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## Document History

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## SUPPORT

### USA

Phone: 800-636-0090  
Email: [support@opticonusa.com](mailto:support@opticonusa.com)  
Web: [www.opticonusa.com](http://www.opticonusa.com)

### Europe

Phone: +31235692728  
Email: [support@opticon.com](mailto:support@opticon.com)  
Web: [www.opticon.com](http://www.opticon.com)

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First	2023/07/20	-	-	Initial release

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## 1. Abstract

This manual provides specifications for the OPN-2500 ultra compact data collector.

## 2. Overview

OPN-2500 is a compact, battery powered laser scanner with a build-in Bluetooth transceiver. For charging and as an additional interface this product also has a mini-USB interface. This product is compliant with RoHS.

### 2.1. Product / Model Name

OPN-2500

### 2.2. Features

- The OPN-2500 is handy data collector with a compact, lightweight design.
- Data transmission is performed via Bluetooth (Low Energy) or via USB.
- Supported Bluetooth profiles are SPP and HID.
- BLE services: Serial port profile, HID, Battery service.
- USB functionality: USB-HID, USB-CDC, USB-VCP, USB-MSD
- The device is powered by a 3.7V, 250 mAh rechargeable lithium-polymer battery.
- Charging via USB, either by a host computer or via a USB power supply.
- Programmable with a free SDK and compiler.
- Several readymade applications available that allows for enormous flexibility:
  - OPN-2001 simulation with Bluetooth addition.
  - USB Mass storage
  - Standard Bluetooth application (Factory default installed)

### 3. Basic Specifications

Item	Specification		Remarks
Control Section	CPU	32 bit	nRF52833
	Clock	64 MHz	
	FROM	1 Mbyte	
	SRAM	256 Kbyte	
Storage	FROM	1 Mbyte	
Input Section	Key type	2 keys: Trigger, Function	
Indication LED	2 multicolor color LEDs (red, green, orange, blue)		
Buzzer	Volume (3 levels), Adjustable tone		
USB	USB-C		12 Mbps, USB-COM / USB-HID / USB-MSD
RTC (clock)	Supported	Year, month, date, hour, minute, second (accuracy: $\pm 90$ seconds per month)	
Power Supply	Main battery	Lithium polymer 250 mAh	
	Continuous operating time	1000 scans or more	Condition: read twice in 10 secs. at room temp.
Scanner (MSL-2001)	Light emitting element	Red laser diode	
	Laser wavelength and output	650 $\pm 10$ nm, up to 1 mW, 25°C	
	Scan rate	100 $\pm 20$ scans / sec	
	Minimum resolution	0.127mm	
	Scanning distance	60 ~ 250mm	Resolution: 1.0 mm PCS 0.9
	Symbology	JAN, EAN, UPC-A, UPC-E, NW-7 (Codabar), Industrial 2 of 5, Code 11, Code 39, Code 93, Code 128, GS1 Data Bar etc.	
Dimensions	62.0 $\times$ 32.0 $\times$ 16.0 (DWH mm)		
Weight	Approx. 29 g		
Environmental Specifications	Operating temperature/humidity	0 ~ 40 °C 20 ~ 85 %RH	No frost, no condensation
	Storage temperature/humidity	-20 ~ 60°C 20 ~ 85%RH	No frost, no condensation
Drop Impact Strength (*1)	Frequency	6 faces, 3 cycles	
	Height	150 cm	
	Floor	Concrete	
Regulatory Compliance	Laser safety: IEC60825-1:2007/2014 CE, FCC		

\*1 : Conditions of drop shock resistance

- Scratches or whitening on plastic surface shall not be counted as a malfunction.
- The product shall work properly after the drop test.

### 4. Detailed View

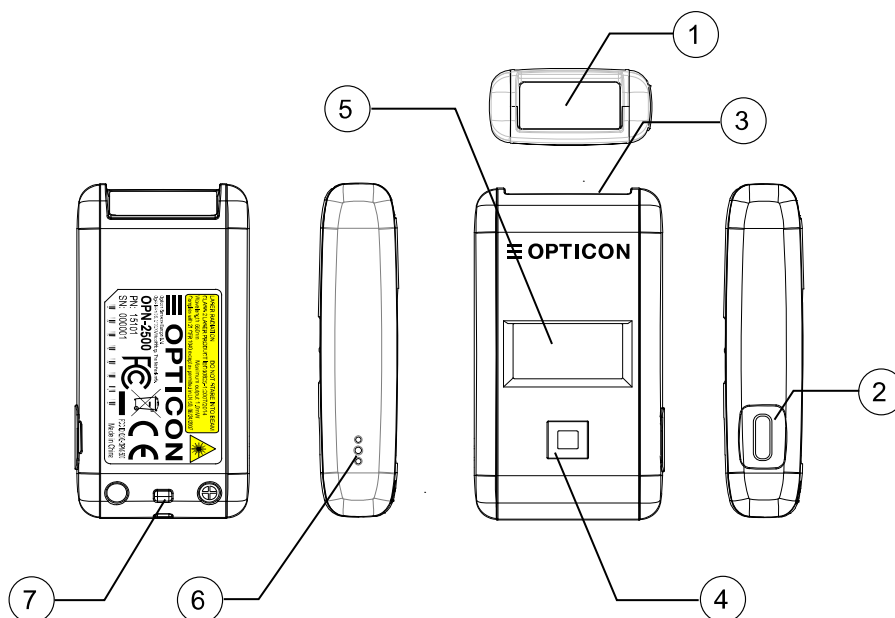


Figure 1: Detailed View

No.	Name	Description
1	Scan Window	Laser light is emitted through this window.
2	USB-C connector	For charging & data communication
3	Trigger Key	Press to start reading barcodes.
4	Function Key	Application specific function key.
5	LED	Status indicator, such as bar code reading and Bluetooth warnings
6	Buzzer Hole	Sound from a built-in buzzer comes out through these holes.
7	Strap Hole	The place to attach a hand strap

## 5. Optical Specifications

### 5.1. Laser Scanning Specifications

Item		Characteristics	Unit
Light-Emitting Element		Red laser diode	-
Emission Wavelength		650 $\pm$ 10 (25° C)	nm
Light Output		1.0 or less	mW
Scanning Method		Bi-directional scanning	-
Scanning Speed		100 $\pm$ 20	scans/s
Scan Angle	Scan Angle	54 $\pm$ 5	degrees
	Read angle	44 (Min)	degrees

#### Notes:

Refer to "Technical Specifications," to read about scanning performance.

### 5.2. Laser Scanning Standards

IEC 60825-1 Ed.2: 2007/2014 Class 2  
CDRH Class II

#### 5.2.1. Laser Scanning Tilt

Vertical differences between both ends of the laser scanning line:

- Up to 1.2° in vertical direction from the scan origin (scanning mirror).
- Up to 3.1 mm measured at 150 mm from the scan origin and with zero skew angle.

#### 5.2.2. Laser Scanning Curvature

The maximum difference between the laser scanning line and a straight line connecting the both ends of the scanning line:

- Up to 1.27° from the scan origin (scanning mirror).
- Up to 3.3 mm measured at 150 mm from the scan origin with zero skew angle.

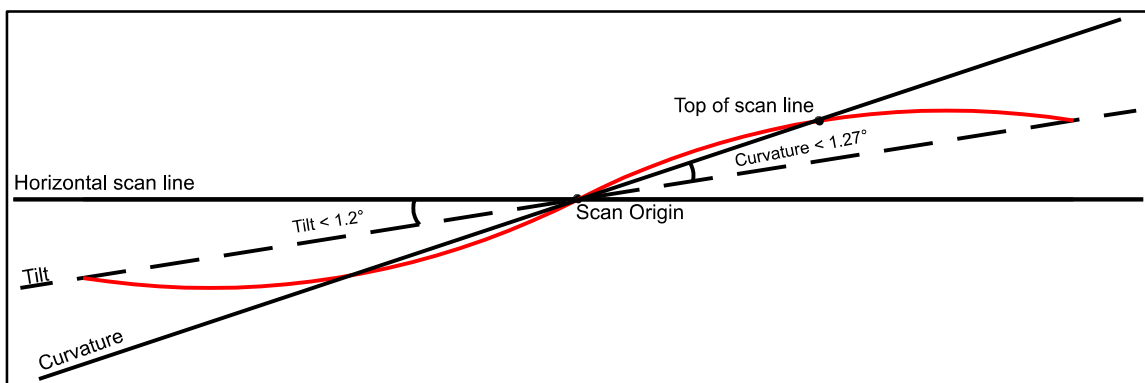


Figure 2: Laser Scanning Tilt and Curvature



### 6. Technical Specifications Barcode Scanner

The conditions are as follows, unless otherwise specified.

#### Conditions

Ambient temperature and humidity:	Room temperature (20° C)
Ambient light:	Room humidity (45% to 85% RH)
Background:	500 to 900 lx (Excluding high frequency fluorescent light)
Decoding test:	Barcode = black bars and white spaces
	Approve when decoding is over 95% successful. Decoding is deemed successful when completed in 0.5 seconds or less.

#### 6.1. Print Contrast Signal (PCS)

PSC 0.45 or higher (70% or higher reflectivity of space and quiet zone)

$$PCS = \frac{\text{Reflectance of white bar} - \text{Reflectance of black bar}}{\text{Reflectance of white bar}}$$

#### 6.2. Minimum Resolution

0.127 mm

#### 6.3. Supported symbologies:

##### Linear (1D)

JAN/UPC/EAN, incl. add-on  
Codabar/NW-7  
Code 11  
Code 39  
Code 93  
Code 128  
GS1-128 (EAN-128)  
GS1 Databar (RSS)  
IATA  
Industrial 2of5  
Interleaved 2of5  
ISBN-ISMN-ISSN  
Matrix 2of5  
MSI/Plessey

S-Code  
Telepen  
Tri-Optic  
UK/Plessey

##### Postal codes (1D)

Chinese Post  
Korean Postal Authority Code

### 6.4. Scan Area and Depth of Field

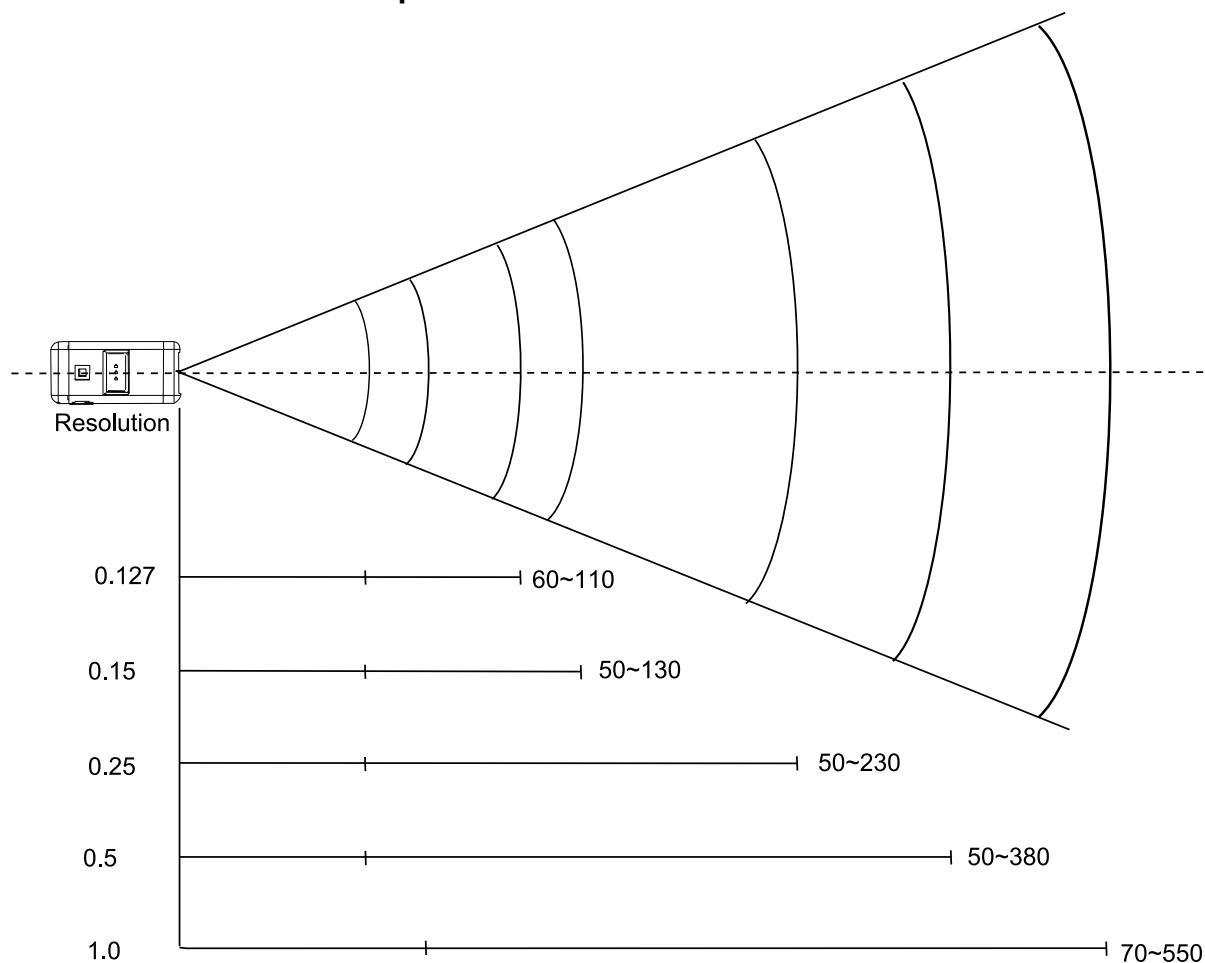


Figure 3: Scan Range and Depth of Field

Resolution	Symbology	PCS	Quiet Zone	No. of Digits
1.0 mm	Code 39	0.9	25 mm	1
0.5 mm	Code 39	0.9	18 mm	3
0.25 mm	Code 39	0.9	10 mm	8
0.15 mm	Code 39	0.9	7 mm	10
0.127 mm	Code 39	0.9	5 mm	4

**Conditions:**

Bar Code Sample : Optoelectronics Test Chart, N/W ratio = 1:2.5  
 Angle :  $\alpha = 0^\circ$   $\beta = 15^\circ$   $\gamma = 0^\circ$   
 Curvature :  $R = \infty$

### 6.5. Pitch, Skew, and Tilt

Pitch	: $\alpha \leq \pm 35^\circ$
Skew	: $\beta \leq \pm 50^\circ$ (Excluding dead zone)
Dead Zone	: $\beta \leq \pm 8^\circ$ (Decoding may fail in some areas as a result of specular reflection)
Tilt	: $\gamma \leq \pm 20^\circ$

#### Conditions

Bar Code Sample	Optoelectronics Test Sample
Distance	110 mm from the edge of the OPN-2500
Label for Pitch, Skew and dead zone:	PCS 0.9, Resolution 0.25 mm 9-digit Code 39, Quiet Zone 10 mm, N/W Ratio = 1 : 2.5
Label for Pitch Tilt	PCS 0.9, Resolution 0.26 mm, EAN-13, Quiet Zone 10 mm
Angles for Pitch and Tilt	Skew angle $\beta = +15^\circ$
Angles for Skew and Dead zone	$\alpha = 0^\circ, \gamma = 0^\circ$
Curvature	$R = \infty$

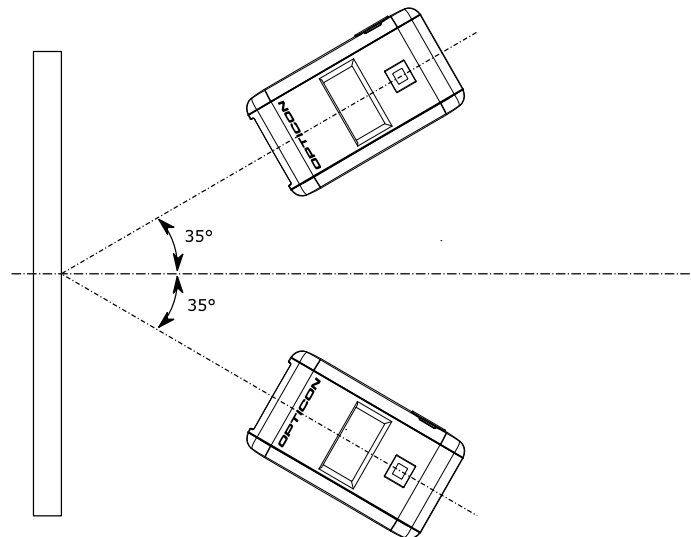


Figure 4: Pitch

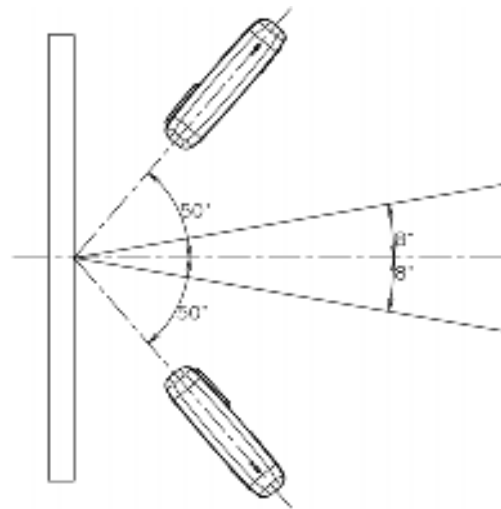


Figure 5: Skew

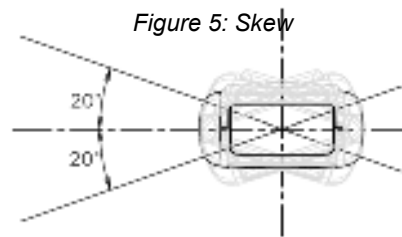


Figure 6: Tilt

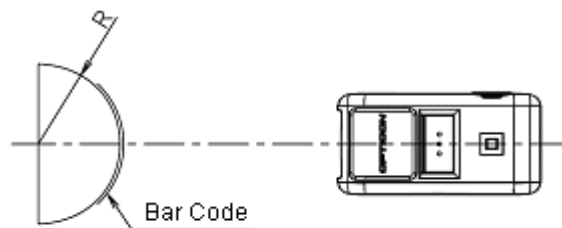


Figure 7: Curvature

## 6.6. Curvature

With 8-digit JAN/UPC/EAN barcodes, decoding performance is guaranteed when  $R \geq 15$  mm

With 13-digit JAN/UPC/EAN barcodes, decoding performance is guaranteed when  $R \geq 20$  mm

### Conditions

Bar Code Sample	Optoelectronics Test Sample
	PCS 0.9, Resolution 0.26 mm, Quiet Zone 10 mm
Distance	110 mm from the edge of the scanner
Angle	Skew angle $\beta = +15$

7. Interface Specifications

7.1. USB

7.1.1. Settings

The interface is full-speed USB.

7.1.2. Cable

Dedicated cable with PC connector is provided.

7.1.3. Connector

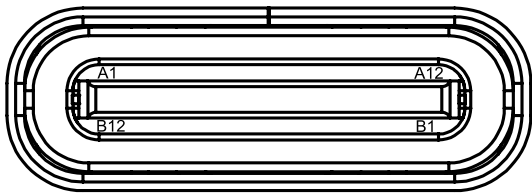


Figure 8: USB B connector

A1, A12, B1, B12	GND
A4, A9, B4, B9	VCC
A5	CC1, 5.1k pull down resistor
A6, B6	D+
A7, B7	D-
A8, B8	External trigger in
B5	CC2, 5.1k pull down resistor
All other pins	Not connected

7.1.4. Interface Circuit

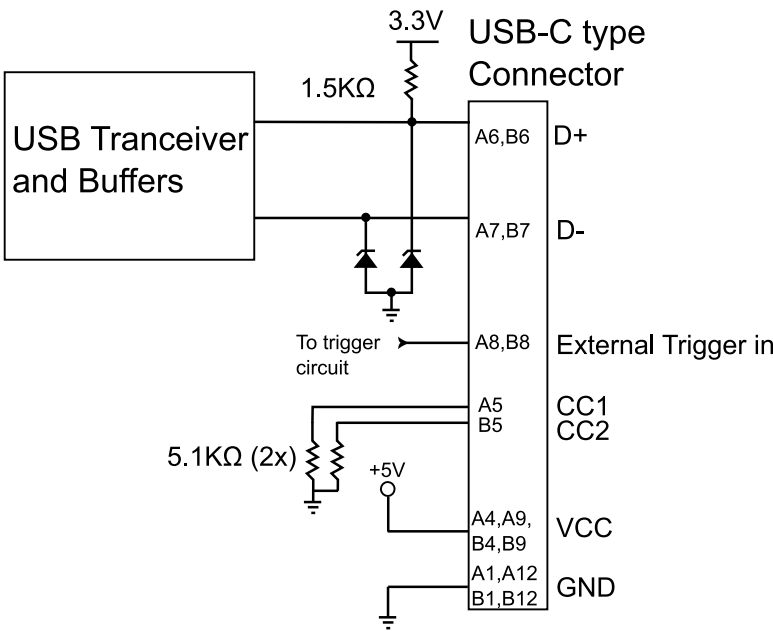


Figure 9: Interface circuit

## 7.2. Bluetooth

### 7.2.1 Module

The OPN-2500 is equipped with integrated *Bluetooth 5*, transceiver (nRF52833)

### 7.2.2 Specifications

Bluetooth standard: 5

Blue low energy

Supported BLE profiles: Proprietary UART / HID (keyboard emulation)

## 8. Product Label

The label shown below is attached to the back of the OPN-2500.

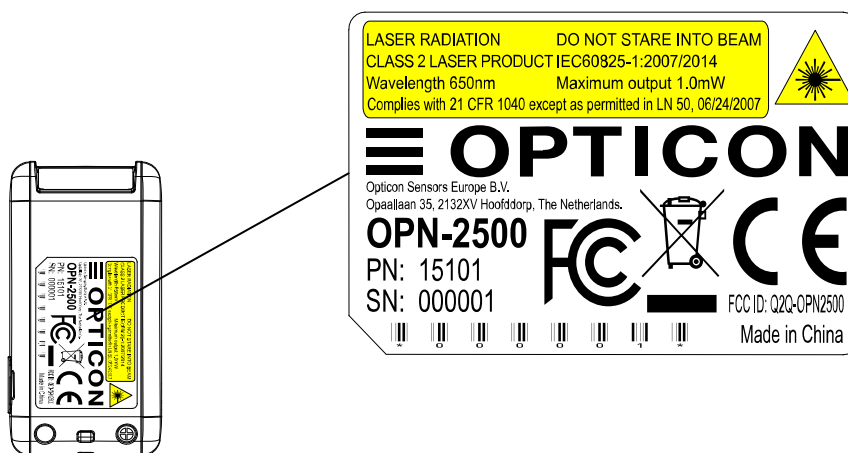
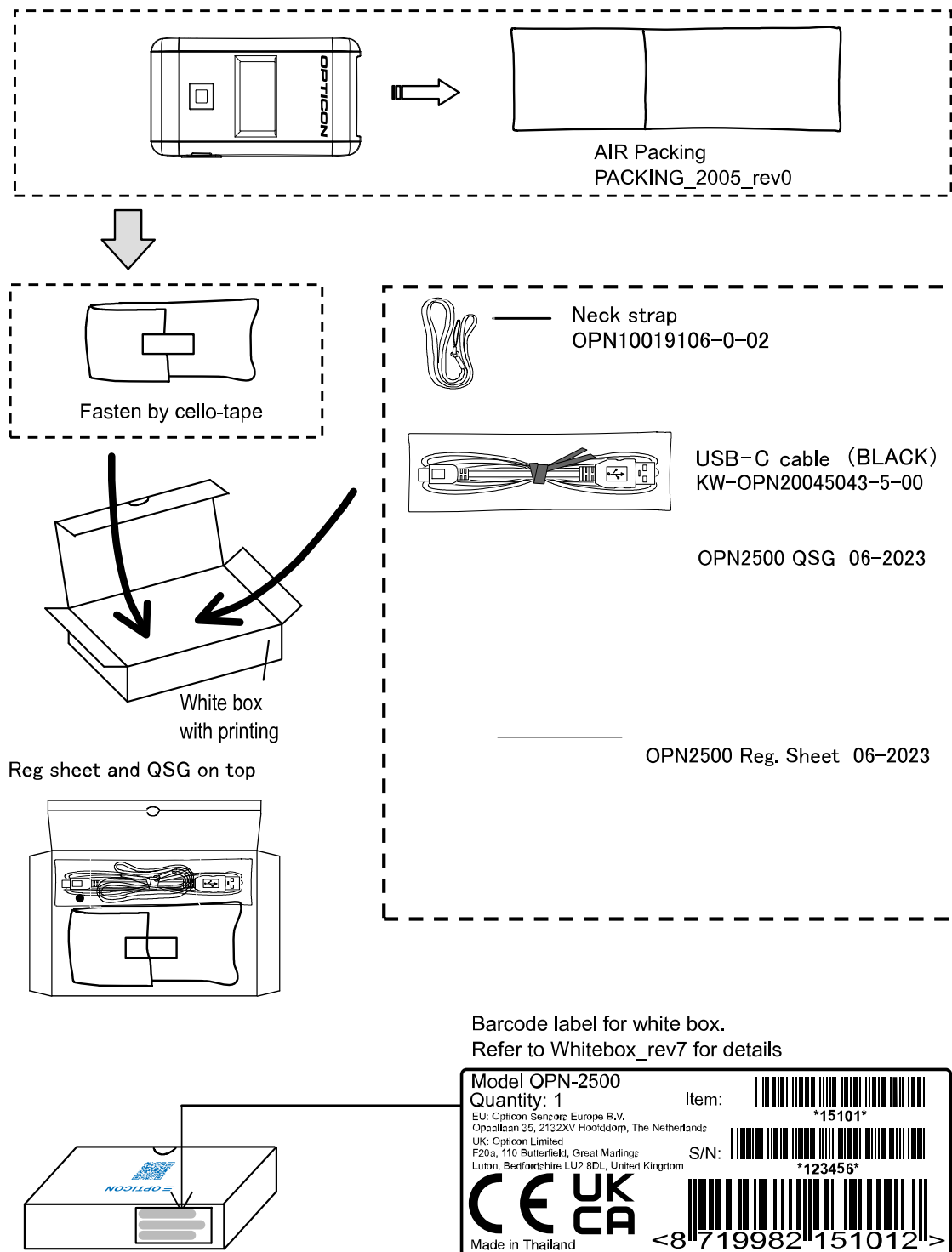


Figure 10: Product & Laser Caution Label

## 9. Packaging Specifications

### 9.1. Individual Packaging Specification ! different cable and numbers !



Do not fold at the barcode position when the label is affixed onto the corner of the box.

The 6-digit serial number on the label is the same as the serial number on the OPN2500.

Figure 11: Individual Packaging



### 9.2. Collective Packaging Specification

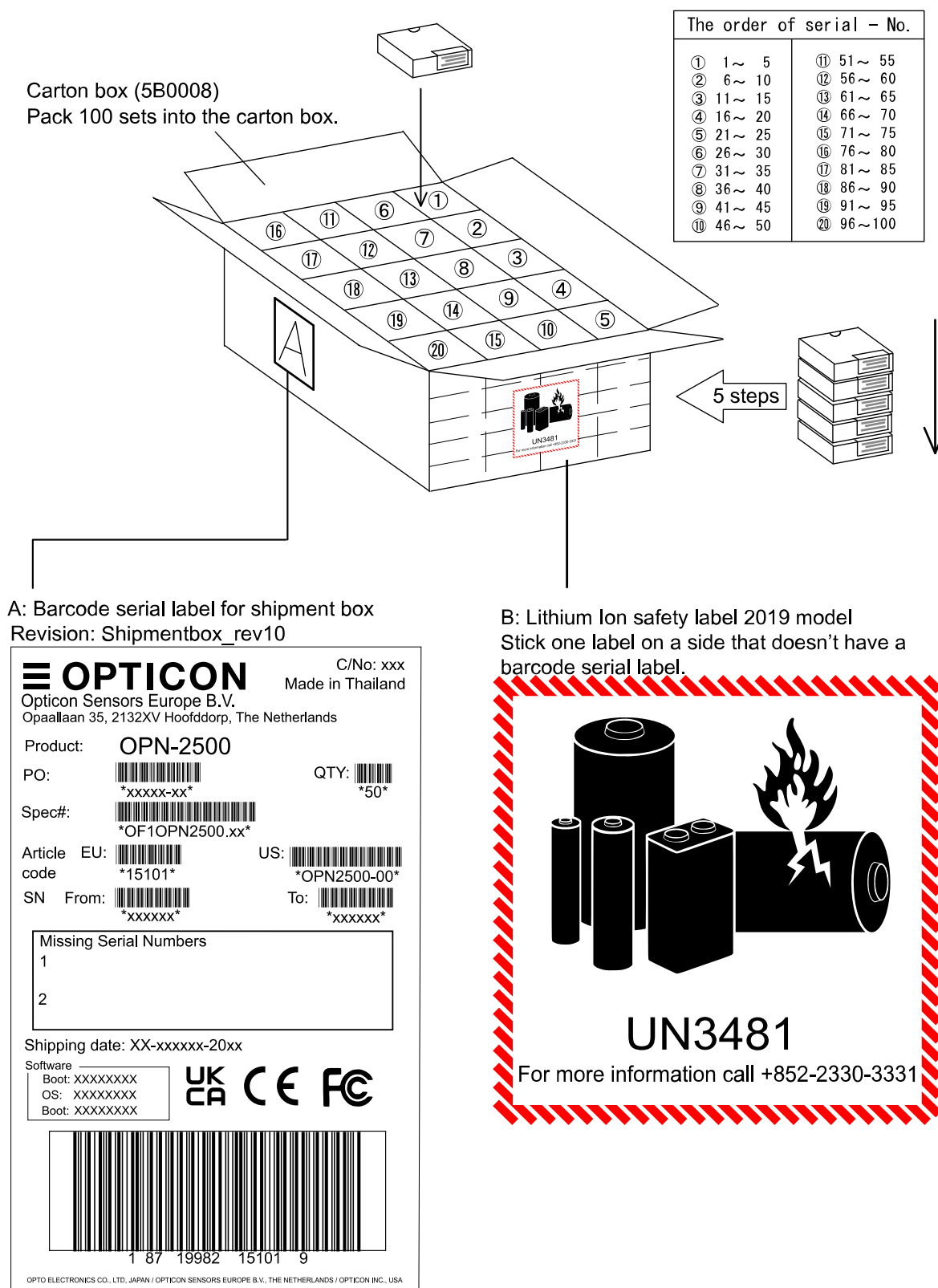


Figure 12: Collective Packaging

## 10. Durability

### 10.1. Ambient Light Immunity

Scanning performance is guaranteed when the barcode surface is illuminated as follows.

Incandescent light : 0 ~ 4,000 lx  
 Fluorescent light : 0 ~ 4,000 lx (excluding high-frequency lighting)  
 Sunlight : 0 ~ 80,000 lx

#### Conditions

Barcode Test Sample	OPTOELECTRONICS test chart PCS = 0.9, Resolution 0.25 mm, 9-digit Code 39, Quiet Zone 10 mm, N/W Ratio = 1:2.5
Distance	150 mm from the front edge of the scanner.
Angles	Pitch: $\alpha = 0^\circ$ , Skew: $\beta = 15^\circ$ , Tilt: $\gamma = 0^\circ$
Curvature	$R = \infty$

Note: Specular reflection may deteriorate the scan performance.

### 10.2. Vibration Strength (without packing)

There shall be no sign of malfunction after the following vibration test.

**Vibration test:** Increase the frequency of the vibration from 10 Hz to 100 Hz at an accelerated velocity of 19.6 m/s<sup>2</sup> (2.0 G) for 30 minutes (60 minutes for a cycle) in non-operating state. Repeat this in X, Y and Z direction.

### 10.3. Vibration Strength (in individual packing)

There shall be no sign of malfunction after the following vibration test.

**Vibration test:** Increase the frequency of the vibration from 10 Hz to 100 Hz at an accelerated velocity of 19.6 m/s<sup>2</sup> (2.0 G) for 30 minutes (60 minutes for a cycle) in the individual packaged state. Repeat this in X, Y and Z direction.

## 10.4. Drop Impact Strength (without packaging)

There shall be no sign of malfunction after the following drop test.

**Drop test:** Drop the scanner 3 times (18 times in total), at each 6 face, from a height of 150 cm onto a concrete floor as shown below.

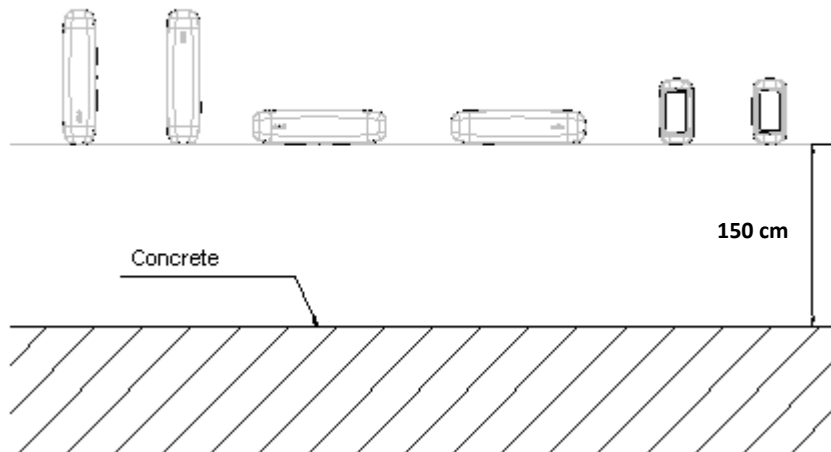


Figure 13: Drop Test

## 10.5. Electrostatic Discharge Immunity

Air discharge:	8 kV Max. (No malfunction) 15 kV Max. (No destruction)
Contact discharge:	4 kV Max. (No malfunction) [Discharged from the frame of the USB connector.] 10 kV Max. (No destruction)
Measurement environment:	Use electrostatic testing device compliant with IEC 61000-4-2
Discharge resistance:	330 $\Omega$
Capacitor charging:	150 pF

## 10.6. MTBF

MTBF (Mean Time Between Failures)	30,000 hours (excluding the following parts)
Laser diode :	10,000 hours
Mirror scan unit :	10,000 hours

## 11. Regulatory Compliance

### 11.1. Laser Safety

IEC 60825-1 Ed.2: 2007/2014 Class 2  
CDRH Class II

### 11.2. EMC

Radio equipment type OPN-2500 is in compliance with Directive 2014/53/EU

This device complies with part 15 of the FCC Rules. Operation is subject To the following two conditions: ( 1 ) this device may not cause harmful Interference, and ( 2 ) this device must accept any interference received, including interference that may cause undesired operation.

FCC RF Radiation Exposure Statement:

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. For portable operation, this device has been tested and meets FCC RF exposure guidelines. When used with an accessory that contains metal may not ensure compliance with FCC RF exposure guidelines.

15.21

You are cautioned that changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

15.105(b)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## 12. RoHS

The OPN-2500 is compliant with RoHS.

RoHS: The restriction of the use of certain hazardous substances in electrical and electronic equipment, 2002/95/EC

## 13. Precautions

### 13.1. Precaution against Laser Light

\*Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Caution –

Do not stare into the laser light from a scanning window. It may harm your eyes.

Do not point the laser directly at others' eyes. It may harm your eyes.

Do not stare into the beam with optical instruments. It may harm your eyes.

### 13.2. Handling

Handle this product carefully. Do not deliberately subject it to any of the following:

#### (1) Shock:

- Do not drop this product from a height greater than specified in this manual.
- Do not place this product under or between any heavy items.
- Do not swing this product around holding the hand strap.

#### (2) Temperature Conditions:

- Do not use this product at temperatures outside the specified range.
- Do not pour boiling water on this product.
- Do not throw this product into a fire.

#### (3) Foreign Materials:

- Do not immerse this product in water or other liquid.
- Do not expose this product to chemicals.

#### (4) Battery:

**CAUTION**  
**RISK OF EXPLOSION IF BATTERY IS REPLACED**  
**BY AN INCORRECT TYPE.**  
**DISPOSE OF USED BATTERIES ACCORDING**  
**TO THE INSTRUCTIONS**

#### (5) Others

- Do not disassemble this product.
- Do not use this product near a radio or a TV. It may cause reception problems.
- This product may be affected by a momentary voltage drop caused by lightning.
- This product may not perform properly in a place where it will be subjected to a flickering light, such as a CRT (computer monitor, television, etc.).

\* This specification manual is subject to change without prior notice.

## Appendix 1: Mechanical Drawing

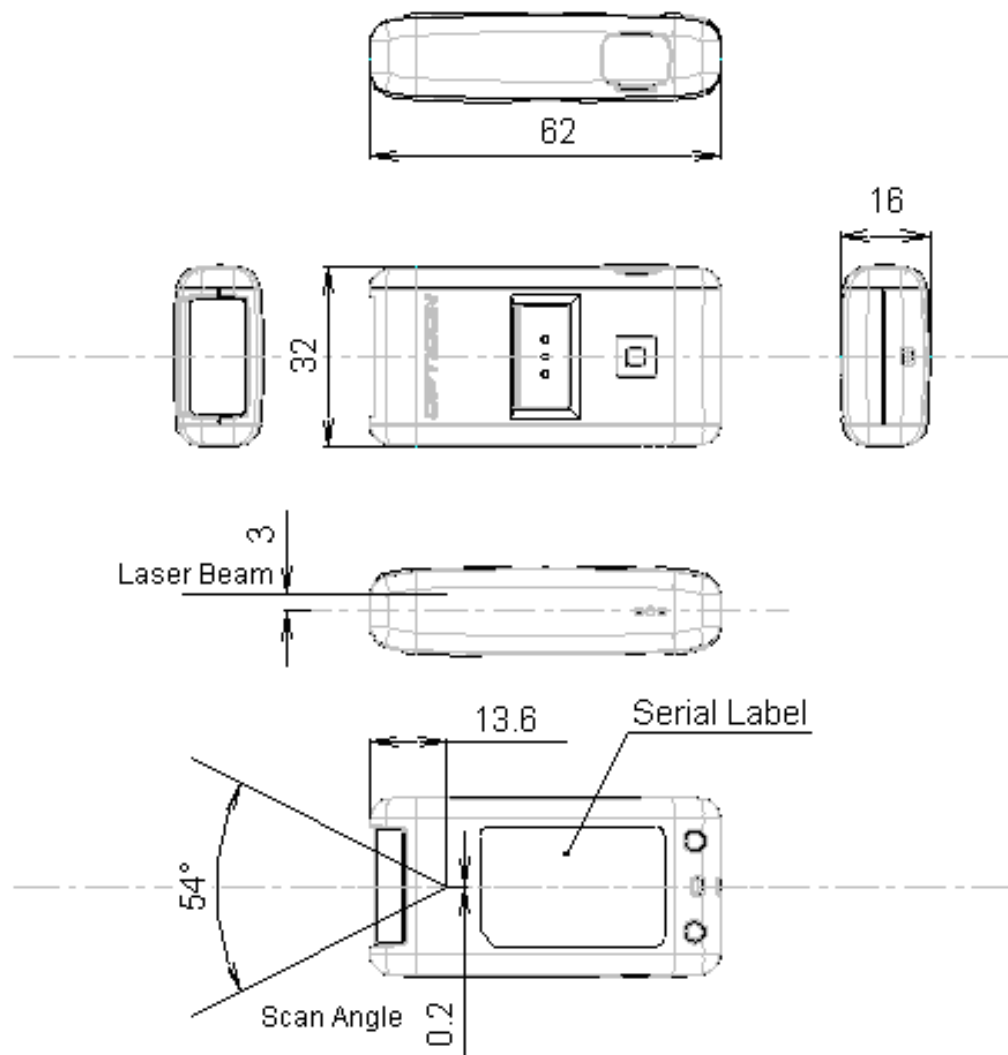


Figure 14: Mechanical Drawing