OPTICON

MSI-5200 MDI-5200/5300

1 Mega Pixel Low Profile Laser Aiming 2D Scan Engine

Integration Guide

The information in this document is subject to change without notice.

Document History

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Contents

Revision History ..... **i**
Contents ..... **ii**
1. Abstract **1**
1.1. Exit Window Material 2
2. Exit Window Material and Placement **3**
2.1. Exit Window Material 3
2.2. Exit Window Placement 4
2.2.1. Installing exit window at short range 4
3. Exit Window Size **5**
3.1. Window Size and Optical Path Clearance 5
3.2. Optical Path 6
3.3. Field of View and Aiming 7
3.4. Scanned Media and Placement 8
4. Installation **9**
4.1. Installation recommendations for the MSI-5200 and the MDI-5200 9
4.1.1. Installing exit window at short range 9
4.1.2. Decoder Board DBM-4050 Installation (MDI-5200) 10
4.1.3. Camera FPC (MDI-5200) 11
4.1.4. FFC and FPC installation 12
4.2. Installation recommendations for the MDI-5300 13
4.2.1. MDI-5300 13
4.2.2. FFC Cable and Connector 14
4.3. Handling Requirements 15
5. Mechanical Drawings **16**
5.1. Drawing of the MSI-5200 and the MDI-5200 16
5.1.1. MSI-5200 16
5.1.2. Decoder Board DBM-4050 (MDI-5200) 17
5.1.3. FPC (MDI-5200) 17
5.2. Drawing of the MDI-5300 18

Table of Figures

Figure 1：Dimensions of The MDI-5300 4
Figure 2：Exit Window Placement of the MSI-5200 and the MDI-5200/5300 5
Figure 3：Optical Path of the MSI-5200 and the MDI-5200/5300..... 6
Figure 4：Field of View and Aiming of the MSI-5200 and the MDI-5200/5300..... 7
Figure 5：Inclination of Scanned Target 8
Figure 6：MSI-5200 Mounting Holes..... 9
Figure 7：Decoder Board Mounting Holes..... 10
Figure 8：FPC of the MDI-5200 11
Figure 9：MSI-5200 and Decoder board DBM-4050 FPC/FCC installation 12
Figure 10：MDI-5300 Mounting Holes..... 13
Figure 11：MDI-5300 FCC installation 14
Figure 12：Drawing of the MSI-5200..... 16
Figure 13：Drawing of the MDI-5200 Decoder Board..... 17
Figure 14：Drawing of the MDI-5200 FPC 17
Figure 15：Drawing of the MDI-5300 18

1. Abstract

This guide provides instructions for installing the MSI-5200 and the MDI-5200/5300 (hereafter called “scan engine”) and is intended for engineers who are responsible for integrating the scan engine into their product. In order to maximize the performance and to minimize problems, read this integration guide carefully and integrate the scan engine in accordance with it. The instructions described in this guide are recommendations. Following them will help to ensure that the scan engine can properly capture images, but it is still advised to check some actual images that the scan engine makes with image capturing tools. These tools are available from the Opticon website.

This manual has three main chapters:

Exit Window Material and Placement	Recommendations on the material and the placement of the exit window, in order to prevent the LED illumination from reflecting off the exit window.
Exit Window Size	Recommendation on the size of the exit window and the clearance for the optical path of the camera and LED illumination.
Installation	Detailed installation instructions.

1.1. Exit Window Material

Reflection from the LED light off the exit window can cause large overexposed areas in the images captured by the scan engine, and should be avoided at all times. This chapter gives recommendations for the material of the exit window that helps to prevent this (Section 2.1). It also describes the best position and inclination of the exit window (Section 2.2).

The picture below is taken from a scan engine with a poorly aligned exit window. It is clear to see what the reflection does to the image. The overexposed spot on the right side of the image makes it much harder, if not impossible, to decode the barcode in the image. It is highly recommended to check some actual pictures made by the scan engine in order to verify that there is no reflection from the LED after the engine has been installed. The software tools for image capture can be found on the Opticon website.

2. Exit Window Material and Placement

2.1. Exit Window Material

Below is a list of recommendations for constructing the exit window. These recommendations help to prevent reflection from the LED illumination off the exit window and help to prevent degradation of the image by scratches and dirt.

- For the best optical quality, use an acrylic material (cast or extruded)
- Select a high-quality achromatic acrylic material with a smooth, flat surface without scratches and dents.
- Recommended 1mm thick acrylic material with an anti-reflective (AR) coating applied to both sides.
- Apply an anti-scratch coating to the surface of the exit window to protect it from scratches during operation. Hard coated acrylic sheets are readily available. Such a coating greatly enhances anti-scratch properties without degrading the optical characteristics of the acrylic material.
- To protect the exit window from dust, stains, and scratches during assembly, most manufacturers cover the raw material with a protective sheet that stays attached during the entire production process of the exit window. This protective sheet should be removed in the final stage of the production process, before operation.
- After removing the protective sheet, use an ion blower to remove any dust that may have been attracted by static electricity.

Recommended acrylic material:

Nitto Jushi Kogyo Co., Ltd.	Clarex Precision Thin Sheet
MITSUBISHI CHEMICAL CO., LTD.	Shinkolite

2.2. Exit Window Placement

Reflection from the LED light off the exit window can cause large overexposed areas in the images captured by the scan engine. Therefore, it is important to position the exit window in such a way that the reflection is minimal and not directed into the camera. Make sure that the distance and inclination of the exit window is within the range specified in the following diagram and associated table.

2.2.1. Installing exit window at short range

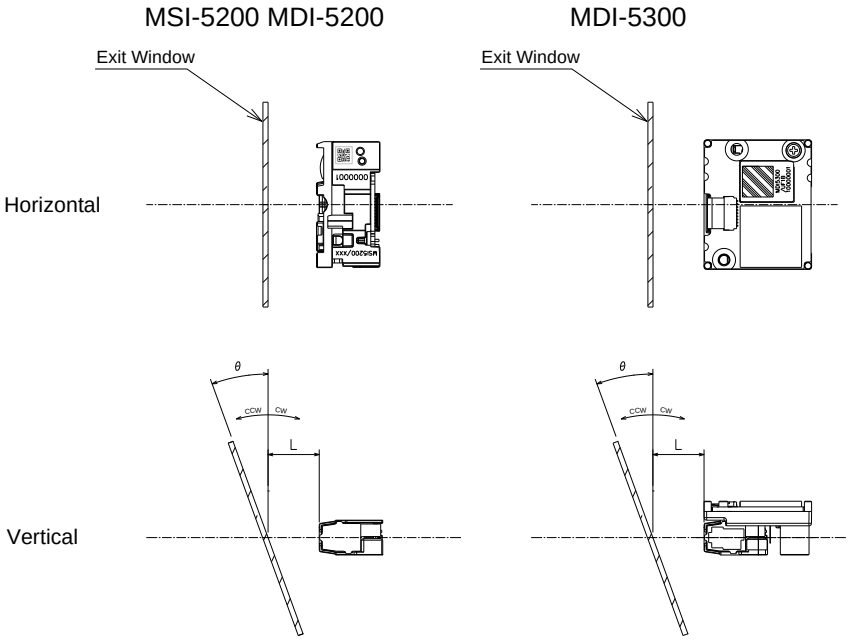

Figure 1：Dimensions of The MDI-5300

The following table shows the recommended mounting position of the window with ‘both sides AR coated’ and ‘non AR coated’.

Conditions

Window 1 mm acrylic sheet

Conditions Visually check reflections by taking images with the scan engine in a darkroom with no light source and no reflecting objects.

Both sides AR coated

L	[mm]	≦1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
θ_{CW}	[deg]	0°	≧0°	✗	✗	✗	≧20°	≧25°	≧25°	≧25°
θ_{CCW}	[deg]	0°	≧0°	✗	✗	✗	≧20°	≧25°	≧25°	≧25°

Recommended values: L = 1 mm, θ_{CW} = 0° and both sides AR coated.

Non AR coated

L	[mm]	≦1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
θ_{CW}	[deg]	0°	✗	✗	✗	✗	✗	≧35°	≧30°	≧30°
θ_{CCW}	[deg]	0°	✗	✗	✗	✗	✗	≧35°	≧30°	≧30°

- Keep a minimum clearance between the scan engine and the exit window of 1mm because of the dimensional tolerances of the mounting holes
- Use of AR coated material for the exit window is recommended.
- External light is not factored in.
- Confirm that there is no reflection of the LED illumination off the exit window by acquiring images from the scan engine.

3. Exit Window Size

Vignetting (radial brightness or saturation fall-off) in the LED illumination and the captured image can occur depending on the size and position of the exit window. Additionally, specular (mirror like) reflection can occur in the target barcode depending on how it is presented to the scanner. This chapter describes the distance and inclination limitations for the exit window to avoid these problems.

3.1. Window Size and Optical Path Clearance

With respect to the optical path depicted below, provide an exit window with sufficient clearance.

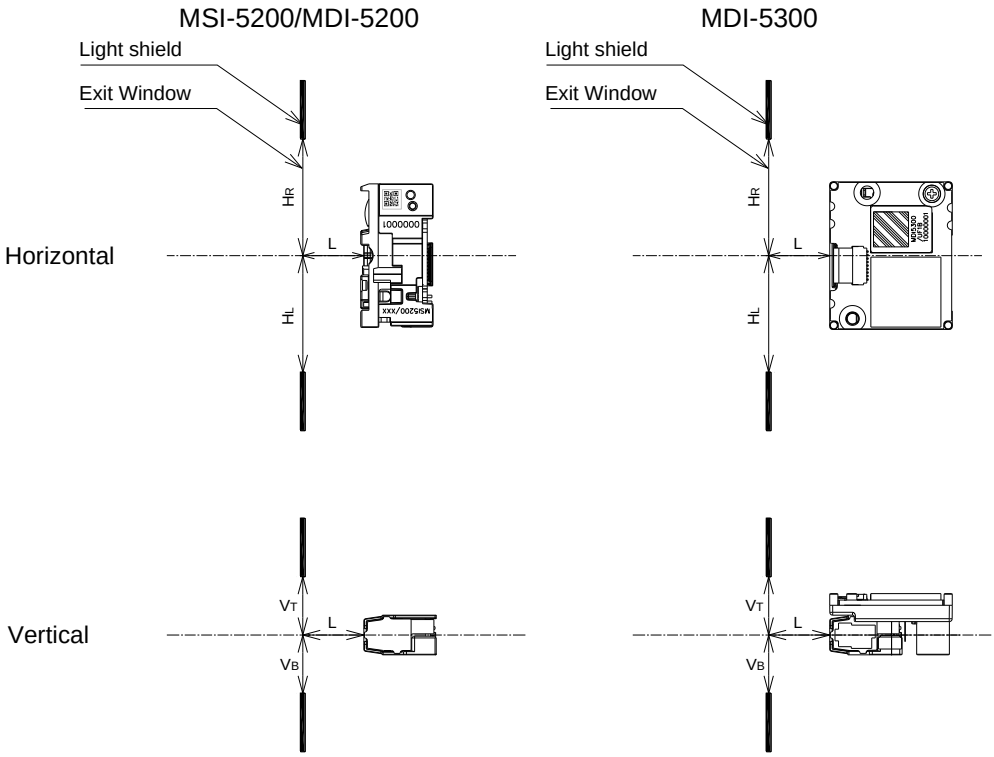

Figure 2：Exit Window Placement of the MSI-5200 and the MDI-5200/5300

The following tables show the requirements for the horizontal and vertical optical path clearance. The light-shielding part should not reflect light (e.g. coated matte black).

Horizontal

L	[mm]	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
H_R	[mm]	≧11.8	≧12.0	≧12.3	≧12.5	≧12.8	≧13.1	≧13.3	≧13.5	≧13.8
H_L	[mm]	≧11.8	≧12.0	≧12.3	≧12.5	≧12.8	≧13.1	≧13.3	≧13.5	≧13.8

Vertical

L	[mm]	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
V_T	[mm]	≧2.7	≧2.9	≧3.2	≧3.4	≧3.5	≧3.7	≧3.9	≧4.2	≧4.4
V_B	[mm]	≧2.7	≧2.9	≧3.2	≧3.4	≧3.5	≧3.7	≧3.9	≧4.2	≧4.4

- Keep V_T equal to V_B and H_R equal to H_L.
- Vignetting is caused by insufficient exit window size. It manifests as darker edges in the image. Confirm this visually by acquiring images from the scan engine in the design phase.

3.2. Optical Path

Install the Exit Window with sufficient clearance for the field of view, LED illumination and LED aiming.

Provide the Exit Window with sufficient clearance with respect to the optical path, as depicted below.

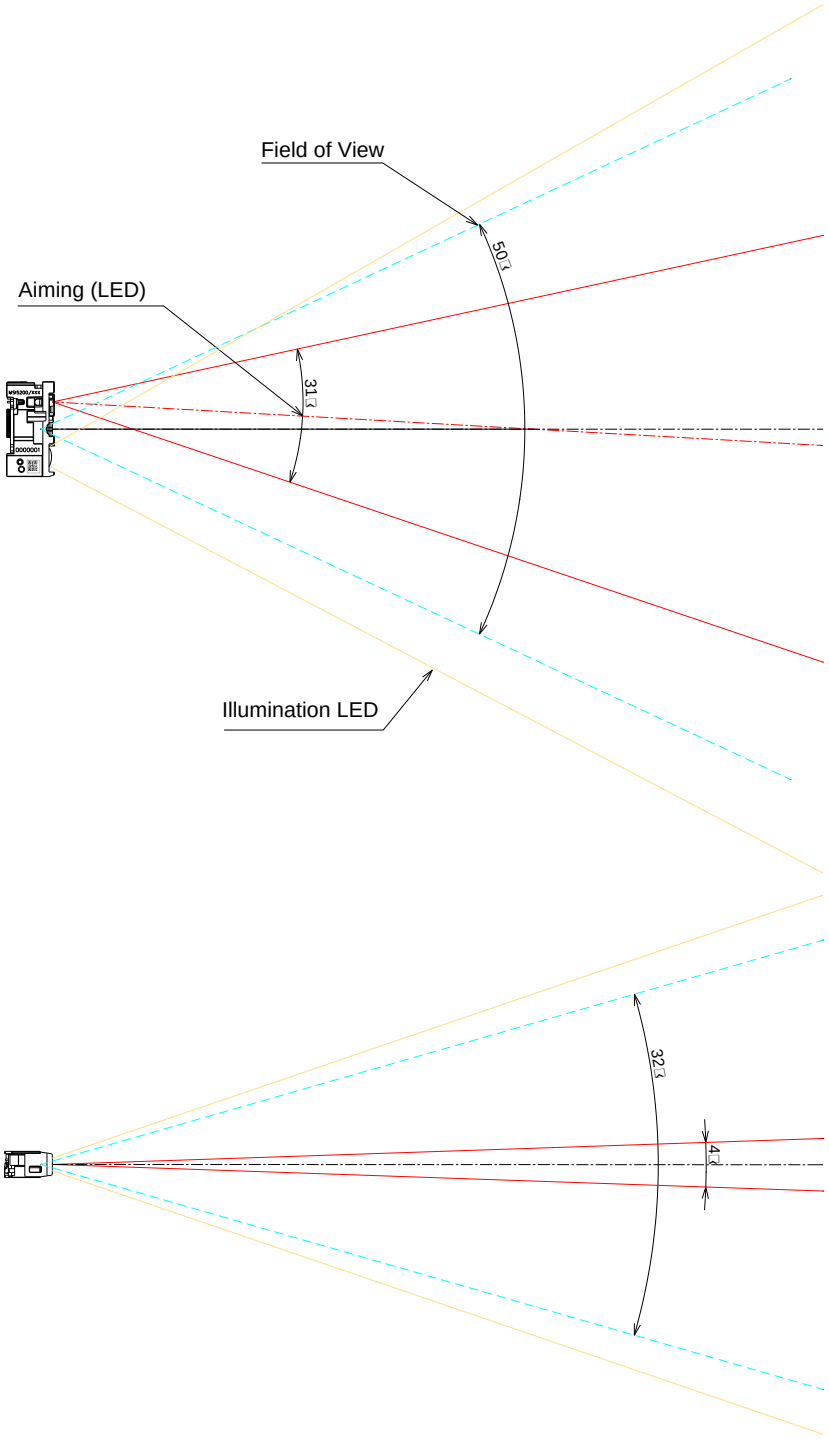

Figure 3：Optical Path of the MSI-5200 and the MDI-5200/5300

- Refer to the 3D drawings for details of the optical path.
  Verify the details of the optical path with an actual device.

3.3. Field of View and Aiming

Install a frame with sufficient clearance for the field of view.

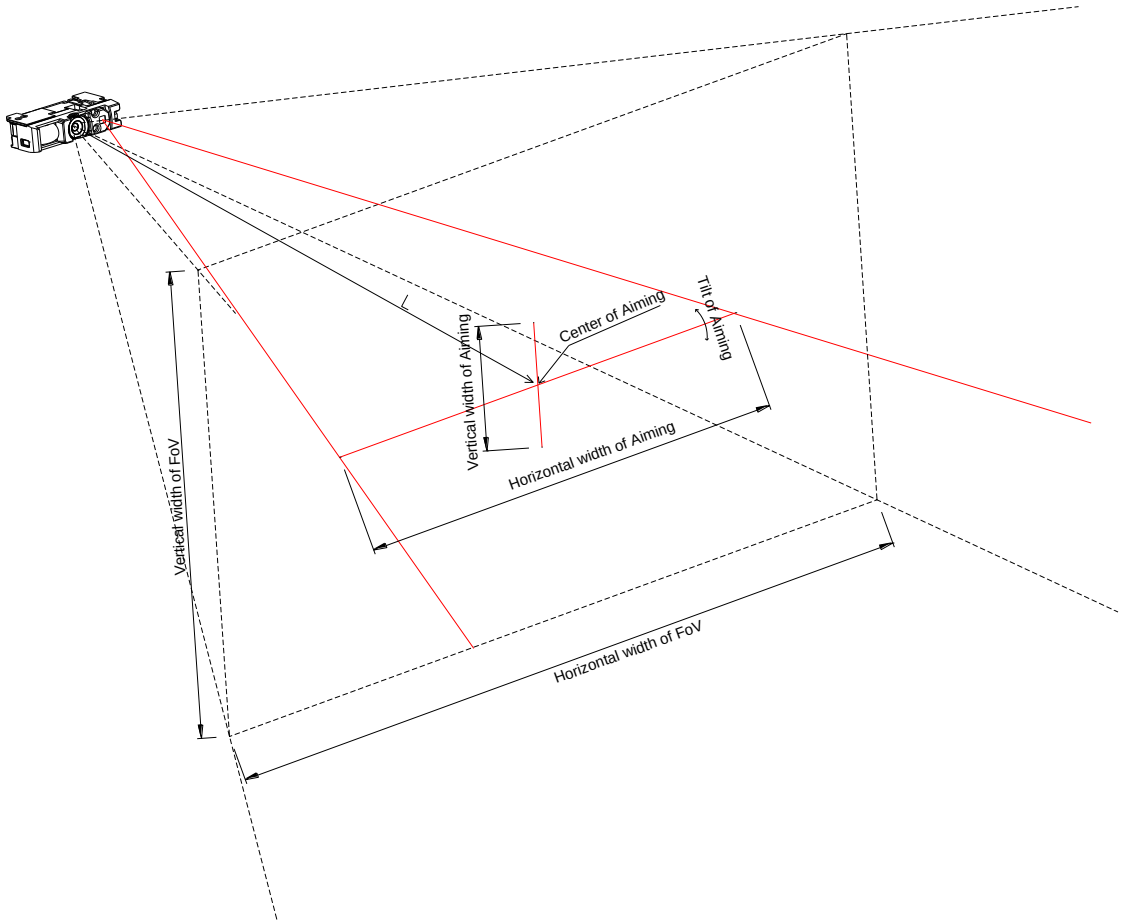

Figure 4：Field of View and Aiming of the MSI-5200 and the MDI-5200/5300

L Distance from front edge of the scan engine
H Horizontal FOV
V Vertical FOV

Field of View

L	[mm]	10	15	20	25	30	35	40	45	50
H	[mm]	15.8	20.5	25.1	29.8	34.5	39.1	43.8	48.5	53.1
V	[mm]	9.7	12.6	15.4	18.3	21.2	24.0	26.9	29.8	32.6

- The table above shows the field of view which should not be obstructed by any parts of a housing.

3.4. Scanned Media and Placement

When an object is being scanned, there are conditions where specular reflection of the LED illumination and intense ambient light can occur.

Problem: Glossy label

Specular reflection of the LED illumination from the scan engine can occur when the target label is on a highly reflective surface.

Solution:

Specular reflection does not occur when an angle is created between the scan engine and the target label as shown in the figure below. The conditions for the occurrence of specular reflection depend on the distance L and the inclination angle θ. The recommended inclination angle is about 15 degrees. Note that as the angle becomes bigger, it becomes more difficult to read the target label.

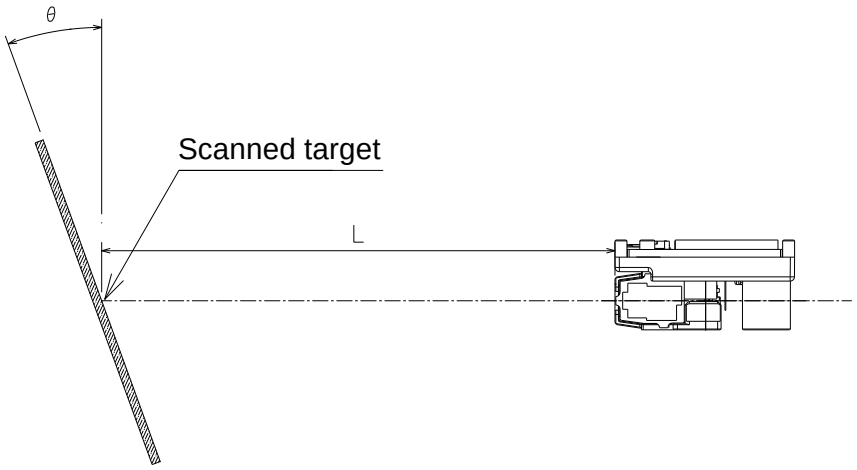

Figure 5：Inclination of Scanned Target

4. Installation

This chapter describes practical guidelines for the mechanical installation. This chapter is divided in two parts, one for the MSI-5200 (camera module and separate decoder board) and one for the MDI-5300(internal decoder).

4.1. Installation recommendations for the MSI-5200 and the MDI-5200

The installation recommendations are listed below.

- Mount the camera module to a material with high thermal conductivity, such as metal, especially when the auto-trigger is used.
- Mount the camera module using the screw holes on the bottom side.
- Make sure not to insert the screws deeper than the specified maximum depth.
- When installing the camera module, only the bottom surface of the camera module should be attached to a chassis.
- Keep enough clearance to avoid damage to the camera module in case the host device is dropped.
- Shock / impact resistance of the camera module to any acceleration applied via the bottom surface is specified up to a certain limit. Any other kind of mechanical stress is likely to damage the camera module, since it contains precise optical elements.
- The case of the MSI-5200 should be electrically grounded.

4.1.1. Installing exit window at short range

Screw type: M1.6 with a pitch of 0.35
Maximum screw depth: 2.0 mm from the mounting surface of the scan engine.
Recommended torque: ≦4 Ncm.

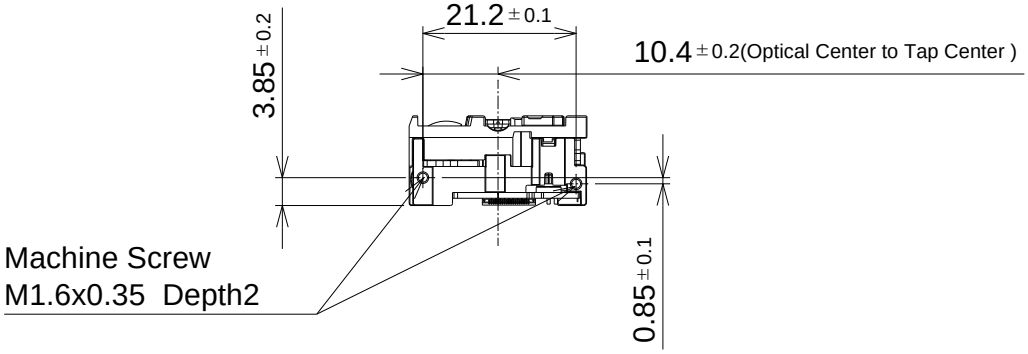

Figure 6：MSI-5200 Mounting Holes

4.1.2. Decoder Board DBM-4050 Installation (MDI-5200)

- Do not screw the decoder board directly on a PCB. Use spacers or screw pillars instead.
- The decoder board may become hot, especially when the auto trigger is used. Make sure that there are not heat sensitive parts close to the decoder board.
- The size of the screw head must not exceed the diameter of the mounting landing.
- The DBM-4050 mounting holes should be grounded.

DBM-4050 Decoder module Installation recommendations

Screw size : M2

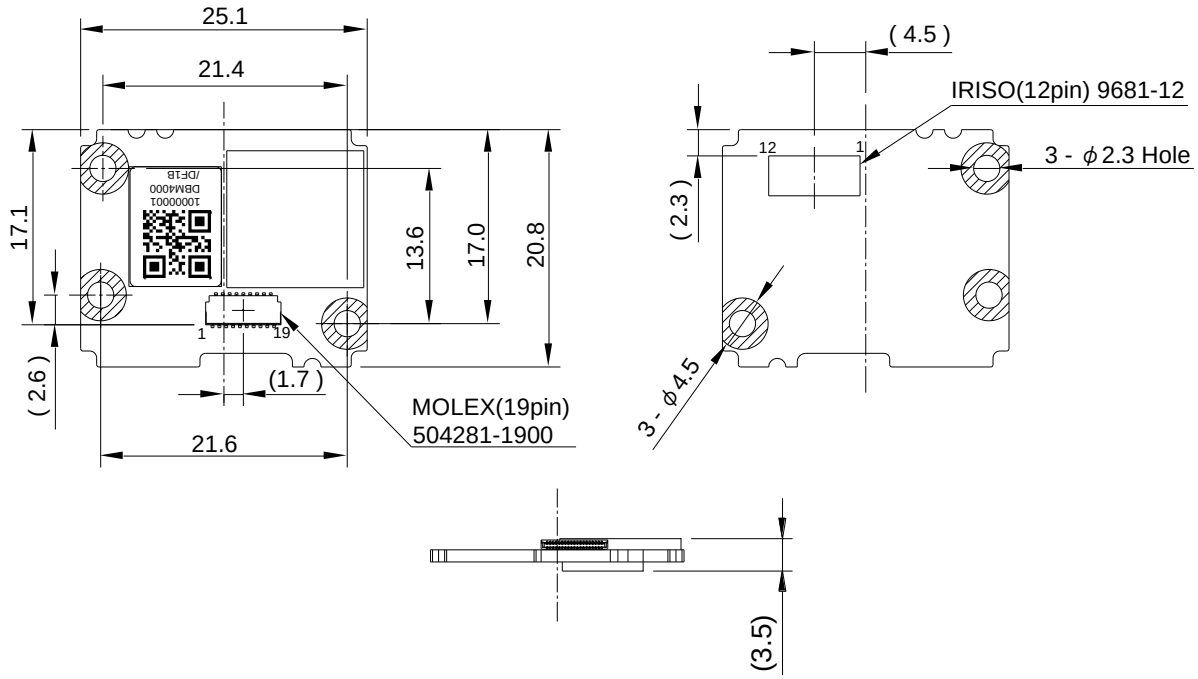

Figure 7 : Decoder Board Mounting Holes

4.1.3. Camera FPC (MDI-5200)

- Do not bend the FPC abruptly.
- When inserting the FPC, make sure the connector is not in the locked configuration.
- Be careful not to apply any force to the FPC after the FPC is fastened.
- It is recommended to use the Opticon supplied FPC cable.

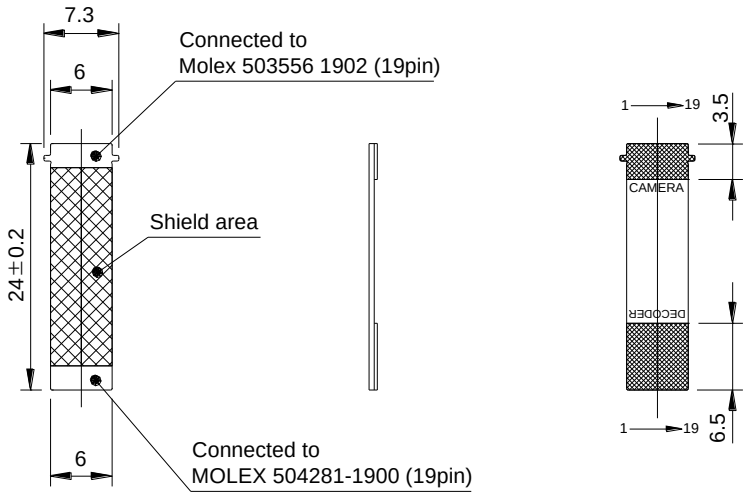

Figure 8：FPC of the MDI-5200

4.1.4. FFC and FPC installation

There are two types of FFC cables that can be used to connect the decoder board to a target PCB. One with contacts and the same side (Type A) and one with contacts on opposite sides (Type B). Below are the specs and a description on how to assemble the camera module to the decoder board and how to connect the decoder board to a target PCB.

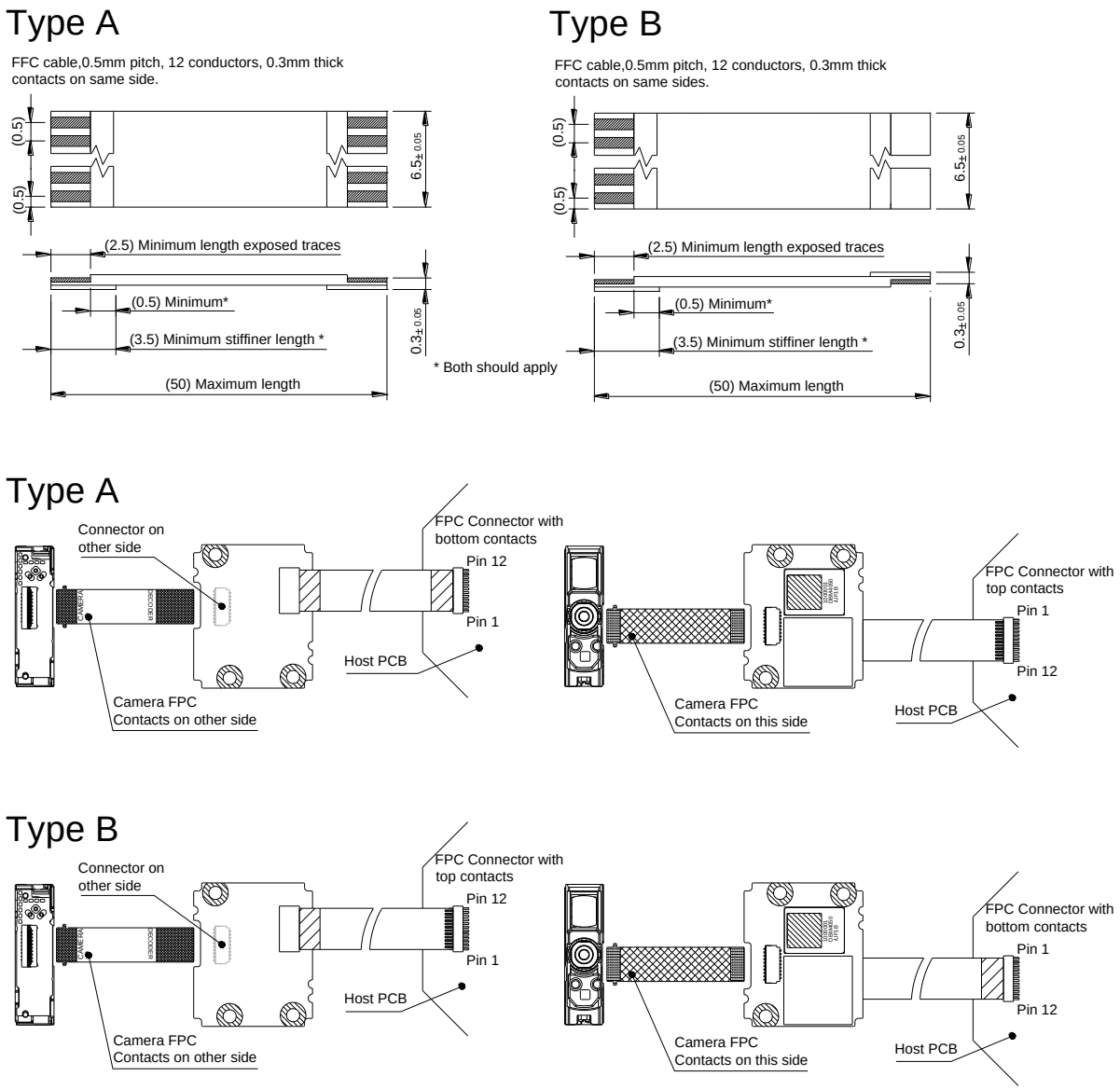

Figure 9：MSI-5200 and Decoder board DBM-4050 FPC/FCC installation

Depending on the specific FFC cable and the orientation of the scan engine, the FFC connector on the target PCB should be either one with top contacts or one with bottom contacts. Refer to the drawing above to see which one should be used. In either case the connector should have 12 pins with a 0.5mm pitch and should accept an FFC cable with a thickness of 0.3mm.

- It is recommended to use a FFC but it is possible to use an FPC as well.
- When an FPC is used, it is recommended to use at least 60um copper thickness.
- When an FPC is used, it is recommended to use “polyimide and thermoset adhesive” as material for the reinforcing film.
- When an FPC is used, make sure the thickness and dimensions are within tolerance.

4.2. Installation recommendations for the MDI-5300

The installation recommendations for the scan engine are listed below.

- Mount the scan engine to a material with high thermal conductivity, such as metal, especially when the auto-trigger is used.
- Do not insert screws further than the maximum specified depth.
- Keep enough clearance to avoid damage to the camera in case the host device is dropped.
- Shock / impact resistance of the camera module to any acceleration applied via the bottom surface is specified up to a certain limit. In case of direct shock however, the camera module will almost certainly be damaged since it consists of precise optical elements.
- The case of the the MDI-5300 should be electrically grounded.

4.2.1. MDI-5300

Screw type: M1.6 with a pitch of 0.35
Maximum screw depth: 2.0 mm from the mounting surface of the scan engine.
Recommended torque: ≦4 Ncm.

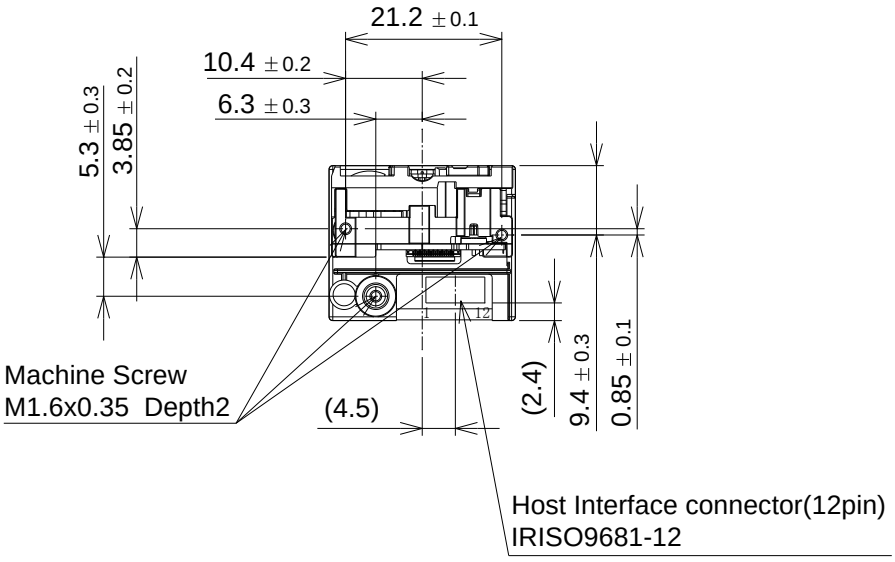

Figure 10：MDI-5300 Mounting Holes

4.2.2. FFC Cable and Connector

There are two types of FFC cables that can be used to connect the MDI-5300 to a target PCB. One with contacts and the same side (Type A) and one with contacts on opposite sides (Type B). Below are the specs and a description on how to connect the decoder board to a target PCB.

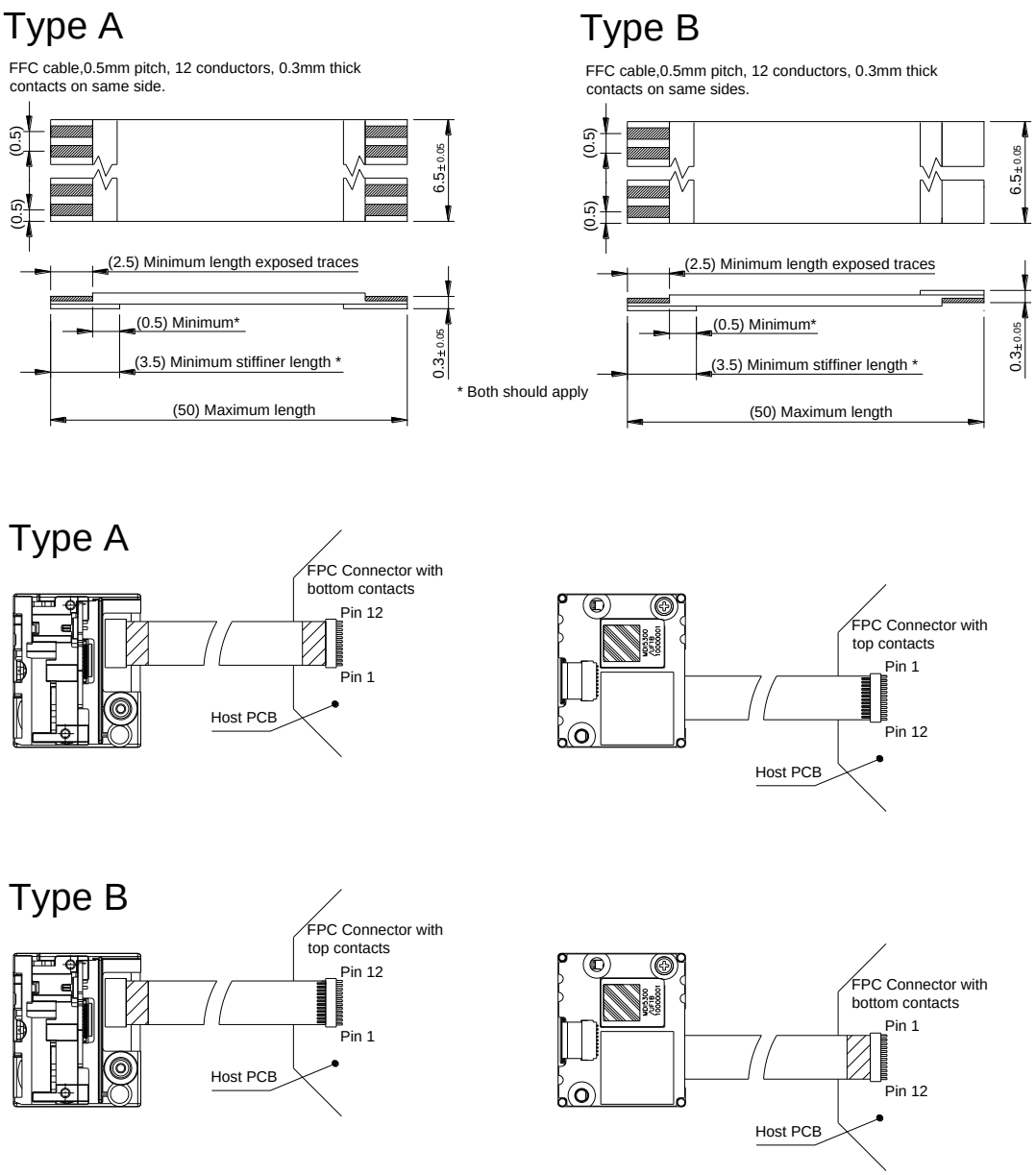

Figure 11：MDI-5300 FCC installation

Depending on the specific FFC cable and the orientation of the scan engine, the FFC connector on the target PCB should be either one with top contacts or one with bottom contacts. Refer to the drawing above to see which one should be used. In either case the connector should have 12 pins with a 0.5mm pitch and should accept an FFC cable with a thickness of 0.3mm.
It is recommended to use a FFC but it is possible to use an FPC as well.
When an FPC is used, it is recommended to use at least 60um copper thickness.
When an FPC is used, it is recommended to use “polyimide and thermoset adhesive” as material for the reinforcing film.
When an FPC is used, make sure the thickness and dimensions are within tolerance.

4.3. Handling Requirements

The recommended handling conditions for incorporating the scan engine into your device are shown below.

- Use anti-static measures such as wearing a grounded hand strap before handling the scan engine in order to avoid damage to the electronic components from electrostatic discharge.
- Hold the scan engine only by the case. Do not touch the circuit board or the front side of the scan engine.
- Do not touch the electronic components or the terminals on the circuit board.
- Installation in a clean environment is recommended in order to protect the imaging lens from dust.
- Operators should wear gloves to avoid contaminating the optical elements.
- Do not drop the MSI-5200 and the MDI-5200/5300.

5. Mechanical Drawings

This chapter describes mechanical drawing for the scan engine.

5.1. Drawing of the MSI-5200 and the MDI-5200

5.1.1. MSI-5200

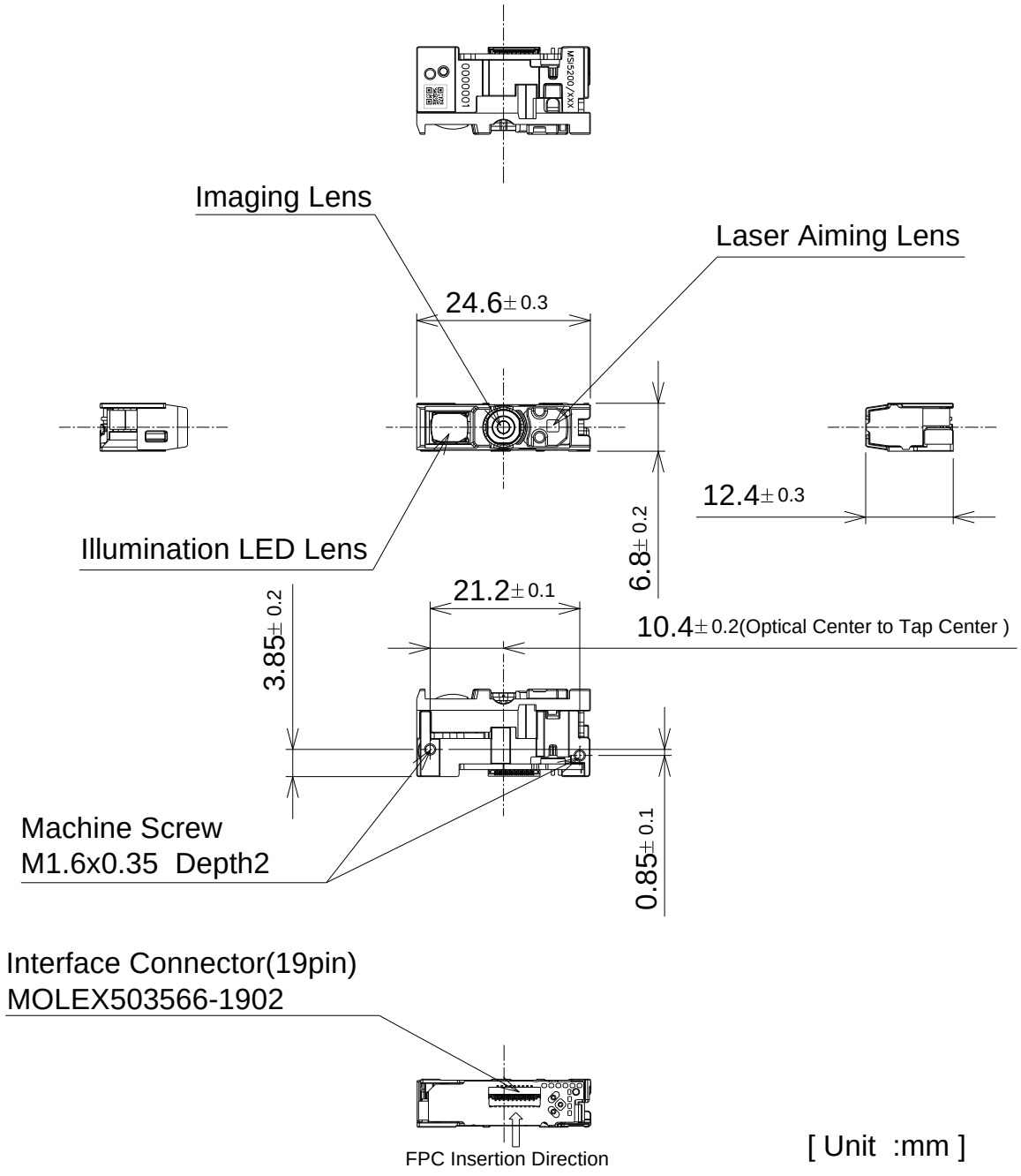

Figure 12：Drawing of the MSI-5200

5.1.2. Decoder Board DBM-4050 (MDI-5200)

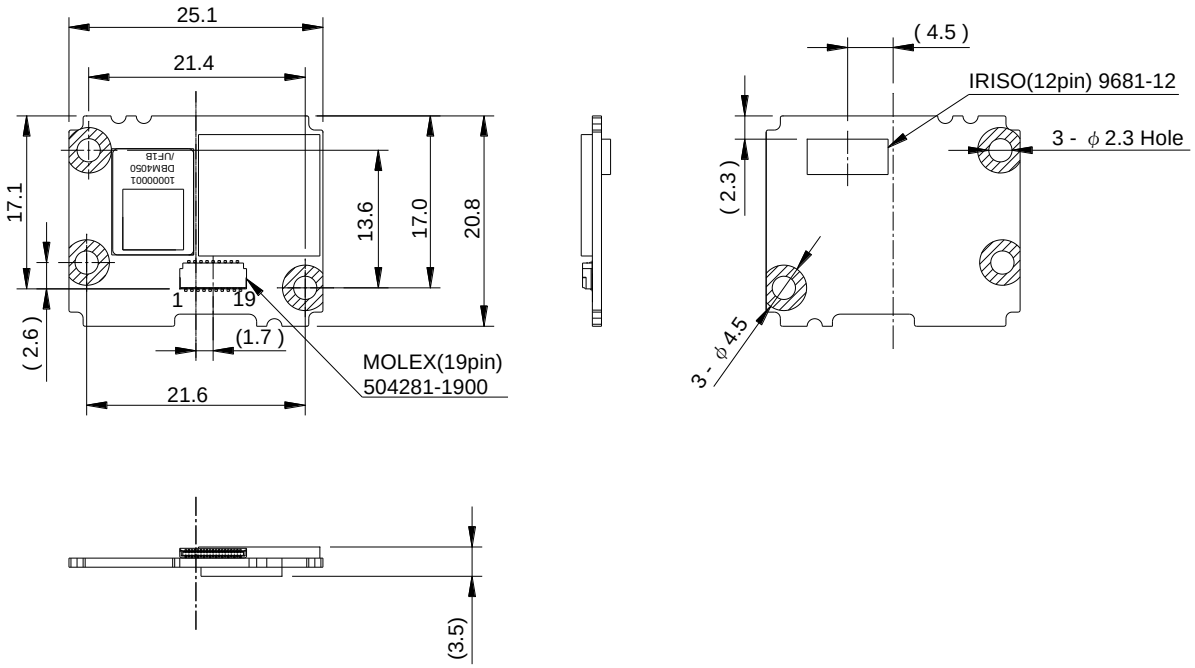

Figure 13：Drawing of the MDI-5200 Decoder Board

5.1.3. FPC (MDI-5200)

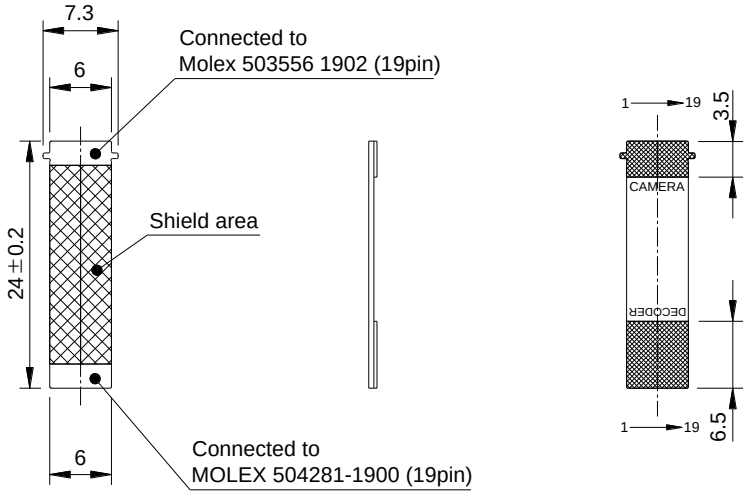

Figure 14：Drawing of the MDI-5200 FPC

5.2. Drawing of the MDI-5300

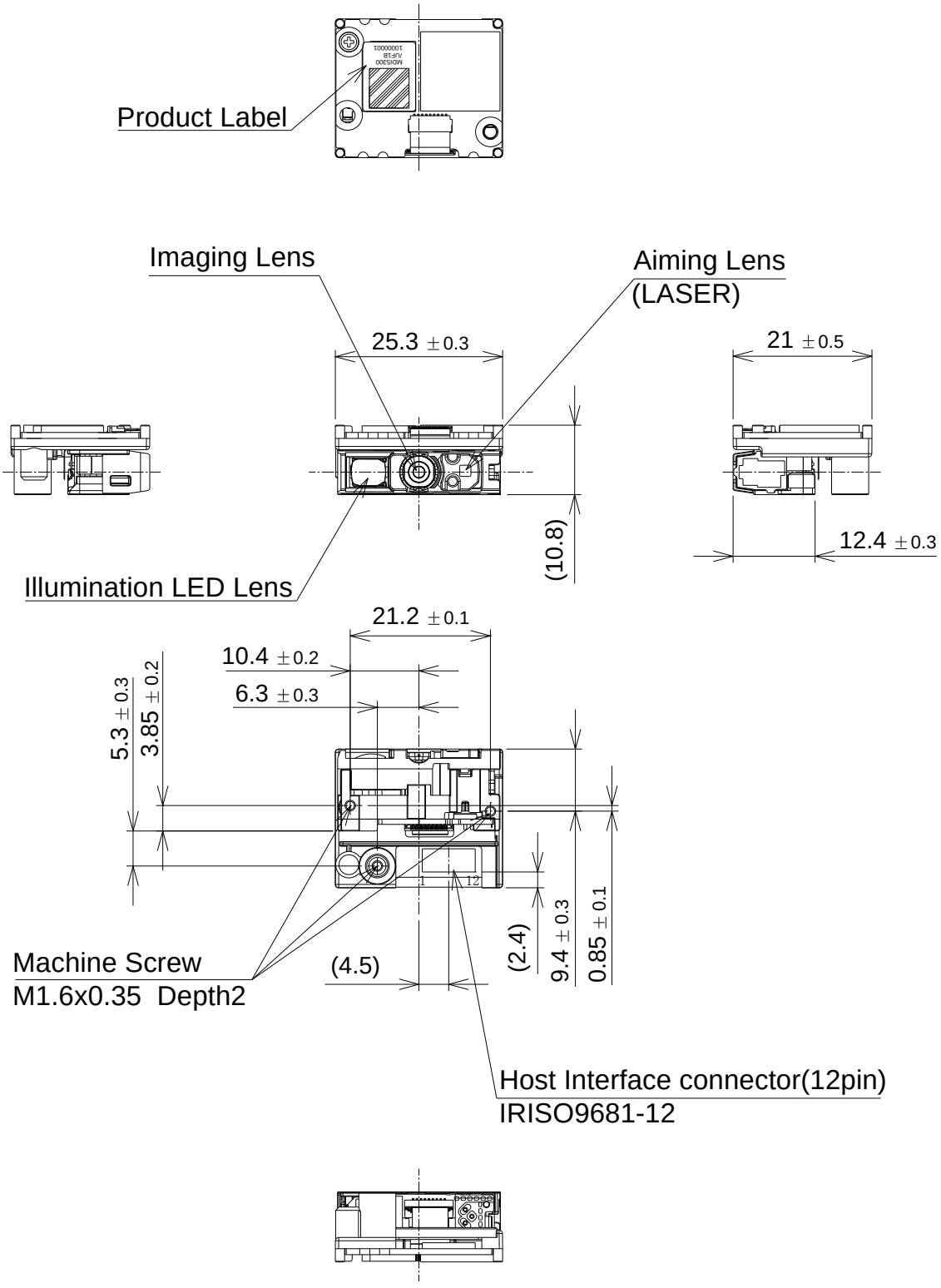

Figure 15：Drawing of the MDI-5300

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We scan, connect and communicate