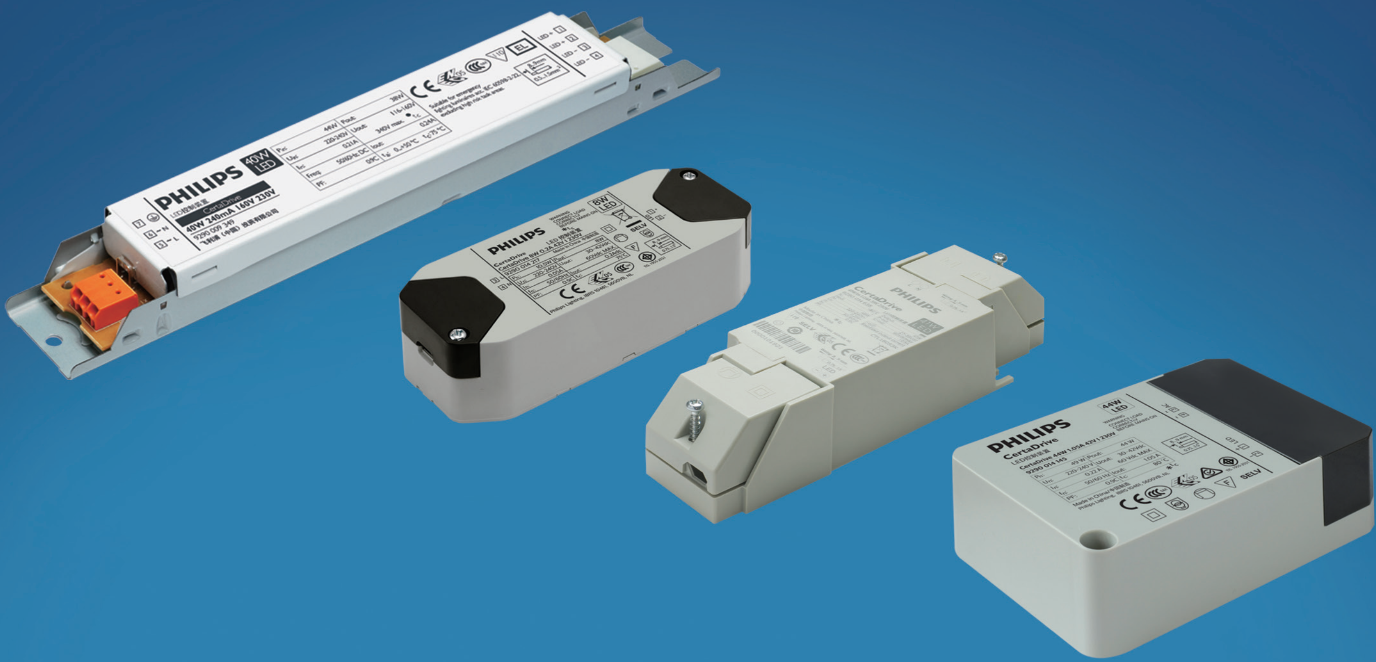
PHILIPS

CertaDrive

LED indoor drivers



Design-in Guide

Enabling **future-proof LED technology** for dynamic LED markets

June, 2023

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Contents

Introduction to this guide

Examples of CertaDrive Indoor LED drivers

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

This edition describes the CertaDrive Indoor LED drivers optimized for indoor application. We advise you to consult our websites for the latest up-to-date information.

Applications

The CertaDrive Indoor LED drivers are designed to operate LED solutions for indoor lighting, like offices, public buildings, retail, residential and consumer environments. If you use Philips LED drivers in combination with Philips LED modules, specific design-in guides are available from below mentioned technology websites.

Information or support

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

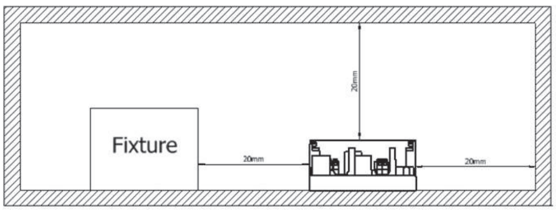
Safety precautions

Warnings:

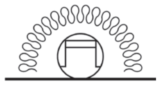
- Avoid touching live parts!
- Do not use drivers with damaged housing and/or connectors!
- Do not use drivers with damaged wiring!
- Class I luminaires must be connected to protective earth!
- Switchable function to make the open load on the driver output is abnormal condition, it is not an intended application that be allowed.
- An external DC-rated fuse must be used when operated on DC mains!

Safety warnings and installation instructions

- Do not use damaged or defective contacts or housings
- 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 his own luminaire design and has to comply with all relevant safety standards
- The CertaDrive Indoor LED drivers are intended for indoor use and should not be exposed to the elements such as snow, water and ice. It is the luminaire manufacturer's responsibility to prevent exposure
- Do not service the driver when the mains voltage is connected, this includes connecting or disconnecting the LED load
- Please provide adequate earth connection when applicable
- For the strain relief installation, Crosshead PH-2 Screw is recommended to be used, recommended torque requirement for screw is 0.7~0.9 N.m.
- In case driver being used in three-wall condition for the independent application, make sure to keep at least 20mm distance from the body to wall for the sufficient thermal dissipation.
- Lamp control gear relies upon the luminaire enclosure for protection against accidental contact with live parts.



Special remarks about RCM certification:
There are three types of applications in Australia/New Zealand, "IC", "Do not Cover", and "Non IC".
Please refer to product label for details.

IC classification 

An independent controlgear that can be abutted against normally flammable materials, including building insulation, and can be covered in normal use. Building elements, building insulation or debris have restricted access to the heated parts of the controlgear.

Do-not-cover classification 

An independent controlgear that can be used where normally flammable materials, including building insulation, are or may be present, but cannot be abutted against any material and cannot be covered in normal use. The control gear is suitable to abut normally flammable materials and to be covered by insulation inadvertently.

Non IC classification (no mark)

An independent controlgear that cannot be abutted against or covered by normally flammable materials or used in installations where building insulation or debris is, or may be, present in normal use.

Philips Design-in support is available; please contact your Philips sales representative.

Introduction to CertaDrive Indoor LED Drivers

CertaDrive Indoor LED Drivers

Introduction

CertaDrive Indoor LED drivers are designed to operate LED solutions for general lighting applications such as down light, spot/accent, linear lighting in offices, public buildings as well as industrial and retail environments to fulfill the market need for essential lighting . The CertaDrive LED drivers offer basic specifications such as specific current and voltage settings, optimal to operate with Philips modules. The CertaDrive LED drivers have both high ripple and low ripple offerings available. Low ripple drivers can provide a better ripple current (<4% LF). These LED drivers are also interesting for OEMs producing and selling their own LED-boards. If the specific V/A specifications of these LED drivers do not suit the LED board specifications of the OEM, Philips offers the possibility to create fast derivative LED drivers with the required V/A of the OEM.

Note: The output current ripple specification highly depends on the Rd value of the load (lower Rd, higher current Ripple). It is suggested that Load Rd is selected according to the ripple specification.

Naming of the drivers

Example: CertaDrive 15W 0.35A 42V I 230V

CertaDrive:	Brand name for reliable, good enough LED drivers
15W:	Maximum output power
0.35A:	Output current
42V:	Maximum output voltage
I:	Independent housing design
230V:	Mains AC input voltage

Electrical Design-in

Surge protection

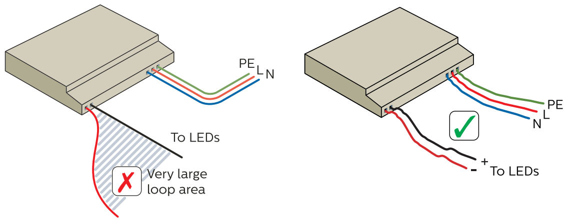
The CertaDrive Indoor LED drivers have built-in surge protection up to a certain limit. Depending on the mains connected, additional protection against excessive high surge voltages may be required by adding a Surge Protection Device. The actual limit can differ per driver and can be found in the driver's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

Touch current

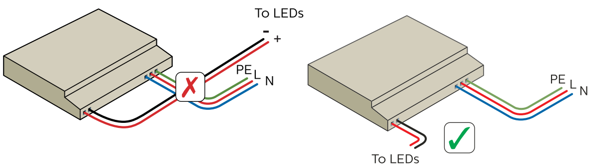
The CertaDrive Indoor LED drivers are designed to meet touch current requirements per IEC 61347-1 standard. The specified maximum values are 0.7 mA peak for IEC. The test is done with the driver alone. In a luminaire, touch current may be higher, since the LED load may introduce additional touch current. Precautions may be required on the luminaire level and if multiple drivers are used in a single luminaire.

Electromagnetic compatibility (EMC)

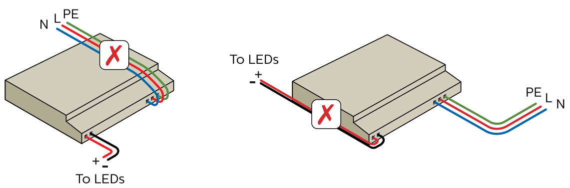
Electromagnetic compatibility (EMC) is the ability of a device or system to operate satisfactorily in its electromagnetic environment without causing unacceptable interference in practical situations. CertaDrive Indoor LED drivers meet EMC requirements per CISPR15 ed 7.2. This test is conducted with a reference setup that includes a driver and an LED load/heat sink combination mounted on a metal plate.



Keeping the wires close together



Keep mains separated from the output wires

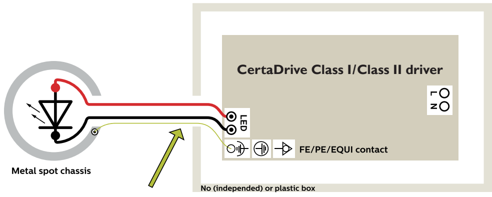


Do not route any wiring over and/or along the driver enclosure

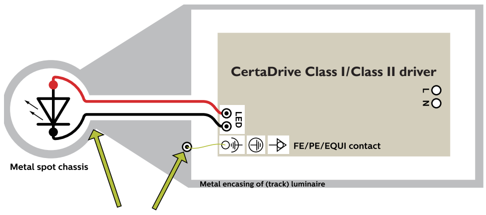
Improvement in EMI Performance

The following practical precautions need to be taken into account in a lighting system to minimize EMI:

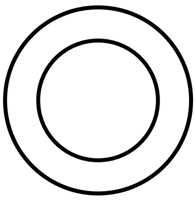
- Minimize the differential mode loop area of the LED wires going from the driver to the light source by keeping the wires close together (bundling). This will minimize the magnetic field and reduce the radiated EMI. Long linear light sources are also part of that loop.
- Minimize the common mode parasitic capacitance of the output wiring + light source to earth by keeping the length of the wires between driver and light source as short as possible. Keep the length of the incoming mains wire inside the luminaire as short as possible.
- Keep mains separated from the output wires (do not bundle).
- Do not route any wiring over and/or along the driver enclosure to avoid any coupling/crosstalk with internal components of the driver.
- Ground the lighting system chassis and other internal metal parts to protective earth (class I luminaires), do not let large metal parts electrically insulated from functional or protective earth. Always connect the protective/functional earth/ equipotential connector or wire from the driver and use equipotential bonding wires for all large metal parts like driver mounting plate, reflector, heatsink etc. Keep the protective/ functional earth/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 torque.



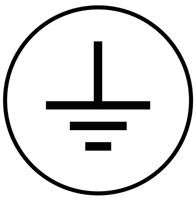
Metal spot chassis of an independent of configuration connected to PE of driver



Luminaire housing connected to FE/PE/EQUI contact of driver



Symbol for Double Isolation between primary and secondary side of a driver, in combination with built-in usage.



Symbol for Protective Earth (PE)

- For Class II it is advised to establish a functional earth connection between all larger conductive, non-accessible luminaire parts and the driver to remedy potential EMC problems.
- Sometimes, radiated EMC compliance cannot be achieved, necessitating the use of a 100 … 300 Ωaxial ferrite bead(s) for either mains or lamp wiring (effective for interference between 30 MHz and 300 MHz), or coupling the wires through ferrite cores within the luminaire may improve the overall EMC performance. However, selection of the type and characteristics of the additional filter depends on what frequency components have to be damped and by how much.

Adhering to these rules will help in EMC compliance. For further questions, please contact your local Philips representative. Alternatively the Philips Lighting OEM Design-In team could be consulted for a possible solution.

Electrical isolation

Isolated drivers (SELV output)

Drivers in this group cannot generate output voltages higher than 120VDC. These drivers have double isolation from the primary to the secondary side and basic isolation (single isolation foil) between all the electronic circuits and the chassis, hence the presence of the Protective Earth (PE) symbol on the driver housing. This means that in case of driver housing accessibility (i.e. touchable by hand without the need of tools to gain access), the driver housing and all other accessible conductive parts need to be connected to PE. 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

- 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 isolated 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.

Low mains voltage

CertaDrive Indoor LED drivers meet the IEC 61347-1 safety standard In accordance to this standard, the following safety requirements are met:

- Basic isolation between the Primary and Secondary side wires:
- Driver output voltage < 1000 VDC
- Insulation test voltage 1000 V + 2 * U
- Double isolation between all wires and chassis: Insulation test voltage: 3750 V.

Non-isolated drivers

These drivers have no isolation from the primary to the secondary side and basic isolation (single isolation foil) between all the electronic circuits and the chassis, hence the presence of the Protective Earth (PE) symbol (see image on the left) on the driver housing.

Non-isolated drivers can be used in Class I luminaires. Be aware that all output connections of these drivers are not touch-safe when the driver is switched on. An adequate earth connection needs to be made to all electrical conductive parts in the luminaire. The bottom part (unpainted) of the driver housing can be used to create earth contact to the luminaire housing, as the earth connector is internally connected to the driver housing. An intermitting earth contact should be prevented, as this is potentially unsafe and can cause a degraded performance. Most drivers in this group typically can generate output drive voltages higher than 60VDC. Always test the quality of your earth contacts between all relevant conductive parts.

Warnings for Non-isolated drivers

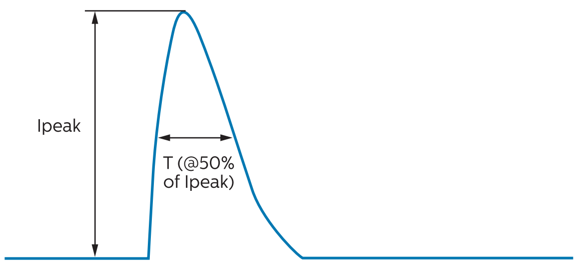
- Do not touch any non-insulated live parts, even on the output(secondary) side!
- Any live part on the output (secondary) side should not touchable during normal operation.

Connectors

Different connectors are used on the Philips CertaDrive Indoor LED drivers. More info about wiring (diameter, length, etc.) can be found in the datasheet. The datasheets of each driver can be downloaded via
www.philips.com/Technology

Mains

Orange push-in connectors are used to connect the drivers to the mains.



Graphical representation of inrush current

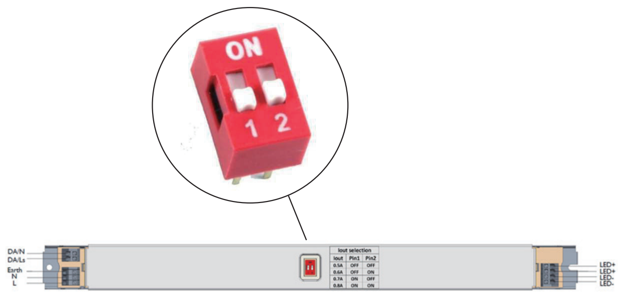
Inrush current

'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-pecific an can be found in the driver datasheet at www.philips.com/technology.



DipSwitch on driver

How to … Set the output current via DipSwitch

Alongside the programmable TD drivers, there are non-programmable TD drivers with DipSwitch.
Users could toggle the DipSwitch to set the output current. The output current matrix is illustrated on the label.
It's not allowed to adjust output current via DipSwitch when the driver is powered on.

DC, DCemDIM and Emergency operation

Some of the CertaDrive Indoor LED drivers are able to operate on DC voltage on the mains input, like when connected to a central DC emergency grid.
Depending on the type, CertaDrive LED drivers are released in compliance with lamp control gear standards as stated under "Emergency standards" in section "Quality" at the end of this document. As a result these drivers are suitable for emergency luminaires in compliance with IEC 60598-2-22, excluding high-risk task areas.

Please note the allowed DC voltage range accepted by the driver is stated in the driver's datasheet.
Values outside that range will have an adverse effect of the driver's performance and possibly reliability.

On selected drivers DCemDIM is available, allowing a pre-defined dim level of the driver's output when switched to DC. More on setting parameters of DCemDIM in section Controllability. For specific input requirements, please check the driver's datasheet at the download section on www.philips.com/technology.

How to… Determine the number of drivers on a MCB

The maximum amount of drivers on a 16A type B Miniature Circuit Breaker (MCB) is stated in the driver's datasheet on www.philips.com/technology.

In the conversion table on the left that stated amount is used as reference (100%).

The maximum quantity of drivers on different types of MCB can be calculated by the reference (see driver's datasheet) x Relative number (last column).

Example;

If datasheet states: max number on type B, 16 A = 20, then for type C, 13 A the value will be 20 x 135% = 27.

Notes

1. Data is based on a mains supply with an impedance of 400 mΩ (equal to 15 m of 2.5 mm^2 cable and another 20 m to the middle of the power distribution) in the worst-case scenario. With an impedance of 800 m^2 the number of drivers can be increased by 10%.
2 Measurements will be verified in real installations; data is therefore subject to change.
3. In some cases the maximum number of drivers is not determined by the MCB but by the maximum electrical load of the installation.
4. Note that the maximum number of drivers is given when these are all switched on at the same time, e.g. by a wall switch.
5. Measurements were carried out on a single-pole MCB. For multiple MCBs it is advisable to reduce the number of drivers by 20%.
6. The maximum number of drivers that can be connected to one 30 mA Residential Current Detector is 30.

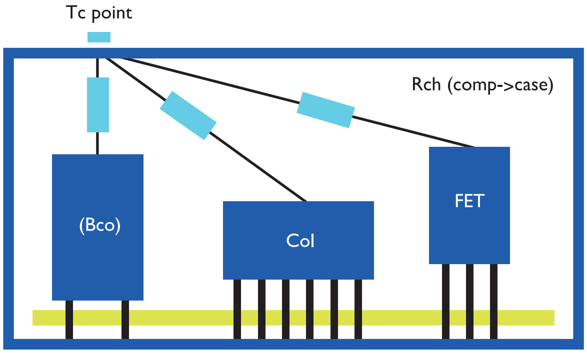
MCB type	Rating (A)	Relative number of LED drivers (%)
B4		25
B	6	40
B1	0	63
B1	38	1
B	16	100 (reference)
B2	0	125
B2	5	156
B3	2	200
B4	0	250
C4		42
C	6	63
C1	0	104
C1	3	135
C	16	170
C2	0	208
C2	5	260
C3	2	340
C4	0	415
D4		80
D	6	130
D1	0	210
D1	3	280
D	16	350
D2	0	470
D2	5	550
D3	2	700
D4	0	940
L, I	16	108
L, I	10	65
G, U, II	16	212
G, U, II	10	127
K, III	16	254
K, III	10	154

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

Thermal Design-In

Introduction

This chapter describes the relationship between the CertaDrive Indoor LED drivers in association with Tc point and lifetime.



Schematically representation of internal thermal paths to the driver Tc point

Definitions

• Case temperature: temperature measured at the Tc point of the driver
• Ambient temperature (Tamb): temperature outside the driver

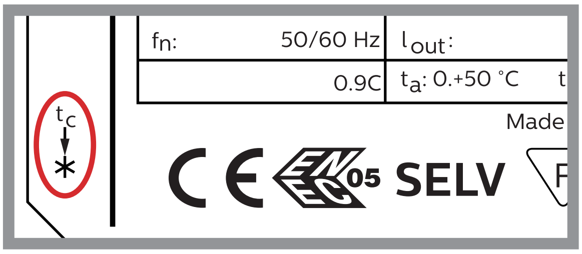
When switched off >2 hours, temperature at Tc point is likely to equal Tamb

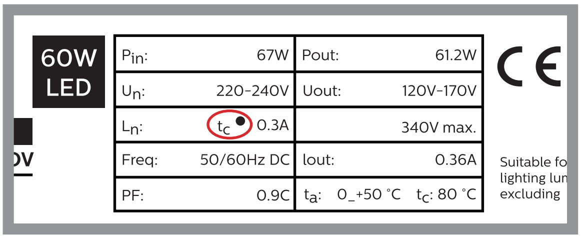
Case Temperature Point (Tc point)

To achieve optimal lifetime and reliability, it is critical that the temperature of the components in the driver remains within its rating. In the LED driver design, all precautions are taken to ensure that the components within the driver are at the lowest possible temperatures.

All temperature measurements are related to a Tcase point (Tc) on the driver. Tc temperature is a reference for the temperatures of the critical internal driver components. The location of the Tc point is identified on the product label. Tc point is marked by the * or -sign on the label of the driver.

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. The CertaDrive LED driver has been designed for indoor use. For approved ambient temperature range please check the associated driver datasheet on www.philips.com/technology

Driver lifetime

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. CertaDrive Indoor LED drivers have a specified minimum lifetime of 30,000 hours with a minimum of 90% survivors at the specified Tc-life (see also respective datasheet).

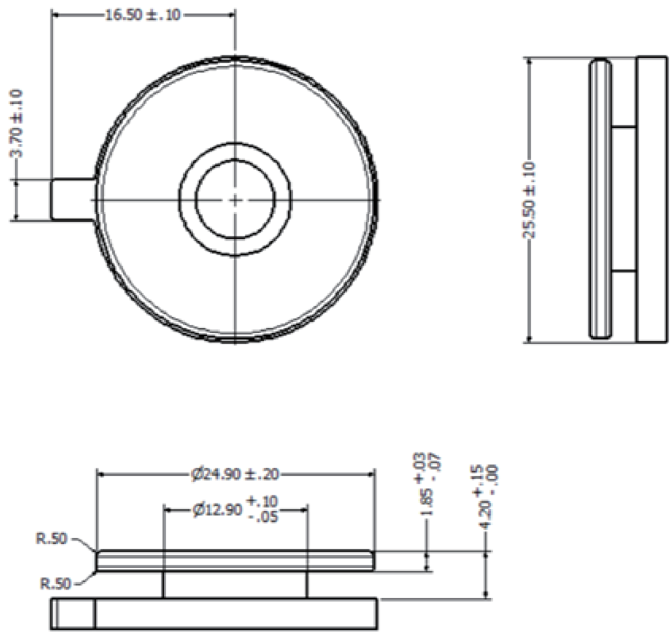
Mechanical design-in

Dimension of nipple for track adapters

For Philips track adapters, the Philips nipple is recommended for all track adaptors series.

OEM manufacturers should take responsibility for the reliability if use customized nipples from third party to work with track adapters. The dimensions of customized nipples should strictly follow Philips nipple's mechanical design. Drivers should stay away from acid and alkali. Organic oil is not allowed because it might embrittle the driver's housing.

Dimension of Philips nipple (Unit: mm)



Quality and Reliability

Switching & cycling lifetime of LED drivers

Impact of on and off switching on lifetime of electronic drivers in LED systems

In this section a description is presented of the impact of mains voltage switching on the lifetime of electronic drivers in lighting systems. Because switching on and off the lighting has an impact on different failure modes, a distinction has to be made between switching on and off, and thermal cycling.

Electrical failures due to switching Vmains on and off

Before the lighting is switched on in the electronic circuit all capacitors are uncharged. By a simple toggle of the mains voltage all capacitors will be charged, causing peak currents in the circuit. Inductors react to this by creating peak voltages. Occurrence of peak currents & voltages during starting is inevitable. The circuit design and component selection should be of sufficient quality that no components are overstressed during the starting conditions. If the quality is not sufficient, failures will occur at a certain rate over time. The failure rate will be influenced by usage conditions such as temperature and mains voltage. The failure rate will be further enhanced by irregular mains voltage events such as dips, surges or black outs. For a good quality design all conditions and components are carefully checked. In general LED systems and products are designed to withstand >100,000 switches under the specified use conditions.

Mechanical failures due to thermal cycling

A completely different failure mode which is also due to switching on and off the light is the failure of solder joints, due to thermal cycling. Stresses in solder joints are caused by the differences of the thermal expansion coefficients (CTE's) of printed circuit board, solder and component materials.

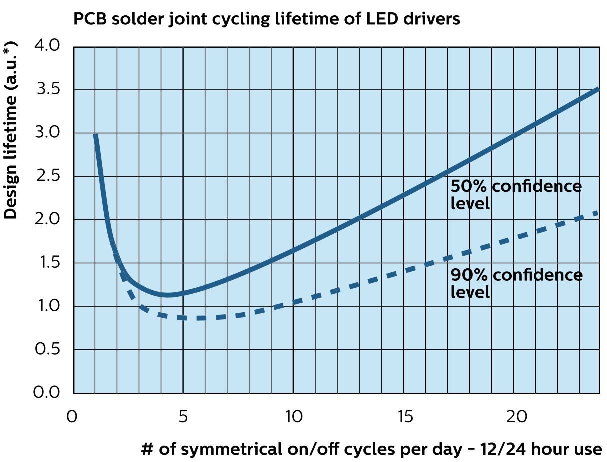
Due to heating up and cooling down mechanical stresses build up in the solder, which eventually result in cracking and finally failure of the joint. In most cases failure of one solder joint means the end of the product. The solder joint failure mechanism is also referred to as solder joint fatigue. This is a typical wear out failure mechanism with a negligible failure rate for many years, but for which after the typical lifetime has passed, failures come at an accelerated speed.

Electronic Drivers for LED lighting are typically designed to last 30,000 operational hours. The reference for this lifetime is a typical user profile of 10-12 hr usage and up to 3x switching on and off every day. In the worst case this could mean 25,000 switches at a regular rate 2 hrs on, 2 hrs off. For the electrical stresses during switching there is no problem switching many more times, even up to >100,000 times. However for the solder joints there can be a risk for the lifetime of the product.

Impact of thermal cycles per day on the driver lifetime

As the drivers are typically designed to withstand 3 full thermal cycles every day, lifetime will reduce with an increasing cycling frequency. However this reduction will be limited by the heating time of the product in the application. As the heating time of a driver in real applications varies typically between 60 and 120 minutes, maximum and minimum driver temperature will not be reached when the cycling frequency is faster than 60 minutes. Because the solder-joint damage relates to a higher power of the temperature difference between hot and cold condition, the negative effect on lifetime reduces for the higher cycling frequencies. This is expressed in the above graph.

Because of the large variation and differentiation between drivers and applications, it is an impossible task to specify the above graph for every driver and application specifically. Therefore only the critical conditions are listed for which there could be a risk to the cycling lifetime of the driver.



*) arbitrary unit value 1.0 means product design - lifetime will be reached (typical 50,000 h). Longer lifetimes can be limited by other failure modes.

Critical conditions for the driver lifetime due to thermal cycling are:

- Small driver / system (short heating time) without appropriate heat sinking (high T_max).
- Large difference between T_max and temperature in off state T_min (e.g. > 50 °C). See also next paragraph.
- Application @ temperatures < -20 °C T_ambient.

Especially if the above parameters occur in combination with each other there can be a risk for thermal cycling lifetime. To improve cycling lifetime when required, it is most relevant to decrease the T_max by appropriate heat sinking of the driver. As a rule of thumb 10 °C diminished ΔT between Tcase on/off, will add 30% to cycling performance.

Impact of product ambient temperature on cycling performance

In the first approximation the solder joint lifetime is independent of the ambient temperature. The driving parameter for the solder joint failure fatigue is the temperature difference between T_max during the 'on' state and T_min during the 'off' state. The way the driver is built in to a luminaire is very important as this can decrease the temperature difference. Appropriate heat sinking of the driver is the most effective way to improve the driver cycling lifetime. As a rule of thumb 10 °C diminished ΔT between Tcase on/off, will add 30% to cycling performance.

For potted products additional failure mechanisms can occur at temperatures <-20 °C, which can increase the impact of thermal cycling on the product lifetime.

Compliance and approval

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

System Disposal

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

www.philips.com/Technology

13 June, 2023
Data subject to change