

Technical application guide

OPTOTRONIC DEXAL NFC G2
LED drivers and T4T-C



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Please note:

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1 Introduction

LED drivers with DEXAL interface enable the easy and seamless connection of sensors and RF modules as well as the bidirectional exchange of data – opening up entirely new application options. Smart networks can be set up conveniently because the drivers feature an open interface which ensures compatibility with numerous wireless light management systems.

With a DEXAL driver, luminaire manufacturers can not only cover different wireless solutions, but also have lower system costs compared to a mains-powered RF module. Fewer components are required, the installation space inside the luminaire is reduced and both luminaire approvals and final production tests become easier. The integration of sensors also enhances the value of the luminaire. In addition, DEXAL offers a particularly low stand-by power consumption.

1.1 Inventronics LED drivers with DEXAL 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® DEXAL NFC G2 CE LED drivers, LED luminaire systems can be optimized to the on-site conditions and cost. With the integrated dimming functions (AstroDIM, StepDIM or DALI), significant energy saving and a reduction of greenhouse gas emissions can be achieved.

The NFC interface implemented in the OT DEXAL NFC G2 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 the very large operating window (voltage/current) of these LED drivers, both Inventronics 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.

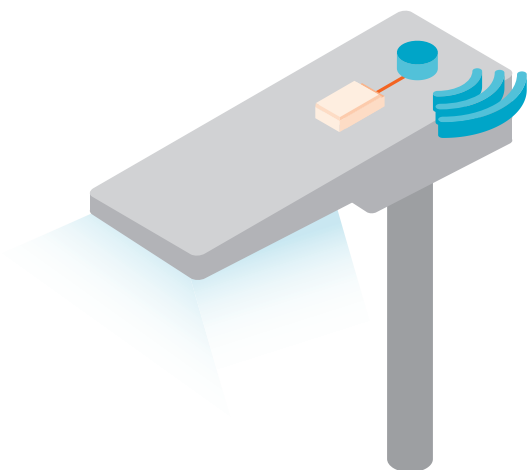
The drivers are DALI-2-certified and support stepless dimming, status requests, and addressing of each individual light point. Compared to devices based on DALI version 1, DALI-2-certified drivers ensure a higher interoperability in the system. Moreover, DALI-2 ensures better integration of additional valuable data services thanks to the DALI DATA extensions part -251 (Luminaire Info), part -252 (Energy Reporting) and part -253 (Diagnostic Data).

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.

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

1.2 DEXAL LED driver family

For outdoor and industrial applications, the DEXAL interface is a future-proof solution. In addition to the powered DALI interface, the OPTOTRONIC Outdoor LED driver family offers a 24 V_{DC} supply for larger power consumers such as radar sensors or wide-range RF modules. This additional luminaire interface is standardized in Zhaga Book 18, allowing the development of luminaires that are compatible with numerous system components. When setting up a wireless network, each luminaire can be used as a network node for a smart urban infrastructure. Even in case of upgrades or new wireless technology standards, the luminaires can be adapted at any time – without complete luminaire replacement.



Today's street lighting is ready for a smart city infrastructure

In the future, a connected infrastructure will play an even more important role in urban lighting. Already today, DEXAL Outdoor LED drivers allow the design of luminaires with the Zhaga Book 18 interface, thus breaking new ground with unprecedented levels of efficiency, flexibility and innovation.



1.3 DEXAL interface

DEXAL is a bidirectional, digital interface that combines a power supply for fixture peripherals and communication capabilities on a two-wire bus. DEXAL LED drivers provide essential performance data related to the luminaire via their DEXAL interface.

The underlying technology of DEXAL is the DALI technology as defined in IEC 62386-102:2009 (Digital Addressable Lighting Interface – General Requirements).

The DEXAL interface (Generation 2) complies with the DiiA specifications DALI Part -250 to DALI Part -253. Part -250 defines the electrical specification of the DALI bus power supply for external sensors and controllers. The Inventronics feature “Luminaire Data”, which corresponds to Part -251, gives the OEM customers the possibility to store their own luminaire data, e.g. luminaire ID, input power, light output and color rendering index in DEXAL LED drivers. The Inventronics feature “Energy and Diagnostic Data”, combines Part -252 and Part -253 for energy reporting as well as diagnostics and maintenance purposes. These data can be used for predictive maintenance and asset tracking purposes. DEXAL Outdoor LED drivers support luminaires according to Zhaga Book 18. This specification defines the mechanical and electrical interface. The provision of a 24 V AUX Power supply complies with the requirements of the DiiA specification DALI Part -150. The figure on the right shows the overview of how the Inventronics features are linked to DiiA standards and Zhaga Books.

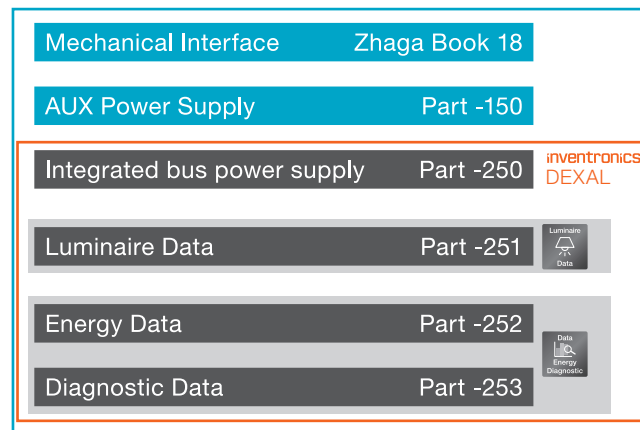
1.4 Data structure and management

With the DEXAL interface, sensors and RF modules from numerous providers can be supplied with power and data can be made available to downstream systems. The RF module transmits the data to the management system, where it is processed and analyzed. The standardized interface ensures the compatibility of the luminaires with numerous system components.

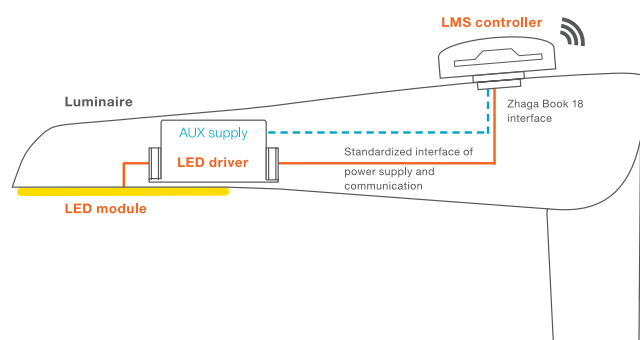
DEXAL Generation 2 drivers comply with the DiiA specifications which can be downloaded from the DiiA website: www.digitalilluminationinterface.org/specifications/download.html

Our DEXAL drivers provide data on the operation and energy consumption of the luminaire. In Generation 2, additional information about the luminaire can be stored and the data model corresponds to the current DiiA specifications. With the Generation 2 devices, the data can also be recalled via the Tuner4TRONIC software.

Optimized overall system based on open standards



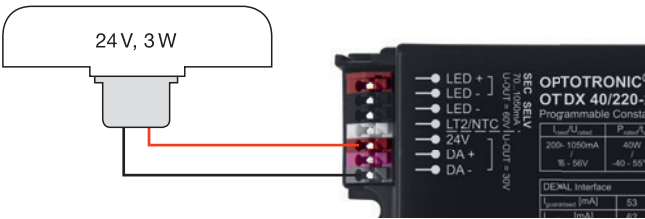
DEXAL driver application:



All features of the LED drivers as well as the creation of an electronic type label for your luminaire (luminaire information according to DiiA specification DALI Part -251) can be programmed with the Tuner4TRONIC software. The driver configuration and the data stored in the driver can be protected by the Configuration Lock with the Tuner4TRONIC software. By default, the luminaire, energy and diagnostic data are not protected. Specific information such as energy reports as well as diagnostic and maintenance data can also be read out with this software. The Tuner4TRONIC software can be downloaded for free from www.inventronicsglobal.com/t4t.

2 Additional features of OPTOTRONIC DEXAL Outdoor LED drivers

For outdoor applications, sensors and LMS controllers with a demand for a higher supply power are used. Therefore, in addition to the internal DEXAL bus power supply, the DEXAL Outdoor LED drivers are equipped with a 24 V AUX Power Supply providing up to $3 W_{avg}/6 W_{pk}$.



Wiring schematic of an outdoor controller/sensor

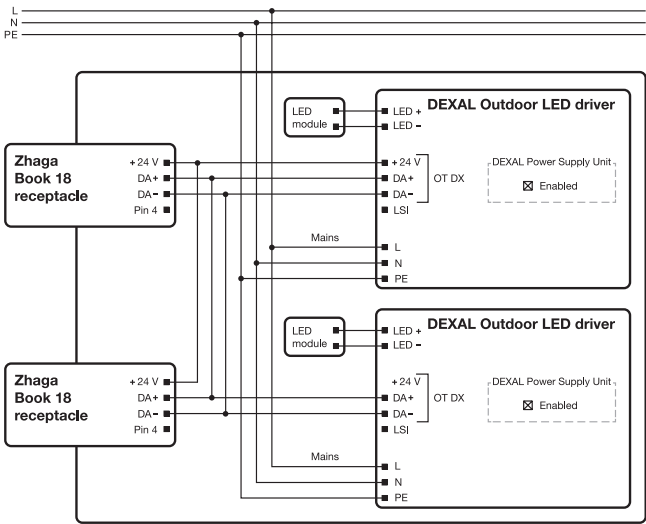
The 24 V power supply of DEXAL Outdoor LED drivers complies with the DiiA specification DALI Part -150, which defines the electrical characteristics of the AUX Power Supply.

Zhaga Book 18 receptacle

The socket is electrically and mechanically defined in the Zhaga Book 18 (see <https://www.zhagastandard.org/books/book18/>).

Contact	Assignment
1	+24 V power supply
2	Negative pole for the protocol (contact 3) [e.g. DA-] Ground for +24 V power supply (contact 1) Ground for LSI (contact 4)
3	Positive pole for the protocol [e.g. DA+]
4	LSI (Locical Signal Interface) for future use. Shall not be connected acc. to Book 18.

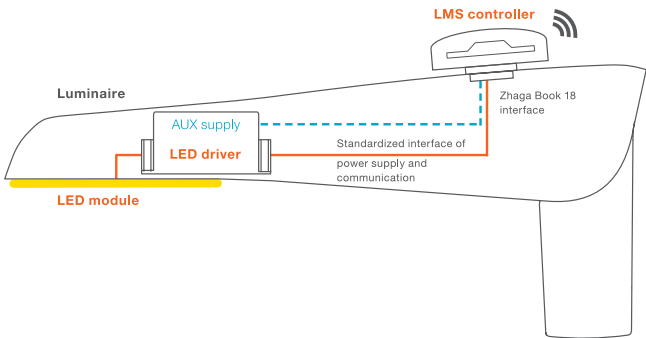
Relation between the contact number of the receptacle and the designated assignment



Wiring schematic of two DEXAL LED drivers, two LED modules and two Zhaga receptacles for a connectivity-ready luminaire

System architecture of a networked luminaire

With a DEXAL driver, the internal luminaire design can be significantly improved in terms of adding smart components such as sensors, RF transceivers and LMS controllers.



Please note:



















1. Multiple AUX power supplies shall not be connected in parallel
2. The total cable length between a DEXAL driver interface and a DEXAL node shall not exceed 3 m.

2.1 DEXAL NFC G2 CE product family

The DEXAL NFC G2 CE product family consists of six different output power classes of up to 200W. All types have the same dimming capabilities and the LEDset2 interface. They can be programmed via the Tuner4TRONIC® software using

the DALI-2 or NFC interface. The following overview shows the main features of these LED drivers.

Table 1: Family overview

Product name							
		OT DX 24/170-240/ 0A7 DIMA NFC G2 CE	OT DX 40/170-240/ 1A0 DIMA NFC G2 CE	OT DX 75/170-240/ 1A0 DIMA NFC G2 CE	OT DX 110/170-240/ 1A0 DIMA NFC G2 CE	OT DX 165/170-240/ 1A0 DIMA NFC G2 CE	OT DX 200/170-240/ 1A0 DIMA NFC G2 CE
General							
Maximum power	W	24 W	40 W	75 W	110 W	165 W	200 W
Input voltage L/N	V_{IN}	170–264 V	170–264 V	170–264 V	170–264 V	170–264 V	170–264 V
Nominal output voltage	V_{OUT}	12–48 V	15–65 V	35–150 V	65–230 V	90–260 V	140–300 V
Programmable output current range	I_[mA]	150–700 mA	150–1050 mA	150–1050 mA	150–700 1050 mA	150–1050 mA	150–1050 mA
Minimum physical output current		35 mA	35 mA	35 mA	35 mA	35 mA	35 mA
DX-PE		6 kV	6 kV	6 kV	6 kV	6 kV	6 kV
L/N-DX		8 kV	8 kV	8 kV	8 kV	8 kV	8 kV
L-N		6 kV	6 kV	6 kV	6 kV	6 kV	6 kV
L/N-PE		10 kV	10 kV	10 kV	10 kV	10 kV	10 kV
Insulation (primary/secondary)		 SELV	 SELV	 Double	 Double	 Double	 Double
Insulation of casing		 Double	 Double	 Double	 Double	 Double	 Double
Stand-by power with DEXAL power supply disabled		<0.35 W	<0.35 W	<0.35 W	<0.35 W	<0.35 W	<0.35 W

2.2 Nomenclature

The product name of each OPTOTRONIC® DEXAL NFC G2 CE LED driver is defined as shown below.

OT:	OPTOTRONIC® LED driver
DX:	DEXAL
40:	Power class: 40 W
170-240:	Input voltage range (L/N): 170-240 V
1A0:	Max. output current: 1050 mA
DIMA:	Analog dimming functionality (DALI, StepDIM, AstroDIM)
NFC:	NFC for LED driver programming
G2:	Generation 2
C:	Compact housing shape
E:	For exterior use under specific conditions

Figure 1: OT 40/170-240/DEXAL NFC G2 CE

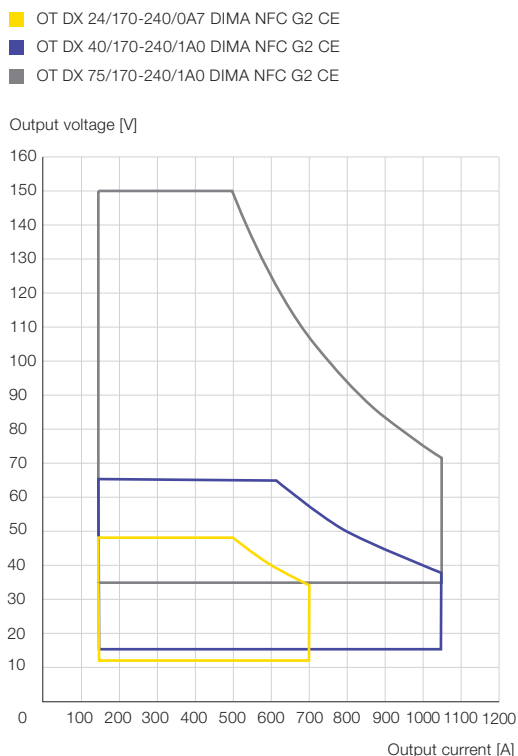


2.3 Operating windows

The OPTOTRONIC® DEXAL NFC G2 CE LED driver family is split up into six different power classes to provide the best suitable power supply for different applications. The nominal programmable output current range is 150 to 1050 mA (150 to 700 mA for the 24 W model). Additionally, the minimum physical output current is 35 mA. This enables a very low dimming level down to 3 %. The minimum dimming level depends on the ratio between 35 mA and the set current. Some examples: Setting the output current at 1050 mA, the minimum dimming level is 3 %, at 700 mA, it is 5 % and at 350 mA, it is 10 %.

Figure 2 gives a complete overview of the possible DEXAL NFC G2 CE operating windows.

Figure 2: Overview of DEXAL NFC G2 CE programmable operating windows



- OT DX 110/170-240/1A0 DIMA NFC G2 CE
- OT DX 165/170-240/1A0 DIMA NFC G2 CE
- OT DX 200/170-240/1A0 DIMA NFC G2 CE

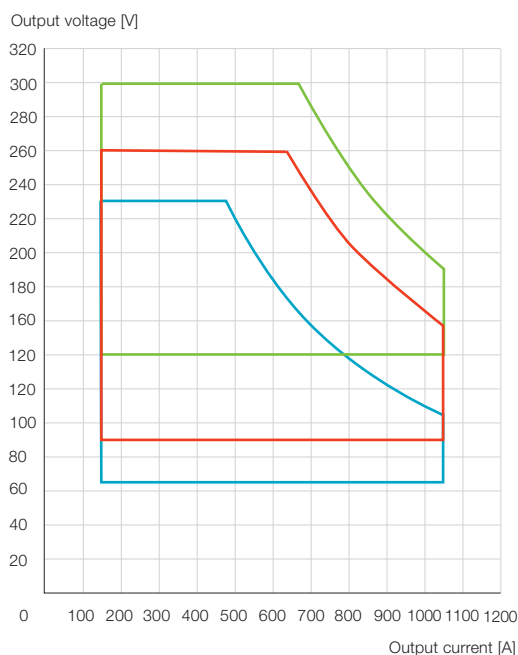


Table 2: DEXAL NFC G2 CE operating range

Product name	OT DX 24/170- 240/0A7 DIMA NFC G2 CE	OT DX 40/170- 240/1A0 DIMA NFC G2 CE	OT DX 75/170- 240/1A0 DIMA NFC G2 CE	OT DX 110/170- 240/1A0 DIMA NFC G2 CE	OT DX 165/170- 240/1A0 DIMA NFC G2 CE	OT DX 200/170- 240/1A0 DIMA NFC G2 CE
P_{max}	24 W	40 W	75 W	110 W	165 W	200 W
t_a	-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}	220–240 V	220–240 V _{AC}	220–240 V
Minimum dimming current	35 mA	35 mA	35 mA	35 mA	35 mA	35 mA
Minimum nominal current	150 mA	150 mA	150 mA	150 mA	150 mA	150 mA
Maximum nominal current	700 mA	1050 mA	1050 mA	1050 mA	1050 mA	1050 mA
Minimum output voltage	12 V	15 V	35 V	65 V	90 V	140 V
Maximum output voltage	48 V	65 V	150 V	230 V	260 V	300 V

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

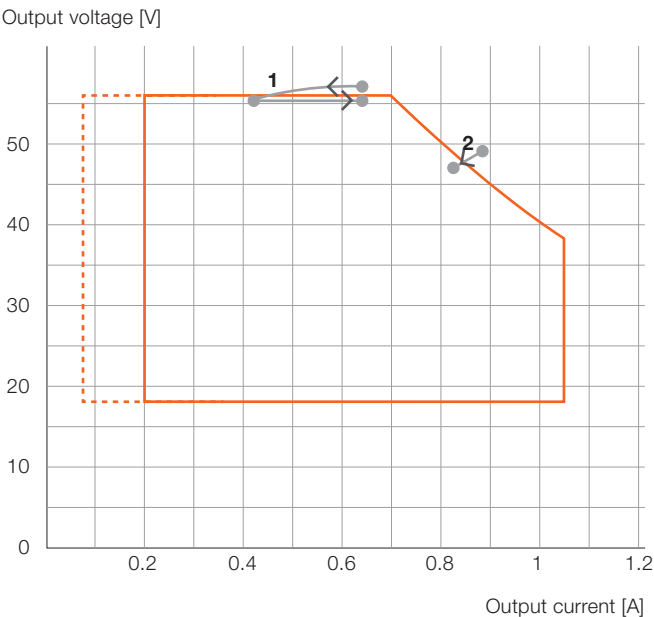
Warning:

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.

2.4 Current foldback

The intelligent DEXAL NFC G2 CE 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.

Figure 3: Current foldback (example: OT 40 DEXAL NFC G2 CE)



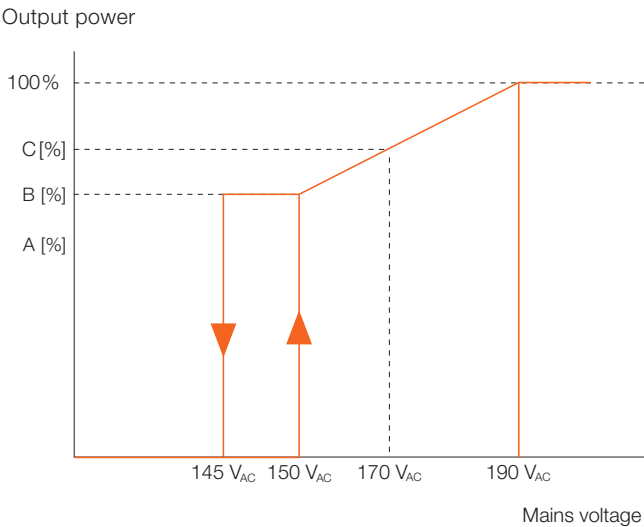
Please note:

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.

2.5 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 4: Input voltage vs. output power DEXAL G2 driver







	A [%]	=	B [%]	C [%]
OT DX 24/170-240/OA7 DIMA NFC G2 CE			64	80
OT DX 40/170-240/1A0 DIMA NFC G2 CE			64	80
OT DX 75/170-240/1A0 DIMA NFC G2 CE			64	80
OT DX 110/170-240/1A0 DIMA NFC G2 CE			64	80
OT DX 165/170-240/1A0 DIMA NFC G2 CE			64	80
OT DX 200/170-240/1A0 DIMA NFC G2 CE			64	80

3 Features

All types offer the same functionalities and feature-set.

 D4i	 DALI-2	 StepDIM (SD(2))	 StepDIM inverse (SD(2))	 AstroDIM (astro-based)	 AstroDIM (time-based)	 Presence detection
 Integrated ESD protection	 Inrush limiter	 DALI protection				

Other features

 Constant Lumen function	 DALI-2 DATA	 LEDset2	 External NTC	 Configuration Lock	 Tuning Factor	 Driver Guard T, P
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Programming software



Tuner4TRONIC®

DEXAL: Smart intra-luminaire connectivity: DALI standard parts -250, -253, -DALI Alliance "D4i"



LED drivers with DEXAL® interface are the centerpiece of a digital ceiling that connects luminaires with integrated sensors and RF modules to set up a close-meshed, radio-based network. DEXAL® supplies RF modules and sensors with power and enables the bi-directional data exchange within the luminaire. Most LED drivers with a DEXAL® interface are now compliant to the DALI Alliance standard "D4i".

DALI-2



In this operating mode, the driver can be controlled by a DALI application controller via the bidirectional DALI interface and it supports status request queries. Through the application controller, the driver can be integrated into a light management system.

The drivers are DALI-2-certified and support stepless dimming, status requests, and addressing of each individual light point. Compared to devices based on DALI version 1, DALI-2-certified drivers ensure more functions and a higher interoperability in the system.

StepDIM/StepDIM inverse



Dimming via an external control phase: Predefined dimming levels can be varied via the Tuner4TRONIC® software and the polarity of the phase. The SD2 port also allows control via a mains-powered presence sensor.

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 DEXAL NFC G2, 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 DEXAL CE drivers have an integrated overvoltage protection of up to 6kV for differential and 10kV 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.

AstroDIM/presence detection



Automatic dimming via an integrated timer (no real-time clock): Five independent dimming levels and zones can be set with the Tuner4TRONIC® software. Brightness variation is possible in combination with an external presence sensor.

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.

Monitoring Data



LED drivers with this feature offer additional operation and status information according to the DALI-2 DATA extensions (Parts -251, -252 and -253) such as energy consumption, power, operating time, overvoltage or undervoltage etc. By using these data, it is possible to offer predictive maintenance and an overall better lighting service. Moreover, it makes the light management system intelligent.

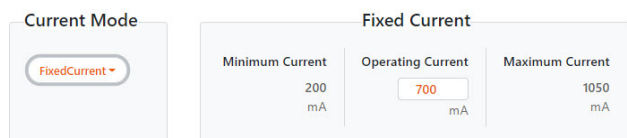
The data can also be visualized in the Tuner4TRONIC® software.

3.1 Operating current

Flexible current setting allows taking advantage of the continuously improving LED technology and building a future-proof system. The DEXAL NFC G2 CE 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 700mA. 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.

3.1.1 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.

3.1.2 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

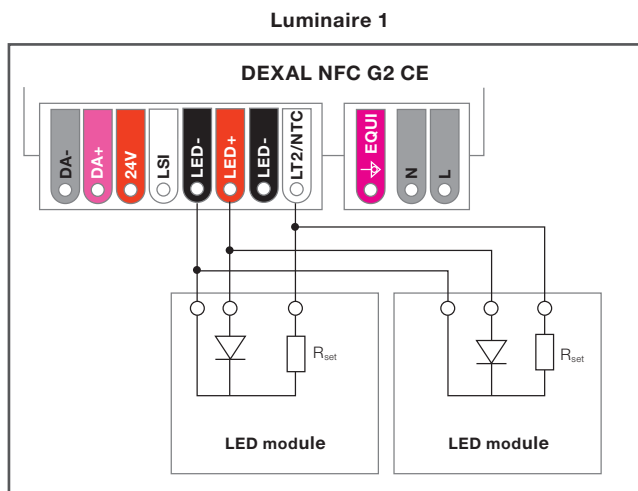
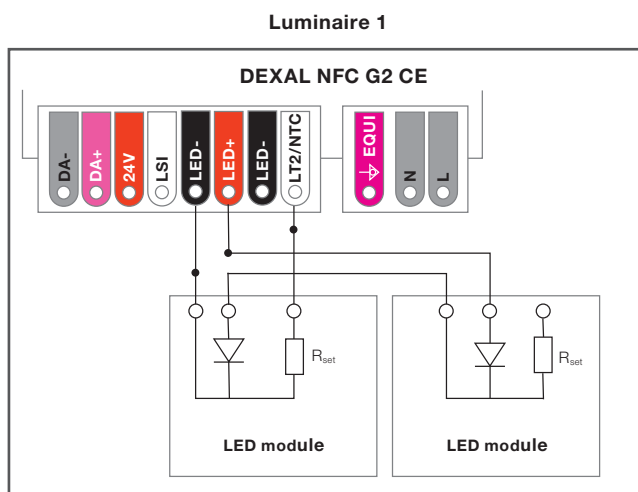
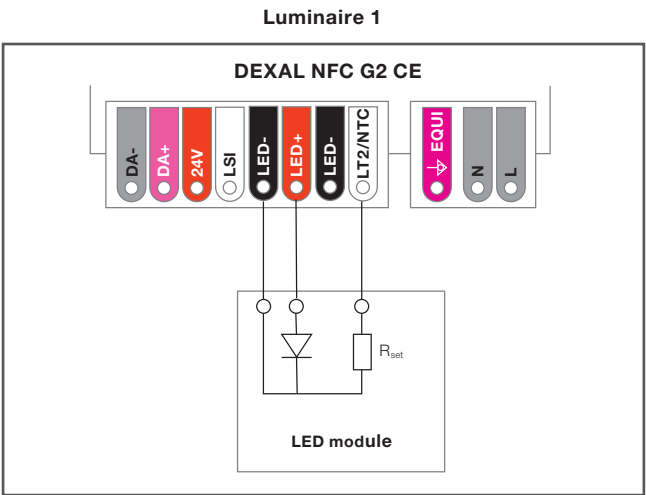


Figure 7: LEDset2 series connection



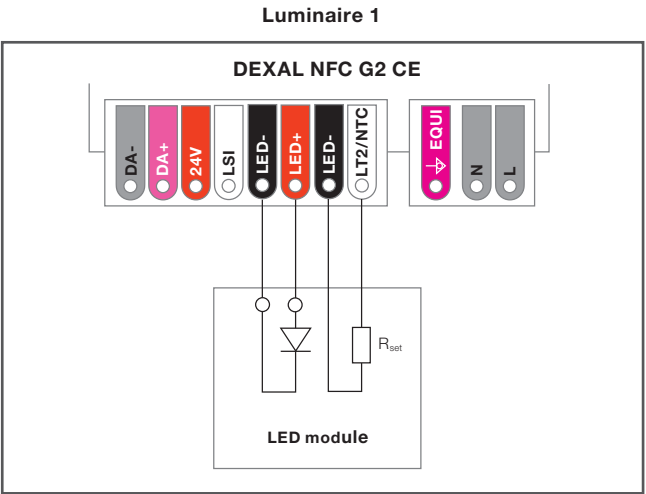
The output current of the LED driver can be set using an externally connected resistor (min. power rating 50mW, max. tolerance 0.5 %). This provides the possibility to set the LED current manually without the need for an additional programming of the LED driver. With a resistor mounted on the LED module 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



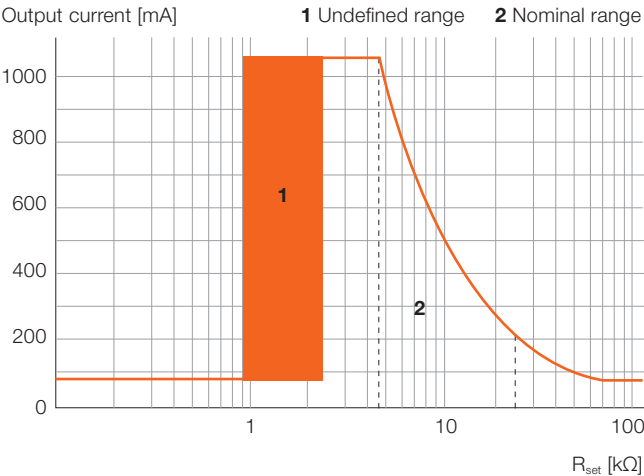
To achieve a more accurate current setting, the second LED- terminal of the LED driver can be used as shown in figure 9. This increases the accuracy by roughly 0.5 %.

Figure 9: R_{set} connection with higher accuracy



The LEDset2 coding for the DEXAL NFC G2 CE 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 ($R_{set} = 4.75\text{--}24.9\text{ k}\Omega$):

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

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

Table 3 gives an overview of commonly used current values and the appropriate resistor values.

Table 3: 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>.

3.1.3 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 2,000–4,000lm. 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



Use this functionality to limit the Light Output using the T4T Field App. Don't forget to update the access rights with the Configuration Lock.

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.

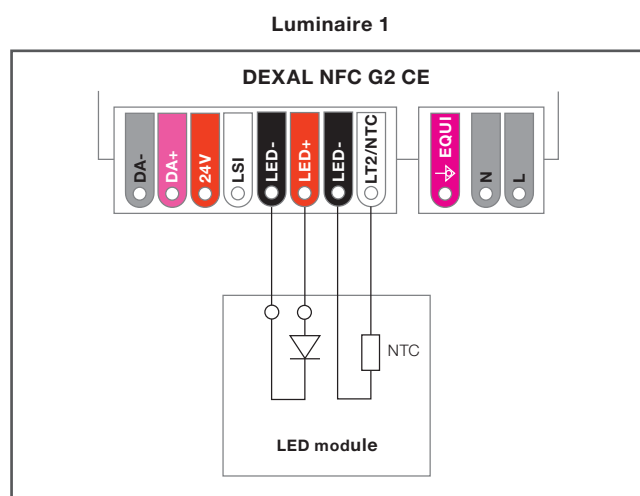
The “limits and reference lumen” can be independently protected by the Configuration Lock feature in order to avoid unauthorized usage of this feature outside the limits defined by the luminaire manufacturer.

3.2 Thermal derating and protection

3.2.1 External temperature sensor

By connecting an external temperature sensor to the NTCset port of the 4DIM 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 4. The specified temperatures can vary, depending on the used NTC component and the corresponding tolerances.

Table 4: Overview of standard NTCs

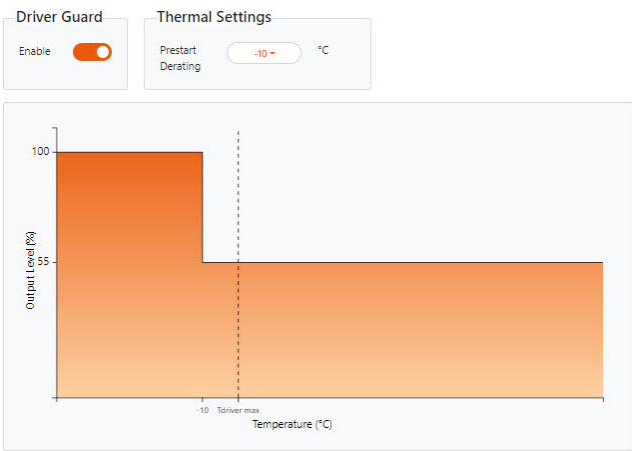
NTC type	Start derating temperature [6.3 kΩ]	End derating temperature ¹⁾ [5.0 kΩ]	Shut-off temperature [4.3 kΩ]
22 kΩ	56 °C	62 °C	67 °C
33 kΩ	66 °C	72 °C	77 °C
47 kΩ	75 °C	83 °C	87 °C
68 kΩ	85 °C	92 °C	97 °C

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

3.2.2 Thermal management and Driver Guard feature

The DEXAL NFC G2 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 50 %. 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.

3.3 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 13.

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 13. 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.

3.4 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 14.

Figure 14: 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".

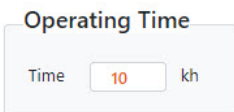
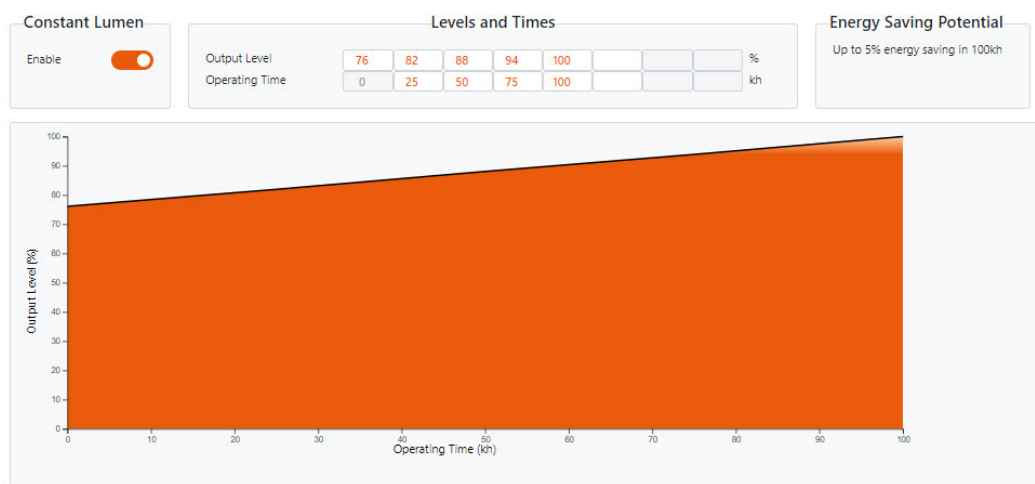


Figure 13: Constant lumen programming graph (operating time = 10 kh)



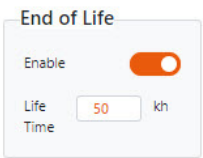
Lamp operating time allows the display and editing of the actual on-time of the LED module, which is the basis for the CLO (constant lumen output) profile. Drivers that feature monitoring data (DiiA: DALI part -253) use “Light Source Diagnostics and Maintenance: On Time – Resettable” to display elapsed time for CLO. “On-Time – Resettable” can be edited by reading Monitoring Data from drivers with T4T-P4.

Cluster	Name	Value	Unit	E R
	Output Power Limitation	N/A		
	Control Gear Power Limitation Counter	N/A		
	Thermal Derating Counter	N/A		
	Thermal Shutdown Counter	N/A		
	Thermal Shutdown	N/A		
	Temperature	N/A	°C	
	Output Current Percent	100		
	Start Counter - Resettable	3		E R
	Start Counter	25		
	On Time - Resettable	0.21	Minimum	E R
	On Time	0.22	Minimum	

3.5 End of life

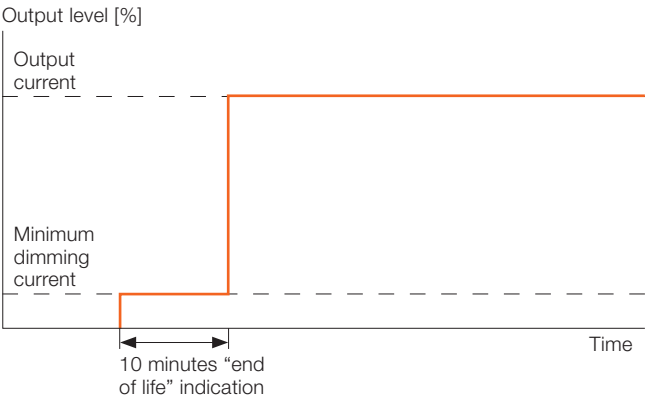
The LED driver can indicate that a preprogrammed lifetime of the connected LED module is reached and the module should be replaced. This function has to be activated in advance via the Tuner4TRONIC® software. The “end of life” indication can be programmed as shown in figure 15.

Figure 15: “End of life” setting



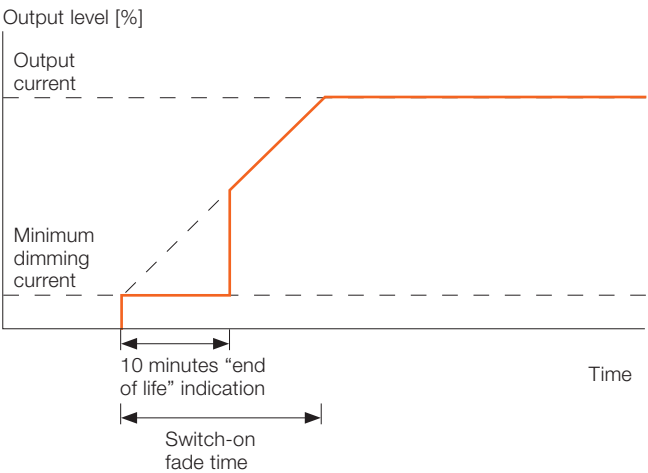
If the specified lifetime is reached, the LED driver indicates this through a lower light output during the first 10 minutes of the switch-on period as shown in figure 16 (the warning is not visible in case the DALI operating mode is selected).

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



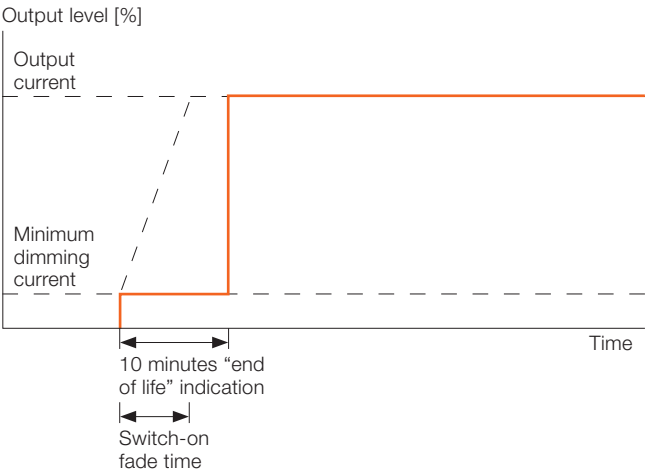
If a switch-on fade time is set, it is overridden by the “end of life” functionality as shown in figure 17. After 10 minutes, the output current is set according to the current switch-on fade time level.

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.

3.6 Smart SPD Monitoring

The Smart SPD, compatible with the OPTOTRONIC DEXAL G2, can be connected to the LED driver and provide the information of its status directly to the LED driver memory bank.

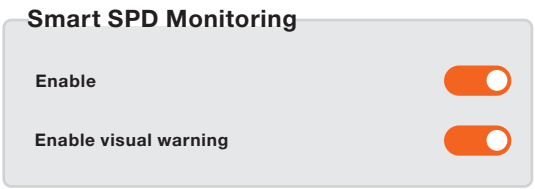
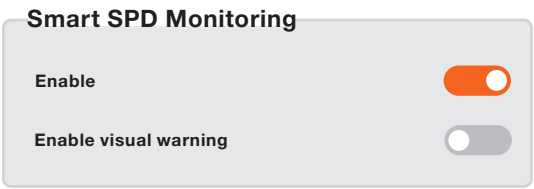
The Smart SPD is a one-port-type SPD, connected in series. This means, once the SPD is damaged, the luminaire still works, and the SPD must be replaced as soon as possible. This is very useful in critical zones such as roundabouts or pedestrian crossing areas, in which the illumination is very critical for the safety of the people.

The status of the Smart SPD can be read out from the memory bank of the LED driver via the DALI/D4i wireless system (if installed) or via NFC (via T4T Field App).

The Smart SPD Monitoring function is available only in combination with the operating mode “AstroDIM (DALI)” and it must be activated via T4T (as shown in figure “enable”).

Additionally, in case the SPD is damaged, the LED driver can be set via T4T in order to indicate a visual warning through lower light output for the first 10 minutes of each power-on cycle (as shown in figures 16, 17 and 18).

The visual warning must be activated via T4T (as shown in the figure “Enable visual warning”).



3.7 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.

Configuration Lock

Enable ☒

Master Key

☐ Service Key

Please do not enter your company secret master and service keys in public mode!

Please apply for a private company workspace at T4Support@osram.com if you use password protection in your LED drivers.

Access to Features

	Everyone	Only Master
Luminaire Info	<input type="radio"/>	<input checked="" type="radio"/>
Emergency Mode	<input type="radio"/>	<input checked="" type="radio"/>
Dimming Levels	<input type="radio"/>	<input checked="" type="radio"/>
Operating Modes	<input type="radio"/>	<input checked="" type="radio"/>
Driver Guard	<input type="radio"/>	<input checked="" type="radio"/>
Thermal Protection	<input type="radio"/>	<input checked="" type="radio"/>
End of Life	<input type="radio"/>	<input checked="" type="radio"/>
Constant Lumen	<input type="radio"/>	<input checked="" type="radio"/>
Tuning Factor: Level	<input type="radio"/>	<input checked="" type="radio"/>
Tuning Factor: Limits / Lumen	<input type="radio"/>	<input checked="" type="radio"/>
Operating Current	<input type="radio"/>	<input checked="" type="radio"/>
Select all	<input type="checkbox"/>	<input checked="" type="checkbox"/>

The service password is a premium functionality. You can create a configuration file using this feature but when programming the drivers, a fee per device will incur. Please contact your OSRAM sales representative for more information.

Configuration Lock

Enable ☒

Master Key

☒ Service Key

Please do not enter your company secret master and service keys in public mode!

Please apply for a private company workspace at T4Support@osram.com if you use password protection in your LED drivers.

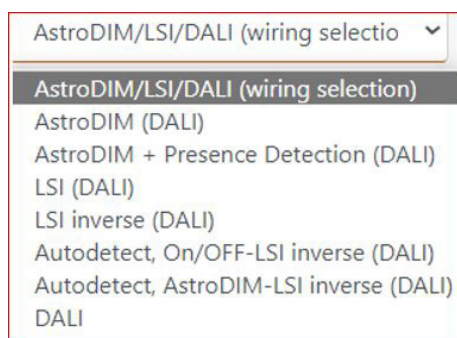
Access to Features

	Everyone	Service and Master	Only Master
Luminaire Info	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Emergency Mode	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Dimming Levels	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Operating Modes	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Driver Guard	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Thermal Protection	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
End of Life	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Constant Lumen	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Tuning Factor: Level	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Tuning Factor: Limits / Lumen	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Operating Current	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Select all	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4 Operating modes

The operating modes of a DEXAL NFC G2 CE LED driver can be selected using the Tuner4TRONIC® software. Only one mode can be selected.

Figure 19: Operating/dimming modes



Note:

DALI always has a higher priority than the selected operating mode and can be activated by a valid DALI command in every mode. After a power-off/on cycle, the LED driver operates in the originally selected dimming mode again.

The LED driver offers the possibility to select one of the two dimming modes “LSI (DALI)” or “AstroDIM (DALI)” via external wiring in case the default dimming mode “StepDIM/AstroDIM/DALI (wiring selection)” is set. Please see chapter 3.2.1 for wiring information.

4.1 On/off operating mode

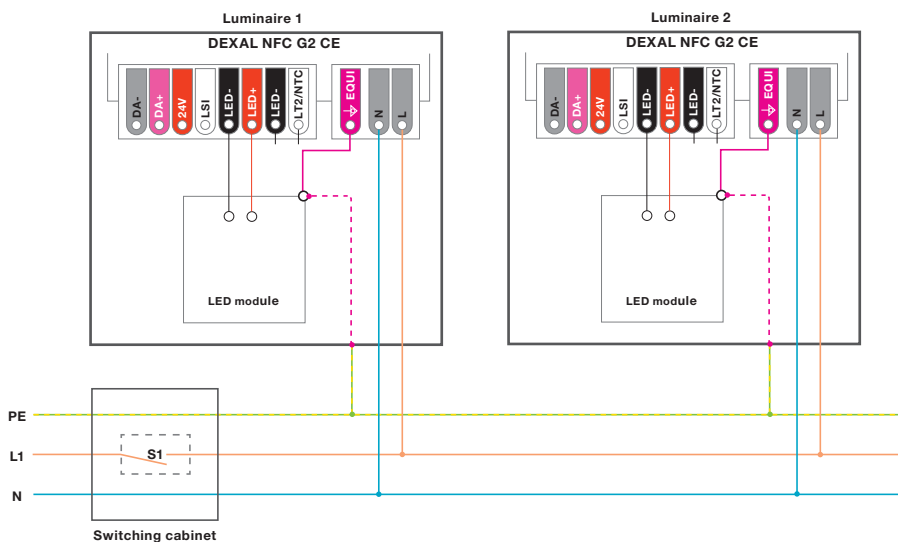
DEXAL NFC G2 CE LED drivers can also be used in a simple on/off operating mode. One of the following dimming modes needs to be selected:

- StepDIM/AstroDIM/DALI (wiring selection) – DALI and LSI port not connected
- StepDIM (DALI) – DALI and LSI port not connected
- DALI – DALI port not connected

Note:

Be aware that the parameters set in these operating modes also have an influence on the behavior of the LED driver in the on/off operating mode.

Figure 20: Wiring for on/off operation



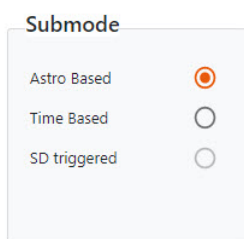
4.2 AstroDIM feature

The AstroDIM feature allows an autonomous dimming without the need for an additional control line. The DEXAL NFC G2 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.

4.2.1 Wiring and feature activation

There are two ways to activate the AstroDIM mode:

– Option 1: By external wiring

Selected dimming mode (factory default):
"StepDIM/AstroDIM/DALI (wiring selection)"

– Option 2: Via the Tuner4TRONIC® software

Selected dimming mode: "AstroDIM (DALI)" or
"AstroDIM PD (DALI)"

AstroDIM activation

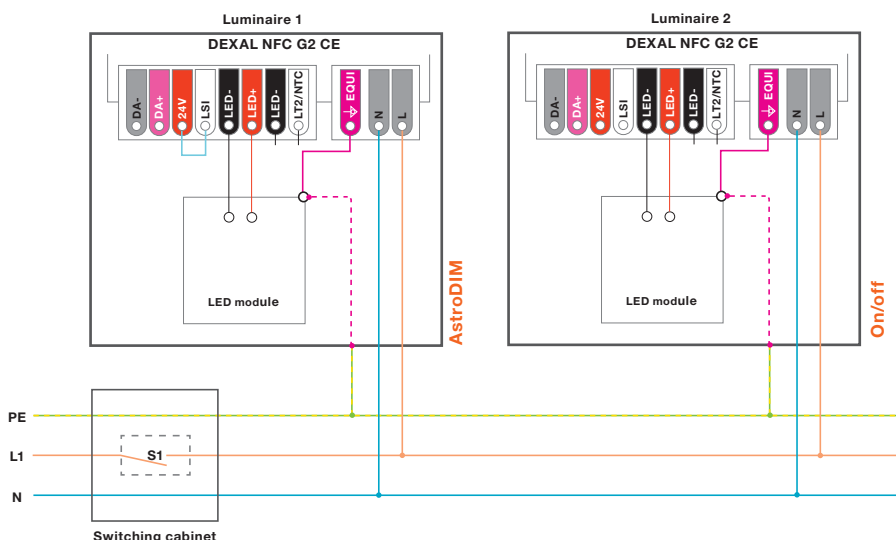
- To enable AstroDIM, a permanent connection between the 24V and LSI ports of the LED driver is required (see figure 21).
- If the LSI port is inactive during the LED driver's start-up phase (first 1 second), the driver operates in on/off mode.

StepDIM activation with OT DX SD Box

- When the OT DX SD Box is connected (see figure 22).
- If the SD2 port of the OT DX SD Box is open (0 V) during start-up (first 1 second), the StepDIM function is activated.
- Once the SD2 port is closed (230 V), the LED driver reduces the output current according to the configured StepDIM settings.

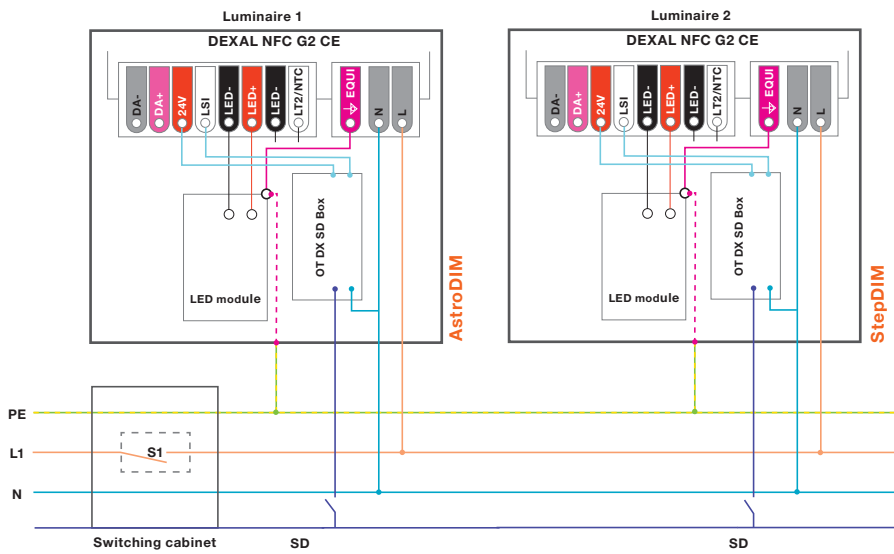
For option 2, the external wiring can be avoided if either the "AstroDIM (DALI)" or "AstroDIM PD (DALI)" dimming mode is selected via the software (see figure 23).

Figure 21: Wiring: StepDIM/AstroDIM/DALI (wiring selection) without OT DX SD Box

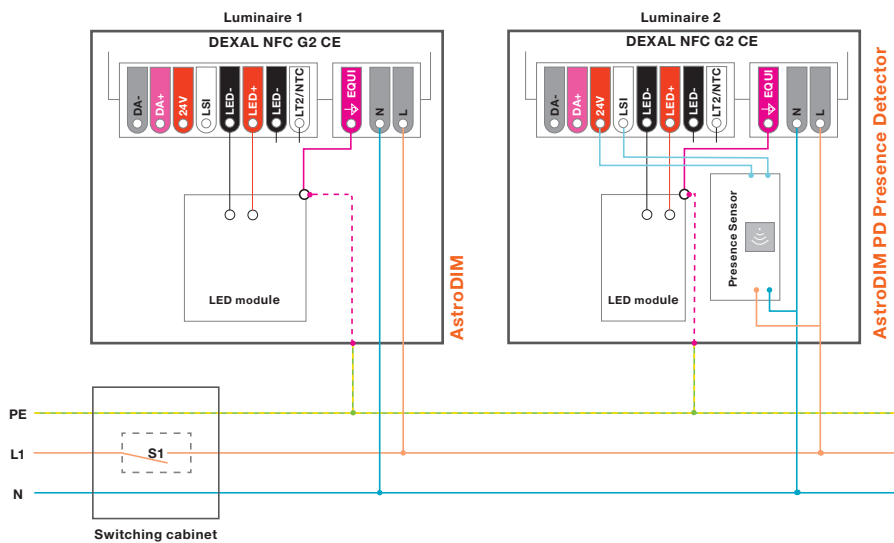


Without OT DX SD Box (selection between AstroDIM and on/off)

- If LSI is connected to +24 AUX during the start-up, AstroDIM is selected (this can be a simple local connection).
- If LSI is left open during the start-up, the driver works as an on/off function.

Figure 22: Wiring: StepDIM/AstroDIM/DALI (wiring selection) with OT DX SD Box**With OT DX SD Box (selection between AstroDIM or StepDIM)**

- If SD is 230 V, then LSI is connected to +24 AUX during the start-up (via OT DX SD Box) and AstroDIM is selected (this can be a simple local connection).
- If SD is open, then LSI is not connected to +24 AUX during the start-up (via OT DX SD Box) and StepDIM is selected.

Figure 23: Wiring: AstroDIM (DALI) or AstroDIM PD (DALI)**4.2.2 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 24: 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 5: 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

4.2.3 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 25: Astro-based AstroDIM



Fade timing:

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

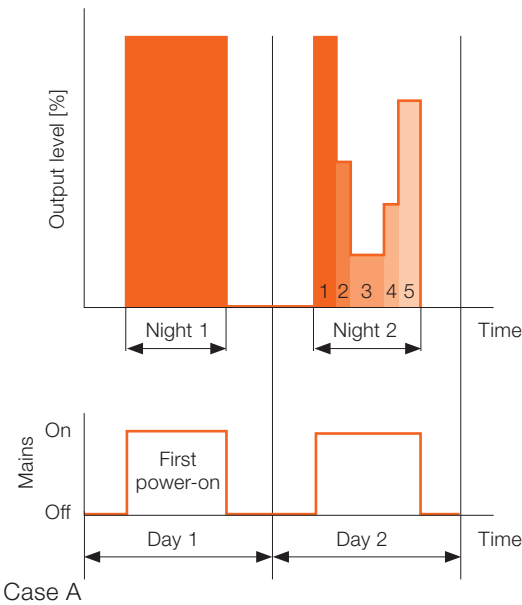
To achieve further energy savings in the twilight phase, the switch-on and switch-off fade time can be set to up to 60 minutes.

- **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.

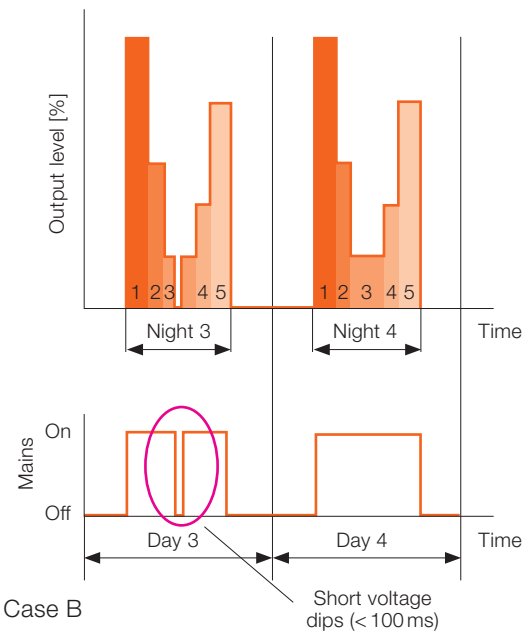
Table 6: Fade timing parameters (astro-based mode)

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

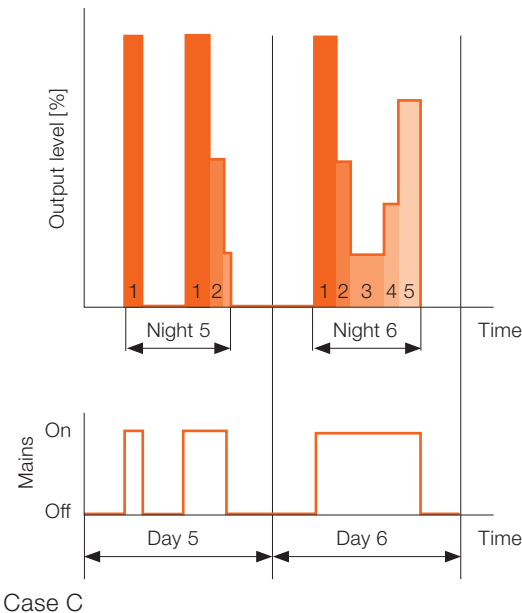
Figure 26: Use cases of AstroDIM mode



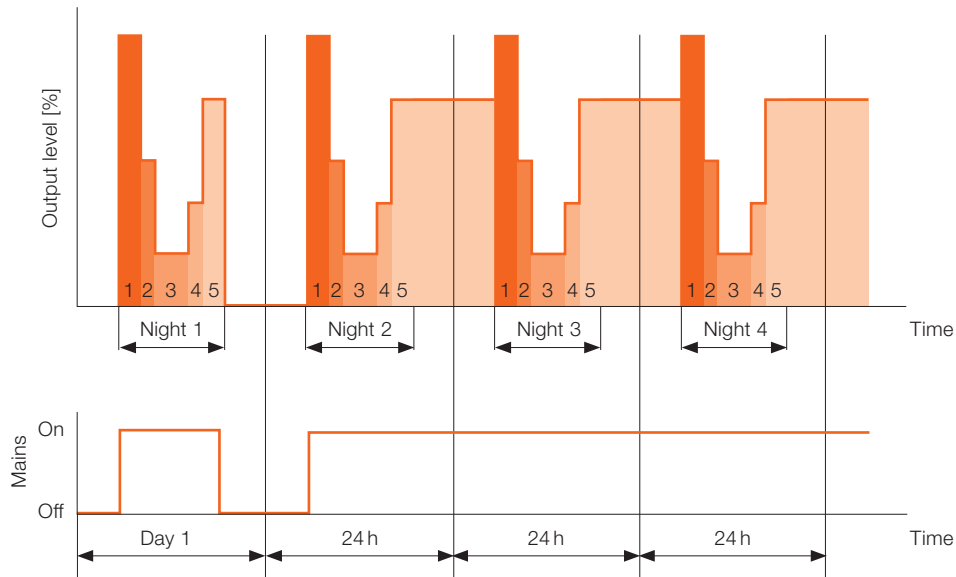
The AstroDIM profile is performed after the first valid on-time.



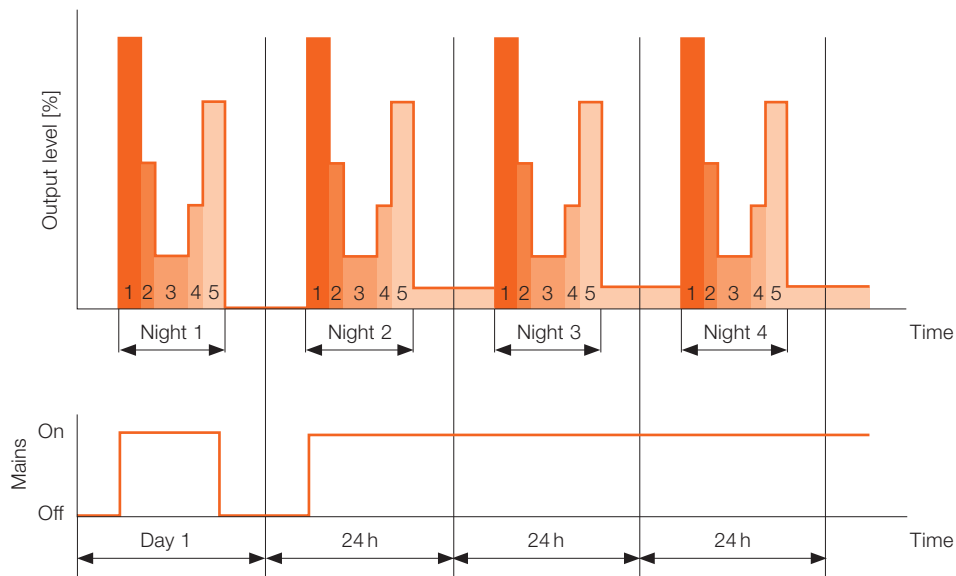
Voltage dips of less than 100 ms do not affect the on-time (case B).



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 DEXAL NFC G2 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.

4.2.4 Presence detection in AstroDIM mode

In the “AstroDIM PD (DALI)” dimming mode, it is possible to override the dimming profile of AstroDIM with the presence detection settings triggered by an external sensor (e.g. motion or presence sensor) that is connected to the SD(2) port. The sensor must support the electrical characteristics of the SD(2) port.

Figure 27: AstroDIM wiring with presence detector

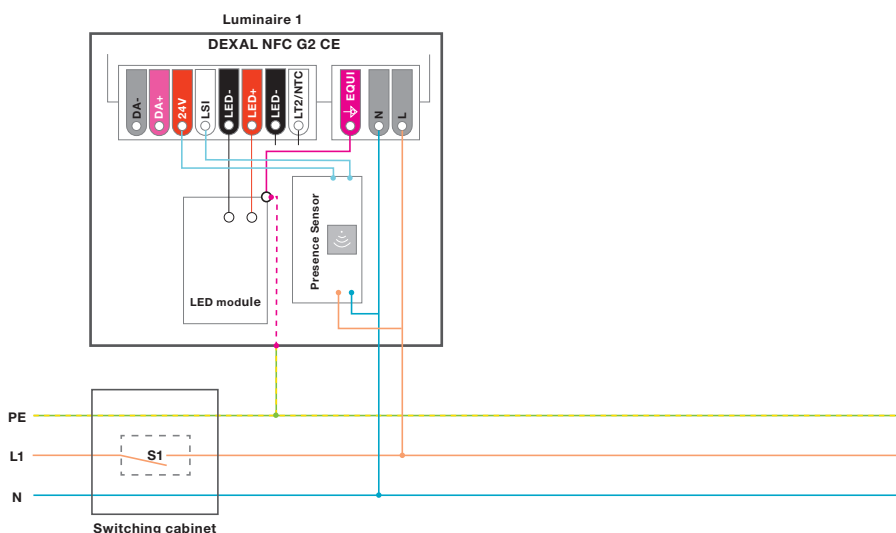
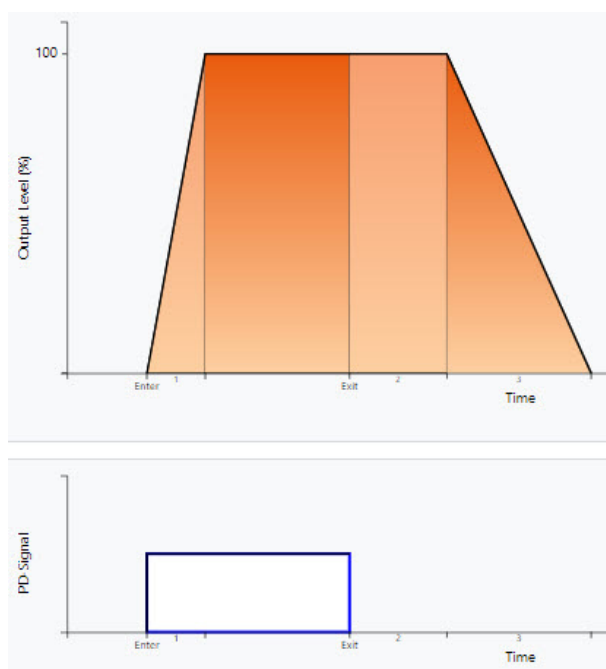


Figure 28: Presence detection in AstroDIM mode



An active signal at the SD(2) port (PD signal) starts the presence detection profile, which is defined by the following four parameters:

- **PD level:** Output level when the SD(2) port is active.
- **Start fade time:** Fade time after the SD(2) port has become active.
- **Hold time:** Hold time after the SD(2) port is not active anymore.
- **End fade time:** Fade time after the hold period.

These parameters can be set using the Tuner4TRONIC® software as shown in figure 29.

Figure 29: Presence detection configuration

Output Levels		PD Timing	
PD Level	100 %	Start Fade Time [1]	00:20 mm:ss
		Hold Time [2]	20:00 mm:ss
		End Fade Time [3]	05:00 mm:ss

4.2.5 AstroDIM LSI triggered

In the “AstroDIM LSI triggered” dimming mode, it is possible to activate the dimming profile of AstroDIM with an active signal at the LSI port. The trigger signal can come from a sensor, connected to the 24V and LSI port, or via the second input phase connected to the SD2 port of the OT DX SD Box (see figure 30). Compared to the usual AstroDIM mode, where the dimming profile starts by switching on the LED driver, in the “AstroDIM LSI triggered” mode, the LED driver can be switched on and set to a defined output level until the trigger signal starts the dimming profile (see figure 31).

To activate this feature, select operating mode AstroDIM + Presence Detection (DALI)” and, within the feature, choose submode “LSI triggered”.

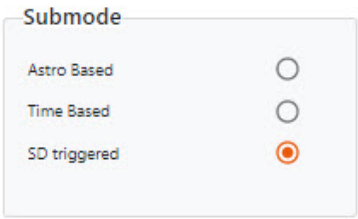


Figure 31 shows the dimming profile according to the reference schedule. The start of the dimming behavior is triggered by the LSI signal and can be changed in the reference schedule table.

Figure 30: AstroDIM wiring StepDIM-triggered

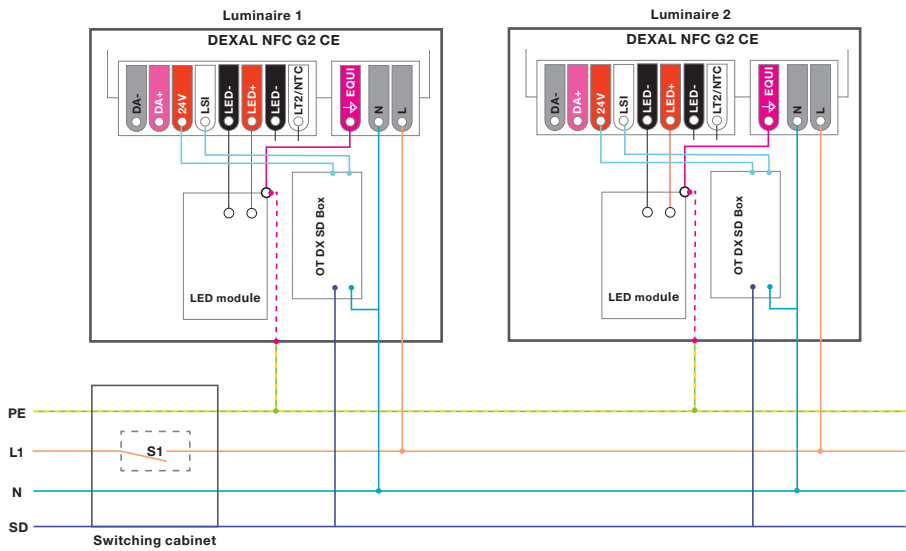


Figure 31: Dimming profile

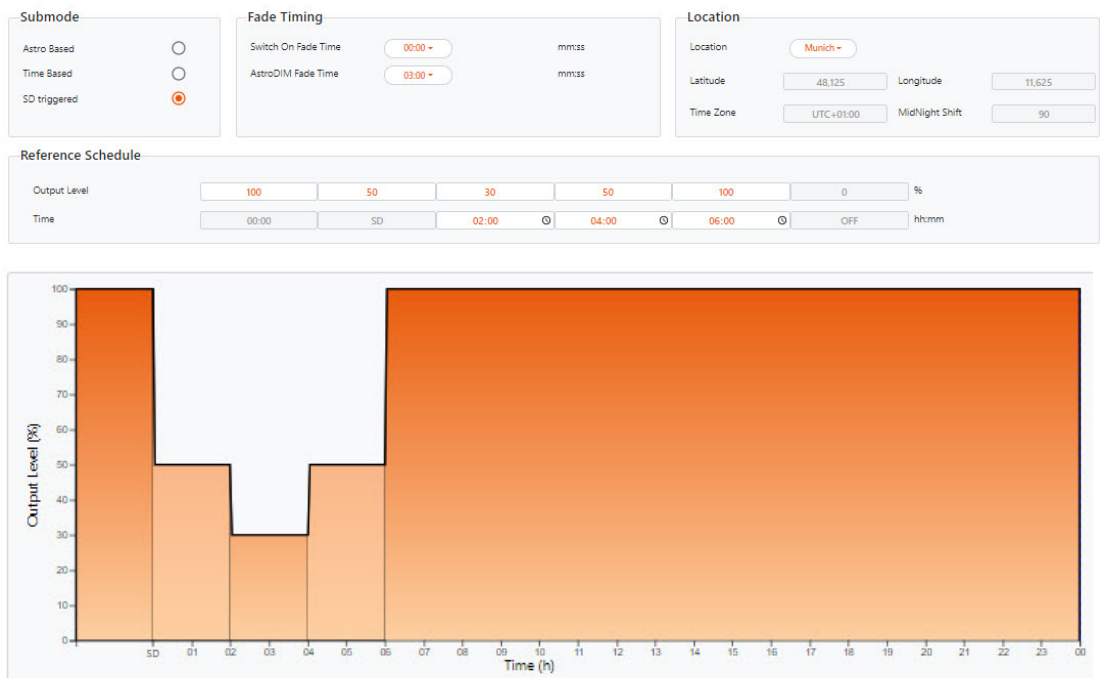


Table 7: Presence detection parameters

Parameter	Min.	Max.	Default
PD level	OFF, 10 %	100 %	100 %
Start fade time	0, 2 s	8 min	OFF
Hold time	0, 15 s	60 min	OFF
End fade time	0, 2 s	8 min	4 s

Warning:

If the output level falls below the minimum physical dimming level, the minimum physical dimming level is used by the LED driver. The software still displays the original value. If the output level falls below the minimum allowed dimming current, the value is visualized in red.

4.3 StepDIM feature

StepDIM is a one-step dimming mode using an additional control line or a switched phase (pilot line) to control one or more light points and set the light output to a preprogrammed light level. The SD level and the fade time can be set using the Tuner4TRONIC® software.

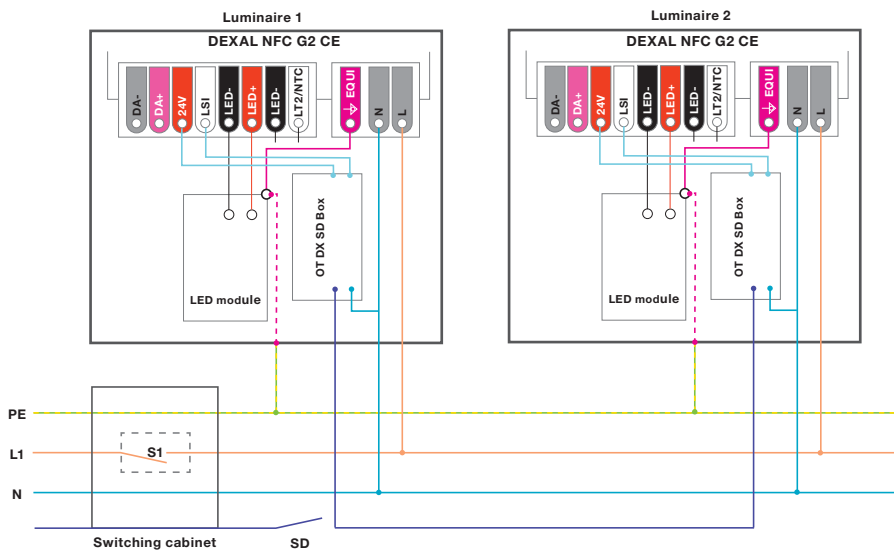
There are three different StepDIM operating modes:

- StepDIM (DALI)
- StepDIM inverse (DALI)
- StepDIM inverse, autodetect (DALI)

For StepDIM operation, the LED driver is connected to the mains and a control line or a switched phase. Figure 32 shows the connection for the two different supply voltage systems.

Figure 32: StepDIM/LSI wiring

For 220-240 V_{AC} supply system:



Please note:

The StepDIM functionality is supported by the OT DEXAL **only in combination with the accessory: OT DX SD Box** (see figure 32).

SD port SD(2) supports both single-phase and three-phase supply systems with nominal voltage of 220-240 VAC, 50/60 Hz.

The StepDIM port (SD(2)) on the OT DX SD Box of the DEXAL NFC G2 CE LED driver is triggered by an input current referenced to the neutral (N) and, if the signal is stable for more than 500 ms, the SD(2) port fulfills the following electrical characteristics:

Table 8: Electrical characteristics of the StepDIM port (SD(2))

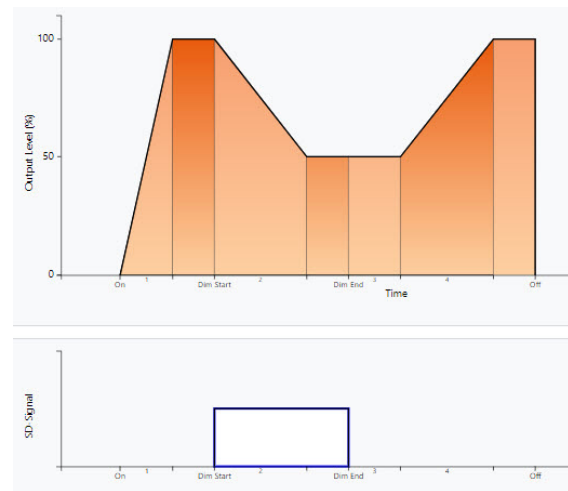
StepDIM signal	Input current SD(2) port	Input voltage SD(2) port (SD(2)-N)
Active (high)	$> 2.0 \text{ mA}_{\text{peak}}$	or $> 196 \text{ V}_{\text{AC}}$
Inactive (low)	$< 0.5 \text{ mA}_{\text{peak}}$	–

In some installations, leakage currents might occur between the different phases due to old or damaged cables, which have insufficient insulation or high-capacitance coupling. The unit can be triggered if the leakage currents exceed the inactive SD(2) input current. False triggering can be avoided by connecting the SD(2) input to the neutral or using a bypass capacitance/resistance between SD(2) and N.

4.3.1 StepDIM

If, in the “StepDIM (DALI)” mode, the switch (S2) is closed and the phase voltage Lx is applied to the SD(2) port (SD active), the output level is set to the SD(2) level. Leaving the SD(2) port floating (SD inactive), the output level is set to the nominal level.

Figure 33: StepDIM behavior



- **Nominal level:** Output level when the SD(2) port is not active.
- **SD level:** Output level when the SD(2) port is active.
- **Switch-on fade time:** Fade time after power-on.
- **Start fade time:** Fade time after the SD(2) port has become active.
- **Hold time:** Hold time after the SD(2) port is not active anymore.
- **End fade time:** Fade time after the hold period.

These parameters can be set using the Tuner4TRONIC® software as shown in figure 34.

Figure 34: StepDIM/LSI configuration

Table 9: StepDIM/LSI parameters

Parameter	Min.	Max.	Default
Nominal level	OFF, 10 %	100 %	100 %
SD level	OFF, 10 %	100 %	50 %
Switch-on fade time	0, 15 s	60 min	0 s
Start fade time	0, 2 s	8 min	3 min
Hold time	0, 15 s	60 min	OFF
End fade time	0, 2 s	8 min	3 min

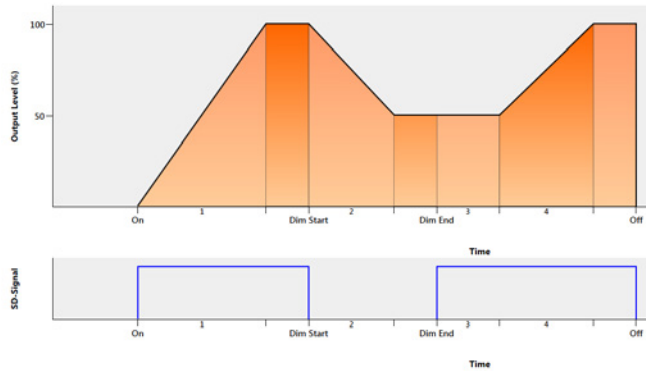
Warning:

If the output level falls below the minimum physical dimming level, the minimum physical dimming level is used by the LED driver. The software still displays the original value. If the output level falls below the minimum allowed dimming current, the value is visualized in red.

4.3.2 StepDIM/LSI inverse

For the “StepDIM inverse (DALI)” mode, the behavior is inverted. If the switch (S2) is opened and the SD(2) port is floating (SD inactive), the output level is set to the SD level. If a phase voltage is applied to the SD(2) port (SD active), the output level is set to the nominal level.

Figure 35: “StepDIM inverse” behavior

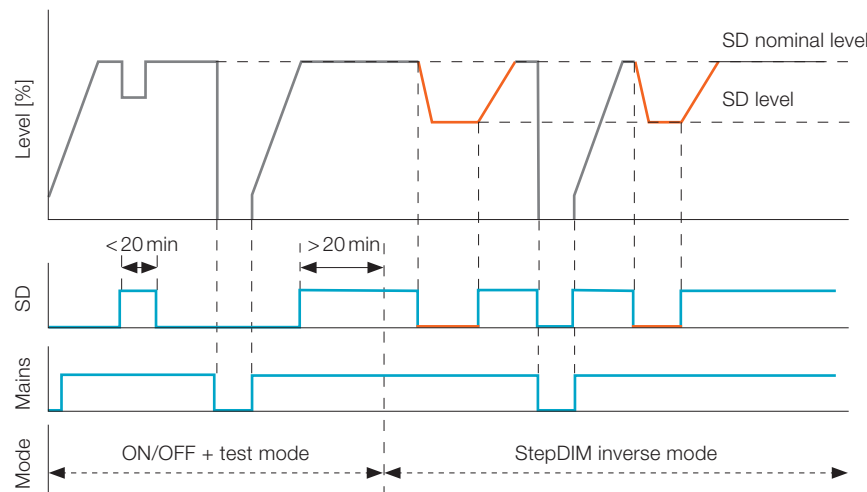


- **Nominal level:** Output level when the SD(2) port is active.
- **SD level:** Output level when the SD(2) port is not active.
- **Switch-on fade time:** Fade time after power-on.
- **Start fade time:** Fade time after the SD(2) port is not active anymore.
- **Hold time:** Hold time after the SD(2) port has become active.
- **End fade time:** Fade time after the hold period.

4.3.3 Autodetect, On/off-StepDIM/LSI inverse

In the “Autodetect, On/off-StepDIM/LSI inverse (DALI)” mode, the LED driver automatically detects if it is used in a simple on/off environment or in a StepDIM inverse installation. If a valid “high” signal (SD active) is detected at the SD(2) port for longer than 20 minutes, the LED driver automatically switches to the “StepDIM inverse” mode. In order to be able to test the correct wiring of the luminaire during the production phase, the first “high” signal at the SD terminal will reduce the light output level to the StepDIM dimming level without changing the driver to the “StepDIM inverse” operating mode.

Figure 36: “Autodetect, On/off-LSI inverse” behavior



This feature allows minimizing the number of different luminaire configurations and keeps the stock lean.

Example:

In some parts of StepDIM installations (e.g. roundabouts or pedestrian crossings), the light output of the installed fixtures should not be reduced during the night. With the “autodetect” feature, all LED drivers can be programmed with the same settings: While the on/off fixtures (SD(2) port not connected) still provide the full light output, the others perform the requested dimming profile.

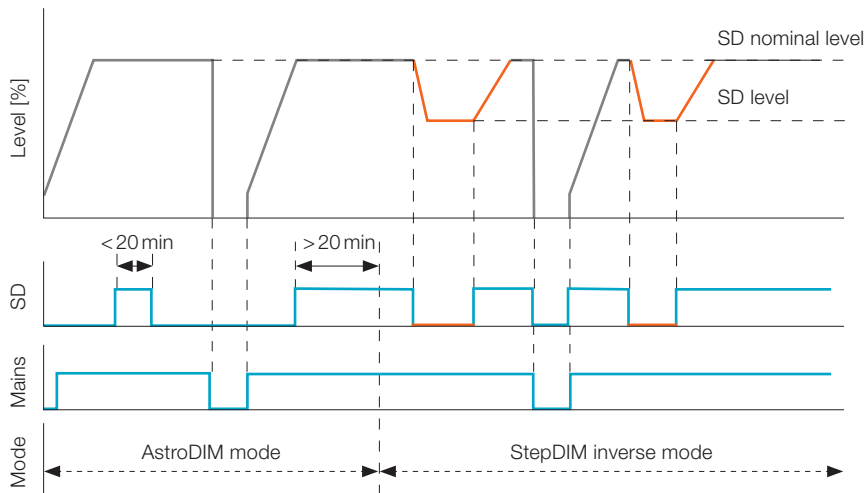
4.3.4 Autodetect, AstroDIM-StepDIM/LSI inverse

In the “Autodetect, AstroDIM-StepDIM inverse (DALI)” mode, the LED driver automatically detects if it is used in an AstroDIM environment or in a StepDIM inverse installation. If a valid “high” signal (SD active) is detected at the SD(2) port for longer than 20 minutes, the LED driver automatically switches to the “StepDIM inverse” mode.

Example:

The most common usage in outdoor applications is either StepDIM or AstroDIM. With the “Autodetect AstroDIM-StepDIM inverse” mode, all LED drivers can be programmed with the same settings: While the AstroDIM fixtures (SD(2) port not connected) still provide the individual AstroDIM profile, the others perform the requested dimming behavior via StepDIM.

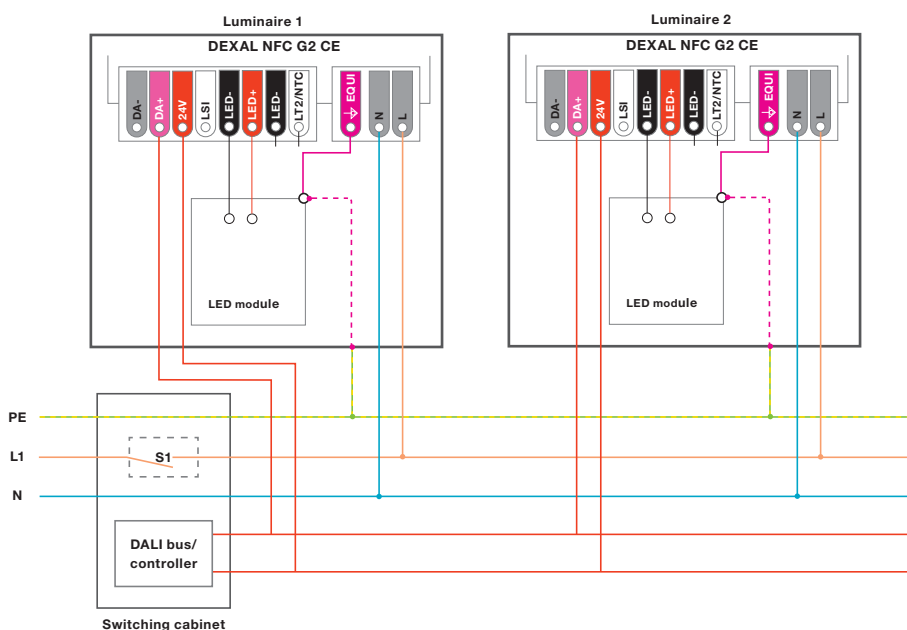
Figure 37: “Autodetect, AstroDIM-StepDIM/LSI inverse” behavior



4.4 DALI operating mode

For DALI operation, the OT DEXAL G2 LED driver is connected to the mains and to a DALI controller or DALI bus (see figure 38). The additional DALI wires can be installed alongside the mains wires. In order to operate in a DALI system with more than 4 LED drivers, the DEXAL PSU must be disabled via Tuner4TRONIC®.

Figure 38: DALI wiring



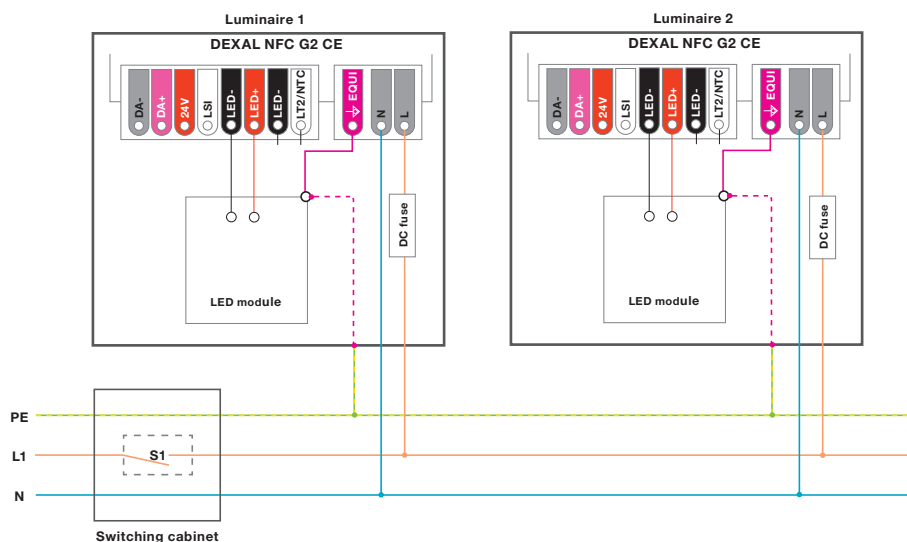
4.5 DC operation feature

OT DEXAL G2 LED drivers are prepared for a DC grid operation. As the built-in OT DEXAL G2 LED driver fuse is not rated for DC operation, an external rated DC fuse has to be installed in front of the driver. The output current in DC operation can be set via the Tuner4TRONIC® software.

Most Inventronics LED drivers are compatible with emergency components from leading emergency lighting companies.

For detailed information on DC operation of our drivers and certificates of compatible components, please consider our “Application notes for DC operation”, which can be found in our OEM Download Center via the following link:
<https://www.inventronics-light.com/application-guides>

Figure 39: DC wiring



5 Benefits in the application

The DEXAL LED drivers are designed to improve reliability, longevity, and ease of use in various lighting applications. One of the key improvements is the higher surge protection on the DALI line, which enhances resilience against voltage spikes and electrical disturbances, ensuring stable and reliable operation even in demanding environments as well as during in-field programming via DALI lines.

Additionally, the driver now includes extra integrated ESD protection, which safeguards sensitive components from electrostatic discharge, reducing the risk of damage during application and exposure to environmental factors.

Another important enhancement is the reduction of inrush current, which minimizes initial current spikes when the driver is switched on. This improvement reduces stress on circuit breakers and electrical installations, allowing multiple drivers to operate efficiently within the same circuit.

Furthermore, the introduction of a new NFC tag enables quick and contactless programming via NFC-enabled devices from the side and from the top surface, thus streamlining installation, commissioning and maintenance processes.

These advancements make the LED driver ideal for applications where high reliability is essential, such as street lighting and industrial lighting systems that frequently experience electrical disturbances.



Additional integrated ESD protection

In case of class II installations, additionally integrated ESD protections avoid potential damages caused by ESD.

In many class II installations, especially in existing infrastructures, or when the poles are not conductive (for instance wooden or concrete poles), the luminaire heads can get slowly electrically charged and then suddenly, a high amount of electrons flows through uncontrolled paths, with high risks of damaging electronics components (in the LED driver or LED module).

The additionally integrated ESD protections in the DEXAL drivers avoid this effect, without the usage of any additional extra device in the luminaire, which normally are used in such cases, ensuring long durability without additional costs for the luminaire manufacturer and end customer.



Integrated inrush current limiter

DEXAL G2 LED drivers offer a very limited inrush current thanks to the integrated inrush current limiter. This allows a high number of drivers per circuit breaker, thus reducing the installation costs.



Surge protection on DALI lines

High surge protection against potential damages during reprogramming via DALI: This enables long DALI cables in the pole for programming or in case of connection to a DALI line.



The new NFC tag

More powerful and can be programmed from the side of the driver and from the top surface.

5.1 Additional integrated ESD protection



Integrated ESD protections minimize risks of ESD damages during lifetime

With Class I luminaires, which have an earthed housing, and with Class II luminaires that are installed on earthed metal poles, electrical static charging cannot occur.

In many other cases, **such as plastic, wood/concrete, unearthed metal poles, wall mounts and rope systems with plastic supports**, **electrical static charging can occur**.

Static charging can generate voltages of several kV, with potential damaging effects on electronic ballasts and LED modules. LED modules in outdoor luminaires are often designed with MC-PCB with a typical insulation thickness of around 70 µm between the LED and the metal core. The static charge is discharged at the weakest point, which is often the LED module, but LED drivers might be damaged as well:

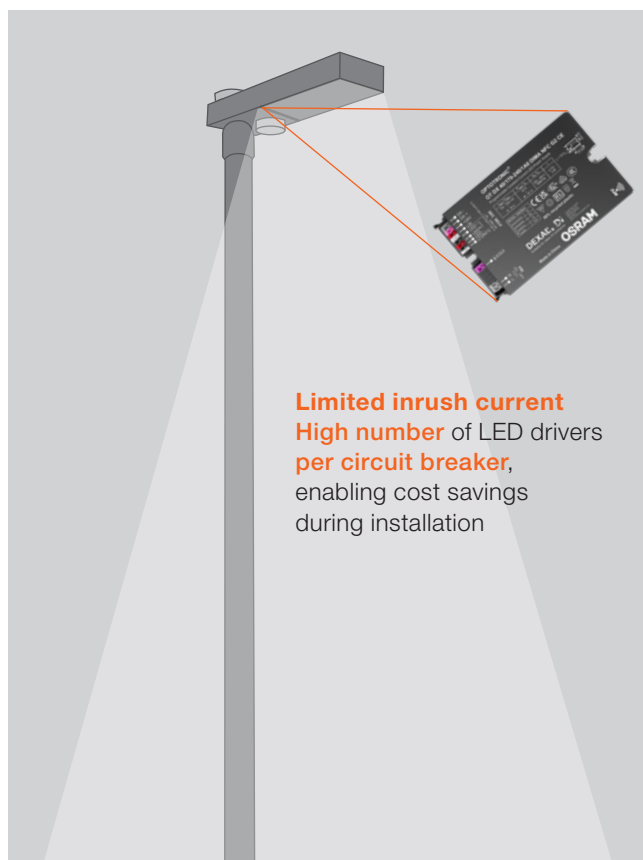
- Partial or complete failure of the LED modules
- Faster aging of the LED modules and thus reduced operating time
- Failure of the LED driver
- Control interface failure

OPTOTRONIC® DEXAL NFC G2 Outdoor LED drivers offer an **integrated ESD protection** to **prevent damages due to ESD** and **very high replacement costs**, independently from the installation conditions. It also enables **cost savings during the luminaire production and installation** because no additional components are needed. Moreover, it helps **to prevent issues during operation time**.

All interfaces are protected against ESD:

- Input side of driver
- Output side of the driver and LED module
- Zhaga node/DALI interface

5.2 Inrush current limiting



OPTOTRONIC® DEXAL NFC G2 Outdoor LED drivers provide lower inrush current values and therefore a higher number of drivers per MCB, reducing the overall cost of installations and increasing advantages in project specifications.

Inrush and indicative values of number of drivers per circuit breakers

Product	Inrush current	T	"Indicative" number of drivers per B16
OT DX 24 NFC G2	27 A	217 µs	30
OT DX 40 NFC G2	27 A	217 µs	30
OT DX 75 NFC G2	3.3 A	3.00 ms	33
OT DX 110 NFC G2	3.3 A	3.00 ms	29
OT DX 165 NFC G2	3.3 A	3.00 ms	20
OT DX 200 NFC G2	3.3 A	3.15 ms	10

Inrush limiter

The inrush limiter helps to reduce installation costs through an increased number of LED drivers per circuit breaker.

Table 10: Max. number of LED drivers permitted on MCBs in B and C characteristic

Product family	I max. [ApK]	Th	Maximum permissible number of LED drivers on MCBs, type B or C					
			Type B10	Type C10	Type B16	Type C16	Type B25	Type C25
OT DX 24/170-240/1A0 DIMA NFC G2 CE	< 24	217 µs	18	30	30	50	46	77
OT DX 40/170-240/1A0 DIMA NFC G2 CE	< 27	217 µs	18	31	30	50	46	78
OT DX 75/170-240/1A0 DIMA NFC G2 CE	< 3.3	3 ms	21	34	33	55	52	85
OT DX 110/170-240/1A0 DIMA NFC G2 CE	< 3.3	3 ms	18	30	29	48	45	75
OT DX 165/170-240/1A0 DIMA NFC G2 CE	< 3.3	3 ms	12	20	20	33	30	51
OT DX 200/170-240/1A0 DIMA NFC G2 CE	< 3.3	3.15 ms	6	10	10	16	16	25

Circuit impedance: The specified load applies with reference to a line impedance of 800 mΩ. (This corresponds to a 15-meter-long feed cable with a diameter of 1.5 mm² from the distribution board to the first luminaire and an additional cable length of 20 meters towards the center of the consumer circuit. At a line impedance of 400 mΩ, the permissible values are reduced by 10 %. At 200 mΩ they are reduced by 20 %.)

5.3 Surge protection on DALI

High surge protection

Thanks to high surge protection in the DALI-2 bus, the OUTDOOR DEXAL G2 enables installations with long DALI cables (up to 15 m) for programming of the LED driver via DALI from the bottom of the pole.

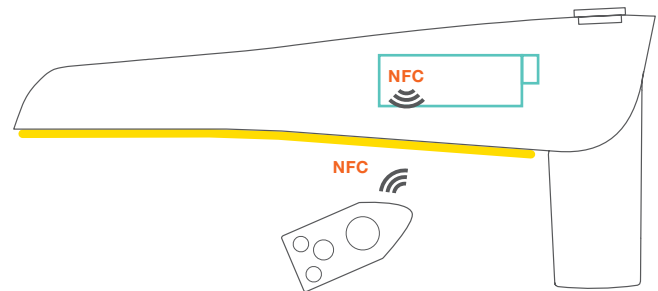
Additionally, the OUTDOOR DEXAL G2 can be used in DALI installations, if the DALI-2 bus is disabled.

5.4 Improved NFC technology

New NFC tag

The new NFC tag is more powerful and can be programmed from the side of the driver and from the top surface. This has two advantages:

- Easy access to the NFC surface when opening the luminaire (in many luminaires, the space between the driver side and the luminaire is reduced).
- If the driver is placed with its top surface just behind a glass or a plastic cover, then the programming via NFC can be done without opening the luminaire.



6 Electrical design-in

The integrated DALI bus power supply of a DEXAL LED driver provides a guaranteed supply current of at least 53 mA. To ensure a reliable communication, the input peak current of the control peripheral (DEXAL sensor or RF module) shall be limited to 46 mA whenever the transmitter (DALI interface) of the control peripheral is not short-circuiting the DEXAL bus for communication purposes. If further DALI devices are connected to the bus, their input current also has to be considered. During DEXAL bus communication, the available average current may drop to 50 % (this means 23 mA for a single DEXAL LED driver). The total maximum DEXAL bus supply current shall not exceed 250 mA (according to IEC62383-101). The total current is calculated by summing up all maximum DEXAL bus currents provided by all connected devices. Up to two (Gen. 1) or four (Gen. 2) of these drivers with activated DEXAL bus power supply unit can be connected. Please check the product datasheets of the connected components in advance, regarding how many DEXAL drivers are supported and regarding the declared input current consumption (peak/average). Any connection of DEXAL LED drivers of different generations is not allowed.

Disabling the DEXAL bus power supply for applications with more than one DEXAL driver is not recommended, since this could cause failures in case of a replacement of drivers supply. In case a standard DALI LED driver (without integrated bus power supply) or a DEXAL LED driver with disabled bus power supply is connected to a DEXAL bus, a peak current demand of 2 mA and an average current demand of 1 mA has to be considered.

Dexal Power Supply Unit

Dexal Power Supply Unit

☒ Enabled

Please note:

Depending on your application, the DEXAL PSU can be switched on (default setting) or off using T4T.

If you operate several operating devices in a luminaire/ installation on the DALI bus, make sure that the permissible DALI bus current is not exceeded, as this can lead to functional problems and possibly damage to the bus devices.

The polarity of the DALI/DEXAL bus terminals shall be considered as indicated on the equipment (DA+/DA-).

Concerning the possible length of the cable for the DEXAL bus, please see the datasheets of the DEXAL drivers.

To set up a DEXAL system, all devices connected to the DEXAL bus need to be considered.

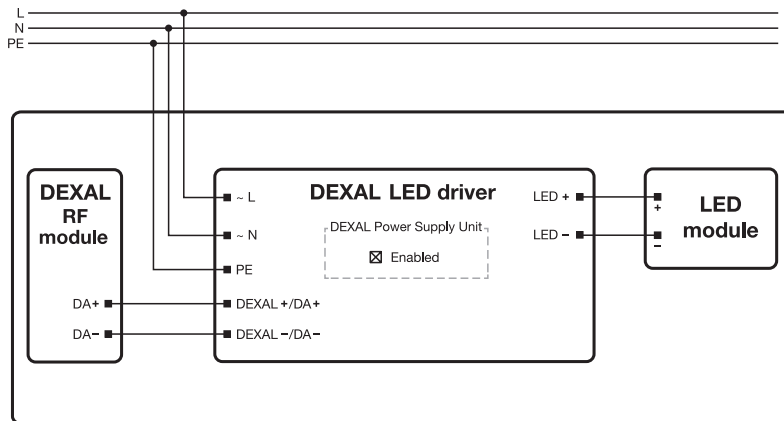
You can find detailed information about DEXAL bus powering in the set-up examples below.

DEXAL (D4i) bus requirements

Maximum allowed DEXAL bus supply current:	250 mA
Maximum input peak current of a control peripheral in non-communication mode:	46 mA
Average input current of a control peripheral during communication:	23 mA

DEXAL (D4i) LED driver specifications from the D4i standard

Minimum guaranteed DEXAL bus supply current of a single driver:	53 mA (Generation 2)
Maximum DEXAL bus supply current of a single driver:	62 mA (Generation 2)

Set-up example 1: One DEXAL (D4i) LED driver and one DEXAL (D4i) RF module

In order to grant a good communication and functionality on the D4i bus, the following must be considered:

- (1) D4i bus current generated by the LED driver must be lower than 250 mA.
- (2) Peak peripheral input current must be lower than 46 mA.
- (3) Average peripheral input current must be less than 23 mA.

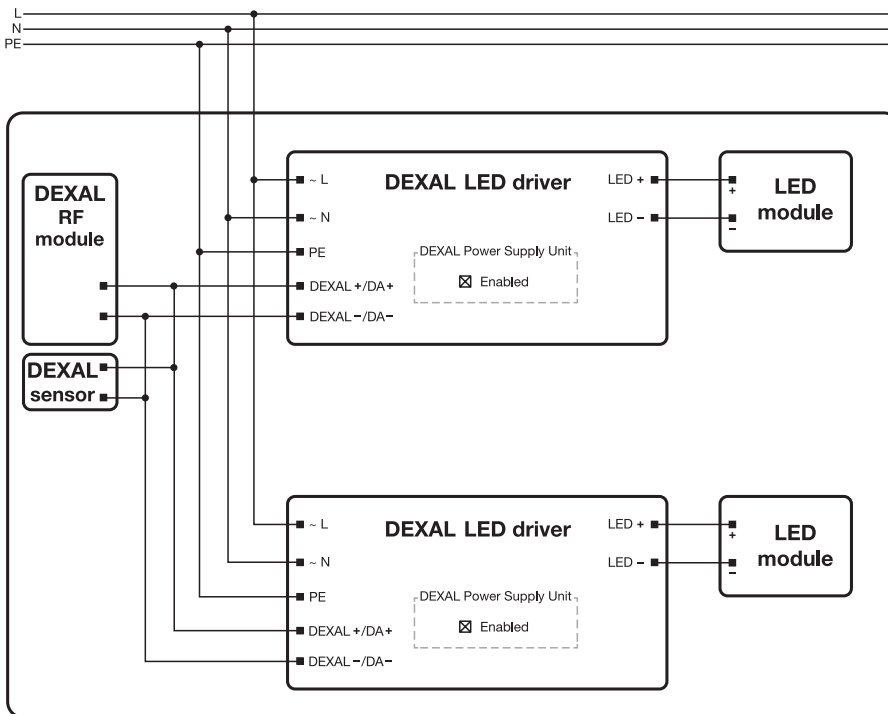
Practical example with one active DEXAL (D4i) bus power supply and one D4i RF module:

RF module: $I_{\text{peak}} = 45 \text{ mA}$
 $I_{\text{avg}} = 20 \text{ mA}$

- (1) 1 x D4i LED driver current is 62 mA which is less than the limit of 250 mA.
- (2) Peak RF module input current is 45 mA which is less than the limit of 46 mA.
- (3) Average RF module input current is 20 mA which is less than the limit of 23 mA.

All the criteria are fulfilled. The configuration is permitted.

Result: Passed

Set-up example 2: Two DEXAL (D4i) LED drivers, one DEXAL (D4i) RF module and one DEXAL (D4i) sensor

In order to grant a good communication and functionality on the D4i bus, the following must be considered:

- (1) D4i bus current generated by the LED driver must be lower than 250 mA.
- (2) Peak peripheral input current must be lower than 46 mA for each driver with DEXAL-D4i-enabled bus.
- (3) Average peripheral input current must be less than 23 mA for each driver with DEXAL-D4i-enabled bus.

Practical example 2A: One active DEXAL (D4i) bus power supply, one deactivated DEXAL (D4i) power supply and one D4i RF module

D4i RF module:	$I_{\text{peak}} = 45 \text{ mA}$
	$I_{\text{avg}} = 20 \text{ mA}$
D4i sensor:	$I_{\text{peak}} = 7 \text{ mA}$
	$I_{\text{avg}} = 5 \text{ mA}$
LED driver (disabled bus power supply):	$I_{\text{peak}} = 2 \text{ mA}$
	$I_{\text{avg}} = 1 \text{ mA}$

- (1) 1 x D4i LED driver current is 62 mA, which is less than the limit of 250 mA.
- (2) Peak RF module input current is $45 \text{ mA} + 7 \text{ mA} + 2 \text{ mA} = 54 \text{ mA}$, which exceeds the limit of 46 mA.

Not all the criteria are fulfilled.
The configuration is **not** permitted.

Result: Failed

Practical example 2B: Two active DEXAL (D4i) bus power supplies, one D4i RF module

D4i RF module:	$I_{\text{peak}} = 45 \text{ mA}$
	$I_{\text{avg}} = 20 \text{ mA}$
D4i sensor:	$I_{\text{peak}} = 7 \text{ mA}$
	$I_{\text{avg}} = 5 \text{ mA}$
LED driver (enabled bus, therefore no longer in the calculation):	$I_{\text{peak}} = 0 \text{ mA}$
	$I_{\text{avg}} = 0 \text{ mA}$

- (1) 2 x D4i LED driver current is $2 \times 62 \text{ mA} = 124 \text{ mA}$, which is less than the limit of 250 mA.
- (2) Peak RF module input current is $45 \text{ mA} + 7 \text{ mA} = 52 \text{ mA}$, which is lower than the limit of $2 \times 46 \text{ mA} = 92 \text{ mA}$.
- (3) Average peripheral input current is $20 \text{ mA} + 5 \text{ mA} = 25 \text{ mA}$, which is lower than $2 \times 23 \text{ mA} = 46 \text{ mA}$.

All the criteria are fulfilled. The configuration is permitted.













Result: Passed

6.1 Additional information

6.1.1 Insulation

DEXAL NFC G2 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 11: Insulation and U_{out}

	OT DX 24/170- 240/0A7 DIMA NFC G2 CE	OT DX 40/170- 240/1A0 DIMA NFC G2 CE	OT DX 75/170- 240/1A0 DIMA NFC G2 CE	OT DX 110/170- 240/1A0 DIMA NFC G2 CE	OT DX 165/170- 240/1A0 DIMA NFC G2 CE	OT DX 200/170- 240/1A0 DIMA NFC G2 CE
Insulation (primary/secondary)						
	SELV	SELV	Double	Double	Double	Double
Insulation of casing						
	Double	Double	Double	Double	Double	Double
V_{out}	12-48 V	15-65 V	35-150 V	65-230 V	90-260 V	140-300 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.

6.1.2 Cable preparation

DEXAL NFC G2 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 40: Cable preparation, primary side

24 W, 40 W, 75 W, 110 W, 165 W, 200 W

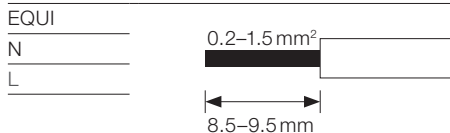
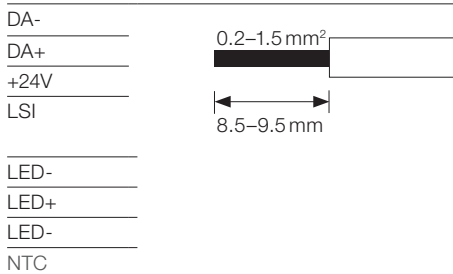


Figure 41: Cable preparation, secondary side and equipotential pin

24 W, 40 W, 75 W, 110 W, 165 W, 200 W



6.1.3 Incorrect wiring on the output side

DEXAL NFC G2 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.

6.1.4 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, I2 t > 160 A2 sec).

6.1.5 Surge protection

DEXAL NFC G2 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 42 and 43). The EQUI pin meets the insulation requirements for protection class I and II luminaires.

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

Table 12: DEXAL NFC G2 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
L/N – PE	10 kV at 12 Ω, common mode	IEC/EN 61547	IEC 61000-4-5
(DA+/DA-) – PE	6 kV at 12 Ω, common mode	IEC/EN 61547	IEC 61000-4-5
L/N – (DA+/DA-)	8 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 42: Protection class I luminaire

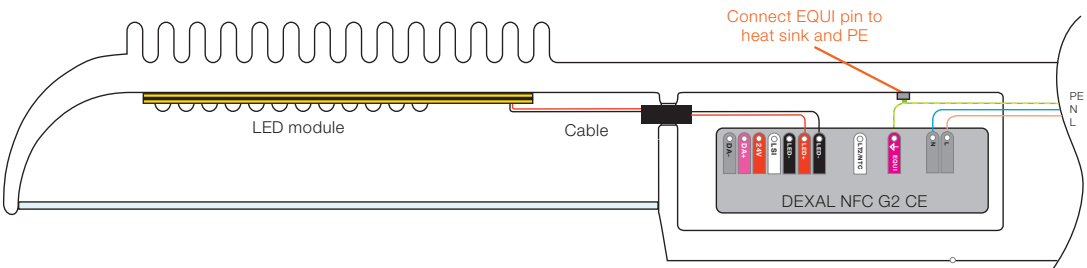
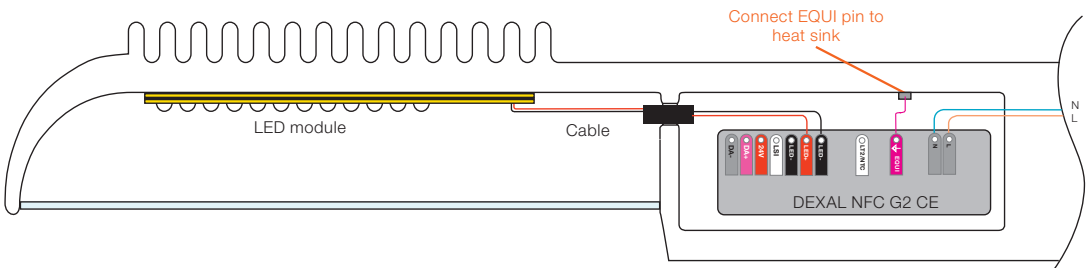


Figure 43: Protection class II luminaire



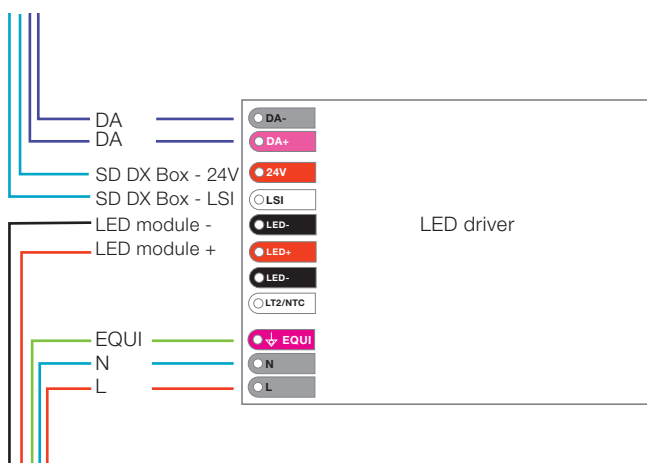
6.1.6 Recommended EMI wiring setup

In order to fulfill 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 44.

Figure 44: Recommended EMI wiring setup



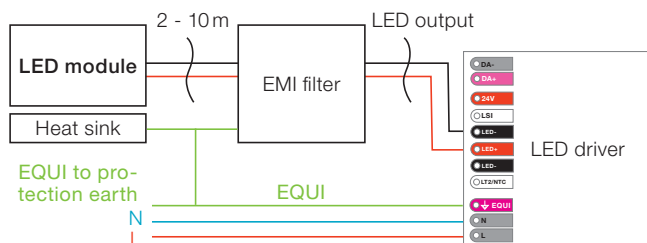
6.1.7 Remote LED driver installation for Class I configuration

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 45, can be used in order to comply with the EMI requirements.

Figure 45: Connection for Class 1 configuration

Class 1



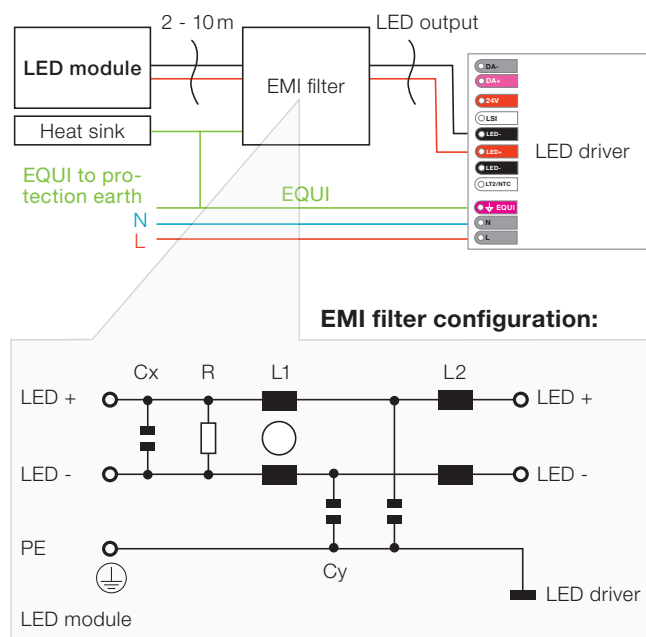
6.1.8 Remote LED driver installation for Class II configuration

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 46, can be used in order to comply with the EMI requirements.

Figure 46: 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

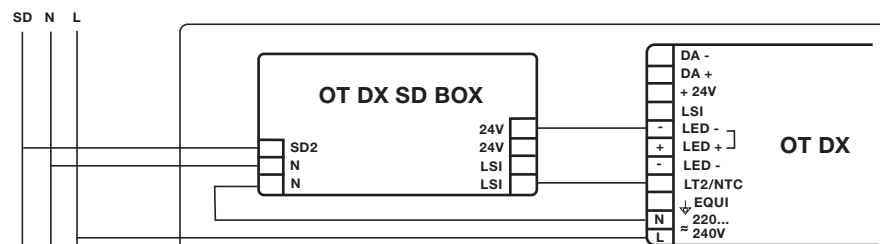
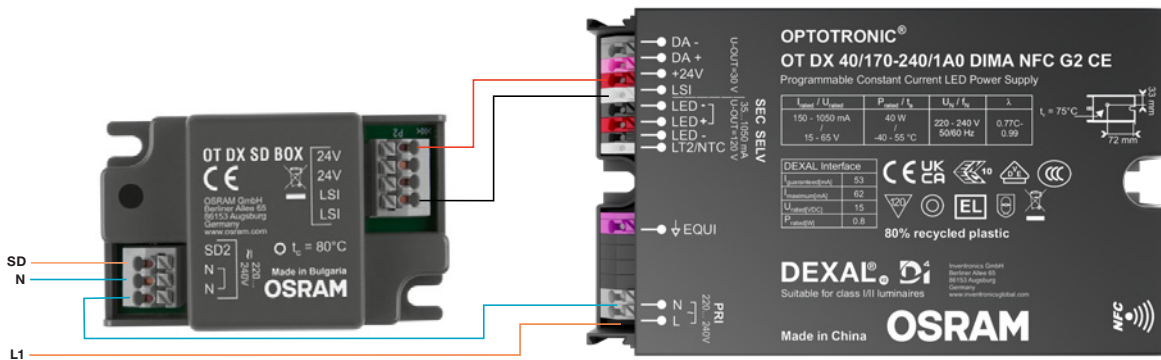
6.1.9 DEXAL StepDIM Box – LSI

- Adding StepDIM functionality to the DEXAL LED driver family
- Integrated surge protection of 6 kV or 10 kV
- Additional integrated LSI functions for StepDIM or presence sensors
- Housing dimensions: 70.5 x 42.5 x 33 mm



LSI:

The only D4i LED driver with additional interface. It allows installation with simple sensors for **presence detection** or accessories inside the luminaire, enabling additional features, for instance the combination with the **OT DX SD Box** to easily implement the **StepDIM** function.



7 Programming

DEXAL NFC G2 CE LED drivers can be programmed using Tuner4TRONIC® either via DALI or NFC. Please find details on the Tuner4TRONIC® tool chain, user manuals, application guides, tutorials and download links on <https://www.inventronicsglobal.com/t4t>

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).

7.1 Programming with DALI magic

DEXAL NFC G2 CE LED drivers need to be powered during programming with DALI magic.

Figure 47: LED driver programming with DALI magic

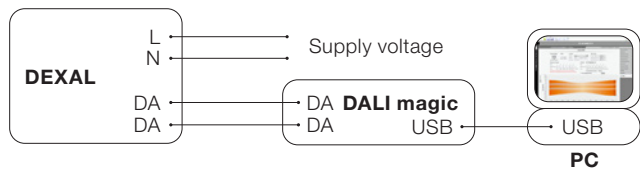


Table 13: Supply voltage during programming

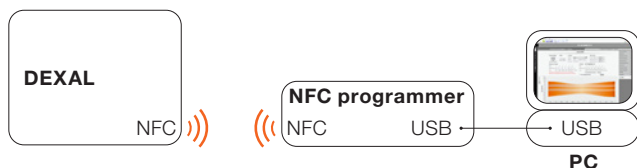
Supply voltage	Power	Ambient temperature
220–240 V _{AC}	All types	Acc. to LED driver datasheet

7.2 Programming with NFC USB readers

DEXAL NFC G2 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:

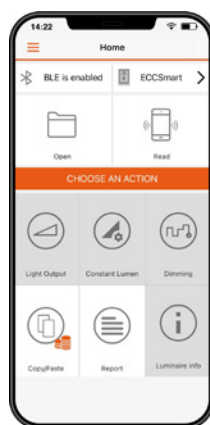
The NFC antenna of the DEXAL NFC G2 CE has been optimized for an easy accessibility from the **top** surface of the LED driver. This enables an optimal access to NFC tags also in very narrow luminaires, in which very often not enough space is left between the luminaire and the LED driver's side surface. 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 48: LED driver programming with NFC**Note:**

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

7.3 Programming with T4T-Field App

DEXAL NFC G2 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.



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

Warning:

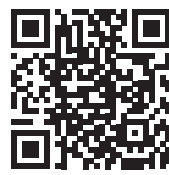
When LED drivers are permanently operated below the minimum nominal current, it is necessary to ensure compliance with relevant IEC standards (for example mains current distortion and power factor). Please consider that the certificates are only valid within the nominal output current range.

Disclaimer

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