PHILIPS

Xitanium

LED Xtreme CR drivers

Desing-in Guide

Reliable and flexible Xtreme technology

for demanding connected LED applications

January 25

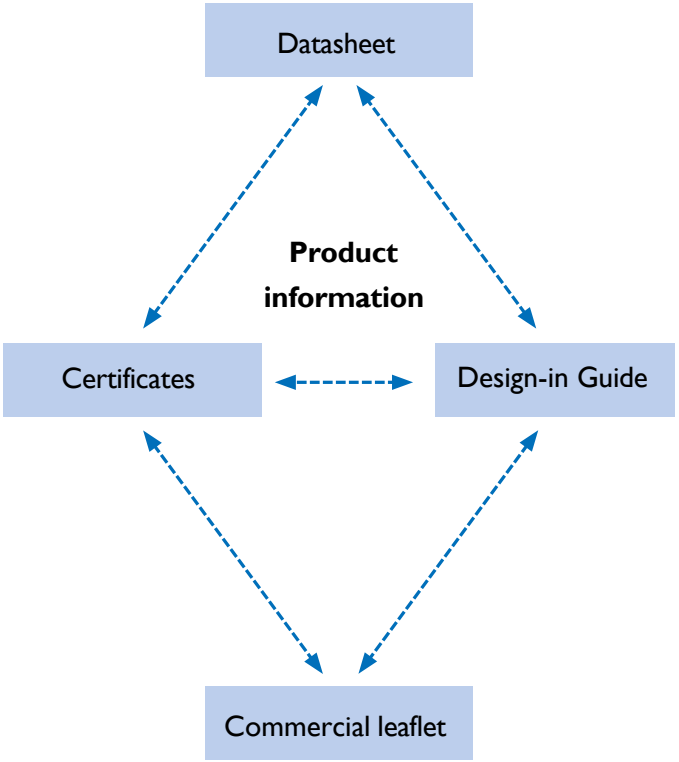
Contents

Introduction to this guide

Xitanium LED Xtreme CR drivers

Thank you for choosing Philips Xitanium LED Xtreme CR drivers. In this guide you will find the information needed to integrate these drivers into a LED luminaire or LED system.

This edition describes the configurable Xitanium LED Xtreme CR drivers. We advise you to consult our websites for the latest up-to-date information.



Applications

Philips Xitanium LED Xtreme CR drivers reduce complexity and cost of wireless connected lighting systems in outdoor and industrial applications. If you use Philips LED Xtreme CR drivers in combination with Philips Sensors and Philips LED modules then specific design-in guides are available from the below mentioned technology websites for further support.

Information and support

Please consult your local Signify office or visit:
www.lighting.philips.com/prof/led-electronics
www.philips.com/multione

Design-in support

Dedicated design-in support from Signify is available on request. For this service, please contact your Signify representative.

Document overview

To provide information in the best possible way, Signify's philosophy on product documentation is the following.

- Commercial leaflet contains product family information & system combinations.
- Datasheet contains the product-specific specifications.
- Design-in guide describes how the product must be used.
- Driver certificates list up-to-date compliance with relevant product standards

All these documents can be found on the download page of the OEM website www.lighting.philips.com/prof/led-electronics. If you require any further information or support, please consult your local Signify representative.

Warnings and instructions

Safety warnings:

- Avoid touching live parts!
- Do not use drivers with damaged housing and/or connectors!
- Do not service the driver when the mains voltage is connected; this includes connecting or disconnecting the LED module!

WARNING: FELV terminals marked "Risk of electric shock" are not safe to touch.

Danger: electricity

WARNING: Circuits connected to any FELV control terminal shall be insulated for the LV supply voltage of the controlgear and terminals connected to the FELV circuit shall be protected against accidental contact.

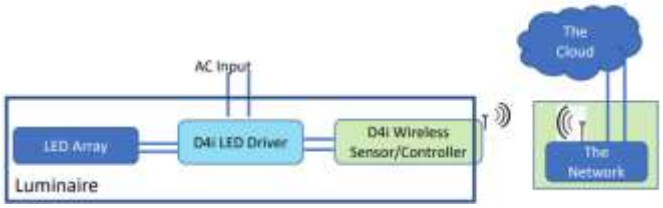
Safety warnings and installation instructions, to be taken into account during design-in and manufacturing.

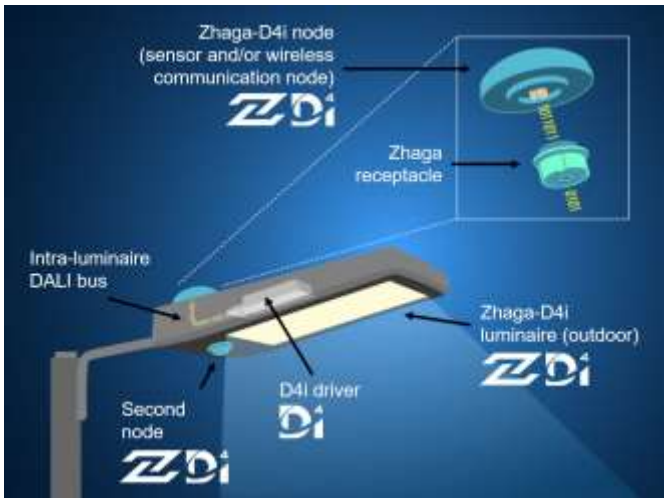
- Do not use damaged products.
- Do not connect mains voltage to the CR interface; immediate driver failure will result.
- The luminaire manufacturer is responsible for its own luminaire design and compliance with all relevant safety standards including minimum required IP rating to protect the driver.
- The Xitanium LED CR drivers are suitable for built-in use only and must be protected against ingress of and exposure to including but not limited to water, dust, insects or any other chemical agent - be it in the gaseous, vapor, liquid or solid form- which can be expected to have an adverse effect on the driver (e.g. use in wet/corrosive/dusty environments). It is the responsibility of both luminaire manufacturer and installer to prevent ingress and exposure. Any suggestion from Signify with reference to minimum required luminaire IP rating serves only as a non-binding guidance; a different IP rating may be required under certain application conditions to protect the driver. Common sense needs to be used to define the proper luminaire IP rating for the application.
- Do not service the driver when mains voltage is connected; this includes connecting or disconnecting the LED module. The driver generates an output voltage of the driver that may be lethal. Connecting a LED module to an energized driver may damage both the LED module and driver.
- No components are allowed between the LED driver and the LED module(s) other than connectors and wiring intended to connect the Xitanium driver to the LED module.
- Adequate earth and/or equipotential connections must be provided whenever possible or applicable.
- Signify Design-in support is available; please contact your Signify sales representative.

Disposal

Please, inform yourself about the local waste disposal, separation and collection system for electrical and electronic products and packaging. Please act according to your local rules and do not dispose of your packaging and old product with your normal household waste. The correct disposal of your product will help prevent potential negative consequences for the environment and human health.

Xitanium LED Xtreme CR drivers





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Xitanium LED Xtreme D4i certified CR drivers

Our Xitanium CR drivers offer great benefits for Lighting Management Systems. To ensure full component interoperability in lighting applications, Signify provides CR drivers with D4i Certification which also covers DALI-2. D4i certified CR drivers provide energy monitoring, store asset information, diagnostic data and identifies failure modes of the power source.

D4i is a certification program for interoperable DALI devices that enable smart, connected luminaires.

D4i systems help building an easier connected luminaire compared to conventional methods. With D4i it is possible to have a connected luminaire with fewer components, interoperability and higher reliability.

D4i Certified products can easily be recognized with the below logo on them:

Xitanium LED Xtreme CR driver versions

The Xitanium LED Xtreme CR drivers described in this guide are available in multiple power and current ratings which enable the most popular light output levels for outdoor and industrial applications. It is always highly recommended to check our latest Xitanium LED Xtreme CR driver leaflet for the most up-to-date overview of our range. This leaflet can be downloaded at www.lighting.philips.com/prof/led-electronics.

Detailed technical specifications can be found in the Xitanium driver datasheets at www.lighting.philips.com/prof/led-electronics.

Configurability Interface (tooling)

The Xitanium LED Xtreme CR drivers are configurable. A tailored package of features and parameters in these drivers can be set via a specific tool. This tool is the MultiOne Configurator. There are two types of interfacing technology used to communicate with this tool:

- DA interface (wired)
- SimpleSet (wireless, based on Near Field Communication NFC)

SimpleSet

Philips SimpleSet wireless programming technology allows luminaire manufacturers to quickly and easily program Xitanium LED Xtreme CR drivers in any stage during of the manufacturing process without a connection to mains power, offering great flexibility. As a result, orders can be met faster while reducing cost and inventory.

For more information, please visit www.philips.com/multione.

DATA SPECIFICATIONS

	D4i requirement
DALI Part 251 – Luminaire Data	Mandatory
DALI Part 252 – Energy Data	Mandatory
DALI Part 253 – Diagnostics Data	Mandatory

POWER-SUPPLY SPECIFICATIONS

	D4i requirement
DALI Part 250 – Integrated Bus Power Supply	Mandatory
DALI Part 150 – AUX Power Supply	Optional

Philips Xitanium Xtreme CR drivers contain all D4i optional and mandatory parts as well as an integrated surge protector based on DALI part 151 on the DALI and Aux ports.

Connected Ready (D4i) Interface (DA+/DA-)

Xitanium LED Xtreme CR drivers reduce complexity and cost of luminaires used in wireless connected lighting systems. They feature a digital DALI interface to enable direct connection to any suitable luminaire-based CMS (City Management System) controller or sensor. The result is a simpler, less expensive luminaire that enables turning every luminaire into a wireless node. The simple two-wire DALI interface is -dependent on driver type- compliant with D4i DALI Parts 250/251/252/253.

Compatibility with regular DALI and D4i devices

D4i Certified Products are designed to fully benefit from the CR driver capability. Xitanium CR drivers are also DALI-2 Certified. So, DALI-2 control devices can also be used together with Xitanium CR drivers, full functionality will be achieved using D4i control devices combined with D4i Xitanium CR drivers.

Compatibility with outdoor CMS systems

In the outdoor segment, the preferred option is to apply the CR driver in combination with the DALI interface for both the CMS nodes and potentially additional controllers. The Xitanium CR drivers can be used in combination with a DALI compliant device. However, a full system verification is advised to avoid high customer dissatisfaction and significant costs to repair.

Auxiliary Power Supply

Next to the switchable DALI PSU, the Xitanium LED Xtreme CR drivers are equipped with a permanently enabled auxiliary 24VDC power supply (+24VDC) which is short-circuit proof and intended to power auxiliary luminaire devices that need more power than the DALI PSU can deliver. This supply is compliant per DALI Part 150. More details about the auxiliary supply can be found in section Electrical design-in.

External DALI

As per DALI part 151 the Xitanium LED Xtreme CR drivers have elevated surge immunity and support extra-luminaire use with a total external cable length up to 15m. Please refer to the datasheet for immunity values.

Adjustable Output Current (AOC)

Flexibility in luminaire design is ensured by the Adjustable Output Current feature (AOC). This feature enables operation of various LED configurations from different LED manufacturers whilst also ensuring the solution remains "future-proof" for new LED generations. The output current can be configured with the Philips MultiOne software and the SimpleSet interface. More information about AOC and how to set the output current can be found in the section Electrical design-in.

Driver Temperature Limit (DTL)

Adjustable limitation of thermal stress on the driver is made possible by the DTL feature on drivers by means of an NTC resistor integrated in the driver. Depending on luminaire design, DTL can also be used as alternative for MTP since the MTP feature is not available on CR drivers. More details about DTL can be found in the section Thermal design-in.

Dimming interface

Interfacing with the Xitanium LED Xtreme CR drivers can be done via the DALI interface. Alternatively, the integrated Dynadimmer feature can be used for autonomous dimming.

Amplitude Modulation (AM) dimming

Philips Xitanium LED Xtreme CR drivers dim the output to the LEDs by means of continuous Amplitude Modulation (AM) dimming of the DC output current. No Pulse Width Modulation (PWM) is applied across any part of the entire output current range. AM dimming guarantees the smoothest and flicker-free operation over the entire dimming range.

Temporal Light Artifacts (flicker & stroboscopic effects)

A small inherent ripple is superimposed on the DC output current of Philips LED Xtreme CR drivers. This ripple consists of a low-frequency LF component (double the mains grid frequency) and a high-frequency HF component. This ripple current has such a low amplitude that Temporal Light Artifacts (flicker & stroboscopic effects) with camera systems other than possibly those for high- speed slow-motion HD recording is not expected. The ripple value of both LF and HF components are specified in the driver datasheet. The typical values for TLA parameters short term flicker value (P_{st}^{LM}) and Stroboscopic Visibility Measure (SVM) can be looked up in the driver datasheet.

Hot-wiring and output sharing

Warning: Philips LED Xtreme CR drivers do not support hot-wiring. In order to prevent damage to LEDs no connection or disconnection should be made to the driver output when mains voltage is present. Please ensure that power is turned off before doing so. Connecting multiple driver outputs in parallel or in series as well as the sharing of multiple LED+ or LED- connections in one wire is not supported either. Outputs of individual drivers must be kept fully separated.

Constant Light Output (CLO)

Traditional light sources suffer from depreciation in light output over time. This applies to LED light sources as well. The CLO feature enables LED solutions to deliver a constant lumen output throughout the life of the LED module. Based on the type of LEDs used, heat sinking and driver output current, a correction of the lumen depreciation can be entered into the driver. The driver then counts the number of operating hours and will correct the output current based on this input.

Since a CLO curve is not generic, the OEM needs to determine the appropriate CLO curve. This can be used to differentiate on e.g. lumen output or power consumption over lifetime.

The CLO feature can be programmed with the Philips MultiOne configurator tool. More information can be found on www.philips.com/multione.

OEM Write Protection (OWP)

OWP allows the OEM to protect their driver setting over the lifetime of the driver by using a password. Drivers equipped with OWP will show this in the feature list if read out by the tool MultiOne. Specific features and also the OWP feature itself can be enabled and protected with that password to prevent unauthorized changes. The password management is under the responsibility of the company which is setting it.

Driver diagnostics & maintenance

Xitanium LED Xtreme CR drivers offer a Diagnostics & Maintenance feature. The purpose of this feature is to gather information and help diagnose the history of the driver and connected LED module for maintenance purposes. This feature consists mainly of counters which keep track of specific variables like the number of startups of the driver, operating hours, temperature of driver and LED modules, current and voltages etc. The Diagnostics & Maintenance feature stores applicable parameters in the non-volatile memory bank specified in DALI Part 253 and the D4i Certified specification.

More information on the diagnostics see the instruction manual of MultiOne Engineering at: www.philips.com/multione.

Energy data

Xitanium CR Xtreme drivers have built-in energy measurement capability and can report energy and actual power consumption data. The metered data accuracy is equal to the accuracy as prescribed in EN50470-1 and EN50470-3, but its accuracy is not certified as such. Accuracy of the power measurement is the higher of following two values across the entire driver operating window: +/-4% of measured input power between %50-%100 load. The energy data feature stores energy reporting data in the nonvolatile memory bank provision specified in DALI-2 Part 252 and the D4i Certified specification.

Luminaire data

Xitanium LED Xtreme CR drivers are equipped with the Luminaire Info feature. This feature supports the extraction of luminaire data as input for system asset management and enables the OEM to issue a unique Global Trade Identification Number (GTIN). This feature is implemented in compliance with DALI Part 251version 4.

Use in hazardous areas

Warning: the use of lighting control gear in hazardous areas is bound to very strict safety regulations. Xitanium LED Xtreme CR drivers are **not** certified per standard IEC/EN 60079 and latest EU directive ATEX for use in hazardous areas in which there is risk of explosion. Therefore, Xitanium LED Xtreme CR drivers do *not* directly support application in luminaires and lighting systems in such environments.

Driver naming

Xitanium LED Xtreme CR drivers are part of a specific naming system. See the example below.

Xi CR 75W 0.2-0.75A SDMP 230V C123 sXt

Protection suffix
sXt = Xtreme technology; high robustness and lifetime
No suffix = basic robustness and long lifetime

Housing
S####, C#### (S=Stretched, C=Compact, ### = length in mm)

Rated AC input voltage
230Vac (= 220-240Vac range)

Features
S = SimpleSet for wireless driver configuration, based on NFC
L = LineSwitch interface for for intra- and extra-luminaire dimming control
1 = 1-10V or 0-10V interface for intra- and extra-luminaire dimming control
D = DALI interface for intra- and extra-luminaire control
A = AmpDim interface for mains voltage dimming
M = Metering of energy data
P = +24V Power supply unit for an intra-luminaire auxiliary device
AOCM = Manually Adjustable Output Current

Output current
Adjustable min-max output current range (AOC) in A

Number of output channels
None = single channel
2 = dual channel

Output power
Rated output power in Watt

LED driver family
None = Single Current, no controllability
Dim = 1-10V dimmable, non-programmable
FP = FULL Prog
LP = LITE Prog
BP = BASIC Prog
CR = Connected Ready
SR = Sensor Ready

Type of LED driver:
Xi = Xitanium

Mechanical Design-in

Dimensions

Xitanium LED Xtreme CR drivers are available in different housing dimensions. The specific dimensions can be found in the driver datasheet. 3D CAD files are available to verify fit and can be found at https://www.lighting.philips.com/prof/led-electronics.

It is recommended to build in drivers such that the driver housing and the driver input and output connectors are not affected by potential water ingress in the luminaire (e.g. due to luminaire sealing malfunction or condensation).

It is highly recommended to mount the driver by using all available mounting feet in order to achieve maximum mechanical robustness against shocks and vibration. The recommended mounting torque is 1.5Nm for drivers with plastic mounting feet. This value should not be exceeded in order to prevent deformation of the mounting feet.

Note: The use of rivets is not recommended since mounting torque cannot be controlled. Damage to the mounting feet and loose mounting may result.

Mounting screw dimensions should be based on the specified fixing hole diameter in the driver datasheet. Oversized and undersized screws should not be used in order to prevent damage to the mounting feet or loose mounting.

Allow for sufficient free space around the driver SimpleSet antenna if the driver is to be configured after mounting in the luminaire. The minimum recommended space is depending on the type of SimpleSet configuration tool. Using SimpleSet tool LCN9620, the minimum recommended distance is 19 mm (+/-1mm).

Depending on the application and the use in development, factory or field, another configuration tool can be selected. Please go to www.philips.com/multione to find the correct type. Every published interface tool is officially approved for use with the MultiOne software. The tool type number can be found by checking the LCN label on the tool itself.

Note: the use of an unapproved tool may result in impaired driver-tool communication and configuration malfunctioning.

Thermal Design-In

Introduction

This section describes the following aspects of the thermal design-in of the Xitanium LED Xtreme CR drivers:

- The LED driver and the relationship between the t_c point temperature and lifetime of the LED driver.
- The LED driver and its non-adjustable response to driver overheating (ThermalGuard).
- The LED driver and configurable Driver Temperature Limit (DTL) to maximize driver and possibly LED module lifetime in the application.

In order to facilitate thermal design-in of a LED driver, the critical thermal management points of the LED driver are set out in this section. Please familiarize yourself with the following key aspects to achieve optimal thermal design-in of the driver.

1: Driver case temperature point (t_c point)

The driver case point temperature (t_c) is the only reference for the temperatures of the critical internal driver components. The location of the t_c point is identified on the driver type plate and is marked by a * or ○ symbol. Please use ***only*** the t_c point as reference to define thermal suitability of a driver in the application. Its temperature can be measured using a thermocouple that is firmly glued to the t_c point surface on the driver housing. For a representative measurement the temperature of the t_c point must be stable before any reliable data can be obtained (typically > 3 hours or when the temperature difference is less than 1 °C within one hour).

2: Driver t_{c_life} value

The specified full driver lifetime and corresponding failure rate will apply as long as the t_c point temperature remains between the lower t_{a_min} and upper t_{c_life} limits.

3: Driver t_{c_max} value

The driver supports running at a higher temperature than the specified t_{c_life} temperature, up to the t_{c_max} temperature. Keep in mind that doing so will be at the expense of the driver lifetime and failure rate. A graphical representation thereof can be found in the driver datasheet. Running the driver above the specified t_{c_max} temperature is ***not*** supported and will negatively affect driver lifetime and void driver warranty. The ***only*** way to verify whether either t_{c_life} or t_{c_max} is exceeded in the application is by using a thermocouple.

4: Driver minimum ambient temperature (t_{a_min})

This lower limit value as specified in the driver datasheet stipulates the minimum ***luminaire*** ambient temperature at which the driver can be used, e.g. in frozen storage warehouses or (sub)arctic areas. Using the driver below its specified minimum t_{a_min} value is not supported and will negatively affect driver performance and lifetime. Driver warranty will then be void.

5: Driver maximum ambient temperature (t_{a_max})

Typically, the driver t_c point will reach its specified t_{c_max} value at the specified driver ambient t_{a_max} temperature ***inside*** the luminaire. However, if the driver is not running at full output power, then the actual t_c point temperature may be lower than the t_{c_max} value. In that case a higher driver t_a is supported up to the point when the specified t_{c_max} value is reached.

6: Driver temperature readout in MultiOne Diagnostics

The "Driver temperature" readout via the Diagnostics function in MultiOne software represents the temperature of a driver-internal thermal sensor. Please do ***not*** use this readout to define thermal suitability of a driver for a given luminaire; this temperature readout does not represent the t_c point temperature and does not correspond 1:1 with the t_c point temperature. It is therefore not suitable as a reference for thermal design-in.

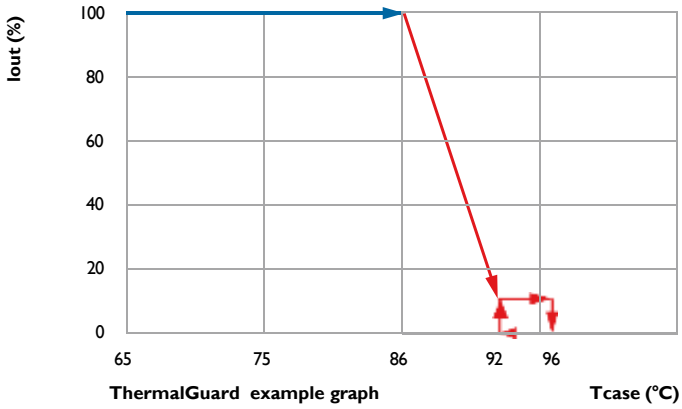
The thermal design-in of the driver inside the luminaire also influences the relation between the driver t_a temperature and t_c temperature. E.g. mounting the driver on an effective heatsink or placing it further away from LED modules will lower the t_c value at a given t_a. The t_c point temperature is always leading with respect to t_{c_life} or t_{c_max}.

In general, lowering the overall driver temperature will increase the driver lifetime since the temperature of critical components inside the driver will be lower. However, applying only local heatsinking of the driver -e.g. to lower the t_c point temperature or any other surface hotspot- will not necessarily lower the temperature of critical components. Do not apply local heatsinking to improve intended thermal driver performance and/or to artificially lower the temperature of the tc point.

ThermalGuard

In a thermally well-designed luminaire, the specified t_{c_max} value will not be exceeded. However, under extremely hot atmospherical conditions the driver may occasionally overheat, in that case the driver will automatically start to reduce the output current as an emergency measure to reduce driver overheating. The result of the output current reduction will be a mitigation of the excess decrease of driver lifetime as a result of thermal overstress. Once the t_c point temperature starts dropping below a certain value the driver will automatically increase the output current up to the pre-set output current. If the output current reduction is not sufficient to counteract the t_c point temperature increase then the output current may either stabilize at a lower value or, depending on driver type, even be reduced to zero in extreme cases. This thermal driver protection feature is called ThermalGuard and its goal is to get the driver back in normal operating thermal conditions in which the specified driver lifetime can be met. Each driver type has its own specific factory default overheating behavior, and it can be found as a ThermalGuard graph in the driver datasheet.

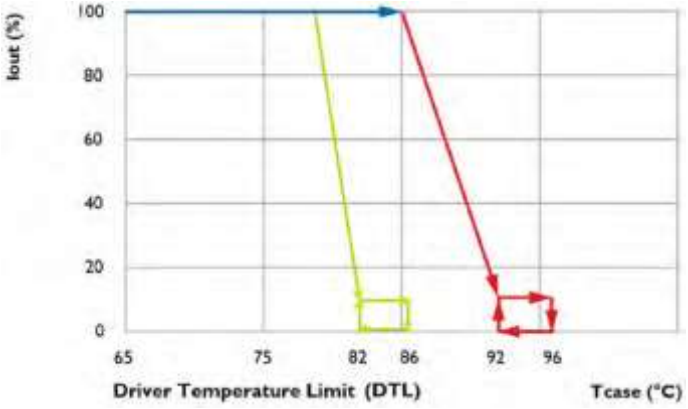
Warning: the ThermalGuard feature is designed as a non-configurable emergency measure to protect the driver. It is ***not intended*** for structural activation to compensate for a poor thermal design of a luminaire. Structural activation will lead to premature driver and will void warranty.



Shown on the left is an example graph of the ThermalGuard feature. In this example, the output current is reduced from t_c point temperature of 86°C onwards down to 10% at 92°C. Between 92°C and 96°C the output current will remain at 10%. If the output current reduction is sufficient to decrease the t_c point temperature, then the output current will be increased accordingly up to the pre-set 100% level.

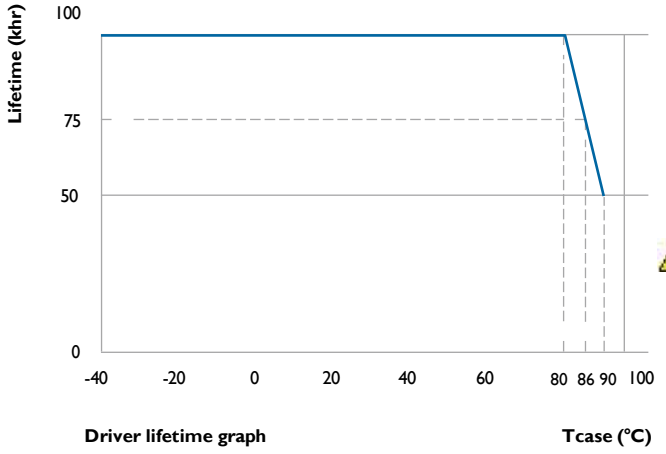
If the unlikely case when output current reduction is not sufficient to offset the t_c point temperature increase, then the output current is eventually reduced to zero at 96°C and the driver output will be switched off. Normal operation will not resume until the t_c point temperature has cooled down to 92°C. A power cycle is not required to resume driver operation. The 4°C hysteresis will prevent the luminaire from blinking on and off.

Note: The ThermalGuard feature is **non-configurable.**



Driver Temperature Limit (DTL)

Depending on commercial or application needs it may be required to optimize driver lifetime. This can be achieved by safeguarding that the maximum driver case point temperature in the application is not exceeding a predefined limit. A configurable feature called DTL (Driver Temperature Limit) enables this by offering an adjustable t_c point temperature threshold at which the output current is reduced (start dim value) and optionally be switched off (shutdown value). DTL configuration can be done by MultiOne software. By factory default, the DTL feature is configured per the specified ThermalGuard graph for a driver as specified in the driver datasheet.

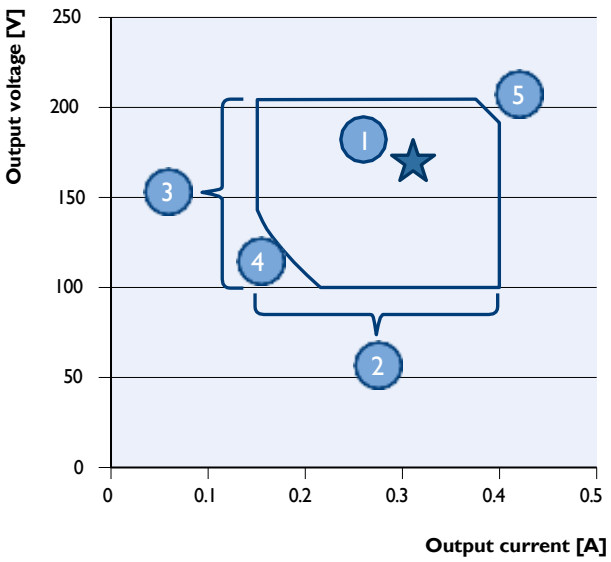


Shown on the left is an example DTL and driver lifetime example graph. The green line represents the output current as function of the t_c point temperature with DTL activated through a custom profile based on the requirement that the driver lifetime be at least 75khrs. The red line represents ThermalGuard behavior. In this example, the output current is reduced from t_c point temperature of 80°C onwards (start dim value) and the t_c point will not exceed 86°C (shutdown value) whereas it would have been allowed to reach up to 96°C without this specific DTL profile.

Warning: thermal luminaire properties will influence the DTL actvation points. Therefore, the configured DTL start dim and shutdown values must be verified **case-by-case** per driver-luminaire combination to ensure that the driver does dim and shut down at the correct t_c point temperature in relation to the configured MultiOne start dim and shutdown values. Otherwise, DTL will act either at a too low or too high t_c point temperature!

The DTL feature can also be applied as a substitute for Module Temperature Protection (MTP) to protect the LED module against overheating and to maintain a certain lumen maintenance. The advantage of using DTL for this purpose is that the additional NTC on the LED module plus required wiring can be omitted. However, DTL can only be used as such if the thermal relation between the driver t_c point and LED module t_c point temperature is well-defined. Therefore, a meticulous thermal investigation of the driver - LED module driver application is required to prevent DTL from being activated at a too low or too high LED module temperature.

Electrical Design-In



Example Operating Window of a Xitanium driver

1. Required set point for the LED solution
2. Current can be set to needs within range (incl. dimming)
3. Driver adapts to required LED module voltage V_f, given it fits range
4. Driver minimum power limit
5. Driver maximum power limit

Xitanium driver operating window

LED technology is rapidly evolving. The use of more efficient LEDs in a next generation means the same light output can be achieved with lower currents. At the same time, LEDs can be driven at different currents levels based on the application requirement. Typically, LED drivers are available in discrete current levels, e. g. 350 mA, 700 or 1050 mA. It is often necessary to replace a driver when more efficient LEDs or different LED modules become available.

One of the key features of the Xitanium LED Xtreme CR drivers is the adjustable output current (AOC) feature, offering flexibility and future-proof luminaire design. The Xitanium drivers can operate in a certain "operating window". This window is defined by the maximum and minimum voltage and current that the driver can deliver. An example of an operating window is shown on the left. The area indicates the possible current/voltage combinations. The current selected will depend on the type and manufacturer of the LEDs or the specific LED configuration of the PCB design. The voltage is the sum of the LEDs used (total Vf string) and dependent on LED drive current and temperature. The operating window of every driver can be found in the driver datasheet.

The output current of these drivers can be set in two ways:

1. SimpleSet: output current can be set using the Philips MultiOne software and SimpleSet interface.

2. D4i interface: output current can be set using the USB2DALI interface LCN8600.

Warning: the forward voltage Vf of the connected LED module **must** remain within the specified driver operating window voltage boundaries under all application conditions. Otherwise, reliable luminaire operation cannot be guaranteed.

How to select an appropriate driver

Depending on application requirements, several drivers may fit a specific application. The following steps will help in selecting the appropriate driver(s). For a complete overview of suitable driver(s) for your application, please use the Easy Design-in Tool (EDIT) at www.easydesignintool.philips.com as starting point.

1. Determine the required driver current (I_{drive}) and voltage (V_f)
2. Calculate the required power (P_{drive}) where $P_{drive} = V_f \times I_{drive}$ (W)
3. Select the datasheets from the website mentioned above based on the driver having a higher power than required.
4. Does the required current fit the current range of the driver? The current range of the driver can be seen in the name itself. For example, for driver Xi CR 75W 0.2 – 1.05A SDMP C123 sXt, the minimum programmable driver current is 0.2A and maximum is 1.05A.
5. Does the required LED voltage fit the voltage range of the driver? The exact value can be found in in the datasheet.
6. Does the required power fit the power range of the driver? In the naming of the driver, you can see the maximum possible output power. For example, for driver Xi CR 75W 0.2 – 1.05 SDMP C123 sXt, the maximum output power is 75W.
7. Choose the preferred dimming method. Please refer to the section Driver naming to verify dimming options.

Programming the output current

The Xitanium LED Xtreme CR drivers offer an extensive range of controls, enabling customizable luminaire design and performance. It is possible to control light output levels, preset dimming protocols and set system specifications in the factory and even in the complete installations.

This can be done with the Philips MultiOne configurator. The MultiOne configurator is a versatile tool that unlocks the full potential of all programmable drivers from Philips, ensuring that the driver performance matches the needs of the lighting solution. It offers unprecedented flexibility, before, during and after the product installation.

Programming of new Xitanium LED Xtreme CR drivers can be done either by using the SimpleSet or the DA interface.

For more information on MultiOne please refer to the section Driver Configuration or visit: www.philips.com/multione. This site contains detailed information on how to install the software and how to program the driver.

Connectors

Philips Xitanium LED Xtreme CR drivers are equipped with push-in type connectors. Connectivity specifications (wiring connection diagram, supported wire cross section range in mm^2, strip length range in mm and wire type) can be found in the driver datasheet.

Notes:

-For currents between 1.0 and 1.5A (rms/DC) per connector, a minimum cross section of 0.75mm^2 is recommended.

-In certain luminaire wiring scenarios two wires may have to be connected to one connector terminal. In that case, the pairing has to be done outside the driver, resulting in only one wire going into the connector terminal. Two wires into one connector terminal are not supported.

The reliability of twin-wire ferrules (or wire end stop), accepting the wires intended to use, should be checked with the supplier of these ferrules.

Mains operating conditions

Xitanium LED Xtreme CR drivers are designed for operation and performance by power sources or grids providing a clean and symmetric sinusoidal voltage wave form. They do not support operation on power sources including but not limited to having e.g. a square-wave voltage form or a "modified sinewave".

Xitanium LED Xtreme CR drivers are able to withstand high and low mains voltages for a limited period of time. This includes under- and overvoltage due to malfunction such as a loose neutral wire in the grid.

Low and high mains voltage

Xitanium LED Xtreme CR drivers are designed to be operated at mains under- and overvoltage per IEC requirements for performance and operational safety with respect to specified rated input voltage range.

The applicable lower limit for driver performance is lowest rated voltage -8% while -10% applies for driver operational safety. For drivers equipped with MainsGuard a lower limit applies for operational safety.

The applicable upper limit for driver performance is highest rated voltage +6 % while +10 % applies to driver operational safety.

The actual limit values can be found in the driver datasheet. For optimal luminaire performance it is always recommended to operate drivers within the specified voltage **performance** range.

Output open-load and short-circuit conditions

Xitanium CR LED Xtreme drivers can withstand output open-load and short-circuit conditions. These are to be considered abnormal driver conditions. Consequently, it is not recommended to use drivers as such. Neither is it recommended to switch the driver output by means of e.g. relays ("hot switching") to connect or disconnect LED modules.

Excessive low mains voltage (MainsGuard)

Previously, LED Xtreme drivers would turn off the output in case of excessive low mains voltage. Depending on the exact driver type a shutdown would occur between 150 ... 180VAC.

This shutdown functionality was intended to prevent overcurrent conditions in the mains grid. Without shutdown the driver input current would increase proportionally with decreasing mains voltage since the driver is designed to maintain full light output of the luminaire and thus output power. This would exacerbate the overcurrent condition further. Consequently, mains cables and relays may be overloaded and melting fuses and/or MCBs may trip.

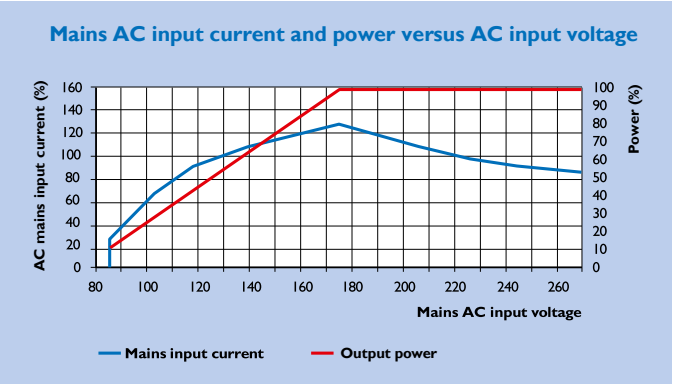
In order to prevent overcurrent conditions, a shutdown mechanism had been implemented in the driver. However, the main disadvantage of this shutdown is total loss of lighting.

Xitanium LED Xtreme CR drivers have a feature incorporated to protect luminaire and mains grid against overcurrent conditions without loss of lighting. This smart feature is called MainsGuard. Its function is to proportionally decrease input current as function of decreasing mains voltage and to keep doing so all the way down to a much lower mains voltage before the driver output is ultimately shut down. A small hysteresis of 5 ... 10Vac against on/off nuisance cycling is implemented before the driver output becomes automatically active again once the mains voltage starts to recover (no mains power cycle required).

A general graphical representation of MainsGuard can be seen in the illustration on the left. Exact values can be found in the MainsGuard graph in the driver datasheet.

Main benefits of MainsGuard are:

- Light will remain on, even at excessive low mains voltage
- Luminaire and grid are protected against undervoltage and overcurrent
- No current overloading of MCBs, fuses and relays



Illustrative graph of the MainsGuard feature. Shown values are example values. Please refer to the driver datasheet for exact values.

Note: the voltage levels at which output power is reduced and the output is eventually shut down and re-activated are fixed and cannot be modified.

Warning: the MainsGuard feature is designed as an emergency measure to protect the driver. It is **not** intended for structural activation to compensate for poor grid conditions.

Excessive high mains voltage

An excessive high mains voltage will stress the driver and will have an adverse effect on the lifetime. Xitanium LED Xtreme CR drivers will survive an input overvoltage of 264 ... 320Vac for a period of max. 48 hours and 320 ... 350Vac for a period of max. 2 hours.

A loose neutral condition has to be avoided as this may reduce the lifetime dramatically. Immediate driver failure may occur if the driver is connected to 400Vac as a result of a connection error in a 3- phase 230/400Vac grid.

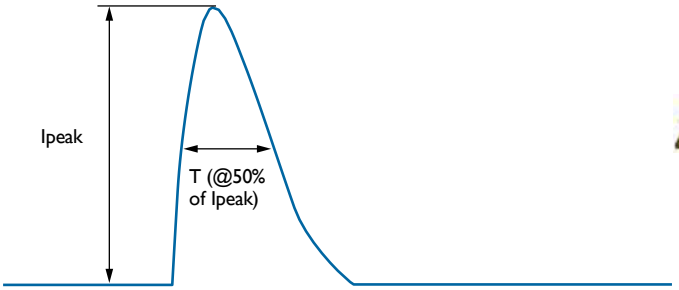
Power grids

Xitanium Xtreme LED CR drivers are suitable for direct connection to TN, TT and IT grids. Depending on driver type, a luminaire-based fuse in the driver neutral connection may be required in case both feeding phases are “hot”.

Note: certain restrictions apply for use in IT grids. Direct connection of Xitanium LED Xtreme CR drivers is only permitted in delta connection with a phase-to-phase voltage of 230Vac. In case the drivers are connected in star connection in a 230V/400Vac IT grid, the use of a separate 1:1 insulation transformer with sufficient power rating is required to power the drivers. The secondary output of the transformer must be connected to earth.

Power Factor (PF)

Xitanium Xtreme LED CR drivers have a high-power factor (PF which is inherently capacitive. Its capacitive nature cannot be compensated for. The output power dependent PF graph can be found in the driver datasheet. By design, the driver will maintain a high-power factor also under dimming conditions.



Graphical representation of inrush current

Inrush current

The term inrush current refers to the briefly occurring high input current which flows into the driver during the moment of connection to mains; see the illustration on the left. Typically, the amplitude is much greater than the steady-state input current. The cumulative inrush current of a given combined number of drivers may cause a Miniature Circuit Breaker (MCB) to trip. In such a case, either one or a combination of the following measures need to be taken to prevent nuisance tripping:

- Replace existing MCB for a less sensitive type (e.g. exchange B type for C type).
- Distribute the group of drivers over multiple MCB groups or phases.
- Power up drivers sequentially instead of simultaneously.

Inrush parameters are driver-specific and can be found in the driver datasheet.

Notes:

- The amplitude and pulse width time of the inrush current are not in any way affected by the driver feature Adjustable Startup Time (AST, see section Control Features).
- Xi CR driver s are not equipped with an internal inrush current limiter.
- The use of an external inrush limiting device (e.g. EBN-OS or Camtec ESB) or a zero-voltage switching relay (e.g Finder 77 series) may enable a larger number of drivers to be connected to a MCB or fuse. Signify has not tested the compatibility or effectiveness of such third-party devices in the actual application. It is the responsibility of both luminaire manufacturer and installer to ensure compliance with national electrical codes when either device is used in the application.

MCB type	Rating (A)	Relative number of LED drivers (%)
B	4	25
B	6	40
B	10	63
B	13	81
B	16	100 (reference)
B	20	125
B	25	156
B	32	200
B	40	250
C	4	42
C	6	63
C	10	104
C	13	135
C	16	170
C	20	208
C	25	260
C	32	340
C	40	415
D	4	80
D	6	130
D	10	210
D	13	280
D	16	350
D	20	470
D	25	550
D	32	700
D	40	940
L, I	16	108
L, I	10	65
G, U, II	16	212
G, U, II	10	127
K, III	16	254
K, III	10	154

The max. recommended number of drivers in the table above is based on inrush current and only serves as guidance. The actual maximum amount in the application may differ; it is dependent on steady-state current, MCB brand/type and inherent MCB tolerances.

How to Determine the Number of Drivers per MCB

The maximum recommended number of drivers connected to a Miniature Circuit Breaker (MCB) *from inrush current perspective* can be calculated with the help of the conversion table shown on the left. In this table the stated amount for a 16A B type MCB is used as reference (100%). The maximum recommended number of drivers for different types of MCB can be calculated by this formula:

Max. number of drivers = reference x relative number in %

This table only applies for drivers without the IntelliStart feature.

Example:

If the datasheet states a max. amount of 20 drivers on a 16A B type, then for a 13A C type the max. amount is 20 x 135% = 27 drivers.

Note: Keep in mind that in case a D type MCB is used that the steady-state current loading may be the limiting factor instead!

How to determine the number of drivers on a melting fuse

The maximum recommended number of drivers on a melting fuse is defined either by the aggregate inrush current or the aggregate steady-state input current.

The number of drivers can be calculated, using the specified values in the datasheet of the maximum input current and inrush current (I_{peak} and T_{width}) as well as the melting integral I^2t value of the applied fuse as specified by the fuse manufacturer.

The melting integral value I^2t of the aggregate inrush current must be 50% below the specified melting integral value I^2t of the fuse in order to prevent melting of the fuse when the drivers are connected to mains voltage simultaneously. And the aggregate steady-state input current loading shall remain below 80% of the fuse rating to prevent overheating of the fuse.

The following formula can be applied to calculate the I^2t value of the driver inrush current:

$$I^2t = (I_{peak})^2 \times (0.8 \times T_{width})$$

Example:

A group of drivers is connected to a 16A melting fuse with a melting integral value of $350A^2s$. Specified driver inrush current peak and width is 65A and 330µs. Steady-state input current is 0.8A per driver.

Question: what is the recommended maximum number of drivers in this group connected to this fuse from inrush current and steady- state input current perspective?

Answer: the corresponding I^2t value of the inrush current is $(65)^2 \times (0.8 \times 330 \times 10^{-6}) = 1.12A^2s$ per driver. The aggregate value of the driver inrush current must remain below $0.5 \times 350A^2s = 175A^2s$. This translates in a maximum of $\sqrt{(175A^2s/1.12A^2s)}$ = **12** drivers.

The steady-state input current per driver is 0.8A. Taking into account a max. allowed steady-state current loading of 16A x 80% = 12.8A, this would allow for max. 12.8A / 0.8A = **16** drivers.

Therefore, the maximum recommended number of drivers is = **12** drivers.

In this example, the maximum recommended number of drivers is defined thus by inrush current.

Notes:

- Specified maximum number of drivers is based on simultaneous switch-on, e.g. by a central switch or relay.
- For multiple MCBs in one cabinet the de-rating of the MCB manufacturer for steady-state load needs to be followed. If the actual de-rating is unknown, then it is recommended to use a steady-state current de-rating of 0.8 by default. No de-rating is needed in respect to inrush current as this is not part of the thermal properties of the MCB cabinet.
- The maximum number of drivers that can be connected to one 30mA Residential Current Device (RCD) is typically 30. However, the actual maximum amount depends on RCD brand and type so the actual number may vary and will have to be defined on-site.

Surge immunity

Xitanium LED Xtreme CR drivers have elevated differential-mode and common-mode surge immunity levels which by far surpass the requirements as defined by IEC. By design, the high immunity levels do not only safeguard reliable driver operation in the field but also provide high immunity for the connected LED modules, thus enabling a high surge immunity on system level. The driver immunity levels can be found in the driver datasheet. In order to achieve these high immunity levels, the driver EQUI terminal must be connected to the metal parts of the luminaire and LED module heatsink in all cases (Insulation Class I: also, to earth). Doing so will guarantee the specified surge immunity levels and will protect the driver and LED module against surge damage. Depending on the local conditions, additional protection against excessive high surge voltages may be required by adding an external Surge Protection Device in the luminaire and/or at installation level (column/distribution cabinet).

Touch current

Xitanium LED Xtreme CR drivers are designed to meet touch current requirements for Insulation Class II applications per lighting control gear standard IEC 61347-1 in order to enable an easy design-in in Insulation Class II luminaires per IEC60598-1. The specified peak values can be found in the driver datasheet and refer to single-driver only level.

The insulation of the wiring to and from the drivers needs to be in compliance with IEC60598. Taking into account the double insulation of the driver between mains input and LED output, the (supplementary) output wiring insulation rating needs to be based on the specified maximum output voltage of the driver. See the driver datasheet for the specific value of this voltage.

Note: In a luminaire, the cumulative touch current may be higher since the LED module may introduce additional touch current. Precautions may be required on the luminaire level if multiple drivers are used in a single luminaire. Do **not** leave the EQUI terminal disconnected to lower the luminaire touch current; impaired EMC performance and reduced system surge immunity will result.

Electro-Magnetic Compatibility (EMC)

Electromagnetic compatibility (EMC) is the ability of a device or system to operate satisfactorily in its electromagnetic environment without causing unacceptable interference with other systems or being too susceptible for external emissions from other systems. Xitanium LED Xtreme CR drivers meet EMC requirements per CISPR15 for conducted and radiated emissions. This test is conducted with a reference setup that includes a driver and an LED module + heat sink combination mounted on a metal plate and verified in Insulation Class I and II configurations.

Remote mounting and EMC

Xitanium LED Xtreme CR drivers are designed for built-in use only and do not support remote mounting.

Signify has successfully performed CISPR15 EMC compliance tests on systems with a standard LED output cable length of 60cm as reference. For longer CISPR15-compliant cable lengths please check the driver datasheet for the maximum specified length.

If a longer distance beyond the maximum specified distance is required, then the EMC performance needs to be verified separately. The use of shielded LED output wires is not recommended.

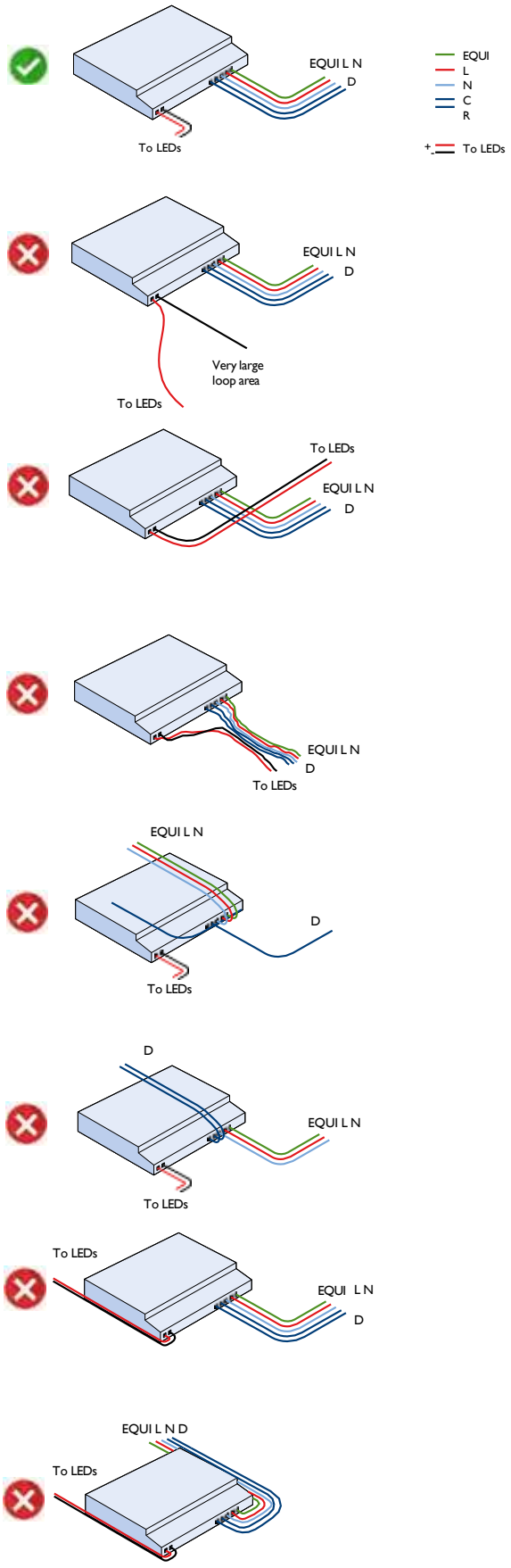
Warning: the driver EQUI terminal must be connected to the luminaire chassis as well as to Protective Earth (Class I) for optimal EMC performance and surge immunity. Doing so for Class II luminaires is in safety compliance with IEC61347-1, IEC60598-1 and IEC61140 regarding the relation between the driver EQUI terminal and live parts with respect to:

- Maximum allowable touch current
- Minimum required insulation resistance
- Minimum required creepage distances & clearances
- Minimum required electric strength

The purpose of the driver EQUI terminal is purely for functional performance reasons by establishing equipotential bonding; the EQUI terminal does **not** have a safety function.

Electrical insulation

Driver insulation classifications between the several inputs and output can be found in the driver datasheet. Insulation classifications of Xitanium LED Xtreme CR drivers are optimized for design-in in Insulation Class II luminaires by offering double or reinforced insulation between live and accessible parts. The insulation between the EQUI terminal and the mains input is classified as double for all Xitanium LED Xtreme CR drivers.



EMC performance precautions

The following practical precautions need to be taken into account in a lighting system for optimal EMC performance:

• Minimize the loop area of the LED output wires going from the driver to the LED module by keeping the output wires close together (bundling).

• Minimize the parasitic capacitive coupling of the LED output wiring towards earth by keeping the wiring length as short as possible.

• Keep the length of the incoming mains wire inside the luminaire as short as possible.

• Keep mains wires, DALI control wires and LED output wires separate. Do not bundle or cross the wires.

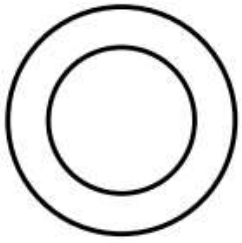
• Do not route any wiring over and/or along the driver enclosure to avoid any noise coupling/crosstalk with internal driver circuitry.

Insulation Class I application: ground the luminaire chassis and other large internal metal luminaire parts (driver mounting plate, reflector, canopy, heat sink etc.) to Protective Earth. **Always** connect the driver equipotential connector (EQUI) to Protective Earth.

Insulation Class II application: use equipotential bonding wires between all large metal luminaire parts (driver mounting plate, canopy, heat sink etc.) Do not keep large metal parts electrically insulated. **Always** connect the driver equipotential connector (EQUI) for equipotential bonding.

• Keep the equipotential wires as short as possible to maximize their effectiveness and use, as much as possible, large metal areas (chassis, mounting plates, brackets) for earthing purposes instead. Establish a reliable electrical connection by using a toothed washer and screw(s) fastened with adequate mounting torque.

Adhering to these rules will help to achieve EMC compliance. For further questions and/or design-in support please contact your local Signify representative.



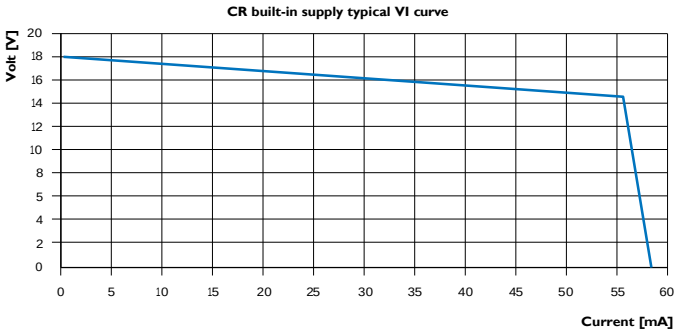
Symbol for Double Isolation between primary and secondary side of a driver. This symbol applies to drivers intended for built-in use only.

Connected Ready (D4i) interface (DA+/DA-)

The simple two-wire DALI interface supports these key functions:

- Switchable built-in DALI bus Power Supply Unit (D4i PSU) to provide power to the connected controller (DALI Part 250)
- Memory Bank 1 Extension to store luminaire data (DALI Part 251)
- Two-way digital communication between the D4i driver(s) and luminaire controller(s), using standard DALI protocol via a polarized DALI bus:
  - -Standard DALI dimming and on/off switching
  - -Actual power consumption and energy data, utilizing the power monitoring integrated in the driver (DALI Part 252)
  - -Diagnostic and Maintenance information (DALI Part 253)

See www.digitalilluminationinterface.org/d4i/ for more info.



Built-in D4i bus Power Supply Unit (D4i PSU)

- Xitanium Xtreme CR drivers have the ability to supply the CR bus with a built-in D4i PSU. This PSU can be disabled and enabled. By factory default, the D4i PSU is enabled and ready for use with an external control device. The D4i PSU is compliant per DALI Part 250.
- The D4i PSU is capable of delivering a minimum current of 52mA (ICR) to the CR bus and the connected device(s).
- The D4i PSU will never supply more than 60mA (ICR_MAX).
- The D4i bus voltage is depending on the controller load and the amount of D4i PSUs connected in parallel. See the graph on the left for the typical VI curve for one D4i PSU.
- When the internal D4i PSU is switched OFF, the CR driver will extract a maximum of 2mA from the D4i bus (like standard DALI gear).

Luminaire control devices

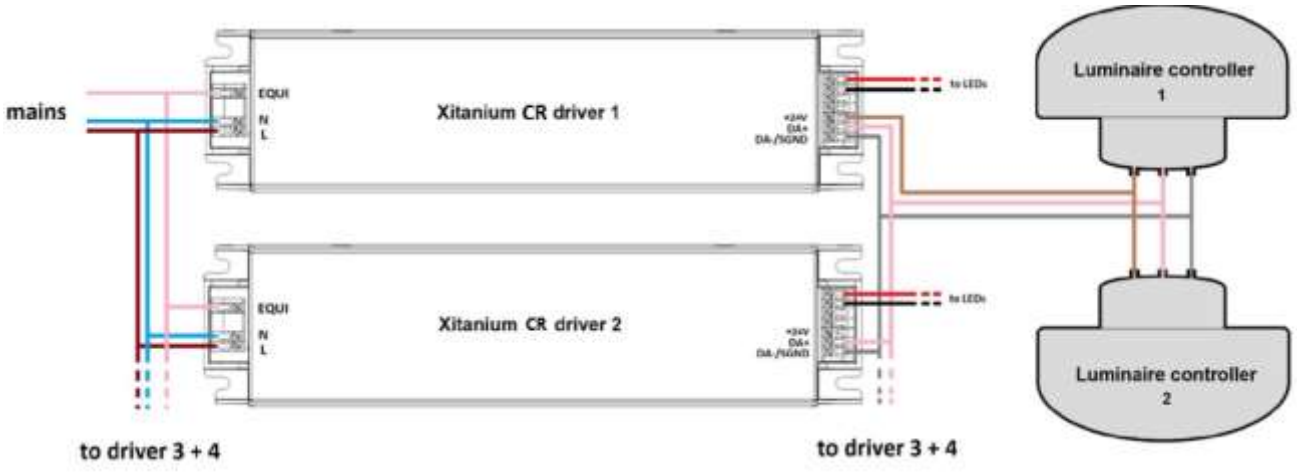
- Most luminaire controllers intended to be used in an D4i system will be powered from the driver D4i bus or the auxiliary power supply.
- When communication is present on the D4i bus, the bus. gets pulled down by the data packages. This reduces the average current available for the power consuming control device. When communicating the average available current can drop with 50%. This should be taken into account when designing the control device.
- The extracted peak current (ICR_EXTRACTED) should be limited by the control device.

Rules for building an D4i system

- D4i (DA+/DA-) bus polarity must be respected when more than one CR interface is connected in parallel.
- The total available D4i bus current (ICR_MAX_TOTAL) must not exceed 250mA. This current can be determined by adding up ICR_MAX of all connected D4i PSUs. As a consequence, a maximum of **four** enabled D4i PSUs are allowed to be connected in parallel. The total current delivered to the D4i bus (ICR_DELIVERED) can be determined by adding up the ICR of all connected enabled D4i PSUs.
- The total current extracted from the DALI bus (ICR_EXTRACTED) can be determined by adding up consuming devices like D4i drivers with disabled D4i PSU, other DALI gear and controllers (max. 2mA/device).
- To guarantee good communication, a margin of 8mA is needed to drive the D4i bus itself (ICR_MARGIN).
- The following rule should be respected: ICR_EXTRACTED + ICR_MARGIN ≤ ICR_DELIVERED.
- It is not allowed to connect multiple +24V auxiliary supplies in parallel.

Warning:

When the above rules are not taken into account, communication cannot be guaranteed and damage to components may occur.



Suggested connection diagram for connecting up to four Xitanium CR Xtreme drivers to one or two luminaire controllers

Typical examples

1. One CR driver is connected to a controller. The D4i PSU of this driver is enabled. The specification of the controller states that the extracted peak current is 40mA. Will this D4i system have good communication?

- One D4i PSU is involved, so D4i BUS polarity is irrelevant.
- ICR_MAX_TOTAL = 60mA. This is ≤ 250mA
- ICR_DELIVERED = 52mA
- ICR_EXTRACTED = 40mA
- ICR_MARGIN = 8mA
- 40 + 8mA ≤ 52mA

Conclusion: this system will function properly.

2. Is it allowed to add an CR driver with disabled D4i supply PSU to this CR system?

Yes, an CR driver with disabled D4i PSU extracts max. 2mA from the D4i bus.

- ICR_EXTRACTED = 40 + 2 = 42mA.
- 42 + 8mA ≤ 52mA

Conclusion: this system will function properly.

3. It is allowed to enable the D4i PSU of the second driver?

Yes, but the polarity of both D4i PSUs must then be

observed.

- ICR_TOTAL = 2 * 60mA = 120mA. This is ≤ 250mA.

Conclusion: this system will function properly.

Digital D4i communication

Dimming via D4i bus commands is possible through the standard digital interface based on DALI protocol.

Note that the output current at 100% level is determined by the driver. The minimum current that can be supplied by the driver is specified in the datasheet. The lowest dim level is defined by the higher of the two values: Minimum output current or 10% dim level.

The driver also supports many diagnostic features/parameters which can be accessed via the DALI interface, as per D4i Certified Specification.

Standby power consumption

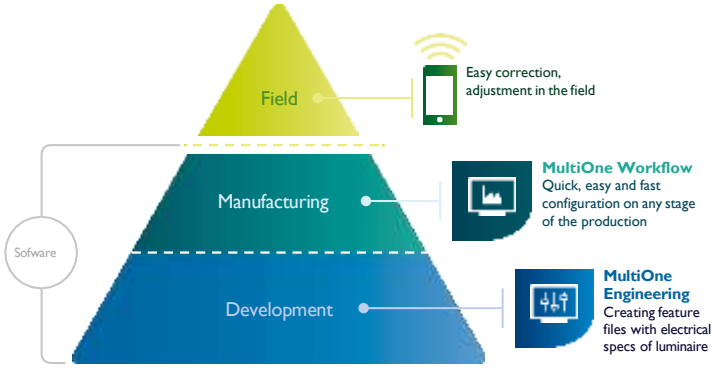
Xitanium LED Xtreme CR drivers consume less than 0.50W per driver when in standby mode. This standby power is excluding power consumed by a sensor connected to the DALI bus and/or +24V auxiliary power supply. The D4i PSU - if enabled- and +24V auxiliary power supply remain active when the driver is in standby mode.

Auxiliary Power Supply (+24VDC)

A 24VDC auxiliary supply is incorporated in Xitanium CR Xtreme drivers to facilitate (transmission) power demands of nodes which the CR bus supply cannot provide due to its limited power capacity. This supply is compliant per Part 150 and shares its common with the D4i PSU common DA-/SGND connector. The driver can withstand a short-circuit of this supply, but the driver output will be pulled down during this short-circuit.

Warning: connecting the + terminals of multiple auxiliary power supplies of multiple drivers in parallel is not supported. These need to be kept separated from each other.

Driver configuration



Introduction

The Xitanium LED Xtreme CR drivers offer a tailored range of controls, enabling customizable luminaire design and performance. It is possible to control light output levels, preset dimming protocols and set system specifications in the factory and even in the complete installations. This can be done with the Philips MultiOne configurator. The MultiOne configurator is an intuitive tool that unlocks the full potential of all configurable drivers from Signify, ensuring that the driver performance matches the needs of the lighting solution. It offers unprecedented flexibility, before, during and after the product installation. Programming of new Xitanium LED Xtreme CR drivers can be done either by SimpleSet or via the DALI interface with the USB2DALI interface.

For more information on MultiOne installation – software and programming: go to www.philips.com/multione.

Control features

How to program the features is explained in the User Manual guide of MultiOne; see the Help function of MultiOne or download it from www.philips.com/multione. In this section the features will be explained in more detail.

Adjustable output current (AOC)

AOC limits the driver output current to match the application requirement. The limited output current is then dimmable over the full user controllable dim range; the AOC level [mA] being the 100% light level.

The default AOC value can be found in the driver datasheet.

Adjustable Light Output (ALO)

ALO limits the light output of the driver to match the application requirement. The limited light output is then dimmable over the full user controllable dim range; the ALO level [%] being the 100% light level. Setting an ALO minimum level prevents the light from dropping below the set level during dimming conditions. This is a useful feature if a minimum light level needs to be maintained under all conditions.

ALO can also be used to permanently set the AOC value at a level below the minimum programmable AOC level. E.g. if the min. programmable AOC value of a driver is 200mA while the required AOC value is 160mA then the ALO feature must be enabled and set at 80%.

Depending on driver type, there are two ALO versions available: one version with and one without the option to set the ALO minimum level. Please check the driver datasheet to find out which ALO version is supported.

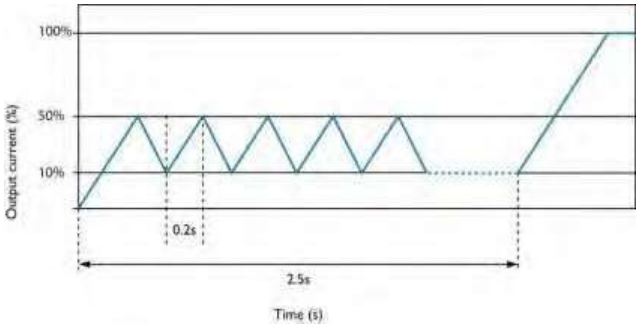
Driver Temperature Limit (DTL)

DTL supports thermal fine tuning of a lighting system via configurable parameters. See section Thermal Design-in for more details. Please check the driver datasheet to check whether DTL is supported.

Constant Light Output (CLO)

CLO will gradually increase the light level over time from an initial lower light level up to 100% light level in order to compensate for LED module depreciation over life. It can also serve as a means to reduce energy consumption.

CLO settings include enabling disabling and redefining the CLO dimming curve. Changes are effective immediately. The allowed range for CLO is 0-100% with 1% increments (note that 0% results in the output being switched off. The 100% level corresponds with the configured AOC value or AOC + ALO values.



End Of Life (EOL)

EOL is providing a visual notification to a customer that the LED module has reached the end of its manufacturer- specified life and that replacement is recommended.

Once active, a visual indication is given at each power-up of the driver, after which the LEDs will flash for 2.5 seconds before normal operation is continued. See the illustration on the left.

A time slider is provided to set back the operating hours to zero in case the CLO feature is used. This will prevent a too high initial lumen output from a new replacement LED module.

Adjustable Start-up Time (AST)

The AST feature enables a time-adjustable gradual increase of the light level after powering up the driver, ensuring a smooth and comfortable transition from a low light level to the full light level. This ramp-up time is configurable via MultiOne software.

The initial low light level is fixed and will be either 10% of the configured AOC value or the absolute minimum output current of the driver, depending on which lower limit is reached first.

Note: the AST feature does not in any way influence the driver inrush current at mains turn-on.

Dynadimmer

The Integrated Dynadimmer is an autonomous dimming control developed by Signify that enables simple, pre-programmed customized multistep dimming without the need for external control infrastructure. Its main function is energy reduction by reducing light levels or switching off the light during the night when it is not required to have full light output.

Dynadimmer operation override is possible by DALI commands at any time. Once in override mode, the driver will remain in DALI mode until the next mains power cycle.

This override does not interfere with the Dynadimmer synchronization algorithm.

Dynadimmer working principle

Dynadimmer offers two options: time-based and location based.

The time-based option does not compensate for seasonal changes and starts executing the Dynadimmer profile as soon as power is applied to the driver. This option is best suited for applications with fixed power-on/off timing.

However, in most outdoor applications the timing will vary per season and the dimming schedule should thus be adapted accordingly. For this Signify has introduced the programmable Dynadimmer feature which simply uses the driver power-on time duration as reference.

Based on the average power-on time of the previous periods, the driver is able to estimate the current time of day and uses this as a virtual clock time which serves as reference for the dimming schedule programmed by the user.

The Dynadimmer feature relies on a regular power-on time from one night to the next. Typically, the power-on time is based on sunset and sunrise and its duration will vary gradually throughout the seasons. The Dynadimmer therefore calculates the power-on time average of the five last preceding stable nights. A stable night is regarded as a night with a power-on time of at least four hours within a tolerance of one hour that equals the latest calculated average power-on time. This implies that after first installation the Dynadimmer will need three stable nights to be able to calculate the virtual clock time required for the programmed dimming schedule. During this synchronization phase the Dynadimmer will not dim the light output for the first three nights.

Depending on geographical location or on the application, the switch-on time is not always evenly distributed around midnight. To be able compensate for the difference in sunrise and sunset over a time zone, the user can set his geographical location in both western or eastern direction.

Dynadimmer working principe (cont'd)

For example, if the sunset in Berlin is at 19:00 this will be in Poland at 18:25 and in Portugal 19:35. To be able to synchronize the absolute clock time with a photocell-controlled system in Poland the offset should be set at -25 minutes and for Portugal +35 minutes.

By default, the mid position of a time zone (in above time-zone this will be close to Berlin) will be selected; in most cases this default value will be accurate enough.

The midnight shift option is of course not available when the Time-based option has been selected.

Since the frequency of the power grid is used the accuracy of timing is very high and is typically far within 1%. Nearby luminaires connected on the same on/off cycle and programmed with the same Dynadimmer schedule will dim down and up simultaneously.

In normal operation mode (after the synchronization phase) the Dynadimmer will handle maintenance or short power interruption in correct ways, thus preventing dimming schedule disruptions.

Dynadimmer attention points

If after synchronization the change in power-on time is more than one hour, then the driver does not need three new power-on cycles for re-synchronization. Instead, the driver looks further back in the history of previous power-on cycles to calculate the virtual clock time. As long as there are three stable power-on cycles in the history of the last five power-on cycles, with all three having the same duration (i.e. less than one hour difference) the driver will still dim as scheduled. This mechanism will prevent disruptions of the Dynadimmer dimming behavior due to occasional mains black- and brownouts.

If the difference in power-on time duration is less than one hour, then this will represent normal operation in which the driver will average the last three power-on times as reference to calculate the virtual clock time. The dimming schedule will stay active while gradually adapting to the new power-on time. Below examples show the sequence of events as the on-time changes.

Influence of mains interruption (blackout):

If the mains voltage drops to zero for more than one second, then the driver will record this as a power-off event and will try to re-calculate the virtual clock time again when power is restored. This only means that the driver will need to synchronize to the regular power-on time duration (see previous section). If the duration of a mains voltage drop to 0V is less than one second, then the Dynadimmer operation will continue and the Dynadimmer dimming cycle remains unaffected.

Influence of mains voltage dip (brownout):

The driver is robust enough to handle a mains voltage dip down to 25VAC for one minute without disruptions of the Dynadimmer timing. Light output will be less and may even drop to zero for the duration of the mains dip, but the dimming schedule will not be affected.

Dynadimmer attention points (cont'd)

Temporary mains power-off (maintenance at night, blackout): If the power outage occurs within the first 4 hours of the night then a new night will be calculated on the remaining on-time. For the next night, the average on-time before the outage will be used as reference. Hence, it won't affect the dimming duration of the next night and regular dimming will result. If the power outage takes place after more than four hours and not closer than at least one hour before the expected end of the night, then this deviating on-time will be taken into account to calculate the average power-on time of the five preceding nights. However, it won't affect the dimming duration of the next night. If the outage takes place within one hour before the expected end of the night, then this deviating power-on time will be taken into account as a valid night to calculate the average power-on time of the three preceding nights. This will then temporarily affect the dimming behavior.

Temporary mains power-on (maintenance during the day):

If the power-on time is less than four hours, then this deviating power-on time will be ignored and the average power-on time before the deviation will be used as reference. Hence, it won't affect the dimming duration of the next night. If the power-on time is more than four hours and at least one hour less than the average power-on time of the three preceding nights, then this deviating power-on time will be taken into account to calculate the average on-time of the five preceding nights. However, it won't affect the dimming duration of the next night.

- **Notes:**
  The Dynadimmer does not compensate stepwise for the 1-hour shift in time due to daylight savings time changes in fall and spring.
- The Dynadimmer feature does **not** support 24h applications (e.g. tunnels, warehouses). A power off/on cycle is required every 24 hours

D4i Power Supply Unit (D4i PSU)

Xitanium LED Xtreme CR drivers are equipped with an integrated Power Supply Unit (PSU) to power a luminaire controller via the D4i communication bus. This PSU can be disabled if power is not needed. The PSU must be disabled if more than four D4i PSUs are connected in parallel in order to prevent DALI bus current exceeding 250mA.

Output Current dependencies

The actual output current in the application depends on configuration of those driver features which influence output current and which are enabled or activated, like ALO, CLO, DALI dim level, DTL, Dynadimmer.

The reference for output current is defined by the configured AOC value in mA. The actual output current then follows the values as configured for the several enabled features.

In formula, the actual output current is:

AOC x ALO x CLO x Dynadimmer x DTL

AOC x ALO x CLO x CR dim level x DTL

AOC x ALO x CLO x DTL

Example 1:

Driver AOC = 700mA, CLO = 70%, Dynadimmer level = 50% and ALO = 80% and driver Tc is such that DTL dictates 50% dimming. Actual output current is then 98mA or minimum specified driver output current, whichever value is reached first.

OEM Write Protection (OWP)

By enabling the OWP feature the OEM can prevent unauthorized changes of crucal driver settings. The OWP feature is based on password protection that will be set in the driver so the preconfigured data of OEM write-protected driver features can only be modified by providing the correct password. Depending on the type of driver the OEM can protect the following:

- a set of features (fixed)
- a selection of individual features (free selection)

In order to indicate which features are locked, you will see a small lock symbol on each feature while trying to write the driver.

How to program this feature is described in the user manual of MultiOne Engineering at www.philips.com/multione.

The password is needed to change the protected features of this driver. Without the password these features cannot be modified.

Encrypted in the feature file, the password can be easy programmed in production via the MultiOne workflow software. New drivers or replacement drivers can be programmed on this way. Already programmed drivers with password are protected and will give an error. They can only be changed using the correct password.

It is important for the OEM to set up a password management system, keeping feature file and password together in the BoM of the luminaire. The password management is under the responsibility of the OEM who sets it. In case of a lost password, the OEM is advised to contact the local Signify representative.

Compliance and approval

Driver compliances and approvals can be found in the published driver Declarations of Conformity (DoC) and ENEC/CB certificates as published on www.philips.com/oem. For further questions please contact your local Signify sales representative.

System Disposal

We recommend that the Xitanium LED drivers and its components are disposed of in an appropriate way at the end of their (economic) lifetime. The drivers are in effect normal pieces of electronic equipment containing components that are currently not considered to be harmful to the environment. We therefore recommend that these parts are disposed of as normal electronic waste, in accordance with local regulations.

Disclaimer

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