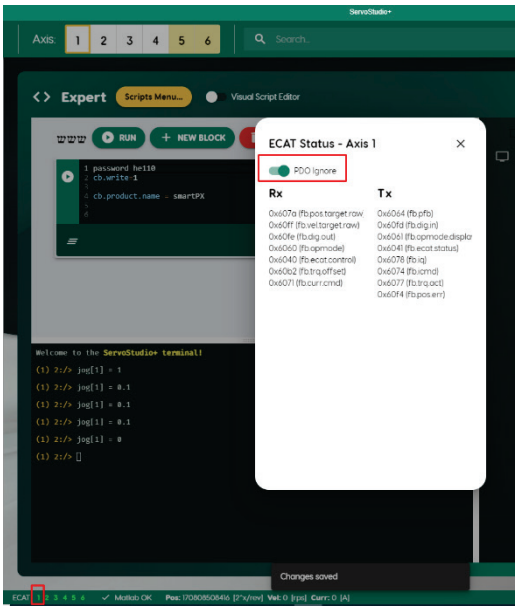
7 EtherCAT Configuration

Note

When the smartPX is connected to an EtherCAT controller, it is still possible to execute **serial** commands in ServoStudio+.

In the status bar at the bottom of the ServoStudio+ screen, click on an axis to open the Axis ECAT Status pane. Set the toggle switch to **PDO Ignore**. When PDO Ignore is active, the axis does not respond to commands from the EtherCAT controller.



7.1 Configuring softMC Controller for smartPX

This section explains how to configure the **softMC** controller for EtherCAT communication and operation with the smartPX drive.

7.1.1 Hardware Setup

The EtherCAT configuration described in the following section is valid for two architecture options:

- A softMC integrated within the smartPX.
- An external softMC connected to the smartPX through interface C2 EC-IN.

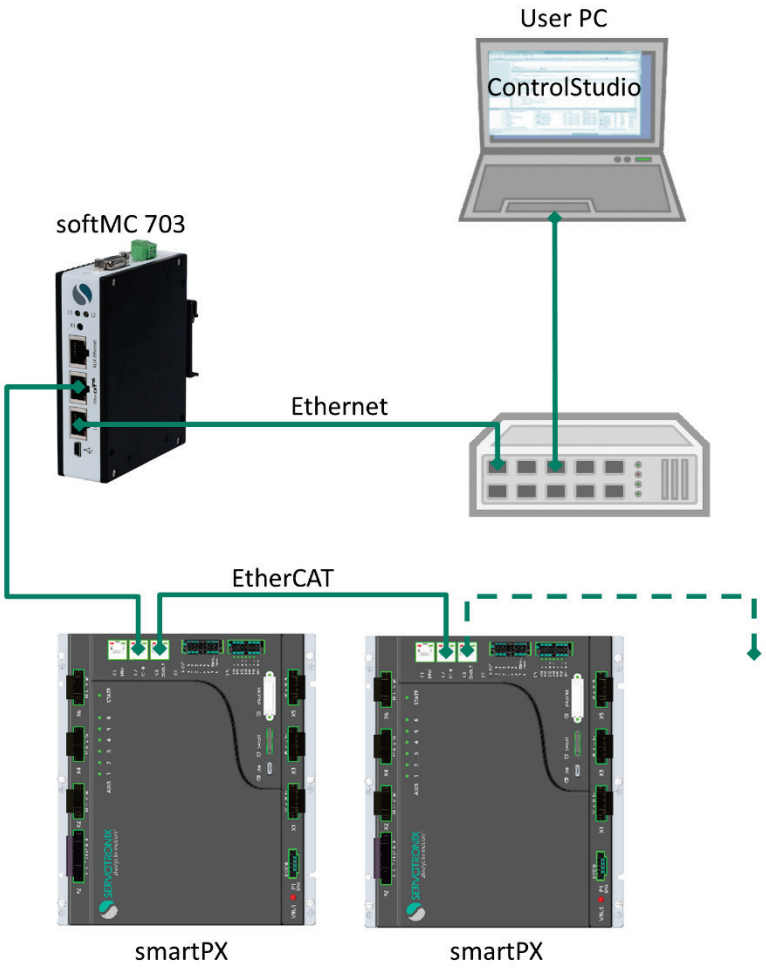


Figure 6-1. softMC Connected to smartPX EtherCAT Interface (Example)

7.1.2 Software Settings

The softMC has a software interface called **ControlStudio+**, which supports application framework, IDE, and EtherCAT network configuration.

In ControlStudio+, the EtherCAT configuration is an integrated function for every system configuration. The user needs to select a system configuration, such as a robot type. The softMC then automatically loads the appropriate set of EtherCAT setup programs.

The following is an example of configuring a 4-axis delta robot connected to a smartPX.

1. In the navigation menu, select **System**.
2. In the System Type pane, click **Change System Type**.

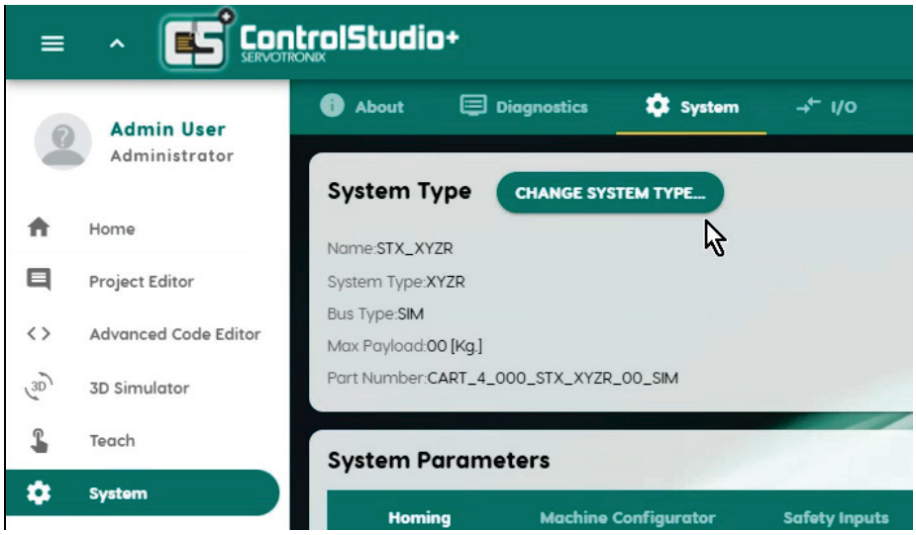


Figure 6-2.

3. At the prompt, select the System Type properties, and enter a project name.

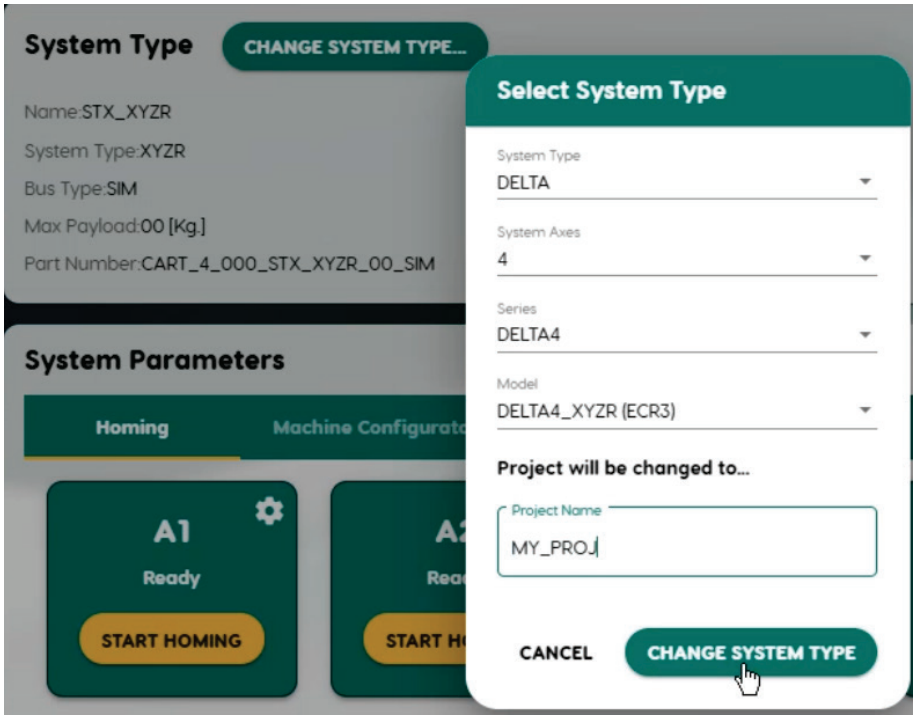


Figure 6-3.

4. Click **Change System Settings Type**.
5. Wait for ControlStudio+ while it configures the system according to the settings, and reboots the softMC.

   After the reboot, ControlStudio+ loads and displays the new system settings.

7.2 Configuring Beckhoff Controller for smartPX

This section explains how to configure a **Beckhoff** controller for EtherCAT communication and operation with the smartPX drive.

The application system consists of the following elements:

- smartPX servo drive, servo motor, and ServoStudio+ software.
- Beckhoff controller with EtherCAT communication module, and **TwinCAT** software.

Notes

- Beckhoff controller refers to TwinCAT NC PTP (point-to-point axis positioning software).
- TwinCAT NC PTP includes axis positioning software (set value generation, position control), an integrated software PLC with NC interface, operating program for commissioning and an I/O connection to the axes through various fieldbuses. TwinCAT NC PTP replaces conventional positioning modules and NC controllers. The controllers that are simulated by the PC cyclically exchange data with drives and measuring systems via the fieldbus.
- Beckhoff controllers are programmed in accordance with the IEC 61131-3 programming standard.

7.2.1 Hardware Setup

Using any RJ45 cables, make the following connections:

- Connect the controller to the smartPX on interface **C2 EC-IN**.
- Connect the next node to interface **C3 EC-OUT**.

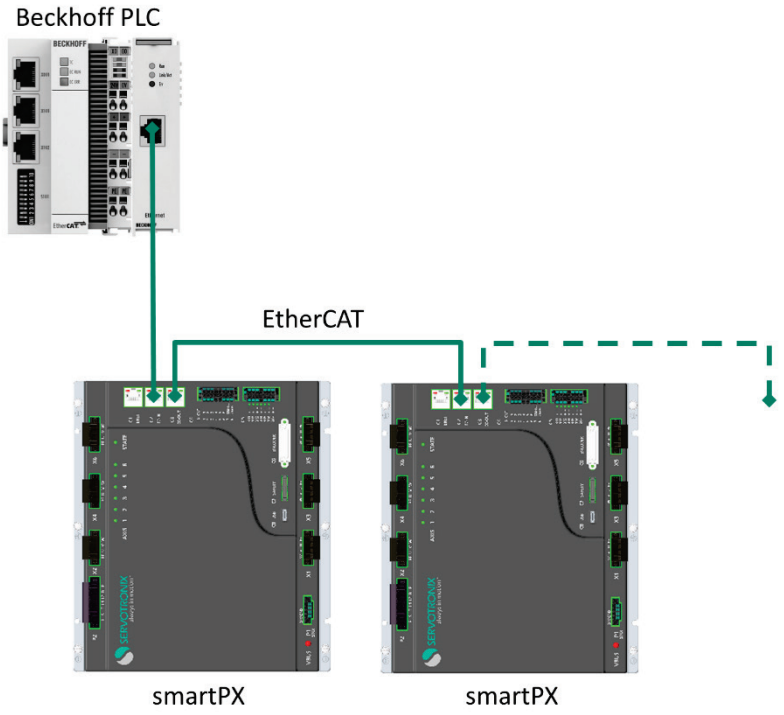


Figure 6-4. Beckhoff Controller Connected to smartPX EtherCAT Interface (Example)

7.2.2 Software Settings

Required Files

Before activating the TwinCAT System Manager, make sure the correct **EtherCAT Slave Information (ESI)** file (*.xml) resides at the TwinCAT installation folder. Possible locations:

- C:\Program Files (x86)\Beckhoff\TwinCAT\3.1\Config\Io\EtherCAT
- C:\TwinCAT\3.1\Config\Io\EtherCAT
- C:\TwinCAT\Io\EtherCAT

Contact Servotronix Technical Support for the appropriate file and instructions, if needed.

Cycle Time

The EtherCAT cycle time is configured by the EtherCAT master. The smartPX reads the value in the parameter **Fb.Cycletime**.

7.2.3 Configuring Communication between Controller and PC

Using TwinCAT software, establish communication between the controller and the PC by performing the following steps.

1. Activate TwinCAT software.
2. Select **New TwinCAT Project**.

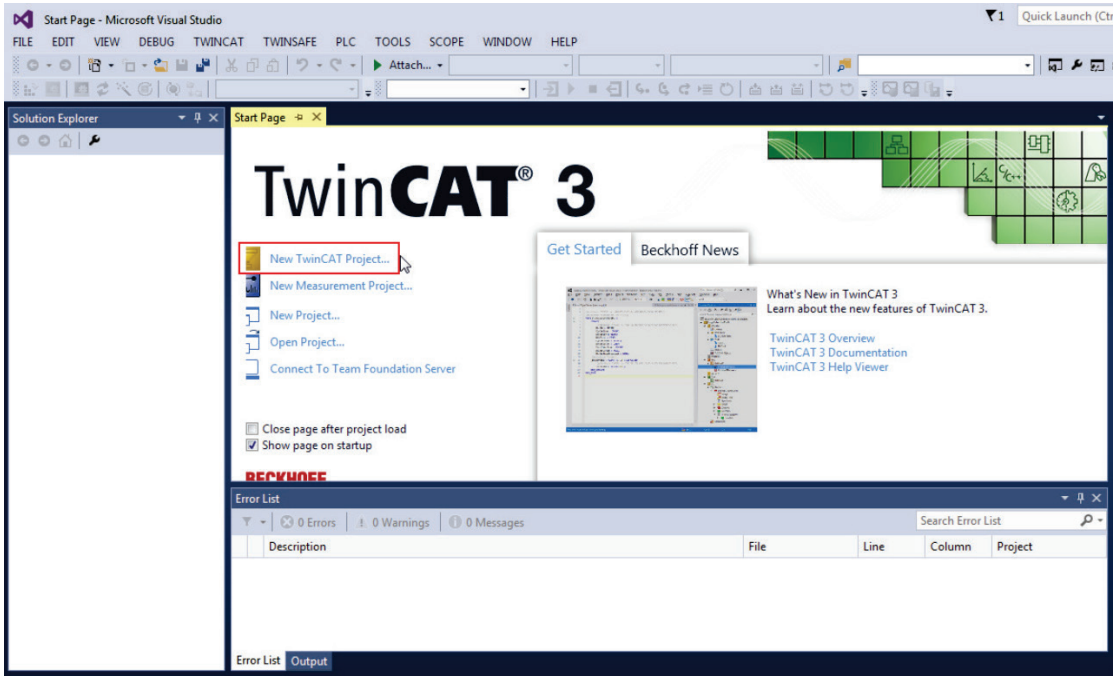


Figure 6-5.

3. In the Name field, enter the name of the project, and click OK.

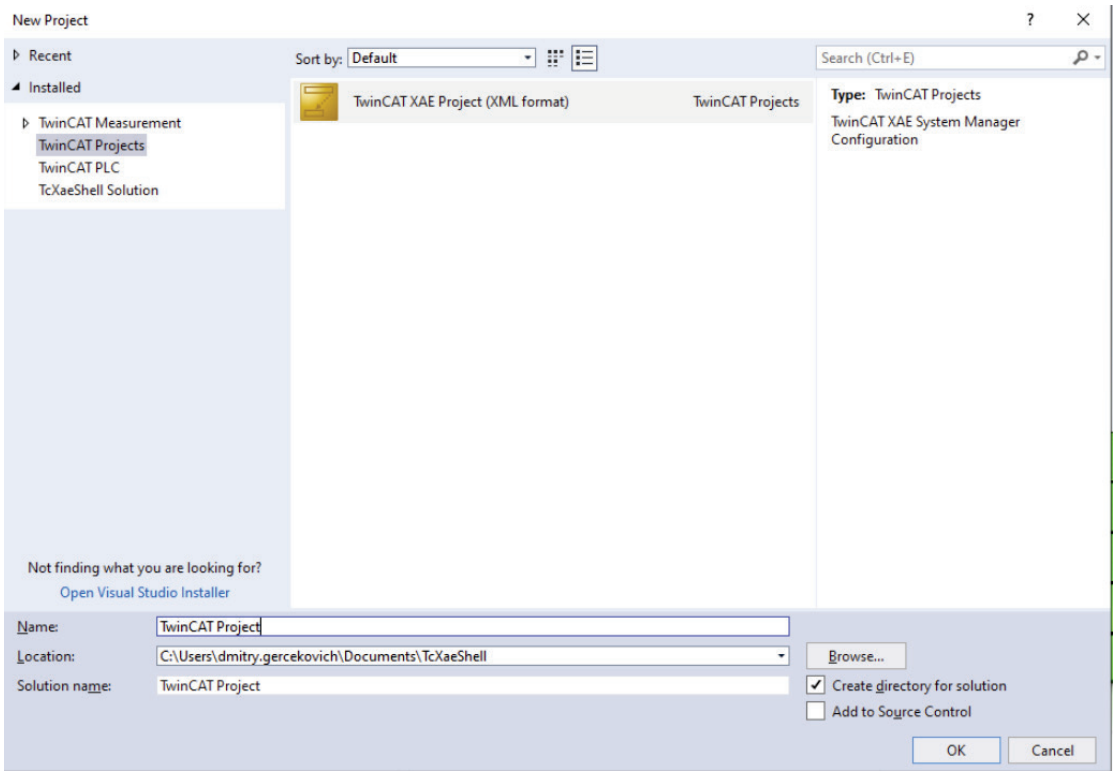


Figure 6-6.

4. In the Solution explorer, select **System**.
5. In the General tab, click **Choose Target**.

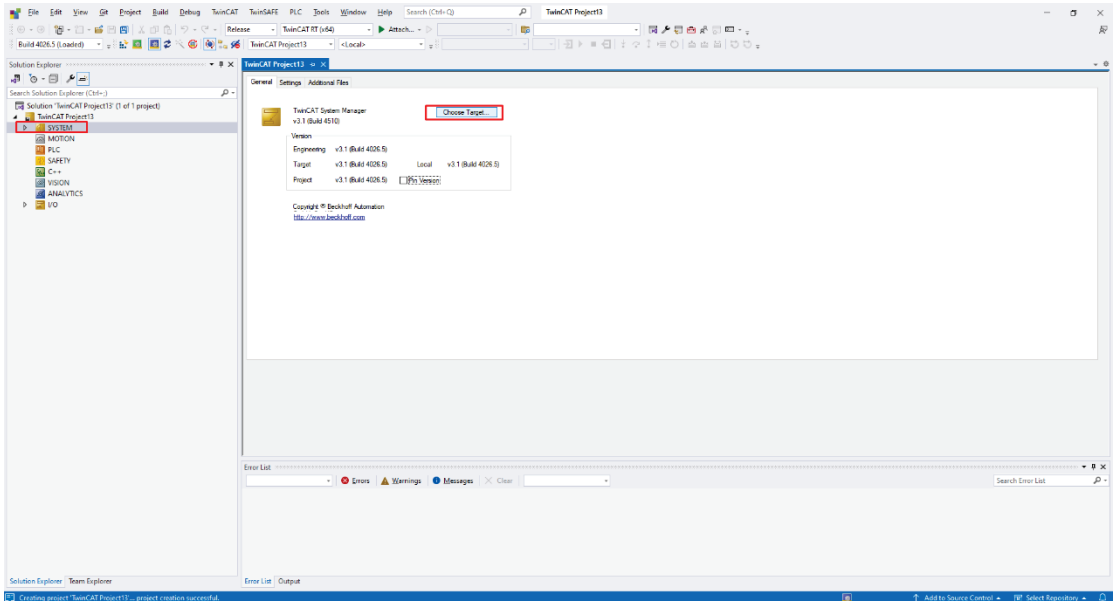


Figure 6-7.

6. The Choose Target System dialog box opens.

   Click **Search (Ethernet)** to search for the controller in the network.

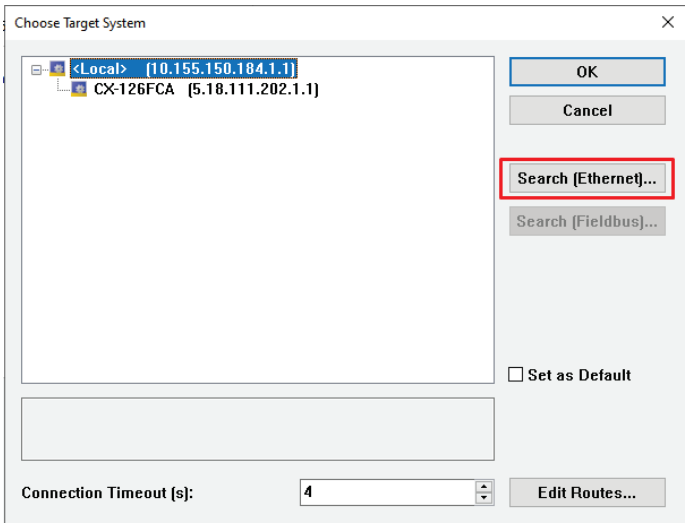


Figure 6-8.

7. In Add Route Dialog:

   a. Enable **Advanced Settings**.

   b. Select the option **IP Address**.

   c. Click **Broadcast Search**.

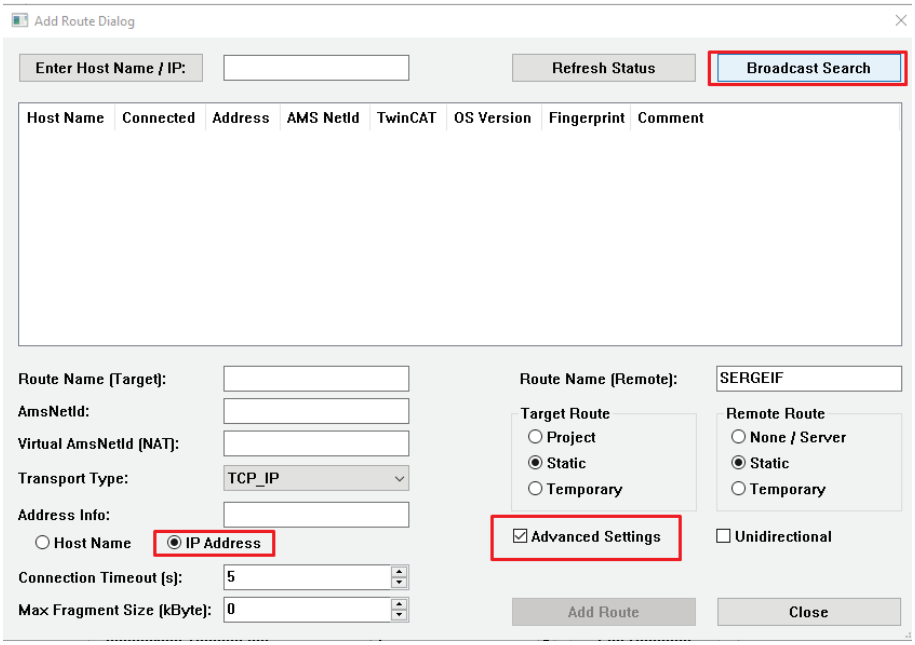


Figure 6-9.

8. Select the Ethernet adapter to which the Beckhoff controller is connected:

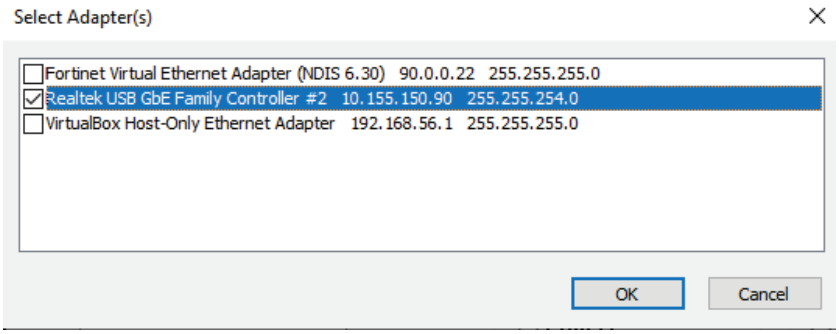


Figure 6-10.

9. Select your Beckhoff controller, and click **Add Route**.

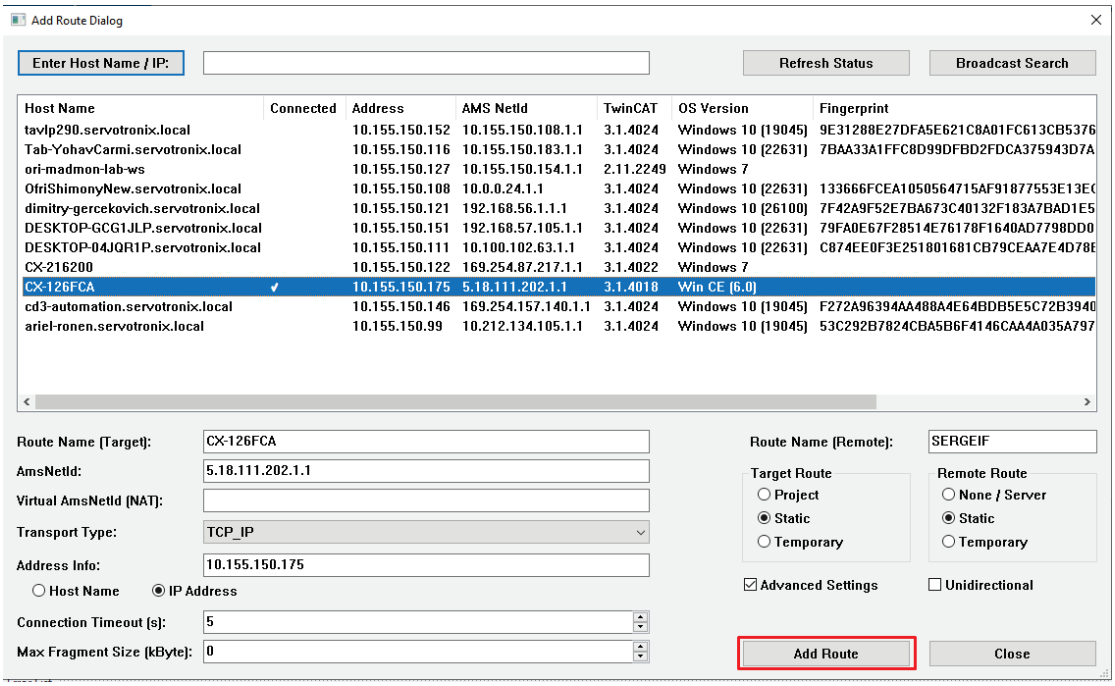


Figure 6-11.

10. Enter the username and password of the controller; the default is:

    User: **Administrator**

    Password: **1**

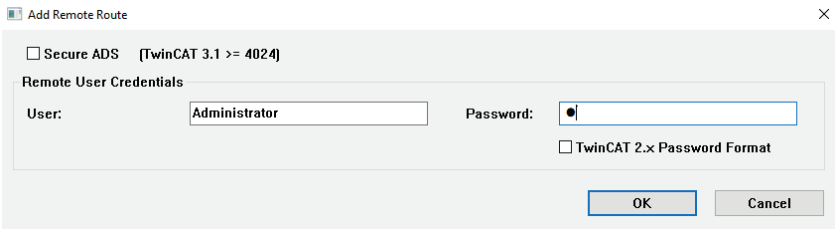


Figure 6-12.

11. Look for the checkmark to confirm the controller is connected.

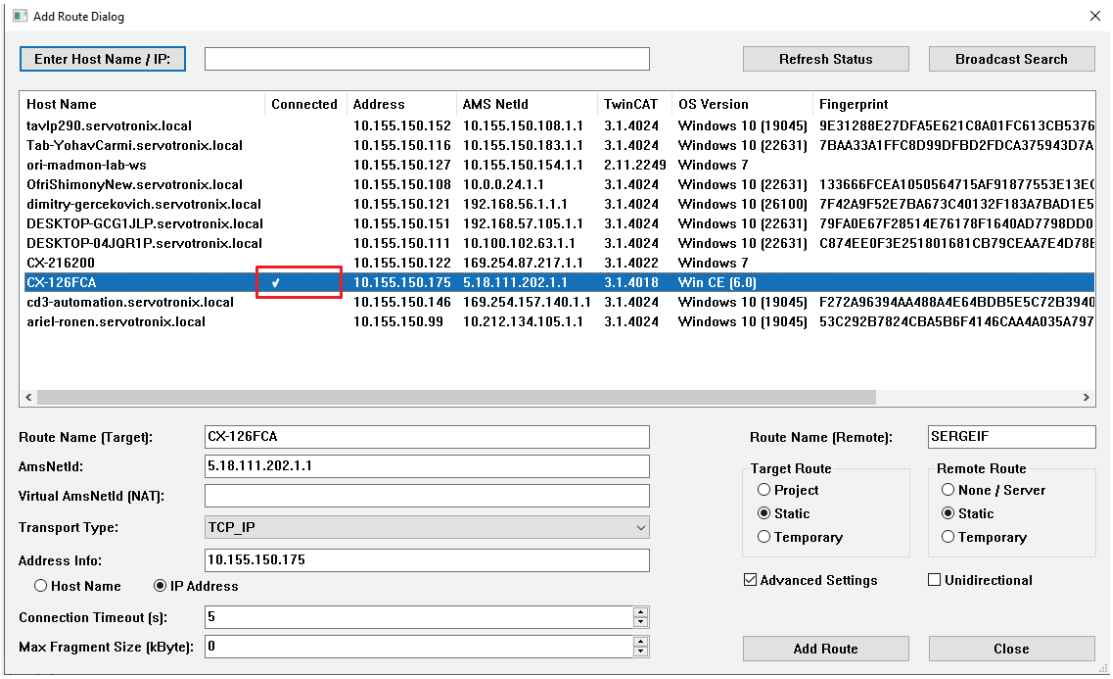


Figure 6-13.

12. Close Add Route Dialog.

13. In Choose Target System dialog, select the controller, and click OK.

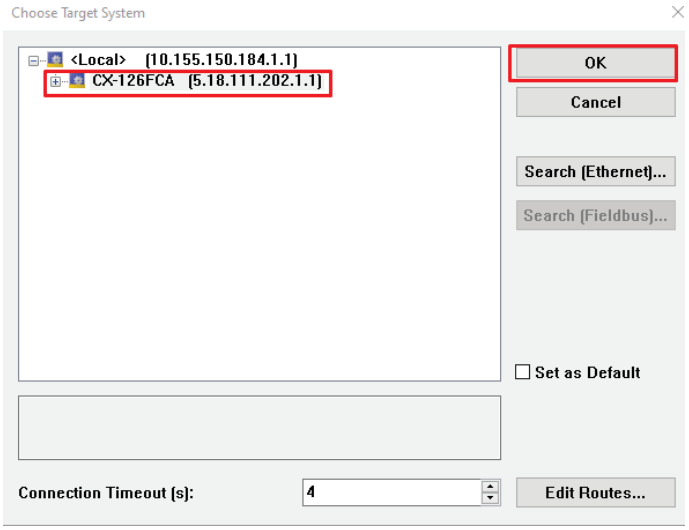


Figure 6-14.

14. Once the connection is established, the host controller should appear on the screen.

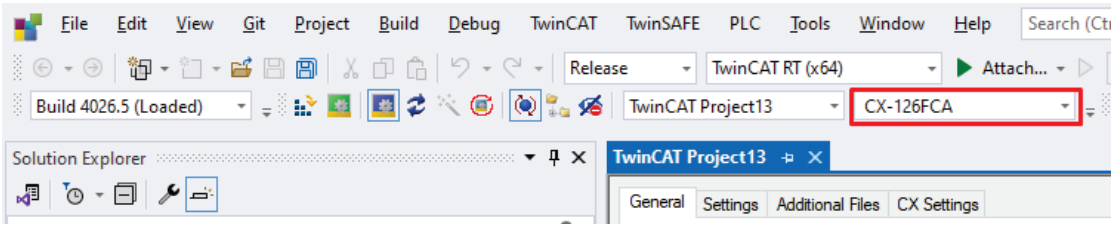


Figure 6-15.

7.2.4 Configuring Communication between Controller and smartPX

1. Set TwinCAT to Config Mode: click **Restart TwinCAT (Config Mode)**.

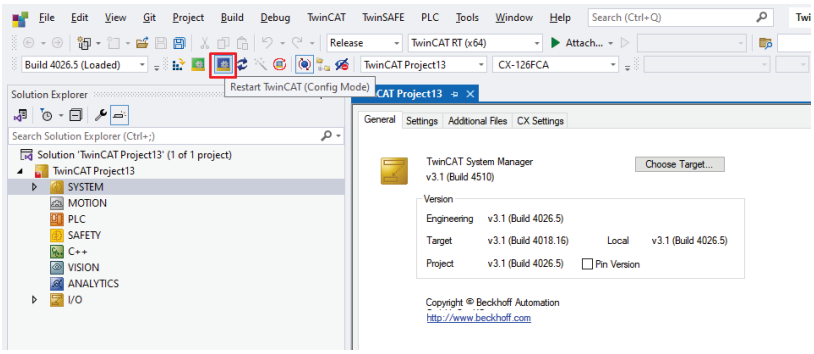


Figure 6-16.

2. At the confirmation prompt, click OK

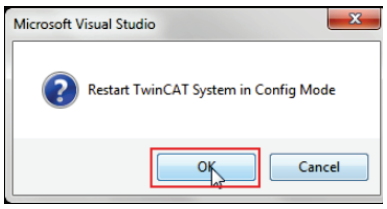


Figure 6-17.

3. Make sure TwinCAT is in Config Mode.

   When Config Mode is active, the Config Mode button in the toolbar is highlighted.

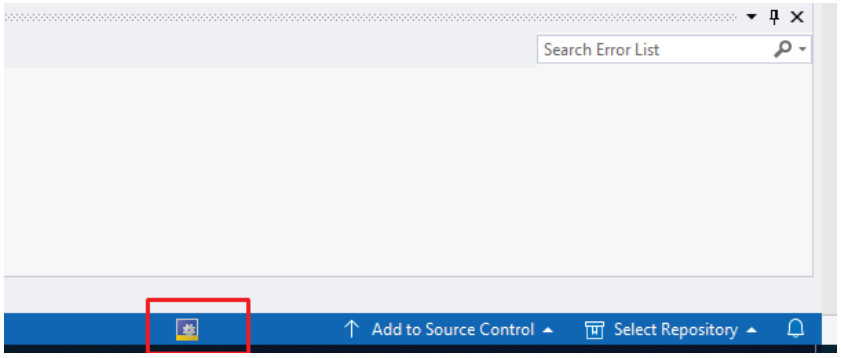


Figure 6-18.

4. Scan for EtherCAT devices:

   a. Navigate to the project **I/O** section.

   b. Right click on **Devices**.

   c. Select **Scan**.

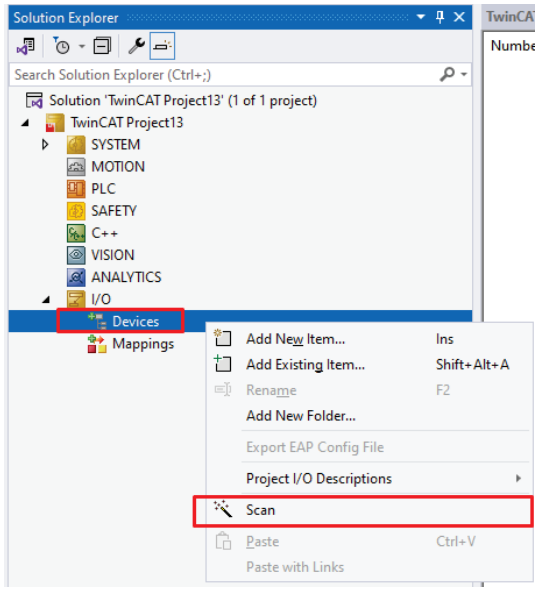


Figure 6-19.

5. At this prompt, click OK.

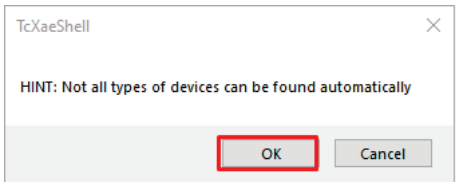


Figure 6-20.

6. If multiple devices are found, select the **EtherCAT device**, and click OK.

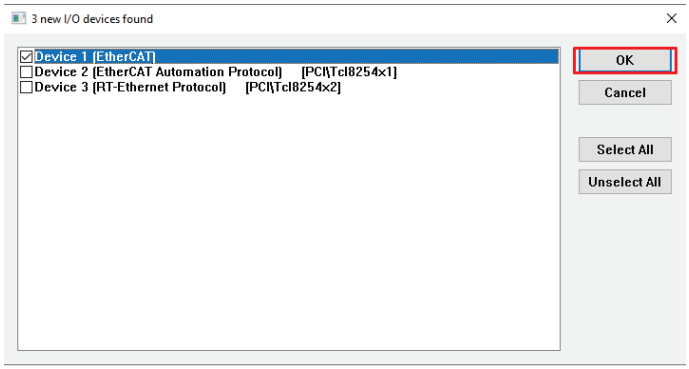


Figure 6-21.

7. At the prompt to scan for boxes, click Yes.

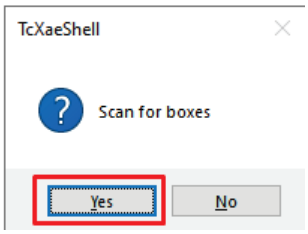


Figure 6-22.

8. In the Append Linked Axis dialog, select **NC – Configuration,** and click OK.

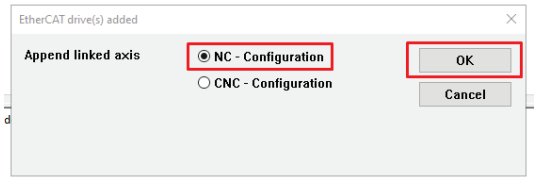


Figure 6-23.

9. At the prompt to activate FreeRun, click Yes.

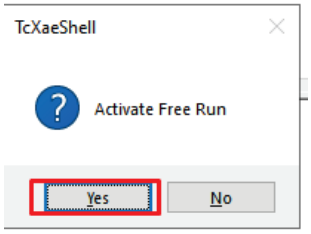


Figure 6-24.

10. At the end of this procedure, a new EtherCAT Device (controller) is displayed in the navigation pane, and shows a smartPX connected to it:

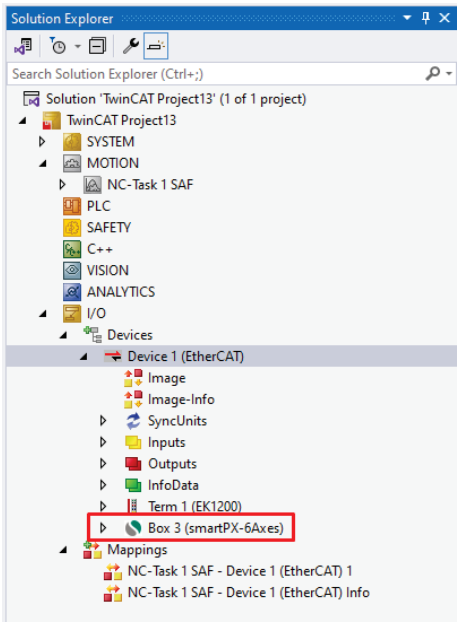


Figure 6-25.

7.2.5 Generating Motion

1. In the navigation pane, go to System, and select **Real-Time**.
2. Set the System real-time clock Base Time. It should be less than or equal to the required cycle time, defined in Step 4 (Task > Cycle Ticks).

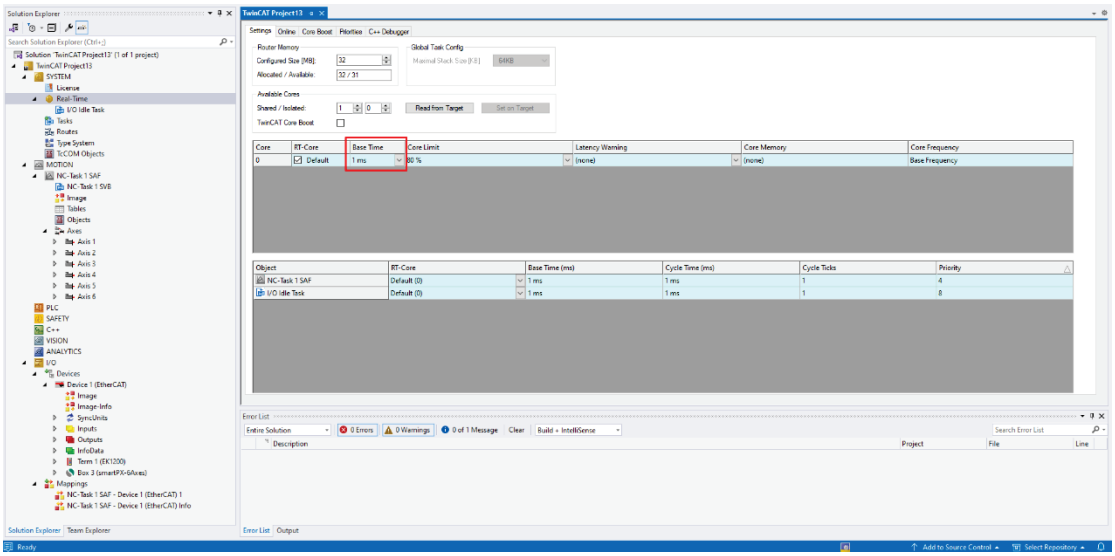


Figure 6-26.

3. In the navigation pane, go to Motion, and select **NC–Task**.

4. In the **Task** tab, set the Cycle Time: **Cycle ticks**.

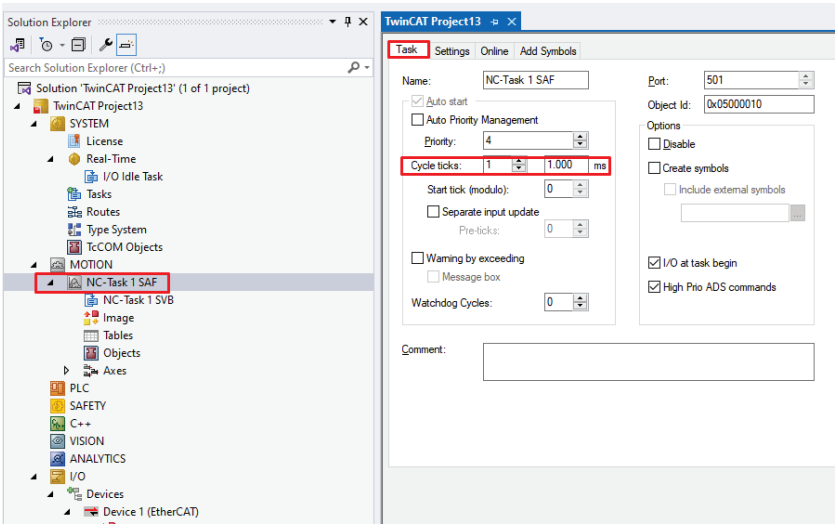


Figure 6-27.

5. In the navigation pane, go to I/O Devices and select the **smartPX**.
6. In the **DC** tab, select Operation Mode –**DC-Synchron.**

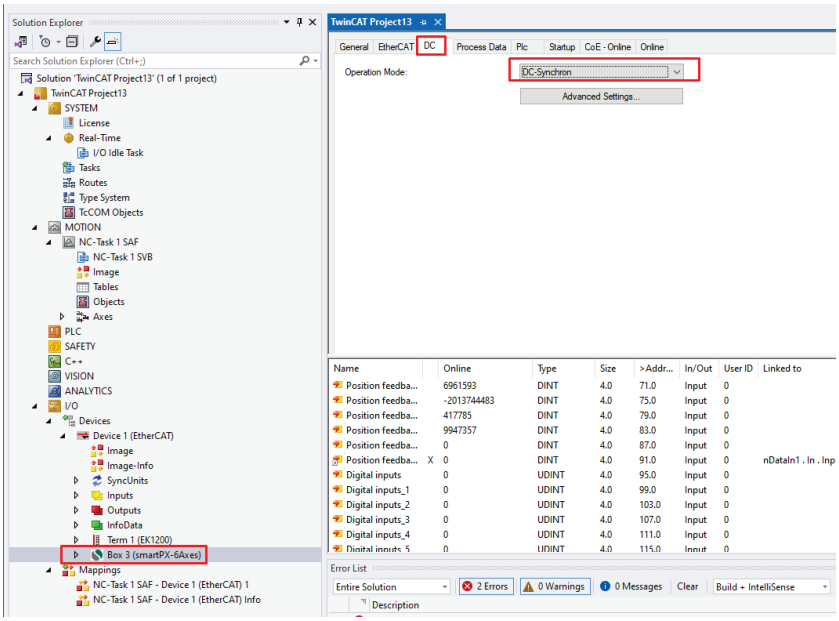


Figure 6-28.

7. Add Motion Axis. The motion axes are added automatically during the drive scan process. The number of axes is dependent on the drive type (4/6 axes).

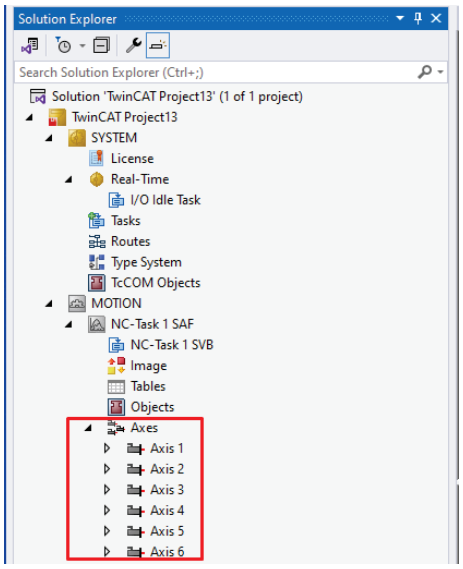


Figure 6-29.

8. Make sure all axes are connected to an I/O device.

   In the navigation pane, go to Motion and select **Axes**.

9. Go to the **Settings** tab.

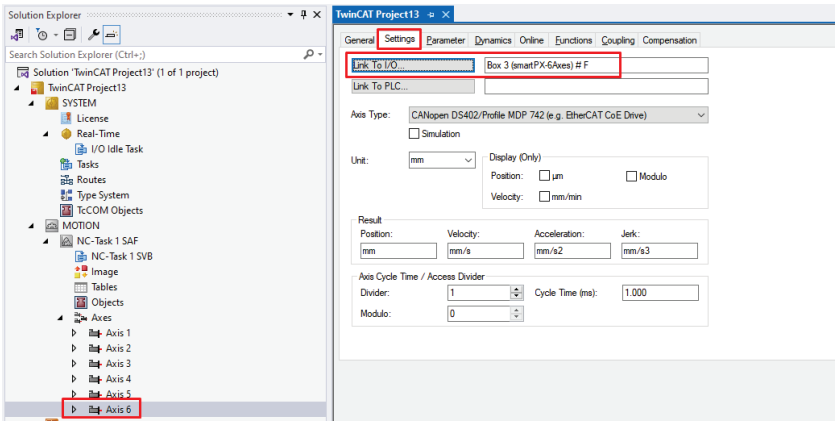


Figure 6-30.

10. If no I/Os are connected, click **Link To I/O** and select an axis to connect. Then click OK.
    - **Unused** shows only the axes that are not linked.
    - **All** shows all axes, irrespective of their link status.

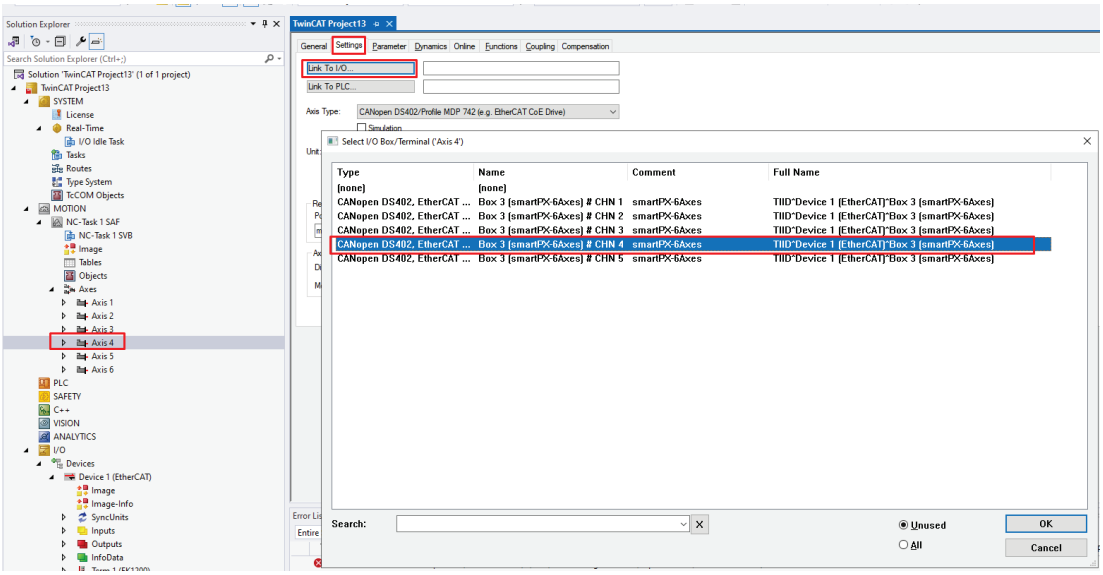


Figure 6-31.

11. Make sure the correct Axis is linked to the I/O.

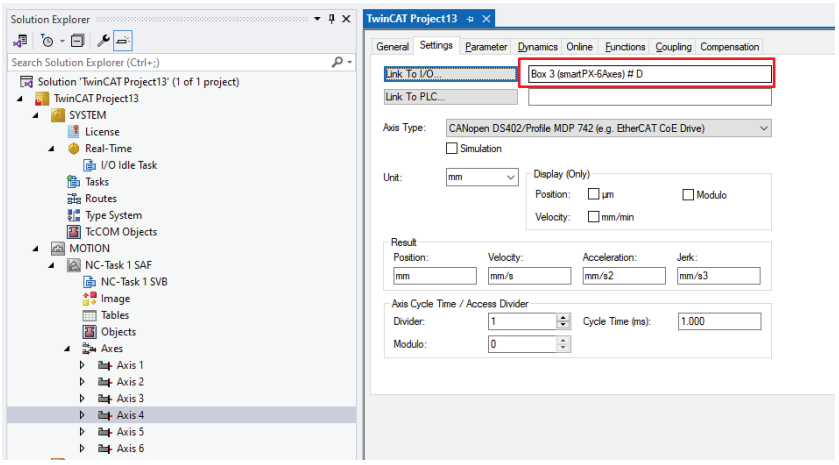


Figure 6-32.

12. Set units scaling.

    In the navigation pane, go to an Axis, and select **Enc**.

13. Select the **Parameter** tab.

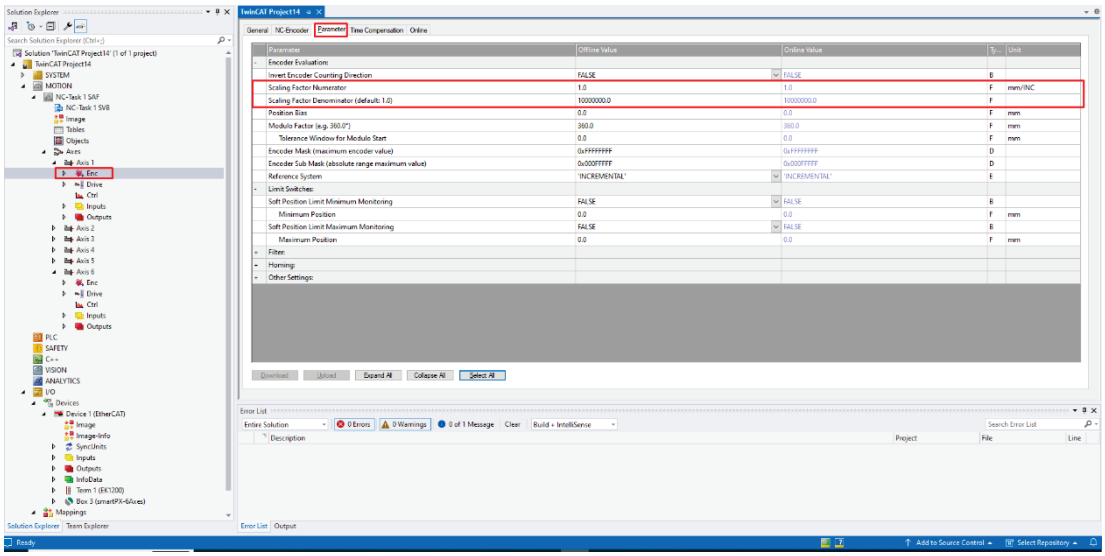


Figure 6-33.

14. Set the Scaling Factor Numerator and Denominator.

    For example: To use the following units:

    Position = Rev
    Velocity = Rev/Sec
    Acceleration = Rev/Sec^2

    Set the scaling as follows:

$$\frac{\text{"Scaling Factor Numerator"}}{\text{"Scaling Factor Denumerator"}} = \frac{\text{0x6091 sub-index 1}}{\text{0x6091 sub-index 2}} \times \frac{\text{0x6092 sub-index 1}}{\text{0x6092 sub-index 2}}$$

    The default value of scaling is:

$$\frac{1}{10{,}000{,}000}$$

15. Configure the operation mode.

    In the navigation pane, go to I/O Devices and select the smartPX.

16. Select the **CoE Online** tab.

17. Set the value of object 0x6060 to **8.**

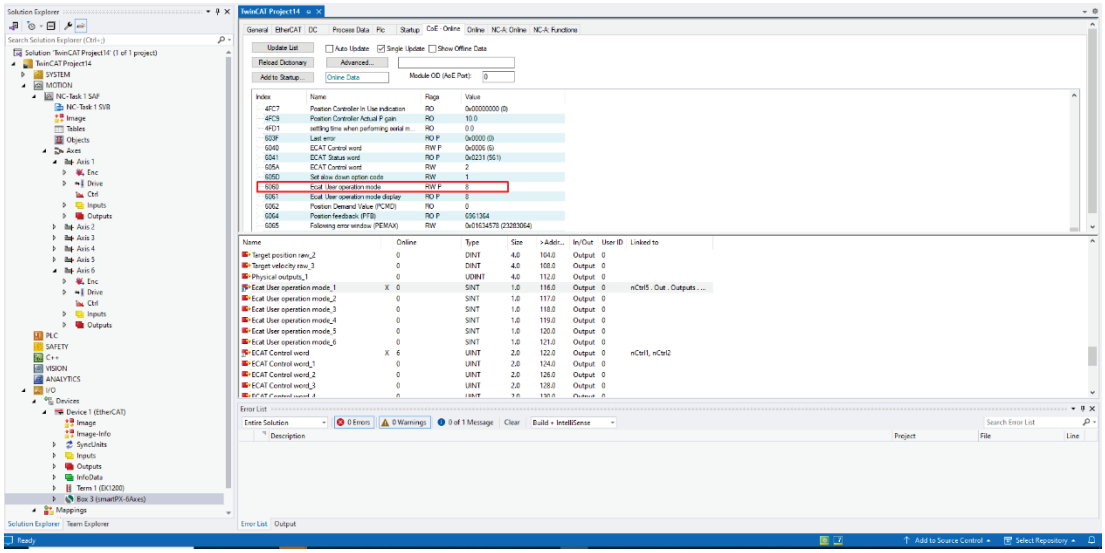


Figure 6-34.

18. In the toolbar, click **Activate configuration** to start the TwinCAT application.

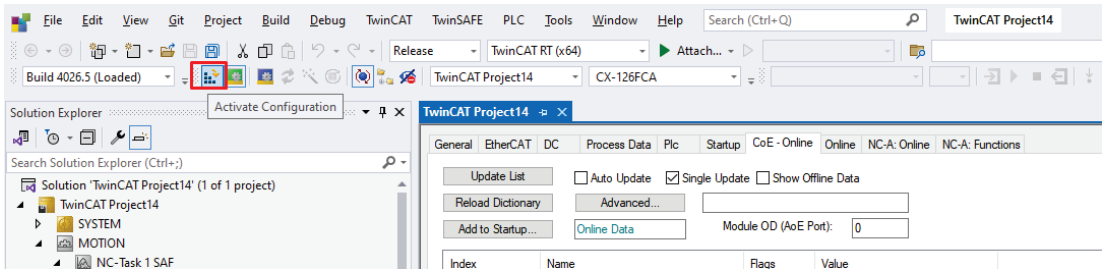


Figure 6-35.

19. Switch to the smartPX **Online** tab, and make sure the drive's Current State is **OP**.

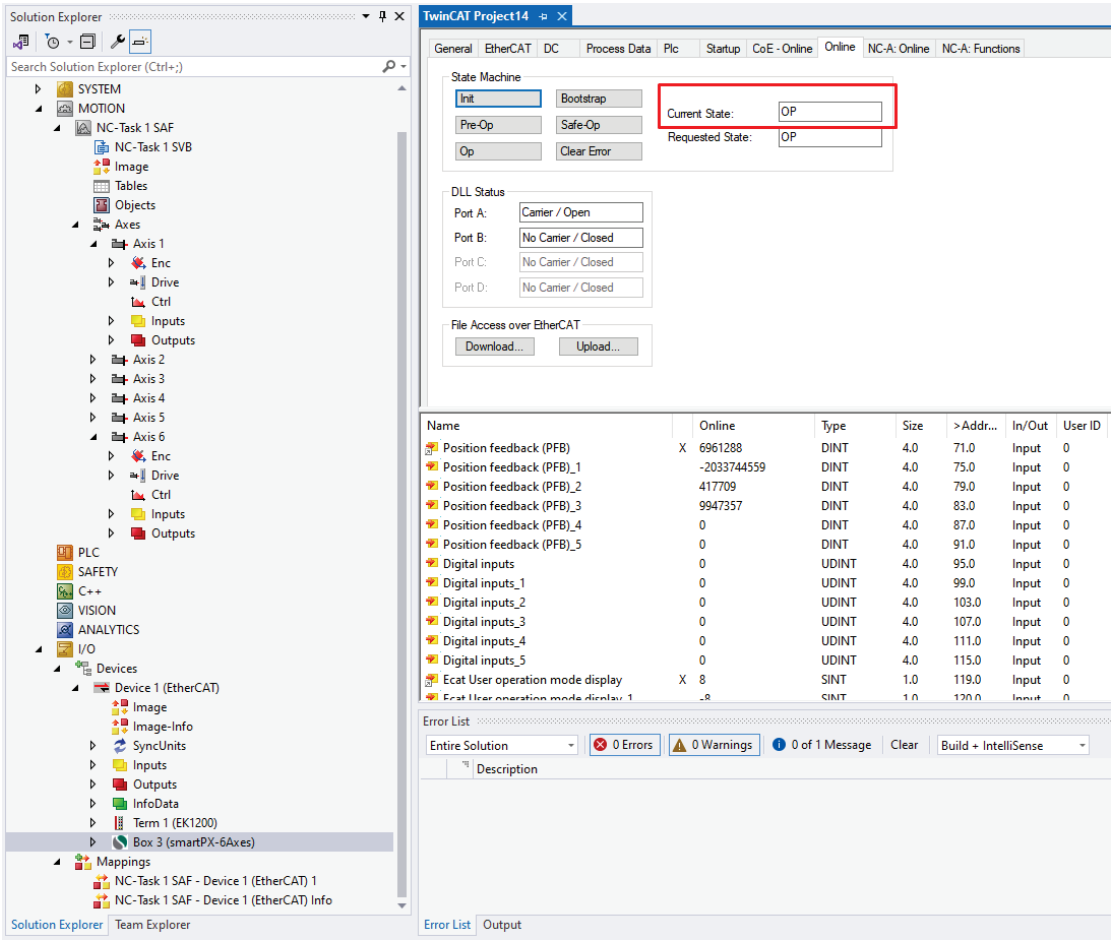


Figure 6-36.

20. Switch to the smartPX **NC-Online** tab, and test communication with the drive.

    Take hold of the motor shaft, and turn it manually; check whether the position feedback value changes.

    Refer to the following figure, which shows the various functions.

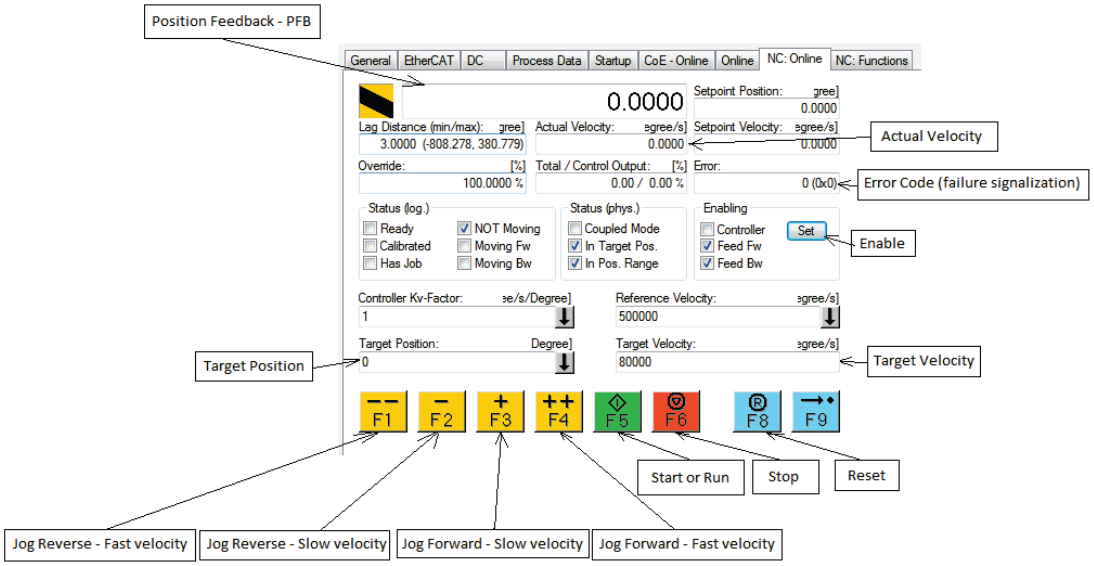


Figure 6-37.

Generating Motion in Cyclic Synchronous Position Mode

The following steps describe how to generate a motion in Cyclic Synchronous Position mode.

From the smartPX **NC-Online** tab, you will send a target position and velocity to the drive. The controller will execute a motion.

1. Enable the drive:
    a. NC-Online tab > Enabling > Set.
    b. Enable the options: Controller, Feed Fw and Feed Bw, or select All.
    c. OK.

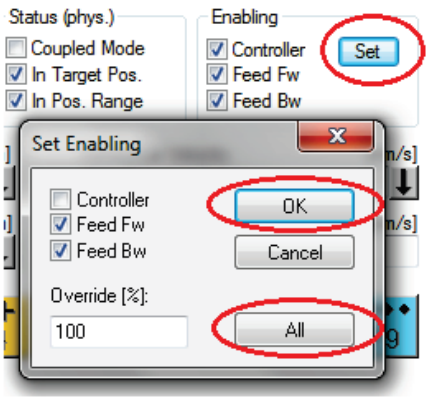


Figure 6-38.

Notes To disable the drive:
NC-Online tab> Enabling > Clear the option Controller > OK

2. Use the motion buttons F1, F2, F3 and F4 to generate the following motion profiles.

   In the navigation pane, select an Axis, and then select the **Parameter** tab.

3. Configure the velocity in the controller using **Manual Velocity** (Slow and Fast).

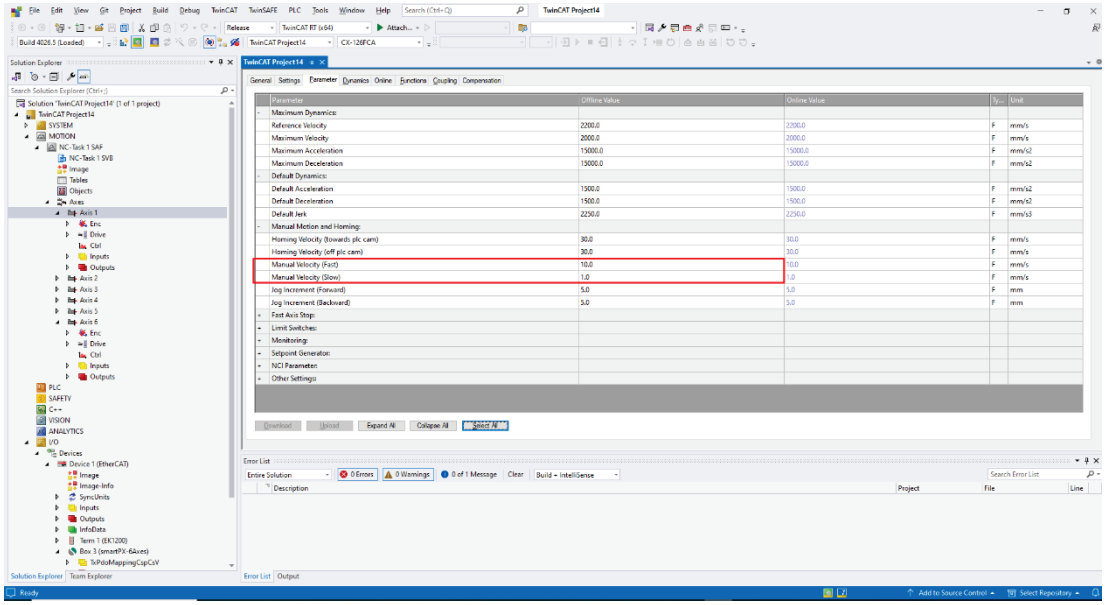


Figure 6-39.

F1. Sends a jog command in the negative direction (CCW) with a fast velocity.

F2. Sends a jog command in the negative direction (CCW) with slow velocity.

F3. Sends a jog command in the positive direction (CW) with slow velocity.

F4. Sends a jog command in the positive direction (CW) with fast velocity.

4. Set values for Target Position and Target Velocity, as shown in this example:

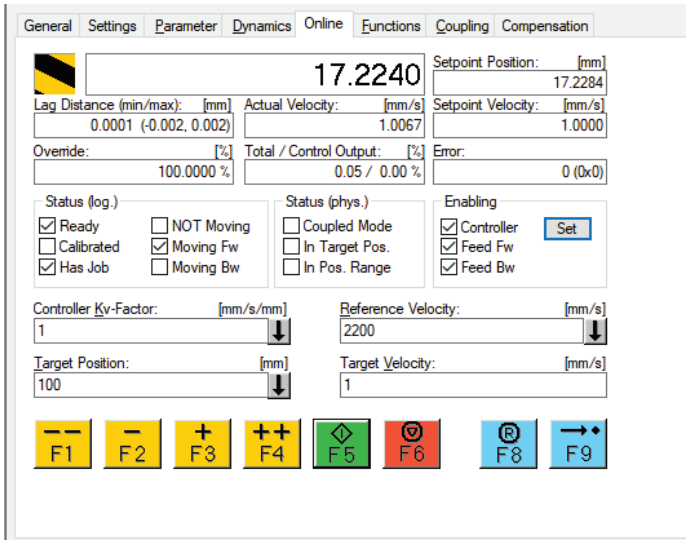


Figure 6-40.

Generating a Step Motion

The following steps describe how to generate a step sequence.

1. In the navigation pane, select an Axis, and then select the **Function** tab.
2. Set the Start Mode settings as shown in this example:

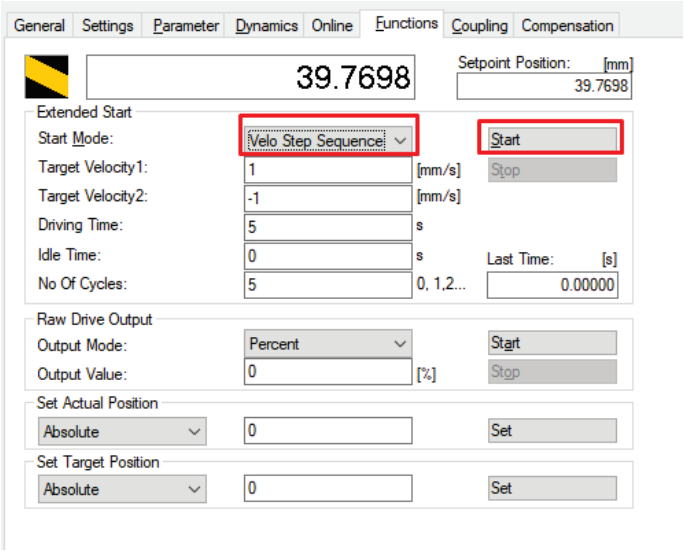


Figure 6-41.

3. Check to see that the motor is performing a back-and-forth motion.