TEST REPORT
IEC 60825-1
Safety of laser products -
Part 1: Equipment classification and requirements

Report Number. ..... :	SHES240701592971
Date of issue..... :	2024-08-20
Total number of pages ..... :	20
Name of Testing Laboratory preparing the Report ..... :	SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
Applicant's name..... :	Qingdao MicroSense Intelligent Technology Co., Ltd.
Address..... :	Room 803, Floor 8, Building F, InnovationPark II, No. 1, Keyuan Wei 1st Road, Laoshan District, Qingdao, Shandong, China
Test specification:	
Standard ..... :	IEC 60825-1:2014
Test procedure ..... :	SGS-CSTC
Non-standard test method ..... :	N/A
TRF template used ..... :	IECEE OD-2020-F1:2021, Ed.1.4
Test Report Form No. ..... :	IEC60825_1G
Test Report Form(s) Originator.... :	OVE
Master TRF..... :	Dated 2021-10-05

This report is not valid as a CB Test Report unless signed by an approved IECEE Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing NCB. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

Test item description..... :	3D TOF CAMERA
Trade Mark(s)..... :	Vzense
Manufacturer..... :	Same as applicant
Model/Type reference..... :	DS77C Lite, DS86, DS87
Ratings..... :	DS77C Lite, DS86:12-24V⎓ DS87:12-24V⎓or POE + Laser Class 1

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**Testing Laboratory:**	SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.	
Testing location/ address.....:		588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China.	
Tested by (name, function, signature).....:		Abby Yang, PE	
Approved by (name, function, signature)...:		Emilien Li, Reviewer	
☐	**Testing procedure: CTF Stage 1:**	N/A	
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 2:**	N/A	
Testing location/ address.....:			
Tested by (name + signature) .....:			
Witnessed by (name, function, signature)..:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 3:**	N/A	
☐	**Testing procedure: CTF Stage 4:**	N/A	
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Witnessed by (name, function, signature)..:			
Approved by (name, function, signature)...:			
Supervised by (name, function, signature) :			

List of Attachments (including a total number of pages in each attachment):

N/A

Summary of testing:

All test data in this report is based on original test report: SHES220901677672, dated on 2023-07-12 with the following changes and/or additions.

- Change the applicant, manufacturer and factory to Qingdao MicroSense Intelligent Technology Co., Ltd. (Address: Room 803, Floor 8, Building F, InnovationPark II, No. 1, Keyuan Wei 1st Road, Laoshan District, Qingdao, Shandong, China).

- Change the product name to 3D TOF CAMERA.

- Delete models: DS77 Lite, DS77 Pro, DS77C Pro.

- Add foreseeable single fault conditions consideration. The products use vertical-cavity surface-emitting laser (VCSEL) to emit laser, and VCSEL has photodiode (PD), and the master chip detects the laser energy through PD. When the laser power rises to the threshold due to component failure, the master chip will control the drive to stop the laser emission.

After evaluation, no additional test was considered necessary.

Tests performed (name of test and test clause):	**Testing location:**
Full tests	SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. 588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China.

Summary of compliance with National Differences (List of countries addressed):

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Use of uncertainty of measurement for decisions on conformity (decision rule) :

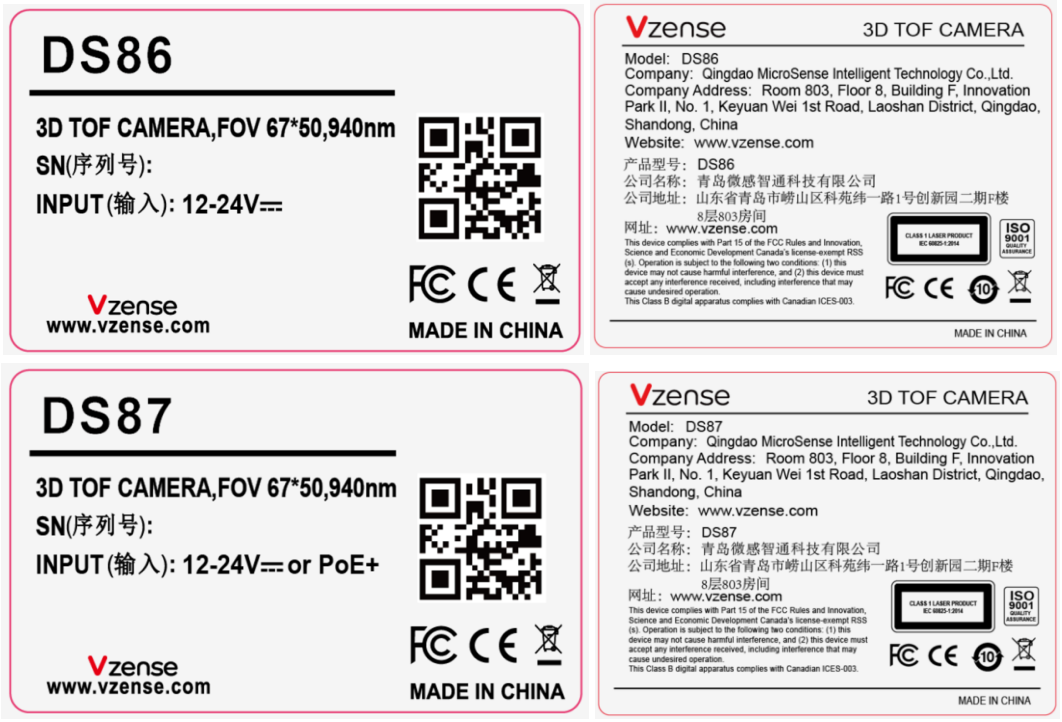
☒ No decision rule is specified by the IEC standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other:… (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)

Information on uncertainty of measurement:
The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE.
IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.
Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.



Test item particulars .....:	
Classification of installation and use.....:	-
Supply Connection .....:	-
.....:	
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)
Testing ..... :	
Date of receipt of test item..... :	Original: 2022-09-13
Date (s) of performance of tests ..... :	Original: 2022-09-13 to 2022-09-30 2023-06-30 to 2023-07-10

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....:	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies)..... : Same as applicant

General product information and other remarks:

The product covered in this report are TOF Camera, all the models have the same laser, except appearance, after reviewer, model DS77C Lite was chose for test.

The product is classified to **Class 1** laser product by the client because he considers all errors and statistical uncertainties that he knows from the production process and this is acceptable.

The test preformed on normal condition.

The products use vertical-cavity surface-emitting laser (VCSEL) to emit laser, and VCSEL has photodiode (PD), and the master chip detects the laser energy emitted through PD. When the laser power rises to the threshold due to component failure, the master chip will control the drive to stop the laser emission.

The products have been classified as **Class 1** laser products.

Following information should be on the manual:
a) adequate instructions for assembly, maintenance and safe use and description of the classification limitations, if appropriate.
b) additional warning for Class 1M and 2M
c) laser beam parameters for radiation above the AEL of Class 1 (Wavelength; Beam divergence; Maximum power or energy output)
d) safety instruction for embedded laser products and other incorporated laser products.
e) MPE and NOHD for Class 3B and 4 laser products; For collimated beam Class 1M and 2M lasers the extended NOHD (ENOHD).
f) information for the selection of eye protection.
g) reproduction of all required labels and warnings.
h) location of laser apertures
i) list of controls, adjustments of procedures for operation and maintenance - and warning statement.
j) information (compatibility requirements) about laser energy source if not incorporated.
k) additional warning for Class 1, 1M, 2, 2M, and 3R regarding skin or corneal burns.

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict

4	**CLASSIFICATION PRINCIPLES**		
4.3	Classification rules		---
4.3 a	Radiation of a single wavelength	940,5 nm	P
4.3 b	Radiation of multiple wavelengths		N/A
	1) Laser product emits at two or more wavelengths shown as additive in Table 1		N/A
	2) Laser product emits at two or more wavelengths not shown as additive in Table 1		N/A
4.3 c	Radiation from extended sources (see 5.4.3)		P
4.3 d	Non-uniform, non-circular or multiple apparent source		N/A
4.3 e	Time bases		---
	1) 0,25 s		N/A
	2) 100 s		P
	3) 30000 s		N/A
4.3 f	Repetitively pulsed or modulated lasers	t_{pulse}=1, 3 ms f=222Hz Ti=5*10^{-6} s	P
	1) Any single pulse	Refer to test result	P
	2) Average power for pulse trains	Refer to test result	P
	3) Pulse duration $t \leq T_i$ ..... : Number of pulses N and C_5 ..... :	Refer to test result	P
	3) Pulse duration $t > T_i$..... : Number of pulses N and C_5 ..... :	Refer to test result	P
4.4	Laser products designed to function as conventional lamps.		N/A
	α measured at 200 mm distance from closest point of human access (α > 5 mrad).		N/A
	Un-weighted radiance L measured at 200 mm distance (comparison with L_T = 1 $MWm^{-2}sr^{-1}/\alpha$) under reasonably foreseeable single fault conditions.		N/A
	Evaluation of emission according to IEC 62471 series (optional): Standard applied (IEC 62471 series)……,…..… : Risk Group……..… : Labelling…… .. : Classification of product based on accessible laser radiation (if no laser radiation accessible: Class 1).		N/A

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict

5	**DETERMINATION OF THE ACCESSIBLE EMISSION LEVEL and PRODUCT CLASSIFICATION**		
5.1	Tests		---
	Compliance under reasonably foreseeable single fault conditions.	Considered.	P
5.3	Determination of the class of the laser product ... : For Class 1C: vertical safety standard applied with requirements for Class 1C.		---
5.4	Measurement geometry		---
5.4.1	General		---
5.4.2	Default (simplified) evaluation		
	Conditions applied ..... :	Condition 1 and Condition 3	P
	Aperture diameter ..... :	50 mm (for Condition 1) 7 mm (for Condition 3)	P
	Reference point : ..... :	Surface of diffuser	P
	Measurement distance ..... : (for each condition)	2000 mm (for Condition 1) 100 mm (for Condition 3)	P
5.4.3	Evaluation condition for extended sources		P
	Conditions applied ..... :	Condition 3	P
	Most restrictive position ..... : (distance from reference point)	100mm	P
	Angular subtense of the apparent source α and C_6: (for each condition)	Refer to test result	P
5.4.3 a	Aperture diameters (for each condition). ..... :	7 mm (for Condition 3)	P
5.4.3 b	Angle of acceptance (for each condition)……...:	Refer to test result	N/A

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Clause	Requirement + Test	Result - Remark	Verdict

Measured accessible laser radiation and comparison with AEL:

1. TEST CONDITIONS

(1) General requirement

Temperature: 20 – 25 °C
Relative humidity: Max. 75 %

(2) Normal operation
The Laser is simulating normal operation to emit intentional optical power.

(3) Fault condition: According to client's requirement, fault condition was not considered.

2. MEASUREMENT METHOD

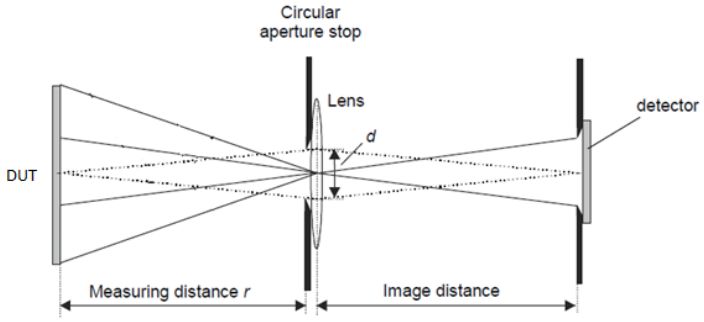
(1) Measurement of Peak wavelength
The peak wavelength of Laser is measured under normal operation

(2) Measuring distance
For condition 1: r = 2000 mm.
For condition 3: r = 100 mm.
For condition Skin Thermal hazard: r = 0 mm

(3) Measurement of radiant power (used optical power meter)

The radiant power emitted from Laser of the product is measured under normal operation.

In case of condition 1, the Laser radiation is collected through a circular aperture stop having a diameter 50 mm and its location is 2000 mm away from the closet point of human access, consists of a lens with 150 mm focal length. See below picture.



In case of condition 3, same as condition 1 except the Laser radiation is collected through a circular aperture stop having a diameter 7 mm and its location is 100 mm away from the apparent source, and focal length of the lens is 35 mm.

In case of condition Skin Thermal Hazard, Laser radiation is collected through a circular aperture stop having a diameter 3,5 mm and its location is 0 mm away from the apparent source.

The measurement is performed at a position to detect a maximum radiation emitted from the apparent source.

After review, test result under condition 3 is stricter compared with condition 1.

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Clause	Requirement + Test	Result - Remark	Verdict

3. TEST RESULT

All below measurements were performed at dark room with ambient temperature 24,5 ±0,5 °C, Relative humidity 60 ± 5%, the product was powered by AC-DC connector.

(1) Measurement of wavelength
λ1= 940,5 nm

(2) Measurement of laser radiant power

Normal operation:

For condition 3
$P_{\lambda 1}$= 1,278 mW;

For condition Skin Thermal hazard: r = 0 mm
$P_{\lambda 1}$= 3,34 mW;

4. CLASSIFICATION OF LASER RADIATION

(1) Compare the accessible emission level of radiation emitted from Laser of the product with the accessible emission limit of certain class. This comparison is evaluated using the measurement value under each condition. Accessible emission levels are measurement value or calculated from the measurement value if necessary.

(2) Time base
The time base is 100 s.

(3) Correction factor for Laser
Pulsed width=1,3 ms, C_5=1,0 (t> Ti, α ≤5 mrad)
Evaluation condition for extended sources:
$C_4 = 10^{0,002(\lambda - 700)}$ =3,03;
α=4,25 mrad;
$C_6 = \alpha / \alpha_{min}$ =4,25 mrad / 1,5 mrad = 2,8;
$T2 = 10 \times 10^{[(\alpha - \alpha_{min})/98,5}$s=10,7s

(4) Comparison with AEL

Condition	Evaluation method	Measured Emission level of laser	AEL Class 1	AEL Class 3B (mW)
Condition 3: r=100mm d=7mm	Extended evaluation	P=1,278 mW Q=5,8*10^{-6} J	AEL_{single} =7 × 10^{-4} t ^{0,75} C_4 C_6 J =4,11*10^{-5} J $AEL_{s.p.train}$ = AEL_{single} × C_5=4,11*10^{-5} J AEL_T= 3,32mW AEL s.p.T= AEL_T/PRF=1.5*10^{-5} J	—
Skin Thermal r=0mm d=3.5mm	Extended evaluation	3,34mW	—	500

Conclusion:
Measured laser radiation was not exceeding the AEL for Class 1. Therefore, the product was classified as **Class 1** laser product. Skin thermal was not exceeding the AEL for Class 3B.

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict

6	**ENGINEERING SPECIFICATIONS**		
6.2	Protective housing		---
6.2.1	General		---
	Protective housing prevents access to energy levels in excess of the AEL for Class 1.		N/A
	Protective housing prevents access to energy levels equivalent to Class 4 and withstands exposures under reasonably foreseeable single fault conditions.		N/A
	Maintenance of Class 1, 1C, 1M, 2, 2M, or 3R (access to emissions of Class 3B or 4 is prevented).		N/A
	Maintenance of Class 3B product (access to emission of Class 4 is prevented).		N/A
6.2.2	Service		N/A
6.2.3	Removable laser system (laser system complies with requirements of Clauses 6 and 7).		N/A
6.3	Access panels and safety interlocks		---
6.3.1	Panel is intended to be removed during operation (or maintenance) and would give access to higher energy levels (see Table 13).		N/A
	Accessible emission (after removal of the panel) corresponds to product Class (designated by “X” in Table 13)		N/A
	Emission through the opening if interlocked panel of Class 1, 1C, 1M, 2, or 2M is removed (Emission < AEL of Class 1M or 2M).		N/A
	Emission through the opening if interlocked panel of Class 3R, 3B, or 4 is removed (Emission < AEL of Class 3R).		N/A
	Requirements regarding reasonably foreseeable single fault condition.		N/A
6.3.2	Override mechanism		N/A
	Behaviour of override in operation when the panel is replaced.		N/A
	Visible or audible warning for override mode.		N/A
6.4	Remote interlock connector		N/A
6.5	Manual reset		N/A
6.6	Key control		N/A
6.7	Laser radiation emission warning		---

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
6.7.1	Laser product is a 3R (λ<400 nm; λ>700 nm), 1C, 3B or 4 laser systems.		N/A
6.7.2	Audible or visible warning.		N/A
	Warning is failsafe or redundant.		N/A
	Viewing of the visible warning does not require exposure to emissions > AEL for Class 1M and 2M.		N/A
6.7.3	Operational control and laser aperture are provided with a warning device when they are separated more than 2 m from warning device.		N/A
6.7.4	Visible indication of output aperture if laser emission may be distributed through more than one output.		N/A
6.7.5	Switch for handheld Class 3R device must be depressed for emission (in lieu of emission indicator).		N/A
6.8	Beam stop or attenuator		N/A
6.9	Controls		N/A
6.10	Viewing optics		N/A
	a) Human access to laser radiation in excess of Class 1M prevented when the shutter is opened or attenuation varied.		N/A
	b) Opening of the shutter or variation of the attenuation prevented when exposure to laser radiation in excess of Class 1M is possible.		N/A
6.11	Scanning safeguard		N/A
6.12	Safeguard for Class 1C products		N/A
	a) Human access to laser radiation in excess of AEL for Class 1 measured under Condition 3 is prevented.		N/A
	b) Human access to laser radiation in excess of AEL for Class 3B measured through 3,5 mm aperture at 5 mm distance from applicator is prevented.		N/A
6.13	Walk-in access		N/A
	a) Means provided so that any person inside the housing can prevent activation of Class 3B or 4 laser hazards.		N/A
	b) A warning device provides adequate warning of emission to any person within the housing.		N/A

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	c) Where “walk-in” access during operation is intended or reasonably foreseeable, emission of laser radiation that is equivalent to Class 3B or 4 while someone is present inside the enclosure of Class 1, Class 2 or Class 3R product is prevented by engineering means.		N/A
6.14	Environmental conditions		---
	- climatic conditions		N/A
	- vibration and shock		N/A
6.15	Protection against other hazards		---
6.15.1	Non-optical hazards (product safety standard)		N/A
	- electrical hazards;		N/A
	- excessive temperature;		N/A
	- spread of fire from the equipment;		N/A
	- sound and ultrasonics;		N/A
	- harmful substances;		N/A
	- explosion;		N/A
6.15.2	Collateral radiation		N/A
6.16	Power limiting circuit		N/A

7	**LABELLING**		
7.1	General		---
	Labels durable, permanently affixed		P
	Labels clearly visible		P
	Reading of labels is possible without exposure to laser radiation in excess of AEL for Class 1.		N/A
	Colour combination		P
	Labelling impractical due to the size or design of the product.		P
	Warning label – Hazard symbol (Figure 3)		P
7.2 - 7.7	Text on explanatory label or pictogram (laser class, warning text)		P
7.8	Aperture label		P
7.9	Radiation output and standards information		---
	Max output of laser radiation ..... :		N/A
	Pulse duration ..... :	1ms	P

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Emitted wavelength(s) ..... :	940nm	P
	Name and publication date of the standard ..... :	IEC 60825-1:2014	P
7.10	Labels for access panels		---
7.10.1 a) – f)	Labels for panels - warning wording used ..... :	See label	P
7.10.2	Labels for safety interlocked panels - Warning wording used ..... :		N/A
7.11	Warning for invisible laser radiation ..... :	Warning laser	P
7.12	Warning for visible laser radiation ..... :		N/A
7.13	Warning for potential hazard to the skin or anterior parts of the eye - warning wording used..... :		N/A

8	**OTHER INFORMATIONAL REQUIREMENTS**		
8.1	Information for the user		---
	a) adequate instructions for assembly, maintenance and safe use and description of the classification limitations, if appropriate.		P
	b) additional warning for Class 1M and 2M		N/A
	c) laser beam parameters for radiation above the AEL of Class 1		---
	• Wavelength ..... :	940nm	P
	• Beam divergence ..... :	-	N/A
	• Pulse pattern ..... : (pulse duration, repetition rate, …)	-	N/A
	• Maximum power or energy output ..... :		N/A
	d) safety instruction for embedded laser products and other incorporated laser products.		P
	e) MPE and NOHD for Class 3B and 4 laser products; For collimated beam Class 1M and 2M lasers the extended NOHD (ENOHD).		N/A
	f) information for the selection of eye protection.		P
	g) reproduction of all required labels and warnings.		P
	h) location of laser apertures		P
	i) list of controls, adjustments of procedures for operation and maintenance - and warning statement.		P
	j) information (compatibility requirements) about laser energy source if not incorporated.		P

IEC 60825-1			
Clause	Requirement + Test	Result - Remark	Verdict
	k) additional warning for Class 1, 1M, 2, 2M, and 3R regarding skin or corneal burns.		P
	l) Information for Class 1C products (e.g. warning that repeated application may pose a risk).		N/A
8.2	Purchasing and service information		P
	a) safety classification of each laser product stated in all descriptive material (e.g. brochures).		P
	b) adequate instructions for servicing available: • warnings and precautions regarding exposure of laser emission above Class 1 • maintenance schedule • list of controls and procedures that could increase accessible emissions • description of displaceable parts • protective procedures for service personnel • reproduction of labels and hazard warnings		P
9	**ADDITIONAL REQUIREMENTS FOR SPECIFIC LASER PRODUCTS**		
9.1	Applicable other parts of the standard series IEC 60825		---
	IEC 60825-2 (Safety of optical communication systems)		N/A
	IEC 60825-4 (Laser guards)		N/A
	IEC 60825-12 (Safety of free space optical communication systems used for transmission of information)		N/A
9.2	Medical laser products: Class 3B and Class 4 medical laser products comply with IEC 60601-2-22		N/A
9.3	Laser processing machines: Comply with IEC/ISO 11553 series.		N/A
9.4	Electric toys: Comply with IEC 62115		N/A
9.5	Consumer electronic products: Comply with IEC 60950 (IT-equipment) or IEC 60065 (AV equipment)		N/A

Annex 1: Photo documentation

Details of: Overview for DS77C Lite

View:

☒ general

☐ front

☐ rear

☐ right

☐ left

☐ top

☐ bottom

☐ internal

Details of: Overview for DS77C Lite

View:

☒ general

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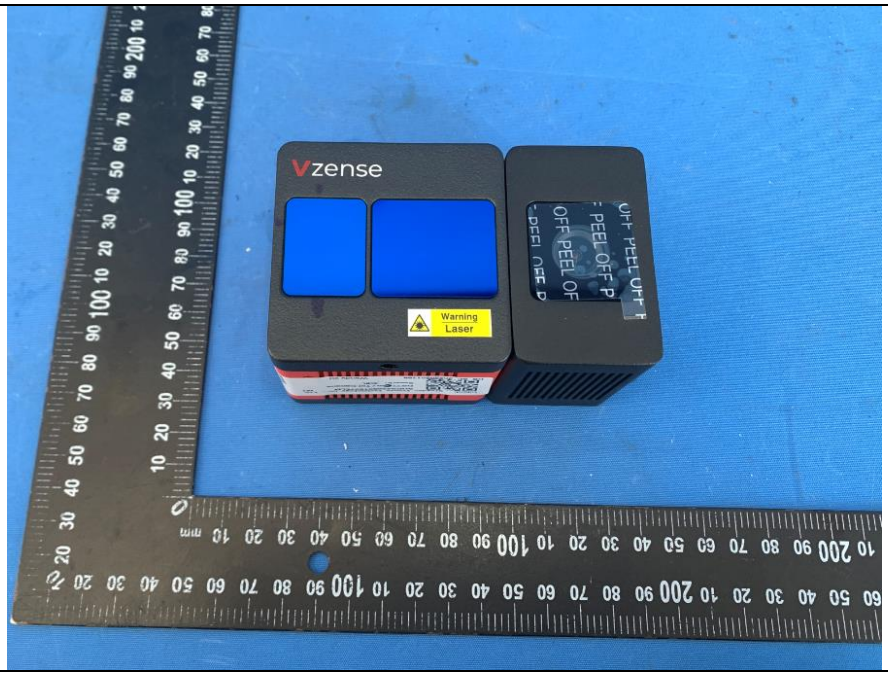

Annex 1: Photo documentation

Details of: Overview for DS86

View:

☒ general

☐ front

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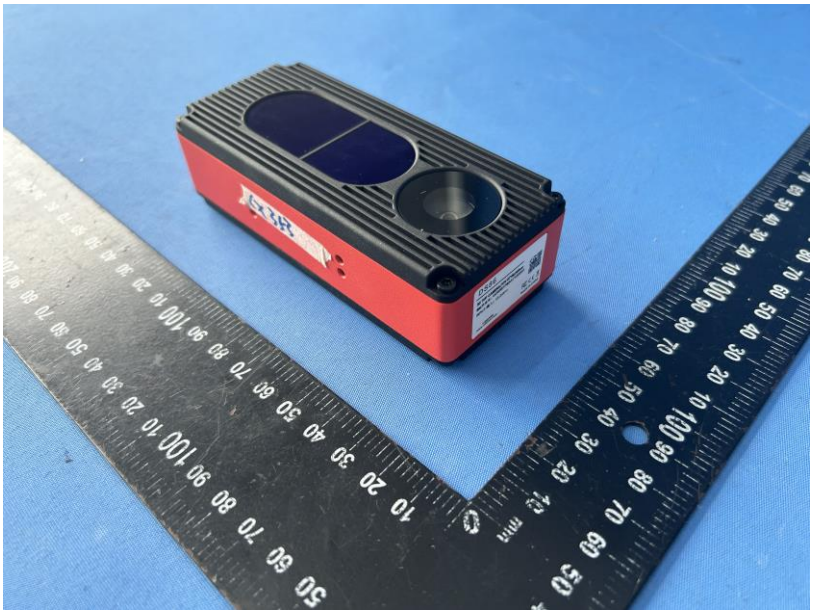

Details of: Overview for DS86

View:

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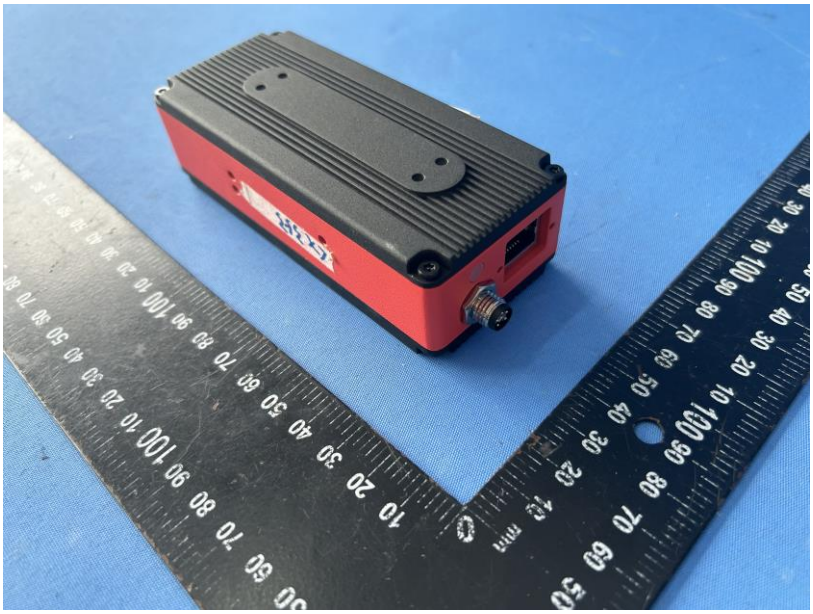

Annex 1: Photo documentation

Details of: Overview for DS86

View:

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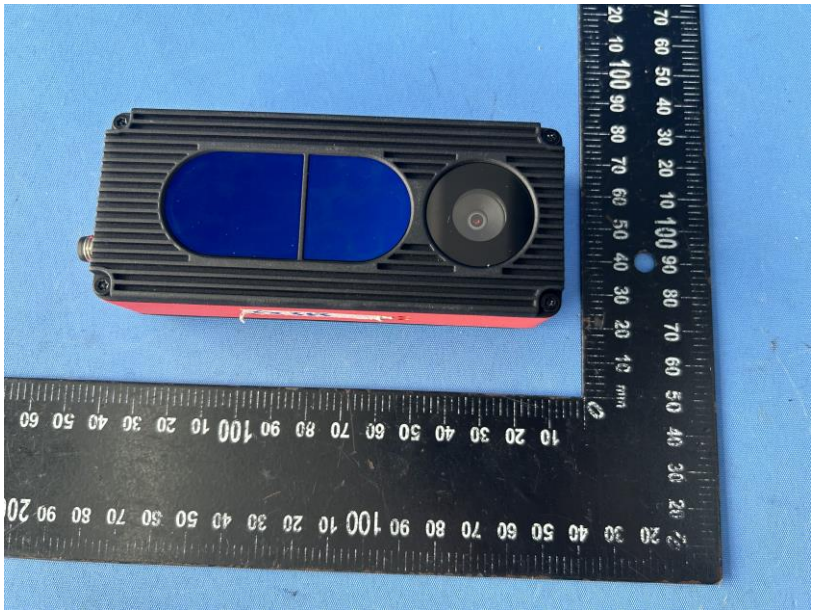

Details of: Overview for DS87

View:

☒ general

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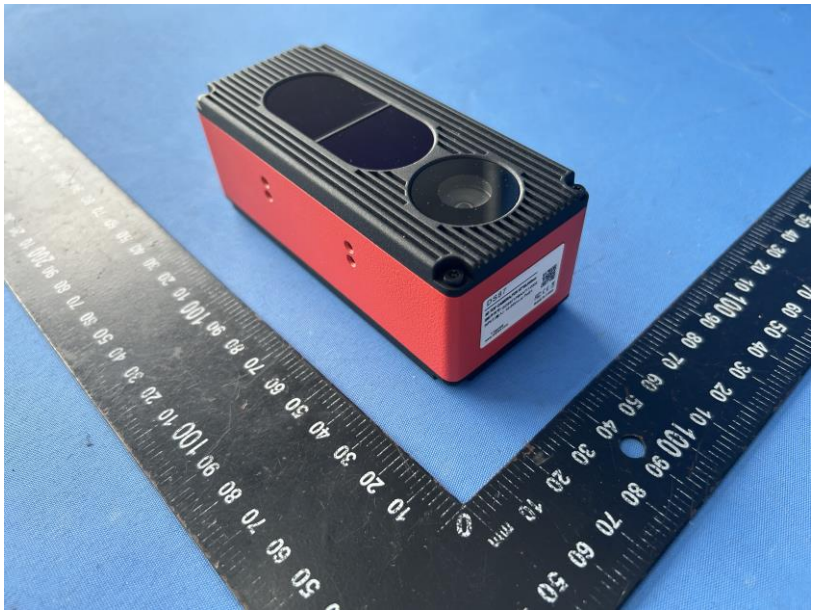

Annex 1: Photo documentation

Details of: Overview for DS87

View:

☒ general

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Details of: Overview for DS87

View:

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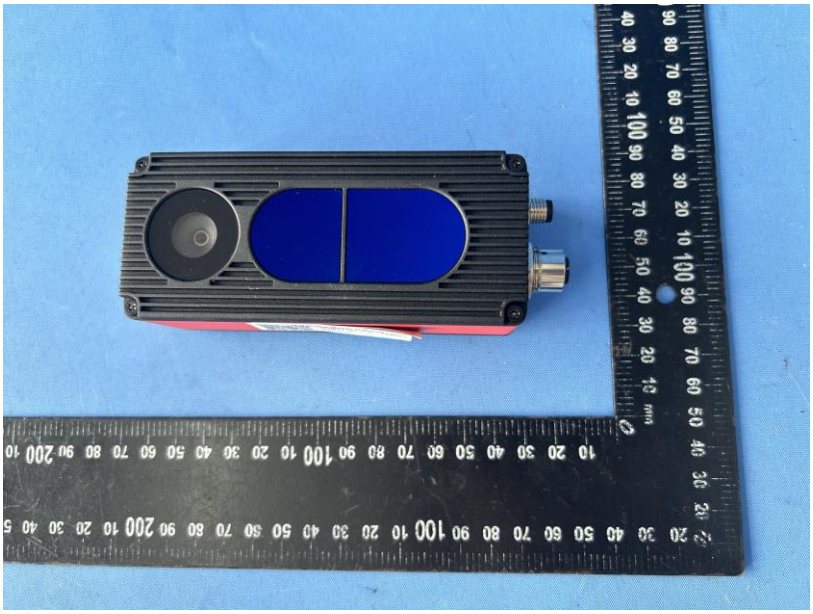

---End of Report---