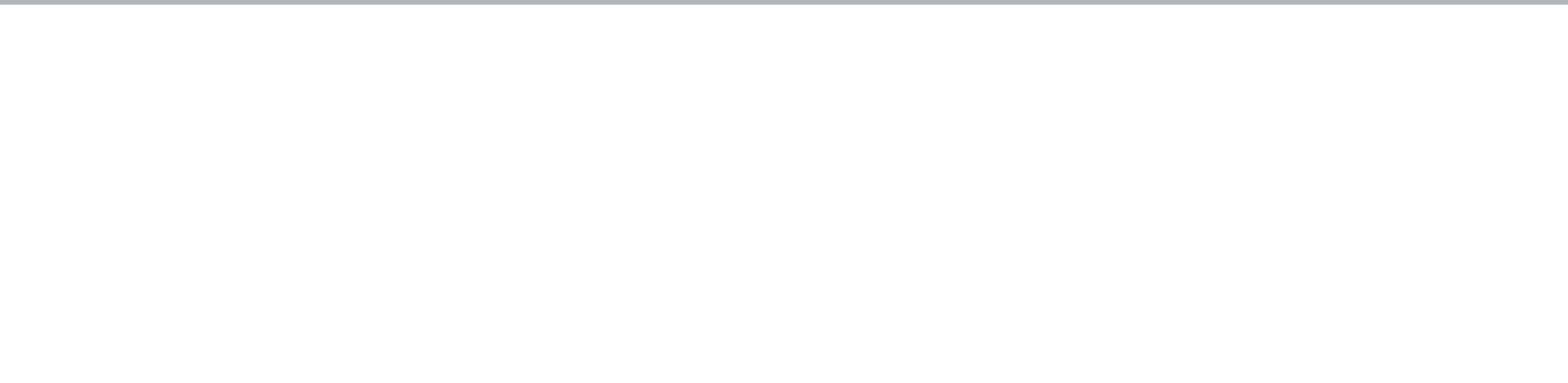


15

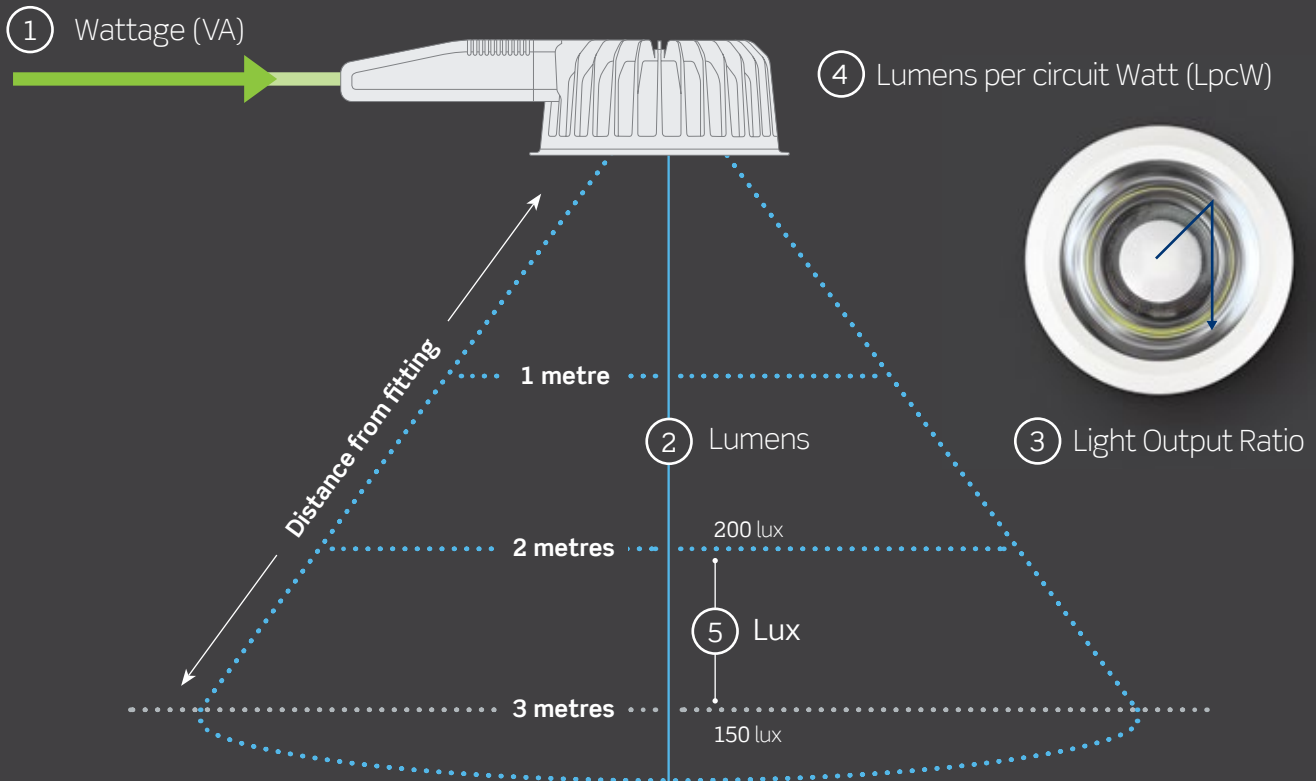
Technical



Lighting explained

A GUIDE TO COMMONLY USED TERMS WITHIN LIGHTING

For full information on understanding lighting performance, visit jcc.co.uk/lighting-explained



- 1 WATTAGE (VA)**
A measure of the energy consumed by a fitting
A measure of power or the rate of energy consumption by an electrical device when it is in operation, calculated by multiplying the voltage at which an appliance operates by the current it draws (Watts = Volts X Amperes).
- 2 LUMENS**
A measure of light output
A lumen is a unit of measurement that is used to express how much illumination a source of light provides.
- 3 LIGHT OUTPUT RATIO (LOR)**
The proportion of light that finally leaves the light fitting
This is a measure of the efficiency of the fitting and is a ratio of the lumens leaving the light source and the lumens that finally leave the fitting.
- 4 LUMENS PER CIRCUIT WATT (LPCW)**
The efficiency of the fitting
A calculation of the efficiency of a fitting. Lumens (3000) ÷ Wattage (50W) = 60 LpcW
- 5 LUX**
A measure of light intensity
A measure of the intensity of light as seen by the human eye and measured by luminous flux per unit area. One lux is equal to one lumen per square metre.

COLOUR RENDERING INDEX (CRI)

The quality of light

A measure of the ability of a light source to reproduce the colours of various objects. A light source with a CRI of 100 (Ra) would be perfect and balanced in terms of colour reproduction, shading and contrast.

LUMEN DEPRECIATION (L70)

The deterioration in a lights performance after a time

Lumen depreciation values reflect the overall performance of a light source through its life. All light sources suffer from lumen depreciation, which can be accelerated by poor thermal conditions, over voltage or incorrect application. L70 is the operating time (hours) until the LED lumen output is depreciated to 70% of its initial lumens.

IP RATINGS

A fittings protection against dust and moisture

Ingress Protection (IP) is a value given to products that have particular protection against dust and/or moisture. The IP number is split, the first digit represents the level of protection against dust particles while the second digit represents the protection against moisture. For example IP00 has no protection against dust or moisture whilst a product with IP68 is dust tight and submersible up to 2m (see page 255 for more information).

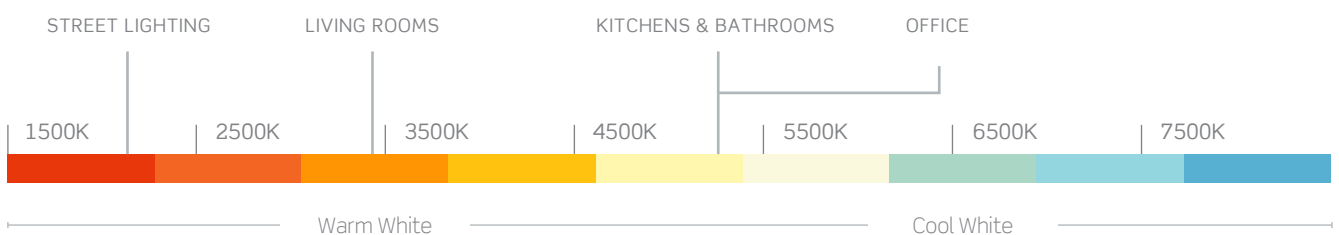
Cone diagrams

Cone diagrams describe the amount of light at different distances from a fitting and are measured by the lux level.



Understanding colour temperature

The colour temperature of a light source is measured in degrees Kelvin. Below is a Kelvin temperature chart with examples of how colour temperature is used within different lighting applications.



High Pressure Sodium
2200K

Standard Incandescent
2700K

Clear Metal Halide
4000K

Cool White Fluorescent
4200K

Natural White Metal Halide
5000K

Building lighting basics

KEY FACTORS TO CONSIDER WHEN LIGHTING A BUILDING

It's important to understand who will be using the area and what will be the layout. The following is a simple checklist:

| | |
|--|--|
| What is the primary use of the area? | The level of light required will depend upon the tasks performed within the area. See CIBSE guidelines below. |
| What colours are used within the decor? | Dark walls, flooring and furniture can absorb up to 80% of the light. |
| How much natural daylight enters the area? | Windows, exterior doors and skylights impact the level of light within an environment. To maintain constant light levels the area may require lighting control such as daylight harvesting (see page 259). |
| Is the ceiling suspended or solid? | Light fittings are often designed for a specific ceiling type. The ceiling within your application may dictate the relevant fittings required. |
| Is there electrical provision for wall mounted lights? | If lighting new areas where fittings do not replace previous lighting, chasing wiring into the wall may be necessary. |
| Which regulations are applicable? | The 2014 Building Regulations stipulate key attributes that are required for fittings used within certain areas (see page 256). |
| What level of maintenance does the area receive? | Without regular cleaning, the light output of all light fittings is reduced. Non-LED fittings require lamps to be replaced dependant upon lamp technology. |
| Are there environmental considerations? | Older lamp technologies such as CDM can considerably add to ambient room temperatures. Areas with heightened levels of dust, dirt and water may require a level of IP rating (see page 255). |

What is the recommended light level?

CIBSE GUIDELINES

| | |
|--|------------------|
| Public areas with dark surroundings, including car parks | ▶ 10 - 50 Lux |
| Simple orientation for short visits | ▶ 100 - 150 Lux |
| Warehouse racking | ▶ 150 Lux |
| Warehouses, homes, theatres and archives | ▶ 150 - 200 Lux |
| Simple office work and classrooms | ▶ 300 - 500 Lux |
| Brighter areas such as bathrooms | ▶ 150 - 200 Lux |
| Normal office work with computers | ▶ 300 - 500 Lux |
| Supermarkets and workshops | ▶ 500 - 1000 Lux |

How to add interest to lighting

Good lighting design recognises the need for depth of view. Both ambient and accent lighting should be used, whilst combining colour temperatures to create a more comfortable working environment.

Ambient lighting is the general lighting within an area and typically contributes 80% of the overall lighting level.

- Skytile® is a good example of product designed for ambient lighting.

Accent lighting adds interest and depth to a design and should compliment but not conflict with the ambient lighting.

This can include wall washing, the subtle use of colour, up lighting and spotlighting.

- Starscoop™ and Hybrid9™ are excellent for accent lighting.

Mixing warm & cool coloured lighting within a design can assist a design:

- The ambient lighting can be a cooler temperature to add a more commercial feel.
- Supplement with warm white as accent lighting to create a more dynamic environment.



Typical areas within commercial applications

A Meeting & boardroom

The main lighting should be focused on the table areas. Remember to allow control of lighting near screens and displays. Use accent lighting to provide depth, and consider lighting pictures and other features.

B Office area

Try to allow for flexible use of the space so that desks can be repositioned. The lighting on desks should be greater than general movement areas. Consider the opportunity to use natural daylight, this may require lighting control for daylight harvesting (see page 259). Adequately light emergency escape routes (see page 257).

C Reception

The reception area can provide a first impression of the business. The ambient and accent lighting should be varied to provide a dynamic feel.

D Stairwells

Primarily focus on safety by ensuring good light levels. Also consider the emergency requirements for emergency escape.

E Basement

Natural light and external views are unavailable and therefore it's vital to create depth of design by mixing accent and ambient light with variations in colour temperature.

F Showroom

The primary focus should be on the products being displayed. Track lighting can provide flexibility for changes of use (see StarSpot™ pages 162-167, 177-179). Good CRI (see page 249) is important to ensure that colours are displayed correctly, LED lighting can have good and consistent CRI. Also consider the reliability of the lighting, a long L70 (see page 249) is important or the products will become dimly lit over time as product performance deteriorates.

G Exterior

Consider the security requirements and the safe passage of people when entering and leaving the building. Good exterior lighting can dramatically change the look of a building so consider both lighting the area around the building and the elevations of the entrance area and side walls.

Lighting guides

GUIDE FOR THE NUMBER OF FITTINGS NEEDED FOR YOUR ROOM SIZE

Skytile Base

The direct fluorescent replacement



| | 5m | 6m | 7m | 8m | 9m | 10m |
|-----|----|----|----|----|----|-----|
| 5m | 6 | 6 | 8 | 8 | 10 | 10 |
| 6m | 6 | 8 | 8 | 9 | 12 | 12 |
| 7m | 8 | 8 | 12 | 12 | 12 | 15 |
| 8m | 8 | 9 | 12 | 12 | 16 | 16 |
| 9m | 10 | 12 | 12 | 16 | 16 | 20 |
| 10m | 10 | 12 | 15 | 16 | 16 | 20 |

Notes

1. All of the above quantities are for guidance only.
2. Based on office lighting level of circa 400 lux
3. 2.4m ceiling throughout
4. 0.8 maintenance factor
5. Reflectance of 70:50:20
6. Length/width in metres

FGLED10

The high output fire rated LED downlight



| | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | 10m |
|-----|---------|---------|----------|----------|----------|----------|----------|----------|----------|
| 2m | 2 1 | 4 2 | 6 3 | 6 3 | 8 4 | 8 4 | 10 5 | 10 6 | 12 6 |
| 3m | 4 2 | 6 4 | 9 4 | 9 4 | 12 6 | 12 6 | 12 6 | 16 8 | 16 8 |
| 4m | 6 3 | 9 4 | 12 6 | 12 6 | 16 6 | 16 8 | 20 8 | 20 9 | 25 12 |
| 5m | 6 3 | 9 4 | 12 6 | 16 9 | 20 9 | 20 9 | 25 12 | 25 12 | 30 12 |
| 6m | 8 4 | 12 6 | 16 6 | 20 9 | 20 9 | 20 12 | 25 12 | 30 16 | 36 16 |
| 7m | 8 4 | 12 6 | 20 7 | 25 9 | 25 12 | 30 12 | 30 16 | 36 16 | 36 16 |
| 8m | 10 5 | 12 6 | 20 8 | 25 12 | 25 12 | 30 16 | 36 16 | 42 20 | 42 20 |
| 9m | 10 6 | 16 8 | 20 9 | 25 12 | 30 16 | 36 16 | 42 20 | 49 20 | 49 20 |
| 10m | 12 6 | 16 8 | 25 12 | 30 12 | 36 16 | 36 16 | 42 20 | 49 20 | 49 25 |

□ Indicates approx. number of 50W GU10 halogen fitting

■ Indicates approx. number of FGLED® fittings

| Lux | 50W GU10 Halogen | | | FGLED10® | | |
|-----|---------------------|-------|-----------------|---------------------|-------|-----------------|
| | Fitting Arrangement | Total | Approx. Spacing | Fitting Arrangement | Total | Approx. Spacing |
| 150 | 4x5 | 20 | 1.23m | 3x3 | 9 | 1.83m |
| 200 | 5x5 | 25 | 1.10m | 3x4 | 12 | 1.58m |
| 250 | 6x5 | 30 | 1.00m | 4x4 | 16 | 1.38m |
| 350 | 7x6 | 42 | 0.85m | 5x4 | 20 | 1.23m |
| 450 | 7x7 | 49 | 0.79m | 5x5 | 25 | 1.10m |

FGLED6.

The high performance fire rated LED downlight



| | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | 10m |
|-----|----|----|----|----|----|----|----|----|-----|
| 2m | 1 | 2 | 3 | 8 | 8 | 10 | 10 | 12 | 12 |
| 3m | 2 | 4 | 4 | 8 | 10 | 10 | 12 | 15 | 15 |
| 4m | 3 | 4 | 4 | 9 | 12 | 15 | 15 | 18 | 18 |
| 5m | 4 | 6 | 6 | 12 | 15 | 18 | 20 | 20 | 24 |
| 6m | 4 | 6 | 8 | 9 | 12 | 12 | 15 | 18 | 20 |
| 7m | 5 | 8 | 9 | 12 | 12 | 16 | 16 | 20 | 20 |
| 8m | 5 | 8 | 10 | 12 | 15 | 16 | 20 | 24 | 24 |
| 9m | 6 | 8 | 12 | 15 | 18 | 20 | 24 | 25 | 30 |
| 10m | 12 | 15 | 18 | 24 | 30 | 35 | 35 | 42 | 49 |

FGLED3.

The cost effective fire rated LED downlight



| | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | 10m |
|-----|----|----|----|----|----|----|----|----|-----|
| 2m | 2 | 3 | 6 | 8 | 8 | 10 | 10 | 12 | 12 |
| 3m | 3 | 6 | 6 | 8 | 10 | 10 | 12 | 15 | 15 |
| 4m | 6 | 6 | 9 | 9 | 12 | 15 | 15 | 18 | 18 |
| 5m | 8 | 8 | 9 | 12 | 15 | 18 | 20 | 20 | 24 |
| 6m | 8 | 10 | 12 | 15 | 20 | 20 | 24 | 24 | 30 |
| 7m | 10 | 10 | 15 | 18 | 20 | 25 | 25 | 30 | 35 |
| 8m | 10 | 12 | 15 | 20 | 24 | 25 | 30 | 35 | 35 |
| 9m | 12 | 15 | 18 | 20 | 24 | 30 | 35 | 36 | 42 |
| 10m | 12 | 15 | 18 | 24 | 30 | 35 | 35 | 42 | 49 |

Notes to the above

1. Based on cool white (4000K) fitting
2. 2.5m ceiling height

Understanding bathroom zones

IEE Wiring Regulations, BS 7671: 2008, Section 701 gives requirements for areas containing a bath or shower. This document should be consulted before installation of appliances.

Areas of the bathroom are split into zones. As a guide only, the requirements for luminaries in each zone may be summarised as follows. Particular care should also be taken with wash basins. Guidance for these are also contained within BS 7671.



Zone 0

Refers to the interior of the bath or shower that can hold water. Requires electrical products to be low voltage (max. 12V) and rated IPX7.

Zone 1

Refers to the area above the bath or shower up to a height of 2.25 metres and requires a minimum rating of IPX4 (splash-proof), plus RCD protection. IPX5 should be considered if water jets may be present i.e. for cleaning purposes.

Zone 2

Covers an area 0.6 metres wide immediately next to, and all around Zone 1. Wash basins should also be treated as Zone 2. The minimum rating here is IPX4.

1

Zone 1 products



15
HYBRID9™



19
HYBRID7™



23
FGLED10®



25
FGLED6®



31
FGLED3®



38
MAINS SHOWERLIGHT

2

Zone 2 products



157
BODO



158
DORCHESTER



159
BERKELEY

IP Numbers

Protection explained

Explanation of IP numbers for degree of protection (for example: IP65)

| First Numeral | Short Description |
|---------------|--|
| 0 | Non-protected |
| 1 | Protected against solid objects greater than 50mm |
| 2 | Protected against solid objects greater than 12mm |
| 3 | Protected against solid objects greater than 2.5mm |
| 4 | Protected against solid objects greater than 1.0mm |
| 5 | Dust - Protected |
| 6 | Dust - Tight |

| Second Numeral | Short Description |
|----------------|--|
| 0 | Non-protected |
| 1 | Protected against dripping water |
| 2 | Protected against dripping water when tilted up to 15° |
| 3 | Protected against spraying water |
| 4 | Protected against splashing water |
| 5 | Protected against water jets |
| 6 | Protected against heavy seas |
| 7 | Protected against the effects of immersion |
| 8 | Protected against submersion |

Example **IP6X**

Example **IPX5**



2014 Building Regulations

Part L

Non-Domestic/Commercial

MINIMUM LIGHT FITTING PERFORMANCE

- **General lighting in office and industrial** – 60 lumens per circuit Watt
- **Display lighting** – 22 lumens per circuit Watt

LIGHTING CONTROLS WILL REDUCE THE REQUIRED EFFICIENCY OF THE LIGHT FITTING

| | Control factor | | | | | | | | | | | | | |
|--|----------------|-----------|-----------|-----------|-----------|-----------|--|-----------|-----------|-----------|-----------|-----------|----------------------|--|
| A Day lit space with photo-switching with or without override | 0.90 | ▼ | | | | | | + | + | | | | | |
| B Day lit space with photo-switching with or without override + dimming | 0.85 | | ▼ | | | | | | | + | + | | | |
| C Unoccupied space with automatic on/off occupancy | 0.90 | | | ▼ | | | | + | | + | | + | | |
| D Unoccupied space with manual on/off occupancy | 0.85 | | | | ▼ | | | | + | | + | | + | |
| E Space not day lit, dimmed for constant illuminance | 0.90 | | | | | ▼ | | | | | | + | + | |
| Minimum performance required from a fitting with lighting controls | | 54 | 51 | 54 | 51 | 54 | | 48 | 45 | 45 | 42 | 48 | 45 | |
| | | | | | | | | | | | | | Combined LpcW | |

Introducing LENI (Light Energy Numeric Indicator)

LENI is a measurement of the buildings energy performance in energy usage per sq/m.

The methodology:

Divides the building into zones according to:

- **Task type** – and hence required luminance (see page 250)
 - **Daylight availability**
 - **Annual usage**
- Calculates annual all-lights-on power usage for each zone
 - Discounts by applicable control factors
 - Adds fixed allowance for standby power consumption
 - Compares the result with the Part L allowance

For more information: www.thelia.org.uk and see lighting guides.

Domestic

MINIMUM LIGHT FITTING PERFORMANCE

- **Internal lighting** - At least 75% of all the light fittings in the main dwelling spaces (excluding infrequently accessed spaces used for storage) must have light fittings with an efficacy greater than 45 lumens per circuit Watt and total light output greater than 400 lumens.
 - Light fittings of less than 5 circuit Watts, such as FGLED3®, are excluded from the calculation.
- **External lighting**
 - Either
 - Light fitting and lamps of greater than 100 Watts must be automatically controlled to switch off after the area becomes unoccupied and automatically controlled to switch off when daylight is sufficient.
 - Or
 - If the light fittings are better than 45 lumens per circuit Watt then they should be automatically controlled, so as to switch off when daylight is sufficient and can be manually controllable.

Emergency lighting

What is an emergency light fitting?

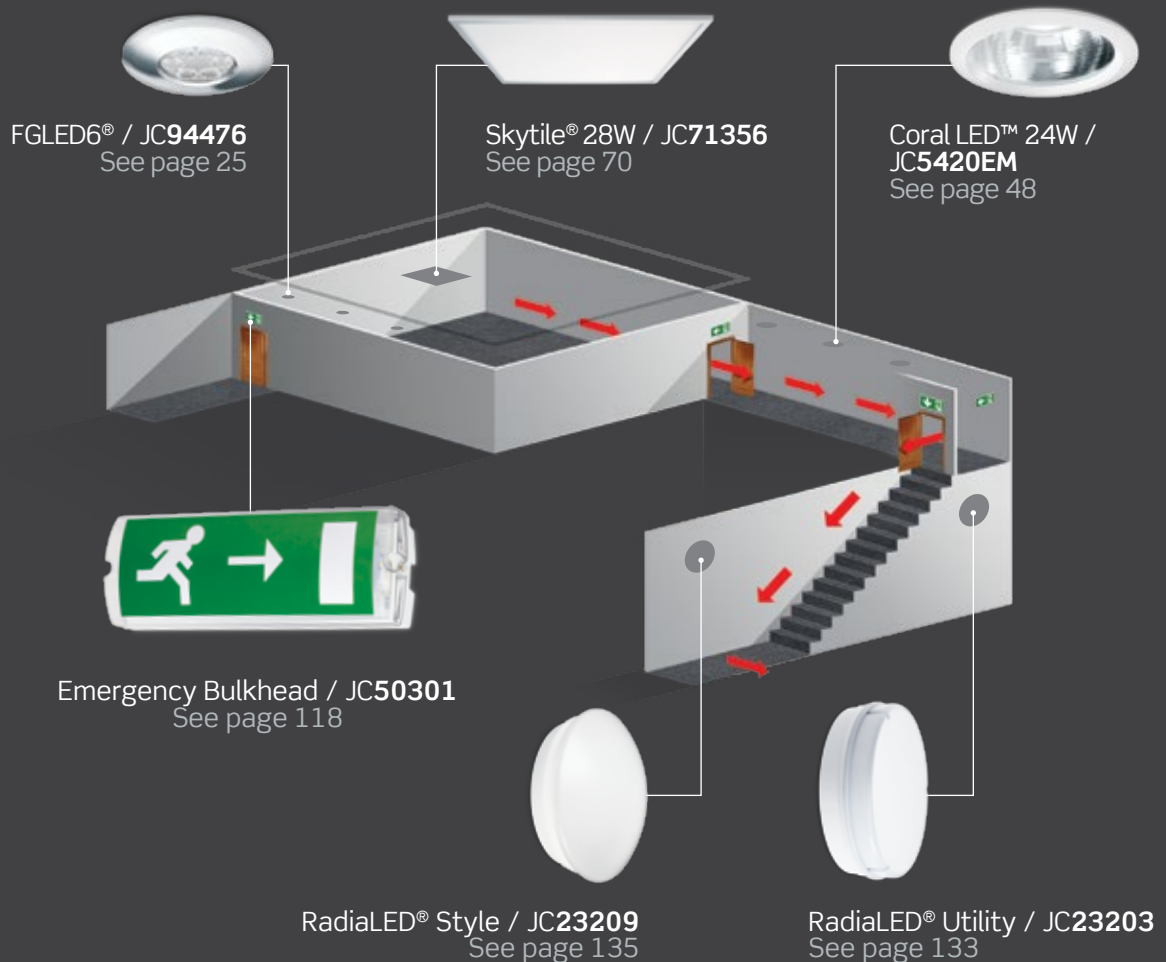
Emergency light fittings include a battery as a backup power source that is continuously charged. Emergency light fittings can tell when the power has failed and immediately switch to using the backup battery. The battery needs to power the light fitting for a minimum of 3 hours. To conserve power, the light output from the fitting is reduced, often to 10% of the normal light output.

What are the different types of emergency light fittings?

Maintained fitting – will operate as a normal light fitting and be controlled with all the other lights in the area, however when the power fails the maintained emergency fitting will continue to operate but, at a lower light level.

Non-maintained fitting – is normally switched off, with its batteries being continuously charged and a green LED showing fully charged. When the power fails then the fitting switches on using its battery supply. Non-maintained fittings are not part of the general lighting but are fittings such as emergency exit signs.

All JCC emergency light fittings can operate as a maintained and non-maintained light.



Open areas

The non-obstructed, quickest and safest escape route must be lit to a minimum of 1 lux during an emergency. If the open area is less than 60m² and isn't part of an escape route then emergency lighting isn't required, however the exit doors for the emergency escape route must have signs or an emergency bulkhead light.

An escape route such as a designated corridor

An escape route must be unobstructed and lit to a minimum of 1 lux during an emergency.

Stairwells

Due to increased hazards, these areas need to be lit to a minimum of 2 lux during an emergency.

Controlling lighting

Why control lighting?

Switching to LED from traditional lighting technology, such as halogen or fluorescent, can provide up to 90% energy savings. However, LED lighting can provide other benefits, such as instantly controlling on/off without deterioration in the fittings operating life. These benefits are suitable for lighting control and allow for significantly improved energy savings and a better lit environment.

Lighting controls can provide an additional 50% energy saving

The government recognises the benefit of lighting control and is starting to introduce regulation that focuses on improvements in the energy efficiency of a complete building. The introduction of Building Regulations Part L (2013) is an example of this change and introduces the concept of a Lighting Energy Numeric Indicator (LENI – see page 256) that calculates the energy usage of a building per metre².

LENI

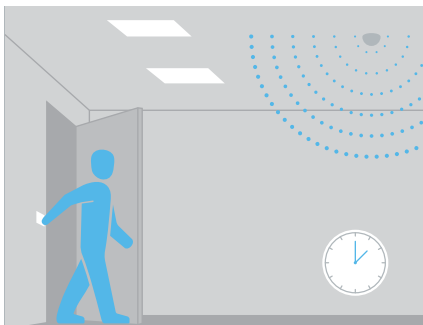
LENI is a new measurement of lighting that changes the focus from the performance of an individual fitting, to the performance of the full lighting installation (see page 256).

What are the types of lighting control?

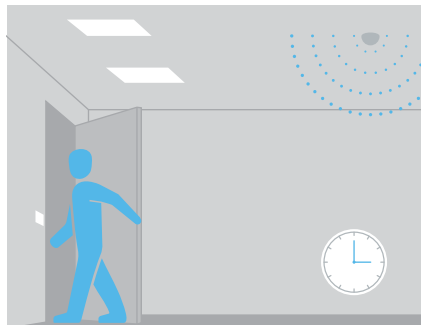
Good lighting control systems should adjust the lighting to compensate for changes in daylight levels and the usage of the area. The main types of control are:

1 ABSENCE DETECTION

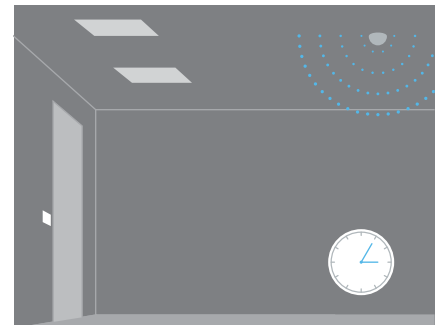
Manual on, auto off



Lighting is switched on using a time switch or detection from an occupancy sensor.



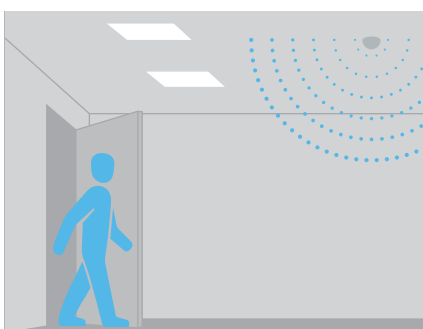
The lighting stays on using a timer.



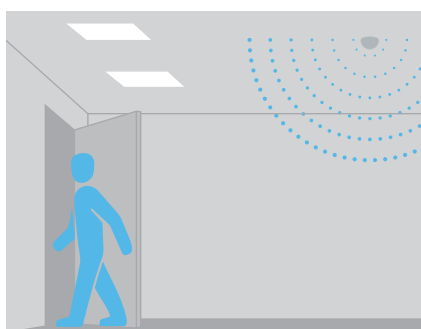
The lighting is automatically switched off after a specified period of time.

2 PRESENCE DETECTION

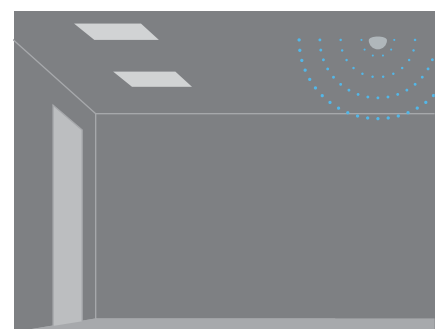
Auto on, auto off



The lighting is switched on after detection by an occupancy sensor.



The sensor detects any further activity.

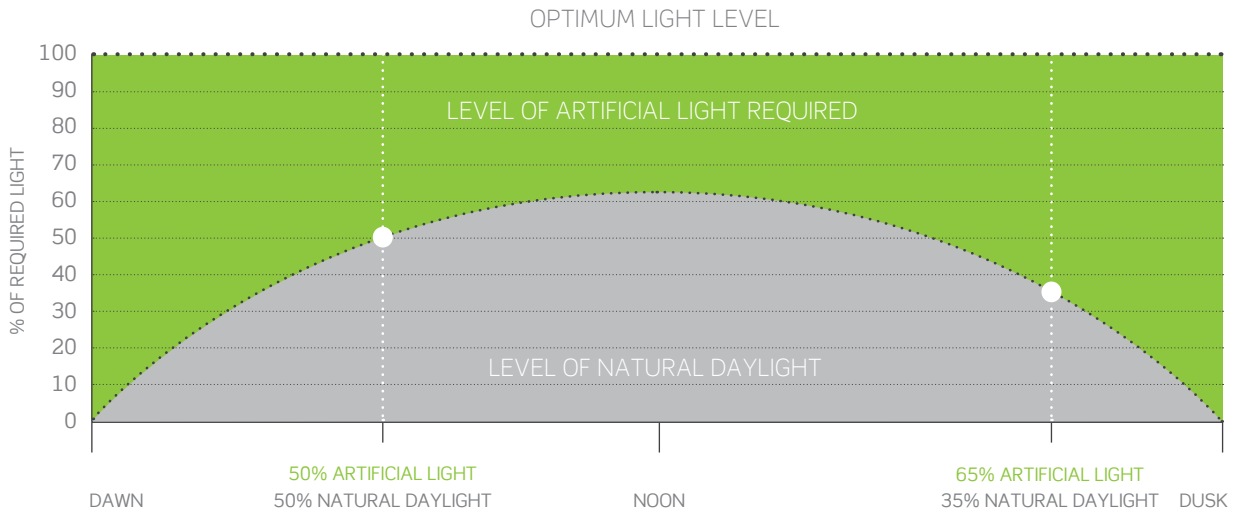


The lighting is switched off when the sensor doesn't detect any further activity.

3 DAYLIGHT COMPENSATION

Harvesting

The cheapest and best form of lighting is natural daylight. Lighting controls can be designed to adjust the light output from the light fittings when the amount of daylight in a room changes throughout the day and seasons.



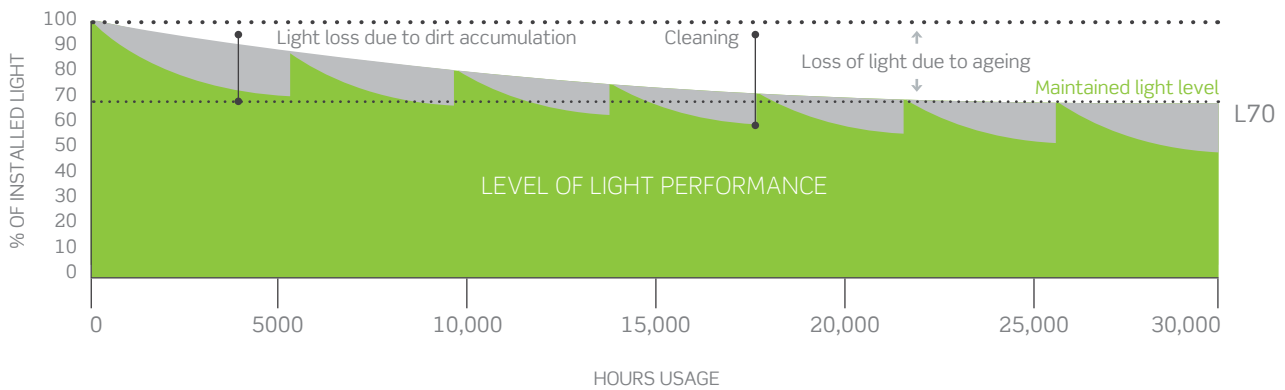
4 CONSTANT ILLUMINANCE

Light fittings lose some of their brightness over time, measured as the time taken to lose 30% of the original light output (L70). LED lights generally have a much better L70 performance than traditional lighting. If lighting controls are used then the area can be maintained at the correct level (maintained level).

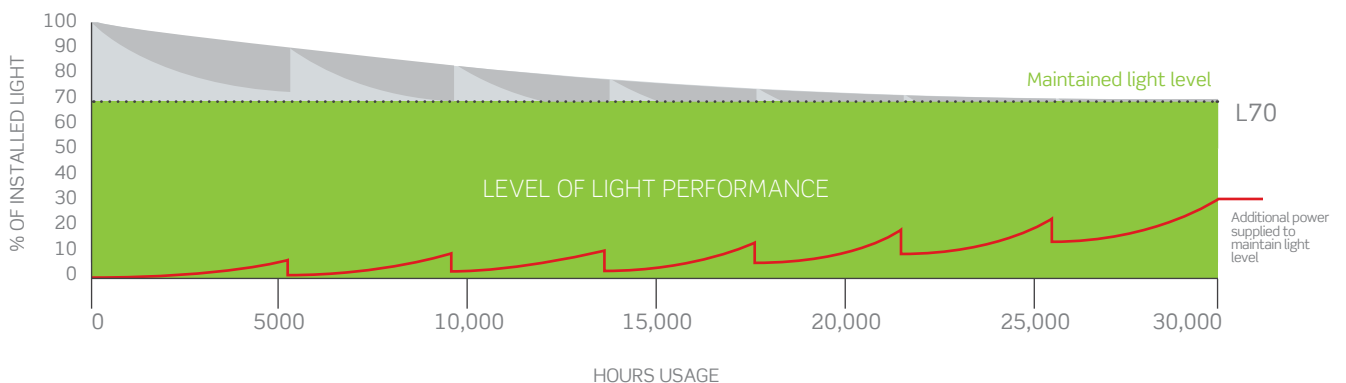
However, if controls are not used then the options available are to:

- Initially over-light an area which will achieve the correct future lighting level, or
- Initially light an area to the correct level and accept that in future the light level will deteriorate.

WITHOUT CONSTANT ILLUMINANCE



WITH CONSTANT ILLUMINANCE



Components of lighting control systems

A lighting control system is constructed from a range of individual components that may be supplied by different manufacturers. Understanding these components and their ease of integration is important when designing a good lighting control system.

DRIVERS

Drivers are the electronic systems that manage the power to an LED fitting and therefore change the light output. The primary driver types are:



Non-dimmable

The driver cannot adjust the power to the LED fitting and can therefore only be switched on/off.

Dimmable

The power to the LED fitting is changed by the driver when it receives a signal from a controller.

Step dimming

The power to the LED fitting can be changed but only in fixed incremental amounts. This is useful when limited illumination is required for safety or security.

DETECTORS

Detectors provide the lighting control system with information on its environment; has the light level changed or are there people in the area? Multi-sensor technologies can be combined into a single detector or operate separately.

The primary sensor types are:



PIR

Identifies people by looking for changes in the heat pattern, heat is always generated by people.

Microwave

A transmitter sends out microwaves that bounce off people and are received back at the sensor. These detectors can be more robust than a PIR but travel through walls and can cause unplanned detection.

Ultrasonic

Operate on the Doppler principle by emitting ultrasonic high-frequency sound waves into the room and then monitoring the variations of that signal as they return to a microphone within the sensor.

Photocell

Detects the amount of light entering the sensor.

SWITCHES

Switches are the manual method of managing lighting.

The primary switch types are:



On/off

Simply interrupts the electrical supply to the light fitting.

On/off timed

Switches the lights on for a pre-programmed time and are often used in communal access corridors and staircases.

Dimmable

Switches allow adjustment of the lighting, often adjusted by rotation or the length of time the switch is held down.

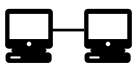
TRANSMISSION OPTIONS

There are three primary types of transmitting control information to light fittings:



Mains power

Simple to install as it only requires a mains supply cable and is used for applications that use limited power such as domestic lighting. Phase dimming uses this form of transmission and the dimmable FGLED® range uses this technology.



Separate control wire

Used to control most commercial applications where the power usage is greater. Allows the transmission of 1-10 Volt, DALI, and DSI directly to the light fittings.



Wireless transmission

Used to transmit a digital signal and doesn't require a separate control wire, however wireless links can suffer interference and are limited in range particularly where walls and metal objects exist. ZigBee is an example standard that allows meshing to increase range and reliability.

Communication protocols

Communications protocols are the method of transmitting information to the light fittings.

PHASE DIMMING

Uses the mains alternating current (AC) to reduce power to the light fitting by cutting out sections of the AC supply. Phase dimming was designed for traditional lighting technology and is common in lower power domestic lighting but is unsuitable for commercial applications due to the larger power requirements.

The supply can be cut from:

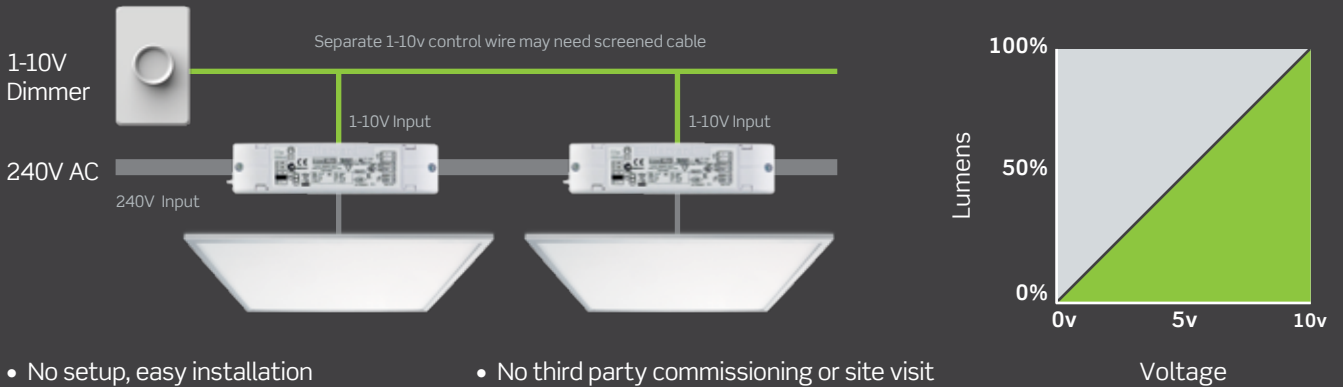
- The front of the AC wave (leading edge dimming) and/or
- The back edge (trailing edge dimming)



- Separate control wire not required
- For lower power applications

1-10 VOLT ANALOGUE

Uses a separate control wire to notify the driver that the power to the LEDs should be changed. The separate control signal is a direct current (DC) and can be adjusted from 1 up to 10 volts, the voltage level is interpreted by the driver to set the LED power.

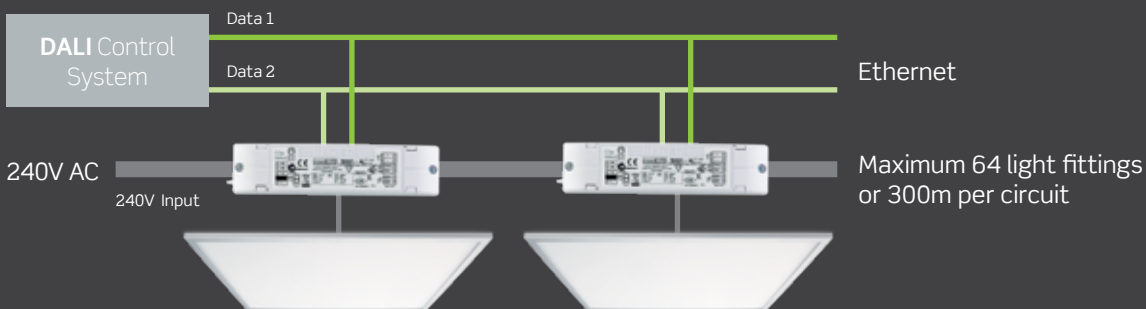


- No setup, easy installation
- No third party commissioning or site visit

This method of control is a low current system (typically 1mA) meaning it can be run along relatively thin cables with little voltage drop and depending on dimmer manufacturer recommendations, allows for up to 50 LED dimmable drivers on one wall mounted dimmer.

DALI (DIGITAL ADDRESSABLE LIGHTING INTERFACE)

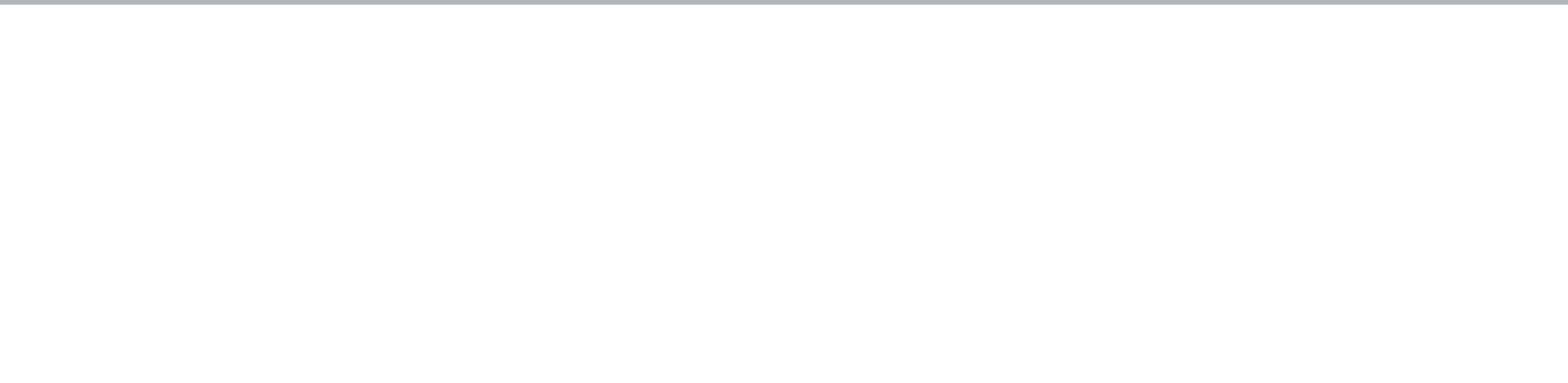
This is a digital communications protocol that was developed for the lighting industry. A separate control wire or BUS is used to send digital information to light fittings and allows the individual light fittings and sensors to communicate with an advanced lighting control system. Although DALI is a standard protocol beware of mixing components between manufacturers without first testing. Along with the correct LED driver the DALI system requires additional control equipment including DALI BUS controllers, power supplies, sensors and user interfaces.



- Fully programmable lighting sleeves
- Individually addressable light fittings

DSI (Digital Serial Interface) – developed by Tridonic, the driver manufacturer. The specification is simpler than DALI but doesn't have the same general industry support.

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All information is correct at the time of printing, but may be subject to change without prior notice. For the latest information of product specifications, please refer to our website: jcc.co.uk

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