POOL ENGINEERING
DOTT. ING. VIRGILIO M. CHIONO

STUDIO DI INGEGNERIA
GEOM. ANDREA ZANUSSO

Progettazione civile e impiantistica - Architettura - Consulenza - Certificazioni - Formazione - Qualità - Sicurezza - Ambiente

Vicolo Cugiano n° 4 - 10090 San Giorgio C.se - (To) - Italy
tel 0124 450 535 - fax 0124 450 839 - info@poolsa.eu

Regione Piemonte
Città Metropolitana di Torino
Comune di Foglizzo

Progetto	**Intervento per la riduzione dei consumi energetici e adozione di soluzioni tecnologiche innovative sulle reti di illuminazione pubblica comunale**
Localizzazione	Foglizzo (capoluogo)
Fase Progettuale	Progetto Definitivo - Esecutivo
Titolo Tavola	INTEGRAZIONE RTES ALLEGATO 01 SIstemi alimentazione riduzione di flusso
Committenza	Comune di Foglizzo via Castello, 6 10090 - Foglizzo (To)
	Per validazione
Professionisti	ORDINE INGEGNERI DELLA PROVINCIA DI TORINO – Dott. Ing. VIRGILIO MARIO CHIONO n° 8645 F COLLEGIO DEI GEOMETRI DI TORINO E PROVINCIA – Andrea ZANUSSO – iscrizione 7397

Riferimenti				
	Rev. n° 000	Data nov 2018	Dis. V.R.	Descr. Emissione definitiva
	Rev. n° 001	Data Gen 2019	Dis. M.F.	Descr. Emissione definitiva
	Rev. n° 002	Data	Dis.	Descr.
	Rev. n° 003	Data	Dis.	Descr.

Tavola		
	Scala	VARIE
	Cod. Comm.	180332
	Cod. Tavola	INT
	N° Tavola	ALL01

Pool Engineering S.A.
P. IVA 08926970016

Pool Engineering S.n.c.
P. IVA 09266390013

Lo studio opera con procedure conformi alla norma ISO 9001:2008

Mod 760-00 08-2010 (Rev 002)

Alimentatori 75-120W

PHILIPS

Xitanium

LED driver

Datasheet

Xitanium FULL Prog LED Xtreme drivers

Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt

Xitanium FULL Prog LED Xtreme drivers

Philips Xitanium Full Programmable LED drivers are specifically designed to deliver the highest performance, protection and configurability. The portfolio offers both central and standalone dimming protocols further increasing the energy savings and CO2 reductions achieved with LED lighting. The Xtreme technology ensures maximum robustness and protection combined with a very long lifetime.

In this product family Philips introduces new drivers in a stretched form factor with state-of-the-art features, which offer high value for both OEM customers and end-users. The products can replace the existing programmable outdoor LED drivers and will bring significant improvement in programming, assembly into a luminaire and electrical performance. One of the key features is SimpleSet®, an easy and fast way to configure the driver in a production environment, without the need to power the driver.

Benefits

- Ultimate robustness, offering peace of mind and lower maintenance costs
- Fully programmable LED-drivers designed for the new digital and connected lighting world
- Extended diagnostics via SimpleSet® and MultiOne
- Easy to design-in, configure and install for insulation Class I and Class II applications
- Energy savings through high efficiency and via multiple dimming options

Features

- SimpleSet®, wireless configuration interface
- High surge immunity (CM/DM)
- Long lifetime and robust protection against moisture, vibration and temperature
- Configurable operating windows (AOC)
- Multiple control interfaces: DALI, LineSwitch, AmpDim
- Autonomous dimming via integrated DynaDimmer
- Suitable for central DC operation (DCemDim)
- Thermal protection for LED module (MTP)
- Constant Light Output (CLO)
- Adjustable Start-up Time (AST)
- Adjustable Light Output (ALO)
- End-Of-Life indicator (EOL)

Application

- Road and street lighting
- Area lighting
- Tunnel lighting
- Industrial lighting

November 2017

Electrical input data

Specification item	Value	Unit	Condition
Rated input voltage range	202...254	V_{ac}	Performance range
Rated input voltage	230	V_{ac}	
Rated input frequency range	47...63	Hz	Performance range
Rated input current	0.37	A	@ rated output power @ rated input voltage
Max. input current	0.4	A	@ rated output power @ minimum performance input voltage
Rated input power	82	W	@ rated output power @ rated input voltage
Power factor	≥ 0.98		@ rated output power @ rated input voltage
Total harmonic distortion	≤ 7	%	@ rated output power @ rated input voltage
Efficiency	≥ 92	%	@ rated output power @ rated input voltage
Rated input voltage DC range	186...250	V_{dc}	Performance range, external DC-rated fuse required
Rated input current DC range	≤ 0.3	A_{dc}	Performance range
Input voltage AC range	198...264	V_{ac}	Operational range, see MainsGuard graph
Input frequency AC range	45...66	Hz	Operational range
Input voltage DC range	169...275	V_{dc}	Operational range
Standby Power (TD)	0.45	W	
Isolation input to output	Double		

Electrical output data

Specification item	Value	Unit	Condition
Regulation method	Constant Current		
Output voltage	35...108	V_{dc}	
Output voltage max.	160	V	Peak voltage at open load
Output current	0.07...1.05	A	
Output current min programmable	300	mA	
Output current min dimming	70	mA	
Output current tolerance	± 3	%	
Output current ripple LF	≤ 4	%	Ripple = peak / average
Output current ripple HF	≤ 15	%	
Output power	3...75	W	

Electrical data controls input

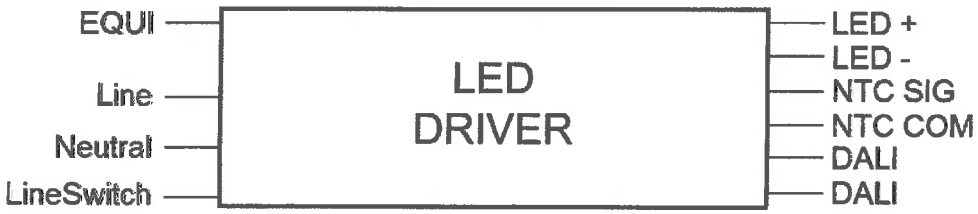
Specification item	Value	Unit	Condition
Control method	AmpDim, DALI, Dynadimmer, LineSwitch single-step		Output current amplitude dimming
Dimming range	10...100	%	DALI acc. IEC62386-101, -102 Ed. 2.0; LineSwitch: Vlow: < 160Vac Vhigh: 170 ... 264Vac
Galvanic Isolation	Double		

Logistical data

Specification item	Value
Product name	Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt
Order code	871869648146200
Logistic code 12NC	9290 009 62506
EAN3	8718696481479
Pieces per box	10

Wiring & Connections

Specification item	Value	Unit	Condition
Input wire cross-section	0.5...2.5	mm^2	WAGO804, solid / stranded wire
	12...20	AWG	WAGO804, solid / stranded wire
Input wire strip length	10...11	mm	
Output wire cross-section	0.2...1.5	mm^2	WAGO250 (3.5 mm), solid / stranded wire
	16...24	AWG	WAGO250 (3.5 mm), solid / stranded wire
Output wire strip length	8.5...9.5	mm	
Dimming wire cross-section	0.2...1.5	mm^2	WAGO250 (3.5 mm), solid / stranded wire
	16...24	AWG	WAGO250 (3.5 mm), solid / stranded wire
Dimming wire strip length	8.5...9.5	mm	
Maximum cable length	2500	mm	CISPR15: between driver and LED module
Maximum NTC output cable length	0.6	m	

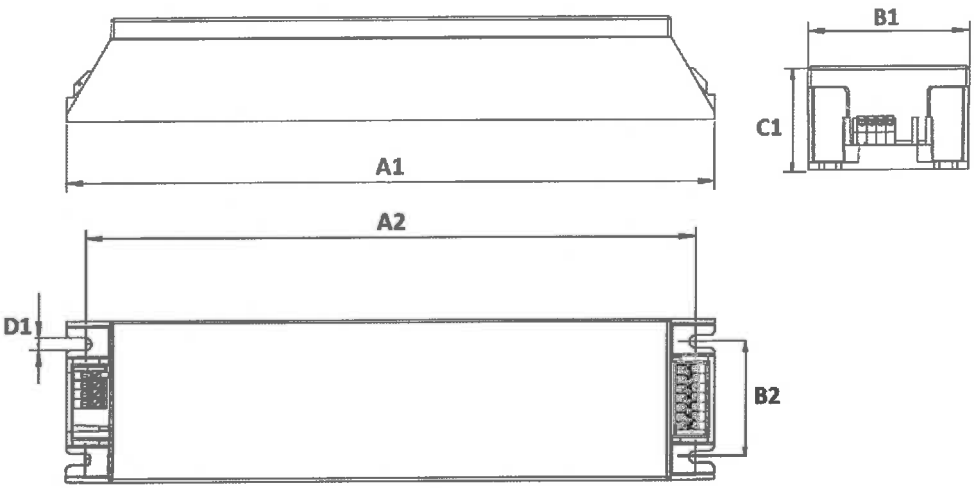


Insulation

Insulation	Mains	EQUI	LED + NTC	LineSwitch	DALI
Mains		Double	Double	NA	Basic
EQUI	Double		Basic	Double	Double
LED + NTC	Double	Basic		Double	Double
LineSwitch	NA	Double	Double		Basic
DALI	Basic	Double	Double	Basic	

Dimensions and weight

Specification item	Value	Unit	Condition
Length (A1)	240	mm	
Width (B1)	59.7	mm	
Width (B2)	42.9	mm	
Height (C1)	37.8	mm	
Fixing hole diameter (D1)	4.5	mm	
Fixing hole distance (A2)	226	mm	
Weight	650	gram	



Operational temperatures and humidity

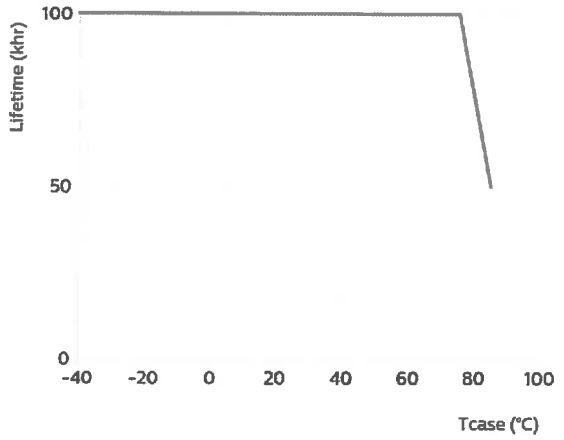
Specification item	Value	Unit	Condition
Ambient temperature	-40...+55	°C	Higher ambient temperature allowed as long as Tcase-max is not exceeded.
Tcase-max	85	°C	Maximum temperature measured at T_{case}-point
Tcase-life	75	°C	Measured at T_{case}-point
Maximum housing temperature	130	°C	In case of a failure
Relative humidity	10...90	%	Non-condensing

Storage temperature and humidity

Specification item	Value	Unit	Condition
Ambient temperature	-40...+85	°C	
Relative humidity	5...95	%	Non-condensing

Lifetime

Specification item	Value	Unit	Condition
Driver lifetime	100,000	hours	Measured temperature at T_{case}-point is T_{case}-life. Maximum failures = 10%



Programmable features

Specification item	Value	Remark	Condition
Set output current (AOC)	Programmable, SimpleSet	See Design-in guide.	Default output current: = 700 mA
LED module temperature derating (MTP)	Yes		
Constant Lumen Over Lifetime (CLO)	Yes		
DC emergency dimming (DCemDIM)	Yes		Default AOC: 15%. EOF(x) range: 10 ... 60%
Diagnostics	Yes		
Adjustable Light Output (ALO)	Yes		
Ampdim	Yes		
LineSwitch single-step	Yes		
Adjustable Start-up Time (AST)	Yes		
Integrated Dynadimmer	Yes		5-step, light turn-off possible
End Of Life indicator	Yes		

Features

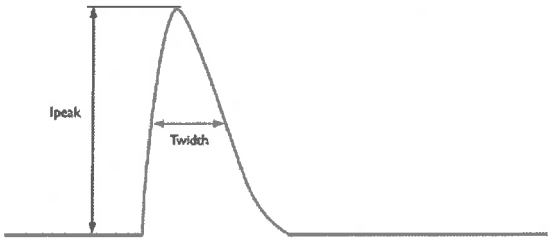
Specification item	Value	Remark	Condition
Open load protection	Yes		Automatic recovering
Short circuit protection	Yes		Automatic recovering
Over power protection	Yes		Automatic recovering
Hot wiring	No		
Suitable for fixtures with protection class	I and II		per IEC60598
Over temperature protection driver	Yes		Automatic recovering
Overheating protection	Yes		Automatic recovering

Certificates and standards

Specification item	Value
Approval marks	CB / CCC / CE / ENEC / RCM / TISI / VDE-EMV / VDE-S
Ingress Protection classification	20

Inrush current

Specification item	Value	Unit	Condition
Inrush current I_{peak}	46	A	Input voltage 230V
Inrush current T_{width}	250	µs	Input voltage 230V, measured at 50% I_{peak}
Drivers / MCB 16A type B	≤ 11	pcs	



MCB	Rating	Relative number of LED drivers
B	10A	63%
B	13A	81%
B	16A	100% (stated in datasheet)
B	20A	125%
B	25A	156%
C	10A	104%
C	13A	135%
C	16A	170%
C	20A	208%
C	25A	260%

Driver touch current / protective conductor current

Specification item	Value	Unit	Condition
Typical touch current (ins. Class II)	< 0.45	mA peak	Acc. IEC61347-1. LED module contribution not included
Typical protective conductor current (ins. Class I)	< 0.3	mA rms	. LED module contribution not included

Surge immunity

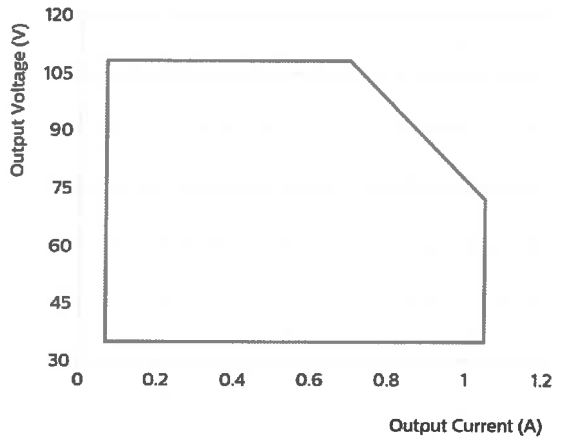
Specification item	Value	Unit	Condition
Mains surge immunity (diff. mode)	6	kV	L-N, Ls-L, Ls-N, acc. IEC61000-4-5. 2 Ohm, 1.2/50us, 8/20us
Mains surge immunity (comm. mode)	8	kV	L/N - EQUI, Ls - EQUI, acc.IEC61000-4-5. 12 Ohm 1.2/50us,8/20us
Control surge immunity (diff. mode)	1	kV	DALI - DALI, acc. IEC61000-4-5. 2 Ohm, 1.2/50us, 8/20us
Control surge immunity (comm. mode)	4	kV	DALI - EQUI, acc. IEC61000-4-5. 2 Ohm, 1.2/50us, 8/20us
DALI surge immunity (comm. mode)	4	kV	DALI - L/N/Ls acc. IEC61000-4-5. 12 Ohm, 1.2/50us, 8/20us

Additional information

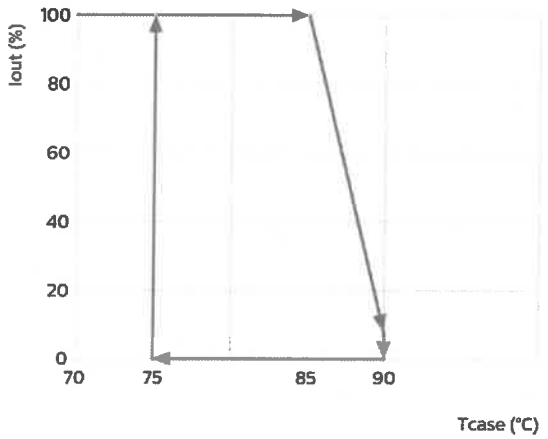
Specification item	Default setting	Remark	Condition
AOC	700	mA	
LineSwitch	ON		
CLO	OFF		
MTP	OFF		
Dynadimmer	OFF		
EOL	OFF		

Graphs

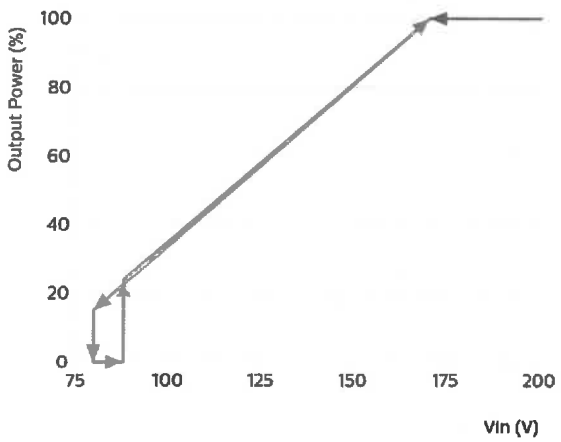
Operating window



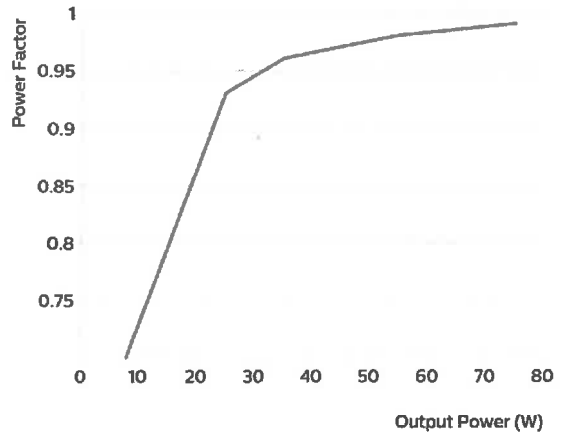
Thermal Guard



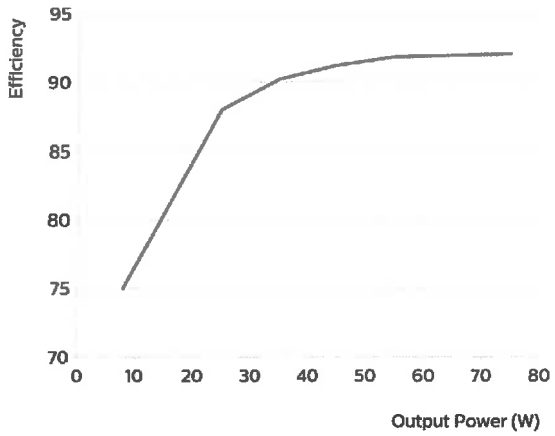
Mains Guard



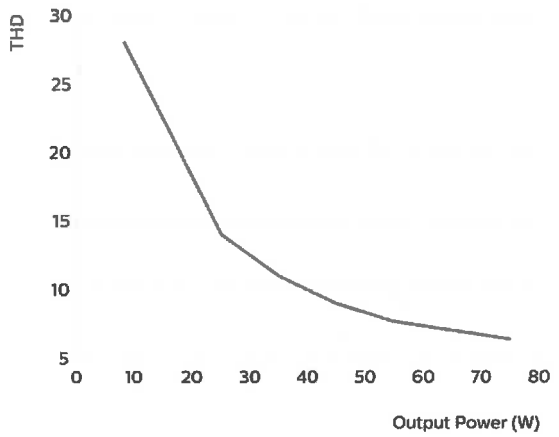
Power factor versus output power



Efficiency versus output power



THD versus output power



CERTIFICATE

Issued to:
Applicant:
Philips Lighting B.V.
High Tech Campus 45
5656 AE Eindhoven
The Netherlands

Manufacturer/Licensee:
Philips Lighting B.V.
High Tech Campus 45
5656 AE Eindhoven
The Netherlands

Product	:	LED driver
Trade name	:	PHILIPS
Types	:	Xi FP 150W 0.2-0.7A SNLDAE 230V S240 sXt
		Xi FP 150W 0.3-1.0A SNLDAE 230V S240 sXt
		Xi FP 75W 0.2-0.7A SNLDAE 230V S240 sXt
		Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt

The product and any acceptable variation thereto is specified in the Annex to this certificate and the documents therein referred to.

DEKRA hereby declares that the above-mentioned product has been certified on the basis of:
- a type test according to the standard EN 61347-1:2008 + A1:2011 + A2:2013, EN 61347-2-13:2014, EN 62384:2006 + A1:2009
- an inspection of the production location according to CENELEC Operational Document CIG 021
- a certification agreement with the number 947556

DEKRA hereby grants the right to use the ENEC KEMA-KEUR certification mark.

The ENEC KEMA-KEUR certification mark may be applied to the product as specified in this certificate for the duration of the ENEC KEMA-KEUR certification agreement and under the conditions of the ENEC KEMA-KEUR certification agreement.

This certificate is issued on: 14 January 2016 and expires upon withdrawal of one of the above mentioned standards.

Certificate number: 2188964.01

DEKRA Certification B.V.

drs. G.J. Zoetbrood
Managing Director

A.P. van der Veen
Certification Manager

ACCREDITED BY THE DUTCH ACCREDITATION COUNCIL

PRODUCTS RvA C 081

SPECIFICATION OF THE CERTIFIED PRODUCT

Product data

product	:	LED driver
trade name	:	PHILIPS
types	:	Xi FP 150W 0.2-0.7A SNLDAE 230V S240 sXt Xi FP 150W 0.3-1.0A SNLDAE 230V S240 sXt Xi FP 75W 0.2-0.7A SNLDAE 230V S240 sXt Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt
rated voltage	:	220-240 Vac
nature of supply	:	ac
rated frequency	:	50/60 Hz
rated input current	:	see product data per type
rated input power	:	see product data per type
power factor	:	0,95
output current	:	see product data per type
output voltage	:	see product data per type
output power	:	see product data per type
max. case temperature (tc)	:	see product data per type
ambient temperature range (ta)	:	-40...+55 °C
description	:	built-in LED driver with double insulation

Additional information

- Constant current type with screwless terminal block
- LED driver is completely potted with asphalt
- Thermal protected

Product data - type Xi FP 150W 0.2-0.7A SNLDAE 230V S240 sXt

rated input current	:	0,8-0,67 Aac
rated input power	:	162 W
output current	:	200-700 mA
output voltage	:	90-283 V; 340 V max
output power	:	150 W
max. case temperature (tc)	:	90 °C

Product data - type Xi FP 150W 0.3-1.0A SNLDAE 230V S240 sXt

rated input current	:	0,76-0,67 Aac
rated input power	:	162 W
output current	:	300-1050 mA
output voltage	:	70-214 V; 260 V max
output power	:	150 W
max. case temperature (tc)	:	90 °C

Product data - type Xi FP 75W 0.2-0.7A SNLDAE 230V S240 sXt

rated input current	:	0,4-0,34 Aac
rated input power	:	82 W
output current	:	200-700 mA
output voltage	:	50-150 V; 190 V max
output power	:	75 W
max. case temperature (tc)	:	85 °C

Product data - type Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt

rated input current	:	0,4-0,34 Aac
rated input power	:	82 W
output current	:	300-1050 mA
output voltage	:	35-108 V; 140 V max
output power	:	75 W
max. case temperature (tc)	:	85 °C

TESTS

Test requirements
EN 61347-1:2008 + A1:2011 + A2:2013
EN 61347-2-13:2014
EN 62384:2006 + A1:2009

Test results
The test results are laid down in DEKRA test file 2188964.00.

Remarks
For component list refers to annex 1 of test reports 2188964.50.
This certificate supersedes the original certificate 2183840.01.

Conclusion
The examination proved that all test requirements were met.

Tested by : J.H. Rikkers

Checked by : L.N.H. Huynh

Ref. Certificate No.
NL-39419

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

SYSTEME CEI D'ACCEPTATION MUTUELLE DE CERTIFICATS D'ESSAIS DES EQUIPEMENTS ELECTRIQUES (IECEE) METHODE OC

CB TEST CERTIFICATE

CERTIFICAT D'ESSAI OC

Product Produit	LED driver
Name and address of the Applicant Nom et adresse du demandeur	Philips Lighting B.V. High Tech Campus 45, 5656 AE Eindhoven The Netherlands
Name and address of the manufacturer Nom et adresse du fabricant	Philips Lighting B.V. High Tech Campus 45, 5656 AE Eindhoven The Netherlands
Name and address of the factory Nom et adresse de l'usine	Philips Lighting Electronics Poland ul. Przemyslowa 29, 64-290 PILA Poland
Rating and principal characteristics Valeurs nominales et caractéristiques principales	Xi FP 150W 0.2-0.7A SNLDAE 230V S240 sXt: Pin:162W; Uin: 220-240 V~; Iin: 0,8-0,67 A~; Freq: 50/60 Hz; PF: 0,95; Pout:150W; Uout: 90-283 V; Iout: 200-700 mA; ta: -40...+55 °C; tc(max): 90 °C Xi FP 150W 0.3-1.0A SNLDAE 230V S240 sXt: Pin:162W; Uin: 220-240 V~; Iin: 0,76-0,67 A~; Freq: 50/60 Hz; PF: 0,95; Pout:150W; Uout: 70-214 V; Iout: 300-1050 mA; ta: -40...+55 °C; tc(max): 90 °C Xi FP 75W 0.2-0.7A SNLDAE 230V S240 sXt: Pin:82W; Uin: 220-240 V~; Iin: 0,4-0,34 A~;Freq: 50/60 Hz;PF: 0,95; Pout:75W; Uout: 50-150V; Iout: 200-700 mA; ta: -40...+55 °C; tc(max): 85 °C Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt Pin:82W; Uin: 220-240 V~; Iin: 0,4-0,34 A~; Freq: 50/60 Hz; PF: 0,95; Pout:75W; Uout: 35-108 V; Iout: 300-1050 mA; ta: -40...+55 °C; tc(max): 85 °C
Trademark (if any) Marque de fabrique (si elle existe)	PHILIPS
Type of manufacturer's Testing Laboratories used Type de programme de laboratoire d'essais constructeur	
Model / Type Ref. Réf. de type	Xi FP 150W 0.2-0.7A SNLDAE 230V S240 sXt Xi FP 150W 0.3-1.0A SNLDAE 230V S240 sXt Xi FP 75W 0.2-0.7A SNLDAE 230V S240 sXt Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt

This CB Test Certificate is issued by the National Certification Body:

Ce Certificat d'essai OC est établi par l'Organisme National de Certification

DEKRA Certification B.V.
Meander 1051, 6825 MJ
Arnhem
The Netherlands

DEKRA

Date: 2016-01-13

Signature: A.P. van der Veen

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

SYSTEME CEI D'ACCEPTATION MUTUELLE DE CERTIFICATS D'ESSAIS DES EQUIPEMENTS ELECTRIQUES (IECEE) METHODE OC

Additional information (if necessary may also be reported on page 2) Les informations complémentaires (si nécessaire, peuvent être indiquées sur la 2ème page)	
A sample of product was tested and found to be in conformity with IEC Un échantillon de ce produit a été essayé et été considéré conforme à la CEI	61347-1(ed.2);am1;am2 61347-2-13(ed.2)
As shown in the test report Ref. No. which forms part of this certificate Comme indiqué dans le rapport d'essais numéro de référence qui constitue partie de ce certificat	2188964.50

This CB Test Certificate is issued by the National Certification Body:

DEKRA Certification B.V.
Meander 1051, 6825 MJ
Arnhem
The Netherlands

Ce Certificat d'essai OC est établi par l'Organisme National de Certification

DEKRA

Date: 2016-01-13

Signature: A.P. van der Veen

Philips Lighting

PHILIPS

EU Declaration of Conformity

Internal Ref. Nr.: 2016A0199
Year in which CE Mark was first affixed: 2015

We, Philips Lighting
I.B.R.S./C.C.R.I. /Numéro 10461
5600 VB Eindhoven, The Netherlands
Declare under our responsibility for the products:

Product :	**NAME:**	Xi FP 150W 0.2-0.7A SNLDAE 230V S240 sXt Electronic Led Driver	Xi FP 150W 0.3-1.0A SNLDAE 230V S240 sXt Electronic Led Driver
Product Code:	**12NC**	929000962206	929000962306
Product :	**NAME:**	Xi FP 75W 0.2-0.7A SNLDAE 230V S240 sXt Electronic Led Driver	Xi FP 75W 0.3-1.0A SNLDAE 230V S240 sXt Electronic Led Driver
Product Code:	**12NC**	929000962406	929000962506

The designated products are in conformity with the essential requirements of the following European Directives and harmonized standards:

Low Voltage Directive (LVD), 2014/35/EU

- EN 61347-1:2008 + A1:2011+A2:2013 — Lamp control gear Part 1: General and safety requirements
- EN 61347-2-13:2014 — Lamp control gear Part 2-13: Particular requirements for DC or AC supplied electronic gear for LED modules

Electromagnetic compatibility Directive (EMC), 2014/30/EU

- EN 55015:2013 — Radio disturbance for lighting equipment test is carried out in CISPR1S
- EN 61000-3-2:2014 — Limits for harmonic currents emissions
- EN 61000-3-3:2013 — Disturbance in supply systems: Voltage fluctuations and Flicker
- EN 61547:2009 — Equipment for general lighting purposes — EMC immunity requirements

EcoDesign requirements for energy-related products Directive (ErP), 2009/125/EC and applicable Implementing Measures

- Implementing Measure EC/1194/2012

Restriction of the use of certain Hazardous Substances in electrical and electronic equipment Directive (RoHS), 2011/65/EU

- EN 50581:2012

and are produced under a quality scheme at least in conformity with ISO 9001 or CENELEC permanent documents.

2016-09-07, Eindhoven

Ms. C. Sweegers
Regulatory Affairs Manager
High tech campus 45
5656 AE Eindhoven, The Netherlands

LED Driver Lifetime and Reliability

While LEDs themselves are extremely reliable and have a long lifetime, are electronic LED drivers capable of providing the required current/voltage input to the LEDs over their whole lifetime? This paper aims to address the above question in general and for the Xitanium family of LED drivers developed by Philips Lighting specifically. It will describe some of the strategies which Philips applies to maximize the LED drivers' lifetime and reliability and support the application of LED-based outdoor lighting.

PHILIPS

In recent years, LED-based lighting technology as well as the number of applications that have embraced it have advanced rapidly. This is primarily because LEDs bring several advantages to the lighting industry, including high efficiency, durability, environmental friendliness and reduced maintenance requirements due to their superior life. All of these factors translate to energy and maintenance savings, and overall reduction in the cost of ownership over the product's lifetime.

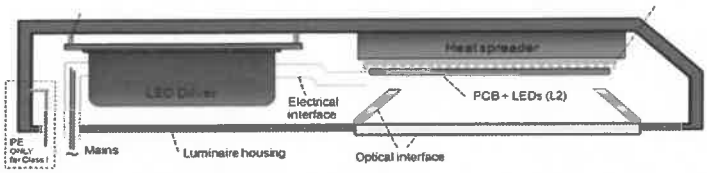


Figure 1. LED system

High-power LED modules typically consist of an array of LEDs soldered to a copper board, separated from a heat sink by an electrically isolating but thermally conductive material. These LED arrays are powered by a LED driver, which could be either configured as a constant current source or as a constant voltage source, depending on application requirements. In most applications, these drivers are connected to the AC line on their input side. Like other power converters, the LED drivers consist of several semiconductor switches, magnetic elements, passive capacitors, resistors and other active components. All these electronic elements raise an important question for LED applications: *While LEDs themselves are extremely reliable and have a long lifetime, are the LED drivers based on power electronics capable of providing the required current/voltage input to the LEDs over their whole lifetime?*

This paper aims to address the above question in general and for the *Xitanium* family of LED drivers developed by Philips Lighting specifically. It will describe some of the strategies which Philips applies to maximize the LED drivers' lifetime and reliability, to avoid a bottleneck in the application of LED-based outdoor lighting.

Definitions related to Reliability and Lifetime

It is important to first understand the definitions related to the lifetime of LED drivers and electronic products in general. Reliability experts often describe the reliability of a population of electronic products using a graphical representation known as the *Bathtub Curve*, as illustrated in Figure 2. The Bathtub Curve can be divided into three periods. The first is an initial period of infant mortality, where the defective/weak products fail. This is followed by the normal life of the product with a low and relatively constant failure rate. Following this is the final period of the product lifetime where wear-out mechanisms of the product kick in and the failure rates increase.

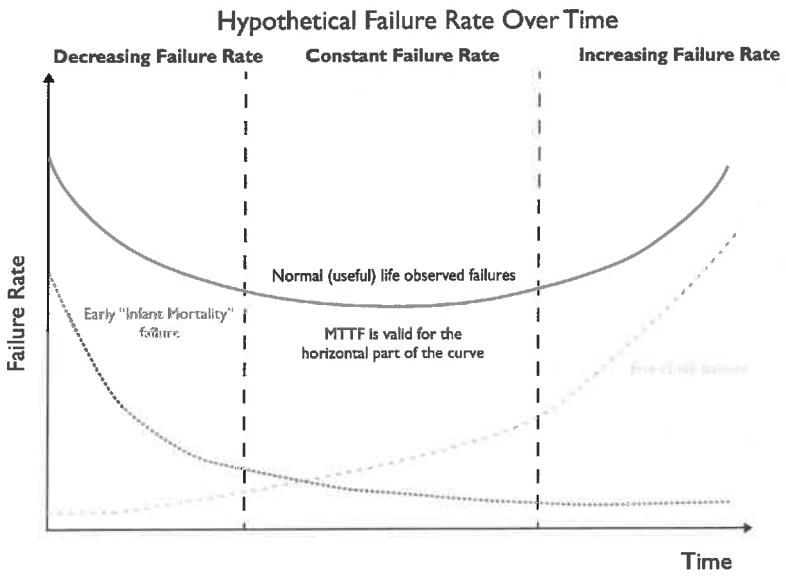


Figure 2. *The Bathtub Curve*

It is important to understand that the Bathtub Curve does not depict the failure rate of a single item, but describes the relative failure rate of an entire population of products over time. Some of the units will fail during the infant mortality period; others will last till the wear-out period while a few of the units will fail during the normal life. Reliability deals with random failures in a population of products and is expressed in terms of rates, such as *Failures in Time* (FIT) or *Mean Time to Failure* (MTTF). MTTF is the theoretical accumulation of random statistical failures of all components in the product, expressing the "constant failure rate" over lifetime. On the other hand, lifetime refers to the length of time that a single product may be expected to function properly before a known wear-out mechanism renders the product unfit for use. Lifetime is typically expressed in hours and normally indicates the duration of time with a minimum survival rate of 90% (obtained from the MTTF calculations). For instance, a lifetime of 100,000 hours implies that under normal conditions[1], in a typical installation (population), 90% of the products installed would be expected to last 100,000 hours before failure.

[1] Please refer to individual product datasheets for specified operating conditions.

MTTF Predictions: While the lifetime of the LED driver depends on the component that is most likely to fail, the failure rate of the driver depends on all the components within the driver. The MIL-HDBK-217F reliability model is used to predict the theoretical failure rate of the *Xitanium* LED drivers.

As an illustration, for a typical 150W Xitanium LED driver operating at a case temperature of about 50° C, a theoretical failure rate of 500 PPM/1000 hours and a MTTF value of approximately 2 million hours is obtained. Please note that for the MTTF calculation, worst case electrical stresses are assumed to obtain a conservative estimate of the LED driver's MTTF. If more realistic values are assumed, higher MTTF values are expected. These calculations also assume a typical operating temperature. If the operating temperatures were higher, the stress levels on the driver components would increase, leading to increased failure rates. Please note that the MTTF data are based on theoretical calculations only and by no means can substitute for actual field data. Past experience has shown that this theoretical prediction is much more conservative than the actual field data. Therefore, whenever possible, actual field return data should be used for predicting reliability.

Designing for Long Lifetime and High Reliability

Developing the most reliable product, which delivers the longest lifetime while also meeting the constraints of cost, size and time to market, is a challenge for every product designer. The *Xitanium* LED drivers are developed through a tightly controlled design and development process, where the quality of product is evaluated at each milestone and activities to realize deliverables (and guidelines on how to perform such activities) are clearly defined. A snapshot describing the overall development process is illustrated in Figure 3.

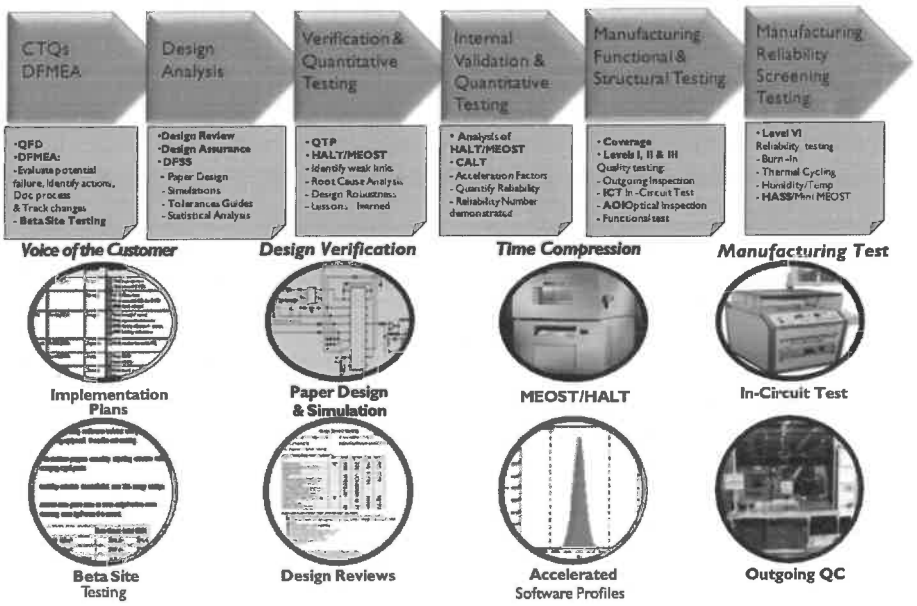


Figure 3. Product development process

Key factors that have to be taken into account to develop the most reliable product are described in the following paragraphs.

Topology Selection: For LED drivers, the first issue is the selection of the most robust power conversion topology given the constraints of power, size, cost, etc. For instance, while a flyback-based topology may be suitable for low power/low voltage applications because of low parts count, with increase in the operating power, a two stage topology might be more suitable from the operating stress and power loss standpoint. High-efficiency topology with soft starting LLC might also be used to further reduce the switching losses of the semiconductor switches thereby further improving efficiency and reducing power loss.

System Efficiency: System efficiency (or power loss) has a direct and significant impact on the reliability and lifetime of a LED driver. This is because all of the lost power is dissipated as heat within the driver, leading to an increase in the temperature of the components within the driver. If the power dissipated in the driver is high, the components within the driver operate at a higher temperature. The reliability of components declines as their operating temperature increases. Therefore, a driver operating with higher efficiency can have a significantly improved lifetime and reliability compared to a lower-efficiency driver.

Additional Protection Mechanisms: In addition to designing for lower power losses, the *Xitanium* LED drivers have a high-temperature roll-off capability. If the case temperature of the driver exceeds a certain value due to abnormal operating conditions, the output current is reduced. This in turn reduces power dissipation and ensures the temperature of the driver's internal components does not rise above a certain threshold. Since the operating temperatures of components have a direct impact on their failure rates, this feature enhances the reliability and lifetime of *Xitanium* drivers. Additional protection schemes are also built into the driver hardware to ensure its reliability. For example, to protect the driver against line surges, e.g. a lightning stroke, additional surge suppressors are added.

Component Selection: Having decided on the right topology that yields the highest efficiency (for a given application), the next challenge is the selection of the components. For the *Xitanium* drivers, each and every component is carefully chosen and passes through extensive design qualification, testing and internal long-term reliability checks. A careful supplier selection process and long-term relationships with the suppliers ensure that only the best components are used in the *Xitanium* drivers. From a design point-of-view, careful analyses of component stresses and adequate derating of the components ensures a highly reliable LED driver that is capable of achieving industry-leading lifetimes. For instance, electrolytic capacitors are operated with a 20% operating voltage margin, while normally semiconductor devices are operated with a 10-20% operating voltage margin. Careful attention is paid during the design phase to ensure that all components operate well within their maximum temperature ratings.

Lifetime Calculations: Having selected the components, it is important to determine which components are most likely to fail. Similar to other power converters, for LED drivers the component most likely to fail, especially when the driver is operating at relatively high temperatures, is the electrolytic capacitor. The electrolyte in the capacitor will vent over time as a function of the operating temperature of the capacitor. Therefore, the lifetime of the driver can be directly derived from the lifetime of the electrolytic capacitor. The operating temperature of the capacitor is a function of the case temperature (which again depends on the power dissipated by the driver and therefore, the driver's efficiency) of the capacitor and the internal heating within the capacitor caused by the ripple current flowing through it. The typical equation for the lifetime of the capacitor operating at a certain ambient temperature, L_T is defined by

$$L_T = kL_0 2^{\frac{T-T_0}{10}}$$

where k is a factor that depends on the ripple current flowing through the capacitor;

T is the temperature at which the capacitor operates;

L_0 is the lifetime of the capacitor at the rated case temperature.

The equation above shows that every 10° C drop in the operating temperature of the capacitor doubles its lifetime. This further reiterates the need to design high-efficiency LED drivers, to minimize power dissipation and therefore lower component temperatures. It is important to size the capacitor properly, to reduce the current ripple flowing into it. Please note that in the datasheets of Xitanium drivers, the lifetime is typically expressed in terms of the case temperature. For obtaining the estimate of the product lifetime, the relationship between the case temperature and the temperature of the electrolytic capacitors is obtained through careful thermal measurements, and it is assumed that the temperature difference between the capacitor and the case is always constant.

System Performance

The preceding discussion focused on lifetime and reliability of individual products. There are other factors which need to be taken into account when addressing lighting system reliability. One critical aspect to consider is the additional thermal stress arising from the mutual heating of different components in a system. Typically the self-generated heat of a driver is 20-25° C. However when the driver is mounted very close to the LED board, the heat from the LEDs will lead to additional temperature increase of the driver. Another challenge is related to the number of system starts, which can have a big impact on system lifetime. The temperature difference between a system at rest in a cold ambient environment and a running system could be in the range of 30° to 60° C. This drastic temperature change can lead to thermal shock. Frequent switching, for example turning the installation off in the middle of the night, will shorten the lifetime of the system. It is preferable to dim the light in order to maximize system lifetime.

Lifetime Outside Specified Operating Conditions: Product specifications include operating parameters for input voltage. Over-voltage, which can occur during switching or load changes, can negatively impact the lifetime of the driver. While there is no way to foresee these occurrences, it is possible to minimize the damage by choosing components with the widest possible specified voltage range. The new Xitanium Programmable LED drivers can operate in a voltage range of 108V - 320V.

In addition to the normal voltage fluctuations in the power line, LED lighting systems are subject to damage from high-voltage surges (e.g. lightning strokes). For a detailed discussion on how to protect your LED installation, please visit www.philips.com/surgeprotection

Lifetime and Reliability in Electronic Gear for Conventional Lighting: While the focus of the discussion has been on performance and reliability of LED drivers, the conclusions are identical for electronic gears for HID lamps. In fact the design of LED drivers is derived from the proven topology of eHID gear, perfected by Philips over the past two decades.

Testing and Qualification: The issues identified above bring us to the next important step in the design process. Extensive qualification testing is performed at the design stage of *Xitanium* drivers to ensure that any design issue is caught during the product development stage. The tests include operating the drivers at all possible operating conditions and also under conditions of extreme humidity and temperature. Furthermore, careful tests are conducted to ensure that all of the components operate within their maximum stress ratings (determined from the derating rules). Additional compliance testing is conducted by various agencies to ensure that the drivers meet all relevant industry standards.

Accelerated life testing, including HALT/ MEOST, is also performed to ensure high driver reliability. For every new product, the data from these tests are compared with those obtained from similar tests done for other released products (which have been operating in the field for a longer duration of time and for which enough field data are available). This ensures that every new product achieves at least the same level of reliability as a previously released product. To limit failures in the infant mortality period, initial burn-in or stress tests are done on statistically relevant sample sizes.

Key Conclusions

This document also describes how the lifetime and reliability of the Xitanium LED drivers are maximized during design and manufacturing. Software modeling is used to estimate the theoretical failure rate of the drivers. Field return data obtained from previously released products show that the estimates obtained using this model are more conservative that actual performance. Therefore, theoretical MTTF data is meant to be an initial estimate and can give an idea regarding weak links in the design. For instance, for Xitanium LED drivers, theoretical calculations reveal that the electrolytic capacitors and the solder joints are the components most likely to fail. It is however recommended that whenever possible, actual field return data should be used.

This document also describes the strict design procedure followed for the development of Xitanium LED drivers to ensure high lifetime and reliability. The design and development of all Xitanium LED drivers pass through a tightly controlled process. The quality of product is critically evaluated at each milestone and activities to realize deliverables (and guidelines on how to perform such activities) are clearly defined. All field return issues are carefully documented and all failure issues are reviewed at the start of each new project so that the learnings can be carried forward to new designs. This feedback and improvement cycle has been part of the Philips product development process for over a decade, resulting in products which perform far better than the theoretical estimates.

Technical abbreviations

CTQs:	Critical to Quality
DFMEA:	Design Failure Mode and Effect Analysis
DFSS:	Design for Six Sigma
FIT:	Failures in Time
HALT:	Highly Accelerated Life Testing
HID:	High Intensity Discharge
ICT:	In -Circuit Test
LLC:	a half-bridge topology with two coils (LL) and one capacitor (C)
MEOST:	Multiple Environmental Overstress Test
MIL-HDBK-217F:	Military Handbook for "Reliability Prediction of Electronic Equipment". MIL-HDBK-217 is published by the Department of Defense, based on work done by the Reliability Analysis Center and Rome Laboratory at Griffiss AFB, NY. The MIL-HDBK-217 handbook contains failure rate models for the various part types used in electronic systems, such as ICs, transistors, diodes, resistors, capacitors, relays, switches, connectors, etc. These failure rate models are based on the best field data that could be obtained for a wide variety of parts and systems; this data is then analyzed create usable models.
MTTF:	Mean Time to Failure
PPM:	Parts Per Million
QC:	Quailty Control
QTP:	Quality Test Plan

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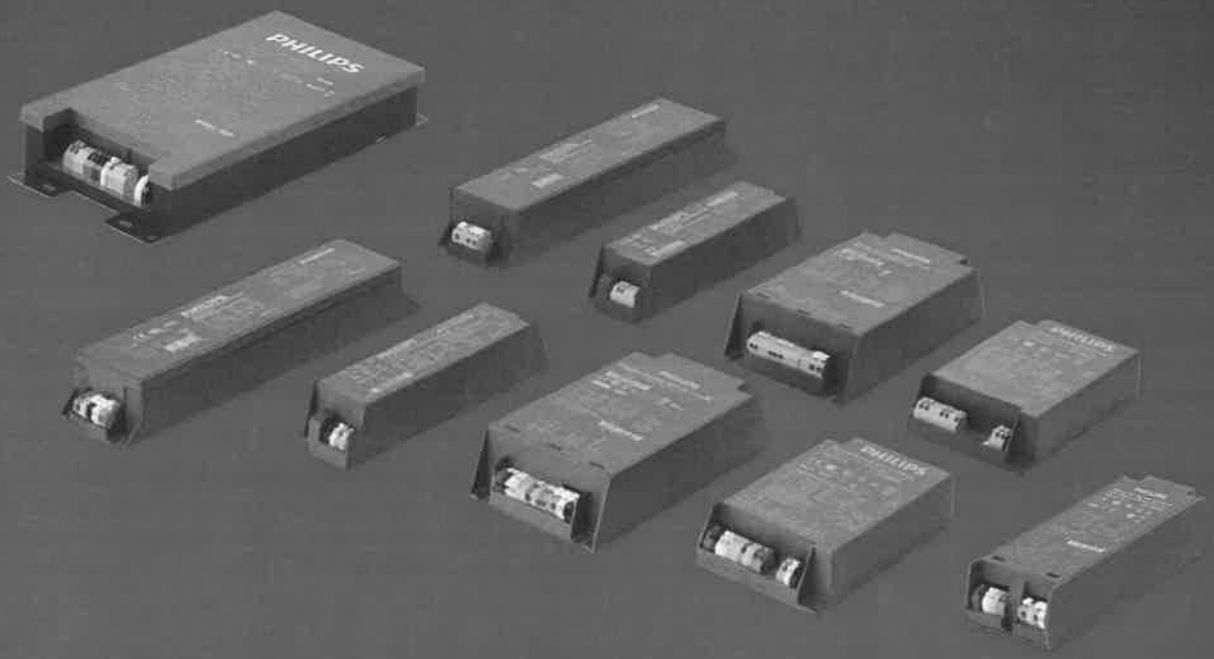
Xitanium

LED Xtreme drivers



Design-in Guide

Reliable Xtreme technology for demanding LED applications

January 2018

Contents

Introduction to this guide

Examples of Xitanium LED Xtreme drivers

Thank you for choosing the 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 the configurable Xitanium FULL Prog (Xi FP) and LITE Prog (Xi LP) LED Xtreme drivers. 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 outdoor and industrial lighting like roads, streets and highbay 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/technology
www.philips.com/multione

Design-in support

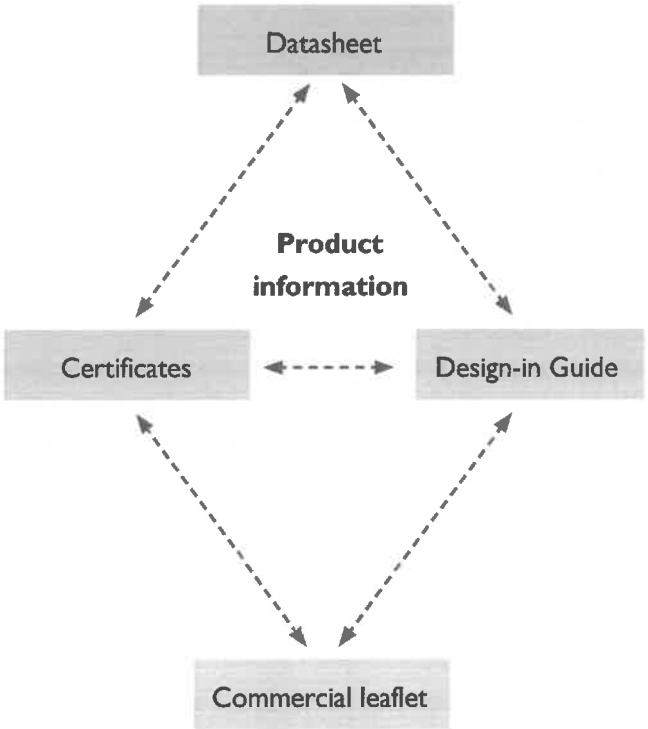
Dedicated design-in support from Philips is available on request. For this service please contact your Philips sales representative.

Document overview

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

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

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



Warnings and instructions

Warning:

- Avoid touching live parts!
- Do not use drivers with damaged housing and/or connectors!
- Do not use drivers with damaged wiring!

Safety warnings and 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 can be lethal. Connecting a LED module to an energized driver may damage both the LED module and driver.
- No components are allowed between the LED driver and the LED module(s) other than connectors and wiring intended to connect the Xitanium driver to the LED module.
- Adequate earth and/or equipotential connections needs to be provided whenever possible or applicable.

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

Xitanium LED Extreme drivers

Examples of Xitanium LED Xtreme drivers

Xitanium LED Xtreme driver families: general feature overview

	Xitanium Single Current	Xitanium LITE Prog	Xitanium FULL Prog
Lifetime 100kHrs	•	•	•
Surge Immunity 8kV CM / 10kV CM / 6kV DM)	*/-/*	-/*/*	-/*/*
1-10V	•	•	
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 operate LED solutions for general lighting applications such as street, road and highbay lighting. 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 two different versions:

Xitanium FULL Prog (Xi FP)

Xitanium LITE Prog (Xi LP)

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/technology

Detailed specifications can be found in the Xitanium driver datasheets which can be downloaded at www.philips.com/technology.

Configurability Interface (tooling)

The Xi FP and LP Xitanium LED Xtreme drivers are programmable. A large 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". Information about configuring drivers with SimpleSet can be found in the section "Configurability".

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 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 Naming at page 9)

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.

Ripple and flicker

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 and has such a low amplitude that optical interference (flicker) with camera systems other than those for high-speed HD recording is not be expected. The ripple value of both components are specified in the driver datasheet.

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. 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

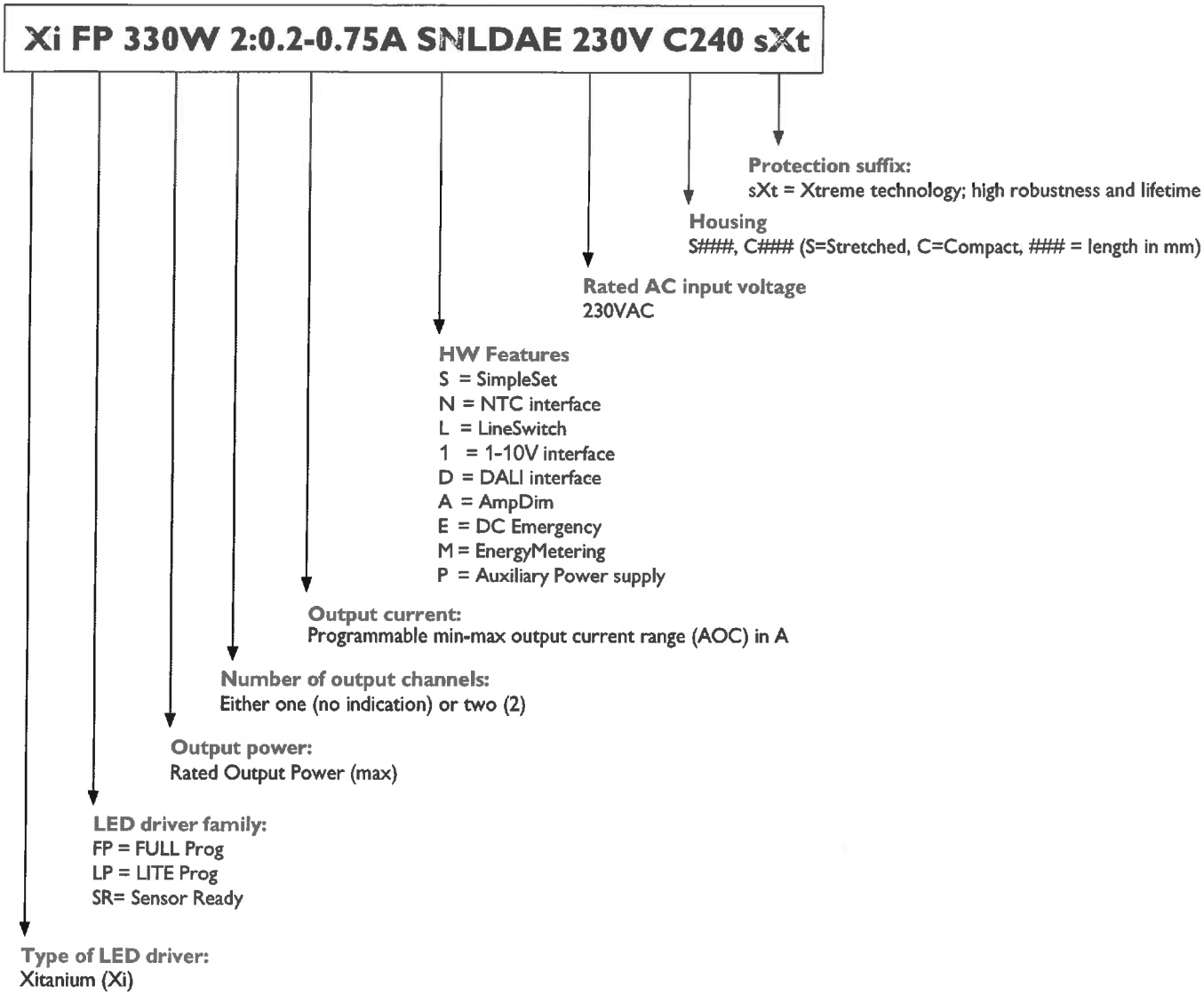
Xitanium LED Xtreme drivers are equipped with a Diagnostics functionality. The purpose of Diagnostics is to gather information and help diagnose the history of the driver and connected LED module. The Diagnostics feature consist mainly of counters which keep track of specific variables like the number of startups of the driver, operating hours, temperature of driver and LED module, output current and voltages etc. 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).

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

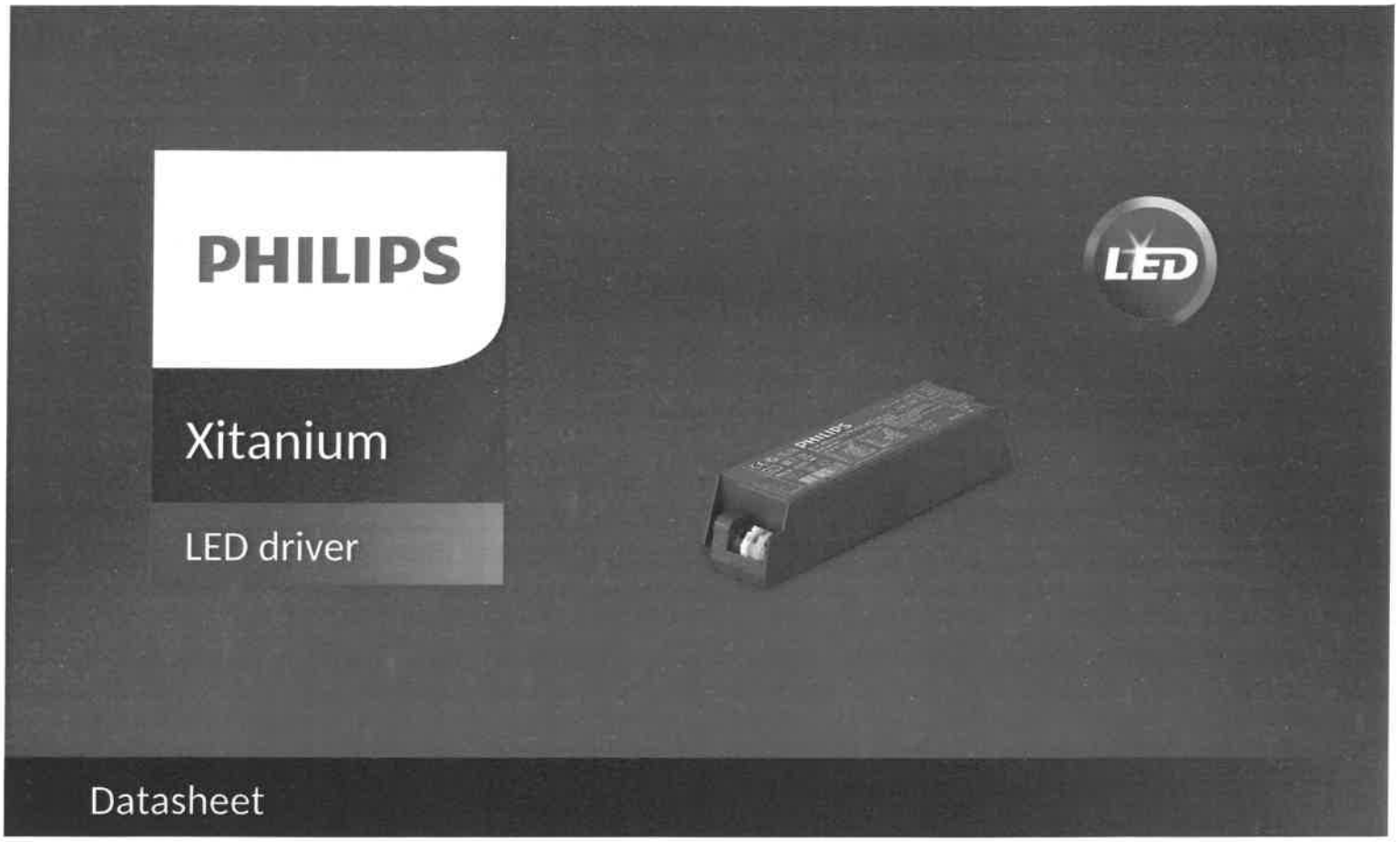
When the driver is shutdown the diagnostics data is stored automatically in non-volatile memory.

Driver naming

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



Alimentatori 22-40W



Xitanium FULL Prog LED Xtreme drivers

Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt

Xitanium FULL Prog LED Xtreme drivers

Philips Xitanium Full Programmable LED drivers are specifically designed to deliver the highest performance, protection and configurability. The portfolio offers both central and standalone dimming protocols further increasing the energy savings and CO_2 reductions achieved with LED lighting. The Xtreme technology ensures maximum robustness and protection combined with a very long lifetime.

In this product family Philips introduces new drivers in a compact form factor with state-of-the-art features, which offer high value for both OEM customers and end-users. The products can replace the existing programmable outdoor LED drivers and will bring significant improvement in programming, assembly into a luminaire and electrical performance.

Benefits

- Ultimate robustness, offering peace of mind and lower maintenance costs
- Fully programmable LED-drivers designed for the new digital and connected lighting world
- Extended diagnostics via MultiOne
- Easy to design-in, configure and install for insulation Class I and Class II applications
- Energy savings through high efficiency and via multiple dimming options

Features

- High surge immunity (CM/DM)
- Long lifetime and robust protection against moisture, vibration and temperature
- Configurable operating windows (AOC)
- Multiple control interfaces: DALI, AmpDim, 1-step and 3-step LineSwitch
- Autonomous dimming via integrated DynaDimmer
- Adjustable thermal protection for driver (DTL, on select models) and LED module (MTP)
- Constant Light Output (CLO)
- Adjustable Start-up Time (AST)
- Adjustable Light Output (ALO)
- End-Of-Life indicator (EOL)

Application

- Road and street lighting
- Area lighting
- Tunnel lighting
- Industrial lighting

Electrical input data

Specification item	Value	Unit	Condition
Rated input voltage range	202...254	V_{ac}	Performance range
Rated input voltage	220	V_{ac}	
Rated input frequency range	47...63	Hz	Performance range
Rated input current	0.2	A	@ rated output power @ rated input voltage
Max. input current	0.21	A	@ rated output power @ minimum performance input voltage
Rated input power	46	W	@ rated output power @ rated input voltage
Power factor	≥ 0.99		@ rated output power @ rated input voltage
Total harmonic distortion	≤ 7	%	@ rated output power @ rated input voltage
Efficiency	≤ 89	%	@ rated output power @ rated input voltage
Rated input voltage DC range	186...250	V_{dc}	Performance range
Rated input current DC range	≤ 0.15	A_{dc}	Performance range
Input voltage AC range	80...264	V_{ac}	Safety operational range, see MainsGuard graph
Input frequency AC range	45...66	Hz	Safety operational range
Input voltage DC range	168...275	V_{dc}	Safety operational range
Standby Power (TD)	0.5	W	
Isolation input to output	SELV		

Electrical output data

Specification item	Value	Unit	Condition
Regulation method	Constant Current		
Output voltage	20...54	V_{dc}	
Output voltage max.	60	V	Maximum voltage at open load
Output current	0.07...1.05	A	
Output current min programmable	300	mA	
Output current min dimming	70	mA	
Output current tolerance	± 3	%	
Output current ripple LF	≤ 4	%	Ripple = peak / average @ < 1kHz
Output current ripple HF	≤ 20	%	
Output power	1.4...40	W	

Electrical data controls input

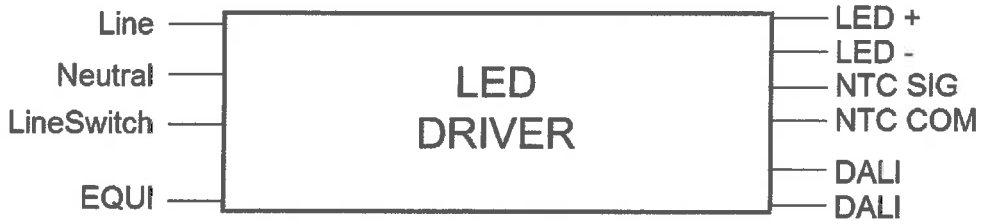
Specification item	Value	Unit	Condition
Control method	AmpDim, DALI, Dynadimmer, LineSwitch 3-step, LineSwitch single-step		Output current amplitude dimming
Dimming range	10...100	%	DALI acc. IEC62386-101, -102 Ed. 2.0; LineSwitch: Vlow: < 160Vac Vhigh: 170 ... 264Vac
Galvanic Isolation	Double		

Logistical data

Specification item	Value
Product name	Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt
Order code	871869652663700
Logistic code 12NC	9290 009 89306
Pieces per box	20

Wiring & Connections

Specification item	Value	Unit	Condition
Input wire cross-section	0.2...1.5	mm^2	WAGO250 (3.5 mm), solid / stranded wire
	16...24	AWG	WAGO250 (3.5 mm), solid / stranded wire
Input wire strip length	8.5...9.5	mm	
Output wire cross-section	0.2...1.5	mm^2	WAGO250 (3.5 mm), solid / stranded wire
	16...24	AWG	WAGO250 (3.5 mm), solid / stranded wire
Output wire strip length	8.5...9.5	mm	
Dimming wire cross-section	0.2...1.5	mm^2	WAGO250 (3.5 mm), solid / stranded wire
	16...24	AWG	WAGO250 (3.5 mm), solid / stranded wire
Dimming wire strip length	8.5...9.5	mm	
Maximum cable length	2500	mm	Total length of wiring including LED module, one way
Maximum NTC output cable length	0.6	m	

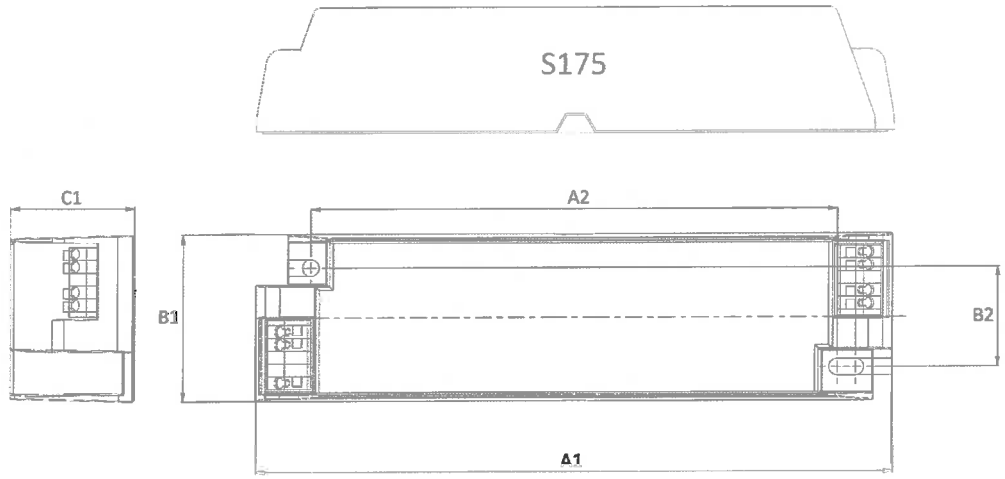


Insulation

Insulation	Mains	EQUI	LED + NTC	LineSwitch	DALI
Mains		Double	SELV	NA	Basic
EQUI	Double		Basic	Double	Double
LED + NTC	SELV	Basic		SELV	Double
LineSwitch	NA	Double	SELV		Basic
DALI	Basic	Double	Double	Basic	

Dimensions and weight

Specification item	Value	Unit	Condition
Length (A1)	175	mm	
Width (B1)	46	mm	
Width (B2)	27.35	mm	
Height (C1)	34	mm	
Fixing hole diameter (D1)	4.5	mm	
Fixing hole distance (A2)	144	mm	
Weight	175	gram	



Operational temperatures and humidity

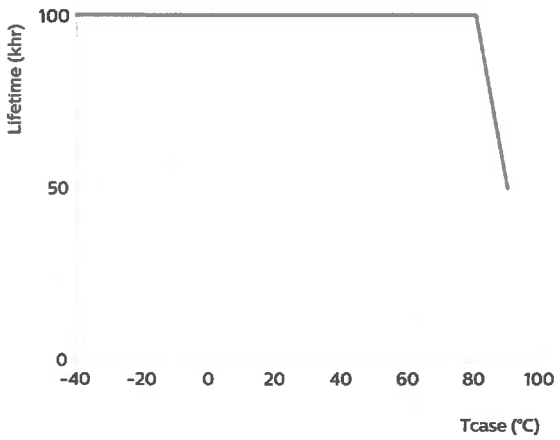
Specification item	Value	Unit	Condition
Ambient temperature	-40...+55	°C	Higher ambient temperature allowed as long as Tcase-max is not exceeded.
Tcase-max	90	°C	Maximum temperature measured at T_{case}-point
Tcase-life	80	°C	Measured at T_{case}-point
Maximum housing temperature	120	°C	In case of a failure
Relative humidity	10...90	%	Non-condensing

Storage temperature and humidity

Specification item	Value	Unit	Condition
Ambient temperature	-40...+90	°C	
Relative humidity	5...95	%	Non-condensing

Lifetime

Specification item	Value	Unit	Condition
Driver lifetime	100,000	hours	Measured temperature at T_{case}-point is T_{case}-life. Maximum failures = 10%



Programmable features

Specification item	Value	Remark	Condition
Set output current (AOC)	Programmable, SimpleSet	See Design-in guide.	Default output current: = 700 mA
LED module temperature derating (MTP)	Yes		
Constant Lumen Over Lifetime (CLO)	Yes		
DC emergency dimming (DCemDIM)	Yes		Default: AOC = 15%. EOFx = 10 ... 60%. No external DC rated fuse required
Diagnostics	Yes		
Adjustable Light Output (ALO)	Yes		
Ampdim	Yes		
LineSwitch single-step	Yes		
LineSwitch 3-step	Yes		
Adjustable Start-up Time (AST)	Yes		
Integrated Dynadimmer	Yes		5-step, light turn-off possible
End Of Life Indicator	Yes		

Features

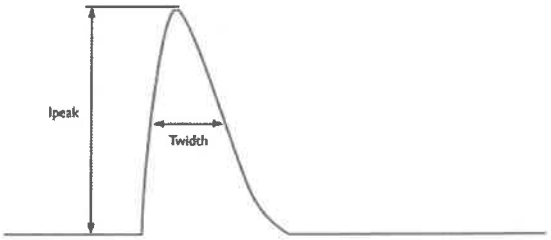
Specification item	Value	Remark	Condition
Open load protection	Yes		Automatic recovering
Short circuit protection	Yes		Automatic recovering
Over power protection	Yes		Automatic recovering
Hot wiring	No		
Suitable for fixtures with protection class	I and II		per IEC60598
Over temperature protection driver	Yes		Automatic recovering
Overheating protection	Yes		Automatic recovering

Certificates and standards

Specification item	Value
Approval marks	CB / CCC / CE / ENEC / SELV / VDE-EMV / VDE-S
Ingress Protection classification	20

Inrush current

Specification item	Value	Unit	Condition
Inrush current I_{peak}	21	A	Input voltage 230V
Inrush current T_{width}	225	µs	Input voltage 230V, measured at 50% I_{peak}
Drivers / MCB 16A type B	≤ 26	pcs	



MCB	Rating	Relative number of LED drivers
B	10A	63%
B	13A	81%
B	16A	100% (stated in datasheet)
B	20A	125%
B	25A	156%
C	10A	104%
C	13A	135%
C	16A	170%
C	20A	208%
C	25A	260%

Driver touch current / protective conductor current

Specification item	Value	Unit	Condition
Typical touch current (ins. Class II)	< 0.34	mA peak	Acc. IEC61347-1. LED module contribution not included
Typical protective conductor current (ins. Class I)	< 0.25	mA rms	Acc. IEC61347-1. LED module contribution not included

Surge immunity

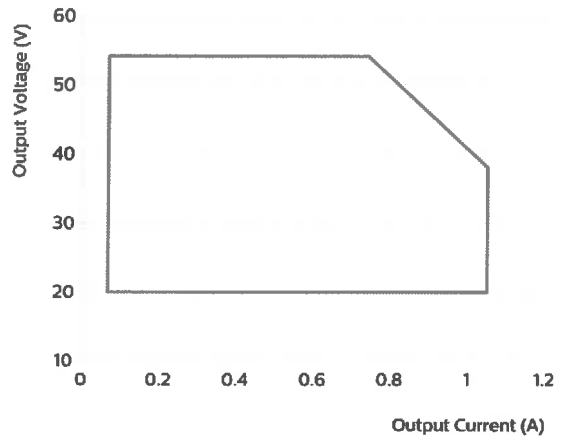
Specification item	Value	Unit	Condition
Mains surge immunity (diff. mode)	6	kV	L-N, Ls-L, Ls-N, acc. IEC61000-4-5. 2 Ohm, 1.2/50us, 8/20us
Mains surge immunity (comm. mode)	10	kV	L/N/Ls - EQUI 10kV acc. EN61547; 8kV acc. IEC61000-4-5, 12 Ohm 1.2/50us,8/20us
Control surge immunity (diff. mode)	0.9	kV	DALI - DALI, acc. IEC61000-4-5. 2 Ohm, 1.2/50us, 8/20us
Control surge immunity (comm. mode)	4	kV	DALI - EQUI, acc. IEC61000-4-5. 2 Ohm, 1.2/50us, 8/20us
DALI surge immunity (comm. mode)	8	kV	DALI - L/N/Ls acc. IEC61000-4-5. 12 Ohm, 1.2/50us, 8/20us

Additional information

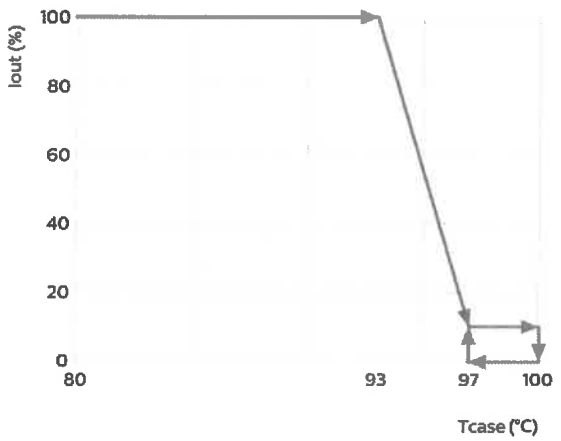
Specification item	Default setting	Remark	Condition
AOC	700	mA	
LineSwitch	ON		
CLO	OFF		
MTP	OFF		
Dynadimmer	OFF		
EOL	OFF		

Graphs

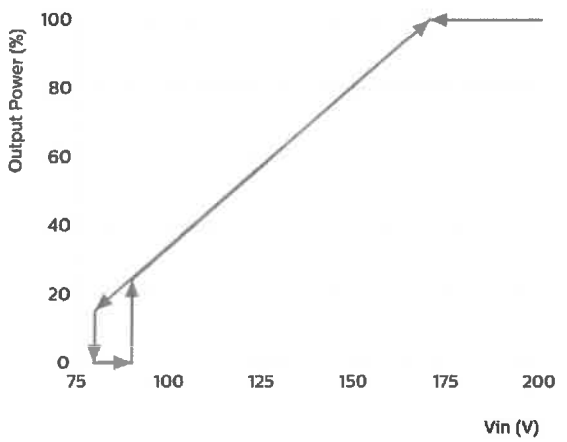
Operating window



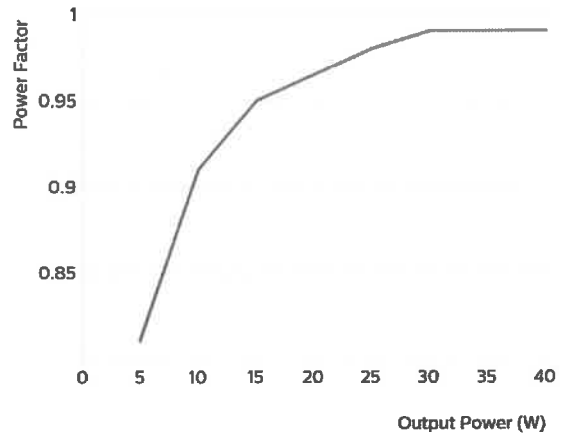
Thermal Guard



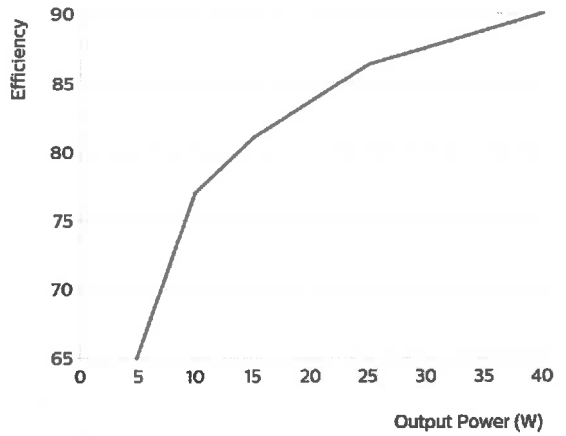
Mains Guard



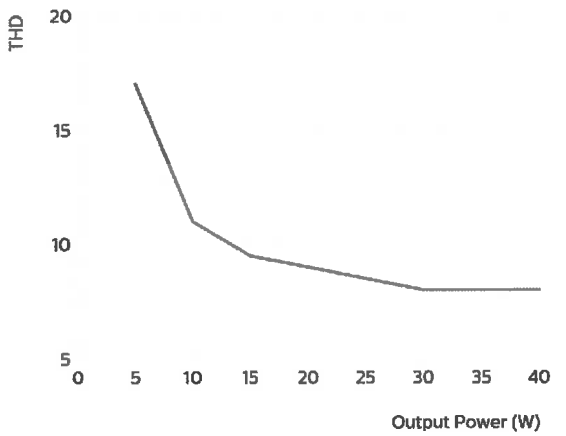
Power factor versus output power



Efficiency versus output power



THD versus output power



CERTIFICATE

Issued to:
Applicant:
Philips Lighting B.V.
High Tech Campus 45
5656 AE Eindhoven, The Netherlands

Licensee:
Philips Lighting B.V.
High Tech Campus 45
5656 AE Eindhoven, The Netherlands

Product	:	LED driver
Trade name(s)	:	PHILIPS
Type(s)/model(s)	:	Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt, Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt, Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt and Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt

The product and any acceptable variation thereto is specified in the Annex to this certificate and the documents therein referred to.

DEKRA hereby declares that the above-mentioned product has been certified on the basis of:
- a type test according to the standard EN 61347-2-13:2014, EN 61347-2-13:2014/A1:2017, EN 61347-1:2015, EN 62384:2006 and EN 62384:2006/A1:2009
- an inspection of the production location according to CENELEC Operational Document CIG 021
- a certification agreement with the number 947556

DEKRA hereby grants the right to use the ENEC certification mark.

The ENEC certification mark may be applied to the product as specified in this certificate for the duration of the ENEC certification agreement and under the conditions of the ENEC certification agreement.

This certificate is issued on 17 December 2017 and expires upon withdrawal of one of the above mentioned standards.

Certificate number: 31-102332

DEKRA Certification B.V.

drs. G.J. Zoetbrood
Managing Director

Rosa Zhou
Certification Manager

ACCREDITED BY THE DUTCH ACCREDITATION COUNCIL

PRODUCTS RvA C 001

SPECIFICATION OF THE CERTIFIED PRODUCT

Product data

Product	:	LED driver
Trade name(s)	:	PHILIPS
Type(s)/model(s)	:	Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt, Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt, Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt and Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt
Rated voltage	:	220-240 V
Nature of supply	:	ac
Rated frequency	:	50/60 Hz
Power factor	:	0,95
Ambient temperature (ta)	:	-40 °C…+55 °C
Temperature declared thermally protection	:	120 °C
Description	:	Built-in with double/reinforced insulation

Product data – type Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt

Rated input current	:	0,12-0,11 A
Rated input power	:	26 W
Output power	:	22 W
Output current	:	200-700 mA
Output voltage	:	16-48 Vdc; 70 Vdc MAX (open-circuit); SELV
Max. case temperature (tc)	:	85 °C

Product data – type Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt

Rated input current	:	0,12-0,11 A
Rated input power	:	26 W
Output power	:	22 W
Output current	:	300-1050 mA
Output voltage	:	8-32 Vdc; 50 Vdc MAX (open-circuit); SELV
Max. case temperature (tc)	:	85 °C

Product data – type Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt

Rated input current	:	0,21-0,19 A
Rated input power	:	46 W
Output power	:	40 W
Output current	:	200-700 mA
Output voltage	:	25-77 Vdc; 100 Vdc MAX (open-circuit); SELV
Max. case temperature (tc)	:	85 °C

Product data – type Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt

Rated input current	:	0,21-0,19 A
Rated input power	:	46 W
Output power	:	40 W
Output current	:	300-1050 mA
Output voltage	:	20-54 Vdc; 60 Vdc MAX (open-circuit); SELV
Max. case temperature (tc)	:	90 °C

TESTS

Test requirements
EN 61347-2-13:2014

EN 61347-2-13:2014/A1:2017
EN 61347-1:2015
EN 62384:2006
EN 62384:2006/A1:2009

Test result
The test results are laid down in DEKRA test file 601849500.

Additional information
constant current type with screwless terminal block

The tests were performed by the manufacturer under the conditions of the agreement concerning the manufacturer's right to conduct type tests for the KEMA-KEUR / ENEC certification system under supervision of DEKRA (CTF Stage 3).

The list of components is laid down at test report 6018495.50.

Conclusion
The examination proved that all requirements were met.

Factory locations
Fideltronik Poland Sp.z.o.o.
UL. Beniowskiego 1
34-200 Sucha Beskidzka, Poland

Taiwan Surface Mounting Technology (SuZhou) Co., Ltd.
No. 888 GanQuan Dong Road Economic
Technology Development Zone WuJiang,
Suzhou, China

Philips Lighting Electronics Poland
ul Przemyslowa 29
64-920 Pila, Poland

Ref. Certif. No.
NL-49846

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

CB TEST CERTIFICATE

Product	LED driver
Name and address of the applicant	Philips Lighting B.V. High Tech Campus 45, 5656 AE Eindhoven The Netherlands
Name and address of the manufacturer	Philips Lighting B.V. High Tech Campus 45, 5656 AE Eindhoven The Netherlands
Name and address of the factory Note. *When more than one factory, please report on page 2*	☒ Additional information on page 2 Taiwan Surface Mounting Technology (SuZhou) Co., Ltd. No. 888 Ganquan Dong Road, Economic Technology Development Zone, Wujiang, Suzhou China
Ratings and principal characteristics	Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt: Uin: 220-240 V; fn: 50/60 Hz; Iin: 0,12-0,11 A; Pin: 26 W; PF: 0,95; Iout: 200-700 mA; Pout: 22 W; Uout: 16-48 Vdc, 70 Vmax; ta: -40…+55 °C; tc: 85 °C; Built-in; SELV Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt: Uin: 220-240 V; fn: 50/60 Hz; Iin: 0,12-0,11 A; Pin: 26 W; PF: 0,95; Iout: 300-1050 mA; Pout: 22 W; Uout: 8-32 Vdc, 50 Vmax; ta: -40…+55 °C; tc: 85 °C; Built-in; SELV Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt: Uin: 220-240 V; fn: 50/60 Hz; Iin: 0,21-0,19 A; Pin: 46 W; PF: 0,95; Iout: 200-700 mA; Pout: 40 W; Uout: 25-77 Vdc, 100 Vmax; ta: -40…+55 °C; tc: 85 °C; Built-in; SELV Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt: Uin: 220-240 V; fn: 50/60 Hz; Iin: 0,21-0,19 A; Pin: 46 W; PF: 0,95; Iout: 300-1050 mA; Pout: 40 W; Uout: 20-54 Vdc, 60 Vmax; ta: -40…+55 °C; tc: 90 °C; Built-in; SELV
Trademark (if any)	PHILIPS
Customer's Testing Facility (CTF) Stage used	CTF Stage 3
Model / Type Ref.	Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt
Additional information (if necessary may also be reported on page 2)	☐ Additional information on page 2

This CB Test Certificate is issued by the National Certification Body

DEKRA Certification B.V.
Meander 1051, NL-6825 MJ Arnhem, Netherlands

DEKRA

Date: 2017-12-14

Signature: Kreny Lin

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

A sample of the product was tested and found to be in conformity with	IEC 61347-1:2015, IEC 61347-2-13:2014, IEC 61347-2-13:2014/AMD1:2016 National differences: EU Group Differences
As shown in the Test Report Ref. No. which forms part of this Certificate	6018495.50

This CB Test Certificate is issued by the National Certification Body

DEKRA Certification B.V.
Meander 1051, NL-6825 MJ Arnhem, Netherlands

DEKRA

Date: 2017-12-14

Signature: Kreny Lin

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

Additional factory

Philips Lighting Electronics Poland
ul Przemysiowa 29, 64-920 Pila
Poland

Fideltronik Poland Sp.z.o.o.
ul Beniowskiego 1, 34-200, SUCHA BESKIDZKA
Poland

This CB Test Certificate is issued by the National Certification Body

DEKRA Certification B.V.
Meander 1051, NL-6825 MJ Arnhem, Netherlands

DEKRA

Date: 2017-12-14

Signature: Kreny Lin

中国国家强制性产品认证证书

证书编号：2017011002030405

委托人名称、地址

Philips Lighting B.V.

High Tech Campus 45,5656 AE Eindhoven, 荷兰

生产者（制造商）名称、地址

Philips Lighting B.V.

High Tech Campus 45,5656 AE Eindhoven, 荷兰

生产企业名称、地址

Fideltronik Poland Sp.z.o.o.

ul Beniowskiego 1, 34-200, Sucha Beskidzka, 波兰

产品名称和系列、规格、型号

LED模块用交流电子控制装置（LED控制装置，内装式，恒流模式，SELV，可调光，ta:55℃，tc:85℃/90℃，定温热保护：120℃）

见附件。220-240V～ 50/60Hz.

产品标准和技术要求

GB17625.1-2012;GB/T17743-2007;GB19510.1-2009;GB19510.14-2009

上述产品符合强制性产品认证实施规则 CNCA-C10-01:2014 的要求，特发此证。

发证日期：2017 年 12 月 12 日　　有效期至：2022 年 12 月 12 日

证书有效期内本证书的有效性依据发证机构的定期监督获得保持。

本证书的相关信息可通过国家认监委网站 www.cnca.gov.cn 查询

主　任：

中国质量认证中心 CHINA QUALITY CERTIFICATION CENTRE

中国质量认证中心

http://www.cqc.com.cn　　中国·北京·南四环西路188号9区 100070　　电话：+86 10 83886666

Q 1854826

CERTIFICATE FOR CHINA COMPULSORY PRODUCT CERTIFICATION

CERTIFICATE NO.: 2017011002030405

NAME AND ADDRESS OF THE APPLICANT

Philips Lighting B.V.

High Tech Campus 45,5656 AE Eindhoven, The Netherlands

NAME AND ADDRESS OF THE MANUFACTURER

Philips Lighting B.V.

High Tech Campus 45,5656 AE Eindhoven, The Netherlands

NAME AND ADDRESS OF THE FACTORY

Fideltronik Poland Sp.z.o.o.

ul Benlowskiego 1, 34-200, Sucha Beskidzka, Poland

PRODUCT NAME, MODEL AND SPECIFICATION

A.C. Supplied Electronic Controlgear For LED Modules (Built-in, Constant Current Mode, SELV, Dimmable, ta:55℃, tc:85℃/90℃, Temperature Declared Thermally Protected: 120℃)

See Appendix. 220-240V~ 50/60Hz

THE STANDARDS AND TECHNICAL REQUIREMENTS FOR THE PRODUCTS

GB17625.1-2012;GB/T17743-2007;GB19510.1-2009;GB19510.14-2009

This is to certify that the above mentioned product(s) complies with the requirements of implementation rules for compulsory certification(REFNO.CNCA-C10-01:2014).

Valid from: Dec.12,2017 **Valid until:** Dec.12,2022

The validity of the certificate is subject to positive result of the regular follow up inspection by issuing certification body until the expiry date.

The certificate information is available through CNCA's website: www.cnca.gov.cn

President: Wang Kejiao

CHINA QUALITY CERTIFICATION CENTRE 中国质量认证中心

CHINA QUALITY CERTIFICATION CENTRE

http://www.cqc.com.cn Section 9, No. 188, Nansihuan Xilu, Beijing 100070 P. R. China Tel: +86 10 83886666

Q 1854826

中国国家强制性产品认证证书

附　　录　　第 1 页 共 1 页

证书编号：2017011002030405　　纸　号：1854826

型号	输出电流	输出电压	最大输出电压	输出功率	tc值
Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt	300mA-1050mA	20-54Vdc	Max. 60Vdc	40W	90℃
Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt	200mA-700mA	25-77Vdc	Max. 100Vdc	40W	85℃
Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt	300mA-1050mA	8-32Vdc	Max. 50Vdc	22W	85℃
Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt	200mA-700mA	16-48Vdc	Max. 70Vdc	22W	85℃

输入：220-240V～ 50/60Hz

注：此附录与证书同时使用时有效。

主　任：

中国质量认证中心

PHILIPS

Philips Lighting

CE CE EU Declaration of Conformity

Document No.: 2017A0126
Year in which CE Mark was first affixed: 2017

Manufacturer: Philips Lighting
I.B.R.S./C.C.R.I. /Numéro 10461
5600 VB Eindhoven, The Netherlands

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Product:	**NAME:**	Xi FP 22W 0.2-0.7A SNLDAE 230V S175 sXt Led Electronic Driver	Xi FP 22W 0.3-1.0A SNLDAE 230V S175 sXt Led Electronic Driver
Product Code:	**12NC**	9290 016 17806	9290 009 91206
Product:	**NAME:**	Xi FP 40W 0.2-0.7A SNLDAE 230V S175 sXt Led Electronic Driver	Xi FP 40W 0.3-1.0A SNLDAE 230V S175 sXt Led Electronic Driver
Product Code:	**12NC**	9290 009 89206	9290 009 89306

The designated products are in conformity with the following Union harmonization legislation and with the applicable requirements of the following harmonized standards:

Low Voltage Directive (LVD), 2014/35/EU

- EN 61347-2-13:2014+A1:2017

Electromagnetic compatibility Directive (EMC), 2014/30/EU

- EN 55015:2013+A1:2015
- EN 61000-3-2:2014
- EN 61000-3-3:2013
- EN 61547:2009

EcoDesign requirements for energy-related products Directive (ErP), 2009/125/EC and applicable Implementing Measures

- Implementing Measure EC/1194/2012

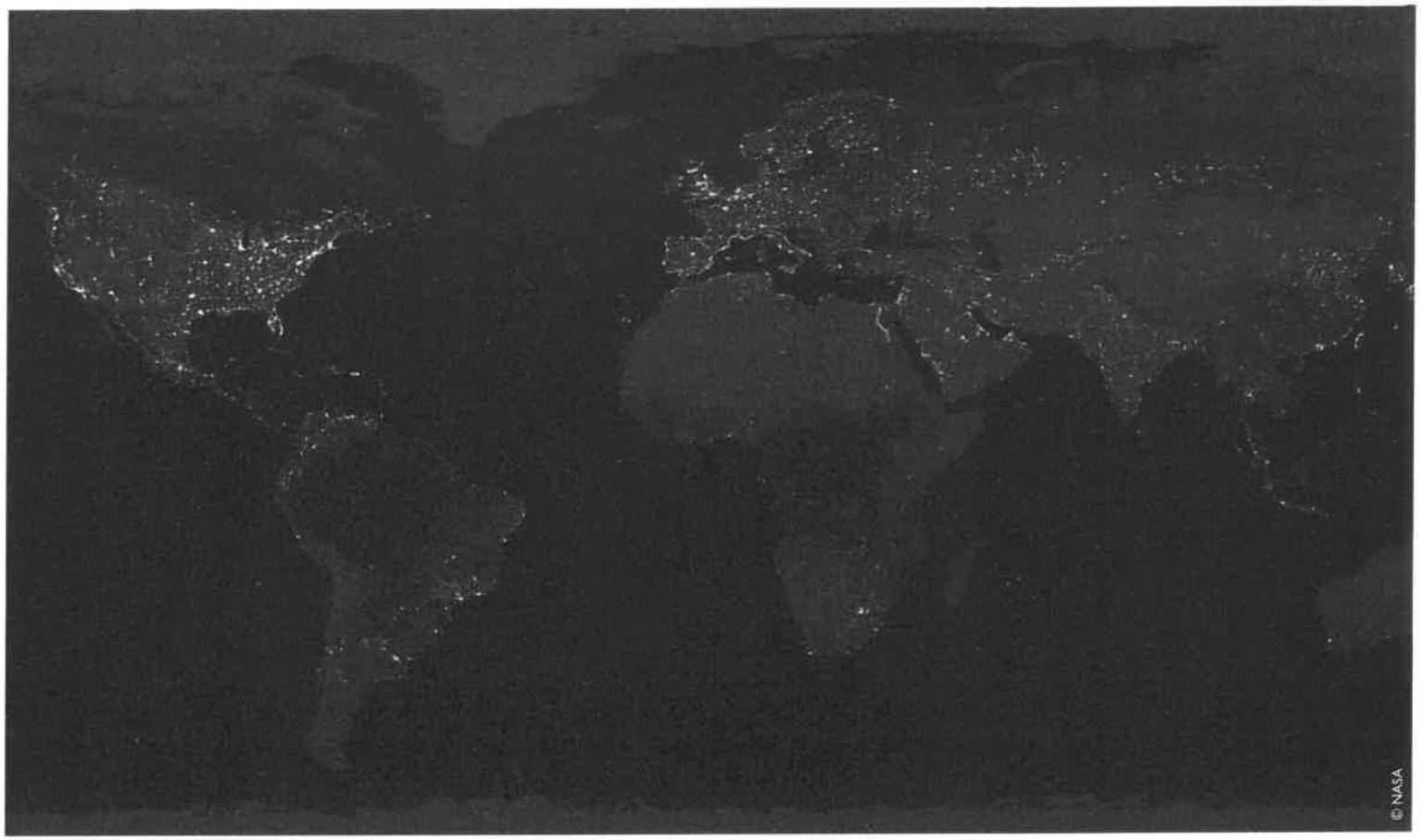
Restriction of the use of certain Hazardous Substances in electrical and electronic equipment Directive (RoHS), 2011/65/EU

- EN 50581:2012

and are produced under a quality scheme at least in conformity with ISO 9001 or CENELEC permanent documents.

2017-12-08, Eindhoven

Ms. C. Sweegers
Regulatory Affairs Manager
High tech campus 45
5656 AE Eindhoven, The Netherlands



LED Driver Lifetime and Reliability

While LEDs themselves are extremely reliable and have a long lifetime, are electronic LED drivers capable of providing the required current/voltage input to the LEDs over their whole lifetime? This paper aims to address the above question in general and for the Xitanium family of LED drivers developed by Philips Lighting specifically. It will describe some of the strategies which Philips applies to maximize the LED drivers' lifetime and reliability and support the application of LED-based outdoor lighting.

PHILIPS

In recent years, LED-based lighting technology as well as the number of applications that have embraced it have advanced rapidly. This is primarily because LEDs bring several advantages to the lighting industry, including high efficiency, durability, environmental friendliness and reduced maintenance requirements due to their superior life. All of these factors translate to energy and maintenance savings, and overall reduction in the cost of ownership over the product's lifetime.

High-power LED modules typically consist of an array of LEDs soldered to a copper board, separated from a heat sink by an electrically isolating but thermally conductive material. These LED arrays are powered by a LED driver, which could be either configured as a constant current source or as a constant voltage source, depending on application requirements. In most applications, these drivers are connected to the AC line on their input side. Like other power converters, the LED drivers consist of several semiconductor switches, magnetic elements, passive capacitors, resistors and other active components. All these electronic elements raise an important question for LED applications: *While LEDs themselves are extremely reliable and have a long lifetime, are the LED drivers based on power electronics capable of providing the required current/voltage input to the LEDs over their whole lifetime?*

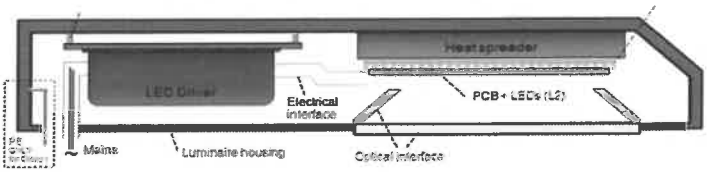


Figure 1. LED system

This paper aims to address the above question in general and for the *Xitanium* family of LED drivers developed by Philips Lighting specifically. It will describe some of the strategies which Philips applies to maximize the LED drivers' lifetime and reliability, to avoid a bottleneck in the application of LED-based outdoor lighting.

Definitions related to Reliability and Lifetime

It is important to first understand the definitions related to the lifetime of LED drivers and electronic products in general. Reliability experts often describe the reliability of a population of electronic products using a graphical representation known as the *Bathtub Curve*, as illustrated in Figure 2. The Bathtub Curve can be divided into three periods. The first is an initial period of infant mortality, where the defective/weak products fail. This is followed by the normal life of the product with a low and relatively constant failure rate. Following this is the final period of the product lifetime where wear-out mechanisms of the product kick in and the failure rates increase.

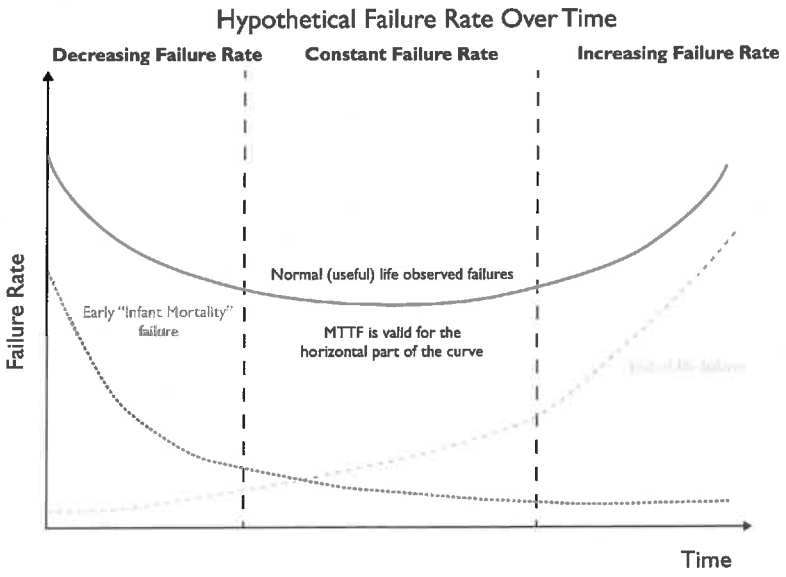


Figure 2. *The Bathtub Curve*

It is important to understand that the Bathtub Curve does not depict the failure rate of a single item, but describes the relative failure rate of an entire population of products over time. Some of the units will fail during the infant mortality period; others will last till the wear-out period while a few of the units will fail during the normal life. Reliability deals with random failures in a population of products and is expressed in terms of rates, such as *Failures in Time* (FIT) or *Mean Time to Failure* (MTTF). MTTF is the theoretical accumulation of random statistical failures of all components in the product, expressing the "constant failure rate" over lifetime. On the other hand, lifetime refers to the length of time that a single product may be expected to function properly before a known wear-out mechanism renders the product unfit for use. Lifetime is typically expressed in hours and normally indicates the duration of time with a minimum survival rate of 90% (obtained from the MTTF calculations). For instance, a lifetime of 100,000 hours implies that under normal conditions[1], in a typical installation (population), 90% of the products installed would be expected to last 100,000 hours before failure.

[1] Please refer to individual product datasheets for specified operating conditions.

MTTF Predictions: While the lifetime of the LED driver depends on the component that is most likely to fail, the failure rate of the driver depends on all the components within the driver. The MIL-HDBK-217F reliability model is used to predict the theoretical failure rate of the *Xitanium* LED drivers.

As an illustration, for a typical 150W Xitanium LED driver operating at a case temperature of about 50° C, a theoretical failure rate of 500 PPM/1000 hours and a MTTF value of approximately 2 million hours is obtained. Please note that for the MTTF calculation, worst case electrical stresses are assumed to obtain a conservative estimate of the LED driver's MTTF. If more realistic values are assumed, higher MTTF values are expected. These calculations also assume a typical operating temperature. If the operating temperatures were higher, the stress levels on the driver components would increase, leading to increased failure rates. Please note that the MTTF data are based on theoretical calculations only and by no means can substitute for actual field data. Past experience has shown that this theoretical prediction is much more conservative than the actual field data. Therefore, whenever possible, actual field return data should be used for predicting reliability.

Designing for Long Lifetime and High Reliability

Developing the most reliable product, which delivers the longest lifetime while also meeting the constraints of cost, size and time to market, is a challenge for every product designer. The *Xitanium* LED drivers are developed through a tightly controlled design and development process, where the quality of product is evaluated at each milestone and activities to realize deliverables (and guidelines on how to perform such activities) are clearly defined. A snapshot describing the overall development process is illustrated in Figure 3.

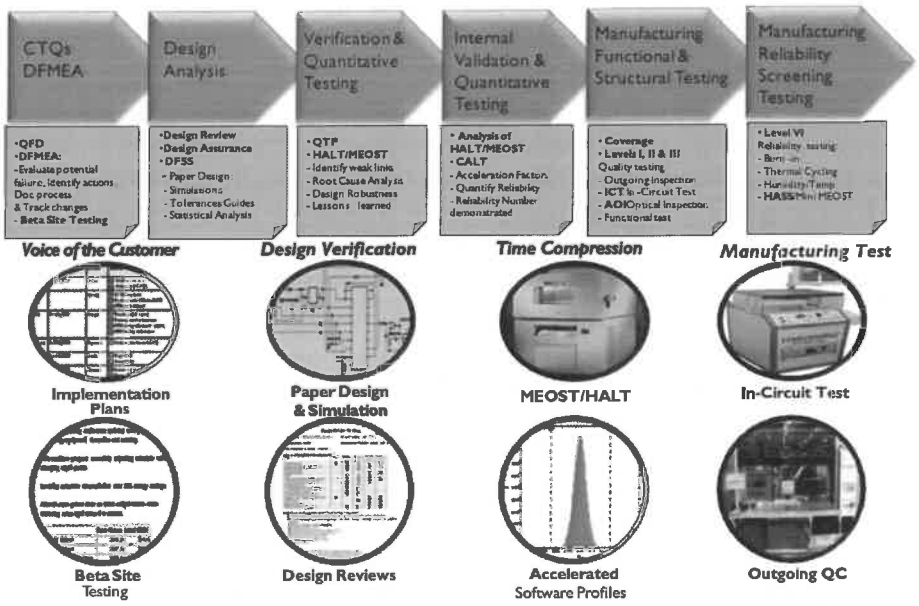


Figure 3. Product development process

Key factors that have to be taken into account to develop the most reliable product are described in the following paragraphs.

Topology Selection: For LED drivers, the first issue is the selection of the most robust power conversion topology given the constraints of power, size, cost, etc. For instance, while a flyback-based topology may be suitable for low power/low voltage applications because of low parts count, with increase in the operating power, a two stage topology might be more suitable from the operating stress and power loss standpoint. High-efficiency topology with soft starting LLC might also be used to further reduce the switching losses of the semiconductor switches thereby further improving efficiency and reducing power loss.

System Efficiency: System efficiency (or power loss) has a direct and significant impact on the reliability and lifetime of a LED driver. This is because all of the lost power is dissipated as heat within the driver, leading to an increase in the temperature of the components within the driver. If the power dissipated in the driver is high, the components within the driver operate at a higher temperature. The reliability of components declines as their operating temperature increases. Therefore, a driver operating with higher efficiency can have a significantly improved lifetime and reliability compared to a lower-efficiency driver.

Additional Protection Mechanisms: In addition to designing for lower power losses, the *Xitanium* LED drivers have a high-temperature roll-off capability. If the case temperature of the driver exceeds a certain value due to abnormal operating conditions, the output current is reduced. This in turn reduces power dissipation and ensures the temperature of the driver's internal components does not rise above a certain threshold. Since the operating temperatures of components have a direct impact on their failure rates, this feature enhances the reliability and lifetime of *Xitanium* drivers. Additional protection schemes are also built into the driver hardware to ensure its reliability. For example, to protect the driver against line surges, e.g. a lightning stroke, additional surge suppressors are added.

Component Selection: Having decided on the right topology that yields the highest efficiency (for a given application), the next challenge is the selection of the components. For the *Xitanium* drivers, each and every component is carefully chosen and passes through extensive design qualification, testing and internal long-term reliability checks. A careful supplier selection process and long-term relationships with the suppliers ensure that only the best components are used in the *Xitanium* drivers. From a design point-of-view, careful analyses of component stresses and adequate derating of the components ensures a highly reliable LED driver that is capable of achieving industry-leading lifetimes. For instance, electrolytic capacitors are operated with a 20% operating voltage margin, while normally semiconductor devices are operated with a 10-20% operating voltage margin. Careful attention is paid during the design phase to ensure that all components operate well within their maximum temperature ratings.

Lifetime Calculations: Having selected the components, it is important to determine which components are most likely to fail. Similar to other power converters, for LED drivers the component most likely to fail, especially when the driver is operating at relatively high temperatures, is the electrolytic capacitor. The electrolyte in the capacitor will vent over time as a function of the operating temperature of the capacitor. Therefore, the lifetime of the driver can be directly derived from the lifetime of the electrolytic capacitor. The operating temperature of the capacitor is a function of the case temperature (which again depends on the power dissipated by the driver and therefore, the driver's efficiency) of the capacitor and the internal heating within the capacitor caused by the ripple current flowing through it. The typical equation for the lifetime of the capacitor operating at a certain ambient temperature, L_T is defined by

$$L_T = kL_0 2^{\frac{T-T_0}{10}}$$

where k is a factor that depends on the ripple current flowing through the capacitor;

T is the temperature at which the capacitor operates;

L_0 is the lifetime of the capacitor at the rated case temperature.

The equation above shows that every 10° C drop in the operating temperature of the capacitor doubles its lifetime. This further reiterates the need to design high-efficiency LED drivers, to minimize power dissipation and therefore lower component temperatures. It is important to size the capacitor properly, to reduce the current ripple flowing into it. Please note that in the datasheets of Xitanium drivers, the lifetime is typically expressed in terms of the case temperature. For obtaining the estimate of the product lifetime, the relationship between the case temperature and the temperature of the electrolytic capacitors is obtained through careful thermal measurements, and it is assumed that the temperature difference between the capacitor and the case is always constant.

System Performance

The preceding discussion focused on lifetime and reliability of individual products. There are other factors which need to be taken into account when addressing lighting system reliability. One critical aspect to consider is the additional thermal stress arising from the mutual heating of different components in a system. Typically the self-generated heat of a driver is 20-25° C. However when the driver is mounted very close to the LED board, the heat from the LEDs will lead to additional temperature increase of the driver. Another challenge is related to the number of system starts, which can have a big impact on system lifetime. The temperature difference between a system at rest in a cold ambient environment and a running system could be in the range of 30° to 60° C. This drastic temperature change can lead to thermal shock. Frequent switching, for example turning the installation off in the middle of the night, will shorten the lifetime of the system. It is preferable to dim the light in order to maximize system lifetime.

Lifetime Outside Specified Operating Conditions: Product specifications include operating parameters for input voltage. Over-voltage, which can occur during switching or load changes, can negatively impact the lifetime of the driver. While there is no way to foresee these occurrences, it is possible to minimize the damage by choosing components with the widest possible specified voltage range. The new Xitanium Programmable LED drivers can operate in a voltage range of 108V - 320V.

In addition to the normal voltage fluctuations in the power line, LED lighting systems are subject to damage from high-voltage surges (e.g. lightning strokes). For a detailed discussion on how to protect your LED installation, please visit www.philips.com/surgeprotection

Lifetime and Reliability in Electronic Gear for Conventional Lighting: While the focus of the discussion has been on performance and reliability of LED drivers, the conclusions are identical for electronic gears for HID lamps. In fact the design of LED drivers is derived from the proven topology of eHID gear, perfected by Philips over the past two decades.

Testing and Qualification: The issues identified above bring us to the next important step in the design process. Extensive qualification testing is performed at the design stage of *Xitanium* drivers to ensure that any design issue is caught during the product development stage. The tests include operating the drivers at all possible operating conditions and also under conditions of extreme humidity and temperature. Furthermore, careful tests are conducted to ensure that all of the components operate within their maximum stress ratings (determined from the derating rules). Additional compliance testing is conducted by various agencies to ensure that the drivers meet all relevant industry standards.

Accelerated life testing, including HALT/ MEOST, is also performed to ensure high driver reliability. For every new product, the data from these tests are compared with those obtained from similar tests done for other released products (which have been operating in the field for a longer duration of time and for which enough field data are available). This ensures that every new product achieves at least the same level of reliability as a previously released product. To limit failures in the infant mortality period, initial burn-in or stress tests are done on statistically relevant sample sizes.

Key Conclusions

This document also describes how the lifetime and reliability of the Xitanium LED drivers are maximized during design and manufacturing. Software modeling is used to estimate the theoretical failure rate of the drivers. Field return data obtained from previously released products show that the estimates obtained using this model are more conservative that actual performance. Therefore, theoretical MTTF data is meant to be an initial estimate and can give an idea regarding weak links in the design. For instance, for Xitanium LED drivers, theoretical calculations reveal that the electrolytic capacitors and the solder joints are the components most likely to fail. It is however recommended that whenever possible, actual field return data should be used.

This document also describes the strict design procedure followed for the development of Xitanium LED drivers to ensure high lifetime and reliability. The design and development of all Xitanium LED drivers pass through a tightly controlled process. The quality of product is critically evaluated at each milestone and activities to realize deliverables (and guidelines on how to perform such activities) are clearly defined. All field return issues are carefully documented and all failure issues are reviewed at the start of each new project so that the learnings can be carried forward to new designs. This feedback and improvement cycle has been part of the Philips product development process for over a decade, resulting in products which perform far better than the theoretical estimates.

Technical abbreviations

CTQs:	Critical to Quality
DFMEA:	Design Failure Mode and Effect Analysis
DFSS:	Design for Six Sigma
FIT:	Failures in Time
HALT:	Highly Accelerated Life Testing
HID:	High Intensity Discharge
ICT:	In -Circuit Test
LLC:	a half-bridge topology with two coils (LL) and one capacitor (C)
MEOST:	Multiple Environmental Overstress Test
MIL-HDBK-217F:	Military Handbook for "Reliability Prediction of Electronic Equipment". MIL-HDBK-217 is published by the Department of Defense, based on work done by the Reliability Analysis Center and Rome Laboratory at Griffiss AFB, NY. The MIL-HDBK-217 handbook contains failure rate models for the various part types used in electronic systems, such as ICs, transistors, diodes, resistors, capacitors, relays, switches, connectors, etc. These failure rate models are based on the best field data that could be obtained for a wide variety of parts and systems; this data is then analyzed create usable models.
MTTF:	Mean Time to Failure
PPM:	Parts Per Million
QC:	Quailty Control
QTP:	Quality Test Plan

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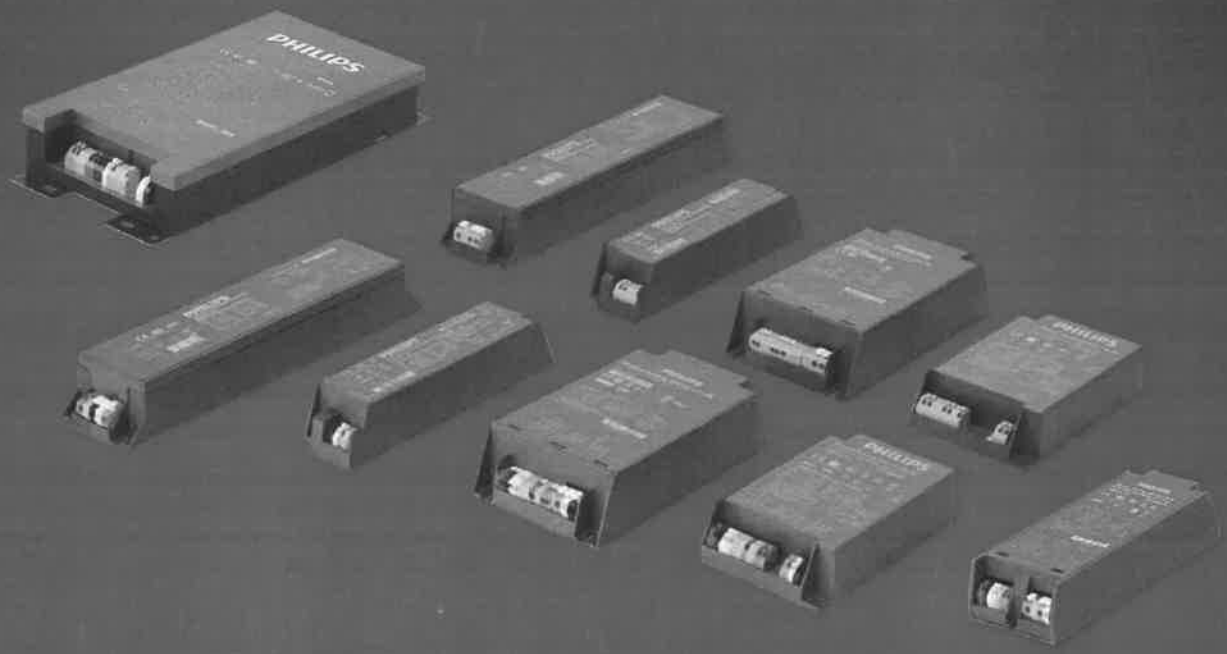
Xitanium

LED Xtreme drivers



Design-in Guide

Reliable Xtreme technology for demanding LED applications

January 2018

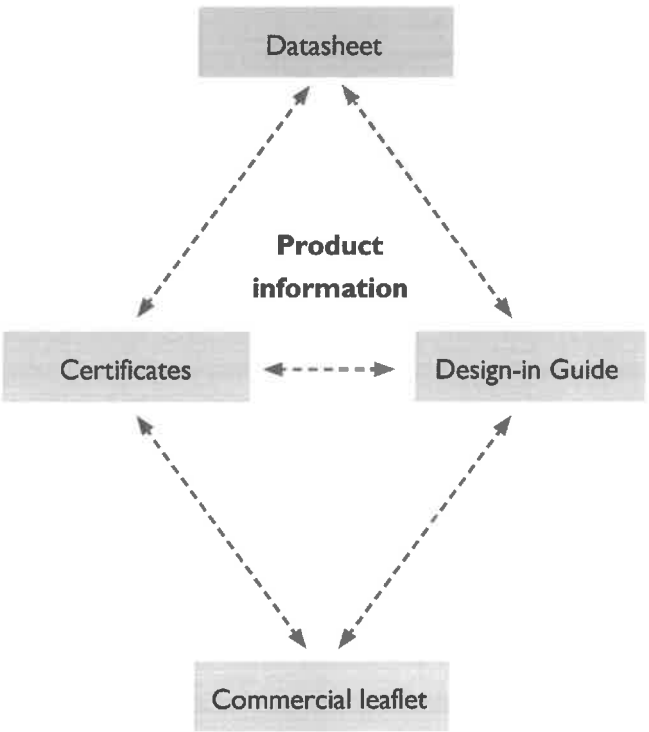
Contents

Introduction to this guide

Examples of Xitanium LED Xtreme drivers

Thank you for choosing the 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 the configurable Xitanium FULL Prog (Xi FP) and LITE Prog (Xi LP) LED Xtreme drivers. 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 outdoor and industrial lighting like roads, streets and highbay 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/technology
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.

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

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

Warnings and instructions

Warning:

- Avoid touching live parts!
- Do not use drivers with damaged housing and/or connectors!
- Do not use drivers with damaged wiring!

Safety warnings and 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 can be lethal. Connecting a LED module to an energized driver may damage both the LED module and driver.
- No components are allowed between the LED driver and the LED module(s) other than connectors and wiring intended to connect the Xitanium driver to the LED module.
- Adequate earth and/or equipotential connections needs to be provided whenever possible or applicable.

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

Xitanium LED Extreme drivers

Examples of Xitanium LED Xtreme drivers

Xitanium LED Xtreme driver families: general feature overview

	Xitanium **Single** Current	Xitanium **LITE** Prog	Xitanium **FULL** Prog
Lifetime 100kHrs	•	•	•
Surge Immunity 8kV CM / 10kV CM / 6kV DM)	•/-/•	-/•/•	-/•/•
1-10V	•	•	
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 operate LED solutions for general lighting applications such as street, road and highbay lighting. 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 two different versions:

Xitanium FULL Prog (Xi FP)

Xitanium LITE Prog (Xi LP)

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/technology

Detailed specifications can be found in the Xitanium driver datasheets which can be downloaded at www.philips.com/technology.

Configurability Interface (tooling)

The Xi FP and LP Xitanium LED Xtreme drivers are programmable. A large 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". Information about configuring drivers with SimpleSet can be found in the section "Configurability".

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 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 Naming at page 9)

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.

Ripple and flicker

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 and has such a low amplitude that optical interference (flicker) with camera systems other than those for high-speed HD recording is not be expected. The ripple value of both components are specified in the driver datasheet.

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. 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. 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).

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

When the driver is shutdown the diagnostics data is stored automatically in non-volatile memory.

Driver naming

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