Mech-Eye 3D Laser Profiler User Manual

v2.2.1

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1. Welcome

Product Introduction

Mech-Eye 3D Laser Profiler ("laser profiler") is developed by Mech-Mind and can output high-quality intensity images, depth maps, and point clouds, suitable for applications of high-accuracy inspection and measurement in industries such as consumer electronics, automobile, EV battery, and home appliances.

You can configure and control the laser profiler through the graphical interface software Mech-Eye Viewer or the application programming interface Mech-Eye API developed by Mech-Mind. Mech-Eye Viewer is only available on Windows.

Meanwhile, the laser profiler is also compliant with the GenICam standard and can be controlled by third-party machine vision software also compliant with the GenICam standard ("GenICam clients").

How the Laser Profiler Works

The following topics provide the basic knowledge on laser profiler, including how the laser profiler scans an object and generates data, as well as how the laser profiler can be integrated to work with other devices in a system. These topics are the foundation for understanding how to use and configure the laser profiler.

- Understand how the laser profiler scans an object and generates data
- Understand how the laser profiler can be integrated into a system
- Getting started with the laser profiler

Use the Laser Profiler

The following topics provide instructions on using Mech-Eye Viewer or Mech-Eye API to adjust the parameters of the laser profiler and acquire data.

- Use Mech-Eye Viewer to adjust parameters and acquire data
- Understand the functional hierarchy and operation workflow of Mech-Eye API

Reference

The following topics provide reference information such as the technical specifications of the laser profiler and after-sales support.

- Laser Profiler Hardware User Manual
- Troubleshooting
- FAQs

2. Getting Started

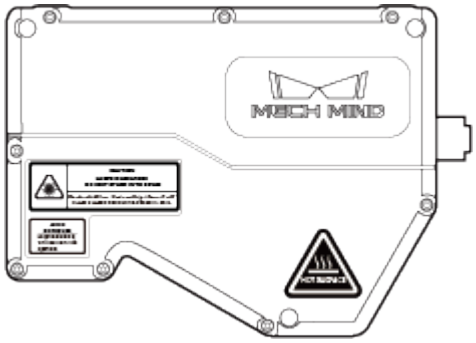
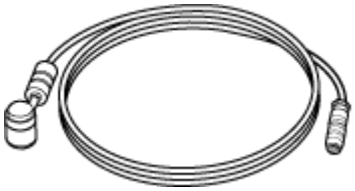
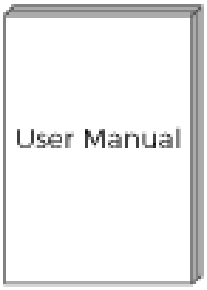
This topic will guide you through the entire process from checking package contents to using Mech-Eye Viewer to acquire data.

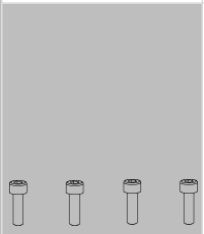
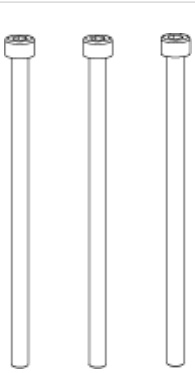
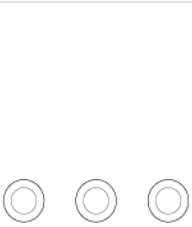
Check Contents of the Package

1. Make sure that the package is intact when you receive it.
2. Check contents according to the “packing list” in the package to ensure that no devices or accessories are missing or damaged.

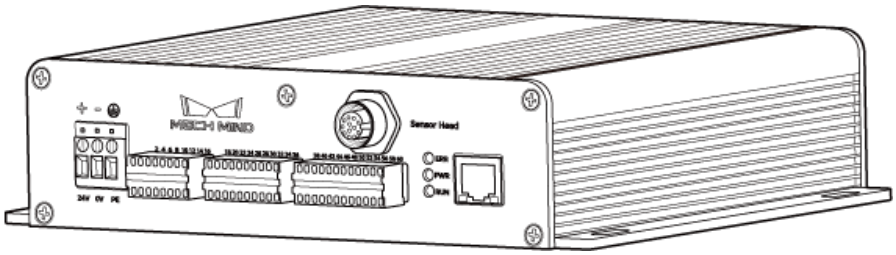
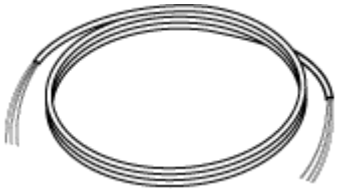
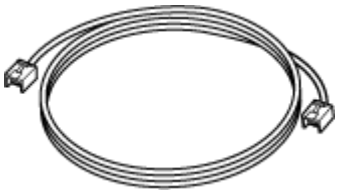
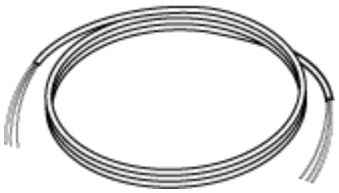
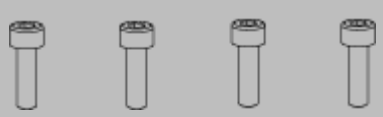
LNX-8030 is used as an example in this tutorial. The table below is for reference only. Please take the packing lists in the package as the final.

Sensor Head

Sensor head	
Sensor-head-to-controller cable CBL-H2C-5M-LU	
User manual	

Accessory bag	M5 × 8 bolts (Qty: 4)	M5 × 70 bolts (Qty: 3)	Φ5 washers (Qty: 3)	Zip ties (Qty: 50)	4 mm hex key (Qty: 1)
					

Controller

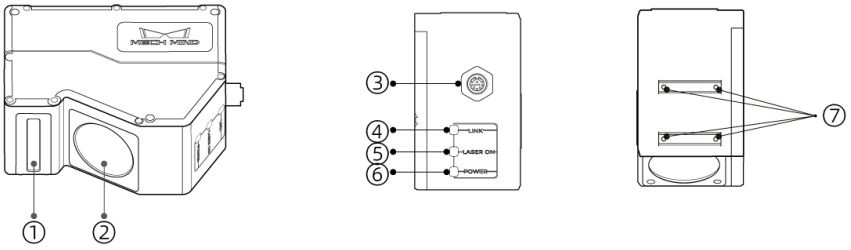
Controller		
Controller DC power cable CBL-CTRL-PWR-3M		
Controller Ethernet cable CBL-CTRL-ETH-3M		
Encoder cable CBL-CTRL-EN-3M		
Accessory bag	M5 × 8 bolts (Qty: 4)	Flat screwdriver (Qty: 1)
		

Check Ports and Indicator Lights

The laser profiler consists of a sensor head and controller. The following sections introduce the sensor head and controller of the laser profiler.

Sensor Head

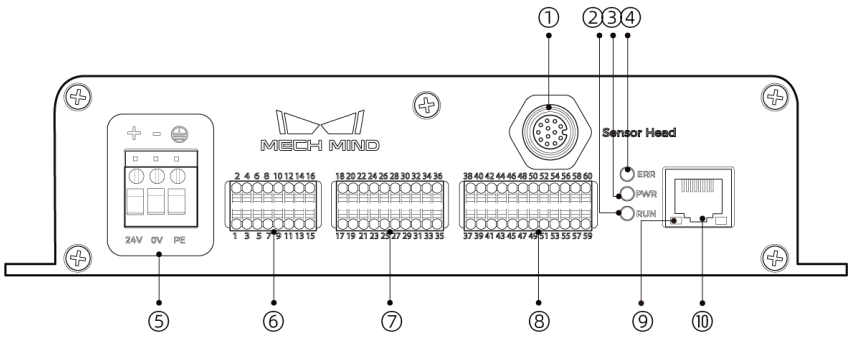
Refer to the following diagrams and table and check the function of each part of the sensor.



No.	Name	Function
①	Laser emitter	Emits laser light.
②	Receiver unit	Receives the laser light reflected by the target surface.
③	Controller port	Used to connect to the controller.
④	LINK indicator light	Off: not connected to network
		Blinking green: data in transmission (2.5 Gbps)
		Blinking yellow: data in transmission (10/100/1000 Mbps)
⑤	LASER ON indicator light	Off: laser light not emitted
		Solid on: laser light being emitted
⑥	POWER indicator light	Off: not connected to power
		Solid green: normal voltage
⑦	Shading device mounting hole	Used to mount shading device onto the sensor head.

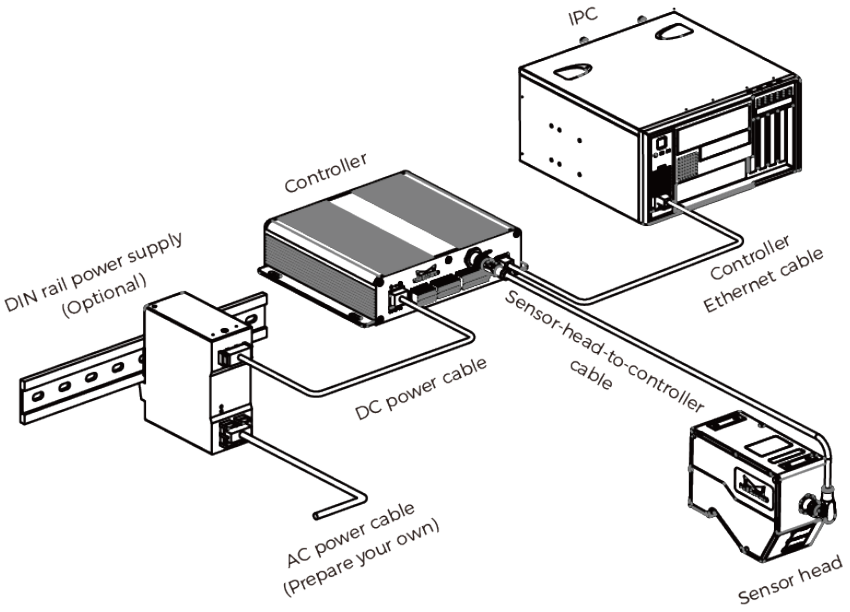
Controller

Please refer to the following figures and tables and check the functions of the ports and indicator lights on the controller.



No.	Name	Function
①	Sensor head port	Used to connect to the sensor head.
②	RUN indicator light	On: data acquisition in progress
		Off: no ongoing data acquisition
③	PWR indicator light	Solid green: normal voltage
		Off: abnormal voltage or not connected to power
④	ERR indicator light	Blinking: malfunctioning
		Off: operating normally
⑤	Power connector	24V: +24 V DC input
		0V: 0 V DC input
		PE: grounding
⑥	Input Signal Terminals	See Input Signal Terminals for details.
⑦	Output Signal Terminals	See Output Signal Terminals for details.
⑧	Encoder Signal Terminals	Used to connect to the encoder. See Encoder Signal Terminals for details.
⑨	Network indicator light	Blinking: data transmission in progress
		Solid: no ongoing data transmission
⑩	RJ45 Ethernet port	Used to connect the RJ45 connector of the Ethernet cable.

Mounting and Connection

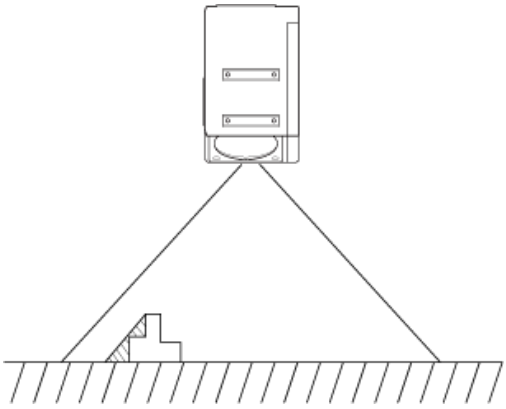
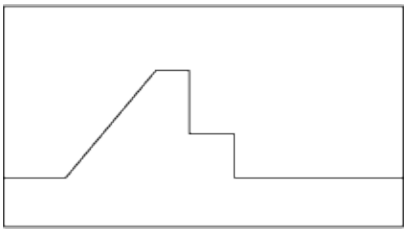


Mount the Sensor Head

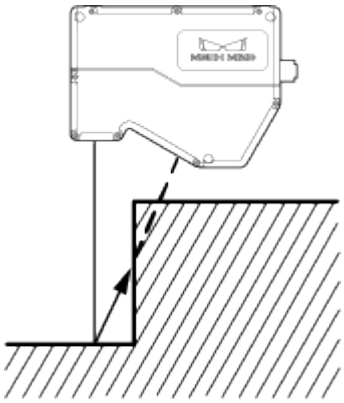
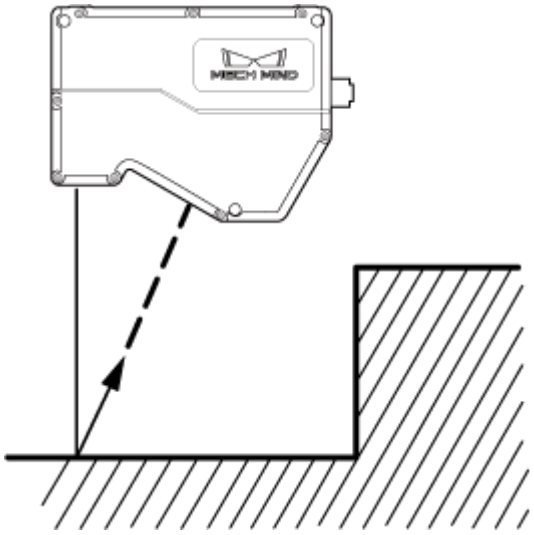
Before Mounting the Sensor Head

Before mounting the sensor head, please check the following precautions:

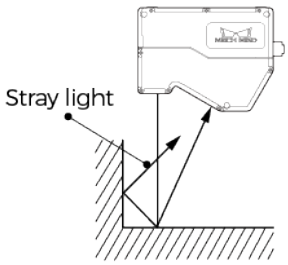
- The shape of the target object may produce blind spots in the measurement range. Please evaluate the effect of blind spots on scanning before mounting the sensor head. The laser light of this product is emitted almost in parallel, and therefore blind spots are rarely present.

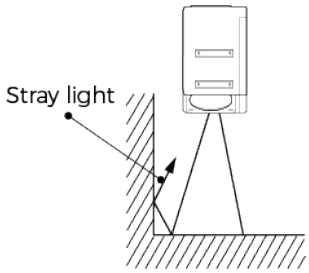
	
Shadowed area represents blind spot	Obtained profile

- Make sure that the laser light reflected by the target object is not blocked and can reach the receiver unit.

	
Incorrect	Correct

- Stray light is produced if the laser light is reflected by surrounding objects such as walls. Please evaluate the effect of stray light on scanning before mounting the sensor head.





- To ensure that the heat from the sensor head is well dissipated, please mount it to a metal plate that has at least one surface with an area of 200 square centimeters or more.

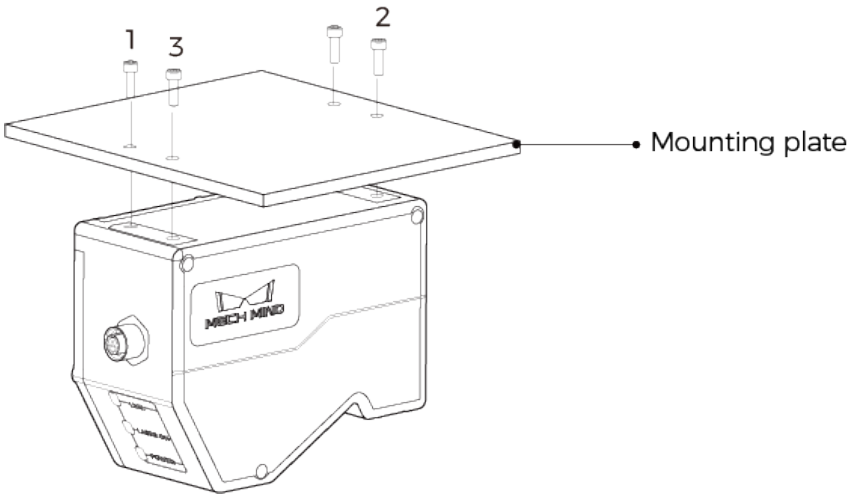
Mounting Method

If the mounting plate is too thick, please prepare M5 bolts with the appropriate length. Please prepare M5 nuts and open-end wrench.

When installing the laser profiler, please refer to the reference distance of the laser profiler.

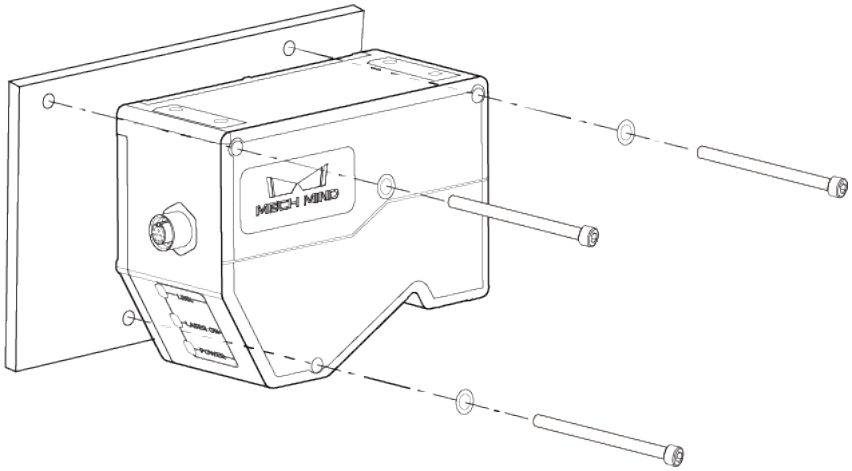
Method 1

As shown below, place four M5 × 8 bolts in the holes, use the 4 mm hex key to loosely screw on the bolts in the specified order, and then fully tighten all the bolts in the specified order.



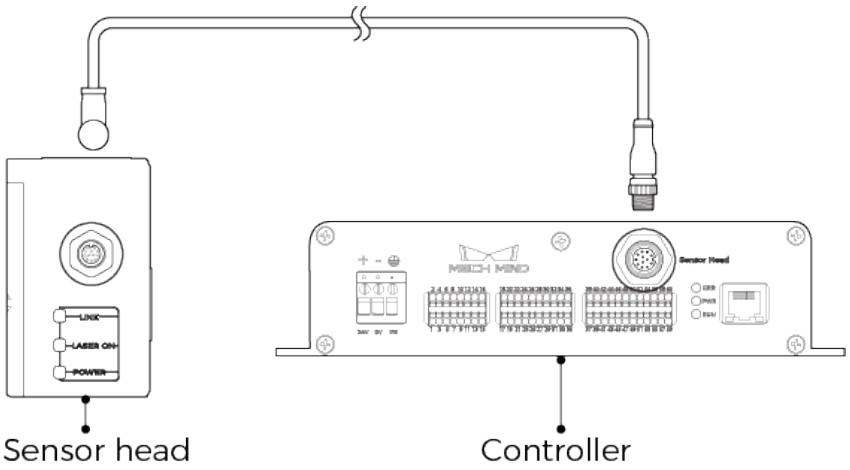
Method 2

As shown below, place the Φ5 gaskets and then the M5 × 70 bolts in the holes, and then use an open-end wrench to tighten the nuts.



Connect the Sensor Head and Controller

Connect the right-angle connector of the sensor-head-to-controller cable to the controller port on the sensor head and the straight connector to the sensor head port on the controller.



1. When inserting the connectors, align the bump in the connector with the notch in the port.

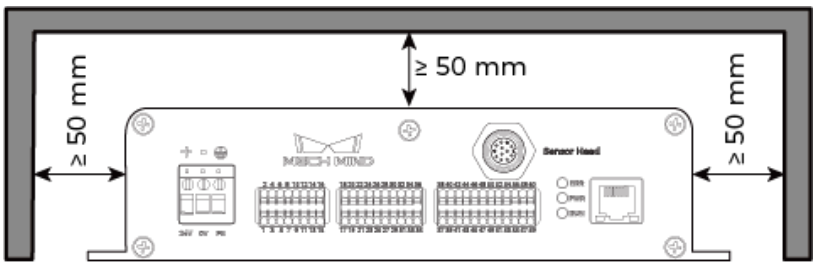
2. Tighten the nut. The recommended tightening torque is 0.7 N·m. A gap of about 2 mm remains after the nut is fully tightened.

Please fasten the cables properly to avoid damaging the cables or connectors due to strain.

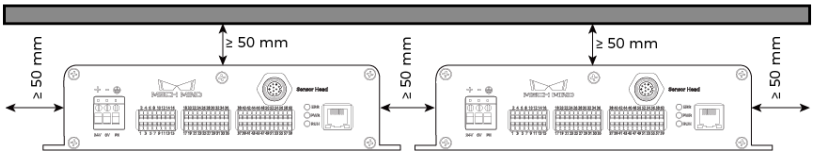
Mount the Controller

Before Mounting the Sensor Head

- Leave at least 50 mm of space above the controller and on both sides. Leave at least 90 mm of space in front of the side where the ports and connectors are located.

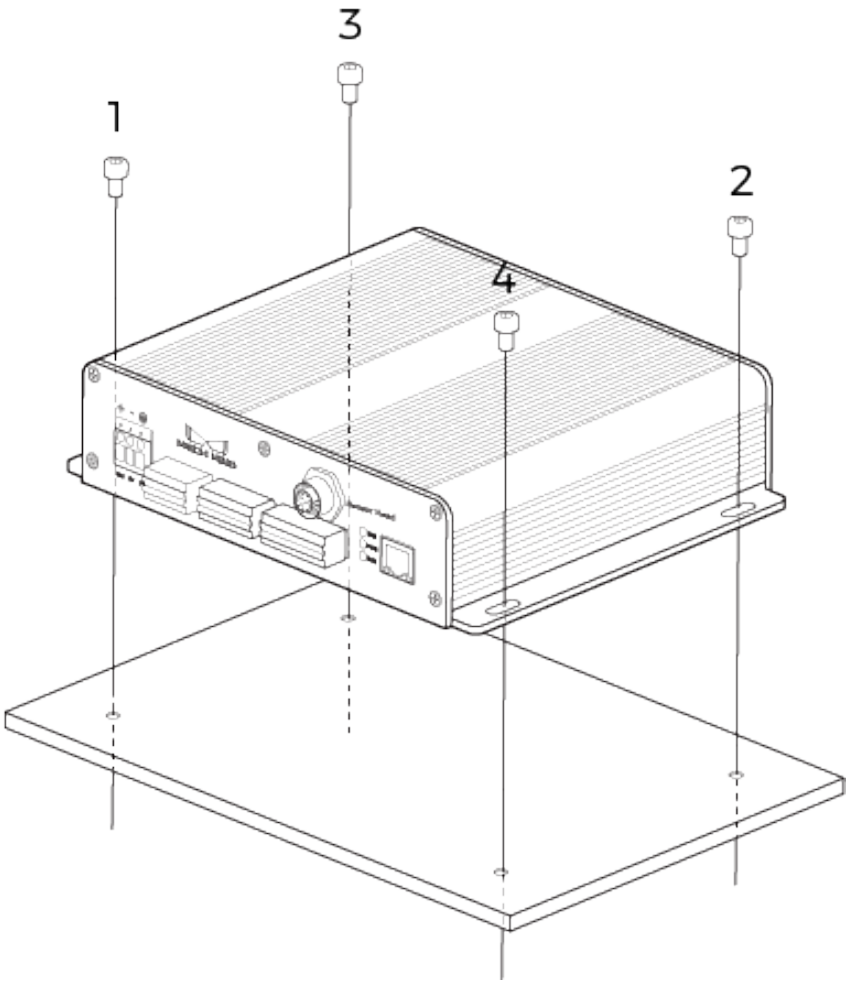


- For controllers mounted side by side, leave at least 50 mm of space between and above controllers.



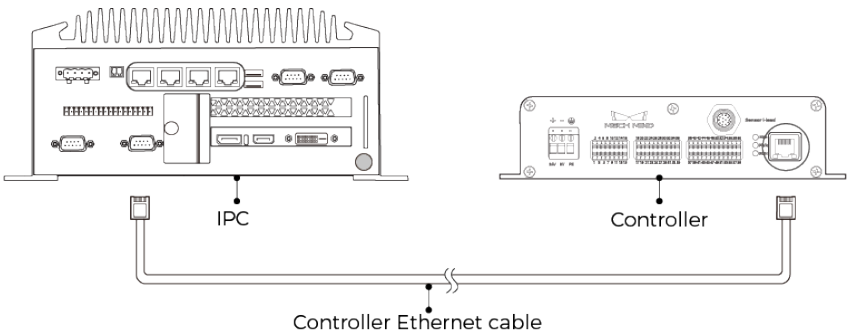
Mounting Method

As shown below, place four M5 × 8 bolts in the holes, and then use an open-end wrench to tighten the nuts.



Connect Controller and IPC

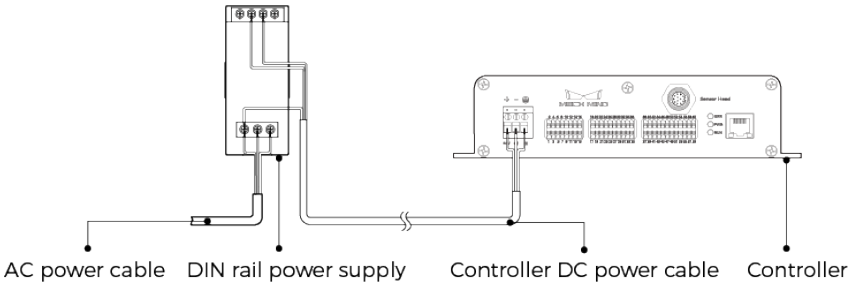
Insert one end of the controller Ethernet cable into the RJ45 Ethernet port on the controller and the other end into the RJ45 Ethernet port on the IPC.



- Do not use expansion hubs. Otherwise, the network connection may become unstable, and data transmission may fail.
- Please use shielded Ethernet cable of the CAT5e or above specification.

Connect Controller and DIN Rail Power Supply

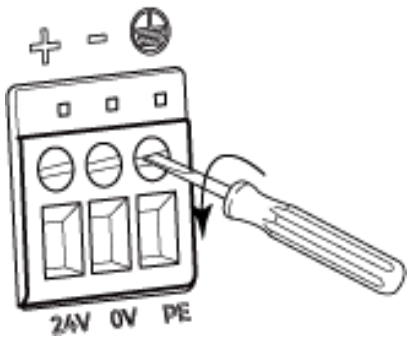
The instructions below apply to the DIN rail power supply provided by Mech-Mind. If you use your own DIN rail power supply, please refer to its user manual for connection instructions.



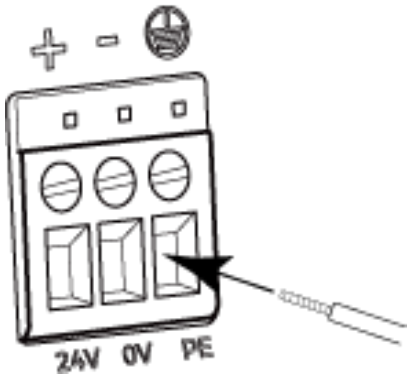
- Please prepare the AC power cable.
- Please use a single-phase, 3-prong power outlet with protective grounding for the AC power.
- It is not recommended to use DC power cables longer than 30 m. It is recommended to use power cables with wires of 15 AWG or smaller specifications (larger diameters) to ensure sufficient current and voltage.

Insert DC Power Cable into Power Connector on Controller

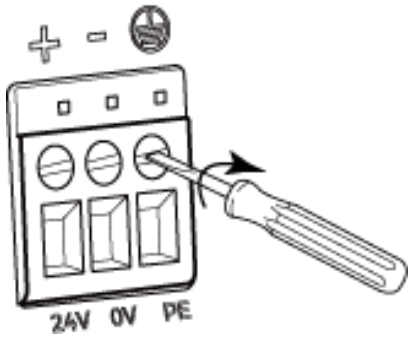
1. Use the flat screwdriver to loosen the screws above the power terminals.



2. Insert the wires into corresponding terminals. Insert the positive wire into the 24V terminal, negative wire into the 0V terminal, and ground wire into the PE terminal (⏚).



3. Use the flat screwdriver to tighten the screws above the power terminals. The recommended tightening torque is 0.2 N·m.

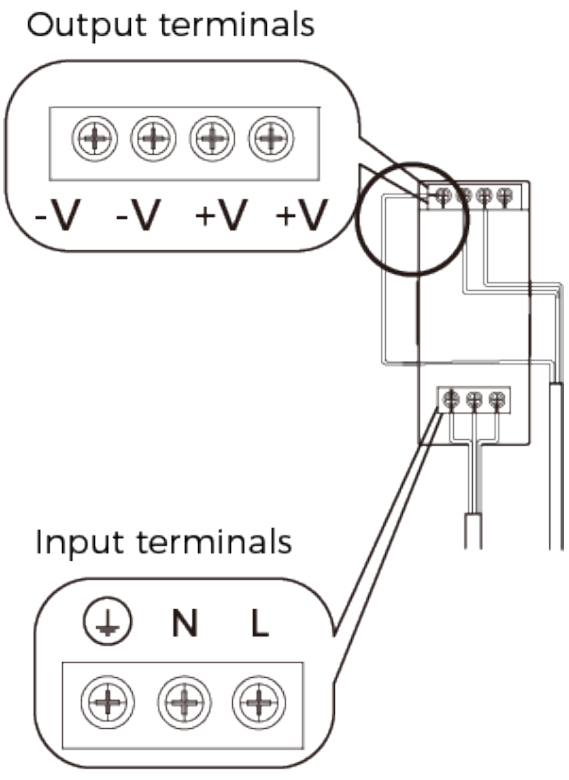
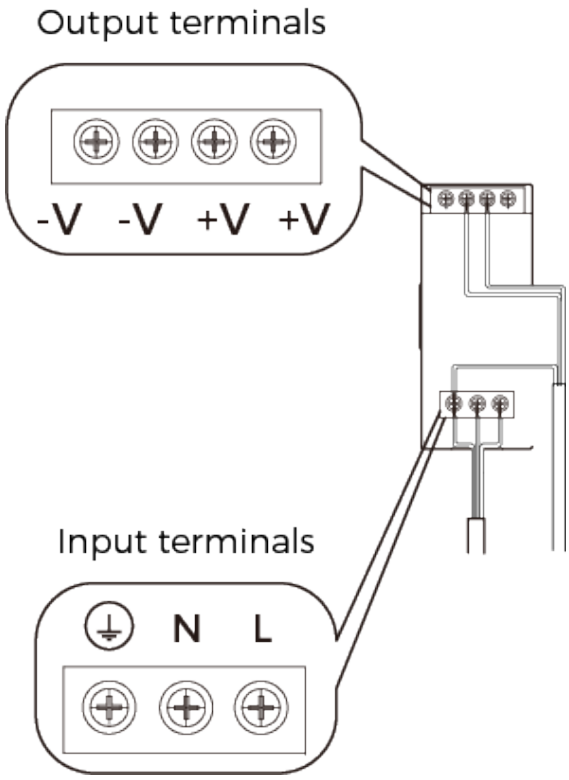


Insert DC Power Cable into Terminals on DIN Rail Power Supply

1. Use the flat screwdriver to loosen the screws on the terminals.
2. Insert the positive wire into one of the +V terminals, negative wire into one of the -V terminals, and ground wire into the ground terminal (⏚).
3. Use the flat screwdriver to tighten the screws on the terminals.

Insert AC Power Cable into Input Terminals on DIN Rail Power Supply

1. Use the flat screwdriver to loosen the screws on the input terminals.
2. Insert the live wire into the L terminal, neutral wire into the N terminal, and ground wire into the ground terminal (⏚).
3. Use the flat screwdriver to tighten the screws on the input terminals.

	
Incorrect	Correct

- Please mount the DIN rail power supply inside a control cabinet.
- The DIN rail power supply or the DIN rail should be reliably grounded. If mounting multiple DIN rail power supplies on the same DIN rail, ensure enough distance in between.
- The stripped part of the PE wire should be as short as possible.
- Supply power after all cables are fully connected. After power is supplied, the PWR indicator light on the controller and the POWER indicator light on the sensor head should be solid green. If not, please contact Mech-Mind.
- After the power is connected, if you need to move or replace the sensor head, please disconnect the power before you disconnect the sensor head from the controller.

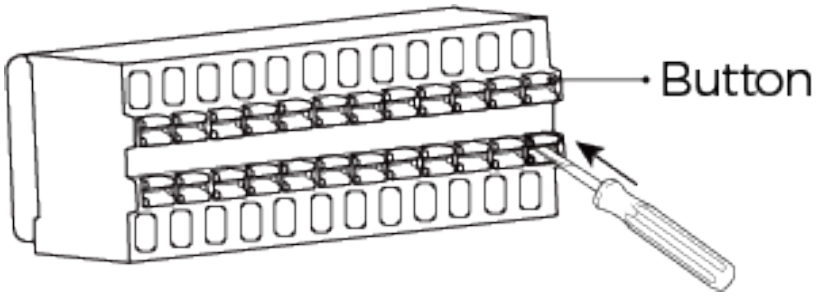
Connect Controller and External Device

You can connect external devices such as PLC and encoder to the corresponding terminals of the controller, in order to provide data acquisition trigger signals to the laser profiler, or provide data acquisition status signals to the external device.

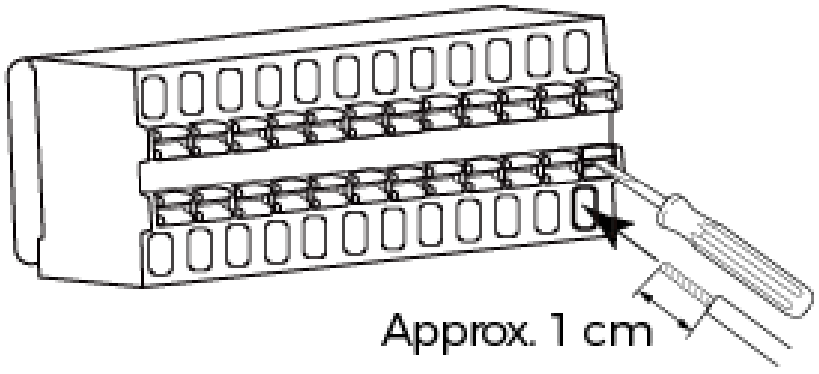
If you need to connect an external device, please refer to Signal Circuit Diagrams and Signal Terminals to check the specifications and functions of the signal terminals.

After checking the terminals to be connected, please follow these steps to connect the wires to the corresponding terminals on the controller:

1. Select the terminal into which the wire should be inserted and use the flat screwdriver to press down the button above/below it.



2. Insert the wire into the terminal, and then remove the flat screwdriver.



- The stripped part of the wire should be about 1 cm. If the stripped part is too short, the wiring might fail.
- If the strands of the wire are loose, please twist the strands together and then insert the wire into the terminal.

3. Gently pull the wire. The wire should not be pulled out if inserted properly. If the wire is pulled out, insert it again.

Do not pull the wire too strongly. Doing so may pull out the wire forcibly and damage the stripped part.

If you need to pull out the wire, press down the button above/below the terminal with the flat screwdriver, and then pull out the wire.

The mounting and connection of the laser profiler hardware is completed. The following sections will introduce how to use Mech-Eye Viewer to connect to the laser profiler and control the laser profiler to capture images.

Download and Install Mech-Eye SDK

You can download the Mech-Eye SDK installation package from Mech-Mind Download Center.

After decompressing the installation package, double-click the installer to install Mech-Eye SDK. For more information on the download, installation, upgrade, and uninstallation of Mech-Eye SDK, please refer to *Mech-Eye SDK Installation Guide*.

Set IP Addresses

Before connecting to the laser profiler, please make sure that the following IP address are unique and in the same subnet.

- IP address of the laser profiler
- The IP address of the computer Ethernet port connected to the laser profiler

The factory IP configuration of the laser profiler is as follows:

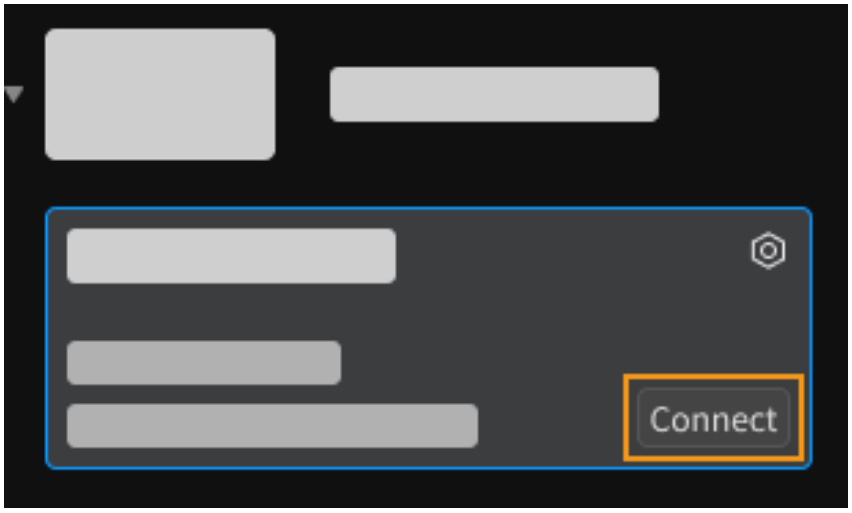
IP address assignment method	Static
IP address	192.168.23.203
Subnet mask	255.255.255.0
Gateway	0.0.0.0

Follow these steps to set the laser profiler IP address:

1. Double-click to open Mech-Eye Viewer.
2. Select the laser profiler to be connected, and click  .
3. Set the laser profiler IP address.

Connect to Laser Profiler

1. Find the laser profiler to be connected in Mech-Eye Viewer, and click **[Connect]**.



If the software or firmware needs to be upgraded, the **[Upgrade]** button is displayed instead. Please click this button to perform upgrade first, and then connect to the laser profiler.

Acquire Data

The laser profiler obtains data by scanning the object line by line. A raw image is acquired as each line is scanned. A single pixel is extracted from each column of pixels in the raw image, and this pixel is called a spot. Spots make up a profile. Finally, the profiles of many lines are combined to generate the intensity image, depth map, and point cloud.

Mech-Eye Viewer provides two data acquisition modes:

- **Profile Mode**: Adjust the parameters relevant to the profile to obtain the satisfactory profile.
- **Scan Mode**: Adjust the parameters relevant to the images and point cloud to obtain the satisfactory intensity image, depth map, and point cloud.

Example Scenario

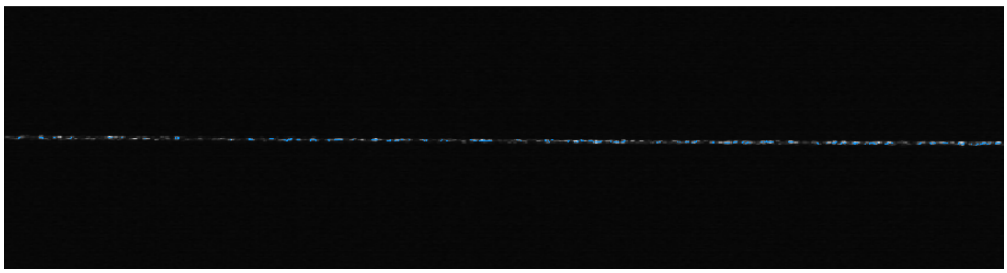
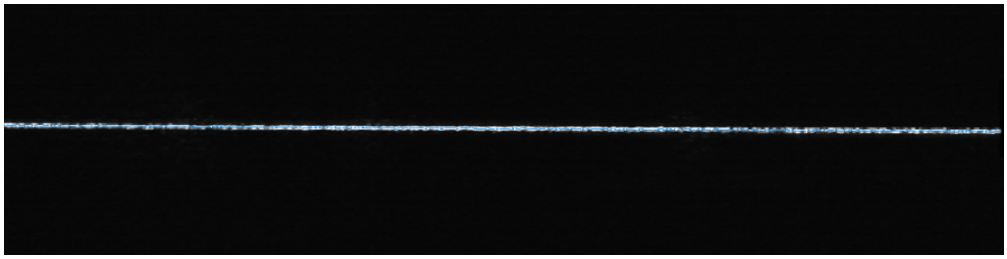
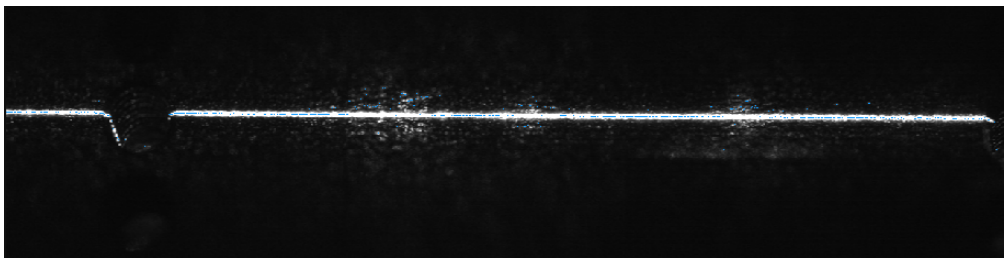
The following content is based on this example scenario:

- Data acquisition is triggered by Mech-Eye Viewer.
- The scan of each line is triggered by the encoder.
- The target object moves in one direction relative to the laser profiler.
- The target object is a metal block, and the dimensions are about 80 × 35 × 8 mm.

Obtain the Profile

Follow these steps to obtain the satisfactory profile:

1. Click to acquire the raw image once.
2. Click on the data types below the scan buttons to switch between the raw image and profile.
   - Raw image: used to adjust the brightness of the laser line.
   - Profile: Used to check the profile extraction result, such as the gaps in the profile.
3. Determine if the brightness of the laser line in the raw image meet the requirement: The grayscale values of the pixels at the center of the laser line should be between 200 and 255.

Too dark	
Good	
Too bright	

In the lower-right corner of the raw image, you can check the grayscale value of the pixel where the cursor is located. If not displayed, please check the **Image Information Box** option in the **View** menu.

4. If the brightness of the laser line does not meet the requirement, please adjust the following parameters in the **Parameters** tab on the right.

   The metal block is made of a single material. Therefore, in the **Brightness Settings** category, select **Timed** for the **Exposure Mode** parameter. Now, adjusting the **Exposure Time** parameter will change the brightness of the laser line in the raw image.

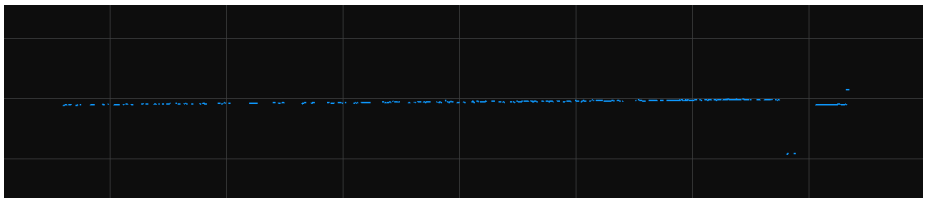
   a. Adjust the **Exposure Time** parameter based on the brightness of the laser line.
      - If the laser line is too dark, increase the value of the **Exposure Time** parameter.
      - If the laser line is too bright, decrease the value of the **Exposure Time** parameter.

   b. Acquire the raw image again, and check the brightness of the laser line. If needed, keep adjusting the parameter until the brightness of the laser line meets the requirement.

   If the target object is made of multiple materials or has multiple colors, you can use the **HDR** exposure mode. For more information, please refer to Exposure Mode.

5. Click **Profile** below the acquisition buttons to check the quality of the profile.

   The profile should be mostly complete without gaps.

Complete profile	
Incomplete profile	

If the profile quality is not good, please adjust the brightness of the laser line in the raw image again.

Obtain Intensity Image, Depth Map, and Point Cloud

The profile obtained in the profile mode is the foundation for generating the intensity image, depth map, and point cloud.

After the profile meets the requirement, follow these steps to obtain the intensity image, depth map, and point cloud.

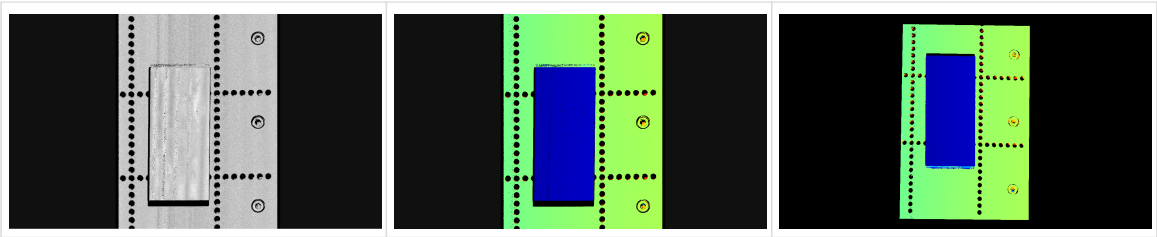
1. Click **[Scan Mode]** in the upper right of the interface to switch to the scan mode.
2. Set the parameters relevant to scan triggering based on the actual scenario:
   - When the data acquisition is triggered by Mech-Eye Viewer, set the **Data Acquisition Trigger Source** parameter in the **Trigger Settings** category to **Software**.
   - When the scanning of each line is triggered by the encoder, set the **Line Scan Trigger Source** parameter in the **Trigger Settings** category to **Encoder**.
   - When the target object moves in one direction relative to the laser profiler, set the **Trigger Direction** parameter to **Channel A leading** or **Channel B leading** based on the actual output signals of the encoder.
3. Click . The laser profiler will complete the current round of data acquisition based on the set value of the **Scan Line Count** parameter, and generate the intensity image, depth map, and point cloud.
4. Click the data types below the acquisition buttons to view the intensity image, depth map, and point cloud.

   For more information on image capturing and data types, please refer to Acquire and View Data.

5. Determine the data quality.

   In the intensity image, depth map and point cloud, the data corresponding to the target object should be complete. Refer to the following table for examples of good-quality data.

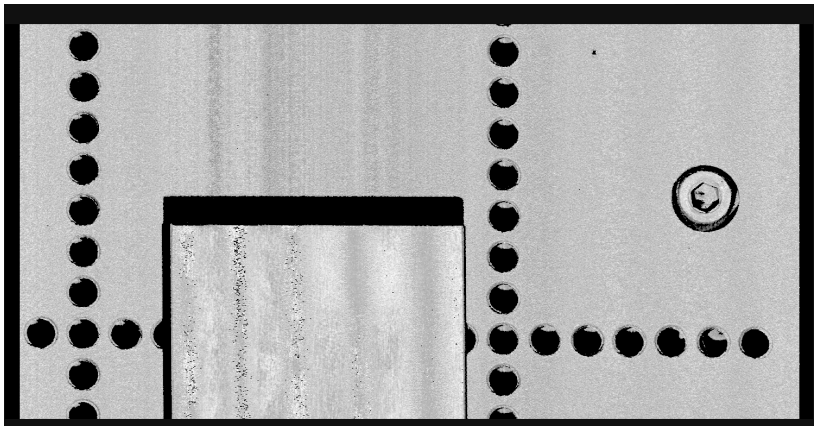
Intensity image	Depth map	Point cloud



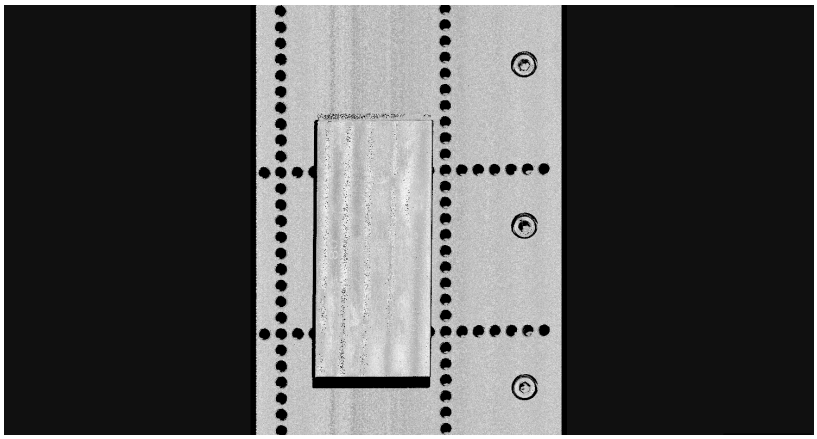
Adjust Parameters

If the obtained data is not complete, please refer to the following example and adjust the **Scan Line Count** parameter in the **Scan Settings** category:

1. Set the **Scan Line Count** parameter to 2000 and acquire data again. Check the intensity image. The metal block in the intensity image is not complete.



2. Based on the proportion of the metal block that was scanned, estimate and set the value of the **Scan Line Count** parameter to 6000. Then, acquire data again. Check the intensity image. The metal block in the intensity image is complete now.



This scenario does not take into account the aspect ratio of the target object in the scan data. If you need the aspect ratio of the target object in the scan data to match that of the actual object, please adjust Trigger Signal Counting Mode and Trigger Interval.

Use Data

The intensity image, depth map and point cloud obtained through Mech-Eye Viewer can be saved locally or can be output to Mech-Vision or third-party machine vision software for subsequent

processing and calculation.

- Save the data: Click  in the data acquisition area, set the destination path, check the data types to be saved, and then click **[Save]**.
- Use the data in Mech-Vision: Please refer to Vision System Tutorial and learn how to build the entire vision system that includes Mech-Vision.
- Use the data in third-party machine vision software: The data obtained by the laser profiler can be transmitted to third-party software through Mech-Eye API or the GenICam interface.

3. Mech-Eye SDK Release Notes

This document introduces the new features, improvements, and resolved issues of Mech-Eye SDK 2.2.1.

Mech-Eye Viewer

New Features

Added Display of Acquisition Info

An Acquisition info tab has been added to Mech-Eye Viewer 2.2.1. In this tab, you can view the temperature of the controller CPU during the current data acquisition.

Resolved Issues

The following issues have been resolved in Mech-Eye SDK 2.2.1:

- The positions of elements such as buttons in Mech-Eye Viewer were inconsistent with the positions that the cursor should actually click.
- The buttons in the data acquisition area were not aligned with the buttons of data types below.
- The displayed text in **Measurement Tool** were not aligned.
- When **Min Laser Line Width** was set to 2, **Max Laser Line Width** could not be set to a value smaller than 30.

Mech-Eye API

New Features

Added Python Mech-Eye API

Mech-Eye SDK 2.2.1 provides Python Mech-Eye API and resources such as relevant samples. The samples can be obtained from the installation path or GitHub. For the usage guide of Python samples, please refer to Sample Usage Guide.

Resolved Issues

The following issues have been resolved in Mech-Eye SDK 2.2.1:

- In the **AcquirePointCloud** sample, the min value of the **ScanLineCount** parameter was listed as 1 in relevant printed text (should be 16).
- LabVIEW: In the **Demo** and **BasicDemo** samples, the max value of **2D HDR Exposure Count** was set to 3 (should be 5).
- When **Min Laser Line Width** was set to 2, **Max Laser Line Width** could not be set to a value smaller than 30.

GenICam Interface

Resolved Issues

The following issues have been resolved in Mech-Eye SDK 2.2.1:

- When **Min Laser Line Width** was set to 2, **Max Laser Line Width** could not be set to a value smaller than 30.

Release Notes of Previous Versions

Mech-Eye SDK 2.2.0 Release notes

4. Mech-Eye SDK Installation Guide

This topic guides you through the downloading, installation, upgrade, uninstallation, repair, and installation modification of Mech-Eye SDK (including Mech-Eye Viewer and Mech-Eye API) on Windows.

When using Mech-Eye Viewer, the resolution and scaling of the screen should follow the correspondence in the table below. If the resolution and scaling of your screen do not match the those in the table below, some display problems may occur.

If you are using dual monitors, make sure that both have the same resolution and scaling.

Resolution	Scaling
1280×800 (16:10)	100%
1920×1080 (16:9)	100%, 125%
2560×1440 (16:9)	125%, 150%
3840×2160 (16:9)	150%, 175%

Download Mech-Eye SDK Installation Package

You can download the Mech-Eye SDK installation package from Mech-Mind Download Center.

Verify the Integrity of Mech-Eye SDK Installation Package

Since the Mech-Eye SDK installation package may be corrupted during transmission or downloading, you need to verify the integrity of the installation package. The integrity of the installation package can be verified with the CRC-32 value, which is provided on the download page.

Please install and use the 7-Zip software to calculate the CRC-32 value.

To verify the integrity of the software installation package, follow these steps:

1. Copy the installation package to a specified directory on the IPC or PC, such as *D:/*.
2. Decompress the installation package. After decompression, you will obtain the software installer (Mech-Eye SDK Installer 2.2.1.exe).
3. Open 7-Zip, and use the address bar to navigate to the directory where the software installation package is located.
4. Select the software installation package, and in the menu bar, select File › CRC › CRC-32 to calculate the CRC-32 value.
5. Check the calculated CRC32 value against the one on the download page. The two values should be identical.
6. Repeat steps 3 to 5 to the software installer obtained after decompression.

If the calculated values do not match those provided on the download page, please download it again.

Install Mech-Eye SDK

To install Mech-Eye SDK, follow these steps:

1. Double-click the downloaded installer to open the Mech-Eye SDK setup wizard.
2. In the **Welcome** window, browse the software information and click **[Next]**.
3. In the **License Agreement** window, read the license agreement carefully, check the **I accept the terms and conditions in the license agreement** check box, and then click **[Next]**.
4. In the **Select Product** window, select the components to install. If needed, check the **Create desktop shortcut(s)** option, and then click **[Next]**.

   - Make sure that the **Add to PATH** option is checked.
   - It is recommended to check the **Mech-Eye SDK Docs** option, which allows you to open the user manual without Internet connection.

5. In the **Set Path** window, change the installation path as required, and then click **[Next]**.

   Default installation path: *C:/Mech-Mind/Mech-Eye SDK-x.x.x*.

6. In the **Confirm** window, confirm that the installation path is correct and then click **[Install]**.
7. In the **Install** window, wait for the installation to complete.
8. After the software is installed, in the **Finish** window, click **[Finish]** to exit the setup wizard.

   It is recommended to restart your computer after the installation. If not restarted, the environmental variable added to PATH may not be effective.

Upgrade Mech-Eye SDK

Follow these steps to upgrade Mech-Eye SDK:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Upgrade** window, click either **[Upgrade and keep history versions]** or **[Upgrade and delete history versions]**.
3. Upgrade the software according to the prompts in the setup wizard.
4. After the software is upgraded, in the **Finish** window, click **[Finish]** to exit the setup wizard.

Uninstall Mech-Eye SDK

You can uninstall Mech-Eye SDK either with the Mech-Eye SDK setup wizard or the Windows Control Panel.

Uninstall Using the Setup Wizard

To uninstall Mech-Eye SDK using the setup wizard, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Maintain** window, click **[Uninstall]**.
3. In the **Uninstall** window, click either **[Keep user configuration files]** or **[Do not keep user configuration files]**.

4. Wait for the uninstallation to complete. After the software is uninstalled, in the **Finish** window, click **[Finish]** to exit the setup wizard.

Uninstall Using the Control Panel

To uninstall Mech-Eye SDK using the Control Panel, follow these steps:

1. Open the **Control Panel** on the computer.
2. Choose Program › Uninstall or change a program.
3. Right-click **Mech-Eye SDK**, and then select **Uninstall**. The Mech-Eye SDK setup wizard will be opened.
4. In the **Maintain** window, click **[Uninstall]**.
5. In the **Uninstall** window, click either **[Keep user configuration files]** or **[Do not keep user configuration files]**.
6. Wait for the uninstallation to complete. After the software is uninstalled, in the **Finish** window, click **[Finish]** to exit the setup wizard.

Repair Mech-Eye SDK

If Mech-Eye SDK failed to work normally, you can repair it using the Mech-Eye SDK setup wizard.

To repair Mech-Eye SDK, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Maintain** window, click **[Repair]**.
3. Wait for the repair to complete. After the software is repaired, in the **Finish** window, click **[Finish]** to exit the setup wizard.

Modify Installed Components

After installation, you can use the setup wizard to change the installed components of the software. To modify installed components, follow these steps:

1. Double-click **Mech-Eye SDK Installer x.x.x.exe** to open the Mech-Eye SDK setup wizard.
2. In the **Maintain** window, click **[Modify]**.
3. In the **Select Product** window, select the products or components to install, or deselect the products or components to uninstall.
4. Install the software according to the prompts in the setup wizard.
5. After the software is installed, in the **Finish** window, click **[Finish]** to exit the setup wizard.

Software License Agreement

For the license agreement of Mech-Eye SDK, refer to End-User License Agreement.

Troubleshoot Common Installation Problems

Failed to Start the Setup Wizard

Symptom:

After double-clicking on the installation package, the setup wizard could not be started properly or crashed.

Possible Causes:

There is not enough space on the system drive.

Troubleshooting Procedure:

Check whether the available space on the system drive is larger than the size of the installer.

- If the available space on the system drive is smaller than the size of the installer, delete unnecessary files to free up the space, and then reinstall. If the issue still exists, contact Mech-Mind Technical Support.
- If there is enough space on the system drive, contact Mech-Mind Technical Support.

Installation Failed

Symptom:

An error message saying “Installation failed.” appeared in the **Finish** window during the installation.

Possible Causes:

- Corrupted installer or missing files.
- The current user does not have administrator access.
- Another Wizard is performing the installation or the Windows system is being upgraded.
- Other reasons.

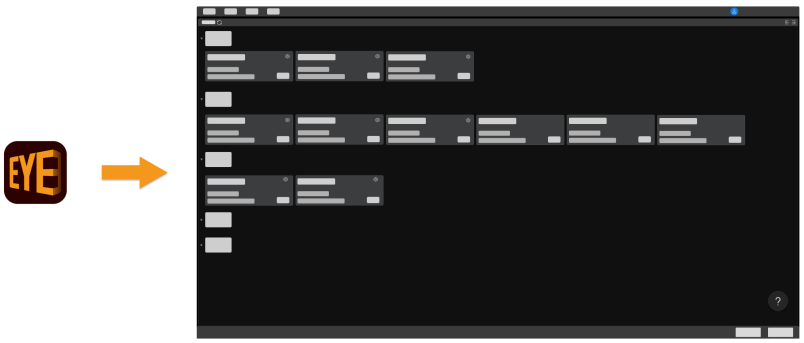
Troubleshooting Procedure:

1. Obtain a new installer and check its integrity, and then try the installation again.
   - If the problem is resolved, the troubleshooting is completed.
   - Otherwise, proceed to step 2.
2. Right-click the installer and select **Run as administrator** to reinstall.
   - If the problem is resolved, the troubleshooting is completed.
   - Otherwise, proceed to step 3.
3. Try the installation again after the installation of other software completes or after the Windows system upgrade completes.
   - If the problem is resolved, the troubleshooting is completed.
   - Otherwise, proceed to step 4.
4. Restart your computer and try the installation again.
   - If the problem is resolved, the troubleshooting is completed.
   - If the problem still exists, click the **installation log** link in the **Finish** window to collect installation logs and send them to Technical Support.

5. Mech-Eye Viewer

Mech-Eye Viewer is a graphical interface software developed based on Mech-Eye API. Based on the characteristics of the target objects, you can use Mech-Eye Viewer to adjust the parameters of the laser profiler to conveniently obtain high-quality intensity images, depth maps, and point clouds.

Currently, Mech-Eye Viewer is only available on Windows. Ubuntu users can control the laser profiler with Mech-Eye API.



Introduction of the **user interface**:

User Interface

Instructions on **connecting to the laser profiler, acquire data, and adjust parameters**:

How to Use

Detailed information on parameters:

Parameter Reference Guide

Instructions on **using the tools in Mech-Eye Viewer**:

Tool

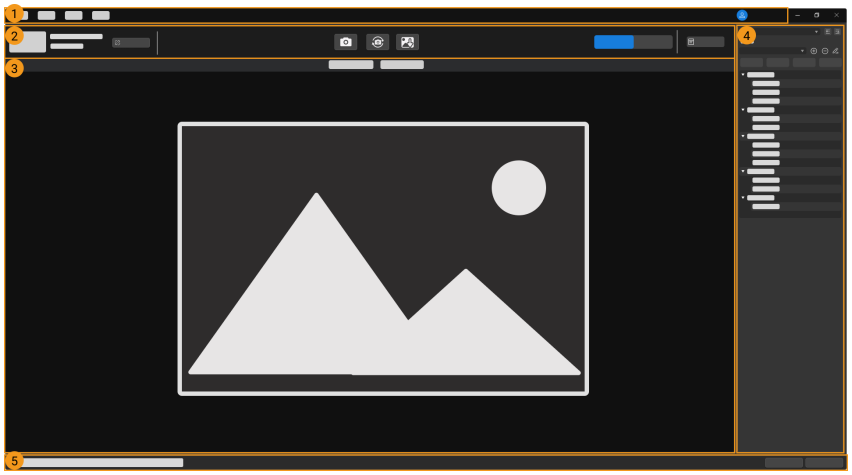
5.1. User Interface

When you open Mech-Eye Viewer, the following interface is displayed.

In this interface, you can view all the available laser profilers and their information, set laser profiler IP address, and connect to a laser profiler.

Hover the cursor on ?, and then click **Laser Profiler** to view the troubleshooting guidance on laser profiler connection issues.

After the laser profiler is successfully connected, the following interface is displayed.



This interface consists of the following parts:

1. Menu bar: provides the **Tools**, **View**, and **Help** menus.
2. Data acquisition area: used to set a custom name, switch data acquisition mode, acquire data, save data, disconnect, and view the log.
3. Data display area: displays the data obtained from the laser profiler.
4. Parameter and acquisition info panel: used to adjust parameters, manage parameter groups, and view the information related to acquisition.
5. Status bar: displays the laser profiler operation status. Click **[Previous]** or **[Next]** to switch between messages.

Menu Bar

The menu bar provides the **Tools**, **View**, **Help** and user switch menus.

Menu	Option	Description
Tool	Custom Reference Frame	Define a custom reference frame used for displaying the depth map and point cloud.
	Measurement Tool	Measure point-to-point distances, point-to-line distances, and height differences in the profile.
View	Toolbar	Check to display the toolbar. Unselected by default.
	Image Information Box	Check to display the image information box on the raw image, intensity image, and depth map. Checked by default.
	Point Cloud Exhibit Button	Check to display the **[Play]** button on the point cloud, used to exhibit the point cloud. Unchecked by default.
	Parameter Description	Check to display the **Parameter Description** section in the **Parameters** tab. Checked by default.
Help	About	Display software version.
	Release notes	Open the Mech-Eye SDK release notes in your browser.
	User Manual	Open the user manual in your browser.
	Online Community	Open Mech-Mind Online Community in the browser.
Options		Switch the software display language. Change is applied after the software is restarted.
		Click to switch the user account. The default account is **Standard**. If you need to use the **Administrator** account, please contact Mech-Mind Technical Support.

Data Acquisition Area

In the data acquisition area, you can:

- Set a Custom Name
- Switch Data Acquisition Mode
- Collect Data
- Save Data
- View the log
- Disconnect from the current laser profiler

Data Display Area

This area displays the data output from the laser profiler. You can switch among different types of data.

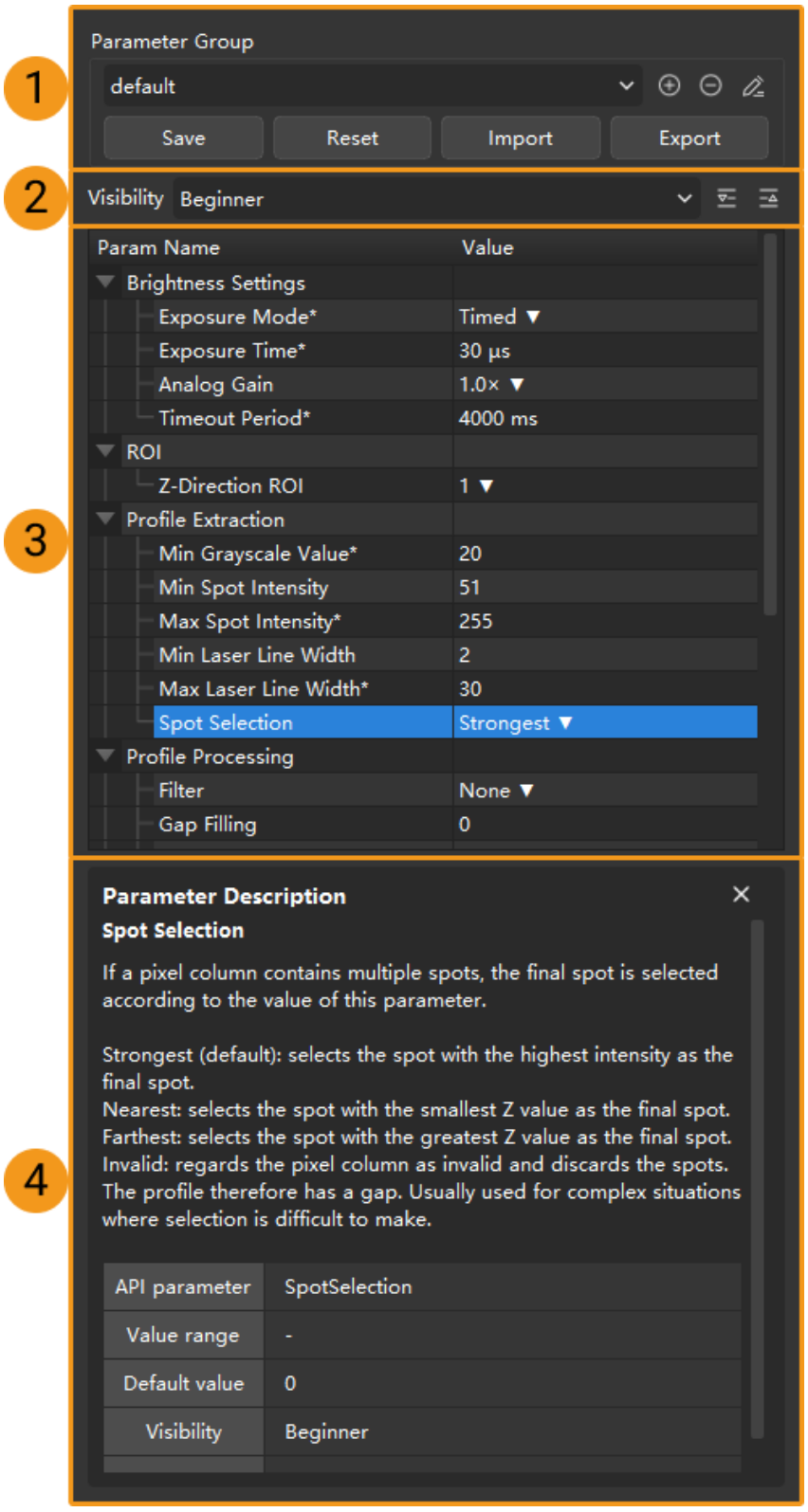
For detailed information on the function of this area, please refer to Adjust Data Display.

Parameter and Acquisition Info Panel

This panel includes two tabs, **Parameters** and **Acquisition info**.

Parameters Tab

The **Parameters** tab consists of the following sections:



1. Parameter group: create a new parameter group, save parameter values to a parameter group, delete a parameter group, rename a parameter group, and import and export parameter groups.

2. Visibility: change the visibility of parameters.
3. Parameter list: adjust parameters.
4. Parameter description: view more information of the selected parameter.

Acquisition Info Tab

The **Acquisition info** tab displays the following information related to the current data acquisition:

- Laser profiler name and the completion time of the acquisition
- CPU temperature: the temperature of the controller CPU

This topic introduced the user interface of Mech-Eye Viewer. Continue reading for instructions on using Mech-Eye Viewer.

5.2. How to Use

This topic provides instructions on using Mech-Eye Viewer to connect to the laser profiler, acquire data, view the data, adjust parameters, and save the data.

Instructions on **setting the laser profiler IP address, connecting to the laser profiler, and setting a custom laser profiler name**:

Set Laser Profiler IP Address and Connect to Laser Profiler

Instructions on **obtaining and viewing the data**:

Acquire and View Data

Instructions on **adjusting parameters** to improve data quality:

Adjust Parameters

Instructions on **saving the acquired data**:

Save Data

Information on **exporting the log** in the case that you encounter a problem with the software:

Manage Log

5.2.1. Set Laser Profiler IP Address and Connect to Laser Profiler

For Mech-Eye Viewer to connect to the laser profiler successfully, please make sure that the following IP addresses are unique and in the same subnet.

- The IP address of the laser profiler
- The IP address of the computer Ethernet port connected to the laser profiler

After setting the IP addresses, you can connect to the laser profiler. Once the laser profiler is connected, you can set a custom name for it for easy recognition of different devices.

If the laser profiler to be connected is not displayed in Mech-Eye Viewer, please refer to Laser Profiler Not Found in Mech-Eye SDK.

Set Laser Profiler IP Address

You can set a static IP address for the laser profiler, or dynamically assign the IP address.

The factory IP configurations of the laser profiler is as follows:

If you are using multiple laser profilers, please modify the laser profiler IP addresses first. Otherwise, issues such as disconnection will occur.

IP address assignment method	Static
IP address	192.168.23.203
Subnet mask	255.255.255.0
Gateway	0.0.0.0

Set Static IP address

Record the set laser profiler IP address for future reference.

Follow these steps to set a static IP address for the laser profiler:

1. Open Mech-Eye Viewer, select the info card of the laser profiler to be connected, and click in the upper right of the card to open the **IP Configuration** window.
2. Select **Set as Static IP**.
3. Based on the IP address and subnet mask displayed in **Computer IP Configuration**, select **IP Address Class**, and enter the laser profiler IP address and subnet mask. Then, click **[Apply]** to apply the changes.

- The IP address must be unique.
- The **Computer IP Configuration** section displays the IP address and subnet mask of the computer Ethernet port connected to the laser profiler.

Using dynamic IP address

Follow these steps to dynamically assign an IP address to thelaser profiler:

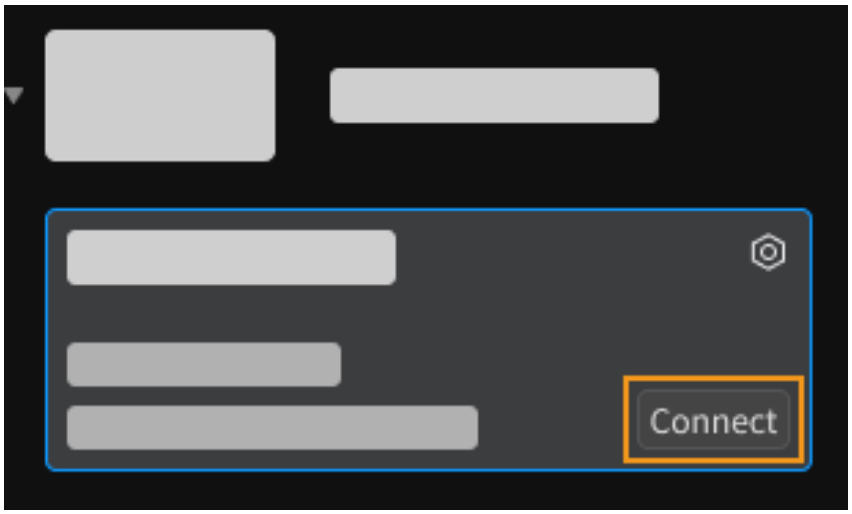
1. Open Mech-Eye Viewer, select the info card of the laser profiler to be connected, and click in the upper right of the card to open the **IP Configuration** window.

2. Select **Set via DHCP** and click **[Apply]**.

If you want to set the IP address of the computer Ethernet port connected to the laser profiler, please refer to Set IP Address on Computer.

Connect to Laser Profiler

When the laser profiler info card displays the **[Connect]** button, click this button to connect to the laser profiler.



For the very first time that the laser profiler is connected to the computer, it may take up to a few minutes for the laser profiler to show up in Mech-Eye Viewer.

If other content is displayed, please complete the corresponding action according to the following table, and then connect to the laser profiler.

Displayed content	Description
[Upgrade] button	Click this button to upgrade the software or the laser profiler firmware first.
Connected	The laser profiler is connected to a GenICam client. Please disconnect the laser profiler from the GenICam client first.
⚠	Hover the cursor here to check the cause and solution, and resolve the issue according to these.

Set a Custom Name

The laser profiler name can be used to distinguish different devices, clarifying the usages and locations of the devices, and more. Please set the custom name according to your actual needs. The custom name will be displayed in the **Device List**.

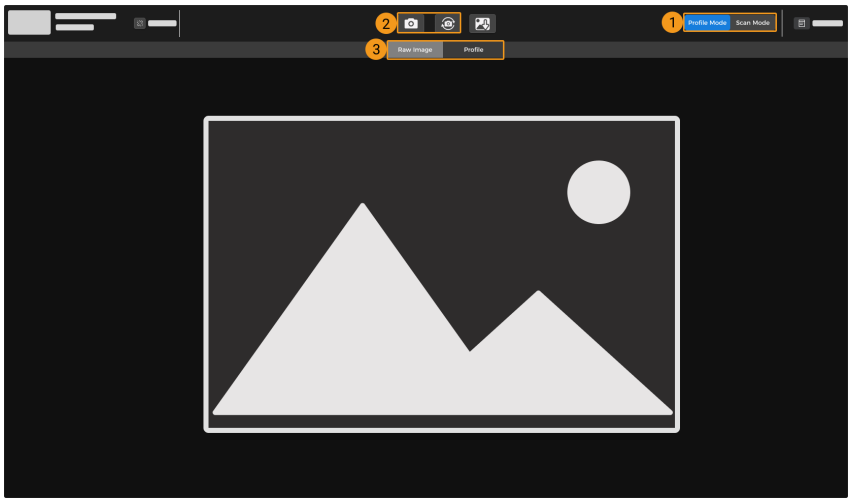
After connecting to the laser profiler, on the left of the data acquisition area, click ✎ or **Set device name** to set a custom name.

- The following characters cannot be used: `\ / : * ? " < > |`.
- Click the custom name again to modify it.

This topic introduced how to set the laser profiler IP address and connect to the laser profiler. After connecting to the laser profiler, you can start acquiring data. The next topic introduces the actions for acquiring data and viewing the obtained data.

5.2.2. Acquire and View Data

Once the laser profiler is successfully connected, the following interface is displayed. In this interface, you can switch the data acquisition mode, acquire data, and view the data.



1. Switch Data Acquisition Mode
2. Acquire Data
3. Switch Data Type

Switch Data Acquisition Mode

Click the corresponding button to switch the data acquisition mode:

- Profile mode: used to acquire the raw image and profile, and adjust the relevant parameters.
- Scan mode: used to acquire the intensity image, depth map, and point cloud, and adjust the relevant parameters.

Read Scanning Mechanism of Laser Profiler to familiarize yourself with the scanning mechanism of the laser profiler.

Acquire Data

You can acquire data with the and buttons in the data acquisition area. The functions of these buttons differ in different data acquisition modes.

Profile Mode

In the profile mode, click the above buttons to acquire the raw image and profile.

- : Click this button to acquire one raw image and one profile.
- Click this button to start acquiring raw images and profiles continuously at the predetermined interval. After the acquisition has started, this button changes to . Click it again to stop the continuous acquisition.

Scan Mode

In the scan mode, the functions of the above buttons differ according to the method of triggering data acquisition in use.

Read Methods for Triggering Data Acquisition and Workflow of Triggering Data Acquisition to familiarize yourself with the different methods of triggering the laser profiler to acquire data.

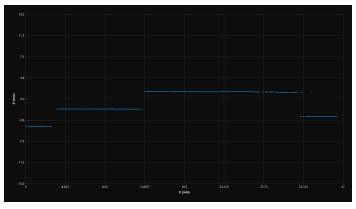
- External:
  - : This button is not available.
  - : Enter the laser profiler into the acquisition ready status. The laser profiler can only respond to externally input signals after it enters the acquisition ready status.
- Software:
  - : Enter the laser profiler into the acquisition ready status and start one round of data acquisition.
  - : Enter the laser profiler into the acquisition ready status and start rounds of data acquisition continuously. After the acquisition has started, this button changes to . Click it again to stop the continuous acquisition.

Switch Data Type

The laser profiler outputs multiple types of data to Mech-Eye Viewer. Click the data type buttons to view the corresponding type of data.

Data Types in Profile Mode

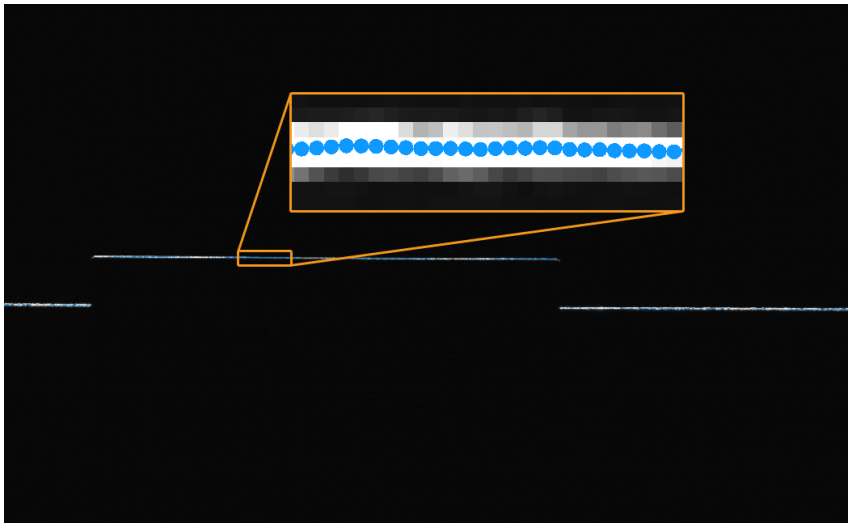
In the profile mode, you can view the **Raw Image** and **Profile** types of data.

Data type	Description	Example
Raw image	Used to check the brightness and location of the laser lines.	
Profile	Used to check the profile extraction result, such as the amount of gaps in the profile.	

Explanation of the raw image

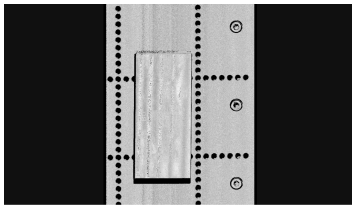
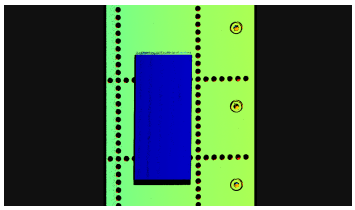
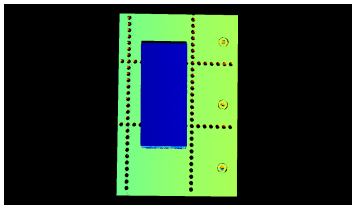
The following figure is a raw image obtained in the profile mode. In which:

- The white line is the laser line.
- The line composed of the blue dots is the extracted profile. Each blue dot is a spot, which is the data point extracted from each column of pixels in the raw image.



Data Types in Scan Mode

In the scan mode, you can view the **Intensity Image**, **Depth Map**, and **Point Cloud** types of data.

Data type	Description	Example
Intensity image	A 2D image that represents the reflectivity of the object surface	
Depth map	A 2D image that contains the depth information of the object surface	
Point cloud	A collection of data points that represent the 3D shape of the object surface	

Adjust Data Display

In the data display area, you can adjust the display of the data through mouse actions, keyboard, and buttons and menus in the software interface.

Adjust Raw Image Display

In the raw image display, you can perform the following actions:

- **Zoom**: While the cursor is on the raw image, scroll the mouse wheel to zoom the raw image.
- **Move**: While the raw image is zoomed in, hold and drag to move the raw image.

- **Reset size**: Right-click the raw image and select **Reset View** to fit it to the window.
- **Check pixel position and grayscale values**: In the image information box at the lower right of the raw image, you can check the pixel position and grayscale values of the pixel where the cursor is located.

  - The pixel position of the upper-left corner of the image is (0, 0).
  - To hide the image information box, uncheck **Image Information Box** in the **View** menu.

Adjust Profile Display

In the profile display, you can perform the following actions:

- **Zoom**: While the cursor is on the profile, scroll the mouse wheel to zoom the profile.
- **Move**: While the profile is zoomed in, hold and drag to move the profile.
- **Reset size**: Right-click the profile and select **Reset View** to fit it to the window.

Adjust Intensity Image Display

In the intensity image display, you can perform the following actions:

- **Zoom**: While the cursor is on the intensity image, scroll the mouse wheel to zoom the intensity image.
- **Move**: While the intensity image is zoomed in, hold and drag to move the intensity image.
- **Reset size**: Right-click the intensity image and select **Reset View** to fit it to the window.
- **Check pixel position and grayscale values**: In the image information box at the lower right of the intensity image, you can check the pixel position and grayscale values of the pixel where the cursor is located.

  - The pixel position of the upper-left corner of the image is (0, 0).
  - To hide the image information box, uncheck **Image Information Box** in the **View** menu.

Adjust Depth Map Display

In the depth map display, you can perform the following actions:

- **Zoom**: While the cursor is on the depth map, scroll the mouse wheel to zoom the depth map.
- **Move**: While the depth map is zoomed in, hold and drag to move the depth map.
- **Reset size**: Right-click the depth map and select **Reset View** to fit it to the window.
- **Check pixel position and coordinates**: In the image information box at the lower right of the depth map, you can check the pixel position and coordinates (in mm) in the laser profiler reference frame of the pixel where the cursor is located.

  - The pixel position of the upper-left corner of the image is (0, 0).
  - To hide the image information box, uncheck **Image Information Box** in the **View** menu.

- **Adjust depth data display**: The display of the depth data can be adjusted in the left panel. For detailed instructions, please refer to Adjust Depth Data Display.

Adjust Point Cloud Display

In the point cloud display, you can perform the following actions:

- **Zoom**: While the cursor is on the point cloud, scroll the mouse wheel to zoom the point cloud.
- **Rotate**:
  - Rotate in 3D space: Hold the left mouse button and drag to rotate the point cloud.
  - Rotate in 2D plane: While holding the `Ctrl` key, hold the left mouse button and drag to rotate the point cloud.
- **Pan**: Hold the mouse wheel and drag to pan the point cloud.
- **Reset the view**:
  - Press the `R` key to reset the panning of the view, and adjust the zoom of the point cloud to a default level.
  - Press the `Backspace` key to reset the panning and rotation of the view, and adjust the zoom of the point cloud to a default level.
- **Adjust depth data display**: The display of the depth data can be adjusted in the left panel. For detailed instructions, please refer to Adjust Depth Data Display.
- **Point Cloud Exhibit**: This function moves the point cloud along a predetermined trajectory to display it from various angles. For detailed instructions, please refer to Point Cloud Exhibit.

Adjust Depth Data Display

In the left panel of the depth map or point cloud display, you can adjust the display reference frame, color rendering, and range of the depth data.

Change Reference Frame

In the **Reference Frame** menu at the top of the left panel, you can select the reference frame used for displaying the depth data.

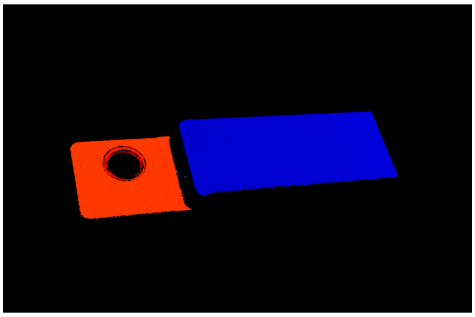
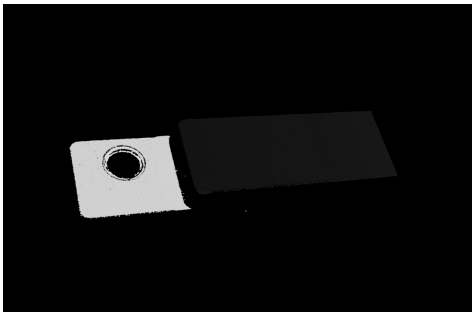
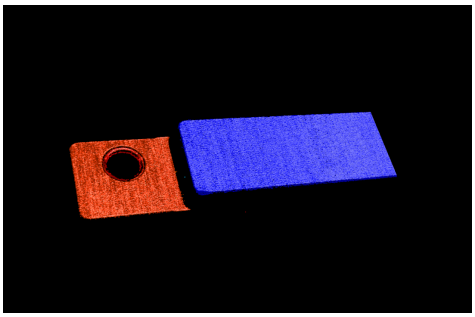
- **Device** (default): displays the depth data in the laser profiler reference frame.
- **Custom**: displays the depth data in the custom reference frame defined by the user.

> The reference frame setting is simultaneously applied to both depth map and point cloud.

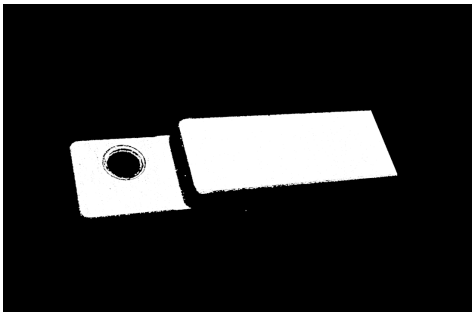
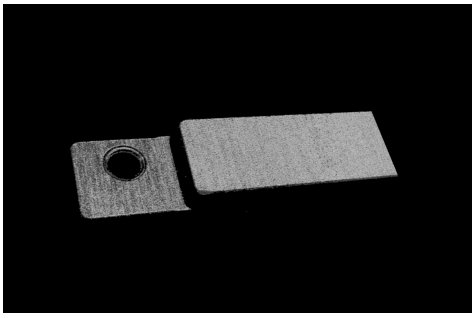
Change Color Rendering

In the **Color** menu in the left panel, you can choose the color rendering scheme of the depth data.

The **Jet**, **Grayscale**, and **Jet + intensity** options are available for both the depth map and point cloud. When one of these three options is selected, the depth range of the color rendering can be adjusted.

Option	Description	Example
Jet	Depth values are displayed in different colors of the jet color scheme.	
Grayscale	Depth values are displayed in different shades of gray.	
Jet + intensity	The intensity information of the object surface is overlaid on the jet color scheme. Suitable for checking the object surface features and depth changes at the same time.	

The **Untextured** and **Textured** options are only available for the point cloud.

Option	Description	Example
Untextured	Displays the untextured, white point cloud.	
Textured	Display the point cloud textured with the intensity image.	

When **Untextured** or **Textured** is selected, if you switch to the depth map display and then switch back to the point cloud display, the **Color** setting will be automatically changed to the option selected in the depth map display.

Adjust Depth Range of Color Rendering

When the depth map and point cloud are displayed in **Jet** ,**Grayscale** or **Jet + intensity**, every time data acquisition is performed, Mech-Eye Viewer automatically adjusts the color rendering according to the range of the obtained depth data.

With the functions in the **Range** section of the left panel, you can adjust the depth range in which the color is rendered, in order to conveniently observe the depth variation in a specific range.

The depth range of color rendering is simultaneously applied to both depth map and point cloud.

Follow these steps to adjust the color rendering range of the depth data:

1. Adjust the range of depth data to be displayed: adjust the **Min** and **Max** values at the two ends of the slider. Depth data outside this range is not displayed.
2. Check the rough depth: On the depth map, move the cursor to the area to be observed, and check the third value of **Coordinates** in the image information box in the lower right. This is the depth value.
3. Adjust depth range of color rendering: Move the slider handles or enter the depth values on the right of the slider to adjust the depth range of color rendering according to your needs.

   After adjusting the range, the depth values outside this range are displayed in the colors corresponding to the minimum/maximum depth values.

4. Lock the range: If you need to compare the depth variations in the same range across multiple acquisitions, you can check the **Lock** option above the slider. When you acquire data again, the depth range of color rendering manually adjusted will be used.

   To change back to the automatically adjusted range, uncheck **Lock** and click **[Reset]** to the upper right.

Point Cloud Exhibit

This function moves the point cloud along a predetermined trajectory to display it from various angles, suitable for scenarios such as exhibits.

Follow these steps to use the **Point Cloud Exhibit** function:

1. Check **Point Cloud Exhibit** in the **View** menu, and a **[Play]** button will appear in the upper right of the point cloud display.
2. Click **[Play]**, and the point cloud will start moving along the predetermined trajectory.
3. While the point cloud is moving, the **[Play]** button is changed to **[Stop]**. Click **[Stop]**, and the point cloud will stop moving.

This topic introduced data acquisition and data types. The next topic will introduce actions related to parameters.

5.2.3. Adjust Parameters

The intensity image, depth map, and point cloud obtained from the laser profiler are made of multiple profiles. The quality of the profiles determines the quality of the intensity image, depth map, and point cloud. Therefore, when adjusting the parameters, you need to adjust the parameters that affect the quality of the profile first, and then adjust the parameters that only affect the quality of the intensity image, depth map, and point cloud.

Read Scanning Mechanism of Laser Profiler to familiarize yourself with the scanning mechanism of the laser profiler.

The parameters in Mech-Eye Viewer are divided into two parts:

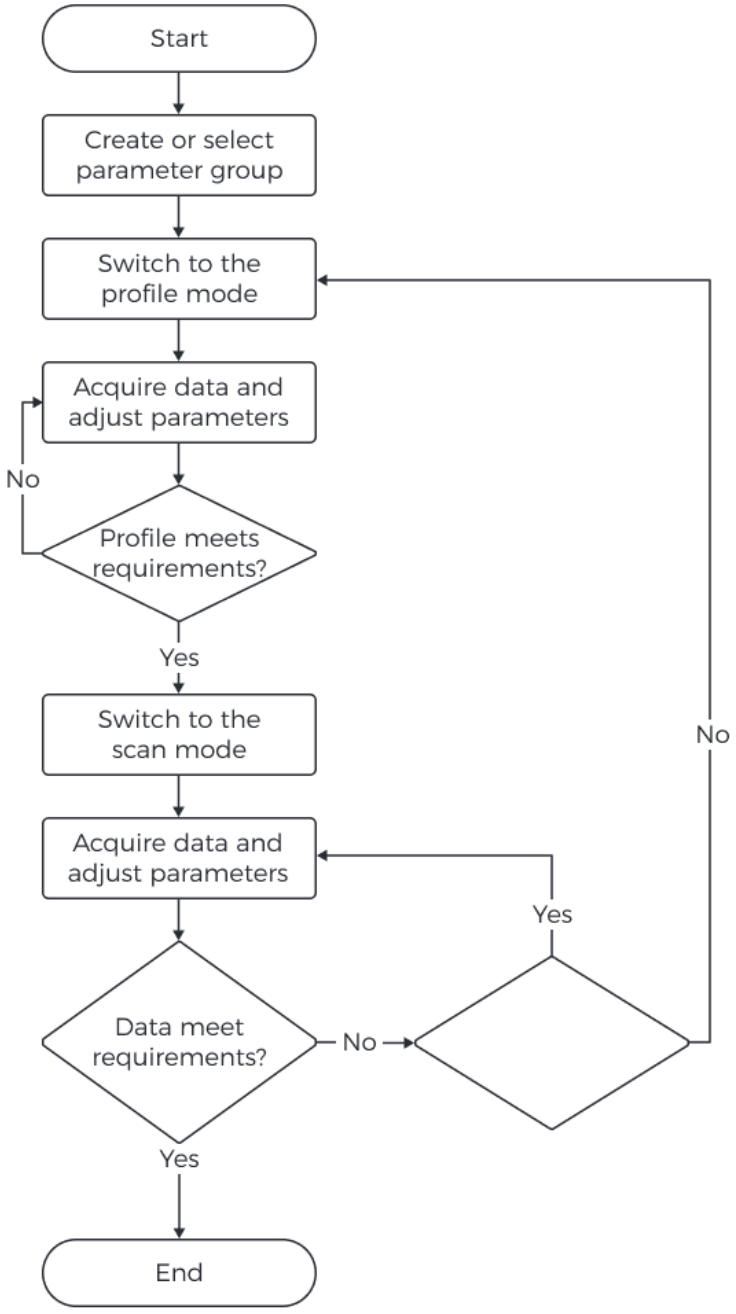
- Parameters in the profile mode: affect the quality of the profile.
- Parameters in the scan mode: only affect the quality of the intensity image, depth map, and point cloud.

This topic introduces the actions related to parameters, including the general workflow of adjusting parameters, managing parameter groups, changing parameter visibility, and checking parameter descriptions.

General Workflow of Adjusting Parameters

When adjusting the parameters, you usually need to acquire the data again to check the result of parameter adjustment.

The general workflow of adjusting parameters is as follows:



1. At the top of the **Parameters** tab, create a parameter group, or select a parameter group for saving the parameter values.
2. Click **[Profile Mode]** in the upper right of the interface to switch to the profile mode.
3. Acquire data, check the data quality, and adjust parameters.
4. Click **[Scan Mode]** in the upper right of the interface to switch to the scan mode.
5. Based on combination of triggering methods in use, configure the corresponding parameters.
6. Acquire data, check the data quality, and adjust parameters.
7. Once the data quality meets the requirements, click **[Save]** at the top of the **Parameters** tab.

- If adjusting the parameters in the scan mode cannot make the data meet the requirements, please adjust the parameters in the profile mode again.
- If the data quality is still not good, you can change the visibility and adjust the newly displayed parameters.

Manage Parameter Groups

Parameter groups are used to save parameter values for different applications, projects, workpieces, and so on. When the application, project, workpiece, etc., changes, switching the parameter group in use can quickly apply the corresponding parameter values.

In Mech-Eye Viewer, you can create a new parameter group, save parameter values to a parameter group, delete a parameter group, rename a parameter group, and import and export parameter groups.

Create a parameter group

Please follow these steps to create a parameter groups using the current parameter settings:

1. On the right of the Parameter Group section, click .
2. In the pop-up window, enter the name for the parameter group, and click **[OK]**.

   The parameter group name cannot be longer than 32 characters.

3. After the parameter group is created, it will be displayed in the drop-down menu in the Parameter Group section.

Save Parameters to Parameter Group

Follow these steps to save parameters to a parameter group:

1. Click the drop-down menu in the Parameter Group section, and select the parameter group used for saving parameter values.
2. Adjust parameters.
3. In the Parameter Group section, click **[Save]** or use the shortcut `Ctrl` + `S` to save the adjusted parameter values to the currently selected parameter group.

An asterisk (*) next to a parameter name indicates that the value of this parameter has not been saved to the parameter group. When the laser profiler is disconnected from power, the unsaved changes are discarded.

Delete a parameter group

To delete a no longer needed parameter group, follow these steps:

1. Click the drop-down menu in the Parameter Group section, and select the parameter group to be deleted.
2. Click , and then click **[Yes]** in the pop-up window to delete the parameter group.

   The **default** parameter group cannot be deleted.

Rename Parameter Group

Follow these steps to rename a parameter group:

1. Click the drop-down menu in the Parameter Group section, and select the parameter group to be renamed.
2. Click  , enter the new name in the pop-up window, and then click **[OK]**.

   The parameter group name cannot be longer than 32 characters.

3. After the change, the new name will be displayed in the drop-down menu of the Parameter Group section.

The **default** parameter group cannot be renamed.

Export parameter groups

You can export all the parameter groups saved in the current laser profiler to a **JSON** file. Follow these steps to export parameter groups:

1. In the Parameter Group section, click **[Export]**, select the file path, and then click **[Save]**.
2. If the parameter groups are successfully exported, the **Successfully exported parameter groups** window will pop-up. Click **[OK]** in the window to close this window.

Import Parameter Groups

You can import parameter groups from a **JSON** file to replace all the parameter groups saved in the current laser profiler. Follow these steps to import parameter groups:

1. In the Parameter Group section, click **[Import]**, find the **JSON** file that stores all the parameter group information, and click **[Open]**.
2. If the parameter groups are successfully imported, the **Successfully imported parameter groups** window will pop-up. Click **[OK]** in the window to close this window.

Reset Parameter Group

To reset the parameter values saved in a parameter group to default values, follow these steps:

1. Click the drop-down menu in the Parameter Group section, and select the parameter group to be reset.
2. Click **[Reset]**, and then click **[Yes]** in the pop-up window to reset the parameter values to those stored in the **default** parameter group.

Change Visibility

The visibility of parameters in Mech-Eye Viewer includes three levels: **Beginner**, **Expert**, and **Guru**. Select from the drop-down menu of **Visibility** to change the visibility.

- The **Beginner** level includes the most frequently used basic parameters.
- The **Expert** level includes all parameters in the **Beginner** level and provides more parameters.
- The **Guru** level includes all parameters in the **Expert** level and provides more parameters.

Usually, adjusting parameters in the **Beginner** level is enough to meet your needs. If the data

quality is still not satisfactory, you can adjust the parameters in the **Expert** level. In rare cases, the parameters in the **Guru** level need to be adjusted to meet special needs.

The **Guru** level is available in the **Administrator** account. If needed, please contact Technical Support.

Check Parameter Description

After you select a parameter in the parameter list, the bottom of the **Parameters** tab displays more information about this parameter, include parameter explanation, API parameter name, value range, default value, visibility and data type. When you adjust parameters, you can use the information here as a reference.

- If the Parameter Description section blocks the parameter list, click **[×]** at the upper right of this section to close it.
- To display the Parameter Description section again, check the **Parameter Description** option in the **View** menu.

5.2.3.1. Profile Mode

This topic introduces how to adjust the parameters in the profile mode, in order to obtain the satisfactory profile.

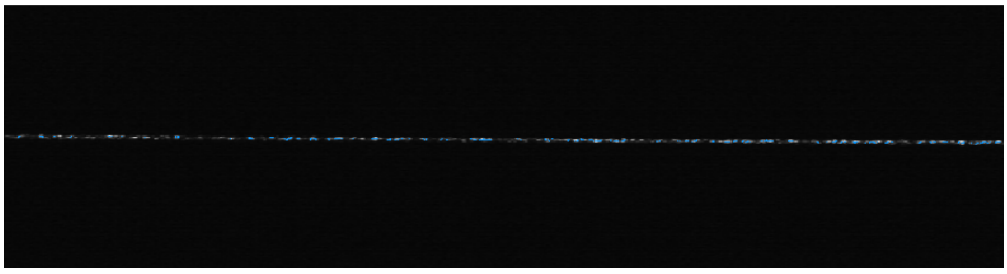
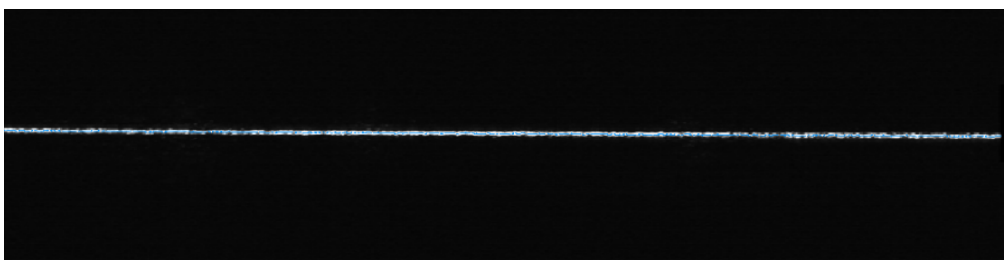
Before reading this topic, please read Adjust Parameters first.

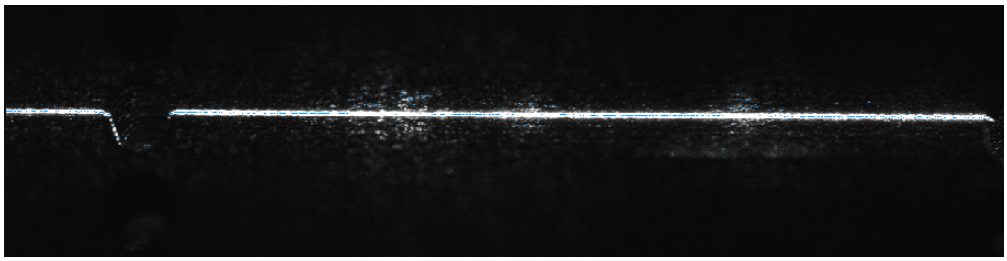
Determine Data Quality

Determine the data quality based on the following criteria. If the data quality is not good, adjust the parameters according to the next section.

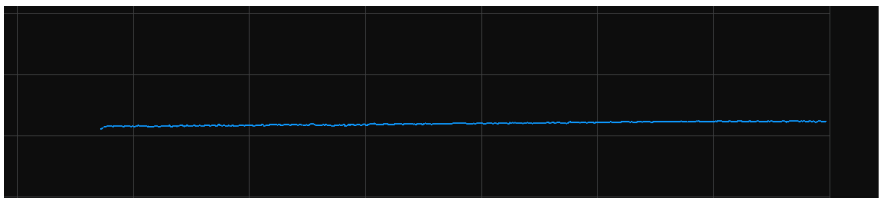
- Raw image: The grayscale values of the pixels at the center of the laser lines should be between 200 and 255.

In the lower-right corner of the raw image, you can check the grayscale value of the pixel where the cursor is located. If not displayed, please check the **Image Information Box** option in the **View** menu.

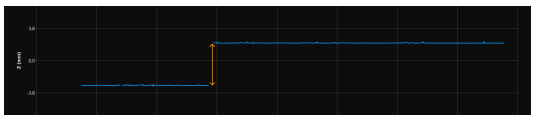
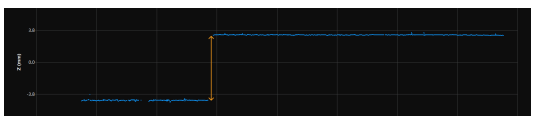
Too dark	
Good	

Too bright	

- Profile:
  - The profile should be mostly complete without gaps.

Complete profile	
Incomplete profile	

  - The tilt of the profile and the height difference between two locations in the profile should match those of the actual object.

Satisfactory profile	
Tilt of the profile not matching that of the actual object	
Height difference of two locations in the profile not matching that of the actual object	

Adjust Parameters in Profile Mode

Please follow the procedure below to adjust the parameters in the profile mode. After adjusting parameters, acquire data again to check if the data quality changes.

1. (Optional) If the tilt of the profile or the height difference between two locations in the profile does not match those of the actual object, perform tilt correction or height correction.
2. Based on the characteristics of the target object, select Exposure mode.
3. Adjust the brightness of the laser lines:

If laser lines too dark	1. Increase Exposure Time. 2. Increase Analog Gain. 3. Increase Digital Gain or Laser Power.
If laser lines too bright	1. Decrease Exposure Time. 2. Decrease Analog Gain. 3. Decrease Digital Gain or Laser Power.

4. Set a Z-direction ROI to reduce the amount of data to be processed and enhance the max scan rate.
5. (Optional) if unneeded data, such as noise and laser lines produced by interreflection, is present at fixed locations, set masks to exclude such data.
6. Adjust the parameters that affect profile extraction result:
   a. Adjust Min Grayscale Value to exclude the pixels that are too dark in the raw image.
   b. Adjust Min Spot Intensity and Max Spot Intensity to exclude the spots whose intensities do not meet the requirements.
   c. Adjust Min Laser Line Width and Max Laser Line Width to exclude the pixel columns whose laser line widths do not meet the requirements.
   d. If multiple laser lines are present, adjust Spot Selection according to the actual situation.
7. Adjust the parameters that affect profile processing:
   a. Use Filter to reduce noise or smooth the profile.
   b. Use Gap Filling to fill the gaps in the profile.

- When adjusting the parameters, you can refer to the parameter description at the bottom of the **Parameters** tab.
- For detailed descriptions of the parameters, please refer to Parameters in the Profile Mode.

5.2.3.2. Scan Mode

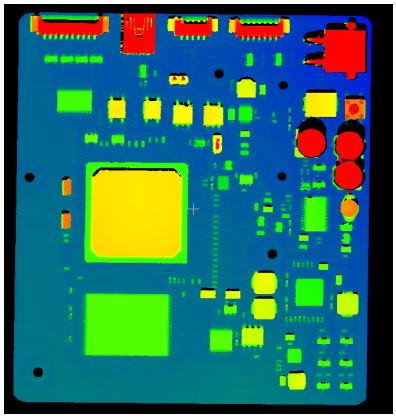
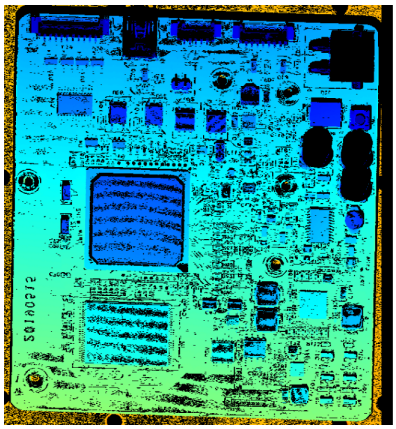
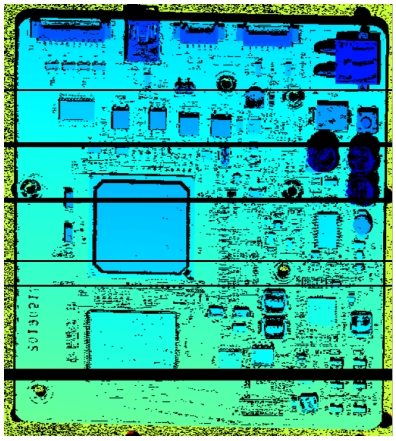
This topic introduces how to adjust the parameters in the scan mode, in order to obtain the satisfactory intensity image, depth map, and point cloud.

Before reading this topic, please read Adjust Parameters first.

Determine Data Quality

Determine the data quality based on the following criteria. If the data quality is not good, adjust the parameters according to the next section.

Intensity image, depth map and point cloud: the needed data is complete. The following table uses point clouds as examples.

Data is complete	Data is incomplete	
		

Adjust Parameters in Scan Mode

Please follow the procedure below to adjust the parameters in the scan mode. After adjusting parameters, acquire data again to check if the data quality changes.

For the methods of triggering the laser profiler to acquire data in the scan mode, please refer to Methods for Triggering Data Acquisition and Workflow of Triggering Data Acquisition.

1. Adjust the rate at which scanning is triggered:

Scanning triggered by encoder	Adjust Trigger Signal Counting Mode and Trigger Interval.
Scanning triggered at fixed-rate	Adjust Trigger Rate.

2. Set the parameters in the **Scan Settings** category.
   - Set the height of the intensity image/depth map through Scan Line Count.
   - Set the Timeout Period for data reception.
3. (Optional) Adjust the aspect ratio of the point cloud through Point Cloud Resolutions.

- When adjusting the parameters, you can refer to the parameter description at the bottom of the **Parameters** tab.
- For detailed descriptions of the parameters, please refer to Parameters in the Scan Mode.

5.2.4. Save Data

Through this function, you can save the acquired intensity image, depth map, and point cloud to local.

The raw image and profile in the profile mode cannot be saved.

Instructions

Please follow these steps to save data:

1. Click in the data acquisition area to open the **Save Data** window.
2. Select the data types to be saved under **Data type**. For detailed descriptions, please refer to Data Types and Formats.

3. (Optional) change **File index**: If the selected **Save to** path already contains data saved through Mech-Eye Viewer, you can change the file index to avoid files with the same names being replaced.

   If you need to replace the files with the same names, check the **Replace file with the same name** option.

4. Click **[...]** to the right of **Save to** to select the folder for saving the data.
5. Click **[Save]**, and the **Data saved successfully** window will pop up. Click **[Show in folder]** in this window to open the folder where the data is saved and check the data.

Data Types and Formats

When saving the data, you can select the file format to be saved, as well as the data structure and color of the point cloud.

- Intensity image: can be saved in the **PNG** (.png) or **JPEG** (.jpg) format.
- Depth map: can be saved in the **PNG** (.png) or **TIFF** (.tiff) format.
- Point cloud: can select the file format, data structure,and color to be saved.

Format	• **PLY** (.ply) • **PCD** (.pcd) • **CSV** (.csv)
Data structure	• Organized: The point cloud resembles a two-dimensional matrix, which corresponds to the actual spacial relationship between points. • Unorganized: The point cloud resembles a one-dimensional list.
Color	• Jet • Grayscale • Jet + intensity • Untextured • Textured

5.2.5. Manage Log

If you encounter a problem when using the laser profiler, you can view the log or export the log and send it to Technical Support to facilitate the troubleshooting process.

View Log

Please follow these steps to view the log:

1. Click **[Show Log]** in the data acquisition area to open the log saved in the laser profiler.
2. Click **[Show Log Entries]** in the lower right to display the full log list.
3. Select a log entry in **Log Entries** to view its content on the left.

The title of the log entry represents the time when it was generated. For example, the log entry titled **20221117171503_887** was generated on November 17, 2022 at 17:15:03.

Export Log

If you encounter a problem when using the laser profiler, follow these steps to export the log.

1. Click **[Show Log]** in the data acquisition area to open the log saved in the laser profiler.
2. Click **[Show Log Entries]** in the lower right to display the full log list.
3. Select the log entry to be exported, click **[Export]**, select the folder for saving the log in the pop-up window, and then click **[Select Folder]**.
4. If you need to export multiple log entries, repeat step 3.

Log Levels

Logs are categorized into four levels:

- i: INFO, descriptive information of execution processes.
- W: WARNING, warning messages of potential issues.
- C: CRITICAL, errors that may not stop the device from operating.
- F: FATAL, errors that severely affects the operation of the device.

Other Actions

You can also perform the following actions in the log window:

- Auto Refresh: automatically refresh the log when enabled.
- Clear: clear the log content displayed in the software.
- Clear Server Logs: delete the log saved in the laser profiler. This action clears the log content displayed in the software at the same time.

5.3. Parameter Reference Guide

This topic provides detailed descriptions of each parameter.

Descriptions of **the parameters in the profile mode**:

Profile Mode

Descriptions of **the parameters in the scan mode**:

Scan Mode

5.3.1. Profile Mode

This topic provides descriptions of the parameters in the profile mode.

Brightness Settings

Parameters in this category affect the brightness of the laser lines in the raw image, thus affecting the quality of the profile, intensity image, and depth map.

- The grayscale values of the pixels at the center of the laser lines should be between 200 and 255.
- The recommended order of adjusting parameters is: **Exposure Time** > **Analog Gain** > **Digital Gain** or **Laser Power**

Exposure Mode

Description	Select the exposure mode for acquiring the raw image based on the color and texture of the target object.
Visibility	Beginner, Expert, Guru
Values	• Timed (default): suitable for target objects of a single texture or color. • HDR: suitable for target objects with various textures or colors.
Instruction	After selecting different options, different parameters are displayed in the **Brightness Settings** category for adjustment: • Timed: displays Exposure Time. • HDR: displays HDR Exposure Settings.

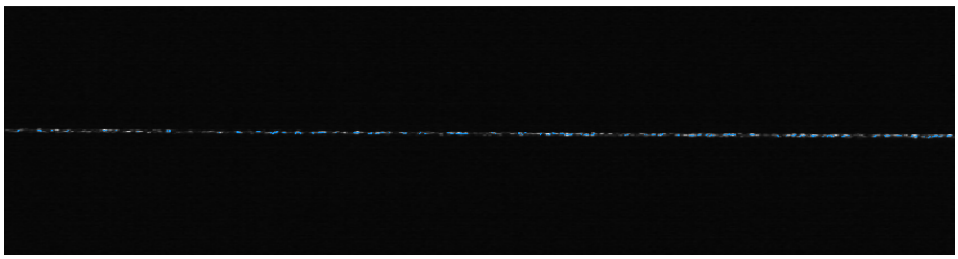
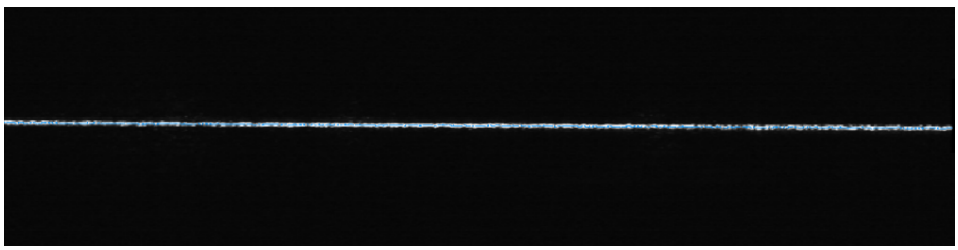
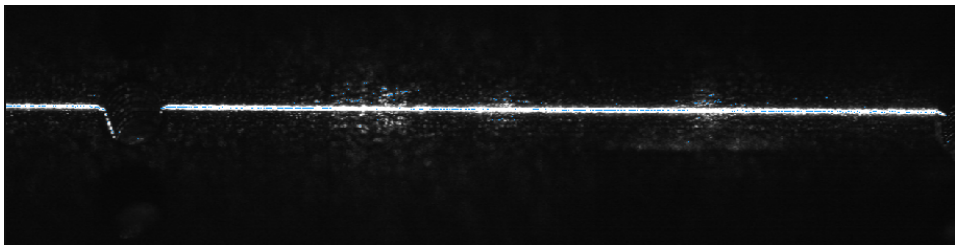
Exposure Time

Description	Set the exposure time for acquiring the raw image. Exposure time affects the brightness and width of the laser lines in the raw image, as well as the max scan rate of the laser profiler. Longer exposure time results in brighter and wider laser lines and lower max scan rate. Shorter exposure time results in darker and narrower laser lines and higher max scan rate.
Visibility	Beginner, Expert, Guru
Values	• Value range: 4 to 5200 µs • Increment: 2 µs • Default value: 30 µs

Instruction	• Shorter exposure time is suitable for objects that are reflective or light-colored; longer exposure time is suitable for objects that are unreflective or dark-colored. • The grayscale values of the pixels at the center of the laser lines should be between 200 and 255. In the lower-right corner of the raw image, you can check the grayscale value of the pixel where the cursor is located. If not displayed, please check the **Image Information Box** option in the **View** menu. • If the laser lines are too dark, increase **Exposure Time**; If the laser lines are too bright or wide, decrease **Exposure Time**. • To enhance the max scan rate, decrease **Exposure Time** and increase Analog Gain. • If **Exposure Time** has reached its maximum value, but the laser lines are still too dark, increase **Analog Gain**. • If **Exposure Time** has reached its minimum value, but the laser lines are still too bright, decrease Laser Power.

You can check the current max scan rate of the laser profiler in the upper right of the data display area.

Raw images obtained with different **Exposure Time** values (all other conditions identical):

Exposure time: 40 µs	
Exposure time: 200 µs	
Exposure time: 1500 µs	

HDR Exposure Settings

Description	Set the exposure time for acquiring the raw image. Exposure time affects the brightness and width of the laser lines in the raw image, as well as the max scan rate of the laser profiler. Longer exposure time results in brighter and wider laser lines and lower max scan rate. Shorter exposure time results in darker and narrower laser lines and higher max scan rate.
Visibility	Beginner, Expert, Guru

Values	• Range of value:
	  ◦ Total exposure time: 12 to 15600 µs
	  ◦ Exposure time 1/2/3: 4 to 5200 µs
	• Increment: 2 µs

Instruction	For detailed instructions, refer to Adjust HDR Exposure Settings below. • The grayscale values of the pixels at the center of the laser lines should be between 200 and 255. In the lower-right corner of the raw image, you can check the grayscale value of the pixel where the cursor is located. If not displayed, please check the **Image Information Box** option in the **View** menu. • If the laser lines are too dark, increase **Total exposure time**; If the laser lines are too bright or wide, decrease **Total exposure time**. • To enhance the max scan rate, decrease **Total exposure time** and increase Analog Gain. • If **Total exposure time** has reached its maximum value, but the laser lines are still too dark, increase **Analog Gain**. • If **Total exposure time** has reached its minimum value, but the laser lines are still too bright, decrease Laser Power.

You can check the current max scan rate of the laser profiler in the upper right of the data display area.

Adjust HDR Exposure Settings

In the HDR exposure mode, each exposure is divided into three phases to ensure that, in the raw image, laser lines reflected by regions of different textures or colors can all achieve appropriate brightness.

When using the HDR exposure mode, you need to adjust the total exposure time and the proportions of the three exposure phases. Among these, the total exposure time is determined by using the timed exposure mode.

Follow these steps to adjust the HDR exposure settings:

1. In the profile mode, find the region with the most complex textures or colors on the target object surface and acquire data.
2. Set **Exposure Mode** to **Timed** and adjust **Exposure Time**, until the brightness of the laser line reflected by the region least likely to overexpose on the target object meets the requirement. The value of **Exposure Time** when the brightness of this laser line meets the requirement is the value that should be set for **Total exposure time** in **HDR Exposure Settings**.

3. Set **Exposure Mode** to **HDR** and double-click **[Edit]** to the right of **HDR Exposure Settings** to open the **HDR Exposure Settings** window.
4. In **Total exposure time**, enter the exposure time determined in step 2.
5. Click **[Apply]** to close the current window. In the profile mode, acquire data again and check the brightness of the laser lines in the raw image.
   - If the brightness of the laser lines meets the requirement, the process is completed.
   - If the brightness of the laser line reflected by the region most likely to overexpose on the target object does not meet the requirement, proceed to step 6.
6. Set **Exposure Mode** to **Timed** and adjust **Exposure Time**, until the laser line reflected by the region most likely to overexpose on the target object is just visible in the raw image. The current value of **Exposure Time** is the value that should be set for **Exposure time 3** in **HDR Exposure Settings**.
7. Set **Exposure Mode** to **HDR** and double-click **[Edit]** to the right of **HDR Exposure Settings** to open the **HDR Exposure Settings** window.
8. Adjust **Expected proportions** until the value of **Exposure time 3** roughly matches the exposure time determined in step 6.

The exposure times of the three exposure phases should satisfy: **Exposure time 1** > **Exposure time 2** > **Exposure time 3**.

If after step 8, the above relationship is not satisfied, please adjust **Expected proportions** again.

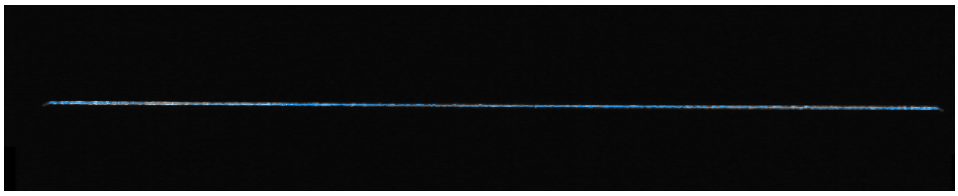
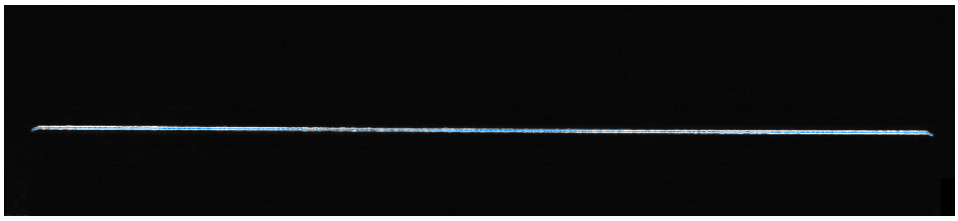
9. Click **[Apply]** to close the current window. In the profile mode, acquire data again and check the brightness of the laser lines in the raw image.
   - If the brightness of the laser lines meets the requirement, the process is completed.
   - If the laser lines still have overexposed parts, please try the following solutions:
     - Increase the proportion of **Exposure time 1** slightly or decrease the proportion of **Exposure time 3** slightly.
     - Decrease **First threshold** or **Second threshold** (available in the **Administrator** account).

Analog Gain

Description	Increasing this parameter can enhance the brightness of the raw image. However, noise will also be introduced.	
Visibility	Beginner, Expert, Guru	
Values	LNX-8030: • 1.0× (default) • 1.3× • 2.0× • 3.0×	LNX-8080 and LNX-8300: • 1.0× (default) • 1.3× • 1.9× • 2.8× • 5.5×

Instruction	• If the laser lines are dark, but a high max scan rate is needed, you can increase **Analog Gain** and decrease Exposure Time (Timed) / Total exposure time (HDR). • If **Exposure Time** / **Total exposure time** has reached its maximum value, but the laser lines are still too dark, you can increase **Analog Gain**. • If **Analog Gain** has reached its maximum value, but the laser lines are still too dark, increase Digital Gain or Laser Power. A large value of **Analog Gain** weakens the effect of HDR. • LNX-8030: The effect of HDR is weakened when the value of **Analog Gain** is equal to or exceeds 2.0×. • LNX-8080 and LNX-8300: The effect of HDR is weakened when the value of **Analog Gain** is equal to or exceeds 1.9×.

Raw images acquired with different **Analog Gain** values (all other conditions identical):

Analog Gain: 1.0	
Analog Gain: 2.8	

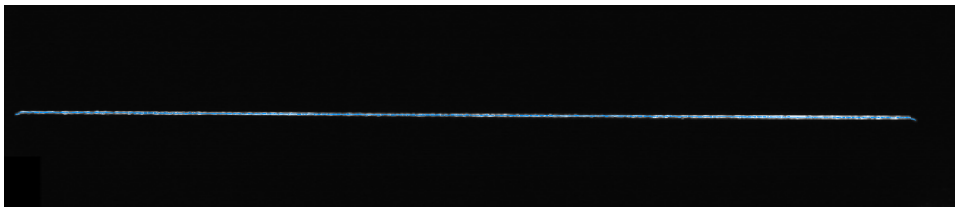
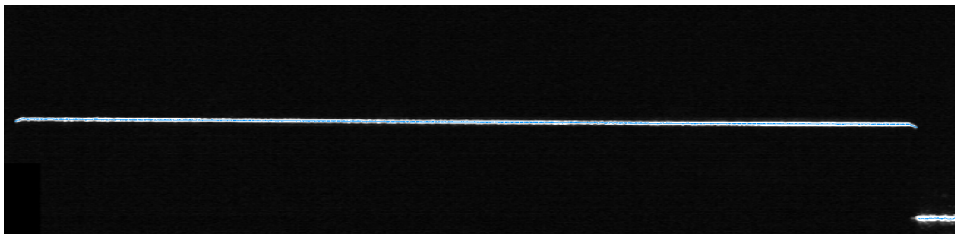
Digital Gain

Description	Increasing this parameter can enhance the brightness of the raw image. However, a relatively large amount of noise will also be introduced. Compared to **Analog Gain**, **Digital Gain** introduces more noise. **Digital Gain** should only be adjusted when **Analog Gain** has reached its maximum value, but the laser lines are still too dark.
Visibility	Expert, Guru
Values	• Value range: 0–10 • Default value: 0
Instruction	If **Analog Gain** has reached its maximum value, but the laser lines are still too dark, you can increase **Digital Gain**.

The value of **Digital Gain** affects the minimum value of Min Grayscale Value:

- Increasing **Digital Gain** increases the minimum value of **Min Grayscale Value** at the same time. If the previously set value of **Min Grayscale Value** is smaller than the updated minimum value, its set value will be changed to the minimum value automatically.
- Decreasing **Digital Gain** decreases the minimum value of **Min Grayscale Value** at the same time.

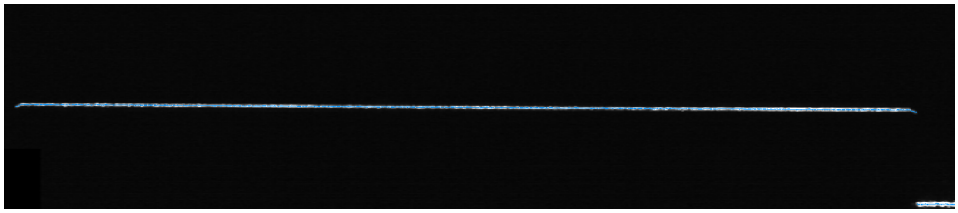
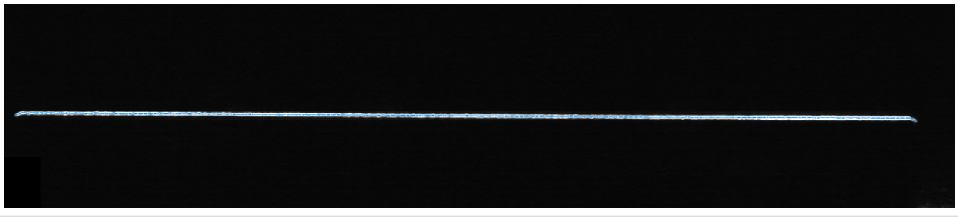
Raw images acquired with different **Digital Gain** values (all other conditions identical):

Digital Gain: 0	
Digital Gain: 5	

Laser Power

Description	Set the power of the emitted laser light, which affects the brightness of the laser lines in the raw image.
Visibility	Expert, Guru
Values	• Value range: 40 to 100 • Increment: 10 • Default value: ◦ LNX-8030: 60 ◦ LNX-8080: 80 ◦ LNX-8300: 95
Instruction	If the object is reflective or light-colored, you can decrease this parameter to reduce the brightness of the laser lines. If the object is unreflective or dark-colored, you can increase this parameter to enhance the brightness of the laser lines. Even at the same power level, the brightness of the laser light emitted by each device differs. Please adjust this parameter based on the actual condition of each device.

Raw images obtained with different **Laser Power** values (all other conditions identical):

Laser Power: 50	
Laser Power: 100	

ROI

Set ROI.

Z-Direction ROI

Description	A Z-direction ROI retains only the middle part of the raw image and trims the top and bottom parts off. Setting a Z-direction ROI can reduce the amount of data to be processed and enhance the max scan rate.
Visibility	Beginner, Expert, Guru
Values	The options are the ratio of the height of the trimmed image to the height of the untrimmed image. • 1 (default) • 1/2 • 1/4 • 1/8 • 1/16
Instruction	The Z-direction ROI reduces the height of the raw image without altering its width. Please adjust this parameter based on the region where the laser lines are, ensuring that the needed laser lines are not trimmed off.

Raw images obtained with different **Z-Direction ROI** values (all other conditions identical):

Z-Direction ROI: 1	Z-Direction ROI: 1/2	Z-Direction ROI:1/4
		

Profile Extraction

The parameters in this category affect the extraction of the profile.

The profile extraction process is as follows:

1. Valid pixels are selected based on the value of **Min Grayscale Value**. In each laser line, the spot of each pixel column is calculated.
2. In each pixel column, the spots that meet the requirements of **Min/Max Spot Intensity** and **Min/Max Laser Line Width** are retained.
3. From pixel columns that contain multiple spots, the final spot is selected based on the value of **Spot Selection**, and the profile is formed.

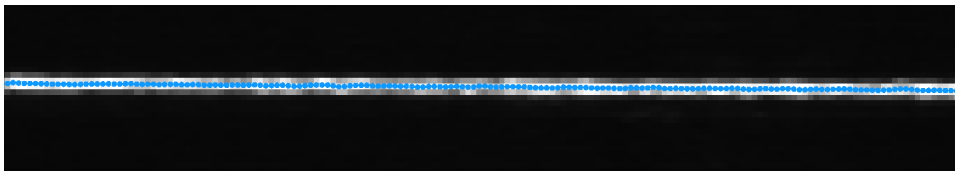
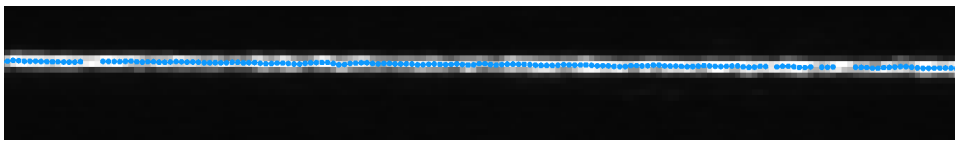
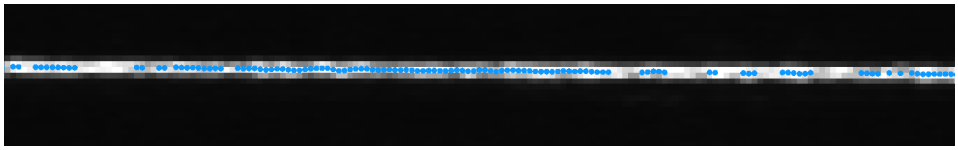
Min Grayscale Value

Description	Set the minimum grayscale value of the valid pixels in the raw image. Pixels with grayscale values smaller than this value will not participate in profile extraction. In the lower-right corner of the raw image, you can check the grayscale value of the pixel where the cursor is located. If not displayed, please check the **Image Information Box** option in the **View** menu.
Visibility	Beginner, Expert, Guru
Values	• Value range: (Variable) to 250 • Default value: 20
Instruction	• This parameter determines the number of valid pixels in each pixel column of each laser line and affects the spot intensity and laser line width.

The influence between **Min Grayscale Value** and other parameters are as follows.

- The minimum value of Min Grayscale Value is affected by the value of **Digital Gain**:
  - Increasing **Digital Gain** increases the minimum value of **Min Grayscale Value** at the same time. If the previously set value of **Min Grayscale Value** is smaller than the updated minimum value, its set value will be changed to the minimum value automatically.
  - Decreasing **Digital Gain** decreases the minimum value of **Min Grayscale Value** at the same time.
- The value of **Min Grayscale Value** determines the minimum value of Min Spot Intensity: minimum value of **Min Spot Intensity** = **Min Grayscale Value** + 1
  - Increasing **Min Grayscale Value** increases the minimum value of **Min Spot Intensity** at the same time. If the previously set value of **Min Spot Intensity** is smaller than the updated minimum value, its set value will be changed to the minimum value automatically.
  - Decreasing **Min Grayscale Value** decreases the minimum value of **Min Spot Intensity** at the same time.

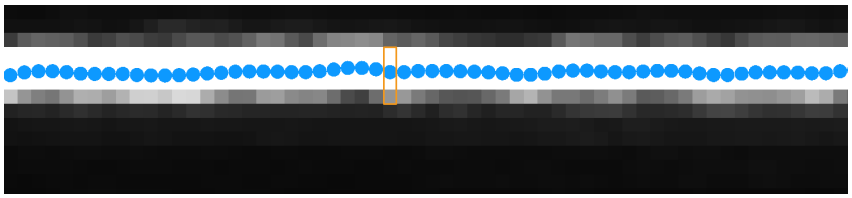
Profile extraction results with different **Min Grayscale Value** values (all other conditions identical):

Min Grayscale Value: 20	
Min Grayscale Value: 50	
Min Grayscale Value: 70	

Min Spot Intensity

A spot is calculated from each pixel column of each laser line. The intensity of a spot is the average grayscale value of all the valid pixels in the pixel column of the laser line.

In the figure below, this column of this laser line has 4 valid pixels, so the intensity of the spot in this column is the average of the grayscale values of these 4 valid pixels.



Description	Set the minimum intensity for the spots. Spots with intensity values smaller than this value will be excluded.
Visibility	Beginner, Expert, Guru
Values	• Value range: (Min Grayscale Value + 1) to 254 • Default value: 21
Instruction	The spots of laser lines produced by stray light or interreflection usually have low intensities. Setting an appropriate minimum intensity can remove these spots.

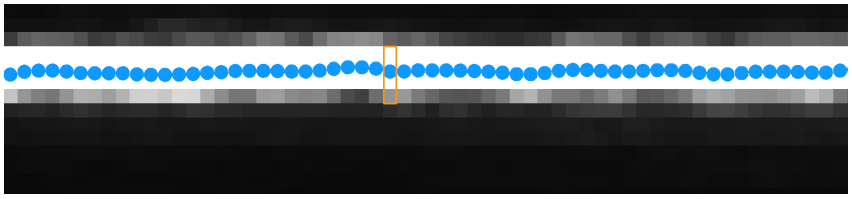
The influence between **Min Spot Intensity** and other parameters are as follows.

- The value of Min Grayscale Value determines the minimum value of **Min Spot Intensity**: minimum value of **Min Spot Intensity** = **Min Grayscale Value** + 1
  - Increasing **Min Grayscale Value** increases the minimum value of **Min Spot Intensity** at the same time. If the previously set value of **Min Spot Intensity** is smaller than the updated minimum value, its set value will be changed to the minimum value automatically.
  - Decreasing **Min Grayscale Value** decreases the minimum value of **Min Spot Intensity** at the same time.
- The value of **Min Spot Intensity** determines the minimum value of Max Spot Intensity: minimum value of **Max Spot Intensity** = **Min Spot Intensity** + 1
  - Increasing **Min Spot Intensity** increases the minimum value of **Max Spot Intensity** at the same time. If the previously set value of **Max Spot Intensity** is smaller than the updated minimum value, its set value will be changed to the minimum value automatically.
  - Decreasing **Min Spot Intensity** decreases the minimum value of **Max Spot Intensity** at the same time.

Max Spot Intensity

A spot is calculated from each pixel column of each laser line. The intensity of a spot is the average grayscale value of all the valid pixels in the pixel column of the laser line.

In the figure below, this column of this laser line has 4 valid pixels, so the intensity of the spot in this column is the average of the grayscale values of these 4 valid pixels.



Description	Set the maximum intensity for the spots. Spots with intensity values greater than this value will be excluded.
Visibility	Beginner, Expert, Guru
Values	• Value range: (Min Spot Intensity + 1) to 255 • Default value: 255
Instruction	Setting an appropriate maximum intensity can remove abnormally bright spots produced by specular reflection.

The value of Min Spot Intensity determines the minimum value of **Max Spot Intensity**:

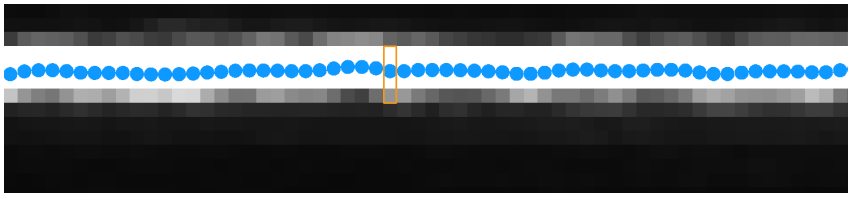
Minimum value of **Max Spot Intensity** = **Min Spot Intensity** + 1

- Increasing **Min Spot Intensity** increases the minimum value of **Max Spot Intensity** at the same time. If the previously set value of **Max Spot Intensity** is smaller than the updated minimum value, its set value will be changed to the minimum value automatically.
- Decreasing **Min Spot Intensity** decreases the minimum value of **Max Spot Intensity** at the same time.

Min Laser Line Width

Laser line width is a property of each pixel column in a laser line. It is equal to the number of valid pixels in such a pixel column.

In the figure below, this column of this laser line has 4 valid pixels, so the laser line width of this pixel column is 4.

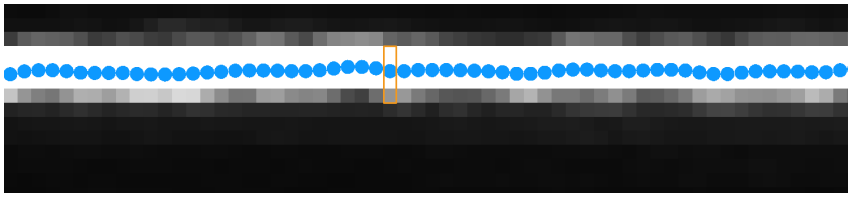


Description	Set the minimum width for the laser lines. If the width of a pixel column in a laser line is smaller than this value, the spot of this pixel column in this laser line is excluded.
Visibility	Beginner, Expert, Guru
Values	• Value range: 0 to (Max Laser Line Width -1) • Default value: 2
Instruction	Setting appropriate minimum and maximum widths can exclude the laser lines produced by stray light or interreflection, which are usually too wide or too narrow.

Max Laser Line Width

Laser line width is a property of each pixel column in a laser line. It is equal to the number of valid pixels in such a pixel column.

In the figure below, this column of this laser line has 4 valid pixels, so the laser line width of this pixel column is 4.



Description	Set the maximum width for the laser lines. If the width of a pixel column in a laser line is greater than this value, the spot of this pixel column in this laser line is excluded.
Visibility	Beginner, Expert, Guru
Values	• Value range: (Min Laser Line Width +1) to 64 • Default value: 30
Instruction	Setting appropriate minimum and maximum widths can exclude the laser lines produced by stray light or interreflection, which are usually too wide or too narrow.

Spot Selection

Description	If a pixel column contains multiple spots, the final spot is selected according to the value of this parameter.
Visibility	Beginner, Expert, Guru
Values	• Strongest (default): selects the spot with the highest intensity as the final spot. • Nearest: selects the spot with the smallest Z value as the final spot. • Farthest: selects the spot with the greatest Z value as the final spot. • Invalid: regards the pixel column as invalid and discards the spots. The profile therefore has a gap. Usually used for complex situations where selection is difficult to make.
Instruction	Adjust based on the actual needs.

Profile Processing

The parameters in this category process the extracted profile, improving the quality of the profile.

Filter

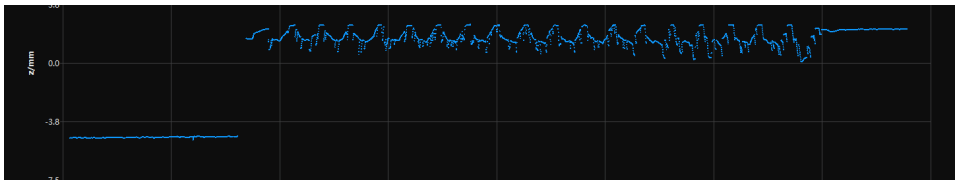
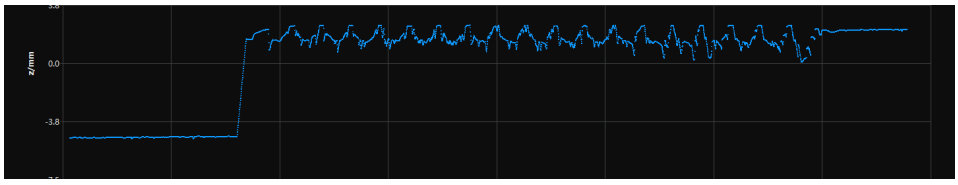
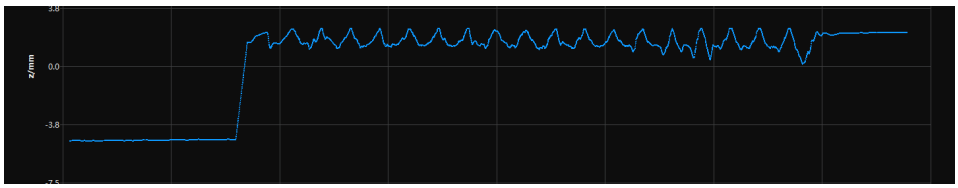
Description	Set the type of filters. Filtering the profile can reduce noise and smooth the profile.
Visibility	Beginner, Expert, Guru

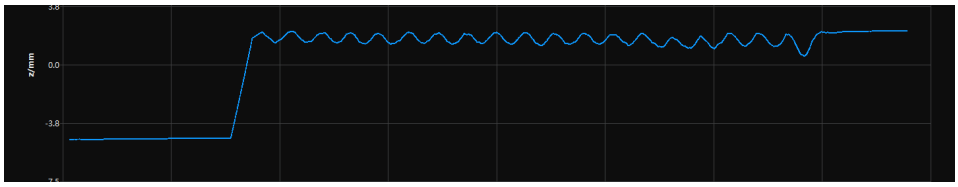
Values	• None (default): does not perform filtering. Select this option when the profile does not contain noticeable noise. • Mean: performs mean filtering, which can smooth the profile. When selecting this option, set Mean Filter Window Size. • Median: performs median filtering, suitable for reducing noise with depth values significantly different from surrounding points. When selecting this option, set Median Filter Window Size. 
Instruction	Adjust based on the actual needs.

Mean Filter Window Size

Description	Set the window size of the mean filter. This parameter should be set when Filter is set to **Mean**.
Visibility	Beginner, Expert, Guru
Values	• 2 (default) • 4 • 8 • 16 • 32
Instruction	Larger window size results in higher intensity of smoothing but may also distort object features.

Profile extraction results with different **Mean Filter Window Size** values (all other conditions identical):

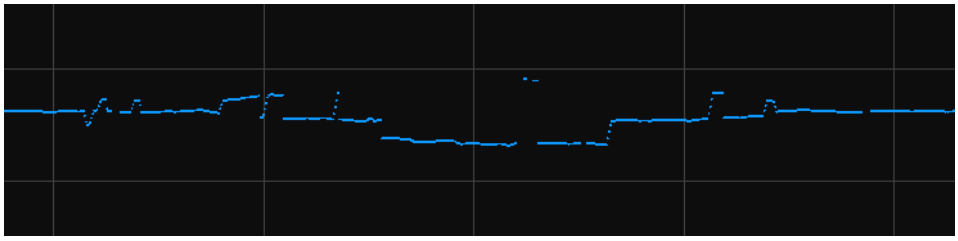
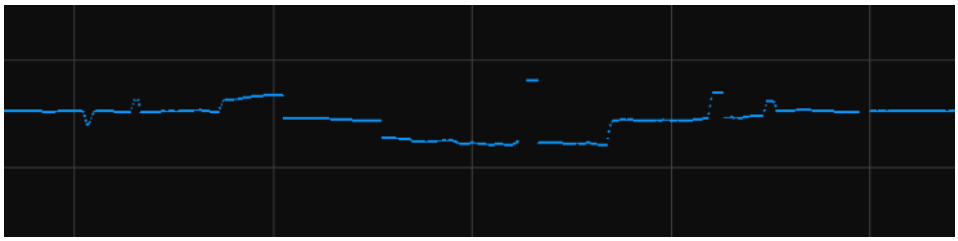
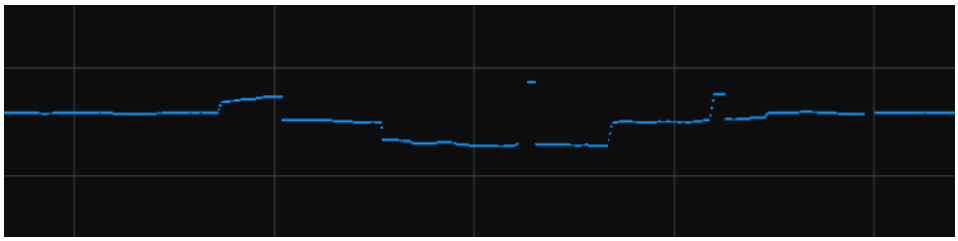
No filter used	
Mean Filter Window Size: 2	
Mean Filter Window Size: 8	

Mean Filter Window Size: 32	

Median Filter Window Size

Description	Set the window size of the median filter. This parameter should be set when Filter is set to **Median**.
Visibility	Beginner, Expert, Guru
Values	• 3 (default) • 5 • 7 • 9
Instruction	Larger window size removes more noise.

Profile extraction results with different **Median Filter Window Size** values (all other conditions identical):

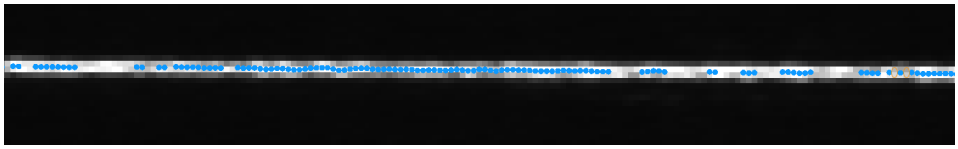
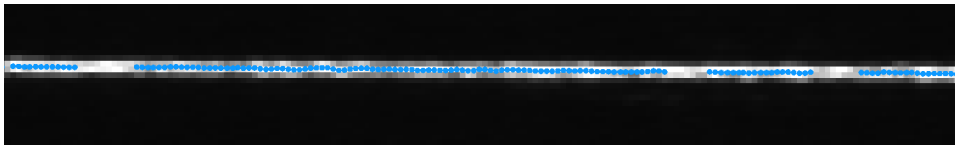
No filter used	
Median Filter Window Size: 5	
Median Filter Window Size: 9	

Gap Filling

Description	Set the size of the gaps that can be filled in the profile. When the number of consecutive data points in a gap in the profile is no greater than this value, this gap will be filled. The data used for filling is calculated based on the difference between the two neighboring points (that is, based on linear interpolation).

Visibility	Beginner, Expert, Guru
Values	• Value range: 0 to 16 • Default value: 0
Instruction	Adjust based on the size of the gaps to be filled. **Gap Filling** may distort features with abrupt depth variations, such as object edges. You can adjust Gap Filling Edge Preservation to reduce the influence on these features.

Raw images obtained with different **Gap Filling** values (all other conditions identical):

Gap Filling: 0	
Gap Filling: 5	

Gap Filling Edge Preservation

Description	Set the degree of preservation of object edges when filling gaps.
Visibility	Beginner, Expert, Guru
Values	• Value range: 1 to 5 • Default value: 3
Instruction	If you need to preserve features with abrupt depth variations, such as object edges, you can increase this parameter, but the amount of gaps being filled will decrease.

Mask

Description	Use masks to exclude unneeded data, such as noise and laser lines produced by interreflection.
Visibility	Beginner, Expert, Guru
Values	**Enable Mask**: • True: Apply the added masks. • False: Do not apply the added masks.
Instruction	Double-click **[Edit]** to open the **Mask Tool** window. For detailed instructions, refer to Use Mask Tool below.

Use Mask Tool

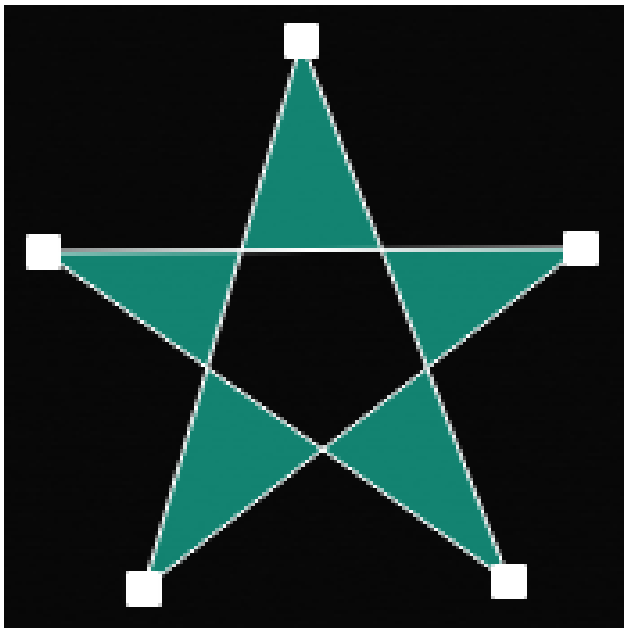
Through the mask tool, you can add, edit, and delete masks.

Add Masks

Follow these steps to add masks:

1. Select the appropriate tool in the toolbar on the left:
   - : used to add a rectangle mask.
   - : used to add a polygon mask.
2. Determine the location of the unneeded data in the raw image and draw a mask:
   - Rectangle mask: Hold and drag.
   - Polygon mask: Click to add a vertex of the polygon mask. After all needed vertices are added, press the `Enter` key or right-click to finish drawing the polygon mask.

In a polygon mask, the overlapped regions are not effective:



- Click **[Acquire again]** at the top to acquire the raw image after the masks are added to check the effect of the masks.
- If the position, shape, or size of the masks are not satisfactory, you can edit the masks or delete the masks.

3. After all masks are added, click **[Apply]** to close the current window.

After **[Apply]** is clicked, the value of the **Enable Mask** parameter is automatically changed to **True**. If you do not need to apply the masks, change the value of this parameter to **False**.

Edit Masks

If the position, shape, or size of the masks are not satisfactory, follow these steps to edit the masks:

1. Click in the toolbar on the left.
2. Select the mask that needs to be edited and conduct the needed adjustment:
   - Move a mask: Select the mask and drag.

- Adjust the size of a rectangle mask: Select a vertex of the rectangle mask and drag.
- Adjust the shape of a polygon mask:
  - Move an existing vertex: Select a vertex of the polygon mask and drag.
  - Add a new vertex: Left-click on an edge of the polygon mask.
  - Delete an existing vertex: Select a vertex of the polygon mask and right-click.

Click **[Acquire again]** at the top to acquire the raw image after the masks are edited to check the effect of the masks.

3. After all editing is completed, click **[Apply]** to close the current window.

After **[Apply]** is clicked, the value of the **Enable Mask** parameter is automatically changed to **True**. If you do not need to apply the masks, change the value of this parameter to **False**.

Delete Masks

Follow these steps to delete unsatisfactory masks:

1. In the right panel, select the mask that needs to be deleted in **Mask list**, and click  .

If you need to delete all the masks, click **[Clear]** to the right of **Mask list**.

2. In the pop-up window, click **[Confirm]** to delete the mask.

Click **[Acquire again]** at the top to acquire the raw image after the mask is deleted to check the effect of the remaining masks.

3. After all deletion is completed, click **[Apply]** to close the current window.

After **[Apply]** is clicked, the value of the **Enable Mask** parameter is automatically changed to **True**. If you do not need to apply the masks, change the value of this parameter to **False**.

Correction

The parameters in this category are used to correct the tilt of and height error in the profile.

Tilt Correction

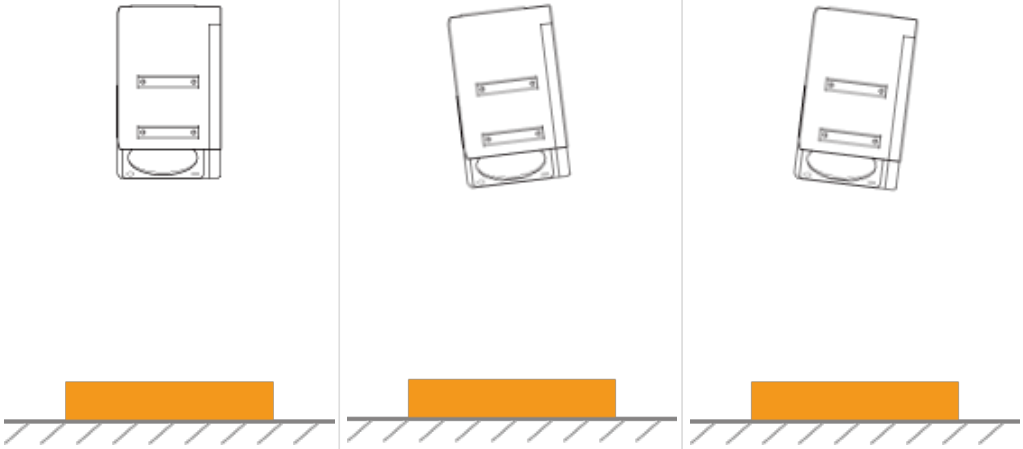
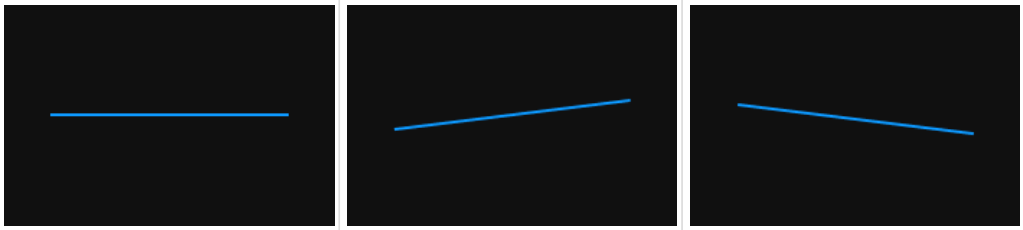
Description	Correct the tilt of the profile, which is caused by the rotation of the laser profiler around the Y-axis.
Visibility	Beginner, Expert, Guru
Values	**Enable Tilt Correction**: • True: Apply the tilt correction result to the profile. • False: Do not apply the tilt correction result to the profile. **Tilt Correction Angle**: • Range: –90° to 90° • Default value: 0°

Instruction	For detailed instructions, refer to Perform Tilt Correction below.

Perform Tilt Correction

This tool is used to correct the tilt of the profile, which is caused by the rotation of the laser profiler around the Y-axis.

As shown below, the rotation of the laser profiler around the Y-axis make the tilt of the acquired profile differ from the tilt of the actual object.

	Not rotated	Rotated around the Y-axis	
Laser profiler			
Acquired profile			

Prerequisites

In order to perform tilt correction, the following prerequisites must be satisfied:

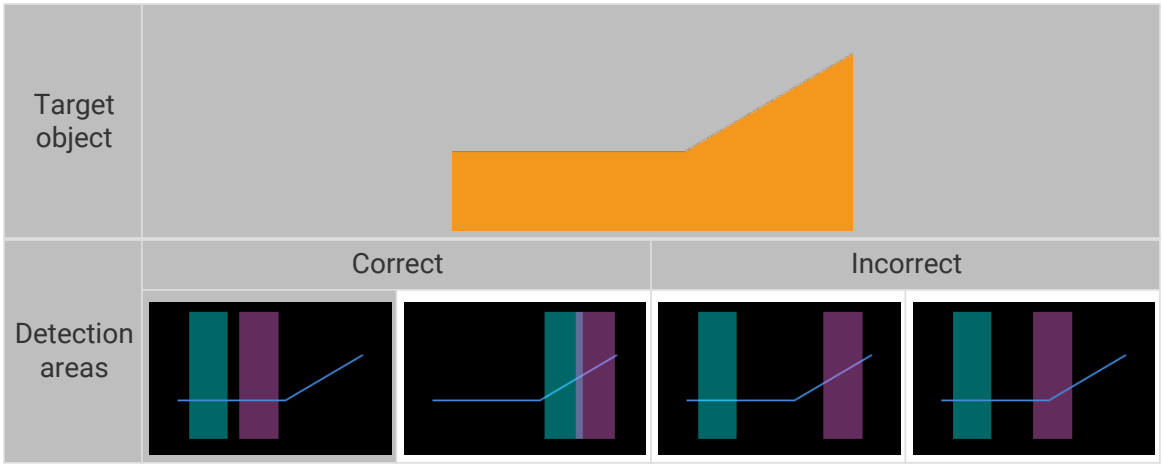
- It is recommended to use a target object whose surface includes flat regions.
- A relatively complete profile of the flat regions can be acquired. If the profile is incomplete, please refer to Profile Mode and adjust the other parameters first.
- Keep the target object still relative to the laser profiler, and acquire the profile of the flat regions on the target object.

Instructions

Follow these steps to perform tilt correction:

1. Double-click **[Edit]** to the right of **Tilt Correction** to open the **Tilt Correction** window.
2. Select the detection areas and drag to adjust their positions. Make sure to satisfy the following criterion while adjusting:

   The profile selected by the two detection areas should correspond to two locations on the same flat region of the target object. Please refer to the following example:



The detection areas can overlap.

3. Select the detection areas and drag the handles on them to adjust their widths. Refer to the following criterion while adjusting:

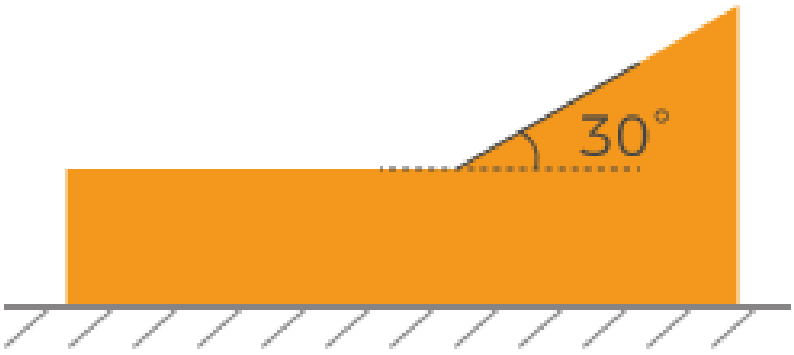
   With the above criterion satisfied, the detection area can be as wide as possible to include more data for tilt correction.

4. In **Expected tilt angle** under **Tilt angles**, enter the angle that the profile in the detection areas should reach after the correction.

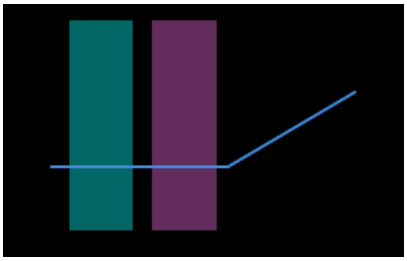
   Positive values rotate the profile counterclockwise; negative values rotate the profile clockwise. The range of possible values is -45° to 45°.

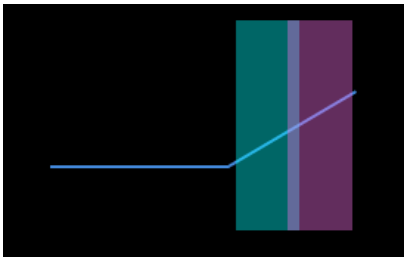
   ▼ Example of expected tilt angle

   A target object as shown below is placed on a horizontal surface:

   The value that should be entered for **Expected tilt angle** depends on the positions of the detection areas:

Detection areas	Expected tilt angle
	0°

Detection areas	Expected tilt angle
	30°

5. Click **[Correct]**. The green line in the image area on the left represents the profile that has been rotated to **Expected tilt angle** after tilt correction. Check if this profile satisfies your requirements:
   - If yes, click **[Apply]** to apply the tilt correction result and close the window.
   - If no, repeat steps 2 to 5.
6. Acquire data again in the profile mode and switch to **Profile** to check the effect of correction.

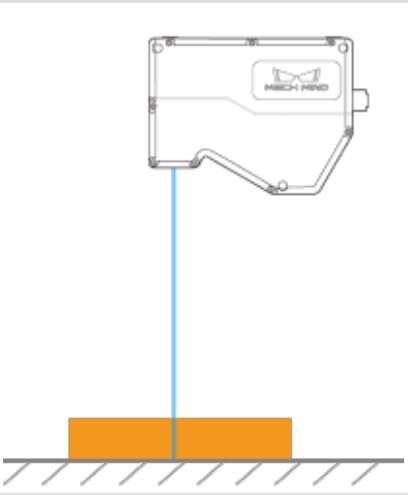
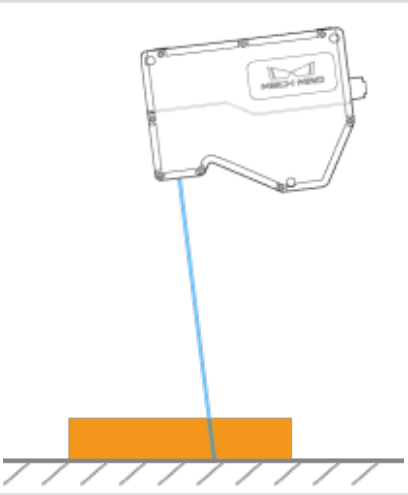
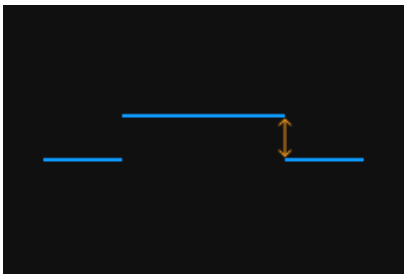
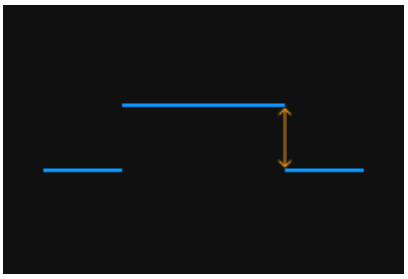
Height Correction

Description	Correct the height error in the profile, which is caused by the rotation of the laser profiler around the X-axis.
Visibility	Beginner, Expert, Guru
Values	**Enable Height Correction**: • True: Apply the height correction result to the profile. • False: Do not apply the height correction result to the profile. **Height Correction Ratio**: • Value range: 0.1 to 8.0 • Default value: 1
Instruction	For detailed instructions, refer to Perform Height Correction below.

Perform Height Correction

This tool is used to correct the height error in the profile, which is caused by the rotation of the laser profiler around the X-axis.

As shown below, the rotation of the laser profiler around the X-axis make the height difference between two locations in the acquired profile differ from the actual difference.

	Not rotated	Rotated around the X-axis
Laser profiler		
Acquired profile		

Prerequisites

In order to perform height correction, the following prerequisites must be satisfied:

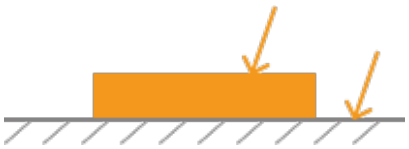
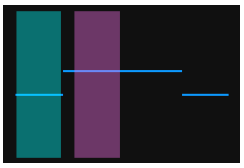
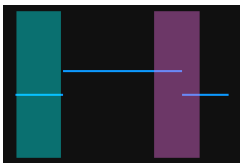
- It is recommended to use a target object with known dimensions and flat surfaces, such as a gauge block, and place the target object on a horizontal surface.
- A relatively complete profile of the target object can be acquired. If the profile is incomplete, please refer to Profile Mode and adjust the other parameters first.
- Keep the target object still relative to the laser profiler.
- Select two surfaces (such as the top surface of the gauge block and the horizontal surface on which the gauge block is placed) for calculating the height difference, and determine the actual height difference of the two surfaces.

Instructions

Follow these steps to perform height correction:

1. Double-click **[Edit]** to the right of **Height Correction** to open the **Height Correction** window.
2. Select the detection areas and drag to adjust their positions. Make sure to satisfy the following criterion while adjusting:

   The profile segments selected by the two detection areas should correspond respectively two the two surfaces used for calculating the height difference.

Two surfaces used for calculating the height difference		
Detection areas	Correct	Incorrect
		 

3. Select the detection areas and drag the handles on them to adjust their widths. Refer to the following criterion while adjusting:

   With the above criterion satisfied, the detection areas can be as wide as possible to include more data for height correction.

4. In **Actual height difference** under **Height differences**, enter the actual height difference between the two surfaces.

   The minimum value of **Actual height difference** is 0.01 mm, and the maximum value is the Z-axis measurement range of the laser profiler.

5. Click **[Correct]**. The green line in the image area on the left represents the profile after height correction. Check if this profile satisfies your requirements:
   - If yes, click **[Apply]** to apply the height correction result and close the window.
   - If no, repeat steps 2 to 5.
6. Acquire data again in the profile mode and switch to **Profile** to check the effect of correction.

5.3.2. Scan Mode

This topic provides descriptions of the parameters in the scan mode.

Trigger Settings

Select the trigger sources and set relevant parameters.

For the methods of triggering the laser profiler to acquire data in the scan mode, please refer to Methods for Triggering Data Acquisition and Workflow of Triggering Data Acquisition.

Data Acquisition Trigger Source

Description	Select the source of the signals that trigger data acquisition. In one round of data acquisition, multiple lines are scanned, multiple profiles are generated, and one intensity image and one depth map are generated using the profile data.
Visibility	Beginner, Expert, Guru
Values	• External • Software (default)

Instruction	If you use externally input signals to trigger data acquisition, select **External**. Otherwise, select **Software**. • Please set **Data Acquisition Trigger Source** and Line Scan Trigger Source based on the combination of triggering methods in use. • When **External** is selected, click  first to enter the laser profiler into the acquisition ready status. The laser profiler can only respond to externally input signals after it enters the acquisition ready status. • About providing data acquisition control signals with an external device, please refer to Workflow of Triggering Data Acquisition and Provide Data Acquisition Control Signals with External Device.

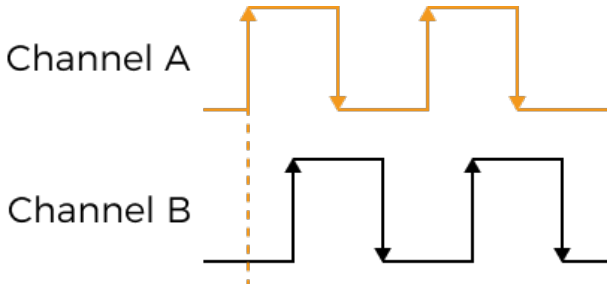
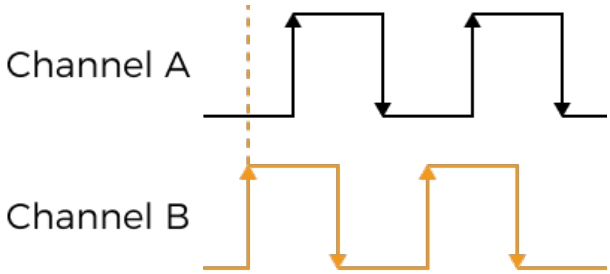
Line Scan Trigger Source

Description	Select the source of the signals that trigger the scan of a single line.
Visibility	Beginner, Expert, Guru
Values	• Encoder (default) • Fixed rate
Instruction	• If you use an encoder to trigger scanning, select **Encoder**. • If you need to trigger scanning at a fixed rate, select **Fixed rate**. Please set Data Acquisition Trigger Source and **Line Scan Trigger Source** based on the combination of triggering methods in use. After selecting different options, different parameters are displayed in the **Trigger Settings** category for adjustment: • Encoder: displays Trigger Direction, Trigger Signal Counting Mode, and Trigger Interval. • Fixed-Rate: displays Trigger Rate.

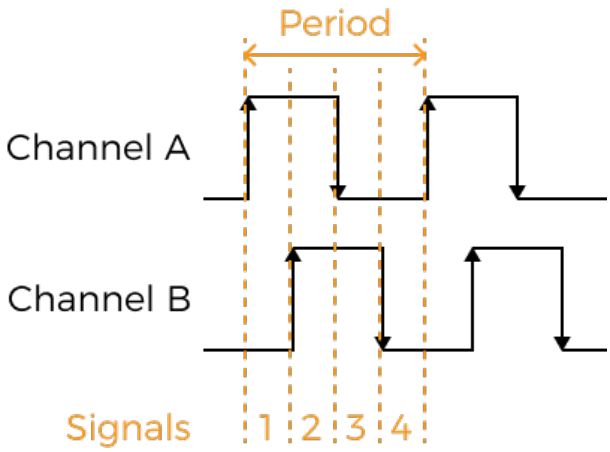
Please set **Data Acquisition Trigger Source** and Line Scan Trigger Source based on the combination of triggering methods in use.

Encoder: Trigger Direction

Description	Select the encoder motion direction that triggers scanning.
Visibility	Beginner, Expert, Guru

Values	• Channel A leading: Scanning is triggered when channel A is leading.  • Channel B leading: Scanning is triggered when channel B is leading.  • Both (default): Scanning is triggered when either channel A or channel B is leading.
Instruction	Adjust this parameter based on the output signals of the encoder and the motion direction of the target object relative to the laser profiler.

Encoder: Trigger Signal Counting Mode

Description	Set the number of quadrature signals to be counted in an encoder period. Counted signals are used to trigger scanning (These signals are trigger signals). Each encoder period contains 4 quadrature signals, as shown below. 
Visibility	Beginner, Expert, Guru

Values	• 1× (default): counts 1 signal in an encoder period. • 2×: counts 2 signals in an encoder period. • 4×: counts 4 signals in an encoder period.
Instruction	• This parameter and Trigger Interval together determine the rate at which scanning is triggered. If the rate at which scanning is triggered is greater than the max scan rate of the laser profiler, some data will be lost. Please refer to Some Data Were Lost to resolve this issue. You can check the current max scan rate of the laser profiler in the upper right of the data display area. • This parameter and **Trigger Interval** together determine the Y-axis resolution of the scan data, thus affecting the scan accuracy as well as the aspect ratio of the intensity image and depth map. For details, please refer to Y-Axis Resolution of Scan Data. • If you need the Y-axis resolution of the scan data to be equal to the X-axis resolution, please adjust **Trigger Interval** through Trigger Interval Calculator (The value of **Trigger Signal Counting Mode** may be affected).

Encoder: Trigger Interval

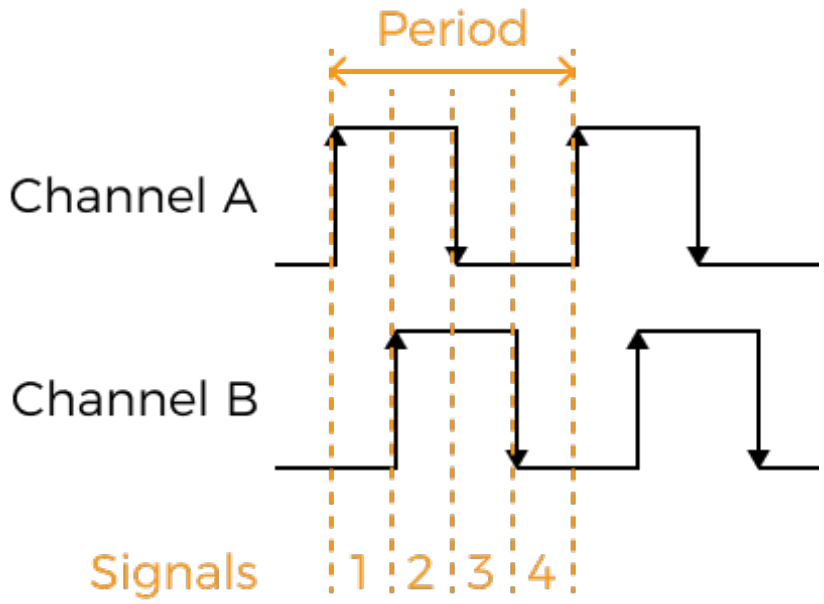
Description	Set the number of trigger signals needed for scanning one line.
Visibility	Beginner, Expert, Guru
Values	• Value range: 1 to 65535 • Default value: ◦ LNX-8030: 2 ◦ LNX-8080: 6 ◦ LNX-8300: 13
Instruction	• This parameter and Trigger Signal Counting Mode together determine the rate at which scanning is triggered. If the rate at which scanning is triggered is greater than the max scan rate of the laser profiler, some data will be lost. Please refer to Some Data Were Lost to resolve this issue. You can check the current max scan rate of the laser profiler in the upper right of the data display area. • Note: This parameter and **Trigger Signal Counting Mode** together determine the Y-axis resolution of the scan data, thus affecting the scan accuracy as well as the aspect ratio of the intensity image and depth map. For details, please refer to Y-Axis Resolution of Scan Data. • If you need the Y-axis resolution of the scan data to be equal to the X-axis resolution, please adjust **Trigger Interval** through Trigger Interval Calculator.

Use Trigger Interval Calculator

Using **Trigger Interval Calculator**, you can calculate the value of **Trigger Interval** that makes the Y-axis resolution of the scan data equal to the X-axis resolution, thus obtaining the intensity image and depth map with the aspect ratio that matches the actual object.

Follow these steps to use **Trigger Interval Calculator** to calculate the value of **Trigger Interval**:

1. Double-click **[Calculate]** to the right of **Trigger Interval** to open **Trigger Interval Calculator**.
2. Enter the value of **Encoder resolution**: The encoder resolution is the travel distance (in μm) of the target object relative to the laser profiler during the duration of each signal in the following figure.



3. Click **[Apply]** to close the current window. In the scan mode, acquire data again and check the aspect ratio of the intensity image and depth map.
   - If the aspect ratio matches the actual object, the process is completed.
   - If the aspect ratio does not match the actual object, proceed to the next step.
4. Check the set value of **Trigger Signal Counting Mode**:
   - If it is **1×** or **2×**, proceed to step 5.
   - If it is **4×**, proceed to step 8.
5. Double-click **[Calculate]** to the right of **Trigger Interval** to open **Trigger Interval Calculator**.
6. Increase the value of **Trigger Signal Counting Mode**.
7. Click **[Apply]** to close the current window. In the scan mode, acquire data again and check the aspect ratio of the intensity image and depth map.
   - If the aspect ratio matches the actual object, the process is completed.
   - If the aspect ratio does not match the actual object, repeat step 4.
8. Based on the aspect ratio of the intensity image and depth map, finetune **Current Value** under **Trigger Interval**:
   - If the images appear compressed relative to the actual object, increase **Current Value** by 1.
   - If the images appear stretched relative to the actual object, decrease **Current Value** by 1.
9. In the scan mode, acquire data again and check the aspect ratio of the intensity image and depth map.
   - If the aspect ratio matches the actual object, the process is completed.

- If the aspect ratio does not match the actual object, repeat step 8.

Fixed-Rate: Trigger Rate

Description	When **Line Scan Trigger Source** is set to **Fixed rate**, set the fixed rate at which the laser profiler is triggered to scan.
Visibility	Beginner, Expert, Guru
Values	• Value range: 2 Hz to the current max scan rate You can check the current max scan rate of the laser profiler in the upper right of the data display area. • Default value: 1000 Hz
Instruction	• This parameter determines the Y-axis resolution of the scan data. Please adjust it based on your needs for the Y-axis resolution. • If you need the Y-axis resolution of the scan data to be equal to the X-axis resolution, please calculate the appropriate **Trigger Rate** value according to the following equation: **Trigger Rate**: = travel speed of the target object relative to the laser profiler (μm/s) ÷ X-axis resolution

Scan Settings

Set other parameters that affect the scanning process.

Scan Line Count

Description	Set the number of profiles needed to generate one intensity image/depth map.
Visibility	Beginner, Expert, Guru
Values	• Value range: 16 to 20000 • Default value: 5000
Instruction	Make sure that the set value can cover one target object completely. You can refer to the following equation to calculate the appropriate parameter value: **Scan Line Count** = length of target object (μm) ÷ Y-axis resolution of scan data (μm) The set value should be slightly larger than the calculated value.

Timeout Period

Description	Set the timeout period for data acquisition. After data acquisition is triggered, if the software does not receive data within the set timeout period, the current round of data acquisition is automatically stopped.
Visibility	Beginner, Expert, Guru
Values	• Value range: 100 ms to 60000 ms • Default value: 4000 ms

Instruction	Adjust based on the actual needs.

Exposure Delay

Description	Set the delay time between laser emission and start of exposure. Larger exposure delay results in more stable brightness of the laser lines in the raw image, thus more stable quality of the intensity image and depth map. However, the max scan rate will be reduced.
Visibility	Guru
Values	• Value range: 1 to 2600 µs • Default value: 5 µs
Instruction	If the quality of the obtained data is unstable (such as the depth fluctuation of the same position on the same object is large), you can increase the value of this parameter.

Point Cloud Resolutions

Check the X-axis resolution and set the Y-axis resolution of the point cloud.

X-Axis Resolution

Description	Displays the resolution in the X direction, which is the distance between two neighboring points along the direction of the laser line. This parameter is read-only and cannot be adjusted.
Visibility	Beginner, Expert, Guru
Values	• LNX-8030: 9.0 µm • LNX-8080: 23.5 µm • LNX-8300 105.0 µm

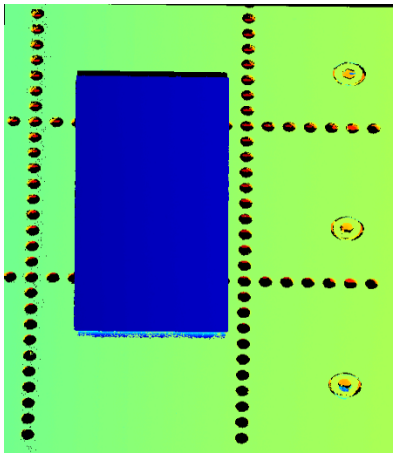
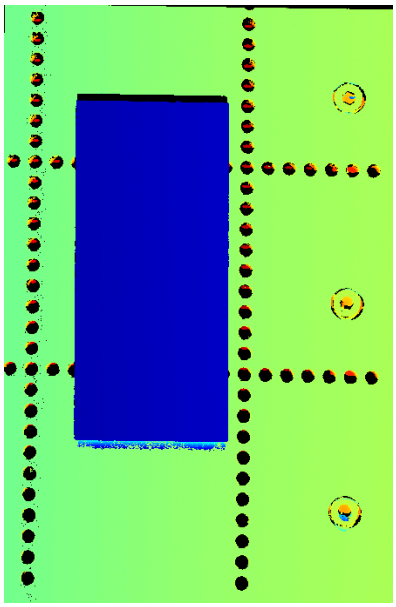
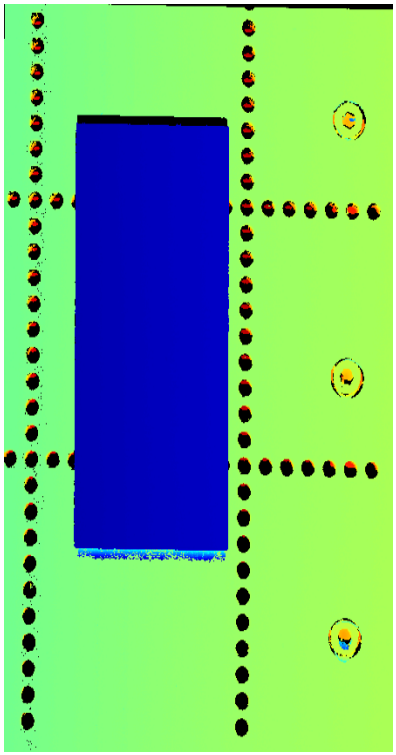
Y-Axis Resolution

Description	Set the resolution in the Y direction, which is the distance between two neighboring points along the travel direction of the target object.
Visibility	Beginner, Expert, Guru

Values	• Default value:
	  ◦ LNX-8030: 9.0 µm
	  ◦ LNX-8080: 23.5 µm
	  ◦ LNX-8300: 105.0 µm

Instruction	This parameter only affects the Y-axis resolution of the point cloud. If in the point cloud, the distance between two points neighboring along the Y-axis is shorter than the actual distance, please increase the value of this parameter. Otherwise, decrease the value of this parameter.

Point clouds obtained with different **Y-Axis Resolution** values (all other conditions identical):

Y-Axis Resolution: 12 μm	Y-Axis Resolution: 23.5 μm	Y-Axis Resolution: 35 μm
		

Mask

Description	Use masks to exclude unneeded data, such as noise and laser lines produced by interreflection.
Visibility	Beginner, Expert, Guru
Values	**Enable Mask**: • True: Apply the added masks. • False: Do not apply the added masks.
Instruction	Double-click **[Edit]** to open the **Mask Tool** window. For detailed instructions, refer to Use Mask Tool below.

Use Mask Tool

Through the mask tool, you can add, edit, and delete masks.

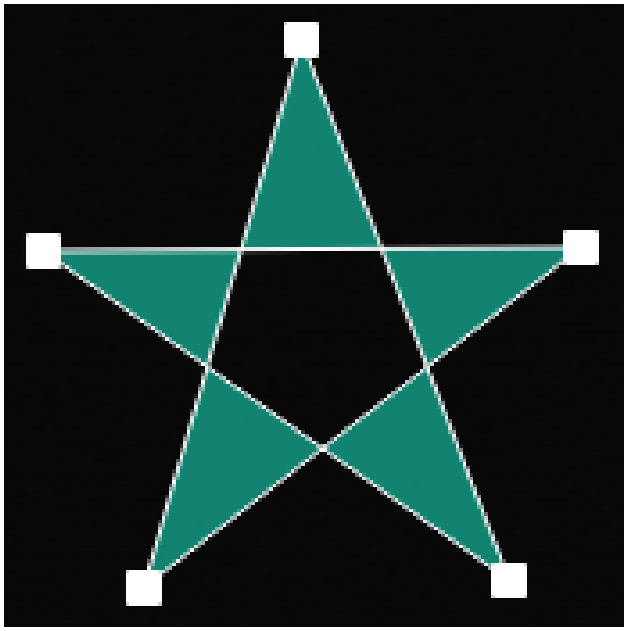
Add Masks

Follow these steps to add masks:

1. Select the appropriate tool in the toolbar on the left:
   - : used to add a rectangle mask.
   - : used to add a polygon mask.
2. Determine the location of the unneeded data in the raw image and draw a mask:
   - Rectangle mask: Hold and drag.

- Polygon mask: Click to add a vertex of the polygon mask. After all needed vertices are added, press the `Enter` key or right-click to finish drawing the polygon mask.

In a polygon mask, the overlapped regions are not effective:



- Click **[Acquire again]** at the top to acquire the raw image after the masks are added to check the effect of the masks.
- If the position, shape, or size of the masks are not satisfactory, you can edit the masks or delete the masks.

3. After all masks are added, click **[Apply]** to close the current window.

After **[Apply]** is clicked, the value of the **Enable Mask** parameter is automatically changed to **True**. If you do not need to apply the masks, change the value of this parameter to **False**.

Edit Masks

If the position, shape, or size of the masks are not satisfactory, follow these steps to edit the masks:

1. Click  in the toolbar on the left.
2. Select the mask that needs to be edited and conduct the needed adjustment:
   - Move a mask: Select the mask and drag.
   - Adjust the size of a rectangle mask: Select a vertex of the rectangle mask and drag.
   - Adjust the shape of a polygon mask:
     - Move an existing vertex: Select a vertex of the polygon mask and drag.
     - Add a new vertex: Left-click on an edge of the polygon mask.
     - Delete an existing vertex: Select a vertex of the polygon mask and right-click.

Click **[Acquire again]** at the top to acquire the raw image after the masks are edited to check the effect of the masks.

3. After all editing is completed, click **[Apply]** to close the current window.

> After **[Apply]** is clicked, the value of the **Enable Mask** parameter is automatically changed to **True**. If you do not need to apply the masks, change the value of this parameter to **False**.

Delete Masks

Follow these steps to delete unsatisfactory masks:

1. In the right panel, select the mask that needs to be deleted in **Mask list**, and click .

> If you need to delete all the masks, click **[Clear]** to the right of **Mask list**.

2. In the pop-up window, click **[Confirm]** to delete the mask.

> Click **[Acquire again]** at the top to acquire the raw image after the mask is deleted to check the effect of the remaining masks.

3. After all deletion is completed, click **[Apply]** to close the current window.

> After **[Apply]** is clicked, the value of the **Enable Mask** parameter is automatically changed to **True**. If you do not need to apply the masks, change the value of this parameter to **False**.

Correction

The parameters in this category are used to correct the tilt of and height error in the profile.

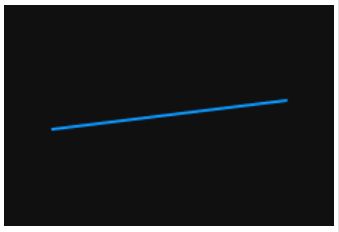
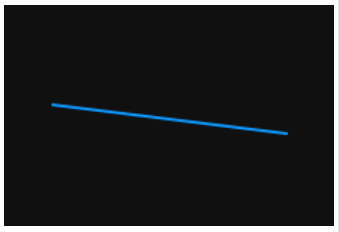
Tilt Correction

Description	Correct the tilt of the profile, which is caused by the rotation of the laser profiler around the Y-axis.
Visibility	Beginner, Expert, Guru
Values	**Enable Tilt Correction**: • True: Apply the tilt correction result to the profile. • False: Do not apply the tilt correction result to the profile. **Tilt Correction Angle**: • Range: –90° to 90° • Default value: 0°
Instruction	For detailed instructions, refer to Perform Tilt Correction below.

Perform Tilt Correction

This tool is used to correct the tilt of the profile, which is caused by the rotation of the laser profiler around the Y-axis.

As shown below, the rotation of the laser profiler around the Y-axis make the tilt of the acquired profile differ from the tilt of the actual object.

	Not rotated	Rotated around the Y-axis	
Laser profiler			
Acquired profile			

Prerequisites

In order to perform tilt correction, the following prerequisites must be satisfied:

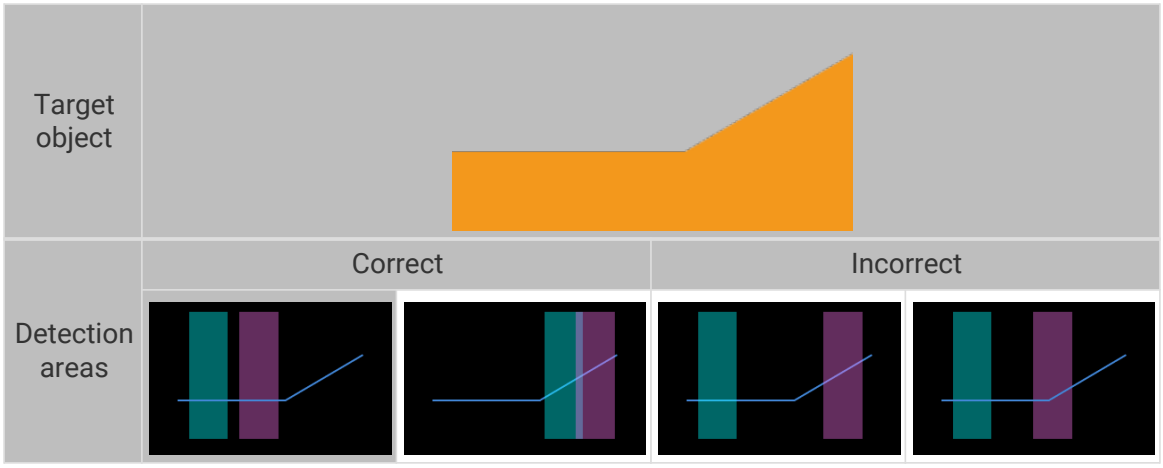
- It is recommended to use a target object whose surface includes flat regions.
- A relatively complete profile of the flat regions can be acquired. If the profile is incomplete, please refer to Profile Mode and adjust the other parameters first.
- Keep the target object still relative to the laser profiler, and acquire the profile of the flat regions on the target object.

Instructions

Follow these steps to perform tilt correction:

1. Double-click **[Edit]** to the right of **Tilt Correction** to open the **Tilt Correction** window.
2. Select the detection areas and drag to adjust their positions. Make sure to satisfy the following criterion while adjusting:

   The profile selected by the two detection areas should correspond to two locations on the same flat region of the target object. Please refer to the following example:



The detection areas can overlap.

3. Select the detection areas and drag the handles on them to adjust their widths. Refer to the following criterion while adjusting:

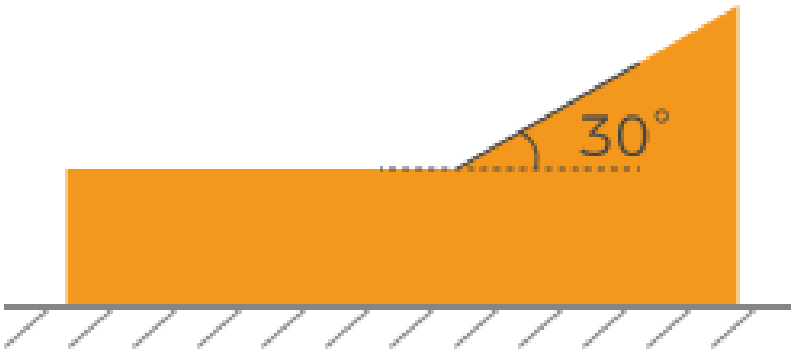
   With the above criterion satisfied, the detection area can be as wide as possible to include more data for tilt correction.

4. In **Expected tilt angle** under **Tilt angles**, enter the angle that the profile in the detection areas should reach after the correction.

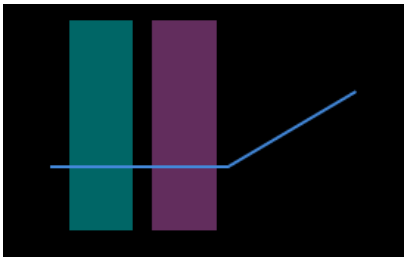
   Positive values rotate the profile counterclockwise; negative values rotate the profile clockwise. The range of possible values is -45° to 45°.

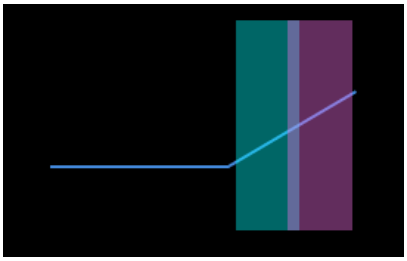
   ▼ Example of expected tilt angle

   A target object as shown below is placed on a horizontal surface:

   The value that should be entered for **Expected tilt angle** depends on the positions of the detection areas:

Detection areas	Expected tilt angle
	0°

Detection areas	Expected tilt angle
	30°

5. Click **[Correct]**. The green line in the image area on the left represents the profile that has been rotated to **Expected tilt angle** after tilt correction. Check if this profile satisfies your requirements:
   - If yes, click **[Apply]** to apply the tilt correction result and close the window.
   - If no, repeat steps 2 to 5.
6. Acquire data again in the profile mode and switch to **Profile** to check the effect of correction.

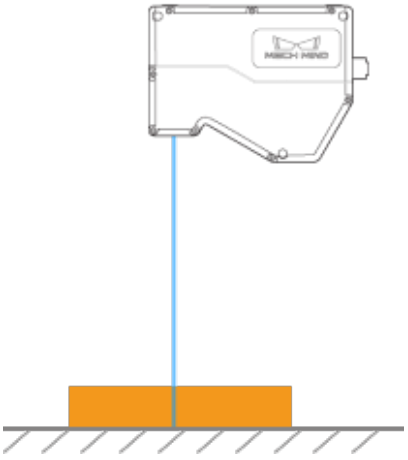
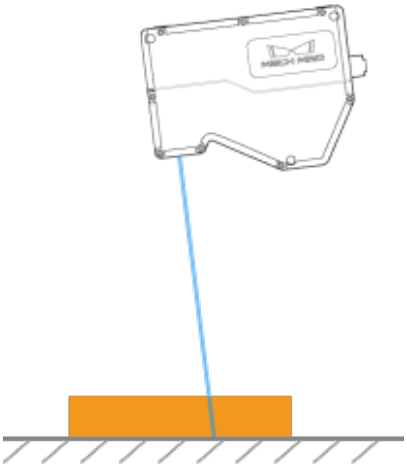
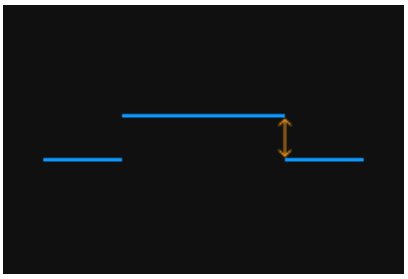
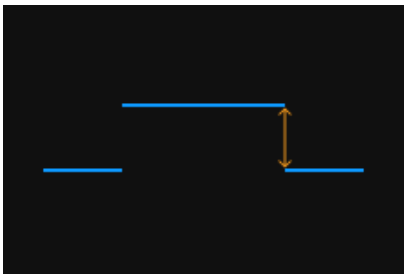
Height Correction

Description	Correct the height error in the profile, which is caused by the rotation of the laser profiler around the X-axis.
Visibility	Beginner, Expert, Guru
Values	**Enable Height Correction**: • True: Apply the height correction result to the profile. • False: Do not apply the height correction result to the profile. **Height Correction Ratio**: • Value range: 0.1 to 8.0 • Default value: 1
Instruction	For detailed instructions, refer to Perform Height Correction below.

Perform Height Correction

This tool is used to correct the height error in the profile, which is caused by the rotation of the laser profiler around the X-axis.

As shown below, the rotation of the laser profiler around the X-axis make the height difference between two locations in the acquired profile differ from the actual difference.

	Not rotated	Rotated around the X-axis
Laser profiler		
Acquired profile		

Prerequisites

In order to perform height correction, the following prerequisites must be satisfied:

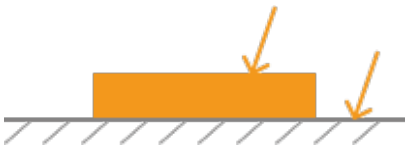
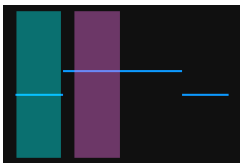
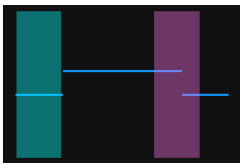
- It is recommended to use a target object with known dimensions and flat surfaces, such as a gauge block, and place the target object on a horizontal surface.
- A relatively complete profile of the target object can be acquired. If the profile is incomplete, please refer to Profile Mode and adjust the other parameters first.
- Keep the target object still relative to the laser profiler.
- Select two surfaces (such as the top surface of the gauge block and the horizontal surface on which the gauge block is placed) for calculating the height difference, and determine the actual height difference of the two surfaces.

Instructions

Follow these steps to perform height correction:

1. Double-click **[Edit]** to the right of **Height Correction** to open the **Height Correction** window.
2. Select the detection areas and drag to adjust their positions. Make sure to satisfy the following criterion while adjusting:

   The profile segments selected by the two detection areas should correspond respectively two the two surfaces used for calculating the height difference.

Two surfaces used for calculating the height difference		
Detection areas	Correct	Incorrect
		 

3. Select the detection areas and drag the handles on them to adjust their widths. Refer to the following criterion while adjusting:

   With the above criterion satisfied, the detection areas can be as wide as possible to include more data for height correction.

4. In **Actual height difference** under **Height differences**, enter the actual height difference between the two surfaces.

   The minimum value of **Actual height difference** is 0.01 mm, and the maximum value is the Z-axis measurement range of the laser profiler.

5. Click **[Correct]**. The green line in the image area on the left represents the profile after height correction. Check if this profile satisfies your requirements:
   - If yes, click **[Apply]** to apply the height correction result and close the window.
   - If no, repeat steps 2 to 5.
6. Acquire data again in the profile mode and switch to **Profile** to check the effect of correction.

5.4. Tool

Mech-Eye Viewer provides the following tools. This topic introduces the functions and usages of the tools and provides detailed instructions.

Instructions on using **Measurement Tool**:

Measurement Tool

Instruction on define a **custom reference frame** used for displaying the depth map and point cloud:

Custom Reference Frame

5.4.1. Measurement Tool

This tool is used to measure the point-to-point distance, point-to-line distance, and height difference in the profile, in order to check if the target object meets the design accuracy requirements.

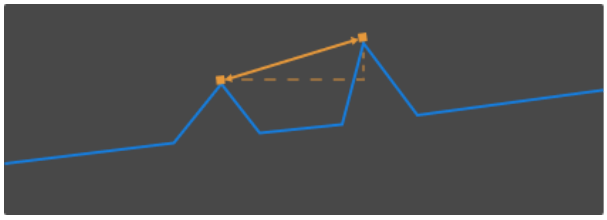
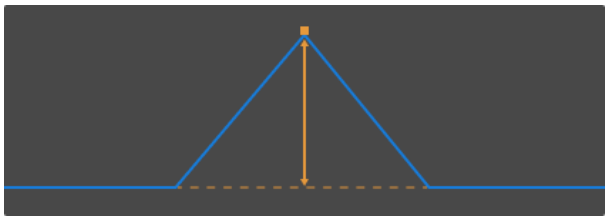
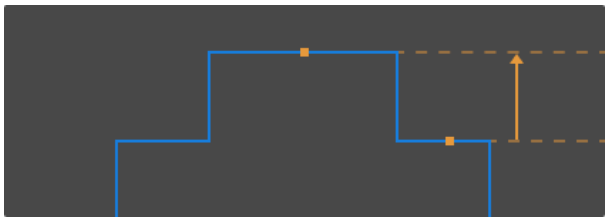
Prerequisites

Before you start the measurement, please check the following prerequisites:

- To ensure the accuracy of the measurement result, please perform tilt correction and height correction before measurement.
- While conducting the following measurement actions, you should keep the target object still. If you need to measure different locations, click **[Acquire again]** after moving the target object to acquire the profile again.

Measurement Mode

This tool provides three measurement modes:

Point-to-point distance	
Point-to-line distance	
Height difference	

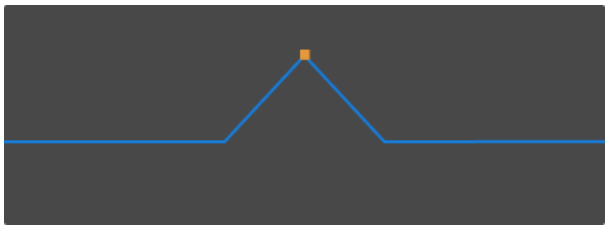
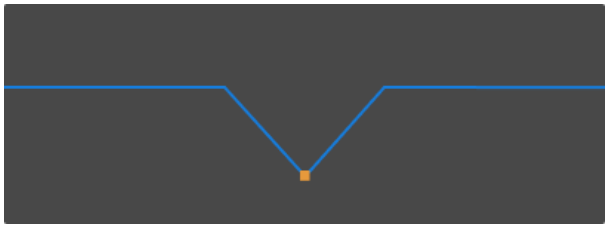
In each mode, **Measurement Tool** detects the measurement target automatically in the selected detection area, and then provides the measurement result.

The following sections provide measurement instructions based on the measurement mode. Please check the corresponding section according to your actual measurement needs.

Measure Point-to-Point Distance

In the point-to-point distance measurement mode, the measurement targets are two automatically detected points, and the measurement result is the distance between the two points.

The detectable types of points include:

Highest point	
Lowest point	

When measuring, you need to set appropriate positions and widths of the detection areas to ensure that the correct points are detected.

Follow these steps to measure the point-to-point distance:

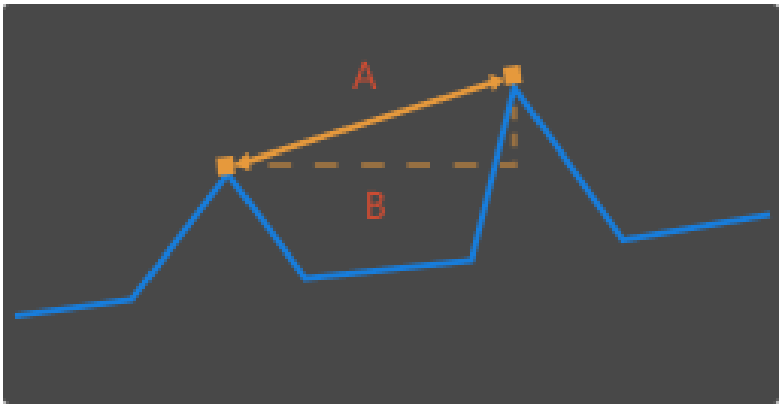
1. In **Measurement Mode**, select **Point-to-point distance**.
2. In the right panel, from the **Point type** menu under the **Measurement target 1** tab, select the type of the first point that needs to be measured.
3. In the image area on the left, select detection area 1 (■) and drag to adjust its position, so that it includes the point to be measured.
4. Select detection area 1 and drag the handles on it to adjust its width, so that its as narrow as possible.

   Reducing the width of the detection area can exclude unneeded data and ensure that the automatically detected point is the point that needs to be measured. For example, if the point that needs to be measured should be the highest point in the detection area, the detection area should not include any point higher than that point.

5. In the right panel, switch to the **Measurement target 2** tab, and from the **Point type** menu, select the type of the second point that needs to be measured.
6. In the image area on the left, select detection area 2 (■) and drag to adjust its position, so that it includes the point to be measured.

   The detection areas can overlap.

7. Select detection area 2 and drag the handles on it to adjust its width, so that its as narrow as possible.
8. In **Measurement method** in the right panel, select the method used to measure the point-to-point distance:
   - Straight-line distance: A in the following figure
   - Horizontal distance: B in the following figure

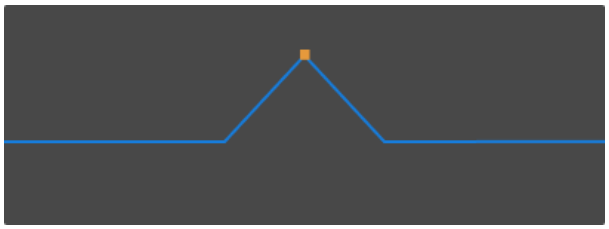
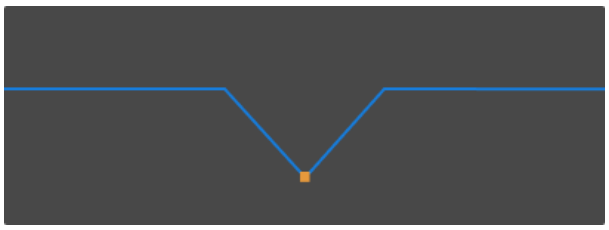


9. Check the measurement result of the point-to-point distance in **Measurement result** at the bottom of the right panel. If the measurement result is inaccurate or not displayed, adjust the positions and widths of the detection areas again.

Measure Point-to-Line Distance

In the point-to-line distance measurement mode, the measurement targets are a automatically detected point and a reference line calculated from the selected data, and the measurement result is the distance between the vertical distance between the point and the reference line.

The detectable types of points include:

Highest point	
Lowest point	

When measuring, you need to set appropriate positions and widths of the detection areas to ensure that the correct points are detected.

Follow these steps to measure the point-to-line distance:

1. In **Measurement Mode**, select **Point-to-line distance**.
2. In the right panel, from the **Point type** menu under the **Measurement target 1** tab, select the type of the point that needs to be measured.
3. In the image area on the left, select detection area 1 (■) and drag to adjust its position, so that it includes the point to be measured.
4. Select detection area 1 and drag the handles on it to adjust its width, so that its as narrow as possible.

Reducing the width of the detection area can exclude unneeded data and ensure that the

automatically detected point is the point that needs to be measured. For example, if the point that needs to be measured should be the highest point in the detection area, the detection area should not include any point higher than that point.

5. In the image area on the left, select detection area 2 (■) and drag to adjust its position, so that it includes the data used for calculating the reference line.

   The orange line in the image area on the left is the calculated reference line.

6. Select detection area 2 and drag the handles on it to adjust its width. Refer to the following criteria while adjusting the width:
   - The profile selected by the detection area should correspond to points on the same plane of the target object.
   - With the above criterion satisfied, the detection area can be as wide as possible to include more data for calculating the reference line.

   If the calculating result is not good, you can add detection area 3 to calculate the reference line using the data from both detection areas 2 and 3:

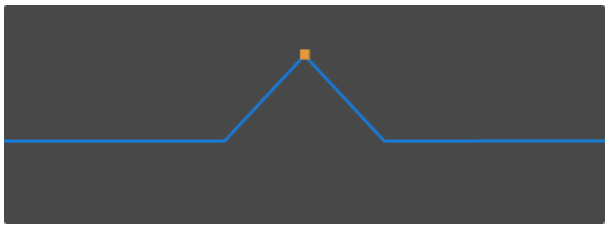
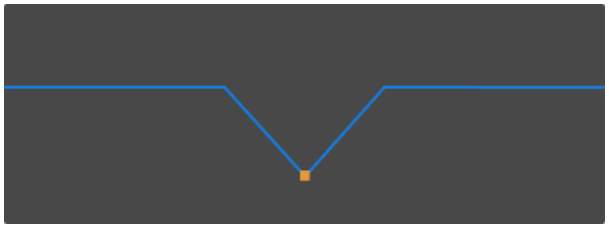
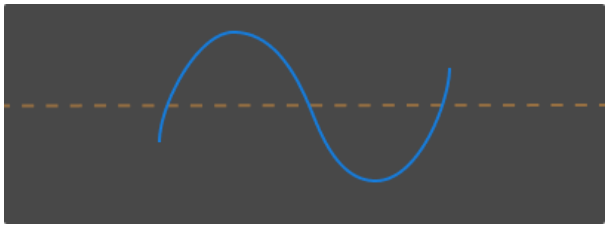
   Under the **Reference** tab in the right panel, check **detection area 3**, and adjust the position and width of detection area 3 (■) in the image area on the left.

7. Check the measurement result of the point-to-line distance in **Measurement result** at the bottom of the right panel. If the measurement result is inaccurate or not displayed, adjust the positions and widths of the detection areas again.

Measure Height Difference

In the height difference measurement mode, the measurement targets are two automatically detected points or lines, and the measurement result is the perpendicular distance between the two measurement targets.

The detectable types of measurement targets include:

Highest point	
Lowest point	
Average	

When measuring, you need to set appropriate positions and widths of the detection areas to ensure that the correct points are detected.

Follow these steps to measure the height difference:

1. In **Measurement Mode**, select **Height difference**.
2. In the right panel, from the **Measurement target type** menu under the **Measurement target 1** tab, select the type of the first measurement target.
3. In the image area on the left, select detection area 1 (■) and drag to adjust its position, so that it includes the measurement target.
4. Select detection area 1 and drag the handles on it to adjust its width. Refer to the following criteria while adjusting the width:
   - If the measurement target is **Highest point** or **Lowest point**:

     Reducing the width of the detection area as much as possible to exclude unneeded data and ensure that the automatically detected point is the point that needs to be measured. For example, if the point that needs to be measured should be the highest point in the detection area, the detection area should not include any point higher than that point.

   - If the measurement target is **Average**:

     The detection area should include only the points used to calculate the average. Meanwhile, the detection area should be as wide as possible to include more data for calculating the average.

     The orange line in the image area on the left is the line that represents the average.
5. In the right panel, from the **Measurement target type** menu under the **Reference** tab, select the type of the second measurement target.
6. Refer to steps 3 to 4 and adjust the position and width of detection area 2 (■).
7. Check the measurement result of the height difference in **Measurement result** at the bottom of the right panel. If the measurement result is inaccurate or not displayed, adjust the positions and widths of the detection areas again.

5.4.2. Custom Reference Frame

This tool is used to define a custom reference frame for display. The depth map and point cloud can be displayed in the custom reference frame.

The custom reference frame only affects the display in Mech-Eye Viewer and does not affect the actual data in the depth map and point cloud.

Instructions

Follow these steps to define a custom reference frame:

1. Adjust the position of the point cloud and find the surface to be used as the XY-plane of the custom reference frame.
2. Hold the `Shift` key and click on the point cloud to select 3 points. The 3 points serve the following functions:
   - The first point is the origin of the reference frame.

- The second point determines the positive direction of the X-axis.
- The third point determines the positive direction of the Y-axis.

3. After the 3 points are selected, the reference frame is generated according to the right-hand rule. Rotate and zoom the point cloud to check if the reference frame meets your needs:
   - Check if the three points are located on the same surface.
   - Check if the orientation of the Z-axis is correct.

     If not, Click **[Reset]** in the lower right, and then repeat step 2.
4. Click **[OK]** to save the custom reference frame.

Use the Custom Reference Frame

To display the depth map and point cloud in the custom reference frame, follow these steps:

1. In the data display area, switch to **Depth Map** or **Point Cloud**.
2. At the top of the left panel, click the **Reference Frame** drop-down menu and select **Custom**. The depth map and point cloud will be displayed in the custom reference frame.

> The reference frame setting is simultaneously applied to both depth map and point cloud.

6. Mech-Eye API

You can use Mech-Eye API to connect to the laser profiler, adjust parameters, and obtain profile data for generating intensity images, depth maps, and point clouds.

The C++ and C# Mech-Eye API are included in the Mech-Eye SDK installation package. The Python Mech-Eye API need to be downloaded and installed separately.

Instructions on **installing Mech-Eye SDK**:

Mech-Eye SDK Installation Guide (Windows)

Mech-Eye SDK Installation Guide (Ubuntu)

Introduction of the **overall structure of Mech-Eye API**:

Functional Hierarchy of Classes

Introduction of the **workflow of using Mech-Eye API to control the laser profiler**:

Operation Workflow

The Mech-Eye API reference guide:

Reference

Instructions on **installing, configuring, building, and running Mech-Eye API samples**:

Sample Usage Guide

Instructions on **using the supplementary tools for Mech-Eye API**:

Firmware Upgrade Tool

6.1. Mech-Eye SDK Installation Guide (Ubuntu)

This topic guides you through the downloading, installation, upgrade, and uninstallation of Mech-Eye SDK on Ubuntu.

If you are using the Windows operating system, please refer to *Mech-Eye SDK Installation Guide*.

Download Mech-Eye SDK

Mech-Eye SDK installation packages for the AMD64 and ARM64 architectures are provided:

- AMD64: **Mech-Eye_API_2.2.1_amd64.deb**
- ARM64: **Mech-Eye_API_2.2.1_arm64.deb**

Please download the corresponding Mech-Eye SDK installation package according to your needs.

Use the `arch` command to check the system architecture.

Install Mech-Eye SDK

If you have installed Mech-Eye SDK already, please upgrade Mech-Eye SDK instead.

Follow these steps to install Mech-Eye SDK on Ubuntu:

1. Enter the path where the installation package is stored and execute the following command to install Mech-Eye SDK:
   - If the system architecture is AMD64, execute the following command:

     ```
     sudo dpkg -i 'Mech-Eye_API_2.2.1_amd64.deb'
     ```

   - If the system architecture is ARM64, execute the following command:

     ```
     sudo dpkg -i 'Mech-Eye_API_2.2.1_arm64.deb'
     ```

2. Execute the following command to check if the installation succeeded. If the Mech-Eye SDK version is printed, the installation succeeded.

   ```
   dpkg -l | grep mecheyeapi
   ```

Upgrade Mech-Eye SDK

If you have installed Mech-Eye SDK already, follow these steps to upgrade Mech-Eye SDK:

1. Execute the following command to check if Mech-Eye SDK has been installed:

   ```
   dpkg -l | grep mecheyeapi
   ```

2. Execute the following command to uninstall Mech-Eye SDK:

   ```
   sudo dpkg -P mecheyeapi
   ```

3. Enter the path where the installation package is stored and execute the following command to

install Mech-Eye SDK:

- If the system architecture is AMD64, execute the following command:

```
sudo dpkg -i 'Mech-Eye_API_2.2.1_amd64.deb'
```

- If the system architecture is ARM64, execute the following command:

```
sudo dpkg -i 'Mech-Eye_API_2.2.1_arm64.deb'
```

4. Execute the following command to check if the installation succeeded. If the Mech-Eye SDK version is printed, the installation succeeded.

```
dpkg -l | grep mecheyeapi
```

Uninstall Mech-Eye SDK

Follow these steps to uninstall Mech-Eye SDK:

1. Execute the following command to uninstall Mech-Eye SDK:

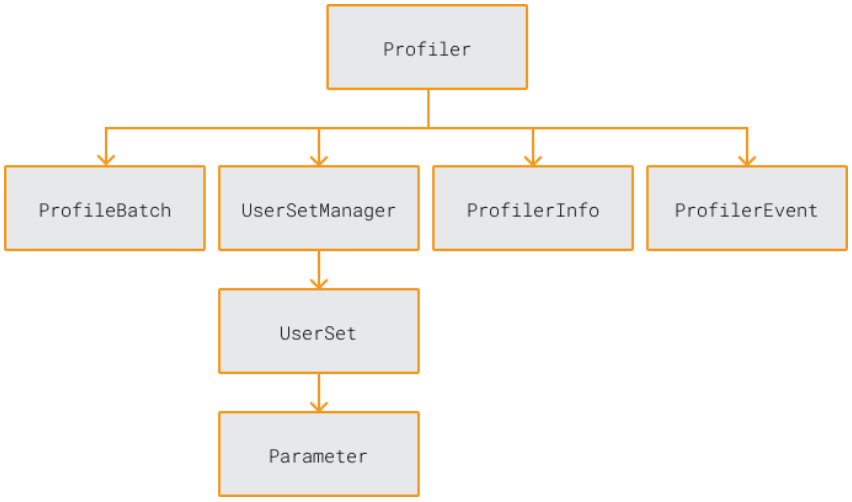
```
sudo dpkg -P mecheyeapi
```

2. Execute the following command to check if the uninstallation succeeded. If no messages are printed, the uninstallation succeeded.

```
dpkg -l | grep mecheyeapi
```

6.2. Functional Hierarchy of Classes

This topic introduces the functional hierarchy of the classes in Mech-Eye API. In the following figure, the classes higher up in the hierarchy provide methods for accessing the objects of the lower classes. Therefore, the higher classes should be instantiated earlier in the client application.



The following sections introduce the functions of each class in the above figure.

Profiler

The `Profiler` class represents a laser profiler. It is the highest class in the functional hierarchy in Mech-Eye API. In the client application, this class should be instantiated first. Through the `Profiler` class, you can access the objects of other classes.

The methods provided by the `Profiler` class mainly include:

- Discover laser profilers
- Connect to a laser profiler
- Trigger scan and retrieve data
- Register the callback function
- Obtain the laser profiler information
- Access the objects of the `UserSetManager` and `UserSet` classes

ProfileBatch

The `ProfileBatch` class is used to store the data of multiple profiles. Using the data in this class, you can generate the intensity image, depth map, and point cloud.

UserSetManager

The `UserSetManager` class provides methods for managing parameter groups, which mainly include:

- Check all available parameter groups
- Select a parameter group
- Create a parameter group
- Delete a parameter group
- Import parameter groups
- Export parameter groups

- Access the object of the `UserSet` class

UserSet

The `UserSet` class represents a parameter group and provides methods relevant to the currently selected parameter group. These methods mainly include:

- Obtain all parameters in the current parameter group
- Reset the current parameter group
- Save parameters to the current parameter group
- Obtain parameter information
- Obtain and adjust parameter values
- Rename the current parameter group

Parameter

The `Parameter` class represents a single parameter and provides methods relevant to individual parameters. These methods mainly include:

- Obtain parameter information (including parameter name, parameter description, data type, maximum value, minimum value, minimum increment, read and write permissions, etc.)
- Obtain and adjust parameter values

ProfilerInfo

The `ProfilerInfo` class is used to store the information of the laser profiler, including model, serial numbers, hardware and firmware versions, and IP configurations.

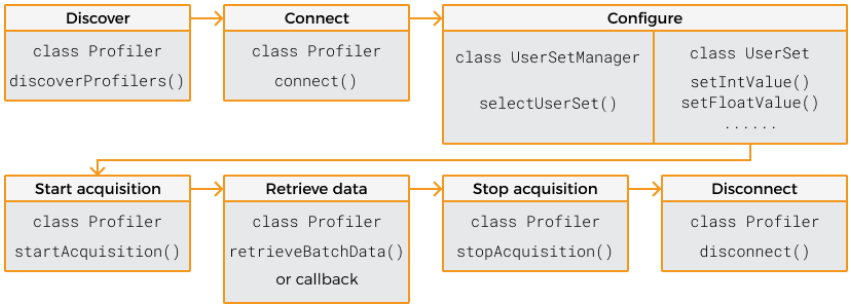
ProfilerEvent

The `ProfilerEvent` class provides methods for detecting events related to the laser profiler. Currently, laser profiler disconnection events can be detected.

This topic introduced the functional hierarchy of the classes in Mech-Eye API. The next topic will introduce the basic workflow of using Mech-Eye API to control a laser profiler.

6.3. Operation Workflow

This topic introduces the basic workflow of using Mech-Eye API to control a laser profiler. The figure and descriptions in this topic use the class and method names of C++ Mech-Eye API. For the corresponding names of different languages, please refer to the example codes.



Discover

Call the `discoverProfilers()` method in the `Profiler` class to enumerate all currently connectable laser profilers and obtain the information of each laser profiler.

C++

```
std::vector<mmind::eye::ProfilerInfo> profilerInfoList = mmind::eye
::Profiler::discoverProfilers();
```

C#

```
var profilerInfoList = Profiler.DiscoverProfilers();
```

Connect

After instantiating the `Profiler` class, call the `connect()` method in this class to connect to the corresponding laser profiler using the IP address or the device information obtained by the `discoverProfilers()` method.

C++

```
mmind::eye::Profiler profiler;
mmind::eye::ErrorStatus status = profiler.connect(profilerInfoList
[inputIndex]);
```

```
mmind::eye::Profiler profiler;
mmind::eye::ErrorStatus status = profiler.connect("192.168.0.10");
```

C#

```
var profiler = new Profiler();
var status = profiler.Connect(profilerInfoList[inputIndex]);
```

```
var profiler = new Profiler();
var status = profiler.Connect("192.168.0.10");
```

Configure

Call the methods in the `UserSetManager` and `UserSet` classes to select the parameter group on the laser profiler and adjust the parameters.

1. Call the `selectUserSet` method in the `UserSetManager` class to select the parameter group to be used.

   You can obtain all the available parameter groups on the laser profiler through the `getAllUserSetNames()` method in this class.

   C++

   ```
   mmind::eye::UserSetManager userSetManager = profiler.
   userSetManager();
   std::vector<std::string> userSets;
   auto status = userSetManager.getAllUserSetNames(userSets);
   status = userSetManager.selectUserSet(userSets.front());
   ```

   C#

   ```
   var userSetManager = profiler.UserSetManager();
   List<string> userSets = new List<string>();
   var status = userSetManager.GetAllUserSetNames(ref userSets);
   status = userSetManager.SelectUserSet(userSets[0]);
   ```

2. Call the `getAvailableParameters()` method in the `UserSet` class to obtain the information of all the parameters in the current parameter group and check the data type of each parameter.

   C++

   ```
   mmind::eye::UserSet currentUserSet = profiler.currentUserSet();
   std::vector<Parameter*> parameters = currentUserSet
   .getAvailableParameters();
   ```

   C#

   ```
   var currentUserSet = profiler.CurrentUserSet();
   var parameters = currentUserSet.GetAvailableParameters();
   ```

3. Call the `getIntValue()` and other similar methods in the `UserSet` class to obtain the current value of a parameter.

C++

```
int exposureTime = 0;
auto status = currentUserSet.getIntValue(mmind::eye
::brightness_settings::ExposureTime::name, exposureTime);
```

C#

```
int exposureTime = 0;
var status = currentUserSet.GetIntValue(MMind.Eye.
BrightnessSettings.ExposureTime.Name, ref exposureTime);
```

4. Call the `setIntValue()` and other similar methods in the `UserSet` class to set the value of a parameter.

C++

```
auto status = currentUserSet.setIntValue(mmind::eye
::brightness_settings::ExposureTime::name, 20);
```

C#

```
var status = currentUserSet.SetIntValue(MMind.Eye.
BrightnessSettings.ExposureTime.Name, 20);
```

5. Call the `saveAllParametersToDevice()` method in the `UserSet` class to save the set parameter values to the laser profiler.

C++

```
auto status = currentUserSet.SaveAllParametersToDevice();
```

C#

```
var status = currentUserSet.SaveAllParametersToDevice();
```

Start Acquisition

Call the `startAcquisition()` method in the `Profiler` class to enter the laser profiler into the acquisition ready status, where it can accept trigger signals for scanning.

- If you use externally input signals to trigger data acquisition, the laser profiler starts to scan when it receives such a signal.

  C++

  ```
  const auto status = currentUserSet.setEnumValue(
      mmind::eye::trigger_settings::DataAcquisitionTriggerSource::
  name,
      static_cast<int>(mmind::eye::trigger_settings
  ::DataAcquisitionTriggerSource::Value::External));
  auto status = profiler.startAcquisition();
  ```

  C#

  ```
  var status = currentUserSet.SetEnumValue(
      MMind.Eye.TriggerSettings.DataAcquisitionTriggerSource.Name,
      (int)MMind.Eye.TriggerSettings.DataAcquisitionTriggerSource
  .Value.External);
  var status = profiler.StartAcquisition();
  ```

- If you use software to trigger data acquisition, call the `triggerSoftware()` method in the `Profiler` class to trigger scanning.

  C++

  ```
  const auto status = currentUserSet.setEnumValue(
      mmind::eye::trigger_settings::DataAcquisitionTriggerSource::
  name,
      static_cast<int>(mmind::eye::trigger_settings
  ::DataAcquisitionTriggerSource::Value::Software));
  auto status = profiler.startAcquisition();
  status = profiler.triggerSoftware();
  ```

  C#

  ```
  var status = currentUserSet.SetEnumValue(
      MMind.Eye.TriggerSettings.DataAcquisitionTriggerSource.Name,
      (int)MMind.Eye.TriggerSettings.DataAcquisitionTriggerSource
  .Value.Software);
  var status = profiler.StartAcquisition();
  ```

```
status = profiler.TriggerSoftware();
```

Retrieve Data

The data obtained by the laser profiler in a single round of data acquisition is returned in several batches. All batches of data must be retrieved first before the intensity image and depth map can be generated.

You can retrieve the data from the laser profiler in two ways:

- Call the `retrieveBatchData()` method in the `Profiler` class. Calling this method once can obtain a single batch of data.
- Define a callback function and call the `registerAcquisitionCallBack()` method in the `Profiler` class to register the callback function.

The callback function must be defined and registered before the `Profiler` class function is called.

The example codes for the two ways of retrieving data are provided below.

- Call the `retrieveBatchData()` method in the `Profiler` class:

C++

```
int dataWidth = 0;
auto status = currentUserSet.getIntValue(mmind::eye::scan_settings
::DataPointsPerProfile::name, dataWidth);
mmind::eye::ProfileBatch batch(dataWidth);
status = profiler.retrieveBatchData(batch);
```

C#

```
int dataWidth = 0;
var status = currentUserSet.GetIntValue(MMind.Eye.ScanSettings
.DataPointsPerProfile.Name, ref dataWidth);
var batch = new ProfileBatch((ulong)dataWidth);
MMind.Eye.ErrorStatus status = profiler.RetrieveBatchData(ref
batch);
```

- Use a callback function:

C++

```
namespace{
std::mutex kMutex;
```

```
void callbackFunc(const mmind::eye::ProfileBatch& batch, void*
pUser)
{
    std::unique_lock<std::mutex> lock(kMutex);
    auto* outPutBatch = static_cast<mmind::eye::ProfileBatch*>(
pUser);
    outPutBatch->append(batch);
}
}
int dataPoints = 0;
showError(currentUserSet.getIntValue(mmind::eye::scan_settings::Data
PointsPerProfile::name, dataPoints));
mmind::eye::ProfileBatch profileBatch(dataPoints);
profiler.registerAcquisitionCallback(callbackFunc, &profileBatch);
```

C#

```
private static readonly Mutex mut = new Mutex();
    private static void CallbackFunc(ref ProfileBatch batch, IntPtr
pUser)
    {
        mut.WaitOne();
        GCHandle handle = GCHandle.FromIntPtr(pUser);
        var outputBatch = (handle.Target as ProfileBatch);
        outputBatch.Append(batch);
        mut.ReleaseMutex();
    }
int dataPoints = 0;
Utils.ShowError(currentUserSet.GetIntValue(MMind.Eye.ScanSettings.Da
taPointsPerProfile.Name, ref dataPoints));
var profileBatch = new ProfileBatch((ulong)dataPoints);
GCHandle handle = GCHandle.Alloc(profileBatch);
IntPtr param = (IntPtr)handle;
profiler.RegisterAcquisitionCallback(CallbackFunc, param);
```

Stop Acquisition

Call the `stopAcquisition()` method in the `Profiler` class to stop the acquisition ready status of the laser profiler, in order to avoid accidental triggering of scanning.

C++

```
profiler.stopAcquisition();
```

C#

```
profiler.StopAcquisition();
```

Disconnect

Call the `disconnect()` method in the `Profiler` class to disconnect from the current laser profiler.

C++

```
profiler.disconnect();
```

C#

```
profiler.Disconnect();
```

This topic introduced the basic workflow of using Mech-Eye API to control a laser profiler. The next topic provides the reference manual for Mech-Eye API.

6.4. Reference

Thank you for using Mech-Eye API! Please refer to Mech-Eye API Reference for detailed information.

6.5. Sample Usage Guide

This topic provides the instructions on using the samples for different platforms and languages, as well as the samples of third-party software calling Mech-Eye API.

- C++ (Windows)
- C++ (Ubuntu)
- C#
- Python (Windows)
- Python (Ubuntu)
- VisionPro

6.5.1. C++ (Windows)

This topic introduces how to configure the Mech-Eye API C++ samples with CMake and then build the samples with Visual Studio on Windows.

Sample List

The following samples are currently provided:

- **AcquireProfileData**: Acquire the profile data, generate the intensity image and depth map, and save the images.
- **AcquireProfileDataUsingCallback**: Acquire the profile data using a callback function, generate the intensity image and depth map, and save the images.
- **AcquirePointCloud**: Acquire the profile data, generate the point cloud, and save the point cloud in the CSV and PLY formats.
- **ManageUserSets**: Manage parameter groups, such as obtaining the names of all parameter groups, adding a parameter group, switching the parameter group, and saving parameter settings to the parameter group.
- **RegisterProfilerEvent**: Define and register the callback function for monitoring the laser profiler connection status.

Prerequisites

In order to use the C++ samples of Mech-Eye API, the following prerequisites must be satisfied:

- Connect the laser profiler and computer correctly.
- Obtain the samples.
- Install the required software.
- (Optional) Install the software libraries on which samples depend and add relevant environment variables.

Obtain Samples

C++ samples are included in the installation path of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation path are the version at the time of Mech-Eye SDK release. The version on GitHub may contain the latest changes.

- The samples in the installation path are located in *xxx/Mech-Eye SDK-2.2.1/API/samples/cpp/profiler*.
- The samples cloned from GitHub are located in *xxx/mecheye_cpp_samples/profiler*.

Install Required Software

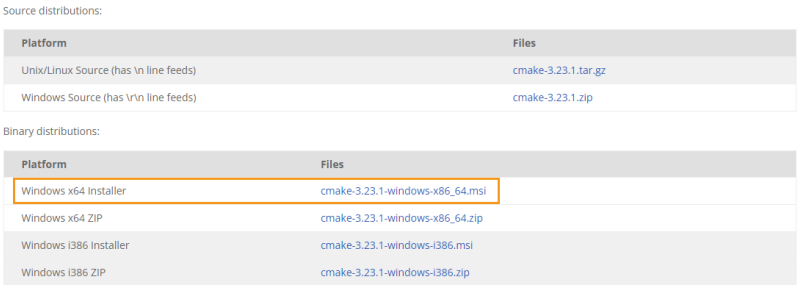
In order to use the C++ samples of Mech-Eye API, Mech-Eye SDK, CMake and Visual Studio must be installed.

Install the Latest Version of Mech-Eye SDK

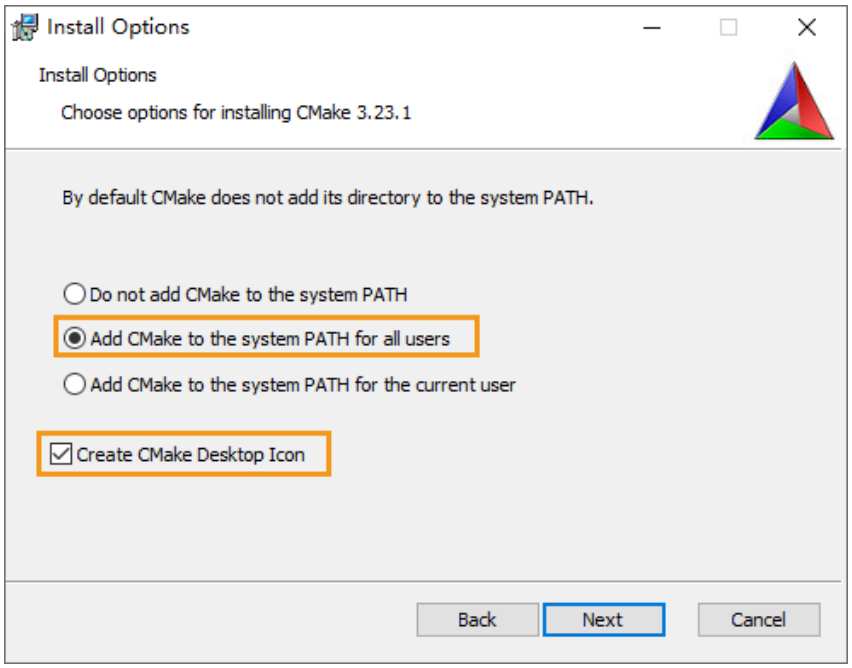
Please install or upgrade Mech-Eye SDK according to *Mech-Eye SDK Installation Guide*.

Install CMake (Version 3.2 or Above)

1. Download CMake: download the installer to the right of **Windows x64 Installer**.



2. When installing, select the following two options to add CMake to environment variables and create a desktop shortcut for CMake.
   - Add CMake to the system PATH for all users
   - Create Cmake Desktop Icon



Install Visual Studio (Version 2017 or Above)

1. Download the Visual Studio installer.
2. When installing, select the following two workloads in the **Desktop & Mobile** category, and then click **[Install]**.
   - Desktop development with C++
   - Universal Windows Platform development

> Please restart your computer after installing Visual Studio. If you still need to install the optional software, you can restart your computer after all installations have been completed.

(Optional) Install Dependent Software Libraries

Some samples contain functions that depend on the following third-party software libraries. If you need to use the samples listed in the table below, you must install the software libraries on which the samples depend.

- OpenCV: version 3.4.5 or above

If any of the optional software libraries is not installed, then you must complete the steps in Disable Unneeded Samples (Optional) before configuring the samples.

Refer to the following table for the samples that depend on third-party software libraries.

Sample
AcquireProfileData
AcquireProfileDataUsingCallback

Install OpenCV

1. Download and install OpenCV. Note down the installation path of OpenCV.
2. Add OpenCV to environment variables:
   a. Right-click **This PC** on the desktop and select **Properties**.
   b. Click **Advanced system settings**, and in the pop-up **System Properties** window, click **[Environment Variables]** to open the **Environment Variables** window.
   c. Double-click **Path** in the user variables to enter the **Edit environment variable** page. Click **[New]** in the upper-right and add the following paths one by one. Then, click **[OK]** to exit the window.
      - *xxx/OpenCV/build/x64/vc14/bin*
      - *xxx/OpenCV/build/x64/vc14/lib*

It is recommended to restart your computer after adding the environmental variables. If not restarted, the environmental variables added may not be effective.

Build and Run Samples

You can build all samples at once or build a single sample individually.

The paths provided in this section correspond to the samples included in the installation path. If you are using the samples cloned from GitHub, please modify the paths correspondingly.

Disable Unneeded Samples (Optional)

If you did not install some of the optional software libraries and still want to build all samples at once, then you must complete the steps in this section. Otherwise, an error will occur during the configuration of samples using CMake.

If you do not need the samples that depend on OpenCV, please edit the CMakeLists file to disable these samples before building all samples at a time.

1. Open **CMakeLists.txt** in *xxx/Mech-Eye SDK-2.2.1/API/samples/cpp/profiler*.
2. Edit the line containing `options`: find the line of `option(USE_OPENCV…)`, change `ON` at the end of the line to `OFF` to disable the samples that depend on OpenCV.
3. Save the changes and close **CMakeLists.txt**.

Configure Samples in CMake

1. Right-click CMake and select **Run as administrator**.
2. Enter the paths of source code and binaries.

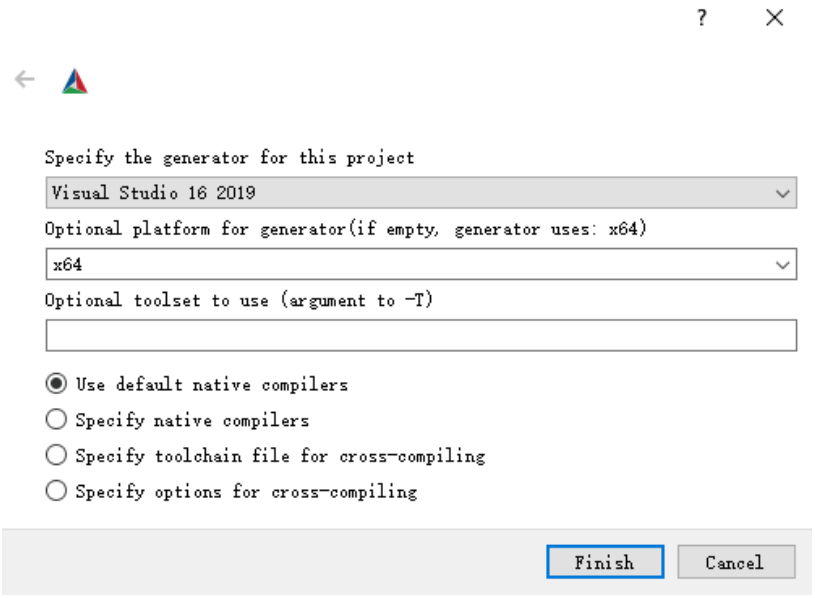
- To build all samples at once, enter the following paths.

Where is the source code	xxx/Mech-Eye SDK-2.2.1/API/samples/cpp/profiler
Where to build the binaries	xxx/Mech-Eye SDK-2.2.1/API/samples/cpp/profiler/build

- To build one sample individually, enter the following paths. Replace **SampleName** with the name of the sample.

Where is the source code	xxx/Mech-Eye SDK-2.2.1/API/samples/cpp/profiler/SampleName
Where to build the binaries	xxx/Mech-Eye SDK-2.2.1/API/samples/cpp/profiler/SampleName/build

3. Click **[Configure]** in the bottom to open the configuration page. Select Visual Studio version, and set the platform to **x64**. Then, click **[Finish]**. When the configuration completes, the log will display **Configuring done**.



4. Click **[Generate]** to generate Visual Studio solution. When the generation completes, the log will display **Generating done**. Then, click **[Open Project]** to open the solution in Visual Studio.

Build Samples in Visual Studio

1. In Visual Studio toolbar, change the solution configuration from **Debug** to **Release**.
2. In the menu bar, select Build › Build Solution. An executable file (.exe) is generated for each sample. The executable files are saved to the **Release** folder, located in the **Where to build the binaries** directory that you entered in CMake.

Run Samples

You can run the samples in Visual Studio after building them, or run the samples by double-clicking the executable files.

Run a Sample in Visual Studio

1. In the **Solution Explorer** panel, right-click a sample, and select **Set as Startup Project**.
2. Click **[Local Windows Debugger]** in the toolbar to run the sample.

   While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

3. If image and/or point cloud files are saved by the sample, you can find the files in the **build** folder (the **Where to build the binaries** directory that you entered in CMake).

Run the Executable File of a Sample

1. Navigate to the **Where to build the binaries** directory that you entered in CMake, and open the **Release** folder.
2. Run the executable file with the same name as the sample.

   While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

3. If image and/or point cloud files are saved by the sample, you can find the files in the **Release** folder.

6.5.2. C++ (Ubuntu)

This topic introduces how to configure the Mech-Eye API C++ samples with CMake and then build the samples with the make command on Ubuntu.

Sample List

The following samples are currently provided:

- **AcquireProfileData**: Acquire the profile data, generate the intensity image and depth map, and save the images.
- **AcquireProfileDataUsingCallback**: Acquire the profile data using a callback function, generate the intensity image and depth map, and save the images.
- **AcquirePointCloud**: Acquire the profile data, generate the point cloud, and save the point cloud in the CSV and PLY formats.
- **ManageUserSets**: Manage parameter groups, such as obtaining the names of all parameter groups, adding a parameter group, switching the parameter group, and saving parameter settings to the parameter group.
- **RegisterProfilerEvent**: Define and register the callback function for monitoring the laser profiler connection status.

Prerequisites

In order to use the C++ samples of Mech-Eye API, the following prerequisites must be satisfied:

- Connect the laser profiler and computer correctly.
- The version of the Ubuntu operating system is 18 or above.
- Obtain the samples.

- Install the required software.
- (Optional) Install software libraries on which the samples depend.

If using a Ubuntu virtual machine, please ensure that the available disk space is greater than 20 GB. Otherwise, installation of the software may fail.

Obtain Samples

C++ samples are included in the installation path of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation path are the version at the time of Mech-Eye SDK release. The version on GitHub may contain the latest changes.

- The samples in the installation directory are located in */opt/mech-mind/mech-eye-sdk/samples/cpp/profiler*.
- The samples cloned from GitHub are located in *xxx/mecheye_cpp_samples/profiler*.

Install Required Software

In order to use the C++ samples of Mech-Eye API, the software source list must be updated, and Mech-Eye SDK and dependencies must be installed.

1. Update software source list:

```
sudo apt-get update
```

2. Install dependencies:

```
sudo apt-get install -y build-essential pkg-config cmake
```

3. Install Mech-Eye SDK: Please refer to Mech-Eye SDK Installation Guide (Ubuntu).

(Optional) Install Dependent Software Libraries

Some samples contain functions that depend on the following third-party software libraries. If you need to use the samples listed in the table below, you must install the software libraries on which the samples depend.

- OpenCV: latest version

If any of the optional software libraries is not installed, then you must complete the steps in Disable Unneeded Samples (Optional) before configuring the samples.

Refer to the following table for the samples that depend on third-party software libraries.

Sample
AcquireProfileData
AcquireProfileDataUsingCallback

Install OpenCV

Execute the following command to install the latest version of OpenCV:

```
sudo apt update && sudo apt install -y unzip
wget -O opencv.zip https://github.com/opencv/opencv/archive/4.x.zip
unzip opencv.zip
mkdir build && cd build
cmake ../opencv-4.x
cmake --build .
sudo make install
```

Build and Run Samples

You can build all samples at once or build a single sample individually.

The paths provided in this section correspond to the samples included in the installation path. If you are using the samples cloned from GitHub, please modify the paths correspondingly.

Disable Unneeded Samples (Optional)

If you did not install some of the optional software libraries and still want to build all samples at once, then you must complete the steps in this section. Otherwise, an error will occur during the configuration of samples using CMake.

If you do not need the samples that depend on OpenCV, please edit the CMakeLists file to disable these samples before building all samples at a time.

1. Open */opt/mech-mind/eye-sdk/samples/cpp/profiler/CMakeLists.txt* in an editor (such as vi).
2. Edit the line containing `options`: find the line of `option(USE_OPENCV…)`, change `ON` at the end of the line to `OFF` to disable the samples that depend on OpenCV.
3. Save the changes in the editor and close the CMakeLists file.

Build the sample

Please follow these steps to run the sample:

1. Enter the directory of the sample(s):
   - If building all samples at once, please use the following command.

     ```
     cd /opt/mech-mind/mech-eye-sdk/samples/cpp/profiler/
     ```

   - If building a single sample individually, please use the following command. Replace **SampleName** with the name of the sample.

     ```
     cd /opt/mech-mind/mech-eye-sdk/samples/cpp/profiler/SampleName/
     ```

2. Create a **build** folder in the directory for saving the built samples and so on.

```
sudo mkdir build && cd build
```

3. Configure and build the sample(s):

```
sudo cmake ..
sudo make
```

If the source code files in the sample folder are altered, please delete the **build** folder and repeat steps 2 and 3 to rebuild the samples.

Run Samples

After building the samples, follow these steps to run the sample:

1. Enter the **build** folder in the directory of the sample(s) (Skip this step if you are running the sample(s) directly after building the sample(s):
   - If all samples were built at once, please use the following command.

     ```
     cd /opt/mech-mind/mech-eye-sdk/samples/cpp/profiler/build/
     ```

   - If a single sample was built individually, please use the following command. Replace **SampleName** with the name of the sample.

     ```
     cd /opt/mech-mind/mech-eye-sdk/samples/cpp/profiler/SampleName/build/
     ```

2. Run the sample: replace **SampleName** with the name of the sample. While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

   ```
   sudo ./SampleName
   ```

3. If image and/or point cloud files are saved by the sample, you can find the files in the **build** folder.

6.5.3. C#

This topic introduces how to build the Mech-Eye API C# samples with Visual Studio on Windows.

Sample List

The following samples are currently provided:

- **AcquireProfileData**: Acquire the profile data, generate the intensity image and depth map, and save the images.
- **AcquireProfileDataUsingCallback**: Acquire the profile data using a callback function, generate

the intensity image and depth map, and save the images.

- **AcquirePointCloud**: Acquire the profile data, generate the point cloud, and save the point cloud in the CSV and PLY formats.
- **ManageUserSets**: Manage parameter groups, such as obtaining the names of all parameter groups, adding a parameter group, switching the parameter group, and saving parameter settings to the parameter group.
- **RegisterProfilerEvent**: Define and register the callback function for monitoring the laser profiler connection status.

Prerequisites

In order to use the C# samples of Mech-Eye API, the following prerequisites must be satisfied:

- Connect the laser profiler and computer correctly.
- Obtain the samples.
- Install the required software.

Obtain Samples

C# samples are included in the installation path of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation path are the version at the time of Mech-Eye SDK release. The version on GitHub may contain the latest changes.

- The samples in the installation path are located in *xxx/Mech-Eye SDK-2.2.1/API/samples/csharp/profiler*.
- The samples cloned from GitHub are located in *xxx/mecheye_csharp_samples/profiler*.

Install Required Software

In order to use the C# samples of Mech-Eye API, Mech-Eye SDK and Visual Studio must be installed.

Install the Latest Version of Mech-Eye SDK

Please install or upgrade Mech-Eye SDK according to *Mech-Eye SDK Installation Guide*.

Install Visual Studio (Version 2019 or Above)

1. Download the Visual Studio installer.
2. When installing, select the following workloads and individual component, and then click **[Install]**.
   - Workloads in the **Desktop & Mobile** category:
     - **.NET desktop development**
     - **Desktop development with C++**
     - **Universal Windows Platform development**
   - Individual component: **.NET Framework 4.8 targeting pack**

C# Mech-Eye API is developed based on .NET Framework 4.8. If .NET Framework 4.8 is not installed, the samples cannot be built.

Install Emgu CV

Some samples contain functions that depend on the OpenCV software libraries. If you need to use the samples listed below, you must install Emgu CV (the .NET wrapper for OpenCV) through NuGet Package Manager in Visual Studio.

For detailed instructions, refer to the guide provided by Microsoft.

- AcquireProfileData
- AcquireProfileDataUsingCallback

Build and Run Samples

After building the samples in Visual Studio, select the appropriate way to run the samples.

Build Samples in Visual Studio

1. Double-click **MechEyeCSharpSamples.sln** in the **profiler** folder.
2. In Visual Studio toolbar, change the solution configuration from **Debug** to **Release**.
3. In the menu bar, select Build › Build Solution. An executable file (.exe) is generated for each sample. The executable files are saved to the **Build** folder, located in the **profiler** folder.

Run Samples

You can run the samples in Visual Studio after building them, or run the samples by double-clicking the executable files.

Run a Sample in Visual Studio

1. In the **Solution Explorer** panel, right-click a sample, and select **Set as Startup Project**.
2. Click **[Local Windows Debugger]** in the toolbar to run the sample.

   While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

3. If image and/or point cloud files are saved by the sample, you can find the files in the **Build** folder.

Run the Executable File of a Sample

1. Enter the **Build** folder in the **profiler** folder.
2. Run the executable file with the same name as the sample.

   While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

3. If image and/or point cloud files are saved by the sample, you can find the files in the **Build** folder.

6.5.4. Python (Windows)

This topic introduces how to obtain and run the Mech-Eye API Python samples on Windows.

Sample List

The following samples are currently provided:

- **acquire_profile_data**: Acquire the profile data, generate the intensity image and depth map, and save the images.
- **acquire_profile_data_using_callback**: Acquire the profile data using a callback function, generate the intensity image and depth map, and save the images.
- **acquire_point_cloud**: Acquire the profile data, generate the point cloud, and save the point cloud in the CSV and PLY formats.
- **manage_user_sets**: Manage parameter groups, such as obtaining the names of all parameter groups, adding a parameter group, switching the parameter group, and saving parameter settings to the parameter group.
- **register_profiler_event**: Define and register the callback function for monitoring the laser profiler connection status.

Prerequisites

In order to use the Python samples of Mech-Eye API, the following prerequisites must be satisfied:

- Connect the laser profiler and computer correctly.
- Make sure that the version of Python installed is between 3.7 and 3.11.

If **Add Python to PATH** was not selected during installation, please add the following two paths to the **Path** environment variable:

  - *xxx/AppData/LocalProgramsPython/Python36/*
  - *xxx/AppData/LocalProgramsPython/Python36/Scripts/*

- Obtain the samples.
- Install the required software.
- (Optional) Install software libraries on which the samples depend.

Obtain Samples

Python samples are included in the installation path of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation path are the version at the time of Mech-Eye SDK release. The version on GitHub may contain the latest changes.

- The samples in the installation path are located in *xxx/Mech-Eye SDK-2.2.1/API/samples/python/profiler*.
- The samples cloned from GitHub are located in *xxx/mecheye_python_samples/profiler*.

Install Required Software

In order to use the Python samples of Mech-Eye API, Mech-Eye SDK and Python Mech-Eye API must be installed.

Install the Latest Version of Mech-Eye SDK

Please install or upgrade Mech-Eye SDK according to *Mech-Eye SDK Installation Guide*.

Install the Latest Version of Python Mech-Eye API

Follow these steps to install the latest version of Python Mech-Eye API:

1. Press Win + R on the keyboard to open Run box. Type “PowerShell” and then press Ctrl+Shift+Enter to run PowerShell as Administrator.
2. Execute the following command to install Python Mech-Eye API:

```
pip install MechEyeAPI
```

(Optional) Install Dependent Software Libraries

Some samples contain functions that depend on OpenCV. If you need to use the samples listed in the table below, OpenCV must be installed (latest version recommended).

- AcquireProfileData
- AcquireProfileDataUsingCallback

Execute the following command to install the latest version of OpenCV:

```
pip install opencv-python
```

Run Samples

The paths provided in this section correspond to the samples included in the installation path. If you are using the samples cloned from GitHub, please modify the paths correspondingly.

Follow these steps to run the samples:

1. Navigate to the folder where a sample is located.

```
cd xxx/Mech-Eye SDK-2.2.1/API/samples/python/profiler
```

2. Run the sample: replace **sample_name** with the name of the sample. While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

```
python sample_name.py
```

3. If image and/or point cloud files are saved by the sample, you can find the files in the folder where the sample is located.

6.5.5. Python (Ubuntu)

This topic introduces how to obtain and run the Mech-Eye API Python samples on Ubuntu.

Sample List

The following samples are currently provided:

- **acquire_profile_data**: Acquire the profile data, generate the intensity image and depth map, and save the images.
- **acquire_profile_data_using_callback**: Acquire the profile data using a callback function, generate the intensity image and depth map, and save the images.
- **acquire_point_cloud**: Acquire the profile data, generate the point cloud, and save the point cloud in the CSV and PLY formats.
- **manage_user_sets**: Manage parameter groups, such as obtaining the names of all parameter groups, adding a parameter group, switching the parameter group, and saving parameter settings to the parameter group.
- **register_profiler_event**: Define and register the callback function for monitoring the laser profiler connection status.

Prerequisites

In order to use the Python samples of Mech-Eye API, the following prerequisites must be satisfied:

- Connect the laser profiler and computer correctly.
- Make sure that the version of Python installed is between 3.7 and 3.11.
- Obtain the samples.
- Install the required software.
- (Optional) Install software libraries on which the samples depend.

Obtain Samples

Python samples are included in the installation path of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation path are the version at the time of Mech-Eye SDK release. The version on GitHub may contain the latest changes.

- The samples in the installation directory are located in */opt/mech-mind/mech-eye-sdk/samples/python/profiler*.
- The samples cloned from GitHub are located in *xxx/mecheye_python_samples/profiler*.

Execute the following command to clone the Python samples from GitHub:

```
cd ~
git clone https://github.com/MechMindRobotics/mecheye_python_samples.git
```

Install Required Software

In order to use the Python samples of Mech-Eye API, dependency libraries, Mech-Eye SDK, and Python Mech-Eye API must be installed.

1. Install Mech-Eye SDK: Please refer to Mech-Eye SDK Installation Guide (Ubuntu).
2. Install pip3 or upgrade pip3 to ensure its version is 20.3.1 or above.

▼ *Instructions*

- Execute the following command to check if pip3 is installed and its version:

```
pip3 -V
```

- Execute the following command to install pip3:

```
sudo apt install python3-pip
```

- Execute the following command to upgrade pip3:

```
python3 -m pip install --upgrade pip
```

3. Upgrade g++ to ensure that its version is 12 or above.

If the g++ version is lower than 12, `import` will fail.

▼ *Instructions*

1. Execute the following command to install a later version g++ (using g++ 13 as an example):

```
sudo add-apt-repository ppa:ubuntu-toolchain-r/test
sudo apt-get update
sudo apt install g++-13
```

2. Use the `ls` command to check the installed versions of g++:

```
ls usr/bin/g++*
```

3. Execute the following command to add all installed versions of g++ as alternatives (using g++ 9 and g++ 13 as examples):

The number at the end of the command is priority. The larger the number, the higher the priority.

```
sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-9 10
sudo update-alternatives --install /usr/bin/g++ g++ /usr/bin/g++-13 20
```

4. Execute the following command to select the g++ version. Enter the number corresponding to the later version g++ to select this version.

```
sudo update-alternatives --config g++
```

5. Execute the following command to check if the later version g++ is successfully selected:

```
g++ --version
```

4. Install Python Mech-Eye API.

```
sudo pip3 install MechEyeApi
```

(Optional) Install Dependent Software Libraries

Some samples contain functions that depend on OpenCV. If you need to use the samples listed in the table below, OpenCV must be installed (latest version recommended).

- AcquireProfileData
- AcquireProfileDataUsingCallback

Execute the following command to install the latest version of OpenCV:

```
sudo apt-get install libopencv-dev
sudo apt-get install python3-opencv
```

Run Samples

The paths provided in this section correspond to the samples included in the installation path. If you are using the samples cloned from GitHub, please modify the paths correspondingly.

Follow these steps to run the samples:

1. Navigate to the folder where a sample is located.

```
cd ~/opt/mech-mind/mech-eye-sdk/samples/python/profiler
```

2. Run the sample: replace **sample_name** with the name of the sample. While the sample is running, input the index of the laser profiler to which you want to connect according to the instruction, and press `Enter` to connect to the laser profiler.

```
sudo python3 sample_name.py
```

3. If image and/or point cloud files are saved by the sample, you can find the files in the folder where the sample is located.

When writing your own program, use the import command to import Mech-Eye API first:

```
python3
```

```
import MechEye
import open3d
```

6.5.6. VisionPro

This topic introduces how to use the VisionPro sample provided by Mech-Mind to connect to the laser profiler and obtain 2D and 3D data through C# Mech-Eye API.

Sample List

The following samples are currently provided:

- **AcquireIntensityAndRangeImagesEncoder**: Trigger line scans with an encoder, obtain intensity and depth data, and generate the Cognex-format intensity image (CogImage8Grey) and depth map (CogImage16Range).
- **AcquireIntensityAndRangeImagesFixedRate**: Trigger line scans at a fixed rate, obtain intensity and depth data, and generate the Cognex-format intensity image (CogImage8Grey) and depth map (CogImage16Range).

Prerequisites

In order to use the VisionPro samples, the following prerequisites must be satisfied:

- Connect the laser profiler and computer correctly.
- Obtain the samples.
- Install the required software.

Obtain Sample

VisionPro samples are included in the installation path of Mech-Eye SDK or can be obtained from GitHub by cloning. The samples in the installation path are the version at the time of Mech-Eye SDK release. The version on GitHub may contain the latest changes.

- The samples in the installation path are located in *xxx/Mech-Eye SDK-2.2.1/API/samples/visionpro/profiler*.
- The samples cloned from GitHub are located in *xxx/mecheye_visionpro_samples/profiler*.

Install Required Software

In order to use the VisionPro samples, Mech-Eye SDK and VisionPro must be installed.

- Mech-Eye SDK: Install the latest version or upgrade according to *Mech-Eye SDK Installation Guide*.
- Cognex VisionPro: Version 9.8 SR1 has been tested.

Configure and Run Sample

The sample can be run after the necessary configurations are completed.

Copy Dynamic-Link Libraries

To call Mech-Eye API in VisionPro, the dynamic-link libraries of Mech-Eye SDK must be copied to the installation path of VisionPro first.

Follow these steps to copy the dynamic-link libraries:

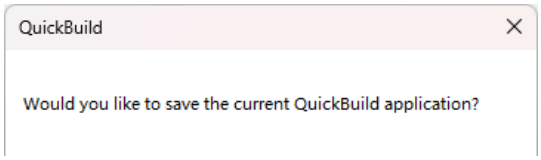
1. Go to the installation path of Mech-Eye SDK and open the following folder: *xxx/Mech-Eye SDK-2.2.1/API/dll*.
2. Copy the following dynamic-line library files (.dll) in the above folder:
   - MechEyeApi
   - MechEyeAPiNet
   - MechEyeApiWrapper
3. Go to the installation path of VisionPro, open the **bin** folder, and paste the copied dynamic-link library files.

Configure Referenced Assembly of Script

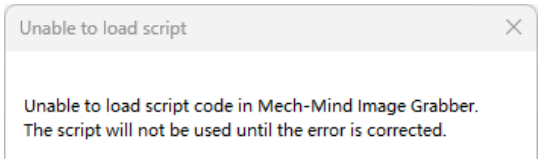
After copying the dynamic-link libraries, you need to configure the path of the referenced assembly in the script of the sample.

Follow these steps to configure the referenced assembly:

1. Open VisionPro QuickBuild and select **Open QuickBuild Application** in the **File** menu.
2. In the pop-up window, select the VisionPro sample to be used, and click the **[Open]** button.
3. The following window will pop-up. Click the **[No]** button in the window to close it.



4. The following window may pop-up. If it pops up, click the **[OK]** button in the window to close it.



5. In the left panel of VisionPro QuickBuild, double-click **Mech-Eye 3D Laser Profiler**.
6. In the left panel of the popped up Job Editor window, double-click **Mech-Mind Image Grabber**.
7. In the toolbar of the popped up **Mech-Mind Image Grabber** window, click the button.
8. In the toolbar of the popped up **Mech-Mind Image Grabber Script** window, click the button.
9. In the popped up **Add / Remove Referenced Assemblies** window, scroll down to the bottom and double-click the **MechEyeApiNet.dll** row.
10. In the popped up **Enter Assembly Name** window, click the **[Browse.....]** button, navigate to the folder where the dynamic-link libraries are located in the Mech-Eye SDK installation path (*xxx/Mech-Eye SDK-2.2.1/API/dll*), and select the **MechEyeApiNet** dynamic-link library file.

11. Click the [OK] button in the **Enter Assembly Name** window to close it, and then click the [OK] button in the **Add / Remove Referenced Assemblies** window to close it.

Set Laser Profiler IP Address

Before running the sample, you need to set the IP address of the laser profiler in the script, so that the laser profiler can be successfully connected.

> You can modify the IP address of the laser profiler using Mech-Eye Viewer or the IP configuration tool.

Follow these steps to set the IP address of the laser profiler:

1. In the **Mech-Mind Image Grabber Script** window, locate the following line and change the IP address in it to the actual IP address of the laser profiler to be connected.

```
status = profiler.Connect("192.168.20.15", 10000)
```

2. Click the button in the toolbar to make the change take effect.
3. Close the **Mech-Mind Image Grabber Script** and **Mech-Mind Image Grabber** windows to return to the Job Editor window.

Run Samples

Follow these steps to run the sample and view the obtained intensity image and depth map:

1. In the toolbar of the Job Editor window, click the button to run the sample.
2. In the left panel, double-click the corresponding tool to view the obtained intensity image or depth map:
   - Intensity image: Double-click **CogAffineTransformTool1**.
   - Depth map: Double-click **Cog3DVisionDataReRenderTool1**.
3. If the obtained images do not meet your requirements, refer to the next section and adjust the laser profiler parameters to improve the quality of the data.

Adjust Laser Profiler Parameters

The laser profiler parameters can be adjusted in Mech-Eye Viewer or in the sample through C# Mech-Eye API. It is recommended to use Mech-Eye Viewer to adjust parameters, as it provides a graphical user interface where you can acquire data immediately after adjusting the parameters to see the effect.

- Adjust parameters using Mech-Eye Viewer: Please refer to How to Use for instructions on connecting to the laser profiler, acquiring data, viewing current parameter values, and adjusting parameters in Mech-Eye Viewer.
- Adjust parameters in the sample through C# Mech-Eye API: To adjust the laser profiler parameters in the sample, you need to add the corresponding methods of C# Mech-Eye API to the script of the sample. Please refer to the following contents and edit the script of the sample.
  - C# Mech-Eye API samples: Refer to C# for an overview of the available samples, where to obtain them, and how to use them.

- Mech-Eye API Reference: Explanations of the methods in C++ Mech-Eye API are provided here.

6.6. Tools

6.6.1. Firmware Upgrade Tool

With this tool, you can upgrade the laser profiler firmware on Ubuntu directly, simplifying the processing of firmware upgrade.

The firmware upgrade tool can be obtained from Mech-Mind Download Center.

The firmware upgrade tool consists of two parts: an executable file named **firmware_upgrader** and a compressed file named **mmind_eye_v2.2.1**.

Follow these steps to upgrade the firmware:

1. Execute the following command to give execute permission to the firmware upgrade tool.

```
chmod 777 xxx/firmware_upgrader
```

2. Execute the following command to upgrade the firmware.

```
sudo xxx/firmware_upgrader xxx/mmind_eye_v2.2.1.zip
```

- Enter the path of **firmware_upgrader** first, followed by the path of **mmind_eye_v2.2.1.zip**. Otherwise, the firmware upgrade tool cannot be executed.
- The two paths must be separated by a space. Otherwise, the firmware upgrade tool cannot be executed.

3. Input the index of the laser profiler whose firmware needs to be upgraded according to the instruction, and press `Enter` to connect to the laser profiler. If **Upgrade Completed** is displayed, the firmware was successfully upgraded.

If the firmware upgrade failed, please retry or contact Technical Support.

6.6.2. IP Configuration Tool

With this tool, you can modify the IP configuration of the laser profiler on Ubuntu directly, simplifying the processing of IP configuration.

Prerequisites

In order to use the IP configuration tool, the following prerequisites must be satisfied:

Download and install Mech-Eye SDK 2.2.0 or above to obtain the IP configuration tool.

The IP configuration tool is an executable file named **ip_configurator**, located in */opt/mech-mind/mech-eye-sdk/bin*.

The IP configuration tool is independent from Mech-Eye SDK. You can move this executable file to

another location and run it on its own.

Instructions

Follow these steps to modify the IP configuration of the laser profiler:

1. Execute the following command to run the IP configuration tool. Replace the path with the actual path where the **ip_configurator** executable file is located.

   ```
   sudo /opt/mech-mind/mech-eye-sdk/bin/ip_configurator
   ```

2. Input the index of the laser profiler whose IP configuration needs to be modified according to the instruction, and press `Enter` to connect to the laser profiler.
3. Select the IP address assignment method based on the prompt: `0` is to assign the IP address dynamically, and `1` is to set a static IP address.
   - To assign an IP address dynamically, proceed to step 6.
   - To set a static IP address, proceed to the next step.
4. Enter the IP address to be set and press the `Enter` key.
5. Enter the subnet mask to be set and press the `Enter` key. To set the subnet mask to `255.255.255.0`, you can enter `0` and then press the `Enter` key.
6. The old and new IP configuration of the laser profiler will be printed in the window. Please check if the new IP configuration is correct:
   - If correct, enter `1` and press the `Enter` key to complete the IP configuration.
   - If incorrect, enter `0` and press the `Enter` key. The program will list all the available laser profilers again. Please go back to step 2 and repeat the process.

7. Laser Profiler Hardware User Manual

7.1. Laser Profiler Models

The sensor head of the laser profiler comes in multiple models. This topic provides the comparison of key specifications and suitable applications for the models.

Comparison of Key Specifications

The following table provides the comparison of key specifications of LNX-8030, LNX-8080, and LNX-8300. For all technical specifications of the laser profiler, please refer to Technical Specifications.

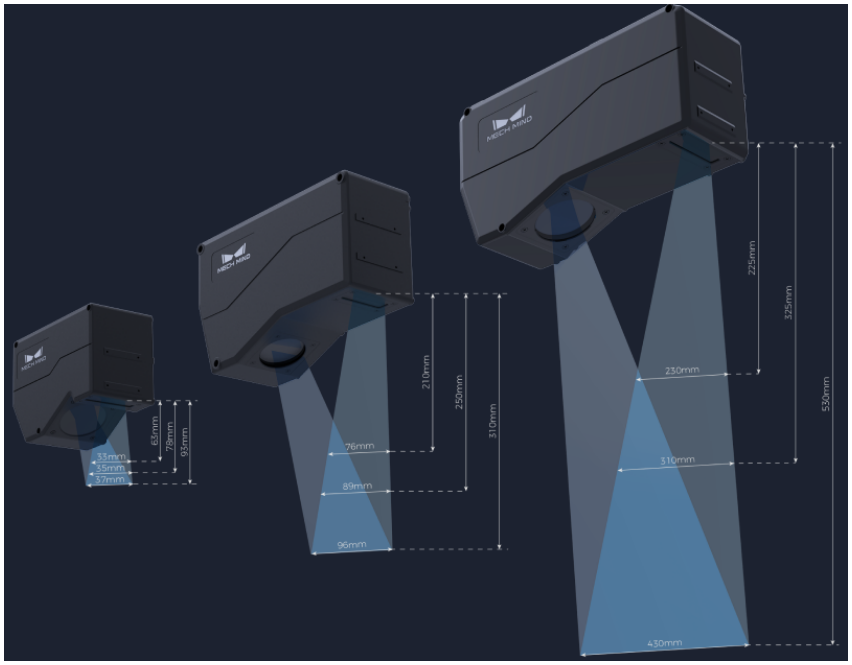
Model			LNX-8030	LNX-8080	LNX-8300
Data points per profile			4096		
Scan rate			3.3–15 kHz		
Reference distance (RD)			78 mm	250 mm	325 mm
Measurement range(1)	Z-axis		30 mm	100 mm	305 mm
	X-axis	Near	33 mm	76 mm	230 mm
		RD	35 mm	89 mm	310 mm
		Far	37 mm	96 mm	430 mm
X-axis resolution			9 μm	23.5 μm	105 μm
Lens inclination(2)			30°	22°	19°

(1) Please refer to Comparison of FOV below.

(2) Please refer to the diagrams in the hardware manual.

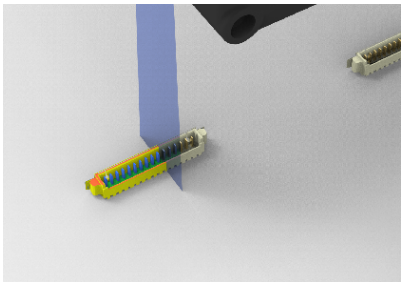
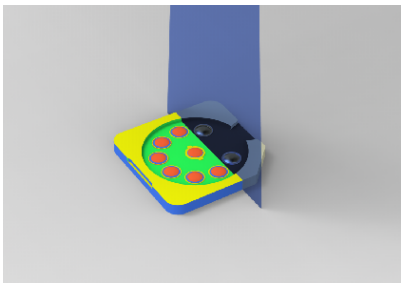
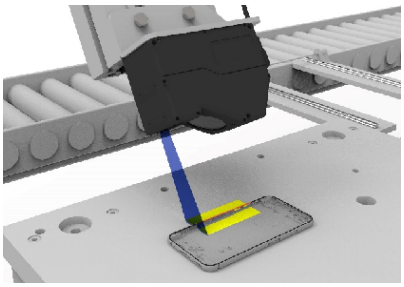
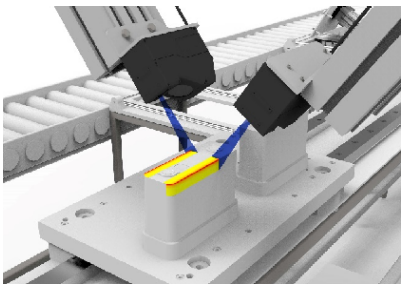
Comparison of FOV

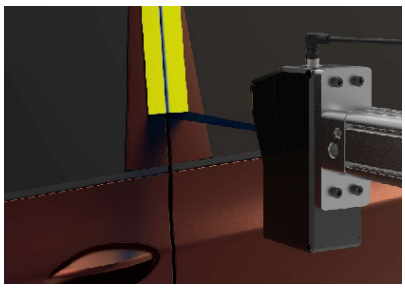
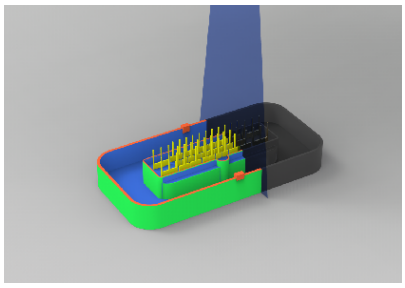
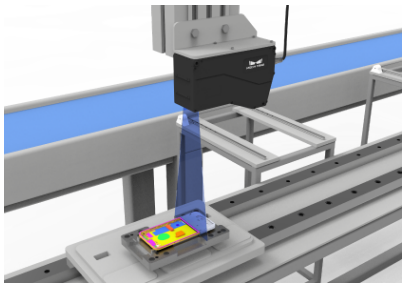
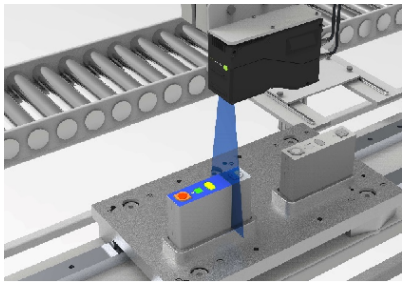
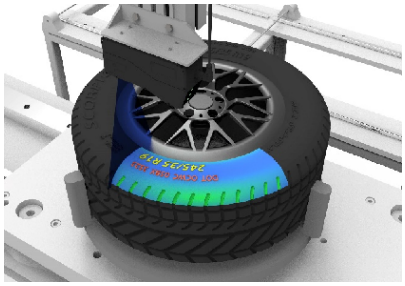
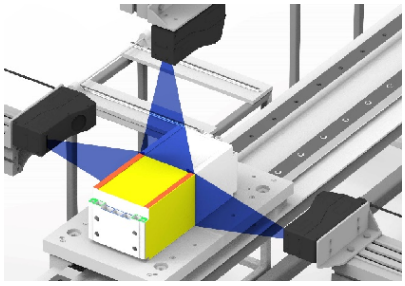
The comparison of the FOV of each sensor head model is shown in the following figure:



Suitable Applications

all the sensor head models have high scan rate and high resolution. You can select the model with the appropriate FOV based on the size of the measurement target and the suitable applications of each model provided below.

Model	Suitable Applications	
LNX-8030	Height measurement of connector pins	
	Height measurement of solder joints	
	Quality inspection of glue on smartphone housings	
	Quality inspection of welding joints on EV battery cell lids	

Model	Suitable Applications	
LNX-8080	Gap inspection of automotive doors	
	Inspection of height / true position of automotive connector pins	
	Measurement of flatness / height difference of smartphone housings	
	Measurement of flatness / height difference of EV battery cell lids	
LNX-8300	Recognition of tire's DOT code	
	Dimension measurement of EV battery modules	

7.2. LNX-8030 / LNX-8080 / LNX-8300

Welcome

Mech-Eye 3D Laser Profiler consists of a sensor head and controller. You can control the product with the accompanying software Mech-Eye SDK and obtain image and point cloud data.

LNX-8030 is used as an example in this manual. The diagrams are for illustrative purposes only. The actual product may differ.

Safety Instructions

- To ensure safe use, please do not use the product until you have read this manual and familiarized yourself with the correct usage. Improper use and maintenance may damage the product or cause other hazards. Mech-Mind shall not be liable for any injury or damage brought upon the user or any third party due to improper use and maintenance.
- Following the instructions and warnings in this manual can lower risks, but cannot eliminate risks. If the product is not used according to this manual, some features may not function normally, or the product may be damaged.
- Every step has been inspected during the drafting of this manual. Please do not hesitate to contact Mech-Mind if you find any mistakes in the manual or have any questions.
- The product is to be mounted, connected, used, and maintained by trained adults only. To ensure safe operation, the product should be transported, stored, mounted, connected, used, and maintained properly.
- Laser is hazardous; please familiarize yourself with the content in Laser Safety before using the product.

Operating Environment

- Do not use the product in locations with explosion hazards. It is PROHIBITED to place any explosive or flammable substances near the product.
- Do not expose the product to open fire or high temperature. Do not place the product in fire or crush the product mechanically. Doing so may cause explosion.
- Do not use the product in environments with extremely high or low temperatures or large temperature variations. The operating temperature of the product is 0–45°C.
- Please use the product indoors.
- Please use the product at altitudes below 4000 meters.
- Please install the product in a well-circulated, open place. Do not place the product in humid and dusty locations.
- Do not install the product under direct sunlight or close to lighting devices. If inevitable, please use shading device to ensure that the product is protected from light interference.
- Do not install the product in locations subjected to vibration or impact.
- Do not install the product in locations where water, oil, or other substance may splash onto the product.

Mounting the Product

- To ensure that the heat from the sensor head is well dissipated, please mount it to a metal plate.

- Install the product and cables away from high voltage lines.
- Do not supply power to the product until the product is securely mounted and the cables are correctly connected.

Using the Product

- When using the product for the first time, remove the protective films on the sensor head.
- Before using, please check the product carefully for damage, signs of water entry, suspicious odor, smoke, loose or damaged bolts, etc., and make sure that the product is in proper working conditions. If any of the above abnormalities occurs, please disconnect the power immediately.
- After the product is powered on, wait at least 30 minutes before using the product. Otherwise, data quality may be unstable. While adjusting the parameters, do not turn off the power. Doing so may lead to loss of the parameter adjustments.
- High temperature will age the power cable. Please check the power cable regularly for signs of aging. If the power cable has aged, please contact Mech-Mind to acquire a replacement.
- The surface of the product may become hot after long time of use. Please use caution to avoid injury.
- Do not collide with, throw, or drop the product. Strong shock or vibration may lead to damage of the product or malfunction.
- Do not allow any foreign object, such as metal pieces, dust, paper, and wood chips, to enter the product. Doing do so may lead to fire, electric shock, malfunction, etc.

Using DIN Rail Power Supply

- Please install the DIN rail power supply inside a control cabinet. Do not install the DIN rail power supply in a place that is difficult to disconnect the power.
- Do not use the product if the power connector or DIN rail power supply is wet.
- Do not heat or put the DIN rail power supply and power cable in fire.
- Please use the specified voltage. Failure to do so may lead to fire or electric shock. If a replacement is required, please use a DIN rail power supply that satisfies relevant safety standards.
- Use copper conductors only.

Laser Safety

- Wear laser safety glasses while using the product.
- The product emits laser beam. Please avoid direct eye exposure to the laser beam. Do not look into the laser beam or the reflected light directly. Do not direct the laser beam at persons. Observing the laser beam may cause visual disturbances such as dazzling and afterimages. Please strictly follow the operational and adjustment requirements in this manual.
- Do not look into the laser beam with optical instruments (such as telescopes). Doing so may lead to eye injuries.
- The laser beam must be lower or higher than and never at eye level.
- Be cautious of the path of the laser beam. Do not enter the areas that the laser beam or reflected light reaches. Do not place reflective objects on the path of the laser beam. Specular or diffuse reflections of the laser beam may result in exposure to the reflected light. Please block the reflections by installing protective enclosure.

- Failure to use the product according to this manual may lead to exposure to harmful laser radiation.
- Do not disassemble the product. The product lacks a mechanism to cease laser emission when disassembled.
- LASER ENERGY - EXPOSURE NEAR APERTURE MAY CAUSE BURNS.

Notice for Disposal

- Please comply with local laws and regulations when disposing of the product to avoid polluting the environment. Do not dispose of the old battery in domestic waste. Do not dispose of the product irresponsibly. Improper disposal may pollute the environment.
- The pollution degree of the product is 3.

Certifications

The product is compliant with the following standards and assessment requirements. Please note that the certification statuses may be updated. For more information, please contact the local sales agents.

Compliant with the following requirements and standards:

- European Electromagnetic Compatibility Standards
- U.S. ANSI C63.4 and 47 CFR PART 15B
- Canada ICES-003
- Japan VCCI-CISPR 32:2016
- South Korea KS C 9832 and KS C 9835

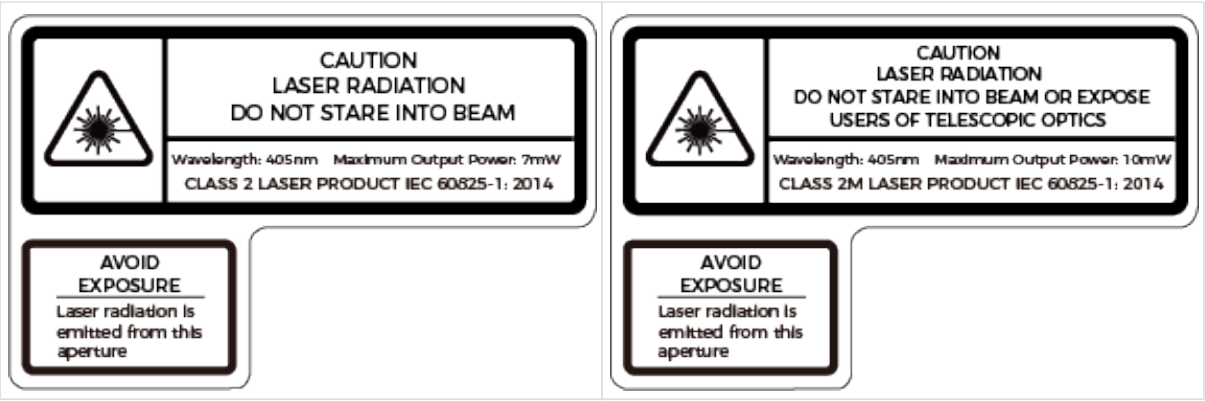
Safety of Laser Products

The laser classification is implemented based on IEC 60825-1:2014 in accordance with the requirements of Laser Notice No. 56 of the FDA (CDRH).

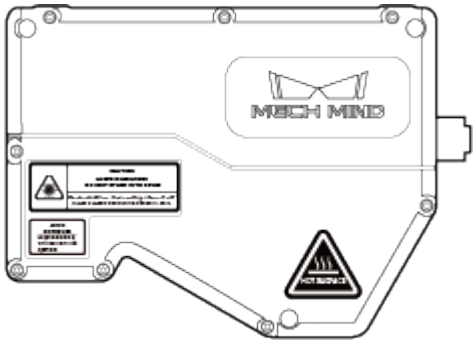
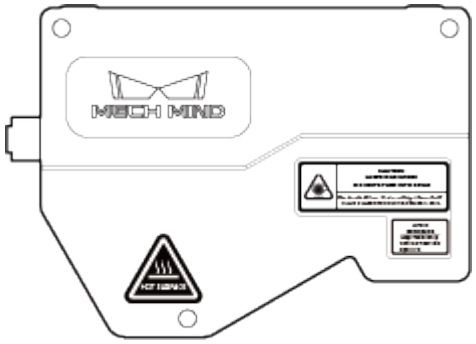
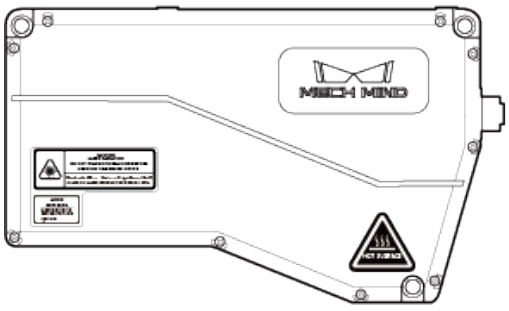
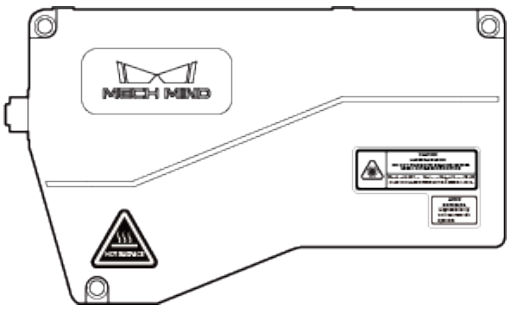
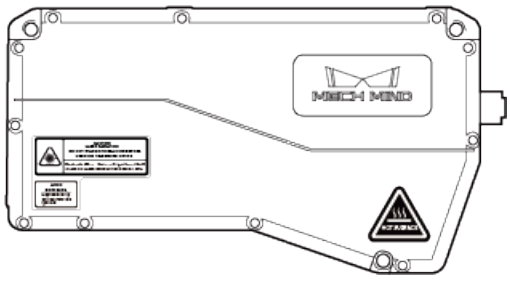
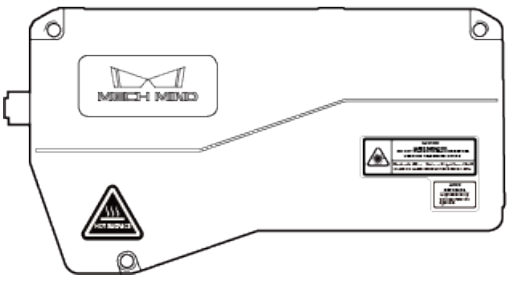
Model	Wavelength	Max. output power	Laser class
LNX-8030	405 nm	7 mW	Class 2
LNX-8080		10 mW	Class 2M
LNX-8300		10 mW	Class 2M

Warning Label

Class 2	Class 2M



Warning Label Attachment

LNX-8030		
LNX-8080		
LNX-8300		

CE

Hereby [Mech-Mind Robotics Technologies Ltd.] declares that [LNX-8030], [LNX-8080], [LNX-8300], and [LNX-8000C] are in compliance with the Electromagnetic Compatibility Directive 2014/30/EU.

The full text of the EU Declaration of Conformity is available at https://downloads.mech-mind.com/?tab=tab-eu-dec

European Electromagnetic Compatibility Standards

- EN 55032:2015+A1:2020+A11:2020
- EN IEC 61000-3-2:2019+A1:2021
- EN 61000-3-3:2013+A1:2019+A2:2021
- EN 55035:2017+A11:2020

All products bearing this symbol are waste electrical and electronic equipment (WEEE as in directive 2012/19/EU) which should not be mixed with unsorted household waste. Instead, you should protect human health and the environment by handing over your waste equipment to a designated collection point for the recycling of waste electrical and electronic equipment, appointed by the government or local authorities. Correct disposal and recycling will help prevent potential negative consequences to the environment and human health. Please contact the local authorities for more information about the location as well as terms and conditions of such collection points.

FCC

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation of the device.

“Le présent appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes : (1) l’appareil ne doit pas produire de brouillage, et (2) l’utilisateur de l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.”

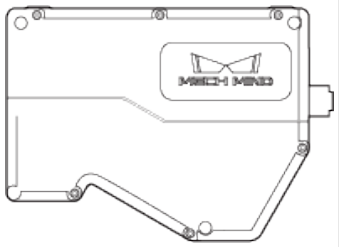
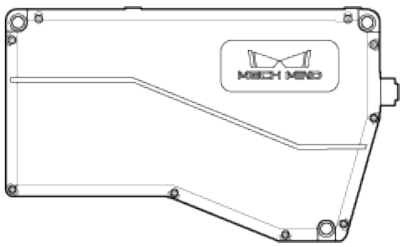
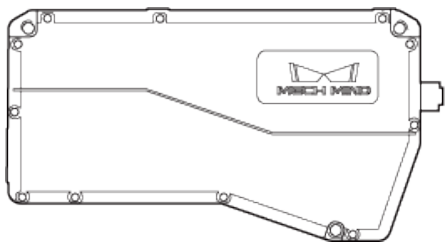
VCCI

This is a Class A equipment. Operation of this equipment in a residential environment could cause radio interference. In such a case, the user may be required to take corrective actions.

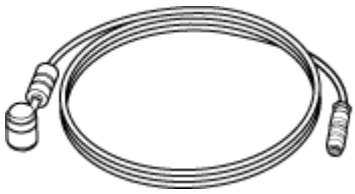
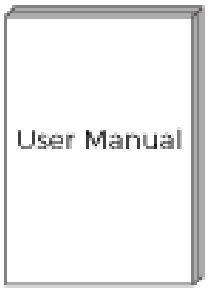
VCCI-A

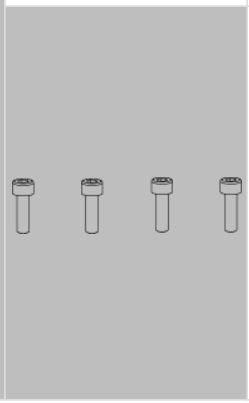
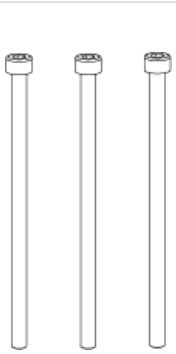
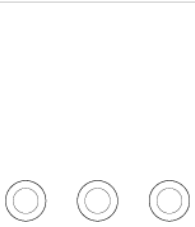
Package Contents

Sensor Head

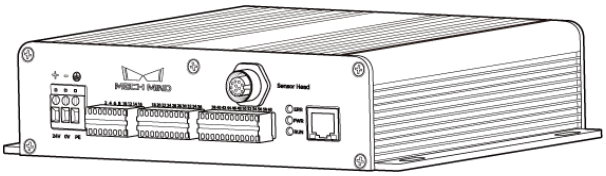
LNX-8030	LNX-8080	LNX-8300
		

Sensor Head Accessories

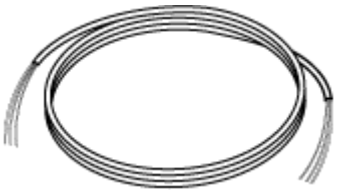
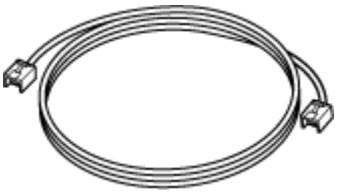
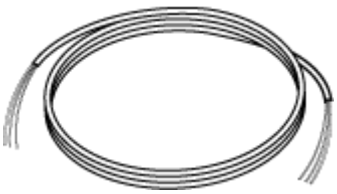
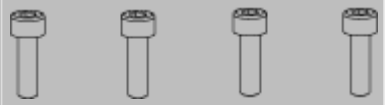
Sensor-head-to-controller cable CBL-H2C-5M-LU	
User manual	

Accessory bag	M5 × 8 bolts (Qty: 4)	M5 × 70 bolts (Qty: 3)	Φ5 washers (Qty: 3)	Zip ties (Qty: 50)	4 mm hex key (Qty: 1)
					

Controller (LNX-8000C)



Controller Accessories

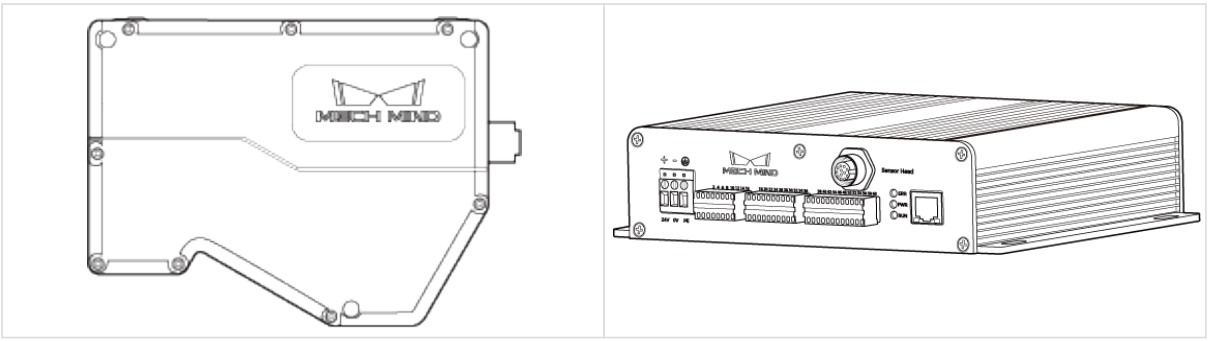
Controller DC power cable CBL-CTRL-PWR-3M		
Controller Ethernet cable CBL-CTRL-ETH-3M		
Encoder cable CBL-CTRL-EN-3M		
Accessory bag	M5 × 8 bolts (Qty: 4) 	Flat screwdriver (Qty: 1) 

- Before using, please make sure that the package is intact, the sensor head and controller are not damaged, and no accessories are missing. Please contact Mech-Mind if any items are damaged or missing.

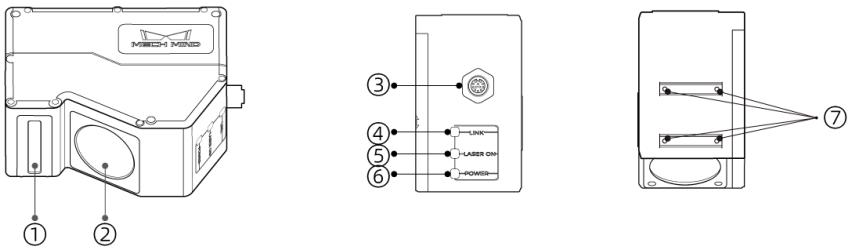
- Detailed descriptions of cable dimensions are provided in Cables.

Functional Diagrams

This product consists of a sensor head and controller.

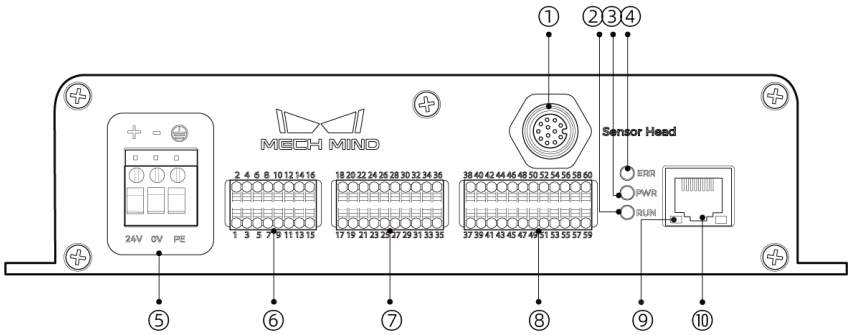


Sensor Head



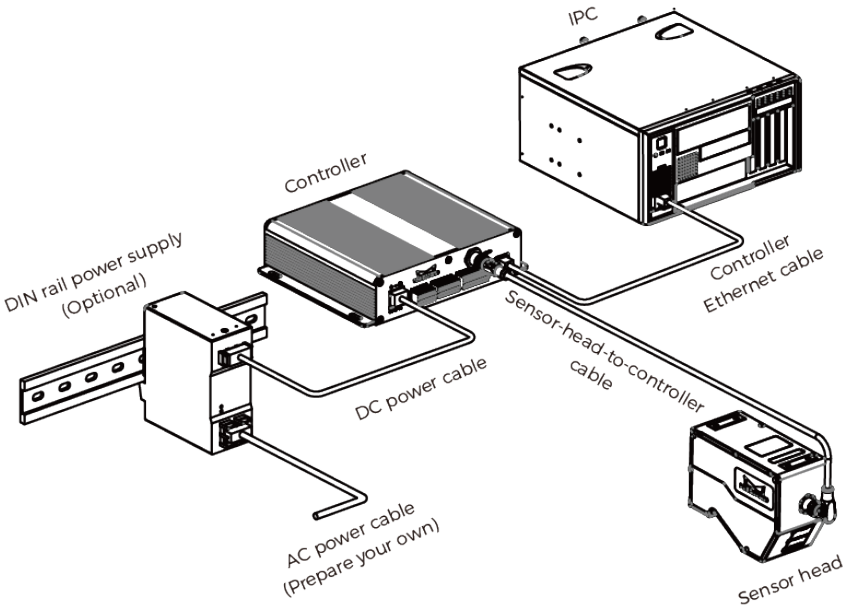
No.	Name	Function
①	Laser emitter	Emits laser light.
②	Receiver unit	Receives the laser light reflected by the target surface.
③	Controller port	Used to connect to the controller. See Controller Port for details.
④	LINK indicator light	Off: not connected to network
		Blinking green: data in transmission (2.5 Gbps)
		Blinking yellow: data in transmission (10/100/1000 Mbps)
⑤	LASER ON indicator light	Off: laser light not emitted
		Solid on: laser light being emitted
⑥	POWER indicator light	Off: not connected to power
		Solid green: normal voltage
⑦	Shading device mounting hole	Used to mount shading device onto the sensor head.

Controller



No.	Name	Function
①	Sensor head port	Used to connect to the sensor head. See Sensor Head Port for details.
②	RUN indicator light	On: data acquisition in progress
		Off: no ongoing data acquisition
③	PWR indicator light	Solid green: normal voltage
		Off: abnormal voltage or not connected to power
④	ERR indicator light	Blinking: malfunctioning
		Off: operating normally
⑤	Power connector	24V: +24 VDC input
		0V: 0 VDC input
		PE: grounding
⑥	Input signal connector	See Input Signal Terminals for details.
⑦	Output signal connector	See Output Signal Terminals for details.
⑧	Encoder signal connector	Used to connect to the encoder. See Encoder Signal Terminals for details.
⑨	Network indicator light	Blinking: data transmission in progress
		Solid: no ongoing data transmission
⑩	RJ45 Ethernet port	Used to connect the RJ45 connector of the Ethernet cable.

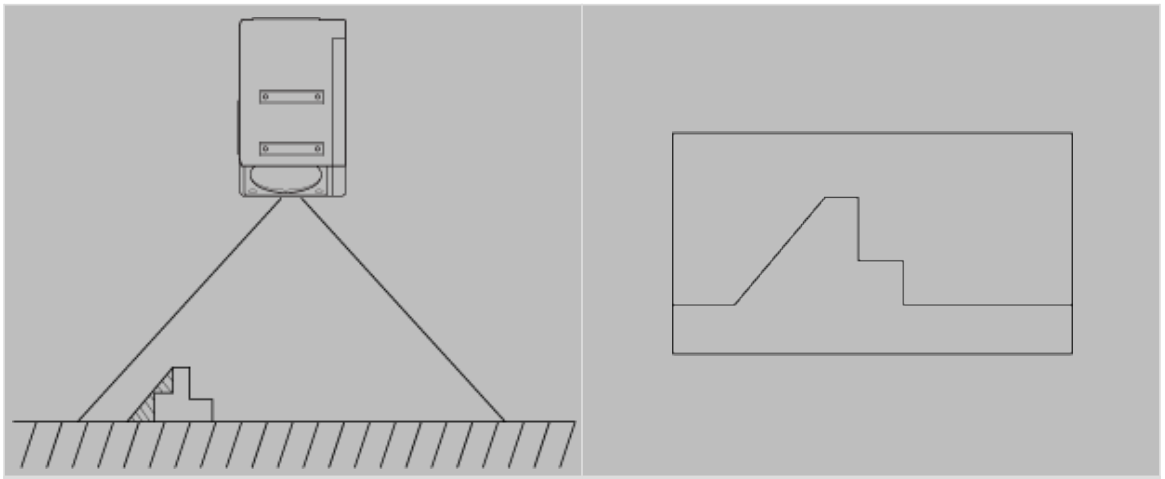
Mounting and Connection



Mount the Sensor Head

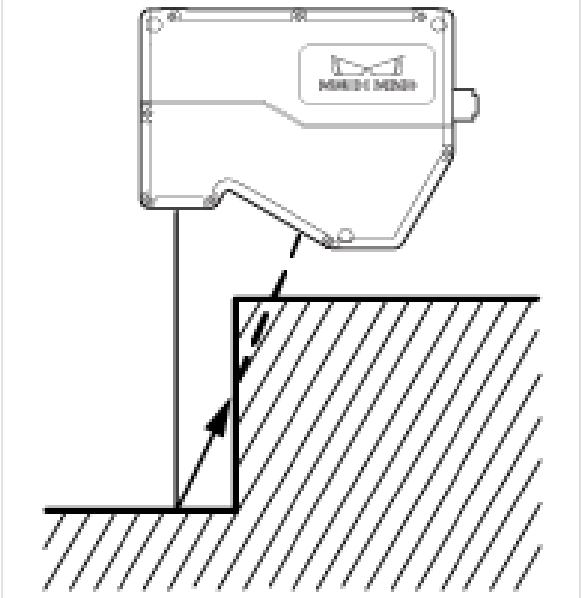
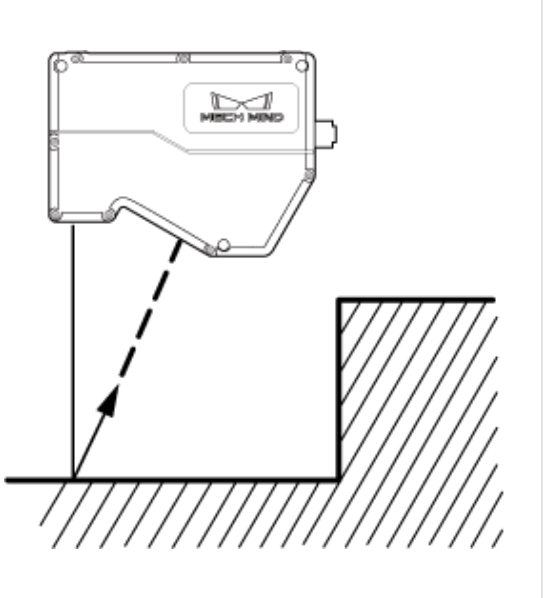
Before Mounting the Sensor Head

- The shape of the target object may produce blind spots in the measurement range. Please evaluate the effect of blind spots on scanning before mounting the sensor head. The laser light of this product is emitted almost in parallel, and therefore blind spots are rarely present.

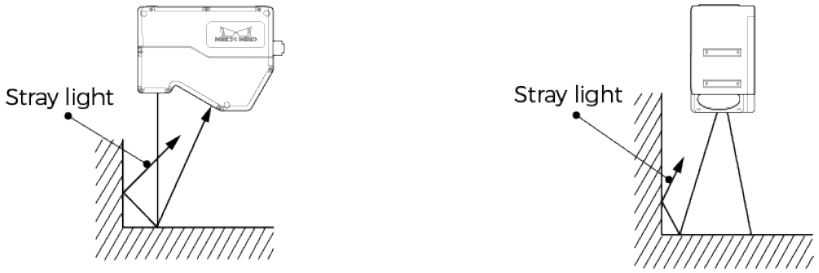


Shadowed area represents blind spot	Obtained profile

- Make sure that the laser light reflected by the target object is not blocked and can reach the receiver unit.

Incorrect	Correct
	

- Stray light is produced if the laser light is reflected by surrounding objects such as walls. Please evaluate the effect of stray light on scanning before mounting the sensor head.



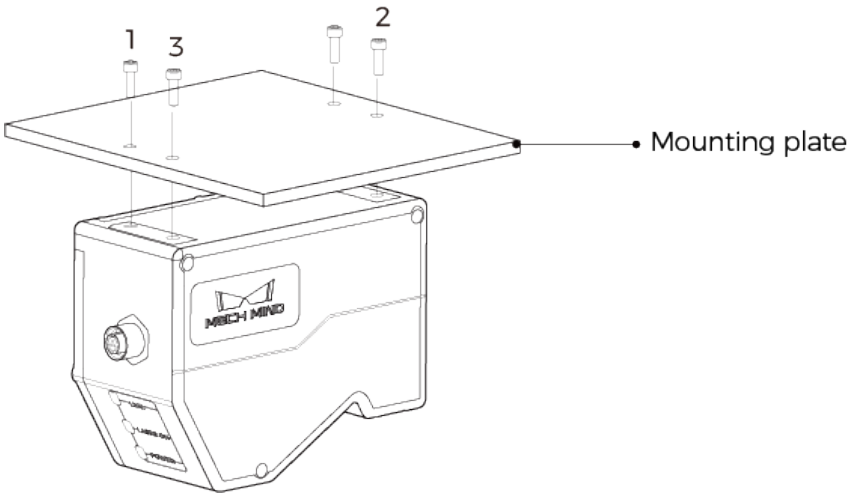
- To ensure that the heat from the sensor head is well dissipated, please mount it to a metal plate that has at least one surface with an area of 200 square centimeters or more.

Mounting Method

If the mounting plate is too thick, please prepare M5 bolts with the appropriate length. Please prepare M5 nuts and open-end wrench.

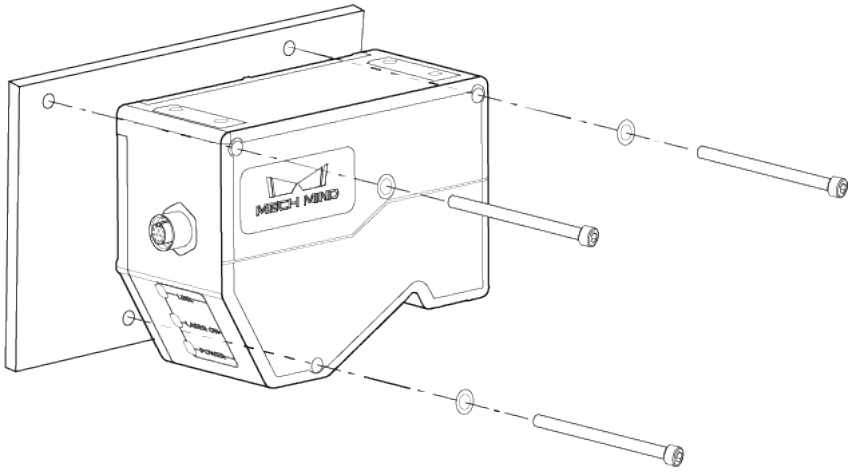
Method 1

As shown below, place four M5 × 8 bolts in the holes, use the 4 mm hex key to loosely screw on the bolts in the specified order, and then fully tighten all the bolts in the specified order.



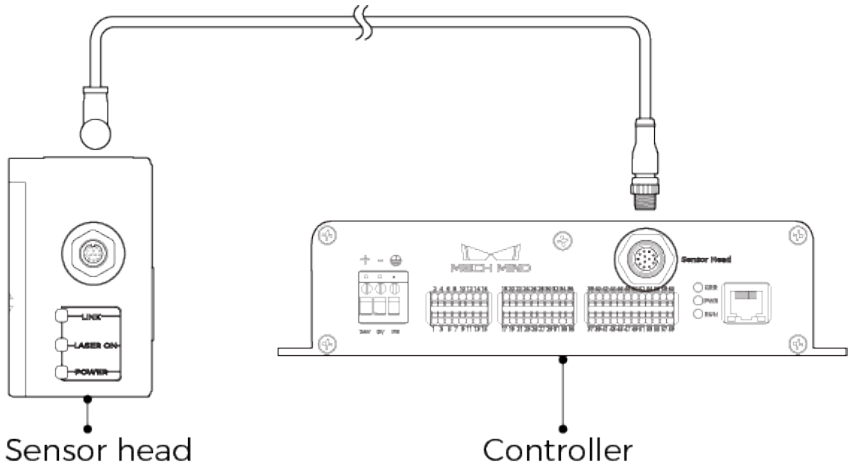
Method 2

As shown below, place the Φ5 washers and then the M5 × 70 bolts in the holes, and then use an open-end wrench to tighten the nuts.



Connect Sensor Head and Controller

Connect the right-angle connector of the sensor-head-to-controller cable to the controller port on the sensor head and the straight connector to the sensor head port on the controller.



1. When inserting the connectors, align the bump in the connector with the notch in the port.

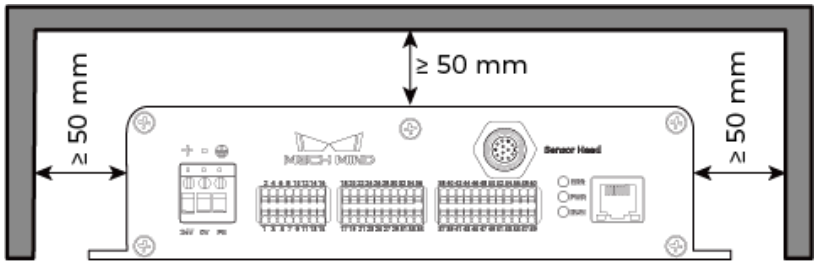
2. Tighten the nut. The recommended tightening torque is 0.7 N·m. A gap of about 2 mm remains after the nut is fully tightened.

Please fasten the cables properly to avoid damaging the cables or connectors due to strain.

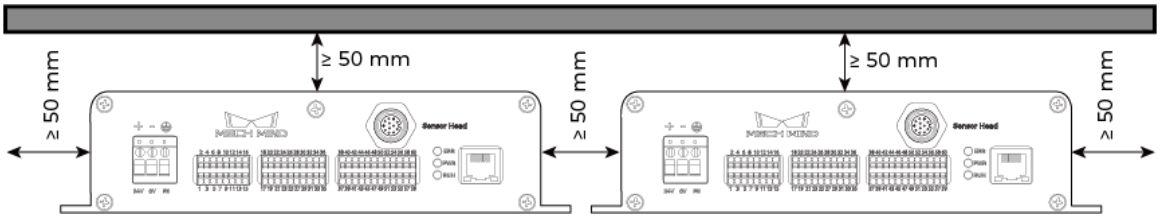
Mount the Controller

Before Mounting the Controller

- Leave at least 50 mm of space above the controller and on both sides. Leave at least 90 mm of space in front of the side where the ports and connectors are located.

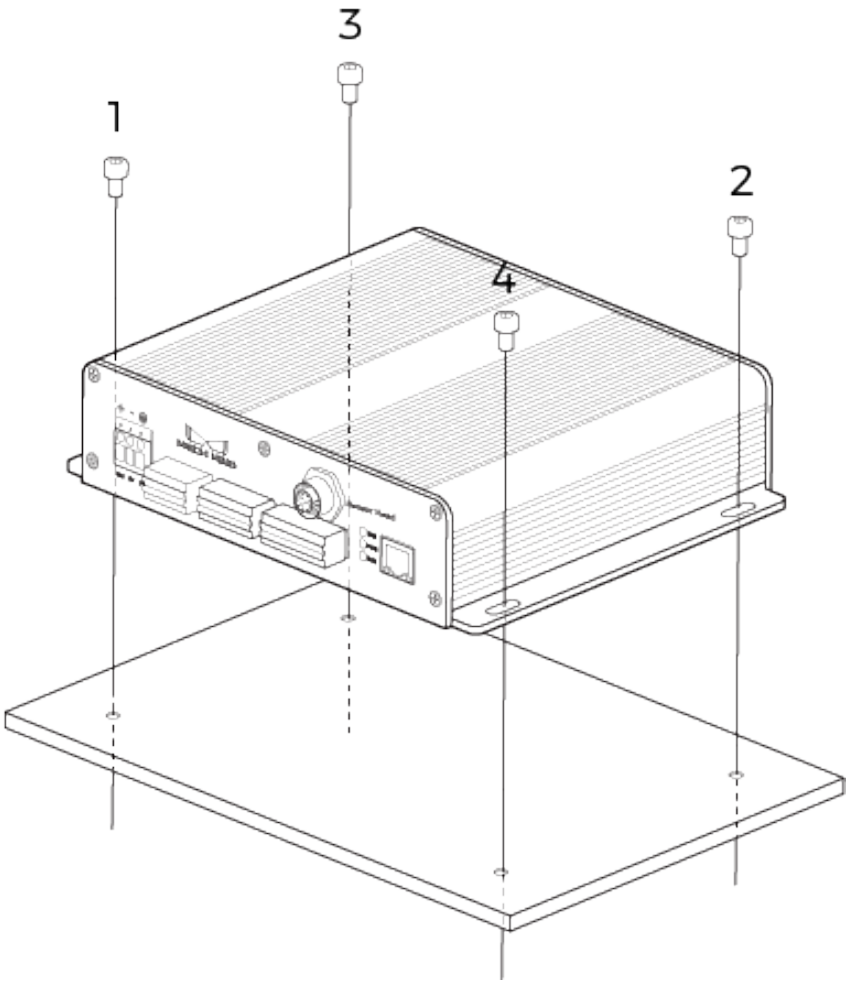


- For controllers mounted side by side, leave at least 50 mm of space between and above controllers.



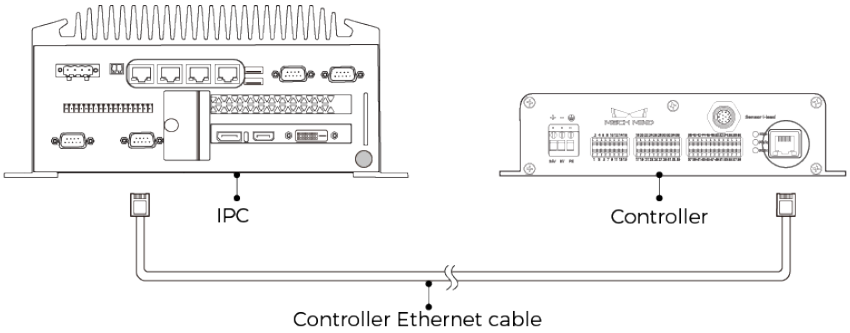
Mounting Method

As shown below, place four M5 × 8 bolts in the holes, and then use an open-end wrench to tighten the nuts.



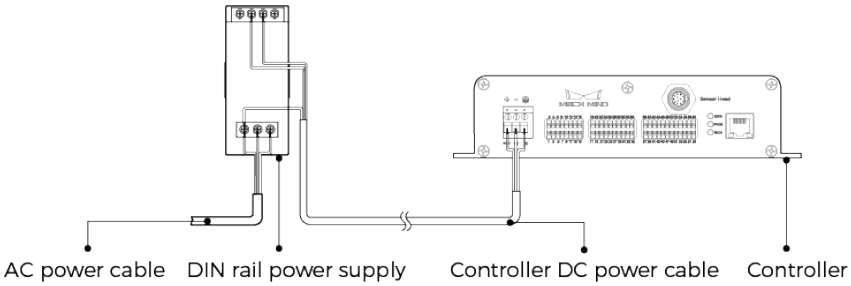
Connect Controller and IPC

Insert one end of the controller Ethernet cable into the RJ45 Ethernet port on the controller and the other end into the RJ45 Ethernet port on the IPC.



- Do not use expansion hubs. Otherwise, the network connection may become unstable, and data transmission may fail.
- Please use shielded Ethernet cable of the CAT5e or above specification.

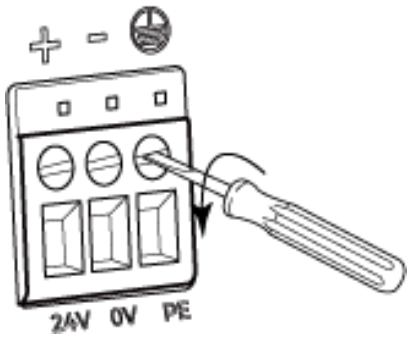
Connect Controller and DIN Rail Power Supply



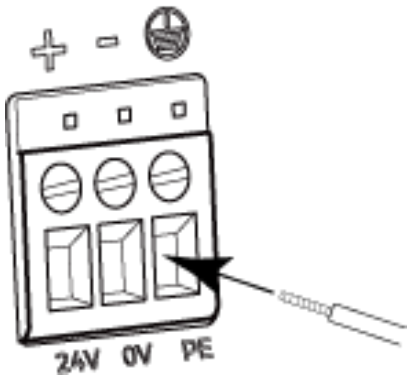
- Please prepare the AC power cable.
- The instructions below apply to the DIN rail power supply provided by Mech-Mind. If you use your own DIN rail power supply, please refer to its user manual for connection instructions.
- Please use a single-phase, 3-prong power outlet with protective grounding for the AC power.
- It is not recommended to use DC power cables longer than 30 m. It is recommended to use power cables with wires of 15 AWG or smaller specifications (larger diameters) to ensure sufficient current and voltage.

Insert DC Power Cable into Power Connector on Controller

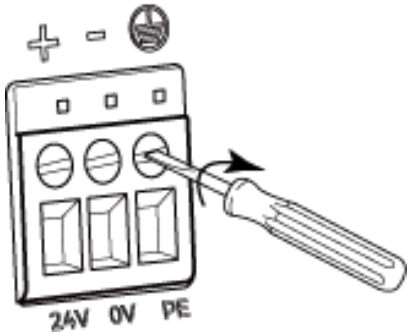
1. Use the flat screwdriver to loosen the screws above the power terminals.



2. Insert the wires into corresponding terminals. Insert the positive wire into the 24V terminal, negative wire into the 0V terminal, and ground wire into the PE terminal (⏚).



3. Use the flat screwdriver to tighten the screws above the power terminals. The recommended tightening torque is 0.2 N·m.

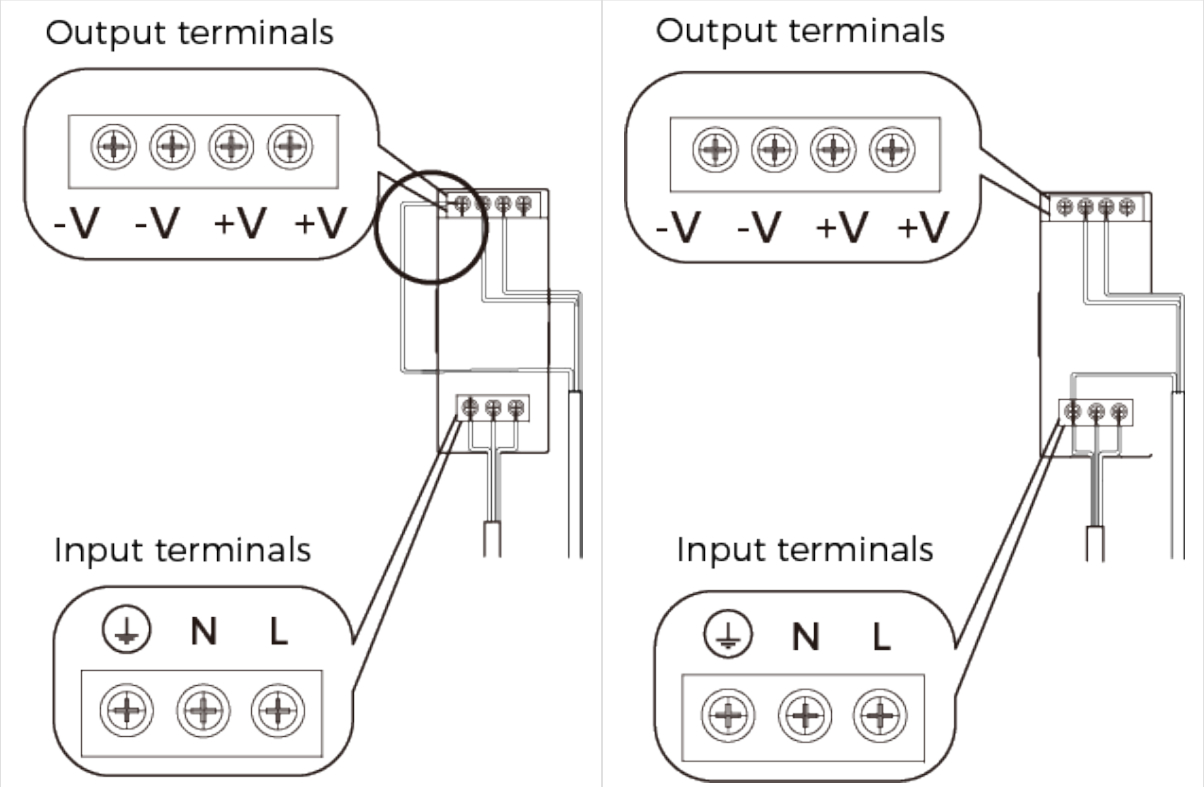


Insert DC Power Cable into Terminals on DIN Rail Power Supply

1. Use the flat screwdriver to loosen the screws on the terminals.
2. Insert the positive wire into one of the +V terminals, negative wire into one of the -V terminals, and ground wire into the ground terminal (⏚).
3. Use the flat screwdriver to tighten the screws on the terminals.

Insert AC Power Cable into Input Terminals on DIN Rail Power Supply

1. Use the flat screwdriver to loosen the screws on the input terminals.
2. Insert the live wire into the L terminal, neutral wire into the N terminal, and ground wire into the ground terminal (⏚).
3. Use the flat screwdriver to tighten the screws on the input terminals.



Incorrect	Correct

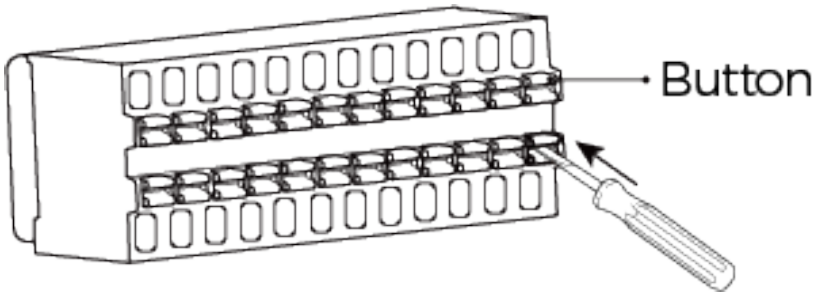
- Please mount the DIN rail power supply inside a control cabinet.
- The DIN rail power supply or the DIN rail should be reliably grounded. If mounting

multiple DIN rail power supplies on the same DIN rail, ensure enough distance in between.

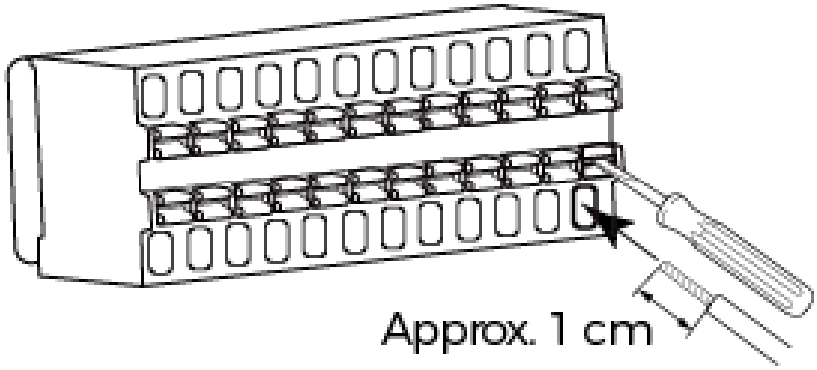
- The stripped part of the PE wire should be as short as possible.
- Supply power after all cables are fully connected. After power is supplied, the PWR indicator light on the controller and the POWER indicator light on the sensor head should be solid green. If not, please contact Mech-Mind.
- After the power is connected, if you need to move or replace the sensor head, please disconnect the power before you disconnect the sensor head from the controller.

Connect Wires to Signal Terminals

1. Select the terminal into which the wire should be inserted and use the flat screwdriver to press down the button above/below it.



2. Insert the wire into the terminal, and then remove the flat screwdriver.



- The stripped part of the wire should be about 1 cm. If the stripped part is too short, the wiring might fail.
- If the strands of the wire are loose, please twist the strands together and then insert the wire into the terminal.

3. Gently pull the wire. The wire should not be pulled out if inserted properly. If the wire is pulled out, insert it again.

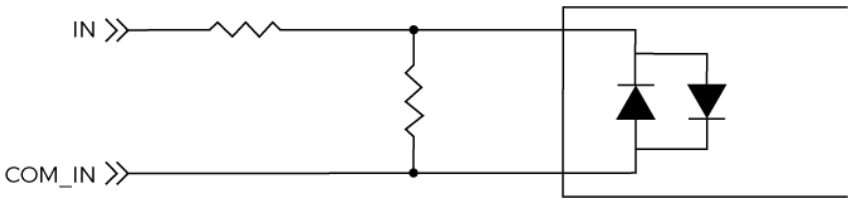
Do not pull the wire too strongly. Doing so may pull out the wire forcibly and damage the stripped part.

If you need to pull out the wire, press down the button above/below the terminal with the flat screwdriver, and then pull out the wire.

I/O Circuit Diagrams

Input Signals

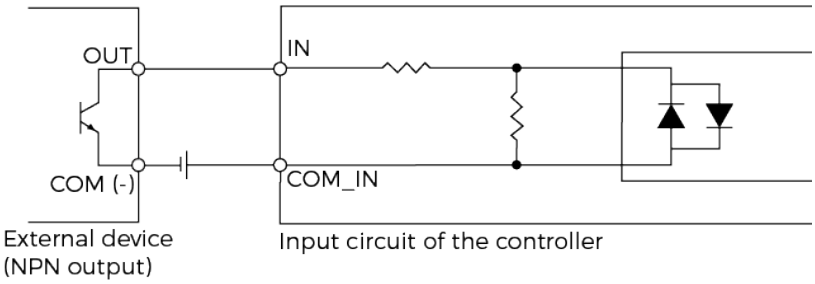
The output signals of an external device can be connected to the input of the controller.



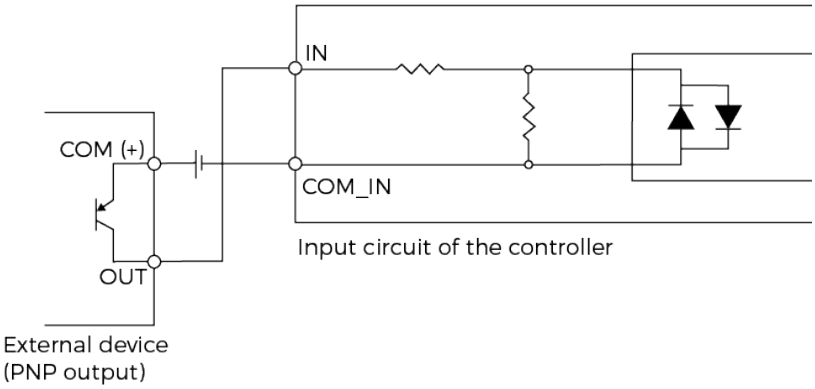
Logical HIGH voltage	22–26 V	Logical LOW voltage	< 5V
Min. current	6 mA	Max. current	50 mA
Max. frequency	1 kHz	Isolation voltage	2500 Vrms (min)

Connection Example

- Connect the NPN output of the external device to the input of the controller.

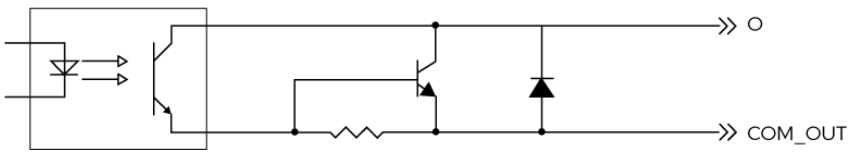


- Connect the PNP output of the external device to the input of the controller.



Output Signals

The output signals of the controller can be connected to the input of an external device.

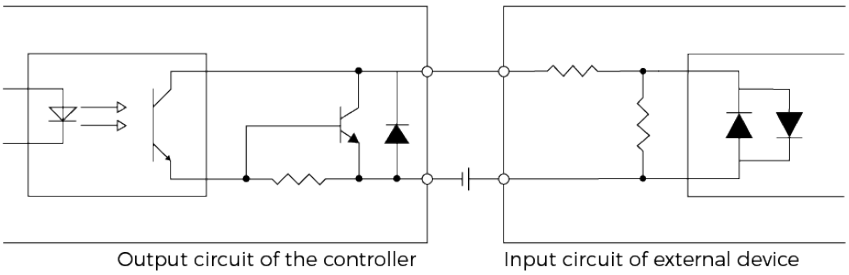


Logical LOW output voltage	< 0.3V	Max. output current	20 mA

Leakage current in closed state	< 0.5 μA	Insulation resistance	> 10^{11} Ω
Max. frequency	1 kHz	Isolation voltage	2500 Vrms (min)

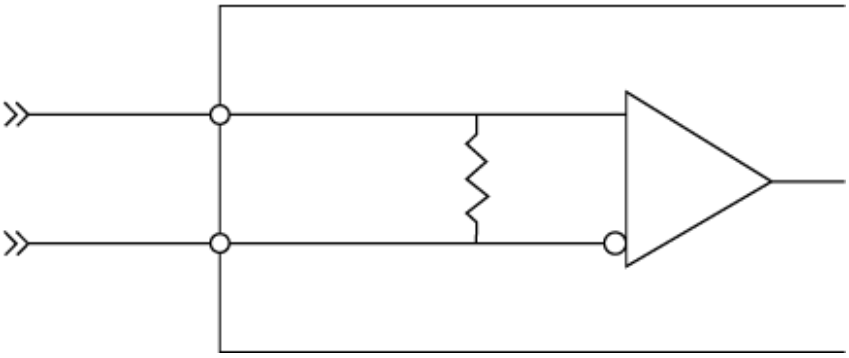
Connection Example

Connect the output of the controller to the input of an external device.



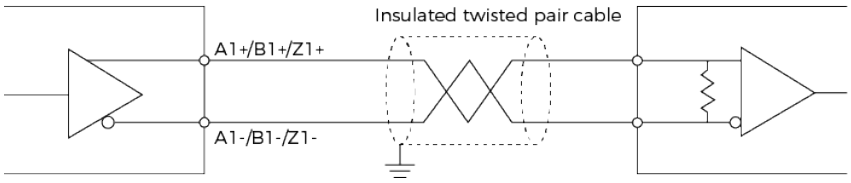
Differential Encoder

The controller provides the input signal connector for differential encoders.



When connecting the encoder, please use shielded cables suitable for RS-422 signals.

Connection Example



Technical Specifications

Sensor Head

Model	LNX-8030	LNX-8080	LNX-8300
Data points per profile	4096		
Scan rate	3.3–15 kHz		
Reference distance (RD)	78 mm	250 mm	325 mm

Model			LNX-8030	LNX-8080	LNX-8300
Measurement range	Z-axis		30 mm	100 mm	305 mm
	X-axis	Near	33 mm	76 mm	230 mm
		RD	35 mm	89 mm	310 mm
		Far	37 mm	96 mm	430 mm
X-axis resolution			9 μm	23.5 μm	105 μm
Z-axis repeatability			0.2 μm	0.5 μm	2 μm
Z-axis linearity			± 0.02% of F.S.		
Weight			About 0.9 kg	About 1.2 kg	About 1.2 kg
Dimensions			About 133 × 61 × 102 mm	About 182 × 63 × 112 mm	About 195 × 61 × 109 mm
Light source			Blue laser (405 nm)		
Laser class			Class 2	Class 2M	
Lens inclination[1]			30°	22°	19°
Operating temperature[2]			0–45°C		
Safety and EMC			CE / FCC / VCCI / KC / ISED / NRTL		
IP rating[3]			IP67		
Cooling			Passive		

(1) Please refer to the diagrams in Field of View.

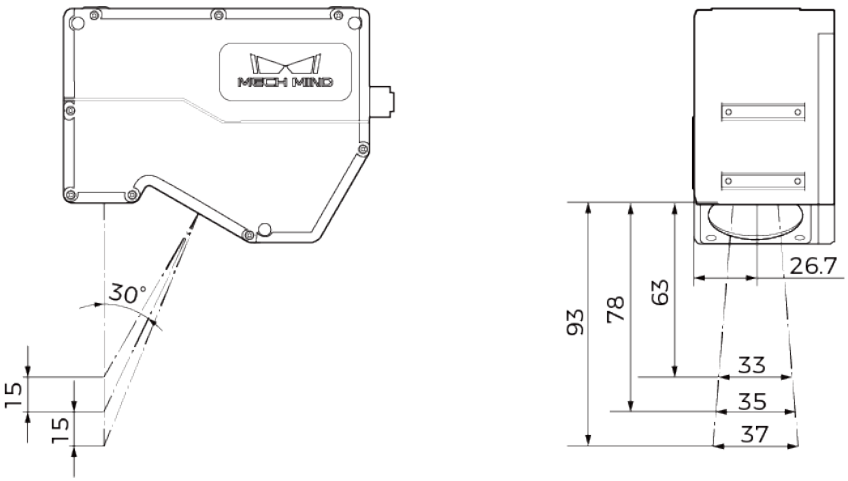
(2) This is the range when the sensor head is mounted on a metal frame and the heat from the sensor head is well dissipated.

(3) Test implemented based on IEC 60529. 6: dust-tight; 7: protected against the effects of temporary immersion in water.

Field of View

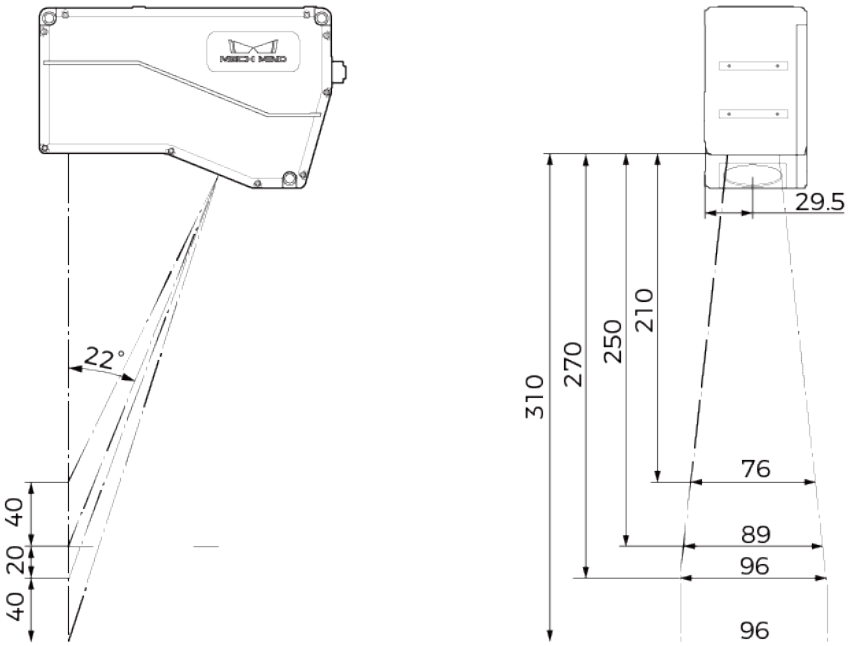
LNX-8030

Unit: mm



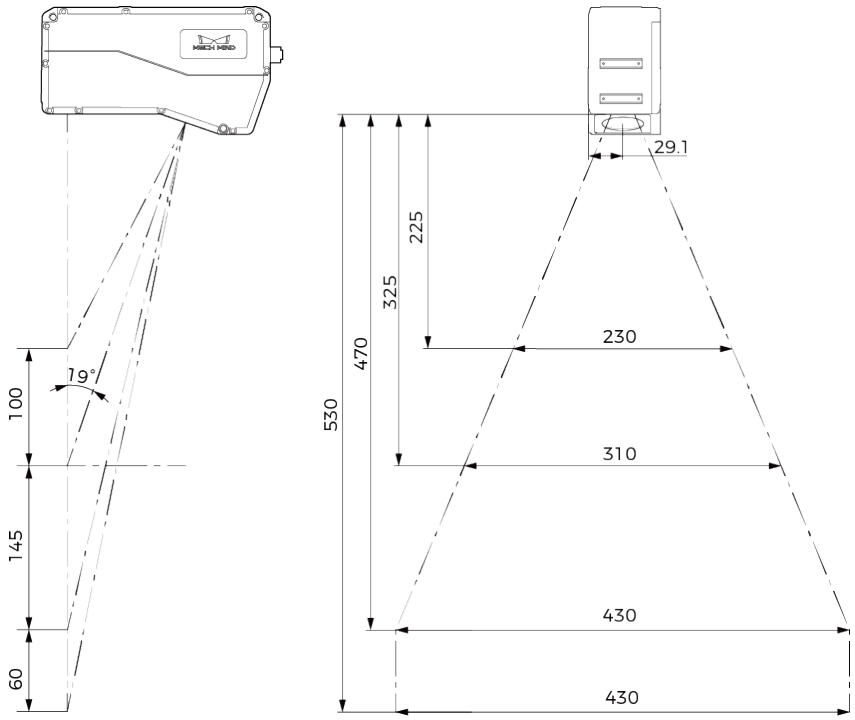
LNX-8080

Unit: mm



LNX-8300

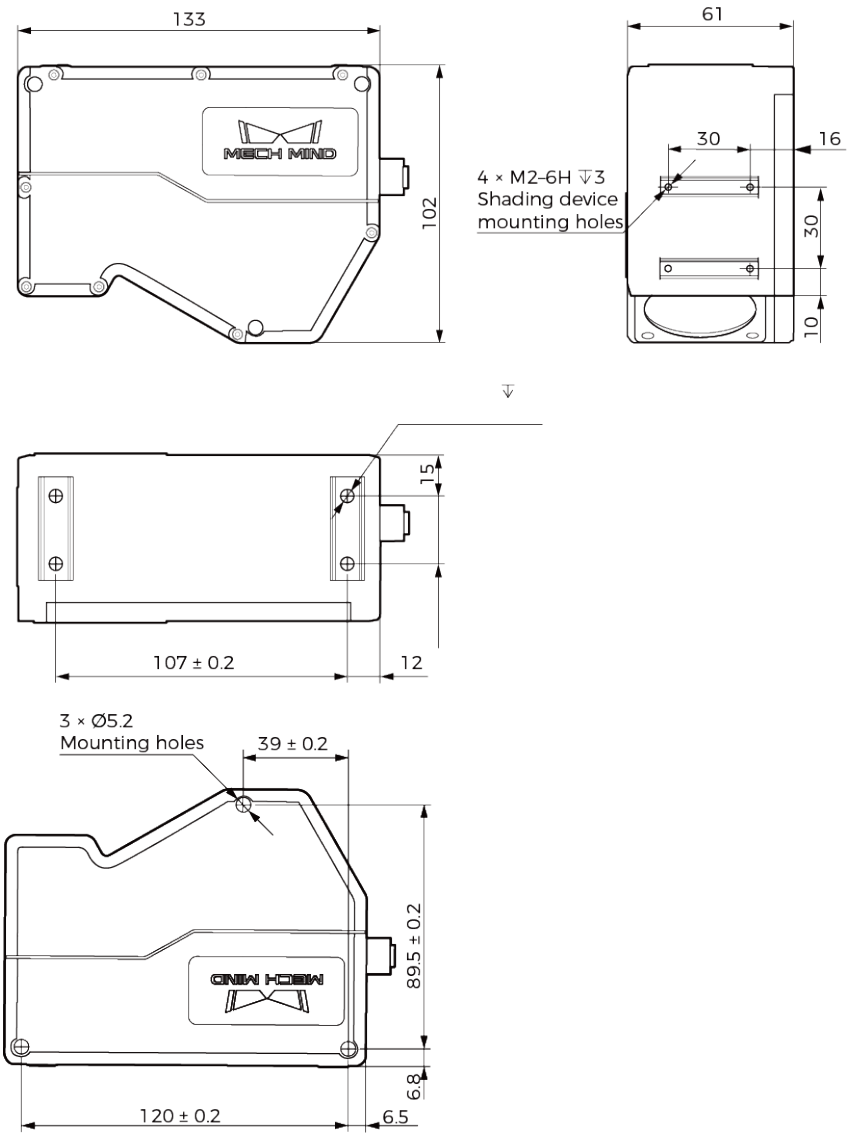
Unit: mm



Dimensions

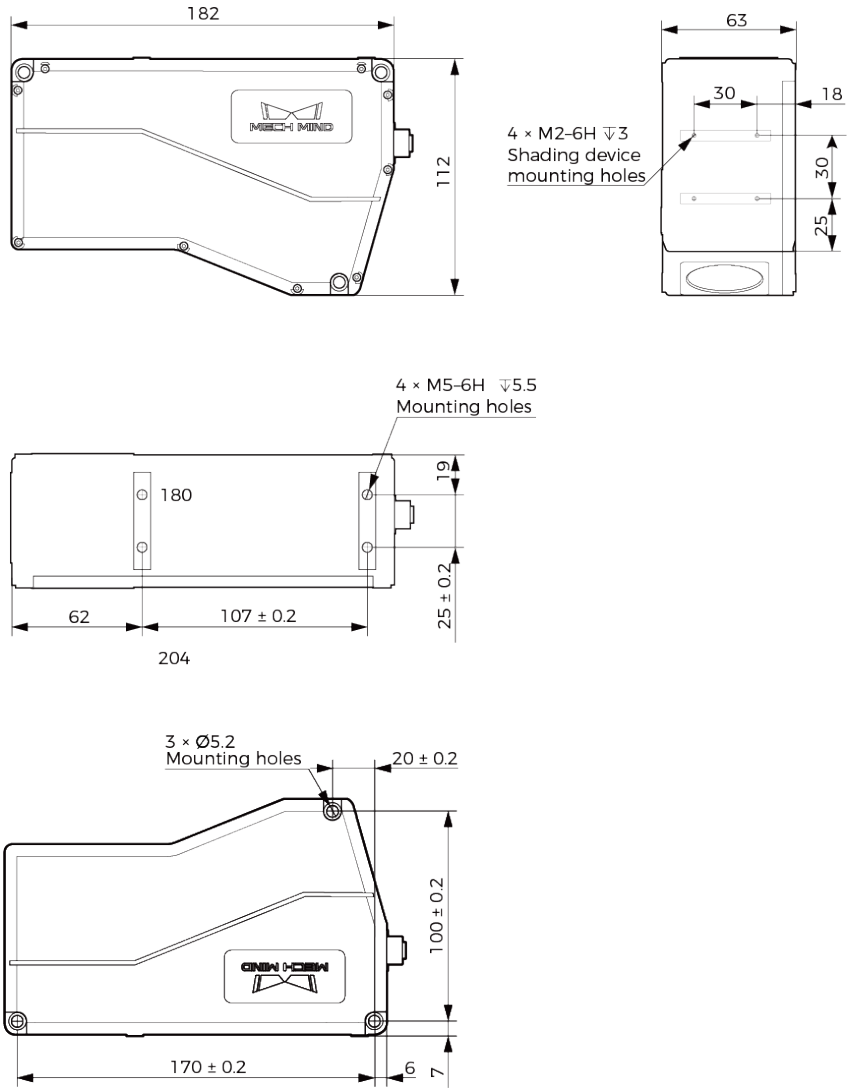
LNX-8030

Unit: mm



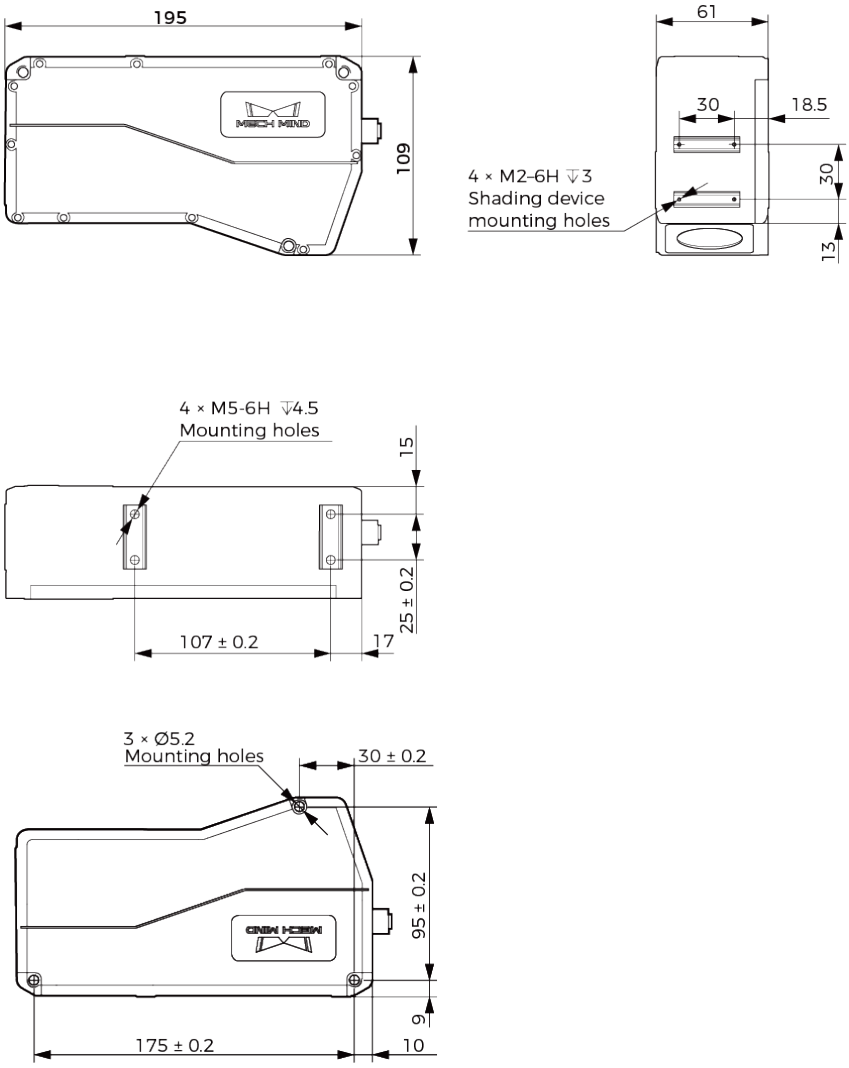
LNX-8080

Unit: mm



LNX-8300

Unit: mm

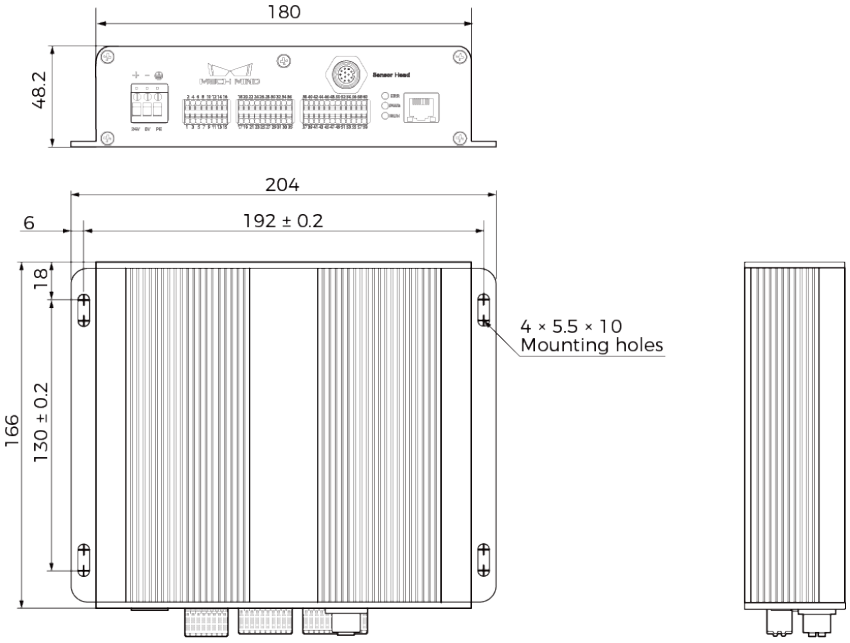


Controller

Model	LNX-8000C
Weight	About 1.2 kg
Dimensions	About 204 × 48.2 × 166 mm
Input voltage	24 VDC ± 10%
Rated current	2 A
Max. power	48 W
Communication interface	Gigabit Ethernet
Operating temperature	0–45°C
Storage temperature	-30–70°C
Safety and EMC	CE / FCC / VCCI / KC / ISED / NRTL
Cooling	Passive

Dimensions

Unit: mm



Maintenance

Cleaning

Disconnect the product from power before cleaning. When cleaning the surface of the product, please use a clean soft cloth to gently wipe off the dust and debris. When cleaning the lenses, to avoid scratching, you can use a clean, soft lint-free cloth with lens cleaner or glass cleaner to carefully wipe the lenses.

- If the product is not disconnected from power during cleaning, electrical shock hazard may be present.
- Do not clean the product with corrosive or volatile solvents such as alcohol, gasoline, and kerosene. These substances may damage the exterior and internal structure of the product.
- Do not use a pressure washer gun or hose to spray and wash the product. Mech-Mind shall not be liable for any damage or loss caused by liquid damage to the product.

Storage

The sensor head is rated as IP67. The enclosure of the sensor head can prevent dust and water from entering and affecting the functions of the sensor head. Please avoid soaking the product in water or placing it outdoors for an extended period of time. When not using, please store the product in an indoor, dry, cool, and well ventilated place. The storage temperature of the product is -30–70°C.

- Disconnect the product from power when storing to avoid fire.
- Do not point the receiver unit directly at the sun or other intense light source. Intense light may cause the image sensor to deteriorate and produce white blur in images.

Disclaimer

It is strongly recommended to use the power supply and cables provided by Mech-Mind to ensure compliance with the safety and EMC standards. Mech-Mind shall not be liable for any issues caused by using the power supply and cables provided by a third party.

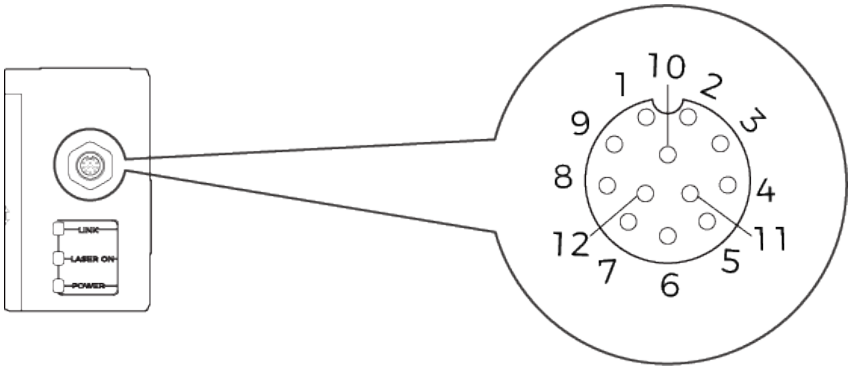
Trademark and Legal Statement

Mech-Mind and Mech-Mind series logos including MECH MIND are registered trademarks of Mech-Mind Robotics Technologies Ltd. and other related entities.

Appendix

Sensor Head

Controller Port

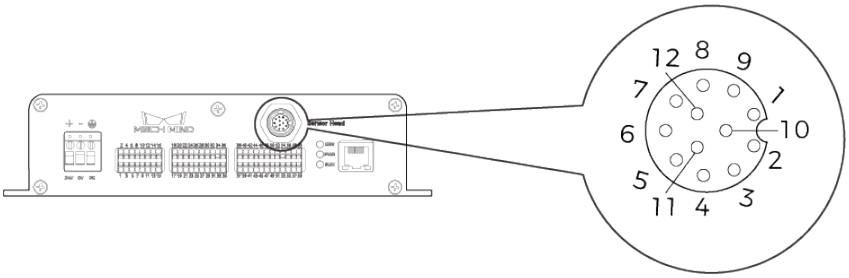


No.	Name	Function	Description
1	GigE_MX1+	Ethernet signal line	2.5GigE
2	GigE_MX1-	Ethernet signal line	2.5GigE
3	GigE_MX2+	Ethernet signal line	2.5GigE
4	GigE_MX2-	Ethernet signal line	2.5GigE
5	GigE_MX3+	Ethernet signal line	2.5GigE
6	GigE_MX3-	Ethernet signal line	2.5GigE

No.	Name	Function	Description
7	GigE_MX4+	Ethernet signal line	2.5GigE
8	GigE_MX4-	Ethernet signal line	2.5GigE
9	DC_12V	12 V power supply	Max. rated current: 2 A
10	DC_0V	12 V power supply return line	Max. rated current: 2 A
11	Trigger	Trigger signal input	Low speed
12	DIR	Direction signal input	Low speed

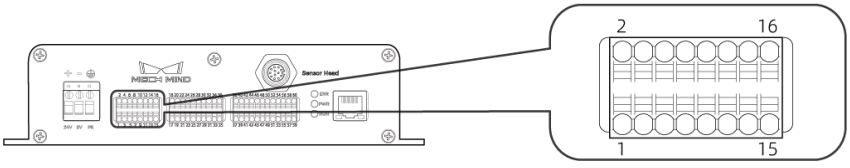
Controller

Sensor Head Port



No.	Name	Function	Description
1	GigE_MX1+	Ethernet signal line	2.5GigE
2	GigE_MX1-	Ethernet signal line	2.5GigE
3	GigE_MX2+	Ethernet signal line	2.5GigE
4	GigE_MX2-	Ethernet signal line	2.5GigE
5	GigE_MX3+	Ethernet signal line	2.5GigE
6	GigE_MX3-	Ethernet signal line	2.5GigE
7	GigE_MX4+	Ethernet signal line	2.5GigE
8	GigE_MX4-	Ethernet signal line	2.5GigE
9	DC_12V	12 V power supply	Max. rated current: 2 A
10	DC_0V	12 V power supply return line	Max. rated current: 2 A
11	Trigger	Trigger signal output	Low
12	DIR	Direction signal output	Low

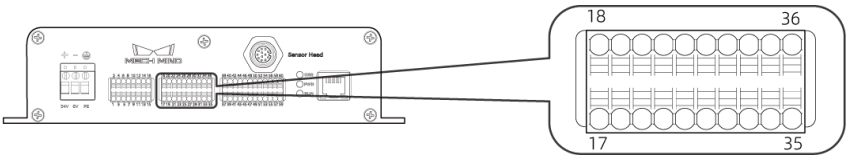
Input Signal Terminals



No.	Name	Description
1	IN1	Universal digital input 1, optocoupler isolation, bidirectional input optocoupler
2	IN2	Universal digital input 2, optocoupler isolation, bidirectional input optocoupler
3	IN3	Universal digital input 3, optocoupler isolation, bidirectional input optocoupler
4	IN4	Universal digital input 4, optocoupler isolation, bidirectional input optocoupler
5	IN5	Universal digital input 5, optocoupler isolation, bidirectional input optocoupler
6	IN6	Universal digital input 6, optocoupler isolation, bidirectional input optocoupler
7-8	RESERVED	Reserved
9	LEVELCONTROL_ENABLE	When enabled, MEASURE_START is effective, and MEASURE_STOP is ineffective; when disabled, both MEASURE_START and MEASURE_STOP are effective. Optocoupler isolation, bidirectional input optocoupler
10	MEASURE_START	Input signal to start acquisition, optocoupler isolation, bidirectional input optocoupler
11	MEASURE_STOP	Input signal to stop acquisition, optocoupler isolation, bidirectional input optocoupler
12	RESERVED	Reserved
13-16	COM_IN	Common terminal for input signal

- For the methods of triggering the laser profiler to acquire data, please refer to Methods for Triggering Data Acquisition.
- For explanations of the **LEVELCONTROL_ENABLE**, **MEASURE_START** and **MEASURE_STOP** terminals, please refer to Provide Data Acquisition Control Signals with External Device.

Output Signal Terminals

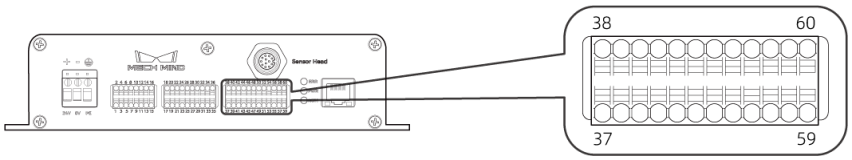


No.	Name	Description
17-20	COM_OUT	Common terminal for output signal
21	O1	Universal digital output 1, optocoupler isolation, NPN output
22	O2	Universal digital output 2, optocoupler isolation, NPN output
23	O3	Universal digital output 3, optocoupler isolation, NPN output
24	O4	Universal digital output 4, optocoupler isolation, NPN output
25	O5	Universal digital output 5, optocoupler isolation, NPN output

No.	Name	Description
26	O6	Universal digital output 6, optocoupler isolation, NPN output
27	O7	Universal digital output 7, optocoupler isolation, NPN output
28	O8	Universal digital output 8, optocoupler isolation, NPN output
29	READY	Signal indicating readiness for acquisition, optocoupler isolation, NPN output
30	ERROR	Signal indicating termination of acquisition due to error, optocoupler isolation, NPN output
31	TRG_ERROR	Signal indicating reception of data acquisition trigger during ongoing acquisition, optocoupler isolation, NPN output
32-36	RESERVED	Reserved

For explanations of the **READY**, **ERROR** and **TRG_ERROR** terminals, please refer to Provide Data Acquisition Status Signals to External Device.

Encoder Signal Terminals

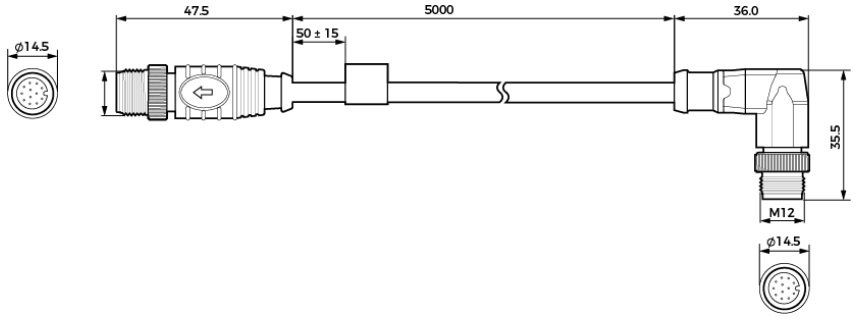


No.	Name	Description
37	A1+	Differential encoder A+ input, optocoupler isolation, RS-422 standard differential input.
38	A1-	Differential encoder A- input, optocoupler isolation, RS-422 standard differential input.
39	B1+	Differential encoder B+ input, optocoupler isolation, RS-422 standard differential input
40	B1-	Differential encoder B- input, optocoupler isolation, RS-422 standard differential input
41	Z1+	Differential encoder Z+ input, optocoupler isolation, RS-422 standard differential input
42	Z1-	Differential encoder Z- input, optocoupler isolation, RS-422 standard differential input
43-54	Terminals for single-ended encoders	Single-ended encoders are not supported currently.
55	R1	RS-232 serial interface 1, input, magnetic isolation
56	T1	RS-232 serial interface 1, output, magnetic isolation
57	G1	RS-232 serial interface 1 ground reference
58	G2	RS-232 serial interface 2 ground reference
59	R2	RS-232 serial interface 2, input, magnetic isolation
60	T2	RS-232 serial interface 2, output, magnetic isolation

Cables

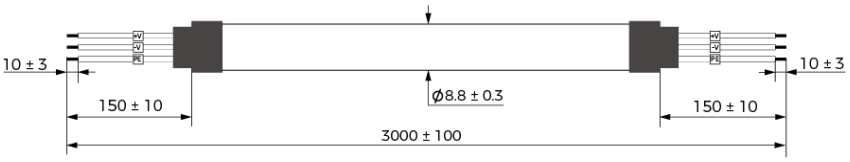
Sensor-Head-to-Controller Cable (CBL-H2C-5M-LU)

Unit: mm



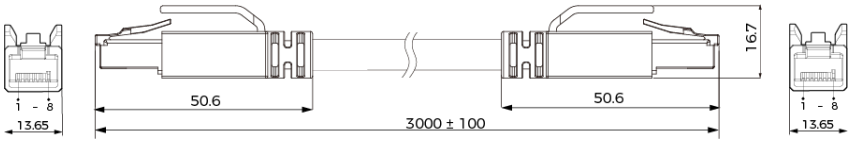
Controller DC Power Cable (CBL-CTRL-PWR-3M)

Unit: mm



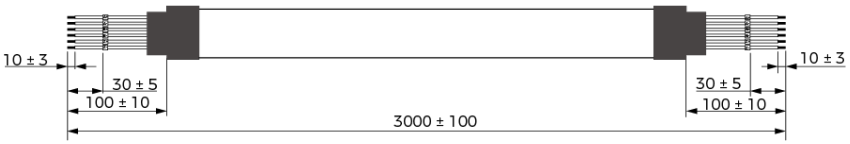
Controller Ethernet Cable (CBL-CTRL-ETH-3M)

Unit: mm



Encoder Cable (CBL-CTRL-EN-3M)

Unit: mm



8. Support

This topic provides troubleshooting guidance and answers to frequently asked questions (FAQs).

Troubleshooting guidance:

Troubleshooting

Answers to FAQs:

FAQs

8.1. Troubleshooting

This topic provides troubleshooting guidance for the following issues.

- Laser Profiler Not Found in Mech-Eye SDK
- Laser Profiler Cannot Be Connected in Mech-Eye SDK
- Some Data Were Lost

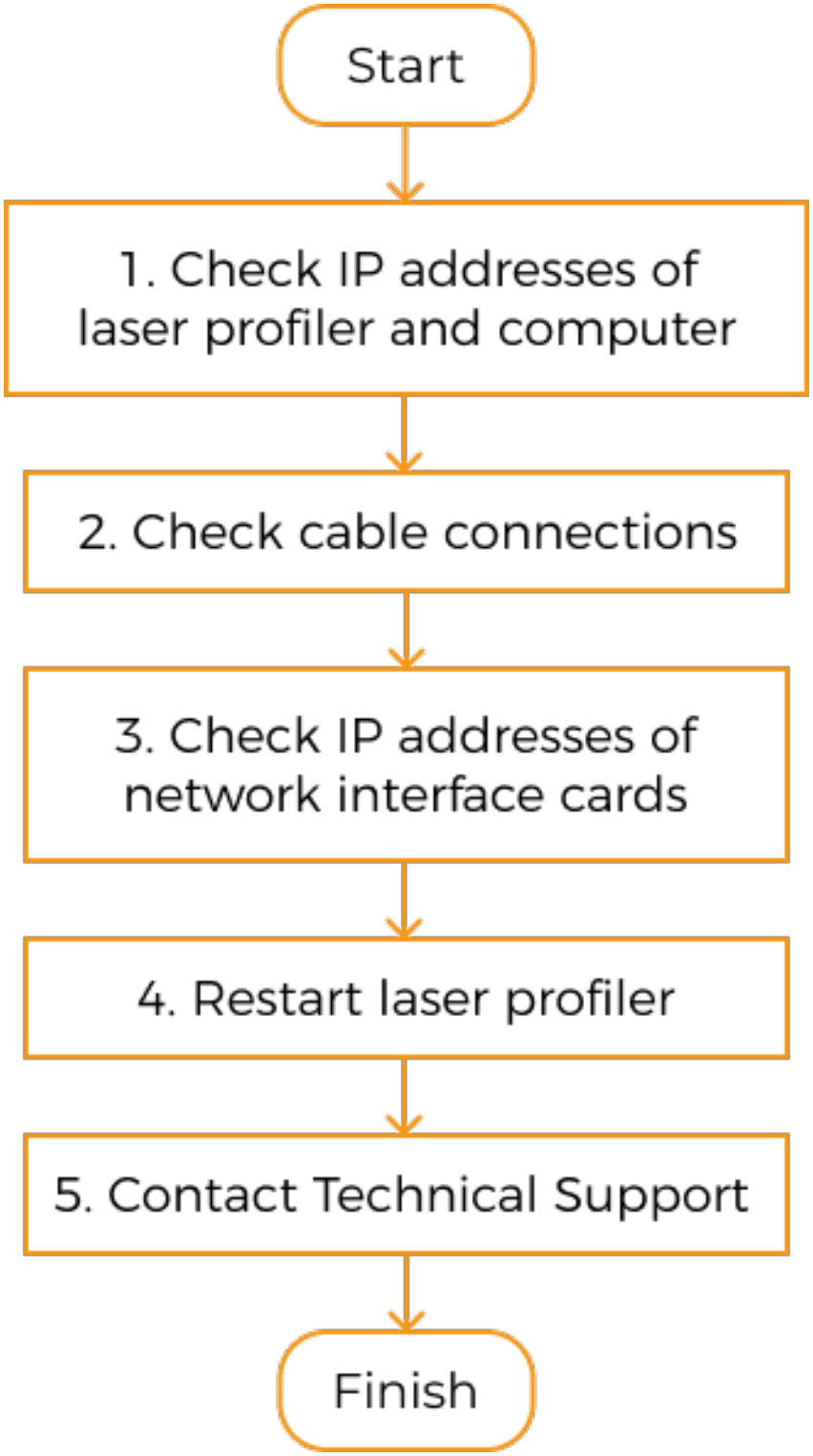
8.1.1. Laser Profiler Not Found in Mech-Eye SDK

Symptom: In Mech-Eye SDK, the laser profiler to which you want to connect does not show up in the list of available laser profilers. This topic provides the possible causes, troubleshooting guidelines and detailed troubleshooting procedures for this problem.

Possible Causes

- IP address conflict between the laser profiler and computer is present.
- Some of the cables are not properly connected.
- Multiple Ethernet ports of the computer have IP addresses in the same subnet.
- Other causes.

Troubleshooting Guidelines



When the laser profiler to which you want to connect does not show up in Mech-Eye SDK, follow these guidelines to troubleshoot:

1. If Mech-Eye SDK can only discover one laser profiler, **check the IP addresses of this laser profiler and the computer**.
2. **Check cable connections**. If the laser profiler still does not show up in Mech-Eye SDK, proceed to the next step.
3. Make sure that **the IP addresses of multiple Ethernet ports are not in the same subnet**.

4. If the laser profiler still does not show up in Mech-Eye SDK, proceed to the next step.
5. Restart the laser profiler. If the laser profiler still does not show up, please contact Mech-Mind Technical Support.

Troubleshooting Procedures

Check IP Addresses of Laser Profiler and Computer

If multiple laser profilers are connected to the computer, but only one Mech-Eye SDK can be discovered in laser profiler, follow these steps to troubleshoot:

1. Check if the following two IP addresses are identical:
   - The IP address of this laser profiler
   - The IP address of the computer Ethernet port connected to the laser profiler
2. If the two IP addresses are identical, modify one of them:
   - Modify the IP address of the laser profiler: Use Mech-Eye Viewer or the IP configuration tool.
   - Modify the IP address of the computer Ethernet port: Please refer to Set IP Address on Computer.
3. Open Mech-Eye SDK and search for the laser profiler.
   - If all laser profilers could be discovered, the troubleshooting is completed.
   - If still not all laser profilers could be discovered, proceed to the next section.

Check Cable Connections

Check the indicator lights of the devices to see if any cable connection issue is present. If the status of the indicator light is different from that listed in the following table, the corresponding cable may be problematic.

Device	Normal status of indicator light	Corresponding cable
Laser profiler	PWR indicator light on the controller is solid green.	Controller DC power cable
	During data transmission: • network indicator light on the controller is blinking.	Controller Ethernet cable
	• LINK indicator light on the sensor head is blinking green or yellow.	Sensor-head-to-controller cable
	POWER indicator light on the sensor head is solid green.	Sensor-head-to-controller cable
IPC cabinet	The Ethernet port indicator light is solid on or matches the normal status described in the computer's user manual.	Ethernet cable
Network switch	The LAN port indicator light is solid on or matches the normal status described in the network switch's user manual.	Ethernet cable

If the laser profiler and computer are connected directly, you do not need to check for the cable connection of the network switch.

IP Addresses of Multiple Ethernet Ports in the Same Subnet

Procedure:

1. Disable Ethernet ports not connected to the laser profiler.

   On the computer, select Control Panel › Network and Internet › Network and Sharing Center › Change adapter settings. The **Network Connections** page will be displayed. Right-click an Ethernet port and select **Disable**.

2. Open Mech-Eye SDK and search for the laser profiler.
3. If the Mech-Eye SDK is successfully discovered, one or more of the disabled Ethernet ports have IP address in the same subnet as the port connected to the Mech-Eye SDK. Enable the other ports one at a time and connect to the laser profiler in Mech-Eye SDK each time. The laser profiler connection will fail when the Ethernet port with the problematic IP address is enabled. Please change the IP address of this Ethernet port to a different subnet.

If the laser profiler still cannot be found, disable the Ethernet port connected to the laser profiler and enable it again. If the laser profiler still cannot be found afterward, connect the laser profiler to a different Ethernet port.

Restart the Laser Profiler

If the laser profiler still does not show up after the above procedures have been performed, please try restarting the laser profiler.

Restart procedure:

1. Unplug the power cable from the laser profiler.
2. Wait for about 20 seconds, and plug the power cable into the laser profiler.

Contact Technical Support

If the laser profiler still does not show up after the above procedures have been performed, please contact Mech-Mind Technical Support.

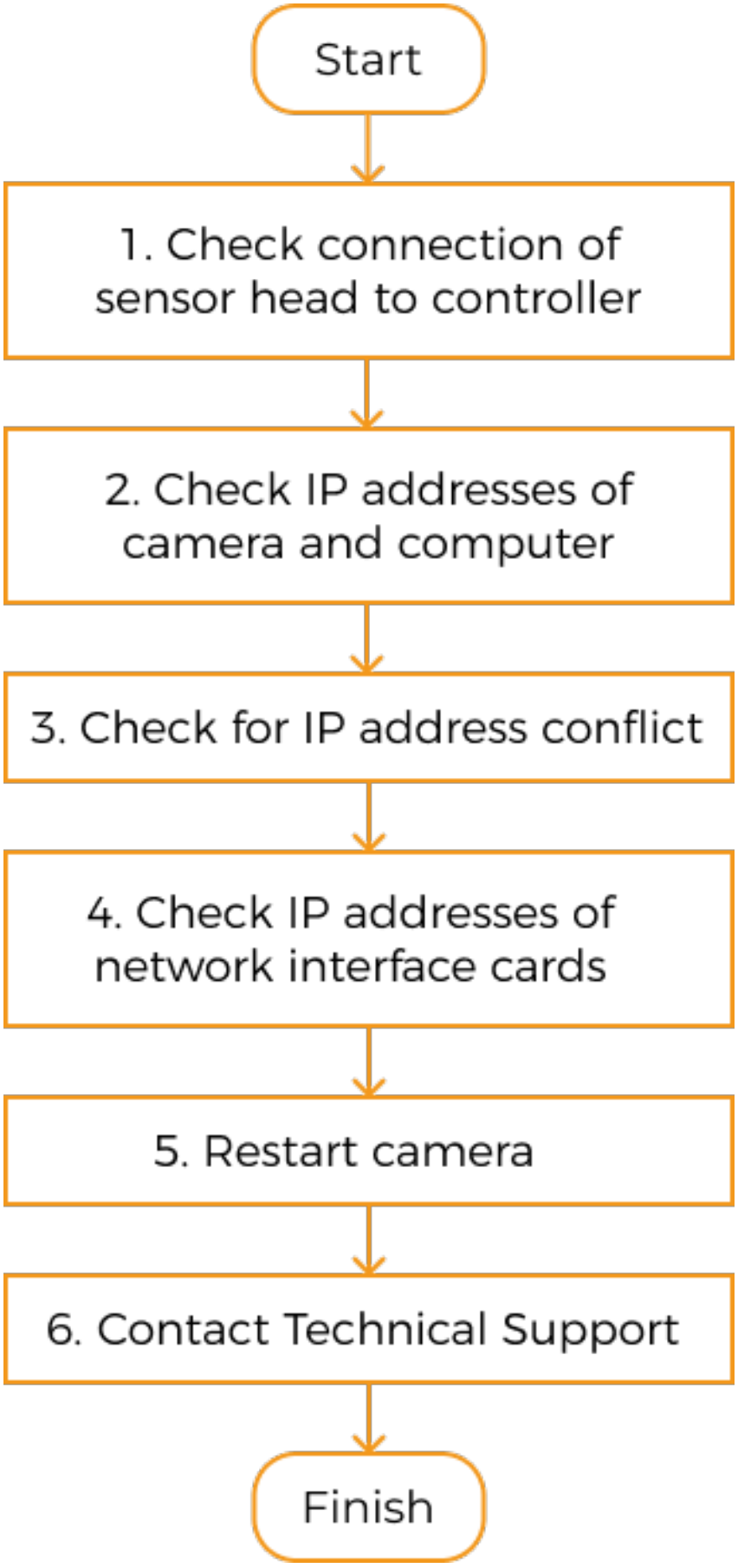
8.1.2. Laser Profiler Cannot Be Connected in Mech-Eye SDK

Symptom: The laser profiler shows up in Mech-Eye SDK but cannot be connected. The status of the IP address displayed in the laser profiler info card in Mech-Eye Viewer is Unreachable. This topic provides the possible causes, troubleshooting guidelines and detailed troubleshooting procedures for this problem.

Possible Causes

- No sensor head is connected to the controller.
- The IP addresses of the laser profiler and computer are not in the same subnet.
- IP address conflict is present.
- Multiple Ethernet ports of the computer have IP addresses in the same subnet.
- Other causes.

Troubleshooting Guidelines



When you cannot connect to the laser profiler in Mech-Eye SDK, follow these guidelines to troubleshoot:

1. **Make sure that the sensor head is correctly connected to the controller**. If the laser profiler still cannot be connected in Mech-Eye SDK, proceed to the next step.
2. **Make sure that the IP addresses of the laser profiler and computer are in the same subnet.** If the laser profiler still cannot be connected, proceed to the next step.
3. Make sure that **no IP address conflicts are present**. If the laser profiler still cannot be connected, proceed to the next step.
4. Make sure that **the IP addresses of multiple Ethernet ports are not in the same subnet**.
5. If the laser profiler still cannot be connected, proceed to the next step.
6. Restart the laser profiler . If the laser profiler still cannot be connected, please contact Technical Support.

Troubleshooting Procedures

Connection between Controller and Sensor Head

Solution:

1. Disconnect the controller from power.
2. Refer to Mounting and Connection and connect the sensor head to the controller.
3. Connect the controller to power.
4. Open Mech-Eye SDK and connect to the laser profiler.

Check IP Addresses of Laser Profiler and computer

Procedure:

1. Check the IP address of the computer. For instructions, please refer to Set IP Address on Computer.
2. Check the IP address of the laser profiler. For instructions, please refer to Set Laser Profiler IP Address.
3. Make sure that the IP addresses of the laser profiler and computer are in the same subnet. If not, please change the laser profiler IP address, so that it is in the same subnet as the IP address of the computer.
4. Open Mech-Eye SDK and connect to the laser profiler.

Check for IP Address Conflict

IP conflict is present among the devices connected to the computer and network switch. IP conflict is where two or more devices have identical IP addresses.

Procedure:

1. Disconnect all devices other than the laser profiler from the computer and/or network switch.
2. Open Mech-Eye SDK and connect to the laser profiler.
3. If the laser profiler is successfully connected, one or more other devices have IP addresses identical to the laser profiler. Please reconnect the other devices one at a time and connect to

the laser profiler in Mech-Eye SDK each time. The laser profiler connection will fail when the device(s) with identical IP address is reconnected. Please change the IP address of this device or the laser profiler, so that the two are no longer identical.

IP Addresses of Multiple Ethernet Ports in the Same Subnet

Procedure:

1. Disable Ethernet ports not connected to the laser profiler.

   On the computer, select Control Panel › Network and Internet › Network and Sharing Center › Change adapter settings. The **Network Connections** page will be displayed. Right-click an Ethernet port and select **Disable**.

2. Open Mech-Eye SDK and connect to the laser profiler.
3. If the laser profiler is successfully connected, one or more of the disabled Ethernet ports have IP address in the same subnet as the port connected to the laser profiler. Enable the other ports one at a time and connect to the laser profiler in Mech-Eye SDK each time. The laser profiler connection will fail when the Ethernet port with the problematic IP address is enabled. Please change the IP address of this Ethernet port to a different subnet.

   If the laser profiler still cannot be connected, disable the Ethernet port connected to the laser profiler and enable it again. If the laser profiler still cannot be connected afterward, connect the laser profiler to a different Ethernet port.

Restart the Laser Profiler

If the laser profiler still cannot be connected after the above procedures have been performed, please try restarting the laser profiler.

Restart procedure:

1. Unplug the power cable from the laser profiler.
2. Wait for about 20 seconds, and plug the power cable into the laser profiler.

Contact Technical Support

If the laser profiler still cannot be connected after the above procedures have been performed, please contact Mech-Mind Technical Support.

8.1.3. Some Data Were Lost

Symptoms

When the scan is triggered by the encoder, the intensity image, depth map, and point cloud contains horizontal black bands or are not displayed at all. Meanwhile, a prompt of **Some data were lost** popped up in the lower right.

Possible Causes

The rate at which the encoder triggers scanning exceeds the max scan rate of the laser profiler.

Solution

Please try the following solutions based on the actual situation:

- Decrease Z-Direction ROI in the profile mode: Reduce the amount of data to be processed to enhance the max scan rate of the laser profiler.

  Adjust the **Z-Direction ROI** to as small as possible while making sure the needed data is not trimmed off.

- Decrease Exposure Time (timed exposure) or **Total exposure time** in HDR Exposure Settings (HDR exposure mode) in the profile mode to enhance the max scan rate of the laser profiler.

  After decreasing **Exposure time** or **Total exposure time**, the brightness of the laser lines in the raw image will decrease. If the brightness is too low, increase Analog Gain in the profile mode.

- Increase Trigger Interval in the scan mode to reduce the rate at which the encoder triggers scanning.

  Adjusting **Trigger Interval** while Trigger Signal Counting Mode is unaltered changes the Y-axis resolution of the scan data.

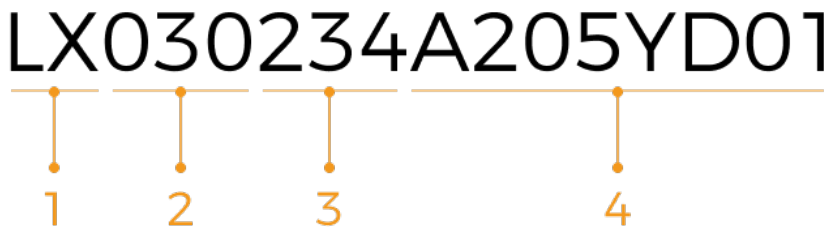
8.2. FAQs

This topic provides answers to frequently asked questions.

8.2.1. How to Read Product Serial Number?

The product serial number (SN) is printed on the label attached to the product. It is the unique identification number of each product.

The serial number has 16 characters, and it contains information such as the product type, model, and production date.



1. The first and second characters represent product type:

Code	Type
LX	Laser profiler sensor head
LC	Laser profiler controller

2. The third to fifth characters represent the product model:

Code	Model
A00	LNX-8000C (controller)
030	LNX-8030 (sensor head)
080	LNX-8080 (sensor head)
300	LNX-8300 (sensor head)

3. The sixth and seventh characters represent the product production year: For example, “23” represents that the production year is 2023.
4. The eighth character represents the product production month:

Code	Month
1 to 9	January to September
A	October
B	November
C	December

5. The ninth to sixteenth characters are the production code of the product.

9. Appendix

Here you can find helpful and informative topics that can aid you with using the laser profiler.

How the Laser Profiler Works

- Scanning Mechanism of Laser Profiler
- Methods for Triggering Data Acquisition
- Workflow of Triggering Data Acquisition

Communication with External Devices

- Provide Data Acquisition Control Signals with External Device
- Provide Data Acquisition Status Signals to External Device

Scan Data

- Y-Axis Resolution of Scan Data

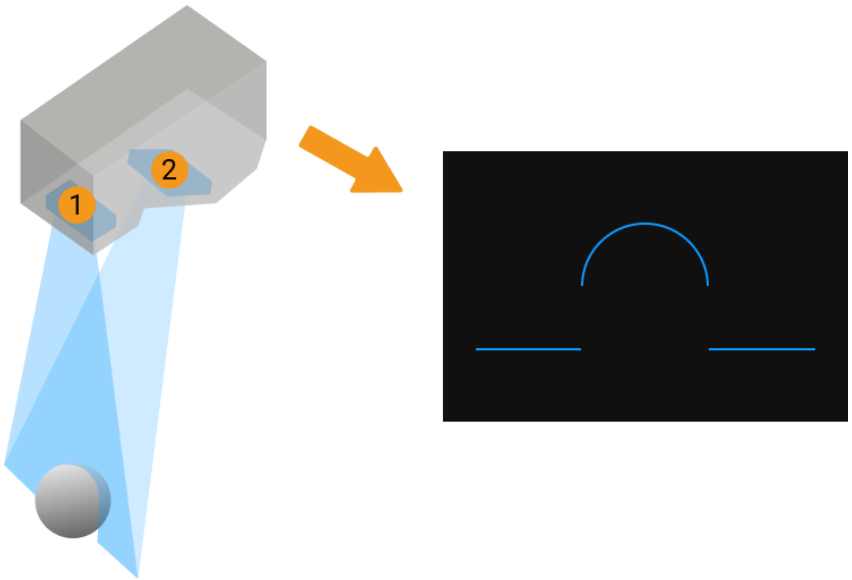
Useful Tips

Set IP Address on Computer

9.1. Scanning Mechanism of Laser Profiler

The laser profiler uses the laser emitter and receiver unit inside it to conduct the scan of the target object. This topic introduces the basic process of scanning and relevant concepts.

Basic Process of Scanning



1. The laser emitter (1 in the figure above) emits a line of laser light onto the target object within the FOV of the laser profiler.
2. The laser light is reflected by the target object and received by the receiver unit (2 in the figure above). Because the receiver unit is at an angle to the laser emitter, the laser light reflected by target object;s surfaces at different heights falls on different positions on the receiver unit. The image generated on the receiver unit at this time is the raw image in Mech-Eye Viewer.
3. The laser emitter, receiver unit and target object form a triangle. According to the principle of triangulation, the laser profiler can calculate the distance from each point on the reflected laser lines to the sensor head using the known angles and distances.
4. Based on the calculation result and other parameter settings, the laser profiler extracts a profile from the raw image. The profile reflects the change in the distance to the sensor head along a section of the target object, that is , the change in height.
5. The target object moves relative to the laser profiler. The laser profiler repeats the above steps to complete multiple scans and obtain a series of profiles of the target object, used to generate the intensity image, depth map, and point cloud.

Relevant Concepts

- Line scan: the process during which the laser profiler emits the laser light once and generates one profile.
- One round of data acquisition: the process during which the laser profiler completes multiple line scans, generates multiple profiles, and stitches the profiles to generate the intensity image, depth map, and point cloud.
- Trigger: the action that makes the laser profiler start a round of data acquisition or a line scan.

  There are two methods for triggering one round of data acquisition or one line scan, respectively, suitable for different scenarios. For details, please refer to Methods for Triggering Data Acquisition.

9.2. Methods for Triggering Data Acquisition

This topic introduces the different methods of triggering the laser profiler to acquire data. The laser profiler supports multiple triggering methods, allowing it to be integrated into a system and work with other devices flexibly to obtain the intensity image, depth map, and point cloud.

Before reading this topic, please read Scanning Mechanism of Laser Profiler first to familiarize yourself with the scanning mechanism of the laser profiler and relevant concepts.

Overview of Triggering Methods

There are two methods each for triggering one round of data acquisition and one line scan.

- Trigger a round of data acquisition:
  - External: Use the signal input from an external device to trigger each round of data acquisition.
  - Software: Use Mech-Eye Viewer, Mech-Eye API or GenICam client to trigger each round of data acquisition.
- Trigger a line scan:
  - Encoder: Use encoder signals to trigger each line scan.

- Fixed rate: Trigger each line scan at a fixed rate.

Combination of Triggering Methods

Different combinations of the triggering methods of a round of data acquisition and a line scan are suitable for different scenarios:

External + Encoder	Controls data acquisition precisely and responds promptly to the signals provided by other devices in the system. Often used in scenarios that require fast respondence and high accuracy. *Example* A Photoelectric sensor triggers a round of data acquisition when it detects the target object, and an encoder triggers line scans based on the travel speed of the target object.
External + Fixed Rate	Controls data acquisition precisely and provides a stable scan rate. Often used in scenarios that require cooperation with a robot and high stability. *Example* A PLC triggers a round of data acquisition when the robot reaches a specified position, and the line scans are triggered at the set rate.
Software + Encoder	Data acquisition is controlled by software. Often used in scenarios that require cooperation with upstream software and high accuracy. *Example* Mech-Vision triggers a round of data acquisition, and an encoder triggers line scans based on the travel speed of the target object.
Software + Fixed Rate	Data acquisition is controlled by software. Easy to control and often used during parameter adjustment. *Example* Use Mech-Eye Viewer to trigger data acquisition as needed to check the data quality and adjust the parameters accordingly.

The next topic introduces the workflow of using each combination of triggering methods to trigger data acquisition.

9.3. Workflow of Triggering Data Acquisition

This topic introduces the workflow of using each combination of triggering methods to trigger data acquisition and obtain the intensity image, depth map, and point cloud.

Before reading this topic, please read Methods for Triggering Data Acquisition first to familiarize yourself with the different methods of triggering the laser profiler to acquire data.

External + Encoder

Use externally input signals to trigger each round of data acquisition, and use encoder signals to trigger each line scan.

Prerequisites

In order to use the external + encoder method to trigger data acquisition, the following prerequisites must be satisfied:

- Connect the hardware:
  - Connect the external device providing the trigger signal to the corresponding input signal terminals on the controller. Please refer to Provide Data Acquisition Control Signals with External Device to select the control logic and connect the corresponding terminals.
  - Connect the encoder providing the trigger signal to the corresponding encoder signal terminals on the controller. Please refer to Signal Circuit Diagrams and Encoder Signal Terminals.
- Improve the quality of the profiles:

  The intensity image, depth map, and point cloud are made of multiple profiles. Therefore, the quality of the profiles determines the quality of the intensity image, depth map, and point cloud.

  Please refer to Profile Mode to adjust the parameters in the profile mode, in order to improve the quality of the profiles.

Workflow

To use the external + encoder method to trigger data acquisition, follow these steps:

1. Set parameters:
   a. Set the Data Acquisition Trigger Source parameter to **External**.
   b. Set the Line Scan Trigger Source parameter to **Encoder**.
   c. Based on actual needs, adjust the other parameters in the scan mode.
2. Enter the laser profiler to the acquisition ready status: The laser profiler can only respond to externally input signals after it enters the acquisition ready status.
   - Mech-Eye Viewer: In the scan mode, click the button.
   - Mech-Eye API: Call the `startAcquisition()` method.
   - GenICam client: Send the `AcquisitionStart()` command to the laser profiler.
3. Start a round of data acquisition: Send a signal that triggers a round of data acquisition from the external device to the laser profiler.
4. Start line scans: Send signals that trigger line scans from the encoder to the laser profiler.
5. End the current round of data acquisition:
   - Send a signal that stops data acquisition from the external device to the laser profiler.

- Set an appropriate value for the Scan Line Count parameter. The current round of data acquisition ends automatically when the set number of lines has been scanned.

6. Start the next round of data acquisition: Repeat steps 3 and 4 after the current round of data acquisition has been completed.
7. Exit the acquisition ready status: Exiting the acquisition status when you do not need to acquire data can avoid triggering data acquisition by mistake.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `stopAcquisition()` method.
   - GenICam client: Send the `AcquisitionStop()` command to the laser profiler.

External + Fixed Rate

Use externally input signals to trigger each round of data acquisition, and trigger each line scan at a fixed rate.

Prerequisites

In order to use the external + fixed rate method to trigger data acquisition, the following prerequisites must be satisfied:

- Connect the hardware:

  Connect the external device providing the trigger signal to the corresponding input signal terminals on the controller. Please refer to Provide Data Acquisition Control Signals with External Device to select the control logic and connect the corresponding terminals.

- Improve the quality of the profiles:

  The intensity image, depth map, and point cloud are made of multiple profiles. Therefore, the quality of the profiles determines the quality of the intensity image, depth map, and point cloud.

  Please refer to Profile Mode to adjust the parameters in the profile mode, in order to improve the quality of the profiles.

Workflow

To use the external + fixed rate method to trigger data acquisition, follow these steps:

1. Set parameters:
   a. Set the Data Acquisition Trigger Source parameter to **External**.
   b. Set the Line Scan Trigger Source parameter to **Fixed rate**.
   c. Based on actual needs, adjust the other parameters in the scan mode.
2. Enter the laser profiler to the acquisition ready status: The laser profiler can only respond to externally input signals after it enters the acquisition ready status.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `startAcquisition()` method.
   - GenICam client: Send the `AcquisitionStart()` command to the laser profiler.

3. Start a round of data acquisition: Send a signal that triggers a round of data acquisition from the external device to the laser profiler.

   After the current round of data acquisition has been started, the laser profiler starts line scans at the set rate.

4. End the current round of data acquisition:
   - Send a signal that stops data acquisition from the external device to the laser profiler.
   - Set an appropriate value for the Scan Line Count parameter. The current round of data acquisition ends automatically when the set number of lines has been scanned.
5. Start the next round of data acquisition: Repeat step 3 after the current round of data acquisition has been completed.
6. Exit the acquisition ready status: Exiting the acquisition status when you do not need to acquire data can avoid triggering data acquisition by mistake.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `stopAcquisition()` method.
   - GenICam client: Send the `AcquisitionStop()` command to the laser profiler.

Software + Encoder

Use software to trigger each round of data acquisition, and use encoder signals to trigger each line scan.

Prerequisites

In order to use the software + encoder method to trigger data acquisition, the following prerequisites must be satisfied:

- Connect the hardware:

  Connect the encoder providing the trigger signal to the corresponding encoder signal terminals on the controller. Please refer to Signal Circuit Diagrams and Encoder Signal Terminals.

- Improve the quality of the profiles:

  The intensity image, depth map, and point cloud are made of multiple profiles. Therefore, the quality of the profiles determines the quality of the intensity image, depth map, and point cloud.

  Please refer to Profile Mode to adjust the parameters in the profile mode, in order to improve the quality of the profiles.

Workflow

To use the software + encoder method to trigger data acquisition, follow these steps:

1. Set parameters:
   a. Set the Data Acquisition Trigger Source parameter to **Software**.
   b. Set the Line Scan Trigger Source parameter to **Encoder**.
   c. Based on actual needs, adjust the other parameters in the scan mode.

2. Enter the laser profiler to the acquisition ready status: The laser profiler can only respond to externally input signals after it enters the acquisition ready status.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `startAcquisition()` method.
   - GenICam client: Send the `AcquisitionStart()` command to the laser profiler.
3. Start a round of data acquisition:
   - Mech-Eye Viewer: After entering the acquisition ready status in step 2, the laser profiler automatically starts a round of data acquisition.
   - Mech-Eye API: Call the `triggerSoftware()` method.
   - GenICam client: Send the `TriggerSoftware()` command to the laser profiler.
4. Start line scans: Send signals that trigger line scans from the encoder to the laser profiler.
5. End the current round of data acquisition: Set an appropriate value for the Scan Line Count parameter. The current round of data acquisition ends automatically when the set number of lines has been scanned.
6. Start the next round of data acquisition:
   - Mech-Eye Viewer: After the last round of data acquisition ends, the laser profiler automatically starts a new round of data acquisition.
   - Mech-Eye API: Repeat step 3.
   - GenICam client: Repeat step 3.
7. Exit the acquisition ready status: Exiting the acquisition status when you do not need to acquire data can avoid triggering data acquisition by mistake.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `stopAcquisition()` method.
   - GenICam client: Send the `AcquisitionStop()` command to the laser profiler.

Software + Fixed Rate

Use software to trigger each round of data acquisition, and trigger each line scan at a fixed rate.

Prerequisites

In order to use the software + fixed rate method to trigger data acquisition, the following prerequisites must be satisfied:

- Improve the quality of the profiles:

  The intensity image, depth map, and point cloud are made of multiple profiles. Therefore, the quality of the profiles determines the quality of the intensity image, depth map, and point cloud.

  Please refer to Profile Mode to adjust the parameters in the profile mode, in order to improve the quality of the profiles.

Workflow

To use the software + fixed rate method to trigger data acquisition, follow these steps:

1. Set parameters:
   a. Set the Data Acquisition Trigger Source parameter to **Software**.
   b. Set the Line Scan Trigger Source parameter to **Fixed rate**.
   c. Based on actual needs, adjust the other parameters in the scan mode.
2. Enter the laser profiler to the acquisition ready status: The laser profiler can only respond to software signals after it enters the acquisition ready status.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `startAcquisition()` method.
   - GenICam client: Send the `AcquisitionStart()` command to the laser profiler.
3. Start a round of data acquisition:
   - Mech-Eye Viewer: After entering the acquisition ready status in step 2, the laser profiler automatically starts a round of data acquisition.
   - Mech-Eye API: Call the `triggerSoftware()` method.
   - GenICam client: Send the `TriggerSoftware()` command to the laser profiler.

   After the current round of data acquisition has been started, the laser profiler starts line scans at the set rate.
4. End the current round of data acquisition: Set an appropriate value for the Scan Line Count parameter. The current round of data acquisition ends automatically when the set number of lines has been scanned.
5. Start the next round of data acquisition:
   - Mech-Eye Viewer: After the last round of data acquisition ends, the laser profiler automatically starts a new round of data acquisition.
   - Mech-Eye API: Repeat step 3.
   - GenICam client: Repeat step 3.
6. Exit the acquisition ready status: Exiting the acquisition status when you do not need to acquire data can avoid triggering data acquisition by mistake.
   - Mech-Eye Viewer: In the scan mode, click the  button.
   - Mech-Eye API: Call the `stopAcquisition()` method.
   - GenICam client: Send the `AcquisitionStop()` command to the laser profiler.

9.4. Provide Data Acquisition Control Signals with External Device

This topic introduces how to use an external device to provide the laser profiler with signals that control data acquisition, in order to obtain the intensity image, depth map, and point cloud from the laser profiler.

- Before reading this topic, please read Methods for Triggering Data Acquisition and

Workflow of Triggering Data Acquisition first to familiarize yourself with the different methods of triggering the laser profiler to acquire data.

- The logical HIGH and LOW signals mentioned in this topic are the signals internal to the controller, that is, the externally input signals after the transformation by the optocoupler.

Relevant Input Signal Terminals

The following input signal terminals are discussed in this topic:

No.	Name
9	LEVELCONTROL_ENABLE
10	MEASURE_START
11	MEASURE_STOP

The logic level of the **LEVELCONTROL_ENABLE** terminal signal determines the data acquisition control logic by the other two terminals. The following sections explain the two control logics. Please select the control logic that corresponds to your actual needs.

Control Data Acquisition with MEASURE_START Only

When the logic level of the **LEVELCONTROL_ENABLE** terminal signal is LOW, the **MEASURE_STOP** terminal does not participate in the control of data acquisition, and only the signals of the **MEASURE_START** terminal controls data acquisition.

- Start data acquisition:

  When the logic level of the **MEASURE_START** terminal signal changes from HIGH to LOW, the laser profiler is triggered to acquire data.

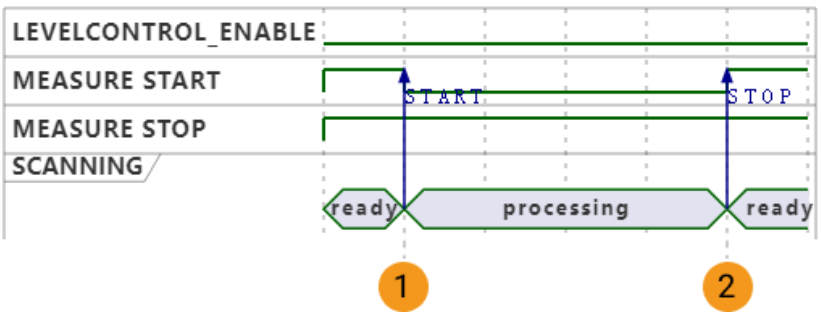
- Stop data acquisition:

  When the logic level of the **MEASURE_START** terminal signal changes from LOW to HIGH, the current round of data acquisition is stopped.

Even if the number of lines set in the Scan Line Count parameter has not been fully acquired, when a stop signal is received from an external device, the current round of data acquisition is stopped.

If you wish to end the data acquisition according to the value of **Scan Line Count**, please use the control logic when the logic level of the **LEVELCONTROL_ENABLE** terminal signal is HIGH.

Example



No.	Data acquisition status	Signal logic level
1	Data acquisition is started.	MEASURE_START: changes from HIGH to LOW.
		MEASURE_STOP: remains HIGH.
2	Data acquisition is stopped.	MEASURE_START: changes from LOW to HIGH.
		MEASURE_STOP: remains HIGH.

Connect Needed Terminals

If you want to control data acquisition with the MEASURE_START terminal only, connect the corresponding terminals according to the following rules:

- Connect the LEVELCONTROL_ENABLE terminal, and keep the logic level of its signal LOW.
- Connect the MEASURE_START terminal, and switch the logic level of its signal to LOW when you need to trigger data acquisition and to HIGH when you need to stop data acquisition.

Control Data Acquisition with MEASURE_START and MEASURE_STOP

When the logic level of the LEVELCONTROL_ENABLE terminal signal is HIGH, the signals of both the MEASURE_START and MEASURE_STOP terminals control data acquisition.

- Start data acquisition:

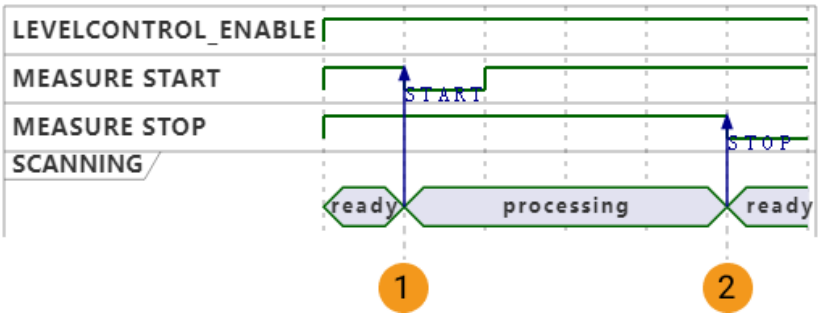
  While the logic level of the MEASURE_STOP terminal signal remains HIGH, when the logic level of the MEASURE_START terminal signal changes from HIGH to LOW, the laser profiler is triggered to acquire data.

- Stop data acquisition:

  While the logic level of the MEASURE_START terminal signal remains LOW, when the logic level of the MEASURE_STOP terminal signal changes from HIGH to LOW, the current round of data acquisition is stopped.

Even if the number of lines set in the Scan Line Count parameter has not been fully acquired, when a stop signal is received from an external device, the current round of data acquisition is stopped. In this case, the acquired intensity image, depth map, and point cloud are incomplete.

Example



No.	Data acquisition status	Signal logic level
1	Data acquisition is started.	MEASURE_START: changes from HIGH to LOW, and then changes back to HIGH.
		MEASURE_STOP: remains HIGH.
2	Data acquisition is stopped.	MEASURE_START: remains HIGH.
		MEASURE_STOP: changes from HIGH to LOW, and then changes back to HIGH.

Connect Needed Terminals

If you want to control data acquisition with both the MEASURE_START and MEASURE_STOP terminals, connect the corresponding terminals according to the following rules:

- Connect the MEASURE_START terminal, and switch the logic level of its signal to LOW when you need to trigger data acquisition.
- If you want to acquire data according to the set value of **Scan Line Count**, then you do not need to connect the MEASURE_STOP terminal.
- If you want to stop data acquisition with externally input signals, then you need to connect the MEASURE_STOP terminal, and switch the logic level of its signal to LOW when you need to stop data acquisition.

The logic level of the LEVELCONTROL_ENABLE terminal signal is HIGH by default. Therefore, this terminal does not need to be connected.

Next Steps

After selecting the control logic and connecting the hardware, please refer to Workflow of Triggering Data Acquisition and complete the other steps in order to trigger data acquisition with externally input signals.

9.5. Provide Data Acquisition Status Signals to External Device

This topic introduces the logic signals of the predefined output signal terminals on the controller. These signals are used to provide the data acquisition status of the laser profiler to external devices and design corresponding control logics.

Relevant Output Signal Terminals

The following output signal terminals are discussed in this topic:

No.	Name
29	READY
30	ERROR
31	TRG_ERROR

READY

The signals output by the **READY** terminal are as follows:

- When the laser profiler has entered the acquisition ready status but is not acquiring data, the **READY** terminal outputs logical HIGH signal.
- The **READY** terminal outputs logical LOW signal when the laser profiler is acquiring data.

For the procedure of entering the laser profiler into the acquisition ready status with different triggering methods, please refer to Workflow of Triggering Data Acquisition.

ERROR

The signals output by the **ERROR** terminal are as follows:

- When the laser profiler has entered the acquisition ready status but is not acquiring data, and when the laser profiler is acquiring data normally, the **ERROR** terminal outputs logical LOW signal.
- When the following errors occur during data acquisition, the **ERROR** terminal outputs logical HIGH signal until the current round of data acquisition ends.
  - The acquired data is not received within the set Timeout Period.
  - When Line Scan Trigger Source is set to **Software**, the data acquisition is not successfully started.

For the procedure of entering the laser profiler into the acquisition ready status with different triggering methods, please refer to Workflow of Triggering Data Acquisition.

TRG_ERROR

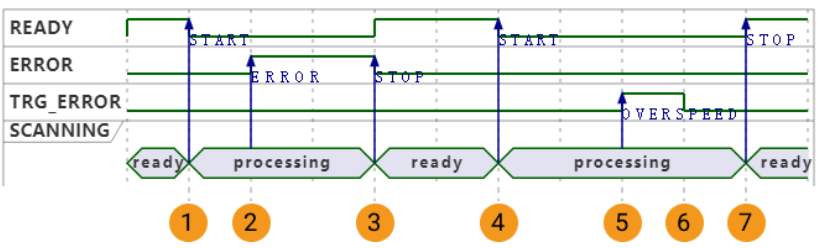
The signals output by the **TRG_ERROR** terminal are as follows:

- When the laser profiler has entered the acquisition ready status but is not acquiring data, and when the laser profiler is acquiring data normally, the **TRG_ERROR** terminal outputs logical LOW signal.
- When the laser profiler receives another data acquisition trigger signal while acquiring data, the **TRG_ERROR** terminal outputs logical HIGH signal until the trigger signal disappears.

For the procedure of entering the laser profiler into the acquisition ready status with different triggering methods, please refer to Workflow of Triggering Data Acquisition.

Example

The correspondence between the terminal signals and data acquisition status is explained using the following figure as an example, in the order of the logic level change of the terminal signals.



No.	Data acquisition status	Signal logic level
1	The first round of data acquisition is started.	READY: changes from HIGH to LOW.
		ERROR: remains LOW.
		TRG_ERROR: remains LOW.
2	An error occurs during data acquisition.	READY: remains LOW.
		ERROR: changes from LOW to HIGH.
		TRG_ERROR: remains LOW.
3	The first round of data acquisition is stopped.	READY: changes from LOW to HIGH.
		ERROR: changes from HIGH to LOW.
		TRG_ERROR: remains LOW.
4	The second round of data acquisition is started.	READY: changes from HIGH to LOW.
		ERROR: remains LOW.
		TRG_ERROR: remains LOW.
5	Another data acquisition trigger signal is received during ongoing data acquisition.	READY: remains LOW.
		ERROR: remains LOW.
		TRG_ERROR: changes from LOW to HIGH.
6	The data acquisition trigger signal disappears.	READY: remains LOW.
		ERROR: remains LOW.
		TRG_ERROR: changes from HIGH to LOW.
7	The second round of data acquisition is stopped.	READY: changes from LOW to HIGH.
		ERROR: remains LOW.
		TRG_ERROR: remains LOW.

9.6. Y-Axis Resolution of Scan Data

The Y-axis resolution of the scan data is the distance between two neighboring data points along the travel direction of the target object. This is equal to the distance between two neighboring profiles. The Y-axis resolution determines the accuracy of the scan data, as well as the aspect ratio of the intensity image and depth map.

The rate at which scanning is triggered determines the distance between two neighboring profiles, and therefore determines the Y-axis resolution of the scan data.

The parameters that affect the rate at which scanning is triggered differ depending on the value of Line Scan Trigger Source:

- When scanning is triggered at a fixed rate: Trigger Rate determines the rate at which scanning is triggered.
- When scanning is triggered by an encoder: Trigger Signal Counting Mode and Trigger Interval together determine the rate at which scanning is triggered.

Adjust Y-Axis Resolution through Parameters

When you have specific requirement on the Y-axis resolution of the scan data, you can change the Y-axis resolution by adjusting the above parameters.

Trigger Rate

When scanning is triggered at a fixed rate, you can refer to the following equation and calculate the value of **Trigger Rate** for achieving the needed Y-axis resolution:

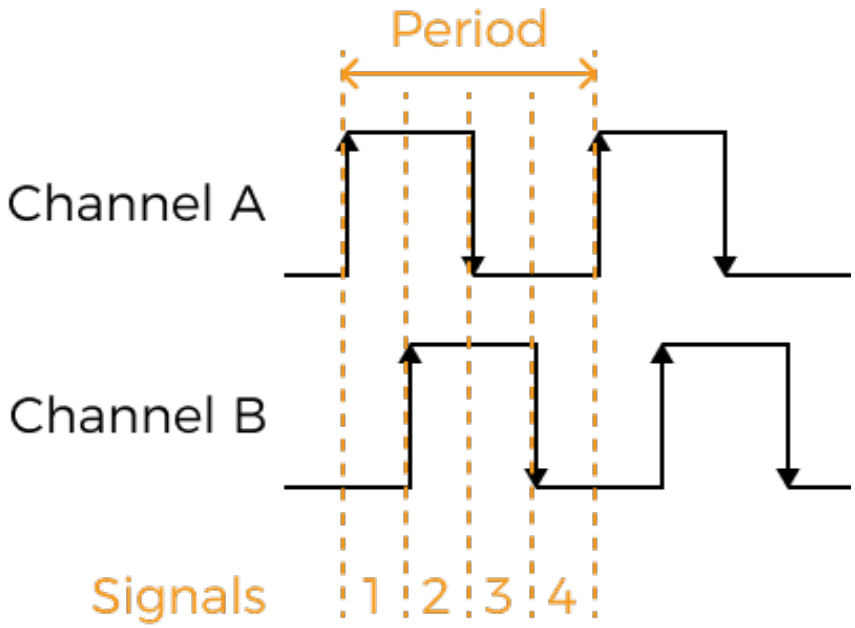
Y-axis resolution (μm) = travel speed of the target object relative to the laser profiler (μm/s) ÷ **Trigger Rate**

Trigger Signal Counting Mode and Trigger Interval

When scanning is triggered by an encoder, you can refer to the following equation and calculate the values of **Trigger Signal Counting Mode** and **Trigger Interval** for achieving the needed Y-axis resolution:

Y-axis resolution (μm) = encoder resolution (μm) × **Trigger Interval** ÷ **Trigger Signal Counting Mode** × 4

Among which, the encoder resolution is the travel distance (in μm) of the target object relative to the laser profiler during the duration of each signal in the following figure.



Calculation Example

If the encoder resolution is 4μm, and the needed Y-axis resolution is 20μm, then:

20 = 4 × **Trigger Interval** ÷ **Trigger Signal Counting Mode** × 4

Simplify the above equation to get: 1.25 × **Trigger Signal Counting Mode** = **Trigger Interval**.

Therefore, the following parameter values can basically satisfy the requirement on Y-axis

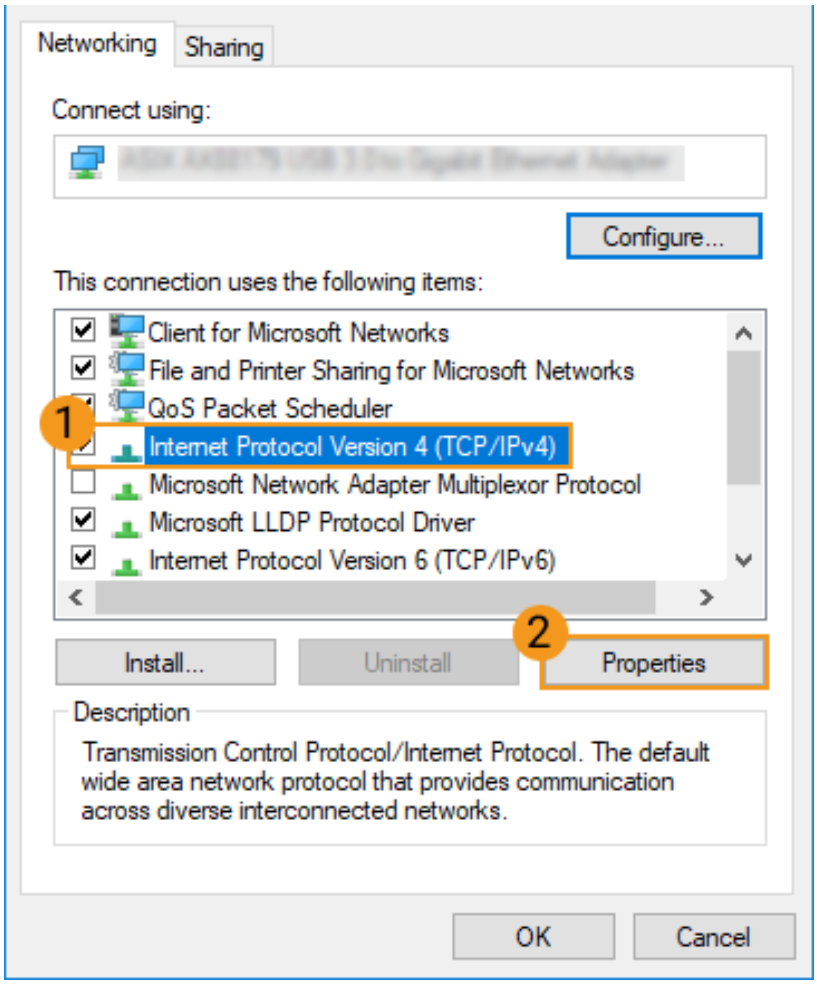
resolution:

Trigger Signal Counting Mode	Trigger Interval
1×	1.25 (Round it to 1 or 2)
2×	2.5 (Round it to 2 or 3)
4×	5

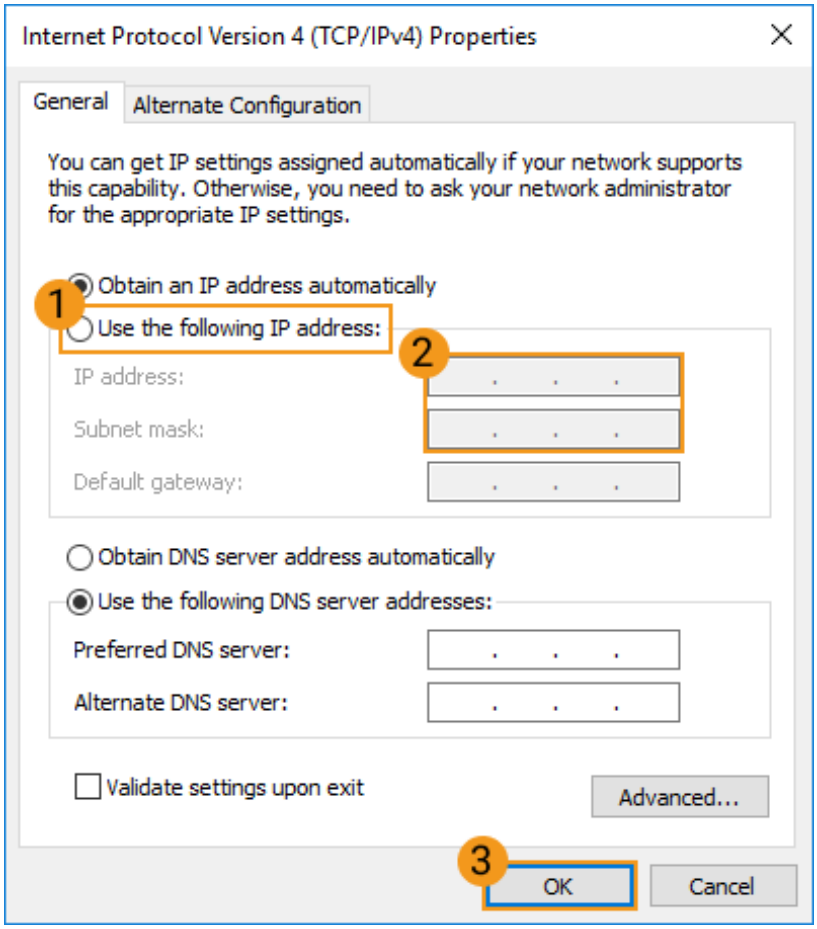
9.7. Set IP Address on Computer

This topic provides instructions on setting the IP address of the computer Ethernet port connected to the laser profiler.

1. On the computer, select Control Panel › Network and Internet › Network and Sharing Center › Change adapter settings. The **Network Connections** page will be displayed.
2. Right-click the Ethernet port connected to the laser profiler, and select **Properties** to enter the **Ethernet Properties** page.
3. Select **Internet Protocol Version 4 (TCP/IPv4)**, and then click **[Property]** to enter the **Internet Protocol Version 4 (TCP/IPv4) Properties** page.



4. Select **Use the following IP address**, and set the **IP address** and **Subnet mask** according to your actual needs. Click **[OK]** to save the changes.



To have the IP address automatically assigned, please select **Obtain an IP address automatically**.