



## **Technical application guide** Multi-Dim LED drivers

**VS Multi-Dim LED drivers -  
VS Tuner4TRONIC®**

186875, 186876, 186877, 186878

# VS MULTI-DIM LED DRIVERS – VS TUNER4TRONIC®



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## INTRODUCTION

### VS LED Drivers with Multi-Dim functionality for outdoor and industrial applications

**1.1** Long lifetime, low maintenance costs and high efficiency are very important for outdoor and industrial applications. Vossloh-Schwabe LED drivers for outdoor applications meet these requirements and unlock the full potential of LEDbased light sources.

Thanks to the high flexibility of the programmable Vossloh-Schwabe LED drivers, LED luminaire systems can be optimally adapted to the on-site conditions and their cost can be optimized. With the four integrated dimming functions (Multi-Dim), significant energy savings and a reduction of greenhouse gas emissions can be achieved.

The NFC interface implemented in the Multi-Dim 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 and saves time compared to a programming process using the DALI-2 interface. Due to the large operating window (voltage/current) of these LED drivers, both Vossloh-Schwabe 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 such as "Luminaire Info", "Smart Grid" and "Monitoring Data" in non-proprietary systems. With the LEDset2 interface, Vossloh-Schwabe has 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 Multi-Dim functionality also set a new standard against common mode surges of up to 10 kV for class I and II luminaires.



K3.1 - 186785, 186786



K72 - 186787



K74 - 186878

## 1.2 Multi-Dim product family

The Multi-Dim product family consists of four different output power classes of up to 110 W. All four types have the same Multi-Dim dimming capabilities and the new multi-vendor LEDset2 interface. They can be programmed via the Tuner4TRONIC® software. The following overview shows the main features of these LED drivers.

Ref. No.	186875	186876	186877	186878
<b>General</b>				
Maximum power	22 W	40 W	75 W	110 W
Input voltage L/N	220–240 V	220–240 V	220–240 V	220–240 V
Output current range	70–1050 mA	70–1050 mA	70–1050 mA	70–1050 mA
Surge (dif/com)	6/10 kV	6/10 kV	6/10 kV	6/10 kV
Insulation (primary/secondary)	SELV	SELV	SELV	double
Insulation of casing	double	double	double	double
Stand-by power	< 0.5 W	< 0.5 W	< 0.5 W	< 0.5 W
<b>Dimming features</b>				
DALI	yes	yes	yes	yes
0–10 V	not supported	not supported	not supported	not supported
Line Switch (SD[2])	yes	yes	yes	yes
Line Switch inverse (SD[2])	yes	yes	yes	yes
MidNight function (astro-based)	yes	yes	yes	yes
MidNight function (time-based)	yes	yes	yes	yes
Mains Voltage Dimming	yes	yes	yes	yes
Presence detection	yes	yes	yes	yes
<b>Other features</b>				
Constant lumen function	yes	yes	yes	yes
Fit for SMART GRID	yes	yes	yes	yes
LEDset2	yes	yes	yes	yes
External NTC	yes	yes	yes	yes
Configuration lock	yes	yes	yes	yes
Tuning factor	yes	yes	yes	yes
Driver guard T, P	yes	yes	yes	yes
<b>Programming software</b>				
Tuner4TRONIC®	yes	yes	yes	yes

### 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.

### Line Switch and Line Switch inverse

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

### MidNight function and 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.

### Mains voltage dimming

Dimming via mains voltage amplitude: This feature is often used in combination with magnetic ballasts in outdoor applications. The dimming behaviour can be set via 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.

### Monitoring data

LED drivers with this feature offer additional operation and status information that exceeds what is currently offered by the DALI standard (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.

### LEDset (generation 2)

The new generation LEDset2 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.

### 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 Multi-Dim LED 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 LEDset2, 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, you can adjust the performance and temperature derating of the LED driver so that they not only match the luminaire, but also lead to a higher reliability of the luminaire.

### 1.3 Nomenclature

The product name of each Vossloh-Schwabe PrimeLine NFC/LEDset S-MD LED driver is defined as shown below.



Figure 1: ECXd 1050...

#### PrimeLine NFC/LEDset S-MD ECXd 1050.352

- PrimeLine: Lifetime up to 100.000
- NFC/LEDset: Current setting via NFC/LEDset
- S: Streetlight
- MD: Multi-Dim (DALI, Line Switch, MidNight function, Mains Voltage Dimming)

### 1.4 Operating windows

The Multi-Dim driver family is split up into four different power classes to provide the best suitable power supply for different applications. The nominal output current of 200–1050 mA is available in the following power packages.

Table 2: Maximum allowed output power

Ref. No.	P <sub>max.</sub>	t <sub>a</sub>	V <sub>IN</sub> (nominal)
186875	22 W	-40 to +60 °C	220–240 V AC
186876	40 W	-40 to +60 °C	220–240 V AC
186877	75 W*	-40 to +55 °C	220–240 V AC
186878	110 W*	-40 to +55 °C	220–240 V AC

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

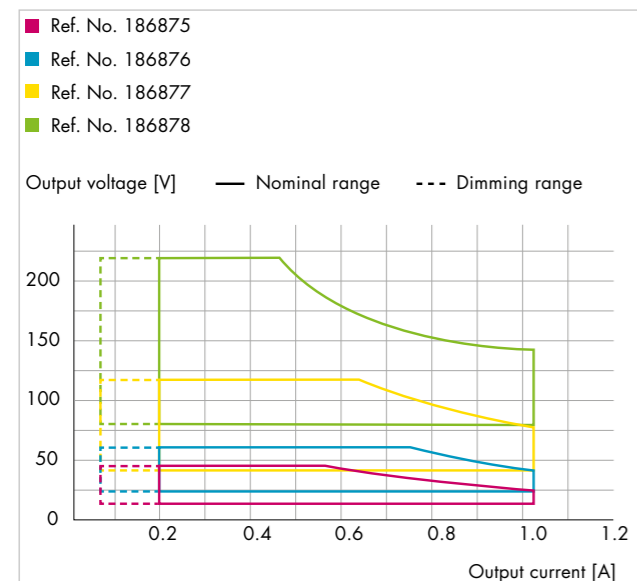


Figure 2: Overview of operating windows

Table 3: Operating range

Ref. No.	Dimming current min (mA)	Nominal current		Output voltage	
		min. mA	max. mA	min. V	max. V
186875	70	200	1050	10	38
186876	70	200	1050	18	56
186877	70	200	1050	35	115
186878	70	200	1050	80	220

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 Supported LEDs

Table 4 shows how many LEDs can be driven with one LED driver. The values are based on the following assumptions: V<sub>f LED</sub> = 3.1 V at 1050 mA and V<sub>f LED</sub> = 2.5 V at 70 mA

Table 4: supported number of LEDs

Ref. No.	Min. number of LEDs	Max. number of LEDs
186875	4	12
186876	7	18
186877	14	37
186878	32	70



#### Warning:

The real number of supported LEDs needs to be checked according to the minimum and maximum forward voltage in the worst case conditions. They have to match the minimum and maximum output voltage of the used LED drivers.

The forward voltage of the connected LED module in dimming condition is lower than the forward voltage in nominal condition but still has to be above the minimum output voltage of the LED driver.

### 1.4.2 Current foldback

The intelligent Multi-Dim 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 power [1] or voltage [2] is not exceeded anymore. If no stable operating point is achieved, the unit switches on and off continuously or switches off completely.

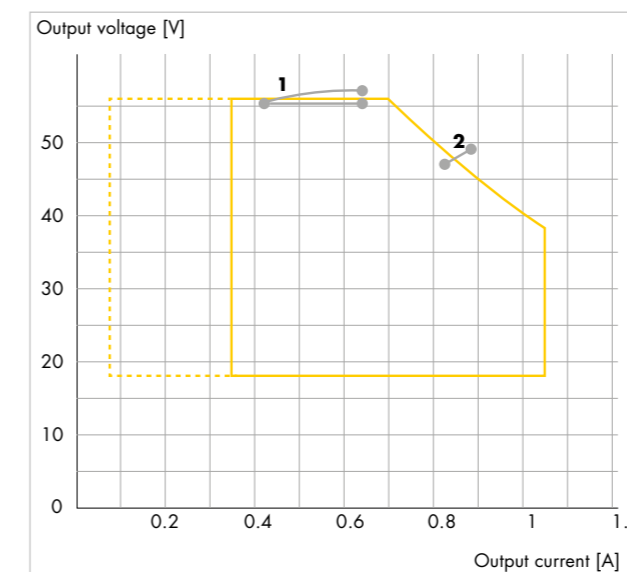


Figure 3: Current foldback

### 1.4.3 Low input voltage protection

In case of a very low input voltage, the driver protects itself against being damaged by high input currents. The behaviour of the driver can be seen in figures 4 and 5.

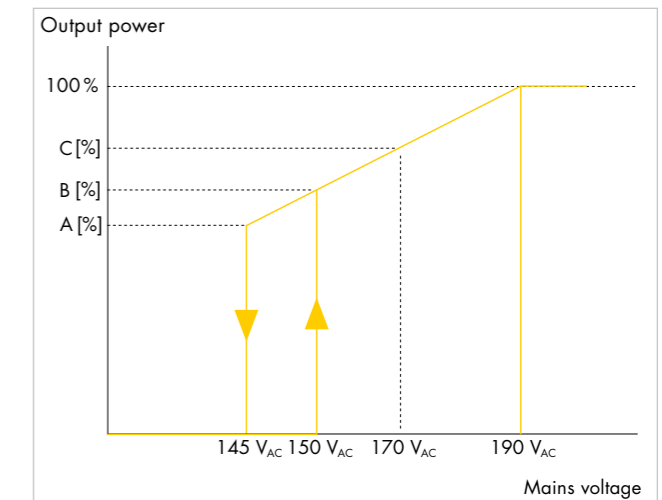


Figure 4: Input voltage vs. output power

Ref. No.	A (%)	B (%)	C (%)
186875	48	50	75
186876	68	70	85
186877	68	70	85
186878	73	75	85

### 1.4.4 Installation Tuner4Tronic

It is only possible to install one version of the Tuner4Tronic (T4T) software. If you have already an existing installation please backup all existing projects before installing the new version.

## 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 Multi-Dim 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

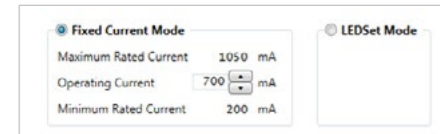


Figure 5: Setting of the operating current

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 of 4.75 kΩ (1050 mA) and 24.9 kΩ (200 mA), 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 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.

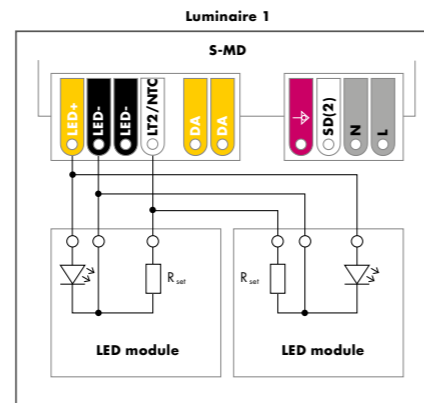


Figure 6: LEDset2 parallel connection

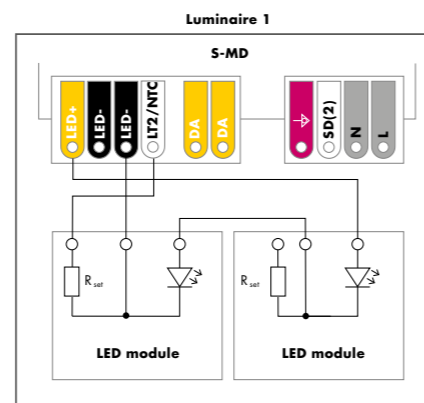


Figure 7: LEDset2 series connection

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.

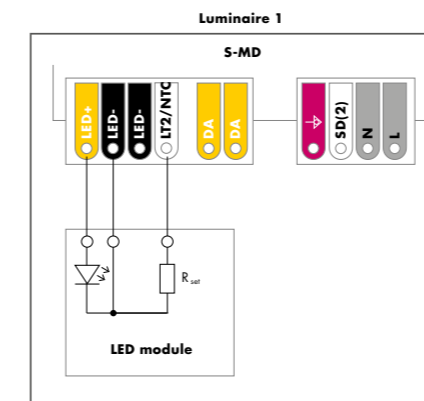


Figure 8: Rset connection

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%.

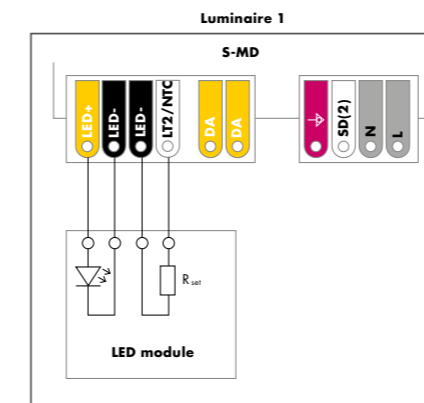


Figure 9: Rset connection with higher accuracy

The LEDset2 coding for the Multi-Dim family is shown in the following graph.

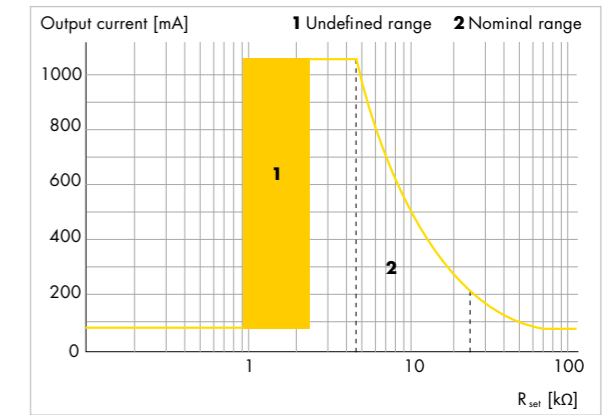


Figure 10: LEDset2 coding

The corresponding output current can be calculated with the following formula within the valid resistor range (Rset = 4.75–24.9 kΩ):  
 $I_{out} [A] = (5 V / R_{set} [\Omega]) \times 1000$

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

The undefined range should be avoided because the output current of the LED driver is not predictable. Table 5 gives an overview of commonly used current values and the appropriate resistor values.

Table 5: LEDset2 resistor coding

I <sub>out</sub> (mA) reference	R <sub>SET</sub> (kΩ) (tolerance ≤ 0.5%)	I <sub>out</sub> (mA) nominal
Open circuit	> 71	70
200	24.9	201
350	14.3 (E192)	349
500	10.0 (E192)	500
700	7.15 (E192)	699
1050	4.75 (E192)	1050
Undefined	0.9–2.37	1050/70
Short circuit	< 0.9	70

### 2.1.3 Tuning factor

Modern street lighting has a high potential to save energy as efficient LED technology allows light planners and luminaire manufacturers to perfectly adapt the behaviour 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.

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

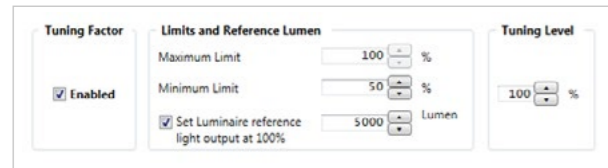


Figure 11: Tuner4Tronic user interface

#### 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: 10–100%.

#### Luminaire reference light output

This value indicates a reference light output of the luminaire at the maximum set operating 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 Multi-Dim 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.

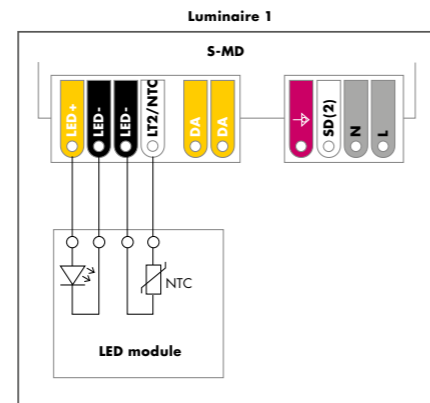


Figure 12: NTC connection

Two different thermal protection modes can be selected in the Tuner4TRONIC® software:

- Resistor-based mode (factory default)
- Temperature-based mode

#### 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 6. The specified temperatures can vary, depending on the used NTC component and the corresponding tolerances.

Table 6: Overview of standard NTCs

NTC type	Derating temperature (6.3 kΩ) Start	Derating temperature (5.0 kΩ) End*	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

\* Switch-on temperature in case the temperature has reached the shut-off condition

### Temperature-based mode

In this mode, the derating behaviour can be defined in temperature values if one of the NTCs listed below is used.

Table 7: Sensor types in temperature-based mode)

Sensor types	Code
Murata 10K NTC	NCP18XH103J03RB
Murata 15K NTC	NCP18XW153J03RB
Murata 15K NTC + 390 Ω	NCP18XW153J03RB in series of 390 Ω
EPCOS B57423V2473Hxxx	B57423V2473Hxxx

After selecting the correct sensor type in the Tuner4TRONIC® software, the favored temperature behaviour can be programmed as shown in figure 13.

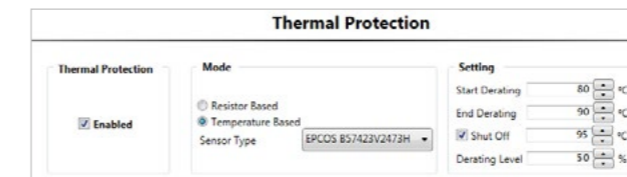


Figure 13: NTC programming

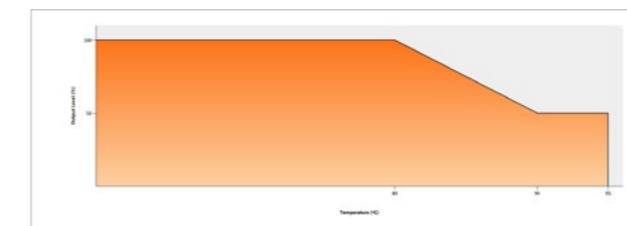


Figure 14: NTC sample behaviour

Table 8: Supported value ranges

Parameter	Min.	Max.	Increment
Resistor range	1.0 kΩ	25 kΩ	25 Ω
Temperature range	40 °C	95 °C	1 °C
Derating level	10%	100%	1%



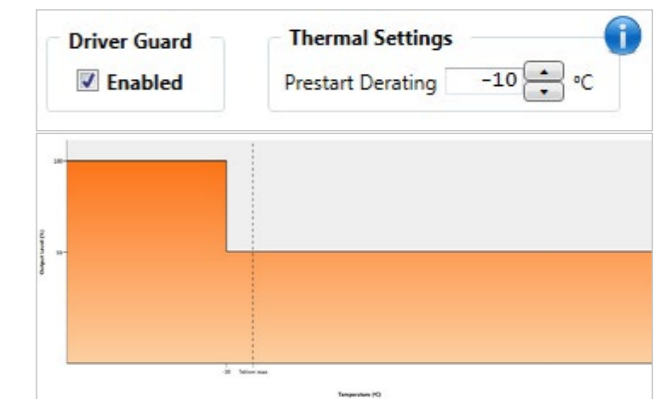
#### Warning:

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

### 2.2.2 Internal LED driver temperature protection

The Multi-Dim 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 behaviour 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 tc 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 tc 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 15.

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 15. This value is only an estimation because it does not consider, for example, the LED Vf behaviour 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 supplier.

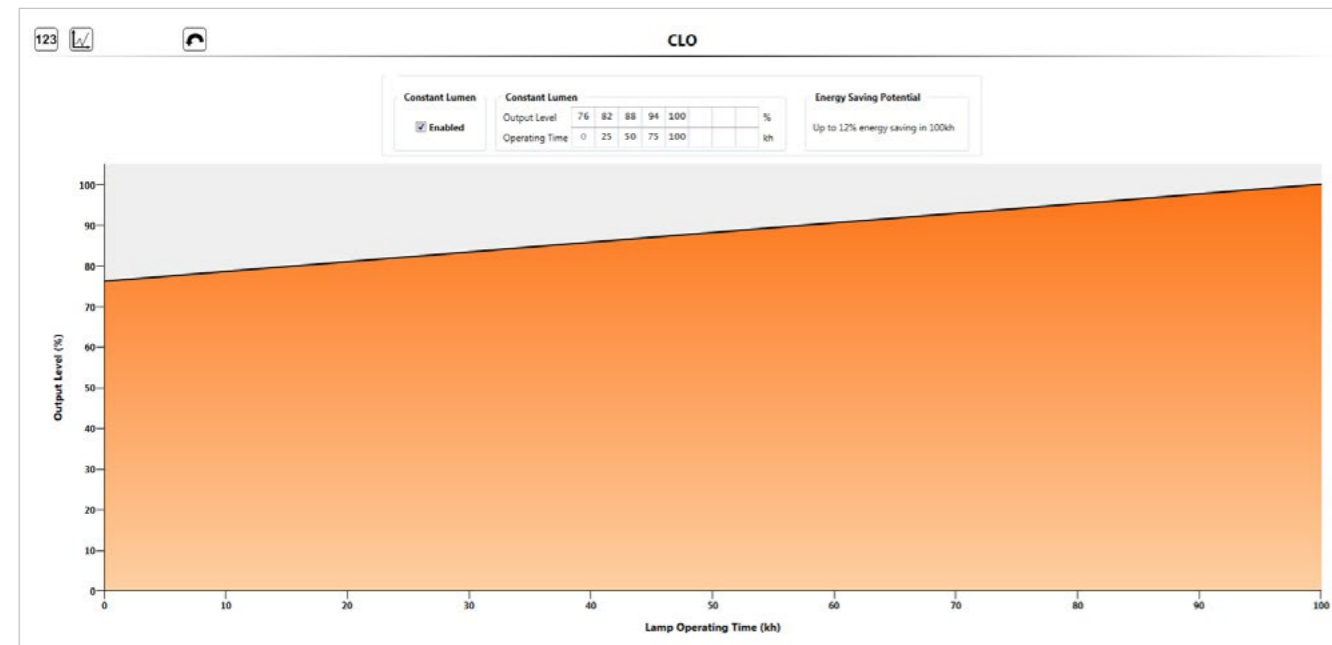


Figure 15: Constant lumen programming graph

### 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 16.

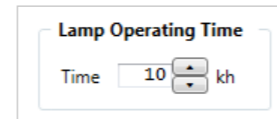


Figure 16: Lamp operating time

### 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 17.



Figure 17: "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 18.

### 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, Vossloh-Schwabe 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.

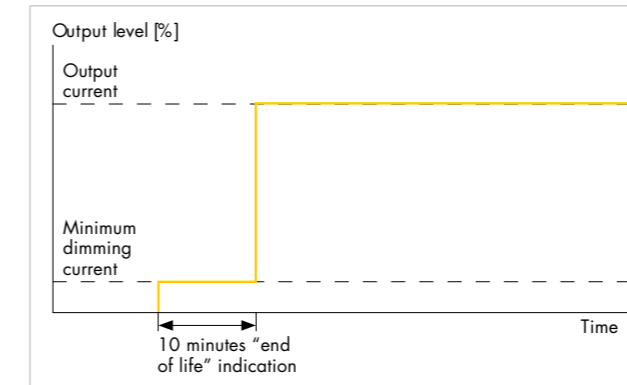
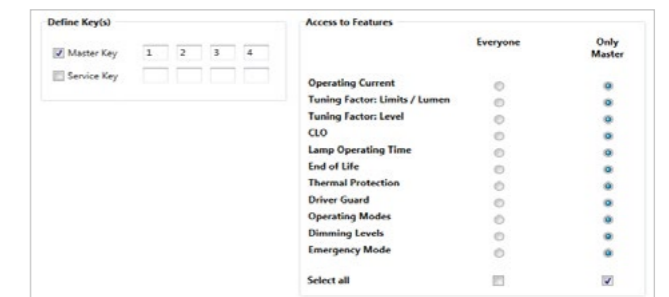


Figure 18: "End of life" behaviour without switch-on fade time

If a switch-on fade time is set, it is overridden by the "end of life" functionality as shown in figure 19. After 10 minutes, the output current is set according to the current switch-on fade time level.

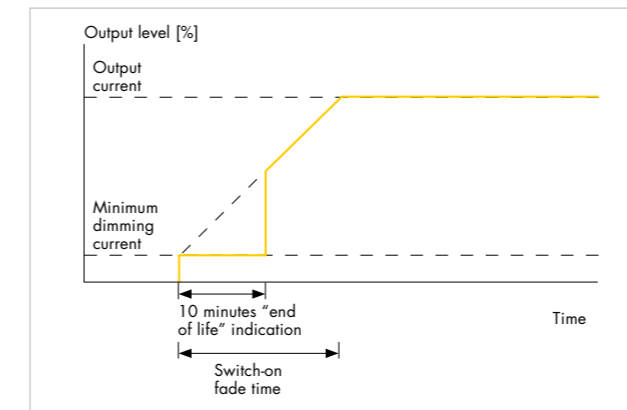


Figure 19: "End of life" behaviour with long switch-on fade time

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 20.

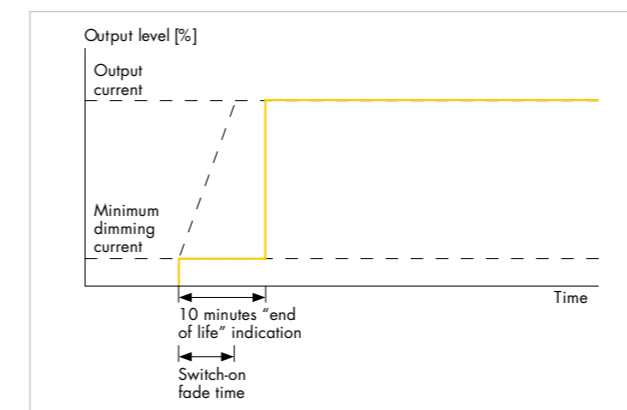


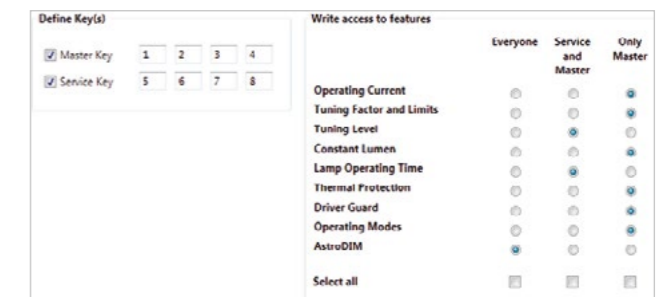
Figure 20: "End of life" behaviour with short switchon fade time



**Note:**

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

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 and they can reset the lamp operating time. 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 of the MidNight function feature can be changed without the need of a key.



### 3 OPERATING MODES

The operating modes of a Multi-Dim LED driver can be selected using the Tuner4TRONIC® software. Only one mode can be selected.

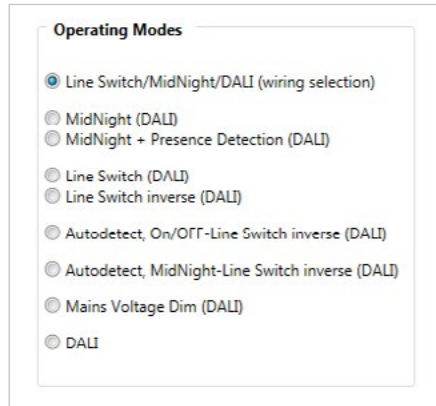


Figure 21: Operating/dimming modes



**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 "Line Switch (DALI)" or "MidNight function (DALI)" via external wiring in case the default dimming mode "Line Switch/MidNight function/DALI (wiring selection)" is set. Please see chapter 3.2.1 for wiring information.

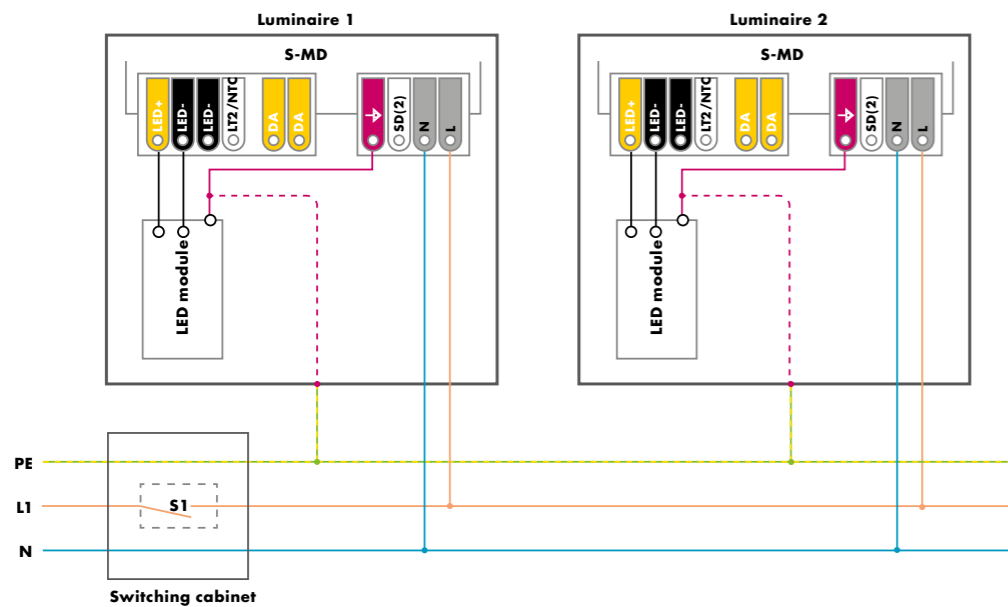


Figure 22: Wiring for on/off operation

### 3.1 On/Off operating mode

Multi-Dim LED drivers can also be used in a simple on/off operating mode. One of the following dimming modes needs to be selected:

- Line Switch/MidNight function/DALI (wiring selection) – DALI and SD(2) port not connected
- Line Switch (DALI) – DALI and SD(2) port not connected
- DALI – DALI port not connected



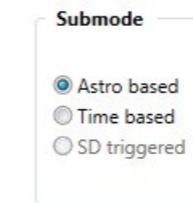
**Note:**

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

### 3.2 MidNight function feature

The MidNight function feature allows an autonomous dimming without the need for an additional control line. The Multi-Dim 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 MidNight function 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 poweroff/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 Wiring and feature activation

There are two ways to activate the MidNight Function mode:

- Option 1: By external wiring  
Selected dimming mode (factory default): "Line Switch/MidNight function/DALI (wiring selection)"
- Option 2: Via the Tuner4TRONIC® software  
Selected dimming mode: "MidNight function (DALI)" or "MidNight function PD (DALI)"

For option 1, the MidNight function feature is activated without the need for programming. Only a permanent connection between the L and the SD(2) port of the LED driver is necessary (see figure 23). If the SD(2) port is not active during the start-up phase of the LED driver (for 1 s), the Line Switch feature is activated instead of the MidNight function feature. Information on the default dimming profile can be found in the datasheet of the applied LED driver.

For option 2, the external wiring can be avoided if either the "Mid-Night function (DALI)" or "MidNight function PD (DALI)" dimming mode is selected via the software (see figure 24).

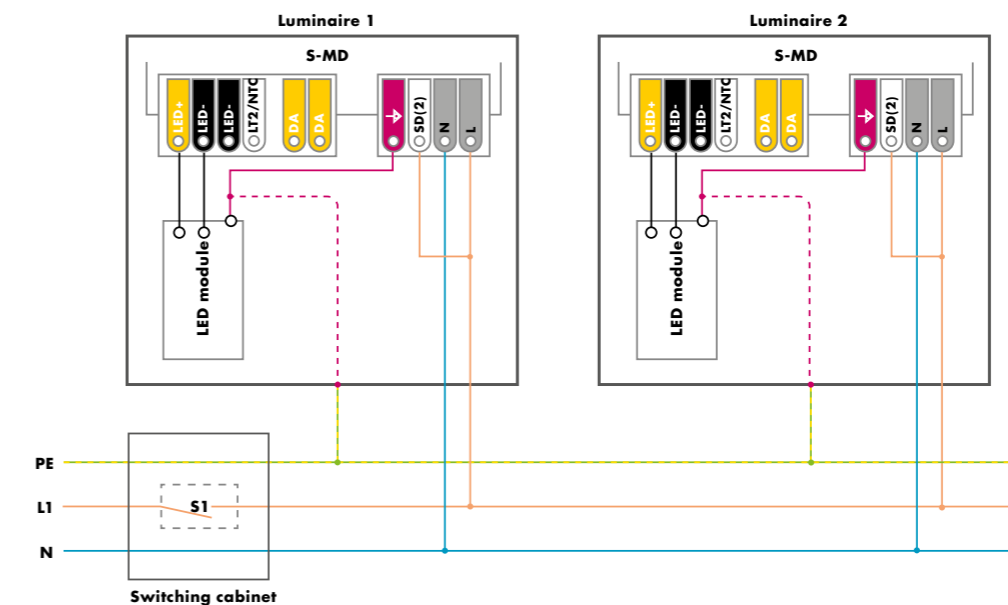


Figure 23: Line Switch/MidNight function/DALI wiring selection



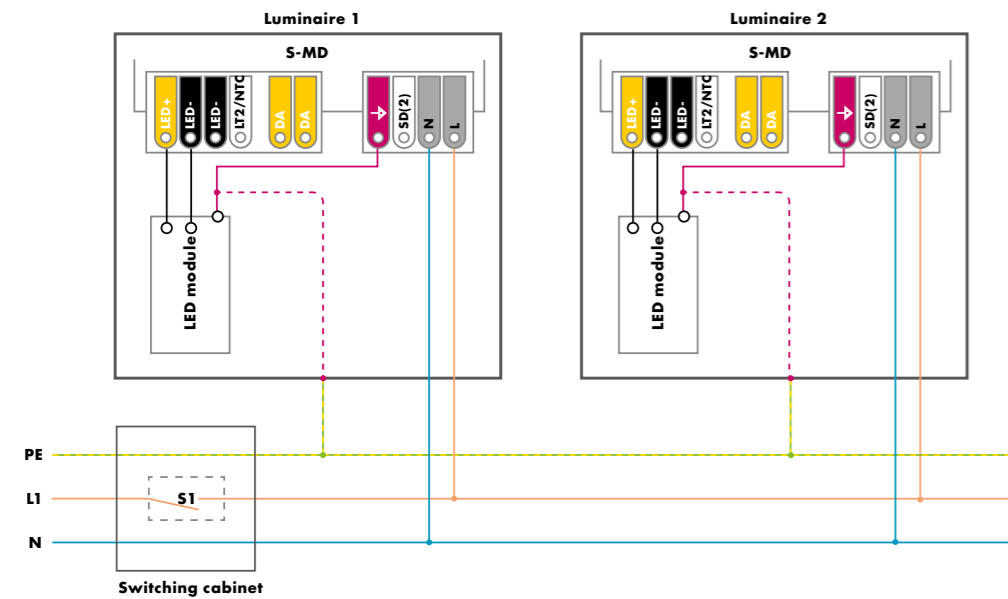


Figure 24: Wiring: MidNight function (DAI) or MidNight function PD (DAI)

### 3.2.2 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 MidNight function 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 MidNight function dimming profile in the time-based mode already starts after the first power-off/on cycle after programming.

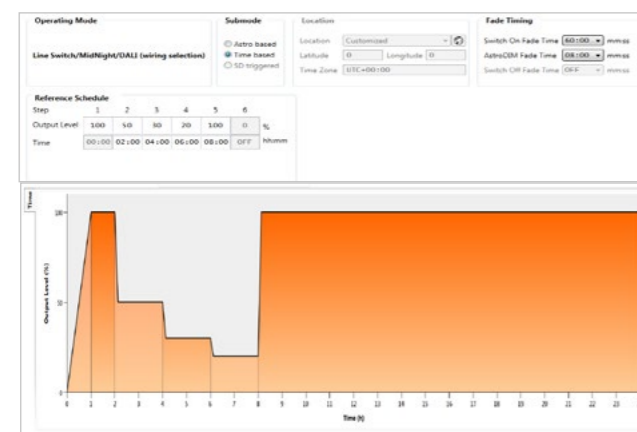


Figure 25: Time based MidNight function

Fade timing:

- MidNight function 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 9: Fade timing parameters

Parameter	Min.	Max.	Default
MidNight function fade time	0 s, 2 s	8 min	3 min
Switch-on fade time	0 s, 1,5 s	60 min	0 s

### 3.2.3 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 MidNight function 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.

Fade timing:

- MidNight function 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 10: Fade timing parameters (astro-based mode)

Parameter	Min.	Max.	Default
MidNight function fade time	0 s, 2 s	8 min	3 min
Switch-on fade time	0 s, 1,5 s	60 min	0 s
Switch-off fade time	OFF, 0 s	60 min	OFF

The "schedule by day" in the MidNight function feature tab calculates the estimated dimming behaviour for a specific day based on the theoretical sunrise and sunset times. If daylight saving has to be considered, the corresponding check box needs to be ticked. The LED driver itself is not able to detect summer and winter time and does not have an internal real-time clock.

In case the installation is not powered on and off at the calculated sunrise and sunset times, the correct values can be entered in the manual mode as shown in figure 27.

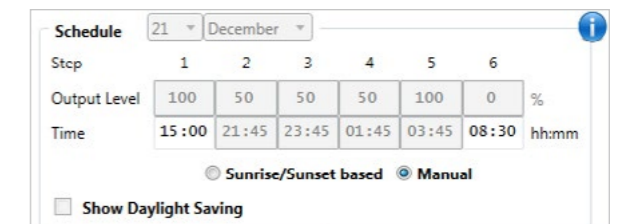


Figure 27: Schedule by day

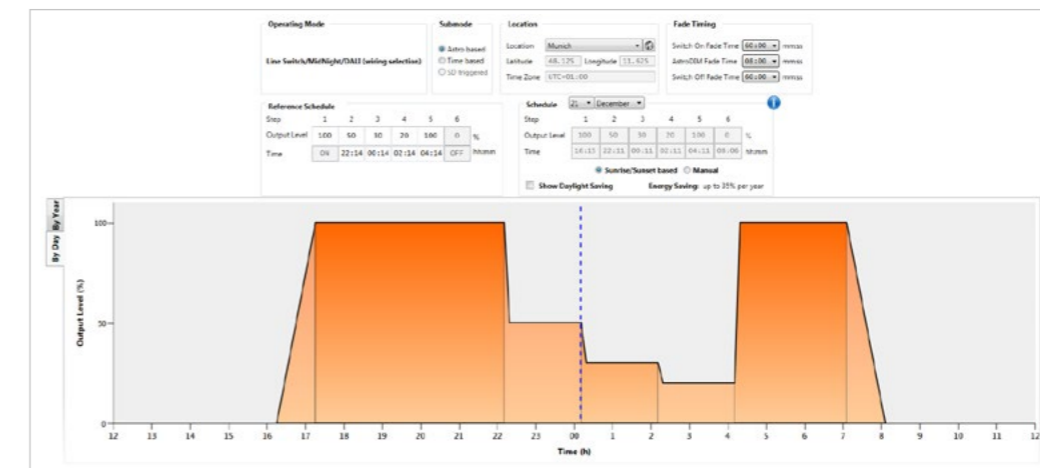


Figure 26: Astro-based MidNight function

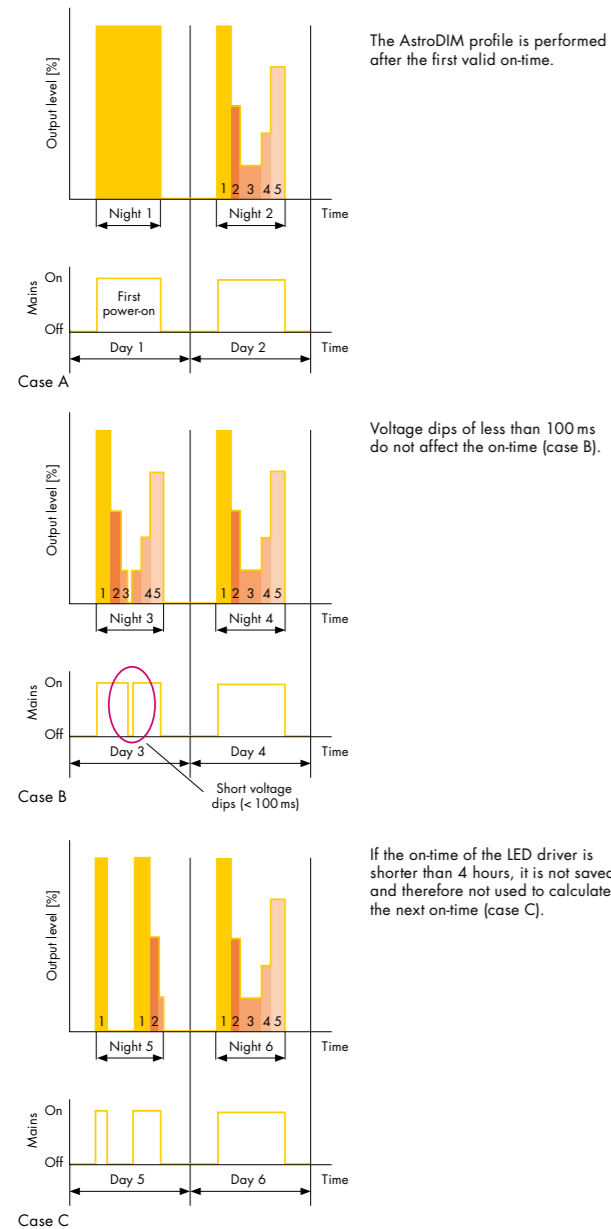
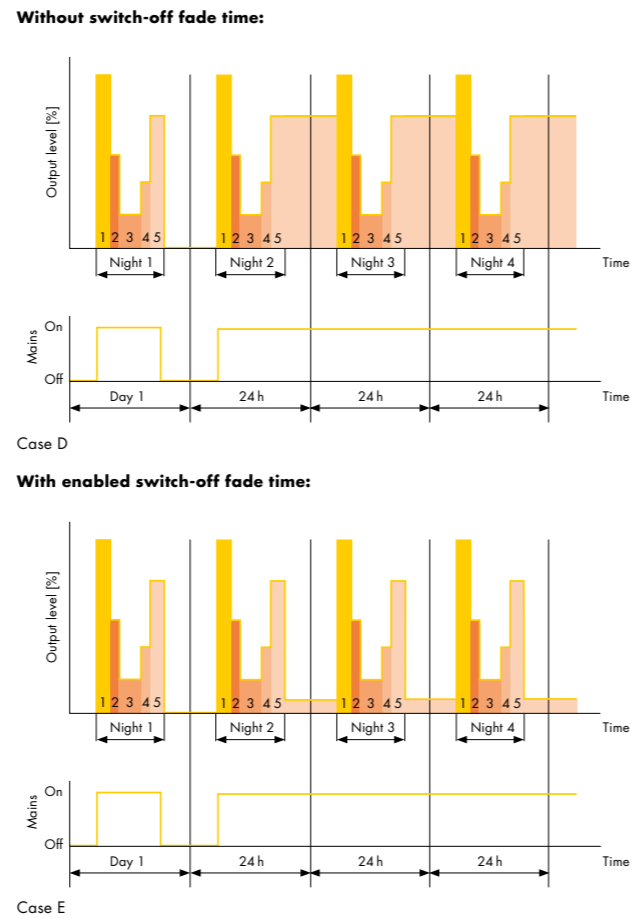


Figure 28: Use cases of MidNight function mode



### 3.2.4 Presence detection in MidNight function mode

In the "MidNight function PD (DALI)" dimming mode, it is possible to override the dimming profile of MidNight function 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.

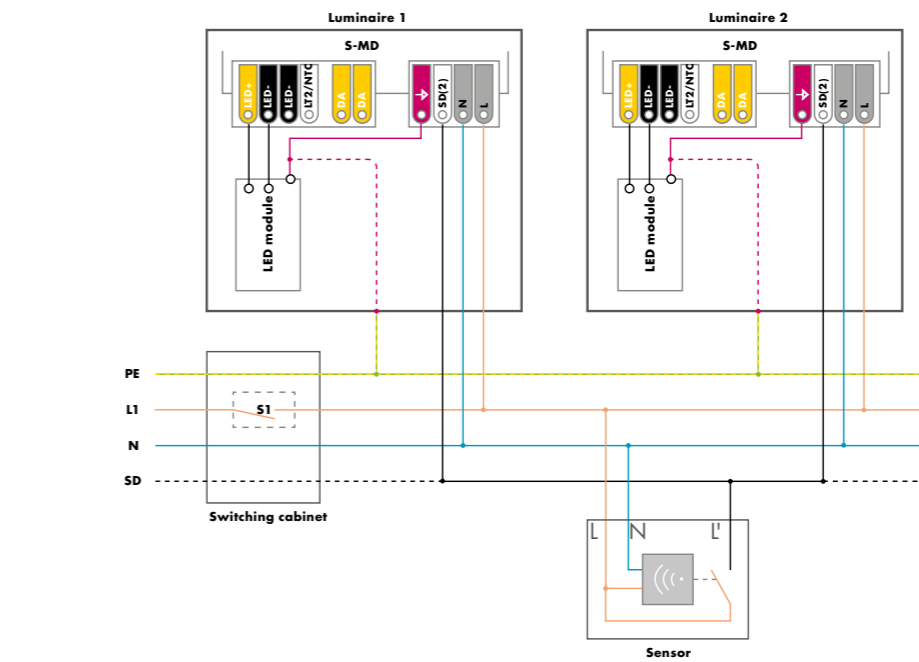


Figure 29: MidNight function wiring with presence detector

The MidNight function 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). 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 Multi-Dim 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.

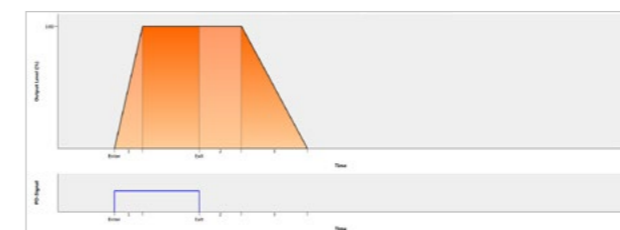


Figure 30: Presence detection in MidNight function mode

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 31.



Figure 31: Presence detection configuration

### 3.2.5 MidNight function LS triggered

In the "MidNight function LS triggered" dimming mode, it is possible to activate the dimming profile of MidNight function with an active signal at the SD(2) port. Compared to the usual MidNight function mode, where the dimming profile starts by switching on the LED driver, in the "MidNight function triggered" mode, the LED driver can be switched on and set to a defined output level until the trigger signal starts the dimming profile.

To activate this feature, select operating mode "MidNight function +Presence Detection (DALI)" and, within the feature, choose submode "LS triggered".

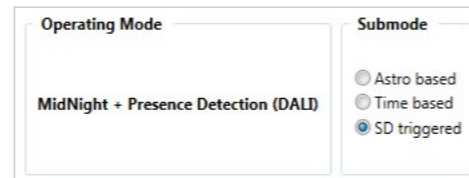


Figure 33 shows the dimming profile according to the reference schedule. The start of the dimming behaviour is triggered by the LS signal and can be changed in the reference schedule table.

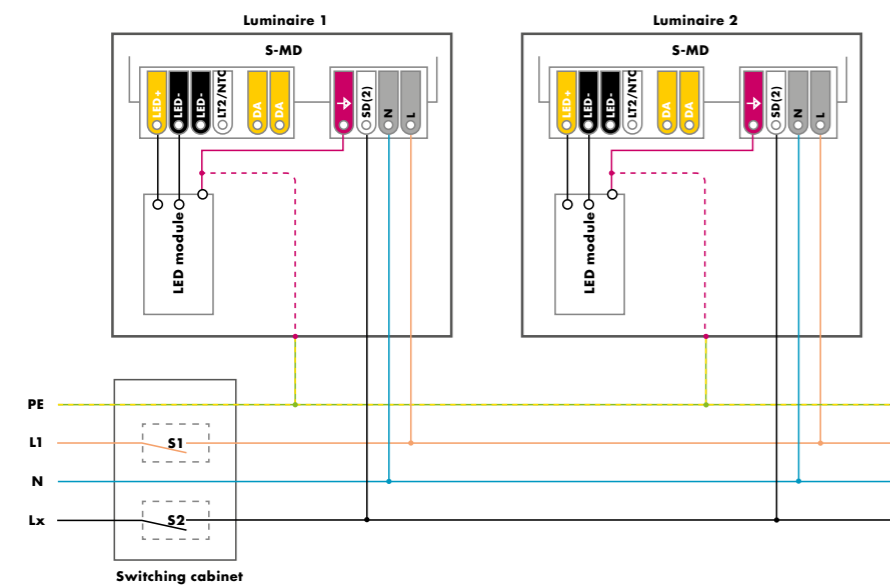


Figure 32: MidNight function wiring Line Switch triggered



Figure 33: Dimming profile

Table 11: Presence detection parameters

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

### 3.3 Line Switch feature

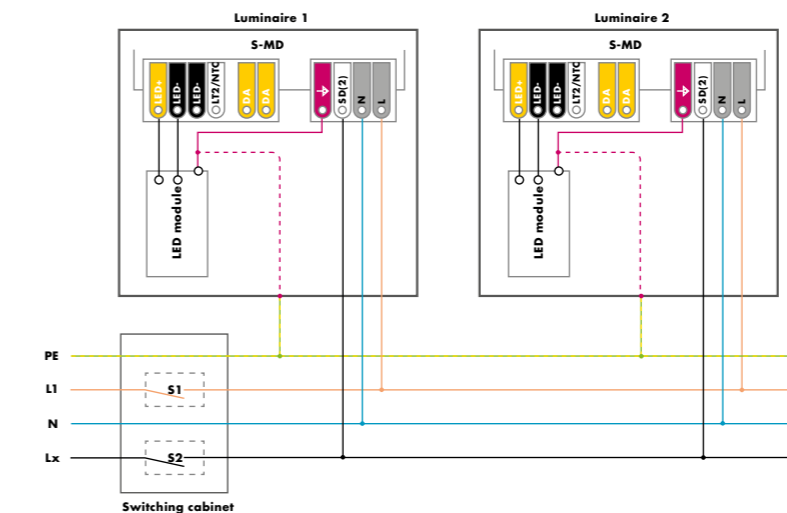
Line Switch is a one-step dimming mode using an additional control line or a switched phase (pilot line) to control one or more light points and set the light output to a preprogrammed light level. The LS level and the fade time can be set using the Tuner4TRONIC® software.

There are three different Line Switch operating modes:

- Line Switch (DALI)
- Line Switch inverse (DALI)
- Line Switch inverse, autodetect (DALI)

For Line Switch operation, the LED driver is connected to the mains and a control line or a switched phase. Figure 34 shows the connection for the two different supply voltage systems.

#### For 220-240 V<sub>AC</sub> supply system:



#### For 277 V<sub>AC</sub> supply system:

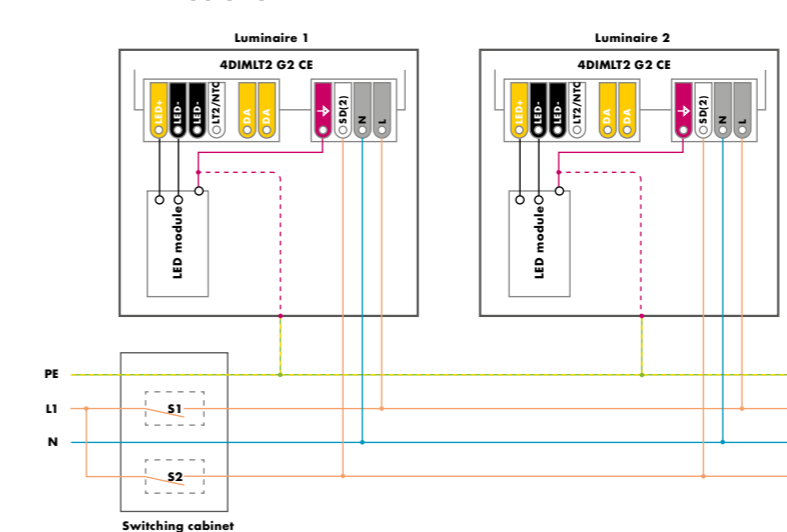


Figure 34: Line switch wiring

The Line Switch application is supported by the following supply systems:

Table 12: SD2 port usage in different supply systems

Supply system	Nominal voltage	Ref. No.			
		186875	186876	186877	186878
Singlephase	170 V AC, 60 Hz	-	-	-	-
	220-240 V AC, 50/60 Hz	yes	yes	yes	yes
	240 V AC, 60 Hz	yes	-	-	-
Threephase	170 V AC, 60 Hz	-	-	-	-
	220-240 V AC, 50/60 Hz	yes	yes	yes	yes
	240 V AC, 60 Hz	-	-	-	-

The Line Switch port (SD(2)) of the Multi-Dim 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 13: Electrical characteristics of the Line Switch port

Line Switch signal	Input current SD(2) port	Input voltage SD(2) port (SD(2)-N)
Active (high)	> 2.0 mA peak	or > 196 V AC
Inactive (low)	< 0.5 mA 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.

### 3.3.1 Line Switch

If, in the "Line Switch (DALI)" mode, the switch (S2) is closed and the phase voltage Lx is applied to the SD(2) port (LS 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.

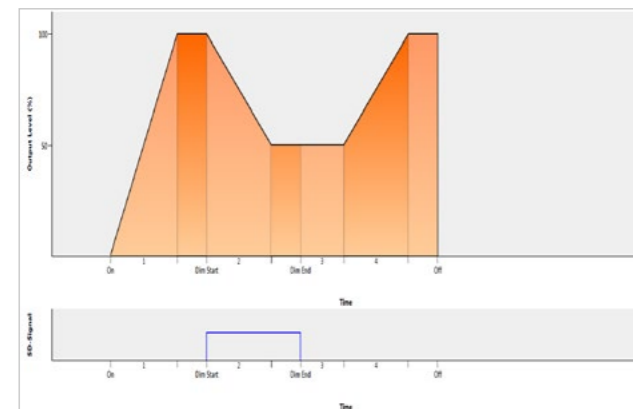


Figure 35: Line Switch behaviour

- Nominal level: Output level when the SD(2) port is not active.
- LS 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 36.



Figure 36: Line Switch configuration

Table 14: Line Switch parameters:

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

### 3.3.2 Line Switch inverse

For the "Line Switch inverse (DALI)" mode, the behaviour is inverted. If the switch (S2) is opened and the SD(2) port is floating (LS inactive), the output level is set to the LS level. If a phase voltage is applied to the SD(2) port (LS active), the output level is set to the nominal level.

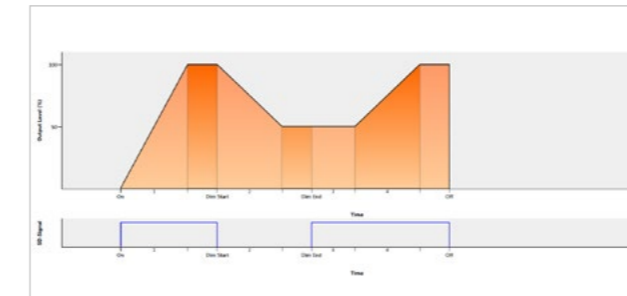


Figure 37: Line Switch inverse behaviour

- Nominal level: output level when the SD(2) port is active.
- LS 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.

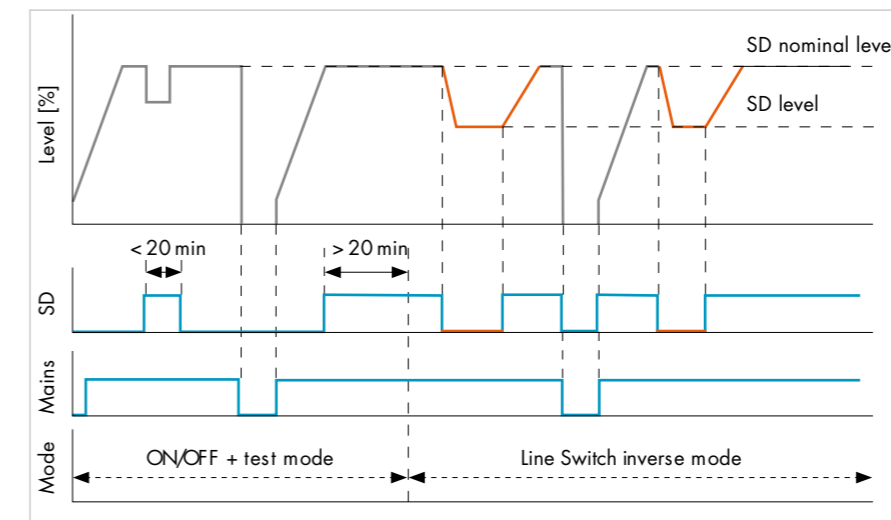


Figure 38: Autodetect, ON/OFF Line Switch inverse behaviour

### 3.3.3 Autodetect, On/Off – Line Switch inverse

In the "Autodetect, ON/OFF-Line Switch inverse (DALI)" mode, the LED driver automatically detects if it is used in a simple on/off environment or in a Line Switch inverse installation. If a valid "high" signal (LS active) is detected at the SD(2) port for longer than 20 minutes, the LED driver automatically switches to the "Line switch 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 Line Switch dimming level without changing the driver to the "Line Switch inverse" operating mode.

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

Example:

In some parts of Line Switch 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.

### 3.3.4 Mixed Line Switch installations with Multi-Dim LED drivers

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

Example:  
The most common usage in outdoor applications is either Line Switch or MidNight function. Vossloh-Schwabe has taken this into account and introduced a new operating mode in addition to the "Autodetect ON/OFF-Line Switch inverse" mode. With the new "Autodetect MidNight function-Line Switch inverse" mode, all LED drivers can be programmed with the same settings: While the MidNight fixtures (SD(2) port not connected) still provide the individual MidNight function profile, the others perform the requested dimming behaviour via Line Switch.

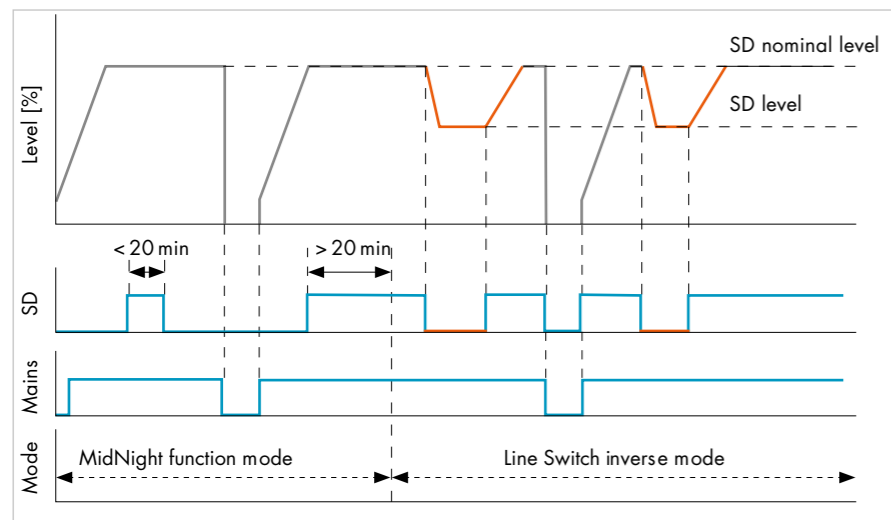


Figure 39: Autodetect, MidNight function, Line Switch inverse behaviour

### 3.4 Mains Voltage Dimming

The reduction of the mains amplitude is partly used for the dimming of conventional lamps. In the Mains Voltage Dimming operating mode, the output current of the LED driver depends on the mains input voltage. Standard electronic drivers compensate for fluctuations in the input voltage and do not support this function. No additional control wires are needed in this dimming mode (see figure 41).

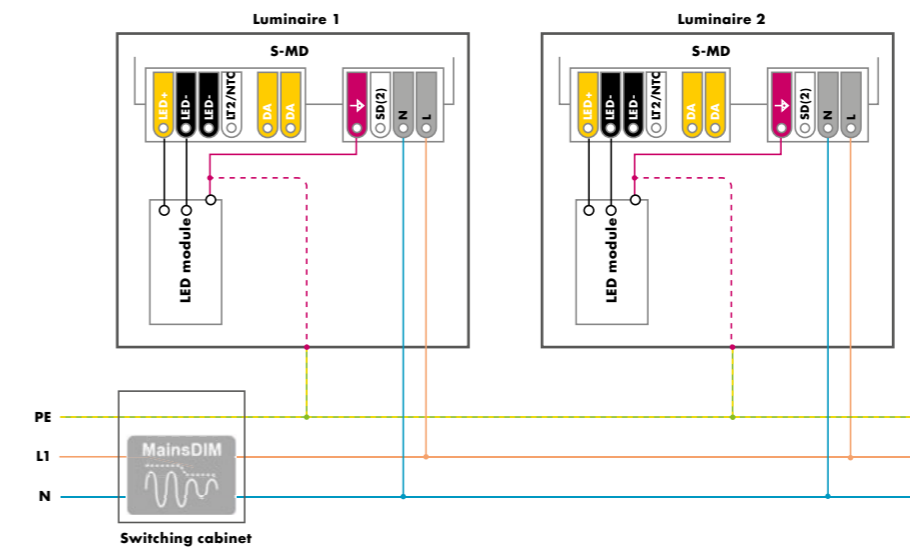


Figure 41: Mains Voltage Dimming wiring

The dimming behaviour of the LED driver can be programmed using the Tuner4TRONIC® software. The programmable values can be found in table 15.

Table 15: Mains Voltage Dimming parameters

Parameter	Min.	Max.	Increment	Default
Start voltage	190 V	250 V	1 V	220 V
Start level	30%	100%	1%	100%
Stop voltage	170 V	230 V	1 V	180 V
Stop level	30%	85%	1%	30%
Start-stop voltage	20 V	—	—	—



**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.

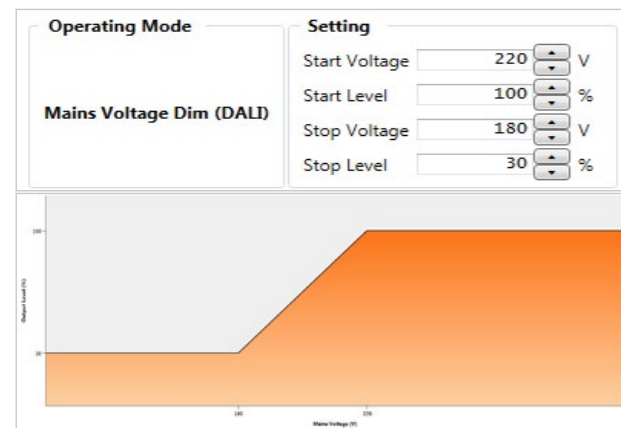


Figure 42: Mains voltage dimming sample programming



**Note:**

To increase the light output stability against small voltage fluctuations, a minimum voltage difference of 5 V from the "start voltage" is necessary to trigger the dimming of the LED driver. The triggering of the dimming is performed with a delay time of approximately 1 to 2 seconds. The setting of the thresholds should also consider the voltage drop in the real installation due to cable and contact resistance.

### 3.5 DALI operating mode

For DALI operation, the Multi-Dim LED driver is connected to the mains and to a DALI controller (e.g. Street Light Control system) or DALI bus (see figure 43). The additional DALI wires can be installed alongside the mains wires.

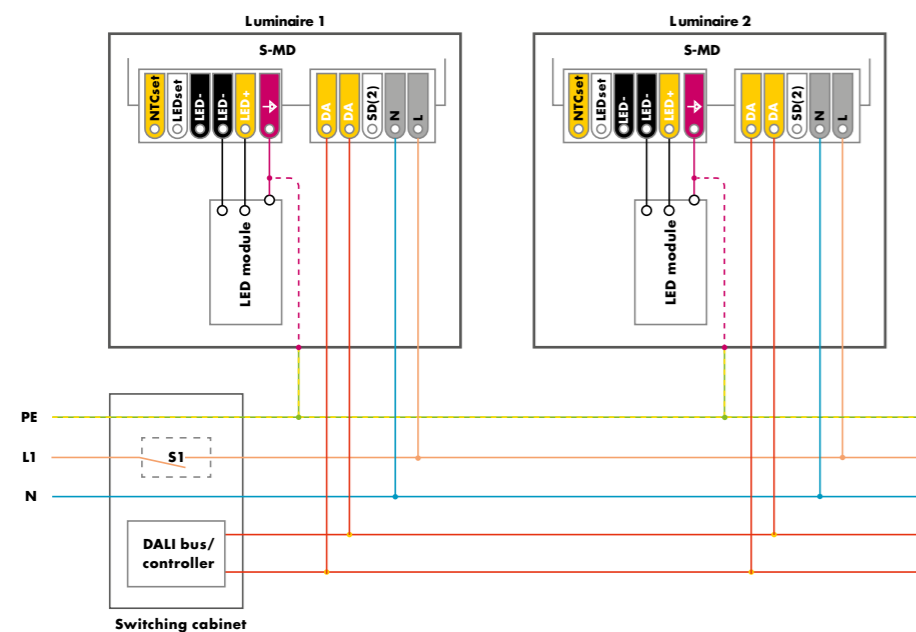


Figure 43: DALI wiring

### 3.5.2 Additional functions

The Multi-Dim family provides additional Vossloh-Schwabe-specific functions, such as:

#### Data for predictive maintenance of luminaires and energy efficiency optimization

LED drivers with this feature offer additional operation and status information that exceeds what is currently offered by the DALI standard (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.

#### Luminaire info with electronic type label

To make light management systems intelligent in terms of service and predictive maintenance, they need basic information about the connected luminaire (model, power, service life etc.). During production, the luminaire manufacturer can store these data in the LED driver, and the light management system can recall these data in the installation.



**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.

Up to 64 DALI LED drivers can be controlled via a two-wire control line – individually, jointly or in up to 16 groups. All of them are connected in parallel to the two DALI wires. DALI connections are not polarized. Therefore, plus and minus do not have to be checked. The maximum allowed wire length between two DALI LED drivers is 300 m. In case of problems, a DALI repeater has to be used.

The lighting can be switched on/off and dimmed via the DALI control line. A logarithmic (default) or linear dimming curve can be set. Additional status information can be read out and exchanged between the LED driver and the control unit.

The DALI mode always has the highest priority. The LED driver switches to the DALI operating mode as soon as a valid DALI command is received. The DALI mode is maintained until the next power-off/on cycle. The dimming behaviour is set to the logarithmic dimming curve by default.

### 3.5.1 DALI-2

Together with the new DALI standard according to IEC 62386 (Edition 2), a manufacturer-independent certification process has been established, again by the Digital Illumination Interface Alliance (DiiA). The product certification by the DiiA ensures a significantly improved interoperability between the different manufacturers. With DALI-2, additional functionalities have been introduced compared to the existing DALI system (Version-1) in the market. Moreover, the backwards compatibility to existing systems has been factored in. Only certified DALI-2 products are allowed to carry the DALI-2 certification mark issued by the DiiA.

With DALI-2, the following additional functionalities have been introduced (e.g.):

- Extended fade times (fade time, fade rate)
- Longer serial number and HW identification for improved device recognition
- Queries to identify which DALI functionalities are supported
- Sensors now have a separate address area, therefore all 64 addresses can be used for drivers. In addition, they can also send commands and therefore do not need to be queried continuously by the application control. This improves the payload of the DALI bus.
- ...

DALI-2-compatible drivers also support light control functions defined in DALI Version-1.

Extended Vossloh-Schwabe-specific add-on functionalities  
Besides the standardized DALI functions, Vossloh-Schwabe devices also support optional add-on functionalities, which bring additional benefits for certain applications. These functions can be activated on demand with the Tuner4TRONIC® software.

### 3.6 DC operation feature

Multi-Dim LED drivers are prepared for a DC grid operation. The use of Vossloh-Schwabe Outdoor LED drivers for central battery systems is limited to the Multi-Dim product family. As the built-in Multi-Dim 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 Vossloh-Schwabe 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: [www.vossloh-schwabe.com](http://www.vossloh-schwabe.com)

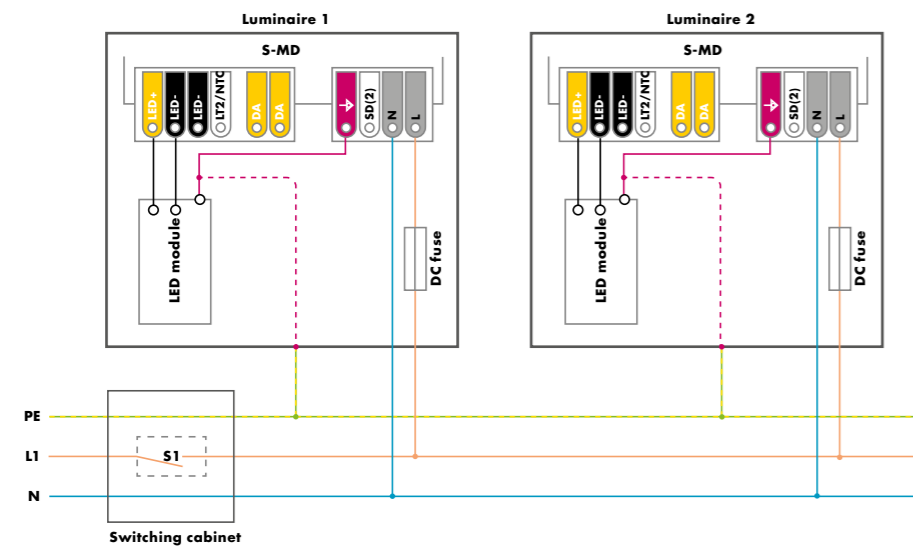


Figure 44: DC wiring

## 4 ADDITIONAL INFORMATION

### 4.1 Insulation

Multi-Dim 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 16: Insulation and Uout

	Ref. No.	186875	186876	186877	186878
Insulation (prim./sec.)	SELV	SELV	SELV	double	double
Insulation of casing	double	double	double	double	double
UOUT	60 V	60 V	120 V	250 V	

The functional earth pin 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

Multi-Dim 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

20 W, 40 W, 75 W, 110 W	
DA	0.2–1.5 mm <sup>2</sup>
DA	
SD(2)	
N	8.5–9.5 mm
L	8.5–9.5 mm

Figure 45: Cable preparation, primary side

#### Secondary side

20 W, 40 W, 75 W, 110 W	
LT2/NTC	0.2–1.5 mm <sup>2</sup>
LED-	
LED+	
FE	8.5–9.5 mm

Figure 46: Cable preparation, secondary side and functional earth pin

### 4.3 Incorrect wiring on the output side

Multi-Dim LED drivers are inherently protected against incorrect wiring on the output side. Incorrect wiring between LED+ and LEDset or NTC-set 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 behaviour might occur if the output voltage falls below the minimum allowed voltage.

### 4.4 Input overvoltage

In case the supply input voltage exceeds 305 V AC, the LED driver shuts down to indicate an unbalanced load condition. The Multi-Dim LED driver can withstand up to 350 V AC for a maximum of two hours.

### 4.5 Surge protection

Multi-Dim LED drivers offer a common mode protection level of up to 10 kV with a unique 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 functional earth pin needs to be connected to the heat sink of the LED module (see figures 47 and 48). The functional earth pin meets the insulation requirements for protection class I and II luminaires. The protection level between L and N or SD(2) and N is 6 kV.

In addition, the SD port contains an active surge suppression element referenced to N. In case an external surge protection device (SPD) is used to protect the DALI port and the mains input, the protection level up of the SPD between DALI port to earth and mains input to earth should be equal. Connecting only an external SPD to the DALI port with a connection to earth is not allowed.

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

Table 17: Multi-Dim surge protection levels

Surge between	Test condition acc. to EN 61547
L-N	6 kV at 2Ω source
SD(2)-N	6 kV at 2Ω source
L-FE / SD(2)-FE / N-FE	8 kV at 12Ω source

Surge between	Test condition acc. to EN 61000-4-5
L-FE / SD(2)-FE / N-FE	10 kV at 12Ω source

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

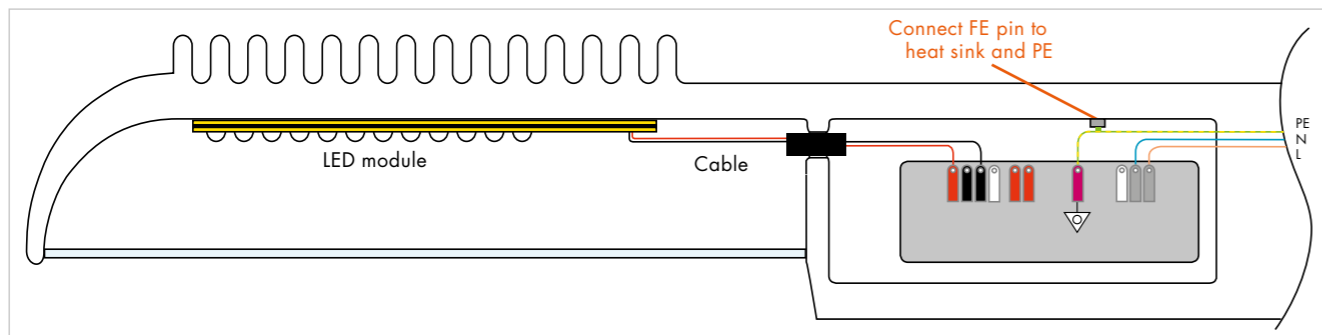


Figure 47: Protection class I luminaire

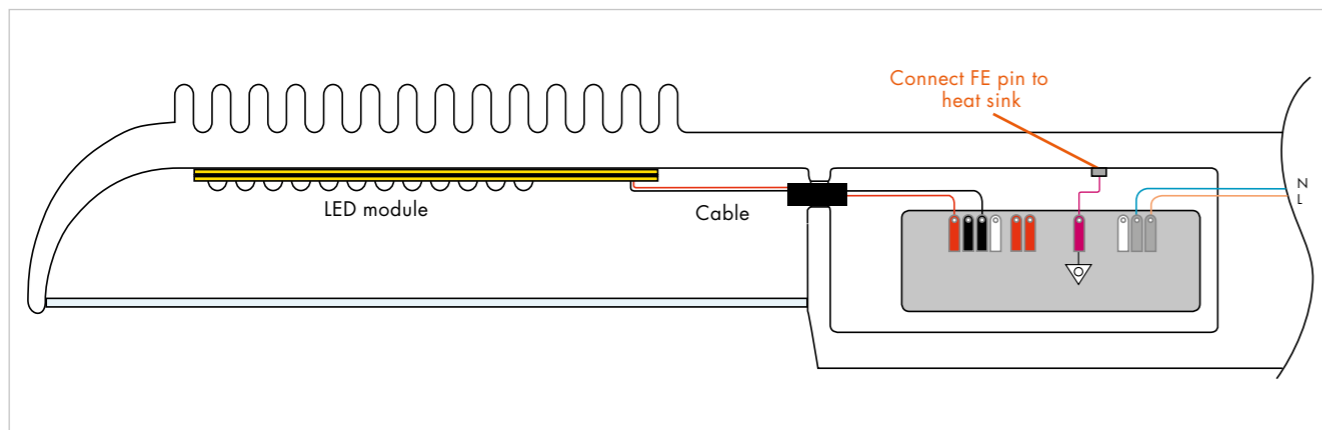


Figure 48: Protection class II luminaire

## 5 PROGRAMMING

Multi-Dim LED drivers can be programmed using the Tuner4TRONIC® PC software together with the hardware programmer DALI magic.

The PC software consists of the following software packages:

- T4T – Development
- T4T – Production

The PC software can be downloaded from the [www.vossloh-schwabe.com](http://www.vossloh-schwabe.com) portal.



### Warning:

In case of partial programming, the SELV DC voltage (case B) needs to be applied to the LED driver for at least 4 seconds.

Table 18: Supply voltage during programming

Case	Min.	Max.	Default
A	220-240 V AC	20, 40, 75 and 110 W	*Acc. to LED driver datasheet*
B	48 V DC+15%/-4%/**	20, 40, 75 and 110 W	-10 to +40 °C

\* The power supply should be capable to deliver an average current of 100 mA and contain an automatic restart function in case of overload (typ. peak inrush current of 1 A).  
 \*\* The 48 V DC programming is not applicable for 3DIMLT(+) LED drivers.



### Note:

A power-off/on cycle is necessary to activate the programmed parameters.

### 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 compared to the mains grid). In order to avoid these effects, a mains filter should be installed after the electrical power supply.

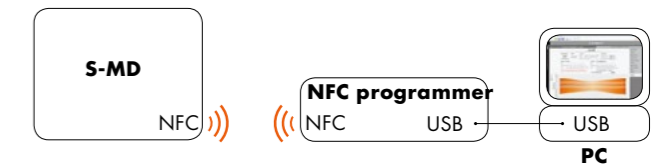


Figure 50: LED driver programming with NFC

Multi-Dim LED drivers do not need to be powered during programming. Place the LED driver on the NFC programmer 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.

### Supported NFC programming devices

- FEIG PRH101
- FEIG CPR30

### Disclaimer

All information contained in this document has been collected, analyzed and verified with great care by Vossloh-Schwabe. However, Vossloh-Schwabe is not responsible for the correctness and completeness of the information contained in this document and Vossloh-Schwabe 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.



Whenever a luminaire goes on around the world, Vossloh-Schwabe is likely to have made a key contribution to ensuring its trouble-free operation.

Headquartered in Germany, Vossloh-Schwabe counts as a technology leader within the lighting sector. This success is based on Vossloh-Schwabe's top-quality and high-performance products.

The product range includes the entire spectrum of lighting components from LED systems with matching control gear, modern control systems (Blu2Light und LiCS) as well as electronic and magnetic ballasts and lampholders.

For the future, the company is geared towards the topic of smart lighting.

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