



# DimIn

## DimIn

# Smart lighting made simple

- EPBD-ready TBS device
- Full BACS integration
- Energy reporting (251/252/253)

*DimIn is a compact, upgradeable control module that connects directly to Optoga AC LED modules. It offers DALI-2, Casambi BLE, potentiometer and switch control, all without the need for an external driver.*

*Lighting as a Technical Building System (TBS)*



*With built-in energy monitoring (DALI Parts 251, 252, 253), DimIn is fully prepared for EPBD 2024/1275. It integrates seamlessly into BACS/BMS systems, providing real-time energy data, diagnostics and compliance for the future of smart buildings.*





## Content

---

Overview.....	2
Product Areas – Built for the Future of Smart Lighting.....	3
Article number structure.....	4
Regulatory & Standards Alignment.....	6
Mounting & Integration.....	8
Wiring for different DimIn versions.....	12
Precautions for use.....	13
ROHS III Compliant.....	13

## Overview

---

DimIn is Optoga’s compact communication module that transforms any OptoDrive IoT LED module into a connected, intelligent light source. By mounting directly on the LED module’s IoT interface, DimIn enables full DALI-2 interoperability, real-time energy reporting, and predictive maintenance capabilities.

### DimIn supports:

- DALI-2 Parts 251, 252, 253 (Luminaire Data, Energy Data, Diagnostics)
- Seamless integration with Casambi and BACS/BMS systems
- TM21-based lifetime data (L80/B50) directly from the LED module
- Field-upgradable firmware via OTA

### Key Features

- Real-time monitoring: Power (W), energy (kWh), Tc temperature, operating hours
- Predictive maintenance: Uses IEC 62386-253 maintenance data for service planning
- Interoperable: Works with any DALI-2 compliant system and Casambi gateways
- Future-proof: EPBD ready, supports energy reporting for BACS integration

### EPBD compliance







DimIn fulfills the functional requirements of EPBD Article 13 by providing continuous monitoring of energy (251), operating time (252), diagnostics (253) and LED module temperature. It also supports task-based zoning as required in EPBD-guidance and LightingEurope comments, enabling each luminaire to act as a granular BACS node.

## Product Areas – Built for the Future of Smart Lighting

DimIn is more than a control module - it is a platform. Compact, removable, and upgradeable, it mounts directly onto Optoga AC LED modules, eliminating the need for external drivers.

With support for DALI-2, Casambi BLE, potentiometer, and switch control, DimIn gives luminaire makers the freedom to choose wired precision, wireless flexibility, or simple manual control. And with built-in energy monitoring (DALI Parts 251, 252, 253), DimIn is EPBD 2024/1275 ready, ensuring seamless integration with BACS/BMS systems for energy reporting, diagnostics, and predictive maintenance.

### One platform Many applications

Platform	Table- or freestanding light 	Downlight 	Spotlight 	Pendent 	Medium size Opaque glass 	Big size Opaque glass 
Lilly80	X	X		X	X	
ADA60	X	X	X	X	X	
ADA76		X	X	(X)		
Sanna158				X	X	
Sanna158 HCL				X		
Sanna290				X		X
Sanna290 HCL				X		X

Application Area	Ideal DimIn + LED Module Combination	Benefits
Table or freestanding luminaires	Lilly80 / ADA60	Minimal footprint, easy retrofits, plug-and-play connectivity
Downlights	Lilly80 / ADA60 / ADA76	Smooth dimming, TW/HCL ready, no external driver needed
Spotlights & Pendants	ADA60 / ADA76	Compact and upgradeable – perfect for decorative fixtures
Medium opaque glass	ADA60 / Lilly80 / Sanna158 IoT	High lumen packages with consistent color quality. Can also be used with Human-Centric Lighting and Tunable White support via DALI-2 DT8.
Large opaque glass luminaires	Sanna290 AC IoT	Powerful output, ready for networked control and monitoring. Can also be used with Human-Centric Lighting and Tunable White support via DALI-2 DT8.

All application areas benefit from DimIn's energy-reporting capability, as each luminaire can become an EPBD-compliant monitoring point in a small zone, in line with LightingEurope recommendations.



## Article number structure

### DimIn

Article code	Article	Control Type	EPBD/BACS Ready	Functions
105656	DimIn DALI PHM126	DALI-2	No	DALI type 2 with 1 channel and PHM126
105766	DimIn DALI Memory PHM126	DALI-2 + Part 251/252/253	Yes	DALI type 2 with 1 channel and PHM126. Energy Monitoring <i>support (251, 252, 253)</i> for BACS/BMS
	DimIn DALI DT8 Memory PHM126	DALI-2 + Part 251/252/253 +TW/HCL	Yes	DALI type 2 with 2 channel and PHM126, TW/HCL + Energy Monitoring <i>support (251, 252, 253)</i> for BACS/BMS
105671	Dimin Casambi IoT2	BLE	No	Wireless Control
	Dimin Casambi IoT2	BLE + momentary switch	No	Wireless Control + external momentary switch
	Dimin Casambi IoT2	BLE	No	Wireless Control with 2 channel TW/HCL
105672	Dimin Casambi IoT2 External Antenna	BLE	No	Wireless Control + External Antenna
	Dimin Casambi IoT2 External Antenna	BLE	No	Wireless Control, 2 channel TW/HCL + External Antenna
105040	DimIn POT	Potentiometer	No	Potentiometer dimming internally in a luminaire
105652	DimIn Switch	Momentary Switch	No	Simple on/off + dimming

### Smart Control & Connectivity - Choose the Right Interface

Optoga's DimIn platform gives luminaire makers full freedom:

select DALI-2 for wired precision, Casambi BLE for wireless control, or manual modules for simple standalone luminaires.

Interface	Key Benefits	EPBD/BACS Readiness
<b>DALI-2</b>	Two-way communication, smooth dimming to 1 %, individual or group addressing	<b>Yes</b> - with DimIn DALI Memory (251/252/253)
<b>DALI-2 DT8</b>	Tunable White & HCL on a single address, scene transitions	<b>Yes</b> - IEQ-ready for EPBD 2024/1275
<b>Casambi BLE</b>	Wireless mesh control, OTA updates, works offline	<b>Yes</b> - bridgeable to BACS/BMS
<b>Potentiometer</b>	Direct manual dimming, on/off function	<b>No</b>
<b>Momentary Switch</b>	Simple push-button dimming, optional auto-off	<b>No</b>

This makes it easy to design future-proof luminaires: start with simple dimming or wireless control today, and upgrade to full EPBD-compliant monitoring later by adding a DimIn DALI Memory module.

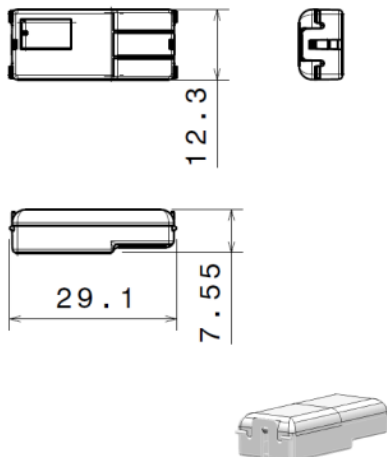
## Accessories

Article code	ARTICLE NAME	DimIn Potentiometer design	Information
105148	Dimin Potentiometer		<p>When the knob is rotated counterclockwise to the end position and you hear (and feel) the click, the resistance between the connectors is basically infinite because that position acts as an open switch.</p> <p>As soon as you turn it clockwise so that it clicks, the resistance becomes very low, 2-3 ohms. If you continue to turn clockwise, the resistance increases up to approx. 100 kOhm.</p>

## Package

Description	Qty (pcs)	Dimension (cm)			GW (kg)
		Length	Width	Height	
Inner box	74	35.6	22.7	9.6	0.5
Outer box	2304	46.5	37.5	39.6	TBD

## Dimensions DimIn Module





## Regulatory & Standards Alignment

Supports EU Fit for 55 climate package by enabling measurable efficiency improvements and lower CO<sub>2</sub>e per light point.

### EPBD 2024/1275

- Integrates with BACS for energy metering and control
- Supports EPBD task-based zoning and luminaire-level data granularity recommended by LightingEurope.
- Real-time data supports SRI assessments
- Tunable White and high CRI for IEQ requirements

### ESG & CSRD

- Energy history and operational data for sustainability reporting
- Contributes to reduced environmental impact through optimized lighting operation
- Operational data supports MEPS reporting via energy logs as referenced in EPBD implementation guidance.

### Standards

- IEC 62031, IEC 62471, EN 60598-1
- DALI-2 (Memory bank 251/252/253) testing under process
- RoHS III, REACH, POPs
- Contributes to IEQ and SRI performance through Tunable White (DT8), high CRI, daylight-ready dimming.

### EPBD Article 13 – DimIn Functional Mapping

<b>EPBD Article 13 requirement</b>	<b>DimIn functionality</b>
<b>Continuous monitoring</b>	Tc, power, runtime, system starts
<b>Energy reporting</b>	DALI 251
<b>Fault reporting</b>	DALI 253
<b>Operating hours</b>	DALI 252
<b>Interoperability (BACS/BMS)</b>	DALI-2 protocol, Memory banks



## EPBD Compliance Summary for DimIn

### EPBD requires luminaires to:

- Measure energy use (251)
- Log operating time and lifetime impact (252)
- Report diagnostics and faults (253)
- Provide temperature history for maintenance
- Communicate with BACS/BMS
- Support zoning at luminaire level

### DimIn enables EPBD compliance by:

- Providing real-time energy, temperature, runtime and diagnostics
- Acting as a BACS node at luminaire level
- Offering upgradeability for renovations and staged compliance
- Supporting SRI indicators through automatic control, feedback and TW/HCL
- Supplying MEPS-relevant operational data

## High-Resolution Analog Dimming

DimIn communicates dimming commands to the LED module at 10 kHz. The LED module converts these commands into a pure analog current regulation using amplitude modulation (AM), not PWM.

This architecture ensures flicker-free operation, stable low-level dimming and predictable electrical behaviour for energy measurement, device diagnostics and smart-building frameworks.

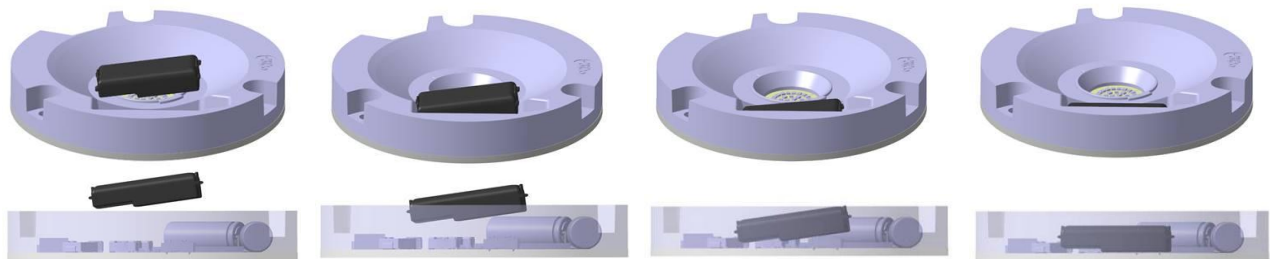
Analog regulation is executed entirely inside the LED module, ensuring consistent dimming performance across all DimIn variants (DALI, Casambi, Switch-Dim, POT).

## Mounting & Integration

DimIn is designed for direct plug-in connection to the LED module through a standardized interface – no additional brackets or adapters are required.

This ensures:

- No impact on luminaire design, same footprint, no redesign needed
- No loss of light output, full optical performance is maintained



## Integrated Power & IoT-Ready

In IoT versions, the AC driver is fully integrated into the LED module.

- **Direct mains connection**, no external driver needed
- **Integrated connector**, easy attachment of DimIn or other functional modules
- **Normal mode fallback**, if no module is attached, the LED module works as a standard dimmable light source

## Compliance & Performance

When a DimIn module is installed:

- **Smart control is activated**, enabling DALI, Casambi or other IoT functions
- **Real-time monitoring**, power, temperature and runtime data are reported
- **Eco-Design compliance**, flicker-free dimming across the entire range, meeting EU 2024 ( $SVM \leq 0.4$ ) requirements

## Flexible Installation

- **At production**: Luminaire manufacturers can pre-install DimIn for ready-to-ship smart luminaires
- **In the field**: Modules can be added later, enabling retrofit upgrades without rewiring
- **Supports EPBD** compliance in both new buildings (2028/2030) and renovations by enabling upgrade of existing luminaires with DALI Memory monitoring.



## Memory Bank Allocation & Responsibility Memorybank 251, 252, 253

Field / Parameter	Definition	Set by:
Device Manufacturer	Optoga	🔒 Optoga
Device Model	LED module model identifier	🔒 Optoga
Device Type	DALI Device Types (6, 50, 51, 52...)	🔒 Optoga
FW Version	DALI/DimIn firmware version	🔒 Optoga
HW Version	PCB hardware revision	🔒 Optoga
Manufacture Time	Production date (YY/WW)	🔒 Optoga
Rated Median Life	Declared lifetime (L80/B50 per EN 62722-2-1)	🔒 Optoga (locked)
Rated Median Starts	Declared lifetime in switching cycles	🔒 Optoga
CRI	Colour quality	🔒 Optoga
CCT	Colour temperature	🔒 Optoga
Nominal Input Power W	Nominal power of module	🔒 Optoga
Nominal Light Output lm	Nominal lumen output	🔒 Optoga
Minimum Dim Power W	Power at minimum dim level	🔒 Optoga
Luminaire Manufacturer	Name of luminaire manufacturer	🔑 Luminaire manufacturer
Luminaire GTIN	GTIN for luminaire	🔑 Luminaire manufacturer
Luminaire Serial	Luminaire serial number	🔑 Luminaire manufacturer
Luminaire Model / ID	Article number or project identifier	🔑 Luminaire manufacturer
Light Distribution / Colour	Light distribution, body colour	🔑 Luminaire manufacturer
Operating Time	Total time under power	🕒 DimIn
Lamp On Time	Total time in ON state	🕒 DimIn
System Starts	Number of power cycles	🕒 DimIn
Lamp Temperature (°C)	Maximum Tc (historical)	🕒 DimIn
Luminaire Maintenance	Recommended next service	🕒 DimIn / 🔑 Luminaire manufacturer
Device Diagnostics	Fault status, warnings	🕒 DimIn
Gear Status / Failure Counters	Real-time driver health data	🕒 DimIn
Lamp Status / Failure Counters	Real-time LED source status	🕒 DimIn
Active Energy (kWh)	Accumulated energy	🕒 DimIn
Active Power (W)	Instantaneous power	🕒 DimIn
Power Factor (%)	Cos $\phi$	🕒 DimIn
Output Current / Voltage	LED current and voltage	🕒 DimIn
Apparent Energy (VAh)	Calculated apparent energy	🕒 DimIn

### Explanation:

1. **LED Module** provides primary data (production info, Tc temperature, lumen output).
2. **Luminaire Manufacturer** download its customer data via the IoT interface on the LED Module
3. **DimIn** reads this data via I<sup>2</sup>C, logs runtime, energy and diagnostics, and stores in DimIn.
4. **DALI Network / Casambi** can read all standardized fields for asset management.
5. **BACS/BMS** uses this information for energy reports, predictive maintenance, and compliance with EPBD.
6. **EPBD/BACS integration:** All fields marked as DimIn responsibility form the mandatory dataset for EPBD Article 13 energy reporting, diagnostics and maintenance planning.



## Luminaire Maintenance

Luminaire Maintenance is an intelligent monitoring function that combines runtime counters, temperature history, and manufacturer-declared lifetime data (e.g. L80/B50 per EN 62722-2-1) to calculate the remaining useful life of the luminaire.

When the predicted end of life approaches, the system can automatically raise a maintenance flag, allowing service actions to be planned before failures occur.

### Key Benefits

- Enables predictive maintenance and minimizes unplanned downtime
- Optimizes service intervals and reduces unnecessary replacements
- Supports EPBD / BACS compliance by providing real-time maintenance data
- Contributes to EPBD-mandated maintenance transparency by providing standardized DALI-253 diagnostic logs.

### Luminaire Maintenance – Parameter Basis

Parameter	Purpose in Calculation
Rated Median Life	Baseline for expected lifetime (e.g. L80/B50 in hours)
Rated Median Starts	Baseline for expected number of switching cycles
Lamp On Time	Real-time counter of ON-state hours
Operating Time	Total time under power (used for thermal aging models)
Lamp Temperature (°C)	Historical Tc values for recalculation of remaining life
System Starts	Number of power cycles compared to Rated Median Starts

### Function Overview

- Algorithm: DimIn continuously compares measured values (Lamp On Time, Tc, System Starts) with the declared lifetime data.
- Trigger: When remaining life falls below a set threshold (e.g. <10%), a maintenance event is flagged.
- Notification: The event can be signaled either by a short dimming indication at power-up or by transmitting data via DALI Part 253 to a BACS/BMS system.
- EPBD role: Predictive maintenance data improves building operational efficiency and supports national MEPS documentation.

### Luminaire Maintenance – Smart Predictive Service

Luminaire Maintenance helps you plan service before failures occur.

By monitoring runtime, temperature and switching cycles, DimIn predicts when the luminaire will reach the end of its useful life and signals service needs – either visually or via the building’s BACS system.

- Fewer unexpected failures
- Optimized maintenance schedules
- Full compliance with EPBD/BACS requirements

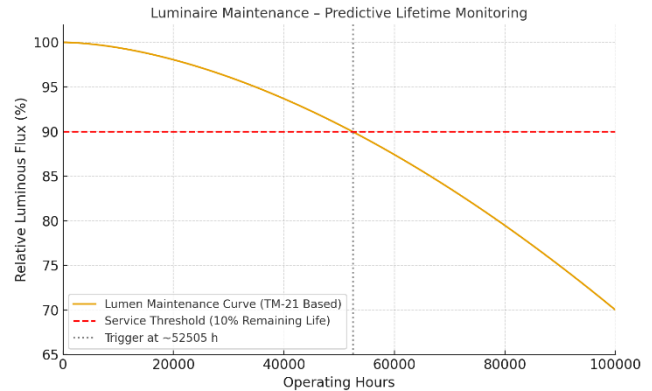
## Configuration & Algorithm Details

### Threshold Settings

The maintenance trigger level is configurable and not hardcoded.

- **Default setting:** 10 % remaining lifetime
- **Adjustable range:** 0 – 30 % (configurable via DALI Part 253 commissioning or Casambi network tools)
- **Adjustment point:** Can be set at the luminaire factory or later during project commissioning

This flexibility allows service intervals to be aligned with customer maintenance policies (e.g. coordinated with relamping cycles or facility shutdown periods).



### Lifetime Prediction Model

The remaining useful life calculation is based on:

- **TM-21 extrapolation curves** derived from LM-80 lumen maintenance data
- **Temperature derating models** using Tc history and thermal profile logging
- **Switching cycle impact**, comparing real System Starts with Rated Median Starts

This creates a **non-linear degradation curve**, reflecting the accelerated lumen depreciation that occurs near end-of-life.

### Firmware Customization

DimIn firmware can be updated to adjust:

- Weighting between runtime, temperature, and switching cycles
- The method of notification (visual indication vs. DALI Part 253 broadcast)
- Threshold values for predictive maintenance events

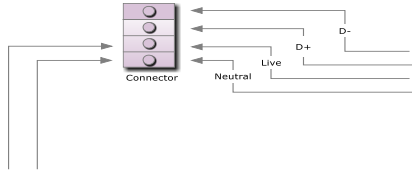
This ensures that luminaires remain compliant with EPBD and BACS requirements while providing realistic and actionable service alerts.

### Footnote

Optoga does not implement Output Lumen Compensation (OLC) in DimIn. Instead, we rely on real measured data (Tc, operating hours, power) to provide accurate lifetime predictions and service recommendations.

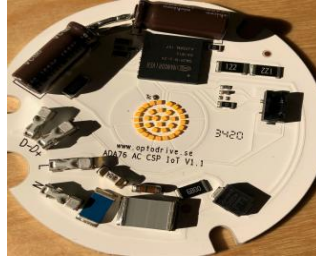
## Wiring for different DimIn versions

### Casambi



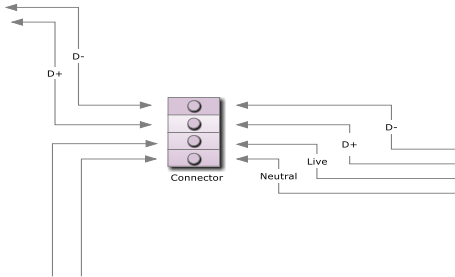
Incoming Wires 110/230VAC

LED Module with IoT (DimIn Casambi)



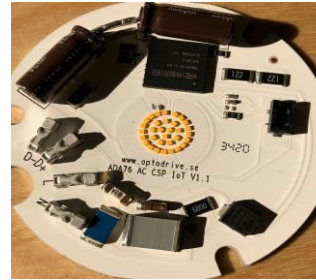
### DALI

DALI BUS Incoming



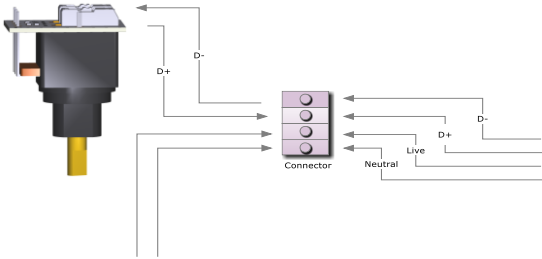
Incoming Wires 110/230VAC

LED Module with IoT (DimIn DALI)



### POT / Potentiometer

Potentiometer



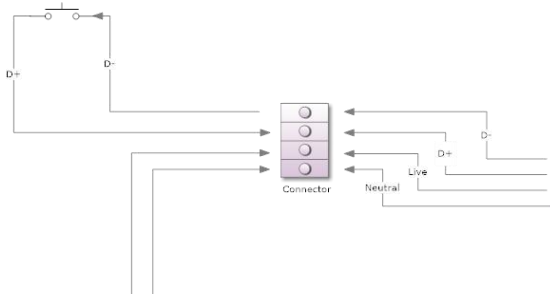
Incoming Wires 110/230VAC

LED Module with IoT (DimIn POT)



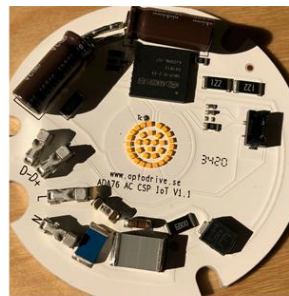
### Switch

Momentary Switch (Switch DIM)



Incoming Wires 110/230VAC

LED Module with IoT (DimIn Switch)





## Precautions for use

---

### Handling in regards to static electricity

- The Optodrive products have integrated circuits (IC) on board that may be damaged if exposed to static electricity. Please handle the products only while using equipment that prevents static electricity. Do not handle them without having ESD protection.
- The Optodrive products are not be installed into the end product without proper ESD protection.
- Optodrive LED Modules meet IEC61547:2009 and IEC61000-4-2. We recommend the light fixture manufacturer to take the mentioned standards under consideration.

### Storage before use

- Use only properly rated test equipment and tools for the rated voltage and current of the product being tested.
- It is strongly suggested to wear rubber insulated gloves and rubber bottom shoes while handling the product.
- Do not wear any conductive items (such as jewellery) which could accidentally contact electric circuits.
- Faults, lightning, or switching transients can cause voltage surges in excess of the normal ratings.
- Internal component failure can cause excessive voltages.
- Stored or residual electricity in long wire could be hazardous.

## ROHS III Compliant

---

All our LED modules meet the Restrictions of Hazardous Substances (RoHS III)!

There has been a growing consensus that Lead Free Systems should increase for the safety of our environment. It is a very serious problem that lead and other harmful materials are being used in commercial and industrial products, causing more and more environmental problems. This has led to regulations such as RoHS (Restriction of the use of certain Hazardous Substances) from the EU and the Japan Ministry of Trade and Industry (MITI). All LED module makers providing products to these countries should comply with these restrictions. In order to meet the RoHS III regulation, Optoga is strictly implementing a ban on lead and other hazardous materials in its products. This is in compliance with our responsibilities as good corporate citizens.

Design for Environment:

According to the EU-directive (RoHS III) the following substances must not be used in this product

Lead	(Pb)	Polybrominated diphenyl ethers	PBDE
Mercury	(Hg)	Bis(2-ethylhexyl) phthalate	DEPH
Cadmium	(Cd)	Butyl benzyl phthalate	BBP
Chromium	VI (Cr <sup>6+</sup> )	Dibutyl phthalate	DBP
Polybrominated biphenyls	PBB	Diisobutyl phthalate	DIBP

# Do you want to know more about benefits of OptoDrive LED?

Read more about OptoDrive at [www.optoga.com](http://www.optoga.com).

You can contact us via [info@optoga.com](mailto:info@optoga.com).

You can also call us on +46 (0)589 490 950.

## Optoga AB

Optoga was founded in November 2004 in Arboga, Sweden and has many years of experience in electronics design. The company develops and supplies LEDs and LED-module solutions for the lighting industry, vehicle manufacturers and electronics companies.

With the OptoDrive LED-module, Optoga has taken the initiative to replace strip lights, incandescent and halogen bulbs with LED-based sources.



Köpingsvägen 4 • SE-732 31 Arboga • SWEDEN

Tel +46 (0) 589 490 950

[info@optoga.com](mailto:info@optoga.com) • [www.optoga.com](http://www.optoga.com)

Copyright © 2025 Optoga AB. All rights reserved.