

PHILIPS

Xitanium

LED Xtreme drivers



Design-in Guide

Reliable Xtreme technology for demanding LED applications

May 2019

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Introduction to this guide



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

This edition describes these configurable drivers:

- FULL Prog (Xi FP sXt)
- LITE Prog (Xi LP sXt)
- BASIC Prog (Xi BP)

We advise you to consult our websites for the latest up-to-date information.

Applications

The Xitanium LED Xtreme drivers are designed to operate LED solutions for general outdoor and industrial lighting like road, street, tunnel and highway applications. If you use Philips LED drivers in combination with Philips LED modules, specific design-in guides and driver datasheets are available from the below mentioned technology websites.

Information and support

Please consult your local Philips office or visit:
www.philips.com/oem
www.philips.com/multione

Design-in support

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

Document overview

In order to provide information in the best possible way, Philips' philosophy on product documentation is the following.

- 7 ca a YfVU ``YUZyh VbHJbgdfcXi VmZLa j mjbZcfa Ujcb/ ' gngHa ' Vza VjbHjcbg
- 8 UHjYYhVbHJbg hY' dfcXi Vm g dYVjVgYVjVhcbg
- 8 Yg j b j b i j XY XYg VjVg\ck hY' dfcXi Vm must be used
- 8 f j Yf VfhZVhYg j gni d!hc!XUH Vza d j UbW k j h fYj Ubh dfcXi Vm g LbXfXg

All these documents can be found on the download page of the OEM website www.philips.com/oem. If you require any further information or support please consult your local Philips office.

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!

Important installation instructions

- Do not use damaged products.
- 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 Xtreme drivers are suitable for built-in use only and must be protected against ingress of and exposure to including but not limited to snow, water, ice, 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 Philips with reference to minimum required luminaire IP rating serves only as non-binding guidance; a higher IP rating may be required under certain application conditions to protect the driver. Common sense needs to be used in order to define the proper luminaire IP rating for the intended 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 to be connected 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 needs to be provided whenever possible or applicable.
- Philips Design-in support is available; please contact your Philips sales representative.

Xitanium LED Xtreme drivers



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Xitanium LED Xtreme driver families: general feature overview

	Xitanium BASIC Prog	Xitanium LITE Prog	Xitanium FULL Prog
Lifetime 100kHrs	•	•	•
Surge Immunity medium / high	•/-	-/•	-/•
I-10V		•	
LineSwitch Single-Step / 3-Step		•/-	-/•
Adjustable Output Current (AOC)	•	•	•
SimpleSet®		•	•
Constant Light Output, full (CLO)			•
Constant Light Output, basic (CLO LITE)		•	
Dynadimmer 5-step incl. light turn-off			•
Dynadimmer 5-step, no light turn-off		•	
Dynadimmer LITE 1-step, no light turn-off		•	
Diagnostics, full			•
Diagnostics, basic		•	
Module Temperature Protection (MTP)		•	•
ThermalGuard		•	•
Driver Temperature Limit (DTL)		•	•
DALI			•
Mains voltage dimming (AmpDim)			•
MainsGuard		•	•
DC-Emergency (DCemDim)			•
Adjustable Startup Time (AST)			•
Reset LED module operating hours			•
OEM Write Protection (OWP)			Xi FP 165W C170

Please refer to the applicable driver datasheet for an exact feature overview

Xitanium LED Xtreme drivers

Xitanium LED Xtreme drivers are designed to enable LED solution for general lighting applications. In the coming years LEDs will continue to increase in efficiency, creating generation and complexity challenges for OEMs. With Xitanium LED Xtreme drivers, flexibility in luminaire design is assured thanks to adjustable output current flexibility. Application-oriented operating windows offer the flexibility required to provide the stable lumen output and light quality levels that lighting specifiers and architects demand. The adjustable output current also enables operation of various LED PCB solutions from different manufacturers.

Xitanium LED Xtreme driver versions

The Xitanium LED Xtreme drivers described in this guide are available in following versions:

Xitanium FULL Prog (Xi FP sXt)

Xitanium LITE Prog (Xi LP sXt)

Xitanium BASIC Prog (Xi BP)

The overview on the left lists in more detail the differences between available features of the different driver versions. These drivers come in a wide range of power ratings and sizes that enable the most popular light output levels for general outdoor and highbay applications. It is always highly recommended to check our latest Xitanium LED Xtreme driver leaflet for the most up-to-date overview of our range. This leaflet can be downloaded at www.philips.com/oem.

Detailed technical specifications can be found in the Xitanium driver datasheets at www.philips.com/oem.

Configurability Interface (tooling)

The Xitanium FP/LP/BP LED Xtreme drivers are programmable. A tailored package of features and parameters in these drivers can be configured via a specific tool and interface to the tool. This tool is the MultiOne Configurator. There are two types of interface technology used to communicate with this tool:

- DALI
- SimpleSet

SimpleSet

Philips SimpleSet new wireless programming technology allows luminaire manufacturers to quickly and easily program Xitanium LED Xtreme 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 or contact your local Philips representative.

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”.

LED Module Temperature Protection (MTP)

Adjustable limitation of thermal stress on the LED module is made possible by the Module Temperature Protection (MTP) feature combined with an NTC resistor integrated in the LED module. More details about MTP and the NTC resistor can be found in the Section “Thermal design-in”.

Driver Temperature Limit (DTL)

Adjustable limitation of thermal stress on the driver is made possible by the DTL feature on select drivers by means of an NTC resistor integrated in the driver. Depending on luminaire design, DTL can also be used as alternative for MTP. More details about DTL can be found in the Section “Thermal design-in”.

Dimming interfaces

Interfacing with the Xitanium LED Xtreme drivers can be done via below interfaces:

- DALI
- 1-10V
- LineSwitch
- Mains input (AmpDim)

Supported interfaces can be found in the naming of the drivers (see section “Driver naming”).

Amplitude Modulation (AM) dimming

Philips Xitanium LED Xtreme 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 most smooth 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 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 be expected.

The ripple value of both LF and HF components are specified in the driver datasheet. The values for TLA parameters short term flicker value ($P_{st,lm}$) and Stroboscopic Visibility Measure (SVM) are below 0.5 and 1 for all Xitanium Xtreme drivers.

Hot-wiring

Philips LED Xtreme drivers do not support hot-wiring. In order to prevent damage to LED module and/or driver, 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.

DC mains operation

Select Xitanium LED Xtreme drivers are allowed to be connected to a DC power grid (e.g. central emergency system). The driver behavior once switched to DC input voltage can be programmed via MultiOne software. More details about DC input voltage suitability can be found in the driver datasheet.

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. Select 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

Xitanium LED Xtreme drivers are equipped with a Diagnostics functionality. The purpose of Diagnostics is to gather information and help diagnose the history of the driver and connected LED module. The Diagnostics feature consist mainly of counters which keep track of specific variables like the number of startups of the driver, operating hours, temperature of driver and LED module, output current and voltages etc. When the driver is shutdown the diagnostics data is stored automatically in non-volatile memory.

Depending on driver type, either a full diagnostic overview is available (all Xi FP, select Xi LP versions) or a basic overview is available (select Xi LP versions).

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

Use in explosive atmospheres



Note: Xitanium LED Xtreme drivers are **not** certified per standard IEC/EN 60079 and latest EU directive ATEX for use in hazardous environments in which there is risk of explosion. Therefore, Xitanium LED Xtreme drivers do not directly support application in luminaires and lighting systems in such environments.

Driver naming

Xitanium LED Xtreme drivers are part of a specific naming system. GY'H.Y'example Velow.

Xi FP 330W 2:0.2-0.75A SNLDAE 230V C240 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
N = NTC interface
L = LineSwitch interface
1 = 1-10V interface
D = DALI interface
A = AmpDim interface
E = DC Emergency
M = Energy Metering
P = Auxiliary Power supply
AOC/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
SR = Sensor Ready

Type of LED driver:

Xitanium
Xi = Xitanium

Mechanical Design-in

Dimensions

Xitanium LED Xtreme 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 www.philips.com/oem.

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 the tool as shown here (LCN9620), the minimum 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.



LCN9620 SimpleSet interface tool

Thermal Design-In

Introduction

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

1. The LED driver and the relationship between the t_c point temperature and lifetime of the LED driver.
2. The LED driver and its non-adjustable response to driver overheating (ThermalGuard).
3. The LED driver and configurable Driver Temperature Limit (DTL) to maximize driver and possibly LED module lifetime in the application.
4. Module Temperature Protection (MTP) function to safeguard the specified LED module lumen maintenance and lifetime.

In order to facilitate design-in of LED drivers, the critical thermal management points of the LED driver are set out in this section. In Philips' product design phase all possible precautions have been taken to keep the component temperature as low as possible. However, the design of the luminaire and the ability to guide the heat out of the luminaire are of utmost importance. If these thermal points are taken into account this will ensure the optimum performance and lifetime of the system.

Driver case temperature point (t_c point)

To achieve optimal lifetime and reliability, it is critical that the temperatures of the components in the driver remains within their ratings. The driver case point temperature (t_c) is a 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.

How to measure t_c point temperature

Its temperature can be measured using a thermocouple that is firmly glued to the surface of the driver housing. For a representative measurement the temperature of the temperature case 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).

Note: Xi FP drivers allow for a driver-internal temperature readout through the MultiOne Diagnostics feature. This readout is purely for diagnostic purposes and does not represent the driver t_c point temperature. Therefore, this readout should **not** be used to define thermal suitability of the driver in the application.



Relation between t_c temperature and ambient

The t_c temperature increases, by approximation, linearly with the driver ambient temperature (t_a). The temperature offset between driver t_a and t_c depends on the thermal design of the luminaire and the actual delivered output power relative to the specified nominal output power. A lower output power allows for a higher driver ambient temperature as long as the maximum specified driver $t_{c(max)}$ temperature is not exceeded.

There are two driver t_c values specified with corresponding lifetimes: $t_c(\text{life})$ and $t_c(\text{max})$. The rated driver lifetime can be achieved if the t_c value remains between $t_a(\text{min})$ and $t_c(\text{life})$. Reduced driver lifetime will result if the driver is running up to $t_c(\text{max})$. The approved driver ambient temperature range and specified $t_c(\text{life})$ and $t_c(\text{max})$ values and corresponding driver lifetimes are specified in the driver datasheet.



Warning: The specified $t_c(\text{max})$ and minimum t_a temperature limit values are not allowed to be exceeded in the application; otherwise driver warranty will be void.



Warning: 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 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 t_c point.

ThermalGuard

In a thermally well-designed lighting system the specified $t_c(\text{max})$ value will not be exceeded. However, under extreme hot application 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 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.

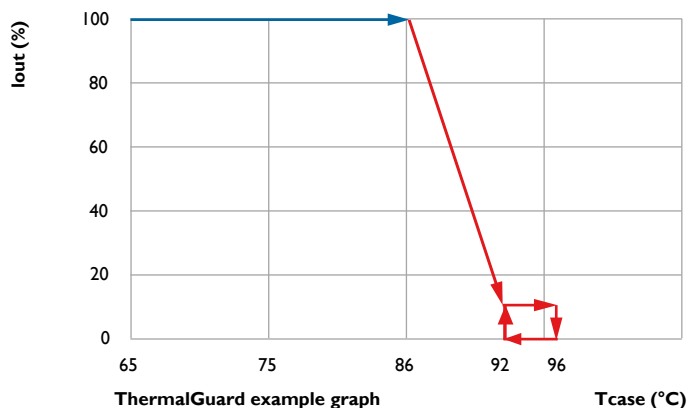
This thermal driver protection feature is called ThermalGuard and its goal is to get the driver back in normal operating thermal conditions in which the specified driver lifetime can be met. Each driver type has its own specific factory default overheating behavior and it can be found as a ThermalGuard graph in the driver datasheet.



Warning: the ThermalGuard feature is designed as an emergency measure to protect the driver. It is **not** intended for structural activation to compensate for a poor thermal design of a lighting system.



Note: Xi LP drivers equipped with ThermalGuard do not support output shutdown in case of driver overheating; the output current will be reduced to min. 10% of the rated AOC value. ThermalGuard on the other hand does support output shutdown reg. select Xi FP drivers. Refer to the driver datasheet for more details.

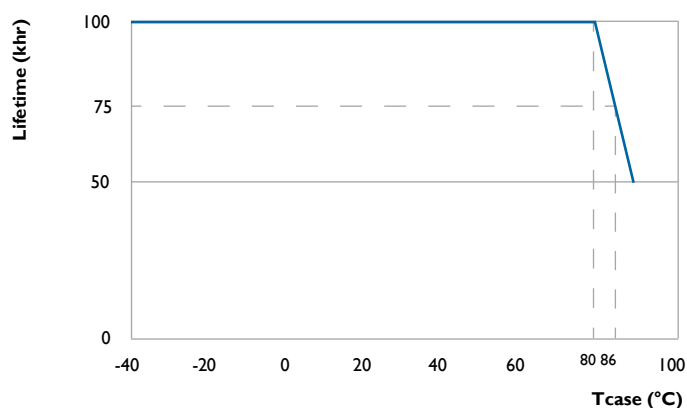
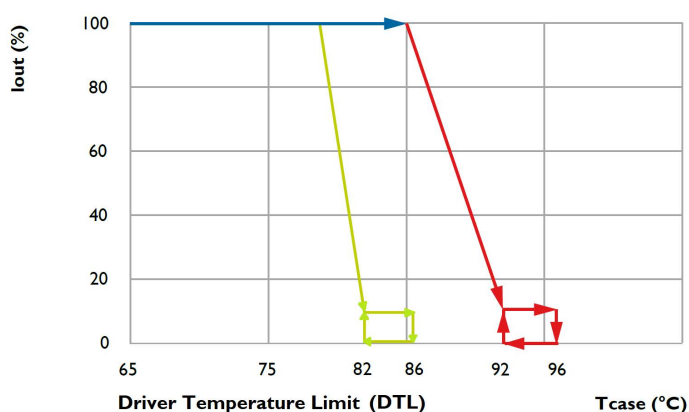


Shown on the left is an *example* graph of the ThermalGuard feature. In this example, the output current is reduced from t_c point temperature = 86°C onwards down to 10% at 92°C. Between 92°C and 96°C the output current will remain at 10%. If the output current reduction is sufficient to decrease the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

If the 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 (nuisance).

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 ThermalGuard feature called DTL (Driver Temperature Limit) enables this by offering an adjustable t_c point temperature threshold at which the output current is reduced and possibly be switched off. DTL configuration can be done by MultiOne software. By factory default, the DTL feature is configured per the specified ThermalGuard graph for a driver.



Shown on the left are a DTL/ThermalGuard 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 represent ThermalGuard behavior. In this example, the output current is reduced from t_c point temperature of 80°C onwards and the t_c point will not exceed 86°C whereas it would have been allowed to reach up to 96°C without this specific DTL profile.



Warning: the DTL t_c point threshold temperature at which the output current should be reduced must not be set too low. Otherwise, undesired light output reduction may result during normal operating conditions. A meticulous thermal investigation of the driver application is required to ensure that the configured DTL threshold occurs neither at too low nor at too high driver operating temperature conditions.

The DTL feature can also be applied as a substitute for Module Temperature Protection (MTP) in order 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!



Note: the DTL feature does not support output shutdown in case of driver overheating reg. Xi LP drivers; the output current will be reduced to min. 10% of the rated AOC value. DTL on the other hand does support output shutdown reg. select Xi FP drivers. Please refer to the datasheet for more details.

LED Module Temperature Protection (MTP)

This feature helps to protect the LED module when operated during abnormal thermal application conditions. The thermal design of a LED module should be designed in such a way that the specified temperature of the LED module ($t_c(\text{life})$ or $t_c(\text{max})$) is not exceeded under normal application conditions. The utilization of an NTC resistor interface (Negative Temperature Coefficient resistor) serves the purpose to help achieve the useful lifetime of the LED module if external thermal influences result in the temperature for lifetime $t_c(\text{life})$ being exceeded. If this occurs then the light output will be reduced to keep the temperature of the LED module below a predefined critical temperature.

Philips Xi FP and Xi LP SN drivers are by default configured for the following three standard NTC types:

1. 10 kilo Ohm NTC - Murata, p/n NCP18XH103J03R
2. 15 kilo Ohm NTC - Vishay, p/n NTCS0805E3153GMT (previous p/n: 2381 615 54153)
3. 15 kilo Ohm NTC - Murata, p/n NCP15XW153E03RC (+ separate 390 ohms resistor in series with the NTC)

Other NTC types are supported as long as they fall within a 5,000 ... 25,000 Ohm resistance range. The applicable values for $R(25^\circ\text{C})$ and β however need to be specified separately during MTP configuration in MultiOne for proper MTP behavior.

MTP behavior setting

It is possible to set the temperature at which the MTP feature is activated, defined by "MTP warn" and the slope, defined by "MTP max". Using the MultiOne Configurator software these settings can be changed.



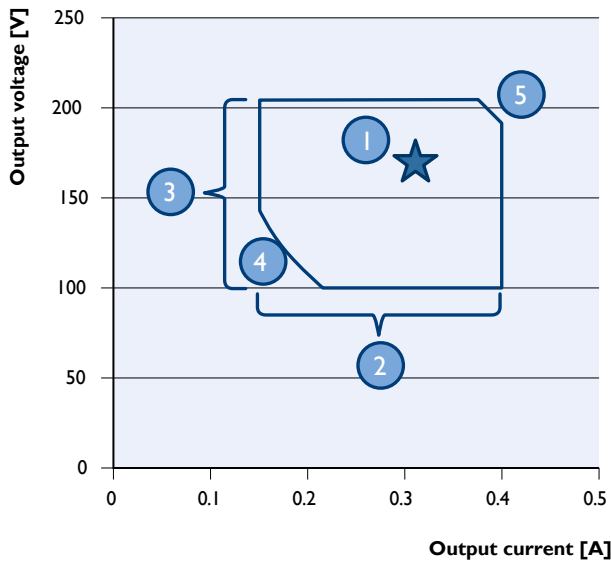
Note: MTP does not support output shutdown in case of LED module overheating reg. Xi LP SN drivers; the output current will be reduced to max. 10% of the rated AOC value. MTP on the other hand does support output shutdown reg. Xi FP drivers.



Warning: follow the instructions below for reliable MTP behavior and to prevent damage to the driver NTC interface.

- Do not combine the NTC ground connection with the LED - connection. These two connections must be kept separate.
- The length of each wire between the NTC driver interface and the NTC on the LED module is not allowed to exceed 60cm. Do not use shielded wiring.
- It is neither allowed to connect multiple NTC inputs from multiple drivers in parallel nor to have multiple NTC interfaces share a common connection. Always keep multiple NTC interfaces fully separated from each other.

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
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 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 string V_f) 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. Drivers with SimpleSet functionality can be configured using the Philips MultiOne software and SimpleSet interface.
2. DALI driver versions can be programmed both via SimpleSet and DALI interface. More information can be obtained at www.philips.com/multione.



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

Dual-channel operation:

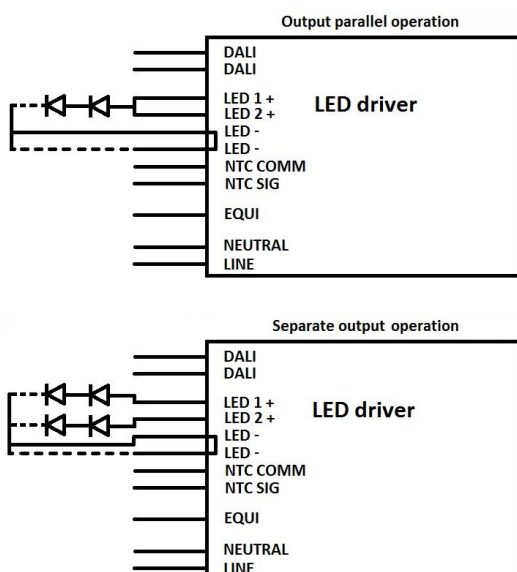
Drivers with a dual-channel output enable higher output current by connecting the two separate outputs in parallel. The actual output current will then be twice the configured value for AOC.

The outputs may also be connected separate from each other. The LED module voltage of the two channels is then allowed to be different from each other. The configured AOC value always applies to both outputs simultaneously.

See the connection diagrams on the left for more details.



Note: The two outputs of a dual-channel driver share a common minus terminal inside the driver. Therefore, the two outputs **cannot** be put in series.



Dual-channel output connection overview

How to Select the 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 the available drivers, please refer to www.philips.com/oem.

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 75W LP 0.2 – 0.7A SI 230 V S240 sXt, the minimum programmable driver current is 0.2A and maximum is 0.7A.
5. Does the required LED voltage fit the voltage range of the driver? The exact values can be found 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 150W LP 0.3-1.0A SL 230V S240 sXt, the maximum output power is 150W.
7. Choose the preferred dimming method. Please refer to the section about naming of the drivers to know what the naming indicates about dimming options.

Programming the output current

The Xitanium LED Xtreme 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 drivers can be done by both the DALI and/or via the SimpleSet interface. The driver name indicates which interface is supported.

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 drivers are equipped with Wago brand or equivalent type push-in connectors. The mains, LineSwitch and Equipotential connectors are -depending on driver type - Wago type 804 or 250 while the DALI, I-10V and LED output connectors are Wago type 805 or 250. All connectors accept stranded, solid core and crimped wires. More info about connectivity (wiring diagram, wire diameters, strip length) can be found in the driver datasheet.



Note: although the driver connectors allow for quite small wire cross section areas (down to 0.2mm^2) it is recommended for optimal connectivity to use mains and LED output wires having at least 0.5mm^2 cross section area.

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

In some scenarios two wires need to be connected to one connector terminal. In this 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 drivers are designed for operation and performance by power sources or grids providing a clean and symmetric sinusoidal voltage wave form and do not support operation on power sources including but not limited to having e.g. a square-wave voltage or a "modified sine wave" form.

Xitanium LED Xtreme 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 a 3-phase grid.

Low and high mains voltage

Xitanium LED Xtreme 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 driver performance it is always recommended to operate drivers within the specified voltage performance range.

Low mains voltage for dimming (AmpDim)

With AmpDim enabled, the drivers are designed to perform below the specified minimum values for operational safety and performance mains voltage that would otherwise apply. Low mains voltage can be used for dimming in combination with the AmpDim feature. This feature can be programmed to regulate the output power when the input voltage drops below a programmed level.

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 (up to 2.5 times) 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 undervoltage 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 drivers now have a new 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 eventually is shut down. A small hysteresis of 5 ... 10V 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.

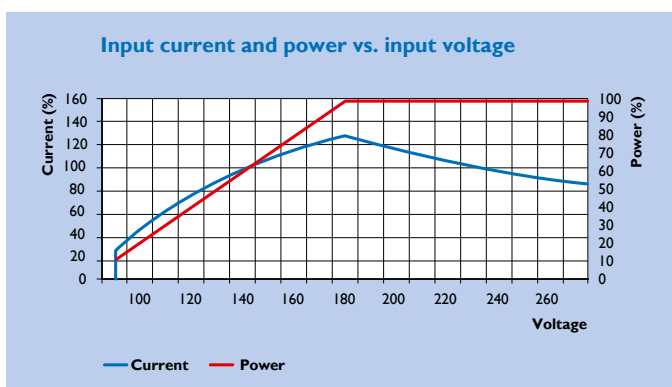
Main benefits of MainsGuard are:

- 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



Note: the MainsGuard feature is properly coordinated with the AmpDim feature in order to prevent interference between these two features.

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.



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

Excessive high mains voltage

An excessive high mains voltage will stress the driver and have an adverse effect on the lifetime. Xitanium LED Xtreme 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.

Use of LineSwitch in a 3-phase 230/400VAC grid

The Xitanium LED Xtreme drivers allow supplying power from another phase than the one controlling the LineSwitch interface.

Power grids

Xitanium Xtreme LED 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".



Warning: certain restrictions apply for use in IT grids. Direct connection of Xitanium LED Xtreme 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

Xitanium Xtreme LED 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.

DC emergency operation (DCemDim) and fusing

Depending on driver type, the driver may be certified acc. IEC 61347-2-13 Part J for operation on a DC input voltage. As a result, the driver enables application in emergency luminaires in compliance with IEC 60598-2-22 *excluding high-risk task areas*. These drivers support operation both a flat DC input voltage as well as operation on rectified sinewave "joker" input voltage.

On select Xi FP drivers, the DC Emergency Dim feature named DCemDim is available. This feature allows a pre-defined dim level of the driver output to which the driver will switch over automatically once connected to a DC input voltage. Please note that the output current cannot reach more than 60% of the configured AOC value during DC operation (exception: Xi FP 165W C170 drivers).

The mains input of DC-rated drivers is not polarity-sensitive for DC input voltage and the driver is fully CISPR15 EMC-compliant when operated on a DC grid. Specific DC input voltage values can be found in the driver datasheet. The DC input is allowed to be a "joker voltage" (inverted sine wave).

Depending on driver type, EL marking may apply. For those drivers the corresponding Emergency Output Factor EOFx range can be found in the driver datasheet.

Nearly all Xi FP drivers are now equipped with an internal fuse rated for AC & DC voltage operation. thus not requiring an external DC voltage rated fuse in case of DC operation. Please refer to the driver datasheet for more details.

If the driver is not yet equipped with an internal fuse rated for DC voltage then the use of an external, luminaire-based DC rated fuse with sufficient DC voltage rating and breaking capacity is required. Suggested fuses (per each driver) are:

- 3.15A 400VDC 1.5kA BC, 5x20mm Littelfuse Slo-Blo® 477
- 3.15A 250VDC 10kA BC, 5x20mm Siba Fast 7008913,3.15
- 3.15A 400VDC 30kA BC, 6.3x32mm Siba gPV 7006526,3.15

More on setting parameters of DCemDim can be found in the section for Controllability. Specific DC input requirements can be found in the driver datasheet.



Note: The allowed DC input voltage ranges for safety and performance are listed in the driver datasheet. Values outside that range will have an adverse effect on the driver performance and reliability.

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 or a fuse to melt. In such a case, either one or a combination of the following measures need to be taken to prevent nuisance tripping:

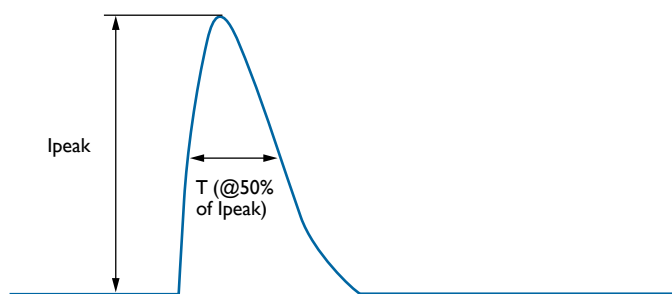
- Replace existing MCB for a less sensitive type (e.g. exchange B type for C type).
- Distribute the group of drivers over multiple MCB groups or phases.
- Power up drivers sequentially instead of simultaneously.

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 on p. 32).
- 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 amount of drivers to be connected to a MCB or fuse. Philips has not tested the 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.



Graphical representation of inrush current

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
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 amount of drivers in the table above only serves as guidance. The actual maximum amount in the application may differ; it is dependent on MCB brand/type and inherent MCB tolerances.

How to Determine the Number of Drivers on a MCB

The maximum recommended amount of drivers connected to a Miniature Circuit Breaker (MCB) 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 amount of drivers for different types of MCB can be calculated by this formula:

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

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 $20 \times 135\% = 27$ drivers.



Note: the conversion table on the left does not apply to the following drivers listed below:

- Xi FP 35-70-110W 0.3-1.0A NLD C150 sXt
- Xitanium FULL PROG 35-70-110W NLD C150 Xt
- Xitanium FULL PROG 35-70-110W NLI C150 Xt
- Xi FP 330W 2:0.2-0.75A SNDAE 230V C240 sXt

The drivers above are equipped with the inrush-limiting feature called SoftStart. As a result, the aggregate steady-state driver input current at total rated output power may limit the maximum amount of drivers that can be connected to a MCB. If the set output power however is set significantly below the rated output power then the max. amount of drivers may be increased until the limit defined by the inrush characteristics is reached.

Therefore, the datasheet for drivers equipped with SoftStart will specify different recommended maximum amounts per MCB: one amount is based on steady-state input current at rated output power (irrespective of MCB type) while a higher amount is based on inrush current characteristics (MCB type-dependent).

How to determine the Number of Drivers on a melting fuse

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

The amount 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 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:

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

Example:

A group of drivers is connected to a 16A gG melting fuse with a melting integral value of $350A^2s$. Specified driver inrush current peak and width is 53A and $300\mu s$. Steady-state input current is 0.9A per driver.

Question: what is the recommended maximum amount 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 $(53)^2 \times (0.8 \times 300 \times 10^{-6}) = 0.68A^2s$ 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 $\sqrt{(175A^2s/0.68A^2s)} = 16$ drivers.

The corresponding steady-state input current is $16 \times 0.9 = 14.4A$. This is above the 80% rating of the 16A fuse. Therefore, the maximum recommended amount of drivers is $(16A \times 0.8) / 0.9 = 14$ drivers.

In this example, the maximum recommended number of drivers is defined by the steady-state input current.



Notes:

- Specified inrush current data is based on a average mains grid with an impedance of $400 m\Omega + 800\mu H$. Deviating mains impedance is of minor importance regarding the maximum amount of drivers per MCB.
- 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 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 drivers have elevated differential-mode and common-mode surge immunity levels which by far surpass the limits 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).



Note: the specified common-mode immunity levels apply with open I-IOV or DALI control interface. Reduced driver/system immunity may result when connecting external control systems. Please check the driver datasheets for details or contact your local Philips representative for further specific technical support.

Touch current

Xitanium LED Xtreme 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 maximum open-load 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 and surge performance 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 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 is verified in Insulation Class I and II configurations.

Remote mounting and EMC

Remote mounting of Xitanium LED Xtreme drivers is allowed as long as the additional summarized voltage drop as function of output current along the LED + and LED – wires is accounted for.

Philips 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 length of the two NTC wires between driver and LED module is not allowed to exceed 60cm; otherwise reliable operation of the MTP feature is not guaranteed.



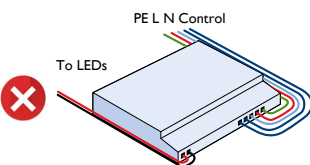
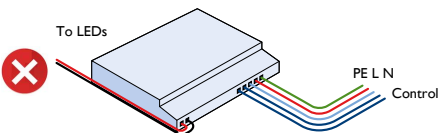
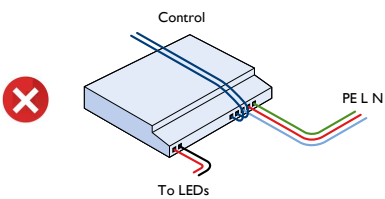
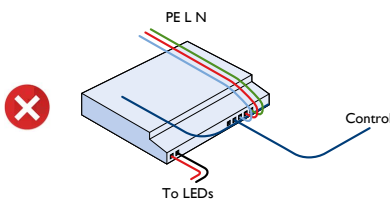
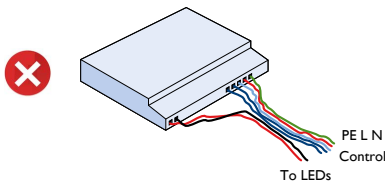
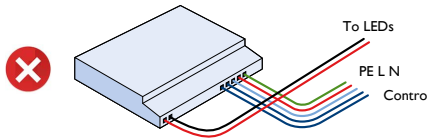
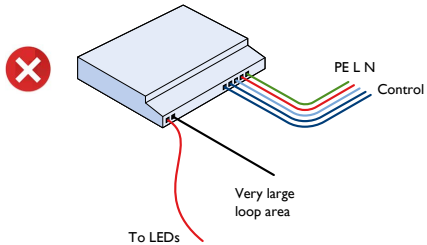
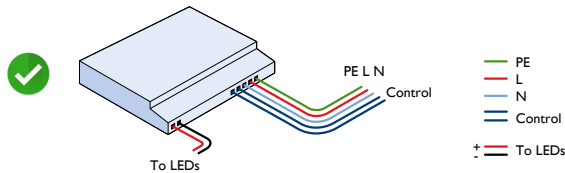
Note: the driver EQUI terminal **must** be connected to the luminaire chassis as well as to Protective Earth (Class I) for optimal EMC performance and surge immunity. Doing so for Class II luminaires is in safety compliance with IEC61347-1, IEC60598-1 and IEC61140 regarding the relation between the driver 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 outputs can be found in the driver datasheet. Insulation classifications of Xitanium LED Xtreme drivers are optimized for design-in in Insulation Class II luminaires as a built-in component 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 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 and control wires separated from the LED output wires. 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.

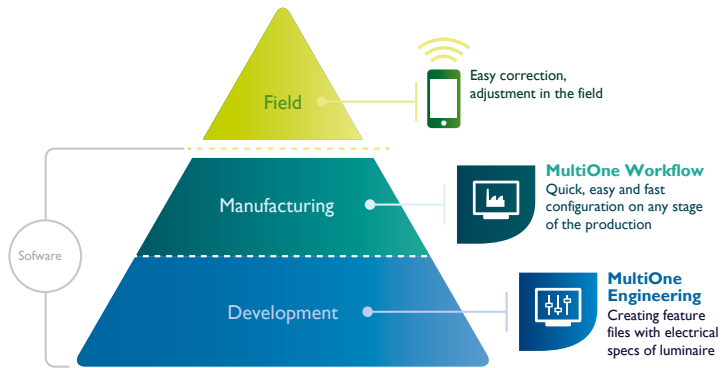


Insulation Class II application: use equipotential bonding wires between all large metal luminaire parts (driver mounting plate, canopy, heat sink etc.) Do not keep large metal parts electrically insulated. **Always** connect the driver equipotential connector (EQUI) for equipotential bonding.

- 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 Philips representative.

Driver configuration



Introduction

Xitanium LED Xtreme drivers offer a 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 an intuitive 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 drivers can be done by both the DALI interface (when present) or via the SimpleSet. In the name of the driver you can see which interface is supported.

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

Control features

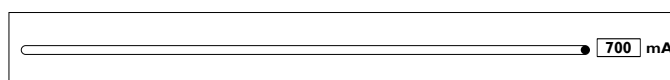
How to program the features is explained in the User Manual guide of MultiOne; see the Help function of MultiOne or download it from www.philips.com/multione. In this section the features will be explained in more detail.

Adjustable output current (AOC)

Applicable to: Xi FP / Xi LP / Xi BP drivers

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)

Applicable to : Xi FP drivers

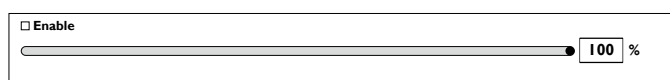
Factory default setting: disabled

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.

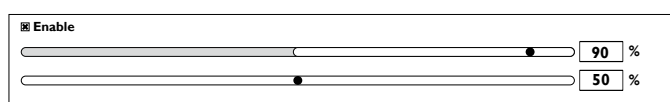
ALO can also be used to permanently set the AOC value at a level below the minimum programmable AOC level. E.g. if the min. programmable AOC value of a driver is 200mA while the required AOC value is 160mA then the ALO feature must be enabled and set at 80%.

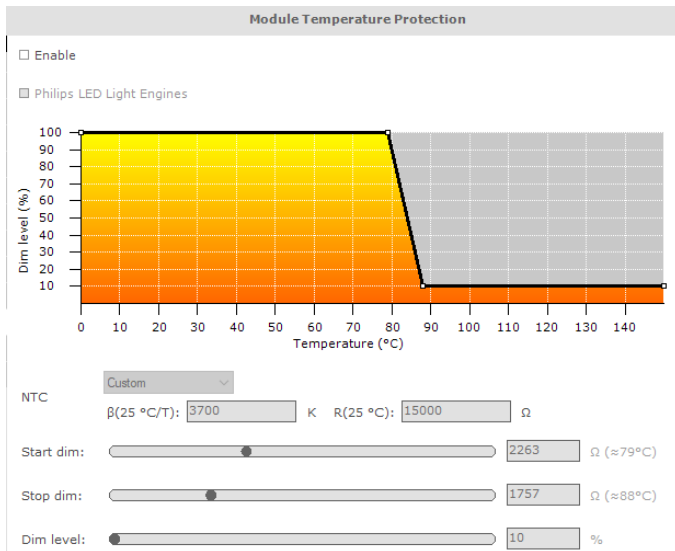
Depending on driver type, there are 2 ALO versions available. Please consult the driver datasheet which ALO version is supported.

- ALO

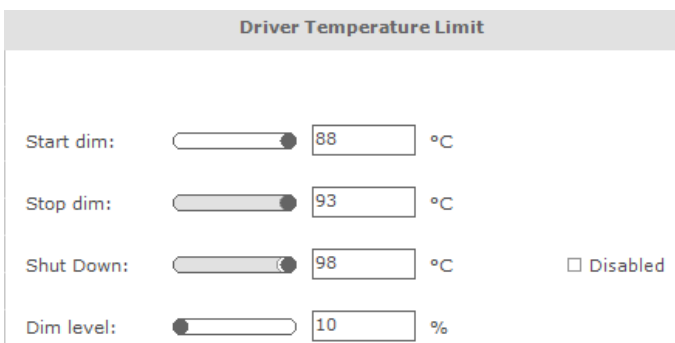


- ALO and ALO min.

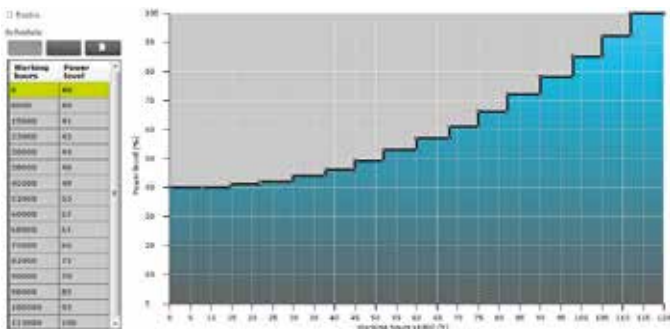




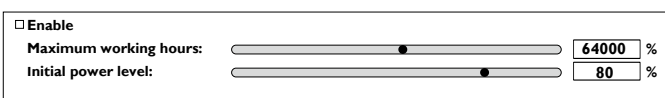
MTP



DTL



CLO



CLO LITE

LED Module Temperature Protection (MTP)

Applicable to: Xi FP / Xi LP SN drivers

Factory default setting: disabled

MTP is the method in which a thermal sensor (NTC resistor) implemented on the LED module is sensed by the driver, which will cut back output current when a predefined (temperature) limit is exceeded in order to protect the LED module from thermal overstress.

The driver accommodates for three NTC resistor choices. See the section Thermal Design-In at page 14 for more details on NTC type.

Driver Temperature Limit (DTL)

Applicable to: **potted** Xi FP and select **potted** Xi LP SI drivers

Factory default setting: enabled with driver-specific ThermalGuard parameters (see datasheet).

Description

Use the Driver Temperature Limit feature to configure the ThermalGuard settings for the driver.

Usage

Use the sliders to changes the values for this feature.

Start dim: Set the temperature at which dimming start.

Stop dim: Set the temperature at which the dimming stops.

Shut Down: Set the temperature at which the output will be turned off. When selecting the **disabled** checkbox, shutdown won't be applied.

Dim level: Set the dim level for the Stop dim temperature.

Please consult the driver datasheet whether DTL is supported.

Constant Light Output (CLO, CLO LITE)

CLO: Applicable to Xi FP drivers

Factory default setting: disabled

CLO LITE: applicable to Xi LP drivers

Factory default setting: disabled

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 includes 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 LEDs being switched off). The 100% level corresponds with the configured AOC value or AOC + ALO values.

CLO LITE can be configured by setting a start point (at 0 hours only) and an end point. The light level between these point will linearly increase.

End of Life (EOL)

Applicable to: Xi FP drivers

Factory default setting: disabled

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

Once active, an 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.

☐ Enable

50,000 h

Adjustable Start-up Time (AST)

Applicable to: Xi FP drivers

AST enables gradual increase of light level at power-up of the driver, ensuring a smooth and comfortable transition from daytime to evening illumination. AST can be programmed to a value between 0 s and 30s, in increments of 1ms.



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

1000 ms

Light Source Operating Hours (LSO)

Applicable to Xi FP drivers

Light Source Operating: set a specific time or reset the operating hours, e.g. after replacing a LED module or driver with another (new) one. When CLO resp. CLO LITE is enabled it is recommended to set the correct light source age.

0 h

DC emergency dimming operation (DCemDim)

Applicable to: Xi FP drivers (except Xi FP NLD)

Factory default setting: enabled

Xi FP drivers are equipped with an auto-detect DC voltage feature. As soon as a DC input voltage is detected, the driver will automatically set the output current to a predefined configurable emergency dimming level.



Note: during DC operation the output current cannot be set higher than 60 % of the programmed AOC value applicable during AC operation.

The driver will ignore all DALI commands when operated at DC input voltage unless the checkbox “Allow dimming” in the DC Emergency tab is selected (Xi FP 165W CI70 only). Please refer to the datasheet to find out whether this function is supported.

☒ Enable
☒ Allow dimming

Emergency level:
 241 [=70%]

Control interface I-10V

Applicable to: Xi LP SI and Xi FP NLI drivers

Factory default setting: enabled, 0-10V/I-10V curve

I-10V dimming provides a traditional way to control the driver output current down to 10% by means of an analog current-controlled voltage source (see graph on the left). The interface is designed to comply with IEC60929 Annex E. The driver dimming interface sources a current of 150µA. The applied I-10V controller should therefore be able to sink the cumulative current sourced by the dimming interfaces of a group of connected drivers and must be of the two-quadrant type.

Depending on driver type, there are two linear dimming curves available that can be selected:

0-10V / I-10V linear curve: (factory default)

- minimum light output at **1V**, max. light output at **8V** and above
- minimum dim level can be set at 10 % and up in 1% increments

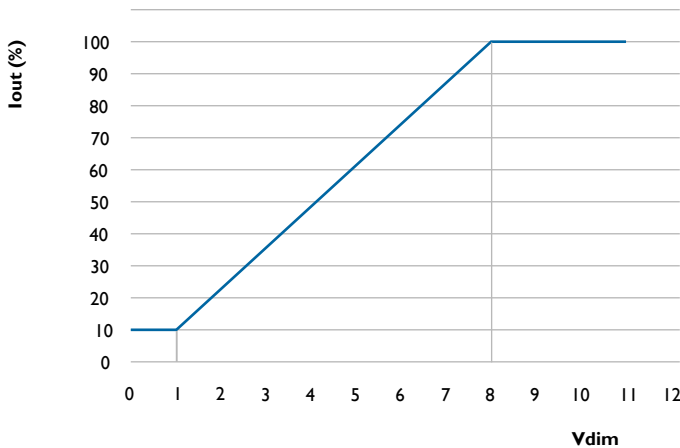
I-9V linear curve:

- minimum light output at **1V**, max. light output at **9V** and above
- minimum dim level has a fixed value of 10 % and cannot be modified

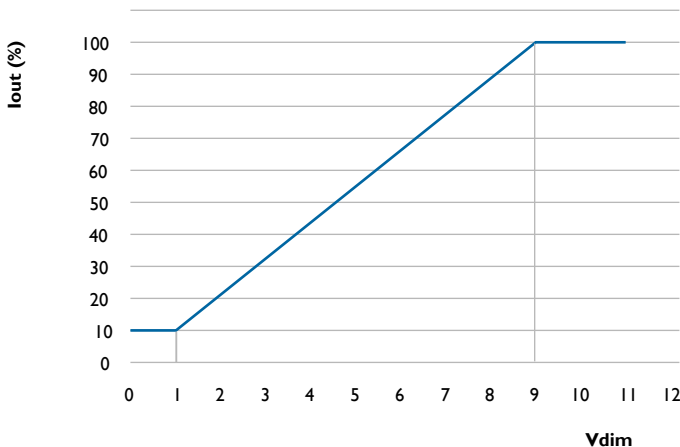
In applications with long I-10V cables there will be a voltage drop which depends on the cable length, number of connected drivers and the wire cross section in mm². The maximum recommended voltage drop on the I-10V dimming wires is 100mV to prevent differences in light level.



Note: the driver output cannot be turned off by pulling down the I-10V interface to 0V. Between 0 and 1V, the minimum light output will be maintained.



Output Current versus Voltage 0-10V / I-10V dimming curve



Output Current versus Voltage I-9V dimming curve

Control interface DALI

Applicable to: Xi FP drivers

Factory default setting: permanently enabled (logarithmic curve)

Digital Addressable Lighting Interface (DALI) is a digital communication protocol commonly used in lighting systems. This protocol is standardized by IEC and there are many control devices from Philips and other manufacturers that communicate using DALI. The voltage across DALI wires is typically 16V and it is polarity insensitive. Using DALI, it is possible to send dimming commands (1-254 levels), set fade rates and fade times, query driver or LED status, etc. The Xitanium LED drivers also respond to public LED-specific DALI commands, for example: Query if the LED module is short-circuit or open-circuit.

For more information on DALI, refer to the IEC specification for DALI protocol. Specific driver DALI compliance can be looked up at www.digitalilluminationinterface.org.



Note: By default, both the DALI interface and LineSwitch interface are enabled with LineSwitch being set as primary interface. On reception of a DALI frame, the driver will switch over to DALI mode and all other interfaces will be ignored until the next mains cycle. If LineSwitch is enabled then the DALI System Fail Level and Power On Level will be inactive. In order to obtain full DALI compatibility in DALI-only applications it is therefore highly recommended to disable the LineSwitch feature via the MultiOne configurator.



Note: The DALI interface of the driver is not designed to handle differential-mode mains voltage. Driver damage may result if mains voltage is applied to both DALI terminals.

DALI curve setting

The DALI dimming curve can be set to linear via MultiOne software by using the Commands tab > Commander > Configuration > Device_Type_6 _Select_Dimming_Curve and setting DTR0 at value 1. Value 0 can be chosen for DTR0 to revert to the logarithmic dimming curve.

LineSwitch

Applicable to: Xi FP / Xi LP SL drivers (except Xi FP SNDAE)

Factory default setting Single-Step: enabled

Factory default setting 3-Step: disabled

The LineSwitch feature requires the use of an extra mains pilot line. This offers a single-step dim solution which enables dimming of groups of luminaires to a predefined level with only a simple switch controlled by a timer, presence detector etc. Dimming to the desired level (Xi FP only: incl. output turn-off) can be achieved by either applying or disconnecting mains voltage to the LineSwitch driver interface. Connecting mains voltage to the LineSwitch interface will lead to a 'High' level (>176VAC). A 'Low' level (<110VAC) is obtained by disconnecting the LineSwitch interface from mains voltage.

Xitanium LED Xtreme drivers are by default programmed with single-step LineSwitch enabled for which the 'Low' level is defined as active (i.e. no dimming when the LineSwitch input is left open). Just like the driver mains input, the LineSwitch interface also has high surge immunity. The immunity level can be found in the driver datasheet.

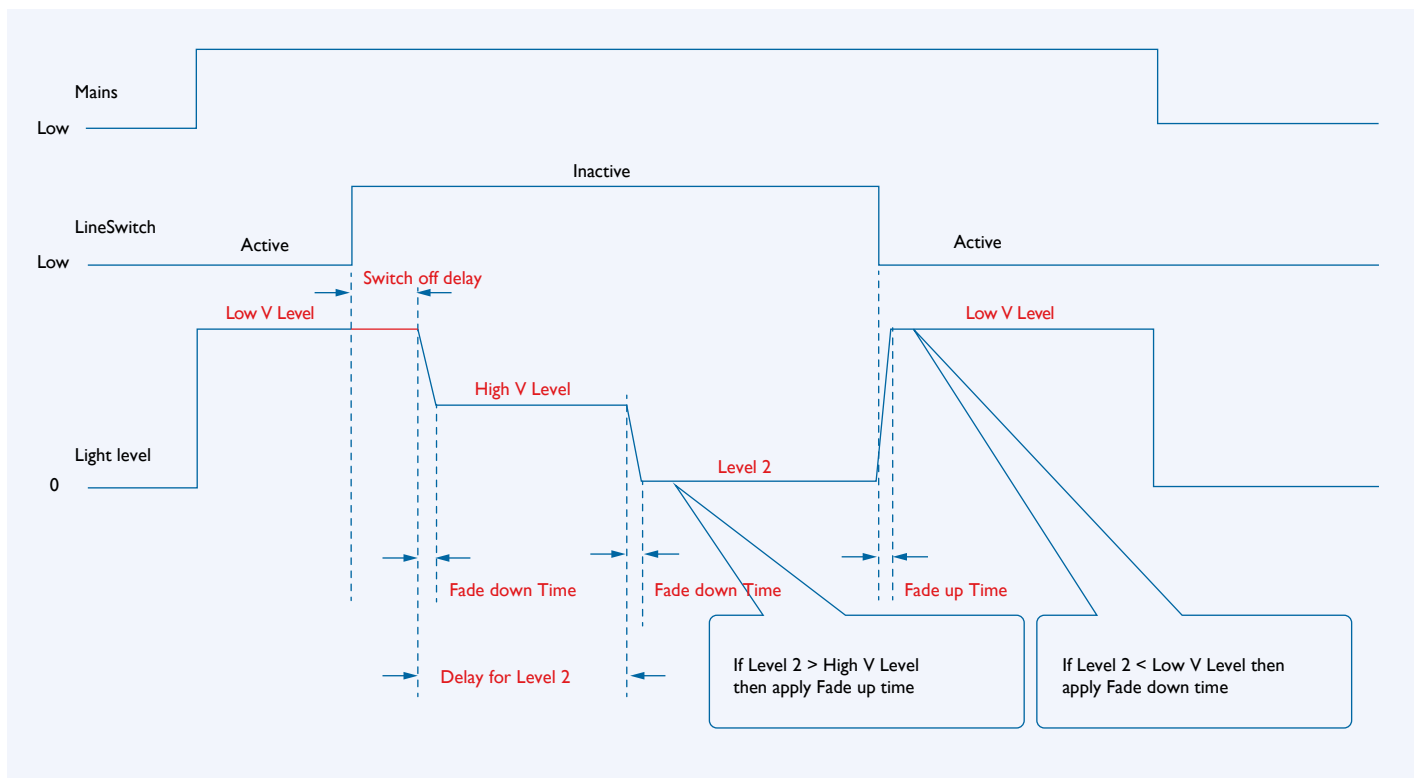
All parameters of LineSwitch including ramp-up and fade-down times can be programmed via the MultiOne configurator.

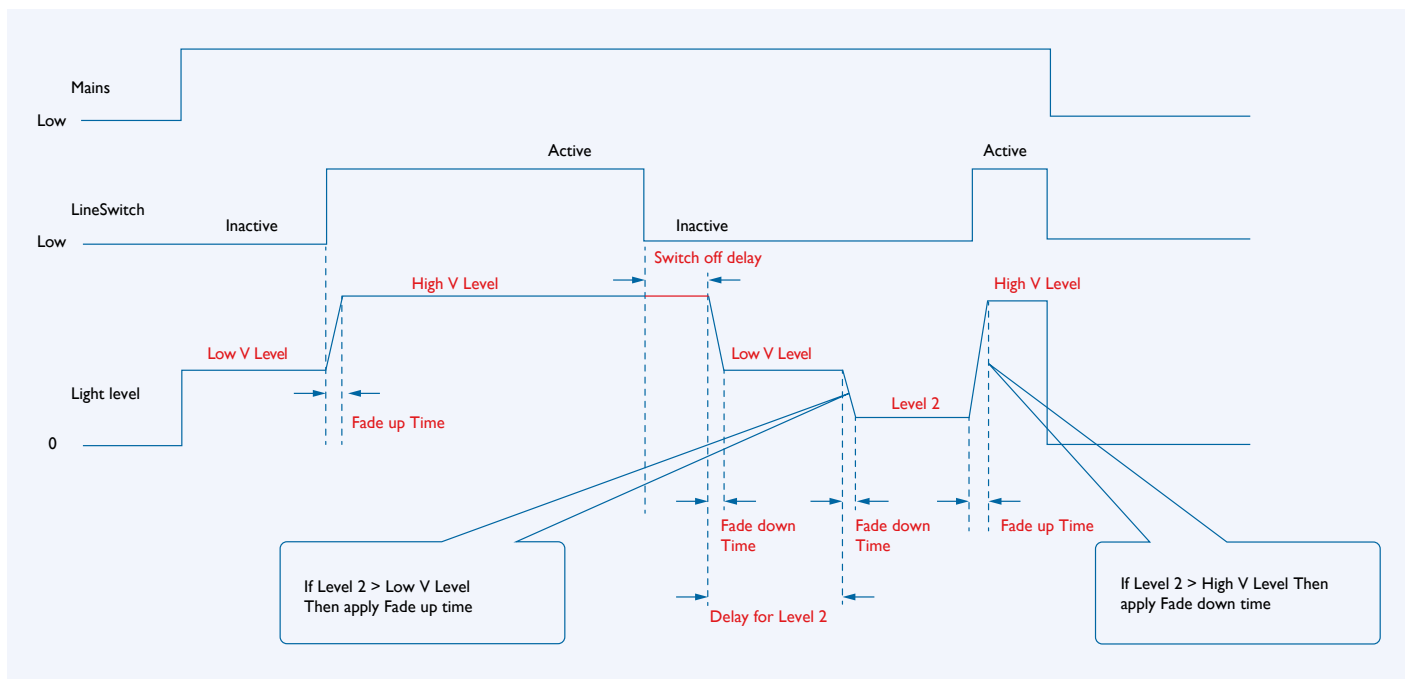
Two versions of LineSwitch are offered: single-step and 3-step. The 3-step option is currently available only on select Xi FP drivers. Please refer to the driver datasheet for more details.

Single-step LineSwitch can provide one dimming level while the 3-step LineSwitch offers the configuration of two additional optional dimming levels plus configurable delay times. See the illustrations below for further details.



Note: LineSwitch is able to override the Dynadimmer/ Dynadimmer LITE profile to temporarily set the light output to 100% (only), e.g. in case of emergencies or other special conditions that require maximum illumination.





High V level: 100 %

Low V level: 50 %

Fade up time: 0 s

Switch off delay time: 0 s

Fade down time: 0 s

Note 1: Low V level = 0 V or open on LineSwitch input, High V level = 220-240VAC on LineSwitch input

Note 2: When Dynadimmer is scheduled, LineSwitch can not be used standalone. It can only be used to override Dynadimmer.

Single-step LineSwitch

High V level: 100 %

Low V level: 50 %

Fade up time: 0 s

Switch off delay time: 0 s

Fade down time: 0 s

Enable level 2: ☐

Delay for level 2: 0 min

Level 2: 0 %

Note 1: High V level = 220-240 V on LineSwitch input, Low V level = 0V open or on LineSwitch input.

Note 2: When Dynadimmer is scheduled, LineSwitch can not be used standalone. It can only be used to override Dynadimmer.

3-step LineSwitch



Note: For proper functionality of the LineSwitch function the length of the LineSwitch pilot line from one luminaire to the next has a restriction. The restriction is given in the below formula:

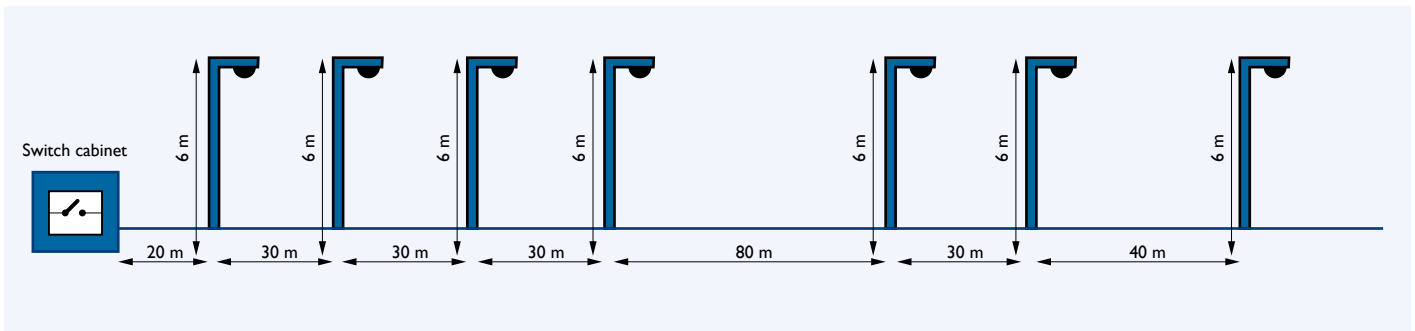
$$\frac{(\sum L)}{\#D} \leq 56$$

In this formula:

L = length of the cable from cabinet to the LED driver in metres

#D = number of connected drivers

Example:



$$\frac{\sum(L)}{\#D} = \frac{26 + 4(36) + 86 + 46}{7} = 43.1 < 56m : \text{OK}$$

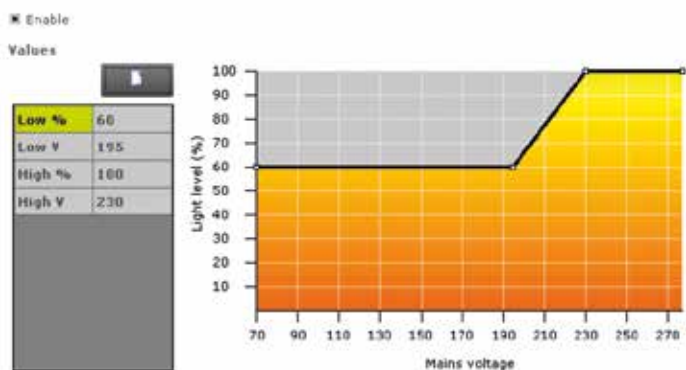
If the distance conditions shown above cannot be met then longer driver-to-driver distances can be realized by adding an external capacitor between the switched pilot line and neutral. This capacitor needs to have a 275VAC voltage rating or more and XI classification and should be added either in the luminaire or centrally in the switch cabinet. A capacitance value of 10nF allows for 60m extra pilot line length while a 100nF value allows for an additional 600m of length. Additional reactive power loading as a result of adding this capacitor is negligible.

In this example the following assumptions have been made:

1. Luminaires are used in a TN or TT power grid.
2. The parasitic capacitance in the mains cabling between the floating pilot line and the live phase is 100pF/meter.
3. No other loads are connected between the pilot line and other phases.
4. Other loads between the pilot line and neutral are allowed. In general this will increase the maximum acceptable cable length.

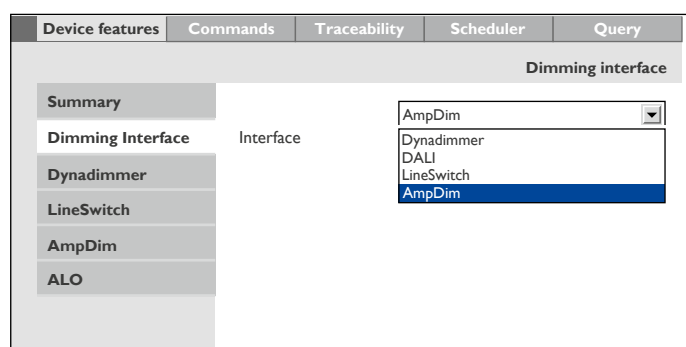


Warning: LineSwitch operation is **not** supported when drivers are connected in line-line connection in any 3-phase or 2-phase grid.



AmpDim

Parameter	Min	Max	Increments
Start Voltage	170 V	240 V	1 V
Stop Voltage	150 V	220 V	1 V
Start Percent	30%	100%	1%
Stop Percent	30%	100%	1%
Start Voltage - Stop Voltage	20 V	100 V	



Mains voltage dimming (AmpDim)

Applicable to: Xi FP (except Xi FP NLD)

Factory default setting: disabled

Historically, mains voltage dimming was used on magnetic ballasts to dim conventional (HPS) lamps. By lowering the mains voltage, a proportionate reduction in light output was achieved. Until now electronic ballasts were not able to replicate this function. AmpDim enables cabinet-based dimming without the need for additional control wires or infrastructure changes.

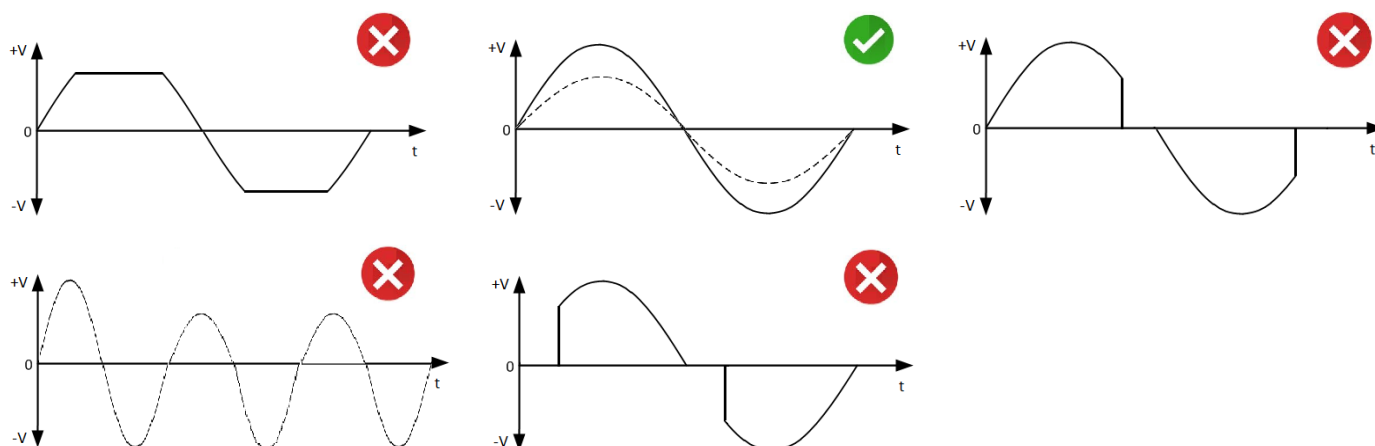
A cabinet controller signals to the driver to lower the light output via a reduction in the amplitude of the mains voltage. The intelligence embedded in the LED driver allows for a configuration of multiple dimming levels based on the amplitude of the mains voltage.

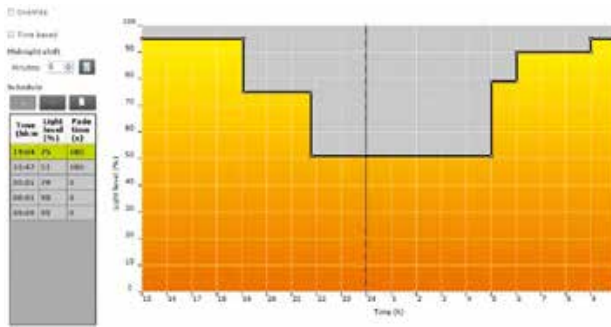
The total range of AmpDim is 170 V – 250VAC. The range can be customized via the programming interface. It is possible to set the Start Voltage, Start Percent, Stop Voltage, and Stop Percent. The figure on the left shows an example of the AmpDim programming interface.



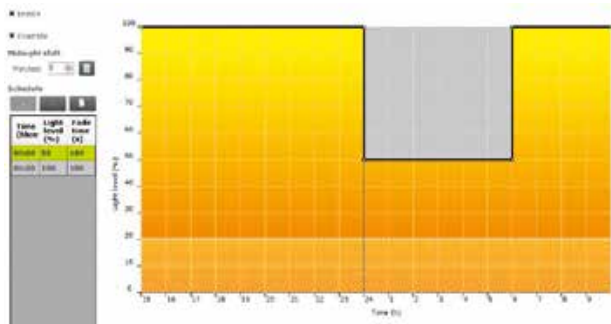
Notes:

- There must be a minimum of 20V difference between Start and Stop Voltage settings when programming the driver. Please refer to the AmpDim parametric table on the left for complete parameters.
- The AmpDim feature only supports dimming methods based on amplitude dimming with constant amplitude reduction and no sinewave waveshape modification. See the illustrations below for details.





Dynadimmer, up to 5 steps (Xi FP / Xi LP SI drivers)



Dynadimmer LITE, single step (Xi LP SL drivers)

Dynadimmer and Dynadimmer LITE

Dynadimmer: applicable to Xi FP / Xi LP SI drivers

Dynadimmer LITE: applicable to Xi LP SL drivers

Factory default setting: disabled

The Integrated Dynadimmer is an autonomous dimming control developed by Philips that enables simple, pre-programmed customized multistep dimming. Its main function is energy reduction by reducing light levels during the night when it is not required to have full light output.

The Dynadimmer is available in several versions: Dynadimmer and Dynadimmer LITE. These are integrated in Xitanium LED Xtreme drivers as follows:

Xi FP: Dynadimmer, up to five configurable steps, incl. light turn-off

Xi LP SI: Dynadimmer, up to five configurable steps, no light turn-off **Xi**

LP SL: Dynadimmer LITE, one configurable step, no light turn-off

See the two illustrations shown on the left for more details. Please consult the driver datasheet which Dynadimmer version is supported.

During Dynadimmer operation the other dimming interface functionalities will be ignored but override is possible in the following ways.

Xi FP: Dynadimmer operation can by default be overruled ("override") by DALI to change over to a different light level. Override can also be accomplished optionally by the use of LineSwitch (change over to either full or minimum light output only).

Override of the Dynadimmer operation by DALI is implemented by default: as soon as the driver detects a DALI frame it will change over from Dynadimmer mode to DALI mode and remain in DALI mode until the next mains power cycle.

Xi FP / Xi LP SL: LineSwitch also offers the option to overrule the Dynadimmer (LITE) by applying mains voltage to the LineSwitch input ('high' input), albeit to change over to either full or minimum light output only. As soon as the LineSwitch input is changed back to 'low', the Dynadimmer will resume operation.

These kinds of override do not interfere with the Dynadimmer synchronization algorithm (see next section).

Xi LP SI: The Dynadimmer can be overruled to change over to full light output (only) by the I-10V interface as described below.

Override by the I-10V interface is possible by shorting the + and – terminals of I-10V interface by means of either an external relay contact or by pulling it down below 2V by an external controller. As soon as either the contact is opened or when the interface voltage is raised above 3.2V, the Dynadimmer will resume operation. These kinds of override do not interfere with the Dynadimmer synchronization algorithm.



Note: simultaneous use of Dynadimmer and I-10V dimming is not possible. These two dimming features are mutually exclusive.

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 Philips 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.

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 three having the same duration (i.e. less than one hour difference) the driver will still dim as scheduled. This mechanism will prevent disruption 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 disruption 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.

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.

Dynadimmer attention points (cont'd)

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:**

- Dynadimmer does **not** compensate 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.
- Dynadimmer operation is **not** supported when the driver is operated on a DC grid.

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 level, MTP, DTL, Dynadimmer, DCemDim and LineSwitch.

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:

$AOC \times ALO \times CLO \times \text{Dynadimmer} \times (\text{MTP and/or DTL})$

$AOC \times ALO \times CLO \times \text{DALI level} \times (\text{MTP and/or DTL})$

$AOC \times ALO \times CLO \times \text{LineSwitch} \times (\text{MTP and/or DTL})$

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.

Example 2:

Driver AOC = 500mA, CLO = 80%, DALI command = 242 (70%). Actual output current is then 280mA.

Example 3:

Driver AOC = 1000mA, ALO = 70%, LineSwitch High V level = 50%. Actual output current is then 350mA.

The following applies for DCemDim-equipped drivers while running on DC input voltage:

Actual output current = rated AOC x 0.6 (max).

Group of features - OEM protection

OEM Write Protection	
Summary	Set the OEM Write Protection password
Dynadimmer	<input type="checkbox"/> Enable
LineSwitch	New password: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
AmpDim	Verify password: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
ALO	The password must contain 4 numbers (0-255).
AOC	
MTP	
CLO	
Startup Time	
EOL	
DC Emergency	
OWP	

OEM Write Protection (OWP)

Factory default setting: disabled

OWP can be used by the OEM to protect the change of setting of the Philips programmable driver. Philips Drivers equipped with the feature OWP will show this in their feature list if read out via the MultiOne Engineering Software. The OWP feature defines a password that will be set in the driver so the data of OEM Write-protected features can only be written to the driver by providing this configured password. Depending on the type of driver OEM can protect:

- a set of features (fixed)
- a selection of individual features (free selection) To know which features are locked you see a small lock symbol on each feature while trying to write the driver.

Individual features - OEM protection

OEM Write Protection	
Summary	OEM Write Protected features
DALI PSU	<input type="checkbox"/> (De)select all
ALO	<input type="checkbox"/> DALI PSU
AOC	<input type="checkbox"/> ALO
OWP	<input checked="" type="checkbox"/> ALO Min
ECO FactoryLink	<input checked="" type="checkbox"/> AOC
	Set the OEM Write Protection password
	New password: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
	Password: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
	must contain 4 numbers (0-255).

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 easily 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 losing the password, the customer can take contact with the local sales department to discuss a possible solution.

Please consult the driver datasheet whether OWP is supported.

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/technology. For further questions please contact your local Philips 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

Note that the information provided in this document is subject to change.

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