Challenge 04: Motion & 3D Viewer App

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Let’s Start!

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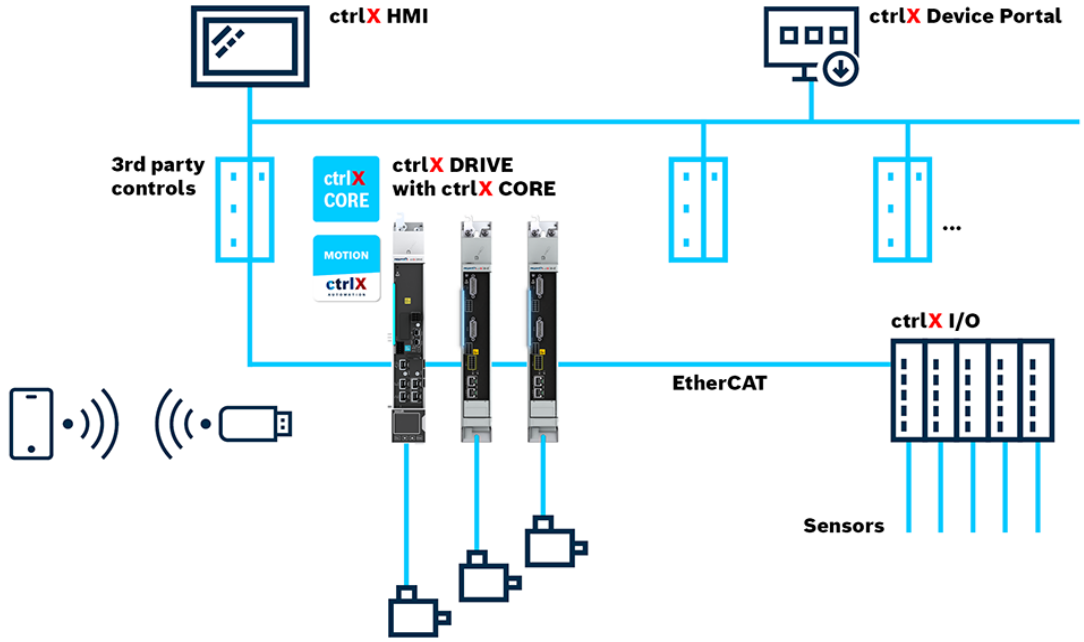
Inform

ctrlX AUTOMATION - Motion

The ultimate solution for precise motion control. This versatile app provides essential functions for single-axis positioning, supporting up to 4 axes per controller and offering seamless management of linear, rotary, and modulo axes as real or virtual entities. With features like PLC Open command libraries, jog and teach modes, unit switching, gantry axle operation, override settings, and advanced functionalities such as collision detection and Rest-API integration, ctrlX MOTION equips you with the tools to master complex motion scenarios and enhance automation efficiency. Plus, its compatibility with optional technology packages allows you to expand its capabilities to meet specific requirements, making it the go-to solution for motion control in various industries.

Information about the ctrlX Motion App can be found online:

- ctrlX Motion App | ctrlX AUTOMATION Community
- FAQ for ctrlX Motion | ctrlX AUTOMATION Community
- ctrlX Motion App | Application Manual



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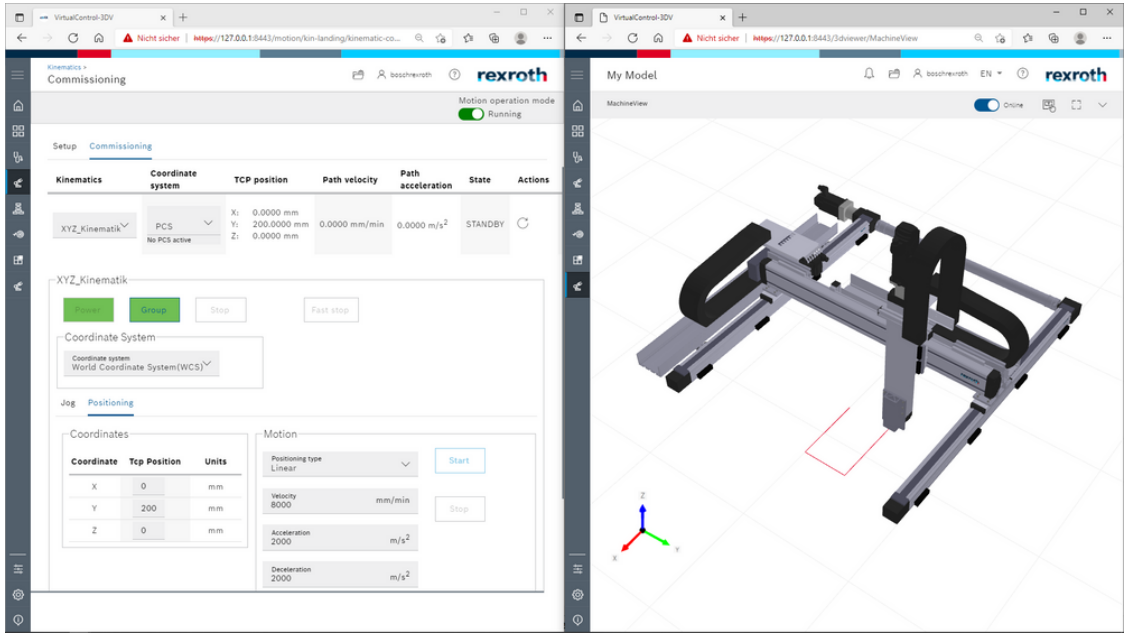
Inform

ctrlX AUTOMATION – 3D Viewer

An innovative application that revolutionizes the way we perceive and interact with digital twins of machines and robots. Built to harness the power of 3D kinematics simulation on the ctrlX CORE, this app serves as a gateway to a new era of virtual commissioning, programming, and validation. By seamlessly integrating the axes relationships of a kinematic system and 3D geometries in STL format, the ctrlX 3D Viewer leverages real axis values from the ctrlX Data Layer to enable precise, synchronized motion of digital twins. The product boasts an array of features, including a user-friendly web-based interface, offline and online modes, a model library, and integration into custom HMI screens. In a world increasingly reliant on 3D visualization, the ctrlX 3D Viewer redefines the possibilities for automation technology, ushering in a future where machines and robots come to life in the virtual realm.



Information about the ctrlX 3D Viewer App can be found online:

- ctrlX 3D Viewer App | ctrlX AUTOMATION Community
- ctrlX 3D Viewer App | Application Manual

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Challenge 04: Motion App

Task 01

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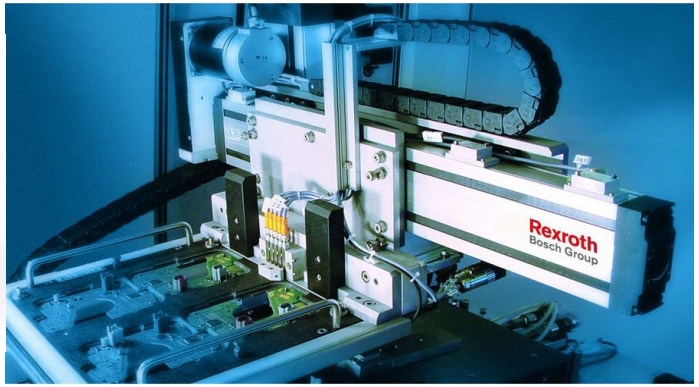
Challenge 04: ctrlX Motion App | Task 01



Description

In an industrial assembly line, you are installing a Cartesian Multi-Axis System (CMS) for pick-and-place tasks. These systems accurately pick components from one location and place them precisely in another location. The precise and synchronized movement along multiple axes enables automation, precision manufacturing, and enhanced productivity. You are assigned to configure and commission the system. When the system is on, you should be able to move the Axes to the desired positions.

Task

This task will test your ability and understanding on configuring and commissioning basic Motion functions for single and multi-axes positioning.

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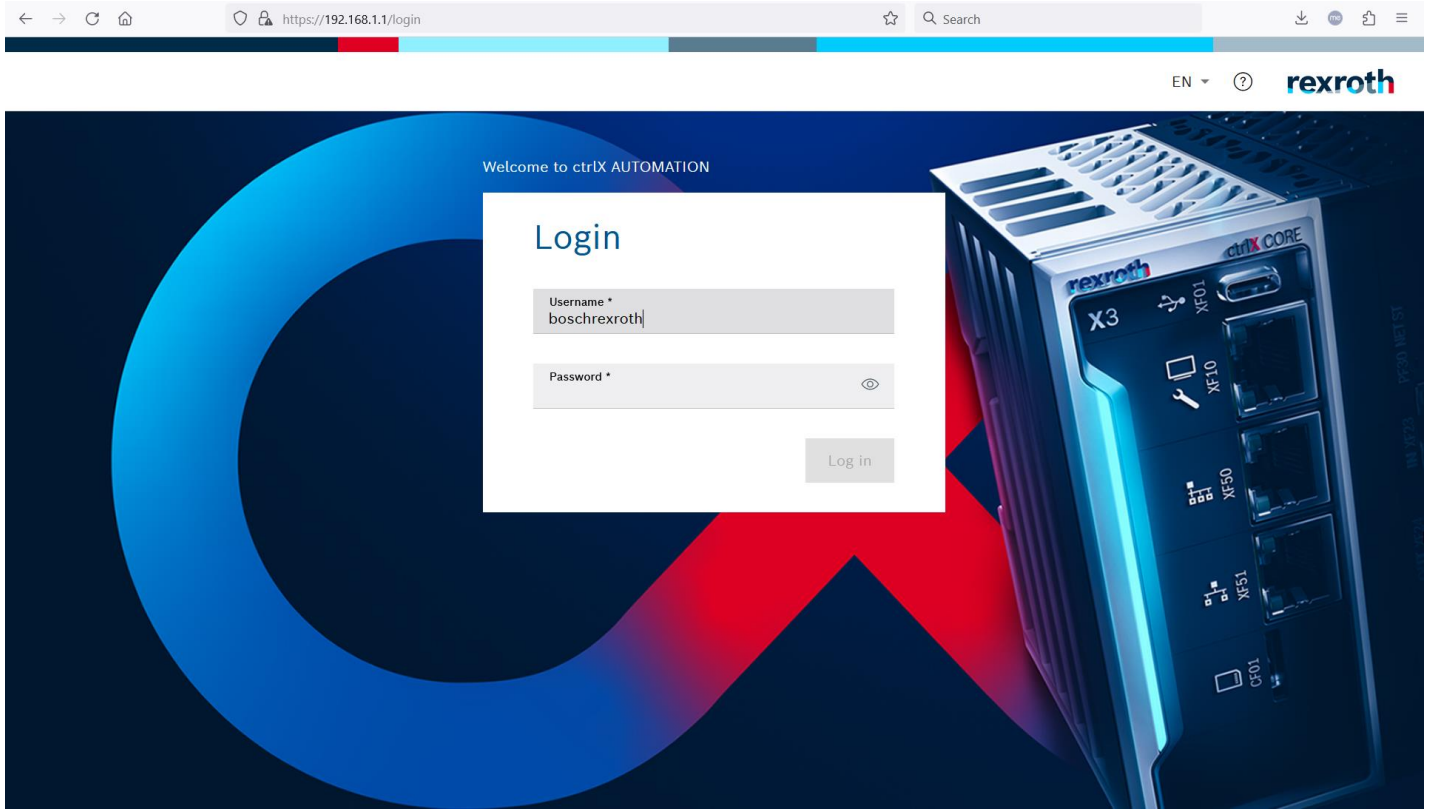
Steps

1. Login into the ctrlX CORE web-based user interface. Enter the Login details (Username: boschrexroth, Password: B0schrexroth).

ctrlX Web-Based User Interface – Login Page



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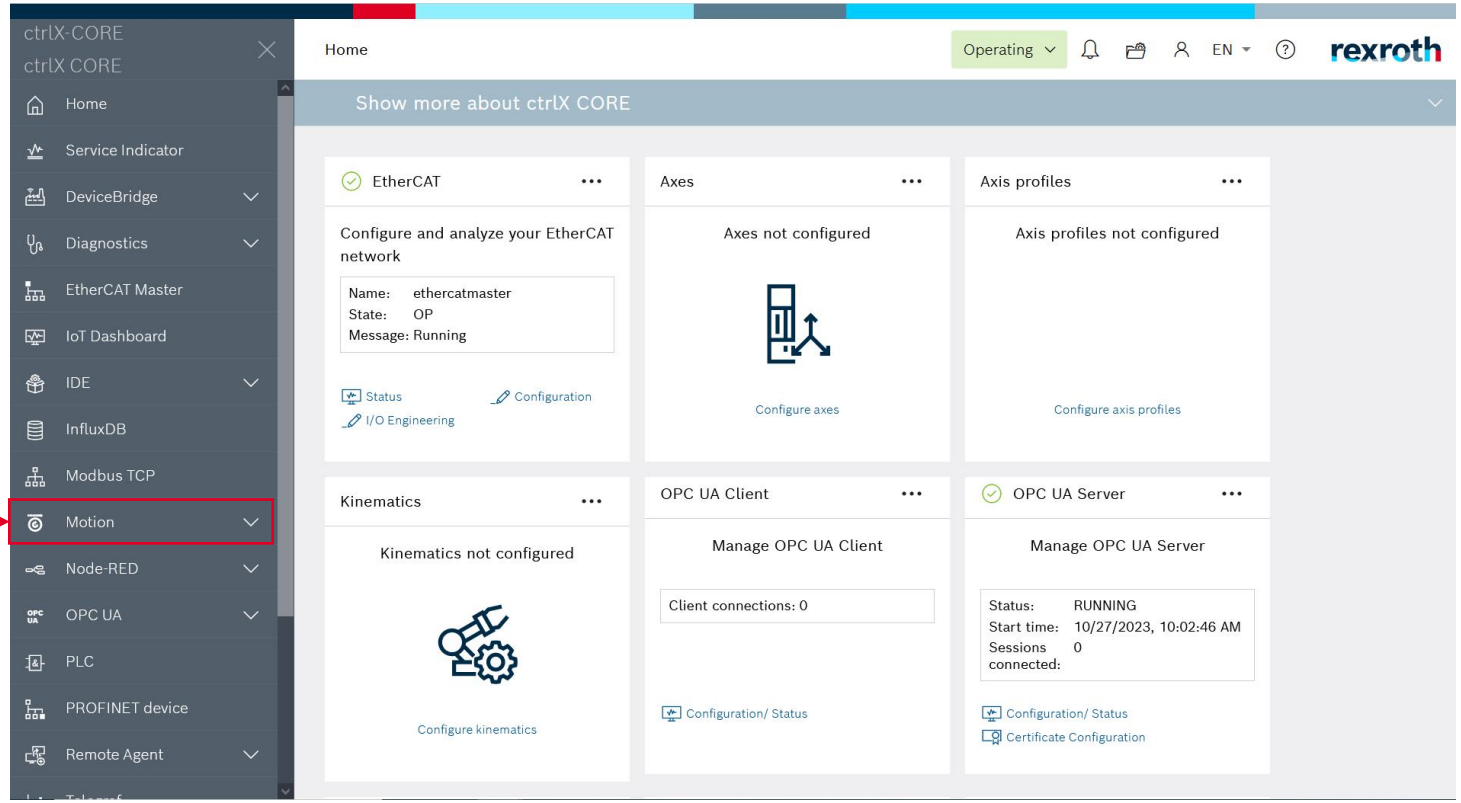
Steps

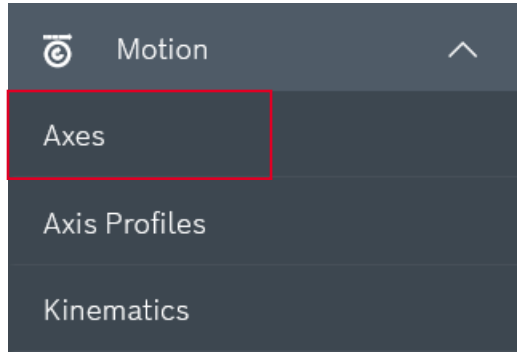
2. After successfully logging in, navigate to the **Motion App** from the Home page of the ctrlX CORE Web Based User Interface.

ctrlX Web-Based User Interface – Home Page



1. Click on the Motion App

2. Click on Axes



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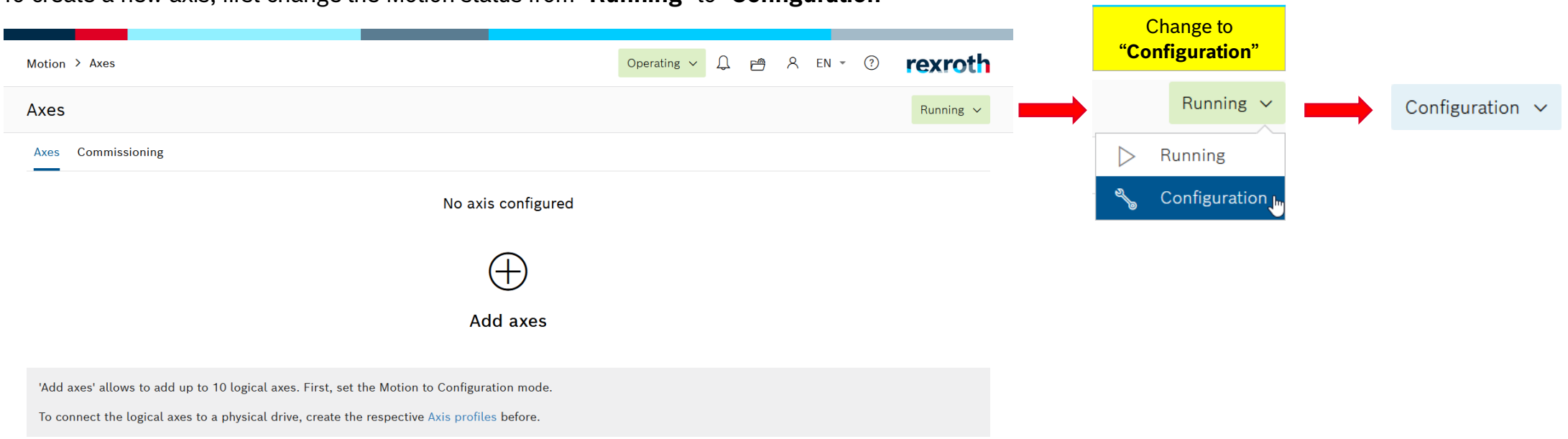
Steps

3. You will view the Motion Axes Overview window which currently has no axis configured. This is where new axes will be added (or edit existing ones).

ctrlX Motion – Axes Overview

- To create a new axis, first change the Motion status from “**Running**” to “**Configuration**”



- A popup notification will indicate a successful change

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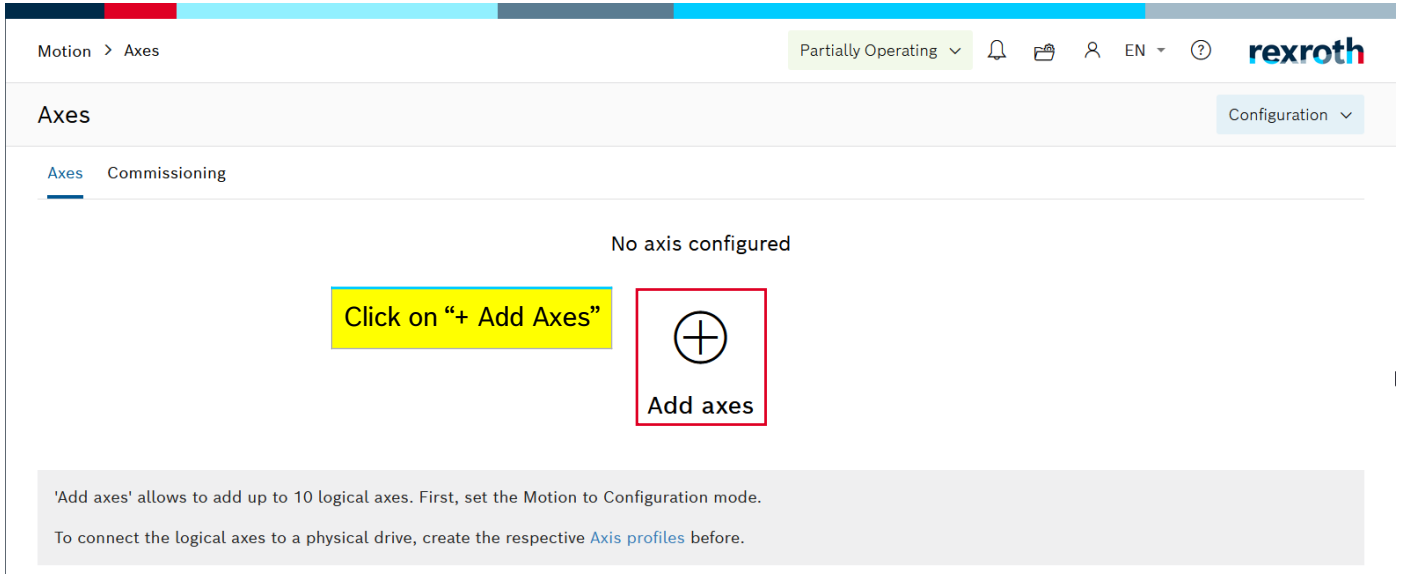
Steps

4. Once in Configuration status, Add an Axis.

ctrlX Motion – Add an Axis

- To add a Motion Axis, click on the ⊕ **Add axes** button at the center of the Axes overview window



- By clicking Add Axes, the editor window will open

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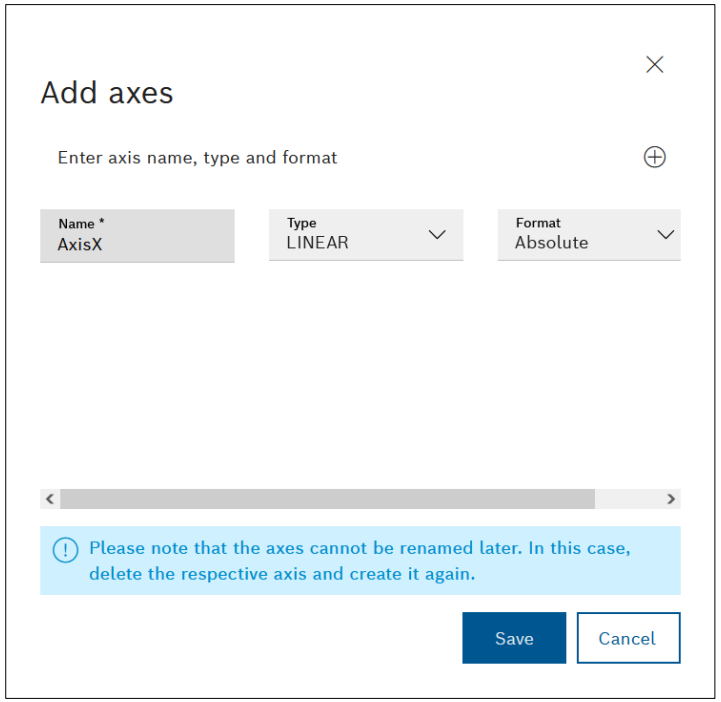
Steps

5. Enter the Axis name, type and format.

ctrlX Motion – Enter Axis Information

- In the Add Axes editor window, fill in the below:
  - Name: **AxisX**
  - Type: **LINEAR**
  - Format: **Absolute**
- Click the **Save** button and the editor is closed
- A popup notification will indicate the axis has been added



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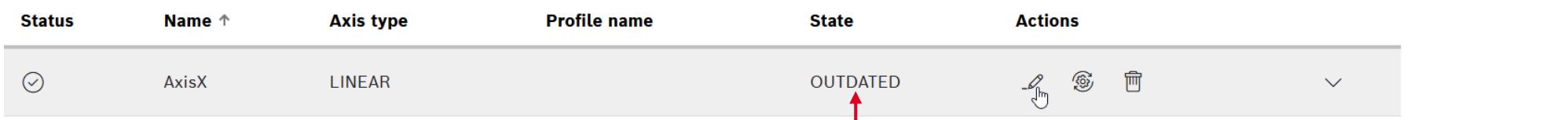
Steps

6. Once an Axis has been added, it can be viewed from the Axis overview page.

ctrlX Motion – Axis State

- For each configured axis, a line is inserted in the table of the Axes overview window in which, apart from the axis name, the axis state as well as possible actions for the axis are listed.



"State"
Operating state of the axis.
An axis can assume the following operating states:

- "DISABLED": Axis is without power
- "STANDSTILL": The axis is setup and has power
- "DISCRETE_MOTION": Single axis in motion
- "SYNCHRONIZED_MOTION": The axis is a gantry slave
- "COORDINATED_MOTION": The axis is part of a kinematics
- "ERRORSTOP": An error occurred in the axis
- "OUTDATED": The Motion system is in "Configuration mode"

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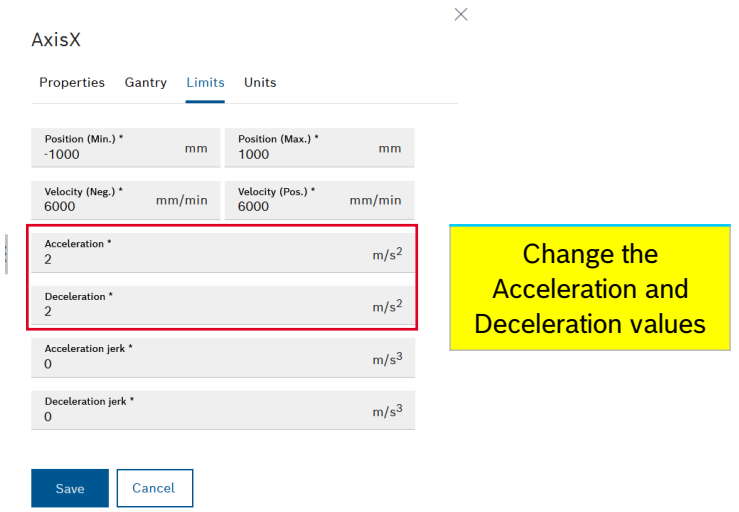
Steps

7. Next, edit the Motion Axis properties.

ctrlX Motion – Axis Properties

- Click on the button to edit the Axis properties.

- In the Axis properties editor, you can view and change the axis settings or the axis assignment
- Select the "**Limits**" tab to specify the limit values of the axis that must not be exceeded in the motion commands
- Fill in the below:
  - Acceleration: **100 m/s²**
  - Deceleration: **100 m/s²**
- Click the **Save** button and the editor is closed



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Steps

8. Now it’s your turn! Complete the tasks below.

Do It Yourself

- Add two (2) new Motion Axes

1. Axis #2
    - Name: **AxisY**
    - Type: **LINEAR**
    - Format: **Absolute**
    - **Limits:**
        - Acceleration: **100 m/s²**
        - Deceleration: **100 m/s²**

2. Axis #3
    - Name: **AxisZ**
    - Type: **LINEAR**
    - Format: **Absolute**
    - **Limits:**
        - Acceleration: **100 m/s²**
        - Deceleration: **100 m/s²**

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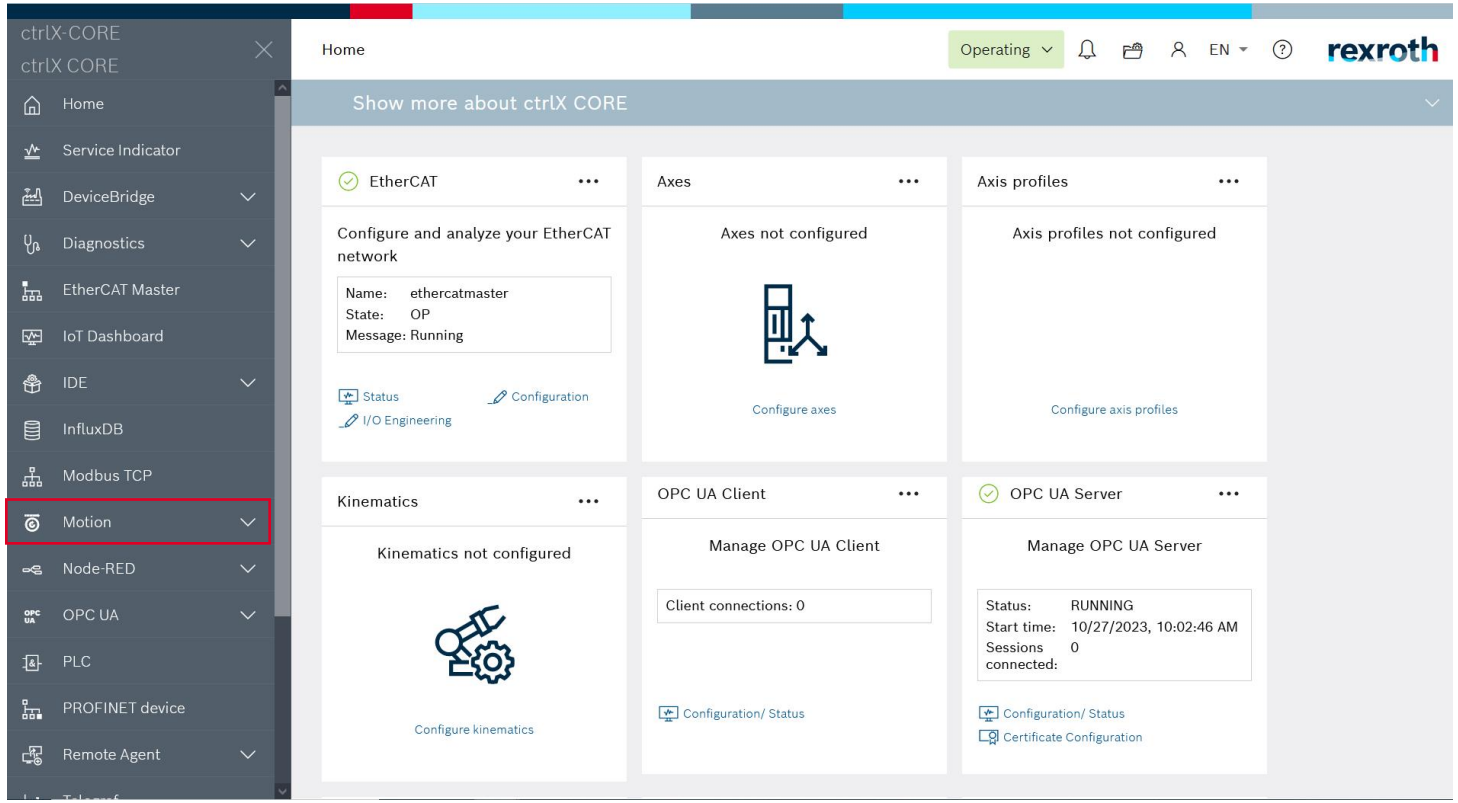
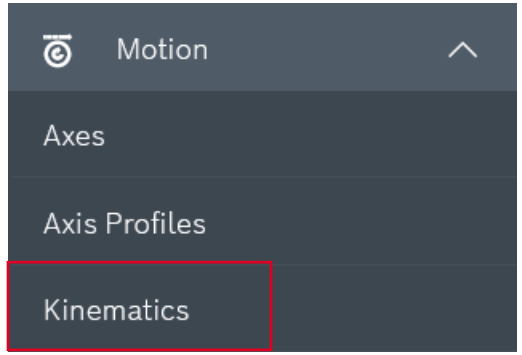
Steps

9. After successfully adding the **Motion Axes**, go to the “**Kinematics**” window. This is where new kinematics will be added.

ctrlX Web-Based User Interface – Home Page



Click on Kinematics



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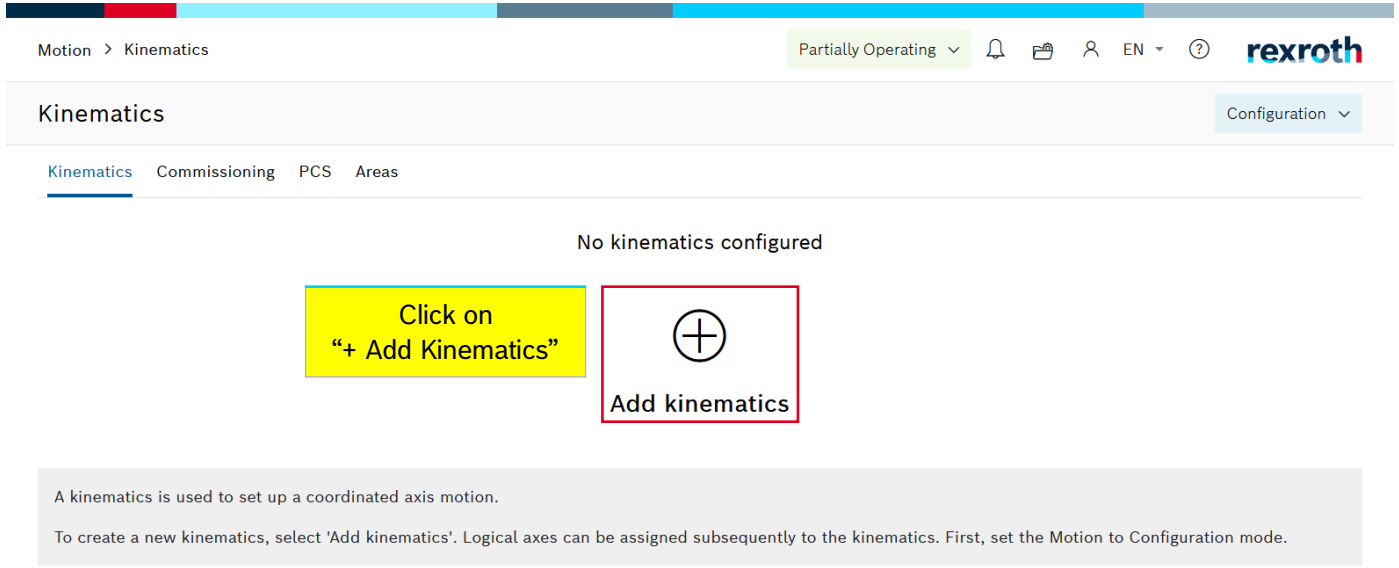
Steps

10. Add a new Kinematics.

ctrlX Motion – Add a Kinematics

- Click on the ⊕ **Add Kinematics** button at the center of the Kinematics overview window



- By clicking Add Kinematics, the editor window will open

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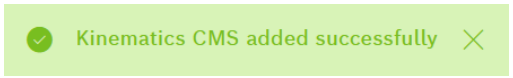
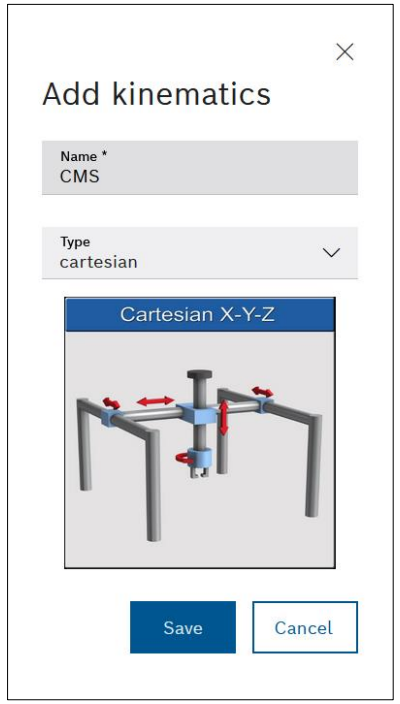
Steps

11. Enter the Kinematics name and type.

ctrlX Motion – Enter Kinematics Information

- In the **Add Kinematics** editor window, fill in the below:
  - Name: **CMS**
  - Type: **cartesian**
- Click the **Save** button and the editor is closed
- A popup notification will indicate the Kinematics has been added





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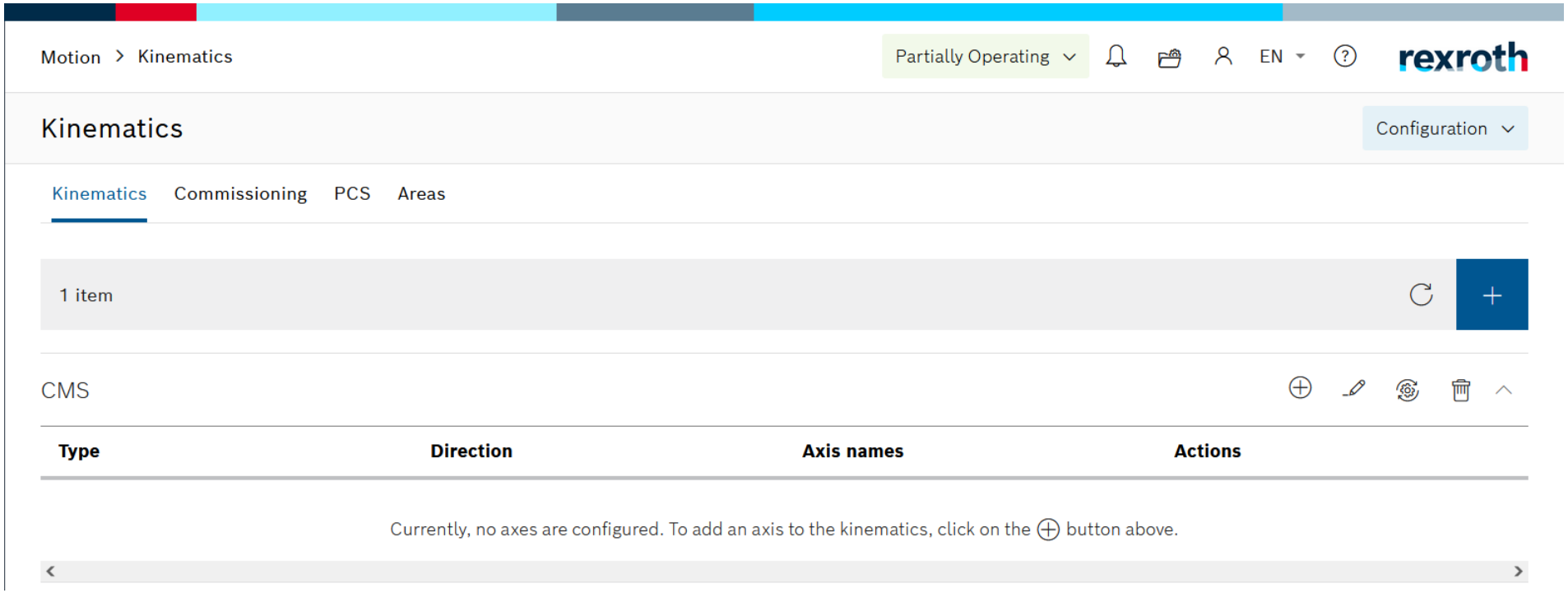
Steps

12. Once the Kinematics have been added, it can be viewed from the Kinematics overview page.

ctrlX Motion – Kinematics Overview

- For each configured kinematics, a line is inserted in the table of the kinematics overview window



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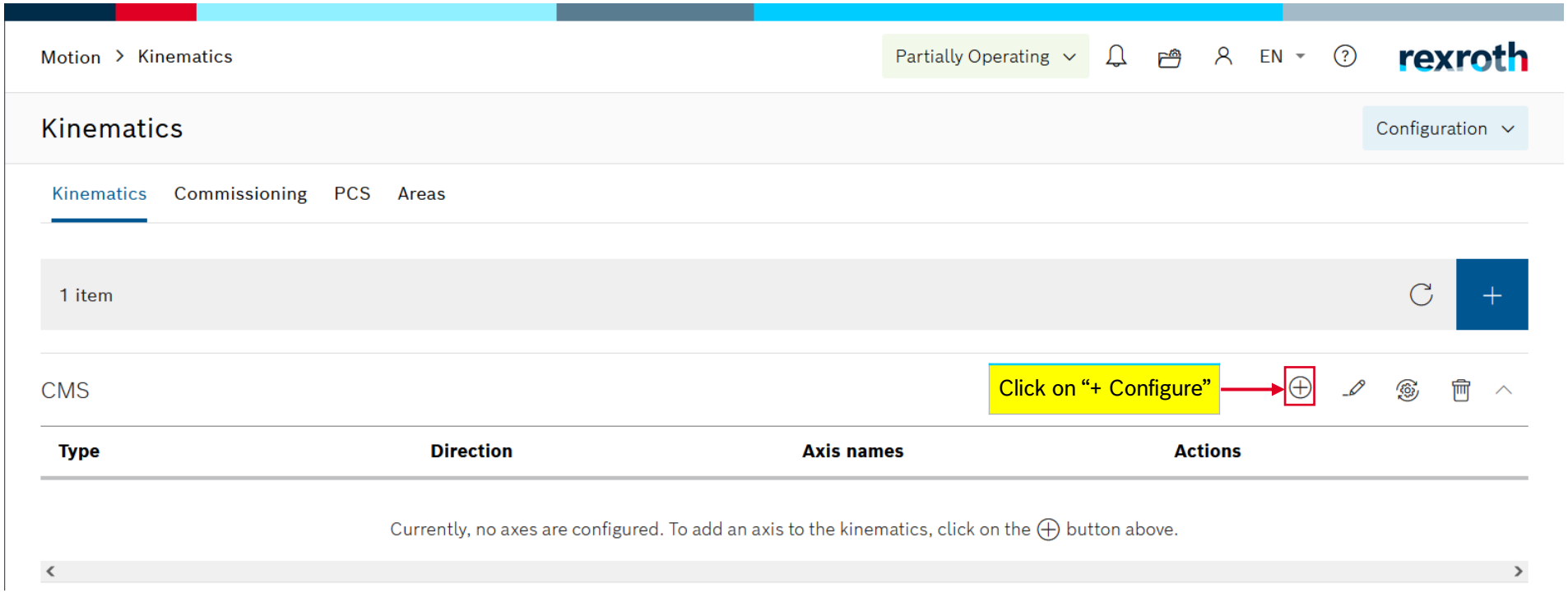
Steps

13. Configure the kinematics and assign the axes to the kinematics.

ctrlX Motion – Configure Kinematics

- Click on the ⊕ button to configure the kinematics. The “**Assign Axis**” editor will open



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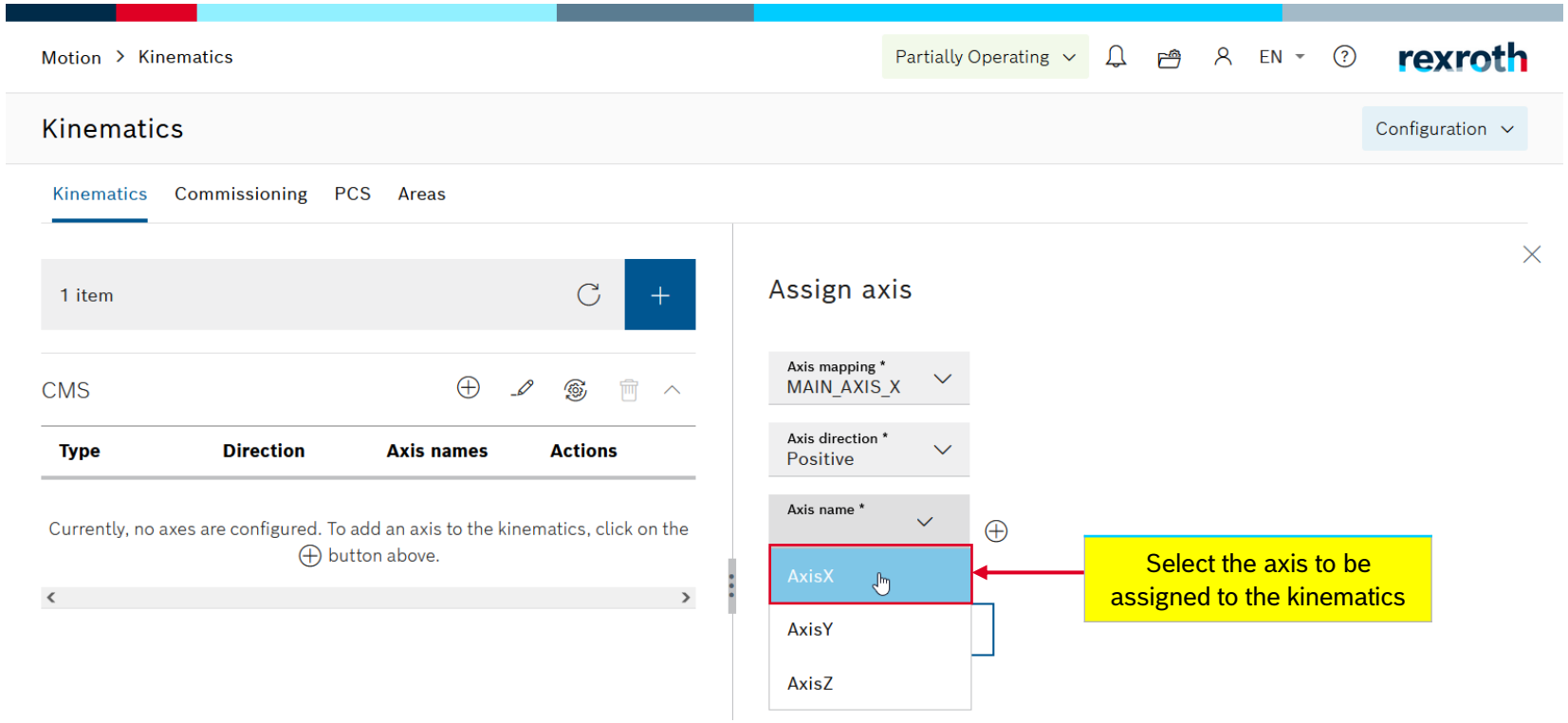
Steps

14. Assign the Axes to the kinematics

ctrlX Motion – Assign Axes to Kinematics

- In the “**Assign Axis**” editor on the right, you can assign already configured axes to the kinematics
- Under the “**Assign Axis**” field, enter the information:
  - Axis mapping: **MAIN_AXIS_X**
  - Axis direction: **Positive**
  - Axis name: **AxisX**
- Click the **Save** button and the editor is closed
- A popup notification will indicate the axis has been added

Axis AxisX added to kinematics CMS.



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Steps

15. Now it's your turn! Complete the tasks below.

Do It Yourself

- Assign the remaining two (2) Axes to the "**CMS**" Kinematics

1. Axis #2
    - Axis mapping: **MAIN_AXIS_Y**
    - Axis direction: **Positive**
    - Axis Name: **AxisY**

2. Axis #3
    - Axis mapping: **MAIN_AXIS_Z**
    - Axis direction: **Positive**
    - Axis Name: **AxisZ**

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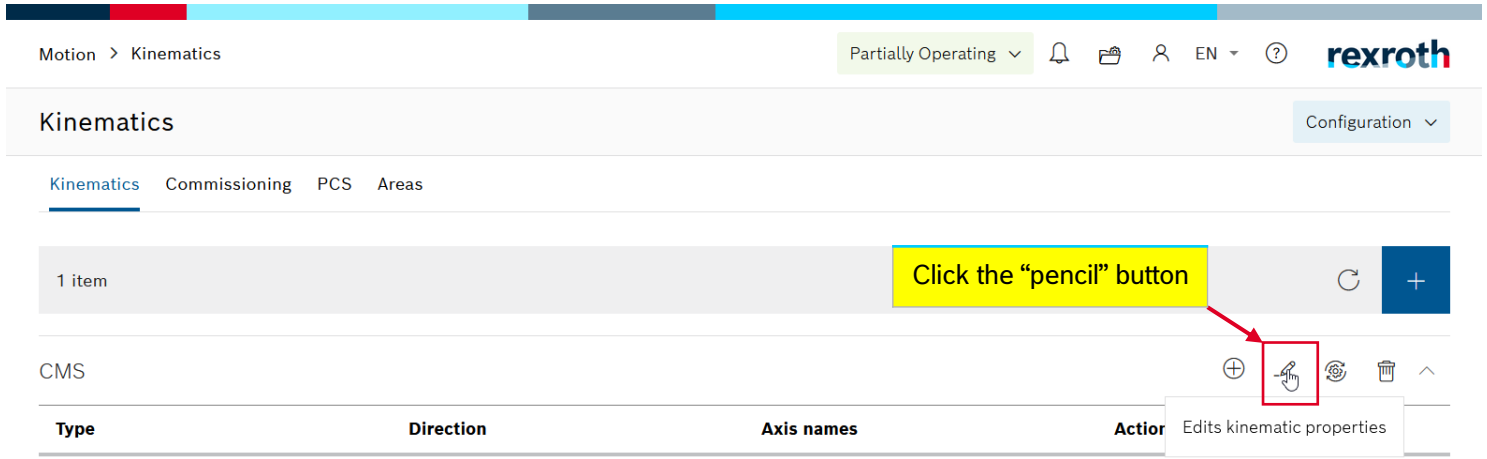
Steps

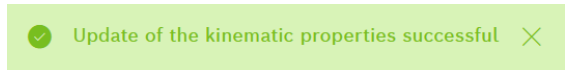
16. After assigning the Axes to the Kinematics, edit the “**kinematics properties**”

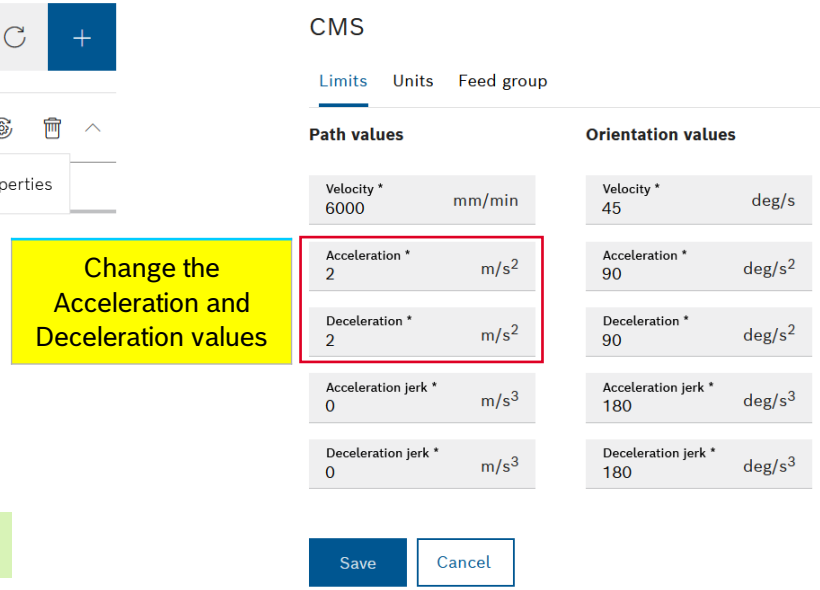
ctrlX Motion – Edit Kinematics Properties

- In the Kinematics overview window, click the button to open the editor



- In the kinematics properties editor, under the “**Limits**” tab, fill in the values:
  - Acceleration: **100 m/s²**
  - Deceleration: **100 m/s²**
- Click the **Save** button and the editor is closed
- A popup notification will indicate the successful update





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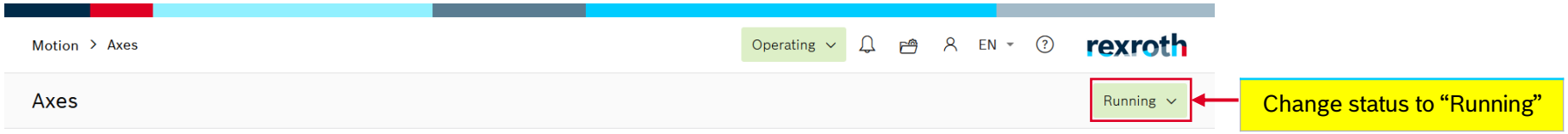
Steps

17. After successfully adding and configuring the Axes and Kinematics, change the Motion status back to “**Running**”.

ctrlX Motion – Change To Running Status

- Change the Motion status from “**Configuration**” to “**Running**”



- A popup notification will indicate a successful change

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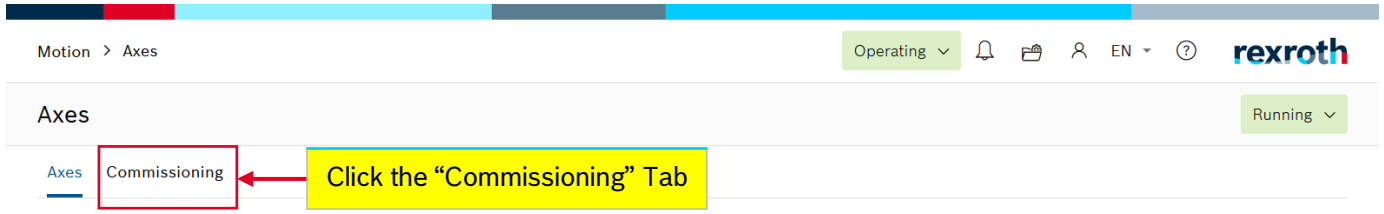
Challenge 04: ctrlX Motion App | Task 01

Steps

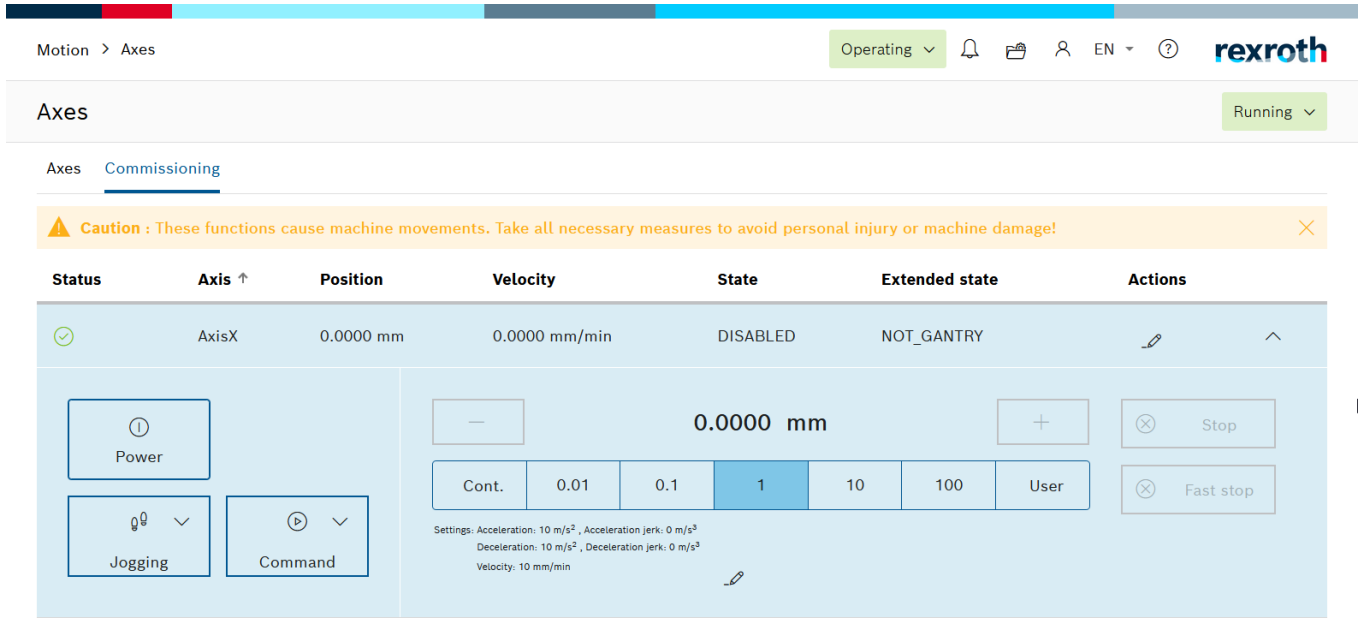
18. The Axes that have been added can be directly tested with the **“Commissioning”** function built-in ctrlX Motion App

ctrlX Motion – Axes Commissioning

- Open the **Axes** overview window and click the **“Commissioning”** tab



- Axes **“Commissioning”** functions to power up and move Axes without writing a PLC program
- This is especially useful during the commissioning if the PLC program is not complete or if an axis is to be moved differently as intended in the PLC program for test purposes



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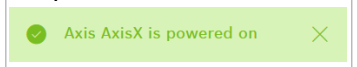
Steps

18. The Axes that have been added can be directly tested with the **"Commissioning"** function built-in ctrlX Motion App

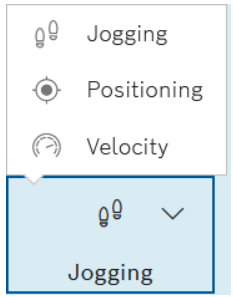
ctrlX Motion – Axes Commissioning (Jogging mode)

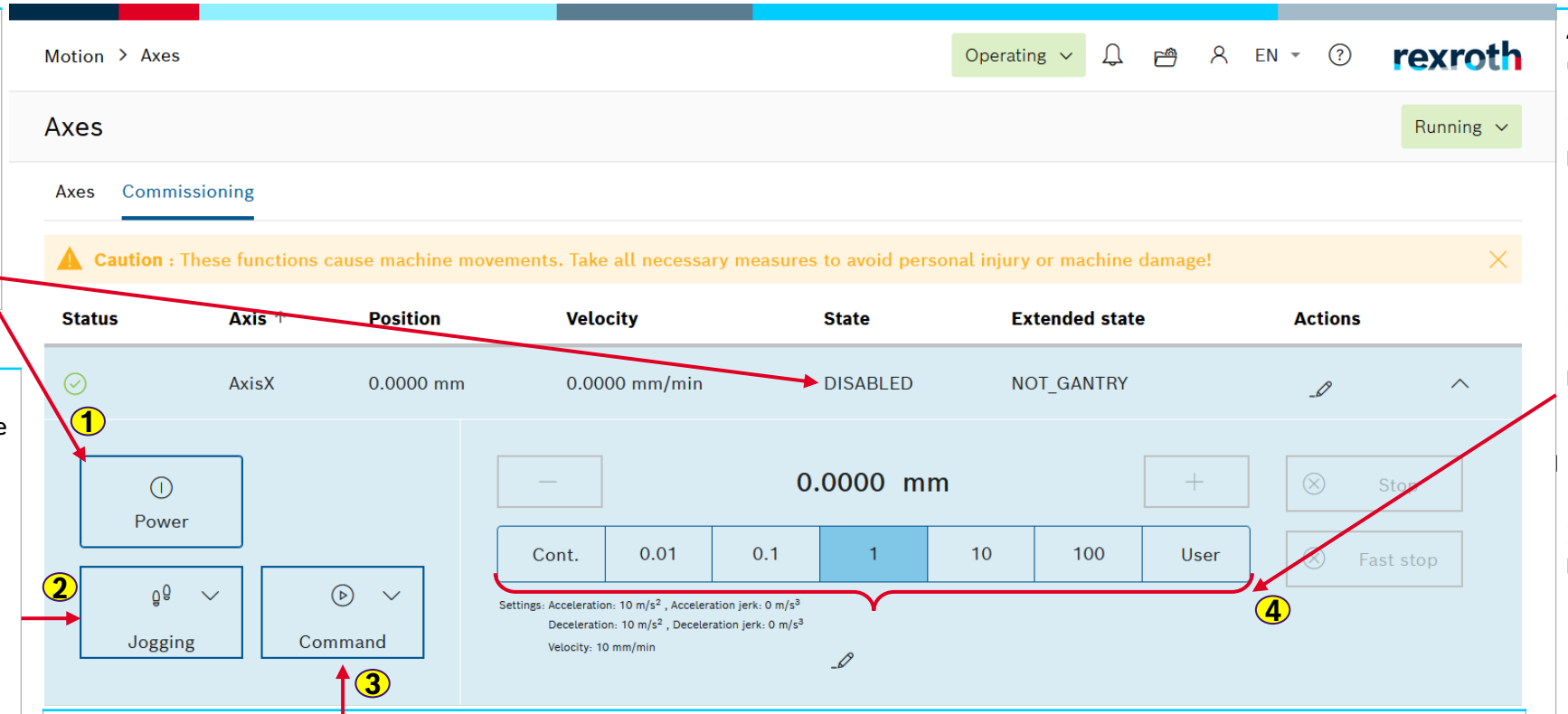
1. Click the "**Power**" button
   - A popup notification will indicate the Axis is powered on



   - State will change to STANDSTILL

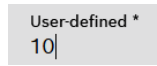
2. "**Motion Type**" button
   - Select "**Jogging**" from the list:





3. "**Command**" or "**Settings**" button. Toggle between displaying the available commands or displaying/ changing the motion parameters (velocity, acceleration, ...)

4. In "**Jogging**" mode,
   - Select the available commands:
   - ➢ **"Cont."**: Continuous
   - ❑ During continuous jogging move the axis in positive direction using the "+" or negative direction "–" button
   - ➢ Incremental : **"0.01", "0.1", "1", "10", "100"**
   - ❑ During incremental jogging, the step width is selected to move the axis in positive or negative direction
   - ➢ **User** : User defined
   - ❑ Any step width can be entered under "**User defined**" field



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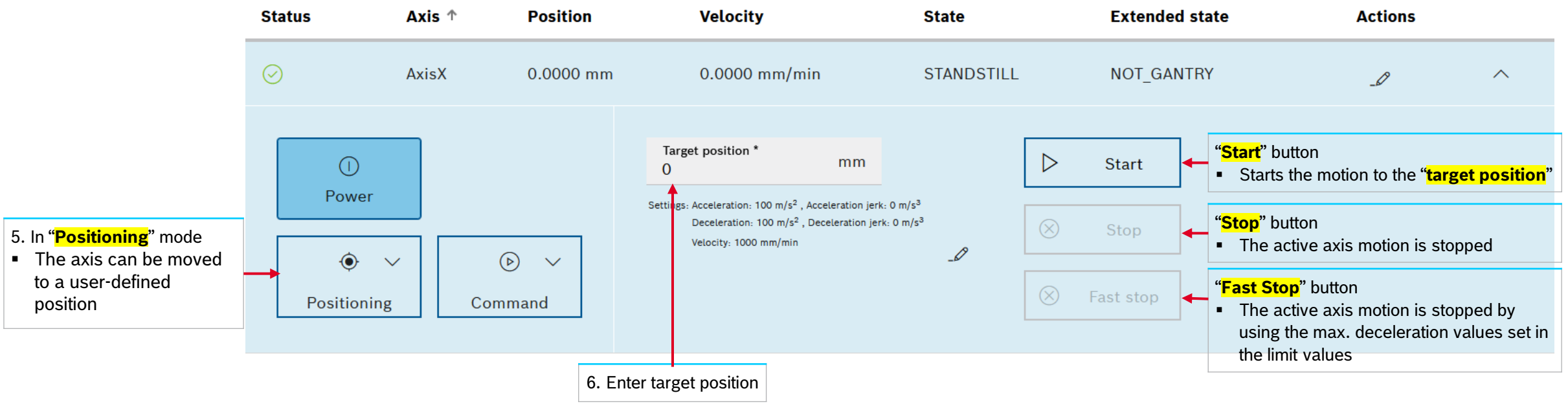
Steps

18. The Axes that have been added can be directly tested with the **“Commissioning”** function built-in ctrlX Motion App

ctrlX Motion – Axes Commissioning (Positioning mode)



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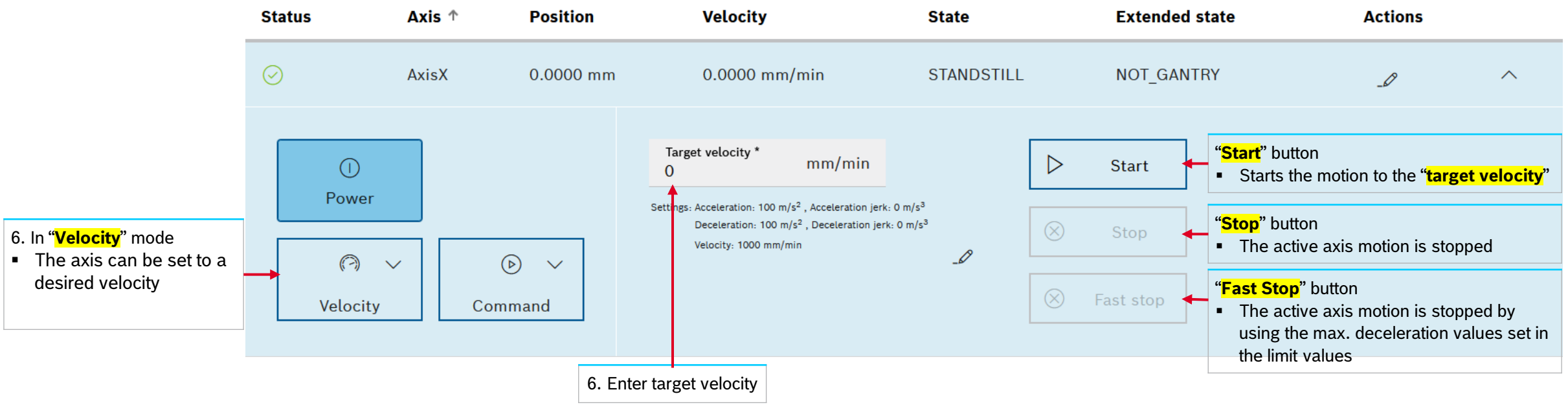
Steps

18. The Axes that have been added can be directly tested with the **“Commissioning”** function built-in ctrlX Motion App

ctrlX Motion – Axes Commissioning (Velocity mode)



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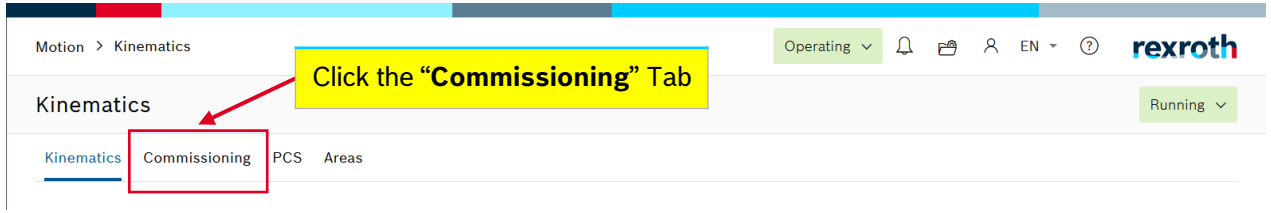
Steps

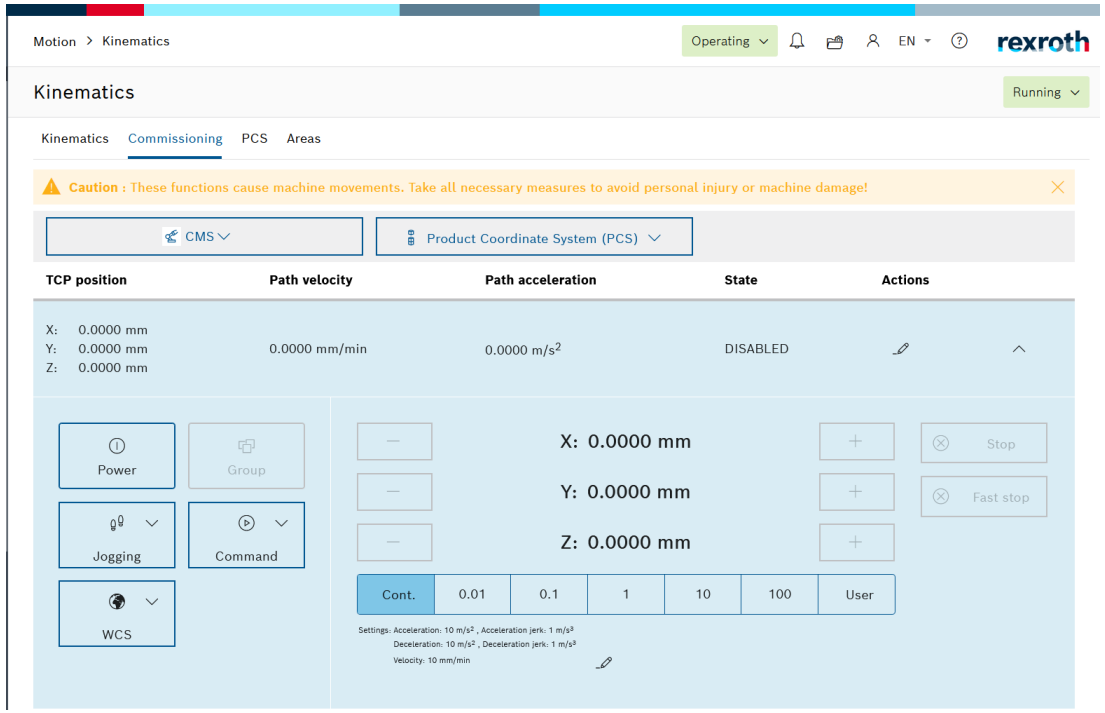
19. The Kinematics that have been added can be directly tested with the **“Commissioning”** function built-in ctrlX Motion App

ctrlX Motion – Kinematics Commissioning

- Open the **Kinematics** overview window and click the **“Commissioning”** tab



- Kinematics **“Commissioning”** functions to move a Group of Axes without writing a PLC program
- This is especially useful during the commissioning if the PLC program is not complete or if a Kinematics is to be moved differently as intended in the PLC program for test purposes



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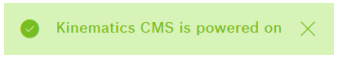
Steps

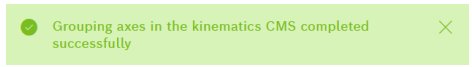
19. The Kinematics that have been added can be directly tested with the **"Commissioning"** function built-in ctrlX Motion App

ctrlX Motion – Kinematics Commissioning (Jogging mode)

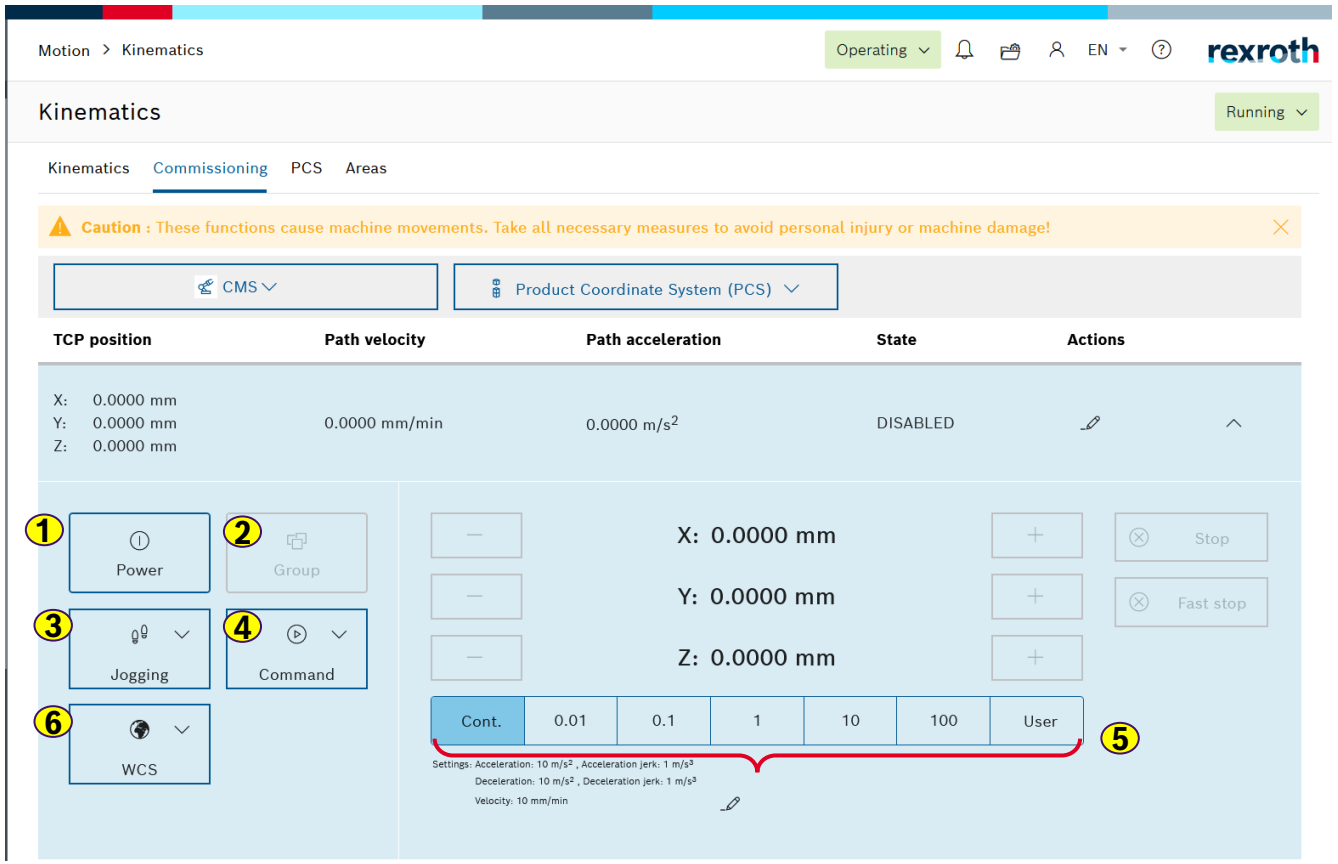
1. Click the "**Power**" button
   - A popup notification will indicate the Kinematics is powered on



2. Click the "**Group**" button
   - By grouping the Axes, it is going to grab the X, Y and Z Motion Axes and pull them into the kinematics and coordinate those Axes together
   - A popup notification will indicate the Grouping is successful



3. "**Motion Type**" button
   - Select "**Jogging**" from the list:



4. "**Command**" or "**Settings**" button.
   - Description same as before

5. In "**Jogging**" mode,
   - Select the available commands:
   - ➢ **"Cont."**: Continuous
   - ❑ During continuous jogging move the axis in positive direction using the "**+**" or negative direction "**–**" button
   - ➢ Incremental : **"0.01", "0.1", "1", "10", "100"**
   - ❑ During incremental jogging, the step width is selected to move the axis in positive or negative direction
   - ➢ **User** : User defined
   - ❑ Any step width can be entered under **"User defined"** field

6. "**WCS**" : World Coordinate System

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Challenge 04: ctrlX Motion App | Task 01

Steps

20. Now it’s your turn! Complete the tasks below.

Try It Yourself

- Switch to “**Positioning**” mode
- In “**Settings**”, change the values:
  - Velocity: **1000 mm/min**
  - Acceleration: **100 m/s²**
  - Deceleration: **100 m/s²**
- Move the Kinematics:
  - X-Axis: **450 mm**
  - Y-Axis: **350 mm**
  - Z-Axis: **150 mm**

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Challenge 04: ctrlX Motion App | Task 01

Steps

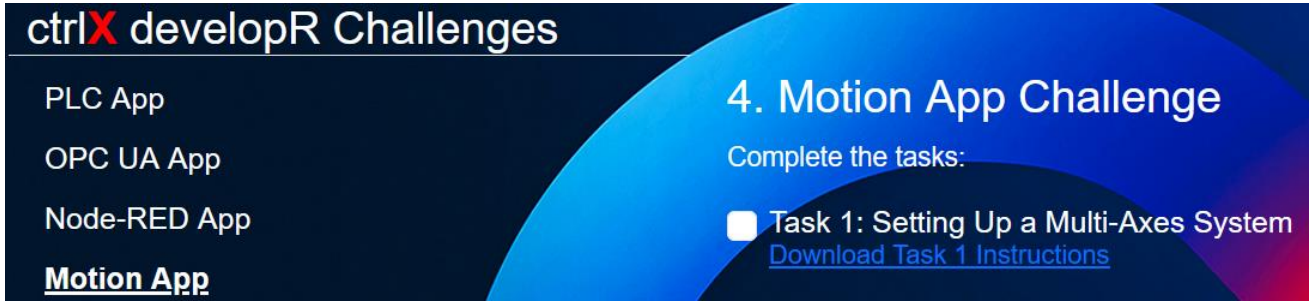
Once you have completed Task 1, follow the steps below.

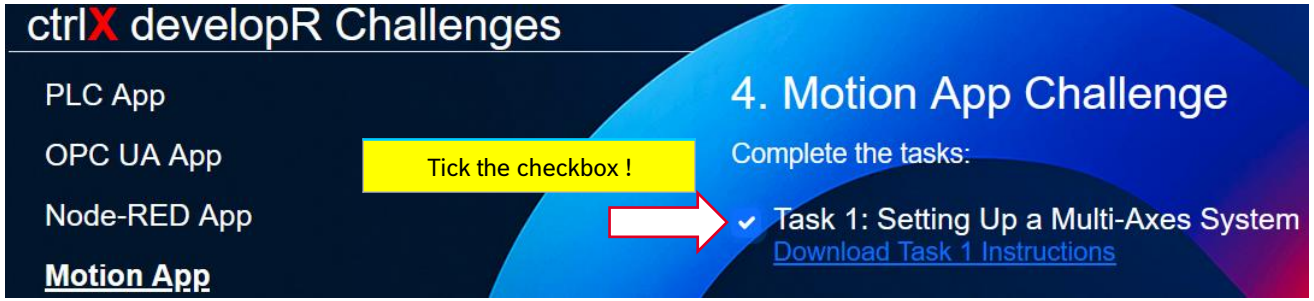
How to complete Task 1 Motion App

- You can test your solution against the Task description
- Once it satisfies the task requirements, confirm that you have completed the task by informing the available instructor for verification
- In the ctrlX developR challenge website, under the Motion App challenge section, tick [✓] the Task 1 checkbox

Congratulations on completing Task 1!

Proceed to Task 2!





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