LED Driver

EM powerLED ST FX

Manual

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Scope of documentation

This operating instruction is valid for combined LED Drivers for general and emergency lighting from the EM powerLED ST FX 45W series.

The series comprises additional versions. However, the other versions EM powerLED PRO DIM FX 45W, EM powerLED BASIC FX 50W and EM powerLED BASIC FX 80W are not covered within this documentation.

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The latest version of these operating instructions is available on our home page.

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We are always open to comments, corrections and requests.

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Safety instructions

The instructions in this section have been compiled to ensure that operators and users of combined emergency lighting LED Drivers of the EM powerLED ST FX 45W series from Tridonic are able to detect potential risks in good time and take the necessary preventative measures.
The operator must ensure that all users fully understand these instructions and adhere to them. This device may only be installed and configured by suitably qualified personnel.

Intended use

Proper use

Operation of LED modules in general lighting and in single battery supplied emergency lighting. The device may only be used for this intended purpose.

Improper use

Outdoor use. Extensions and modifications to the product.

WARNING!

Improper use could result in injury, malfunction or damage to property.
It must be ensured that the operator informs every user of existing hazards.

Dangers associated with the operation of the system

DANGER!

Danger of electrocution
Disconnect the power to the entire lighting system before working on the lighting system!

Environment

DANGER!

Not to be used in corrosive or explosive environments.

CAUTION!

Risk of damage caused by humidity and condensation

_ Only use the LED Driver in dry rooms and protect it against humidity!

_ Prior to commissioning the system, wait until the LED Driver is at room temperature and completely dry!

Safety instructions

Additional instructions

⚠ CAUTION!

Electromagnetic compatibility (EMC)

Although the device meets the stringent requirements of the appropriate directives and standards on electromagnetic compatibility, it could potentially interfere with other devices under certain circumstances!

Introduction

About the device

The combined LED Drivers for general and emergency lighting EM powerLED is the smart solution where cost optimised or feature driven emergency lighting is required. It integrates functions for mains operation and emergency lighting into one unit. Devices are available for a broad range of applications from compact housings for installations inside the luminaire to independent devices with strain relief for use with downlights. The strain relief variant (SR) in conjunction with plug-in remote batteries offers a turnkey solution.

Available are versions for manual testing (BASIC), version for selftests (ST) and DALI addressable devices (PRO) for automatically controlled and monitored testing.

This document covers the selftest version (ST) of the portfolio. The innovative compact ST versions enable a combination of general lighting and emergency selftesting with only one product. The PRO version is covered in a separate documentation (see Reference list, p. 63).

Testing of emergency systems

There are statutory requirements covering the testing of emergency systems in buildings accessible to the public. This includes that testing must be carried out at a time of minimum risk, normally during unsocial hours, and must allow time for the batteries to be recharged before the next expected occupancy of the building.

Without automated test systems all steps must be performed manually. This includes the initiation of the test by interrupting the power supply, the visual inspection of each luminaire and the logging of all test results.

The combined emergency LED Driver EM powerLED ST FX 45W enables automated selftesting with a number of advantages:

- The EM powerLED ST FX covers the complete test procedure including error indication. This is possible without any expensive, time-consuming testing procedures. Tests are therefore more reliable and cheaper.
- Combining mains and emergency operation in one unit eliminates compatibility issues between LED Driver and emergency units and ensures an optimal electromagnetic compatibility.
- The EM powerLED ST FX devices are designed to meet the requirements of IEC 62034 (Automatic test systems for battery powered emergency escape lighting).

Portfolio of products

Housing variants

The EM powerLED ST FX is available in two different housing variants:
compact and compact strain relief (independent).

Image	Description
	Housing variant compact _ Compact shape _ For installations inside the luminaire _ Typical area of application: Spotlights, downlights _ Dimensions: 183 x 82 x 34 mm
	Housing variant compact strain relief (independent) _ Compact shape _ For installations outside the luminaire _ Typical area of application: Spotlights, downlights _ Dimensions: 209 x 82 x 34 mm

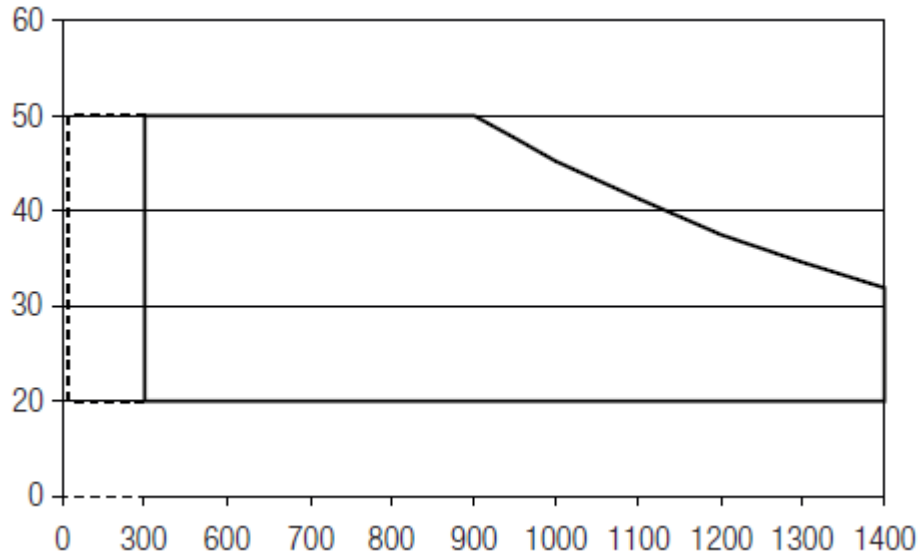
Output voltage range

Output voltage range

The output voltage range results from the current selected.

The diagram below shows the forward voltage ranges as a function of the output current and are intended as a guide. For detailed values and explanations please refer to the data sheets (see Reference list, p. 63).

Output voltage [V]



Output current [mA]

Operating window 100 %

Operating window dimmed

Functions in mains operation

Overview of the main functions in mains operation:

Area	Function	
Dimming	switchDIM, p. 11	✓
	corridorFUNCTION V2, p. 15	✓
Adjustable output current, p. 20	Adjustable via resistor or I-select 2 plug	Step size: 25 mA
Functions and performance, p. 22	Intelligent Temperature Guard (ITG), p. 22	✓
	Standby losses	< 0.2 W
	Rated supply voltage	220 - 240 V

switchDIM

switchDIM

Description

With the switchDIM function it is possible to use the mains voltage as a control signal.
The phase is connected via a simple standard mains voltage push button to the terminal marked Rest/L and the neutral conductor is connected to the terminal Rest/N.

Using the function is easy and convenient:

_ A short press (50-600 ms) switches the device on or off

_ A long press (> 600 ms) fades the connected operating device alternately up and down (between 1 and 100 %).

switchDIM is therefore a very simple form of lighting management. It also has a positive effect on material and labour costs.

The device has a switchDIM memory function. This is used, among other things, for storing the last dimming value in the event of interruptions in the power supply.
When power returns, the device automatically returns to its previous operating state and the light source is dimmed to the stored value.

⚠ CAUTION!

Glow switches are not approved for using switchDIM.
Glow switches may cause the LED Driver to spontaneously switch on or off or make sudden changes in the dimming value.

⚠ CAUTION!

To ensure correct operation a sinusoidal mains voltage with a frequency of 50 Hz or 60 Hz is required at the control input.
Special attention must be paid to achieving clear zero crossings. Serious mains faults may impair the operation of switchDIM and corridorFUNCTION.

⚠ CAUTION!

A maximum number of 25 operating devices per switchDIM system should not be exceeded.

Commissioning

ⓘ NOTICE

If the corridorFUNCTION is activated, the LED-Driver is controlled only by motion. To operate the LED-Driver via switchDIM, the corridorFUNCTION must be deactivated.

Using the switchDIM function

switchDIM is operated by the push button that connects phase with the terminal marked Rest/L.

Procedure:

_ Switch the device on/off by briefly actuating the switch (50-600 ms) or

_ Dim the device by holding down the switch (> 600 ms)

switchDIM

Synchronising devices

If the devices in a system do not operate synchronously the devices must be synchronised, i.e. put in the same status (on/off) and the same dim level.

Procedure:

_ Hold down the switch for 10 seconds
-> All devices will be synchronised to the same status
-> LEDs will be set to a uniform light value (approx. 50 %)
-> The fading time will be set to it default value (approx. 3 seconds)

Changing the fading time

The default value for the fading time is approx. 3 seconds. It can be changed to approx. 6 seconds.

Procedure:

_ Hold down the switch for 20 seconds
-> After 10 seconds: all devices will be synchronised to the same status
-> After 20 seconds: a fading time of approx. 6 seconds will be set
-> LEDs will be set to a uniform light value (approx. 100 %)

Switching the LED Driver to automatic mode

In automatic mode the device detects which control signal (switchDIM) is connected and automatically switches to the corresponding operating mode.

Procedure:

_ Press the switch 5 times within 3 seconds

Installation

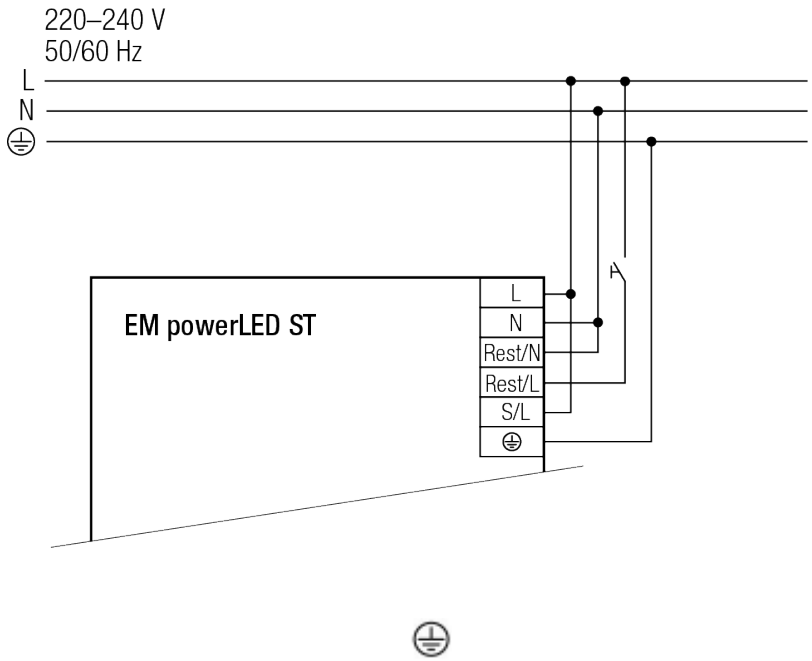
Wiring variants

There are two options for installing switchDIM: four-pole and five-pole wiring

switchDIM

Four-pole wiring

Configuration:



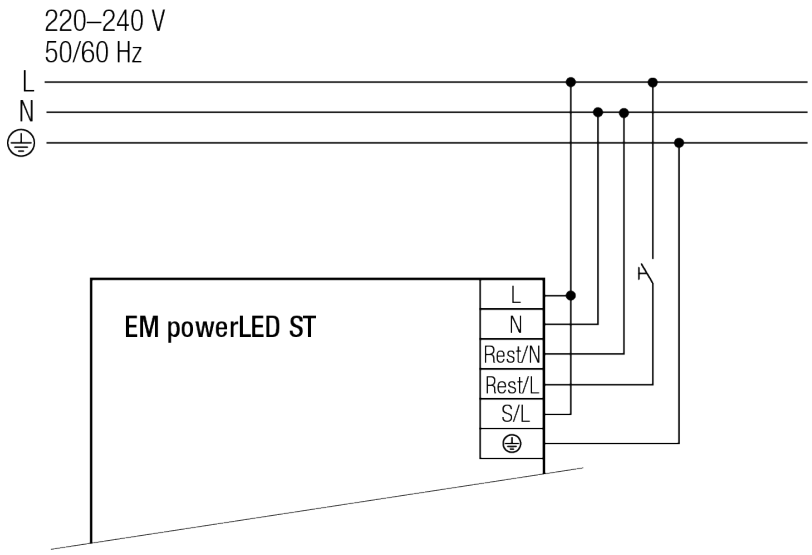
phase (L), neutral (N), control line (S/L), earth

Benefits:

No need for a control line thanks to connecting terminal 8 with the N-connection of the luminaire

Five-pole wiring

Configuration:



switchDIM

phase (L), neutral (N), control line (S/L), earth

CAUTION!

For five-pole wiring the neutral conductor must be connected to Rest/N.

This prevents 400 V being applied between adjacent terminals if a different phase is used for the control input.

corridorFUNCTION V2

corridorFUNCTION V2

Description

The corridorFUNCTION enables the illuminance to be linked to the presence or absence of people. A conventional relay motion sensor is connected. The luminous intensity is increased when a person enters the room. When the person leaves the room the motion sensor switches off after a certain delay and the luminous intensity is automatically reduced. The corridorFUNCTION is particularly beneficial in applications in which light is needed round the clock for safety reasons, for example in public buildings, large apartment complexes, car parks, pedestrian underpasses and underground railway stations. Since the luminous intensity only has to be increased when there is a demand for light the corridorFUNCTION offers effective lighting management and helps saving energy and costs. Another benefit of the corridorFUNCTION is the enhanced convenience of automatic lighting control.

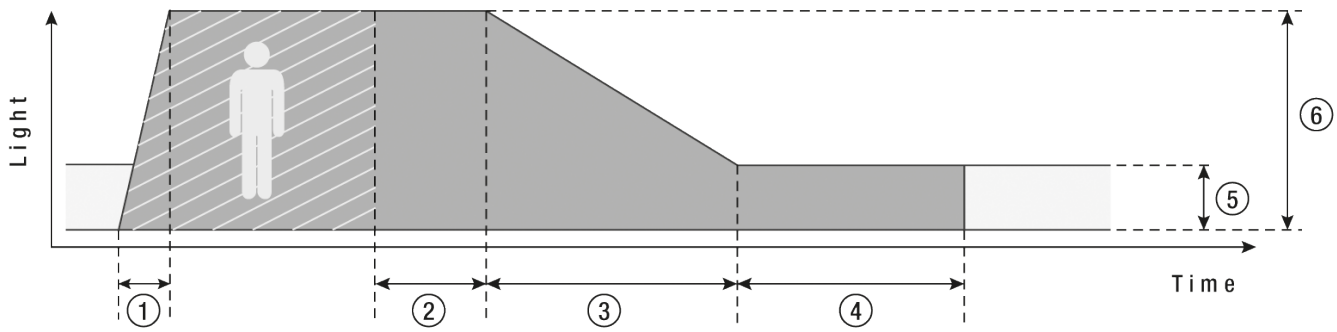
⚠ CAUTION!

To ensure correct operation a sinusoidal mains voltage with a frequency of 50 Hz or 60 Hz is required at the control input.
Special attention must be paid to achieving clear zero crossings. Serious mains faults may impair the operation of corridorFUNCTION.

Profile settings:

The corridorFUNCTION is activated by applying 230 volts to the interface terminals Rest/N - Rest/L for a period of at least 5 minutes. After activating the device it goes into the standard profile "Never off".

The standard profile has the following fixed parameters:



1. Fade-in time: the time that starts as soon as the presence of a person is detected. During the fade-in time the luminous intensity is faded up to the presence value (default: 0s).
2. Run-on time: the time that starts as soon as the presence of a person is no longer detected. If the presence of a person is detected again during the run-on time the run-on time is restarted from zero. If no presence is detected during the run-on time the fade time is started as soon as the run-on time expires.
3. Fade time: the time during which the luminous intensity is faded from the presence value to the absence value (default: 30 s).
4. Switch off delay: the time during which the absence value is held before the lighting is switched off. Depending on the profile selected the switch-off delay may have different values or may not be defined (default: "Never Off").
5. Absence value: the luminous intensity when there is no person present (default: 10 %).
6. Presence value: the luminous intensity when persons are present (default: 100 %).

Adjusting the parameters

With the series EM powerLED ST FX devices the parameters are fixed and cannot be changed.

corridorFUNCTION V2

Commissioning

Activating the corridorFUNCTION

Procedure by means of the mains voltage

Activating the corridorFUNCTION is simple. If an a.c. voltage of 230 V is applied to the terminals Rest/N - Rest/L of the LED Driver for a period of at least 5 minutes the LED Driver detects the corridorFUNCTION and automatically activates it. Activation is required only once per device.
There are three procedures for activating by means of the mains voltage. The requirements are the same in each case.

Requirements:

_ Device is correctly wired according to wiring diagram

_ Input voltage is applied

_ A motion sensor is connected to Rest/N or Rest/L

Procedure Version 1:

_ Remain in the activation range of the motion sensor for more than 5 minutes
-> The motion sensor detects movement and switches on
-> The corridorFUNCTION is activated automatically after 5 minutes
-> The light value switches to presence level (default: 100 %)

Procedure Version 2:

_ Set the run-on time on the motion sensor to a value greater than 5 minutes

_ Remain in the activation range of the motion sensor for a short time
-> The motion sensor detects movement and switches on
-> The corridorFUNCTION is activated automatically after 5 minutes
-> The light value switches to presence value (default: 100 %)

_ Reset the run-on time of the motion sensor to the required value

Procedure Version 3: Only possible if the motion sensor offers a manual override option

_ Set the slide switch on the motion sensor to the "Never-Off" function

_ Wait 5 minutes
-> The corridorFUNCTION is activated automatically after 5 minutes
-> The light value switches to presence value (default: 100 %)

_ Reset the slide switch on the motion sensor to the "automatic" function

Deactivating the corridorFUNCTION

If the corridorFUNCTION is activated, the LED Driver is controlled only by motion. To operate the LED Driver via switchDIM the corridorFUNCTION must be deactivated.

Procedure

_ Connect mains voltage push button to the terminal marked Rest/L

_ Connect neutral conductor to the terminal Rest/N

corridorFUNCTION V2

_ Press the switch 5 times within 3 seconds

Installation

Requirements:

_ Device is correctly wired according to wiring diagram

_ A motion sensor is installed in the lighting system

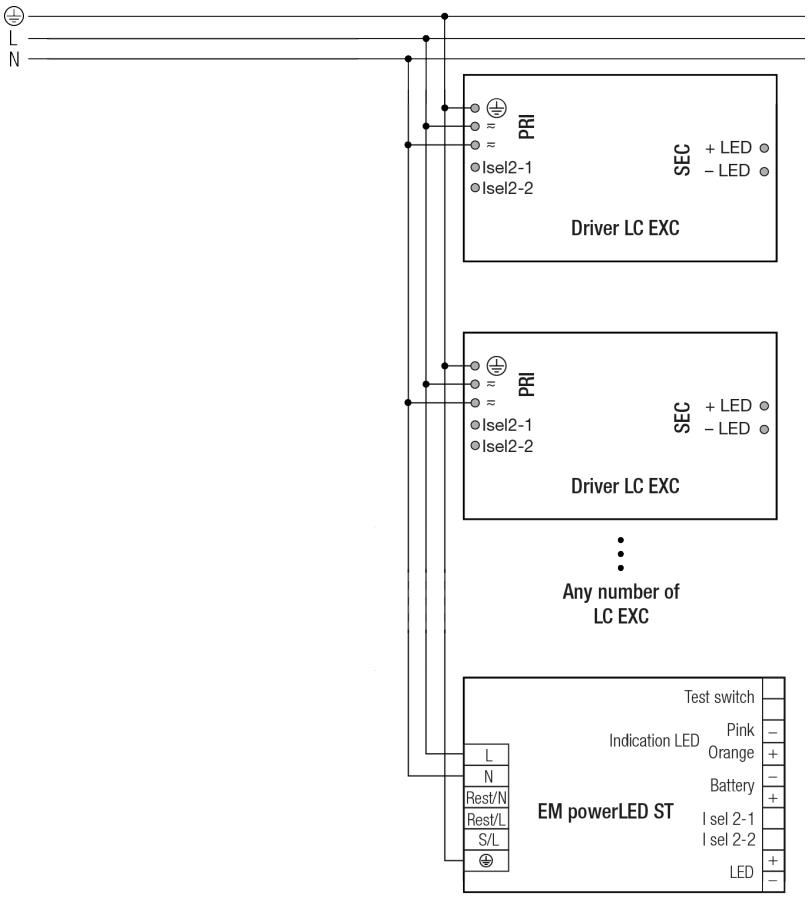
_ The motion sensor is connected to the LED Driver

Procedure:

_ Connect the neutral conductor (N) to terminal Rest/N on the LED Driver

_ Connect the output of the motion sensor (switched phase) to terminal Rest/L on the LED Driver

Wiring versions:



CAUTION!

Use conventional relay motion sensors!

Electronic motion sensors (Triac) are not suitable because of their technical design.

corridorFUNCTION V2

CAUTION!

Do not use glow switches!

Glow switches may affect the control system.

CAUTION!

Make sure that the control line (L') of the motion sensor is connected to terminal Rest/L and the neutral conductor (N) to terminal Rest/N.

CAUTION!

For five-pole wiring the neutral conductor must be connected to Rest/N.

This prevents 400 V being applied between adjacent terminals if a different phase is used for the control input.

NOTICE

For large installations, supply to the LED Driver may be split among several phases (L1, L2, L3).

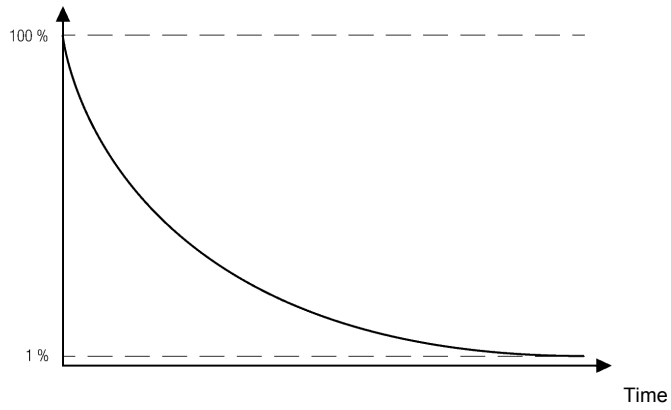
Any phase can be used for the control input.

Any number of motion sensors can be connected in parallel.

Dimming technology

Dimming technology

Output current/dimming level



The dimming range is controlled by adjusting the amplitude of the current. The current value specified for the device corresponds to a dimming level of 100 %. The amplitude of the current is reduced to reduce the dimming level. The logarithmic dimming curve is stepless and adapted to the human eye.

Adjustable output current

Adjustable output current

EM powerLED ST FX allow for different combinations of current and forward voltage based on the standard lumen packages available on the market.

The output current can be adjusted via different resistance values, I-select 2 plugs.

Adjusting the output current via different resistance values

The output current of the LED Driver can be adjusted by using different resistance values. The resistance values are taken from the E96 series.

The mathematical relationship between output current and resistor value looks like this:

$$R[k\Omega] = \frac{5\ V}{I_{out}[mA]}\ 1000$$

_ Resistor value tolerance <= 1 %; resistor power >= 0.1 W; base isolation necessary

NOTICE

If the resistor is connected by wires a max. wire length of 2 m may not be exceeded and potential interferences have to be avoided.

Adjusting the output current via I-select 2 plugs

The output current of the LED Driver can be adjusted by using a suitable I-select 2 plug which has to be inserted into the I-select 2 terminal.

Most important data about I-select 2 plugs:

_ Ready-for-use resistor to set output current value

_ Compatible with LED Driver featuring I-select 2 interface; not compatible with I-select (generation 1), e.g. EM powerLED 50W BASIC

_ Resistor is base isolated

_ Resistor power 0.25 W

_ Current tolerance ± 2 % to nominal current value

_ Compatible with LED Driver series EM powerLED PRO DIM, EM powerLED ST FX, LCA PRE, LC EXC

Example of calculation:

_ R [kOhm] = 5 V / I_out [mA] x 1000

_ Resistor value tolerance <= 1 %; resistor power >= 0.1 W; base isolation necessary

_ When using a resistor value beyond the specified range, the output current will automatically be set to the minimum value (resistor value too big), respectively to the maximum value (resistor value too small)

Adjustable output current

NOTICE

Please note that the resistor values for I-select 2 are not compatible with I-select (generation 1). Installation of an incorrect resistor may cause irreparable damage to the LED module(s).

Resistors for the main output current values can be ordered from Tridonic. Further information about accessories can be found on the TRIDONIC homepage (see Reference list, p. 63).

Intelligent Temperature Guard

Intelligent Temperature Guard

WARNING!

The maximum t_c temperature is the maximum permitted in terms of life time. Operating the LED Drivers above the permitted t_c temperature is not allowed.
The Intelligent Temperature Guard function does not replace the proper thermal design of the luminaire and does not enable the lighting to operate for lengthy periods of time in impermissible ambient temperatures.

Description

The Intelligent Temperature Guard function provides protection against temporary thermal overloads. Thermal overload protection is triggered if the t_c temperature is exceeded. This way, instant failure of the LED Driver can be prevented.

Behaviour

The following table shows the exact behaviour and parameters of the Intelligent Temperature Guard function.

Parameter	Description
Starting point of power reduction	When maximum t_c temperature is exceeded. (1) **NOTICE** The temperature at which the power reduction starts is device-specific and depends on the load and the installation situation. Depending on the installation situation and the load of the device, the temperatures at different measuring points of the device may differ. As a result, it may happen that the actual measured temperature is not identical to the temperature at the t_c point. In any case, the starting point of the power reduction is higher than the predetermined maximum t_c temperature. For the functioning of the protective function these deviations are not decisive. The starting point of the power reduction is selected by the device in a way that the protective function starts when the rated life time would otherwise be significantly affected.
Type of power reduction	Power reduction takes place in gradual steps.
Power reduction process and control	Power reduction is dependent on temperature: _ Power reduction continues if temperature still rises _ Power reduction stops if temperature does not rise anymore or if maximum power reduction is reached (minimum power level = 50 %) _ If temperature falls below a certain level, power is increased again until 100 % is reached _ If temperature still rises even if maximum power reduction is reached, drivers go to 15 % dim level

Intelligent Temperature Guard

Min. power level	ca. 50 % dim level [2]
Shut-off behaviour	No shut off behaviour: Device will not shut off if temperature still rises. _ AC mode: Device switches to 15 % dimming level
Automatic restart behaviour	No automatic restart behaviour (because there is no shut off behaviour).
Restart temperature	No restart temperature.

[1] Rated t_c is device-specific.

[2] The lowest possible dim level depends on the connected load.

NOTICE

The standard setting for the dimming curve is logarithmic:

If alternative dimming curves are used the power reduction can be implemented differently.

Functions in emergency operation

Overview of the main functions in emergency operation:

Area	Function	
Test function, p. 33	Automatic function and duration test	Test activation via selftest
	Function test (interval)	weekly
	Duration test (interval)	annual
Rated duration	Adjustable to 1, 2 or 3 hours [1]	✓
	Adjustable on the device via DIP switch	✓
Status display	Via two-colour indicator LED, p. 31	✓
Battery charge system	Intelligent multilevel charging system, p. 27	✓
Adjustable output current in emergency operation, p. 25	Automatic adjustment by device	✓
Commissioning	Automatic	✓
Rest mode, Inhibit mode and Relight command, p. 27	Activation	Activation via DC pulse

[1] Special case: 2-hours rated duration

The first duration test will take 120 minutes, following duration tests are rated with 90 minutes. If the battery is disconnected or replaced, the next duration test will again be rated with 120 minutes.

Adjustable output current in emergency operation

Adjustable output current in emergency operation

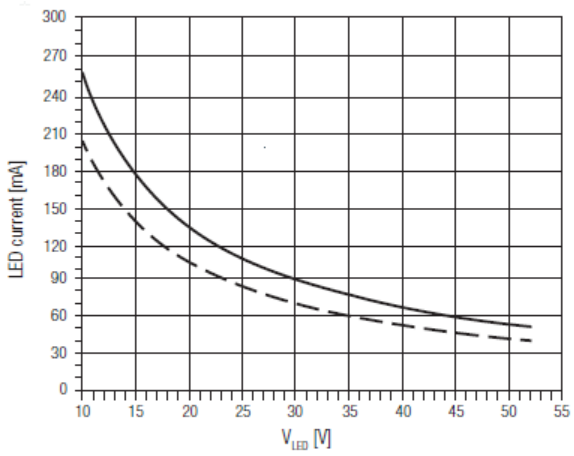
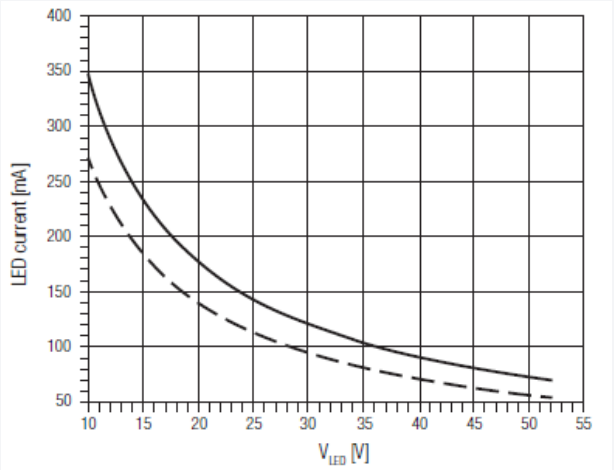
Description

If the EM powerLED ST FX switches to emergency operation in case of a power failure, the device will detect the forward voltage of the connected LED modules and set the correct LED current. Setting a constant output power ensures maximum light output in emergency mode for the specified operating time.

An EM powerLED ST FX with 3 or 4 watts output power operates the connected LED modules with the output power mentioned before. For this purpose, the device detects the connected LED forward voltage, and adjusts the LED forward current to the appropriate value, resulting in an output power of 3 or 4 watts.

NOTICE

At the lowest range of permissible forward voltage, the efficiency may be slightly lower. In this case the output power is also slightly lower.

EM powerLED ST FX 103	EM powerLED ST FX 104
	
Max. output power: 3 W	Max. output power: 4 W

Adjustable output current in emergency operation

Calculation

Formel: P = U * I

P	=	U	*	I
Emergency output power: Given by the EM powerLED ST FX type		LED forward voltage: Detected by the EM powerLED ST FX		LED forward current: Automatically adjusted by the EM powerLED ST FX

Example

Given:

_ LED forward voltage: 45 V (chosen as an example)

_ LED forward current (at 45 V): 60 mA (taken from diagram EM powerLED ST FX 103)

Wanted:

_ Emergency output power?

Result:

_ Emergency output power:
P = U * I = 45 V * 60 mA = 3 W

Different battery cell numbers offer flexibility in the available emergency output power - 3 cells and 4 cells for LED modules from 20 V to 50 V forward voltage.
The LED current in emergency mode is automatically adjusted by the EM powerLED ST FX based on the total forward voltage of the LED modules connected and the associated battery.

Control gear	Forward voltage range	SELV	Number of battery cells
EM powerLED ST FX 103	20-50 V	SELV < 60 V	3 cells for lower light output in emergency operation
EM powerLED ST FX 104	20-50 V	SELV < 60 V	4 cells for higher light output in emergency operation

NOTICE

There is a separate chapter that describes how the light output in emergency operation can be determined (see Determining light output in emergency operation, p. 38).

Intelligent multilevel charging system

Intelligent multilevel charging system

The multilevel charging system is used for minimising charging times while maximising battery life. During normal functional mains operation the module charges the batteries using a specially developed charging algorithm.

_ Initial charge mode:
  20 hours of high charging current at the start to prepare the new battery cells and fully charge them.

_ Trickle charge mode:
  Continuous low charge to maintain battery output and reduce battery temperature.

_ Fast charge mode:
  Automatic adjustment of the charge time ensures minimal overcharging:

    _ 10 or 15 hours of rapid charge after a full discharge.

    _ Shorter charge time after only a partial discharge.

When the permanent power supply is switched on for the first time the EM powerLED ST FX starts to charge the batteries for 20 hours in fast charge mode. This 20-hour preparatory charge ensures that the new batteries are completely charged before being used. The 20-hour recharge is also used if a new battery is connected or if the device leaves the Rest mode (see Rest mode, Inhibit mode and Relight command, p. 27).

At the end of the 20-hour charge the module automatically switches to trickle charge mode. This ensures that the batteries remain at optimum charge levels and avoids any overheating due to overcharging.

_ batteries are charged with a constant charging current in trickle charge mode

After a power outage and subsequent emergency mode the EM powerLED ST FX recharges the batteries in fast charge mode. However, the charge time is set so that only the power consumed during emergency mode is replaced. If emergency mode did not last as long as the prescribed operating time the charging time will be reduced. If emergency mode extended for the full operating time the charging time will be 10 hours for modules with an operating time of 1 hour, and 15 hours for modules with an operating time of 2 and 3 hours. Once the batteries are fully charged again the module automatically switches to trickle charge mode.

In trickle charge mode the battery status is continually monitored to ensure that the charging currents and battery voltages remain within the specified limits. If these limits are exceeded error status flags are set for monitoring with the aid of a suitable control system. The status LED also shows such faults locally.

If a duration test is required while the battery is not yet fully charged the test will be postponed until charging is complete. This prevents a duration test from being carried out with a battery that is not fully charged.

NOTICE

A partially charged battery is defined as one for which the charger is operating in fast charge mode.
A fully charged battery is defined as one for which the charger is operating in trickle charge mode.

If the power supply fails during rapid charging the module will power the lamp immediately in emergency mode for as long as the charge in the batteries will allow.

Rest mode, Inhibit mode and Relight command

Emergency operation is automatically started when the mains supply is switched off. If the Rest mode is activated, the discharging of the battery will be minimized by switching off the LED output.

Rest mode and Relight function

Rest mode can be used during short periods of time when a building is completely unoccupied and the mains supply is to be switched off intentionally, for example during a holiday period. Using Rest mode prevents a full discharge and possible damages to the batteries during these times.

Rest mode has to be activated by a competent person. Activation is only possible after the mains supply has been switched off. Contrary to this, if the Inhibit mode has been activated in advance, Rest mode will be automatically switched on if the mains supply is switched off.

By sending the Relight command both modes, Rest mode and Inhibit mode, will be deactivated. The emergency unit will switch back to the previous operating mode. If it has been in Rest mode, it will switch back to emergency mode, if it has been in Inhibit mode, it will switch back to charging mode

For all the different changes, activating Rest mode and Inhibit mode and sending the Relight command, DC voltage pulses of different lengths are used. The table at Switching between operating modes, p. 30 gives an overview of all the operating modes.

CAUTION!

Even in Rest mode there is self discharge current and an extremely small level of discharge current flowing from the batteries. If the batteries remain in Rest mode for prolonged periods of time this can lead to deep discharge and potential damage. Further information can be found in the data sheet of the batteries (see Reference list, p. 63).

Activate Rest mode

Rest mode is activated as follows:

_ Disconnect power supply

_ Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"

  _ The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 150 - 1,000 ms

  _ The polarity of the voltage pulse does not matter

NOTICE

Rest mode cannot be activated as long as the power supply hasn't been disconnected.
The maximum number of emergency units on one bus is 100 pieces with a maximum recommended cable length of 1,000 metres.
Rest mode voltage can be applied across all emergency modules (parallel connection).

Deactivate Rest mode via Relight command

By sending the Relight command the Rest mode is deactivated. The emergency unit will switch back to emergency mode.
To deactivate Rest mode via Relight command, proceed as follows:

_ Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"

  _ The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 1,001 - 2,000 ms

  _ The polarity of the voltage pulse does not matter

NOTICE

Reapply the power supply does also deactivate Rest mode. In this case, the device switches from Rest mode to charge mode.

Rest mode and Relight function

Activate Inhibit mode

Inhibit mode is activated as follows:

_ Make sure that the mains supply is switched on

_ Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"

  _ The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 150 - 1,000 ms

  _ The polarity of the voltage pulse does not matter

-> Emergency unit switches to Inhibit mode

-> Inhibit mode is active for a duration of 15 minutes

-> Inhibit mode is indicated by indicator LED (double pulsing GREEN)

For further information see Indicator LED, p. 31.

NOTICE

The inhibit mode must be activated before the mains supply is switched off.

Automatically switch from Inhibit mode to Rest mode

The emergency unit automatically switches from Inhibit mode to Rest mode if the following conditions are met:

_ Inhibit mode has been activated -and-

_ Within 15 minutes after activation, the mains supply is switched off

Automatically deactivate Inhibit mode

Inhibit mode is automatically deactivated and the emergency unit switches back to charging mode if the following conditions are met:

_ Within 15 minutes after activation, the mains supply is **not** switched off

Deactivate Inhibit mode via Relight command

By sending the Relight command the Inhibit mode is deactivated. The emergency unit will switch back to charging mode.
To deactivate Inhibit mode via Relight command, proceed as follows:

_ Apply DC voltage pulse at the two terminal points "REST/L" and "REST/N"

  _ The signal must have an amplitude of 9.5 - 22.5 V with a pulse length of 1,001 - 2,000 ms

  _ The polarity of the voltage pulse does not matter

Rest mode and Relight function

Switching between operating modes

The device has four different operating modes (Standby/Charge mode, Emergency mode, Rest mode and Inhibit mode). Depending on the initial mode and the length of the applied DC voltage pulse the device switches between these operating modes. The following table gives an overview:

Applied pulse length	Charging mode	Emergency mode	Rest mode	Inhibit mode
150 - 1,000 ms	Switches to Inhibit mode	Switches to Rest mode	-	-
1,001 - 2,000 ms (Relight command)	-	-	Switches to Emergency mode	Switches to charging mode

Indicator LED

Indicator LED

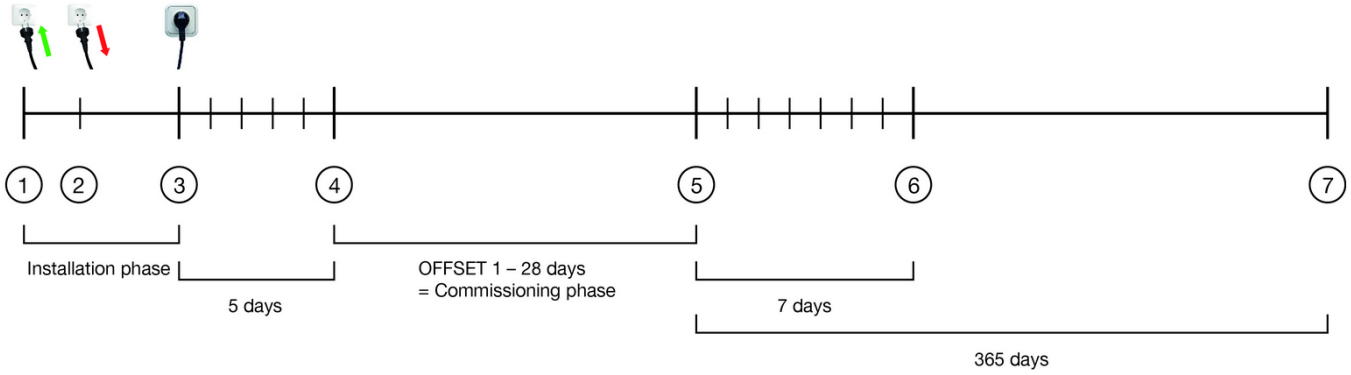
System status is locally indicated by a bi-colour indicator LED.

LED indication	Status	Description
Permanent GREEN	Standby, System OK	Mains operation, battery is charged
Fast flashing GREEN (0,1 s on - 0,1 s off)	Function test underway	
Slow flashing GREEN (1 s on - 1 s off)	Duration test underway	
Double pulsing GREEN	Inhibit mode is activated	The Inhibit mode makes it possible to set the emergency mode to "inhibited"; in this mode, the power can be turned off without switching to emergency mode. The Inhibit mode is activated by sending the inhibit signal, while the modules are still connected to mains. Just as in Rest mode, the device supports the Relight functions. After a break of 15 minutes, the inhibit mode is automatically reset.
Permanent RED	Lamp failure	Open circuit -or- Short circuit -or- LED failure NOTICE After an exchange of the LED module, the indicator LED remains permanent RED. The lamp failure indication remains set until a function test has been successfully completed (automatically with the weekly function test or immediately by briefly interrupting the power supply or by manually starting the function test with a test switch (see Starting the function test, p. 36)). The LED module's mains operation does not reset the lamp failure indication.
Fast flashing RED (0,1 s on - 0,1 s off)	Charging failure -or- device failure	Incorrect charging current NOTICE While the battery is in trickle charge mode and the mains supply is connected, the micro controller in the emergency unit monitors the charging parameters. If an error is detected or a parameter is out of tolerance, the indicator LED switches to fast flashing RED. If the error has been corrected, the indicator LED immediately switches back to GREEN and continues the charging operation of the battery.

Indicator LED

Slow flashing RED (1 s on - 1 s off)	Battery failure	Battery failed duration test or function test -or- Battery is defect -or- Incorrect battery voltage NOTICE Battery failed duration test or function test: If the battery does not reach full operating time, the indicator LED is slow flashing RED. After an exchange of the battery the indicator LED switches to GREEN. To guarantee a satisfactory operating time, the battery is then charged for 20 hours and a second duration test is carried out. NOTICE Battery is defect or incorrect battery voltage: While the battery is in trickle charge mode and the mains supply is connected, the micro controller in the emergency unit monitors the condition of the battery. If an error is detected , the indicator LED switches to RED. If the error has been corrected, the indicator LED immediately switches back to GREEN and continues the charging operation of the battery.
GREEN and RED off	Battery operation	Emergency mode: Mains disconnected -or- mains failure

Settings for emergency tests



Annotation:

(1) First connection to the power supply

(2) Phase, in which the power supply is switched on and off (possibly numerous times)

(3) Phase, in which the power supply is "permanently" connected (no interruption for at least 5 days)

(4) Delaying the commissioning test for 1-28 day

(5) Commissioning test begins

(6) First function test

(7) First duration test

Settings for emergency tests

Test times and test intervals

Devices of the EM powerLED ST FX series are tested via selftest function. The following table gives an overview of the parameters:

Test trigger	Test times	Test intervals
Test triggered by emergency lighting unit	There are two variants for setting the test time. In some cases different rules apply for the setting of the day and the time: _ Automatic setting of the function test: The time of the function test is the same as the time when the device was first connected to the power supply (see (1) in above diagram), the day of the function test is the same as the day when the commissioning test was carried out (see (5) in above diagram and Commissioning test, p. 34). _ Automatic setting of the duration test: The time of the duration test is set by the Adaptive test mode, p. 36, the day of the duration test is the same as the day when the commissioning test was carried out (see (5) in above diagram and Commissioning test, p. 34). _ Manual setting of the test time and the test day for a single luminaire via test switch (see Setting the test time for one luminaire, p. 37). _ Manual setting of the test time and the test day for all the luminaires in an emergency lighting circuit by switching the power supply on and off (see Setting the test time for all the luminaires in an emergency lighting circuit, p. 37). To prevent that the emergency lighting tests of all luminaires are carried out at the same time, each luminaire has a pre-programmed code which delays the test time for a specified time (see Commissioning test, p. 34).	Test time intervals between the tests are fixed: _ Function test: weekly _ Duration test: annual

Commissioning test

The commissioning test is a first duration test. The relevant standard (IEC 62034: Automatic test systems for battery powered emergency escape lighting) requires that such a test is carried out after the installation.

The commissioning test is often made more difficult because the power supply is switched on and off during the installation phase. This is the case, for example, if the site is powered off at night for security reasons. To address this problem, the EM powerLED ST FX monitors the power supply and will only start with the commissioning test if the power supply hasn't been interrupted for 5 days.

To prevent that all the luminaires perform the emergency test at the same time, each luminaire has a pre-programmed code with a value of 1-28, which delays the test time of that luminaire for a specified time.

_ Devices with code 1 will be tested one day after the completion of the 5 day long monitoring of the power supply (that is 6 days after the uninterrupted connection to the supply).

_ Devices with code 2 will be tested two days after the completion of the 5 day long monitoring of the power supply (that is 7 days after the uninterrupted connection to the supply).

_ Devices with higher code numbers will be tested with a delay that corresponds to that code number.

28 days after the start of the commissioning all devices will have completed the required commissioning test.

Settings for emergency tests

The day of the commissioning test serves as a reference point for all further function and duration tests (see Test times and test intervals, p. 34).
Function tests will be performed on the same day in a weekly interval, duration tests will be performed on the same day in an annual interval.

Weekly function test

The 5 second long, weekly function test serves to check the functionality of the emergency unit, the batteries and the LED module.

The first function test after the commissioning test would normally take place one week after the start of the commissioning test.
In the actual implementation of this and all further functional tests two aspects must be considered, however:

_ To prevent that people are on the site and are disturbed by the test, the start of the function test is delayed until the switched phase is switched off.
  _ If this is the case, the function test will be carried out 10 seconds later.
  _ If this is not the case, because the switched phase remains permanently switched on, the function test will be carried out exactly 24 hours later, regardless of whether the switched phase is then turned off or not.

NOTICE

While waiting for the switched phase to be switched off (which can take up to 24 hours), the indicator LED shows that the test has not been carried out satisfactorily (fast blinking GREEN).

_ If the function test detects a battery failure and the battery was not fully charged at the test time, the device returns to charging mode and starts the function test a second time once the battery is fully charged.

NOTICE

In this case (battery failure and battery not fully charged), the indicator LED does not show an error.
During the charging of the battery, the indicator LED shows that the function test is continuing in the background (fast flashing GREEN).
If the charging of the battery is completed and a function test has been carried out but the status still doesn't change, the indicator LED shows a battery failure (slow flashing RED).

NOTICE

If the power supply is interrupted, the information in the EM powerLED ST FX is stored for at least one week. If the power supply is interrupted for more than one week, the EM powerLED ST FX will perform another commissioning test when the power supply returns (after 20 hours initial charge mode).

NOTICE

If the power supply is interrupted during battery replacement, the EM powerLED ST FX loses its memory contents. When the power supply returns, the EM powerLED ST FX will charge the battery for 20 hours and then perform a commissioning test.

Annual duration test

The annual duration test checks whether the batteries are able to ensure the required operating time of 1, 2 or 3 hours.

Settings for emergency tests

The first duration test after the commissioning test would normally take place exactly one year after the start of the commissioning test.
In the actual implementation of this and all further duration tests two aspects must be considered, however:

_ To prevent that the duration test is carried out at a time of maximum hazard or highest presence density, the device automatically uses the adaptive test mode, p. 36 to determine a suitable test time.

_ Furthermore, the test time can be set manually (see Functionality of the test switch, p. 36).

NOTICE

If the power supply is interrupted during battery replacement, the EM powerLED ST FX loses its memory contents. When the power supply returns, the EM powerLED ST FX will perform another commissioning test (after 20 hours initial charge mode).

Adaptive test mode

Adaptive test mode sets the time for the duration test to a time of minimum risk and minimum presence.

This is achieved by monitoring the switched phase of the lighting. This tells the emergency lighting unit which times the lighting is switched off (i.e. no one is in the room) and the unit stores these times. If non-presence of more than five hours is detected the start time for the duration test is set to two hours after the start of the non-presence time.

Example:
A room is not used between 8 pm and 6 am. The lights are switched off. The duration test will therefore begin at 10 pm. This provides a certain buffer before the start and after the end of the duration test, and the batteries can be recharged after the duration test before the room is in use again.

Room usage is monitored on a monthly basis and the time for the duration test is constantly adjusted. This allows for seasonality in room usage to be taken into account.

If a suitable time cannot be found (perhaps because the room is in use round the clock) the duration test is performed at the time set during startup (this is the time when the emergency lighting unit was first connected to the power supply). If subsequently a suitable period is found the time for the duration life test will be suitably adapted.

If none of this is successful because the startup time is unsuitable and no other suitable period can be found, the time for the duration test can be set manually (see Setting the test time, p. 37).

Functionality of the test switch

The optional test switch enables you to make a series of settings manually.

NOTICE

The test switch can remain permanently connected and used as a startup tool.

Starting the function test

_ A short press on the button (0.15 - 1 s) starts a function test lasting 5 seconds.
-> The indicator LED flashes GREEN.
-> The result of the function test is displayed on the two-colour indicator LED.

Settings for emergency tests

Starting the test mode

_ A longer press on the button (1 - 10 s) switches the light source to emergency mode but does not perform a time controlled function test.
-> On release of the button the emergency units switch back to charge mode.
-> The indicator LED goes off for 1 second and then on for the rest of the time (maximum of 9 seconds).

Setting the test time

The time and day for the function and duration test is stored in the internal timer. To change the test time, the timer needs to be reset. The previously stored test time will be deleted and replaced by the time of resetting.

NOTICE

Resetting the timer deactivates the adaptive test mode, p. 36. Because of this, the test time is no longer adapted to the room usage of the building. The function test and duration test is always carried out at the newly set test time.

The timer can be reset for one luminaire or for multiple luminaires:

Setting the test time for one luminaire

_ Holding down the button (> 10 s) resets the timer.
-> The indicator LED goes off for 1 second and then shows GREEN and goes off again after 10 seconds.
-> By going off after 10 seconds the indicator LED confirms that the timer has been successfully reset (to the current time).

Setting the test time for all the luminaires in an emergency lighting circuit

_ If the unswitched power supply of an emergency lighting circuit is switched on and off 5 times within 60 seconds, the timers for all the emergency units in the emergency lighting circuit is reset (to the current time).

Determining light output in emergency operation

To determine the light output in emergency operation the following parameters are crucial:

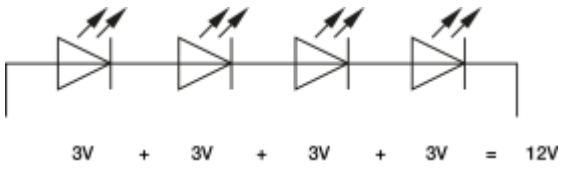
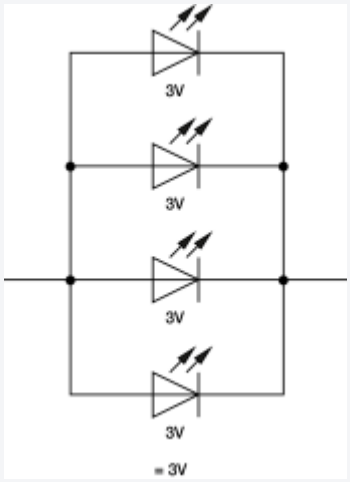
1. LED forward voltage (total forward voltage of all connected LED modules)
2. LED current in emergency operation
3. Light output in emergency operation

Parameter 1: LED forward voltage

_ The total forward voltage of all connected LED modules must be within the forward voltage range of the EM converterLED ST FX.

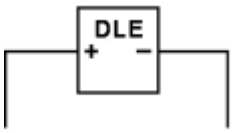
Total forward voltage of all LED modules

The forward voltage of a single LED module can be found in the data sheet. When calculating the total forward voltage of all LED modules, series and parallel circuits must be handled differently:

Series circuit	Parallel circuit
	
The values of the individual LED modules are summed up.	The total value is the same as the value of a single LED module.

Parameter 1: LED forward voltage

Example 1: 1 LED module DLE



Given:

_ Forward voltage DLE: 24.2 V (taken from data sheet)

Wanted:

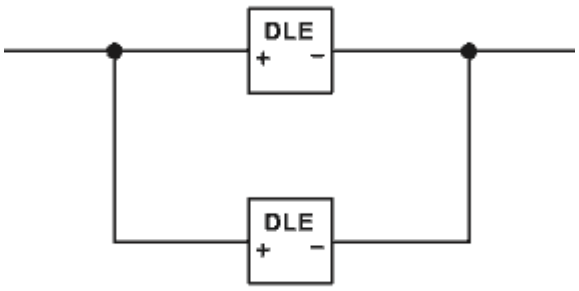
_ Total forward voltage of all LED modules in emergency operation

Result:

_ The total forward voltage of all LED modules is 24.2 V because there is only 1 LED module.

Parameter 1: LED forward voltage

Example 2: 2 LED module DLE in parallel



Given:

_ Forward voltage DLE: 24.2 V (taken from data sheet)

Wanted:

_ Total forward voltage of all LED modules?

Result:

_ The total forward voltage of all LED modules is 24.2 V (no addition of the values in a parallel circuit).

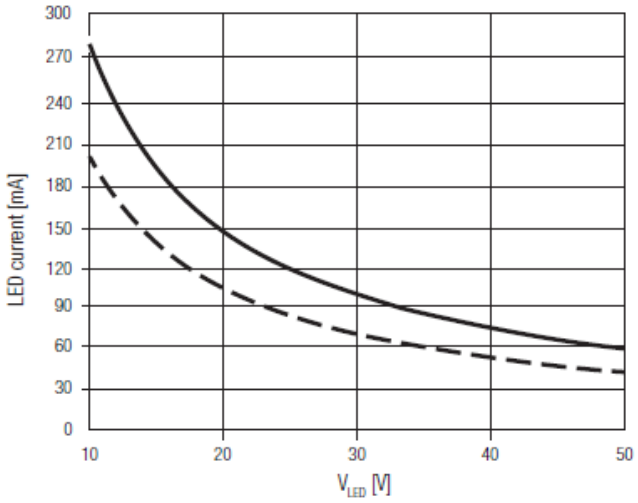
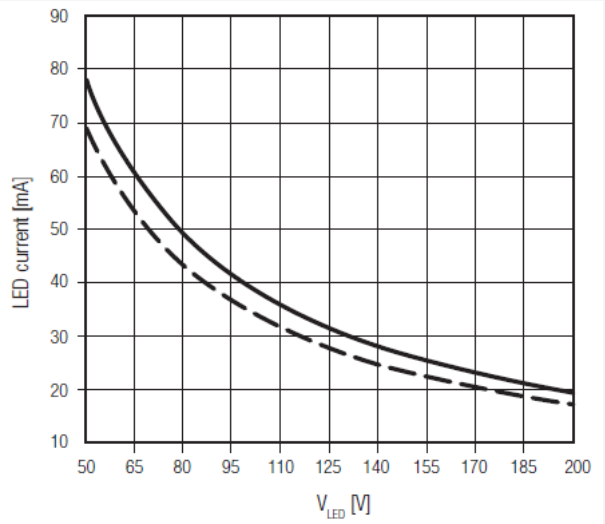
NOTICE

As Example 2 shows, parallel circuits make it possible to use multiple LED modules where the forward voltage does not add up.

Parameter 2: LED current

Parameter 2: LED current

Each EM powerLED ST FX has a specific current/voltage characteristic. The corresponding current/voltage curve can be found in the datasheet:

EM powerLED ST FX 103 50V	EM powerLED ST FX 104 50V
	

Knowing the total forward voltage of all LED modules, the value for the LED current can be read from the current/voltage curve:

_ Mark the value of the total forward voltage of all LED modules on the x-axis of the graph

_ From that point move up vertically
-> The crossing points with the two curves define a range of values.

The value of the LED current lies within this range. The effective value depends on tolerances.

Parameter 2: LED current

Example 1: 1 LED module DLE

Given:

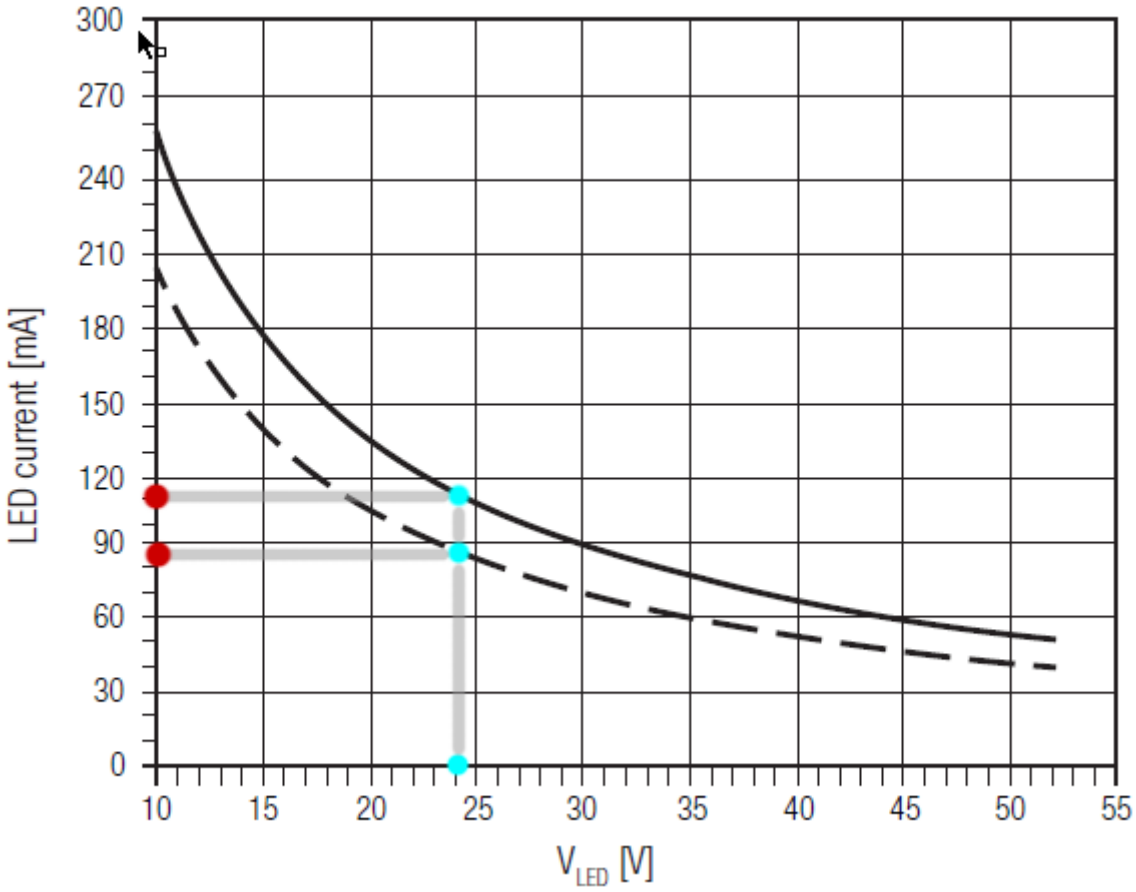
_ Total forward voltage of all LED modules: 24.2 V (calculated before)

Wanted:

_ LED current?

Result:

Figure: Determining LED current for EM converterLED ST FX 103 50V



_ The two crossing points are at around 85 mA (minimum value) and 111 mA (maximum value).

_ The effective value of the LED current is between these two values.

Parameter 3: Light output in emergency operation

Parameter 3: Light output in emergency operation

The ratio between emergency operation and normal operation is the same for light output and LED current. The values for normal operation can be found in the LED module data sheet, the value for the LED current in emergency operation can be found in the data sheet (see example above).

$$\frac{light\ output\ in\ emergency\ operation}{light\ output\ in\ mains\ operation} = \frac{LED\ current\ in\ emergency\ operation}{LED\ current\ in\ mains\ operation}$$

With this equation the light output in emergency operation can be isolated and calculated:

$$light\ output\ in\ emergency\ operation =$$

$$\frac{LED\ current\ in\ emergency\ operation}{LED\ current\ in\ mains\ operation}\ x\ light\ output\ in\ mains\ operation$$

Example 1: 1 LED module DLE

Given:

_ LED current in emergency operation: approx. 85 mA (minimum value) and approx. 111 mA (maximum value) (taken from the previous example, see Example 1: 1 LED module DLE, p. 42)

_ LED current in mains operation 750 mA (taken from data sheet DLE G3 2000 lm, Article number: 89600574)

_ Light output in mains operation: 2,100 lm (taken from data sheet DLE G3 2000 lm, Article number: 89600574)

Wanted:

_ Light output in emergency operation?

Result:

_ Minimum light output in emergency operation = 85 mA / 750 mA * 2,100 lm = 238 lm

_ Maximum light output in emergency operation = 111 mA / 750 mA * 2,100 lm = 310.8 lm

Compatibility between LED module and LED Driver

Compatibility between LED module and LED Driver

There are two stages involved in the check for compatibility between the LED module and the LED Driver.

_ The requirements for operating together can be checked by comparing the data sheets

_ Subsequent practical tests can ensure that there are no unexpected problems during actual operation

Comparison of data sheet values with a 5-point guideline

Different values for the two devices need to be considered when comparing the data sheets. The following table shows which values are involved and which requirements they must meet.

Comparison of…	Value in LED module		Value in LED Driver	Detailed procedure
(1) Current	I_{rated} @HO	≥	Output current	_ Determine forward current of module _ Check whether LED Driver can be operated with the same output current _ Check whether I_{max} of module is greater than or equal to output current of LED Driver (including tolerances) ⚠ CAUTION! The I_{max} can be temperature dependent! Refer to the derating curve of the LED module data sheet. turn page... →
	I_{max}	≥	Output current + tolerances	

Compatibility between LED module and LED Driver

<table>
<tr><th>Comparison of…</th><th>Value in LED module</th><th></th><th>Value in LED Driver</th><th>Detailed procedure</th></tr>
<tr><td rowspan="3">(2) Voltage</td><td>Min. forward voltage</td><td>≥</td><td>Min. output voltage</td><td rowspan="2">_ Check whether voltage range of LED module is completely within the voltage range of LED Driver

⚠ CAUTION!
The forward voltage is temperature dependent!
Refer to the Vf/t_p diagram in the data sheet.</td></tr>
<tr><td>Max. forward voltage</td><td>≤</td><td>Max. output voltage</td></tr>
<tr><td>Min. forward voltage @ min. dim level</td><td>≥</td><td>Min. output voltage</td><td>Only relevant for dimmable LED Driver !

ⓘ NOTICE
To ensure full dimming performance the forward voltage of the LED module at min. dim level must be greater than or equal to the min. output voltage of the driver.

_ Determine the forward voltage of the LED module at lowest dim level
_ In case there is no data available for the LED module at lowest dim level: take the min. forward voltage minus 20% as an approximation
_ Check whether the forward voltage of the LED module is greater than or equal to the min. output voltage of the driver</td></tr>
<tr><td>(3) LF current ripple</td><td>Max. permissible LF current ripple</td><td>≥</td><td>Output LF current ripple (<120Hz)</td><td>_ Check whether max. permissible LF current ripple of LED module is greater than or equal to output LF current ripple of LED Driver</td></tr>
<tr><td>(4) Max. peak current</td><td>Max. permissible peak current</td><td>></td><td>Max. output current peak</td><td>_ Check whether max. permissible peak current of LED module is greater than max. output current peak of LED Driver</td></tr>
<tr><td rowspan="2">(5) Power (pertinent for multi channel LED Driver)</td><td>Min. power consumption</td><td>></td><td>Min. output power</td><td rowspan="2">_ Check whether power range of LED module is completely within output power range of LED Driver</td></tr>
<tr><td>Max. power consumption</td><td><</td><td>Max. output power</td></tr>
</table>

Compatibility between LED module and LED Driver

Application of the 5-point guideline

The compatibility check with the 5-point guideline is shown here using two examples.

Example 1

Comparison data for LED Driver

LED Driver	
Designation	LCI 20W 350mA-900mA TOP C
Manufacturer	TRIDONIC

Data sheet values of LED Driver	
Output current	500 mA
Output current tolerance	± 5 %
Min. output voltage	18 V (1)
Max. output voltage	40 V (1)
Output LF current ripple	± 2 %
Max. output current peak	600 mA
Output power	20.0 W

(1) Values at 500mA

Comparison data for LED module

LED module	
Designation	Fictitious LED module
Manufacturer	Other manufacturer

Data sheet values of LED module	
Forward current	500 mA
Max. DC forward current	1,050 mA
Typ. forward voltage	33 V +/-10 % (1)
Min. forward voltage	29.7 V (1)
Max. forward voltage	36.3 V (1)
Max. permissible LF current ripple	100 mA

Compatibility between LED module and LED Driver

Max. permissible peak current	1,500 mA
Power draw	16.4 W

(1) Values at 500mA

Questions

_ Are the two components mutually compatible?

_ Can the required luminous flux of 1,510 lm be achieved with this combination?

Compatibility between LED module and LED Driver

Procedure

Comparison of data sheet values

Comparison of…	Value in LED module		Value in LED Driver	Result	Explanation
(1) Current	500 mA	=	500 mA	✓	_ To produce a luminous flux of 1,510 lm the LED module must be operated with a forward current of 500 mA. _ The LED Driver can be set so that it delivers precisely this value of 500 mA as the output current (with a resistance of 49.90 kOhm).
	1,050 mA	≥	525 mA	✓	_ The output current of the LED Driver including tolerances (500 mA + 5 % = 525 mA) is less than or equal to the max. DC forward current of the LED module (1,050 mA).
(2) Voltage	29.7 V	>	18 V	✓	_ The voltage range of the LED module (29.7 V - 36.3 V) lies completely within the voltage range of the LED Driver (18 V - 40.0 V).
	36.3 V	<	40 V	✓	
(3) LF current ripple	100 mA	>	10.5 mA	✓	_ The Output LF current ripple (2 % of output current plus tolerances: [500 mA + 5 %] x 0.02 = 10.5 mA) of the LED Driver is less than the max. permissible LF current ripple of the LED module (100 mA).
(4) Max. peak current	1,500 mA	>	600 mA	✓	_ The max. output current peak of the LED Driver (500 mA + 20 % = 600 mA) is less than the max. permissible peak current with which the LED module can be operated (1,500 mA).
(5) Power	16.4 W	<	20.0 W	✓	_ The power draw of the LED module (16.4 W) is less than the output power of the LED Driver (20.0 W).

Result

All the values meet the requirements. The components are mutually compatible.

Compatibility between LED module and LED Driver

Example 2

Comparison data for LED Driver

LED Driver	
Designation	LCI 20W 350mA-900mA TOP C
Manufacturer	TRIDONIC

Data sheet values of LED Driver	
Output current	500 mA
Output current tolerance	± 5 %
Min. output voltage	18 V (1)
Max. output voltage	40 V (1)
Output LF current ripple	± 2 %
Max. output current peak	600 mA
Output power	20.0 W

(1) Values at 500mA

Comparison data for LED module

LED module	
Designation	Fictitious LED module
Manufacturer	Other manufacturer

Data sheet values of LED module	
Forward current	500 mA
Max. DC forward current	1,050 mA
Typ. forward voltage	39.5 V +/-10 % (1)
Min. forward voltage	35.55 V (1)
Max. forward voltage	43.45 V (1)
Max. permissible LF current ripple	100 mA
Max. permissible peak current	1,500 mA
Power draw	19.75 W

(1) Values at 500mA

Compatibility between LED module and LED Driver

Questions

_ Are the two components mutually compatible?

_ Can the required luminous flux of 1,800 lm be achieved with this combination?

Compatibility between LED module and LED Driver

Procedure

Comparison of data sheet values

Comparison of…	Value in LED module		Value in LED Driver	Result	Explanation
(1) Current	500 mA	=	500 mA	✓	_ To produce a luminous flux of 1,800 lm the LED module must be operated with a forward current of 500 mA. _ The LED Driver can be set so that it delivers precisely this value of 500 mA as the output current (with a resistance of 49.90 kOhm).
	1,050 mA	≥	525 mA	✓	_ The output current of the LED Driver including tolerances (500 mA + 5 % = 525 mA) is less than or equal to the max. DC forward current of the LED module (1,050 mA).
(2) Voltage	35.55 V	>	18 V	✓	_ The voltage range of the LED module (35.55 V - 43.45 V) is **not** within the voltage range of the LED Driver (18 V - 40.0 V)
	43.45 V	<	40 V	✗	
(3) LF current ripple	100 mA	>	10.5 mA	✓	_ The Output LF current ripple (2 % of output current plus tolerances: [500 mA + 5 %] x 0.02 = 10.5 mA) of the LED Driver is less than the max. permissible LF current ripple of the LED module (100 mA).
(4) Max. peak current	1,500 mA	>	600 mA	✓	_ The max. output current peak of the LED Driver (500 mA + 20 % = 600 mA) is less than the max. permissible peak current with which the LED module can be operated (1,500 mA).
(5) Power	19.75 W	<	20.0 W	✓	_ The power draw of the LED module (19.75 W) is less than the output power of the LED Driver (20.0 W).

Result

One of the values **does not** meet the requirements. The components are **not** mutually compatible.

Practical tests

Practical tests are used to ensure fault-free operation of the LED module and LED Driver. The following aspects must be checked.

Technical aspects

_ Transient behaviour

_ Colour shift

_ Connection during operation

Installation notes

_ Parasitic capacitance

Visual aspects

_ Flickering

_ Stroboscopic effect (video applications)

_ Dimming behaviour

_ Colour change/stability

_ Luminous flux

Conditions

When conducting the tests the following conditions must be considered:

_ All tolerances

_ Entire temperature range

_ Different output voltage ranges (incl. no load)

_ Entire dimming range

_ Short circuit

NOTICE

If the values are slightly over or under the specified threshold values or if there are any other concerns or questions please contact Technical Support: techservice@tridonic.com

NOTICE

The cabling, wiring and mounting for an LED Driver varies depending on the design and manufacturer of the LED module.
The following description should therefore not be taken as comprehensive installation instructions but merely as important general information.

To obtain further information, proceed as follows:

_ Read the documentation provided by the lamp manufacturer. Follow the guidelines and instructions of the lamp manufacturer!

_ Observe all relevant standards. Follow the instructions given in the standards!

Installation notes

Safety information

WARNING!

_ Comply with the general safety instructions (see Safety instructions, p. 5) !

_ To avoid failures due to ground faults protect the wiring against mechanical loads from sharp-edged metal parts (e.g. cable penetrations, cable holders, metal frames, etc.

_ Electronic control gear from Tridonic are protected for a maximum of 48 hour against overvoltage of up to 320 V. Make sure that the control gear is not exposed to overvoltage for long periods!

_ Electronic control gear of the EM powerLED ST FX series from Tridonic have type of protection IP 20. Comply with the requirements for this type of protection!

Installation notes

Function of the earth terminal

The earth connection is conducted as protection earth (PE). The LED Driver can be earthed via earth terminal or metal housing (if device has metal housing). If the LED Driver will be earthed, protection earth (PE) has to be used. There is no earth connection required for the functionality of the LED Driver. Earth connection is recommended to improve following behaviour.

_ Electromagnetic interferences (EMI)

_ LED glowing at standby

_ Transmission of mains transients to the LED output

In general it is recommended to earth the LED Driver if the LED module is mounted on earthed luminaire parts respectively heat sinks and thereby representing a high capacity against earth.

Avoiding residual LED glow on standby

Residual LED glow on standby may occur as a result of capacitive leakage currents from the LED module onto earthed luminaire parts (such as the heat sink). This mainly affects high-efficiency LED systems with large surface areas installed in luminaires with protection class 1.

The topology has been improved so that residual LED glow can be virtually eliminated by earthing the devices.

NOTICE

If the LED Driver cannot be earthed or if earthing is not desired, residual LED glow can be minimised by adequate insulation (for example by using heat-conducting double-sided insulation foil).

Avoiding the transfer of mains transients to the LED output

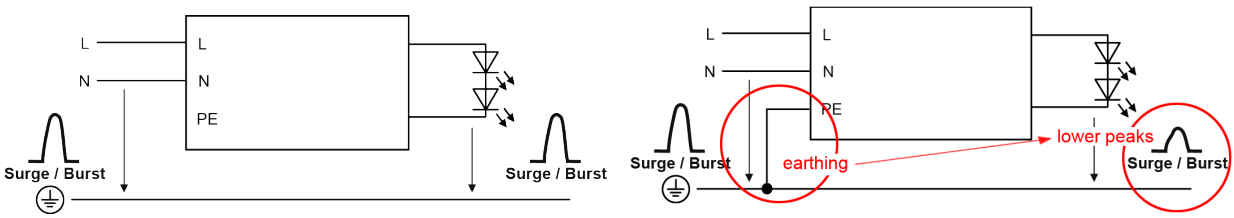
The transfer of mains transients to the LED output presents a problem for many LED Driver topologies currently on the market, and TRIDONIC devices may be affected.

Voltage peaks at the input of the LED Driver may be transferred to the output of the device where they lead to differences in potential between the LED output and earthed luminaire parts. These differences in potential may result in flashovers if the insulation is inadequate or if the creepage and clearance distances are too small. Flashovers will cause the LED module to fail.

Earthing the LED Driver attenuates voltage peaks and reduces the likelihood of flashovers. The precise degree of attenuation depends on the capacitance of the LED module with respect to earth. If voltages at the output are higher than 0.5 kV, it is mentioned in the data sheet.

Installation notes

Figure: Voltage peaks for LED Driver without earthing (left) and with earthing (right)



NOTICE

Irrespective of whether the LED Driver is earthed or not, LED modules must be insulated in accordance with the requirements of the luminaire protection class. Improved insulation of the LED module can also reduce the risk of flashovers.

Installation notes

Routing the wires

Tests

NOTICE

The performance of the prescribed tests and compliance with relevant standards are the responsibility of the luminaire manufacturer.
The following descriptions merely indicate the most important tests and are no substitute for a full research of the relevant standards.

Insulation and dielectric strength testing of luminaires

LED Driver for lamps are sensitive to high-voltage transients. This must be taken into consideration when subjecting luminaires to routine testing during manufacture.

According to IEC 60598-1 Annex Q (for information only!) and ENEC 303-Annex A, each luminaire should be subjected to an insulation test for 1 second at 500 V DC. The test voltage is applied between the linked phase/neutral conductor terminal and the protective earth terminal. The insulation resistance must be at least 2 megaohm.

CAUTION!

As an alternative to measuring the insulation resistance, IEC 60598-1 Annex Q describes a dielectric strength test at 1,500 V AC (or 1.414 x 1,500 V DC). To avoid damaging electronic control gear, it is strongly disadvised to perform this dielectric strength test.

Type testing

Type testing of the luminaire is performed according to IEC 60598-1 Section 10.
The wiring for protection class 1 luminaires is tested at a voltage of 2xU + 1,000 V. In order not to overload the control gear all the inputs and outputs of the control gear are connected to one another.
U_{out} is used for measuring the voltage for luminaires with control gear with U_{out} > 250 V:
For U_{out} 480 V the voltage for the type test is 2000 V.

Wiring

NOTICE

The wiring procedure is device specific. Further information about wiring, wire cross sections and the length of stripped off insulation can be found in the data sheet.

Wiring guidelines

_ The cables should be run separately from the mains connections and mains cables to ensure good EMC conditions.

_ The LED wiring should be kept as short as possible to ensure good EMC. The max. secondary cable length is 2 m (4 m circuit), this applies for LED output as well as for I-select and temperature sensor.

_ Depending on the design of the luminaire it may be possible to improve the radio interference properties by earthing the device at the earth connection.

Installation notes

_ The LED Driver has no inverse-polarity protection on the secondary side. Wrong polarity can damage LED modules with no inverse-polarity protection.

_ Maximum lead length for the test switch and indicator LED connection is 1 m.

_ The test switch and indicator LED wiring should be separated from the LED leads to prevent noise coupling.

_ The battery wires are specified with a cross section of 0.5 mm and a length of 1.3 m.

_ If the optional mains switch is not used, connect S/L to L.

Wiring the plug-in terminal

_ Use solid wire or stranded wire with the correct cross-section

_ Strip off correct length of insulation; you may need to twist the tool slightly

_ If stranded wire is used: push onto the terminal from above to be able to insert the wire

_ Insert the bare end into the terminal

Detaching the plug-in terminal

_ Push onto the terminal from above to release the wire

_ Pull out the wire at the front

Installation notes

Maximum loading of circuit breakers

Importance of maximum loading

A circuit breaker is an automatically operated electrical switch that protects an electrical circuit from damage caused by overload or short circuit. Unlike a fuse that must be replaced if it triggers, a circuit breaker can be reset (either manually or automatically) and used further. Circuit breakers are available in different sizes and with different technical data.

The inrush current is a short increased peak current that occurs when an electronic control gear is switched on.

In electrical installations, numerous control gear are connected to one circuit breaker. The maximum loading of a circuit breaker indicates how many control gear can be connected to the circuit breaker without triggering the circuit breaker because of the summation of the different inrush currents. The value is calculated through simulation programs based on the circuit breakers characteristic.

Information about the maximum loading can be found in Tridonic data sheets. The following table shows the data for EM powerLED ST FX 45W as an example

utomatic circuit breaker type	C10	C13	C16	C20	B10	B13	B16	B20	Inrush current	
Installation Ø (in mm^2)	1.5	1.5	2.5	2.5	1.5	1.5	2.5	2.5	I_{max}	time
EM powerLED ST FX	18	26	30	36	9	13	15	18	23.9 A	187 µs

Calculation of maximum loading

Tripping characteristics of circuit breakers

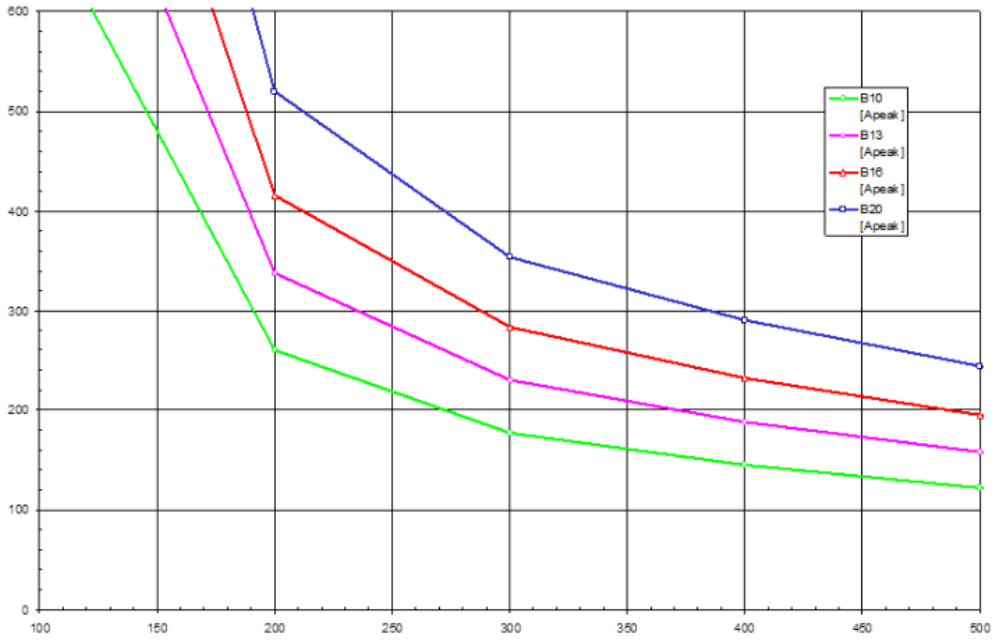
The load at which a circuit breaker triggers is defined by the height and the duration of the applied current.
The following table shows exemplary values for different circuit breakers (B10, B13, B16, B20).

Duration [µs]	Current B10 [A_{peak}]	Current B13 [A_{peak}]	Current B16 [A_{peak}]	Current B20 [A_{peak}]
100	700	910	1,120	1,400
200	260	338	416	520
300	177	230.1	283	354
400	145	188.5	232	290
500	122	158.6	195	244
600	110	143	176	220
700	102	132.6	163	204
800	97	126.1	155	194
900	93	120.9	149	186
1000	90	117	144	180

The combination of both parameters can also be displayed graphically. This results in the tripping characteristic for a certain circuit breaker.

Current [A]

Installation notes



Duration [µs]

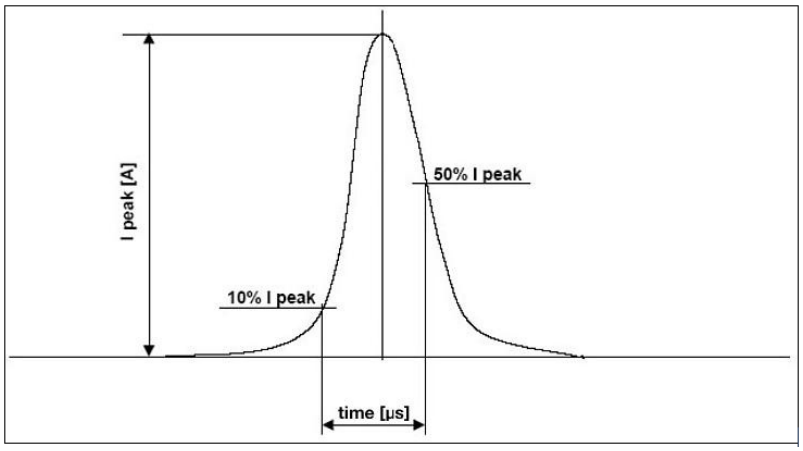
NOTICE

Information about the specific tripping characteristics of a circuit breaker must be requested from the respective manufacturer !

Calculation of the inrush current

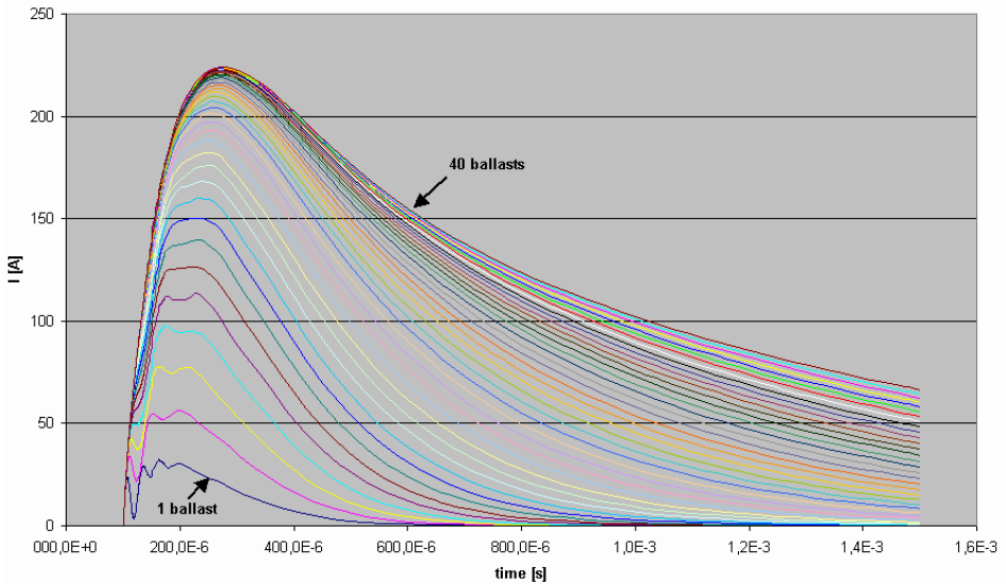
The inrush current of a control gear is also defined by its duration and its height. The duration is typically measured as the time between 10 % of maximum current (ascending) and 50 % of maximum current (descending).

The following illustration shows the inrush current of a single control gear:



If several control gear are connected to one circuit breaker, the inrush current increases with the number of connected devices.

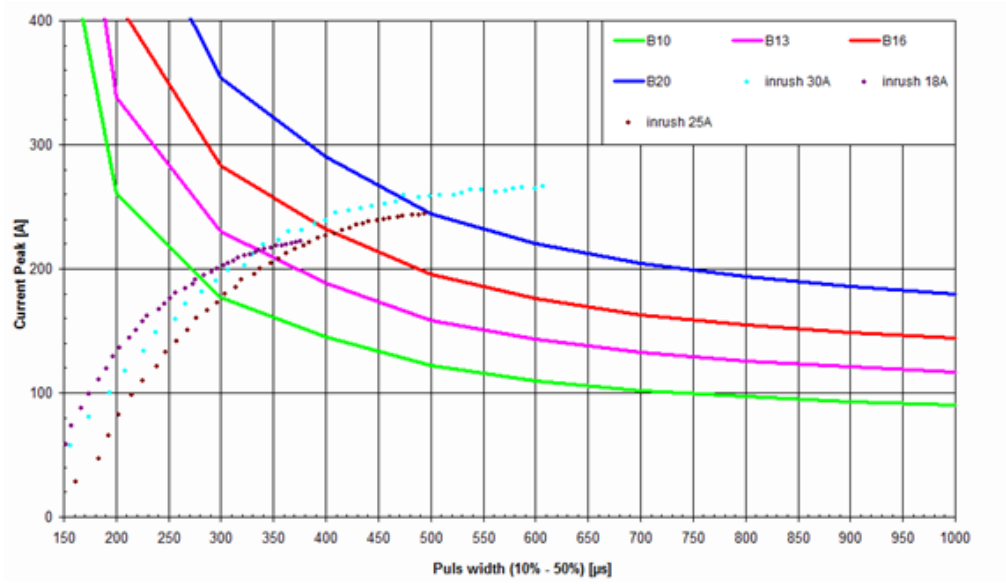
Installation notes



Implementation of the simulation

The above-mentioned parameters, height and duration of the current pulse in both the circuit breaker and the control gear, are entered into the simulation program.

The result of the simulation is presented in graphical form.



The different elements have the following meaning:

_ Circuit breaker:

B10, B13, B16, B20 (solid line) represent the tripping characteristics of different circuit breakers.

_ Inrush current:

The dotted lines represent different inrush currents.

The index of a point signifies the number of control gear, that is, point 1 represents the result for 1 ballast, point 2 the result for 2 ballasts, etc.

Installation notes

The simulation results can be read as follows:

_ The crossing of the two lines shows the maximum value for the selected combination of circuit breaker and inrush current.

_ The index of the point at this maximum value shows the max. number of ballasts.

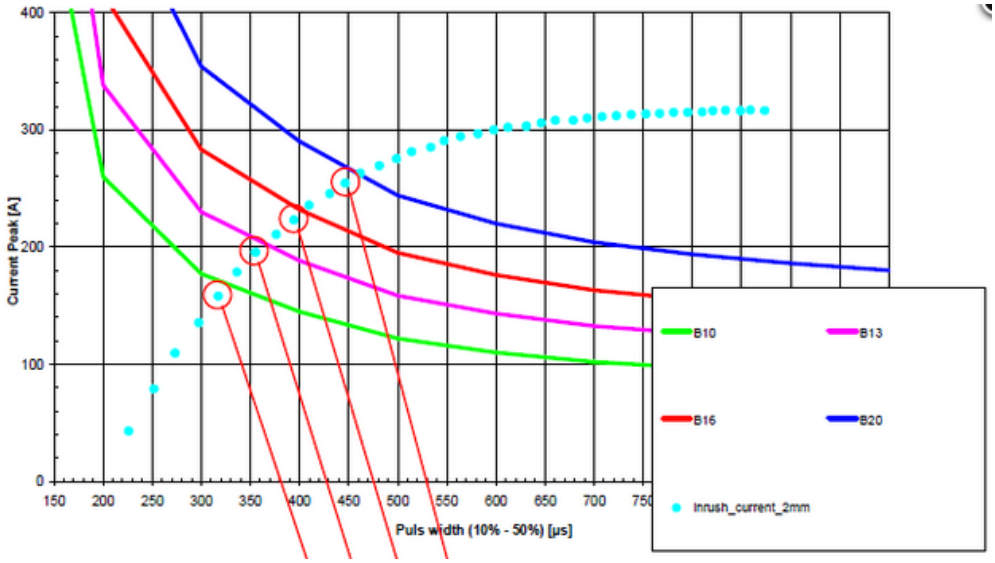
The following example shows the maximum number of control gear at four different circuit breakers:

_ max. 5 devices at circuit breaker B10 (green tripping characteristic)

_ max. 7 devices at circuit breaker B13 (pink tripping characteristic)

_ max. 9 devices at circuit breaker B16 (red tripping characteristic)

_ max. 12 devices at circuit breaker B20 (blue tripping characteristic)



Installation notes

NOTICE

The results of different simulations can only be compared if all of the relevant factors are the same. The following points can influence the results:

_ Tripping characteristic used for the circuit breakers

_ Definition used for the duration of the inrush current (Tridonic: 10-50 %)

_ Gear used for the measurement of the inrush current (especially important: Which electrolytic capacitor is installed in the control gear?)

_ Considering a safety buffer (Tridonic: +20 % for the electrolytic capacitor)

_ Considering different system impedances

_ Switch-on point used: should always be at max. input voltage

_ Adopted cable lengths and cable data (Tridonic: Cable length 40 cm; Resistivity: 0.0172 Ohm * mm^2 / m; inductance: 5nH / cm; terminal resistance: 2mOhm)

_ The modeling of the control gear is performed from the input to the bus voltage electrolytic capacitor . For inductance the saturation values must be used.

Reference list

Related documents

_ Data sheet EM powerLED ST FX C 45 W: http://www.tridonic.com/com/en/download/data_sheets/EM_powerLED_ST_FX_C_45W_en.pdf

_ Data sheet EM powerLED ST FX SR 45 W: http://www.tridonic.com/com/en/download/data_sheets/EM_powerLED_ST_FX_SR_45W_en.pdf

_ Data sheet EM powerLED PRO DIM C 45 W: http://www.tridonic.com/com/en/download/data_sheets/EM_powerLED_PRO_DIM_C_45W_en.pdf

_ Data sheet EM powerLED PRO DIM SR 45 W: http://www.tridonic.com/com/en/download/data_sheets/EM_powerLED_PRO_DIM_SR_45W_en.pdf

_ Flyer EM powerLED PRO DIM C/SR: http://www.tridonic.com/com/en/download/brochures/Flyer_EM_powerLED_PRO_DIM_C_SR_45W.pdf

_ Brochure Emergency Lighting: http://www.tridonic.com/com/en/download/Emergency_Lighting_Overview_EN.pdf

_ corridorFUNCTION: http://www.corridorfunction.com/corridorFUNCTION/index.html

Additional information

_ Declarations of conformity: http://www.tridonic.com/com/en/news-declarations-of-conformity.asp

_ Company certificates: http://www.tridonic.com/com/en/company-certificates.asp

_ Guarantee conditions: http://www.tridonic.com/com/en/guarantee.asp

_ Data sheets: http://www.tridonic.com/com/en/data-sheets.asp

_ Environmental declarations: http://www.tridonic.com/com/en/environmental-declarations.asp

_ Tender text: http://www.tridonic.com/com/en/tender.asp

_ Other technical documents: http://www.tridonic.com/com/en/technical-docs.asp

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