

KINOVA

Together in robotics



Link 6 user guide

Optional gripper shown

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Disclaimer for the document

Link 6 is an evolving product. Kinova continually works towards improving the reliability and performance of its products. Kinova does its best to ensure the content of the Link 6 user guide is accurate and precise with respect to the latest version of the robot. However, Kinova does not take responsibility for any erroneous or missing information.

Certain aspects of the Link 6 user guide may appear differently from what is installed in your environment. Differences include, but are not limited to, the color and finishing of the robot.



Note: The user guide may be updated from time to time. Please make sure to look at the latest version on the website.

The version of this document is in the header of the pages of the document.

Abbreviations

AC	alternating current
AWG	American Wire Gauge
BCD	Binary Coded Decimal
cUL	tested to Canadian standards by Underwriters' Laboratories
DC	direct current
DoF	degrees of freedom
DIN	Deutsches Institut für Normung
EFT	Electrical Fast Transient
EFT/B	refer to <i>EFT</i>
ESD	electrostatic discharge
EMI	electromagnetic interference
E-stop	emergency stop
GPU	graphics processing unit
GUI	Graphical User Interface
I/O	input output
IEC	International Electrotechnical Commission
LSB	Least Significant Bit
MCU	Main Control Unit
MPU	Main Processing Unit
NPN	Negative logic
NC	Normally Closed
OSSD	Output Signal Switching Device
PCB	printed circuit board
PLC	programmable logic controller
PLd	Performance Level d
PE	protective earth
RTU	remote terminal unit
stop category	stop category
SCU	Safety Control Unit
SWU	a file format, used by Kinova, to package firmware updates
TCP	Tool Center Point
TCP/IP	Transmission Control Protocol/Internet Protocol
USB	Universal Serial Bus

UL

Underwriters Laboratories

Link 6

The Link 6 is an [arm](#) with six *degrees of freedom (DoF)*, a powerful [controller](#), and a Kinova [teach pendant](#). It works under the Kortex software framework and [the Web App](#). The Web App works on the teach pendant and from a web browser on a remote computer.

Each axis is a joint and the part of the arm between each joint is a link. The robot parts from base to wrist are referred to as the arm. The arm has six parts.

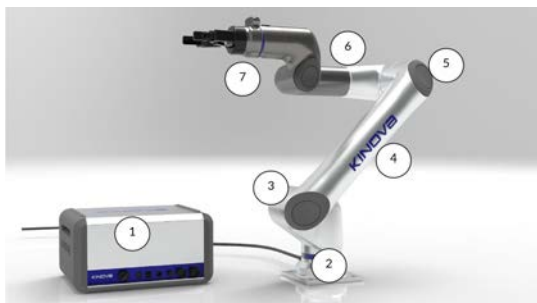


Figure 1: Link 6

- 1 Controller
- 2 Base
- 3 Shoulder
- 4 Arm
- 5 Elbow
- 6 Forearm
- 7 Wrist
- 8 Teach pendant (not shown)

The robot can be manipulated by one hand. The wrist has a set of buttons on it that are used for toggling between *Cartesian* and Joint Hand Guiding, waypoint capturing, moving the arm, and [end effector](#) actions. With these buttons on the wrist, it is easy to teach the robot the movements it needs to learn.

Thanks to the modular design of the robot, a variety of optional interfaces are available to connect end effectors. Each of these optional interfaces has no visible cables. Also, Kinova offers a variety of optional parts.

- Kinova wall mount kit attaches the controller to walls.
- Graphics card kit is required, in some cases, for cameras and the vision module.
- Robotiq Adapter attaches directly to the wrist and is compatible with Robotiq tools.
- Gigabit Ethernet Adapter [flange](#) attaches directly to the wrist and is compatible with third-party Vision adapters.
- The flange attaches to the OnRobot ISO adapter, as well as the OnRobot RG2 Gripper.
- [Emergency stop](#) attaches to the controller.
- [Enabling device](#) attaches to the controller.

The end of the arm has a force torque sensor built into it. With the force torque sensor, hand guiding Link 6 is smooth.

At the end of the arm is an end effector. The end effector may be a gripper, polishing disk, nail gun, screwdriver, tool changer, and so on. It is the only part of the robot that is in direct contact with the piece being manipulated.

The controller can be considered the brain of the robot. It is stored on an accessible location on the floor, table, wall, or in a cabinet; store it wherever it makes it easy to power on or off the robot. Some installations of the controller require the optional Kinova wall mount kit.

Related topics

[Components](#) on page 14

[Accessories](#) on page 203

Intended use

Link 6 is intended for typical industrial applications to manipulate objects and tools in a non-explosive environment.

To ensure safe operation for all intended uses, perform a risk assessment and mitigate all the risks to a safe, acceptable level. Use the robot in industrial applications only and within the stated specifications.

There are many different types of industrial applications in which Link 6 can be used.

- Material handling
- Small parts assembly
- Machine tending
- Packaging
- Palletizing
- Bin picking
- Screw driving



Important: The list of industrial applications is not exhaustive.

Related topics

[Safety](#) on page 47

Unintended uses

Link 6 is not intended to work in certain applications because it can damage the robot system, or lead to serious injury to, or death of, the user.

Kinova is not responsible for any damage caused to the robot system when the robot is not used as intended.

There are many different types of industrial applications in which Link 6 cannot be used.

- Flammable environments
- Radioactive environments
- Liquid environments, including water
- Outdoor climate conditions
- Medical applications
- Life critical applications

There also are a number of uses that can damage the robot and cause injury or death.

- Using the robot without first performing a risk assessment
- Climbing on the robot while it is in its box or on the robot when it is not in its box
- Standing on the controller
- Placing liquids, such as cups of coffee or tea, directly on the controller



Important: The lists of unintended uses is not exhaustive. There are many more unintended uses that are not cited.



Notice: Kinova assumes no liability of any kind if safety measures are not followed. Please read all the information concerning this product before using it.

Warranty information

Subject to the terms of this clause, Kinova warrants to the End User that the Products are free from defects in materials and workmanship that materially affect their performance for a period of twelve (12) months from the date Kinova ships the Products to the End User, known as the "Delivery Date".

Kinova agrees to repair or replace, at Kinova's discretion, all Products that fail to conform to the relevant warranty provided that:

1. notification of the defect is received by Kinova within the specified warranty period;
2. the allegedly defective Products are returned to Kinova, at the End User's expense, with prior authorization from Kinova within thirty (30) days of the defect becoming apparent;
3. the Products have not been altered, modified, or subject to misuse, incorrect installation or maintenance, neglect, accident, or damage caused by excessive current or having been used with incompatible parts;
4. the End User is not in default under any of its obligations under this Agreement;
5. replaced Products must have the benefit of the applicable warranty for the remainder of the applicable warranty period.

If Kinova diligently repairs or replaces the Products in accordance with this section, it will be deemed to have no further liability for a breach of the relevant warranty.

Allegedly defective Products returned to Kinova in accordance with this contract will be returned to the End User if found by Kinova on examination not to be defective. Kinova may charge a fee for examination and testing. The warranty cannot be assigned or transferred, and is to the sole benefit of the End User. Where the Products have been manufactured and supplied to Kinova by a third party, any warranty granted to Kinova in respect of the Products may be passed on to the End User. Kinova is entitled in its absolute discretion to refund the price of the defective Products in the event that such price has already been paid.

Technical specifications

The Link 6 is a modern, robust, and collaborative-capable robot for all industries that want to benefit from automation.

Table 1: General

Degrees of freedom (DoF)	6
Continuous payload (full range, at 200 mm from wrist, for optimal performance)	6.0 kg
Maximum semi-dextrous reach	1000 mm
Maximum Cartesian translation speed	1.65 m/s
Repeatability according to ISO 9283 specification	up to 0.1 mm
Power supply voltage and frequency	110-240 VAC, 50 Hz - 60 Hz
Recommended circuit breaker rating	15 A at 120 VAC 7.5 A at 240 VAC
Ingress protection rating (arm and controller)	IP54
Ambient operating temperature	0 °C to 40 °C
Arm weight (with 5 m cable)	23.45 kg
Arm materials	Aluminum, ABS plastic
Installation orientation	All
Acoustic noise level	70 dBA
Robot base footprint diameter	149 mm
Lifetime	35000 hrs

Table 2: Integrated force torque sensor

Range force/torque Fx, Fy, Fz, Tx, Ty, Tz	200 N / 20 N·m
Repeatability force/torque Fx, Fy, Fz, Tx, Ty, Tz	0.5 N / 0.05 N·m

Table 3: Actuators

Joint 1, 2, 3 range	± 360°, 120 °/s
Joint 4, 5, 6 range	± 360°, 300 °/s
Actuators sensors	Redundant position, current, voltage and estimated torque

Table 4: Interfaces

Software	Kinova [®] Kortex [™] API
----------	---

Programming	Visual programming, Python, ROS, C++
Controller interfaces	USB 3.0, Ethernet
Controller I/O	Digital: 16 inputs (8 redundant safe), 16 outputs (8 redundant safe)
	General purpose analog: 4 programmable input/output
	General purpose digital: 8 inputs, 8 outputs
Wrist I/O	Digital: 8 programmable input/output
	Analog: 2 programmable input/output
	RS-485, Gigabit Ethernet, 24 V supply @ 4 A
Wrist - Mechanical	Flange ISO 9409-1-50-4-M6

Table 5: Controller

Controller dimensions (without covers, feet, and protrusions)	454 mm x 208 mm x 395 mm
Controller dimensions (with covers; without feet and protrusions)	
Controller weight (approx.)	17.6 kg
Processor	Intel® Core™ i7 processor ¹
Optional GPU	Up to NVIDIA RTX™ 3090
Memory	RAM: 8 GB DDR4
	Storage: 128 GB SSD

Table 6: Teach pendant

General	12.1", touch capacitive, IP54
Weight (approx.)	2 kg

Table 7: Safety

Notice: All safety specifications are currently in progress.

Certification	Developed according to UL1740, as well as ISO 10218-1:2011, and EU directives
Safety functions	All safety functions <i>PLd</i> Cat3 (developed according to ISO 13849-1/-2:2015)

Table 8: Main accessories (optional parts)

Vision module	Up to: 1920 x 1080 @ 30 fps with FOV 65° ± 3°
----------------------	---

¹ Intel, the Intel logo, and Intel Core are trademarks of Intel Corporation or its subsidiaries.

	Focusing range: 30+ cm
	0.6 kg
Tool adapters with mounting hardware	Robotiq, OnRobot, Gigabit Ethernet
	0.2 kg
Controller wall mount kit	1 kg
E-Stop button	0.2 kg

Related topics

[Accessories](#) on page 203

Schematics and dimensions

The dimensions of the [arm](#) and the [controller](#) are important for integration purposes. The arm must be placed such that it can reach the start and end locations of the objects.



Remember: Add the height of the [end effector](#) and its required workspace to Link 6, as well as the height of the surface on which the base is installed, for an accurate assessment of the amount of space required to install a robot.

Each joint can turn as much as +360° and -360°. Trying to turn more than that when manually [backdriving](#) the robot can break the internal wiring. The maximum amount each joint can turn can be modified on the **Joint Limits** in [the Web App](#).

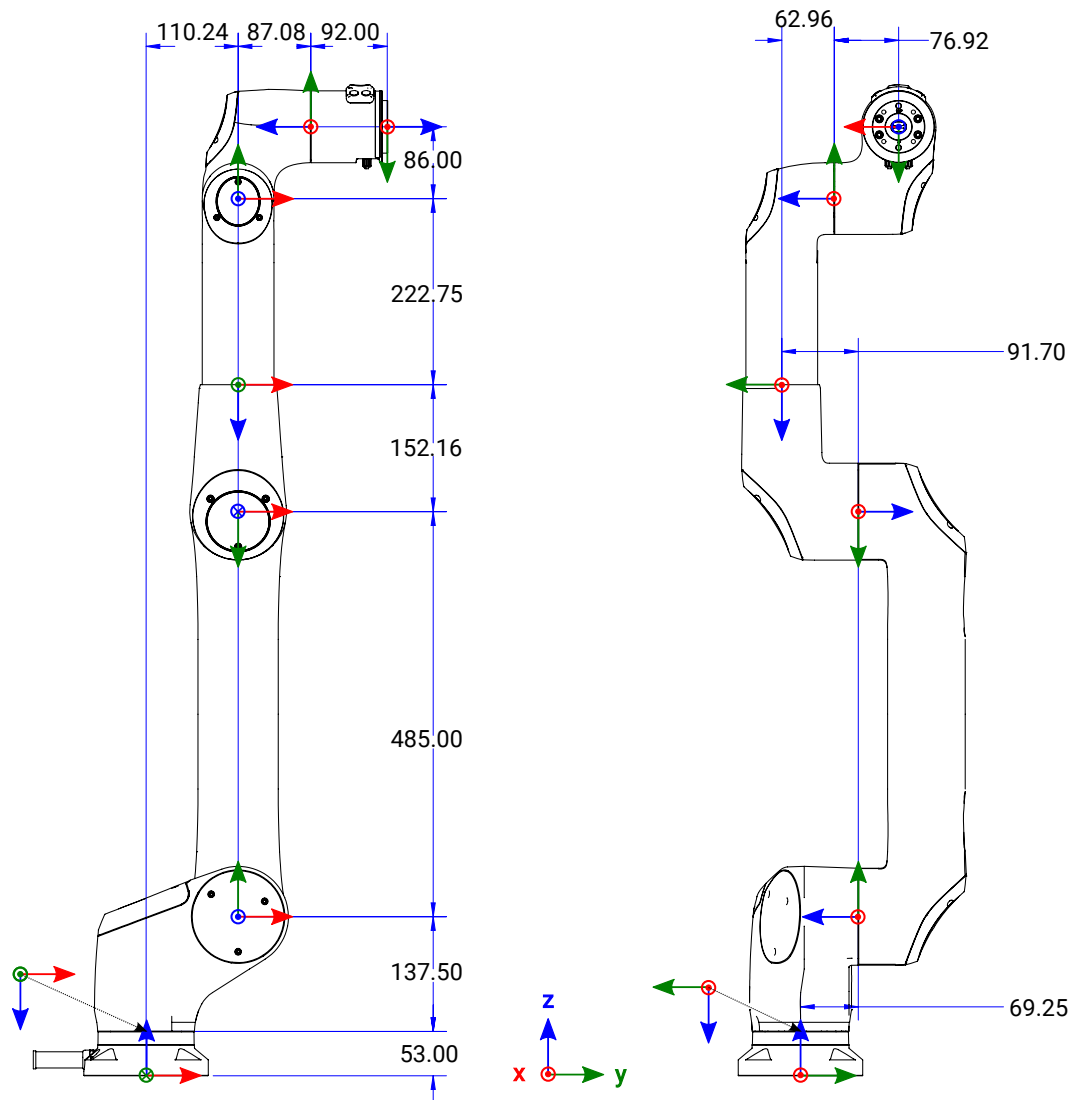


Figure 2: Arm dimensions in millimeters

The controller is a box that sits on a table, floor, wall, or in a cabinet near the arm.



Note: To install the controller in a cabinet or on a wall, use the Kinova wall mount. The wall mount is an optional accessory.

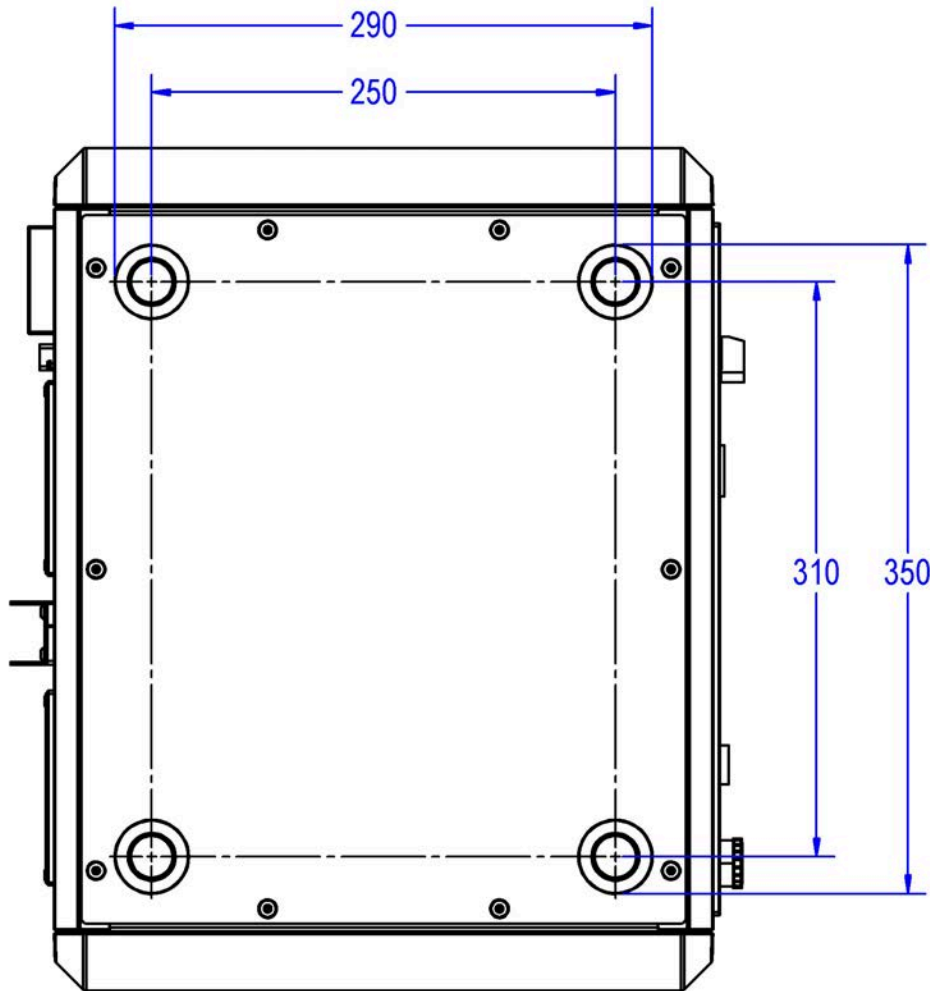


Figure 3: Controller dimensions in millimeters: Bottom view

Related topics

[Safety directives and warnings](#) on page 47

[Move robot arm without power](#) on page 52

[Joint limits](#) on page 59

[Controller wall mount](#) on page 203

Effective workspace

Link 6 requires enough space to work optimally without interference from other equipment and people when it is being integrated. The workspace can be limited by the [the Web App](#) when the robot is used in a restricted environment.

The space used by the robot is spherical. Take the spherical aspect of the recommended reach and maximum working area into account when integrating the robot so that Link 6 is used for optimal performance.

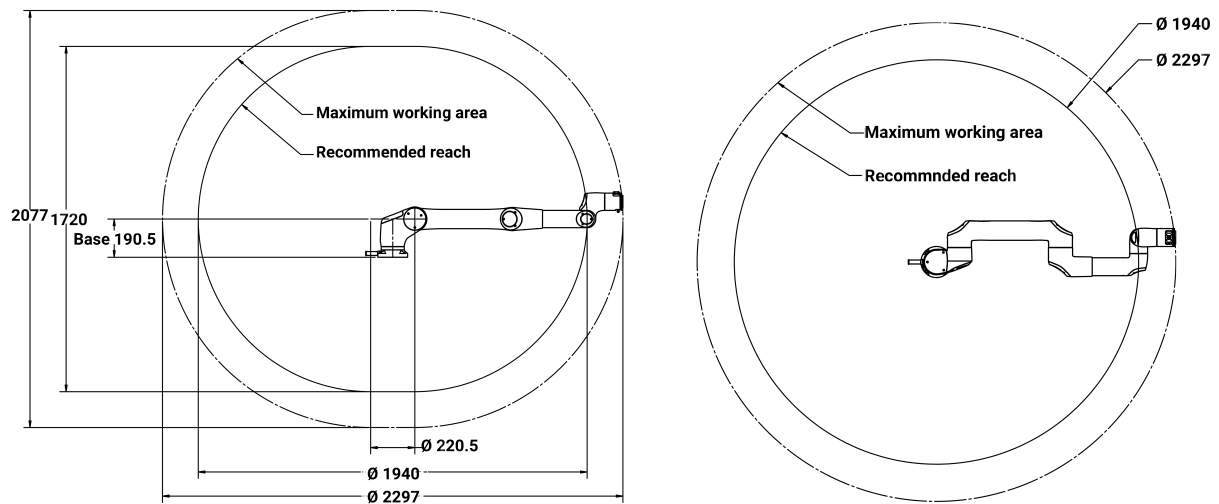


Figure 4: Recommended reach and maximum working area, vertical and horizontal

Components

Each component of Link 6 can be considered as modular parts of the robot; each one has its specific role to play in the overall functionality.

There are several main components that make the robotic arm.

- [Base](#)
- [Actuators](#)
- [Wrist](#)
- [Controller](#)
- [Teach pendant](#)
- [Industrial I/O panel](#)
- [Wrist I/O](#)

Related topics

[Link 6](#) on page 5

Base

The [base](#) is mainly a mounting interface for the [arm](#). It also is an electrical and mechanical interface for the first [actuator](#).

The base base has a cable that comes out of it that is used to connect it to the [controller](#).



Figure 5: The base component

Specifications and dimensions of the base of the arm

The [base](#) of the [arm](#) is designed to take into account the most common base sizes in industries, which facilitates swapping robotic arms.

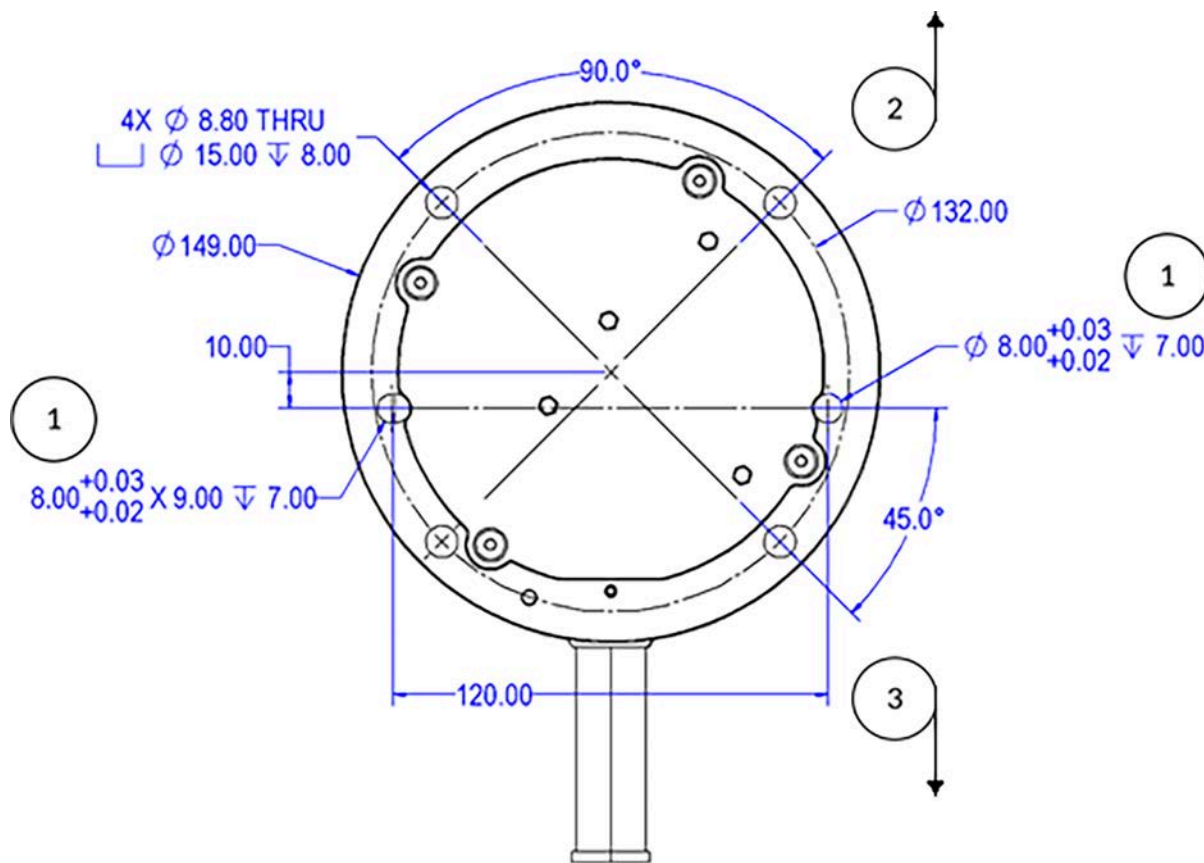


Figure 6: Top view of base dimensions in millimeters

- | | |
|---|--|
| 1 | Dowel hole feature for optional dowel pins |
| 2 | Front |
| 3 | Back |

Related topics

[Installing the arm directly to a surface](#) on page 91

[Installing the arm on a third-party adapter plate](#) on page 93

Actuators

Link 6 has six [actuators](#). The actuators come in two sizes. Three are large; three are small.

The Size 110 actuators have more load capacity than the Size 80 actuators. The Size 80 actuators have more speed capacity than the Size 110 actuators. The Size 110 actuators are in the first three joints, when counting joints from the [base](#) upward. All actuators include dual [microcontrollers](#) and various sensors to satisfy the Safety architecture category 3, [performance level D](#) monitoring architecture.

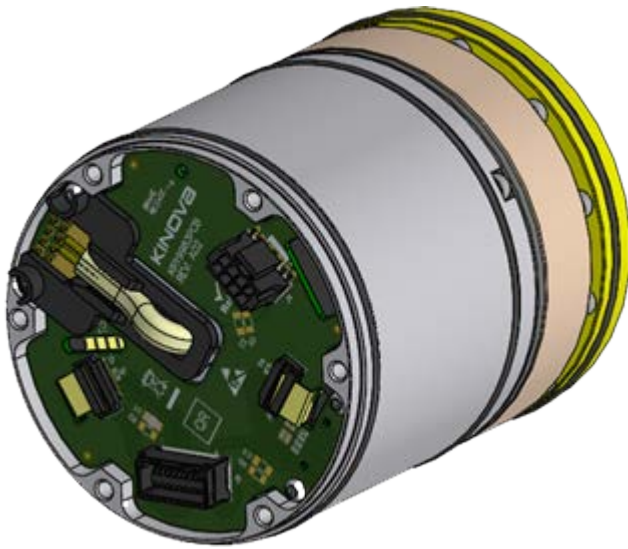


Figure 7: Size 80 actuator



Figure 8: Size 110 actuator

Each actuator also has a mechanical brake that is activated from the [firmware](#) or when the power is removed from the arm.

Wrist interface overview

The [wrist](#) is a modular component to which a variety of [end effectors](#) can be attached.

The wrist has buttons for the user to control the robot manually, buttons for the user to interact with [the Web App](#), and LED status indicators on the [wrist ring](#) to indicate the current state of the robot. The wrist also has a built-in force torque sensor. The sensor is used in different applications, such as [Cartesian](#) Hand Guiding. The sensor ensures the correct amount of force and torque is used with the tool.

The wrist interface is made of eight main parts, one of which is not visible.



Figure 9: Top of wrist

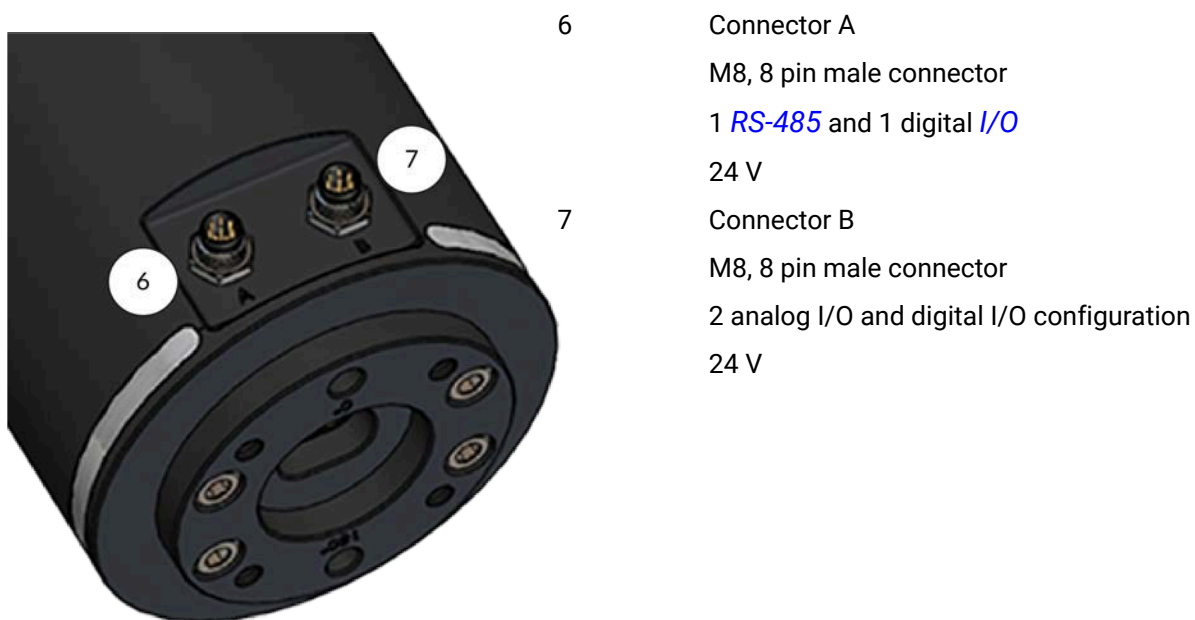


Figure 10: Bottom of wrist, M8 connectors

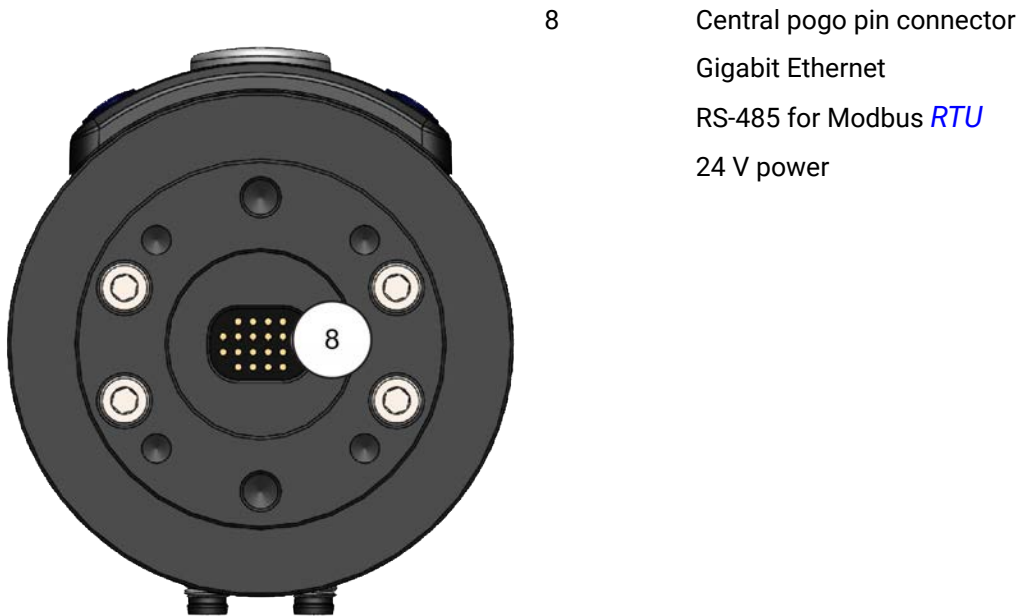


Figure 11: Bottom of wrist, pogo pin connector

Use the buttons on the top of the wrist to control the arm manually.



Figure 12: Buttons on the wrist

- | | |
|---|---|
| 8 | Central pogo pin connector
Gigabit Ethernet
RS-485 for Modbus RTU
24 V power |
| 1 | Hand Guiding mode Toggle button

Press to toggle between Cartesian and Angular Hand Guiding modes. |
| 2 | Waypoint capture (Snapshot button)

Press to capture a snapshot of the current location of the arm when you are editing a waypoint block during visual programming. |
| 3 | Wrist enabling device

Press and hold while moving the arm to teach it the trajectory. |
| 4 | End effector actions

Press + and - as a way of using the actions of the end effectors as defined by the plugin of the end effector. For example, + can close grippers and - can open grippers. |

Related topics

[Modes of operation of Link 6](#) on page 72

[Robot lights and what they mean: a reference](#) on page 86

Force torque sensor

The force torque sensor detects the force and torque applied to the *end effector*.

The six-axis force torque sensor is used in Hand Guiding mode to provide smooth and effortless experience.



Important: Applying forces above 1000 N and torques above 100 N·m can permanently damaged the sensor.

Mechanical interface

The *wrist* is designed to connect to many different types of *end effectors*. Its interface complies to ISO 9409-1-50-4-M6.

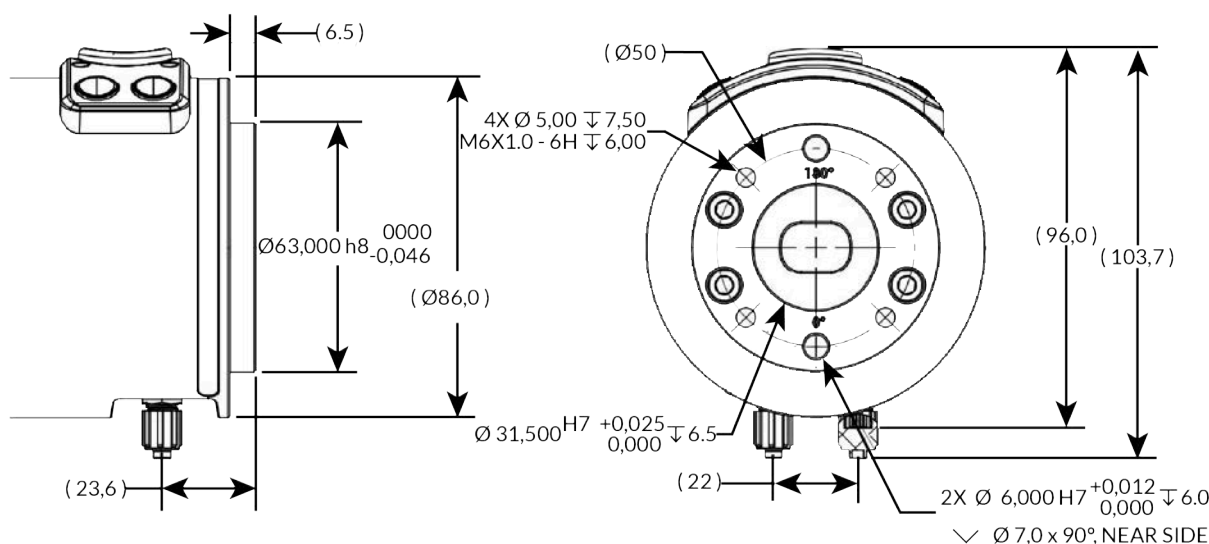


Figure 13: Mechanical interface of the wrist

Electrical interface

The *wrist* can connect electrically with *end effectors* through any combination of M8 8-pin connectors, central pogo pin, or all central pogo pins. Each of these methods is considered an interface.



Important: Accessories that connect to the wrist may or may not use the central connection of pogo pins. When the accessory does not use the central connection, keep the cap on the central pins to avoid potential damage to the pads on the *printed circuit board (PCB)*.



Figure 14: Central connector on wrist with cap on and with cap off

M8 connectors

Each of the two M8 connectors, which are compliant to IEC61131-2, have 8 pins. They provide 24 V power to whatever is attached to them. Connector A has two analog I/Os and four digital I/Os. Connector B has an RS-485 interface and four digital I/Os. The digital I/Os of connector A and connector B can be configured independently so that you can have as many as eight different configurations.

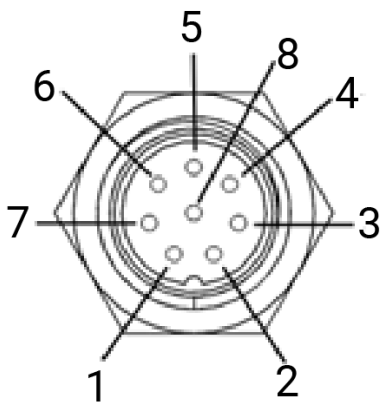


Figure 15: M8 connectors when facing the connector

Table 9: M8 Connectors

	Connector A	Connector B
Pin #	Signal	Signal
1	AOL_1	RS_485_P

	Connector A	Connector B
Pin #	Signal	Signal
2	AOL_2	RS_485_N
3	DIGITAL_IO1	DIGITAL_IO1
4	DIGITAL_IO2	DIGITAL_IO2
5	+24v	+24v
6	DIGITAL_IO3	DIGITAL_IO3
7	DIGITAL_IO4	DIGITAL_IO4
8	Ground	Ground



Remember: Always leave the caps on the M8 connectors when they are not being used.

Each analog I/O can be configured in four different ways.

Table 10: Analog interface configuration

Input or Output	Bottom Range	Upper Range	Notes
Input	0 V	10 V	
Input	4 mA	20 mA	
Output	0 V	10 V	for high impedance loads
Output	4 mA	20 mA	for high impedance loads

Each digital I/O can be configured in three different ways.

Table 11: Digital interface configurations

Input or Output	Bottom Range	Upper Range	Maximum
Input - low signal	-3 VDC	15 VDC	15 mA
Input - high signal	15 VDC	30 VDC	15 mA
Output 0	24 V	24V	600 mA

Pogo pins

In the center of the front of the wrist is an interface for pogo pins. It is supplied with 24 VDC, a dedicated Gigabit Ethernet, and [RS-485](#). Each pin has an associated connector pin assignment, which can be seen in the pogo pin distribution table and figure.

Table 12: Pogo pin distribution

Pin Number	1	2	3	4	5	6
1						
2		Ground	BI_DD+	BI_DD-	Ground	

3	485_P	BI_DB-RX0-	24 V	24 V	BI_DA-TX0+	485_N
4	485_N	BI_DB-RX0+	24 V	24 V	BI_DA-TX0-	485_P
5		Ground	BI_DC-	BI_DC+	Ground	
6						

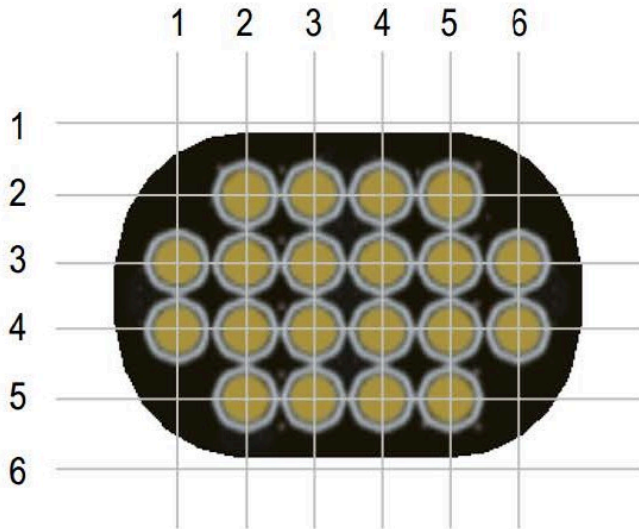


Figure 16: Pogo pin distribution

Available power in the wrist

The wrist can handle a maximum of 5 A among all M8 connectors plus central pogo pin. If one M8 connector is using 1 A, there is only 4 A left for the other interfaces.

Table 13: Power limitations

Electrical interface	Maximum continuous current
M8-8 24 V pin	1.5 A
Single pogo pin in center	2 A
All pins in center	5 A

Related topics

[Wrist I/O](#) on page 44

Wrist interface compatibility

The [wrist](#) must be compatible with the [end effector](#), and other peripherals, attached to it.

Link 6 is compatible with a variety end effectors.

- Kinova accessories
 - Gigabit Ethernet adapter is an optional Kinova accessory that exposes an M12 X-Coded Gigabit Ethernet connector to connect easily to Ethernet devices.
 - Robotiq adapter is an optional Kinova accessory that interfaces both mechanically and electrically with Robotiq products. It has central pogo pins, which means no cables are required when attaching Robotiq products.
- ISO flange, which follows the standard ISO 9409-1-50-4-M6, interfaces with end effectors.

Related topics

[Gigabit Ethernet adapter](#) on page 205

[OnRobot RG2 grippers](#) on page 211

[Robotiq adapter](#) on page 207

Controller overview

The [controller](#) powers the [arm](#). It stores all safety and non-safety parameters, the [firmware](#), the trajectories, arm calibration, and so on.

Typically, the controller is connected to the [teach pendant](#) or an external computer that runs [the Web App](#). The controller sends commands to [actuators](#) that translate the commands into movements in the joints of the arm.

! **Important:** The controller is associated with its arm. When there are multiple arms and multiple controllers, never switch the arms to different controllers.

The controller can be placed on a table or floor. It also can be mounted on a wall.

The front of the controller has switches, buttons, and [I/O](#) ports.

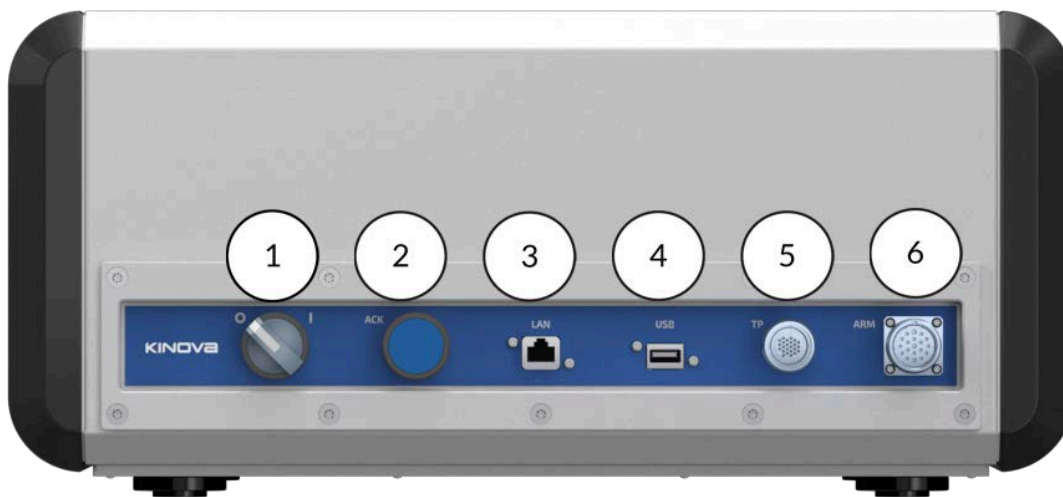


Figure 17: Front of controller and its parts

- 1 Power knob

A light illuminates behind the power knob when electrical power is coming through the controller. The light acts as a visual cue of the state the robot is currently in.

- 2 ACK button

A light illuminates in the center of the button and acts as a visual cue of the state the robot is currently in and what action needs to be taken.

3 Ethernet connector

Use the Ethernet connector in the front of the controller to connect to a laptop or computer.



Note: Alternatively, use the Ethernet connector on the back of the controller.

4 **USB** port

Use the port to insert a **USB** key that contains data that must be pushed onto the controller, such as a new software unit package.

Use the port to insert a USB key to store files that must be retrieved from the controller, such as an exported program.

5 TP connector

Plug the teach pendant into the connector marked TP to connect to the controller.

6 ARM connector



Note: The image depicts the ARM connector with a cap on.

Plug the arm into the connector marked ARM to connect it to the controller.

It also has a panel on the side to access **I/O** wiring to connect to the arm of the robot. Inside the panel, there is a map of the location of each type of input and output.



Figure 18: Location of input and output connectors, which on the side panel

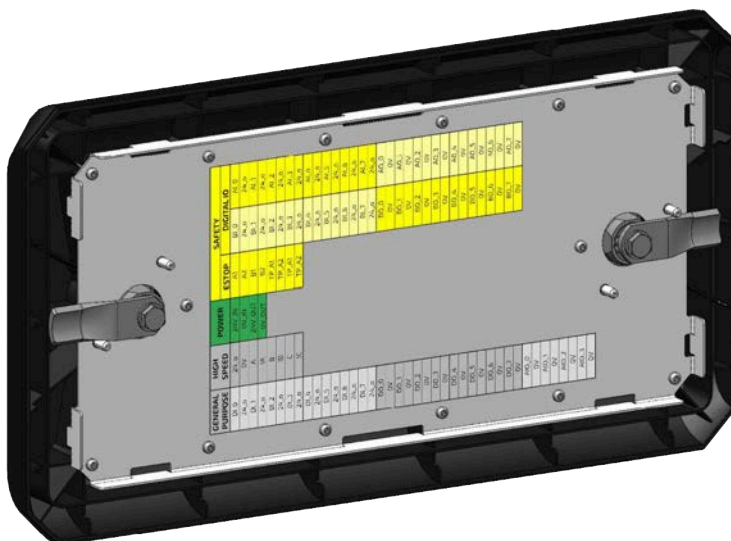


Figure 19: Map of input and output connectors is on the inside of the side panel

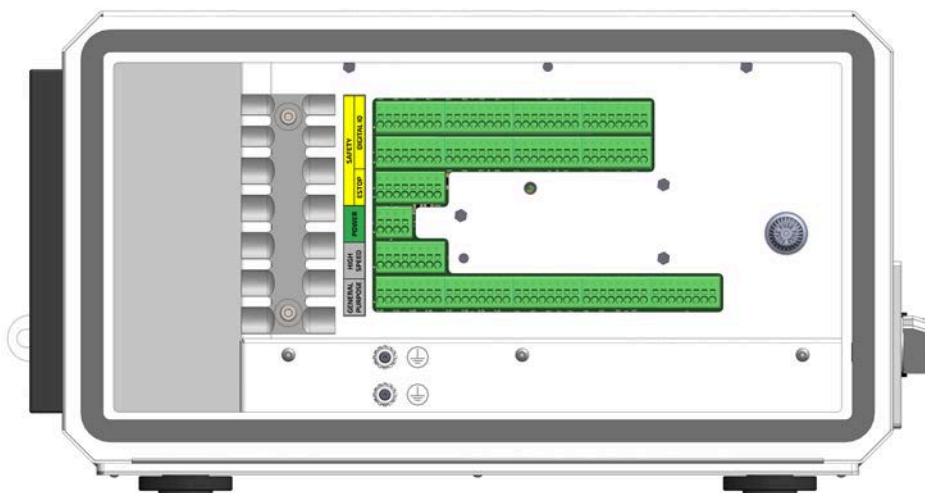


Figure 20: Input and output connectors are on the controller behind the side panel

The controller uses 12 VDC to power the internal computer units, which include *Safety Control Unit (SCU)*, *Main Processing Unit (MPU)*, *I/O* module, and optional *GPU*. It uses 48 VDC to power the arm.

Connect the controller to a power supply from its back.

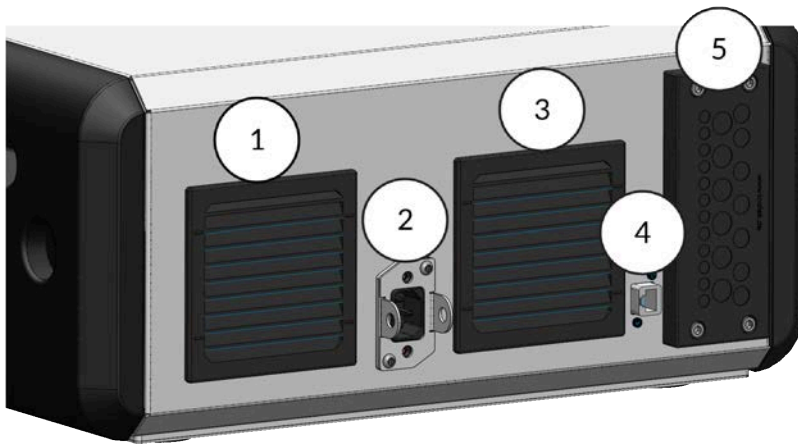


Figure 21: Back of controller

- 1 Fan-powered air exhaust
- 2 Electrical input for *alternating current (AC)* power
Unplug the AC power cord from the controller and use the brackets around the input to lock access to the power input whenever you perform maintenance on the robot.
- 3 Fanless air intake
- 4 [RJ45](#) Ethernet connector
Use the Ethernet connector at the back of the controller to connect to the network.
 **Note:** Alternatively, use the Ethernet connector on the front of the controller.
- 5 Entry plate for I/O connectors
Puncture holes in the entry plate for the wires that need to connect to the controller. The entry plate protects the wires from dust and liquids.

Controller mounting interface

The [controller](#) can be mounted on the floor or on the wall using either the feet mounting locations or an optional wall bracket.

An appropriate location to install the controller satisfies certain conditions.

- The underside of the installation surface is accessible.
- There is enough space to hold the controller.
- There is ample space around the controller for the airflow and access.



Figure 22: Mounting points of the controller

Related topics

[Considerations before installing the controller](#) on page 93

[Installing the controller on a flat surface](#) on page 95

Surface mount of controller

Dimensions of the [controller](#), along with the location of its mounting points, is important to know before the robot is installed.

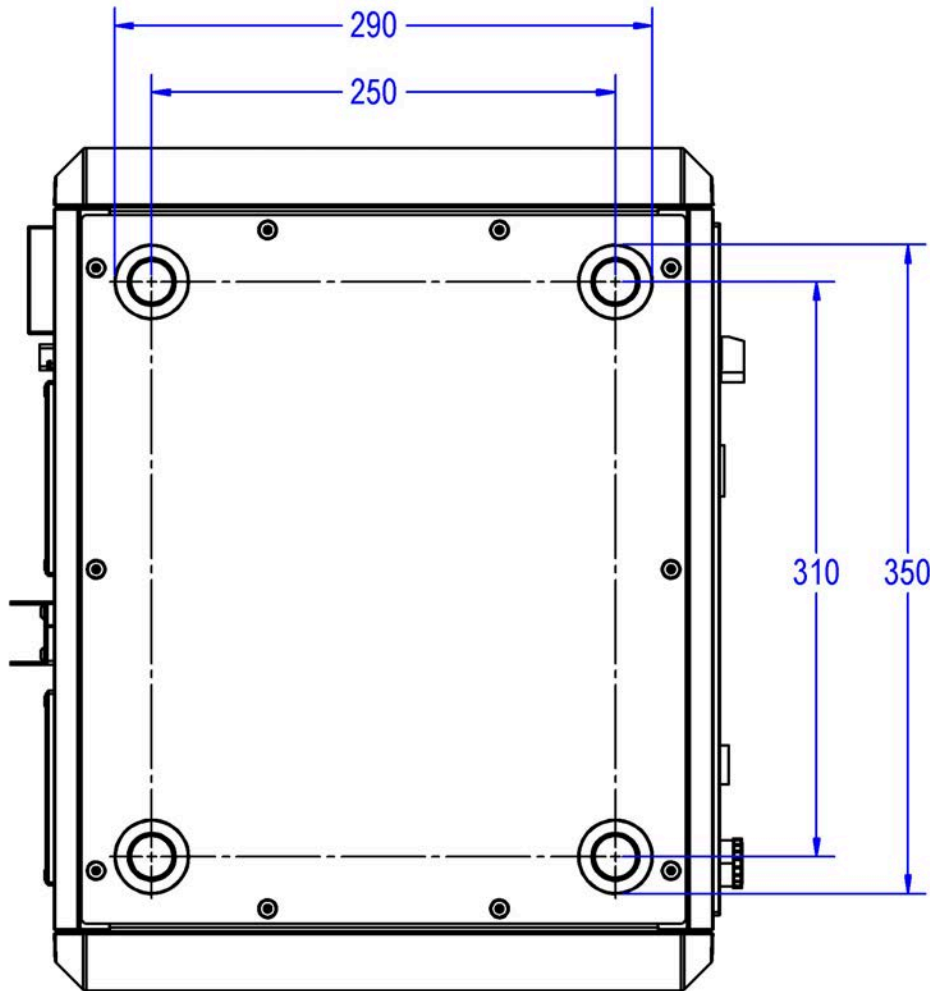


Figure 23: Mounting point measurements in millimeters

Related topics

[Installing the controller on a flat surface](#) on page 95

Controller electrical and communications interface

There is an access panel on the [controller](#) with a mapping of all the inputs and outputs listed directly on the back.

The access panel is on the side of the controller. It is held closed by two [camlocks](#). Lock and unlock directions are indicated on the front of the side panel. A bent lip on the door aids in guiding the door on and off the rest of the box.



Figure 24: Controller side panel

- 1 Camlocks; Use 8 mm hex key to unlock and lock

On the inside of the panel is a mapping of the location of each input and output. See [Figure 19: Map of input and output connectors is on the inside of the side panel](#) on page 25.

GENERAL PURPOSE	HIGH SPEED	POWER	SAFETY					
			ESTOP	DIGITAL IO				
DI_0	24_o	24V_IN	A1	BI_0	AI_0			
24_o	0V	0V_IN	A2	24_o	24_o			
DI_1	A	24V_OUT	B1	BI_1	AI_1			
24_o	!A	0V_OUT	B2	24_o	24_o			
DI_2	B		TP_A1	BI_2	AI_2			
24_o	!B		TP_A2	24_o	24_o			
DI_3	C		TP_B1	BI_3	AI_3			
24_o	!C		TP_B2	24_o	24_o			
DI_4					BI_4	AI_4		
24_o					24_o	24_o		
DI_5					BI_5	AI_5		
24_o					24_o	24_o		
DI_6					BI_6	AI_6		
24_o					24_o	24_o		
DI_7					BI_7	AI_7		
24_o					24_o	24_o		
DO_0		BO_0			AO_0			
0V		0V			0V			
DO_1		BO_1			AO_1			
0V		0V			0V			
DO_2		BO_2			AO_2			
0V		0V			0V			
DO_3		BO_3			AO_3			
0V		0V			0V			
DO_4		BO_4			AO_4			
0V		0V			0V			
DO_5		BO_5			AO_5			
0V		0V			0V			
DO_6		BO_6			AO_6			
0V		0V			0V			
DO_7		BO_7			AO_7			
0V		0V			0V			
AIO_0								
0V								
AIO_1								
0V								
AIO_2								
0V								
AIO_3								
0V								

Figure 25: Inputs and outputs map on the back of the panel

I/O connections are connected to the controller through the side panel. The *protective earth* mount points and fuse are also inside the side panel of the controller.

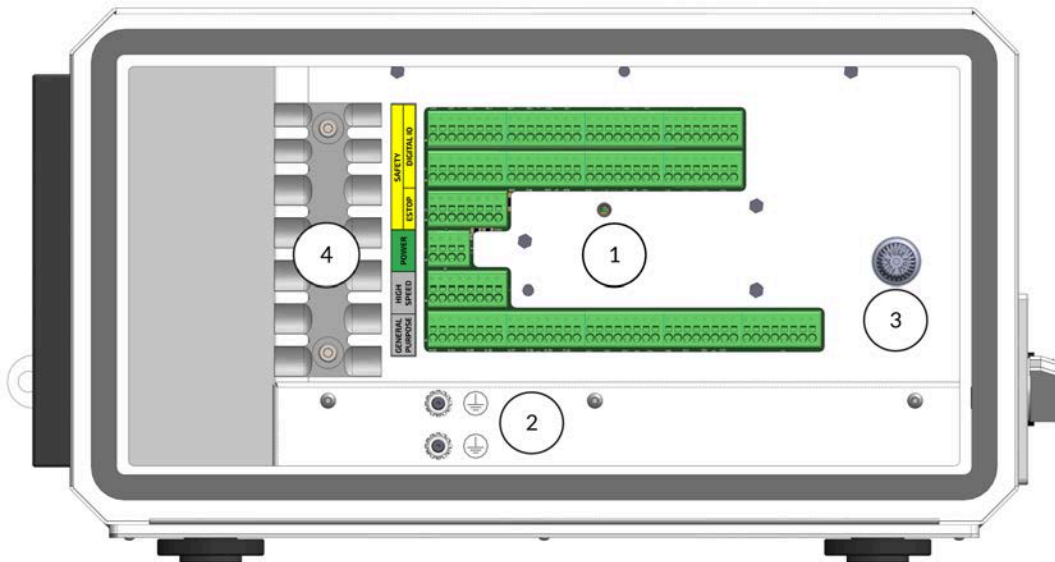


Figure 26: Inside the side panel of the controller

- 1 *I/Os*
From top to bottom, they are Safety Digital I/O, Safety Digital I/O, Safety ESTOP, Power, High Speed, and General Purpose
- 2 Protective earth stud
- 3 Fuse holder with a fuse held in it
- 4 Strain relief mounting plate, used to tie-wrap and secure cables; ensures not too much strain is applied to the terminal

Teach pendant overview

The *teach pendant* is a hand-held device used by *integrators* to configure and program the motions of a robot and by *operators* to select a program to run.

A cable connects the teach pendant to the *controller*. The controller saves the information coming from the teach pendant.

The teach pendant is a touchscreen device with three buttons.

- *Emergency stop*
- Power
- *Pendant enabling device*

To configure trajectories and to operate the robot, use *the Web App*.



Figure 27: Teach pendant front

1 *E-stop button*

Use the E-stop button to stop the robot in emergency situations.

2 *Power button*

Use the power button to turn on the teach pendant and access the Web App.



Figure 28: Teach pendant back

3 *Pendant enabling device*

Press and hold the pendant enabling device in the middle position when you are using the Jog interface to manually move the robot or when you are running a program in Hold-to-Run mode.

4 *Mounting interface*

Align the mounting interface with the mounting hooks and slide the pendant on the mount.

5 *Strap holding interface*

Slide your hand underneath the strap such that your thumb rests on top of the strap.

There are two types of users who use the teach pendant.

- The integrator can use the teach pendant when they configure or program the robot.
- The operator can use the teach pendant to run a validated program, provided they use it within an area defined by the integrator. The area should be outside of the [robot cell](#).

Related topics

[Installing the teach pendant mount](#) on page 97

Industrial I/O panel overview

The [controller](#) provides general-purpose electrical inputs and outputs from the Industrial [I/O](#) panel. It also provides safety-related electrical inputs and outputs from the I/O panel.



Note: Unless otherwise specified, all voltages and currents are *direct current (DC)*.

The I/O panel is made of two parts.

The safety I/Os are always powered by the internal power supply. The safety I/Os are divided into two banks, bank A and bank B, for redundancy. Each bank consists of eight (8) digital inputs and eight (8) digital outputs. The safety I/Os also contain the connections for an Emergency stop button.

The general-purpose I/Os are powered by 24 V IN or 0 V IN terminals. The terminals can receive their power from 24 V OUT or 0 V OUT terminals, or from an external power supply. The general-purpose I/Os contains eight (8) digital inputs, eight (8) digital outputs, four (4) analog I/Os, and provisions for high-speed encoder inputs.

The *industrial I/O panel* complies with specific standards.

- Immunity requirements for safety I/O are in accordance with IEC 61000-6-7.
- Safety digital inputs and general-purpose digital inputs are in accordance with IEC 61131-2 Type 1 and Type 3.
- Safety digital outputs and general-purpose digital outputs are in accordance with IEC 61131-2 Type 1 and Type 3.
- *electrostatic discharge (ESD)*, surge, and *Electrical Fast Transient(EFT)* are in accordance with IEC 62326-3-1.

Positive logic, which is current sinking input and current sourcing output, is supported on the panel. *Negative logic (NPN)* is not supported on the panel.

GENERAL PURPOSE	HIGH SPEED	POWER	SAFETY		
			ESTOP	DIGITAL IO	
0I_0	24_o	24V_IN	A1	BI_0	AI_0
24_o	0V	0V_IN	A2	24_o	24_o
0I_1	A	24V_OUT	B1	BI_1	AI_1
24_o	!A	0V_OUT	B2	24_o	24_o
0I_2	B		TP_A1	BI_2	AI_2
24_o	!B		TP_A2	24_o	24_o
0I_3	C		TP_B1	BI_3	AI_3
24_o	!C		TP_B2	24_o	24_o
0I_4				BI_4	AI_4
24_o				24_o	24_o
0I_5				BI_5	AI_5
24_o				24_o	24_o
0I_6				BI_6	AI_6
24_o				24_o	24_o
0I_7				BI_7	AI_7
24_o				24_o	24_o
D0_0				BO_0	AO_0
0V				0V	0V
D0_1				BO_1	AO_1
0V				0V	0V
D0_2				BO_2	AO_2
0V				0V	0V
D0_3				BO_3	AO_3
0V				0V	0V
D0_4				BO_4	AO_4
0V				0V	0V
D0_5				BO_5	AO_5
0V				0V	0V
D0_6				BO_6	AO_6
0V				0V	0V
D0_7				BO_7	AO_7
0V				0V	0V
AIO_0					
0V					
AIO_1					
0V					
AIO_2					
0V					
AIO_3					
0V					

Figure 29: Default factory setting with internal supply used and external E-stop bypassed

Table 14: Industrial I/O terminals

Mechanical	Min	Typical	Max	Unit
Conductor size (<i>UL/cUL</i>)	16		24	American Wire Gauge (AWG)
Conductor size (<i>International Electrotechnical Commission (IEC)</i>)	0.2		1.5	mm ²
Stripping Length	8		10	mm
Terminal pitch		3.5		mm
Ferrule		<i>Deutsches Institut für Normung (DIN) 46228-4</i>		

Related topics

[Installing the external 3-position enabling device](#)

Industrial I/O power supply

Negative connections, labeled as 0V, are only for power and signaling. *protective earth (PE)* provides a low impedance path to ensure proper functioning in case of faults.

Be careful to connect power to the supplies correctly. When connected incorrectly, you can end up undesirable side effects, such as reverse polarity, improper voltage levels, and improper frequencies. Link 6 is designed such that the 24V_IN and 0V_IN terminals are protected against reverse polarity.



Important: Use only DC frequency.



Important: Do not exceed 28 V under any conditions.

During the power up sequence, all outputs are low and all inputs are not read.

During the power down sequence, all outputs shut down to the low state. The output from the *emergency stop (E-stop)* enters a low state; it generates an *E-stop* event on all external devices connected to this terminal. All inputs are not read.

Table 15: Internal power

Internal 24 V power supply	Min	Typical	Max	Unit
Voltage	23.5	24	24.5	V
Current (total)			2	A

Table 16: External power

External 24 V input requirements	Min	Typical	Max	Unit	Note
Voltage	20	24	28	V	IEC 61131-2

External 24 V input requirements	Min	Typical	Max	Unit	Note
Current (total)			5	A	Fused internally at 10 A. The external power supply should be fused to a lesser value. It is recommended to fuse it at 5 A with an opening time that is less than 5 seconds.

The terminal connections belong to the POWER terminal group.

Table 17: Power terminal connections

Label	Purpose
24V_IN	24 V input to supply the general purpose I/Os.
0V_IN	0 V input to supply the general purpose I/Os.
24V_OUT	24 V output of the internal I/O power supply. Use only to jump with the terminal 24V_IN. If an external power supply is used to connect on the 24V_IN terminal, leave the terminal unconnected.
0V_OUT	0V output of the internal I/O power supply. Use only to jump with the terminal 0V_IN. If an external power supply is used to connect on the 0V_IN terminal, leave the terminal unconnected.

There are specific times when you can use the external power supply for general purpose I/Os.

- The total output current of the I/O panel exceeds 2 A.
- The general purpose I/Os need to be supplied from the same power supply as the rest of the industry floor.
- The general purpose I/Os are tied to an external reference point, with up to 2000 V electrical isolation from the rest of the controller.



Figure 30: Internal power supply terminal connections

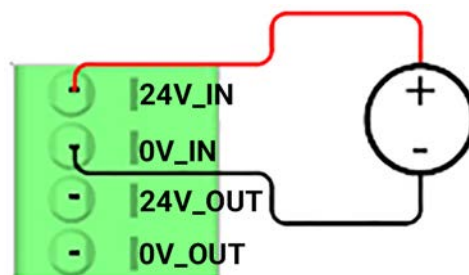


Figure 31: External power supply terminal connections

General-purpose digital inputs

There are no common points between channels. Each input has its own associated 24 V wetting port.

The panel may not work properly when there is a miswired condition coming from any other location on the panel. However, miswired conditions do not lead to any permanent damage. When the miswiring is fixed, the panel starts working.



Important: The panel may be damaged if the miswiring comes from an external device.



Important: Miswiring issues does not apply to the 24 V power supply output.

There are isolation potentials between a channel and other circuits, including earth, as well as between channels under normal operation.

There is a monitoring point and a binary state of a visual indicator although there is no actual hardware visual indicator.

There are side effects when you withdraw or insert an input module that is under power.

There is an additional external load when interconnecting inputs and outputs.

Table 18: Digital inputs

Digital inputs	Min	Typical	Max	Unit	Note
Low state voltage	-3	0	5	V DC	
High state voltage	11	24	30	V DC	
Current		2.0	2.6	mA	
Voltage drop					
Function					Current sinking
IEC 61131-2 Type		1, 3			Digital input type 1 and 3 according to IEC 61131-2

Each wetting port is designed to provide the power needed for a single input point. Do not use it as a generic power source.

The terminal connections belong to the GENERAL PURPOSE terminal group.

Table 19: Digital input terminal connections

Label	Purpose
DI_n (n=[0-7])	Terminal points for digital input
24_o	Wetting port for each digital input
	Each input has its own wetting port.

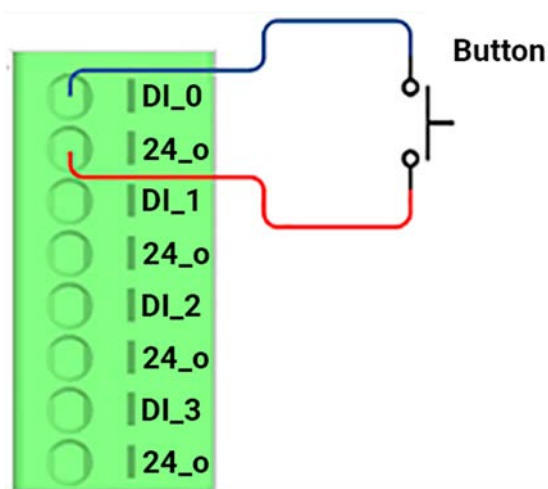


Figure 32: Digital input terminal connections

General-purpose digital outputs

All 0 V ports are common, although each output has its own 0 V terminal.

All the digital outputs are short-circuit protected. An incorrect terminal connection does not lead to any permanent damage.

There are isolation potentials between a channel and other circuits, including earth, as well as between channels under normal operation.

Under normal operation, channels are not isolated from each other.

There is a monitoring point and a binary state of a visual indicator although there is no actual hardware visual indicator.

The a delay time for transitions between 0 and 1 and 1 and 0 depends on the load and on software delays.

Table 20: Digital outputs

Digital outputs	Min	Typical	Max	Unit	Note
Rated current			500	mA	
Voltage drop				V	At maximum current
Leakage current				mA	For low state
Type					Positive logic, current sourcing

Each output can drain up to a maximum of 500 mA. If many outputs are connected and are high, the maximum current available from the internal power supply could be exceeded; an external power supply must be used.

The terminal connections belong to the GENERAL PURPOSE terminal group.

Table 21: Digital output terminal connections

Label	Purpose
DO_n (n=[0-7])	Terminal points for digital output

Label	Purpose
0V	0 V input to supply the digital I/Os

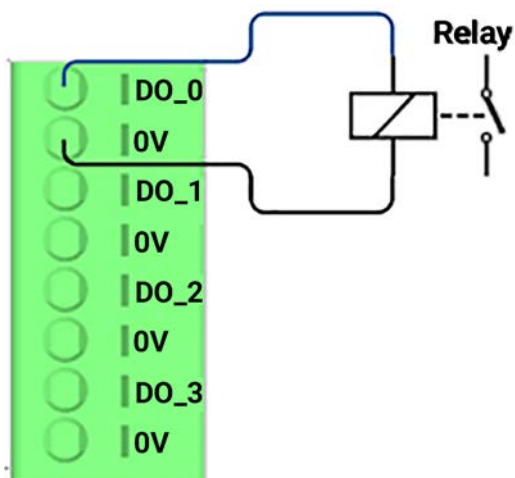


Figure 33: Digital output terminal connections

Analog inputs

There are four (4) analog inputs.

Analog input types are current and voltage. The input impedance in the signal range is in the on or off state; the state is specified by the manufacturer.

Table 22: Analog inputs in current mode

Analog inputs	Min	Typical	Max	Unit	Note
Current	4		20	mA	
Voltage		24		V	
Resolution		16		Bits	

Table 23: Analog inputs in voltage mode

Analog inputs	Min	Typical	Max	Unit	Note
Voltage	0		10	V	
Current				mA	
Resolution		16		Bits	

The terminal connections belong to the GENERAL PURPOSE terminal group.

Table 24: Analog input general purpose terminal connections

Label	Purpose
AIO_n (n=[0-7])	Terminal points for analog input.
0V	0 V input to supply the analog I/Os.

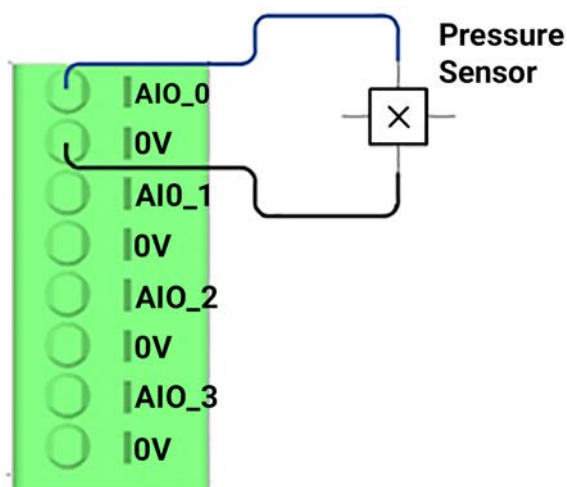


Figure 34: Analog terminal connections

Analog outputs

There are four (4) analog outputs.

Analog output types are current and voltage. The output impedance is in the signal range is in the on or off state; the state is specified by the manufacturer.

The analog output has a maximum error at 25 °C $\pm$ % of full scale, with a temperature coefficient $\pm$ % of full scale/K. The maximum error over the full temperature range is $\pm$ % of the full scale.

The digital resolution is measured in number of bits.

The data format returned from the application program is in binary, *Binary Coded Decimal (BCD)*, and so on. The value of the data is in the *Least Significant Bit (LSB)*.

Table 25: Analog outputs in current mode

Analog outputs	Min	Typical	Max	Unit	Note
Current	0		10	mA	
Resistance			760	ohm	
Resolution		13		Bits	

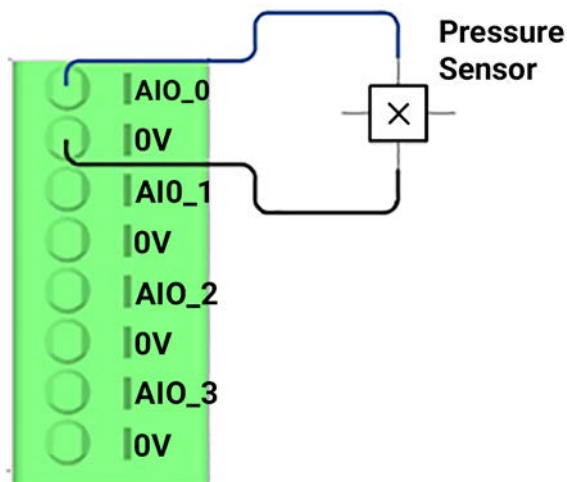
Table 26: Analog outputs in voltage mode

Analog outputs	Min	Typical	Max	Unit	Note
Voltage	0		10	V	
Current			29	mA	
Resolution		13		Bits	

The terminal connections belong to the GENERAL PURPOSE terminal group.

Table 27: Analog output general purpose terminal connections

Label	Purpose
AIO_n (n=[0-7])	Terminal points for analog output.
0V	0 V input to supply the analog I/Os.

**Figure 35: Analog terminal connections**

Emergency stop inputs

Stop working on the risk assessment of Link 6 if additional emergency stop devices are required. Emergency stop devices must comply with ISO 13850:2015.

Link 6 requires an emergency stop device with two (2) *Normally Closed (NC)* redundant contacts. The terminal connections belong to the SAFETY - ESTOP terminal group.

Table 28: Emergency stop terminal connections

Label	Purpose
A1	24 V wetting port
A2	Channel A - digital input
B1	24 V output
B2	Channel B - digital input

A typical installation involves a teach pendant that is connected on the front panel. The emergency stop is part of the teach pendant. The only thing to do is to install a jumper on A1, A2, B1, and B2.

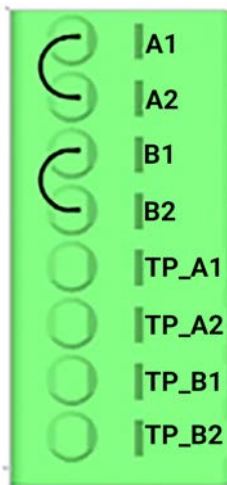


Figure 36: Terminal connections with jumper on A1, A2, B1, and B2 when the teach pendant is connected

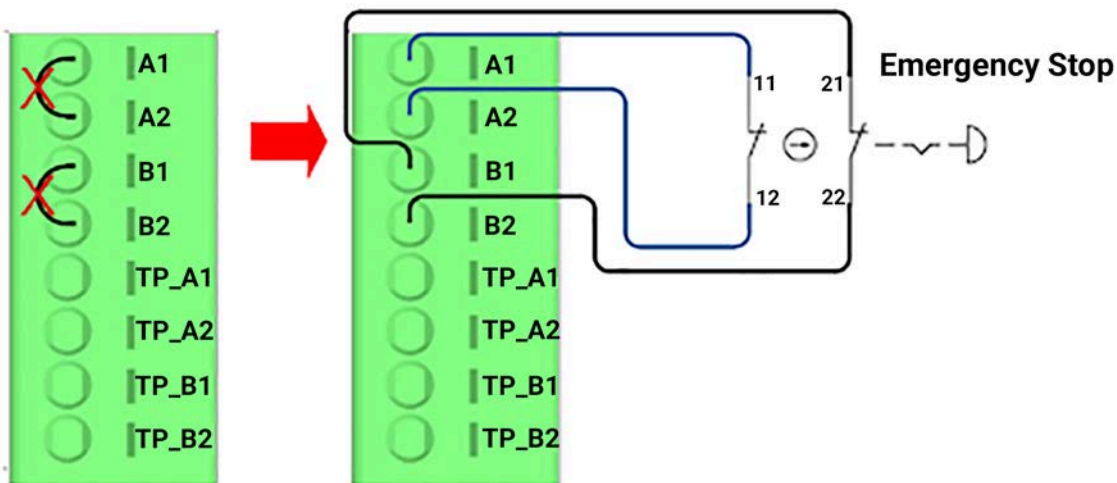


Figure 37: Terminal connections with external emergency stop connected

Teach pendant bypass inputs

There are only two ways to bypass teach pendant inputs. All other configurations prevent the robot arm from receiving power.



Important: Make sure the teach pendant is not installed when you bypass teach pendant inputs.

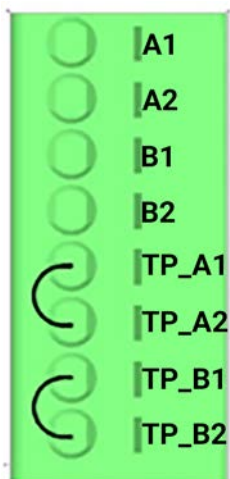
If a teach pendant is connected on the front panel, leave TP_A1, TP_B1, and TP_B2 open. Remove any jumpers that are installed.

If a teach pendant is not connected on the front panel, connect TP_A1 to TP_A1 and TP_B1 to TP_B2.

The terminal connections belong to the SAFETY - ESTOP terminal group.

Table 29: Teach pendant bypass inputs terminal connections

Label	Purpose
TP_A1	24V wetting port
TP_A2	
TP_B1	24V wetting port
TP_B2	

**Figure 38: Teach pendant bypass inputs terminal connections**

Safety-rated digital inputs

Safety-rated digital inputs can be used as redundant signals.

To use the inputs as redundant signals, connect Bank A to one of the contacts of the safety device and connect Bank B to the redundant, secondary contact of the same safety device. For example, A0 and B0 can be connected to an enabling device.

All safety-rated inputs are expected to be *NC* when both redundant contact are in a fault state. A fault is triggered when there is a disagreement between the status of the tied redundant signals.

The terminal connections belong to the SAFETY - DIGITAL IO terminal group.

Table 30: Safety-rated digital inputs terminal connections

Label	Purpose
AI_n (n=[0-7])	Safety rated Bank A digital inputs
BI_n (n=[0-7])	Safety rated Bank B digital inputs
24_o	24V wetting port for safety rated Bank A and safety rated Bank B digital inputs

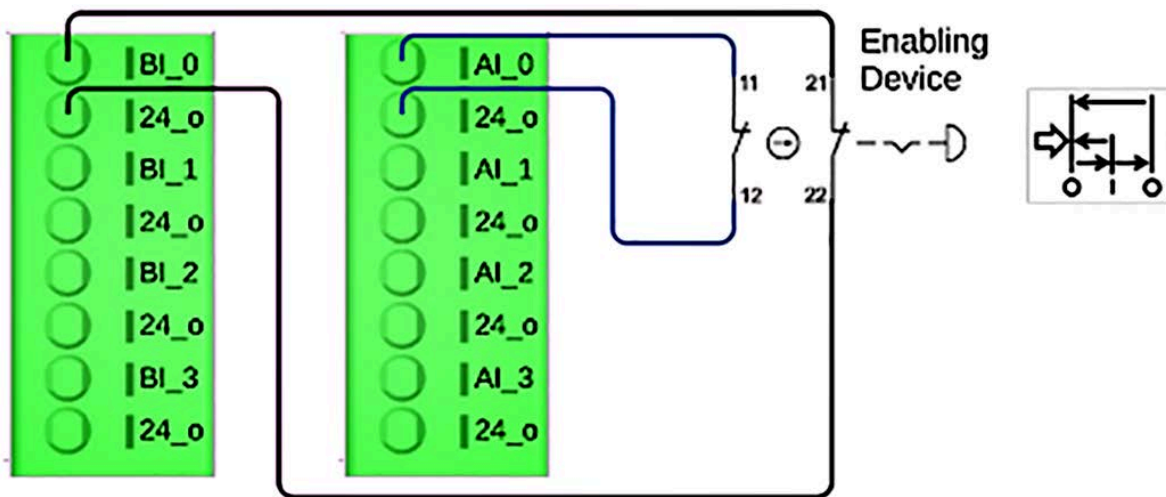


Figure 39: Safety-rated digital inputs terminal connections

Wrist I/O

Each of the two M8 connectors has eight (8) pins. The I/O levels associated with the connectors are compliant to IEC 61131-2.

Connector A has two analog I/Os and four digital I/Os. Connector B has a Modbus *remote terminal unit (RTU)* with an [RS-485](#) interface and four (4) digital I/Os. The digital I/Os of connector A and of connector B can be configured independently.

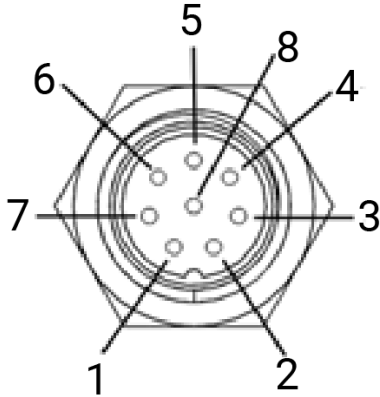


Figure 40: M8 connectors when facing the connector

Table 31: M8 Connectors

Connector A			Connector B	
Pin #	Label	Purpose	Label	Purpose
1	AOL_1	Analog In/Out	RS_485_P	RS-485 D+ (B)
2	AOL_2	Analog In/Out	RS_485_N	RS-485 D- (A)
3	DIGITAL_IO1	Digital In/Out	DIGITAL_IO5	Digital In/Out
4	DIGITAL_IO2	Digital In/Out	DIGITAL_IO6	Digital In/Out

Connector A			Connector B	
Pin #	Label	Purpose	Label	Purpose
5	+24v	Power	+24v	Power
6	DIGITAL_IO3	Digital In/Out	DIGITAL_IO7	Digital In/Out
7	DIGITAL_IO4	Digital In/Out	DIGITAL_IO8	Digital In/Out
8	GND	Ground	GND	Ground

Wrist power supply

The maximum current is shared among all power outputs of the wrist, including the A and B connectors and the pogo pad.

The wrist can handle a maximum of 5 A among all connection points. If one M8 connector is using 1 A, there is only 4 A left for the other interfaces.



Important: The maximum current that can be used by any one M8 connector is 1.4 A.

General-purpose inputs and outputs for the wrist

Unless otherwise specified, all general-purpose digital and analog inputs and outputs have the same specifications as the [Industrial I/Os](#).

Related topics

[General-purpose digital inputs](#) on page 37

[General-purpose digital outputs](#) on page 38

[Analog inputs](#) on page 39

[Analog outputs](#) on page 40

Wrist RS-485

[RS-485](#) on the wrist is used only for Modbus [RTU](#) when it is exposed through EIA/TIA-485-A, commonly referred to as RS-485.



Important: There is no [RS-485](#) communication available from [the Web App](#).

Table 32: RS-485 pins on the wrist

Label	Purpose
RS_485_P	RS-485 D+ (B)
RS_485_N	RS-485 D- (A)
GND	RS-485 SC (G)

Table 33: RS-485 power inputs

RS-485	Min	Typical	Max	Unit
Input voltage at A/B terminal	-7	5	12	V
Current			2	A

Gigabit Ethernet on the wrist

Use the Gigabit Ethernet adapter to use the Gigabit Ethernet on the wrist.

The Gigabit Ethernet uses the 1000BASE-T signal, which makes it compliant with IEEE802.3. It uses an ANSI/TIA-568 T568B termination.

Photo: Binder



Figure 41: Plug-in side

Table 34: Gigabit Ethernet pins

M12 X-coded pin	Label	T568B color
1	DA+	white/orange
2	DA-	orange
3	DB+	white/green
4	DC+	blue
5	DC-	white/blue
6	DB-	green
7	DD+	white/brown
8	DD-	brown

For 100BASE-TX (Fast Ethernet) and for devices that are compatible with 4-pole D-coded M12 Ethernet, connect pins 1, 2, 3, and 6 only.

Single-pair, 1000BASE-T1, is not supported.

Related topics

[Gigabit Ethernet adapter](#) on page 205

Safety

Link 6 is a powerful robot that can perform heavy duty industrial tasks. Read and understand all safety considerations before installing and using the robot.

Safety includes general warnings about the robot, risk assessments, what to do in an emergency, how to work the robot when it loses power, and so on

It also includes all safety functions of Link 6.



Important: Any and all topics that discuss safety refer specifically to Link 6 and do not apply to the robot system or interactions with other systems or devices.

Related topics

[Installing the arm directly to a surface](#) on page 91

[Installing the arm on a third-party adapter plate](#) on page 93

Precautions

Always observe precautions to avoid serious injury to users, damage to other equipment, and damage to Link 6.

Read all safety information available in this guide, as well as diagnostic, maintenance, servicing, support, and troubleshooting topics, to perform a proper risk assessment and to know how to train users.

Use the robot as it is intended to be used.

Perform a risk assessment not only on Link 6, but on the entire [robot system](#). Make sure in the risk assessment that the international safety standard for robotic systems, ISO 10218-1/-2, is respected, as well as all territory-specific standards for your area when applicable.

Perform a *Lockout Tagout (LOTO)* procedure so that no cable can be connected to the robot when it is under maintenance or any other situation where the power needs to be removed; it prevents the robot from being switched on accidentally.

Dispose of the robot in accordance with the laws and regulations of the territory in which the robot is installed.

Related topics

[Intended use](#) on page 6

[Risk assessment](#) on page 49

[Maintenance](#) on page 219

[Servicing](#) on page 224

[Disposal](#) on page 225

Safety directives and warnings

Follow basic safety guidelines when working with Link 6 to avoid injury to the user or damage of the equipment.

Familiarize yourself with what must be done to avoid the various dangers, warning, and cautions when working with the robot.

Directives specific to the integrator

The *integrator* is responsible for the safe use of Link 6. For the robot to be used safely, there are certain directives the integrator must follow.

- Perform a risk assessment based on the system, the environment, and the user before installing Link 6.
- Include any and all external equipment, objects, and any other parts of the complete robot system added by the integrator in the risk assessment.
- Include specific precautions with respect to earthquakes when the robot is installed in an earthquake zone.
- Install the [arm](#) and the [controller](#) such that they are easily accessible for maintenance purposes.
- Install the arm and the controller such that they do not impede on the ergonomics of the entire robotic environment.

Danger



DANGER: A danger is an impending hazardous situation that can result in serious injury or even death, or can severely damage property. Avoid impending hazardous situations that are associated with dangers.

Keep objects and hands out of [pinch point](#) zones.

Disconnect the power supply and perform *Lockout Tagout* procedures when maintenance tasks must be performed.

Stop the robot when a person is trapped by the robot or some other similar emergency.

1. Push the robot out of the way, using approximately 60 N of force.



Important: Applying too much force may damage the arm.



Important: The [backdriving](#) range is +/- 180°.

2. Make sure nothing is interfering with the robot and that it is safe to proceed,
3. Clear the fault.
4. Power the arm.

Stop the robot immediately when a part of the robot begins to vibrate. Contact support at support@kinova.ca.

Stop the robot immediately when a joint on arm suddenly becomes loose. Contact support at support@kinova.ca.

Stop the robot immediately when the arm suddenly loosens from the base. Secure the arm tightly to the surface.

Warnings



Warning: A warning is a potentially hazardous situation that can cause minor to moderate injury to workers, might result in serious injury or even death, and can damage the property significantly. Avoid potentially hazardous situations that are associated with warnings.

The personnel working with Link 6 should always be trained.



Note: Training requirements are determined by the integrator's [risk analysis](#).

Either warm or cool the environment before storing the robot.

Do not store the robot in an environment that is below -40 °C.

Do not store the robot in an environment that is above +65 °C.

Do not power the robot in an environment that is below 0 °C; the robot may malfunction.

Do not power the robot in an environment that is above 40 °C; the robot may malfunction.

Do not use the robot in an environment that is below -20 °C; the robot may malfunction.

Do not use the robot in an environment that is above 30 °C; the robot may malfunction.

Do not touch the robot if the temperature of the environment is above 30 °C. The robot may be hot to the touch.

Do not use the robot when there are external signs of significant damage on the arm, controller, or the teach pendant.

Do not use the robot when the I/O panel is open or damaged.

Do not open the controller panel when the controller is in a wet environment.

Do not open the controller panel when the controller is in an EMI-sensitive environment.

Do not use the robot near flames or sources of heat.

Cautions



CAUTION: A caution is a hazardous situation that may cause minor to moderate injury to workers and can damage the property. Avoid hazardous situations that are associated with cautions.

Do not touch the robot when the surface of the robot or the controller become hot.

Remove objects blocking the enclosure fans.



Note: Obstructed fans can lead to loss of functionality in internal components and can cause the controller to become hot to the touch.

If there are no objects blocking the enclosure fans and the controller becomes hot to the touch, the fans may be clogged by dust or debris. Perform basic maintenance and fan cleaning.

Related topics

[Intended use](#) on page 6

[Unintended uses](#) on page 6

[Weekly maintenance](#) on page 220

[Installing the arm directly to a surface](#) on page 91

[Installing the arm on a third-party adapter plate](#) on page 93

Risk assessment

Before installing Link 6, determine all potential risks in using the robot according to applicable standards ISO 10218, ISO 12100 for robot and machine safety.

There are several different steps in determining all potential risks.

Hazard identification

Identify all hazard and risk factors that can potentially cause harm

Risk analysis

Analyze and evaluate the risk associated with each hazard.

Risk control

Eliminate, or reduce the risk to an acceptable level, each potential hazard.

Take into account the entire **robot system** and its environment when performing a risk assessment, not just Link 6. It is impossible to cite every potential hazard because of the myriad applications into which Link 6 can be integrated. The potential hazards listed is not exhaustive.

Examples of what to take into account when performing a risk assessment

- Other robots used in the robot system
- Anticipated tasks of the robot system
- Anticipated workpieces
- Anticipated tools
- Anticipated uses
- Anticipated tasks
- Anticipated environments
- Types of applications, whether **collaborative** or **non-collaborative**



Note: For more details, please refer to ISO 10218 and ISO TS 15066.

- Robot parameters including, but not limited to, speeds and trajectories
- Safety function parameters including, but not limited to, restricted areas and speed limited by areas
- Protective measures including, but not limited to, interlocks, presence detection, fencing, and guards
- User training

Perform all risk assessments in compliance with the applicable standards of the territory where the robot is installed.



Important: Make sure to make the risk assessment accessible to all robot users.

Safety equipment

Applicable standards and the results of the **risk analysis** determine the requirements for safety equipment.

The equipment includes items that protect users against injury and death. Some equipment is mandatory.

Examples of mandatory equipment

- One or more emergency stops

The exact number of required emergency stop buttons is determined by the layout of the system and the application of the robot.

- One **enabling device**

Some equipment may be useful, depending on the environment, standards, and risk analysis.

Examples of optional, yet useful, equipment

- Fencing
- Dividers
- One or more light curtains to detect when something is entering the working area of the robot
- One or more scanners to detect when something is entering the working area of the robot

Assessments before using the robot

Every time before using Link 6, perform system checks to prevent potential damage to the robot, the robot system, and the user that could lead to a dangerous situation.

Make sure the risk assessment is available to all users.

Make sure all users receive training regarding safety concerns.

Verify that all tasks that are intended to be performed with the robot, including installation, programming, maintenance, and decommissioning, are listed in the risk assessment and that the risk assessment has been performed.

Related topics

[Preventive maintenance](#) on page 220

Stop categories

The different categories of stopping the motion of the robot safely when an emergency arises is designed to reduce existing hazards. The *stop category (SC)* are aligned with IEC 60204-1.

Table 35: Stop categories

Stop category	Description
0	Initiated by pressing the E-stop button and by faults detected by the Safety control unit (SCU). Removes electrical power from the robot immediately.
1	Initiated by faults detected by the <i>SCU</i> . Stops the movement of the robot and, when the robot has stopped moving, removes electrical power from the robot.
2	Brings the robot to a Monitored Stop. Power remains available to the robot.

Related topics

[List of safety functions](#) on page 52

[State: Monitored stop](#) on page 77

[Operating modes](#) on page 79

Emergency stop

An emergency is an unexpected situation that can lead to injury, or can damage the robot system or the objects it manipulates. An *E-stop* helps to stop the robot quickly in case of emergency.

When an emergency arises during the operation of Link 6 or any other part of the robot system, press the *E-stop* button. Pressing the button triggers a stop category 0, which removes power from the robot and applies the brakes.

Whenever the *E-stop* is pressed, the light behind the ACK button on the controller and the light around the wrist wring switches off. Re-arm the *E-stop* button and reset the robot in [the Web App](#). After recovering from the stop, inspect the area for any obstructions that can interfere with the operation of the robot. Also, inspect the robot to ensure it has not been damaged.

If there is no damage and the emergency situation has been handled, restart the robot using the Web App.

Related topics

[State: Fault](#) on page 78

Move robot arm without power

It is possible to move the [arm](#) when it has no power to prevent injuring a person who is trapped by the robot, for instance. The action is known as [backdriving](#).

Move the arm to a safe position even without a powered drive system by backdriving the brakes manually in each joint. Moving the arm without power requires a substantial amount of force.



Warning: Backdriving the actuators more than 360 ° may damage the robot and internal cables. Depending on the position of the robot, damage may occur when the movement is less than 360 °.



Warning: Backdriving the actuators may require the arm to be reprogrammed.



CAUTION: Backdriving the actuators manually may damage the brakes.

Related topics

[Safety directives and warnings](#) on page 47

Safety functions

Link 6 has built-in tools designed to help the [integrator](#) to reduce risk when performing the risk analysis.

The tools are also known as safety functions. They rely on the hardware, firmware, the SCU, electronics, sensors, and other elements of the robot.

List of safety functions

Safety functions are built into Link 6 to minimize hazards in the robot system.

Table 36: List of safety functions

Number	Name	Triggers stop category	Level of performance	Designed according to performance level
SF01	Emergency stop	SC0	PLd	ISO 13850
SF02	Protective stop	SC2	PLd	ISO 10218-1:2011

Number	Name	Triggers stop category	Level of performance	Designed according to performance level
SF03	<i>Joint position</i>	SC2	PLd	ISO 10218-1:2011, 5.12.3
SF04	<i>Joint speed</i>	SC2	PLd	
SF05	<i>Monitored stop</i>	SC2	PLd	
SF06	<i>Protection zone</i>	SC2	PLd	
SF07	<i>Tool Center Point (TCP) & Elbow speed</i>	SC2	PLd	

Related topics

[Stop categories](#) on page 51

[Safety modes](#) on page 58

[Robot safety protections and limits](#) on page 59

[Protection zones](#) on page 61

[Status of safety functions](#) on page 176

SF01 Emergency stop

What does SF01 monitor?

SF01 monitors external emergency signals from the Safety I/Os to the robot. It initiates a [stop category](#) 0 in which all electrical power is removed from the [actuators](#) and the [end effector](#).

Cause of the trigger

- The [E-stop](#) button is pressed on the [teach pendant](#).
- A signal is detected on the input reserved for emergency stops.

Remedy

1. Make sure that it is safe to resume operation of the robot.
2. Tap **CLEAR FAULT** in the Robot control panel to remove the signal.
3. Reset the e-stop button by turning the button.
4. Switch the arm on.

Related topics

[State: Fault](#) on page 78

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

SFo2 Protective stop

What does SFo2 monitor?

SFo2 monitors [protective stop](#) signals sent to the robot. Protective stops interrupt the robot motion, but it does not remove power from the robot. It is a [stop category 2](#).

Cause of the trigger #1

Internal processes of the [main processing unit](#) (MPU) are avoiding a category 0 stop before safety thresholds are exceeded.

Remedy for trigger #1

Tap **Diagnostics > Notifications** or tap  > **VIEW ALL** to identify the cause of the protective stop.

Cause of the trigger #2

External devices assigned as protective stops on the **Safety I/O** page.

Remedy for trigger #2

Ensure the signal of the specific I/O channel is off by sending a Protective Stop Reset signal. For example, switch off the light curtain signal, close a door linked with this specific signal, and so on.

Related topics

[Safety I/O](#) on page 69

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

SFo3 Joint position monitoring

What does SFo3 monitor?

SFo3 monitors the positions of each joint and compares the positions with the limits set in the **Joint Limits Position Limits** page.

Cause of the trigger

Certain trajectories may inadvertently make a single joint rotate constantly in the same direction without unwrapping. It is most common with the last joint. The unidirectional rotation may also happen when operating in Auto and Recovery modes. It results in a [stop category 2](#) protective stop.

Remedy

1. Clear the associated fault.
2. Identify which joint is nearing its position limit.
3. Move that joint in the position opposite to its limit.
4. Launch the **Jog Angular** panel and check the current joint positions.
5. Adjust the trajectory that caused the fault so that the joint unwraps before it reaches the limit.

Related topics

[Joint limits](#) on page 59

[Operating modes](#) on page 79

[Mode: Manual Jog](#) on page 80

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

SFo4 Joint speed monitoring

What does SFo4 monitor?

SFo4 monitors the speed of each joint and compares the speeds with the limits set in the **Joint Limits Speed Limits** page.

Cause of the trigger

- Unforeseen environmental forces could cause parts of the robot to exceed the speed planned for its trajectory. The unforeseen forces, such as a collision with a wall, may cause the [actuators](#) to [backdrive](#).
- It can also be caused when the robot is in Monitored Stop when an external force is applied to it.

It results in a [stop category 2](#) protective stop.

Remedy

Resume the trajectory. Link 6 has built-in functions to saturate its speed limits automatically.

If the error is triggered consistently, consider modifying the trajectory.

Related topics

[Joint limits](#) on page 59

[Elbow limits](#) on page 61

[Operating modes](#) on page 79

[Mode: Manual Jog](#) on page 80

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

SFo5 Monitored stop

What does SFo5 monitor?

SFo5, or [Monitored stop](#), monitors the velocity of each joint and makes sure the velocity is zero when the robot is not moving. It is a [stop category 2](#) in which electrical power still feeds the robot.

Cause of the trigger

Motion in the [actuators](#) is detected. For example, when the robot is vibrating a lot, there may be movement in the actuators.

Remedy

1. Remove the external source of motion.
2. Add damping elements to each source of vibration that is in contact with the robot.

Related topics

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

SFo6 Protection zone monitoring

What does SFo6 monitor?

SFo6 monitors the robot to make sure no part of the robot, including the user-defined tool sphere, comes in contact with any of the user-defined *protection zones* that are enabled.

Cause of the trigger

The robot touches an enabled protection zone when operating in Manual or running a program. It results in a [stop category 2](#).

Remedy

1. Power the robot.
2. Clear the fault.
3. Use Recovery mode to leave the protection zone.
4. Reconfigure protection zones if necessary and safe from **Safety > Protection Zones** in [the Web App](#).
5. Disable protection zones if necessary and safe from **Safety > Protection Zones** in the Web App.

Related topics

[Operating modes](#) on page 79

[Protection zones](#) on page 61

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

SFo7 TCP and elbow speed monitoring

What does SFo7 monitor?

SFo7 monitors the *Cartesian* speeds of the *TCP* and the *elbow*, which is the third joint, so that the speeds do not exceed the values set in the **TCP & Elbow Limits** page.

Cause of the trigger

- A large force is exerted on the robot during Hand Guiding mode, causing the speed of the *TCP* or elbow to increase.
- Joint commands, especially on the first joint, reach large angular speeds.

It results in a [stop category 2](#).

Remedy

- Apply constraints on local motion to limit the joint speeds and to keep the joint speeds within safe values.

- Modify the trajectory to include more waypoints such that the end effector and the elbow cannot reach high velocities.

Related topics

[Mode: Hand Guiding](#) on page 82

[Tool center point limits](#) on page 60

[Elbow limits](#) on page 61

[List of safety functions](#) on page 52

[Status of safety functions](#) on page 176

Stopping time and distance

The stopping time, measured in milliseconds, and distance, measured in degrees, are detailed for the first three joints of the [arm](#). It follows ISO 10219-1:2011.

Table 37: Stopping time and distance in accordance with ISO 10218-1:2011

Percentage of maximum payload (%)	Extension (%)	Speed (%)	First joint (Base)		Second joint (Shoulder)		Third joint (Elbow)	
			Stop time (ms)	Stop distance (°)	Stop time (ms)	Stop distance (°)	Stop time (ms)	Stop distance (°)
33%	33%	33%						
		66%						
		100%						
	66%	33%						
		66%						
		100%						
	100%	33%						
		66%						
		100%						
66%	33%	33%						
		66%						
		100%						
	66%	33%						
		66%						
		100%						
	100%	33%						
		66%						
		100%						

Percentage of maximum payload (%)	Extension (%)	Speed (%)	First joint (Base)		Second joint (Shoulder)		Third joint (Elbow)	
			Stop time (ms)	Stop distance (°)	Stop time (ms)	Stop distance (°)	Stop time (ms)	Stop distance (°)
100%	33%	33%						
		66%						
		100%						
	66%	33%						
		66%						
		100%						
	100%	33%						
		66%						
		100%						

Diagnostic coverage

Link 6 continually monitors itself and all diagnostics are displayed in [the Web App](#).

All safety functions are monitored. The state of each part that makes the [arm](#) work are also monitored. Problems encountered, with respect to safety functions of the arm, are displayed on the **Status** pages. The problems must be resolved before the robot can move again.

General and detailed information about the [base](#), [actuators](#), [end effector](#), and [flange](#) positions are displayed on the **Monitoring** pages.

Related topics

[Diagnostics](#) on page 175

[Status of safety functions](#) on page 176

Safety modes

Configure speeds both as normal or reduced to define safe operation of the robot.

Normal [safety mode](#) determines the maximum speeds at which the robot can move in [Cartesian](#) and [Angular](#) directions.

Reduced safety mode also determines the maximum speeds at which the robot can move in Cartesian and Angular directions. However, the maximum speeds in reduced mode are lower than those of the normal safety mode.

Reduced mode can be triggered by safety inputs. For instance, when the robot is learning its trajectories through Hand Guiding, the speed is dictated by the reduced mode to prevent injury.



Remember: It is the responsibility of the [integrator](#) to set all normal and reduced speeds with respect to the risk assessment. Also, all reduced speeds must be configured to be less than the corresponding normal speed.

Reduced mode can be selected from [the Web App](#).

Related topics

[Mode: Manual Jog](#) on page 80

[Mode: Hand Guiding](#) on page 82

[Mode: Hold-to-Run](#) on page 83

[List of safety functions](#) on page 52

[Robot safety protections and limits](#) on page 59

Robot safety protections and limits

To make sure the robot operates safely in its working environment, configure joint limits, [TCP](#) and [elbow](#) limits, [protection zones](#), and safety I/Os.

All tasks related to configuring the robot with respect to safety are performed by the *integrator*.



Important: Safety parameters can be modified only when there is no power in the arm.

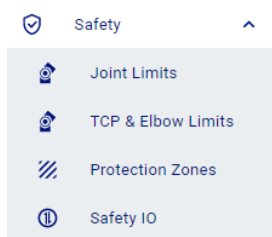


Figure 42: Accessing the safety pages

The [controller](#) prevents movement, speed, and force outside of the configured limits. The configured limits are monitored by certain safety functions.

- [Emergency stop](#)
- [Protective stop](#)
- [Joint position](#)
- [Joint speed](#)
- Protection zone
- TCP and elbow speed

Related topics

[List of safety functions](#) on page 52

[Safety modes](#) on page 58

Joint limits

Each joint can be configured with specific minimum and maximum [Angular](#) positions. Additionally, the speed of each joint can be configured in both normal and reduced safety modes.

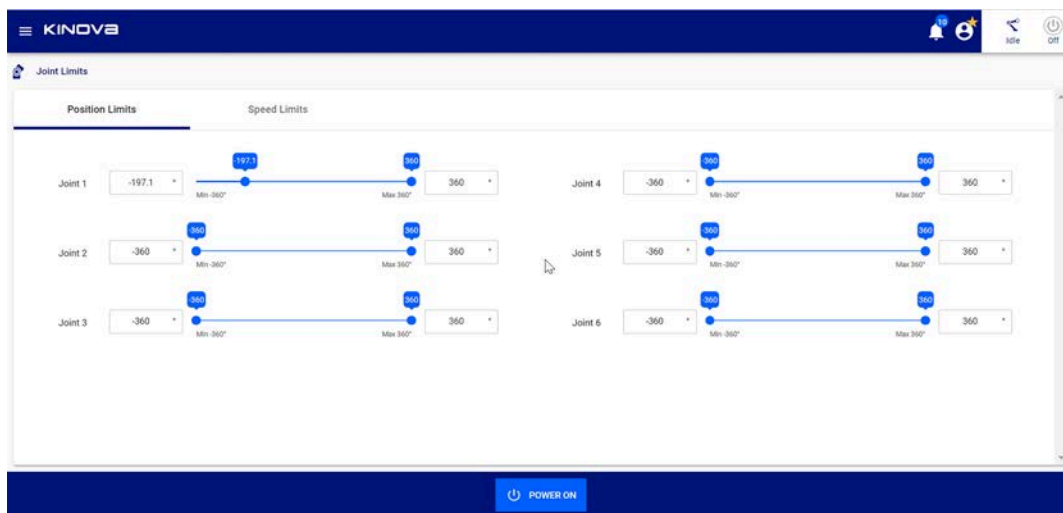


Figure 43: Position Limits page of Joint Limits page

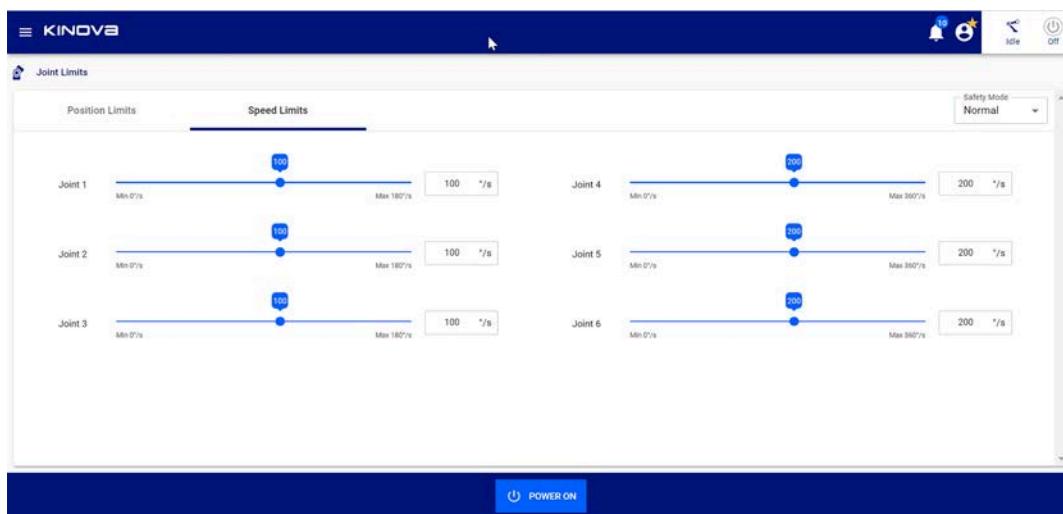


Figure 44: Speed Limits page of Joint Limits page

Table 38: Ranges of speed limits for joints

Safety mode	Joint size	Speed range
Normal	Size 110	0 °/s to 180 °/s
	Size 80	0 °/s to 360 °/s
Reduced	Size 110	0 °/s to 100 °/s
	Size 80	0 °/s to 200 °/s

Tool center point limits

The position and orientation of the *end effector* being used must be configured.

The *TCP* has translation and orientation speed, force, and *Angular* positions. The configured *TCP* speeds in the reduced safety mode must be less than the configured *TCP* speeds in the corresponding normal safety mode.



Important: There must be no power in the arm when the robot safeties are being configured.

Table 39: TCP configuration limits

TCP limit	Safety mode	Range
Translation Speed	Normal	0 m/s to 1.8 m/s
	Reduced	0 m/s to 0.75 m/s
Orientation Speed	Normal	0 °/s to 300 °/s
	Reduced	0 °/s to 150 °/s
Force	n/a	0 N to 200 N
Orientation X	n/a	-180° to + 180°
Orientation Y	n/a	-180° to + 180°
Orientation Z	n/a	-180° to + 180°

Elbow limits

The speed and orientation of the [elbow](#) must be configured.

The position and orientation of an [end effector](#) being used must be configured.



Important: There must be no power in the arm when the robot safeties are being configured.

Table 40: Elbow configuration limits

Elbow limit	Safety mode	Range
Speed	Normal	0 m/s to 1.8 m/s
	Reduced	0 m/s to 0.75 m/s
Force	n/a	0 N to 200 N

Protection zones

Prevent or limit where the robot can move by creating [protection zones](#).

The zones are three-dimensional geometric volumes intended to limit the possibility of the robot running into users or objects near the it. Protection zones define such things as [end effectors](#), walls, tables, and objects. Up to eight zones, excluding the tool zone, can be active simultaneously.



Important: The zone defined for the tool is the only zone that cannot be disabled. However, like the other zones, it can be modified. The tool zone must exist so that the robot takes the size of the end effector into account.



Important: There must be no power in the arm when the zones are being defined.

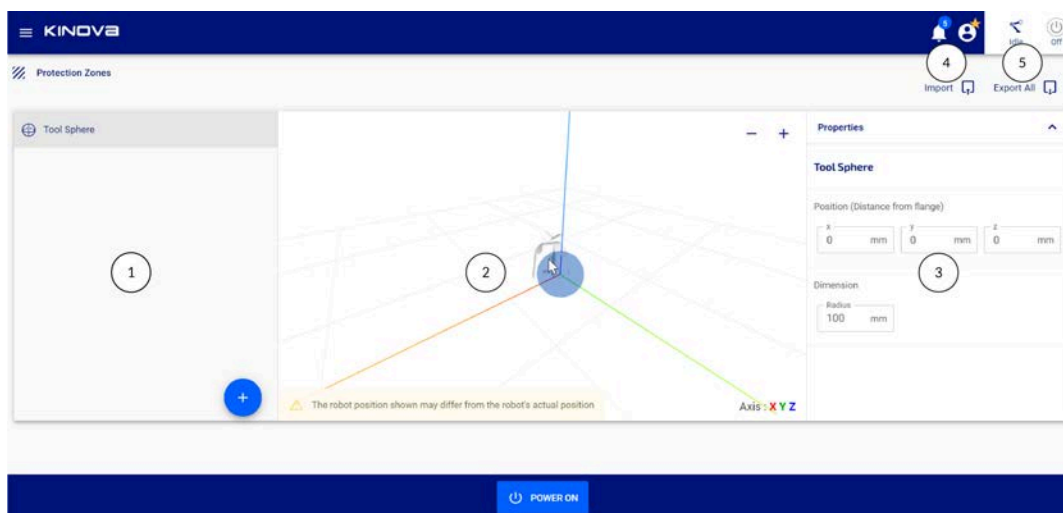


Figure 45: The Protection Zones page

- 1 Zones pane
- 2 Visualization pane
- 3 Zones configuration pane
- 4 **Import**



Important: Import is available on the teach pendant only when a [USB](#) is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.

- 5 **Export All**



Important: Export is available on the teach pendant only when a [USB](#) is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.

Related topics

[List of safety functions](#) on page 52

Tool sphere

The tool sphere, displayed in the **Protection Zones** page, is a [protection zone](#) for the [end effector](#) on the [arm](#). The tool sphere is the only protection zone that can move.

The end effector and the arm must never collide with each other. Therefore, the tool sphere is always displayed in the **Protection Zones** page. It can never be deleted and it can never be deactivated. However, the zone of the tool sphere can be modified.



Important: Always make sure the tool sphere size and offset reflect reality.

Zones pane

Create, rename, duplicate, and delete zones from the Zones pane. Export individual protection zones as XML or JSON from a web browser.

The zone for the [end effector](#) is always present; in the pane, it is listed as the **Tool Sphere**.



Important: The zone defined for the tool is the only zone that cannot be deleted. It must exist so that the robot takes the shape and offset of the end effector into account.

Protection zones that are already defined are listed in the Zones pane.

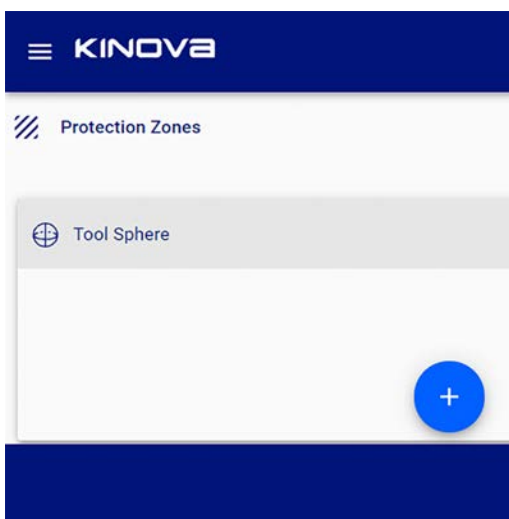


Figure 46: Example when no zones, except for the tool, are listed in the Zones pane

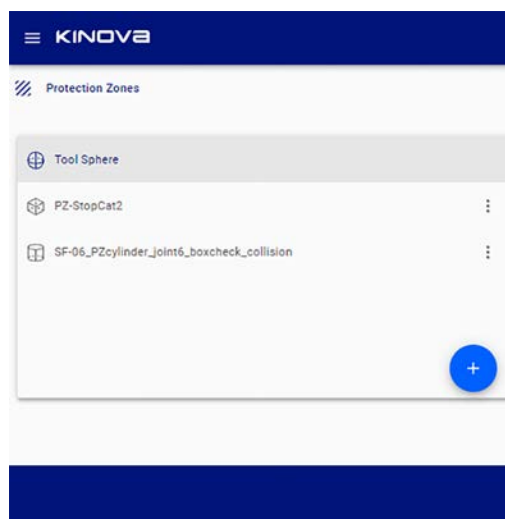
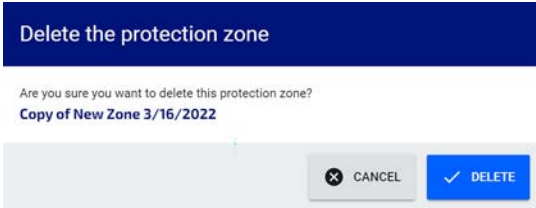


Figure 47: Example of multiple zones listed in the Zones pane

Table 41: Actions that can be performed on each protection zone from the *kebab* (:) menu

Selected zone actions	Description
Rename	Enter a meaningful name for the selected protection zone.
Duplicate	Create a new zone that is a duplicate of the selected protection zone. Tip: When the maximum number of zones are created, a message is displayed on the page indicating that no more zones can be added. Also, the option to duplicate from the menu is not selectable.
Delete	Delete the selected zone. A confirmation dialog launches. Tap Delete to delete the zone. 

Selected zone actions	Description
Export XML	Export the currently saved configuration of the selected zone as an XML file.  Important: Export is available on the teach pendant only when a USB is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.
Export JSON	Export the currently save configuration of the selected zone as a JSON file.  Important: Export is available on the teach pendant only when a USB is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.

Adding a safety zone

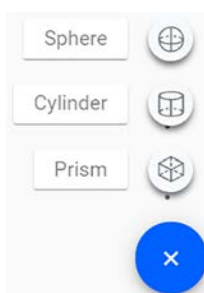
Safety zones are areas where the robot cannot enter.

About this task

Create one safety zone for each object or area that the robot must avoid. Up to eight zones can be active and monitored by the robot at one time. However, more than eight zones can be created; zones can be left inactive.

Procedure

1. Tap the hamburger menu (☰) to expand the menu.
2. Tap **Safety > Protection Zones**.
3. Tap  in the Zones pane of the **Protection Zones** page.
A menu of zone shapes launches.



4. Tap one of the three shapes.
The new zone with its shape is highlighted in the Visualization pane.
The default values of the zone is launched in the Configuration pane.
5. Enter the desired values in the Configuration pane.
6. Tap **Activate Zone** to make the zone active.

Manipulating existing safety zones

Deleting, duplicating, and renaming zones are all ways of manipulating existing zones.

About this task

The entire operation is performed within the Zones pane.

Procedure

1. Tap the hamburger menu () to expand the menu.
2. Tap **Safety > Protection Zones**.
3. Tap the zone in the list that needs to be manipulated.
A single tap selects the zone.
4. Tap the associated *kebab* () menu.
A menu for the selected zone launches.
5. Tap the action needed for that zone.
 - Tap **Delete** to delete a zone.
 - Tap **Duplicate** to duplicate a zone. Modify the zone properties after duplicating it.
 - Tap **Rename** to rename a zone. Most often, the renamed zone is a duplicated zone.
 - Tap **Export JSON** to export the zone to a JSON file.

 **Important:** Export is available on the teach pendant only when a [USB](#) is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.
 - Tap **Export XML** to export the zone to an XML file.

 **Important:** Export is available on the teach pendant only when a [USB](#) is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.

Zone shapes

Each zone is created using a specific shape.

There are three shapes that are available. Some properties are shared among all shape. Some properties are specific to the shape. The properties of the zones must be defined or configured. Configure the zones in the Configuration pane.

Table 42: Properties specific to the tool sphere zone

Properties	Description
Position	Distance is measured from the x,y,z coordinates of the flange and is measured in millimeters. Default coordinates: (0,0,0)
Dimension	The dimension of the radius of the end effector measured in millimeters. Default radial size: 100 mm

Table 43: Properties common to all zone shapes that can be added

Properties	Description
Name	When the shape is first created, its name is automatically set to the current date appended to the string "New Zone".

Properties	Description
	Change the name to something meaningful.
Activate Zone	By default, the zone is active. Deactivate the zone when the environment around the robot is going to change. For example, when a single arm is used in multiple setups, it is convenient to be able to activate the desired zone for the current environment.

Table 44: Properties specific to the cylinder zone



Properties	Description
Orientation - Euler	Enter the orientation of the end effector using the extrinsic ZYX Euler angle convention. Orientation is measured in degrees.
Position	Distance is measured from the x,y,z coordinates of the base and is measured in millimeters. Default coordinates: (0,0,0)
Dimension	Enter the height (z) of the cylinder and the radius of the zone. Height and radius are measured in millimeters. Default height: 300 mm Default radial size: 200 mm

Table 45: Properties specific to the prism zone



Properties	Description
Orientation - Euler	Enter the orientation of the end effector using the extrinsic ZYX Euler angle convention.
Position	Distance is measured from the x,y,z coordinates of the base and is measured in millimeters. Default coordinates: (0,0,0)
Dimension	Enter the length (x), width (y), and height (z) of the zone. Length, width, and height are measured in millimeters. Default length: 250 mm Default width: 250 mm Default height: 250 mm

**Table 46: Properties specific to the sphere zone**

Properties	Description
Dimension	Enter the dimension of the zone as a radius.
	The radius is measured in millimeters.
	Default radial size: 200 mm
Position	Distance is measured from the x,y,z coordinates of the flange and is measured in millimeters.
	Default radial size: 200 mm

Related topics

[Euler angle convention used](#) on page 67

Euler angle convention used

Euler angles are used to represent the orientation of an object, such as a robot tool. The convention used is Tait-Bryan, extrinsic ZYX.

There are three ways to rotate from the reference coordinate from (x,y,z) to the considered rigid body.

1. Rotation about fixed x axis of an angle r_x (γ).
2. Rotation about fixed y axis of an angle r_y (β).
3. Rotation about fixed z axis of an angle r_z (α).

With this angle convention, we can define the associated rotation matrix.

$$R = Z(\alpha)Y(\beta)X(\gamma)$$

Exporting or importing all zones into one file

All zones can be exported into one XML or JSON file after they are defined. All zones can be imported at once.

About this task

Exporting zones is a fast way to integrate the robot, especially when multiple robots are in the working environment. Define zones for one of the robots, import the file for the next robot, and modify the values for it. Again, these new zones can be exported.



Important: Export is available on the teach pendant only when a [USB](#) is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.



Important: Import is available on the teach pendant only when a [USB](#) is connected in the USB port on the controller. It is available from a web browser when there is no USB stick.



Important: The exported and imported zones do not include the zone definition for the tool.



Figure 48: Location of Protection zone Export All button

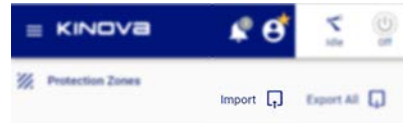


Figure 49: Location of Protection zone Import button

Procedure

Export all zones to one file

1. Tap **Export All** > **Export JSON** to export all the zones to a JSON file.
All zones are saved in the zone definition file.

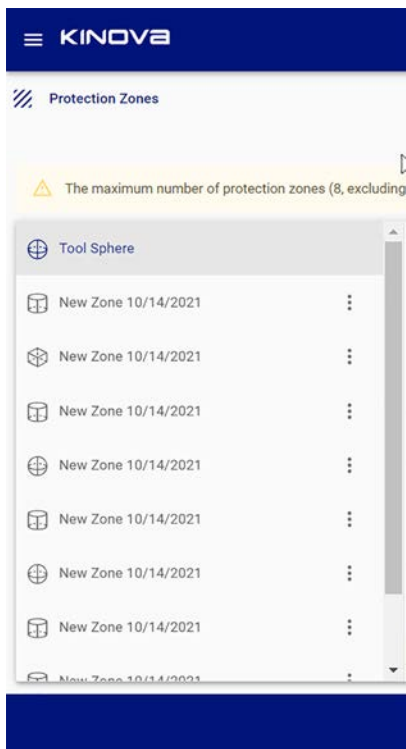
Import all zone from one file

2. Tap **Import**.
3. Browse to the location where the protection zone XML or JSON files are stored.
4. Select the desired file.

Results

The Zones pane populates with all the zones defined in the file.

Example



Visualization pane

A visualization of the defined protection zones, as well as the arm of Link 6 in its current position, is in the Visualization pane. The view helps to determine the protection zones in a 3-dimensional space with respect to the robot.

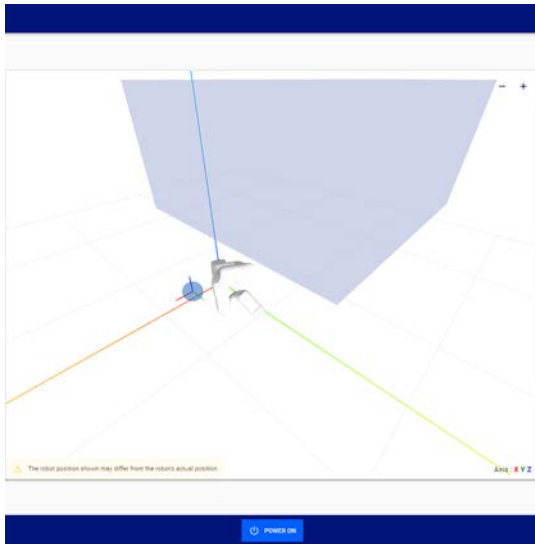


Figure 50: Visualization pane with tool sphere, robot, and other protection zones

Zoom in, zoom out, and view the zones from different angles.

Safety I/O

Each input safety function can be assigned through [the Web App](#) to one of eight channels.

A maximum of six possible safety equipment can be connected to the controller, plus an external [E-stop](#) button.

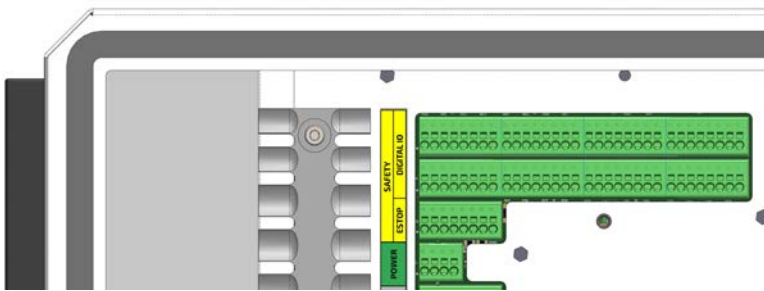


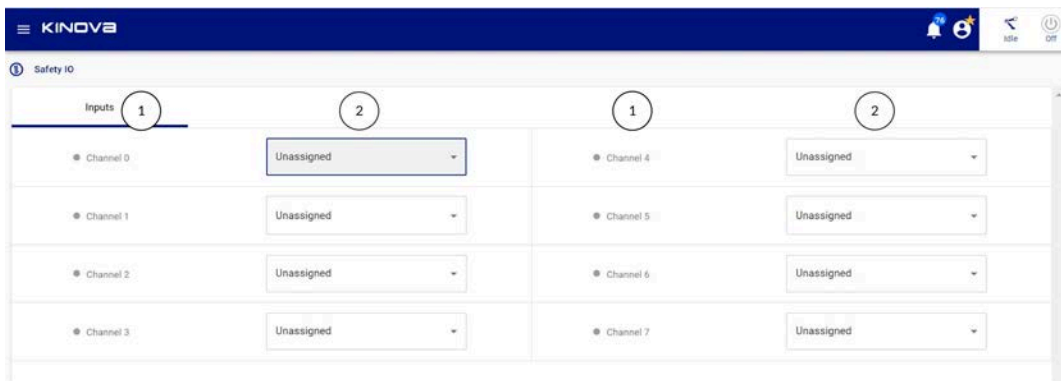
Figure 51: Location of connectors for the Safety I/O equipment

When the physical equipment is connected to the [controller](#) through the green slots, it can then be assigned a specific behavior on the corresponding input channel in the Web App. The input channels are numbered 0 through 7.



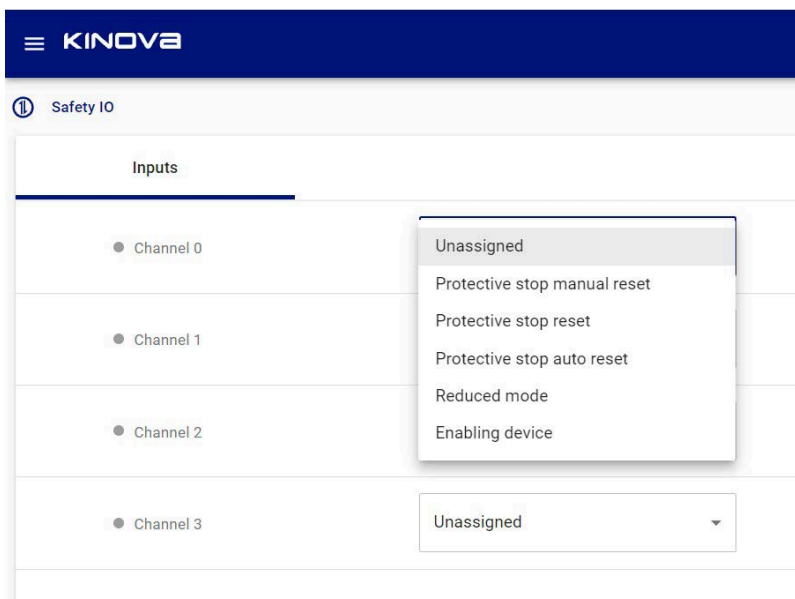
Important: Make sure the arm is in the *Idle state* before you configure safety inputs. The arm is in the *Idle state* when the arm is switched off, but the controller is switched on.

Access the **Safety I/O** page by tapping **Safety > Safety I/O**.



- 1 Input channel 2 Safety behavior

The safety input behavior drop-down has several choices. Each safety input monitors a specific condition. The different conditions are listed in the safety input drop-down.



All safety digital inputs are *NC*.

Table 47: Input safety choices available for each channel

Safety input behavior name	Description
Unassigned	Channel behavior is not altered for the connected equipment.
Protective stop manual reset	The robot automatically comes to a stop, either because of a fault or because an intrusion in the working zone is detected. After the fault is cleared or the intrusion is gone, the user must reset the robot before it can resume operations.
Protective stop reset	It resets a <i>protective stop</i> . The robot is in <i>Monitored stop</i> when it is in a protective stop. Use the reset input of the protective stop to resume operation.

Safety input behavior name	Description
Protective stop auto reset	The robot automatically comes to a stop, either because of a fault or because an intrusion in the working zone is detected. After the fault is cleared or the intrusion is gone, the robot automatically resets itself and resumes operations.
Reduced mode	The robot operates at reduced speed when the connected equipment is configured to use the reduced speed.
Enabling device	Connect an external enabling device to the controller and assign the corresponding channel the enabling device behavior. When one enabling device is pressed, regardless of where it is, the robot is enabled.

Input signals are compatible with devices that implement [OSSD](#) behavior. The pulsed *Output Signal Switching Device* (OSSD) signals are filtered with the period is less than 3 ms.

Modes of operation of Link 6

The robot enters different *states* and *modes* during operation. The states often have a visual component for the user to recognize. The modes are how the user interacts with the robot. However, even the modes of operation have a visual component for the user to recognize.

The basic modes of operation require user intervention.

- Startup
- Operation
- Recovery

Within each of the basic modes are internal modes and states.

There are three places to look for cues to determine what state the robot is in.

- [Controller](#)
- [Wrist](#)
- [The Web App](#)

Location of lights to watch on the controller and the wrist

Communication between the robot and the user is achieved by lights found on the controller and around the [wrist ring](#).

Table 48: Controller and arm when Link 6 is off



- 1 Power knob
- 2 ACK button

- 3 Wrist ring

Convention for the representation of the states

In an attempt to help visualize what is happening, the graphics follow a convention for flashing lights. In every case, the number of lines represent the number of flashes for each second.

- A single line coming out the sides of what is supposed to be the lit portion of equipment indicates one flash for each second. The color of the lines represents the color of the lights.

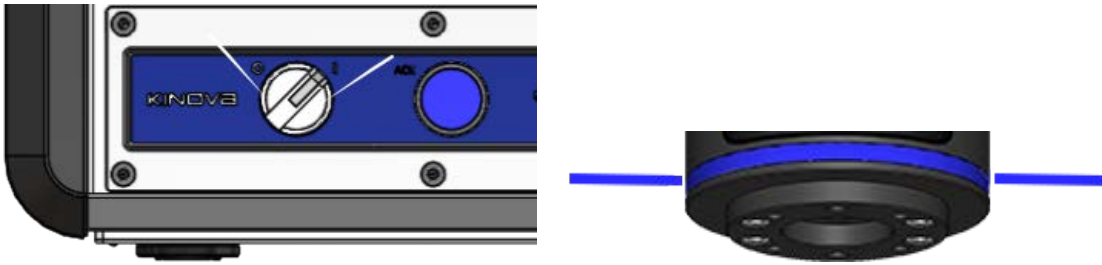


Figure 52: Example of equipment flashing once per second

- Two lines coming out the sides of what is supposed to be the lit portion of equipment indicates two flashes for each second. The color of the lines represents the color of the lights.

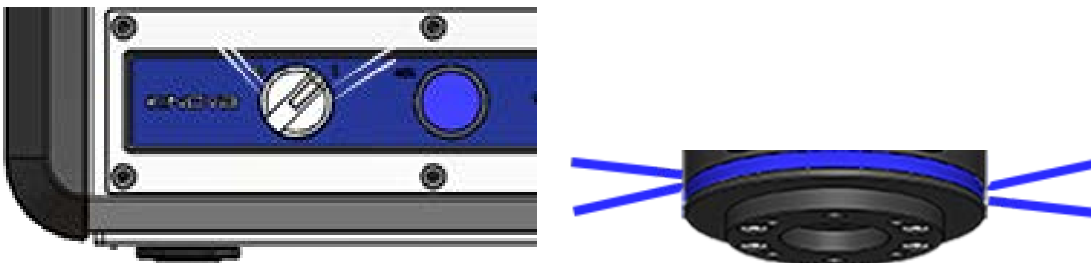


Figure 53: Example of equipment flashing twice per second

There also is a table that explains what each portion of a graphic is attempting to represent.

Complete start-up sequence

It is a two-part process to start up Link 6: first turn on the [controller](#) and then the [arm](#). This two-part process means the robot goes through six different *states*.

Off — Controller initialization — Controller idle — Arm initialization — Arm maintenance — [Monitored stop](#)

State: Off

Link 6 is off and is not energized when the power button on the [controller](#) is switched off.

Before you start working with the [arm](#), make sure it is off. When it is off, all lights are extinguished.

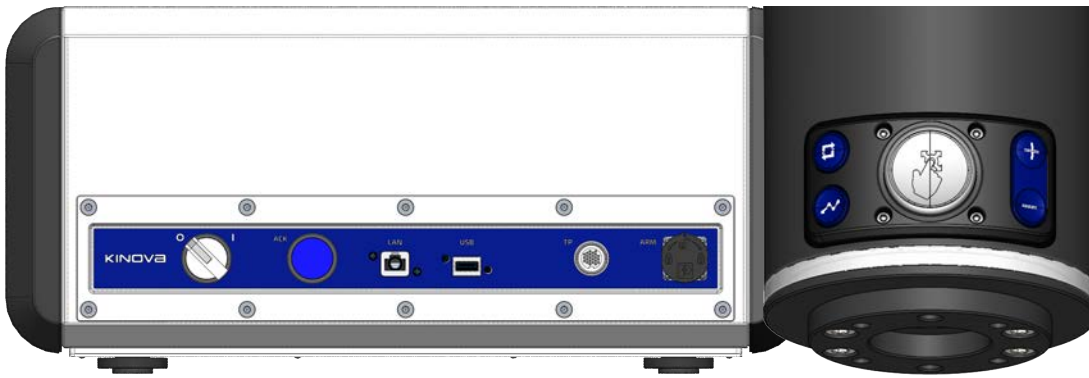


Figure 54: Controller when it is off

Figure 55: Wrist ring when it is off

Important: If there is a light on the controller power knob, turn off Link 6 by turning the power knob to the off position.

Controller lights	Wrist ring	Description
Power knob points to the O, or off, position.	No light illuminates on the wrist ring.	Arm does not receive power.
No light illuminates on the controller power knob.		
ACK button on the controller does not illuminate.		

The startup workflow begins with switching on the controller and switching on the arm.

State: Controller initialization

When the knob on the [controller](#) is turned to the I, or on, position the controller is in its initialization state.

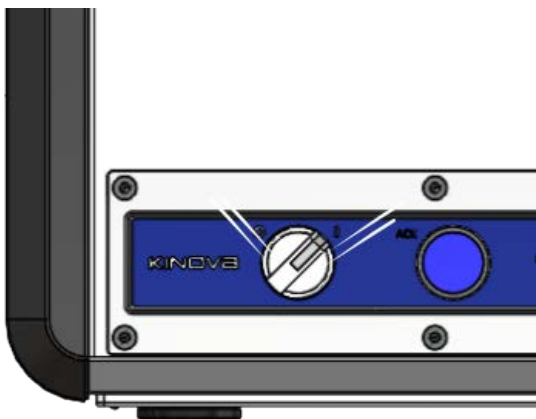


Figure 56: Visual cues for controller initialization

Controller lights	Wrist ring	Description
Power knob points to the I, or on, position.	No light illuminates on the wrist ring.	Controller receives power.

Controller lights	Wrist ring	Description
Power knob on the controller flashes white twice (2) each second.		Processors in controller boot .
ACK button on the controller does not illuminate.		Application software for the I/O boards and teach pendant, if installed, start.
		Calibration, configuration, and safety checks are validated.

When the light behind the power button is a steady white, the initialization of the controller is complete. The controller enters a new state: Idle.

State: Controller idle

When Link 6 is in the idle state, there is power in the [controller](#), but not in the [arm](#).

You can recognize the Idle state by looking at the power button on the controller; its light is a steady white.

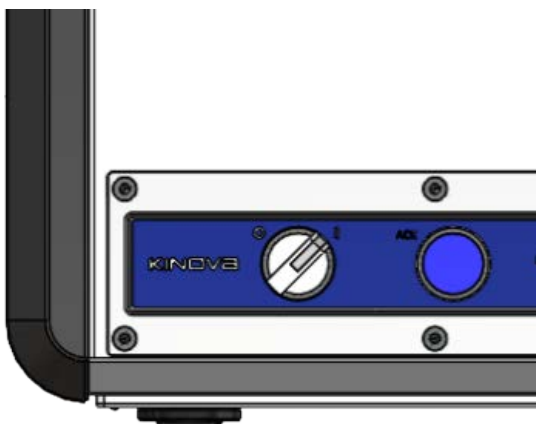


Figure 57: Controller when it is idle

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	No light illuminates on the wrist ring.	Controller is fully operational and idle.
ACK button on the controller does not illuminate.		Arm is not on.

State: Arm initialization

After you turn on the [arm](#) from [the Web App](#), the arm needs to initialize itself, much like the [controller](#).

Arm initialization is recognized by looking at the white light of the power knob on the controller and at the light around the wrist.



Figure 58: Visual cues of arm initialization

Controller lights	Wrist ring	Description
Power knob on the controller flashes white twice (2) each second.	Wrist ring flashes blue twice (2) each second.	Arm is receiving power. Arm is booting up the actuators and is checking the firmware and software are compatible with the arm.
Power knob on the controller flashes white twice (2) each second.		The Web App displays the state as Initialized .

If the hardware needs a firmware update, the arm enters the Arm maintenance state and returns to the Arm initialization state after maintenance is complete. Firmware updates take approximately 5 minutes.

After the arm is initialized and the firmware is up-to-date, the brakes in the actuators release.

The brakes in each actuator for each joint are released one at a time in a specific sequence. The sequential release keeps the robot steady when it is powering up.

State: Arm maintenance

Maintenance only happens when the **firmware** needs to be updated.

After the firmware is updated, the robot restarts the Arm initialization process to make sure there are no other issues.

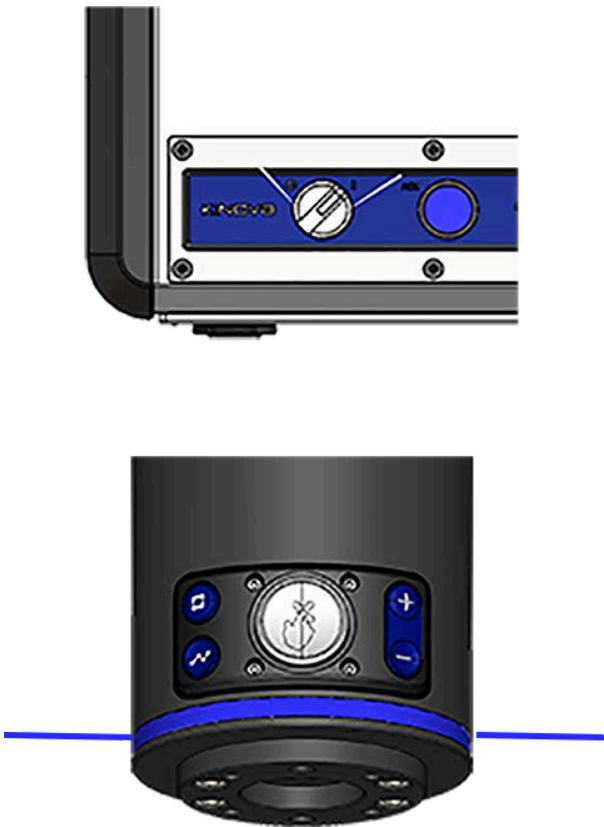


Figure 59: Visual cues of arm maintenance in progress

Controller lights	Wrist ring	Description
Power knob on the controller flashes white once (1) each second.	Wrist ring flashes blue once (1) each second.	Microcontrollers on the actuators receive firmware updates.
ACK button on the controller does not illuminate.		The Web App displays the state as Initialized .

After firmware is updated, the Arm initialization state restarts.

State: Monitored stop

Link 6 is ready to be used and is in a standstill position; it is waiting for user input.



Figure 60: Visual cues of robot in *Monitored stop*

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	Wrist ring flashes green once (1) each second.	Mechanical brakes in the <i>arm</i> are released.
ACK button on the controller does not illuminate.		The arm is fully operational and is waiting for commands.

Related topics

[Stop categories](#) on page 51

State: Fault

Link 6 can stop unexpectedly or may need to stop suddenly.

There are a few main ways the robot can stop suddenly.

- The *arm* exceeds the configured safety limits for position; a *protective stop* has been issued to the arm.
- Someone presses the *emergency stop* button.
- A fault is detected. Faults are failures in internal, built-in tests and safety functions.

The *SCU* is responsible for triggering a *stop category* 0 fault; no power is in the arm

The *Main Control Unit (MCU)* is responsible for triggering the fault; the *wrist ring* illuminates red.



Figure 61: Visual cue of fault without power



Figure 62: Visual cue of fault with power

Controller lights	Wrist ring	Description
Power knob on the controller flashes white four (4) times each second.	No light illuminates on the wrist ring.	An internal fault occurred.
ACK button on the controller does not illuminate.		There is no power in the arm.
Power knob on the controller flashes white four (4) times each second.	Wrist ring illuminates red steadily.	An internal fault occurred.
ACK button on the controller does not illuminate.		There is power in the arm.

Related topics

[Recovery mode](#) on page 86

[Why can the robot not exit recovery mode?](#) on page 230

Operating modes

When the [controller](#) and [arm](#) are on, Link 6 is in the Monitored Stop state and can be used in any of the modes of operation available to it.

Each mode of operation is a way in interacting with the robot to make it move.

- Manual Jog

- Hand Guiding
- Hold-to-Run
- Auto

Related topics

[Stop categories](#) on page 51

Mode: Manual Jog

Use the mode Manual Jog to move the [arm](#) with [the Web App](#). There are two jog interfaces: [Cartesian](#) control and joint, or [Angular](#), control.

There are a few requirements before you start moving the arm.

- Use the [teach pendant enabling device](#). If the *pendant* is not available, use an external [enabling device](#) connected to the [controller](#). The enabling device must be pressed down and held in its center position.
- There must be a request for movement coming from the Web App.

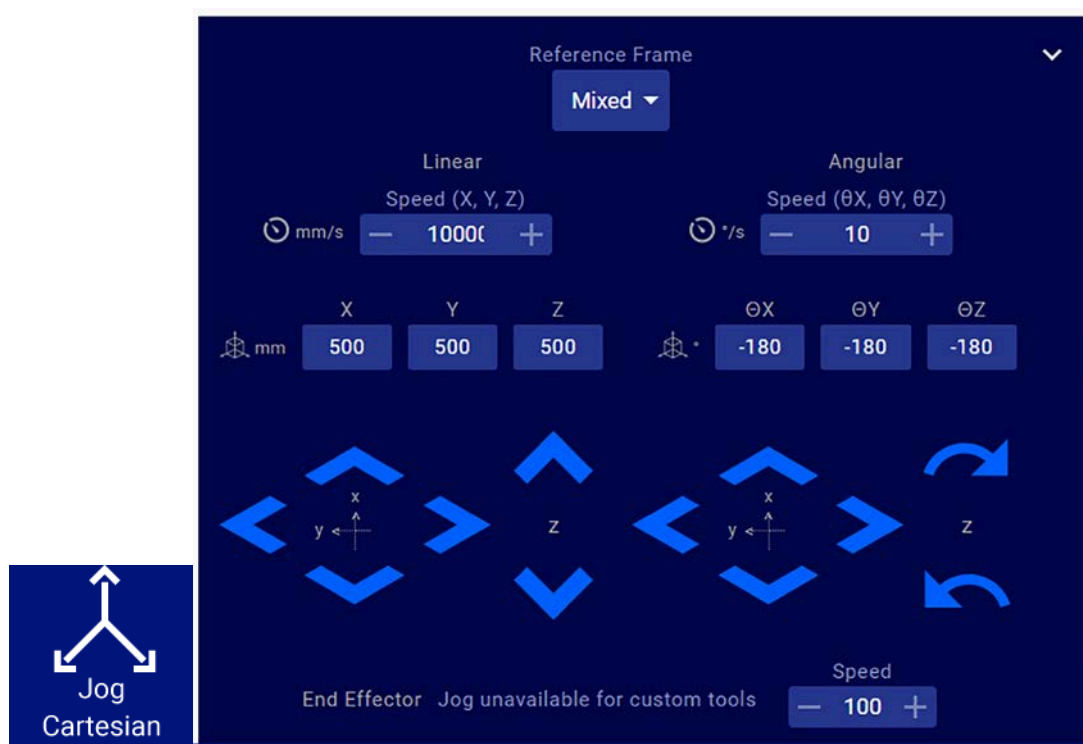


Figure 63: Jog Cartesian icon and control panel



Figure 64: Jog angular icon and control panel



Figure 65: Location of enabling device on the teach pendant

When the robot is in the mode Manual Jog, there is a steady, white light behind the power knob on the controller and a steady, blue light on the wrist.

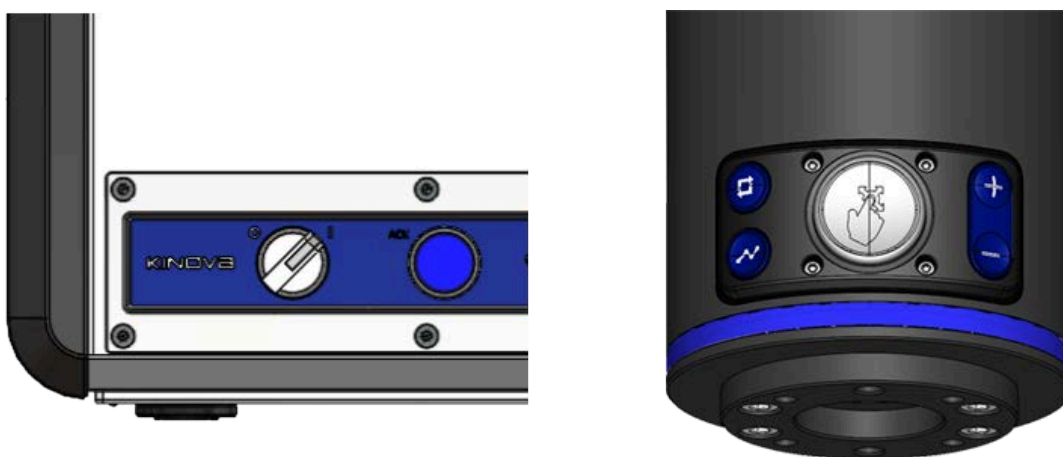


Figure 66: Visual cues of Manual mode

² Disclaimer: the color of the hardware in the image may differ from your installation

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates blue steadily.	Move the arm in any direction with the Web App while holding the pendant enabling device in the pressed position.
ACK button on the controller does not illuminate.		

When the robot is in Manual mode, Link 6 operates strictly in Reduced safety speeds to reduce the possibility of injury.

Exit Manual jog mode by releasing the enabling device. Link 6 returns to the *Monitored stop* state.

Related topics

[Safety modes](#) on page 58

[Jog Angular panel](#) on page 167

[Jog Cartesian panel](#) on page 165

Mode: Hand Guiding

Use Hand Guiding mode to move the robot to a specific location by using one hand.

While keeping the *wrist enabling device* pressed in the middle position, move the *arm* up or down, left or right, forward or backwards, as well as rotate the arm or the wrist around any of the joints.



Figure 67: Center button on the wrist is the wrist enabling device button

The arm stops moving when the wrist enabling device is not pressed or when it is pressed completely.

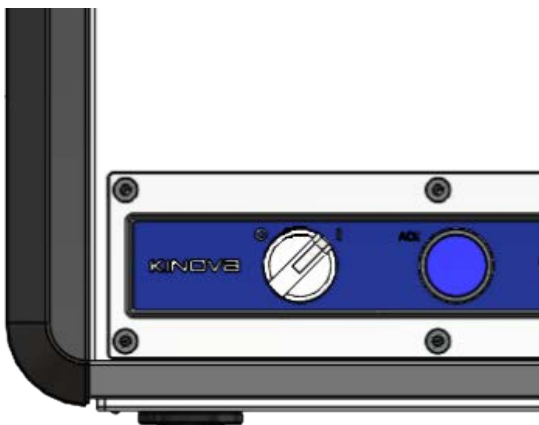


Figure 68: Visual cues of the Hand Guiding mode

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates blue steadily.	Move the arm in any direction while holding the wrist enabling device button in the pressed position.
ACK button on the controller does not illuminate.		

Within the Hand Guiding mode are two different Guidance modes.

- [Cartesian](#)



Warning: Cartesian Hand Guiding uses sensors situated internally to the wrist. To avoid unintentional movement, it is recommended to manipulate the arm from the wrist only during Cartesian Hand Guiding.

- [Angular](#)

Enable Hand Guiding mode by pressing the [wrist enabling device](#). Press the Hand Guiding mode Toggle button to enable one of the two Hand Guiding modes.



Figure 69: Location of Hand Guiding mode Toggle on the wrist

When the robot is in Hand Guiding mode, Link 6 operates strictly in Reduced safety speeds to reduce the possibility of injury.

Related topics

[Safety modes](#) on page 58

[Hand Guiding panel](#) on page 164

Mode: Hold-to-Run

Hold-to-Run is a special mode available only to users with [admin](#) privileges.

The Hold-to-Run mode is used to develop and verify a programmed sequence works as expected before the program is release to other users.

Hold-to-Run is also used for troubleshooting a situation with the robot. Robotic movement can be slowed during this mode to ease observing the actual actions in the programmed sequence.

To be able to move the [arm](#), an [enabling device](#) must be on.

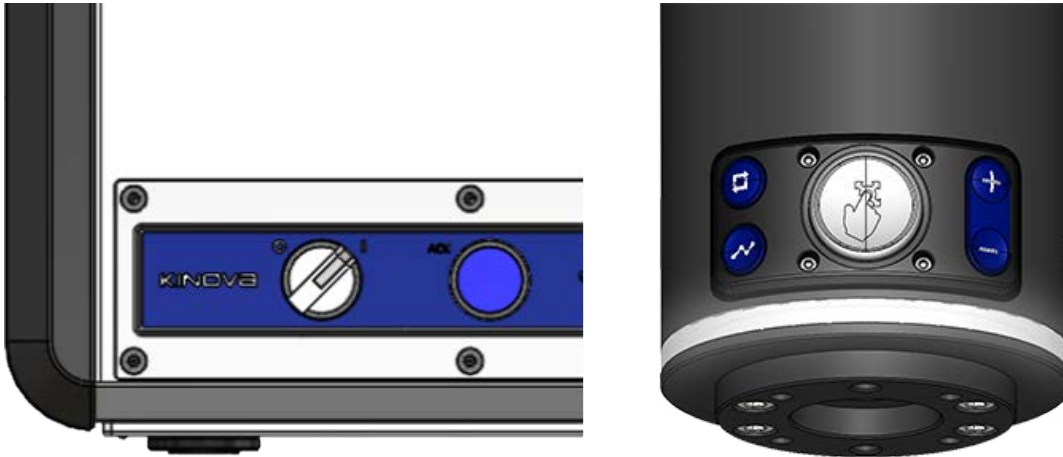


Figure 70: Visual cues of the mode Hold-to-Run when there is no issue

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates white steadily.	The selected program is ready to be verified.
ACK button on the controller does not illuminate.		

When the robot is in Hold-to-Run mode, Link 6 can operate in either Reduced or Normal safety speeds. By default, the robot operates in Reduced safety speeds to reduce the possibility of injury. The reduced speed can be configured slower.

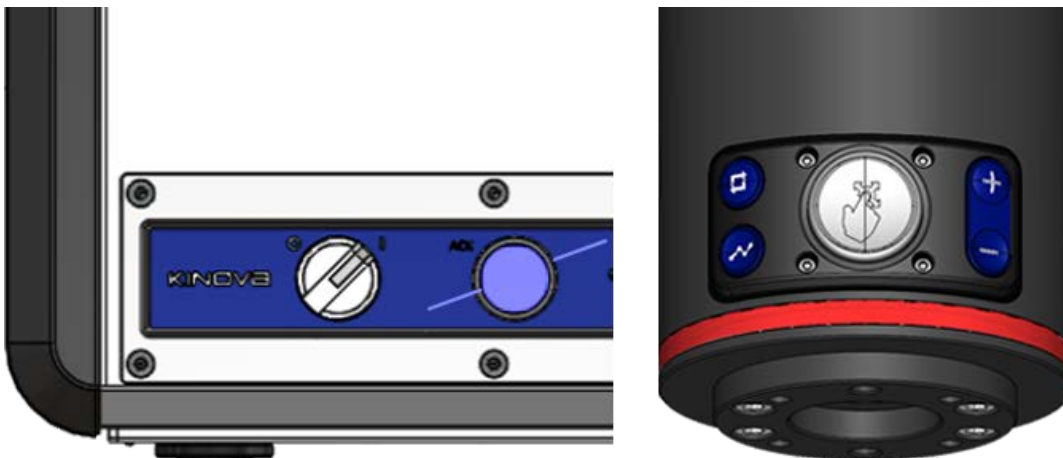


Figure 71: Visual cues of the mode Hold-to-Run when there is an issue

Controller lights	Wrist light	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates white steadily.	The robot is in <i>Monitored stop</i> . When the robot starts to move again, it runs at the Reduced Safety mode speed.
ACK button on the controller flashes blue once (1) each second.		



DANGER: Do not attempt to use the wrist buttons when a program is running and the robot is in Hold-to-Run mode; it can result in serious injury.

Related topics

[User management](#) on page 112

[Running a program in Automatic mode](#) on page 173

[Safety modes](#) on page 58

[Running a program in Hold-to-Run mode](#) on page 174

Mode: Automatic

Known as the normal mode of operation, it is used to play a *program sequence* that has been validated.

When the robot is in Auto mode, Link 6 can operate in either Reduced or Normal safety speeds. By default, the robot operates in Normal safety speeds.



Note: Auto mode is intended for the *operator*.

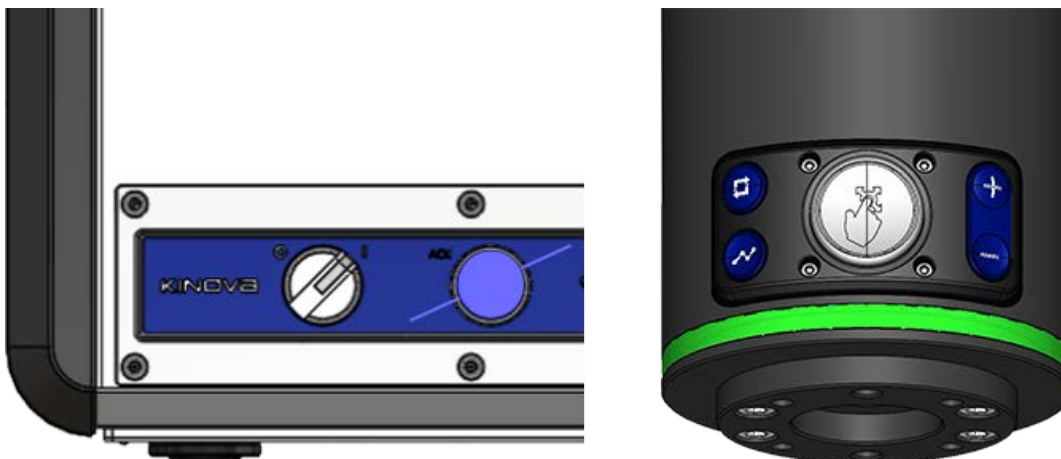


Figure 72: Visual cues for the Auto mode

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates green steadily.	The selected program is ready to be run.
ACK button on the controller flashes blue once (1) each second.		

Related topics

[Safety modes](#) on page 58

[Running a program in Automatic mode](#) on page 173

Recovery mode

Some faults stop the robot in a state that triggers the same fault after it has been cleared. These are the faults that require a recovery strategy for the robot.

There are several ways a fault can be cleared and leave the robot in a fault state. One example is a robot enters a [protection zone](#) and stops. The fault is cleared using [The Web App](#), but the [arm](#) is still within the protection zone.

There is only one way to get out of recovery mode. Move the robot to a safe position using either Hand Guiding or Manual Jog. All position-related safeties are ignored during recovery.

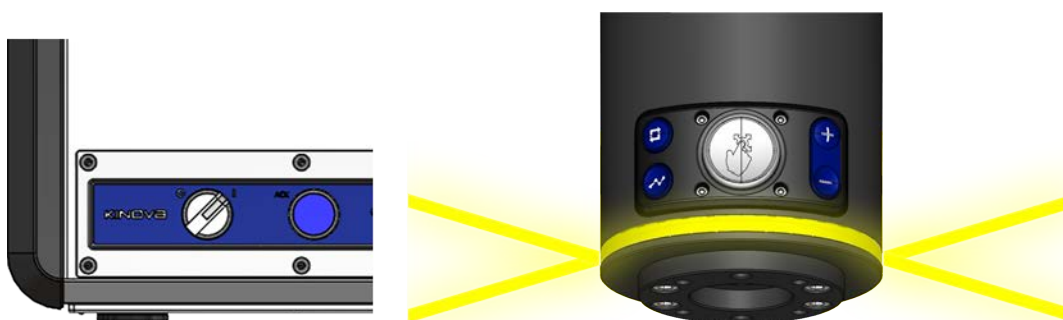


Figure 73: Visual cues of robot in Recovery

Controller lights	Wrist ring	Description
Power knob on controller illuminates white steadily.	Wrist ring flashes yellow two (2) times each second.	The robot requires user intervention that involves using the Web App and the wrist enabling device .
ACK button on the controller does not illuminate.		

Related topics

[State: Fault](#) on page 78

[Why can the robot not exit recovery mode?](#) on page 230

Robot lights and what they mean: a reference

You can tell which mode or state the robot is currently in by looking at the lights on the [controller](#) and on the [wrist ring](#) on the [arm](#).

Table 49: What the lights on the controller and the wrist ring on the arm mean

Description	Meaning
Power knob points to the O, or off, position.	Controller is off.

Description	Meaning
ACK button on the controller does not illuminate.	
Power knob on the controller flashes white twice (2) each second.	Controller is powering on. Processors in controller <i>boot</i> .
ACK button on the controller does not illuminate.	Application software for the I/O boards and <i>teach pendant</i> , if installed, start. Calibration, configuration, and safety checks are validated.
Power knob on controller illuminates white steadily.	Controller is fully operational and idle.
ACK button on the controller does not illuminate.	Arm is not on.
Power knob on the controller flashes white twice (2) each second.	Arm is powering on.
ACK button on the controller does not illuminate.	Controller checks whether the <i>firmware</i> in the arm matches the firmware in the software unit in the controller.
Wrist ring flashes blue twice (2) each second.	<i>The Web App</i> displays the state first as Initialized and then as Brakes Released during this stage unless a firmware updates is required. If firmware updates are required, The Web App displays first Initialized , then Maintenance , and then Brakes Released .
Power knob on the controller flashes white once (1) each second.	Firmware updates.
ACK button on the controller does not illuminate.	 Important: Firmware in the arm updates right after powering on the arm only when an update occurs in the software unit in the controller.
Wrist ring flashes blue once (1) each second.	The Web App displays the state as Maintenance .
Power knob on controller illuminates white steadily.	The arm is fully operational and is in <i>Monitored stop</i> .
ACK button on the controller does not illuminate.	The Web App displays the state first as Brakes Released and then as Operational .
Wrist ring flashes green once (1) each second.	
Power knob on controller illuminates white steadily.	Link 6 is operating either in Hold-to-Run mode or in Auto mode.
ACK button on the controller flashes blue once (1) each second.	
Wrist ring illuminates white steadily.	
Power knob on controller illuminates white steadily.	The robot is operating either in Hold-to-Run mode or in Auto mode.
ACK button on the controller flashes blue once (1) each second.	The program is running and the <i>enabling device</i> has not been pressed for over five (5) minutes.

Description	Meaning
Wrist ring illuminates white steadily.	It is also possible that the configured speed is greater than the reduced mode speed.
Power knob on controller illuminates white steadily.	The robot is operating in Manual Jog mode.
ACK button on the controller does not illuminate.	Move the arm in any direction with the Web App and with the enabling device pressed in the middle position.
Wrist ring illuminates blue steadily.	
Power knob on controller illuminates white steadily.	The robot is operating in Hand Guiding mode.
ACK button on the controller does not illuminate.	Move the arm in any direction while holding the wrist enabling device button in the middle position.
Wrist ring illuminates blue steadily.	
Power knob on controller illuminates white steadily.	The robot is operating in Auto mode.
ACK button on the controller flashes blue once (1) each second.	
Wrist ring illuminates green steadily.	
Power knob on controller illuminates white steadily.	The robot is in Recovery mode.
ACK button on the controller does not illuminate.	The arm of the Link 6 is outside the area in which it is allowed to be in, such as within a protection zone , or one or more of the joints is outside its safety limits.
Wrist ring flashes yellow two (2) times each second.	
Power knob on controller illuminates white steadily.	The robot is recovering from an emergency stop caused by pressing the <i>E-stop</i> button.
ACK button on the controller illuminates blue steadily.	
No light illuminates on the wrist ring.	
Power knob on the controller flashes white four (4) times each second.	An internal fault occurred.
ACK button on the controller does not illuminate.	There is no power in the arm.
No light illuminates on the wrist ring.	
Wrist ring flashes white four (4) times each second.	An internal fault occurred.
ACK button on the controller does not illuminate.	There is power in the arm.
Wrist ring illuminates red steadily.	The joint or zone limit is reached.

Related topics

[Indicators, user profile, and power](#) on page 109

Hardware installation

Link 6 requires installation in the working environment.

Installation involves placing the [arm](#) where it is going to be performing tasks, placing the [controller](#) within the constraints of the length of the cable to the arm in an accessible location, and making sure the robot is installed according to safety guidelines.

Before unpacking, the [integrator](#) should already know the size of the robot from the technical specifications, have performed a risk assessment, and be familiar with the safety considerations.

! **Important:** Always place the boxes so that the arrows on the boxes point up to avoid possible damage to the equipment.

Related topics

[Safety directives and warnings](#) on page 47

Inside the Link 6 boxes

Link 6 comes in two cardboard boxes. Both boxes are heavy. It is advisable to have two people carry each box.

The smaller box contains the [controller](#), a box with the accessories, and a box with the [teach pendant](#). The box with accessories contains the power cord for the controller, as well as all optional accessories bought with Link 6.

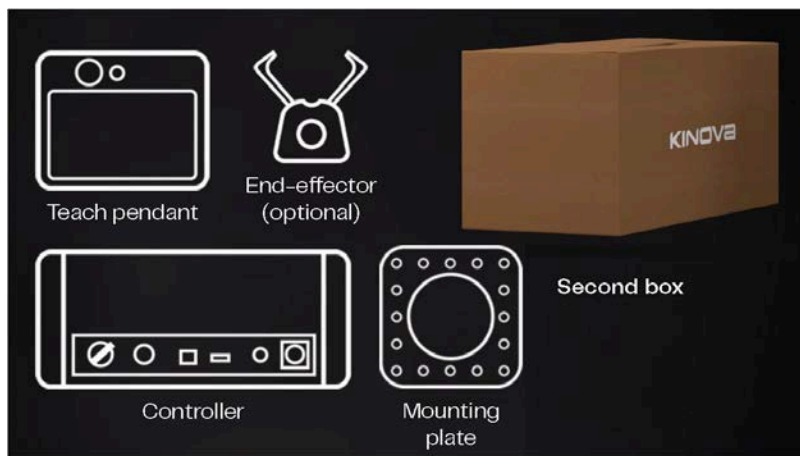


Figure 74: Box with controller, mounting plate, accessories box, and teach pendant box

The larger box contains the [arm](#), along with its cable attached to the [base](#) of the arm.



Figure 75: Box with arm and attached cable

Related topics

[Accessories](#) on page 203

[Components](#) on page 14

Unpacking the arm

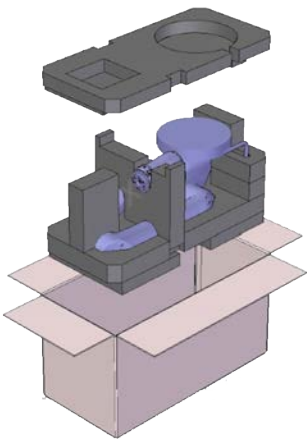
The box containing the [arm](#) is the larger of the two Link 6 boxes.

About this task

It is recommended to unpack the contents of the arm box at the installation site for the arm.

Procedure

1. Make sure the arrows on the box are pointing upward.
2. Open the larger box.
3. Lift the layer of foam off and set it aside.



4. Remove the arm from the box.

Considerations before installing the arm

The **arm** is heavy and large. It is advisable for two people to be involved in unpacking and installing the arm.

Make sure the box that contains the arm is near the area where the arm is to be installed. Have all the tools and screws necessary for installing the arm easily accessible at the mounting location.

Wherever the arm is installed, there is a set of guidelines that should be followed.

- Make sure all the tools and screws necessary to install the arm are easily accessible at the mounting location.
- Make sure the surface on which the arm is to be mounted is flat within 0.1 mm.
- Make sure the surface on which the arm is to be mounted is stiff enough so that it does not degrade the task to be performed by the robot.



DANGER: When the mounting surface where the arm is not sufficiently sturdy, the arm could become a hazard to people and equipment around it.

- Make sure you know which installation approach is required: directly on a surface or on a mounting plate.
- Have a minimum of two (2) people for safe installation for any orientation installation that is not on a flat, horizontal surface.
- Make sure to adjust the gravity vector for any orientation installation that is not on a flat, horizontal surface.
- Use the mounting dowel holes when your installation requires the robot to be repositioned accurately at the same place.



DANGER: The arm could be unstable until is fixed securely.

The arm must be kept within specific temperatures ranges during storage and use.

Table 50: Safe temperatures for the arm

Action	Minimum temperature	Maximum temperature
Storage	-40 °C	65 °C
Powering up	0 °C	40 °C
Operating	-20 °C	40 °C

Related topics

[Safety directives and warnings](#) on page 47

[Configuring controls for the robot](#) on page 128

Installing the arm directly to a surface

One way to install the **arm** is directly to a surface, without a mounting plate.

Before you begin

Personnel

- **Number of Workers:** 2 when the orientation installation is not on a flat, horizontal surface

Supplies

- 4 x M8 socket head cap screws, grade 12.9 steel



Note: Torque: 20 N·m



Note: An equivalent imperial 5/16 in screw with equal or better mechanical properties and underhead contact patch can be used.

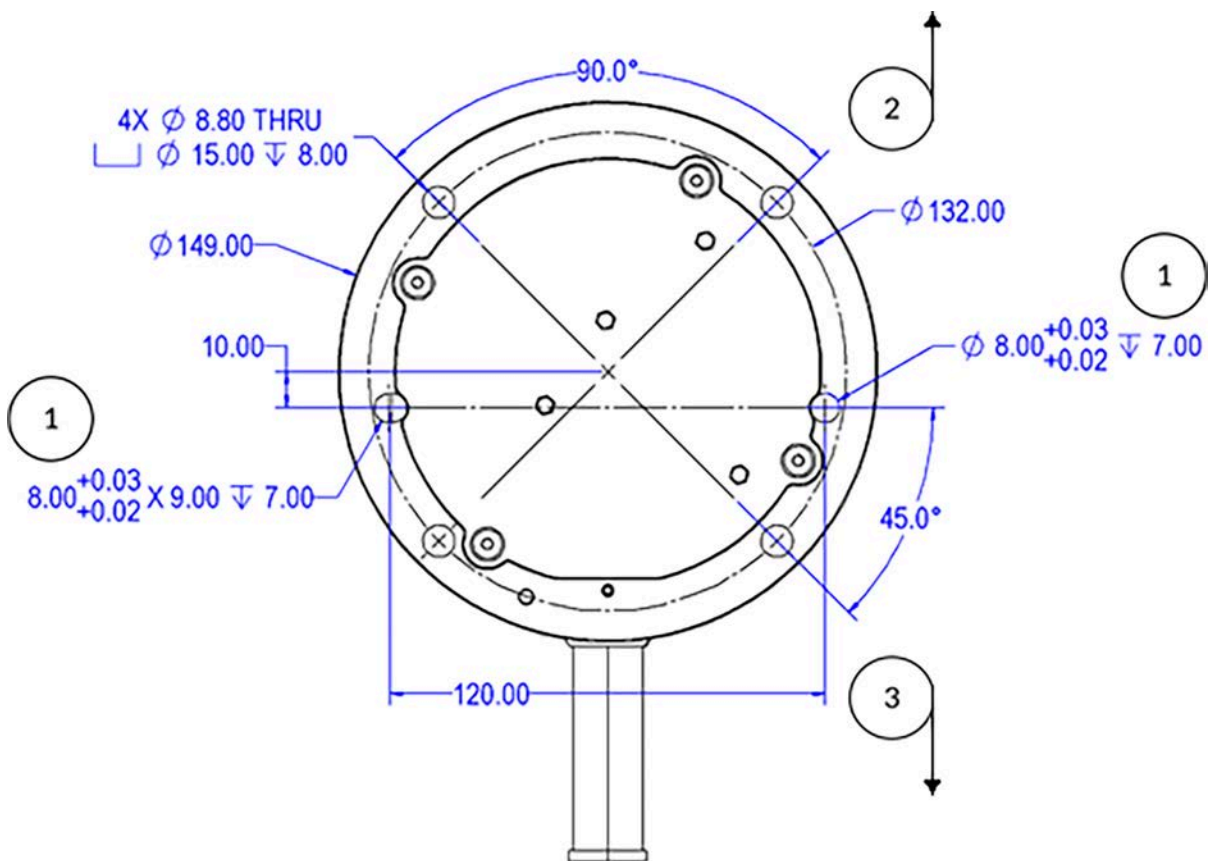
- 2 x 8 mm dowels

About this task

The arm is in a flat packaging pose to minimize the amount of space it takes in its packaging. This packaging pose also eases installation.

Procedure

1. Define the location and prepare the surface according to the mounting pattern drawing.



1 - Dowel hole feature for optional dowel pins; 2 - Front; 3 - Back

2. Place the arm on the surface with the holes of the **base** lining up with the holes of the surface.
3. Secure the base with 5 mm hex key according to the hardware requirement.
4. Remove the protective covering from the arm.

Related topics

[Specifications and dimensions of the base of the arm](#) on page 14

[Safety](#) on page 47

[Safety directives and warnings](#) on page 47

Installing the arm on a third-party adapter plate

One way to install the [arm](#) is to install it on a mounting plate.

About this task

Follow the installation procedure outlined in the third-party documentation.

Related topics

[Specifications and dimensions of the base of the arm](#) on page 14

[Safety](#) on page 47

[Safety directives and warnings](#) on page 47

Unpacking the controller

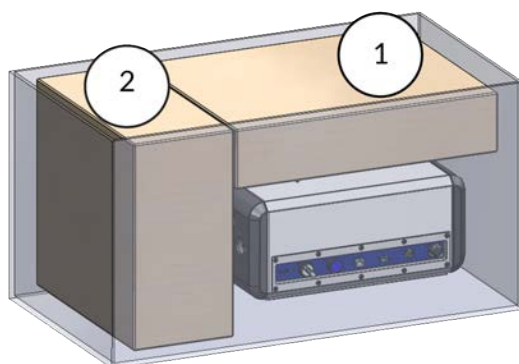
The box containing the [controller](#) is the smaller box, but it contains all the accessories bought with Link 6, as well as the power cord for the controller.

About this task

Unpack on a stable surface clear of other objects to make unpacking easier. It is recommended to unpack the contents of the controller box near the installation site for the controller.

Procedure

1. Make sure the arrows on the box are pointing upward.
2. Open the smaller box.
Two cardboard boxes become accessible.



- 1 Accessories box
- 2 [Teach pendant](#) box

3. Remove the accessories and teach pendant boxes and place them on a stable surface.
4. Open the boxes and make sure everything you bought is there.
5. Remove the items from their foam wrapping one at a time and set them aside in a safe place.
6. Take out the Quick start guide and place it in an accessible location.
7. Remove the controller from the box and place it on a table.

Considerations before installing the controller

The [controller](#) must be installed on a stable surface. The surface must be able to support the weight of the controller without becoming deformed or unstable.

There are several ways in which the controller can be installed.

- Placed on a stable surface, such as a table.
- Secured to a stable surface, such as a table.
- Secured to a wall.
- Secured it in a stable cabinet, either on a shelf or on the wall of the cabinet.



Note: When the controller needs to be secured to a wall or to the inside wall of a cabinet, it is recommended to use the optional Kinova wall bracket.

Wherever the controller is installed, there is a set of guidelines that should be followed.

- Do not put anything on top of the controller.
- Make sure the controller has ample space around it.
- Make sure the controller is not in a position where it can be bumped.
- Make sure the controller is installed less than the attaching cable length away from the arm; the cable that connects the arm to the controller has a finite length and the route the cable must take must be taken into account.
- Make sure there is at least a 50 cm gap in the back where the fans are installed.
- Make sure 10 cm on the side from a wall to maintain proper air flow around the controller.
- Make sure the I/O panel and the controls on the front of the controller are easy to access.
- Make sure the LED on the power knob and on the ACK button are visible.



Figure 76: Linear perspective of the controller and its airflow requirements

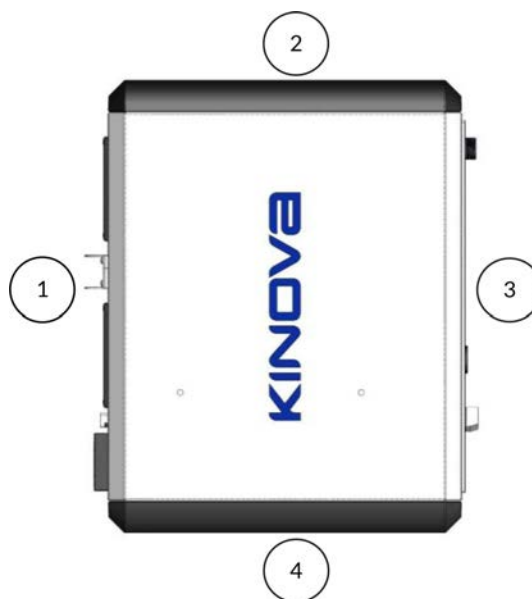


Figure 77: Top view of the controller and its airflow requirements

- | | |
|---|---|
| 1 | Minimum 50 cm from the wall for fan airflow |
| 2 | Minimum 10 cm from the wall |
| 3 | Easy access to connectors, switches, and LED status |
| 4 | Easy access to I/O panel |

If there is no access to the underside of the installation surface and there is no need to fix it, leave the controller on its four rubber feet. However, if there is a need to fix it and it cannot be fixed to the installation surface, use the optional Kinova wall bracket.

The controller must be kept within specific temperatures ranges during storage and use.

Table 51: Safe temperatures for the controller

Action	Minimum temperature	Maximum temperature
Storage	-40 °C	65 °C
Powering up	0 °C	40 °C
Operating	-20 °C	40 °C

Related topics

[Controller mounting interface](#) on page 26

[Installing the controller on a flat surface](#) on page 95

[Maximum ambient temperature reached](#) on page 180

[Maximum core temperature reached](#) on page 180

Installing the controller on a flat surface

The [controller](#) must never be in a position where it can slip or fall.

Before you begin

Personnel

- **Number of Workers:** 1

Supplies

- 4 x M6-1.0-6h screws, closed end nut inserts



Note: Maximum thread engagement depth: 6 mm



Note: Torque: 7-9 N·m

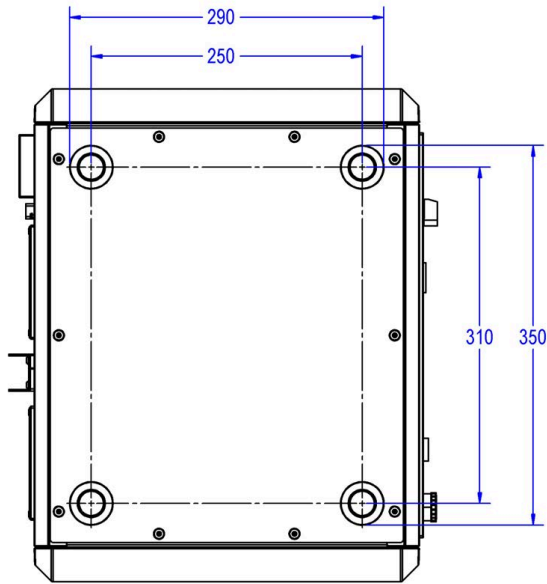


Figure 78: Mounting points of the controller, measured in millimeters

About this task

Verify the technical specifications of the controller to ensure there is maximum airflow around the controller, as well as enough space to hold the controller without putting it in a position in which it can be bumped.

The controller does come with anti-slip feet. Therefore, it is possible that placing it on a suitable flat surface suffices.

Alternatively, the controller can be secured to a flat surface.

Procedure

1. Align the foot mounts on the controller with the holes in the stable surface.
2. Place each of the M6 screws from under the surface into the foot mount location on the controller.
3. Tighten each screw until the controller cannot move.

Related topics

[Considerations before installing the controller](#) on page 93

[Controller mounting interface](#) on page 26

[Surface mount of controller](#) on page 27

Connecting the arm to the controller

The [arm](#) receives commands from the [controller](#) through a cable.

Procedure

1. Take the cable that comes out of the [base](#) of the arm.

2. Connect the end of the cable into the connector marked ARM on the controller.



3. Screw the cable in place.

Installing the teach pendant mount

The [teach pendant](#) comes with a flat display mounting interface (FDMI) that can be attached to a wall or other vertical surface. When the teach pendant is not in use, store it on the mount.

Before you begin

Personnel

- **Number of Workers:** 1

Supplies

For the MIS-D installation

- 4 x MIS-D compatible screws (M4 with 0.7 mm thread)
- Washers

For the 90 x 45 mm

- 4 x M8 screws

About this task

The teach pendant mount is compatible with VESA MIS-D, 75, and is compatible with the VESA Flat Display Mounting Interface (FDMI™) Standard. It has a 75 x 75 mm screw mounting pattern.

It also has a 90 x 45 mm pattern, which is not FDMI compatible. However, that pattern can be used to anchor the mount with M8 screws. The 90 x 45 mm alternative approach is excellent for such installations as 45 mm extrusion systems.



Figure 79: Teach pendant mount

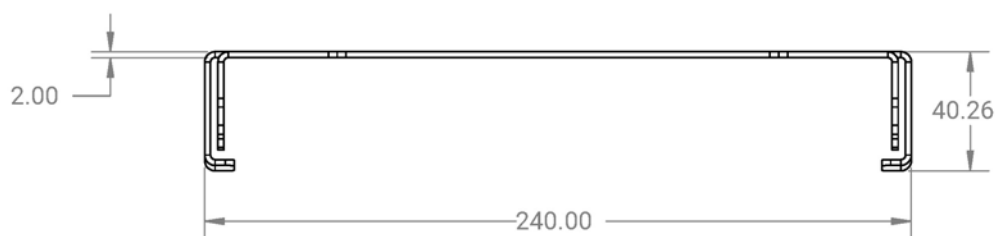


Figure 80: Specifications of the top view of the teach pendant mount

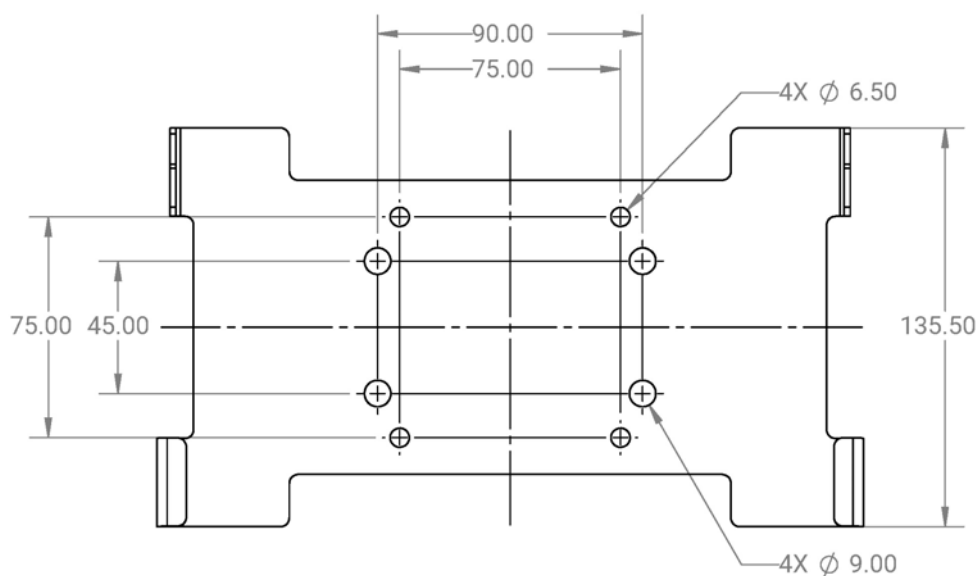


Figure 81: Specification of the front view of the teach pendant mount

Procedure

1. Choose whether you are installing using the FDMI standard or the 90 x 45 mm pattern; this determines which equipment and tools you need for installation.
2. Use the specifications in the figures to secure the teach pendant mount to the surface.

Related topics

[Teach pendant overview](#) on page 31

Connecting the teach pendant to the controller

The [controller](#) sends and receives commands from [the Web App](#) on the [teach pendant](#).

About this task

A cable is attached permanently to the teach pendant.

Procedure

1. Take the cable that comes out of the teach pendant.
2. Connect the end of the cable into the connector marked TP on the controller.



3. Screw the cable in place.

Connecting power to the controller

The [controller](#) requires power to power the rest of the robot.

Before you begin

The AC power line must be protected with a 15 A circuit breaker, or equivalent overcurrent protective device, at 120 VAC, and with a 7.5 A circuit breaker, or equivalent overcurrent protective device at 240 VAC.

The controller must be switched off.

About this task

The [arm](#) must be connected to the controller before the initial start-up of the controller.

Procedure

1. Plug one end the AC cord into the back of the controller.



2. Plug the other end of the AC cord into an electric socket.



Connecting a computer to the controller

[The Web App](#) may be run on a computer, but it works only if the computer is connected to the [controller](#).

Before you begin

You need to have an Ethernet CAT5 cable.

About this task

You can use a computer to program Link 6, particularly when you want to program the robot with minimal downtime.

Procedure

1. Connect one end of the cable to the Gigabit Ethernet port on the front or back of the controller.
2. Connect the other end of the cable to the computer.

Connecting a network to the controller

There are times when you need a permanent set-up in which the *controller* connects directly to a network.

Before you begin

You need to have an Ethernet CAT5 cable.

About this task

You can use a computer to program Link 6, particularly when you want to program the robot with minimal downtime.

Procedure

1. Connect one end of the cable to the Ethernet port on the front or the back of the controller.
2. Connect the other end of the cable to the network computer.

Initial software setup

Before you can start using Link 6, you have to configure the robot using [the Web App](#).

The Web App is a Web-based [GUI](#) used for configuring, controlling, and monitoring the robot.

Supported client devices

[The Web App](#) runs on the [teach pendant](#) that is connected to the [controller](#) with a cable. It also runs on a web browser on the computer that is connected to the controller over a wired Ethernet.

The Web App is a responsive web application. It is designed to adapt itself to various aspect ratios and resolutions so that it can run on multiple platforms.



Figure 82: The Web App on a teach pendant

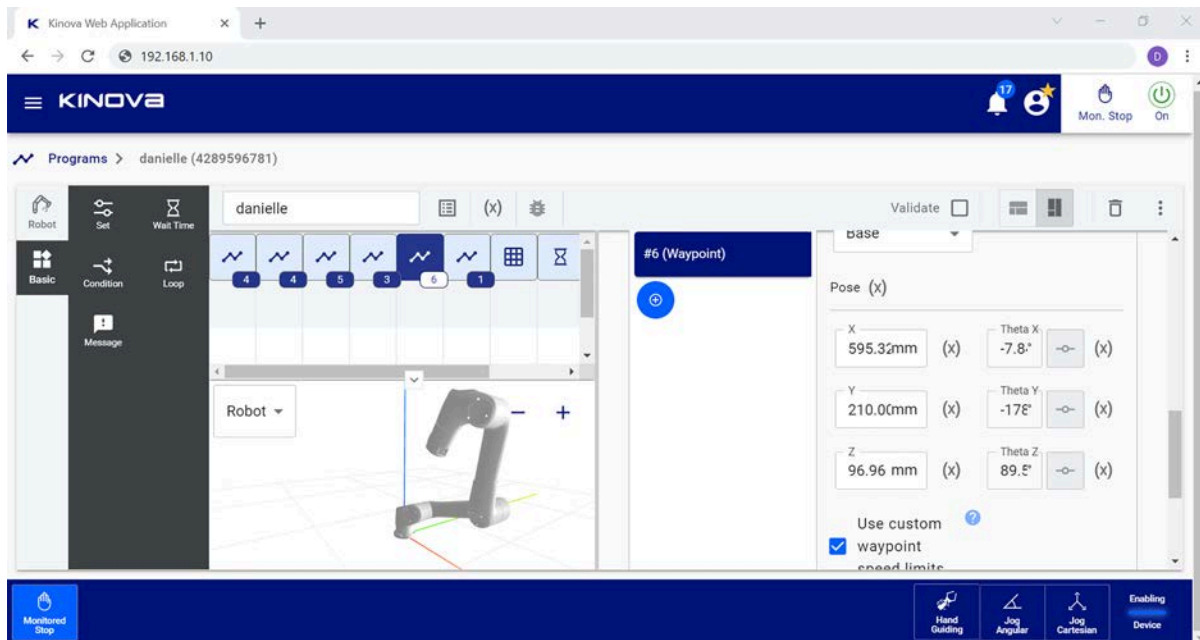


Figure 83: The Web App in a web browser

Logging in

The first step in using Link 6 is to log into [the Web App](#). You can use either a computer or a [teach pendant](#).

Before you begin

When you use the Web App in a web browser, make sure the [controller](#) and the computer are connected with an Ethernet cable so that there is an established network connection.

When you use the Web App in a teach pendant, make sure it is connected to the controller. There is no need to establish a network connection in this case.

Link 6 may still be in its package position. It also is possible that it is in its home position.

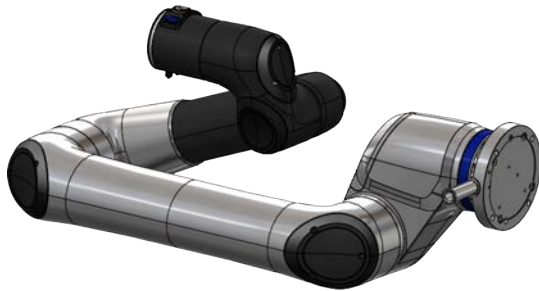


Figure 84: Link 6 in its package position

About this task

The Web App is a Web-based *Graphical User Interface (GUI)* used for configuring, controlling, and monitoring the robot.

Procedure

1. Switch on the controller.



The power knob flashes a white light while the controller initializes the software and *firmware*. When the controller is ready to be used, the power knob illuminates a steady white light.

The teach pendant switches on automatically if it is connected to the controller.

The Web App launches automatically. It uses the default IP address 192.168.1.10.

The Web App launches its login dialog.

Kortex™ Web App

Username
admin

Password

Language
English

Advanced Settings

CONNECT

Version: 3.0.0-r.29 Branch: release/3.0.0

2. Enter the user name and password of the admin user.

Username is admin.

Password is admin.



Important: Change the admin password when this is the first log in.



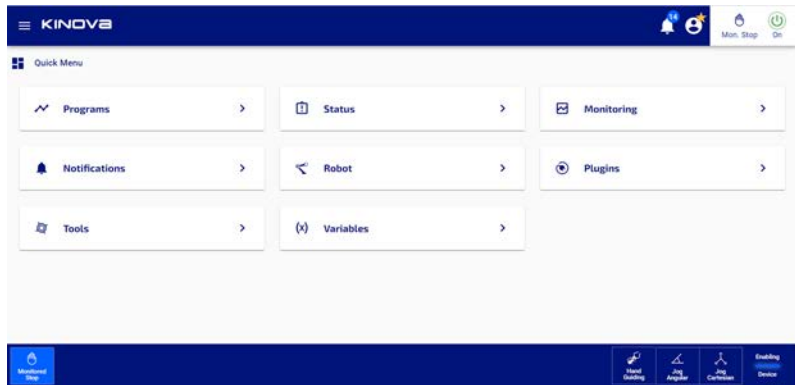
Important: Usernames and passwords are case sensitive.



Tip: The version of the Web App is on the bottom of the login dialog.

3. Tap **CONNECT**.

The **Home** page of The Web App launches. The **Home** page displays the Quick Menu.



Repositioning the arm to use it for the first time

After the [arm](#) is installed, it probably will not be in an optimal position for starting to use the robot.

About this task

The robot must be on and the [admin user](#) must be logged on. The robot is in its factory settings, which means there are no programs yet. Use [the Web App](#) in close proximity to the robot arm to make it easier to reposition the arm for the first time.

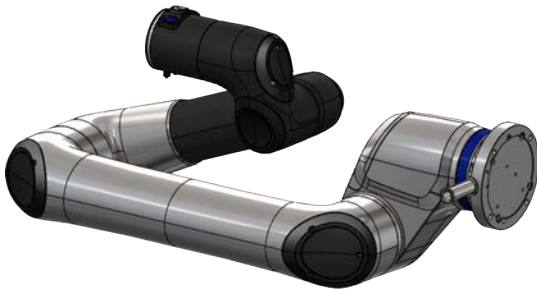


Figure 85: Link 6 in its package position

The angles of each joint, from joint 1 to joint 6, of the packaging pose are -90° , 0° , -152° , 0° , -62° , and 0° , respectively.

Figure 86: Angles of each joint in the Packaging pose

JSON Object Editor

package

Joint Angles

Angle -90	↑ ↓
Angle 0	↑ ↓
Angle -152	↑ ↓
Angle 0	↑ ↓
Angle -62	↑ ↓
Angle 0	↑ ↓

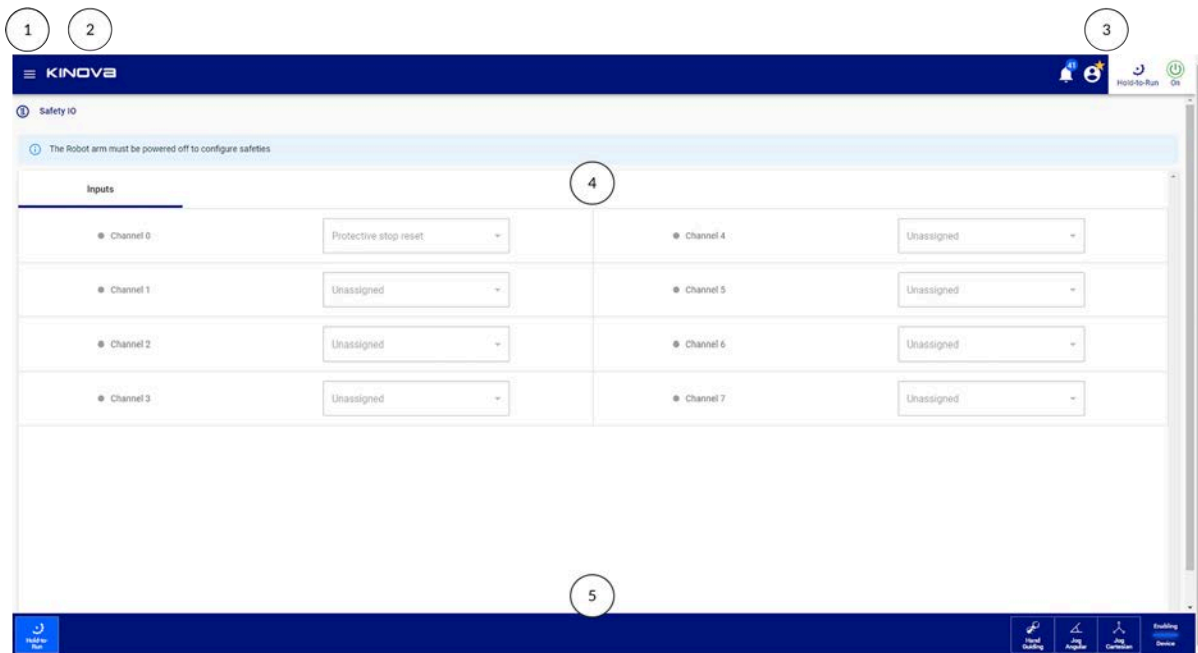
✕ CANCEL ✓ SAVE

Procedure

1. Press and hold the [wrist enabling device](#) on the arm.
2. Use joint or [Angular](#) to move the robot out of its packaging pose and into a stable starting pose.
3. Release the wrist enabling device.
The arm is now in the correct position to begin programming.

The Web App layout

[The Web App](#) is made of several sections.



- 1 Hamburger to access pages
- 2 Quick Menu
- 3 Notification indicator, User profile, Mode indicator, On
- 4 Main information panel
- 5 Robot control panel

Menu pages

From either the Hamburger and a Quick Menu, you can access the different [the Web App](#) functionalities.

When you first log in to the Web App, you are brought automatically to the Quick Menu page. All of the most frequently accessed pages are there. Tapping on any of the items in the Main information panel brings you to the selected function.

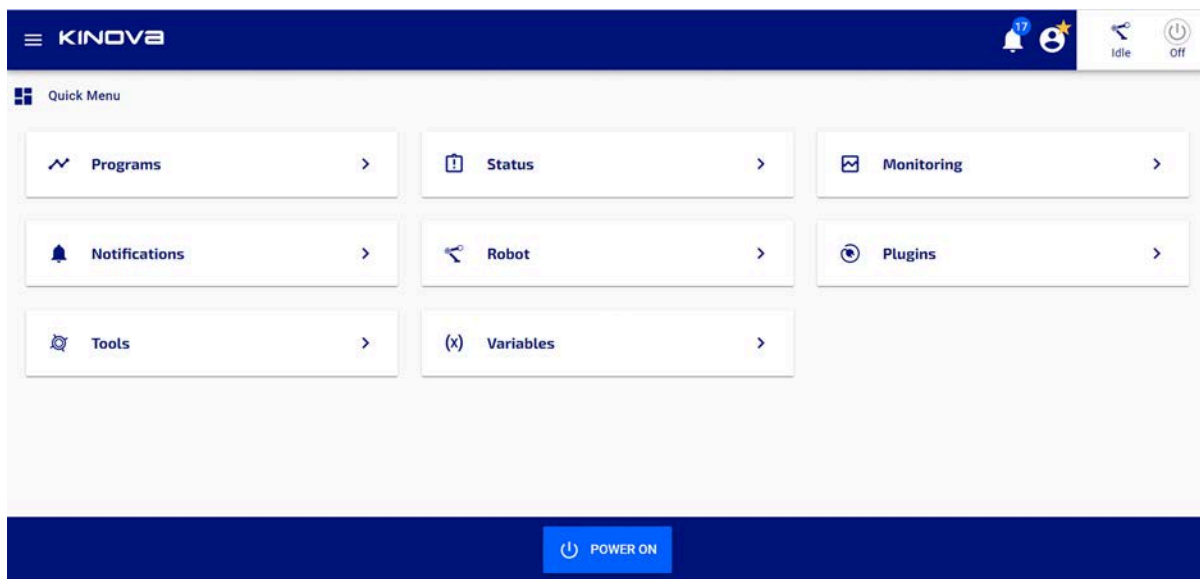


Figure 87: Home page is also the Quick menu

Alternatively, you can tap on the Hamburger icon () to display the full menu. The different functions are organized into logical groups.

When you are not on the home page, tap on the Kinova logo to access the Quick Menu.

The main menu is made of four main options, each of which is subdivided further.

Access all safety-related actions you can take on the robot from the Safety menu.

- **Joint Limits:** Define the maximum position of each joint from -360° to $+360^\circ$, as well as the maximum speeds at which the joints move in reduced safety mode and normal safety mode.
- **TCP and Elbow Limits:** Define the maximum translation and rotation speeds, as well as the maximum force and orientation that can be used on the *TCP*.
- **Protection zones:** Define the zones where the robot is not to enter.
- **Safety IO:** Define the behavior of the equipment connected to the safety I/Os on the controller on the corresponding input channels.

Access everything you need to create a program from the Programming menu.

- **Variables:** Define variables, along with their scopes, for modifying plugins and creating programs.
- **Programs:** Select and create programs, using actions defined by plugins and variables in the system.

Access monitoring and status information from the Diagnostics menu.

- **Status:** View the status of the main parts of the robot
 - **Safety Functions**
 - **Controller**
 - **Actuators**
 - **SCU**
 - **Wrist**
- **Monitoring:** View notifications and information that is monitored as long as the robot is switched on. The information exists in **Overview** and **Detailed** formats.

From the Systems menu, you can access information about the system in general, as well as perform general purpose tasks, such as upgrading the system and adding new users.

- **Information:** View basic information about Link 6.
- **Robot:** Configure controls for the robot.
- **Networks:** View and modify the existing network communication system.
- **Plugins:** View, modify, and add [plugins](#) to use with the robot.
- **Tools:** View, modify, and add tools to reflect what is installed on the robot.
- **Upgrade:** View the current version for the Web App, the [firmware](#) bundle, and firmware versions. Upgrade the robot to the latest software and firmware updates. Reset the robot to its factory settings.
- **Users:** View, modify, and add users who can use the robot. All admin users and operators are listed on this page.

Indicators, user profile, and power

Sometimes, you need a quick way to access notifications, your profile, the current mode of the robot, and a way to power on or off the [arm](#) of Link 6.

In the same banner as the Hamburger and the Kinova logo are four more icons.

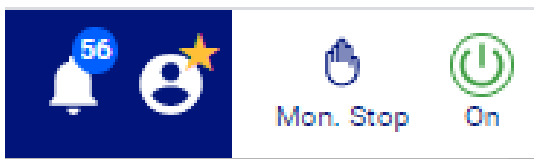
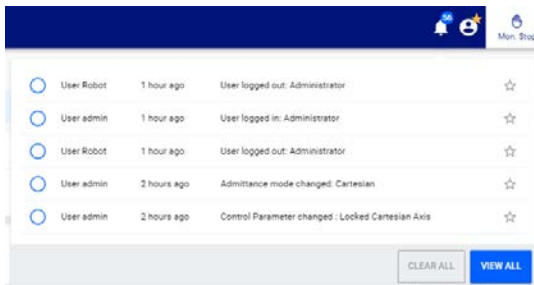


Figure 88: Indicators, modes, and arm power status



Tap the Notification icon to launch the **Notifications panel**. The circled number indicates the number of notifications that have not been read.



The **Notifications panel** displays the list of notifications to be read.

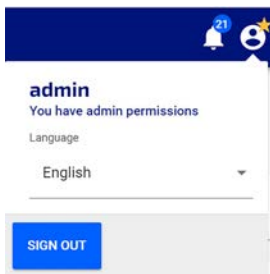


The admin user is logged into the Web App.



An [operator](#) is logged into [the Web App](#).

Tap the User profile icon to launch the **User profile**.

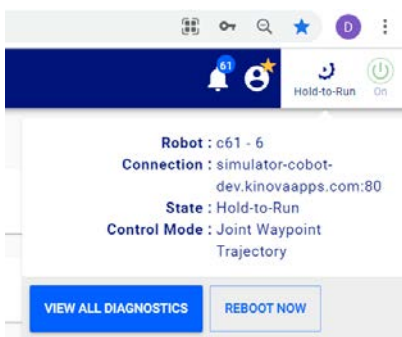


The **User profile** displays the role and permissions of the currently logged-in user. It is from this panel that you can sign out.



The Robot status icon displays the current mode that Link 6 currently is in. The arm is not operational during certain modes.

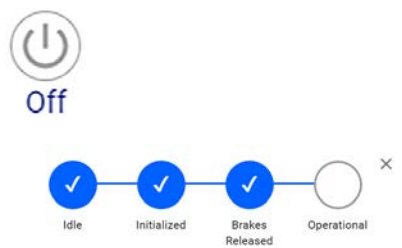
- Monitored Stop
- Hold-to-Run
- Auto



Tap the Robot status icon to launch a summary of the diagnostics of the robot.

Tap **VIEW ALL DIAGNOSTICS** to view information on the **Status** page.

Tap **REBOOT NOW** to *reboot* the robot.



The Power Off icon indicates the arm of Link 6 is off. The icon is gray.

When the arm is switched off, the state of the arm shows that it is still on, but is not operational.



The Power On icon indicates the arm of Link 6 is on. The icon is green. The states above the Robot control panel indicate the arm is operational.



When the arm is switched on, the state of the arm shows that it is on and is operational.

Related topics

[Event notifications](#) on page 192

[Robot lights and what they mean: a reference](#) on page 86

[User management](#) on page 112

Robot control panel

The Robot control panel is both a status panel when operating the [arm](#) manually and another form of access to controls of the arm.

The current operating mode is displayed on the left of the panel. Tap it to access the other available operating modes.



Figure 89: Example of the Robot control panel

Tap the current operating mode in the Robot control panel to access other operating modes. The current mode is a lighter blue than the panel.

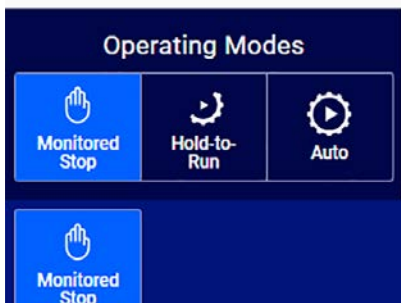


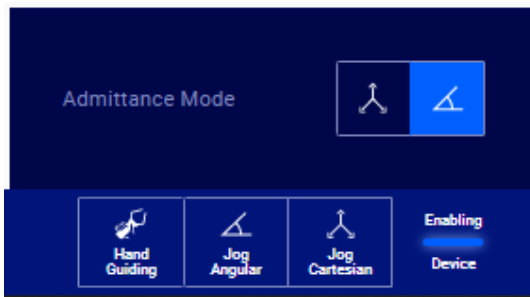
Figure 90: Tapped Robot status icon displays current mode as well as other operating modes

At the opposite end of the Robot control panel are the manual control modes, as well as the [enabling device](#) status.



Figure 91: Virtual controls and mode toggles with enabling device off and then on

Tapping any one of these three buttons launches a window with controls. The controls are available only when the enabling device is held in the middle position.



Virtual controls in angular Hand Guiding mode

Virtual controls in *Angular* Manual Jog mode

i **Tip:** The controls are available only when the enabling device is held in the center position.

Virtual controls in *Cartesian* Manual Jog mode

i **Tip:** The controls are available only when the enabling device is held in the center position.



Note: When you tap Hand Guiding in the Robot control panel, the current mode is automatically Monitored Stop ().



Note: When you tap Jog Angular or Jog Cartesian in the Robot control panel, the current mode is automatically Manual.

Related topics

[Additional settings](#) on page 168

User management

There are two different types of users: *admin* users, and *operators*. Each of these user types are associated with *roles*, which determine what they can and cannot do in an application. It is common to refer to a user by the role they have.

The Administrator role carries more permissions than the Operator role. For instance, an admin is able to create users, but an operator cannot. However, both are able to run a validated program.

When there is a star beside the User profile icon, the user is an admin user. When there is no star, the user is an operator user.

Table 52: Access to pages depending on role

Admin user ()	Operator user ()
Login	Login
Quick Menu , Home page	Quick Menu , Home page
• Programs • Status • Monitoring • Notifications • Robot • Plugins • Tools • (x) Variables	• Programs • Status • Monitoring • Notifications
Safety	Safety
• Joint Limits • TCP & Elbow Limits • Protection Zones • Safety I/O	• Joint Limits • TCP & Elbow Limits • Protection Zones • Safety I/O
Configure	View only
Programming	Programming
• (x) Variables • Programs	• Programs
Create, debug, validate for use, run program	Select and run validated program
Diagnostics	Diagnostics
• Status: View only • Monitoring: ◦ View only. ◦ Download snapshot of current data if a USB is inserted in the USB port of the controller . • Notifications ◦ Search for an event. ◦ Print all the events. ◦ Filter for specific events. ◦ Mark an event with a star. ◦ Select an event and delete it.	• Status: View only • Monitoring: ◦ View only. ◦ Download snapshot of current data if a USB is inserted in the USB port of the controller . • Notifications ◦ Search for an event. ◦ Print all the events. ◦ Filter for specific events. ◦ Mark an event with a star. ◦ Select an event and delete it.
view only	view only

Admin user ()

Systems

- **Information:** View only
- **Robot:** Configure
- **Networks:** Configure
- **Plugins:** Install and configure
- **Tools:** Add and configure
- **Upgrade:** Upgrade software and firmware
- **Users:** Manage users

Operator user ()

Systems

- **Information:** View only

All user management tasks are accessed by tapping **Systems > Users**.

Related topics

[Indicators, user profile, and power](#) on page 109

Adding a user

New [operators](#) can be added to the system.

About this task

The [admin](#) user adds users to the system. Additional admin users cannot be added because there should be only one device, or person, controlling the robot at any given time. All users added to the system are operators.

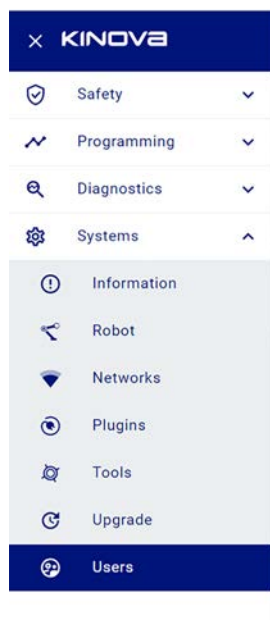
Procedure

1. Tap **Systems > Users**.

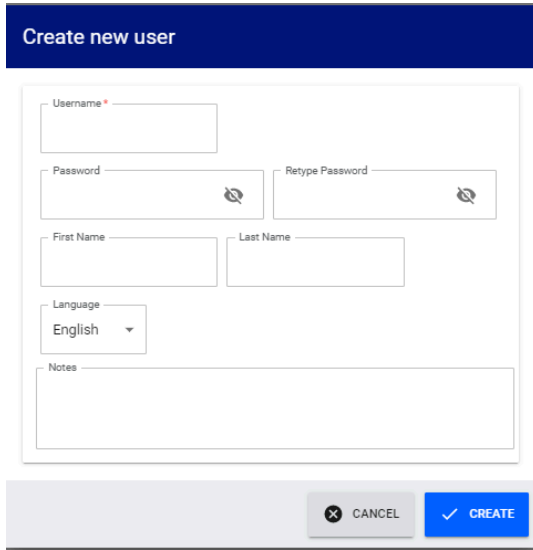
All users are displayed on the **Users** page.



Important: The first time the **Users** page is accessed, one user is already listed. That is the Administrator user account used to log into Web App.



2. Tap  in the bottom right corner to add more users. The **Add User** dialog launches.



The "Create new user" dialog is shown. It has a dark blue header with the text "Create new user". Below the header is a form with the following fields:

- Username (required, indicated by a red asterisk)
- Password (with a toggle icon to show/hide)
- Retype Password (with a toggle icon to show/hide)
- First Name
- Last Name
- Language (dropdown menu, currently set to "English")
- Notes (text area)

At the bottom of the dialog are two buttons: "CANCEL" (with a close icon) and "CREATE" (with a checkmark icon).

3. Enter information in the fields.

- Username
- Password
- Retype Password
- First Name
- Last Name
- Notes

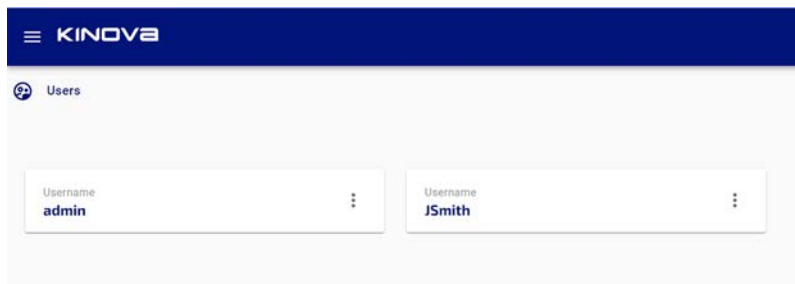


Important: The username and password are case sensitive.

4. Tap **CREATE**.

Results

A user is added to the list of current users.



Editing a user

When a user is created in the system, it is possible that the user's name was misspelled, a different username needs to be used, the password needs to be updated, or the user wants to work in a different language. In all these cases, the admin must edit the user information.

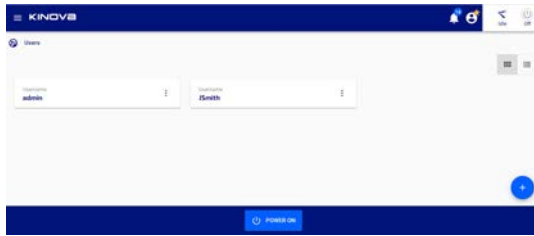
About this task

The [admin](#) edits users in the system.

Procedure

1. Tap **Systems > Users**.

All users are displayed on the **Users** page.



2. Tap on a user's name.

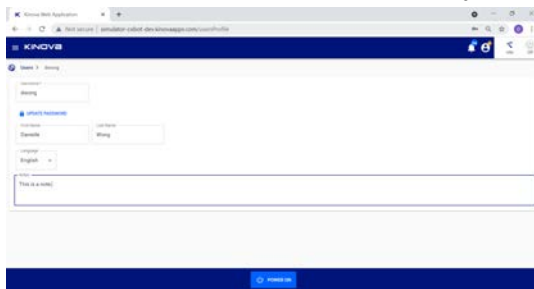
3. Tap the *kebab menu*.



4. Tap **Edit**.



The **Edit User Profile** page is displayed.

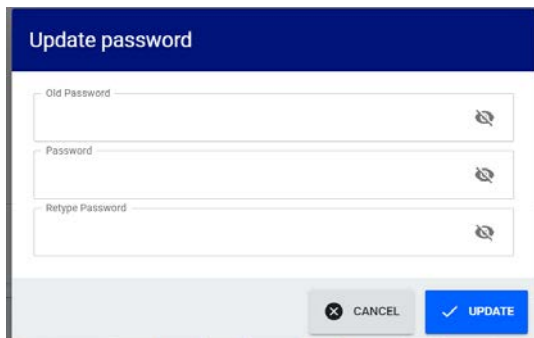


5. Update the information.

- Username
- First Name
- Last Name
- Notes
- **Language**

6. Tap **UPDATE PASSWORD** to change the user's password.

The **Update password** dialog launches.



7. Enter the **Old Password**, **new Password**, and **Retype Password**.
8. Tap **UPDATE**.

Results

All edited information is saved automatically.

Deleting a user

Sometimes a user needs to be removed from the system.

About this task

The [admin](#) removes users from the system.

Procedure

1. Tap **Systems > Users**.
All users are displayed on the **Users** page.
2. Tap the *kebab menu* of the user to be deleted.

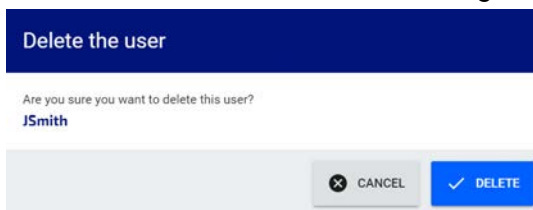


Note: Administrator accounts cannot be modified or deleted. The content of the kebab menu is not selectable.

A contextual menu launches, one of the choices being to delete the user.



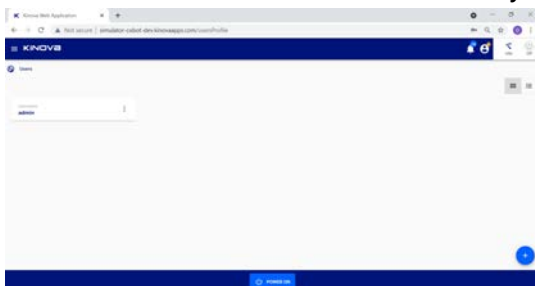
3. Tap **Delete**.
A **Delete the user** confirmation dialog launches.



4. Tap **Delete** to delete the selected user.

Results

The selected user is deleted from the system.



Elevating permissions

The [role](#) of a user may need to change from [operator](#) to [admin user](#).

Before you begin

Log in [the Web App](#) as an operator.

About this task

An operator can elevate their permissions to the administrator level only when the operator knows the admin password.

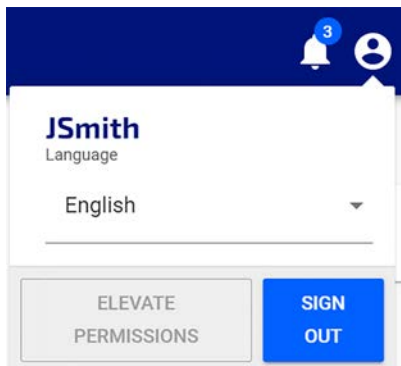


Tip: An operator can elevate their permissions only if they know the admin password.

Procedure

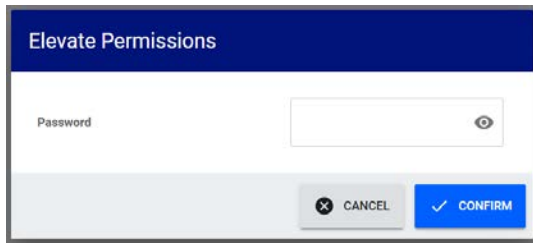
1. Tap **User Profile** .

A **User profile** launches.



2. Tap **ELEVATE PERMISSIONS**.

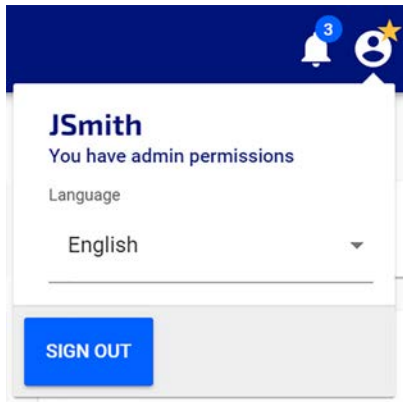
The **Elevate Permissions** dialog launches.



3. Enter the admin user password.

4. Tap **CONFIRM** to elevate permissions.

The current user can now do the same tasks as an admin user.



Tip: A quick way to make sure the current user is an admin user or an operator is to look at the **User Profile** icon. If there is a star beside it, the current user is an admin user. If there is no star beside the **User Profile** icon, the current user is an operator.

Robot networking and communication

An Ethernet cable connects the controller of Link 6 to the rest of the network. Link 6 can be connected to an IPv4 network.

All networking and communication configurations are accessed by tapping **Systems > Networks**.

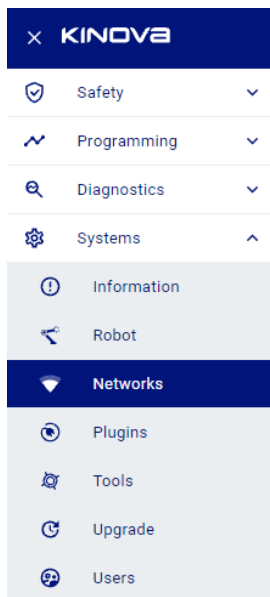


Figure 92: Accessing robot networking and communication configurations

The factory settings of the Controller Ethernet port IPv4 network can be modified in the **Network** page typing in the appropriate values.

- IPv4 Address
- IPv4 Subnet Mask

- IPv4 Default Gateway

When you change the values on the **Network** page, tap **APPLY** for the values to take effect.

Upgrading software

There are continuous improvements made to Link 6. Make sure that your operations take advantage of these improvements by upgrading the software driving the robot.

About this task

Only the [admin](#) can update the software.

All software upgrades are accessed by tapping **Systems > Upgrade**.

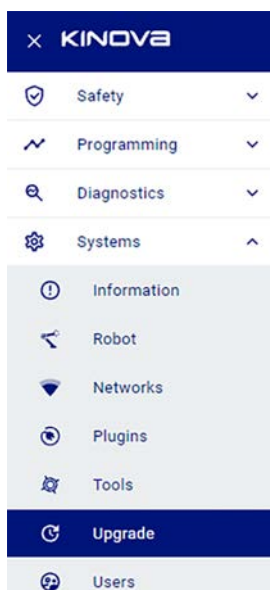
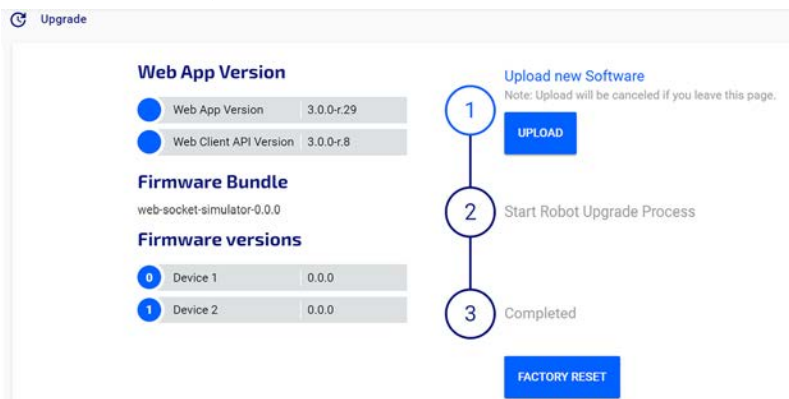


Figure 93: Accessing the software upgrade operation

Procedure

1. Tap **Off** in the On section of *the Web App* to turn off the *arm*.
2. Tap **Systems > Upgrade**.
The **Upgrade** page launches. It shows the current version of the Web App, Web Client API, *firmware* bundle, and firmware versions.



3. Tap **UPLOAD**.
 - a. The *controller* receives its upgrades. Controller upgrades take little time.
 - b. Each *actuator* receives their upgrades. This takes more time than the controller. There are six (6) actuators and each actuator receives two different firmware updates.
 - Safety *MCU* updates
 - Normal operation updates
 - c. The user cannot access the Web App until after the controller *reboots*.

Results

The robot reboots with the upgraded firmware and software.

Installing plugins

Link 6 comes with three pre-installed *plugins*. However, some *end effectors*, for example, have their own plugins that need to be installed before they can be used.

Before you begin

The *arm* must be turned off before plugins are installed.

About this task

If you are installing any of the optional end effectors that Kinova offers, Contact Kinova to get the appropriate plugin file.

Plugin files have a `.kp` extension.

All installed plugins are accessed by tapping **Systems > Plugins**.

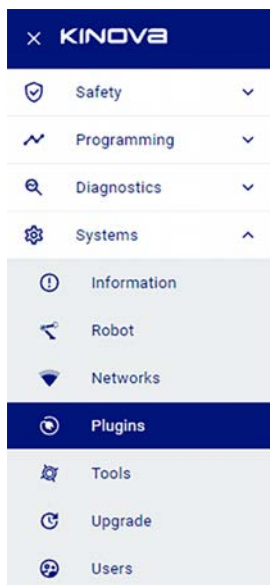


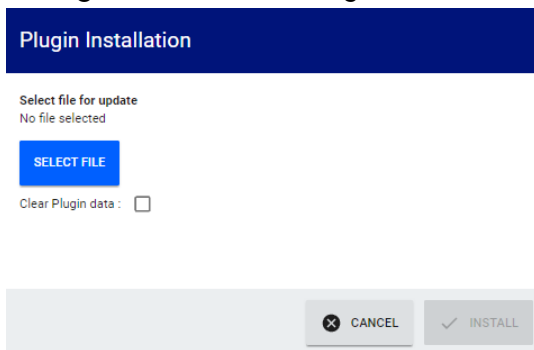
Figure 94: Accessing the plugins

Procedure

1. Tap **Systems > Plugins**.
The **Plugins** page launches.



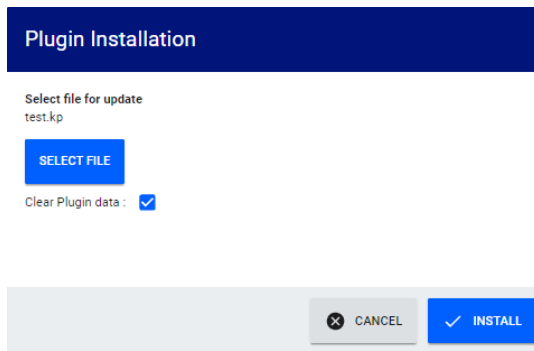
2. Tap **+**.
A **Plugin Installation** dialog launches.



3. Tap **SELECT FILE**.
A window launches.
4. Browse and select the file with **.kp** extension.

5. Tap **Open**.

The **Plugin Installation** dialog shows the name of the selected file.



6. Tap **Clear Plugin data**.

When you clear the plugin data, you are making sure you have a clean installation of the plugin.

7. Tap **INSTALL**.

Results

The installed plugin appears on the **Plugins** page and is running.

Configuring tools

An *end effector* tool *plugin* can be installed even if the corresponding tool is not mounted on the robot.

About this task

A single plugin can communicate with multiple end effector models. Therefore, it is necessary to configure the properties of the tool currently installed on the robot. The associated tool plugin may populate the **Tools** page with tools.

All tool configuration tasks are accessed by tapping **Systems > Tools**.



Tip: Before you can edit the active tools, the robot must be switched on and it must be in Monitored Stop.

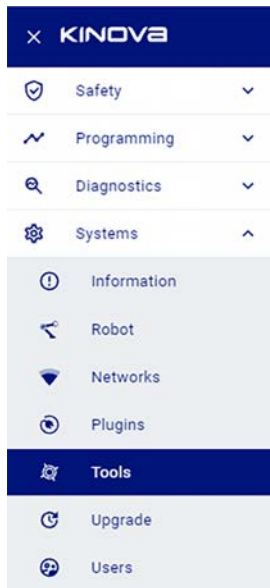
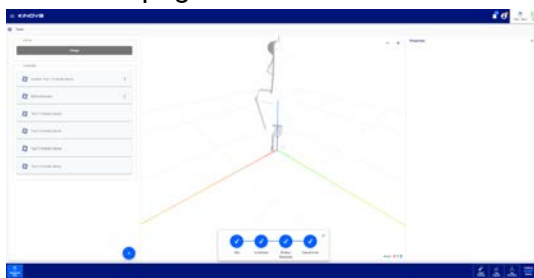


Figure 95: Accessing tool configuration operations

Procedure

1. Tap **Systems > Tools**.
The **Tools** page launches.



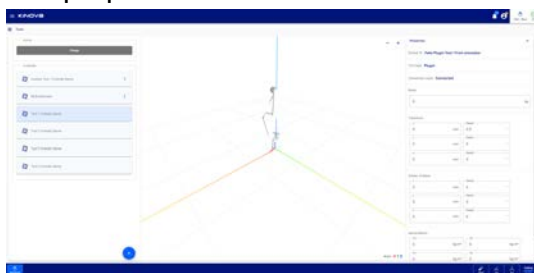
The tools are listed on the left side in two groupings: Active and Available. The flange is always listed in the Active tools list because all tools are attached to it.

The center is a 3D view of the arm that can be moved around to help you visualize the tool reference frame. Tap + or - to zoom in or out. Hold and move the view around to have different viewpoints of the robot.



Remember: The visualization of the arm may not be in exactly the same position as the arm physically is in.

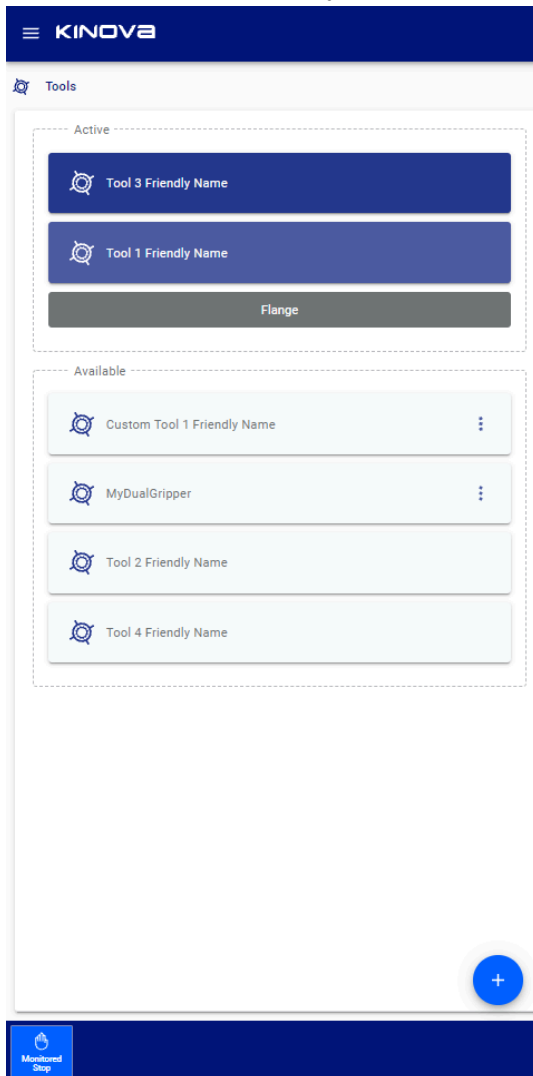
- 2. Select a tool in the Available list.**
The properties of the selected tool are displayed on the right.



3. Modify the values in the **Properties** panel.

4. Drag each tool in order they are assembled onto the *flange* of the *wrist*.

A flange is already on the wrist. When you physically add a tool, if the next one is Tool 1 Friendly Name, drag that tool to be above Flange. If the next tool is Tool 3 Friendly Name, drag that above Tool 1 Friendly Name.



Adding tools

Custom tools may not come with their own *plugins*. They still can be added to the robot so that the robot can take the tool into consideration when following position commands.

Before you begin

Know the mass, transformation, center of mass, and inertia matrix.

About this task

Only advanced users should use this functionality.

The properties of the custom tool affect the *TCP* of the entire robot.

Procedure

1.



Tap

The **Create new custom tool** dialog launches.

2. Enter the information about the custom tool.

- Name
- Mass
- Transform: x, y, z in mm
- Transform: θ_x , θ_y , θ_z in $^\circ$
- Center of Mass: x, y, z in mm
- Center of Mass: θ_x , θ_y , θ_z in $^\circ$
- Inertia Matrix: ixx, ixy, ixz, iyy, iyz, izz in kg/m^2

3.



DANGER: Make sure the **Mass** and **Center of Mass** input for the payload correspond to the physical mass and center of mass of the payload installed on the robot.

If the physical mass and physical center of mass of the payload does not match what is entered in the Create new custom tool form, it could lead to erratic behavior of the robot when it is used in Hand Guiding mode.

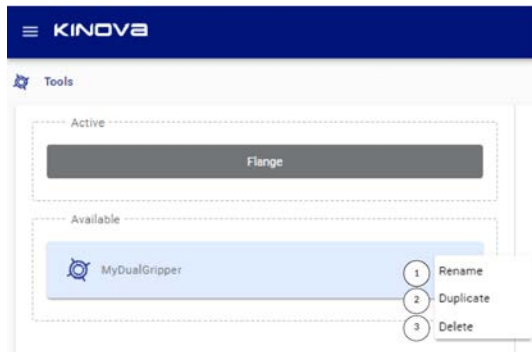
Always validate the mass and center of mass that is entered in Create new custom tool against the physical inertial parameters.

Tap **CREATE CUSTOM TOOL**.

The new tool is added to the list of available tools.

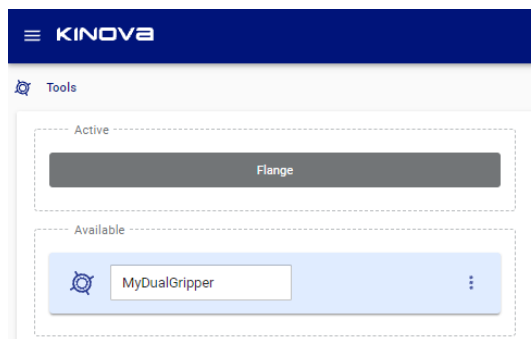
Other actions that can be taken on tools

There are three actions you can take on available tools.



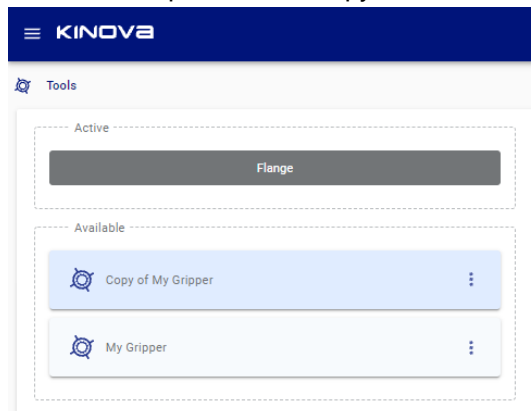
1 **Rename**

Enter a new name and press Enter.
The name of the tool changes.



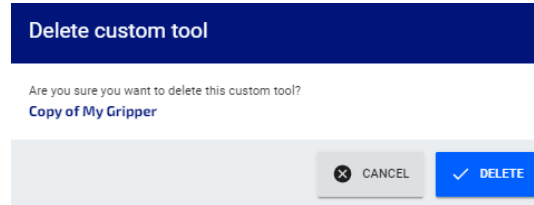
2 **Duplicate**

The tool is duplicated as "Copy of" followed by the name of the copied tool.

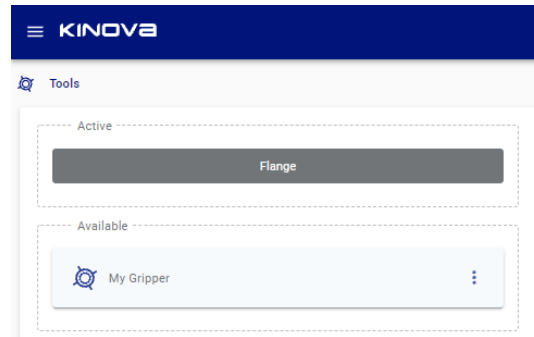


3 Delete

A confirmation dialog launches.



Tap **Delete** and the selected tool is no longer available.



Configuring controls for the robot

About this task

All software upgrades are accessed by tapping **Systems > Robot**.

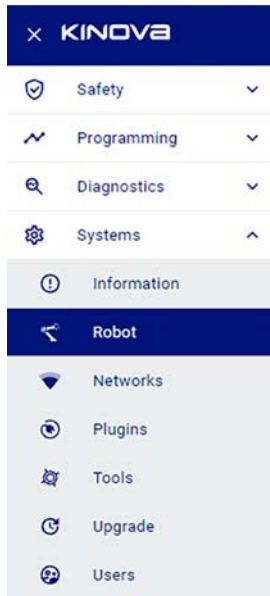


Figure 96: Accessing the robot settings

Procedure

1. Tap **Systems > Robot**.
The **Robot** page launches.



2. Tap any one of **Base**, **Gravity Vector**, or **Payload** to view their current corresponding values.
The robot control pane expands and exposes the values.

3. Option Description

Base

Tap **RESTORE** to reinstate factory settings in the [base](#).

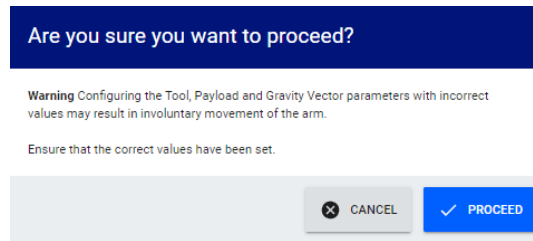


Remember: When you restore factory settings, all configurations, [plugins](#), and programs are deleted.

Option	Description
Gravity Vector	The default values for Gravity Vector assumes that Link 6 is installed on a table or floor. Gravity Vector must be defined when the robot is installed on a wall, ceiling, or other location that is not on a table or floor.

- Enter values for x , y , and z in m/s^2 , expressed in the Base reference system.
- Tap **SEND**.

A confirmation dialog launches when errors are suspected.



- Tap **CLEAR** to erase the values.

Payload

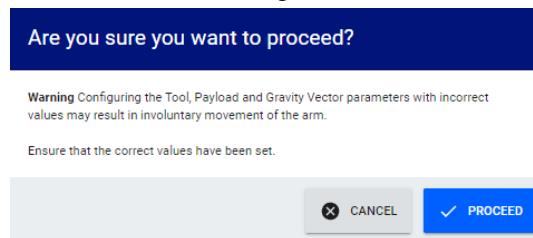


Important: *Payload* does not refer to the *end effector*. It refers to the mass of the object that the robot is picking.

The mass and its center of the object being picked affect the positioning and speed of the robot.

- Enter the *Mass* in kg and the *Mass Center* of the object being picked.
- Tap **SEND**.

A confirmation dialog launches when errors are suspected.



- Tap **CLEAR** to erase the values.

Related topics

[Restoring factory defaults](#) on page 130

Restoring factory defaults

If ever you do not like an upgrade, restore the robot to its factory settings.

About this task

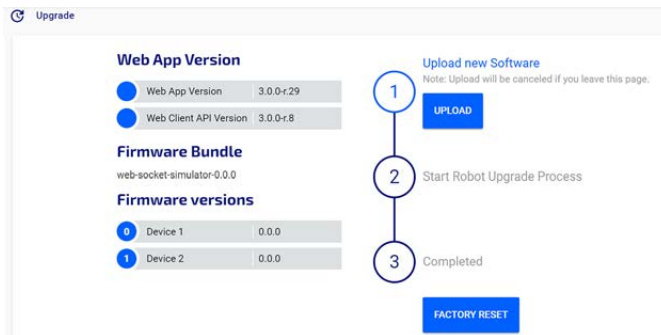
Only the *admin user* can update the software.



CAUTION: When you restore factory defaults, you lose all your configurations, settings, and programs. You also lose all the user profiles.

Procedure

1. Tap **Off** in the On section of *the Web App* to turn off the *arm*.
2. Tap **Systems > Upgrade**.



3. Tap **FACTORY RESET**.

All settings and configurations revert to the factory settings. All programs, *plugins*, and users, except for the admin user account, are deleted. All safety I/Os revert to their default values.

The username and password of the admin user reverts to the `admin` and `admin`, respectively.

Related topics

[Configuring controls for the robot](#) on page 128

Visual programming

Part of the foundation of any program is the definition of variables. After variables are defined, the program can be built. The drag-and-drop functionality on the **Program** page in [the Web App](#) facilitates building and testing programs.

The result is accurate trajectories with reduced downtime for the robot.

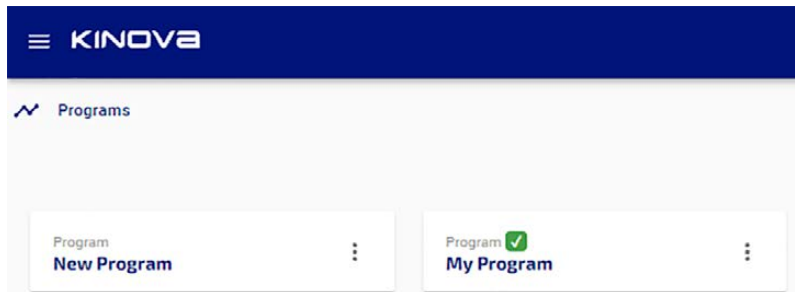


Figure 97: Programs page after programs are created

Variables

Define variables for the entire robot and for specific [plugins](#) with a global [namespace](#). Variables in the program affect how the robot functions.

Tap **Programming > Variables** to access the **Variables** page.

Namespace helps define the *scope* of the variable. Variables defined on this page are defined in the global namespace. For instance, when a variable needs to be shared among all parts of the robot and its plugins, use the namespace **globals**. All variables defined from the **Variables** page with the **globals** namespace can be found in the **Variable Manager** page as **Persistent Variables**.

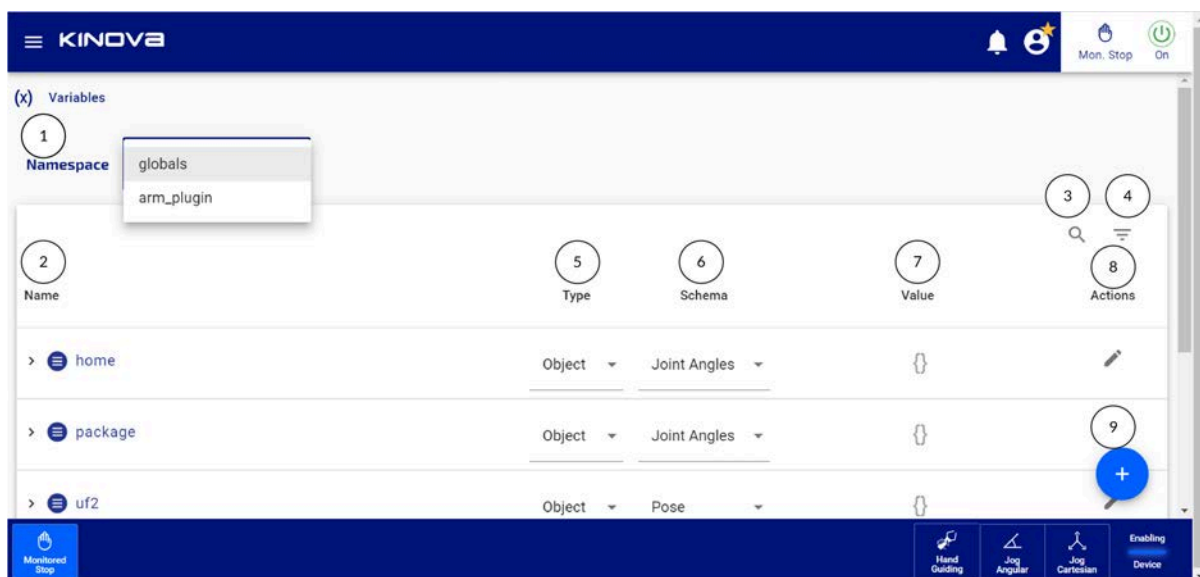


Figure 98: The Variables page

- 1 Namespace that is global to all programs.

- 2 Name of the variable that is defined in the global namespaces, including the arm_plugin global namespace.
- 3 Tap to search variable names, types, or schema. The result is displayed on the page. For example, search *package* results in the page displaying all global variables named **package** if it exists as a global variable in the currently selected global namespace.

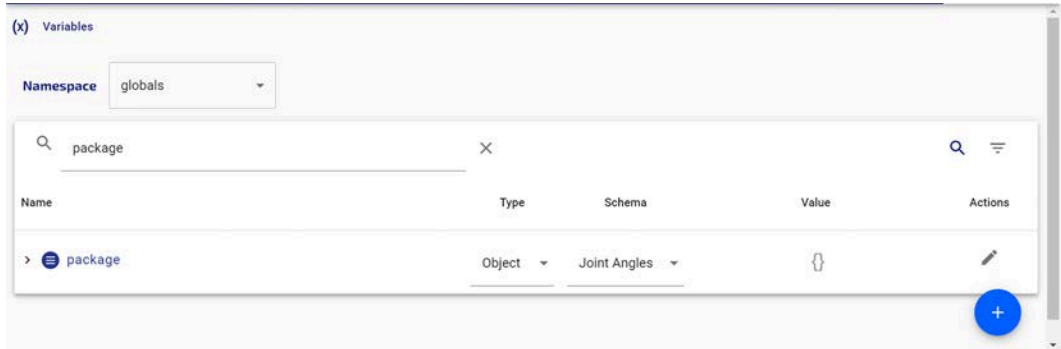


Figure 99: Result of a search for variable *package* in global namespace

- 4 Tap the filter icon ($\equiv$) to filter the list of variables by Type and by Schema on the **Variables** page.

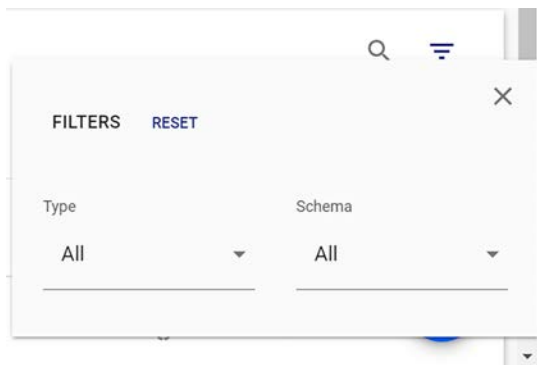


Figure 100: Filter panel

- 5 Define the type of the variable by selecting a type from the **Type** drop-down.
 - **All**: Boolean, Number, Object, and String
 - **Boolean**: True, False
 - **Number**: Integer, float
 - **Object**: Complex structure
 - **String**: Text

- 6 Define the schema of the variable by selecting a schema type from the **Schema** drop-down.
- **Unknown**: custom structure
 - **Pose**: Cartesian transformation
 - **Joint Angles**: List of angles, one for each joint
 - **Matrix Output**: List of poses
 - **Read Input Output**: Read input and its corresponding defined output



Remember: There are four types of read input.

- **Digital**
- **Analog**
- **Wrist digital**
- **Wrist analog**



Note: Read Input Output is used in conjunction with the Industrial I/O plugin.

- 7 Define the value associated with the variable. Tap the {} icon to invoke the **JSON Object Editor** dialog and change the key-pair values as necessary.

When the schema type is **Read Input Output**, define the output of the Read Input as a property. The output of the Read Input must be a digit or floating point number.

- 8 There are at most two actions that can be taken for each global namespace variable.
-  edit
 -  delete

Tap the edit icon (✎) to modify the name of the global variable.

When the global variables that come with Link 6 are used, their location is displayed on the dialog.

The dialog has a dark blue header with the text "Edit variable". Below it, the "Name" field contains the text "home". A checkbox labeled "Rename all references" is checked. Under the heading "Where Used", there is a table with two columns: "Program" and "Action Type". The table contains two rows: "Validated program example" and "Afternoon Program", both with "Waypoints" in the "Action Type" column. At the bottom, there are two buttons: "CANCEL" with a close icon and "SAVE" with a checkmark icon.

Program	Action Type
Validated program example	Waypoints
Afternoon Program	Waypoints

Figure 101: Edit variable dialog for global variable *Home*

The dialog has a dark blue header with the text "Edit variable". Below it, the "Name" field contains the text "new_variable_0". At the bottom, there are two buttons: "CANCEL" with a close icon and "SAVE" with a checkmark icon.

Figure 102: Edit variable dialog for user-defined global variable

Tap the delete icon (🗑️) to delete the user-defined global variable.

Global variables that come with Link 6 cannot be deleted. At most, the ability to rename all references to the variable can be invoked or removed. However, user-created global variables can be deleted from the **Variables** page.

The dialog has a dark blue header with the text "Delete". Below it, the text "globals/new_variable_1" is displayed. A question "Are you sure you want to delete this variable?" is shown. At the bottom, there are two buttons: "CANCEL" with a close icon and "DELETE" with a checkmark icon.

Figure 103: Delete user-defined global variable confirmation dialog

- 9 Tap to add a new global variable in the currently selected namespace.

Related topics

[Variable management](#) on page 144

[Industrial I/O plugin](#) on page 196

Examples of JSON statements

JavaScript Object Notation (JSON) is a key-value format for representing structured data. It is text-based, which makes it readable. There are a few things to know about its syntax.

Defining strings

Use double quotation marks around strings.

Examples:

```
1 {"name": "John"}
2 {"age": 30}
3 {"sale": true}
```

Defining iterators

When you define a variable as an iterator, it must be defined as type Number. The first index is always 0. `${var.n[${i}]}` outputs the value of each iteration over the array.

Adding a variable to the global namespace

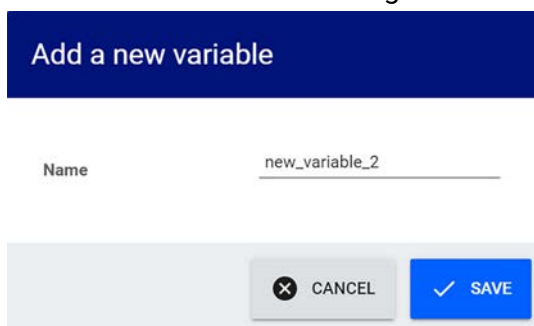
Variables can be added to the global [namespace](#) from the **Variables** page.

About this task

Variables that are added to the global namespace are available as global variables only within the program where they are defined. Variables that belong to the global namespace are accessible as **Persistent Variables** in the **Select Variable** page.

Procedure

1. Tap **Programming > Variables**.
The **Variables** page launches.
2. Tap .
The **Add a new variable** dialog launches.



3. Enter a meaningful name for the global variable.
Underscores are allowed. Spaces and dashes are not allowed in the name.
4. Tap **SAVE**.
The new variable is displayed on the **Variables** page.
5. Select one **Type** for the variable.

Option	Description
String	Enter a string.

Option	Description
Boolean	Select either False or True .
Number	Enter an integer or floating point number.
Object	Select a Schema . • Unknown • Pose • Joint Angles • Matrix Output • Read Input Output

6. (Only when the variable is of **Type Object**.) Tap the **Value** icon ({}) next and enter the values in the **JSON Object Editor** and tap **SAVE**.

The information entered can then be available in entities of various tiles.



Figure 104: Editor for object type Unknown

JSON Object Editor

new_variable_2

Pose

X
0

Y
0

Z
0

Theta X
0

Theta Y
0

Theta Z
0

CANCEL SAVE

Figure 105: Editor for object type Pose

JSON Object Editor

new_variable_2

Joint Angles

Angle
0

Angle
0

Angle
0

Angle
0

Angle
0

Angle
0

CANCEL SAVE

Figure 106: Editor for object type Joint Angles

JSON Object Editor

new_variable_2

Matrix output

Generated Pose List

+

CANCEL SAVE

Figure 107: Editor for object type Matrix Output

JSON Object Editor

new_variable_0

Read Input's output

result
1

CANCEL SAVE

Figure 108: Editor for object type Read Input Output

Adding a variable to a program

Variables can be added to the [namespace](#) of the program from the **Select Variable** page.

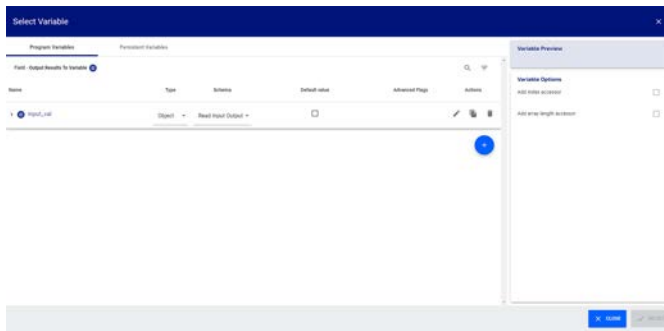
About this task

Variables that are added to the program namespace are available as **Program Variables** on the **Select Variable** page.

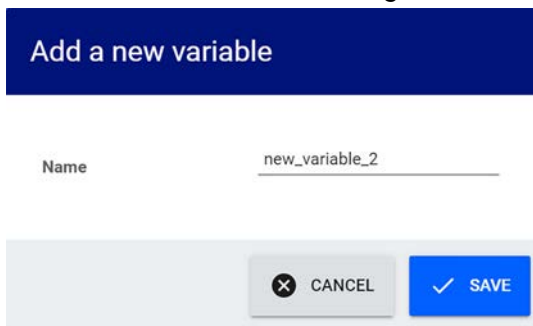
Procedure

1. Tap **Programming > Programs** and select a program.
The **Program** page launches.

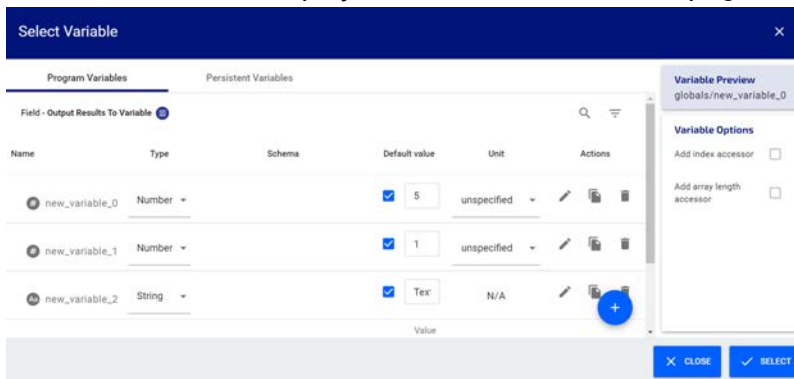
2. Tap (x) beside **Output Results To Variable (X)**.
The **Select Variable** page launches



3. Tap +.
The **Add a new variable** dialog launches.



4. Enter a meaningful name for the variable.
Underscores are allowed. Spaces and dashes are not allowed in the name.
5. Tap **SAVE**.
The new variable is displayed on the **Select Variable** page.



6. Select a **Type** for the variable.

Option

String

Boolean

Number

Object

Description

Enter a string.

Select either **False** or **True**.

Enter an integer or floating point number.

Select a **Schema**.

- **Unknown**
- **Pose**

Option**Description**

- **Joint Angles**
- **Matrix Output**
- **Read Input Output**

7. (Only when the variable is of **Type Object**.) Tap the **Value** icon ({}) next and enter the values in the **JSON Object Editor** and tap **SAVE**.

The variable is available in entities of various tiles.

Figure 109: Editor for object type Unknown

Figure 110: Editor for object type Pose

Figure 111: Editor for object type Joint Angles

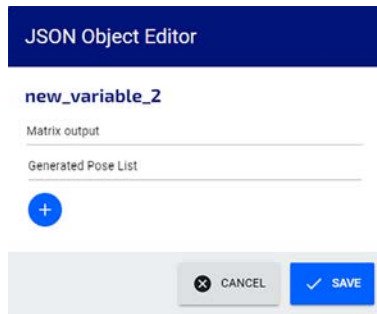


Figure 112: Editor for object type Matrix Output

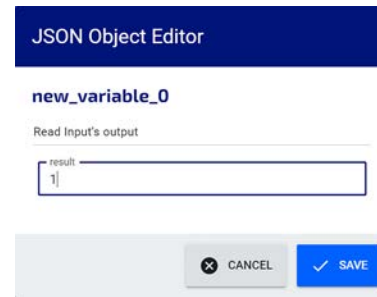


Figure 113: Editor for object type Read Input Output

8. Tap CLOSE.

The **Select Variable** page closes and the **Program** page is displayed.

Selecting a variable

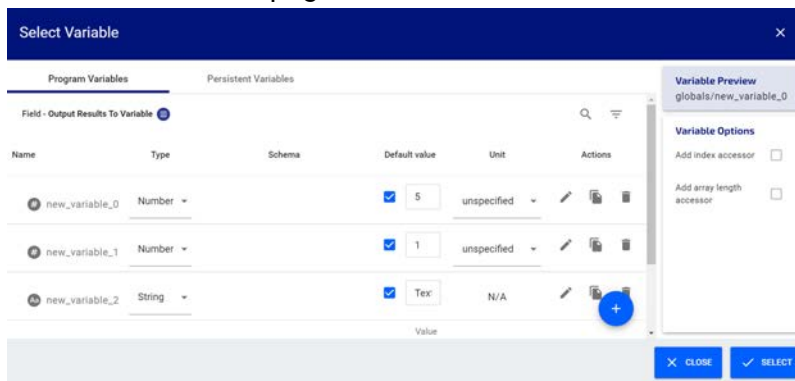
Sometimes you need to select a variable that is already defined and use it in a program.

About this task

It assumes that all program variables and global variables are already defined.

Procedure

1. Tap a tile in the program.
2. Tap the (x) beside **Output Results To Variable**.
The **Select Variable** page launches.



3. Tap the variable that you want.
The name of the variable is highlighted and a check mark displays beside the name.



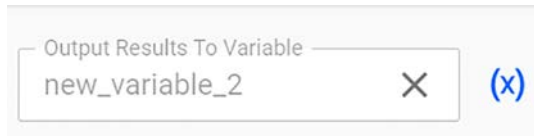
4. Tap **SELECT**.

The **Select Variable** page closes.

The name of the selected variable displays in the **Output Results To Variable** text box.



Remember: The name of the selected variable is in the text box where the **Select Variable** is invoked.



Overview of the Program page

The **Program** page is where programs are created and debugged.

Tap **Programming > Program** to access the visual programming interface.

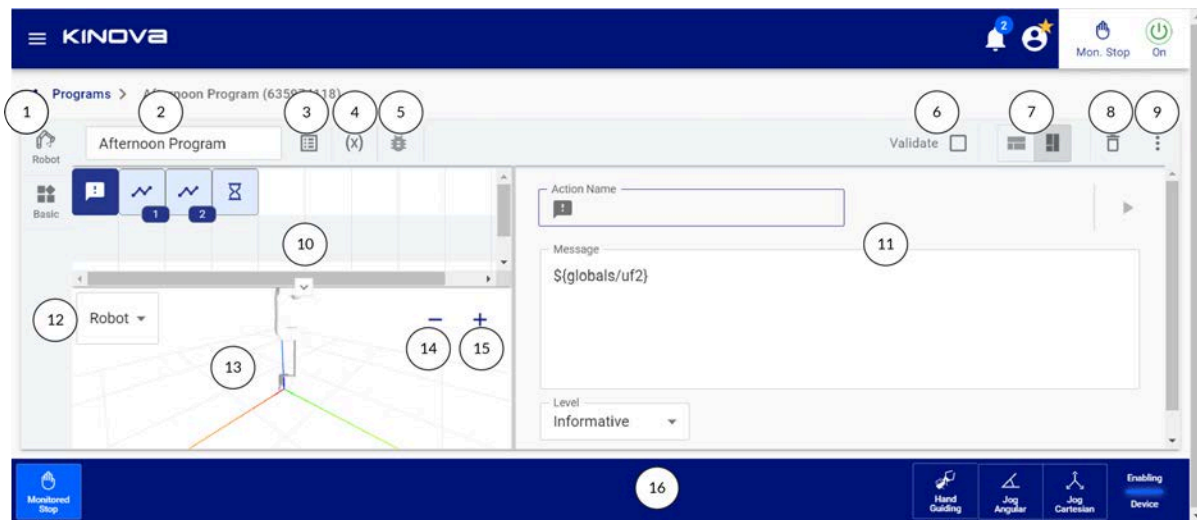
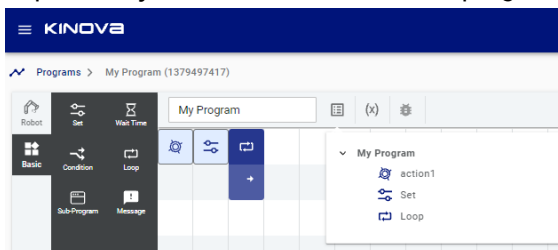


Figure 114: Parts of the Program page

- 1 Drag available core **Tiles** into the **Sequence editor** pane to create a program.
- 2 Enter a meaningful name for the program.
- 3 Tap **Tree layout** to view the tiles of the program in tree layout.



- 4 Tap **Variable Manager** to launch the **Variable Manager** and define variables within the scope of the program.

- 5 Tap **Debugger** to select the debugger tool and gather information about the program and its events while it runs. Tap **Debugger** to exit the debugger.



Tip: The **Debugger** button acts as a toggle button. When it is a dark blue, it is on. When it is gray, it is off.

- 6 Tap the **Validate** button to release the program to the operator.
- 7 Tap one of the two **Layout** buttons.



is the default layout where the entire **Sequence editor** pane is to the right of the **Sequence editor** pane.



has the **Sequence editor** pane across the top half of the **Program** page.

- 8 Tap **Delete** to delete the currently selected tile.
 - 9 Tap the **kebab menu** (⋮) to access additional tasks that can be performed on the program in the **Sequence editor** pane. The additional tasks are **Duplicate**, **Delete**, and **DeleteExport JSON**.
 - 10 **Sequence editor** pane is a drag-and-drop timeline editor of tiles that are executed by the program when it runs.
 - 11 Tap on any tile in the program to populate the **Tile configuration** pane with the fields to create the correct parameters for the tile.
 - 12 Select the visualization object.
-  **Note:** Currently, the only visualization object that is available is the robot.
- 13 The **Visualization** pane displays the robot in its current position.
 - 14 Zoom out in the **Visualization** pane.
 - 15 Zoom in the **Visualization** pane.
 - 16 Use the icons in the Robot control panel to change modes of operation and to manipulate the playing of a program.

When [the Web App](#) is operating in Hold-to-Run mode and in Auto mode, the Robot control panel displays two more parts.

- Program play area
- Program speed control



Figure 115: The parts of the Robot control panel

Program play area

- 1 Tap  to play the program.
- 2 Tap  to stop the program.
- 3 Tap  to play the program repeatedly.
- 4 Tap  to read notifications related to the program.

Program speed control

- 5 Tap  to run the program at normal speed.



Important: It is recommended to run at the normal speed when you are operating in Hold-to-Run; injury is possible.

- 6 Tap  to run the program at reduced speed.



Important: It is recommended to run at the reduced speed when you are operating in Hold-to-Run.

Variable management

Define variables for the entire robot and for specific *plugins* within the scope of the program. Variables in the program affect how the robot functions.

Access the **Variable Manager** page by tapping the (x) on the **Programs** page.



Remember: Access the **Programs** by selecting a program from **Programming > Programs**.

Namespace helps define the *scope* of the variable. Variables defined on the **Variable Manager** page are defined in the program namespace, not globally.

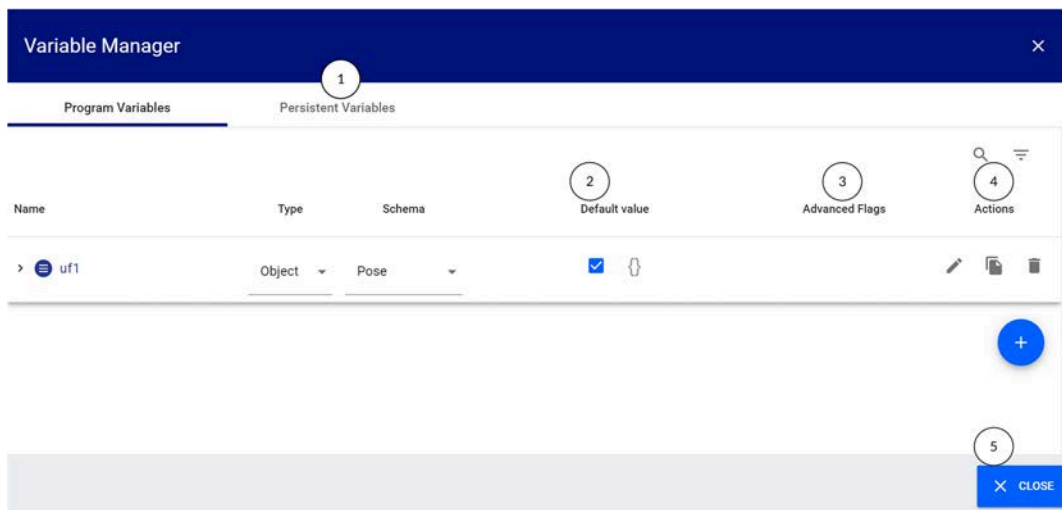


Figure 116: The Variable Manager page

For the most part, the **Variable Manager** is like the **Variables** page. However, there are a few more parameters for the program namespace variables, as well as more actions.

- 1 **Persistent Variables** are the global variables defined on the **Variables** page.
- 2 Select the **Default value** checkbox if the value for the variable is the default value.
- 3 List any **Advanced Flags** associated with the variable.
 - **Input:** Indicates whether a parent program can provide the variable. It only applies when the program is used as a sub-program.
 - **Output:** Indicates whether a parent program can access the variable after it is run.
 - **Required:** Indicates whether the variable must be set before the program starts. It only applies when the input flag is set.

- 4 Tap the filter icon () to filter the list of variables by Type and by Schema on the **Variables** page.

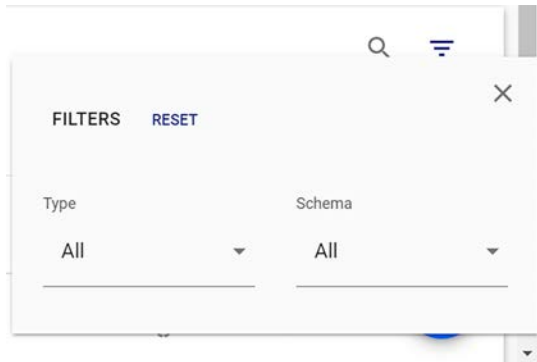


Figure 117: Filter panel

- 5 Tap **CLOSE** to close the **Variable Manager** page and return to the **Programs** page.

Related topics

[Variables](#) on page 132

[Industrial I/O plugin](#) on page 196

Core tiles

The **Programs** page has a set two sets of core tiles that are used to drag and drop into the **Sequence editor** pane to help create programs.

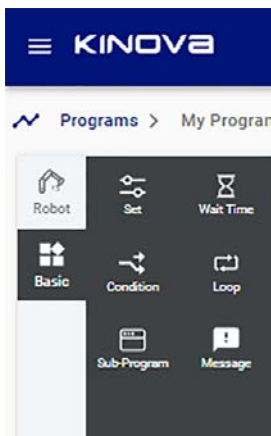
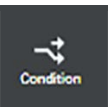


Figure 118: Base tiles

Table 53: Tiles that belong to the Base

Tile	Tile name	Description
	Condition	Create a condition in the program.

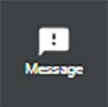
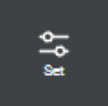
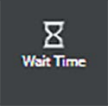
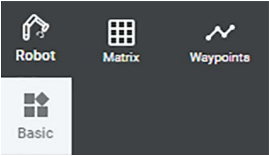
Tile	Tile name	Description
	Loop	Create a loop in the program.
	Message	Create a message in the program.
	Set	Set the value of a variable. If there is a default value, Set overrides the default value.
	Wait Time	Introduce a period of time to wait before proceeding to the next step in the program.
		

Figure 119: Robot tiles

Table 54: Tiles

Tile	Tile name	Description
	Matrix	Define a matrix of positions.
	Waypoints	Create a list of waypoints in the program.  Tip: Each list must be all <i>Angular</i> or all <i>Cartesian</i> .



Important: Aside from the core tiles, each installed *plugin* may have its own set of tiles. These additional tiles are displayed in the same area as the core actions to ease programming.

Each core tile has its own set of variables that must be defined in the **Tile configuration** pane.

Common core parameters in the Tile Configuration pane

The **Tile configuration** pane changes dynamically, depending on which tile is dragged into the **Sequence editor** pane.

The content of the **Tile configuration** pane changes dynamically with the selected tile. However, there are a few parameters that remain the same for all tiles.

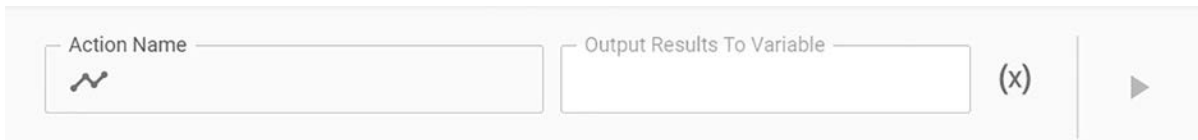


Figure 120: Common parameters in the Tile Configuration pane

Table 55: Entities common to all core tiles

Item	Description
Action Name	Enter a meaningful name for the currently selected tile.
Output Results To Variable	Output results of a variable that is selected for the currently selected tile.
	 Note: Not all tiles have any information for this field. It is used for the Industrial I/O tiles.
(X)	Tap to launch the Select Variable page. Select and modify, or create a variable.
	 Note: Not all tiles can select a variable. It is used for the Industrial I/O tiles.
	Play the selected tile when you are in Hold-to-Run mode. It launches Variables use by action , where you can modify values, if necessary, before playing tapping PLAY .
	Tap to launch a circle help visualize the angle. Use the circle to change the angle of the joint.
	

Base: Set tile parameters

The **Set** tile is a core base tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Set** that can be configured.

Use **Set** when you need to set the value of one or more variables.



Tip: Whenever you see **(X)** beside an exposed entity, tap it to launch the **Select Variable** page and store the value you entered in a variable.

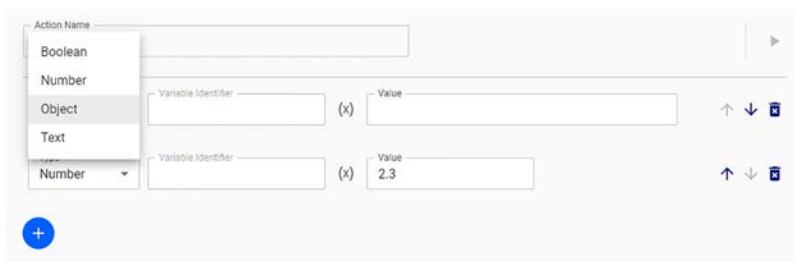


Figure 121: The Tile configuration pane when Set is the current tile

Table 56: Core base Set entities

Item	Description
Type	Select from the drop-down. • Boolean: true, false • Number: digit or floating point • Object: complex type • Text: string of letters
Variable identifier	Enter a meaningful name for the variable.  Note: Tapping the text field launches the Select Variable window where you can select an existing variable, in which case you are assigning the variable a value, or you can create a variable.
Value	Enter the value of the variable.
	Tap to move the variable either up or down in the list of variables.
	Tap to delete the variable from the list.

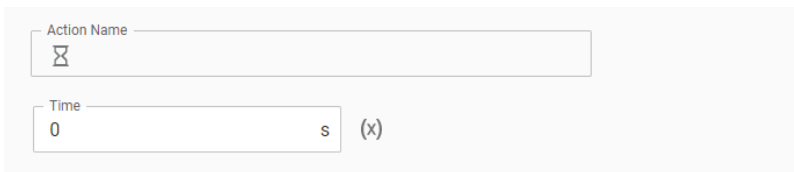
Base: Wait tile parameters

The **Wait Time** tile is a core base tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Wait Time** that can be configured.

Use **Wait Time** when you need to introduce a specified amount of time for the robot to stop moving before proceeding in the program.



Tip: Whenever you see **(X)** beside an exposed entity, tap it to launch the **Select Variable** page and store the value you entered in a variable.


Figure 122: The Tile configuration pane when Wait Time is the current tile**Table 57: Core base Wait Time entities**

Item	Description
Time	Enter either an integer or a floating point value. Time is measured in seconds.

Base: Condition tile parameters

The **Condition** tile is a core base tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Condition** that can be configured.

Use **Condition** when you need to introduce one or more conditions in the program before proceeding in the program.



Tip: Whenever you see **(X)** beside an exposed entity, tap it to launch the **Select Variable** page and store the value you entered in a variable.

When the **Condition** tile is dragged into the **Sequence editor** pane, it expands.

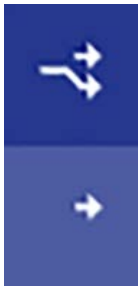


Figure 123: The Condition tile expands in the Sequence editor pane

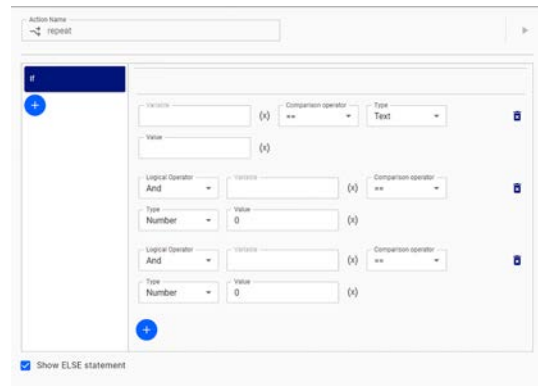


Figure 124: The Tile configuration pane when Condition is the current tile

A condition starts with **If** and requires variables and values to set the condition.

Table 58: Core base Condition entities

Item	Description
Variable	Tap to launch the Select Variable window where you can select or create a variable to use in the condition.
Comparison operator	Select from the drop-down. • == • > • >= • < • <=
Type	Select from the drop-down. • Boolean: true, false • Number: integer or floating point • Text: string of letters
Value	Enter or select the value associated with the selected type.

Item	Description
	Tap to introduce an alternative condition as an Else If statement. The Else If also requires a Variable, Comparison operator, Type, Value for the selected Type. When Else If is selected, another tile is displayed in the Sequence editor pane. 
Show ELSE statement	Select to show the program going through the else condition. The tile in the Sequence editor pane expands. 

Base: Loop tile parameters

The **Loop** tile is a core base tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Loop** that can be configured.

Use **Loop** when you need actions to repeat a certain number of times.



Tip: Whenever you see **(X)** beside an exposed entity, tap it to launch the **Select Variable** page and store the value you entered in a variable.

When the **Loop** tile is dragged into the **Sequence editor** pane, it expands.



Figure 125: The Loop tile expanded in the Sequence editor pane

The parameters of the **Loop** tile are grouped into three parts. Each part is a sub-pane in the **Tile configuration** pane. Each sub-pane is accessible by tapping on its name.

- **Loop**
- **Incrementer**
- **Conditions**

Action Name

Loop Incrementer Conditions

Maximum Iterations (x)

⚠ If Maximum Iterations is set to 0 and no condition is specified, the loop (and all actions it contains) will be played indefinitely until the program is stopped.

☒ Do at least once

Figure 126: Entities of the Loop tile on the Loop sub-pane in Tile configuration pane

Table 59: Core base Loop entities on the Loop sub-pane

Item	Description
Maximum Iterations	Enter the maximum number of times the actions within the loop are needed.
Do at least once	Select if you need to perform the actions in the loop at least once.

Action Name

Loop **Incrementer** Conditions

Variable (x)

Figure 127: Entities of the Loop tile on the Incrementer sub-pane in the Tile configuration pane

Table 60: Core base Loop entities on the Incrementer sub-pane

Item	Description
Variable	Tap to launch the Select Variable window where you can select or create a variable to use for the loop.

Figure 128: Entities of the Loop tile on the Conditions sub-pane in the Tile configuration pane

Table 61: Core base Loop entities on the Conditions sub-pane

Item	Description
Variable	Tap to launch the Select Variable window where you can select or create a variable to use for the loop.
Comparison operator	Select from the drop-down. • == • > • >= • < • <=
Type	Select from the drop-down. • Boolean: true, false • Number: integer or floating point • Text: string of letters
Value	Enter or select the value associated with the selected type.
	Tap to add more conditions.
Logical Operator	Select from the drop-down. • And • N/A • Or

Base: Message tile parameters

The **Message** tile is a core base tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Message** that can be configured.

Use **Message** when you want to print messages when a program runs.

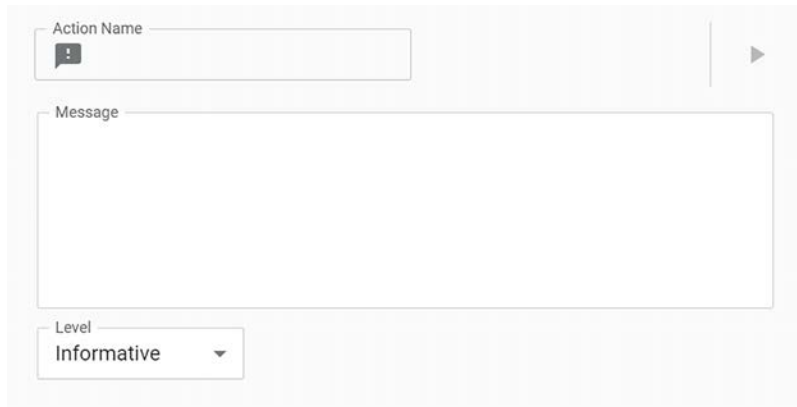


Figure 129: The Tile configuration pane when Message is the current tile

Although messages are primarily string-based, you can print out the values of variables.

Table 62: Core base Message entities

Item	Description
Message	Enter a message. Messages can contain variables. Example A variable can be defined as <pre>meaningful_variable_name = { "employee": {"name": "John", "age": 30, "city": "Montreal" }</pre> Enter in the message field: Hello, <code>\${meaningful_variable_name.employee.name}</code>. When the program reaches the message, it prints out Hello, John.
Level	Select the level of severity for the message. • Error • Informative • Warning

Robot: Waypoints tile parameters

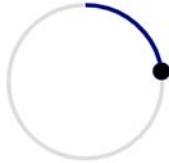
The **Waypoints** tile is a core robot tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of the waypoints that can be configured.

The parameters of the list of waypoints are grouped into three parts. Each part is a sub-pane in the **Tile configuration** pane. Each sub-pane is accessible by tapping on its name.

- **Waypoints**
- **Constraints**
- **Custom Frame (Optional)**

i **Tip:** Whenever you see **(X)** beside an exposed entity, tap it to launch the **Select Variable** page and store the value you entered in a variable.

i **Tip:** Whenever you see  beside an exposed entity, launch a circle help visualize the angle of the currently selected joint. Use the circle to change the angle of the joint.



Remember: Whenever you modify any of the waypoints in the list of waypoints, you must tap **UPDATE** ().

The screenshot shows the 'Waypoints' sub-pane of the 'Tile configuration' pane. At the top, there are fields for 'Action Name' and 'Output Results To Variable'. Below this, there are three tabs: 'Waypoints', 'Constraints', and 'Custom Frame (Optional)'. The 'Waypoints' tab is active, showing a dropdown for 'Waypoints Type' set to 'Cartesian', a checked box for 'Use optimal blending', and a dropdown for 'Go-To Options' set to 'Go-To'. Below these are the 'Waypoints (X)' list, which includes waypoints #1 through #6. Waypoint #6 is selected, and its configuration is shown in the main area. This includes fields for 'Index' (6) and 'Name' (#6 (Waypoint)), a 'Reference Frame' dropdown set to 'Base', and a 'Pose (X)' section with X, Y, and Z coordinates in mm and Theta X, Y, and Z angles in degrees. At the bottom, there are checkboxes for 'Use custom waypoint speed limits' and sliders for 'TCP Translation Speed' (set to 10 mm/s) and 'TCP Rotation Speed' (set to 2 °/s). Buttons for 'GOTO' and 'UPDATE' are visible at the top right of the configuration area.

Figure 130: Entities of the Waypoints tile on the Waypoints sub-pane in the Tile configuration pane

Table 63: Core robot Waypoint entities on the Waypoints sub-pane

Item	Description
Waypoints Type	Select Cartesian , which is moving the arm, or Angular , which is moving the joints.
Use optimal bleeding	When selected, the robot takes an optimal path from one end of the trajectory to another without actually reaching the intermediary points.
Go-To Options	Go-To Play from a specific waypoint. Play-Until Play until you reach a specific waypoint. Play-From Play from a specific waypoint. Custom Range Enter the start and end waypoints using index values. For example, if 6 waypoints are defined in a tile and you want to investigate only from waypoint #2 and want to end at waypoint #5, you would enter the range as 2 - 5.
	Tap to add a waypoint to the list of waypoints for the currently selected waypoint tile.
Index	Each waypoint in the list of waypoints in the waypoints tile has an associated index number. The first waypoint is 1, the second is 2, and so on.
Name	Enter a meaningful name for the currently selected waypoint in the list of waypoints.
Reference Frame	Select a frame of reference. The waypoint pose converts automatically with respect to the frame of reference. • Base • Tool • Custom
Pose	When the list of waypoints is defined as being Cartesian , the pose is expressed in Cartesian coordinates.
XYZ	The current Cartesian position of the waypoint selected in the list is displayed. Change the values if you know your values are more accurate than what is currently listed. Measurements are in millimeters.

Item	Description
Theta XTheta YTheta Z	The current angular position of the waypoint selected in the list. Change the values if you know your values are more accurate than what is currently listed. Measurements are in degrees.
Angles	When the list of waypoints is defined as being Angular , the pose is expressed in degrees.
Use custom waypoint speed limits	Select when you want speed limits set on the waypoint selected in the list. When the currently selected waypoint in the waypoint list is defined as Cartesian, the speed must be defined for TCP translation and for TCP rotation. When the currently selected waypoint in the waypoint list is defined as Angular, the speed must be defined for each joint.
TCP Translation Speed	Enter the desired translation speed for the <i>TCP</i>. The value must be between 10 and 1000 mm/s. It overrides the values under Constraints because this speed is for each waypoint.  Remember: The option is available only when the waypoint is defined as Cartesian.
TCP Rotation Speed	Enter the desired rotational speed for the <i>TCP</i>. The value must be between 1 and 2 °/s. It overrides the values under Constraints because this speed is for each waypoint.  Remember: The option is available only when the waypoint is defined as <i>Cartesian</i>.
Joint 1, Joint 2, Joint 3, Joint 4, Joint 5, Joint 6	The current angular position of the waypoint selected in the list is displayed. Change the values if you know your values are more accurate than what is currently listed. The speed must be between 1 and 100 °/s.  Remember: The option is available only when the waypoint is defined as Angular.

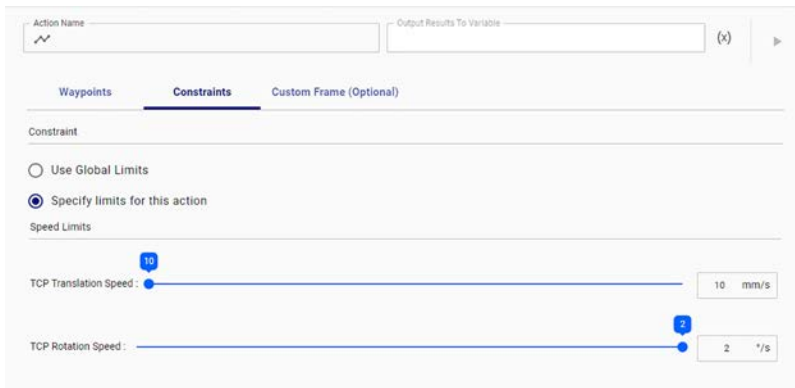


Figure 131: Entities of the Waypoints tile on the Constraints sub-pane in the Tile configuration pane

Table 64: Core robot waypoint entities on the Constraints sub-pane

Item	Description
Use Global Limits	Tap to apply the safety limits for the joints.
Specify limits for this action	Tap to apply specific speed limits for the joints. These limits must be less than the global safety limits configured for the joints.
TCP Translation Speed	Change the translation speed for all waypoints when the currently selected waypoint is defined as Cartesian. The speed must be between 10 and 1000 mm/s.  Remember: The option is available only when the waypoint is defined as Cartesian.
TCP Rotation Speed	Change the rotational speed for all waypoints when the currently selected waypoint is defined as Cartesian. The speed must be between 1 and 2 °/s.  Remember: The option is available only when the waypoint is defined as Cartesian.
Same limit for all joints	Deselect when you want to define a custom speed for each joint. The speed must be between 1 and 100 °/s. Select it when you want all joints to have the same customized speed limits. The speed must be between 1 and 100 °/s.  Remember: The option is available only when the waypoint is defined as Angular.

The screenshot shows the 'Custom Frame (Optional)' sub-pane of the 'Waypoints' tile configuration. At the top, there are fields for 'Action Name' and 'Output Results To Variable'. Below these are three tabs: 'Waypoints', 'Constraints', and 'Custom Frame (Optional)'. The 'Custom Frame (Optional)' tab is active. It contains a 'Custom Point of Reference' field with a unit '(x)' and an 'UPDATE' button. Below this, a note states: 'All Cartesian Offset waypoints will be relative to this pose. This pose needs to be in the Base reference frame.' There are six input fields arranged in two columns. The left column contains 'X' (0 mm), 'Y' (0 mm), and 'Z' (0 mm). The right column contains 'Theta X (degrees)' (0), 'Theta Y (degrees)' (0), and 'Theta Z (degrees)' (0). Each field has a unit indicator and a variable selection icon (X).

Figure 132: Entities of the Waypoints tile on the Custom Frame sub-pane in the Tile configuration pane

Table 65: Core robot waypoint entities on the Custom Frame (Optional) sub-pane

Item	Description
Custom Point of Reference	Waypoints that are Cartesian offsets must be offset relative to the defined pose. The frame of reference must be the Base. X, Y, and Z are measured in millimeters. Theta X, Theta Y, and Theta Z are measured in degrees.

Robot: Matrix tile parameters

The matrix tile is a core robot tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of the matrix that can be configured.

The parameters of the matrix are grouped into three parts. Each part is a sub-pane in the **Tile configuration** pane. Each sub-pane is accessible by tapping on its name.

- **Parameters**
- **Coordinates**
- **Computed Poses (Read Only)**



Tip: Whenever you see **(X)** beside an exposed entity, tap it to launch the **Select Variable** page and store the value you entered in a variable.

The screenshot shows the 'Parameters' sub-pane of a 'Matrix' tile configuration. At the top, there are fields for 'Action Name' and 'Output Results To Variable'. Below these are three tabs: 'Parameters' (selected), 'Coordinates', and 'Computed Poses (Read Only)'. The 'Grid' section contains 'Number of rows' (set to 1), 'Number of columns' (set to 1), 'Starting point' (set to 'Bottom left'), and 'Order' (set to 'Rows first, zigzag'). The 'Layers' section contains 'Number of layers' (set to 1) and 'Distance between layers' (set to 'new_variable_0'). At the bottom, there is a checkbox labeled 'Bottom to top?'.

Figure 133: Entities of the Matrix tile on the Parameter sub-pane in the Tile configuration pane

Table 66: Core robot Matrix entities on the Parameters sub-pane

Item	Description
Grid	
Number of rows	Enter the number of rows in the matrix.
Number of columns	Enter the number of columns in the matrix.
Starting point	Select from the drop-down. • Bottom left • Bottom right • Top left • Top right
Order	Select from the drop-down. • Rows first, zigzag • Rows first, back and forth • Columns first, zigzag • Columns first, back and forth • Randomized
Layers	
Number of layers	Enter the number of layers in the matrix.
Distance between layers	Tap in the text field or tap (X) to select, or create, a variable that defines the distance between layers.
Bottom to top?	Select to run the matrix from the bottom layer to the top layer. Deselect to play from the top layer to the bottom.

The screenshot shows the 'Coordinates' sub-pane of the Matrix tile configuration. At the top, there are tabs for 'Parameters', 'Coordinates' (selected), and 'Computed Poses (Read Only)'. Below the tabs, there are three main sections:

- Origin (bottom left) (x):** Contains fields for X (globals/package.angles), Y (new_variable_1.y), Z (new_variable_1.z), Theta X (new_variable_1.thetaX), Theta Y (new_variable_1.thetaY), and Theta Z (new_variable_1.thetaZ). Each field has a variable selection button (X) and an 'UPDATE' or 'CLEAR' button.
- Other end of first row (bottom right) (x):** Contains fields for X (0 mm), Y (0 mm), and Z (0 mm). Each field has a variable selection button (X) and an 'UPDATE' or 'CLEAR' button.
- Other end of first column (top left) (x):** Contains fields for X (0 mm), Y (0 mm), and Z (0 mm). Each field has a variable selection button (X) and an 'UPDATE' or 'CLEAR' button.

Figure 134: Entities of the Matrix tile on the Coordinates sub-pane in the Tile configuration pane

Table 67: Core robot Matrix entities on the Coordinates sub-pane

Item	Description
Origin	The origin is the selected Starting point on the Parameters sub-pane. Tap the X, Y, Z, Theta X, Theta Y, Theta Z text boxes, or the (X) beside them, to select or create a variable that has the associated values.  Remember: Tap UPDATE when you change the values in the text boxes. Tap CLEAR to undo changes you made.
Other end of first row	Enter values for X, Y, and Z.  Remember: Tap UPDATE when you change the values in the text boxes. Tap CLEAR to undo changes you made.
Other end of the first column	Enter values for X, Y, and Z.  Remember: Tap UPDATE when you change the values in the text boxes. Tap CLEAR to undo changes you made.

The screenshot shows the 'Computed Poses (Read Only)' sub-pane of the Matrix tile configuration. It contains a 'Computed Poses' section with a 'pose' sub-section. The 'pose' sub-section has fields for X, Y, Z, Theta X, Theta Y, and Theta Z. Each field has a variable selection button (X) and an 'UPDATE' or 'CLEAR' button. Below each field, there is a red error message: 'Must be a valid number'.

Figure 135: Entities of the Matrix tile on the Computed Poses sub-pane in the Tile configuration pane

Table 68: Core robot Matrix entities on the Computed Poses (Read Only) sub-pane

Item	Description
Pose	Based on the information entered on the Parameters and Coordinates panes, the poses for the matrix are computed. The X, Y, Z, Theta X, Theta Y, and Theta Z computed values are displayed in their respective text boxes.

Industrial I/O: tiles

The Industrial I/O plugin has a few tiles that can be used in programs.

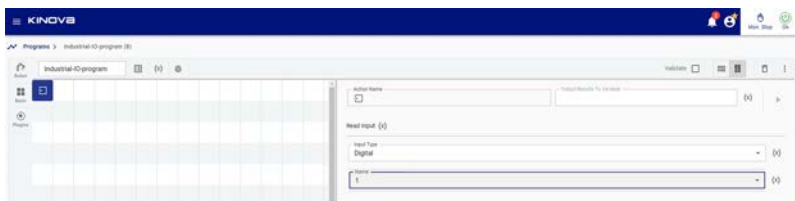
Table 69: Tiles that belong to Industrial I/O

Tile	Tile name	Description
	Read Input	Requires a variable of type Read Input; its value is available as result.
	Set Output	Set the output type and its variable strings. The tile may or may not wait for the completion of a tile.
	Wait for Input	Set a time to wait for input before proceeding in the program. The program aborts after waiting for the specified time.

Industrial I/O: Read Input tile parameters

The **Read Input** tile is an Industrial I/O tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Read Input** that can be configured.

Use **Read Input** to configure the type of input that needs to be used at that point in the program.

**Figure 136: The Tile configuration pane when Read Input is the current tile****Table 70: Industrial I/O Read Input parameters**

Item	Description
Read Input (X) Input Type	Select one of the available read input types. • Digital • Analog • Wrist digital • Wrist analog

Item	Description
Name	Displays the name of the variable for read input as a numerical value.
	When the Output Type is digital, the name is numerical.
	When the Output Type is analog, the name is a one character alphabetic.

Industrial I/O: Set Output tile parameters

The **Set Output** tile is an Industrial I/O tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Set Output** that can be configured.

Use **Set Output** to configure the type of input that needs to be used at that point in the program.

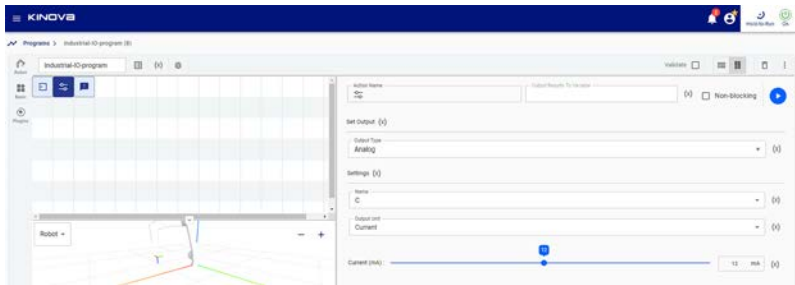


Figure 137: The Tile configuration pane when Set Output is the current tile

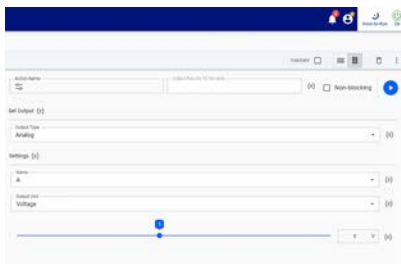


Figure 138: The Tile configuration pane when Set Output is the current tile

Table 71: Industrial I/O Set Output parameters

Item	Description
Set Output (X) Output Type	Select one of the available set output types. • Digital • Analog • Wrist digital • Wrist analog
Settings (X) Name	Displays the name of the variable for setting the output.

Item	Description
	When the Output Type is digital, the name is numerical.
	When the Output Type is analog, the name is a one character alphabetic.
State	When the Output Type is digital, the state is either High or Low .
	When the Output Type is analog, there is no State .
Output unit	When the Output Type is analog, the Output unit is Voltage .

Industrial I/O: Wait for Input tile parameters

The **Wait for Input** tile is an Industrial I/O tile. When you drag it into an available tile in the **Sequence editor** pane, the **Tile configuration** pane changes dynamically to expose the entities of **Wait for Input** that can be configured.

Use **Wait for Input** to configure the type of input that needs to be used at that point in the program.

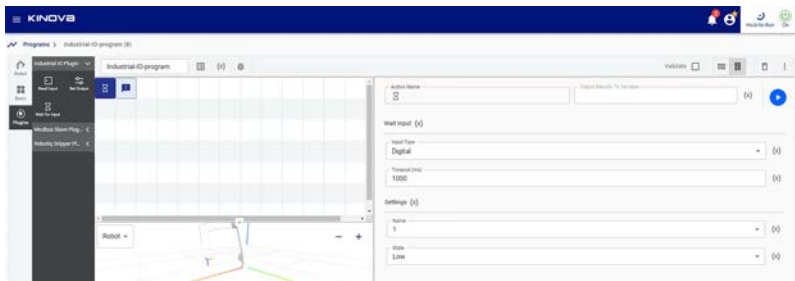


Figure 139: The Tile configuration pane when Wait for Input is the current tile and the Input Type is Digital

Table 72: Industrial I/O Wait For Input parameters

Item	Description
Wait Input (X) Input Type	Select one of the available set output types. • Digital • Analog • Wrist digital • Wrist analog
Timeout (ms)	Force the program to stop running if it must wait the number of milliseconds entered.
Settings (X) Name	Displays the name of the variable for setting the output. When the Output Type is digital, the name is numerical.

Item	Description
	When the Output Type is analog, the name is a one character alphabetic.
State	When the Output Type is digital, the state is either High or Low .
	When the Output Type is analog, there is no State .

Hand Guiding panel

Hand Guiding takes into account external forces and torque feedback from the environment of the robot.

When you press and hold the Wrist enabling device in the middle position, the **Hand Guiding** in the Robot control panel is selected and the **Enabling Device** icon illuminates blue.



Figure 140: Hand Guiding button in the panel

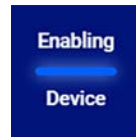


Figure 141: Enabling Device icon

There are two types of motion in Hand Guiding mode.

- **Cartesian:** The tool moves according to the force and torque applied on the *end effector*.
- **Joint:** The joints of the robot rotate according to the external torques applied at the joint.

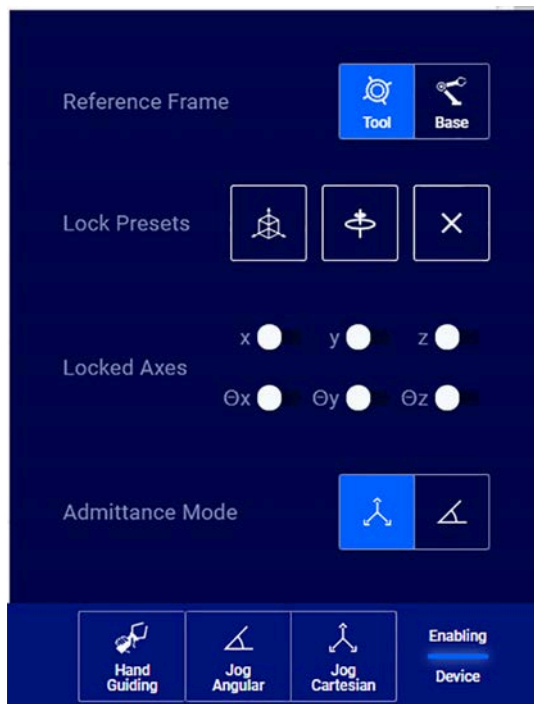


Figure 142: Hand Guiding panel

In this mode, usually you are interacting directly with the arm. However, some actions can be performed from the panel.

- Select the frame of reference as either **Tool** or **Base** when locking axes.
- Use **Lock Presets** to control the Hand Guiding constraints in *Cartesian* translation and rotation admittance mode.



Locks all x, y, and z axes. Cartesian movement is constrained. Only rotations are possible.



Locks all θ_x , θ_y , and θ_z coordinates. Rotations are constrained. Only movement in Cartesian translation are possible.



Cancels the selected lock preset. There are no constraints on the admittance mode.

- Any combination of zero or more axes, and zero or more angles, can be selected from **Locked Axes** to control the Hand Guiding movement with greater precision.

Related topics

[Mode: Hand Guiding](#) on page 82

Jog Cartesian panel

To control the position and orientation of the *end effector* of the robot, use the **Jog Cartesian** panel in Web app.



Important: Jog Cartesian is accessible only when the *teach pendant enabling device* or an external *enabling device* is held in the middle position.

Tap **Jog Cartesian** in the Robot control panel to access the **Jog Cartesian** panel.



Figure 143: Jog Cartesian button in the panel

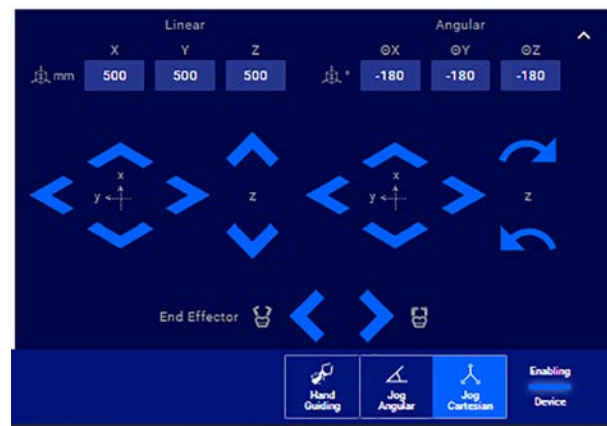


Figure 144: Jog Cartesian panel

Related topics

[Mode: Manual Jog](#) on page 80

Translation and rotation from the Jog Cartesian panel

Control linear and angular motion of the tool by using the **Jog Cartesian** panel.

There are two sets of virtual joysticks.

- The linear joystick applies a translational motion to the *TCP*.
- The angular joystick applies a rotational motion to the *TCP* with respect to the current position.



Figure 145: Controls for the Cartesian movement of the arm

Each set of virtual joysticks features a 2-axis joystick for controlling the x and y axes, and a 1-axis joystick to control in the z-axis.

When you tap on the controls, the values are displayed for the current position (x, y, z) and orientation (θ_x , θ_y , θ_z) of the end effector.



Figure 146: Values of the position of the arm



Note: The orientation representation uses a z-y-x Tait-Bryan extrinsic convention.

Finger controls

When a gripper is installed, open and close the fingers using a single 1-axis virtual joystick control.

Tap the left arrow to open the fingers. Tap the right arrow to close the fingers.



Figure 147: Finger controls on the Jog Cartesian panel for some grippers



Note: Some grippers, such as the Robotiq, require a reset program to be run before trying to use these buttons.

Additional settings

Reference frames, linear speeds, and [Angular](#) speeds are not modified as often as other [Cartesian](#) settings, but can be modified in the **Jog Cartesian** panel.

There is an up arrow in the upper right corner.

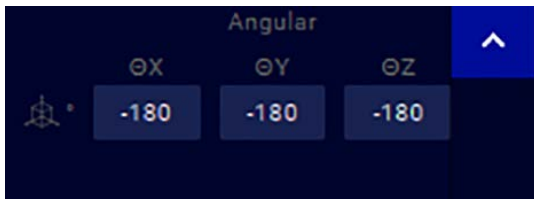


Figure 148: Jog Cartesian panel up arrow

Tapping it unveils additional settings available in Jog Cartesian mode.

- speed control
- reference frame selection

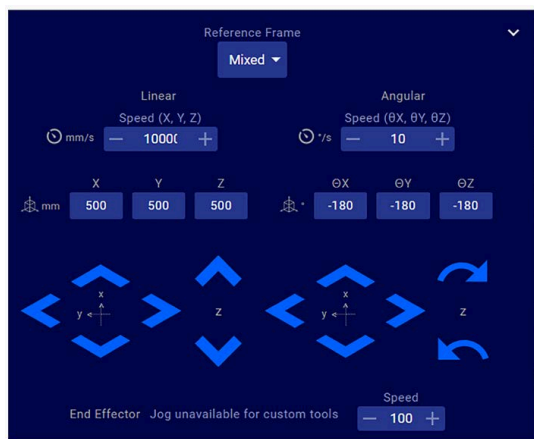


Figure 149: Additional settings in the Jog Cartesian panel

The linear and angular speeds are for the actuators. They are the hard limits for the robot. The linear speeds are measured in mm/s and the angular speeds in °/s. Configure the linear and angular speeds for the motion.

The position of the [end effector](#) specified in one of three reference frame conventions.

- **Mixed:** linear with the [base](#) being the frame of reference; angular with the tool being the frame of reference
- **Tool:** linear and angular with the base being the frame of reference
- **Base:** linear and angular with the base being the frame of reference



Figure 150: Available frames of reference in the Jog Cartesian panel

Jog Angular panel

To control the joint by joint movement of the robot, use the **Jog Angular** panel in [the Web App](#).

With the **Jog Angular** panel, control the robot joint angles and the *end effector* using a mouse or *teach pendant*.

Tap **Jog Angular** in the Robot control panel to access the **Jog Angular** panel.



Figure 151: Jog Angular button in the panel



Figure 152: Jog Angular panel

The joint angles are controlled through angular velocity. Control the angle of each *actuator*, as well as end effectors. The robot *arm* responds to the virtual *Angular* manipulation.



Note: For joints with joint rotation limits, the robot enforces software joint angle limits to prevent these joints from reaching the physical limits. When you control these joints, the software causes the arm joints to stop responding when the limits are reached.

Each angle is measured in degrees. The value displayed is restricted to minus or plus a full rotation; that is, -360° to $+360^\circ$.

Related topics

[Mode: Manual Jog](#) on page 80

Additional settings

Maximum speeds for actuators and fingers are not modified as often as other *Angular* settings, but can be modified in the **Jog Angular** panel.

There is an up arrow in the upper right corner.

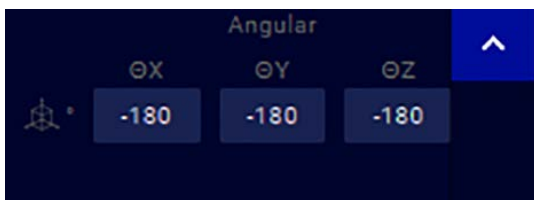


Figure 153: Jog Angular panel up arrow

Tapping it unveils additional settings available in Jog Angular mode.

- Maximum speed for each actuator
- Maximum speed for fingers when a gripper is installed



Figure 154: Additional settings in the Jog Angular panel

To control the angle of each [actuator](#), use the virtual controls to apply a velocity in the given direction. Increase the angle by tapping the up arrow; decrease the angle by tapping the down arrow. The speed does not exceed the set limit. The angle continues to change as long as the arrows are being used.



Note: The desired joint speeds must be less than the default joint speeds. Alternatively, the desired joint speeds must be less than the general or mode-specific speed limits configured and set on the **Speed Limit** page.

When a gripper is installed, control the end effector finger position with the side-pointing arrows on the bottom of the **Jog Angular** panel. Tap the left arrow to open the fingers and the right arrow to close them.

Related topics

[Robot control panel](#) on page 111

Program creation

The [admin](#) is responsible for creating programs that can be run safely by [operators](#).

It is common practice to create a program using a combination of Hand Guiding, Manual Jog, and [the Web App](#). The combination used is a matter of preference. However, there are times when using Hand Guiding and the Web App is the preferred approach, such as when the robot [arm](#) is approaching a surface.

After the program is debugged and is known to be working as expected, it must be validated. Tap **Validate**.

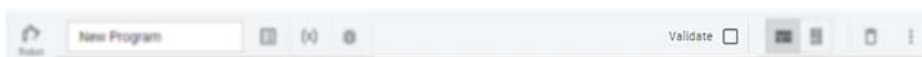


Figure 155: Validate button on the same line as the name of the program on the Program page

Validated programs on the **Programs** page have a green check mark.

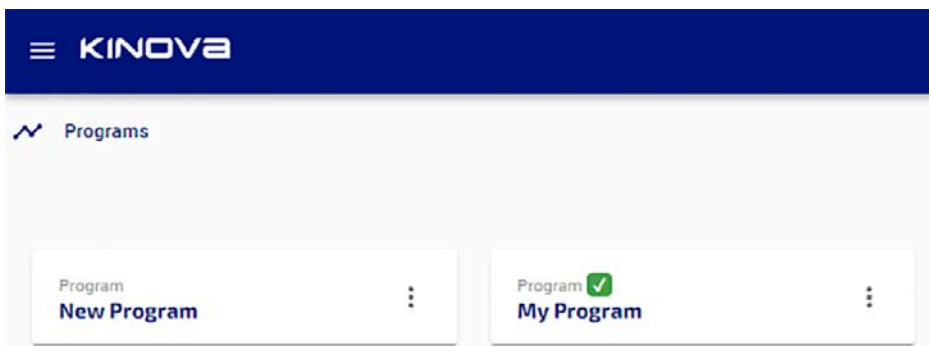


Figure 156: Example of a validated program

Only validated programs are available to operators.

Creating a program

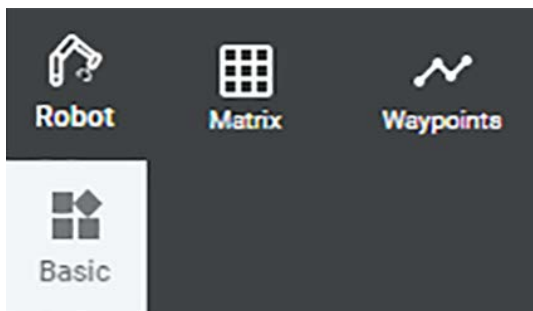
Every program is unique to the work environment of the robot.

About this task

The force torque sensor is in the [wrist](#). Touch only the wrist when you use [Cartesian](#) Hand Guiding mode. Guide any joint in [Angular](#) Hand Guiding mode.

Procedure

1. Press and hold the [enabling device](#), and move the [arm](#) to the starting position.
2. Let go of the enabling device.
3. Tap **Robot** (🤖) to access the tiles that are available for the robot.



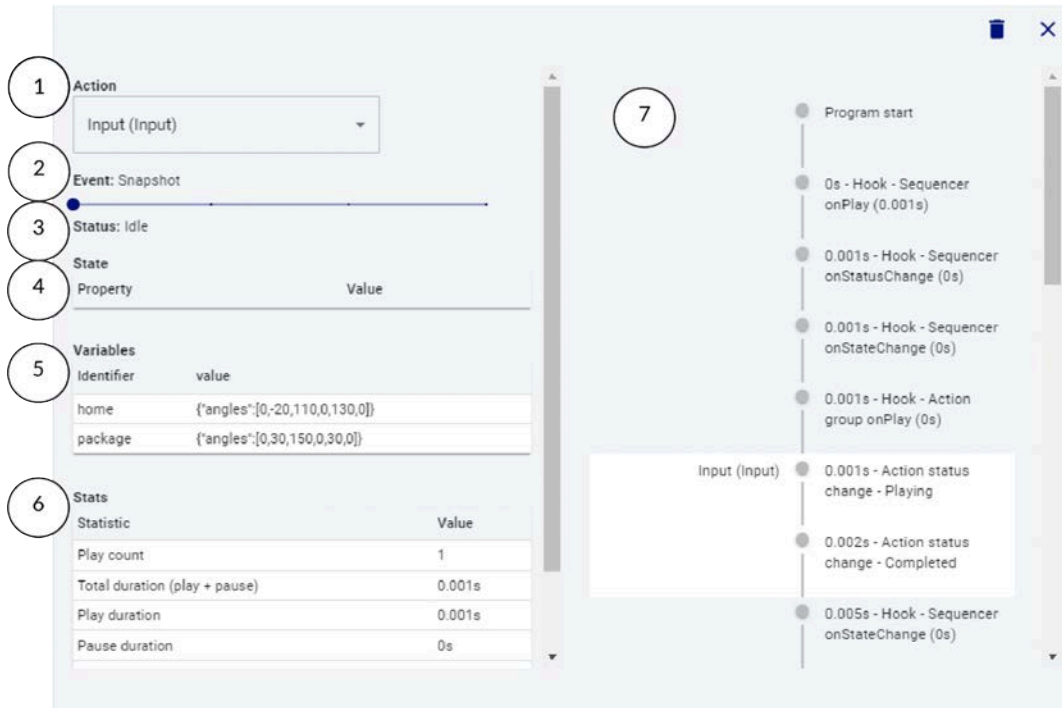
4. Drag a **Waypoints** tile in the first tile in the **Sequence editor** pane.
5. Record the position of the robot.
 - Press the waypoint snapshot button on the wrist.
 - Tap 📍 under Waypoints in the **Tile configuration** pane.

The current position of the robot is recorded in the list of waypoints associated with the currently selected waypoint tile.
6. Repeat moving the arm to another location in the trajectory and recording the position until you need a different action taken by the robot.
7. Drag a tile from **Robot** (🤖), **Basic** (📦), or any of the other tiles made available from the installed [plugins](#), that is associated with how you need the robot to move and configure the tile in the **Tile configuration** pane.

8. Put the robot in Hold-to-Run mode.
9. Tap either **Normal** () or **Reduced** () speed.
10. Tap **Play** () to run the program.
Tap **Stop** () at any time to correct the program.

Debug panel overview

It is important to know whether the program is running optimally or suboptimally before it is released to the users. The **Debug** panel launches at the end of the run of a debugging session.



- 1 **Action** Select one of the actions in the drop-down to highlight them in the timeline.
Alternatively, tap on any of the events in the timeline to view the action in the drop-down list.
- 2 **Event** Event is the action selected from which the debugger is to run.
- 3 **Status** Status is the mode of operation the robot is in.
- 4 **State** State lists the different property states and their values during the run of the program.
- 5 **Variables** Variables are used by the program.
 - Identifier is the name of the variable.
 - Value is the value of the named variable.

- 6 Stats (Statistics) Statistics are information about the program.
- Play count is the number of times the program is run.
 - Total duration (play + pause) is the total of time the program runs, before pauses, before the program ends.
 - Play duration is the amount of time the program plays before it ends.
 - Pause duration is the amount of time the program is paused.
 - Pause count is the number of times the program is paused.
 - Failure count is the number of times the program fails.
- 7 Timeline of events The visual timeline of events that occur while the program runs.
- Tap on any of the events in the timeline to view information related to that event.

Debugging a program

Determine whether the program is running optimally or suboptimally by using the debugger and the play controls in the Robot control panel.

About this task

There must be a program in the **Program** page.

Procedure

1. Tap the Robot status icon in the Robot control panel.
The launches.



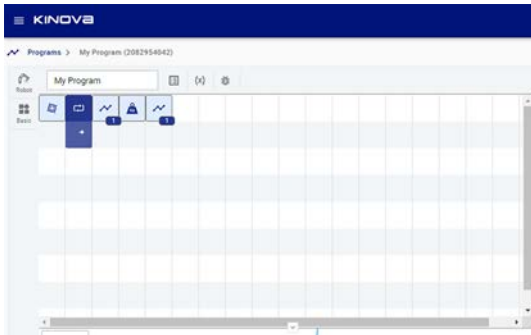
2. Tap Hold-to-Run ().
3. Tap **Debug** ().



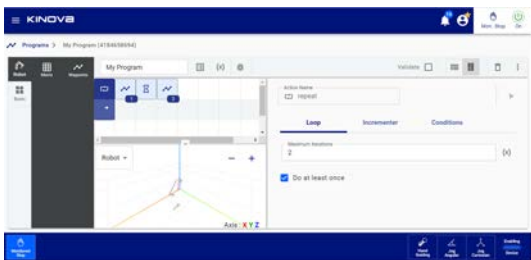
4. Tap a tile in the **Sequence editor** pane from where you want to start debugging.



Tip: It is easier to debug small portions of a program. However, remember to debug from the very beginning of the program as well to make sure the program runs smoothly between sections.



The **Tile configuration** pane populates with details about the selected action.



Program is ready to use

The robot is ready to be used in its environment and to perform its tasks.

All users can run a program that is validated. There are different ways to run a program.

- Run the program in Auto mode. This is the most common way of running a program for users.
- (Admin users only) Run a program in Hold-to-Run mode.

Additionally, users can choose to run in normal speed or reduced speed. Reduced speed is often used for safety reasons.

Running a program in Automatic mode

Work in Auto mode to run a program with little to no intervention.

Before you begin

The program is fully debugged and validated.

About this task

The robot must be on and operational. All users can run a validated program.

Procedure

1. Tap **Programming > Programs**.
2. Tap the program to select a program to run.
3. Tap Auto (🔄).

4. Tap  in the Robot control panel



The program runs at the programmed speed.



Note: At any time in Auto mode, tap the Program speed control buttons to slow down the speed of the program and to resume its normal speed.

Related topics

[Mode: Automatic](#) on page 85

Running a program in Hold-to-Run mode

Work in Hold-to-Run mode to run a program knowing that intervention may be required.

Before you begin

The program is validated.

About this task

The robot must be on and operational. When you run a program in Hold-to-Run mode, you may want to determine whether it needs further debugging or they may want to see how it works either at reduced or normal speeds.

When the playing speed of the program exceeds 250 mm/s

Procedure

1. Tap **Programming > Programs**.
2. Tap the program to select a program to run.
3. Tap Hold-to-Run (.
4. Tap  in the Robot control panel.



The program runs at the programmed speed.



Note: At any time in Hold-to-Run mode, tap the Program speed control buttons to slow down the speed of the program and to resume its normal speed.

Related topics

[Mode: Hold-to-Run](#) on page 83

Diagnostics

There are three diagnostic pages where you can view potential issues in any part of the robot. The pages are found under the **Diagnostics** menu.

- **Status:** displays the results of all the built-in tests
- **Monitoring:** displays live information from the sensors about the robot, divided into four groups
- **Event notifications:** displays events that occur in the robot, including events in [the Web App](#)

Built-in self tests

[The Web App](#) displays notifications, such as a robot component not functioning properly, on the **Status** page.

The **Status** page displays an overview of the status of each component in the system.

There are two ways to access the **Status** page.

- Tap the [hamburger menu](#) ☰ > **Diagnostics** > **Status**.
- Tap the robot status icon beside the user profile icon and then tap **VIEW ALL DIAGNOSTICS**.

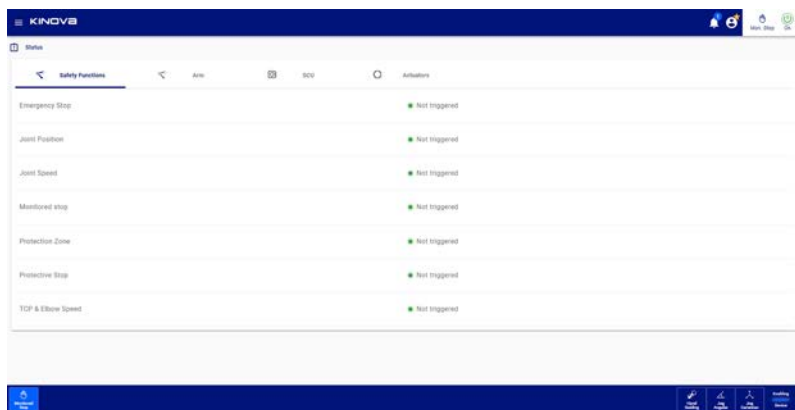
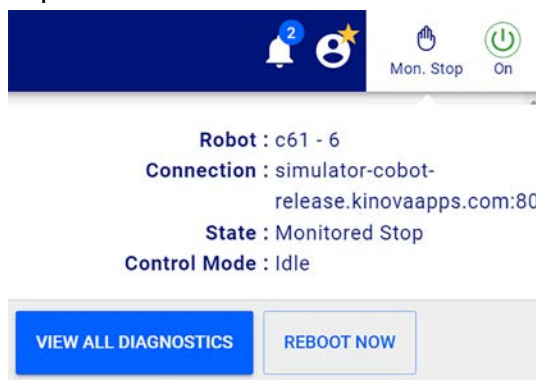


Figure 157: Status page

The page is divided into four panes.

- **Safety Functions**
- **Arm**
- **SCU**

- **Actuators**

Each pane displays the status of every test performed on individual components of the robot.

Status of safety functions

The safety functions are listed on the **Safety Functions** pane on the **Status** page are the same safety functions listed with their current state.

Safety functions are monitored by the SCU. The state of each safety function is displayed.

- A green circle is beside the name of the safety function with the text **Not triggered** beside the circle.
- A red circle is beside the name of the safety function with the text **Triggered** beside the circle.

Related topics

[List of safety functions](#) on page 52

[SF01 Emergency stop](#) on page 53

[SF02 Protective stop](#) on page 54

[SF03 Joint position monitoring](#) on page 54

[SF04 Joint speed monitoring](#) on page 55

[SF05 Monitored stop](#) on page 55

[SF06 Protection zone monitoring](#) on page 56

[SF07 TCP and elbow speed monitoring](#) on page 56

Status of the arm

The status of each part of the [arm](#) is displayed on the **Arm** pane on the **Status** page.

The status of the arm summarizes the state of the entire robot.

On the **Arm** pane, you can search for specific state strings, all errors, or all warnings.



Figure 158: Filter for specific errors

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.

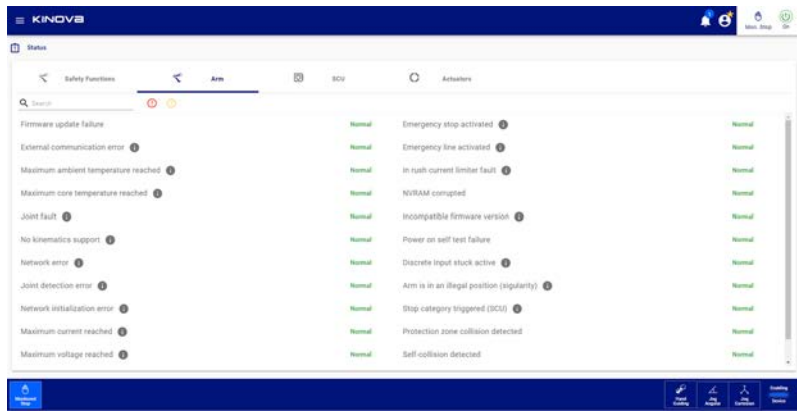


Figure 159: Status page of the arm

Each status has text that indicates its overall state: Normal, Warning, or Error. When there is an error, attempt to clear the fault. If the error persists, you may not be able to intervene.

The **Arm** pane displays all the status that are being monitored, including internal variables. Some of the internal variables cannot be accessed by users; the variables may be associated with hardware problems. Contact support at support@kinova.ca.

Table 73: Listing of arm status

Status	Not addressable by users	Addressable by users
Firmware update failure		X
External communication error		X
Maximum ambient temperature reached		X
Maximum core temperature reached		X
Joint fault		X
No kinematics support	X	
 Tip: If this happens, you may still want to contact support.		
Network error	X	
Joint detection error	X	
Network initialization error	X	
Maximum current reached		X
Maximum voltage reached		X
Minimum voltage reached		X
In rush current limiter fault	X	
NVRAM corrupted	X	
Incompatible firmware version		X

Status	Not addressable by users	Addressable by users
Power on self test failure	x	
Discrete Input stuck active	x	
Arm is in an illegal position (singularity)		x
Stop category triggered (SCU)		x
Protection zone collision detected		x
Self-collision detected		x
Collision detected		x

When you are not able to intervene with a status, you can attempt to recover on your own before contacting support.

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the *firmware update package (SWU)* if the error persists.
4. If the problem persists, contact support at support@kinova.ca.

Related topics

[Protection zones](#) on page 61

Firmware update failure

What does *Firmware update failure* monitor?

Firmware update failure monitors whether the latest [firmware](#) uploaded to the robot is installed properly.

Causes of the trigger

- Communication is faulty when the SWU package is uploaded to the robot.
- Firmware is corrupted during its initial download from the Kinova Artifactory server.

Procedure

1. Download the latest version of the firmware from our Artifactory server.
2. Restart the firmware installation.

Incompatible firmware version

What does *Incompatible firmware version* monitor?

Incompatible firmware version monitors whether the [firmware](#) installed on the controller is compatible with the robot.

Cause of the trigger

A SWU package meant for another model of the robot may have been installed on the controller.

Procedure

1. Download the latest version of the firmware from our Artifactory server.
2. Restart the firmware installation.

Joint detection error

What does *Joint detection error* monitor?

Joint detection error monitors whether the number of [actuators](#) detected by the [controller](#) is the same as its expected configuration.

Cause of the trigger

Communication packets may be lost between the internal devices of the robot.

Procedure

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the SWU package if the problem persists.
4. If the problem persists, contact support at support@kinova.ca.

Joint fault

What does *Joint fault* monitor?

Joint fault monitors all actuators to determine whether any of them are currently in a fault state.

Cause of the trigger

There are multiple reasons for actuators being in fault.

Procedure

1. Tap **Actuators**.
2. Search *Joint*.
3. Identify the [actuator](#) in fault and its trigger.

Related topics

[Status of the actuators](#) on page 182

[Status of the safety actuators](#) on page 186

No kinematics support

What does *No kinematics support* monitor?

No kinematics support monitors whether the [controller](#) can find the kinematic information to control the [arm](#) properly.

Cause of the trigger

The files that contain the information in the file system of the controller may be corrupted.

Procedure

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the SWU package if the problem persists.
4. If the problem persists, contact support at support@kinova.ca.

Maximum ambient temperature reached

What does *Maximum ambient temperature reached* monitor?

Maximum ambient temperature reached monitors the ambient temperature.

Cause of the trigger

- The room where the [controller](#) is installed may be too warm.
- There is not enough space behind the controller for its fan to disperse its internal heat properly; the temperature close to the controller is warmer than the actual temperature of the room.

Remedy

Make sure the controller has enough room to dissipate heat properly and that it operates under the recommended conditions.

Related topics

[Considerations before installing the controller](#) on page 93

Maximum core temperature reached

What does *Maximum core temperature reached* monitor?

Maximum core temperature reached monitors the temperature within the core of the [controller](#). It must not exceed 75 °C.

Cause of the trigger

The fan within the controller is not able to dissipate heat efficiently enough.

Procedure

- Make sure the air filters on the controller are clean.
- Make sure the fan is spinning freely.
- Make sure the controller has enough room to dissipate heat properly.

Related topics

[Considerations before installing the controller](#) on page 93

Maximum current reached

What does *Maximum current reached* monitor?

Maximum current reached monitors whether the electrical current pulled by the [controller](#) stays below a certain amount.

Cause of the trigger

The instantaneous power pulled by the robot for its motion in addition to the power required by the components of the controller may exceed the limits of the hardware.

Procedure

- Avoid having computationally expensive algorithms running on the controller when the robot has to apply high torques if possible.
- Reduce the force or velocity output by the robot during its trajectory.

Network error

What does *Network error* monitor?

Network error monitors whether the controller can find all the expected devices on its network.

Cause of the trigger

Communication packets may be lost between the internal devices of the robot.

Procedure

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the *SWU* package if the problem persists.
4. If the problem persists, contact support at support@kinova.ca.

Procedure

1. Reboot the controller.
2. Re-install the *SWU* package if the problem persists.
3. Contact support at support@kinova.ca.

Self-collision detected

What does *Self-collision detected* monitor?

Self-collision detected monitors whether non-consecutive robot links are at risk of entering in contact with each other.

Cause

Manual control and trajectories can drive the robot in configurations where self-collisions can occur.

Procedure

- Modify your trajectory accordingly when it is clear from observing the pose of the robot which links are at risk of entering in contact.
- Validate the size of your Tool Sphere in the **Protection Zones** page.

Related topics

[Protection zones](#) on page 61

Status of the actuators

The status of each *actuator* is displayed on the **Actuators** pane of the **Status** page.

The status of the actuators summarizes the state of the actuators.

On the **Actuators** pane, you can search for specific state strings, all errors, or all warnings.



Figure 160: Filter for specific status

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.

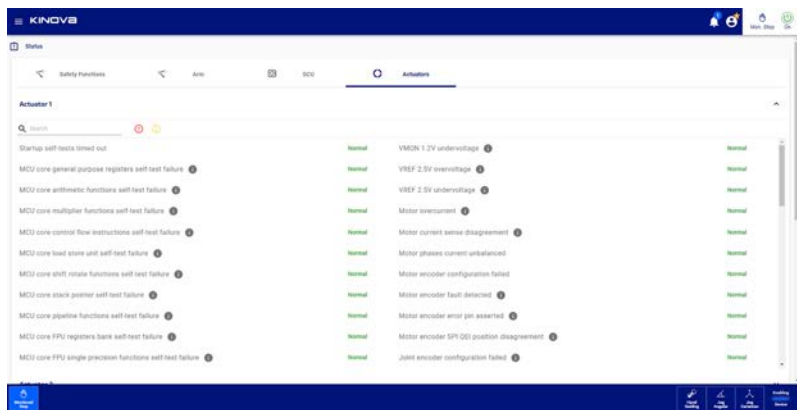


Figure 161: Status page of the actuators with an actuator pane expanded

Each status has text that indicates its overall state: Normal, Warning, or Error.

The **Actuators** pane displays all the status that are being monitored, including internal variables. Some of the internal variables cannot be accessed by users; the variables may be associated with hardware problems.

Table 74: Listing of status of all actuators

Status	Status
Startup self-test timed out	VMON 1.2V undervoltage
MCU core general purpose registers self-test failure	VREF 2.5V overvoltage
MCU core arithmetic functions self-test failure	VREF 2.5V undervoltage
MCU core multiplier functions self-test failure	Motor overcurrent
MCU core control flow instructions self-test failure	Motor current sense disagreement
MCU core load store unit self-test failure	Motor phases current unbalanced
MCU core shift rotate functions self-test failure	Motor encoder configuration failed
MCU core stack pointer self-test failure	Motor encoder fault detected
MCU core pipeline functions self-test failure	Motor encoder error pin asserted

Status	Status
MCU core FPU registers bank self-test failure	Motor encoder SPI QEI position disagreement
MCU core FPU single precision functions self-test failure	Joint encoder configuration failed
MCU core cache management logic self-test failure	Joint encoder fault detected
MCU RAM self-test failure	Joint encoder diagnostic pin asserted
Joint position following error	Joint encoder SPI QEI position disagreement
Joint maximum velocity	Encoders position disagreement
Joint position limit high	Motor housing temp sensor I2C error
Joint position limit low	Motor housing temperature too high
Joint maximum torque	Motor housing temperature too low
Motor driver configuration failed	Core temperature too high

When you are not able to intervene with a status, you can attempt to recover on your own before contacting support.

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the SWU if the error persists.
4. If the problem persists, contact support at support@kinova.ca.

Table 75: Listing of status with which you cannot intervene

Status	Status
Startup self-tests timed out	Joint encoder faults
MCU core self-test failures	Encoder position disagreement
VMON over/undervoltage	EEPROM errors
VREF 2.5V over/undervoltage	FRAM errors
Motor driver errors	XCOM errors
Motor current sense disagreement	Sensor disagreement
Motor phases current unbalanced	Safe communication failure
Motor encoder faults	Independent watchdog reset occurred

Related topics

[Joint fault](#) on page 179

Remedy for MCU firmware corruption

Many different errors of the status of the [actuators](#) can be caused by corrupted [firmware](#) on the *MCU*.

About this task

Take the same remedial steps for each of the actuator status.

- Startup self-tests timed out
- *MCU* core general purpose registers self-test failure
- *MCU* core arithmetic functions self-test failure
- *MCU* core multiplier functions self-test failure
- *MCU* core control flow instructions self-test failure
- *MCU* core load store unit self-test failure
- *MCU* core stack pointer self-test failure
- *MCU* core pipeline functions self-test failure
- *MCU* core FPU registers bank self-test failure
- *MCU* core FPU single precision functions self-test failure

Procedure

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the [controller](#).
3. Re-install the *SWU* if the error persists.
4. If the problem persists, contact support at support@kinova.ca.

Status of the Safety Control Unit

The status of each low-level safety validation feature is displayed on the **SCU** pane of the **Status** page.

The *SCU* status rarely enter warning or error states because there are watchers in the *MCU* that normally trigger their own faults before the *SCU* reaches its thresholds.

On the **SCU** pane, you can search for specific state strings, all errors, or all warnings.



Figure 162: Filter for specific status

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.

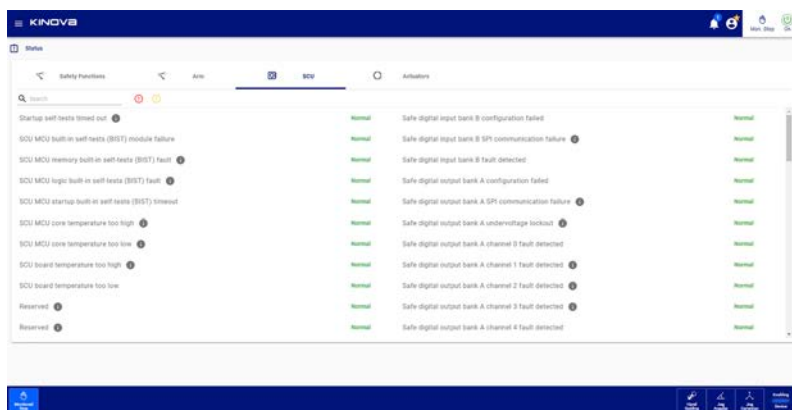


Figure 163: Status page of the SCU

Each status has text that indicates its overall state: Normal, Warning, or Error.

Table 76: Listing of SCU status

Status	Status
Startup self-test timed out	Safe communication failure joint [1 to 7] main MCU
SCU MCU built-in self-test (BIST) module failure	Safe communication failure joint [1 to 7] safety MCU
SCU MCU memory built-in self-test (BIST) fault	Safe communication failure wrist main MCU
SCU MCU logic built-in self-tests (BIST) fault	Safe communication failure wrist safety MCU
SCU MCU startup built-in self-tests (BIST) timeout	Safe digital input bank A configuration failed
SCU MCU core temperature too high	Safe digital input bank A SPI communication failure
SCU MCU core temperature too low	Safe digital input bank A fault detected
SCU board temperature too high	Safe digital input bank B configuration failed
SCU board temperature too low	Safe digital input bank B SPI communication failure
Reserved	Safe digital input bank B fault detected
Reserved	Safe digital output bank A configuration failed
SBC SPI configuration failed	Safe digital output bank A SPI communication failure
SBC fault detected	Safe digital output bank A undervoltage lockout
SBC debug mode active	Safe digital output bank A channel [0 to 7] fault detected
Clamp VIN overvoltage	Safe digital output bank B configuration failed
Clamp VIN undervoltage	Safe digital output bank B SPI communication failure
Clamp VOUT overvoltage	Safe digital output bank B undervoltage lockout
Clamp VOUT undervoltage	Safe digital output bank B channel [0 to 7] fault detected
Clamp temperature too high	FCCU reset occurred
Arm overcurrent	Software watchdog timer reset occurred
Emergency stop button signals disagreement	SBC watchdog reset occurred
Safety input [0 to 7] signals disagreement	Joint fault detected
Teach pendant emergency stop button signals disagreement	Joint [1 to 7] position disagreement
Teach pendant enabling button signals disagreement	Joint [1 to 7] speed disagreement
Safe communication failure MPU	Joint [1 to 7] torque disagreement

You can attempt to recover on your own before contacting support.

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the SWU if the error persists.
4. If the problem persists, contact support at support@kinova.ca.

Emergency stop button signals disagreement

What does *Emergency stop button signals disagreement* monitor?

Emergency stop button signals disagreement monitors whether the signals coming from the emergency stop button are in alignment with the state of the robot.

Cause

The emergency stop button may not be fully engaged or fully released.

Remedy

Procedure

1. Make sure the button is either fully engaged or fully released.
2. Take note of the exact error along with the conditions that seem to have triggered it.
3. Reboot the controller.
4. Re-install the SWU package if the problem persists.
5. If the problem persists, contact support at support@kinova.ca.

Safety input signals disagreement

What does *Safety input signals disagreement* monitor?

Safety input signals disagreement monitors whether each of the safety I/O signals are in alignment with the state of the robot.

Cause

The connections on the [I/O](#) panel may be loose.

Remedy

Procedure

1. Make sure the connections on the I/O panel are secure.
2. Take note of the exact error along with the conditions that seem to have triggered it.
3. Reboot the controller.
4. Re-install the SWU package if the problem persists.
5. If the problem persists, contact support at support@kinova.ca.

Status of the safety actuators

The status of each safety actuator is displayed on the **Actuators** pane of the **Status** page.

The status of the [actuator](#) actuators summarizes the state of the safety actuators.

On the **Actuators** pane, you can search for specific state strings, all errors, or all warnings.



Figure 164: Filter for specific status

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.



Figure 165: Status page of the actuators with a safety actuator MCU pane expanded

Each status has text that indicates its overall state: Normal, Warning, or Error.

Table 77: Listing of status of all safety actuator MCUs

Status	Status
Startup self-tests timed out	Emulated EEPROM corrupted
VMON 48V overvoltage	XCOM SPI communication failure
VMON 48V undervoltage	Motor driver enable pin disagreement
VREF 2.5V overvoltage	Brake driver enable pin disagreement
VREF 2.5V undervoltage	VMON 48V disagreement
Motor current sense disagreement	Motor housing temperature disagreement
Motor encoder error pin asserted	Joint position disagreement
Joint encoder diagnostic pin asserted	Motor position disagreement
Encoders position disagreement	Joint velocity disagreement
Motor housing temp sensor I2C error	Motor velocity disagreement
Motor housing temperature too high	Motor current disagreement
Motor housing temperature too low	Safe communication failure
Core temperature too high	Independent watchdog reset occurred
Core temperature too low	

Safety actuator status monitor low-level safety validation features. If any of the status are in error, you can attempt to recover on your own before contacting support.

1. Take note of the exact error along with the conditions that seem to have triggered it.
2. Reboot the controller.
3. Re-install the SWU if the error persists.
4. If the problem persists, contact support at support@kinova.ca.

Table 78: Listing of status with which you cannot intervene

Status	Status
Startup self-tests timed out	Joint encoder faults
MCU core self-test failures	Encoder position disagreement
VMON over/undervoltage	EEPROM errors
VREF 2.5V over/undervoltage	FRAM errors
Motor driver errors	XCOM errors
Motor current sense disagreement	Sensor disagreement
Motor phases current unbalanced	Safe communication failure
Motor encoder faults	Independent watchdog reset occurred

Related topics

[Joint fault](#) on page 179

Core temperature too high**What does *Core temperature too high* monitor?**

Core temperature too high monitors whether the core temperature is below a specific temperature.

Cause of the trigger

Trajectories with sustained high torques generate heat at a faster pace than it is dissipated.

Remedy

Leave the robot at rest and let it cool down. If a continuous program is triggering this fault, consider modifying the trajectory to reduce the duration of high applied torques.

Core temperature too low**What does *Core temperature too low* monitor?**

Core temperature too low monitors whether the core temperature is above a specific temperature.

Cause of the trigger

Low internal temperature is a consequence of low ambient temperature.

Remedy

Make sure the robot is operating in the recommended ambient temperature.

Motor housing temperature too high**What does *Motor housing temperature too high* monitor?**

Motor housing temperature too high monitors whether the temperature of the motor housing is below a specific temperature.

Cause of the trigger

Trajectories with sustained high torques generate heat at a faster pace than it is dissipated.

Remedy

Leave the robot at rest and let it cool down. If a continuous program is triggering this fault, consider modifying the trajectory to reduce the duration of high applied torques.

Motor housing temperature too low

What does *Motor housing temperature too low* monitor?

Motor housing temperature too low monitors whether the temperature of the motor housing is over a specific temperature.

Cause of the trigger

Low internal temperature is a consequence of low ambient temperature.

Remedy

Make sure the robot is operating in the recommended ambient temperature.

Robot monitoring

At any time, you can view current information about the [base](#), [actuators](#), [end effector](#) that is in use, and the flange pose.

To access the robot **Monitoring** page, tap  > **Diagnostics** > **Monitoring**.

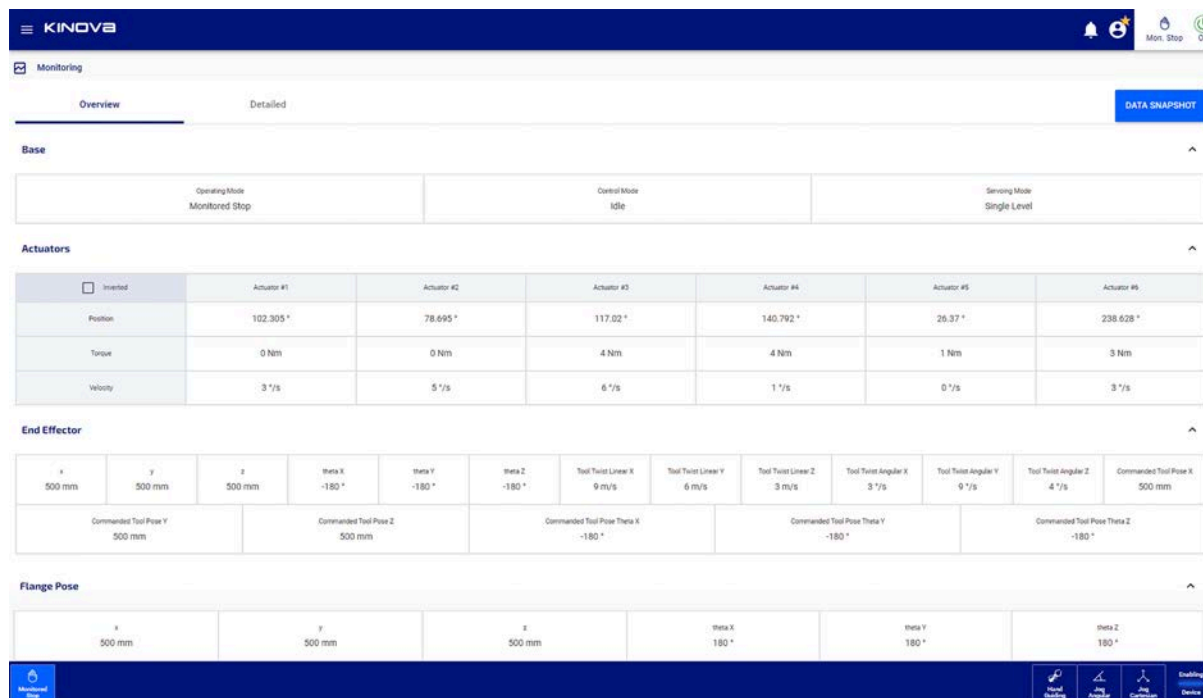


Figure 166: Overview pane of the Monitoring page

The page is divided into two panes.

- **Overview**
- **Detailed**

Both panes have a **Data Snapshot** button. To use the snapshot button, you must either have a *Universal Serial Bus (USB)* in the port on the controller or you must be working from a computer. Tapping **Data Snapshot** saves a JSON file that contains all the information displayed on the pane you are viewing in the **Monitoring** page.

Besides saving a snapshot of the robot and viewing the robot, you can change the Actuators table to invert the top row with the first column.

Overview pane of the Monitoring page

The **Overview** pane displays an overview of the position and state the robot is currently in.

It is subdivided into four main parts.

- **Base**
- **Actuators**
- **End Effector**
- **Flange Pose**

Table 79: Content of the Overview pane

Part	Information displayed
Base	Operating mode
	Control mode
	Servoing mode
Actuators	Position of each actuator; measured in °
	Torque of each actuator; measured in N·m
	Velocity of each actuator; measured in °/s
End Effector	X, Y, and Z; measured in mm
	Theta X, theta Y, and theta Z; measured in °
	Tool twist linear X, Y, and Z; measured in m/s
	Tool twist angular X, Y, and Z; measured in °/s
	Commanded tool pose X, Y, and Z; measured in mm
	Commanded tool pose Theta X, theta Y, and theta Z; measured in °
Flange Pose	X, Y, and Z; measured in mm
	Theta X, theta Y, and theta Z; measured in °

Detailed pane of the Monitoring page

The **Detailed** pane displays an more details about the current details of the [base](#) and the [actuators](#). The information about the [end effector](#) and the [flange](#) are the same as that in the **Overview** pane.



Figure 167: Detailed pane of the Monitoring page

Table 80: Content of the Detailed pane

Part	Information displayed
Base	Operating mode
	Control mode
	Servoing mode
	Arm voltage
	Arm current
	CPU temperature
	Acceleration X, Y, and Z
	Angular velocity X, Y, and Z
Actuators	Position of each actuator, measured in °
	Torque of each actuator, measured in N·m
	Velocity of each actuator, measured in °/s
	Motor current of each actuator; measured in A
	Voltage of each actuator; measured in V
	Motor temperature; measured in °C
	Core temperature; measured in °C

Part	Information displayed
End Effector	X, Y, and Z; measured in mm
	Theta X, theta Y, and theta Z; measured in °
	Tool twist linear X, Y, and Z; measured in m/s
	Tool twist angular X, Y, and Z; measured in °/s
	Commanded tool pose X, Y, and Z; measured in mm
	Commanded tool pose Theta X, theta Y, and theta Z; measured in °
Flange Pose	X, Y, and Z; measured in mm
	Theta X, theta Y, and theta Z; measured in °

Event notifications

Notifications about the robot and actions taken in [the Web App](#) are sent through the Web App. There are a few ways to access the **Notifications** page.

- Tap  to access the last five (5) notifications that are in the system.

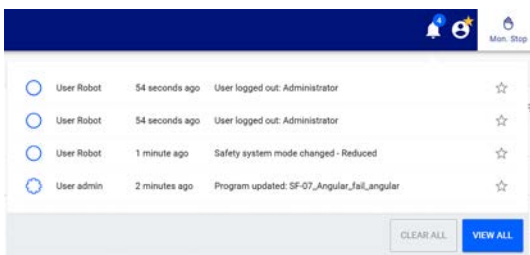


Figure 168: Quick access to the notifications

- Tap **VIEW ALL** to view all notifications on the **Notifications** page from the quick access to notifications.
- Tap **Notifications** from the Quick Menu.

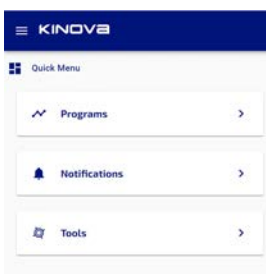


Figure 169: Access to Notifications from the Quick Menu

- Tap  > **Diagnostics** > **Notifications**.

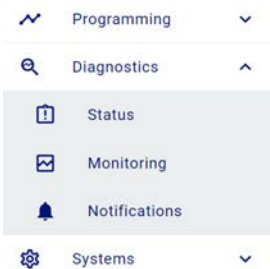


Figure 170: Access to Notifications from the Diagnostics menu

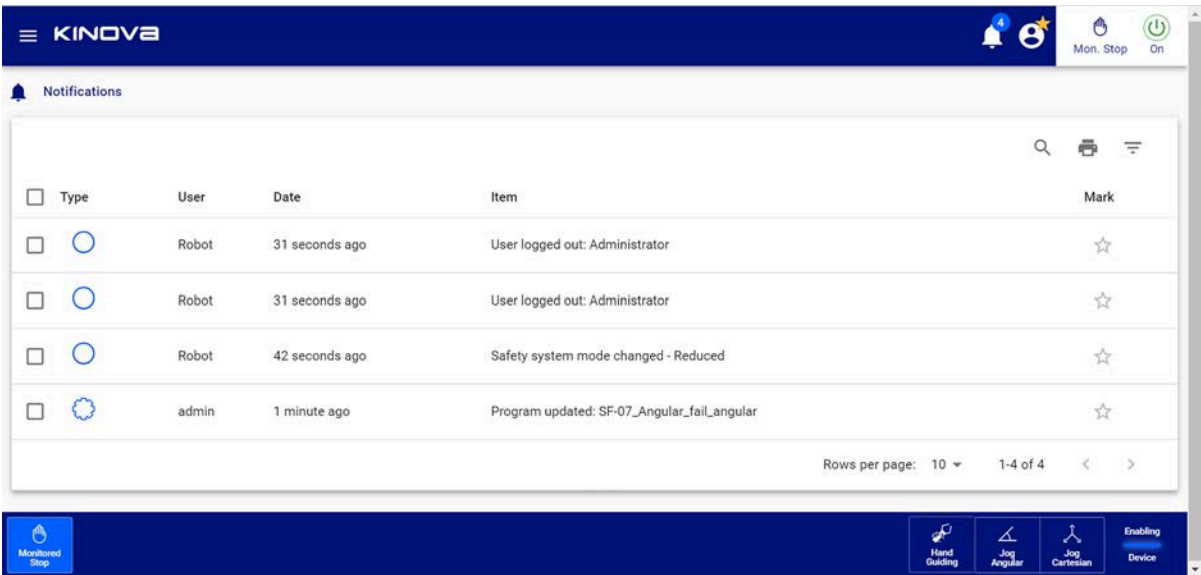


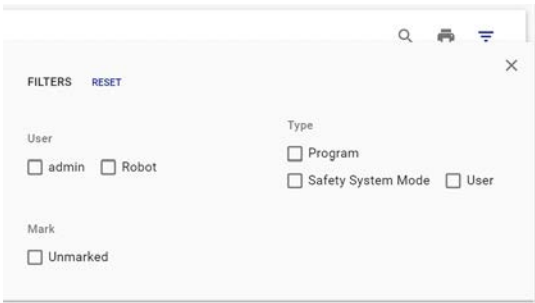
Figure 171: Notifications page

Table 81: Actions that can be performed on the Notifications page

	Search for a specific notification or notification type by entering a string beside the search icon.
	Print the content of the Notifications to a file or to a printer.



Launch a filter pane so that you can filter though all the notifications for specific ones.



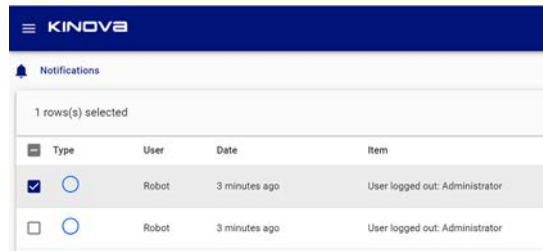
Filter on User, Type, and whether the notification is marked.



Tap to mark a notification to make it easier to find.



Tap to remove a mark from a notification.



Select one or more notification checkboxes that you want to prepare for deletion.



Delete the selected notifications.

Plugins

The modular design of Link 6 makes it a robot with expanding capabilities. The expanding capabilities are added on as [plugins](#).

Link 6 comes with three pre-installed plugins and cannot be uninstalled.

Arm plugin

The plugin handles all actions needed to control the [arm](#). The configuration and settings of the arm plugin are not visible because they are not modifiable.

Industrial I/O plugin

The plugin handles all general [I/O](#) between the [controller](#) and on the [wrist](#). That is, the plugin exchanges information using pure electrical signals through cables connected to some other piece of equipment.

Modbus TCP/IP Server plugin

The Modbus [TCP/IP](#) Server handles all commands sent from external devices, such as [PLCs](#), to the robot through the Ethernet connector. It is used to monitor and control the robot.

In addition to the pre-installed plugins, the [administrator](#) can add the functionality of each [end effector](#) used with the robot so that configuration and control of the end effector is achieved through [the Web App](#).

Anyone can create more plugins specific to the tool installed on the robot by using the API.

All plugins start to run right after they are installed. However, they can be stopped so the settings can be modified. All plugins that are running are, by default, active. They can be deactivated if the system is lagging.

Many plugins contain actions that the user can use when programming the robot with the visual programming interface in the Web App. Each plugin also contains the parameters that can be modified in the Web App from the corresponding plugin page.

All plugins have two pages: **Configurations** and **About**.

Related topics

[Visual programming](#) on page 132

[Installing plugins](#) on page 121

[OnRobot plugin](#) on page 212

[Robotiq plugin](#) on page 208

Arm plugin

Link 6 comes with the [arm plugin](#) pre-installed.

There are no configurable parameters for the arm. The **Configurations** portion of the **Arm plugin** page merely states that it does not have any modifiable configurations.

The **About** portion lists information specific to the arm, such as name, package name, version, type of installation, and a description of the plugin.

Industrial I/O plugin

Link 6 comes with the Industrial I/O [plugin](#) pre-installed.

The Industrial I/O plugin provides blocks through the visual programming interface in [the Web App](#) to exchange information using pure electrical signals through cables connected to some other piece of equipment. The equipment is connected to the general purpose and high speed connectors in the [controller](#).

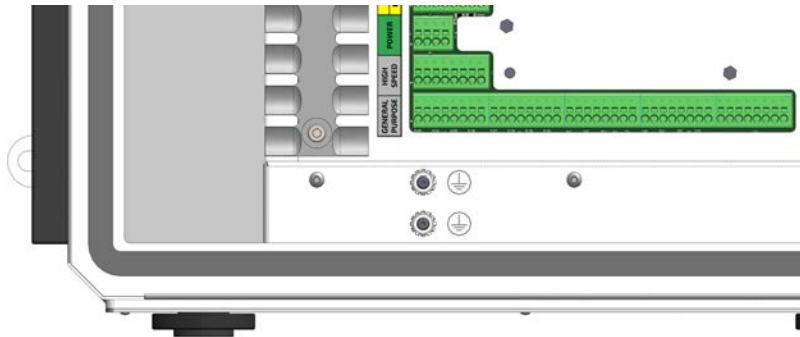


Figure 172: Industrial equipment connection on the controller

There are many configurable parameters for the Industrial I/O plugin. All parameters are found on different panes in the **Industrial I/O** page.

- **Controller Analog**
- **Controller Digital Inputs**
- **Controller Digital Outputs**
- **Wrist Analog**
- **Wrist Digital**



DANGER: Do not plug or unplug the industrial I/O power while the controller is on. It prevents the industrial I/O plugin configuration pages from refreshing properly. Eventually, you see the message

1 Unable to fetch configuration.

The behavior of the robot with respect to the industrial I/Os may become unstable.



Trouble: Should the industrial I/O power be plugged in or unplugged while the controller is on, perform a factory reset to re-establish normalcy.

Related topics

[Variables](#) on page 132

[Variable management](#) on page 144

Controller analog on the Industrial I/O plugin page

You can configure the controller with analog inputs and outputs.

Access the parameters available for the analog inputs and outputs of the controller by tapping **Controller Analog**.

Analog has a voltage resolution of 0.1 V and a current resolution of 0.1 A.

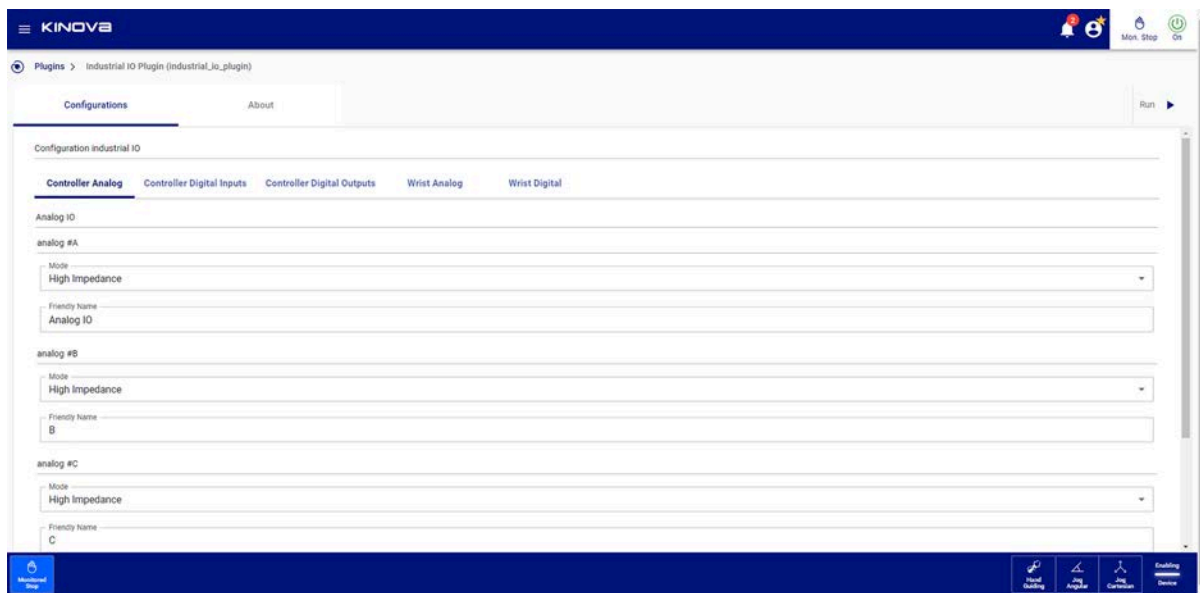


Figure 173: Controller Analog pane

Table 82: Controller analog configurations

Parameter	Description
Mode	Select a driver mode. • High Impedance (disable) • Voltage Output • Current Output • Voltage Input • Current Input
Friendly Name	Enter a meaningful name for that specific analog input or output for the controller.

Controller digital inputs on the Industrial I/O plugin page

All digital inputs for the [controller](#) must be configured on the **Controller Digital Inputs** pane of the **Industrial I/O** plugin page.

Each digital input for the controller is defined independently from the other digital input for the controller.

Access the parameters available for the analog inputs and outputs of the controller by tapping **Controller Digital Inputs**.

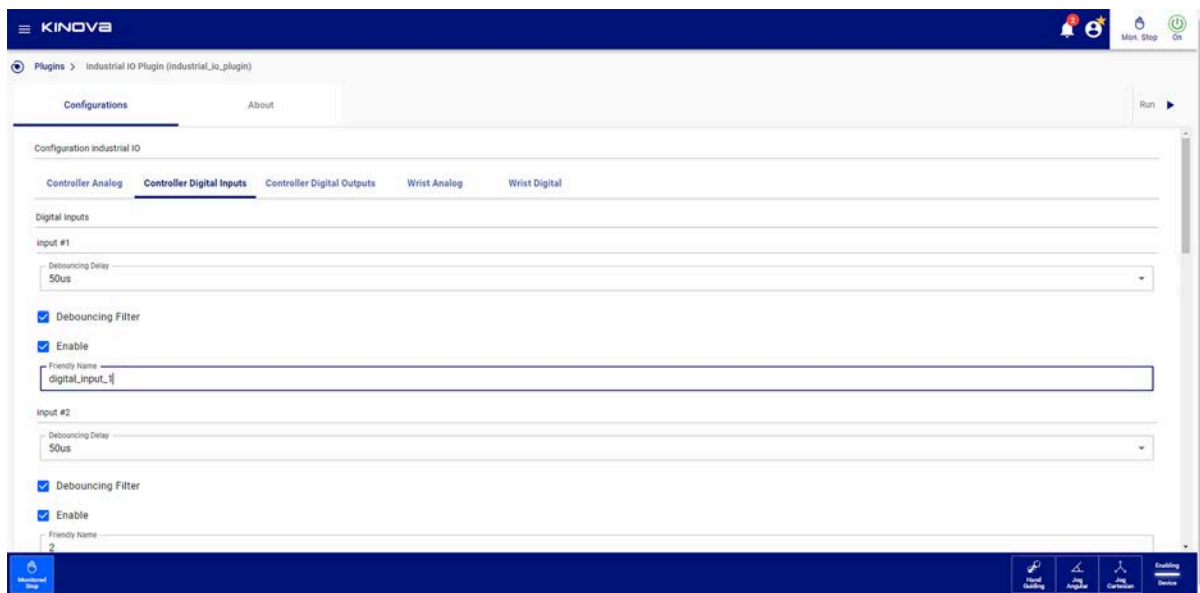


Figure 174: Controller Digital Inputs pane

Parameter	Description
Debouncing Delay	The <i>debouncing</i> delay is set in microseconds. Valid values are 50, 100, 400, 800, 1600, 3200, 12800, 20000.
Debouncing Filter	Select to configure the debouncing delay.
Enable	Select when you want to enable the input.
Friendly Name	Enter a meaningful name for that specific digital input for the controller.

Controller digital outputs on the Industrial I/O plugin page

All digital outputs for the controller must be configured on the **Controller Digital Inputs** pane of the **Industrial I/O** plugin page.

Each digital output for the *controller* is defined independently from the other digital output for the controller.

Access the parameters available for the analog inputs and outputs of the controller by tapping **Controller Digital Outputs**.

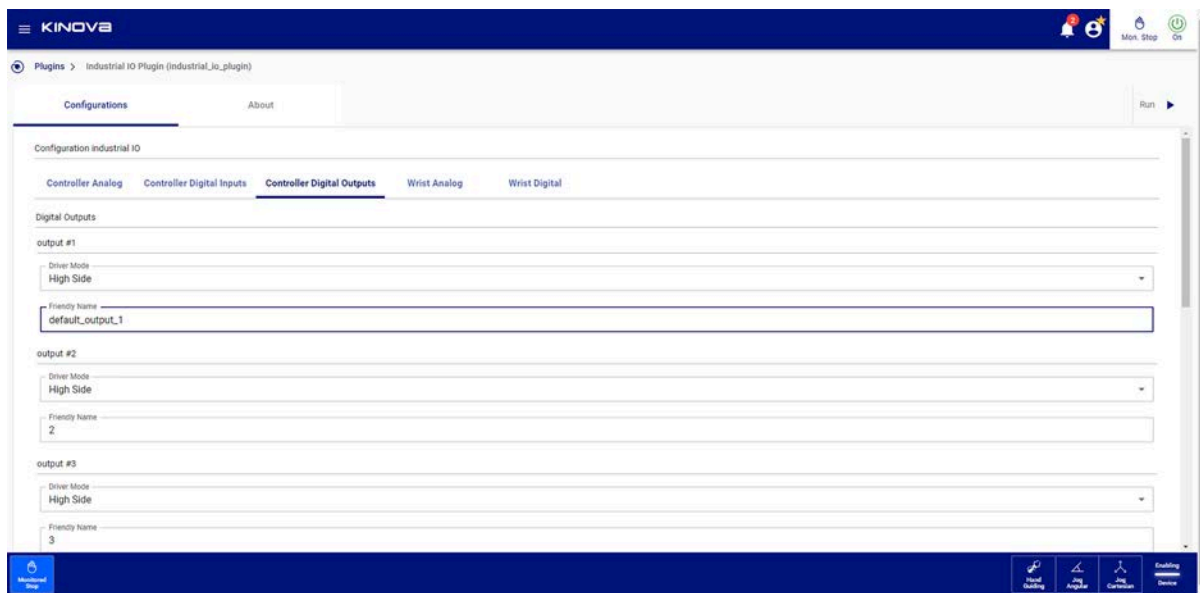


Figure 175: Controller Digital Outputs pane

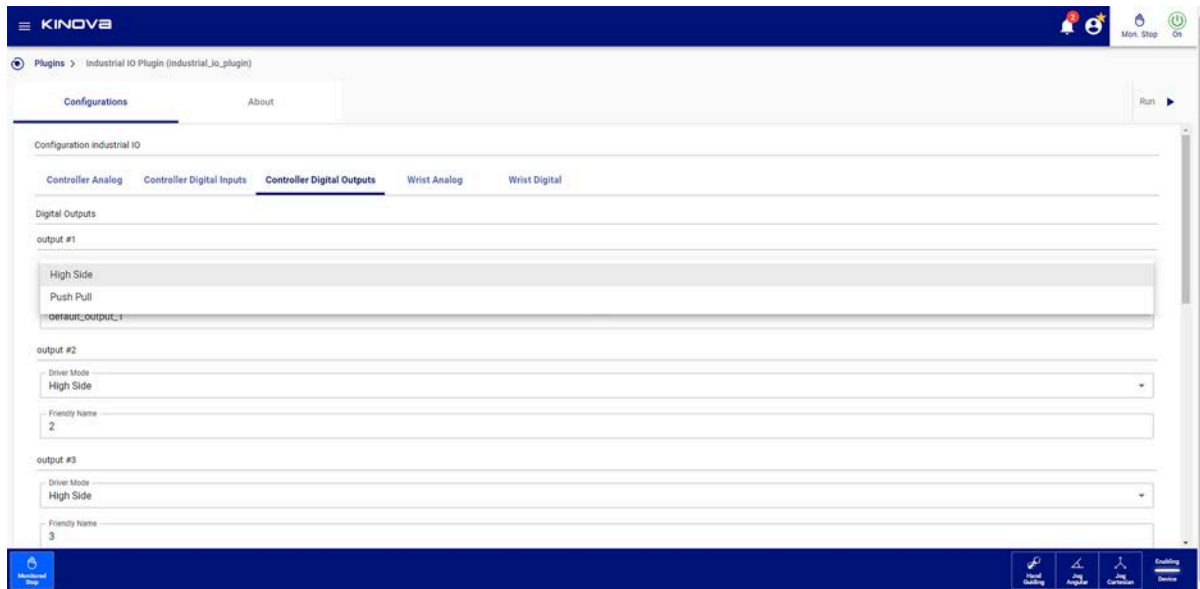


Figure 176: Controller Digital Outputs pane with driver drop-down

Parameter	Description
Driver Mode	Select a driver mode. • High Impedance (disable) • Voltage Output • Current Output • Voltage Input • Current Input
Friendly Name	Enter a meaningful name for that specific digital output for the controller.

Wrist analog on the Industrial I/O plugin page

You can configure the *wrist* with analog inputs and analog outputs.

Access the parameters available for the analog inputs and outputs of the wrist by tapping **Wrist Analog**.

Analog has a voltage resolution of 0.1 V and a current resolution of 0.1 A.

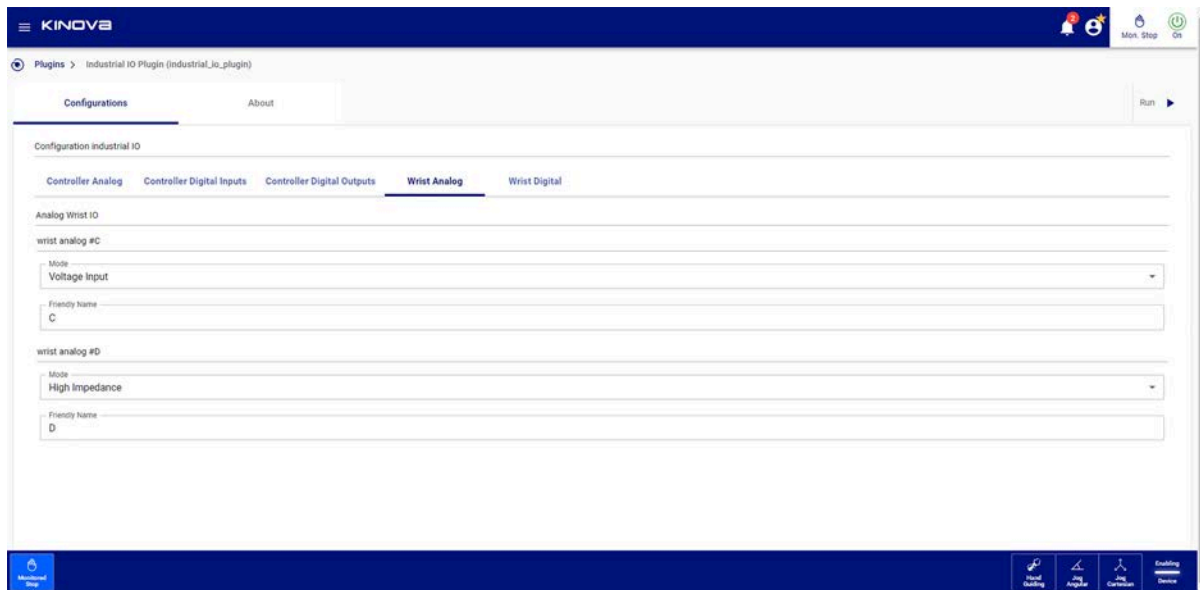


Figure 177: Wrist Analog pane

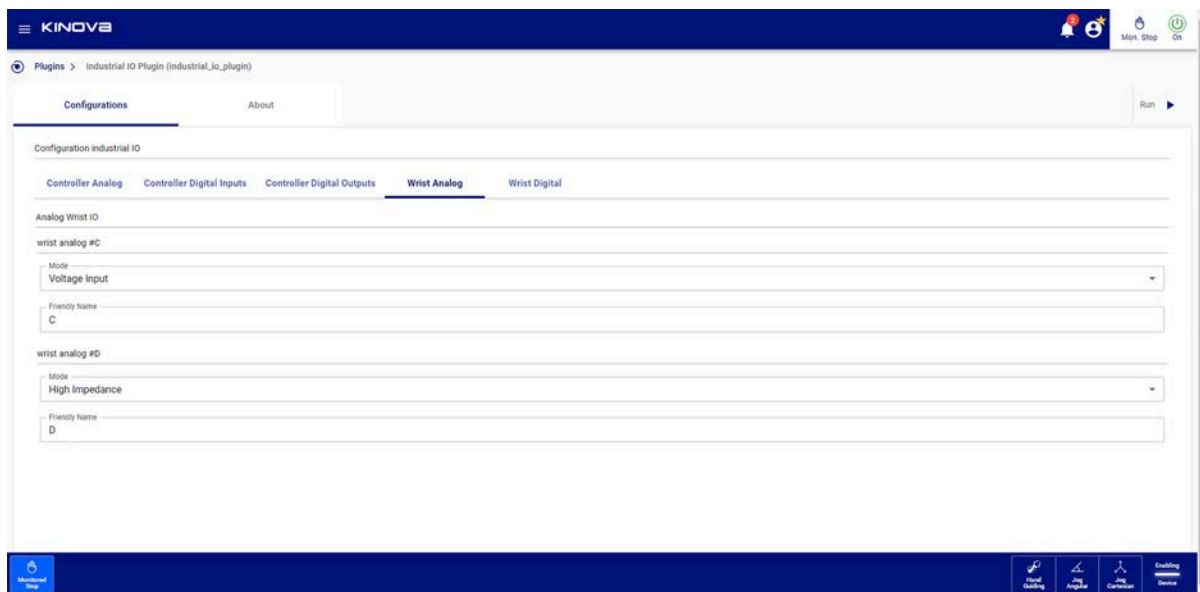


Figure 178: Wrist Analog pane with Mode drop-down

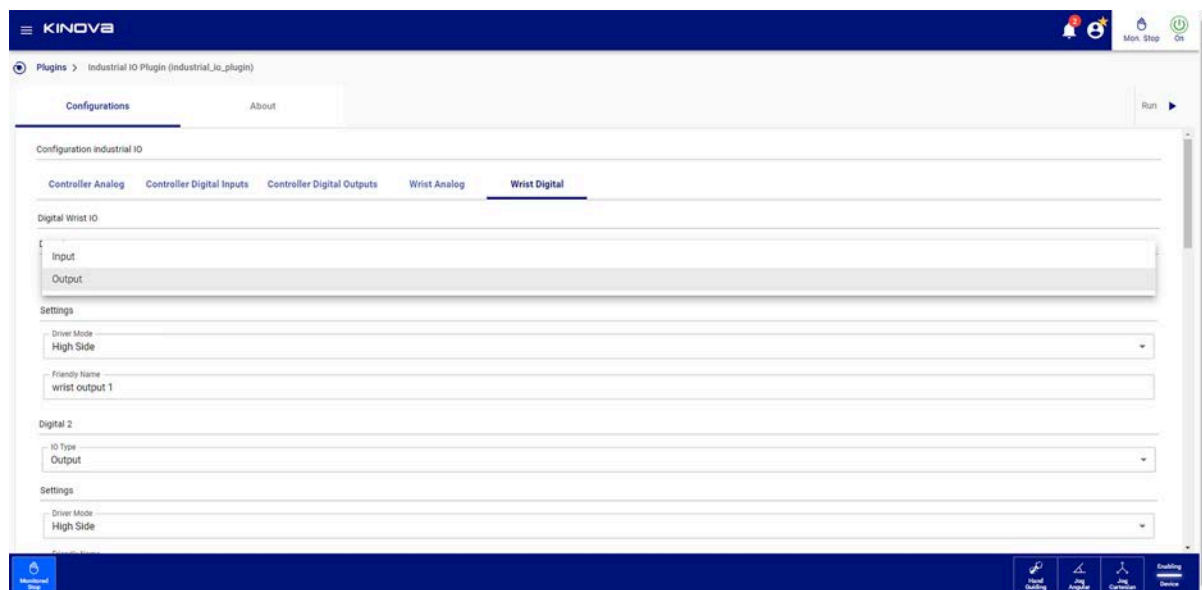
Table 83: Wrist analog configurations

Parameter	Description
Mode	Select a mode. • High Impedance (disabled) • Voltage Output • Current Output • Voltage Input • Current Input
Friendly Name	Enter a meaningful name for that specific analog input or output for the controller.

Wrist digital on the Industrial I/O plugin page

All digital inputs and outputs for the *wrist* must be configured on the **Wrist Digital** pane of the **Industrial I/O** plugin page

Each digital input and output of the wrist is defined independently from the other digital input and output of the wrist.

**Figure 179: Wrist Digital pane****Table 84: Wrist digital configurations**

Parameter	Description
IO Type	Select either Input or Output .

Parameter	Description
Mode	Select a mode. • High Impedance (disabled) • Voltage Output • Current Output • Voltage Input • Current Input
Friendly Name	Enter a meaningful name for that specific analog input or output for the controller.

Modbus Server plugin

Link 6 comes with the Modbus Server [plugin](#) pre-installed.

The Modbus Server [plugin](#) transmits instructions from a device to the [arm](#). Instructions include such things as to move a certain direction or to start performing a program.

There are no configurable parameters for the Modbus plugin.

Accessories

Accessories can enhance the Link 6 experience, either by keeping the work environment aesthetically pleasing or by increasing the functional capabilities of the robot.

Accessories range from mounts to adapters .

Related topics

[Link 6](#) on page 5

Controller wall mount

Install the [controller](#) on a vertical structure, such as on a wall or in a cabinet by using the Kinova controller wall mount.

The wall mount can be installed on the vertical structure with and without the controller already attached to it. The wall mount has pocket holes to facilitate installation. The space behind the wall mount can be used to route cables.

Fix the wall mount with the arrow facing up. Attach the controller to the wall mount such that the I/O panel opens towards the ground; the panel facing the ground is optimal for cable, ingress, and thermal management.

The wall mount is 36 mm away from the wall. Its size and its distance between mounting holes are shown in the figure.

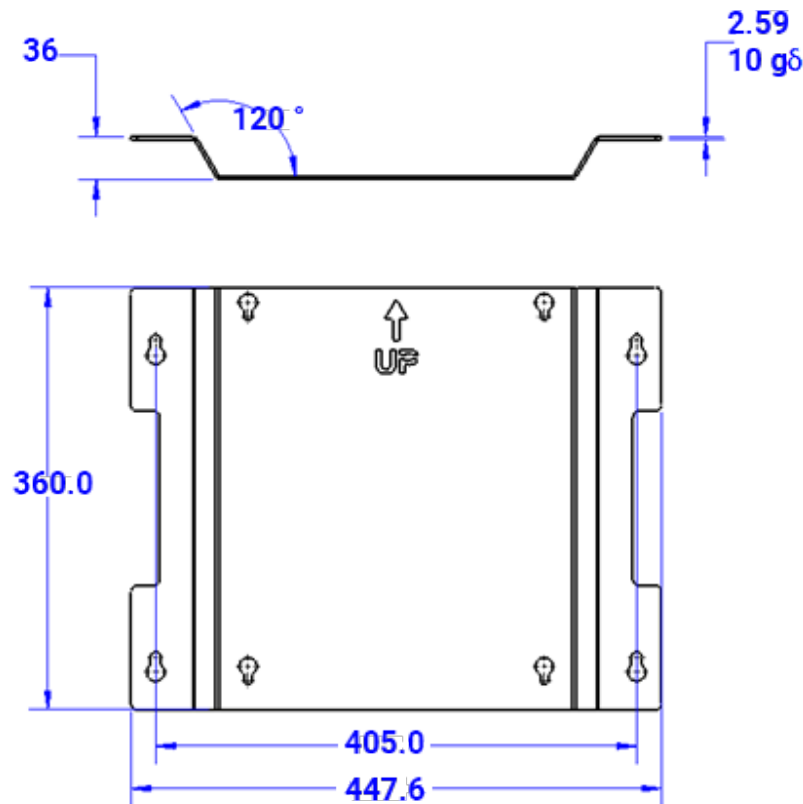


Figure 180: Dimensions of the Kinova wall mount measured in millimeters

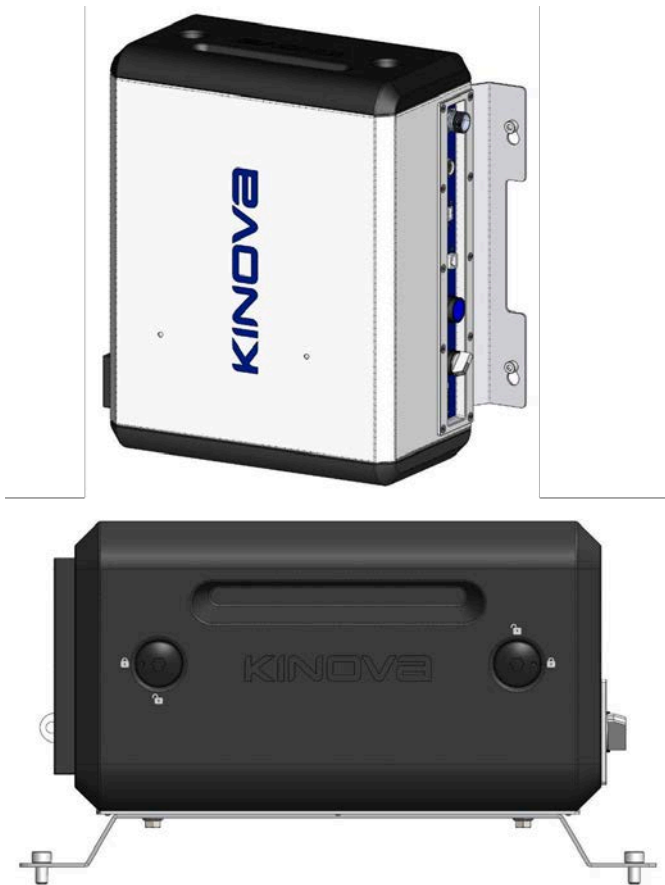


Figure 181: Controller with Kinova wall mount

Installing the Kinova wall mount

The Kinova wall mount is designed to fit perfectly with the Link 6 [controller](#).

Before you begin

Personnel:

- **Number of Workers:** 1

Supplies

- 4 x M6-1.0-6h screws



Note: maximum thread engagement depth: 6 mm



Note: Torque: 10 N·m

- 4 x M8 screws



Note: Torque: 8 N·m

About this task

A minimum flat area required to install the wall mount is 360x448 mm.

The position of the controller mounting screws are at 270x406 mm.

Either fix the mount to the controller before installing on the vertical surface, or fix the mount to the vertical surface and then fix the controller to the mount. The procedure describes the former.

Procedure

1. Fix the wall mount to the controller with the M6 screws such that the I/O panel is on the side opposite to the UP arrow on the mount.

The fastening screws must be torqued to 10 N·m.

2. Fix the controller with the wall mount to the vertical surface with the M8 screws.

The fastening screws must be torqued to 8 N·m.

Gigabit Ethernet adapter

The Gigabit Ethernet adapter is used for tools that require an M12 X-coded connector.

The Gigabit Ethernet adapter is compliant with ISO 9409-1-50-4-m6. It replicates the ISO 9409-1-50-4-m6 flange and central pogo pins. 24 VDC flows through the adapter. It has an [RS-485](#) communication port. All of this put together is sufficient to power most tools without needing wires.

It has mounting points so that other tools, such as third-party cameras, can be installed.

It can be installed on the wrist at 0 ° or at 180 °.



Figure 182: Wrist side of the Gigabit Ethernet adapter

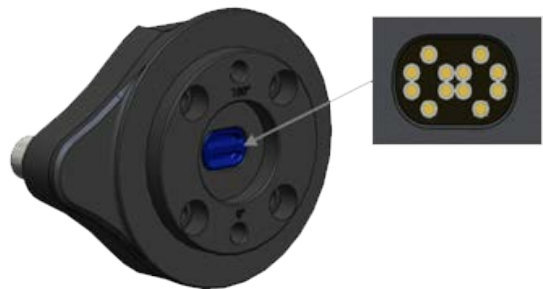


Figure 183: Output side of the Gigabit Ethernet adapter with close-up view of the printed circuit board pad

Related topics

[Wrist interface overview](#) on page 16

[Mechanical interface](#) on page 19

[Electrical interface](#) on page 19

[Gigabit Ethernet on the wrist](#) on page 46

Dimensions of the Gigabit Ethernet adapter

The adapter can connect nearly any tool to Link 6, provided the dimensions of the Gigabit Ethernet adapter are taken into account.

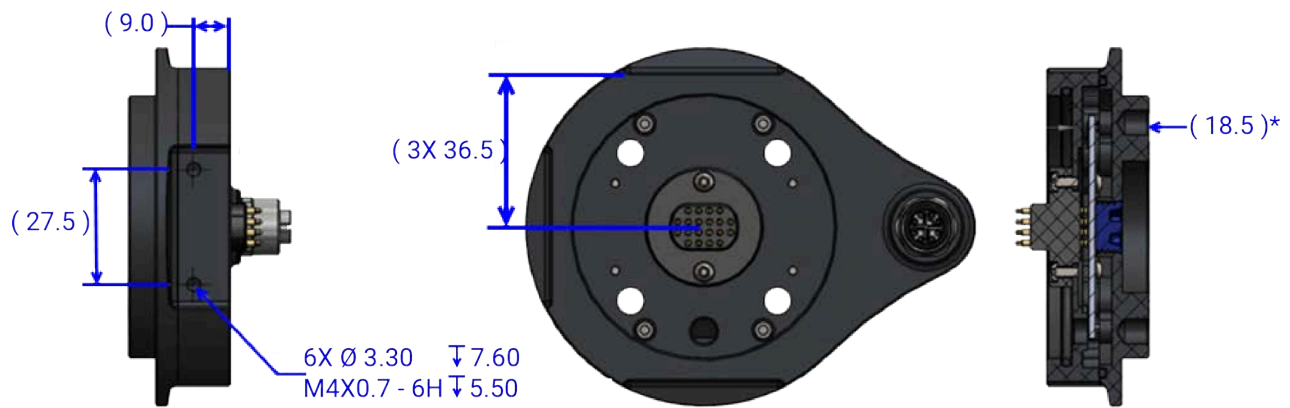


Figure 184: Dimensions of the Kinova Gigabit Ethernet adapter measured in millimeters

Installing the Gigabit Ethernet adapter

The adapter installs directly to the *wrist* of Link 6.

Before you begin

Personnel:

- **Number of Workers:** 1

Supplies

- 4 x M6-1.0-6h screws



Note: maximum thread engagement depth: 6 mm



Note: Torque: 7-9 N·m

- 2 x 6 mm dowels



Note: The dowels are not used to stabilize the *end effector*; they are used to guide the end effector onto the wrist.

- *Flange* system position: 0° and 180°

About this task

Installation of optional tools is done in a stacking fashion. That is, the Gigabit Ethernet adapter must be fixed to the wrist before other optional tools are attached to the adapter.

Procedure

1. Remove the end cap from the wrist and the end cap from the adapter.

2. Align the holes on the adapter with the holes in the wrist.



The center connection pins on the wrist and the adapter align with each other.

3. Secure the adapter with the screws.

Robotiq adapter

The Robotiq adapter is an optional, but vital, part when connecting Robotiq tools to Link 6. It contains the electrical and mechanical interface needed to connect the two products.

The adapter has central pogo pins for connections, which means no external cables are needed.



Figure 185: Wrist interface side of Robotiq adapter



Figure 186: Robotiq tool side of Robotiq adapter

Related topics

[Plugins](#) on page 195

[Wrist interface overview](#) on page 16

[Mechanical interface](#) on page 19

[Electrical interface](#) on page 19

[Robotiq plugin](#) on page 208

Installing the Robotiq adapter

The Robotiq adapter is an optional tool that is necessary to connect Robotiq tools to Link 6.

About this task

Installation of any Robotiq tool is done in a stacking fashion. That is, the Robotiq adapter must be fixed to the [wrist](#). Then the Robotiq tool is fixed to the Robotiq adapter.

Make sure all tools and screws needed to install the adapter are nearby.

Procedure

1. Remove the end cap from the wrist and the end cap from the Robotiq adapter.
2. Align the adapter dowel pin to the 0° reference dowel hole on the wrist.
3. Secure the adapter with the screws using a fastener torque of 7-9N·m.

What to do next

1. Install the Robotiq tool.
2. Configure the tool from **Tools** in [the Web App](#).
3. Install the required [plugins](#) from **Plugins** in the Web App.

Related topics

[Configuring tools](#) on page 123

[Installing plugins](#) on page 121

Robotiq plugin

The Robotiq [plugin](#) works with the Robotiq 2F-85 and 2F-140 grippers. Install the [plugin](#) to control the gripper.

The [wrist](#) of Link 6 has a central Ethernet connection to the Kinova Flange for the Robotiq Gripper, which provides a connection without cables between robot and gripper.



Figure 187: Wrist, Kinova adapter for Robotiq Gripper, and Robotiq Gripper

The plugin declares all of its variables within the *namespace* `robotiq_gripper_plugin`.

The plugin contains two different types of parameters.

- One set of parameters is for configuring communication between the Robotiq gripper and Link 6.
- One set of parameters is for configuring the actions that the gripper can perform.

Related topics

[Robotiq adapter](#) on page 207

Robotiq plugin configurations

The parameters in the Robotiq [plugin](#) that have an overall affect on the [wrist](#) and the gripper are configured on the **Configurations** page of the Robotiq plugin.

To access the **Configurations** page of the Robotiq plugin, tap **Systems > Plugins > Robotiq Plugin**.

Plugins > Robotiq Gripper Plugin (robotiq_gripper_plugin)

Configurations About

Configuration schema

Period of the plugin's main thread (in ms). Ex: If this value is 10, then the plugin will send a command to the gripper every 10 ms (100 Hz).

Period of the main thread.

IP address of the gripper.

IP address of the gripper.

Port the modbus socket will try to connect.

Modbus port of the gripper.

Gripper's modbus device ID

Modbus device ID.

Figure 188: Configuration page for the Robotiq plugin

There are five exposed parameters that are configurable. However, some of the Robotiq parameters should not be touched unless absolutely necessary.

Period of the main thread

Tweak the communication rate with the gripper in milliseconds.



Attention: The value is the default rate defined by the Robotiq gripper. It is not recommended to change this value.

IP address of the gripper

The gripper is mounted on the wrist. The IP address of the wrist is the IP address of the gripper.

Port of the modbus server

The modbus server is the default listening port of the wrist.



Attention: It is not recommended to change this value.

Gripper's modbus device ID

The modbus server ID is the default value of the Robotiq grippers. Change this value only when the device ID of the Robotiq Grippers has changed. The device ID is a number between 1 and 9.

Robotiq plugin actions

The Robotiq gripper has its own set of actions available for further configuration when programming Link 6.

The Robotiq *plugin* has five actions available. Some actions have their own set of parameters to make them configurable. All of the actions can have a specific name assigned to them, output results to variables, and can set the action as *non-blocking*.

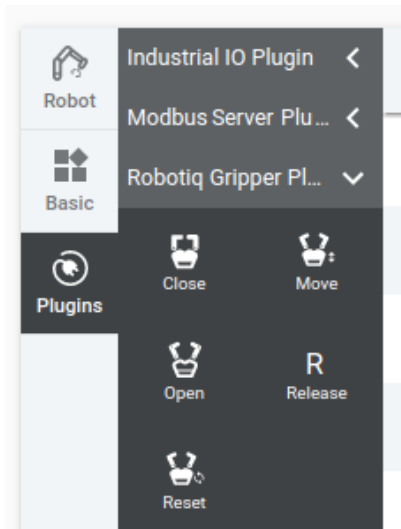


Figure 189: Actions available from the Robotiq plugin

Table 85: Parameters of Robotiq plugin actions

Action	Action icon	Parameter
Close		Closes the gripper. Velocity Target The higher the value, the faster the gripper closes. 100% is full speed. Force Target The higher the value, the greater amount of force is needed before the closing movement stops.

Action	Action icon	Parameter
Move		Moves the gripper to a specific location. Position Target The higher the value, the faster the gripper moves to the position. 100% is fully closed. Velocity Target The higher the value, the faster the gripper moves. 100% is full speed. Force Target The higher the value, the greater amount of force is needed before it stops moving.
Open		Opens the gripper. Velocity Target The higher the value, the faster the gripper opens. 100% is full speed. Force Target The higher the value, the greater amount of force is needed before the opening movement stops.
Release		Stops applying force to the object the gripper is holding and slowly opens the fingers until all motion axes reach their mechanical limits. The gripper sends a fault signal. Run Reset to reactive the gripper. Only after it is reactivated can the gripper move again.  Important: Do not use under normal operating conditions.
Reset		Initializes the gripper. The gripper opens to its maximum position, closes to its maximum position, and opens again during initialization. Run Reset each time the gripper receives power. The wrist buttons can then interact with the gripper; the gripper actions are available to the robot.

OnRobot RG2 grippers

The OnRobot RG2 grippers connect to the [wrist](#) of Link 6 with the OnRobot ISO Flange and an external cable.

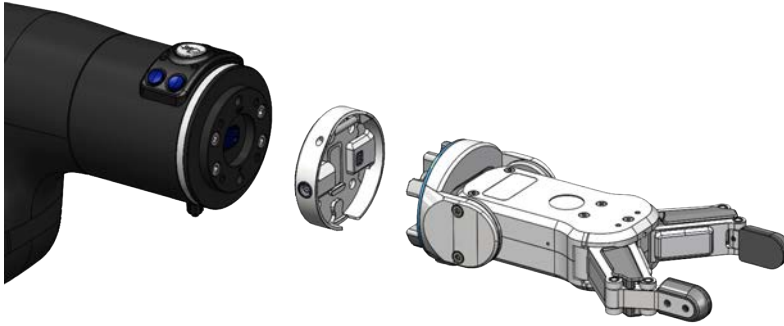


Figure 190: Wrist, flange, OnRobot ISO adapter, and OnRobot RG2 Gripper

Related topics

[Wrist interface overview](#) on page 16

[Mechanical interface](#) on page 19

[Electrical interface](#) on page 19

Installing OnRobot grippers

The OnRobot RG2 grippers can connect to Link 6.

About this task

Installation of the OnRobot grippers is done in a stacking fashion. That is, the OnRobot ISO Flange must be fixed to the [wrist](#). Then the OnRobot gripper is fixed to the OnRobot flange.

Make sure all tools and screws needed to install the adapter are nearby.



Tip: Refer to the OnRobot documentation for more information about installing OnRobot grippers.

Procedure

1. Fix the OnRobot ISO Flange and RG2 gripper to the wrist of Link 6.
2. Connect the OnRobot wire through the M8 connector B on the wrist of Link 6.

What to do next

1. Configure the tool from **Tools** in [the Web App](#).
2. Install the required plugins from **Plugins** in the Web App.

OnRobot plugin

The OnRobot [plugin](#) works with the OnRobot RG2 grippers. Install the plugin to configure the behavior of the gripper.

The wrist of Link 6 connects to the OnRobot ISO Flange for the OnRobot RG2 Gripper with an external cable.

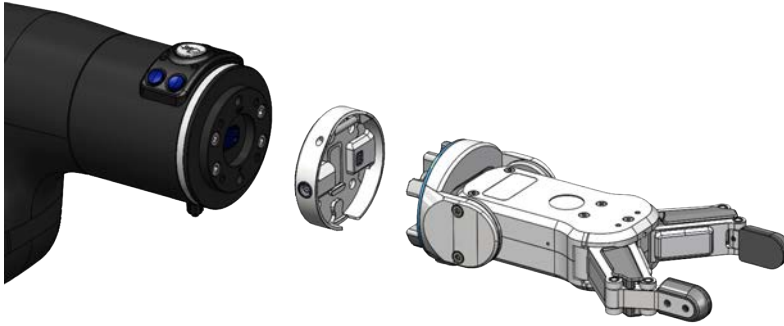


Figure 191: Wrist, flange, OnRobot ISO adapter, and OnRobot RG2 Gripper

The plugin declares all of its variables within the [namespace](#) `onrobot_gripper_plugin`.

The plugin contains two different types of parameters.

- One set of parameters is for configuring communication between the OnRobot RG2 gripper and Link 6.
- One set of parameters is for configuring the actions that the gripper can perform.

OnRobot plugin configurations

The parameters in the OnRobot [plugin](#) that have an overall affect on the [wrist](#) and the gripper are configured on the **Configurations** page of the OnRobot plugin.

To access the **Configurations** page of the OnRobot plugin, tap **Systems > Plugins > OnRobot Plugin**.

Figure 192: Configuration page for the OnRobot plugin

There are five exposed parameters that are configurable. However, some of the OnRobot parameters should not be touched unless absolutely necessary.

Period of the main thread

Tweak the communication rate with the gripper in milliseconds.



Attention: The value is the default rate defined by the OnRobot gripper. It is not recommended to change this value.

IP address of the gripper

The gripper is mounted on the wrist. The IP address of the wrist is the IP address of the gripper.

Port of the modbus server

The modbus server is the default listening port of the wrist.



Attention: It is not recommended to change this value.

Gripper's modbus device ID

The modbus server ID is the default value of the OnRobot grippers. Change this value only when the device ID of the OnRobot Grippers has changed.

Fingertip offset

Specify the distance from the inside of the gripper fingertip to the reference point on the attached fingertip in 1/10 mm.

OnRobot plugin actions

The OnRobot gripper has its own set of actions available for further configuration when programming Link 6.

The OnRobot *plugin* has four actions available. Some actions have their own set of parameters to make them configurable. All of the actions can have a specific name assigned to them, output results to variables, and can set the action as *non-blocking*.

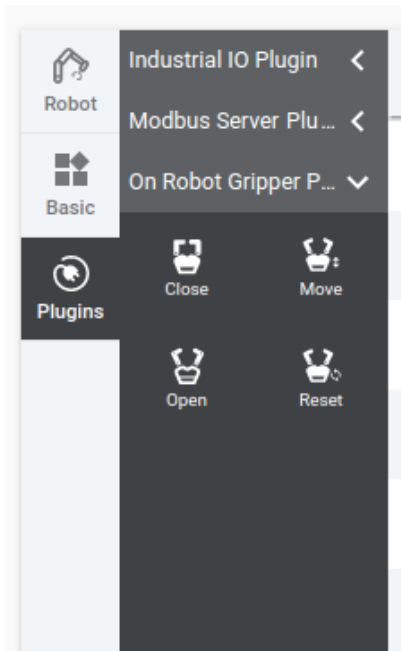


Figure 193: Actions available from the OnRobot plugin

Table 86: Parameters of OnRobot plugin actions

Action	Action icon	Parameter
Close		Closes the gripper
		Force Target
		The higher the value, the greater amount of force is needed before the closing movement stops.

Action	Action icon	Parameter
Move		Moves the gripper to a specific location
		Move Type • Absolute: The gripper moves to the specified width. • Absolute with offset: The gripper moves to the specified width taking into account the finger offset defined in the Configurations page.
		Force Target The higher the value, the greater amount of force is needed before it stops moving.
		Width The gripper needs to be at this width when it stops moving.
Open		Opens the gripper
		Force Target The higher the value, the greater amount of force is needed before the opening movement stops.
Reset		Switches off the gripper and then switches it back on
		Any other equipment attached to the M8 A connector is also switched off and switched back on when the gripper is reset.
		Run Reset when the gripper is in a fault state.

External emergency stop station

The *E-stop* station is an optional component that provides *E-stop* functions in case the [teach pendant](#) is not used or additional *E-stop* locations are required. It is connected directly to the terminals in the [controller](#).

Photo: Rockwell Automation



Figure 194: Rockwell Automation 800F-1YMQ3

Related topics

[Safety I/O](#) on page 69

Installing an external emergency stop station

Whenever you need to install an external *E-stop* station, be sure to read and follow all mounting instructions from the manufacturer.

Before you begin

Personnel:

- **Number of Workers:** 1

Supplies

- 1 x Emergency stop station
- 1 x Cable

Tools

- Ferrule (optional)

About this task

View or download publications at rok.auto/literature .

Procedure

1. Make sure the [controller](#) is switched off.
2. Connect the *E-stop* to the controller. Use the wire order on the E-stop connector.

Terminal (Controller side)	Wire color	Pin (Device side)
A1	Black	2
A2	Red	1
B1	White	4
B2	Yellow	3

3. Connect the 4-pin connector to the Emergency stop station.

Related topics

[Safety I/O](#) on page 69

Maintenance

Preventive maintenance of Link 6 averts major issues that can arise, and keeps the robot and users safe.

There are three main things to do to give the robot a long and productive life.

- Clean the robot.
- Perform a visual inspection of the robot.
- Service the robot according to schedule.

To perform basics in maintenance, always have a good supply of consumables.

Maintenance is made of preventive measures and maintaining fasteners.

Consumables

Some parts of Link 6 can be removed and misplaced. Other parts may wear out. Always make sure you have a good supply of spare parts to lessen downtime.

The number of each part that should be kept on hand is only a recommendation of the minimum number of each part. It may be wise to have more than the recommended minimum quantity listed.



Note: Blank cells in the table Recommended spare parts list indicate there is no information available at the time of writing.

Table 87: Recommended spare parts list

Part	Manufacturer	Part number	Order number	Quantity on hand	Note
Plastic dust protection cap - M23	Phoenix Contact	RC-Z2469	1611797	1	
Plastic dust protection cap - M16	Sealcon			1	
Sealed cap for wrist Pogo pins	Kinova	KR21537		1	
Controller cable entry plate	Icotek	KEL-DPZ 24 25	50710	0	Replace if needed. The plate will not seal the controller if the cables are removed.
Controller cable entry plate plug kit	Icotek	ST-B	42801	0	Seal the controller after removing the cables.
Fuse 3AG, Fact-Acting, 15A	Bussman	ACD-15-R		2	
Fan filter	Rübsamen & Herr	AM 115P		5	Quantity may vary, based on working environment.

Preventive maintenance

Always perform preventive maintenance within the time scheduled maintenance time frame to avoid downtime of the robot.

Different parts of Link 6 require maintenance checks on a daily, weekly, quarterly, or yearly schedule. Some preventive maintenance does not adhere to a specific schedule.

Daily maintenance

Always perform daily tasks daily to avoid downtime of the robot.

Table 88: Daily checks for preventive maintenance

Validation task	Corrective action
Check the emergency stop functions as expected.	Contact support at support@kinova.ca.
Check all states of the 3-position enabling device function as expected if it is expected to be used.	Contact support at support@kinova.ca.
Check all terminal connections are secured.	Redo connections.
Check the cables are in good condition with no rips, tears, or frays.	Contact support at support@kinova.ca.
Check the robot joint caps are installed properly on the robot with no visible gaps and secure.	Contact support at support@kinova.ca.
Check the tools and accessories are attached correctly and are not loose.	Secure the tools and accessories.
Check the joints are not loose.	Contact support at support@kinova.ca.
Check the bolts on the base are tightened according to the specifications and the base does not move when the robot moves.	Secure the base of the arm.
Check the casing of the controller is closed, with no openings along the edges or elsewhere.	Contact support at support@kinova.ca.
Check the I/O panel on the controller is closed.	Close the panels on the controller.
Check the end caps are on all electrical connectors that are not in use.	Place end caps on all exposed electrical connectors.
Check the environment is the same as usual, with no additional objects in the area.	Remove objects that normally are not in the environment.

Weekly maintenance

Always perform weekly tasks weekly to avoid downtime of the robot.

Table 89: Weekly checks for preventive maintenance

Validation task	Corrective action
Check the air filter in the controller is clean.	Replace the air filter.

Quarterly maintenance

Always perform quarterly tasks every three months to avoid downtime of the robot.

Table 90: Quarterly checks for preventive maintenance

Validation task	Corrective action
Check the main power is secured to the controller.	Reattach the latch.
Check all connected safety inputs and outputs are secured and functioning.	Contact support at support@kinova.ca.
Check the cable and connector of the Teach pendant are in good shape.	Contact support at support@kinova.ca.
Torque check the base fastener.	Retorque.
Torque check the wrist fastener and end effector tooling.	Retorque.
Make sure the actuator covers are not loose.	Retorque.
Check that the fan in the controller is rotating freely.	Contact support at support@kinova.ca.

Yearly maintenance

Always perform yearly tasks every year to avoid downtime of the robot.

Table 91: Yearly checks for preventive maintenance

Validation task	Corrective action
Check Protective earth grounding resistance is less than 0.1 Ω to the controller.	Replace the cable.
Check Protective earth grounding resistance is less than 0.1 Ω to the arm.	Replace the cable.

Unscheduled maintenance

Even by following a maintenance schedule, unexpected maintenance is required.

Some of the unscheduled maintenance tasks are also scheduled maintenance tasks under certain circumstances. For instance, when there is a sudden power outage or when an accident happens with the robot, it is recommended to perform a visual inspection of the robot.

Table 92: Unscheduled maintenance tasks

Validation task	Corrective action
Cables are in good condition with no rips, tears, or frays.	Contact support at support@kinova.ca.
Make sure the joint caps are on the robot. Also, make sure there are no visible gaps and that they are secured in place.	Contact support at support@kinova.ca.

Validation task	Corrective action
Tools and accessories are attached correctly and are not loose.	Secure the tools and accessories.
Joints are not loose.	Contact support at support@kinova.ca.
The base is fixed correctly. In other words, the bolts on the base are tightened according to the specifications and the base does not move when the robot moves.	Secure the base of the arm.
The casing of the controller is closed, with no openings along the edges or elsewhere.	Contact support at support@kinova.ca.
Panels on the controller are closed.	Close the panels on the controller.
End caps are on all electrical connectors that are not in use.	Place end caps on all exposed electrical connectors.
The environment is the same as usual, with no additional objects in the area.	Remove objects that normally are not in the environment.
Make sure the fuse is functioning.	Replace the fuse.

Fastener maintenance

To keep Link 6 safe, the fasteners require regular maintenance.

Table 93: Fastener locations and maintenance

Robot part	Location	Quantity	Fastener type	Recommended torque	Maximum thread engagement
Base	Base to table	4	M8×1.25	20 N·m	
	Protective earth screw	1	M5×0.8		
Arm	Actuator covers - Size 80	3			
	Actuator covers - Size 110	4			
Wrist	End effector tooling	4	M6×1.0	7-9 N·m	6.0 mm
	Bracket for GigE adapter (2x side)	2	M4×0.7		5.0 mm
Controller	Cable pass-through plate	4	M5×0.8		
	Protective earth stud	1	M5×0.8		
	Mounting bracket fasteners to controller	4	M6×1.0 - 10		

Robot part	Location	Quantity	Fastener type	Recommended torque	Maximum thread engagement
	Mounting bracket fasteners to wall	4	M8×1.25 - 14		
Teach pendant	Mounting bracket fasteners to wall	4			

Servicing

Some routine maintenance and repair work must be performed by a Kinova expert.

Not servicing Link 6 in a timely manner voids the Kinova warranty.

Contact Kinova support to learn how to have the robot serviced.

Disposal

The product contains parts that are deemed to be hazardous waste at the end of the life of the product.

After Link 6 has reached its life expectancy, you have two options.

- Continue using the device.
- Replace the robot and dispose of the old device appropriately.

If you wish to continue using Link 6 after its expected lifespan, Kinova highly recommends that you return the device temporarily to Kinova for routine servicing that includes inspection of the robot, as well as replacement and repair of any internal components that may be worn out.



■ If you wish to dispose of the robot, note that the robot contains materials that can be recycled. However, some of the materials are deemed hazardous. Specialized companies can dismantle the unit and sort out these materials. When you dispose of the unit, inform yourself about local regulations concerning waste management.

Troubleshooting

Knowing how to correct and recover from robotic issues is important to keeping the Link 6 working.

When Link 6 encounters a problem, it usually triggers a fault. When a fault is triggered, the information on the **Status** page should be enough to come to a diagnostic. There may be cases in which some users view certain behaviors as undesirable; however, from the point of view of the robot, the supposed undesirable behavior is expected. There is no diagnostic information available for expected behavior.

There are many examples of expected robot behavior that some users may deem undesirable listed. If you believe you have an issue with Link 6, check to see if you can find a similar issue. If you cannot find an issue similar to yours, please write to us at support@kinova.ca.

Issues related to hardware

Examples of hardware-related issues that you may have deal with the controller, the arm, the buttons on the wrist, the tool, and external equipment.

Why does the controller have no power?

Condition

The power button on the controller is switched on, but there is no power in the controller.

Cause

The power cable may not be connected to the controller or to a power source.

Procedure

- Connect the power cable to the controller.
- Connect the other end of the power cable to the power source.

Why is the robot not powering on?

Condition

The controller is on, but the robot does not power on.

Cause

The cable attached to the arm of the robot is not connected to the controller.

Remedy

Connect the robot cable to the controller.

Why is the robot moving in joint Hand Guiding mode by itself?

Condition

The robot is in Joint Hand Guiding mode and it is moving without the application of external forces.

Cause

The masses or centers of mass of the tool or payload is not correct.

Procedure

- Make sure the mass of the tool entered in the Web App matches that of the tool.
- Make sure the center of mass of the tool entered in the Web App matches that of the center of mass of the tool.
- Make sure the mass of the payload entered in the Web App matches that of the payload.
- Make sure the center of mass of the payload entered in the Web App matches that of the center of mass of the payload.

Why is the snapshot button not working?

Condition

When the waypoint capture, or snapshot, button is pressed, the waypoint does not appear in the program that is currently on the **Program** page.

Cause

The current context on the **Program** page is selecting a block that is not a waypoint block.

Procedure

1. Look at the **Sequence editor** pane to see which block is selected.
2. Select the waypoint capture block that represents where you currently are in the program.
3. Press the waypoint capture button.

Why is my tool not working?

Condition

The tool connected to the robot is not working.

Cause

The plugin associated with the tool is not installed or is not activated.

Procedure

1. Tap **Systems > Plugins** to access the **Plugins** page.
2. Install the plugin associated with the tool if it is not already installed.
3. Activate the plugin associated with the tool.
4. Reset or initialize the plugin associated with the tool if the plugin requires this action.

Related topics

[Installing plugins](#) on page 121

Emergency stop

Condition

An emergency stop signal is sent to the robot through the Safety I/Os.

Cause

There are two possible causes.

- The e-stop button on the teach pendant, or elsewhere in the system, is pressed.
- A signal is detected on the input reserved for emergency stops.

Procedure

1. Make sure nothing is interfering with the robot and that it is safe to proceed.
2. Remove the signal.
Release the e-stop button, such as the one on the teach pendant, by turning the button.
3. Clear the fault.
4. Make sure the jumper configuration matches the installation.

Why is the wrist enabling device not enabling Hand Guiding mode?

Condition

The robot cannot be moved by hand. The wrist ring flashes green once each second.

Cause

The enabling device on the wrist is not pressed and held in its center position.

Remedy

Press the Wrist enabling device in the center position until the wrist ring illuminates a steady blue. Continue to hold the button in the center position while you move the arm.

Why is the controller hot?

Condition

The [controller](#) is hot or the diagnostics in [the Web App](#) indicate the SCU or the MCU are overheating.

Cause

The temperature of the SCU core or MCU board is too high.

Procedure

- Check the controller fans are spinning freely.
- Check that neither the controller fans nor the fan filter are clogged.

Issues related to safety elements

Examples of safety-related issues that you may have deal with the safety configurations and safety I/O connections.

Why can I not edit any safety configurations?

Condition

None of the parameters on any of the **Safety** pages are modifiable.



Note: This condition only happens when the user is an *operator* and is not an *admin user*.

Cause

The user is an operator. Only admin users can modify safety configurations.

Procedure

- Tap  > **ELEVATE PERMISSIONS** and enter the admin password.
- Contact an admin user to discuss which safeties may need to be modified.

Why is the external safety device not working?

Condition

The external device attached to the robot is not working. The robot is in a *stop category0*, where there is no electrical power in the robot.

Cause

The device is not configured correctly on the safety I/O channel.

Remedy

Make sure the safety I/O channel associated with the external device is configured correctly.

Select the correct safety type from the safety type drop-down on the **Safety I/O** page in [the Web App](#) for the channel where the device is connected.

Why is the robot stuck in Reduced mode?

Condition

The robot is moving at Reduced speed. All **Safety** pages indicate the robot should be moving at Normal speeds.

Cause

The robot is receiving a signal to operate at Reduced speed.

Remedy

Make sure no safety I/O channel is sending a signal to the robot to operate at Reduced speed.

Issues related to modes of operations

Examples of issues with modes of operation that you may have include modes being disabled and modes that seem stuck.

Why is Manual mode disabled?

Condition

The arrows of the virtual joystick of Jog Angular and Jog Cartesian in [the Web App](#) are grayed out.

The [enabling device](#) in the Web App illuminates white.

Cause

The enabling device is not held in its center position.

Procedure

- Make sure you are not pressing the enabling device all the way to the bottom.
- Make sure you are pressing the enabling device in its middle position.

Why can the robot not exit recovery mode?

Condition

The robot cannot exit Recovery mode. The wrist ring flashes yellow two times each second.

Cause

There are two situations where the robot remains in recovery mode.

- The initial cause of the fault is still in effect.
- After clearing the initial fault, another fault is triggered in the current configuration of the robot.

Procedure

- Make sure the robot is far from its position limits.
- Make sure the robot is outside of the enabled protection zones.
 - a) Tap **Safety > Protection Zones**.
 - b) Visualize the current pose of the robot relative to the protection zones.
 - c) Move the robot to a safe position using either Hand Guiding or Manual Jog mode.

Related topics

[Protection zones](#) on page 61

[Recovery mode](#) on page 86

[State: Fault](#) on page 78

Issues related to plugins

Examples of issues you may have with plugins deal with plugin installation, configuration, and activation.

Why can I not configure Industrial I/Os?

Condition

The fields on the **Configurations** page of the **Industrial I/O** plugin page are not selectable.

Cause

The Industrial I/Os need to be switched on before they can be configured.

Remedy

Make sure the Industrial I/Os are receiving power.

Related topics

[Industrial I/O plugin](#) on page 196

[Industrial I/O panel overview](#) on page 32

Issues related to programs and programming

Examples of issues related to programs and programming deal with variables, action blocks, and programs.

Why can I not assign a variable to a field?

Condition

When a program is being created or modified, the user attempts to assign a variable to a field.

Cause

The type of the variable does not match that of the field.

Modify the definition of the variable to match what it is supposed to be.

Why are tiles missing in the visual programming interface?

Condition

The tiles cannot be found anywhere under the plugin actions on the **Program** page or tiles in the **Sequence editor** pane have question marks (?) on them.

Cause of the trigger #1

The plugin associated with the missing tiles is not installed or is not activated.

Remedy for trigger #1

Procedure

1. Tap **Systems > Plugins** to see if the plugin associated with the missing actions is installed.

Option	Description
Plugin is not installed	Install the plugin.

2. Tap the plugin to access its **Configurations** page.

Option	Description
Run  is displayed	Plugin is not active. Tap Run to activate the plugin.
Stop  is displayed	Plugin is active.

3. Return to the **Program** page of the program where the issue occurred.
The plugin is displayed on the page with all its available actions.

Cause of the trigger #2

A fault occurs in the arm.

Remedy for trigger #2

Procedure

1. Restart the program.
2. Refresh the page.

Related topics

[Installing plugins](#) on page 121

Why can I not find a program in the list of programs?

Condition

A specific program is not found on the **Programs** page in the Web App.



Note: This condition only happens when the user is an *operator* and is not an *admin user*.

Cause

The user is an operator and the admin user has not validated the program.

Remedy

The admin user must validate the program. After it is validated, the program appears in the list of programs for all users, including operators.

Why do some of the tiles of an imported program show a question mark?

Condition

A program is imported. One or more tiles on the **Program** page displays a question mark.

Cause

The imported program contains tiles from plugins that currently are not installed or activated on the controller.

Procedure

1. Remove the program from the Web App.

2. Install the missing plugins.
3. Activate the plugins.
4. Re-import the program.

Issues related to the Web App

Examples of issues related [the Web App](#) include such things as software and configuring problems.

Why is the robot not going to the programmed position?

Condition

The robot is programmed to go to specific locations. The robot is not moving to the expected locations.

Cause

The tool is not configured correctly.

Procedure

1. Tap **Systems** > **Tools** to access the **Tools** page.
2. Make sure the tool is added in the correct stacking position.
3. Make sure all configurable parameters of the tool have the correct values.

Related topics

[Adding tools](#) on page 125

[Configuring tools](#) on page 123

Why is the computer not connecting to the Web App?

Condition

The controller is on, but [the Web App](#) is not displayed on the computer.

Cause #1

The Ethernet cable is not connected to the computer or the controller.

Remedy #1

Make sure one end of the Ethernet cable is connected to the controller and that the other end is connected to the computer.

Cause #2

The netmask of the Ethernet interface on the computer does not match the IP address of the controller.

Remedy #2

Make sure the netmask of your Ethernet interface is appropriate for the range of the two or more devices that are communicating with the robot. The default IP address of the controller is 192.168.1.10.

Why is the Web App not responding on my computer?

Condition

The Web App is running on a computer, but there is no response from interacting with the application. The application behaves as if it were frozen.

Cause

The computer has memory performance issues.

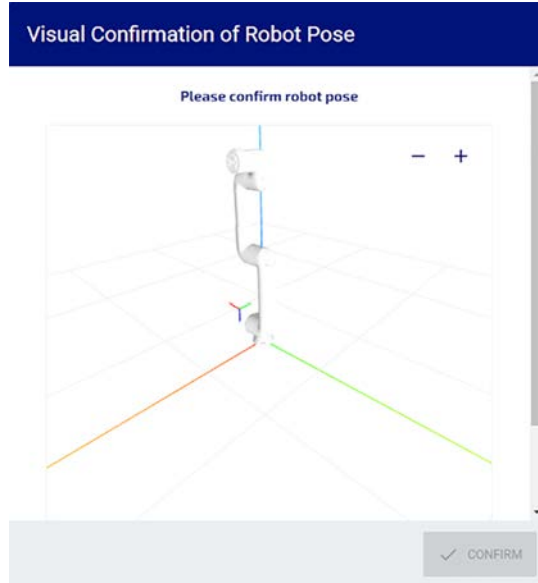
Remedy

Refresh the browser.

Why is there a pop-up requesting visual confirmation of the robot pose after the robot reboots?

Condition

A pop up appears after boot. It requests confirmation of pose of the robot.



Cause

After the robot is transported or when the robot is backdriven while it is switched off, a mismatch occurs between the last known position in memory and the current position.

Remedy

If the position of robot matches the visual representation, tap **CONFIRM**.

If the position of robot does not match the visual representation, do not confirm a mismatched pose. contact support at support@kinova.ca for investigation.

Glossary

A

AC

type of electrical current
alternating current (AC)

actuator

a device that is responsible for robot motion

administrator

a person who configures and uses the robot

synonym: admin user, admin

Angular

refers to an object with joints and its rotational capabilities

arm

the part of the robot that is connected to the base and that moves

AWG

a standardized wire gauge system; unit of measurement
American Wire Gauge (AWG)

B

backdrive

to move the robot manually without using electrical power

base

the bottom-most part of the arm of the robot that is placed on a surface for installation

BCD

a way to represent each decimal digit in its binary equivalent using no more than 4 binary digits
Binary Coded Decimal (BCD)

boot

to switch on, or start

C

camlock

a type of fastener

Cartesian

linear movement along the x, y, and z coordinate lines

collaborative

the ability for an integrated robot to work in a shared space, or in close proximity of people and other equipment, based on its integration

controller

the part of the robot from where the software operates

cUL

tested to Canadian standards by Underwriters' Laboratories

D

DC

type of electrical current

direct current (DC)

debounce

the act of ensuring one and only one signal is used when opening or closing a contact in an electronic device

DoF

the number of different motions a system can apply to a reference frame or end effector; when an object possesses six degrees of freedom, it means the object can move linearly in three directions (front/back, up/down, left/right) and can rotate in three directions (pitch, yaw, roll)



Note: Pitch, yaw, and roll are particular cases of Euler angles, which are mathematical constructs used to describe orientation in 3D space.

degrees of freedom (DoF)

DIN

a German standardization organization that is part of the ISO standards body

Deutsches Institut für Normung (DIN)

synonym: German Institute for Standardization

E

elbow

the location of the 3rd actuator in the robot arm

EFT

a series of quick, high frequency pulses often caused by a lack of electricity flowing through the circuitry

Electrical Fast Transient(EFT)

synonym: fast transient, burst

EFT/B

refer to *EFT*

EMI

the operation of an electronic device is disrupted by another electronic device that is nearby
electromagnetic interference (EMI)

enabling device

a device used to send a signal to the robot that the user is going to move the robot either in Manual Jog mode or Hand Guiding mode.

synonym: pendant enabling device, wrist enabling device

end effector

the end of the arm of a robot; also, a tool or *flange* connected to the end of the arm of the robot

ESD

the sudden flow of electricity between two objects that have different charges

electrostatic discharge (ESD)

E-stop

a sudden removal of all electrical power to the entire robot

emergency stop (E-stop)

synonym: SFO1

F

firmware

in computers, it is low-level software that is programmed into read-only memory and is used directly by hardware

flange

a rim used for attaching another object

G

GPU

originally created to enhance graphic rendering, it also has proven itself useful many other applications, such as artificial intelligence

graphics processing unit (GPU)

GUI

a way of interacting with a program of a computer that involves windows, dialogs, icons, and menus

Graphical User Interface (GUI)

synonym: human machine interface (HMI)

H

hamburger menu

three vertical lines that, when tapped, expose a menu of actions or tasks from which the user can choose; usually used for main menus



synonym: menu, hamburger, main menu

hazard identification

the act of identifying all hazards that may cause harm

I

I/O

input output

input output (I/O)

IEC

an organization that creates international standards for electrotechnology
International Electrotechnical Commission (IEC)

industrial I/O panel

a panel on the *controller* where the *integrator* connects external devices

integrator

a person who incorporates the robot in a larger system or environment

J

joint position

the rotational position of a joint, measured in °

synonym: SFo3

joint speed

the velocity at which the joint rotates, measured in °/s

synonym: SFo4

K

kebab menu

three vertical dots that, when tapped, expose a menu of actions or tasks from which the user can choose; usually used for contextual menus

⋮

synonym: contextual menu, menu options, options, menu

L

Lockout Tagout

safety procedure where power is removed from the machinery, one or more locks is placed on the power supplies, and a tag is added to the lock with the name or initials of the worker who locked out the machinery

Lockout Tagout (LOTO)

LSB

the right-most bit in a binary number

Least Significant Bit (LSB)

M

MCU

a device used in the actuators to read sensors and report sensor information

Main Control Unit (MCU)

microcontroller

in computers, a miniature computer integrated on a computer chip; often has firmware installed on it

mode

describes how a function is performed

Monitored stop

the robot is not moving, has power, and is actively monitoring that it is not doing anything

MPU

a device in the controller that manages external communication and inverse kinematics, sends commands to each actuator, and collects information from all other devices

Main Processing Unit (MPU)

N

namespace

a way in computer science of grouping together all objects that work together such that each object has a unique name

NPN

the meanings of binary signal levels are interchanged such that high voltage is 0 and low voltage is 1

Negative logic (NPN)

NC

electricity flows through a contact in its normal state

Normally Closed (NC)

non-blocking

the ability for a robotic program to proceed to its next step even when the current, non-blocking, action is not finished

non-collaborative

the inability for the robot to work in a shared space, or in close proximity of people and other equipment; the need for the robot to be in an enclosed, self-contained area to operate safely

O**operator**

a person who uses, but who does not configure, the robot

OSSD

a device that outputs a signal to shut down the machine; used as part of a safety system of a machine

Output Signal Switching Device (OSSD)

P**payload**

the load the robot carries excluding the tool that the robot carries

PCB

a structure that is made up of conductive and insulating layers
printed circuit board (PCB)

pendant

a device used to configure and control the movements of a robot

synonym: teach pendant

pendant enabling device

enabling device located on a teach pendant, usually as a button

[enabling device](#) on page 238

synonym: enabling device, teach pendant enabling device

PLd

Performance Level D

Performance Level d (PLd)

pinch point

an area in which a body part can get in between a stationary part and a moving part of the machinery

PLC

an industrial computer used in controlling manufacturing processes
programmable logic controller (PLC)

plugin

software that is added to an pre-existing base software so as to give the application additional capabilities

program sequence

the sequence of actions that a program must use to complete its task
program sequence

synonym: program

protection zone

an area where the robot cannot enter

synonym: SFo6

PE

a system that connects a power supply with the ground
protective earth (PE)

synonym: ground

protective stop

a stop in which the robot stops, but there still is power in the robot

synonym: SFo2

R**reboot**

to restart the computer

RTU

an electronic device controlled by microprocessors that interfaces with other systems and is used to send and receive data

remote terminal unit (RTU)

risk analysis

a study of the potential dangers in using something, often equipment

risk control

the plan to avoid or lessen the risk involved

RJ45

a jack with 8 pins

robot cell

a set of one or more machines that work in conjunction with one or more programmable robots

robot system

an entire automated system consisting entirely of robots or automated equipment

role

the position held that is capable of performing a specific set of tasks

RS-485

a standard that defines electrical traits that are used in serial communication systems

S**safety mode**

one of two speeds that are used when determining the maximum speed at which the robot can operate

scope

in computer science, the area of code that is valid within the confines of another area of code

SCU

a processor in the controller that processes all safety functions

Safety Control Unit (SCU)

state

describes the overall condition of the system, in our case Link 6

stop category

a type of safety control function

stop category (SC)

SWU

a file format, used by Kinova, to package firmware updates
firmware update package (SWU)

T

TCP

the position and orientation of the tool
Tool Center Point (TCP)

TCP/IP

set of communication protocols used in computer networks and in the Internet
Transmission Control Protocol/Internet Protocol (TCP/IP)

teach pendant

a device used to configure and control the movements of a robot
synonym: pendant

teach pendant enabling device

enabling device located on a teach pendant, usually as a button
[enabling device](#) on page 238
synonym: enabling device, pendant enabling device

U

UL

Underwriters Laboratories Inc., an organization dedicated to testing and creating standards for electrical products
Underwriters Laboratories (UL)

USB

industry computer bus standard that makes it easier to transfer data between computers
Universal Serial Bus (USB)

W

the Web App

the [GUI](#) that runs on a web server on the [controller](#) and is accessed on the [teach pendant](#) or on an external computer

The Web App

see [the Web App](#)

wrist

the part found at the end of the robot arm to which end effectors may be attached

wrist enabling device

enabling device located on the wrist of the robot, usually as a button

[enabling device](#) on page 238

synonym: enabling device

wrist I/O

the area of connector on the *wrist* where the *integrator* connects external devices

wrist ring

the LED ring found around the wrist

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