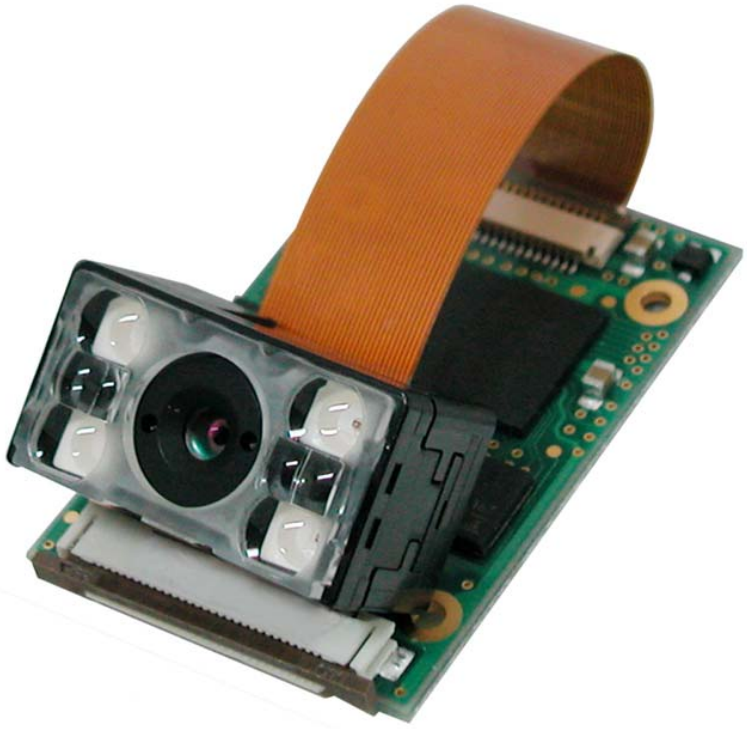
OPTICON

2D CMOS Imager

MDI 1000



This manual provides specifications for the MDI 1000 2D imager scan engine.

Specifications Manual

All information subject to change without notice.

Document History

Model Number:	MDI 1000	**Specification Number:**	SS06044
Edition:	4b	**Original Spec Number:**	SS06020
Date:	2008-10-02		

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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. 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 scanner or send it for service. Damage caused by improper packaging during shipment is not covered by the warranty.

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1. Abstract

This manual provides specifications for the MDI 1000 2D imager scan engine.

2. Overview

The MDI 1000 includes the following features:

- A 1.3 million-pixel (SXGA) CMOS area image sensor and a compact camera module with wide-angle lens that enables scanning of high-resolution and wide symbologies.
- Wide-lens optics that make it possible to scan wider symbologies from up close.
- A small, high-performance, energy-saving decoder that processes data of 1.3 million pixels and realizes smoother scanning of both linear (1D) and 2D symbologies.
- Supported symbologies

Linear (1D)	2D
JAN/UPC/EAN, incl. add-on	Aztec Code
Codabar/NW-7	Data Matrix (ECC 0-140, ECC200)
Code 39	Maxi Code (mode 0–5)
Code 93	Micro PDF417
Code 128	Micro QR Code
Composite Codes: (incl. CC-A/B/C)	PDF417
GS1-128 (EAN/UCC-128)	QR Code
GS1 DataBar (RSS)	
IATA	
Industrial 2of5	
Interleaved 2of5	
MSI/Plessey	

- The ability to change symbology settings, scanning settings, communication settings, and other feature settings by sending commands.
- Command input and image data output between the host system and the MDI 1000 is transmitted using serial communication.
- The MDI 1000 complies with the Restriction of Hazardous Substances (RoHS).

3. Physical Features

3.1. Dimensions

Camera module: W 21.5 mm x D 14.2 mm x H 11.8 mm

Decoder board: W 25.2 mm x D 39.0 mm x H 4.2 mm

3.2. Weight

Camera module: 3.9 grams (max.)

Decoder board: 3.8 grams (max.)

4. Environmental Specifications

4.1. Operating Temperature and Humidity

Temperature: -20 to 55° C

Humidity: 5 to 90% RH

4.2. Storage Temperature and Humidity

Temperature: -25 to 70° C

Humidity: 5 to 90% RH

4.3. Ambient Light Immunity

Decoding performance is guaranteed when the range of illumination on a barcode surface is between zero and the following values:

Incandescent light	to 10,000 lx
Fluorescent light	to 10,000 lx
Sunlight	to 100,000 lx

Conditions

Barcode Sample: PDF417 with 0.254mm resolution

Distance:	110 mm from the mask of the camera module
Angle:	α = 0°, β = +15°, γ = 0°
Curvature:	R = ∞
Power Supply Voltage:	3.3 V

Scanning performance is guaranteed as long as direct light or a reflection from a light source does not impact the light detection range of the MDI 1000.

Note: α, β and γ respectively represent pitch, skew and tilt. Please see section 7 for how these values are defined.

5. Electrical Specifications

5.1. Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Power supply voltage (V_{CC} to GND)	V_{CC}	3.9	V
Input voltage	V_I	-0.3 to V_{CC} +0.3	V
Output voltage	I_O	±4	mA

5.2. Electrical Characteristics

V_{CC} =3.3 V, T_A=25° C

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Range of power supply voltage[1]		V_{cc}		3.15	3.3	3.45	V
Rush current[2]		I_{PK}		-	6	7	A
Input voltage	H level	V_{IH}		2.4	-	V_{cc} +0.3	V
	L level	V_{IL}		-0.3		0.9	V
Output voltage	H level	V_{OH}	I_{OH} = -4 mA	2.8	-	-	V
	L level	V_{OL}	I_{OL} = 4 mA	-	-	0.5	V

5.3. Consumption Current with Default Settings

When the scan engine is configured to “Prior snapshot ON” and “Snapshot and decoding parallelism ON”.

Parameter	Symbol	Min	Typ	Max	Unit
Operating current	I_{OP}	-	310	410	mA
Stand-by current	I_{STB}	-	125	155	mA
Power-down current[3]	I_{SLP}	-	25	50	mA

[1] Input connector.
[2] Vcc is supplied by a direct-current power of 10 A and is measured using a current probe. If it is necessary to decrease impressed current, please supply the power slowly.
[3] When configured with the SLEEP command or power-down mode.

5.4. Consumption Current with Standard Scanning Mode

When the scan engine is configured to “Prior snapshot OFF” and “Snapshot and decoding parallelism OFF”.

Parameter	Symbol	Min	Typ	Max	Unit
Operating current	I_{OP}	-	250	390	mA
Stand-by current	I_{STB}	-	90	110	mA
Power-down current[4]	I_{SLP}	-	10	25	mA

[4] When configured with the SLEEP command or power-down mode.

5.5. Timing

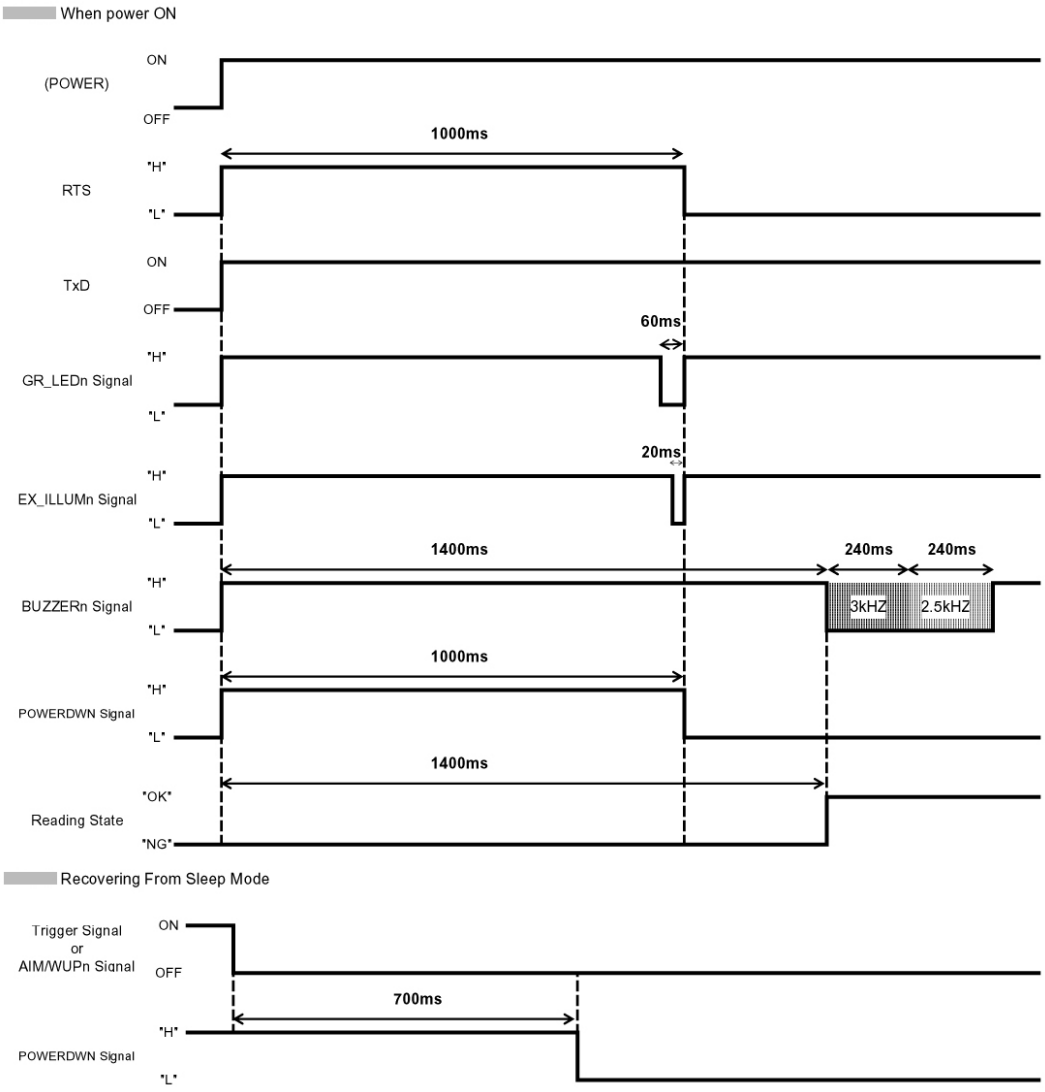


Figure 1: Timing Chart

Conditions

Timing Chart

Input Voltage	3.3 V
Down peak	2.36 V / 1.00 V fall after 0.7 ms
Peak	2.7 A during 0.01 ms after 0.7 ms

5.6. Power Mode Transition

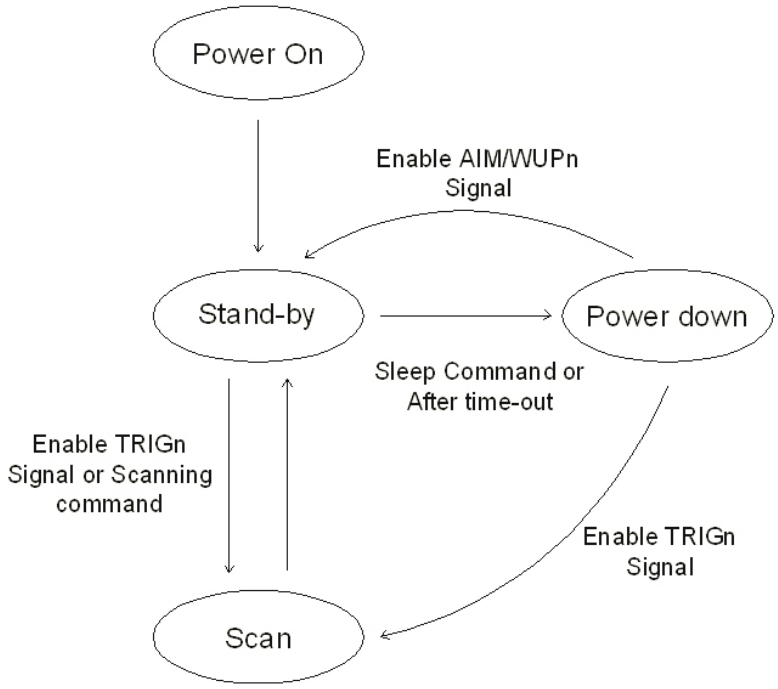


Figure 2:Power mode transition

When in Power Down mode, the MDI 1000 automatically enters the power-down state from Power On.

When the MDI 1000 is in Power Down mode and the MDI 1000 is switched to a Standby state by sending a CTS signal or AIM/WUPn signal, or there is no event that causes the MDI 1000 to switch to another mode, the MDI 1000 enters Power Down mode after the time-out.

If the MDI 1000 enters a power-down state while using USB_VCP as an interface, it may cause defects that affect the operation of a Windows device driver.

6. Optical Specifications

6.1. Laser Scan Specifications

Parameter	Specification	Unit
Scan method	CMOS area sensor (grayscale)	-
Scan rate	30	fps
Range of readable pixels	1280 (H) x 1024 (V)	pixel
Center wave length of aiming LED (2 green LEDs)	527	nm
Center wave length of LED for Lighting (4 red LEDs)	630	nm
View angle	Horizontal: 47 Vertical: 37.5	°

6.2. Imager Output

Item	Specification
Image data format	Windows Bitmap, JPEG, TIFF
Shades of gray	256, 16, 2
Range of output image	Select in horizontal and vertical scale.
Resolution of output image	Full, 1/2, 1/3, 1/4
Interface of output image	RS-232C, USB-VCP
Transmission time	USB-VCP (Full speed) About 4 sec RS-232C (115.2 kbps) About 120 sec **Conditions:** Shades of gray: 256 Resolution: full

7. Technical Specifications

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

Conditions

Ambient temperature and humidity	21° C/70° F, 60% RH
Ambient light	1000 to 1500 lx (on the surface of a barcode)
Light source	3 wavelength inverter fluorescent light
Power supply voltage	3.3 V
Scan performance	70% and higher
Barcode sample	Refer to the chart below

7.1. Test Samples: 1D Symbologies

7.1.1. Code 39

Resolution	Symbology	PCS	Size (mm)	Digits
0.127 mm	Code 39	0.9	11 x 10	4
0.254 mm	Code 39	0.9	14 x 10	2
0.508	Code 39	0.9	29 x 25	2

7.1.2. JAN

Resolution	Symbology	PCS	Size (mm)	Digits
0.26 mm	8-digit JAN	0.9	17.5 x 15.5	8
0.26 mm	13-digit JAN	0.9	25 x 19	13

Barcode samples with 0.127 mm and 0.26 mm resolution are OPTOELECTRONICS test samples. Other charts are printed by a regular printer.

N/W ratio	1:2.5
Angle	α = 0°, β = 15°, γ = 0°
Curvature	R = ∞

7.2. Test Samples: 2D Symbologies

7.2.1. PDF417

Resolution	Error Correction	PCS	Size (mm)	Characters
0.127 mm	Level-4	0.9	13 x 8	17
0.254 mm	Level-4	0.9	26 x 16	17
0.339 mm	Level-4	0.9	35 x 22	17

Charts are printed by a regular printer.
Horizontal to Vertical ratio is 3:1.

7.2.2. Data Matrix

Resolution	Model	PCS	Size (mm)	Characters
0.169 mm	ECC200	0.9	4 x 4	40
0.212 mm	ECC200	0.9	5 x 5	40
0.339 mm	ECC200	0.9	8 x 8	40

Charts are printed by a regular printer.

7.2.3. Maxi Code

Resolution	Model	PCS	Size (mm)	Characters
0.889 mm	Standard	0.9	26 x 26	29

Charts are printed by a regular printer.

7.2.4. QR Code (Model–2)

Resolution	Error Correction	PCS	Size (mm)	Characters
0.169 mm	M	0.9	5 x 5	44
0.212 mm	M	0.9	6 x 6	44
0.339 mm	M	0.9	10 x 10	44

Charts are printed by a regular printer.

7.3. Print Contrast Signal (PCS)

0.45 (MRD 32%) or higher (over 70% of reflectivity of space and quiet zone).

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

Scanning performance may decline if dirt or scratches mar the optical window. Keep the optical window clean.

7.4. Minimum Resolution

Resolution	Symbology
0.127 mm	Code 39 & PDF417
0.169 mm	Data Matrix & QR Code
0.889 mm	Maxi Code

7.5. Scan Area and Resolution

7.5.1. Depth of Field

The depth of field is measured from the mask of a camera module.

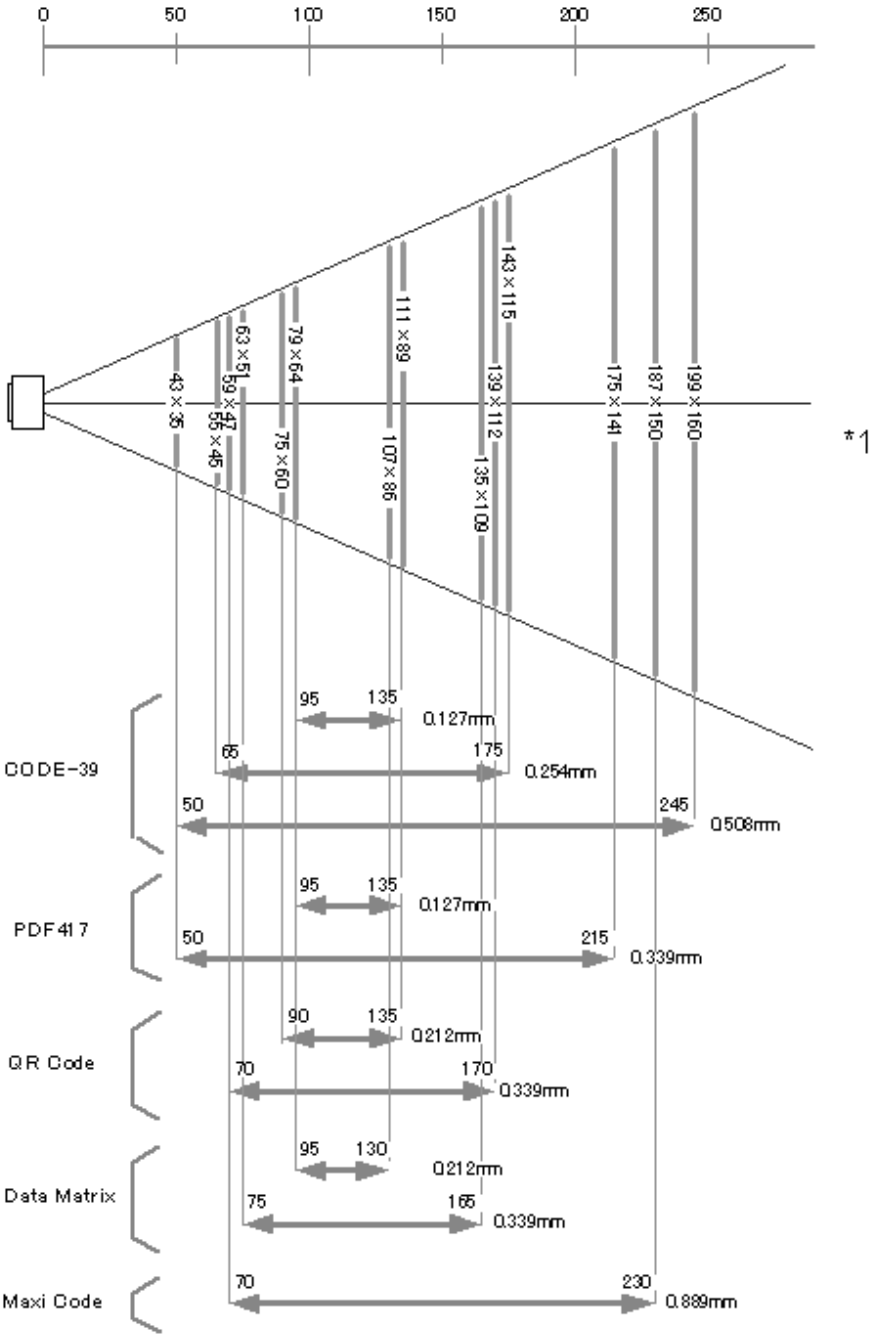


Figure 3: The reading range in millimeters

*1 Typical value of depth of field (horizontal and vertical).

The size of barcodes does not include quiet zones.

Symbology	Resolution (mm)	Decode Depth (mm)	PCS
Code 39	0.127 0.254 0.508	95–135 65–175 50–245	0.9
Data Matrix	0.212 0.339	95–130 75–165	0.9
MaxiCode	0.889	70–230	0.9
PDF417	0.127 0.339	95–135 50–215	0.9
QR Code	0.212 0.339	90–135 70–170	0.9

7.6. Pitch, Skew, and Tilt

7.6.1. Pitch Angle

α = ±50°

7.6.2. Skew Angle

Skew angle: β = ±60°

7.6.3. Tilt Angle

γ = 360°

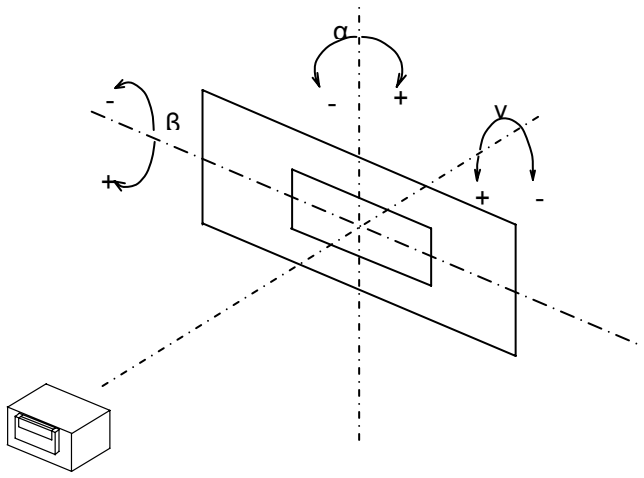


Figure 4: Angles

Conditions

Barcode Sample: Code 39 and PDF417 with 0.245 mm resolution

Distance	110mm from the mask of the camera module
Angle	Curvature: R = ∞ (The calculation of pitch and tilt angles is based on the skew angle formula being β = +15°)

Notes

When a barcode is printed on glossy paper or a card case, it may cause difficulties in scanning due to the reflection of red LEDs. To improve scanning performance under these circumstances, scan the barcode with a scan angle of 15 degrees or with red LEDs turned off. When scanning a barcode with red LEDs turned off, confirm that the ambient lighting intensity is higher than 1000 lux, or scanning performance may decline. Scanning performance may also decline if room lights reflect on the camera.

7.7. Curvature

With 8-digit JAN/UPC/EAN barcodes, decoding performance is guaranteed when R≥15 mm.

With 13-digit JAN/UPC/EAN barcodes, decoding performance is guaranteed when R≥20 mm.

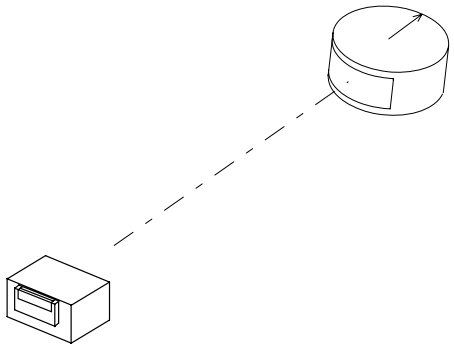


Figure 5: Curvature

Conditions

Barcode Sample: JAN barcode

Distance:	110 mm from the mask of the camera module
Angle:	α = 0°, β = + 15°, γ = 0°

8. Aiming

8.1. Aiming Patterns

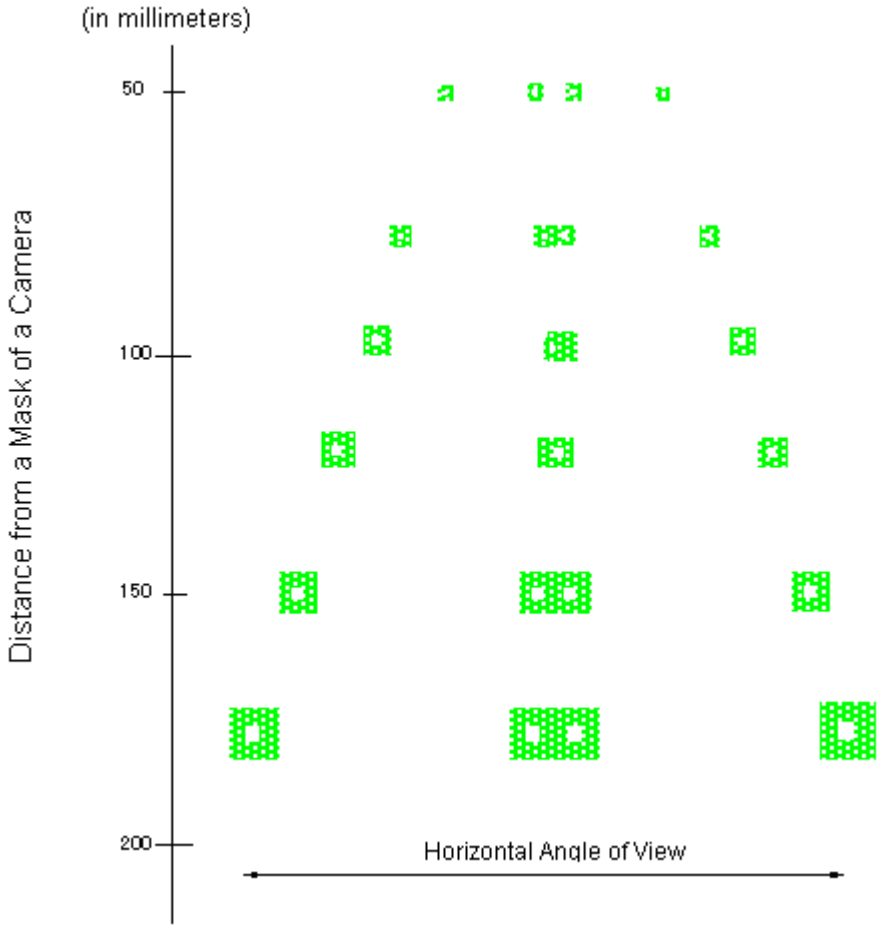


Figure 6: Aiming patterns

Notes

Aiming is a guide to assist with scanning. An aiming pattern does not indicate the exact scannable width or distance between a scanner and a barcode.

8.2. Aiming Guide

- The focal point is where two central LED light patterns (green and square-shaped) overlap—where two dots meet.
- To scan a barcode within the aiming range, make sure that two central LED light patterns overlap, then place the center of the overlapping LED light patterns on the center of the barcode.
- To scan a barcode wider than a width of the aiming range, aim at the barcode from further away. Make sure that the barcode is between two LED light patterns on both the right and left.

9. Interface Specifications

9.1. Interface Signals

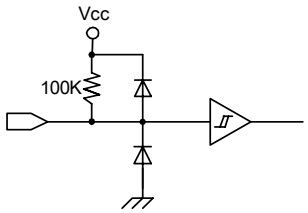
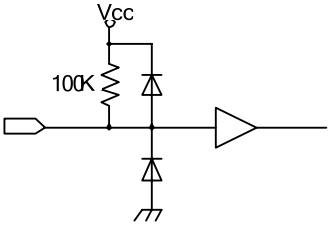
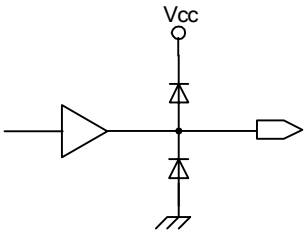
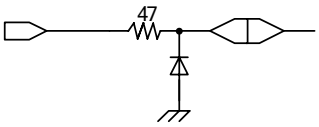
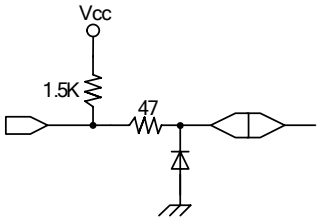
Connector used was produced by Molex Incorporated.

Product No.: 52437-3071 (bottom contact)

No.	Signal			State	Note
	Name	Function	I/O		
1	DWNLDn	Download control signal	In	L: Download mode H: Normal operation	Check the signal as soon as the power is supplied and enables updates of software.
2	Vcc	Power input	In		
3	GND	System ground			
4	RxD	Received data signal	In		Asynchronous data from the host system
5	TxD	Transmitted data signal	Out		Asynchronous data to the host system
6	CTS	Communication control signal from host system	In		Request for a data output from the host system
7	RTS	Communication control signal to host system	Out		Request for a data output from the MDI 1000
8	POWERDWN	Power down of MDI 1000	Out	L: Normal H: Power Down	
9	BUZZER	Activate external buzzer	Out		Possible to change tones and sound pressure by sending PWM signals.
10	GR_LEDn	Good read	Out	L: LED On H: LED Off	
11	AIM/WUPn	When in power down state: recovery from Power Down state	In	L: Recover from Power Down H: No action	

No.	Signal			State	Note
	Name	Function	I/O		
		When not in Power Down state: Aiming control	In	L: Aiming LED On H: Aiming LED Off	Prioritize aiming control of MDI 1000 during the scanning operation.
12	TRIGn	Trigger on	In	L: Start Operation H: No action	Command signal for reading images and decoding operation.
13	Reserved		Out		Not connected
14	GND	System ground			
15	Reserved		In		Not connected
16	GND	System ground			
17	Reserved		In		Not connected
18	Vcc	Power input	In		Not connected
19	Reserved		Out		Not connected
20	Reserved		In		Not connected
21	Reserved		Out		Not connected
22	GND	System ground			
23	USB+		In/Out		USB 1.1
24	USB-		In/Out		
25	GND	System ground			
26	Reserved	Power On	In		Not connected
27	USB_Vcc5	USB Power On	In		Monitoring USB bus power supply
28	EX_ILLUMn		Out	L: External Illumination On H: External Illumination Off	Control of an external light source.
29	Reserved		In		Not connected
30	Reserved		In		Not connected

9.2. Interface Circuit

Signal	Circuit Configuration
DWNLDn, AIM/WUPn, TRIGn	
CTS, RxD	
POWERDWN, EX_ILLUMn, GR_LEDn, RTS, TxD, BUZZER	
USB-	
USB+	

10. Integration Specifications

10.1. Camera Module and Decoder Board

The nonvolatile memory on the MDI 1000 decoder board contains information concerning the sensor chip for a MDI 1000 camera module. This information is vital to the scanning and image acquisition operations of the MDI 1000. The camera module and decoder board are a set and must both be integrated into your products.

10.2. Connection between a Camera Module and Decoder Board

Use a cable developed in accordance with specifications provided by the connector manufacturer to connect the MDI 1000 camera module with the MDI 1000 decoder board.

Manufacturer	**Molex Incorporated**
Product No	54809-3373 (33-pin)
Cable Length	70 mm (maximum)
Signal Connection	Connect Camera Module 1-pin and Decoder Board 33-pin using a single-sided FPC.

The cable with connector can also be obtained at Opticon.

- Cable length 49 mm: Product No. 11575.
- Cable length 69 mm: Product No. 11620.

10.3. Connection between a Decoder Board and a Host System

Use a cable developed in accordance with the following specifications provided by the connector manufacturer to connect the MDI 1000 decoder board with a host system.

Manufacturer	Molex Incorporated
Product No	98266-0319
Cable Length	76 mm (maximum)

The cable with connector can also be obtained at Opticon:

- Cable length 76 mm: Product No. 11785.

11. Serial Number

The serial number is written on the following labels that are attached to camera modules and decoder boards.

Figure 7: Camera module serial number

Figure 8: Decoder board serial number

Center: Administration 2D Code (QR Code)

Right side: Model name and serial number

The serial number is a seven-digit number that starts from 0000001 regardless of batch.

12. Packaging Specifications

12.1. Collective Packaging Specification

335 mm (W) × 290 mm (D) × 185 mm (H)

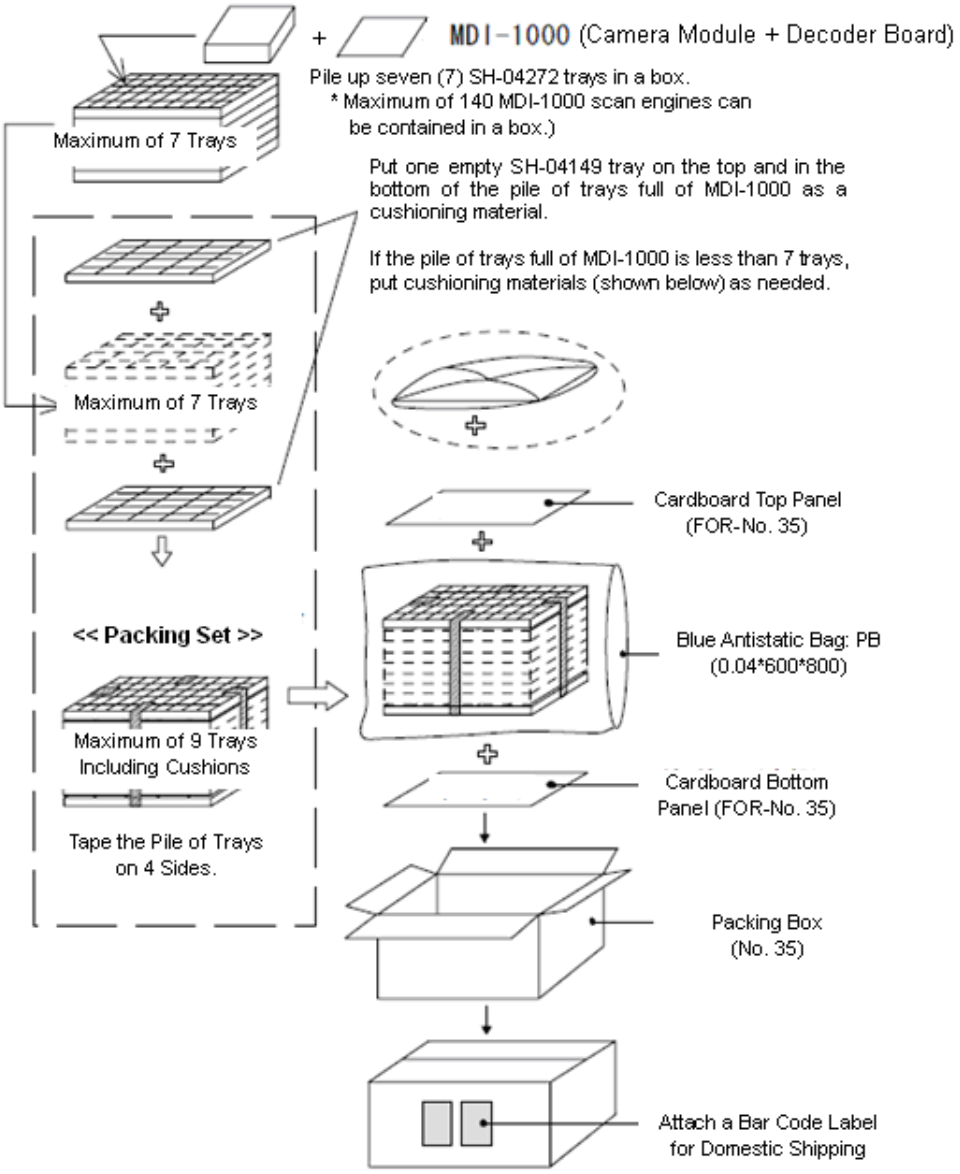


Figure 9: Packaging

The model number, the number of products in the box, and the name of the manufacturer must be displayed on the packing box.

Note: The “RO” mark labeled 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 document does **not** have any legal weight in the European Union.

13. Durability

13.1. Electrical Noise

13.1.1. Scanning Symbologies

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

Conditions

Scan method: Continuous scanning

Barcode Sample:

Resolution:	0.254 mm
Symbology:	PDF417
Distance:	110 mm from the mask of the camera module
Angle:	α = 0° β = 15° γ = 0°
Curvature:	R = ∞
Power Supply Voltage:	3.3 V

13.1.2. Acquisition of Image Data

There were no outstanding noises or misalignments in acquired images when sinusoidal electrical noise (50 Hz to 100 kHz, <20 mVp-p) was added to the power supply line.

Notes

There may be a case where the electrical noise affects the quality of captured images. The signal processing system of the MDI 1000 is especially designed for the purpose of scanning symbologies, not for the acquisition of image data. Therefore, the quality of images captured by the MDI 1000 may be lower than that of digital cameras in general.

13.2. Shock

13.2.1. Drop Test (with individual packaging)

No malfunction occurred after the following drop test.

Shock Test: Put the MDI 1000 inside an appointed dummy case and dropped it on its top, bottom, front, back, left, right, top-left, top-right, bottom-left and bottom-right from the height of 1.8 m to a concrete floor. The shock test was done once in each direction.

Barcode Sample:

Resolution:	0.254 mm
Symbology:	PDF417
Distance:	110 mm from the mask of the camera module
Angle:	α = 0° β = 15° γ = 0°
Curvature:	R = ∞
Power Supply Voltage:	3.3 V

13.3. Vibration

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 3.3 G for over ten minutes. Continued this routine for two hours in X direction, two hours in Y direction, and four hours in Z direction.

Barcode Sample:

Resolution:	0.254 mm
Symbology:	PDF417
Distance:	110 mm from the mask of the camera module
Angle:	α = 0° β = 15° γ = 0°
Curvature:	R = ∞
Power Supply Voltage:	3.3 V

14. Reliability

MTBF (Mean Time Between Failures) of this product is 50,000 hours.

The estimate of MTBF is based on standard operation of the product within the recommended temperature range and without extreme electronic or mechanical shock.

15. Regulatory Compliance

15.1. LED Safety

All LED-based products are LED class 1 and are safe under reasonably foreseeable operating conditions. Do not stare into the beam.

- JIS C6802: 2005: Class 1
- IEC 60825-1+A2: 2001 Class 1

15.2. RoHS

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

16. Safety

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

16.1. Shock

- Do not throw or drop the scan engine.
- Do not place heavy objects on the cables.

16.2. Temperature Conditions

- Do not use the scan engine at temperatures outside the specified range.
- Do not pour boiling water on the scan engine.
- Do not throw the scan engine into the fire.
- Do not forcibly bend the cables at low temperatures.

16.3. Foreign Materials

- Do not immerse the scan engine in liquids.
- Do not subject the scan engine to chemicals.

16.4. Other

- Do not plug/unplug the connectors before disconnecting the power.
- Do not disassemble this product.
- Do not use the scanner near a radio or a TV receiver. It may cause reception problems.
- The scan engine may be damaged by voltage drops.
- The scan engine may not perform properly in environments when placed near a flickering light, such as a computer monitor, television, etc.

17. Mechanical Drawing

17.1. Camera Module

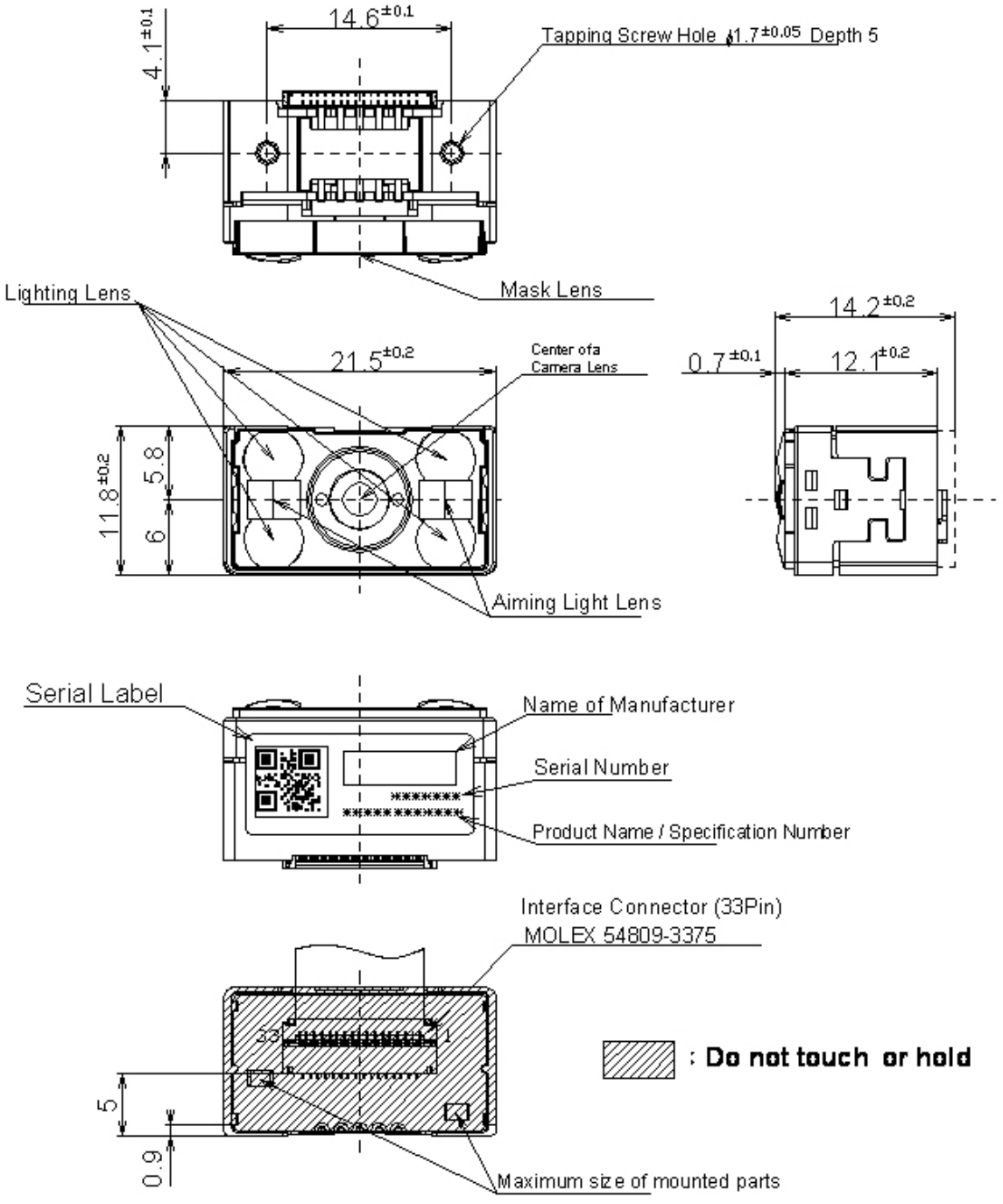


Figure 10: Camera module

17.2. Decoder Board

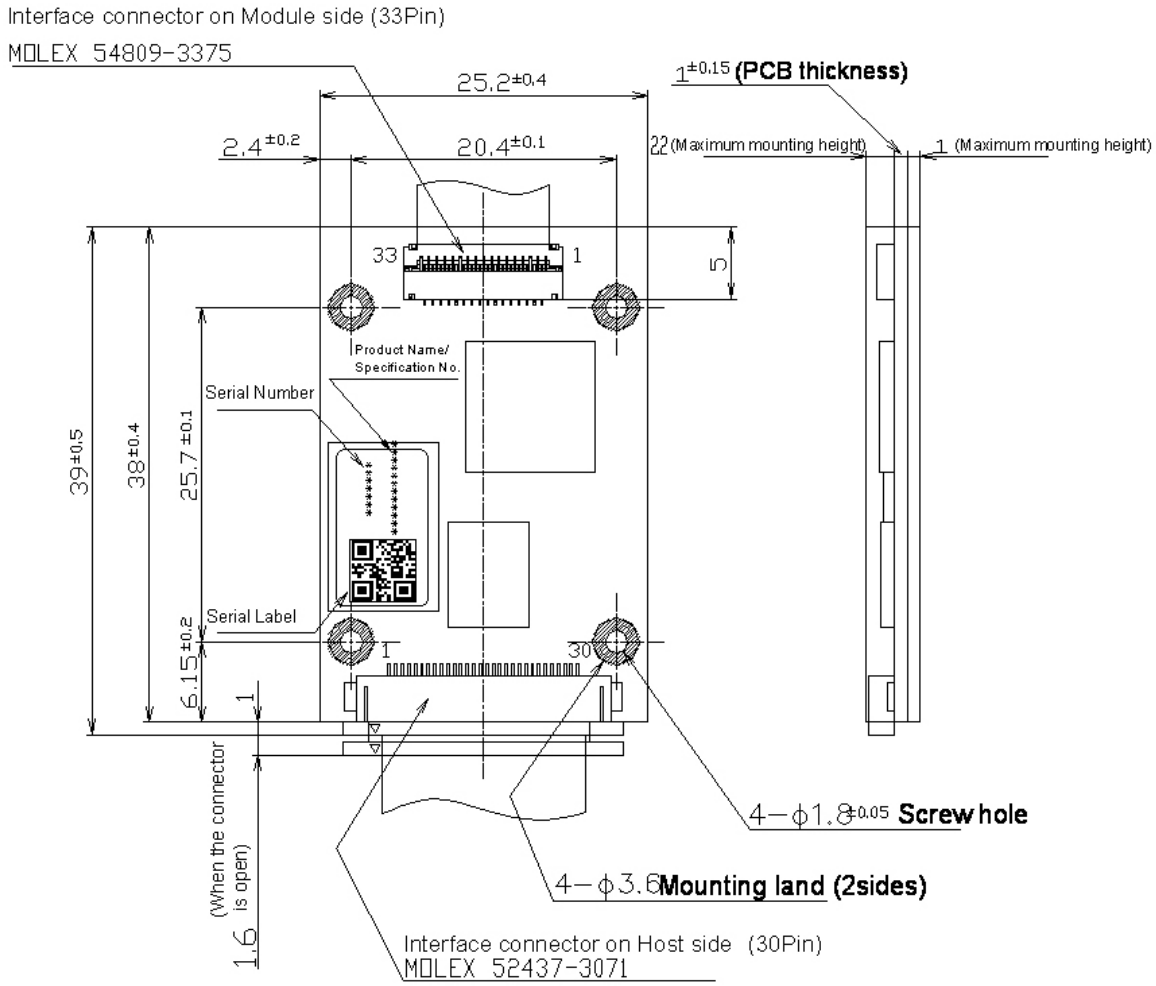


Figure 11: Decoder board