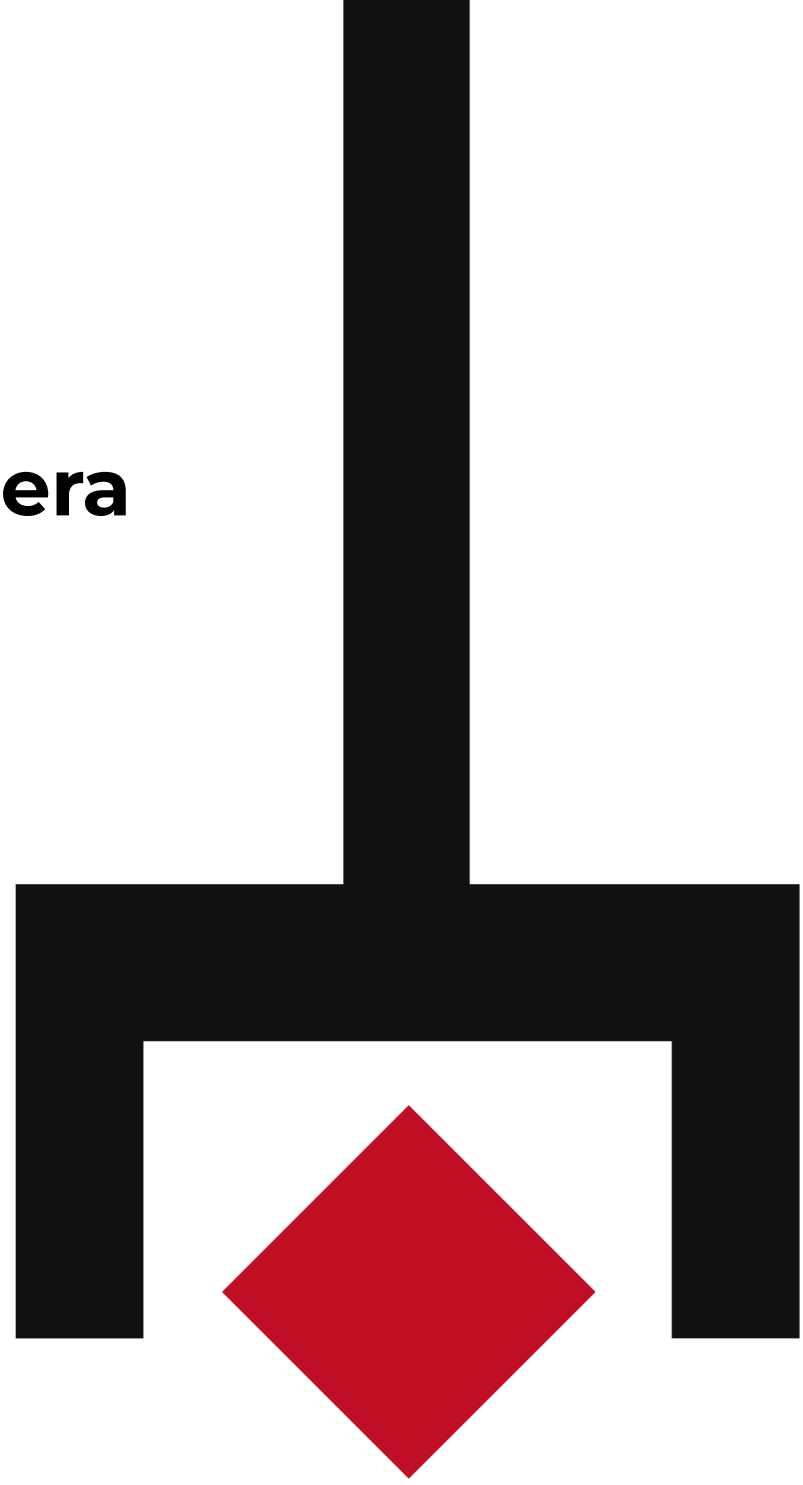
EUREKA
ROBOTICS

User Manual

Eureka 3D Camera



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1 Introduction

The Eureka 3D Camera is a stereo vision system designed for industrial applications, particularly table-top picking operations. This manual provides comprehensive instructions for installation, configuration, and operation of the camera system.

1.1 Safety Warnings and Precautions

Warning

- Ensure proper mounting support (minimum 5kg load capacity)
- Use only PoE-compatible network equipment
- Operating temperature: 0°C - 50°C
- Handle calibration components with care

2 Package Contents and Specifications

2.1 What's in the Box (Eureka 3D Camera-G3)

Inside the package you will find:

1. Eureka 3D Camera-G3.
2. Camera to robot mounting plate (ECA3-120 only).
3. Camera to profile mounting plate (ECA3-156 only).
4. Calibration board.
5. Calibration board adapter.
6. Calibration board lower fixing plates.
7. Calibration board upper fixing plates.
8. M3x10 screws (5 pieces).
9. M3x6 screws (4 pieces).
10. M5x10 screws (4 pieces).
11. M6x10 screws (4 pieces).

2 PACKAGE CONTENTS AND SPECIFICATIONS

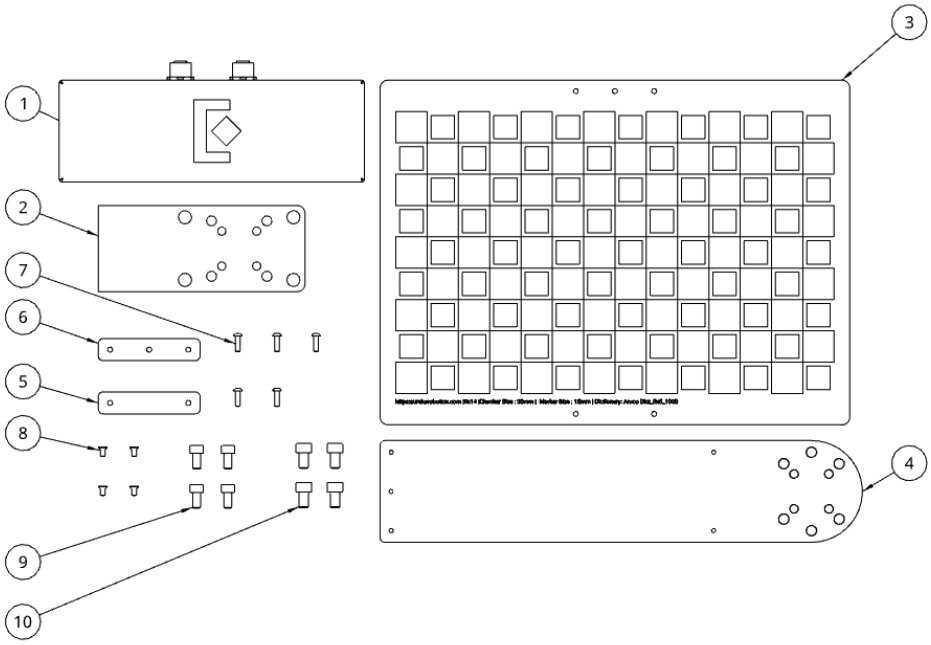


Figure 1: ECA3-120 package content

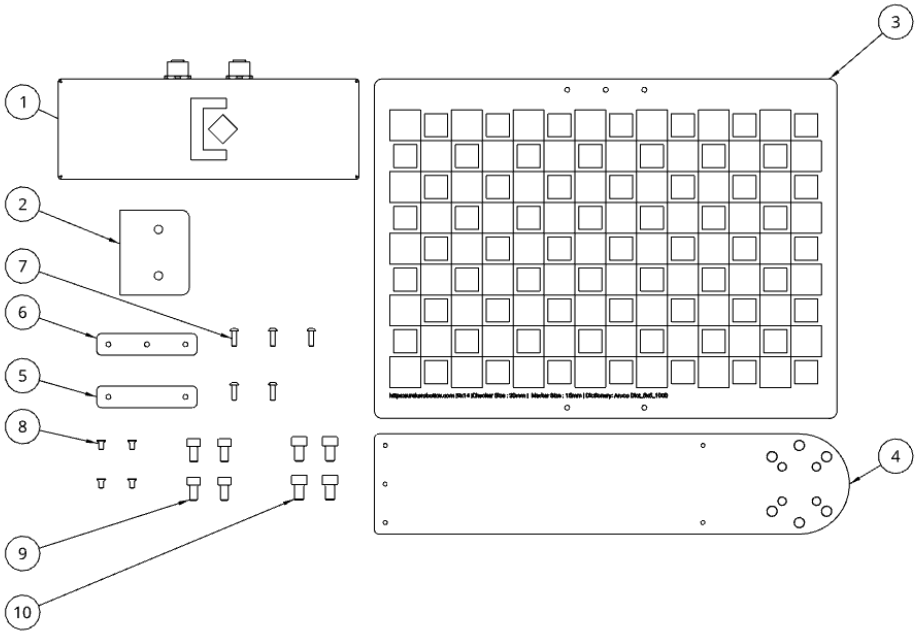


Figure 2: ECA3-156 package content

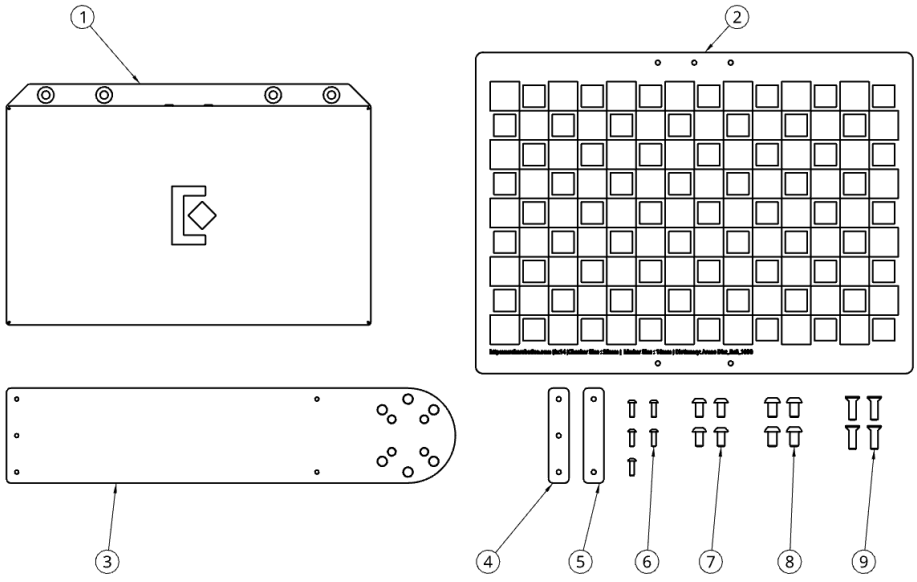
2.2 Technical Specifications (Eureka 3D Camera-G3)

Product name	Eureka 3D Camera-G3	Eureka 3D Camera-G3	Eureka 3D Camera-G3
Model	ECA3-120-F1	ECA3-156-F2	ECA3-156-F3
Usage note	In-hand picking	Table top picking	Long range picking
Recommended working distance	300-600 mm	600-1200 mm	1200-4000 mm
FOV @ min distance	210 x 188 mm	454 x 374 mm	917 x 746 mm
FOV @ max distance	448 x 376 mm	918 x 749 mm	3186 x 2486 mm
Resolution (max)	1440x1080	1440x1080	1440x1080
Expected Z error variation	0.26 - 1.04 mm	0.80 - 3.18 mm	3.18 - 35.38 mm
Weight	0.6 kg	0.7 kg	0.7 kg
Baseline	120 mm	156 mm	156 mm
Dimensions	160 x 80 x 40 mm	195 x 80 x 40 mm	195 x 80 x 40 mm
Typical capture time (2)	0.1 - 1.2 s	0.1 - 1.2 s	0.1 - 1.2 s
Operating temperature	0°C - 50°C	0°C - 50°C	0°C - 50°C

2.3 What's in the Box (Eureka 3D Camera-G2)

Inside the package you will find:

1. Eureka 3D Camera-G2.
2. Calibration board.
3. Calibration board adapter.
4. Calibration board upper fixing plates.
5. Calibration board lower fixing plates.
6. M3x10 screws (5 pieces).
7. M5x10 screws (4 pieces).
8. M6x10 screws (4 pieces).
9. M5x16 countersunk screws (4 pieces).



2.4 Technical Specifications (Eureka 3D Camera-G2)

Product name	Eureka 3D Camera-G2	Eureka 3D Camera-G2
Model	ECA2-156-N	ECA2-156-F
Usage note	Table top picking	Table top picking with low-latency requirement
Recommended working distance	500-1200 mm	500-1200 mm
FOV @ 0.5m	300 x 255 mm	250 x 305 mm
FOV @ 1.2m	950 x 620 mm	830 x 740 mm
Resolution (max)	1920x1080	1440x1080
Point Z-value repeatability (1)	NA	NA
Depth accuracy (1)	NA	NA
Weight	2.7 kg	2.6 kg
Baseline	156 mm	156 mm
Dimensions	250 x 165 x 60 mm	250 x 165 x 60 mm
Typical capture time (2)	0.5 - 1.2 s	0.1 - 1.2 s
Operating temperature	0°C - 50°C	0°C - 50°C

Remark: (1): Pending test result. (2): Faster capture time can be achieved by reducing resolution and faster AI model.

3 Installation

3.1 Physical Installation

3.1.1 Camera Mounting (Eureka 3D Camera-G3 In-hand)

1. Align the camera to robot mounting plate to the 3D camera, and secure by using 4 M3x6 screws.
2. Align the 3D camera, Effector to the robot-hand, and secure by using 4 M5x10 or M6x10 screws depend on robot-hand model.

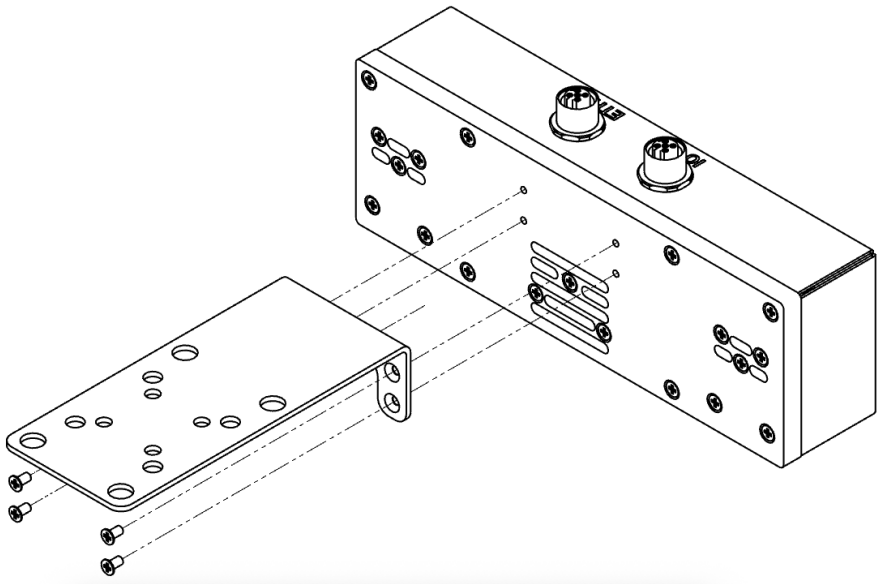


Figure 3: Assemble camera to robot mounting bracket

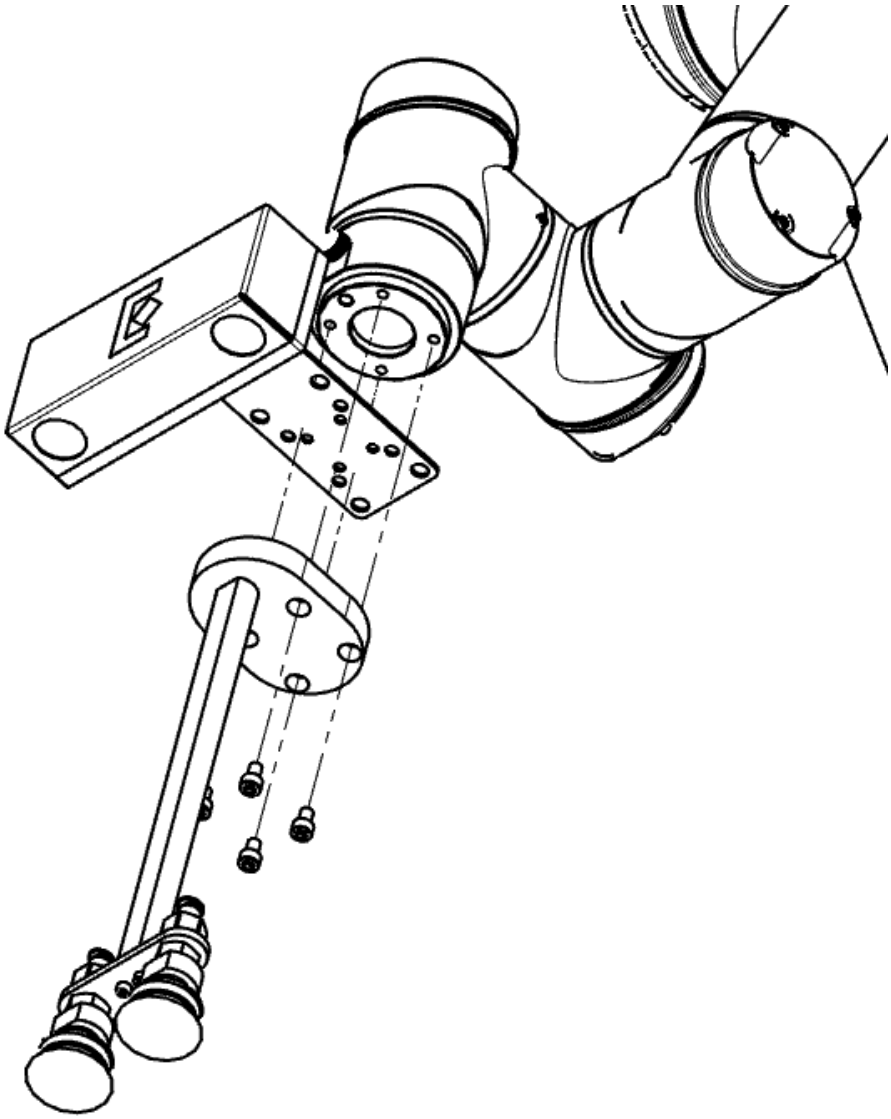


Figure 4: Assemble to Robot

3.1.2 Camera Mounting (Eureka 3D Camera-G3 Standard)

1. Align the camera to robot mounting plate to the 3D camera, and secure by using 4 M3x6 screws.
2. Align the 3D camera to the frame, and secure by tightening 2 M5x14 screws to M5 post-assembly nuts.

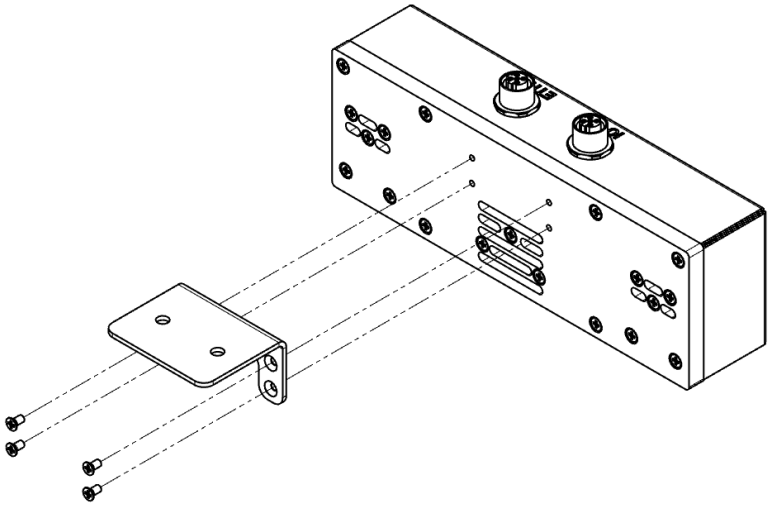


Figure 5: Install camera to frame mounting plate

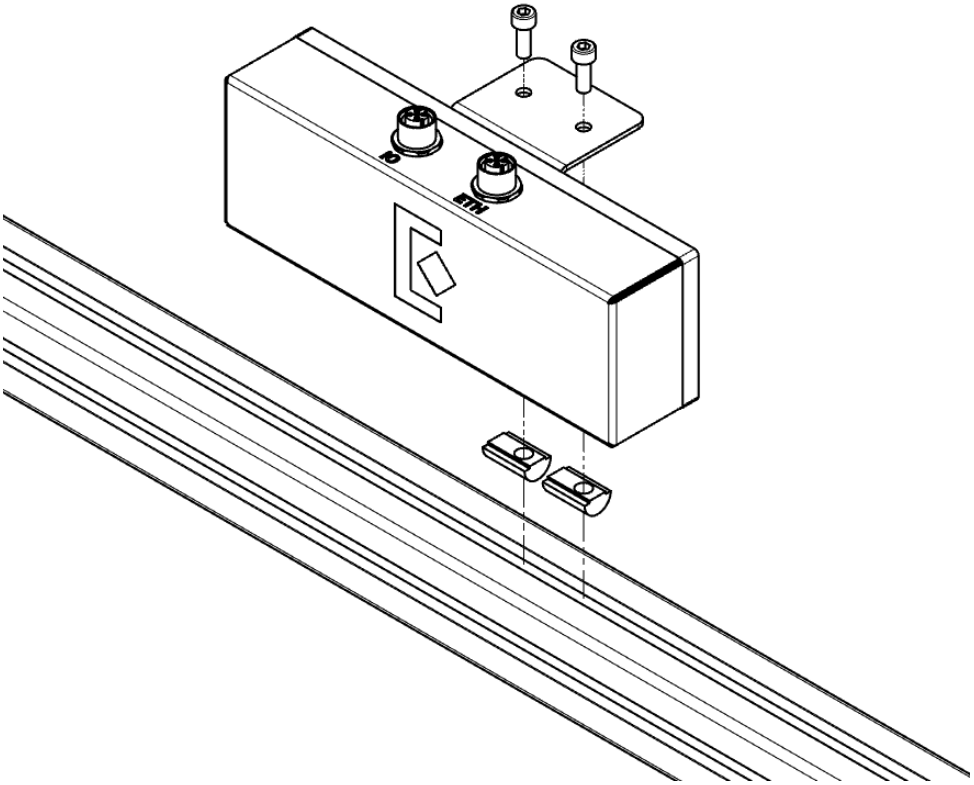
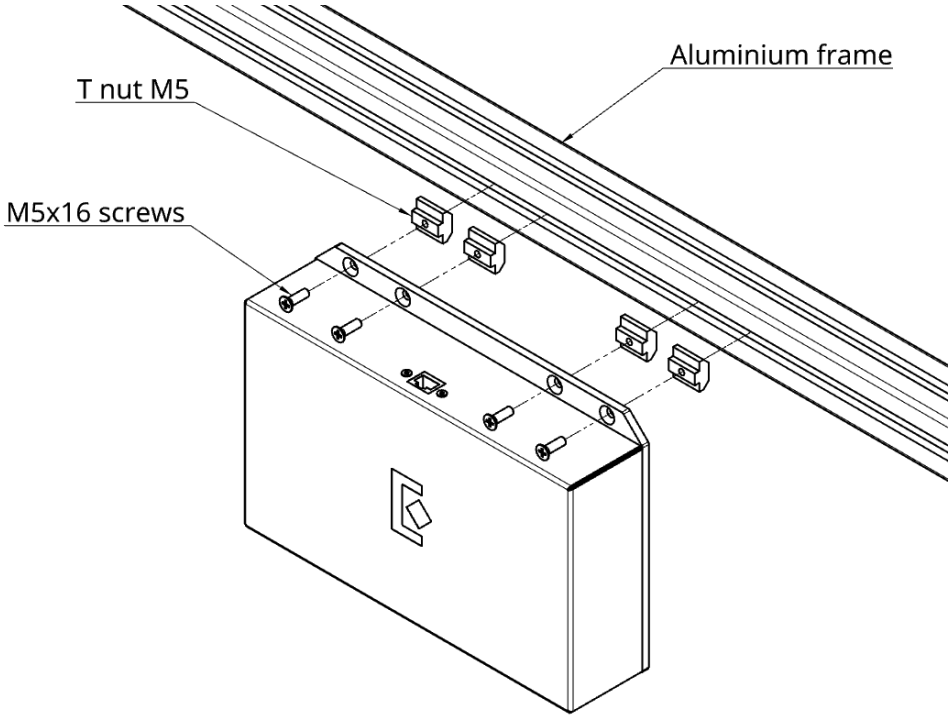


Figure 6: Install camera to frame

3.1.3 Camera Mounting (Eureka 3D Camera-G2)

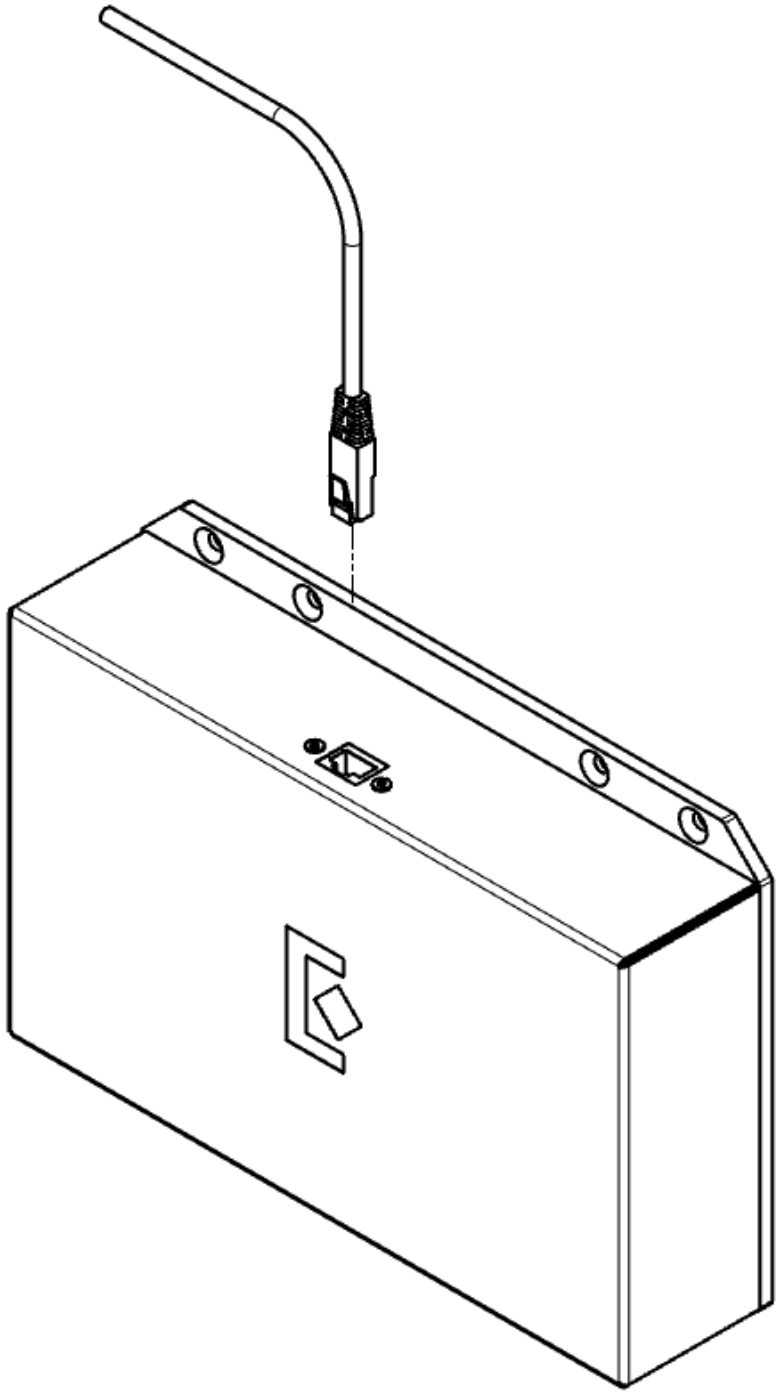
1. Align the 3D camera to the frame (this frame should be a 4040 aluminum frame and able to support a load of a minimum of 5kg).

2. Use 4 pieces of M5x16 countersunk screws included in the package to secure the 3D camera to the frame. (The T-nuts are not included).

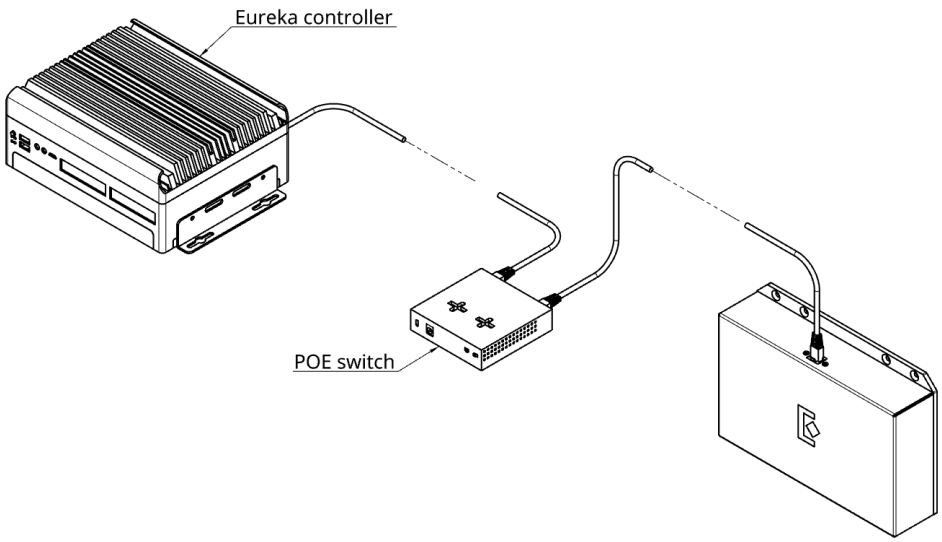


3.2 Network Setup

Plug an Ethernet cable with an RJ45 connector (CAT6 or above) to the RJ45 female connector on top of the camera.



Plug the other side of the Ethernet cable to a Power-over-Ethernet (PoE) switch and connect the PoE switch to the Eureka controller by another (CAT6 or above) ethernet cable.



4 Basic Usage

4.1 Network Configuration

Use the Eureka IP Configurator to configure camera network settings.

Warning

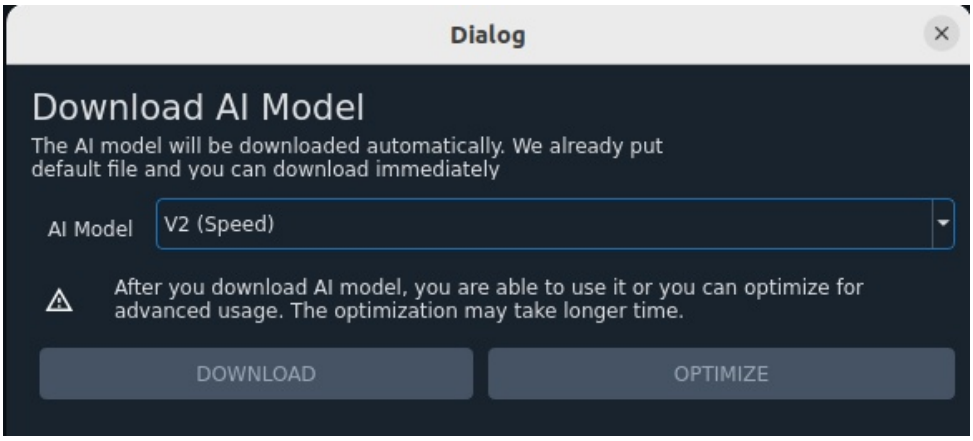
By default the camera has default IP Address at 192.168.0.11. To avoid conflict, ensure that no device on the network is at this IP Address or 192.168.0.12.

4.2 Software Prerequisites

4.2.1 Download AI Models for Depth-Reconstruction

By default some AI models for depth-reconstruction are pre-installed on the camera. If it's not the case, follow the steps below to download the AI model.

1. Login with ML Studio application using your assigned credential. Failing to do this will result in error in later steps.
2. Click on the `AI Model` button in the top right corner of the configurator dialog.
3. Choose from the available models in the dropdown list based on your application needs. "Balance" model is a good starting point.
4. Download and optionally optimize the model:
   - To download the selected model, click Download.
   - If you have already downloaded the model, you can choose to optimize the model. The optimization may take a few hours so you can Download the model to test first. If it works well, you can Optimize either in this dialog or Device dialog later for better performance.
   - An optimized model has better processing speed on suitable hardware.



4.2.2 Download Calibration File

Info

Downloading the calibration file is only required if you are using EC GUI version 0.93 or older.

Every Eureka 3D camera has been factory-calibrated (i.e. the 3D camera intrinsic parameters). In order to obtain this camera-specific calibration profile:

1. Login with ML Studio application using your assigned credential. Failing to do this will result in error in later steps.
2. Click on the `Calibration` button in the top right corner of the configurator dialog.
3. Save the calibration file to a local directory

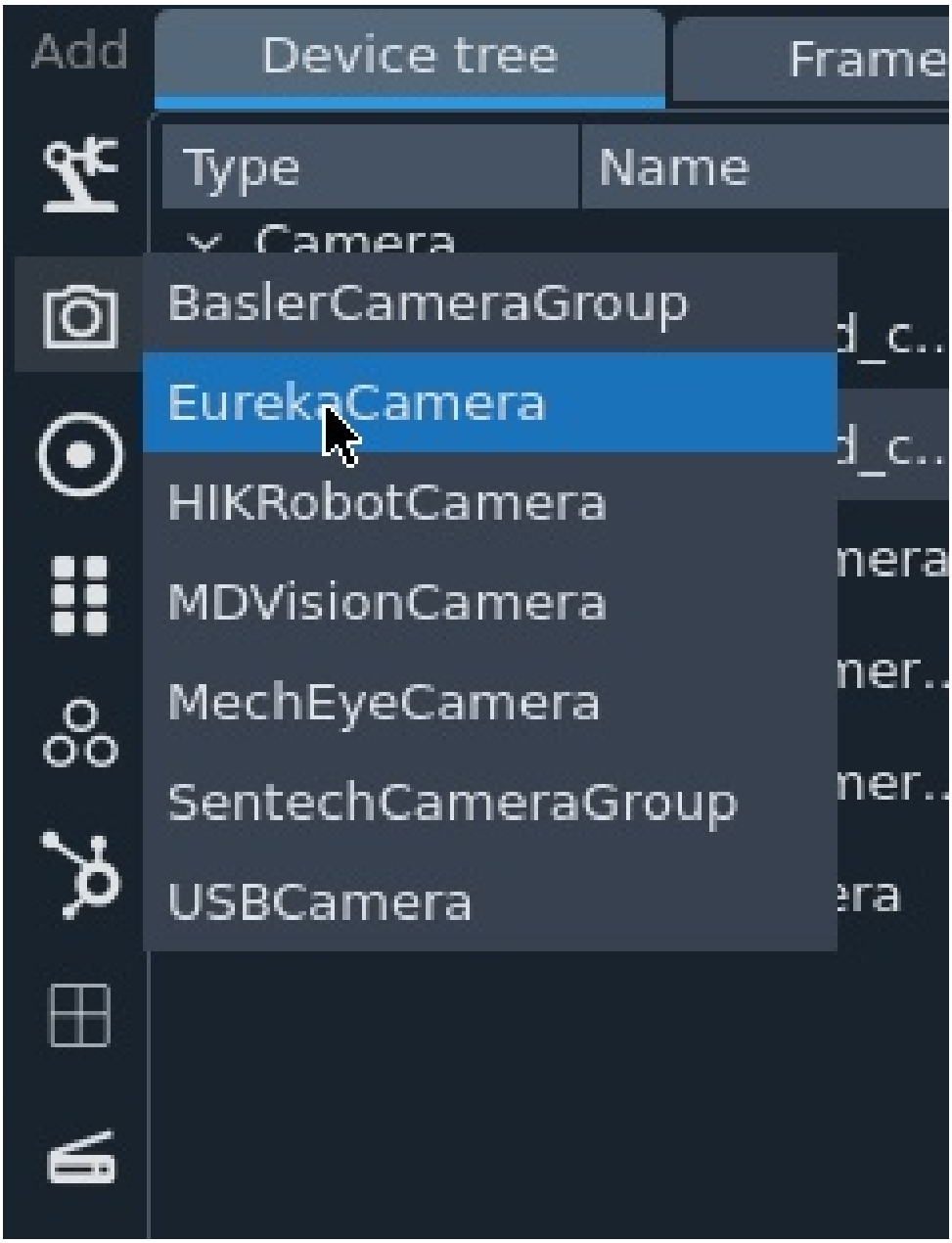
Note

To download the Calibration file, please ensure you are logged into your ML Studio account to authenticate access.

4.3 Adding Camera to Project

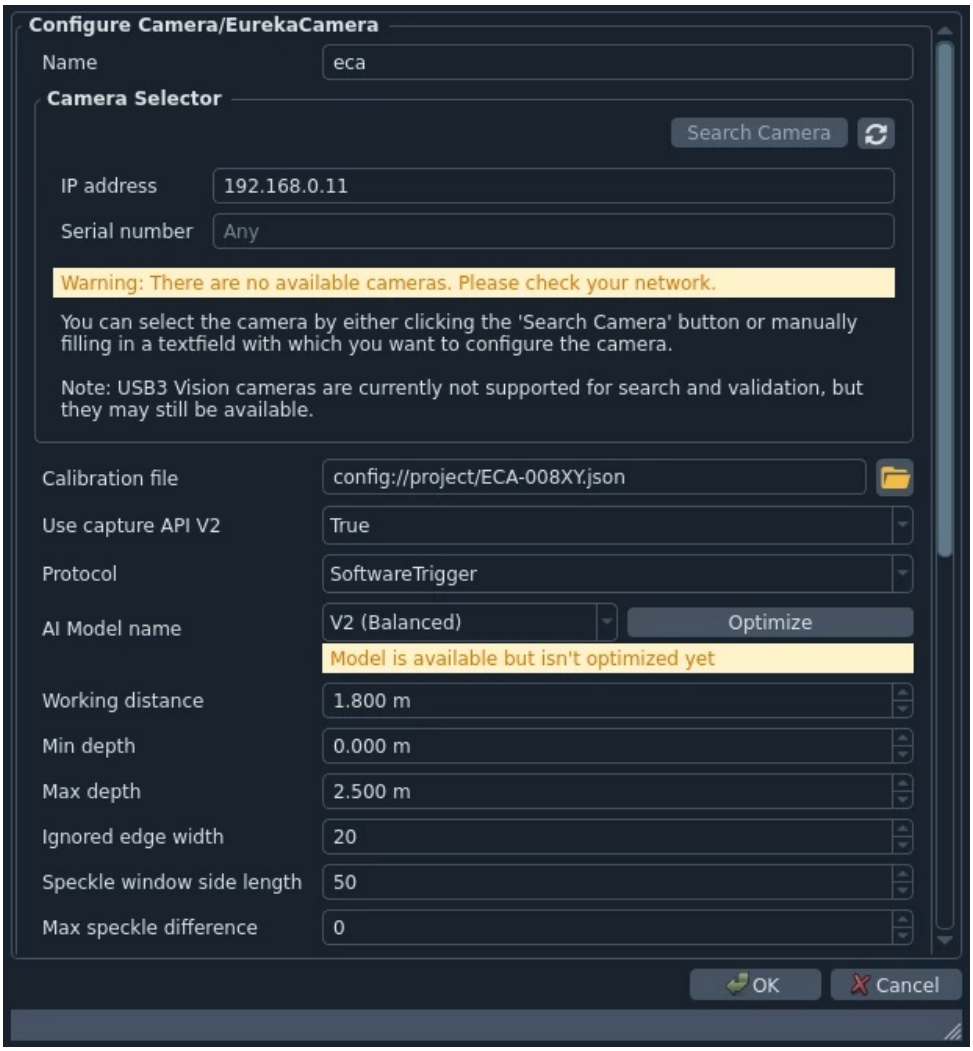
To add a Eureka camera device to use in a project:

1. Open the Eureka Controller GUI.
2. Create or open a new project.
3. Select Camera category from the left bar (see screenshot below).
4. Choose a `EurekaCamera` device.



In the below camera configuration dialog:

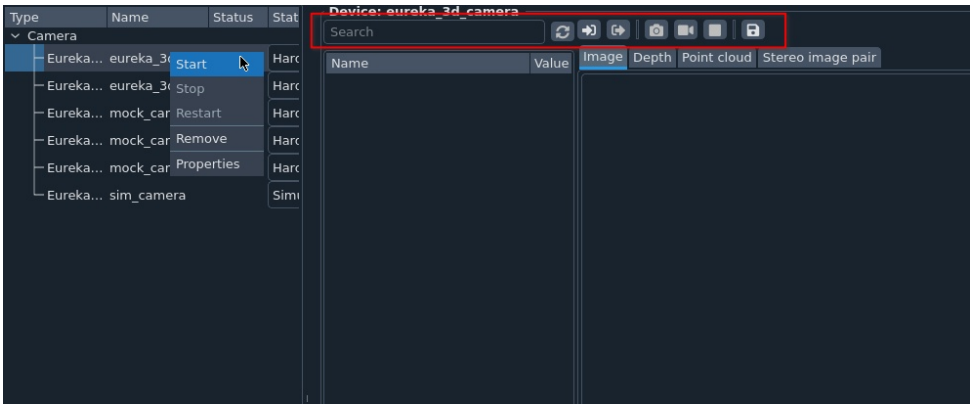
1. In `Camera Selector`: Set the IP Address field to the IP address of the camera that you configured previously.
2. For `Calibration File`: From EC GUI version 0.94 onward, calibration file is applied automatically so you can leave this field blank. If you're using an older version or prefer manual control, you can choose the calibration file of the camera that you downloaded (see the section Download Calibration File).
3. Choose the AI model that you have downloaded previously. If the AI model has not been optimized previously, it is also possible to optimize it in the dialog by clicking the `Optimize` button.
4. Set "Use Capture API V2" to True to use the new capture API version. This is recommended for new projects.
5. Leave most of the settings at the default values.

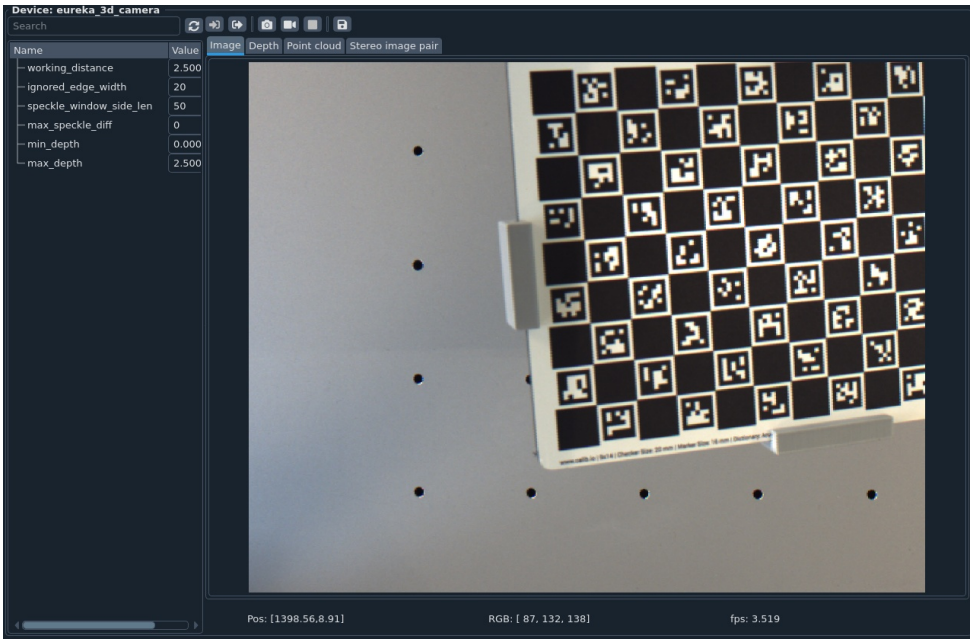


4.4 Connecting and Capturing Images

4.4.1 Using the Camera Panel

1. Right click on the camera item on the device tree and select `Start`.
2. Double click on a camera device to show the device panel.
3. Click `Connect` button in the control panel.
4. Capture images using either the `Capture Once` button or the `Stream` button.
5. View results in the `Image`, `Depth`, `Point Cloud`, and `Stereo image pair` tabs.

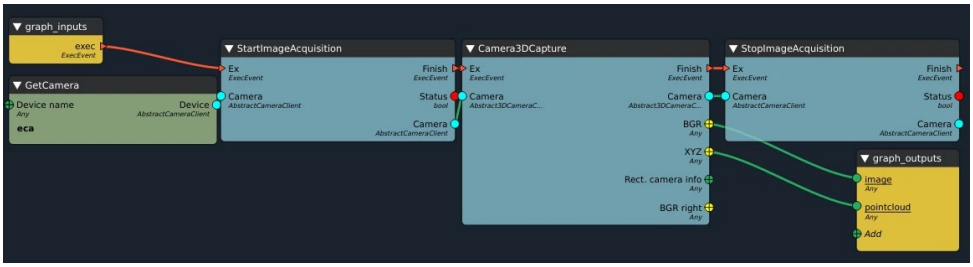




4.4.2 Using Graph Nodes

The capture image flow can be achieved using a graph as shown in the below image.

- `GetCamera` node obtains a reference to the Eureka 3D camera.
- `StartImageAcquisition` node starts the acquisition of the camera, this action only needs to be done once before capturing images.
- `Camera3DCapture` node captures images and point cloud from the camera. Since we are starting and stopping acquisition using the two nodes manually, set the `Start stop grabbing` node property to `False`.
- The `Rect. camera info` output contains the camera matrix of the rectified left image in port `BGR`.
- `StopImageAcquisition` node stops the acquisition of the camera.



Consult the documentation of the `Camera3DCapture` node and the below section for more usage information.

4.5 Understanding Output Formats

4.5.1 Capture API V1

Used when "Use Capture API V2" is set to False. The camera driver outputs images at the raw input resolution: `1920x1080` for `N` model cameras and `1440x1080` for `F` model cameras.

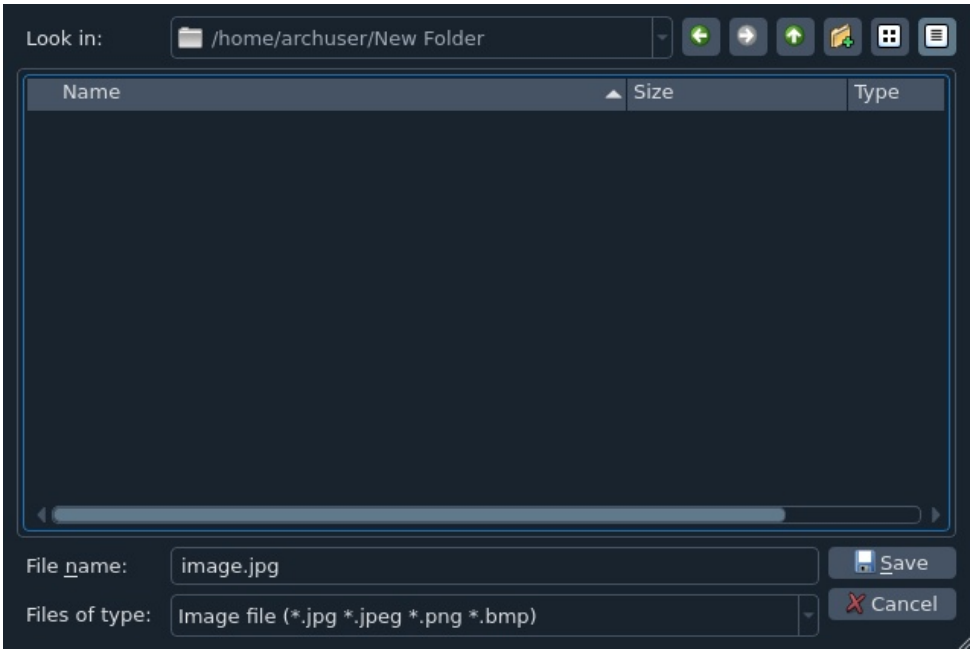
4.5.2 Capture API V2

Used when "Use Capture API V2" is set to True (recommended). The output image resolution defaults to the depth-reconstruction model's output size, which varies based on specific models.

To match V1 driver behavior, use the `Camera3DCapture` node and set the "Rectify output size" option to `FULL`.

4.6 Saving Image Data

1. Capture an image and point cloud using the panel. You should see the image shown in the panel viewer.
2. Choose the save button on the camera panel.
3. Enter the name of the image and choose `Save`.



This saves two files to disk: `image.jpg` and `image.jpg.npy`. The first file is the left image, rectified to remove distortion and to correct stereo imperfection. The numpy array contains the XYZ array registered with the image. This means pixel values on the image and the XYZ array correspond to each other, and combining the image and the float array gives the `RGB` or `RGBXYZ` image.

5 Advanced Usage

5.1 Camera Parameter Adjustment

Adjust camera parameters using the parameter tree on the left side of the image panel:

Parameter	Description
Working distance	Specifies the working distance for stereo rectification. Consider increasing this value if the point cloud appears flat/incorrect. Measure the distance from the camera's glass lens.
Ignore edge width	Pixels to be ignored at the left and right edges of the disparity map.
Speckle window side length	The maximum speckle size to consider it a speckle. Larger blobs are not affected by the filterSpeckles algorithm.
Max speckle diff	Maximum difference between neighbor disparity pixels to put them into the same blob.
Min depth	Used for filtering the point cloud. Points with depth below min_depth will be filtered out.
Max depth	Used for filtering the point cloud. Points with depth above max_depth will be filtered out.
Balance ratio	This value sets the selected balance ratio control as an integer.
Balance ratio selector	Selects a balance ratio to configure. Once a balance ratio control has been selected.
Balance white auto	Balance White Auto is the 'automatic' counterpart of the manual white balance feature.
Exposure time	Exposure time in microseconds.
Gain	Gain applied to the image in dB.
Gamma	Controls the gamma correction of pixel intensity.
GevSCPD	Indicates the delay (in timestamp counter units) to insert between each packet for this stream channel. This can be used as a crude flow-control mechanism if the application or the network infrastructure cannot keep up with the packets coming from the device.
Pixel binning†	Reduce the input image size for faster capture speed. Set to 0 for the default image size. This parameter is used to reduce the image transfer time.
Width*	The cropped width of the image. This parameter is used to crop the image to a smaller size.
Height*	The cropped height of the image. This parameter is used to crop the image to a smaller size.
Left OffsetX*	The offset of the left camera cropped image in the X (horizontal) direction.
Left OffsetY*	The offset of the left camera cropped image in the Y (vertical) direction.
Right OffsetX*	The offset of the right camera cropped image in the X (horizontal) direction.
Right OffsetY*	The offset of the right camera cropped image in the Y (vertical) direction.
UserSetDefault	This enumeration sets the configuration set to be used as the default startup set. The configuration set that has been selected as the default startup set will be loaded as the active set whenever the camera is powered on or reset.
UserSetLoad	This command loads the selected configuration set from the non-volatile memory in the camera to the volatile memory and makes the selected set the active configuration set. Once the selected set is loaded, the parameters in the selected set will control the camera.
UserSetSave	This command copies the parameters in the current active configuration set into the selected user set in the camera's non-volatile memory.
UserSetSelector	This enumeration selects the configuration set to load, save or configure. Possible values for the User Set Selector are: Default: Selects a configuration set that contains factory settings. User Set 1: Selects the first user set.

†Only supported on F variant cameras with Capture API 2 (settable in the camera configuration dialog).
*Only supported cameras with Capture API 2 (settable in the camera configuration dialog).

5.2 User Sets Management

User sets are used in the following use cases:

1. To allow users to load a parameter configuration on startup.
2. To allow users to switch between parameter configurations while using the camera.

To store the current settings in an userset and configure it to automatically load:

1. Select User Set 1 (or User Set 2, User Set 3) using the UserSetSelector parameter.
2. Execute the UserSetSave parameter.
3. Select User Set 1 (or User Set 2, User Set 3) in the UserSetDefault parameter.
4. Next time when the camera starts the current configuration will be loaded.

5.3 Region of Interest (ROI) Configuration

If the working area of the application is much smaller than the camera's field of view, the depth-reconstruction quality may degrade.

In such cases, it is recommended to adjust the Region-Of-Interest (ROI) of both left and right cameras to focus on the relevant area. Note that this feature is only supported with Capture API 2 (configurable in the camera configuration dialog) and without pixel binning enabled.

Use these parameters to configure the cropped images:

- Width
- Height
- Left OffsetX
- Left OffsetY
- Right OffsetX
- Right OffsetY

Ensure that the object of interest remains visible in both cropped images. The raw cropped images can be inspected in the `Stereo image pair` tab of the camera panel.

5.4 Uploading New Calibration Files

Follow these steps to upload a calibration file using the Eureka Controller:

5.4.1 Step 1: Open EC Application

Launch the Eureka Controller application from your desktop or system menu.

5.4.2 Step 2: Access Camera Configurator

Navigate to **Device** → **Camera Configurator** in the top menu bar.

5.4.3 Step 3: Select Camera

From the list of detected cameras, select the target camera.

5.4.4 Step 4: Upload Calibration

Click **Upload Calibration** to open the file upload dialog.

5.4.5 Step 5: Select JSON File

Browse to your calibration file (must be JSON format) and click **Open**.

5.4.6 Step 6: Confirm Upload

Click **Yes** when prompted to upload the selected file.

Note

Ensure the calibration file is in the correct JSON format before uploading. If you encounter issues, verify the file format and try again.

6 Troubleshooting

6.1 Connection Issues

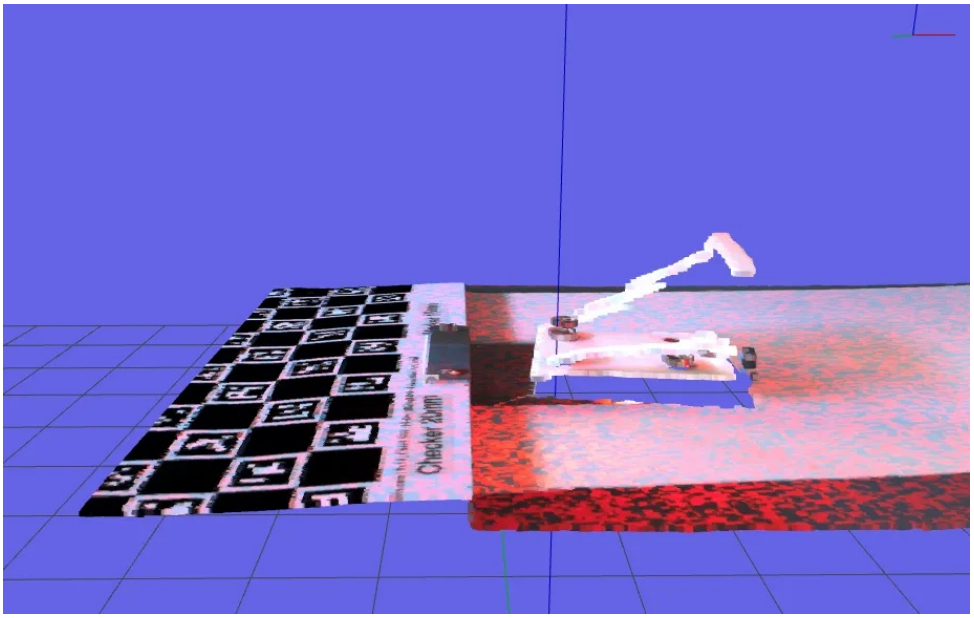
6.1.1 Long Initial Connection with ECA2-156-F Camera

During the initial connection stage, the `ECA2-156-F` camera (Eureka 3D Camera-G2) needs to establish a precision time protocol (PTP) connection with the pair of stereo cameras. The PTP connection can take up to 30 seconds to establish. This behavior is normal and does not affect any subsequent operations of the cameras.

In a recent version of Eureka software, it is possible to use the `Software` trigger protocol from the camera configuration dialog. This protocol enables a faster connection time.

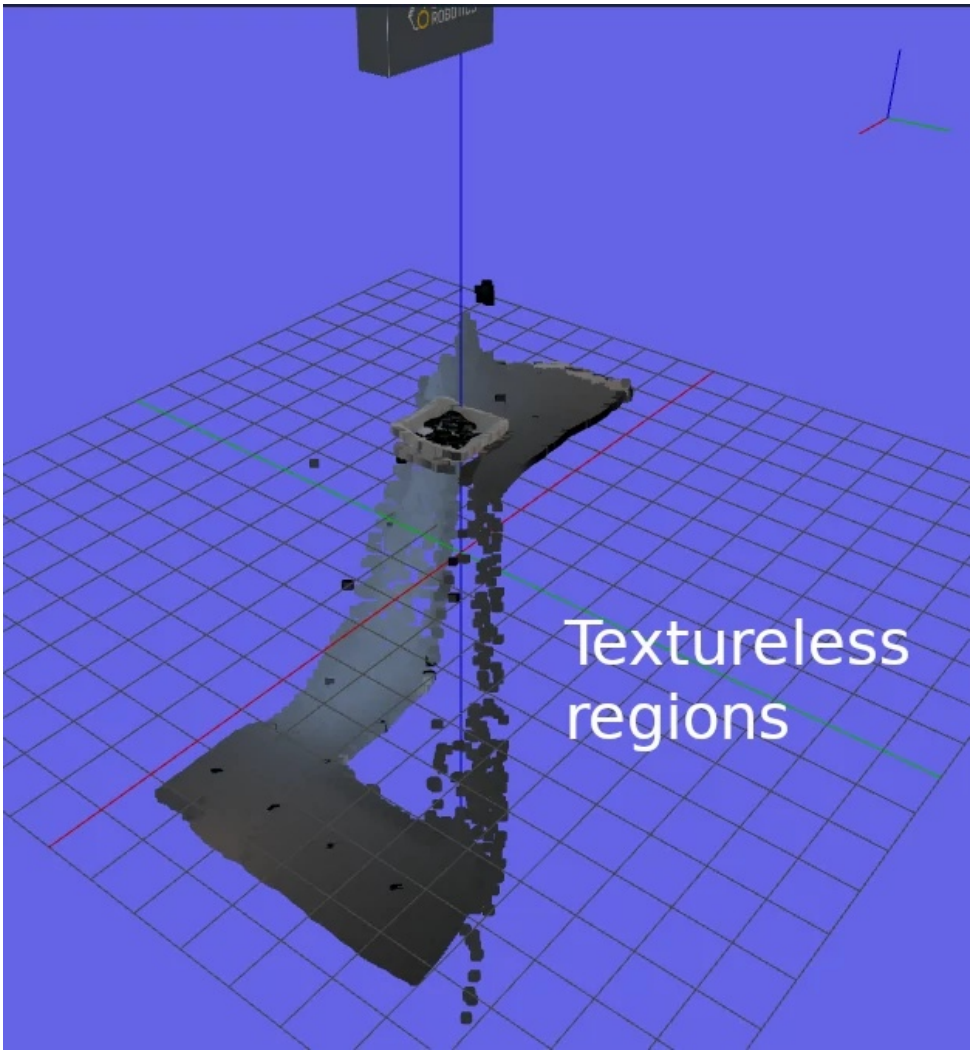
6.2 Image Quality Issues

6.2.1 "Flat" Looking Point Clouds

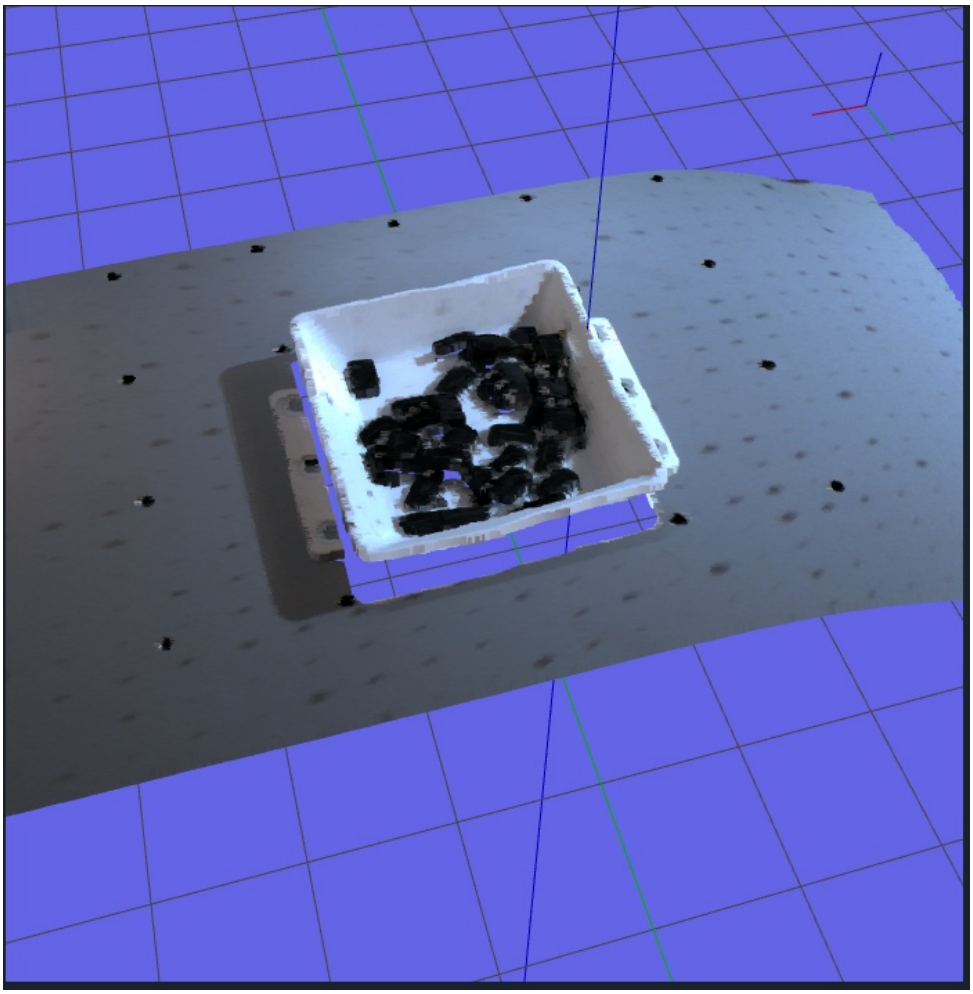


If the point cloud appears to be "flat" without any apparent depth, it is likely that the "Working distance" parameter needs adjustment. Ensure that the parameter is set to the distance of the current surface being inspected.

6.2.2 Poor Quality on Textureless Surfaces



Objects without a textured surface may appear incorrectly constructed due to the AI model's inability to find correspondence between the two cameras' images.



A solution to this problem is to project a pattern onto the object using a simple LED projector. The pattern should be a cloud of points with relatively sparse spacing, as shown in the image above.

Industrial projectors with structured light patterns can also be used for reliability and industrial guarantees:

- EFFI-Lase V2
- Opto Engineering pattern projectors

6.3 Performance Issues

6.3.1 Slow Capture Speed

Solutions:

- Reduce image resolution
- Use faster AI models
- Enable pixel binning (F variant cameras with Capture API 2)
- Optimize AI models in the configuration dialog

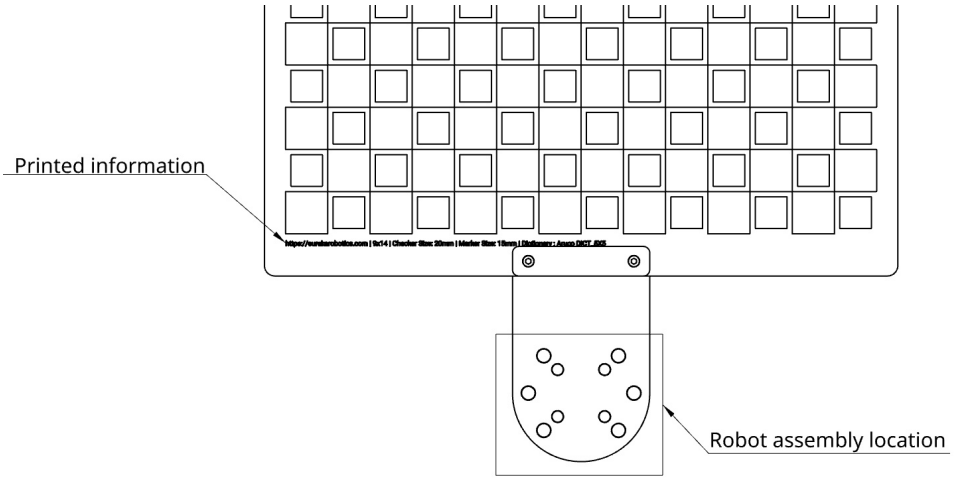
7 Hardware Reference

7.1 Calibration Pattern

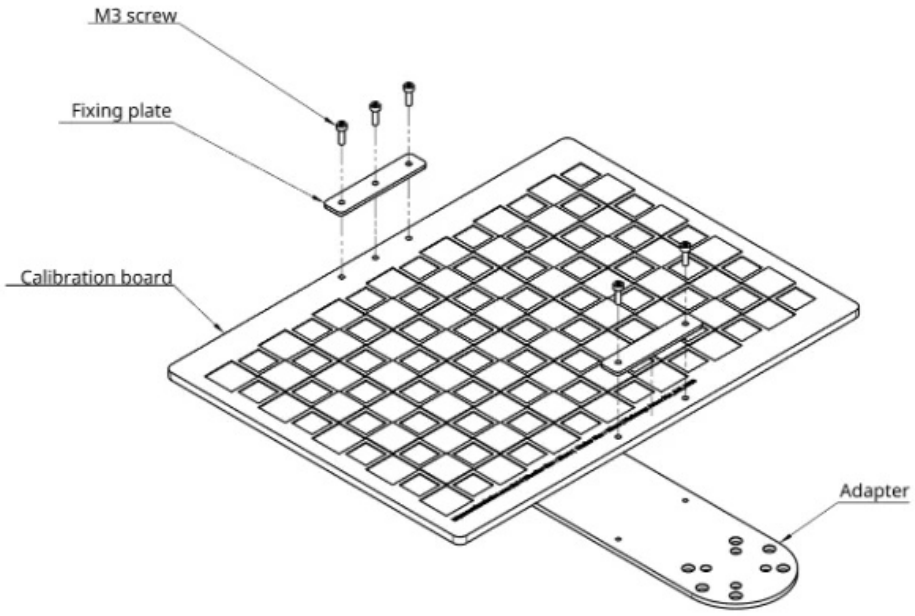
In the package you will find a calibration pattern that can be used to recalibrate the Eureka Camera as well as calibrate the camera with a robot.

7.1.1 Assembling Calibration Pattern with Adapter Plate

- Align the calibration board with the two fixing plates and the adapter as in the below drawing.
- Note that the lower-left corner of the calibration pattern, which contains the printed information, is positioned correctly as the below drawing.



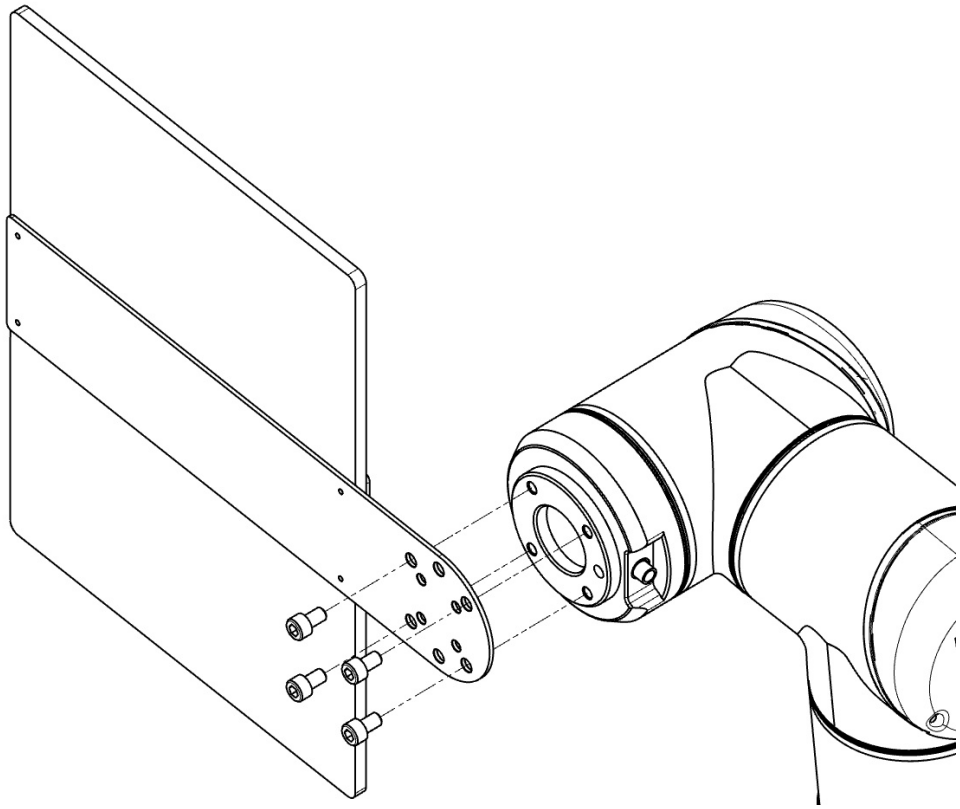
Use 5 pieces of M3x10 screws included in the package to fix the calibration board.



7.1.2 Mounting to Robot End-Effector

- Align the calibration pattern assembly (see previous section) with the robot end-effector.

- Use 4 pieces of M5x10 or M6x10 screws (depending on robot model) included in the package to secure the calibration board assembly.

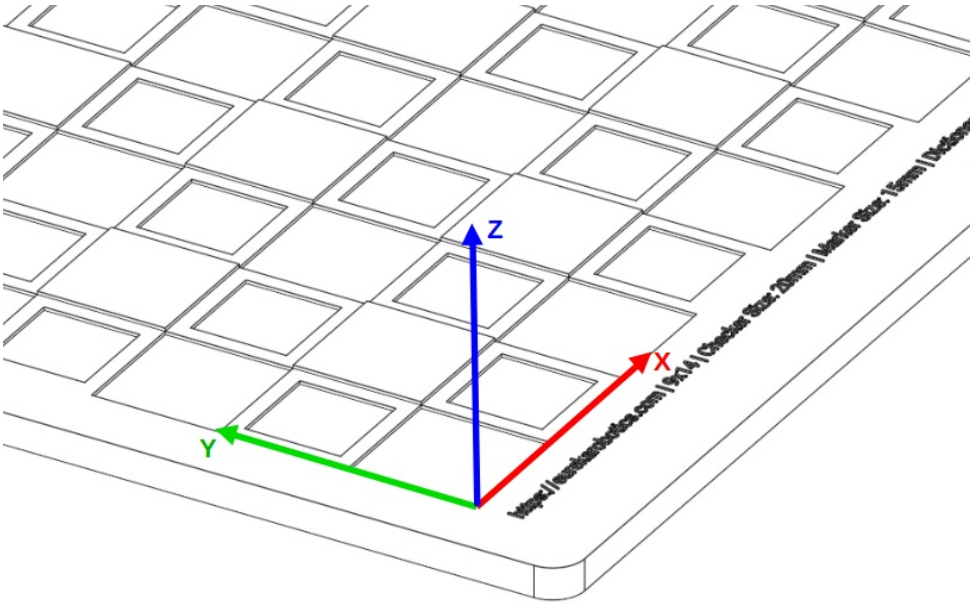


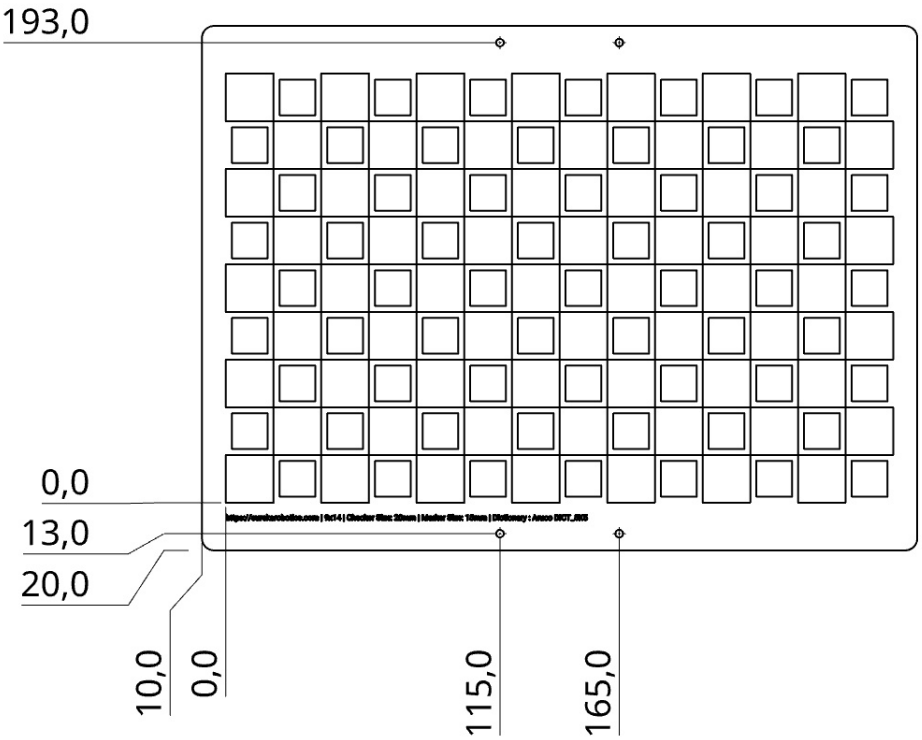
7.1.3 Compatible Robots

Brand	Models
Universal Robots	UR3e, UR5e, UR10e, UR16e.
ABB	IBR 1010, IBR 1090, IBR 1100, IBR 1200, IBR 2400, IBR 2600, IBR 4400, IBR 4600.
Denso	VP-5243, VP-6242, VS-050, VS-060, VS-068, VS-087, VS-6556, VS-6577, COBOTTA PRO 900, COBOTTA PRO 1300.
Yaskawa	GP7, GP8, GP8L, HC10DTP, HC20DTP, HC30DTP, MPP3H, MPP3S.
Fanuc	CRX-series
Kawasaki	RS003N, RS005N, RS005L, RS007N, RS007L, RS013N, duAro1, duAro2

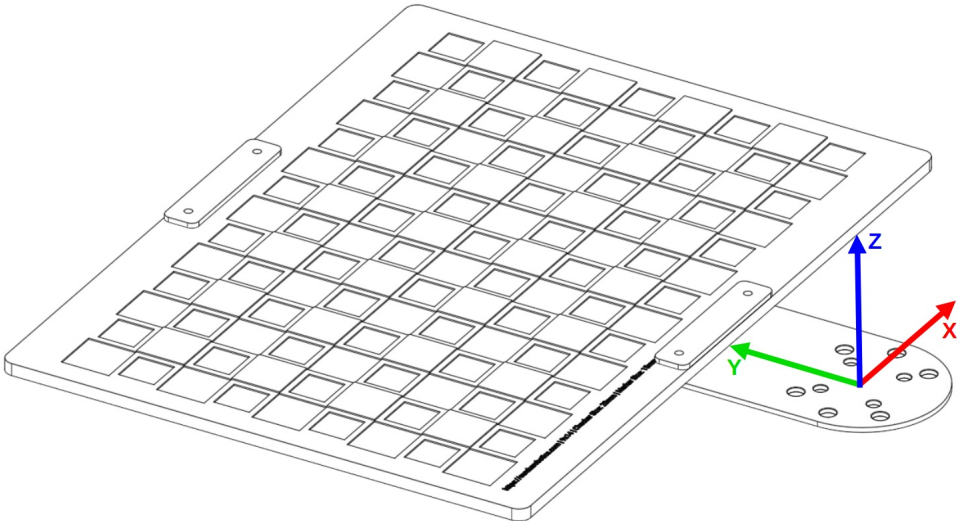
7.1.4 Technical Measurements

The original coordinate of the calibration board: located in lower-left corner of the pattern on the calibration board:

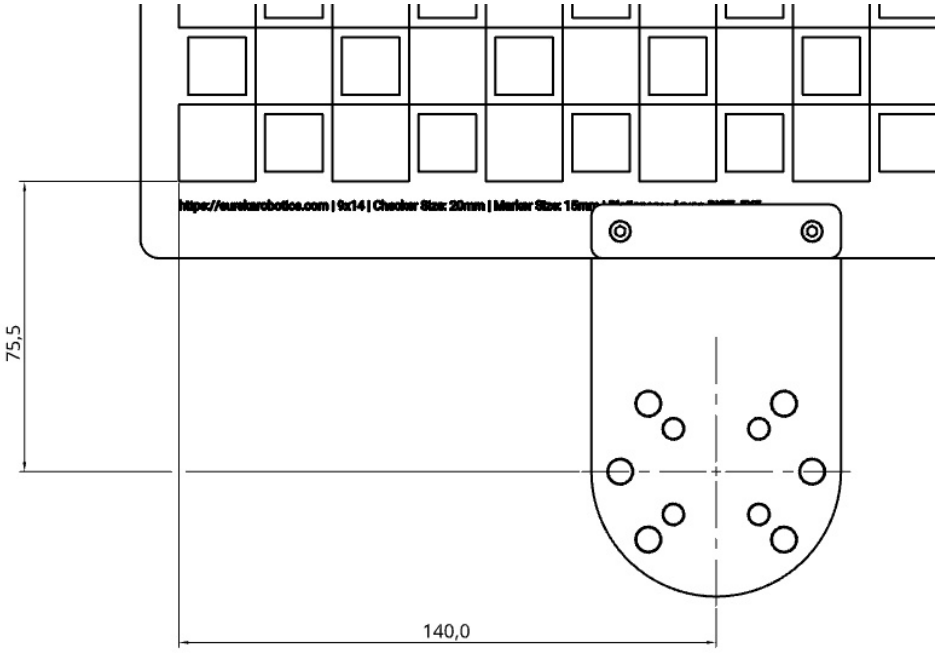




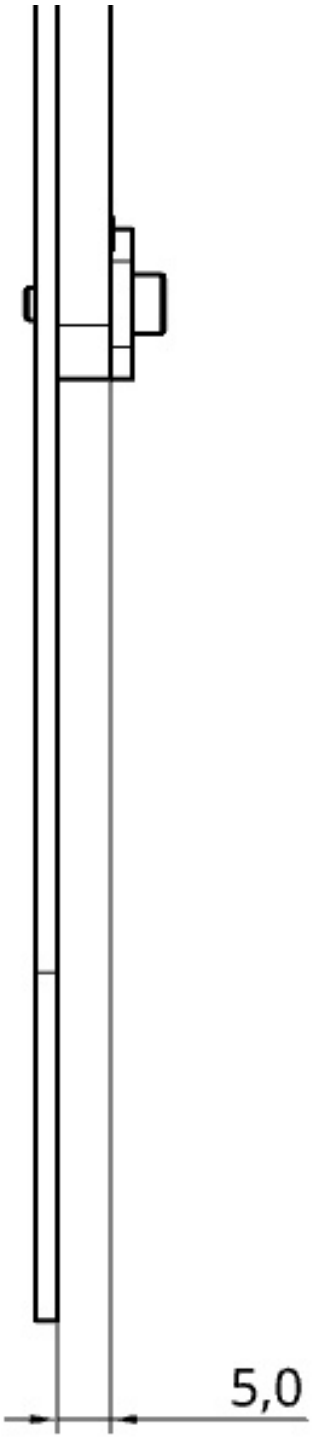
The original coordinate of the calibration board assembly: located in centre of the robot assembly location on adapter:



The dimension X and Y between the assembly original coordinate and the calibration original coordinate are shown in below pictures:



The dimension Z:



This calibration board is suggested to use with the working distance from 0.5 to 1.0 metre.

7.2 3D Models

3D models can be downloaded from eurekarobotics.com.