SCHUCH - Technical Supplement

Table (of Contents	
1.	Explosion-Protected lighting	259
1.1	Introduction	259
1.2	Legal basis	259
1.2.1	Directive 94/9/EC - 2014/34/EU	259
1.2.2	EC Directive 99/92/EC	259
1.3	Technical principles	259
1.3.1	Equipment groups	259
1.3.2	Zone classification (according to Directive 1999/92/EC)	259
1.3.3	Equipment categories	260
1.3.4	Temperature classes according to IEC 60079-0	260
1.3.5	Group II	260
1.3.6	Group III	260
1.3.7	Classification of flammable gases, mists, vapours	260
1.3.8	Combustible dusts	260
1.3.9	Types of protection	261
1.3.9.1	Flameproof enclosure "d"	261
1.3.9.2	Increased safety "e"	261
1.3.10	Marking	262
1.4	Special operating conditions	262
_		
2.	Marking	262
-		
3 .	General	263
3.1	Permissible ambient temperatures	263
3.2	Rated voltage	263
3.3	EMIC	263
	Properties of LED luminaires 26	2 261
 // 1	Pated values in the data sheets of LED luminaires	262
4.1	Service life data of LED luminaires	205
4.2	Switching resistance of LED luminaires	263
4.5 Л Л	Use of LED luminaires in corrosive atmospheres	263
4.5	Use of LED luminaires in humid atmospheres	263
4.5	Mounting of LED outdoor luminaires of protection class	11
1.0	on mounting devices mounting devices that are electric:	allv
	insulated from insulated from earth potential	263
47	Overvoltage protection for LED outdoor luminaires	264
4.8	Restrictions in the operation of LED outdoor luminaires	with
	power reduction	264
4.9	Inrush currents with LED luminaires - limited automatic	
	capacity	264
4.10	Photobiological safety	264
4.11	Replacement of control gear and LED modules during	
	repair of luminaires.	264
4.12	Light emissions (ULOR+ULR)	264
	5 ,	
5.	Control of lighting systems, dimming and	
5.	Control of lighting systems, dimming and power reduction 26	4-265
5. 5.1	Control of lighting systems, dimming andpower reduction26DIMA (analogue dimming)	4-265 264
5. 5.1 5.2	Control of lighting systems, dimming and 26 power reduction 26 DIMA (analogue dimming) 26 DIMD (Digital dimming and control with DALI) 26	4-265 264 264
5 .1 5.2 5.3	Control of lighting systems, dimming and power reduction26DIMA (analogue dimming)DIMD (Digital dimming and control with DALI)DIMC (Corridor function with control phase)	4-265 264 264 265
5 .1 5.2 5.3 5.4	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for	4-265 264 264 265
5. 1 5.2 5.3 5.4	Control of lighting systems, dimming and power reduction26DIMA (analogue dimming)DIMD (Digital dimming and control with DALI)DIMC (Corridor function with control phase)LR (power reduction with control phase) for outdoor luminaires	4-265 264 264 265 265
5. 1 5.2 5.3 5.4 5.5	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for outdoor luminaires LA (self-sufficient power reduction without control phase	4-265 264 265 265 265 e)
5. 1 5.2 5.3 5.4 5.5	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for outdoor luminaires LA (self-sufficient power reduction without control phase with outdoor luminaires	4-265 264 265 265 e) 265
5 .1 5.2 5.3 5.4 5.5 5.6	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for outdoor luminaires LA (self-sufficient power reduction without control phase with outdoor luminaires CL (constant luminous flux function)	4-265 264 265 265 e) 265 265 265
5 .1 5.2 5.3 5.4 5.5 5.6 5.7	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for outdoor luminaires LA (self-sufficient power reduction without control phase with outdoor luminaires CL (constant luminous flux function) MA-Z (central monitoring of self-contained luminaires	4-265 264 265 265 e) 265 265 266
5 .1 5.2 5.3 5.4 5.5 5.6 5.7	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for outdoor luminaires LA (self-sufficient power reduction without control phase with outdoor luminaires CL (constant luminous flux function) MA-Z (central monitoring of self-contained luminaires via DALI line)	4-265 264 265 265 265 265 266 266
5 .1 5.2 5.3 5.4 5.5 5.6 5.7 5.8	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) LR (power reduction with control phase) for outdoor luminaires LA (self-sufficient power reduction without control phase with outdoor luminaires CL (constant luminous flux function) MA-Z (central monitoring of self-contained luminaires via DALI line) DIMD MA-Z (central control and monitoring of self-cont	4-265 264 265 265 265 265 266 266 ained
5 .1 5.2 5.3 5.4 5.5 5.6 5.7 5.8	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) 1 LR (power reduction with control phase) for outdoor luminaires 1 LA (self-sufficient power reduction without control phase) 1 Vith outdoor luminaires 1 CL (constant luminous flux function) 1 MA-Z (central monitoring of self-contained luminaires via DALI line) 1 DIMD MA-Z (central control and monitoring of self-contained luminaires with with DALI-2 ECG) 1	4-265 264 265 265 265 266 266 ained 266
5 .1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) 14 K (power reduction with control phase) for outdoor luminaires 14 LA (self-sufficient power reduction without control phase) 14 Vith outdoor luminaires 14 CL (constant luminous flux function) 14-Z (central monitoring of self-contained luminaires Via DALI line) DIMD MA-Z (central control and monitoring of self-contained luminaires DIMD MA-Z (central control and monitoring of self-contained self-contained luminaires 14 Uninaires with with DALI-2 ECG) DI (central monitoring of self-contained Ex luminaires	4-265 264 265 265 265 266 266 266 ained 266
5 .1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) 1 LR (power reduction with control phase) for outdoor luminaires 1 LA (self-sufficient power reduction without control phase) 1 Vith outdoor luminaires 1 CL (constant luminous flux function) 1 MA-Z (central monitoring of self-contained luminaires via DALI line) 1 DIMD MA-Z (central control and monitoring of self-cont luminaires with with DALI-2 ECG) 1 DI (central monitoring of self-contained Ex luminaires via DALI line) 1	4-265 264 265 265 265 266 266 266 266 266
5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) 14 K (power reduction with control phase) for outdoor luminaires 14 LA (self-sufficient power reduction without control phase) 16 Vith outdoor luminaires 16 CL (constant luminous flux function) 16-2 MA-Z (central monitoring of self-contained luminaires via DALI line) 11 DIMD MA-Z (central control and monitoring of self-cont luminaires with with DALI-2 ECG) 11 DI (central monitoring of self-contained Ex luminaires via DALI line) 11 DIMD (central control and monitoring of self-contained DIMDI (central control and monitoring of self-contained 12	4-265 264 265 265 265 266 266 266 266
5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10	Control of lighting systems, dimming and power reduction 26 DIMA (analogue dimming) DIMD (Digital dimming and control with DALI) DIMC (Corridor function with control phase) E DIMC (Corridor function with control phase) for outdoor luminaires E LA (self-sufficient power reduction without control phase) for outdoor luminaires E CL (constant luminous flux function) MA-Z (central monitoring of self-contained luminaires via DALI line) DIMD MA-Z (central control and monitoring of self-contained luminaires with with DALI-2 ECG) E DIMDI (central control and monitoring of self-contained Ex luminaires with DALI-2 ECG) E	4-265 264 265 265 265 266 266 266 266 266

5.11	RFL (luminaire with Zhaga Book 18 base(s), prepared for light control)	266
5 12	Light Management System (LMS)	266
5.13	Other dimming functions	266
5.14	Restrictions on the use of radar sensors	266
5.15	Restrictions on the use of infrared sensors	266
6.	Safety classification for luminaires	267
6.1	Degrees of protection to DIN VDE 0711/EN 60598/IEC 598	267
6.2	Protection classes	267
7.	Areas of application and properties of SCHUCH	
	luminaires	267
7.1	Use of moisture-proof luminaires taking into account	
	their degree of protection	267
7.2	"F" mark	267
7.3	Luminaires with limited surface temperature	
	"D" symbol	267
7.4	Frameless luminaires made of toughened safety glass	268
7.5	Use of luminaires in animal husbandry	268
7.6	PC cover glasses	268
8.	Emergency lighting	268
8.1	Classification and terms	268
8.2	Occupational safety	268
8.3	Electrical requirements	268
8.4	Lighting requirements	268
8.5	Use of luminaires in emergency lighting systems with	
	central power supply systems (ZB)	269
8.6	Individual monitoring of LED luminaires in emergency	
	lighting systems with central power supply systems	269
8.7	Individual monitoring of self-contained LED luminaires	
8.8	Conversion of general lighting luminaires to	269
	emergency luminaires	
9.	Plastics in SCHUCH luminaires	269
9.1	Chemical resistance	269
10.	Corrosion resistance of sheet steel luminaires	270
11.	Glare rating in industrial lighting	270

The technical appendix provides information and notes that are important for the planning, installation and operation of lighting systems with SCHUCH Light Fittings.

Explosion-Protected lighting 1

1.1 Introduction

Luminaires may only be brought into areas with explosive atmospheres if they do not constitute a source of ignition for these explosive atmospheres. An explosion is defined as an oxidation or decomposition reaction that takes place at a high reaction rate and produces an increase in temperature or pressure or both at the same time. It involves reactions of flammable gases, mists and vapours or dusts and combustible flyings with the oxygen in the air.

Possible hazardous areas are, for example, in chemical factories, refineries, paint factories, paint shops, cleaning plants, mills and storage facilities for ground products, tank and loading facilities for flammable gases, liquids and solids.

Legal basis 1.2

Electrical installations and equipment in potentially explosive atmospheres are subject to special directives and regulations.

1.2.1 Directive 94/9/EC - 2014/34/EU

For the CENELEC (European Committee for Electrotechnical Standardization) area, Directive 94/9/EC (commonly referred to as ATEX 95, formerly ATEX 100a) of the European Parliament and Council of 23 March 1994 is of fundamental importance. ATEX means: Atmosphères Explosibles, i.e. explosive atmospheres.

The directive is primarily addressed to the manufacturers of explosion-protected equipment.

The harmonised standards of the EN 60079 ff series describe the different types of protection. Conformity with the requirements of the Directive is demonstrated for electrical equipment in categories 1 and 2 by the EU type examination certificate. For category 3 equipment, the manufacturer declares conformity with the requirements of the Directive on his own responsibility and issues an EU declaration of conformity or, for components, an attestation of conformity. The EU type examination certificate can be issued by a German authority, e.g. the Physikalisch Technische Bundesanstalt in Braunschweig (PTB, Notified Body No. 0102) as well as by another Notified Body.

On 29 March 2014, the new version of the ATEX Directive 2014/34/EU was published in the Official Journal of the European Union. The new directive has been in force since 20 April 2016. There are no fundamental improvements for manufacturers and designers. Mainly adaptations to the New Legislative Framework (NLF) are made. Old certificates according to Directive 94/9/EC remain valid.

1.2.2 EC Directive 1999/92/EC

EC Directive 1999/92/EC is generally known as ATEX 137 (formerly ATEX 118a) and is aimed primarily at the operators of installations with potentially explosive atmospheres. In Germany it was transposed into national law on 27 September 2002 as the "Ordinance on the Simplification of Legislation in the Field of Safety and Health Protection in the Provision of Work Equipment and its Use at Work, Safety in the Operation of Installations Requiring Monitoring and the Organisation of Occupational Health and Safety" (Betriebssicherheitsverordnung - Betr.SichV, 27 Sept. 2002 BGBI, I p.2777).

1.3 Technical principles

An explosive atmosphere is a mixture of air and flammable gases, vapours, mists or dusts and combustible flyings under atmospheric conditions in which, after ignition has occurred, the combustion process is transferred to the entire unburned mixture. In a potentially explosive atmosphere, the atmosphere may become explosive due to local and operational conditions.

In EU Directive 2014/34/EU, electrical equipment for potentially explosive atmospheres is divided into groups, categories and temperature classes. This is necessary because the same requirements do not have to be placed on the equipment for every application and for every hazard level, which would also not make economic sense.

Electrical equipment for installations in potentially explosive atmospheres is generally designed for an ambient temperature range of -20 °C to +40 °C, unless an additional temperature specification extends or restricts this.

1.3.1 Equipment groups

A distinction is made between two equipment groups:

Equipment group I applies to equipment for use in underground operations of mines and their surface installations which may be endangered by firedamp and/or combustible dust.

Equipment group II applies to equipment for use in other areas which may be endangered by an explosive atmosphere.

1.3.2 Zone classification (according to Directive 1999/92/EC)

Potentially explosive atmospheres are classified into the following zones according to the likelihood of explosive atmospheres occurring:

Gases, vapours or mists

An area in which an explosive atmosphere is present either conti-Zone 0 nuously or over long periods of time or frequently as a mixture of air and combustible gases, vapours or mists. Zone 1 An area where under normal operating conditions an explosive atmosphere may occasionally be present as a mixture of air and combustible gases, vapours or mists. Zone 2 An area where an explosive atmosphere is not likely to be present under normal operation but if it should occur for some reason it would normally only exist for a **short period** as a mixture of air and combustible gases, vapours or mists. Dusts Zone 20 An area in which an explosive atmosphere is present either continuously or over long periods or frequently as a cloud of combustible dust in the air. Zone 21 An area where under normal operating conditions an explosive atmosphere may **occasionally** be present as a cloud of combustible dust in the air. Zone 22 An area where an explosive atmosphere is not likely to be present under normal operation but if it should occur for some reason it would normally only exist for a **short period** as a cloud of combustible dust in the air. Illustration 1 and Illustration 2 show typical Zone 2 examples for the Zoning for flammable liquids

Illustration 1: Storage of flammable liquids







1.3.3 Equipment categories

Acc. to the ATEX standards (2014/34/EU) the appliances for application in their relative zones are classified into categories. Similar to the different zones there are three different categories for group II equipment. Consequently, the explosion protected products can be allocated to the ex-zones existing in the production area.

- **Category 1** comprises appliances which have been designed in such a way that they may be operated in compliance with the characteristic parameters given by the manufacturer and which ensure a **very high level** of safety. **Appliances of this category** may be used in ZONES 0 and 20 as per their certification.
- **Category 2** comprises appliances which have been designed in such a way that they may be operated in compliance with the characteristic parameters given by the manufacturer and which ensure a **high level** of safety. **Appliances of this category** may be used in ZONES 1 and 21 as per their certification.
- Category 3 comprises appliances which have been designed in such a way that they can be operated in compliance with the characteristic parameters given by the manufacturer and which ensure a **normal level** of safety. Appliances of this category may be used in ZONES 2 and 22.

 Table 1 shows the relationship between zoning and equipment category.

Zone	Explosive Atmosphere	Category according to 2014/34/EU
Zone 0 Zone 20	continuously, long periods or frequently	Category 1
Zone 1 Zone 21	occasionally	Category 2
Zone 2 Zone 22	infrequently and short periods	Category 3

Table 1: Zoning - Equipment category

1.3.4 Temperature classes acc. to IEC 60079-0

An important parameter for the classification of gases is the ignition temperature. The ignition temperature is the lowest temperature value of a hot surface at which an explosive atmosphere ignites on it. This maximum surface temperature must always be lower than the ignition temperature of the gas, mist or vapour/air mixture in which it is used. **Table 2** shows the temperature classes according to IEC 60079-0.

Temperature classification	Maximum permissible surface tem- peratures of equipment [°C]	Ignition temperatures of in- flammable substances [°C]
T1	450	> 450
T2	300	> 300 ≤ 450
Т3	200	> 200 ≤ 300
T4	135	> 135 ≤ 200
T5	100	> 100 ≤ 135
T6	85	> 85 < 100

Table 2: Temperature classes

1.3.5 Group II

EN ISO/IEC 80079-20-1 "Material characteristics for gas and vapour classification" describes a method for determining the maximum experimental safe gap MESG. The maximum gap width is of considerable importance for the type of protection flameproof enclosure "d". Table 3 shows the maximum gap widths of group II for

Group	Gap width M E S G	
IIA	> 0,9 mm	
IIB	\geq 0,5 bis \leq 0,9 mm	
IIC	< 0,5 mm	

a volume of 20 ml according to EN ISO/IEC 80079-20-1, gap length 25 mm.

Table 3: Group/maximum gap width (according to EN ISO/IEC 80079-20-1 with 25 mm gap length volume 20 ml)

1.3.6 Group III

Combustible solid particles in form of dust or flyings can explode in combination with air and an ignition source. The type of substance is decisive for the selection of equipment. Combustible solid particles are divided into subgroups according to their properties, see **Table 4**.

t	Group	
h	IIIA	combustible flyings
e	IIIB	non-conductive dusts: Specific electrical resistance > 1 k Ω m
	IIIC	conductive dusts: Specific electrical resistance $\leq 1 \text{ k}\Omega \text{ m}$

Table 4: Classification

of flammable solid particles into sub-groups (according to the test method in EN ISO/IEC 80079-20-2)

1.3.7 Classification of flammable gases, mists, vapours

Table 5 shows the classification of gases, mists and vapours into groups and tempe-

Explosion group	Classification of gases and vapours into temperature classes					
	T1	T2	Т3	T4	T5	T6
lIΑ	Acetone Ethane Ethyl acetate Ammonia Ethyl chloride Benzol Acetic acid Carbon Methanol Methanol Methyl chloride Naphta- lene Phenol Phenol Toluol	i-amyl acetate n-butane n-butyl alcohol Cyclohe- xane 1,2-dichlo- rethane Acetic anhydride	Gasoline Diesel fuel Aviation fuel Heating oils n-hexane	Acetal- dehyde		
IIB	Town gas	Ethylene Ethyl alcohol	Hydrogen sulphide	Ethyl ether	-	
IIC	Hydrogen	Acetylene			-	Carbon disphide
I	Methane					

rature classes.

Table 5: Classification of flammable gases, mists and vapours

1.3.8 Combustible dusts

Similar to gases, mists and vapours, all combustible dusts and flyings (fibres that have become detached from fabrics or similar materials and are caught, for example, in the lint filter of a clothes dryer) can also react explosively under certain conditions. Possible ignition sources are electric sparks, hot surfaces, electrostatic charges etc. To exclude these ignition sources for the dust atmosphere, special types of ignition protection are used, such as "encapsulation", "pressurised enclosure" or "protection by enclosure".

With the "protection by enclosure" type of protection, dust and flyings are prevented from entering the luminaire by a dust-protected or dust-tight housing.

Dust or flyings can ignite on the outer surfaces of a luminaire. In this case, the surface temperature is the ignition source.

The highest occurring temperature of the luminaire surface with which combustible dust or flyings can come into contact must be noted as the maximum surface temperature on the type plate.

The properties of dust or flyings for explosion protection in luminaires are mainly described by two parameters, the **minimum ignition temperature of a dust cloud**



(MIT_C) and the **minimum ignition temperature of a dust layer (MIT**_L). The **layer ignition temperature** is the temperature of a hot surface on which a layer of dust 5 mm thick begins to glow.

The **minimum ignition temperature** is the lowest temperature at which a dust cloud can ignite on brief contact with a heated wall.

If the minimum ignition temperature of the combustible dust that occurs is known, the maximum surface temperature of the luminaire can be used to decide on the particular application.

It is important to keep a safety margin between these two values. The lower of the two values is decisive.

The surface temperature of the equipment must be at least 75 K below the layer ignition temperature and must not be greater than 2/3 of the ignition temperature of the dust cloud. An example for hard coal:

 $\rm MIT_{C}$ = 590 °C (minus 1/3 $\rm MIT_{C}$ = 394 °C).

MIT₁ = 245 °C (minus 75 K = 170 °C)

-> max. permissible surface temperature with a dust layer of max. 5 mm: 170 °C

Depending on the height of the dust accumulating on the luminaire, the maximum permissible surface temperature is reduced. A diagram for this can be found in the EN 60079-14 standard, where further information can also be found. For the example given above, this means that with coal dust and a layer thickness of 50 mm, the maximum surface temperature of the equipment must not exceed 80 °C, i.e. the layer ignition temperature is 80 °C with the appropriate safety margin.

A typical luminaire for areas susceptible to dust is shown in Fig. 3.



Fig. 3: Explosion-protected luminaire e865 for dust-hazardous areas of zone 21 in type of protection: protection by enclosure "t".

1.3.9 Types of Protection

In areas where it is not possible to prevent the presence of a hazardous explosive atmosphere (primary explosion protection), only explosion-protected equipment may be used. The design measures required for this are described in the types of protection.

Luminaires are generally built with type of protection flame proof enclosure $\,{}_{\!\!\!\!\!\!\!\!\!\!\!\!\!}d''$ or increased safety ${}_{\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!\!}e''.$

EN 60079-7	- stands for: "Increased safety"	- code: " e "
EN 60079-1	- stands for: "Flameproof enclosure"	- code: " d "
EN 60079-5	- stands for: "Powder filling"	- code: " q "
EN 60079-2	- stands for: "Pressurised apparatus"	- code: " p "
EN 60079-11	- stands for: "Intrinsic safety"	- code: " i "
EN 60079-18	- stands for: "Encapsulation"	- code: " m "
EN 60079-31	- stands for: "Protection by enclosure"	- code: " t "
EN 60079-15	- stands for: "Zone 2"	- code: " n "
EN 60079-28	- stands for: "Limitation of optical radiation"	- code: " op is "

Analogous to the degree of protection of the equipment category (according to Directive 2014/34/EU) or the equipment protection levels EPL (according to IEC 60079-0), some types of protection are subdivided into levels of protection, e.g. the type of protection encapsulation in ma (use in Zone 0, 1, 2 or 20, 21, 22); mb (use in Zone 1, 2 or 21, 22) and mc (use in Zone 2 or 22), and the type of protection increased safety in eb (use in Zone 1, 2) and ec (use in Zone 2).

1.3.9.1 Flameproof enclosure "d"

The type of protection flameproof enclosure ",d" is used for luminaires for use in Zone 1 mainly where ignition sources such as electric sparks and hot surfaces do not permit the use of the light source in luminaires of the type of protection increased safety. This is the case, for example, with LEDs. The parts of an item of electrical equipment that can ignite a potentially explosive atmosphere are enclosed in a housing with this type of protection. The explosive mixture can penetrate the enclosure. In the event of an explosion of this mixture inside, the enclosure must withstand this pressure and prevent the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

The fundamental difference to the type of protection increased safety "e" is that in the case of the type of protection "increased safety", the occurrence of ignition sources that can trigger an explosion is prevented. With flameproof enclosure "d", an explosion may occur inside the enclosure, but its transmission to the outside is prevented.

1.3.9.2 Increased safety "e"

The principle of this type of protection is to prevent sources of ignition from the equipment, i.e. measures are taken to prevent, with an increased level of safety, the possibility of e.g. impermissibly high temperatures and the occurrence of sparks or arcs inside or on external parts of electrical equipment. The type of protection is applicable to electrical equipment and parts thereof which do not produce sparks or assume dangerous temperatures under normal operating conditions. The type of protection increased safety "e" has become established worldwide for luminaires for fluorescent lamps, especially for economic reasons for use in Zone 1. LEDs must have an additional type of protection in order to be installed in luminaires for use in Zone 1, e.g. encapsulation.

Figs. 4 and 5 show special luminaires with type of protection increased safety "e".





Fig. 4: Explosion-protected high-bay luminaire e8825 with type of protection: increased safety "e"

Figure 5: Explosion-protected floodlight e8820 in the type of protection: increased safety "e"

Fig. 6 and **Fig. 7** show two typical luminaires with type of protection increased safety "e". The advantage over luminaires in flameproof enclosure "d" is the considerably lower weight and the simplified replacement of electronic components and easier maintenance. In terms of price, this luminaire also has advantages over the luminaire in flameproof enclosure "d".





Fig. 6: Explosion-protected polyester diffuser luminaire e865 in type of protection increased safety "e"

Fig. 7: Explosion-protected steep roof luminaire e821 in the type of protection increased safety "e"

Figure 6 shows an Ex-protected LED diffuser luminaire for use in Zone 1 and Zone 21. The LED modules are manufactured with a special encapsulation. The following characteristic data apply:

<u>Type of protection</u>: eb <u>Explosion protection</u>: II 2 G Ex eb mb q IIC T4 Gb (Zone 1) II 2 D Ex tb IIIC T80°C Db (Zone 21)



1.3.10 Marking

Fig. 8 shows the type plate of an explosion-protected LED luminaire in the type of protection increased safety "e" in which other types of protection also apply, in this case encapsulation "m" for the LED module and powder filling "q" in which the electronic ballast is designed and encapsulated.



Figure 8: Example of marking of an explosion-protected luminaire

	Community mark for flameproof and explosi- on-proof equipment
	Equipment group II (above ground)
	Equipment category (luminaires for Zone 1 or 21 hazardous areas)
	Atmosphere (G = gases)
II2 G Exeb mb q	IIC T4 Gb
	Equipment protection level suitable for use in Zone 1 and Zone 2
	Temperature class T4
	(i.e. max. permissible surface temperatures in and on the luminaire less than 135°C)
	Equipment group subdivision IIC Suitable for e.g. hydrogen
	Type of protection of the luminaire: Increased safety "e"; level of protection "eb"(use in Zone 1, 2) EX Components in encapsulation "m"; level of protection "mb" (use in Zone 1, 2 or 21, 22) and powder filling "q".
	explosion-proof

Community mark for flameproof and explosion-proof equipment Equipment group II (above ground) Equipment category (luminaires for Zone 1 or 21 hazardous areas) Atmosphere (D = dusts) (Ex II 2 D Ex tb IIIC T80°C Db Equipment protection level suitable for use in Zone 21 and Zone 22 max. surface temperature max. temperature of a surface that can come into contact with dust; here 80 °C Equipment group subdivision IIIC suitable conductive dusts e.g. coal dust Type of protection of the luminaire: Protection by enclosure "t", level of protection "tb" (use in Zone 21, 22) explosion-proof In addition, the following information is required:

-30 °C \leq Ta \leq +55 °C permissible operating temperature range if different from -20 °C bis +40 °C

IBExU Notified body (Institute for Safety Engineering)

C€ 0102 C€ -marking with the number of the Notified Body that monitors the QM system (0102 = Physikalisch Technische Bundesanstalt, PTB).

1.4 Special operating conditions

If the luminaire is subject to special oerating conditions, such as chemical, mechanical, thermal, electrical, vibration, humidity, etc., this must be discussed in advance between the operator and the manufacturer so that additional measures can be taken if necessary. This is pointed out both by Directive 1999/92/EC and by the standard DIN EN 60079-14 or VDE 0165, which is authoritative for the operator of electrical equipment in potentially explosive atmospheres.

Ex luminaires usually have a high IP degree of protection, expressed e.g. by the marking "IP66". However, this does not mean that the luminaire is hermetically sealed.

Luminaires are classified and tested in different degrees of protection according to the European standard EN 60529. This standard contains the German translation of the international standard IEC 60529 and is also a VDE regulation, as it has been approved by the VDE and classified under VDE 0470, Part 1.

In the current edition of this standard, a brief description and definition for the degrees of protection represented by the second code number is given in section 6.

For example, the short description for the second code number 6 is: "Protected against strong jets of water." The definition given is: "Water splashing against the enclosure from any direction as a strong jet shall have no harmful effects."

In this standard, the humidity of the air is not taken into account as a relevant criterion when classifying the degrees of protection.

Damp and cold ambient conditions combined with low duty cycles can restrict the use of luminaires with electronic ballasts.

Before installing luminaires, e.g. in rainwater retention basins, in water treatment plants or above clarification basins, etc., the manufacturer should be consulted in order to use special designs if necessary.

2. Marking

All SCHUCH luminaires bear the $\zeta \in$ -marking. The $\zeta \in$ -marking documents that the product complies with the relevant EU directives and may be freely marketed on the EU domestic market.

Whether a luminaire has test marks or other optional markings can also be found in the product data sheet.



General information 3

3.1 Permissible ambient temperatures

If no additional information is given, LED luminaires are designed for a maximum permissible ambient temperature of -20 °C to +25 °C.

Emergency luminaires are excluded from this.

Explosion-protected equipment is generally designed for an ambient temperature of up to +40 °C.

Special versions for lower (T..) or higher (H..) temperatures are available on request.

3.2 Rated voltage

Unless otherwise indicated, all luminaires listed in the catalogue are suitable for a rated voltage of 230 V \pm 10 % / 50 Hz. Luminaires for other voltages and frequencies are usually available on request.

3.3 FMC

The EMC Directive and the Electromagnetic Compatibility Act (EMVG) regulate the requirements for EMC and ensure that only luminaires with a sufficient level of electromagnetic compatibility are placed on the European market; EMC is therefore a product characteristic and thus a quality feature. The corresponding technical requirements as a basis for EMC are defined in the European standards. In Germany, the Bundesnetzagentur is responsible for and monitors EMC.

EMC conformity means that every luminaire complies with the protection requirements; these are:

 limited interference emission 	(EN IEC 55015)
adequate immunity to interference	(EN IEC 61547)
 limitation of mains harmonics 	(EN IEC 61000-3-2)

· limitation of voltage changes/fluctuations and flicker (EN IEC 61000-3-3)

Compliance with the standards ensures a defined compatibility of different loads. Nevertheless, even if the standards are complied with, unfavourable distances between useful and interference levels may impair e.g. radio reception when using a radio with a rod antenna. In this case, the distance between the radio and the luminaire must be increased, for example.

4. **Properties of LED luminaires**

4.1 Rated values in the data sheets of LED luminaires

All tolerances of the rated values for system wattage, luminaire luminous flux and luminous efficacy stated in the catalogue comply with the specifications according to IEC 62722-2-1. The luminaire luminous flux is not more than 10 % below the stated rated luminous flux. The connected load of the luminaire is not more than 10 % above the rated power specified in the data sheet. All rated values refer to an ambient temperature of Ta = 25 °C unless otherwise stated. If LED luminaires are operated at higher temperatures, the luminaire luminous flux is typically reduced by 1.5 % per 10 K.

4.2 Service life specifications of LED luminaires:

The data sheet specifies the average rated service life Lx. Lx describes the time after the original luminaire luminous flux has decreased to a percentage value x. At the rated service life L, the luminaire luminous flux is x% of the initial value. Typical values of "x" are $\hat{7}0$ (L₇₀), or 80 (L₈₀). The specification of the rated service life is linked to the proportion of luminaires with increased luminous flux reduction B, and is represented as $L_y B_y$. The value B_{50} thus means that 50 percent of the luminaires fall short of the declared luminous flux component "x" at the end of the average rated service life ${\rm L}_{\rm v}$ and 50 percent exceed it. The service life specifications are based on defined test procedures. The specifications in the data sheet are expected values. The specified service life is therefore not a guaranteed property of **the luminaire.** The specification $L_{80}B_{10} \ge 50,000h$ means that statistically 90 % (100-10) of all luminaires still have at least 80 % of their original luminous flux after 50,000 h. $B_y = B_{50}$ applies to the average rated service life Lx (without addition). According to a recommendation of the ZVEI, this value should be stated in the data sheets

Failures of control gear as well as the degree of soiling of the luminaire are not taken into account here

The failure rate of operating devices depends not only on the specification of the components and their quality, but also to a large extent on the operating temperature. The following applies: for tc max. (maximum permissible device temperature)

the failure rate is 2 ‰ per 1,000 h, i.e. for a service life of 50,000 h the percentage of failed units is up to 10 %.

Example: With 100 ECGs in continuous operation (at the max. permissible t, temperature), statistically up to 10 units will have failed after 5.7 years.

Operation at lower ambient temperatures reduces failure rate.

Switching resistance of LED luminaires: 4.3

Switching frequency/switching cycles: Frequent switching can lead to an increased failure rate of LED modules. According to the specifications of the International Electrotechnical Commission (IEC), one switching per day is assumed for outdoor luminaires and up to three switching per day for indoor luminaires. If switching is to take place more frequently, the use of the corridor function (DIMC) is recommended. The corridor function (see chapter 5) enables unlimited switching of the luminaires. In corridor mode, the luminaires are not switched off but dimmed to 10 %.

4.4 Use of LED luminaires in corrosive atmospheres

Harmful gases and other corrosive substances (e.g. ammonia, sulphur or chlorine compounds) can damage LEDs. Depending on the substance, concentration, temperature and duration of exposure, damage or even total failure is possible.

Even luminaires with a high ingress protection are affected by this. Corrosive atmospheres can penetrate the luminaires. A high IP code does not automatically mean that a luminaire is gas-tight The suitability of the luminaires for the respective application can be determined e.g. by a practical test on site.

We recommend the use of luminaires from our luminaire range that are specially designed for use in areas exposed to hazardous gases.

- ER version: Increased protection against corrosive atmospheres. Luminaires in ER version are approved e.g. for use in production facilities and warehouses for vehicle tyres.
- Version HR: High protection against corrosive atmospheres. Luminaires in version AUS HR are approved e.g. for use in outdoor areas of sewage treatment plants.
- Version XR: Absolutely gas-tight luminaire. The Primo XR luminaire is approved for hazardous gas areas (exception: explosive atmospheres, swimming pools, exposure to chemicals that attack PMMA or stainless steel).

4.5 Use of LED luminaires in a humid atmosphere

If luminaires are operated in damp and cold ambient conditions in combination with low duty cycles, there is a risk of premature failure. Luminaires with a high IP code are also affected. Critical applications are e.g. rainwater retention basins, water treatment plants and certain applications in the agricultural sector.

After the luminaire is switched off, a underpressure is created, which leads to the intake of humid outside air. This atmosphere can damage or destroy electronic components in the luminaire.

This problem can be remedied by switching the luminaire on regularly and for longer periods of time. Under certain circumstances, an additional vent is necessary. Where this is not possible, only luminaires in XR or HR design (gas-tight or corrosion-resistant) should be used. Other suitable special designs are available on request.

4.6 Mounting of LED outdoor luminaires of protection class II on mounting devices that are electrically insulated from the earth potential.

When mounting LED luminaires of protection class II on fixing devices that are electrically insulated from the earth potential, electrostatic charges may occur due to weather conditions, among other things. This can cause damage to the control gear and/or the LED modules.

Mounting devices insulated from the earth potential are, for example, wooden, concrete or plastic poles, insulated steel poles, wall mountings and cable suspensions.

The installation of a luminaire in protection class I is a remedy. In this case, charges are discharged via the PE.

If protection class II luminaires are to be installed, a special version with ESD discharge is available.



4.7 Overvoltage protection for LED outdoor luminaires

LED outdoor luminaires are significantly more sensitive to overvoltage events than luminaires with conventional ballasts.

Switching operations/load changes can cause overvoltages of up to approx. 6 kV in the mains.

Lightning strikes in the vicinity of outdoor lighting installations can cause voltages up to a multiple of 10 kV, depending on the distance of the strikes to the luminaire and the conductivity in the ground.

In the case of direct lightning strikes in a streetlight, the pulse heights that occur are so great that there is no economically justifiable protective measure.

The ECGs used by SCHUCH already have an increased surge voltage resistance.

The surge voltage resistance of the luminaire can be further increased by an additional surge protection module in the luminaire or in the cable junction box.

Surge protection modules, which disconnect the luminaire from the mains in the event of their own defect, offer even greater operational safety.

Increased overvoltage protection in protection class II luminaires is only possible to a limited extent for normative reasons, among others!

No protective earth conductor may be connected in protection class II luminaires. However, comprehensive overvoltage protection is only possible if the protective earth conductor is available and the luminaire housing and mast are connected to the protective earth conductor.

As a further measure, we recommend installing surge arresters in the distribution boards. This will intercept direct and indirect lightning strikes into the supply network.

he probability of a lightning strike varies greatly from region to region and in Central Europe varies from less than one strike per year and km² to over 20 strikes per year and km².

Should outdoor LED luminaires or outdoor luminaires with electronic ballasts be installed e.g. in areas with an increased probability of lightning strikes, we recommend the use of luminaires of protection class I and an additional surge protection module in the cable junction box, or in the luminaire (on request) as well as measures in the distribution board.

4.8 Restrictions in the operation of LED outdoor luminaires with power reduction

In extremely rare cases, leakage currents may occur between the phases or phase and neutral. This can lead to incorrect switching behaviour in luminaires with power reduction. The luminaires then do not switch to power reduction.

Leakage currents can be caused by old, damaged cables with insufficient insulation or high capacitive coupling.

When replacing individual luminaires in existing installations with older LED luminaires or when extending lighting installations, problems can also occur when switching to power reduction. In such cases, additional relays must be retrofitted at the control phase input in the luminaires already installed. In such cases, it is more cost-effective to add luminaires with autonomous power reduction (LA => without control phase).

4.9 Inrush currents with LED luminaires - limited automatic load capacity

In contrast to luminaires with conventional control gear, in lighting systems with LED luminaires all luminaires start at the same time (also applies to ECG luminaires with conventional lamps).

In the storage capacitor of these ECGs, a very high charging current flows for a short time at the moment of switch-on. The maximum permissible number of luminaires per miniature circuit-breaker is not limited by the operating current but by the inrush current. It can be found online on the respective product data sheet of the luminaire.

4.10 Photobiological safety

The photobiological safety of luminaires is dealt with in the DIN EN 62471:2009 standard. It describes limit values or risk groups for irradiation as well as corresponding measurement methods in the UV, visible and infrared spectral range. The protection goal is to exclude thermal as well as photochemical hazards to the human eye and skin.

Almost all SCHUCH luminaires fall into the lower risk groups 0 and 1. They cannot cause any photobiological damage to the eye or human skin and are therefore harmless. Luminaires that fall into risk group 2 are marked with a picture symbol ("do not look into the light source"). In addition, the installation instructions indicate the

distance at which looking into the luminaire is safe. Due to the installation location, a hazard can be ruled out for most technical luminaires of risk group 2, as it is not possible to look into the luminaire from a short distance. Doubling the distance reduces the radiation reaching the eye to a quarter (square law of distance). Therefore, in most cases, caution is only required during maintenance work.

Luminaires in risk group 3 cannot be approved because they would pose a not inconsiderable risk.

4.11 Replacement of control gear and LED modules when repairing luminaires.

SCHUCH LED luminaires contain "light sources that cannot be replaced by the user*", so-called LED modules. These LED modules may only be replaced by SCHUCH, a service technician appointed by SCHUCH or a similarly qualified person. (* not an electrotechnical specialist).

The replacement of electrical components or the repair of LED luminaires may only be carried out with components supplied or authorised by SCHUCH.

Many control gear units have programming, i.e. replacing a control gear unit with an identical unit does not automatically guarantee the desired function!

When repairing LED luminaires, there is a risk that LEDs may be damaged or even directly destroyed by electrostatic discharges. ESD protective measures must therefore be taken when repairing the luminaires (dissipative work surface, ESD shoes/ESD wristband, ESD clothing).

In protection class II luminaires with metal housings, cables with double insulation are installed for safety reasons and cables are fixed to each other with cable ties at terminal points. When repair work is carried out, the original condition of the luminaire must be restored, e.g. double-insulated cables must not be replaced by single-insulated cables. Cable ties that have been removed must be replaced.

4.12 Light emissions (ULOR+ULR)

ULOR (Upward Light Output Ratio): Indicates the proportion of the luminous flux emitted by a horizontally aligned luminaire (inclination 0°) into the upper half-space. The value is usually given as an integer percentage.

ULR (Upward Light Ratio): In contrast to ULOR, which refers exclusively to the luminaire, ULR indicates the proportion of luminous flux emitted into the upper half-space by a luminaire mounted in an installation. This is therefore largely dependent on the inclination of the luminaire. The value is usually given as an integer percentage.

5 Control of lighting systems, dimming and power reduction

5.1 DIMA (Analogue Dimming)

By means of an external potentiometer or a control voltage of 1-10V, dimming in the range of typically 10-100 % is possible (LED). Several luminaires can be operated in parallel on one 1-10 V line, the max. number depends on the load capacity of the potentiometer/control unit and the line length . The number of ECGs to be connected can be increased with a signal amplifier. Due to voltage drop on the line and coupling of interference, luminaires on a line may nevertheless have slightly different dimming levels.

All luminaires with DIMA feature are supplied with 2 additional terminals, marked "1-10 V+" and "1-10 V-". The cables to the control inputs must be of mains voltage-proof design and can be included in the connection cable.

5.2 DIMD (Digital Dimming and Control with DALI)

DALI (Digital Addressable Lighting Interface) and the further developed standard DALI-2 are a protocol for controlling luminaires. With a small number of lines, many luminaires can be controlled individually even over long distances. In addition, DALI can be easily integrated into higher-level building automation systems such as KNX, EIB or LON.

DALI-2 is the latest version of DALI, which ensures improved interoperability between components from different suppliers through mandatory certification and extended functions, e.g. energy data.

Up to 64 operating devices can be controlled via one DALI line. It should be noted that several control gear units can be installed in one luminaire. The maximum cable length is 300 m with a minimum cable cross-section of 1.5 mm². The range may be limited due to unfavourable conditions. A larger range can only be achieved with repeaters, a higher number of luminaires per DALI line only with broadcast commands. (Attention, this severely limits the functionality of a DALI-2 system in particular). Better is the parallel operation of several DALI lines with one controller. With LIMAS Line PRO SCE controllers, 3 DALI lines can be operated. By networking (LAN) several controllers, up to 15 DALI lines are possible (960 control gear units).

Dimming levels of 1-100 % are possible depending on the control gear. For the operation of a DALI system, further devices are required (controller, power supply unit, etc.), which are not included in the scope of delivery of the luminaire.

All luminaires with DIMD feature are delivered with 2 additional terminal points, marked "DA". The polarity is irrelevant. The cables to the control inputs must be of mains voltage-proof design and can be included in the connection cable.

DALI inputs have only a low overvoltage resistance. Networking with DALI is therefore not recommended for outdoor luminaires. The lines should be routed from the luminaire to the cable transition box at the most, e.g. for connecting Powerline or a programming interface. Additional overvoltage protection is recommended.

DALI luminaires and DALI cables must not be installed or laid in the vicinity of high-voltage equipment. Electrical and magnetic fields can interfere with DALI communication or even destroy DALI components.

If the DALI function is not used but the lines have been laid, they should be shortcircuited at a central point to avoid interference (disconnect bus power supply!).

There should be no mixed installations of DALI and DALI-2 peripherals.

Further information is available at: https://www.dali-alliance.org/

5.3 DIMC (corridor function with control phase)

The corridor function enables simple power reduction of luminaires to a fixed value by means of an ordinary 230 V control voltage.

In combination with motion sensors or door contacts, high energy savings are possible in rarely used areas.

In the standard setting, the luminaire only provides 100 % luminous flux as long as the control phase is active. After deactivation of the control phase, the luminaire dims down to the background level of 10% within approx. 30 seconds (due to technical limitations, a higher dimming level results for individual versions). As LED modules and control gear only have a limited switching resistance, dimming results in a significantly longer service life of the luminaire compared to switching the luminaire on and off directly (without DIMC). The luminaire never switches itself off, but may be switched off by the user at any time.

The graphic shows the luminous flux output of a luminaire with DIMC that is controlled via a motion sensor.



The following default settings are made for luminaires with DIMC. The parameters can be customised on request:

- Delay time: luminaire maintains 100 % luminous flux for time duration X after switching off the control phase (default setting 0 seconds, but customer can set his own "hold time" by setting the switch-off time delay of the motion sensor).
- Fade time: faster or slower dimming down of the luminaire in time period Y (default setting: approx. 30 seconds)
- Automatic switch-off: Luminaire switches off completely after time period Z without activity. (Standard setting: never switch off; versions Z30: luminaire switches off after 30 minutes)
- Background level: Dimming level when there is no activity. (Standard setting: 10 %; due to technical limitations, a higher dimming level may result for individual versions).

All luminaires with DIMC feature are supplied with a 4-pole terminal.



For the different versions, the following instructions must be observed during installation:

- DIMC SENS luminaires have an integrated motion sensor, as well as a connection for the control phase L'. (The connection here is both input and output). For this reason, the supply of all DIMC SENS luminaires, as well as all external motion sensors, must be on the same phase and a common circuit breaker. (-> Note the limited number of luminaires per common circuit breaker).
- DIMC luminaires do not contain an integrated motion sensor. They only have one input for the control phase L' (-> at least one additional external detector or one additional DIMC SENS luminaire is required). The supply of all DIMC luminaires operated on one control phase can be divided among all 3 phases and any number of common circuit breaker. (-> number practically unlimited)

Radar sensors are built into DIMC and SENS luminaires to detect movement. Objects (e.g. metal partition walls, concrete beams, etc.) that reflect or absorb the radar waves have an influence on the detection range of the sensor. Radar waves can also penetrate lightweight walls, for example, and detect unwanted movements behind these walls. In the vicinity of transmission masts (e.g. on the roofs of parking garages), there may also be functional impairments.

When using external motion sensors/sensors, only units with relay output may be used.

5.4 LR (power reduction with control phase) for outdoor luminaires

In the standard setting, the luminaire delivers 100% luminous flux when the control phase is applied. Without control phase, the luminaire is dimmed to 50 %.

The time until the lower dimming level (usually 50 %) is reached can be up to 180 seconds (comfort function). The 100 % level is reached without any time delay.

Optionally, other dimming levels (10 %-90 %) and an inverse function of the control phase (reduced operation 50 % when control phase is present) are possible.

All luminaires with LR feature have an additional terminal point, labelled LST. The control phase does not have to be in phase with the supply (L).

Chapter 4 describes possible restrictions in the operation of LED outdoor luminaires with power reduction via control phase.

5.5 LA (autonomous power reduction without control phase) for outdoor luminaires

If luminaires with power reduction are to be operated in existing installations where there is no control line, a self-sufficient power reduction can be used.

The time until the dimming level (usually 50 %) is reached can be up to 180 seconds. The same applies to switching back to 100 %. The gradual lowering or raising of the luminous flux of luminaires with power reduction means that switching is not visually perceptible. It thus serves the comfort of the user, as disturbing influences on road users or residents are avoided. Since a visual check of the power reduction is not possible, the change of the luminaire input current or the illuminance should be used for a possibly necessary verification of the proper function.

After the initial start-up, a luminaire needs up to 3 days until the line reduction works reliably.

The luminaire dims completely automatically to different levels (between 10 % and 90 %) at preset times. Several dimming levels per night are possible. Standard: One dimming level, 50% luminous flux from 22:00-04:00 CET and 23:00-05:00 CEST.

The luminaire does not use a real-time clock as a timer; instead, the dimming times are recalculated every night from the previous switch-on and switch-off times. This excludes the possibility of deviations in the dimming rate, even after decades of operation.



For this reason, however, it is also not possible to change over to daylight saving time, as the switch-on and switch-off times are determined by twilight. Controlling the luminaires via a timer is not recommended; the dimming times are then dependent on the respective setting.

In Germany, shifts of up to +18 or -18 minutes may occur due to the width of the time zone.

Special programming may be necessary for installation locations outside Germany.

5.6 CL (constant luminous flux function)

Luminaires with feature CL are initially set to approx. 90 % of the output compared to basic types without CL. The luminous flux remains constant throughout the entire service life. The output increases from 90 % to a maximum of 100 % at the end of the service life (100,000 h). After this time, the luminous flux degradation is no longer compensated by an increase in output.

5.7 MA-Z (central monitoring of self-contained luminaires via DALI line)

Up to **64 luminaires** with MA-Z version can be centrally **monitored** via a DALI line. All known restrictions of a DALI system apply (see 5.2).

In addition, a LIMAS Line PRO SCE controller is required (not included in delivery). The emergency luminaires can be switched on and off via a 230 V control phase (L') using a switch.

All control gear is certified according to IEC 62386-202 (DALI-Self-contained emergency control gear).

5.8 DIMD MA-Z (central control and monitoring of self-contained luminaires with DALI-2 ECG)

Up to **32 luminaires** with DIMD MA-Z version can be centrally **monitored and controlled** via a DALI line. All known restrictions of a DALI system apply (see 5.2).

In addition, a LIMAS Line PRO SCE controller is required (not included in delivery).

The emergency luminaires can only be dimmed and switched via DALI-2 compatible control elements/sensors. No 230V control phase may be connected.

All control gear is DALI-2 and certified according to IEC 62386-202 (DALI-Self-contained emergency control gear).

5.9 DI (central monitoring of self-contained Ex luminaires via DALI line)

Up to **64 luminaires** with DI version can be centrally monitored via a DALI line. All known restrictions of a DALI system apply (see 5.2).

In addition, a LIMAS Line PRO SCE controller is required (not included in delivery). The emergency luminaires can be switched on and off via a 230V control phase (L') using a switch.

All control gear is certified according to IEC 62386-202 (DALI-Self-contained emergency control gear).

5.10 DIMDI (central control and monitoring of self-contained Ex luminaires with DALI-2 ECG)

Up to **64 luminaires** with DIMDI version can be centrally **monitored and controlled** via a DALI line. All known restrictions of a DALI system apply (see 5.2). A LIMAS Line PRO SCE controller is required to monitor and control the luminaires (not included in delivery).

The emergency luminaires can only be dimmed and switched via DALI-2 compatible control elements/sensors. No 230 V control phase may be connected.

DIMDI control gear is IEC 62386-202 (DALI-Self-contained emergency control gear) and DALI-2 compatible.

5.11 RFL (luminaire with Zhaga Book 18 socket(s), prepared for light control)

Luminaires with RFL socket (Ready for Lightmanagement System) enable easy retrofitting of light controls and/or sensors. The luminaire does not have to be opened or rewired. All Zhaga Book 18 compatible and D4i certified sensors, IoT nodes etc. are supported.(Due to the variety of systems on the market, we can only provide support for setting up the systems we sell).

Versions:

- RFLO: The luminaire has a socket on the top of the luminaire e.g. for stand-alone photocell or controller with GPS and radio reception
- RFLU: The luminaire has a socket on the underside, e.g. for stand-alone motion sensors or controllerwith radio reception.
- RFLOU: The luminaire has 2 interconnected sockets at the top and bottom, e.g. for controller and motion sensor (use only compatible products).

Due to the design of some luminaires, the socket can only be installed at the top or at the bottom. For Pole-Top luminaires, the socket is located in the luminaire (luminaire must be opened for replacement).

Zhaga and D4i define, among other things, the mechanical and electrical connection of luminaire and light management products. The choice of light management system can thus be made independently of the luminaire manufacturer. However, different light management systems are not compatible with each other!

All luminaires are delivered with sealing caps mounted on the sockets. If no components are installed, the sealing caps must not be removed! Without a cap, the luminaire does not meet the specified IP protection class and warranty claims cannot be made.

When installing the light management components, ensure that they engage properly in the socket and that they are firmly seated (bayonet lock).

The connection of non-Zhaga/ D4i compliant adapters, extension cables or devices is not permitted. Electrical and magnetic fields can interfere with radio communication.

In many applications, RFL luminaires are initially operated without light management components, but are initially intended to contain special functions that later conflict with the selected light management system:

The constant luminous flux function (CL) and the set maximum luminous flux are not affected (for luminaires in VARIO version, the maximum luminous flux can possibly be increased via DIP switch).

All other functions (autonomous dimming LA, control phase LR) are automatically deactivated as soon as the base is used. DIMD (DALI) versions are not possible.

5.12 Light management system (LMS, LMG, RFL)

Luminaires with LIMAS light management system (LMS, LMG) are system-compatible with RFL components such as RFL LIMAS HUB3 and RFL LIMAS HUB3 G2 GPS SIM. With LMS luminaires, the components are permanently installed in or on the luminaire and cannot be replaced.

For LMS luminaires and RFL luminaires with RFL LIMAS HUB3, a USB dongle is required for on-site programming. Programming via the cloud is possible if an RFL LIMAS HUB3 G2 GPS SIM or a gateway is present in the mesh network.

For control according to time profiles, at least one LMG luminaire (with GPS antenna), one RFL luminaire with RFL LIMAS HUB3 G2 GPS SIM or one gateway in the mesh network must be used.

Gateways must be installed outdoors in plastic control cabinets in direct proximity to LMS or RFL luminaires with RFL LIMAS HUB3.

5.13 Other dimming functions

Other dimming functions are available on request, e.g.:

- amplitude dimming (dimming by varying the mains voltage)
- different dimming levels in emergency lighting mode for luminaires on central battery systems (see also chapter Emergency lighting).

5.14 Limitations when using radar sensors:

Radar sensors work ideally when steady movements in the environment (background noise) are as low as possible.

(background noise) are as low as possible. In heavy fog, rain and branches and leaves moved by wind, the detection of moving objects such as pedestrians, cyclists and cars is made more difficult. Conversely, heavy rain and/or branches and leaves moved by wind, for example, may trigger motion detection. Shrubs and trees in the vicinity of the radar sensor should therefore be continuously cut back. In the vicinity of high-voltage power lines and transmission masts, the function of radar sensors may also be impaired.

5.15 Restrictions on the use of infrared sensors:

IR sensors operate with a pixel-based detection field that detects temperature differences between moving objects (road users) and their surroundings.

The detection range of the sensor depends on the corresponding light spot height and luminaire inclination.

In practical operation, objects cannot be detected under the following conditions:

- Sensor is covered by object (e.g. branch)
- Persons or objects do not have the required size in the detection range of the sensor
- Persons or vehicles are moving at a speed < 1 m/s
- Persons (e.g. with special heat-insulating clothing) or vehicles (e.g. still cold vehicles in winter) do not have a sufficient temperatemperature difference (at least 4 K to the environment).



- People move precisely between the rasterised pixel-based detection points. detection points.
- Persons or objects are too far away from the detection range of the sensor. of the sensor.

In addition, there are operating conditions under which the sensor has no function or a malfunction:

- Condensation on the sensor (e.g. in fog) or icing.
- Static charge caused by wind (should, however, be discharged through the earthed luminaire housing).
- Operation outside of the specified operating temperature (see product data sheets)
- Incorrect switching due to air turbulence, e.g. on branches

6. Safety classification for luminaires

The selection of luminaires for certain applications requires the consideration of corresponding protection types and protection classes.

6.1 Ingress Protection Code according to DIN VDE 0711/EN IEC 60598-1

	-	-	
	1st CHARACTERISTIC NUMERAL	2 nd CHARACTERSTIC NUMERAL	
RA- TING	SOLID PARTICLE PRO- TECTION	LIQIUD INGRESS PROTECTION	Symbol
IP 20	solid objects > 12 mm	non-protected	
IP 23	solid objects > 12 mm	protected against spraying water	
IP 40	solid objects > 1 mm	non-protected	
IP 43	solid objects > 1 mm	protected against spraying water	
IP 44	solid objects > 1 mm	protected against splashing water	
IP 54	dust protected	protected against spraying water	*
IP 55	dust protected	protected against water jets	* 1
IP 65	dust tight	protected against water jets	
IP 66	dust tight	protected against heavy seas	
IP 67	dust tight	protected against effects of immersion in water between 15 cm and 1m for 30 minutes	
IP 68	dust tight	protected against effects of immersion in water under pressure for long periods	
IPx9k	dust tight	protected against effects of high pressure water jets	

6.2 Protection classes

	Meaning	Notes	
' (Light fittings with connection point for protective conductor, to which all touchable metal parts must be connected, which can immediately be on mains voltage level in the event of a fault.	Connection to the mains protective conductor is mandatory. The symbol is attached to the connec- tion point.	
" 🗆	In the case of such light fittings, no metal parts may be touched that could immediately be on mains voltage level in the event of a fault (protective insulation or double in- sulation).	The light fitting must not have a protective earth connection and must not be connected to a protecti- ve earth conductor (except for functional earth*).	
	Light fittings for operation with safety extra-low voltage, i.e. with voltages below 42 V, which are generated with a safety transformer according to VDE 0551 or taken from batteries or accumulators.		
* Functional earth: Earthing of a point in a system, which is necessary e.g. to start a lamp or to fulfil EMC requirements. This is not part of the electrical protection system. Symbol:			

7. Areas of application and properties of SCHUCH luminaires

DIN VDE 0100 must be observed when selecting luminaires. (see section 4).

7.1 Use of moisture-proof luminaires taking into account their degree of protection

Damp-proof luminaires with a high ingress protection (IP 65) are indoor luminaires for ceiling, pendant and trunking mounting (horizontal mounting). If these luminaires are not used as intended, e.g. if they are mounted outdoors, in a different mounting position and/or in extremely high humidity, condensation may occur. In the very dense luminaires, a underpressure is created during the cooling phase after switching off or in the case of strong temperature fluctuations (e.g. mounting in outdoor installations). This can cause moist air to be drawn into the interior of the luminaire and to condense. Water accumulation in a moisture-proof luminaire is thus by no means due to a leaky luminaire, but rather to a luminaire that is too tight. (The tighter the luminaire, the greater the risk of condensation).

For such cases, e.g. for outdoor use, SCHUCH has special luminaires such as the 161/162... AUS series. These luminaires are suitable for unprotected use outdoors.

When installing moisture-proof luminaires on cold surfaces, condensation can also occur. In such cases, it is necessary to mount the luminaires at a distance from the mounting surface. Luminaires with protection class IP65 are "jet water protected". Direct spraying (e.g. during cleaning work) with high-pressure cleaners/steam jets is not permitted. The forces that occur are many times higher than during a water jet test and can lead to water ingress.

7.2 "F" symbol

Luminaires suitable for mounting on normally flammable surfaces (ignition temperature >200 °C) must be constructed in such a way that in the event of a fault, a maximum of 180°C will occur on the mounting surface.

Such luminaires used to be marked with the \overline{V} -symbol. Luminaires that do not meet the requirements must now be negatively marked with the symbol $\frac{1}{N}$.

7.3 Luminaires with limited surface temperature "D" symbol

In areas subject to fire hazards (risk of combustible dust deposits), only luminaires that comply with the requirements of DIN EN 60598-2-24 and bear the marking be used. The marking prepares the FF representation of the marking previously used in Germany. Examples include lighting installations in paper and wood processing and agricultural premises.

Requirements and information are given in the installation regulations (e.g. VDE 0100 Part 482) and also in the requirements of property insurers (e.g. VDS 2033).

Similar to gases, mists and vapours, all combustible dusts and fluff can also react explosively under certain conditions, i.e. in these cases Ex luminaires must be used. In case of doubt, consult the supervisory authorities, e.g. the trade inspectorate or the TÜV.

7.4 Frameless glass made of toughened safety glass

Frameless glass must not be damaged by installation or maintenance work, neither on the surface nor in the edge area!

If, for example, a tool hits the edge of the glass and material flakes off, glass breakage cannot be ruled out. Such a breakage can also occur with a considerable time delay after the damage.

7.5 Use of luminaires in animal husbandry

When used in stables, luminaires are particularly exposed to ammonia from animal excrement.

The LED modules mounted in linear luminaires of classic design (e.g. series 161 or 163) and their control gear are damaged by ammonia exposure.

We recommend the use of the Tube light fitting "Primo XR LW". This luminaire is hermetically sealed to prevent aggressive substances from entering the interior of the luminaire.

The linear luminaire "LUXANO 2 LW", or other luminaires in the "LW" or "ER" versions are also suitable for most agricultural applications. Please consult us.

In poultry farming, the "Primo XR LW DIMD" luminaire should be used. This meets the special requirements regarding flicker as required by the Federal Ordinance on Livestock Husbandry.

SCHUCH

7.6 PC cover glasses

Polycarbonate has the property that it tends to turn yellow under the influence of UV light. PC luminaire cover glasses are exposed to natural UV light when installed outdoors. However, the UV content of the light sources used must also be taken into account

The polycarbonates we use to manufacture our PC cover glasses are provided with so-called UV additives that improve UV stability.

However, "yellowing" due to UV radiation cannot be prevented. The additives merely delay this process!

The parameters here are the operating time of the luminaire and the level of UV exposure.

Discolouration of PC glasses does not represent a product defect.

8. **Emergency lighting**

Classification and terms 8.1

Emergency lighting is divided into emergency escape lighting and standby lighting. Emergency escape lighting is subdivided into:

- safety lighting for escape routes

- High-risk task area lighting

- anti-panic lighting

8.2 **Occupational safety**

In Germany, occupational safety is divided into two parts. State ordinances (e.g. Workplace Ordinance) and the regulations of the German Social Accident Insurance (DGUV) apply (e.g. DGUV Regulation 3, previously BGV A3).

Under the Workplace Ordinance, which has been in force since August 2004, safety lighting must be provided in workplaces where it is not safe to leave or where there is a risk of accidents occurring if the general lighting fails.

The individual regulations are concretised by the "Technical Rules for Workplaces", which are important for safety lighting:

- ASR A1.3 Safety and health signage

- ASR A2.3 Escape routes, emergency exits, escape and rescue plan

- ASR A3.4/7 Technical rules for workplace safety lighting, optical safety systems

8.3 **Electrical engineering requirements**

DIN VDE 0108-1 with its comprehensive statements on the design of safety lighting systems was withdrawn in March 2007. It has been replaced by a European standard published as DIN EN 50172 (VDE 0108-100):2005-01. The withdrawal of DIN 0108-1 had become necessary because national standards have to be withdrawn as soon as a European standard on the same subject appears.

DIN EN 50172 / VDE 0108-100 is to be regarded as a European "consensus paper" because it deals only with basic safety lighting issues and does not reflect the long-established status of safety lighting in Germany - especially with regard to central battery-supplied safety lighting systems.

In the meantime, DIN VDE V 0108-100-1 (VDE V 0108-100-1):2018-12 is available. DIN VDE V 0108-100-1 is recommended for use by UK 221.3.

It should be noted that the application of this pre-standard should be agreed separately between the building owner and the installer.

Lighting requirements 8.4

The lighting requirements for emergency lighting are set out in DIN EN1838 (11/2019) and DIN EN1838 Supplement 1 (11/2018).

Emergency lighting is the lighting that takes effect when the power supply to the general lighting system is disrupted.

Safety lighting for escape routes

The following applies to emergency lighting for escape routes:

Emin

 \geq 1 lx (horizontal illuminance on the floor along the centre line of the escape route, measured at a height of up to 2 cm).

E_{min} / E_{max} ≤ 1:40 on the escape route

Glare limitation:

h = mounting height

= maximum permissible luminous intensity at specific exit angles

Colour rendering index: Ra ≥40

Escape routes must not only be illuminated but also marked.

Safety signs and identification of escape routes:

Escape signs must be visible from every point along the escape route.

The colours must comply with ISO 3864.

The luminance of the safety colour green must be at least 2cd/m² at every point after mains failure.

In mains operation, the luminance of the contrast colour white shall be 500cd/m².

Lmin / Lmax > 10 : 1

Lwhite / Lgreen = 5 : 1 to 15 : 1

To determine the intended recognition range of a safety sign, the following definition applies:

 $l = h \times z$

with h = height of the pictogram

z = 100 for illuminated signs

z = 200 for backlit signs

High-risk task area lighting:

h[m]	< 2,5	$2,5 \le h < 3$	3 ≤ h < 3,5	$3,5 \le h < 4$	$4 \le h < 4,5$	≥ 4,5
l _{max} [cd]	500	900	1.600	2.500	3.500	5.000

For High-risk task area lighting workplaces, the following applies:

 $Emin \ge 10$ % Em (Emin = 15 lx).

Em = maintenance value of illuminance for the corresponding visual task

Uniformity U0 of illuminance >0.1 (U0 is the quotient Emin/ E of minimum and average illuminance)

Glare limitation:

h

= mounting height

= maximum permissible luminous intensity at specific exit angles I max

h[m]	< 2,5	2,5 ≤ h < 3	3 ≤ h < 3,5	$3,5 \le h < 4$	$4 \le h < 4,5$	≥ 4,5
l _{max} [cd]	500	900	1.600	2.500	3.500	5.000

Colour rendering index: Ra ≥40

8.5 Use of luminaires in emergency lighting systems with central power supply systems (ZB)

Many control gear units are labelled as also suitable for 220 V DC operation. This does not mean that they are automatically suitable for central battery systems. These operating devices as well as the luminaire must fulfil all requirements of DIN EN 60598-2-22, which applies to luminaires with central emergency power supply (ZB) and also to single-battery luminaires (EB).

They must meet the requirements from this standard, e.g. section 22.7.3 for protecting the luminaire with e.g. a DC fuse or to section 22.19 for operation at higher temperature (70 °C).

SCHUCH supplies luminaires in the so-called "ZB version" for such cases.



8.6 Individual monitoring of LED luminaires in emergency lighting systems with central power supply systems

The (common) monitoring modules of the companies INOTEC, CEAG, Ecker/Stahl for 230 V system voltage monitor the current consumption on the primary side of the control gear and give an error message if the current falls below a certain value.

LED modules are made up of series and parallel circuits of individual LEDs.

Low-resistance failures of individual LEDs of an LED module (on the secondary side of the control gear) do not necessarily lead to a change in the current consumption on the primary side, which is recognised as a fault by monitoring modules!

8.7 Individual monitoring of LED self-contained luminaires

According to DIN VDE V 0108-100-1, the status of the luminaire must be monitored for safety purposes (ready for operation, malfunction, etc.) and displayed at a central, suitable location during the time required for operation. SCHUCH supplies luminaires for such cases, e.g. DALI emergency lighting control gear (see options).

For the operation of a DALI bus system, further devices (control unit, power supply unit) are required which are not included in the scope of delivery of the luminaire.

8.8 Conversion of general lighting luminaires to emergency luminaires

Converting a general lighting luminaire into an emergency luminaire creates a new product. This new luminaire must comply with all technical regulations and statutory provisions applicable to the product, such as RED, LVD, EMC, RoHS, VDE regulations, DIN standards, and a new conformity assessment must be carried out and a new declaration of conformity drawn up. See "Information on the conversion of general lighting luminaires to emergency luminaires" (ZVEI 05/2019).

Literature:

B. Weis, H. Finke: "Not - und Sicherheitsbeleuchtung", Hüthig & Pflaum-Verlag Fachbuch: ISBN 978-3-8101-0584-4 E-Book/PDF: ISBN 978-3-8101-0585-1

9. Plastics in SCHUCH luminaires

9.1 Chemical resistance

The **luminaire housings** of many SCHUCH luminaires are made of **glass-fibre reinforced polyester**. This material is heat-resistant, mechanically stable, electrically insulating, weatherproof and chemically resistant.

The luminaire covers are usually made of silicate glass, polycarbonate (PC) or polymethyl methacrylate (PMMA).

For polycarbonate (PC) and polymethyl methacrylate (PMMA), their resistance to various chemical substances - according to the current knowledge of the relevant material manufacturers - is given below. Experience shows that the temperature of chemical (aggressive) substances often plays a significant role.

Parts made of polycarbonate (trade name Makrolon, Lexan etc.) are more impact resistant and heat resistant than parts made of PMMA (trade name Diakon, Plexiglas etc.). Polycarbonate is not resistant to all agents. For cleaning, we recommend warm water with a weakly alkaline detergent, e.g. REI and PRIL. Afterwards, rinse well with clear water. After rinsing, there must be no residual cleaner on the treated luminaire. The PH value of the cleaner must be less than 7.5. For this reason, no soap or similar should be used. In particular, we would like to point out that PC is not resistant to oils and greases! For moisture-proof diffuser luminaires with plastic caps, their chemical resistance must also be taken into account (please consult us). In many cases, KE fasteners (made of stainless steel) are an alternative.

Material	Poly- methylacrylat (PMMA)	Polycarbonat (PC)	Thermoplastic polyester (PBT)		
Acetone	-	-	-		
Ethylalcohol (to 30 %)	o	o 96 % 1)	+		
Battery acid	+	+	n/a		
Ammonia	+	-	+ up to 10 % ¹⁾		
Boric acid 3 %	+	+	n/a		
Sodium Hypochlorite	+	-	n/a		
Chlorine (moist)	-	-	n/a		
Chromium acid 10 %	o	+	n/a		
Acetic acid concentrated	-	-	-		
Acetic acid (up to 10%)	+	+ < 10 % ¹⁾	+		
Formaldehyde (up to 10%)	o	+	n/a		
Glycerin	+	0	+		
Uric acid (up to 20 %)	+	n/a	n/a		
Potassium (20-25 °C)	+	-	-		
Kerosene (aviation gasoline)	o/-	-	+		
Sea water	+	+	+		
Methyl alcohol (up to 23 °C)	o/-	-	+		
Lactic acid < 4 %	+	+	n/a		
Sodium chloride	+	+	+ up to 10 % ¹⁾		
Sodium hydroxide Solution 20-25 °C	+	-	+		
Petroleum	o	o	+		
Phosphoric acid Concentrated	-	+ 10 up to 30 $\%$ $^{1)}$	+ 25 % 1)		
Soap liquor (at 23 °c)	+	ο	up to 10 % OK		
Sulfuric acid H2S04	-	-	-		
Sulfuric acid up to 30 %	+	+	+ bis 10 % 1)		
Sulphur dioxide dry (at 23 °C)	-	o	n/a		
Turpentine (at 23 °C)	+/o	-	+		
Toluene	-	-	-		
Acidity of wine	+ up to 50 % $^{\mbox{\tiny 1)}}$	+ up to 10 % ¹⁾	n/a		
Citric acid up to 20 %	+	+	+ up to 10 % ¹⁾		
Legend: + = resistant, O = limited resistent - = volaltile (unstably) $^{1)}$ = concentration					



10. Corrosion resistance of sheet steel luminaires

Our sheet steel luminaires are powder-coated with a high-quality polyester lacquer.

In addition to corrosion protection, the coating offers very good scratch resistance.

Depending on the conditions of use at the installation site, however, corrosion on the housings cannot be completely ruled out.

Examples of this are applications with permanent humidity, mounting locations near lakes under canopies or areas with aggressive media/chemicals.

For such conditions, depending on the requirements, we offer modified versions with KTL coating, aluminium or VA enclosures.

11. Glare evaluation in industrial lighting

A distinction is made between 2 types of glare:

1. Discomfort glare

This causes an unpleasant sensation without necessarily involving a noticeable reduction in visual acuity.

2. Disability glare

This results in a reduction in visual function.

The United Glare Rating (UGR) method was developed to standardise the assessment of discomfort glare caused by indoor/office lighting worldwide.

In industrial lighting, however, it is usually a question of visual performance and thus of disability glare, which is essential for occupational safety and accident prevention.

The UGR method cannot assess disability glare. Accordingly, it is not taken into account in lighting design in industrial plants. The UGR method is therefore not suitable for assessing the glare of lighting installations in industrial applications, especially for hall lighting.

A suitable procedure must be developed for these applications in the future. The relevant expert committees in the ZVEI have already taken up this task.

Detailed information:

• ZVEI position paper "UGR method - application and limits". www.schuch.de/de/Positionspapier-UGR_ZVEI

• Statement "Glare assessment in industrial lighting" by Prof. Dr. Bruno Weis, Technical Manager Adolf Schuch GmbH

www.schuch.de/de/Blendungsbewertung-Industriebeleuchtung_Weis

Literature:

B. Weis, G. Finke: Emergency and safety lighting, Hüthig & Pflaum-Verlag. ISBN 978-3-8101-0584-4

B. Weis, J-G. Kaiser, N. Wittig: Industrial lighting, Hüthig & Pflaum-Verlag Volume 1: Fundamentals - Standards - Regulations ISBN 978-3-8101-0370-3 Volume 2: Installation regulations - Applications ISBN 978-3-8101-0391-8







Summery of the products

Series	Page	Series	Page	Series	Page	Series	Page
1 07	115-116	167 G2 (emergency)	250-251	59/49 RFL	184	FOCO L (7700 SBL)	163
107 LW	116	167 G2 AUS / VARIO	104	59/49 VARIO	183	FOCO L (7700 SSK)	160
107 XR DIMD	116	167 G2 DIMC/Z30	107	7 600 SBL	162	FOCO L VARIO/RFL (7700)	217-223
110	117-118	167 G2 DIMD	105	7600 VARIO	214-216		21/-216
110 DIMD	110		100		214 210		161
	118		109	7600 VARIO RFL	210	FOCO XL (7800 SSK)	101
110 H50	118	167 G2 HE CS	108	7700 SBL	163	FOCO XL (7800 SBL)	163
130/131 G2	114	167 G2 HE VARIO	104	7700 SSK	160	FOCO XL VARIO/RFL (7800)	217-223
131 W MA	255	167 G2 HL	108	7700/7800	217-223	FR-Installation material	125-127
131 ZB	255	167 G2 IFS / VARIO	105	7700/7800 RFL	220-222	Konic - Vario / RFL (544 G2)	189-192
131/131 G2 (emergency)	254-255	167 G2 LW	109	7700/7800 VARIO	219	LIMAS Air/LIMAS Air GUARD	8-13
142	123-124	167 G2 SENS/730	107	7800 SBI	163	LIMAS Air (FR)	74
142	05.00	167 G2 5EN3/250	107	7800552	105		120
144	95-96	167 G2 1407 H50	108	7800 SSK	101		130
144 AUS	96	185	120-122	7850 MA	227	LIMAS AIr GUARD (NOT)	241
161 (emergency)	246-247	185 SSK	121	7850 ME	226	LIMAS Air for sports facilities	26-27
161 MA	247	190	119	7850	224-227	LIMAS AU/RFL	19-25
161 ZB	247	3 301 ER	135	7950	228-230	LIMAS Line BASIC/PRO/ESC	14-18
161/162 AUS	91	3301 LW	135	8 040 (EX)	70	LIMAS Line BASIC/PRO (EX)	30
161/162 DIMC/730	89	3301 SBI	135	8118 (FX)	70	LIMAS Line BASIC/PRO (EB)	75
161/162 ED / HD	03	3301/02 JES	133		125		121
161/162 EK / HK	95	3301/02 IF3	154		125		151
161/162 FF / FC	94	3301/02 VARIO	134	AREALO (7850)	224-227	LIMAS Line ESC (emergency)	241
161/162 H50	90	3301/3302	132-136	AREALO 2 (7950)	228-230	LIMAS Line PRO (emergency)	240
161/162 IFS / LM	91-92	3302 V	137	AREALO external pole mounting	227	LUCA (46 G2 VARIO)	180-181
161/162 SENS/Z30	89	3305	138-139	AREALO internal pole mounting	226	LUXANO 2 (FR)	103-110
161/162 T40	90	3305 IFS	139	B ELLA - VARIO (564/565)	211-213	LUXANO 2 (emergency)	250-251
161/162 T40 / H70	90	3401 G3	151-153	CAMINO - RFL (48/47)	175-176	n D822	59-60
161/162 TP	90	2401/2402 62	142 145		173 173	nD022	61 62
	90	2407/3402 02	143-145		472 477	DOC11	57.50
161/162 VARIO	87/91/92	3403	146-148	CAMINO (48/47)	1/2-1//	nD8611	57-58
161/162 (FR)	86-94	3403 G3	154-156	CAPA - VARIO (541 G2)	199-201	nD866	51-53
161/162 DIMD	87	3405	149-150	CILA - VARIO (558 G2)	199-201	nD866 DIMD	52
161/162 RLED OV	102	3405 G3	157-159	CUPINA - VARIO (556 G2)	193-195	nD866 H	52
161PX AUS	81	3410/3420/3430	140-142	D UEVO (3301/3302)	132-136	nD867	54-56
161PX CS	80	3610	111	DUEVO XI (3305)	138-139	nD867 DIMDI	55
161PX ER / HR	84	3611 (FR)	117	DV (EX)	68	nD867 H	55
	04		256 257		107	- D0700	55 62 64
161PA FC	65	3611 (emergency)	250-257	DV (FR)	127	ND8700	03-04
161PX H50	80	3611 MA	256	e 821	43-44	nD8700 A	64
161PX HE	84	3611 ZB	257	e821 DIMD	44	nD8800	65-66
161PX IFS / LM	82-83	42 VARIO/42 AL VARIO	178-179	e840	37-38	nD8800 A	66
161PX SENS/Z30	79-80	4210 (EX)	69	e840 PM	38	PENDO - RFL (59/49)	184
161PX T40	81	4216 (EX)	69	e855	39-40	PENDO - VARIO (59/49)	183
161PX T40 / H70	81	46 G2 VARIO	180-181	e855 7B	40	PLANEO - VARIO (557 G2)	196-198
	01		100 101	0856	40	Polo arm carriers (ALI)	224
	77/04/02	47TOL	173		41-42		234
16TPX VARIO	///81/83	48/4 /	1/2-1//	e856 DIMDI	42	Pole-top brackets (AU)	235-236
161PX (NOT)	242-243	48/47 RFL	175-176	e864	34-36	PRIMO XR (107)	115-116
161PX H50 MA	244-245	48/47 VARIO/NFC	174	e864 DIMDI	35	PROXIMA (FR) (161PX)	76-85
161PX MA	243	5 1/52	166-171	e865	31-33	PROXIMA (NOT) (161PX)	242-243
161PX ZB	243	51/52 RFL	169-170	e865 DIMD	32	R EDONDO - RFL (55)	188
161PX (FR)	76-85	51/52 VARIO/NEC	168	e865 H	32	REDONDO - VARIO/NEC (55)	187
161PX DIMC/730	79	5/1 62	202-204	e865 T40	32		185-188
	75		202-204		47.40		225.226
	//	341 GZ VARIO	204	68820	47-48	Reducing adapters (AU)	235-230
163 G2 MA	249	543 G2	205-207	e8820 DIMD	48	RETRO - VARIO (543 G2)	205-207
163 G2 ZB	249	543 G2 VARIO	207	e8825	45-46	RETRO Z - VARIO (553 G2)	208-210
163 G2 (emergency)	248-249	544 G2	189-192	e8825 DIMD	46	SEGURO (142)	123-124
163 G2 DIMC/Z30	99	544 G2 RFL	192	e9310	50	Smart lighting LIMAS Air AREALO	232-233
163 G2 DIMD	100	544 G2 VARIO	191	e9312	49	TRIANO disc (3410/3420/3430)	140-142
163 G2 H50	100	55	185-188	ExDLIEV(0 (nD8301/02)	61-62	TRIANO G2 (3401/3402 G2)	143-145
162 G2 SENIS/720	00 100	55 PEI	105 100	Explete 1 (2865)	21 22	TPIANO G2 (2401/2402 G2)	151 152
105 G2 3EN3/250	99-100		100		24.26	TRIANO 63 (3401/3402 63)	146.440
163 G2 140	100	55 VARIO/NFC	187	EXELED T N (e864)	34-36	TRIANO L (3403)	146-148
163/164 G2 (FR)	97-101	553 G2	208-210	ExeLED 2 (nD866)	51-53	TRIANO L G3 (3403 G3)	154-156
163/164 G2 IFS	100	553 G2 VARIO	210	ExeLED 2 N (nD867)	54-56	TRIANO XL (3405)	149-150
163/164 G2 IFS	100	556 G2	193-195	ExFOCO L (nD8700)	63-64	TRIANO XL G3 (3405 G3)	157-159
163/164 RLED OV	102	556 G2 VARIO	195	ExFOCO XL (nD8800)	65-66	TRS / AL (FR)	125-126
164 KL (emergency)	252-252	557 62	196-198		10	TRS 1000 (FR)	126
	202-200		100		43		120
104 KL IVIA	252	557 GZ VAKIU	198		6/-/0	TRS 2000 (FK)	125
104 KL ZB	253	558 GZ	199-201	EXSPECT (69310)	50	TKS ZUUU/AL (EX)	67
164KL G2	113	558 G2 VARIO	201	ExSTREAM (e8820)	47-48	TUBEO (110)	117-118
167 G2 MA	251	564/565 G2	211-213	ExSTREAM (e8825)	45-46	V IA - RFL (51/52)	169-170
167 G2 VARIO ZB	251	564/565 G2 VARIO	213	FILOS (42 VARIO/42AL VARIO)	178-179	VIA - VARIO / NFC (51/52)	168
167 G2 (FR)	103-110	59/49	182-184	FOCO (7600 SBL)	162	VIA (51/52)	166-171
1		L				1	

²⁷² SCHUCH