

# How to Choose the Right SSL Solution in Technology of Light Engines

Technical reasons for limitations in control wire length

Secondary wire length ECG  $\beta$  à Module

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02/15/11 - Israel

SEE THE WORLD IN A NEW LIGHT

**OSRAM**

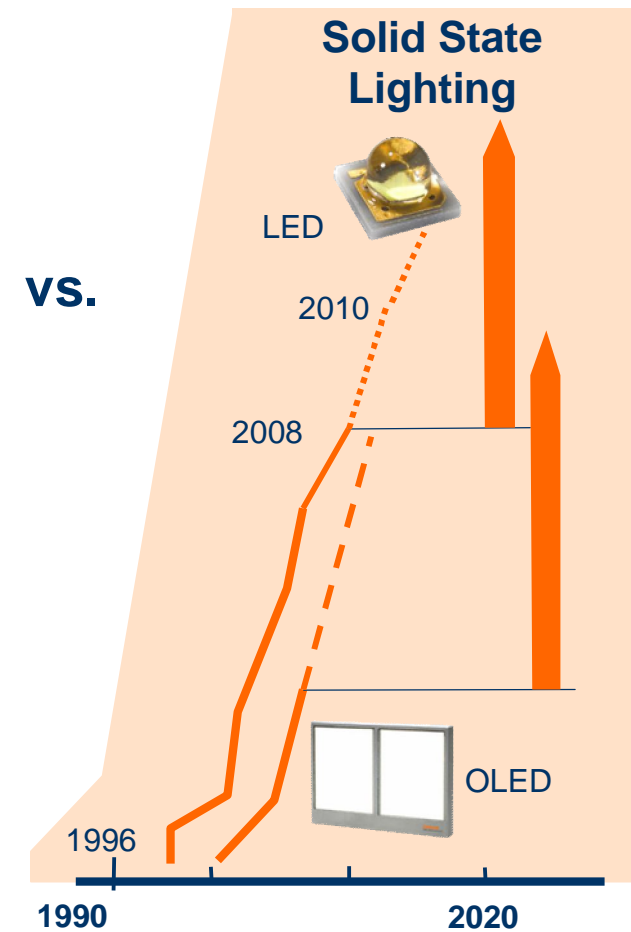
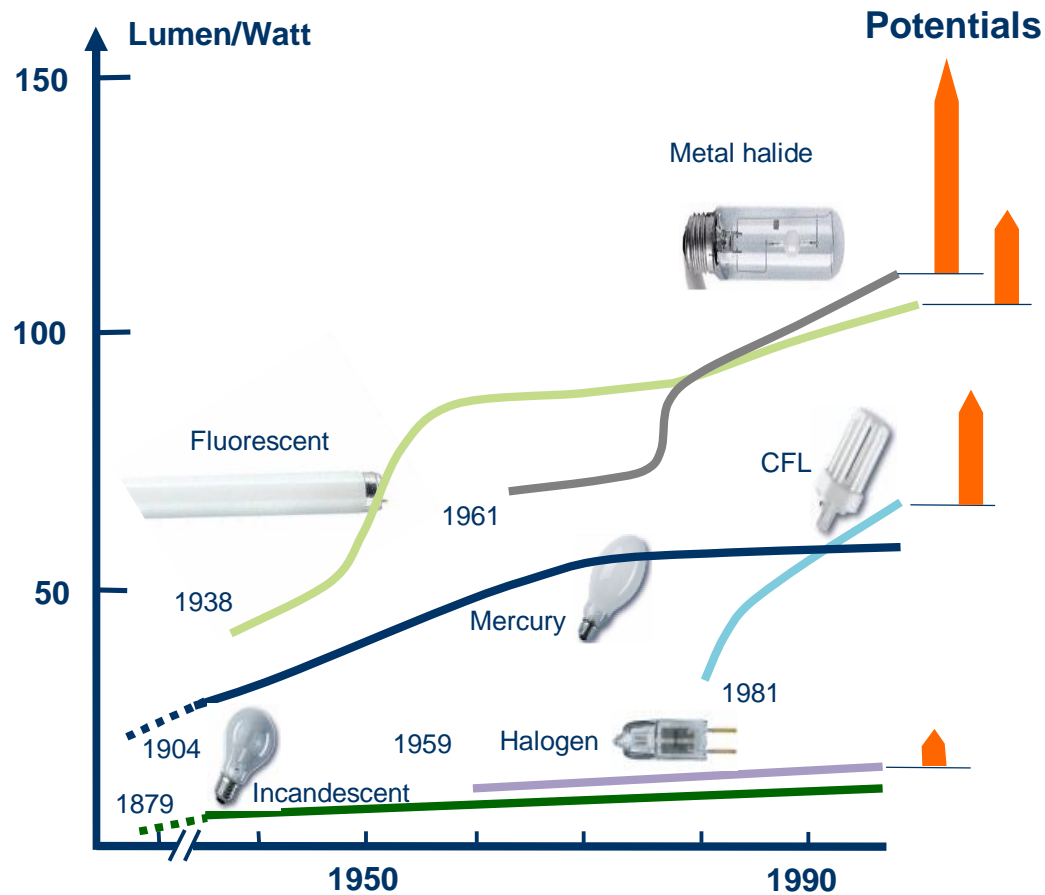


# AGENDA

1. LIGHT ENGINES AND STANDARDIZATION
2. SIMPLE AND SMART LED CONTROLLING (DALI, 1-10V)
3. FAST AND DYNAMIC LED LIGHTING (DMX)
4. CORRECT APPLICATION APPROACH

# LED is already the most efficient technology

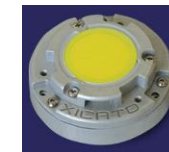
## Technical milestones



# Technology decision: LED array vs. remote phosphor

PrevaLED array offers highest lumen, efficacy and CRI at small color shift.

	LED array 1	LED array 2	Remote phosphor 1	Remote phosphor 2
lm	800 – <b>3000</b>	1100 – 2000	1100 – 2000	400 – 1000
lm / W	HD ~ <b>75</b> ECO ~ 55	55	70	45
CRI	HD > <b>90</b> ECO > 80	> 80	80	80
SDCM	3 - 4	4	5	2
Handicap	Shadowing	Efficacy/Shadowing	Color shift	Efficacy



# Challenges of LED arrays

- **Left side:**

- Original PrevaLED 2100 HD with simple reflector leads to coloured light
- *Also brightness variations can be seen with Eco-Modules*



- **Right side:**

- Additional diffusing panel for Pre-Mixing enables use of simple reflectors



Diffusing panel



# Supplier independent challenge

- Both reflectors faceted
- Both reflectors not optimized for light engine
- Both modules show very similar effect of brightness variations



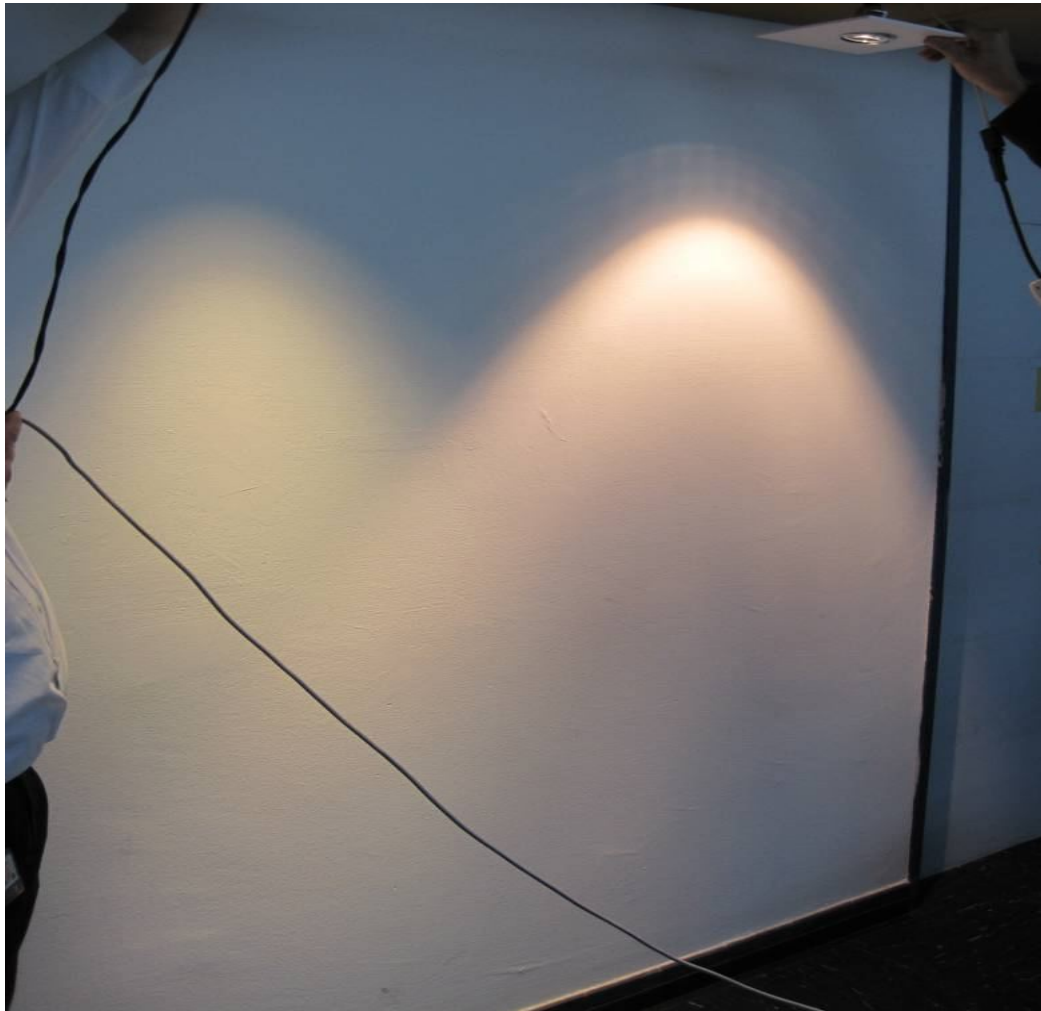
# Comparison between a LED light engine and Halogen

**800lm HD**

**PrevaLED**

**10W**

**With reflector  
and diffuser**



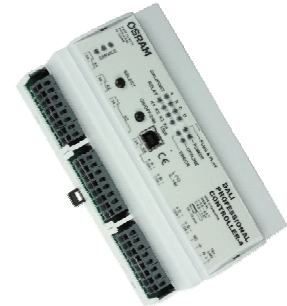
**50W Halogen**



# How to choose the right solution? - Decisions

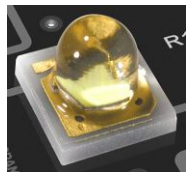
## Fundamental Decisions:

1. Fundamental Decision: Do you have sufficient experience and resources on your own or do you choose a partner who is an expert in LED, components and electronics?
2. Fundamental Decision: Do you want to buy „ready to go“ **light engines** or do you want to develop own LED modules based on single components?



## These decisions should be based on three essential conditions:

1. Your special core competency
2. Time to market
3. Resources





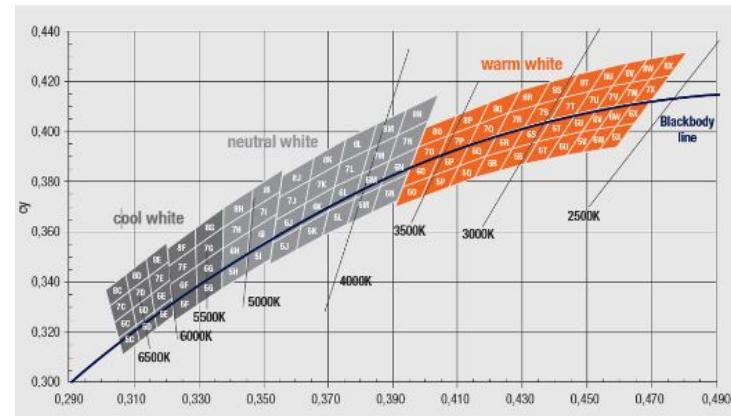
# How to choose the right solution? - Parameters

## Parameters for the choice of the right LED solution:

- Lighting Effect (Needed lumen for the application)
- Color Temperature CCT (Lumen, CCT, Binning)
- Color Rendering Index (White LED, Color Mixing)
- Ambient Environment and Temperature conditions
- Standards (e.g. LM-80; LM-79)

## Essential LED data:

- CCT (K)
- CRI (Ra)
- Lifetime Lxx, Bxx (h) → Environmental conditions must be stated (Temperature)
- Lamp Lumen Maintenance Factor (LLMF) → Must be on system level not only LED degradation
- Lamp Survival Factor (LSF) → Keep an eye on the electronic as well
- Operating Temperature (Tc) → That has to fit in your application



# Example for selection: SIEMENS booth Exporeal



## Products:

- BL02
- LD06
- Downlight M



## Example: SIEMENS booth Exporeal

Nr.	Stück	Bezeichnung (Korrekturfaktor)	$\Phi$ [lm]	P [W]
1	1440	OSRAM 4008321260208 BACKlight Protect_BL02LP-W3F-830 (1.000)	9	0.4
2	20	OSRAM 4008321968692 LEDVANCE DOWNLIGHT M 840 L36 WT (1.000)	700	13.5

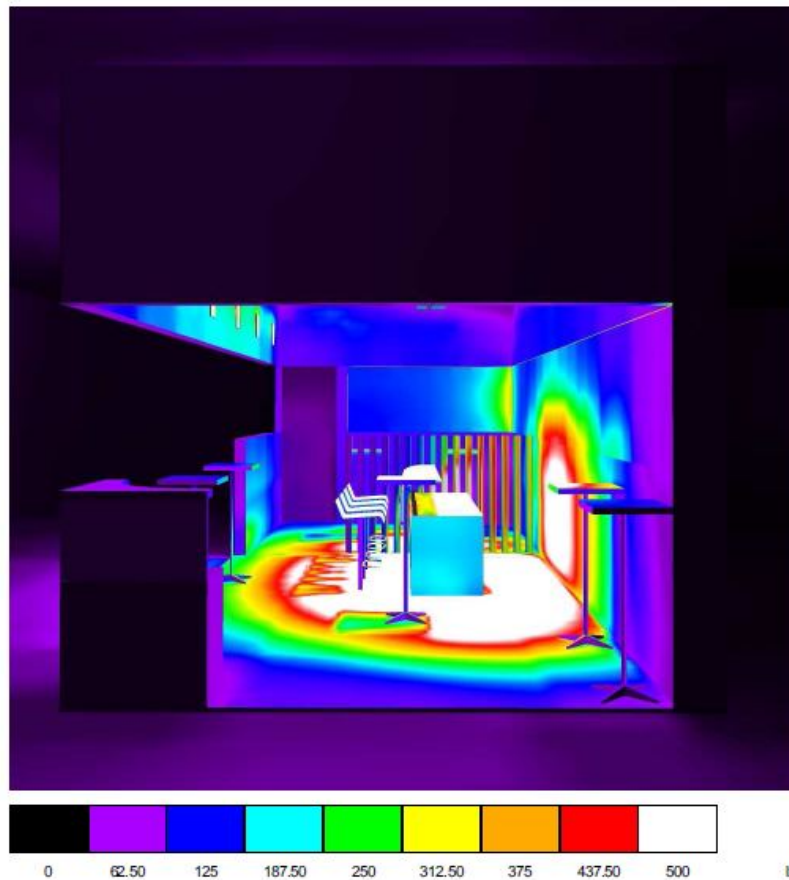
**Essential parameters:**

**Lighting effect:  $E_m=300\text{lx}$**

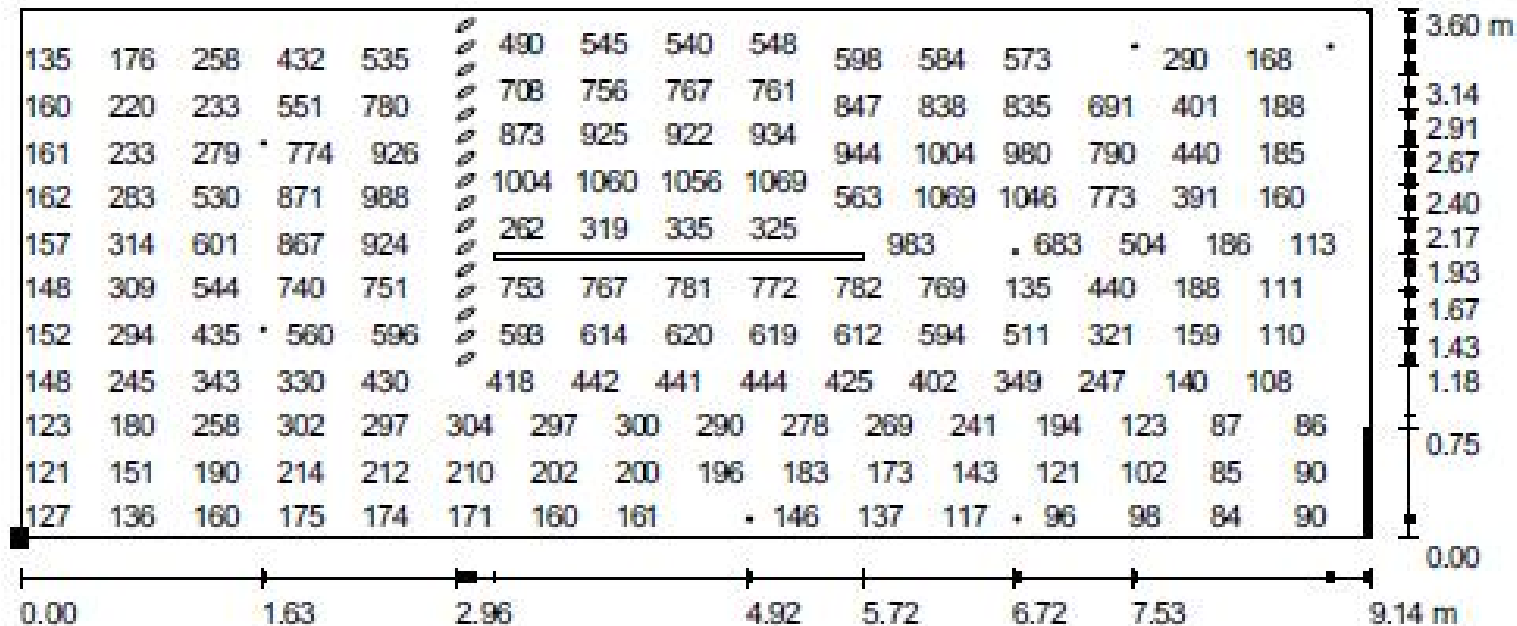
**CCT: 4000K**

**CRI: 80**

## Example: SIEMENS booth Exporeal



## Example: SIEMENS booth Exporeal



$E_m$  [lx]  
415

$E_{min}$  [lx]  
70

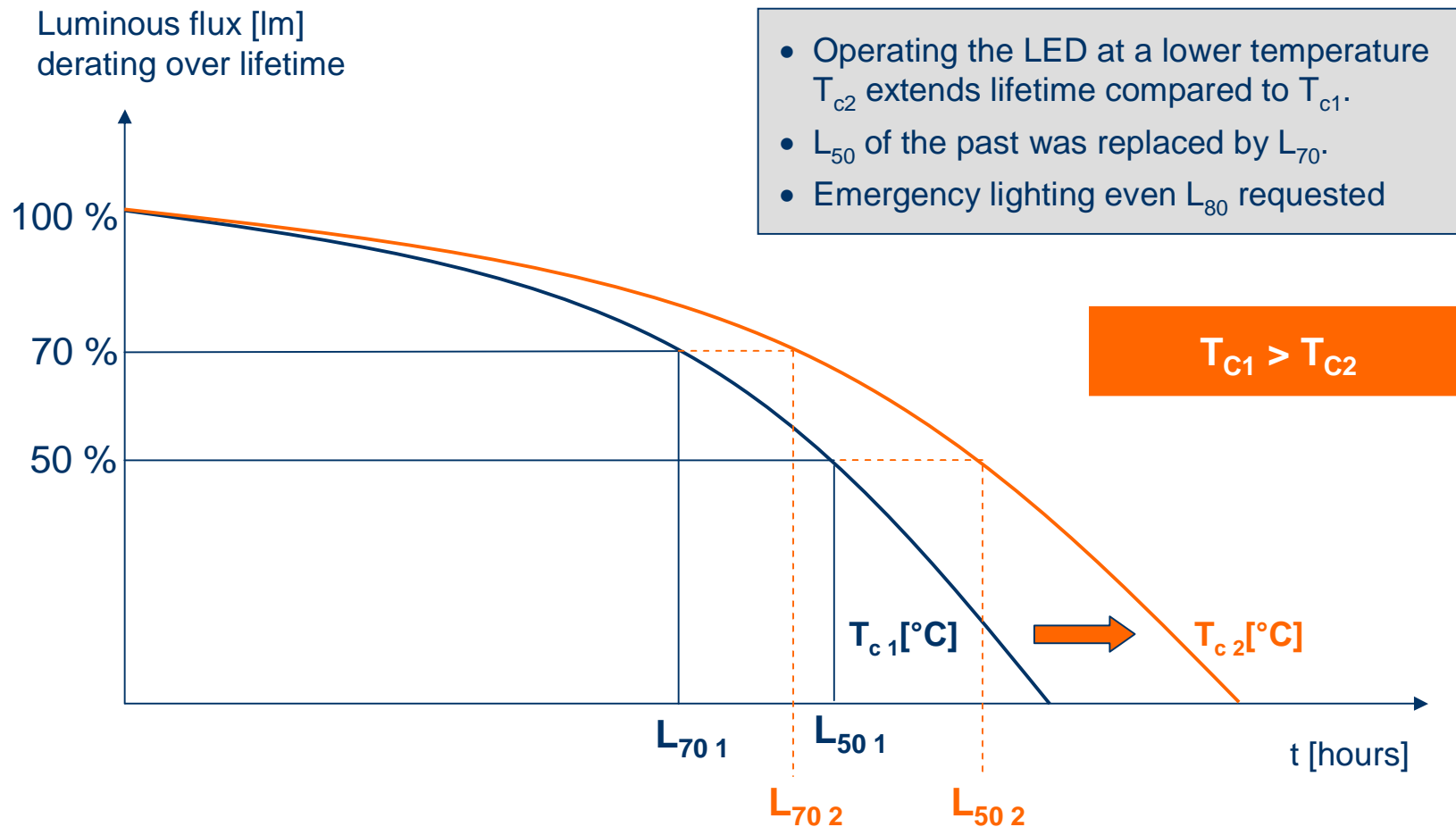
$E_{max}$  [lx]  
1121

$g_1$   
0.168

$g_2$   
0.062

# How to choose the right solution? - Lifetime

Lifetime  $L_{50}$  was replaced by  $L_{70}$  – derating characteristic remains.





# How to choose the right solution? – CRI, CCT

<p><b>Fair</b> 50–60 CRI</p> <p>Standard Warm White Fluorescent Standard Cool White Fluorescent</p> <p><b>60–70 CRI</b> Premium High Pressure Sodium Conventional Metal Halide</p>	
<p><b>Better</b> 70–80 CRI</p> <p>Thin Coat Tri-Phosphor Fluorescent</p>	
<p><b>Best</b> 80–90</p> <p>White High Pressure Sodium Warm Metal Halide Thick Coat Tri-Phosphor Fluorescent</p> <p><b>90–100</b> High CRI Fluorescents Incandescent and Tungsten-Halogen</p>	

Warm White 4000K LED

CRI 60-70 with 100 lm

Normal Warm White LED

CRI 70-80

Light engine with LED Mix



CRI 91

CRI 70

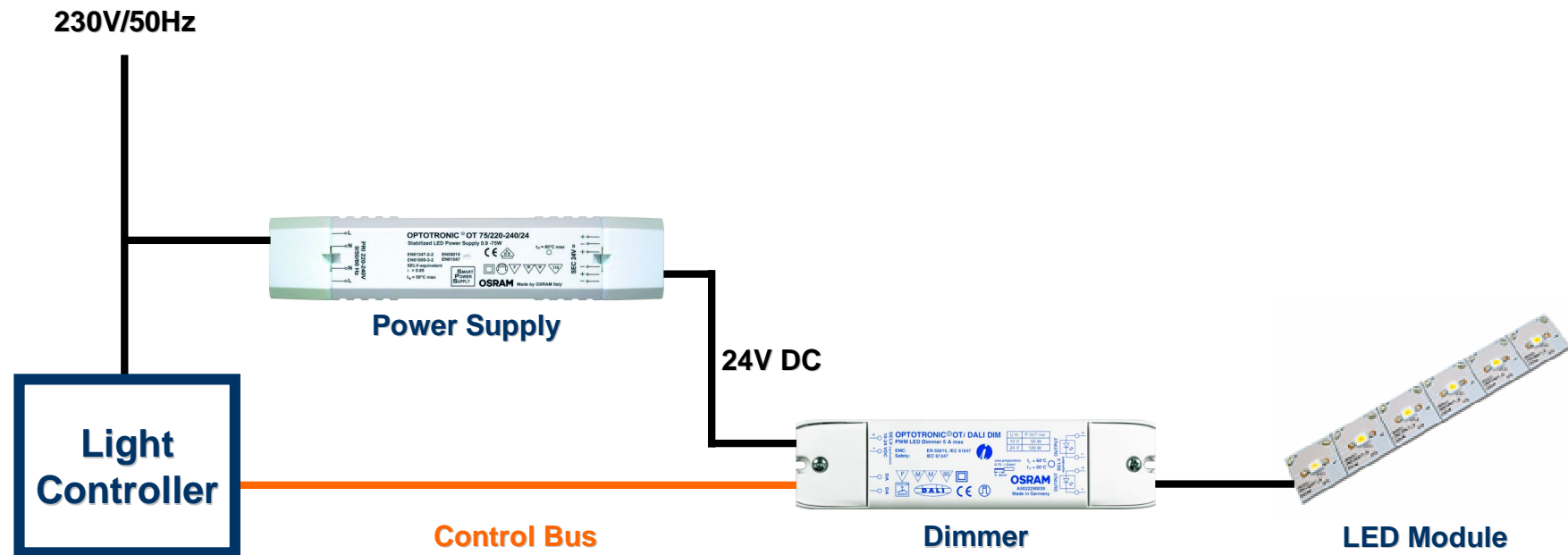




# AGENDA

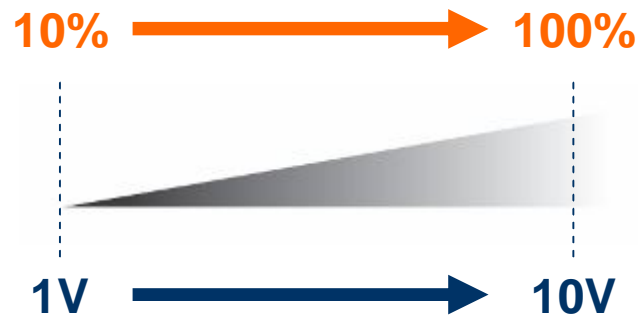
1. LIGHT ENGINES AND STANDARDIZATION
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# LED Control Overview

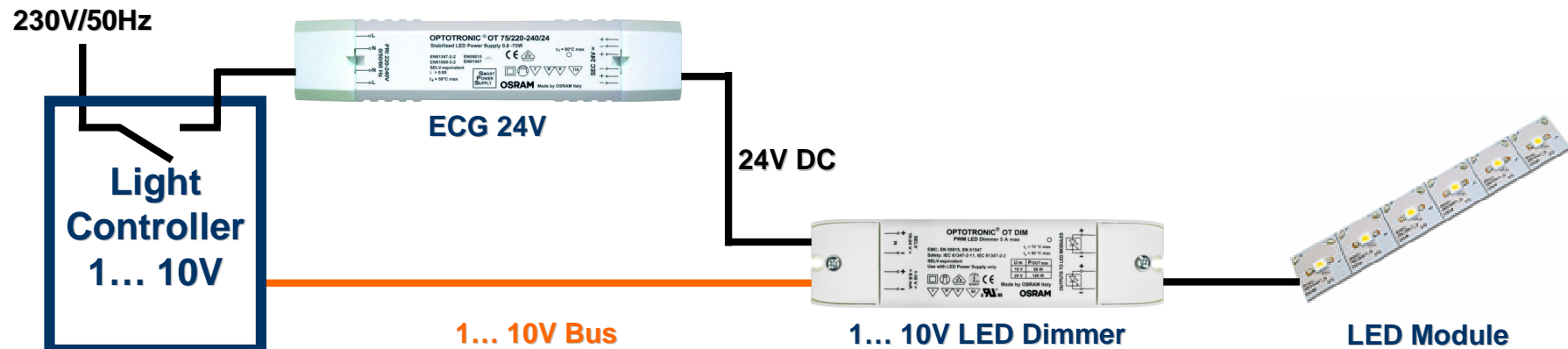


# What is 1... 10V?

- Analog bus using the voltage variation to set up the dimming level:

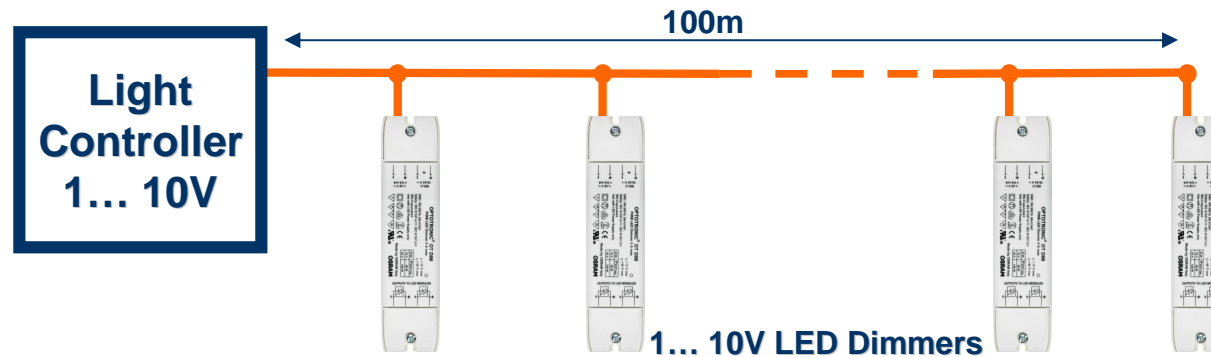


- Relays needed to switch off the light:

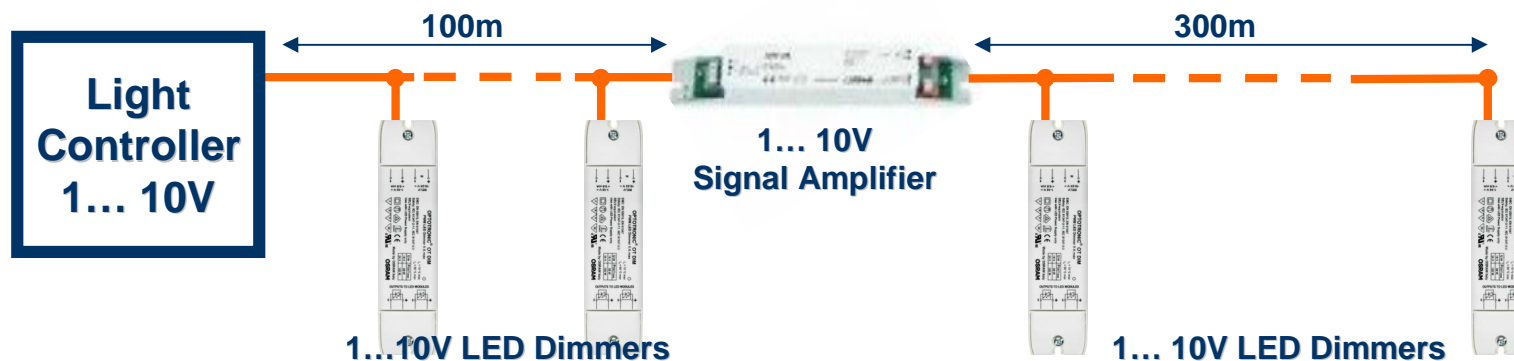


# What is 1... 10V?

- Two wires connection with a maximum cable length of 100m:

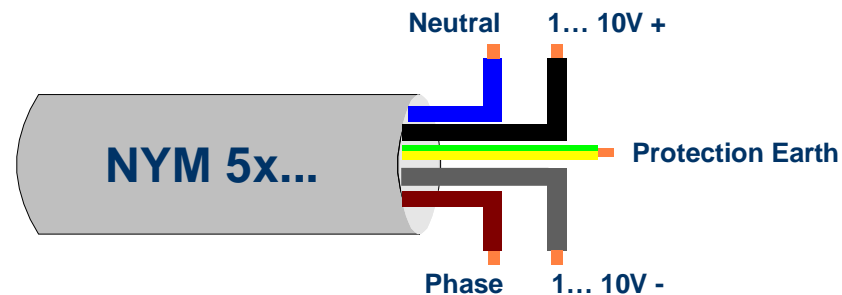


- Cable length extension by the usage of signal amplifiers:



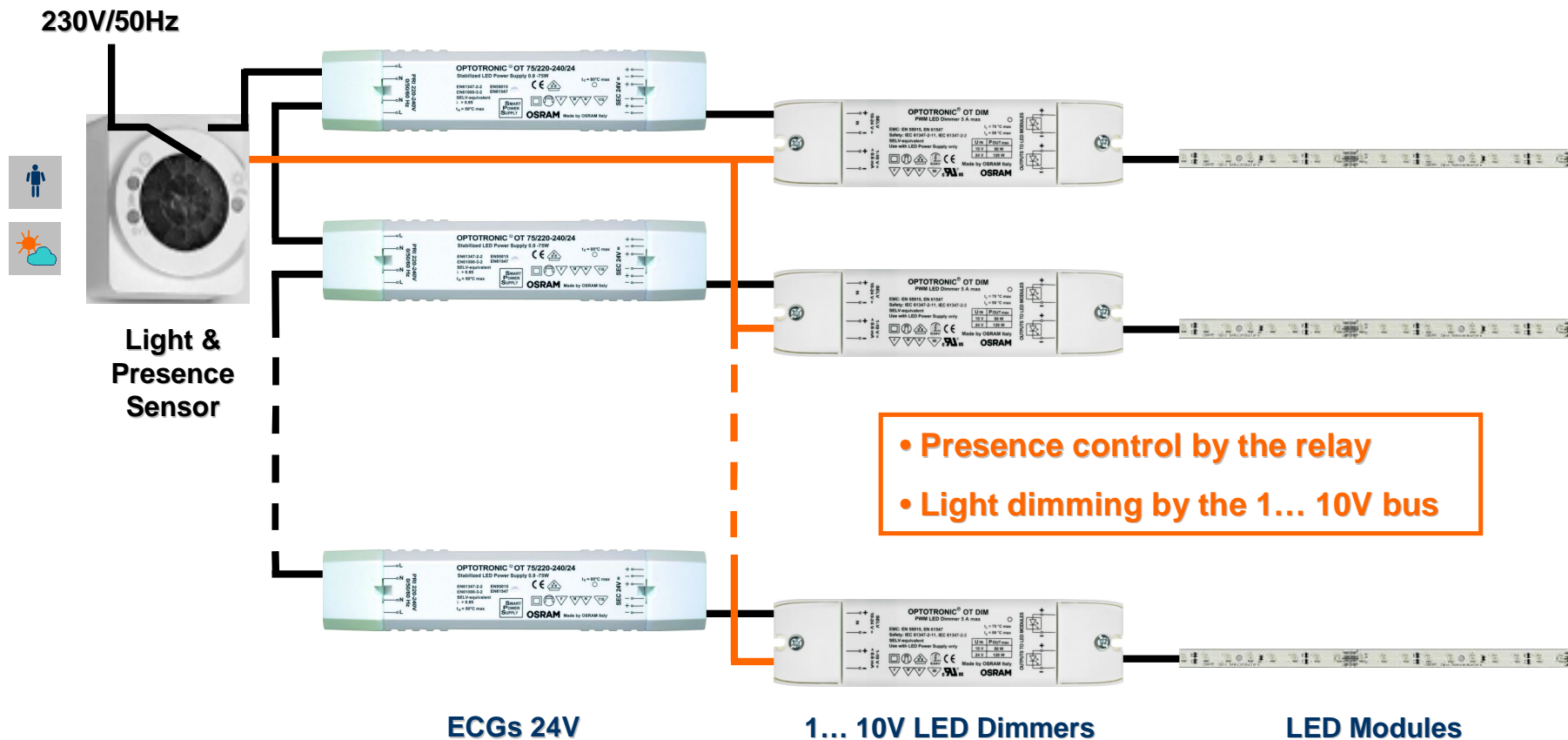
## Additional Rules for 1... 10V Connections

- Mains and 1... 10V line can be integrated together; this means that a 5-core NYM cable can be used for 1...10V connections:



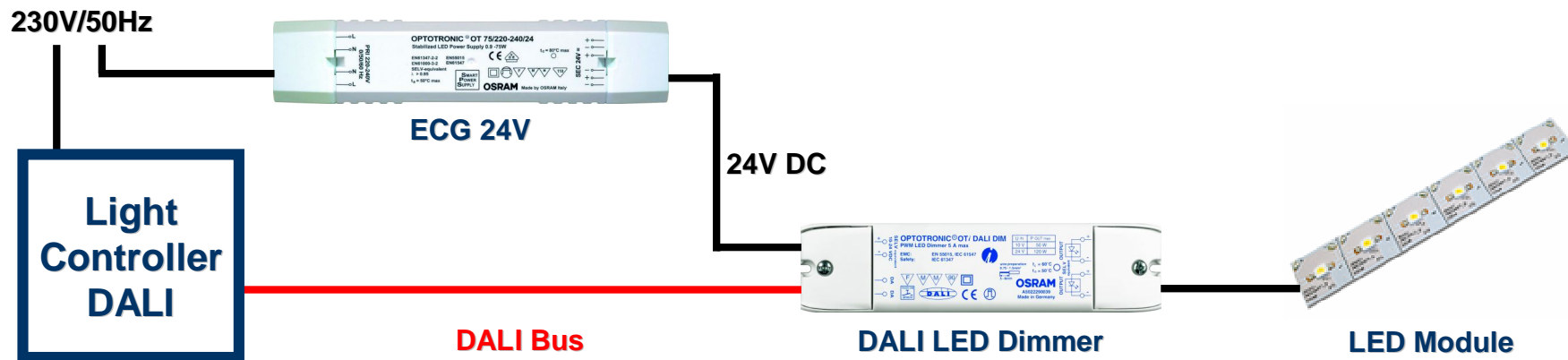
- The 1... 10V connection is polarized à Polarity mistakes can happen + and – have to be respected
- The number of ECGs allowed on a 1... 10V line depends on the max. current managed on the 1... 10V line by the controller, taking into account that each 1... 10V ECG provides 0,6 mA

# 1... 10V Application Example – Sensor Control



# What is DALI?

- DALI = Digital Addressable Lighting Interface.
- All the commands sent by a two wires bus:

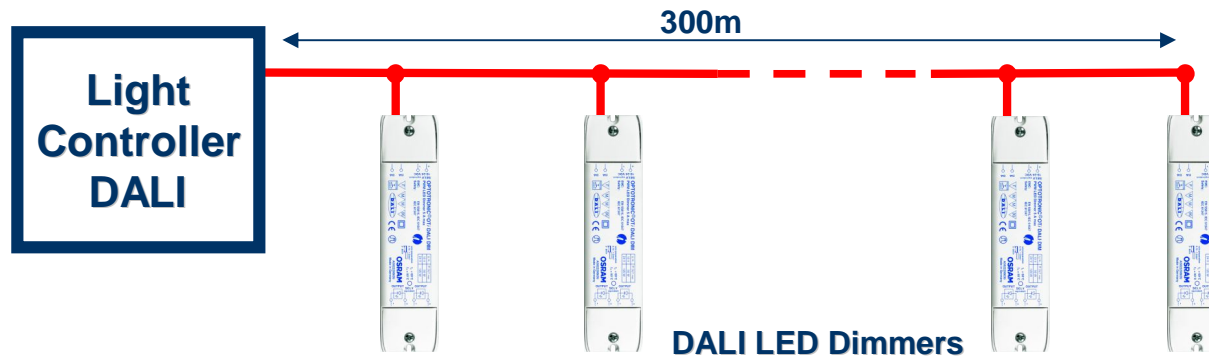


- The DALI bus is bi-directional and it is possible to receive feedbacks from the luminaires about their status (fault signalization).
- Each DALI line provide 64 output addresses (64 DALI ECGs or dimmers controlled independently).

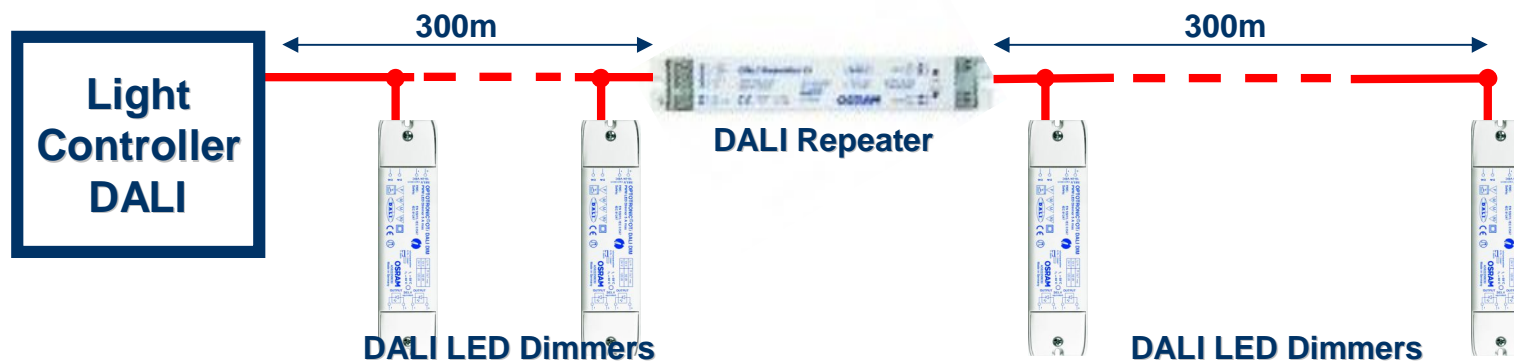


# What is DALI?

- Two twisted pair wires connection with a maximum cable length of 300m:

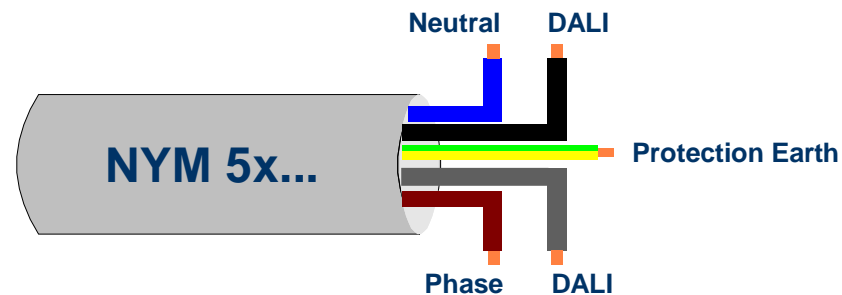


- Cable length extension by the usage of repeaters:



## Additional Rules for DALI Connections

- Mains and DALI line can be integrated in the same cable; this means that a 5-core NYM cable can be used for DALI connections:



- The DALI connection is not polarized ⇒ No polarity mistakes possible
- The number of ECGs allowed on a DALI line depends on the current provided on the DALI line by the controller, and from the current absorbed by the ECGs (i.e. for the OSRAM DALI ECGs is 2 mA)

## Additional Rules for DALI Connections

DALI standard: maximum current allowed on a DALI line à 250mA

The cable length limitation is linked to the voltage drop along the line (maximum 2V at 250mA current); for this reason the cross section of the cables is calculated as:

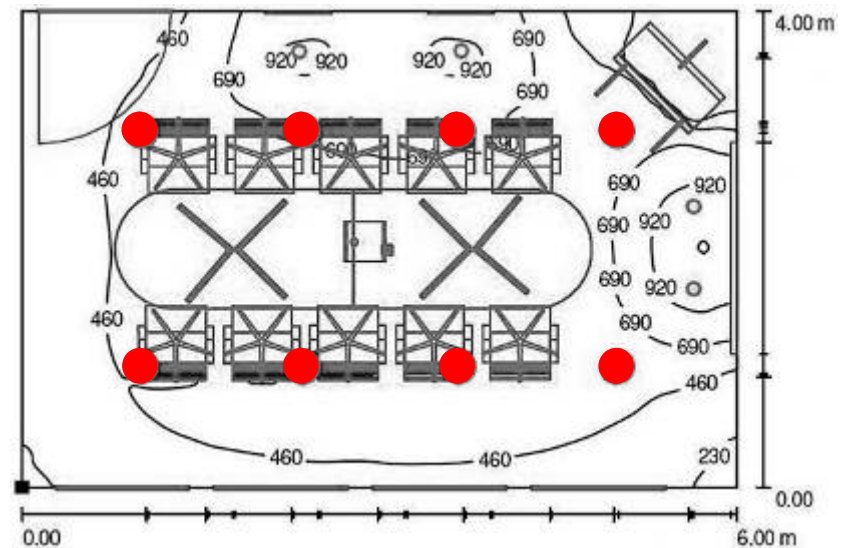
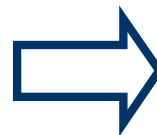
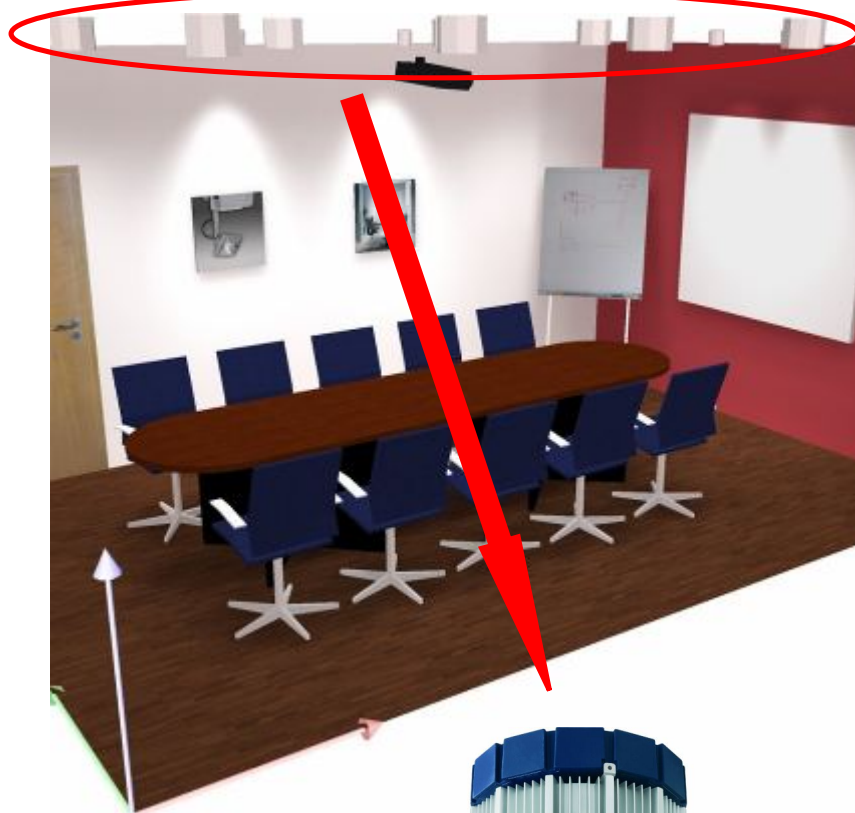
$$A = L \times I \times 0,018$$

A = Line cross section (mm<sup>2</sup>), L = Cable length (m),  
I = Max. current provided on the DALI line (A), 0.018 = Specific resistance of copper

Accordingly with the rule mentioned above:

Line Length	up to 100 m	from 100 to 150 m	from 150 to 300 m
Line Cross Section	0,5 mm <sup>2</sup>	0,75 mm <sup>2</sup>	1,5 mm <sup>2</sup>

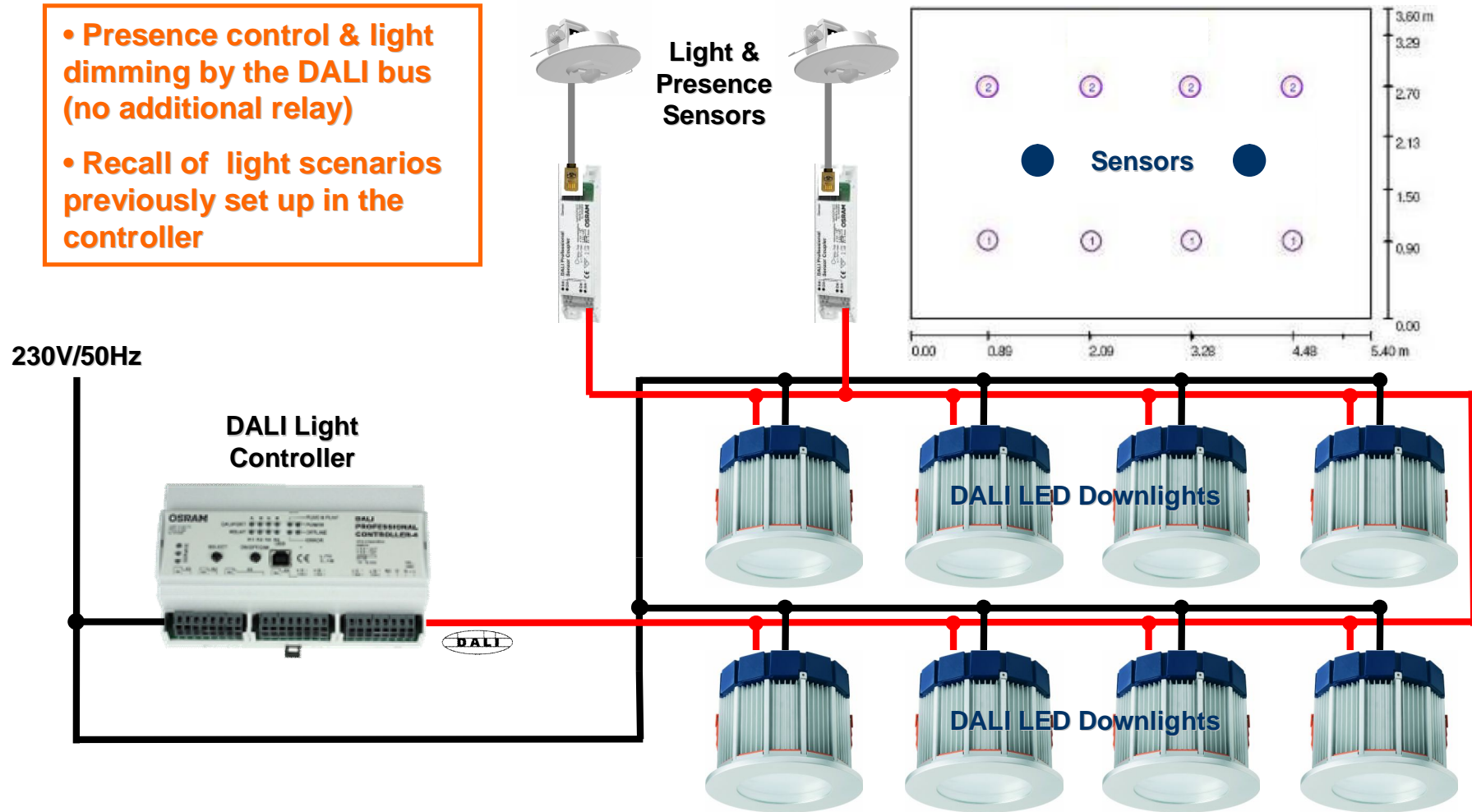
# DALI Application Example – Meeting Room



**8 DALI LED Downlight**

# DALI Application Example – Meeting Room

- Presence control & light dimming by the DALI bus (no additional relay)
- Recall of light scenarios previously set up in the controller

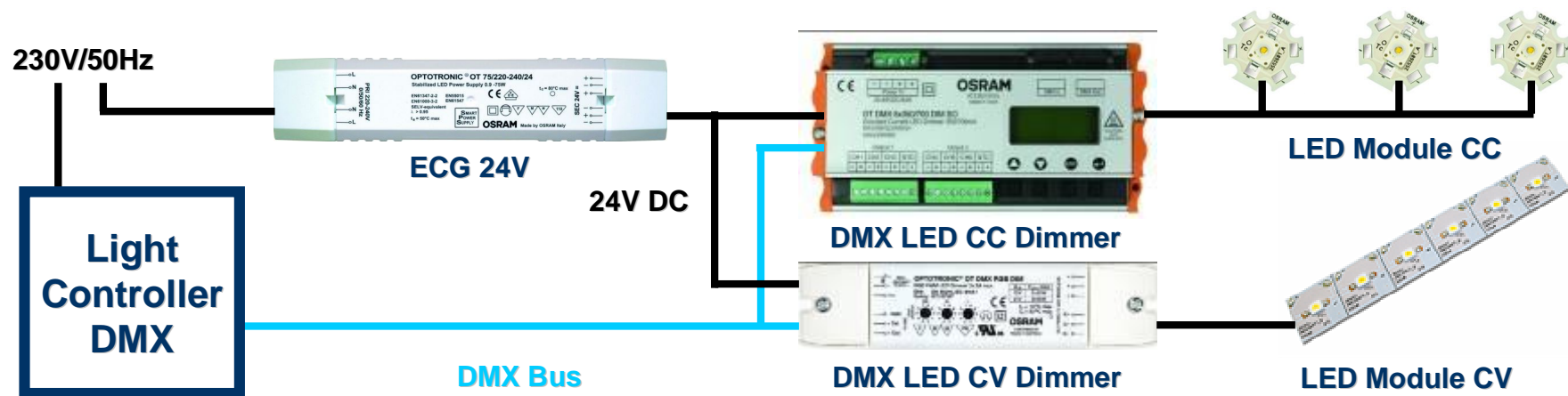


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# What is DMX?

- DMX = Digital Multiple Xing
- All the commands sent by a three wires bus:

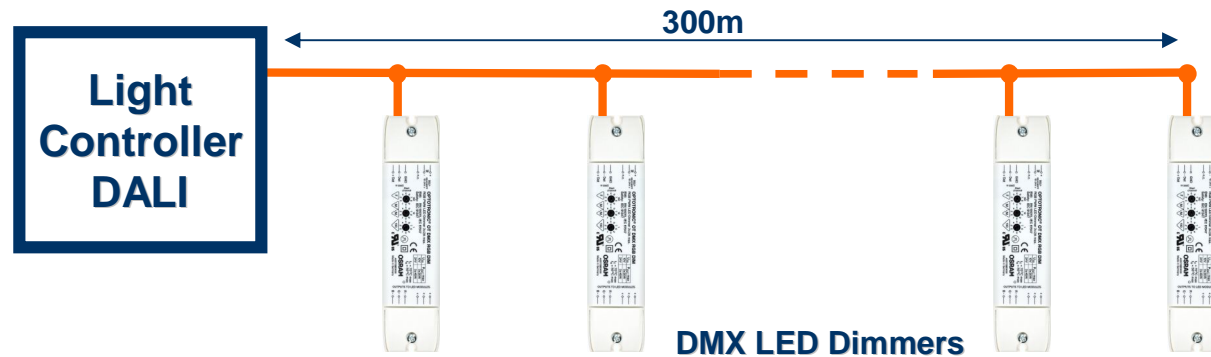


- One DMX universe = 512 output channels  
à One RGB LED = 3 DMX channels (one per color).
- Real time event synchronization possible (Music, Video)  
à High speed protocol

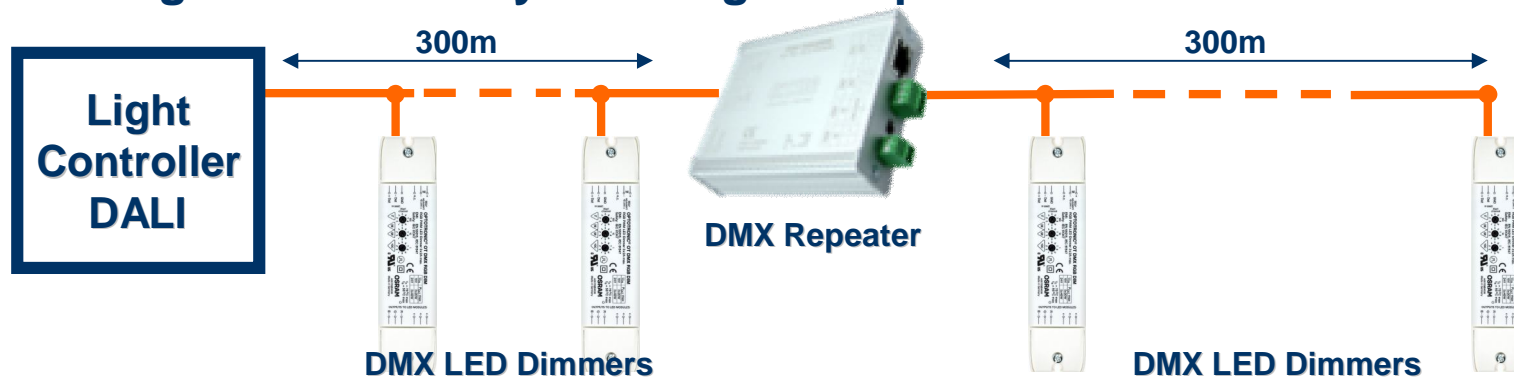


# What is DMX?

- Shielded DMX (110  $\Omega$ ) or Ethernet cable with a maximum length of 300m:



- Cable length extension by the usage of repeaters:



# Additional Rules for DMX Connections

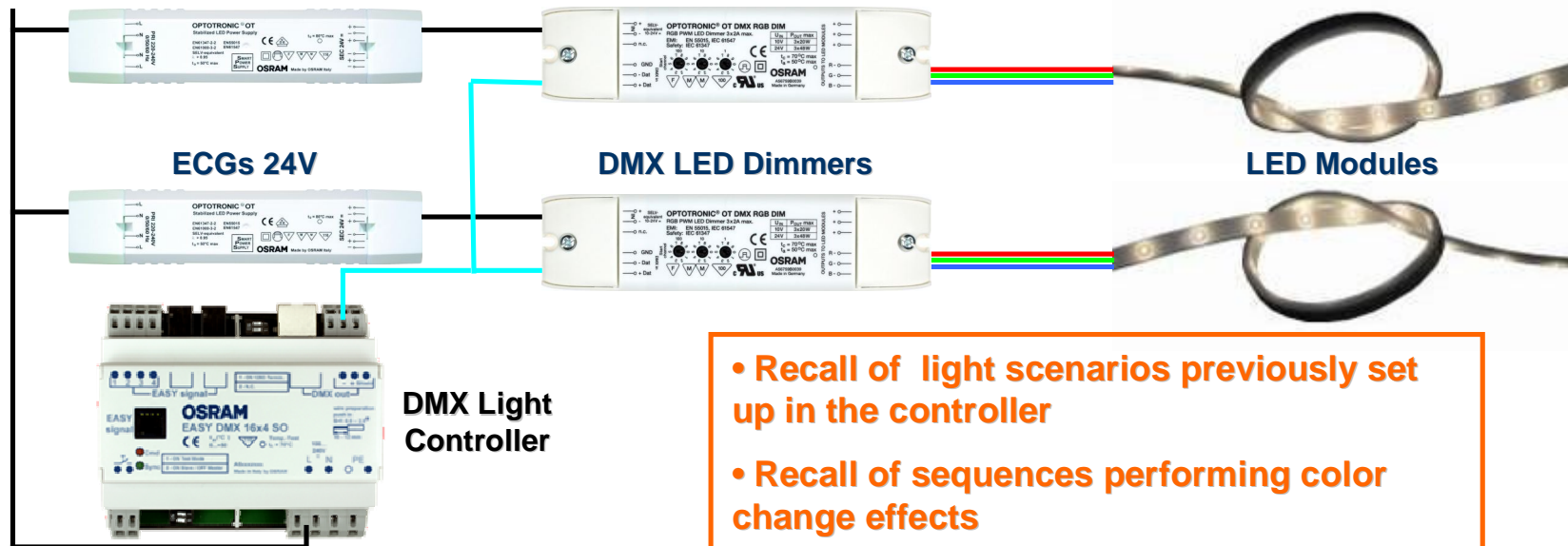
- The DMX protocol is based on the RS-485
  - à electrical characteristics compliant with the RS-485 standard
- According to RS-485 protocol
  - à One single DMX controller: up to 32 devices (standard input resistance 12K) in daisy-chain network topology; this number can be increased using higher impedance devices or using DMX repeaters.
- To maintain a stable voltage reference on the DMX line, it is required to add a 120  $\Omega$  resistor at the end of the control line on both sides (normally the DMX controllers includes already this resistor)



# DMX Application Example – RGB Color Change



230V/50Hz



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# Lighting Control Overview

1... 10V



- General Light Control
- Simple Manual Dimming
- Sensors Based Control



DALI



- General Light Control
- Scenes Based Control
- Sensors Based Control



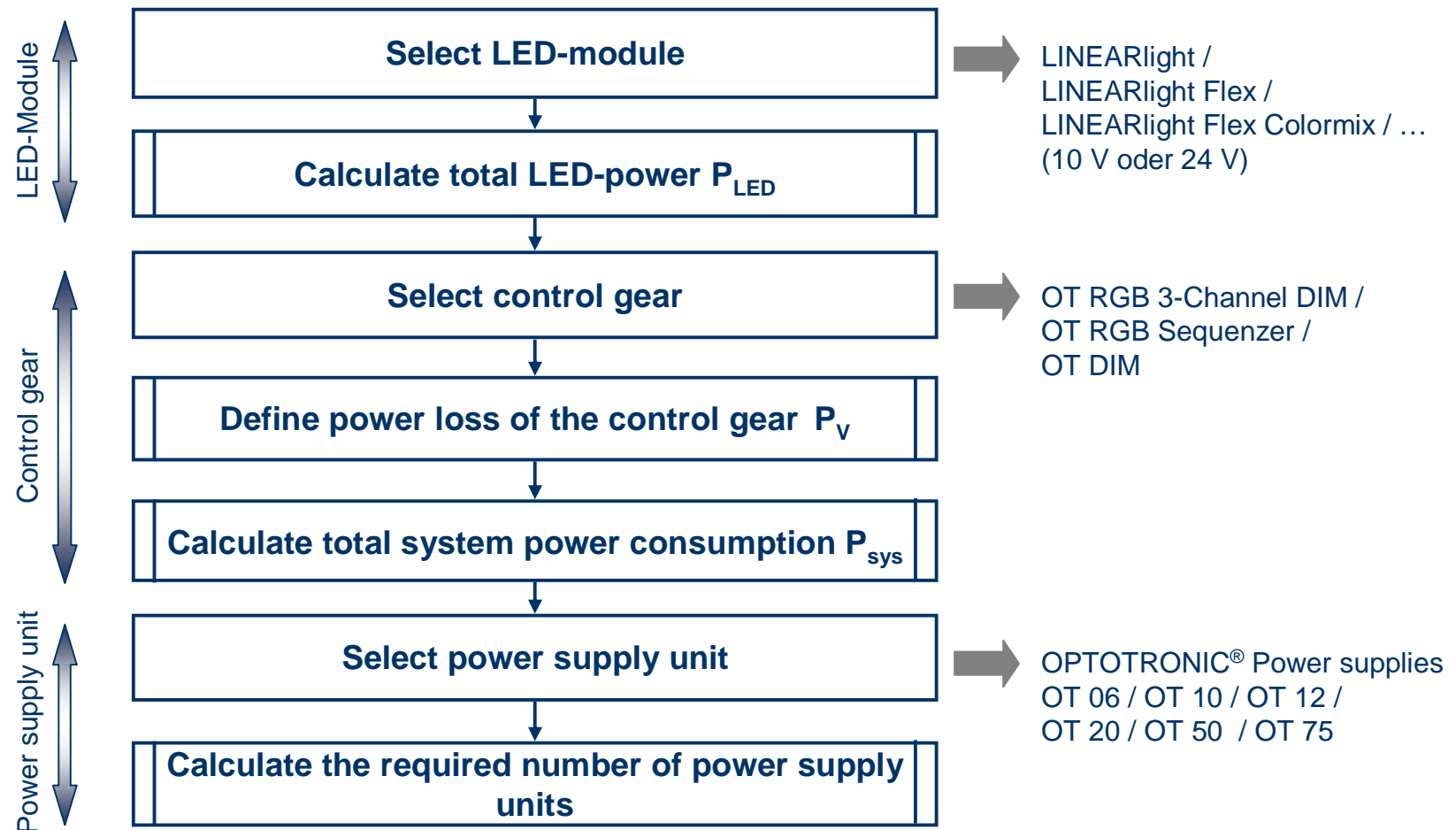
DMX



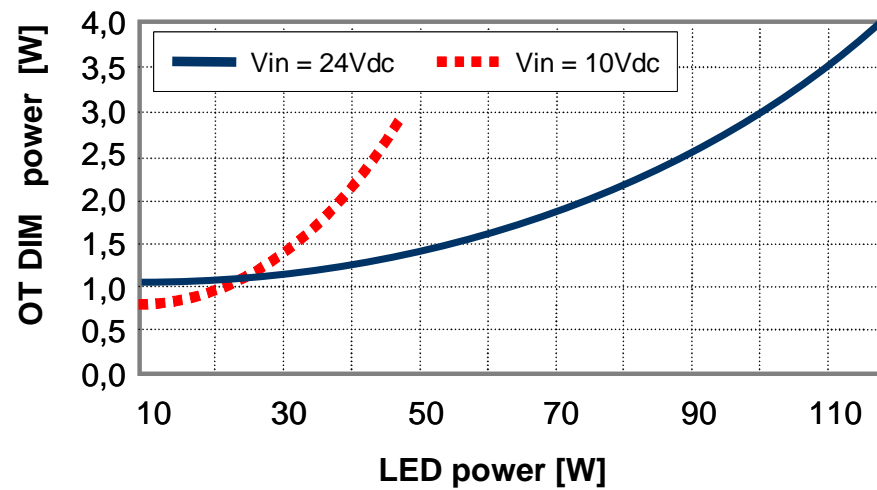
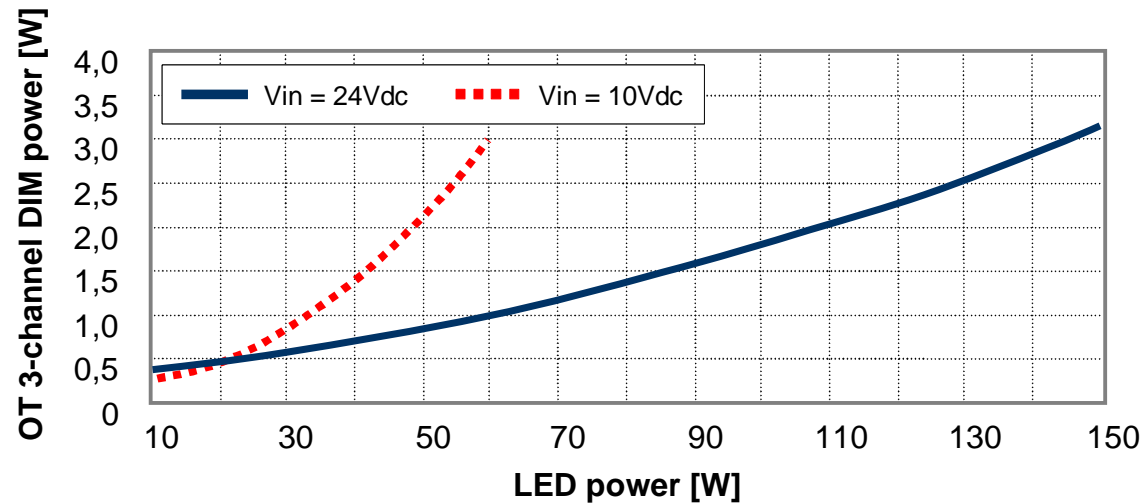
- Dynamic Light Control
- RGB Colour Change
- Tuneable White



# Dimensioning of LED-Systems



# Power losses of controls





# Secondary wire lenght

## Two main reasons for restrictions:

1. EMI – EN 55015

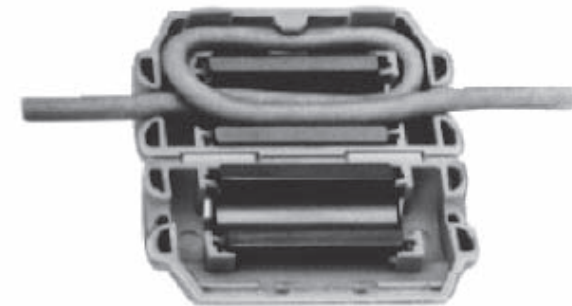
2. Voltage Drop:

$$L_{\max} \leq \frac{1}{2\rho} \times (V_{OT} - V_{DIM} - V_{LED}) \times \frac{V_{LED}}{P_{LED}}$$

Parameter	Explanation
$\rho$	Resistance of cable used on secondary side (in $[\Omega/m]$ ). See table below for typical values of secondary cables.
$V_{OT}$	OPTOTRONIC® output voltage (10.5 V or 24 V)
$V_{LED}$	Minimum input voltage of LED modules (typically 10 V or 23 V)
$V_{DIM}$	Voltage drop of OPTOTRONIC® dimmer (if used). A typical value for e.g. OT DIM is $V_{DIM} \sim 0.3$ V. The voltage drop of dimmers is also specified in the data sheets on page 82.
$P_{LED}$	Total maximum wattage of attached LED modules



ZCAT-C TYPE



Example of an EMI Filter

Thank you for your attention

[www.osram.com](http://www.osram.com)

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