

OPTICON

Auto Focus 2D Scan Engine

MDI-2300



This document provides the specifications for the auto-focus imager scan engine, MDI-2300.

Specifications Manual

All information subject to change without notice.

Document History

| | | | |
|----------------------|-------------------|------------------------------|----------------|
| Model Number: | MDI-2300 | Specification Number: | SS10031 |
| Edition: | 5th | Original Spec Number: | SS10030 |
| Date: | 2013-03-04 | | |

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Revision History

Specification No. : SS10031
Product name : MDI-2300

| Edition | Date | Page | Section | Description of Changes |
|---------|------------|------|-----------------------------|---|
| First | 2010/08/10 | - | - | Initial release |
| 2nd | 2010/11/10 | 6 | 7. Optical Specifications | - Changed the Maximum radiation output 1mW to '390 mW'. - Removed 'Class 1M compliant output' from *3. |
| | | 14 | 11.2. Laser Safety | Changed Class 2 to 'Class 1'. |
| | | 18 | 17.3. FPC | Added the description 'Do not bend here' to the drawing. |
| 3rd | 2010/11/29 | 1 | 2. Overview | Remove parentheses around 1D and remove statement about RoHS compliance in Europe. |
| | | 4 | 6.1. Interface signals | Inserted H: Buzzer Off and 2.4 kHz: Buzzer On in row 15 |
| | | 6 | 7. Optical Specifications | Removed "about" before the view angles; note 1 clerical change. |
| | | 12 | 9.3. Ambient Light Immunity | Replaced first sentence. |
| 4th | 2010/12/10 | 4 | 6.1. Interface signals | Changed H: Buzzer Off to L: Buzzer Off |
| 5th | 2013/03/04 | - | - | Changed page numbering of document (including references in this changelog) to move page 1 after the ToC |
| | | 6 | 7. Optical Specifications | changed Maximum radiation output from 390 mW to 390 μ W. |

Contents

| | |
|--|-----------|
| Contents | 1 |
| 1. Abstract | 1 |
| 2. Overview | 1 |
| 3. Physical Features | 1 |
| 3.1. Dimensions | 1 |
| 3.2. Weight | 1 |
| 4. Electrical Specifications | 2 |
| 4.1. Absolute Maximum Ratings | 2 |
| 4.2. Electrical Characteristics | 2 |
| 4.3. Current Consumption in Default Setting | 2 |
| 5. Power Mode Transition | 3 |
| 6. Interface Specifications | 4 |
| 6.1. Interface Signals | 4 |
| 6.2. Interface Circuit | 5 |
| 7. Optical Specifications | 6 |
| 8. Technical Specifications | 7 |
| 8.1. Decode Depth of Field and Resolution | 9 |
| 8.2. Print Contrast Signal | 10 |
| 8.3. Resolution | 10 |
| 8.4. Angles | 10 |
| 8.5. Curvature | 11 |
| 9. Environmental Specifications | 12 |
| 9.1. Temperature | 12 |
| 9.2. Humidity | 12 |
| 9.3. Ambient Light Immunity | 12 |
| 9.4. Electrical Noise | 12 |
| 9.5. Vibration | 13 |
| 9.6. Shock | 13 |
| 10. Integration Specifications | 14 |
| 11. Compliance with Law and Standards | 14 |
| 11.1. LED Safety | 14 |
| 11.2. Laser Safety | 14 |
| 12. RoHS | 14 |

13. Reliabilities14

14. Caution14

15. Packing Specifications15

 15.1. Packing 15

 15.2. Package Size16

16. Serial Number16

17. Mechanical Drawing.....17

 17.1. Camera Module.....17

 17.2. Decoder Board18

 17.3. FPC18

1. Abstract

This manual provides the specifications for the auto-focus imager scan engine, MDI-2300.

2. Overview

MDI-2300 is a compact imager scan engine adopting the auto-focus function which enables high speed scanning of linear 1D and 2D symbologies for the first time in the industry. Main features of MDI-2300 are as follows:

- ◆ High-Speed Scanning
Customized High-speed/ultra-sensitive CMOS image sensor at a maximum of 80fps and the fastest shutter speed in the industry enables high-speed scanning without being affected by hand movement.
- ◆ Reading both at high resolution and at long range.
With the auto-focus function using the embedded liquid lens, the MDI-2300 is able to read barcodes both at high resolution and at long range.
- ◆ High-Speed Auto-Focus
High-speed CMOS image sensor combined with high-speed auto-focus by using laser light for distance ranging. When the distance ranging with laser light is impossible due to the environmental conditions, focus adjustment will be done by contrast method.
- ◆ World's fastest image processing speed
Compact, energy-saving 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-2300 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.
- ◆ Complies with RoHS
MDI-2300 complies with RoHS.

3. Physical Features

3.1. Dimensions

| | |
|---------------|-------------------------------------|
| Camera Module | : 27.3mm(W) × 14.2mm(D) × 13.4mm(H) |
| Decoder Board | : 18.5mm(W) × 30.3mm(D) × 4.8mm(H) |

3.2. Weight

| | |
|---------------|---------------------|
| Camera Module | : 7 grams (maximum) |
| Decoder Board | : 4 grams (maximum) |

4. Electrical Specifications

4.1. Absolute Maximum Ratings

| Items | 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

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

| Items | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|------------------------------------|----------|--------------------------|------|------|----------------|------|
| Range of Power Supply Voltage (*1) | V_{CC} | | 3.15 | 3.3 | 3.45 | V |
| Rush Current Peak (*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".

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

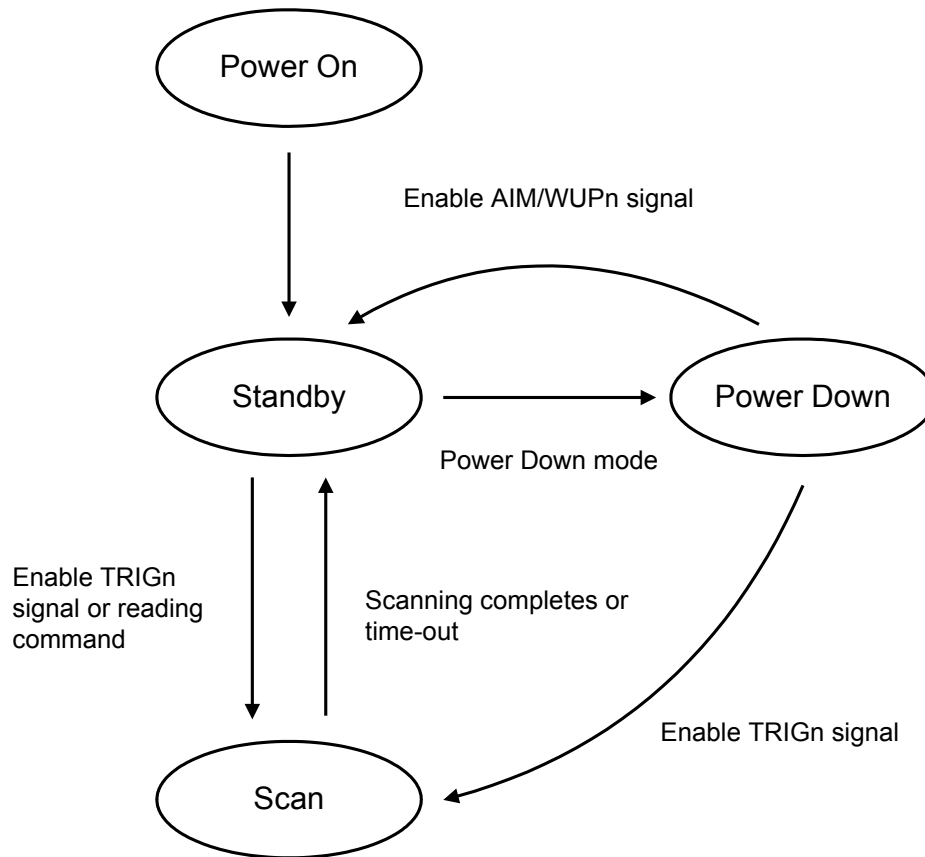
| Items | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------|-----------|------------|------|------|------|------|
| Operating Current | I_{OP} | | - | 240 | 300 | mA |
| Standby Current | I_{STB} | | - | 70 | 100 | mA |
| Power-down Current (*3) | I_{SLP} | | - | 15 | 25 |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

*1: Input Connector

*2: V_{CC} is supplied by a direct-current power supply of 10A 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 3.3V (soft start power supply).

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

5. Power Mode Transition



*1: When "Power Down" mode is enabled, the MDI-2300 automatically enters power down state after Power On.

*2 When "Power Down" mode is enabled and the MDI-2300 is in standby state, the MDI-2300 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 MDI2300 uses its USB_COM interface. This is done because every time the MDI2300 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-2300 |
| 7 | RTS | Communication control signal to host system | Out | L: On H: Off | Request for a data output from MDI-2300 |
| 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 | L: Buzzer Off 2.4 kHz: Buzzer On | 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) | 900 × 512 dot |
| Capture image speed (*1) | Frame rate | 80 fps |
| Lens F-number | 3.0 | - |
| View angle | Horizontal | 40° |
| | Vertical | 23° |
| Auxiliary light source (LED × 1) | InGaIP 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 degrees C, IF = 50M A).

*4: Class 1 compliant output.

8. Technical Specifications

Scanning is done by aiming the MDI-2300'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 | : 3.3V |
| PCS (1D and 2D) | : 0.9 or higher |
| Scanning Test | : Carry out 10 scanning tests. Scan engine is approved when scanning is successful in 70% of the tests. |
| Barcode Test Sample (1D and 2D) | : Specified below |

Code 39 (resolution 0.0762, 0.127, and 1.0 mm) and JAN codes used for the tests are listed on the OPTOELECTRONICS test chart. Other codes listed on a chart 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 |
|------------|-----------|-----|-----------|---------------|
| 0.0762mm | Code 39 | 0.9 | 8 × 10 | 5 |
| 0.127mm | | | 11 × 10 | 4 |
| 0.254mm | | | 14 × 10 | 2 |
| 1.0mm | | | 56 × 30 | |

◆ JAN

| Resolution | Symbology | PCS | Size (mm) | No. of Digits |
|------------|--------------|----------|-------------|---------------|
| 0.260mm | 13-digit JAN | 0.9/0.45 | 25 × 19 | 13 |
| 0.260mm | 8-digit JAN | 0.9 | 17.5 × 15.5 | 8 |
| 0.330mm | 13-digit JAN | 0.9 | 31.5 × 25.0 | 13 |

Supported 2 D symbology

◆ PDF417

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

◆ QR Code (Model-2)

| Resolution | Error Correction | PCS | Size (mm) | No. of Characters |
|------------|------------------|-----|-----------|-------------------|
| 0.381mm | M | 0.9 | 12 × 12 | 44 |
| 0.169mm | | | 5 × 5 | |
| 0.127mm | | | 4 × 4 | |

◆ Data Matrix

| Resolution | Error Correction | PCS | Size (mm) | No. of Characters |
|------------|------------------|-----|-----------|-------------------|
| 0.254mm | ECC200 | 0.9 | 6 × 6 | 40 |
| 0.169mm | | | 4 × 4 | |
| 0.127mm | | | 3 × 3 | |

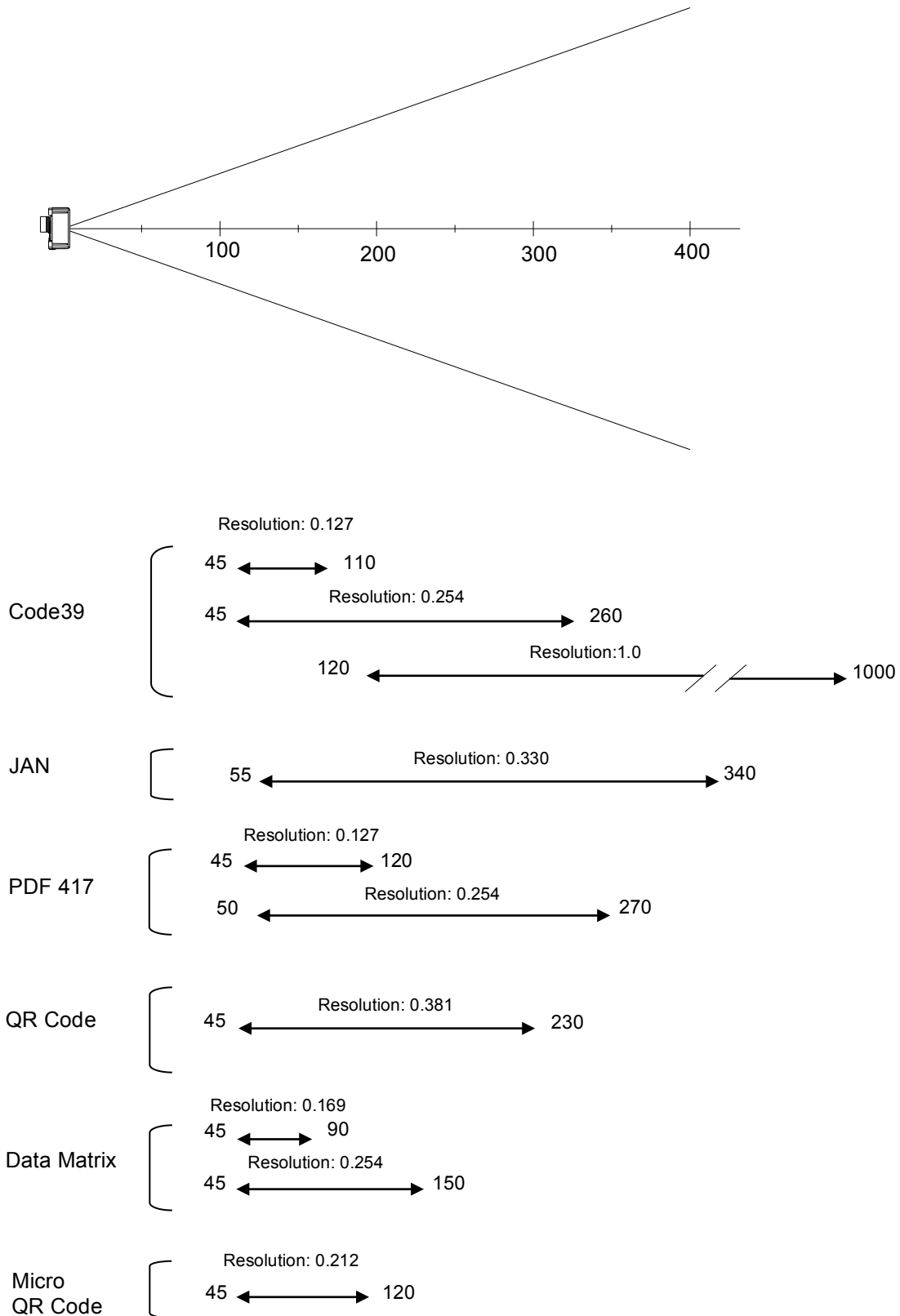
◆ MicroQR

| Resolution | Error Correction | PCS | Size (mm) | No. of Characters |
|------------|------------------|-----|-----------|-------------------|
| 0.212mm | L | 0.9 | 5 × 5 | 11 |

8.1. Decode Depth of Field and Resolution

The depth of decode field is measured from the case front the camera module.

(in the millimeters)



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 case front of the camera module.
 Barcode test sample : PDF417 specified in Chapter 8. (Resolution: 0.254 mm, PCS: 0.45)
 (1D and 2D) JAN specified in Chapter 8. (Resolution: 0.260 mm, PCS: 0.45)

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. Resolution

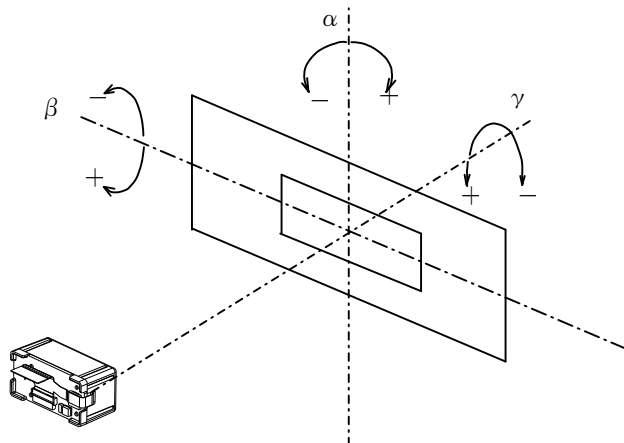
0.0762mm : Code 39 specified in Chapter 8
 0.127mm : PDF417 specified in Chapter 8
 0.127mm : Data Matrix and QR Code specified in Chapter 8

8.4. Angles

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

<Conditions>

Bar Code Sample : Code 39 and PDF417 with 0.245mm resolution specified in Chapter 8
 Distance : 120 mm from the case front of the camera module
 Curvature : $R = \infty$
 For the pitch angle and tilt angle measurement, set the skew angle $\beta = +15^\circ$



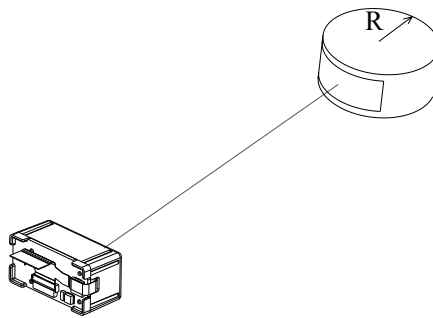
8.5. Curvature

8-digit JAN : Scanning is feasible when R is longer than 15 mm.

13-digit JAN : Scanning is feasible when R is longer than 20 mm.

<Conditions>

Bar Code Sample : JAN as specified in Chapter 8
Distance : 120 mm from the case front of the camera module
Angle : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$



Note: Scanning performance may fail due to the specular reflection of illumination LED when the reflectivity is high. In that case, either way below will help to solve the problem.

- Tilting the scan engine 15 degrees for the skew direction when scanning.
- Set illumination LED off.

When the illumination LED is turned off, make sure that the ambient light is 500lux or more, otherwise the quality of scanning performance may be lowered.

9. Environmental Specifications

9.1. Temperature

| | |
|-----------------------|-----------------------|
| Operating Temperature | : -20 to 55 degrees C |
| Storage Temperature | : -40 to 70 degrees C |

9.2. Humidity

| | |
|--------------------|---|
| Operating Humidity | : 5 to 85% RH (non-condensing non-freezing) |
| Storage Humidity | : 5 to 85% RH (non-condensing non-freezing) |

9.3. Ambient Light Immunity

Maximum ambient light limits:

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

<Conditions>

| | |
|----------------------|---|
| Bar Code Sample | : PDF417 with 0.254 mm resolution specified in Chapter 8 |
| Distance | : 120 mm from the case front of the camera module |
| Angle | : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$ |
| Curvature | : $R = \infty$ |
| Power Supply Voltage | : 3.3V |

* 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-2300.

9.4. Electrical Noise

(a) Scanning Symbolologies

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

<Conditions>

| | |
|----------------------|---|
| Scan Method | : Continuous Scanning |
| Bar Code Sample | : PDF417 with 0.254 mm resolution specified in Chapter 8 |
| Distance | : 120 mm from the case front of the camera module |
| Angle | : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$ |
| Curvature | : $R = \infty$ |
| Power Supply Voltage | : 3.3V |

(b) Image Data Acquisition

There shall be no excessive noise or misalignments in acquired images when sinusoidal electrical noise (50Hz to 100kHz, smaller than 20mVp-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-2300 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-2300 may be lower than that of general digital cameras.

9.5. Vibration

There shall be no sign of malfunction of MDI-2300 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 | : PDF417 with 0.254 mm resolution specified in Chapter 8 |
| Distance | : 120 mm from the case front of the camera module |
| Angle | : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$ |
| Curvature | : $R = \infty$ |
| Power Supply Voltage | : 3.3V |

9.6. Shock

There shall be no sign of malfunction of MDI-2300 after the following shock test.

Shock Test: Put the MDI-2300 in a specific dummy case and dropped facing its top, bottom, front, back, left, right, top-left, top-right, bottom-left and bottom-right from the height of 1.5 m to a concrete floor. Repeat this procedure 10 times.

<Conditions>

| | |
|----------------------|---|
| Bar Code Sample | : PDF417 with 0.254 mm resolution specified in Chapter 8 |
| Distance | : 60 mm from the case front of the camera module |
| Angle | : $\alpha = 0^\circ$, $\beta = +15^\circ$, $\gamma = 0^\circ$ |
| Curvature | : $R = \infty$ |
| Power Supply Voltage | : 3.3V |

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-2300 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 (maximum)

11. Compliance with Law and Standards

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

Compliance to 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

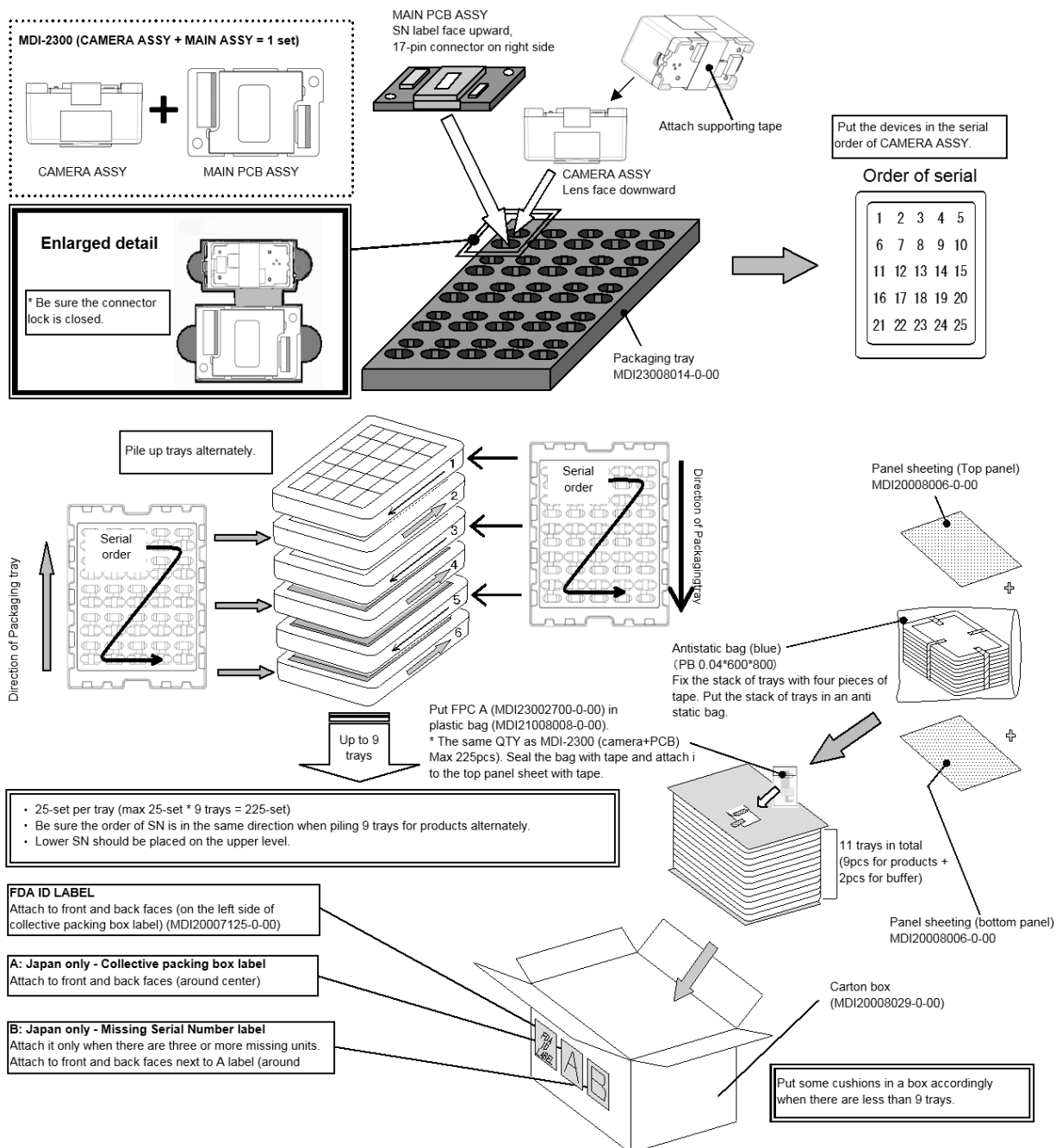
- * The reliability of MDI-2300 is guaranteed as far as it is operated under normal operating conditions in the range of advised operating temperature and without excessive electrical or mechanical shock.

14. Caution

- All work-benches, tools, measuring instruments and any part of human body which have contacts with MDI-2300 must undergo preliminary antistatic treatments.
- Do not touch the optical and electrical components. Hold it on the metal chassis when carrying the MDI-2300.
- Avoid the handling of MDI-2300 in a dusty area. In case dust gets on MDI-2300, gently blow it off with dry air. The MDI-2300's performance may deteriorate if optical components are wiped with materials such as cotton cleaning sticks or cotton cloth.
- Do not drop the MDI-2300.

15. Packing Specifications

15.1. Packing



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

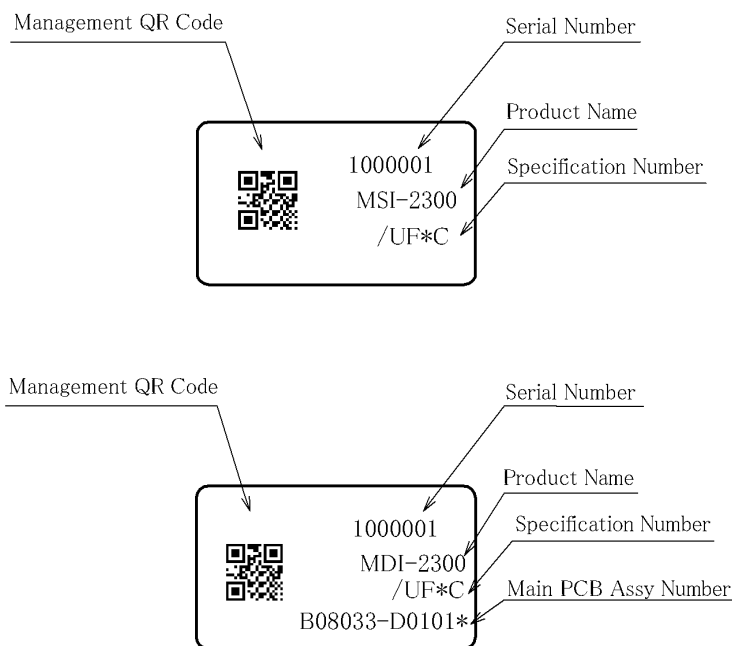
15.2. Package Size

335mm(W) × 290mm(D) × 185mm(H)

* 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 mark does not have legal weight in EU.

16. Serial Number

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

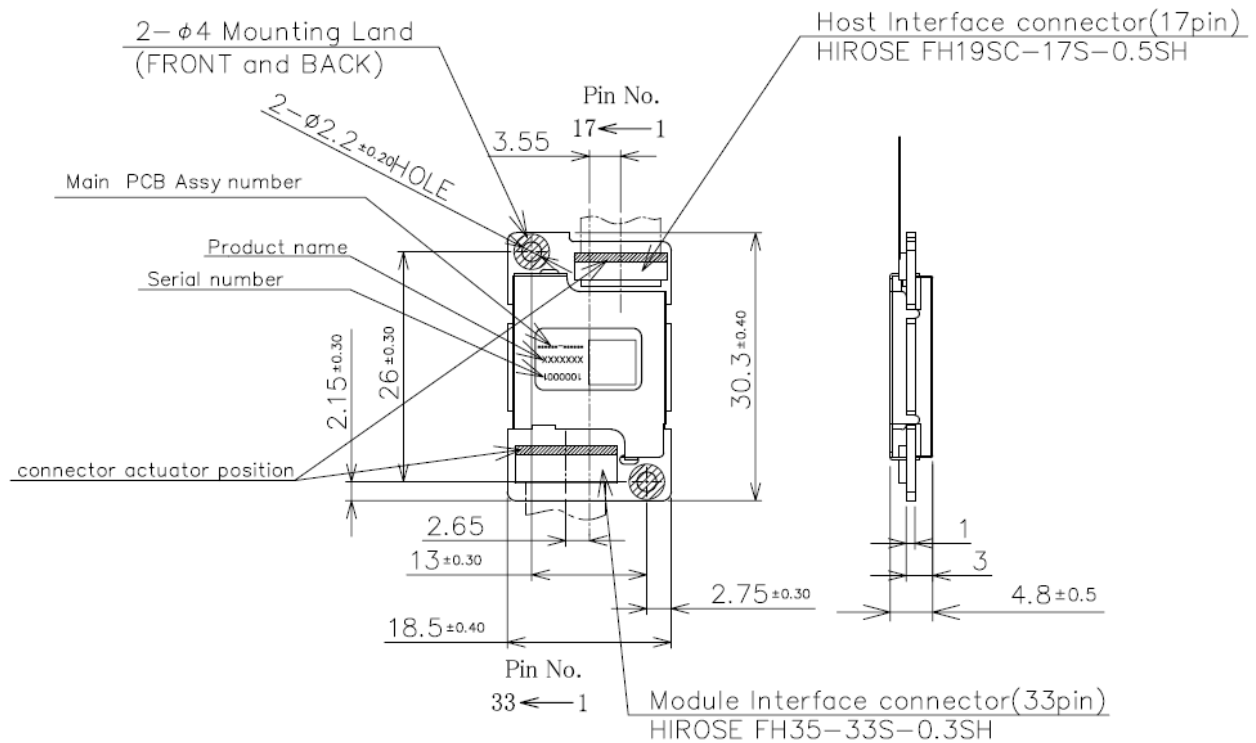


A serial number is seven-digit and it starts from 1000001 regardless of batch.

17.1. Camera Module



17.2. Decoder Board



17.3. FPC

