

Why you need dimming curves

Perfect LED dimming

Often, when dimming, the amount of light output doesn't change much in the first half of the dimmer's range and then drops fast when the dimmer is past halfway – leaving half of the dimmer's range virtually unused. This white paper explains why this happens and how to use dimming curves to solve it.

An LED lighting system consists of a (wall) dimmer or controller, a driver and a luminaire. To dim the light, you move the slider or turn the wheel and the dimmer sends a signal to the driver. The driver translates that signal to an electrical current that powers the LED.



Figure 1 – Typical LED dimming system

If the system is not configured properly, dimming performance can be unsatisfactory. In figure 2, the difference in light output between two dimmer settings is quite large at deep dimming levels (left side of the graph). And at the bright end on the right, the difference between two settings is barely noticeable. The cause of this behaviour lies in the combination of dimmer and driver, and in the workings of the human eye.

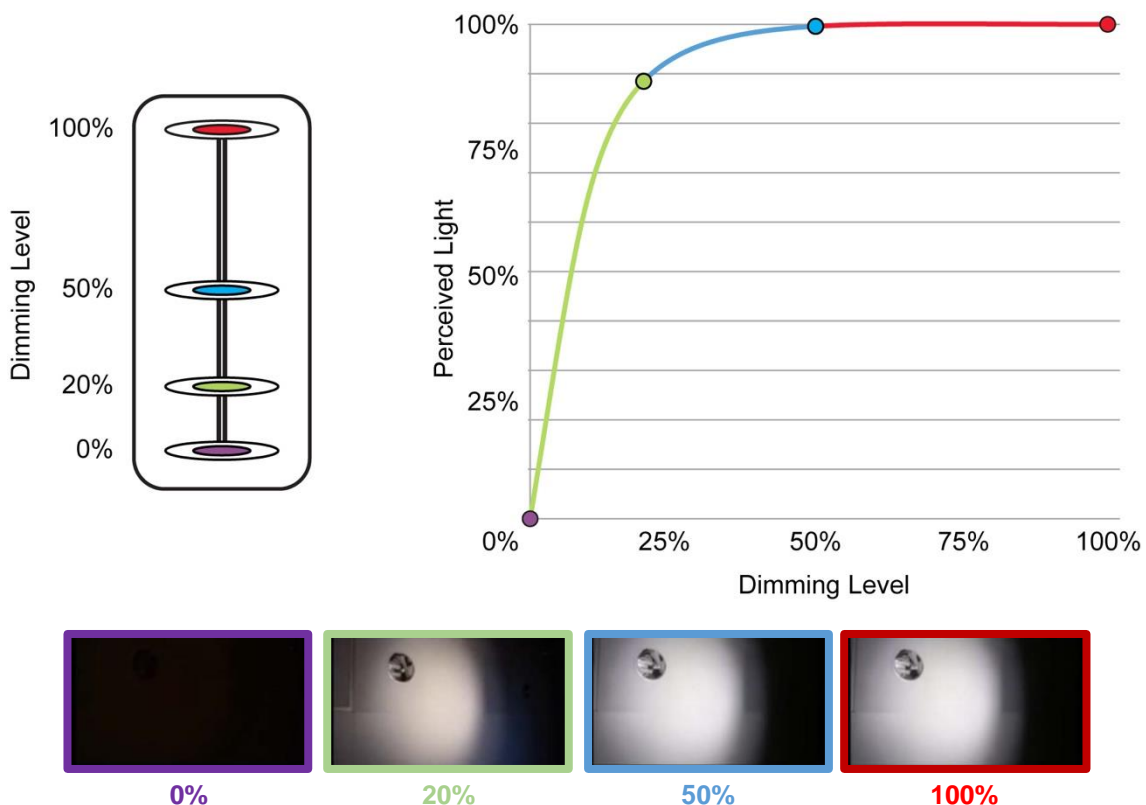


Figure 2 – Bad dimming performance

The result of a much better implementation of a lighting system is shown in figure 3. The light level changes evenly with the dimmer position. For example, when the dimmer's slider is at 25%, you will get 25% perceived brightness.

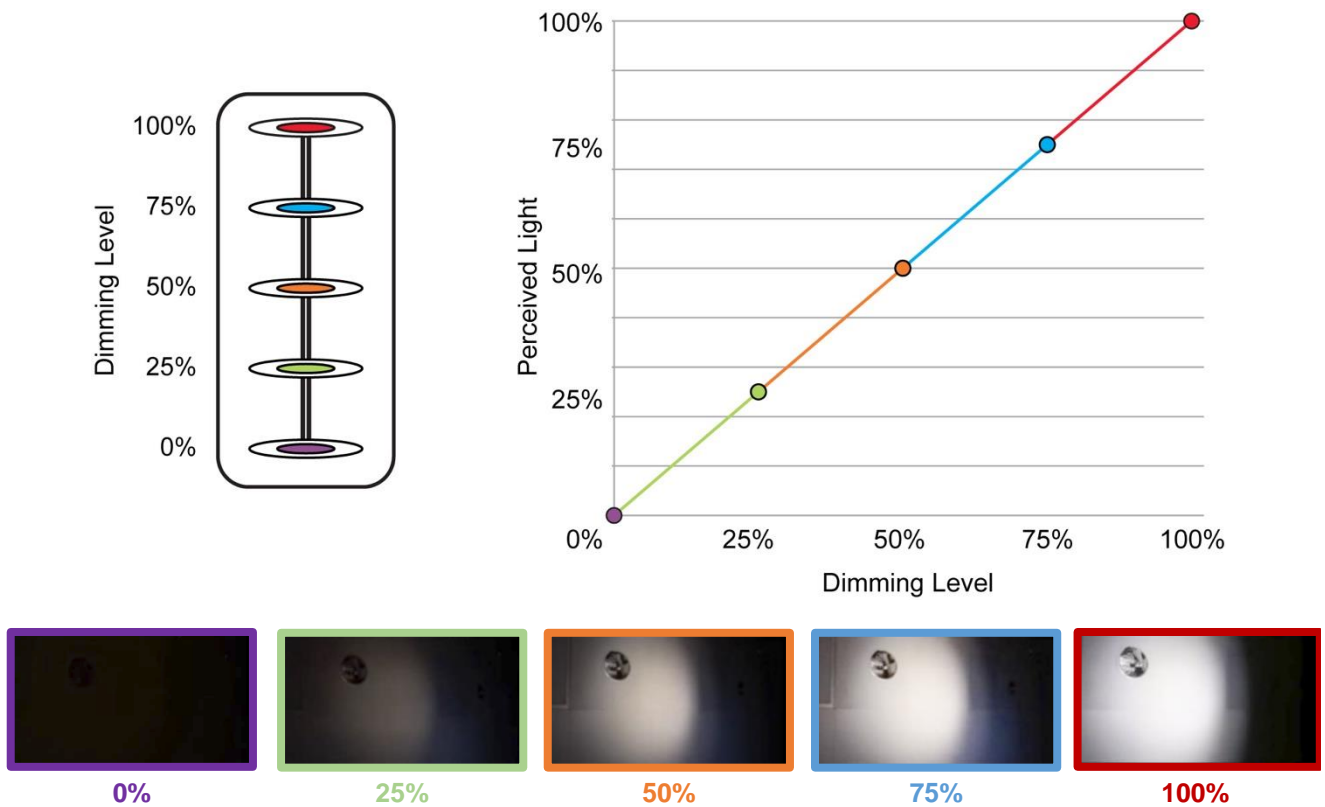


Figure 3 – Perfect dimming performance

Light and the human eye

The human eye does not perceive changes in brightness in a linear fashion. That means that there is a difference between the actual, measured light intensity and the way we perceive it.

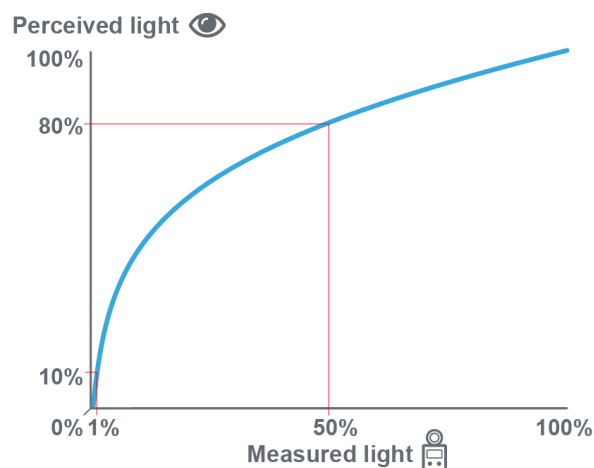


Figure 4 – Light intensity and how we perceive it

In figure 4, the horizontal axis shows light output measured by means of a light meter and the vertical axis shows the light output as we perceive it. At low measured values humans experience the light brighter than it really is. For instance, a measured light intensity of 1%, will be perceived as 10%. And 50% measured light, will have a perceived brightness of about 80%. This means that dimming to 1% will be perceived as dimming to 10%.

Linear and logarithmic dimmers

Both dimmers and drivers can be linear or logarithmic. In a linear dimmer, the signal that the dimmer sends to the driver is linear in relation to the position of the dimmer's slider. For instance, if the slider of the dimmer is at 25% of its range, then the signal to the driver also is at 25% – see figure 5A.

In logarithmic dimmers – the signal to the driver changes slower at deeper dimming levels and faster at the brighter end – see figure 5B.

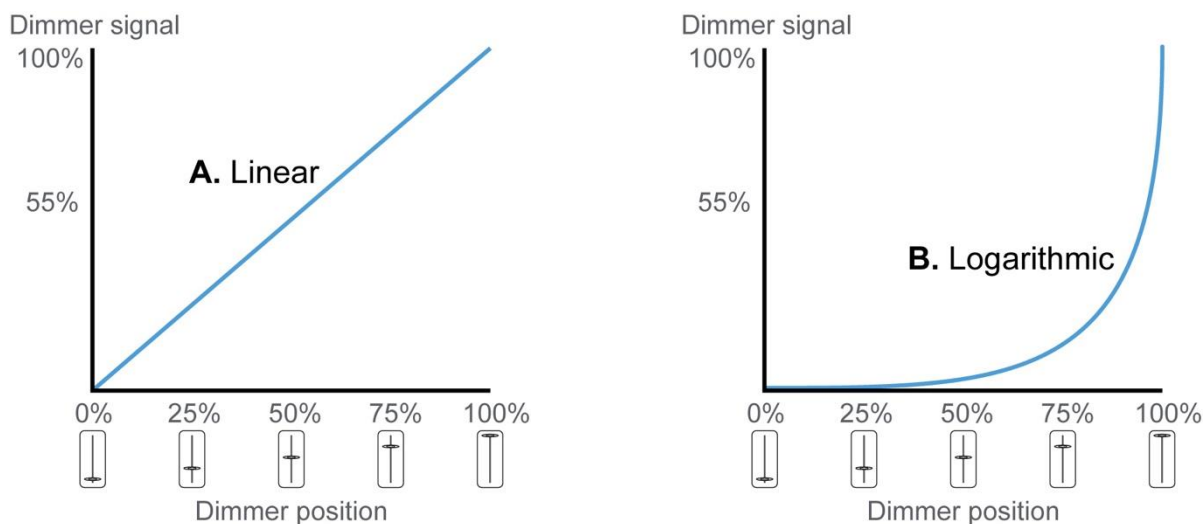


Figure 5 – Dimmer behaviour

In most dimmers the behaviour cannot be changed; they are either linear or logarithmic. Only a few dimmers allow you to choose between a linear or logarithmic behaviour.

Matching the driver to the dimmer

Like dimmers, LED drivers can also be linear or logarithmic. In LED drivers this is called *dimming curves*.

To achieve perceived linear dimming, the brightness of the LED must be matched to the way our eyes behave. With a linear dimmer, a logarithmic dimming curve should be used in the driver. And with a logarithmic dimmer, a driver with a linear dimming curve should be used.

Dimmer	Driver	LED	Eye	Perceived changes in brightness
Linear	Linear	→	→	Bad
Logarithmic	Logarithmic	→	→	Bad
Linear	Logarithmic	→	→	Good
Logarithmic	Linear	→	→	Good

Selecting dimming curves in eldoLED drivers

By default, eldoLED drivers have a logarithmic dimming curve preselected and show good dimming behaviour with linear dimmers and controllers.

Soft linear and square dimming curves

In addition to linear and logarithmic dimming curves, eldoLED drivers offer soft linear and square dimming curves for more control over dimming behaviour.

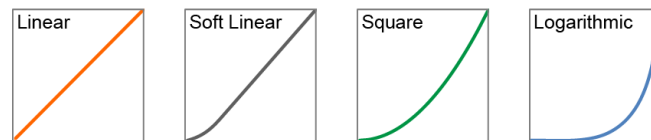


Figure 6 – Dimming curve types

To configure an eldoLED driver, [download](#) and install eldoLED FluxTool software for PC or Mac, and connect a TOOLbox pro to this PC or Mac and to the driver's LEDcode connectors.

Choosing the right dimming curve

DALI

DALI can have one of two standardised ways to behave. Typically, DALI controllers are linear. For these controllers, select a logarithmic dimming curve in the driver. In exceptional cases, DALI controllers are logarithmic and a linear dimming curve should be selected in the driver.

0-10V

For 0-10V, dimming curves are not standardised. Most 0-10V dimmers are linear and therefore, a logarithmic dimming curve should be used in the driver. A small part of the market uses logarithmic dimmers. In that case, use a linear or soft-linear dimming curve. [Download](#) the compatibility sheet from the eldoLED website for a list of dimmer and controller brands with recommended dimming curves.

DMX

DMX is typically used for dynamic lighting applications. For best performance in these applications, a square dimming curve is recommended.

If you are not sure which dimming curve to use, contact your sales representative.

Available dimming curves in eldoLED drivers¹

Family	Linear	Logarithmic	Soft linear	Square
ECOdrive DALI	✓	✓	✗	✗
ECOdrive 0-10V ²	✓	✓	✓	✓
SOLOdrive DALI	✓	✓	✗	✗
SOLOdrive 0-10V ²	✓	✓	✓	✓
DUALdrive	✓	✓	✗	✗
POWERdrive ³	✓	✓	✗	✓
LINEARdrive ³	✓	✓	✗	✓

¹ Global overview only, refer to the LED driver's datasheet for actual specifications per model.

² On older, discontinued products only linear and logarithmic can be selected.

³ Square dimming curve is available on select models only.

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