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HOW TO GUIDE

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# Universal Robots Safety Configuration with MachineMotion (V1E0+)

Version  
3.xMM1

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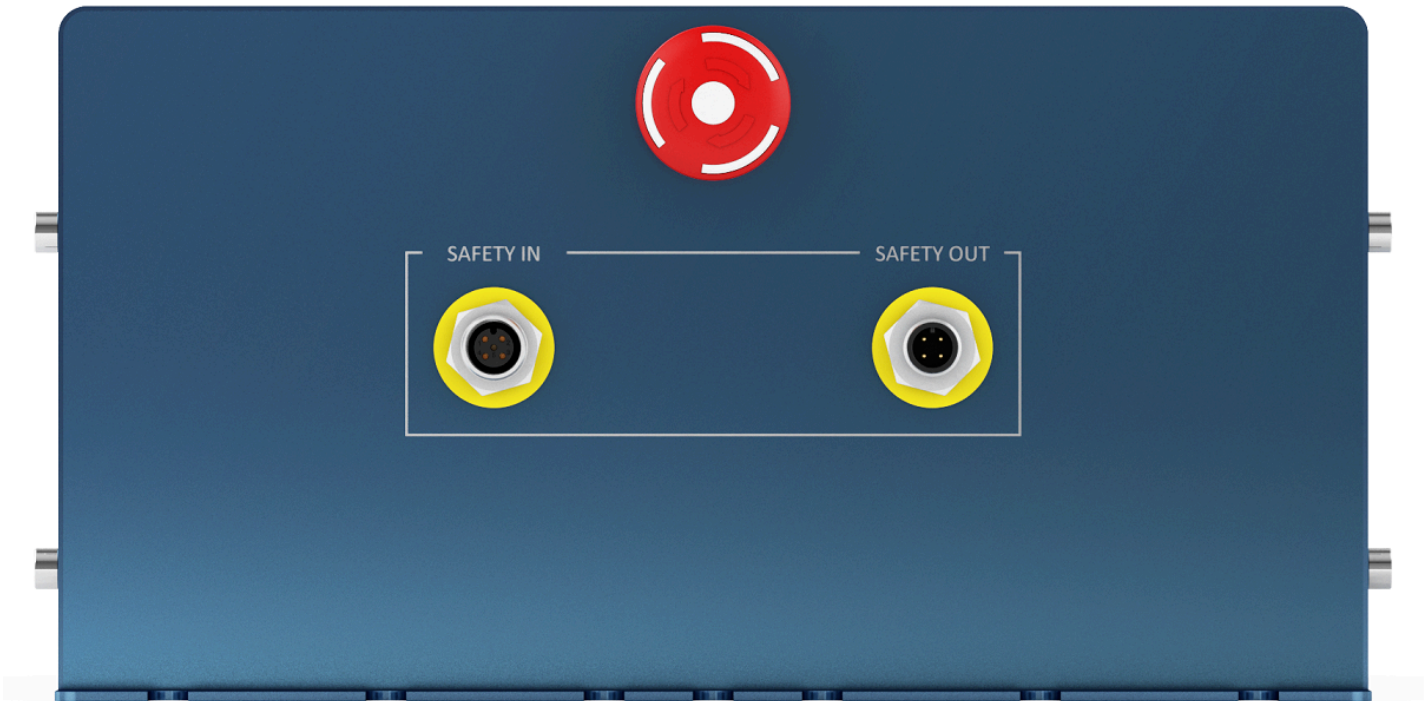
## Overview

This guide describes the safety configurations of Universal Robots with MachineMotion V1E0 and later V1 versions.

The goal of the safety system is to power off all actuators upon an E-stop event.

## MachineMotion Safety IO

Three main components dictate the safety configuration of the MachineMotion: The E-stop button, the SAFETY IN and the SAFETY OUT ports. These components are illustrated in the figure below.



*MachineMotion controller back panel*

The following table describes the functionality of each component

| MachineMotion connector | Description                                                                                                                                        |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| SAFETY IN               | Used to connect other safety devices that can place MachineMotion in an emergency stop mode (This input should be fed by a redundant dry contacts) |
| SAFETY OUT              | Used to trigger and place other devices in an emergency stop mode (redundant dry contacts, normally closed)                                        |

## E-stop button

When pressed, the E-stop button places the system in emergency stop mode.

Needs to be released to disengage the emergency stop mode.

## Status LED Indications

To understand the status LED, please refer to the table below:

MachineMotion controller is booting up

MachineMotion controller is ready to run

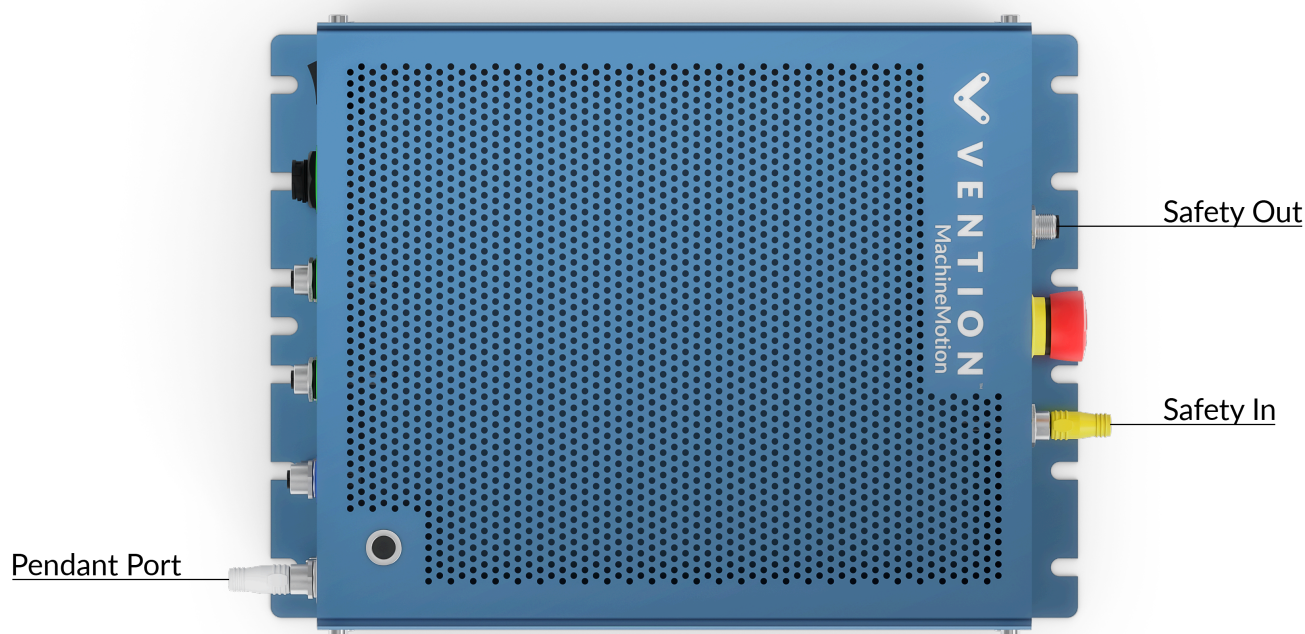
MachineMotion controller is not ready to run.

This means that the physical e-stop on the MachineMotion controller is triggered, or the software e-stop is on.

## Safety Setup Jumpers

The safety setup of the MachineMotion requires you to connect a device to the SAFETY IN and to the PENDANT port. These ports cannot be left unconnected; otherwise, they will trigger an emergency stop mode in the MachineMotion. Follow the instruction below to setup your MachineMotion

- If you do not have any system to connect to the SAFETY IN, you need to insert the appropriate yellow jumper in the SAFETY IN plug.
- If you are not using a pendant, insert the white jumper in the pendant plug on the front panel of the MachineMotion



*MachineMotion with safety jumpers*

## Universal Robots and MachineMotion Safety Configuration

### Universal Robots Safety Interfacing

This section will cover the two options for wiring the safety systems of Universal Robots and Vention MachineMotion.

#### Option 1: UR Controller as a Safety Parent Controller

In this configuration, pressing the UR E-stop button will trigger the MachineMotion E-stop, however pressing the E-stop on the MachineMotion will **not** trigger the E-stop in the UR controller. Another way to think of this configuration is that E-stop events will propagate from the UR controller to MachineMotion, but not vice versa.

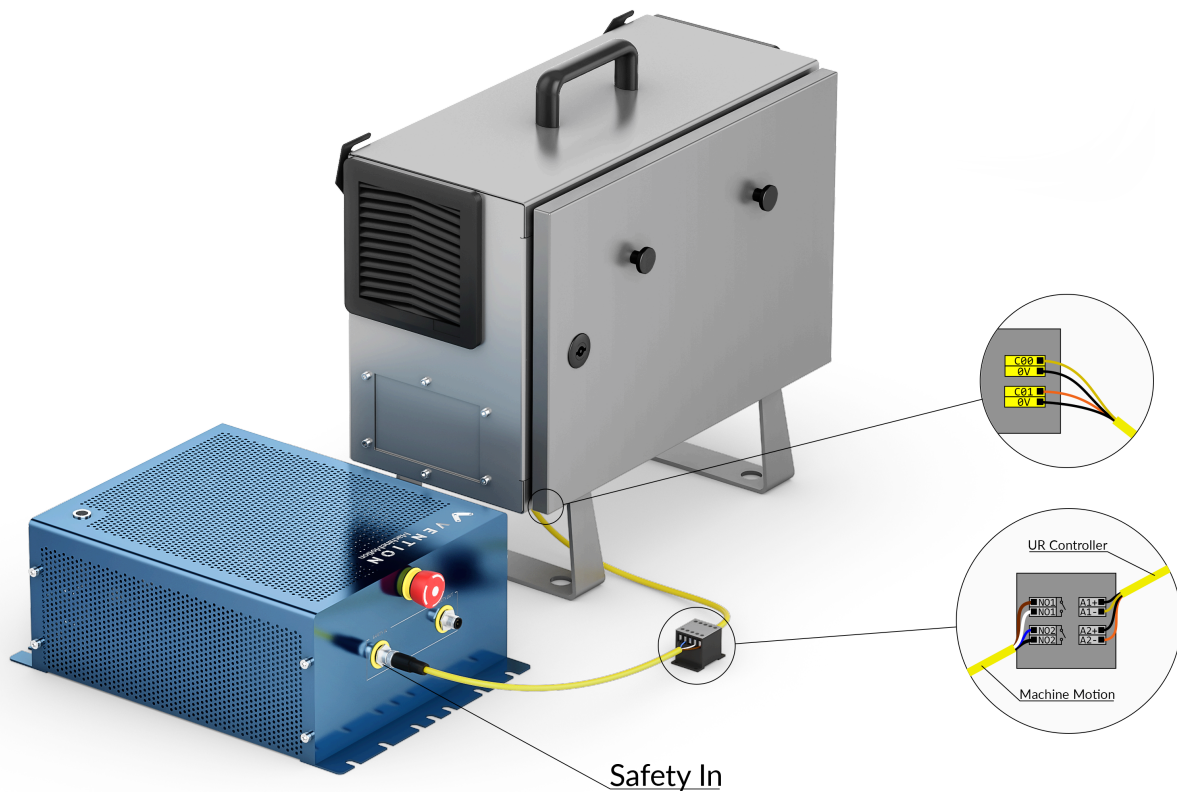
When using this configuration, all safety devices (such as light curtains) must be wired into the UR controller to ensure all movement is stopped.

Below are the steps to wire the UR controller as a safety parent controller:

##### 1. Wire the MachineMotion to UR

Follow the diagram below to wire MachineMotion to the Universal Robots controller. A **Safety Rated, normally open (NO) dual-channel dry contact 24 VDC relay** is necessary to interface UR's digital safety output pins with MachineMotion dual dry contact input.





### Option 1: Safety configuration

The relay is necessary since the Safety In port of the MachineMotion requires continuity between certain pins to allow the system to leave E-stop state.

When not in E-stop, the UR controller safety circuit is a closed electric circuit that supplies voltage to the C00 and C01 terminals. This closes the relay and allows for continuity on the Safety In pins.

When the emergency stop mode is engaged on the UR controller, the safety circuit becomes an open electrical circuit, no longer supplying voltage to the C00 and C01 terminals. This opens the relay and prevents continuity on the Safety In pins, triggering an E-stop state on the MachineMotion.

Therefore, this configuration requires a **Safety Rated, normally open (NO) dual-channel dry contact 24 VDC relay**.

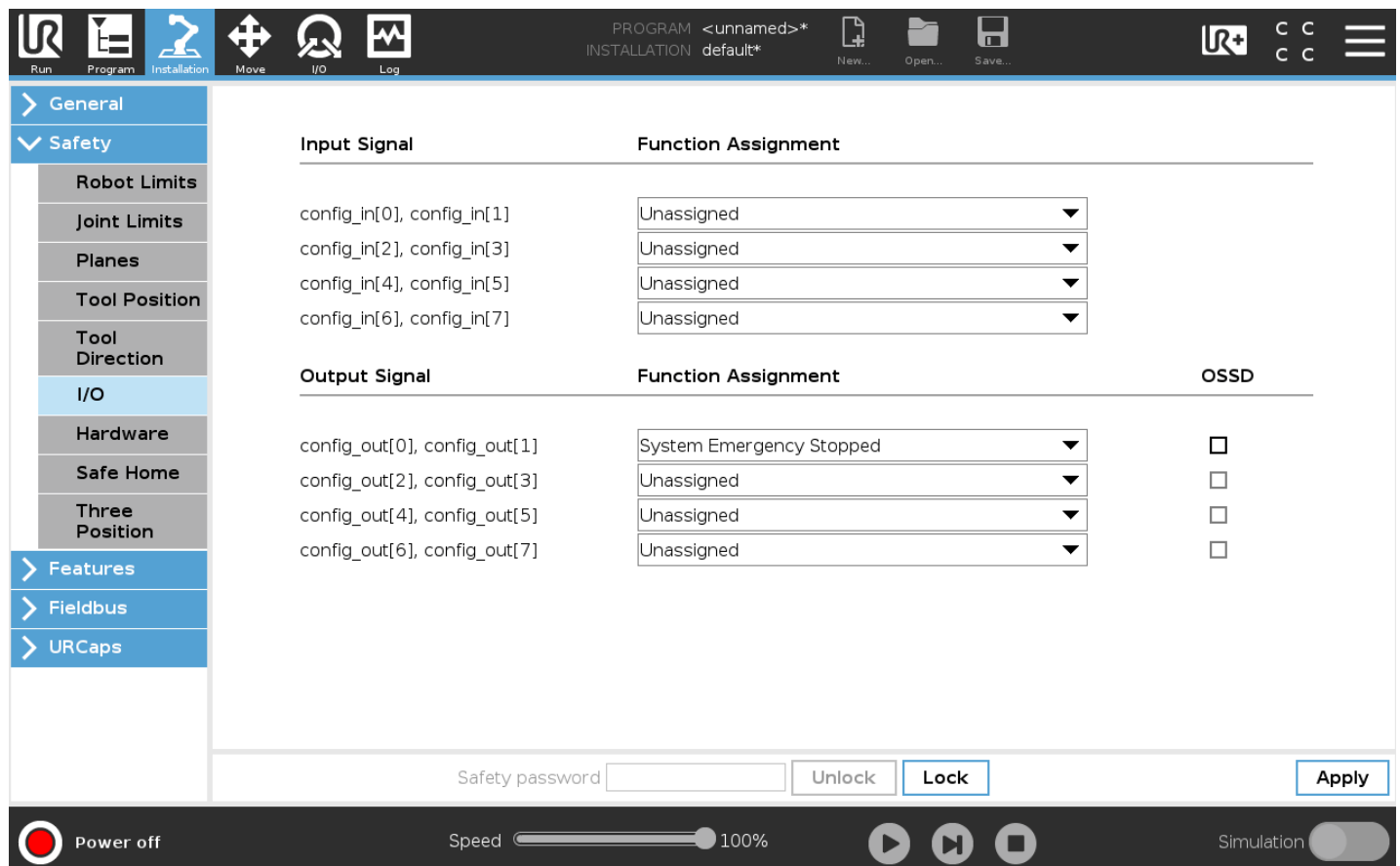


**Important note:** do NOT connect the Safety In of the MachineMotion to any external power source, and do NOT connect it to the ground of another source. In other words, the Safety In pins can only be connected to each other via a dry contact relay.

## 2. Configure UR's Safety Output Pins

The output pins on the Universal Robots controller can be configured as safety pins using the UR Teach Pendant.

1. Navigate to *Installation* > *Safety* > *I/O* to configure the safety pins
2. Set *config\_out[0]*, *config\_out[1]* to “System Emergency Stop”, as seen in the figure below

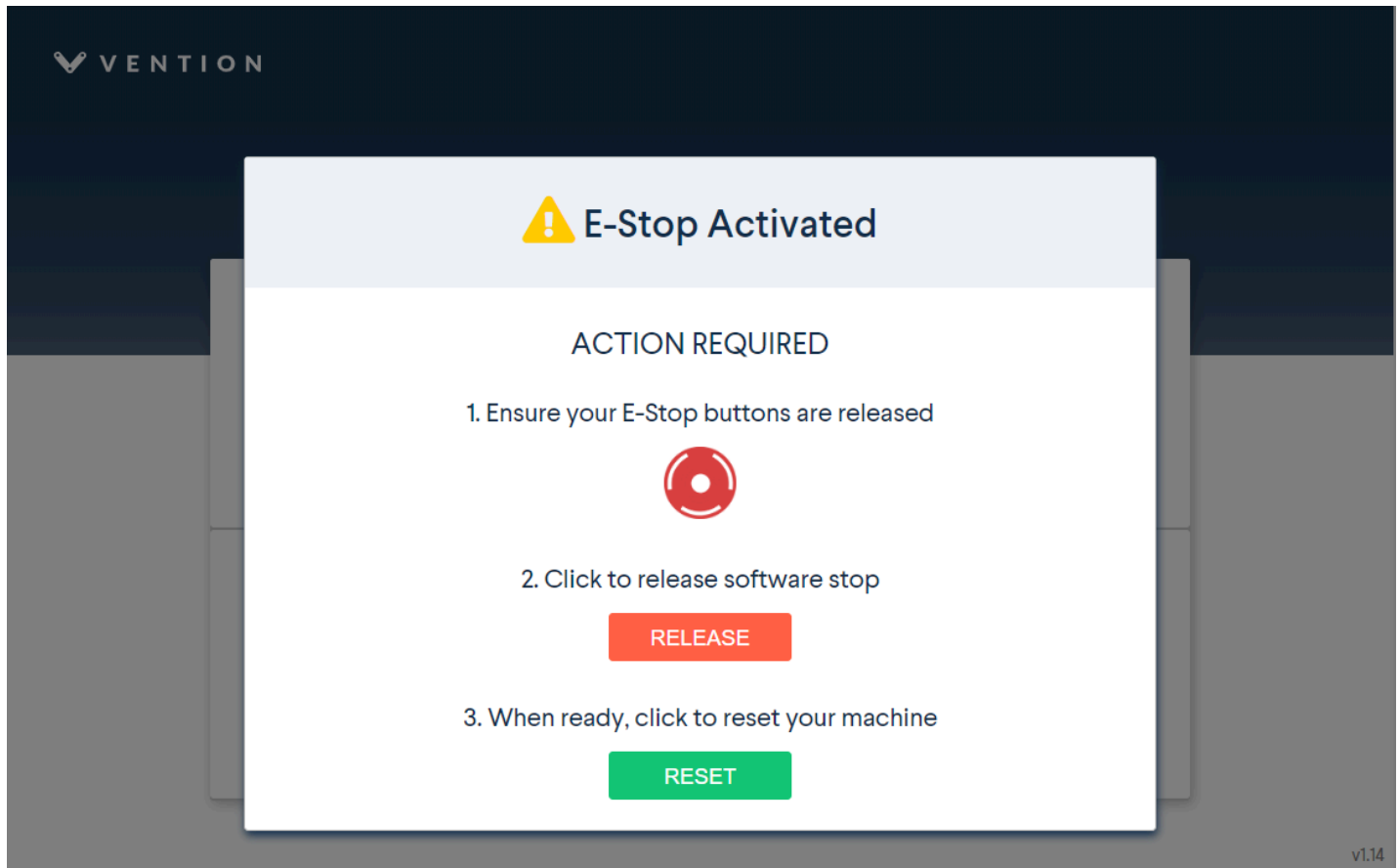


**UR Teach Pendant configuration**

## 3. Resetting MachineMotion after an Emergency Stop

After an emergency stop, you need to release the software E-stop on the MachineMotion. This requires you to interact with E-stop pop-up on the MachineMotion Control Center, as seen in the figure below.

It is a 2-step process, involving releasing all the safety inputs, as well as a user confirmation to restart the system.

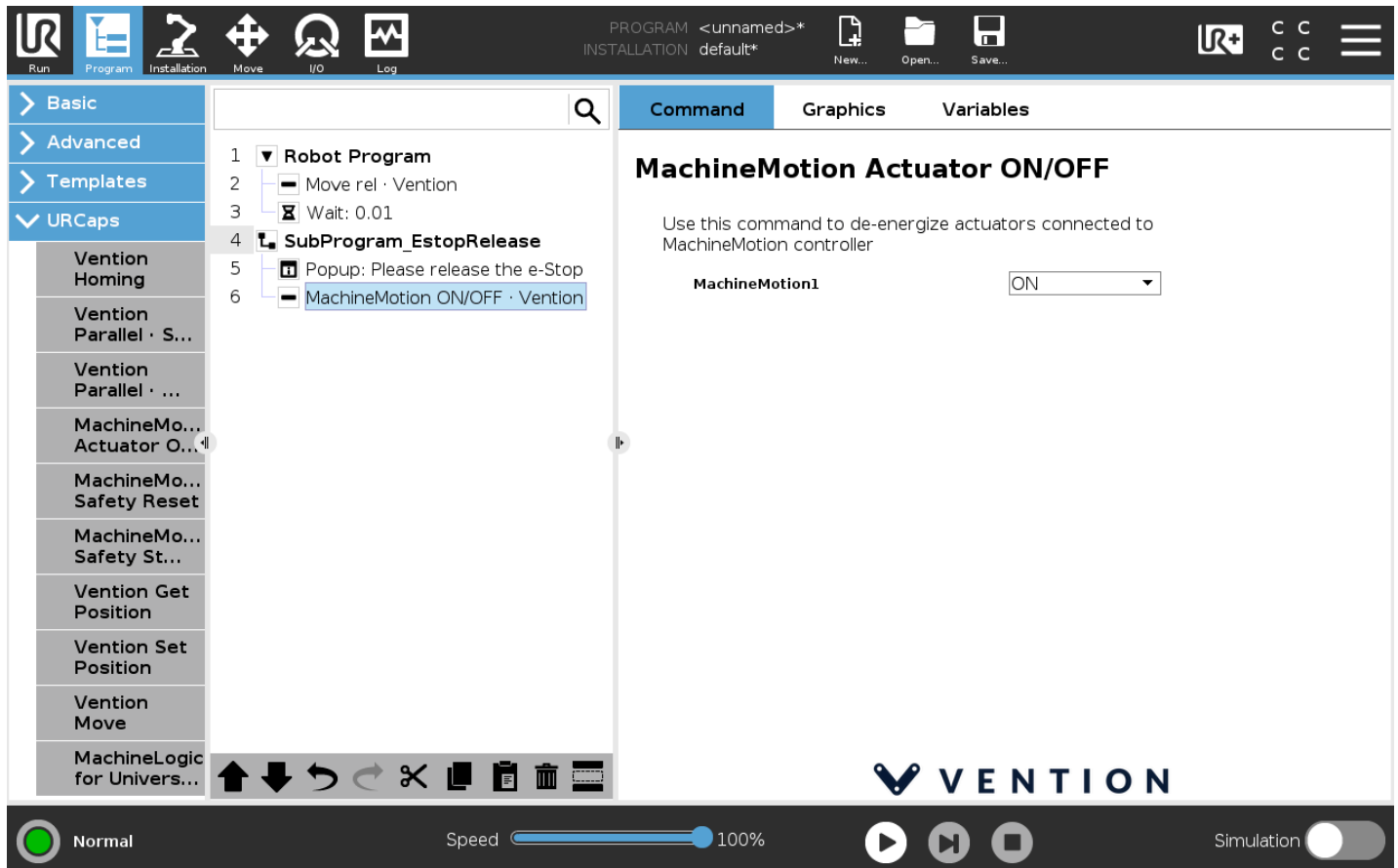


### ***E-stop pop-up***

When using a Universal Robots, you have the option reset the MachineMotion using the UR Teach Pendant, without accessing the MachineMotion.

To do so, the *MachineMotion ON/OFF* instruction must be used. This can be done at the beginning of the program or can be placed in a sub-program that will allow you to release the software E-stop and reset the MachineMotion. You can add this sub-program to your existing program and use it after an emergency stop. Refer to the figures below.

1. Create a sub-program in your UR program. You can call it "SubProgram\_EstopRelease"
2. Add a popup to notify the user to release the E-stop manually first
3. Add the *MachineMotion ON/OFF* instruction from the Vention URCap
4. Set the *MachineMotion1* to ON as seen in the figure below on the right



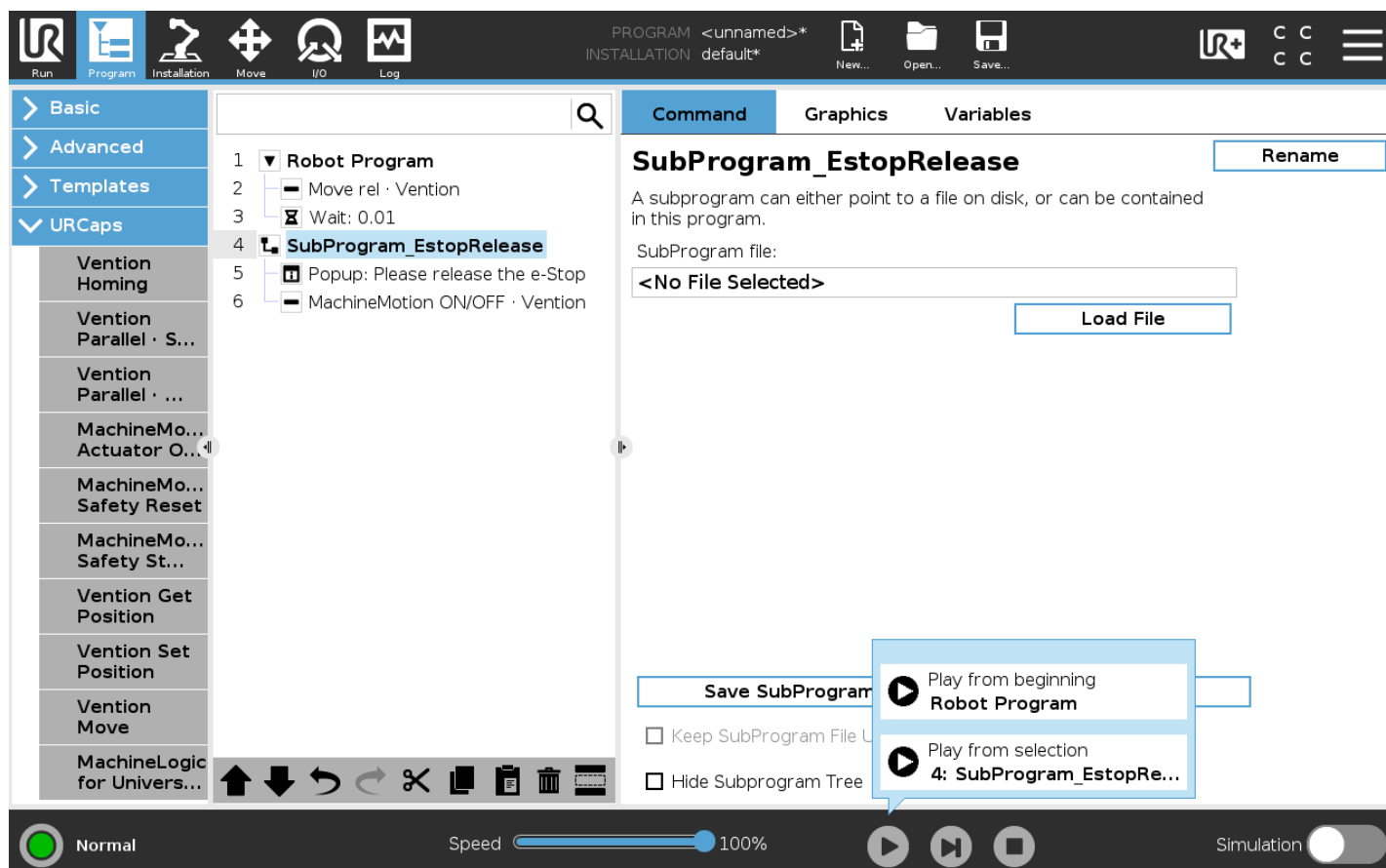
### UR Teach Pendant - Sub-program configuration

After an emergency stop has been engaged, make sure to release all E-stop buttons manually. Afterwards, do the following instructions to reset the MachineMotion (refer to the figure below):

1. Select the sub-program “SubProgram\_EstopRelease”
2. Press the play button on the bottom
3. Select the “SubProgram\_EstopRelease”

Doing so, will send the command to release and reset the MachineMotion on the software level.

Once the system is reset, you can run your main program again by selecting it and pressing the play button.



**UR Teach Pendant - Sub-program execution**

## Option 2: UR Controller and MachineMotion in a Safety Loop

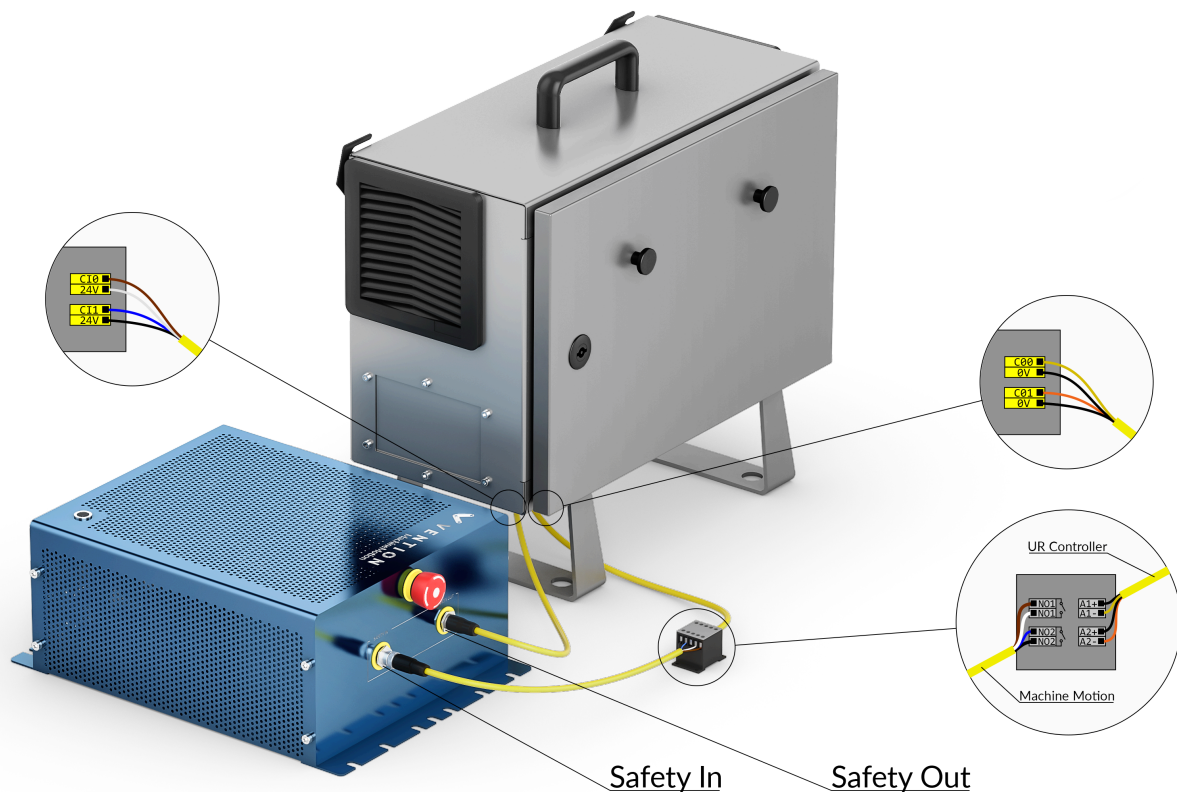
In this configuration, triggering any E-stop will cause both UR and MachineMotion E-stops to be triggered. The system is reset through the Teach Pendant on the UR controller.

For the MachineMotion to exit the E-stop state, the software E-stop reset must be disabled. If after completing the steps below the MachineMotion and UR become stuck in the E-stop active state, please contact [integration@vention.cc](mailto:integration@vention.cc) for instructions on how to disable the software E-stop reset on the the MachineMotion.

The following connections must be made to wire up MachineMotion and UR in a “Safety Loop”. In this configuration, all safety devices will trigger an emergency stop within the system.

### 1. Wire the MachineMotion to UR

Follow the diagram below to wire MachineMotion to the Universal Robots controller. A **Safety Rated, normally open (NO) dual-channel dry contact 24 VDC relay** is necessary to interface UR's digital safety output pins with MachineMotion dual dry contact input.



### ***Option 2: safety configuration***

The relay is necessary since the Safety In port of the MachineMotion requires continuity between certain pins to allow the system to leave E-stop state.

When not in E-stop, the UR controller safety circuit is a closed electric circuit that supplies voltage to the C00 and C01 terminals. This closes the relay and allows for continuity on the Safety In pins.

When the emergency stop mode is engaged on the UR controller, the safety circuit becomes an open electrical circuit, no longer supplying voltage to the C00 and C01 terminals. This opens the relay and prevents continuity on the Safety In pins, triggering an E-stop state on the MachineMotion.

Therefore, this configuration requires a **Safety Rated, normally open (NO) dual-channel dry contact 24 VDC relay**.





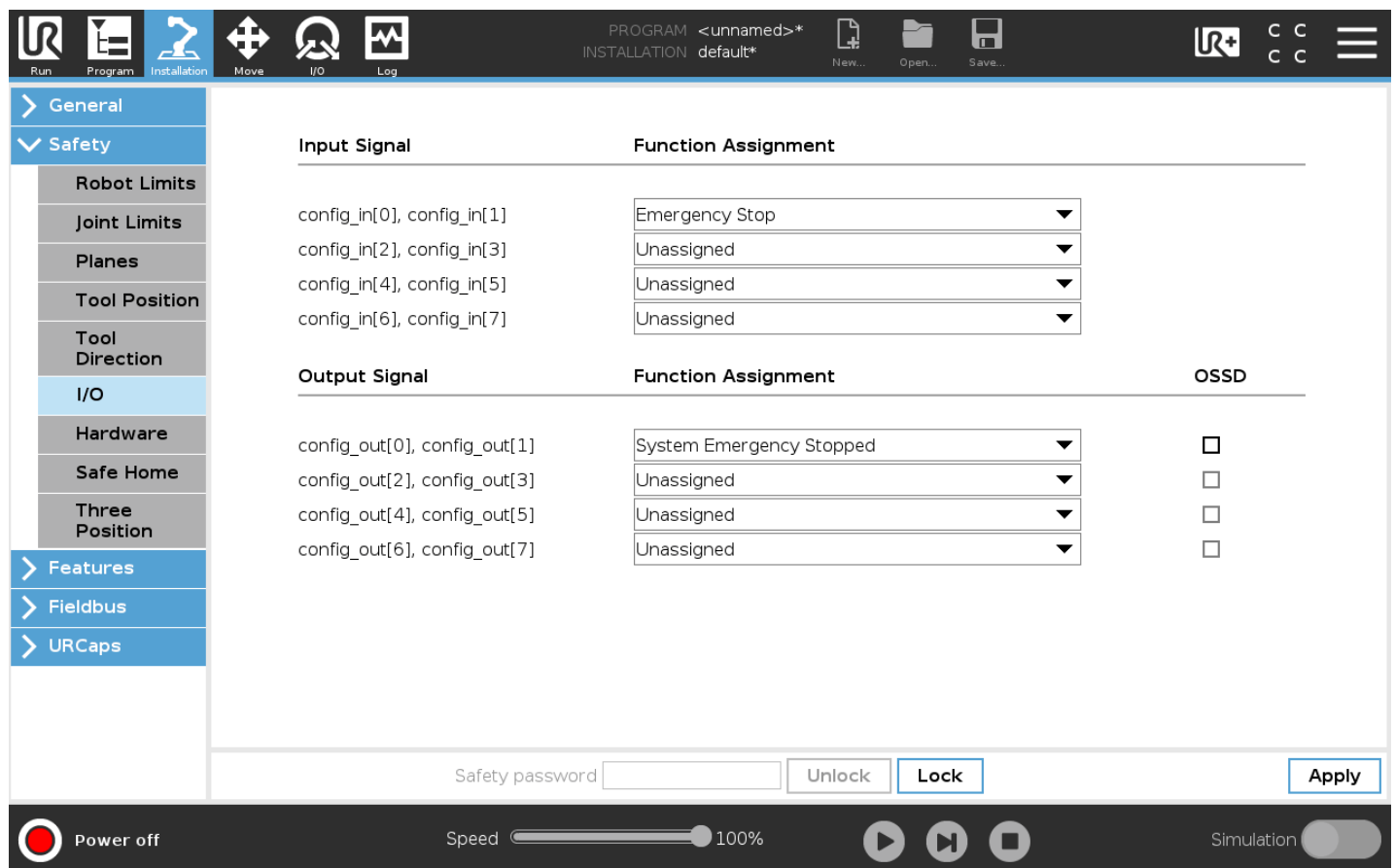
**Important note:** do NOT connect the Safety In of the MachineMotion to any external power source, and do NOT connect it to the ground of another source. In other words, the Safety In pins can only be connected to each other via a dry contact relay.

No relay required between MachineMotion Safety Out and UR Configurable Safety In.

## 2. Configure UR's Safety Output and Input Pins

The output pins and input pins on the Universal Robots controller can be configured as safety pins using the UR Teach Pendant.

1. Navigate to *Installation > Safety > I/O* to configure the safety pins
2. Set *config\_out[0], config\_out[1]* to “System Emergency Stop”, as seen in the figure below
3. Set *config\_in[0], config\_in[1]* to “System Emergency Stop”, as seen in the figure below



**UR Teach Pendant configuration**

