USER MANUAL Updated: July 19th, 2021

MachineMotion 1 Controller Manual

Contents

Overview

MachineMotion is an all-in-one automation controller. It contains the necessary components to rapidly create general motion control and automation projects. Its embedded single-board computer, multi-function sensor inputs and connectivity options greatly simplify system setup time and configuration. Even users with limited programming experience can create automated machines.

Software Installation

No software installation is required to start working with the MachineMotion controller. A computer with Google Chrome installed is enough to access the controller, create MachineLogic programs to control a machine. Along with MachineLogic, there are a number of other programming options available. See section Programming Options for more details.

Status LED

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

Figure 1: MachineMotion status LED

The status LED colours are:

MachineMotion controller is booting up

MachineMotion controller has finished booting and the e-stop is not engaged. The MachineMotion is ready to run.

MachineMotion controller has finished booting and the e-stop is engaged. Both the physical and software e-stop must be released for the MachineMotion to exit this status

Connecting Components

As shown in the two figures below, MachineMotion contains several connectors. Each MachineMotion is shipped with an Automation System Diagram (ASD) which shows where every piece of automation hardware is connected to the MachineMotion for a particular design. For any questions regarding the ASD, please contact integration@vention.cc for assistance. Jumpers are required for all unused SENSOR ports, the PENDANT port (if a pendant is not installed) and the SAFETY IN port (if additional safety devices are not installed).

The MachineMotion must be in E-stop or powered off before motor cables are connected/disconnected.

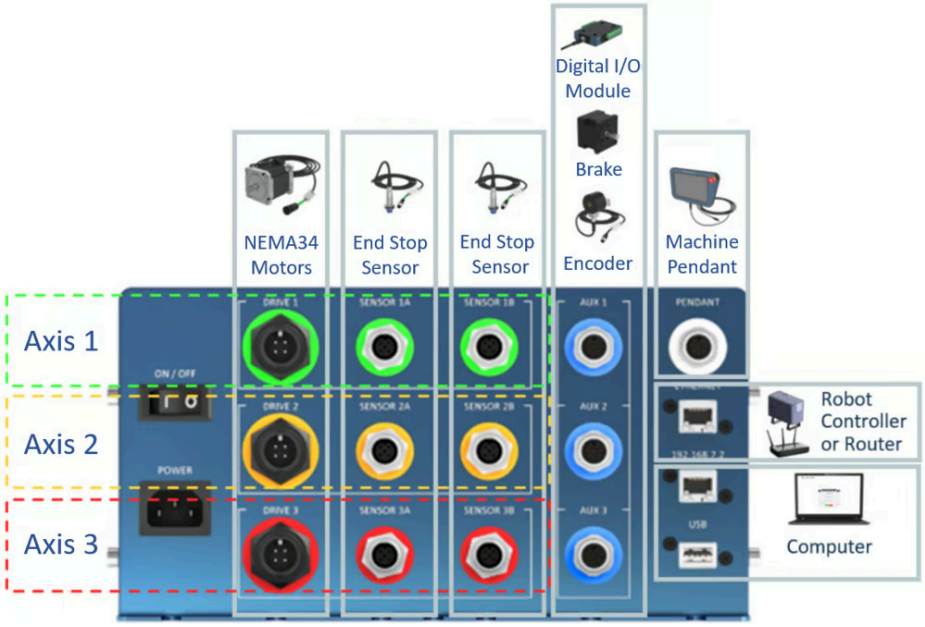


Figure 2. MachineMotion controller front panel

The SAFETY IN and SAFETY OUT ports accept redundant dry contacts.

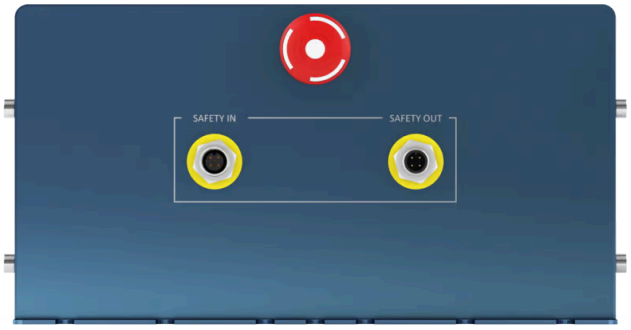


Figure 3. MachineMotion controller back panel

Vention Automation Components

Device	Vention Part Number	MachineMotion Connector
Stepper Motors	MO-SM-00X-0001 (https://www.vention.io/parts-library/category/control-and-motors/electric-motors)	DRIVE1 DRIVE2 DRIVE3
End-of-Travel Sensors	CE-SN-004-0001 (https://www.vention.io/parts/244)	SENSOR1A/B SENSOR2A/B SENSOR3A/B
Encoder	CE-SN-002-0001 (https://www.vention.io/parts/hollow-shaft-optical-rotary-encoder-630)	AUX1 AUX2 AUX3

Digital IO Module	CE-MD-001-0001 (https://www.vention.io/parts/digital-io-module-559)	AUX1 AUX2 AUX3
Power-Off Brake	MO-PT-002-0001 (https://www.vention.io/parts/power-off-brake-583)	AUX1 AUX2 AUX3

Safety Devices

Device	Description	MachineMotion Connector
Safety System Input	Input used to place the system in emergency stop mode (redundant dry contacts)	SAFETY IN
Safety System Output	Output used to trigger the system inputs of other devices (redundant dry contacts)	SAFETY OUT

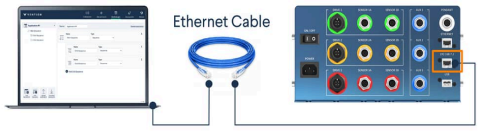
For additional details on the safety configuration, consult the MachineMotion Safety Guide (https://vention.io/docs/guides/machinemotion-v1e-controller-safety-guide-104).

For additional details on electrical specifications, consult the MachineMotion Datasheet (https://www.vention.io/technical-documents/machinemotion-controller-datasheet-10).

Communicating with the Controller

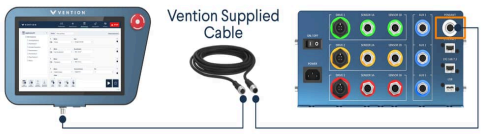
There are three ways to connect to the MachineMotion for programming and operation.

- Peer-to-Peer Ethernet with Fixed IP
  - Connect to IP 192.168.7.2
  - Requires Ethernet cable



- Standard Ethernet
  - ETHERNET communication port
  - Requires Ethernet cable

- MachineMotion Pendant
  - PENDANT connector
  - Connect with Vention supplied cable



Method 1 - Peer to Peer Ethernet with Fixed IP

This method is required for the first time connecting to the MachineMotion. It only allows for one to one connection between a computer and the MachineMotion on a fixed IP address (192.168.7.2).

Simply plug an Ethernet cable into the connector labelled 192.168.7.2 and a computer. Some computer models will require the Ethernet-to-USB adapter provided with the controller.

Figure 4: The 192.168.7.2 Ethernet port on the MachineMotion controller, in the green box.

Method 2 - Standard Ethernet

Using the ETHERNET port is useful when connecting MachineMotion to a standard, multi-device Ethernet network. This type of connection is required if more than just one MachineMotion and one computer need to be on the same network.

Out of the box, this port is not configured with an IP address. The first time connecting to the MachineMotion the 192.168.7.2 port must be used. Once connected on the 192.168.7.2 port, the ETHERNET port IP address can be changed, allowing for connection through this port.

Figure 5: The standard configurable Ethernet connector.

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 8 pin M12 cable. In this case there is no network configuration required, since the pendant communicates directly with the MachineMotion.

Connecting to Control Center

Once a communication method is determined, the next step is connecting to Control Center.

POWER ON the MachineMotion controller by switching on the rocker switch. The status LED should display blue as it is booting up. **Wait for the status LED to turn green or red (~ 90 seconds) before attempting to connect.**

- If there is a pendant, simply wait for the boot sequence to complete, and Control Center will load automatically.

- If this is the first time connecting to a given MachineMotion, use an ethernet cable to connect the computer to the 192.168.7.2 port and Browse to 192.168.7.2 using Google Chrome.
- If an IP address has already been configured for the ETHERNET port (as explained in the Network Configuration section), use an ethernet cable to connect the computer to the ETHERNET port and Browse to the previously assigned IP address using Google Chrome.

Once Control Center loads on either the pendant or in browser, the screen below will appear. Ensure the physical red e-stop button on the controller is released before proceeding. Click "RELEASE" to disable the software stop. Click "RESET" when ready to operate the machine. The status LED should display green once this step is completed.

If the status light remains red after pressing "RELEASE" and "RESET", double check that the yellow safety jumper is plugged into the "Safety In" port. Also, if a pendant is not pulled in, check that the white pendant jumper is plugged in to the "PENDANT" port.

The Control Center menu will appear and give access to the numerous MachineMotion functionalities. The currently installed software version can be found at the bottom right-hand corner.

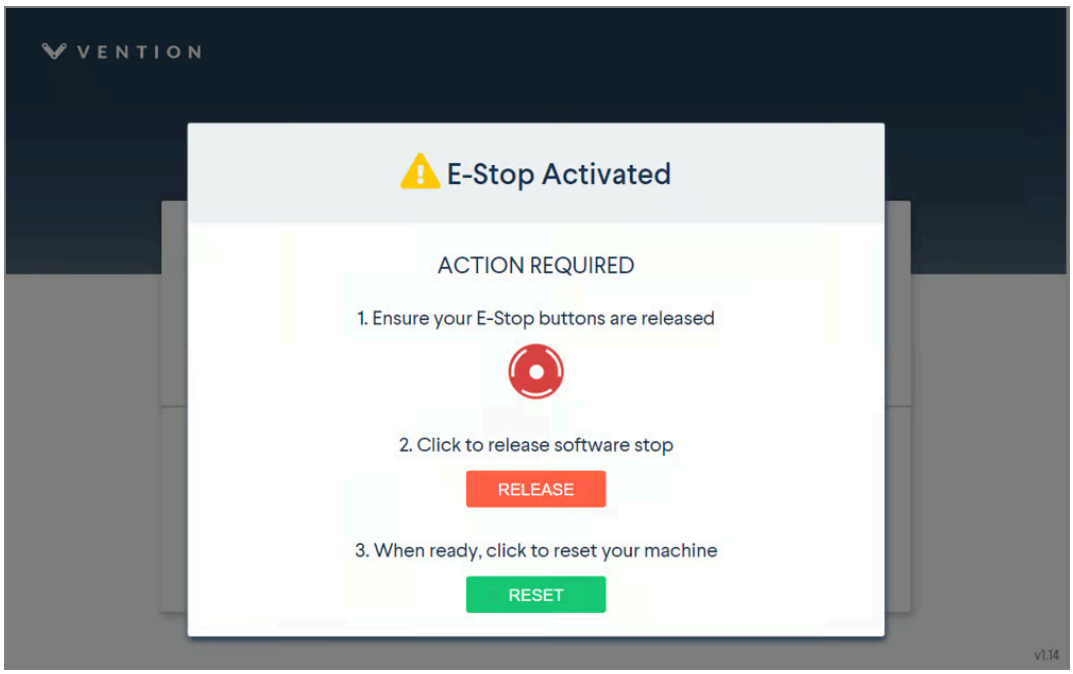


Figure 6: MachineMotion controller start up

Network Configuration

To be able to set the IP address of the MachineMotion, the network needs to be configured. Depending on the use case, this may not be necessary.

Click on the **Network Connection** application.

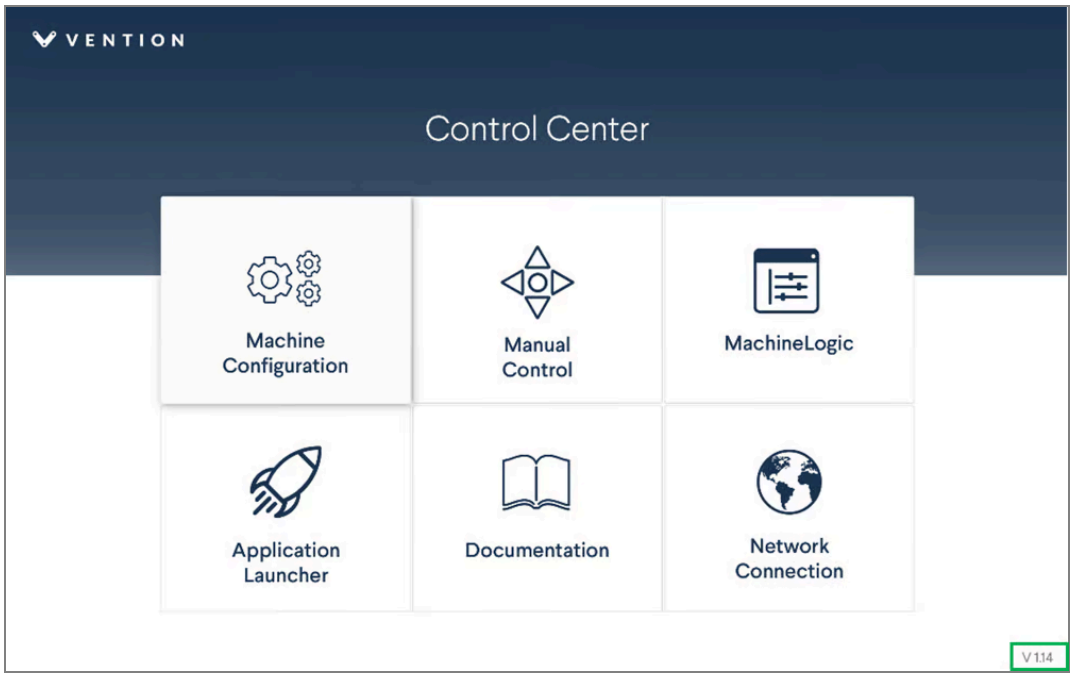


Figure 7: MachineMotion Control Center main page

- Enter the desired IP, Netmask, and Gateway information for the "ETHERNET" port and select **Use Static Mode**. In this example the following address is used:

  IP: 192.168.0.2
  Netmask: 255.255.255.0
  Gateway: 192.168.0.1

  The MachineMotion must be power cycled for the new configuration to take effect. Remember that this only changes the "ETHERNET" port IP address, the "192.168.7.2" port IP address cannot be changed.

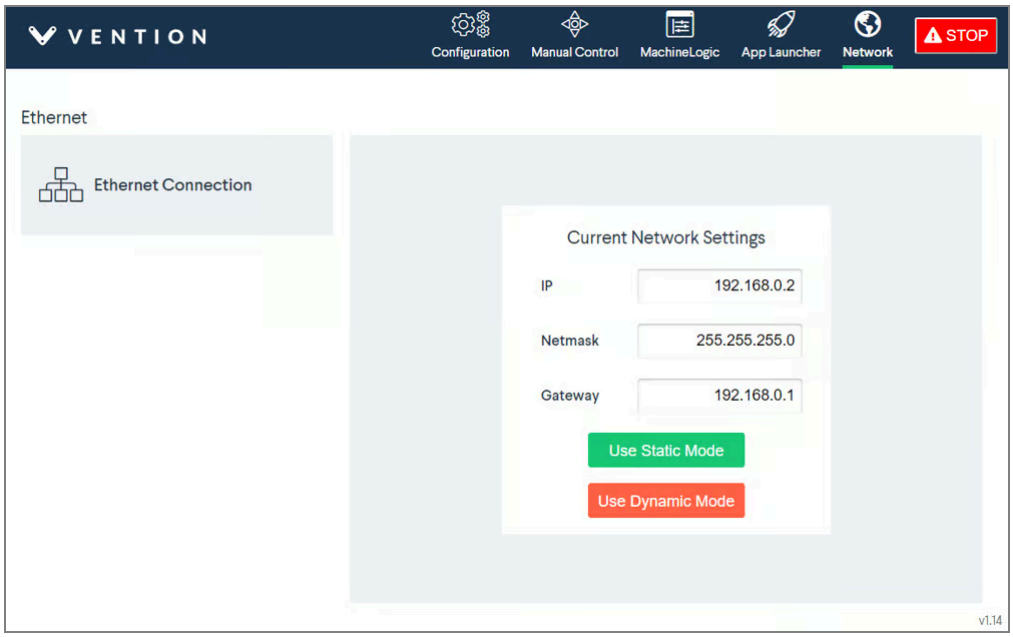


Figure 8: MachineMotion network settings

Actuator Software Configuration

To be able to control an axis, first the software must be configured to match the connected hardware. This is done via the **Configuration** tab.

An Automation System Diagram (ASD) will be in the box with the MachineMotion. Use the ASD to complete the configuration. Contact integration@vention.cc for any questions or concerns.

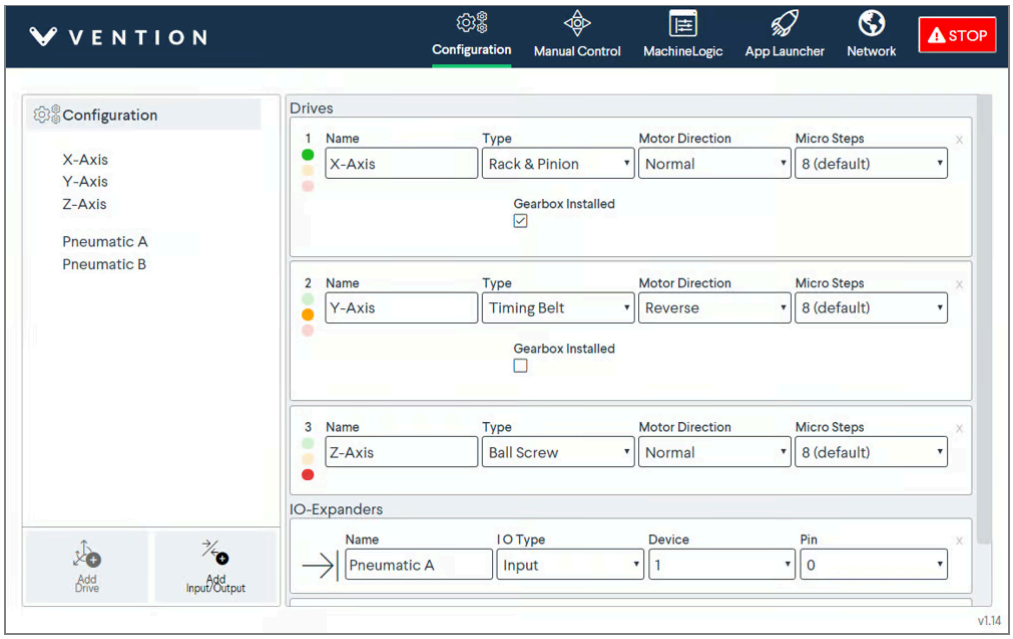


Figure 9: Control Center axis configuration tab

The configuration parameters of each actuator can be changed independently as seen in the figure above. The initial page will appear blank. To configure a drive, click **Add Drive** at the bottom left-hand corner. Up to three drives can be added. To configure a digital input/output device, click **Add Input/Output**.

Enter all fields for each drive:

- **Name**: Friendly name given to the actuator.
- **Type**: The actuator type, select based on the machine design.
- **Motor Direction**: Rotation direction, see Motor Rotation Direction below.
- **Micro Steps**: Determines the precision and torque of the motor, this value must match the setting on the motor controller hardware. Check the ASD for correct settings.
- **Gearbox Installed**: If a gearbox installed on the actuator, select "Gearbox Installed"

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**: The device ID (also called address) of the IO-Expander, it is written on the nameplate of the IO-Expander. **Note:** the device number is not the same as the port number where the IO-Expander is connected.
- **Pin**: Which terminal on the IO-Expander the device is connected. Select between 0 to 3, depending on the device location. **Note:** The IO-Expander faceplate may number the connections 1 to 4. The software always 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 software.

Actuator Hardware Configuration

Motor Rotation Direction

By convention, motors have a positive and a negative rotation direction. This is an important consideration when installing the motor on a linear axis. When looking at the motor shaft and key, clockwise is the positive direction when using the normal motor direction setting. See figures below for motor rotations.

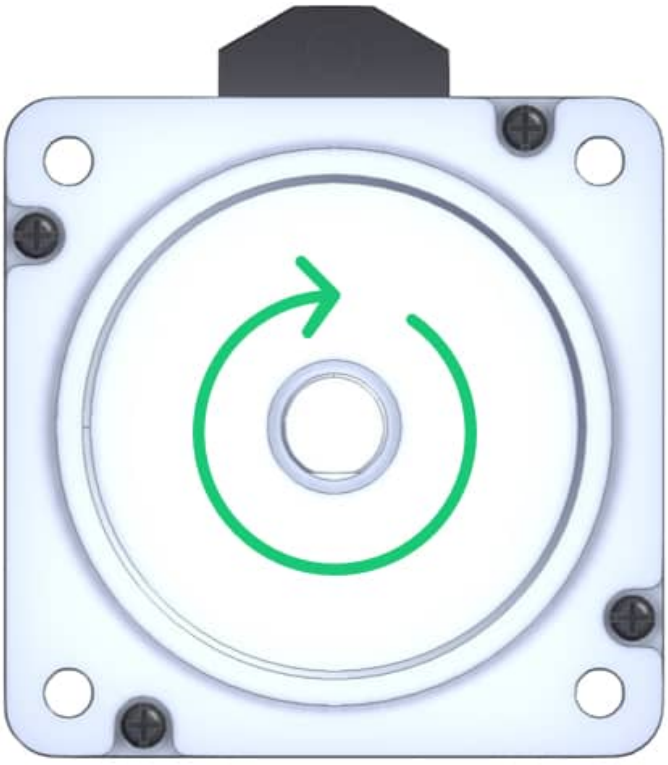


Figure 10: Motor positive rotation

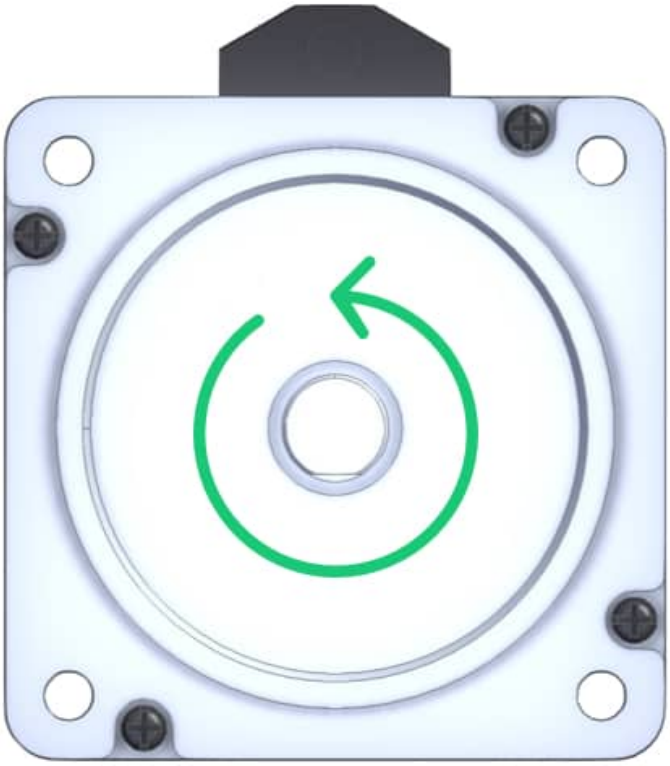
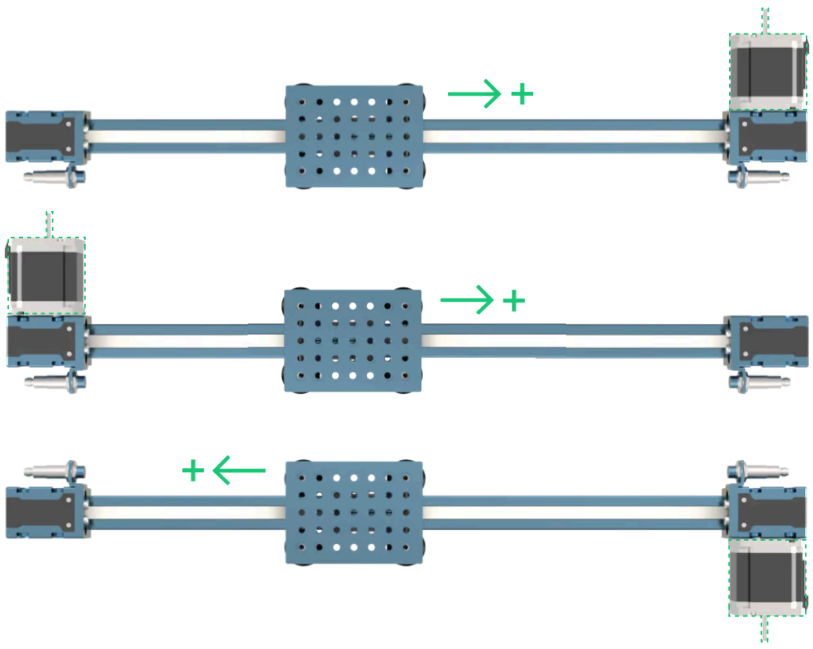


Figure 11: Motor negative rotation

Linear Axis Direction

In order to satisfy the application requirements, positive rotation of the motor shaft should result in linear motion in the desired direction. The figure below shows how the linear axis moves depending on where the motor is installed.



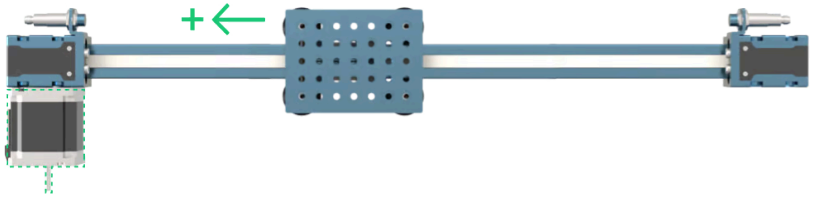


Figure 12: Axis direction based on motor location

End-of-Travel Sensors

Linear axes require end-of-travel sensors for two reasons:

- To perform homing operations (placing the axis in a known position, called home or zero)
- To disable motion before the actuator reaches the mechanical end of travel stops.

Inductive sensors are the preferred option for end-of-travel sensing since they are non-contact and less subject to environmental interference.

- M18 Inductive Proximity Sensor (Sn = 10 mm): CE-SN-004-0001 (https://www.vention.io/parts/244)

The image below details how to connect and position the end-of-travel 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 SENSOR1A
- The *over-travel* sensor is positioned such that a positive motion moves towards it
- The *over-travel* sensor is connected to port SENSOR1B

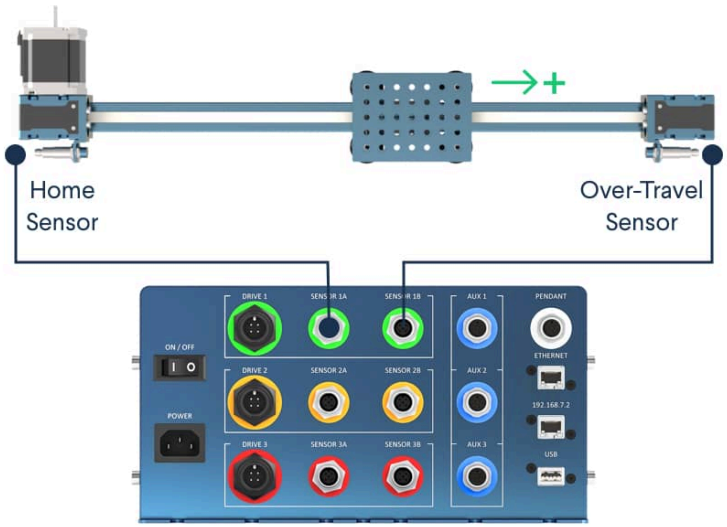


Figure 13: End-of-travel sensors connection

Direction Reversal

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

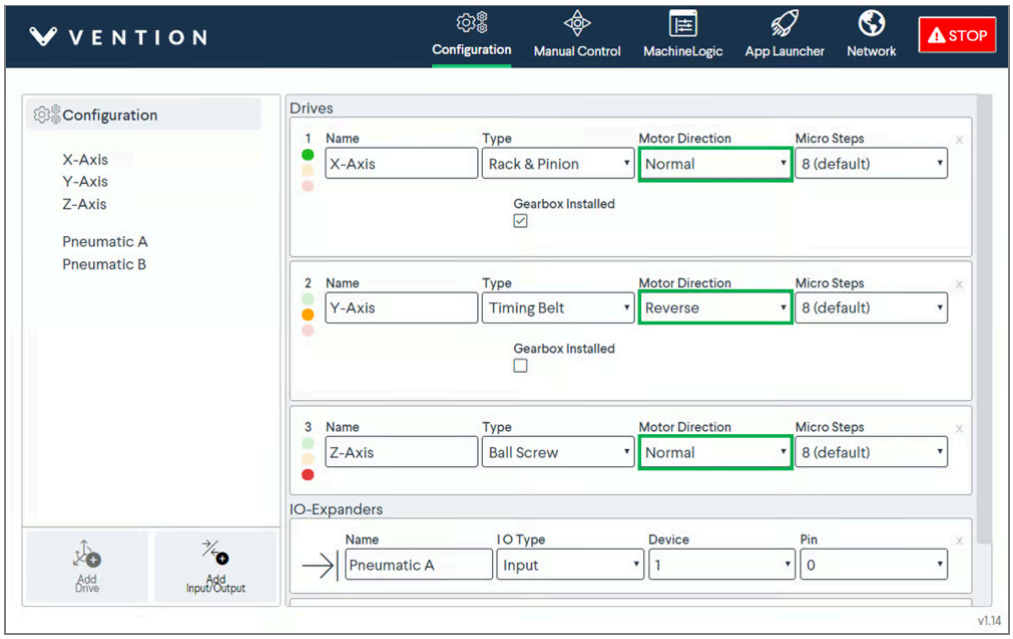


Figure 14: Axis direction reversal

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

Reversing the axis 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 SENSOR1B
- The *over-travel* sensor is positioned such that a positive motion moves towards it
- The *over-travel* sensor is connected to port SENSOR1A

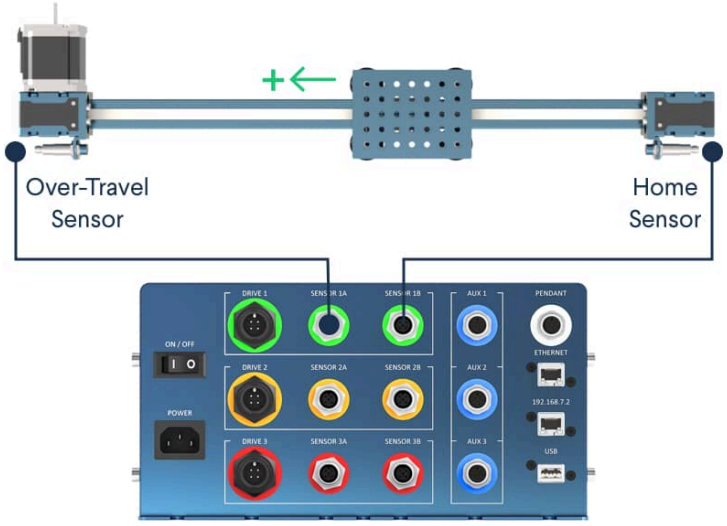


Figure 15: End-of-travel sensors connection in reversed mode

Testing Using Control Center

After configuring the axes and setting up the hardware, test the equipment using the **Manual Control** application.

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

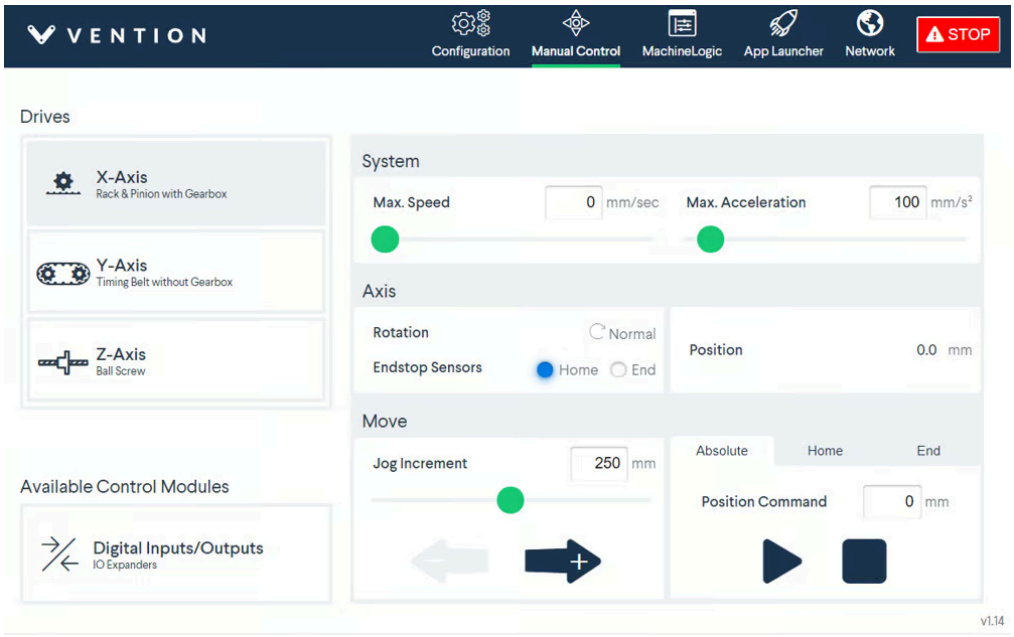


Figure 16: Getting to manual mode

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^2) under the field "**Max. Acceleration**" for testing purposes.

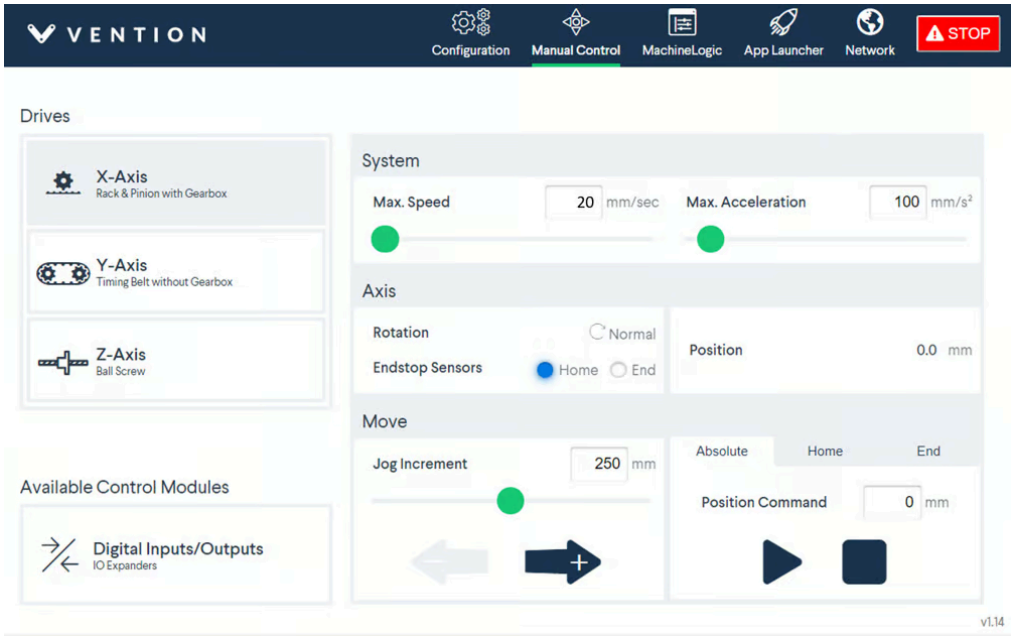


Figure 17: Setting max. speed and max. acceleration

STEP 3: Test the functionality of the end-stop sensors to ensure they are properly connected. Place a metal object (like a fastener or house key) in front of the 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.

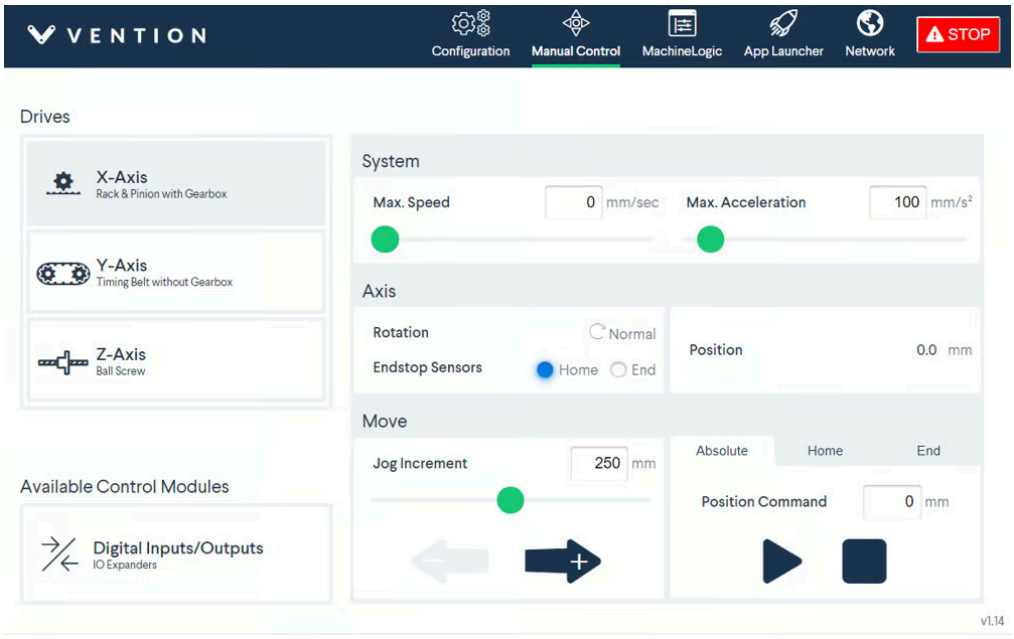


Figure 18: Triggering the home sensor

STEP 4: Jog the actuator at a set increment to ensure the motor is properly connected. Enter the desired jog increment (recommended: 50 mm), and click the left or right arrow to move the actuator. The actuator will move in that increment every time the left or right arrow is pressed. **Check that a positive jog moves the gantry toward the End sensor.**

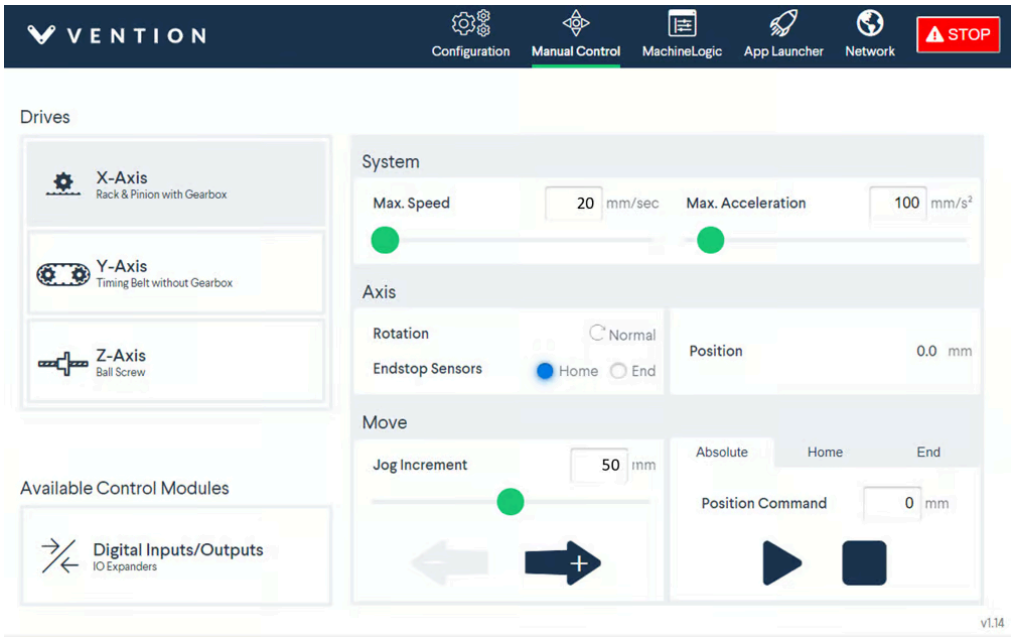


Figure 19: Jog the actuator

Programming Options

There are a few ways to program a MachineMotion controller, depending on the use case.

MachineApps

MachineApps are pre-built applications created by Vention for common use cases, such as palletizing and path following. MachineApps are code-free, only requiring configuration. MachineApps are purchased separately from the MachineMotion controller.

URCap

The Vention MachineMotion URCap allows for easy communication between the MachineMotion and a Universal Robots controller. The URCap is purchased separately from the MachineMotion controller and installed on the UR controller. For additional details on MachineMotion URCap, consult the URCap Guide (https://vention.io/docs/guides/urcapv3-machinelogic-for-universal-robots-108)

MachineLogic

The MachineLogic programming interface is a simple code-free programming tool for MachineMotion. To access MachineLogic, click on the **MachineLogic** tab across the top of the Control Center screen. For additional details on MachineLogic, consult the MachineLogic Guide (https://vention.io/docs/guides/how-to-automate-with-machinelogic-29)

Python Programs

Programs can also be written in Python either directly on the MachineMotion, or on a external computer. For additional details on Python Programming for MachineMotion, consult the Python Programming Manual (https://vention.io/docs/guides/programming-manual-python-55). Refer to the latest Python API (https://vention.io/resources/datasheets/python-api-reference-v4-0-203) for available commands in Python.

Low Level Socket Commands

The MachineMotion can be controlled by any device which can send and receive TCP/IP communication. These commands are typically used when a PLC or robot is going to control the MachineMotion. Refer to the latest Low Level Socket API (https://vention.io/resources/guides/socket-api-61) for available commands.