MachineMotion 2 Controller Manual

Contents

Overview

MachineMotion 2 is an all-in-one automation controller. It contains the necessary components to rapidly create general motion control and automation projects. The controller allows connection for up to 4 step-servo motors, and external modules. On the software side, even users with limited programming experience can create automated machines.

MachineMotion v2 key features

- Control up to four 250 W high performance step-servos with accurate and automatic position adjustments. This allows the actuator to always reach the user-specified position, thanks to a built-in encoder that enables the motors to operate in closed control loops
- Step-servo junction box with simple cabling, where the brake, home and end-stop sensors can be directly wired to the motor
- Status light on servo motors and controller for quick diagnostics
- Loaded with code-free software including:
  - Control Center
  - MachineLogic

- Python
- Open source development tools including:
  - Cloud 9 IDE
  - Javascript
  - Operator mode
  - Manual joggers
- The MachineMotion 2 controller is certified to Canadian, US & European standards.
- IP30 rated enclosure for industrial applications, with active cooling and replaceable filters
- Connect digital I/O and analog modules to control I/O devices
- Single continuous flex cable to power an actuator, sensors and power-off brake
- Plug and play with all Vention actuators
- Native support for Universal Robots with URcap
- Plug and play safety system with physical and software reset
- Directly connect peripherals locally or remotely using the teach pendant, keyboard, mouse, and monitor

What is included with each MachineMotion

When you order a MachineMotion, the following items are included:

- MachineMotion Controller
- AC Power Cord (NEMA5-15P and CEE 7/7)
- Pendant jumper
- User Manual
- Safety cable with flying leads
- **Note that a safety device is not included. If a safety device is needed, include an** [e-stop and reset module](#)

Safety Notice

MachineBuilder is a complete 3D-CAD platform that allows users to quickly design complex automation solutions. It needs to be noted that safe design principles and techniques are to be considered by the user. Although the MachineMotion controller is thoroughly tested and certified to international electrical safety standards, the end user is responsible for the safe installation of Vention's products. To ensure safe operations of Vention products, it is required to perform a risk assessment before the installation and deployment of any Vention designed machine.

Before proceeding with the unboxing, installation and deployment of any Vention machine, the end user is required to read this manual. At all times, Vention's Terms and Conditions should be respected. Vention Terms and Conditions can be found at https://www.vention.io/terms-of-use.

Status LED

Located on the top of the MachineMotion controller, there is a status LED to display the state of the controller.

Figure 1: MachineMotion status LED

To understand the status LED, please see table below:

○	MachineMotion controller is booting up
●	MachineMotion controller is ready to operate (e-stop inactive)
◐	MachineMotion is running a script
●	MachineMotion controller is not ready to run: It is in an emergency stop state. This means that the physical e-stop on the MachineMotion controller is triggered or the software stop is on.

Connecting Components

As shown in the two figures below, MachineMotion contains several connectors. Each connector is meant to be used for certain device types. Follow the figures and tables below to connect your components. Add jumpers to all unused SENSOR ports, the PENDANT port and the SAFETY IN port. The SAFETY IN and SAFETY OUT ports accept redundant dry contacts. **Disconnect the power supply before connecting or disconnecting motor cables on any of the connector sockets. Failure to do so may result in serious injury and equipment damage.**
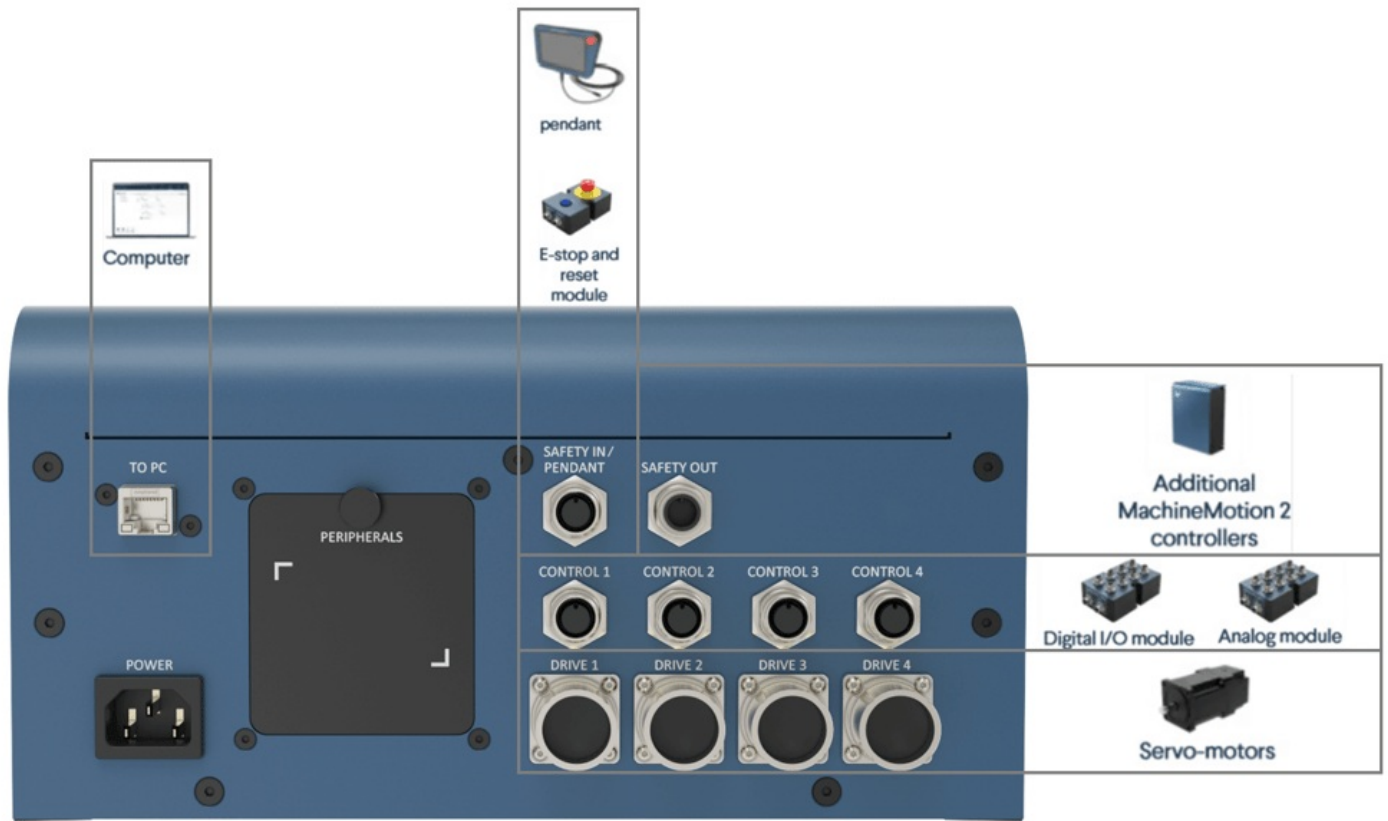
Figure 2: MachineMotion front view - CE-CL-010-0004

Vention automation components plugged to controller

Device	Vention Part Number	MachineMotion Connector
Servo motors	MO-SM-01X-0000	DRIVE1, DRIVE2*, DRIVE3*, DRIVE4*
Pendant	CE-TP-004-0001	PENDANT
Control Modules	CE-MD-00X-000X	CONTROL1, CONTROL2, CONTROL3, CONTROL4
Safety system input	Input used to place the system in emergency stop mode (redundant dry contacts). **IMPORTANT: It is required to connect a safety device here. This could be an e-stop and reset module or another safety device that connects to the flying leads end from the safety cable.**	Safety In
Safety system output	Output used to trigger the system inputs of other devices (redundant dry contacts)	Safety Out
Additional MachineMotion v2 controllers	CE-CL-010-0004, CE-CL-010-0001	LAN1, LAN2
Mouse & keyboard	Personal mouse, keyboard to operate MachineMotion V2 interface	USB

| Device	Vention Part Number	MachineMotion Connector
Monitor	Personal monitor to operate MachineMotion V2 interface	HDMI
MachineMotion v2 software update	Update MachineMotion v2 hardware with SD card	micro SD

Only available on CE-CL-010-0004

## Vention automation components plugged to junction box

Device	Vention Part Number	MachineMotion Connector
Brake	MO-PT-002-0001	**BRAKE**
Home sensor	CE-SN-004-0001	**SENSOR A, SENSOR B**
End-stop sensor	CE-SN-004-0001	**SENSOR A, SENSOR B**

Communicating with the Controller

- Peer-to-Peer Ethernet with Fixed IP
  - Plug into TO PC
  - Requires Ethernet cable
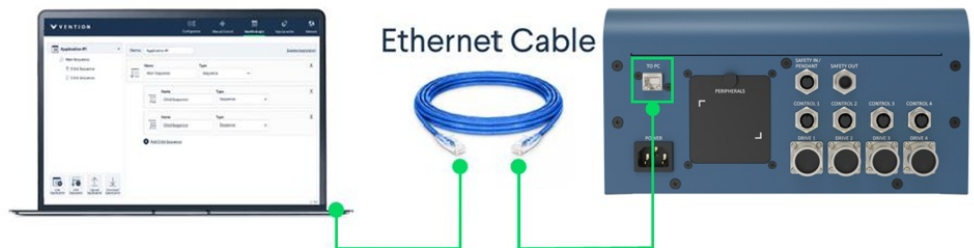
- Standard Ethernet
  - Plug into LAN1, LAN2
  - Requires Ethernet cable
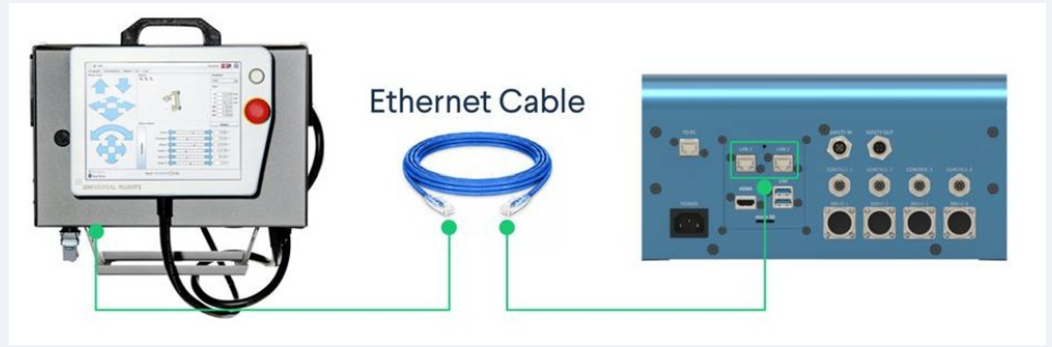
- MachineMotion Pendant
  - Plug into PENDANT connector
  - Connect with Vention supplied cable

Method 1 - Peer to Peer Ethernet with Fixed IP

This method is most commonly used to get started. This method is used to connect a computer to MachineMotion in a peer-to-peer way (one to one connection).

Simply plug an Ethernet cable into the connector labelled "TO PC" and to your computer. If you do not have an Ethernet port on your computer, use the Ethernet-to-USB adapter provided with the controller.
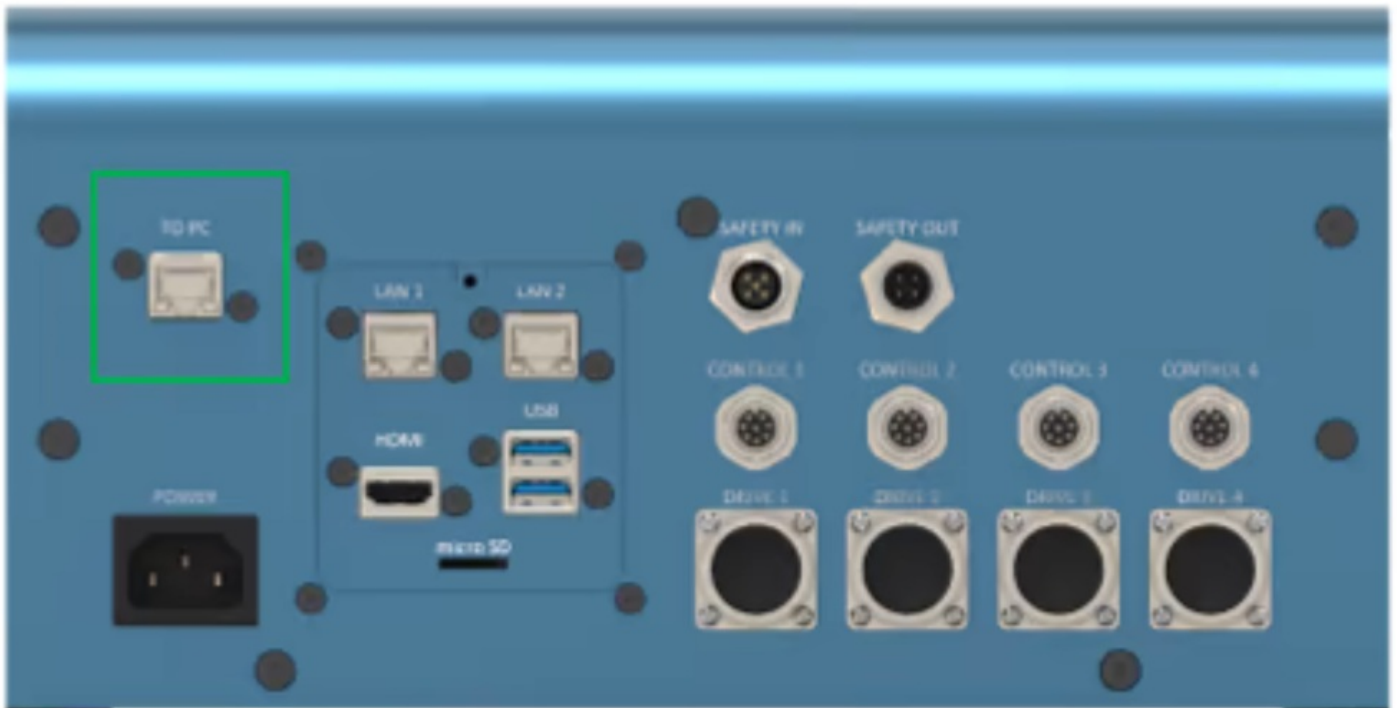
Figure 4: The "TO PC" Ethernet port on the MachineMotion controller, in the green box. MachineMotion 2 controller shown - CE-CL-010-0004.

Follow the steps in Power on and set-up to proceed with the software configuration.

Method 2 - Standard Ethernet

Using the LAN1 and LAN2 ports are useful when connecting MachineMotion to a standard, multi-device Ethernet network. This use case becomes necessary

when connecting multiple MachineMotion controllers together and when connecting MachineMotion on a LAN or WLAN.
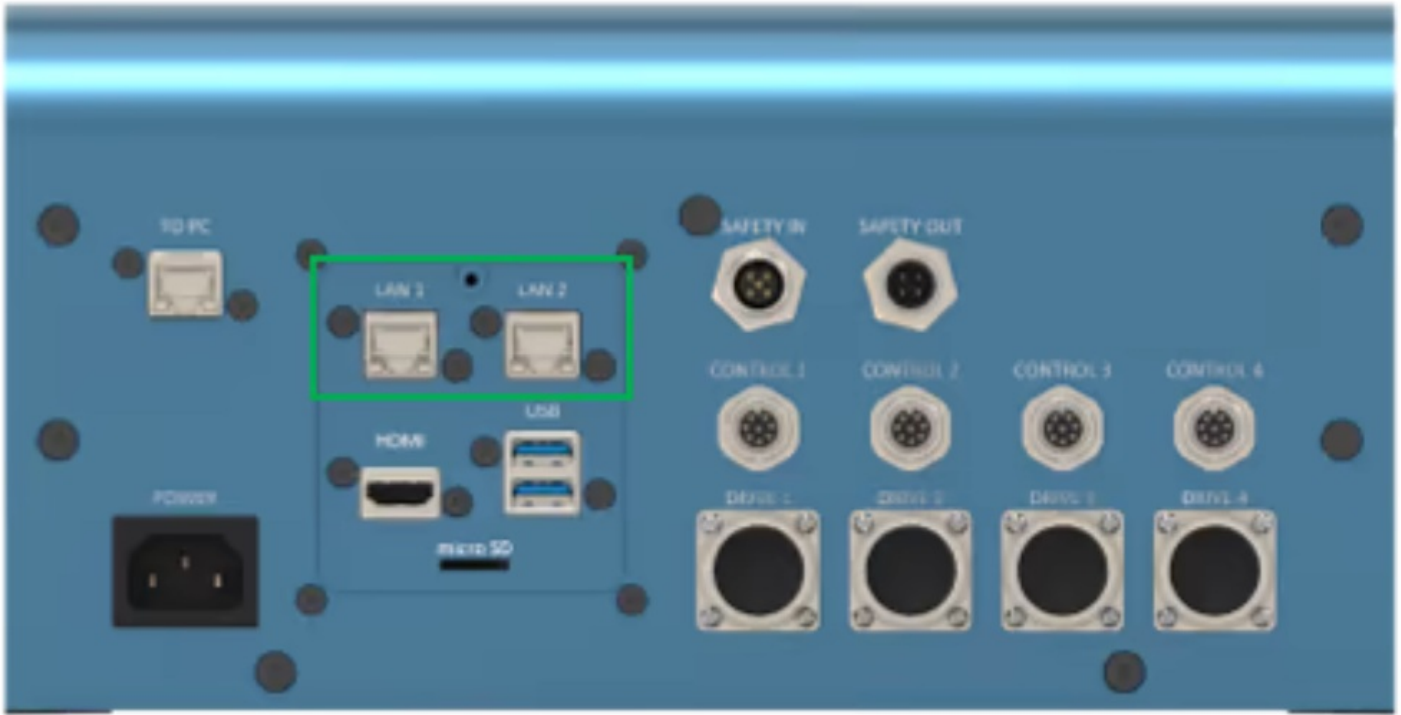
Figure 5: The standard configurable Ethernet connector. MachineMotion 2 controller shown - CE-CL-010-0004.

Method 3 - MachineMotion Pendant

The MachineMotion pendant allows users to have a configuration free connection to the controller. Simply connect the pendant in the PENDANT connector using its 12 pin M12 cable. If no pendant is present in the design, connect a safety jumper to the pendant port. Follow the steps in Power on and set-up, except the first and last step.

Power on and set-up

- Follow the steps below to set-up your controller.
  - Step 1: Connect a computer to the "TO PC" port and **POWER ON** the MachineMotion controller by switching on the POWER ON button. The status LED should display blue as it is booting up. **Wait for the status LED to turn green (~ 90 seconds).** Browse to **192.168.7.2** using Google Chrome.
  - Step 2: The screen below will appear. Ensure you have released all physical e-stop buttons before proceeding. After, click "RELEASE" to disable the software stop. Click "RESET" when you are ready to operate the machine. The status LED should display green once this step is completed. If the screen below still appears, check to ensure the pendant port has a jumper connected to it, if no pendant is present and ensure a safety system is properly connected into the "Safety-in" connector.

- Step 3: The Control Center menu will appear and give access to the numerous MachineMotion functionalities. Click on the **Network Connection** application. You could also check your software version at the bottom right-hand corner.

- Step 4: Enter the IP, Netmask, and Gateway information below and select **Use Static Mode**.
  IP: 192.168.0.2
  Netmask: 255.255.255.0
  Gateway: 192.168.0.1

Actuator Software Configuration

The section below will give detailed information on how motors, end-of-travel sensors and linear actuators are configured in a Vention system.

For motion control to be possible, a position reference must exist. This is what **homing** refers to, the action of finding the position reference of an actuator. This position reference is also called home or zero.

End-of-travel sensors are used for homing and detecting over-travel operations. They must be mechanically installed properly on your linear actuator, but correct installation depends on how the motor is installed on the linear actuator. See end-of-travel sensor configuration details here.

Software Configuration

Before you can operate an actuator, you must first configure it through the **Control Center - Configuration**, located at the top of the screen. **IMPORTANT NOTE: The servo-motors may lose power during configuration, which engages the brakes. This is especially important for brakes to be installed on vertically positioned actuators.**
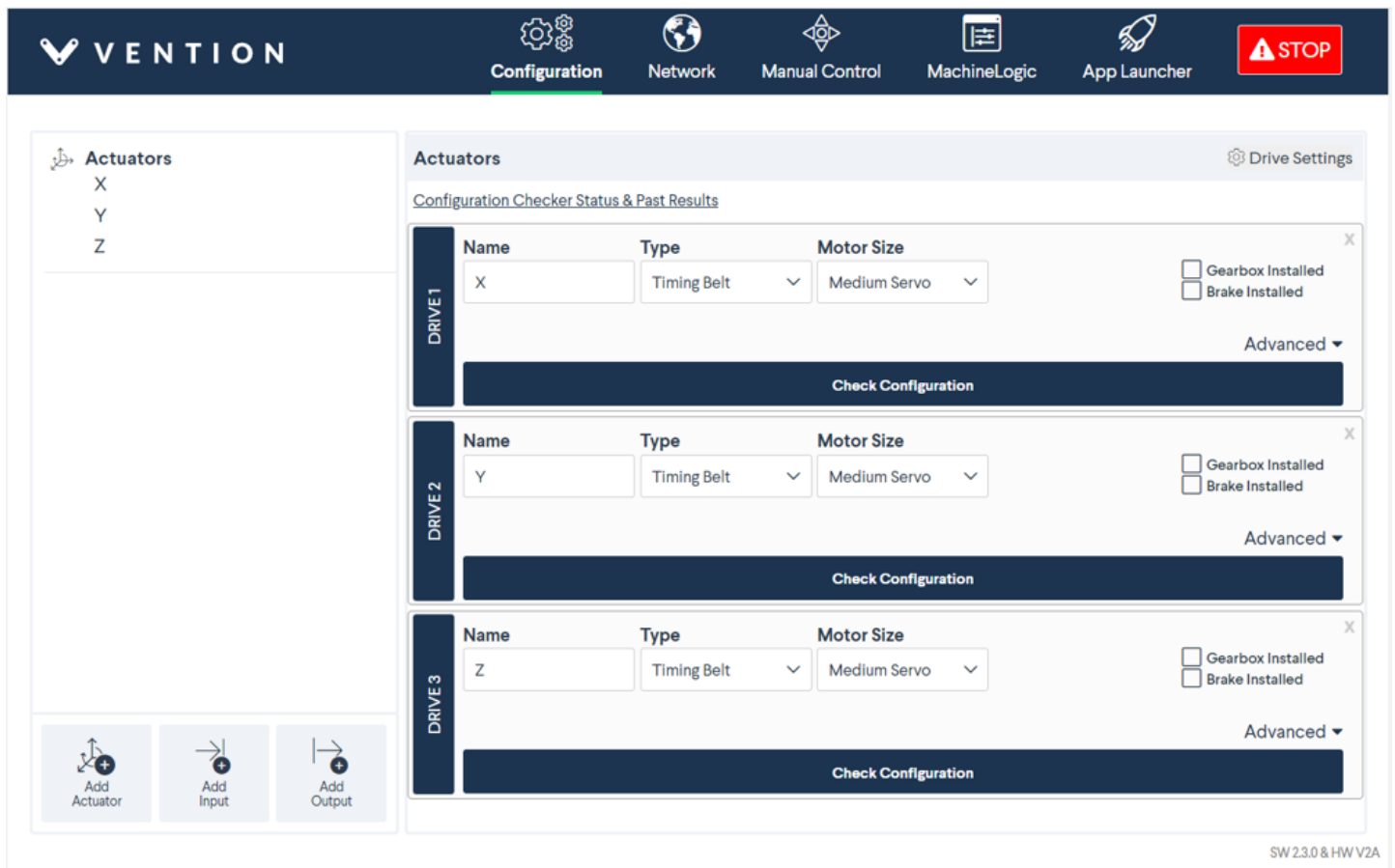
Figure 9: Control Center actuator configuration tab - MachineMotion 2 controller shown - CE-CL-010-0004.

The configuration parameters of each actuator can be changed independently as seen in the figure above. The initial page will appear blank. To configure an actuator, click **Add Actuator** at the bottom left-hand corner. You could add up to four drives. To configure a digital input/output device, click **Add Input/Output**.

Enter all fields to each drive:

- **Name**: Friendly name given to the actuator
- **Type**: The actuator type. Select based on your machine design.
- **Motor Direction**: Rotation direction, see Motor Rotation Direction below.
- **Gearbox installed**: If you have a gearbox installed on the actuator, check "Gearbox Installed"
- **Brake installed**: If you have a power-off brake installed on the actuator, check "Brake Installed"
- **Motor size**: Select the motor size associated with the actuator. The drop-down menu has three options (small servo (68 mm), medium servo (100 mm) and large servo (157 mm)). If an electric cylinder is selected as the actuator type, only the Nema 17 stepper option will be available.
- **Motor current**: Specify the current to power the servo-motor with. See table below for current rating of each servo- motor.
- **Micro steps**: This is an advanced feature if more precision is required. The micro steps should be left at 8 (default). Select based on your machine design support for high precision applications.
- **Tuning profile**: This allows you to tune your step-servo motor using various profiles, to achieve the best performance for your application. Note that the tuning profile is only configurable in a closed-loop setting.

Enter all fields for each IO device:

- **Name**: Friendly name given to each input/output device
- **IO Type**: To determine if the device is an input or output device
- **Device**: Represents the device ID of your digital IO module. Select between 1 to 3, depending on what is written on the nameplate of the digital IO module.
- **Pin**: Represents the number of the digital IO module pin you have connected your input/output device to. Select between 0 to 3, depending on where you have plugged your device. Please be careful: if the digital IO module faceplate numbers them from 1 to 4, your configuration and your programs (MachineLogic or Python) numbers them from 0 to 3. Therefore, input pin 1 as written on the faceplate of the IO-Expander corresponds to input pin 0 in the Control Center and MachineLogic.

Actuator Hardware Configuration

Motor Rotation Direction

By convention, motors have a reverse and a normal rotation direction. This is an important consideration when installing the motor on an actuator. When sending motion commands to the controller (for example a relative move of +200 mm), it is important that the actuator moves in the desired direction. See figures below for motor rotations; the figures show the side of the output shaft.
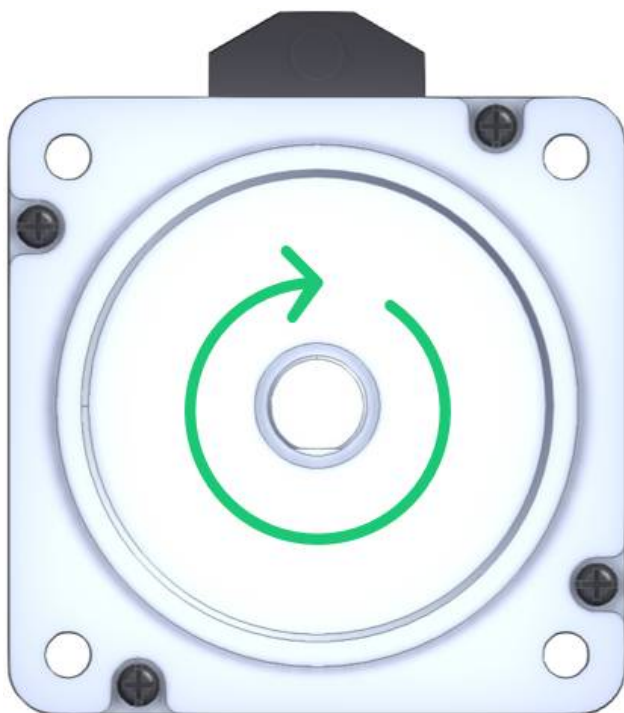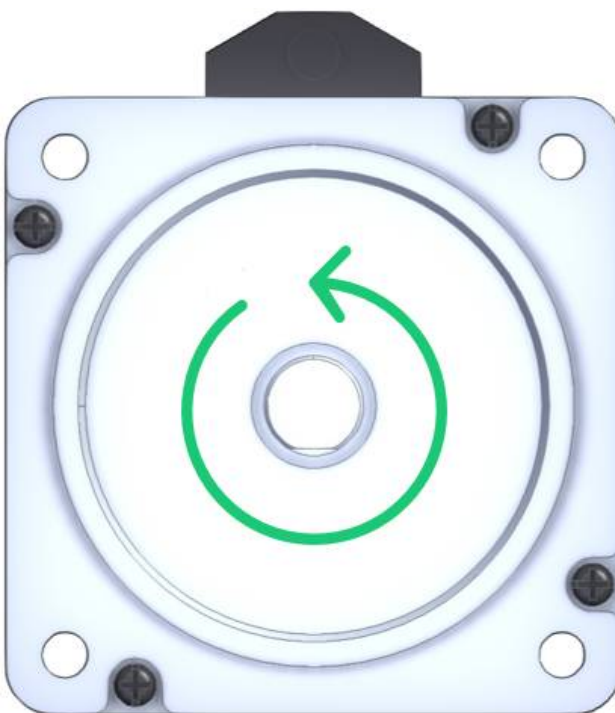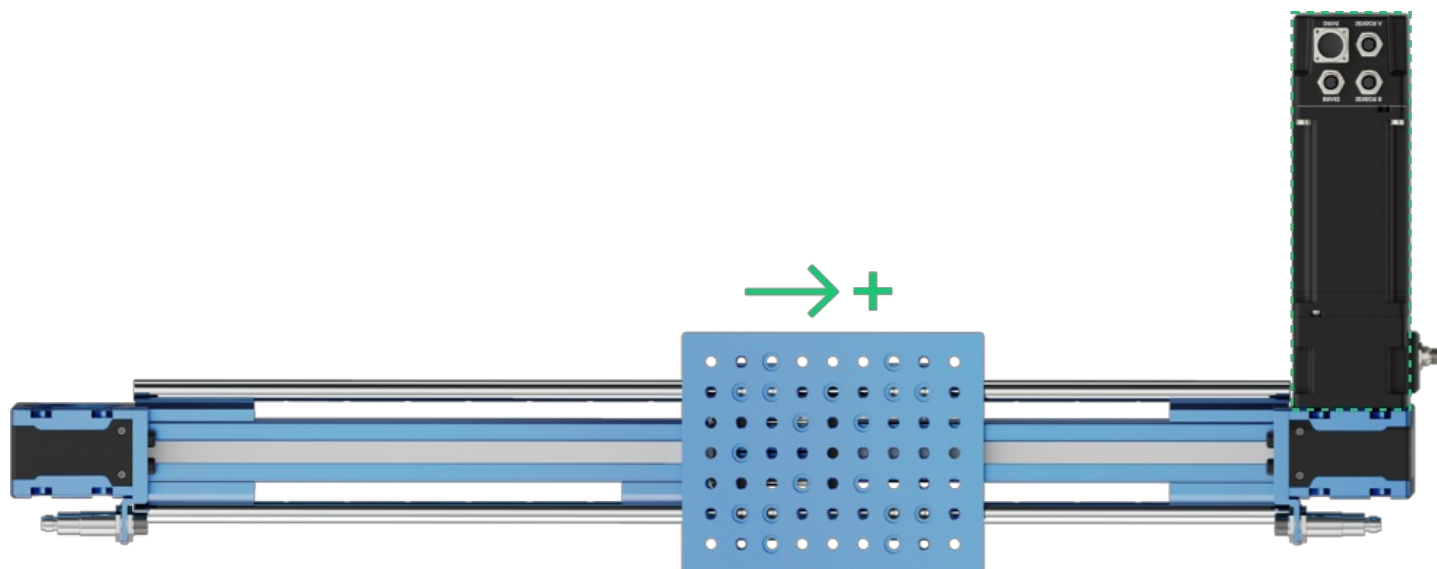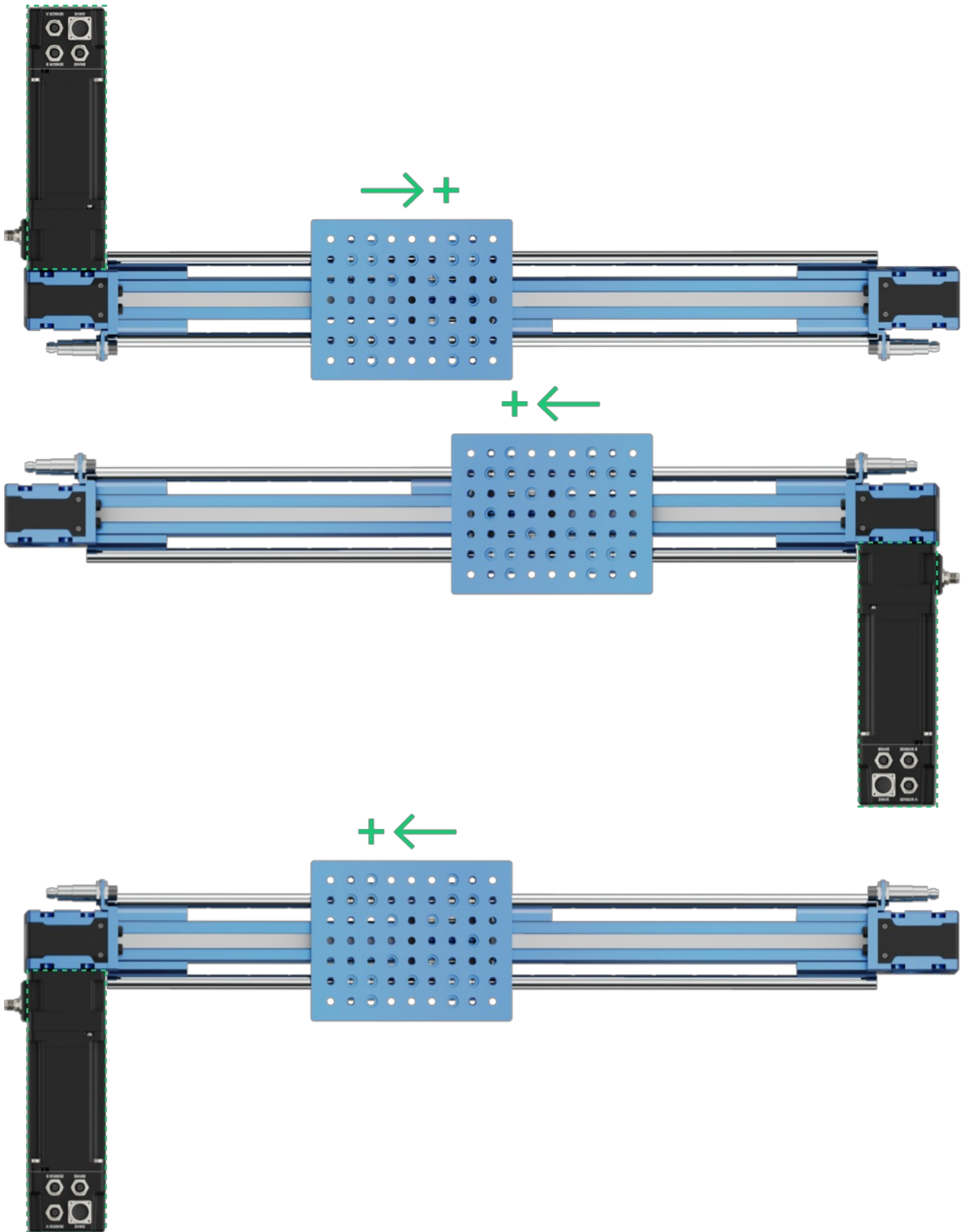

Figure 10: Normal rotation

Figure 11: Reverse rotation

Linear Actuator Direction

In order to satisfy the application requirements, ensure the installed positioning on the step-servo motor has the intended positive direction. The figure below shows how the linear actuator moves depending on where the motor is installed.

End-stop Sensors

Linear actuators require end-stop sensors for two reasons:

- To perform homing operations (placing the actuator in a known position, called home or zero) on the actuator. This allows the actuator to zero its position to initialize its position.
- To disable motion in the event of over- or under-travel. Over- or under-travel occurs when the gantry travels beyond the limits of an actuator.

Inductive sensors are the preferred option for end-stop sensors since they are non-contact and less subject to environmental interference:

- M18 Inductive Proximity Sensor (Sn = 10 mm): CE-SN-004-0001

The image below details how to connect and position the end-stop sensors for a specific motor position. Important points:

- The *home* sensor is positioned such that a negative motion moves towards it
- The *home* sensor is connected to port SENSOR A on the motor junction box
- The *over-travel* sensor is positioned such that a positive motion moves towards it
- The *over-travel* sensor is connected to port SENSOR B on the motor junction box
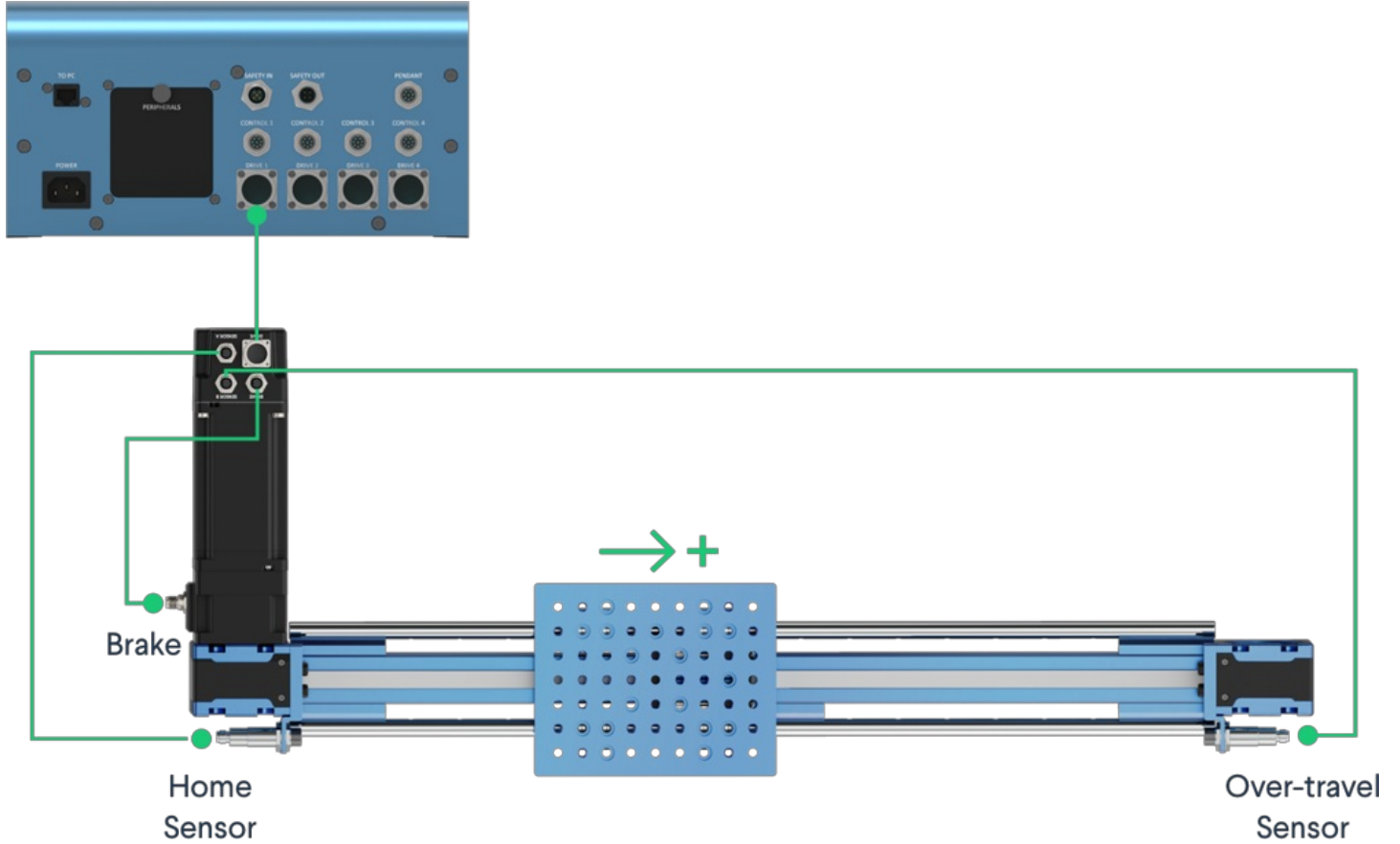
Figure 13: End-stop sensors connection. MachineMotion 2 controller shown - CE-CL-010-0004.

Direction Reversal

It is possible that for design reasons, the motor has to be placed at a specific place on the linear actuator (due to space or mechanical constraints). This could result in an undesired positive motion direction of the linear actuator. For this reason, there is also a software command that permits reversing the direction of a given actuator. The **Configuration** tab contains a software command that allows you to reverse motor direction, as shown below:
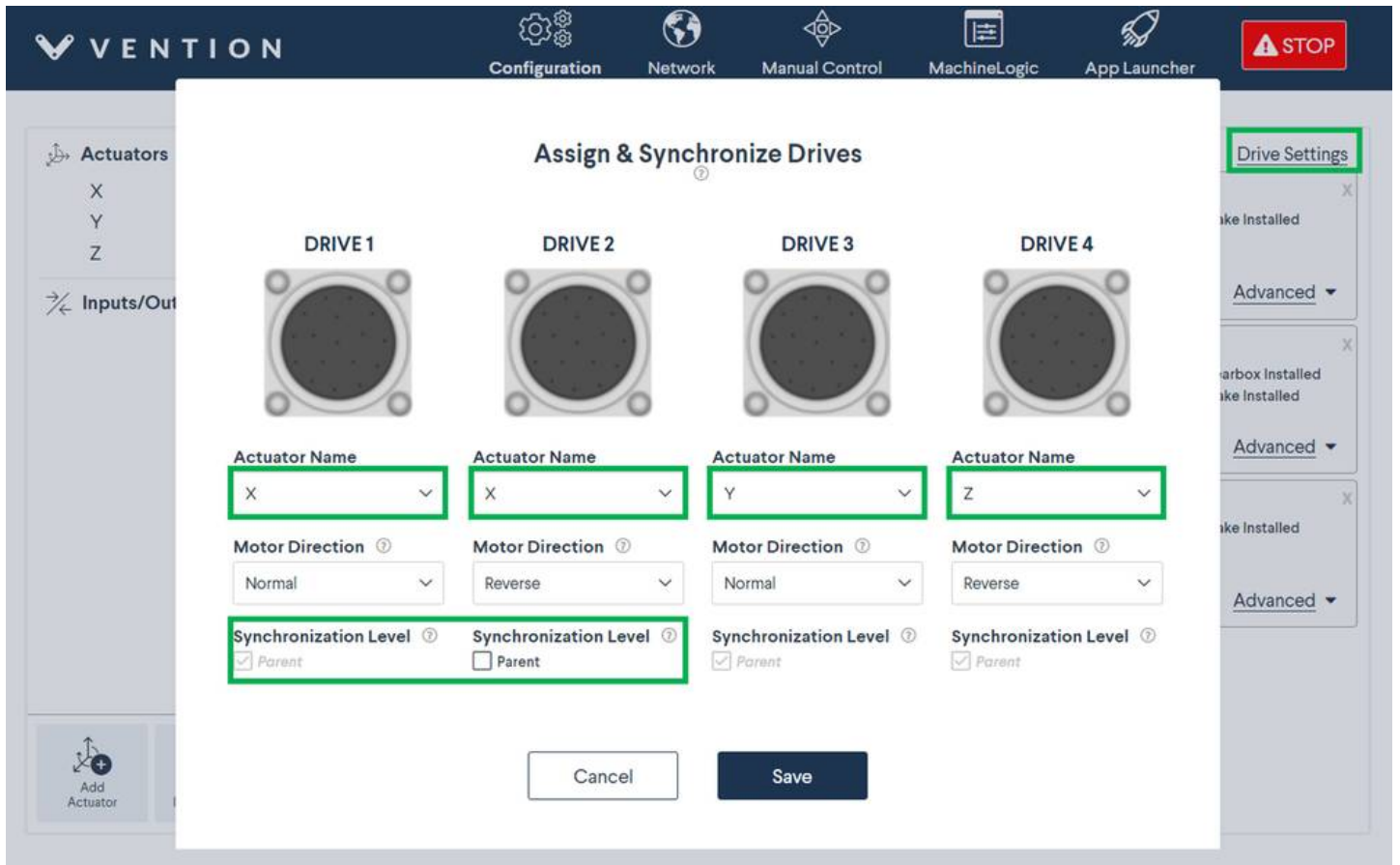
Figure 14: Actuator direction reversal

This configuration reverses the motor default rotation direction, but also reverses the position of the home and over-travel sensors.
Reversing the motor direction results in the following configuration:

- The *home* sensor is positioned such that a negative motion moves towards it
- The *home* sensor is connected to port SENSORB on the motor junction box
- The *over-travel* sensor is positioned such that a positive motion moves towards it
- The *over-travel* sensor is connected to port SENSORA on the motor junction box
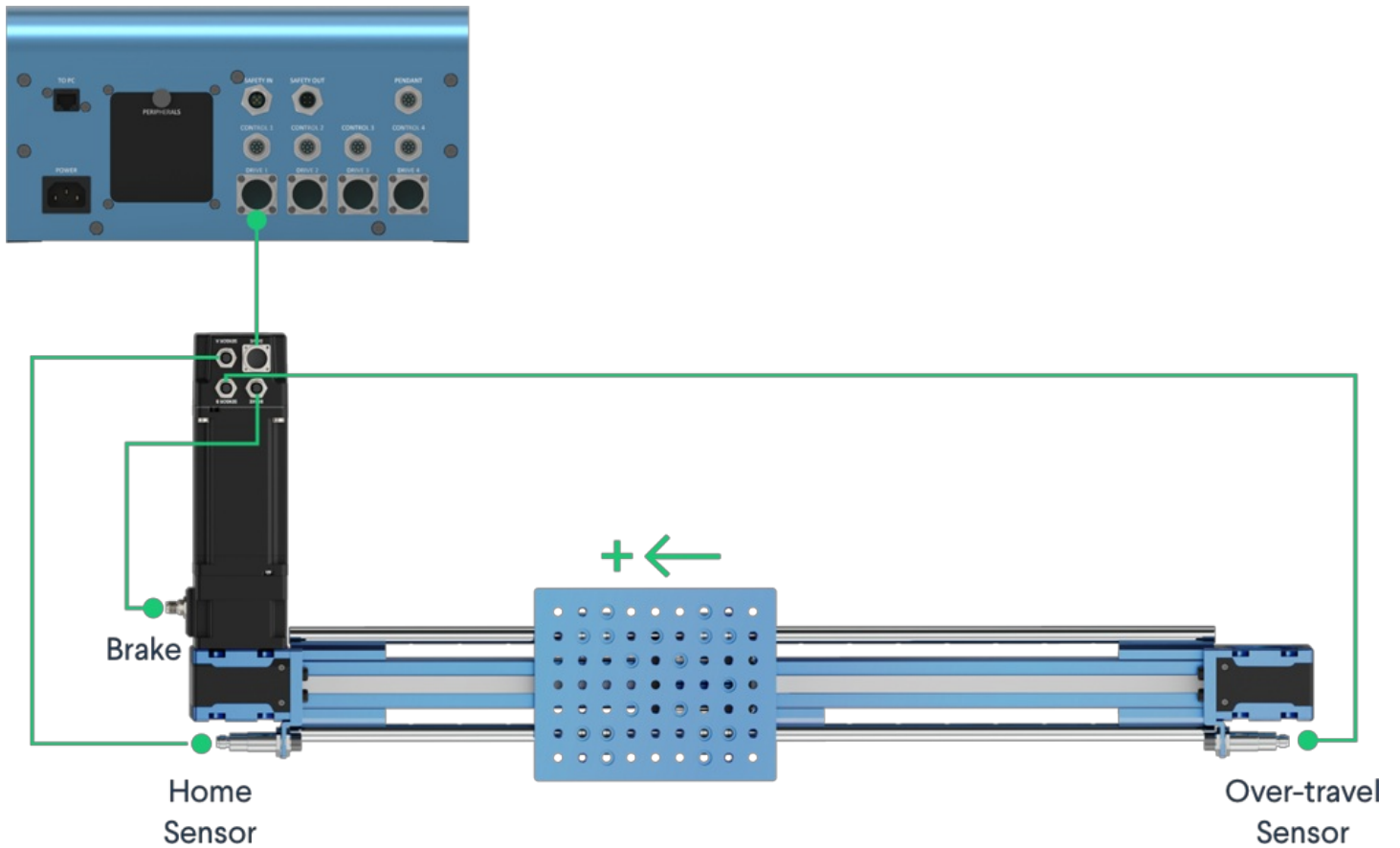
Figure 15: End-stop sensors connection in reversed mode. MachineMotion 2 controller shown - CE-CL-010-0004.

Synchronize drives

Using the **Drive settings** in the configuration tab will also allow you to synchronize drives together. Drives can only be synchronized if the actuator type, gearbox setting, brake setting, motor current, and motor sizes are the same. Follow the steps below to synchronize drives together:

1. Go to the configuration tab
2. Click "Add Actuator" and configure the actuator.
3. Click "Drive settings" and in the "Actuator Name" drop-down, you can select the same actuator name in multiple drives to synchronize the motors.

Parent synchronization level means that the motor has the home and end sensor connected. The child drive should not have any home or end sensors (only jumper sensors connected into the sensor ports).
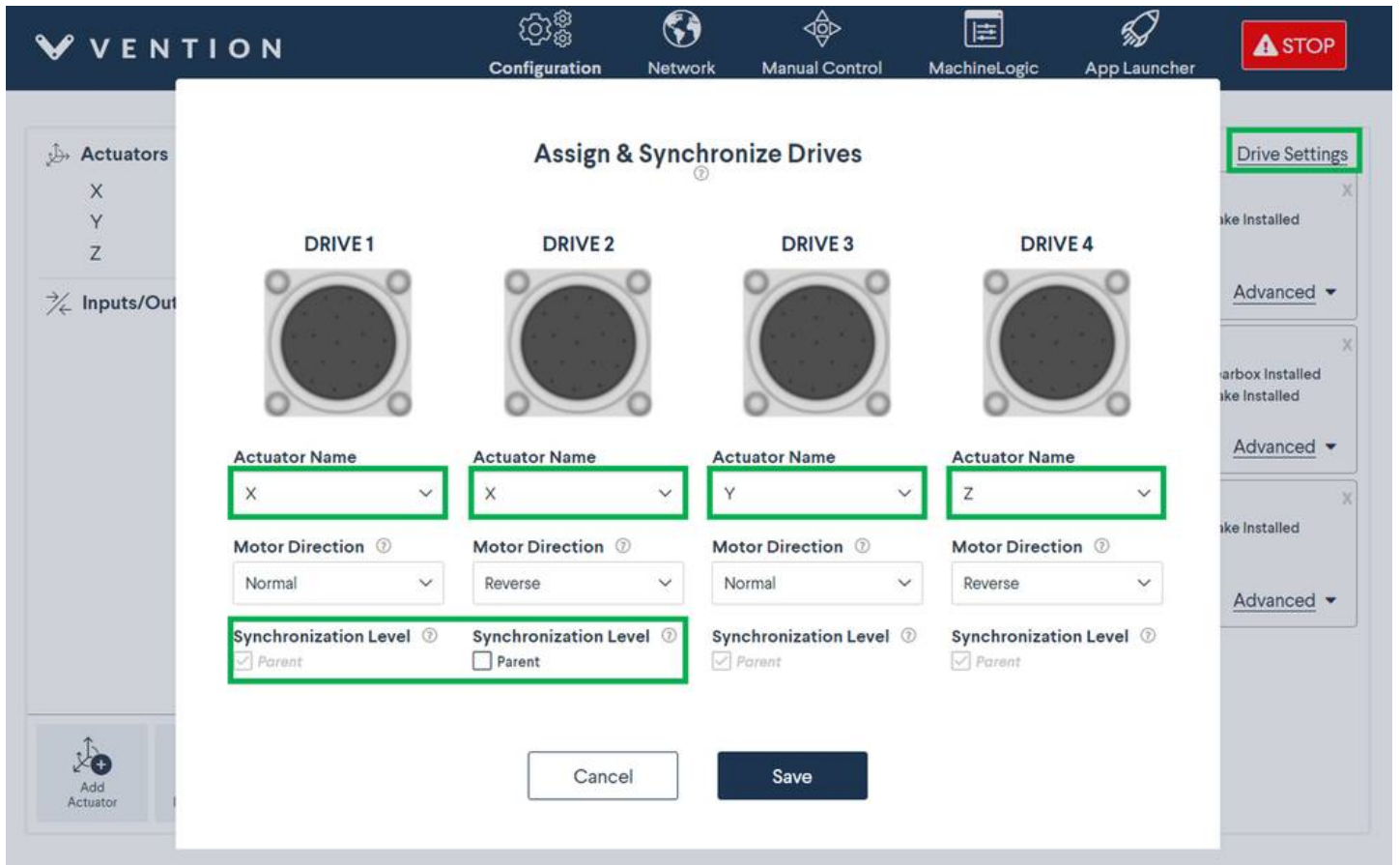
Figure 16: Synchronizing drives

Testing your set-up using Control Center

After configuring your actuators and setting up your hardware, we recommend testing your automated equipment using the **Manual Control** tab.

STEP 1: Click **Manual Control** (underlined in green, the tab at the top of the screen).

Figure 17: Getting to manual mode

STEP 2: Set a relatively low speed (recommended: 20 mm/sec) under the field **Max. Speed** and a low acceleration (recommended: 100-150 mm/s) under the field "**Max. Acceleration**" for testing purposes.

Figure 18: Setting max. speed and max. acceleration

STEP 3: Test the functionality of your end-stop sensors to ensure they are properly connected. Place a metal object (like a fastener or house key) in front of your home and end sensors. If properly connected, the "Home" and "End" circles should turn blue. See the figure below as a reference for when the home sensor is triggered.

Figure 19: Triggering the home sensor

STEP 4: Jog your actuator at a set increment to ensure the motor is properly connected. Enter the increment at which you would like to jog your actuator (recommended: 50 mm). Click the left or right arrow to jog your actuator in that increment. Your actuator should move in that increment every time you press the left or right arrow.

Figure 20: Jog your actuator

Cloud9 Integrated Development Environment

For users that desire to access the single-board computer that is located inside the controller, the Cloud9 IDE is available on port 3000.

Cloud9 offers a terminal access and file explorer for developing software directly on the MachineMotion controller.

To access Cloud9, browse to 192.168.7.2:3000 or ‹your_custom_machine_motion_ip›:3000.
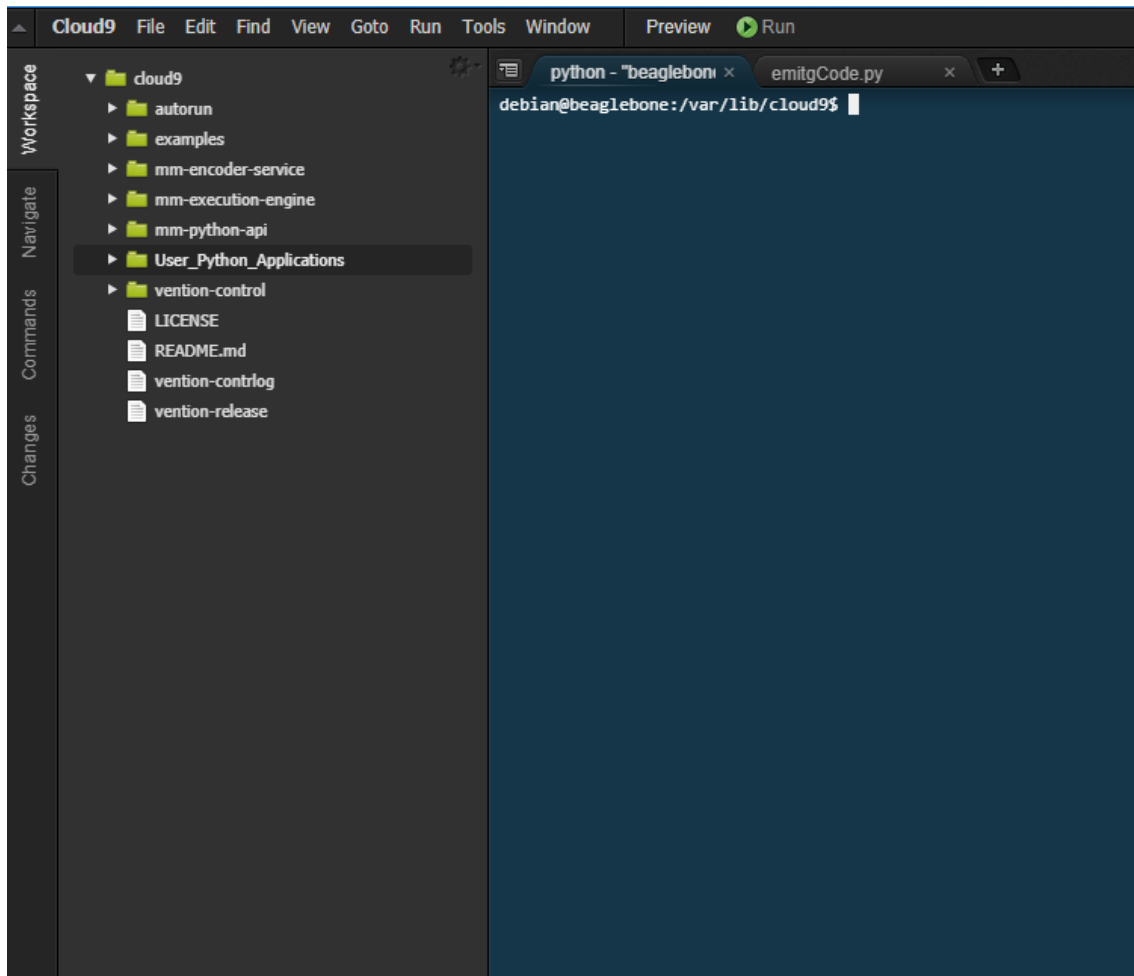
Additional Details

- password: temppwd

Figure 21: Cloud9 IDE

Programming Options

MachineLogic

The MachineLogic programming interface is a simple code-free programming tool for MachineMotion. Click here for a direct link to MachineLogic on your MachineMotion controller.

Python Programs

Refer to the latest Python API for details on how to create programs for MachineMotion using Python.