

Product Document



Datasheet

DS001030

TARA2000-940-W-AUT-SAFE

Automotive Infrared VCSEL Illuminator With On-Diffuser Eye Safety Mechanism

v3-00 • 2023-Jun-20

Abstract

The TARA2000-940-W-AUT-SAFE is a small form factor surface mount infrared laser illuminator enabling 2D and 3D use cases on a variety of platforms for in-cabin sensing applications. The integrated eye safety feature is an interlock resistive layer on the diffuser used to ensure the detection of the glass crack or detach.

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1 General Description

1.1 Key Benefits & Features

The TARA2000-940-W-AUT-SAFE module is specifically designed for monochromatic, infrared, high-efficient and uniform illumination.

The compact modules are assembled with ams OSRAM state-of-the-art component manufacturing processes and are reflow solderable. These modules, using laser illumination, allow improved efficiency, reduced footprint, and overall improved system performance.

Figure 1:
Added Value Overview

Features	Benefits
Edge-to-Edge high-power illumination over a rectangular field	Uniform power distribution
Interlock layer on the diffuser	Integrated eye safety feature for glass detach and crack detection
Low spectral bandwidth and temperature drift	Robustness against sunlight
<1 ns fall and rise time	High modulation frequency for high resolution iToF systems
AEC-Q102 – Grade 1 standard	High reliability and robustness
ASIL A and ISO26262 compliant	Functional safety compliance
2D barcode on the diffuser	Full traceability for easy data back tracking
4.0 mm x 4.0 mm x 1.21 mm ±0.100 mm	Reduced footprint on PCB
Standard lead-free solder reflow compatible	Easy component mounting

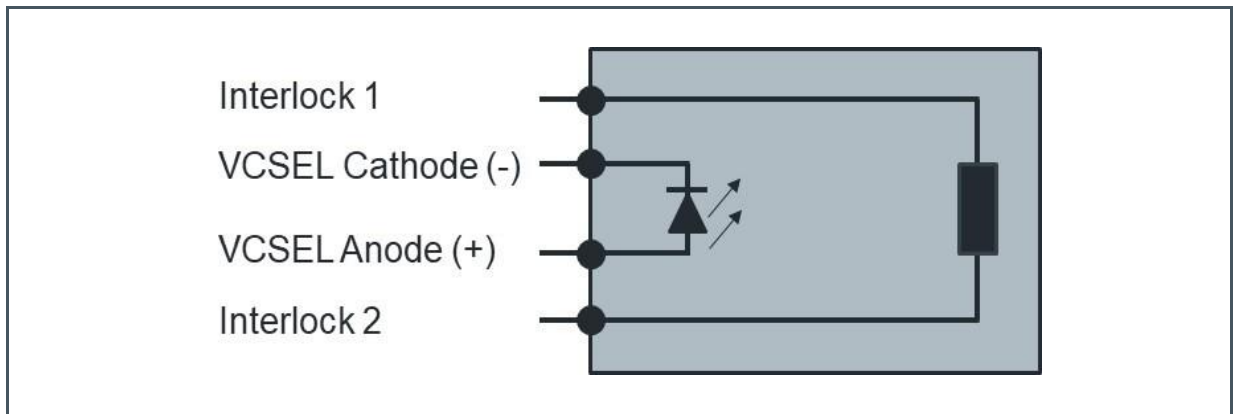
1.2 Applications

- Illumination for 2D Near-Infrared Cameras and 3D Time-of-Flight for in-cabin sensing
- Interior monitoring
- Driver/Passenger monitoring
- Gesture sensing

1.3 Block Diagram

The functional block of this device is shown below:

Figure 2:
Functional Block of TARA2000-940-W-AUT-SAFE



1.4 Other General Characteristics

Some additional features of this device are shown below:

Figure 3:
Additional Characteristics

Parameter	Value
Light Source	VCSEL
Electrical Contacts	Anode/Cathode/Interlock on backside
Number of Electrical Contacts	1x Cathode, 1x Anode, 2x Interlock
Assembly Type	Reflow Compatible

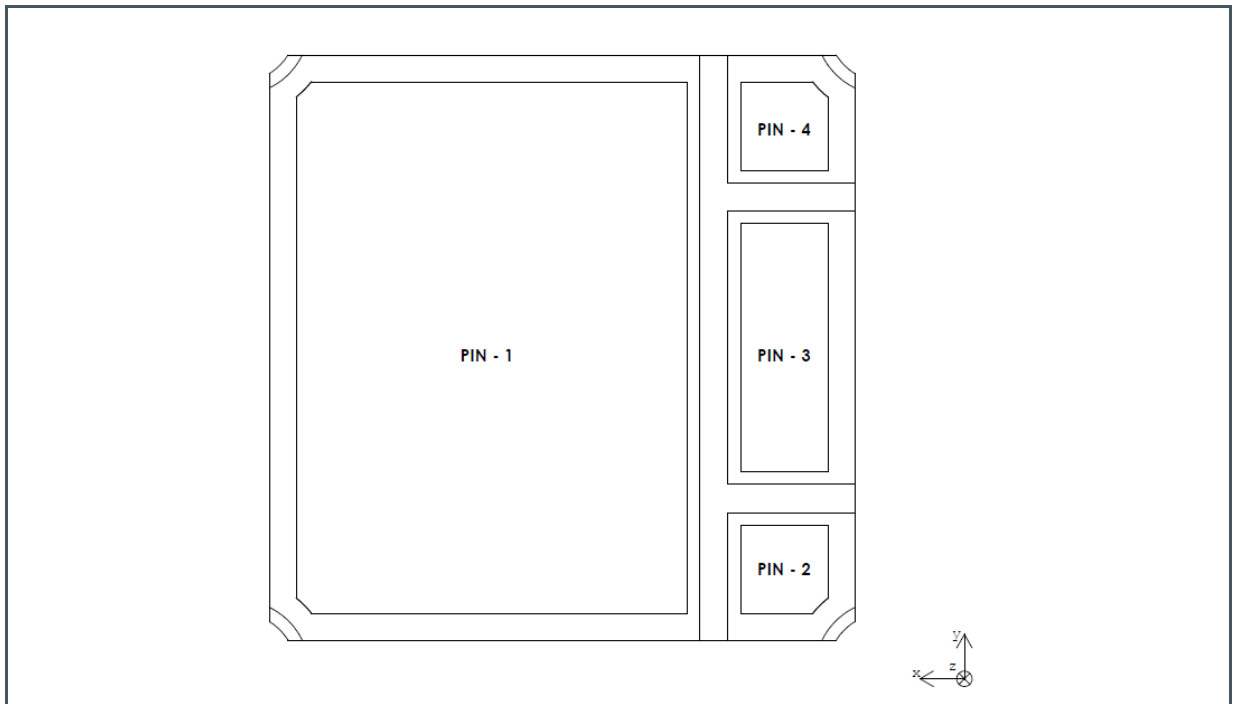
2 Ordering Information

Ordering Code	Package	Delivery Form	Delivery Quantity
Q65114A0205	TARA2000-940-W-AUT-SAFE	Tape & Reel	4000 pcs/reel

3 Pin Assignment

3.1 Pin Diagram

Figure 4:
Pin Diagram (Module Bottom View)



3.2 Pin Description

Figure 5:
Pin Description of TARA2000-940-W-AUT-SAFE

Pin Number	Pin Name	Description
1	Cathode	VCSEL Power
2	Interlock 1	Interlock Monitor
3	Anode	VCSEL Power
4	Interlock 2	Interlock Monitor

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 6:
Absolute Maximum Ratings of TARA2000-940-W-AUT-SAFE

Symbol	Parameter	Min	Max	Unit	Comments
Electrical Parameters					
$I_{F,LD}$	Laser Diode Forward Current		5	A	CW @ 25 °C
$I_{F,LD \text{ pulse}}$	Laser Diode Forward Current Pulse		10	A	Duty Cycle = 1% Pulse Width = 100 μ s @ 25 °C
$V_{R,LD}$	Laser Diode Reverse		5	V	CW @ 25 °C
$I_{R,LD}$	Laser Diode Reverse Current		25	nA	CW @ 25 °C
Electrostatic Discharge					
ESD_{HBM}	Electrostatic Discharge HBM		± 4	kV	JEDEC JS-001-2017
ESD_{CDM}	Electrostatic Discharge CDM		± 750	V	JEDEC JS-002-2018
Temperature Ranges and Storage Conditions					
T_A	Operating Ambient Temperature	-40	125	°C	
T_{STRG}	Storage Temperature Range	-40	125	°C	
T_J	Operating Junction Temperature		150	°C	
RH_{NC}	Relative Humidity (non-condensing)		85	%	
MSL	Moisture Sensitivity Level		2		JESD22-A113D Maximum floor life time of 1 year

5 Performance Characteristics

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

5.1 Electrical Characteristics

Figure 7:
Electrical Parameters

Parameter	Conditions	Min	Typ	Max	Unit
Optical Output Power ⁽¹⁾	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	3.3		4.1	W
Operating Voltage ⁽¹⁾	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	1.9		2.6	V
Slope Efficiency	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	0.7	1.0		W/A
Threshold Current	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	0.2	0.75	1.1	A
Power Conversion Efficiency	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	31	35		%
Interlock Resistivity	@ 25 °C	3.8	4.4	5	k Ω

(1) Depending on driving conditions and thermal management.

5.2 Optical Characteristics

Figure 8:
Optical Parameters

Parameter	Condition	Min	Typ	Max	Unit
Wavelength	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	932	940	948	Nm
Spectral Width ⁽¹⁾	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	0.1		3	Nm

(1) Full width at half maximum

Figure 9:
Field of Illumination (FOI)

Parameter	Condition	Min	Typ	Max	Unit
Horizontal FOI ⁽¹⁾⁽²⁾	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	112	116	120	Deg
Vertical FOI ⁽¹⁾⁽²⁾	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	83	87	91	Deg
Horizontal Radiant Intensity Ratio	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	1.1		1.6	
Vertical Radiant Intensity Ratio	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	1		1.5	
Corner Radiant Intensity Ratio	Pulse width = 100 μ s, Duty cycle = 2%, @ 5 A @ 25 °C	1.2		2.4	

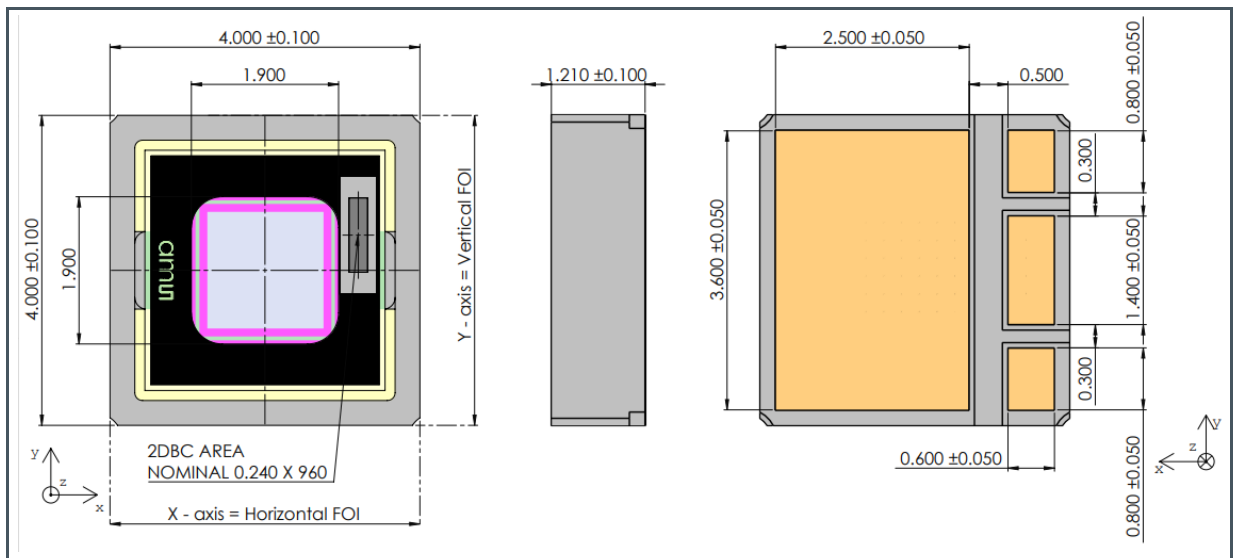
(1) Angle at 50% level normalized to the centroid

(2) Radiant intensity (W/sr)

6 Package Drawings

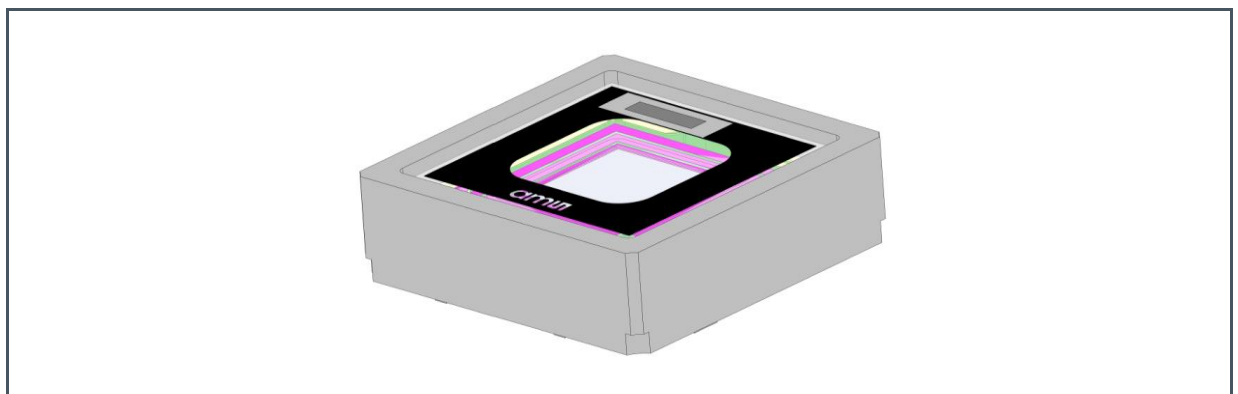
The drawing below is showing the module size and tolerances of the TARA2000-940-W-AUT-SAFE module.

Figure 10:
Package Dimensions⁽¹⁾



(1) All dimensions in mm.

Figure 11:
3D View of the Module

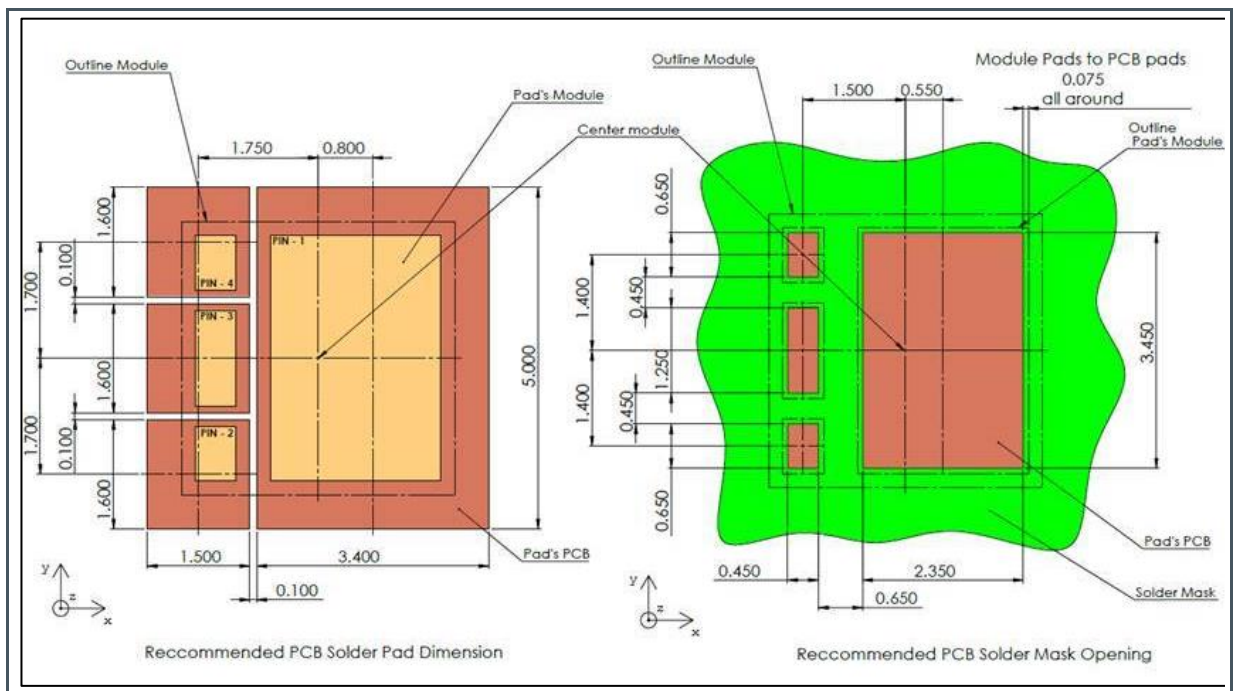


7 Application Information

7.1 PCB Pad Layout and Solder Mask Recommendation

The drawing below is 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 12:
Recommended PCB Pad Layout (top view)⁽¹⁾



(1) All dimensions in mm.

7.2 Orientation of the Field of Illumination

The drawings below are showing the emitting area of the TARA2000-940-W-AUT-SAFE module.

The (x,y,z) coordinates refer the below directions (as illustrated also on Figure 13):

- x: Horizontal FOI direction
- y: Vertical FOI direction
- z: Perpendicular direction to x and y

Figure 13:
FOI Orientation Regarding Module Footprint

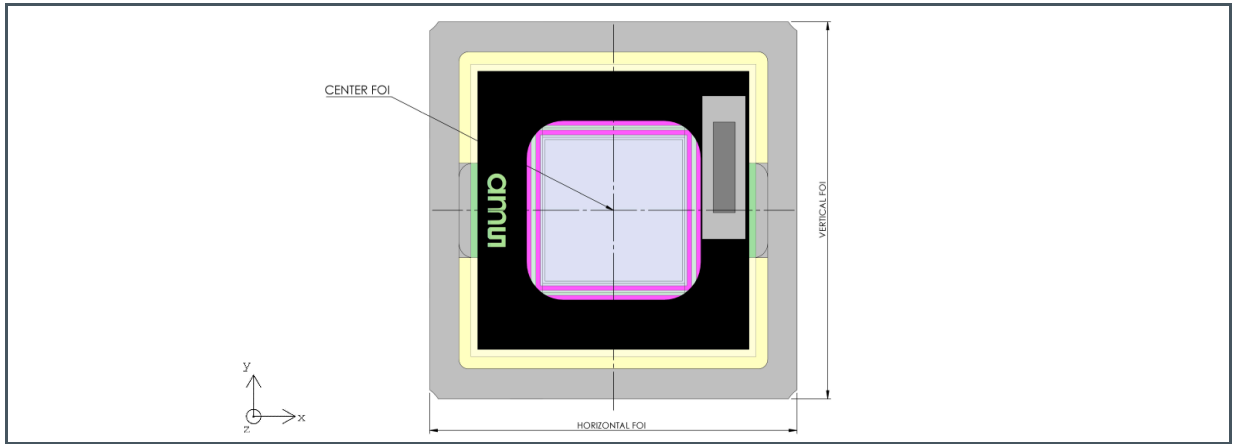
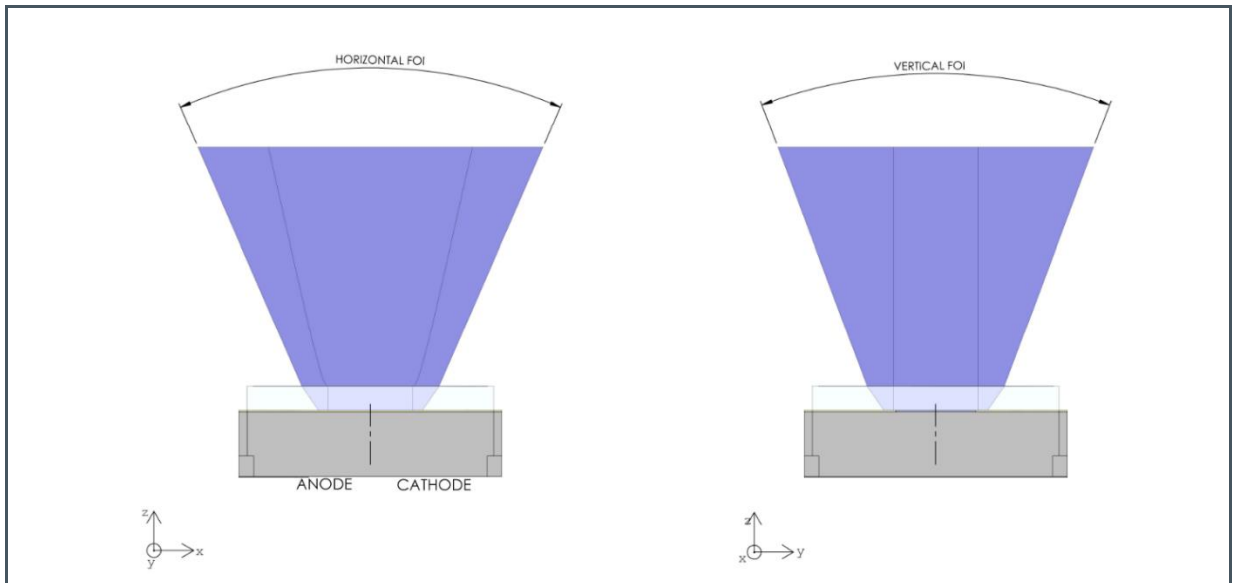


Figure 14:
FOI Projection



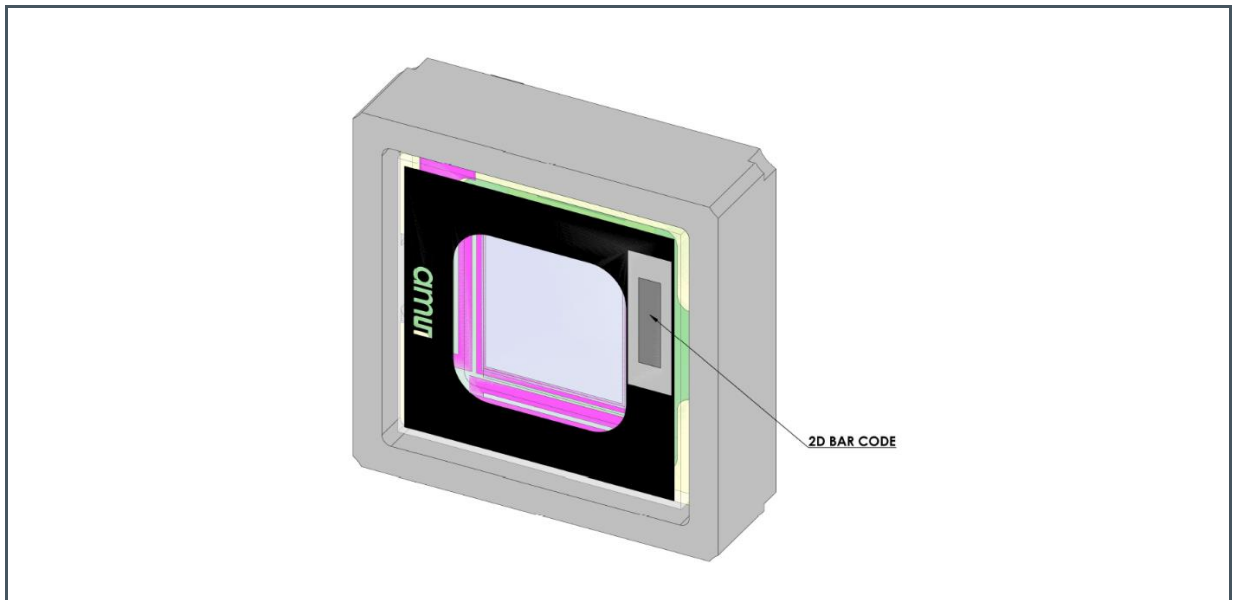
7.3 Information on the 2D Barcode

The figure below shows the 2D barcode on the module that can be used for traceability purpose. The 2D barcode has 13 characters and contains the following information:

- Product Code
- Year / Month / Day of manufacturing
- Lot running number and row & column coordinates located in the wafer
- Build type
- Configuration details

The module lot number can be traced back through module traceability report by referencing to the optics lot number.

Figure 15:
2D Barcode Location on the Module



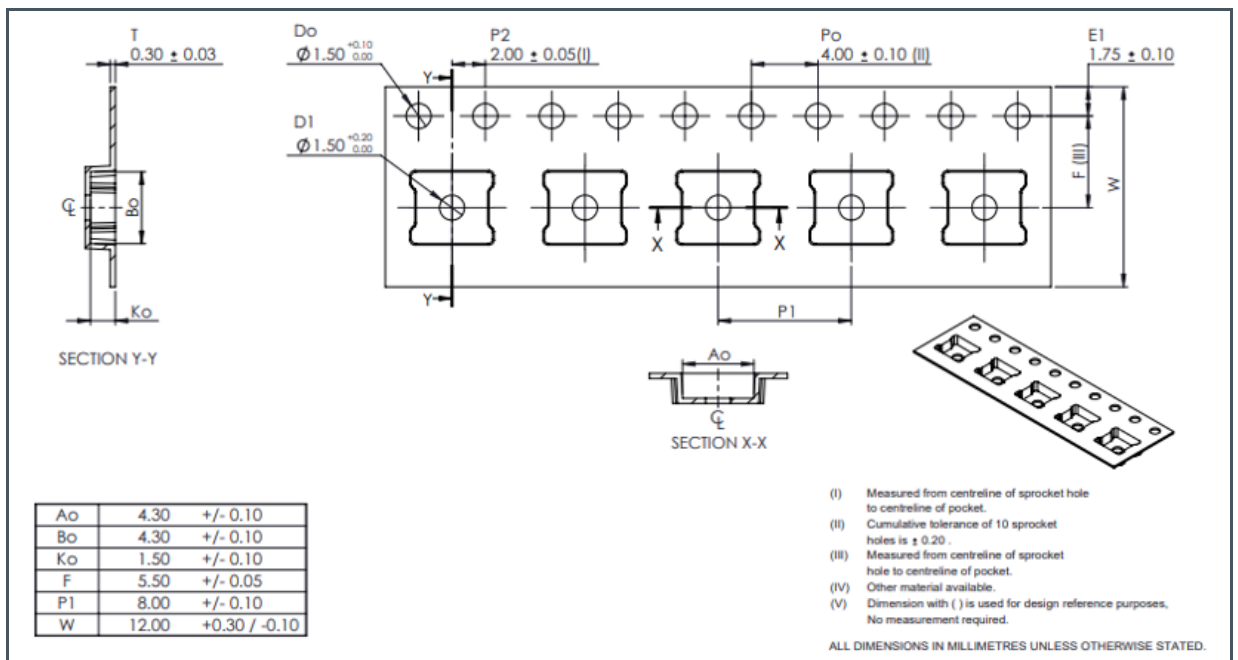
8 Tape & Reel Information

8.1 Overview

Sampling Shipments: The modules are shipped in tape & MBB Bag

MP Shipments: The modules are shipped in tape & reel

Figure 16:
Carrier Tape Dimensions and Overview⁽¹⁾⁽²⁾⁽³⁾



- (1) Cover tape dimensions are 9.3 mm.
- (2) Device pin 1 oriented towards tape holes.
- (3) Reference material: Polystyrene carrier and Polyester clear tape

8.2 Plastic Reel & MBB Bag

Reels are individually labeled and put inside a Moisture Barrier Bag (MBB). The label information is as follows:

- Part number
- Lot number
- Date code manufacturing
- Manufacturing country
- Expire date
- VCSEL batch
- Quantity
- Supplier information

Figure 17:
Shipping Label Example



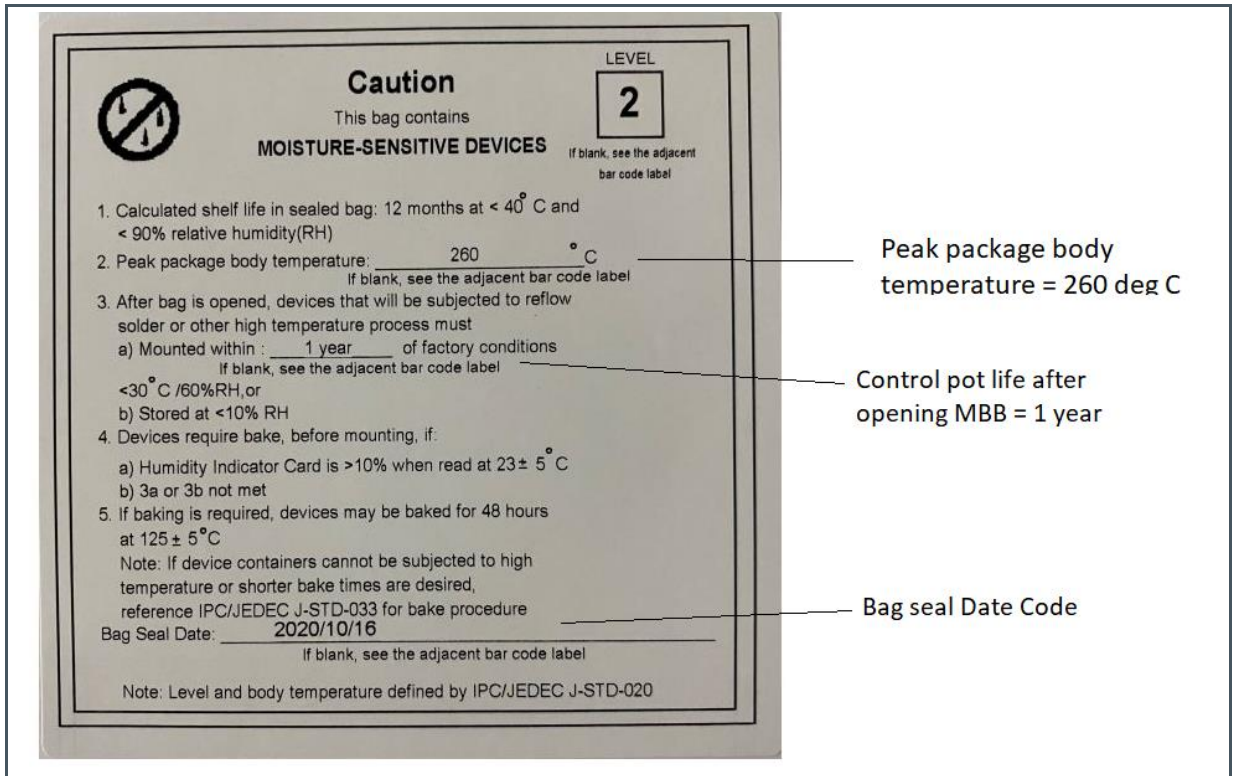
SN	Field	Definition	Remarks
1	Part No	Part Number	Product Device/Config
2	PT Lot No	Lot Number	Lot Number from system
3	Date Code 1	Date Code manufacturing	20 = year 2020, 08= week 08
4	Date Code 2	Date Code Lot 2 (merge lot)	
5	COO	Manufacturing Country	TH= Thailand
6	Expire date	Expire date about 1 year from manufacturing date	1 year from date code
7	Wafer No	VCSEL batch	
8	Wafer No 2	VCSEL batch 2 (merge lot)	
9	Quantity	Quantity of unit	
10	Supplier info	2D code information	

Label Size : 80x48 mm

8.3 MSL Label

The Moisture Sensitivity Level information is mentioned in the MBB Bag as shown in the figure below.

Figure 18:
MSL Label Example on MBB Bag



8.4 Label at Outer Box

The outer box containing all the plastic reels contain information as shown in the figure below.

Figure 19:
Label at Outer Box Example

S N	Field	Definition	Remarks
1	(P) Material No (Customer Part No)	Material Number	Customer partnumber for shipping label
2	Vendor P/N	Manufacturing part number	Marketing / Ordering Code
3	Vendor	Manufacturing part number	Vendor Code (for shipping label)
4	(Q) Quantity	Package quantity	built quantity
5	(4L) Country of Assembly	Country of Origin	this is similar with Country of Origin
6	(K) Trans. ID (Customer P.O No)	Need Info	Customer PO from Picklist
7	(P) SEC	Need Info	Customer partnumber for shipping label
8	MPN	Material Number	SAP MatNr
9	(2S) Shipment ID	Need Info	Picklist Generated - Hana generated
10	(3S) Package ID	Need Info	HUMO identification - Hana generated
11	Gross Weight	Weight	actual weight of box for shipment

Size : 140x80 mm

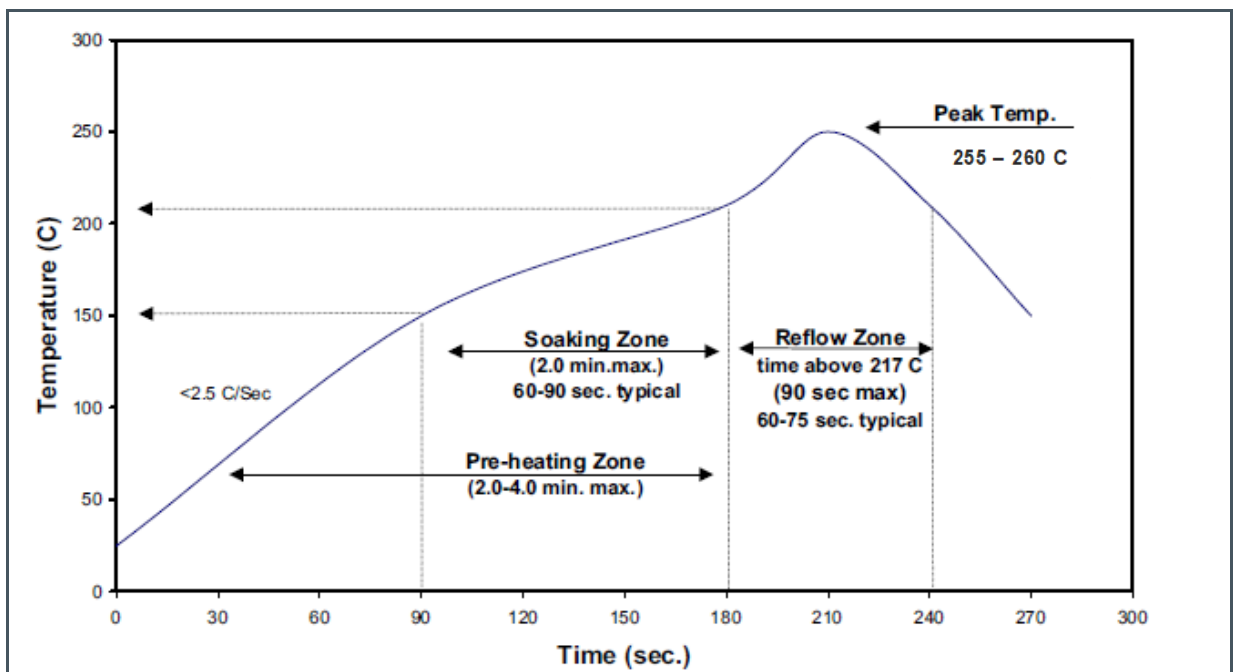
9 Soldering & Storage Information

9.1 Soldering Information

The TARA2000-940-W-AUT-SAFE modules have been tested for lead-free solder reflow compatibility with peak temperatures up to 260 °C.

Although an example of reflow profile is provided in the following figure, the exact reflow profile may depend on exact solder used.

Figure 20:
Solder Reflow Profile Graph Example (for reference only)



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 “no clean 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.

9.2 Storage Information

Moisture sensitivity optical characteristics of the device can be adversely affected during the soldering process by the release and vaporization of moisture that has been previously absorbed into the package. To ensure the package contains the smallest amount of absorbed moisture possible, each device is baked prior to being dry packed for shipping. Devices are dry packed in a sealed aluminized envelope called a moisture-barrier bag with silica gel to protect them from ambient moisture during shipping, handling, and storage before use.

9.3 Shelf Life

The calculated shelf life of the device in an unopened moisture barrier bag is 12 months from the date code on the bag when stored under the following conditions:

- Shelf Life: 12 months
- Ambient Temperature: <40°C
- Relative Humidity: <90%

Rebaking of the devices will be required if the devices exceed the 12 month shelf life and the Humidity Indicator Card shows that the devices were exposed to conditions beyond the allowable moisture region.

9.4 Floor Life

The module has been assigned a moisture sensitivity level of MSL 2. As a result, the floor life of devices removed from the moisture barrier bag is 1 year from the time the bag was opened, provided that the devices are stored under the following conditions:

- Floor Life: 1 year
- Ambient Temperature: <30°C
- Relative Humidity: <60%

If the floor life or the temperature/humidity conditions have been exceeded, the devices must be rebaked prior to solder reflow or dry packing.

9.5 Rebaking Instructions

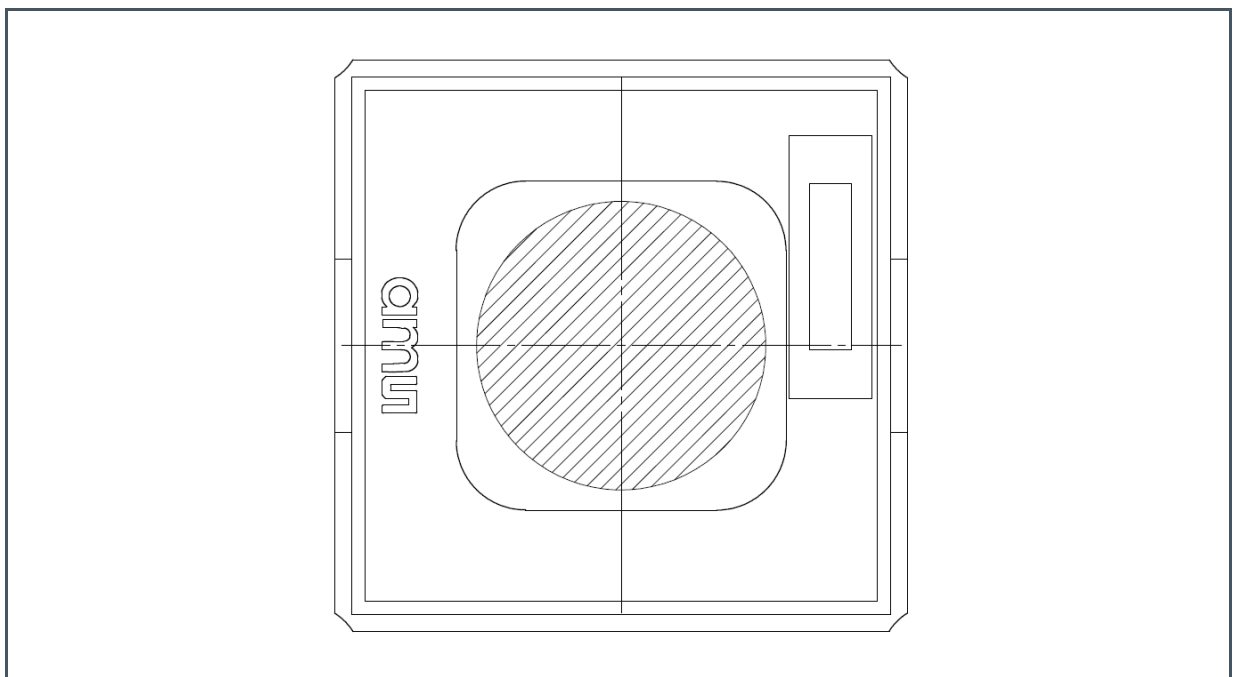
When the shelf life or floor life limits have been exceeded, rebaking is required based on recommended baking conditions (12h at 125 °C).

10 Handling

10.1 Pick Up

Recommended pick up position on the top window (hatched area in the figure), touching directly the glass.

Figure 21:
Pick Up Location



11 Appendix

11.1 RoHS Compliance

The TARA2000-940-W-AUT-SAFE module is RoHS compliant.

11.2 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.
- Obstructing, redirecting or focusing the optical power back to the module is considered a device misuse and can potentially lead to a health hazard.



LASER PRODUCT

LASER RADIATION – AVOID DIRECT EYE EXPOSURE

WAVELENGTH: 940nm

MAXIMUM OUTPUT POWER: Depends on drive mode

WEAR PROTECTIVE GLASSES

11.3 Symbols and Abbreviations

Figure 22:
Symbols and Abbreviations Used in the Datasheet

Symbol/Abbreviation	Description
DI	Deionized
FOI	Field of Illumination
FWHM	Full Width at Half Maximum
ID	Identification
IR	Infrared
LD	Laser Diode
LI	Light-Current
LIV	Light-Current-Voltage
MP	Mass Production
MSL	Moisture Sensitivity Level
RoHS	Restriction of Hazardous Substances
SMT	Surface Mount Technology
VCSEL	Vertical Cavity Surface Emitting Laser

12 Revision Information

Document Status	Product Status	Definition
Product Preview	Pre-Development	Information in this datasheet is based on product ideas in the planning phase of development. All specifications are design goals without any warranty and are subject to change without notice
Preliminary Datasheet	Pre-Production	Information in this datasheet is based on products in the design, validation or qualification phase of development. The performance and parameters shown in this document are preliminary without any warranty and are subject to change without notice
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Changes from previous version to current revision v3-00	Page
Updated Figure 6: Adding Laser Diode Forward Current Pulse	7
Adding Section 7.1 PCB Pad Layout and Solder Mask Recommendation	11

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

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