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SINAMICS G: Telegram extension of a position controlled drive

SIMATIC S7-1500, SINAMICS G120

<https://support.industry.siemens.com/cs/ww/en/view/109737292>

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1 Task and Solution

1.1 Introduction

SIMATIC S7-1500 CPUs support the connection of PROFIdrive-capable drives via PROFINET or PROFIBUS as a speed axis or positioning axis. To do this, a technology object communicating with the drive via defined standard telegrams is configured in the control program.

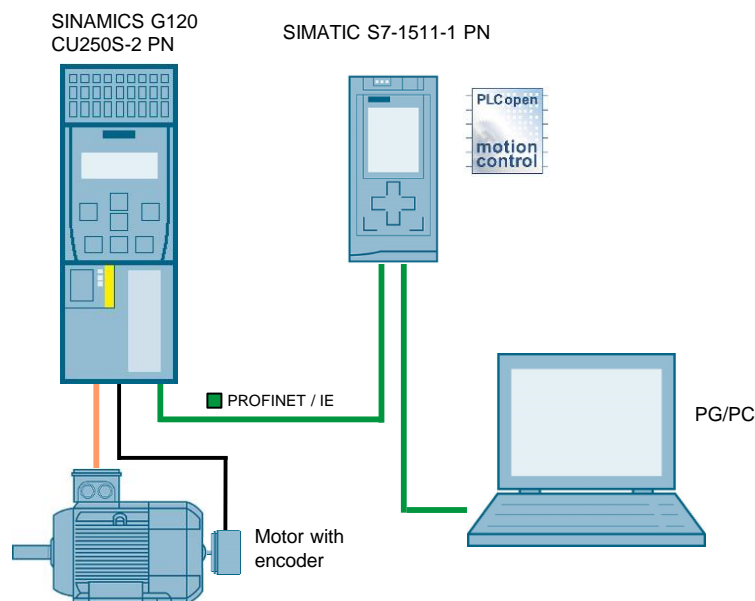
In this application example, a SINAMICS G120 is operated as position-controlled drive. In addition to the already existing standard telegram, the following parameter values shall be transmitted between the controller and the drive:

- The smoothed actual current value (parameter r27) and the encoder actual position value (parameter r482) which are read from the drive,
- The variable current limit (parameter p641) which is transmitted to the drive.

1.2 Solution

By adding a telegram extension to the existing configuration, you will be able to exchange further parameter values between the controller and the drive.

Figure 1-1: Existing components



Advantages

The telegram extension is a simple way of exchanging additional parameter values by means of cyclic communication between the controller and the drive.

Topics not covered by this application

Configuration, installation and function of the "Positioning axis" technology object are not discussed in this application example.

Assumed knowledge

Basic knowledge of the TIA Portal and Startdrive is assumed.

1.3 Hardware and software components

1.3.1 Validity

This application example is valid for

- STEP 7 Professional as of V14
- SINAMICS Startdrive as of V14
- SINAMICS G120 CU250S-2 PN with firmware V4.7.3
- SIMATIC S7-1511-1 PN with firmware V1.8

1.3.2 Components used

Hardware components

Table 1-1: Hardware components

Component	Qty.	Article number	Note
SIMATIC CPU 1511-1 PN	1	6ES7511-1AK00-0AB0	Alternatively, you can also use a different SIMATIC S7-1500 CPU.
SINAMICS CU250S-2 PN Vector	1	6SL3246-0BA22-1FA0	-
SINAMICS PM240-2 IP20	1	6SL3210-1PE12-3UL1	-
Asynchronous motor	1	1LA7060-4AB10-Z	Alternatively, you can use a different asynchronous motor.
HTL speed encoder	1	1xP8001-1	-

Software components

Table 1-2: Software components

Component	Article number	Note
STEP 7 (TIA Portal) V14 Professional	6ES7822-1..04-..	-
SINAMICS Startdrive V14	6SL3072-4EA02-0XA0	https://support.industry.siemens.com/cs/de/en/view/68034568

Example files and projects

The table 1-3 below includes all files and projects required in this application example.

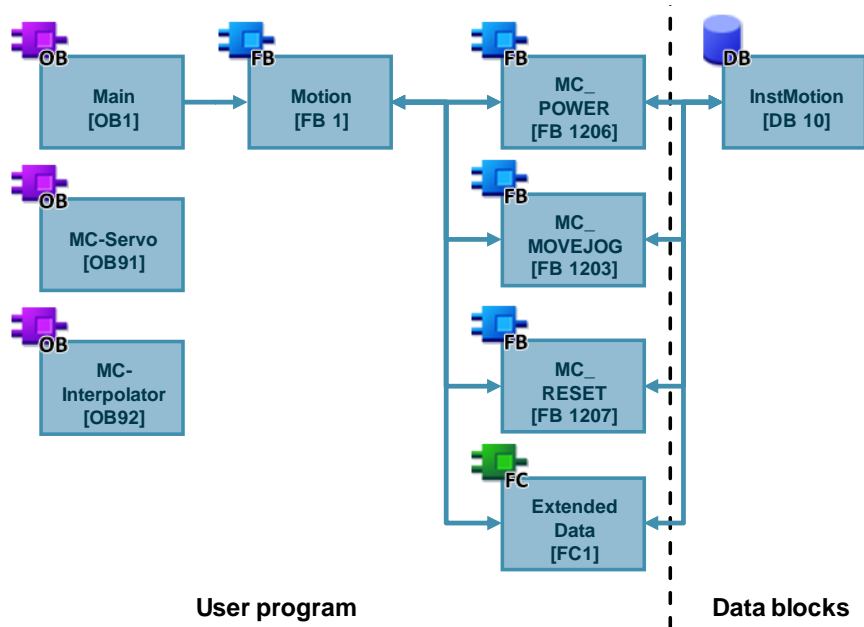
Table 1-3: Example files and projects

Component	Note
109737292_extended_communication_G120_v10.zip	This zip file contains the STEP 7 V14 project.
109737292_extended_communication_G120_DOCU_v10_en.pdf	This document

2 Function Principle of the Application Example

The TIA Portal V14 program included in this application example is structured as follows:

Figure 2-1: Program overview



The program shall carry out the following two tasks:

- Position-controlled operation of a SINAMICS drive by using the “Positioning axis” technology object,
- Standardization and processing of additional drive parameters.

2.1 Data exchange using the standard telegram

In this example, the “Positioning axis” technology object uses standard telegram 3 to communicate with the drive. Standard telegram 3 contains all parameters required for operating a position-controlled drive.

Table 2-1: Structure of standard telegram 3

PZD 1	PZD 2	PZD 3	PZD 4	PZD 5	PZD 6	PZD 7	PZD 8	PZD 9
STW1	NSOLL_B		STW3	G1_STW	-	-	-	-
ZSW1	NIST_B		ZSW3	G1_ZSW	G1_XIST1		G1_XIST2	

Table 2-2: Data in standard telegram 3

Name	Content
Send telegram to the drive	
STW1	Control word 1
NSOLL_B	Speed setpoint B (32 bit)
STW2	Control word 2
G1_STW	Encoder 1 control word
Receive telegram from the drive	
ZSW1	Status word 1
NIST_B	Actual speed value B (32 bit)
ZSW2	Status word 2
G1_ZSW	Encoder 1 status word
G1_XIST1	Encoder 1 actual position value 1
G1_XIST2	Encoder 1 actual position value 2

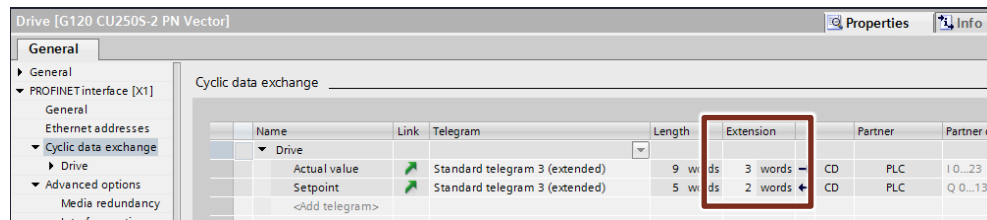
You can select standard telegram 3 when configuring the drive.

2.2 Extending the standard telegram

2.2.1 Telegram extension

If you want to cyclically exchange further parameter values between the controller and the drive for a standard telegram, it is possible to extend the telegram. This extension can be configured in the “Device view” of the drive.

Figure 2-2: Extending the standard telegram



When you add the telegram extension, the standard telegram used will be extended.

- The value of parameter p641 (variable current limit with the FloatingPoint32 data type) is transmitted to the drive. For this reason, you have to extend the “Setpoint” by two words.
- The value of parameter r27 (smoothed actual current value with the FloatingPoint32 data type) is read by the drive. This parameter value is transmitted in a standardized way. For this reason, you have to extend the “Actual value” by one word to transmit this parameter value.
- The value of parameter r482 (encoder actual position value with the Unsigned32 data type) is read by the drive as well. This parameter value is not transmitted in a standardized way. For this reason, you have to extend the “Actual value” by another two words to transmit this parameter value.

Note

How to configure the telegram extension is described in chapter 3.1.

After extension, the number of process words (PZD) of the telegram used to exchange information between the drive and the controller has increased.

- Two PZD have been added for transmitting the setpoints.
- Three PZD have been added for transmitting the actual values.

Table 2-3: Contents of the PZD words of the extended telegram

1	2	3	4	5	6	7	8	9	10	11	12
Standard telegram 3 Send telegram to the drive					Extension for p641		-	-	-	-	-
Standard telegram 3 Receive telegram from the drive									Extension for r27	Extension for r482	

Note

For a description of the PZD parameters of the SINAMICS G120 CU250S-2 PN, refer to the drive documentation \9\.

<https://support.industry.siemens.com/cs/de/en/view/109478829>

2.2.2 Standardization

To ensure that a parameter value with the floating point (REAL) data type is transmitted in a send or receive word, you have to standardize the parameter value. For this, the parameter value with reference parameter settings which are stored in the drive will be converted.

A SINAMICS G120 has the following relevant reference parameters:

Table 2-4: Reference parameters

Parameter	Name	Meaning
p2000	Reference speed	Reference parameter for speed and frequency values
p2001	Reference voltage	Reference parameter for voltage values
p2002	Reference current	Reference parameter for current values
p2003	Reference torque	Reference parameter for torque values
p2006	Reference temperature	Reference parameter for temperature values

With an entry of 16384 (hexadecimal value of 4000), the parameter value transmitted in the send or receive word corresponds to the value stored in the relevant reference parameter. This means that a received hexadecimal value of 4000 corresponds to 100 % of the reference parameter value.

Example

In this application example, the smoothed actual current value (parameter r27) is additionally transmitted from the drive to the controller. For this reason, the telegram regarding the actual values has been extended by one word (PZD word 10) (see Table 2-3).

The added PZD word 10 can be accessed in the user program of the controller by loading the corresponding I/O address of the input word.

To ensure that you can use in the program the actual current value of parameter r27 as floating point value (REAL value), the value has to be converted. To do this, use the following formula:

$$r27 (REAL) = \frac{PZD\ 10\ (r27)}{16384} * reference\ value\ (parameter\ p2002)$$

In the TIA Portal project of this application example, this calculation is carried out by means of the “ExtendedData” function.

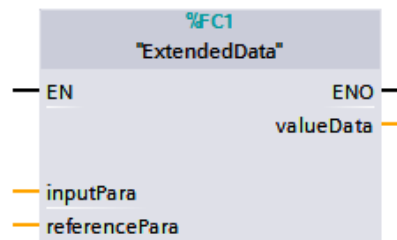
2.2.3 “ExtendedData” function

The “ExtendedData” function is used for converting a PZD word read via an I/O input into the actual parameter value.

Calling the block

You can call the “ExtendedData” block in an organization block (OB) or in another function block.

Figure 2-3: Calling the “ExtendedData” block



Block parameters

The following table lists the input and output parameter of the “ExtendedData” function.

Table 2-5: Inputs and outputs of the block

Name	Type	Start value	Function
Inputs			
inputPara	WORD	16#0	Entering the I/O input
referencePara	REAL	0.0	Reference parameter value
Output			
valueData	REAL	0.0	Calculated parameter value

Note

The contents of the “ExtendedData” function are shown in chapter 3.2.

3 Configuration and Settings

In this application example, additional parameters are exchanged for a position-controlled drive between the controller and the drive by means of a telegram extension. For this, it is assumed that you have already configured the position-controlled drive with the hardware listed in [Table 1-1](#) and have put it into operation without any errors.

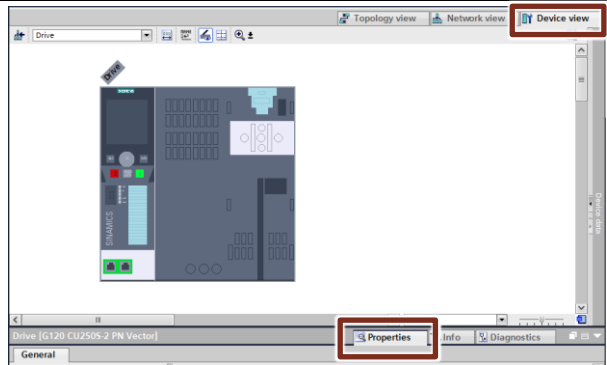
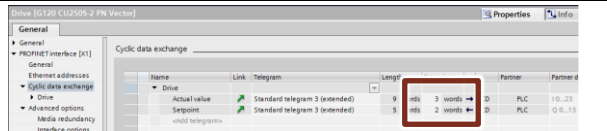
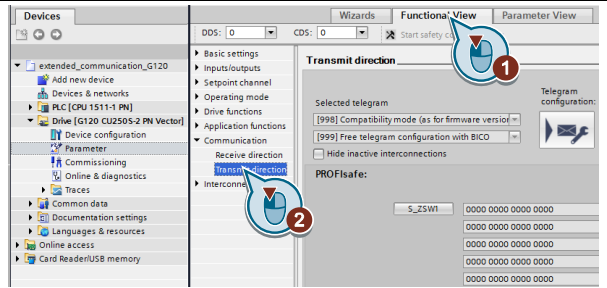
Note A detailed example of positioning a SINAMICS G120 with a SIMATIC S7-1500 is given in the application example [\4](#).

<https://support.industry.siemens.com/cs/de/en/view/81666970>

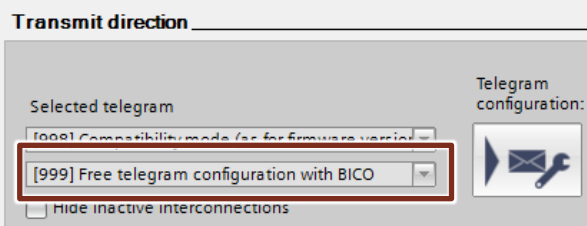
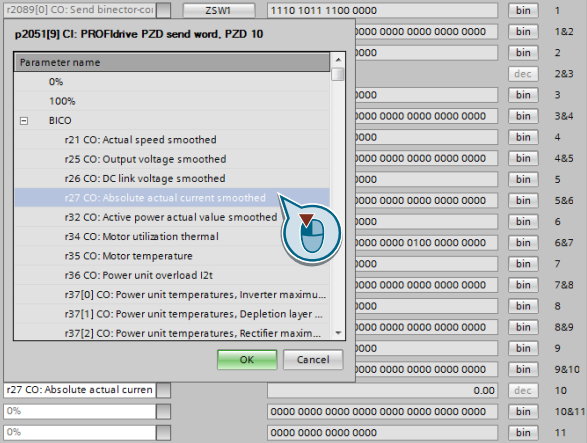
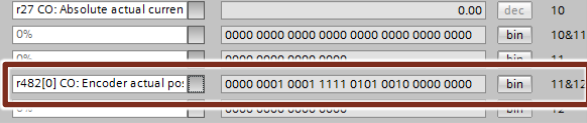
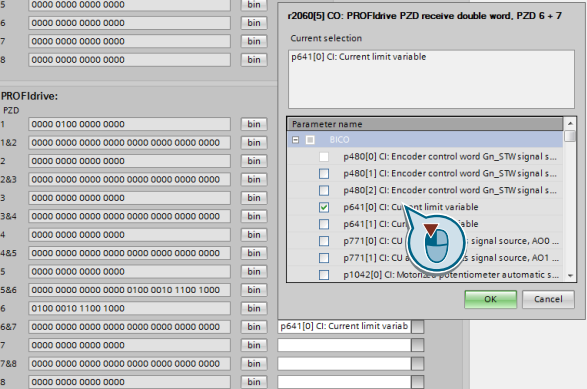
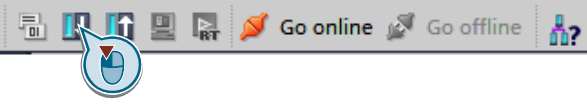
3.1 Configuring the telegram extension

The steps listed in the following table show how to configure the telegram extension of standard telegram 3.

Table 3-1: Configuring the telegram extension

No.	Action	Remark
1.	Go to the "Device view" of the SINAMICS and open the "Properties" of the drive.	
2.	In the "Cyclic data exchange" tab, enable standard telegram 3 and enter the extension.	
3.	Open the parameter list of the drive. 1. Go to the "Functional view". 2. Open the functional view of the "Transmit direction".	

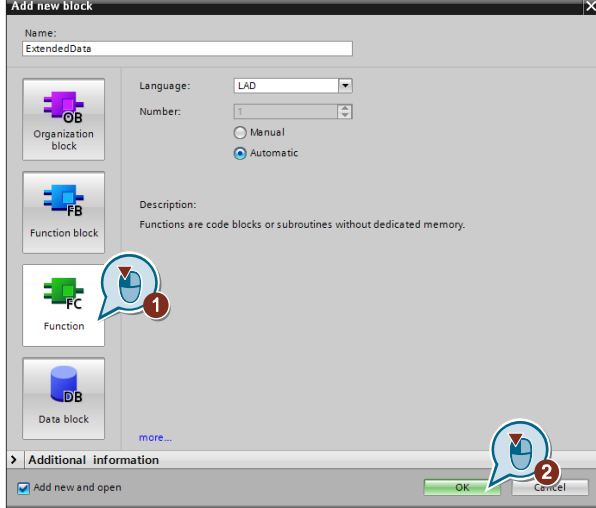
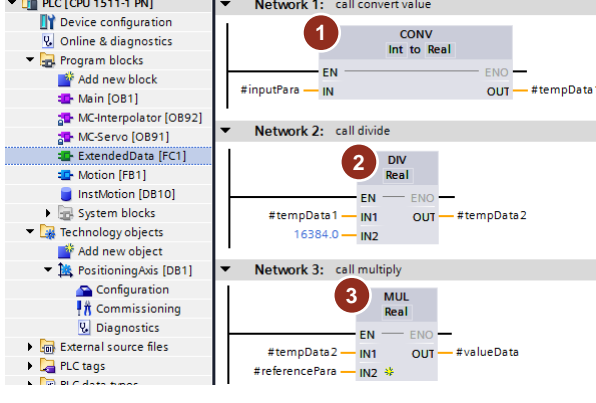
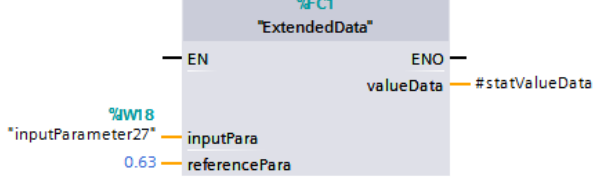
3 Configuration and Settings

No.	Action	Remark
4.	When configuring the telegram extension, the selected telegram will be automatically set to "Free telegram configuration with BICO [999]".	
5.	In the functional view of the "Transmit direction", you can now configure parameter r27 "Absolute actual current smoothed" in the PZD word no. 10.	
6.	Repeat step 5 and configure parameter r482 "Encoder actual position value" in the PZD words 11 and 12.	
7.	In the functional view of the "Receive direction", you can configure parameter p641 "Current limit variable" in the PZD words 6 and 7.	
8.	Save the configuration and load it into the drive.	

3.2 Extending the S7 program

To ensure that you can use the read current value of parameter r27 in the program as floating point number, the current value has to be converted.

Table 3-2: Extending the S7 program

No.	Action	Remark
1.	Add a function to the existing control program. <ol style="list-style-type: none"> Select a function as block to be added. Confirm with "OK". 	
2.	To convert the parameter value, follow the following steps (see chapter 2.2.2): <ol style="list-style-type: none"> Convert the PZD word read via an I/O input into the REAL data type. Divide the PZD word (in REAL) by the value 16384.0 (hexadecimal value of 4000). Multiply the result of step 2 by the value of the relevant reference parameter (see Table 2-4). The result of this calculation is a REAL value that corresponds to the parameter value in the drive.	
3.	Call the function in the control program.	
4.	Save the program and load it into the controller.	-

4 Installation and Commissioning

4.1 IP addresses and device names

In the application example, the following IP addresses and device names are used. Subsequent changes can be made at any time.

Table 4-1: IP addresses and device names

Components	Device name	IP addresses
SIMATIC S7-1511	PLC	192.168.0.1
SINAMICS CU250S-2	Drive	192.168.0.2
PG/PC	-	192.168.0.200

In this example, the network mask is 255.255.255.0 and no router is used.

4.2 PG/PC settings

To establish a connection between the components of the application example and your development system (PG/PC), you need to assign a fixed IP address to the network card of the PG/PC. These settings can be changed in the Control Panel of the PG/PC.

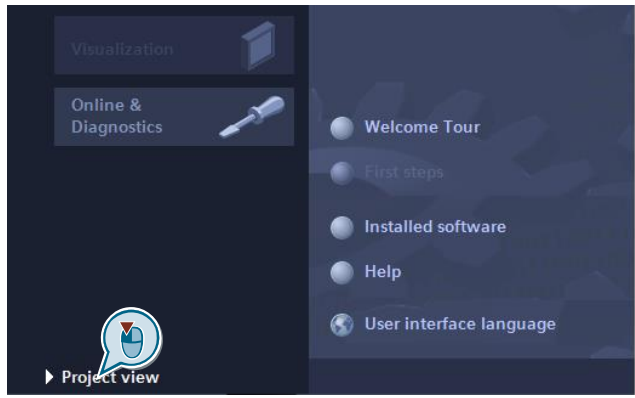
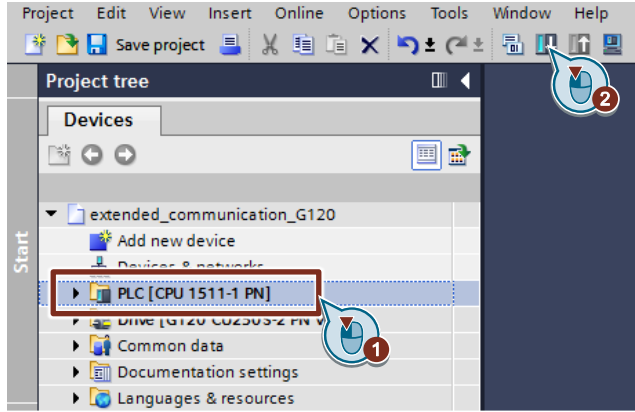
Table 4-2: PG/PC settings

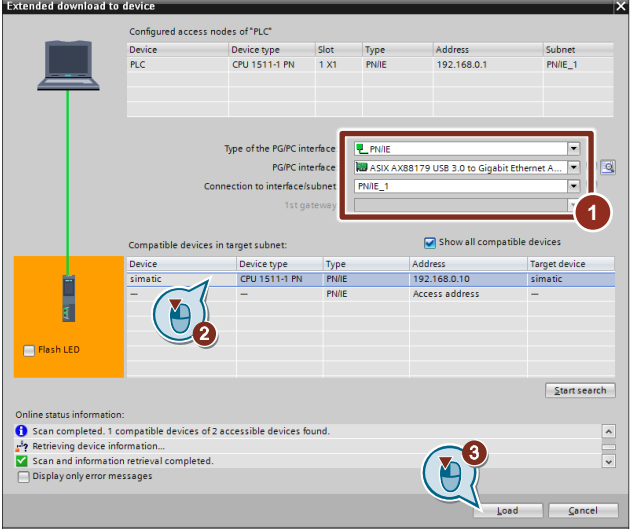
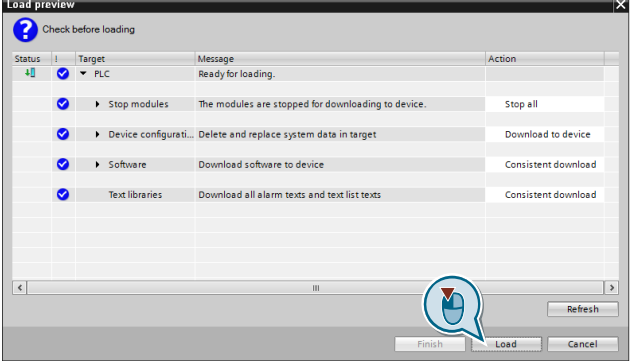
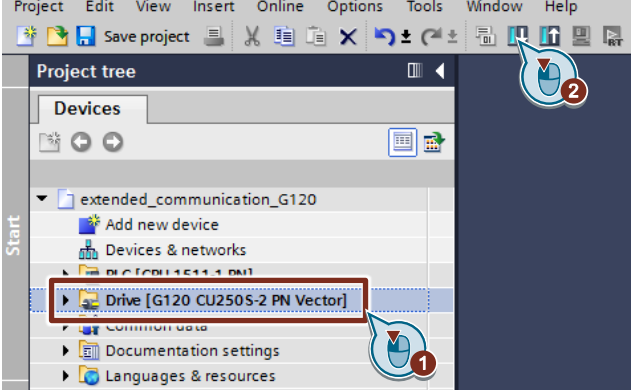
No.	Action	Remark
1.	In the Control Panel, set the PG/PC interface. Select "S7ONLINE (STEP7)" as access path of the application example and "TCP/IP -> <network card used>" as interface parameter assignment used.	
2.	Assign a free, fixed IP address 192.168.0.x to the network card used (e. g. x = 200) and assign the subnet mask 255.255.255.0. With these settings, you can now establish a connection to the components of the application example.	

4.3 Downloading from the project into the components

The steps listed in the following table show how to load the individual programs of the application example into the components.

Table 4-3: Downloading into the components

No.	Action	Remark
1.	Retrieve the following zip file into a local directory: "109737292_extended_communication_G120_v10.zip"	-
2.	Double-click the ap14 file in the project folder just retrieved in order to open the project in TIA Portal.	-
3.	As soon as the portal view of TIA Portal opens, go to the "Project view".	
4.	Download the program of the SIMATIC controller: 1. Select the S7 controller in the project tree. 2. Load the project into the controller.	

No.	Action	Remark
5.	<p>As soon as the “Extended download to device” dialog box opens, proceed as follows:</p> <ol style="list-style-type: none"> 1. Select the settings required for your online connection. 2. Select the CPU. 3. Load the configuration. 	
6.	<p>Keep the settings made in the “Load preview” and load the program.</p>	
7.	<p>Then, load the configuration of the drive.</p> <ol style="list-style-type: none"> 1. Select the SINAMICS drive in the project tree. 2. Load the configuration into the drive. 	

5 Operating the Application Example



WARNING

Make sure that no persons or system components are endangered by the moving drive.

Take appropriate measures to prevent the drive from exceeding technical or mechanical limits.

The operating and monitoring options of the application example are summarized in the “ControlMotion” watch table.

1. Operating and monitoring the “MC_POWER” block
2. Operating and monitoring the “MC_RESET” block
3. Operating and monitoring the “MC_MOVEJOG” block
4. List of parameters transmitted via the telegram extension
 - a. The “InstMotion.statValueData” tag contains the result of the standardization of the “ExtendedData” function. This corresponds to the value of drive parameter r27. The “inputParameter482” tag contains the value of drive parameter r482.
 - b. The “outputParameter641” tag contains the value of drive parameter p641. For changing the value, it is written directly to the I/O address (in this case output double word 10).

Figure 5-1: Watch table

	Name	Address	Display format	Monitor value	Modify value
1	// MC_POWER				
2	*InstMotion*.instMcPower.Enable		Bool	<input checked="" type="checkbox"/> TRUE	TRUE
3	*InstMotion*.instMcPower.StopMode		DEC+/-	0	
4	*InstMotion*.instMcPower.Status		Bool	<input checked="" type="checkbox"/> TRUE	
5	*InstMotion*.instMcPower.Busy		Bool	<input checked="" type="checkbox"/> TRUE	
6	*InstMotion*.instMcPower.Error		Bool	<input type="checkbox"/> FALSE	
7	*InstMotion*.instMcPower.ErrorId		Hex	16#0000	
8	// MC_RESET				
9	*InstMotion*.instMcReset.Execute		Bool	<input type="checkbox"/> FALSE	FALSE
10	*InstMotion*.instMcReset.Restart		Bool	<input type="checkbox"/> FALSE	
11	*InstMotion*.instMcReset.Done		Bool	<input type="checkbox"/> FALSE	
12	*InstMotion*.instMcReset.Busy		Bool	<input type="checkbox"/> FALSE	
13	*InstMotion*.instMcReset.CommandAborted		Bool	<input type="checkbox"/> FALSE	
14	*InstMotion*.instMcReset.Error		Bool	<input type="checkbox"/> FALSE	
15	*InstMotion*.instMcReset.ErrorId		Hex	16#0000	
16	// MC_MOVEJOG				
17	*InstMotion*.instMcMovejog.JogForward		Bool	<input checked="" type="checkbox"/> TRUE	TRUE
18	*InstMotion*.instMcMovejog.JogBackward		Bool	<input type="checkbox"/> FALSE	FALSE
19	*InstMotion*.instMcMovejog.Velocity		Floating-point nu...	20.0	20.0
20	*InstMotion*.instMcMovejog.InVelocity		Bool	<input checked="" type="checkbox"/> TRUE	
21	*InstMotion*.instMcMovejog.Busy		Bool	<input checked="" type="checkbox"/> TRUE	
22	*InstMotion*.instMcMovejog.CommandAborted		Bool	<input type="checkbox"/> FALSE	
23	*InstMotion*.instMcMovejog.Error		Bool	<input type="checkbox"/> FALSE	
24	*InstMotion*.instMcMovejog.ErrorId		Hex	16#0000	
25	// input parameter r27 and r482				
26	*inputParameter27*	%IW18	Hex	16#2385	
27	*InstMotion*.statValueData		Floating-point nu...	0.3496454	
28	*inputParameter482*	%ID20	DEC	38773248	
29	// output parameter p641				
30	*outputParameter641*	%OD10	Floating-point nu...	100.0	100.0

6 Links & Literature

Table 6-1: Links & literature

	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Download page of the entry https://support.industry.siemens.com/cs/ww/en/view/109737292
\3\	Guide for Commissioning a Position-Controlled Drive https://support.industry.siemens.com/cs/de/en/view/109479977
\4\	SINAMICS G: Positioning a G110M/G120 (Startdrive) with S7-1500 (TO) via PROFINET/PROFIBUS with Safety Integrated and HMI https://support.industry.siemens.com/cs/de/en/view/81666970
\5\	SINAMICS G: Speed Control of a G110M / G120 (Startdrive) with S7-1500 (TO) via PROFINET or PROFIBUS with Safety Integrated (via Terminal) and HMI https://support.industry.siemens.com/cs/de/en/view/78788716
\6\	Interaction of SIMATIC control technology with SINAMICS drives https://support.industry.siemens.com/cs/de/en/view/60733299
\7\	SIMATIC S7-1500 Automation System https://support.industry.siemens.com/cs/ww/en/view/59191792
\8\	SIMATIC S7-1500 Motion Control Function Manual in the TIA Portal V14 https://support.industry.siemens.com/cs/ww/en/view/109739589
\9\	Operating Instructions for SINAMICS G120 inverter with CU250S-2 Control Units https://support.industry.siemens.com/cs/de/en/view/109478829
\10\	List Manual for SINAMICS G120 inverter with CU250S-2 Control Units https://support.industry.siemens.com/cs/de/en/view/109477253

7 History

Table 7-1: History

Version	Date	Modifications
V1.0	03/2017	First version