



Eva Robotic Arm

Technical Reference User Manual
Version 1.0 – November 2018

The goal of this manual is to provide helpful information on the particulars of
Eva's
software, electronics and mechanics.

It does not contain comprehensive safety or risk information.

**Before reading this manual, attempting to set up or operate the robot,
ensure you read and understand the separate safety manual and carry out a
risk assessment.**

Download the latest version of this manual from <https://automata.tech>

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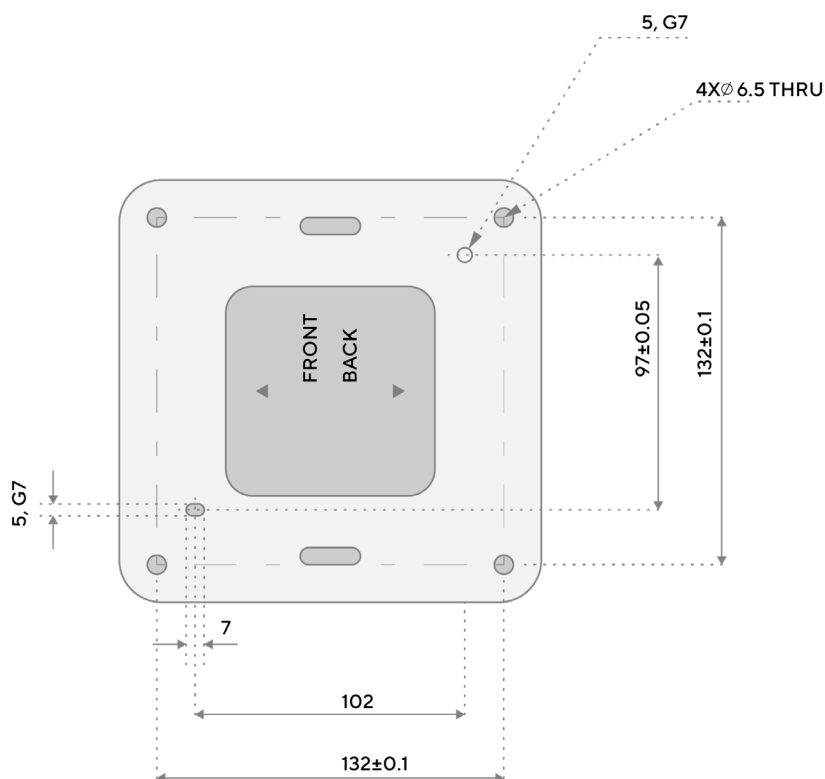
01 Installing the robot

Physical Setup

In the box you will find Eva, an emergency stop switch and a power supply (with cables for each), a safety manual, and a user manual.

Consult the safety manual for information on proper installation.

In summary, screw the robot base into a supportive surface with four M6 screws or bolts. Connect the emergency stop (consult the safety manual) and plug the robot into mains power.

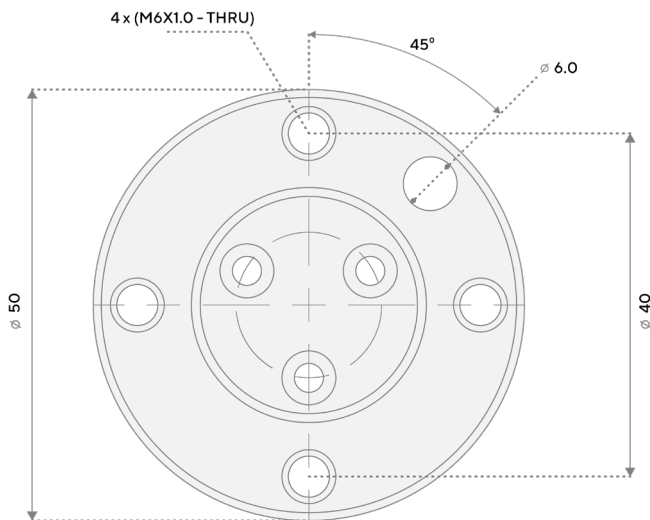


For greater precision and consistency between installations, use two dowel pins, 5 mm in diameter, to align the two reference holes on the baseplate (located inwards from the mounting holes, as shown on the diagram) with similar slots in your work surface. The pins should rise a maximum of 5 mm above the surface of the baseplate.

Tooling

Eva has an aluminium flange, or toolplate for attaching tools such as grippers or sensors.

It has an ISO 9409-1 designation of 40-4-M6. This means it uses 4x M6 threaded holes arranged in a circular pattern, 40 mm in diameter. Refer to the drawing for detailed dimensions.



A locating hole, 6 mm in diameter, is present between two of the mounting holes. Many tools include a locating pin that slots tightly into this hole to home the orientation of the tool and reduce unwanted rotation. This pin should be aligned before screwing in the tool.

The inner holes of the toolplate fix it to the robot. They sit within a recessed circle that also helps to align some tools.

Powering on and Connecting

Power

Power will only be available to Eva's joints while the emergency stop button (e-stop) is connected and released. The e-stop is activated by a simple push, and released by twisting the button in the direction shown on the top.

The main power button is located on the robot base, above the input/output panel. This button does not disconnect physical power from the robot.

The robot will be in a sleep state when first connected to a power source. Wake the robot by pushing the button once. When the system is awake and running, the button indicator ring and the LEDs on the robot head will illuminate **white**.

When the robot is idle, press the power button once to shut the robot down. A shutdown can be forced by pressing and holding the power button for several seconds. This is not an emergency procedure. Refer to the safety manual for information on e-stops and other protective features.

Communication

Connect to the robot for the first time via wifi or ethernet.

Wi-Fi

Eva will be available as its own wireless access point, identified with the format **eva-Name**. Connect to this access point with the password on the sticker below, open a browser and navigate to the URL **eva.automata** or **172.16.172.1**.

Ethernet

To connect via ethernet, configure your host side interface to **IP: 172.16.16.1**, **Subnet Mask: 255.255.255.0**. Open a browser and navigate to **172.16.16.2**.

Once connected, it's possible to configure the robot to connect to another wifi access point or an ethernet network with a static IP. If Eva detects it has lost its connection, or has been configured with invalid settings, it will continue to attempt to connect for three minutes, before rolling back to the default access point and ethernet configuration.

First time setup

After navigating to Eva's IP address for the first time, a setup screen will be displayed:

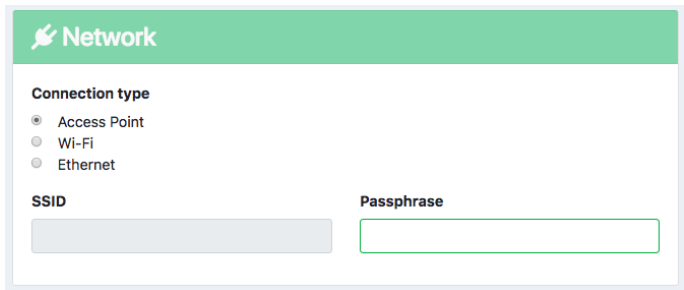
Administrator

Email
lunit01@nge.uk

Password

Password Confirmation

Use this screen to provide credentials for the robot administrator. This user has the ability to add and remove other users from the robot.



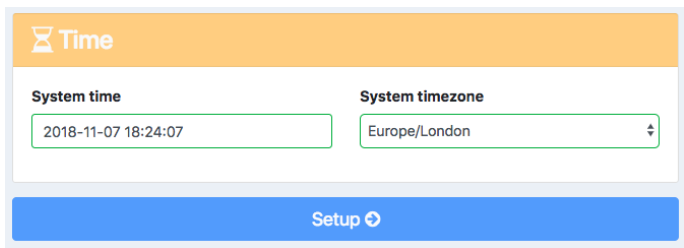
The second part of first time setup allows a connection type to be specified.

Access Point Mode causes the robot to behave like its own wireless network, with the SSID displayed below. This screen also provides an opportunity to modify the Passphrase for connecting to this access point. IP settings will be determined automatically via DHCP.

Wi-Fi Mode causes the robot to behave like a device connected to a local wireless network. The user must provide the SSID and Passphrase for the chosen network. Eva must also be assigned a unique Static IP, and a valid Netmask and Gateway in order to connect. On a home network, a typical Netmask and Gateway might be 255.255.255.0 and 192.168.1.1 respectively.

Consult your network admin for advice on the appropriate configuration.

Ethernet Mode is similar to Access Point mode, but the user can specify the IP settings for the robot when it's connected to a device or network via ethernet. Ethernet Mode will 'remember' the passphrase set for the wireless access point in Access Point Mode. Ethernet connections are also possible in Access Point Mode and Wi-Fi Mode, but IP settings for the robot will return to default.



Updating the Robot

Download the latest Eva software and firmware packages from <https://automata.tech>.

To update the robot, navigate to the config page of Choreograph and take ownership.

Drag and drop the relevant robot update package (or select 'upload and install') to the Software Update section of the page. Confirm the update by clicking 'Yes'. You will be disconnected.

Do not attempt to operate the robot or use Choreograph until the update is complete. **Never unplug the robot while updating.**

As long as Eva remains online and errorless, it will execute any valid instruction from the device (such as a computer or tablet) with **Robot Ownership**.

The simplest way to take ownership and send instructions to the robot is with Choreograph – a simple user interface accessible with your web browser.

Engaging the **lock button** on the main **Choreograph** toolbar claims ownership and prevents any other device from doing the same, until the lock is disengaged or the user is idle for five minutes.



Choreograph provides a **Dashboard** and a **Viewer** for manipulating a 3D virtual robot, which the physical robot can imitate.

Many programs require no code at all from the user. Choreograph can instruct the robot to execute a single **Toolpath** indefinitely, or for a fixed number of cycles. Toolpaths consist of a series of **Waypoints** along a **Timeline**, each specifying a position and orientation for the robot's toolplate.

Advanced programs might involve multiple toolpaths, triggered by certain conditions, and some applications might circumvent toolpaths entirely, relying instead on rotating individual joints by a specific number of degrees.

Either can be achieved by writing code that sends API requests to the robot. In these cases, Choreograph still serves as a handy tool for monitoring the robot and managing user permissions.

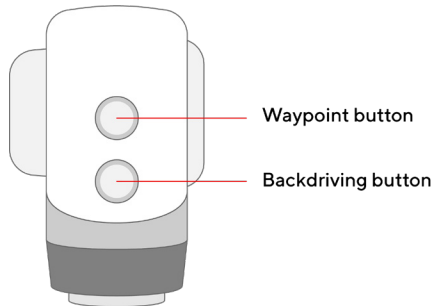
Waypoints

There are three ways to create waypoints:

Press and hold the **backdriving button** on the head to release the brakes and physically manipulate the robot into a desired position.

Release this button and press the **waypoint button** to create a waypoint. This will be picked up by the device with **robot ownership** (see: Installing the robot - Powering On and Connecting).

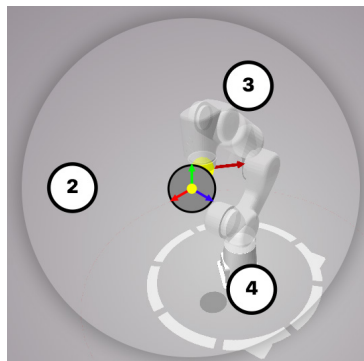
1. Teach by example



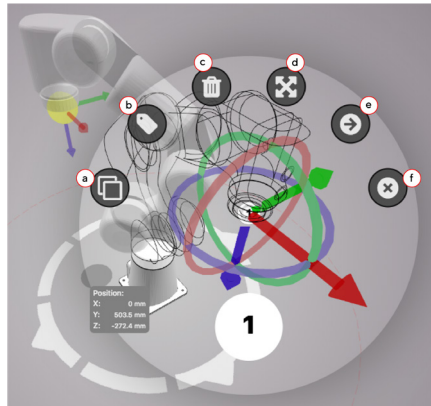
*For instance, if a user has taken robot ownership with Choreograph, the new waypoint will appear in the **3D workspace** of the **viewer**, at the current robot position. The waypoint will become visible when the robot moves to a new location.*

2. Manipulate existing waypoints

Click on a waypoint in the 3D Workspace of the Choreograph Viewer to select it. If multiple waypoints, or the yellow **gizmo sphere**, are nearby, a wheel menu will open. Use this menu to specify which waypoint you intend to select:



When a waypoint is selected, a new wheel menu will open:



These icons:

- a. Make a **copy** of the waypoint
- b. Add a text **label** to the waypoint
- c. **Delete** the waypoint
- d. Move the waypoint to a new **absolute position** specified by XYZ coordinates, relative to the base of the robot
- e. **Move** the robot (real or virtual, depending on ownership) to this waypoint
- f. **Close** the menu

At the bottom of the menu, the waypoint icon can be clicked and dragged into the **timeline** (see **Populating the Timeline**).

Besides setting **absolute position** (d. In the wheel menu), waypoints can also be moved with **gizmo controls**. These are represented as red, green and blue gimbals which can be rotated, and axes which can be shifted. This is achieved in both cases by clicking and dragging.

Alternatively, double click an axis or gimbal to specify movement by a certain number of millimetres or degrees.

3. Off-the-robot Programming

Even if Choreograph is 'unlocked' and does not have robot ownership, it remains connected to the robot. In this mode, it's possible to work on toolpaths without being affected by the movement of the real robot.

Regardless of whether Choreograph has robot ownership, selecting any part of the robot in the 3D Workspace allows the user to create a waypoint at the virtual robot's current position.

If Choreograph does not have robot ownership, the virtual robot can be manipulated independently:

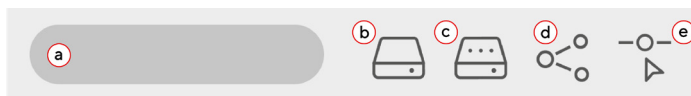
- a. Selecting the yellow positioning sphere at the end of the toolplate provides access to the same gizmo controls that are used to move waypoints
- b. Selecting any part of the robot and clicking the Absolute Position icon opens the same coordinate input controls that are used to move waypoints
- c. Selecting any joint of the robot allows the user to rotate that joint individually by clicking and dragging

The Timeline

Click on the tab in the bottom left corner of the Choreograph Viewer to reveal the Timeline at the bottom of the screen. The timeline reflects the actual actions Eva will take when the current toolpath is uploaded and executed. Any waypoints in the 3D viewer that are not present on the timeline will not affect the real robot, although they will be saved along with the timeline in the toolpath file.

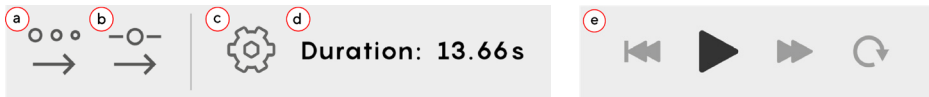
To add a waypoint to the timeline, select a waypoint in the 3D workspace, and click and drag its icon onto the timeline. Waypoints can be rearranged by dragging them into desired positions along the timeline.

The top left controls above the timeline deal with the file system:



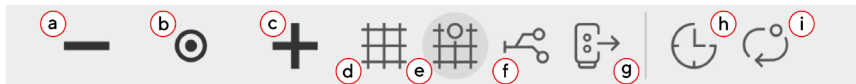
- a. **Name** the current toolpath
- b. **Save** the toolpath
- c. **Save** the toolpath **as** a new file
- d. **Share** the toolpath with another user
- e. Close the current toolpath and return to the **toolpath selection** screen

The remainder of this toolbar deals with the properties of the toolpath:



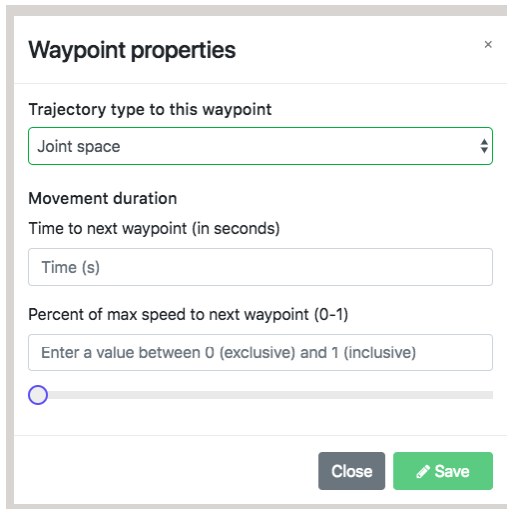
- a. **Reassign numbers** to waypoints based on the order in which they were created
- b. **Reassign numbers** to waypoints based on the order they first appear on the timeline
- c. Open the **toolpath settings** menu, dealing with global speed and analog I/O modes
- d. The **total duration** of the timeline is displayed, based on current settings
- e. **Simulate** the toolpath; restart, play, skip or loop the timeline (**Off-the-robot** only) Beneath this toolbar is a timeline slider that can be dragged to simulate the toolpath.

Beneath the timeline slider is a toolbar that deals with special waypoints and views:



- a. **Zoom out** from the timeline
- b. **Restore** the timeline to its default view
- c. **Zoom in** to the timeline
(note: navigate by clicking and dragging in empty space on the timeline)
Drag into the timeline to create a **grid loop sequence**
- d. Drag into a grid branch to create a **grid waypoint**
- e. Drag into the timeline to create a **conditional branch**
- f. Drag into the timeline to create an **I/O action**
- g. Drag into the timeline to create a **wait action**
- h. Drag into a conditional loop branch to create a **restart action**
- i. (note: see **Programming with Choreograph** for information on grids and conditions)

Right click on any waypoint in the timeline to change its properties:

A screenshot of a 'Waypoint properties' dialog box. The title bar says 'Waypoint properties' with a close button (X) on the right. The first section is 'Trajectory type to this waypoint' with a dropdown menu showing 'Joint space'. The second section is 'Movement duration' with the label 'Time to next waypoint (in seconds)' and a text input field containing 'Time (s)'. The third section is 'Percent of max speed to next waypoint (0-1)' with a text input field containing 'Enter a value between 0 (exclusive) and 1 (inclusive)' and a slider below it. The slider has a blue circle at the left end. At the bottom right are two buttons: 'Close' and 'Save' (with a pencil icon).

There are three **types of trajectories** between waypoints:

- a. **Joint Space** trajectories - represented by **circles** on the timeline - instruct the robot to move to the waypoint in a way that is 'natural' for the joints
- b. **Linear** trajectories - represented by **squares** on the timeline - instruct the robot to move its end-effector to the waypoint in a straight line. This results in cartesian motion
- c. **Pass Through** trajectories - represented by **triangles** on the timeline - instruct the robot to pass through a waypoint without stopping. This results in cartesian motion

The **speed of a single trajectory** can be defined in one of two ways:

- a. By defining a duration for the trajectory, in seconds.
- b. By assigning a scale factor in relation to maximum robot speed.
(note: individual trajectory speeds override global speed. Setting a scale factor greater than 0.33 may result in speeds greater than 250 mm per second. This kind of motion is not considered safe for desktop operations. Consult the Safety Manual for more information.)

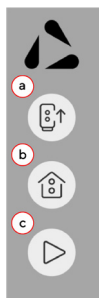
Special waypoints have their own set of properties to define, some of which do not relate to movement trajectories.

Executing and Monitoring Toolpaths

When Choreograph has **robot ownership**, it can send instructions to the robot.

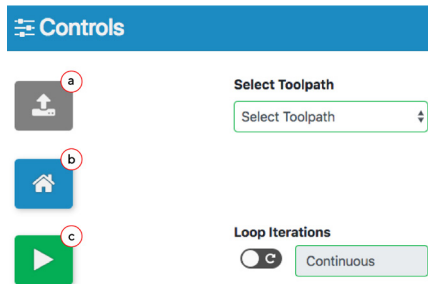
Note that the **active toolpath** in the robot memory is not necessarily the same as the toolpath shown in Choreograph. New toolpaths must be uploaded to the robot memory before they can be executed.

The robot owner has access to a small control panel on the left hand side of the **viewer**. These controls:



- Upload the toolpath shown in the viewer to the robot memory. This will overwrite any toolpath currently remembered by the robot.
- Instruct the robot to return to the starting point of the toolpath in its memory.
- Execute the toolpath in robot memory.

The same controls are available in the **dashboard**, along with information about the robot's status and a toolpath selection menu:

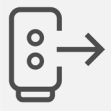


By default, Choreograph will instruct the robot to repeat the toolpath continuously. Toggle the **Loop Iterations** slider to specify a certain number of cycles to run the toolpath. Looping is only possible for toolpaths that start and end on the same waypoint.

When the robot is running, a **pause** button and an **end** button become available on both control panels. It is **not recommended** to use the pause button at high speeds (greater than 0.33), as this will result in a hard stop and repeated use may result in damage to the brakes. The end button will allow the robot to finish its current loop before coming to a stop.

Programming with Choreograph

Communicating with other devices

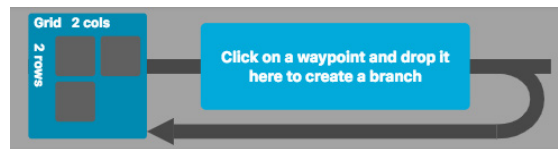


Dragging the output icon onto the timeline opens a dialog box, asking for a specific electronic output pin and a value. When the toolpath is executed and this waypoint is reached, your chosen signal will be sent to this pin.

Some tools require signals from more than one pin to take action. For instance, a gripper might open when it receives a 0 at [input a] and a 1 at [input b]; and close when it receives a 1 at [input a] and a 0 at [input b].



Dragging the grid icon onto the timeline opens a dialog box, asking for the number of rows and columns in your grid. This creates a new grid loop:



There are always three slots in the **grid properties** function. Fill these slots with waypoints to specify the first position of the grid, the **final position on the first row**, and the **first position on the final row**. A plane will appear in the 3D workspace to visually represent the new grid.



Drag a **grid waypoint** from the special waypoints toolbar onto the higher branch of the grid loop to specify the point in time when the robot should move to a grid position. When the toolpath is executed, the loop will be repeated the same number of times as grid positions (eg: a 3x3 grid will iterate 9 times). In each iteration, the grid waypoint specifies a new position, completing each row before moving to the next.

Right click on a grid waypoint to modify its properties, including specifying a **z offset**. This function sets the waypoint to a position a certain number of millimetres **above** the grid position (or below if using a negative value).

Drag additional waypoints to the grid loop to complete the toolpath.

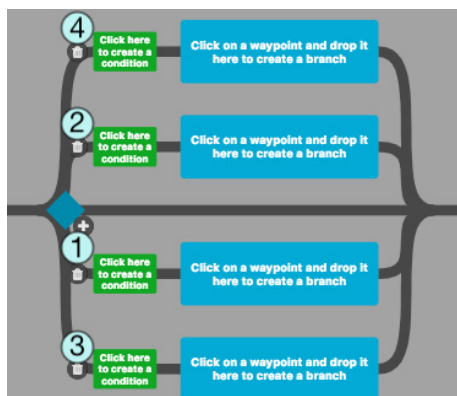
Conditional Branches

Dragging the conditional branch icon onto the timeline creates a new branch, starting with a **conditional waypoint**.



If the condition is **true**, any waypoints along this branch will be executed. If the condition is **false**, the branch will be skipped (ie: the central, empty branch will be chosen).

It's also possible to add or remove additional branches to the same tree, using the plus and delete icons respectively. If several conditions are true, the branch that was **created first** will be executed, and the other branches will be skipped. Eg: If there are four branches, they will be evaluated in the order shown to the right, and only the first branch to return 'yes' to the condition will be executed.



Restart waypoints can also be added to conditional branches, instructing the robot to execute the toolpath again from the beginning.

Programming with the API

After setting up Eva for the first time with Choreograph and creating a user profile, it's possible to generate an API token from the user profile menu.

A quality control application could be programmed as follows:

A) Use Choreograph to create and save three toolpaths:

- i)** Picking up a component and showing it to a measuring device.
- ii)** Moving the component to the 'good' drawer
- iii)** Moving the component to the 'bad' drawer

B) Write code that:

- i)** Calls the API to execute toolpath 1
- ii)** Waits for information from the measuring device
- iii)** Calls the API call to execute toolpath 2 or 3 depending on the result
- iv)** Repeats

C) Run the program

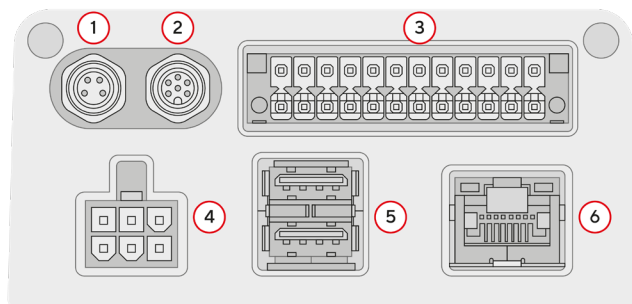
Visit <https://automata.tech> for up-to-date API documentation

The main robot computer is stored in the base. Physical controls are available on the rear.

Power Button

The robot power button is found above the Input/Output panel.

Input/Output Panel




Key:

1. Emergency Stop Connection
2. Unused (reserved for future expansion)
3. Base I/O
4. Power Input
5. USB x 2
6. Ethernet

1. Emergency Stop Connection

Please consult the **safety manual** for information about the appropriate installation of Eva's emergency stop function.

This port is designed for a DPDT, 2NC e-stop push button switch conforming to IEC 60947-5-5, such as the button provided with Eva, or the **ABB CEPY1-1001**. The interface is a standard A-coded circular M8 female connector (IEC 61076-2-104). The pinout can be seen below

M8 Connector Pin	Colour	PIN Function	<div>PIN</div> 
1	Brown	Eb_24V	
2	White	Eb -E- Stop Channel A	
3	Blue	Ea -E-Stop Channel B	
4	Black	Ea_24V	

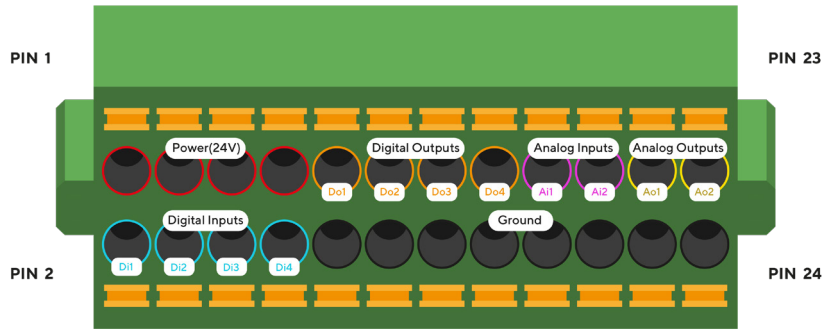
2. Reserved Stop Connection

This port is not in use, and is reserved for future expansion.

Download the latest software, along with the latest version of this manual from <https://automata.tech>.

3. Base I/O

The connector pins are spring terminated. Press and hold the orange tab to retract the spring and insert a stripped wire end, then release the orange tab to engage the spring and lock the wire in place. The connector is designed for use with 16 - 24 AWG wire.



A) Power

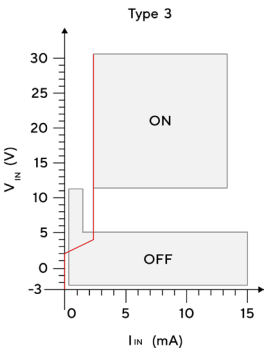
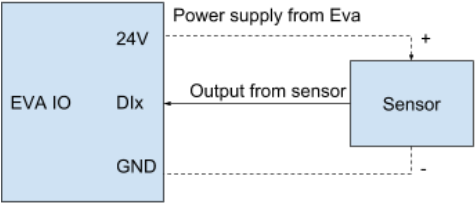
There are four 24 V power pins on the base I/O, which can collectively source a maximum of 1.875 A. These are found in the first four columns of the top row:

24 V (Pin 1)	24 V (Pin 3)	24 V (Pin 5)	24 V (Pin 7)
Base Di1 (Pin 2)	Base Di1 (Pin 4)	Base Di1 (Pin 6)	Base Di1 (Pin 8)

B) Digital Inputs

Beneath the power pins are four digital input pins. These are 24 V IEC 61131-2 Type-3 current sinking inputs, for use with PNP type sensors or outputs.

The robot and the outputting device should share a common ground, to ensure all signals are referenced to the same level.



Signal	Min	Typ	Max
V_{IABS} Absolute max input voltage	-60V	-	60V
V_I Typical input voltage range	-3V	-	30V
V_{IL} Low level threshold voltage for input transitioning from high to low	8.53V	9.26V	10.5V
V_{IH} High level threshold voltage for input transitioning from low to high	9.88V	10.46V	11.10V
I_I Current (high input)	2.05mA	-	2.56mA

C) Digital Outputs

There are four 24 V IEC61131-2 sourcing output pins on the base I/O, accompanied by four ground pins:

Base Do1 (Pin9)	Base Do2 (Pin 11)	Base Do3 (Pin 13)	Base Do4 (Pin 15)
GND (Pin 10)	GND (Pin 12)	GND (Pin 14)	GND (Pin 16)

These general purpose digital outputs can source up to 625 mA of current. They can be used to drive equipment like electromagnetic relays directly or for communication with other PLC systems.

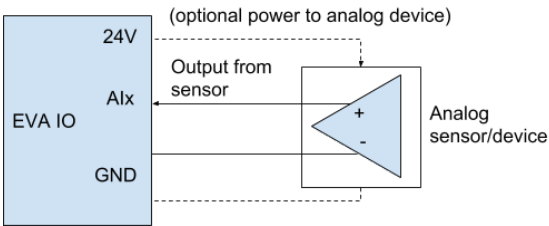
Signal	Min	Typ	Max
Voltage Output		24V	
I _{OB} Current (Base outputs)	0	-	625 mA
I _{OT} Current (Tool outputs)	0	-	100 mA

D) Analog Inputs

There are two non-differential, single ended analog inputs on the base I/O, able to measure a signal in current (4 – 20 mA) or voltage mode (0 – 10 V). The mode can be specified through Choreograph, or via API calls.

Base Ai (Pin 17)	Base Ai2 (Pin 19)
GND (Pin 18)	GND (Pin 20)

These inputs could, for example, be used to monitor the output of an analog position sensor, detecting if an object ready for picking. The robot and the sensor should share a common ground, to ensure all signals are referenced to the same level.



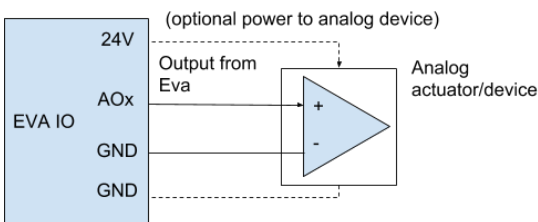
Signal	Min	Typ	Max
ADC Resolution	-	11-bit	-
V _{AVMAX} Voltage mode absolute max inputs	-0.3	-	26V
V _{AV} Voltage mode inputs	0V	-	10V
Voltage mode input resistance		~100kΩ	
I _{AIMAX} Current mode max input	-	-	30mA
I _{AI} Current mode inputs	4mA	-	20mA
Current mode input resistance		265Ω	320Ω

E) Analog Outputs

There are two non-differential, single ended analog outputs on the base I/O, configurable as current (4 - 20 mA) or voltage (0 - 10 V) mode. The mode can be specified in Choreograph, or via API calls.

Base Ao1 (Pin21)	Base Ao2 (Pin 23)
GND (Pin 23)	GND (Pin 24)

They can, for example, be used to control a gripper with an analog position control input.



Signal	Min	Typ	Max
DAC Resolution	-	12-bit	-
V_{AV} Voltage mode outputs	0V	-	10V
I_{AI} Current mode outputs	4mA	-	20mA

Advice for getting a clean analog signal:

- Current mode will usually be more immune to noise than voltage mode
- Use screened cable to improve noise immunity. Ground the screen at one side only
- Keep connections as short as possible, with a maximum length of 3 m
- Connect to the ground pin closest to the analog I/O on the robot

4. Power Input

Plug Eva into an RCD-protected ordinary mains socket with the provided power supply. It has the following specifications:

Meanwell GST280A24 - C6P

100-240 VAC

50/60 Hz

Output: 24 V, 11.67 A, 280 W MAX

5. USB x 2

These ports are not in use, and are reserved for future expansion.

6. Ethernet

This port is used to connect the robot to a local area network, or directly to a computer or another controller. It uses a standard RJ45 connection and transfers data at 100 Mbps.

The robot also creates its own wireless access point by default, and after first time setup it can be configured to connect to your local wifi network with its own static IP. See **Installing the Robot: Powering On and Connecting** for more information.

Head Interface

Eva's head features two control buttons and a tool port.

Control Buttons

1. Backdriving Button

Press and hold the button closest to the toolplate to enable backdriving mode. All robot joints can be manipulated by hand as long as the button remains depressed.

2. Waypoint Button

Press the button farthest from the toolplate to save the robot's current position and orientation as a waypoint. The waypoint will be picked up by any device with **robot ownership**.

The control buttons are each surrounded by an LED ring. The colours of these rings indicate robot status:

- Both lights white** = System Idle
- Both lights green** = Toolpath Running
- Backdriving button green, Waypoint button white** = Backdriving Mode
- Both lights yellow** = Fault detected

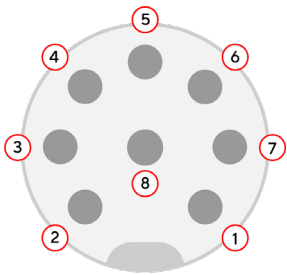
Tool Port

The tool port uses a circular M8 female connector. It mates with a standard M8 circular male connector, for example the Phoenix Contact 1404178

Available from distributors such as:

- Digi-Key 277-12798-ND
- Mouser 651-1404178
- RS Components 861-0762

PIN	Function
1	Analog Input 1
2	Analog Input 2
3	Digital Input 1
4	Digital Input 2
5	POWER (+24V)
6	Digital Input 1
7	Digital Input 2
8	Tool GND (OV)



The tool port shares a common ground with the base I/O. Ensure all signals connected to the tool port are referenced to the same level. Care must be taken to control ground paths when measuring analog signals.

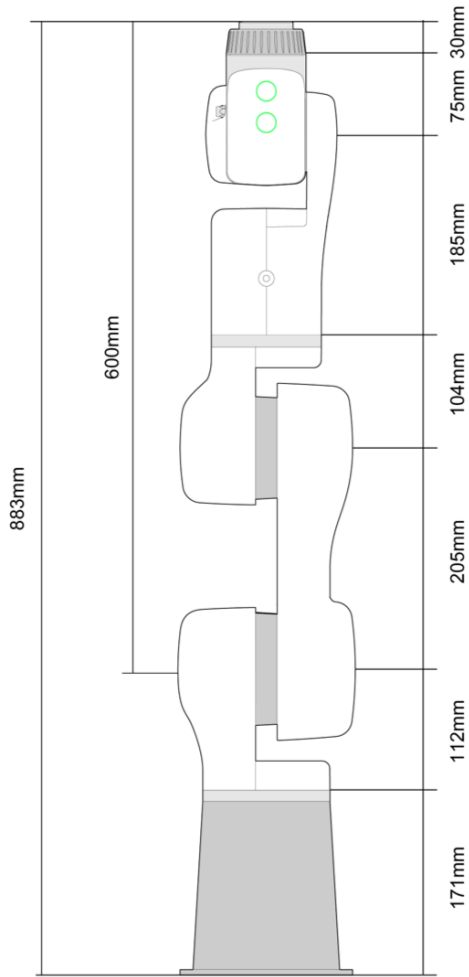
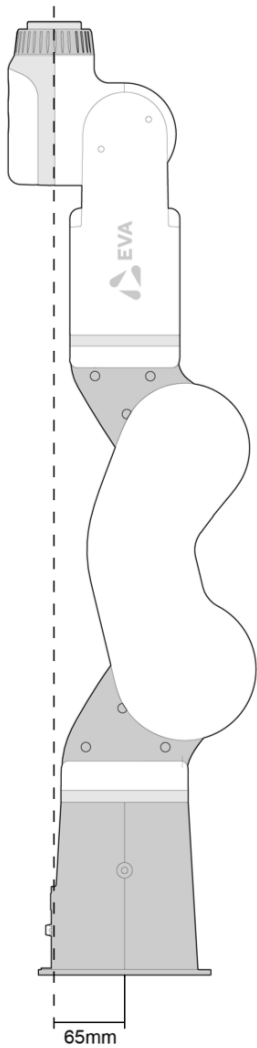
The digital output and analog input pins on the head I/O are configured differently from the pins on the base I/O.

The two digital output pins can source 100 mA of current each, while the single 24 V power pin on the tool port can source a maximum of 1 A. This is shared with the digital outputs and so there may be less than 1 A available at the 24 V pin depending on your configuration.

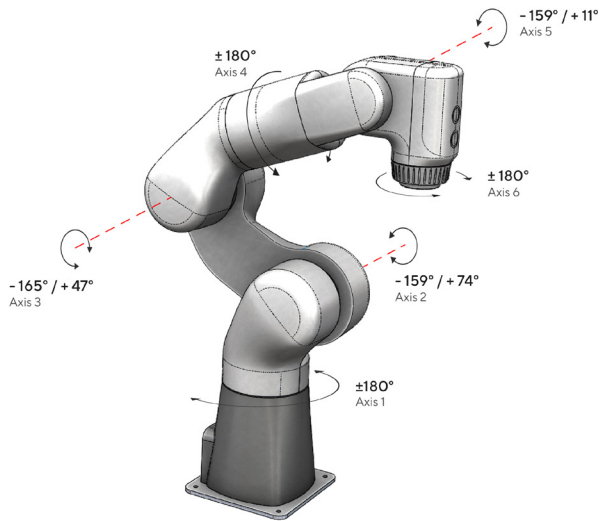
Digital outputs are protected from over-current damage with a Positive Temperature Coefficient (PTC) resistor. If an overcurrent event occurs you may need to wait for the PTC to cool for 10 minutes before outputs can be used again.

The two analog input pins can only measure in voltage mode. They are configured as follows:

Signal	Min	Typ	Max
ADC Resolution	-	16-bit	-
V _{AVMAX} Voltage mode absolute max inputs	-0.3V	-	32V
V _{AV} Voltage mode inputs	0V	-	24V
Input Resistance		~51kΩ	



Eva achieves movement and maintains its position with six revolute joints:



Each axis has its own mechanical brakes. These are engaged by default, and disengaged when the robot is instructed to move.

A manual brake release is present in axes 2, 3 and 5. Consult the safety manual to learn how to carry out this procedure.

Ratings and Limitations

Eva should always be installed upright to ensure appropriate performance. Due to its six axes, the robot has six degrees of freedom; this allows it to travel through x, y, and z axes as well as turning around each axis.

The robot weighs 9.5 kg, has a repeatability of ± 0.5 mm, a maximum payload of 1.25 kg and a reach of 600 mm. The joints have a maximum velocity of 120° per second, which allows the head of the robot to move up to 750 mm per second. The maximum speed for desktop operations is 250 mm per second, as per ISO 10218. Consult the safety manual for information on setting an appropriate speed for your application.

The ingress protection rating of the robot enclosure is IP20. This means it's protected against solid, foreign objects larger than 12 mm wide entering the robot and causing hazards or damage. The enclosure offers no protection from the ingress of harmful liquids. It's therefore essential to keep the workspace dry and dust free.

Eva's peak power consumption is 280 W. Power is sourced from a 24 VDC power supply.

Beside the hard limits specified for each axis above, the robot software is programmed to resist movement as it approaches these limits.

Consult the safety manual for information on environmental ratings.

05 Getting the most of EVA

- When programming precise applications, mathematics is likely to give better results than backdriving and relying on the human eye
- Individual toolpaths can be exported as Base64, decoded into Javascript, edited and imported back to the robot computer
- Don't backdrive aggressively - this could cause a hard stop and wear out the solenoids over time
- To prolong robot life, avoid manually shaking the joints. When not in use, don't store the robot in positions where there is additional stress on the joints



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