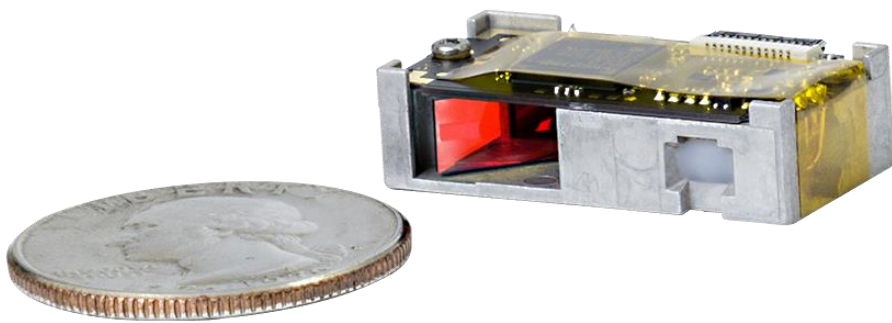


MDL-1500

1D Laser Scan Engine

Specifications Manual



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1 Overview

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

2 About the MDL-1500 Scan Engine

The MDL-1500 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 a red laser beam enhances the visibility of the scan line.

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

The MDL-1500 is a RoHS-compliant product.

3 Physical Features

3.1 Dimensions

W: 28 mm x D: 14 mm x 8.0 mm

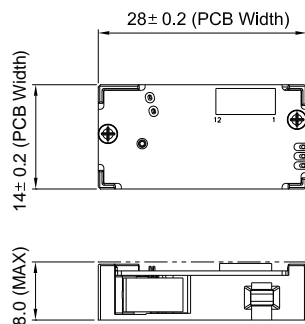


Figure 1: Dimensions of the MDL-1500

3.2 Weight

3.9 g (max.)

4 Electrical Specifications

4.1 Absolute Maximum Ratings

Note: 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 of time may affect device reliability.

Voltage	Symbol	Typical Value	Unit
Input Voltage	(V _{CC})	-0.3 to 3.9	V
Signal Input Voltage	(V _I)	-0.3 to V _{CC} +0.3	V

4.2 Recommended Operating Conditions

Voltage	Symbol	Typical Value	Unit
Input Voltage	(V _{CC})	3.0 ~ 3.6	V
Signal Input Voltage	(V _I)	0 ~ V _{CC}	V

4.3 Current Consumption

V_{CC} = 3.3V, T_A = 25°C

Current and Interval	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Peak Rush Current*	Power On	I _{PK1}	Boot	-	-	300	mA
	Idle	I _{PK2}	Recovery	-	-	200	mA
Rush Current Interval	Power On and Idle	I _{PK1/2}	Boot Recovery	-	20	100	µs

* Measured at the scan engine connector.

V_{CC} = 3.3V, T_A = 25°C

Current	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Current	Read	I _{OP1}	-	-	110	125	mA
Operating Current	Read	I _{OP2}	-	-	95	110	mA
Aiming Current	AIM	I _{AIM}	AIM On	-	50	65	mA
Idle Current	Idle	I _{IDL}	-	-	30	40	mA
Low Power Mode Current	Low Power	I _{LOW}	-	-	0.05	-	mA

4.4 Signal Electrical Characteristics

Signal	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
TRIG _n , AIM/WAKEn, Rx _D , CTS, TEST*	Input Voltage	V _{IH}		V _{CC} x 0.8	-	V _{CC}	V
		V _{IL}		0	-	V _{CC} x 0.2	V
GR_LED _n , BUZZER _n , Tx _D , RTS, POWERDWN*	Output Voltage	V _{OH}	I _{OH} = -1.0 mA	V _{CC} -0.5	-	V _{CC}	V
		V _{OL}	I _{OL} = 1.0 mA	0	-	0.5	V

* CMOS logic levels.

4.5 Recovery Time from Low Power and Power Down States

V_{CC} = 3.3V, T_A = 25°C

Time	Mode/State	Conditions	Min.	Typ.	Max.
Recovery time (ms)	Low Power Mode	-	-	11	-
Boot time (ms)	Power Down	-	-	56	-

4.6 Current Waveform

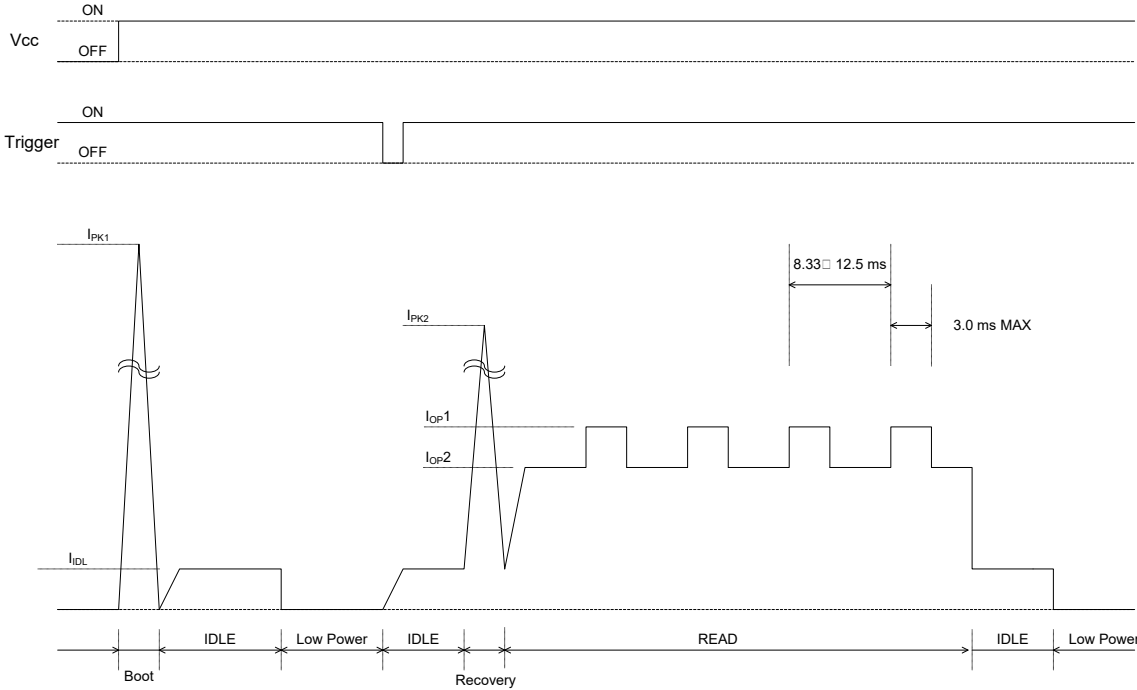


Figure 2: Current Waveform

5 Power Mode Transition

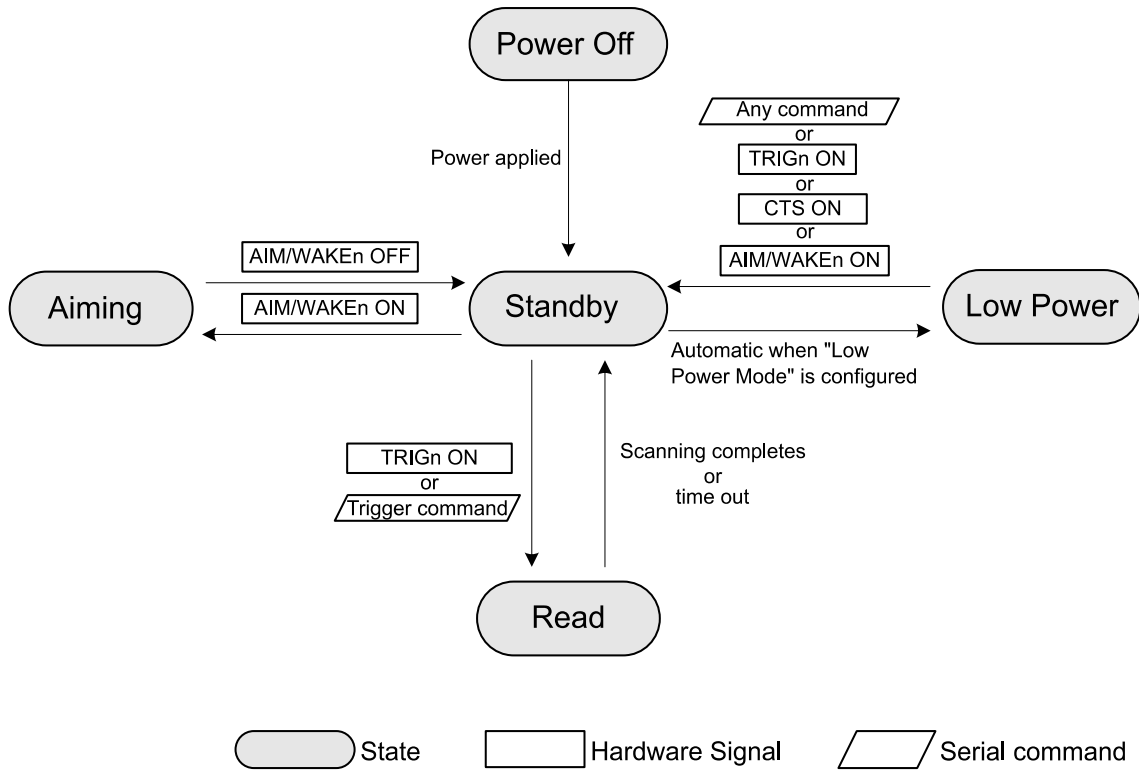


Figure 3: Power Mode Transition

6 Interface Specifications

An IRISO Electronics Co., Ltd. IMSA-9681S-12Y901 (12-pin, 0.5 mm pitch, bottom contact) FFC equivalent connector is used.

Interface Signals

No.	Name	Function	I/O	State	Notes
1	TEST	Special	I	High or Open	100K pull up required*
2	VCC	Input Voltage	-	3.0~3.6V, 3.3V Typ.	
3	GND	Ground	-	0V	
4	RxD	Input Serial Data, CMOS Logic Level	I		When configured as UART
	USB-	USB Data line	I/O		When configured as USB
5	TxD	Output Serial Data, CMOS Logic Level	O		
6	CTS	Clear to Send, CMOS Logic Level	I		When configured as UART, 100K pull up required*
	USB+	USB Data line	I/O		When configured as USB
7	RTS	Request to Send, CMOS Logic Level	O		
8	POWERDWN	Power Down Output, CMOS Logic Level	O	L: Normal state H: Low Power state	
9	BUZZERn	Buzzer Control Pulse Output, CMOS Logic Level	O	ACTIVE: PWM signal (frequency and duration configurable) IDLE: Steady high	PWM control A transistor or FET circuit should be used to drive the buzzer.
10	GR_LEDn	LED Output, CMOS Logic Level	O	L: LED on H: LED off	A transistor or FET circuit should be used to drive the LED.
11	AIM/WAKEn	Wakeup Input, CMOS Logic Level	I	L: Wake Up H: No action	100K pull up required*
		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	100K pull up required*

* Required pull up on HOST side for normal operation.

7 Optical Specifications

7.1 Laser Scanning

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

7.2 Laser Line Specifications

7.2.1 Tilt of Scan Line

The tilt is the angle between the average center of the scan line and the horizontal line:
0.92° or less

The angle is measured at the center of the scan line. When measured at 150 mm from the scan origin, the maximum is 2.46 mm.

7.2.2 Curvature of Scan Line

The curvature is the angle between two lines: the tilt line and the line connecting the scan origin and the top of the scan line.

The curvature is 1.17° or less. When measured at 150 mm from the scan origin, the maximum is 3.06 mm.

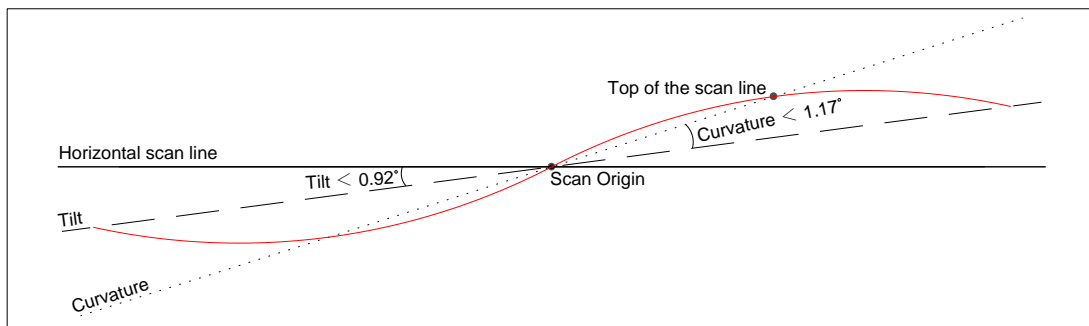


Figure 4: Laser Line Tilt and Curvature

8 Technical Specifications

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

Technical Specification Conditions

Specification	Condition
Ambient Temperature and Humidity	Room temperature and room humidity
Ambient Light	700 ~900 lux (excluding high-frequency lighting)
Pitch Angle	$\alpha = 0^\circ$
Skew Angle	$\beta = 15^\circ$
Tilt Angle	$\gamma = 0^\circ$
Code Position	Center of the laser line
Curvature	$R = \infty$
Input Voltage	3.3 V
PCS	0.9 or higher
Scanning Test	Accept the performance with 90% or more success rate for 10 scan attempts. (Decoding is deemed successful when completed in 0.5 seconds or less.)
Barcode Test Sample	Specified in “Barcode Test Labels” on page 8.

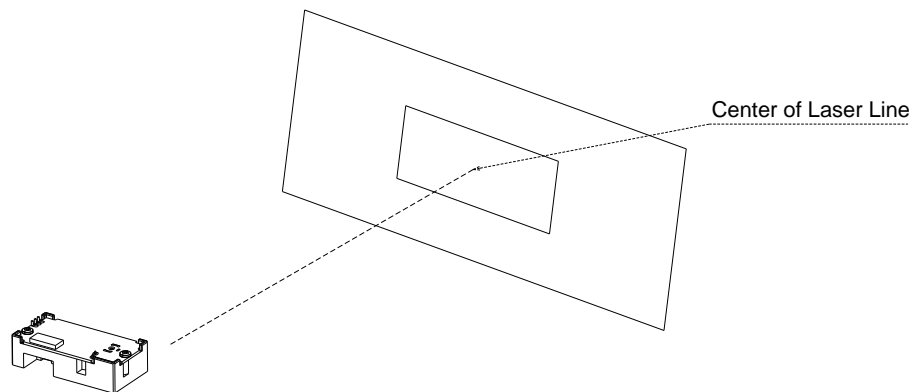


Figure 5: Test Condition for Depth of Field

8.1 Barcode Test Labels

This section describes the barcode labels used when the depth of field was measured.

Code 39

Resolution	PCS (MRD)	Size (mm)	No. of Digits
0.076 mm (3 mil)	0.9 (70)	7.5 × 10	5
0.127 mm (5 mil)		11 × 10	4
0.15 mm (5.9 mil)		26 × 10	10
0.20 mm (7.9 mil)		110 × 10	34
0.254 mm (10 mil)		32.5 × 12	7
0.508 mm (20 mil)		43 × 25	3
1.016 mm (40 mil)		42.5 × 30	1

Code 128

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

UPC/EAN

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

Note: Size is measured using the outline dimensions, excluding the quiet zone.

8.2 Scan Area and Depth of Field

The scan area is measured from the front edge of the scan engine. The depth of field depends on the view angle and symbol length. The depth of field values provided are the typical values.

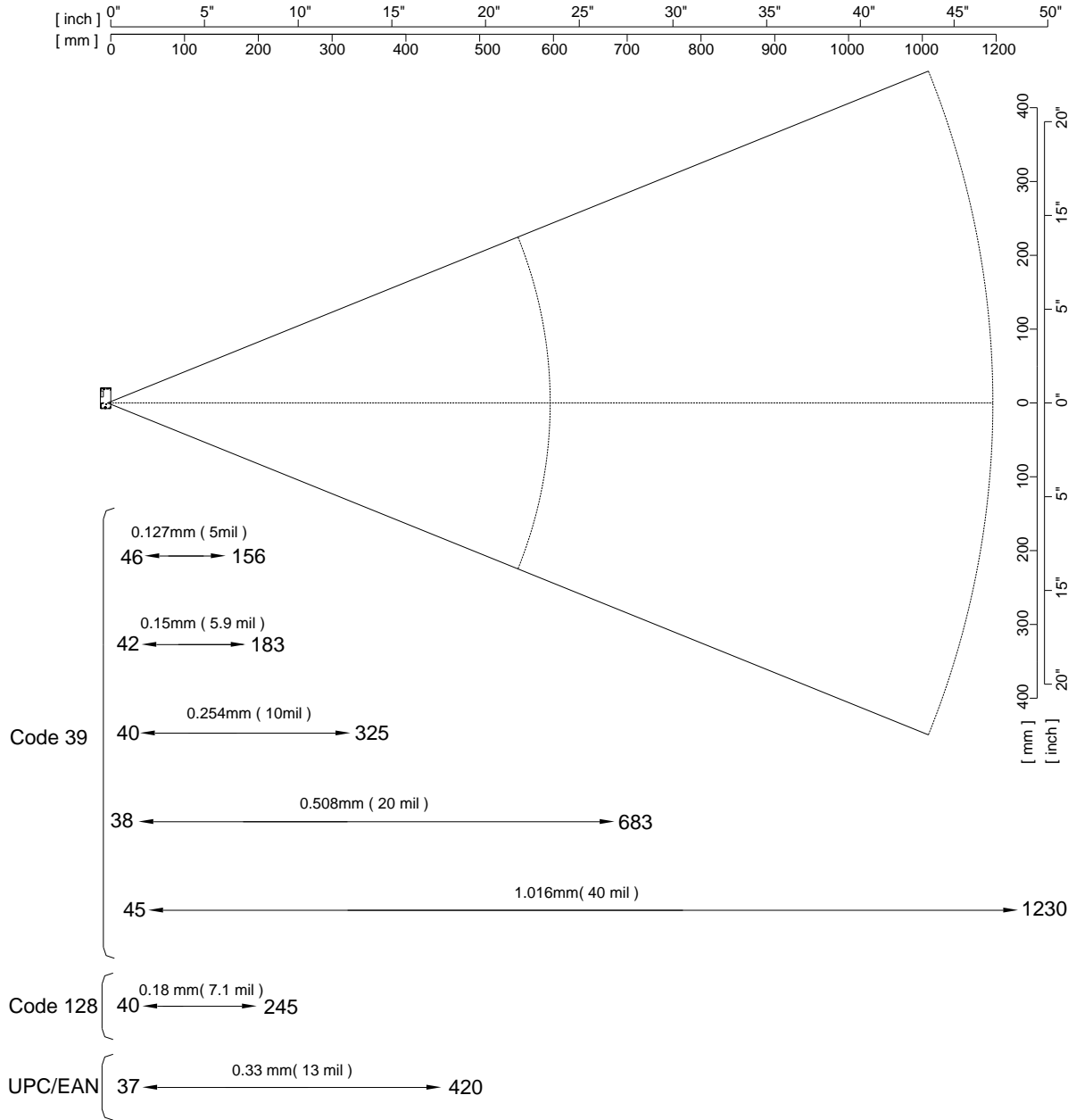


Figure 6: Scan Area and Depth of Field

Depth of Field

T_A = 25°C

Resolution	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")
0.254 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")
0.508 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 (40 mil)	Code 39	0.9 (0.7)	50 mm (2.0")	1000 mm (39.3")	45 mm (1.8")	1230 mm (48.4")
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")
0.33 mm (13 mil)	UPC/EAN	0.9 (0.7)	40 mm (1.6")	370 mm (14.5")	37 mm (1.5")	420 mm (16.5")

8.3 Print Contrast Signal (PCS)

PCS: 0.2 or higher

PCS Conditions

Condition	Description
MRD	13 and higher (70% or higher reflectivity of space and quiet zone)
Distance	110 mm from the front edge of the scan engine
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 Barcode (Code 39): 0.076 mm (3 mil)

For details, see “Scan Area and Depth of Field” on page 9.

Minimum Resolution Conditions

Condition	Description
Distance	65 mm from the front edge of the scan engine
Angle	$\alpha = 0^\circ, \beta = +15^\circ, \gamma = 0^\circ$
Curvature	R = ∞

8.5 Barcode Width

Barcode width: 100 mm

Barcode Width Conditions

Condition	Description
Barcode Sample	Code 39, 0.20 mm. For details, see “Scan Area and Depth of Field” on page 9.
Distance	150 mm from the front edge of the scan engine
Angle	$\alpha = 0^\circ, \beta = +15^\circ, \gamma = 0^\circ$
Curvature	$R = \infty$

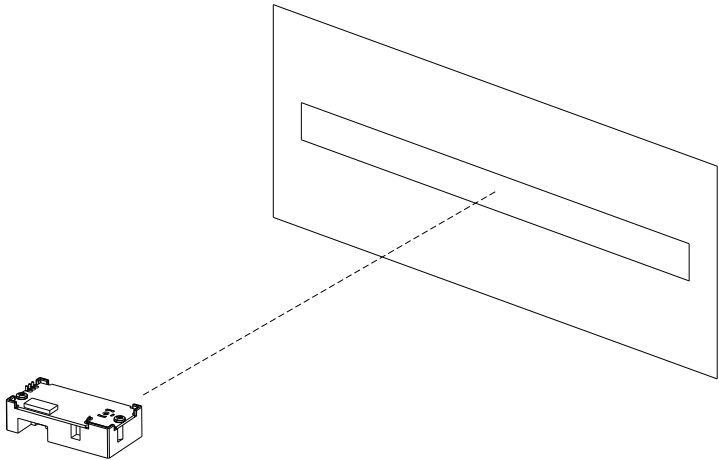


Figure 7: Barcode Width

8.6 Pitch, Skew, and Tilt

For pitch angle and tilt angle measurements, set the skew angle β to $+15^\circ$.

Pitch, Skew, and Tilt

Orientation	Description
Pitch	$\alpha = \pm 45^\circ$
Skew	$\beta = \pm 65^\circ$
Tilt	$\gamma = \pm 25^\circ$
Dead Zone*	$\beta \leq \pm 8^\circ$

Note: Decoding may fail due to specular reflection.

Pitch, Skew, and Tilt Conditions

Condition	Description
Barcode Sample	Code 39, 0.20 mm. For details, see “Scan Area and Depth of Field” on page 9 .
Distance	110 mm from the front edge of the scan engine
Curvature	$R = \infty$

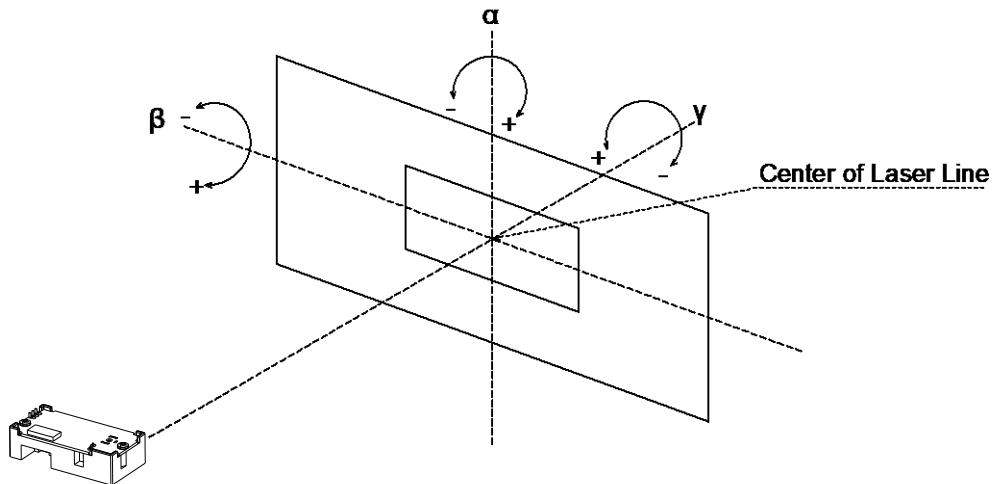


Figure 8: Pitch, Skew, and Tilt

8.7 Curvature

0.33 mm 12-digit UPC: $R \geq 20 \text{ mm}$

Curvature Conditions

Condition	Description
Barcode Sample	UPC, 0.33 mm. For details, see “Barcode Test Labels” on page 8.
Distance	110 mm from the front edge of the scan engine
Angle	$\alpha = 0^\circ, \beta = +15^\circ, \gamma = 0^\circ$

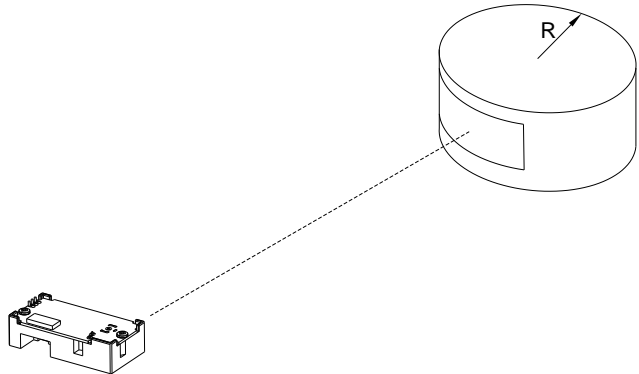


Figure 9: Curvature

8.8 Motion Tolerance

Motion tolerance: 6 m/s

Motion Tolerance Conditions

Condition	Description
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 scan engine
Skew	$\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature	$R = \infty$
Input Voltage	3.3 V
PCS	0.9 or higher
Barcode Sample	0.33 mm UPC. For details, see “Barcode Test Labels” on page 8.

Note: Successful reading at the indicated speed cannot be guaranteed. If the surface is highly reflective, the illumination LED may be reflected and cause scanning to fail.

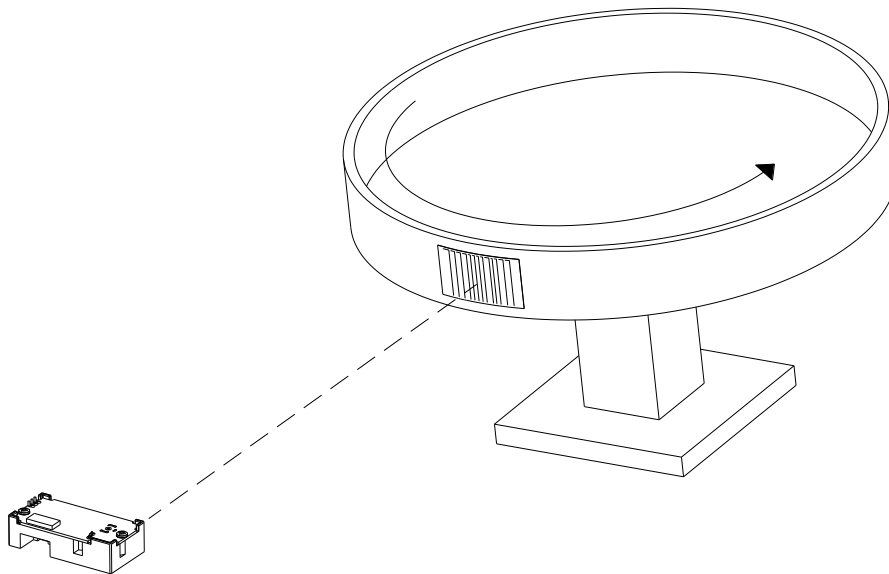


Figure 10: Motion Tolerance

9 Environmental Specifications

Unless otherwise noted, these conditions apply to all environmental specifications where applicable.

Environmental Specification Conditions

Condition	Description
Barcode Sample	0.33 mm UPC. For details, see “Barcode Test Labels” on page 8.
Distance	110 mm from the front edge of the scan engine
Angle	$\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature	$R = \infty$
Input Voltage	3.3 V

9.1 Temperature

Operating Temperature: -20 to 65 °C

Storage Temperature: -30 to 70 °C

9.2 Humidity

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

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

9.3 Ambient Light Immunity

Scanning performance is optimal when the illumination on the surface of a barcode is between zero and these values:

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

Note: To achieve the best scanning performance, make sure that direct ambient light and specular reflection do not enter the light receiving section of the scan engine.

9.4 Electrical Noise

Scanning performance is not affected when the electrical noise added to the Input Power pin is less than 0.1Vpp and has a frequency between 50 Hz and 100 kHz.

9.5 Vibration Tolerance

The scan engine is designed to withstand the conditions of the following vibration test.

Vibration Test: Increase the frequency of the vibration from 12 Hz to 200 Hz at a maximum acceleration of 32.3 m/s² (3.3 g) for 10 minutes. Continue the process for 2 hours in the X-direction, 2 hours in the Y-direction, and 4 hours in the Z-direction.

9.6 Drop Impact Tolerance

The scan engine is designed to withstand the conditions of the following drop test.

Drop test: Fix the MDL-1500 scan engine in a specific aluminum-made dummy case with these dimensions: W = 80 mm, D = 50 mm, H = 30 mm. Drop the case a total of 10 times (from the top, bottom, front, back, left, right, top-left, top-right, bottom-left, and bottom-right faces) from a height of 1.8 m onto a concrete floor.

10 Integration Specifications

To connect the scan engine to a host system, use an FFC or FPC cable designed to meet the specifications provided by the connector manufacturer.

Recommended connector: Product No.: 9681-12 (12-pin, 0.5 mm pitch, 0.3 mm thick), produced by IRISO Electronics Co., Ltd.

Recommended cable length: Max. 50 mm. The resistance caused by the length of the cable must not drop the voltage to the scan engine below 3.0 V.

11 Regulatory Specifications

Laser Safety:

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

12 RoHS

The MDL-1500 is compliant with RoHS.

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

13 Reliability

The scan engine will perform reliably if it is operated under normal operating conditions in the range of advised operating temperature and without excessive electrical or mechanical shock.

Reliability Measures

Measure	Description
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

14 Precautions

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

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.

All work benches, tools, measuring instruments, and any part of the human body that may come into contact with the scan engine must use ESD anti-static precautions.

Do not touch the optical and electrical components. When possible, hold the camera body when handling the scan engine.

Avoid handling the scan engine in a dusty area. If dust gets on the scan engine, gently blow it off with dry air. Direct contact with the optics of the scan engine may reduce its performance.

Do not drop the scan engine.

15 Serial Number Label

This serial number label is affixed to the MDL-1500.

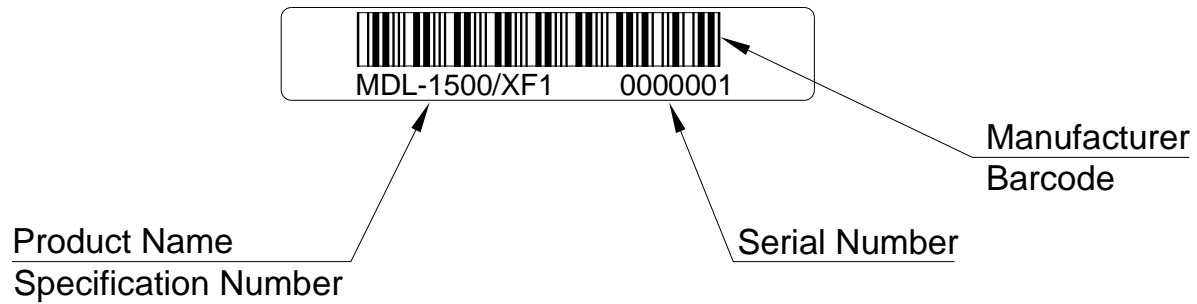


Figure 11: Serial Number Label

The top part of the label is the Manufacturer barcode:

- Data: 7-digit serial number
- Symbology: Code 39

The lower part contains this information:

- Product name and specification number
- Serial number: The serial number starts at 0000001 and is in order regardless of the lot number.

16 Packaging Specifications

Note: The “RO” mark labelled on the package tray or package box guarantees that the applicable product has passed our test of RoHS restrictions compliance (the restriction of the use of certain hazardous substances in electrical and electronic equipment, 2002/95 EC). However, this mark does not have any legal weight in the European Union.

16.1 Packaging

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

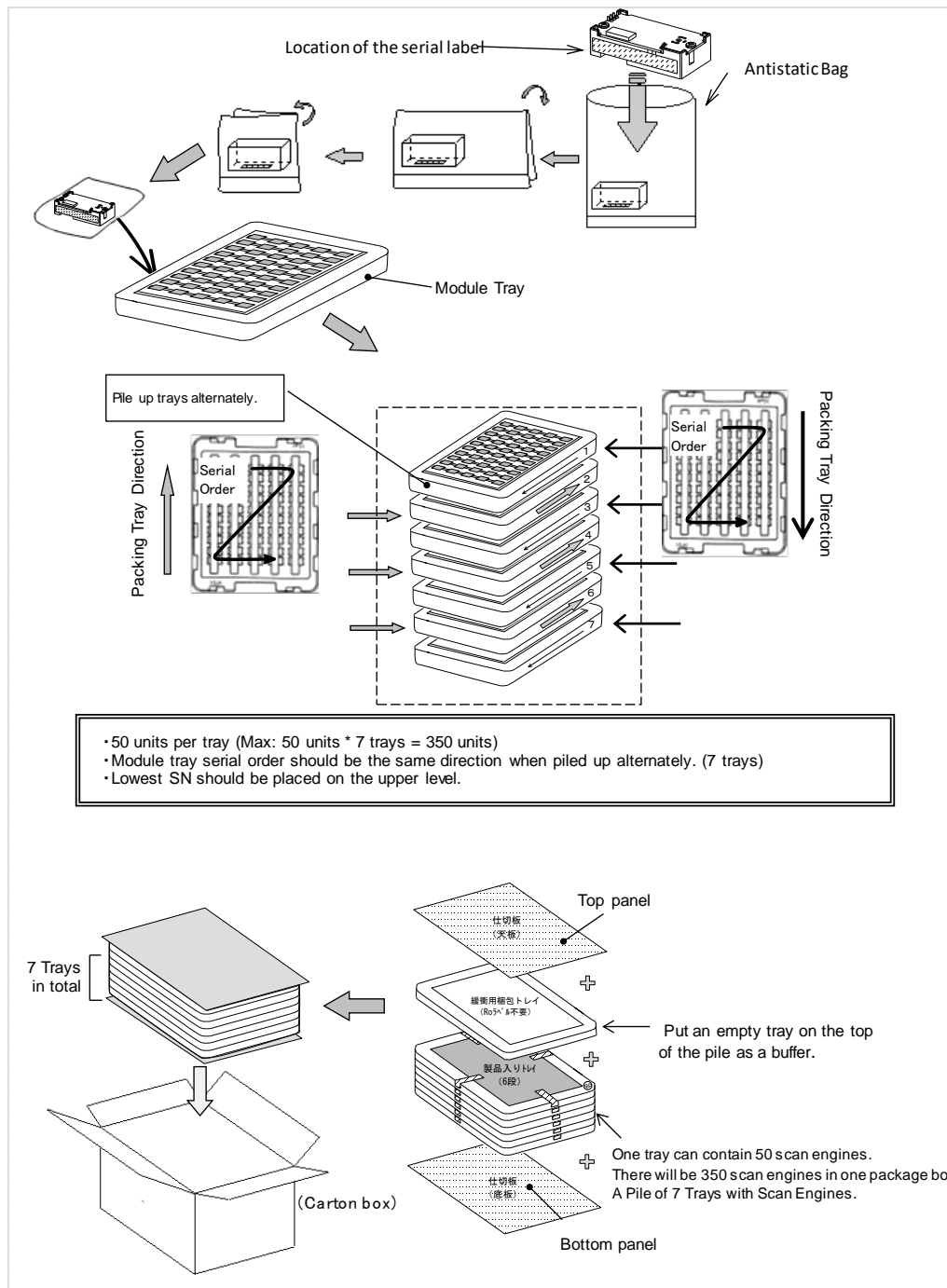


Figure 12: Packaging

16.2 Package Size

Outer dimensions are approximately W: 365 mm, D: 290 mm, H: 185 mm

17 Mechanical Drawing

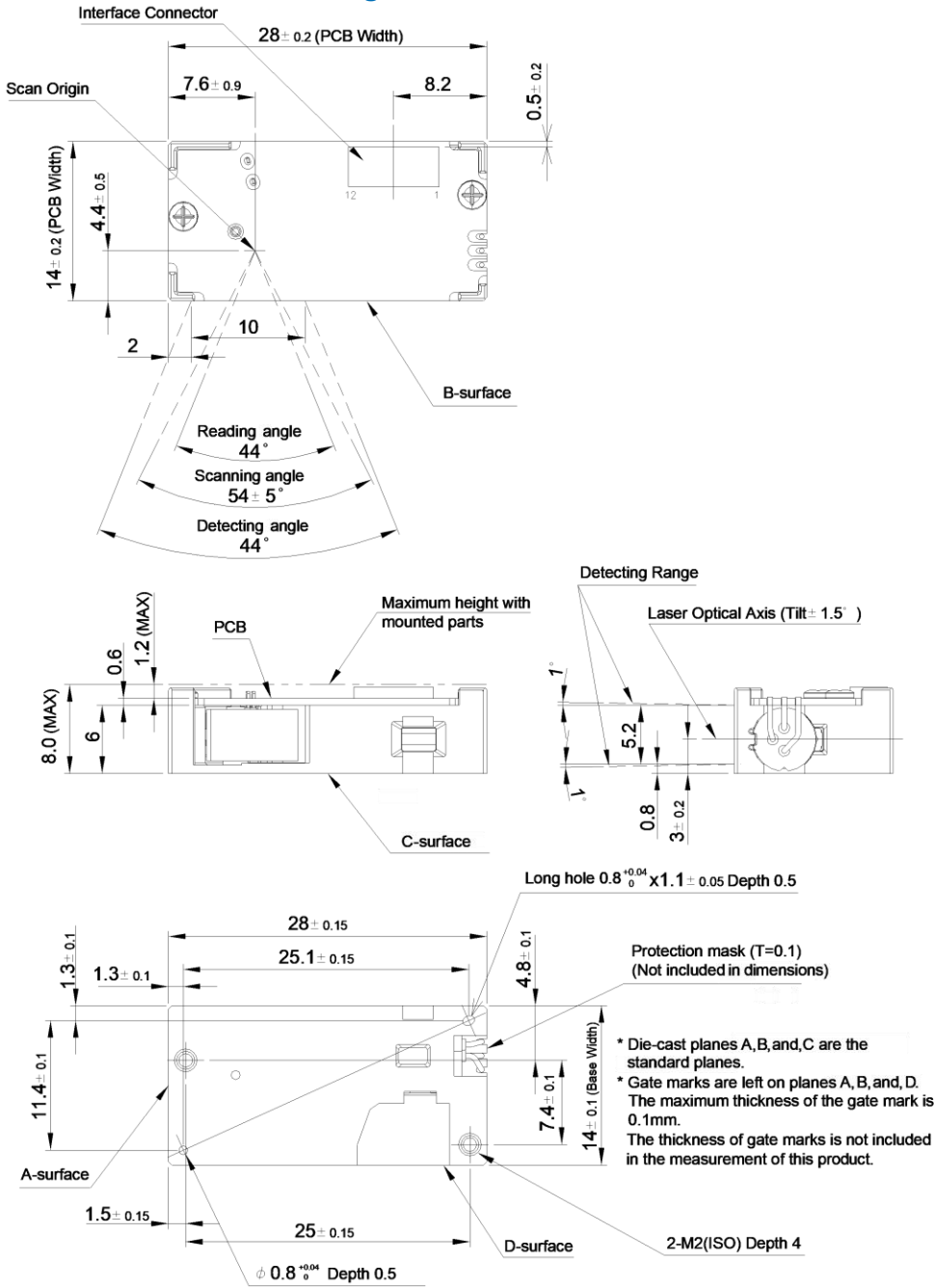


Figure 13: MDL-1500 Mechanical Drawing