



## Datasheet

DS000676

# Belago1.1

## Dot-Pattern Infrared Illuminator

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### Abstract

The Belago1.1 infrared illuminator is the most compact dot-projector for stereoscopic imaging available today. It produces a high-contrast dot pattern that stereo-matching algorithms can use to mitigate the problem of lack of texture, and to produce high-accuracy depth maps.

Belago1.1 enables active stereoscopic imaging to be implemented on a variety of platforms, from robotics to mobile devices.

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# 1 General Description

## 1.1 Key Benefits & Features

Stereoscopic imaging systems often suffer from impaired performance when the scene lacks features: an example is a flat, smooth surface such as a wall. In such cases, the 3D information captured by stereoscopic imaging systems is typically incomplete or inaccurate. Furthermore, the search for features in the images often results in high computational loading.

**ams** has developed a unique, proprietary solution to this problem. The Belago1.1 infrared illuminator, the most compact dot-projector for stereoscopic imaging available today, produces a high-contrast dot pattern that stereo-matching algorithms can use to mitigate the problem of lack of texture, and to produce high-accuracy depth maps. The presence of the infrared pattern also reduces considerably the computational load imposed by the software, as it offers many features to facilitate matching of the left and right images.

Belago1.1 enables active stereoscopic imaging to be implemented on a variety of platforms, from robotics to mobile devices.

Belago1.1 provides a feedback loop, integrated on the lens, that allows monitoring of a lens or package damage by the operating platform.

Belago1.1 provides an improved non-periodic pattern for single IR illuminator camera configurations.

The benefits and features of Belago1.1, Dot-Pattern Infrared Illuminator for 3D Stereoscopic Imaging, are listed below:

**Figure 1:**  
**Added Value of Using Belago1.1**

Benefits	Features
Small package size	4.2 mm x 3.6 mm x 3.325 mm
Module height compatible with integration in mobile platforms	3.325 mm $\pm$ 0.05
Power efficient	High optical efficiency, high VCSEL efficiency
Easy component mounting	Standard lead-free solder reflow compatible
Randomized high density, high contrast dot pattern	Optimized for active stereo vision systems
Eye Safety interlock	Integrated feedback loop on the lens

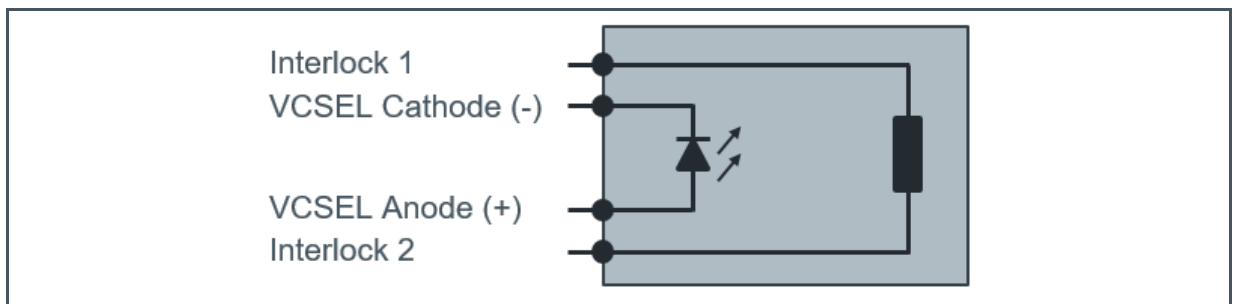
## 1.2 Applications

- Active stereo 3D sensors
- Integrated mobile 3D sensors
- Integrated tablets and all-in-one 3D sensors
- Front-facing and world-facing 3D cameras

## 1.3 Block Diagram

The functional blocks of this device are shown below:

**Figure 2 :**  
**Functional Blocks of Belago1.1**



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## 2 Ordering Information

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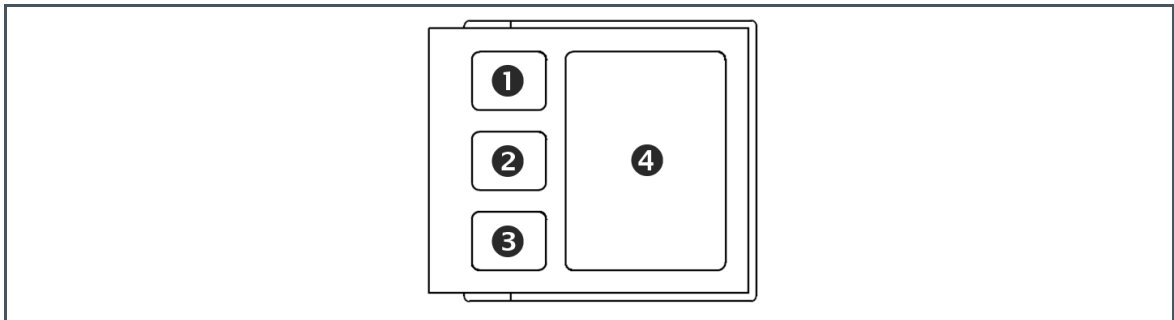
Ordering Code	Description	Delivery Form	Delivery Quantity
AQAA-20	Belago1.1 Dot Pattern Illuminator	Tray	490 pcs per tray

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## 3 Pin Assignment

### 3.1 Pin Diagram

Figure 3:  
Module Bottom View



### 3.2 Pin Description

Figure 4:  
Pin Description of Belago1.1

Pin Number	Pin Name	Description
1	Sense 1	Resistive Interlock connection
2	Anode	VCSEL Power
3	Sense 2	Resistive Interlock connection
4	Cathode	VCSEL Power

## 4 Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under “Operating Conditions” is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Figure 5**  
**Absolute Maximum Ratings of Belago1.1**

Symbol	Parameter	Min	Max	Unit	Comments
<b>Electrical Parameters</b>					
$V_F$	Forward Voltage		3	V	25 °C, Pulse >10 nsec
$I_F$	Forward Current		7	A	25 °C, Pulse >10 nsec
$I_{rev}$	Reverse Current		10	$\mu$ A	25 °C instantaneous
<b>Continuous Power Dissipation (<math>T_{Case} = 70\text{ °C}</math>)</b>					
$P_T$	Continuous Power Dissipation		1000	mW	Input power
<b>Temperature Ranges and Storage Conditions</b>					
$T_{STRG}$	Storage Temperature Range	- 40	80	°C	
$T_{Op}$	Operating Temperature	0	80	°C	IPC/JEDEC J-STD-020
MSL	Moisture Sensitivity Level		3		JESD22-A113D

## 5 Belago1.1 Specification

**Figure 6:**  
Individual Emitter Characteristics

Parameter	Condition	Min	Typ	Max	Unit
Horizontal FOI 50% (deg)	Full width half max.	57	61	65	deg
Vertical FOI 50% (deg)	Full width half max.	74	78	82	deg
Number of dots	@Camera FOV 56°x74°		4700		Dots
Contrast <sup>(1)</sup>		15			
Wavelength	@ 350 mA, 25 °C	932	940	948	nm
Spectral width	Full width half max @ 350 mA, 25 °C	0	1.5	3	nm
Wavelength shift with temperature			0.065	0.075	nm/°C
Thermal resistance	@100% duty cycle		26		K/W
Operating temperature	Heat sink temperature	10		60	°C
Storage temperature		-40		80	°C

(1) Contrast is defined as the ratio of the 95th percentile of the dot intensity over the median intensity of the background.

**Figure 7:**  
Other General Characteristics

Parameter	Value
Light Source	VCSEL
Pattern Rotation	15° ±1.5° (testing value)
Dimensions (X Y Z) (mm <sup>3</sup> )	4.2 x 3.6 x 3.325
Electrical Contacts	Anode, cathode and interlock on backside
Number of Electrical Contacts	1x cathode and 1x anode 2x sense
Assembly Type	Reflow compatible



## 6 Electrical Characteristics

All limits are guaranteed. The parameters with Min and Max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

**Figure 8:**  
**Electrical Characteristics of Belago1.1**

Symbol	Parameter	Conditions <sup>(1)</sup>	Min	Typ	Max	Unit
$I_{op1}$	Operating current	At RT, 10 ms / 30 fps		350		mA
$P_{op1}$	Operating power	At $I_{op}=350$ mA At RT, 10 ms / 30 fps	200	250	280	mW
$V_{op1}$	Operating voltage	At $I_{op}=350$ mA At RT, 10 ms / 30 fps	1.6		2.2	V
$I_{op2}$	Operating current	At RT, 1 ms / 30 fps		425		mA
$P_{op2}$	Operating power	At $I_{op}=425$ mA At RT, 1 ms / 30f ps	260	300	340	mW
$V_{op2}$	Operating voltage	At $I_{op}=425$ mA At RT, 1 ms / 30 fps	1.6		2.3	V
$PCE_{op}$	Operating PCE	At $I_{op}=350-425$ mA At RT, 1 ms / 30 fps	32	37		%
Duty cycle	PWM control			5	30	%
$R_{interlock}$	Resistance	At RT	10.8	13	21	kOhm
$t_{rise}$	Rise time				5	ns
$I_{th}$	Threshold current	At RT, CW	32		130	mA

- (1) Specified temperatures refer to the emitter case temperature (the emitter is mounted on a temperature-controlled stage); RT stands for Room Temperature (25 °C).
- (2) Pulsed operating condition as reference parameter set.

## 6.1 Typical Operating Characteristics

Figure 9:  
Electro-Optical Performance

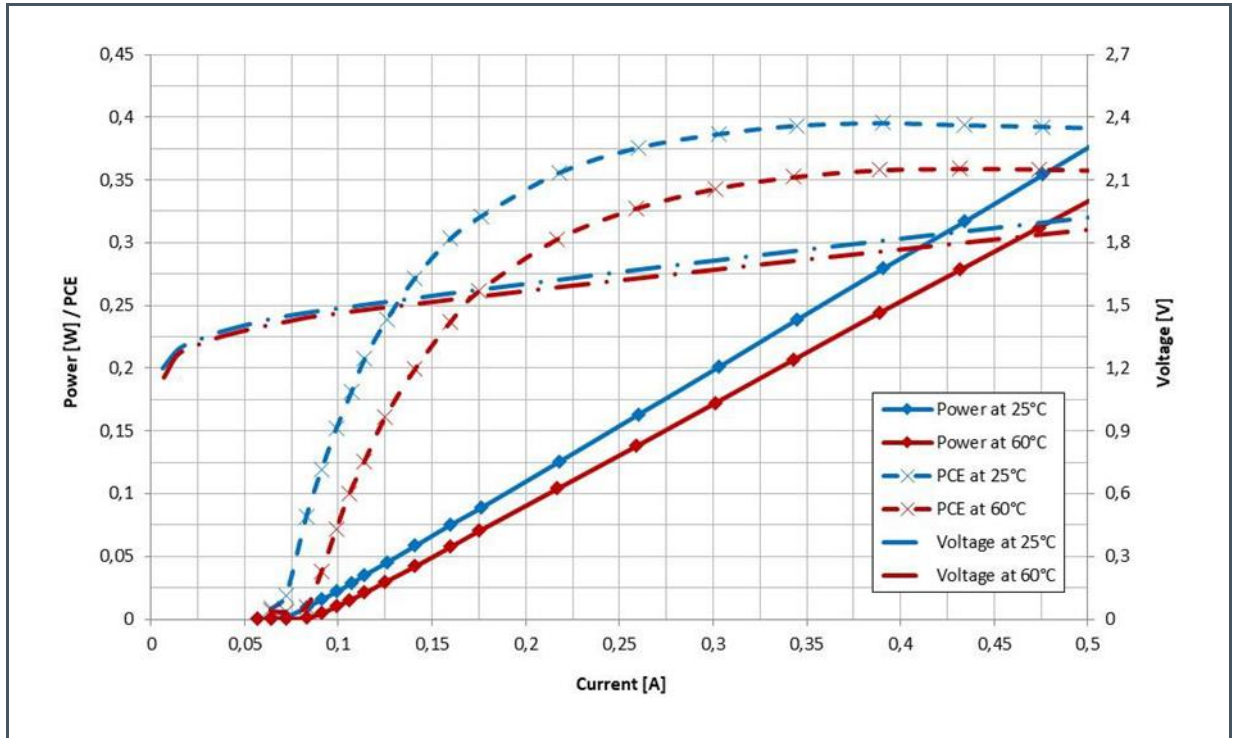
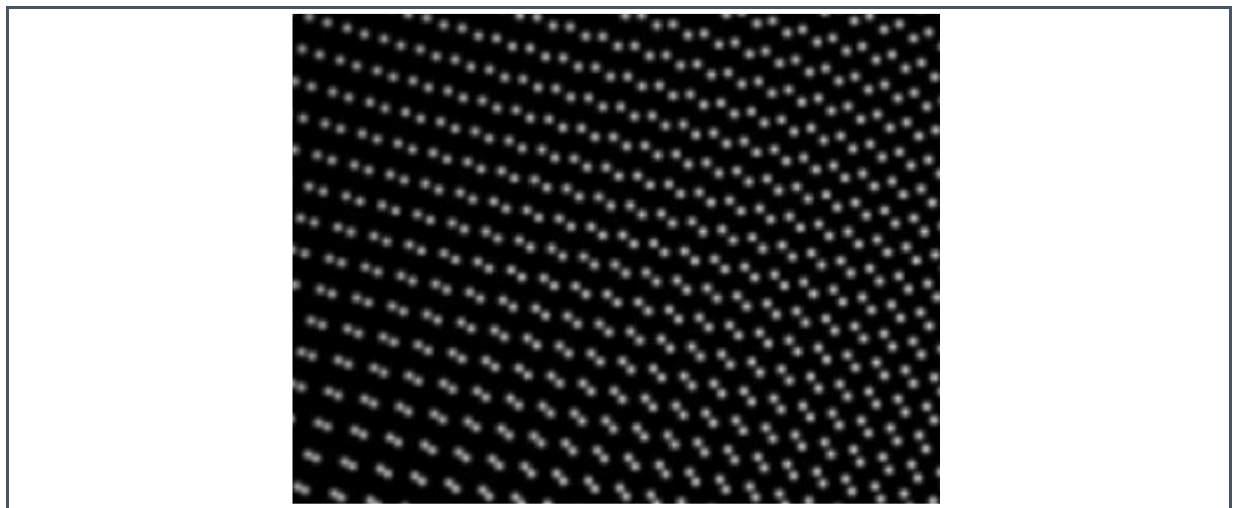


Figure 10:  
Projected Dot Pattern



(1) Projected dots pattern measured from Belago1.1 (cropped image showing a magnified section of the FOI)

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## 6.2 Imaging Setup

For the pattern characterization, the output is projected onto a white, matte-finished target board (Lambertian surface), at a distance. Images are taken inside a dark chamber with a monochrome CCD camera and a wide angle objective.

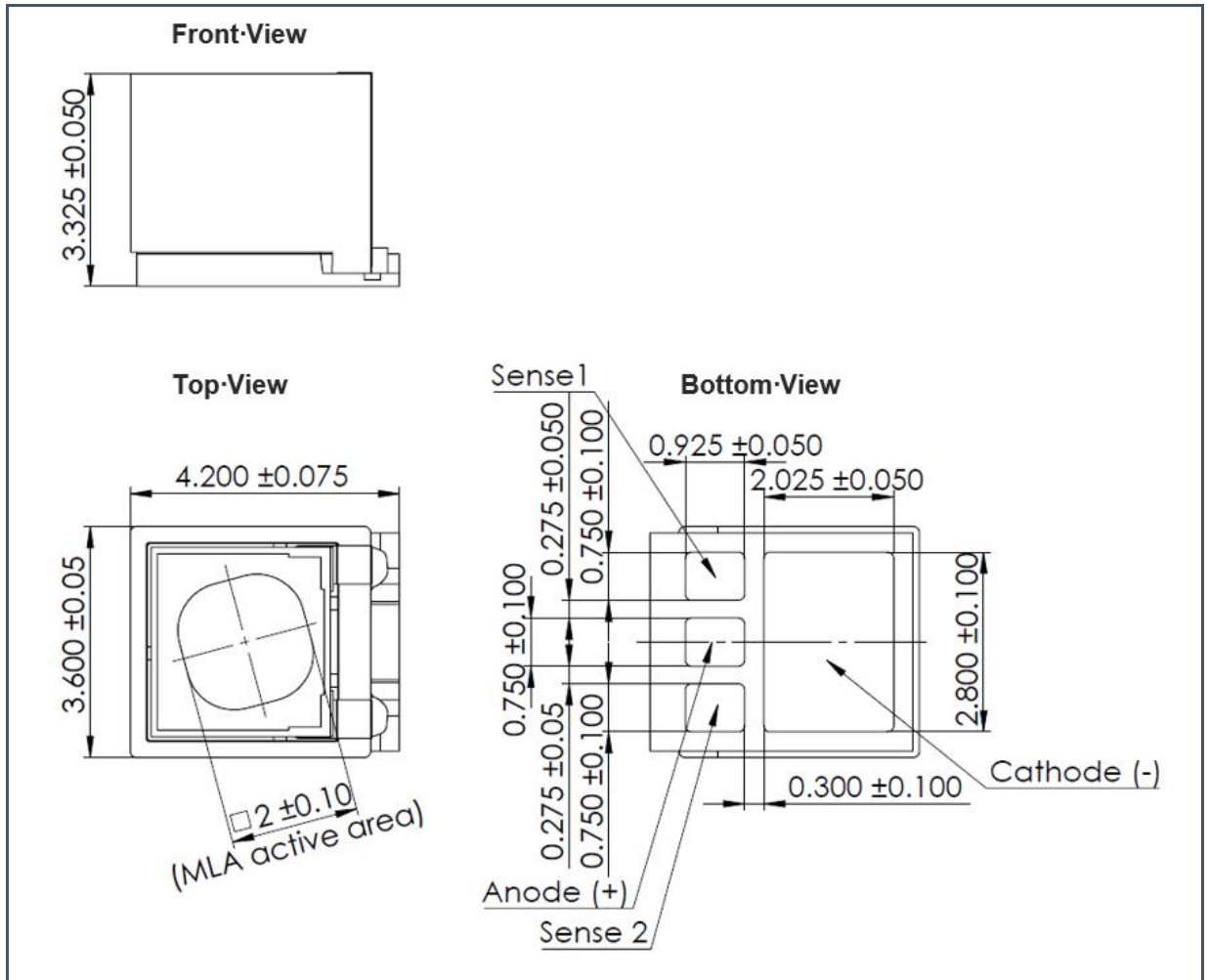
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## 6.3 Hotspot Detection

Every individual Belago1.1 module is inspected during production to detect the presence of hotspots and similar non-uniformities that cause excessive brightness of the infrared pattern and could be harmful to the human eye.

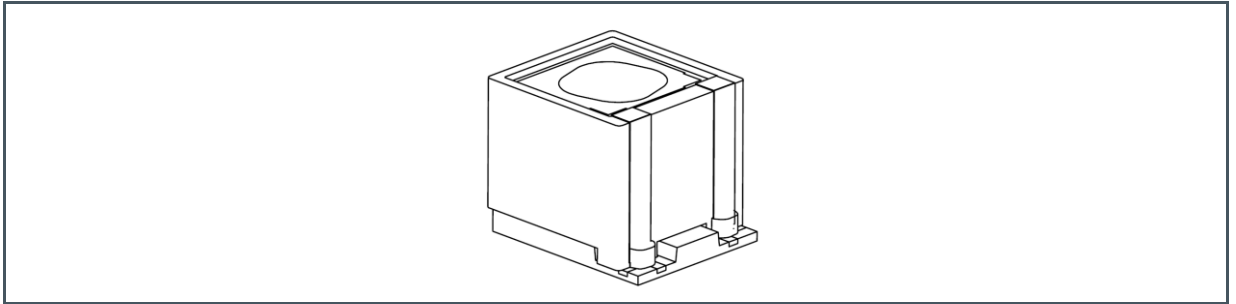
# 7 Mechanical Drawings

Figure 11:  
Package Dimensions

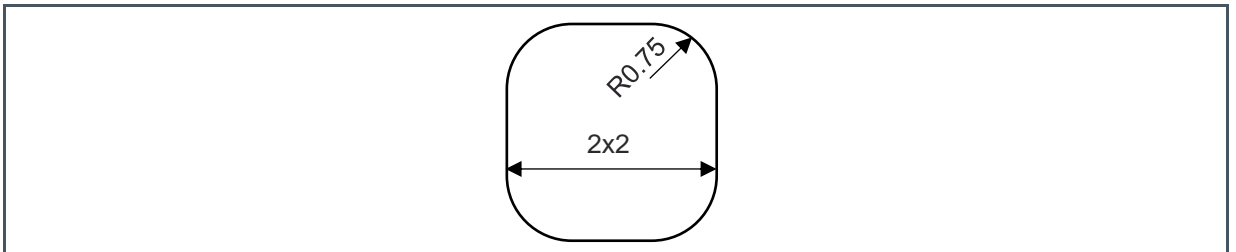


- (1) Outline dimensions Belago1.1
- (2) All dimensions in mm

**Figure 12:**  
3D View

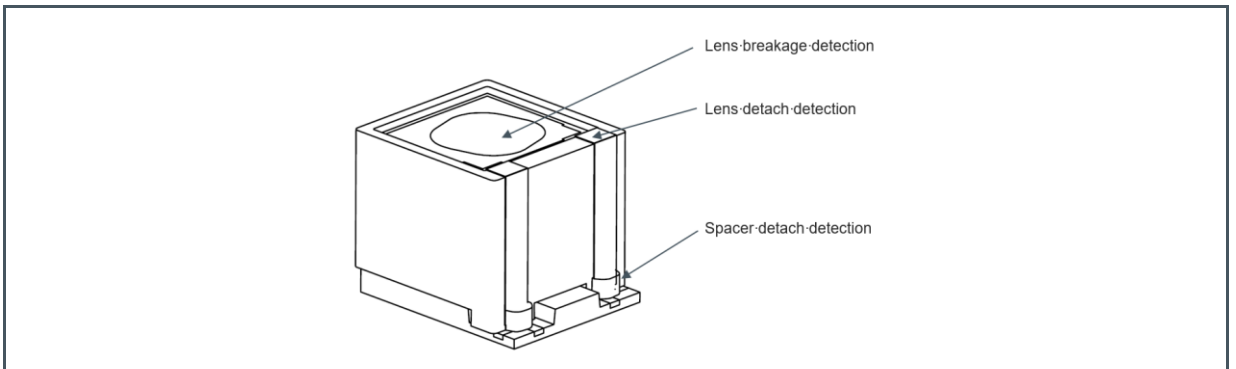


**Figure 13:**  
Optical Aperture



- (1) Optical aperture dimensions (defining the opening where the light is emitted through).
- (2) All dimensions in mm

**Figure 14:**  
Safety Interlock



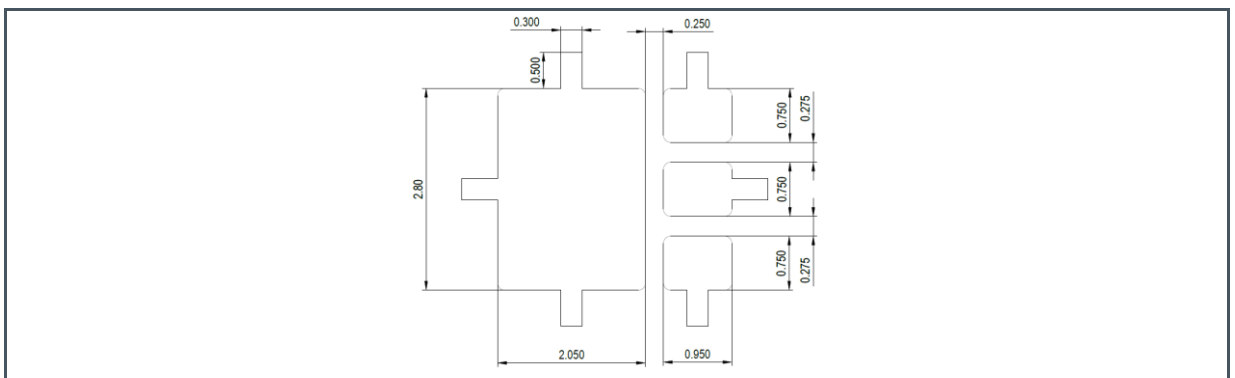
- (1) Conductive loop covering the optical active area of the lens and connecting to the bottom side pads for module integrity monitoring. A damage of the module results in an open circuit.
- (2) Resistance value should be in the specified range when module is operated, to ensure the functioning of the interlock

## 8 Application Information

### 8.1 PCB Pad Layout and Solder Mask Recommendation

The drawings below are showing a recommendation for pad layouts and solder mask. This is only to be used as guide and not to be considered as a firm specification.

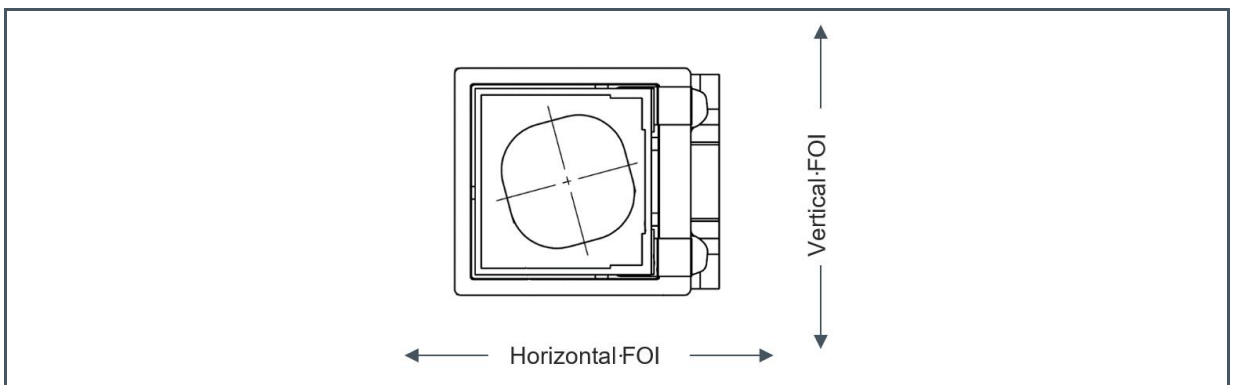
**Figure 15:**  
**Solder Mask Layout**



(1) All dimensions in mm

### 8.2 Orientation of the Field of Illumination

**Figure 16:**  
**FOI Orientation**

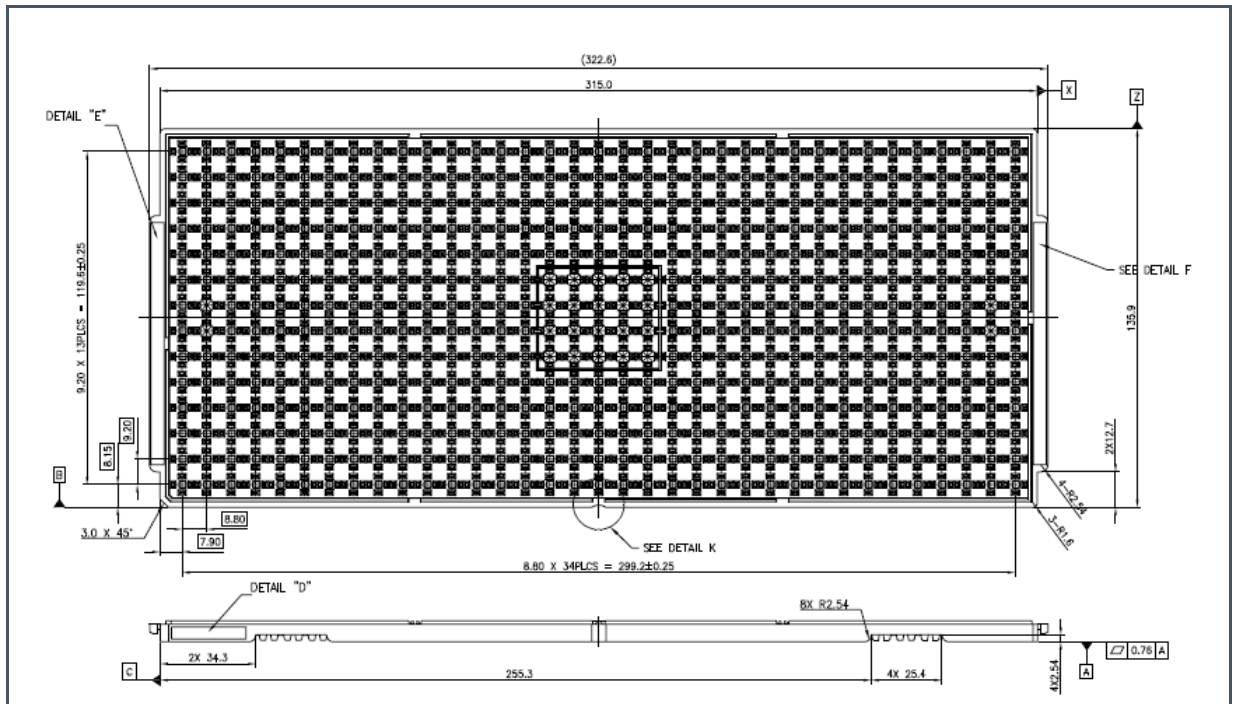


(1) Orientation of the Field of Illumination with respect to the Belago1.1 module.

# 9 Packing Information

## 9.1 Overview

Figure 17:  
Shipping Tray Dimensions and Overview



(1) All dimensions in mm

## 9.2 Tray Label

Trays are individually labeled. The label information is as follows:

- Part number (XXXX-XX)
- Tray ID
- Quantity
- Shipment date
- Manufacturing country

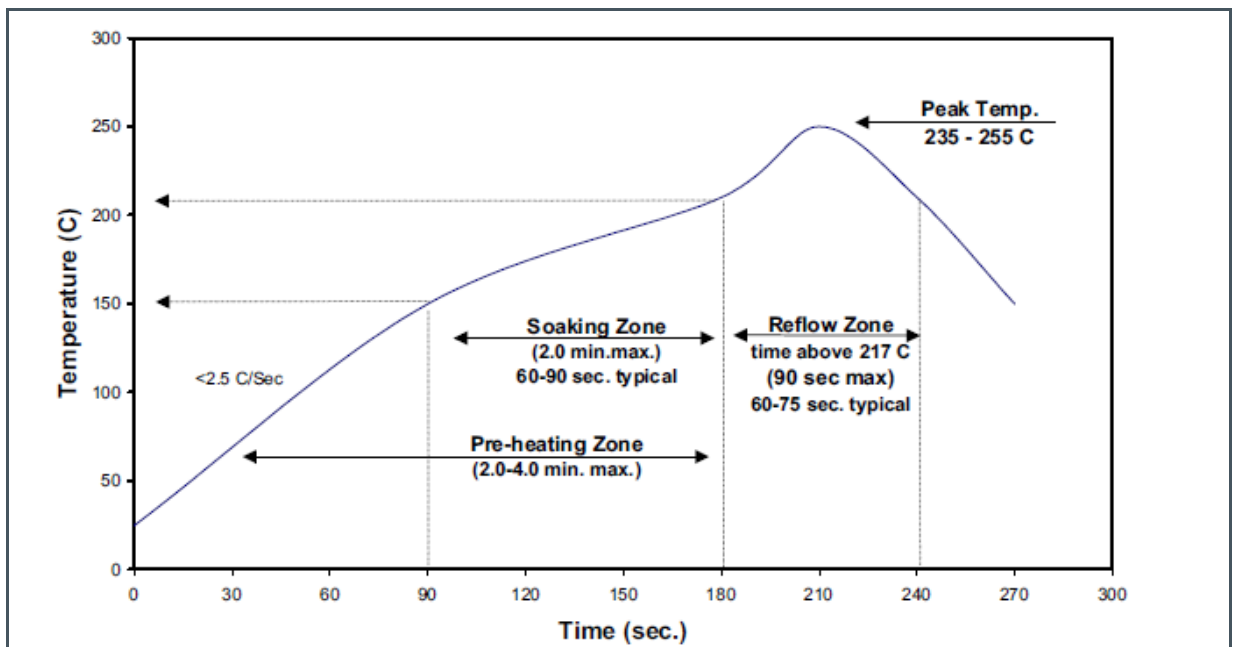
## 10 Soldering & Storage Information

Belago1.1 modules have been tested for lead-free solder reflow compatibility with peak temperatures up to 250 °C (MSL3).

An example reflow profile is provided in Figure 18. The exact reflow profile may depend on exact solder used.

An example of solder paste that can be used is Tamura LFSOLDER TLF-204-NH(20-38).

**Figure 18:**  
Solder Reflow Profile Graph



### Attention

The module contains a ventilation hole to allow pressure equalization with the ambient.

It is not advised to proceed to cleaning after SMT reflow process.

The modules **MUST NOT** be cleaned using ultrasonic cleaning.

We suggest to use flux free solder paste and not to clean after SMT.

In case a cleaning is un-avoidable, rinse with DI water, followed by a 2h bake @70 °C



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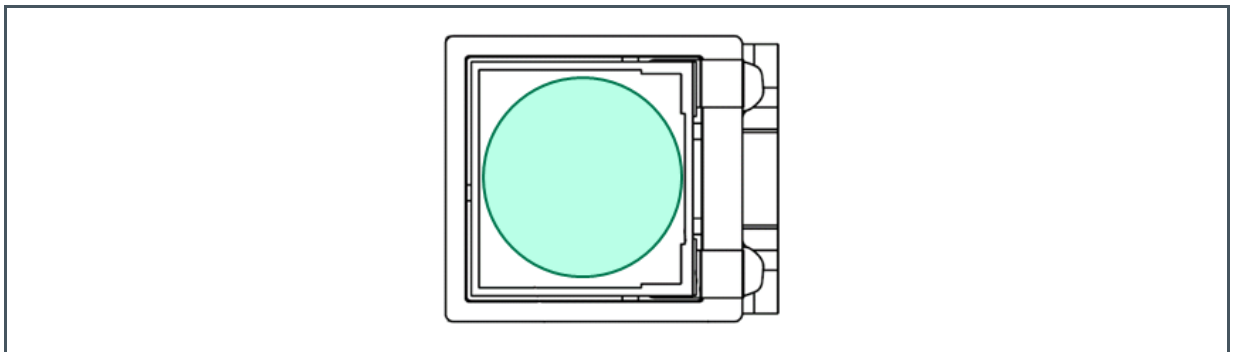
# 11 Handling

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## 11.1 Pick Up

Recommended pick up position on the top window (green circle), touching directly the glass.

**Figure 19:**  
**Pick Up Location**



(1) Picking area within green area

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## 12 Appendix

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### 12.1 RoHS & REACH Compliance

The Belago1.1 module is compliant with the European RoHS Directive 2002/95/EC (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) and REACH (Registration, Authorization and Restriction of Chemicals, European Union Regulation (EC) 1907/2006).

### 12.2 Safety Advice

Depending on the operational use of the device, the modules can emit highly concentrated non-visible infrared light, which can be hazardous to the human eyes. Products incorporating these modules may have to follow the safety precautions described by IEC 60825-1:2014.

This product emits infrared radiation and has not yet been classified under IEC 60825-1:2014. All appropriate safety precautions should be exercised in the operation and use of this product.



#### CAUTION

Avoid direct eye exposure except as may be determined and directed by Purchaser.  
Appropriate protective eyewear should be worn when operating.  
Use of magnifying optical instruments with this component may increase eye hazard.



**LASER PRODUCT**  
**LASER RADIATION – AVOID DIRECT EYE EXPOSURE**  
**WAVELENGTH: 940nm**  
**MAXIMUM OUTPUT POWER: Depends on drive mode**  
**WEAR PROTECTIVE GLASSES**



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