LED solutions

DC-String

Product Manual

TRIDONIC

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Scope of documentation

1. Validity

These operating instructions are valid for LCU DC power supply devices and LMI DC LED Drivers.
If a reference is made to one of the two versions then the descriptions are valid only for that version.

TRIDONIC GmbH & Co KG is constantly striving to develop all its products. This means that there may be changes in form, equipment and technology.
Claims cannot therefore be made on the basis of information, diagrams or descriptions in these instructions.
The latest version of these operating instructions is available on our home page at
http://www.tridonic.com/com/en/operating-instructions.asp

1.1. Copyright

We are always open to comments, corrections and requests. Please send them to info@tridonic.com

1.2. Imprint

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General safety instructions

2. General safety instructions

The instructions in this section have been compiled to ensure that operators and users of LCU DC power supply devices and LMI DC LED Drivers 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.

2.1. Intended use

2.1.1. Proper use

Operation of light modules and associated DC LED drivers in luminaires and track light systems. The device may only be used for this intended purpose.

2.1.2. 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.

2.2. 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!

2.3. Environment

⚠ DANGER!

Not to be used in corrosive or explosive environments.

⚠ CAUTION!

Risk of damage caused by humidity and condensation

_ Only use the control device in dry rooms and protect it against humidity!

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

General safety instructions

2.4. 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!

Key features

3. Key features

3.1. Description of key features

Modern LED technology not only provides maximum efficiency and long life for the luminaire, but also enables luminaires to be miniaturised. With its new DC-String, Tridonic has the solution to minimise shapes and therefore maximise ceiling harmonics.

DC-String at a glance:

_ Miniaturisation of luminaires and tracks.
Tridonic’s new DC-String provides miniaturisation of luminaires and tracks to achieve a harmonic and aesthetic ceiling.

_ Individual luminaire control via the DC power lines:
Despite the miniaturisation, DC-String still offers full control of individual track luminaires by sending the commands via the DC power lines.

_ Safe and easy luminaire exchange by everyone.
Due to the low DC voltage in the track, a luminaire replacement is safe and easy for everyone.

Layer structure

3.2. Two-part layer structure

LCU DC power supply and LMI DC LED Driver both contain two different layers (DIM and FO).
The combinations of LCU DIM + LMI DIM and LCU FO + LMI FO differ as follows:

3.2.1. Dimming

Portfolio	LCU DIM + LMI DIM	LCU FO + LMI FO
Dimmable	✅ Control for dimming LMI DIM	❎ no control for dimming
Dimming method	Amplitude dimming	
Dimming range	100 to 5%	
Dimming curve	Logarithmic dimming curve (standard) Switching to linear dimming curve via masterCONFIGURATOR is possible.	
Dimming interface	DALI V2-DT6, DSI, ready2main, corridorFUNCTION V2, switchDIM	

3.2.2. Functions

Portfolio	LCU DIM + LMI DIM	LCU FO + LMI FO
Constant Light Output	✅	
Intelligent Temperature Guard	✅	✅
Power-up Fading	✅	

Layer structure

3.2.3. Output current

Portfolio	LCU DIM + LMI DIM	LCU FO + LMI FO
Adjustable output current	✅	✅
Adjustable via...	DALI V2-DT6 Signal from LCU DC power supply LCU DIM, adjustable on LMI DC LED Driver via DALI V2 DT6	DIP switch and potentiometer
Step size	1 mA (stepless)	see data sheet
Tolerance	+/- 5-10%	see data sheet

For further information see Adjustable Output Current and Output Voltage., p. 10

(1) More detailed information on t_a, t_c can be found in the data sheet (see Reference list, p. 54).
(2) Varies with the set output current, detailed values can be found in the data sheet (see Reference list, p. 54).

Adjustable Output Current and Output Voltage

3.3. Adjustable Output Current and Output Voltage

3.3.1. Output current for LMI DIM

The LMI DC LED Driver LMI DIM allows setting the output current via DALI V2-DT6, DSI, ready2main which are connected to the LCU DC power supply.

3.3.2. Output current for LMI FO

The LMI DC LED Driver LMI FO allows setting the output current via a combination of DIP switch and potentiometer.

_ Via DIP switch the max. output current can be set to a value within a certain value range

_ Via potentiometer the set max. output current can be further reduced

The following table shows an example for the different settings:

		S1-1	S1-2	S1-3	S1-4	S1-5	S1-6
Output current	350 mA	OFF	OFF	OFF	ON	–	–
	375 mA	OFF	OFF	ON	OFF	–	–
	400 mA	OFF	OFF	ON	ON	–	–
	425 mA	OFF	ON	OFF	OFF	–	–
	450 mA	OFF	ON	OFF	ON	–	–
	475 mA	OFF	ON	ON	OFF	–	–
	500 mA	OFF	ON	ON	ON	–	–
	525 mA	ON	OFF	OFF	OFF	–	–
	550 mA	ON	OFF	OFF	ON	–	–
	575 mA	ON	OFF	ON	OFF	–	–
	600 mA	ON	OFF	ON	ON	–	–
	625 mA	ON	ON	OFF	OFF	–	–
	650 mA	ON	ON	OFF	ON	–	–
	675 mA	ON	ON	ON	OFF	–	–
	700 mA	ON	ON	ON	ON	–	–
Function	Potentiometer	–	–	–	–	ON	OFF
	Fixed current	–	–	–	–	OFF	ON

The DIP switches S1-5 and S1-6 can be used to determine whether the max. output current is fixed (function "Fixed current") or whether it can be lowered further via potentiometer (function "Potentiometer"). By lowering the output current via potentiometer, the light level is automatically lowered as well.

Adjustable Output Current and Output Voltage

NOTICE

The "Potentiometer" function requires that a potentiometer is connected.
The two housing forms of the LMI FO (see also Housing variants, p. 12) differ in the use of a potentiometer:

_ Housing variant slim: The device has a potentiometer fixed on the printed circuit board

_ Housing variant regular: The device has terminals for the connection of an external potentiometer

In order to use the "Potentiometer" function on a device with the housing variant regular, it is necessary to connect an external potentiometer!

NOTICE

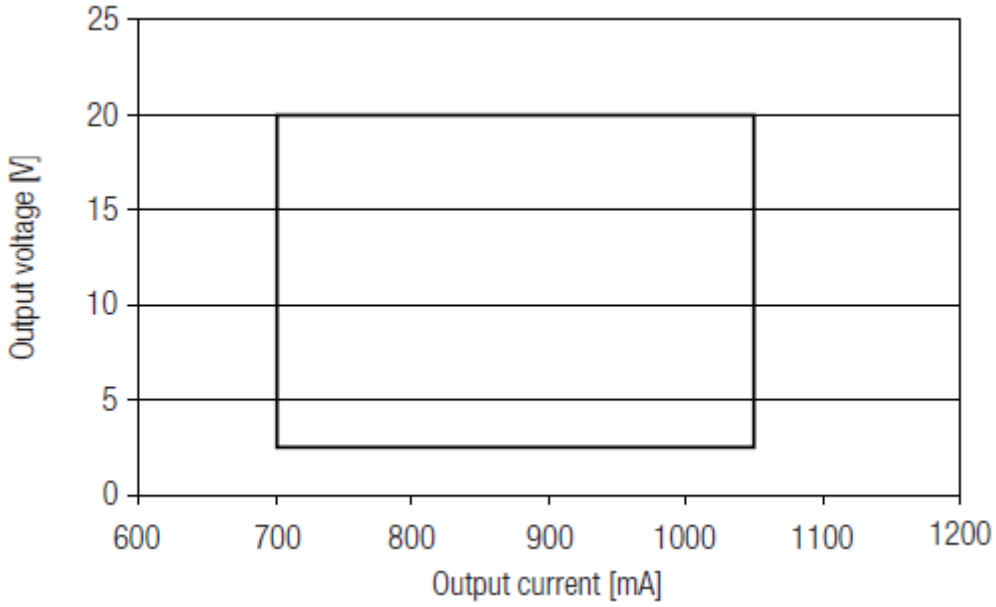
The factory default setting (no dip switch are set) is 325 mA ±20%.
This is no normal operation.

Max. torque for potentiometer is 5 Ncm.
The tolerance of the potentiometer additionally influences the tolerance of the output current.

3.3.3. Output voltage

The output voltage range results from the current selected.

The relationship between output current and output voltage is illustrated by the operating window. Different LMI DC LED Driver have specific operating windows. The following figure shows the operating window of a LMI G2 48V 350-700mA 3-20V DIM Slim device as an example. For detailed values and an explanation of the methods available, please refer to the data sheets (see Reference list, p. 54).



Housing variants

3.4. Housing variants

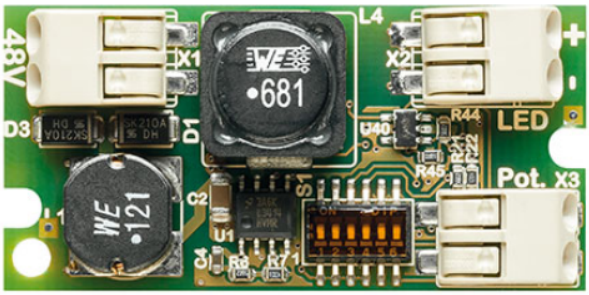
Both DC-String devices, LCU DC power supply and LMI DC LED Driver, are available in two different housing variants.

3.4.1. Housing variants of LCU DC power

Image	Description
	Housing variant SR _ Long and small shape for installation outside the luminaire casing (remote) _ Typical area of application: Spotlights, Downlights _ Special characteristic: Full loop-through capability of mains and interface (DALI) cables
	Housing variant lp _ Flat shape for a space-saving installation inside the luminaire casing (in-built) _ Typical area of application: area lighting, linear lighting

Housing variants

3.4.2. Housing variants of LMI DC LED Driver

Image	Description
	Housing variant slim _ Ultra compact slim shape schmale Bauform for the miniaturisation of luminaires and tracks _ Typical area of application: track light systems, slim indirect luminaires
	Housing variant regular _ Compact shape _ Typical area of application: track light systems, compact design luminaires

Compatibility between LED module and LMI DC LED Driver

4. Compatibility between LED module and LMI DC LED Driver

There are two stages involved in the check for compatibility between the LED module and the LMI DC 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

4.1. Comparison of data sheet values with a 4-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 LMI DC LED Driver	Detailed procedure
(1) Current	I_{max}	=	Output current	_ Determine forward current of LED module _ Check whether LMI DC LED Driver can be operated with the same output current _ Check whether max. DC forward current of LED module is greater than or equal to output current of LMI DC LED Driver (including tolerances) **⚠ CAUTION!** The max. DC forward current can be temperature dependent! Refer to the derating curve of the LED module data sheet (see Reference list, p. 54). continue... → ↓
	Max. DC forward current	≥	Output current + tolerances	

Compatibility between LED module and LMI DC LED Driver

Comparison of…	Value in LED module		Value in LMI DC LED Driver	Detailed procedure
(2) Voltage	Min. forward voltage	>	Min. output voltage	_ Check whether voltage range of LED module is completely within the voltage range of LMI DC LED Driver
	Max. forward voltage	<	Max. output voltage	**⚠ CAUTION!** The forward voltage is temperature dependent! Refer to the Vf/t_p diagram in the data sheet (see Reference list, p. 54).
	Min. forward voltage @ min. dimlevel	>	Min. output voltage	**ⓘ 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 LMI DC LED 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 LMI DC LED Driver
(3) LF current ripple	Max. permissible LF current ripple	≥	Output LF current ripple (<120Hz)	_ Check whether max. permissible LF current ripple of LED module is greater than or equal to output LF current ripple of LMI DC LED Driver
(4) Max. peak current	Max. permissible peak current	>	Max. output current peak	_ Check whether max. permissible peak current of LED module is greater than max. output current peak of LMI DC LED Driver

Compatibility between LED module and LMI DC LED Driver

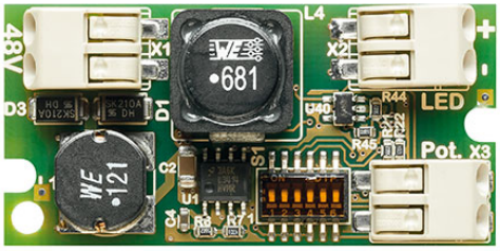
4.2. Application of the 4-point guideline

The compatibility check with the 4-point guideline is shown here using two examples.

4.2.1. Example

Comparison data for LMI DC LED Driver

LMI DC LED Driver	
Designation	LMI 48V 350–700mA 20–42V FO Regular
Manufacturer	TRIDONIC



Data sheet values of LMI DC LED Driver	
Output current	500 mA
Output current tolerance	± 8%
Min. output voltage	20 V (1)
Max. output voltage	42 V (1)
Output LF current ripple	± 2%
Max. output current peak	600 mA

(1) Values at 500mA

Compatibility between LED module and LMI DC LED Driver

Comparison data for LED module

LED module	
Designation	Fictitious device
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	630 mA
Max. permissible peak current	1,500 mA
Power draw	16.4 W

(1) Values at 500mA

Questions

_ Are the two devices mutually compatible?

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

Compatibility between LED module and LMI DC LED Driver

Procedure

Comparison of data sheet values

Comparison of…	Value in LED module		Value in LMI DC 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 LMI DC 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 kΩ).
	1,050 mA	≥	540 mA	✅	_ The output current of the LMI DC LED Driver including tolerances (500 mA + 8% = 540 mA) is less than or equal to the max. DC forward current of the LED module (1,050 mA).
(2) Voltage	29.7 V	>	20 V	✅	_ The voltage range of the LED module (29.7 - 36.3 V) lies completely within the voltage range of the LMI DC LED Driver (20 - 42 V).
	36.3 V	<	42 V	✅	
(3) LF current ripple	630 mA	>	551 mA	✅	_ The Output LF current ripple (2% of output current plus tolerances: [500 mA + 8%] x 1.02 = 551 mA) of the LMI DC LED Driver is less than the max. permissible LF current ripple of the LED module (630 mA).
(4) Max. peak current	1,500 mA	>	600 mA	✅	_ The max. output current peak of the LMI DC 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).

Result

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

Compatibility between LED module and LMI DC LED Driver

Procedure

Comparison of data sheet values

Result

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

Compatibility between LED module and LMI DC LED Driver

4.3. Practical tests

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

4.3.1. Technical aspects

_ Transient behaviour
_ Colour shift
_ Connection during operation
_ Parasitic capacitance

4.3.2. Visual aspects

_ Flickering
_ Stroboscopic effect (video applications)
_ Dimming behaviour
_ Colour change/stability
_ Luminous flux

4.3.3. 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

Standards and directives

4.4. Standards and directives

4.4.1. Standards and directives for modules

The following standards and directives were taken into consideration in designing and manufacturing the modules:

CE

Name	Description
2006/95/EG	Low-voltage directive: Directive relating to electrical equipment for use within certain voltage limits
2004/108/EG	EMC directive: Directive relating to electromagnetic compatibility

RoHS

Name	Description
2002/95/EC	RoHS(1) directive: Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment

(1) RoHS: Restriction of (the use of certain) hazardous substances

Safety

Name	Description
DIN IEC 62031:2008	Safety requirements for LED modules
EN 60598-1:2008 und A11:2009	General requirements and tests for luminaires
EN 60598-2-2:1996 und A1:1997	Luminaires - Part 2. Special requirements; Main section 2: Recessed luminaires
EN 62471:2008	Photo-biological safety of lamps and lamp systems

Standards and directives

Safety and performance

Name	Description
EN 61347-1:2009	General and safety requirements
EN 61347-2-13:2007	Special requirements for dc and ac powered electronic operating equipment for LED modules
EN 62384:2007 IEC 62384 A1:2009	Operational requirements

Energy labelling

Name	Description
EU Regulation No: 874/2012	"Energy labelling of electrical lamps and luminaires"

4.4.2. Standards and directives for LED Driver

The following standards and directives were taken into consideration in designing and manufacturing the LED Driver:

EMI

Name	Description
EN 55015 2008	Limit values measurement methods for radio interference properties of electrical lighting equipment and similar electrical devices
EN 61000-3-2:2005 A1: 2008 und A2:2009	Limit values for harmonic currents (equipment input current < 16 A per conductor)
EN 61000-3-3:2005	Limit values for voltage fluctuations and flicker in low-voltage systems for equipment with an input current < 16 A per conductor that are not subject to any special connection conditions
EN 61547:2001	EMC(1) requirements

(1) EMC: Electromagnetic compatibility

Standards and directives

Safety

Name	Description
EN 50172 2005	Safety lighting systems

DALI

Name	Description
IEC 62386-101:2009	General requirements, system
IEC 62386-102:2009	General requirements, controller
IEC 62386-207:2009	Special requirements, controller; LED modules

5. Installation

5.1. Guideline for installation

The LMI DC LED Driver devices were tested with severity level 2. The guideline for installation can be taken from the ESD document.

NOTICE

EOS/ESD safety guidelines
The device/module contains components that are sensitive to electrostatic discharge and may only be installed in the factory and on site if appropriate EOS/ESD protection measures have been taken. No special measures need be taken for devices/modules with enclosed casings (contact with the pc board not possible), just normal installation practice.
Please note the requirements set out in the document EOS/ESD guidelines (Guideline_EOS_ESD.pdf) at:

_ http://www.tridonic.com/com/de/download/technical/Richtlinie_EOS_ESD_de.pdf

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

5.1.1. Requirements for installation

Depending on the installation situation for the LCU DC power supply, the LMI DC LED Driver and the LED-Module, the following requirements must be met:

_ Sufficient distance to active conducting materials

_ Sufficient strain relief when the LMI DC LED Driver cover is closed

_ Sufficient cooling of the modules (the max. temperature at the tc point must not be exceeded)

_ Unrestricted exit of light from the LED modules

_ The LED module's push-in terminals allow easy wiring. They can be released via the trigger

5.2. Protection measures against damage

5.2.1. Mechanical stress

LMI DC LED Driver contain electronic components that are sensitive to mechanical stress. Such stress should be kept to an absolute minimum. In particular the following mechanical stresses should be avoided as these may cause irreversible damage:

_ Pressure

_ Drilling,

_ Milling,

_ Breaking,

_ Sawing,

_ and similar mechanical processing.

5.2.2. Compressive stresses

The components of the LMI DC LED Driver (circuit boards, electronic components etc.) are sensitive to compressive stresses. The components must not be exposed to compressive stresses.

6. Electrical Aspects

NOTICE

The cabling, wiring and mounting for a LMI DC LED Driver and a LCU DC power supply varies depending on the design and manufacturer of the LED module.
The following description should therefore not be viewed 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!

WARNING!

_ Comply with the general safety instructions (see General 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.

_ LMI DC LED Driver from Tridonic are protected for a maximum of 48 hour against overvoltage of up to 320 V. Make sure that the LMI DC LED Driver is not exposed to overvoltages for long periods!

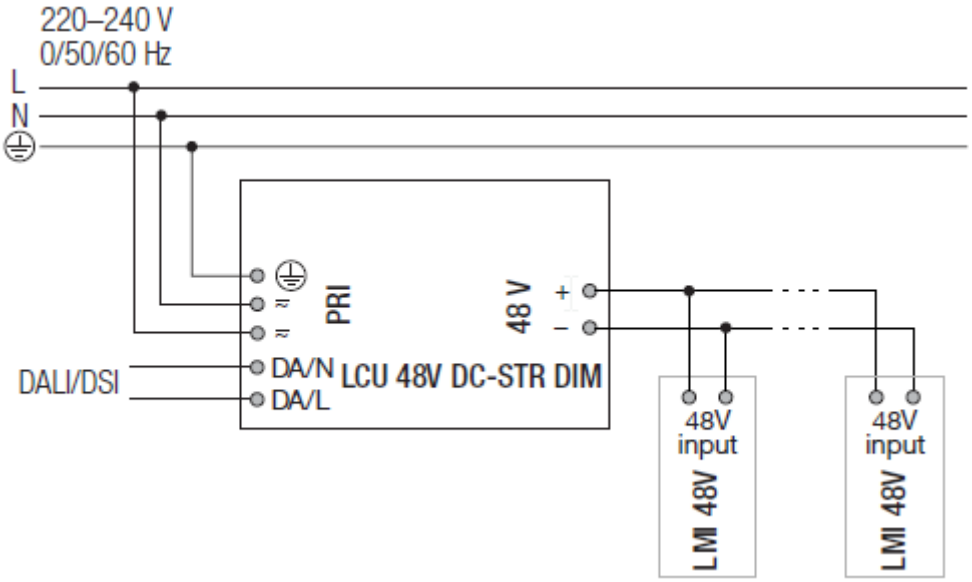
_ LCU DC power supply devices of the LCU DIM and LCU FO series from Tridonic have protection type IP 20. Comply with the requirements for this type of protection!

_ LMI DC LED Drivers don't have any protection.

Electrical Aspects

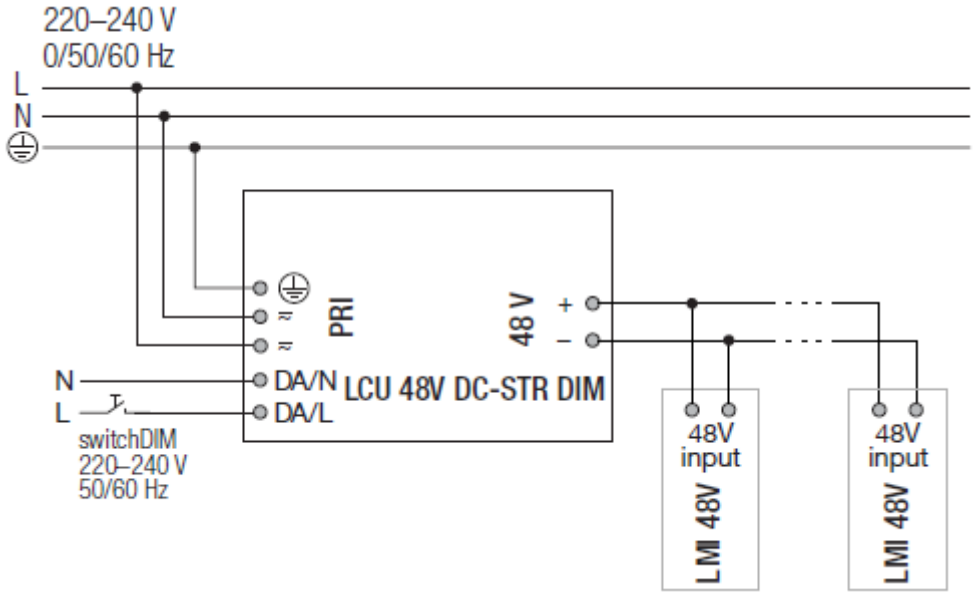
6.1. Wiring diagrams

6.1.1. Wiring diagram for DALI



The wiring diagram shows the connection between mains, LCU DC power supply, LMI DC LED Driver.

6.1.2. Wiring diagram for switchDIM



The wiring diagram shows the connection between mains, LCU DC power supply, LMI DC LED Driver.

Electrical Aspects

6.1.3. Connections on the LMI DC LED Driver and LCU DC power supply

	Pin	Connection
LCU	⏚	Function earth
LCU	~	Power input 230 – 240 V AC
LCU	~	Power input 230 – 240 V AC
LCU	DA[1]	Control input for DALI / switchDIM
LCU	DA[1]	Control input for DALI / switchDIM
LMI/LED	+LED	TALEXXmodule STARK SLE GEN4
LMI/LED	-LED	TALEXXmodule STARK SLE GEN4
LCU/LMI	48V+	48 V bus (polarity at the inputs of the LMI DC LED Driver does not matter)
LCU/LMI	48V-	48 V bus (polarity at the inputs of the LMI DC LED Driver does not matter)
LMI FO		Potentiometer [2]
LMI FO		Potentiometer [2]

[1] Only for operation with LMI DC LED Driver and LCU DC power supply
[2] Only for LMI DC LED Driver with potentiometer terminal

Electrical Aspects

6.2. Function of the earth terminal

The earth connection is conducted as protection earth (PE). The LCU DC power supply can be earthed via earth terminal or metal housing (if device has metal housing). If the LCU DC power supply will be earthed, protection earth (PE) has to be used. There is no earth connection required for the functionality of the LCU DC power supply.

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 LMI DC LED Driver if the LED module is mounted on earthed luminaire parts respectively heat sinks and thereby representing a high capacity against earth.

6.2.1. Mains transients at 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 LCU DC power supply may be transferred to the output of the LMI DC LED Driver 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 LMI DC 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. Voltages at the output of the LMI DC LED Driver are not higher than 450 V.

NOTICE

Irrespective of whether the LCU DC power supply is earthed or not, LED modules and LMI DC LED Driver must be insulated in accordance with the requirements of the luminaire protection class. Improved insulation of the LED module can also reduce the likelihood of flashovers.

6.3. Routing the wires

6.3.1. 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.

6.3.2. Insulation and dielectric strength testing of luminaires

LCU DC power supply devices 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 MOhm.

As an alternative to measuring the insulation resistance, IEC 60598-1 Annex Q describes a dielectric strength test at 1500 V AC (or 1.414 x 1,500 V DC). To avoid damaging electronic control gear, this dielectric strength test should be performed exclusively for type testing. This test should certainly not be used for routine testing.

NOTICE

Tridonic recommends performing an insulation test because a dielectric strength test may damage the device irreparably.

6.3.3. 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. (Routine testing is always performed at 500 V DC)

6.3.4. Wiring between LCU and LMI

Wiring guidelines

_ The 48 V cables should be run separately from the mains connections and mains cables to ensure good EMC conditions.

_ The 48 V DC output wiring should be kept as short as possible to ensure good EMC.The max. secondary cable length is 30 m (60 m circuit) till beginning of a grounded metal track light.

_ If track light is not grounded or made of plastic, cable length including track light is 30 m.

_ Inside the track light cable length is limited by voltage drop that last LMI 48V in the track light is still supplied with minimum 46 V.

_ Secondary switching is not permitted. It is allowed to add or remove one DC/DC-LED Driver during operation.

Hot plug-in of LMI DC LED Driver

_ Hot plug-in is supported for LMI DC LED Driver.

6.3.5. Wiring between LMI and LED

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 wiring between LMI and LED 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).

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

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

Electrical Aspects

Detaching the plug-in terminal

_ Push onto the terminal from above to release the wire

_ Pull out the wire at the front

Electrical Aspects

6.4. Maximum loading of circuit breakers

NOTICE

The maximun loading of circuit breakers ist only relevant for LCU DC power supply, but not for LMI DC LED Driver.

6.4.1. 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 LCA 50W 100-400mA one4all lp PRE as an example

Automatic circuit breaker type	C10	C13	C16	C20	B10	B13	B16	B20	Inrush current	
Installation Ø	1,5 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2	1,5 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2	I_{max}	time
LCA 50W 100-400mA one4all lp PRE	18	26	28	34	9	13	14	17	22,4 A	176 µs

6.4.2. 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).

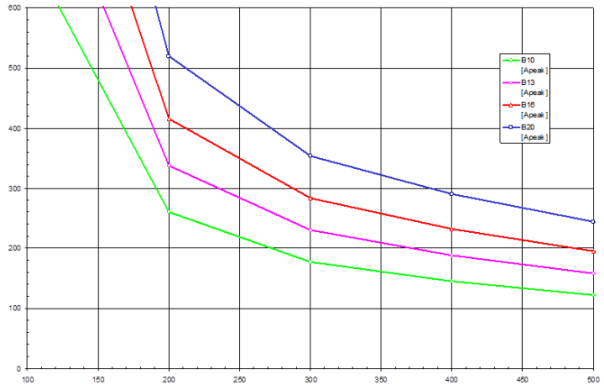
Duration [µs]	Current B10 [A_{peak}]	Current B13 [A_{peak}]	Current B16 [A_{peak}]	Current B20 [A_{peak}]
100	700	910	1,120	1,400
200	260	338	416	520
300	177	230.1	283	354

Electrical Aspects

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]



Duration [µs]

NOTICE

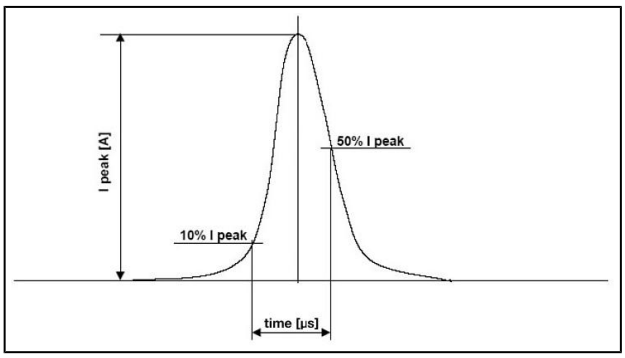
Information about the specific tripping characteristics of a circuit breaker must be requested from the respective manufacturer !

Calculation of the inrush current

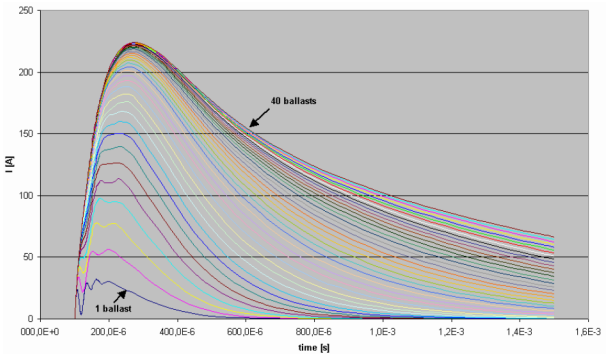
The inrush current of a control gear is also defined by its duration and its height. The duration is typically measured as the time between 10% of maximum current (ascending) and 50% of maximum current (descending).

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

Electrical Aspects



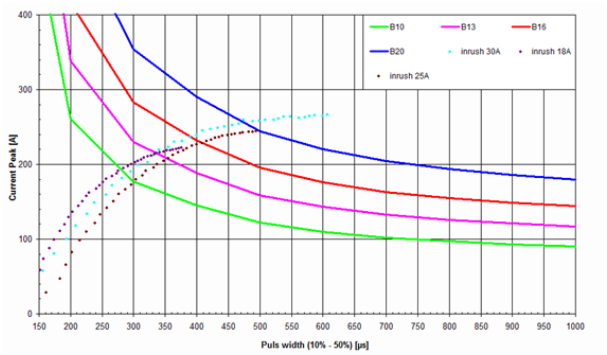
If several control gear are connected to one circuit breaker, the individual inrush currents add up.



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.

The simulation results can be read as follows:

Electrical Aspects

_ 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.

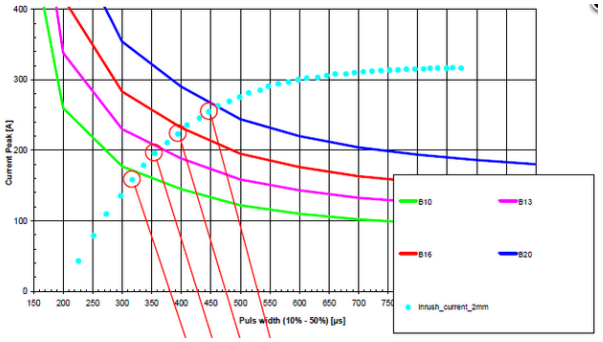
The following example shows the maximum number of control gear at four different circuit breakers:

_ 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)



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 * mm2 / 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.

Functions

7. Functions

NOTICE

The corridorFUNCTION and switchDIM only work broadcast via LCU DC power supply to all LMI DC LED drivers.

7.1. corridorFUNCTION V2 (combination of LCU DIM and LMI DIM only)

7.1.1. 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.

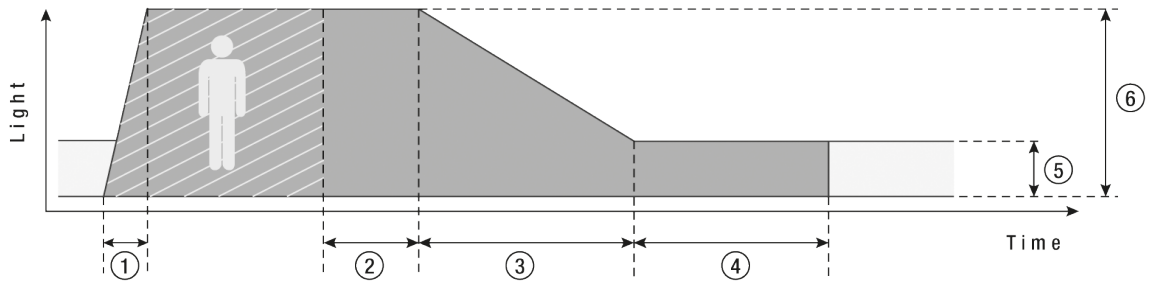
CAUTION!

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 switchDIM and corridorFUNCTION.

Profile settings:

Standard profile for activating via 230V on the interface terminal DA/N - DA/L for 5 minutes is **"Never off"**

The control gear have different profiles so they can provide the best possible performance in a range of conditions. The profiles are defined by a series of values:



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: 30s).
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%).

Variable switch-off times

The profiles and their values can be freely adjusted. The values can be adjusted via a connection to a DALI bus on the LCU DC power supply.

7.1.2. Installation

Requirements:

_ The control gear is correctly installed in the luminaire and cabled on the power supply side

_ A motion sensor is installed in the lighting system

_ The motion sensor is connected to the control gear

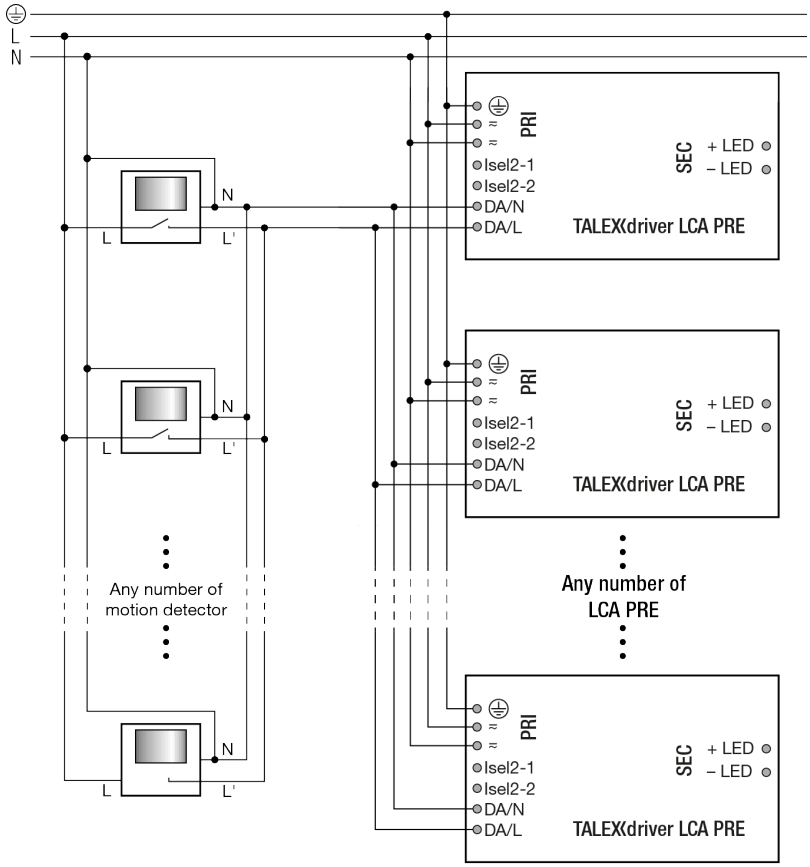
Procedure:

_ Connect the neutral conductor (N) to terminal DA/N on the control gear

_ Connect the output of the motion sensor (switched phase) to terminal DA/L on the control gear

corridorFUNCTION V2

Wiring versions:



Benefits:

Control can be changed at any time to a digital control signal (DSI or DALI) without having to change the luminaire or provide an additional control line

⚠ CAUTION!

Use conventional relay motion sensors!
Electronic motion sensors (Triac) are not suitable because of their technical design.

⚠ CAUTION!

Do not use glow switches!
Glow switches may affect the control.

⚠ CAUTION!

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

⚠ CAUTION!

For five-pole wiring the neutral conductor must be connected to DA/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 control gear 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.

7.1.3. 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 digital interface of the control gear for a period of at least 5 minutes the control gear 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:

_ The control gear is correctly installed in the luminaire

_ Input voltage is applied

_ A motion sensor is connected to information DA/N or DA/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

Procedure via the masterCONFIGURATOR

The corridorFUNCTION can also be activated via the masterCONFIGURATOR.

Further information can be found in the masterCONFIGURATOR manual (see Reference list, p. 54).

Deactivating the corridorFUNCTION

If the corridorFUNCTION is activated the control gear is controlled only by motion. To operate the control gear via DALI, DSI or switchDIM the corridorFUNCTION must be deactivated.

Procedure via mains

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

_ Connect neutral conductor to the terminal marked DA/N

_ Press the push button 5 times within 3 seconds

Procedure via DALI/DSI

_ Send 5 DALI or DSI commands within 3 seconds to the control gear

Procedure via masterCONFIGURATOR

If the corridorFUNCTION was activated via the masterCONFIGURATOR it can be deactivated as follows:

_ Send 5 DALI or DSI commands within 3 seconds to the control gear

Adjusting the values of the corridorFUNCTION

The values of the corridorFUNCTION can be individually adjusted. The values are set via a DALI USB on the bus and by entering special DALI commands via the masterCONFIGURATOR.

Further information can be found in the masterCONFIGURATOR manual (see Reference list, p. 54).

7.2. DALI (LCU DIM only)

7.2.1. Description

DALI standard

NOTICE

LCU DIM devices support the new DALI standard V2 (according to EN 62386-102).

DALI (Digital Addressable Lighting Interface) is an interface protocol for digital communication between electronic lighting equipment.

The DALI standard was developed by Tridonic together with renowned manufacturers of operating and control equipment. Today, these manufacturers belong to the DALI Activity Group which promotes the use and further development of DALI.

The DALI standard is defined in IEC 62386. A test procedure standardised by the DALI Activity Group ensures compatibility between products from different manufacturers. Tridonic products have undergone this test and meet all the requirements. This is indicated by the logo of the DALI Activity Group on the device.

The agreement by the lighting industry to adopt a common protocol has opened up a virtually unlimited number of options. With the right choice of individual DALI components an extremely wide range of requirements can be met, from operating a simple light switch to lighting management systems for entire office complexes with thousands of light sources.

DALI in Action

DALI offers a lot of possibilities:

_ DALI line: 64 control gear can be grouped to a line
_ DALI groups: Every control gear can be attributed into 16 groups
_ Addressability: All control gear are individually addressable
_ Grouping: Possible without complicated rewiring
_ Programmability: Individual programmability makes it possible to use functions which transcend the DALI standard
_ Monitoring: Easily possible thanks to status feedback
_ Wiring: Simple wiring with five pole standard cables and a cable length of max. 300 metres
_ Wiring: Polarity-free control lines can be used for mains and control lines
_ Wiring: Multiple wiring possibilities (star, series and mixed wiring)
_ Unaffected by interruptions: All luminaires receive the same, unaffected digital signal and dimming level
_ Similar light level from first to last luminaire

Technical data of a DALI line:

_ DALI voltage: 9.5 V - 22.4 DC
_ Maximum DALI system current: max. 250 mA

_ Data transfer rate: 1200 Baud

_ Maximum line length: up to 300 m (for 1,5 mm^2)

7.2.2. Commissioning

NOTICE

If the corridorFUNCTION is activated the control gear is controlled only by motion. To operate the control gear via DALI, DSI or switchDIM the corridorFUNCTION must be deactivated.

Further information can be found in the DALI Handbook (see Reference list, p. 54).

eD

eD ("enhanced DALI") offers extended DALI commands. They can be used to activate specific commands of the control gear. The masterCONFIGURATOR software works with eD commands. These commands are Tridonic specific. They are not part of the DALI standard and are not publicly available.

7.3. DSI (LCU DIM only)

7.3.1. Description

DSI (Digital Serial Interface) enables DSI control gear to be controlled. The DSI line can be wired separately via a two-core cable or together with the mains cable in a five-core cable. Communication is not impaired by the mains cable. In contrast to DALI, there is no individual addressing of the ballasts with DSI.

DSI offers a series of benefits:

_ Expansion options via submodules, for example in combination with daylight control or additional switch modules

_ Wiring: Simple wiring with five pole standard cables and line length of up to 250 metres

_ Wiring: Polarity-free control lines can be used for mains and control lines

_ Wiring: Multiple wiring possibilities (star, series and mixed wiring)

_ Unaffected by electrical interference

_ Uniform light level from the first to the last light source

_ reverse polarity protected connection: can be connected with any polarity

The main benefits of DSI are the optimisation of energy consumption of extensive groups of luminaires (e.g. in sports stadiums and factories).

7.3.2. Commissioning

NOTICE

If the corridorFUNCTION is activated the control gear is controlled only by motion. To operate the control gear via DALI, DSI or switchDIM the corridorFUNCTION must be deactivated.

Further information can be found in the DALI Handbook (see Reference list, p. 54).

7.4. switchDIM (LCU DIM only)

7.4.1. Description

With the switchDIM function it is possible to use the mains voltage as a control signal.
The phase of a simple standard mains voltage push button is connected to the terminal marked DA/L and the neutral conductor is connected to the terminal marked DA/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 LCU DC power supply alternately up and down (between 5 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 LED is automatically restored to its previous operating state and dimmed to the last value.

⚠ CAUTION!

Glow switches are not approved for controlling switchDIM.
Glow switches may cause the LCU DC power supply 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 terminal.
Special attention must be paid to achieving clear zero crossings. Serious mains faults may impair the operation of switchDIM and corridorFUNCTION.

⚠ CAUTIONS!

A maximum number of 25 operating devices per switchDIM system should not be exceeded.
If you have more devices please use DALI or DSI.

7.4.2. Installation

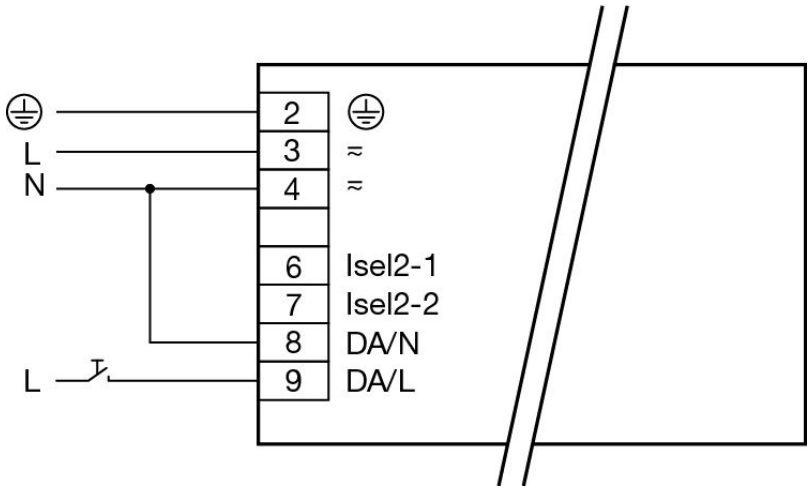
Wiring variants

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

switchDIM

Four-pole wiring

Configuration:



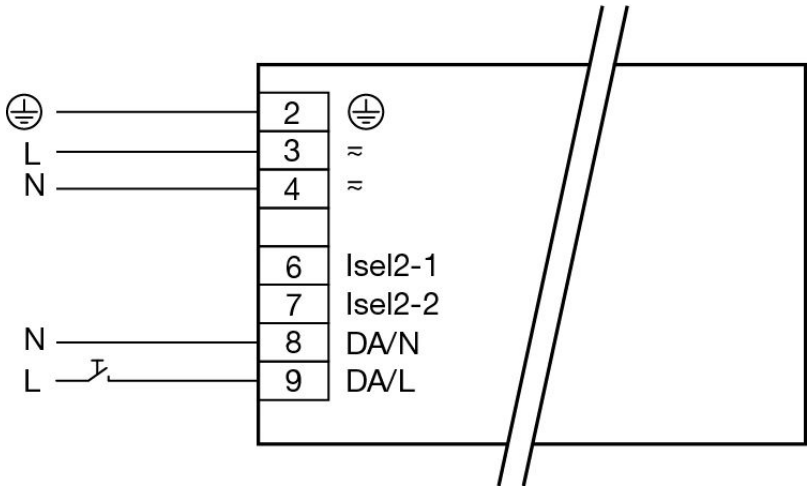
Phase (L), neutral (N), earth (PE), control line (L')

Benefits:

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

Five-pole wiring

Configuration:



Phase (L), neutral (N), earth (PE), control line (L), neutral (N)

Benefits:

Control can be changed at any time to a digital control signal (DSI or DALI) without having to change the luminaire or provide an additional control line

switchDIM

⚠ CAUTION!

For five-pole wiring the neutral conductor must be connected to DA/N.
This prevents 400 V being applied between adjacent terminals if a different phase is used for the control input.

7.4.3. Commissioning

NOTICE

If the corridorFUNCTION is activated the LCU DC power supply is controlled only by motion. To operate the LCU DC power supply via DALI, DSI or switchDIM the corridorFUNCTION must be deactivated.

Using the switchDIM function

switchDIM is operated by the mains voltage push button.

Procedure:

_ Switch the device on/off by briefly actuating the push button or

_ Dim the device by holding down the push button

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).

Procedure:

_ Hold down the push button for 10 seconds
→ All devices will be synchronised to the same status
→ LEDs will 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 push button 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 LCU DC power supply to automatic mode

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

Procedure:

_ Press the push button 5 times within 3 seconds

7.5. Constant Light Output (LMI DIM only)

7.5.1. Description

The light output of an LED module reduces over the course of its life. The Constant Light Output function compensates for this natural decline by constantly increasing the output current of the LED driver throughout its life. As a results, a virtually uniform light output is achieved at all times.

For configuration purposes the expected module-specific values for lifetime and residual luminous flux must be specified. The output current is then controlled automatically on the basis of these values.
The LED driver typically starts with an output current ("Required Intensity") that corresponds to the expected residual luminous flux and calculates the increase in the value on the basis of the anticipated lifetime.

If the OTL function is enabled, visual feedback is given as soon as the LED exceeds the expected LED lamp life. If the expected LED lamp life is exceeded, the luminaire flashes for 2 seconds after being switched on.

7.5.2. Commissioning

Procedure via the masterCONFIGURATOR

NOTICE

To be able to adjust the parameters "Required intensity", "LED burning hours" and "Expected LED life" the "Advanced settings" must be activated.
Further information can be found in the masterCONFIGURATOR manual (see Reference list, p. 54).

Activating the Constant Light Output function

_ Open dialog box "Tridonic-specific configuration"
_ Click tab "CLO and OTL"
_ Set drop-down menu "Constant intensity" to "enabled"
_ Click "save"
→ Changes are saved

Activating the Over the Lifetime function

_ Open dialog box "Tridonic-specific configuration"
_ Click tab "CLO und OTL"
_ Set drop-down menu "Visual feedback" to "enabled"
_ Click "save"
→ Changes are saved

Constant Light Output

Setting Required intensity and Expected LED life

_ Open dialog box "Tridonic-specific configuration"

_ Click tab "CLO and OTL"

_ Enter values in input fields "Required intensity" and "Expected LED life"

_ Click "save"
→ Changes are saved

Transferring existing values to a new control gear

If a control gear is replaced the existing parameter values can be transferred to the new control gear.

_ Chose a control gear that is in the same room as the new control gear

_ Open dialog box "Tridonic-specific configuration"

_ Click tab "CLO and OTL"

_ Note down the values for "Required intensity", "LED burning hours" and "Expected LED life"

_ Close dialog box "Tridonic-specific configuration"

_ Chose the new control gear

_ Open dialog box "Tridonic-specific configuration"

_ Click tab "CLO and OTL"

_ Take the noted values and enter them in the input fields "Required intensity", "LED burning hours" and "Expected LED life"

_ Click "save"
→ Changes are saved

Replacing the LED module

If an LED module is replaced the parameter "LED burning hours" must be set to "0".

_ Open dialog box "Tridonic-specific configuration"

_ Click tab "CLO and OTL"

_ Delete value from input field "LED burning hours"
→ CLO function is automatically restarted
→ Changes are saved

Further information can be found in the masterCONFIGURATOR manual (see Reference list, p. 54).

7.6. Intelligent Temperature Guard

⚠ WARNING!

The T_c temperature is the maximum permitted in terms of safety.
Operating the control gear above the permitted T_c temperature is not compliant with relevant standards.
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.

7.6.1. Description

LCU DC power supply devices have a special overtemperature protection. It works as follows:

In the event of overtemperature (approx. 5-10 °C above t_c max), the output of the LCU DC power supply switches off and on three times. Doing so, the device will blink three times.

Afterwards, the device checks every 30 seconds whether there is still overtemperature.

_ If this is the case, the procedure is repeated and the output is again switched off and on three times

_ If this is no longer the case, normal operation is resumed.

Power-up Fading

7.7. Power-up Fading (combination of LCU DIM and LMI DIM only)

7.7.1. Description

The power-up fading function offers the opportunity to realise a soft start. The soft start will be applied at turning on the mains and at starts by switchDIM. The function is programmed as a DALI fade time in the range from 0.7 to 16 seconds and dims in the selected time from 0% to the power-on level.

By factory default power-up fading is not active (0 seconds).

7.7.2. Commissioning

Procedure via the masterCONFIGURATOR

_ Open dialog box "Tridonic-specific configuration"

_ Click tab "Power-up Fading"

_ Choose value from drop-down menu "Power-up Fading"

_ Click "save"
→ Changes are saved

Further information can be found in the masterCONFIGURATOR manual (see Reference list, p. 54).

Reference list

8. Reference list

8.1. Additional information

_ Web page Dimming series (LMI DC LED Driver DIM and LCU DC power supply DIM): http://www.tridonic.com/com/en/products/led-dc-string-dimming.asp

_ Web page Fixed output series (LMI DC LED Driver FO and LCU DC power supply FO): http://www.tridonic.com/com/en/products/led-dc-string-fixed-output.asp

_ Data sheets: Go to above web page link and click "Products" > "Downloads" > "Data sheet"

_ Data sheets DC-String: http://www.tridonic.com/com/en/products/led-dc-string.asp

_ Leaflet DC-String: http://www.tridonic.com/com/en/download/brochures/Leaflet_DC-String_EN_web.pdf

_ DALI manual: http://www.tridonic.com/com/en/download/technical/DALI-manual_en.pdf

_ Documentation masterCONFIGURATOR: http://www.tridonic.com/com/en/download/Manual_masterConfigurator_en.pdf

_ Leaflet ready2mains: http://www.tridonic.com/com/en/download/brochures/Leaflet_ready2mains_EN_web.pdf

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

_ DC-String Video animation: https://www.youtube.com/watch?v=rZgKPLTZ3jY

8.2. Downloads

_ Tridonic software: http://www.tridonic.com/com/en/software.asp

_ Download masterCONFIGURATOR: http://www.tridonic.com/com/de/software-masterconfigurator.asp

8.3. Technical data

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

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

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

_ LED/lamp matrix: http://www.tridonic.com/com/en/lamp-matrix.asp

_ Operating instructions: http://www.tridonic.com/com/en/operating-instructions.asp

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

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

_ Declarations of conformity: Available documents are found on each product page of our website in the "Certificates" tab for the specific product, www.tridonic.com/com/en/products.asp