MDL-1500

Laser Scan Engine

Specification Manual – Rev 3.0

The information in this document is subject to change without notice.

Document History

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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.

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Revision History

Product Name : MDL-1500 Specifications Manual

Edition	Date	Page	Section	Description of Changes
1st	2016/11/01	-	-	1st Spec Version
2nd	2016/12/14	-	-	Spelling corrections all over the document
3rd	2024/07/26	-	-	Updated to new layout

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1 Abstract

This manual provides specifications for the MDL-1500 laser scan engine.

2 Overview

The MDL-1500 laser scan engine is a compact laser barcode scan engine that can be installed in various handheld products such as handy terminals, data collectors and ticket readers. This module is capable of scanning target codes of up to 44 mm width at close range and wider labels at greater distance determined by the 44° scan angle. The use of short wave-length red laser beam enhances the visibility of the scan line.

A decoder is built in MDL-1500 that enables this scan engine to decode barcodes after scanning and output the information via its serial interface.

MDL-1500 is compliant to Restriction of Hazardous Substances (hereinafter called as “RoHS”).

3 Physical Features

3.1 Dimensions

Laser Scan Engine (MDL-1500)	28 x 14 x 8.0 (WDH: mm)

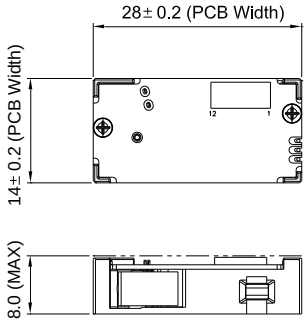


Figure **1***: Dimensions of the MDL-1500*

3.2 Weight

Laser Scan Engine (MDL-1500)	3.9 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 ~ 3.9	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		Boot	-	-	300	mA
	Idle		Recovery	-	-	200	mA
Rush Current Interval	Power On Idle		Boot Recovery	-	20	100	µs

* Measured at the MDL-1500 connector

(V_{CC} = 3.3V, T_A = 25℃)

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Current 1	Read		-	-	110	125	mA
Operating Current 1	Read		-	-	95	110	
Aiming current	AIM		AIM On	-	50	65	
Idle current	Idle		-	-	30	40	mA
Low Power Mode current	Low Power		-	-	0.05	-	mA

4.4 Signal Electrical Characteristics

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
TRIGn, AIM/WAKEn, RxD, CTS, N/C (*1)	Input Voltage			V_{CC} x 0.8	-	V_{CC}	V
				0	-	V_{CC} x 0.2	
GR_LEDn, BUZERn, TxD, RTS, POWERDWN (*1)	Output Voltage		I_{OH} =-1.0mA	V_{CC} -0.5	-	V_{CC}	
			I_{OL} =1.0mA	0	-	0.5	V

*1 CMOS logic levels

4.5 Recovery Time from Low Power and Power Down States

(V_{CC} = 3.3V, T_A = 25℃)

Item	Mode/State	Conditions	Min	Typ.	Max	Unit
Recovery time	Low Power Mode	-	-	11	-	ms
Boot time	Power Down	-	-	56	-	ms

4.6 Current Waveform

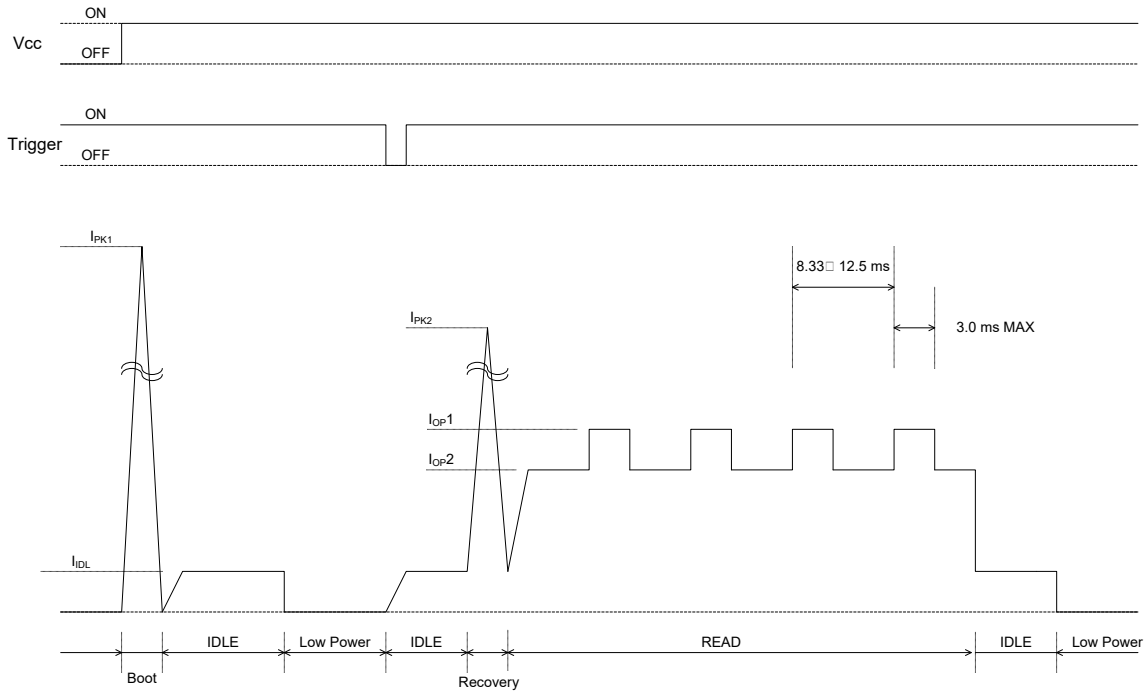


Figure ***2****: Current Waveform*

5 Power Mode Transition

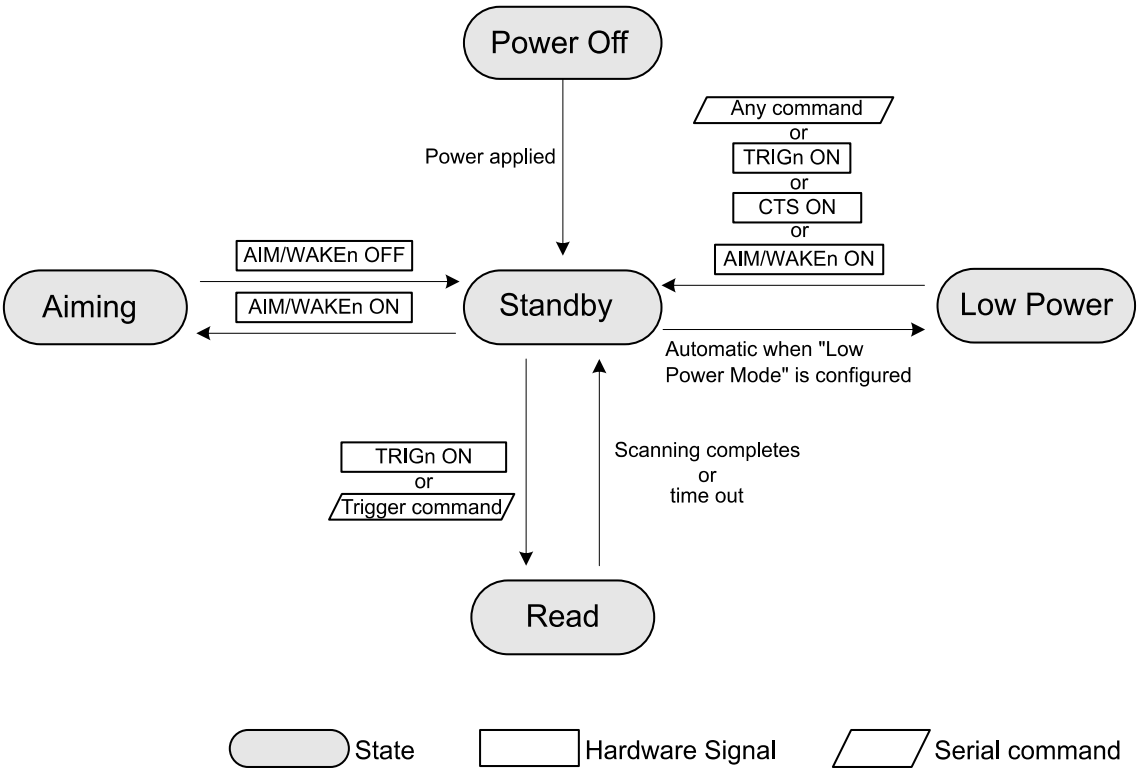


Figure **3***: Power Mode Transition*

6 Interface Specifications

No.	Signal	function	I/O	Control State	Annotation
1	N/C		I	High or Open	Pull up
2	V_{CC}	Power Supply	-	3.0～3.6V	
3	GND	Ground	-		
4	RxD	Input Serial Data, CMOS Logic Level	I		Pull up
5	TxD	Output Serial Data, CMOS Logic Level	O		Pull up
6	CTS	Clear to Send, CMOS Logic Level	I		Pull up
7	RTS	Request to Send, CMOS Logic Level	O		Pull up
8	POWERDWN	Power Down Output, CMOS Logic Level	O	L: Normal state H: Low Power state	Pull up
9	BUZERn	Buzzer Control Pulse Output, CMOS Logic Level	O	ACTIVE: PWM signal (frequency and duration configurable) IDLE: Steady high	PWM control Pull up
10	GR_LEDn	LED Output, CMOS Logic Level	O	L: LED on H: LED off	Pull up
11	AIM/WAKEn	Wakeup Input, CMOS Logic Level	I	L: Wake Up H: No action	Pull up
		Aiming Input, CMOS Logic Level	I	L: Aiming on H: Aiming off	
12	TRIGn	Trigger Input, CMOS Logic Level	I	L: Start operation H: No action	Pull up

Connector used was produced by IRISO ELECTRONICS CO., LTD..
Product No. IMSA-9681S-12Y901
12 pin 0.5 mm pitch FFC Connector Bottom contact.

7 Optical Specifications

7.1 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

7.2 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.)

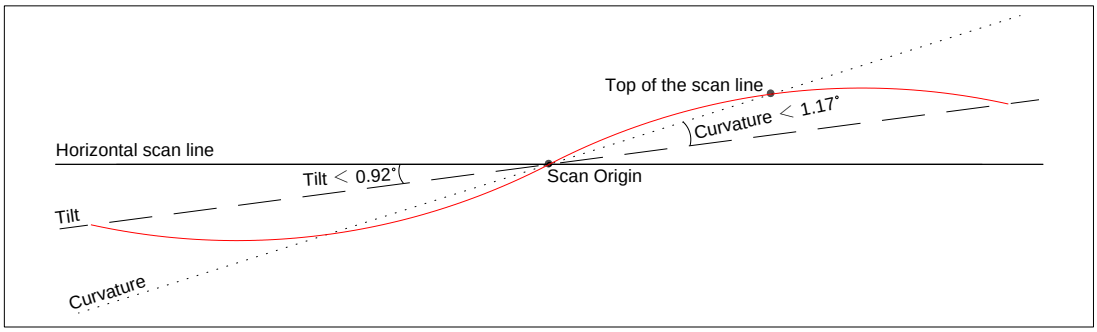


*Figure **4**: Laser line Tilt and Curvature*

8 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	700 ~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 all ten tests. (Decoding is deemed successful when completed in 0.5 seconds or less.)
Barcode Test Sample	Specified below

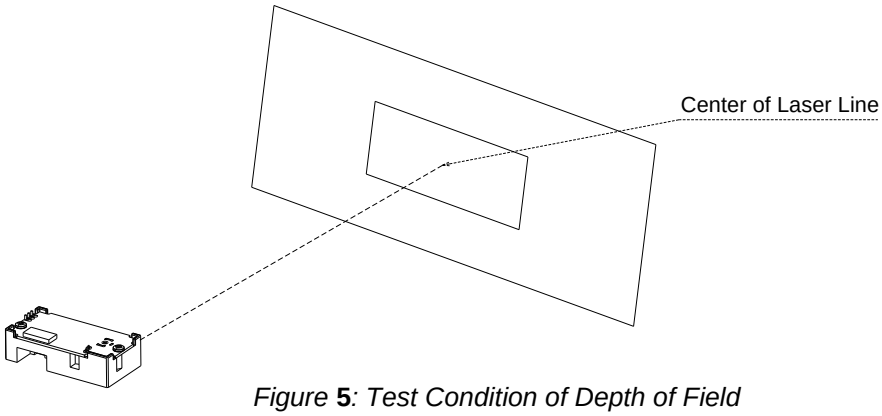


Figure ***5****: Test Condition of Depth of Field*

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

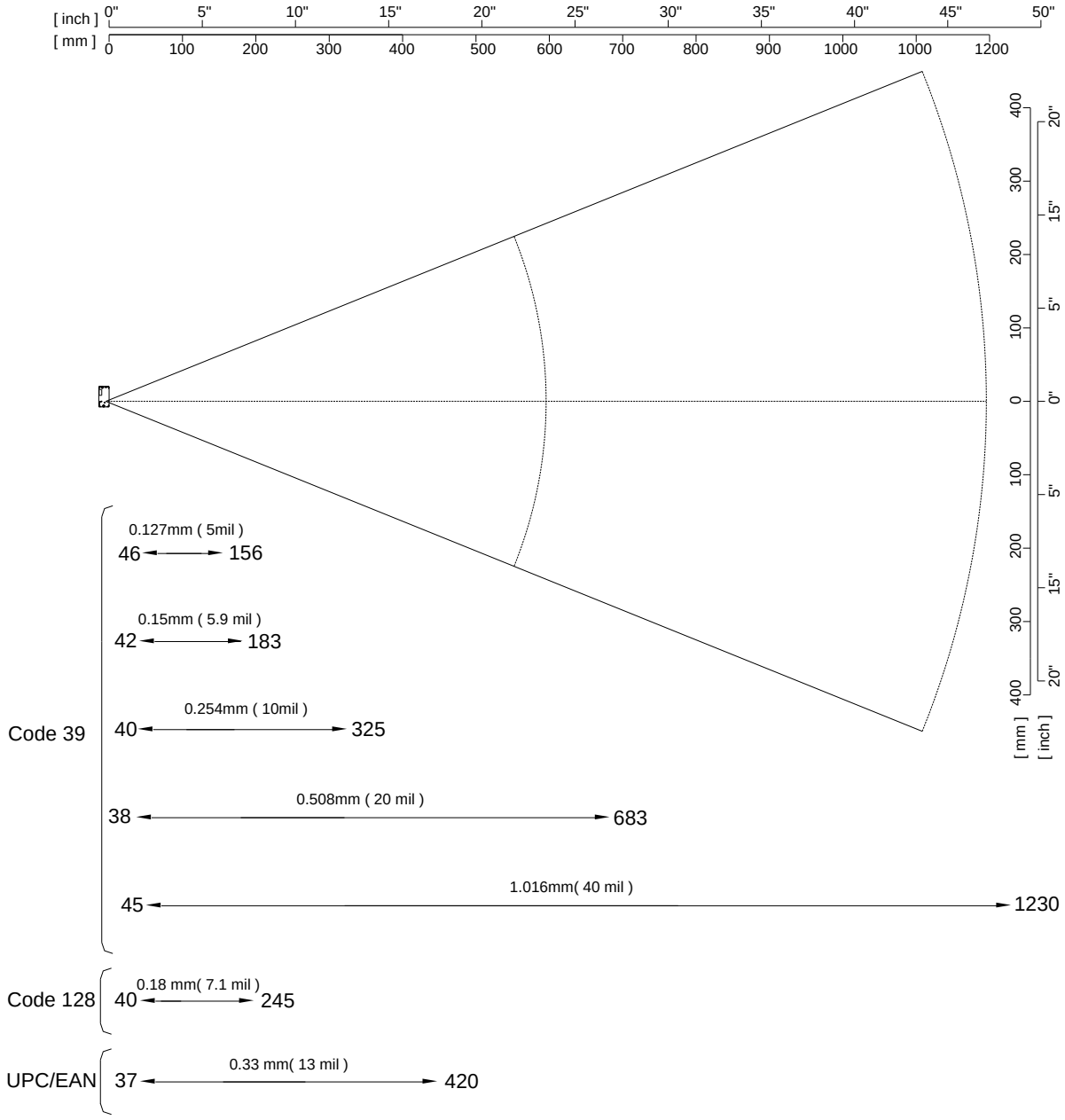
<UPC/EAN>

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.

8.1 Scan Area and Depth of Fields

The scan area is measured from the front edge of the scan engine.



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

Figure **6***: Scan Area and Depth of Field*

8.2 Scan Area and Depth of Fields

The scan area is measured from the front edge of the Laser module.

(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)	55 mm (2.2″)	135 mm (5.3″)	46 mm (1.8″)	156 mm (6.1″)
0.15 mm (5.9 mil)	Code 39	0.9 (0.7)	50 mm (2.0″)	160 mm (6.3″)	42 mm (1.7″)	183 mm (7.2″)
0.18 mm (7.1 mil)	Code 128	0.9 (0.7)	50 mm (2.0″)	210 mm (8.2″)	40 mm (1.6″)	245 mm (9.6″)
0.254 mm (10 mil)	Code 39	0.9 (0.7)	45 mm (1.8″)	285 mm (11.2″)	40 mm (1.6″)	325 mm (12.8″)
0.33mm (13mil)	UPC/EAN	0.9 (0.7)	40 mm (1.6″)	370 mm (14.5″)	37 mm (1.5″)	420 mm (16.5″)
0.508 mm (20 mil)	Code 39	0.9 (0.7)	45 mm (1.8″)	600 mm (23.6″)	38 mm (1.5″)	683 mm (26.9″)
1.018 mm (40mil)	Code 39	0.9 (0.7)	50 mm (2.0″)	1000 mm (39.3″)	45 mm (1.8″)	1230 mm (48.4″)

8.3 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

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

8.4 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 = ∞

8.5 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 = ∞

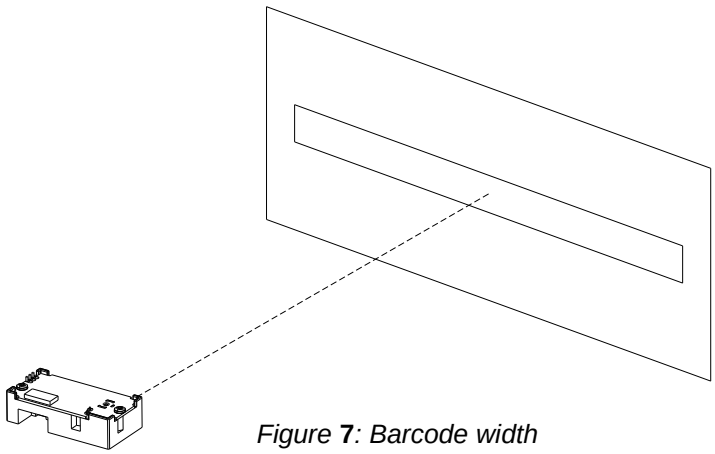


*Figure **7**: Barcode width*

8.6 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°

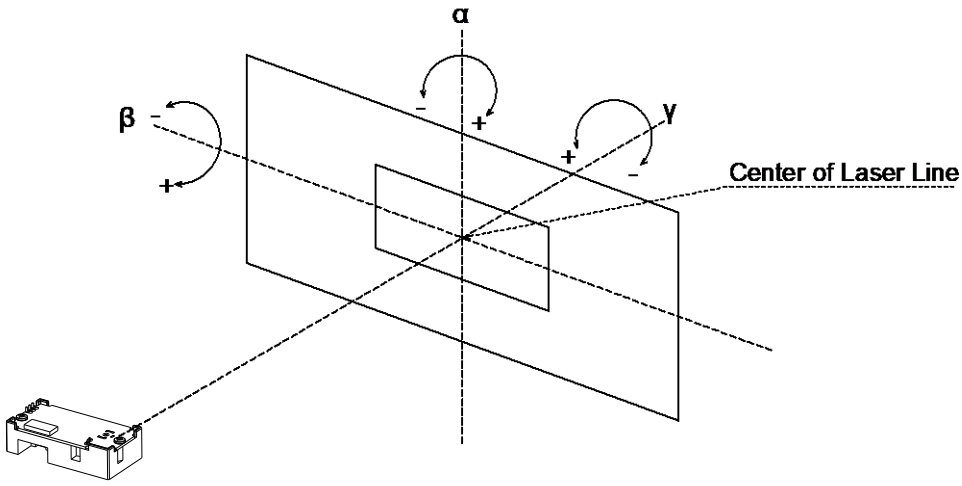


Figure **8***: Pitch, Skew, and Tilt*

8.7 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°

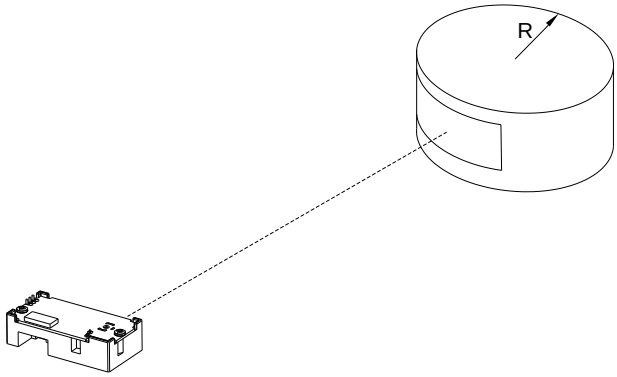


Figure **9***: Curvature*

8.8 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

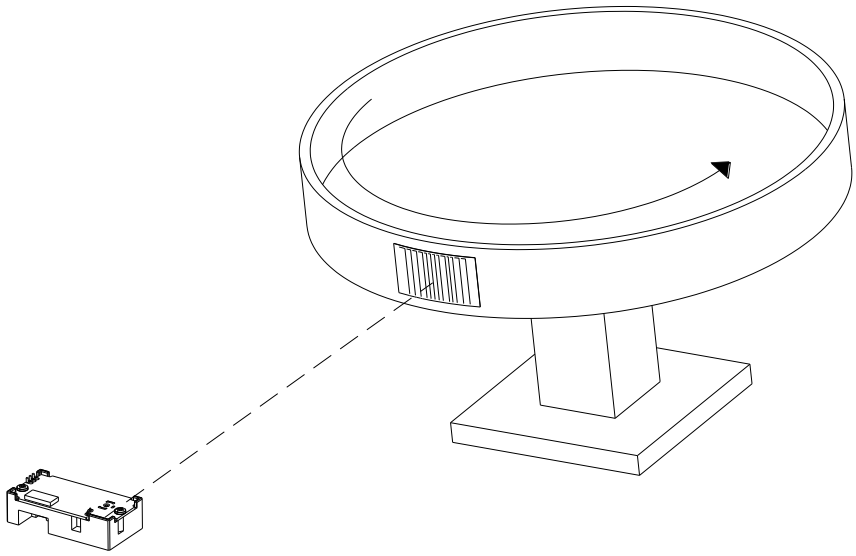


Figure **10***: Motion Tolerance*

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.

9 Environmental Specifications

9.1 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

9.2 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

9.3 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 0 for details on those parameters.

9.4 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

9.5 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

9.6 Shock

No malfunction occurred after the following drop test.
Drop Test: Fixed an MDL-1500 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

10 Integration Specifications

Connection between the MDL-1500 and a host system:

Use a FFC or FPC cable developed in accordance with specifications provided by the connector manufacturer to connect the MDL-1500 with the host system.

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

Product No.	9681-12 (12pin, 0.5mm pitch, 0.3mm thick)
Recommended Cable Length	50 mm (max)

11 Regulatory Compliance

Laser Safety

IEC 60825-1 : 2014 (3rd Edition) Class 2.

12 RoHS

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

13 Reliability

MTBF	30,000 hours
(Mean Time Between Failures)	(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.

14 Precautions

14.1 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.

14.2 Handling

- All work-benches, tools, measuring instruments and any part of the human body that may come into contact with MDL-1500 must undergo preliminary antistatic treatment.
- Do not touch the optical and electrical components. Hold the MDL-1500 on the metal chassis when you pick it up.
- Avoid handling MDL-1500 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 MDL-1500.

15 Serial Number

The serial number label shown below is affixed to the MDL-1500.

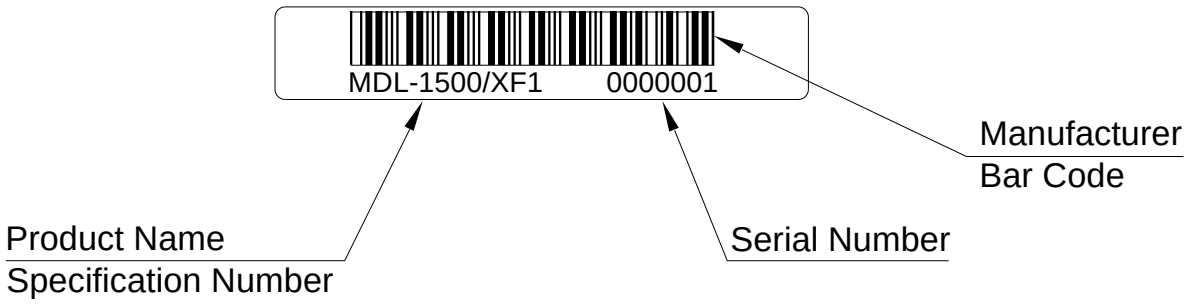


Figure **11***: Serial Number Label*

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.

16 Packaging Specifications

16.1 Packaging

A carton box: 350 pieces MDL-1500 (MAX)

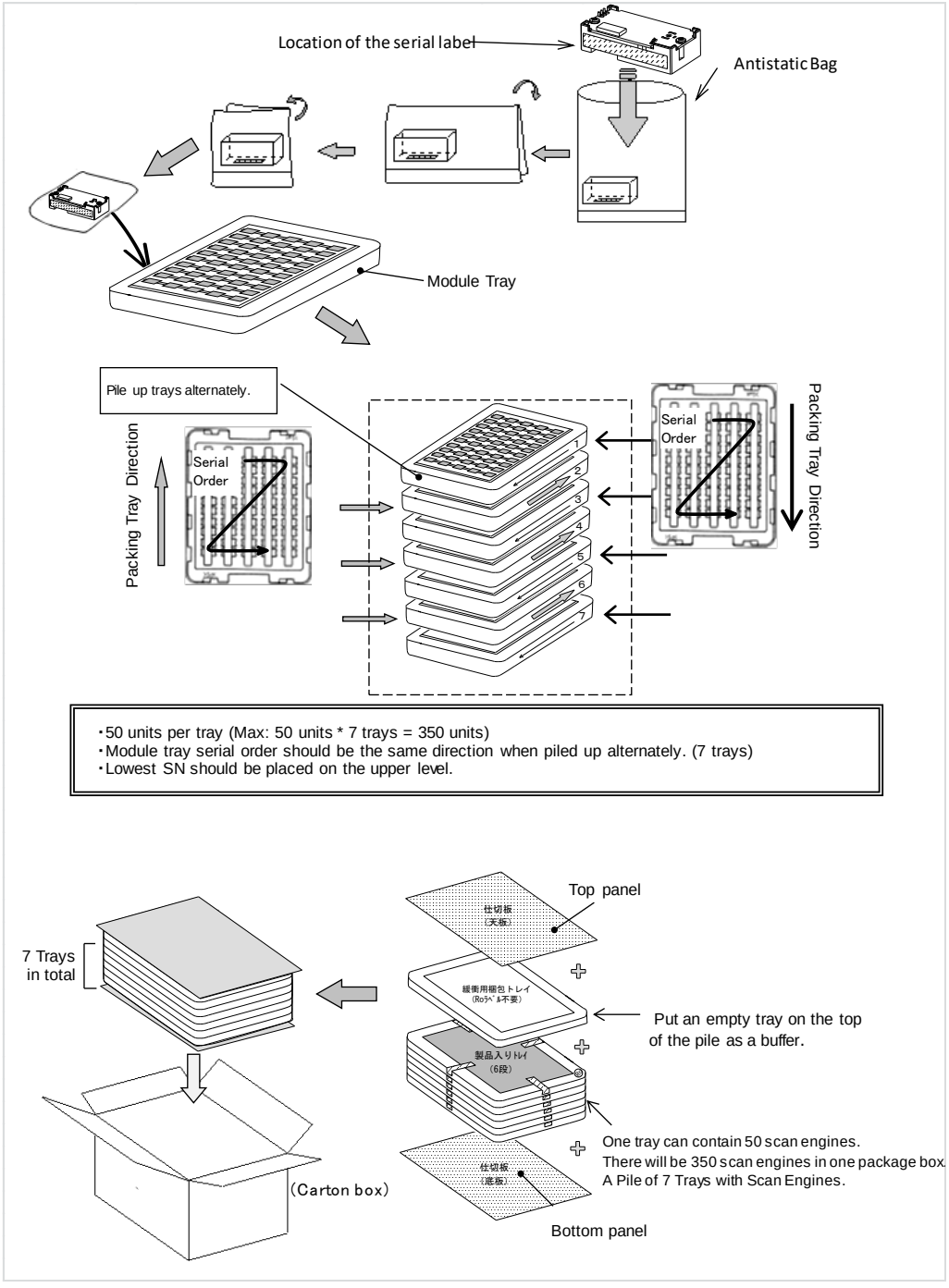


Figure **12***: Packaging*

16.2 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.

17 Mechanical Drawing

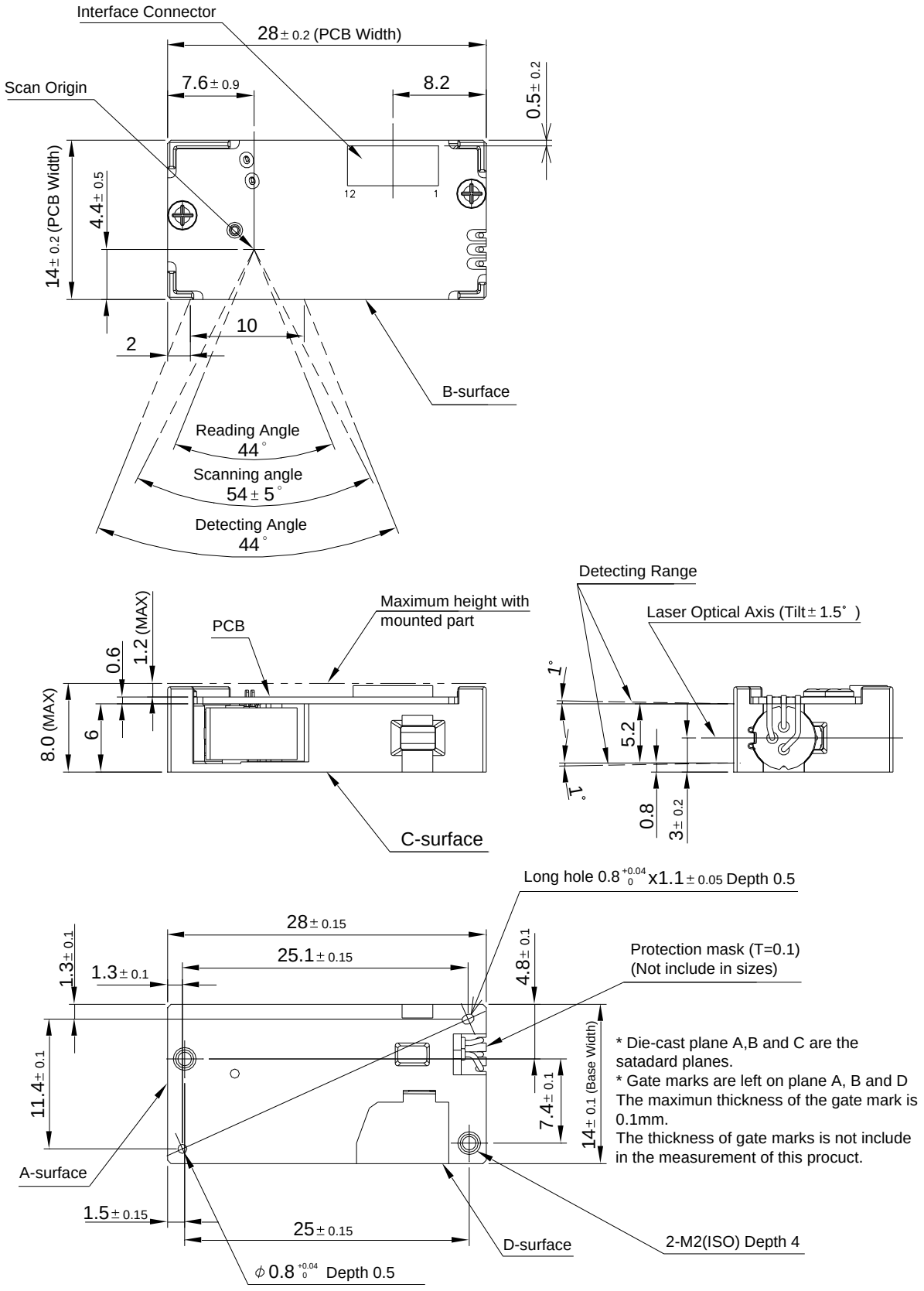


Figure **13***: Drawing (MDL-1500)*