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SINAMICS V90 PN EPOS function with S7-200 Smart PLC

SINAMICS V90 PN / V1.0 / Epos / Telegram 111

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1 Introduction

1.1 Overview

Introduction

STEP 7-Micro/WIN SMART V2.4 and the S7-200 SMART V2.4 CPU firmware add functions of PROFINET communication. It supports the communication connection with SINAMICS V90 PROFINET and this POROFINET communication port supports 8 SINAMICS V90 PN connections. In this manual, the basic applications of the basic positioner (EPOS) in SINAMICS V90 PN with S7-200 SMART will be described in detail.

Overview of the automation task

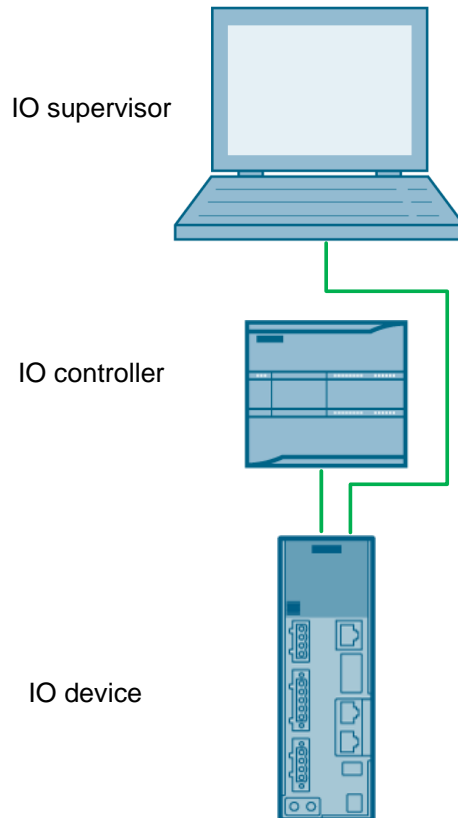The figure below provides an overview of the automation task.

Figure 1-1
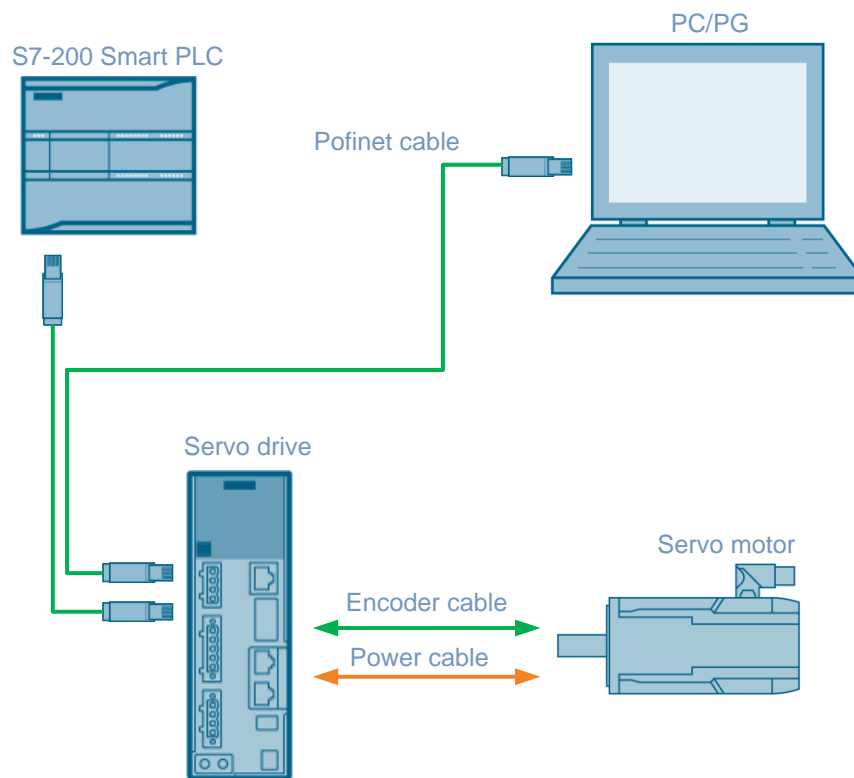
2 Solution

2.1 Solution overview

Schema Display

The following figure displays the most important components of the solution:

Figure 2-1

IO supervisor

IO controller

IO device

Delimitation

This document is not focusing on every content of blew topics, but for the general usage information which will be found in it.

- Profinet communication
- STEP 7-Micro/WIN SMART V2.5
- SINAMICS V90 PN EPOS function

Basic knowledge of these topics is assumed

Required knowledge

Basic knowledge on S7-200 Smart PLC and Program software of STEP 7-Micro/WIN SMART are assumed.

2.2 Hardware and Software Components

2.2.1 Validity

This application examples are valid for

- STEP 7-Micro/WIN SMART V2.5 or newer
- S7-200 Smart PLC FW2.5 or newer
- SINAMICS Control Library update tool V1.1.0 or newer
- SINAMICS V90 PN FW 1.03 or newer

2.2.2 Used Components

This application was generated with the following components:

Hardware components

Table 2-1

Components	No.	Article Number	Note
SIMATIC S7-200 SMART CPU ST60	1	6ES7288-1ST60-0AA0	V2.5
SINAMICS V90 PN 200V	1	6SL3210-5FB10-1UF0	100W
SIMOTICS 1FL6 motor	1	1FL6024-2AF21-1AA1	100W

Standard software components

Table 2-2

Components	No.	Article Number	Note
STEP 7 Micro/WIN SMART	1		V2.5
V-Assistant for V90 PN commissioning	1		V1.06

Sample files and projects

The following list includes all files and projects that are used in this example.

Table 2-3

Component	Note
SINAMICS V90 PN EPOS function with S7-200 Smart PLC.smart	S7-200SMART PLC Project file
SINAMICS V90 PN EPOS function with S7-200 Smart PLC_V1.0	Reference document

3 Basics

3.1 Basics regarding SINAMICS V90 PN version

Supported telegrams

When SINAMICS V90 PN is working in EPOS mode, the following telegrams are supported:

- Standard telegram 7
- Standard telegram 9
- Standard telegram 110
- Standard telegram 111

Among these four telegrams, telegram 111 is factory default telegram and the mostly frequently used one. **Thus, the telegram 111 will be used in this basic application.**

Number of IO devices

When the basic positioner (EPOS mode) is used in SINAMICS V90 PN the number of IO device depends on the number of slaves supported by the controller; For SIMATIC S7-200 SMART PLC supports maximally 8 slaves (IO devices or SINAMICS V90 PN).

NOTE	You can only use SIMATIC S7-200 SMART ST/SR20, ST/SR30, ST/SR40, ST/SR60 CPU as PROFINET IO controller. The firmware version must be V2.4 or higher.

3.2 Installation and startup

3.2.1 Hardware installation

The figure below shows the hardware configuration of the application:

Figure 3-1
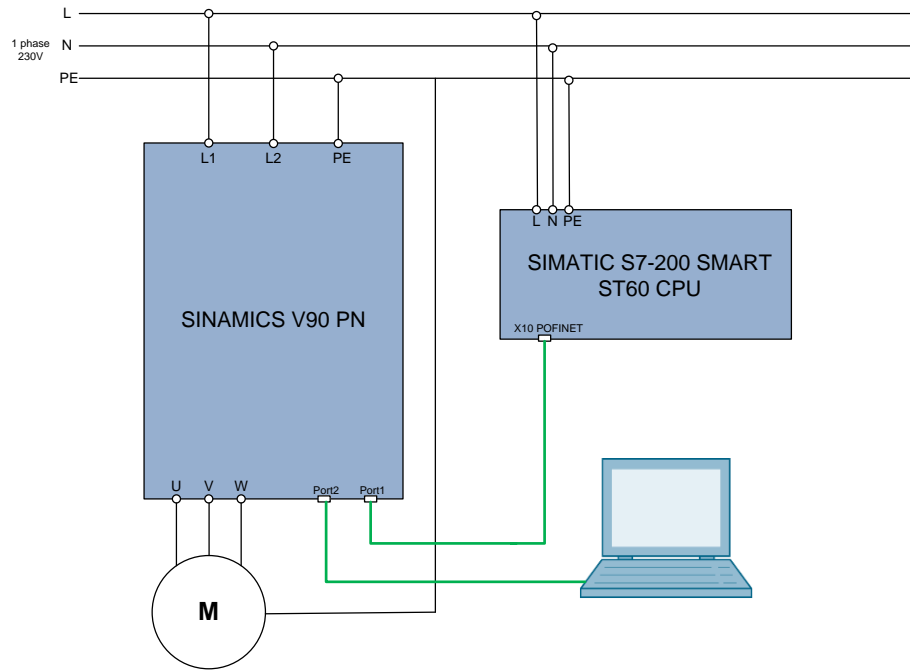
3.2.2 Trial-run

Table 3-1

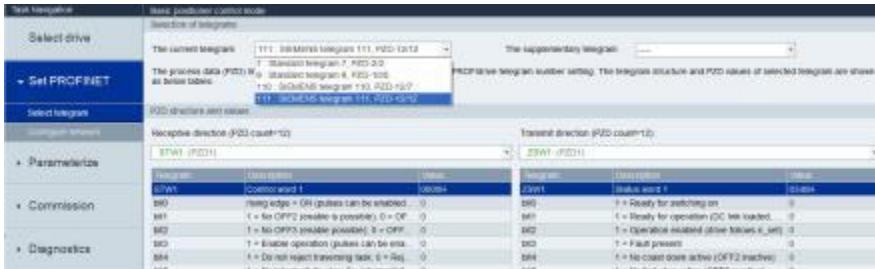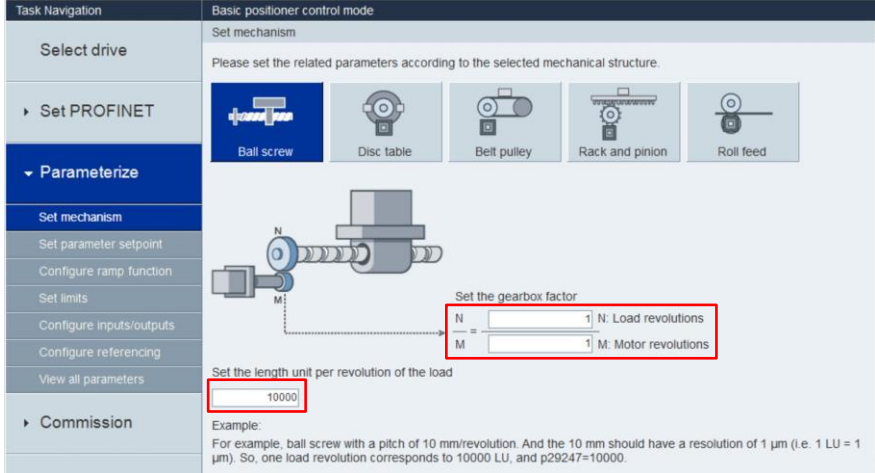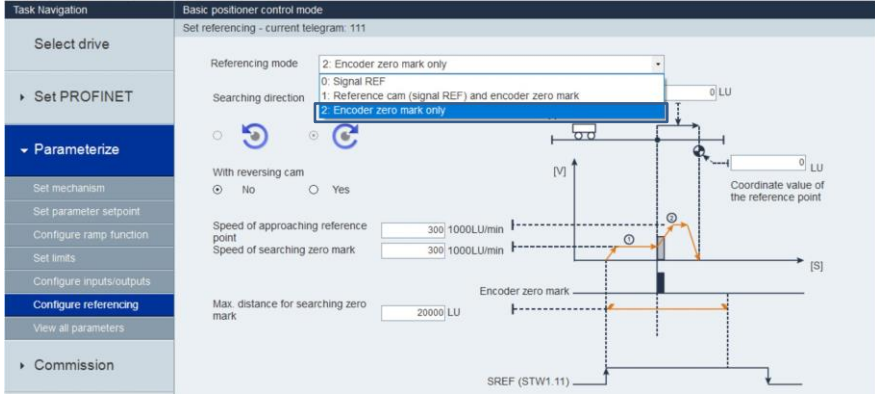| No.	Action	Remarks
1.	Set V90 PN P29018 to be 1	JOG function is enabled when p29018=1
2.	Switch to JOG menu with BOP operation	
3.	Press ▲ or ▼ button to run the motor	Check if the motor can run properly

4 Configuration

In this section, use the S7-200 Smart ST60 CPU to connect with V90 PN. The configuration of V90PN and STEP 7-Micro/WIN SMART V2.5 will be described in detail. The used telegram is telegram 111 and V90 PN works with EPOS mode.

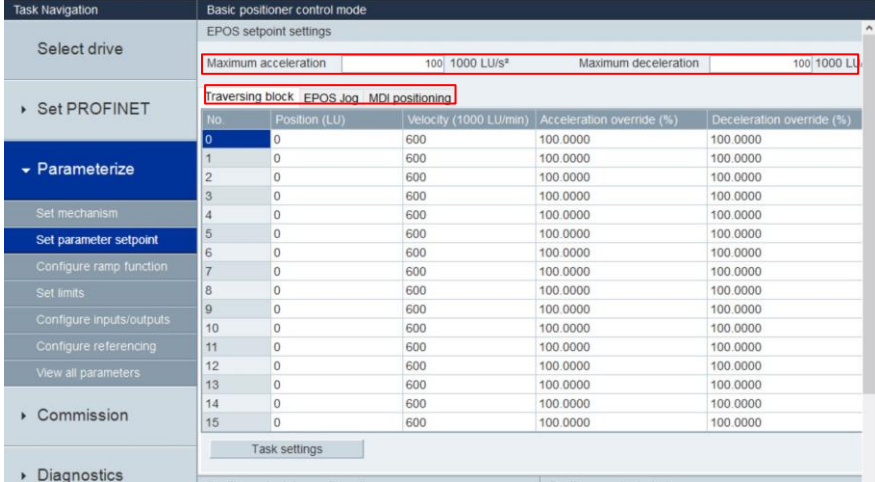## 4.1 V90 PN configuration via V-ASSISTANT

Table 4-1

Step	Description
1.	**Go online with V-Assistant** 1. Select the "**Online**" working mode 2. Click the "**OK**" button to proceed
2.	**Change control mode** 1. Open the drop-down list 2. Select "**Basic positioner control (EPOS)**" **Note:** Change of the control mode needs a restart of servo drive, so the parameters must be saved before drive restart.

Step	Description
3.	**Configure telegram settings** After successfully switching to EPOS mode, you can select the telegram to 111 according to actual application: 1. Click **"Select telegram"** 2. Select telegram 111 from the drop-down list.
4.	**Configure network settings** 1. Click "**Configure network**" 2. Input "**v90pn1**"as the device name. 3. Input valid IP address for the drive. 3. IP addree:192.168.0.2 4. Subnet mask:255.255.255.0 4. Click the "**Save and active**" button. **Note:** 　　　　After setting and saving, you need to restart the servo drive.

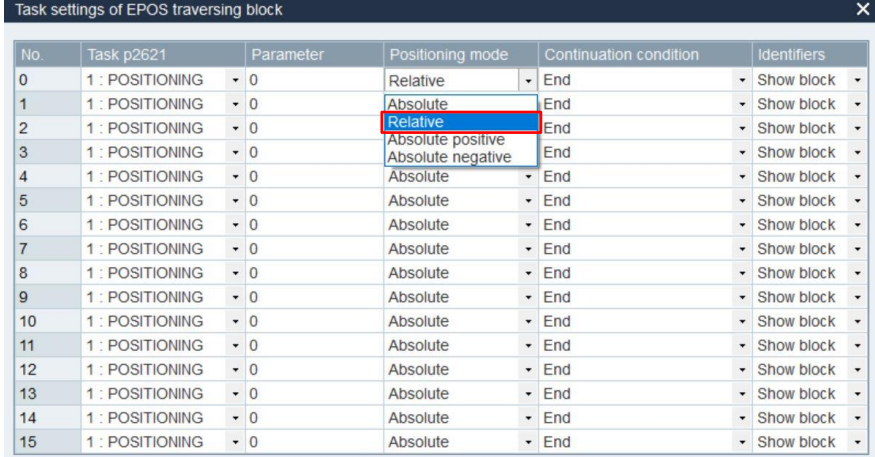| Step	Description
5.	**Configure mechanism** Set relevant mechanism parameters according to actual mechanism system: Click "Parameterize" 1. Click "**Set mechanism**" 2. Set the gearbox factor. In this example, keep default settings 3. Set the length unit per revolution of the load. In this example, keep default settings.
6.	**Configure referencing** Configure the referencing mode: Click "Parameterize" 1. Click "**Configure referencing**" 2. Three referencing modes are available for SINAMCIS V90 PN working in EPOS mode. In this example, select the third mode: "**Encoder zero mark only**"

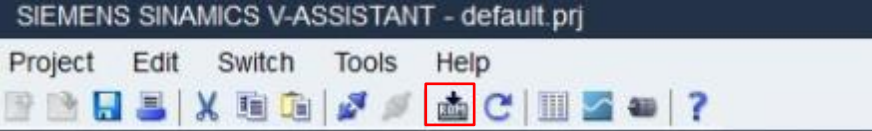| Step	Description
7.	**Configure setpoint parameters** Configure setpoint parameters for EPOS traversing block, EPOS MDI and EPOS Jog: Click "Set parameter setpoint" 1. Click to switch between the headlines of traversing block, EPOS Jog and MDI positioning 2. Input a target position for traversing block 0. In this example, set 10000LU as the distance. 3. Click "Task settings" to configure task setting for traversing block 0: In this example, use the "**relative positioning**" for traversing blocks 0. **Note:** You also could set other parameters according to the actual application like torque limit, DI/DO, maximum acceleration/deceleration, Jog and MDI settings, etc. For SINAMICS V90 PN EPOS function, you could refer to the operating manual of V90PN as below: https://support.industry.siemens.com/cs/cn/en/view/109763150

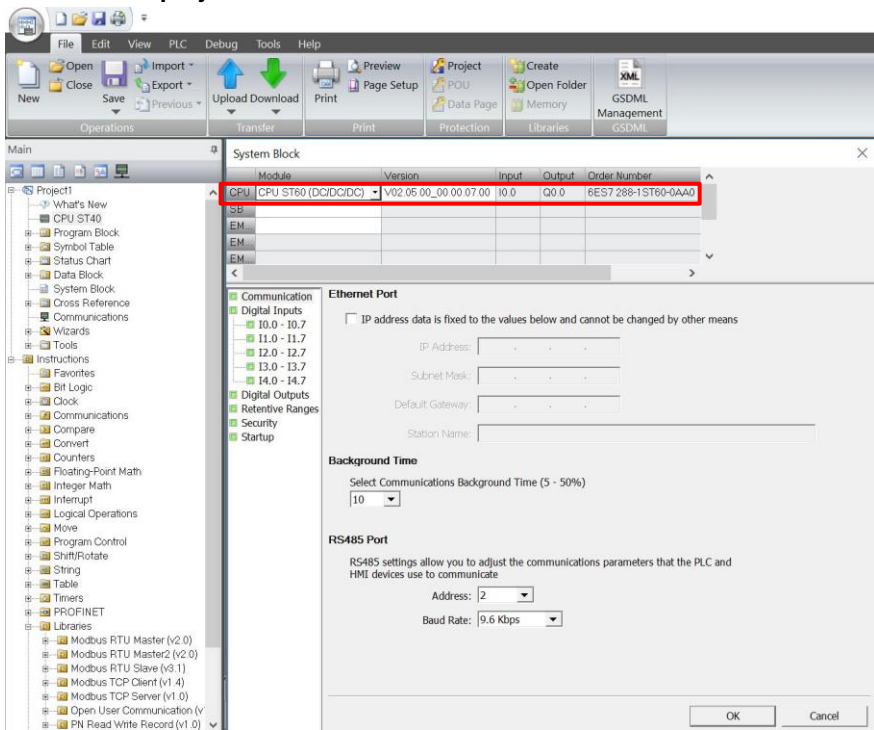| Step	Description
8.	**Save parameter settings into drive ROM** SIEMENS SINAMICS V-ASSISTANT - default.prj Project Edit Switch Tools Help

4.2 Configurations in STEP 7-Mirco/WIN SMART

From STEP 7-Micro/WIN SMART V2.4 version, it provides SINAMICS Control library to make the drives configuration and program easier. You can control the position and speed of physical drive and read or modify the drive parameters with SINAMICS library. SINA_POS will be used with SINAMCIS V90 PN EPOS mode in this application and will be described in detail.
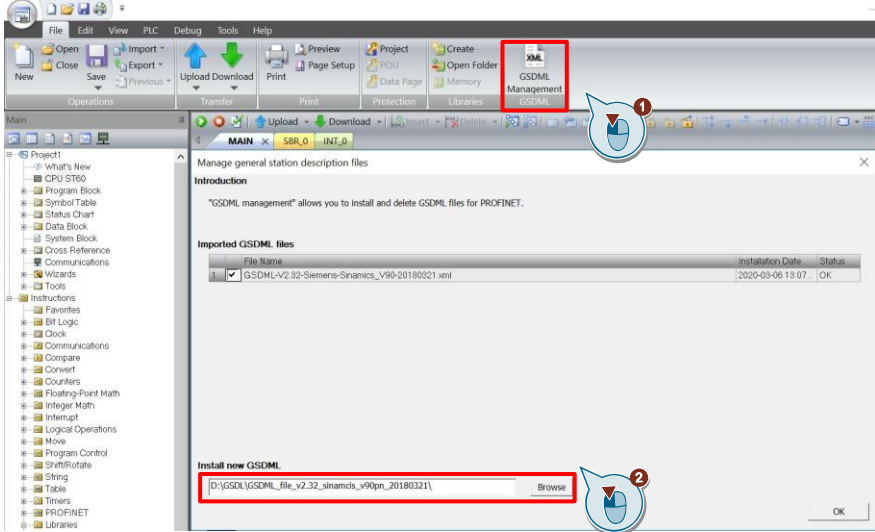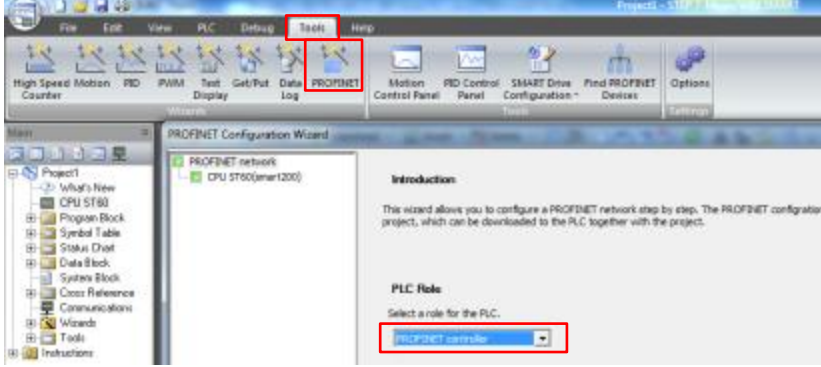
NOTE | The library version of SINAMICS Control should start from V1.1, if user install STEP 7-Micro/WIN SMART V2.4, the SINAMICS Control library version is V1.0 and the upgrade of SINAMICS Control library is necessary. User could use the update tool to do the upgrade. Please refer to below link download this tool.
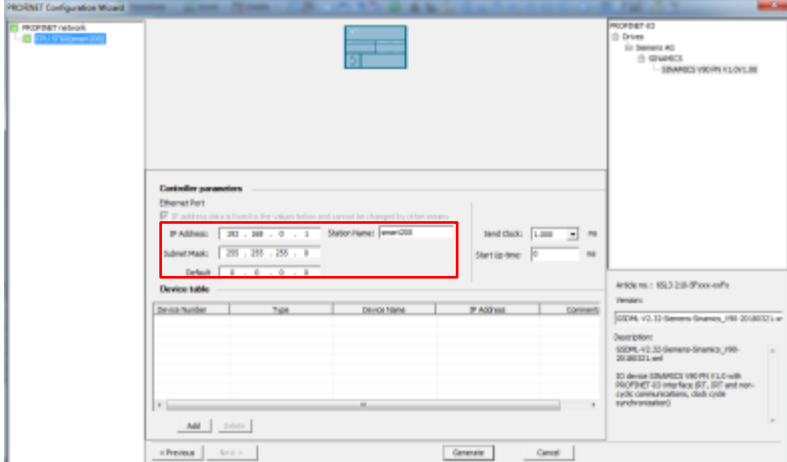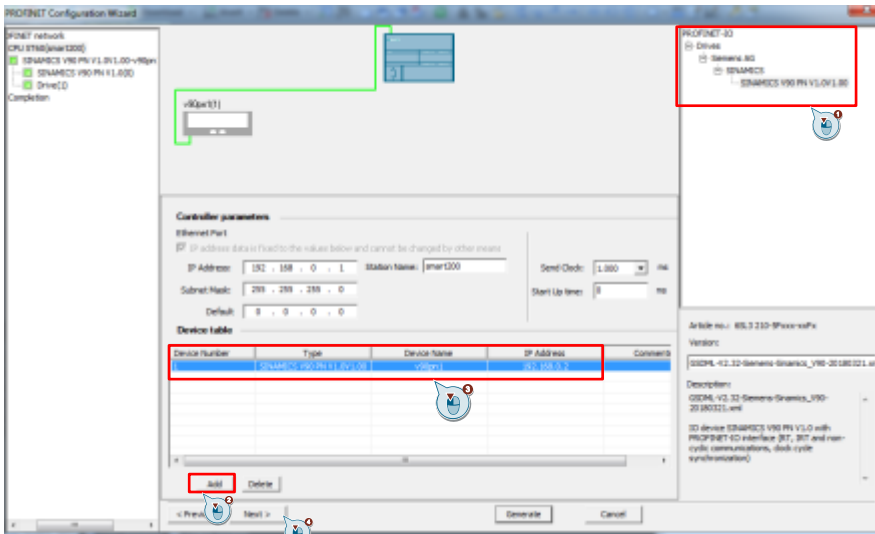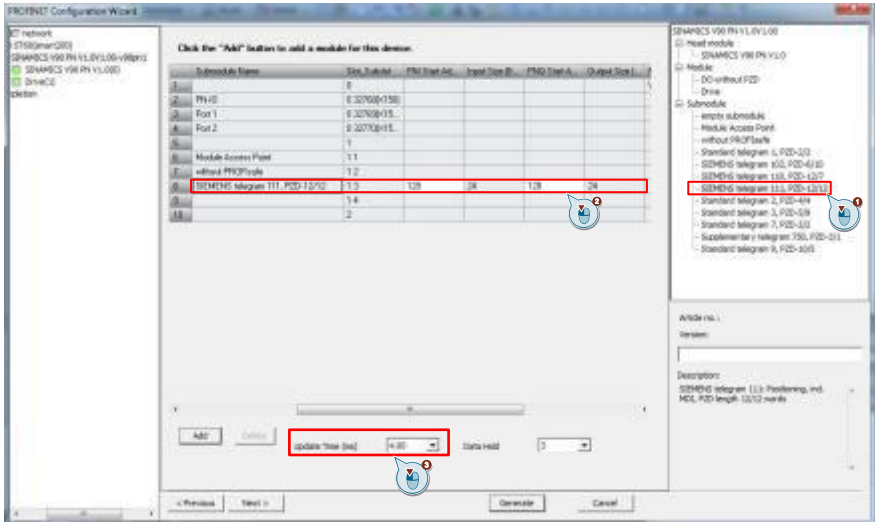
https://support.industry.siemens.com/cs/cn/en/view/109766118

Table4-2

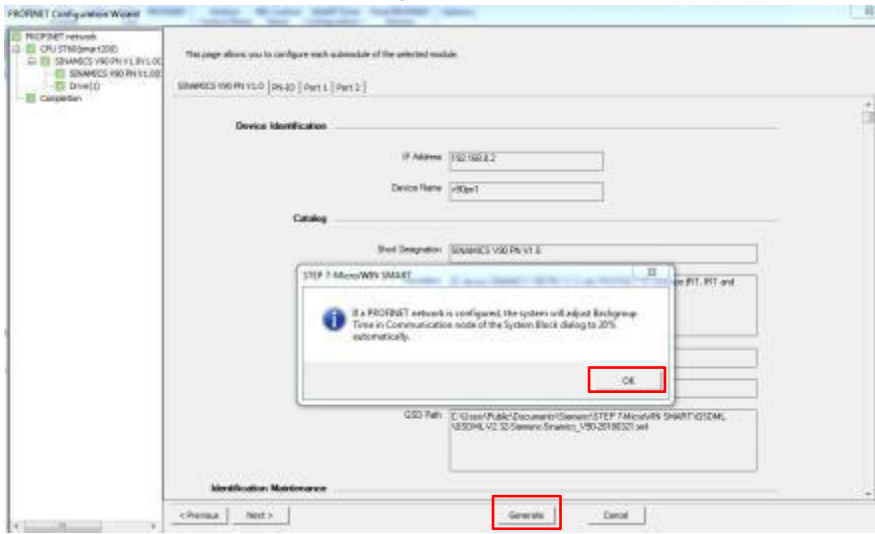| Step	description
1.	**Create a new project** 1. Open STEP 7-Mirco/WIN SMART 2. Select the CPU module. In this application, CPU ST60 is used. 3. Select the CPU FW version. In this application, V02.05.00 is used.

Step	description
2.	Install SINAMICS V90 PFOFINET GSD Download the SINAMICS V90 PN GSD file from below link: https://support.industry.siemens.com/cs/cn/en/view/109737269 1. Uncompressed the download file and install it.
3.	**Configure Profinet connection via PROFINET Wizard** 2. Click the headline "**Tools**" 3. Select the "**PROFINET**" 4. Enable "**PROFINET controller**"

Step	description
4.	**Make device configuration for PLC** 1. Input the IP address for PLC:192.168.0.1 2. Set the station name: smart200

Step	Descriptions
5.	**Insert SINAMICS V90 PN into Profinet network** Click the "PROFINET-IO" and select the "SINAMICS V90 PN V1.0V1.00" 1. Click " **Add**" 2. Double click the "**Device Name**" and change the device name to "**v90pn1**" 3. Double click the "**IP address**" and change the IP address to "**192.168.0.2**" 4. Click "**Next**" to next steps.
6.	**Configure the telegram for SINAMICS V90 PN** 1. Click the "**Submodule**" 2. Select the telegram 111 for this application and drag it to left side empty slot 3. Change the update time to minimum: 4ms. Note: The minimum update time also depends on the communication component set for PROFINET, on the number of PROFINET devices and the quantity of configured data.

Step	Descriptions
7.	**Finish the PROFINET Wizard configuration** 1. Click the "**Generate**" 2. Click the "**OK**"

# 5 Operation of the application

5.1 SINA_POS introduction

In the following paragraph, function block SINA_POS will be used to perform the operations of SINAMICS V90 PN with EPOS (Basic positioner).

5.1.1 Input and output interface of SINA_POS instruction

This function block should be used with telegram 111 and servo driver works under EPOS mode.

Figure5-1 SINA_POS instruction
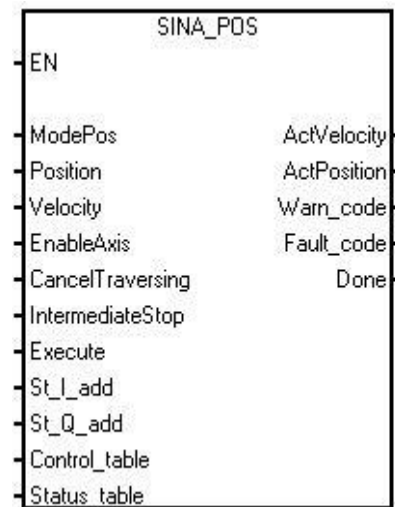
NOTE	For the four inputs "St_I_add", "St_Q_add", "Control_table" and "Status_table", the mode of addressing instruction operands is the indirect addressing.
	You must enter an ampersand (&) at the beginning of the input operand and keep the offset consistent with that in the PROFINET wizard.

Table 5-1 interface parameters of SINA_POS instruction

Parameter and type		Data type	Description
ModePos	IN	INT	Operating mode: 1 = relative positioning 2 = absolute positioning 3 = positioning as setup 4 = referencing (active homing) 5 = referencing (set reference point) 6 = traversing block 0 – 15 7 = jog mode 8 = incremental jog
Position	IN	DINT	Position setpoint in [LU] for direct setpoint input / MDI mode or traversing block number for traversing block mode. (Default = 0)
Velocity	IN	DINT	Velocity in [LU/min] for MDI mode. (Default value = 0 [1000LU/min])
EnableAxis	IN	BOOL	Switching command: 0 = OFF, 1 = ON
CancelTraversing	IN	BOOL	0 = reject active traversing task 1 = do not reject (Default)

Parameter and type		Data type	Description
IntermediateStop	IN	BOOL	0 = active traversing command is interrupted 1 = no intermediate stop (Default)
Execute	IN	BOOL	Activate traversing task/setpoint acceptance/ activate reference function.
St_I_add	IN	DWORD	Pointer of I memory area starts address for PROFINET IO. For example, &IB128.
St_Q_add	IN	DWORD	Pointer of Q memory area starts address for PROFINET IO. For example, &QB128.
Control_table[1]	IN	DWORD	Pointer of the start address of Control_table. For example, &VD8000.
Status_table[2]	IN	DWORD	Pointer of the start address of Status_table. For example, &VD9000.
ActVelocity	OUT	DWORD	Actual velocity
ActPosition	OUT	DWORD	Actual position in LU
Warn_code	OUT	WORD	The warning code information from V90.
Fault_code	OUT	WORD	The fault code information from V90.
Done	OUT	BOOL	Target position is reached when the operating mode is relative positioning or absolute positioning.

Definition of "Control_table[1]" parameters

Table 5-2 Control_table parameter

Byte offset	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Reserved	Reserved	AckError	FlyRef	Jog2	Jog1	Negative	Positive
1	Reserved							
2	OverV: Velocity override is active for all modes. The value range is 0%~199% and the default value is 100%.							
3								
4	OverAcc: Acceleration override is active. The value range is 0~100% and the default value is 100%.							
5								
6	OverDec: Deceleration override is active. The value range is 0~100% and the default value is 100%.							
7								
8	ConfigEpos[3]							
9								
10								
11								

Description of "ConfigEpos[3]"configuration

The following table lists the bit mapping between "ConfigEpos" and "Telegram111"

Table 5-3

ConfigEpos	Telegram	Meaning
ConfigEPos.%X0	STW1.%X1	OFF2: 1 = no pulse inhibits
ConfigEPos.%X1	STW1.%X2	OFF3: 1 = no pulse inhibits
ConfigEPos.%X2	EPosSTW2.%X14	Software limit switch: 1 = active)
ConfigEPos.%X3	EPosSTW2.%X15	Stop output cam: 1 = active
ConfigEPos.%X4	EPosSTW2.%X11	reserved
ConfigEPos.%X5	EPosSTW2.%X10	reserved
ConfigEPos.%X6	EPosSTW2.%X2	signal source reference mark
ConfigEPos.%X7	STW1.%X13	external block change
ConfigEPos.%X8	EPosSTW2.%X12	continuous setpoint transfer MDI: 1 = active
ConfigEPos.%X9	STW2.%X0	reserved
ConfigEPos.%X10	STW2.%X1	reserved
ConfigEPos.%X11	STW2.%X2	reserved
ConfigEPos.%X12	STW2.%X3	reserved
ConfigEPos.%X13	STW2.%X4	reserved
ConfigEPos.%X14	STW2.%X7	reserved
ConfigEPos.%X15	STW1.%X14	reserved
ConfigEPos.%X16	STW1.%X15	reserved
ConfigEPos.%X17	EPosSTW1.%X6	reserved
ConfigEPos.%X18	EPosSTW1.%X7	reserved
ConfigEPos.%X19	EPosSTW1.%X11	reserved
ConfigEPos.%X20	EPosSTW1.%X13	reserved
ConfigEPos.%X21	EPosSTW2.%X3	reserved
ConfigEPos.%X22	EPosSTW2.%X4	reserved
ConfigEPos.%X23	EPosSTW2.%X6	reserved
ConfigEPos.%X24	EPosSTW2.%X7	reserved
ConfigEPos.%X25	EPosSTW2.%X12	reserved
ConfigEPos.%X26	EPosSTW2.%X13	reserved
ConfigEPos.%X27	STW2.%X5	reserved
ConfigEPos.%X28	STW2.%X6	reserved
ConfigEPos.%X29	STW2.%X8	travel to fixed endstop: 1 = active
ConfigEPos.%X30	STW2.%X9	reserved

NOTE   In order to make SINAMICS V90 PN could be enable, you need to do the assignment of ConfigEpos in the program and the initial value of ConfigEpos must be equal to 3. (it means that ConfigEPos. %X0=1and ConfigEPos. %X1=1)

Definition of "Status_table[2]" parameters

Table 5-4

Byte offset	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	Reserved	Over-rang_Error[10]	AxisError[9]	AxisWarn[8]	Lockout[7]	AxisRef[6]	AxisPosOK[5]	Axisenabled[4]
1	Error ID[11]: Identify the error type.							
2	Actmode: Currently active mode. (Default = 0)							
3								
4	Epos_zsw1[12]: Status of EPos_zsw1 (bit-granular). (Default = 0)							
5								
6	Epos_zsw2[13]: Status of EPos_zsw2 (bit-granular). (Default = 0)							
7								

Axisenabled[4]: Drive is ready and switched on. (Default = 0)

AxisPosOK[5]: Target position of the axis is reached. (Default = 0)

AxisRef[6]: Reference point set. (Default = 0)

Lockout[7]: Switching-on inhibits. (Default = 0)

AxisWarn[8]: Drive alarm is active. (Default = 0)

AxisError[9]: The drive has an error. (Default = 0)

Over-rang_Error[10]: The data you enter is out of the range.

Error ID[11] for the "Status_table" parameter

Table 5-5 Error codes for the "Status_table"

Error code	Description
0	No error.
1	An error from the drive is detected.
2	The drive is disabled.
3	The selected mode is not supported.
4	The rate of parameters OverV, OverAcc and OverDec exceeds the supported value range.
5	The selected block is out of range under the motion mode "traversing block".

Epos_zsw1[12] assignment

Table5-6 Epos_zsw1

Bit	Addr.	Designation	Drive parameter	Function chart
0	ActTrvBit0	Active traversing block, bit 0	r2670.0	3650
1	ActTrvBit1	Active traversing block, bit 1	r2670.1	3650
2	ActTrvBit2	Active traversing block, bit 2	r2670.2	3650
3	ActTrvBit3	Active traversing block, bit 3	r2670.3	3650
4	ActTrvBit4	Active traversing block, bit 4	r2670.4	3650
5	ActTrvBit5	Active traversing block, bit 5	r2670.5	3650
6	Bit6	Reserved		
7	Bit7	Reserved		
8	StpCamMinAct	STOP cam minus active	r2684.13	3630
9	StpCamPlsAct	STOP cam plus active	r2684.14	3630
10	JogAct	Jog mode is active	r2094.0[1]	2460
11	RefAct	Reference point approach mode active	r2094.1[1]	2460
12	FlyRefAct	Flying referencing active	r2684.0[1]	3630
13	TrvBlAct	Traversing blocks mode active	r2094.2[1]	2460
14	MdiStupAct	In the direct setpoint input / MDI mode, setup is active	r2094.4[1]	2460
15	MdiPosAct	In the direct setpoint input / MDI mode, positioning is active	r2094.3[1]	2460

[1]r2669 (function diagram 3630) displays bit-granular. P2099 [0] = r2699 is interconnected at the input of the connector-bisector converter for this purpose.
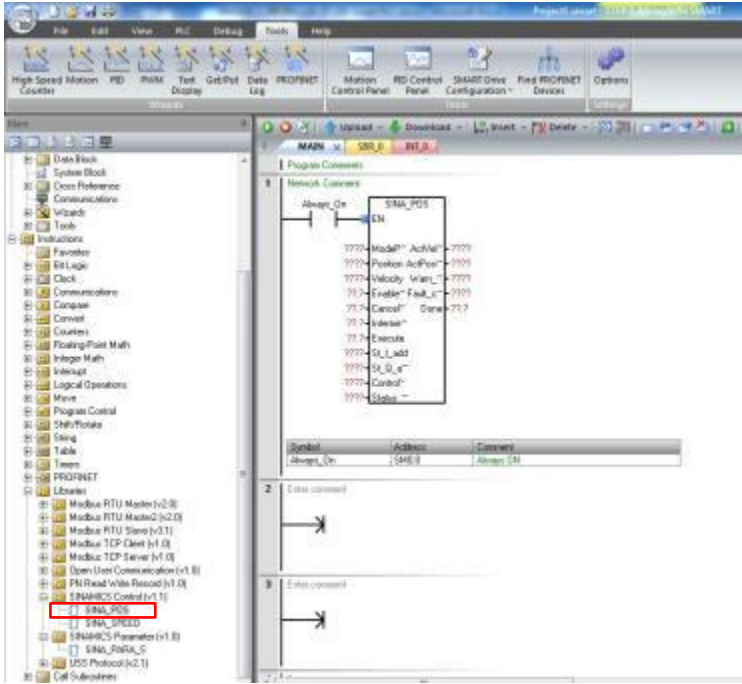
Epos_zsw2[13] assignment

Table5-7 Epos_zsw2

Bit	Addr.	Designation	Drive parameter	Function chart
0	TrkModeAct	Follow-up/tracking mode active	r2683.0	3645
1	VeloLimAct	Velocity limitation active	r2683.1	3645
2	SetPStat	Setpoint static	r2683.2	3645
3	PrntMrkOut	Print mark outside outer window	r2683.3	3614
4	FWD	Axis moves forward	r2683.4	3635
5	BWD	Axis moves backward	r2683.5	3635
6	SftSwMinAct	Minus software limit switch actuated	r2683.6	3635
7	SftSwPlsAct	Plus software limit switch actuated	r2683.7	3635
8	PosSmCam1	Position actual value <= cam switching position1	r2683.8	4025
9	PosSmCam2	Position actual value <= cam switching position2	r2683.9	4025
10	TrvOut1	Direct output 1 with the traversing block	r2683.10	3616
11	TrvOut2	Direct output 2 with the traversing block	r2683.11	3616
12	FxStpRd	Fixed stop reached	<not used> (r2683.12)	3645
13	FxStpTrRd	Fixed stop clamping torque reached	<not used> (r2683.13)	3645
14	TrvFxStpAct	Travel to fixed stop active	<not used> (r2683.14)	3645
15	CmdAct	Traversing active	r2683.15	3645

5.1.2 Operations in STEP 7-Mircro/WIN SMART

Table5-8 Operations

Step	Descriptions
1.	Making PLC programming 1. Open program view by clicking "Main [OB1]"and drag the "SINA_POS" to main program from library. 2. Create the following variables address: {{VARTABLE}}

<table>
<tr><td>Mode_setting</td><td>VW7000</td></tr>
<tr><td>Position_setting</td><td>VD7002</td></tr>
<tr><td>Velocity_setting</td><td>VD7006</td></tr>
<tr><td>Enable</td><td>V7010.0</td></tr>
<tr><td>Non_stop</td><td>V7010.1</td></tr>
<tr><td>Non_pause</td><td>V7010.2</td></tr>
<tr><td>Start</td><td>V7010.3</td></tr>
<tr><td>Control_table</td><td>VD8000</td></tr>
<tr><td>Status_table</td><td>VD7500</td></tr>
<tr><td>ActPosition</td><td>VD7020</td></tr>
<tr><td>ActVelocity</td><td>VD7024</td></tr>
<tr><td>Warn_Code</td><td>VW7028</td></tr>
<tr><td>Fault_Code</td><td>VW7030</td></tr>
<tr><td>Done</td><td>V7032.0</td></tr>
<tr><td>OverV</td><td>VW8002</td></tr>
<tr><td>OverAcc</td><td>VW8004</td></tr>
<tr><td>OverDec</td><td>VW8006</td></tr>
<tr><td>ConfigEpos</td><td>VD8008</td></tr>
</table>
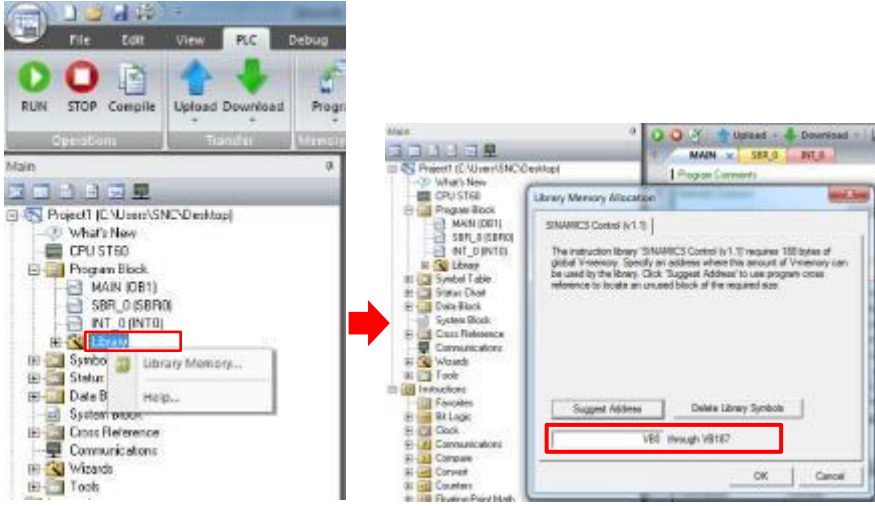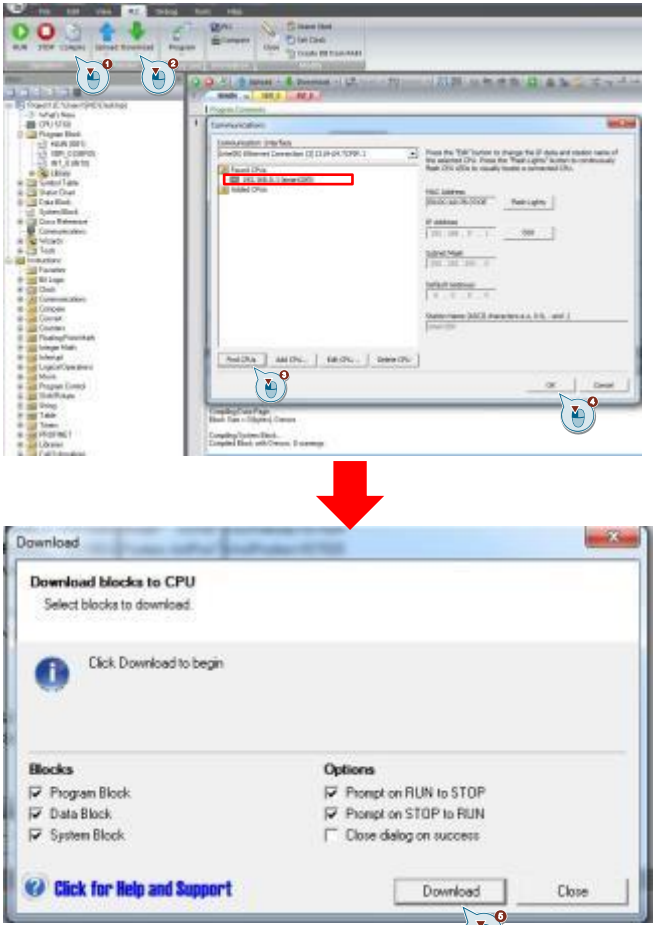
2.	Making the program base on the symbol table
	1. Make the praogram
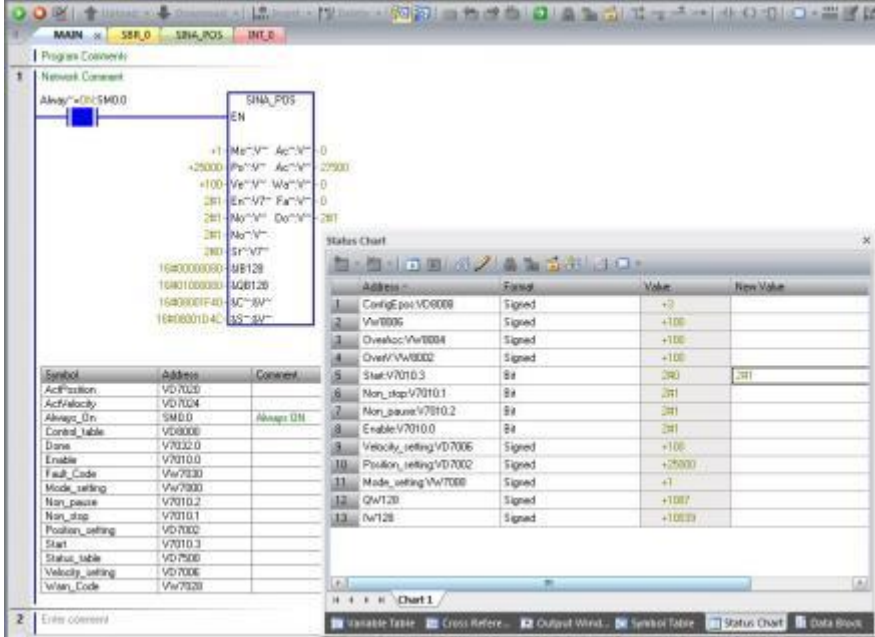
Note：

The "St_I_add" and "St_Q_add" refer to the telegram assigned address. Such information can be found in the PROFINET configuration as follows:

Step	Description
	2. Assign the V-Memory for Library to use, right click the "Library" and select "Library memory"
3.	Compile and download PLC program to CPU ST60

Step	Description
4.	Test the program with the status table monitor
5.	There are eight operating modes you could test and the detailed steps and values setting, please refer to system manual as below link: https://support.industry.siemens.com/cs/cn/en/view/109745610

6 Appendix

6.1 Service and Support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks at:
https://support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. You send queries to Technical Support via Web form:
www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

With our globally available training courses for our products and solutions, we help you achieve with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to:
www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

6.2 Application Support

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6.3 Links and Literature

Table6-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109780748
\3\	SINAMICS V90 PN Operating manual https://support.industry.siemens.com/cs/cn/en/view/109763150
\4\	SINAMICS library V1.1 in STEP 7-Micro/WIN SMART V2.4 https://support.industry.siemens.com/cs/cn/en/view/109766118
\5\	S7-200SMART V2.5 system manual https://support.industry.siemens.com/cs/cn/en/view/109745610
\6\	SINAMICS V90 PN_Basic Positioner(EPOS) https://support.industry.siemens.com/cs/cn/en/view/109747750

6.4 Change documentation

Table 6-2

Version	Date	Modifications
V1.0	03/2020	First version