PI²-LED®

DALI | **ZIG**BEE

PI-LED *my* | **Ci** Digital Illumination Interface Alliance

LUMITECH
YOUR LIGHTING SOLUTION

LINEAR SYSTEM M - ZHAGA

Human Centric Lighting makes the day light.

| 1.800 K | 2.000 K | 3.000 K | 4.000 K | 5.000 K | 6.000 K | 7.000 K | 16.000 K |

Tunable white
1,800K - 16,000K

Brightness dimmable
1% - 100%

RGB/CIE-xy adjustable
Colour points and sequences

Biorhythmic lighting
Vitalisation and recreation

2 Control modes
DALI DT8, ZigBee 3.0

Excellent CRI
CRI>90

*According to IEEE 1789-2015 (valid for all dimming levels, CCT and colour settings)

RoHS | CE

▌▌ TECHNICAL DATA

TECHNICAL DATA	min. 2 LED modules	max. 8 LED modules
Luminous source	SMD LED modules	
Supply voltage	48V DC	
Typ. power	19.6W	78.4W
Luminous flux	2,250lm	9,000lm
Efficiency	115lm/W	
Control mode	ZigBee 3.0, DALI DT8	
Dimmable	1% - 100% Modular Dimming: no effects caused by Flicker*	
CCT and colour control	1,800 - 16,000K / adjustable CIE-xy-colours and RGB colours	
Ambient / storage temperature	+10°C ... +45°C / -20°C ... +80°C	
$t_{c, max}$ LED module / $t_{c, max}$ LMU	+75°C / +85°C	
Lifetime	50,000h L80B10	
Additional features	Low tolerance for colour temperature MacAdam 1 (typical/initial) Integrated overtemperature protection	

min. 2 LED modules
max. 8 LED modules

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▌▌ ORDERING DATA AND TECHNICAL DATA – LINEAR SYSTEM M

Type	Description	Control mode	Cable [mm]	Lum. flux [lm]	Voltage [V DC]	Power typ. | max. [W]	Energy Efficiency Class
LTS-02020-15-LS	PI-LED Linear M 2250LM / 2x280mm / 19.6W / DALI DT8 / 140mm	DALI DT8	140	2,250	48	19.6 | 20	F
LTS-02020-15-LS1	PI-LED Linear M 2250LM / 2x280mm / 19.6W / DALI DT8 / 400mm	DALI DT8	400	2,250	48	19.6 | 20	F
LTS-02020-16-LS	PI-LED Linear M 2250LM / 2x280mm / 19.6W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	2,250	48	19.6 | 20	F
LTS-02020-16-LS1	PI-LED Linear M 2250LM / 2x280mm / 19.6W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	2,250	48	19.6 | 20	F
LTS-03020-15-LS	PI-LED Linear M 3375LM / 3x280mm / 29.4W / DALI DT8 / 140mm	DALI DT8	140	3,375	48	29.4 | 30	F
LTS-03020-15-LS1	PI-LED Linear M 3375LM / 3x280mm / 29.4W / DALI DT8 / 400mm	DALI DT8	400	3,375	48	29.4 | 30	F
LTS-03020-16-LS	PI-LED Linear M 3375LM / 3x280mm / 29.4W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	3,375	48	29.4 | 30	F
LTS-03020-16-LS1	PI-LED Linear M 3375LM / 3x280mm / 29.4W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	3,375	48	29.4 | 30	F
LTS-04020-15-LS	PI-LED Linear M 4500LM / 4x280mm / 39.2W / DALI DT8 / 140mm	DALI DT8	140	4,500	48	39.2 | 40	F
LTS-04020-15-LS1	PI-LED Linear M 4500LM / 4x280mm / 39.2W / DALI DT8 / 400mm	DALI DT8	400	4,500	48	39.2 | 40	F
LTS-04020-16-LS	PI-LED Linear M 4500LM / 4x280mm / 39.2W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	4,500	48	39.2 | 40	F
LTS-04020-16-LS1	PI-LED Linear M 4500LM / 4x280mm / 39.2W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	4,500	48	39.2 | 40	F
LTS-05020-15-LS	PI-LED Linear M 5625LM / 5x280mm / 49W / DALI DT8 / 140mm	DALI DT8	140	5,625	48	49 | 50	F
LTS-05020-15-LS1	PI-LED Linear M 5625LM / 5x280mm / 49W / DALI DT8 / 400mm	DALI DT8	400	5,625	48	49 | 50	F
LTS-05020-16-LS	PI-LED Linear M 5625LM / 5x280mm / 49W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	5,625	48	49 | 50	F
LTS-05020-16-LS1	PI-LED Linear M 5625LM / 5x280mm / 49W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	5,625	48	49 | 50	F
LTS-06020-15-LS	PI-LED Linear M 6750LM / 6x280mm / 58.8W / DALI DT8 / 140mm	DALI DT8	140	6,750	48	58.8 | 60	F
LTS-06020-15-LS1	PI-LED Linear M 6750LM / 6x280mm / 58.8W / DALI DT8 / 400mm	DALI DT8	400	6,750	48	58.8 | 60	F
LTS-06020-16-LS	PI-LED Linear M 6750LM / 6x280mm / 58.8W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	6,750	48	58.8 | 60	F
LTS-06020-16-LS1	PI-LED Linear M 6750LM / 6x280mm / 58.8W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	6,750	48	58.8 | 60	F
LTS-07020-15-LS	PI-LED Linear M 7875LM / 7x280mm / 68.6W / DALI DT8 / 140mm	DALI DT8	140	7,875	48	68.6 | 70	F
LTS-07020-15-LS1	PI-LED Linear M 7875LM / 7x280mm / 68.6W / DALI DT8 / 400mm	DALI DT8	400	7,875	48	68.6 | 70	F
LTS-07020-16-LS	PI-LED Linear M 7875LM / 7x280mm / 68.6W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	7,875	48	68.6 | 70	F
LTS-07020-16-LS1	PI-LED Linear M 7875LM / 7x280mm / 68.6W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	7,875	48	68.6 | 70	F
LTS-08020-15-LS	PI-LED Linear M 9000LM / 8x280mm / 78.4W / DALI DT8 / 140mm	DALI DT8	140	9,000	48	78.4 | 80	F
LTS-08020-15-LS1	PI-LED Linear M 9000LM / 8x280mm / 78.4W / DALI DT8 / 400mm	DALI DT8	400	9,000	48	78.4 | 80	F
LTS-08020-16-LS	PI-LED Linear M 9000LM / 8x280mm / 78.4W / ZigBee 3.0 / 140mm	ZigBee 3.0	140	9,000	48	78.4 | 80	F
LTS-08020-16-LS1	PI-LED Linear M 9000LM / 8x280mm / 78.4W / ZigBee 3.0 / 400mm	ZigBee 3.0	400	9,000	48	78.4 | 80	F

▌▌ NOTES ON STANDARDS AND SECURITY POLICIES

EOS/ESD security police	The PI-LED LINEAR M SYSTEM contains components that are sensitive to electrostatic discharge. It may only be installed if appropriate EOS/ESD protection in manufacturing and in application is applied.
CE - marking of the luminaire	The PI-LED LINEAR M SYSTEM is tested according to the applicable standards (see standards below). Corresponding standard tests of the final product must be carried out separately.
Fulfilled standards Underlying standards	EN62031 — LED modules for general lighting - Safety specifications EN62471 — Photobiological safety of lamps and lamp systems EN61347-2-13 — Particular requirements for d.c. or a.c. supplied electronic control gear for LED modules ETSI EN 300 328 V2.1.1 — Wideband transmission systems - Data transmission equipment operating in the 2,4 GHz ISM band EN 301 489-3 — Electromagnetic compatibility and Radio spectrum Matters (ERM) EEE 1789-2015 — IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers

Notes:
• All values apply at ta=25°C, tc=45°C and 4,000K | Illumination specifications in accordance with CIE1931
• Tolerance ranges: illumination data +/-15% | electrical data +/-15% | supply voltage 48V DC +/- 5%
• If the supply voltage exceeds the max. permitted operating voltage, the PI-LED system will be overstressed. This will result in a highly reduced service life.
• If the maximum temperature limits are exceeded, the lifetime of the PI-LED system will be greatly reduced or the system may be damaged. Temperature measurements of the LED modules or PI-LED system have to be taken in the thermally stable state by means of a temperature sensor as per EN60598-1.
• The maximum system power of the PI-LED Linear M System is limited to the associated value above in column "Power typ. | max. (W)" due to its software.
• According to colour temperature and temperature of the PI-LED system, the Mac Adam tolerance takes on values < 4.
• All diagrams in this document show typical curves and not the exact behaviour of single LED modules.

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▮▮ TECHNICAL DRAWINGS AND DATA

Dimensions/Features of the LED modules			
L/W [mm]	Design type	Light spots P / B / R	Assembly of light spots
280 x 24	Zhaga (Book 7) L28W2	12 / 12 / 12	Linear, 45°

System type	Number of LED modules	
	Master	Slave
LTS-02020-1x-LSx	1	1
LTS-03020-1x-LSx	1	2
LTS-04020-1x-LSx	1	3
LTS-05020-1x-LSx	1	4
LTS-06020-1x-LSx	1	5
LTS-07020-1x-LSx	1	6
LTS-08020-1x-LSx	1	7

⚠ **The PI-LED Linear System M must be operated only after complete configuration and cabling.**
The PI-LED Linear System M must not be operated with less or more LED modules than provided for the system. Operation with a wrong number of LED modules can lead to destruction of the LED modules.

The connection of the LED modules within the PI-LED Linear System M has to be always in the order ˝1 x Master - 1-7 x Slave˝.
Other combinations are not possible due to the module specific placement. The order of the 1-7 LED Slave modules is defined by numbered labels.
The PI-LED Linear System M is delivered in a not prewired state.

LED module Master: with connector for cabling with LMU
**LED module Slave:** no connector for cabling with LMU

Size in mm

LMU Size in mm

tc point on the LMU = any point on the heat sink

The LED Master module is connected to the LMU by using the connection cable (length 140mm or 400mm).
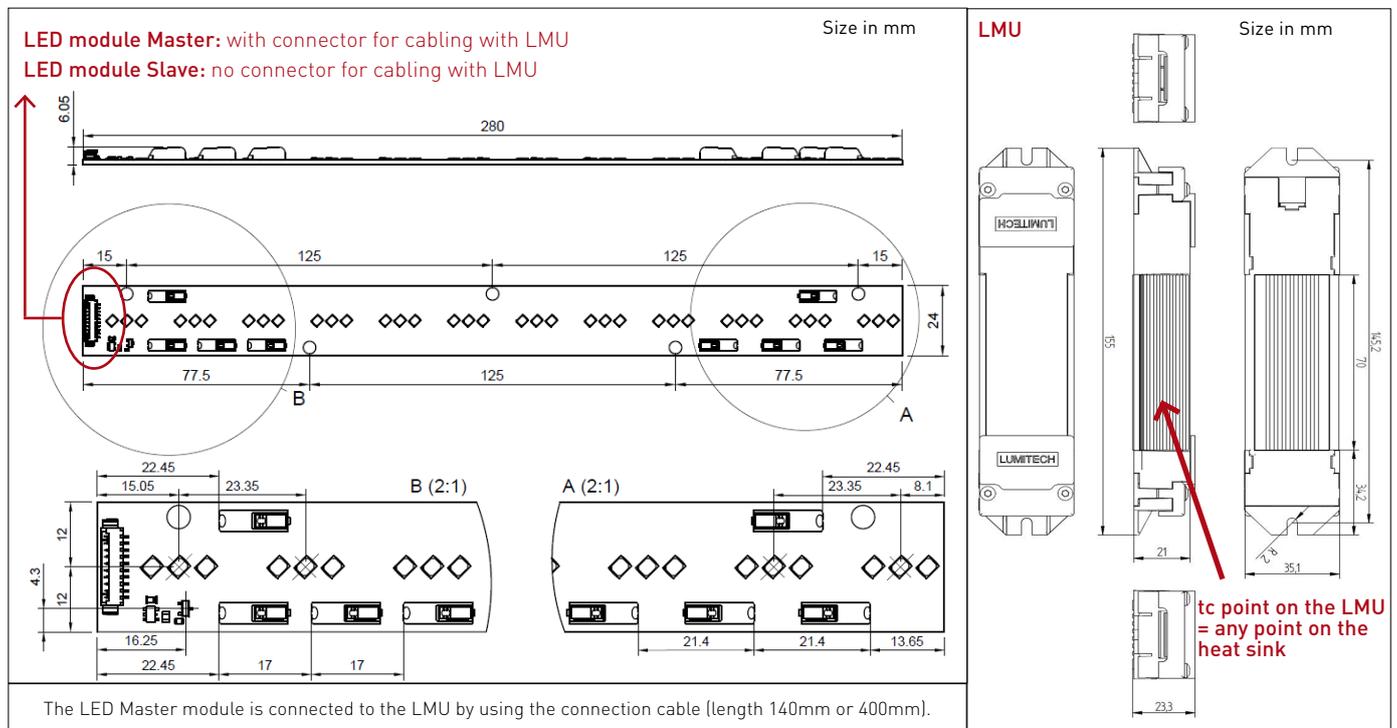
▮▮ ASSEMBLY OF THE PI-LED LINEAR SYSTEM M

Configuration example
LMU, 140mm connection cable, 1 x Master module, 2 x Slave modules
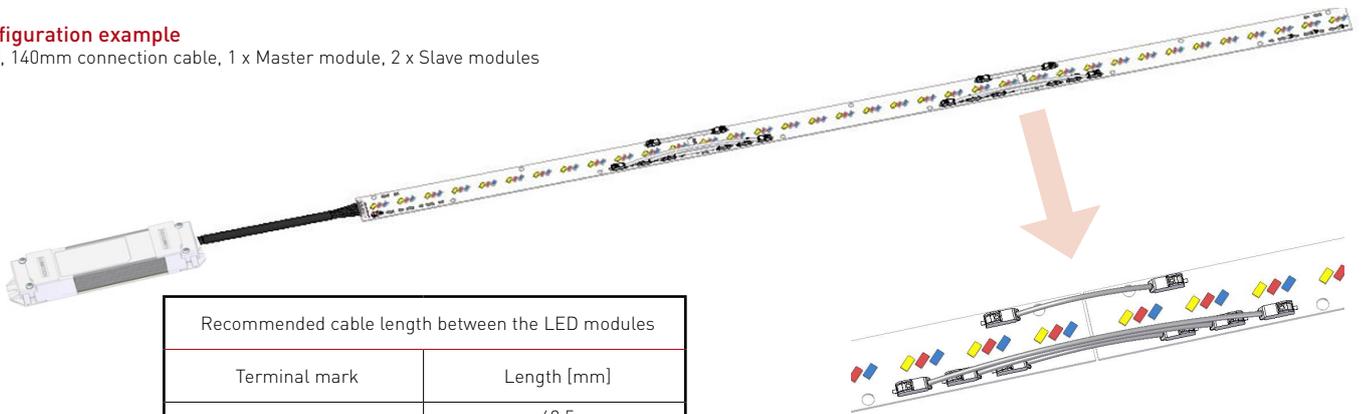
Recommended cable length between the LED modules	
Terminal mark	Length [mm]
+	60.5
–B	60.5
–R	100
–P	135

Clamping area: 0.2 - 0.75mm² (solid and stranded conductors)

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▌▌ ACCESSORIES: RECOMMENDED LED DRIVERS

PI-LED system data			LED drivers
			LTP-1116 100W 48V IP20 LT 350x30x18mm
Type	typ. power (W)	max. power [W]	
LTS-02020-1x-LSx	19.6	20	recommended
LTS-03020-1x-LSx	29.4	30	recommended
LTS-04020-1x-LSx	39.2	40	recommended
LTS-05020-1x-LSx	49	50	recommended
LTS-06020-1x-LSx	58.8	60	recommended
LTS-07020-1x-LSx	68.6	70	recommended
LTS-08020-1x-LSx	78.4	80	recommended

▌▌ CONNECTION - DALI DT8
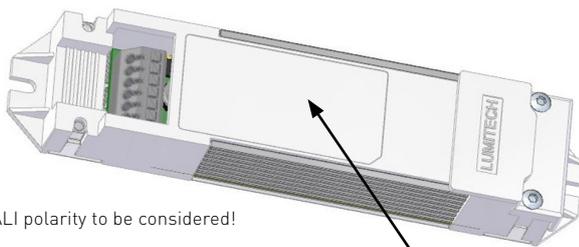
No DALI polarity to be considered!

Terminal connection

Terminal No.	Function
1	+ 48V DC
2	- 0V DC
3	DALI IN
4	DALI OUT
5	DALI IN
6	DALI OUT

▌▌ FUNCTIONAL DESCRIPTION - DALI DT8*

Mode	CCT	RGB	CIE
Colour	1,800K-16,000K	Channels separately controllable	PI-LED colour space
Brightness	1% - 100%		

Information:
Colour accuracy in the colour mode is given only for CIE-xy points.

Possible assignment to a maximum of 16 groups and 16 light scenes
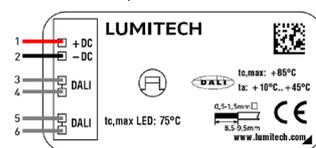
*PI-LED systems with DALI interface are DALI1 / DALI Device Type 8 registered where colour control with regard to DALI Device Type 8 is fully implemented according to the underlying DALI standard. Since there is currently no possibility for testing products for compliance with the DALI Device Type 8 standard (no official DALI tester exisiting or available), a formal verification can not be provided.
"The DALI colour control functionality (part 209/Device Type 8) of this product has not been verified."*

▌▌ CONNECTION - ZIGBEE 3.0

Terminal connection

Terminal No.	Function
1	+ 48V DC
2	- 0V DC
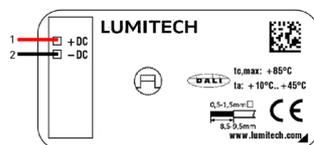
▌▌ FUNCTIONAL DESCRIPTION - ZIGBEE 3.0

Mode	CCT	RGB	CIE
Colour	1,800K-16,000K	Channels separately controllable	PI-LED colour space
Brightness	1% - 100%		

Information:
Colour accuracy in the colour mode is given only for CIE-xy points.

Possible assignment to groups and light scenes depending on control unit

Possible control units:
• LTP-1026 (NeoLink Box) together with the myPI-LED App for Android/iOS
• K-ZWALLY-x.2

Information:
*Depending on the assembly situation of the LMU, the range of the ZigBee module can vary.*
*Mounting the LMU inside of a sealed metal case can dramatically reduce the ZigBee range!*

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▌▌ PHOTOMETRICAL PROPERTIES
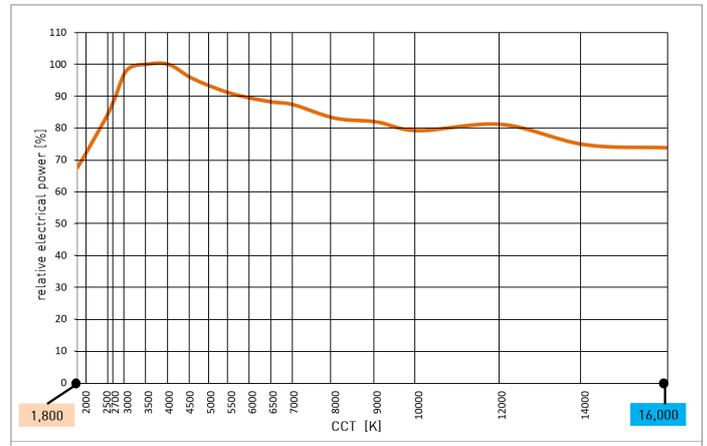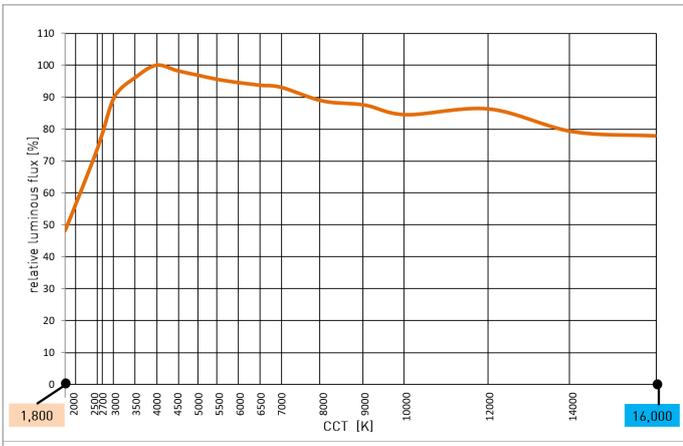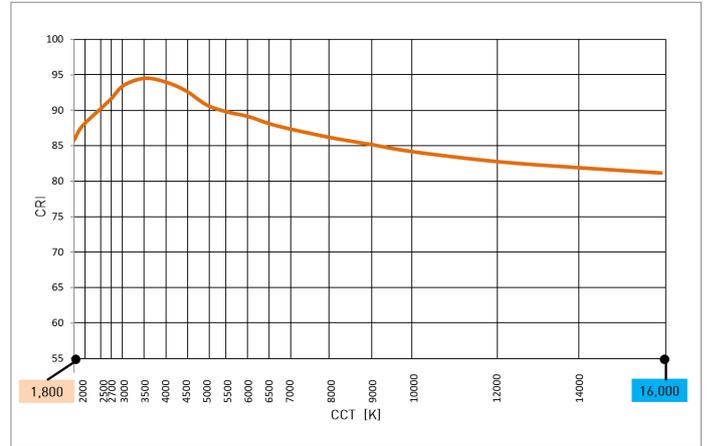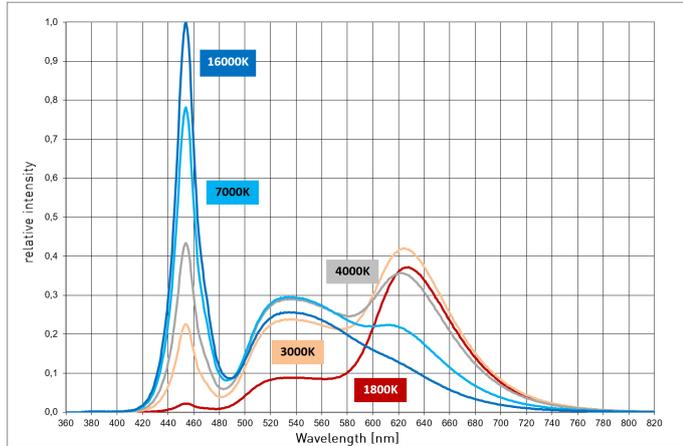
| CCT [K]	general data			visual data (exemplary for a PI-LED LINEAR SYSTEM with 8 LED modules)		melanopic values (relevant for melanopic light design)			
	CRI	CIE-x	CIE-y	Luminous flux [lm]	Efficiency [lm/W]	alpha (smel)	alpha (smel) x correction factor 1.103	Luminous flux (smel, d65) in %	Efficiency (smel, d65) in lm/W
1,800	85.8	0.5492	0.4082	4,340	82	0.242	0.267	13	22
2,000	87.8	0.5268	0.4133	4,914	87	0.284	0.313	17	27
2,500	90.5	0.4770	0.4137	6,403	98	0.379	0.418	30	41
2,700	91.6	0.4599	0.4106	7,079	101	0.414	0.457	36	46
3,000	93.5	0.4369	0.4041	8,130	105	0.465	0.513	46	54
3,500	94.5	0.4053	0.3907	8,663	110	0.542	0.598	58	66
4,000	94.0	0.3804	0.3767	9,000	115	0.611	0.674	67	77
4,500	92.8	0.3608	0.3635	8,844	117	0.673	0.743	73	87
5,000	90.8	0.3451	0.3516	8,716	119	0.728	0.803	78	96
5,500	89.8	0.3324	0.3410	8,592	121	0.778	0.858	82	103
6,000	89.1	0.3221	0.3318	8,505	121	0.822	0.906	86	110
6,500	88.1	0.3135	0.3236	8,434	122	0.861	0.950	89	116
7,000	87.4	0.3064	0.3165	8,376	122	0.896	0.989	92	121
8,000	86.1	0.2952	0.3048	7,991	123	0.956	1.055	94	129
9,000	85.1	0.2869	0.2956	7,879	123	1.006	1.109	97	136
10,000	84.1	0.2806	0.2883	7,606	123	1.046	1.154	98	141
12,000	82.8	0.2718	0.2776	7,766	122	1.108	1.222	105	149
14,000	81.9	0.2659	0.2702	7,129	122	1.154	1.272	101	155
16,000	81.1	0.2618	0.2648	7,009	121	1.188	1.310	102	159

Remark: The coefficient alpha(smel) describes the melanopic effectiveness of the light source on humans and their circadian rhythm. To give the natural human biorhythm the best possible support, the melatonin production can be minimized by higher values of alpha(smel) throughout the day and stimulated by lower values in the evening. PI-LED enables the implementation of an illumination that is not only visual but also biological/melanopic effective. For a standard-conforming lighting design, Lumitech recommends the document DIN SPEC 5031-100 to be taken as a basis.

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▌▌ IES TM-30
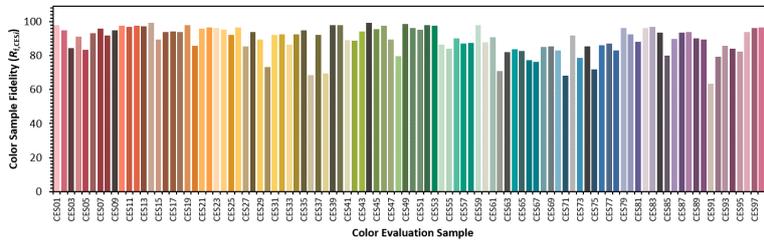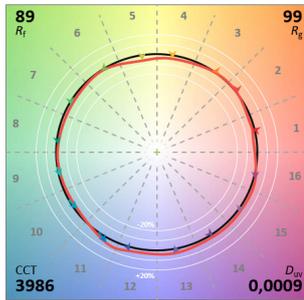
▌▌ COORDINATES AND TOLERANCES ACCORDING TO CIE 1931
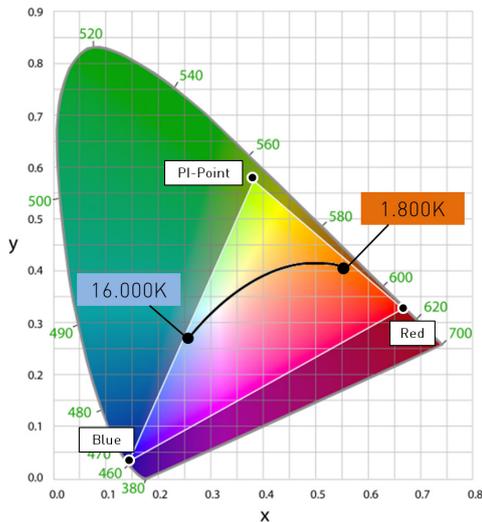
Representable PI-LED colour space in the CIE 1931 system

If a colour point outside of the triangle (PI-LED colour space) is set, the closest colour point within the triangle is referenced.

▌▌ LIFETIME

tp [°C]	L80B10 [h]
75°C	50,000

Notes:
- Value L is a statistical value, the actual drop in the luminous flux can vary across the delivered LED modules.
- tp-position = tc-position LED Module

▌▌ THERMAL CHARACTERISTICS

Ambient temperature	+10°C ... +45°C
Storage temperature	-20°C.. +80°C
$t_{c, max}$ LED Module	+75°C
$t_{c, max}$ LMU	+85°C @ ta = 45°C

Lumitech PI-LED systems are equipped with integrated overtemperature protection that protects the LED module against thermal overloads.

If the temperature tc at the LED module reaches 75°C, power is reduced by lowering the brightness. If the temperature remains at that level or reaches 80°C, the LED is totally switched off. The LED module is switched on again when the temperature tc drops to below 65°C again.