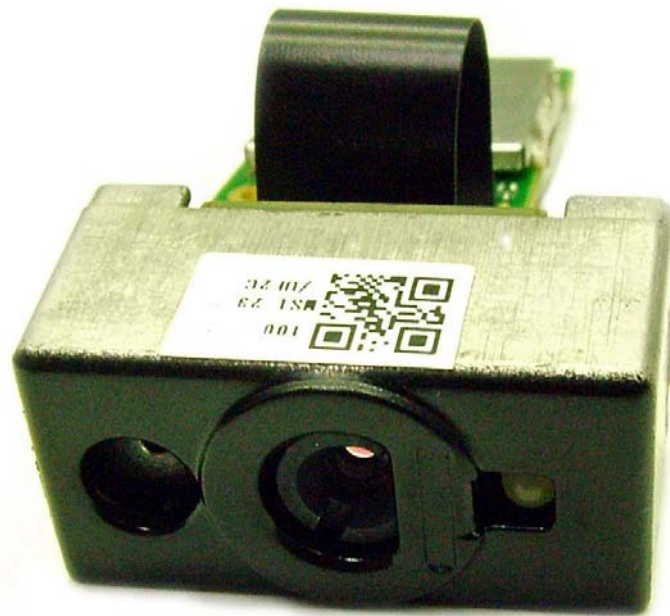


OPTICON

2D Scan Engine

MDI-2350



This document provides specifications for the MDI-2350 imager scan engine.

Specifications Manual

All information subject to change without notice.

Document History

Model Number:	MDI-2350	Specification Number:	SS11029
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Revision History

Specification No. : SS11029
Product name : MDI-2350

Edition	Date	Page	Section	Description of Changes
First	2011/08/08	-	-	Initial release
2nd	2011/09/13	6	7	Optical Specifications: changed the focal distance from 90 mm to 120 mm.
		8	8	Changed the depth of field.
3rd	2011/12/27	16	17	Changed the Camera module drawing

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1. Abstract

This manual provides specifications for the MDI-2350 fixed-focus imager scan engine.

2. Overview

MDI-2350 is a compact imager scan engine which enables high speed scanning of linear (1D) and 2D symbologies for the first time in the industry. Main features of MDI-2350 are as follows:

- Comfortable reading suitable for embedded system
A 1.3 million pixels sensor and wide-angle optical system with 120 mm focal distance enable comfortable reading of wide and high resolution codes at close range.
- World's fastest image processing speed
Compact and high-performance ASIC enables a smooth response by processing vast amount of information transferred from the mega pixel CMOS image sensor in a very short time.
- Various Settings
It is possible to change symbology settings, scanning settings, communication settings and other feature settings by sending commands.
- Wide range of supported symbologies
MDI-2350 supports symbologies such as GS1 DataBar (Old: RSS), Aztec Code, EAN, UCC Composit barcode and so on. Please refer to "Specification for Software Interface" for details of supported symbologies.
- RoHS compliance
The MDI-2350 is a RoHS compliant product, which is declared by Optoelectronics Co., Ltd.complies with RoHS.

3. Physical Features

3.1. Dimensions

Camera Module	: 27.3 × 14.2 × 13.4 (WDH mm)
Decoder Board	: 18.5 × 30.3 × 4.8 (WDH mm)

3.2. Weight

Camera Module	: 7 grams (max)
Decoder Board	: 4 grams (max)

4. Electrical Specifications

4.1. Absolute Maximum Ratings

Item	Symbol	Rated 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 Current	I_O	± 4	mA

4.2. Electrical Characteristics

($V_{CC} = 3.3V$, $T_A = 25^\circ C$)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Voltage (*1)	V_{CC}		3.15	3.3	3.45	V
Peak 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} $I_{OH} = -4mA$	2.8			V
	L Level	V_{OL} $I_{OL} = 4mA$			0.5	V

4.3. Current Consumption in Default Setting

When the scan engine is configured to "Snapshot and decoding parallelism ON".

($V_{CC} = 3.3V$, $T_A = 25^\circ C$)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating Current	I_{OP}		-	240	300	mA
Standby Current	I_{STB}		-	70	100	mA
Power Down Current (*3)	I_{SLP}		-	15	25	mA

*1: Input Connector

*2: V_{CC} is supplied by a direct-current power supply of 10 A and measurement is done using a current probe. If it is necessary to decrease the rush current, please use a circuit to gently increase the operating voltage from 0 to 3.3 V (soft start power supply).

*3: When configured with Sleep command or in Power Down mode.

5. Power Mode Transition

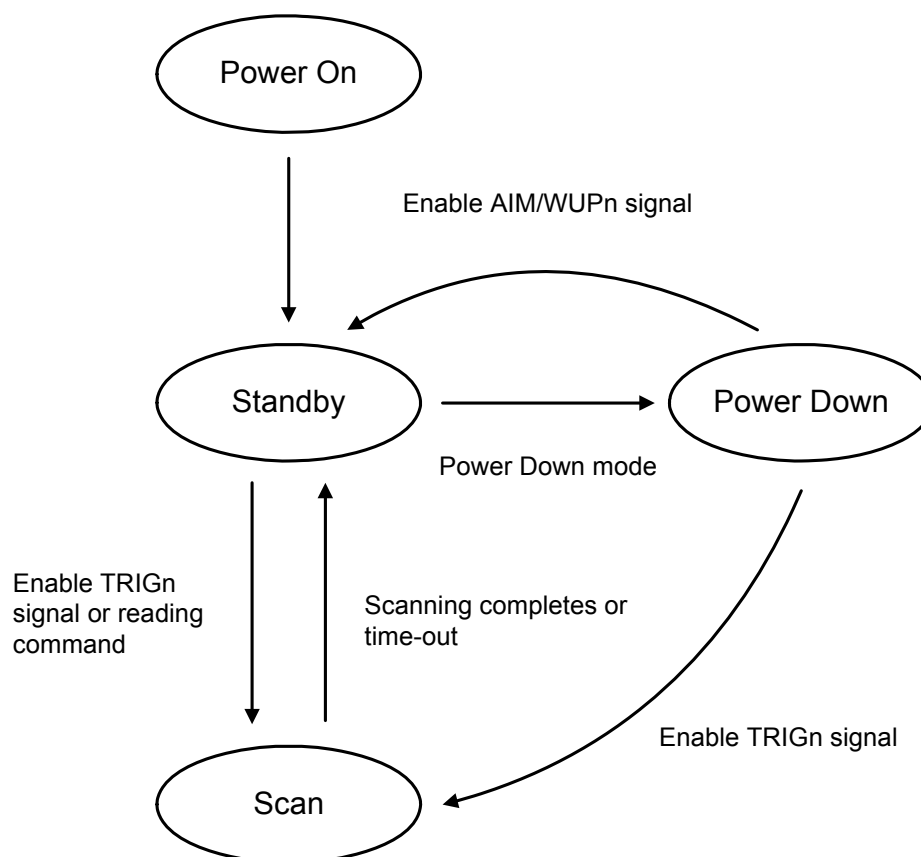


Figure 1: Power Mode Transition

- *1 When Power Down mode is enabled, the MDI-2350 automatically enters Power Down state after Power On.
- *2 When Power Down mode is enabled and the MDI-2350 is in Standby state, the MDI-2350 goes to Power Down state after the time out period specified by power saving command has elapsed. (In case there are no events to move to other states,)
- *3: Power Down state is not supported when the MDI-2350 uses its USB_COM interface. This is done because every time the MDI-2350 enters Power Down state, a USB device driver would get a disconnect message.

6. Interface Specifications

6.1. Interface Signals

Connector used was produced by Hirose Electric Co., Ltd.
Product No.: FH19SC-17S-0.5SH (Bottom contact)

No.	Signal			State	Note
	Name	Function	I/O		
1	DWNLDn	Download control signal	In	L: Download mode H: Normal state	Check the signal when the power is supplied and enable rewriting software.
2	V _{CC}	Power input	In	3.3V±5%	
3	GND	System ground			
4	RxD	Received data signal	In	L: On H: Off	Asynchronous data from the host system
5	TxD	Transmitted data signal	Out	L: On H: Off	Asynchronous data to the host system
6	CTS	Communication control signal from host system	In	L: On H: Off	Request for a data output to MDI-2350
7	RTS	Communication control signal to host system	Out	L: On H: Off	Request for a data output from MDI-2350
8	POWERDWN	Shows Power Down state	Out	L: Normal state H: Power Down	
9	USB+		In/Out		USB 1.1
10	USB-		In/Out		
11	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	
12	TRIGn	Trigger on	In	L: Start operation H: No action	Command signal for image reading and decoding
13	V _{CC}	Power input	In	3.3V±5%	
14	GND	System ground			
15	BUZZER	Activate external buzzer	Out		PWM signals allow to control tones and sound pressure
16	GR_LEDn	Good Read	Out	L: LED on H: LED off	
17	EX_ILLUMn	Signal for external illumination control	Out	L: External illumination on H: External illumination off	Control of an external illumination light source

6.2. Interface Circuit

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

7. Optical Specifications

Item		Characteristics
Scan method	CMOS area sensor (black and white)	-
Number of effective pixel	(H) × (V)	1280 × 1024 dot
Image capture speed (*1)	Frame rate	30 fps
Focal distance	From the front edge of scan engine	120 mm
View angle	Horizontal	Approx. 48°
	Vertical	Approx. 34°
Auxiliary light source (LED × 1)	InGaP Red LED	-
	Peak Wave Length	645 nm
	Directivity angle 2θ1/2 (*2)	60°
	Maximum radiation output (*3)	5040 mcd
Light source for aiming / distance ranging (Laser diode)	Red Laser Diode	-
	Peak Wave Length	650 nm
	Maximum radiation output (*4)	390 μW

*1 The fastest speed of image capture.

*2 The reference value extracted from the datasheet.

*3 The reference value extracted from the datasheet (conditions: 25 °C, IF = 50 MA)

*4 Class 1 compliant output.

8. Technical Specifications

Scanning is done by aiming the MDI-2350's laser to the center of a barcode. When scanning from a distance, ambient light which is reflected to the scan field may affect the scanning performance. 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	: 1000 lux to 1500 lux (on the surface of a bar code)
Angles	: $\alpha = 0^\circ$
Skew	: $\beta = 15^\circ$
Tilt	: $\gamma = 0^\circ$
Curvature	: $R = \infty$
Power Supply Voltage	: 3.3 V
PCS (1D and 2D)	: 0.9 or higher
Scanning Test	: Accept the performance with 70% success rate for 10 tries of scan
Barcode Test Sample (1D and 2D)	: Specified below

Code 39 (resolution 0.127 and 0.2 mm) and UPC codes used for the tests are listed on the OPTOELECTRONICS test chart. Other codes are printed by a normal printer (NW ratio = 1 : 1.25).

Supported 1 D symbology

<Code 39>

Resolution	Symbology	PCS	Size (mm)	No. of Digits
0.127 mm	Code 39	0.9	11 × 10	4
0.20 mm			14 × 10	24

<UPC>

Resolution	Symbology	PCS	Size (mm)	No. of Digits
0.264 mm	12-digit UPC	0.9/0.45	25 × 19	12
0.330 mm	12-digit UPC	0.9	31.5 × 25.0	12

Supported 2 D symbology

<PDF417>

Resolution	Error Correction	PCS	Size (mm)	No. of Character
0.254 mm	Level-4	0.9/0.45	26 × 16.5	17
0.127 mm	Level-4	0.9	13 × 8	17

<QR Code: Model-2>

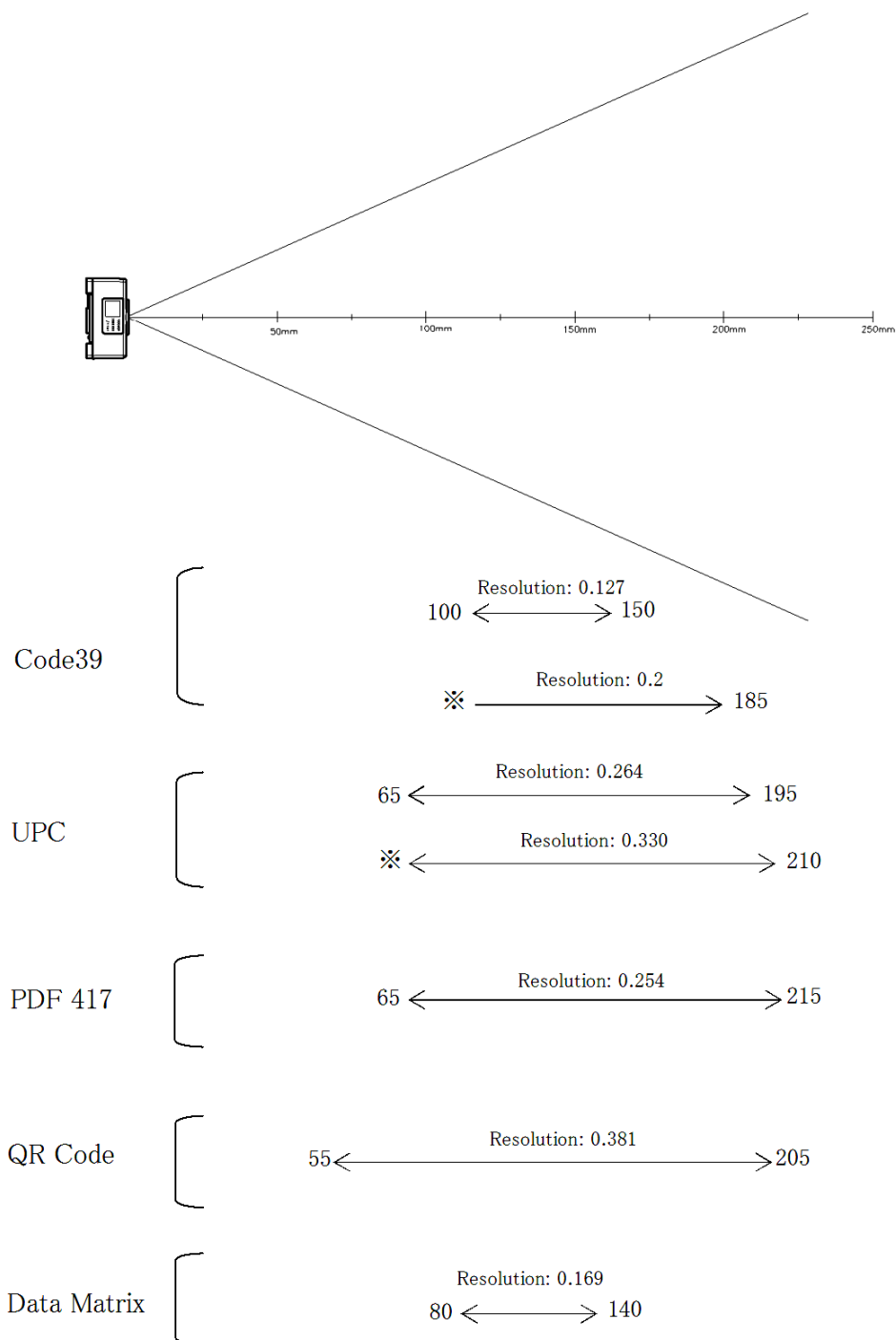
Resolution	Error Correction	PCS	Size (mm)	No. of Character
0.381 mm	M	0.9	12 × 12	44

<DataMatrix>

Resolution	Error Correction	PCS	Size (mm)	No. of Character
0.169 mm	ECC2000	0.9	4 × 4	40

8.1. Scan Area and Depth of Field

The scan area is measured from the front of the camera module.
(in the millimeters)



※The depth of field depend on the view angle and symbol length

Figure 2: Scan Area and Depth of Field

8.2. Print Contrast Signal

PSC 0.45 or higher

<Conditions>

MRD : 32% and higher (70% or higher reflectivity of space and quiet zone)
Distance : 120 mm from the front edge of the camera module.
Barcode test sample : UPC specified in Chapter 8. (Resolution: 0.33 mm, PCS: 0.45)
(1D and 2D)

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

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

8.3. Minimum Resolution

0.127 mm : Code 39 and PDF417 specified in Chapter 8
0.169 mm : DataMatrix specified in Chapter 8

<Conditions>

Bar Code Sample : 0.127 mm Code 39 and PDF417, 0.169 mm DataMatrix specified in Chapter 8
Distance : 120 mm from the front edge of the camera module
Angle : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature : $R = \infty$

For the pitch angle and tilt angle measurement, set the skew angle $\beta = +15^\circ$

8.4. Pitch, Skew, and Tilt

Pitch : $\alpha = \pm 50^\circ$
Skew : $\beta = \pm 50^\circ$
Tilt : $\gamma = 360^\circ$

<Conditions>

Bar Code Sample : UPC with 0.33 mm resolution specified in Chapter 8
Distance : 120 mm from the front edge of the camera module
Curvature : $R = \infty$
For the pitch angle and tilt angle measurement, set the skew angle $\beta = +15^\circ$

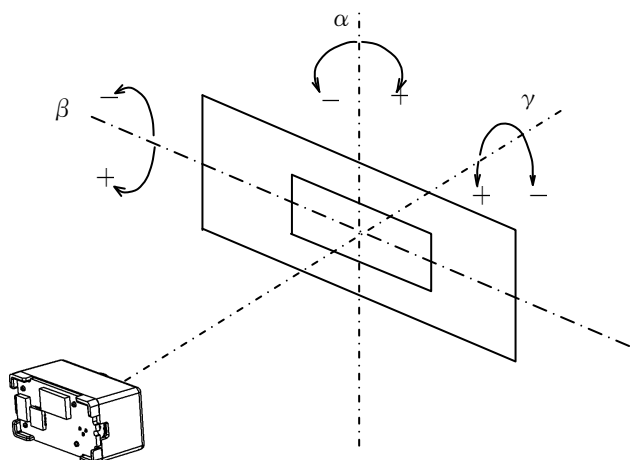


Figure 3: Pitch, Skew, and Tilt

8.5. Curvature

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

<Conditions>

Bar Code Sample : UPC as specified in Chapter 8

Distance : 120 mm from the front edge of the camera module

Angle : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$

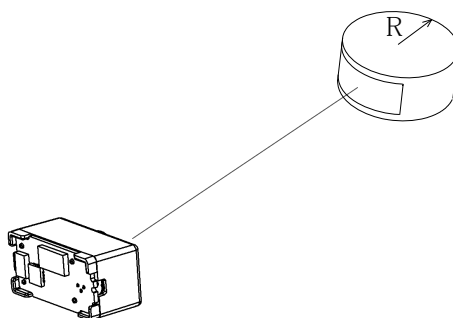


Figure 4: Curvature

Note: Scanning may fail due to the specular reflection of illumination LEDs when the reflectivity is high. In that case, scan the code tilting the scanner in the skew direction or set the illumination LED off so that the performance can improve. Make sure of the sufficient environmental illuminance (500 lx or more) when the illumination LED is off to keep the scanning performance. The ambient lights also may cause the reflection and the degraded scanning performance.

9. Environmental Specifications

9.1. Temperature

Operating Temperature	: -20 to 55 °C
Storage Temperature	: -40 to 70 °C

9.2. Humidity

Operating Humidity	: 5 to 85% RH (no condensation, no frost)
Storage Humidity	: 5 to 85% RH (no condensation, no frost)

9.3. Ambient Light Immunity

Scanning performance is guaranteed when the illuminance 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	: UPC with 0.33 mm resolution specified in Chapter 8
Distance	: 120 mm from the front edge of the camera module
Angle	: $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature	: $R = \infty$
Power Supply Voltage	: 3.3 V

* 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-2350.

9.4. Electrical Noise

(a) Scanning Symbolologies

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

<Conditions>

Scan Method	: Continuous Scanning
Bar Code Sample	: UPC with 0.33 mm resolution specified in Chapter 8
Distance	: 120 mm from the front edge of the camera module
Angle	: $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature	: $R = \infty$
Power Supply Voltage	: 3.3 V

(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 20 mVp-p) is added to the power supply line.

* There may be a case where the electrical noise affects the quality of captured images. The signal processing system of MDI-2350 is especially designed for the purpose of scanning symbolologies but not for the acquisition of image data. Therefore, the quality of captured images of MDI-2350 may be lower than that of general digital cameras.

9.5. Vibration Strength

There shall be no sign of malfunction of MDI-2350 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	: UPC with 0.33 mm resolution specified in Chapter 8
Distance	: 120 mm from the front edge of the camera module
Angle	: $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature	: $R = \infty$
Power Supply Voltage	: 3.3 V

9.6. Drop Impact Strength

There shall be no sign of malfunction of MDI-2350 after the following shock test.

Drop test: Fix the MDI-2350 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 150 cm onto a concrete floor.

<Conditions>

Bar Code Sample	: UPC with 0.33 mm resolution specified in Chapter 8
Distance	: 120 mm from the front edge of the camera module
Angle	: $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$
Curvature	: $R = \infty$
Power Supply Voltage	: 3.3 V

10. Integration Specifications

Connection between the decoder board and a host system:
Please Use a cable developed in accordance with specifications provided by a connector manufacturer to connect the MDI-2350 decoder board with the host system.

Connector used is produced by Hirose Electric Co.,Ltd.
Product No. : FH19SC-17S-0.5SH (17pin)
Cable Length : 70 mm (max)

11. Regulatory Compliance

11.1. LED Safety

Lamp classification: IEC62471:2006 Exempt Group

11.2. Laser Safety

IEC 60825-1:2007 Class 1
CDRH Class I

12. RoHS

The MDI-2350 is compliant with RoHS.

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

13. Reliabilities

MTBF 10,000 hours

* The reliability of MDI-2350 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 work-benches, tools, measuring instruments and any part of human body which have come into contact with MDI-2350 must undergo preliminary antistatic treatments.
- Do not touch the optical and electrical components. Hold it on the metal chassis when carrying the MDI-2350.
- Avoid handling the MDI-2350 in a dusty area. In case dust gets on the MDI-2350, 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-2350.

15. Packaging Specifications

15.1. Packaging

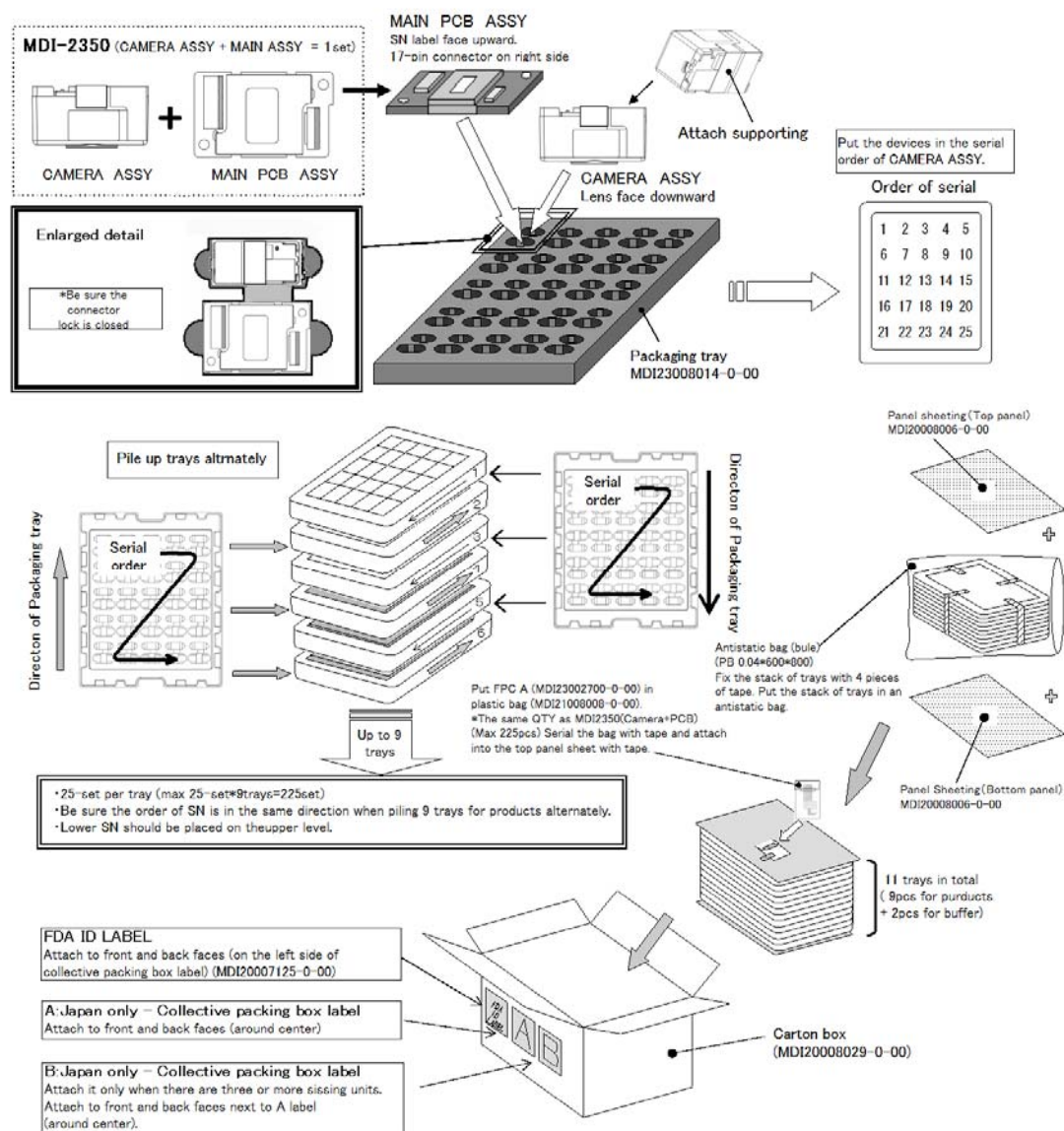


Figure 5: Packaging

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

15.2. Package Size

335 × 290 × 185 (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.

16. Serial Label

The following labels with serial number is attached to the camera module and decoder board.

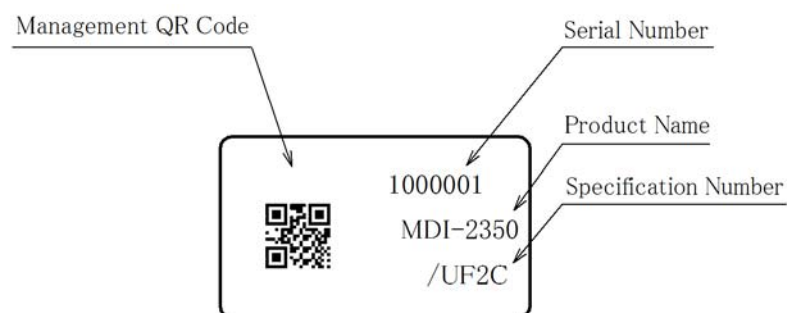


Figure 6: Camera Module

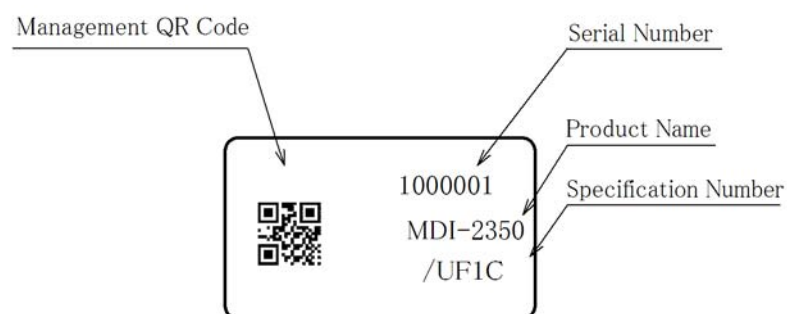


Figure 7: Decoder Board

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

17. Mechanical Drawing

17.1. Camera Module

33	1
32	2
31	3
30	4
29	5
28	6
27	7
26	8
25	9
24	10
23	11
22	12
21	13
20	14
19	15
18	16
17	17
16	18
15	19
14	20
13	21
12	22
11	23
10	24
9	25
8	26
7	27
6	28
5	29
4	30
3	31
2	32
1	33
PIN No. DECODER	PIN No. CAMERA

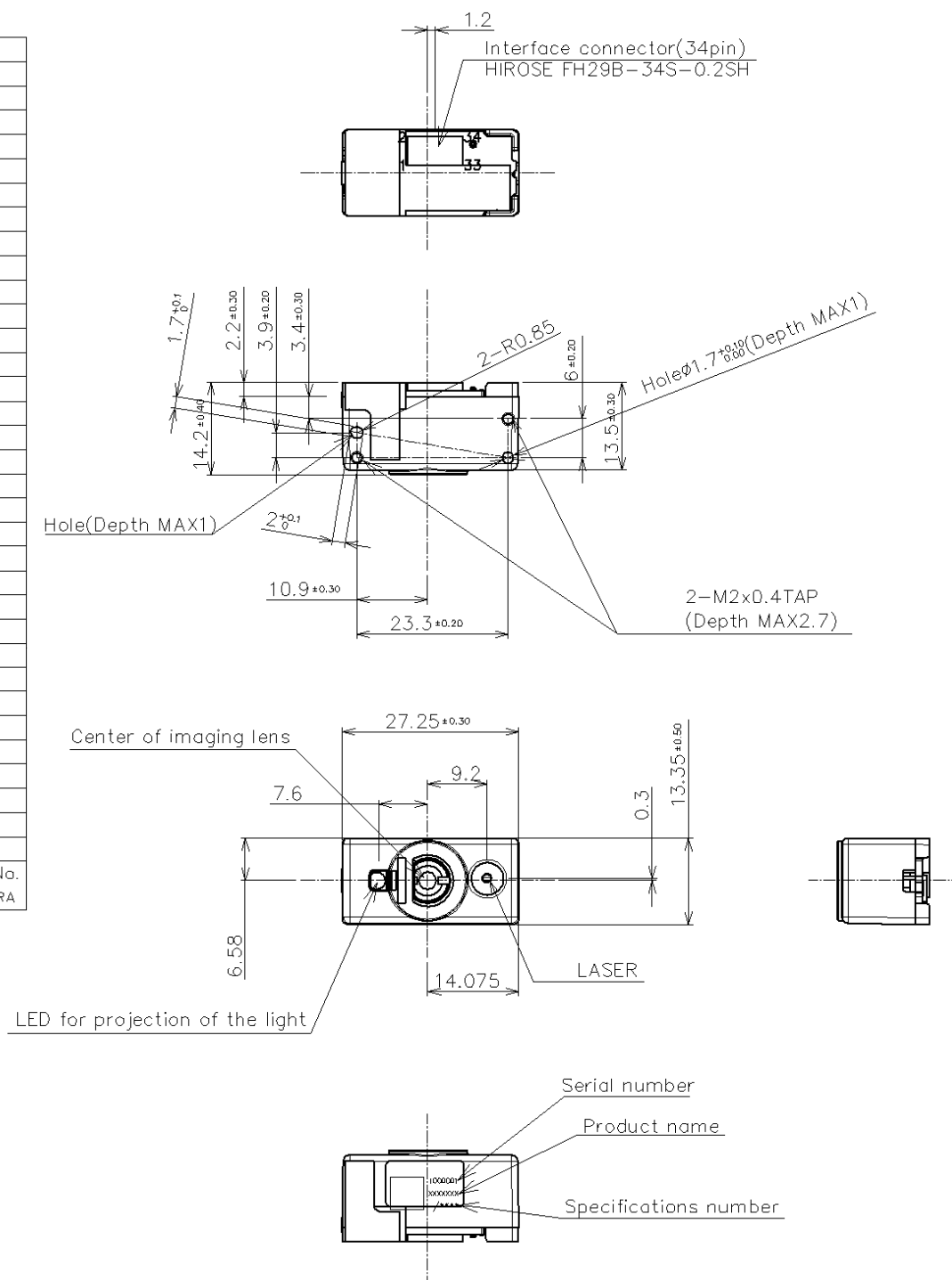


Figure 8: Camera Module

17.2. Decoder Board

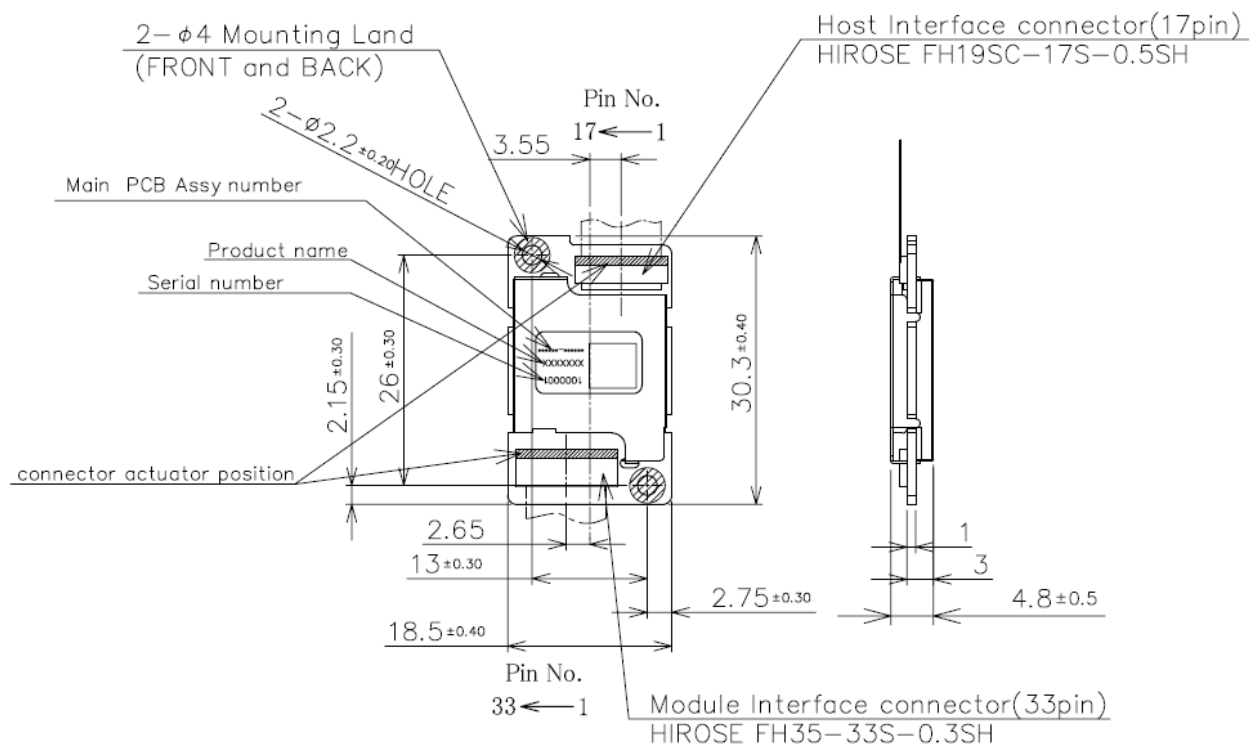


Figure 9: Decoder Board

17.3. FPC

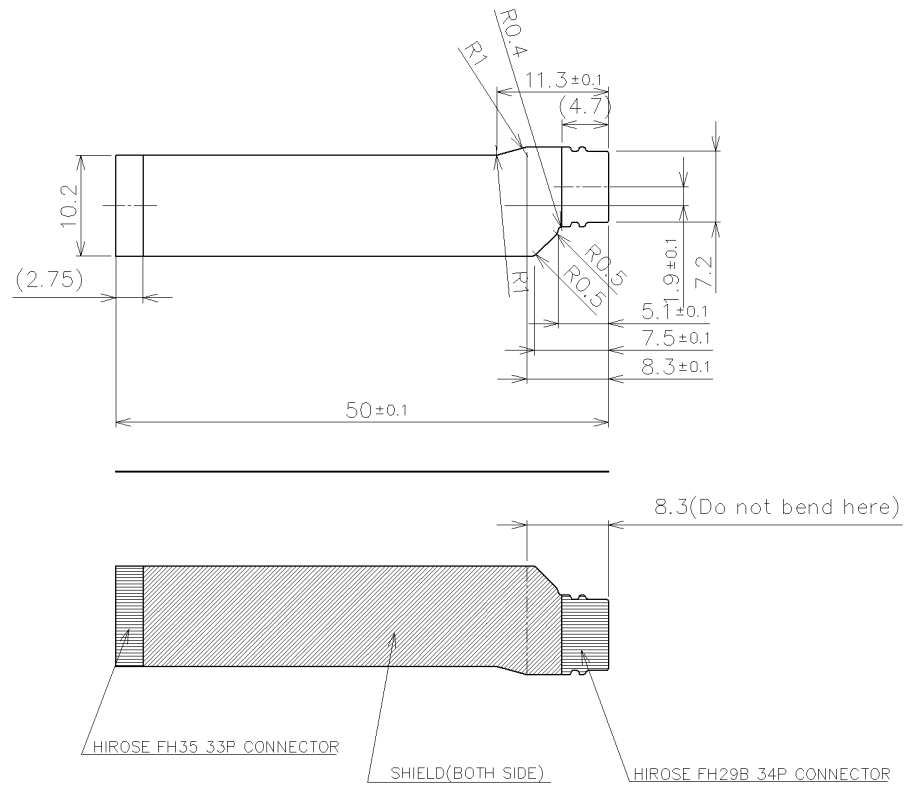


Figure 10: FPC