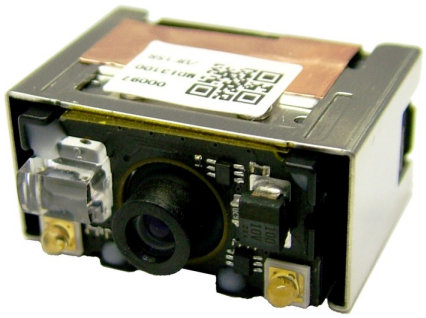
OPTICON

2D Scan Engine

MDI-3100-HD



MDI-3100-HD

This document provides specifications for the MDI-3100-HD imager scan engine.

Specifications Manual

All information subject to change without notice.

Document History

Model Number:	MDI-3100 -HD	Specification Number:	SS12022
Edition:	2nd	Original Spec Number:	SS12011
Date:	2012-08-15		

Limited Warranty and Disclaimers

PLEASE READ THIS MANUAL CAREFULLY BEFORE INSTALLING OR USING THE PRODUCT.

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Revision History

Specification No. : SS12022
Product name : MDI-3100-HD

Edition	Date	Page	Section	Description of Changes
First	2012/06/28	-	-	Initial release
Second	2012/08/15	-	-	Corrections and Clarifications throughout

Table of contents

1. Abstract

This manual provides specifications for the MDI-3100-HD imager scan engine.

2. Overview

The MDI-3100-HD is an imager scan engine with an integrated decoder, which enables high speed scanning of high resolution linear (1D) and 2D symbologies at close range. Main features of the MDI-3100-HD are as follows:

- High-speed reading
  Extremely high-speed performance ensures stress free scanning and fast response without being affected by hand movement and light conditions.

- Integrated decoder
  The MDI-3100 with its combined camera and decoder module offers an ultra-miniature module.
  The compact design enables easy installation.

- Low power consumption
  Power consumption in operating, standby and low power states has been drastically reduced. Various power saving settings can be configured in low power mode.

- LED aiming
  LED's provide a crisp green line for clear and consistent targeting.

- RoHS compliance
  The MDI-3100 is a RoHS compliant product, which is declared by Optoelectronics Co., Ltd.

Note: Refer to “Serial Interface / Software Specifications” for supported codes and commands.

3. Physical Features

3.1. Dimensions

Module : 25.3 × 21.2 × 12.4 (WDH mm)

3.2. Weight

Module : 8 grams (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 ~ 7.0	V
Input Voltage	V_I	-0.3 ~ V_{CC} +0.3	V

4.2. Electrical Characteristics

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Voltage (*1)	V_{CC}		3.0		5.5	V
Peak Rush Current (*2)	I_{PK}				2.5	A

(V_{CC} = 3.3V, T_A = 25°C)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
RxD, CTS	V_{IH}		2			V
	V_{IL}				0.8	V
AIM, WAKEn DWNLDn, TRIGn	V_{IH}		2			V
	V_{IL}				0.2 x V_{CC}	V
POWERDWN	V_{OH}		100K to V_{CC}			V
	V_{OL}	(I_O= 1.5mA)			0.4	V
BUZZERn, GR_LEDn	V_{OH}		100K to V_{CC}			V
	V_{OL}	(I_O= 16mA)			0.55	V
TxD, RTS	V_{OH}	(I_O= -6mA)	10K to V_{CC}			V
	V_{OL}	(I_O= 6mA)			0.55	V

(V_{CC} = 5.0V, T_A = 25°C)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
RxD, CTS	V_{IH}		0.7 x V_{CC}			V
	V_{IL}				0.3 x V_{CC}	V
AIM, WAKEn DWNLDn, TRIGn	V_{IH}		2			V
	V_{IL}				0.2 x V_{CC}	V
POWERDWN	V_{OH}		100K to V_{CC}			V
	V_{OL}	(I_O= 4mA)			0.4	V
BUZZERn, GR_LEDn	V_{OH}		100K to V_{CC}			V
	V_{OL}	(I_O=16mA)			0.55	V
TxD, RTS	V_{OH}	(I_O=-12mA)	10K to V_{CC}			V
	V_{OL}	(I_O=12mA)			0.55	V

*1 Input connector portion
*2 V_{CC} is supplied by a direct-current power supply of 2A and measurement is done using a current probe.

4.3. Current Consumption in Default Setting

(V_{CC} = 3.3V, T_A = 25°C)

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Current	Read	I_{OP}	-	-	240	390	mA
Standby Current	Standby	I_{STB}	-	-	45	50	mA
Deep Standby Mode Current (*1)		I_{DSP}	Configured	-	27	30	mA
Sleep Mode Current (*2)	Low Power	I_{SLP}	Configured	-	0.25	0.3	mA
Power Off Mode Current (*3)		I_{PWO}	Configured	-	0.02	0.03	mA

(V_{CC} = 5.0V, T_A = 25°C)

Item	State	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Current	Read	I_{OP}	-	-	160	260	mA
Standby Current	Standby	I_{STB}	-	-	35	40	mA
Deep Standby Mode Current (*1)		I_{DSP}	Configured	-	25	28	mA
Sleep Mode Current (*2)	Low Power	I_{SLP}	Configured	-	0.22	0.27	mA
Power Off Mode Current (*3)		I_{PWO}	Configured	-	0.04	0.05	mA

*1 When set to Deep Standby mode by a command. In Deep Standby mode, command control conditions differ from the normal Standby mode. Besides that, there is no difference from the normal Standby mode.
*2 When set to Sleep Mode by a command
*3 When set to Power Off by a commend
*2*3 In Low Power mode, Sleep or Power Off modes are configurable
* Refer to “Serial Interface / Software Specifications” for details.

4.4. Recovery Time from Low Power and Power Down States

Item	State	Conditions	Min	Typ	Max	Unit
Sleep Mode	Low Power	Configured	-	75	100	ms
Power Off Mode		Configured	-	550	700	ms
Power ON	Power Down	-	-	550	700	ms

Note: Refer to “Serial Interface / Software Specifications” for details.

5. Power Mode Transition

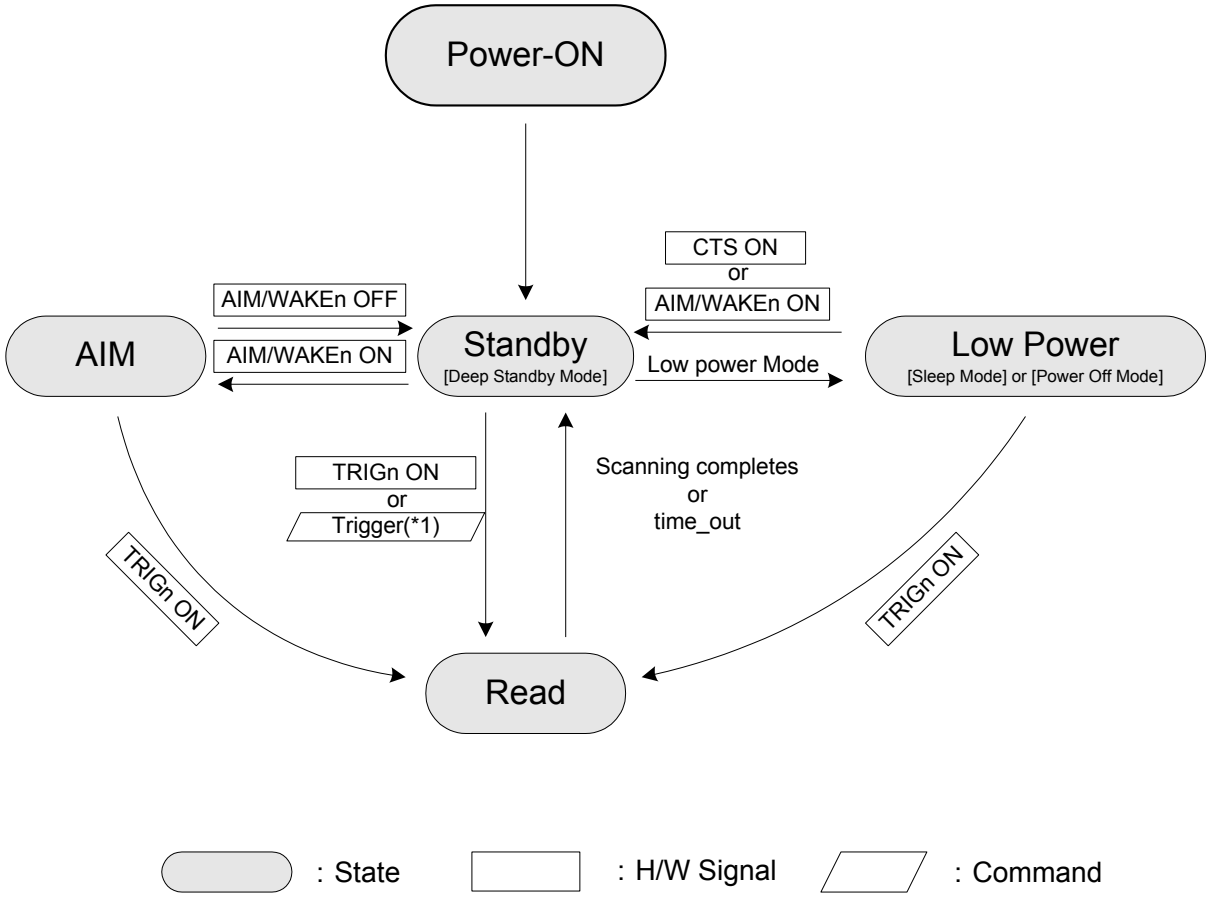


Figure 1: Power Mode Transition

*1 When Deep Standby mode is set, there are control conditions for command transmission.
* When Low Power state is enabled, the MDI-3100 automatically enters Low Power state after Power On.
* In Low Power state, Sleep mode or Power Off mode is configurable.
* When Low Power state is enabled, the MDI-3100 is in Standby state, and there are no events to move to other states, the MDI-3100 goes to Low Power state after the time out period specified by power saving command has elapsed.
* Refer to “Serial Interface / Software Specifications” for details.

6. Interface Specifications

6.1. Interface Signals (Serial-232 Mode)

The default communications mode for this module is the serial-232 mode [command “U2”]. The table below shows the interface signals while in this mode.

Note: When the mode changes from USB to Serial mode, the signals on pins 6 through 9 will change functionality.

No.	Name	Function	I/O	State	Note
1	TRIGn	Trigger on	In	L: Start operation H: No action	
2	AIM/WAKEn	Recovery signal from Low Power state	In	L: Recover from Low Power state H: No action	
		Aiming control signal in other states than Low Power	In	L: Aiming LED on H: Aiming LED off	
3	GR_LEDn	Good read LED signal	Out	L: LED on H: LED off	
4	BUZERn	Activate external buzzer signal	Out	L: Active H: No action	Possible to change tones and sound pressure by sending PWM signals.
5	POWERDWN	Shows Low Power state	Out	L: Normal state H: Low Power state	
6	RTS	Communication control signal to host system	Out		
7	CTS	Communication control signal from host system	In		
8	TxD	Transmitted data signal	Out		
9	RxD	Received data signal	In		
10	GND	System ground			
11	V_{CC}	Power input	In	3.0 ~ 5.5V	
12	DWNLDn	Forced download control signal	In	L: Forced Download mode H: Normal state	Check the signal when the power is supplied and enable rewriting software.

Note: Refer to “Serial Interface / Software Specifications” for UART communication timing.

6.2. Interface Signals (USB Mode)

This module may be configured to operate in a USB mode (either USB-HID/keyboard mode [command “SU”] or USB-VCP virtual com port mode [command “C01”]). The table below shows the interface signals while in this mode.

Note: When the mode changes from Serial to USB mode, the signals on pins 6 through 9 will change functionality.

No	Signal			Control State	Note
	Name	Function	I/O		
1	TRIGn	Trigger on	In	L: Start operation H: No action	
2	AIM/WUPn	In Power Down state: Recovery from Power Down state	In	L: Recover from Power Down H: No action	
		Not in Power Down state: Aiming control	In	L: Aiming laser on H: Aiming laser off	
3	GR LEDn	Good Read		L: LED on H: LED off	
4	BUZZER	Activate external buzzer	Out	L: Active H: No action	Possible to change tones and sound pressure by sending PWM signals.
5	POWERDWN	Shows Power Down state	Out	L: Normal state H: Power Down	
6	*{UNUSED}*				
7	USB_D+	USB Data Signal (+)	I/O		
8	*{UNUSED}*				
9	USB_D-	USB Data Signal (-)	I/O		
10	GND	System ground	-		
11	Vcc	Power input	In	3.3V±5%	
12	DWNLDn	Download control signal	In	L: Download mode H: Normal state	Check the signal when the power is supplied and enable rewriting software.

7. Optical Specifications

7.1. Basic Optical Specifications

Item		Characteristics
Scan method	2D CMOS area array sensor	Gray-scale
Number of effective pixel	(H) × (V)	752 × 480 dot
Image capture speed (*1)	Frame rate	60 fps
Motion Tolerance	Speed of Object in FOV	1M/s (40ips)
Focal distance	From the front edge of scan engine	70 mm
View angle	Horizontal	Approx. 40.6°
	Vertical	Approx. 26.4°
Auxiliary light source (LED × 2)	Red LED	-
	Peak Wave Length	617 nm
	Directivity angle 2θ1/2 (*2)	60°
	Maximum radiation output (*3)	15000 mcd
Light source for aiming (LED x 1)	Green LED	-
	Peak Wave Length	528 nm
	Maximum radiation output (*4)	18700 mcd

*1 The fastest speed of an image capture
*2 The reference value extracted from the LED datasheet
*3 *4 The reference value extracted from the datasheet (conditions: 25 °C, IF = 140 mA)

7.2. Aiming Pattern

The aiming is used for the following purpose:
1. Fill light to recognize the reading range.
2. Fill light when auto trigger is used.

The aiming specifications are as follows:
- An optical axis of imaging filed of view and the center of horizontal aiming width coincide at a distance of L = 110 ± 20 mm from the front edge of the camera module.
- The aiming horizontal width to the horizontal width of imaging filed of view at a distance of L = 110 is 80% ± 10%.

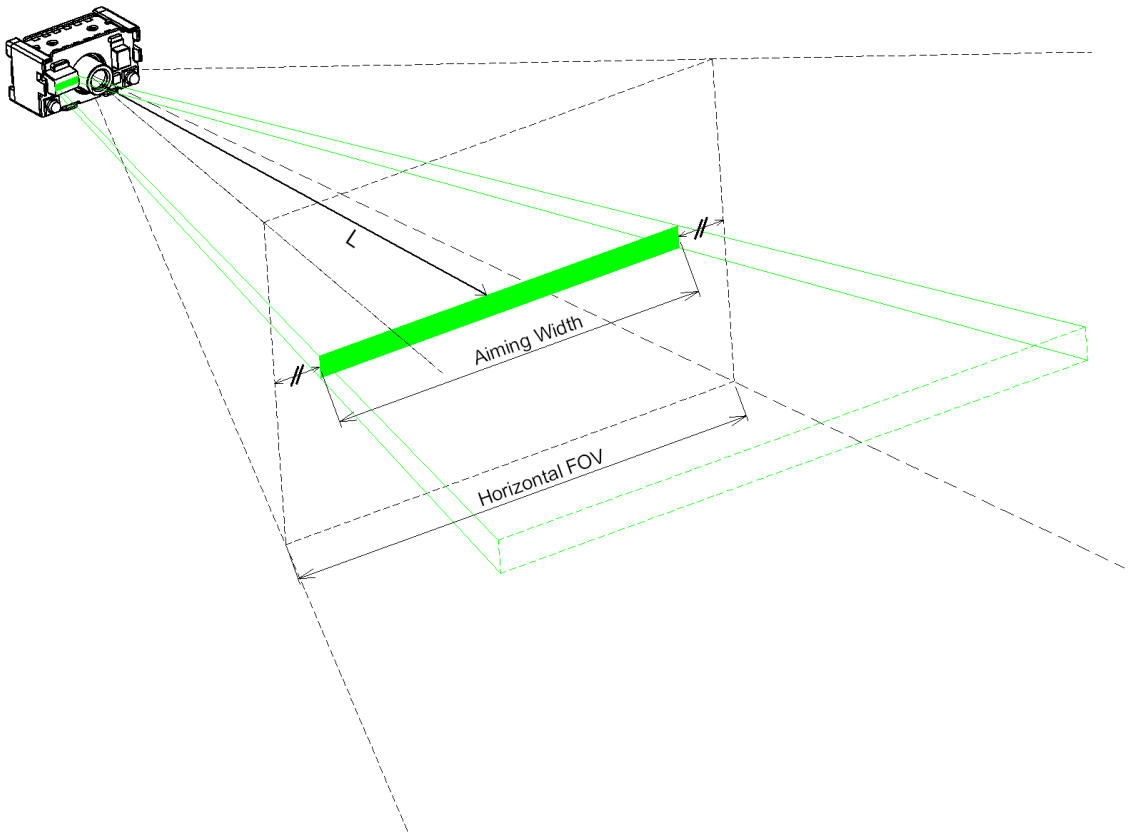


Figure 2: Aiming Pattern

8. Technical Specifications

Emit aiming light of the MDI-3100-HD to the center of a bar code for scanning. The conditions for technical specifications are as follows, unless otherwise specified in each section.

<Conditions>

Ambient Temperature and Humidity	: Room temperature and room humidity
Ambient Light	: 100 ~200 lux (on the surface of a bar code)
Pitch Angle	: α = 0°
Skew Angle	: β = 15°
Tilt Angle	: γ = 0°
Curvature	: R = ∞
Power Supply Voltage	: 3.3 and 5.0 V
PCS (1D and 2D)	: 0.9 or higher
Scanning Test	: Accept the performance with 90% or more success rate for 10 tries of scan. One scan should be tested within 2 seconds.
Bar Code Test Sample (1D and 2D)	: Specified below

< Test chart >

For 1D codes, OPTOELECTRONICS test samples

For GS1 Databar, stacked codes and 2D codes, printed by a dedicated printer for bar code

8.1. Bar Code Test Sample

1 D Bar Codes

<Code 39>

Resolution	Symbology	PCS	Size (mm)	No. of Digits
0.076 mm (3mil)	Code 39	0.9	24 × 10	20
0.127 mm (5mil)			32 × 10	15
0.20 mm (7.9mil)			70 × 10	20
0.254 mm (10mil)			32.5 × 12	7

<Code 128>

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

<UPC>

Resolution	Symbology	PCS	Size (mm)	No. of Digits
0.330 mm (13mil)	12-digit UPC	0.9/0.3	31.5 × 25.0	12

GS1 Databar

<GS1-Databar>

Resolution	Symbology	PCS	Size (mm)	No. of Digits
0.127 mm (5mil)	Limited	0.9	9.0 × 1.0	14
0.127 mm (5mil)	Limited-Composite	0.9	9.0 × 2.5	26

2 D Codes

<PDF417>

Resolution	Error Correction	PCS	Size (mm)	No. of Character
0.127 mm (5mil)	Level-3	0.9	12 × 8	58
0.254 mm (10mil)			35 × 15	

<QR Code: Model-2>

Resolution	Error Correction	PCS	Size (mm)	No. of Character
0.127 mm (5mil)	M	0.9	4 × 4	44
0.169 mm (6.7mil)			5 × 5	
0.381 mm (15mil)			11 × 11	

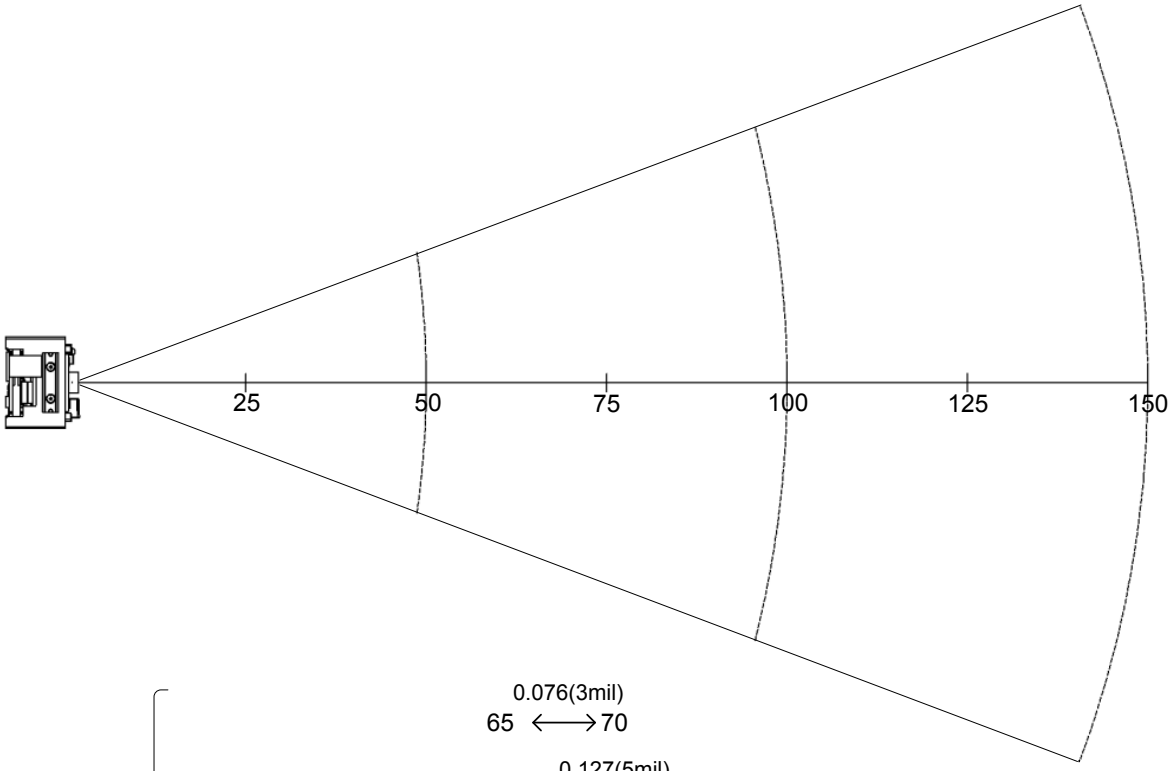
<Data Matrix>

Resolution	Model	PCS	Size (mm)	No. of Character
0.127 mm (5mil)	ECC2000	0.9	3 × 3	40
0.212 mm (8.4mil)			5 × 5	

Note: The size is outline dimensions excluding quiet zone.

8.2. Scan Area and Depth of Field

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



[Unit : mm]

Code 39	0.076(3mil)	65 ⟷ 70
	0.127(5mil)	60 ⟷ 90
	0.254(10mil)	* 55 ⟷ 120
Code 128	0.18(7.1mil)	* 50 ⟷ 105
UPC 100%	0.33(13mil)	* 50 ⟷ 125
PDF417	0.127(5mil)	60 ⟷ 85
	0.254(10mil)	* 60 ⟷ 120
QR Code	0.169(6.7mil)	65 ⟷ 85
	0.381(15mil)	40 ⟷ 120
Data Matrix	0.212(8.4mil)	60 ⟷ 95

Note: The depth of field depends on the view angle and symbol length

Figure 3: Scan Area and Depth of Field

8.3. Print Contrast Signal

PCS 0.3 or higher

<Conditions>
MRD : 32% and higher
(70% or higher reflectivity of space and quiet zone)
Distance : 70 mm from the front edge of the camera module
Bar Code Sample : UPC specified in Chapter 8. (Resolution: 0.33 mm, PCS: 0.3)

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

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

8.4. Minimum Resolution

1D Code : 0.076 mm (3 mil) Code 39 specified in Chapter 8
GS1-Databar : 0.127 mm (5 mil) GS1 Databar-Limited specified in Chapter 8
Stacked Code : 0.127 mm (5 mil) PDF417, GS1 Databar-Limited Composite specified in Chapter 8
2D Code : 0.127 mm (5 mil) QR Code and Data Matrix specified in Chapter 8

<Conditions>
Bar Code Sample : The above codes specified in Chapter 8
Distance : 70 mm from the front edge of the camera module
Angle : $\alpha = 0°$, $\beta = +15°$, $\gamma = 0°$
Curvature : $R = \infty$
For the pitch angle and tilt angle measurement, set the skew angle $\beta = +15°$

Note: The depth of field for minimum resolution depends on printing quality.

8.5. Wide Bar Code

Code 39 of 70 mm width and resolution 0.2mm can be read.

<Conditions>
Bar Code Sample : 0.20 mm Code 39 / CPS 0.9 specified in Chapter 8
Distance : 100 mm from the front edge of the camera module
Angle : $\alpha = 0°$, $\beta = +15°$, $\gamma = 0°$
Curvature : $R = \infty$

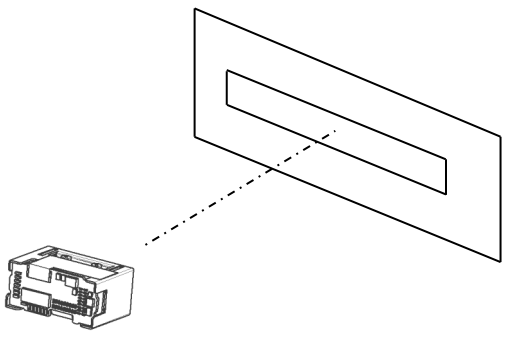


Figure 4: Wide Bar Code

8.6. Motion Tolerance

0.381 mm QR Code can be read when it is moving at 1M/s.

<Conditions>

Ambient Temperature and Humidity	: Room temperature and Room humidity
Ambient Light	: 500 lux to 1000 lux (on the surface of a bar code)
Distance	: 100 mm from the front edge of the camera module
Angles	: α= 0°
Skew	: β = 15°
Tilt	: γ = 0°
Curvature	: R = ∞
Power Supply Voltage	: 3.3 and 5.0 V
PCS (1D and 2D)	: 0.9 or higher
Bar Code Sample	: UPC with 0.33 mm resolution specified in Chapter 8

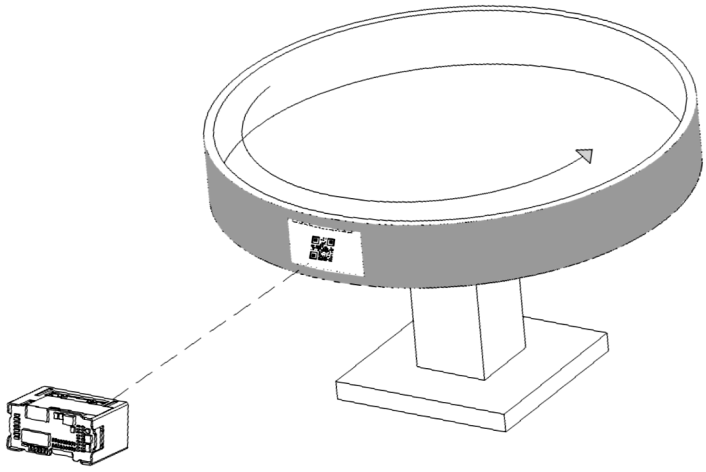


Figure 5: Motion Tolerance

Note: The above shows the possibility of high speed decoding, but 100% decoding at high speed can not be guaranteed, since other factors can influence this capability. If high speed (>=1M/s) capability is required, then always run in-motion evaluation test along with image captures to determine if this product satisfies all requirements before a large purchase is made.

While this module is capable of high speed in-motion decoding by itself, other factors may be required in certain applications, such as:

- Eliminating all specular reflections
- Adding External Illumination
- Using an External Trigger signal (i.e. photoeye)
- Improving the quality and contrast of the bar code symbol.

8.7. Pitch, Skew, and Tilt

Pitch : α = ± 50°
Skew : β = ± 50°
Tilt : γ = ± 180°

<Conditions>
Bar Code Sample : 0.33 mm UPC specified in Chapter 8
Distance : 70 mm from the front edge of the camera module
Curvature : R = ∞
For the pitch angle and tilt angle measurement, set the skew angle β = +15°

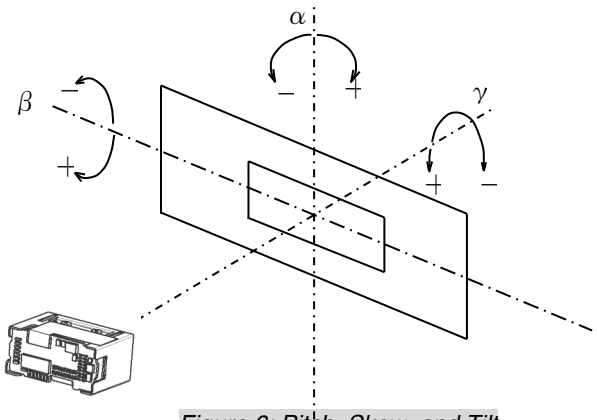


Figure 6: Pitch, Skew, and Tilt

8.8. Curvature

12-digit UPC (0.33 mm) : R ≧ 20 mm

<Conditions>
Bar Code Sample : 0.33 mm UPC specified in Chapter 8
Distance : 70 mm from the front edge of the camera module
Angle : α = 0°, β =＋15°, γ = 0°

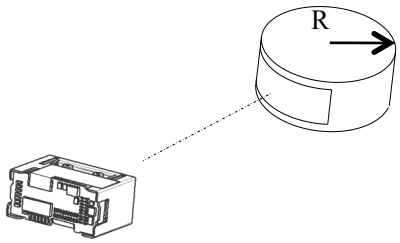


Figure 7: Curvature

Note: Scanning may fail due to the specular reflection of illumination LEDs when the reflectivity is high.

9. Environmental Specifications

9.1. Temperature

Operating Temperature : -30 to 60 °C
Storage Temperature : -40 to 70 °C

<Conditions>
Bar Code Sample : 0.33 mm UPC specified in Chapter 8
Distance : 70 mm from the front edge of the camera module
Angle : α = 0°, β = +15°, γ = 0°
Curvature : R = ∞
Scanning Test : Read at intervals of 300 ms
Power Supply Voltage : 3.3 and 5.0 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>
Bar Code Sample : 0.33 mm UPC specified in Chapter 8
Distance : 70 mm from the front edge of the camera module
Angle : α = 0°, β = +15°, γ = 0°
Curvature : R = ∞
Power Supply Voltage : 3.3 and 5.0 V

9.3. Ambient Light Immunity

Scanning performance is guaranteed when the luminance on a bar code surface is between zero and the following values:

Incandescent Light : 10,000 lux
Fluorescent Light : 10,000 lux
Sunlight : 100,000 lux

<Conditions>
Bar Code Sample : 0.33 mm UPC specified in Chapter 8
Distance : 70 mm from the front edge of the camera module
Angle : α = 0°, β = +15°, γ = 0°
Curvature : R = ∞
Power Supply Voltage : 3.3 and 5.0 V

Note: Scanning performance is guaranteed as far as the direct ambient light or specular reflection from the illumination LED does not enter the light receiving section of the MDI-3100.

9.4. Electrical Noise

(a) Scanning Symbologies
There shall be no abnormalities in the output signals when sinusoidal electrical noise (50 Hz to 100 kHz, smaller than 0.1Vp-p) is added to the power supply line.

<Conditions>

Scan Method	: Continuous Scanning
Bar Code Sample	: 0.33 mm UPC specified in Chapter 8
Distance	: 70 mm from the front edge of the camera module
Angle	: α = 0°, β = ＋15°, γ = 0°
Curvature	: R = ∞
Scanning Test	: Read at intervals of 300 ms
Power Supply Voltage	: 3.3 and 5.0V

(b) Image Data Acquisition
There shall be no excessive noise or misalignments in acquired images when sinusoidal electrical noise (50 Hz to 100 kHz, smaller than 20mVp-p) is added to the power supply line.

Note: There may be a case where the electrical noise affects the quality of captured images. The signal processing system of the MDI-3100 is especially designed for the purpose of scanning symbologies but not for the acquisition of image data. Therefore, the quality of captured images of the MDI-3100 may be lower than that of general digital cameras.

9.5. Vibration

There shall be no sign of malfunction of the MDI-3100 after the following vibration test.
Vibration Test: Increase the frequency of the vibration from 12Hz to 200Hz at accelerated velocity 32.3m/S^2 (3.3G) for ten minutes. Continue this routine for 2 hours to X-direction, 2 hours to Y-direction and 4 hours to Z-direction.

<Conditions>

Bar Code Sample	: 0.33 mm UPC specified in Chapter 8
Distance	: 70 mm from the front edge of the camera module
Angle	: α = 0°, β = ＋15°, γ = 0°
Curvature	: R = ∞
Power Supply Voltage	: 3.3 and 5.0 V

9.6. Shock

There shall be no sign of malfunction of the MDI-3100 after the following shock test.
Drop test: Fix the MDI-3100 in a specific dummy case and drop it 10 times in total, at top, bottom, front, back, left, right, top-left, top-right, bottom-left and bottom-right faces, from a height of 180 cm onto a concrete floor.

<Conditions>

Bar Code Sample	: 0.33 mm UPC specified in Chapter 8
Distance	: 70 mm from the front edge of the camera module
Angle	: α = 0°, β = ＋15°, γ = 0°
Curvature	: R = ∞
Power Supply Voltage	: 3.3 and 5.0 V

10. Integration Specifications

Connection between the decoder board and a host system:

Use a cable developed in accordance with specifications provided by a connector manufacturer to connect the MDI-3100 with the host system.

Connector used is produced by IRISO Electronics Co., Ltd.

Product No. : 9681-12 (12pin)
Cable Length : 50 mm (max)

Note: Refer to “Integration Guide” for details.

11. Regulatory Specifications

11.1. LED Safety

Lamp classification: IEC62471:2006 Exempt Group

12. RoHS Compliant

The MDI-3100 is compliant with RoHS.

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

13. Reliability

MTBF 53310 hours

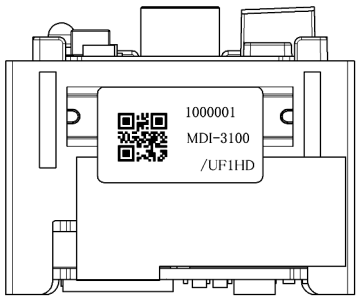
Note: The reliability of the MDI-3100 is guaranteed as far as it is operated under normal operating conditions in the range of advised operating temperature and without excessive electrical or mechanical shock.

14. Precautions

- All workbenches, tools, measuring instruments and any part of human body, which have come into contact with MDI-3100, must undergo preliminary antistatic treatments.
- Do not touch the optical and electrical components. Hold it on the chassis when carrying the MDI-3100.
- Avoid handling the MDI-3100 in a dusty area. In case dust gets on the MDI-3100, 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 MDI-3100.

15. Serial Label

The serial label is affixed to the MDI-3100 as shown below.



The details of the label are as follows.

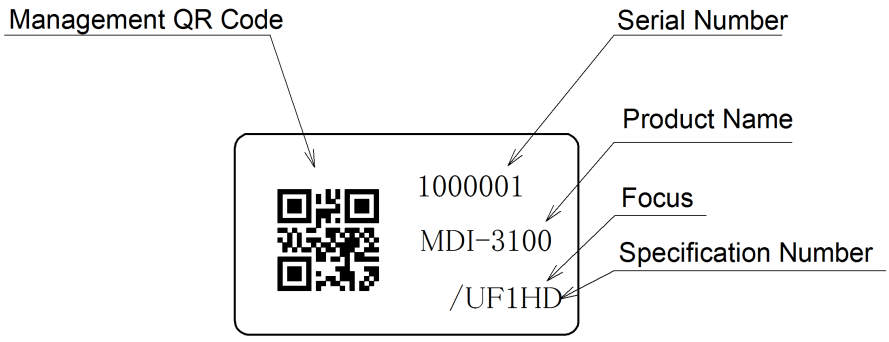


Figure 9: Serial label

The serial number (seven-digit) starts from 1000001 and is sequentially numbered regardless of lot number.

Note: HD stands for High Density Focus.
: SR stands for Standard Range Focus.

16. Packaging Specifications

16.1. Packaging

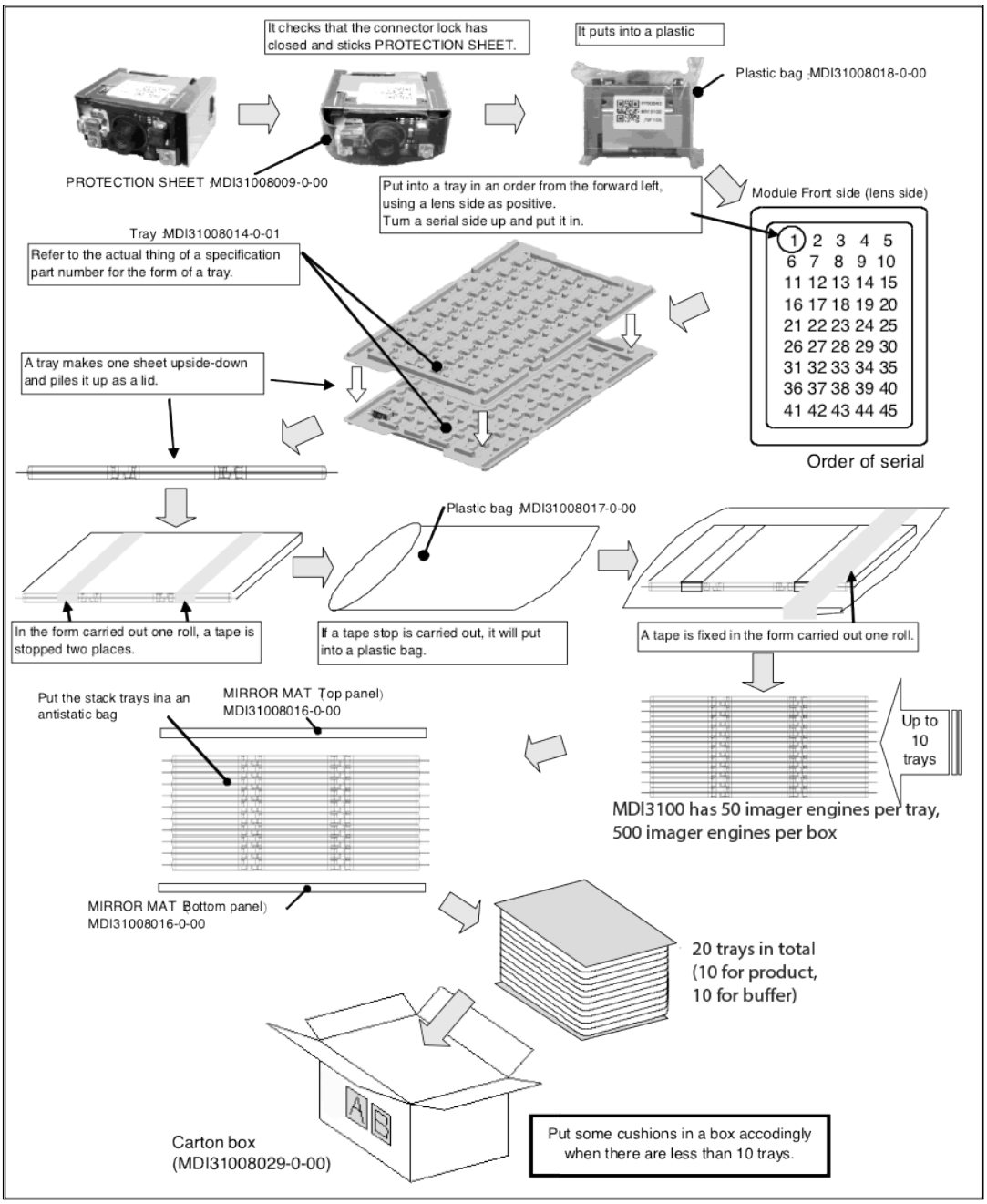


Figure 8: Packaging

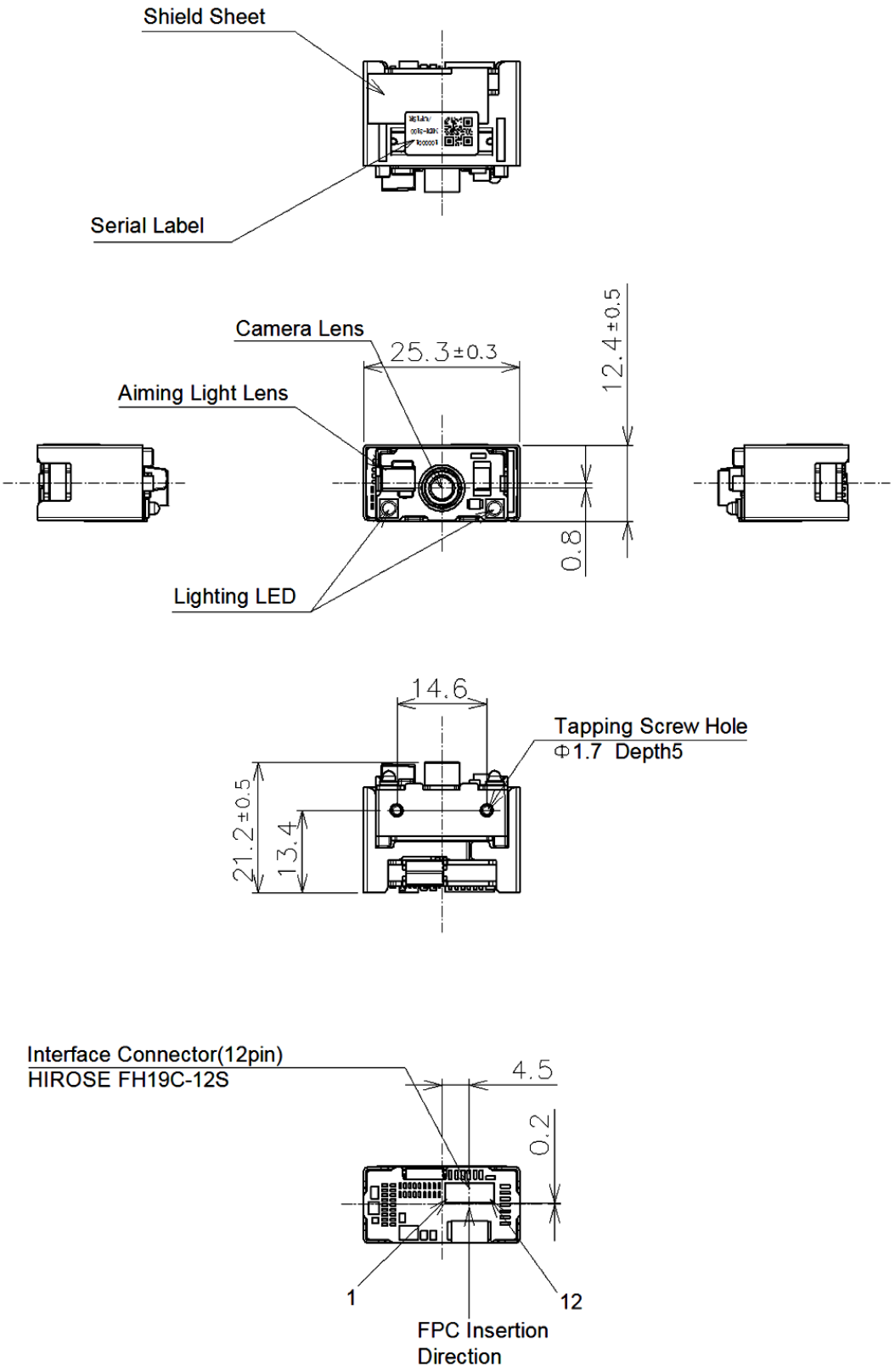
Product name, number of products contained within and name of the manufacturer shall be displayed on the packing box.

16.2. Package Size

405 × 260 × 211 (WDH mm)

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

17. Mechanical Drawing



Note: The depth of the HD model is 0.2 mm deeper in size than that of the SR model.

Figure 10: Camera Module