

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
DC	Direct Current
DIN	German Institute for Standardization
EFT	Electrical Fast Transient
EFT/B	Electrical Fast Transient
ESD	Electrostatic discharge
E-stop	emergency stop
GUI	Graphical User Interface
LSB	Least Significant Bit
MCU	Main Control Unit
MPU	Main Processing Unit
NC	Normally Closed
OSSD	Output Signal Switching Device
	printed circuit board
SF02	protective stop
SCU	Safety Control Unit
6 DOF	Six Degrees of Freedom
TCP	Tool Center Point
USB	Universal Serial Bus

Link 6

The Link 6 is an [arm](#) with six degrees of freedom (6 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.

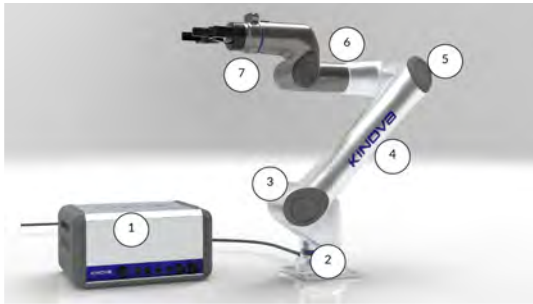


Figure 1: Link 6

- 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 (*E-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 12

[Accessories](#) on page 197

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 30

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	1.6 m/s
Repeatability according to ISO 9283 specification	up to 0.1 mm
Power supply voltage and frequency	120-240 VAC, 50 Hz - 60 Hz
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
Controller interfaces	USB 3.0, Ethernet
Controller I/O	Digital: 16 inputs (8 redundant safe), 16 outputs (8 redundant safe)

Wrist I/O	General purpose analog: 4 programmable input/output
	General purpose digital: 8 inputs, 8 outputs
	Digital: 8 programmable input/output
	Analog: 2 programmable input/output
Wrist - Mechanical	RS-485, Gigabit Ethernet, 24 V supply @ 4 A
	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



Notice: All safety specifications are currently in progress.

Table 7: Safety

Certification	Developed according to UL1740, as well as ISO 10218-1:2011 and 2020, and EU directives
Safety functions	All safety functions PLd 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°
	Focusing range: 30+ cm
	0.6 kg
Tool adapters with mounting hardware	Robotiq, OnRobot, Gigabit Ethernet

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

	0.2 kg
Controller wall mount kit	1 kg
E-Stop button	0.2 kg

Related topics

[Accessories](#) on page 197

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.

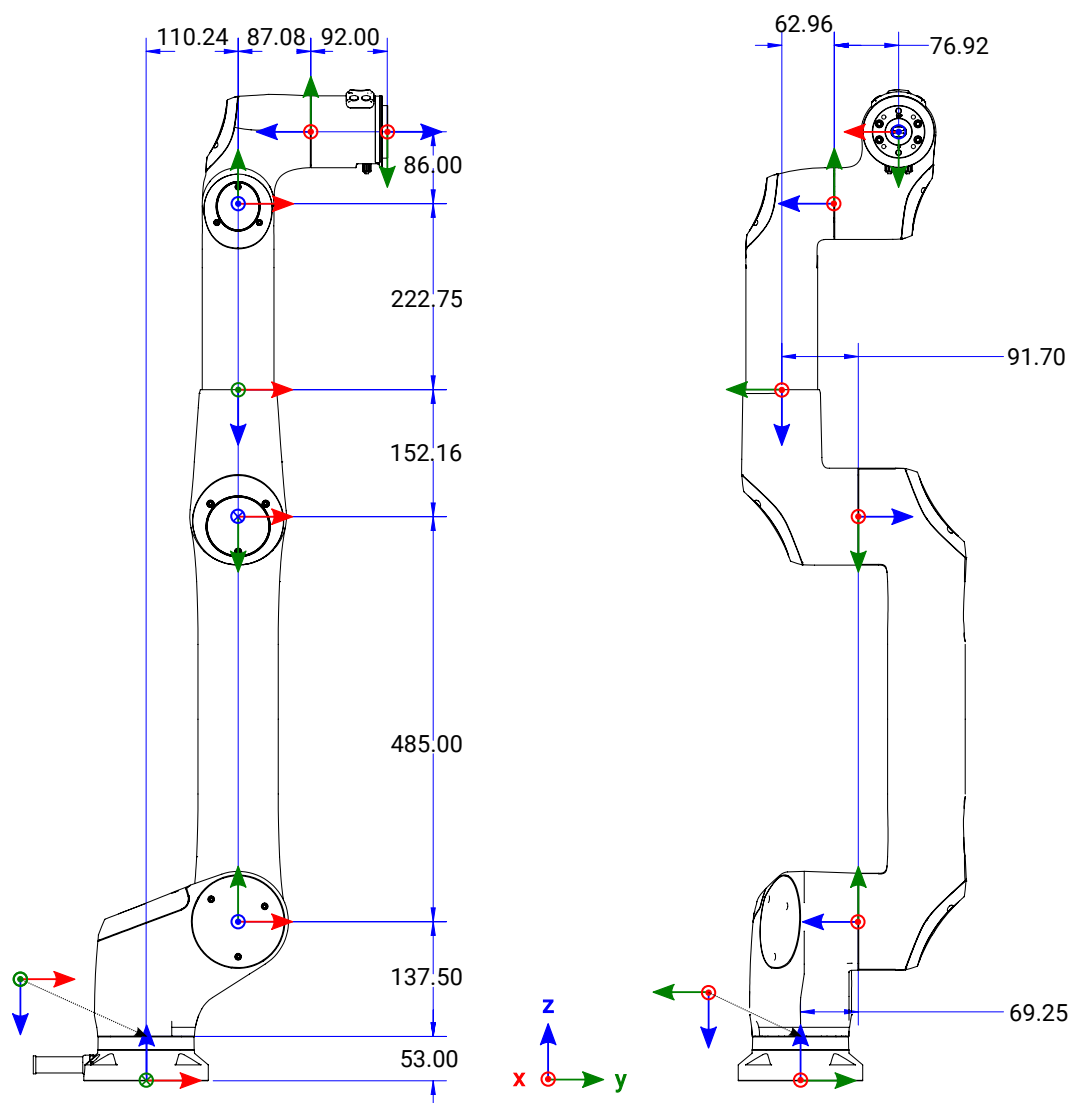


Figure 2: Arm dimensions in millimeters

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.

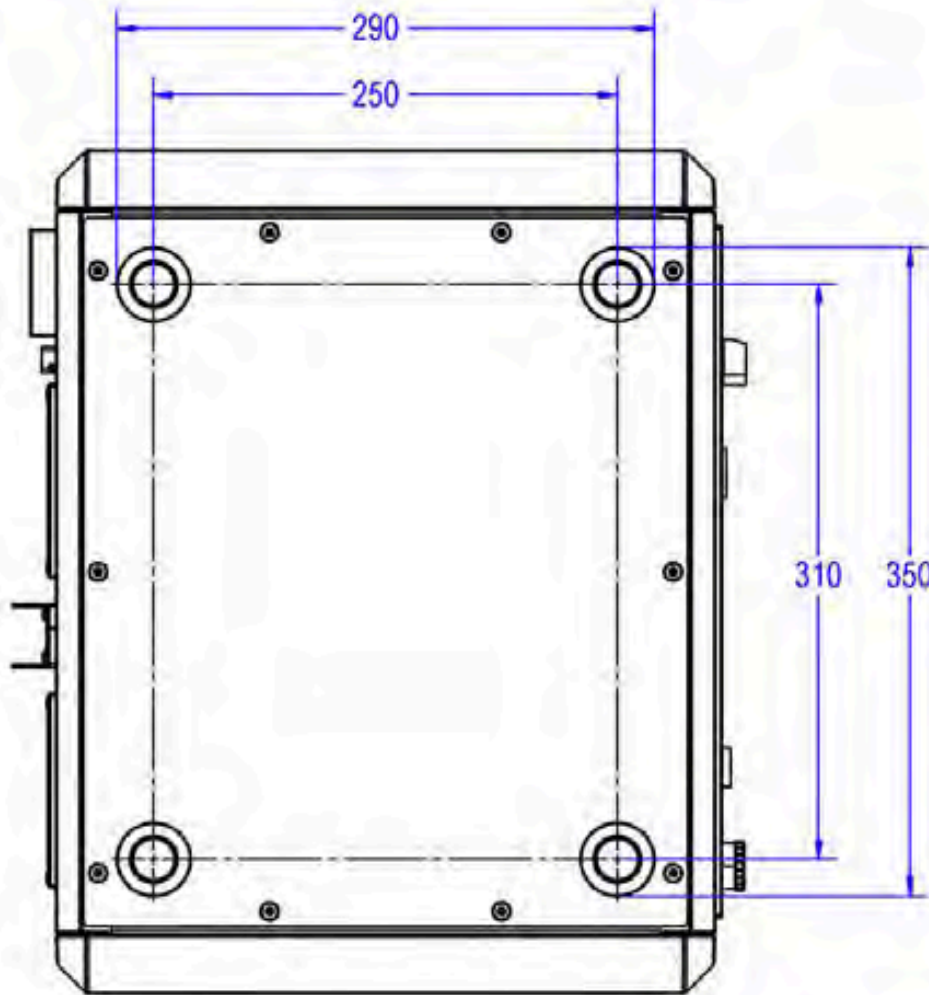


Figure 3: Controller dimensions in millimeters: Bottom view

Related topics

[Safety directives and warnings](#) on page 30

[Move robot arm without power](#) on page 35

[Joint limits](#) on page 41

[Controller wall mount](#) on page 197

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.

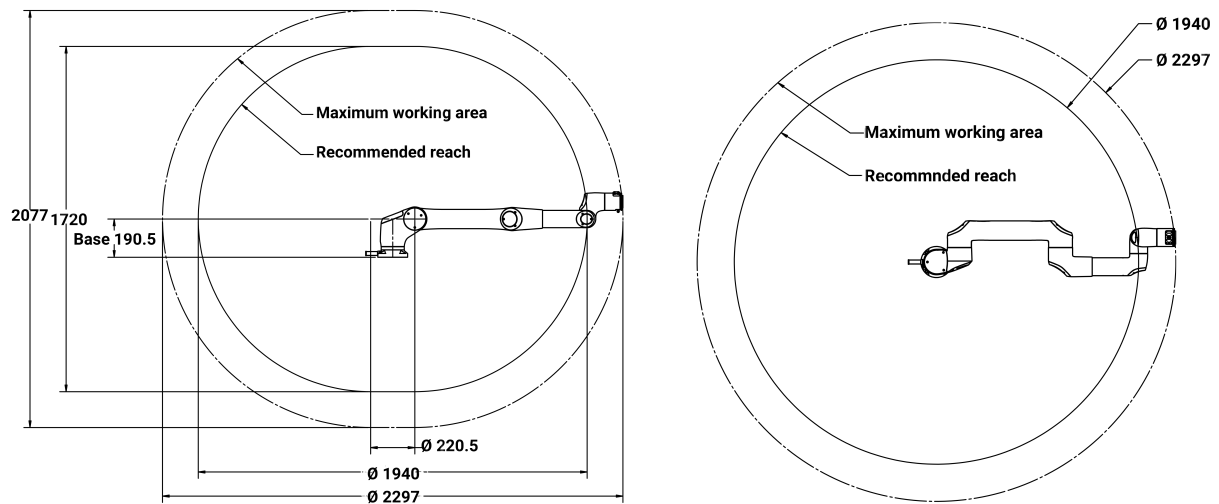


Figure 4: Recommended reach and maximum working area, vertical and horizontal

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 five main components that make the robotic arm.

- [Base](#)
- [Actuators](#)
- [Wrist](#)
- [Controller](#)
- [Teach pendant](#)

Related topics

[Link 6](#) on page 3

Base

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

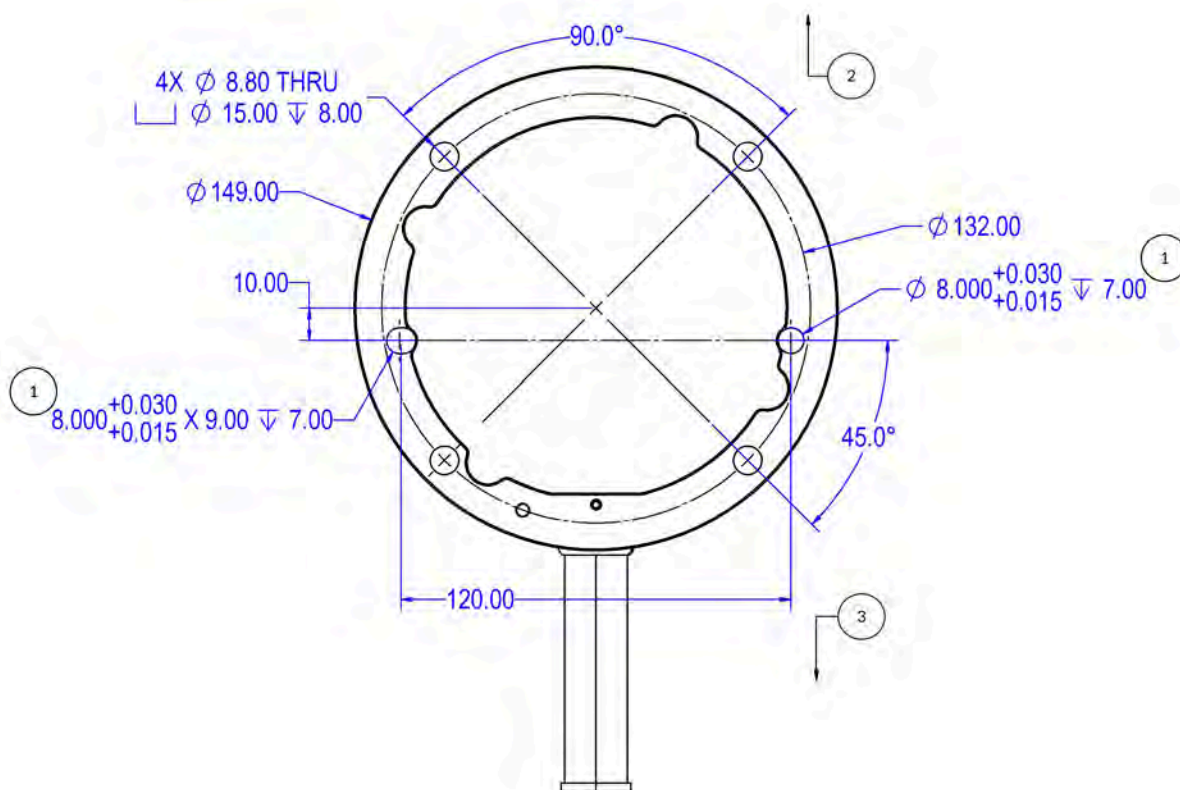
The base has a cable that comes out of it that is used to connect it to the [controller](#).



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.



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

Figure 6: Top view of base dimensions in millimeters

Related topics

[Installing the arm directly to a surface](#) on page 73

[Installing the arm on a third-party adapter plate](#) on page 75

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.

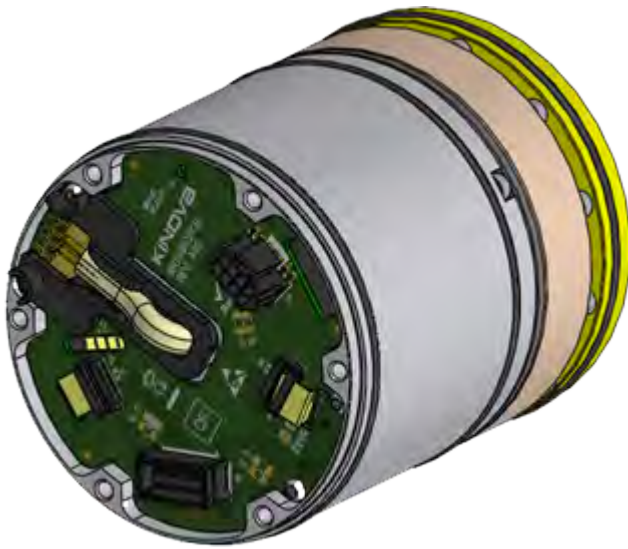


Figure 7: Size 80 actuator



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

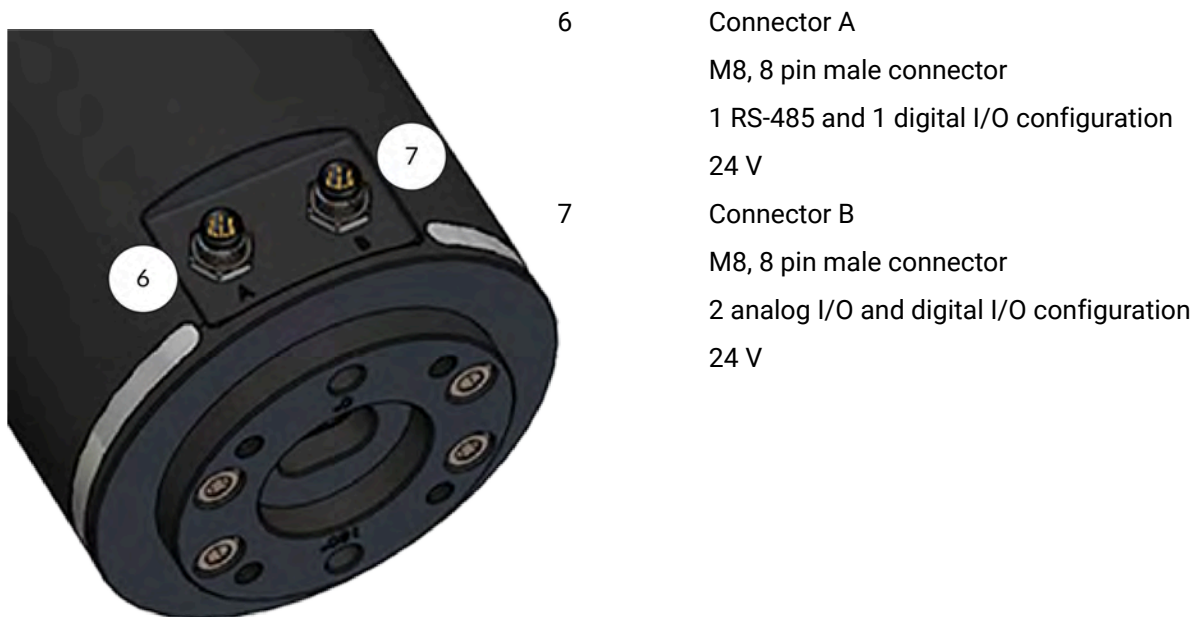


Figure 10: Bottom of wrist, M8 connectors

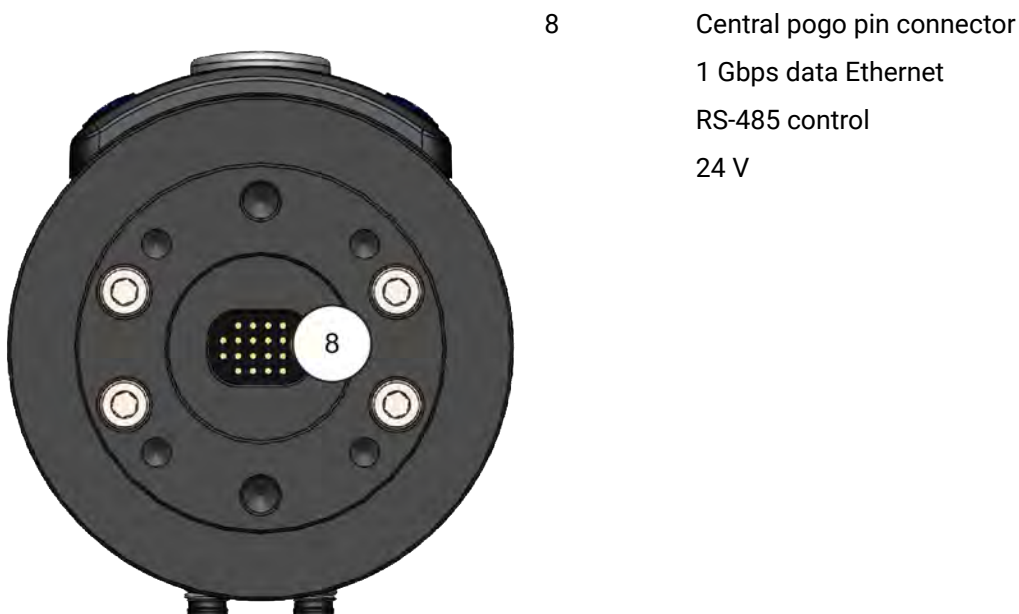


Figure 11: Bottom of wrist, pogo pin connector

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



Figure 12: Buttons on the wrist

- | | | |
|---|---------------------------------------|---|
| 1 | Hand-guiding mode toggle | Press to toggle between Cartesian Hand-guiding and angular Hand-guiding modes. |
| 2 | Waypoint capture (snapshot) | 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 54

[Robot lights and what they mean: a reference](#) on page 68

Force torque sensor

The force torque sensor detects the force and torque applied to the [end effector](#).

The six-axis force torque sensor is also 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.

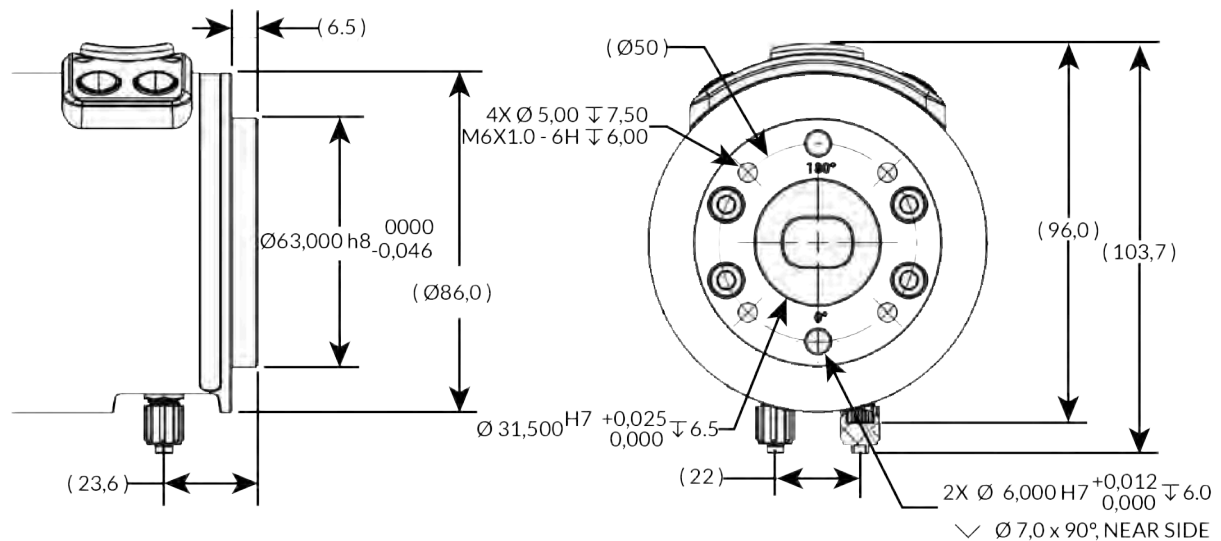


Figure 13: Mechanical interface of the wrist

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 [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.

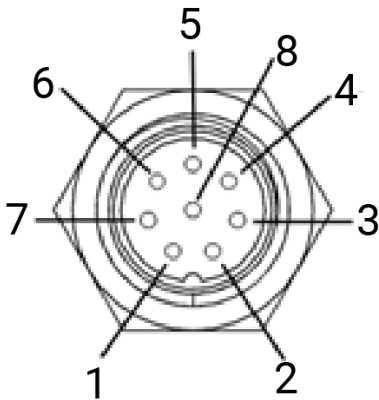


Figure 15: M8 connectors when facing the connector

Table 9: M8 Connectors

	Connector A	Connector B
Pin #	Signal	Signal
1	AOL_1	RS_485_P
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						

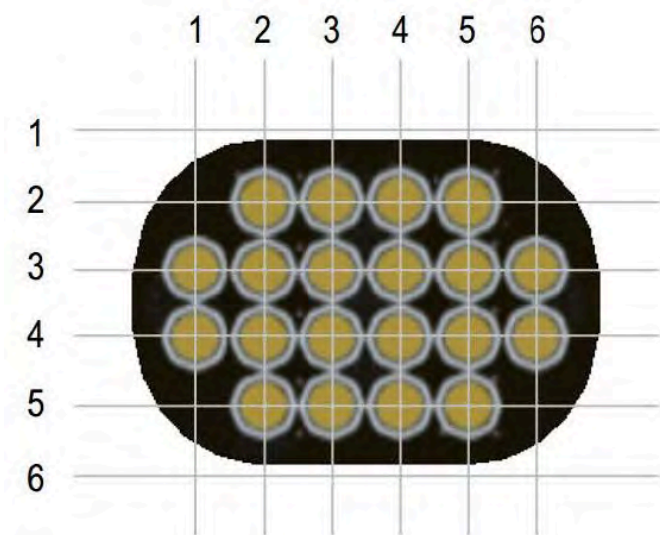


Figure 16: Pogo pin distribution

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 92

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 199

[OnRobot RG2 grippers](#) on page 205

[Robotiq adapter](#) on page 201

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 external 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.

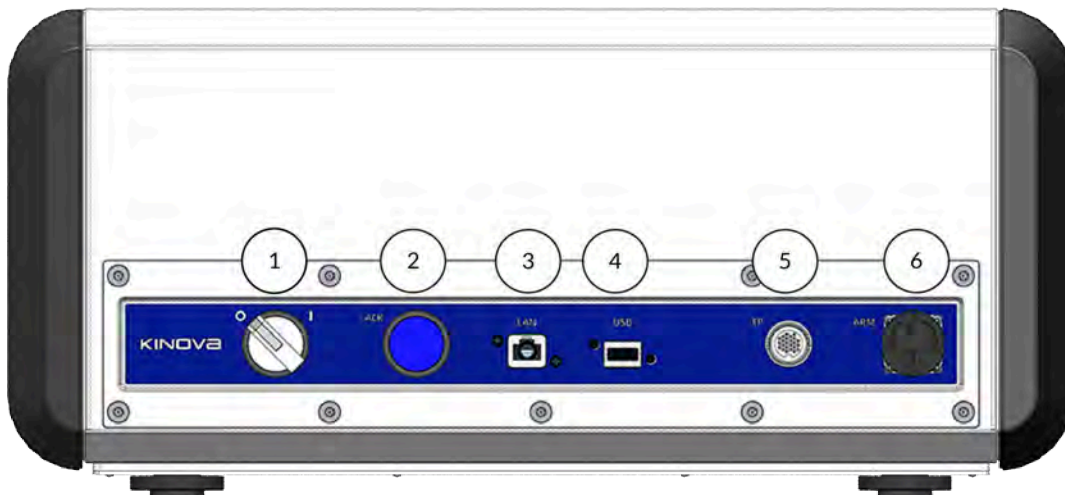


Figure 17: Front of controller and its parts

- 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.
- 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 TP connector to connect to the teach pendant

6 ARM connector



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

Plug the arm into the ARM connector 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

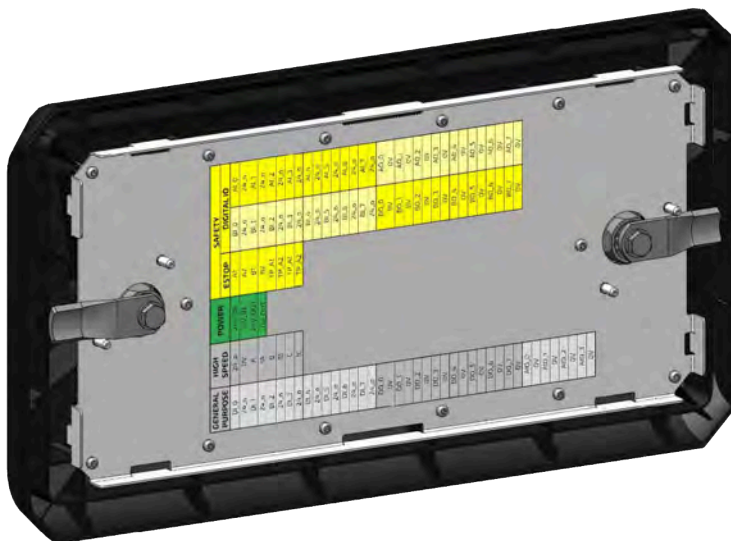


Figure 19: Map of input and output connectors is on the inside of the side panel

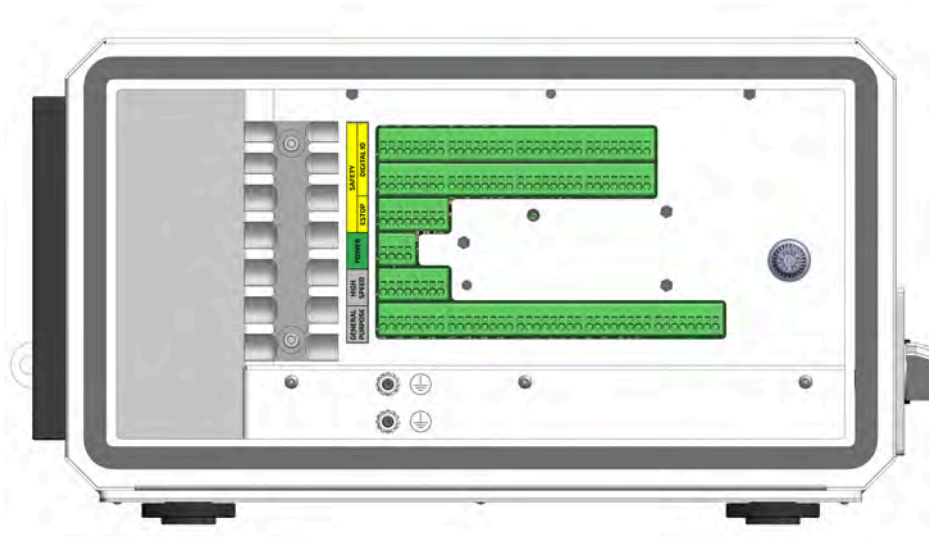


Figure 20: Input and output connectors are on the controller behind the side panel

The controller uses 12 VDC to power the internal computer units, which include SCU, 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.

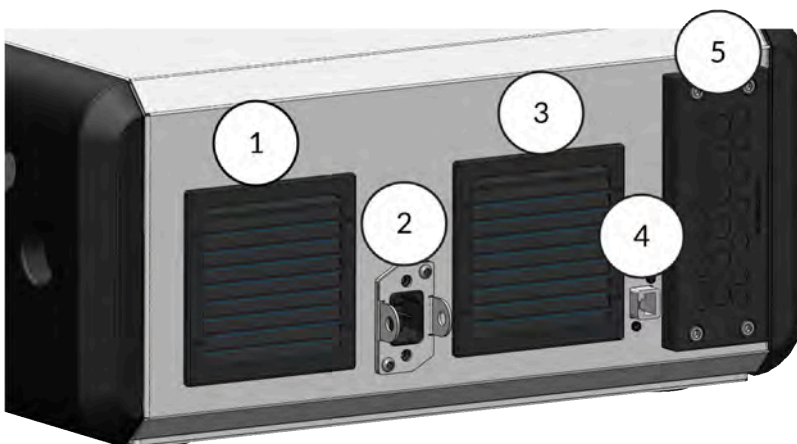


Figure 21: Back of controller

- 1 Fan-powered air exhaust
- 2 Electrical input for AC power
- 3 Fanless air intake
- 4 RS-485 Ethernet connector
- 5 Entry plate for I/O connectors

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.

Use the Ethernet connector at the back of the controller to connect to the network.

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 75

[Installing the controller on a flat surface](#) on page 77

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.

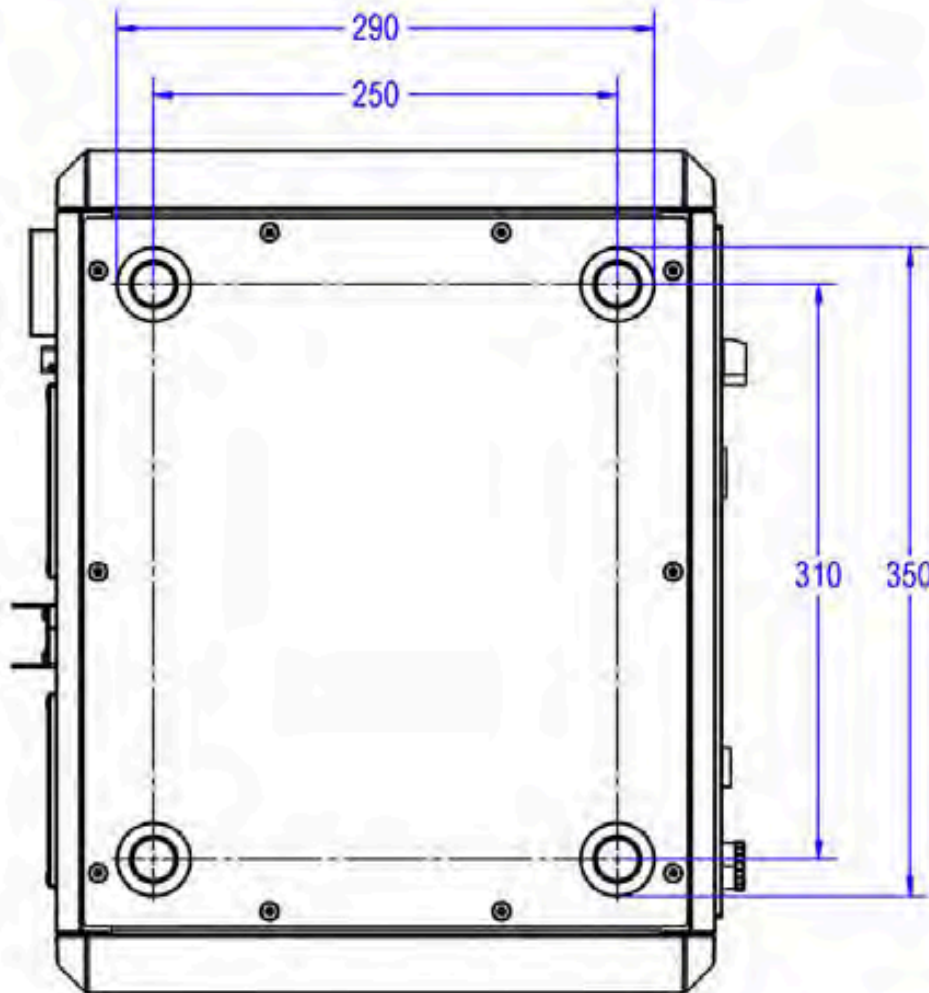


Figure 23: Mounting point measurements in millimeters

Related topics

[Installing the controller on a flat surface](#) on page 77

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.



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

Figure 24: Controller side panel

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 22.

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.

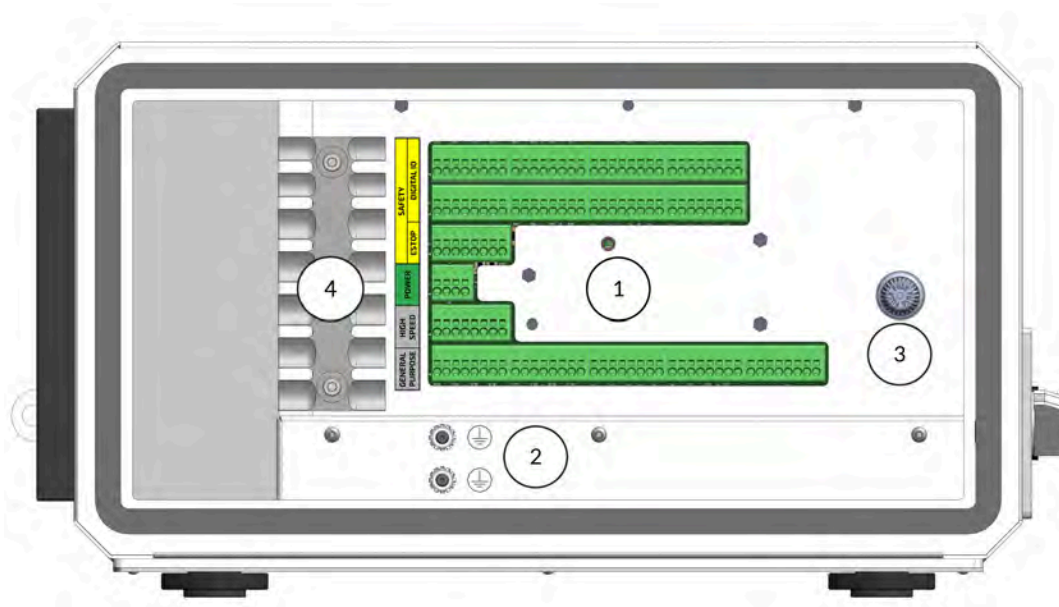


Figure 26: Inside the side panel of the controller

- 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 \(E-stop\)](#)
- 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 79

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 73

[Installing the arm on a third-party adapter plate](#) on page 75

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](#) 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 powered 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 4

[Risk assessment](#) on page 33

[Maintenance](#) on page 213

[Servicing](#) on page 218

[Disposal](#) on page 219

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 be trained when they are to work with the robot in collaborative mode.



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 4

[Unintended uses](#) on page 4

[Weekly maintenance](#) on page 214

[Installing the arm directly to a surface](#) on page 73

[Installing the arm on a third-party adapter plate](#) on page 75

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 de-commissioning, are listed in the risk assessment and that the risk assessment has been performed.

Related topics

[Preventive maintenance](#) on page 214

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 categories](#) (SC) are aligned with IEC 60204-1.

Table 14: 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 SCU.
	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 35

[State: Monitored stop](#) on page 59

[Operating modes](#) on page 61

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 [emergency 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 [Emergency stop \(E-Stop\)](#) 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 60

Move robot arm without power

It is possible that power to the arm is removed 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 brakes 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 brakes may require the arm to be reprogrammed.



CAUTION: Backdriving the brakes manually may damage the brakes.

Related topics

[Safety directives and warnings](#) on page 30

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 [Safety Control Unit \(SCU\)](#), 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 15: List of safety functions

Number	Name	Triggers stop category	Designed according to performance level
SF01	Emergency stop	SC0	ISO 13850
SF02	Protective stop	SC2	ISO 10218-1:2011
SF03	Joint position	SC2	ISO 10218-1:2011, 5.12.3
SF04	Joint speed	SC2	
SF05	Monitored stop	SC2	
SF06	Protection zone	SC2	
SF07	TCP & Elbow speed	SC2	

Related topics[Stop categories](#) on page 34[Safety modes](#) on page 40[Robot safety protections and limits](#) on page 41[Protection zones](#) on page 43[SF01 Emergency stop](#) on page 36[SF02 Protective stop](#) on page 37[SF03 Joint position monitoring](#) on page 37[SF04 Joint speed monitoring](#) on page 38[SF05 Monitored stop](#) on page 38[SF06 Protection zone monitoring](#) on page 39[SF07 TCP and elbow speed monitoring](#) on page 39[Status of safety functions](#) on page 169**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 60

[List of safety functions](#) on page 35

[Status of safety functions](#) on page 169

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 51

[List of safety functions](#) on page 35

[Status of safety functions](#) on page 169

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 Automatic and Recovery modes. It results in a 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 41

[Operating modes](#) on page 61

[Mode: Manual jog](#) on page 62

[List of safety functions](#) on page 35

[Status of safety functions](#) on page 169

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 41

[Configuring elbow limits](#) on page 43

[Operating modes](#) on page 61

[Mode: Manual jog](#) on page 62

[List of safety functions](#) on page 35

[Status of safety functions](#) on page 169

SFo5 Monitored stop

What does SFo5 monitor?

SFo5 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 35

[Status of safety functions](#) on page 169

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 61

[Protection zones](#) on page 43

[List of safety functions](#) on page 35

[Status of safety functions](#) on page 169

SFo7 TCP and elbow speed monitoring

What does SFo7 monitor?

SFo7 monitors the Cartesian speeds of the *tool center point* (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 64

[Tool center point limits](#) on page 42

[Configuring elbow limits](#) on page 43

[List of safety functions](#) on page 35

[Status of safety functions](#) on page 169

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

[Status of safety functions](#) on page 169

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 62

[Mode: Hand Guiding](#) on page 64

[Mode: Hold-to-Run](#) on page 65

[List of safety functions](#) on page 35

[Robot safety protections and limits](#) on page 41

Robot safety protections and limits

To make sure the robot operates safely in its working environment, configure joint limits, tool center point (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.

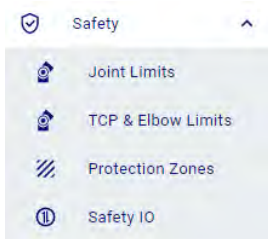


Figure 29: Accessing the safety pages

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 35

[Safety modes](#) on page 40

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.

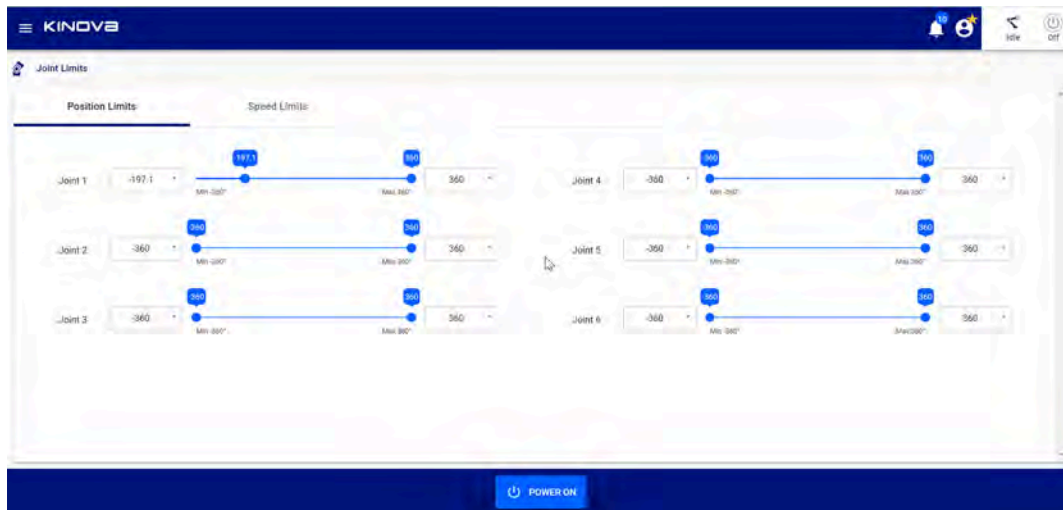


Figure 30: Position Limits page of Joint Limits page

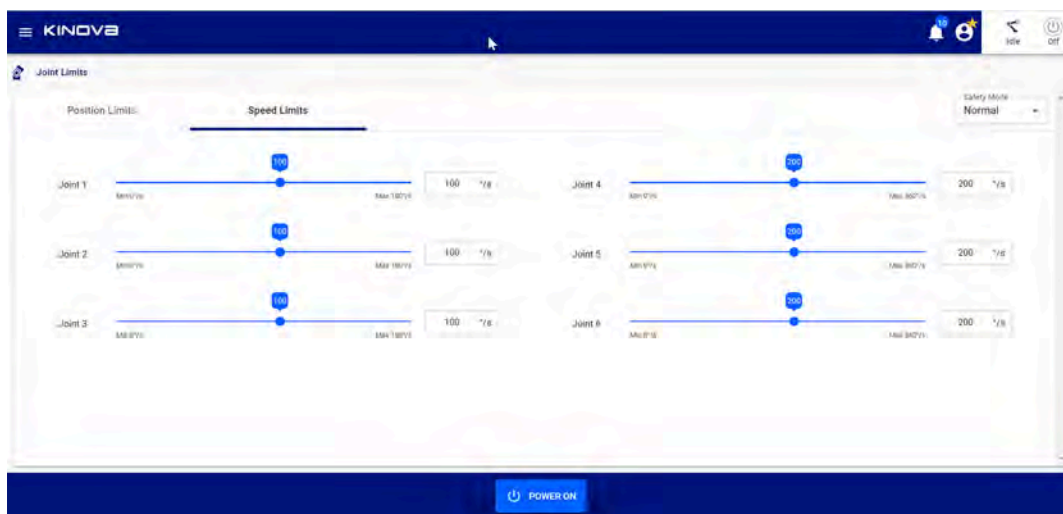


Figure 31: Speed Limits page of Joint Limits page

Table 16: 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 an end effector being used must be configured.

About this task

The *tool center point* (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 17: Ranges of speed limits for joints

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°

Configuring elbow limits

The speed and orientation of the elbow must be configured.

About this task

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 18: Ranges of speed limits for joints

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.

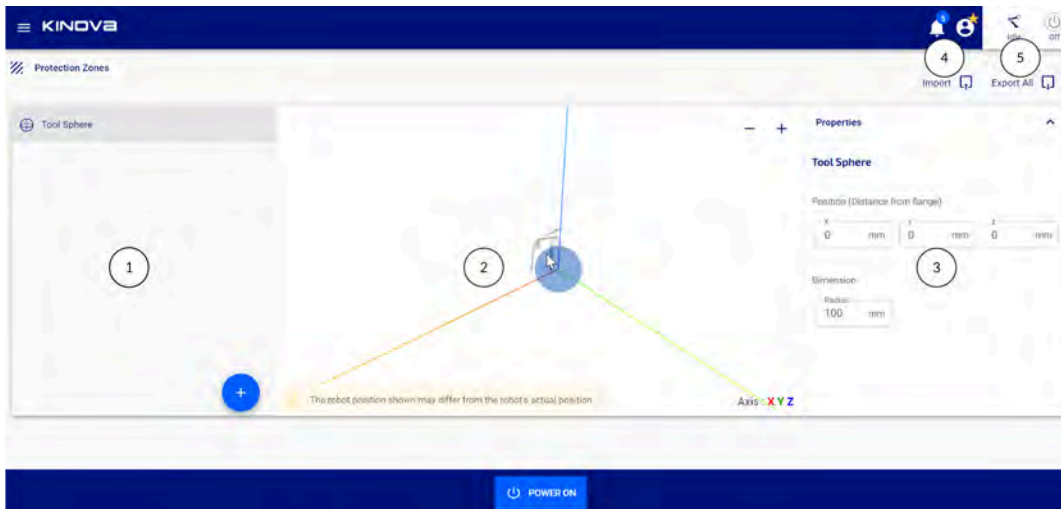


Figure 32: The Protection Zones page

- 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 35

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.

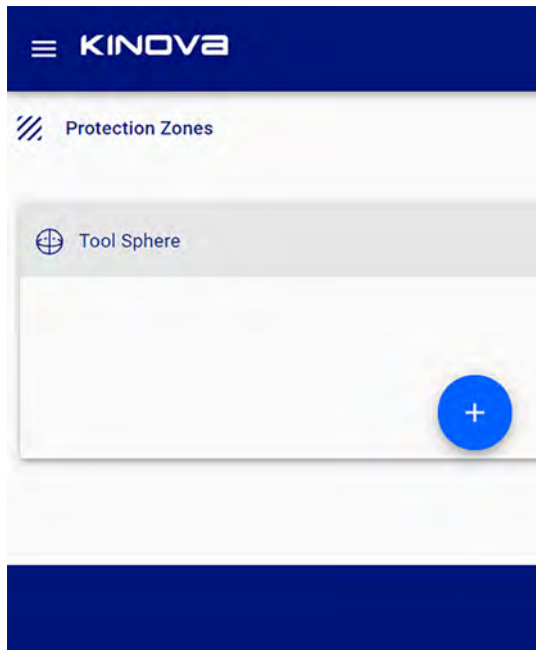


Figure 33: Example when no zones, except for the tool, are listed in the Zones pane

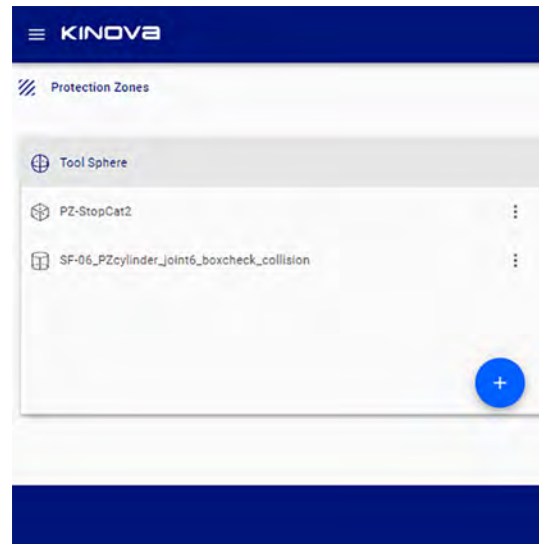


Figure 34: Example of multiple zones listed in the Zones pane

Table 19: 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.

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

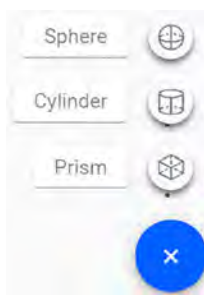
Safety zones are areas where the robot cannot enter.

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 20: 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 21: 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 22: Properties specific to the cylinder zone



Properties	Description
Orientation - Euler	Enter the orientation of the end effector using the fixed XYZ 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 23: Properties specific to the prism zone



Properties	Description
Orientation - Euler	Enter the orientation of the end effector using the fixed XYZ 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 24: 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 49

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 35: Location of Protection zone Export All button

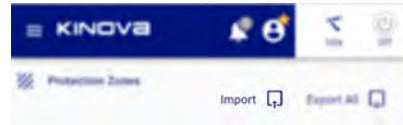


Figure 36: Location of Protection zone Import button

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.

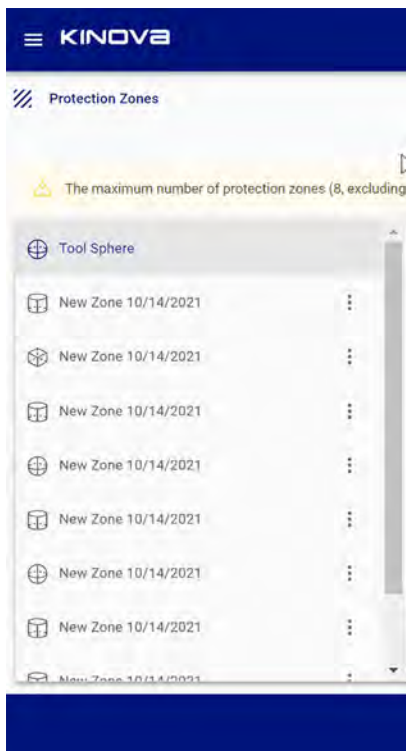
Import all zone from one file

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.

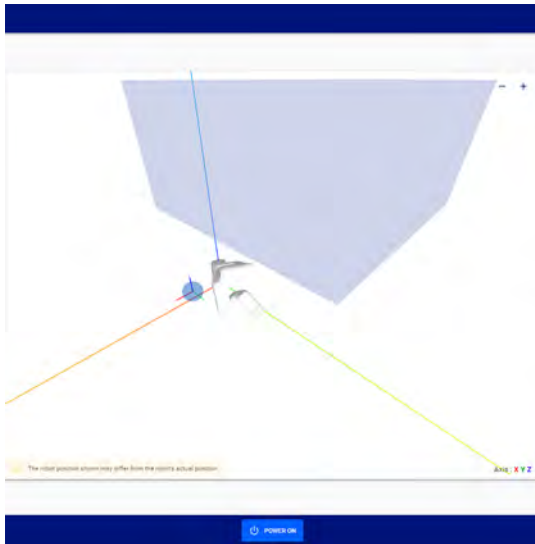


Figure 37: Visualization pane with tool sphere, robot, and other protection zones

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 eight possible safety equipment can be connected to the controller, plus an external E-stop button.

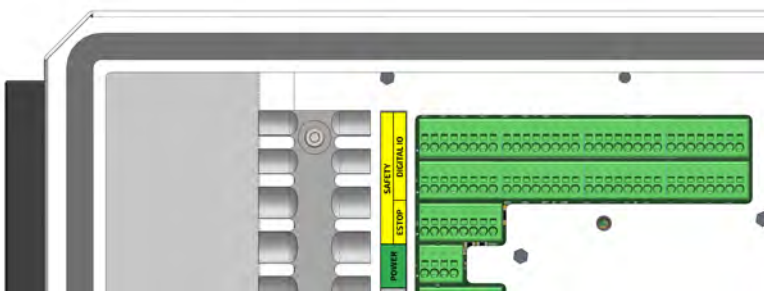
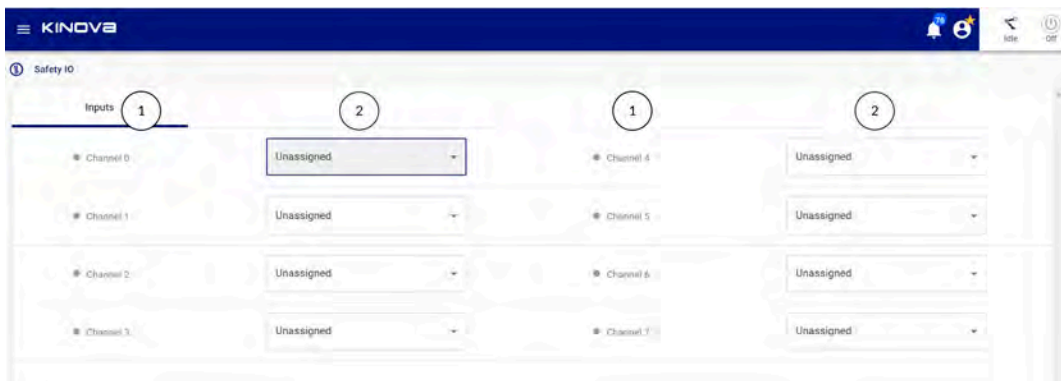


Figure 38: Location of connectors for the Safety I/O equipment

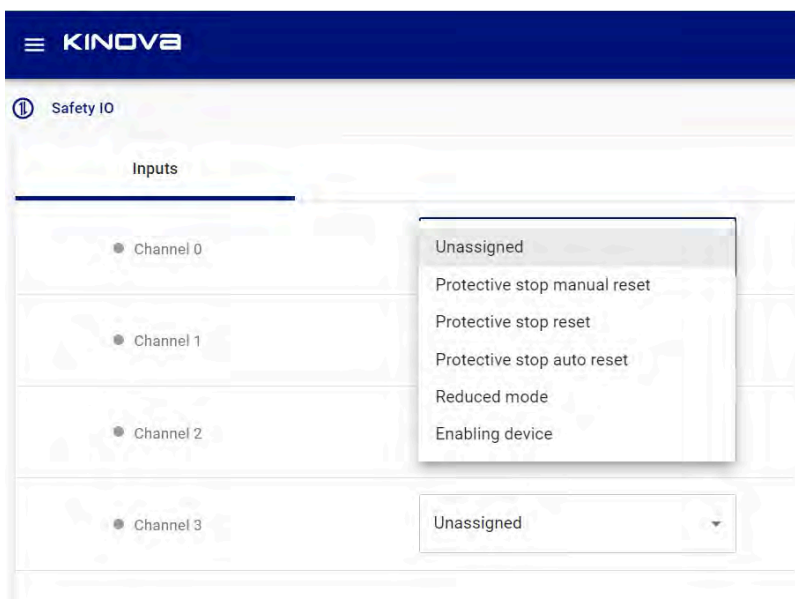
When the physical equipment is connected to the controller through the green slots, it can then be assigned a specific behavior on the corresponding input channel in the Web App. The input channels are numbered 0 through 7.

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



- 1 Input channel 2 Safety behavior

The safety behavior drop-down has several choices.



All safety digital inputs are *Normally Closed*.

Table 25: Input safeties 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 Protective stop. The robot is in Monitored Stop when it is in a Protective stop. Use the reset input of the Protective stop to resume operation.
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.

Safety input behavior name	Description
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 *Output signal switching device* (OSSD) behavior. The pulsed OSSD signals are filtered with the period is less than 3 ms.

There are five safety digital outputs.

- Emergency stop
- Protective stop
- Monitored stop
- Arm moving
- Normal speed mode

There is no OSSD behavior in the safety digital outputs.

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 26: 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.

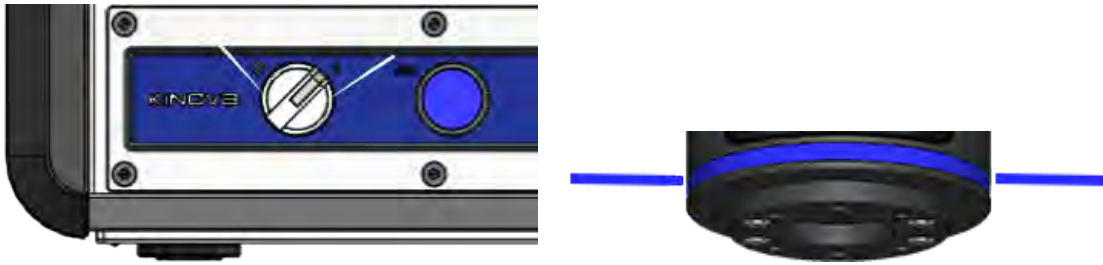


Figure 39: Example of equipment flashing once per second

- 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.

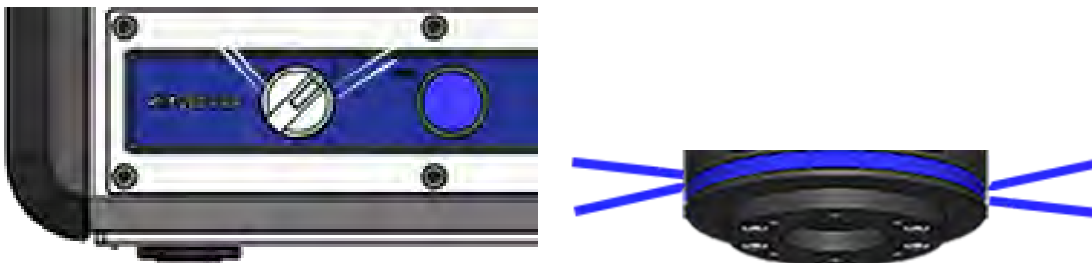


Figure 40: Example of equipment flashing twice per second

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 receives 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 41: Controller when it is off

Figure 42: 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 light	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 43: Visual cues for controller initialization

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

Controller lights	Wrist light	Description
Power knob on the controller flashes white twice (2) each second.		Processors in controller <i>boot</i> .
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 44: Controller when it is idle

Controller lights	Wrist light	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 45: Visual cues of arm initialization

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

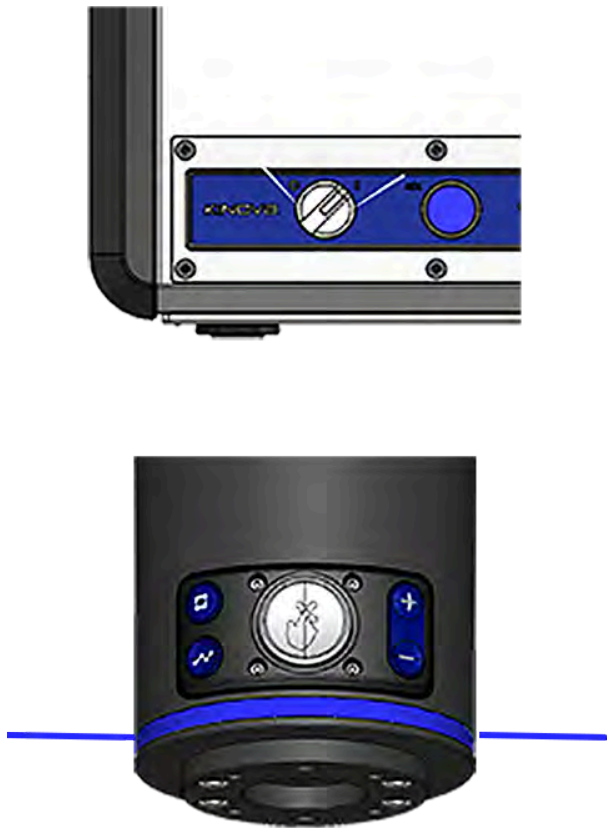


Figure 46: Visual cues of arm maintenance in progress

Controller lights	Wrist light	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 47: Visual cues of robot in Monitored stop

Controller lights	Wrist light	Description
Power knob on controller illuminates white steadily.	Wrist ring flashes green once (1) each second.	Mechanical brakes in the arm 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 34

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 *Safety Control Unit* (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.

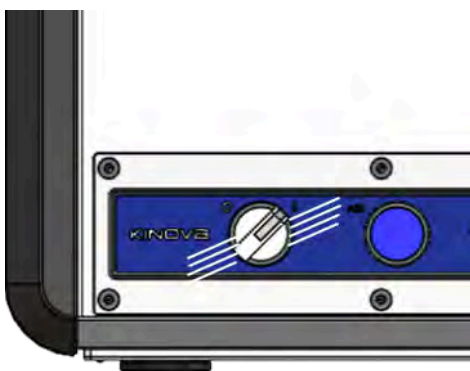


Figure 48: Visual cue of fault without power

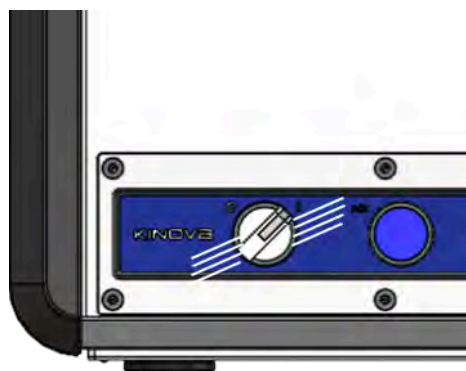


Figure 49: Visual cue of fault with power

Controller lights	Wrist light	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 68

[Why can the robot not exit recovery mode?](#) on page 224

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
- Automatic

Related topics

[Stop categories](#) on page 34

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 50: Jog Cartesian icon and control panel



Figure 51: Jog angular icon and control panel



Figure 52: Location of enabling device on the teach pendant

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

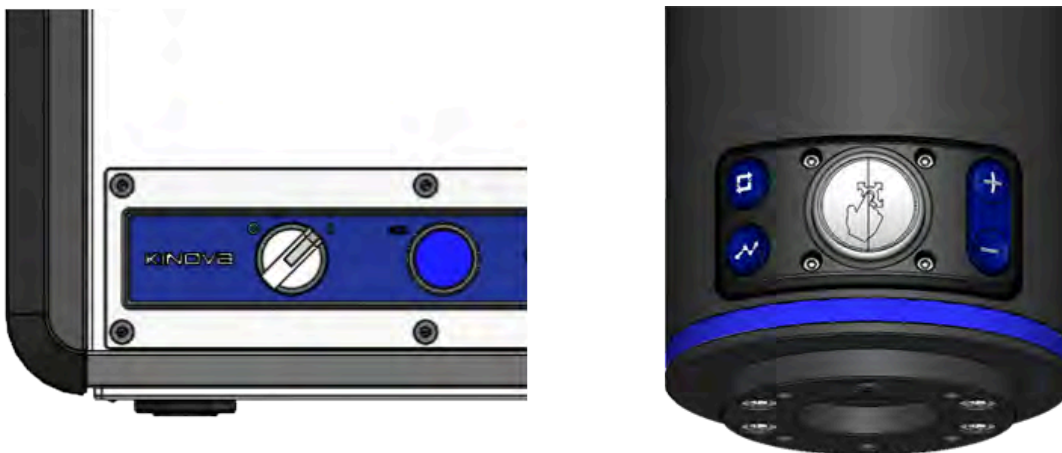


Figure 53: Visual cues of Manual mode

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

Controller lights	Wrist light	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 40

[Jog Angular panel](#) on page 160

[Jog Cartesian panel](#) on page 158

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 54: 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.

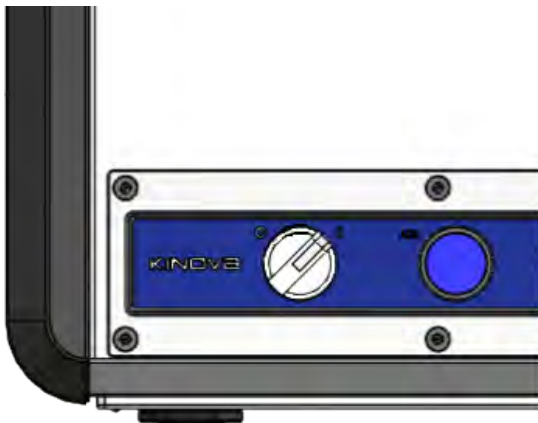


Figure 55: Visual cues of the Hand-guiding mode

Controller lights	Wrist light	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates blue steadily.	Move the arm in any direction while holding the Wrist enabling 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 or Joint*

Access Guidance modes from the Teach mode toggle on the wrist.



Figure 56: Location of Teach 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 40

[Hand Guiding panel](#) on page 156

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.

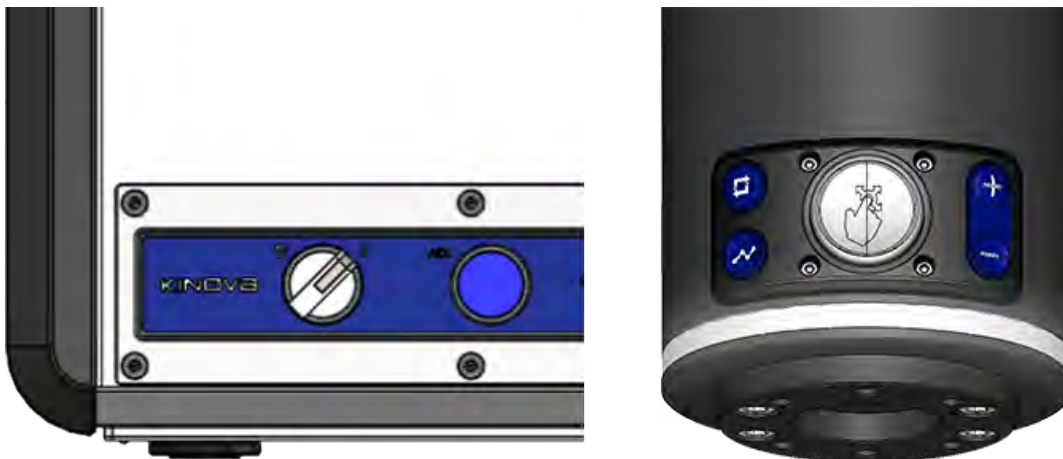


Figure 57: Visual cues of the mode Hold-to-Run when there is no issue

Controller lights	Wrist light	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.

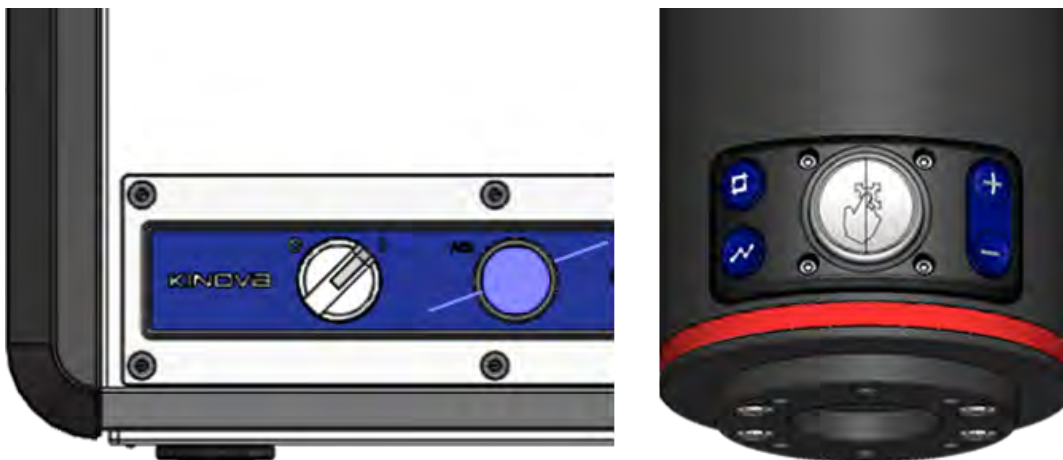


Figure 58: Visual cues of the mode Hold-to-Run when there is an issue

Controller lights	Wrist light	Description
Power knob on controller illuminates white steadily.	Wrist ring illuminates white steadily.	The robot is in Monitored stop. 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 106

[Running a program in Automatic mode](#) on page 166

[Safety modes](#) on page 40

[Running a program in Hold-to-Run mode](#) on page 167

Mode: Automatic

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

Programs can be run in both reduced and full speeds in Automatic mode.



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

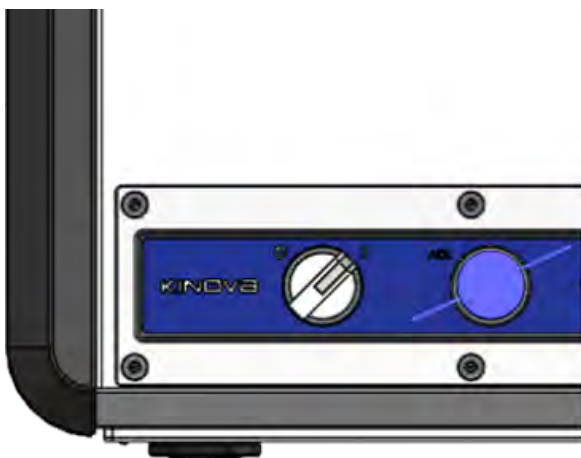


Figure 59: Visual cues for the mode Auto

Controller lights	Wrist light	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 does not illuminate.		

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

When the robot is in Automatic 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.

Related topics

[Safety modes](#) on page 40

[Running a program in Automatic mode](#) on page 166

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.

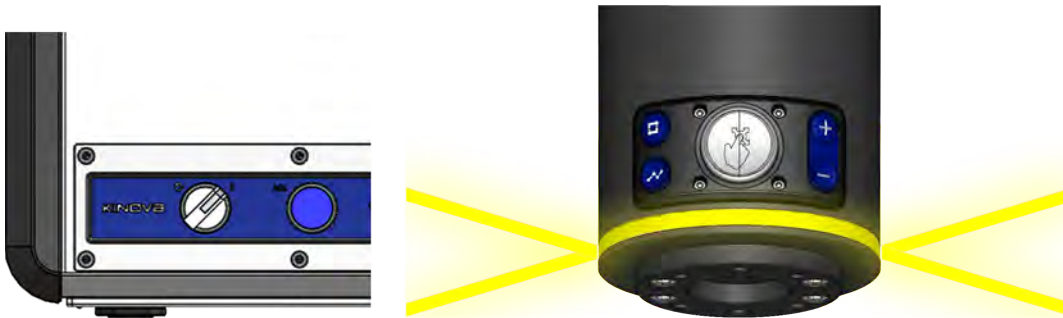


Figure 60: Visual cues of robot in Recovery

Controller lights	Wrist light	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 60

[Why can the robot not exit recovery mode?](#) on page 224

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 27: 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.
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> .

Description	Meaning
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.
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 firmware in the arm matches the firmware in the software unit in the controller.
Wrist ring flashes blue twice (2) each second.	The Web App 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 Monitored stop.
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 Automatic 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 Automatic mode.
ACK button on the controller flashes blue once (1) each second.	The program is running and the enabling device has not been pressed for over five (5) minutes.
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 Jog manual 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.

Description	Meaning
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 button in the middle position.
Wrist ring illuminates blue steadily.	
Power knob on controller illuminates white steadily.	The robot is operating in Automatic 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 protective 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 E-stop 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 102

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 30

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.

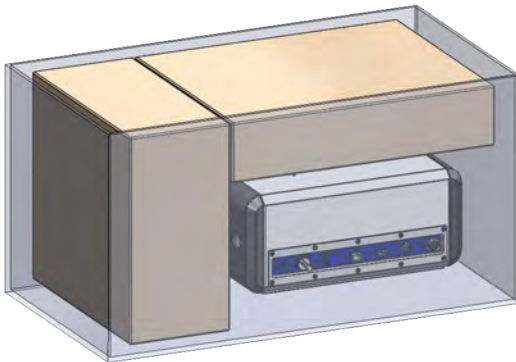


Figure 61: Box with controller, accessories box, and teach pendant box

The larger box contains the arm, along with its cable attached to the base of the arm.

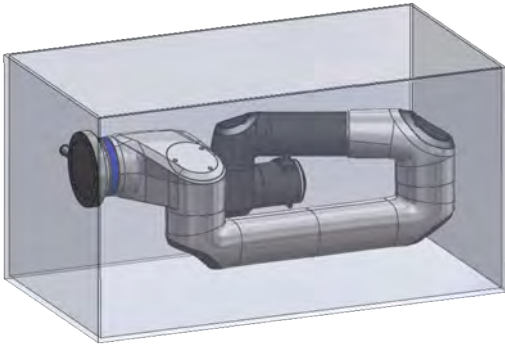


Figure 62: Box with arm and attached cable

Related topics

[Accessories](#) on page 197

[Components](#) on page 12

Unpacking the arm

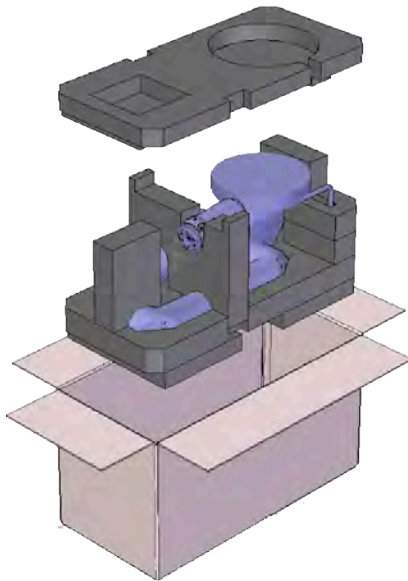
The box containing the arm is the larger of the two Link 6 boxes.

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 28: 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 30

[Configuring controls for the robot](#) on page 121

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.

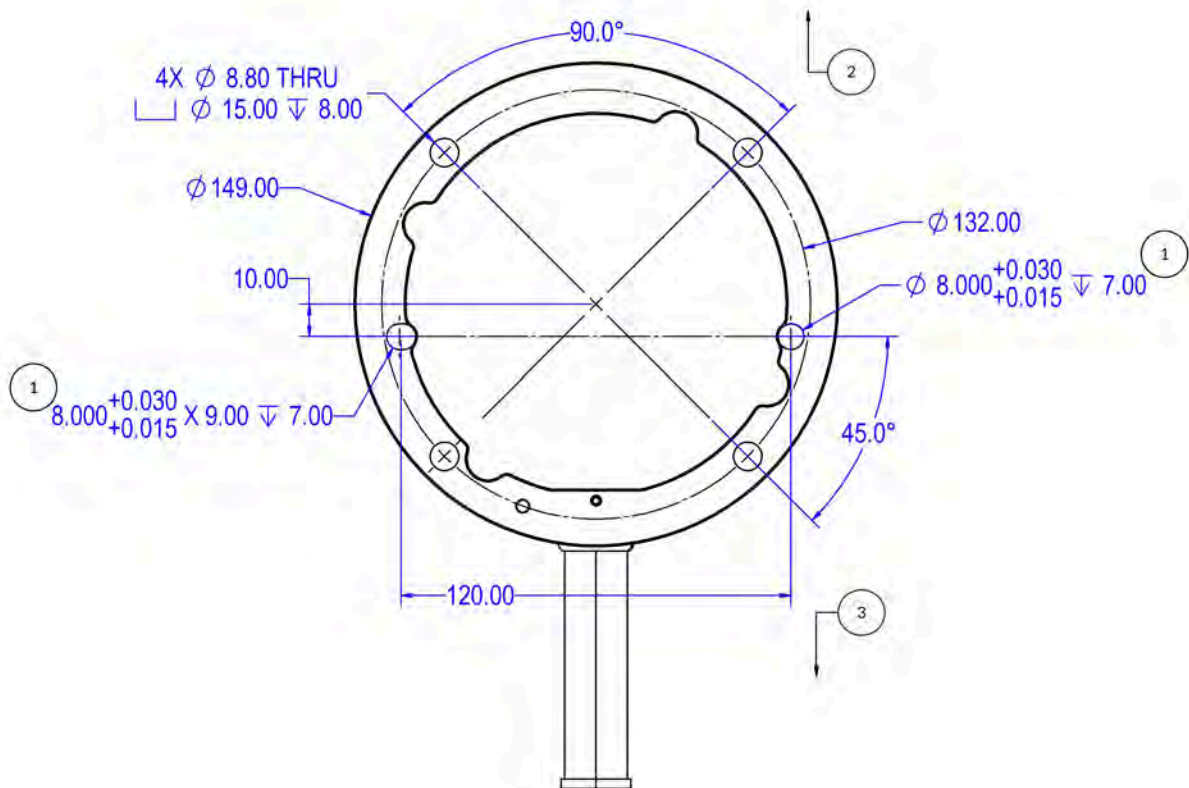
- 2 x 8 mm dowels

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 12

[Safety](#) on page 30

[Safety directives and warnings](#) on page 30

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 12

[Safety](#) on page 30

[Safety directives and warnings](#) on page 30

Unpacking the controller

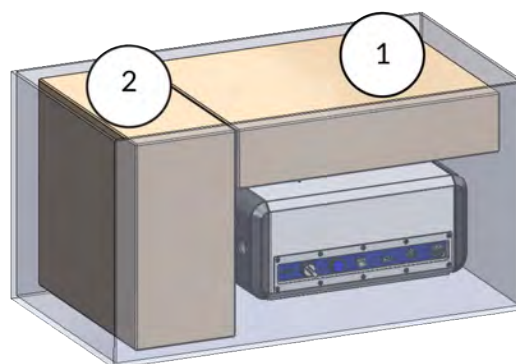
The box containing the controller is the smaller box, but it contains all the accessories bought with Link 6, as well as the power cord for the controller.

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 63: Linear perspective of the controller and its airflow requirements

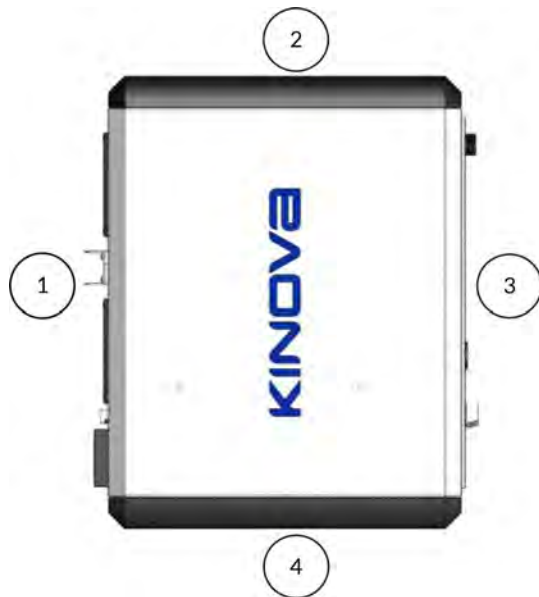


Figure 64: Top view of the controller and its airflow requirements

- | | |
|---|---|
| 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 29: 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 24

[Installing the controller on a flat surface](#) on page 77

[Maximum ambient temperature reached](#) on page 173

[Maximum core temperature reached](#) on page 173

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

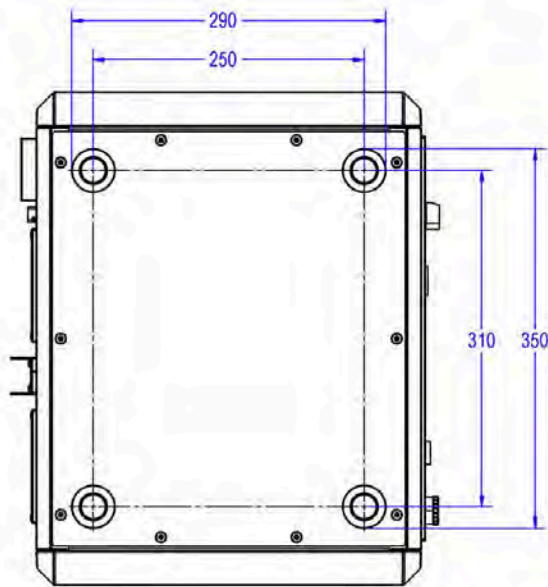


Figure 65: Mounting points of the controller, measured in millimeters

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 75

[Controller mounting interface](#) on page 24

[Surface mount of controller](#) on page 24

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 66: Teach pendant mount

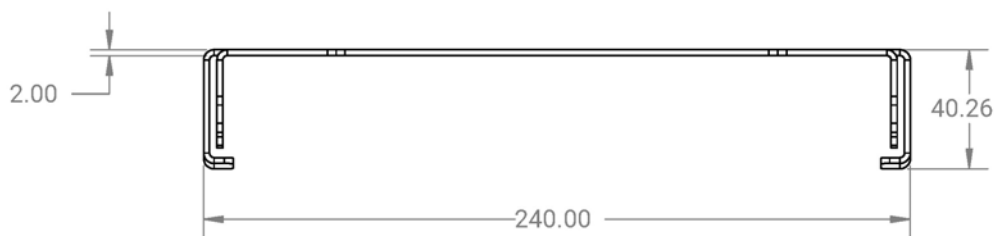


Figure 67: Specifications of the top view of the teach pendant mount

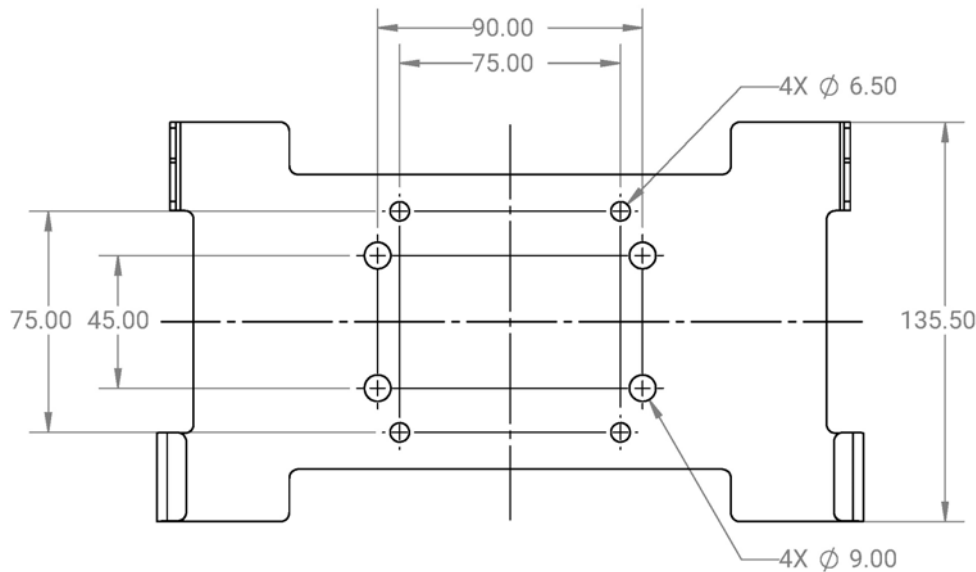


Figure 68: Specification of the front view of the teach pendant mount

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 28

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.

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.

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 contains 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, or NPN, is not supported on the panel.

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	IA	0V_OUT	B2	24_o	24_o
DI_2	B		TP_A1	BI_2	AI_2
24_o	IB		TP_A2	24_o	24_o
DI_3	C		TP_B1	BI_3	AI_3
24_o	IC		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 69: Default factory setting with internal supply used and external E-stop bypassed

Table 30: Industrial I/O terminals

Mechanical	Min	Typical	Max	Unit
Conductor size (UL/CUL)	16		24	AWG
Conductor size (IEC)	0.2		1.5	mm ²
Stripping Length	8		10	mm
Terminal pitch		3.5		mm
Ferrule		DIN 46228-4		

Related topics

[Installing the external 3-position enabling device](#) on page 211

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 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 31: Internal power

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

Table 32: External power

External 24 V input requirements	Min	Typical	Max	Unit	Note
Voltage	20	24	28	V	IEC 61131-2
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 33: 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.

Label	Purpose
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_OUT 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_OUT 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.

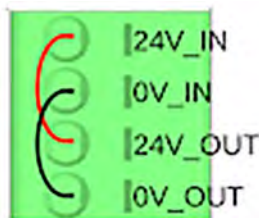


Figure 70: Internal power supply terminal connections

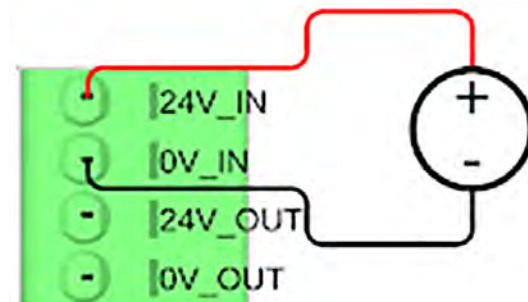


Figure 71: External power supply terminal connections

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 34: Digital inputs

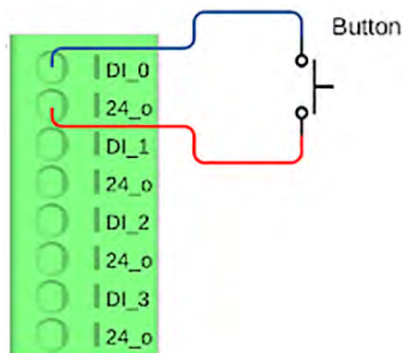
Digital inputs	Min	Typical	Max	Unit	Note
Low state voltage	-3	0	5	V DC	
High state voltage	11	24	30	V DC	
Current		2.0	2.6	mA	
Voltage drop					
Function					Current sinking
IEC 61131-2 Type		1.3			Digital input type 1 and 3 according to IEC 61131-2

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 35: 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 72: 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 36: 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 37: Digital output terminal connections

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

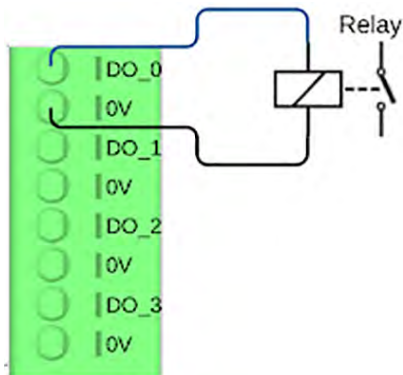


Figure 73: Digital output terminal connections

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 38: Analog inputs in current mode

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

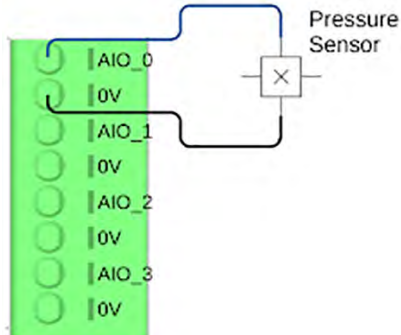
Table 39: Analog inputs in voltage mode

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 40: 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 74: Analog terminal connections**

Analog outputs

There are four (4) analog outputs.

Analog output types are current and voltage. The output impedance 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 41: Analog outputs in current mode

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

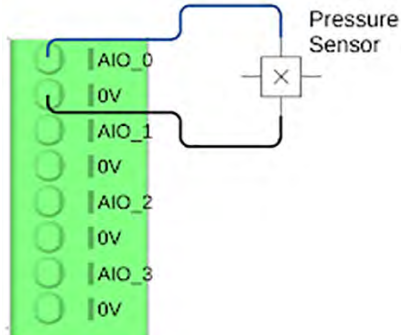
Table 42: Analog outputs in voltage mode

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 43: 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 75: 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 (2NC) redundant contacts. The terminal connections belong to the SAFETY - ESTOP terminal group.

Table 44: Emergency stop terminal connections

Label	Purpose
AI	24 V wetting port

Label	Purpose
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.

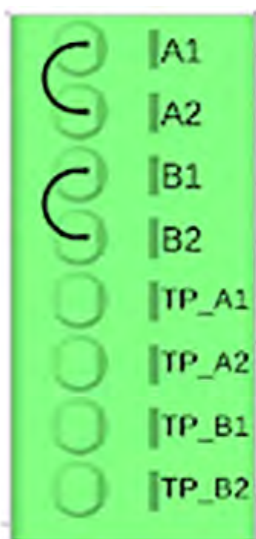


Figure 76: Terminal connections with jumper on A1, A2, B1, and B2 when the teach pendant is connected

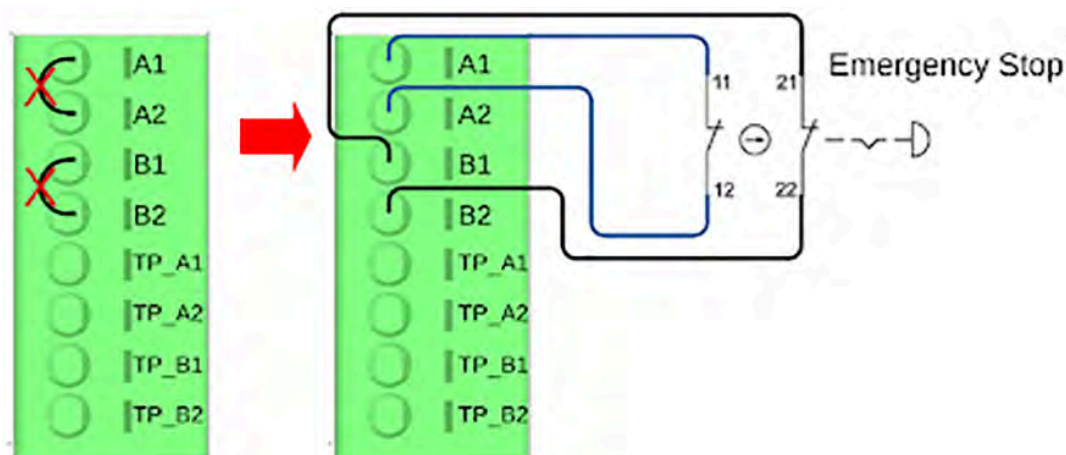


Figure 77: Terminal connections with external emergency stop connected

Teach pendant bypass inputs

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

If a teach pendant is connected on the front panel, leave open TP_A1, TP_B1, and TP_B2. 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 45: Teach pendant bypass inputs terminal connections

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

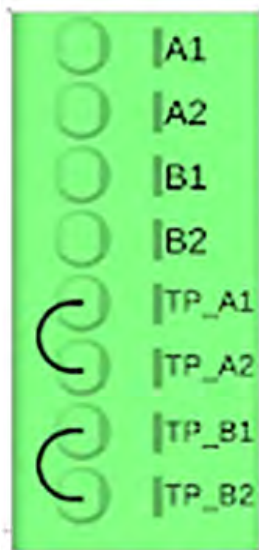


Figure 78: Teach pendant bypass inputs terminal connections

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 Normally Closed (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 46: 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

Label	Purpose
24_o	24V wetting port for safety rated Bank A and safety rated Bank B digital inputs

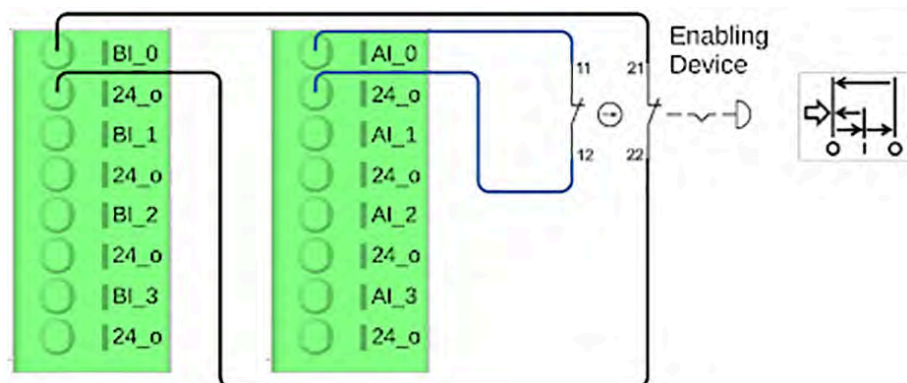


Figure 79: Safety-rated digital inputs terminal connections

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 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.

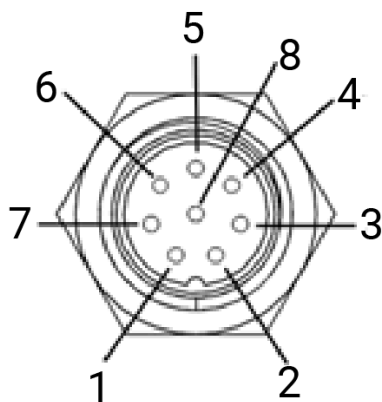


Figure 80: M8 connectors when facing the connector

Table 47: 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

Connector A			Connector B	
Pin #	Label	Purpose	Label	Purpose
4	DIGITAL_IO2	Digital In/Out	DIGITAL_IO6	Digital In/Out
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 M8 connectors. 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 85

[General-purpose digital outputs](#) on page 86

[Analog inputs](#) on page 87

[Analog outputs](#) on page 88

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.

There is no RS-485 communication available from the Web App.

Table 48: 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 49: RS-485 power inputs

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

RS-485	Min	Typical	Max	Unit
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.

Table 50: 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 199

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 *graphical user interface* (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 81: The Web App on Teach pendant

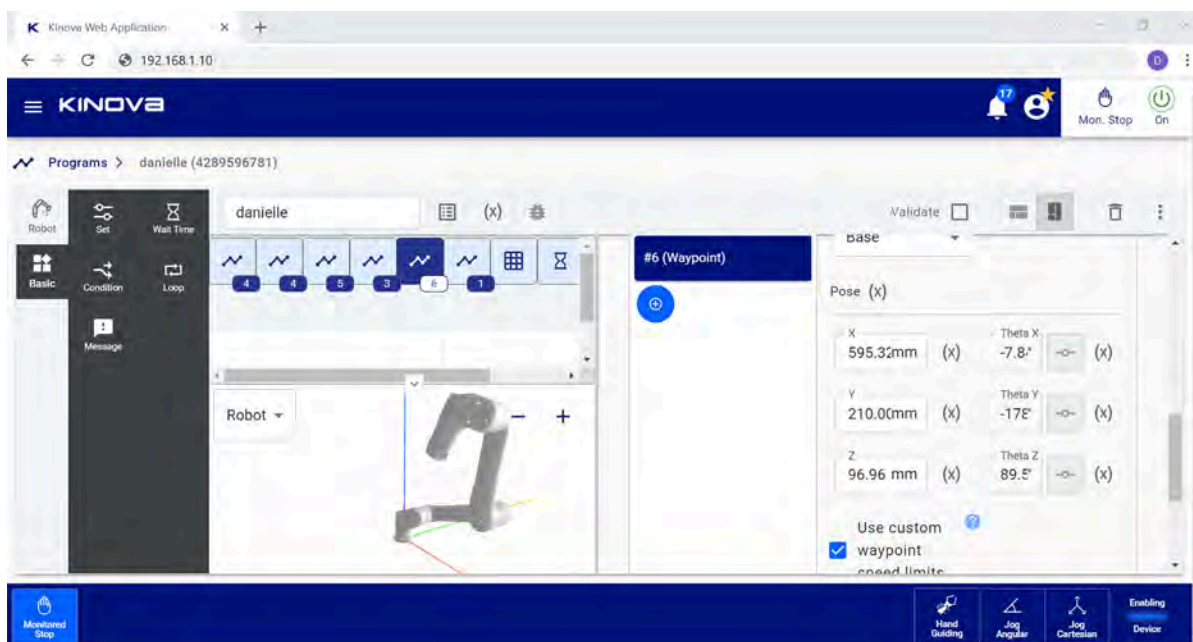


Figure 82: The Web App in a web browser

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.

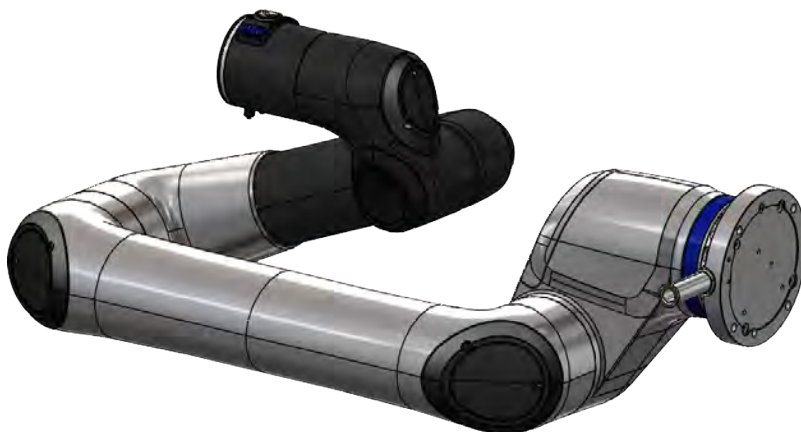


Figure 83: Link 6 in its package position

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.



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.



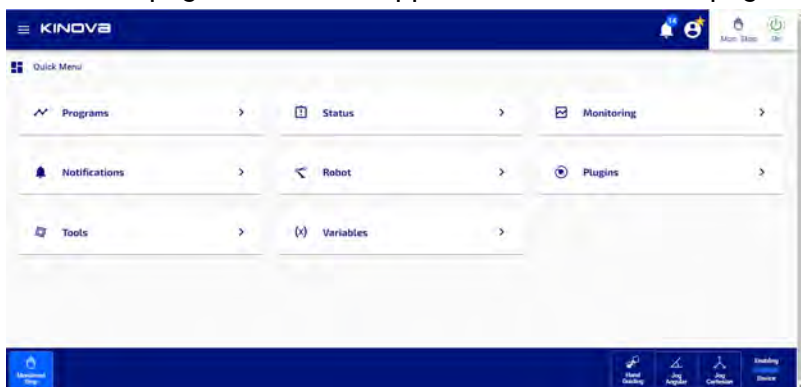
Important: Usernames and passwords are case sensitive.



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.

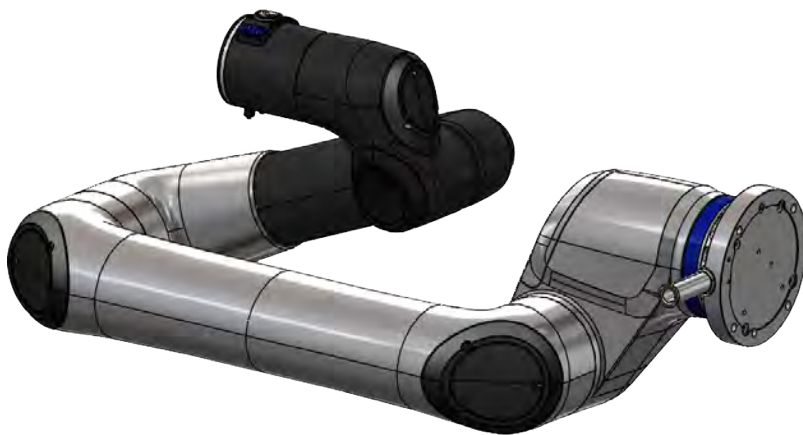


Figure 84: Link 6 in its package position

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 85: Angles of each joint in the Packaging pose

JSON Object Editor

package

Joint Angles

Joint	Angle	Up Arrow	Down Arrow
1	-90	↑	↓
2	0	↑	↓
3	-152	↑	↓
4	0	↑	↓
5	-62	↑	↓
6	0	↑	↓

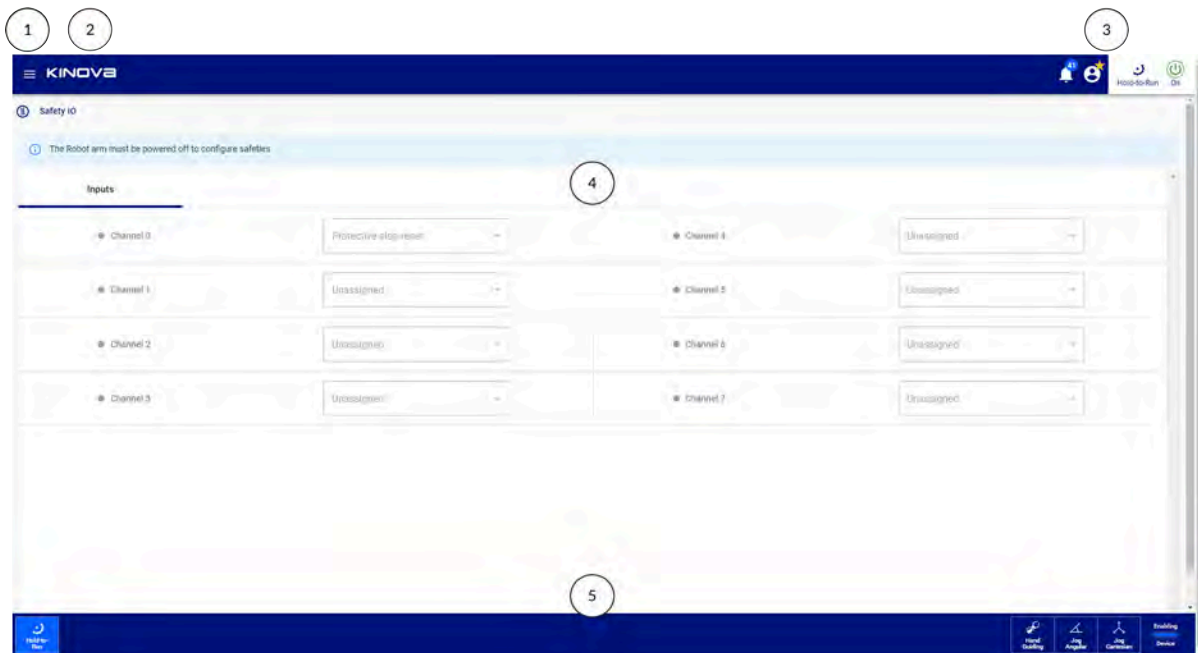
CANCEL **SAVE**

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.

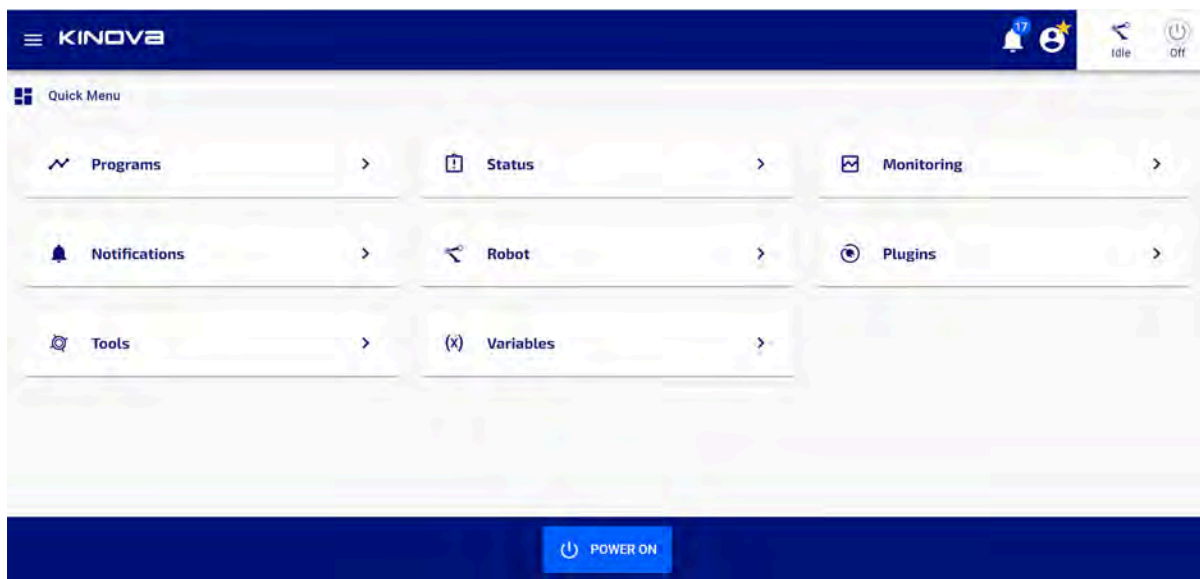


Figure 86: Home page is also the Quick menu

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 *tool center point* (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.

Diagnostics status, monitoring notifications

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.

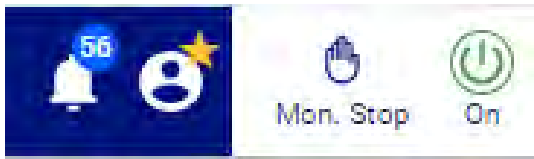
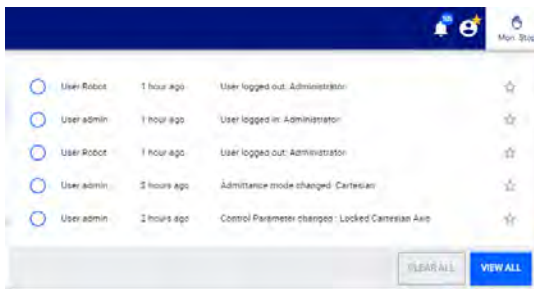


Figure 87: Indicators, modes, and arm power status



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



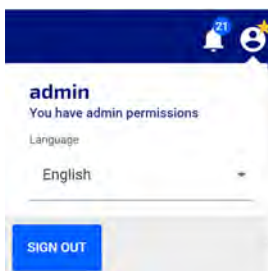
The **Notifications panel** displays the list of notifications to be read.



The admin user is logged into the Web App.

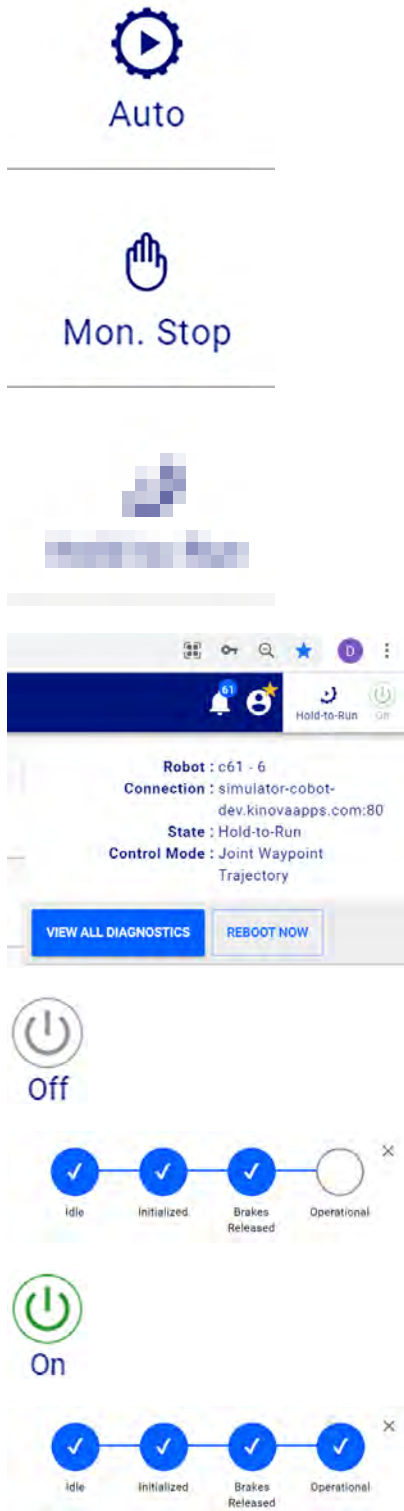


An operator is logged into the Web App.



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

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



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

- Monitored Stop
- Hold-to-Run
- Automatic

Tap the Robot 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

[Robot lights and what they mean: a reference](#) on page 68

[User management](#) on page 106

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 mode that the robot is operating in is displayed on the left of the panel as a .Robot icon. Tap it to access the other available operating modes.



Figure 88: 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.



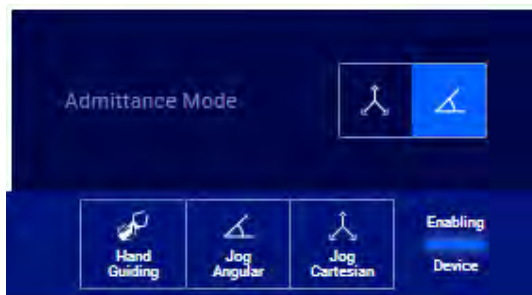
Figure 89: Tapped Robot icon displays current mode as well as other operating modes

At the opposite end of the Robot control panel are the Manual control modes, as well as the Enabling device status.

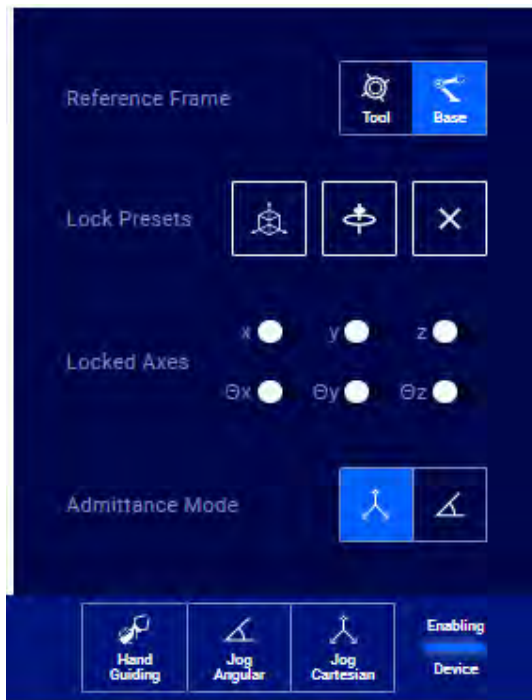


Figure 90: Virtual controls and mode toggles with Enabling device off and then on

Tapping on 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 joint angular Hand Guiding mode



Virtual controls in Cartesian Hand Guiding mode



Virtual controls in angular Manual Jog mode

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



Virtual controls in Cartesian Jog Manual mode

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 161

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 51: 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

Admin user ()

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.

view only

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 ()

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.

view only

Systems

- **Information:** view only

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

Related topics

[Indicators, user profile, and power](#) on page 102

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.

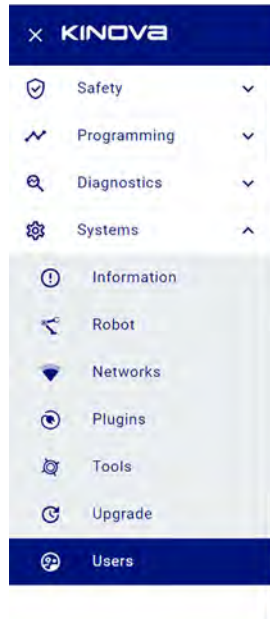
Procedure

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.

Create new user

Username *

Password  Retype Password 

First Name Last Name

Language
English

Notes

 CANCEL  CREATE

3. Enter information in the fields.

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

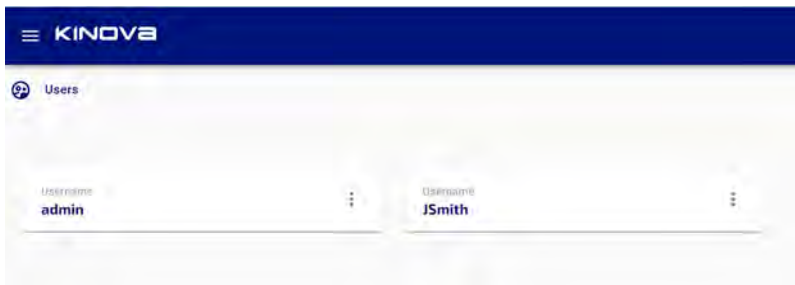


Important: The username and password are case sensitive.

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.

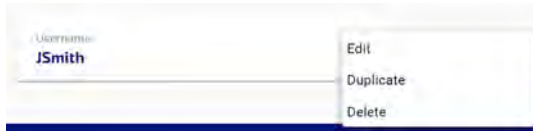


2. Tap on a user's name.

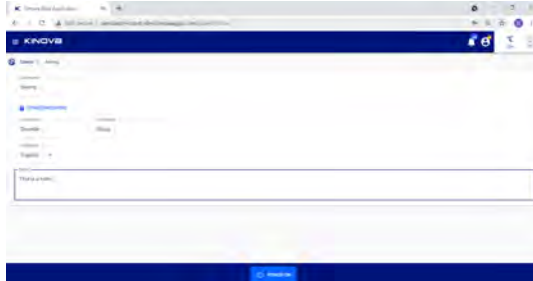
3. Tap the *kebab menu*.



4. Tap **Edit**.



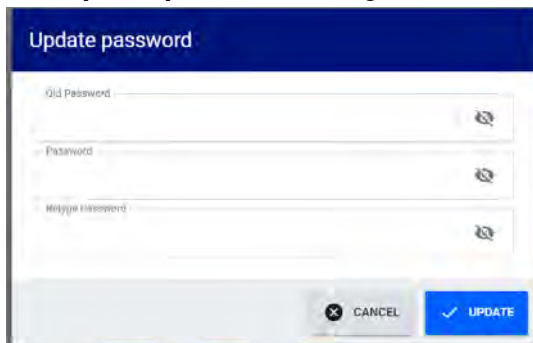
The **Edit User Profile** page is displayed.



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.



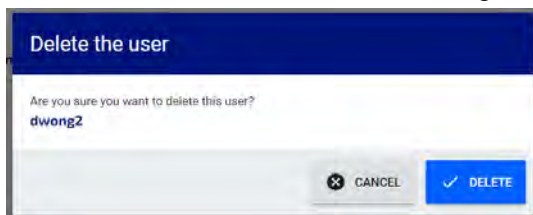
Note: Administrator accounts cannot be modified or deleted. The content of the kebab menu is not selectable.

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.

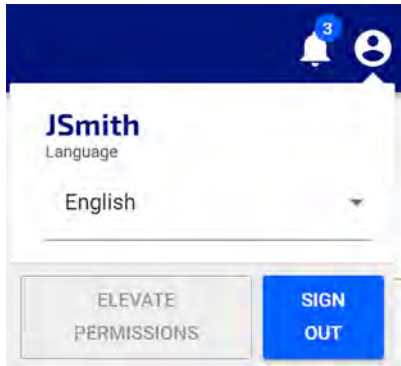


Tip: An operator can elevate their permissions only if they know the admin password.

Procedure

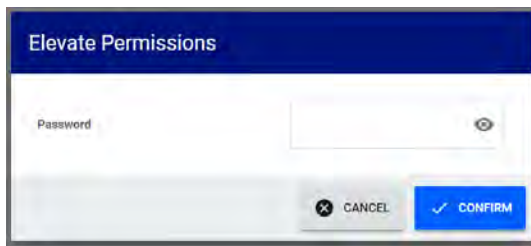
1. Tap **User Profile** .

A **User profile panel** launches.



2. Tap **ELEVATE PERMISSIONS**.

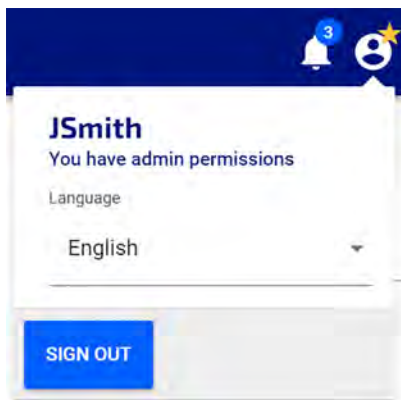
The **Elevate Permissions** dialog launches.



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..**

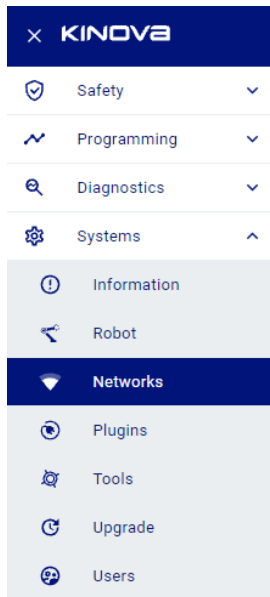


Figure 91: Accessing robot networking and communication configurations

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



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**.

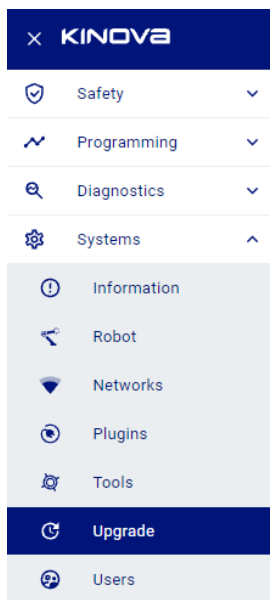
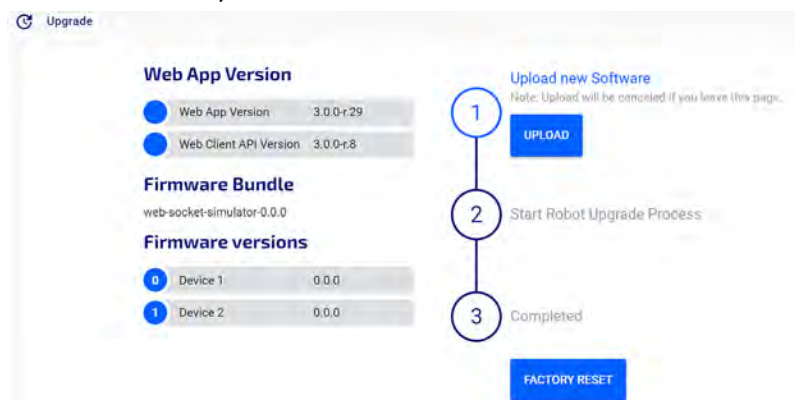


Figure 92: Accessing the software upgrade operation

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**.

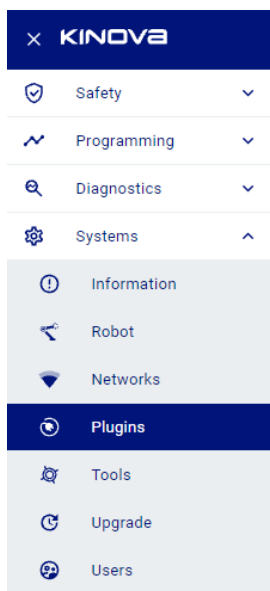


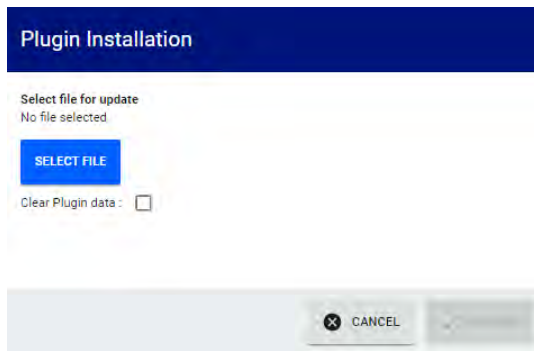
Figure 93: Accessing the plugins

Procedure

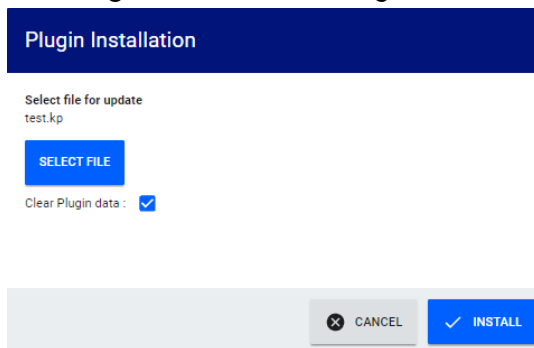
1. Tap **Systems > Plugins**.
The **Plugins** page launches.



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 powered on and it must be in Monitored Stop.

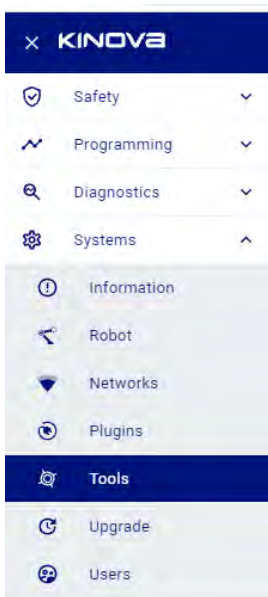


Figure 94: Accessing tool configuration operations

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.

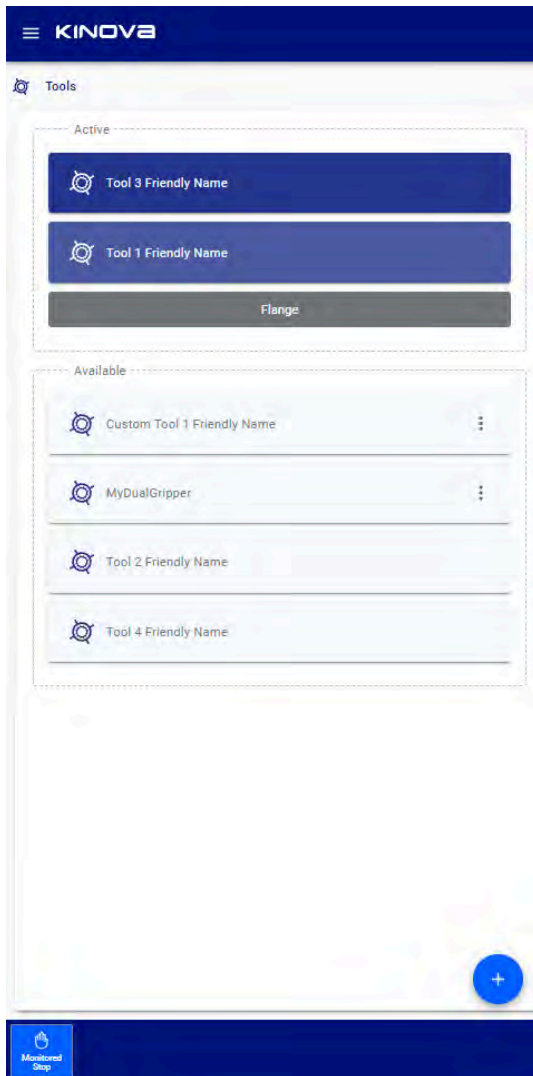


Remember: The visualization of the arm may not be in exactly the same position as the arm physically is in.

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 tool center point of the entire robot.

Procedure

1.



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

2. Enter the information about the custom tool.

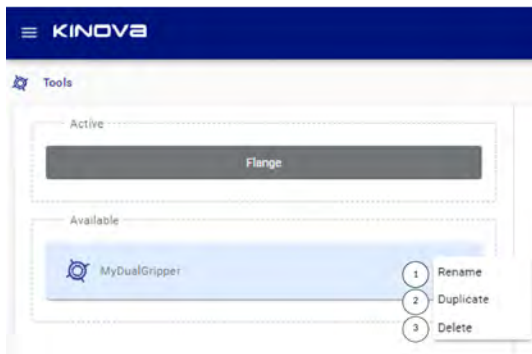
- Name
- Mass
- Transform: x, y, z in mm
- Transform: #x, #y, #z in °
- Center of Mass: x, y, z in mm
- Center of Mass: #x, #y, #z in °
- Inertia Matrix: ixx, ixy, ixz, iyy, iyz, izz in kg/m²

3. 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.



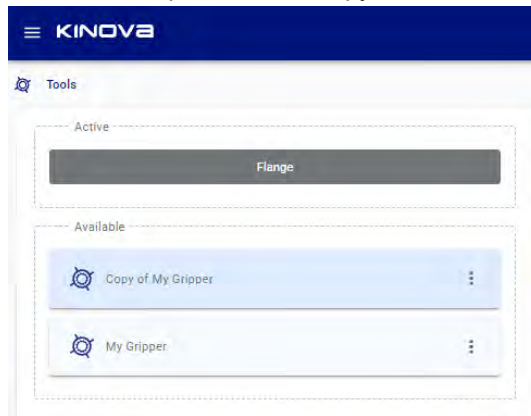
1 Rename

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



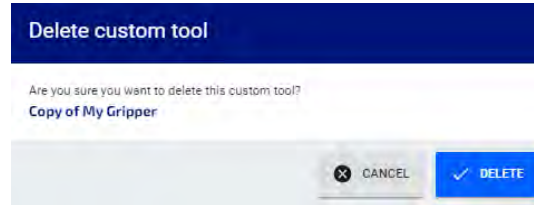
2 Duplicate

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

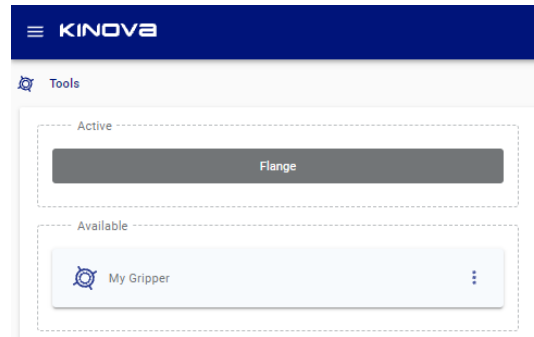


3 Delete

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**.

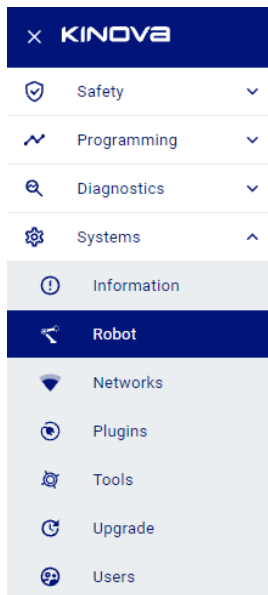


Figure 95: Accessing the robot settings

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.

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.

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

A confirmation dialog launches when errors are suspected.

Are you sure you want to proceed?

Warning Configuring the Tool, Payload and Gravity Vector parameters with incorrect values may result in involuntary movement of the arm.

Ensure that the correct values have been set.

CANCEL

PROCEED

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

Payload



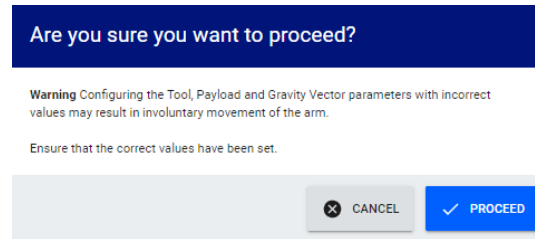
Important: Payload does not refer to the end effector. It refers to the mass of the object that the robot is picking.

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

- a. Enter the Mass in kg and the Mass Center of the object being picked.

Option**Description****b. Tap SEND.**

A confirmation dialog launches when errors are suspected.

**a. Tap CLEAR to erase the values.****Related topics**

[Restoring factory defaults](#) on page 123

Restoring factory defaults

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

About this task

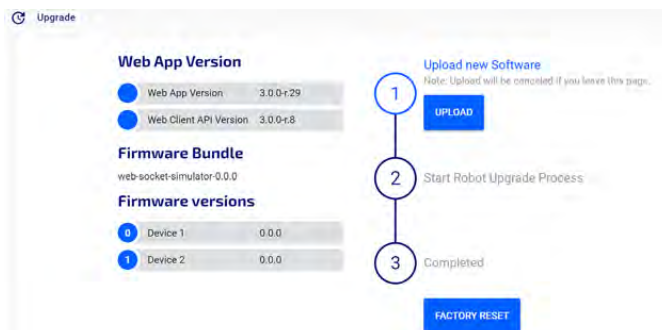
Only the *admin* user can update the software.



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 121

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.

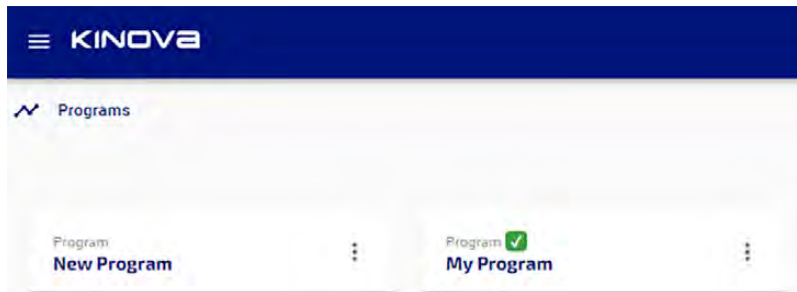


Figure 96: Programs page after programs are created

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 97: 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.

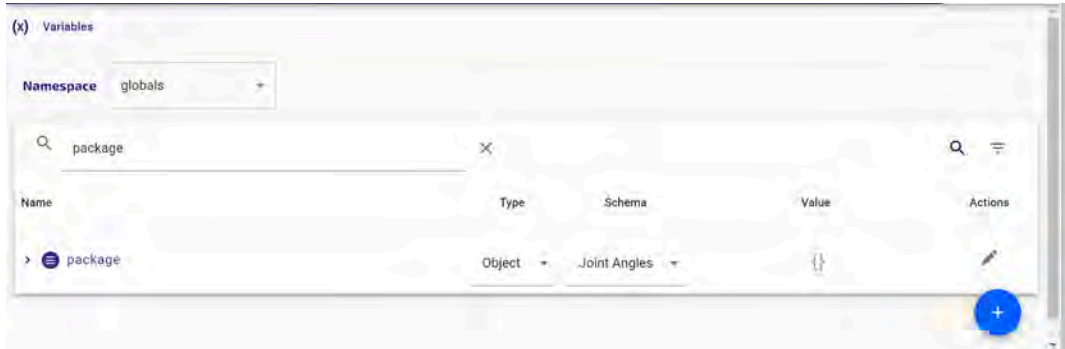


Figure 98: Result of a search for variable *package* in global namespace

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

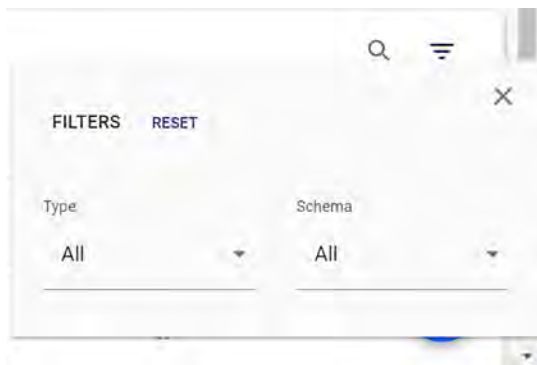


Figure 99: Filter panel

- 5 Define the type of the variable by selecting a type from the **Type** drop-down.
 - **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.

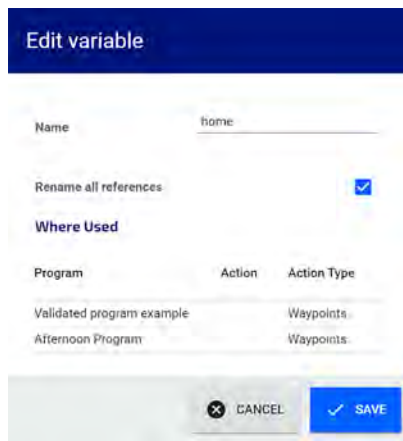


Figure 100: Edit variable dialog for global variable *Home*

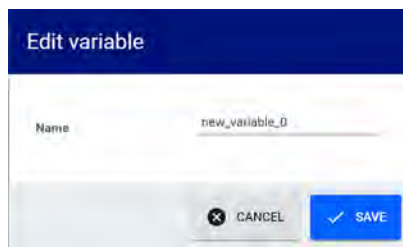


Figure 101: Edit variable dialog for user-defined global variable

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.

Tap the delete icon (🗑️) to delete the user-defined global variable.

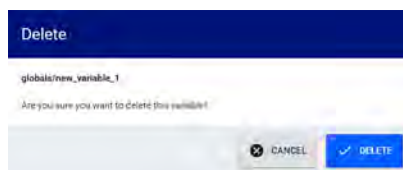


Figure 102: Delete user-defined global variable confirmation dialog

- 9 Tap to add a new global variable in the currently selected namespace.

Related topics

[Variable management](#) on page 136

[Industrial I/O plugin](#) on page 190

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}
```

Nesting values

You can also nest values as long as you continue to respect the JSON format.

Example

```
1 meaningful_variable_name = {
2   "employee": {"name": "John", "age": 30, "city": "Montreal"}
3 }
```

Access the value John by writing `${meaningful_variable_name.employee.name}`.

Defining arrays and lists

A variable does not have to be strictly for one value. It is possible to have an array, or list, of values defined to a variable. When defining a variable as an array, the first index is always 0.

Example

Define a variable named `var` as an array of values. `{"n": [0, 1, 2, 3, 4, 5]}`. The result of `${var.n[0]}` is 0 and of `${var.n[3]}` is 3.

Defining iterators

When you define a variable as an iterator, it must be defined as type Number. It must start at 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.

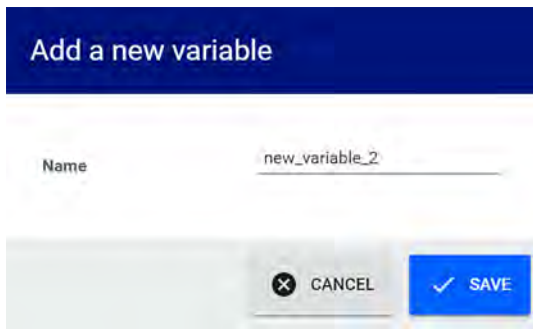
About this task

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.
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 103: 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

Figure 104: Editor for object type Pose

JSON Object Editor

new_variable_2

Joint Angles

Angle
0

Angle
0

Angle
0

Angle
0

Angle
0

Figure 105: Editor for object type Joint Angles

JSON Object Editor

new_variable_2

Matrix output

Generated Pose List

Figure 106: Editor for object type Matrix Output

JSON Object Editor

new_variable_0

Read Input's output

result
1

Figure 107: Editor for object type Read Input Output

Adding a variable to a program

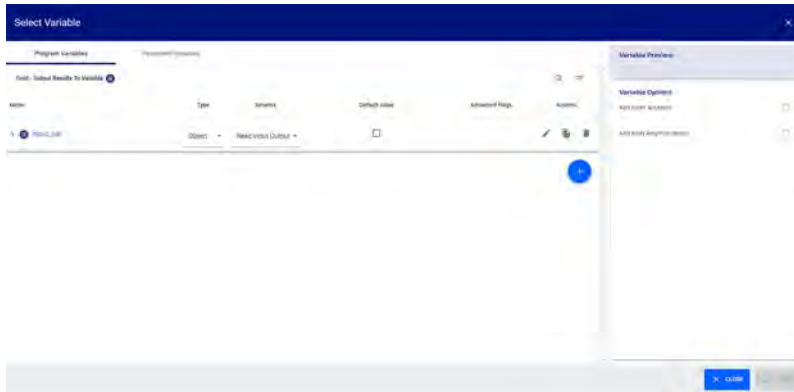
Variables can be added to the namespace of the program from the **Select Variable** page.

About this task

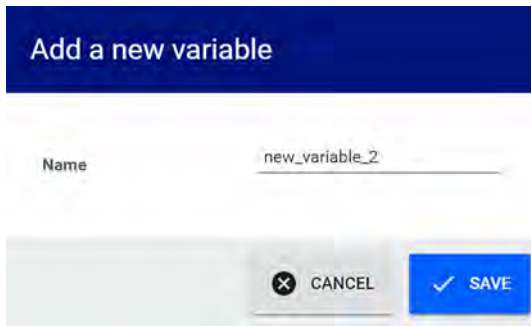
Variables that are added to the program namespace are available as **Program Variables** on the **Select Variable** page.

Procedure

1. Tap **Programming > Programs** and select a program.
The **Program** page launches.
2. Tap (x) beside **Output Results To Variable**.
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 one **Type** for the variable.

Option	Description
String	Enter a string.
Boolean	Select either False or True .
Number	Enter an integer or floating point number.
Object	Select a Schema . • Unknown • Pose • Joint Angles

Option**Description**

- **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 108: 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 109: Editor for object type Pose

JSON Object Editor

new_variable_2

Joint Angles

Angle
0

Angle
0

Angle
0

Angle
0

Angle
0

CANCEL SAVE

Figure 110: Editor for object type Joint Angles

JSON Object Editor

new_variable_2

Matrix output

Generated Pose List

+

CANCEL SAVE

Figure 111: Editor for object type Matrix Output

JSON Object Editor

new_variable_0

Read Input's output

result
1

CANCEL SAVE

Figure 112: Editor for object type Read Input Output

8. Tap **CLOSE**.

The **Select Variable** page closes and the **Program** page is displayed.

Selecting a variable

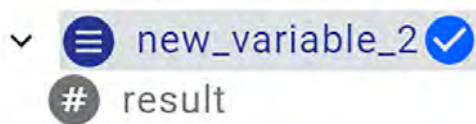
Sometimes you need to select a variable that is already defined and use it in a program.

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 checkmark 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.



Overview of the Program page

The **Program** page is where programs are created and debugged.

Tap **Programming > Program** to access the visual programming interface.

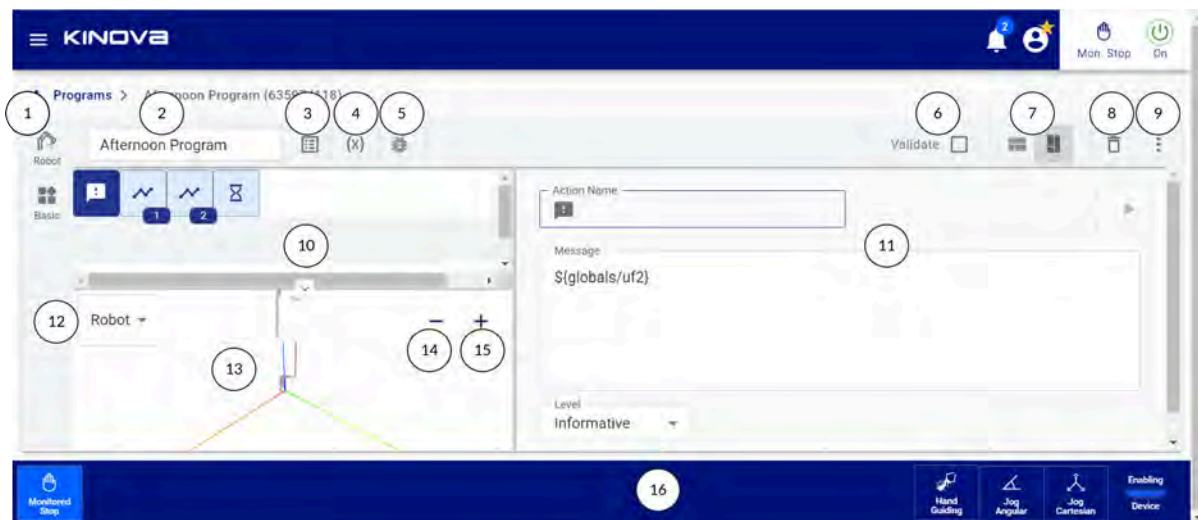
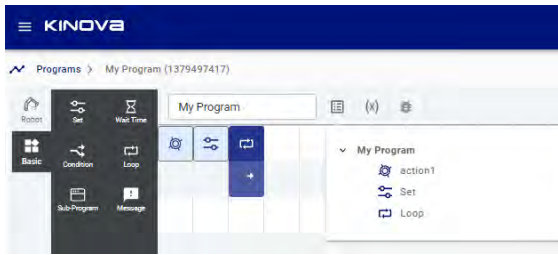


Figure 113: Parts of the Program page

- 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 then 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 Select the visualization object.



Note: Currently, the only visualization object that is available is the robot.

- 12 **Visualization pane** displays the robot in its current position.
- 13 Zoom out in the **Visualization pane**.
- 14 Zoom in the **Visualization pane**.
- 15 Tap on any tile in the program to populate the **Tile configuration pane** with the fields to create the correct parameters for the tile.
- 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 Automatic mode, the Robot control panel displays two more parts.

- Program play area
- Program speed control

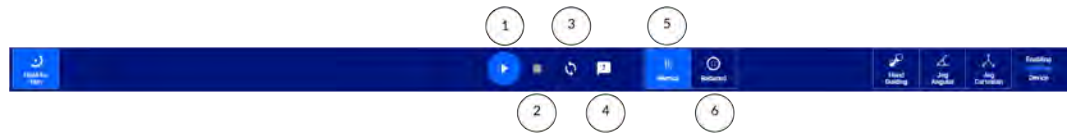


Figure 114: The parts of the Robot control panel

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 the globally.

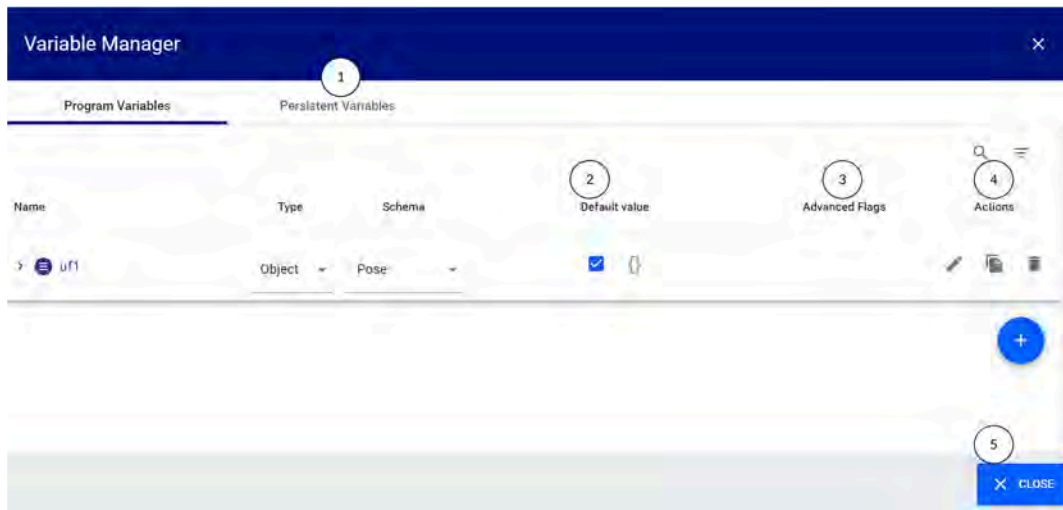


Figure 115: The Variable Manager page

For the most part, the **Variable Manager** is like the **Variables**. 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 ($\equiv$) to filter the list of variables by Type and by Schema on the **Variables** page.

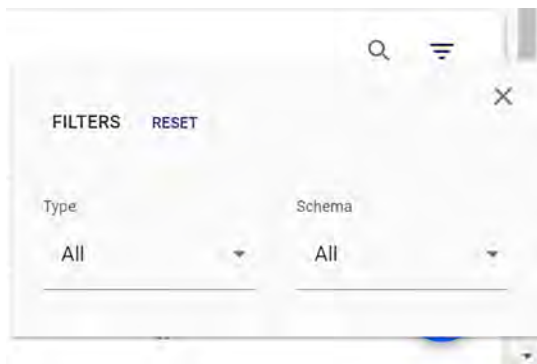


Figure 116: Filter panel

- 5 Tap **CLOSE** to close the **Variable Manager** page and return to the **Programs** page.

Related topics

[Variables](#) on page 124

[Industrial I/O plugin](#) on page 190

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.

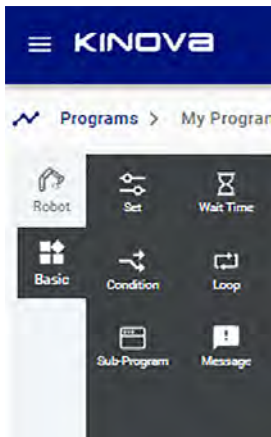
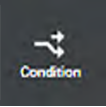
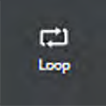
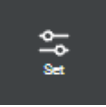
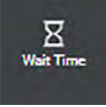


Figure 117: Base tiles

Table 52: Tiles that belong to the Base

Tile	Tile name	Description
	Condition	Create a condition in the program.
	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.

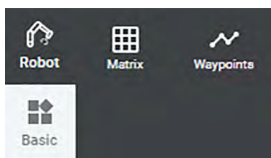


Figure 118: Robot tiles

Table 53: 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 angular or all Cartesian.



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**.

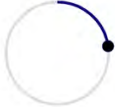
Common core parameters in the Tile Configuration pane

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 119: Common parameters in the Tile Configuration pane****Table 54: 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 .

Item	Description
	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 120: The Tile configuration pane when Set is the current tile

Table 55: 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 121: The Tile configuration pane when Wait Time is the current tile

Table 56: 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.

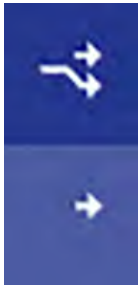


Figure 122: The Condition tile expands in the Sequence editor pane

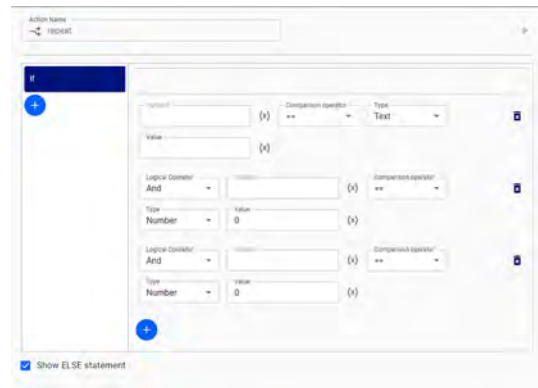


Figure 123: The Tile configuration pane when Condition is the current tile

A condition starts with **If** and requires variables and values to set the condition.

Table 57: 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.
	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. 

Item	Description
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 124: The Loop tile expanded in the Sequence editor pane

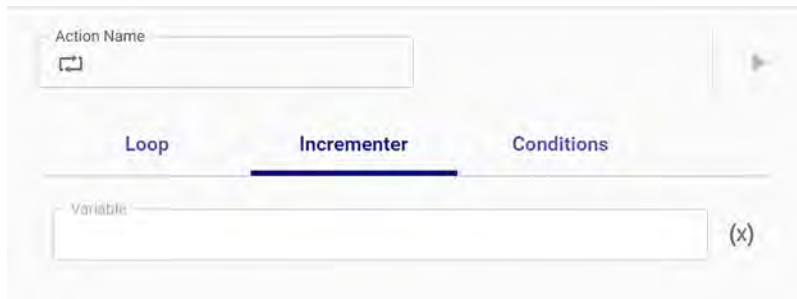
The parameters of the **Loop** tile are grouped into three parts. Each part is a sub-pane in the **Tile configuration pane**. Each sub-pane is accessible by tapping on its name.

- **Loop**
- **Incrementer**
- **Conditions**

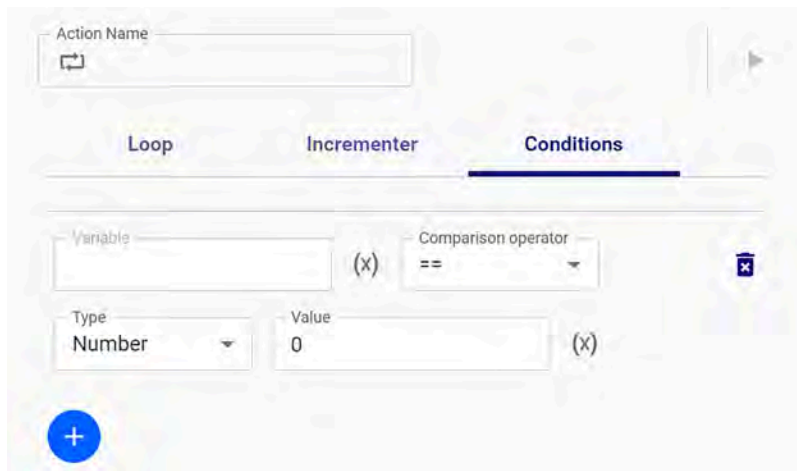
Figure 125: Entities of the Loop tile on the Loop sub-pane in the Tile configuration pane

Table 58: 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.

**Figure 126: Entities of the Loop tile on the Incrementer sub-pane in the Tile configuration pane****Table 59: 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 127: Entities of the Loop tile on the Conditions sub-pane in the Tile configuration pane****Table 60: 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.

Item	Description
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.

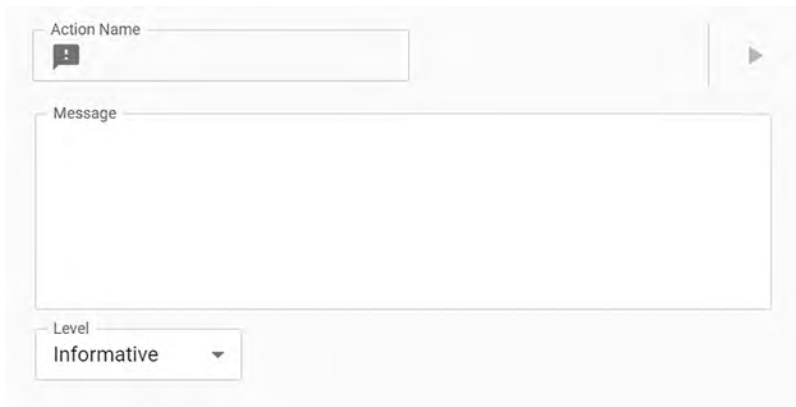


Figure 128: The Tile configuration pane when Message is the current tile

Although messages are primarily string-based, you can print out the values of variables.

Table 61: 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)**



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.



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 in the configuration interface. At the top, there are tabs for 'Waypoints', 'Constraints', and 'Custom Frame (Optional)'. Under 'Waypoints', the 'Waypoints Type' is set to 'Cartesian'. A checkbox 'Use optimal blending' is checked. Below this, a 'Go-To Options' dropdown is set to 'Go-To'. A list of waypoints on the left shows #6 (Waypoint) is selected. The configuration for #6 includes a 'Name' field with '#6 (Waypoint)', a 'Reference Frame' dropdown set to 'Base', and a 'Pose (x)' section with input fields for X (595.32 mm), Y (210.003 mm), Z (96.96 mm), Theta X (-7.848), Theta Y (-178.816), and Theta Z (89.539). There are also 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). 'GOTO' and 'UPDATE' buttons are visible at the top right of the configuration area.

Figure 129: Entities of the Waypoints tile on the Waypoints sub-pane in the Tile configuration pane

Table 62: 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.

Item	Description
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.
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.

Item	Description
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 TCP. 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 TCP. 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 Cartesian.
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.

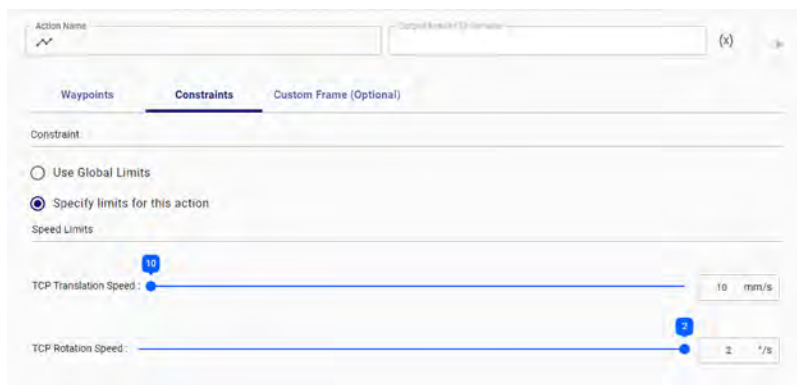
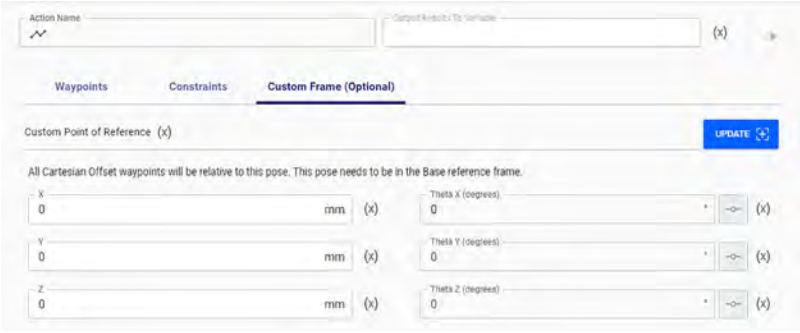


Figure 130: Entities of the Waypoints tile on the Constraints sub-pane in the Tile configuration pane

Table 63: 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. At the top, there are tabs for 'Waypoints', 'Constraints', and 'Custom Frame (Optional)'. Below the tabs, there is a 'Custom Point of Reference (x)' field with an 'UPDATE' button. A note states: 'All Cartesian Offset waypoints will be relative to this pose. This pose needs to be in the Base reference frame.' Below this, there are six input fields arranged in two columns. The left column contains 'X', 'Y', and 'Z' with units 'mm' and a '(x)' icon. The right column contains 'Theta X (degrees)', 'Theta Y (degrees)', and 'Theta Z (degrees)' with units '°' and a '(x)' icon. All input fields are currently set to '0'.

Figure 131: Entities of the Waypoints tile on the Custom Frame sub-pane in the Tile configuration pane

Table 64: 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 the Matrix tile configuration. At the top, there's a 'Grid (X)' section with 'Number of rows' set to 1 and 'Number of columns' set to 1. Below this is the 'Starting point' dropdown set to 'Bottom left' and the 'Order' dropdown set to 'Rows first, zigzag'. The 'Layers (X)' section has 'Number of layers' set to 1 and 'Distance between layers' set to 'new_variable_0'. At the bottom, there's a checkbox labeled 'Bottom to top?' which is currently unchecked.

Figure 132: Entities of the Matrix tile on the Parameter sub-pane in the Tile configuration pane**Table 65: 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.

Item	Description
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.

Figure 133: Entities of the Matrix tile on the Coordinates sub-pane in the Tile configuration pane

Table 66: 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.

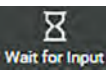
**Figure 134: Entities of the Matrix tile on the Computed Poses sub-pane in the Tile configuration pane****Table 67: Core robot Matrix entities on the Computed Poses (Read Only) sub-pane**

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.

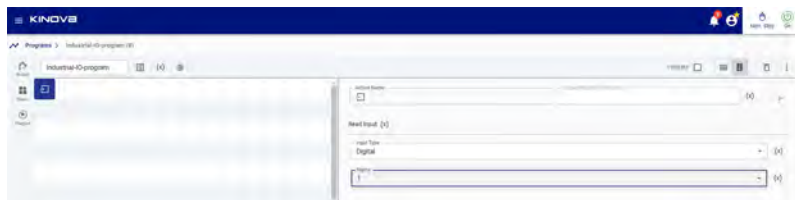
Table 68: Tiles that belong to Industrial I/O

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 135: The Tile configuration pane when Read Input is the current tile****Table 69: 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
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.

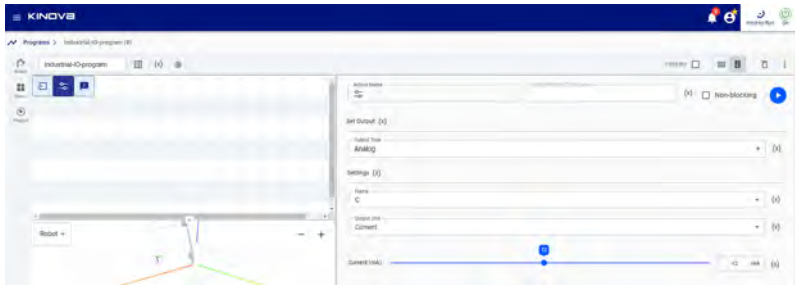


Figure 136: The Tile configuration pane when Set Output is the current tile

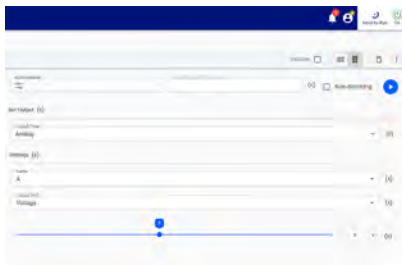


Figure 137: The Tile configuration pane when Set Output is the current tile

Table 70: 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. 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.

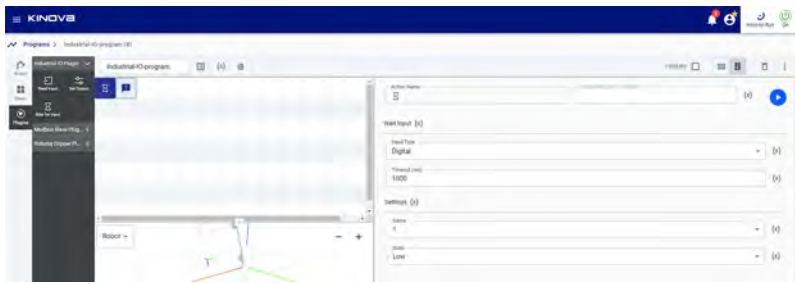


Figure 138: The Tile configuration pane when Wait for Input is the current tile and the Input Type is Digital

Table 71: 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. 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 139: Hand Guiding button in the panel

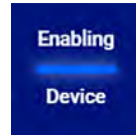


Figure 140: Enabling Device icon

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.

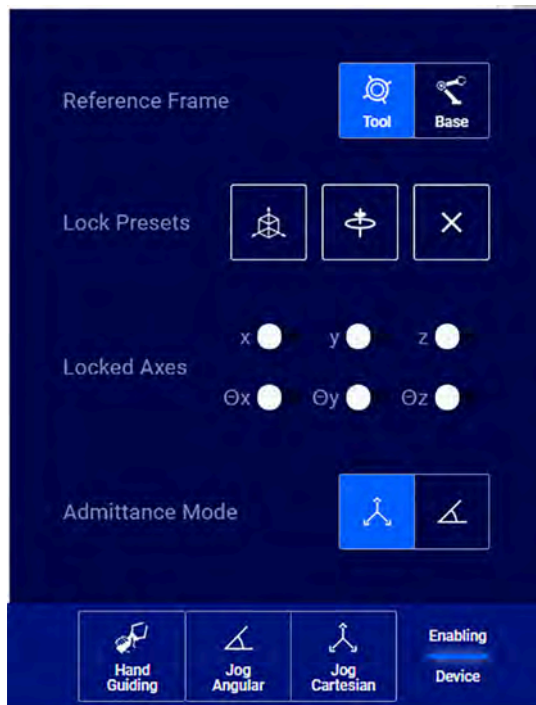


Figure 141: Hand Guiding panel

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 64

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 142: Jog Cartesian button in the panel



Figure 143: Jog Cartesian panel

Related topics

[Mode: Manual jog](#) on page 62

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 Tool Center Point.
- The angular joystick applies a rotational motion to the Tool Center Point with respect to the current position.



Figure 144: 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 145: 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 146: 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.

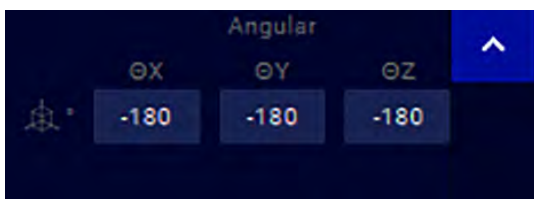


Figure 147: Jog Cartesian panel up arrow

Tapping it unveils additional settings available in Jog Cartesian mode.

- speed control
- reference frame selection

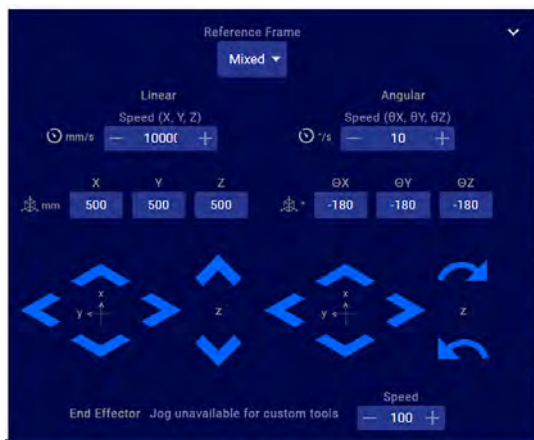


Figure 148: Additional settings in the Jog Cartesian panel

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 149: 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 150: Jog Angular button in the panel



Figure 151: 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 62

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.

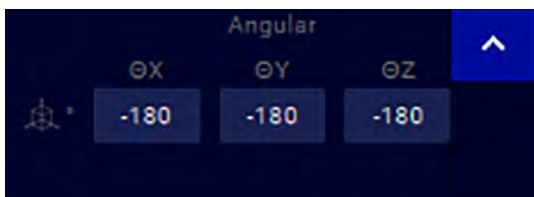


Figure 152: Jog Angular panel up arrow

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 153: 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 104

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**.

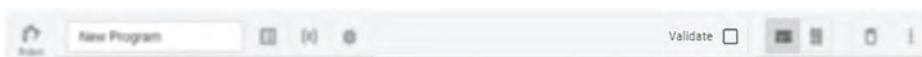


Figure 154: Validate button on the same line as the name of the program on the Program page

Validated programs on the **Programs** page have a green checkmark.

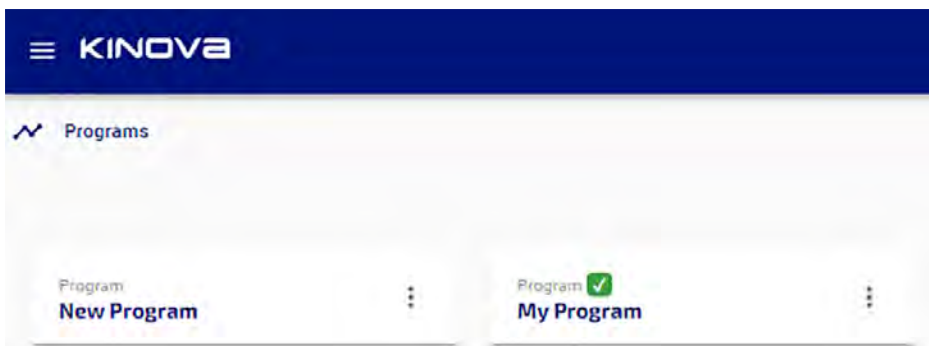


Figure 155: Example of a validated program

Only validated programs are available to operators.

Creating a program

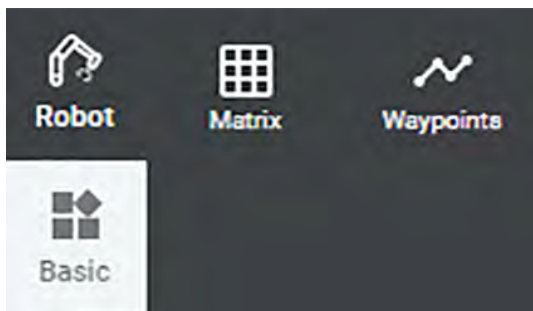
Every program is unique to the work environment of the robot.

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**.

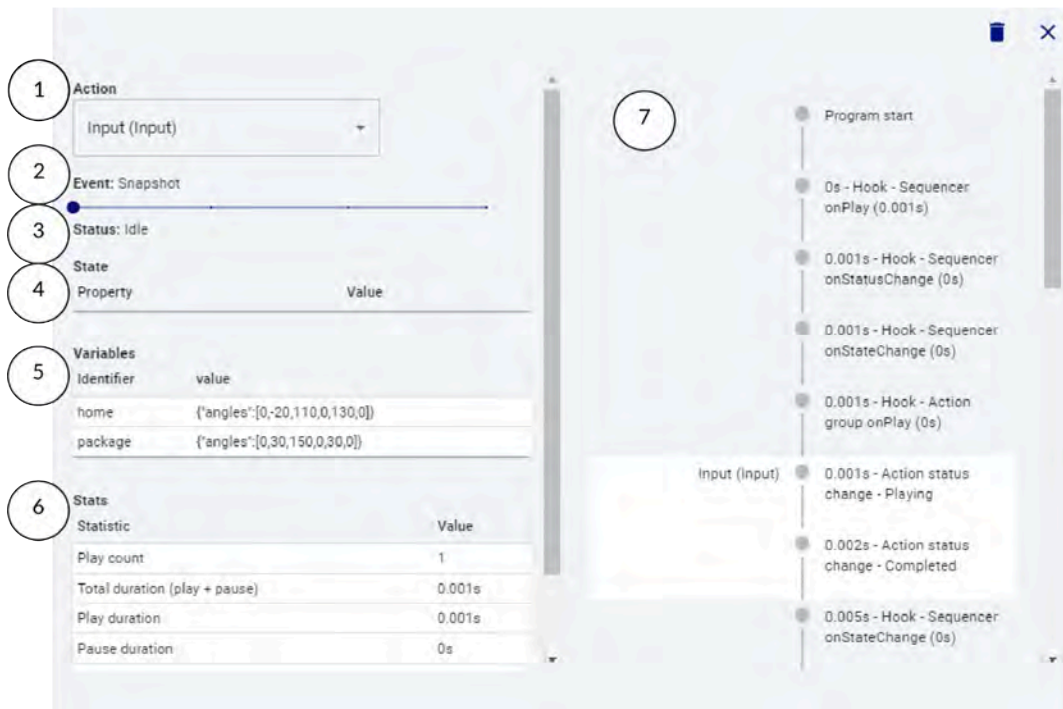
The current position of the robot is recorded in the list of waypoints associated with the currently selected waypoint tile.

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 icon in the Robot control panel.
The **Operating modes panel** launches.



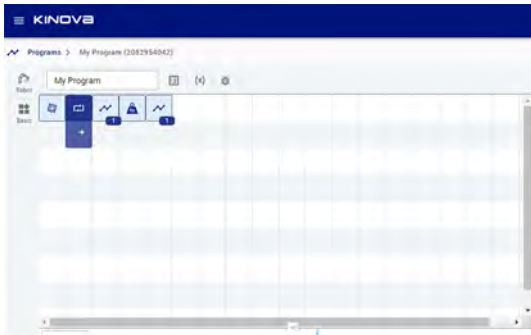
2. Tap Hold-to-Run (🎮).
3. Tap **Debug** (⚙️).



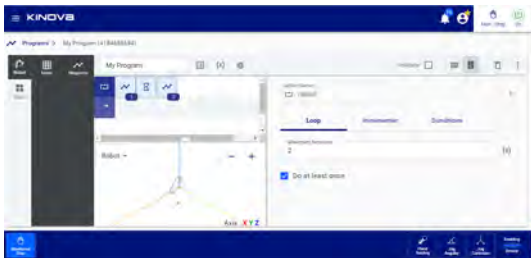
4. Tap a tile in the **Sequence editor pane** from where you want to start debugging.



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 Automatic 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 Automatic 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 program.

Procedure

1. Tap **Programming > Programs**.
2. Tap the program to select a program to run.

3. Tap Automatic (.
4. Tap  in the Robot control panel



The program runs at the programmed speed.



Note: At any time in Automatic 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 67

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 users run a program in Hold-to-Run mode, they may want to determine whether it needs further debugging or they may want to see how it works either at reduced or normal speeds.

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 65

Diagnostics

There are three diagnostic pages where you can view potential issues in any part of the robot. The pages are found under the **Diagnostic 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**.

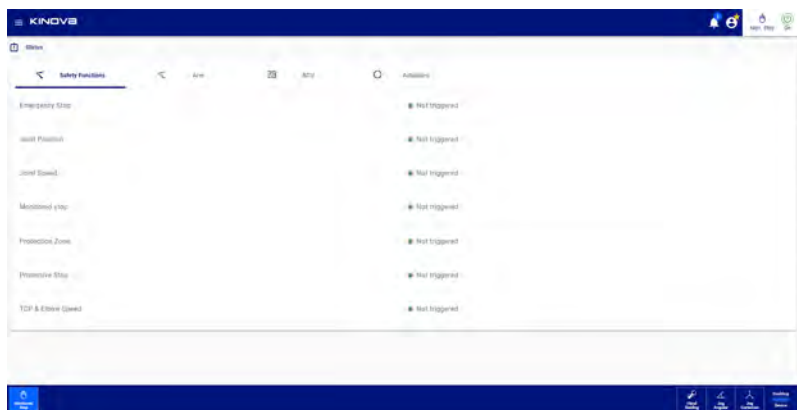
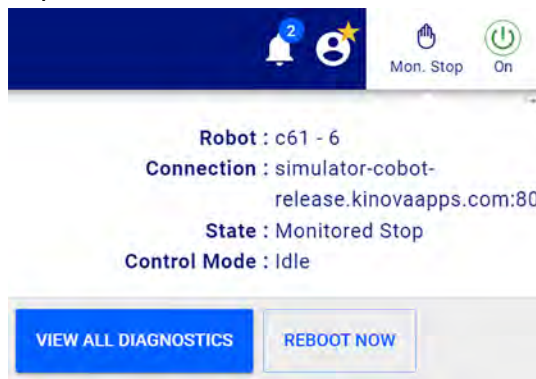


Figure 156: Status page

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 *Safety Control Unit* (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 35

[SF01 Emergency stop](#) on page 36

[SF02 Protective stop](#) on page 37

[SF03 Joint position monitoring](#) on page 37

[SF04 Joint speed monitoring](#) on page 38

[SF05 Monitored stop](#) on page 38

[SF06 Protection zone monitoring](#) on page 39

[SF07 TCP and elbow speed monitoring](#) on page 39

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 157: Filter for specific errors

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.

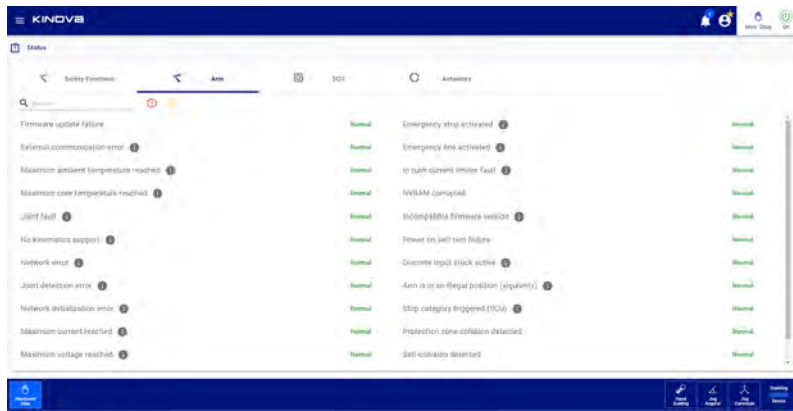


Figure 158: Status page of the arm

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 72: Listing of arm status

Status	Addressable by users	Not 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	Addressable by users	Not 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 SWU if the error persists.
4. If the problem persists, contact support at support@kinova.ca.

Related topics

[Protection zones](#) on page 43

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 177

[Status of the safety actuators](#) on page 179

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 75

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 75

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 43

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 *Safety Control Unit* (SCU) status rarely enter warning or error states because there are watchers in the *Main Control Unit* (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 159: Filter for specific status

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.

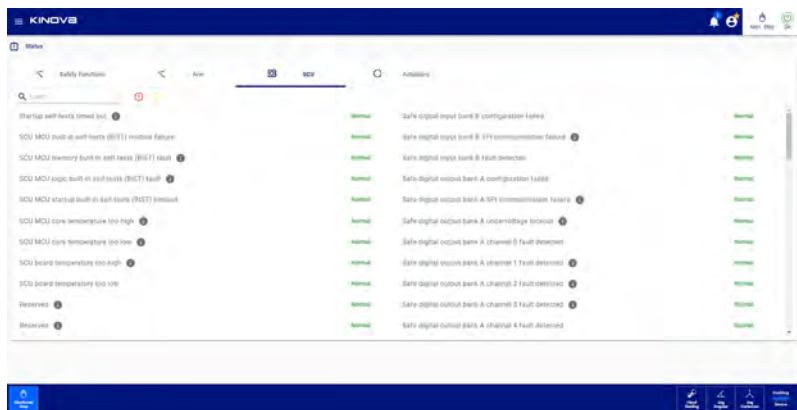


Figure 160: Status page of the SCU

Each status has text that indicates its overall state: Normal, Warning, or Error.

Table 73: 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

Status	Status
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 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 161: Filter for specific status

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.

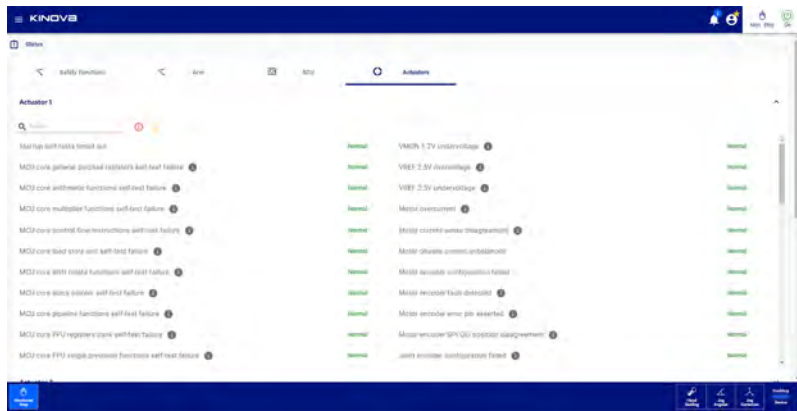


Figure 162: Status page of the actuators with an actuator pane expanded

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
MCU core FPU registers bank self-test failure	Motor encoder SPI QEI position disagreement

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

Status	Status
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 172

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 actuators

The status of each safety actuator is displayed on the **Actuators pane** of the **Status** page.

The status of the 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 163: Filter for specific status

Some status have an information icon beside them. Tap them to view the thresholds associated with the status.



Figure 164: 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 76: 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 77: 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 172

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**.

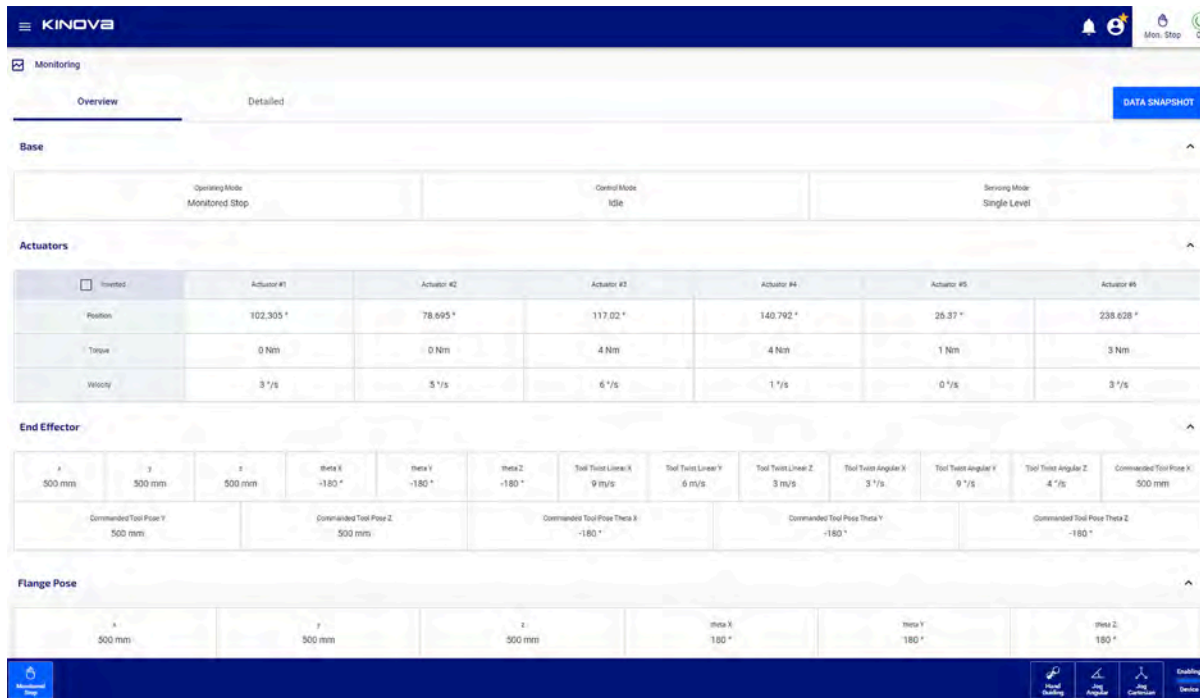


Figure 165: Overview pane of the Monitoring page

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 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 78: Content of the Overview pane

Part	Information displayed
Base	Operating mode
	Control mode

Part	Information displayed
	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.

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Figure 166: Detailed pane of the Monitoring page

Table 79: 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
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.

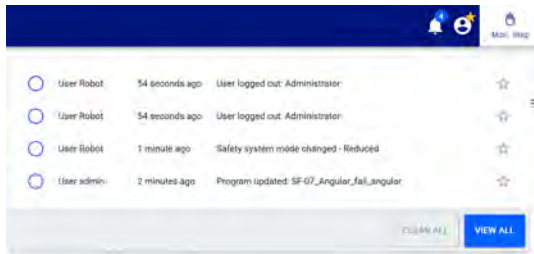


Figure 167: Quick access to the notifications

- Tap **VIEW ALL** to view all notifications on the **Notifications** page from the quick access to notifications.
- Tap **Notifications** from the Quick Menu.



Figure 168: Access to Notifications from the Quick Menu

- Tap  > **Diagnostics** > **Notifications**.



Figure 169: Access to Notifications from the Diagnostics menu

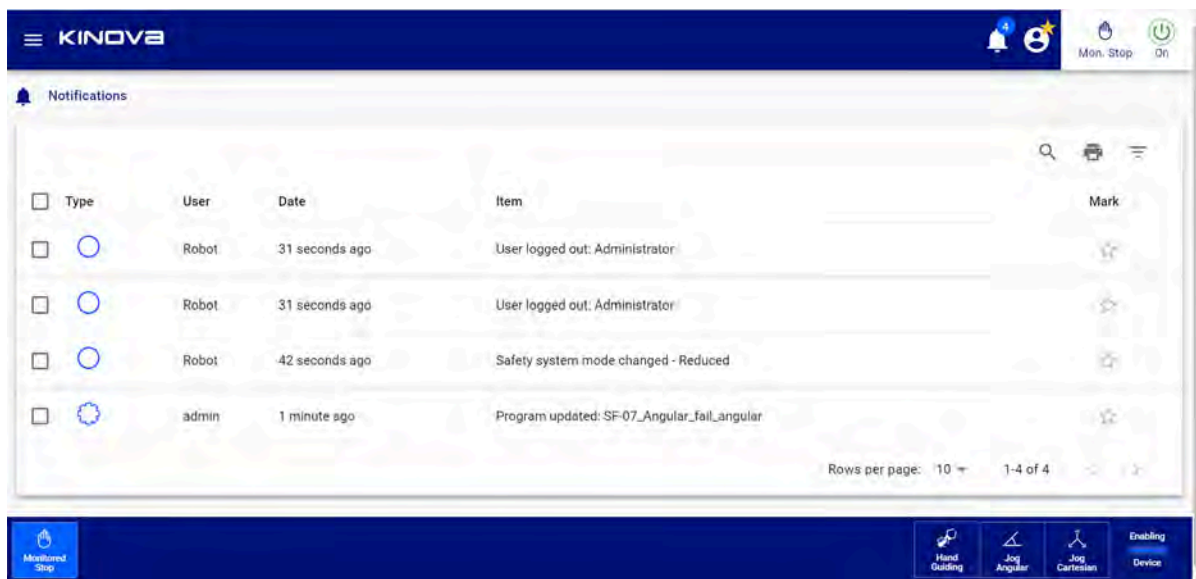
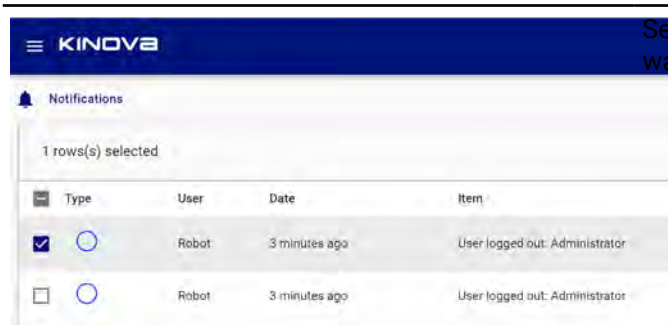


Figure 170: Notifications page

Table 80: 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 through 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.



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 124

[Installing plugins](#) on page 115

[Overview of working with plugins](#)

[OnRobot plugin](#) on page 206

[Robotiq plugin](#) on page 202

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.

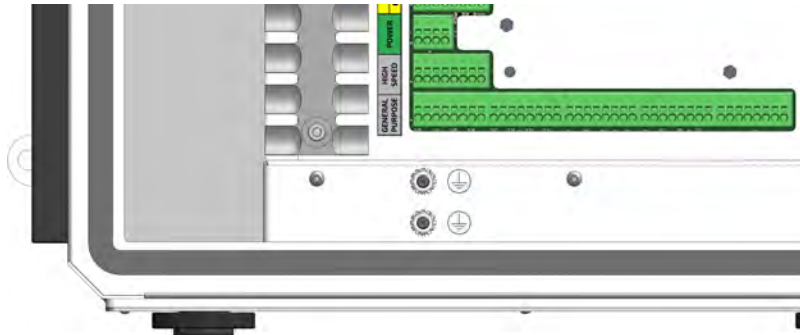


Figure 171: Industrial equipment connection on the controller

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**

Related topics

[Variables](#) on page 124

[Variable management](#) on page 136

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.

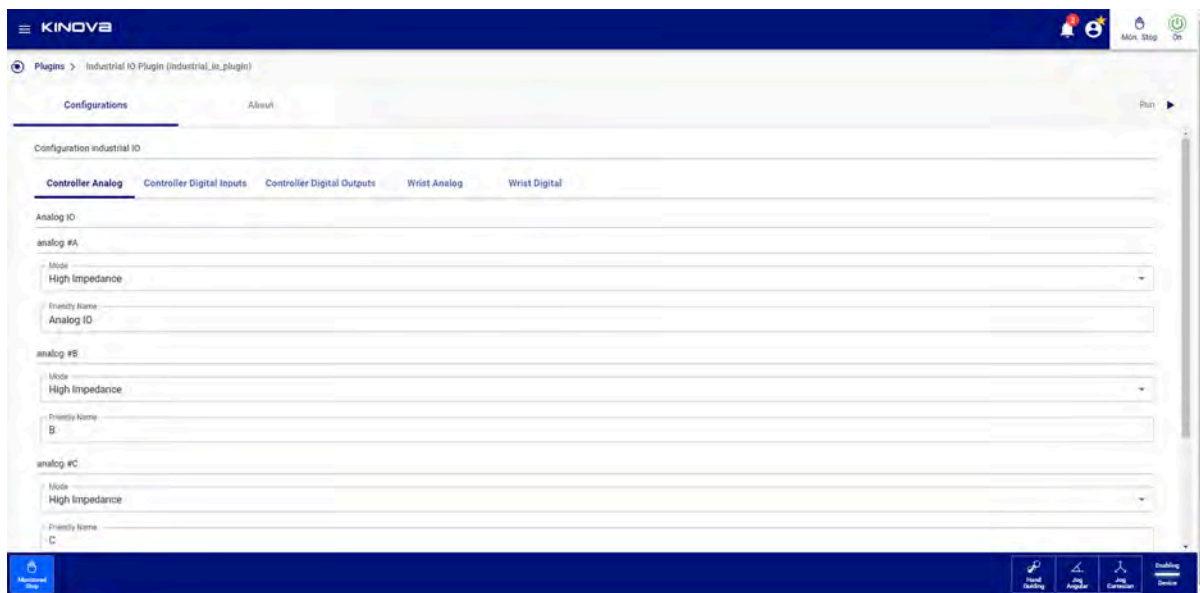


Figure 172: Controller Analog pane

Table 81: 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.

Figure 173: Controller Analog pane

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**.

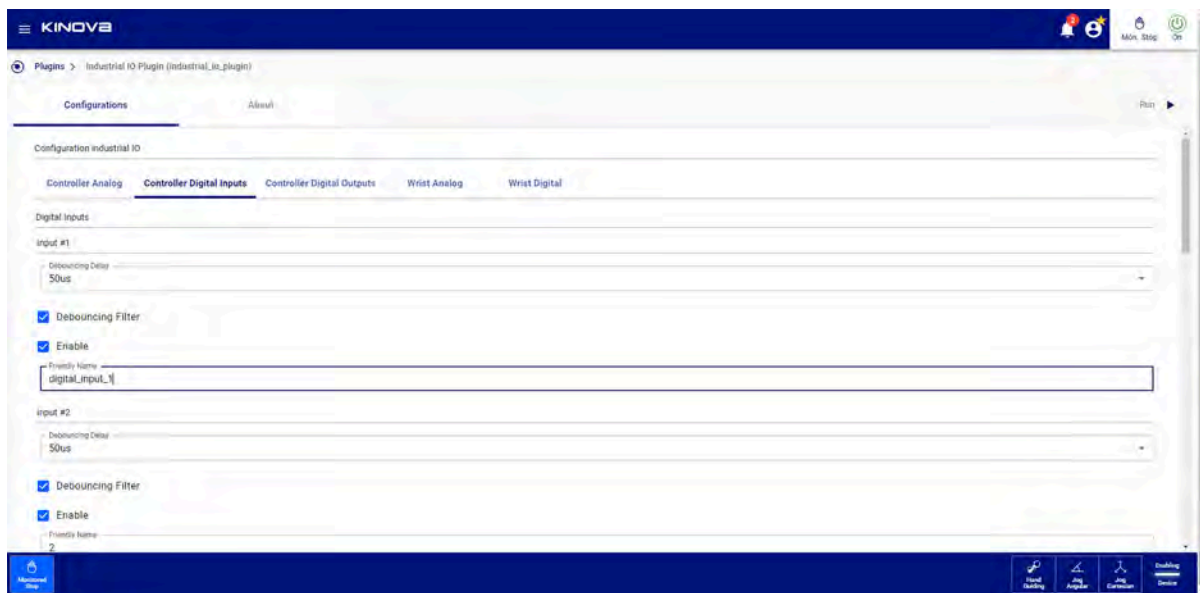


Figure 174: Controller Digital Inputs pane

Parameter	Description
Debouncing Delay	The debouncing 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**.

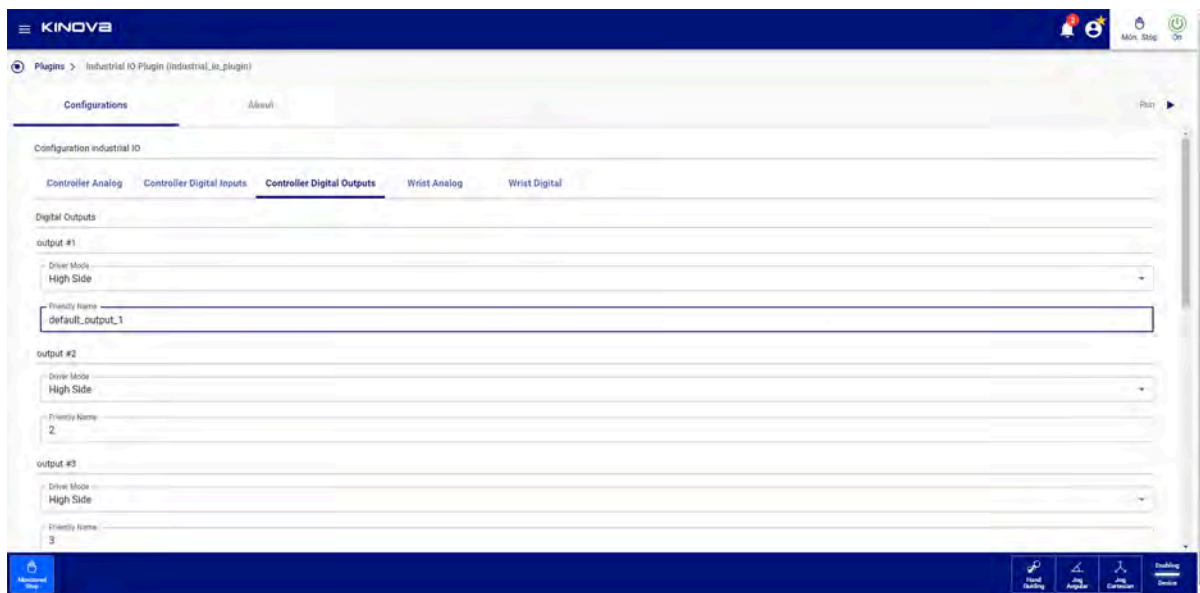


Figure 175: Controller Digital Outputs pane

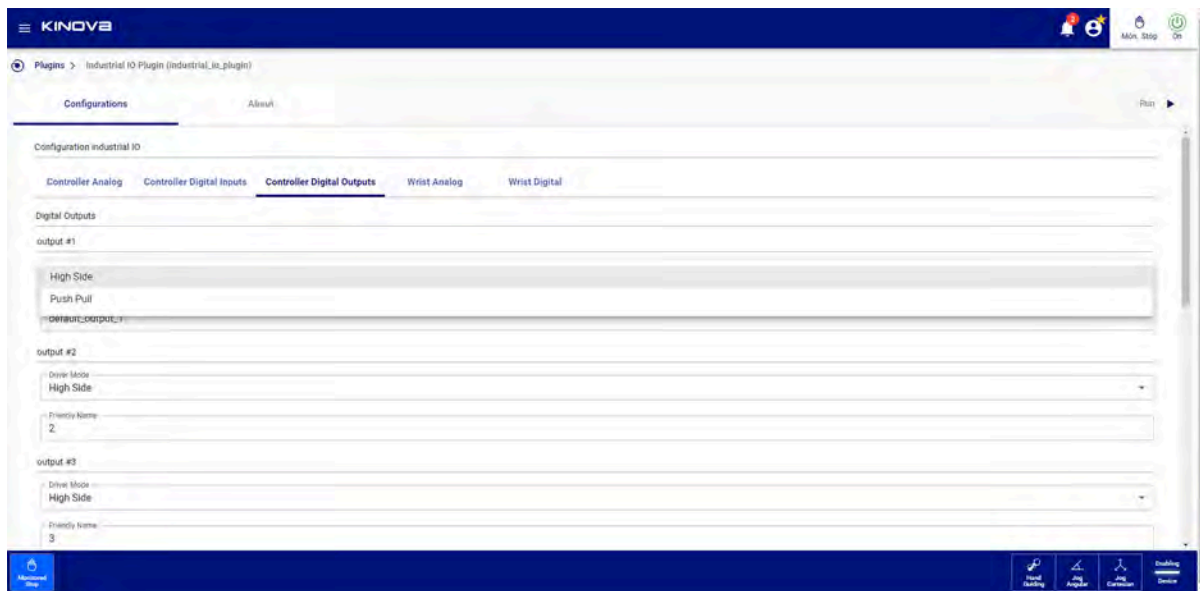


Figure 176: Controller Digital Outputs pane with driver drop-down

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

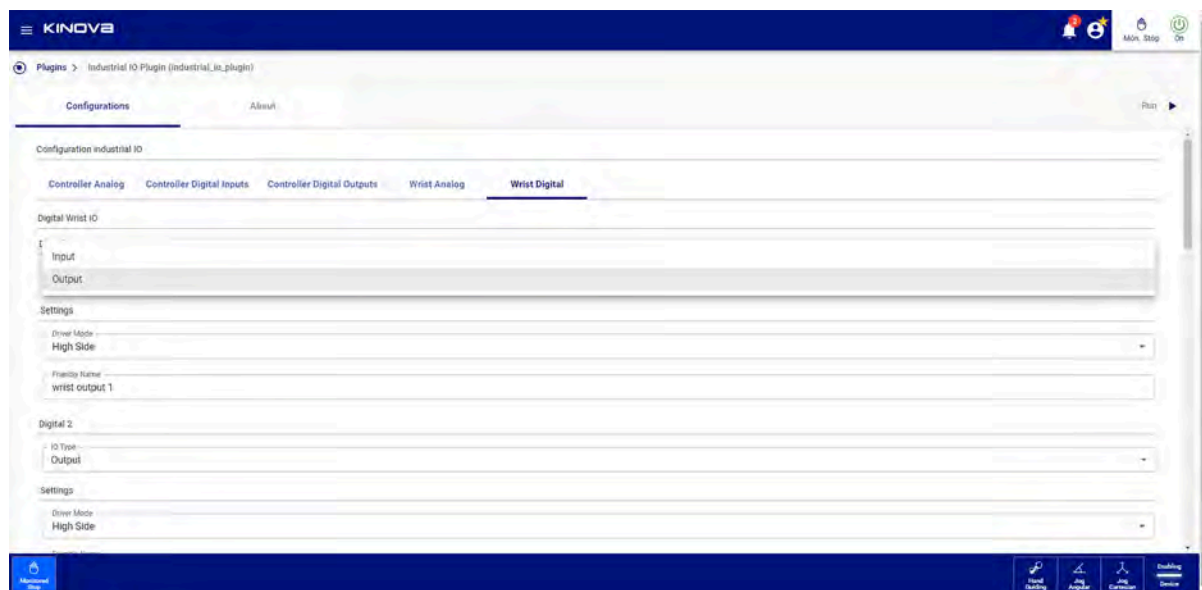
Table 82: Wrist analog configurations

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 83: 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 3

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.

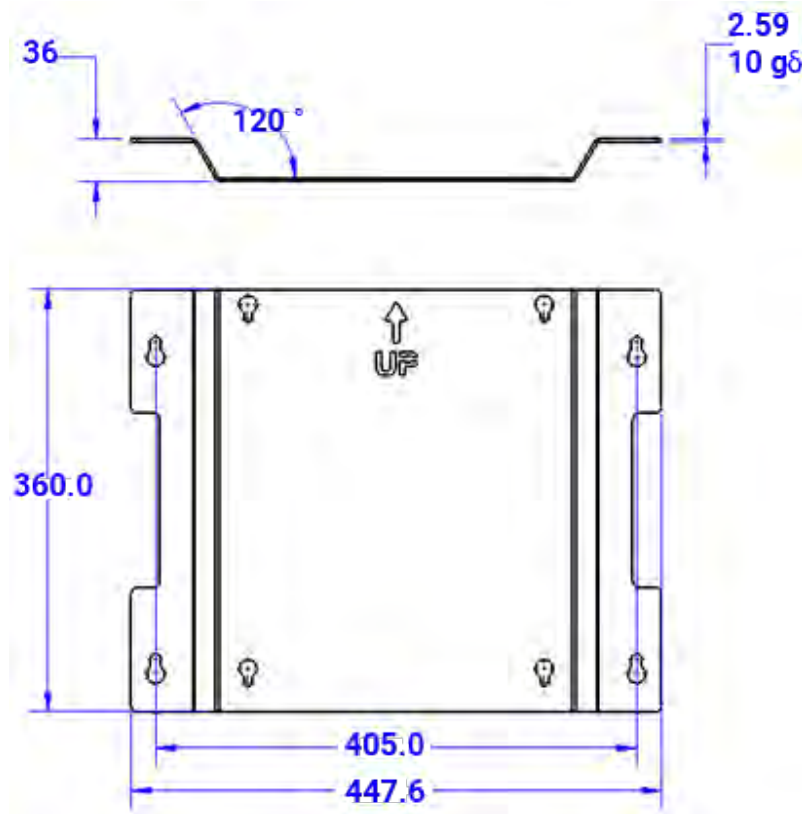


Figure 180: Dimensions of the Kinova wall mount measured in millimeters



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

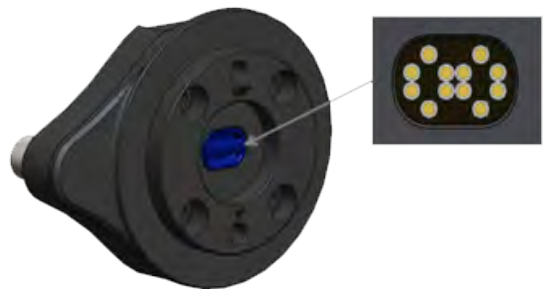


Figure 183: Output side of the Gigabit Ethernet adapter with close-up view of the printed circuit board pad

Related topics

[Wrist interface overview](#) on page 14

[Mechanical interface](#) on page 17

[Electrical interface](#) on page 17

[Gigabit Ethernet on the wrist](#) on page 94

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.

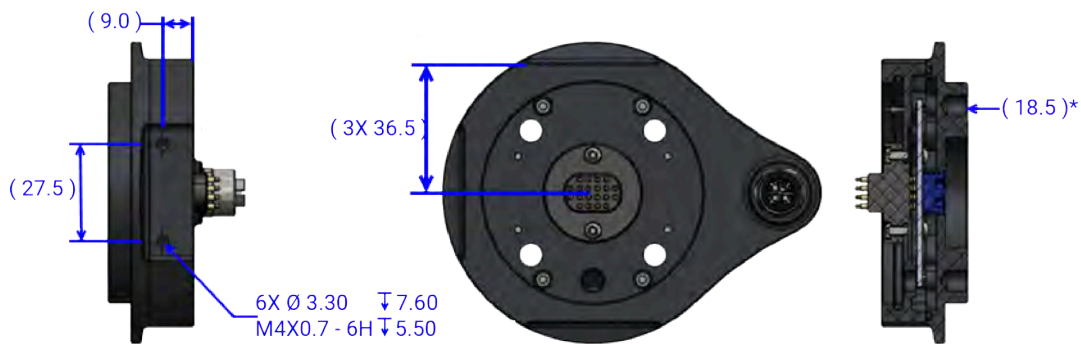


Figure 184: Dimensions of the Kinova Gigabit Ethernet adapter measured in millimeters

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 189

[Wrist interface overview](#) on page 14

[Mechanical interface](#) on page 17

[Electrical interface](#) on page 17

[Robotiq plugin](#) on page 202

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 holes on the adapter with the holes in the wrist.
3. Secure the adapter with the screws.

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 116

[Installing plugins](#) on page 115

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 201

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**.

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*.

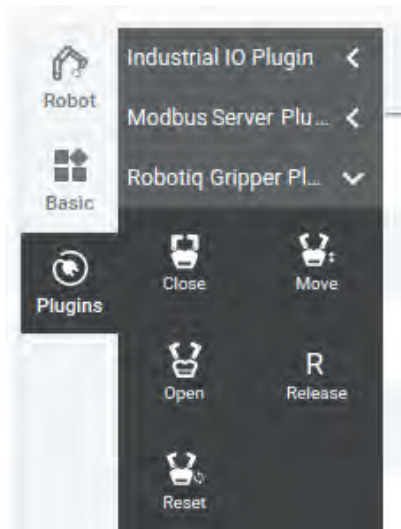


Figure 189: Actions available from the Robotiq plugin

Table 84: 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 is powered. 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 14

[Mechanical interface](#) on page 17

[Electrical interface](#) on page 17

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 s 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 A 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**.

The screenshot shows the 'On Robot Gripper Plugin (on_robot_gripper_plugin)' configuration page. It has two tabs: 'Configurations' (selected) and 'About'. Under 'Configurations', there is a 'Configuration schema' section with five parameters:

- Period of the plugin's main thread.** It is a value in ms. Ex: If this value is 10 then the plugin will send a command to the gripper every 10 ms (100 Hz). The input field contains '100'.
- IP address of the gripper.** If the gripper is mounted on the a wrist, you must enter the wrist's IP address. The input field contains '10.10.0.16'.
- Port the modbus socket will try to connect.** The input field contains '502'.
- Gripper's modbus device ID.** The input field contains '65'.
- The fingertip offset is used to specify the distance from the inside of the gripper aluminum fingertip to the reference point on the attached fingertip.** The input field contains '4'.

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*.

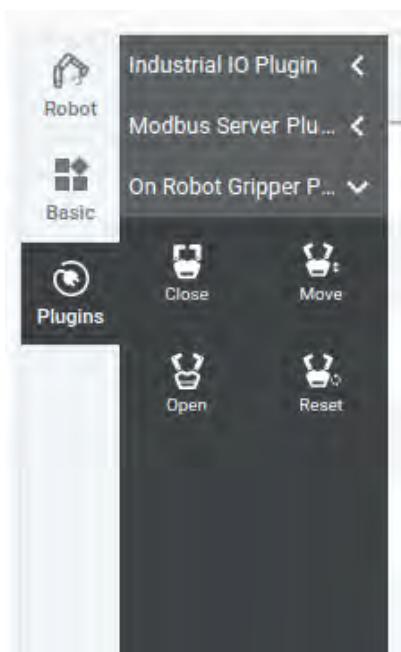


Figure 193: Actions available from the OnRobot plugin

Table 85: 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.
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 **emergency stop** station is an optional component that provides **estop** functions in case the teach pendant is not used or additional estop 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 51

Installing an external emergency stop station

Whenever you need to install an external [emergency 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 (https://literature.rockwellautomation.com/idc/groups/literature/documents/td/800-td008_-en-p.pdf)

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 51

External 3-position enabling device

The external 3-position [enabling device](#) is an optional component that provides enabling device functions in case the teach pendant is not used. It is connected directly to the terminals in the controller.

It is connected directly to the terminals in the controller.

Photo: IDEC



Figure 195: IDEC HE1G-21SM

Related topics

[Safety I/O](#) on page 51

Installing the external 3-position enabling device

Whenever you need to install an external 3-position [enabling device](#), be sure to read and follow all mounting instructions from the manufacturer.

Before you begin**Personnel:**

- **Number of Workers:** 1

Supplies

- 1 x 3-position enabling device
- 1 x Cable

Tools

- Ferrule (optional)

About this task

View or download publications at https://ca.idec.com/idec-ca/en/CAD/resources_and_documents (<https://ca.idec.com/idec-ca/en/USD/Safety-Components/Grip-Switches/HE1G-Grip-Switch/p/HE1G-21SM>)

Procedure

1. Make sure the controller is switched off.
2. Follow the wiring instructions in Industrial I/O Safety I/O inputs.
Wiring for use of Channel 0

Terminal (Controller side)	Wire color	Pin (Device side)
AI_0	Black	2
24_o (Bank A)	Red	1
BI_0	White	4
24_o (Bank B)	Yellow	3

3. Set the Safety I/O to **Enabling Device**.

Related topics

[Safety I/O](#) on page 51

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 86: 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 87: 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 88: 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 89: 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 90: 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 91: 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 92: 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 passthrough 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 is there no power in the controller?

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 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 115

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 category 0, 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 43

[Recovery mode](#) on page 68

[State: Fault](#) on page 60

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 powered before they can be configured.

Remedy

Make sure the Industrial I/Os are powered.

Related topics

[Industrial I/O plugin](#) on page 190

[Industrial I/O panel overview](#) on page 81

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.

Cause

The plugin associated with the missing tiles is not installed or is not activated.

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 and The plugin is displayed on the page with all its available actions.

Related topics

[Installing plugins](#) on page 115

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 118

[Configuring tools](#) on page 116

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.

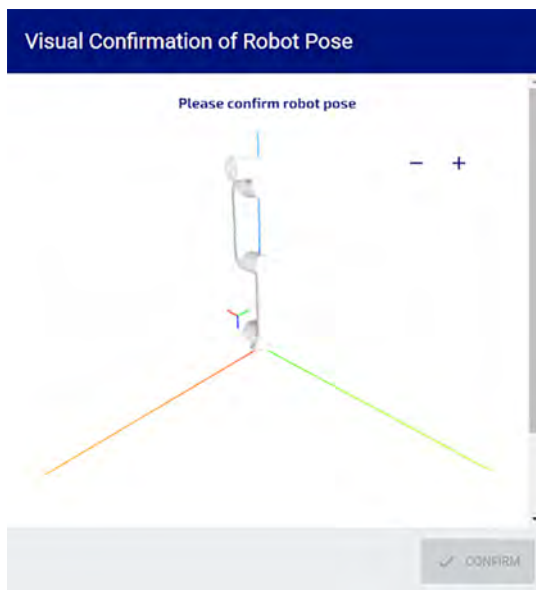
Remedy

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 powered 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

actuator	a device that makes the robot operate
administrator	a person who uses and sets up the robot
<i>synonym</i> , admin user, admin	
Alternating Current (AC)	type of electrical current
joint agular	the angle of rotation of a joint
arm	the part of the robot that is connected to the base and that moves
American Wire Gauge (AWG)	a standardized wire gauge system; unit of measurement
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
Binary Coded Decimal (BCD)	a way to represent each decimal digit in its binary equivalent using no more than 4 binary digits
boot	to switch on or restart the computer
<i>synonym</i> , restart	
camlock	a type of fastener
Cartesian	linear movement along the x, y, and z coordinate lines
collaborative	the ability for the robot to work in a shared space, or in close proximity of people and other equipment
Controller	the part of the robot where all parts of the robot are attached and where the software operates
Direct Current (DC)	type of electrical current
German Institute for Standardization (DIN)	a German standardization organization that is part of the ISO standards body
Electrical Fast Transient (DIN) and (EFT/B)	a series of quick, high frequency pulses often caused by a lack of electricity flowing through the circuitry
<i>synonym</i> , fast transient, burst	
Electrostatic discharge (ESD)	the sudden flow of electricity between two objects that have different charges
emergency stop (E-stop)	a sudden removal of all electrical power to the entire robot
<i>synonym</i> , e-stop	

enabling device synonym , pendant enabling device, wrist 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.
end effector	a tool connected to the end of the arm of the robot
Graphical User Interface (GUI)	a way of interacting with a program of a computer that involves windows, dialogs, icons, and menus
hazard identification	the act of identifying all hazards that may cause harm
integrator	a person who incorporates the robot in a larger system or environment
joint position	the rotational position of a joint, measured in °
joint speed	the velocity at which the joint rotates, measured in °/s
Least Significant Bit (LSB)	the right-most bit in a binary number
Lockout Tagout (LOTO)	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
Main Control Unit (MCU)	a device used in the actuators to read sensors and report sensor information
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
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
Main Processing Unit (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
namespace	a way in computer science of grouping together all objects that work together such that each object has a unique name
non-blocking	the ability to follow the programmed trajectory using the most optimal path to the final destination, without actually reaching each point in the path
non-collaborative	the inability for the robot to work in a shared space, or in close proximity of people and other

Normally Closed (NC)	equipment; the need for the robot to be in an enclosed, self-contained area to operate safely
operator	electricity flows through a contact in its normal state
Output Signal Switching Device (OSSD)	a person who uses, but who does not set up, the robot
payload	a device that outputs a signal to shut down the machine; used as part of a safety system of a machine
pinch point	the load the robot carries
program sequence	an area in which a body part can get in between a stationary part and a moving part of the machinery
protection zone	the sequence of actions that a program must use to complete its task
protective stop (SF02)	an area where the robot cannot enter
risk analysis	a stop in which the robot stops, but there still is power in the robot
risk control	a study of the potential dangers in using something, often equipment
robot cell	the plan to avoid or lessen the risk involved
robot system	a set of one or more machines that work in conjunction with one or more programmable robots
role	an entire automated system consisting entirely of robots or automated equipment
RS-485	the position held that is capable of performing a specific set of tasks
synonym , TIA-485(-A), EIA-485, RJ-485	a standard that defines electrical traits that are used in serial communication systems
scope	in computer science, the area of code that is valid within the confines of another area of code
Safety Control Unit (SCU)	a processor in the controller that processes all safety functions
Six Degrees of Freedom (6 DOF)	the number of possible linear and angular directions an object can take; 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)
stop category (SC)	a type of safety control function

Tool Center Point (TCP)	the position and orientation of the tool with respect to the robot flange
teach pendant <i>synonym</i> , pendant	a device used to control the movements of a robot
teach pendant enabling device <i>synonym</i> , enabling device	enabling device located on a teach pendant, usually as a button
Universal Serial Bus	industry computer bus standard that makes it easier to transfer data between computers
wrist	the part found at the end of the robot arm to which end effectors may be attached
Wrist enabling device <i>synonym</i> , enabling device	enabling device located on the wrist of the robot, usually as a button
Wrist ring	the LED ring found around the wrist

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