Control & Dimming of LED luminaires

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Helvar to the Market

**Finland (Karkkila)**
HQ & Competence centre → Ballasts + LED drivers

**UK (Dartford)**
Competence centre → Lighting Controls

**Representation**
- Europe
- Middle East
- Far East
Benefits of a lighting system

- Scene setting (Emotional)
  - Creating atmosphere
  - Health and well-being
  - Comfort (e.g. hospital)
  - Influencing mood (e.g. retail)

- Functional (Rational)
  - Task lighting (right light @ right place)
  - Safety (e.g. railway station, pedestrian road crossing)
  - Productivity (e.g. factory floor)
  - Energy saving (e.g. 1kWh → 600gr CO₂ → €0.08)
  - Prolong lamp life → less thermal stress on LED
  - Reduced overall Cost of Ownership

Architectural Lighting systems

Commercial Lighting systems
1. Luminaire Based Controls
   - Single luminaire / Single room
   - Basic functionality

2. Stand-alone Controls
   - Single room / Multiple-rooms
   - Basic functionality

3. Networked Controls
   - Multiple rooms / floors
   - From basic to advanced functionality (e.g. Building Management)
Recommended Lighting Control selection process:

- **Application need**
  - Where is it used?
  - How is it used?
  - By who is it used?

- **Functional requirements**
  - Switching / dimming
  - Time schedules
  - Sensor
  - Dynamics
  - Colour change

- **Light source need**
  - Phase, 1-10V, DALI, DMX, Switched etc.
  - Power & Control

- **LC technology choice**
  - Luminaire based
  - Stand-alone
  - Networked

Example: Retail shop - Banana Republic
Why dimming?

- Light needs change throughout the day and conditions (weather)
- Lighting control also increases productivity
  - allowing the user to select the level they need to reduce eye strain
- Dimming LEDs saves energy linearly (Nearly).
- Dimming LEDs also makes them run cooler -> longer life time
  - Intelligent drivers use active temperature monitoring (NTC type) to dim the LEDs if temperature is exceeding a defined limit
  - Junction temperature, phosphor
LED fixture building blocks

- Input Voltage (230V)
- Power supply
- Control interface
- Driver unit
- Housing
- Diffuser
- Heatsink
- Optics
- LED Module

Dimming protocol
**Main driver types**

- **Constant Current** drivers
  - Typically 350/700 mA, directly related to the LED current
  - Some drivers support multiple current output
  - Sufficient voltage to be used typically 3.5 V per LED
  - Serial and parallel connection allowed
  - Normally used for downright applications with high power LEDs
  - More energy efficient than Constant voltage LED drivers

- **Constant Voltage** drivers
  - Typically 12 or 24 V
  - Modules need a current regulator
  - Normally used with parallel LED connections
  - Often seen as drivers for LED strips
A method of changing voltage between 1-10VDC that will control the device: dimmer, ballast of driver.

Normally a potentiometer (TK4) or other device like DIGIDIM 472 controller.

Single channel control

Separate mains switching and control circuits
- Standard method of controlling ballast’s and other load interfaces.
- Digital bus that allows bi-directional control and addressing of devices.
- Possible to control each device or groups of devices
- Digital ON/OFF switching
DALI colour

- Extended version of existing DALI protocol with added command set for colour control
  - Tc, Brightness
  - RGBWAF
  - X,Y
  - Primary N

- Adds control users are actually looking for (Tc, Brightness in stead of WW/CW)
DMX

- DMX (Digital MultipleX) originally for theatre and stage lighting applications
- Protocol for consoles to control dimmers, moving lights and colour wheels etc.
- It is popular for controlling LED lighting, including colour-changing
- Each DMX link can control up to 512 different lighting channels over a single pair of wires
- DMX is a one way, serial control signal (RS485)
DMX-RDM

- RDM is a development built on the DMX512 standard
- RDM allows two way communication
- Common uses might be remote setting of DMX start addresses, collecting fault reports from the equipment like lamp hours monitoring, temperature sensor reporting, fault codes, more setting...
Forward Phase Control

- Most common method of dimming control.
- Lamp is energized only during the last portion of each power-line half cycle.
- Uses robust electronics

Suitable for:
- GLS
- Mains Halogen
- LV-Halogen with con. Transformer
- LED power supplies
Reverse phase-cut dimming

- Lamp is energized during the initial portion of the half cycle
- Is more expensive because it uses more complex electronics

**Suitable for:**
- GLS
- Mains Halogen
- LV-Halogen with El. Transformer
- LED power supplies
Sine wave dimming produces a pure sine wave output for a lighting load.

The intensity of the light is controlled by the amplitude of the sine wave.

This method does not cause annoying acoustic noise and electrical interference problems (silent dimmer).

Suitable for:
• Any load
LED fixture building blocks

Input Voltage (230V)

Power supply → Driver unit

Control interface

Housing
Diffuser
Heatsink
Optics
LED Module

Dimming Techniques
Dimming techniques - PWM

- Pulse Width Modulation (PWM) via digital control interface and control device

- The output is switched on and off at high frequency

- More reliable dimming and better linear control of LEDs

- Number of steps during a period determines the LED’s brightness - resolution.

- 12 bit resolution most common = 4096 steps
Continuous Current Reduction (CCR), decreases the forward current

LEDs cannot be dimmed by reducing voltage

Simple dimming method is to use a variable resistor (potentiometer).

Risk of colour shift due to current change.