

PHILIPS



Fortimo

LED system

DLM EaseSelect G2



Design-in Guide

State of the art integration
for downlight solutions

March 2023

Contents

Introduction to this guide	3	Electrical design-in	11
Determine which documents contain what information	3	Connecting the module	11
Warnings and instructions	4	Wire preparation	11
Safety warnings and installation instructions	4	Connection to the mains supply	11
Design-in phase	4	Isolation	12
Manufacturing phase	4	Strain Relief	12
Installation and service for luminaires incorporating the Fortimo LED DLM System	4	Emergency Mode	12
Philips Design-in support	4	Reliability	13
Disposal	4	Lumen maintenance	13
Introducing the DLM EaseSelect	5	Complementary Partners	14
Application Information	5	Compliance and approval	15
Module types	5	Compliance and approbation	15
Naming of the Fortimo DLM ES modules	5	IP rating, humidity and condensation	15
Can the module be used in outdoor luminaires? In this design-in guide	5	Electrostatic discharge (ESD)	15
Optical design-in	6	Safety	15
Definitions	6	Electromagnetic compatibility	15
Light Distribution	6	Environmental	15
Rayset Files	6	Cautions	15
Mechanical design-in	7	During operation	15
Fortimo DLM ES	7	Contact details	16
Mechanical fixation	7	Philips Fortimo DLM ES	16
Thermal design-in	8	Philips ESD support	16
Key Definitions	8	Design-in Support Terms & Conditions for EMEA	17
Test requirements	9		
Critical measurement points	9		
How to measure the critical temperature point Tc	9		
Thermal interface material	10		
Operating at a Tc other than Tc nom	10		

Introduction to this guide



Fortimo DLM EaseSelect

Thank you for choosing the Philips Fortimo DLM EaseSelect (ES). In this guide you will find the information required to design this module into a luminaire.

Information and support

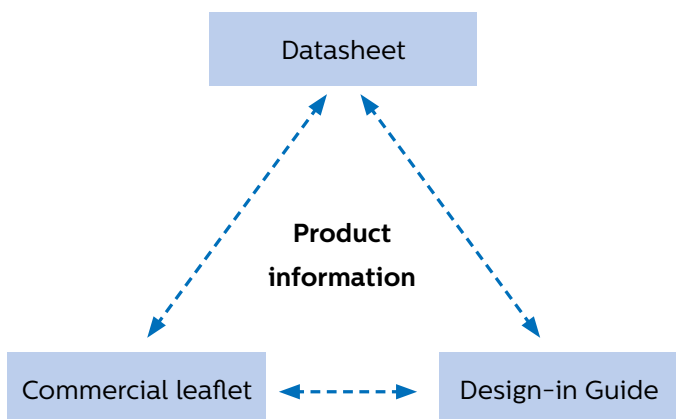
If you require any further information or support please consult your local Philips office or visit our website: www.Philips.com/Technology

Determine which documents contain what information

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

- **Commercial leaflet** contains product family information
- **Datasheet** contains the module specification
- **Design-In Guide** describes how to design-in the products

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

Safety warnings and installation instructions

To be taken into account during design-in and manufacturing.

Design-in phase

- The 1100 and 2000lm modules are suited for both IEC Class I and II luminaires
- The 3000lm modules are suited for IEC Class I luminaires only.
- Provide adequate environmental protection
- It is recommended to use thermal grease to maintain good thermal resistance. The grease must be kept within the marked area on the backside of the module.

Manufacturing phase

- Do not use damaged or defective products.
- Do not drop the DLM ES or damage in any way.
- Keep the housing and diffuser clean.
- It is recommended to use thermal grease to maintain good thermal resistance. The grease must be kept within the marked area on the backside of the module.
- Do not connect an external driver.
- Ensure than line and neutral are correctly connected.

Installation and service for luminaires incorporating the Fortimo LED DLM System

- Do not remove the housing while the mains are connected.
- In case required, the light source must be serviced/replaced by the OEM, a service agent or a similar qualified person.

Philips Design-in support

Is available; please contact your Philips sales representative.

Disposal

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

Introducing the DLM EaseSelect



Application Information

The Philips Fortimo DLM ES is a high-performance, compact, integrated driver on board (DoB) series of products for general down-lighting. This product offers a long-lifetime and energy efficient lighting solution for general down-lighting applications. It is consistent with other Fortimo families of modules, delivering a high quality of light and peace of mind.

Module types

The DLM ES module comprises of a range of lumen packages and color options. An overview is provided in the Commercial Leaflet in the download section on www.Philips.com/Technology. This provides the user with a full portfolio comprising of a wide range of products.

In this guide you will find the specific information required to develop a luminaire based on Philips Fortimo DLM ES module. Product specific data can be found in the associated datasheet on www.Philips.com/Technology.

Naming of the Fortimo DLM ES modules

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

Fortimo DLM ES 1100/830 G2

Fortimo	: our brand name for high-quality, efficient, smart, future-proof and reliable LED lighting
DLM	: Downlight module
ES	: EaseSelect; representing the Philips Driver on board range
1100	: 1100 lumen
830	: for a color rendering index >80; 30 stands for a CCT of 3000 K
G2	: Indicates the second generation

Can the module be used in outdoor luminaires?

This product does not have an IP classification. If these products are used in luminaires for outdoor applications, it is up to the OEM to ensure proper protection of the luminaire. Please consult us if you wish to deviate from the design rules described in this guide.

In this design-in guide

In this design-in guide you will find all necessary guidelines to use the Fortimo DLM ES module to exactly fit your needs. Since this module has an integrated driver on board (DoB), the hassle of choosing and connecting a matching driver is already taken care of by us. We provide you with the optimum solution for your application.

Optical design-in

This section is about the relevant definitions, and tips for obtaining the desired light distribution from your luminaire.

Definitions

Color consistency refers to the spread in color points between the modules. It is expressed in SDCM (Standard Deviation of Color Matching), the size of the MacAdam ellipse that encircles the color points of all modules. The full 3 SDCM distribution is within the ANSI bin.

Intensity distribution is expressed as luminous intensity (candela = lumen/steradian) versus direction. The data is collected in the far field at 10 meter or 30 feet from the light source.

Ray sets are derived from near-field measurements of luminance distributions.

Light Distribution

DLM modules generate a close to Lambertian intensity distribution. To prevent light loss, the secondary optics should not cover the exit aperture of the module.

Far field intensity distributions (in .ies and .ldt format) of the module are available on www.philips.com/technology.

Rayset Files

They are available for the module and can be downloaded from www.philips.com/technology. The table below shows the available formats for ray sets of 100,000 rays. Ray sets for larger number of rays are available on request with your local sales representative.

Ray sets available for:

ASAP	.dis
LightTools	.ray
TracePro/Oslo (ASCII)	.dat
Zemax	.dat

Mechanical design-in

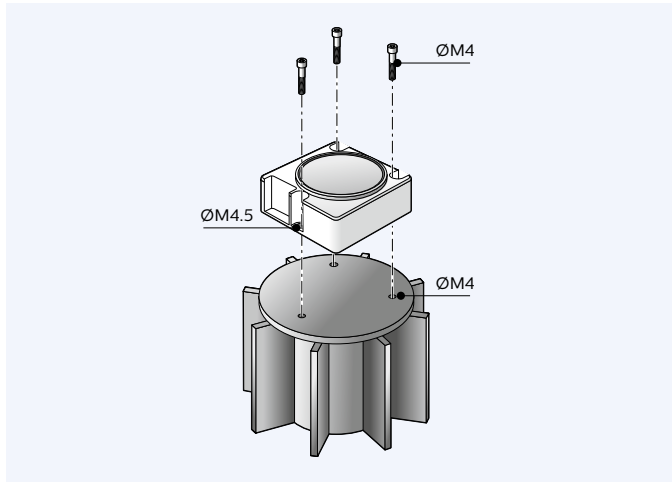
Fortimo DLM ES

The dimensions for the Fortimo DLM ES modules are provided in the respective datasheets. These, along with the 3D CAD files can be downloaded from our website www.Philips.com/Technology.

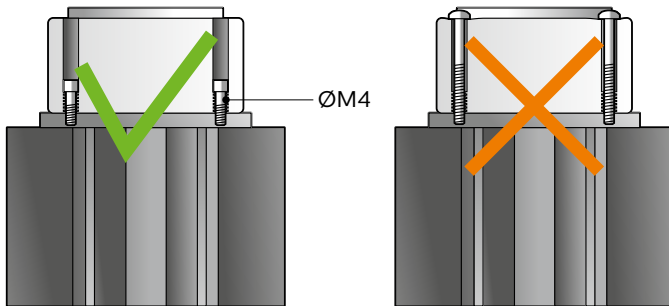
Mechanical fixation

The DLM ES is delivered as a complete module (PCB + housing). In case this housing is separated during transit, it can simply be screwed together with the PCB to the heat sink.

Please note that due to the thickness of the LED board, mounting of the light engine from the back is not possible, only fixation through the module is applicable. The picture on the left shows the correct mounting procedure. 2D or 3D CAD drawings are available upon request or at www.Philips.com/Technology.



Fixing holes at the module to screw the heat sink



Recommended screw type

It is suggested to use a M4 metric socket cap screw from the top of the module to heat sink. The recommended torque on the M4 screws is 0.5 Nm.

Advice: Do not screw into the top of the module.

Thermal design-in

Attention needs to be paid to thermal design-in to ensure optimum performance and life time of the luminaire. The critical thermal management items for the LED module are set out in this chapter in order to facilitate the design-in. If these thermal items are taken into account, this will help to ensure optimum performance and lifetime of the luminaire. Relevant definitions are explained along with guidance on how and where to measure the temperatures.

Key Definitions

Module temperature: This is the temperature measured at the specified T_{case} or T_c point of the module. This temperature is directly related to the LED junction temperature, which is the critical parameter for operation.

Ambient temperature: This is the temperature of the air surrounding the luminaire in the test environment or application. The module and driver temperature increase, by approximation, linearly with the ambient temperature. This relation can be used to predict module and driver temperatures at a different ambient temperature.

T_c nominal: This is the module temperature at which the performance is specified.

T_c life: This is the module temperature at which the lifetime of the module (e.g. lumen maintenance of L_{xxByy}) is specified.

T_c max: This is the maximum module (equal or higher than T_c life) to stay within safety limits. This temperature must not be exceeded, even in case of fan failure.

The specified T_c nominal, T_c life, and T_c max are listed in the relevant datasheets that can be found at www.Philips.com/Technology.

Test requirements

Temperature, light output and power measurements can be considered reliable once the luminaire is thermally stable, which may take between 0.5 and 2 hours, and is defined as at least 3 readings of light output and electrical power over a period of 30 minutes, taken 15 minutes apart with a variation of less than 0.5%. The stabilization time depends on the heat capacity of the luminaire (see also the relevant clauses in IEC 60598-1) and ANSI/UL 8750 8.3.6. The test is to continue until constant temperatures are obtained. A temperature is considered constant if:

- The test has been running for at least 3 hours, and
- Three successive readings, taken at 15-minute intervals, are within 1 °C (1.8 °F) of one another and are still not rising

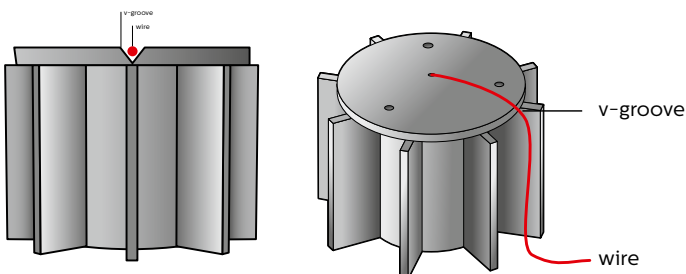
Critical measurement points

Because LEDs are temperature sensitive, LED modules require a different approach with respect to the maximum permissible component temperature. This is different to most other types of conventional light sources.

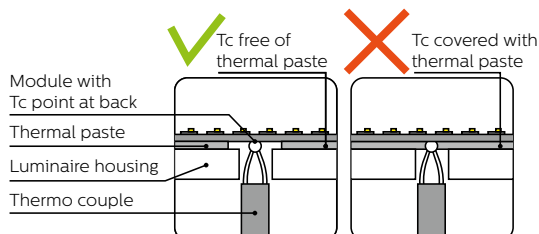
For LEDs, the junction temperature is the critical factor for operation. Since there is a direct relation between the case temperature and the LED junction temperature, it is sufficient to measure the aluminum casing of the LED module at its critical point. The critical point is on the rear surface of the LED module; in the centre, as shown in the figure on the left. If the case temperature (T_c) at the critical measurement point exceeds the recommended maximum temperature, the performance of the LEDs will be adversely affected, for example in terms of light output, lifetime or lumen maintenance.

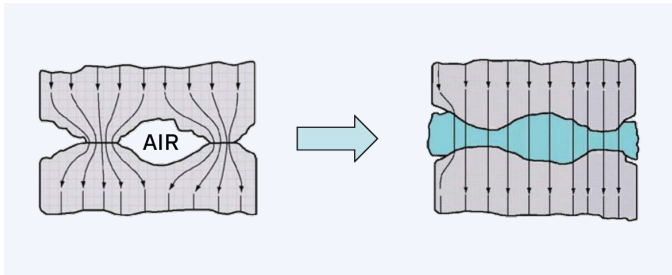
How to measure the critical temperature point T_c

The T_{case} point can be reached with a thermocouple by making a thin groove in the heatsink that fits a thermocouple (see Figure). The thermocouple must be glued in the groove with glue that can withstand typical module temperatures. Apply strain relief on the thermocouple with adhesive tape. Make sure that the junction of the thermocouple is pointed to the module to make sure that the module temperature is measured instead of the thermal interface material. It is also possible to measure the T_c via an access point cut through the mounting surface of the module. This is described in the figure on the left.



Thin v-groove in the heat sink to embed a thermocouple





The working principle of thermal interface material (TIM)



Boundary for limiting thermal grease

Thermal interface material

The DLM ES modules have a relatively small footprint in relation to their electrical and thermal power. A good thermal contact via a thermal interface material to an adequate heat sink, either integrated in the luminaire head or separate, is a necessity for a good luminaire.

The function of the thermal interface material is to reduce thermal resistance between the LED module and the heat sink. It fills air gaps which are thermal insulators. This is shown in on the left.

The module surface and the heat sink surface must be smooth and free of burrs to obtain optimal contact by only a thin layer of the thermal interface material. It is recommended to use a thermal grease material for optimum performance. Please ensure that the grease is limited within the boundary marked on the module. The thickness of the grease is recommended to be within 0.1-0.2 mm.

It is possible to use a thermal pad as an interface material. If this is the case, we recommend to test the T_c on the module and not on the heatsink (via an access point as described above).

The heat sink should not be locked up in a confined space. It should be in contact with the ambient air for optimal heat transfer to the ambient.

Operating at a T_c other than $T_{c\text{ nom}}$

In case the OEM chooses to allow the temperature at T_c other than nominal, the lifetime and reliability of the LED module must be taken into account. Given a constant drive current (mA), following temperature regions can be distinguished:

1. Temperature at $T_c < \text{nominal value } (^{\circ}\text{C})$
 - a) Efficacy (lm/W) higher than nominal value. Light output (lm) higher than nominal value.
 - b) Lifetime > 50,000 hours.
2. Temperature at T_c between nominal value and lifetime value ($^{\circ}\text{C}$)
 - a) Efficacy (lm/W) lower than nominal value. Light output (lm) lower than nominal value.
 - b) Lifetime > 50,000 hours.
3. Temperature at T_c between lifetime value and absolute maximum value ($^{\circ}\text{C}$).
 - a. Efficacy (lm/W) lower than nominal value. Light output (lm) lower than nominal value.
 - b. Lifetime < 50,000 hours.
4. Temperature at $T_c > \text{absolute maximum value}$: do not exceed the absolute maximum value as this can lead to LED module failure. No warranty is applicable in this case.

Electrical design-in



Connecting the module

There are two connectors available on the DLM ES and these have been clearly marked for Line (L) and Neutral (N). These can be used with simple push in wires in order to connect to the mains. Wires of 0.25-0.75 mm² (AWG 18-24) can be used. In case a wire of >0.75 mm² is required, this can be handled in the luminaire after the strain relief connection.

Wire preparation

Strip length of the wires must be between 6 and 7 mm. Stranded wires should be pre-bonded or twisted and tinned before insertion.

The wires entry angle should be 0° to the PCB plane.

Note: Auto-insert is not supported. Do not interchange L and N.

Connection to the mains supply

The DLM ES is an integrated Driver on board product. The mains supply must be connected to the module.



Label on module warning users to not remove the housing while mains is connected.

Isolation

It is necessary to use the module as a whole (PCB + housing).



Warning:

In case the module needs to be replaced/serviced within the luminaire, this must be done by the OEM or a qualified service agent only. The housing must not be removed from the module while mains is connected.

The 1100lm and 2000lm modules can be selected to create Class I and Class II luminaires. The module can be used in Class I luminaires without further action. The creepage distance and clearance are fulfilled. In Class II luminaires either double insulated wires that are stripped to the correct length or additional insulation in the area of the input connector must be used.

The 3000lm modules are suited for IEC luminaire Class I only

Strain Relief

Strain relief must be dealt with by the OEM at the luminaire level.

Emergency Mode

This module can operate on DC input.

Reliability

Lumen maintenance

L70B50 @ 50,000 hours

The quality of the DLM ES portfolio is backed by the Philips' claim of B50L70 @ 50,000 hours. This means that at 50,000 hours of operation at least 50% of the LEDs' population will emit at least 70% of its original amount of lumens.

This is contrary to conventional light sources, where some time after Service Life Hours the conventional light source emits no light at all.

Average rated life is based on engineering data testing and probability analysis.

Complementary Partners

Thermal/Optical solutions are not a part of our system offering. There are many different companies who have a standard portfolio of compatible heat sinks, thermal interface materials and reflectors. The tables below give a list of complementary partners offering compatible systems.

Reference to these products does not necessarily mean that they are endorsed by Philips. Philips makes no warranties regarding these products and assumes no legal liability or responsibility for any loss or damage resulting from the use of the information given here.

Partners for reflector solutions

Complementary reflector partners	Website
Jordan Luxar	www.jordan-luxar.de
NATA	www.nata.cn
Widegerm	www.widegerm.com.hk
ACL	www.reflektor.de
Almecogroup	www.almecogroup.com

Partners for thermal interface materials

Thermal interface partners	Website
Laird Technologies	www.lairdtech.com
The Bergquist Company	www.bergquistcompany.com

Partners for cooling solutions

Complementary heat sink partners	Website
Sunon	www.sunon.com
AVC	www.avc.com.tw
Wisefull	www.wisefull.com
MechaTronix	www.mechatronix-asia.com

Compliance and approval

Compliance and approbation

The modules bear the CE mark since they comply with the appropriate European EC directives.

The relevant standards are summarized below. To ensure luminaire approval, the conditions of acceptance need to be fulfilled. Details can be requested from your local sales representative. All luminaire manufacturers are advised to conform to the international and national standards of luminaire design (luminaire standards IEC 60598-1).

IP rating, humidity and condensation

The DLM ES modules are build-in modules and therefore have no IP classification, indicating that they are not designed for operation in the open air. The luminaire builder is responsible for proper IP classification and approbation of the luminaire in case it is desired to be used outside.

The DLM ES has been developed and released for use in dry or damp locations. If there is a possibility that condensation could come into contact with the modules, the customer must take precautions to prevent this.

Electrostatic discharge (ESD)

ESD in production environment

Depending on the protection level of the LED module a minimum set of measures has to be taken when handling LED boards. Philips LED products have a high degree of ESD protection by design. ESD measures are required in a production environment where values can exceed the values shown in the ESD specifications table below.

ESD consultancy

Independent ESD consultancy companies can advise and supply adequate tools and protection guidance. Philips Innovation Services can provide consultancy www.innovationservices.philips.com

More information can be found in the section entitled 'Contact details'.

Philips Fortimo DLM ES modules comply with the standards shown below.

Safety

IEC/EN 62031	LED modules for general lighting – safety specifications
IEC TR 62778	Photobiological safety of lamps and lamp systems (included as part of the IEC 62031 approbation)
IEC/EN 61347-1	Lamp control gear

Electromagnetic compatibility

EN 55015, CISPR 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
IEC/EN 61000-3-2	Limits for harmonic current emissions (equipment input current <16 A per phase)
IEC/EN 61000-3-3	Disturbance in supply systems: voltage fluctuations and flicker
IEC/EN 61547	Equipment for general lighting purposes – EMC immunity requirements

Environmental

The product is compliant with European Directive 2011/65/EC on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS2).

Cautions

During storage and transportation

- Store in a dark place. Do not expose to sunlight.
- Maintain temperature between -40 °C +65 °C, and RH 5 – 90%.

During operation

Philips shall not be held responsible for any damage to the user resulting from an accident or any other cause during operation if the system is used without due observance of the absolute maximum ratings.

Please note that warranty is applicable for The Philips Fortimo DLM ES modules for 3 switching cycle/day.

Contact details

Philips Fortimo DLM ES

www.Philips.com/Technology

Or contact your local Philips sales representative

Philips ESD support

www.innovationservices.philips.com

Phone: +31- (0) 40 27 46658

Fax: +31 - (0) 40 27 42224

The Philips corporate EMC competence centre is a leading provider of approbation and consultancy services.

Design-in Support Terms & Conditions for EMEA

These Design-in Support Terms and Conditions (“**these Terms**”) apply to all design-in support (“**Support**”) provided by **Philips Lighting B.V.** (through its Business Group LED Electronics) (“**Philips Lighting**”) to a customer requesting the Support (“**Customer**”).

Any report provided by Philips Lighting in connection with the Support is not an official testing certificate and cannot be used or construed as a document authorizing or otherwise supporting an official release of the luminaire. The Customer remains at all times liable and responsible for any and all required testing and approbation prior to the manufacture and sale of the luminaire in question.

The testing performed by Philips Lighting, as well as the scenarios, observations, conclusions, recommendations and other results or advice contained in any report provided by Philips Lighting in connection with the Support, are provided solely for informational purposes for internal evaluation by the Customer. Philips Lighting does not make and hereby expressly disclaims any warranties or assurances whatsoever as to the accuracy, completeness, reliability, content and/or quality of any testing, scenarios, observations, conclusions, recommendations and other results or advice contained in any reports or any other document provided in connection with the Support, whether express or implied including, without limitation, any warranties of satisfactory quality, fitness for a particular purpose or non-infringement. Philips Lighting has not investigated, and is under no obligation or duty to investigate, whether the scenarios, observations, conclusions, recommendations and other results or advice contained in any report provided in connection with the Support are, or may be, in conflict with existing patents or any other intellectual property rights. The scenarios, observations, conclusions, recommendations and other results or advice contained in any report or any other document in connection with the Support are provided by Philips Lighting on an “as is” basis, at the customer’s sole risk and expense.

Philips Lighting shall not be liable to the Customer for any damages (whether direct damages, lost profits, lost savings, loss of reputation, loss of goodwill, indirect, incidental, punitive, special or consequential damages) arising out of or in connection with the Support provided by Philips Lighting (including resulting from the use of any report, implementing any recommendations, and/or interactions of the solution in the later produced luminaires, the application of the luminaires or otherwise) whether or not such damages are based on tort, warranty, contract or any other legal theory – even if Philips Lighting has been advised, or is aware, of the possibility of such damages.

The laws of the Netherlands govern these Terms and any disputes that cannot be settled through consultation in good faith within thirty (30) days after notice from either the Customer or Philips Lighting that a dispute exists, will be referred to and finally resolved by the exclusive jurisdiction of the courts of Amsterdam, The Netherlands.

These Terms shall constitute the entire agreement between Philips Lighting and the Customer relating to the subject matter hereof. Any waiver of these Terms shall only be effective if it is in writing and signed by Philips Lighting. If any part of these Terms is found invalid or unenforceable by a court of competent jurisdiction, the validity and enforceability of the remaining provisions or portions of them, will not be affected.



© 2023 Signify Holding. All rights reserved. The information provided herein is subject to change, without notice. Signify does not give any representation or warranty as to the accuracy or completeness of the information included herein and shall not be liable for any action in reliance thereon. The information presented in this document is not intended as any commercial offer and does not form part of any quotation or contract, unless otherwise agreed by Signify.

Philips and the Philips Shield Emblem are registered trademarks of Koninklijke Philips N.V. All other trademarks are owned by Signify Holding or their respective owners.