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LED lighting: keeping the lights under control

Sam Woodward of Havells Sylvania Europe, and one of the technical authors of the IET *Code of Practice for the Application of LED Lighting Systems*, writes about the reasons for and approaches to controlling lighting as part of new and retro-fit lighting schemes.

Developments in the lighting controls market

Whereas the wiring of most building services involves connecting up a tried and tested mains supply, be it single- or three-phase, or connecting 240 V wires for mains switching, the installation of modern lighting controls often involves adding a mysterious extra pair of wires carrying a low-voltage signal and conveying data that are often unfathomable even with the aid of a trusty multimeter.

Perhaps this is one reason why the world of lighting controls is often portrayed as a dark art, populated by mysterious protocols with acronyms for dimming, such as DALI, DSI and DMX[1]. Furthermore, with a wide array of new wireless technologies now gaining market share, lighting controls can be implemented without any wired connections whatsoever!

Many have asked what the purpose of lighting controls is, and how they can best be applied to LED and other lighting systems. In this article I'm going to explore the motivations and methods for controlling lighting, rather than going into the detail 'under the hood'.

Why control lighting?

The primary reasons to control lighting in the first place are clear, pressing, and far from technical. I like to think of them as the three-Cs: conservation, cost-saving and compliance.

Conservation: the environmental imperative to preserve the planet. It's estimated that in the UK the demand for electricity could outstrip supply[2] as soon as 2016. Lighting consumes 18% of the UK's electricity production, at 58,000 TWh per year (a significantly scary amount). Properly considered and commissioned controls would enable this to be cut by 70% to around 5% of UK electricity production[3].

Cost-saving: reduced energy usage leads to reduced energy bills. Typical pay-back on a lighting controls system can be in the region of 1-2 years, depending on occupancy and available daylight. Consequently, adding automatic controls to lighting schemes makes good sense from a financial point of view.

Compliance: there's a tsunami of new legislation concerning the efficient lighting of buildings. For example, the new 'Part L', which came into effect earlier this year in an attempt to help fulfil our Kyoto promises, makes significant allowances for lighting that allow for the use of some of the control strategies outlined below.

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However, there's also a fourth 'C'-initialled reason for deploying lighting controls, and that's ***Comfort***. Lighting controls enable us to ensure that a space is adequately lit when people are in it, to ensure that the space isn't uncomfortably over-lit, and to add dynamic elements of colour, colour-temperature and brightness variation throughout the day to make the space more interesting to users, more productive for work or more livable. There's no need for the requirements of energy saving to be in conflict with the requirements of user comfort; instead, the two strategies go hand-in-hand when a control system is commissioned. Adequate light levels can mean artificial light, daylight, or a measured mixture of the two.

Techniques for controlling lighting

A number of energy-saving strategies can be facilitated by controls:

- ***Putting users in control*** – this has the dual effect of enabling personal buy-in by end users into the light levels in the space and, as studies have proven, increasing productivity by as much as 5%[4] by giving users the ability to customise their environment.

- ***Occupancy detection*** – by passive infrared (PIR) or microwave sensors. PIR sensors detect the movement of a warm body, whereas microwave sensors utilise the 'Doppler effect' to sense any movement at all. Occupancy detectors typically function in one of two ways:

    - *presence detection*, where lights come on automatically when someone enters the space and extinguish automatically after the space has been unoccupied for a set period of time; or
    - *absence detection*, where occupants are required to switch on the lights manually (typically with a wall switch or control panel) but the switching off will be automatic.

  Where a space is unoccupied for long periods of time (such as in store rooms, corridors, WCs, meeting-rooms and back-of-house areas), substantial energy-savings can be made through occupancy detection

- ***Daylight harvesting and maintained illuminance*** – light-level sensors measure the amount of light reflected for surfaces below. The technique of measuring the amount of light in a space has two benefits.

  Firstly, a new lighting installation is usually designed with a 'maintenance factor' in mind. This is an amount by which the space is over-lit on day one, such that it will still meet required standards for lighting levels after the light sources have begun to degrade, or a build-up of dirt has taken place on the luminaires. This over-lighting factor is typically as much as 120% at the time of installation. Automatic controls can dim the lighting from day one, gradually increasing the power delivered to the light-sources over time to compensate for the dimming effects of aging and grime.

  Secondly, an automatic measurement of the light in a space can enable artificial lighting to be dimmed or even extinguished when the space is adequately lit by natural light, such as sunlight through windows or light-pipes. Use of free sunlight in this way removes a portion, typically around 25%, of the energy required to light a space. This can also allow for other combinations such as the integration of automated artificial lighting with shading controls for natural lighting.

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- ***Dimming*** – it's no secret that lighting fixture companies are continually trying to outdo each other in terms of light output from fixtures as part of the specification process in order to win sales - as though partaking in a game of Top Trumps. A fixture that outputs 2,000 lux must be better than one at 1,800 lux at the same price, surely? This thought process can lead to spaces becoming over-lit, and dimming controls can have the effect of correcting that problem, whilst saving energy at the same time.

- ***Timing*** – if the occupancy pattern of a building is known then automatic timing can be deployed. Likewise many systems now offer astronomical time-clock features, such that lighting can be synchronised with sunrise and sunset times. For example, consider a restaurant that might be brightly lit during the day, but which has lighting configured to slowly fade to a more intimate, dimmed lighting scene as the sun sets, to better capture the more relaxed and romantic interests of evening diners.

Moving ahead with lighting controls

There are many other strategies for automating lighting in a building to achieve a perfect blend of comfort, conservation, cost-saving and compliance.

With the reasons for controlling lighting being simple and compelling, and the strategies straightforward and effective, there is a very real imperative to consider controls on all new-build and retro-fit lighting projects.

End note

The role of lighting control systems, relevant technologies, wiring, protocols and overall integration in lighting schemes are examined in detail in the IET's new *Code of Practice for the Application of LED Lighting Systems*: http://www.theiet.org/resources/standards/led-cop.cfm.

Sam Woodward's presentation from the *IET Built Environment Sector Summit: Lighting* is also available on the IET Lighting MyCommunity website: http://mycommunity.theiet.org/groups/blogpost/view/478/549/1090.

References:

[1] See also Wiring Matters feature #47, Summer 2013.
[2] Source: Society of Light and Lighting
[3] Source: UK Lighting Sector Strategy, LIA & UK Government, May 2014
[4] Boyce et al. Lighting Quality and Office Work: A Field Simulation Study

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The electrician's experience: LED lighting systems

Dean Coleman, of Crest Electrical Services, gives his view on the LED installer market, based on his domestic installation experience.

How long have you been fitting LEDs?
I've been fitting LEDs for approximately 8 years.

From a consumer perspective, the market seems muddled. How have you navigated your way?
Extensive reading and research over the years and buying products to test at home.

What do you find is the biggest selling point for your clients?
It varies, most clients like the fact that LEDs will last many years, particularly the elderly and the less able. (Although LEDs are newer to the consumer market and, to my knowledge, the projected life expectancy is still a theoretical projection, approximately 25,000 hours.)

Also LEDs generate a fraction of the heat that most traditional lamps do, and for flush downlights, this brings safety benefits.

Many are keen to hear the cost saving e.g. less energy usage, often recovering the cost of the LED lamp within 1 year of purchase.

What is the biggest challenge?
Influencing clients that the initial purchase cost brings far greater benefits.

Also sadly, people and media still refer to LED lamps as 'low energy lamps', which have a bad reputation. They are generally referring to CFLs (compact fluorescents) that were given freely by energy companies and take a long time to warm up.

LEDs are very low energy (average 5 Watts) and illuminate instantly.

Is the line of work growing?
Yes – and will continue, as the development of LEDs give more options to clients, e.g. colour, spread of light, brightness, aesthetics and design, etc.

What is generally involved in fitting LEDs?

- *What needs to be taken into consideration?*

  Type of fitting required, e.g. 240 V or 12 V.

  240 V mains lights can generally accept a new LED lamp without further expense or disruption; however, 12 V fittings ideally need the transformer replaced within the lamp location, e.g. bathroom/kitchen, internal/external.

  Purpose of the LED, e.g. aesthetics, task, ambience etc.

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- *What checks need to be made?*

  As per the IET Wiring Regulations, the normal checks to ensure the fitting is safe for continued use and the upgrade of the lamp/fitting.

- *Practically, how do you go about it?*

  Consulting with the client to assess their requirements and whether LEDs are suitable. If so, discuss the various features and benefits to ensure they meet client requirements. By going through this process I ensure that my clients are extremely satisfied with the outcome.

How does the installation of LED lighting compare to older/existing lighting products?
At this time, for me, because I mainly retro-fit lamps, the installation is similar as fittings are of similar size. If retro-fitting, the cable needs to be adequate to carry the existing load as per the original design.

What do you need to consider when designing an LED lighting installation and how does it differ from installing older/existing lighting products?
Many considerations are similar, however, now there is a huge choice of application that can be discrete but functional and safe, such as lighting stair cases, book cases, wardrobes (this needed careful planning due to fire risks from heat output) and kitchen/cupboard drawers. So there is now a wider scope of installation that needs consideration, such as colour rendering, smart/intelligent controls.

What are your top tips for other installers in the field?
Listen to what the client requires. Take your time explaining the benefits and address their concerns. Demonstrate examples of LEDs in operation during the initial appointment.

Do you expect the market to continue to grow?
Yes, greatly. The cost of LEDs is decreasing and the choice of fittings is rapidly expanding.

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LED lighting: catching our eye

Paul Ruffles, of Lighting Design & Technology, sent through two photographs showcasing the use of LED lighting systems in museums settings.

The American Museum in Britain, lit with eighteen 2 W adjustable LED downlights. These were positioned on the ceiling to light a given area or object well with a specific beam angle. For example, the long information panel at the front was lit by just three spots with elongation beams to give a long wide light spread.

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The History Gallery at the Birmingham Museum & Art Gallery showing LED spots on tracks, adjustable LED downlights in structures and cases using LED projectors.

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