LG 14 Control of Electric Lighting

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CIBSE HCNE

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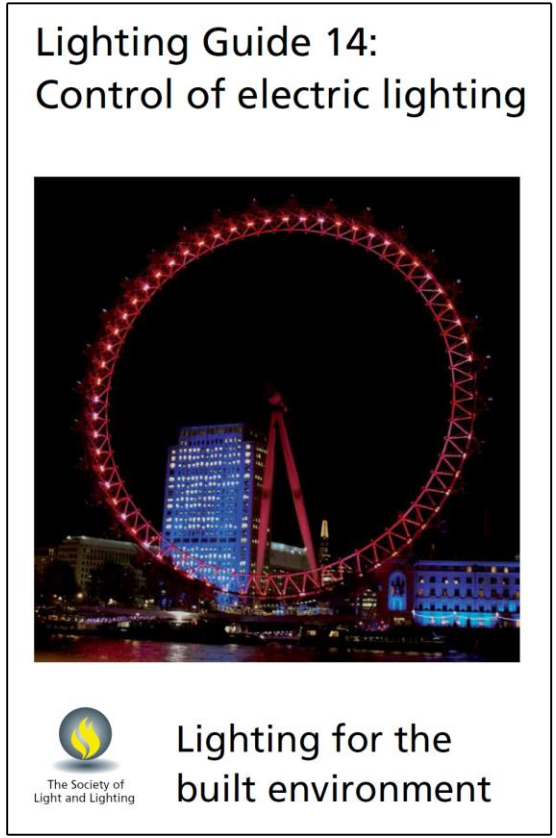
Contents



1. Context

- Who are the target audience ?
- Why do we need LG 14?
- Compatibility with the LG series

2. Terminology- *Product examples*

Inside LG 14 - let's start at the beginning and understand industry jargon and acronyms

Presence detection

Absence detection

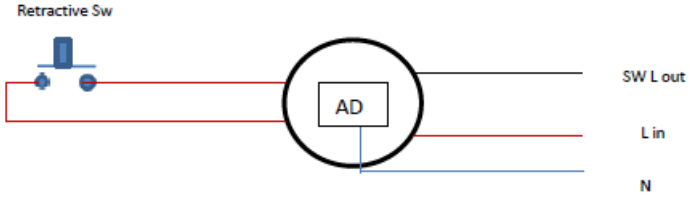
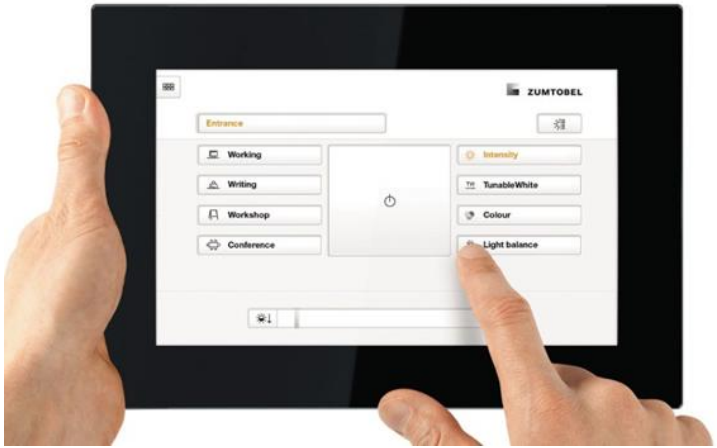


Fig 2.4.1 Basic Absence Detector Operation

Scene selection



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2. Terminology – *application example*

Daylight linking

2. Terminology- Acronyms

0-10 or 1-10 volt an analogue voltage input at the luminaire ballast/driver used to regulate the light output.

CCR (constant current reduction) a dimming method sometimes found in LED luminaire drivers. This method is based on light output being proportional to the amount of current flowing through the LED. Care should be taken to ensure the perceived light output does not shift beyond acceptable limits when using CCR dimming. CCR drivers are controlled by regulation.

DALI (Digital Addressable Lighting Interface) to ensure compatibility between controls and luminaire control gear. DALI systems can either be DALI broadcast where typically just the grouping of luminaires into zones and dimming functionality is used. DALI addressable affords more functionality and each field device and luminaire have an individual address for control and identification purposes.

it is important to ensure all DALI enabled devices meet the relevant performance requirements of the IEC 62386 series standard.

DMX (Digital Multiplexing) is a method of switching/controlling lighting and typically used for creating effects with display, façade or theatre lighting. It is important to ensure that DMX equipment meets the ANSI standard E.111-2008 (DMX 512-A). Variants such as ACN exist for live concerts and theatres, applications which are outside the scope of this guide.

DSI (Digital Serial Interface) Is used primarily for regulating fluorescent lighting and other associated functionality.

PWM (Pulse Width Modulation) is commonly used with in LED luminaire drivers relying on a separate control signal (DALI for example) to limit the output to enable dimming. This is a regulating function within the luminaire driver and relies on the optimum driver current being switched on and off rapidly. The time elapsed between the on/off pulses determines the luminaire output. PWM is often used as it maintains the lamp CCT when regulation is applied.

RGB/RGBW (Red ,Green, Blue/ White) a digital method of controlling colour change of luminaire output by mixing primary colours, sometimes with a separate white channel where a higher quality of white light is required.

dimming/ regulating switch

3 channel DALI controller

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3. The designer

- **The performance specification**
- **The right light in the right place at the right time**
- **Compliance**
- **Managing the expectation**

	Key Requirements	Application Options	Notes
1	Have the building floor layout(s) been designed? Including the usage by individual space? e.g. General arrangement designs. If relevant, are external lighting designs available?	Basic design, based on presence, absence, detector coverage and detector type for spaces that are not continuously occupied, daylight linking for day lit spaces, manual switching, scene setting etc.	Absence/presence detectors enable the relevant de-rating factor to be applied when carrying out compliance checks as per EN 15193 and/or Building Regulations (L2A England e.g.)
2	Has the lighting installation been specified/designed including the production of a luminaire schedule?	Detector/lighting control devices use a regulating/switching protocol compatible with the lighting design	Regulated luminaires enable a de-rating factor to be applied when carrying out compliance checks as per EN 15193 and/or building Regulations (L2A England e.g.)
3	Are there any sustainability models/requirements for lighting energy?	Eg: BREEAM, LEED, SKA etc	
4	Lighting System Compliance	Does the completed design comply with as a minimum, the local Building Regulations (L2A 2013 section 12 for England) and/ or other requirements such as the current EN15193 Energy Performance of Buildings- Energy Requirements for Lighting	Consider that lighting energy could be measured for a period of time after occupancy and actual lighting energy used over time compared to design intent.
5	Does the system design need to comply with any requirements to attract financial rebates/subsidies?	Ensure products selected and system design meet relevant/current requirements	Eg: ECA rebates (UK) ACA (Ireland)
6	What is the extent of the lighting control coverage?	Internal/external or both?	Highway lighting would fall under the relevant authority

4. Human factors

When to fully automate ?

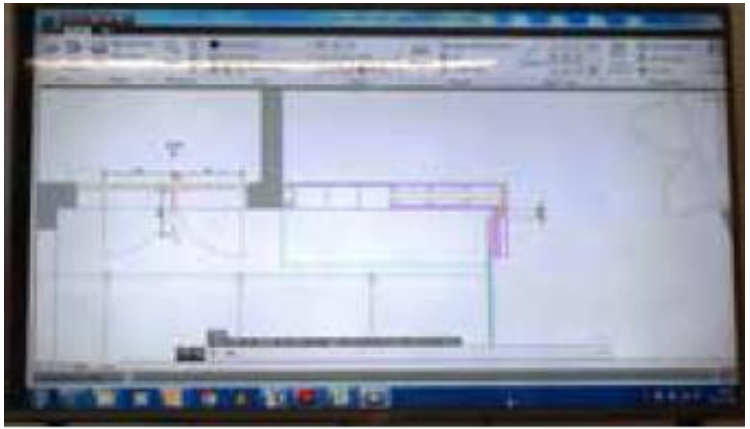
When <u>not</u> to fully automate?

Classification	How space is used	Examples
Owned spaces	Small rooms, individual space	Cellular offices, consulting rooms
Managed spaces	Spaces where lighting scenes are pre-determined by use	Retail spaces, hotel foyers, reception desks, sports hall, place of worship, Front of house entertainment venues
Shared spaces	Spaces of multiple occupation but would require some local or personal space control	Open plan offices, library study areas, hospital wards of multiple occupancy
Occasionally visited spaces	Periodic use for short periods of time	WCs, stores, warehouse aisles
Temporarily owned spaces	Depends on space	Classrooms, lecture theatres, meeting rooms, single patient hospital rooms
Unowned space	General open spaces, usually unsupervised	Circulation, general open spaces

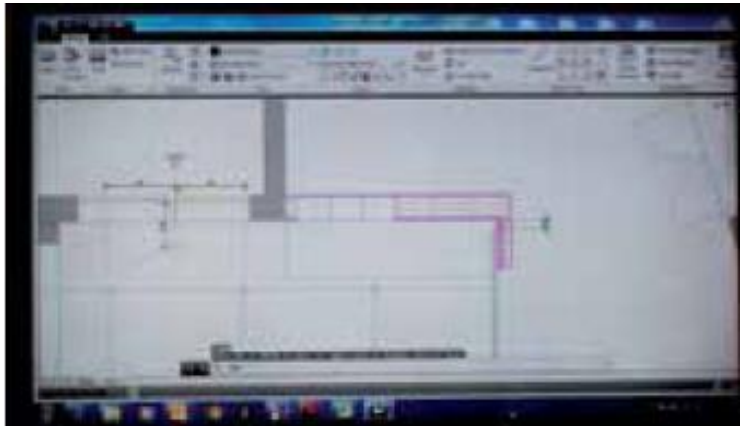
4. Human factors

5. Visual interest & comfort

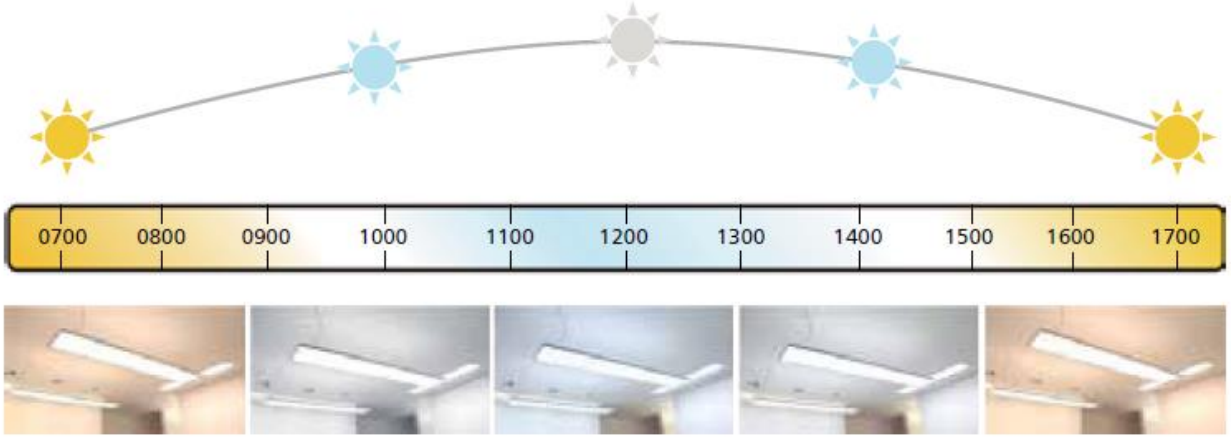
DMX control



Screen glare



5. Visual interest & comfort



Circadian lighting needs compatible lighting control

6. Energy conservation

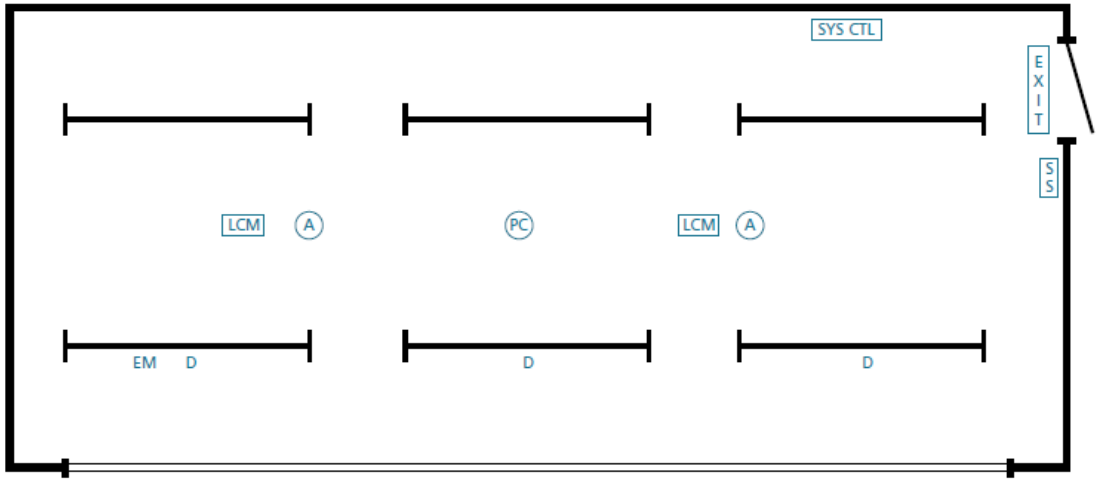
BS EN 15193-2017 *Energy performance of buildings- energy requirements for lighting*

Building regulations L2A & B *Compliance Guide*

The common denominator is LENI (lighting energy numercial indicator)

6. Energy Conservation- LENI

Location of typical parasitic loads



SS	Scene select switch (hard-wired)
LCM	Lighting control module
SYS CTL	System controller
A	Absence detector
PC	Photocell
EXIT	Exit sign battery charger
D	Regulated luminaire (ballast/driver when luminaire apparently off)
EM	Integral emergency light (charger parasitic when luminaire off)

6. Energy conservation- Building Regulations part L chapter 12 de-rating factors.

Table 42 Recommended minimum lighting efficacy with controls in new and existing buildings

General lighting in office, industrial and storage spaces		Initial luminaire lumens/circuit-watt 60
Controls	**Control factor**	**Reduced luminaire lumens/circuit-watt**
a daylit space with photo-switching with or without override	0.90	54
b daylit space with photo-switching and dimming with or without override	0.85	51
c unoccupied space with auto on and off	0.90	54
d unoccupied space with manual on and auto off	0.85	51
e space not daylit, dimmed for constant illuminance	0.90	54
a+c	0.80	48
a+d	0.75	45
b+c	0.75	45
b+d	0.70	42
e+c	0.80	48
e+d	0.75	45
General lighting in other types of space		The average initial efficacy should be not less than 60 lamp lumens per circuit-watt
Display lighting		The average initial efficacy should be not less than 22 lamp lumens per circuit-watt

6. Energy conservation- LENI

- De-rating factors for use of controls
- Accounting for parasitic current (ballast/driver and lighting control equipment)

Step 1 Determine daytime energy use *(Ed)*

$$Ed = \frac{Pl \times Fo \times Fd \times Fc \times Td}{1000}$$

Where-

Pl = Total power in W consumed by the luminaires

Fo = Occupancy de-rating factor (Fo= 1 if not incorporated)

Fd = Daylight de-rating factor (Fd = 1 if not incorporated)

Fc = Constant illuminance factor (Fc = 1 if not incorporated)

Td = Day time hours of lighting operation

Step 2 Determine night time energy use *(En)*

$$En = \frac{Pl \times Fo \times Fc \times Tn}{1000}$$

Where-

Tn = Night time hours of lighting operation

Fo = Occupancy de-rating factor (Fo= 1 if not incorporated)

Fc = Constant illuminance factor (Fc = 1 if not incorporated)

6. Energy conservation- LENI Cont.

Step 3 Determine the parasitic load associated with the lighting installation (Ep)

This calculation will need to be the sum of the parasitic load associated with the Ed hours (step 1) and the En hours (step 2) as the load may vary between the two periods.

Step 4 Calculate the total lighting energy expressed as Kwh per m^2 per year (LENI)

$$LENI = \frac{Ed + En + Ep}{A}$$

Where-
A = the m^2 of the lit space subjected to calculation

The calculated energy expressed as Kwh per m^2 per year should then be less than or equal to the lighting performance criteria specified for the project.

6. Energy conservation- LENI recommended limits

Building Regulation L2 A & B Energy limits

Usually achieved by luminaire selection and controls addition

Table 44 Recommended maximum lighting energy consumption (kWh) per sqm per year in new and existing buildings (lighting energy limit)

Hours			Illuminance (lux)								Display Lighting	
Total	Day	Night	50	100	150	200	300	500	750	1000	Normal	Shop window
1000	821	179	1.11	1.92	2.73	3.54	5.17	8.41	12.47	16.52	10.00	
1500	1277	223	1.66	2.87	4.07	5.28	7.70	12.53	18.57	24.62	15.00	
2000	1726	274	2.21	3.81	5.42	7.03	10.24	16.67	24.70	32.73	20.00	
2500	2164	336	2.76	4.76	6.77	8.78	12.79	20.82	30.86	40.89	25.00	
3000	2585	415	3.31	5.72	8.13	10.54	15.37	25.01	37.06	49.12	30.00	
3700	3133	567	4.09	7.08	10.06	13.04	19.01	30.95	45.87	60.78	37.00	
4400	3621	779	4.89	8.46	12.02	15.59	22.73	37.00	54.84	72.68	44.00	96.80
5400	4184	1216	6.05	10.47	14.90	19.33	28.18	45.89	68.03	90.17	54.00	
6400	4547	1853	7.24	12.57	17.89	23.22	33.87	55.16	81.79	108.41	64.00	
8760	4380	4380	10.26	17.89	25.53	33.16	48.43	78.96	117.12	155.29	87.60	192.72

7. Networked & Integrated Systems

Networked lighting control devices

Automatic testing & monitoring of emergency lighting

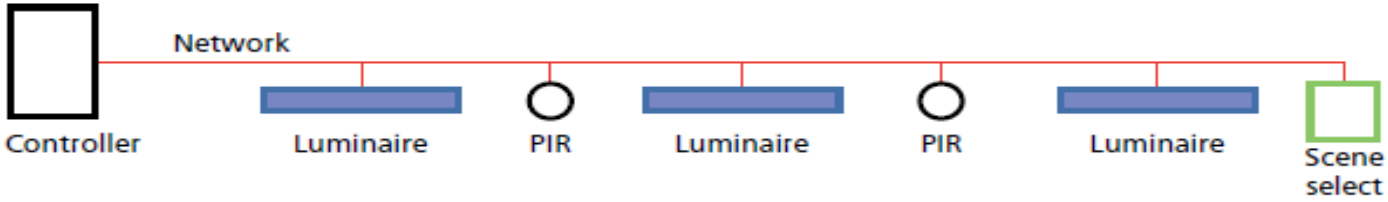
Sharing of lighting control data with BMS systems

BMS outstations or nodes as lighting control devices

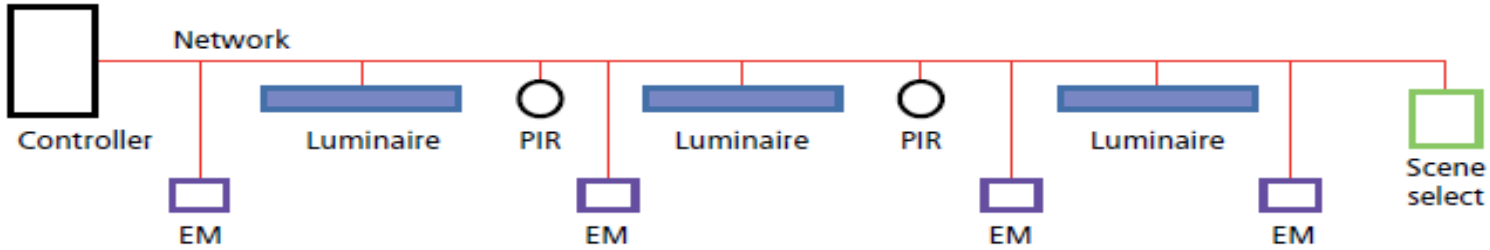
Internet & Wi Fi connectivity

Control module with Ethernet connectivity

7. Integrated Systems/ cont.



Switch or PIR cause and effect time not less than 200–250 ms



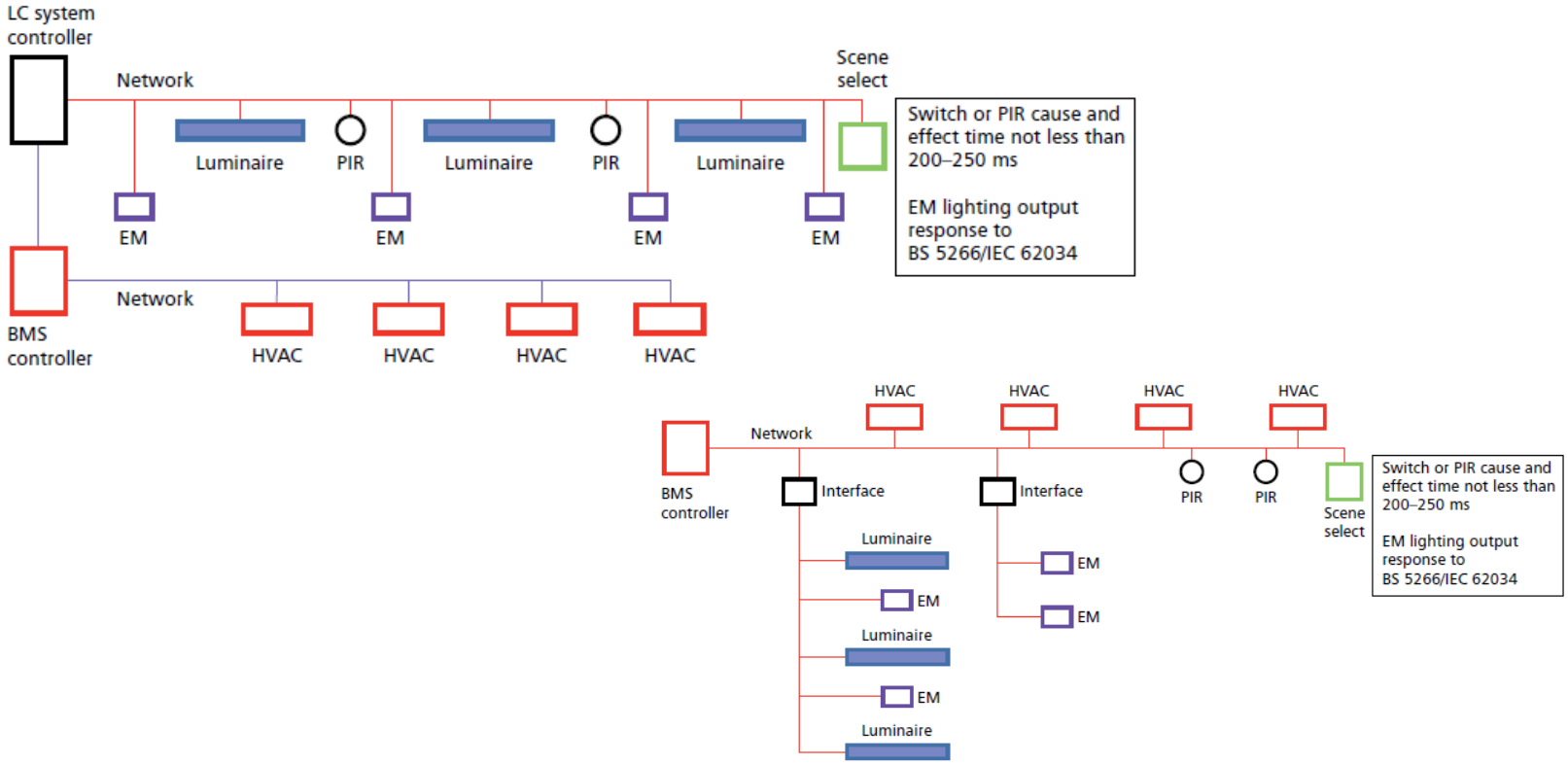
EM lighting output response

Escape and open areas: 5 sec. to 50%, 60 seconds to 100%

High risk areas: 0.5 seconds to 100%

Controls to BS 5266/IEC 62034

7. Integrated Systems/ Cont.



8. Commissioning & Handover

- **Commissioning (not factory defaults) essential for energy performance optimisation**
- **Commissioning requirement needs consideration as part of the design phase to determine timescale & site conditions required (impact on project programme)**
- **Useful exercise to ensure lighting controls can be programmed to ensure installation meets design intent**
- **Suggest use check list for information capture** *(included in LG 14)*
- **Commissioning engineer should be provided with commissioning information pack in advance of commencing work**
- **Consider if seasonal re-commissioning will be required**

Other related documents

CIBSE Commissioning Code C Automatic Controls 2001 Section C6.4 ***(under review)***
CIBSE Commissioning Code L 2018
CIBSE TM54- 2013 Section 8- Post Occupancy Evaluation

8. Commissioning &Handover/ Cont.

May be two types of handover-

- **FM orientated** *(List included in LG 14)*
- **End-User orientated** *(List included in LG 14)*

Historically, more sophisticated lighting control systems can quite often seen by the end-user as problematic and of no benefit-

- **not set up/commissioned correctly**

and/or

- **the end-user not aware/sure how the system works & the benefits**

What's New?

- **LiFi**
- **PoE**
- **IoT**

Q & A

LG 14 can be obtained and/or downloaded
(.pdf version at no charge for CIBSE members)
from www.cibse.org

http://www.cibse.org/knowledge/cibse-lg/lighting-guide-14-control-of-electric-lighting-lg1