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Good Outdoor Lighting for the Home



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# Editorial

There is a very old saying that all cats look grey at night. Today, thanks partly to the growing trend to furnish private homes and gardens with sophisticated outdoor lighting, that saying is no longer as true as it once was.

Facades subtly accentuated by light and encircled by greenery imbue such buildings with an inviting, homely atmosphere. Illuminated gardens extend the domestic living space outwards, illuminated boundaries enable the space to be experienced as a whole, even in winter. The result is a sense of security, orientation and comfort – enhanced by the light that shines through the windows, through the eyes, as it were, of the building.

Ensuring the right results calls for professional lighting planning conducted in close cooperation between client, architect, interior designer, landscape designer and lighting designer. Part of the challenge lies in crafting a solution that achieves harmony and balance while successfully underlining the design statement of facades and accentuating the design of the exterior facilities. The most important thing to consider at all times, however, is the personal space of those who live in the building. Tailoring the colours, contours and materials of the architecture to personal lifestyle is crucially important for the wellbeing of those occupying the space. So, too, is the task of defining and meeting the lighting requirements presented.

Especially where the client wishes to fit outdoor lighting with more conventional, more energy-intensive lamps – which may seem a more economical option at first because of the lower initial outlay – thought should at least be given to harnessing the extensive possibilities of modern building services technology. Efficient automation of electrical installations is a vital requirement for resource conservation and sustainability; so is the use of lamps that use less energy to deliver the same amount of light.

Hence the increasing use of LEDs in outdoor lighting. Appealingly petite, they can often be concealed behind protrusions or embedded in building joints. This coincides with the current zen-inspired preference for minimalist design, allowing luminaires to become physically discreet space-defining elements. On the other hand, light used to create an eye-catching, space-dominating feature, e.g. a designer light sculpture, is found to enhance, enliven and add interest to the surroundings.

May this booklet be a source of inspiration and ideas for your personal wellbeing.

Andrea Nusser  
PLDA Lighting Designer

**[Front cover]** The lighting concept here meets every major outdoor home lighting requirement: facade illumination, orientation lighting for the route to the front door, wall luminaires for garage and entrance and a self-illuminating house number.

**[01]** A trail of light created by LED in-ground luminaires leads to the terrace.



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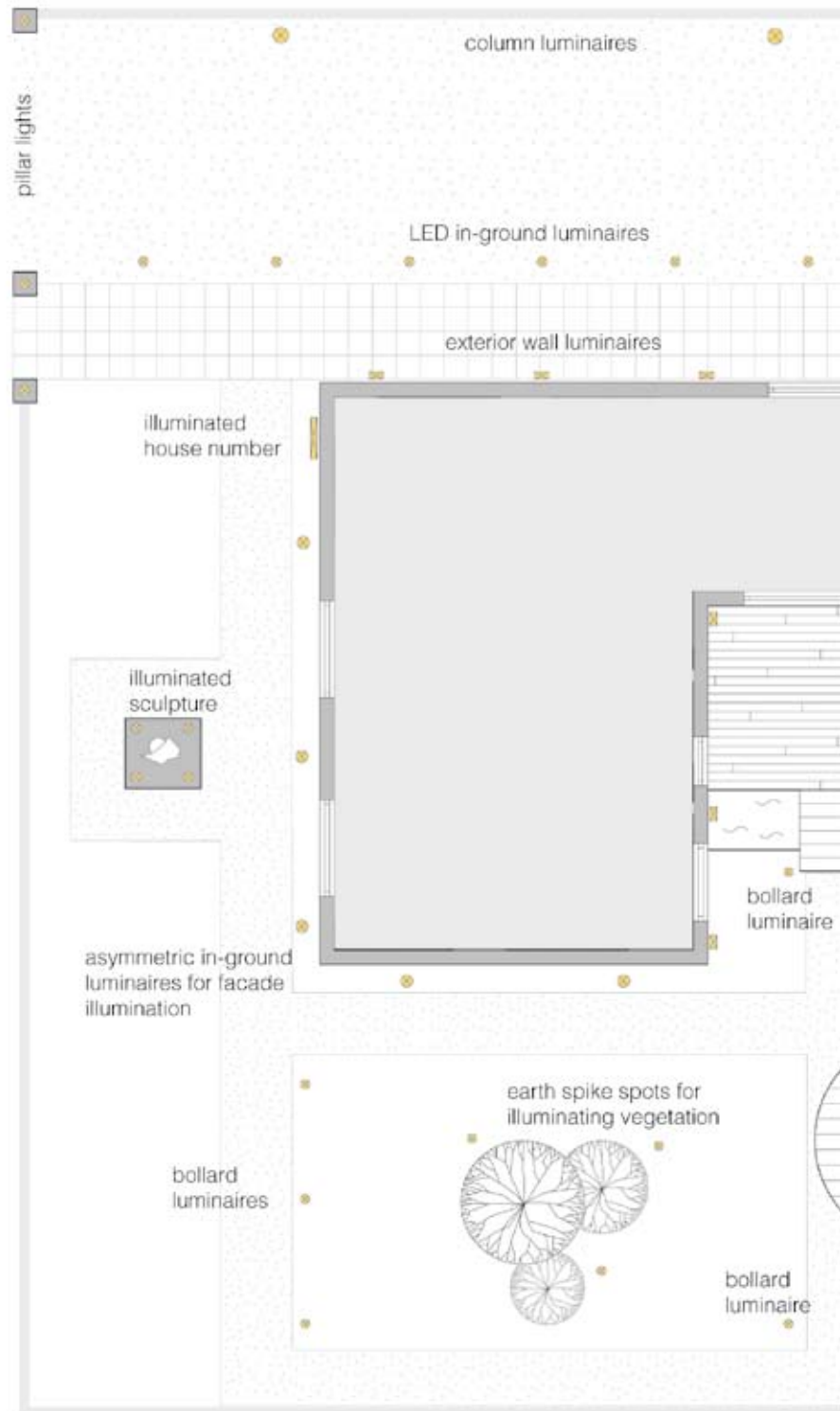
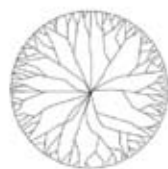
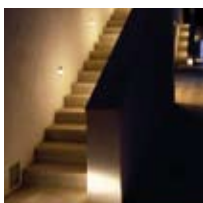
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Detailed professional information on major issues relating to good outdoor lighting, product quality, planning basics, safety, energy efficiency and lamps.

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# Facade lighting

At night, lighting can do a great deal more than just highlight facades for better orientation. It can also invest them with drama.

Contours, colours and textures bring facades to life. In daylight, of course, they are all plainly visible; at night, their design contribution can be ensured by exterior lighting. But facade lighting can do more than that: it can even create a totally different visual impact. Skilfully planned, artificial lighting can produce precisely the effect that is required. Favourable elements can be emphasised, unfavourable elements concealed. In the case of a rendered facade with an uneven surface, for example, it is possible to achieve an even and uniform effect through the use of frontal spots or floods. Glancing light falling on the facade from an acute angle, on the other hand, produces shadows and emphasises the depth of surface structures. This makes it a good tool for accentuating the decorative details of natural stone facades, wood cladding and walls rendered by special techniques. Wall luminaires or asymmetric in-ground luminaires positioned close to the building are

available for this purpose. Depending on luminous intensity, distance from the wall and number of light sources, they can be used to illuminate small or larger areas of the facade. Architectural details such as pillars, ledges or ornaments can also be accentuated effectively by narrow-angle spots.

## Photoelectric lighting control for greater convenience

To avoid wasting energy, lighting can be automatically activated by a photoelectric lighting controller and then deactivated at a specified time by a timer. There is also a wide range of energy-efficient light sources available – such as fluorescent or compact fluorescent, halogen and LEDs lamps. LED lamps, in particular, present a very low energy cost burden because their electricity consumption is minimal. What is more, having a life of around 50,000 hours, they rarely need to be replaced.



02

[02] Asymmetric in-ground projectors (wallwashers) positioned close to the building highlight the structures and colour of the wood cladding. Accents are set by wall luminaires from the same design family as the column luminaires.

[03] This elegant facade cries out to be illuminated with glancing light. The masonry blocks with their emphasised joints and the even texture of the render become an eye-catching three-dimensional feature.

[04-05] Their contours accentuated by glancing light from in-ground luminaires close to the building, the supports and columns of this villa are bathed in coloured light that changes according to a lighting control system programme.



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# Driveway, carport and garage lighting

The lighting requirements of a driveway, access path, carport, parking space or garage are primarily functional. Good visibility for safety has top priority here. If good luminaires and suitable lamps are installed at the right places, however, there is no need to forgo aesthetic design.

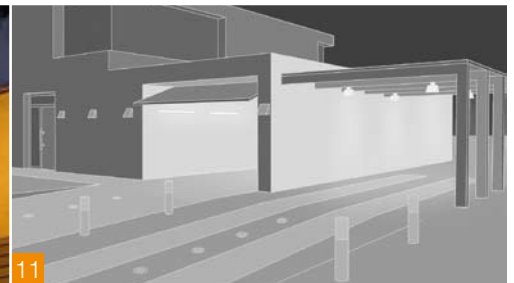
[06, 09] Bollard luminaires concentrate their beam entirely on the path and can create a homely atmosphere.

[07] Where a carport or garage entrance has an overhanging roof, surface-mounted or recessed ceiling luminaires make for good illumination. Even if space is tight, pinpoint parking becomes child's play.

[08, 10] Drive-over in-ground luminaires help us get our bearings on garage access routes and provide guidance for perfect parking.

Access path lighting mainly needs to be designed to ensure that residents and visitors can negotiate the path between parking space and front door without problems and that possible tripping hazards – such as uneven ground or objects in the way – are identified in good time. This calls for glare-free, uniform, adequately bright lighting provided by bollard or medium-height column luminaires. Special bollard luminaires can throw light directly onto paths without excessively brightening the surroundings. Where routes to the front door are particularly long, brightness from above is also recommended for long-range visibility and a sense of security.

This can be realised with column luminaires. Column and bollard luminaires of uniform design can be combined to good effect. It is a good idea to make provision for path lighting to be operated not only from the house but also from the garage or carport. Luminaires governed by integrated photoelectric lighting controllers or motion detectors are a particularly convenient solution. External photoelectric motion detectors are available for switching all luminaires simultaneously. To prevent lights being on all night, the photoelectric lighting control function can be overridden by a timer for programmed deactivation.



## Lighting tip: Carport and garage

Security and functionality [11]: Garages are often small and cramped. Good exterior and interior lighting helps prevent scrapes and scratches on the car or on any other cherished object “parked” in the garage. A solitary luminaire in the middle of the ceiling is not recommended. This would only illuminate the roof of the parked vehicle and leave other areas in shadow. Correct general lighting for inside a garage can be provided, e.g. by linear fluorescent or compact fluorescent lamps. Mounted high enough on the side walls – or below the ceiling to the left and right of the automobile – they can distribute light evenly, directly and without obstruction throughout the room. The car can thus be loaded and unloaded, for example, or the engine inspected, in good light.

## House entrance lighting

There are numerous reasons for not scrimping on lighting at a house entrance. Tailored lighting offers security on the way to the front door. It is also vital for helping visitors find the house number easily. “Uninvited” guests, on the other hand, tend to be deterred and the risk of burglary is thus reduced.

Front door lighting is an application that should be given full attention at the lighting design stage. After all, the entrance to the home is the interface between the safe settled indoor space of the home and the constantly changing world outdoors with its many unknown variables. It is the dividing line between private and public space. Suitable lighting at the front door guarantees mutual identification across that line. Because those with criminal intent are averse to being in the spotlight, it can thus provide protection from unpleasant surprises. Invited guests, on the other hand, positively welcome not having to stand in the dark. It means they have no problems finding the house number, the name on the door or the door-bell. Another very practical function of front door lighting – one which should not be underestimated – is that it

enables us to find the door key and the keyhole. It instantly eliminates the need for endless groping and fiddling – as well as the agitation that frequently accompanies it.

### Inviting lighting makes guests feel welcome

A brightly and invitingly illuminated house entrance also strikes a prestigious note because it helps shape a visitor's first impression. Invited guests feel less appreciated if they are left in the dark by their host. So good general lighting is important even on the route to the front door. It sends a signal that the visitor is welcome and the bright surroundings it creates give a general sense of security. This lighting task can be performed by in-ground or bollard luminaires. Where steps or stairs need to be negotiated,

supplementary luminaires should be positioned nearby to help eliminate tripping hazards.

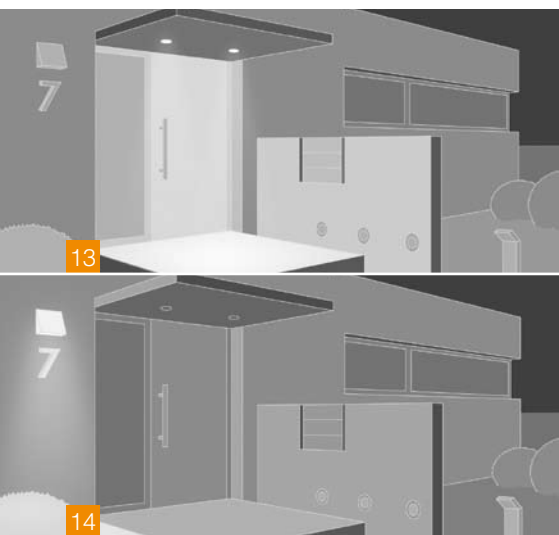
A well-illuminated house number plays a particularly important role. In an emergency, where every second counts, it enables the rescue service, fire fighters or police to locate the address as swiftly as possible. And in less dramatic situations, it performs a valuable service as an aid for orientation. In the dark winter months especially, couriers and taxi drivers will thank you with a smile.





[12] Luminaires fitted with photoelectric light controllers are activated automatically when daylight starts to fade. The next morning, when daylight reaches a certain brightness level, they switch themselves off again. Alternatively, they can be combined with a timer, which deactivates them at a predefined time, e.g. midnight.

[15] A bollard luminaire with compact fluorescent lamp provides diffuse light for a safe approach to the front door. The entrance area is illuminated by a wall luminaire of the same design. The house number light features large, clearly legible numerals.



## Lighting tips: House entrance

Front door lighting [13]: Where a canopy is present, weather-resistant downlights can make for excellent general lighting. The luminaires themselves are discreet and the effective lighting they provide ensures high illuminance at the door. Check the rating plate and approval marks. The minimum requirement for luminaires used outdoors is IP44 (protection from foreign bodies, such as insects, and splashwater).

House number lighting [14]: Unfortunately, there are a number of dedicated house number lights available with integrated light sources that cannot be recommended for the task. Look out for brand suppliers that make luminaires of the right size and with sufficiently large numerals (at least 10 cm high). The luminaires will then perform excellent service. Illuminated house numbers should have numerals at least 20 cm high. In an emergency, good legibility can save lives. In Hamburg, building regulations actually require house owners to affix a self-illuminating house number light.



# Lighting Special: Luminaire types and technical terms

This Lighting Special is designed to explain technical features and terms in layman's language, facilitate effective communication with lighting professionals and thus help avoid misunderstandings at the planning and design stage of an outdoor lighting project.

## Stationary luminaires

Stationary luminaires are available for ground, wall and ceiling mounting. They are permanently installed or recess mounted along with the power supply cables.

With mounting heights of 2 – 2.5m, **column luminaires [a]** illuminate a relatively large area. They can thus be spaced fairly widely apart. This also makes them less dominating.

**Bollard luminaires [b]** are mainly used for path lighting. The lower the mounting height, the closer the spacing required for uniform illumination. They are often fitted with optical controllers that throw the light directly onto the path, eliminating the risk of glare.

**Pillar lights [c]** are mounted on plinths, walls or posts, so mounting heights can be high.

**Recessed luminaires (in-ground and recessed wall and ceiling luminaires) [d]** need to be planned at an early stage because their power supply lines are laid in walls or below ground. Installed in cavities that are precisely cut out during the construction phase, they discreetly blend into the architecture and let the light make the impact.

**Ceiling luminaires [e]** are used beneath overhanging roofs or canopies where recess mounting is not possible. They direct light mostly onto walls and floor.

**Wall luminaires [f]** are available with or without wall brackets. They dramatically highlight walls and overhanging roofs and are used where luminaires are also required to be decorative.

**Steplights [g]** are special wall luminaires for recess mounting close to the ground on staircases. They render steps clearly visible and thus make for safety.

**Underwater luminaires [h]** in ponds and pools are operated on a protective extra-low voltage (12V). They are corrosion-resistant and protected against ingress of water. Lamps are replaced by detaching the waterproof housing from its base under

[16] Overview of luminaire types: [a] Column luminaires [b] Bollard luminaires [c] Pillar lights [d] Recessed luminaires (in-ground and recessed wall and ceiling luminaires) [e] Ceiling luminaires [f] Wall luminaires [g] Steplights [h] Underwater luminaires [i] Earth spike spots [j] Clamp luminaires [k] Light sculptures





water and raising it to the surface on its long, waterproof cable. Out of the water, the housing can be opened and the lamp safely replaced.

### Mobile luminaires

Non-permanently mounted luminaires are a flexible solution for use wherever light happens to be required. Supplied with electricity via overground cables, they are an option for creating dramatic lighting effects in the garden as well as on a balcony or terrace.

**Earth spike spots [i]** are simply pressed into the ground. They can be easily repositioned as required.

**Clamp luminaires [j]** are a particularly flexible solution. To illuminate vegetation, they are clamped in a tree or shrub at the required angle.

**Light sculptures (mobile/stationary) [k]** are luminaires that are not primarily deployed to address a lighting task. They are decorative objects used for the principal purpose of grabbing attention.

### Lamp or light?

The words “lamp” and “light” are often confused. Lights are what the industry today calls luminaires but they are frequently referred to in common parlance as “lamps”. A lamp is actually only the light source, i.e. the fitment that emits light inside a luminaire. So anyone talking about a lamp is really talking only about the “light bulb”.

### Basic lighting variables

**Luminous flux** is measured in lumen (lm) and is the visible power of a lamp radiating in all directions.

**Luminous intensity**, measured in candela (cd), is the amount of luminous flux radiating in a particular direction. There are many different luminaires and reflector lamps that are distinguished by their beam. This determines how the luminous intensity is distributed in the room.

**Luminance** is the brightness of a luminous

or illuminated surface as perceived by the human eye. Measured in candela per square metre (cd/m<sup>2</sup>), it indicates how high the luminous intensity is over a defined area of that surface.

**Illuminance** is the luminous flux falling on a defined area. It is measured in lux (lx) and amounts to 1 lux where an area of 1 square metre is uniformly illuminated by 1 lumen of luminous flux.

### Reflectance

Reflectance is the percentage of luminous flux that is reflected by a surface. The brighter the surface, the higher the reflectance and the higher the level of ambient brightness. White walls have a reflectance of up to 85 percent.

### Glare

Glare reduces visual performance and visual comfort and can thus interfere with vision. There are two types of glare: direct glare, which is caused by luminaires or by very bright daylight, and indirect glare, caused by light reflected on shiny surfaces. In the case of luminaires, the source of glare is shielded. What also helps limit glare is the use of non-reflective materials.

### Light colour

Light colour is the intrinsic colour of the light emitted by an artificial light source. The lower a lamp's Kelvin (K) rating, the warmer its light. Light colours are divided into three groups: warm white (<3,300 K), neutral white (3300-5300 K) and daylight white (above 5,300 K). For garden lighting, warm white light is predominantly used to emphasise reds and yellows. Blues and greens are highlighted by the other light colours. A balcony or terrace bathed in warm white light feels cosy and relaxing; neutral white light creates a more business-like ambience. This, at any rate, is how lighting atmosphere is rated in Central Europe. Southern Europeans, on the other hand, prefer daylight white light.

### Colour rendering

Colour rendering indicates how naturally we see colours in artificial lighting. Colour rendering properties range from R<sub>a</sub>20 - R<sub>a</sub>100 and depend crucially on the quality of the light source. Under the light of a lamp with a R<sub>a</sub> rating of 100, all colours appear natural. Halogen lamps have the best R<sub>a</sub> index (100), fluorescent lamps and energy-saving lamps achieve very good ratings around R<sub>a</sub> 80-90.

### Light immission / light pollution

Light immission denotes interference by stray artificial light. Outdoor lighting installations can lead to “light trespass” in neighbouring residential properties or to glare. So for open space and garden lighting, preference should be given to asymmetric luminaires or luminaires with shielding, which reduce the amount of stray light in the atmosphere. The term “light pollution” is used particularly in connection with the “glow” effect due to stray light escaping from cities.

**For degrees of protection, protection classes and marks of approval, see page 20/21**

## Path, step and staircase lighting

Paths, steps and staircases should be included in the lighting concept for outdoor facilities from the very beginning. They will then integrate harmoniously into the overall picture later. Good path lighting discreetly ensures safe and comfortable access at night.

Good lighting for outdoor communication routes around the home motivates us to enjoy the garden much more often after dark. This is because outdoor staircases and paths that can still be used safely after daylight fades are more likely to be used than dark ones, which understandably make us feel a little insecure. Where our eyes are unable to perform important checks, tripping hazards due to obstacles and uneven ground or flooring are pre-programmed. However, adequate lighting keeps us physically safe and puts our mind at rest. The more discreet it is, the better it integrates in the overall lighting design of the outdoor facilities.

### Staircase lighting gives a sense of security

Special attention needs to be devoted to lighting for steps and staircases outdoors because elevation differences make them even harder to negotiate in the dark than paths. Here as well, the aim is not to realise high illuminance values but to ensure adequate lighting with the right luminaires at the right place. Good lighting enables us to make out the entire staircase clearly in both directions. 80 percent of accidents on staircases occur on the way down, so each individual stair needs to be clearly visible, especially from above. A luminaire at the top of the

staircase picks out the contours of each stair and produces a short, soft shadow that distinguishes it clearly from the next. This also enables us to gauge the height of the risers more accurately. What is particularly important here is the need to ensure adequate glare limitation of the luminaire so that there can be no risk of confusion on the stairs. Where a staircase is flanked on one side by a wall, steplighting is a recommended option.





[17] Where there are only a few steps, orientation lights like the LED in-ground luminaires shown here are generally enough. They should not emit too much light and should be sufficiently shielded to prevent glare.

[18] The bollard luminaires incorporate reflectors that throw the light directly onto the path.

[20] Steplighting is provided here by recessed wall spots on both sides of the stairs. Producing short soft shadows, they clearly delineate each individual step while at the same time illuminating the facing wall. The reflected light makes for an agreeable background brightness.



## Lighting tip: Paths, steps and stairs

Guiding light [19]: Path lights and wallwashers with wide angle beams distribute light directly and evenly on paths. Obstacles are thus identifiable in good time. The glancing light cast by low-level luminaires such as mini-bollards or in-ground luminaires is particularly effective for highlighting uneven ground. This can be useful for gravel or roughly paved paths because it reduces the risk of tripping. Modern reflector technology enables light to be focused largely and thus efficiently on paths and stairs. It also prevents unnecessary disturbing light scatter in the direction of the sky. Even relatively low illuminance levels are sufficient for good lighting. Too much light makes for bright communication routes but may interfere with the “stage-lighting” for the garden.



## Balcony and terrace lighting

During the warm months of the year, life can actually revolve around the balcony or terrace. The more attractive and functional it is, the more enthusiastically it is used. Given good lighting, these outdoor facilities are like a second living room on mild summer evenings. And in the colder months, they offer a delightful view and optically extend the indoor space.

[21] Wall luminaires provide sufficient light and create an agreeable atmosphere. The lighting helps sets the scene for a fine dining experience.

[23] Wall lights and decorative low-level bollard luminaires form islands of light that lend structure to the large terrace. They make for good background lighting.

[24] Good lighting extends the living room outwards onto the terrace. And in winter, the lighting enhances the view of the attractive surroundings.

Balconies and terraces are used in summer for all sorts of purposes. They become a dining and living room, a place for playing games, for reading or for taking time out to unwind. The right lighting makes it possible to enjoy all these activities even when daylight fades. To do so, it needs to be designed for multifunctional use. Where light is provided in a range of different qualities, there is nothing to stop outdoor areas being used as casually and fully as any other part of the home. Having said that, the lighting should also create an engaging, low-key atmosphere.

Where there is a possibility of indirect lighting via walls and ceiling, it should be realised. The soft, even light thus produced has a very special flair and is completely glare-free if reflected by matt surfaces. Even low levels of illuminance suffice for illuminating a house wall to provide appropriate background brightness on a balcony or terrace.

With a dimmer function, the lighting level can be flexibly regulated for different occasions. The light can thus be made bright enough for eating or subdued enough for relaxing and observing nature.



### Lighting tip: Balcony

Adequate provision of power points helps avoid tripping hazards [22]: No matter how good the lighting, cables trailing across a balcony are dangerous. For anyone in a rush to reach the phone or answer the door, they present a tripping hazard that can easily be forgotten. An adequate number of electric sockets well distributed around the balcony enables cables to be kept short. So mobile luminaires can be deployed as Christmas decorations in winter and the electric barbecue can be set up for a cosy dinner on the balcony in summer without the need for extension cables. Where possible, stationary wall or ceiling luminaires should be planned to avoid the problem of trailing cables.





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### Luminaires can be discreet or can actively set decorative accents

Background lighting can be provided by in-ground – preferably wide-beam – spots directed at the wall. Where there is an overhanging roof, recessed ceiling luminaires casting light onto the wall from above are an alternative option. The luminaires themselves are inconspicuous, the eye-catching feature is the light itself. Anyone who prefers an actively decorative element can opt for a conventional wall luminaire, instead. Technically speaking, it performs the same function. A wide variety of very attractive luminaires are available for this purpose.

Weatherproof design is essential to ensure that luminaires look good – and above all remain in perfect working order – for years. IP 44 is the minimum degree of protection needed to meet

this requirement, guaranteeing at the same time that no foreign bodies penetrate inside the luminaire. Terraces look particularly attractive if they are hemmed with in-ground spots, bollard or column luminaires of low luminous intensity. Such luminaires offer fascinating points of light and, as edge-markers, make for better orientation. Steps leading to the garden should also be furnished with orientation lights so they can be seen more clearly.

Light for illuminating flowers and plants – or for reading or playing games – can be provided by mobile luminaires positioned according to requirements. Earth spike lights, which are designed for such purposes, can be accommodated in planters. The more power points are provided for the balcony or terrace as a whole, the greater the scope for using mobile luminaires.

For dynamic mood lighting and programmed lighting scenarios, dimmable light sources can be used to divide a terrace or balcony into different lighting zones. Interesting light-dark effects can thus be achieved – enhancing the view through the window and extending the living room outwards even in winter.

[25, 27] Bollard luminaires provide good background lighting and an optical boundary for the terrace. Wall luminaires of the same luminaire family brighten the house wall.

[26] This inclined LED luminaire emits downward-directed light with no scatter loss, providing good, energy-efficient floor lighting.

[29] Good lighting underlines the architectural concept of the home and highlights its special features – a function performed here by different light sources on walls and ground.



### Lighting tips: Terrace

**Timely planning [28]:** Timely planning guarantees enough power points for electrical equipment. Electricity from a socket is needed not only for mobile luminaires but also for an electric table barbecue or a wok. Including multiple circuits in your planning offers the advantage that lighting for different parts of the garden can be activated and deactivated separately.

**Photoelectric lighting controller/timer:** Incorporating a photoelectric lighting controller to switch outdoor lighting automatically makes for greater lighting comfort and security. It activates the lighting at nightfall and deactivates it again at daybreak. The time at which the system is deactivated can be set as required – e.g. at midnight – using a timer. To save electricity, all luminaires governed by photoelectric lighting controllers should ideally be fitted with energy-saving lamps.



# Lighting Special: Product quality, reliability and longevity

Outdoor luminaires are exposed to marked differences in temperature and need to operate reliably at all times, even in damp or dusty conditions. For this reason alone, every luminaire used should meet high quality standards.

Outdoor luminaires need to satisfy demanding criteria to cope with the range of environmental conditions to which they are exposed. These include humidity, rain and snow as well as intense cold and heat. In developing high-quality products, materials and manufacturing techniques, the industry has succeeded in effectively protecting luminaires for outdoor use from such environmental factors. That success has its price, of course, but the expense is recouped within a very short time. Quality luminaires guarantee life-long operational reliability, they are easy

[30] Outdoor luminaires need to meet high quality requirements. As a matter of principle, permanent installations may only be realised by a professional electrician.

to clean and they retain their good looks for many years. Luminaires from cut-price providers are often substandard in terms of material characteristics and longevity. In many cases, this results in loss of appearance, performance and quality of lighting after only a brief period of service. The inferior quality of materials used in many a presumed “bargain” can sometimes be identified just by picking the item up. If it is extremely light, the manufacturer has probably economised on materials. If the surface of a luminaire “gives” under light pressure, this is an indication that non-weatherproof sheet metal has been used instead of a corrosion-resistant material. Even the use of stainless steel does not *per se* mean that the material is high quality because there are various grades of stainless steel on the market. So do not be dazzled by marketing phrases like “100% stainless steel”.

Condensation that cannot escape is the enemy of any luminaire – because moisture trapped inside a luminaire not only makes the enclosure look unsightly; in the long term, it can also lead to the corrosion of lampholders. Brand luminaires get around this problem by having good ventilation that allows them to “breathe”. Even so, care must be taken to ensure that the ventilation openings are not blocked. In the case of “cut-price” luminaires, however, ventilation is poor and condensation gradually accumulates over time. Low-quality plastic luminaire shielding quickly turns yellow or milky, at which point any pleasure that the luminaires once gave is literally dulled. Mobile luminaires from a bargain basement should be checked to see if the strain relief mechanism is adequate. If it is not, the cable could become detached from the luminaire. Another shortcoming of “bargain offers” is that technical descriptions and marks of approval are often missing. So it is essential to check the rating plate, which shows marks of conformity

such as ENEC or VDE and gives details of the manufacturer, model number, information about lamping, degree of protection and protection class. Exterior luminaires need to be protected to at least IP 44.

CE mark 

The CE mark is mandatory for products placed on the market in the European Union. By affixing this mark, manufacturers and importers assert – generally on their own responsibility – that their products meet the “essential requirements” of specific European directives and protection targets. The abbreviation “CE” stands for “Communautés Européennes” (European Community). However, contrary to what many people think, CE marking is not based on testing by a neutral certification body. Products are self-certified by the manufacturer.

ENEC/VDE certification symbols 

The ENEC certification symbol (EN for European Norms, EC for Electrical Certification) is the European approval mark for luminaires. In Germany, it is awarded in combination with the VDE symbol. Where products display the VDE/ENEC symbols, it can be assumed that they conform to the current state of the art and thus meet the requirements of the Equipment and Safety Product Act (GPSG). The numeral following the ENEC symbol is a key to the name and location of the certification institute. As well as inspecting products, VDE engineers also monitor production.

GS mark 

The GS mark shows that a product conforms to the German Equipment and Product Safety Act (GPSG) and the relevant EU directive. Awarded by authorised





certification agencies, it is based on product safety testing and an assessment of whether operating instructions are clear and complete. The GS symbol may be used only in conjunction with the logo of the certifying body (e.g. VDE, TÜV). Control audits are conducted to maintain certification. These may involve monitoring production facilities or checking product modifications against the unit tested.

### Standards

The aim of standardisation is to promote the national and international exchange of goods and services and prevent technical trade barriers by standardising the requirements that need to be met by tangible and intangible goods. A standard is a norm or requirement established and published by a standards body or standards organisation. It is designed to set standards and thus improve public safety.

### Degrees of protection:

| Code numerals | 1st code numeral: Protection against foreign bodies and contact | 2nd code numeral: Protection against water       |
|---------------|---|--|
| 0             | non-protected   | non-protected                                    |
| 1             | protected against solid foreign bodies > 50 mm                  | protected against dripping water                 |
| 2             | protected against solid foreign bodies > 12 mm                  | protected against dripping water when 15° tilted |
| 3             | protected against solid foreign bodies > 2.5 mm                 | protected against spray water                    |
| 4             | protected against solid foreign bodies > 1 mm                   | protected against splash water                   |
| 5             | protected against dust  | protected against jets of water                  |
| 6             | dustproof   | protected against powerful jets of water         |
| 7             | -   | protected against temporary immersion            |
| 8             | -   | protected against prolonged submersion           |

The degree of protection assigned to a luminaire indicates the limits on its safe and reliable operation. The IP code (Ingress Protection) consists of two numerals: the first refers to protection against solid foreign bodies and particles, the second indicates the degree of protection against water and moisture. For example: IP44 identifies a luminaire protected against solid foreign bodies larger than 1 mm and against splashwater (see table above). A capital "X" in place of one of the two numerals means the degree of protection is not specified.

### Classes of protection

EN 61140 (formerly DIN VDE 0140) divides items of electrical equipment such as luminaires into three classes of protection according to the protective measures taken to avoid electric shock:

#### Protection Class I

In the case of Protection Class I luminaires, the user is protected by live parts being insulated (so-called basic insulation) and by exposed conductive metal parts being connected to a protective conductor (earthing). The protective conductor terminal is marked with an earth symbol (see above). If the basic insulation fails, exposed conductive parts cannot accept hazardous shock voltages.

#### Protection Class II

In the case of Protection Class II luminaires, live parts are provided with protective insulation in addition to the basic insulation. Connection to a protective conductor is not permitted. Even if luminaires have conductive surfaces, they are protected from contact with live parts by reinforced insulation.

#### Protection Class III

In the case of Protection Class III luminaires, protection is based on the use of a SELV (safety extra-low voltage) system. Typical applications include pond or pool lighting. The supply voltage is established in conjunction with a safety transformer (or equivalent device).

### Take advantage of the expertise of the lighting trade

To get maximum enjoyment out of the products you select, trust in the expertise of specialist lighting dealers. They can give detailed advice on all major criteria and provide a professional after-sales service. Anyone who invests valuable time in good planning for his house and garden lighting and goes to the trouble of realising extensive installations wants a long-term assurance that the products being used will be right and reliable. If luminaires serve their purpose poorly or the wrong lamps

are used, the result is inevitably disappointment. If in doubt, it is better to refrain from buying the cheap item that seems such a bargain. A luminaire that needs to be replaced just two or three years after purchase is not the most economical option.

More information and links about standards, approval marks and safety can be found at [www.licht.de](http://www.licht.de).

[31] Outdoor luminaires need to be protected to at least IP 44. The degree of protection provided is found on the luminaire rating plate, which also identifies the manufacturer, shows a model number and protection class and provides information about lamping and ENEC/VDE conformity.









# Conservatory lighting

Conservatories are an area of the home where we particularly like to spend time. With their large glass fronts, they are a mixture of outdoor and indoor space and convey a sense of endless expanse. What could be more relaxing on a cool evening than to sit in a warm place and gaze at the world outdoors?

During the cold months of the year, when we prefer to stay indoors where it is warm, conservatories become our favourite place in the home. Even if they are not a paradise of plants but simply furnished as an oasis for relaxation and wellbeing, they offer an unobstructed view of outdoor space that puts us in contact with nature. This also works after dark if the lighting level in the conservatory is in line with outdoors. So conservatory lighting should always be planned in conjunction with lighting for outdoor areas. The more harmonious the illuminance transitions are, the greater the visual comfort and the better the visibility. If the illuminance in the conservatory is too high or too low, there is a risk of creating a visual black hole or producing reflections in the glass.

## The solution: good background lighting – supplemented by variable luminaires

Good background lighting is achieved by discreetly brightening the house wall onto which the conservatory is built. A low illuminance wallwasher is sufficient for this because wallwashing produces a greater subjective brightness. Where there are pictures on the wall, asymmetric floods realised as in-ground spots or picture lights are a suitable solution. Suspended track or wire systems are another option for conservatories. They have the advantage that they can be flexibly fitted with different luminaires, such as spots or pendant luminaires, to meet different requirements. Whichever option is chosen, detailed planning is needed in advance to ensure that the connections are available for in-ground and wall luminaires and that sufficient electric sockets are installed for variable mobile lights. Free-standing luminaires, e.g. with tungsten halogen lamps, are a flexible option for supplementing the background lighting for special tasks such as reading, playing games or dining. Pendant luminaires can be used to brighten a coffee or

dining table and limit the light reflected in panes of glass.

If garden lighting is activated in the evening and luminance in the conservatory is lower than outdoors, the unpleasant effect of a “black hole” can be avoided. Otherwise, reflections will occur on the glass facade, instantly making the conservatory appear to double in size and obscuring everything outside from view. The luminaires outdoors must naturally be positioned so that they do not shine into the conservatory; that would make them a potential source of glare.

Energy-saving compact fluorescent lamps are a good choice for bathing a conservatory in soft, uniform light. But excellent results can also be achieved nowadays with warm white LED lamps. The luminaires’ dimming capability offers scope for different lighting moods and the lighting can be adjusted to suit daylight conditions at different times of the year.



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## Lighting tip: Conservatory

**Table lighting [35]:** Dining in a conservatory calls for appropriate table lighting. If sufficiently large supporting beams are available for cabling and mounting, there is no need to forgo the attractive light of pendant luminaires, which brightens only the table area and not the surroundings. Otherwise, there is the option of a free-standing boom luminaire. To ensure undisturbed, glare-free eye contact for those at the table, luminaires should ideally be 60 cm above the table top. Suspended track systems or wire systems stretched from side to side can also offer good solutions. They have the added advantage of permitting the use of diverse lighting elements such as pendant luminaires or spots to cater flexibly to new room arrangements. Again, the advice regarding illuminance is: less is more. A pleasurable experience is then assured not only for the palate but also – because of the view outside – for the eye.

[32] Punctual light sources integrated into supporting beams and controlled by a dimmer can simulate the firmament at night. Ideally, the room lighting should be supplemented by wall or free-standing luminaires.

[33] Wire systems stretched across the room offer ideal solutions for conservatories. The possibility of positioning spots, ambient lights and/or pendant luminaires anywhere along a line makes for a considerable degree of flexibility.

[34] Good lighting is provided in this two-storey conservatory by wallwashers. The bright walls act as reflective surfaces.





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# Garden and vegetation lighting

Balanced garden lighting provides a wonderful backdrop for outdoor activities at home in the evening. Especially after a hard or hectic day at work, the garden is an oasis of relaxation and wellbeing.

For years, the trend has been to spend less evening leisure time in public places and more in a private environment – alone, with the family, with friends or good neighbours. During the warm months of the year, the garden is a place where we can savour mouth-watering specialities from the barbecue or simply lean back in a comfortable garden chair and chat or unwind – relaxing under the heavenly vault listening to the noises of nature and breathing in its delightful scents. And if the garden is well illuminated, we can also enjoy the intense colours of the vegetation even after daylight fades. With the interplay of light and dark, twilight and colour, it is possible to conjure up a whole new world by casting the garden at night in literally a different light.

Trees and tall shrubs offer great opportunities to embellish a dark garden with light because the light they reflect can be seen from a distance. Illuminated by lamps with a suitable colour temperature between warm and cold white, they radiate as much natural charisma as during the day. If the selected light is coloured, however, they

can also acquire a distinctly mystical quality. The range of options here leaves nothing to be desired. What is certainly true of any good garden lighting is that “less is more”. The secret lies not in extravagant brightness but in harmonious transitions between light and dark areas. They divide outdoor facilities into zones and, in the process, introduce an element of drama. More subdued lighting is also good for the biorhythm of plants because it does not disturb their natural night-time rest. Particularly suitable for lighting low bushes and shrubs are earth spike spots, which lend themselves very well to experimentation because of their mobility.

## Illuminated vegetation: An experience for the senses

Particularly striking effects can be achieved by illuminating trees. In summer, as in winter, they can be a focus of garden lighting architecture and also open up a whole range of differentiated design opportunities. Wide-angle luminaires illuminating a tree top from below can conjure up a bright canopy of foliage and thus create a natural space. If the vertical orientation of the tree trunk is to be emphasised, however, narrow-angle uplights should be used, positioned as close to the trunk as possible.



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## Lighting tip: Illuminating vegetation

Effective lighting for bushes and trees [39]:

Bushes and trees lend themselves to a particularly wide range of differentiated lighting effects. Uniform illumination of the tree top is best achieved with a number of wide-angle floods at a moderate distance from the tree (see illustration, centre).

This emphasises the size and shape of the tree as a whole and underlines its distinctive character.

The example in the background of the illustration shows two clamp spots used to brighten only the branches and foliage in the middle of the tree.

This creates the impression of a floating tree top.

If the idea is to emphasise the vertical line of the trunk, however, narrow-angle uplights (see illustration, right) close to the trunk are the answer.



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[36, 37] Uplights set in the ground close to the trunk emphasise a tree's vertical orientation. Coloured light on bushes can intensify or alter their intrinsic colour.

[38] In winter, reflection in snow means that light and luminaires have a very different impact than in summer.

[40] Stationary installed pillar sockets supplied with electricity by cables in the ground enable luminaire leads to be kept short. Cable clutter is thus avoided.





Good luminaire orientation minimises glare and unnecessary emission of light into the surroundings. This helps avoid the widely and rightly discussed problem of light pollution – the obscuring of the night sky by too much artificial light. The luminaire industry takes this issue extremely seriously and has already developed very good solutions, e.g. with innovative reflectors.

#### Every spot sets a special accent and emphasises details

Flowerbeds and shrubberies can make a glorious contribution to the garden experience at night if their colourful blooms are illuminated. There are two options here: the lighting can be geared for natural appeal or it can create a dramatic scene with coloured light. Another important consideration is that the type of lighting should be in line with the overall concept. When luminaires are selected, preference should be given to earth spike spots because they can be deployed at different points during non-flowering months.

One of the hallmarks of good outdoor lighting is a sensitive design that accepts and responds to the dictates of the existing garden architecture. Lines of light can emphasise the spatial orientation of the garden, dramatic highlighting of individual elements can draw attention to special features.

The design as a whole should be based on hierarchical analysis of the various viewing directions. First, the main line of sight is established by identifying the occupant's favourite place in the garden. This may be at the barbecue stand, for instance, on the veranda or on a secluded seat by the pond. Then the less frequent viewing directions are defined in order of preference. These steps are vital for deciding how the open space should regain its spatial dimensions at night through the creation of a foreground and background with light. The fine nuances of smooth transitions between light and dark create a space that provides orientation and a sense of cosy security. Illuminated steps, stairs and paths fit discreetly into the overall picture while light

for ponds, fountains or rivulets is crafted to underline their impact as eye-catching garden features.

#### Garden lighting is a stage production with light

In garden lighting, as in any good stage production, technical feasibility is a key consideration. Theatre directors can introduce a “deus ex machina” only if they have the machinery needed to make the character suddenly appear. In the context of a garden, this means that the laying and routing of all direct cables need to be well planned. Power for mobile lights is supplied via outlet pillars permanently installed at selected locations.

[41] In-ground spots cast the vegetation in a theatrical light and, unlike spike spots, do not interfere with lawn care.

[42] The dramatic lighting makes the tree a central feature. Recessed LED luminaires in the paving round off the lighting production.



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# Lighting Special: Planning basics and professional installation

As with any lighting concept, choosing the right luminaires and planning the electrics play a key role in ensuring the successful realisation of an outdoor lighting installation. The actual electrical work must be done only by a professional electrician.

The more carefully a lighting concept is planned, the greater and longer is the pleasure afforded by the result. Even if not all the lighting tasks are addressed straight away, they should be included in the planning from the outset. Solutions will then fit seamlessly into the overall picture when they are realised at a later date.

In the case of existing buildings where the planned lighting installation is a retrofit project, surface mounted wall and ceiling luminaires can be used if cable outlets are available; mobile luminaires are an answer if they not.

## Direct cabling for the garden

Direct cables connecting the stationary luminaires around the building to the electrics indoors have many advantages. Lighting in outdoor areas can be conveniently controlled from indoors or from the terrace, so the magic of garden lighting can be enjoyed even in snow or rain without getting wet. With pre-defined circuits, luminaires can be activated singly or in groups. Another advantage of connecting to the indoor electrics is that the circuits can be protected by a central residual current device (RCD), which is mandatory for

[43] Underground cables and cable ducting must be laid at a depth of around 60 cm, beyond the reach of a spade. A tape with a printed warning of the cable's presence positioned 20 cm above the cable duct signals the need for caution to anyone digging in the soil later.

[44, 45] Where recessing depth is limited, LED luminaires are always a particularly suitable option.

[46] Asymmetric in-ground spots are excellent for illuminating facades or objects. Given early planning, they can be realised as effectively in a lawn as in a paved area.

## Recessed luminaires for the building

Particularly impressive effects can be achieved in home lighting by the use of barely perceptible recessed luminaires for ground, wall or ceiling mounting. What makes the design impact here is the light itself. Where such solutions are envisaged, early planning needs to be performed before the construction phase gets underway so that the necessary cavities can be provided in walls and floors and the relevant wiring can be done by the electrician. In





outdoor installations. Apart from that, direct power supply lines avoid an unnecessary tangle of cables, which not only spoils the appearance of the outdoor facilities but also presents tripping hazards.

Underground cables for connecting luminaires and outlet pillars are laid singly or bundled in protective ducting at a depth of 60 cm. Where waterproof plug-in systems (IP 68) are used, the individual luminaires can be conveniently connected to the circuit by plugs and couplings.

To keep open the option of extending or upgrading the installation later, it is advisable to select cable ducting with a larger diameter than necessary at the time of planning. This enables more cables to be laid quickly and easily if required. Alternatively, at least multi-strand cable should be used. Careful planning of installations and the excavation of cable trenches are investments for the future that certainly pay off.

#### Outlet pillars

Almost every garden lighting design includes a number of mobile luminaires, which require electricity from a socket. For central lighting areas, permanently installed outlet pillars are deployed and con-

nected to the power supply by a cable laid underground. The general rule here is that it is better to plan too many of these special power outlets than too few. They enable not only mobile luminaires such as earth spike spots but also electrical appliances to be deployed anywhere in the garden and supplied with power via short leads.

#### Mounting

On firm, well-compacted ground, the base for bollard luminaires or pillar lights can simply be anchored in the soil. In most other soils, however, small concrete foundations offer a better guarantee of long-term reliability for stationary luminaires. In both cases, luminaires with mounting plates can be screwed directly onto the base. Column luminaires always need solid concrete foundations to ensure a secure footing. Earth spike spots are sufficiently anchored if they are dug or firmly pressed into the soil.

#### Photoelectric light controllers, timers, motion detectors

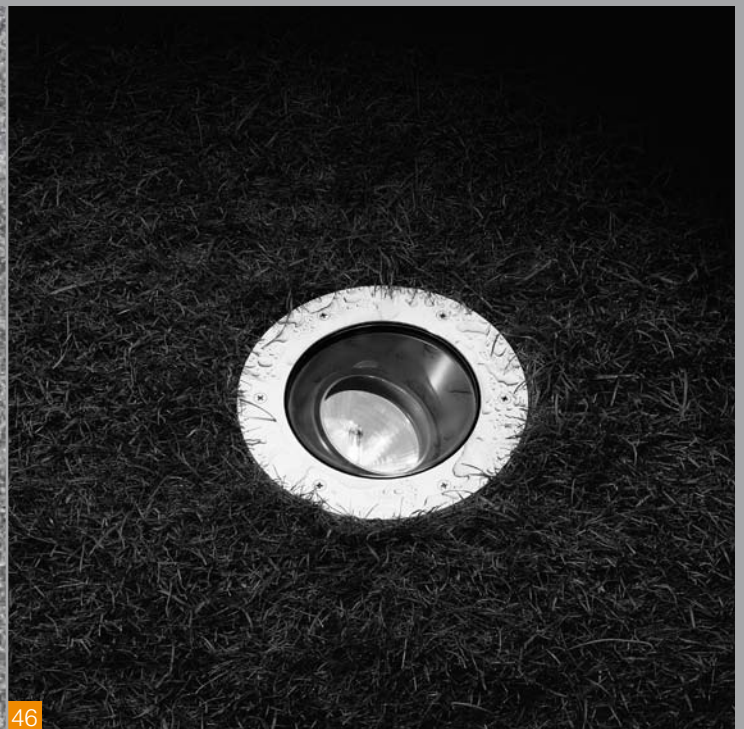
When installing photoelectric light controllers, which automatically activate lighting at the end of the day and deactivate it again at daybreak, make sure they are facing

east or north to ensure that they work. They can also be connected with a timer, which deactivates them automatically regardless of ambient illuminance. Deactivation can be programmed for any time.

Motion detectors automatically switch lights on for a pre-defined length of time when they detect the infrared heat radiated by moving bodies. To do this, the direction in which they face needs to be at right angles to the direction of movement. The detection radius is freely selectable. During daylight, a light sensor can ensure that they remain inactive when not needed. Motion detectors provide occupants of the house and their visitors with good automatic lighting on routes to the building or garden. Uninvited guests, on the other hand, are deterred by the sudden activation of lights. Motion detectors are integrated into many luminaires. Where this is not the case, they can be coupled with a luminaire externally.



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# Sculpture lighting

Sculpture derives its vitality from its three-dimensional nature. To register the third dimension – the depth of a space or object – the human eye needs to make out light/dark contrasts. At night, a stage production of bright, semi-dark and dark zones is required to lend an object visual impact.

Sculptures and other works of art in the garden are not the only things that can make fascinating night-time features if they are skilfully illuminated. Boulders, walls and decorative elements can do the same. However, lighting needs to be planned with the utmost attention to detail and more than one light source may be needed to do the object full justice. What definitely does not work is frontal illumination alone. That would have precisely the opposite effect, making the object look flat. What is needed to indicate depth is accent or glancing light – illuminating the object from the side, for example, or from an angle between the front and the side. Light from above can

also have an intriguing effect and can be realised with clamp luminaires if the object is under a tree or pergola. In the case of fairly small figures or objects, such as those often found in private gardens, a low illuminance is enough for good perceptibility. Depending on the structure of the surface, too much light may cause undesirable dazzling effects. If the luminaire is installed close to the object, it needs to have a sufficiently wide emission angle so that surfaces and contours can be picked out in full. In addition, or as an alternative, spots can be used to direct the eye to certain characteristic details that would not otherwise stand out.

The correct positioning of luminaires always depends on the viewing direction of the observer. So what needs to be established first is the point from which the object is most frequently viewed. The relationship between foreground and background should also be carefully planned. An object stands out much more starkly against a wall of darkness than against a backdrop of illuminated vegetation or a floodlit pond.

[47] Coloured light sets the stage here for fountains. The blue stands out in stylish contrast to the rust red of the twisted metal.

[48] Artificial light can achieve the required effects even in situations like this. The lighting emphasises a characteristic detail that would otherwise be in shadow.

[49] Light from different angles picks out the colour and contour of the dark ball, emphasising its depth. The illuminated surroundings make an interesting contrast.

[50] The shape of the sculpture is ideally underlined by light and dark zones. The blue light in the background makes us forget the massive plinth and directs the eye to the seemingly floating sculpture.



## Pool and pond lighting

Sparkling pearls of water gushing from a fountain, reflections on a water surface, the revelation of an underwater world that is otherwise hidden – illuminated water is always a fascinating sight with a magical allure. The right light opens up new dimensions of vision.

In many people's eyes, light and water are perfect partners for soothing visual impressions. Anyone fortunate enough to have a pond in the garden should not forgo the enchanting effects of well-planned pond lighting. In the right light, small waterfalls, rivulets and fountains also become oases of sensuous pleasure where we can let our thoughts run free as we quietly unwind in the evening. Well illuminated water features, too, enthrall every visitor as visual highlights of garden design. A skilled hand can produce magical results. Whether a pond is illuminated from above or below is a matter for personal choice. But there are a number of good reasons for choosing the one or the other method, so it is worth considering certain factors for best results.

A pond surrounded by shrubs and flowering plants is particularly attractive after dark if the vegetation is reflected in the water

surface – an effect achieved by illuminating the plants. The spots need to be aligned so that they do not give rise to dazzling reflections in the water.

### Underwater spots create fascinating zones of light around ponds and pools

A gleaming water surface is an eye-catching feature if the surroundings are correspondingly darker. To preserve the sharp light-dark contrast, reflections of other garden lights should be avoided. Underwater luminaires need to meet special requirements such as corrosion resistance and waterproofness (IP 68). They may only

be operated on a safe extra-low voltage (SELV) and with transformers installed outside the water.

Underwater lighting is not recommended for fishponds because it can interfere with the natural rhythm of fish life.

[51] Underwater luminaires lend allure to the lily pond even at night.

[52] Fountains are at their most fascinating when illuminated from below by special luminaires. The movement of the water becomes a focus of attention.

[53] Discreet underwater lighting leaves the water surface of the swimming pond dark enough to permit enchanting reflections of the illuminated surroundings.

[55] Uplights close to the house perform the function of orientation lighting. Dedicated underwater luminaires illuminate the pool and clearly mark the pool perimeter.







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## Lighting tips: Pool lighting

Good lighting for safety where water is present [54]: Underwater lighting is not only visually attractive, it also makes for safety and draws a visual line between the water and its surroundings. Dedicated pool luminaires for recessed or surface mounting on pool walls provide light for the entire pool. The luminaires need to be absolutely waterproof and identified as protected to IP 68. Nevertheless, the area around the pool should not be excessively dark; it can be illuminated with bollard, column or wall luminaires.

Lamp replacement: Lamps are replaced in a pool lighting system by removing the waterproof housing from the base under water and raising it to the surface on its long, waterproof cable. Out of the water, the housing can be opened and the lamp safely replaced.



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# Lighting Special: Energy efficiency and environment

If certain fundamental rules are observed, good outdoor lighting need not cost a fortune in energy. What is more, a knowledge and observance of the basics of energy efficiency is good for the environment.

Artificial lighting accounts for around 19 percent of global electricity consumption. Thanks to modern light sources such as energy-saving lamps and energy-saving halogen or LED lamps, that percentage could be substantially reduced even today. However, attention must also be paid to quality of lighting and to the actual efficiency of lamps for specific applications.

## There are many one-to-one substitutes for the inefficient incandescent lamp

In the conventional incandescent lamp, current flows through a tungsten filament and heats it to 2,900° Celsius. This massive amount of heat is generated at the expense of relatively low luminous efficacy. Furthermore, the average service

[56] The feel good factor need not always suffer when power economies are made. With a considered choice of luminaires and especially lamps, we can all do our bit to reduce carbon emissions.

life of the conventional “light bulb” is very short – just 1,000 hours. In March 2009, the European Commission approved Regulation no. 244/2009 implementing a directive for the gradual phase-out of inefficient general lighting service lamps by 2012. However, there is no need for consumers to fear they will not be able to use their present light fittings beyond 2012. Lamp manufacturers long ago came up with adequate one-to-one alternatives.

## Progressive phase-out of inefficient technologies

Qualifying only for energy efficiency classes F and G, traditional incandescent lamps do not meet today's requirements for the conservation of resources. In September 2009, incandescent bulbs with a 100 W rating or more were no longer allowed to be placed on the European market. By 2016, all other inefficient lamps will be similarly removed from the range admissible for sale in Europe. Along with the familiar energy-saving lamps with an energy efficiency class A (in some

cases B) rating, Class B and C energy-efficient halogen lamps will continue to be allowed. Up-to-the-minute information about the latest EU directives is available at [www.licht.de](http://www.licht.de).

## Which lamp technology is suitable for which application?

Lamp technologies are not all equally suitable for every application. Fluorescent lamps take time to develop their full brightness. Coupling them with motion detectors, especially for outdoor applications, can be problematical if the period of activation is brief.

## Halogen lamps

Halogen lamps work in much the same way as incandescent lamps, except that halogens are added to the gas in the bulb. A distinction is made between two types of halogen lamp: low-voltage and high-voltage. The new generation of energy-saving halogen lamps are extremely efficient. Thank to an inert gas mix, they can lower power consumption by as much as 50%. Fully dimmable energy-saving halogen lamps in classic light bulb designs with E27 or E14 base are a new trend.

Preferred applications for halogen lamps outdoors: wall and recessed luminaires as well as luminaires that are switched on and off frequently and/or need to deliver their full luminosity instantly under the control of a motion detector.

## Fluorescent lamps Compact fluorescent lamps

Fluorescent lamps produce ultraviolet radiation by sending an electrical discharge through an inert gas (mixed with mercury). The UV radiation is then converted to visible light by interaction with a fluores-





cent coating on the inside surface of the glass tube. Compact fluorescent lamps consume up to 80 percent less energy than a conventional incandescent lamp of the same brightness and have a much longer life. A ballast is required to operate the lamps. This is either integrated in the lamp base or incorporated separately in the luminaire. Electronic ballasts are more energy-efficient lamp operators than conventional models. With all fluorescent lamps and compact fluorescent lamps, strict rules need to be observed to ensure their separate, environmentally safe disposal.

The range of compact fluorescent lamps available with screw and pin bases is extremely wide. In contrast to budget-priced products, quality lamps made by brand manufacturers have the combined advantages of higher luminous efficacy, lower energy consumption and a longer life. They also offer higher switch resistance and, depending on type, can even be dimmed. Economy lamps generally fail to meet some or all of these requirements and are thus often the more expensive alternative.

Preferred applications for fluorescent or compact fluorescent luminaires outdoors: luminaires with long operating intervals, bollard and column luminaires, house number and wall luminaires as well as garage and carport luminaires.

### LED lamps

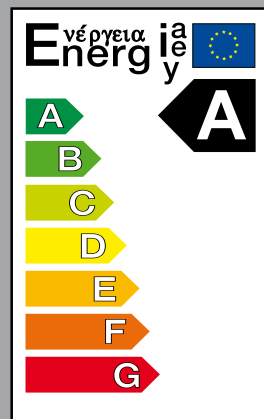
LED lamps consist of a semiconductor material and can convert electricity directly to light. The energy they require to do so is minimal and their life, at up to 50,000 operating hours, is extremely long. A great deal of light is generated here from very little energy. What is more, the diminutive dimensions of an LED mean it can be deployed and integrated almost anywhere.

LED lamps require a ballast to reduce the 230 V mains voltage to a low voltage. Some LED lamp types have this control gear built in, so they can be used as a direct replacement for e.g. incandescent lamps. When buying LED lamps, always

pay attention to light colour and colour rendering properties.

Preferred applications for LED lamps outdoors: building, stair and path lighting – e.g. with recessed wall luminaires – in-ground orientation lighting and coloured accent lighting with non-white LEDs. However, LEDs are also practical options for wall luminaires, ceiling luminaires and luminaires controlled by motion detectors.

### Energy efficiency classes



The EU Energy Label indicates how energy-efficient a lamp actually is, assigning it to one of a series of “energy efficiency classes”. These range from “A” (very efficient) to “G” (inefficient). Conventional incandescent lamps consume so much electricity that they reach no higher than class D. Regular 230 V halogen lamps are also assigned class D – or even class E - status. However, modern energy-saving halogen lamps reach class C or even B. But the most energy-efficient lamps of all are energy-saving lamps; they get class A or B ratings. Some labels display additional information about the luminous flux, power input or life of the lamp.

Because of the dynamic advances in LED energy efficiency, LEDs are not covered by this system. However, LEDs from brand manufacturers are extremely efficient and mostly qualify for class A ratings.

### How can energy costs be reduced?

The table below compares the efficiency, longevity and thus cost of energy-saving lamps and conventional incandescent lamps.

|  | Energy-saving lamp <sup>1)</sup> | Incandescent lamp     |
|--|----------------------------------|-----------------------|
| Wattage  | 11 Watt (W)                      | 60 Watt (W)           |
| Operating time                                     | 10,000 hours                     | 10,000 hours          |
| Life   | 10,000 hours                     | 1,000 hours           |
| Power consumption over operating time              | 110 kWh <sup>2)</sup>            | 600 kWh <sup>2)</sup> |
| Cost of electricity at 0.18 euro/kWh <sup>2)</sup> | 19.80 €                          | 108.00 €              |
| + Price of lamp(s)                                 | 12.19 €                          | 8.90 € <sup>3)</sup>  |
| Total cost   | 31.99 €                          | 116.90 €              |
| Saving   | 84.91 €                          |                       |

1) The calculation applies analogously to compact fluorescent lamps with pin base.  
 2) kWh = kilowatt hour  
 3) Price of 10 incandescent lamps at € 0.89 each

### How to calculate the costs:

1 kilowatt hour = kilowatt x hours  
 1 kW = 1,000 Watt (W);  
 Price of electricity e.g. : 0.18 €/kWh;  
 An operating time of 10,000 hours is equivalent to 3 hours operation a day for approx. 9.1 years.

**Cost of electricity for 60 W incandescent lamp**  
 0.06 kW x 10,000 h x 0.18 €/kWh = € 108.00  
**Cost of electricity for 11 W energy-saving lamp**  
 0.011 kW x 10,000 h x 0.18 €/kWh = € 19.80  
**Saving: € 88.20**

### Calculation example: Exterior lighting for a one-family house with garden:

|                              | Number of luminaires | in the past | now  | Money saved <sup>1)</sup> |
|------------------------------|----------------------|-------------|------|---------------------------|
| Driveway                     | 3x                   | 60 W        | 11 W | 264.60 €                  |
| Garage/carport               | 2x                   | 75 W        | 15 W | 216.00 €                  |
| Entrance                     | 2x                   | 60 W        | 11 W | 176.40 €                  |
| Path lighting                | 5x                   | 40 W        | 7 W  | 297.00 €                  |
| Terrace lighting             | 3x                   | 60 W        | 11 W | 264.60 €                  |
| Vegetation and pond lighting | 3x                   | 40 W        | 7 W  | 178.20 €                  |
| <b>Total saving:</b>         |                      |             |      | <b>1396.80 €</b>          |

1) Cost of electricity saved after incandescent lamps are replaced by energy-saving lamps, calculated on the basis of 10,000 operating hours at an average electricity price of 0.18 euro/kWh.



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| Lamp type   | Lamp category | Three-band<br>Ø 16mm<br>high luminous efficacy | Three-band<br>Ø 16mm<br>high luminous flux | Three-band<br>Ø 26mm                 | Three-band<br>1-, 2-, or<br>3-tube lamp | Three-band<br>elongated design | Three-band<br>4-tube lamp | Three-band<br>incandescent-shape | Three-band<br>1-, 2-, or<br>3-tube lamp |
|---|---------------|--|--|--------------------------------------|---|--------------------------------|---------------------------|----------------------------------|---|
|   |               | 1  | 2  | 3                                    | 4, 5, 6                                 | 7                              | 8                         | 9                                | 10                                      |
| Characteristics   | Lamp category | Linear fluorescent lamps                       |  |                                      | Compact fluorescent lamps               |                                |                           |                                  |   |
| Power rating<br>(W)   | from<br>to    | 14<br>35                                       | 24<br>80                                   | 18<br>70                             | 5<br>70                                 | 18<br>80 <sup>2)</sup>         | 16<br>38                  | 5<br>23                          | 5<br>23                                 |
| Luminous flux <sup>5)</sup><br>(lumen)                            | from<br>to    | 1,100<br>3,300                                 | 1,650<br>6,150                             | 1,350<br>6,200                       | 250<br>5,200                            | 1,200<br>6,000                 | 1,050<br>2,800            | 150<br>1,350                     | 250<br>1,550                            |
| Luminous efficacy <sup>5)</sup><br>(lumen/W)                      | from<br>to    | 79<br>93                                       | 69<br>88                                   | 75 <sup>1)</sup><br>93 <sup>1)</sup> | 50<br>82                                | 67<br>87                       | 61<br>78                  | 30<br>59                         | 50<br>67                                |
| Light colour  |               | ww, nw,<br>dw                                  | ww, nw,<br>dw                              | ww, nw,<br>dw                        | ww, nw,<br>dw                           | ww, nw,<br>dw                  | ww, nw,<br>dw             | ww                               | ww,                                     |
| Colour rendering index R <sub>a</sub><br>(in some cases as range) |               | 80-85  | 80-85                                      | 80-85                                | 80-85                                   | 80-85                          | 80-85                     | 80-89                            | 80-89                                   |
| Base  |               | G5   | G5   | G13                                  | G23;<br>G24;<br>2G7;<br>GX24;<br>GR14q  | 2G11                           | 2G10;<br>GR8;<br>GR10q    | E14; E27                         | E14; E27                                |



# Lighting Special: Lamps



9



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## Three-band fluorescent lamps (1, 2, 3)

Three-band fluorescent lamps offer high luminous efficacy coupled with good colour rendering and a long life. In conjunction with electronic ballasts (EBs), they achieve even higher luminous efficacy, a longer life and greater lighting comfort.

16 mm-diameter T5 lamps are designed for EB operation only. With appropriate EBs, all three-band fluorescent luminaires can be dimmer-controlled.

## Compact fluorescent lamps (4-10)

Compact fluorescent lamps have the same characteristics as three-band fluorescent lamps. Here too, luminous efficacy, service life and lighting comfort are enhanced by electronic ballasts and dimmer control is possible with appropriate EBs.

In some versions (9, 10), the ballast is integrated. Compact fluorescent lamps consume up to 80% less energy than incandescent lamps and have a much longer life.

## 230 V halogen lamps (11-15)

Halogen lamps for mains operation produce an agreeable white light with good colour rendering properties. They have a longer life than incandescent lamps and achieve higher luminous efficacy. They are fully dimmable and available also as reflector lamps. The latest generation of energy-saving halogen lamps reduces power consumption by up to 50%.

## Low-voltage 12 V halogen lamps (16, 17, 18)

Low-voltage halogen lamps produce an agreeable white light with very good colour rendering properties. To operate them, a transformer is needed to reduce the voltage to 12 V. With appropriate transformers, they can be dimmer-controlled. IRC (Infra-Red Coating) lamps consume up to 30% less energy for the same luminous flux.

## Light-emitting diodes (19, 20)

LED (Light Emitting Diode) lamps are available in many conventional lamp designs, consume very little energy and have an extremely high impact resistance. They also have a very long service life – up to 50,000 hours. Currently in vogue are LED retrofit lamps in classical lamp designs, e.g. with E27 or E14 base. They come with an integrated ballast and can thus be simply exchanged for conventional incandescent lamps.

| Halogen lamp shape <sup>3)</sup> | Halogen reflector lamp <sup>3)</sup> | Halogen pin base lamp | Halogen lamp base at both ends | Halogen reflector lamp <sup>3)</sup> | Halogen reflector lamp | Halogen pin base lamp <sup>3)</sup> | LED lamp incandescent-shape <sup>3)</sup> | LED reflector lamp <sup>3)</sup> |
|----------------------------------|--------------------------------------|-----------------------|--------------------------------|--------------------------------------|------------------------|-------------------------------------|---|----------------------------------|
| 11                               | 12                                   | 13                    | 14                             | 15                                   | 16                     | 17                                  | 18  | 19                               |
| 230 V halogen lamps              |                                      |                       |                                | 12 V halogen lamps                   |                        |                                     | LED                                       |                                  |
| 18                               | 40                                   | 20                    | 60                             | 20                                   | 14                     | 5                                   | 7   | 5                                |
| 105                              | 100                                  | 60                    | 2,000                          | 75                                   | 50                     | 90/100                              |   | 7                                |
| 180                              | 650                                  | 200                   | 840                            | 250 <sup>4)</sup>                    | 480 <sup>4)</sup>      | 50                                  | 230 <sup>6)</sup>                         | 800 <sup>4)</sup> <sup>6)</sup>  |
| 1,900                            | 2,400                                | 980                   | 44,000                         | 950 <sup>4)</sup>                    | 2,850 <sup>4)</sup>    | 1,800                               |   |                                  |
| 11                               | -                                    | 10                    | 14                             | -                                    | -                      | 10                                  | 37  | 37                               |
| 20                               | -                                    | 15                    | 22                             | -                                    | -                      | 20                                  |   |                                  |
| ww                               | ww                                   | ww                    | ww                             | ww                                   | ww                     | ww                                  | ww, dw                                    | ww, dw                           |
| 100                              | 100                                  | 100                   | 100                            | 100                                  | 100                    | 100                                 | 7)  | 7)                               |
| E14;<br>E27                      | E14;<br>E27                          | G9                    | R7s                            | GZ10;<br>GU10                        | GU5.3                  | GY 6.35;<br>G4                      | E27                                       | E27;<br>GU10                     |

<sup>1)</sup> Luminous efficacy increases to 81 – 100 lm/W with EB operation. The power input of the lamps is reduced from 18 W to 16 W, from 36 W to 32 W and from 58 W to 50 W.

<sup>2)</sup> 40 W, 55 W and 80 W only with EB

<sup>3)</sup> Also available in different shapes

<sup>4)</sup> Value stated in candela (=luminous intensity)

<sup>5)</sup> At 25° ambient temperature

<sup>6)</sup> For neutral-white light colour

<sup>7)</sup> LED colour rendering depends on the type of LED

**ww** = warm white  
colour temperature below 3,300 K

**nw** = neutral white  
colour temperature 3,300 – 5,300 K

**dw** = daylight white  
colour temperature above 5,300 K

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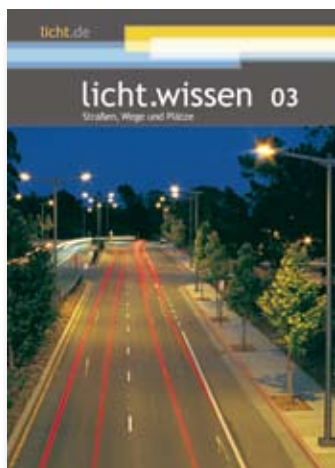


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