

# Challenge 04: Motion & 3D Viewer App

**MOTION**

**ctrlX**  
AUTOMATION

**3D Viewer**

**ctrlX**  
AUTOMATION



# Let's Start!

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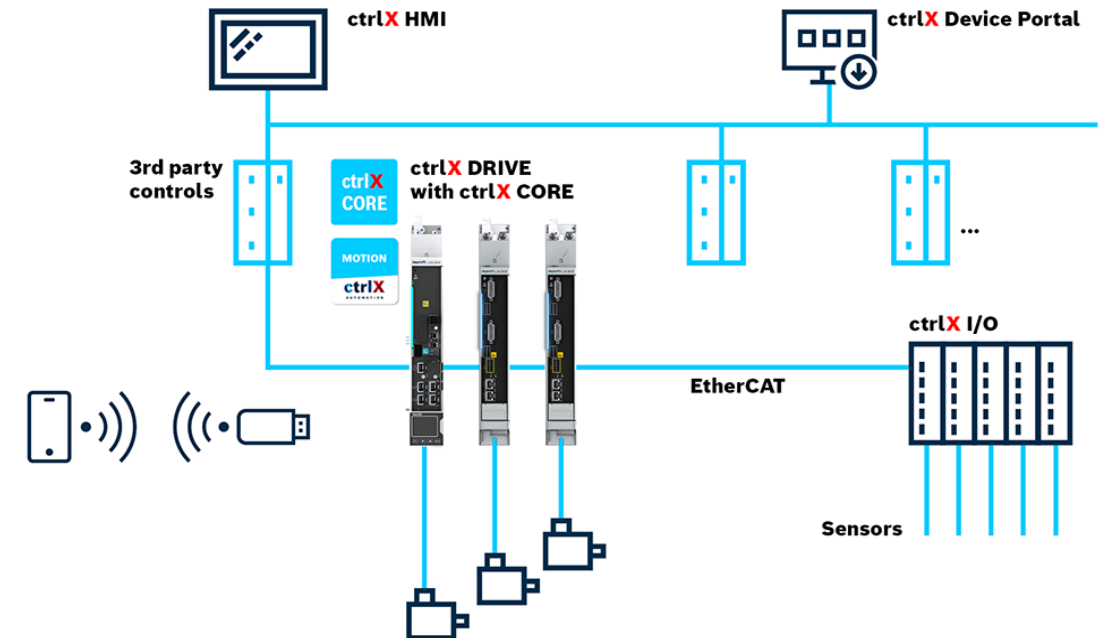
## Inform

### 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](#)



# Let's Start!

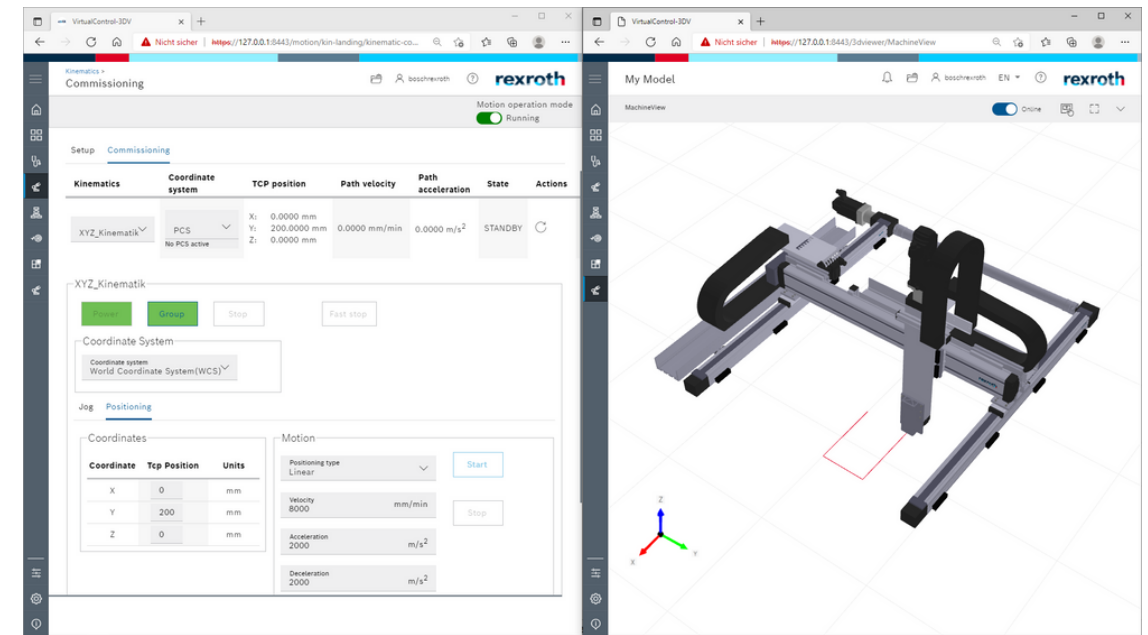
## Inform

### 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](#)

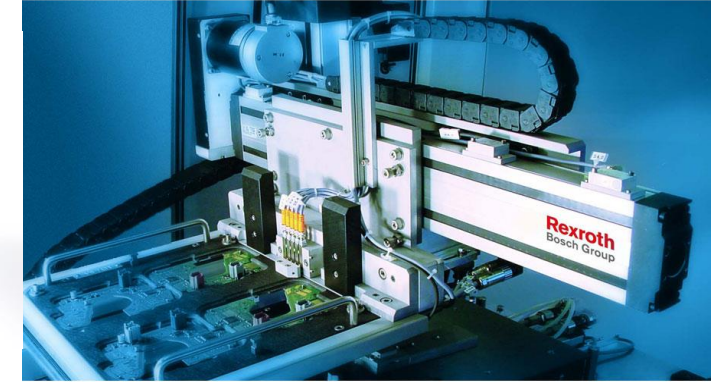




# Challenge 04: Motion App

## Task 01

## 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

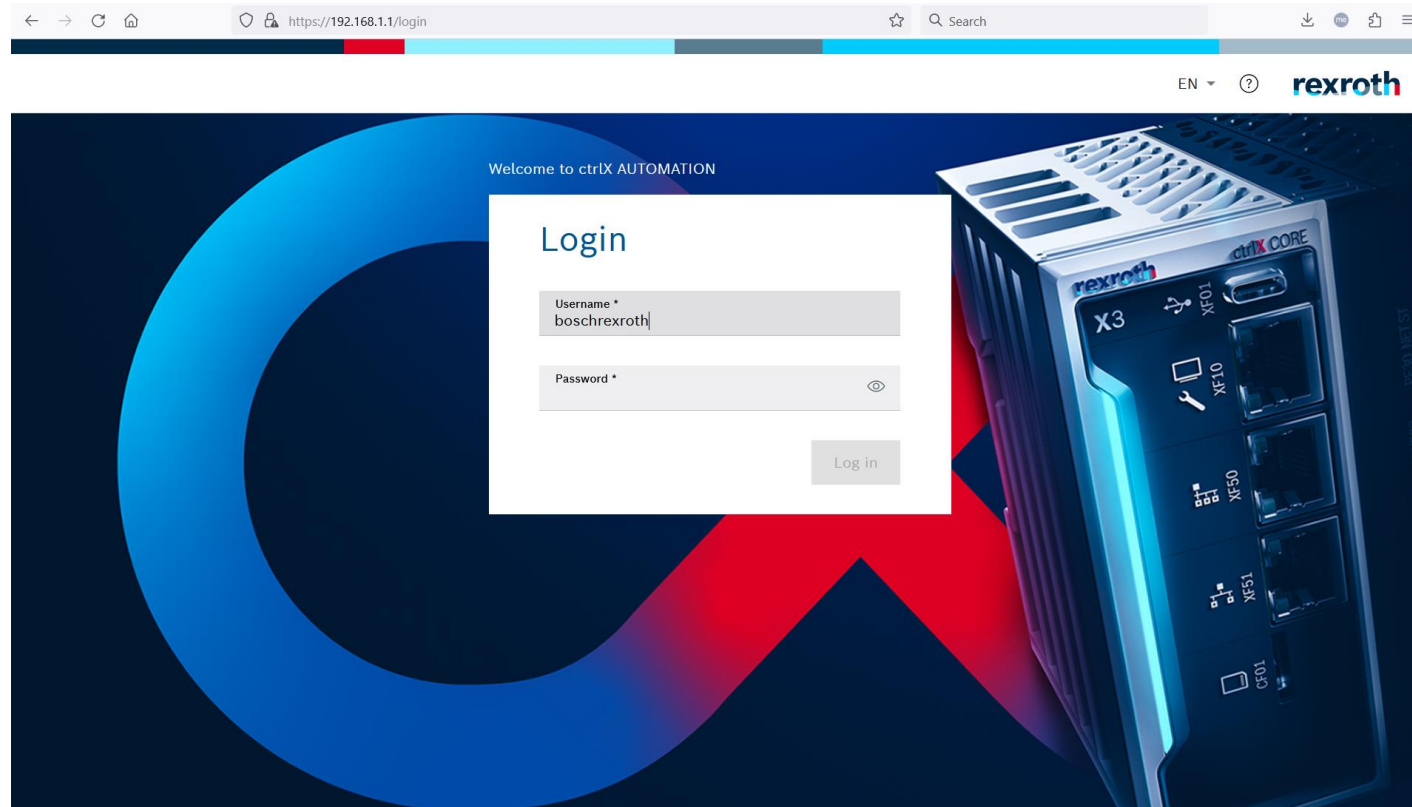
This task will test your ability and understanding on configuring and commissioning basic Motion functions for single and multi-axes positioning.

# Challenge 04: ctrlX Motion App | Task 01

## 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



# Challenge 04: ctrlX Motion App | Task 01

## 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

ctrlX-CORE

ctrlX CORE

Home

Service Indicator

DeviceBridge

Diagnostics

EtherCAT Master

IoT Dashboard

IDE

InfluxDB

Modbus TCP

**Motion**

Node-RED

OPC UA

PLC

PROFINET device

Remote Agent

Home

Operating

Show more about ctrlX CORE

EtherCAT

Configure and analyze your EtherCAT network

Name: ethercatmaster  
State: OP  
Message: Running

Status I/O Engineering Configuration

Axes

Axes not configured

Configure axes

Axis profiles

Axis profiles not configured

Configure axis profiles

Kinematics

Kinematics not configured

Configure kinematics

OPC UA Client

Manage OPC UA Client

Client connections: 0

Configuration/ Status

OPC UA Server

Manage OPC UA Server

Status: RUNNING  
Start time: 10/27/2023, 10:02:46 AM  
Sessions connected: 0

Configuration/ Status  
Certificate Configuration

2. Click on Axes

Motion

**Axes**

Axis Profiles

Kinematics



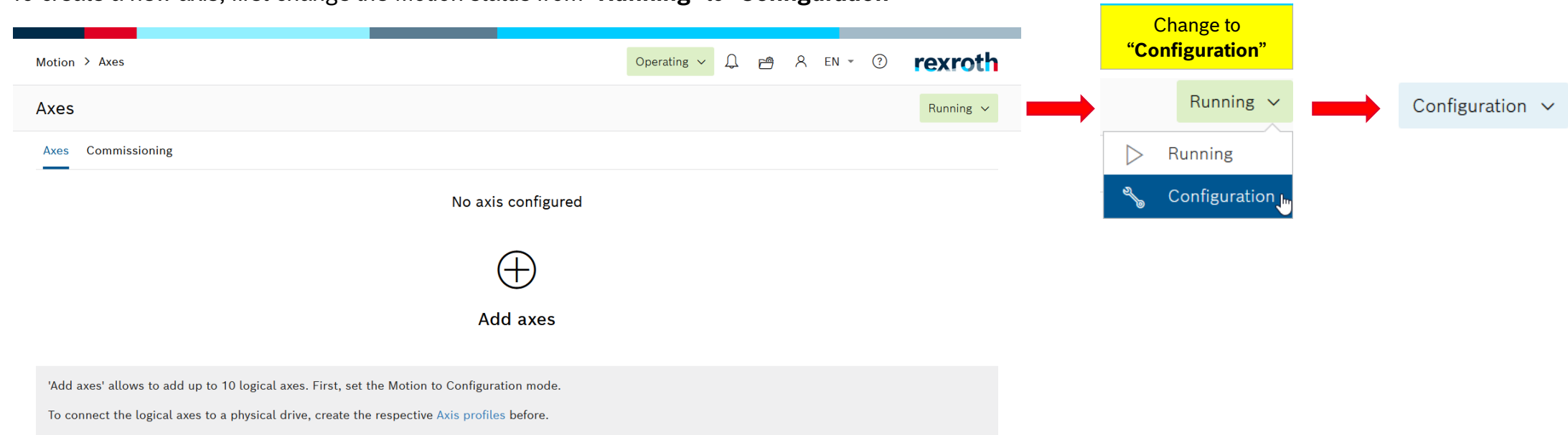
# Challenge 04: ctrlX Motion App | Task 01

## 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



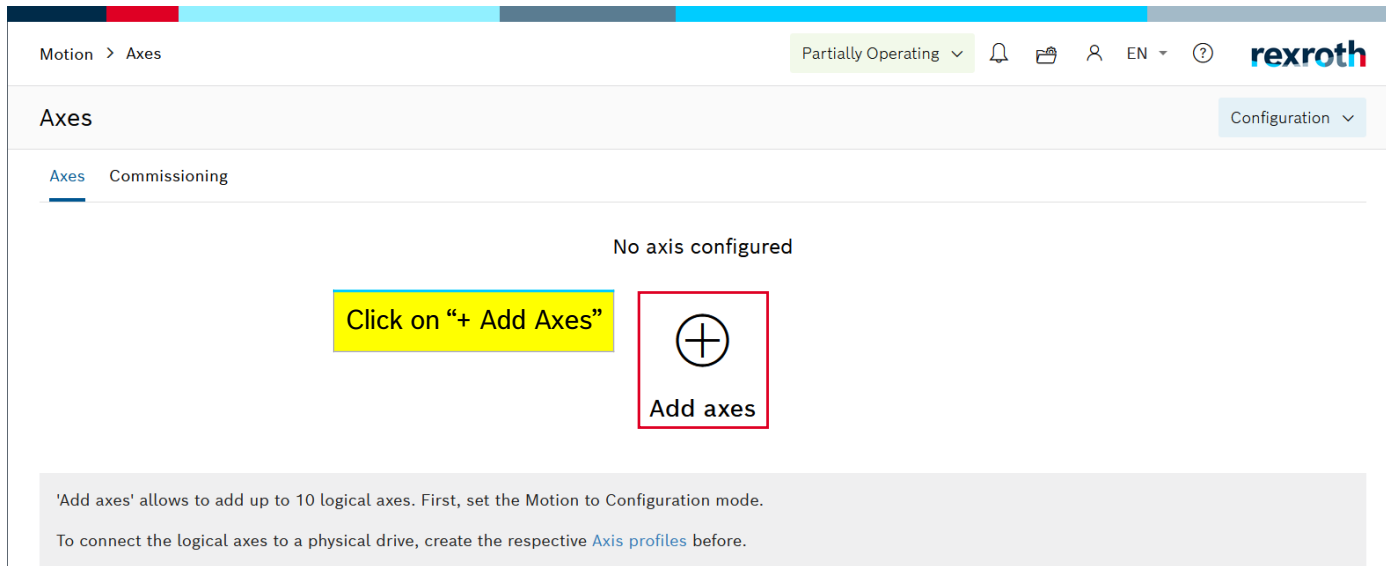
# Challenge 04: ctrlX Motion App | Task 01

## 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

# Challenge 04: ctrlX Motion App | Task 01

## 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

✓ 1 axes added successfully ✕

Add axes

Enter axis name, type and format

Name \*  
AxisX

Type  
LINEAR

Format  
Absolute

! Please note that the axes cannot be renamed later. In this case, delete the respective axis and create it again.

Save Cancel






# Challenge 04: ctrlX Motion App | Task 01

## 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.

Status	Name ↑	Axis type	Profile name	State	Actions
	AxisX	LINEAR		OUTDATED	   

↑

“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”








# Challenge 04: ctrlX Motion App | Task 01

## Steps

7. Next, edit the Motion Axis properties.

### ctrlX Motion – Axis Properties

- Click on the  button to edit the Axis properties.

Status	Name ↑	Axis type	Profile name	State	Actions
	AxisX	LINEAR		OUTDATED	<div>   </div> <div>Edits axis properties</div>

- 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/s<sup>2</sup>**
  - Deceleration: **100 m/s<sup>2</sup>**
- Click the **Save** button and the editor is closed

AxisX

Properties Gantry Limits Units

Position (Min.) *	mm	Position (Max.) *	mm
-1000		1000	
Velocity (Neg.) *	mm/min	Velocity (Pos.) *	mm/min
6000		6000	
Acceleration *	m/s <sup>2</sup>		
2			
Deceleration *	m/s <sup>2</sup>		
2			
Acceleration jerk *	m/s <sup>3</sup>		
0			
Deceleration jerk *	m/s <sup>3</sup>		
0			

Save Cancel

Change the Acceleration and Deceleration values

# Challenge 04: ctrlX Motion App | Task 01

## 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/s<sup>2</sup>**
  - Deceleration: **100 m/s<sup>2</sup>**

#### 2. Axis #3

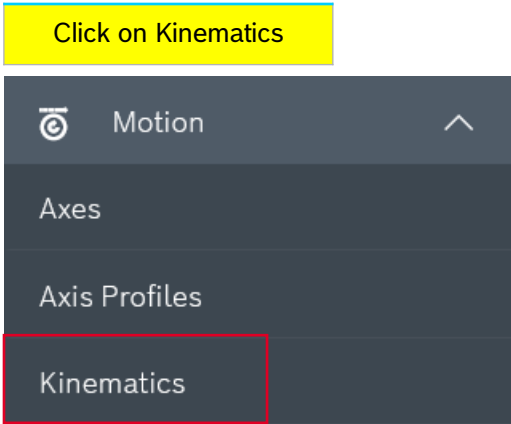
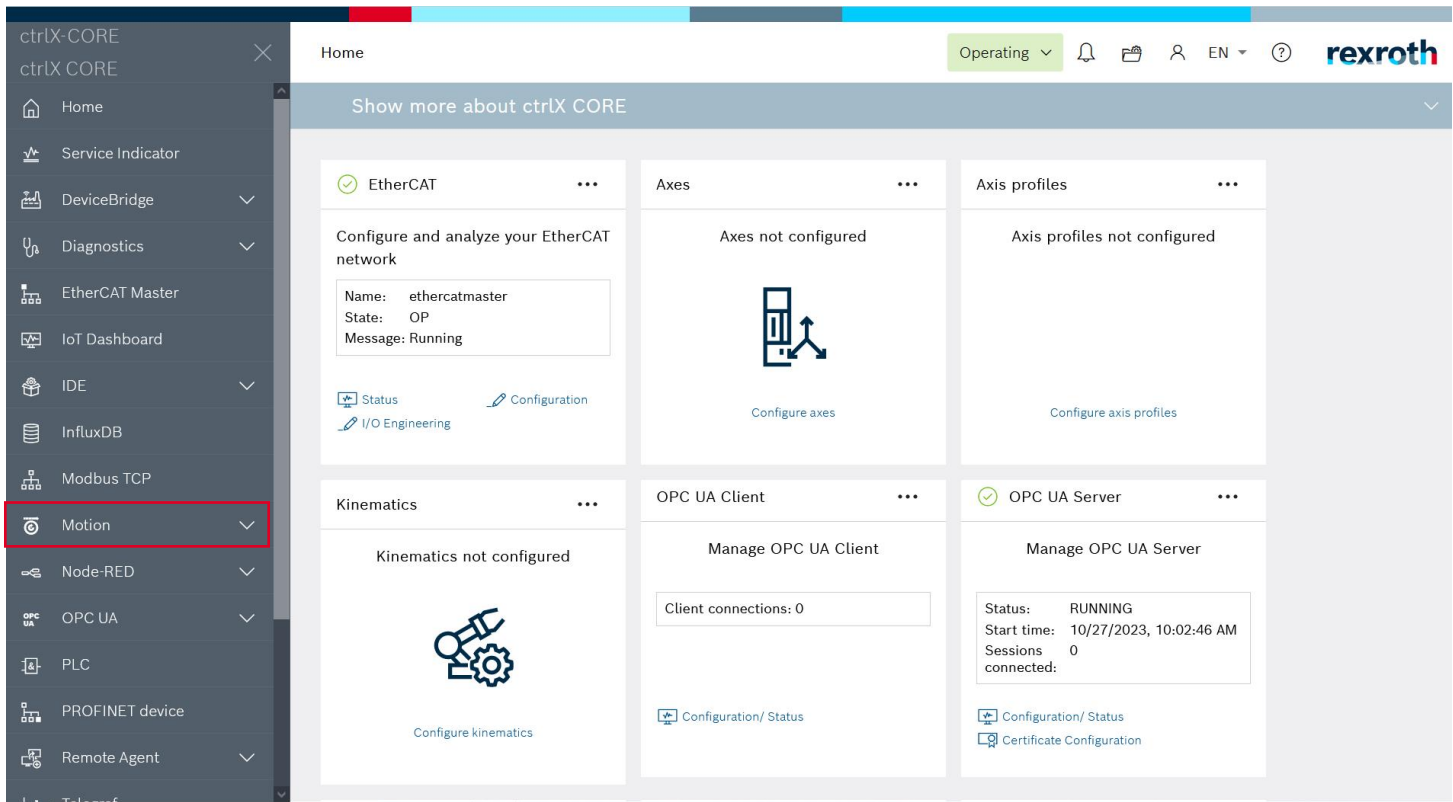
- Name: **AxisZ**
- Type: **LINEAR**
- Format: **Absolute**
- **Limits:**
  - Acceleration: **100 m/s<sup>2</sup>**
  - Deceleration: **100 m/s<sup>2</sup>**

# Challenge 04: ctrlX Motion App | Task 01

## 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




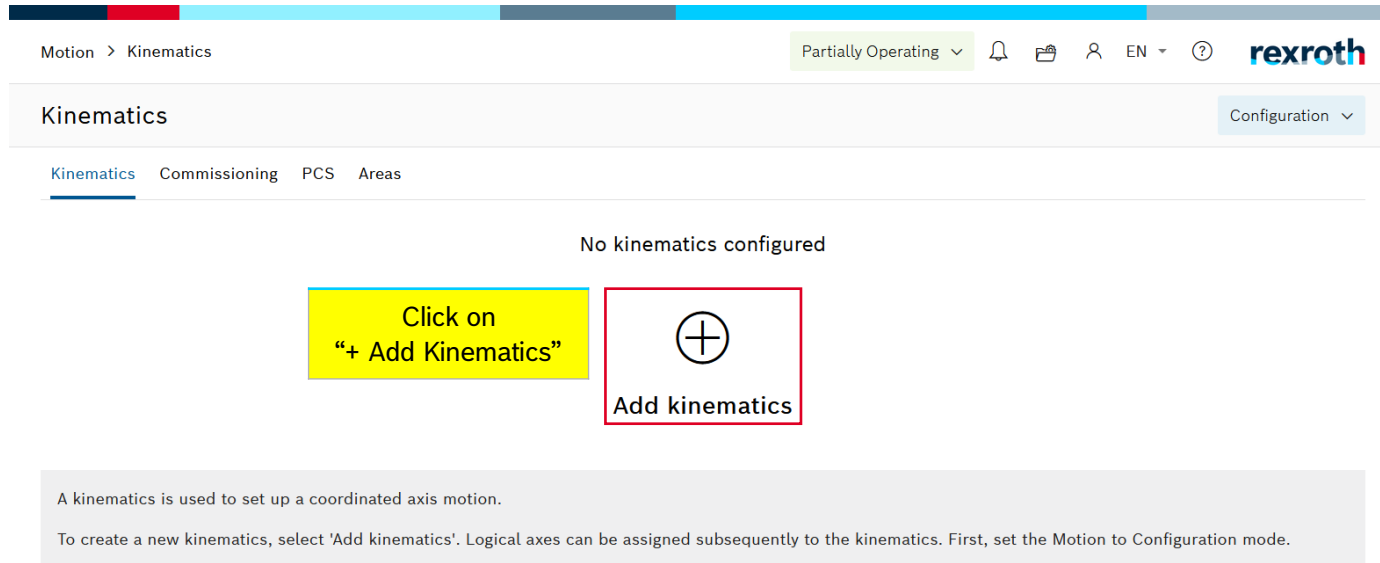
# Challenge 04: ctrlX Motion App | Task 01

## 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



# Challenge 04: ctrlX Motion App | Task 01

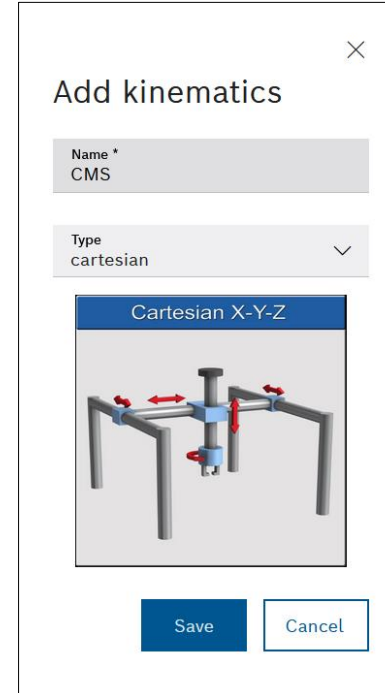
## Steps

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

✓ Kinematics CMS added successfully ✕



# Challenge 04: ctrlX Motion App | Task 01

## 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

Motion > Kinematics

Partially Operating

EN

rexroth

Kinematics

Configuration

Kinematics

Commissioning

PCS

Areas

1 item

CMS

Type	Direction	Axis names	Actions
Currently, no axes are configured. To add an axis to the kinematics, click on the <span>⊕</span> button above.			

<

>

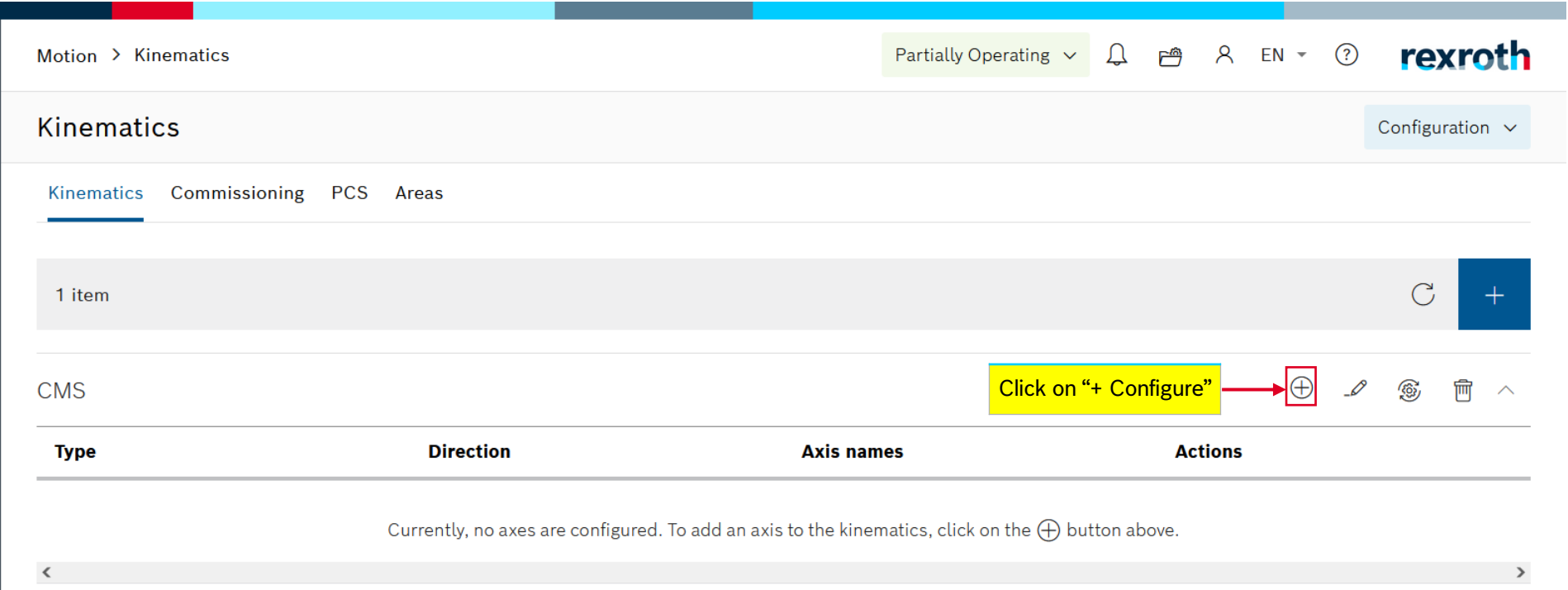
# Challenge 04: ctrlX Motion App | Task 01

## 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



# Challenge 04: ctrlX Motion App | Task 01

## 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. ✕

The screenshot displays the 'ctrlX Motion' software interface. At the top, a status bar shows 'Partially Operating' and the 'rexroth' logo. The main navigation bar includes 'Motion > Kinematics' and a 'Configuration' dropdown. The 'Kinematics' section is active, showing a list of 1 item with a refresh and add button. Below this, a table with columns 'Type', 'Direction', 'Axis names', and 'Actions' is shown, with a message stating 'Currently, no axes are configured. To add an axis to the kinematics, click on the + button above.' On the right, the 'Assign axis' dialog box is open. It contains three dropdown menus: 'Axis mapping \*' set to 'MAIN\_AXIS\_X', 'Axis direction \*' set to 'Positive', and 'Axis name \*'. Below these, a list of available axes is shown: 'AxisX', 'AxisY', and 'AxisZ'. 'AxisX' is highlighted with a red box and a hand cursor. A yellow callout box with an arrow points to 'AxisX' with the text 'Select the axis to be assigned to the kinematics'.



# Challenge 04: ctrlX Motion App | Task 01

## 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**

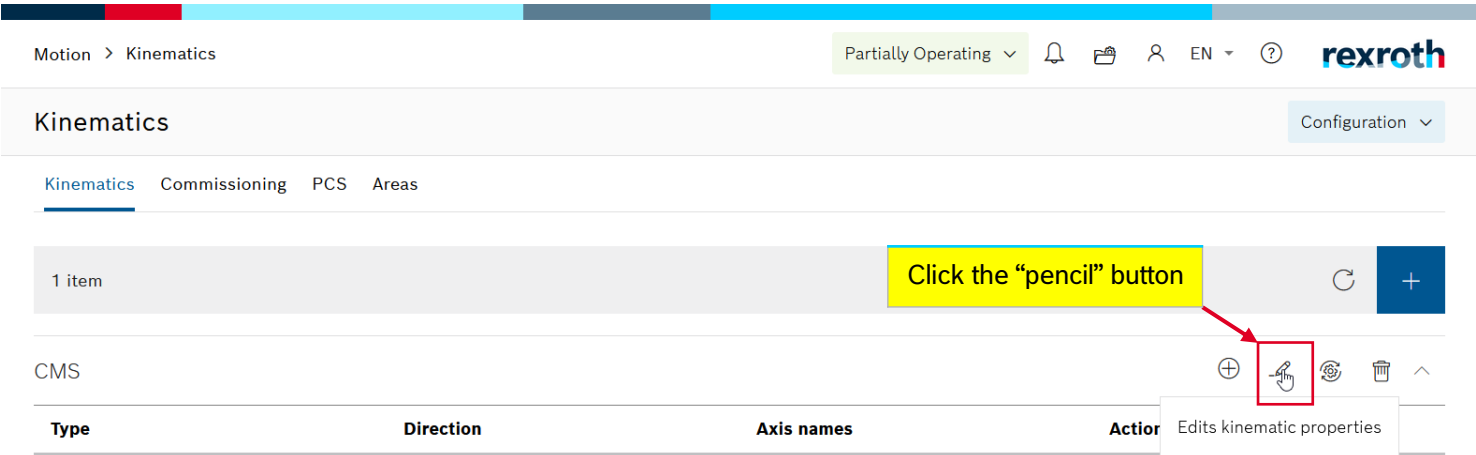
# Challenge 04: ctrlX Motion App | Task 01



## Steps

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

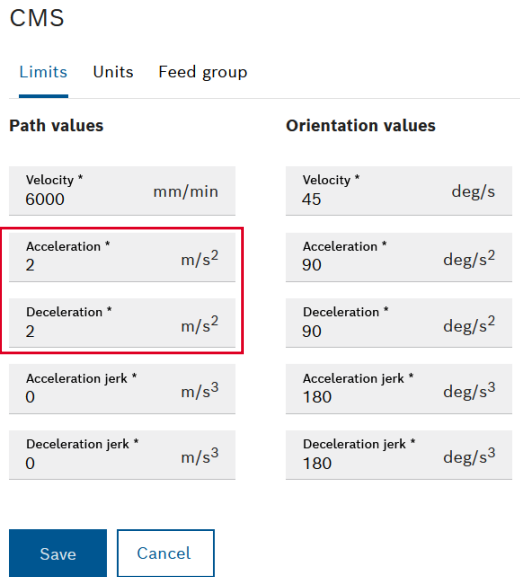
### ctrlX Motion – Edit Kinematics Properties

- 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/s<sup>2</sup>**
  - Deceleration: **100 m/s<sup>2</sup>**
- Click the **Save** button and the editor is closed
- A popup notification will indicate the successful update  Update of the kinematic properties successful 

Change the  
Acceleration and  
Deceleration values



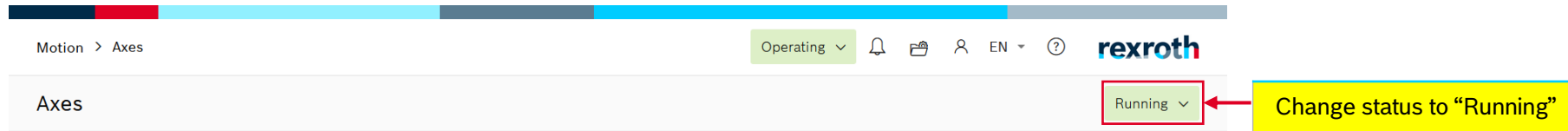
# Challenge 04: ctrlX Motion App | Task 01

## 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



# 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

Motion > Axes

Operating

Axes

Running

Click the “Commissioning” Tab

Motion > Axes

Operating

Axes

Running

Axes Commissioning

⚠ Caution : These functions cause machine movements. Take all necessary measures to avoid personal injury or machine damage!

Status	Axis ↑	Position	Velocity	State	Extended state	Actions
✓	AxisX	0.0000 mm	0.0000 mm/min	DISABLED	NOT_GANTRY	

① Power

⏸ Jogging

▶ Command

0.0000 mm

Cont. 0.01 0.1 1 10 100 User

Settings: Acceleration: 10 m/s<sup>2</sup> , Acceleration jerk: 0 m/s<sup>3</sup>  
Deceleration: 10 m/s<sup>2</sup> , Deceleration jerk: 0 m/s<sup>3</sup>  
Velocity: 10 mm/min

⊗ Stop

⊗ Fast stop



# 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 (Jogging mode)

1. Click the “**Power**” button

A popup notification will indicate the Axis is powered on

Axis AxisX is powered on

State will change to **STANDSTILL**

2. “**Motion Type**” button

Select “**Jogging**” from the list:

Jogging

Positioning

Velocity

Jogging

Motion > Axes

Operating

Running

Axes

Commissioning

Caution : These functions cause machine movements. Take all necessary measures to avoid personal injury or machine damage!

Status	Axis	Position	Velocity	State	Extended state	Actions
✓	AxisX	0.0000 mm	0.0000 mm/min	DISABLED	NOT_GANTRY	<div>① Power</div> <div>② Jogging</div> <div>③ Command</div> <div>0.0000 mm</div> <div>Cont. 0.01 0.1 1 10 100 User</div> <div>Settings: Acceleration: 10 m/s<sup>2</sup>, Acceleration jerk: 0 m/s<sup>3</sup> Deceleration: 10 m/s<sup>2</sup>, Deceleration jerk: 0 m/s<sup>3</sup> Velocity: 10 mm/min</div> <div>Stop</div> <div>Fast stop</div>

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

User-defined \* 10|



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

# 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 (Positioning mode)

Status	Axis ↑	Position	Velocity	State	Extended state	Actions
✓	AxisX	0.0000 mm	0.0000 mm/min	STANDSTILL	NOT_GANTRY	 

5. In “**Positioning**” mode

- The axis can be moved to a user-defined position

Power

Positioning

Command

Target position \*  
0 mm

Settings: Acceleration: 100 m/s², Acceleration jerk: 0 m/s³  
Deceleration: 100 m/s², Deceleration jerk: 0 m/s³  
Velocity: 1000 mm/min

6. Enter target position

Start

Stop

Fast stop

“**Start**” button

- Starts the motion to the “**target position**”

“**Stop**” button

- The active axis motion is stopped

“**Fast Stop**” button

- The active axis motion is stopped by using the max. deceleration values set in the limit values

# 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 (Velocity mode)

Status	Axis ↑	Position	Velocity	State	Extended state	Actions
✓	AxisX	0.0000 mm	0.0000 mm/min	STANDSTILL	NOT_GANTRY	

6. In “**Velocity**” mode

- The axis can be set to a desired velocity

Power

Velocity

Command

Target velocity \*  
0 mm/min

Settings: Acceleration: 100 m/s<sup>2</sup> , Acceleration jerk: 0 m/s<sup>3</sup>  
Deceleration: 100 m/s<sup>2</sup> , Deceleration jerk: 0 m/s<sup>3</sup>  
Velocity: 1000 mm/min

Start

Stop

Fast stop

“**Start**” button

- Starts the motion to the “**target velocity**”

“**Stop**” button

- The active axis motion is stopped

“**Fast Stop**” button

- The active axis motion is stopped by using the max. deceleration values set in the limit values

6. Enter target velocity

# Challenge 04: ctrlX Motion App | Task 01

## 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

The top screenshot shows the 'Kinematics' overview window. The 'Commissioning' tab is highlighted with a red box, and a yellow callout box points to it with the text 'Click the “Commissioning” Tab'. The bottom screenshot shows the 'Commissioning' screen. It features a table with the following data:

TCP position	Path velocity	Path acceleration	State	Actions
X: 0.0000 mm Y: 0.0000 mm Z: 0.0000 mm	0.0000 mm/min	0.0000 m/s <sup>2</sup>	DISABLED	

Below the table, there is a control panel with buttons for Power, Group, Jogging, Command, and WCS. To the right of these buttons, there are input fields for X, Y, and Z coordinates, each with a minus and plus button. Below these are buttons for Stop and Fast stop. At the bottom, there is a 'Cont.' button and a table of settings:

Cont.	0.01	0.1	1	10	100	User
Settings: Acceleration: 10 m/s <sup>2</sup> , Acceleration jerk: 1 m/s <sup>3</sup> Deceleration: 10 m/s <sup>2</sup> , Deceleration jerk: 1 m/s <sup>3</sup> Velocity: 10 mm/min						

# Challenge 04: ctrlX Motion App | Task 01

## 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

Kinematics CMS 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

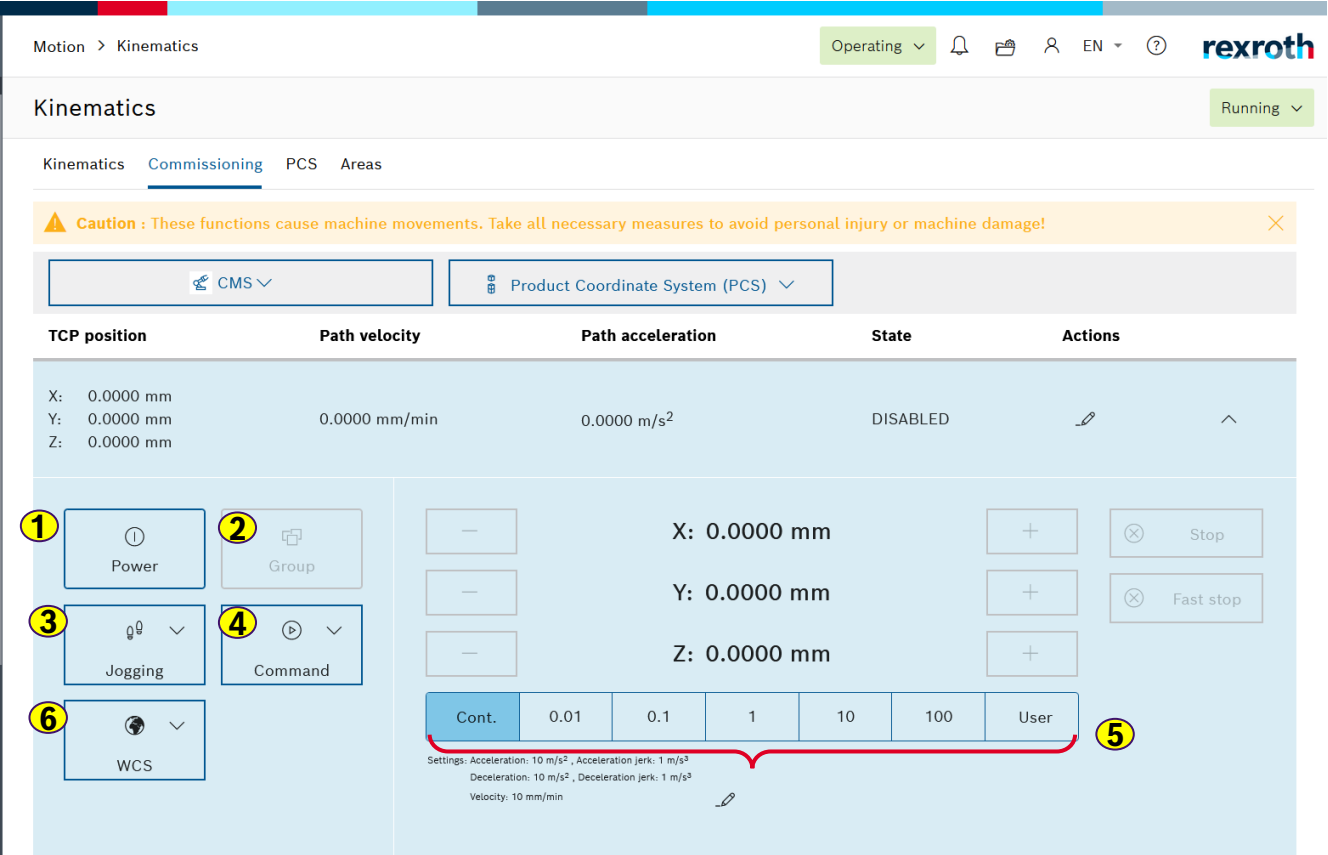
Grouping axes in the kinematics CMS completed successfully
3. “**Motion Type**” button

  - Select “**Jogging**” from the list:

Jogging

Positioning

Jogging



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

# 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/s<sup>2</sup>**
  - Deceleration: **100 m/s<sup>2</sup>**
- Move the Kinematics:
  - X-Axis: **450 mm**
  - Y-Axis: **350 mm**
  - Z-Axis: **150 mm**

# 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!**

