S7-200 Smart to Stepper Drive Communication

S7-200 SMART V2.4/ TIA V15.1

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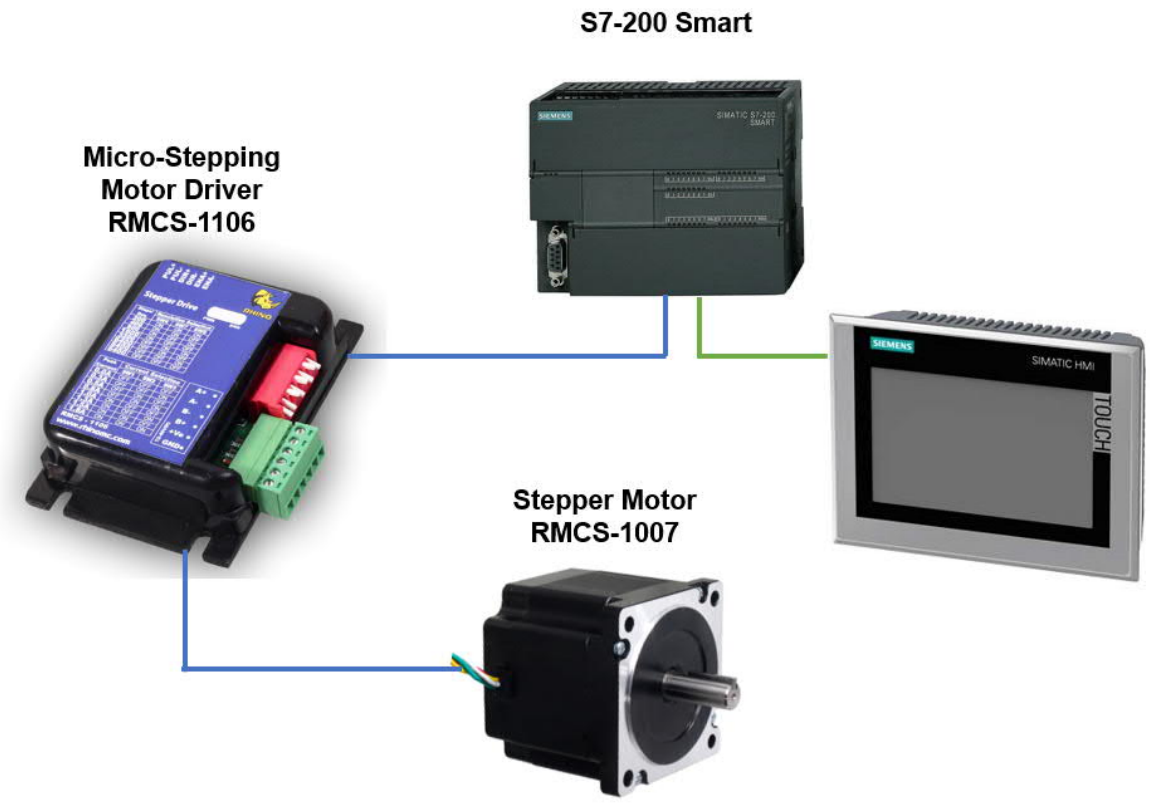
1 Task

Communication between Stepper Drive and a PLC is often required in a diversity of general “Cutting-to-Lenght“ applications. Taking reciprocating controlled positioning of an axis for example, communication between a controller（S7-200 Smart）and a Stepper Drive RHINO MOTION CONTROLS RMCS-1106.

1.1 Overview of the automation task

In the application, RMCS-1106 Stepper Drive controls a RMCS-1107 Stepper Motor using motion control wizard.

The following figure provides an overview of the automation task:



2 Automation solution

2.1 Hardware and software components used

2.1.1 Hardware components

No.	Component	Order number	Quantity
1	SIMATIC S7-200 Smart ST30	6ES72881ST300AA0	1
2	Micro-Stepping Motor Driver (Max. 40Vdc and 2A per phase)	RMCS-1106	1
3	Stepper Motor 3.75° Step Angle 0.65 Kgcm Torque	RMCS-1007	1
4	Comfort Panel TP 700	6AV2124-0GC01-0AX0	1
4	Ethernet Cable		1

2.1.2 Software components

User can order these CDs that contain the following software tools:

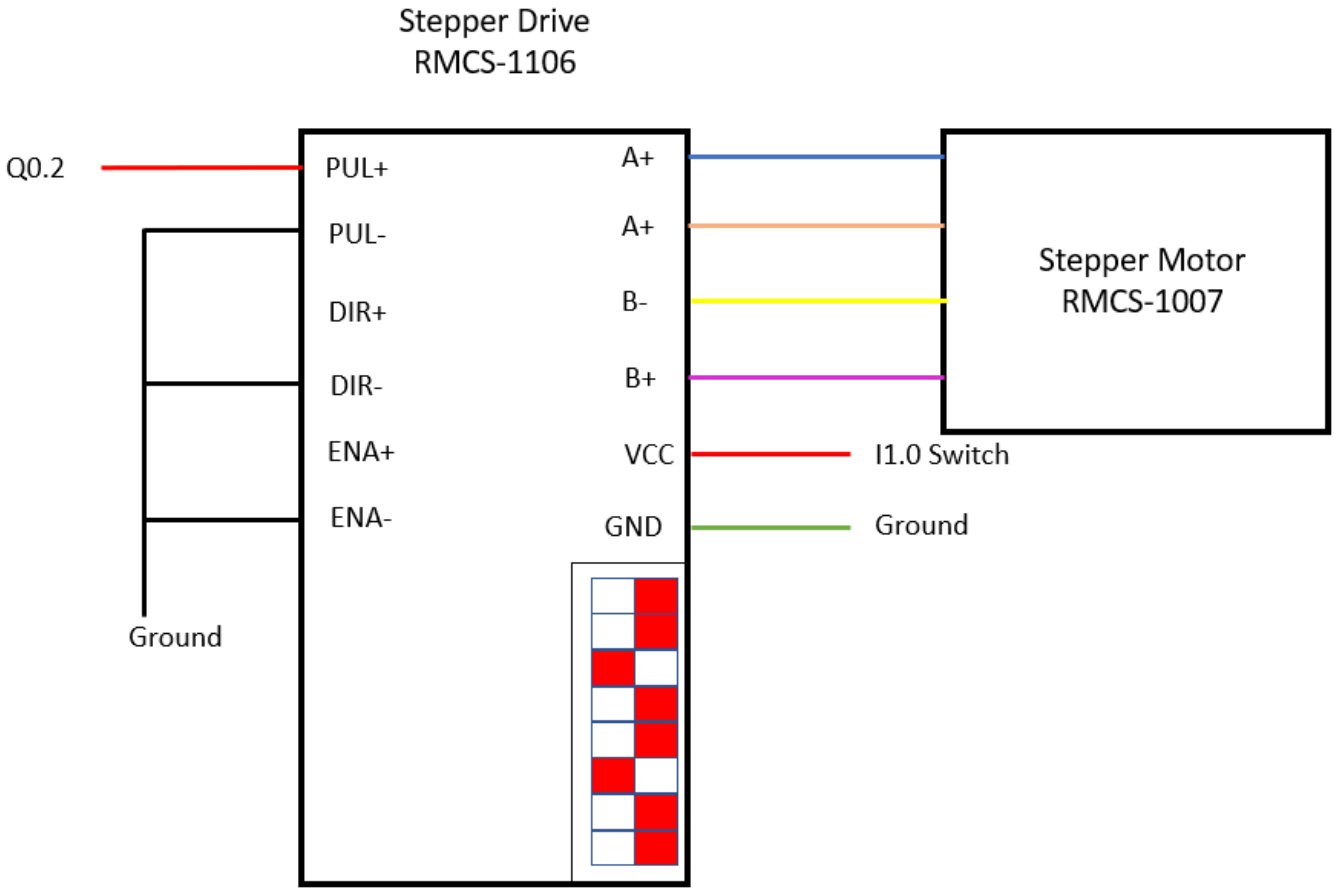
No.	Component	Order number	Quantity
1	STEP7 Micro/WIN SMART 2.4	6ES7288-SW01-0AA0	1

Note

Most of the hardware components shown in the table are commercially available in the global market. If unavailable in your country (or region), find an appropriate substitute at your own discretion.

The table lists key hardware components required for this project. Other accessories such as cables and wires, supports, terminal strips, and so on can be purchased separately.

2.2 Setup



2.2.1 Figure 2-1 Stepper Motor connection

Note For more detail please refer operating manual of Stepper Drive RMCS-1106 and Stepper Motor RMCS-1007

3 Functional mechanisms

3.1 Axis Control

The Axis of Motion provides a single pulse train output with integrated direction control and disable outputs. It also includes programmable inputs which allow the CPU to be configured for several modes of operation, including automatic reference point seek. The Axis of Motion provides a unified solution for open loop control of the speed and position for either stepper motors or servo motors.

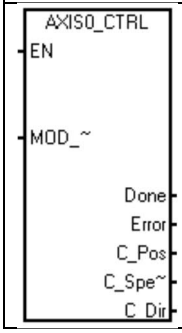
To simplify the use of motion control in your application, STEP 7-Micro/WIN SMART provides a Motion wizard to configure Axis of Motion and a PWM wizard to configure PWM. The wizards generate motion instructions that you can use to provide dynamic control of speed and motion in your application. For the Axis of Motion, STEP 7-Micro/WIN SMART also provides a control panel that allows you to control, monitor, and test your motion operations.

The motion control built into the CPU uses an Axis of Motion to control both the speed and motion of a stepper motor or a servo motor. Using the Axis of Motion requires expertise in the field of motion control. This chapter is not meant to educate the novice in this subject. However, it provides fundamental information that will help as you use the Motion wizard to configure the Axis of Motion for your application.

For more details refer operating manual section *12.2 Using Motion Control*

3.2 Control program

3.2.1 AXISx_CTRL subroutine

LAD / FBD	STL	Description
	CALL AXISx_CTRL, MOD_EN, Done, Error, C_Pos, C_Speed, C_Dir	The AXISx_CTRL subroutine (Control) enables and initializes the Axis of Motion by automatically commanding the Axis of Motion to load the configuration/profile table each time the CPU changes to RUN mode. Use this subroutine only once in your project per motion axis, and ensure that your program calls this subroutine every scan. Use SM0.0 (Always On) as the input for the EN parameter.

3.2.1.1 Figure 3-1

Input/output	Date Type	Value
MOD_EN	BOOL	I, Q, V, M, SM, S, T, C, L, Power Flow
Done, C_Dir	BOOL	I, Q, V, M, SM, S, T, C, L
Error	BYTE	IB, QB, VB, MB, SMB, SB, LB, AC, *VD, *AC, *LD
C_Pos, C_Speed	DINT, REAL	ID, QD, VD, MD, SMD, SD, LD, AC, *VD, *AC, *LD

The MOD_EN parameter must be on to enable the other motion subroutines to send commands to the Axis of Motion. If the MOD_EN parameter turns off, then the Axis of Motion aborts any command that is in progress and performs a decelerated stop.

The output parameters of the AXISx_CTRL subroutine provide the current status of the Axis of Motion.

The Done parameter turns on when the Axis of Motion completes any subroutine.

The C_Pos parameter is the current position of the Axis of Motion. Based upon the units of measurement, the value is either a number of pulses (DINT) or the number of engineering units (REAL).

The C_Speed parameter provides the current speed of the Axis of Motion. If you configured the measurement system for the Axis of Motion for pulses, C_Speed is a DINT value containing the number of pulses/second. If you configured the measurement system for engineering units, C_Speed is a REAL value containing the selected engineering units/second (REAL).

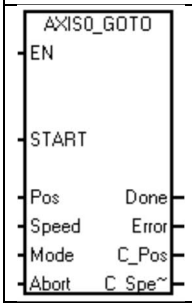
- Signal state of 0 = positive
- Signal state of 1 = negative

Note

The Axis of Motion reads the configuration/profile table only at power-up or when commanded to load the configuration.

• If you use the Motion wizard to modify the configuration, then the AXISx_CTRL subroutine automatically commands the Axis of Motion to load the configuration/profile table every time the CPU changes to RUN mode.
• If you use the Motion control panel to modify the configuration, clicking the Update Configuration button commands the Axis of Motion to load the new configuration/profile table.
• If you use another method to modify the configuration, then you must also issue an AXISx_CFG command to the Axis of Motion to load the configuration/profile table. Otherwise, the Axis of Motion continues to use the old configuration/profile table.

3.2.2 AXISx_GOTO subroutine

LAD / FBD	STL	Description
	CALL AXISx_GOTO, START, Pos, Speed, Mode, Abort, Done, Error, C_Pos, C_Speed	The AXISx_GOTO subroutine commands the Axis of Motion to go to a desired location.

3.2.2.1 Figure 3-2

Input/output	Date Type	Value
START	BOOL	I, Q, V, M, SM, S, T, C, L, Power Flow

Pos, Speed	DINT, REAL	I, Q, V, M, SM, S, T, C, L
Mode	BYTE	IB, QB, VB, MB, SMB, SB, LB, AC, *VD, *AC, *LD, Constant
Abort, Done	BOOL	I, Q, V, M, SM, S, T, C, L
Error	BYTE	IB, QB, VB, MB, SMB, SB, LB, AC, *VD, *AC, *LD
C_Pos, C_Speed	DINT, REAL	ID, QD, VD, MD, SMD, SD, LD, AC, *VD, *AC, *LD

Turn on the EN bit to enable the subroutine. Ensure that the EN bit stays on until the DONE bit signals that the execution of the subroutine has completed.

Turn on the START parameter to send a GOTO command to the Axis of Motion. For each scan when the START parameter is on and the Axis of Motion is not currently busy, the subroutine sends a GOTO command to the Axis of Motion. To ensure that only one GOTO command is sent, use an edge detection element to pulse the START parameter on.

absolute move) or the distance to move (for a relative move). Based upon the units of measurement selected, the value is either a number of pulses (DINT) or the engineering units (REAL).

The Speed parameter determines the maximum speed for this movement. Based upon the units of measurement, the value is either a number of pulses/second (DINT) or the engineering units/second (REAL).

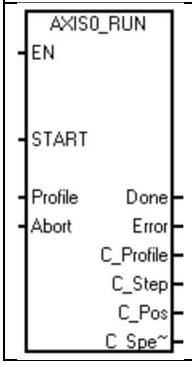
The Mode parameter selects the type of move:

- 0: Absolute position
- 1: Relative position
- 2: Single-speed, continuous positive rotation
- 3: Single-speed, continuous negative rotation

The Done parameter turns on when the Axis of Motion completes this subroutine. Turn on the Abort parameter to command the Axis of Motion to stop execution of this command and decelerate until the motor comes to a stop.
The C_Pos parameter contains current position of the Axis of Motion. Based upon the units of measurement, the value is either a number of pulses (DINT) or the number of engineering units (REAL).

The C_Speed parameter contains the current speed of the Axis of Motion. Based upon the units of measurement, the value is either a number of pulses/second (DINT) or the engineering units/second (REAL).

3.2.3 AXISx_GOTO subroutine

LAD / FBD	STL	Description
	CALL AXISx_RUN, START, Profile, Abort, Done, Error, C_Profile, C_Step, C_Pos, C_Speed	The AXISx_RUN subroutine (Run Profile) commands the Axis of Motion to execute the motion operation in a specific profile stored in the configuration/ profile table.

3.2.3.1 Figure 3-3

Input/output	Date Type	Value
START	BOOL	I, Q, V, M, SM, S, T, C, L, Power Flow
Profile	BYTE	IB, QB, VB, MB, SMB, SB, LB, AC, *VD, *AC, *LD, Constant
Abort, Done	BOOL	I, Q, V, M, SM, S, T, C, L
Error, C_Profile, C_Step	BYTE	IB, QB, VB, MB, SMB, SB, LB, AC, *VD, *AC, *LD
C_Pos, C_Speed	DINT, REAL	ID, QD, VD, MD, SMD, SD, LD, AC, *VD, *AC, *LD

Ensure that the EN bit stays on until the Done bit signals that the execution of the subroutine has completed.

Turn on the START parameter to send a RUN command to the Axis of Motion. For each scan when the START parameter is on and the Axis of Motion is not currently busy, the subroutine sends a RUN command to the Axis of Motion. To ensure that only one command is sent, use an edge detection element to pulse the START parameter on.

The Profile parameter contains the number or the symbolic name for the motion profile. The "Profile" input must be between 0 - 31. If not, the subroutine will return an error. Turn on the Abort parameter to command the Axis of Motion to stop the current profile and decelerate until the motor comes to a stop.

The Done parameter turns on when the Axis of Motion completes this subroutine. The Error parameter (Page 695) contains the result of this subroutine. The C_Profile parameter contains the profile currently being executed by the Axis of Motion.

The C_Step parameter contains the step of the profile currently being executed. The C_Pos parameter contains the current position of the Axis of Motion. Based upon the units of measurement, the value is either a number of pulses (DINT) or the number of engineering units (REAL).

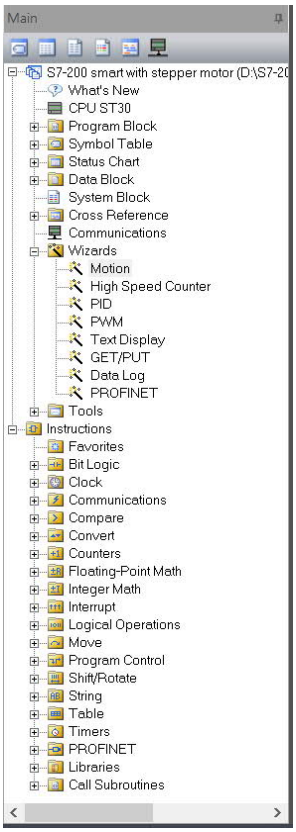
The C_Speed parameter contains the current speed of the Axis of Motion. Based upon the units of measurement, the value is either a number of pulses/second (DINT) or the engineering units/second (REAL).

3.2.4 Error codes for the Motion instruction

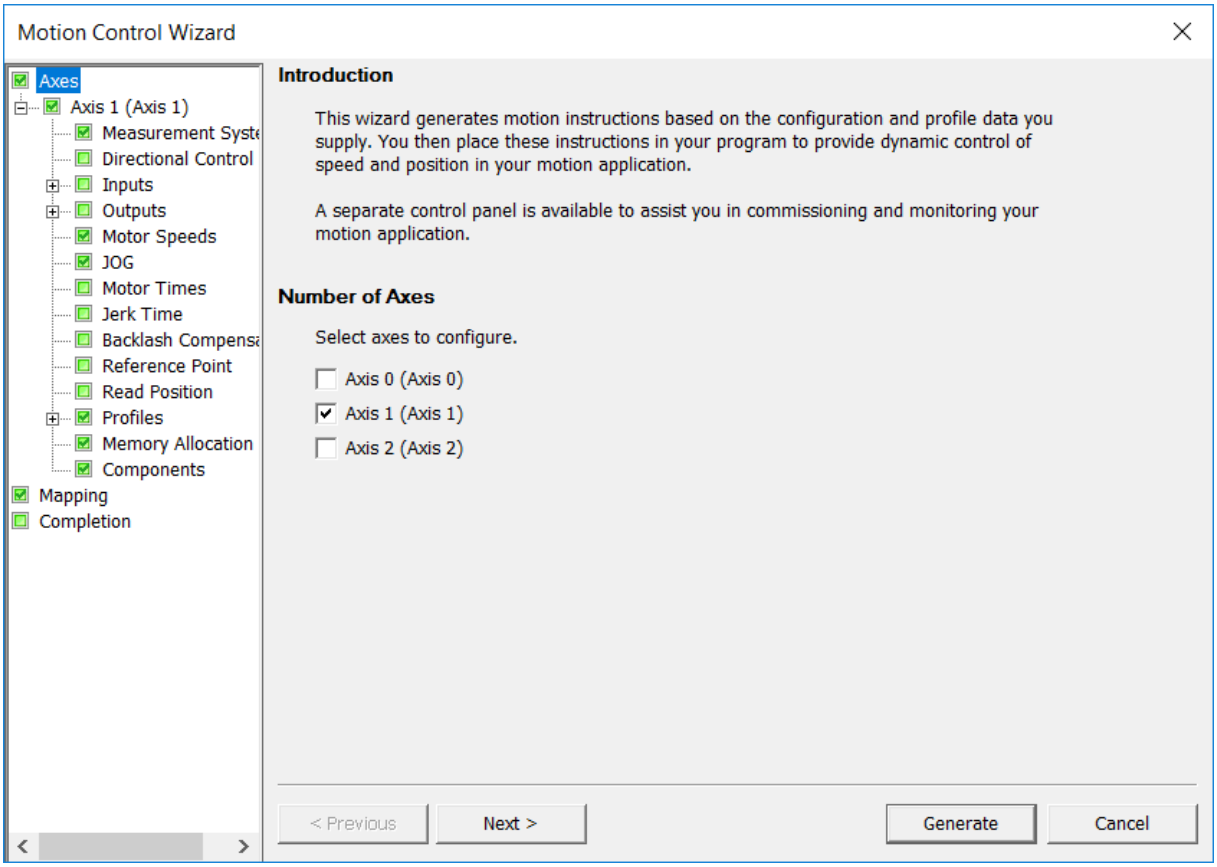
Error Code	Description
0	No error
1	Aborted by user
2	Configuration error (This error occurs if there is an error in the SDB0 configuration.)
3	Illegal command
4	Aborted due to no valid configuration (This error occurs if there is an error in the configuration table.)
5	Reserved
6	Aborted due to no defined reference point
7	Aborted due to STP input active
8	Aborted due to LMT- input active
9	Aborted due to LMT+ input active
10	Aborted due to problem executing motion
11	No profile block configured for specified profile
12	Illegal operation mode
13	Operation mode not supported for this command
14	Illegal number of steps in profile block
15	Illegal direction change
16	Illegal distance
17	RPS/TRIG trigger occurred before target speed reached
18	Insufficient RPS active region width
19	Speed out-of-range
20	Insufficient distance to perform desired speed change
21	Illegal position
22	Zero position unknown
23	No DI1S output is defined
24	Reserved
25	Aborted due to CPU going to stop
26	Aborted due to expiration of Motion control panel heartbeat
27 to 127	Reserved
128	Axis of Motion cannot process this instruction: either the Axis of Motion is busy with another instruction, or there was no Start pulse on this instruction.
129	Reserved
130	Axis of Motion is not enabled
131	Reserved
132	Reserved
133	Illegal profile specified. The AXISx_RUN and AXISx_CACHE instructions profile number range must be between 0 - 31.
134	Illegal mode specified in AXISx_GOTO instruction

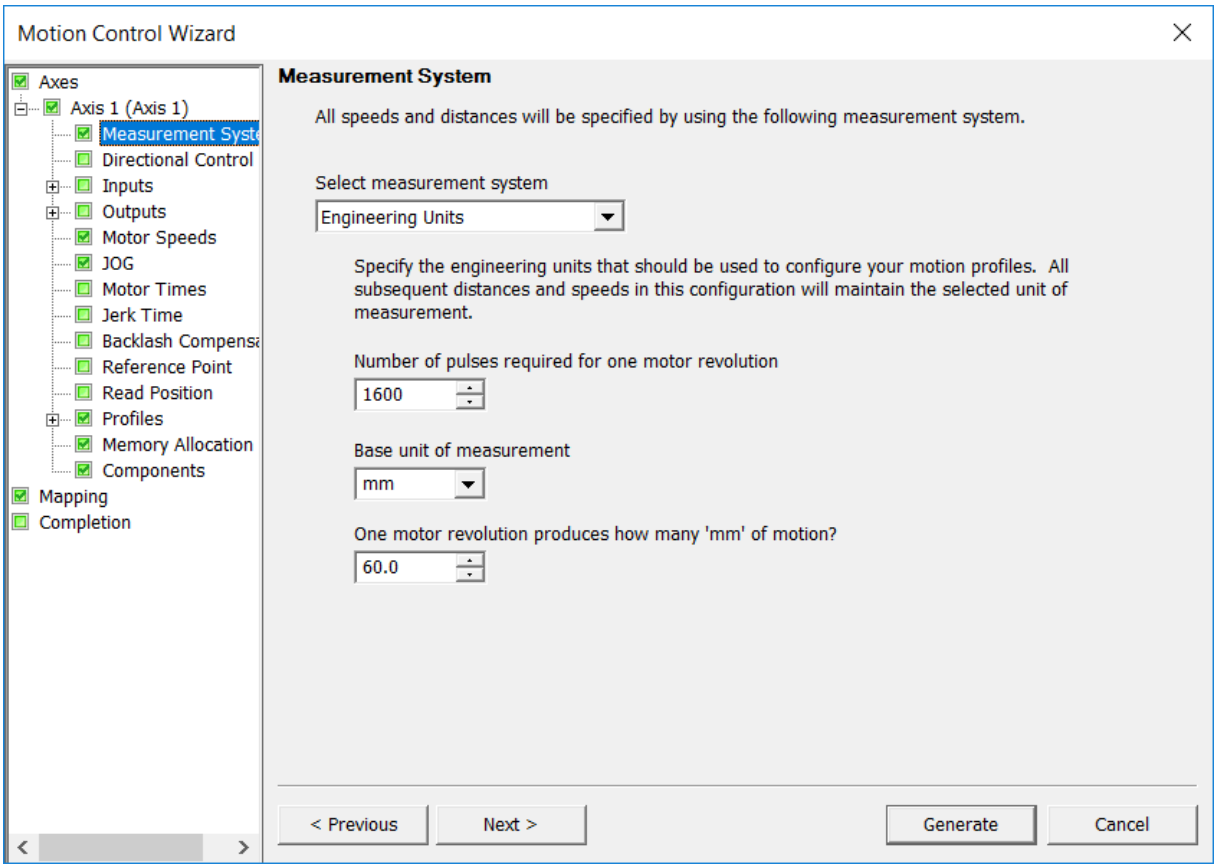
4 Commissioning

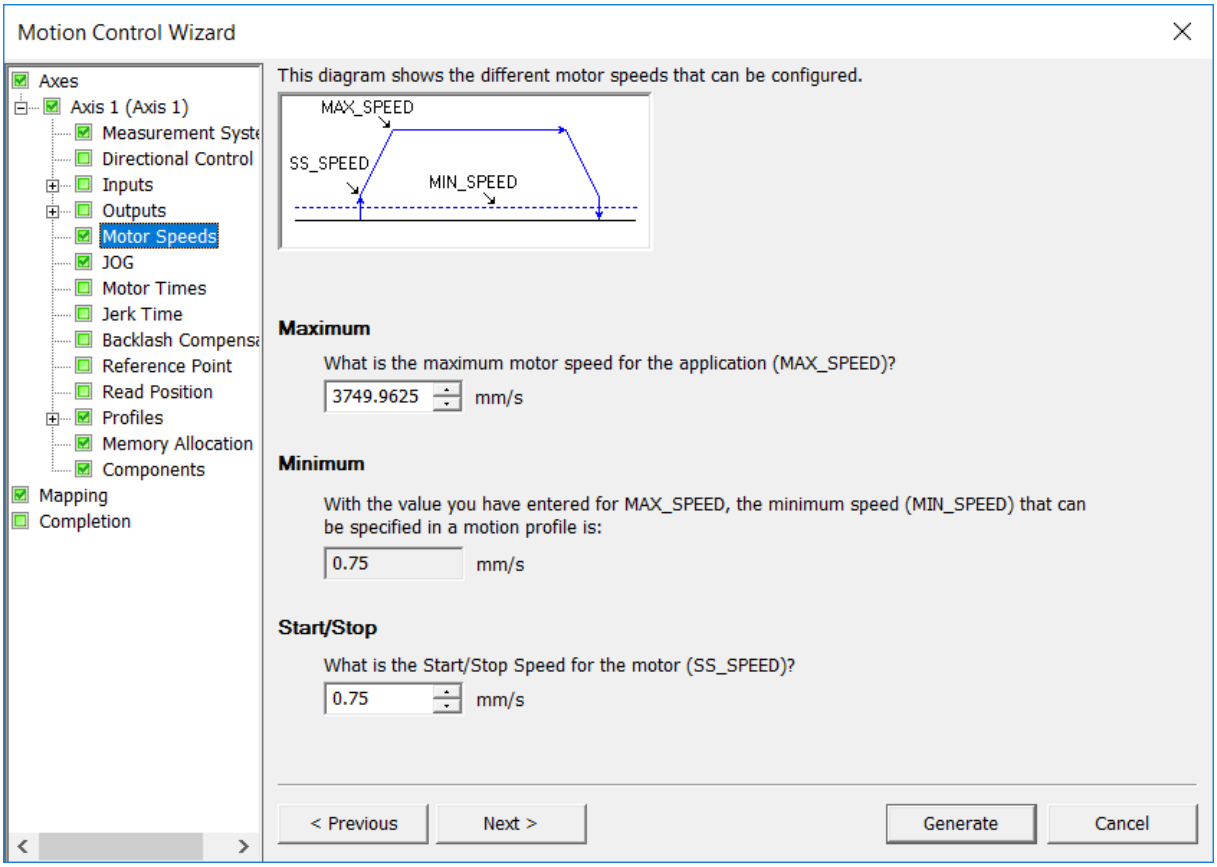
4.1 Setting Motion Control Wizard

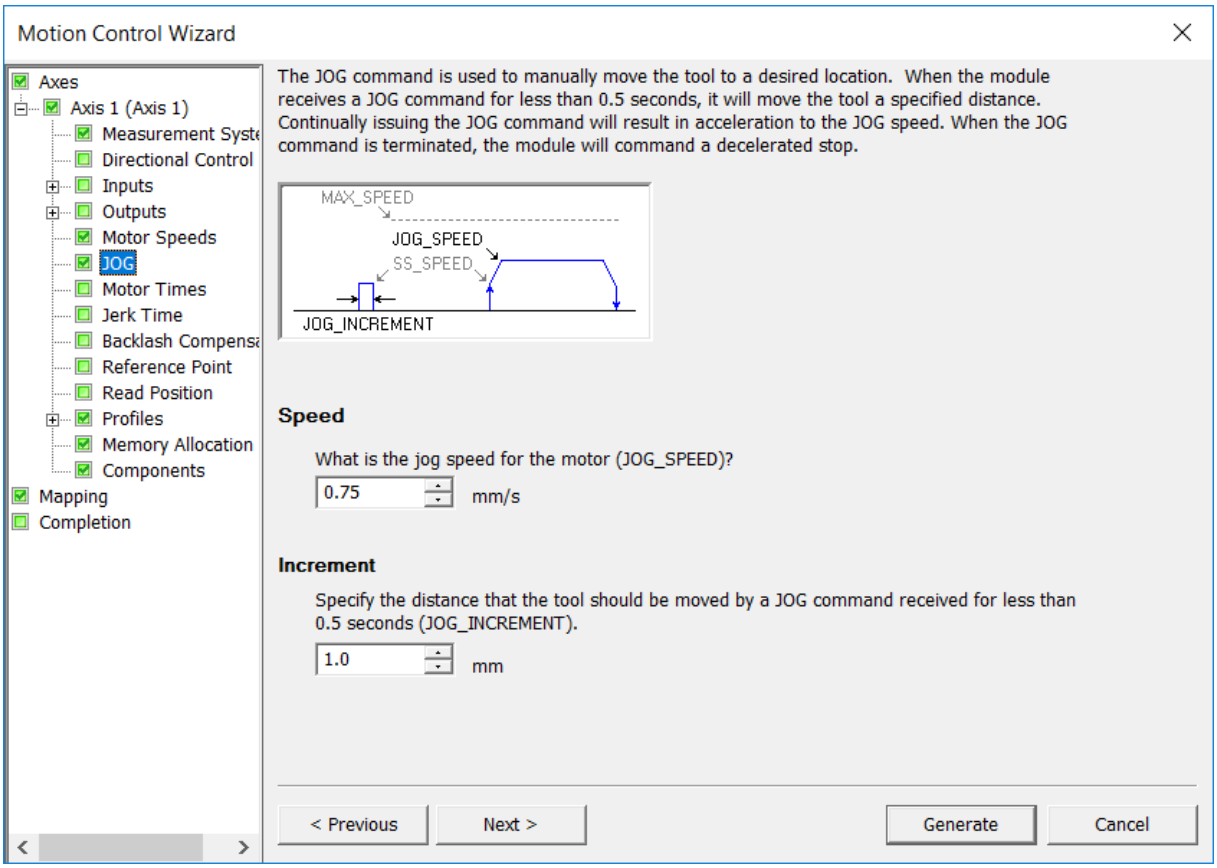


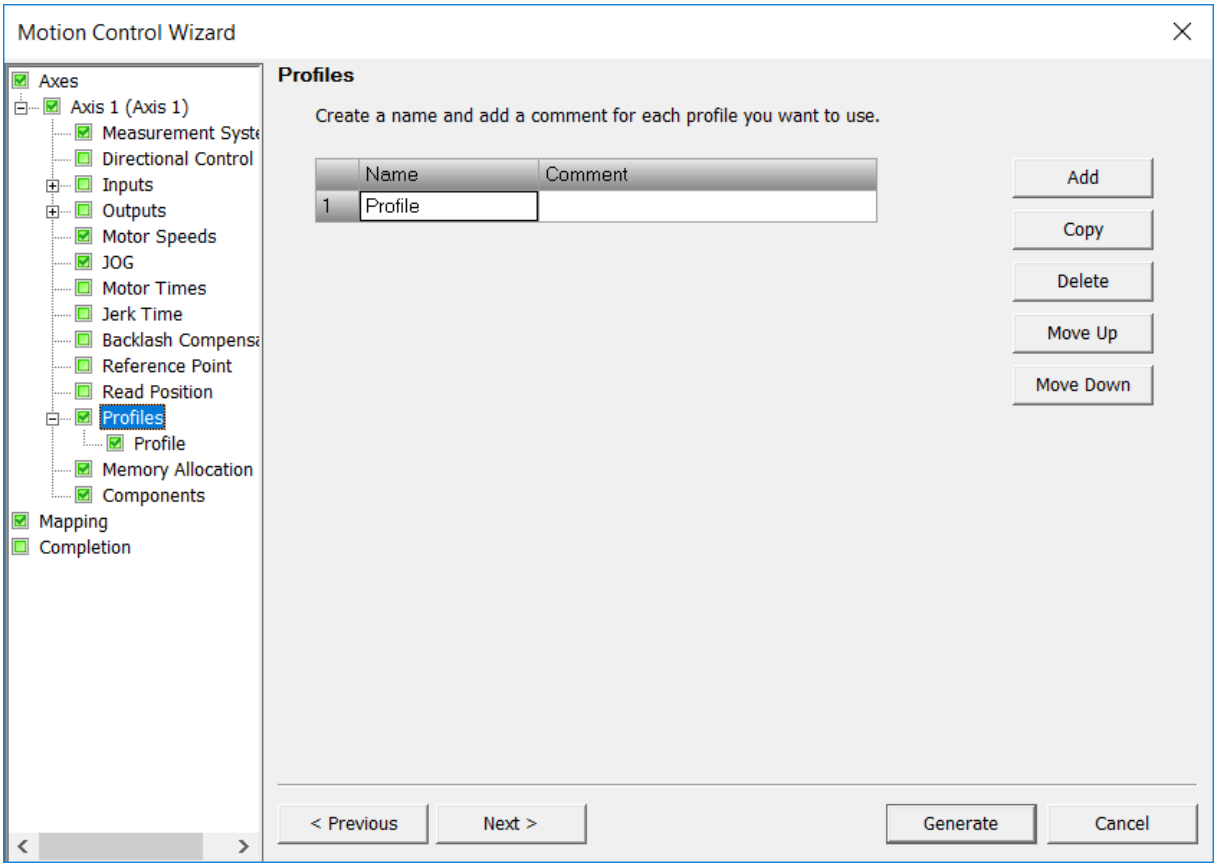
To start the Motion wizard, either click the Tools icon in the navigation bar and then double-click the Motion wizard icon, or select the Tools > Motion wizard menu command.

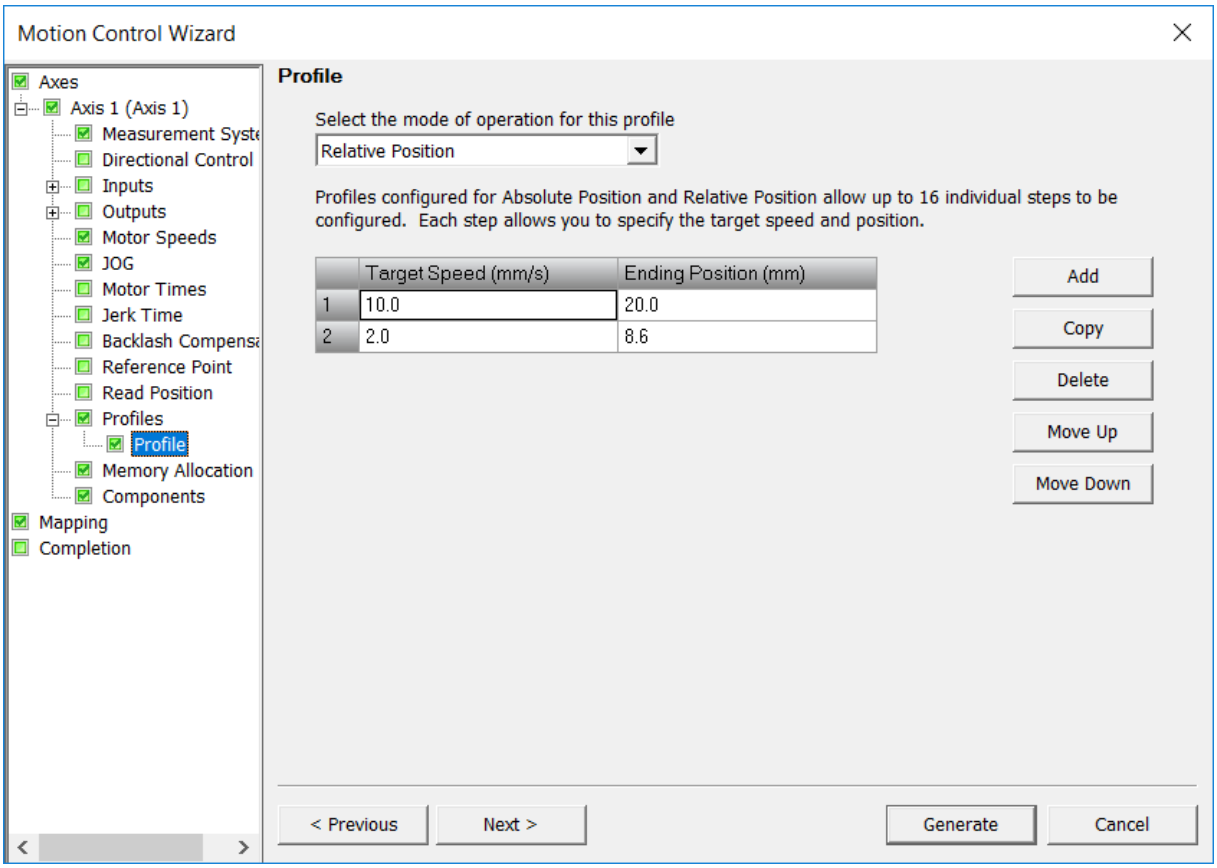


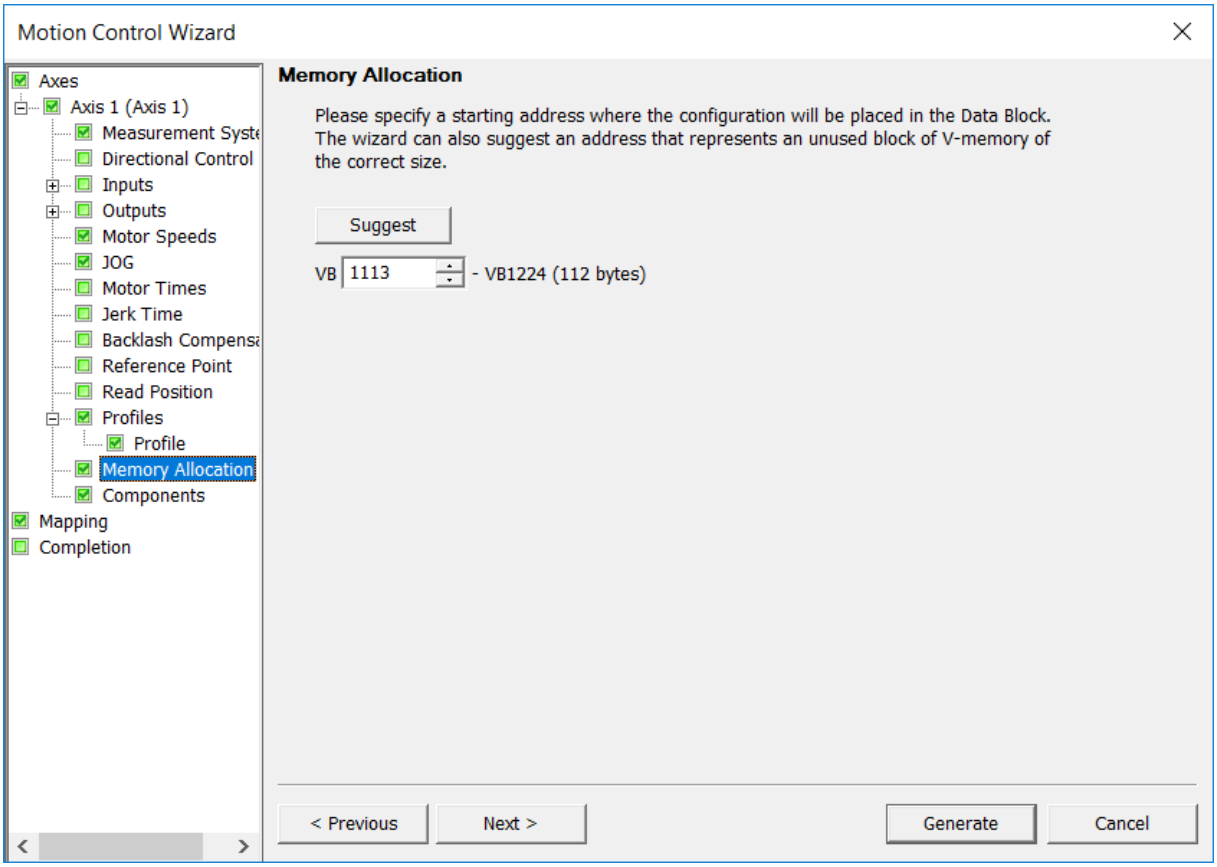


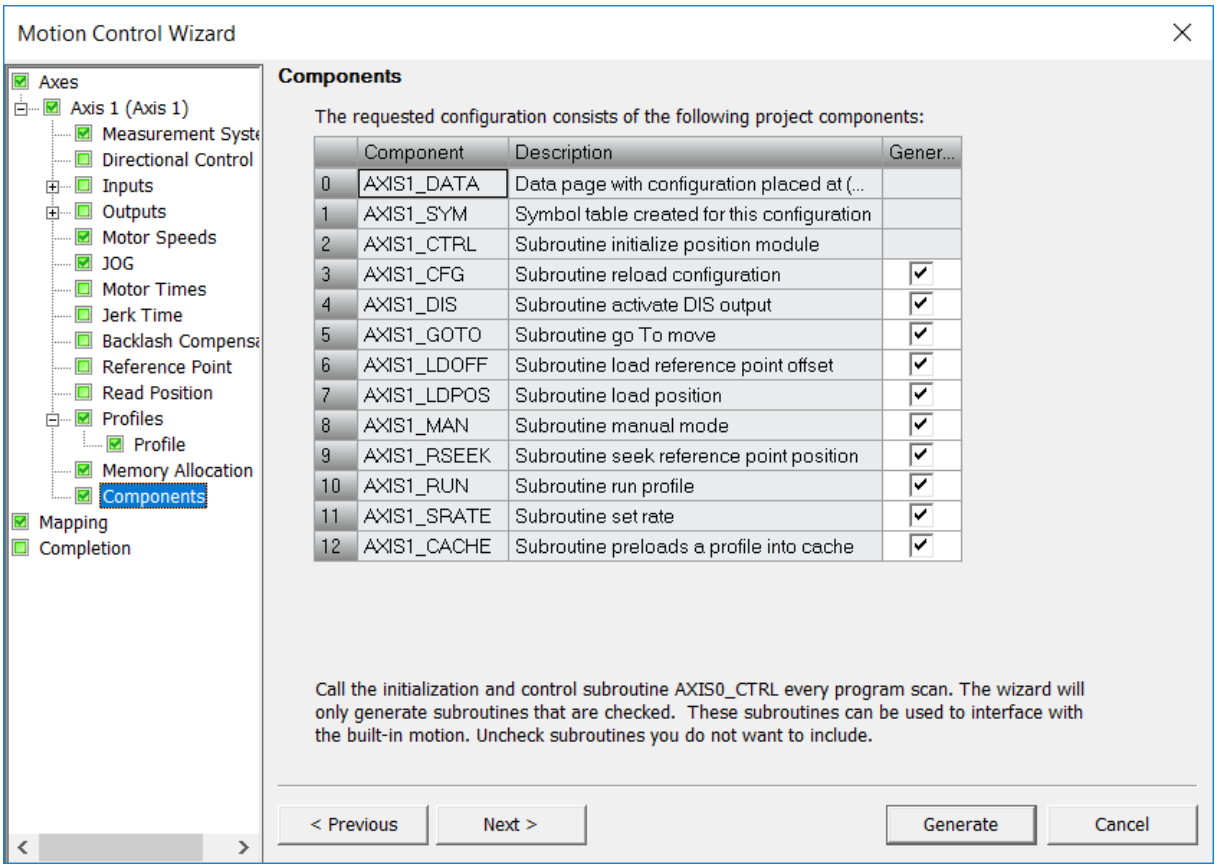


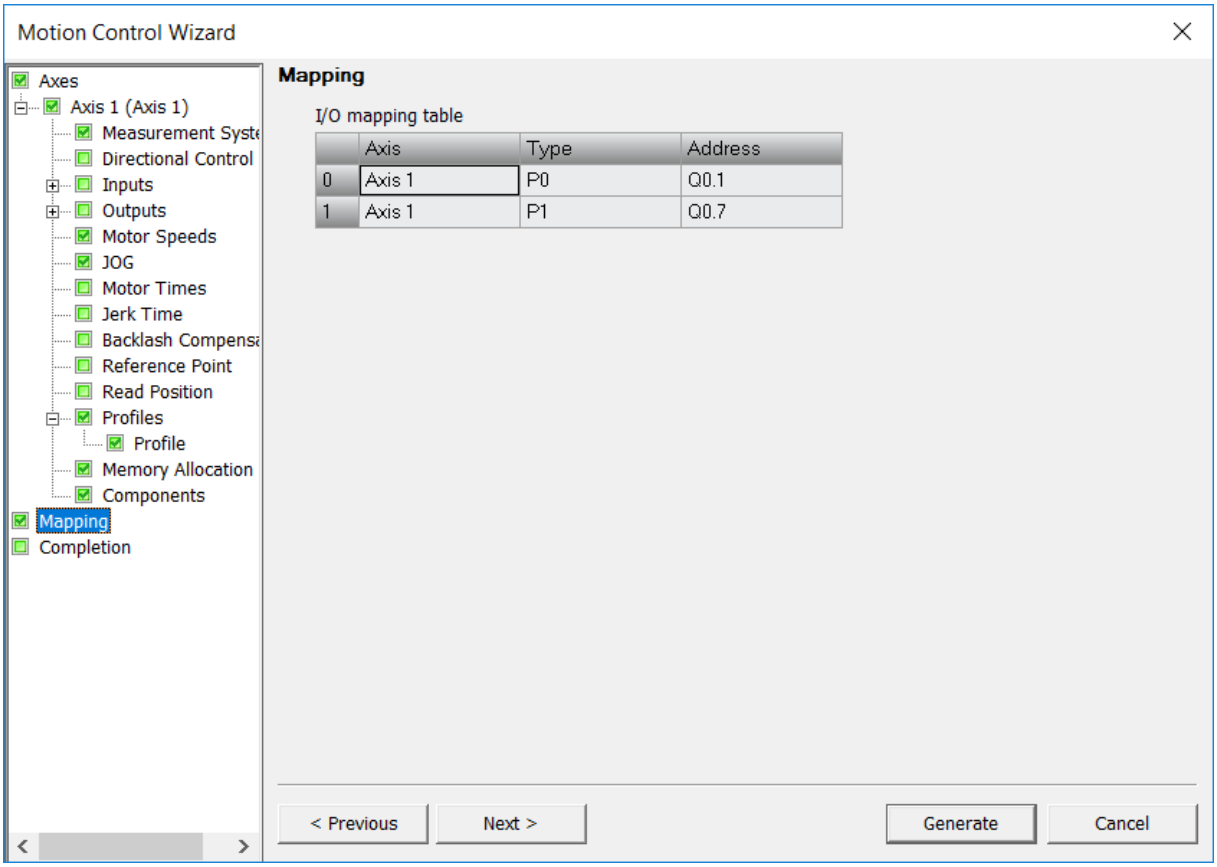








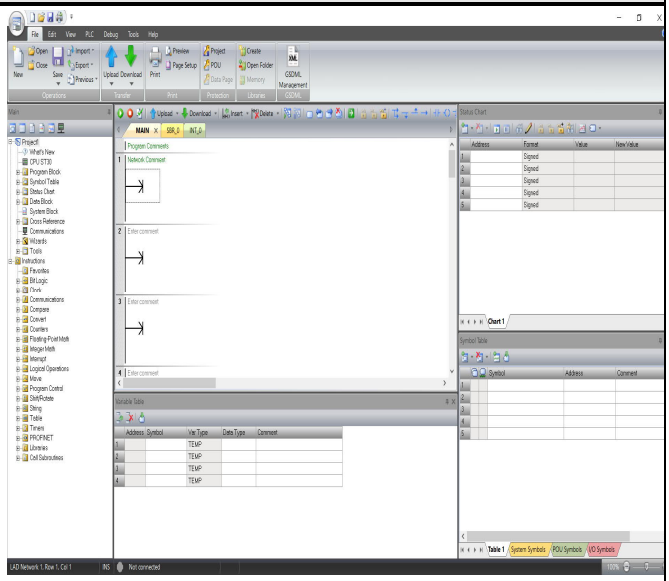


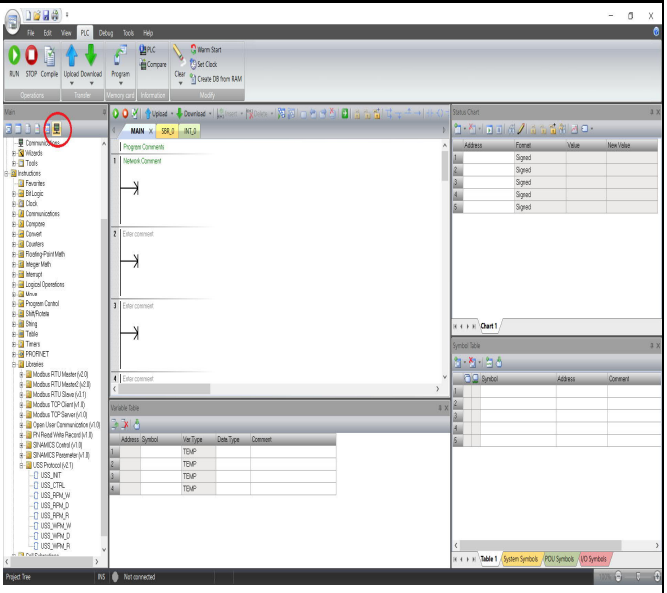
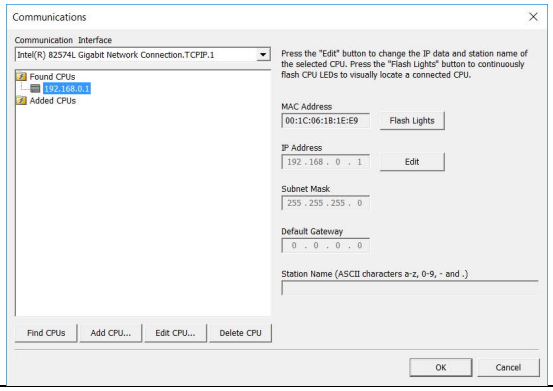


4.2 Downloading the SIMATIC program

This chapter describes the steps for the installation of the example code.

We offer you examples with test code test parameters as a download. The software examples support you during the first steps and tests with your STEP7-Micro/WIN SMART. The enable quick testing of hardware and software interfaces between the products described in the tool.

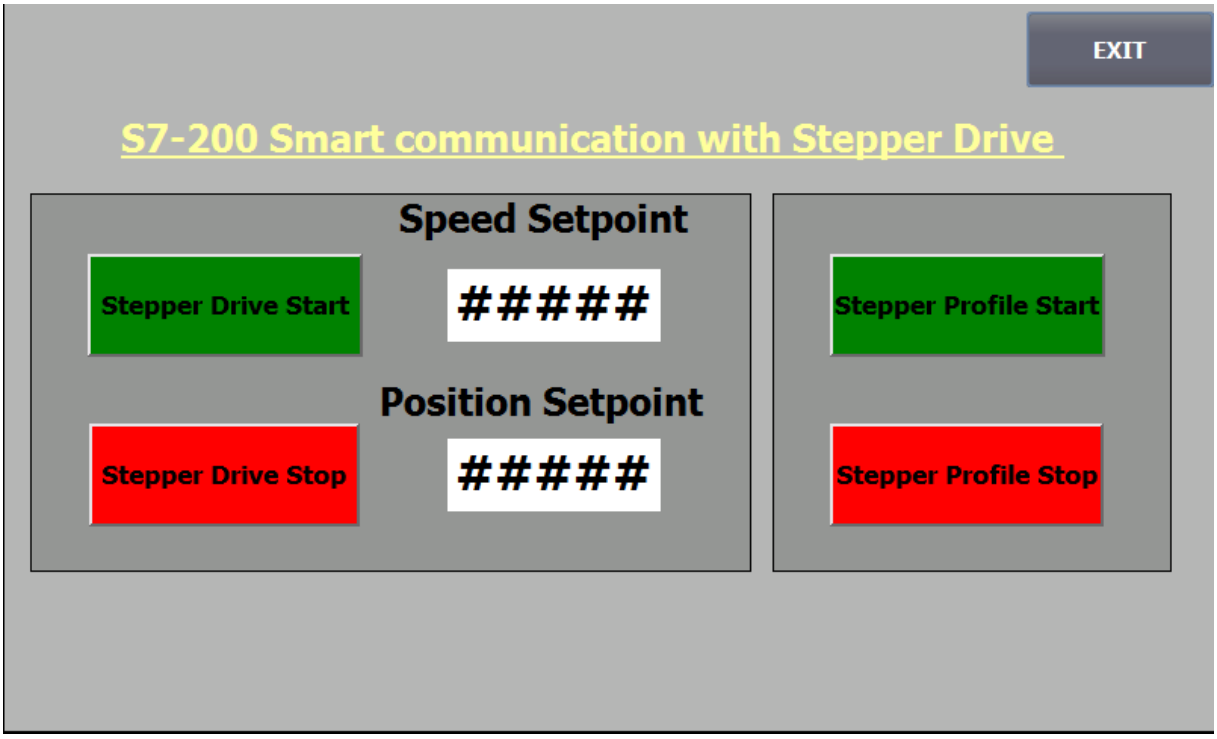
No.	Action	Remarks
1.	Start STEP7-Micro/WIN SMART	

No.	Action	Remarks
3.	Call up “Communication”. Click “Communication” and select the right “Find PLC”. (All types of S7-200 SMART are available.)	 

5 Operation

Here we have HMI screen shown below for controlling the operations i.e.

1) Controlling with settable position and speed.
2) Controlling with 'Profile' function.



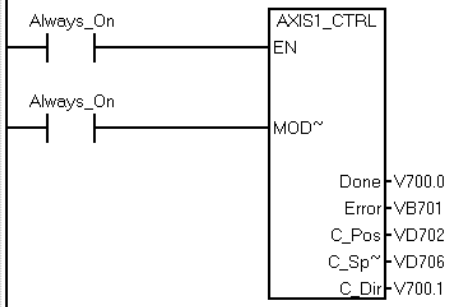
5.1 Positioning

Address	Value	Description
V700.2	1	Start Positioning
VD714	Entered from HMI	Speed
VD710	Entered from HMI	Position

5.1.1 Table 5-1 Positioning address

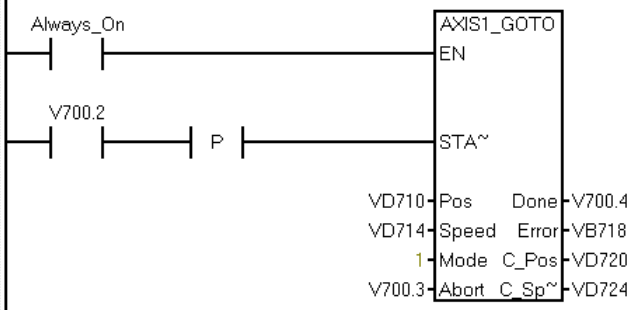
When you set the input signals as indicated in the Table 5-1, the status changes are shown as follows:

1 The AXISx_CTRL subroutine (Control) enables and initializes the Axis of Motion by automatically commanding the Axis of Motion to load the configuration



Symbol	Address	Comment
Always_On	SM0.0	Always ON

2 The AXISx_GOTO subroutine commands the Axis of Motion to go to a desired location.



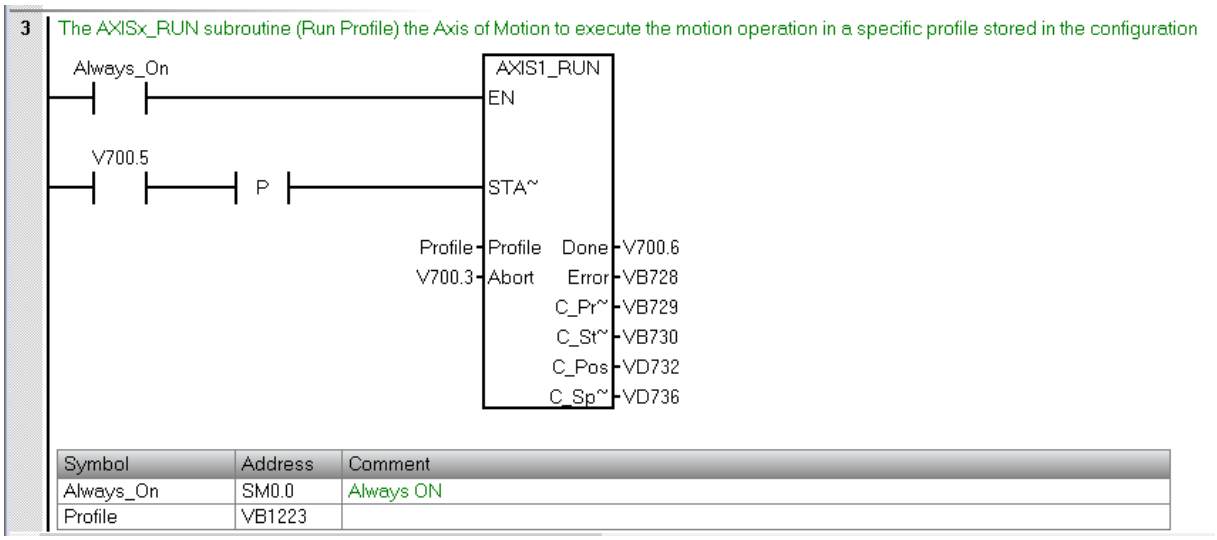
Symbol	Address	Comment
Always_On	SM0.0	Always ON

5.2 Profiling

Address	Value	Description
V700.2	1	Start Profiling
VB1223	Entered from HMI	Profile Selection
V700.3	Entered from HMI	Abort

5.1.2 Table 5-2 Profiling address

When you set the input signals as indicated in Table5-2, the status changes are shown as follows:



6 Appendix

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6.3 Links and literature

Table 6-1

	Topic	Title / link
/1/	Reference to the document	
/2/	Siemens Industry Online Support	http://support.automation.siemens.com
/3/	Industry Mall-Siemens DE	https://eb.automation.siemens.com/goos/WelcomePage.aspx?regionUrl=/de&language=en
/4/	S7-200 SMART System Manual	https://assets.new.siemens.com/siemens/assets/api/uuid:aa045b50-b9f4-4e46-a4c4-ca882c5f00ec/version:1573480788/s7-200-smart-system-manual-en-us.pdf
/5/	S7-200 SMART website	https://new.siemens.com/in/en/products/automation/systems/industrial/plc/simatic-s7-200-smart.html

6.4 Change documentation

Table 6-2

Version	Date	Modifications
V1.0	01/2020	First version