PHILIPS

Xitanium

LED indoor drivers

Linear SR

Xitanium SR Indoor LED Drivers Design-in Guide

Wireless,

connected,

streamlined

Contents

Introduction to this guide

Thank you for choosing Philips Xitanium SR Drivers.
In this guide you will find the information you need to design Xitanium SR LED Drivers into a luminaire. We advise you to consult our websites for the latest up-to-date information.
Xitanium SR Indoor Drivers are designed to operate LED solutions for indoor lighting such as offices, public buildings, industrial applications and retail environments.

Figure 1. Xitanium SR Indoor LED Driver 36W

Information and support

If you require any further information or support please consult your local Philips
office or visit:

- Xitanium SR Drivers www.philips.com/xitaniumsr
- Xitanium Drivers www.philips.com/xitanium
- OEM general info www.philips.com/oem

Safety precautions

Warning:

- Avoid touching live parts!
- Do not use drivers with damaged wiring!
- Turn off DALI power supply when using driver as standard DALI driver!

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

- Do not use damaged or defective contacts or housings.
- Do not service the driver when the mains voltage is connected; this includes connecting or disconnecting the LED load.
- Do not use damaged products.
- Cap off all unused wires to prevent accidental contact with the luminaire or driver housing.
- The luminaire manufacturer is responsible for its own luminaire design and has to comply with all relevant safety standards.
- The Xitanium SR LED Driver is intended for indoor built-in use only and should not be exposed to water, moisture and chemical agents. Exposure will lead to premature driver failure and should be avoided. It is the luminaire manufacturer's responsibility to prevent exposure.
- Driver must be installed in accordance with national and local electrical codes.
- Design-in support is available; please contact your Philips sales representative.

Introduction to Philips Xitanium SR Indoor LED Drivers

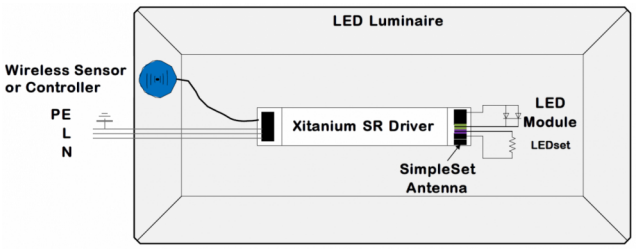


Figure 2. Block representation of an intelligent lighting luminaire with Xitanium SR Driver

Application note

Energy saving, flexible in design, long lasting and low maintenance, LED-based light sources are an excellent solution for indoor environments. For optimal performance, these lighting applications require reliable drivers matching the long lifetime of the LEDs.
Philips Xitanium SR LED Drivers reduce complexity and cost of light luminaires used in wireless connected lighting systems. Please refer to the SR Interface section for detailed information on using its features.

Xitanium SR Indoor LED Drivers provide different methods to program output current: LEDset, SR interface and SimpleSet (using Philips MultiOne software). SimpleSet is especially useful as it provides a way to program the output current without drivers connected to power, significantly reducing luminaire assembly time.

Explanation of the commercial naming of the Xitanium LED Drivers

The names of the drivers are defined as shown in the example below:

Xitanium 36W 0.3-1A 54V SR 230V

Xitanium: Concept name for highly efficient and reliable drivers
36W : Maximum output power
0.3-1A : Adjustable output current range to meet specified max output current and dimming range
54V : Maximum output voltage
SR : Sensor Ready
230V : Rated input voltage

Driver connection and wiring

Driver connectors and corresponding functions are shown in Figure 3. The driver housing must be grounded (earth connection) via the metallic mounting tabs of the housing.

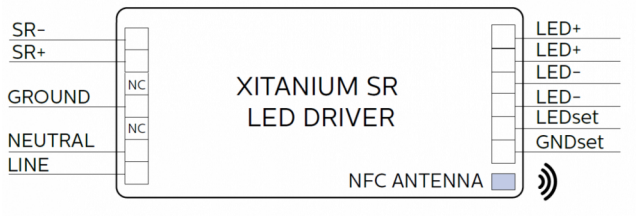


Figure 3. Xitanium SR Driver connections

Important

- Keep wiring between the driver and the LED module as short as possible. However, “remote LED load connection” is acceptable, and Table A gives an indication of remote mounting distance vs. driver current in A and cross wire section in mm^2. The table is based on the assumption that 1V drop is acceptable (e.g., the max driver output voltage rating must be at least 1V higher than the maximum LED voltage). Keep in mind that remote mounting also impacts efficiency of the system (as an example, a 1V drop on a 4A driver results in 4W losses in the wiring, so if less losses are desired, a correspondingly large wire size should be chosen). Also, the remote mounting impacts EMC behavior and additional measures may be necessary for EMC compliance if remote mounting is used (for example adding a ferrite clamp around output wires would reduce radiated EMI). In general, lead length should be kept as short as possible to avoid EMC issues.
- Please refer to the SR interface for the wiring requirements.

Output current (A)	**Wire Cross section (mm^2)**					
	4.0	**2.5**	**1.5**	**0.75**	**0.5**	**0.3**
0.35	250	160	100	65	40	25
0.53	170	105	65	40	25	15
0.7	125	80	50	30	20	12
1.05	85	55	35	20	13	8.5
1.5	60	38	25	15	9.5	6
2	45	28	18	11	7	4.5
3	30	19	12	7.5	4.5	3
4	22	14	9	5.5	3.5	2
5	18	11	7	4.5	3	1.5

Table A. Max Allowed Distance between Driver and LED Module in meters as function of output current (based on 1V drop)

Features of Xitanium SR LED Drivers

Driver output current seting (AOC) via LEDset, SimpleSet or SR interface

Output current can be set via a resistor connected between LEDset and GNDset. Figure 4 shows the LEDset value vs output current for drivers with LEDset function. When LEDset is not connected, the output current of the drivers is max specified output current. When output current needs to be set at less than max output current, a correct LEDset is required.

LEDset [Ω]	Idrive [mA]	LEDset [Ω]	Iset [mA]	LEDset [Ω]	Iset [mA]	LEDset [Ω]	Iset [mA]
open	avoid*	23700	211	11000	455	5110	978
49900	100	23200	216	10700	467	4990	1002
48700	103	22600	221	10500	476	4870	1027
47500	105	22100	226	10200	490	4750	1053
46400	108	21500	233	10000	500	4640	1078
45300	110	21000	238	9760	512	4530	1104
44200	113	20500	244	9530	525	4420	1131
43200	116	20000	250	9310	537	4320	1157
42200	118	19600	255	9090	550	4220	1185
41200	121	19100	262	8870	564	4120	1214
40200	124	18700	267	8660	577	4020	1244
39200	128	18200	275	8450	592	3920	1276
38300	131	17800	281	8250	606	3830	1305
37400	134	17400	287	8060	620	3740	1337
36500	137	16900	296	7870	635	3650	1370
35700	140	16500	303	7680	651	3570	1401
34800	144	16200	309	7500	667	3480	1437
34000	147	15800	316	7320	683	3400	1471
33200	151	15400	325	7150	699	3320	1506
32400	154	15000	333	6980	716	3240	1543
31600	158	14700	340	6810	734	3160	1582
30900	162	14300	350	6650	752	3090	1618
30100	166	14000	357	6490	770	3010	1661
29400	170	13700	365	6340	789	2940	1701
28700	174	13300	376	6190	808	2870	1742
28000	179	13000	385	6040	828	2800	1786
27400	182	12700	394	5900	847	2740	1825
26700	187	12400	403	5760	868	2670	1873
26100	192	12100	413	5620	890	2610	1916
25500	196	11800	424	5490	911	2550	1961
24900	201	11500	435	5360	933	2490	2008
24300	206	11300	442	5230	956	short	avoid**

* driver's default current, however not stable. For details see section on 'Default driver output current'

** driver's maximum current, however not absolute. For details see section on 'Default driver output current'

Figure 4. LEDset value vs output current setting

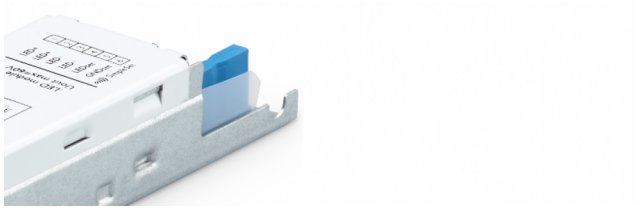


Figure 5. SimpleSet antenna

Figure 6. SimpleSet Driver and programming tool

Xitanium SR Indoor LED Drivers also provide two others methods to program output current: SimpleSet and SR interface.

Simpleset utilizes an antenna (a Blue Block) as shown in Figure 5, a programming tool as shown in Figure 6, and Philips MultiOne software.

The output current of LED driver can be programmed when the driver is not powered (i.e., offline programming). Or the driver can be programmed when the driver is powered on (i.e., online programming).

For reliable error-free programming, the drivers need to be grounded when online programming is performed.
For detail programming instruction, please see SimpleSet getting started instruction at www.philips.com/simpleset.
The driver output current can also be programmed via the digital SR (DALI-based) interface utilizing the MultiOne software tool.

Notes:

1. The AOC setting configured through SimpleSet or SR interface can be reset to LEDset (if required) via the MultiOne software using the “External Rset” flag under the AOC tab for MultiOne GUI. This flag is “unchecked” when the driver is programmed via SimpleSet or SR interface. To return to the default LEDset mode, this flag can be “checked” and the driver will be reprogrammed to return to LEDset.
2. The AOC value configured through software (either SimpleSet or SR interface) will have higher priority over LEDset. Between SR interface and SimpleSet, the driver will follow the last programmed value. So there is no specific priority assigned to SR interface and SimpleSet. The same logic applies for the auxiliary power supply (refer to the next section).

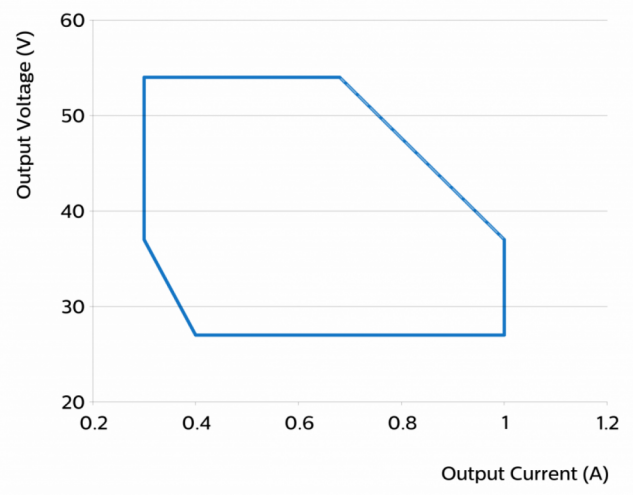


Figure 7. Operating window 36W Indoor SR Driver

Operating window

Drivers can deliver different levels of output power, depending on driver type. For each driver there is specified output current/output voltage window. The connected LED load current and voltage characteristics must be within the driver window (under steady state, full output or dim). Driver performance cannot be guaranteed outside the window. See Figure 7 for the operating window for the 36W Indoor SR Driver. The LED load voltage is typically influenced by a number of factors such as temperature, binning (tolerance), drive current and aging. It is important to consider these factors when determining the required voltage range for a certain LED load to ensure that the LED voltage stays within the operating window of the driver. The driver will limit the voltage available for the LEDs based on the window shown. For example, if the LED driver is set to 1.0A and the LED load voltage at 1.0A would be 54V, then the driver would limit the voltage to 36V as shown in Figure 7. The resulting current at 54V could be less than 700mA. If the upper voltage limit is reached at -20C (when the LED voltage is highest), care must be taken to ensure that sufficient current flows through the LED load to allow the LEDs to warm up and eventually operate within the window area (otherwise, desired drive current will not be achieved).

Warning:

If LED current and/or voltage characteristic falls outside the driver window, please consult with Philips for application guidance and driver selection.

SR (Sensor Ready) interface

Xitanium SR LED Drivers reduce complexity and cost of light luminaires used in (wireless) connected lighting systems. It features a digital interface (SR: Sensor Ready) to enable direct connection to any suitable RF sensor (see Figure 8). Functionality integrated into the SR driver eliminates auxiliary components such as power supplies and relay boxes used today in many typical applications. The result is a simpler, less expensive luminaire that enables turning every luminaire into a wireless node.

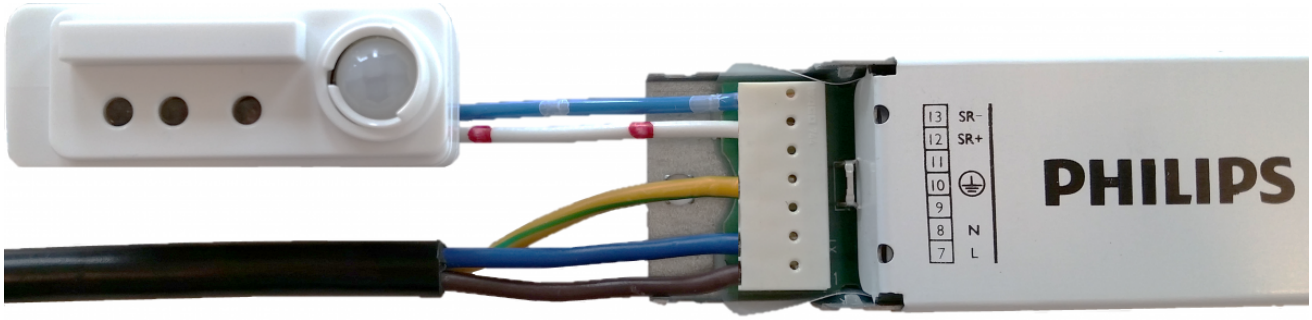


Figure 8. Driver input-side showing SR connector and two-wire connection to a radio sensor

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

- Switchable built-in SR bus power supply to provide power to the connected control device (e.g., an RF sensor)
- Two-way digital communication between the SR driver and control device using standard DALI-based 2.0 protocol:

  > Standard DALI-based dimming, ON/OFF and control functions

  > Power and energy reporting utilizing the power monitoring integrated in the driver

  > Diagnostic information

These functions are described in detail below:

SR bus power supply

- The SR driver has the ability to supply the SR bus with a built-in power supply that can be turned ON/OFF. By default the power supply is turned on and ready to be used with an external control device (eg., RF sensor).
- The internal power supply can be turned ON/OFF with the MultiOne configuration software using the Simpleset tool or the SR interface (DALI-based) tool.
- The built-in SR supply is capable of delivering a minimum current of 52mA (ISR) to the SR bus and the connected device(s).
- The built-in SR supply will never supply more than 60mA (ISR_MAX).
- The SR bus voltage will be between 12V and 20V depending on the connected device load and the amount of SR supplies put in parallel. See the graph below for the typical VI curve for one SR supply.
- When the internal SR supply is switched OFF the SR driver will extract a maximum of 2mA from the SR bus (like standard DALI-based gear).

Control device(s)

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

Rules for building an SR system

- Respect SR bus polarity when more than one SR supply is connected in parallel.
- The total maximum SR bus current (ISR_MAX_TOTAL) must be ≤ 250mA. This current can be determined by adding ISR_MAX of all SR supplies. As a consequence a maximum of four SR supplies can be connected in parallel.
- The total current delivered to the SR bus (ISR_DELIVERED) can be determined by adding ISR of all SR supplies.
- The total current extracted from the SR bus (ISR_EXTRACTED) can be determined by adding consuming devices like SR drivers with switched OFF SR supply, other DALI-based gear and control devices.
- To guarantee good communication, a margin of 8mA is needed to drive the SR bus itself (ISR_MARGIN).
- The following rule should be respected: ISR_EXTRACTED + ISR_MARGIN

Warning:

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

Typical SR supply characteristics

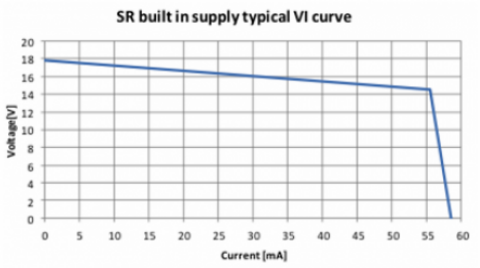


FIgure 9. Typical VI curve for SR interface

Digital communication:

- Dimming is possible through the standard digital interface based on DALI 2.0 (IEC 62386 101, 102 Ed2.0).
- Note that the output current at 100% level is determined by the driver. The minimum current that can be supplied by the driver is specified in the datasheet.
- The SR driver has built-in energy measurement capability and can report energy and actual power consumption. Accuracy of power measurement is higher of following 2 values: 0.5W or +/-4 % measured input power. This feature stores parameters in the memory bank provision specified in the DALI 2.0 standard.
- The driver also supports many diagnostic features/parameters which can be accessed via the SR interface.

Other consideration for SR interface

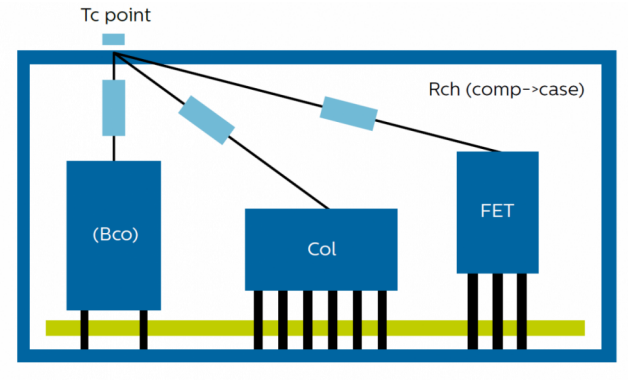
- Length of wiring; using 0.75 mm^2, the maximum length of the dim wiring, when used for DALI communication, should not exceed 15m.
- The SR control interface terminals are double-insulated from mains and output terminals per IEC61347-1.

Configuration options

	Configuration Interface		
Configurable Parameter within the Driver	**LEDset (Factory Default)**	**SimpleSet**	**SR (DALI) Interface using MultiOne Tool**
Adjustable Output Current (AOC)	✓	✓	✓
Auxiliary Power Supply (ON/OFF)		✓	✓
Standard DALI 2.0 Configurable Parameters			✓

Table B. Configuration Options

Thermal design-in



Schematically representation of internal thermal paths to the driver Tc point

Introduction

This chapter describes the thermal aspects of the Xitanium Indoor Linear LED drivers:
The LED driver itself and relationship between case temperature point (Tc) and lifetime of the LED driver.

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.

Definitions

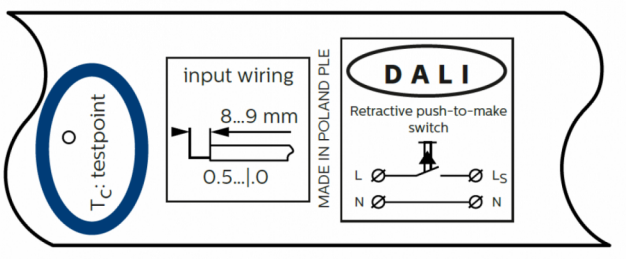
- Case temperature: temperature measured at the Tc point of the driver
- Ambient temperature (Tamb): temperature outside the luminaire When switched off >2 hours, temperature at Tc point is likely to equal Tamb

Tc point

To achieve optimal lifetime and reliability, it is critical that the temperature of the components in the driver remains within its rating.

The Tc test point (case temperature) indicates a reference point for measuring the LED driver's temperature. This can be used during the luminaire design to verify that the temperature remains below the maximum specified temperature for the Tc point.

Since there is a direct relation between the case temperature (Tc) and the driver components inside the driver, it is sufficient to measure the temperature at the Tc point of the LED driver. This Tc point must not exceed the maximum values stated in the associated datasheet in the download section on
www.philips.com/technology.



Example of Tc point position on driver housing

How to measure Tc at the Tc point

The location of the Tc point is identified on the product label. Tc point is inside the dot (See ellipse in figure on the left). The temperature can be measured using for example a thermocouple that is firmly glued to the driver housing. For a representative measurement the temperature must be stable before any reliable data can be obtained (typically > 0.5 hours).

Relation between Tc and ambient temperature

The Tc increases by approximation linear with the ambient temperature (Tamb). The temperature offset between Tamb and Tc depends on the thermal design of the luminaire. For approved ambient temperature range please check the associated driver datasheet on www.philps.com/technology .

Driver lifetime

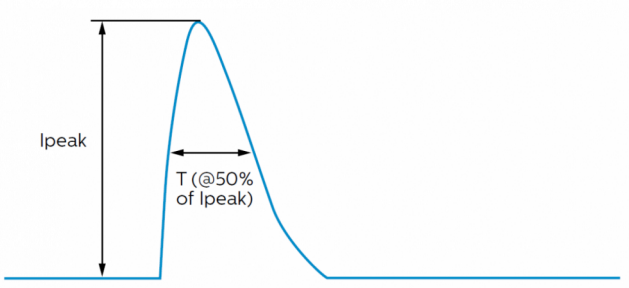
Tc, Tc-life and Tc-max

The lifetime of LED drivers depends on the temperature during operation. This means there is a relationship between the Tc point on the LED driver and its lifetime in hours.

- Xitanium Indoor Linear LED drivers typically have a specified minimum lifetime of ≥50,000 hours with a minimum of 90% survivors at the specified Tc-life.
- Xitanium Indoor Linear Xtreme LED drivers typically (iXt) have a specified minimum lifetime of ≥100,000 hours with a minimum of 90% survivors at the specified Tc-life.

Tc-max is the maximum allowed Tc for the driver. Please check the driver's datasheet in the download section on www.philips.com/technology for the lifetime and Tc-life.

Electrical design-in



Graphical representation of inrush current

Inrush current

'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 Mains Circuit Breakers (MCB) to trip. In such a case, either one or a combination of the following measures need to be taken to prevent nuisance tripping:

1. Replace existing MCB for a less sensitive type (e.g. exchange B type for C type)
2. Distribute the group of drivers over multiple MCB groups or phases
3. Power up drivers sequentially instead of simultaneously
4. Install external inrush-current limiting devices

Inrush parameters are driver-specific an can befound in the driver datasheet at www.philips.com/technology.

Surge protection

The Xitanium Linear drivers have built-in surge protection up to a certain limit. Depending on the mains connected, additional protection against excessive high surge voltages may be required by adding a Surge Protection Device. The actual limit can differ per driver and can be found in the driver's datasheet in the download section on www.philips.com/technology.

Earth Leakage current

The Xitanium SR LED drivers are designed to meet earth leakage current requirements per IEC 61347-1 standard.

The specified peak value can be found in the driver datasheet. The current is specified on driver-only level. In a luminaire, total leakage current may be higher since the LED load may introduce additional leakage current. As such, precautions may be required on the luminaire level and if multiple drivers are used in a single luminaire.

Electromagnetic compatibility

Xitanium SR LED Drivers meet EMC requirements per CISPR15. These tests are conducted with a reference setup that includes a driver and an LED load/heat sink combination mounted on a metal plate (grounded). To maintain good EMC performance at the luminaire level, the input, output and dim wires should be routed separately.

Cable length and EMC

Philips has successfully performed EMC tests for a total length 4 m (sum of wire length and length of the Philips Fortimo LED Line boards). The only limitation of wiring length –apart from voltage drop- is EMC performance. Since EMC performance of the lighting system is heavily dependent on the wiring itself it is highly advised for longer lengths to repeat EMC testing.

Electrical isolation

Isolated drivers (SELV output)
Drivers in this group cannot generate output voltages higher than 60 VDC. By design these drivers are intended for built-in use, not suited for independent use. The driver must be placed in a suitable adequate enclosure according to the applicable norms and standards. Hence the double circle symbol is to be used, not the double-square symbol (Amendment 2 of safety standard IEC61347-1).

However, these isolated drivers (SELV output) can be used in both Class I and Class II luminaires under the following conditions:
- When used for Class I the protective earth connection should be present (see previous section "Non-isolated drivers").
- When used for Class II (and SELV), the driver should be incorporated in the luminaire in such a way that:
a) The driver housing is electrically insulated with respect to electrical conductive materials, such as the housing or reflector and as such not touchable during installation or operation.
b) All metal luminaire parts (chassis, heat sink, metallic reflector) connected to the driver housing are not allowed to be accessible by bare hand, or
c) Any accessible conductive luminaire parts should have basic isolation towards the non-accessible luminaire parts and/or driver housing.

Note: for Class II, EMC requirements should be met without PE connection and particularly also any functional earth connection from driver to accessible fixture/chassis is strictly prohibited, as it will form insufficient (non-single fault-proof) insulation with respect to live parts connected to the driver.

Xitanium Indoor Linear LED drivers meet the IEC61347-1 safety standard
In accordance to this standard, several driver input and output isolation levels apply. See the driver datasheet for more details.

How to... Use these Indoor Linear LED drivers as"independent" driver
By design the Xitanium Indoor Linear LED drivers are intended for built-in use, not suited for independent use. The driver must be placed in a suitable adequate enclosure according to the applicable norms and standards when used independently.

Mechanical design-in

Mounting of the driver must address three critical issues:

1. Solid fastening of the driver in order to avoid movement of the driver relative to luminaire.

Size of mounting screws/bolts needs to be maximum allowed by the size of driver mounting holes/slots. The tightening torque has to be per screw/bolt manufacturer recommendations.

2. Electrical grounding of the driver.

It is recommended to use a star washer under the head of the mounting screw. The teeth of the star washer will "bite" into the surface to ensure good electrical connection to the grounded luminaire.

3. Maximize interface area between driver enclosure surface and luminaire mounting surface (heat dissipator) for best (lowest) possible driver Tcase temperature.

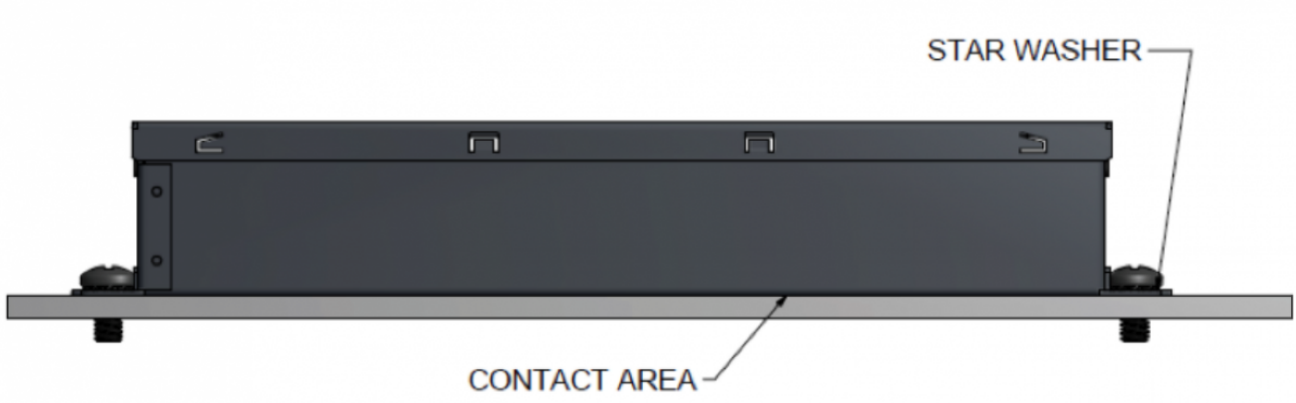


Figure 18. Recommended mounting of the driver

Disclaimer

Philips will perform the testing of the LED systems to high standards of workmanship. The tests are carried out with reference to the EN/IEC standards, if any, which are regarded by Philips as being of major importance for the application of the lamp gear and the lamp within the fixture for horticultural applications.

The design-in guide, regarding the testing and design in of the LED system provided by Philips, is not an official testing certificate, and cannot be regarded as a document for official release of the fixture. The OEM is liable for the official testing by a certified test body and all markings, such as CE and ENEC marks, on the fixture assembly.

The design-in guide is for information purposes only and may contain recommendations for detecting weak points in the design of the system (lamp – lamp gear – fixture), if any.

Specifically mentioned materials and/or tools from third parties are only indicative: other equivalent equipment may be used but it is recommended that you contact Philips for verification.

Philips will not be liable for unforeseen interactions of the proposed solutions when applied in the fixtures or applications using these fixtures. Philips has not investigated whether the recommendations are or will in the future be in conflict with existing patents or any other intellectual property right. Philips does not warrant that its recommendations are technically or commercially the best options.

Since the tests are only performed on one particular fixture provided by the customer, it will be treated as a prototype. This means that there is no statistical evidence regarding later production quality and performance of the lamp – lamp gear – fixture system.

As Philips does not have control over manufacturing of the fixtures, Philips cannot be held liable for the fixture assembly.

Philips will not accept claims for any damage caused by implementing the recommendations.

No warranty whatsoever may be claimed by the OEM with regard to the content and/or quality of the design-in guide or any other advice, or the conclusions and/or recommendations in the design-in guide or any other document, either express or implied, and Philips expressly disclaims any implied warranties of any kind, including without limitation any warranties of satisfactory quality, fitness for a particular purpose or non infringement and any warranties regarding the design-in guide or any other advice or the use of the results of any activity performed while testing the fixture with respect to its correctness, quality, accuracy, completeness, reliability, performance or otherwise.

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The OEM must bring any claim for damages within ninety (90) days of the day of the event giving rise to any such claim, and all lawsuits relative to any such claim.

For more information please visit:
www.philips.com/technology