



Datasheet

DS000618

BELICE-850

Dot-Pattern Infrared Illuminator for 3D Stereoscopic Imaging

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Abstract

The BELICE infrared illuminator is the most compact dot-projector for stereoscopic imaging available today. It produces a very 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.

BELICE 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, however, 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.

Now ams has developed a unique, proprietary solution to this problem. The BELICE infrared illuminator, the most compact dot-projector for stereoscopic imaging available today, produces a very 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.

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

The benefits and features of BELICE-850, Dot-Pattern Infrared Illuminator for 3D Stereoscopic Imaging, are listed below:

Figure 1:
Added Value of Using BELICE-850

| Benefits | Features |
|---|--|
| Small package size | 3.4mm x 3.5mm x 3.56mm |
| Module height compatible with integration in mobile platforms | 3.56mm \pm 0.1 |
| Power efficient | High optical efficiency, high VCSEL efficiency |
| Easy component mounting | Standard lead-free solder reflow compatible |
| High contrast dot pattern | Optimized for active stereo vision |

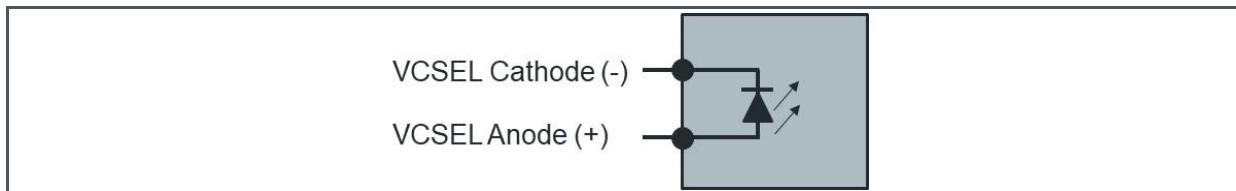
1.2 Applications

- 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 BELICE-850



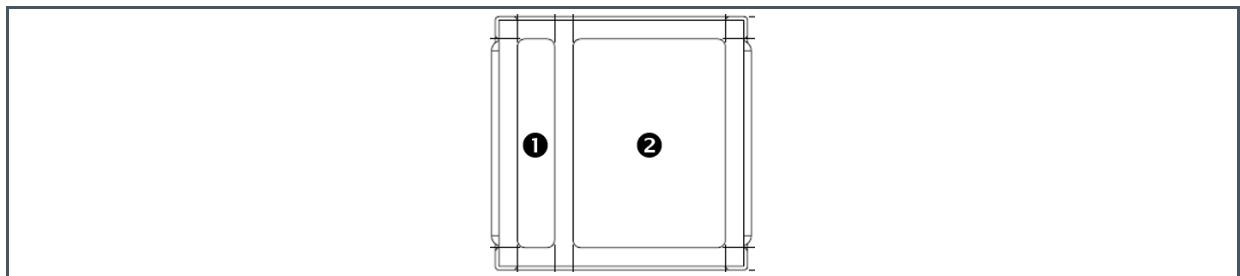
2 Ordering Information

| Ordering Code | Description | Delivery Form | Delivery Quantity |
|---------------|---|---------------|-------------------|
| APDE-00 | Emitter type A with 5° pattern rotation / SMT contacted | Tray | 143 pcs/tray |
| APDB-00 | Emitter type B with 15° pattern rotation / SMT contacted | Tray | 143 pcs/tray |

3 Pin Assignment

3.1 Pin Diagram

Figure 3:
Module Bottom View



3.2 Pin Description

Figure 4:
Pin Description of BELICE-850

| Pin Number | Pin Name | Description |
|------------|----------|-------------|
| 1 | Anode | VCSEL Power |
| 2 | 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 BELICE-850

| Symbol | Parameter | Min | Max | Unit | Comments |
|---|------------------------------|------|-----|---------|---------------------|
| Electrical Parameters | | | | | |
| V_F | Forward Voltage | 3 | | V | 25°C, Pulse >10nsec |
| I_F | Forward Current | 7 | | A | 25°C, Pulse >10nsec |
| I_{rev} | Reverse current) | 10 | | μ A | 25°C instantaneous |
| Continuous Power Dissipation ($T_{Case} = 70$ °C) | | | | | |
| P_T | Continuous Power Dissipation | 1000 | | mW | input power |
| Temperature Ranges and Storage Conditions | | | | | |
| 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 Belice Specification

Figure 6:
Individual Emitter Characteristics

| Parameter | Condition | Min | Typ | Max | Unit |
|-----------------------------------|-----------------------------------|------|-------|-------|-------|
| Horizontal FOI 50% (deg) | Full width half max. | | 71 | | deg |
| Vertical FOI 50% (deg) | Full width half max. | | 51 | | deg |
| Number of dots | @ Camera FOV 68°x48° | 5500 | 5700 | 5900 | Dots |
| Contrast ⁽¹⁾ | | 10 | 13 | | |
| Wavelength | @ 350mA, 25°C | 842 | 850 | 858 | nm |
| Spectral width | Full width half max @ 350mA, 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 | | 85 | °C |

⁽¹⁾ Contrast is defined for a single emitter grid, as the ratio of the 95th percentile of the dot intensity over the median intensity of the background.

Figure 7:
Other General Characteristics (pair of emitters)

| Parameter | Value |
|--|---|
| Light Source | VCSEL |
| Pattern Rotation | Type A (5°) ±1.5° (testing value) |
| Each element of a BELICE pair | Type B (15°) ±1.5° (testing value) |
| Dimensions (X Y Z) (mm3) (Single emitter) | Type A/B 3.5 x 3.4 x 3.56 |
| Electrical contacts | Type A/B Anode and cathode on backside |
| Number of electrical contacts | 1x cathode and 1x anode |
| 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.

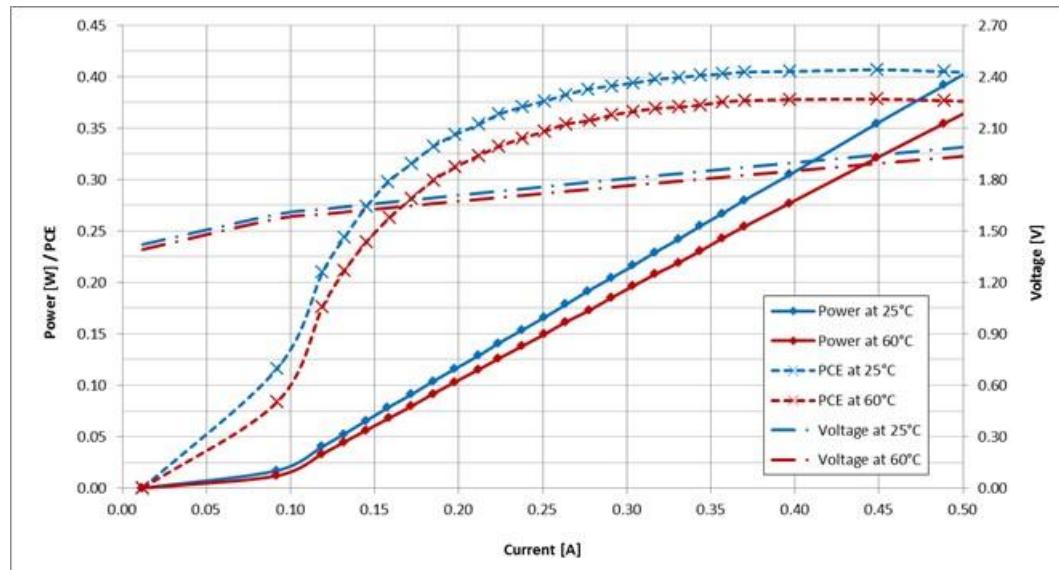
Figure 8:
Electrical Characteristics of BELICE-850

| Symbol | Parameter | Conditions ⁽¹⁾ | Min | Typ | Max | Unit |
|------------|-------------------|---------------------------|-----|-----|-----|------|
| I_{op} | Operating current | Entire temp. range, CW | | 350 | | mA |
| P_{op} | Operating power | At RT, CW | 200 | 250 | 280 | mW |
| V_{op} | Operating voltage | Entire temp. range, CW | 1.6 | 1.9 | 2.3 | V |
| PCE_{op} | Operating PCE | Entire temp. range, CW | 28 | 37 | | % |
| Duty cycle | PWM control | | | 5 | 100 | % |
| t_{rise} | Rise time | | | | 10 | ns |
| I_{th} | Threshold current | At RT, CW | 60 | 88 | 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)

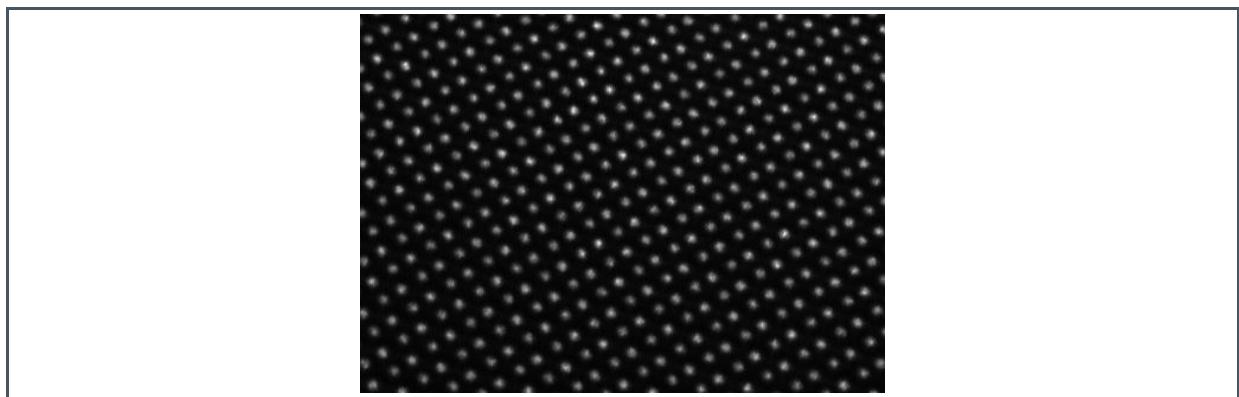
6.1 Typical Operating Characteristics

Figure 9 :
Electro-Optical Performance



(1) Typical Light - Current – Voltage and PCE (Power Conversion Efficiency) Characteristics of single BELICE configuration versus temperature. Measured at continuous operation, mounted on Cu block.

Figure 10:
Projected Dot Pattern



(1) Projected dots pattern measured from BELICE (cropped image showing the central portion of the FOI)

6.2 Imaging Setup

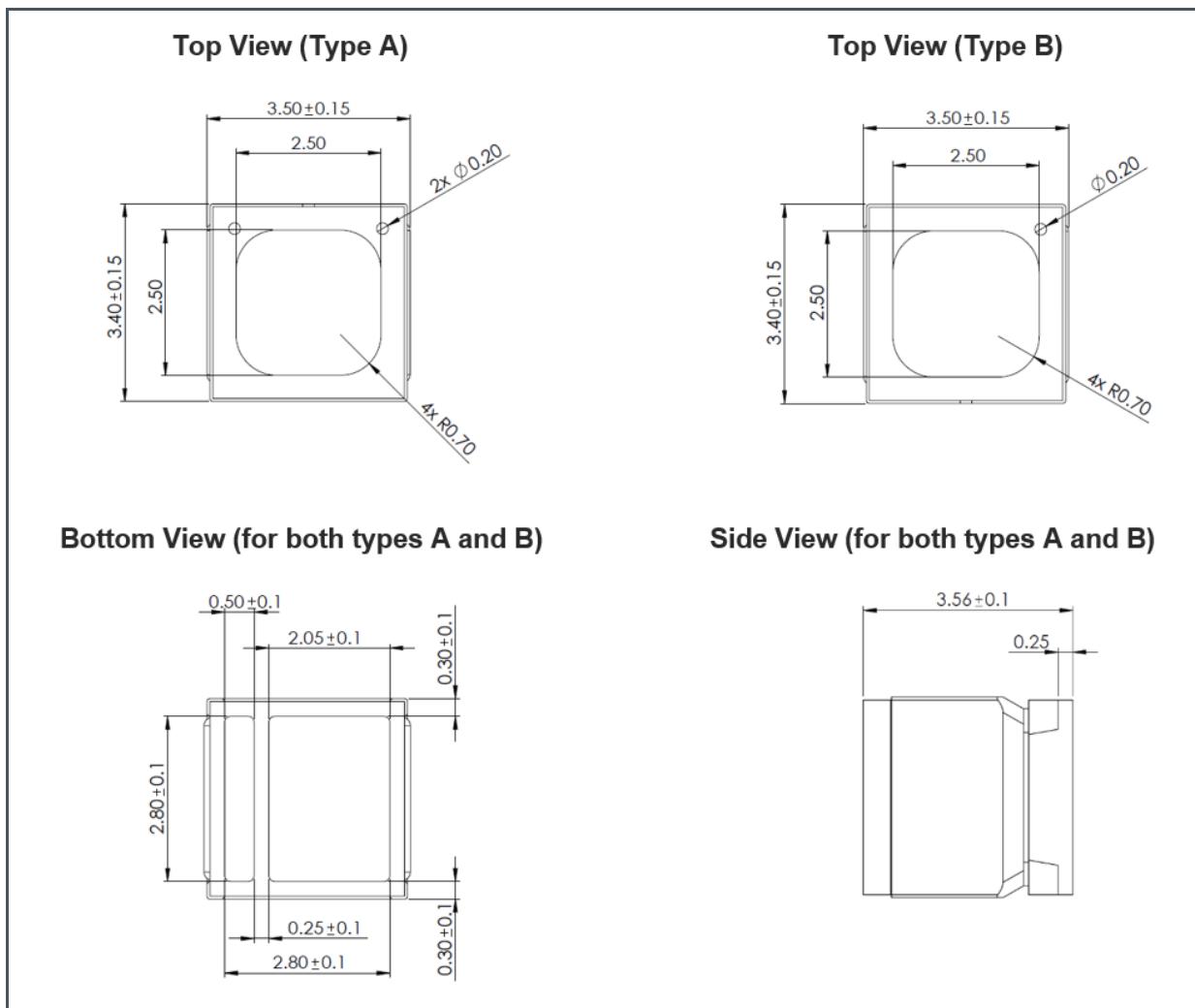
For the pattern characterization, the output is projected onto a white, matte-finished target board (Lambertian surface), at a distance. Images are taken inside a dark chamber with a monochrome CCD camera and a wide angle objective.

6.3 Hotspot Detection

Every individual BELICE emitter 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.

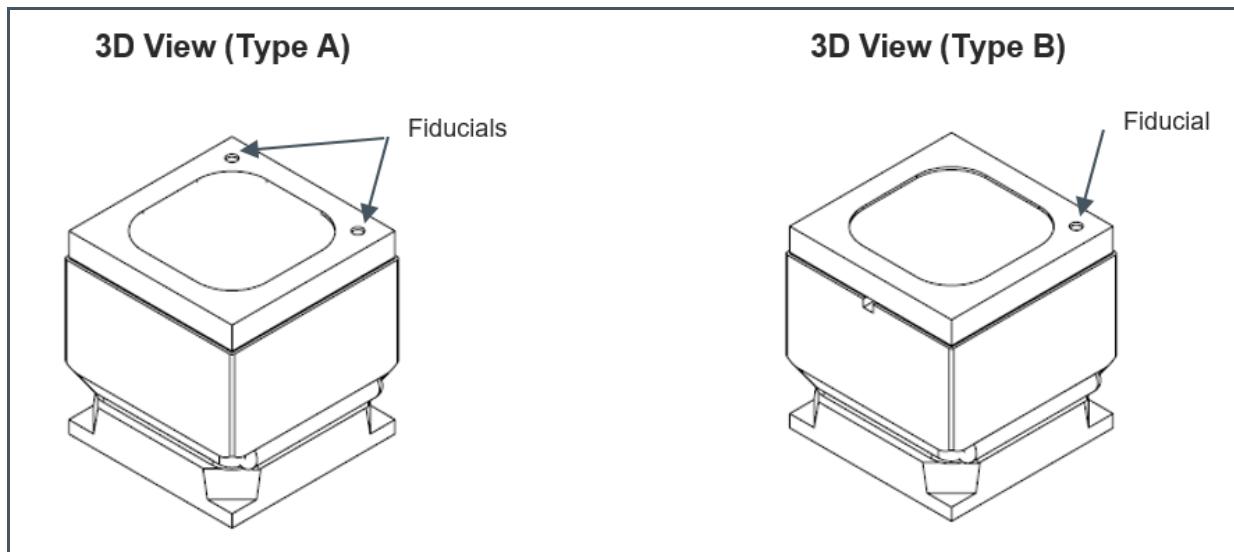
7 Mechanical Drawings

Figure 11:
Package Dimensions



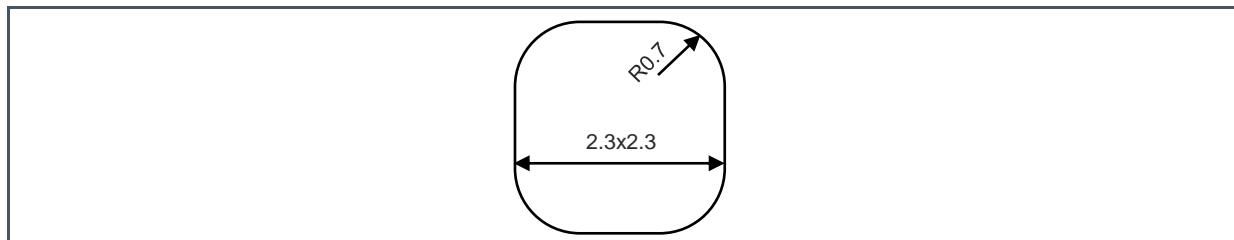
(1) Outline dimensions of individual BELICE emitters Type A and B
(2) All dimensions in mm

Figure 12:
3D View



(1) 3D view with Fiducials for distinguishing between type A and B

Figure 13:
Optical Aperture



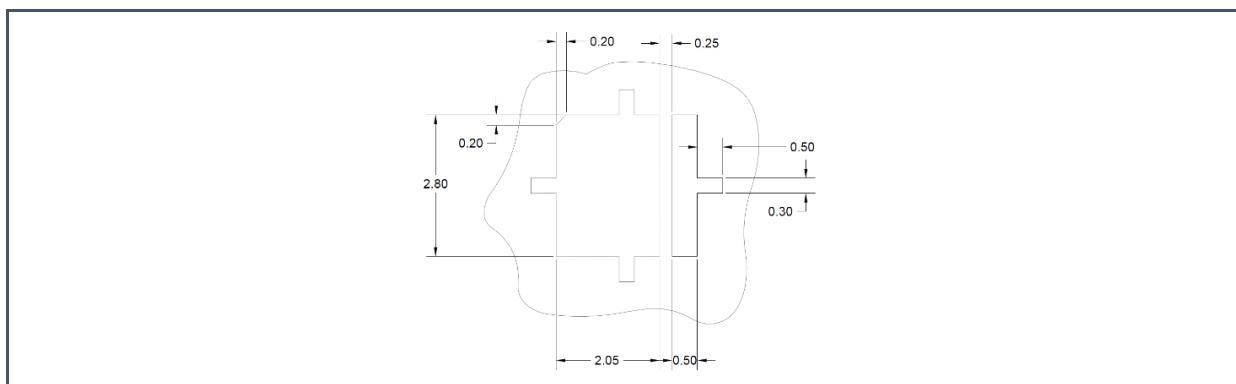
(1) Optical aperture dimensions (defining the opening where the light is emitted through)
(2) All dimensions in mm

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.

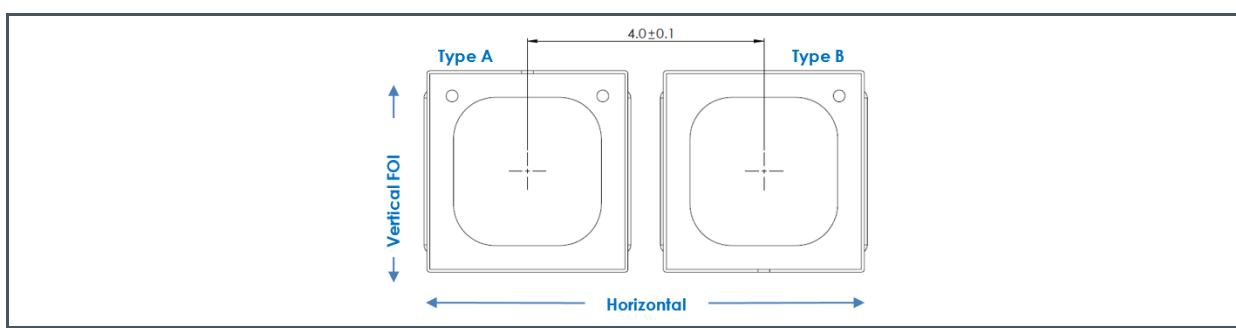
Figure 14:
Solder Mask Layout Type A/B



(1) All dimensions in mm

8.2 Orientation of the Field of Illumination

Figure 15:
FOI Orientation



(1) Orientation of the Field of Illumination with respect to the BELICE emitter pair (the Horizontal direction of the FOI is to be aligned to the stereo camera pair axis). Recommended assembly of the two emitters forming BELICE (top view). One emitter is Type A, the other Type B. Note that the recommended nominal spacing between the two emitter lens centers is $4\text{mm} \pm 0.1$

Figure 16:
Alignment of BELICE-850 Modules

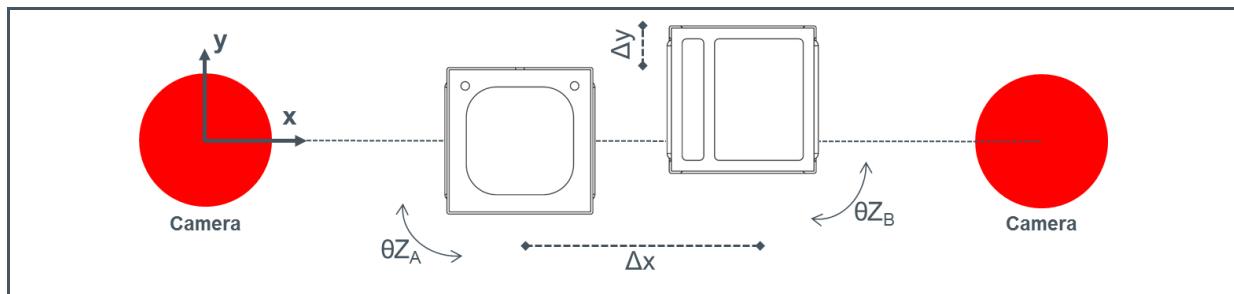


Figure 17:
Alignment Requirements for BELICE-850

| Parameter | Tolerance | Conditions | Unit |
|-------------------|------------------|--|------|
| Δx | Not critical | | mm |
| Δy | Not critical | | mm |
| Δz | Not critical | | mm |
| Θx | Not critical | | deg |
| Θy | Not critical | | deg |
| Θz Top | $\pm 2^\circ$ | When aligned to Top side fiducials ⁽³⁾ (emitting aperture) (Recommended) | deg |
| Θz Bottom | $\pm 0.85^\circ$ | When aligned to Bottom side fiducials ⁽³⁾ (edges of anode and cathode Cu pad) | deg |

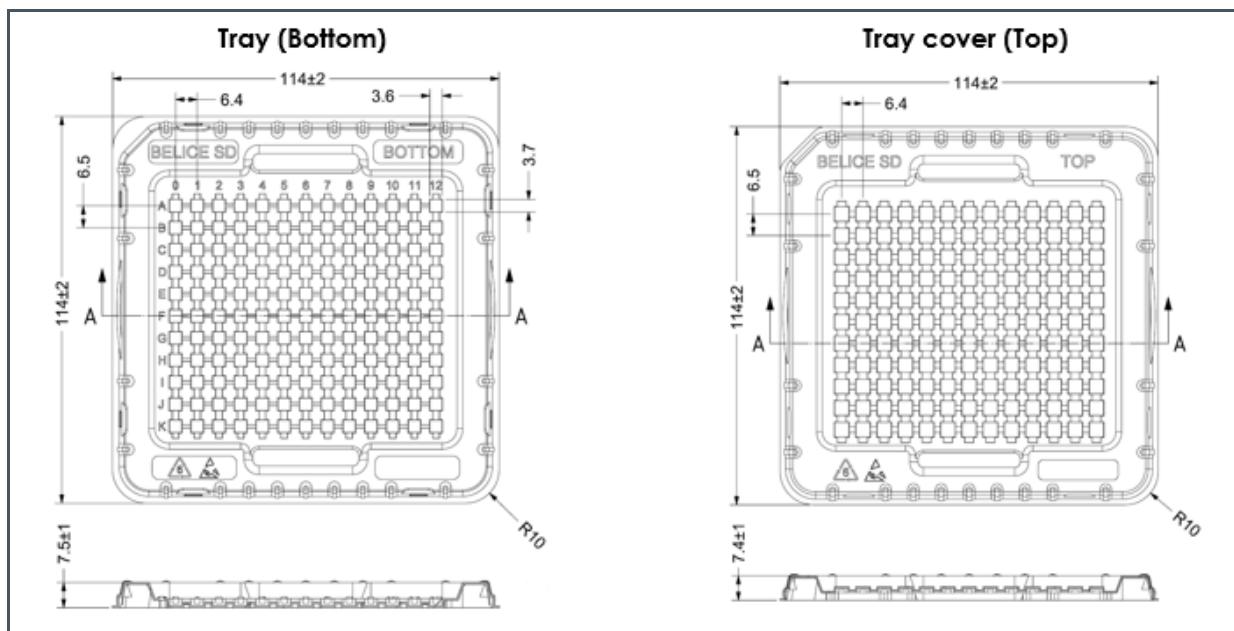
- (1) Orientation of the Field of Illumination with respect to the BELICE emitter pair (the Horizontal direction of the FoI is to be aligned to the stereo camera pair axis). Recommended assembly of the two emitters forming BELICE (top view). One emitter is Type A, the other Type B. Note that the recommended nominal spacing between the two emitter lens centers is $4\text{mm} \pm 0.1$
- (2) After assembly, the rotation (Θz) of the BELICE module with respect to the horizontal axis of the stereo camera pair should be within the tolerance in the above table.
- (3) Do not use the outer module outline as reference for alignment. Use the features mentioned in the table
- (4) Fiducials to be referred to:
 - Top Side: round dots which are used to differentiate between type A and B, the baffle opening or the Cr aperture.
 - Bottom Side: Lead frame edges of anode and cathode Cu pad.

9 Packing Information

9.1 Overview

Sampling Shipments: The modules are shipped in trays (Material: PS Natural, 0.8mm).
MP Shipping: The modules are shipped in JEDEC trays

Figure 18:
Shipping Tray Type A and B Dimensions and Overview



9.2 Tray Label

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

- Part number (XXXX-XX) & Type A/B
- Tray ID
- Quantity
- Shipment Date
- Manufacturing country

The underlined items are included in the bar code

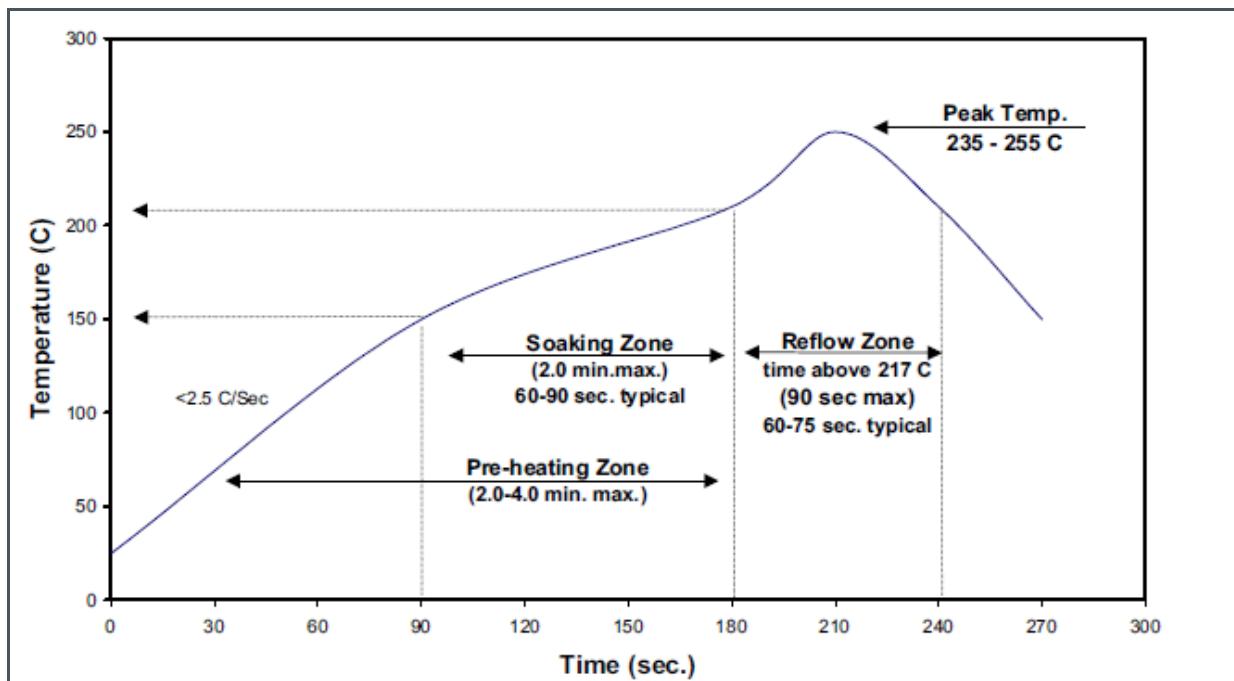
10 Soldering & Storage Information

BELICE 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 19. 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 19:
Solder Reflow Profile Graph



Attention

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.

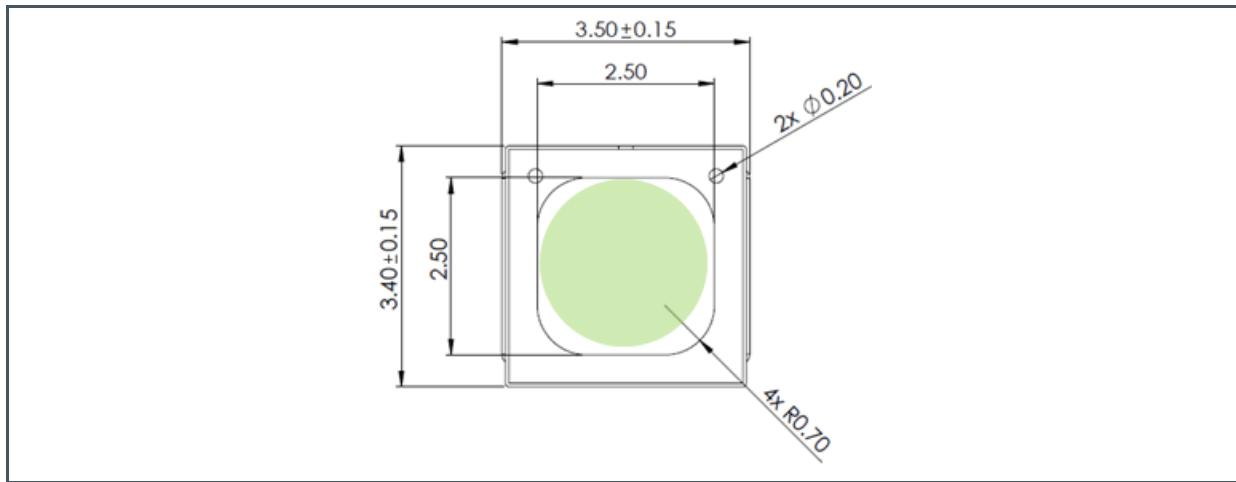
In case a cleaning is un-avoidable, rinse with DI water, followed by a 2h bake @70°C.

11 Handling

11.1 Pick Up

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

Figure 20:
Pick Up Location



(1) Picking area within green area

12 Appendix

12.1 RoHS & REACH Compliance

The BELICE 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 and IEC 62471.

This product emits infrared radiation and has not yet been classified under IEC 60825-1. 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: 850nm
MAXIMUM OUTPUT POWER: Depends on drive mode
WEAR PROTECTIVE GLASSES

13 Revision Information

| Document Status | Product Status | Definition |
|--------------------------|-----------------|--|
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