



Lighting Controls for **Energy Management**

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Prepared by:
IES Energy Management Committee

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1.0 INTRODUCTION

Lighting controls play an essential role in all lighting systems, providing the functions of switching (ON/OFF) and/or dimming (raise/lower). These functions are used to enact various control strategies to satisfy visual needs of users and energy management needs of owners.

These functions support visual needs (luminance, contrast, color difference, size, movement, and time - see *IES DG-18-08 Light + Design A Guide to Designing Quality Lighting for People and Buildings*) by allowing users to select illuminance, enabling mood setting and/or task tuning to achieve optimal viewing and working conditions. They support energy management needs by reducing lighting system operating time and/or input power, with control typically being implemented by automatic control devices. Lighting energy management is the process of meeting lighting quality requirements as well as space, task and user needs with low energy consumption. Refer to the *IES Lighting Handbook, 10th Edition - Chapter 17* and **Annex A**.

In recent years, automatic energy-saving lighting controls have steadily gained in importance in lighting design in nonresidential buildings due to energy codes and the sustainable design movement. These devices and systems automatically switch or dim designated loads in response to events such as time of day, daylight fluctuations, occupancy or energy demand reduction events. The current energy reference standard, *ANSI/ASHRAE/IES Standard 90.1-2010 Energy Efficiency Design of New Buildings Except Low-Rise Residential Buildings*, co-sponsored by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the IES, contains comprehensive mandatory control requirements, with advanced control strategies encouraged via lighting power adjustment credits.¹

This LEM document is intended to help designers, users, commissioning agents, and other interested parties understand energy-saving strategies, design considerations, equipment, the variety of communication protocols and the importance of commissioning for lighting control systems installed in both interior and exterior applications in all types of buildings (See also *IES DG-29-11 Design Guide for The Commissioning Process Applied to Lighting and Control Systems*).

2.0 LIGHTING CONTROL STRATEGIES

Lighting controllers are input/output devices that receive manual or automatic input, evaluate that

input, and respond accordingly with switching or dimming outputs. The result is the implementation of various strategies that can enhance flexibility and/or save energy. Multiple strategies may be combined in the same space to amplify energy savings. By designing with lighting “layers” (i.e., ambient, focal and “sparkle” – for additional lighting design information, refer to *IES DG-18-08 Light + Design A Guide to Designing Quality Lighting for People and Buildings*) and then designing discrete lighting control zones, a highly specific degree of flexibility can be provided.

- *Manual controllers* - respond to human commands typically operated by hand. Depending on the control device, the user can switch or dim the lights according to personal or group need or preference. Manual control is therefore typically used to support visual needs. Examples include toggles, rotary knobs, sliders, push buttons, remote control and other types.
- *Automatic controllers* - respond to signals generated by computers, time-clocks, sensors or other devices indicating the status of a critical input such as time of day, illuminance, occupancy or utility demand response signal. The controller evaluates this signal to determine if the lighting should be adjusted and if so by how much. This type of strategy is typically implemented to save energy by limiting the use of electric lighting.
- *Switching* - the supply or removal of power from a given lighting load, changing its status between ON and OFF. Switching controls are relatively simple to design and maintain, while being economical, though abrupt changes in illuminance may be irritating to users. As a result, switching is best suited for manual control in spaces where users expect and accept that the lighting will change, and automatic control in spaces that are unoccupied or where the switching effect is unlikely to be regarded as intrusive.
- *Continuous dimming* - smoothly reduces light output over a range from full output to as low as 1% or less, depending on the system. Control changes can be relatively subtle, although this option typically imposes a higher initial cost. Continuous dimming is best suited for manual control in spaces where users want a high degree of flexibility, and for automatic control in spaces where users would find switching intrusive (e.g., spaces with critical, stationary tasks). It also supports designs where complex layers require careful balancing of luminous contrast ratios.