5 Components for Incandescent

Transformers and converters for low-voltage halogen lamps

Operating low-voltage halogen lamps depends on operating devices that transform the usual mains voltage of 230 V to under 24 V. Safety transformers, of either electromagnetic or electronic (converter) design, have been in almost exclusive use for several years now. The type plate of electromagnetic transformers bears the symbol for safety transformers in accordance with VDE 0570, corresponding to EN 61558. Electronic converters are marked with the sign for Safety Extra-Low Voltage (SELV), which indicates that the product is an isolating converter whose secondary output is safe to touch even during no-load operation.

All Vossloh-Schwabe transformers are safety transformers, i.e. isolation transformers for supplying SELV (safety extra-low voltage) and PELV (protection extra-low voltage) circuits. With such systems, the voltage must not exceed a value of 50 V AC or 120 V DC (smoothed) between the conductors or a conductor and the earth conductor of a circuit that is separated from the mains by a safety transformer. The specified values apply for protected (non-touchable) voltages; 25 V AC and 60 V DC (smoothed) apply for exposed (touchable) voltages.

Depending on their design features to protect against touchable live parts, transformers and converters fall into one of two protection classes. Operating devices of protection class I are base-insulated and have a protective earth conductor connection terminal that must be connected to the protective earth conductor for safety reasons. Isolating transformers and converters of protection class II are equipped with double or reinforced insulation that protects against dangerous casing currents; these operating devices are solely available as independent operating devices (also see page 371; Protection Classes of Luminaires and Operating Devices).

Electronic converters can also be fitted with a functional earth terminal that must be connected to a functional earth to ensure compliance with EMC requirements. In addition, some electronic converters are designed in such a way that neither a protective earth conductor nor a functional earth needs to be connected.

Operating devices can also be differentiated according to the way they are used. Built-in transformers have to be installed in a permanent casing, e.g. a luminaire. In contrast, so-called independent transformers and converters can be operated independently of a luminaire. These are often found in ceiling installations; in order to prevent possible noise development, isolation transformers must be mounted in such a way as to avoid vibration transmission.

Transformers or converters bearing the MM mark can be mounted on surfaces of unknown flammability, which can be the case when mounting these devices on wooden furniture elements. Such devices comply with the temperature requirements of VDE 0710, part 14, of < 95°C during normal and < 115°C during abnormal operation.

Converters are labelled with a t_c point. The stipulated temperature (e.g. 75°C) must not be exceeded when installed so that the service life of the converter is not shortened. The temperature quoted in the triangle (e.g. 110) denotes that the surface of the converter must never (even in the event of a defect) exceed this temperature.

Protection symbols

Safety transformer

SELV

Safety Extra Low Voltage

Protection class II

Independent operating device

Furniture installation
Normal operation < 95 °C
Abnormal operation < 115 °C

If the maximum value of 130 °C is not exceeded, the luminaire does not have to be tested in accordance with F conditions.

$t_c = 75$ °C
Measuring point for maximum permissible casing temperature

Temperature-protected converter (in this case < 110 °C)

Dimmability of VS transformers and VS converters

Electromagnetic VS transformers can be controlled using phase-cutting leading-edge dimmers. These dimmers "cut" the sinusoidal mains voltage in the negative and positive half wave at an angle in the ascending portion of this sinusoidal half wave. The higher the angle is set at the dimmer controls, the lower the effective value of the voltage and hence the lamp's output.

Electronic VS converters can be controlled using phase-cutting trailing-edge dimmers. In this case, a semiconductor ensures the predefined descending portion of the sinusoidal half wave is clipped, i.e. the voltage is reduced in reverse mode. Again, higher the angle is set at the dimmer controls, the lower the effective value of the voltage and hence the lamp's output.

Converters of the LiteLine (EST 70/12.380, EST 105/12.381, EST 150/12.622 and EST 60/12.635) families can be operated using conventional phase-cutting trailing-edge and phase-cutting leading-edge dimmers.

Electronic Converters

The safe operation of electronic converters is dependent on the maximum permissible temperature not being exceeded at the measuring point. Vossloh-Schwabe has determined a casing temperature measuring point – $t_{c\ max.}$ – on all converter casings. To avoid shortening the service life or diminishing operating safety, the stipulated maximum temperature must not be exceeded at this t_c point. This point is determined by testing the converter during normal, IEC-standardised operation at the specified max. ambient temperature (t_a), which is also indicated on the type plate. As both the design-related ambient temperature and the converter's inherent heat generation, as determined by the installed load, are subject to great variation, the casing temperature should be tested at the converter's t_c point under real installation conditions.

Temperature-protected converters feature a further protection symbol, namely a triangle containing the maximum temperature. This symbol certifies that the stipulated surface temperature of the device casing will not be exceed during any operating state or in the event of a defect.

Vossloh-Schwabe electronic converters are tested in accordance with EN 61347. Function tests are carried out in accordance with EN 61047. VS converters can be operated without causing any inadmissible system reactions as all devices comply with EN 61000-3-2 on the limitation of mains harmonics. They also meet the EMC requirements of EN 61547. These devices are thus also protected against mains surges (as defined in the standard) that can be caused by, for instance, inductive ballasts during combined operation of fluorescent and low-voltage halogen lamps.

In addition, all devices comply with the RFI requirements of EN 55015. As the highly effective integrated filter can only limit the unit's own interference, the secondary conductor should be kept to under 2 metres in length so as to avoid RFI interference in the lighting system.

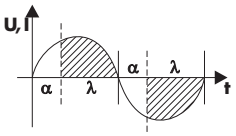
Dimmable using phase-cutting leading-edge or trailing-edge dimmers

Dimmable using phase-cutting leading-edge dimmers

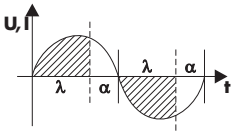
Dimmable using phase-cutting trailing-edge dimmers

Working principle of a phase-cutting leading-edge dimmer

α = Ignition angle
λ = Operating angle
U = Voltage
I = Current



Working principle of a phase-cutting trailing-edge dimmer



Assembly Instruction for Electronic Converters

For mounting and installing electronic converters for low-voltage halogen lamps

Mandatory regulations

DIN VDE 0100	Erection of low voltage installations
EN 60598-1	Luminaires – part 1: general requirements and tests
EN 61000-3-2	Electromagnetic compatibility (EMC) – part 3: maximum values – main section part 2: maximum values for mains harmonics (device input current up to and including 16 A per conductor)
EN 55015	Maximum values and methods of measurement for RFI suppression in electrical lighting installations and similar electrical appliances
EN 61547	Installations for general lighting purposes – EMC immunity requirements
EN 61347-1	Operating devices for lamps – part 1: general and safety requirements
EN 61347-2-2	Operating devices for lamps – part 2-2: special requirements for DC- or AC-powered electronic converters for incandescent lamps
EN 61047	DC- or AC-powered electronic converters for incandescent lamps – performance requirements

Designations for VS converters

Designations for electronic converters are first listed by the name of the product family, which in each case reflects the visible product properties. The type designation should be read as follows:

EST	60	/12	.388
Electronic safety transformer	Max. wattage	Lamp voltage	Serial number

Mechanical mounting

Mounting position Any

Clearance	Min. of 0.1 m from walls, ceilings, insulation; min. of 0.1 m from other electronic converters; min. of 0.25 m from sources of heat (lamp)
Surface	Solid; device must not be allowed to sink into insulation materials
Mounting location	In dry rooms or in luminaires, cases, casings or similar in the instance of built-in converters
Fastening	Independent converters: using screws, Ø 4 mm Built-in converters: fix M8 nut on the threaded stud
Heat transfer	If the electronic converter is destined for installation in a luminaire, sufficient heat transfer must be ensured between the converter and the luminaire casing. During operation, the t_c point must not exceed the specified value.

Technical specifications

Type		Operating voltage range AC	Dimmability		Temperature protection	Through-wiring[3]	Type of automatic cut-out and number of possible VS devices			
		Unsuitable for DC operation	Phasecutting trailing edge[1]	Phasecutting leading edge[1]	Electronic control[2]	Converter quantity	B (10A)	B (16A)	C (10A)	C (16A)
LiteLine	EST 70/12.380	230–240	x	x	x	–	28	45	28	45
	EST 105/12.381	230–240	x	x	x	–	20	32	20	32
	EST 150/12.622	230–240	x	x	x	–	14	23	14	23
...Mini	EST 60/12.635	220–240	x	x	x	–	35	56	35	56

1 The dimmer is connected to the primary side between mains and converter.
It is possible to connect several converters to one dimmer (whereby the dimmer's minimum and maximum load must be observed).
The dimmer-converter system should be subjected to function and noise development tests prior to installation.
2 The rating is decreased electronically in the event of overheating.
3 Distributed secondary leads are only permitted on non-metallic surfaces (RFI suppression)

Properties of electronic converters

Overheating — Protection against overheating is provided by an electronic controller (see table above).

Short-circuit — The converter will be electronically disconnected in the event of a short-circuit at the output; once the short-circuit has been eliminated, the converter will switch on again automatically.

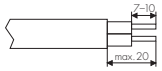
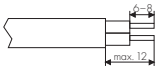
Overload — Minor overloads (< 50%) will trigger the temperature switch against overheating; major overloads (> 50%) will trigger the same reaction as for short-circuit.

Should any of the above-mentioned safety functions be triggered, disconnect the converter from the power supply, then find and eliminate the cause of the problem.

Protection against transient mains peaks
Values compliant with EN 61547 (immunity)

Electrical installation

Conductors
Primary conductor cross-section: min. 0.75 mm²
Secondary conductor cross-section: min. 0,75 mm² for 50 W output and min. 1 mm² for 100 W output

Stripping		
Converter	60/12.635	70/12.380, 105/12.381, 150/12.622
Type of lead	All usual types of lead up to 4 mm²	H03-VVH2-F 2X0.75 H05-VVH2-F 2X0.75 H03-VV-F 2X0.75 H05-VV-F 2X0.75
Lead preparation		

Connections
Screw terminals: max. initial torque of 0.4 Nm must not be exceeded

Secondary length
Min. 0.25 m (clearance to lamp), max. 2 m (RFI protection)

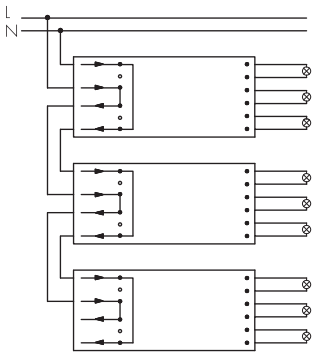
Secondary wiring
Min. 0.1 m clearance from the mains (RFI protection)

Star wiring
Twist single-wire or lead wires narrowly; silicone-insulated leads are recommended

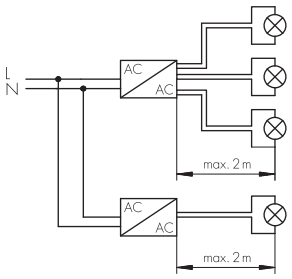
Parallel connection
Secondary-side parallel connection is inadmissible

Feed-through of the mains voltage
See table on page 337
Distributed secondary leads are only permitted on non-metallic surfaces (RFI suppression)

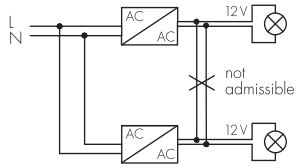
Connection circuit



Lead length



Wiring



Selection of automatic cut-outs for VS converters

Dimensioning automatic cut-outs
High transient mains current pulses occur when a converter is switched on because the capacitor has to load. As the lamps ignite almost simultaneously, this also creates a high power drain. The high currents that occur when the system is switched on put a strain on the automatic conductor cut-outs, which must be selected and dimensioned to suit.

Release reaction
Release reaction of automatic cut-outs in accordance with VDE 0641, Part 11; for B and C characteristics. The values provided in the table on page 337 are meant as guidelines only and may vary depending on the respective lighting system.

No. of converters
The maximum number of VS converters (see table on page 337) applies to cases where the devices are switched on simultaneously. Specifications apply to single-pole fuses. The number of permissible ballasts must be reduced by 20% for multi-pole fuses. The considered circuit impedance equals 400 mΩ (approx. 20 m [2.5 mm²] of conductor from the power supply to the distributor and a further 15 m to the luminaire).

Dimmability of electronic converters

Dimmed operation
VS converters can be operated with phase-cutting trailing-edge dimmers. Some converters can additionally be operated with phase-cutting leading-edge dimmers (see table on page 337). The dimmer is connected to the primary side between mains and converter. It is possible to connect several converters to one dimmer (whereby the dimmer's minimum and maximum load must be observed). The dimmer-converter system should be subjected to function and noise development tests prior to installation.

Electromagnetic compatibility (EMC)

Mains Harmonics

Maximum values are observed in accordance with EN 61000-3-2.

Interference

The requirements of EN 55015 must be met for luminaires with converters for operating low-voltage halogen lamps.
Vossloh-Schwabe converters are designed and manufactured to ensure these requirements are satisfied provided the installation instructions regarding the interference voltage at the connection terminals and electromagnetic interference fields up to 300 MHz are observed.

Additional information

Wiring

To ensure good radio interference suppression and the greatest possible operating safety, the following points should be observed when installing electronic converters:

- Conductors between the EST and the lamp (HF conductors) must be kept short (reduction of electromagnetic interference).
- Mains and lamp conductors must be kept separate and if possible should not be laid in parallel to one another. The distance between HF conductors and mains conductors should be as large as possible, ideally > 5 cm. (This prevents the induction of interference between the mains and lamp conductors).
- The mains conductor within the luminaire must be kept short (to reduce the induction of interference).
- The mains conductor must not be laid too close to the EST (this is especially important in the event of through-wiring).
- Mains and lamp conductors must not be crossed. Should this be impossible to avoid, conductors should be crossed at right angles to one another (to avoid inducing interference between mains and HF conductors).
- Should conductors be wired through metal parts, such conductors must always be additionally shielded (e.g. with an insulating sleeve or grommet).

Temperature

Reference point temperature t_c
The safe operation of electronic converters is dependent on the maximum permissible temperature not being exceeded at the measuring point. Vossloh-Schwabe has determined a casing temperature measuring point – $t_{c\ max.}$ – on all converter casings. To avoid shortening the service life or diminishing operating safety, the stipulated maximum temperature must not be exceeded at this t_c point. This point is determined by testing the converter during normal, IEC-standardised operation at the specified ambient temperature (t_a), which is also indicated on the type plate. As both the design-related ambient temperature and the converter's inherent heat, as determined by the installed load, are subject to great variation, the casing temperature should be tested at the t_c point under real installation conditions.
Ambient temperature t_a
The ambient temperature – as specified on every converter – denotes the permissible temperature range within the luminaire or at the place of installation.

Reliability

Service life of 50,000 hrs at reference point temperature t_c, whereby a switching cycle of 165 minutes on and 15 minutes off is assumed. Failure rate: ≤ 0.2%/1,000 hrs
In order to achieve the average service life, the maximum temperature ($t_{c\ max.}$) must not be exceeded at the t_c point.

Emergency lighting

VS electronic converters cannot be used for emergency lighting purposes as they are unsuitable for DC voltage operation.

Electromagnetic Transformers

Owing to the low internal impedance of electromagnetic transformers, high currents can occur in the event of a short-circuit on the secondary side, which can lead to the transformer being destroyed. For this reason, IEC 61558-1 differentiates between three types of transformer:

Transformers without short-circuit resistance
These transformers require external protection to prevent excessive temperatures being generated.

At Vossloh-Schwabe, these transformers are marked with the symbol "not short-circuit proof safety transformer". To protect against current overload during overload or short-circuit operation, Vossloh-Schwabe recommends installing a fuse on the primary side. As an aid to the user, the rating of this fuse is stated on the type plate in accordance with IEC 60127. The installed primary-side fuse should be easily accessible so that it can be readily replaced at any time.

Transformers with (limited) short-circuit resistance
These transformers feature a safety device that prevents excessive temperatures being generated.

Electromagnetic transformers with thermal cut-outs afford a limited degree of short-circuit resistance and do not need to be additionally fused. VS safety transformers of limited short-circuit resistance are designed to safely cut out in the event of overload or short-circuit, but not to restart automatically after cooling off. The transformer must first be disconnected from the mains (i.e. switched off and on) before it can be restarted. The thermal cut-outs are dimensioned to ensure that the maximum permissible winding temperature of 225°C (transformers of thermal class B) or 240°C (F) or 260°C (H) is not exceeded in the event of overload or short-circuit.

Transformers with (unlimited) short-circuit resistance
These transformers are designed to ensure that fixed maximum temperatures are not exceeded in the event of overload or short-circuit.

This type of safety transformer is not in common use within the lighting industry due to the relatively large dimensions it needs to meet the overload and short-circuit requirements.

All transformers will function perfectly and meet the requirements of the standard after the overload or short-circuit has been eliminated.

In addition to the above, there are also so-called **failsafe transformers** that are rendered permanently inoperative in the event of improper use, but do not pose a threat to the user or the surroundings. Vossloh-Schwabe does not provide this type of isolation transformer.

All Vossloh-Schwabe transformers are tested for compliance with the safety requirements of European standard EN 61558 regarding creepage and air clearance distances, the winding temperature and the maximum permissible ambient temperature (t_a).

EN 61558 specifies five insulation classes for electromagnetic transformers; respective testing temperatures and times are assigned to these classes. Due to the quality of the insulation materials used by Vossloh-Schwabe, VS transformers are only available in the three highest insulation classes B (120°C), F (140°C) and H (165°C). In this case, the quoted temperature refers to the maximum permissible winding temperature during permanent operation.

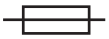
As luminaire casings made of plastic or sheet metal will discharge heat to varying degrees and because transformer installation conditions can differ, a transformer's winding temperature must be tested within the luminaire. The measured values will show whether the maximum temperature corresponds to the transformer's insulation class.

On request, Vossloh-Schwabe can carry out such luminaire tests to assess built-in components.

Protection symbols

Non short-circuit proof safety transformer

Limited short-circuit proof safety transformer



Rated fuse value

t_a 65

Transformer's maximum permissible ambient temperature

Thermal cut-out (reset after disconnection from the mains)

Assembly Instruction for Electromagnetic Transformers

For mounting and installing electromagnetic transformers for low-voltage halogen lamps

Mandatory regulations

DIN VDE 0100	Erection of low voltage installations
EN 60598-1	Luminaires – part 1: general requirements and tests
EN 61558-1	Safety of transformers, power supply units and similar – part 1: general requirements and tests
EN 61558-2-6	Safety of transformers, power supply units and similar – part 2-6: special requirements for safety transformers for general use
EN 61000-3-2	Electromagnetic compatibility (EMC) – part 3: maximum values – main section part 2: maximum values for mains harmonics (device input current up to and including 16 A per conductor)
EN 55015	Maximum values and testing methods for radio disturbance of electrical lighting facilities and similar electrical equipment
EN 61547	Installations for general lighting purposes – EMC immunity requirements

Technical specifications

Mains voltage range	VS safety transformers can be operated at the specified mains voltage within a tolerance range of ±10%
Leak current	≤ 0.1 mA per safety transformer
Power factor	$\lambda \geq 0.85$
Compensation	Not required

Mechanical mounting

Mounting position

Any

Mounting location

Safety transformers are designed for installation in luminaires or comparable devices. Independent safety transformers do not need to be built into a casing.

Fastening — Preferably using screws, Ø 4 mm

Insulation classes and maximum temperatures

In accordance with EN 61558, safety transformers are assigned to insulation classes on the basis of the insulation materials used (also called insulation material classes for this reason) in the transformers. These insulation classes also prescribe respective maximum winding temperatures that must not be exceeded during normal operation or in the event of overload or short-circuit.

Compliance with the maximum winding temperatures is tested by measuring the resistance of the transformer's copper winding.

Insulation classes for safety transformers in accordance with EN 61558-1

	A	E	B	F	H
Max. winding temperature (1.06 U_N) during normal operation	100 °C	115 °C	120 °C	140 °C	165 °C
Max. winding temperature in the event of overload or short-circuit	200 °C	215 °C	225 °C	240 °C	260 °C

Electromagnetic compatibility (EMC)

Interference — Interference voltage measurements do not have to be taken for luminaires with magnetic safety transformers for operating low-voltage halogen lamps as these are systems with lamp voltages of under 100 Hz and it is assumed that such systems do not cause interference.

Interference immunity

Thanks to the robust design and choice of materials, magnetic safety transformers provide a high degree of interference immunity and are not impaired by admissible mains power interference.

Mains harmonics

Owing to the Ohmic resistance characteristics of low-voltage halogen lamps and the low degree of distortion caused by magnetic transformers, mains harmonics remain low.

Safety functions of VS transformers

Load	Transformer features	
	Unprotected (OS)	With self-locking temperature protection (TS)
Overheating	Is not recorded	Protection is provided by the built-in thermal switch
Short-circuit	Protection must be provided by devices fitted in the luminaire (fuse or thermal switch)	
Overload		

Should one of the safety functions be triggered, the transformer must be disconnected from the mains, the cause of the fault found and then eliminated.

Dimmer operation

VS safety transformers can be controlled using progressively adjustable phase-cutting leading-edge dimmers for low-voltage halogen lamps.

Reliability and service life

VS safety transformers are designed for a long service life. Provided the specified maximum values for the winding temperature are complied with during operation, a service life of 10 years can be expected. Failure rate: < 0.025%/1,000 hrs

Electrical installation

Conductors — Primary conductor cross-section: min. 0.75 m², secondary conductor cross-section: min. 0.75 m² for 50 W output and a min. of 1 mm² for 100 W output

Connections — Terminal screws: max. torque of 0.5 Nm must not be exceeded

Parallel connection — Parallel connection is admissible on the primary side, but is inadmissible on the secondary side

Conductors for low-voltage halogen installations

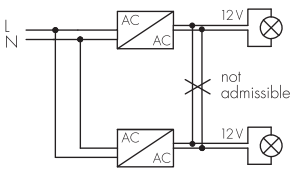
As the high temperatures associated with the operation of low-voltage halogen lamps place severe demands on lampholder conductors, a skilful combination of conductor and insulation is essential. Tin-plated copper conductors with silicone insulation are recommended for temperatures of up to 180°C at the cable's conductor; nickel-plated copper cables with polytetrafluoroethylene (PTFE) sheathing are recommended for temperatures of up to 250°C. Welded connections ensure the most effective heat discharge. Control measurements should be carried out if other connection types are used, e.g. crimping or plug connectors. To prevent the risk of additional heat generation, the maximum permissible current load must be observed when dimensioning the conductor cross-section. When using electromagnetic transformers, the conductor resistance causes a relatively large voltage drop. This drop in voltage is always associated with a reduction of luminous flux. For instance, an 11% drop in voltage will lead to a 30% drop in luminous flux. For this reason, care should be taken to ensure secondary conductors are kept as short as possible and conductor cross-sections are adequately dimensioned when wiring luminaires. Nevertheless, transformers should not be mounted too near the light source (> 25 cm clearance if possible) to prevent the heat generated by the lamp from raising the ambient temperature above the critical level for a transformer.

As electronic converters operate at high frequencies, consideration must be taken of the skin effect, i.e. the displacement of the electrons from the middle of the conductor to its surface. As a result, the full cross-section of the conductor is no longer used, resistance increases and thus leads to a greater drop in voltage. In addition, AC resistance, which is caused by feed line inductance, can result in an even greater voltage drop. It is therefore recommended that lamp conductors be laid closely parallel or twisted together.

Voltage losses (V) with a two-metre secondary conductor

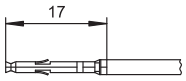
Working frequency	Load	Cross-section/Voltage drop		
	W	0.75 mm²	1 mm²	1.5 mm²
50 Hz (electromagnetic transformers)	50	0,38 V	0.29 V	0.2 V
any wiring layout	100	0.74 V	0.56 V	0.39 V
40 kHz (electronic converters)	50	1.4 V	1.25 V	1.2 V
any wiring layout (loops)	100	3.3 V	3.1 V	3 V
40 kHz (electronic converters)	50	0.5 V	0.45 V	0.35 V
wires twisted together or closely parallel	100	1.2 V	1 V	0.85 V

Wiring

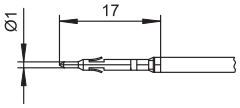


Conductor Contacts

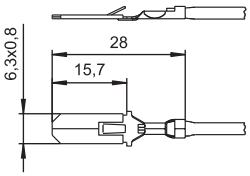
Pin contact Ø 1



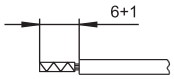
Socket connector



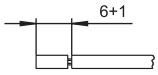
Flat connector 6.3x0.8



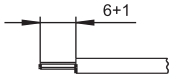
Cable with ferrules



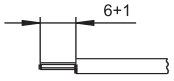
Cable, notched at 6 mm



Cable, bared at 6 mm



Ultrasonically welded cable end



Conductors for installations with halogen lamps

All conductors must be selected to suit the luminaire conditions (see table) in terms of material, cross-section and insulation. Testing these conductors under worst case conditions is essential as the commonly occurring high temperatures considerably reduce the conductivity of the conductor and hence its current-carrying capacity.

Insulation	Conductor Material	Cross-section mm²	Mains voltage V	Max. temperature °C
SI	Cu tin-plated (Cu vz)	0.75	300	180
FEP	Cu tin-plated (Cu vz)	0.75	300	180
PTFE	Cu nickel-plated (Cu vn)	0.75	500	250
PTFE	Cu nickel-plated (Cu vn)	1	500	250
PTFE	Ni	1	500	250
PTFE	Ni	1.5	500	250

Lampholders

For low-voltage halogen lamps

With the exception of B15d bases, the low-voltage sector is dominated by pin bases, which are fitted with a variety of different pin distances and diameters. Apart from classic lampholders that ensure both the electrical contact and the correct positioning of the lamp, connection elements are also available. These components are solely responsible for establishing electrical contact and are used in cases where, for instance, the regulations demand that the lamp be attached to its reflector (e.g. cold-light reflector lamps with GZ4 and GX5.3 bases). Extremely high temperatures are also generated when operating low-voltage halogen lamps as a result of the tungsten-halogen cycle and high lamp currents. In addition, the respective luminaires are often of very compact design, which leads to heat accumulation and thus to high internal temperatures. The materials the lampholder is made of thus play a vital role for the luminaire's operating safety and the lamp's service life. In addition to tried-and-tested materials – ceramics for casings and mica for covers – ever more frequent use is being made of highly heat-resistant plastics like LCP (liquid crystal polymer for e.g. G4, GU4, GX5.3, GU5.3 and GY6.35 lampholders) and PPS (polyphenylene sulphide for G4 lampholders). Plastic lampholders provide clear advantages: narrow dimensional tolerances, no material fractures, low weight and clip-attachment options.

VS lampholders for the UL market and UL approved leads are available for all common lamp types.

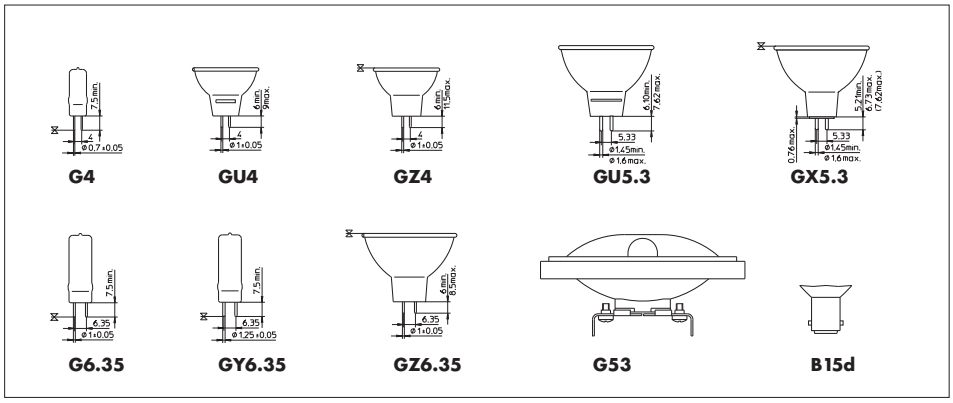
Further information can be found at www.unvlt.com.

The type of contact also plays an important role. Conventional contacts are only attached to one side of the lamp pin. In contrast, additional contact points – known as multipoint contacts – lead to a reduction of current density at the point of transition from the lamp pins to the lampholder contact and with that to a decrease in temperature. These contacts provide the further advantage of ensuring superior heat dissipation from the lamp pins to the conductor. The temperature advantage of multipoint contacts in defined conditions (including welded-on conductors) can amount to as much as 100 °C. In extremely rare cases, due to the high internal pressure in the bulb, it is possible for the lamp to shatter. For reasons of fire prevention (high temperature of the glass bulb), the lamp's components must be prevented from falling out. Enclosed luminaires meet these requirements. Open luminaires, however, may only be operated using lamps with enclosed bulbs or low-pressure lamps. Lamps of this kind are suitably marked with pictograms on the lamp's packaging and in the lamp manufacturer's documentation. Lamps marked with pictogram No. 1 are suitable for use with open luminaires, whereas those marked with pictogram No. 2 may only be used in enclosed luminaires.

1 **2**

Lampholders for low-voltage halogen lamps are equipped with mounted cables or with plug-type connectors. In addition to the various lampholders contained in the catalogue, further lampholder models with various cable lengths and of various qualities as well as lampholders with plug-connected cables can be made available on request.

Bases of the most widely used low-voltage halogen lamps



Lampholders for mains voltage halogen lamps

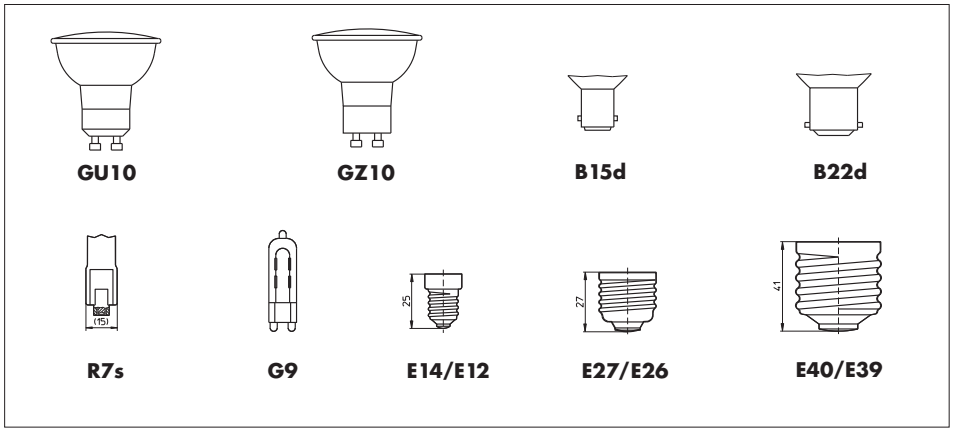
A major factor in lampholder design is the lamp temperature, which is determined by the tungstenhalogen cycle, high lamp current and high wattages. Lampholder casings can be made of ceramics, metal or the ever more popular highly heat-resistant thermoplastics like PET (polyethyleneterephthalate), PPS (polyphenylene sulphide) and LCP (liquid crystal polymer). The most suitable contact materials for these temperatures are nickel, copper-nickel alloys or copper materials with sufficiently thick nickel coatings. For tubular lamps (R7s base), the standard IEC 60061-2 7005-53 prescribes the respective contact pressure of lampholder contact materials.

Although halogen lamps offer twice the service life of general-purpose light bulbs, this can only be fully realised if luminaire manufacturers observe the recommended maximum temperatures at the lamp's pinch point. There is usually a welded-on molybdenum plate at the pinch point where the lamp base pins join the lamp filament. Lamp manufacturers ascertain the pinch temperature at this point, which is generally located within the lamp's quartz glass, using specially prepared measuring lamps. The pinch temperature is a critical thermal reference point which must not be exceeded within the luminaire.

VS lampholders for the UL market and UL approved leads are available for all common lamp types.

Further information can be found at www.unvlt.com.

The bases of the most widely used mains voltage incandescent lamps



Retrofit Lamps

So-called retrofit lamps have been introduced to the market thanks to LED technology. Some of these can significantly exceed the weight of the original lamp.
When using such lamps in luminaires already introduced to the market (with conventional lampholders), but also for new luminaire designs (with conventional lampholders), this can cause a greater risk with regard to disconnecting the power supply and, in addition, can lead to greater mechanical damage.