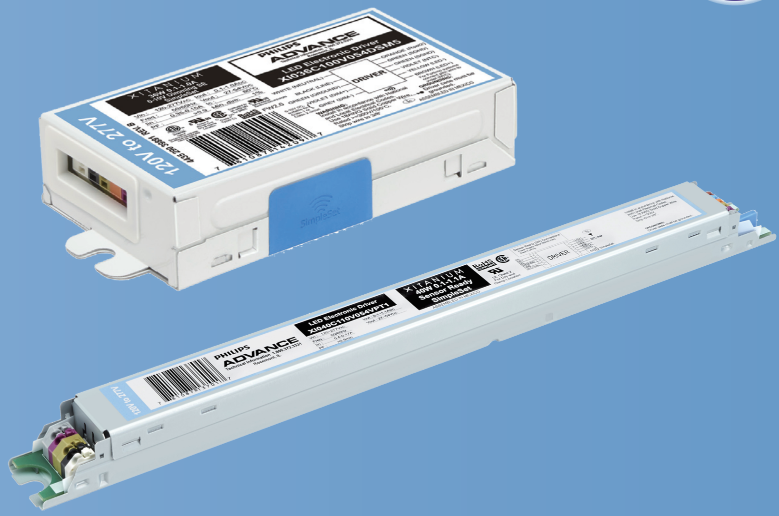
PHILIPS
ADVANCE

LED Drivers

Design-in Guide

Xitanium Indoor



The **reliable, flexible choice** for easy indoor luminaire design-in

Contents

Introduction to Philips Advance Xitanium LED drivers

Philips Advance Xitanium 50W LED driver.


Philips Advance Xitanium 40W linear driver.

This guide contains information to help you design Philips Advance Xitanium LED drivers into a luminaire. We advise you to consult our website for the latest up-to-date information.

Information and support

If you require any further information or support please consult your local Philips sales representative or visit www.philips.com/leddrivers.

Application note

These drivers are designed to address the growing demand for controllability and flexibility. The adjustable output current (AOC) feature enables operation of various LED configurations from different LED manufacturers and offers “future-proof” solutions for new LED generations. Some indoor drivers also integrate NTC feedback for LED module temperature protection.

These drivers also feature many other configurable features (minimum dimming level, dimming curve, etc.). Please see the section under "Features of Philips Advance Xitanium LED drivers."

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. The Xitanium LED drivers offer reliability and flexibility for optimal solutions in luminaire design. Luminaire manufacturers are able to streamline logistics without compromising on performance. With a unique dimming interface, multiple choices for output current are also possible to provide flexibility in lumen output and efficacy.

The remarkable energy savings and CO_2 reductions achieved with LED lighting can be further extended with dimming. Xitanium LED drivers offer the industry standard 0-10V dimming interface, which works with various external dimming devices and sensors including Philips LuxSense and Actilume control devices.

Safety precautions

Warnings:

- Avoid touching live parts!
- Do not use drivers with damaged wiring!

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

- 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 wire of 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 must comply with all relevant safety standards.
- The Philips Advance Xitanium LED driver is intended for built-in use and should not be exposed to the elements such as snow, water or ice. Exposure will lead to corrosion of the driver housing and should be avoided. It is the luminaire manufacturer's responsibility to prevent exposure. Xitanium indoor drivers are specified for UL damp and dry locations.
- Driver must be installed in accordance with national and local electrical codes.
- For support with any of these aspects, please contact your local Philips sales representative.

Features of Philips Advance Xitanium LED drivers

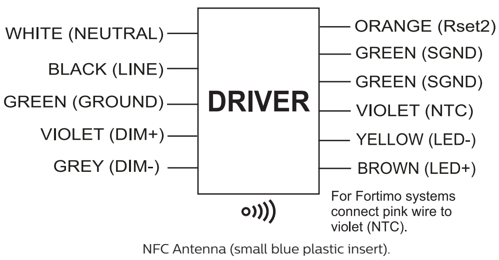


Figure 1. Driver connector color code definition.

Output Current (A)	AWG Wire Size					
	12	14	16	18	20	22
0.35	855	540	340	215	136	85.5
0.53	565	356	225	142	89.5	56.5
0.7	428	270	170	107	67.8	42.8
1.05	285	180	113	71.6	45.2	28.5
1.5	200	126	79.4	50.1	31.6	20
2	150	94.4	59.6	37.6	23.7	15
3	100	62.9	39.7	25.1	15.8	10
4	75	47.2	29.8	18.8	11.9	7.5
5	59.9	37.8	23.8	15	9.5	6

Table A. Max allowed distance between driver and LED module in feet (based on 1V drop).

Number of Drivers	AWG Wire Size				
	14	16	18	20	22
10	15738	9925	6263	3950	2500
20	7863	4963	3138	1975	1250
30	5250	3313	2088	1313	838
40	3938	2488	1563	988	625
50	3150	1988	1250	788	500
60	2625	1650	1050	663	413
70	2250	1413	900	563	363
80	1963	1238	788	500	313
90	1750	1100	700	438	275
100	1575	988	625	400	250

Table B. Max allowed length of 0-10V control wires in feet (based on 100mV drop and 150uA drive current)

Driver wiring

Connector terminals with corresponding functions are shown in Figure 1 for a 0-10V dimmable driver. The driver housing must be grounded (earth connection) via the metallic mounting tabs of the housing. The mains connections are accomplished via the black and white connections. The "SGND" terminals are used for connecting the signal return leads from Rset and NTC functions. These are both electrically connected. Two terminals are provided for convenience. These SGND terminals should not be connected to LED-, GROUND or DIM- terminals.

Please ensure that the wire gages of the leads inserted into the connectors comply to the specification of the connector.

Important

- Keep wiring between the driver and the LED module as short as possible. However, “remote wiring” is acceptable, and Table A gives an indication of remote mounting distance vs. driver current and AWG wire size. The table is based on the assumption that a 1V drop is acceptable (e.g., the driver output voltage rating must be at least 1V higher than the maximum LED voltage). Please consult your local Philips sales representative for further design-in services about calculating the voltage drop and wire losses.
- 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 lower losses are desired, a correspondingly large wire size should be chosen). Also, the remote mounting impacts electromagnetic interference (EMI) behavior, and additional measures may be necessary to reduce EMI 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 EMI issues.
- Depending on wire gauge, the length of dimming wires begins to add a voltage drop to cause a shift in dim level from the intended target. This is a minimal shift in voltage and is not sufficient to become noticeable. Table B gives an indication for dim lead wiring lengths assuming a maximum offset of 100mV for different numbers of drivers connected to a single controller.

A maximum wire gauge size of 16AWG can be used with the connectors for the LED driver. If a heavier wire is needed to reduce wire loss between the LED module and LED driver a short section of 16AWG or smaller diameter wire will need to be connected to the LED driver and a connection to the heavier wire can be made. The connectors used for the Philips Advance Xitanium indoor LED drivers can only accommodate solid wire sizes of 16AWG - 22AWG (need to confirm this). Consult factory for any other wire types.

Operating window

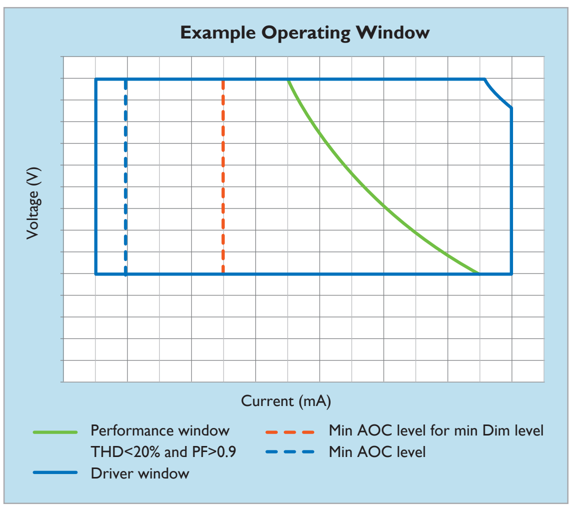


Figure 2. Example Operating Window (dimmable driver).

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). The driver performance cannot be guaranteed outside the window. See Figure 2 for an illustrated example of an operating window for a dimmable driver. Please check the driver datasheet for the specified operating window.

The LED load voltage is typically influenced by a number of factors such as the LED 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.

SimpleSet Configurable Features

Note: These features are only supported from MultiOne 2.11/WF 2.4 onward. Please also refer to the "Philips MultiOne Configurator" user manual for more information.

Feature	Description of the feature	Notes and examples
1-10V: minimum dim level	This feature gives flexibility in selecting the minimum dim % level. Default minimum dim level setting = 1%. When this setting is 100%, the driver works as a non-dimmable driver. Note: This feature is not supported in previous generation 5% dimming drivers.	An application may require the absolute minimum light level to never fall below 10%. In this case this parameter should be set at 10%. One example of using this feature is bi-level dimming, where a relay can be used in conjunction with the driver to give bi-level dimming capability, just by opening and shorting the dim leads. In this case, the setting of the intended minimum dim level can be programmed to the lumen level required.
1-10V: dim curve selection	This feature allows the selection between linear and logarithmic dimming curves. The dimming curve relates the voltage applied to the dimming leads to the output current of the driver. The default setting is linear. Note: This feature is not supported in previous generation 5% dimming drivers.	Most energy-saving luminaire applications use a linear dimming curve selection. Choosing the proper dimming method can provide smoother transitions to very low dim levels (e.g., 1%). It is common to use the driver log dimming curve with dimmers that have a linear dimming response to give a better control on the light levels at lower dimming and vice versa, to use the driver linear dimming curve with dimmers that tend to have more logarithmic dimming response, like some passive dimmers.
AOC	Adjustable output current (AOC). This feature allows the maximum output current of the driver to be set within the stated range in the datasheet for the output current (Iout). The default value is equal to the maximum LED driver output current allowable as specified in the individual driver datasheet. Typically, SimpleSet technology is used to adjust this parameter. Some drivers allow this value to be adjusted via Rset. In this case the default value is based on Rset. The Rset information is included in the individual driver datasheet.	The luminaire manufacturer sets the AOC value to set the maximum LED driver current supplied to the LED module. This allows the use of a single LED driver model for many luminaire types with LED module design and cost optimization for specific lumen outputs (e.g., linear troffers with 4000, 3000 and 2000 lumen outputs).

Feature	Description of the feature	Notes and examples
ALO (%)	Adjustable lumen output (ALO). This feature gives installers the ability to select the output current as a percentage of AOC. When ALO is 100%, the output current is the same as AOC. ALO is limited by ALO minimum. Note: This feature is not supported in previous generation 5% dimming drivers.	ALO is expressed in percent and allows the OEM or end user to fine-tune the light output. For example, a fixture with an initial light output of 4000 lumens could be adjusted to 3000 lumens if desired. This tuning can be accomplished without the addition of a dimming control.
ALO min (%)	Adjustable lumen output minimum (ALO min). This feature gives the OEM the ability to select the minimum output current output as a percentage of AOC. Setting the minimum current prevents end users from setting ALO outside of the intended LED driver performance window and helps ensure electrical performance conditions are met (for example, PF and THD specifications required by DLC). The default value is decided by the ratio of the minimum output current (Iout) indicated in the driver datasheet and by the AOC. Note: This feature is not supported in previous generation 5% dimming drivers.	ALO min is expressed in percent and is adjustable within the following range: maximum = 100%; minimum (default value) = minimum AOC value divided by maximum AOC values. (Both values are from the product datasheet.) For example, the maximum (default) AOC for the 40W linear driver with SimpleSet technology is 1.1A (1100mA) and the minimum AOC is 100mA. Therefore, the default ALO min is 100/1100, or about 9%.
OWP	OEM write protection (OWP). This feature gives the OEM the ability to enable or disable OWP. When OWP is enabled, the following features are password-protected: AOC, ALO min, minimum dim level and dim curve selection. Note: This feature is not supported in previous generation 5% dimming drivers.	**Caution:** If OWP is not enabled by the OEM, an end user with a programming interface (MultiOne) and access to the LED driver has the ability to change any or all of the following features: AOC, ALO min, minimum dim level and dim curve selection. Without OWP enabled, the end user also has the ability to enable OWP and password-protect the feature settings. Passwords must be managed carefully by the OEM and cannot be recovered without returning the LED driver to Philips.

Thermal management

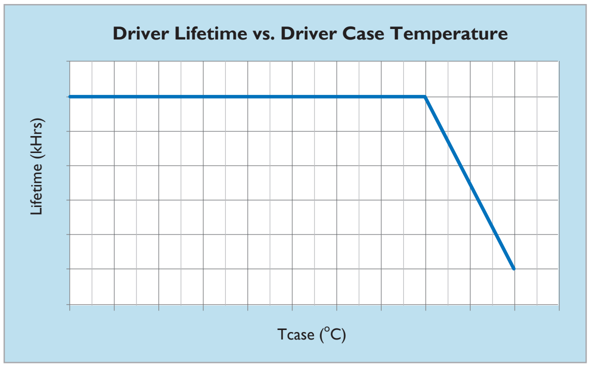


Figure 3. Example Lifetime Versus Tc.

The following section covers the critical thermal management points to facilitate design-in. Taking thermal considerations into account will help ensure optimum performance and lifetime of an LED system. The maximum case temperature (Tc max) of the driver should not be exceeded. It is mandatory to keep driver Tc max within specification to meet driver lifetime and failure rate specifications.

The driver maximum case temperature allowed may not give a lifetime that meets warranty requirements. It is important to note the case temperature that provides the necessary lifetime for warranty. The maximum case temperature is provided to allow short excursions to a higher temperature without immediate failure of the product. Extended operation at temperatures approaching the maximum case temperature may shorten the life of the product. Please refer to individual product datasheets for specific values (Figure 3).

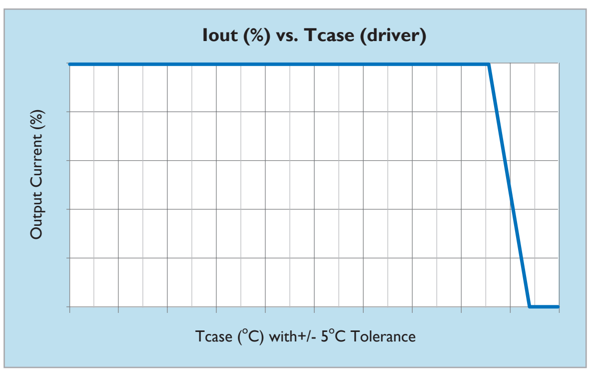


Figure 4. Example Thermal Fold Back (TFB).

Thermal fold back (TFB) of driver

The driver will reduce the current to the LED module if the driver itself is overheating. The driver will limit the current when the driver case temperature exceeds the maximum specified temperature. Refer to the individual driver datasheet for the specified fold back value (Figure 4).

Temperature case point

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

Tc point temperature is a proxy for the temperatures of the critical internal driver components.

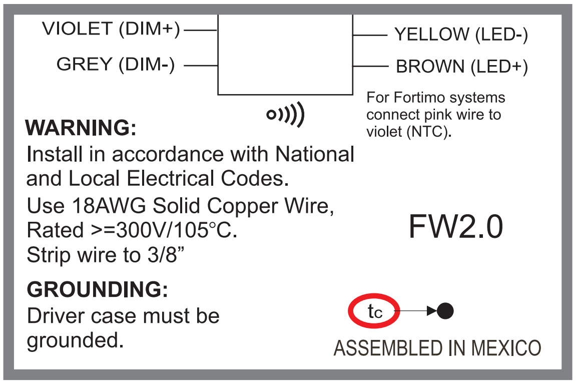


Figure 5. Product label indicating Tc point of SmartMate driver.

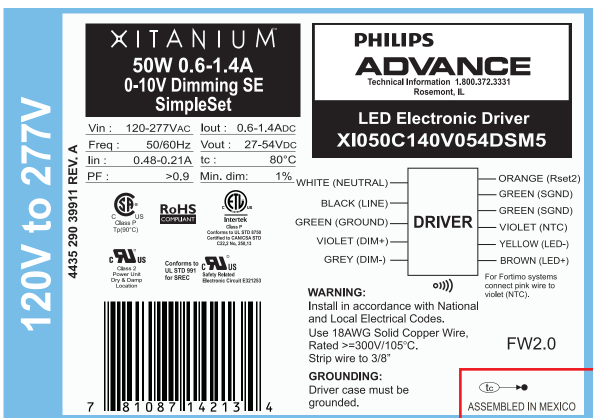


Figure 6a. Product label indicating Tc point on the label surface of a typical downlight driver.

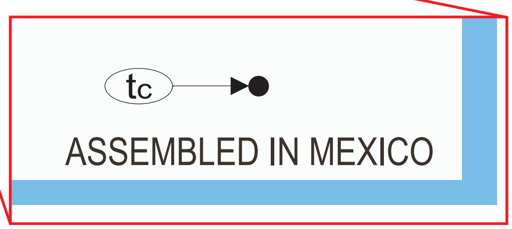


Figure 6b. Product label indicating Tc point on the label surface of a typical downlight driver (detail).

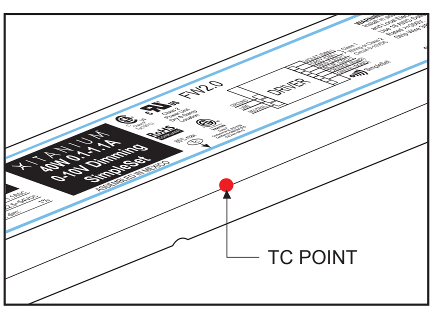


Figure 7. Example Product Label Indicating Tc Point.

The location of the Tc point is identified on the product label (Figure 5). The Tc point on the drivers is on the dot indicated by the arrow as shown in Figures 6a. and 6b. In some of our drivers the Tc arrow points to a location on the side of the driver housing as shown in Figures 7. In this instance the thermocouple is intended to be placed on the sidewall of the driver housing.

Note:

The specified Tc max of the driver must NEVER be exceeded. A measurement using a thermocouple placed on the Tc location is necessary. The thermocouple must maintain good contact with the driver housing for the duration of the test. In order to help ensure accurate Tc test results, the case temperature should not vary by more than 1°C for a period of at least 30 minutes after a stable temperature has been achieved. The Tc point and the driver surface surrounding the Tc point of at least 1/2 radius should not be touching anything when mounted in the luminaire/enclosure. If the Tc point comes in contact with anything during normal installation of the LED driver, it will become necessary to measure a different unobstructed location and correlate this to the original Tc point with the driver operated in free air.

Dimming methods

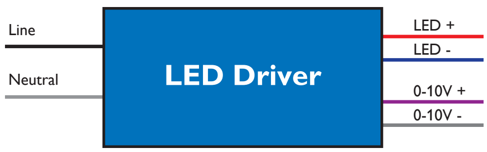


Figure 7. LED driver with 0- 10V dimming interface.

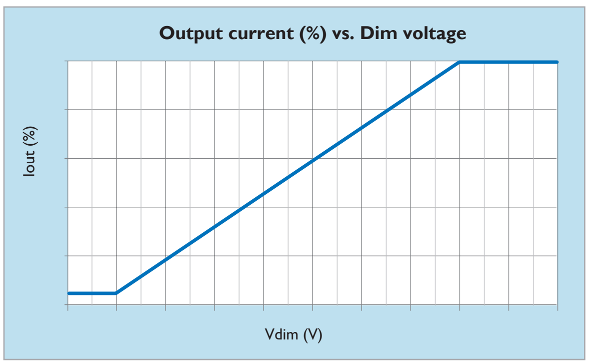


Figure 8. Output current in % vs dimming voltage (linear dimming curve), example.

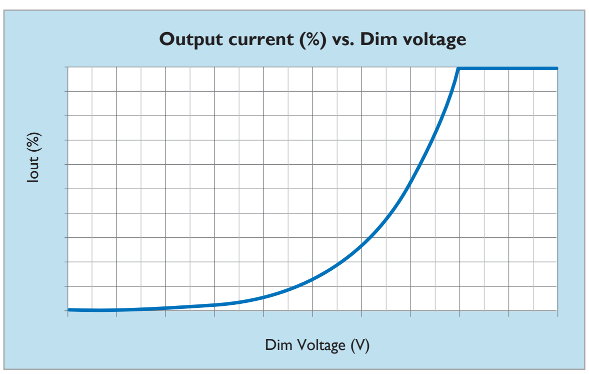


Figure 9. Output current in % vs dimming voltage (logarithmic dimming curve), example.

0-10V dimming

0-10V is a commonly used dimming interface for LED drivers. The interface requires two wires (0-10V + and -) to connect an LED driver to a 0-10V dimmer (Figure 7). The LED driver provides approximately 150μA sourcing current to the dimmer. Dimming curves are shown in Figures 8 and 9. Logarithmic and linear dimming curve configurations are possible. The curve can be configured via MultiOne. The default for the 0-10V interface is linear dimming.

Note that the output current at 100% level is determined by the driver. The absolute minimum and absolute maximum output current that can be supplied by the driver is specified in the datasheet, and this is limited by the driver hardware. It is possible to configure both of these values within the absolute limits using MultiOne. The lowest dim level is defined by the higher of the two values: minimum output current or 10% dim level for indoor drivers.

For Class 2 drivers, the 0-10V dimming leads are isolated from the mains but may not be isolated from the Class 2 output. Thus, the dimming leads are only suitable for Class 2 wiring.

When long dimming wires are required in some applications, maximum length of the dimming wires can be estimated based on voltage drop on the dimming wires. The recommended max voltage drop on the two wires is 100mV.

Note:
Even though dimming leads of LED drivers meet Class 2 requirements, when multiple drivers are connected together to one dimmer, the leakage current to the dimmer from each driver will be added together. In these situations, precaution is recommended for the system to meet applicable safety requirements.

Inrush current

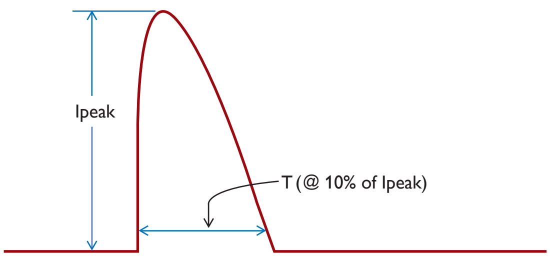


Figure 10. Inrush current vs. time.

Inrush current refers to the brief high-input current that flows into the driver during the initial start-up to charge the capacitors on the input side. Typically, the amplitude is much greater than the operating or steady-state current, as illustrated in Figure 10.

Philips Advance Xitanium LED drivers meet the inrush specification values per NEMA 410.

The peak and duration values are given in the individual product datasheet.

The best way to reduce inrush is to turn on relays or switches at the zero crossing of the mains. Many controllers do this to reduce the large inrush currents.

What does inrush current do? High inrush currents can cause circuit breakers or fuses to open if not designed to handle this current. It can limit how many drivers can be connected to a circuit breaker (CB) or fuse.

Surge protection

Note:
Please consult the fuse and circuit breaker manufacturer recommendations when selecting appropriate fuse and/ or circuit breakers in conjunction with LED luminaires.

Philips Advance Xitanium LED drivers have limited built-in surge protection (in accordance with IEEE /ANSIC82.77-5 Transient Surge Requirements). Additional protection against excessive high surges can be achieved 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 http://www.philips.com/leddrivers.

Leakage current

Philips Advance Xitanium LED drivers are designed to meet leakage current requirements per UL 8750 standards. In a luminaire, leakage current may be higher since the LED load introduces additional parasitic capacitance. As such, precautions should be taken at the luminaire level and also if multiple drivers are used in the luminaire.

Electromagnetic compatibility (EMC)

Philips Advance Xitanium LED drivers are designed to meet EMC requirements per FCC Title 47 Part 15 Class A. Compliance to this standard means our products are suitable for commercial and industrial lighting applications.

Electrical isolation

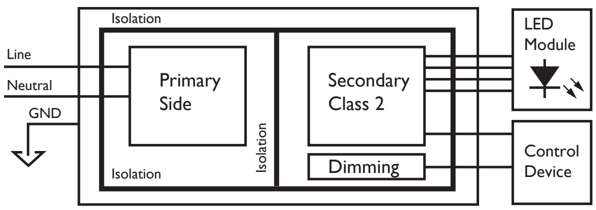


Figure 12. Isolation scheme for Class 2 drivers, example.

The Philips Advance Xitanium LED driver's output (secondary) is isolated from the input (primary) for isolated Class 2 drivers – see the individual driver datasheet for the particular isolation type used.

Isolation is also provided between all the electronic circuits and the chassis. Figure 12 illustrates the isolation scheme for Class 2 drivers.

Xitanium LED drivers are designed to meet the UL 8750 safety standard. Xitanium Class 2 drivers are also designed to meet UL1310 Class 2 safety standard.

All of the wires in the Philips Advance Xitanium LED drivers are designed to meet the UL1452 safety standards.

Mechanical mounting

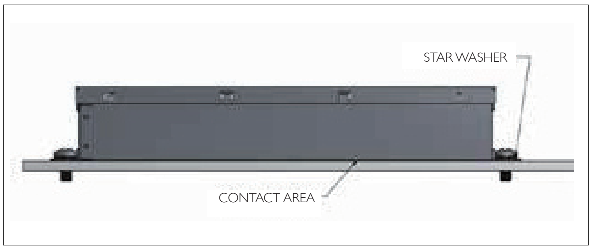


Figure 13. Chassis mounting.

Mounting of the LED driver must satisfy three critical criteria:

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

The size of mounting screws/bolts needs to be the 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

The driver enclosure is painted. It is recommended to use star washers under the head of the mounting screws – the teeth of the star washer breaks through the paint to ensure electrical connection to the grounded fixture.

3. Maximum interface area between driver enclosure surface and luminaire mounting surface (cooler) for best possible driver Tcase temperature (lowest)

Figure 13 illustrates recommended mounting of the driver. Thermally conductive gap pads (or other thermally conductive grease, paste, etc.) may be used between driver and luminaire surface to eliminate air gaps and further improve driver thermal performance (lower Tcase temperature).

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