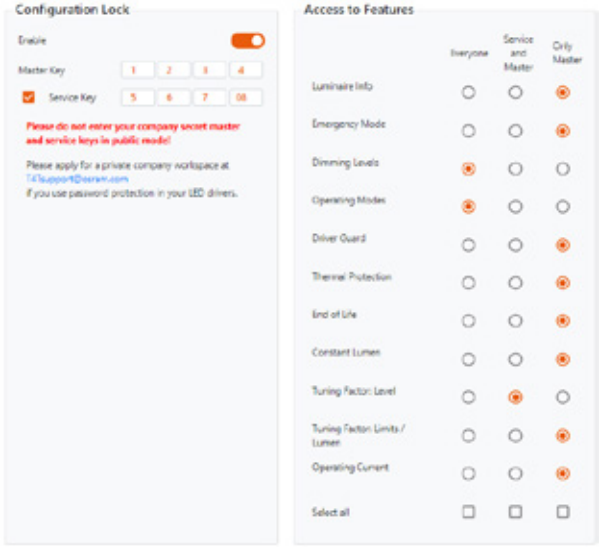
The luminaire manufacturer sets a “Master Key” and locks all the features. Without knowing the programmed “Master Key,” nobody can change the LED driver settings anymore. Features can be kept unlocked by selecting “Everyone” in the corresponding line.



Example 2:
Luminaire manufacturer defines boundary conditions and enables in-field programming.

The luminaire manufacturer defines his “Master Key” and keeps the full access rights to the settings of the LED driver. An additional “Service Key” can be set to allow people knowing this key to adapt the corresponding feature(s) of the LED driver.

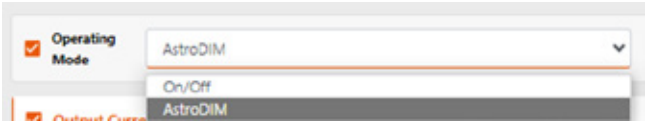
In this example, people who received the “Service Key” (e.g. service personnel) can change the light output of the luminaire using the tuning factor level. As the “Limits and Reference Lumen” of the Tuning Factor feature is locked, the user can only adapt the light output within the limits defined by the luminaire manufacturer. In this case, all settings related to operating modes and AstroDIM can be changed.



3 Operating modes

The operating modes of a 1DIM NFC G3 CE LED driver can be selected using the Tuner4TRONIC® software. Only one mode can be selected.

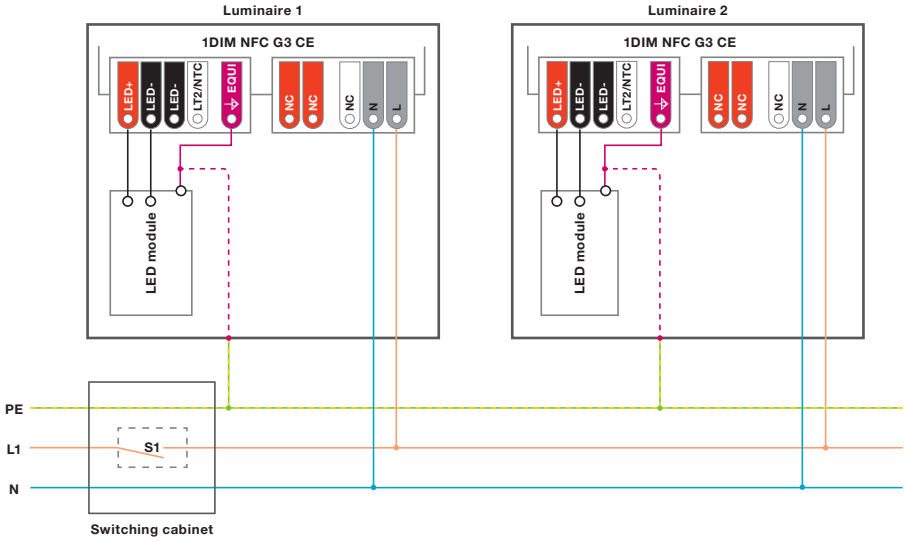
Figure 19: Operating/dimming modes



3.1 On/off operating mode

1DIM NFC G3 CE LED drivers can also be used in a simple on/off operating mode.

Figure 20: Wiring



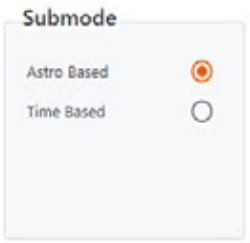
3.2 AstroDIM feature

The AstroDIM feature allows an autonomous dimming without the need for an additional control line. The 1DIM NFC G3 CE LED drivers support up to five independent dimming levels and flexible settings of fade times between the individual dimming levels.

The output levels can be set to 0 % (OFF) or between 10 % and 100 % in steps of 1 %.

In addition, switch-on and switch-off fade times can be programmed at the beginning and the end of a switching cycle to allow for further energy savings during the twilight phase. This function is also helpful for installations with a pedestrian crossing where no specific infrastructure is available to switch the pedestrian crossing illumination independently of the rest of the street light illumination.

Two different modes for AstroDIM are supported:



Time-based: The dimming profile defined in the reference schedule is referenced to the switch-on time of the LED driver.

Astro-based: The dimming profile defined in the reference schedule is referenced to the annual average middle of the night, which is calculated based on the theoretical sunrise and sunset times.

The LED driver does not have a real-time clock. The internal reference clock is derived from the mains frequency and the driver detects if it is connected to a 50 Hz or 60 Hz supply system, assuming a time base of 20 ms or 16.6 ms. This allows a synchronized switching of all units. In case of DC operation (see chapter 3.6), the dimming mode is stopped until the AC voltage is applied again and a power-off/on cycle is performed.

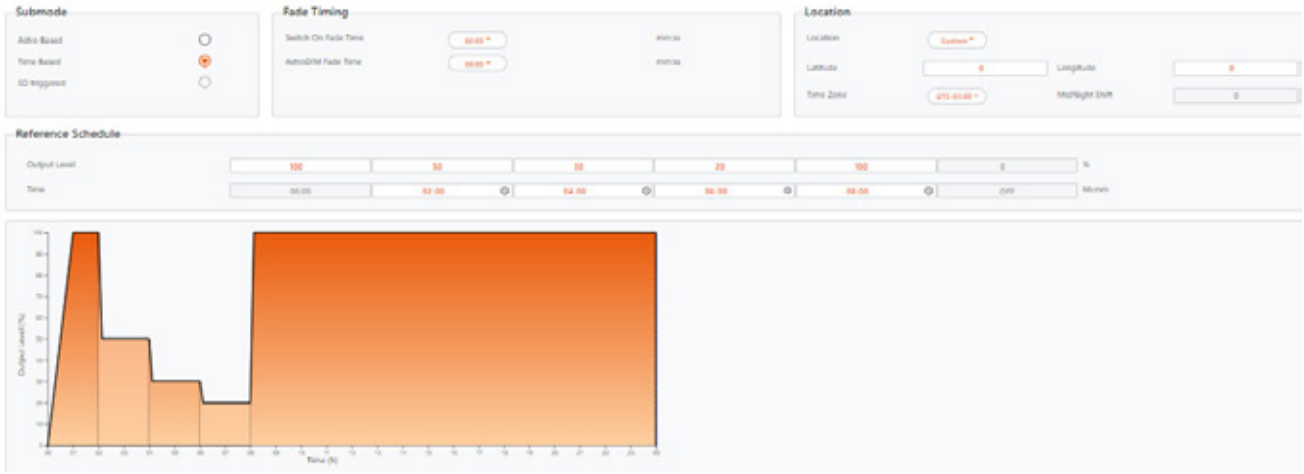
Warning:
If the output level is set below the minimum physical dimming level of the LED driver (except OFF), the minimum dimming current is used. The software still displays the original value. If the output level falls below the minimum allowed dimming current, the value is visualized in red.

3.2.1 Time-based mode

In this mode, the LED driver performs the dimming profile defined in the reference schedule based on the switch-on time of the unit. Five independent output levels can be set for each step. The minimum length of one dimming period has to be longer than the AstroDIM fade time.

The maximum duration of the schedule is 23 h and 59 min. If less than five output levels need to be performed, two sequenced levels have to be set to the same value. The AstroDIM dimming profile in the time-based mode already starts after the first power-off/on cycle after programming.

Figure 21: Time-based AstroDIM



Fade timing:

- **AstroDIM fade time:** Fade time between the different dimming levels.
- **Switch-on fade time:** Fade time after the power-on of the LED driver. The output level at the end of this fade time is defined by the output level of the corresponding dimming period.

Table 6: Fade timing parameters (time-based mode)

Parameter	Min.	Max.	Default
AstroDIM fade time	0, 2 s	8 min	3 min
Switch-on fade time	0, 15 s	60 min	0 s

3.2.2 Astro-based mode

In this mode, the LED driver performs a dimming profile based on the daily power-on and power-off times. The dimming schedule is adapted according to the length of the night.

The Tuner4TRONIC® software calculates the annual average middle of the night based on the theoretical sunrise and sunset times, which are related to the location selected in the software. Based on this average middle of the night, five independent dimming periods can be defined in the reference schedule. The minimum length of one dimming period has to be longer than the AstroDIM fade time. Valid time values can be set between 12:00 pm and 11:59 am. If less than five output levels need to be performed, two sequenced levels have to be set to the same value.

The defined dimming profile is already performed after the second power-off/on cycle after programming.

Figure 22: Astro-based AstroDIM

Fade timing:

— **AstroDIM fade time:** Fade time between the different dimming levels.

To achieve further energy savings in the twilight phase, the switch-on and switch-off fade time can be set to up to 60 minutes.

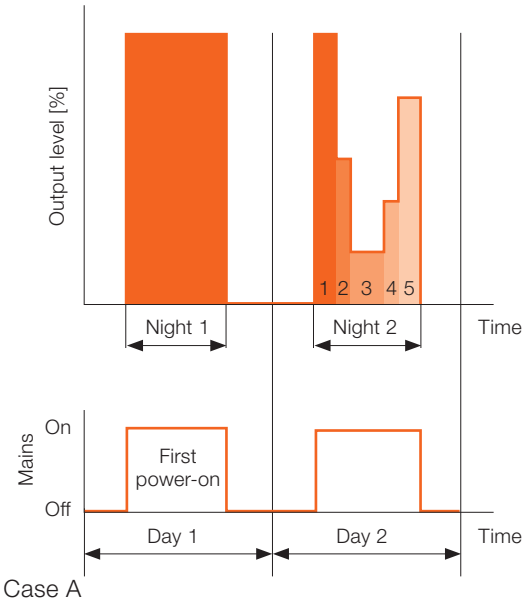
— **Switch-on fade time:** Fade time after the LED driver has been powered on. The output level at the end of this fade time is defined by the output level of the related dimming period (step x).

— **Switch-off fade time:** Fade time prior to the estimated power-off point. The switch-off fading is performed down to the minimum dimming current until the LED driver is switched off externally.

Table 7: Fade timing parameters (astro-based mode)

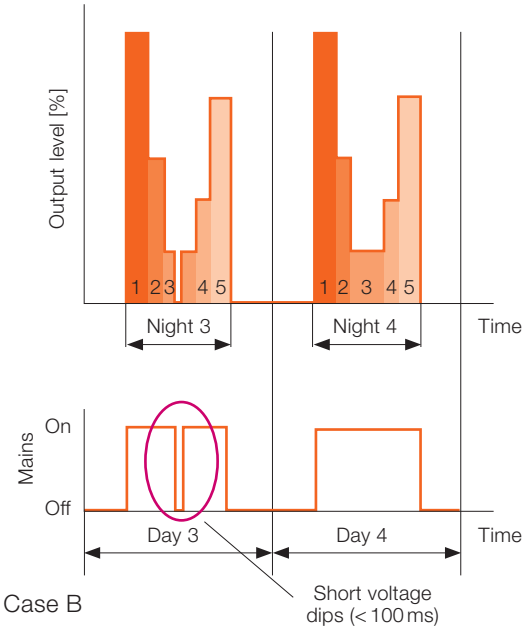
Parameter	Min.	Max.	Default
AstroDIM fade time	0, 2 s	8 min	3 min
Switch-on fade time	0, 15 s	60 min	0 s
Switch-off fade time	OFF, 0 s	60 min	OFF

Figure 23: Use cases of AstroDIM mode



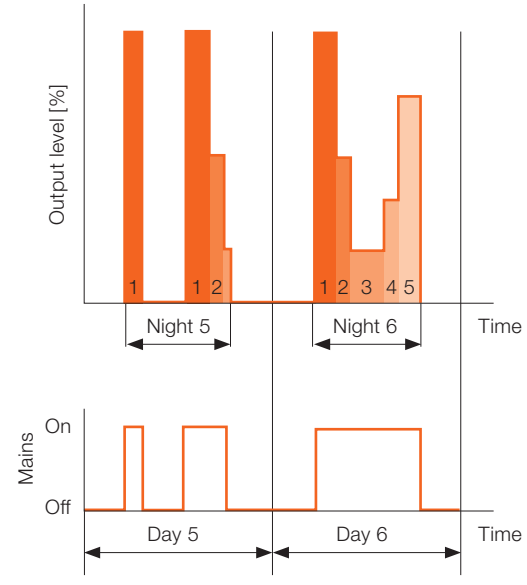
Case A

The AstroDIM profile is performed after the first valid on-time.



Case B

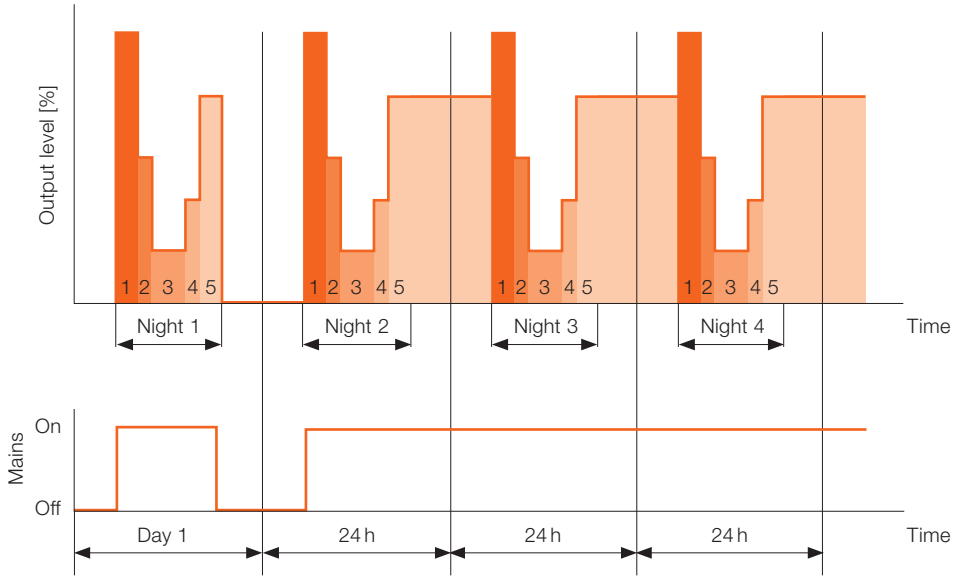
Voltage dips of less than 100 ms do not affect the on-time (case B).



Case C

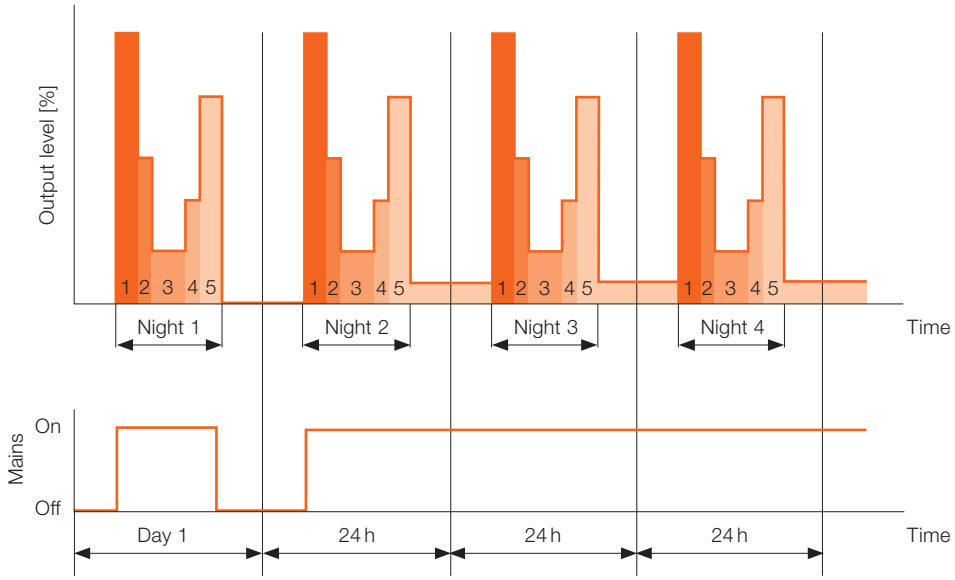
If the on-time of the LED driver is shorter than 4 hours, it is not saved and therefore not used to calculate the next on-time (case C).

Without switch-off fade time:



Case D

With enabled switch-off fade time:



Case E

If the on-time of the LED driver is longer than 24 hours, it is not saved and therefore not used to calculate the next on-time.

Note:
If the 1DIM NFC G3 CE LED driver is operated longer than 24 hours, it cannot be assumed that the different dimming level will start at the same time, because the time base is affected by the accuracy of the mains frequency over the day, week, month and year.

4 Additional information

4.1 Insulation

1DIM NFC G3 CE LED drivers have a double/reinforced insulation between the primary and the secondary side and a double/reinforced insulation between all electronic parts and the casing.

Table 8: Insulation and U_{out}

	OT 20/170-240/1A0 1DIM NFC G3 CE	OT 40/170-240/0A7 1DIM NFC G3 CE	OT 40/170-240/1A0 1DIM NFC G3 CE	OT 75/170-240/0A7 1DIM NFC G3 CE	OT 75/170-240/1A0 1DIM NFC G3 CE	OT 110/170-240/0A7 1DIM NFC G3 CE	OT 110/170-240/1A0 1DIM NFC G3 CE	OT 165/170-240/1A0 1DIM NFC G3 CE
Insulation (primary/secondary)	SELV	SELV	SELV	Double	SELV	Double	Double	Double
Insulation of casing	Double	Double	Double	Double	Double	Double	Double	Double
U_{out}	60 V	120 V	60 V	185 V	120 V	250 V	220 V	320 V

The equipotential pin (EQUI) meets the requirements for double insulation versus the primary side and requirements for basic insulation versus the secondary side (it complies with the requirements of IEC 60598-1 Annex A – “safe to be touched” – in case of insulation fault between all secondary circuits and accessible conductive parts).

The detailed insulation levels are defined in the instruction sheet of the product.

4.2 Cable preparation

1DIM NFC G3 CE LED drivers use open terminals for easy and quick wiring. To ensure a safe and stable hold of the wires, the insulation of the cables should be stripped accordingly. Solid and flexible wires can be used.

Primary side:

Figure 24: Cable preparation, primary side

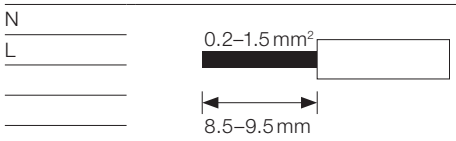
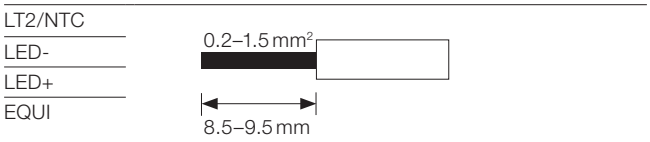


Figure 25: Cable preparation, secondary side and equipotential pin



4.3 Incorrect wiring on the output side

1DIM NFC G3 CE LED drivers are inherently protected against incorrect wiring on the output side. Incorrect wiring between LED+ and LEDset or NTCset can irreversibly damage the LED driver. If there is a short circuit between LED+ and LED-, the LED driver shuts down and tries to switch the load back on. The same behavior might occur if the output voltage falls below the minimum allowed voltage.

4.4 Input overvoltage

The driver withstands an input voltage of up to 305 V_{AC} for an unlimited time but a shutdown of the output load might occur in case the supply voltage exceeds 270 V_{AC}. In case of miswiring, the driver can withstand up to 360 V_{AC} for no longer than two hours. Under operation conditions in which overvoltage levels >264 V_{AC} occur, the product needs to be additionally protected by an external fuse (400 V 4 A, time lag, $I^2t > 160$ A2 sec).

4.5 Surge protection

1DIM NFC G3 CE LED drivers offer a common mode protection level of up to 10 kV with an integrated overvoltage suppression for the connected LED module, which minimizes the stress on the LED module and thus ensures high reliability in the field. To achieve the surge protection levels, the EQUI pin needs to be connected to the heat sink of the LED module (see figures 26 and 27). The EQUI pin meets the insulation requirements for protection class I and II luminaires. The protection level between L and N is 6 kV.

The following protection levels can be achieved for class I and II luminaires:

Table 9: 1DIM NFC G3 CE surge protection levels

Surge between	Test description	Product standard	Basic standard
L-N	6 kV at 2 Ω, differential mode	IEC/EN 61547	IEC 61000-4-5
	1 kV at 2 Ω, differential mode	–	IEC 61000-4-5
L-EQUI/N-EQUI	10 kV at 12 Ω, common mode	IEC/EN 61547	IEC 61000-4-5
	8 kV at 12 Ω, common mode	IEC/EN 61547	IEC 61000-4-5
	6 kV at 12 Ω, common mode	IEC/EN 61547	IEC 61000-4-5

If an additional external surge protection device is used, please contact your INVENTRONICS sales contact for support.

Figure 26: 1DIM protection class I luminaire

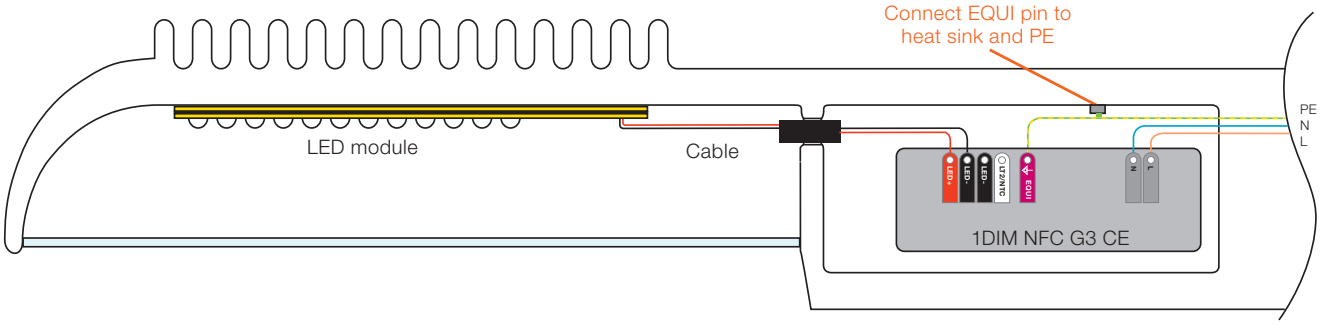
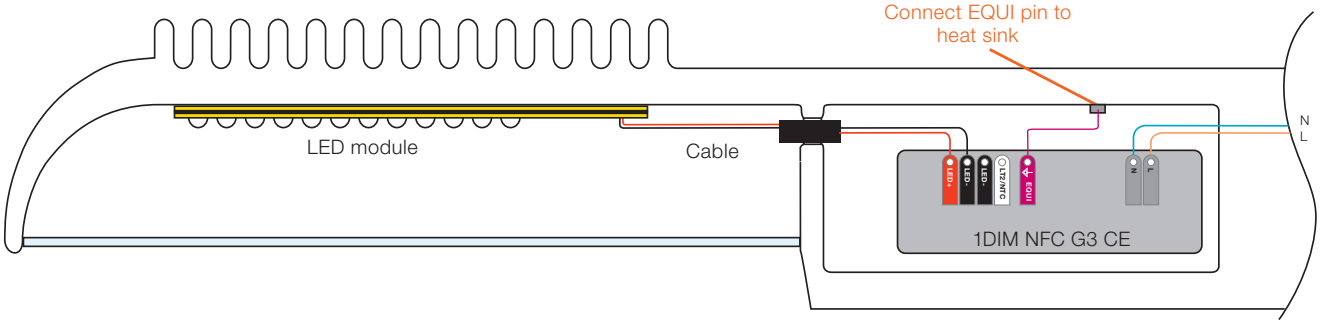


Figure 27: 1DIM protection class II luminaire



5 Programming

1DIM NFC G3 CE LED drivers can be programmed using Tuner4TRONIC® via NFC. Please find details on the Tuner4TRONIC® tool chain, user manuals, application guides, tutorials and download links on https://www.inventronics-light.com/tuner4tronic

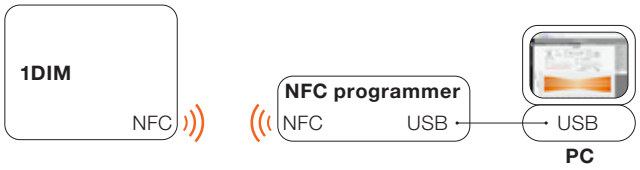
Note:
Performance check: If electronically controlled control gears are combined with electrical power supplies, the electronic circuits of both devices might influence each other. This could lead to wrong measurements (e.g. lower power factor).

5.1 Programming with NFC USB readers

1DIM NFC G3 CE LED drivers must not be powered during programming with T4T-Production via NFC. Place the LED driver on the NFC reader and align the antennas of both devices. The position of the NFC antenna is indicated by the NFC logo on the label of the LED driver and is mounted vertically at the side of the driver's housing. When using box programming, the NFC logo on the box needs to be placed in the center of the FEIG Antenna ANT310/310. Please find a list of supported NFC readers in the T4T-Production user manual.

Please note:
The NFC antenna of the 1DIM NFC G3 CE has been optimized for an easy accessibility from the **top** surface of the LED driver. This enables an optimal access to NFC tags also in very narrow luminaires, in which very often not enough space is left between the luminaire and the LED driver's side surface. This eases the service operation in the field via the T4T Field App. For single LED driver programming during production, ensure that the antenna is placed on the **top** surface of the LED driver.

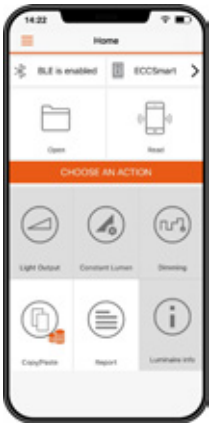
Figure 28: LED driver programming with NFC



Note:
A power-off/on cycle is necessary to activate the password settings in ConfigLock

5.2 Programming with T4T-Field App

1DIM NFC G3 CE LED drivers can be programmed via NFC with the Tuner4TRONIC® Field app available for download to Android and iOS mobile devices from GooglePlay and AppStore. T4T-Field App allows reading driver data, programming drivers from production files and editing data such as light output, CLO, dimming profiles and luminaire info data. Reading and writing data with T4T-Field App is possible with and without powering the driver with mains. Programming data may be restricted by password settings from the luminaire manufacturer.



6 Additional information for electrical design-in

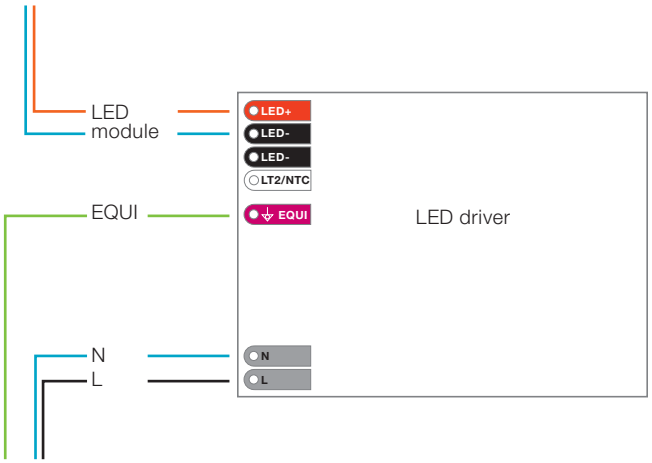
6.1 Recommended EMI wiring setup

In order to fullfill EMI requirements, the following precautions need to be taken into account:

- Keep LED output wires close together and avoid loop areas.
- Keep the wiring length as short as possible.
- Keep the length of the mains wires as short as possible.
- Keep mains and control wires separated from the LED output wires.
- Avoid any wiring over the driver housing.

Recommended wiring setup is shown in figure 29.

Figure 29: Recommended EMI wiring setup



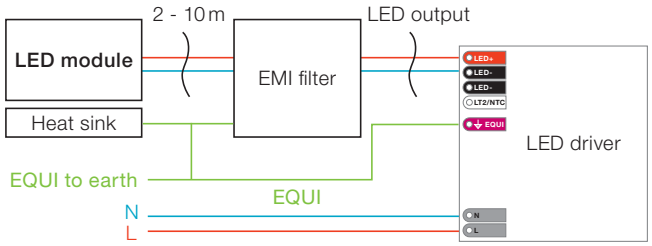
6.2 Remote LED driver installation for Class I configuration

Remote mounting of LED drivers is allowed as long as the additional voltage drop on the output wires is accounted for.

For **Class I** configurations, in case of remote driver installation (output wires with a length between 2 and 10 meters), an EMI filter, as shown in figure 30, can be used in order to comply with the EMI requirements.

Figure 30: Connection for Class 1 configuration

Class 1



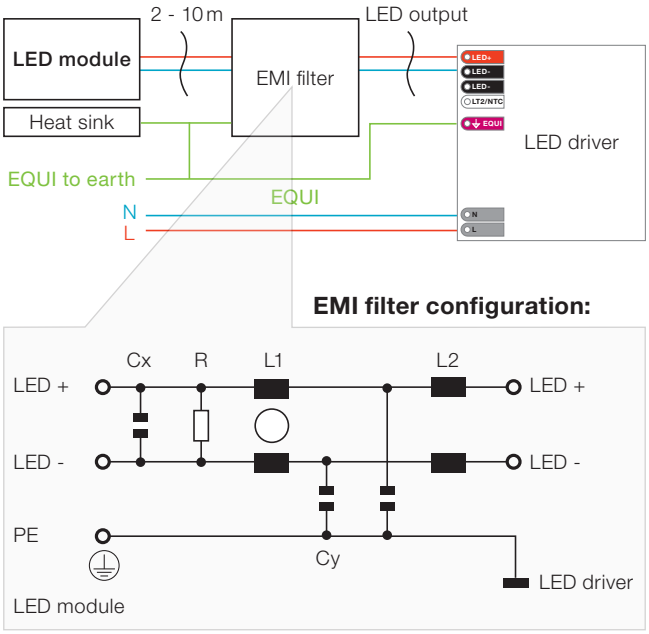
6.3 Remote LED driver installation for Class II configuration

Remote mounting of LED drivers is allowed as long as the additional voltage drop on the output wires is accounted for.

For **Class II** configurations, in case of remote driver installation (output wires with a length between 2 and 10 meters), an EMI filter, as shown in figure 31, can be used in order to comply with the EMI requirements.

Figure 31: Connection for Class 2 with EQUI configuration

Class 2



L1 = 2 mH Cy = 4.7 nF Cy = 470 nF
L2 = 100 uH R = 1000 K

Disclaimer

All information contained in this document has been collected, analyzed and verified with great care by INVENTRONICS. However, INVENTRONICS is not responsible for the correctness and completeness of the information contained in this document and INVENTRONICS cannot be made liable for any damage that occurs in connection with the use of and/or reliance on the content of this document. The information contained in this document reflects the current state of knowledge on the date of issue.

Use our contact form

www.inventronics-light.com/contact-us

Service contact:
Inventronics GmbH
Parkring 31-33, 85748 Garching, Germany
www.inventronics-light.com
support@inventronicsglobal.com

inventronics