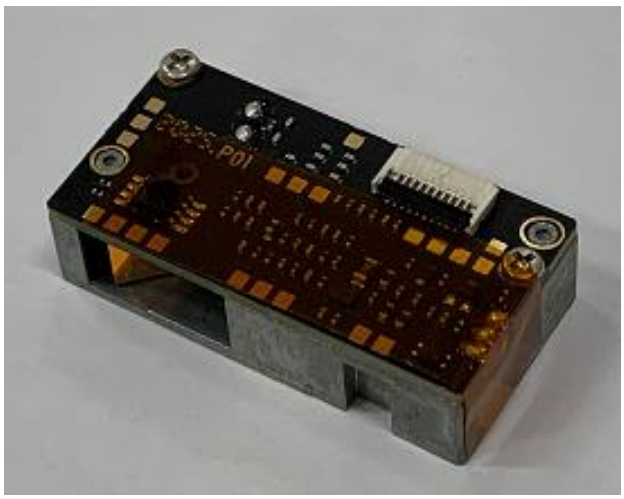
SPECIFICATIONS MANUAL

MSL-1400

1D Laser Scan Engine



Low Profile High-performance Laser Scan Engine

1st

OPTICON

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Document History

Model Number:	MSL-1400	Specification Number:	SSxxxxx
Edition:	1st	Original Spec Number:	(SSxxxxx)
Date:	29-March-2021		

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Limited Warranty and Disclaimers

Please read this manual carefully before installing or using the product.

Serial Number

A serial number appears on all Opticon products. This official registration number is directly related to the device purchased. Do not remove the serial number from your Opticon device. Removing the serial number voids the warranty.

Warranty

Unless otherwise agreed in a written contract, all Opticon products are warranted against defects in materials and workmanship for two years after purchase excluding batteries. Opticon will repair or, at its option, replace products that are defective in materials or workmanship with proper use during the warranty period. Opticon is not liable for damages caused by modifications made by a customer. In such cases, standard repair charges will apply. If a product is returned under warranty and no defect is found, standard repair charges will apply. Opticon assumes no liability for any direct, indirect, consequential or incidental damages arising out of use or inability to use both the hardware and software, even if Opticon has been informed about the possibility of such damages.

Packaging

The packing materials are recyclable. We recommend that you save all packing material to use should you need to transport your data collector or send it for service. Damage caused by improper packaging during shipment is not covered by the warranty.

Trademarks

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Revision History

Product Name : MSL-1400

Edition	Date	Page	Section	Description of Changes
pre	2021/3/29	-	-	1st

Contents

Table of Figures

1 Abstract

This manual provides specifications for the MSL-1400 laser scan engine.

2 Overview

The MSL-1400 laser scan engine (hereinafter called as “this scan engine”) is a compact laser bar code scan engine which can be installed in various handheld products such as handy terminals. When scanning a target from the minimum scanning distance, this scan engine can scan up to 44 mm wide at an angle of 44°. The use of short wave-length red laser beam enhances the visibility when scanning lines.

This scan engine scans bar codes using laser light and out put those bar code images in logic level signal (hereinafter called as “signal”). This scan engine also outputs timing waveforms (signals) synchronized with scanning. Such timing waveforms (signals) are hereinafter called as “TIMING”. This scan engine can be turned on and off via external input signal “POWER EN”. The laser light emission of this scan engine can be controlled via external input signal “LASER EN”.

This scan engine is compliant with RoHS.

3 Physical Features

3.1 Dimensions

Laser Scan Engine (MSL-1400) 28 x 14 x 8.0 (WDH: mm)

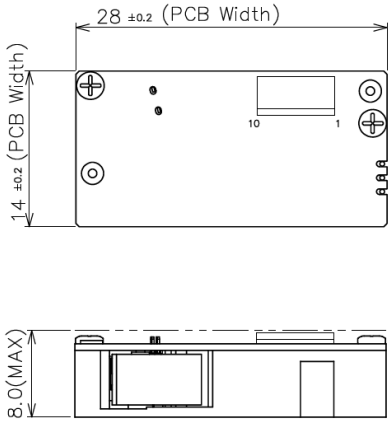


Figure **1***: Dimensions of the MSL-1400*

3.2 Weight

Laser Scan Engine (MSL-1400) 8.4g (typ) 9.0 g (max)

4 Electrical Specifications

4.1 Absolute Maximum Ratings

Item	Symbol	Rated Value	Unit
Power Supply Voltage (V_{CC} to GND)	V_{CC}	-0.3 ~ 3.9	V
Input Voltage	V_I	-0.3 ~ V_{CC} +0.3	V

* Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

4.2 Recommended Operating Conditions

Item	Symbol	Rated Value	Unit
Power Supply Voltage (V_{CC} to GND)*	V_{CC}	3.0 ~ 3.6	V
Input Voltage	V_I	0 ~ V_{CC}	V

4.3 Current Consumption

(V_{CC} = 3.3V, T_A = 25℃)

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Peak Rush Current *	Power On	I_{Peek}	With Vcc Applied	-	250	500	mA

* Measured at the MSL-1400 connector

(V_{CC} = 3.3V, T_A = 25℃)

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Current 1	Read	I_{OP1}	-	-	35	45	mA
Operating Current 2	Read	I_{OP2}	-	-	55	65	
Idle current	Idle	I_{IDL}	POWER EN = ON, LASER EN = OFF	-	35	45	mA
Low Power Mode current	Low Power	I_{Low}	-	-	-	1	uA

4.4 Signal Electrical Characteristics

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Laser EN, Power EN, POLARITY, Filter SEL1, Filter SEL2,	Input Voltage	V_{IH}		V_{CC} -0.5	-	-	V
		V_{IL}		-	-	0.5	V
SIGNAL, TIMING	Output Voltage	V_{OH}	I_{OH} < 1mA	V_{CC} -0.3	-	-	V
		V_{OL}	I_{OL} < 1mA	0	-	0.3	V

*1 CMOS logic levels

4.5 Current Waveform

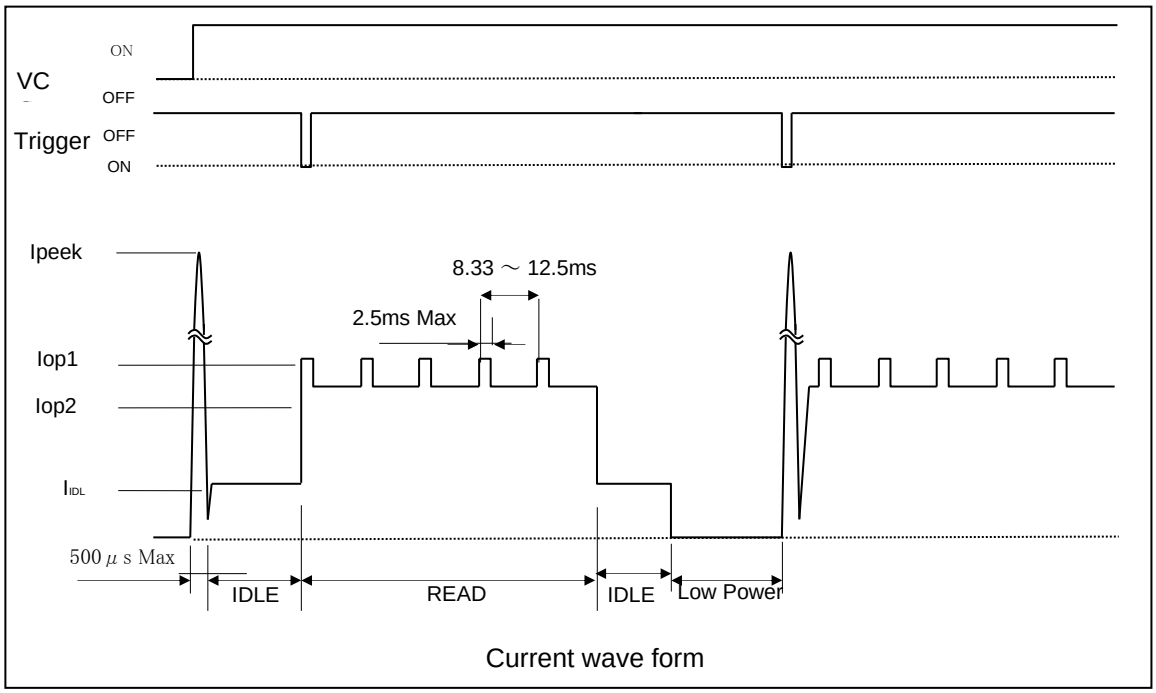


*Figure **2**: Current Waveform*

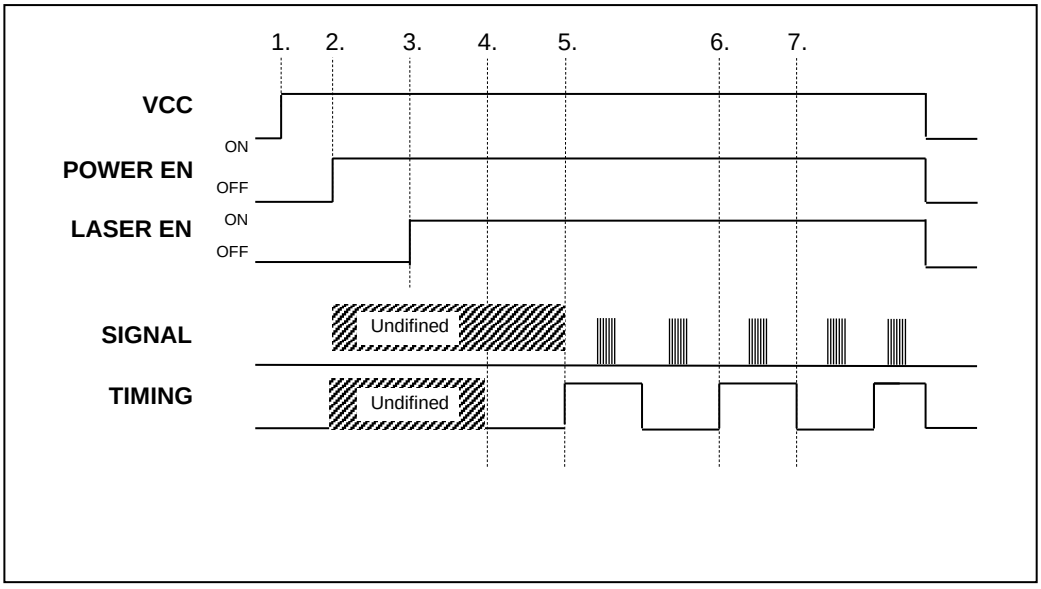
5 Interface Specifications

5.1 Interface Connector

No.	Signal	I/O	Electrical Specifications
1	Vcc	-	Power Supply: DC 3.0 to 3.6V
2	LASER EN	I	C-MOS Logic Level for Laser Control (ON/OFF: High = ON, Low = OFF)
3	POWER EN	I	C-MOS Logic Level for Power Supply (ON/OFF: High = ON, Low = OFF)
4	SIGNAL	O	C-MOS Logic Level for Logic Output of Bar Code Image: (High = Bars, Low = Spaces)
5	TIMING	O	C-MOS Logic Level for Synchronously-scanned Output: (High = Left to Right, Low = Right to Left)
6	POLARITY	I	C-MOS Logic Level for Selecting Signal Polarity: (High = Reversed Symbol, Low = Normal)
7	Filter SEL 1	I	C-MOS Logic Level for Selecting Analog Processing Filter
8	Filter SEL 2	I	SEL1/2 (00 = Standard Mode, 01 = Mode 1, 10 = Mode 2, 11 = Mode 3)
9	TEST	I	Set to Low or Open
10	GND	-	Ground

Connector used was produced by Molex
Product No. 503480-1000
10 pin 0.5 mm pitch FFC Connector Bottom contact, BackFlip.

5.2 Timing Waveform



Interface Timing

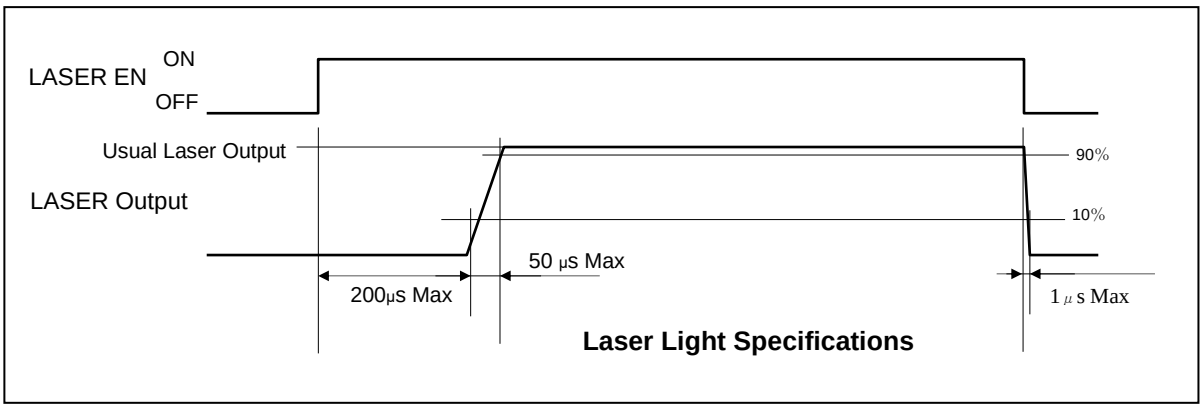
Timing	Items	Marks	Minimum	Maximum	Unit
1 - 2	POWER EN (ON)	T_{PS}	0	-	mSec
2 - 3	LASER EN (ON)	T_{LS}	10	-	mSec
2 – 4	TIMING (ON)	T_{TUP}	-	60	mSec
3 – 5	SIGNAL (ON)	T_{SUP}	0	100	mSec
6 - 7	TIMING (Width)	T_{TW}	8.33	12.5	mSec

- The interface timings listed above are conditional on the quality of bar codes. Bar codes with quality satisfying the quality specified in “7-1. Decode Depth of Field and Resolution” must be in the depth field specified therein.
- When there is a defect in a scanning circuit, the Timing signal does not satisfy the Timing (Width) above. In order to detect a defect in the scanning circuit, monitor the TIMING signal 60mSec after POWER EN is ON.
- The TIMING (ON) and the SIGNAL (ON) are conditional on the POWER EN (ON) and the LASER EN (ON) satisfying the specifications.

Note: Rising and falling periods of “LASER EN”
Rising and falling time periods for “LASER EN” must be set within 100µs. The laser may get damaged due to the anomalous emission of light if foregoing time period is longer than 100µs.

5.3 Laser Light Specifications

Items	Conditions	Minimum	Typical	Maximum	Unit
Time Delayed	LASER EN = ON	—	100	200	µsec
Start-up Time	LASER EN = ON	—	10	50	µsec
Falling Time	LASER EN = OFF	—	—	1	µsec



Laser Light Specifications

6 Optical Specifications

6.1 Laser Scanning

Parameter	Specification	Unit
Light-emitting element	Red laser diode	-
Emission wavelength	645 ~ 664 (25° C)	nm
Light output	1.6 or less	mW
Scanning method	Bi-directional scanning	-
Scanning speed	100 ±20	scans/s
Scan angle	Scan angle: 54 ±5	degrees
	Read angle: 44 (Min)	degrees

6.2 Laser Line Specifications

1. Tilt of Scan Line
   The angle between the average center of the scan line and the horizontal line:
   0.92° or less
   (Maximum 2.46 mm when measured at 150 mm from the scan origin.
   The measurement shall be done at the center of the scan line).

2. Curvature of Scan Line
   The curvature is the angle between two lines, the tilt line (as described above this is the average center of the scan line) and the line connecting the scan origin and the top of the scan line.
   The curvature is 1.17° or less (Maximum of 3.06 mm measured at 150 mm from the scan origin.)

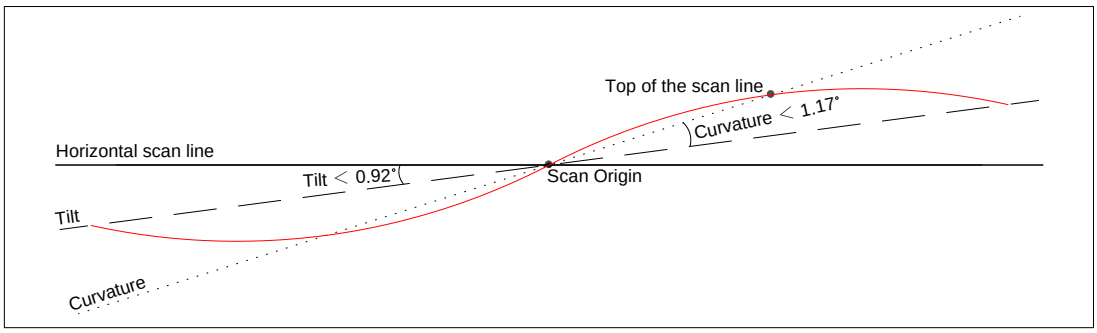


Figure ***3****: Laser line Tilt and Curvature*

7 Technical Specifications

The conditions for the technical specifications are as follows, unless otherwise specified in each section.

Conditions

Ambient Temperature and Humidity	Room temperature and room humidity
Ambient Light	500 ~900 lux (excluding high-frequency lighting)
Pitch Angle	α = 0°
Skew Angle	β = 15°
Tilt Angle	γ = 0°
Code Position	Center of the laser line
Curvature	R = ∞
Power Supply Voltage	3.3 V
PCS	0.9 or higher
Scanning Test	Approve the performance when decoding is successful in over 95%.
Barcode Test Sample	Specified below

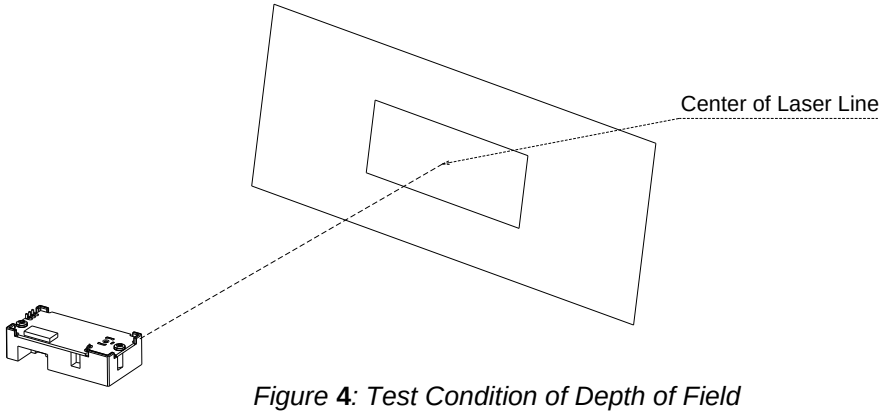


*Figure **4**: Test Condition of Depth of Field*

Barcode test labels

<Code 39>

Resolution	Symbology	PCS(MRD)	Size (mm)	No. of Digits
0.076 mm (3mil)	Code 39	0.9 (70)	7.5 × 10	5
0.127 mm (5mil)			11 × 10	4
0.15 mm (mil)			26 × 10	10
0.20 mm (7.9mil)			110 × 10	34
0.254 mm (10mil)			32.5 × 12	7
0.508 mm (20mil)			43 × 25	3
1.016 mm (40mil)			42.5 × 30	1

<Code 128>

Resolution	Symbology	PCS(MRD)	Size (mm)	No. of Digits
0.18 mm (7.1mil)	Code 128	0.9 (70)	32 × 10	13

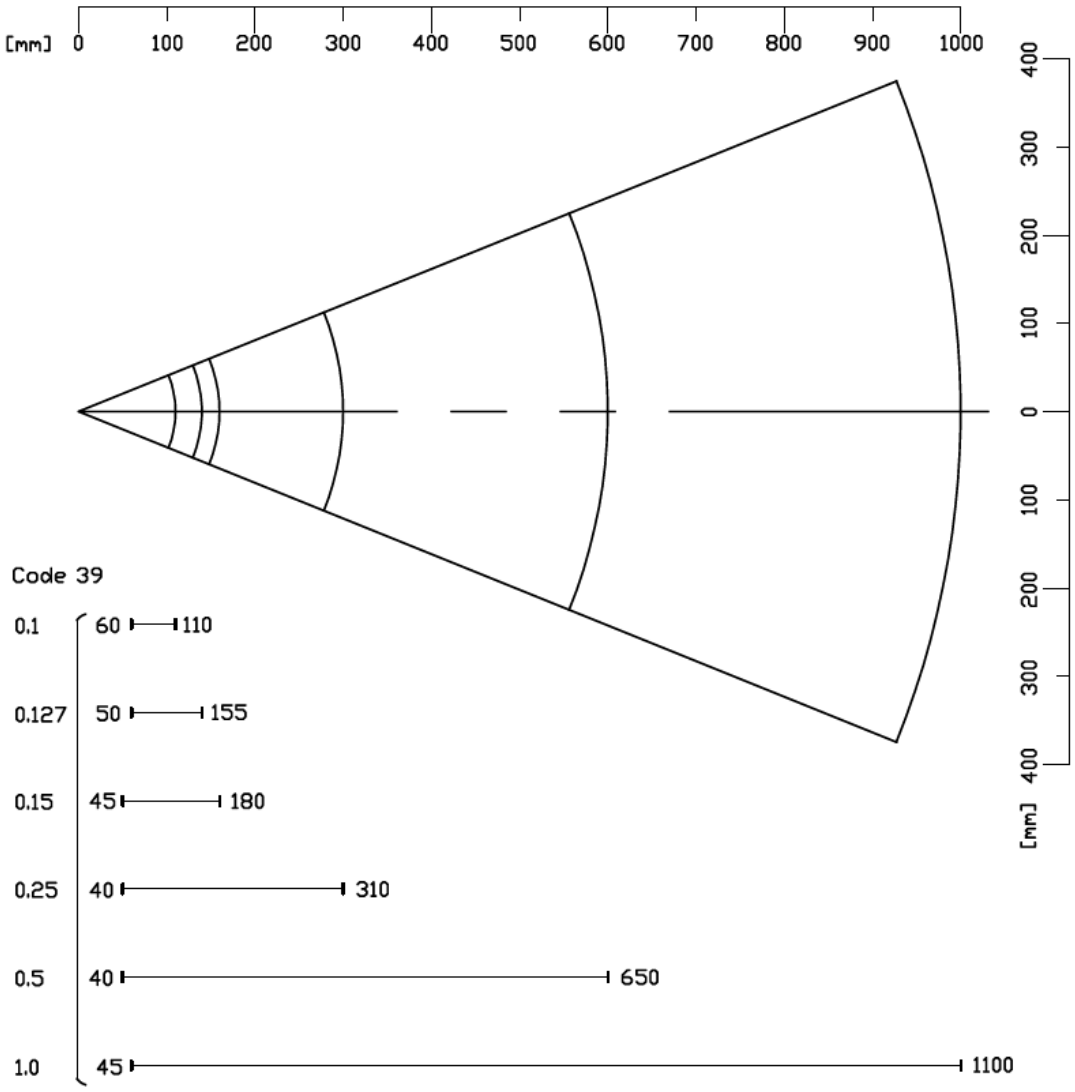
<UPC/EAN>

Resolution	Symbology	PCS(MRD)	Size (mm)	No. of Digits
0.330 mm (13mil)	UPC/EAN	0.9/0.2 (70/13)	31.5 × 24.5	12/13

Note: The size is outline dimensions excluding quiet zone.

7.1 Scan Area and Depth of Fields

The scan area is measured from the front edge of the scan engine.
Filter Selection : Standard Mode



*The depth of field values mentioned are the typical values measured at an ambient temperature of 25°C

Figure **5***: Scan Area and Depth of Field*

7.2 Scan Area and Depth of Fields

The scan area is measured from the front edge of the Laser module.
Filter Selection : Standard Mode

(T_A = 25 °C)

Resolution mm (mil)	Symbology type	PCS (MRD)	Guaranteed Value		Typical Value	
			Near	Far	Near	Far
0.127 mm (5 mil)	Code 39	0.9 (0.7)	60 mm (2.2″)	130mm (5.3″)	50 mm (1.8″)	155 mm (6.1″)
0.15 mm (5.9 mil)	Code 39	0.9 (0.7)	50 mm (2.0″)	160 mm (6.3″)	45 mm (1.7″)	180 mm (7.2″)
0.18 mm (7.1 mil)	Code 128	0.9 (0.7)	50 mm (2.0″)	200 mm (8.2″)	45 mm (1.6″)	230 mm (9.6″)
0.254 mm (10 mil)	Code 39	0.9 (0.7)	45 mm (1.8″)	280 mm (11.2″)	40 mm (1.6″)	310 mm (12.8″)
0.33mm (13mil)	UPC/EAN	0.9 (0.7)	40 mm (1.6″)	350 mm (14.5″)	37 mm (1.5″)	400 mm (16.5″)
0.508 mm (20 mil)	Code 39	0.9 (0.7)	45 mm (1.8″)	500mm (23.6″)	40 mm (1.5″)	650 mm (26.9″)
1.018 mm (40mil)	Code 39	0.9 (0.7)	50 mm (2.0″)	900 mm (39.3″)	45 mm (1.8″)	1100 mm (48.4″)

7.3 Print Contrast Signal

PCS 0.2 or higher

Conditions

MRD	13 and higher (70% or higher reflectivity of space and quiet zone)
Distance	110 mm from the front edge of the laser module
Barcode Sample	UPC specified in Chapter 8. (Resolution: 0.33 mm, PCS: 0.2)

MRD = Minimum reflectance of white space - Maximum reflectance of black bar

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

7.4 Minimum Resolution

1D Code 0.076 mm (3 mil) Code 39 specified in Chapter 8

Conditions

Distance	65 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞

7.5 Barcode Width

110 mm

Conditions

Barcode Sample	0.20 mm Code 39 specified in Chapter 8
Distance	150 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞

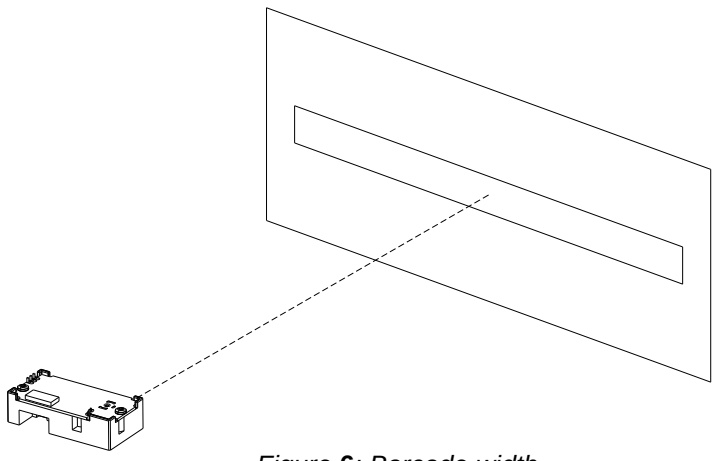


Figure **6***: Barcode width*

7.6 Pitch, Skew, and Tilt

Pitch	α = ±45°
Skew	β = ±65°
Dead zone	β ≤ ±8° (There are some areas where decoding fails due to specular reflection)
Tilt	γ = ±25°

Conditions

Barcode Sample	0.25 mm Code 39 specified in Chapter 8
Distance	110 mm from the front edge of the laser module
Curvature	R = ∞

For pitch angle and tilt angle measurements, set the skew angle β to +15°

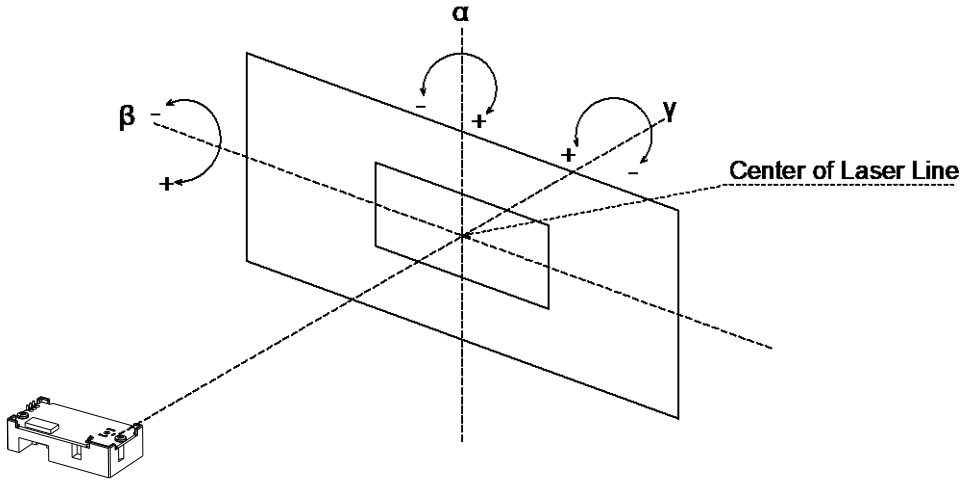


Figure **7***: Pitch, Skew, and Tilt*

7.7 Curvature

0.33 mm 12-digit UPC	R ≧ 20 mm

Conditions

Barcode Sample	0.33 mm UPC/EAN specified in Chapter 8
Distance	110 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°

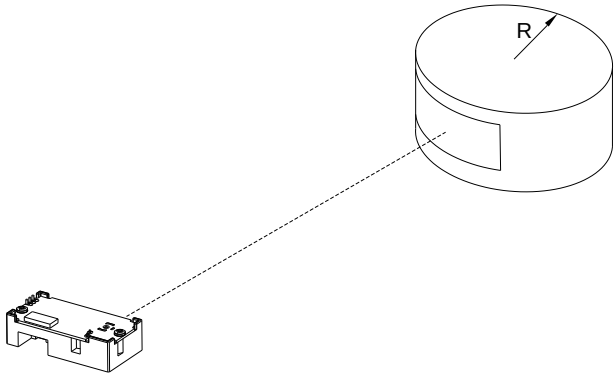


Figure **8***: Curvature*

7.8 Motion Tolerance

6 m/s.

Conditions

Ambient Temperature and Humidity	Room temperature and Room humidity
Ambient Light	500 lux to 1000 lux (on the surface of the barcode)
Distance	110 mm from the front edge of the laser module
Skew	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V
PCS	0.9 or higher
Barcode Sample	UPC with 0.33 mm resolution specified in Chapter 8

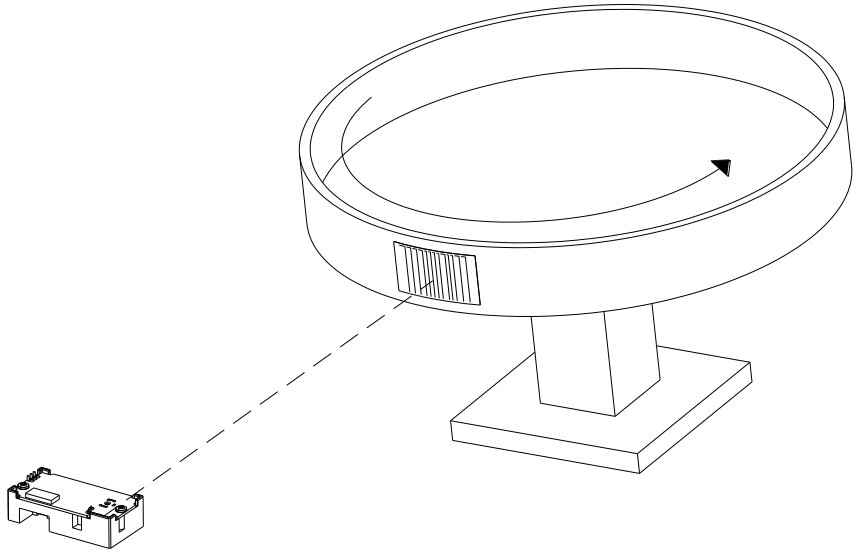


Figure **9***: Motion Tolerance*

Note: Successful reading at the indicated speed cannot be guaranteed. Reading may fail due to specular reflection of the laser line when reflectivity is high.

8 Environmental Specifications

8.1 Temperature

Operating Temperature	-20 to 65 °C
Storage Temperature	-30 to 70 °C

Conditions

Barcode Sample	0.33 mm UPC specified in Chapter 8
Distance	110 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V

8.2 Humidity

Operating Humidity	5 to 90% RH (no condensation, no frost)
Storage Humidity	5 to 90% RH (no condensation, no frost)

Conditions

Barcode Sample	0.33 mm UPC specified in Chapter 8
Distance	130 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V

8.3 Ambient Light Immunity

Scanning performance is guaranteed when the illuminance on the surface of a barcode is between zero and the following values:

Incandescent Light	4,000 lux
Fluorescent Light	4,000 lux
Sunlight	80,000 lux

Conditions

Barcode Sample	0.33 mm UPC specified in Chapter 8
Distance	150 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V

Avoid specular (mirror like) reflection from the laser line.
Note: α, β and γ respectively represent pitch, skew and tilt. Refer to section 7.6 for details on those parameters.

8.4 Electrical Noise

No malfunction occurred when sinusoidal electrical noise (50 Hz -100 kHz, < 0.1Vp-p) was added to the power supply line.

Conditions

Scan Method	Continuous scanning
Barcode Sample	0.33 mm UPC specified in Chapter 9
Distance	150 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V

8.5 Vibration Strength

No malfunction occurred after the following vibration test.
Vibration test: Increase the frequency of the vibration from 12 Hz to 200 Hz with accelerated velocity 32.3 m/s^2 (3.3 G) for over 10 minutes. Repeated this routine for 2 hours to X direction, 2 hours to Y direction, and 4 hours to Z direction.

Conditions

Barcode Sample	0.33 mm UPC specified in Chapter 8
Distance	150 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V

8.6 Shock

No malfunction occurred after the following drop test.
Drop Test: Fixed an MSL-1400 in a specific an aluminum-made dummy case 80x50x30 (WDH :mm) and dropped it on its top, bottom, front, back, left, right, top-left, top-right, bottom-left and bottom-right sides from 1.8 meters above a concrete floor. Repeated this routine ten times.

Conditions

Barcode Sample	0.33 mm UPC specified in Chapter 8
Distance	150 mm from the front edge of the laser module
Angle	α = 0°, β =+15°, γ = 0°
Curvature	R = ∞
Power Supply Voltage	3.3 V

9 Integration Specifications

Connection between the MSL-1400 and a host system:

Use a FFC or FPC cable developed in accordance with specifications provided by the connector manufacturer to connect the MSL-1400 with the host system.

The connector used is produced by Molex Electronics Co., Ltd.

Product No.	503480-1000 (10pin, 0.5mm pitch, 0.3mm thick, back flip type)
Recommended Cable Length	xx mm (max)

10 Regulatory Compliance

Laser Safety

IEC 60825-1：2014, EN60825-1：2014 Class 1

11 RoHS

RoHS: The restriction of the use of certain hazardous substances in electrical and electronic equipment, 2011/65/EU.

12 Reliability

MTBF (Mean Time Between Failures)	30,000 hours (excluding the laser diode and the mirror scan unit)
Life cycle of laser diode	10,000 hours
Life cycle of mirror scan unit	10,000 hours

Note: These values are calculated based on standard operation of the product within the recommended temperature range and without extreme electronic or mechanical shock.

13 Precautions

13.1 Precautions

Caution – The use of controls, adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Caution – Do not stare into the laser beam directly. It may harm your eyes.
Do not point the laser directly at others' eyes. It may harm their eyes.
Do not view the laser beam directly with optical instruments. It may harm your eyes.

13.2 Handling

- All work-benches, tools, measuring instruments and any part of the human body that may come into contact with MSL-1400 must undergo preliminary antistatic treatment.
- Do not touch the optical and electrical components. Hold the MSL-1400 on the metal chassis when you pick it up.
- Avoid handling MSL-1400 in a dusty area. In case dust gets on this product, gently blow it off with dry air. Direct contact of swabs and such on its optical part may cause deterioration of its performance.
- Do not drop the MSL-1400.

14 Serial Number

The serial number label shown below is affixed to the MSL-1400.

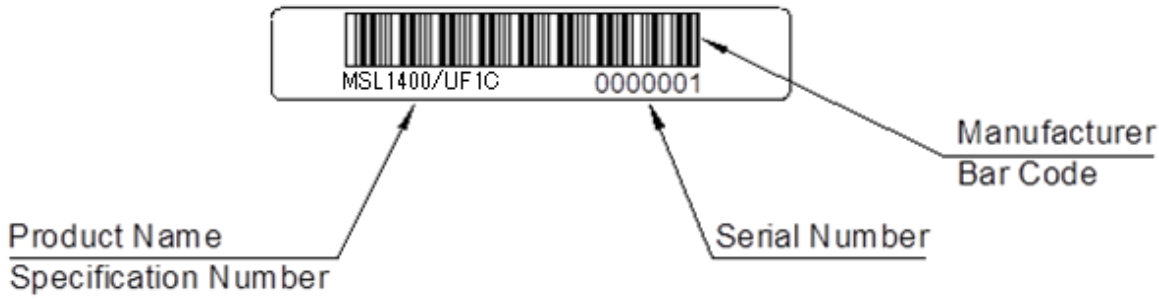


Figure **10***: Serial Number Label*

Top half	Manufacturer barcode
Data	7-digit serial number
Symbology	Code 39
Lower half	Product name and specification number plus the serial number

*The serial number starts from 0000001 and is in order regardless of the lot number.

15 Packaging Specifications

15.1 Packaging

A carton box: 350 pieces MSL-1400 (MAX)

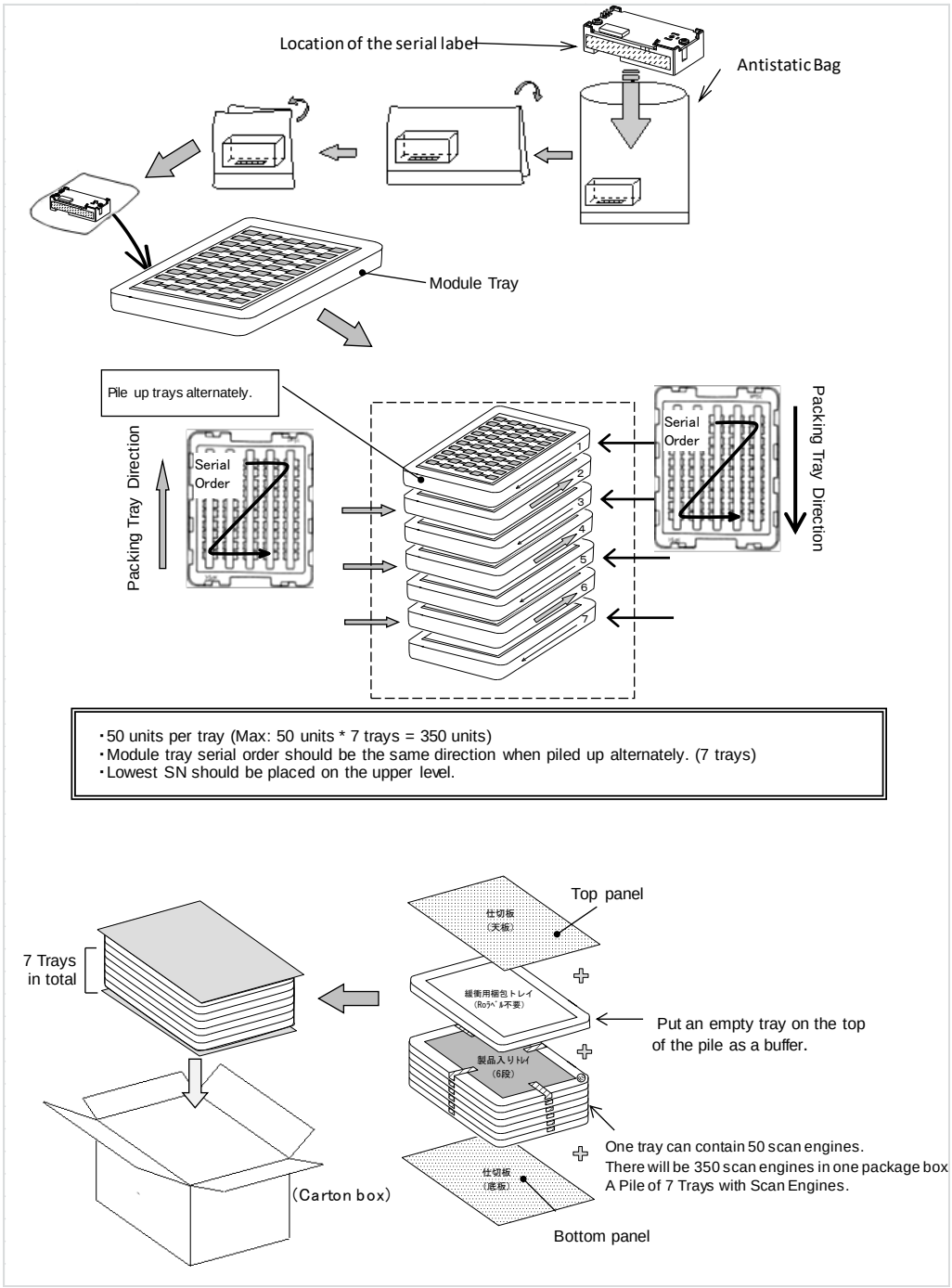


Figure **11***: Packaging*

15.2 Collective Packaging Dimention

355 (W) × 290 (D) × 185 (H) mm

Note: ‘Ro mark’ on the trays and the boxes for the product indicates that the product is RoHS compliant as declared by Optoelectronics Co., Ltd.

16 Mechanical Drawing

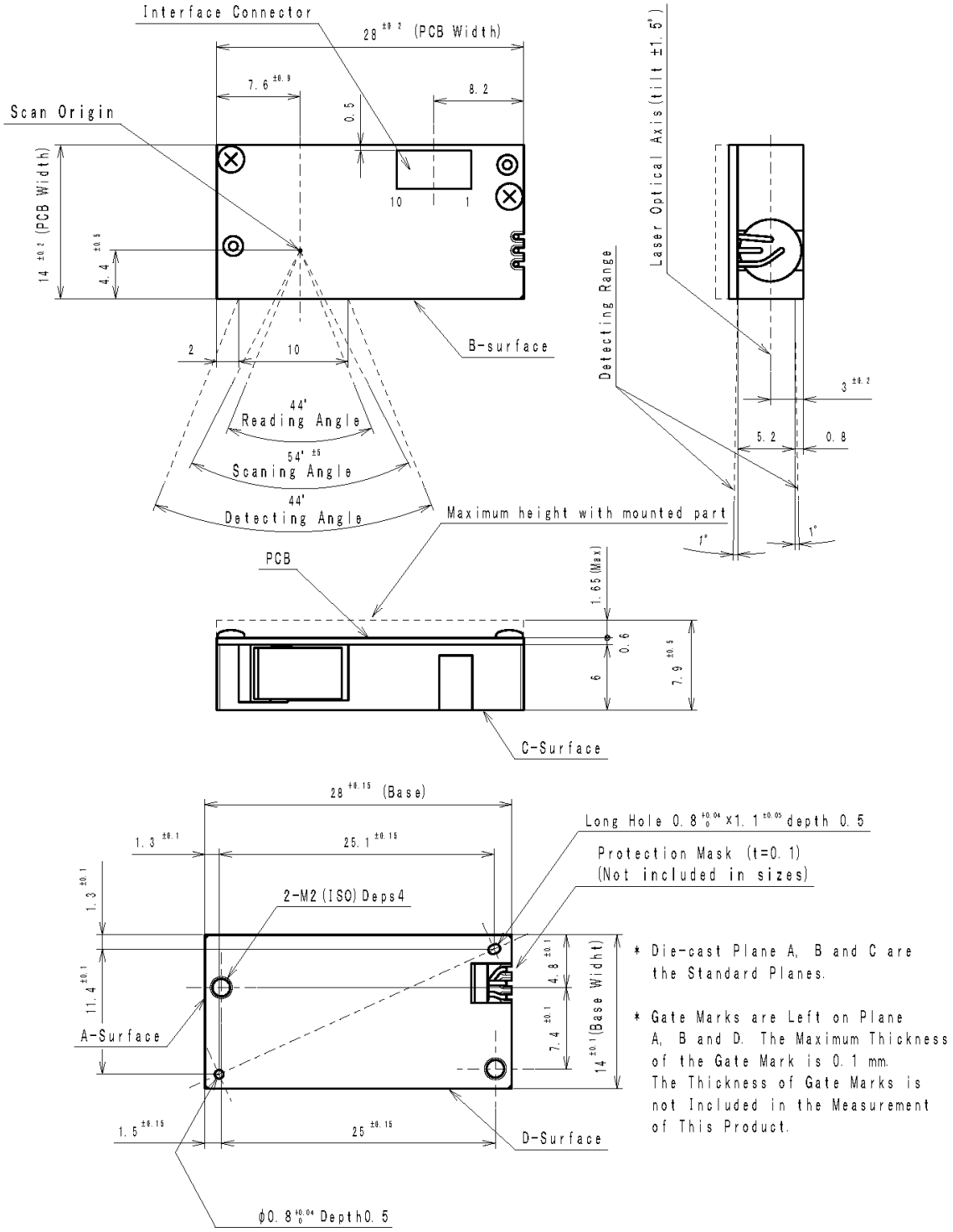


Figure **12***: Drawing (MSL-1400)*