



AutoBee-D1

User manual



This document is copyrighted by Elnec s.r.o., Presov, Slovakia. All rights reserved. This document or any part of it may not be copied, reproduced or translated in any form or in any way without the prior written permission of Elnec s.r.o.

The control program is copyright Elnec s.r.o., Presov, Slovakia. The control program or any part of it may not be analyzed, disassembled or modified in any form, on any medium, for any purpose.

Information provided in this manual is intended to be accurate at the moment of release, but we continuously improve all our products. Please consult manual on www.elnec.com.

Elnec s.r.o. assumes no responsibility for misuse of this manual.

Elnec s.r.o. reserves the right to make changes or improvements to the product described in this manual at any time without notice. This manual contains names of companies, software products, etc., which may be trademarks of their respective owners. Elnec s.r.o. respects those trademarks.

COPYRIGHT 1991 – 2025

Elnec s.r.o.
Presov, Slovakia

Table of Contents

Introduction.....	4
AutoBee-D1 hardware.....	5
Technical specifications.....	6
System requirements.....	6
Machine layout.....	6
Machine dimensions.....	9
PG4UWAUTO – the machine software.....	10
Software installation.....	10
Description of the user interface.....	11
User Level.....	14
Settings panel.....	15
Driver console.....	16
Work order.....	18
Vision.....	20
Adapter.....	23
Media.....	25
Options.....	29
Run.....	31
First startup - AutoBee-D1.....	35
1. Machine setup.....	35
2. Preparation for work.....	35
3. Configure application parameters.....	36
Project creation.....	37
Vision settings.....	37
Adapter settings.....	40
Media settings.....	42
Options settings.....	45
Run programming.....	46
Platform editor.....	48
Platform check.....	50
Calibrate recognition camera sequence.....	53
Learning sequence.....	54
Diagnostics sequence.....	55
Maintenance and Lubrication.....	56
Troubleshooting.....	58
Requirements for operator.....	59
Safety instructions.....	60
General Safety Instructions.....	60
Mechanical Safety.....	60
Electrical Safety.....	60
Pneumatic Safety.....	60
Fire Safety.....	60
Ergonomic and Environmental Guidelines.....	61
Emergency Stop.....	61
Maintenance and Service.....	61

Terminology used in the manual:

Device	any kind of programmable integrated circuits or programmable devices
ZIF socket	Zero Insertion Force socket used for insertion of target device
USB port	type of PC port (serial), which is dedicated for connecting portable and peripheral devices.
XML	Extensible Markup Language is file format for storing, transmitting, and reconstructing arbitrary data.

Introduction

This user manual covers the automated programming machine AutoBee-D1 from Elnec. AutoBee-D1 is a desktop machine designed for the automatic operation of two programmers simultaneously, specifically the BeeHive304 programmers from Elnec. BeeHive304 is ultra speed universal 4x64-pindrive concurrent multiprogramming system designed for high volume production programming of high capacity memories. The devices are programmed at near theoretical maximum programming speed.

The principle of the AutoBee-D1 machine consists of transferring devices between programmers and media. The machine uses linear guides grouped into a Cartesian coordinate system (XYZ) for movement. AutoBee-D1 uses nozzle with a vacuum system for handling devices. Vacuum is also used for opening and closing ZIF sockets on Elnec programmers.

For the control of the AutoBee-D1 machine, the PG4UWAUTO application has been developed by Elnec. The application is described in detail in this user manual.

The machine is supplied in the form of a kit. To assemble it, several mechanical steps are required. Therefore, it is recommended for a mechanically skilled person to complete the assembly of the AutoBee-D1 machine.

AutoBee-D1 hardware

The hardware of the AutoBee-D1 machine consists of a robust construction in combination with aluminum profiles sized 40x40 mm and aluminum plates with a thickness of 4 mm. The entire machine is enclosed by Plexiglas with a thickness of 3 mm. Access to the interior of the machine is secured by swing doors, assisted by gas springs during opening.

Technical specifications

Machine type: Desktop	Number of Heads: 1
Model of Elnec programmers: BeeHive 304	Noozle type: Vacuum
Up to 2 Elnec programmers	Number of cameras: 2
Type of input/output media: Tray	Units per hour (UPH): ~500
Number of media: 4 + Reject tray	Power supply: 220V/50Hz
Air supply: 0,5 – 0,7 MPa (min. 65 l/min)	Max Power consumption: 600W
Data interface: USB 3.0	Noise: 70 dB
Total dimensions LxWxH: 1111x925x950 mm	Weight: 89 kg
Height when doors are open: 1220 mm	Repeat position accuracy: 0,05/300 mm
Size of the workspace: 660 x 520 x 51 mm (XYZ)	Endstop sensors type: Optical
Minimum tray size: 198x60 mm	Minimum Component Size: 3x3 mm
Maximum tray size: 386x165,5 mm	Up camera: USB 720p camera
Axis feed rate: X: 750mm/s Y: 750mm/s Z: 230mm/s	Recognition camera: Ximea MQ013MG-E2
Probe Z: Touch through a nozzle. Touch is detected by an optical sensor.	Backlight: Ring light 6W

System requirements

OS: Windows 7/8/10/11

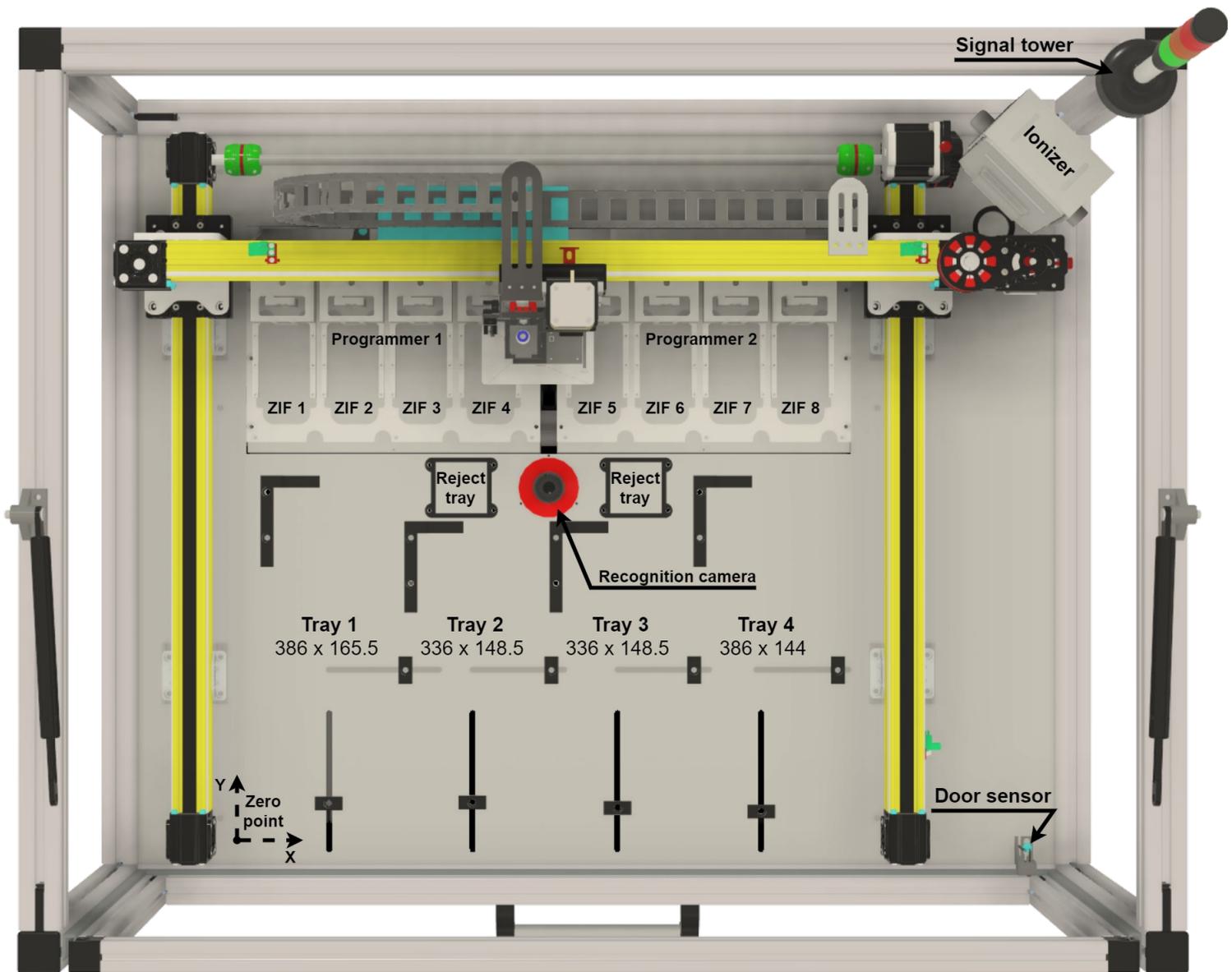
Processor: Quad core processor (Core i5 or better)

Memory: 4 GB RAM

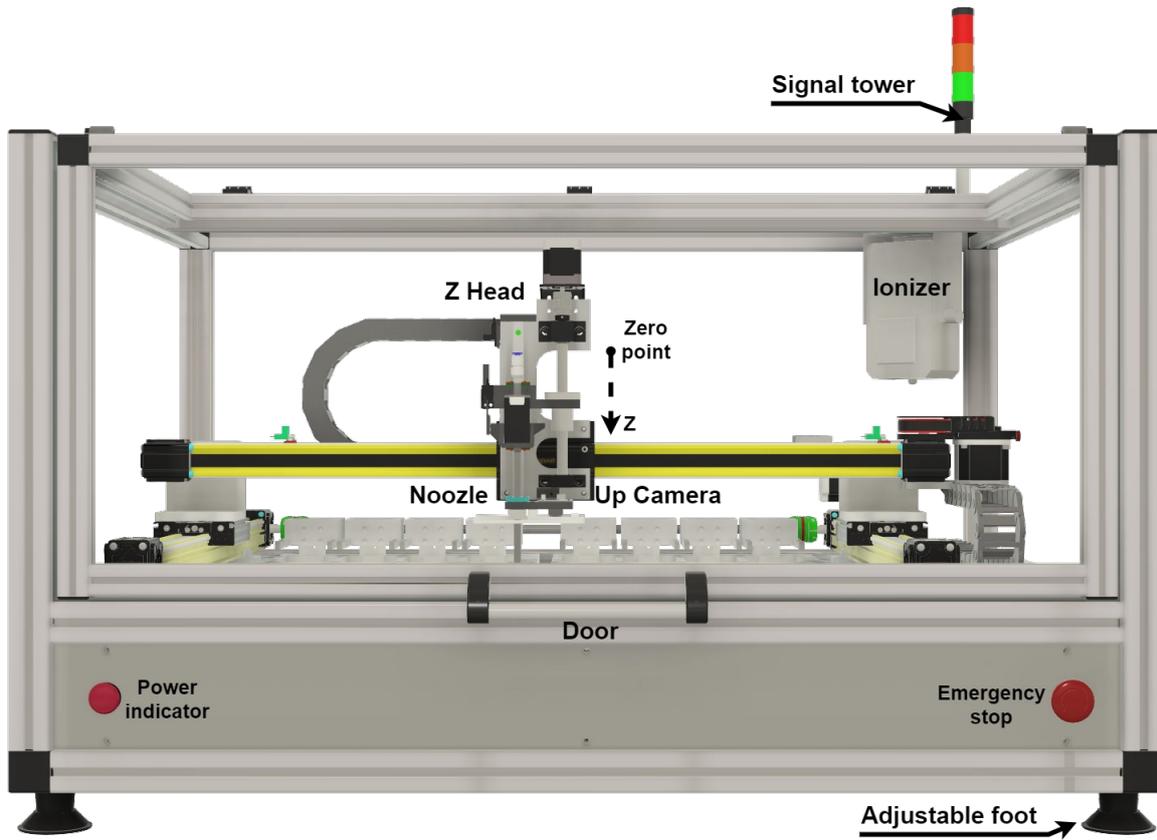
Storage: 3000 MB available space

Monitor with a resolution of 1034 x 810 and higher.

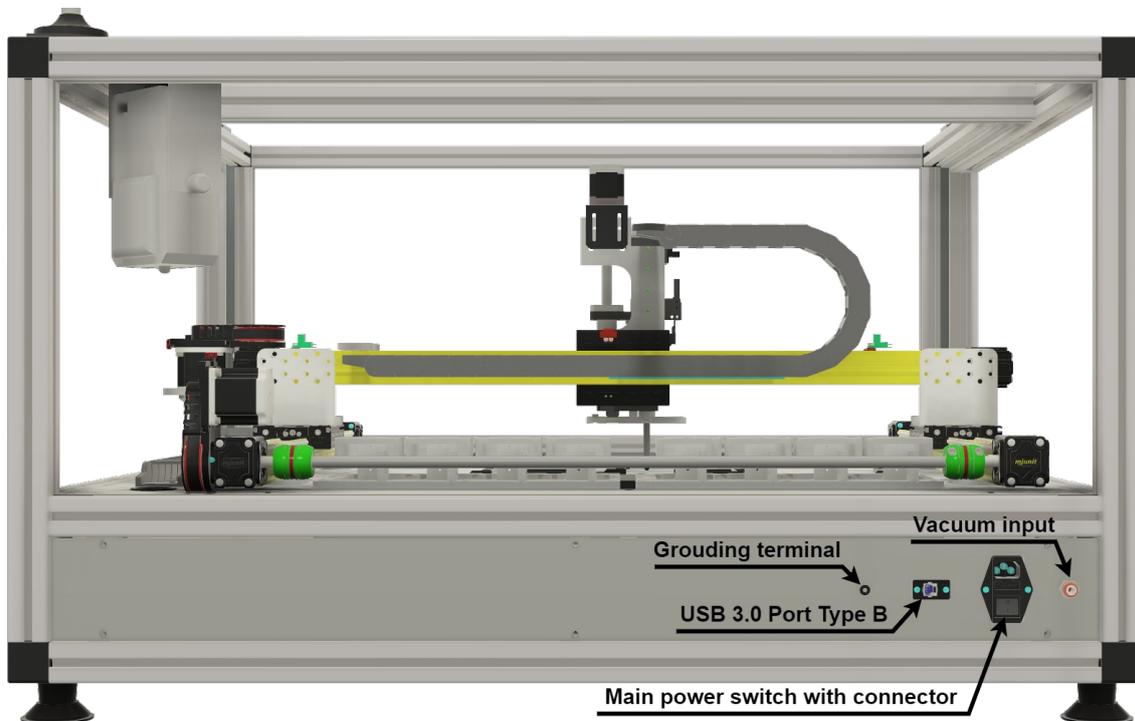
Machine layout



Top view

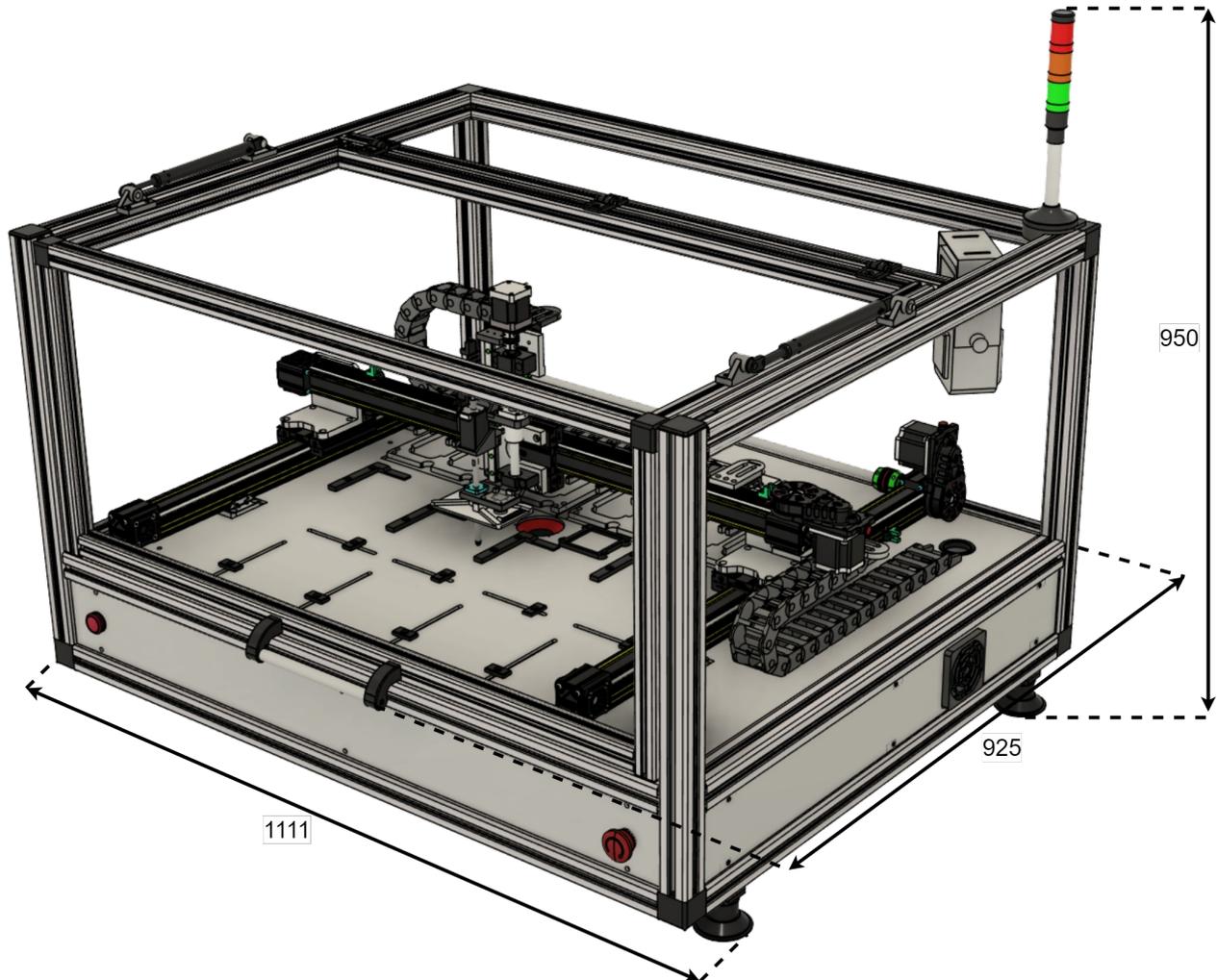


Front view



Back view

Machine dimensions



PG4UWAUTO – the machine software

PG4UWAUTO.exe is the main control program for the AutoBee-D1 machine by Elnec. Currently, the program only operates on the Windows operating system. Its function is to control the manipulator and other peripherals of the AutoBee-D1 machine. It simultaneously utilizes remote control to operate the PG4UWMC.exe program, which is the control program for Elnec programmers installed in the AutoBee-D1 machine.

Software installation

1 Installer

The installer is provided on the USB flash drive included with the machine.

If needed, the installer can also be downloaded from the official Elnec website:

📄 <https://www.elnec.com/en/support/download/>

Look for the file named: **PG4UWAUTO_setup.exe**

2 Installing the Application

2.1 Launch the Installer

Double-click on **PG4UWAUTO_setup.exe**.

If prompted by **User Account Control (UAC)**, click **Yes** to proceed.

2.2 Select Destination Folder (Custom Installation)

The default path is: **C:\Program Files (x86)\Elnec_sw\AutoBee**

Click **Browse...** to choose a different location.

Click **Next >** to continue.

2.3 Select Additional Tasks (Custom Installation)

Install **XIMEA drivers** (third-party software)

→ Required if XIMEA drivers are not already installed on your PC.

Select the options you want and click **Next >**.

2.4 Complete the Installation

Click **Install** to begin the process.

Once installation finishes: click **Finish** to close the installer.

2.5 Install the PG4UWMC

Similarly, following the steps above, **install the PG4UWMC** program using the **PG4UWMC_setup.exe** file.”

3 Platform installation

3.1 On the supplied USB flash drive, locate the folder named **Platform** and inside it the file **Copy_Platform file.bat**.

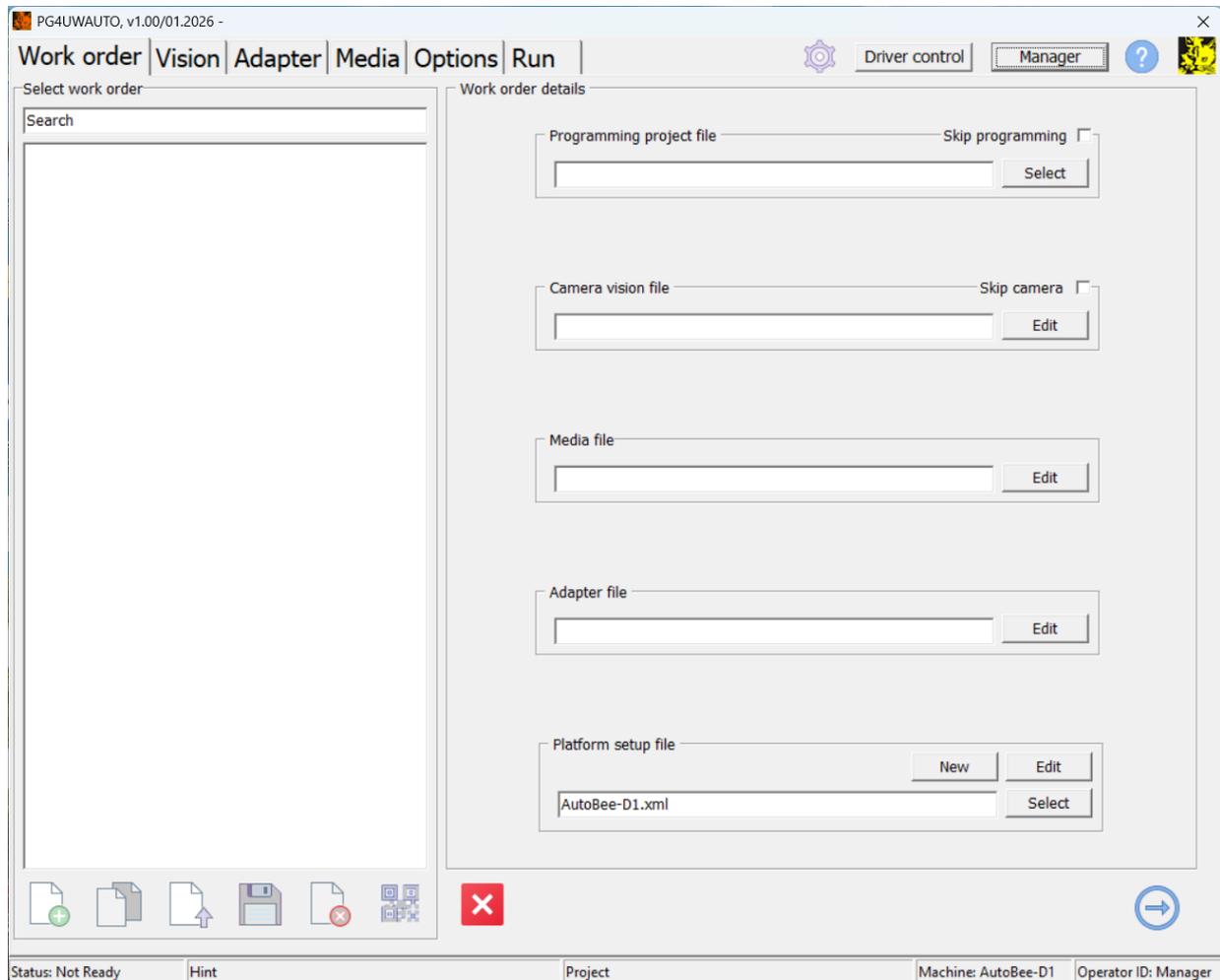
3.2 Run the file **Copy_Platform file.bat**.

This file will copy the included platform file **AutoBee-D1.xml** to the default platform directory: %AppData%\Roaming\Elnec\PG4UWAUTO\Platform\

Description of the user interface

The layout of the application consists of Top bar, Status bar, Control panel and Work panel.

The application window size is fixed and cannot be resized.



The top bar contains the main tabs and buttons for general application settings.

Tabs:

- **Work order** is the main tab of the application, where it is determined which project will be executed and links to all other parts of the project that can be edited.
- **Vision** provides information about cameras and their parameters, which can be edited.
- **Media** is a tab where you can define input, output, and rejected media parameters. You edit their size, position, and quantity there."
- In the **Adapter** tab, the exact position of individual adapters in the programmers is defined.
- **Options** tab provides an overview of the selected project sections and defines which media should be used as input, output, or reject. It also specifies the recognition method to be used and whether a particular adapter should be enabled or not.
- **Run** is the main tab for initiating and controlling machine programming. It displays the programming status in real-time and can modify its progress.

Buttons:

-  **User level** – Opens User login dialogue for change user level.
-  **Driver control** – Opens Driver console for handling with manipulator.
-  **Settings** – Opens Settings panel for general app settings.
-  **Help** – Opens the manual document.
-  **Website** – Opens the website of Elnec s.r.o.

All tabs and buttons are described in detail in the chapters below.

Bottom bar is used to inform the user about the status of the application and the machine, as well as the functions it is currently performing.

Status bar shows one of possible **statuses**, that are:

- **Not Ready** – The application or the machine is not ready to start programming.
- **Ready** – Everything is ready to start programming.
- **Paused** – Programming was paused.
- **Stopped** – An immediate programming termination sequence is in progress.
- **Stopped Input** – A sequence is in progress where the machine completes the current ongoing programming but will not continue further.
- **Run Programming** – Programming is in progress.

Hint bar provides information about the current processing of commands and their results.

Project bar displays the name of the currently active project.

Project files and projects are displayed in the list box on the left side of the application. The buttons below the list box are reserved for working with these files. Project files are in .XML format, and projects are in .ZIP format. All files are saved in the directory defined in the settings under the path "Directory."

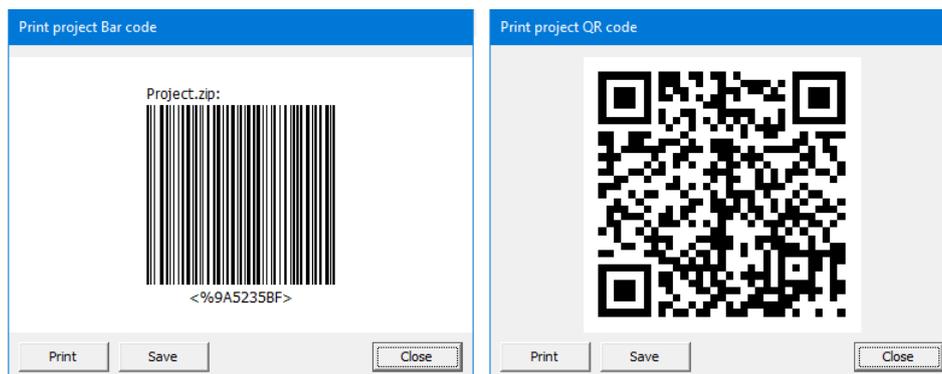
File management buttons:

-  **New file** – Creates new XML file in active tab.
-  **Load file** – Loads chosen XML file into active tab.
-  **Save file** – Saves current data of active tab to XML file.
-  **Delete file** – Deletes chosen XML file in list box.
-  **Code** – Shows dialogue for generate bar or QR code of path for Work order file (.zip).
-  **Exit** – Closes the application.
-  **Next** – Moves to next tab.
-  **Back** – Moves to previous tab.
- **Double-click** on the file name – Rename the file.

 **Note:** The "Save" button only saves files selected in individual tabs and does not save the entire project. To save the entire project, you should use the "Save" button in the "WorkOrder" tab.

Code button opens a panel with the generated bar or QR code. The code encrypts the directory path to the project. The code can be printed by clicking the "Print" button or saved by clicking the "Save" button.

The Code button is temporarily unavailable.



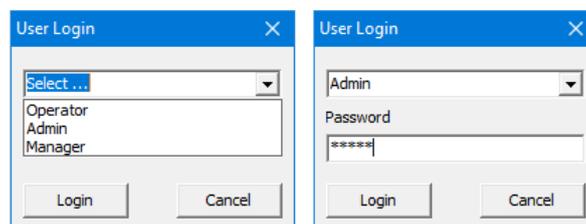
User Level

The change of user level is performed by clicking on **Operator button** in the upper right corner of the application. The **User Login dialogue** is displayed. Operator level is set as default. There the change is made by selecting user level from drop-down list. After entering the correct password for the selected user level and clicking on the "**Login**" button, the application will unlock the permissions for the selected user level. Operator has no password authorization.

The **password** for each user level can be changed in the Settings panel. The manager has the option to reset the admin password to the default value ("admin").

There are **3 user levels**:

- **Operator**
 - Accessible tabs: Work order, Run.
 - In the Work order tab, operator can only select project and set skip programming.
 - The run tab is fully accessible to the operator.
- **Admin**
 - Accessible tabs: Work order, Vision, Media, Adapter Options, Run.
 - Another approach: Settings, Driver control.
 - Each tab is fully accessible to the admin, except for access to platform setup and camera basic settings.
 - Default password: "admin"
- **Manager**
 - Full access to all the application's features.
 - Default password: "manager"



Settings panel

Settings panel is used to set general application settings. These settings apply to the entire application, regardless of the selected project. Changes are not accepted until you click the OK button.

Basic settings contains box for change user password. After entering the passwords into labels needs clicking the Change button. Then a dialogue will appear, if the password change was successful or not. Button Reset admin password is enabled only for Manager user level. It will sets admin password to default value.

In the field "Export code type," you specify what type of code will be generated after clicking the "Code" button. *This feature is temporarily unavailable.*

The statistics box shows data on the total operating hours and the number of programmed devices.

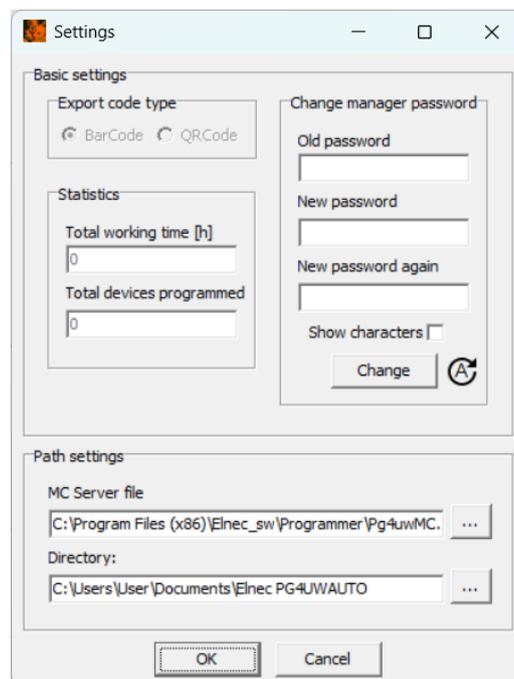
Path settings contains paths for MC Server file and Directory of projects folders. Path can be change manually directly in label or by clicking on button . On the first run of the application, the application attempts to generate paths automatically.

MC Server file requires a set path to PG4UWMC.exe file. It should be located in install directory of PG4UWMC application. The exact path is defined in the default path.

Directory is path, where are located or will be created projects files in individual folders.

Default paths:

- **MC Server file:** Disk:\Program Files (x86)\Elnec_sw\Programmner\Pg4uwMc.exe
- **Directory:** Disk:\Users\User Name\Documents\Elnec PG4UWAUTO



Driver console

Driver console is the user interface for the manipulator control. The manipulator moves in the XYZ axes and rotates in the A axis.

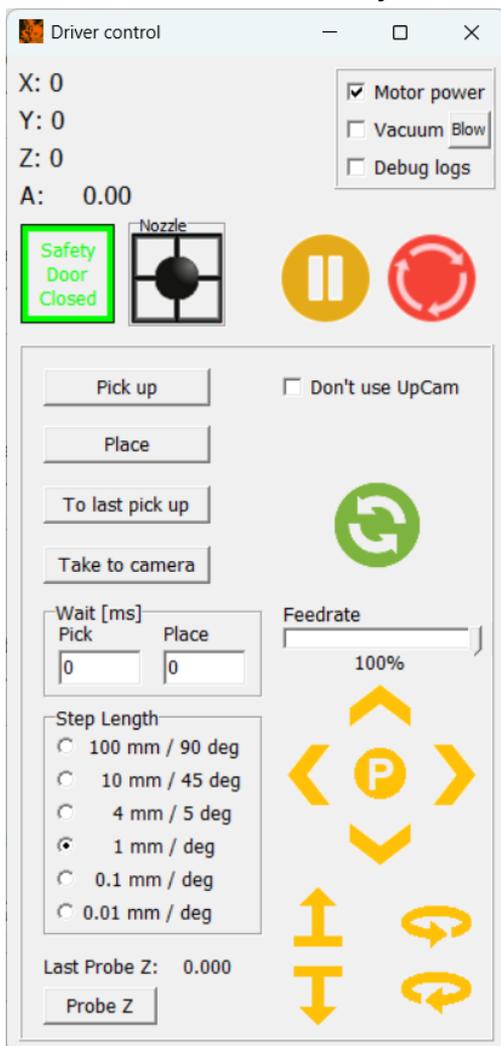
The driver **move control** is possible in 2 ways:

- Set “**Step Length**” and use one of buttons to control corresponding axis:



- Keep CTRL button pressed in combination with **arrow keys** on keyboard to move in **XY** directions. Movement is performed in 10mm steps.
- For movement in the **Z**(4mm steps) and **A**(45° steps) axes, use the buttons on the **numeric keyboard** in combination with pressed the CTRL button.

- Keys:** 8[Z+] 2[Z-] 6[A+] 4[A-]



- Pick up** – in the current XYZ position, it initiates the Probe Z sequence to determine the depth of the object. Subsequently, it pick up the object and returns to the initial position.
- Place** – the manipulator places the chip at the current XY position and at a depth of Z corresponding to the last measured value of the Z probe (Last Probe Z).
- To last pickup** – the manipulator returns to the XY position where it last picked up the chip.
- Take to camera** – the manipulator moves to the XYZ down camera position. This position is determined by the values in the Platform table in the Camera row.
- Park** – the manipulator moves at the parking position. This position is determined by the values in the Platform table in the Parking row.
- (Re)Initialize** – It (re)initializes the driver and finds the manipulator's zero points on the XYZA axes.
- Probe Z** – It initiates the probing sequence at the current XY position. The manipulator descends along the Z-axis until it encounters an object, then

returns to its original Z position. The determined Z value is stored in the variable "Last Probe Z."

- **Emergency Stop** – It immediately stops the manipulator's movement. Additionally, a controller restart and subsequent driver reinitialization are required. After pressing the button, you should wait, as everything will be executed automatically.
- **Stop** – It pauses the manipulator's movement. Upon pressing, the button changes to "Continue," which, when pressed, resumes the movement.
- **Safety door** – indicates whether the machine safety doors are open or not. It has two states, Closed (green) and Open (red). If the doors are open, the manipulator will stop all its movements and will not continue until the doors are closed again.
- **Don't use UpCam** – If the checkbox is not checked, the Up camera view is used as a reference point for the manipulator's position. After starting any sequence, the manipulator moves to the XY position where the camera was previously and executes the sequence. The offset value between the manipulator's position and the camera is defined in the Platform table under the Up Cam row. If the checkbox is checked, all sequences are executed immediately, and no consideration is given to the top camera.
- **Wait pick [ms]** – the value in milliseconds that the manipulator waits before picking the chip through the vacuum.
- **Wait place [ms]** - the value in milliseconds that the manipulator waits before placing the chip through the vacuum.
- **Feedrate** – It sets the current feedrate as a percentage of the maximum feedrate speed.
- **Nozzle** – It graphically displays whether the nozzle is occupied by a device or not.
- **Debug Logs** – It initiates debug logging in the log window.
- **Vacuum** – It initiates air suction through the nozzle if the checkbox is checked.
- **Blow** – It turns off the vacuum if it's on and performs a quick air blow.
- **Motor Power** – It disconnects the motors from the power supply, allowing manual manipulation of the manipulator. The checkbox is still checked by default. After turning off, reinitialization is required.
- **Step Length** – By selecting one of the options, the step length for subsequent movements in the XYZ axes, performed using the manipulator control buttons, is determined. The step length does not affect the sequence's progress.



Warning: Before starting a sequence and using the Up camera, always check if the "Don't use UpCam" checkbox is not checked to avoid unwanted collisions. However, if you are not using the Up camera for orientation, the "Don't use UpCam" checkbox should be checked.

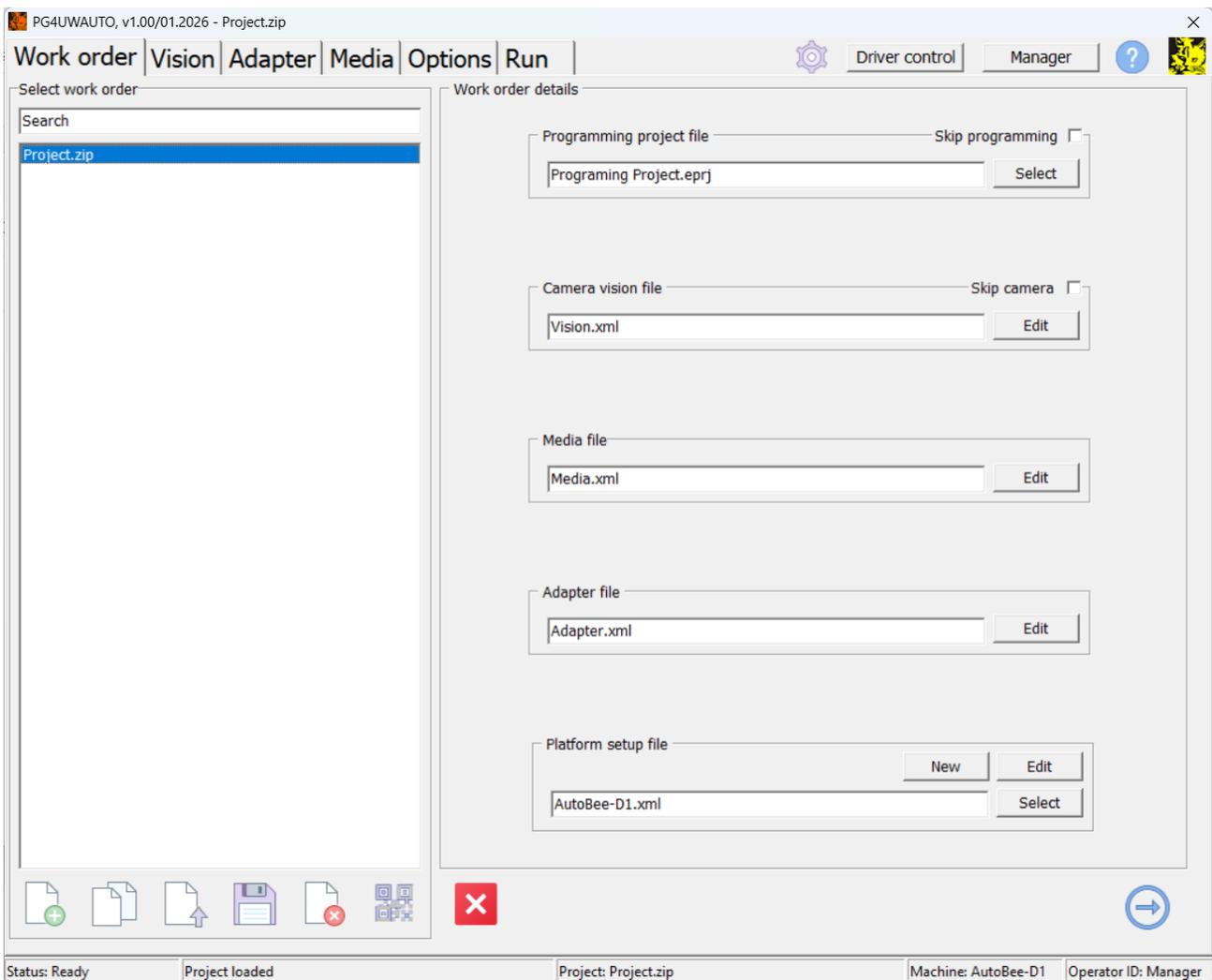
Work order

Work order is the introductory and basic tab of the application. In this tab, the project for production can be created, loaded and edited. Operator user can only select the project. To select a project, just click on its name in the list-box. Projects are created as ZIP archive. These are saved in Directory path in folder “Work order”.

Project ZIP archive contains two files:

- **settings.xml** - it contains all the settings and parameters of the project that are loaded when the project is opened.
- ***.eprj** – Elnec PG4UW project file to be programmed.

When you choose a project from the list-box, all the attached files are displayed in the work order details. You can navigate to the corresponding page by clicking the "Edit" button, or you can use the "Next" button.



The screenshot displays the PG4UW AUTO software interface, version 1.00/01.2026, with the 'Project.zip' file selected. The interface is divided into several sections:

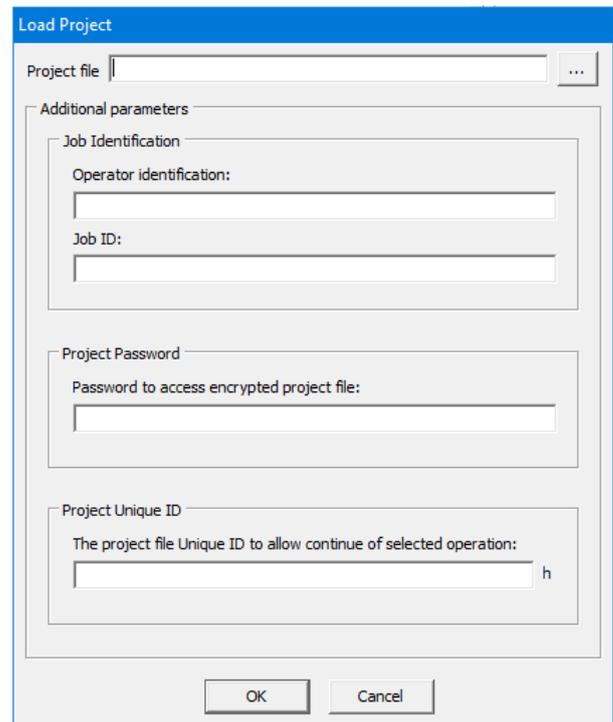
- Work order details:** This section contains five file selection fields, each with a corresponding button:
 - Programming project file:** Contains 'Programing Project.eprj' and a 'Select' button. A 'Skip programming' checkbox is present.
 - Camera vision file:** Contains 'Vision.xml' and an 'Edit' button. A 'Skip camera' checkbox is present.
 - Media file:** Contains 'Media.xml' and an 'Edit' button.
 - Adapter file:** Contains 'Adapter.xml' and an 'Edit' button.
 - Platform setup file:** Contains 'AutoBee-D1.xml' and buttons for 'New', 'Edit', and 'Select'.
- Select work order:** A list box on the left shows 'Project.zip' selected.
- Navigation:** A 'Next' button (blue circle with a right arrow) is located at the bottom right of the details section.
- Status Bar:** At the bottom, it shows 'Status: Ready', 'Project loaded', 'Project: Project.zip', 'Machine: AutoBee-D1', and 'Operator ID: Manager'.

Programming project need to be loaded in Programming project file box in Work order tab by clicking on “**Select**” button. After clicking, the “**Load project**” panel will be displayed.

The “**Project file**” defines the path to the project file you want to use for programming. The file must be in the “.**epri**” format (Elnec PG4UW project). You can enter the path manually or by using the “Add” button.

Some projects may require additional parameters for opening and use. These parameters may include Operator identification, Job ID, or a password for password-protected projects. Additionally, some projects may have their own Unique ID. You must enter the necessary additional parameters in the respective boxes.

Changes and settings are not accepted until you click the OK button.



Skip programming function is an option in which the chip programming is skipped during work. The manipulator inserts the device into the adapter, but the programming process is not executed. Subsequently, the device is treated as if it has already been programmed and can be further serviced. This function is primarily for testing purposes. It is enabled by checking the checkbox.

Skip camera is a function that, when enabled, skips the process of aligning the device using a camera during work. Changes the alignment to **None**. This function is primarily for testing purposes and it is not recommended for use in mass production, as camera alignment is the most accurate and helps prevent potential accidents.

Platform setup file includes coordinates, orientations and other parameters for programmers, cameras and media. Platform is XML type of file.

Platform file can be created by clicking on button **New** in Platform setup file box. By clicking on button **Edit**, Platform file can be edited. After clicking on one of the buttons **New** and **Edit**, **Platform editor** will be displayed. With button **Select** is possible to load Platform file from directory.

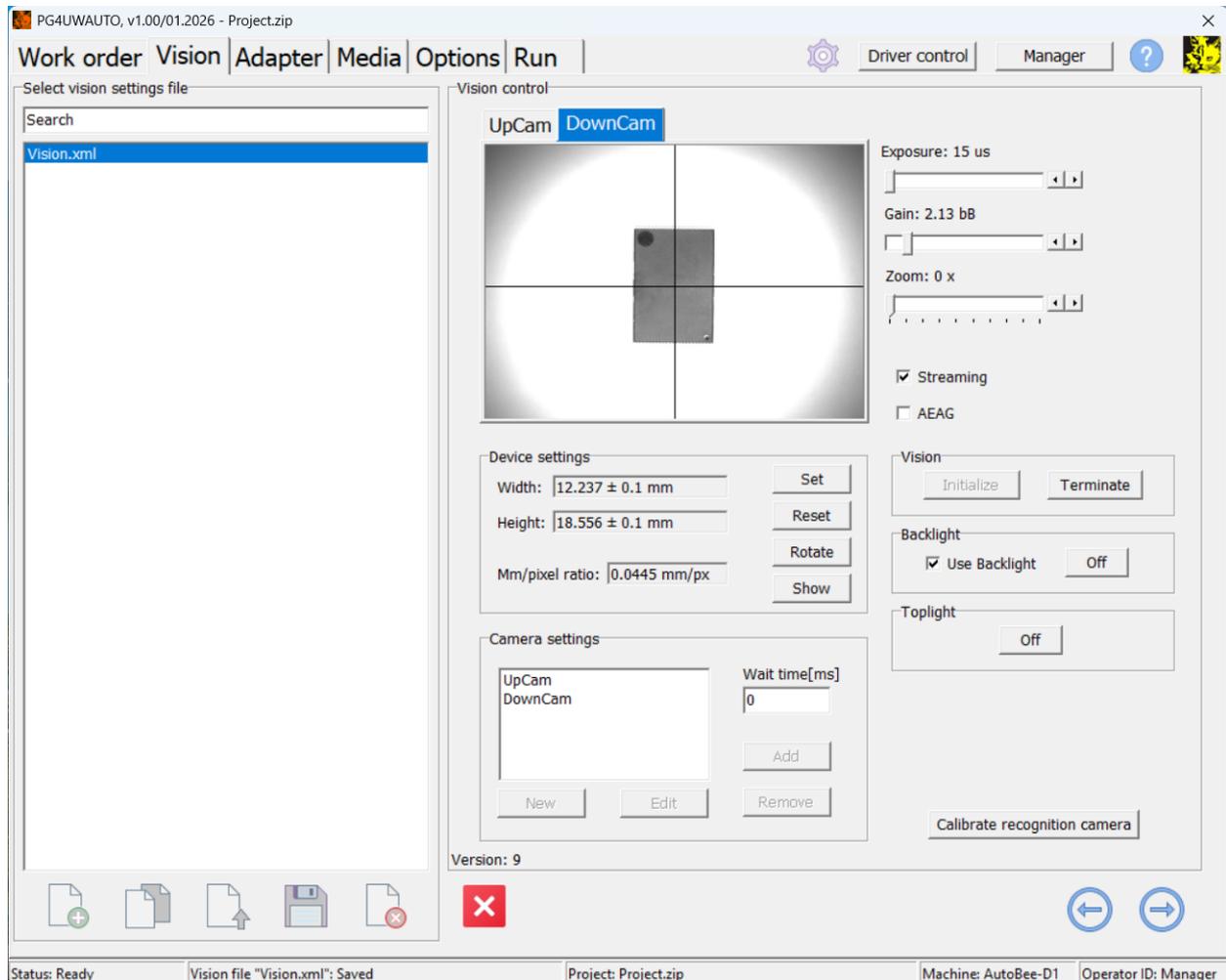
The **Platform editor** and instructions on how to retrieve and input data for the platform are described in detail in the “**Platform**” section.



Note: Only the Manager user is allowed to edit and create a new platform file.

Vision

The Vision tab is intended for initialization of cameras and their settings. It is also used to recognize the device area and adjust it.



In the Vision tab user can create a vision model. Every user have different permissions in this tab. For Operator this tab is not available. Admin does not have access to the recognizer camera calibration and the camera settings box except for the Add button. The Manager has the whole tab available.

Camera settings

The user interface for setting camera parameters before its initialization and adding cameras to the camera panel.

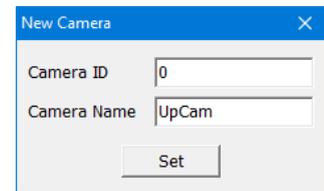
Changes are made to the camera that is selected and highlighted in the list box.

- **New:** adds a new camera. A window appears where you enter camera parameters such as the Camera name and Device ID. After clicking "Set," a new camera is created in the list box.

- **Camera ID:**

Each camera connected to the system is identified by a **Camera ID**.

AutoBee-D1 Cameras	OpenCV Backend / API	Camera ID
UpCam	Default / Standard	0*
DownCam	XIMEA API (cv::CAP_XIAPI)	1100



- Standard cameras are assigned sequential IDs starting from 0.
 - *If additional cameras are connected, the **UpCam ID** may be higher than 0.
- For cameras using a specific backend (API/driver), use the ID defined in the [OpenCV Video I/O Flags](#), which are publicly available online.
- **Edit:** opens a window with camera parameters that can be edited. Changes are saved by pressing the "Set" button.



Note: the changes you make using this method will not affect previously added cameras in the camera panel.

- **Remove:** removes the highlighted camera from the list box.
- **Add:** adds the highlighted camera to the camera panel.
- **Wait time:** is the time in milliseconds that the manipulator waits over the camera before the device recognition sequence during programming. It is mainly used when the camera takes some time to stabilize its image, especially during rapid changes in lighting conditions. By default, this time delay is not necessary.

Device Settings

Device settings determine the parameters of the device to be programmed. They also define the device area for the camera, which allows the camera to locate the device in the camera image.

- **Width:** The parameter for the width of the programmed device.
- **Height:** The parameter for the height of the programmed device.
- **Mm/pixel ratio:** Calibration variable for device recognition. It determines the ratio between the image (pixels) and the real dimensions (millimeters) of the device. It is determined through the Calibrate recognition camera sequence.
- **Set:** It initiates the sequence to determine the area for device recognition and simultaneously detects its dimensions. The **recognition sequence** attempts to find the device in the current image from the recognition camera. The image should have a clear contrast between the device (black) and the background (white). If it finds the device, it displays a window with the image, and the found device is outlined with a red line. This red area is then used as a reference area for recognizing the device and determining its position relative to the center of the camera.



- **Reset:** It resets the area of the device and its dimensions.
- **Rotate:** It swaps the current height and width of the learned device. So, the device area is rotated by 90 degrees.
- **Show:** It opens a window displaying the current image from the recognition camera, along with the reference area of the device in the center of the image.

Camera panel

The image from the cameras is displayed in this panel. Each camera has its own tab.

Press the right mouse button on the camera panel to display the pop-up menu.

- **Remove:** removes the selected camera page from the camera panel.
- The **Set as a device recognizer** button sets the selected camera as device recognizer camera.

Camera parameters change the properties of the image obtained from the camera:

- **Exposure** track-bar sets exposure level of the camera.
- **Gain** track-bar sets gain level of the camera.
- **Zoom** track-bar sets zoom level of the camera if supported.
- **Streaming** checkbox sets continuous stream from the camera.
- **AEAG** checkbox enables the automatic exposure and automatic gain functions in the camera if supported.



Note: For Vision initialization one camera must still be marked as chip recognizer.

- **Initialize:** It initializes all the configured cameras. If initialization is unsuccessful, check the camera's connection to the PC and its functionality in Windows. Another possible error could be incorrectly entered camera ID. Initialization typically takes several seconds.
- **Terminate** button disconnects all cameras. Before disconnecting, a dialogue will appear asking if you want to save the changes if any have been made.

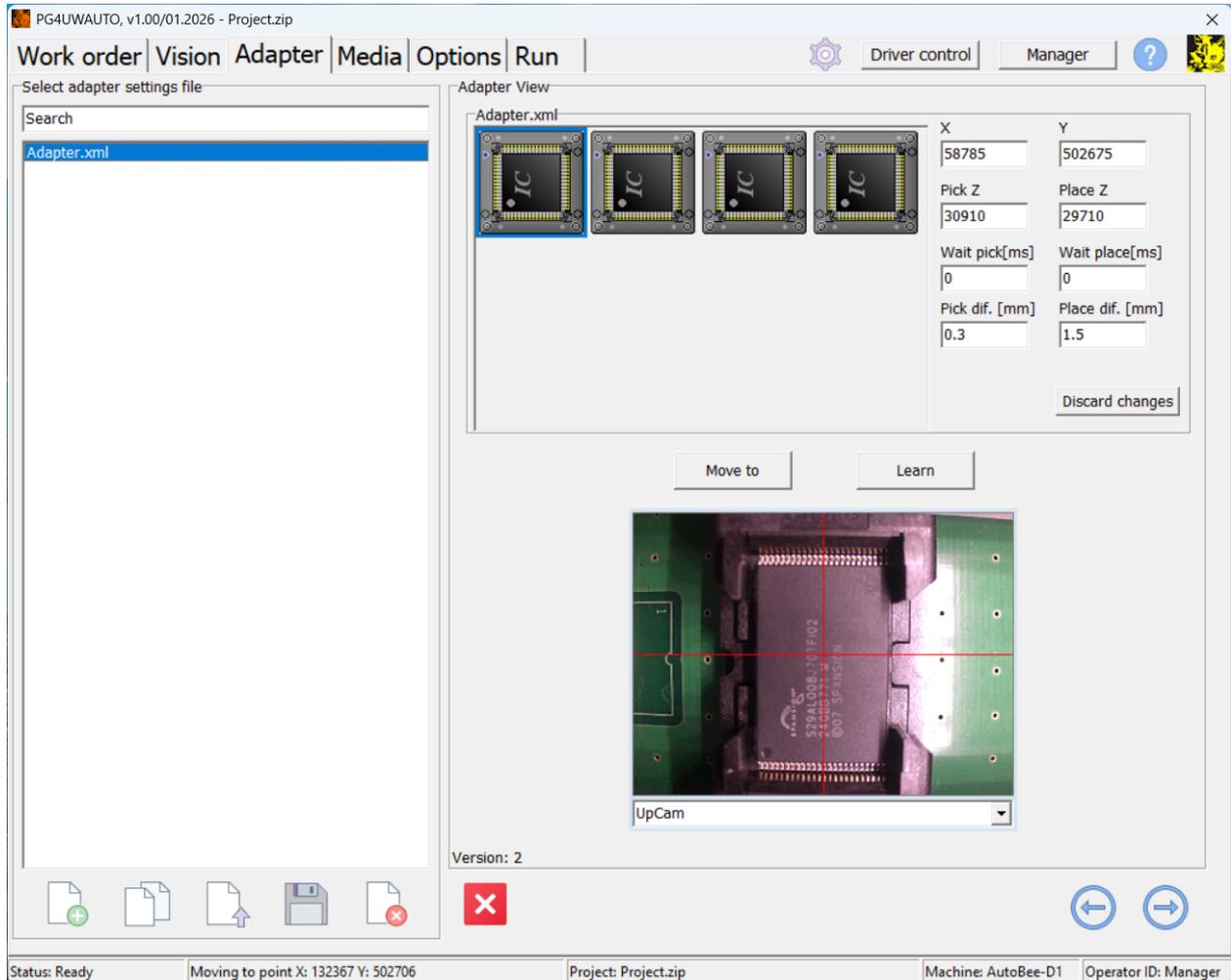


Note: Sometimes initialization may fail on the first attempt. In such cases, press the "Terminate" button and then click the "Initialize" button again.

- **Backlight** is used to illuminate the device for easier recognition by the camera.
 - **Use backlight:** Determines whether the backlight will be used during the device recognition sequence in the machine's programming.
 - **On/Off:** It turns the backlight on or off.
- **Toplight** provides illumination for the top camera (UpCam).
 - **On/Off:** It turns the toplight on or off.
- **Calibrate recognition camera** The "Calibrate recognition camera" button is used to initiate the calibration sequence for the recognition camera. This function determines the appropriate value for the **mm/pixel ratio** for device recognition calculations in the image. The procedure and details of this sequence are described in the "Calibrate recognition camera" section of the documentation.

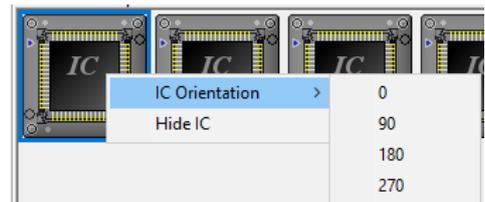
Adapter

The Adapter tab is used to define coordinates for adapters. The number of available adapters depends on the number of programmers installed in the AutoBee-D1 machine. Specifically, there can be a maximum of two programmers and a minimum of one. Each programmer includes four adapters.



To **edit the coordinates** of the adapter you wish to select, click on the adapter icon. The adapter icons are arranged in order from left to right, with the first one on the left.

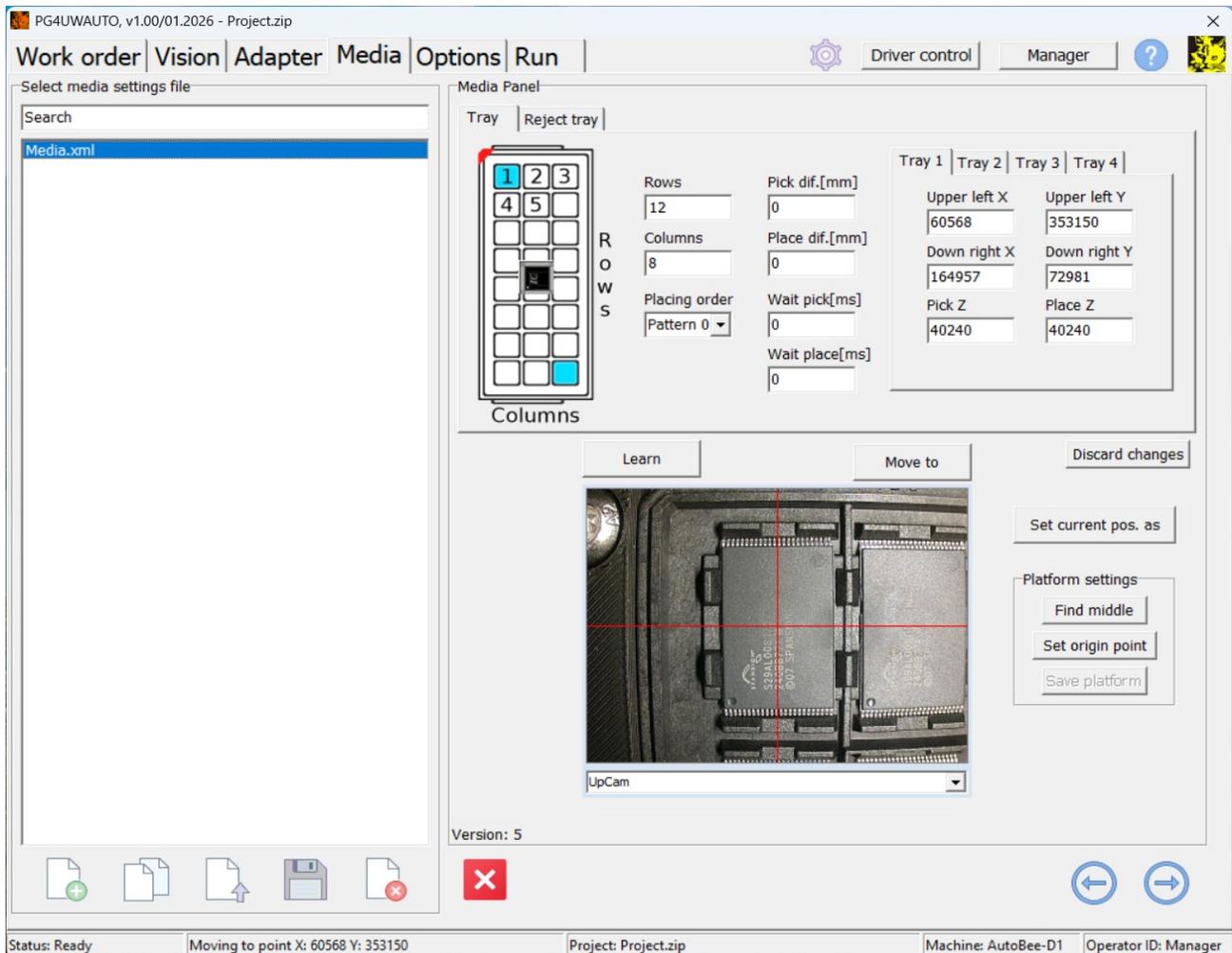
- IC orientation:** When clicking with right mouse button on adapter icon, then shows pop-up menu, where orientation of device in adapter can be changed. Orientation changes apply to all adapter. Orientation is determined with respect to the position of the programmer. The **default orientation** (0 degrees) is perceived as a front view of the programmer.



- **X** – The X coordinate of the adapter.
- **Y** – The Y coordinate of the adapter.
- **Pick Z** – The depth value Z for picking the device from the adapter during machine programming.
- **Place Z** – The depth value Z for placing the device into the adapter during machine programming.
- **Pick dif.*** – The value is given in millimeters and is used to reduce the Z-axis depth when picking the device from the adapter during machine programming.
- **Place dif.*** – The value is given in millimeters and is used to reduce the Z-axis depth when placing the device into the adapter during machine programming.
- **Wait pick*** – The value in milliseconds that the manipulator waits before picking the device.
- **Wait place*** – The value in milliseconds that the manipulator waits before placing the device.
- The "**Learn**" button is used to initiate a learning sequence. After clicking, the learning sequence starts immediately. Therefore, it's necessary for the manipulator to be **positioned over the adapter** and approximately over the center of the device in the adapter, the coordinates of which need to be determined. The learning sequence is described in more detail in the "**Learning Sequence**" section.
 - After completing the learning sequence, the "**Learnt Result Dialog**" is displayed. In this dialog, the difference between the original and learned coordinates of the adapter is shown. Depending on the update options (X, Y, Z), the coordinates of the learned adapter are updated when the "Update" button is clicked.
- The "**Move to**" button immediately moves the manipulator to the XY position of the currently selected adapter. This function is useful for quick movement within the machine space and also serves as a verification tool to check whether the selected adapter has the correct coordinates defined.
- "**Select Camera**" is used for displaying the image from a camera in the panel. In the toolbar below the panel, you can choose one of the initialized cameras.
- **Discard changes:** Returns all changes made in the adapter file.

Media

The Media tab is for defining and editing input, output and reject media.



The **tray** model is defined by rows and column count, placing order pattern, upper left point (ULP) and lower right point (LRP). Points need to be taught with help of the manipulator.

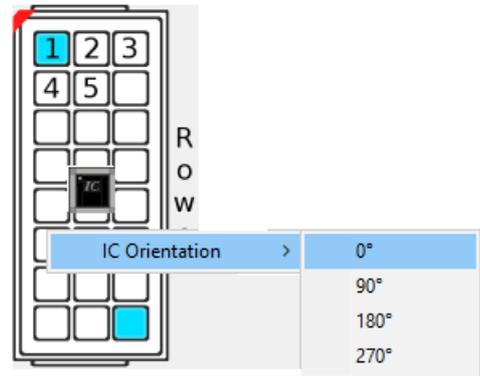
The maximum number of trays is 4. Tray1 is the main tray. In addition, trays 2, 3 and 4 can be used.

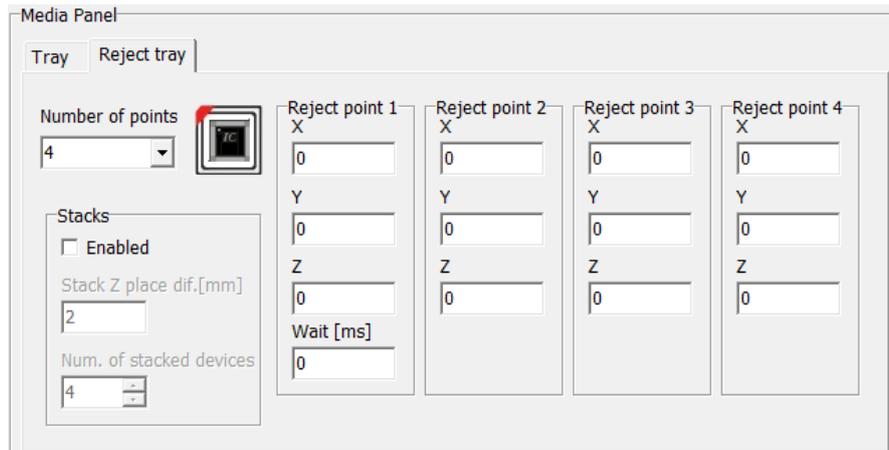
Note: Parameters marked with * are common parameters for all trays.

Labels defining the tray model:

- **Rows*** – The value of the number of rows of the tray.
- **Columns*** – The value of the number of columns of the tray.
- **Placing order*** – By selecting a pattern, you determine the order in which devices should be picked from the tray. There are 8 available patterns. The pattern is displayed on the tray image.

- **Pick dif.*** – Value is given in millimeters and is used to reduce the Z-axis depth when picking the device during machine programming.
- **Place dif.*** – Value is given in millimeters and is used to reduce the Z-axis depth when placing the device during machine programming.
- **Wait pick*** – The value in milliseconds that the manipulator waits before picking the device.
- **Wait place*** – The value in milliseconds that the manipulator waits before placing the device.
- **Orientation*** – Orientation of chips on a tray. It can have values of 0 °, 90 °, 180 °, 270 °. It changes by clicking on the icon  .
- **Upper left X** – X coordinate of the upper left point of the tray. This refers to the center of the upper left device on the tray.
- **Upper left Y** – Y coordinate of the upper left point of the tray. This refers to the center of the upper left device on the tray.
- **Down right X** – X coordinate of the down left point of the tray. This refers to the center of the down left device on the tray.
- **Down right Y** – Y coordinate of the down left point of the tray. This refers to the center of the down left device on the tray.
- **Pick Z** – The depth value Z for picking the device from the tray during the machine programming.
- **Place Z** – The depth value Z for placing the device on the tray during machine programming.
- **Auto generate** checkbox is only available for tray 2, 3 and 4. By checking it, the coordinates of the selected tray will be generated automatically with respect to the tray reference point entered in the Platform. The generated tray has the same properties as Tray1.



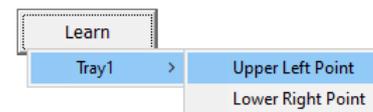


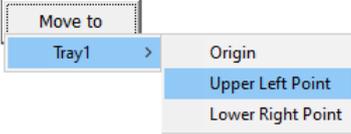
The "**Reject tray**" tab is used to define rejection points. These points are designated as locations within the machine to store rejected devices that have not been properly programmed.

- **Number of points** label define the number of reject points used during machine programming. The maximum number of reject points is 4, and the minimum is 1.
- **Stack box** contains settings for stacking reject points.
 - **Enabled:** When enabled, rejected devices will be stacked at the reject points. If it is disabled, only one device can be stored at one reject point.
 - **Stack Z place dif.:** It defines the value for the depth(Z axis) change of device placement in millimetres, which will decrease for each device placed in the stack. It is recommended to use a minimal value for the height of the programmed device.
 - **Num. of stacked chips:** It defines the number of devices in one stack.
- **X, Y, and Z** labels contain coordinates for locating the reject point in the machine space.
- **Wait** label defines the value in milliseconds that the manipulator waits before placing the device into the reject point. The "Wait" parameter is common to all reject points.

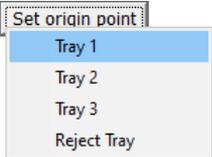
 **Note:** If the reject points are filled to full capacity during programming, the programming process will pause and prompt for the emptying of reject points. After emptying, programming can resume.

- "**Select Camera**" is used for displaying the image from a camera in the panel. In the toolbar below the panel, you can choose one of the initialized cameras.
- The "**Learn**" button is used to initiate a learning sequence. By selecting a point from the pop-up menu, the learning sequence for the chosen point on the tray is activated. The learning sequence is described in more detail in the "**Learning Sequence**" section.



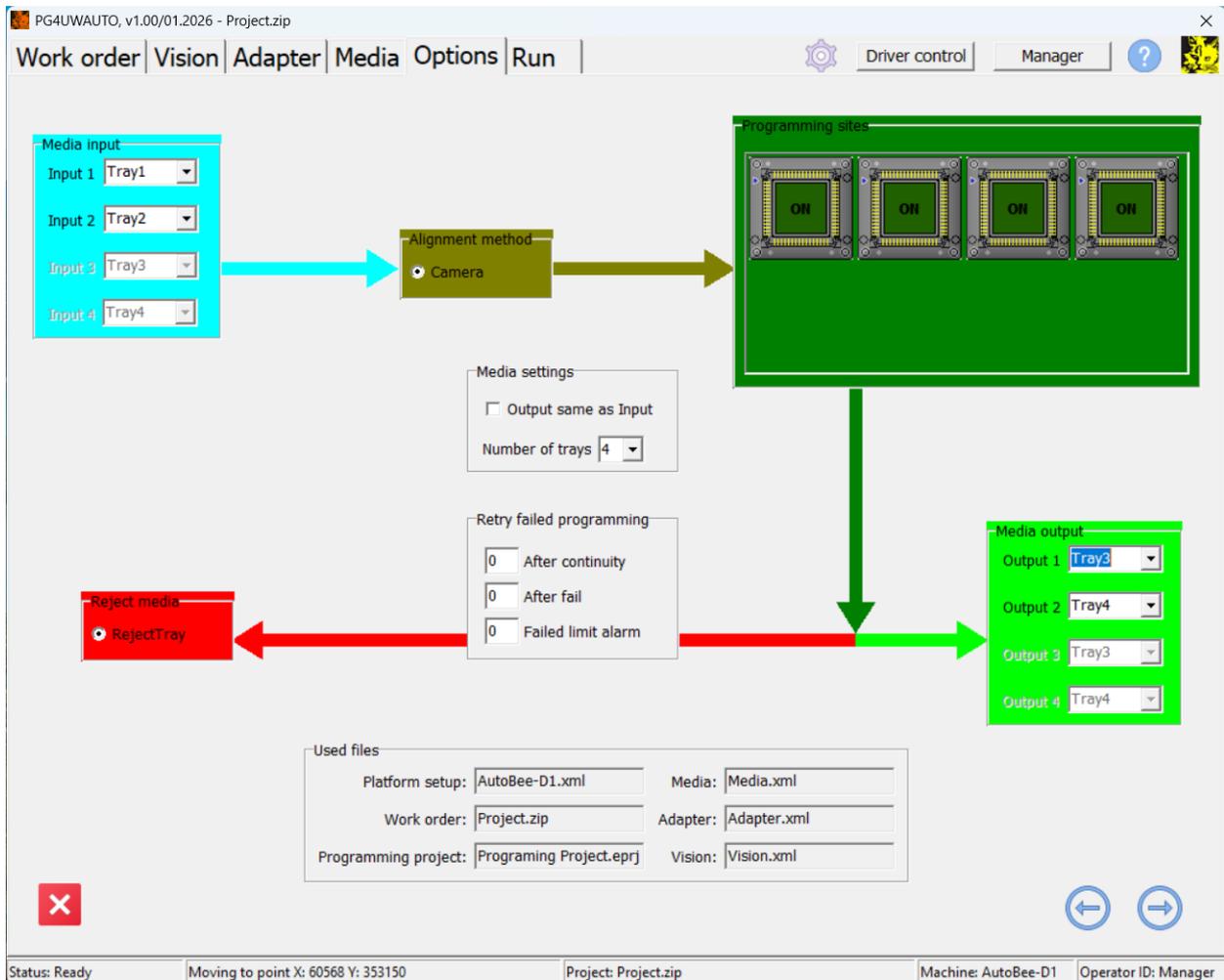
- After completing the learning sequence, the "**Learnt Result Dialog**" is displayed. In this dialog, the difference between the original and learned coordinates of the point is shown. Depending on the update options (X, Y, Z), the coordinates of the learned point are updated when the "Update" button is clicked.
- The "**Move to**" button displays a pop-up menu with buttons that, when clicked, move the manipulator to the defined XY position of the selected point. This function is useful for quick movement within the machine space and also serves as a verification tool to check whether the selected point has the correct coordinates defined.
- **Discard changes:** Returns all changes made in the media file.
- **Set Current pos. as:** It displays a pop-up window with points. By selecting a point, the current X and Y coordinates of the manipulator are saved as the XY coordinates for the selected point. It also takes into account the offset of the Up camera.

Platform settings box is intended for Manager user. It can be used to change the reference/origin points of individual media.

- The "**Only learn**" button starts the learning sequence, but the Learning result dialogue does not appear at the end of the sequence. This method of learning is suitable if you want to define the upper-left points of the trays as the origin points or just to find the center of the device.
- The "**Set origin point**" button displays a pop-up menu with a list of media. After clicking on one of the media options, the current XY coordinates are saved as the origin point for the selected media in the Platform. It also takes into account the offset of the Up camera.
- **Save platform** button saves the platform with the changes made.

Options

Options is used to define input and output components of the project.



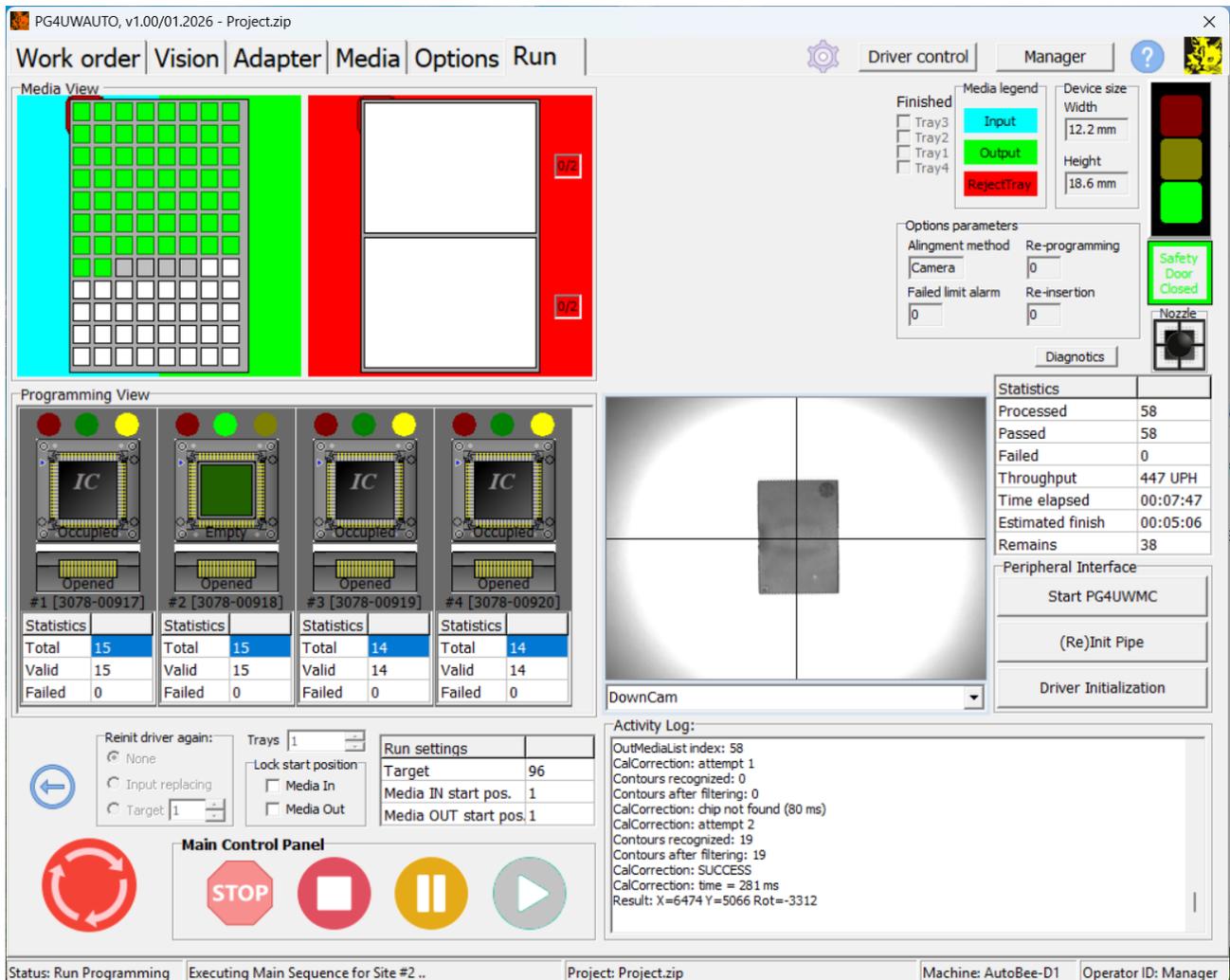
Note: The "Next" button will take you to the next Work Order card, but before that, a window will open, suggesting that you save the entire project.

- **Media input** – sets which trays will be used as inputs during programming.
- **Alignment Method** – sets the alignment method during the programming process. The available alignment options are: Camera, None (Only if the “Skip Camera” check box is checked in the Work Order section).
- **Programming sites** – specifies which adapters to use during production and which not. By left-clicking on the adapter icon, you can toggle its status between "Enabled" and "Disabled."
- **Media Output** – sets which trays will be used as outputs during programming.
- **Reject media** – sets which media will be used as reject tray during programming. The Same as tray option is only available if the Same as tray check box is checked in the Media section

- **Media settings** – determines the number of total trays in the machine. And defines whether Input trays are used at the same time as Output trays or not.
- **Retry failed programming** – contains parameter values that specify how many times the programming process should be repeated after a specific error.
 - "**After continuity**" specifies how many times the manipulator should repeat the process of inserting the device into the ZIF adapter if the **insertion test** was incorrect. The manipulator will lift the device from the adapter, perform the alignment sequence again, return the device to the ZIF, and restart the device programming. If the insertion test fails again, the process will be repeated as many times as the value of the variable specifies.
 - "**After fail**" specifies how many times the programming should be restarted if the programming result is a failure. If the programming result is a fail and the ZIF is opened, the programmer will simply close the ZIF and restart the programming. This process will be repeated as many times as the value of the variable specifies.
 - "**Failed limit alarm**" determines after how many rejected chips to stop production. If the value is 0, no limit is specified.
- **Used files** box contains labels with the names of the all files used in the project.

Run

The Run tab is used to start and control the production process.



- **Media View** – displays the layout and the current status of each tray. Every position can have 4 statuses, that are presented through colors:
 - Empty and ready  - position is empty and chip is not included. The position is ready to store the chip. This designation does not apply to the input medium.
 - Successful device  - a successfully programmed device is in position.
 - Rejected device  - an unsuccessfully programmed device is in position.
 - Empty used position  - a device has already been taken from position that is now empty.

- **Stack status** displays the value of how many chips are currently in the stack. It is defined as the "current value of devices in the stack / maximum value of devices in the stack". **0/3**
- **Finished** shows which of the trays are already finished (programmed) and which are not. If the input is not the same as the output, the status **Checked** means - Tray(Input) is empty / Tray(Output) is full.
- **Media legend** box shows which media has which role.
- **Device size** box displays approximate device size values.
- **Options parameters** displays the values of parameters set in the "Options" tab.
- **Safety door** indicates whether the machine's safety doors are open or not. It has two states, "Closed" (green) and "Open" (red). When the doors are open, the manipulator cannot move. It also stops production until they close again.
- **Nozzle** graphically indicates whether there is a picked-up chip on the nozzles or not.
- **Diagnostics button** starts the Diagnostics sequence.
- **Signal tower** indicates the current status of the machine. It consists of three light indicators: Red, Orange and Green.

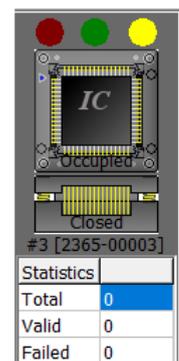
Statuses:

- **Ready** – Red – On, Orange – Off, Green – Off;
- **Paused** – Red – Off, Orange – Off, Green – Blinking;
- **Error** – Red – Off, Orange – Blinking, Green – Off;
- **Programming** – Red – Off, Orange – Off, Green – On;
- **Programming View** displays the status and statistics of adapters. It graphically represents whether the ZIF of the adapter is occupied by a device or empty, as well as whether the ZIF of the adapter is open or closed. The following variables are included in the statistics table:
 - **Total** - Total number of serviced devices
 - **Valid** - Number of successfully programmed devices
 - **Failed** - Number of unsuccessfully programmed devices

The serial numbers of the individual adapters are displayed in this form: #n [serial number] (Where "n" is the adapter number).

The three circular indicators indicate the result/status of device programming:

- Orange – busy
- Green – good
- Red – bad



Right-clicking on the adapter image displays a pop-up menu where you can **enable or disable the selected adapter**. This can also be done during programming. Subsequently, the manipulator stops putting the devices into the adapter or starts using it.

- **Statistics** table included:
 - **Processed** – shows the value of the total processed devices.
 - **Passed** – shows the value of successfully processed devices.
 - **Failed** – shows the value of unsuccessfully processed devices.
 - **Throughput** – displays the value of devices processed within one hour (Units per hour).
 - **Time elapsed** – shows how much time has passed since the start of programming.
 - **Estimated finish** – estimated time until the end of programming.
- **Peripheral interface** included:
 - **Start PG4UWMC** button – will try to launch the PG4UWMC application whose path is defined in the Settings panel.
 - **(Re)Init Pipe** button – will try to initialize the pipe between the PG4UWMC and the BeeProg devices.
 - **Driver initialization** button - it initiates the initialization sequence of the manipulator and other peripherals.
- **Run settings** is used to define the basic parameters before starting programming.
 - **Target** – here, you enter the total number of devices to be programmed.
 - **Media IN start pos.** - a value defining at which position from the input media programming should start.
 - **Media OUT start pos.** - a value defining at which position from the output media programming should start.
 - **Trays** - a value of numbers of input trays. This value varies depending on the target value and start positions. Changing this value manually changes the target value. Overwrites the target to a multiple of the number of trays and the size of the trays.

- **Lock start position** included:
 - **Media In** – It locks the starting position for the input media. With each media replacement, after it has been emptied during programming, the manipulator will begin programming from the specified starting position.
 - **Media Out** – It locks the starting position for the output media. With each media replacement, after it has been filled during programming, the manipulator will begin programming from the specified starting position.
- **Reinit driver again:** This function allows for the reinitialization of the manipulator if certain conditions are met. There are three conditions that can be set for when the manipulator should be reinitialized. Every mechanical component has a slight backlash in its movement. This function helps to maintain the precision of the manipulator, especially when handling a large number of devices.
 - **None** - No reinitialization.
 - **Input replacing** - It reinitializes the manipulator after each exchange of the input media.
 - **Target** - It reinitializes the manipulator after servicing the selected number of devices in the "target" column.
- **Activity Log** shows every information about activity of machine and application. This informations with the write time are written in **Log.txt** in folder “Log” located in general directory, defined in Settings panel. The display of debugging information in the active log is configured in the Driver Control Panel through the Debug log checkbox.
- **Main Control Panel** contains the main buttons for controlling ongoing programming. Contains buttons:
 - **Run** button starts programming. This is possible only if all essential project parameters are defined, and the PG4UWMC application is connected.
 - **Pause** button pause programming. If production is paused, the button changes to resume. The manipulator then waits for the programming to continue.
 - **Stop Input** causes the manipulator not to pick up devices from the input media. Instead, it waits for the programmers to finish their work, services them, and places the devices on the output media. Subsequently, it terminates the entire programming process.
 - **Stop ALL** The "Stop All" button immediately interrupts the ongoing sequence and terminates the entire programming process. The programming of devices that are currently in the programmers will be completed.
 - **Emergency stop** button stops the manipulator immediately. If the button was pressed while programming was not in progress, you can initialize the manipulator immediately. However, first resolve the issue that prompted the button press.

First startup - AutoBee-D1

In this chapter, the procedure for connecting the AutoBee-D1 machine and its operation is described.

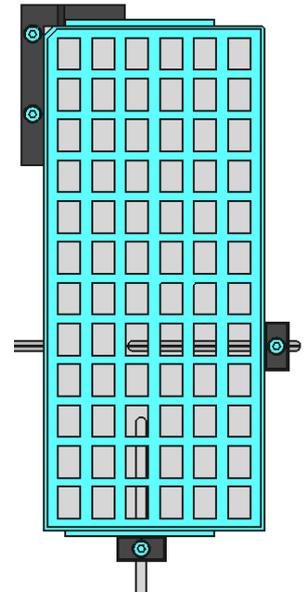
A **video** file named *PG4UWAUTO_QuickGuide.mp4* is included on the supplied **USB flash** drive. It provides guidance for setting up your project.

1. Machine setup

- Make sure the machine is turned off. The Main switch should be in the "Off" position.
- Connect the air supply to the machine via the quick coupling on the rear side of the machine. A connector for a **6mm diameter air hose** is used for the connection. The maximum input pressure is **0.7 Mpa**, minimum **0.5 Mpa**.
- Connect the machine to the power supply (**115/230V AC**). The connector is located on the back of the machine.
- Connect your computer to the **USB 3.0 Type B port**, which is located on the back of the machine.

2. Preparation for work

- **Insert trays:** Open the machine and insert the trays into slots. To secure the trays in the slots, use the **sliding brackets**. Release the bracket by turning the Hex key (size 4mm) to the left. Loosen the screw by **half a rotation**, but **no more than one full rotation**. Press the brackets against the edges of the tray to prevent any movement. Then, securely tighten the brackets.
- **Insert ZIF sockets** into the programmer's adapters. The instructions on how to correctly insert ZIF sockets into the programmer are described in the manual for the selected Elnec programmer.
- **Place the devices** on reference points that are important for creating a new project in the PG4UWAUTO application.



Reference points:

- Top left corner of all trays
- Bottom right corner of all trays
- Reject tray points
- Adapter ZIF socket (These are inserted later after initializing the BeeHive304 programmer.)



Warning: When inserting devices into the reference points, ensure their correct rotation relative to the trays and ZIF sockets.

- **Turn on the machine** using the switch on the rear panel. Subsequently, wait for the initialization of the BeeHive programmers. It is complete when the indicator LEDs on the programmers stop blinking.

3. Configure application parameters

- **Start the application** PG4UWAUTO in the Windows environment: double click to icon **PG4UWAUTO.exe** . After start, control program PG4UWAUTO automatically scan all existing **USB ports** and search for the connected AutoBee-D1 machine. The search result will be displayed on the initialization screen. In the next step, the application will launch the program **PG4UWMC.exe**, which will search for available Elnec programmers on the USB port and initialize itself. After successful connection to the programmers, the program enters into remote control mode and is further controlled only through the PG4UWAUTO program. You can find more information about the PG4UWMC program and how to operate it in a separate documentation available on the Elnec company's website.



Note: Starting PG4UWMC may not be successful for the first time. If the application PG4UWAUTO did not find the location of the file PG4UWMC.exe, it can be set manually in the Settings panel.

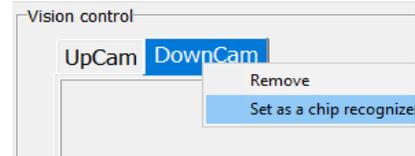
- **Log in** as a manager. In the top right corner, click on the 'Operator' button and change the user to 'Manager.' Input the manager password. The default password is “*manager*”.
- **Open the settings**  and check the Path settings. If the PG4UWMC program started when launching the application, then the 'MC Server file' path is correct. The directory path is automatically set to the user's Documents folder. You can also change the access **password** for the manager account. Keep your password carefully, if you forget it you will not be able to recover it. To confirm the changes, press 'OK'.

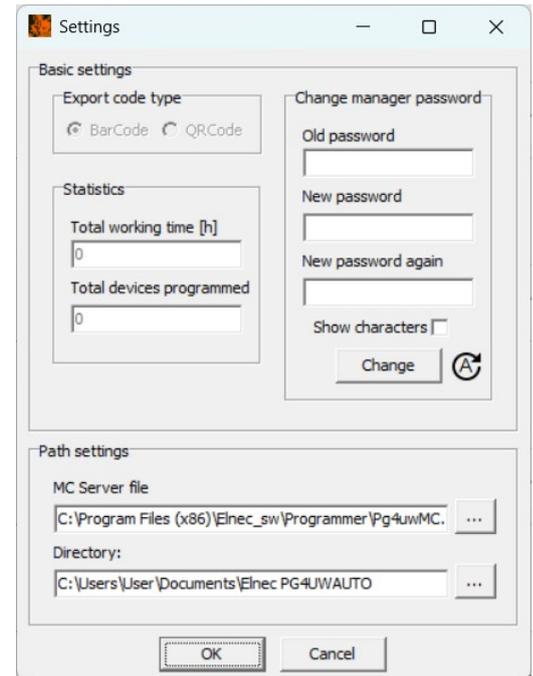
- Check if the correct **Platform file** is loaded. The original Platform file is named '**AutoBee-D1.xml**'. If no file is selected, choose it using the 'Select' button.
- **Open Driver Control** and initiate the manipulator initialization by pressing the '(Re)Initialize' button . Wait for the initialization to complete. Now you can move the manipulator using the buttons. **Check the machine** to ensure nothing obstructs the manipulator's movement, and **close the safety doors**.
- Perform the Platform check procedure to verify and properly set the machine parameters.
It is not necessary.

Project creation

- Open the Work Order tab and create a **new project** by clicking the 'New file' button.
- Select '**Programming project**' by pressing the 'Select' button and enter all the parameters required for the programming project.

Vision settings

- **Initialize cameras**
 1. Create a new **Vision file** by clicking the '**New file**' button in Vision tab.
 2. In the **Camera Settings** section, select the camera you want to add and press the '**Add**' button. In the default setup, there is a camera for the top view (UpCam) and one for the bottom view (DownCam).
 3. The **Down camera** is used as a chip recognizer, so you should define it accordingly. In the camera window, select the Down camera tab, then right-click to open a pop-up window, and choose the '**Set as chip recognizer**' option.
 4. Initialize the cameras by pressing the '**Initialize**' button. If initialization doesn't proceed correctly, press the '**Terminate**' button and try again. Alternatively, check if the camera **IDs** are correctly entered in their settings using the '**Edit**' button. If the issue persists, verify the proper connection and functionality of the cameras in Windows.
 5. If you want to use the camera's light while operating the machine, check the '**Use Backlight**' box. Checked by default.
 6. Check if the **pixel ratio** is not equal to zero. If it is, you will need to calibrate it. The calibration procedure is described in the '**Calibrate recognition camera sequence**'.

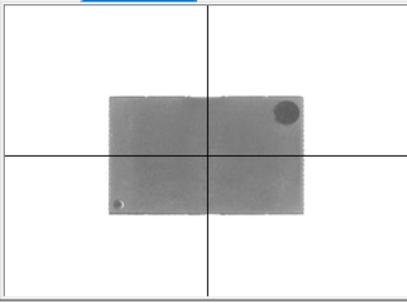
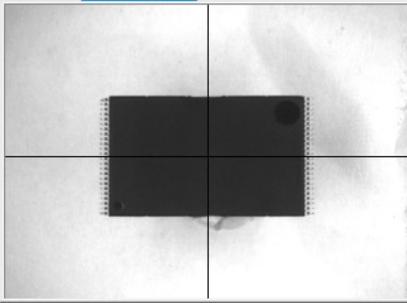
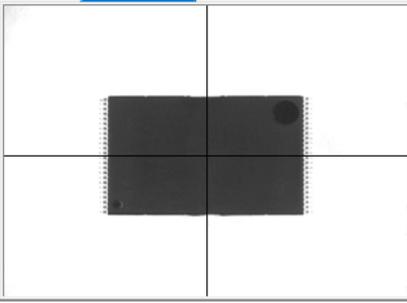


- **Camera settings**

1. In **Vision Control**, switch to the top camera (UpCam). Enable the '**Streaming**' checkbox.
2. Switch on the **Toplight** and configure the camera settings using **Exposure** and **Gain** to obtain an optimal image quality.
3. Using the **Driver control**, move the manipulator above the **center of any device**. The center of the cross in the image from the Up camera should align with the approximate center of the device. Move only in the X and Y axes.
4. Press the '**Pick up**' button in the Driver control. The manipulator will initiate the chip pick up sequence."
5. Press the '**Take to camera**' button. The manipulator will move, along with the device, to the Down camera."
6. In **Vision Control**, switch to the Down camera. Enable the "**Streaming**" checkbox.
7. If you want to use the backlight during programming and have the "Use Backlight" checkbox selected, press the "**On**" button in the **Backlight** frame.

 **Warning: Do not look directly into the light source, as it could damage your eyesight.**

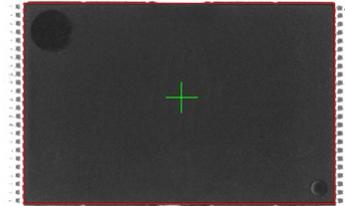
8. Set the image parameters (**Exposure, Gain**) to achieve a clean white background and clear device visibility in the image. If the image is **blurry**, it may be necessary to manually adjust the **focus distance** on the camera lens and, if needed, the aperture.

Bad result – too high exposure	Bad result – low contrast, shadows	Good result – high contrast
<p>UpCam <input checked="" type="radio"/> DownCam</p> 	<p>UpCam <input checked="" type="radio"/> DownCam</p> 	<p>UpCam <input checked="" type="radio"/> DownCam</p> 

8. If your image is good and you would like to set up the program to recognize the device for your project, continue to the "**Device Settings**" section.

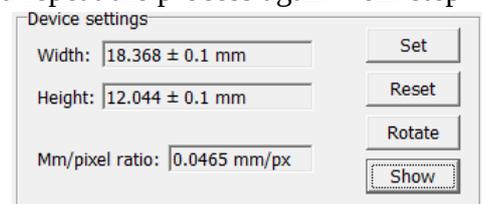
- **Device settings:**

1. Make sure you have the device in the center (it doesn't have to be exactly in the center) of the Down camera and it is correctly illuminated.
2. In the "Device Settings" frame, press the "Set" button.
3. The program will recognize the device in the image and display a window with an image of the device along with a red area indicating where the device is located. This red area represents the reference area by which the device's position will be checked during programming.



3.1. If the recognition was not successful, please check the lighting of the device or the camera's functionality. Alternatively, you can try a different position for the device within the camera's field of view. And repeat the process again from step 3.

4. You can close the device area window.
5. Check if the device dimensions in the Device settings match the actual dimensions of the device. A small deviation is tolerated. In our case, the device had dimensions of 18.40 mm x 12.00 mm.



Device settings	
Width:	18.368 ± 0.1 mm
Height:	12.044 ± 0.1 mm
Mm/pixel ratio:	0.0465 mm/px

6. If the dimensions have a significant deviation, try repeating the process from step number 3. If the issue persists, it is necessary to perform a camera calibration. The calibration process is described in the "Calibrate recognition camera sequence" section.
7. If the red area has been generated perpendicular to the actual position of the device, simply use the "Rotate" button to rotate the red field.



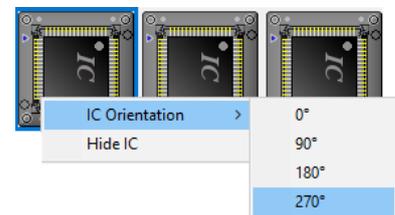
Note: The rotation of the red field must match the rotation in which devices will be inserted into the adapters during programming.

8. If all the steps have been performed correctly, you can save the Vision file using the "Save file" button.
- In the Driver Control section, press the "To last pick up" button. The manipulator will move to the XY position where you last used the "Pick up" function.
 - In the Driver Console, press the "Place" button. The manipulator will place the chip back into its position on the tray. Before doing so, make sure you haven't made any changes to the rotational axis A to ensure that the chip is not in the wrong orientation and to prevent damage.

Adapter settings

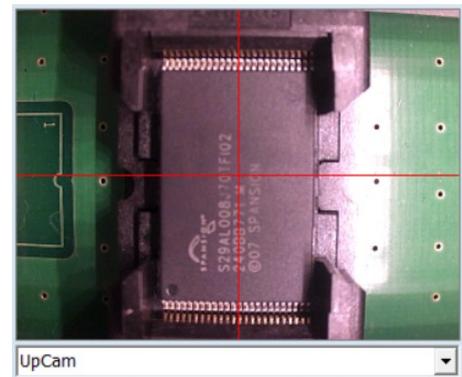
- **Adapter preparation**

1. Switch to the **Adapter** tab
2. Move the manipulator to a position where it won't obstruct your access to the programmers.
3. Before setting up the adapter, it's necessary to **insert a device into each ZIF socket** in the programmers. Insert the device only when the ZIF socket is open, and there is no ongoing sequence or manipulator movement.
4. Close Safety door
5. Set the **orientation** of the device in relation to the Elnec programmer by right-clicking on the device symbol labeled "IC." From the context menu, select the orientation angle relative to the front of the programmer.

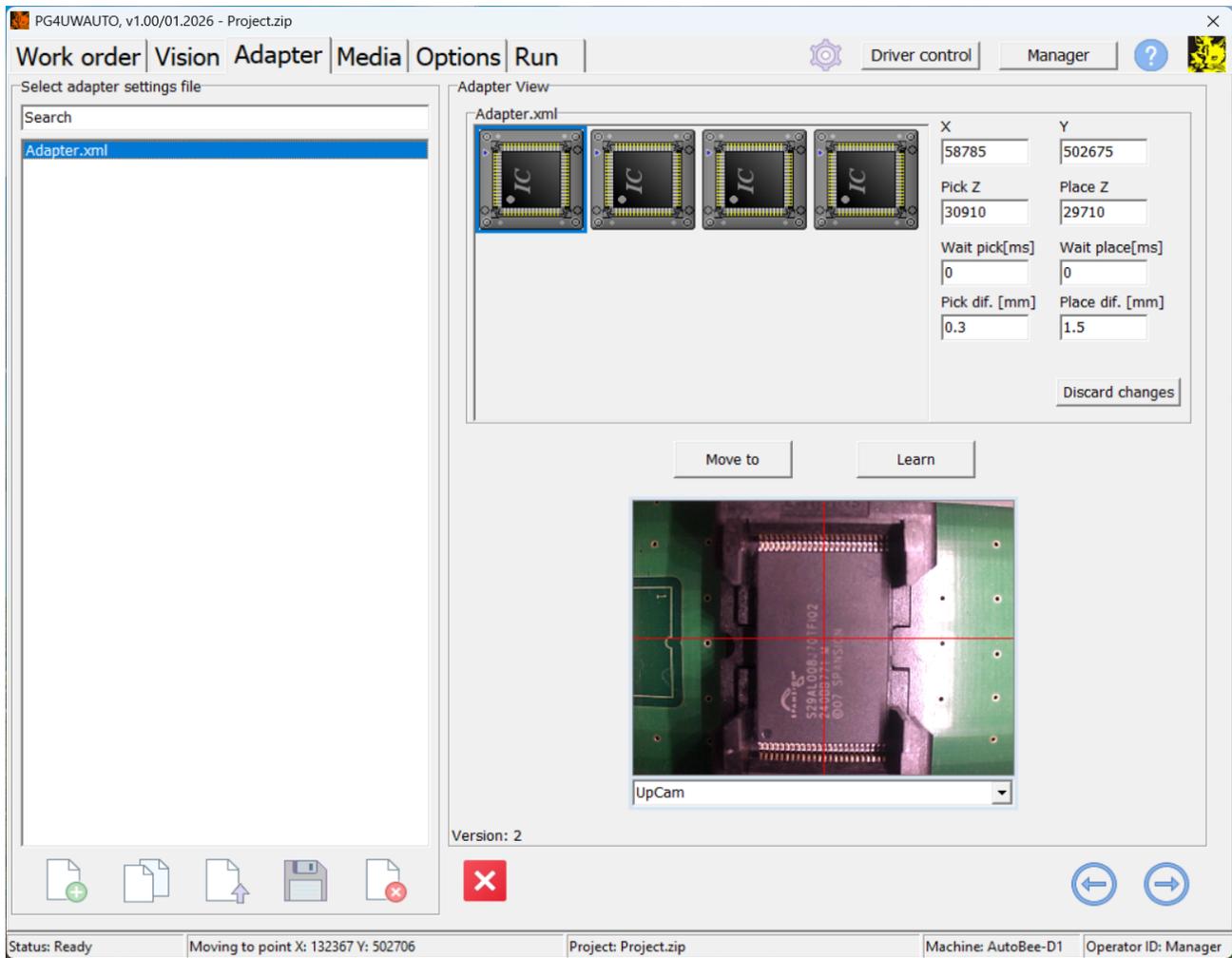


- **Adapter learning**

1. In the camera window, select the top camera from the menu by choosing "**Select Camera**". The camera must be initialized.
2. Use the Driver Control window and, using the buttons, move the manipulator in the X and Y axes over the ZIF socket of adapter 1 on the programmer.
3. Make sure that the "**Don't use UpCam**" function is disabled in the Driver Control window.
4. Set the difference for device picking and placing. You can also set their **wait times** if desired. In our case, for example, it is 0.3 for "**Pick dif.**" and 1.5 for "**Place dif.**".
5. Click the "**Learn**" button. The manipulator will initiate the learning sequence. Further details about this sequence are described in the "Learning sequence" chapter. Wait for the sequence to complete.
6. After a successful learning sequence, the **Learn Result Dialog** window will appear. Select which coordinates you want to update and confirm by clicking the "**Update**" button.
7. **Repeat** the process from step 2 to step 6 for each available adapter.
8. **Save** the Adapter file using the "Save File" button.



9. Use the "Move To" button to move to each learned position and visually check if it's correct through the Up camera.



The screenshot displays the AutoBee-D1 software interface. The main window is titled "PG4UWAAUTO, v1.00/01.2026 - Project.zip". The menu bar includes "Work order", "Vision", "Adapter", "Media", "Options", and "Run". The "Adapter" menu is currently selected, showing a list of adapter settings files, with "Adapter.xml" selected. The "Adapter View" panel shows four IC components and a table of settings:

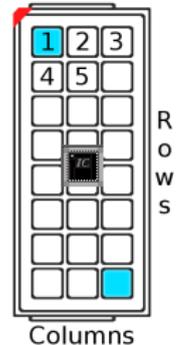
X	Y
58785	502675
Pick Z	Place Z
30910	29710
Wait pick[ms]	Wait place[ms]
0	0
Pick dif. [mm]	Place dif. [mm]
0.3	1.5

Below the table are buttons for "Move to" and "Learn", and a "Discard changes" button. The "UpCam" section shows a camera view of a component on a green PCB, with a red crosshair indicating the current position. The status bar at the bottom shows "Status: Ready", "Moving to point X: 132367 Y: 502706", "Project: Project.zip", "Machine: AutoBee-D1", and "Operator ID: Manager".

Media settings

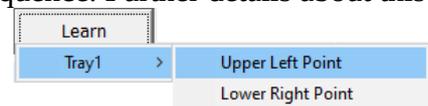
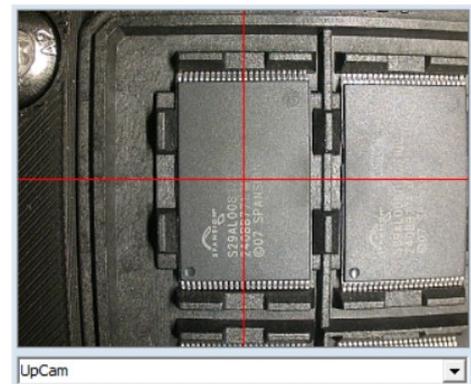
- **Tray settings**

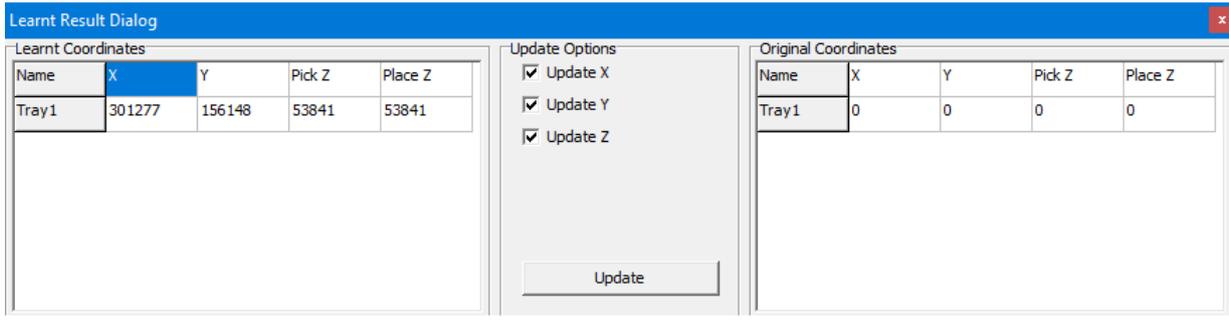
1. Switch to the **Media** tab.
2. Create a new Media file by clicking the 'New file' button.
3. In the Media Panel, on the Tray tab, it is necessary to set the parameters for the tray.
4. Set the **orientation** of the device in relation to the tray by clicking the left mouse button on the device symbol labeled "IC." Alternatively, you can change it by right-clicking with the mouse to access a pop-up menu.
5. Fill in the number of **rows** and **columns** for the used tray. You can also change the **placing order** to suit your preferences.
6. Set the difference for device picking "**Pick dif.**" and placing "**Place dif.**". You can also set their wait times if desired.



- **Tray learning**

1. In the camera window, select the top camera from the menu by choosing "**Select Camera**". The camera must be initialized.
2. Use the Driver Control window and, using the buttons, move the manipulator in the X and Y axes over the **upper-left point**(device) on the tray.
3. Make sure that the "**Don't use UpCam**" function is disabled in the Driver Control window.
4. Click the "**Learn**" button, and in the pop-up menu, select "**Tray 1 -> Upper left point**". The manipulator will initiate the learning sequence. Further details about this sequence are described in the "Learning sequence" chapter. Wait for the sequence to complete.
5. After a successful learning sequence, the **Learn Result Dialog** window will appear. Select which coordinates you want to update and confirm by clicking the "**Update**" button.
6. **Repeat** the process from step 2 to step 5, but this time, move to the "**Lower Right Point**" of the tray.





7. In the Media Panel, select the **Tray 2** tab.

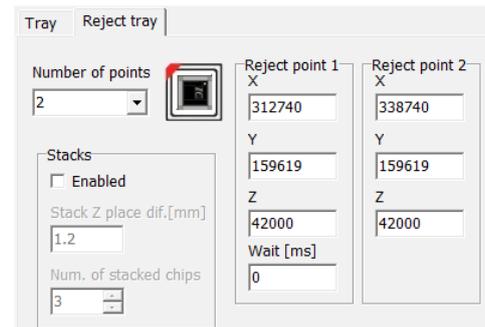
8. If **origin** points for trays are defined in the Platform, you can check the "**Auto generate**" box, and the coordinates for Tray 2 will be filled automatically. If origin points are not defined, you will need to obtain the coordinates for Tray 2 in the same way as you did for Tray 1. Therefore, repeat the process from step 2 to 6, but this time do it for Tray 2.

- **Reject tray learning**

1. Click on the "**Reject tray**" tab in the media panel.

2. Choose the **number of reject points** you want to have. The min. is 1, and the max. is 4.

3. Set the **orientation** of the device in relation to the reject point by clicking the left mouse button on the device symbol labeled "IC." Alternatively, you can change it by right-clicking with the mouse to access a pop-up menu.



4. If you want devices to be stacked on top of each other at one reject point, check the "**Enabled**" box in the "**Stacks**" section.

4.1. Set in the "**Stack Z place dif.**" the value for the depth change of device placement in millimeters, which will decrease for each device placed in the stack. It is recommended to use a minimal value for the height of the programmed device.

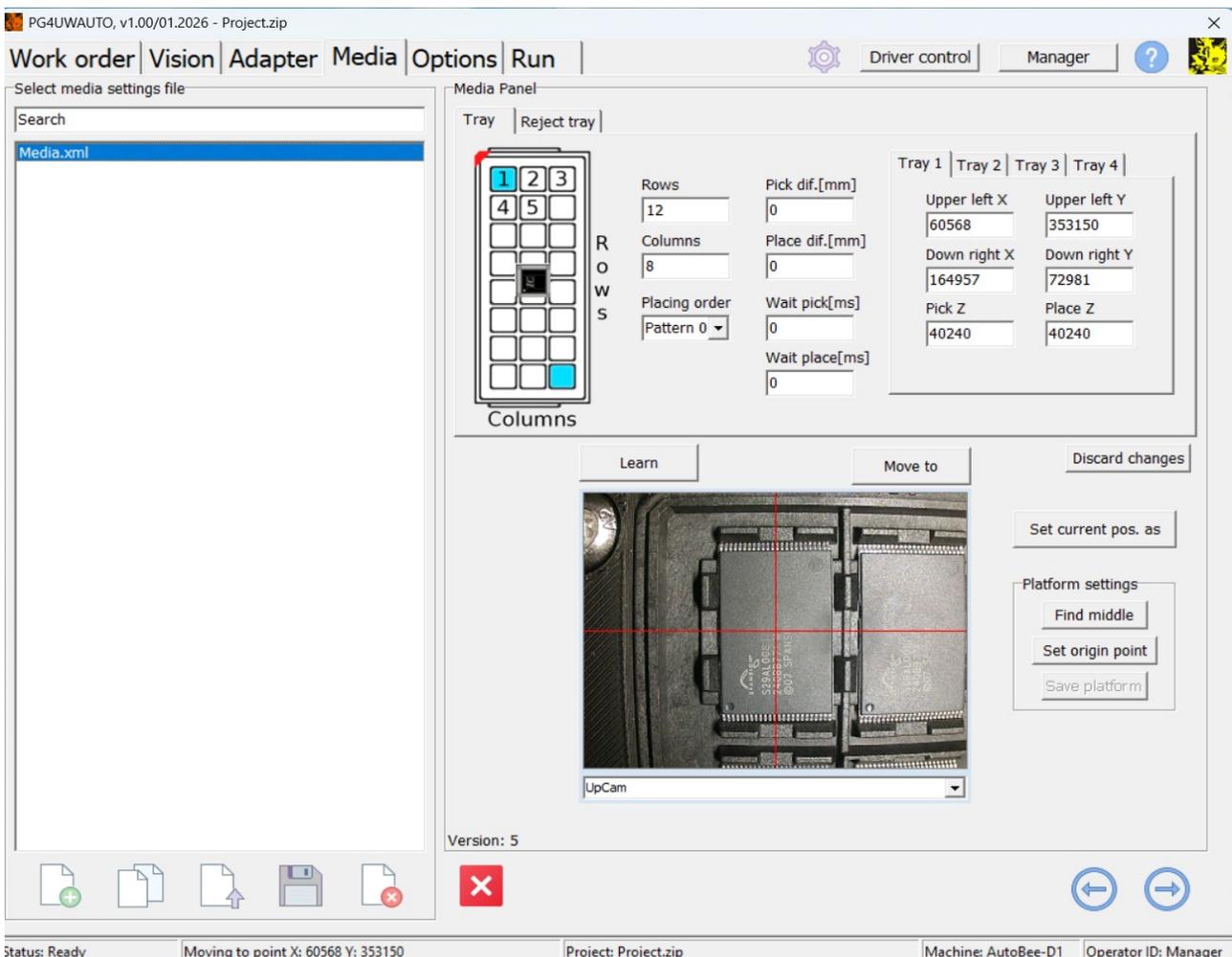
4.2. Set the number of devices to be in one stack.

5. Move the manipulator over **Reject point 1** using the buttons in the Driver Control.

6. You can initiate the **Learning sequence** as in the case of "Tray learning" in steps 2 to 5. Additionally, the Reject tray pad is made of a soft material and would affect the Z height when using the learning sequence result. That's why it's necessary to **adjust the Z coordinate manually**.

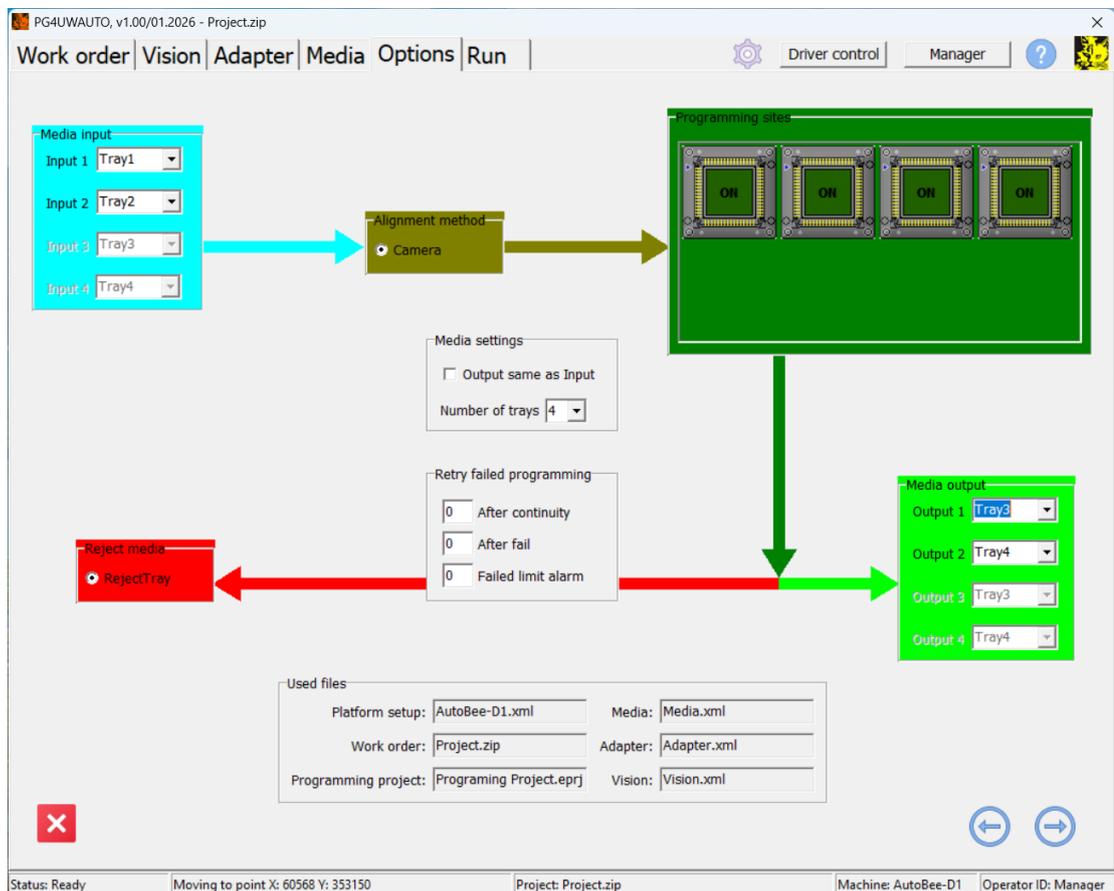
6.1. Alternatively, you can use the manual approach through the "**Set current pos. as**" function, where the current position will be used as the X and Y coordinates for Reject point. The "Z" coordinate needs to be determined manually by moving the Z-axis down and manually entering the result in the Z column for Reject point. The manual approach is sometimes more suitable, as absolute accuracy is not necessary for reject points since they don't have defined landing areas.

7. Enter the value for the **Wait time** if desired.
8. Repeat steps 6 to 7 for each available Reject point.
9. **Save** the Media file using the "Save File" button.
10. Use the "**Move To**" button to move to each learned position and visually check if it's correct through the Up camera.



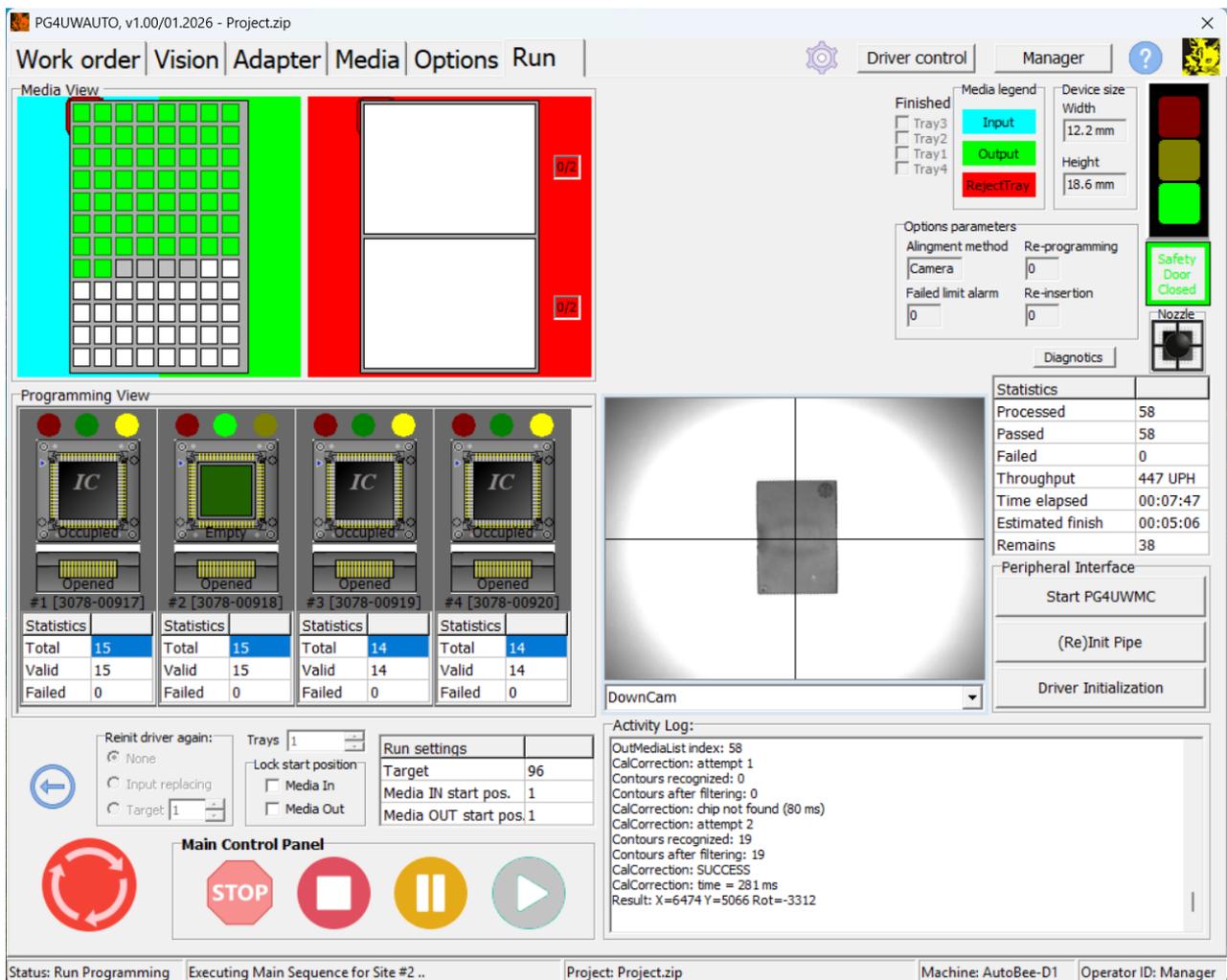
Options settings

- Switch to the Options tab
- In the **Media input**, select which tray should be used as media for devices that have yet to be programmed
- If you haven't used the Skip Camera function, the **alignment method** is through the Camera. In the second case, option None would be available.
- By clicking the left mouse button on the symbols of the adapters in the **Programming sites** window, you can enable or disable individual sites. Disabled sites will not be used in programming.
- In the **Media output**, select which tray is to be used as the media for successfully programmed devices.
- In the **Reject media**, Reject points are selected as the medium for unsuccessfully programmed devices.
- Set the values for individual variables in the "**Retry failed programming**" table. Details of these variables are described in the "Options" tab section.
- Use the "**Next**" arrow, which will prompt you to **save** the entire project and move you to the "Run" tab.



Run programming

1. Switch to the Run tab
2. **Check** the tray placement and settings, device size, options parameters, ensure that the safety doors are closed, and verify that the nozzle is empty.
3. If you want, you can set the “**Reinit driver again**” function.
4. Set the value for “**Target**” manually or by using the number of input trays in the “Trays” column.
5. If some devices on the board are missing or you want to process only a certain number of devices from the tray, select the value in the fields “**Media In / Out start pos**”. To apply this setting to each tray, select the check boxes in “**Lock start position**”.
6. You can start the programming by pressing the “**Run**” button.
7. You can **pause** or **stop** the programming process at any time.
8. After successful production, the manipulator is moved to the parking point.



The screenshot displays the PG4UWMC software interface with the following components:

- Work order | Vision | Adapter | Media | Options | Run** (Navigation tabs)
- Media View**: A grid of 40 media slots (5x8) with a red vertical bar on the right. The right side is labeled "0/2".
- Programming View**: Four IC chip images labeled #1 to #4. #1 and #3 are "Occupied", #2 is "Empty", and #4 is "Occupied". Each has a "Statistics" table below it.

IC	Total	Valid	Failed
#1 [3078-00917]	15	15	0
#2 [3078-00918]	15	15	0
#3 [3078-00919]	14	14	0
#4 [3078-00920]	14	14	0
- Options parameters**:

Alignment method	Camera	0
Failed limit alarm	0	0
Re-programming	0	0
Re-insertion	0	0
- Device size**: Width 12.2 mm, Height 18.6 mm.
- Safety Door Closed** indicator.
- Statistics** table:

Processed	58
Passed	58
Failed	0
Throughput	447 UPH
Time elapsed	00:07:47
Estimated finish	00:05:06
Remains	38
- Peripheral Interface**: Start PG4UWMC, (Re)Init Pipe, Driver Initialization.
- Main Control Panel**: Reinit driver again (None, Input replacing, Target), Lock start position (Media In, Media Out), Run settings (Target: 96, Media IN start pos: 1, Media OUT start pos: 1), and buttons for Stop, Pause, and Play.
- Activity Log**:


```

      OutMediaList index: 58
      CalCorrection: attempt 1
      Contours recognized: 0
      Contours after filtering: 0
      CalCorrection: chip not found (80 ms)
      CalCorrection: attempt 2
      Contours recognized: 19
      Contours after filtering: 19
      CalCorrection: SUCCESS
      CalCorrection: time = 281 ms
      Result: X=6474 Y=5066 Rot=-3312
      
```
- Status Bar**: Status: Run Programming | Executing Main Sequence for Site #2.. | Project: Project.zip | Machine: AutoBee-D1 | Operator ID: Manager

Tray exchange:

- If any of the trays becomes **full or empty**, the machine will **pause** production and prompt you to **exchange the tray**. In this case, open the machine doors, remove the desired tray, and insert a new tray. You can close the doors and **confirm** the successful exchange in the application.



Warning: When exchanging the tray, make sure that the tray fits precisely into the designated holders and holds firmly in its place.

Dialogues that may appear during production:

- **“Device not picked properly!”** - Appears if the manipulator did not detect any device on current position during the Pick up procedure.
 - Retry – Repeats the Pick Up procedure.
 - Ignore – Skips the position and moves to the next one.
 - Abort – Cancels programming.
- **“Failed device limit alarm has been achieved. Do you want to continue?”** - is displayed if the number of incorrectly programmed devices exceeds the set limit.
 - Ok – Continues with programming.
 - Cancel – Cancels programming.
- **“Please replace In/Out media (tray)”, “Please replace input media (tray)”, “Please replace output media (tray)”, “Please replace reject media tray”** - these messages appear when you need to replace one of the trays.
 - Ok – Continues with programming. **Press only if the media has been exchanged.**
 - Cancel – Cancels programming.
- **“Vacuum lost! Continue anyway?”** - appears if the manipulator loses the device during operation, even if it should have held it.
 - Ok – Continues with programming.
 - Cancel – Cancels programming.

Platform editor

The Platform Editor is used to edit the main peripherals of the AutoBee-D1 machine. It is used to edit the coordinates in the XYZ axes, rotation in the A axis, and their availability.

The platform file is automatically loaded on the first run of the application.

The platform file applies to all projects in the application. It is not necessary to create/load a new platform file for each project.

Due to the possibility of small mechanical shifts in the peripherals during machine assembly and transport, it is necessary to check all the specified parameters in the platform file. And in case of inaccuracies, adjust the parameter to the correct value.

The coordinates for individual peripherals are filled with the XYZ values of their origin points.

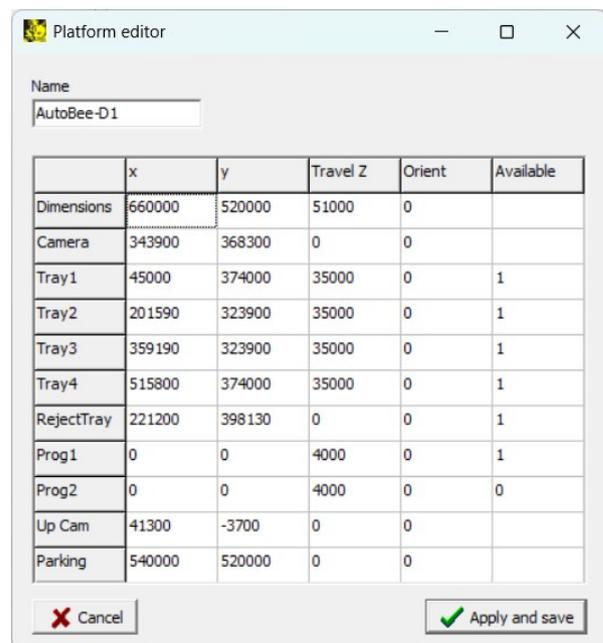
The **Name** box is used to edit the name of the platform file.

- **Platform elements:**

- **Dimensions** – It determines the maximum dimensions in the XYZ axes within which the manipulator can move.
- **Camera** – Coordination of the center of the device recognition camera.
- **Tray1(2..4)** – Coordination of the origin point for Tray1(2..4).
- **RejectTray** - Coordination of the origin point for Reject tray.
- **Prog1, Prog2** - Coordination of the origin point for programmers.
- **Up Cam** – Up Cam offset size values.
- **Parking** – Coordination of the parking point.

- **Properties:**

- **X** – The value of the X-axis coordinate.
- **Y** – The value of the Y-axis coordinate.
- **Travel Z** – The value of the depth in the Z-axis at which the manipulator will move above the peripheral during programming. When this value is incorrectly chosen, it can lead to a collision between the manipulator and the peripheral, resulting in damage. For example, during programming, if the manipulator moves from Tray 1 to Tray 2, it will not rise to the value $Z = 0$ but will only rise to the height defined in Travel Z in the Platform. This parameter is defined to save manipulator movement during production. Be aware that "Travel Z" doesn't have the same meaning for all elements.
- **Orient** – It defines the orientation of the element in the machine's space.
 - Available values: 0 [0°] 1 [90°] 2 [180°] 3 [270°].



The screenshot shows the 'Platform editor' window with the name 'AutoBee-D1'. Below the name is a table with the following data:

	x	y	Travel Z	Orient	Available
Dimensions	660000	520000	51000	0	
Camera	343900	368300	0	0	
Tray1	45000	374000	35000	0	1
Tray2	201590	323900	35000	0	1
Tray3	359190	323900	35000	0	1
Tray4	515800	374000	35000	0	1
RejectTray	221200	398130	0	0	1
Prog1	0	0	4000	0	1
Prog2	0	0	4000	0	0
Up Cam	41300	-3700	0	0	
Parking	540000	520000	0	0	

At the bottom of the window, there are two buttons: 'Cancel' (with a red X icon) and 'Apply and save' (with a green checkmark icon).

- **Available** – Availability of individual elements in the machine. Values:
 - 0 – Unavailable 1 – Available
- **Travel Z with different meaning for elements:**
 - **Camera:** The value of Travel Z for the camera represents the depth in the Z-axis at which device recognition will occur during programming/learning.
 - **Trays, Programmers:** The value of the depth in the Z-axis at which the manipulator will move above the element during programming.



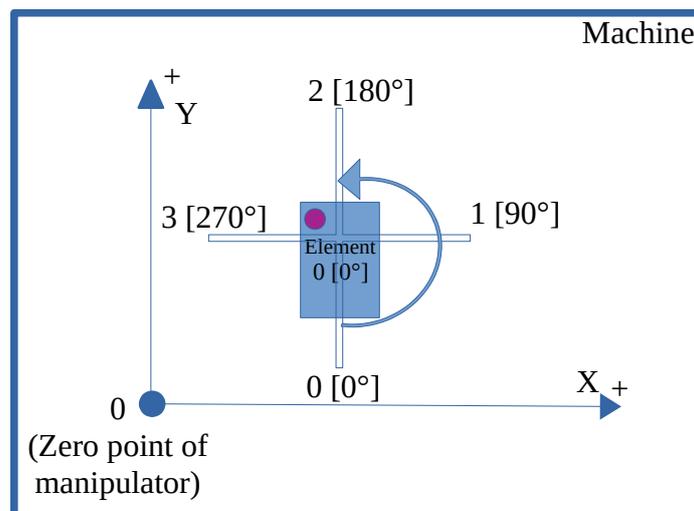
Note: It is not necessary to define all properties for the machine to make the machine work properly.

- **Apply and save:** The "apply and save" button applies the made changes and saves them.
- **Cancel:** Closes the platform editor without saving the changes made.



Note: After making changes, it is recommended to reload and save all projects. Additionally, you should check the project components that might have been affected by the changes in the Platform.

The following figure can help you define the **orientation** of the elements.



Platform check

This chapter serves as a guide for setting up and checking the correct parameters for the Platform file.

These operations should only be carried out in case of a machine issue. Under normal conditions, the data is set to factory defaults.

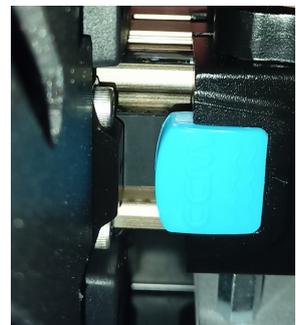
During the assembly and transportation of the machine, there might have been slight mechanical shifts. Therefore, it is necessary to check the coordinates in the platform and adjust them to the correct values if needed.

Before starting the inspection, make sure that the machine is ready for operation:

- Follow the instructions in the **Machine Setup** section.
- Make sure that nothing obstructs the manipulator's path and **initialize** it.
- Initialize the **Up camera** and **Down camera**.

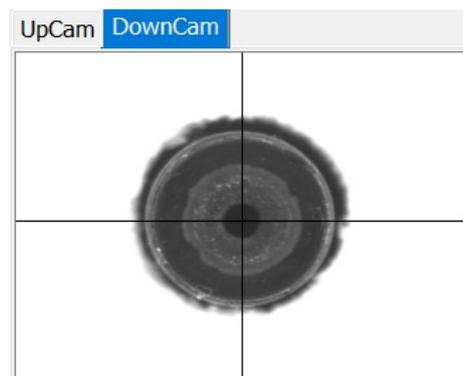
You can start checking each element of the platform now:

- **Dimensions:**
 - Get the manipulator to position X=0 and Y=0.
 - Utilize one of the manipulator's movement options and proceed with **slow steps** in the X-axis towards the **end position**. Be careful to avoid any collisions at the end of the axis. In this position, the manipulator should have a small distance (approximately 5mm) from the end of the linear guide of the X-axis.
 - The end value of the X-axis for AutoBee-D1 is 660000. If your current X value differs from the specified X value in the platform at the end position, you need to change it in the platform to match your current value.
 - You can increase or decrease the value, but always ensure that the distance from the end of the linear guide axis is at least approximately 5mm. Be careful to avoid collisions.
 - Repeat the same process for the **Y-axis** (value 520000).
 - Repeat the same process for the **Z-axis**, but with the difference that for the Z-axis, you are lowering the manipulator to the floor of the machine, and you read the final value when the **nozzle gently touches the floor**.
 - Save the platform using the "**Apply and Save**" button. Also, save the currently selected project and reinitialize the driver. Then you can reopen the platform and continue with the changes.



- **Camera:**

- In the "Driver control", press the "**Take to camera**" button. The manipulator will move to the coordinates specified in the platform for the camera.
- Switch to the Vision tab and display the image from the Down camera. Start streaming. Turn on the backlight if you are using it.
- Move the manipulator's nozzle over the camera if it's not already there. Make sure that the **Z-axis is set to 0**. (Z=0 is the recognition height for AutoBee-D1.)
- Try to move the center of the nozzle as accurately as possible to the **center** of the camera (black crosshair). You can use the **zoom** function to help you with this.
- The center doesn't have to be absolutely precise. Afterward, subtract the values of X and Y and write them into the Platform for the camera.
- You can turn off the backlight.



- **UpCam:**

- The UpCam parameters define the offset between the center of the camera and the center of the nozzle. The UpCam parameters are set at the factory, but they can be adjusted if needed.

- **Trays:**

- Display the live image from the Up camera.
- Move to the upper-left corner of the selected tray, specifically to its holder.
- Try to position the center of the camera to the inner corner of the holder where the tray's edge is inserted. Align it so that the ends of the red crosshair match the edges of the holder.
- Click on the **Media tab**.
- Press the **Set Origin Point** button and select **Tray1(2/3/4/Reject)**
- Click on the **Save platform**.
- Repeat this for each available tray in the machine.



Note: Programmers do not need to have defined X and Y coordinates for origin points.

- **Parking:** In the machine space, choose a parking position for the manipulator. Write its X and Y coordinates in the Platform for Parking. You can also choose a Z position, but it is recommended to leave $Z = 0$. If the default parking position is obstructive, you can select another one, but make sure the manipulator doesn't interfere when handling trays.
- **Travel Z:** Travel Z has different functions for individual platform elements.
 - For **Dimensions**, it represents the maximum depth for the manipulator in the Z-axis.
 - For the **Camera**, it is the depth at which device recognition takes place. For AutoBee-D1, this value is always 0.
 - For **trays, tubes, tapes, and programmers**, it is the travel height for the manipulator. The height value is set so that the manipulator has enough clearance and does not collide with the element. The height should also be sufficiently high to avoid collisions with any objects when transitioning between elements.
 - For **UpCam**, it doesn't have a specific meaning.
 - For **Parking**, it determines the height at which the nozzle is parked.
- **Available:** The availability of individual elements for AutoBee-D1 is already set to the default. If you modify your machine and add/remove an element, you can enable/disable it in the platform by changing 0 to 1 or vice versa.

After changes you can save and close the platform editor. In order for the changes in the platform to be valid, it is necessary to reinitialize the driver (manipulator).

Calibrate recognition camera sequence

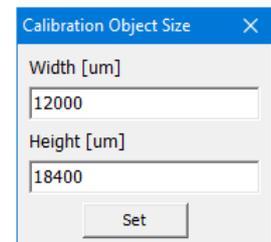
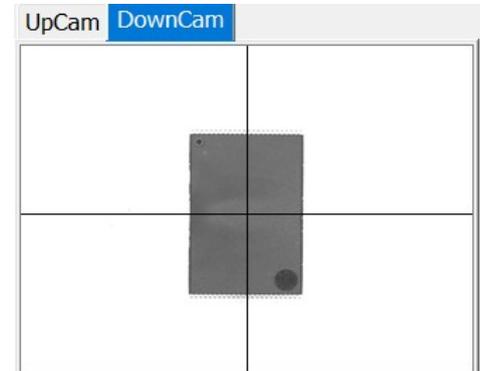
Calibrating the recognition camera requires having a vision file created with camera parameters properly configured. The process is detailed in the Vision settings section.

1. Go to the Vision tab, switch to the upper camera view, and use the manipulator to locate any device on the tray or even outside of it. Move to the relative center of the chip

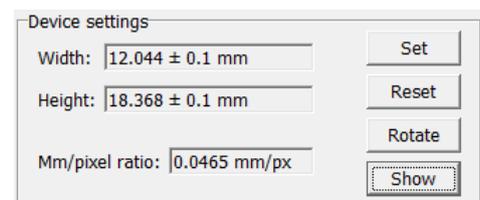


Note: Instead of a device, you can use any object with a dark surface, the dimensions of which you know and that the manipulator can pick up.

2. Press the "**Pick Up**" button in the Driver Control panel. The manipulator will pick up the device.
3. Press the "**Take to camera**" button.
4. **Turn on the backlight** if you are using it.
5. Set the camera parameters to ensure a sharp image and good contrast between the device and the background. The procedure is described in the Vision settings section.
6. In the Vision tab, press the "**Calibrate recognition camera**" button. This will initiate the device recognition sequence.
7. The "**Calibration Object Size**" window will open, where you should enter the dimensions (in micrometers) of the object you intend to recognize. Enter the dimensions with consideration for the orientation of the object.
8. Press the **Set** button. A window will appear with an image from the camera, and on the image, the object will be enclosed within a red box.
9. If the calibration was successful, you will see informational dialog boxes.
 - "If the red box does not have the same size as the object, try changing the camera settings and repeat the calibration."
 - "Camera has been successfully calibrated. Compare the object dimensions with the measured ones in the device settings."



11. If **calibration failed** or the object dimensions differ significantly from the measured dimensions, adjust the camera settings and repeat the calibration.
12. You can close the "Device area" window.
13. The result of calibration is the value for the **mm/pixel ratio** parameter.
14. The calibration is completed.



Learning sequence

The main task of the learning sequence is to find the coordinates of the point that represents the **center of the device**.

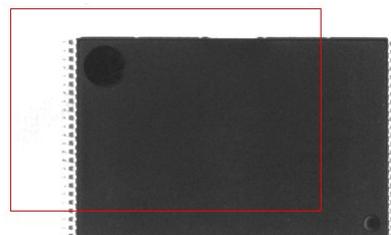
It is used for learning the coordinates of the centers of the adapters and the corner points of the media.

Before starting the learning sequence, it is always necessary for the manipulator to be in the XY axis over the approximate center of the device whose center you are about to determine.

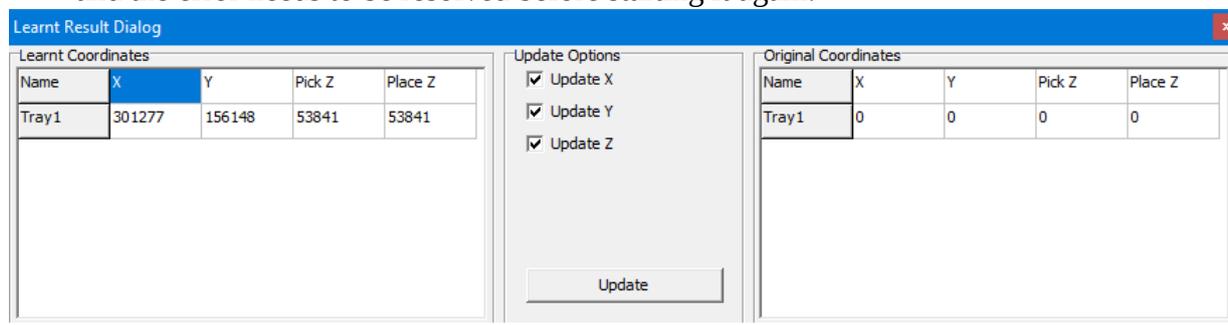
For spatial orientation within the machine, we recommend using the Up camera. The center of the Up camera represents the center of the nozzle on the manipulator. Make sure that "**Don't use UpCam**" is disabled in the Driver Control.

The Learning Sequence Procedure:

1. Press the "Learn" button.
2. The Probe Z sequence is initiated. The Z-axis will start descending slowly until it makes contact with the device. Upon contact, the sensor is triggered, and the depth of the device is measured. The Z-axis will then return to the zero position.
3. The manipulator will perform the device pickup.
4. If the pick-up was successful, it will move to the center of the recognition camera.
5. The backlight will be illuminated (if enabled), and the application will use the camera to recognize the device in the image and calculate its displacement from the exact center of the camera.
6. A window will appear with an image from the camera, along with a highlighted reference field of the device in the center of the image. (The window will close by itself.)
7. The manipulator will return to the pickup position.
8. It will place the device in its original position.
9. The manipulator will move in the XY axis by the values of the device's deviation from the center, which were determined using the camera.
10. The procedure is repeated from point 3 to point 10 again.
11. The "Learn result dialog" will be displayed.



12. If the learning sequence proceeded correctly without any errors, the "Learn result dialog" will be displayed. In the case of any errors in the sequence, the learning sequence will fail, and the error needs to be resolved before starting it again.



Diagnostics sequence

The diagnostic sequence serves to determine the machine's status. The collected data is saved in a ZIP file, which may be required by support staff. For data integrity, the ZIP file is password-protected. *The diagnostic sequence does not solve machine problems; it only collects data.*

Before starting the diagnostic sequence, ensure the following:

- The **top camera is initialized** as the only active camera.
Create a Vision project containing only the top camera.
- The **machine is initialized** for movement.
- A successful **connection with the PG4UWMC.exe** program is established.

Sequence steps:

1. The manipulator is initialized.
2. The vacuum test is performed.
3. Endpoints are checked to ensure no changes or misalignment of the limit switches have occurred.
4. The manipulator photographs the positions of four points on the machine table and generates screenshots.

Diagnostic results:

- The results are saved in a ZIP file named:
AB_SN_(serial)_(date).ZIP
- The ZIP file, along with the screenshots, is stored in the **Diagnostics** folder, located at the path specified in **Settings** → **Directory**.

Default path for Diagnostics:

DISK:\Users\USER\Documents\EInec PG4UWAUTO\Diagnostics\

Maintenance and Lubrication

Arrange regular inspection and maintenance system

Daily inspection	Items
Check before power on	<ul style="list-style-type: none"> • Cleanliness of linear guides. • Cleanliness of cameras and lenses. • Insertion of ZIF sockets in programmers. • Placement of media. • Unwanted objects in the working area. • Air connection and air pressure. • Cleanliness of the nozzle.
Check after power on	<ul style="list-style-type: none"> • Function of the Emergency stop button. • Sensors and whether the signal LEDs are lit. • Initialization of programmers. • Whether the signal tower is lit in red. • That there are no abnormal sounds during the manipulator's movement.

Monthly inspection	Tasks
Motors X/Y/Z/A	<ul style="list-style-type: none"> • Make sure the motors are not overheating. • Check the belts of the gearboxes and their wear. • Check if the synchronous wheels have not loosened.
Linear guides X/Y	<ul style="list-style-type: none"> • Check the tension of the belts and their wear. • Check if the guides are sufficiently lubricated. • Tighten the screws on the couplings of the synchronous rod for the Y-axis linear guides.
Z-axis	<ul style="list-style-type: none"> • Tighten the screws on the motor coupling. • Check and add grease in the ball screw. • Check the lubrication of the linear rail. • Lubricate the ball bearing of the pipe.
Electrical installation	<ul style="list-style-type: none"> • Check the connection of the endstops for the XYZ axes and Probe Z. • Check the motor cable connections. • Check the mobility and wear of the energy chains.
Vacuum	<ul style="list-style-type: none"> • Check all the air hoses for possible air leaks. • Check for clogging of the air filter. Clean it if necessary.

Lubricant selection:

For lubrication, use the same lubricants as for **rolling bearings**.



Warning: The use of lubricants containing MoS₂ or graphite is prohibited.

MAINTENANCE & LUBRICATION		
Component	Task	Interval
 Linear Guides	 Lubricate	 Every 200 hrs.
 Z-Axis Head	 Lubricate Ball Screw & Guides	 Every 200 hrs.
 Screws & Fasteners	 Check & Tighten	 Every 100 hrs.
 Belt Tension	 Check & Adjust	 Every 100 hrs.
 General Inspection	 Visual Check	 Every 100 hrs.

Troubleshooting

Before attempting any troubleshooting, check if the machine is **powered on** and if the **air supply** is connected with the correct pressure (min. 0.3 MPa/ max. 0.7 MPa). Also, check the **USB connection** to your computer.

Problem	Reason	Solution
Nozzle can't grab the device.	Leak in the vacuum system. Dirty nozzle. Incorrect pick-up height setting.	Check the air supply to the machine and for any possible leaks. Clean the nozzle. Adjust the value of Pick dif. or Pick Z in the Media tab.
The manipulator had a collision with one of the machine elements.	Careless manipulation of the manipulator controls. Incorrectly set Travel Z of elements in the Platform file.	Be careful when handling, especially with the Z-axis height and step length. In the platform file, change the Travel Z parameter. Alternatively, set it to a value of 0.
The manipulator refuses to move.	The manipulator is not initialized. Machine doors are open.	Initialize the driver in the Driver Control. Close the doors or check the door sensor.
Manipulator incorrectly place devices into the media.	Incorrectly created model of media. Incorrectly entered origin point of the media. Incorrectly placed media in the holders.	Perform the learning of media again. Set the origin point correctly in the Platform. Check the placement of the media and securely fasten it in the holders.
If I send the manipulator to the camera, it is not in the center.	Incorrectly set point for the center of the camera.	Move to the center of the camera and set new coordinates in the Platform.
When learning or programming, the manipulator does not rotate the device into the position for the adapter.	Incorrectly set rotations of the device in media or adapter tabs. Incorrectly entered rotations of elements in the Platform.	Check your rotation in media and adapter cards. Check the rotation of elements in the Platform.
The camera cannot recognize the device.	The camera is not initialized. Poor lighting of the device.	Initialize the camera in the Vision tab. Use backlight or adjust the brightness and exposure of the camera.
The cameras cannot be initialized.	Incorrect USB connection. Incorrect camera IDs. Device recognizer camera not selected.	Check if your computer recognizes that the camera is connected. Check the ID value for each camera in the Vision tab. Select one of the cameras as the recognizer.

Requirements for operator

The operator of the AutoBee-D1 machine should adhere to the following guidelines:

- **Complete Basic Operator Training:**
 - The operator should undergo basic training covering all the necessary skills and knowledge required to operate the machine safely.
- **Strictly Follow Equipment's Instructions:**
 - Operate strictly according to the provided instructions and guidelines. Refrain from continuing work in case of issues and contact the service personnel.
- **Maintain Focus:**
 - Stay focused on observing and listening to the surroundings. Notice any unusual situations, sounds, or issues and address them promptly.
- **Manual Intervention:**
 - Address minor issues such as media installation, correction of placement positions, etc. For more significant problems, consult with the service personnel.
- **Risk Mitigation:**
 - Develop measures to reduce and prevent major issues.

These guidelines help ensure the safe and effective operation of the AutoBee-D1 machine.

Safety instructions

General Safety Instructions

- Read this manual carefully before using the machine.
- Only trained and authorized personnel may operate the machine.
- Follow all safety regulations applicable at the machine's location.
- Unauthorized persons must not be present near the machine during operation.
- Never bypass safety features or modify the machine's structure.
- Before each use, check the condition of protective covers and safety sensors.

Mechanical Safety

- Handle the machine and its components with care to avoid injury.
- Do not interfere with moving parts while the machine is in operation.
- The machine doors must always be closed and secured with the safety sensor during operation.
- Never insert hands or objects into the workspace while the machine is running.
- Install the machine on a stable and level surface to prevent vibrations or unexpected movement.

Electrical Safety

- The machine must be connected to a power supply with the correct voltage (220V/50Hz) and proper grounding.
- Use only the original power cable and ensure it is undamaged.
- Electrical connections should only be made by a qualified technician.
- In case of a malfunction or power failure, inspect the machine before restarting.
- Never touch electrical components while the machine is connected to the power supply.
- Always disconnect the machine from power before cleaning or maintenance.

Pneumatic Safety

- The machine requires a compressed air supply of 0.5 – 0.7 MPa (min. 65 l/min).
- Use only clean and dry compressed air to avoid damage to pneumatic components.
- Before any maintenance, disconnect the air supply and release residual pressure from the system.
- Inspect hoses and connections before starting the machine to prevent air leaks.

Fire Safety

- The machine should be placed away from open flames.
- In the event of a short circuit or smoke, immediately disconnect the machine from the power supply and contact a qualified technician.
- Ensure that an appropriate fire extinguisher (e.g., powder or CO₂) is available near the workstation.

Ergonomic and Environmental Guidelines

- The workspace must be well-lit and properly ventilated.
- When handling programmed components, follow electrostatic discharge (ESD) protection measures to prevent damage.

Emergency Stop

- The machine is equipped with safety sensors and protective mechanisms. If any irregularity occurs, immediately stop the machine and inspect the cause.
- In case of an emergency, use the main switch to immediately power off the machine.

Maintenance and Service

- Only authorized personnel are allowed to perform maintenance.
- Regularly check and clean the working area to prevent dust and debris accumulation.
- Inspect and tighten mechanical components if necessary.
- If the machine exhibits unusual behavior, stop operation and contact technical support.