Distributed Speed Control of a Drive via the USS Protocol

with S7-1200, SINAMICS G110/ G120/ S110 and KTP600

Configuration Example x11 • December 2009

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CE X11 - Distributed Speed Control of a Drive with S7-1200 via the USS Protocol

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1 Automation Problem

1.1 Application automation problem

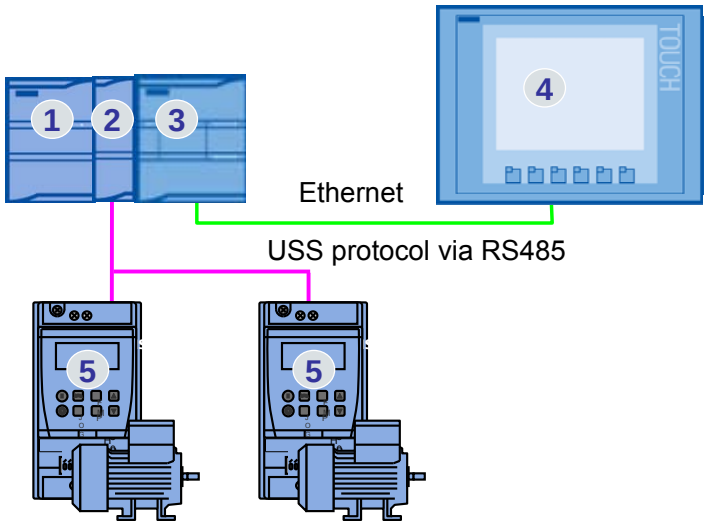
Two asynchronous motors, each of them connected to the SINAMICS G110 frequency inverter, are to be controlled by an S7-1200 controller (CPU1211C) via the CM1241 (RS485) communication module.

Communication between controller and frequency inverter takes place with the aid of the USS protocol.

A KTP600 touch panel that is connected to the S7-1200 controller via an Ethernet connection is used for operation and visualization.

STEP7 Basic V10.5 is used as a configuration tool for the control program and the HMI.

Figure 1-1



1 PM1207 Power Module 2 CM 1241 Communication Module 3 SIMATIC S7-1200 CPU
4 KTP600 Basic Panel 5 SINAMICS G110 Frequency Inverter

The motors are to be operated on speed. A setpoint from 0 to 100% is specified. It is to be possible to change the direction of rotation and to acknowledge drive errors.

During runtime it is to be possible to read and change parameters of the frequency inverter via the USS protocol.

The actual speed is to be displayed together with the drive status.

1.2 List of components

Products

Table 1-1

	Component	No.	MLFB/order number	Note
1.	PM1207 power supply	1	6EP1332-1SH71	
2.	CM1241 RS485 communication module	1	6ES7241-1CH30-0XB0	
3.	S7-1200 CPU1211C	1	6ES7211-1AD30-0XB0	DC/DC/DC
4.	KTP600 Basic Panel (color, PN)	1	6AV6647-0AD11-3AX0	Optional
5.	SINAMICS G110 120 W without filter; USS variant, FS A	At least 1	6SL3211-0AB11-2UB1	
6.	BOP	At least 1	6SL3255-0AA00-4BA1	
7.	4-pole asynchronous motor, aluminum frame, 120 W	At least 1	1LA7060-4AB10	

Note

The program example comprises the call of two USS nodes to show the call structure for several nodes. However, it is sufficient to connect only one physical node to show the functionality. For this reason, you need only at least one frequency inverter with motor.

A KTP600 is not mandatory either. STEP7 Basic PC Runtime can be used to simulate the user interface.

Accessories

Table 1-2

	Component	No.	MLFB/order number	Note
8.	Profibus cable	1	6XV1830-0EH10	
9.	Profibus connector with PG port	1	6ES7972-0BB12-0XA0	
10.	Adapter to mount the SINAMICS frequency inverter FS A on the DIN rail	At least 1	6SL3261-1BA00-0AA0	Optional
11.	Filter for low leakage currents	At least 1	6SE6400-2FL01-0AB0	Optional
12.	Commutating inductor	At least 1	6SE6400-3CC00-4AB3	Optional
13.	Ethernet connection cable between KTP600, S7-1200 CPU and PC	2	6XV1870-3QH20	

Note

The actual configuration is intended for industrial application. In industrial applications, industrial networks are mostly used for power supply. It is therefore not necessary to use special filters/inductor with low leakage currents.
If the configuration is used in sensitive networks (for example, PCs on the same network), we recommend that filters or inductors be used.

For more information on the SINAMICS G110, use this link:
https://www.automation.siemens.com/sd/sinamicsg110/index_76.htm

Programming package

Table 1-3

	Component	No.	MLFB/order number	Note
14.	STEP 7 Basic V10.5	1	6ES7 822-0AA00-0YA0	

Alternative drive products

Table 1-4

	Component	No.	MLFB/order number	Note
15.	SINAMICS G120 compact 0.37 kW without filter incl. PM240, CU240E and BOP; USS variant, frame size FSA	At least 1	6SL3214-3AE13-7UB0	3 380 V AC
16.	SINAMICS S110, consisting of: PM340 Power Module CU305DP Control Unit	 At least 1 At least 1	 6SL3210-1SB12-3UA0 6SL3040-0JA00-0AA0	USS variant for firmware v4.3 and higher
17.	SINAMICS S110 MMC incl. Firmware v4.3 and license	At least 1	6SL3054-4ED00-0AA0	optional
18.	STARTER Commissioning Tool on DVD	1	6SL3072-0AA00-0AG0	Version 4.1.5 and higher for firmware 4.3
19.	Serial null modem cable to commission the SINAMICS S110	1	Specialist dealers	

Note

For more information on the SINAMICS G120, please use this link:
https://www.automation.siemens.com/sd/sinamicsg120/index_76.htm

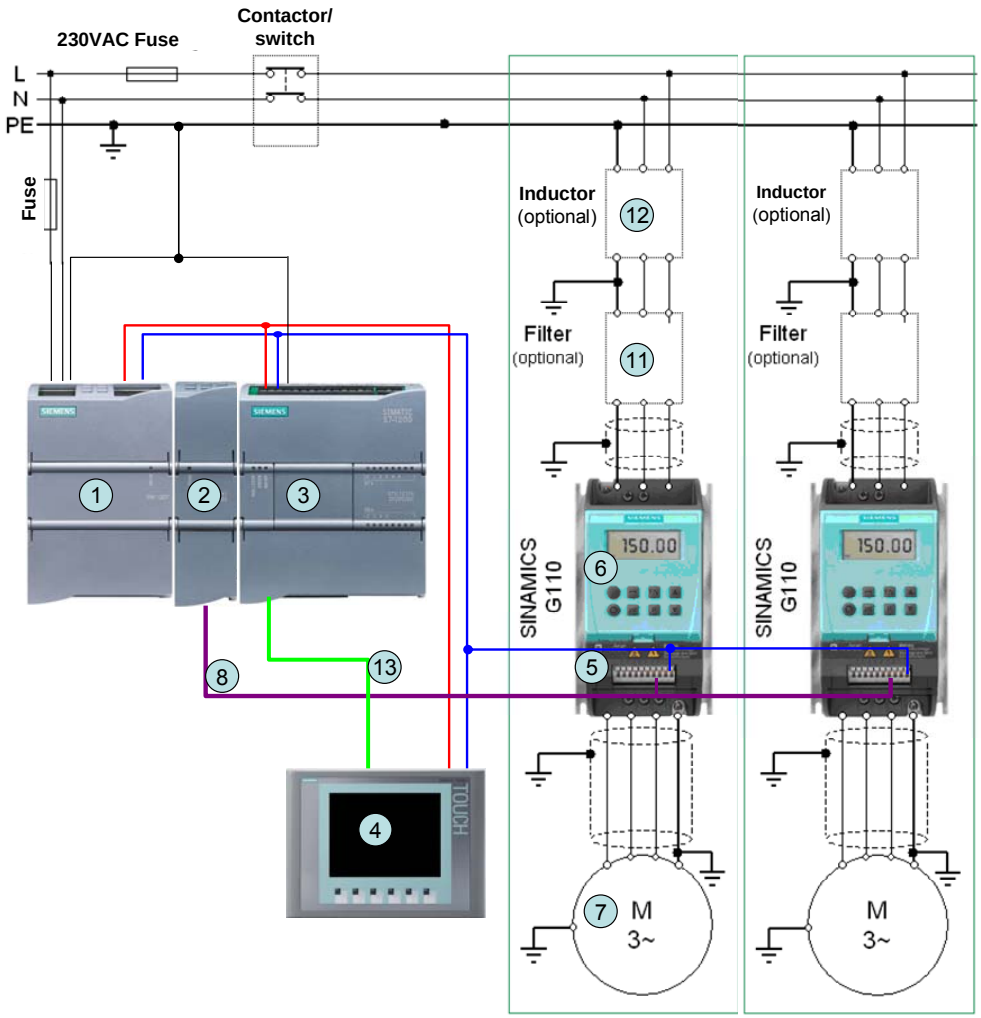
More information on the SINAMICS S110 is available here:
http://siemens.de/sinamics-s110

You can also download the actual STARTER version here:
http://support.automation.siemens.com/WW/view/en/26233208

2 Automation Solution

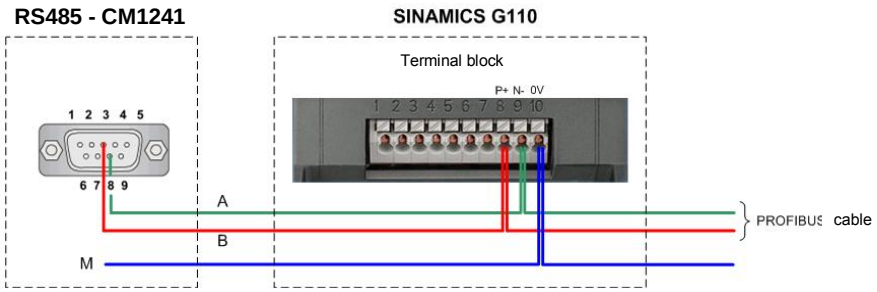
2.1 Connection diagram

Figure 2-1 – Wiring



Note The 4-pole asynchronous motors with 400 V/230 V star/delta winding must be connected to the frequency inverter in a delta connection (Δ 230 V).

Figure 2-2 – Bus connection wiring detail



NOTICE

What should be done to avoid electromagnetic interference:

- Make sure there is a good conductive connection between the frequency inverter and the (grounded) metal mounting plate.
- Ensure that all devices in the cabinet are grounded using short grounding cables with large cross-sectional areas and connected to a common grounding point or grounding bar.
- Ensure that the S7-1200 CM connected to the frequency inverter is connected to the same grounding or grounding point as the frequency inverter using a short cable with a large cross-sectional area.
- Please use shielded control cables, e.g. a SIEMENS Profibus cable, to set up the RS485 bus. Ground the shield on the inverter side using shield connections.
- If possible, control cables have to be installed separately from power cables in separate trunkings. Crossings between power cables and control cables should be at a 90° angle.
- Connect the protective conductor of the motor to the ground connection (PE) of the associated frequency inverter.
- The cable ends have to be properly terminated and non-shielded cables must be as short as possible.

Use shielded cables for the motor connections, ground the cable shield on both the inverter and the motor side using cable clamps.

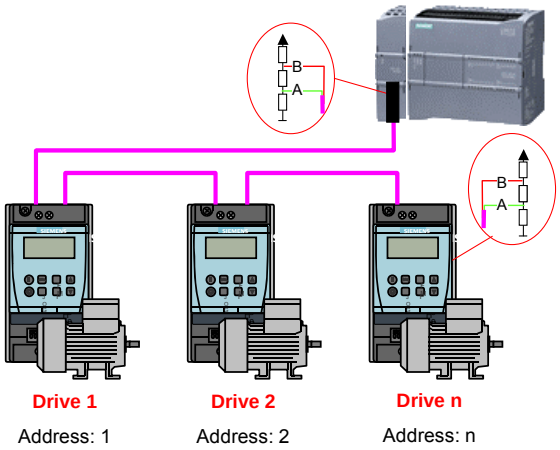
2.2 Addressing drives and terminating an RS485 bus with USS protocol

An RS485 bus allows data transmission using the USS protocol via a 2-core cable between one master (for example, CPU 1211C) and up to 16 slaves (e.g., SINAMICS G110) per communication module. It is necessary that each slave can be identified by a unique address between 1 and 16.

The USS protocol allows only one master to which no address has to be assigned.

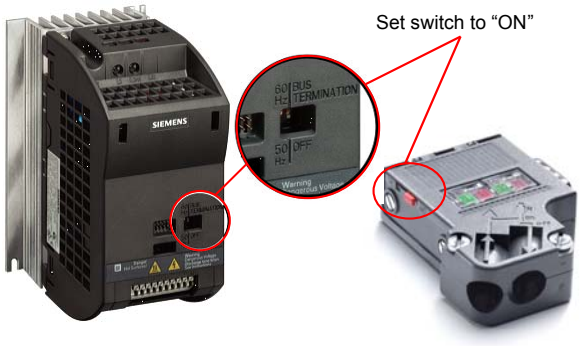
To avoid reflections at the start or end of the bus, which may cause a distorted data signal, the bus must be terminated with the aid of terminating resistors as shown in figure 2-3.

Figure 2-3



As shown in figure 2-4, in this example this is done on the controller side via the PROFIBUS connector and on the last SINAMICS G110 in the network by switching on both assigned DIP switches under the BOP.

Figure 2-4



2.3 USS protocol structure

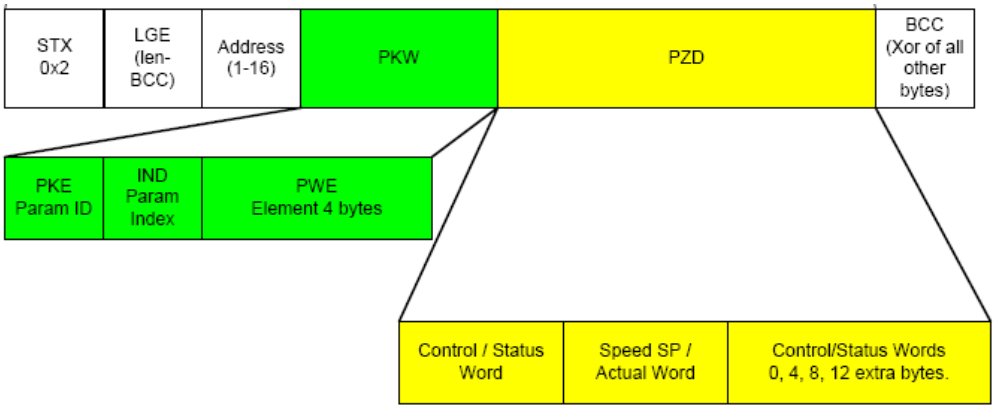
The USS protocol was developed to exchange process data between a central controller and bus nodes (in the following referred to as drive) on an RS485 bus. Each drive is identified by a unique bus address.

Even if PROFIBUS uses the same physical RS485 technology, PROFIBUS and USS protocol differ considerably.

The structure of a USS telegram is as follows (figure 2-5):

- STX: Start text
- LGE: Telegram length
- ADR: Slave address
- PKW: Parameter ID value (PIV)
- PZD: Process data
- BCC: Check block (checksum)

Figure 2-5



The PZD part is used to transfer control commands and setpoints to the drive. The drive responds with status information and actual values. By default, the first PZD word contains the control word or the status word. The second PZD word contains the main setpoint or the actual value. Another 6 words (12 bytes) can be used as desired. The PZD length can thus vary between 2, 4, 6 or 8. The PZD length on the drive and in the controller must match.

The PKW part is used to read or write individual parameter values in the drive. It thus enables the user to change or read out individual parameters in the drive during runtime. The PKW part consists of

- PKE: Parameter ID
- IND: Parameter index
- PWE: Parameter value

The size of both PKE and IND is 1 word. The length of PWE can vary between 1 or 2 words, depending on which data type is to be transferred (word, double word, real). The overall length of PKW can be set for most drives and, when communicating with an S7-1200, must be set to a fixed length of 4 words. Due to this, the PWE part has a size of 2 words.

Note For more information on the USS protocol, please use the following link:
http://support.automation.siemens.com/WW/view/en/24178253

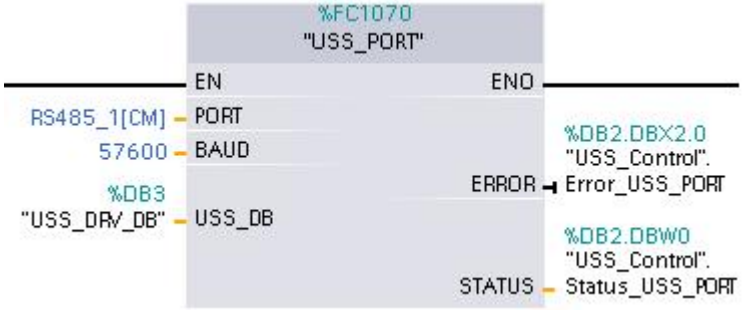
2.4 Communication with the drives

Communication of the S7-1200 controller with the drives via the communication module is performed by integrating a library that is included in the scope of delivery of STEP7 Basic.

Communicating with USS_PORT

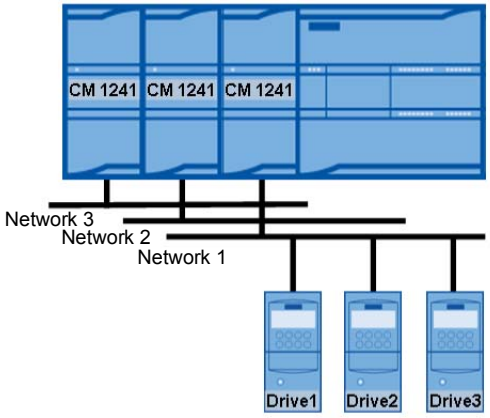
For a command to be sent from the controller to the drive, a function is necessary that controls communication between the CPU and the drive via the PtP communication module. This is done with the aid of the “USS_PORT” block (figure 2-6).

Figure 2-6



The “Port“ block parameter specifies the communication module via which the drives are connected. Max. 16 drives can be operated per communication module. Since the S7-1200 supports max. 3 communication modules, up to 48 drives can be connected in 3 different networks.

Figure 2-7



With each call of the block, communication with a drive is processed. Communication with the drive is asynchronous. This means that several cycles are executed in the S7-1200 controller before the data exchange with a drive is completed.

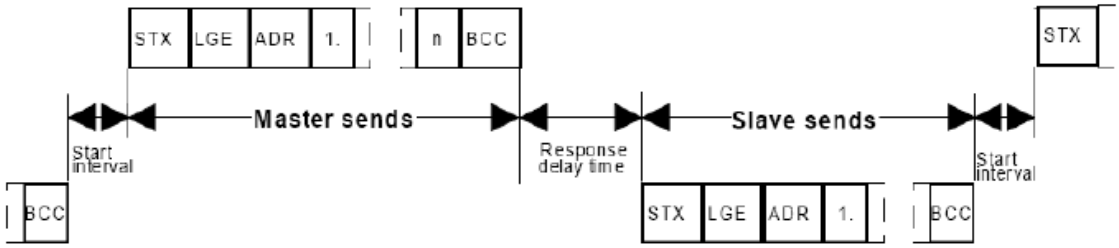
This is why the “USS_PORT” block is usually called from a time-delay interrupt OB at the defined interval. The call interval corresponds to the time that is required for a transaction with the drive.

The block can also be called cyclically; however, this does not increase the number of transactions. If a call occurs while the block is still active, the call will be ignored. If the cycle time is high, the interval between the calls is extended and communication aborts may occur.

Depending on the baud rate, there is a “Worst Case Message Time” (WCMT) for each transaction, thus the time that can be required for a transaction in the worst case. This time is listed in table 2-1. It is composed of the length of a send and receive telegram and of the associated waiting times (figure 2-8). The individual parts are listed below:

- The start interval corresponds to the time that must pass before the USS master may send a request (formula: (2*11) / baud rate [bits per second])
- Request telegram of the master
- Maximum response delay time of 20 ms
- Response telegram of the slave

Figure 2-8



By default, the library for the USS protocol repeats each transaction up to two times. This results in a minimum call interval for USS_PORT that can be calculated using the following formula:

Minimum call interval USS_PORT [ms] = 2 * WCMT

In addition, it must be ensured that the “USS_PORT” block is called within the timeout interval of the drive. The timeout interval of a drive is the time available for a transaction when – due to communication errors – 3 attempts are necessary to complete the transaction. The formula below is used to calculate the timeout interval of a drive:

Timeout interval per drive [ms] =
3 repetitions * minimum call interval USS_PORT

If the network includes multiple drives, the number of drives in the network has to be considered for the timeout interval of a drive by multiplication. The timeout interval for each drive is increased by this calculated value.

Timeout interval per drive [ms] =

(3 repetitions * minimum call interval USS_PORT) * number of drives in the network

Table 2-1

Baud rate	WCMT [ms]	Minimum call interval for USS_PORT [ms]	Timeout interval per drive [ms]
1200	405.00	790	2370
2400	212.50	405	1215
4800	116.25	213	639
9600	68.13	117	351
19200	44.06	69	207
38400	32.03	45	135
57600	28.02	37	111
115200	24.01	29	87

Sample calculation:

The network includes 2 drives. The transmission rate is 57600 baud.

- Minimum call interval for USS_PORT = (2 * 28.02) = 37 ms
- Timeout interval per drive = (3 * 37) * 2 = 222 ms

Result:

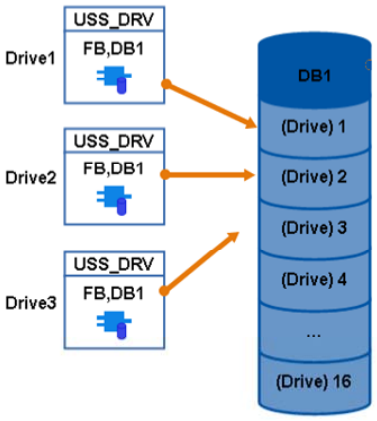
- The time-delay interrupt OB in which the USS_Port block is called must be configured at an interval of at least 37 ms.
- Communication monitoring on the drive must be configured with at least 222 ms, a configuration with 230 ms is better.

Transferring process data to drives with USS_DRV and reading it out

The “USS_DRV“ block exchanges data with the drives by generating request telegrams and evaluating response telegrams. An instance data block is used to store the data. A separate USS_DRV block must be used for each drive in the network. Up to 16 called USS_DRV blocks share one and the same instance data block.

After the first USS_DRV block has been inserted into the STEP7 Basic Editor, the instance data block is automatically generated. The same instance data block has to be specified for all other USS_DRV blocks.

Figure 2-9



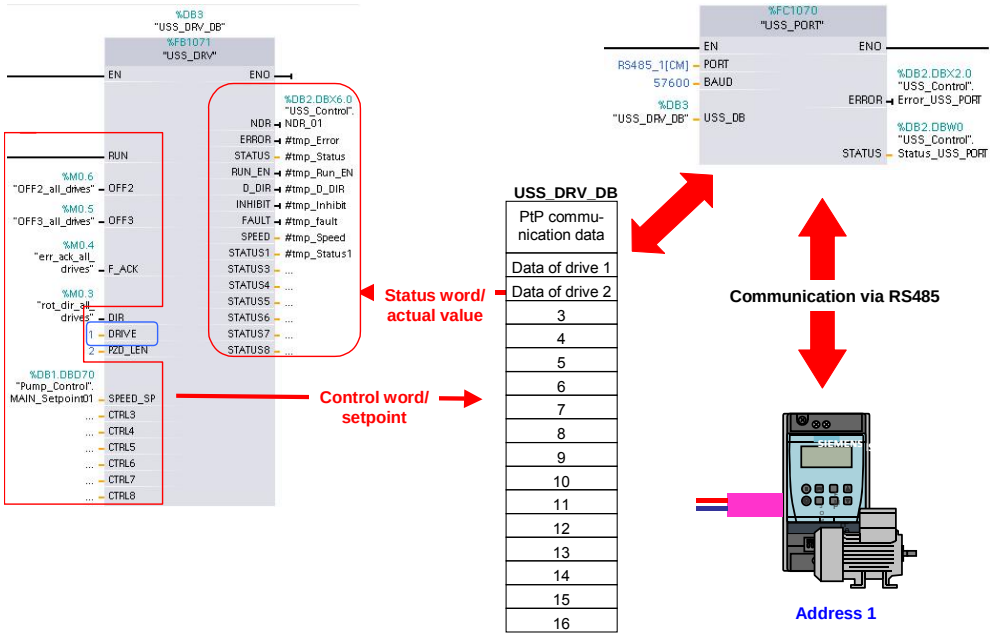
The USS_DRV block must be called cyclically. When executing the block for the first time, the drive specified for the “Drive” parameter is initialized in the instance data block. USS_PORT can start the communication with this drive only after this initialization. It is thus mandatory that the USS_DRV block be called at least once per drive. When the drive number is changed during runtime, the instance data block has to be reinitialized by first setting the controller to STOP and then back to RUN.

The parameters of the USS_DRV block on the left side are used to configure the control word (RUN, OFF2, OFF3, F_ACK, DIR) and the main setpoint (SPEED_SP) of the assigned drive. CTRL3 – CTRL8 are the process data words of the send telegram that can be freely used. These configured parameters are stored in the send buffer of the instance data block.

The status word (STATUS1) and the actual value (SPEED) of the drive are read out of a previous valid response buffer and provided at the outputs of the USS_DRV block. STATUS3 – STATUS8 are the process data words of the response telegram that can be freely used. The individual RUN_EN, D_DIR, INHIBIT and FAULT bits are a selection from the 1st status word.

While executing USS_DRV, there is no data transfer. The communication with the drives starts only after executing USS_PORT. USS_DRV configures only the telegrams to be sent and evaluates data that has previously been received via USS_PORT. (Figure 2-10)

Figure 2-10



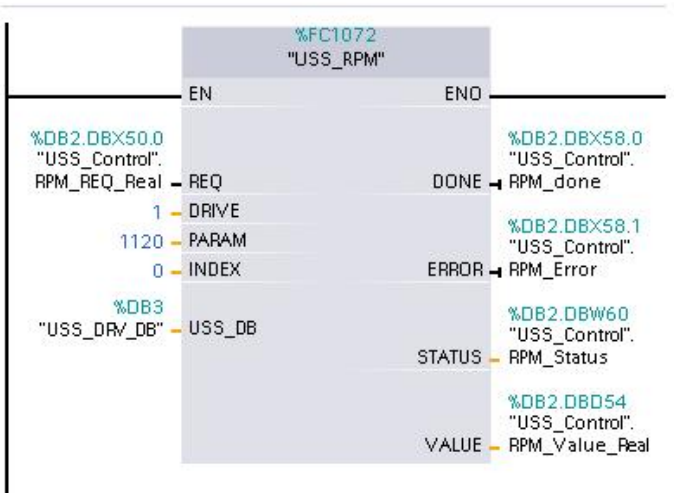
Reading parameters with USS_RPM

The USS_RPM block is used to read parameters out of the drive. It uses the same instance data block that was assigned to the relevant USS network.

After a positive edge has been detected at the REQ input, the send buffer of the instance data block is configured with the required parameters, including the index value of the parameter. Once USS_PORT has processed the communication with this drive, the value of the required parameter is stored in the response buffer of the instance data block. USS_RPM provides the value at the VALUE output and sets the DONE bit.

The data type at the VALUE output must match the data type of the parameter in the drive (word, double word, real).

Figure 2-11



Writing parameters with USS_WPM

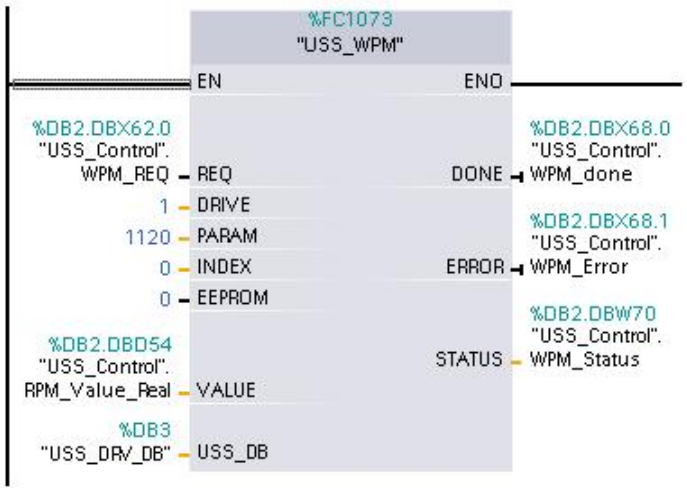
The USS_WPM block is used to write parameters to the drive. It uses the same instance data block that was assigned to the relevant USS network. To be able to write parameters, the relevant permission has to be given in the drive.

After a positive edge has been detected at the REQ input, the send buffer of the instance data block is configured with the parameter to be written, the index and the parameter value. Once USS_PORT has processed the communication with this drive, the DONE bit is set.

The data type at the VALUE input must match the data type of the parameter in the drive (word, double word, real).

The EEPROM input defines whether the parameter is to be written only to the RAM of the drive or whether it is to be permanently stored in the ROM. Unlike the RAM, the ROM is still available after restarting the drive.

Figure 2-12



Note Do not use the EEPROM write operation too frequently. Keep the number of EEPROM write operations as low as possible to extend the life of the EEPROM.

Evaluating communication errors

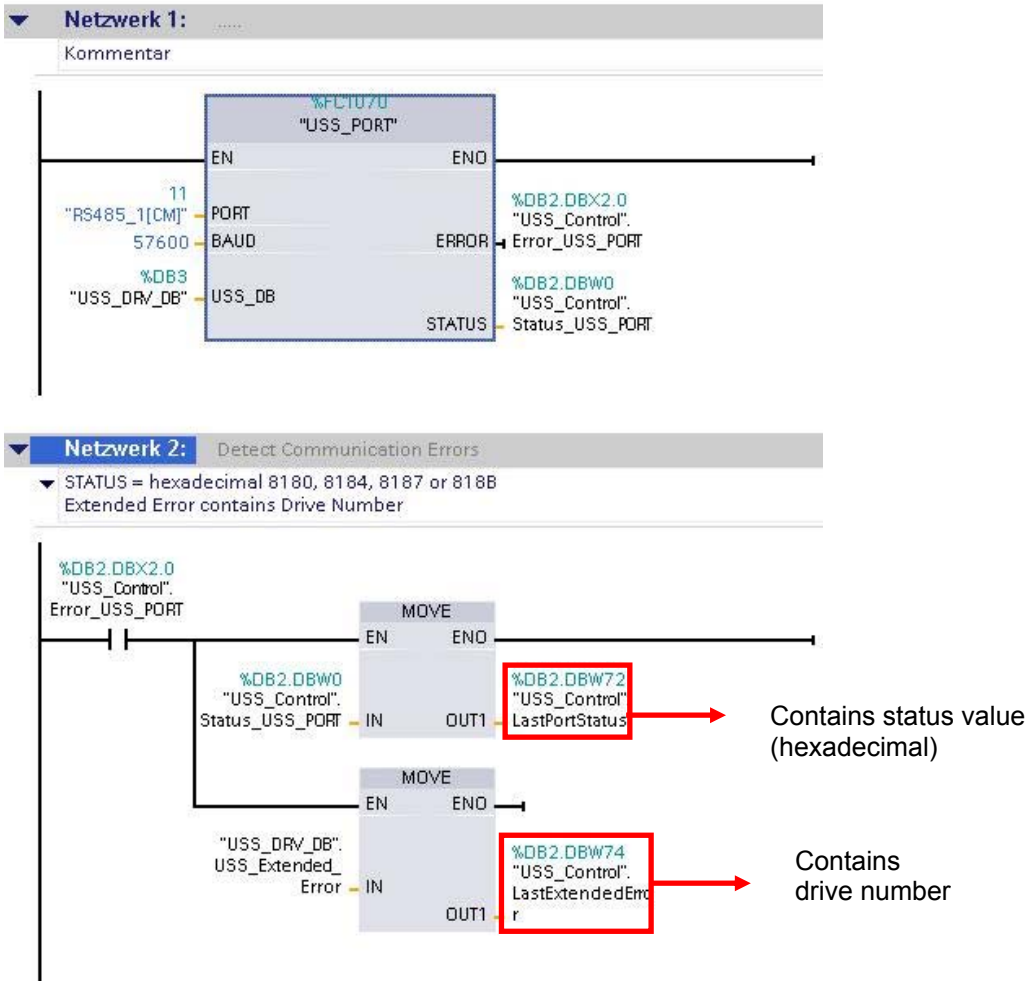
Communication errors are only output on the USS_PORT block, not on USS_DRV. They have the status value hex 8180, 8184, 8187 or 818B.

To find out from which drive the error message originates, the instance data block contains a variable named “USS_Extended_Error”. If communication errors occur, the address of the faulty drive is stored in this variable.

Since the status message for an error is pending at the output of USS_PORT only for the duration of one cycle, it has to be saved when an error occurs (figure 2-13).

For an overview of status messages, please refer to chapter 6.3.1 of the S7-1200 System Manual.

Figure 2-13



Evaluating write/read errors

The evaluation of write/read errors follows the same principle as the evaluation of communication errors. The status message is pending only for the duration of one cycle and has to be saved when an error occurs.

When the status value is hex 818C, an extended error code from the drive is stored in the “USS_Extended_Error” variable of the instance data block. The meaning of the error code depends on the drive version and can be looked up in the drive manual.

3 Configuration

3.1 Installing and wiring the hardware

Table 3-1

No.	Action	Comment/picture
1.	Mount • the fuse • the PM 1207 power supply unit • the S7-1200 CPU 1211C • the CM1241 • and the frequency inverters on a DIN rail.	
2.	Mount the motors on a suitable fixture.	
3.	Connect the controller to the 24 V DC supply voltage of the PM 1207.	See figure 2-1.
4.	Connect the frequency inverters to the motors.	See figure 2-1.
5.	Connect the PROFIBUS cable to the S7-1200 CM1241 and the frequency inverters.	See figure 2-1.
6.	Connect all ground connections to ground.	

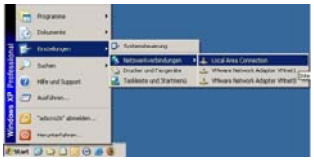
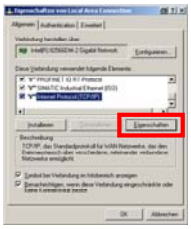
Note At this point it is assumed that the necessary software has been installed on your computer and that you are familiar with handling the software.

WARNING

Before installing and commissioning the frequency inverter, please carefully read all safety and warning notices listed in the instruction manual of the frequency inverter and all warning labels on the device. Please make sure that the warning labels remain legible and that they are not removed from the device.

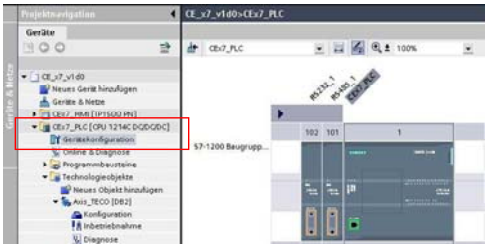
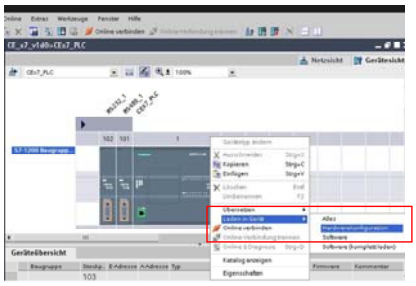
3.2 Connecting S7-1200 and PG/PC

Table 3-2

No.	Action	Comment/picture
1.	Use an Ethernet cable to connect your development system (PG/PC) to the S7-1200 CPU.	
2.	Open the network connection in the control panel of the PG/PC.	
3.	Open the network connection properties.	
4.	Open the Internet Protocol (TCP/IP) Properties.	
5.	In the “General” tab, select “Use the following IP address” and set the address: • IP address: 192.168.0.100 • Subnet: 255.255.255.0	
6.	Close all windows by confirming with OK.	

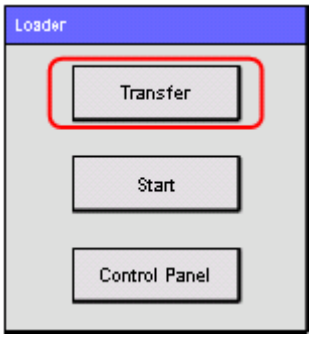
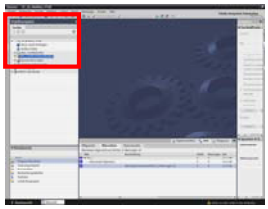
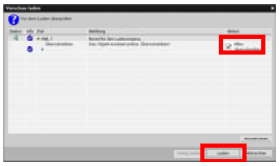
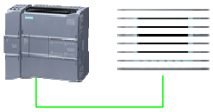
3.3 Downloading the project to the S7-1200 CPU1211C

Table 3-3

No.	Action	Comment/picture
1.	Extract the file from table 4-1, no. 1.	CE_x11_S7-1200_v1d0.zip
2.	Open the extracted project with STEP7 Basic v10.5	*.ap10
3.	In the project navigation, select “PLC_1” and open the device configuration.	
4.	Check the device configuration and if necessary, adjust your hardware.	• Expansion modules • IP-address
5.	Download the project to the CPU. • Select the CPU, right-click and select “Download to device” → “All”. • After downloading, set the CPU to “RUN”.	

3.4 Downloading the project to the SIMATIC Panel KTP600

Table 3-4

No.	Action	Comment/picture
1.	• Connect the KTP600 to a 24 V DC supply voltage. • Use an Ethernet cable to connect your development system (PG/PC) to the KTP600.	
2.	After the “bootloader“ sequence select the “Transfer” button. First make sure that the IP address set in the panel matches the IP address assigned to the panel in the project. The panel is now ready to download the project.	
3.	In the project navigation, right-click on HMI_1 [KTP600].	
4.	Select “Download to device” → “All“.	
5.	Check the “Action” column and click on “Download”.	
6.	The HMI project is downloaded. The panel starts automatically after completion.	
7.	Once the S7-1200 project has been successfully downloaded, use an Ethernet cable to connect the KTP600 to the S7-1200 CPU1211C.	

3.5 Using PC Runtime instead of the panel

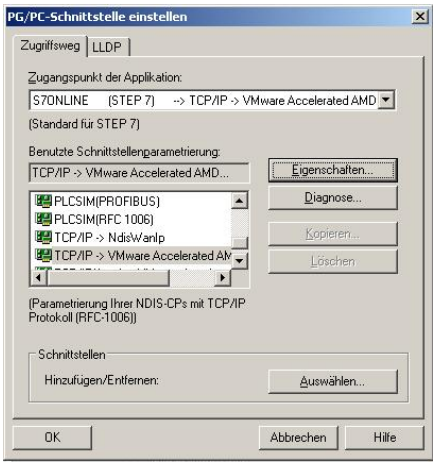
Aside from programming a controller, STEP7 Basic V10.5 also offers the visualization of the project. The software supports all presently available Basic Panels with Ethernet interface.

If no panel is available, the panel can be simulated by the integrated PC Runtime.

For convenient operation of the project, an HMI project was integrated that can also be simulated via PC Runtime.

To make the simulation executable, proceed as follows:

Table 3-5

No.	Action	Comment/picture
1.	Go to the control panel of your programming unit and set the PG/PC interface as follows: • Access point: S7Online • Interface: TCP/IP -> "Your network adapter"	
2.	Return to the STEP7 Basic project.	*.ap10
3.	• In the project navigation, select "HMI_1 [KTP600]". • Then click on the "Start Runtime" icon.	

3.6 Terminating the RS 485 bus with terminating resistors

Table 3-6

No.	Action	Comment/picture
1.	• Remove the BOP of the frequency inverter (last drive). • To activate the terminating resistor, change the DIP switches as follows: - 50 Hz: 1=OFF, 2=ON, 3=ON - 60 Hz: 1=ON, 2=ON, 3=ON • Snatch the BOP back onto the frequency inverter.	
2.	• To activate the terminating resistor on the controller (first bus node), set the switch to the “ON” position.	

3.7 Parameterizing the frequency inverter

3.7.1 SINAMICS G110/G120

Parameterizing the frequency inverter of the first drive (address 1)

Table 3-7

Step	Action	Comment/picture
1.	Put the BOP on the SINAMICS G110/G120 frequency inverter to which address 1 is to be assigned.	
2.	• To change a parameter, proceed as follows: • Select parameterization mode: P • Choose the parameter with the cursor: ▲ / ▲ • Select the parameter: P • Select the value with the cursor: ▲ / ▲	

<table>
<tr><th>Step</th><th>Action</th><th>Comment/picture</th></tr>
<tr><td></td><td colspan="2">• Apply the value: P</td></tr>
<tr><td>3.</td><td colspan="2">To set the traversing parameters, proceed as follows:
<table>
<tr><th>Function</th><th>Parameter</th><th>Value</th></tr>
<tr><td>Reset the frequency inverter to the condition at delivery from the plant</td><td>P0010</td><td>30</td></tr>
<tr><td></td><td>P0970</td><td>1</td></tr>
<tr><td>Start quick commissioning</td><td>P0010</td><td>1</td></tr>
<tr><td>Check the parameter setting to suit the DIP switch: Europe 50 Hz, power in kW[1]</td><td>P0100</td><td>0</td></tr>
<tr><td>Rated motor voltage</td><td>P0304</td><td>230 V</td></tr>
<tr><td>Rated motor power</td><td>P0307</td><td>0.12 kW</td></tr>
<tr><td>Rated motor frequency</td><td>P0310</td><td>50 Hz</td></tr>
<tr><td>Rated motor speed</td><td>P0311</td><td>1350 rev/min</td></tr>
<tr><td>Command source (USS)</td><td>P0700</td><td>5</td></tr>
<tr><td>Frequency setpoint source (USS)</td><td>P1000</td><td>5</td></tr>
<tr><td>Minimum motor frequency</td><td>P1080</td><td>0.0 Hz</td></tr>
<tr><td>Maximum motor frequency</td><td>P1082</td><td>50.0 Hz</td></tr>
<tr><td>Ramp-up time</td><td>P1120</td><td>10.0 s</td></tr>
<tr><td>Deceleration ramp</td><td>P1121</td><td>10.0 s</td></tr>
<tr><td>End of quick commissioning</td><td>P3900</td><td>1</td></tr>
<tr><td>Enable expert mode</td><td>P0003</td><td>3</td></tr>
<tr><td>Reference frequency</td><td>P2000</td><td>50.0 Hz</td></tr>
<tr><td>Data transmission rate: 57,600 b/s</td><td>P2010</td><td>9</td></tr>
<tr><td>Address (slave)</td><td>P2011</td><td>1</td></tr>
<tr><td>USS PZD length</td><td>P2012</td><td>2</td></tr>
<tr><td>USS PKW length</td><td>P2013</td><td>4</td></tr>
<tr><td>Communication monitoring:
Value 0 without monitoring</td><td>P2014</td><td>230 ms</td></tr>
<tr><td>Back up data in E²PROM</td><td>P0971</td><td>1</td></tr>
</table></td></tr>
<tr><td>4.</td><td colspan="2">To back up the parameters in the BOP, proceed as follows:
<table>
<tr><th>Function</th><th>Parameter</th><th>Value</th></tr>
<tr><td>Enable expert mode</td><td>P0003</td><td>3</td></tr>
<tr><td>Enable parameterization mode</td><td>P0010</td><td>30</td></tr>
<tr><td>Transfer parameters from G110 to BOP</td><td>P0802</td><td>1</td></tr>
</table></td></tr>
<tr><td>5.</td><td>To display the current frequency during operation, select the P0000 parameter and use the P button.</td><td></td></tr>
</table>

[1] These values are pre-assigned (except for parameter value 2) depending on the DIP switch position on the front of the SINAMICS G110. For details on the interaction of P0100 and the DIP switch position, please refer to the SINAMICS G110 parameter list. **Parameter value and DIP switch position must correspond for parameter value 0 and 1!**

Parameterizing the frequency inverter of the second drive (address 2)

Table 3-8

Step	Action	Comment/picture
6.	Remove the BOP from the frequency inverter of the first drive and attach it to the second SINAMICS G110/G120.	
7.	• To change a parameter, proceed as follows: • Select parameterization mode: P • Choose the parameter with the cursor: ▲ / ▲ • Select the parameter: P • Select the value with the cursor: ▲ / ▲ • Apply the value: P	
8.	To apply the settings of the second frequency inverter and to adjust the address, proceed as follows:	
9.	To display the current frequency during operation, select the P0000 parameter and use the P button.	

Function	Parameter	Value
Enable expert mode	P0003	3
Enable parameterization mode	P0010	30
Transfer parameters from BOP to G110	P0803	1
Change address to 2	P2011	2
Save data in E²PROM	P0971	1

Note Ensure that a flashing light is visible on the SINAMICS G110. If this is not the case, the SINAMICS G110 is running and a configuration is not possible.

3.7.2 SINAMICS S110

The SINAMICS S110 can be set up easily and quickly using the STARTER Commissioning Tool. Basic knowledge of handling the software is required. The easiest motor to configure is a motor with DRIVE-CLiQ interface. Asynchronous motors are also possible, however, you need motor characteristics and profound knowledge of configuring and optimizing the motor parameters.

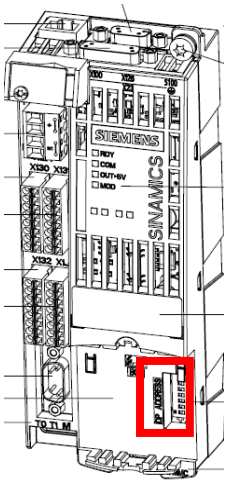
The following section explains how to configure the SINAMICS S110 for the use of the USS-interface so that this Configuration Example is executable. The configuration of the motor is not explained since it depends on the motor type.

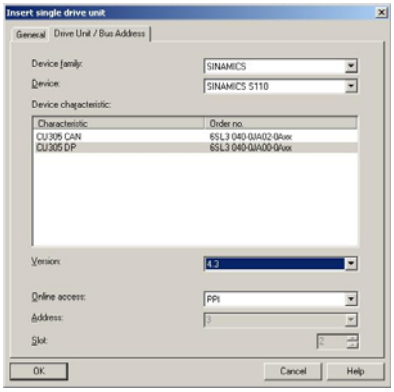
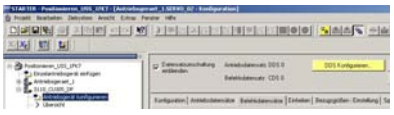
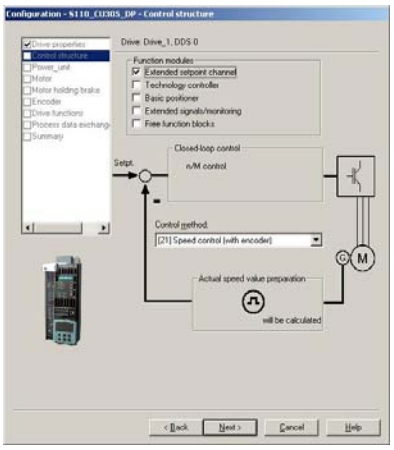
Hinweis

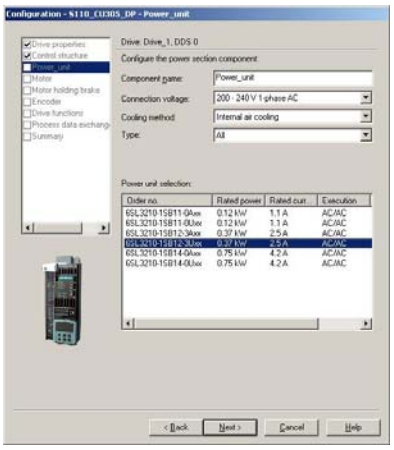
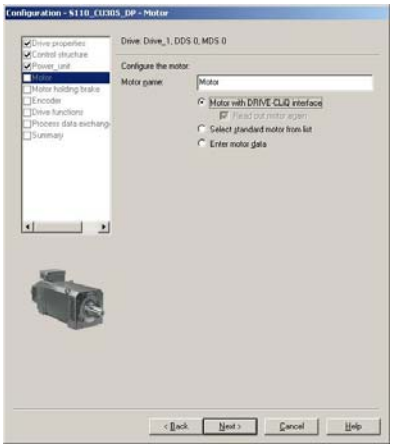
At the internet page where you downloaded this documentation, you find an example of a STARTER-project. This project is configured for the SINAMICS S110 from component list (chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**) and a 1LA7070 250W-asynchronous motor

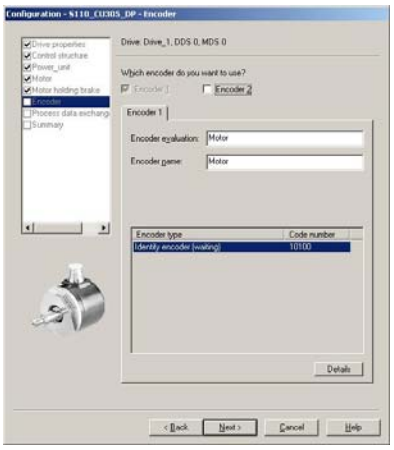
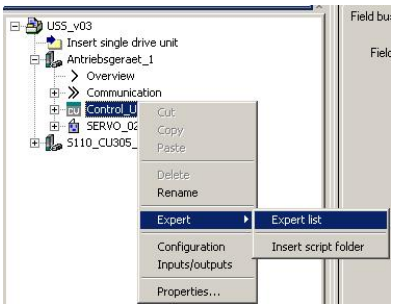
This project serves for exemplification and it can be adapted to your components, if necessary.

Table 3-9

Step	Action	Comment/picture
1.	Open the STARTER program.	
2.	Use the serial null modem cable to connect the PC to the RS232 interface of the SINAMICS S110.	A connection is also possible over Profibus interface. A special Profibus adapter for PC is needed
3.	Set the address (1 or 2) of the drive using the DIP switches on the CU305DP. Then switch on the drive.	
4.	Create a new project.	

Step	Action	Comment/picture
5.	Insert a new single drive unit with the following characteristics: • SINAMICS S110 • CU305 DP • Version 4.3 • Online access: PPI	
6.	Double-click on “Configure drive unit”.	
7.	• Assign an object name. • Click on Next.	
8.	Define the control structure. • Select the “Extended setpoint channel” function module. • Speed control with or without encoder – depending on the motor. Click on Next.	

Step	Action	Comment/picture
9.	• Select a power section, e.g. 6SL3210-1SB12-3Axx, 0.37 kW, 2.5 A, AC/AC • Click on Next.	
10.	• Select a motor, for example the motor with DRIVE-CLiQ interface. • Click on Next.	
11.	• Select no motor holding brake. • Click on Next.	

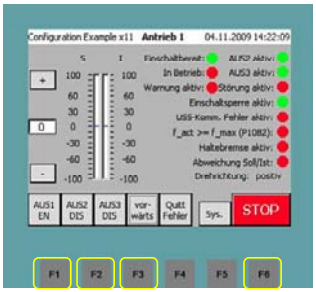
Step	Action	Comment/picture
12.	Encoder 1 is selected by default (motor encoder). Click on Next.	
13.	• As setpoint source, select the PROFIDrive Standard Telegram 1 PZD2/2. • Click on Next, then on Finish. → The function module „Extended setpoint channel" is now wired with Standard Telegram. The Ramp-function generator is standard set to 10s. → depending on motor type, a motor identification and maybe a optimization has to be executed	
14.	Select: "Your drive unit" → Communication → Field bus. Set the following values: • Field bus protocol: USS • Baud rate: 57600 • PZD drive object: "Your drive" (e.g.: SERVO) • PZD length: 2 • PIV drive object: "Your drive" (e.g.: SERVO) • PIV length: 4	
15.	Open expert list of Control Unit • In the project tree, right-click on "Control Unit" → Expert → Expert list.	
16.	Look for the P2040 COMM_INT monitoring time parameter and set it to 230 ms.	TimeOut monitoring of the drive.
17.	Connect to the target system.	

Step	Action	Comment/picture
18.	Download your project to the target system and select “Copy from RAM to ROM”.	

3.8 Operating the application via HMI

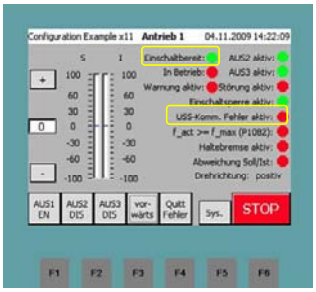
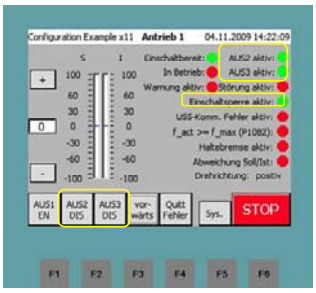
3.8.1 Meaning of the softkeys

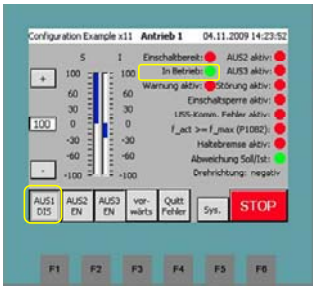
Table 3-10

Step	Action	Comment/picture
1.	• Softkey F1 changes to drive 1 • Softkey F2 changes to drive 2 • Softkey F3 changes to read/write parameter of drive 1 • Softkey F6 switches between German and English	

3.8.2 Disabling the on inhibit and enabling the drive

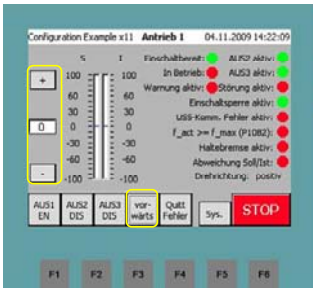
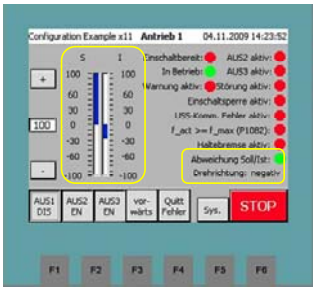
Table 3-11

Step	Action	Comment/picture
1.	When the drive is switched on, properly parameterized and connected, it signals “Drive ready”. No USS communication error has occurred.	
2.	To disable the on inhibit, the two OFF2 and OFF3 inputs on the “USS_DRV” block must be set to TRUE. The OFF1 enable must have been previously set to FALSE. • If OFF1 is still set, use “OFF1 DIS” to disable OFF1. • Use “OFF2 DIS” and “OFF3 DIS” to disable OFF2 and OFF3. → The status message that OFF2 and OFF3 are active disappears, so does the message indicating that the on inhibit is enabled.	

Step	Action	Comment/picture
3.	Only then can the drives be enabled individually. • Select “OFF 1 EN” for the drive you want to enable. → The drive signals “Drive running”.	

3.8.3 Specifying setpoint and direction

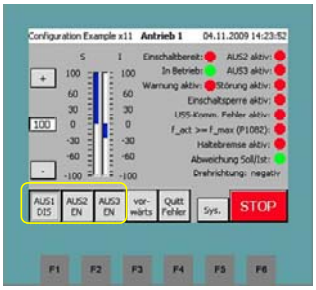
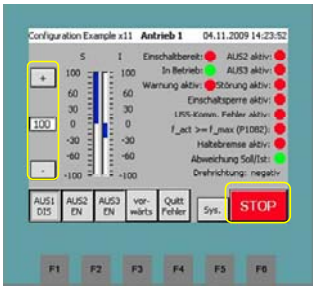
Table 3-12

Step	Action	Comment/picture
1.	• To increase the setpoint by 10 %, use the “+” button. • To decrease the setpoint by 10 %, use the “-” button. • To enter your own setpoint, use the I/O field and enter a setpoint between -100 and 100. • When you want to move forward in the positive direction, use “forward”. • When you want to move backward in the negative direction, use “reverse”.	
2.	• The left blue bar displays the specified setpoint. • The right blue bar displays the current actual value. • The status message indicates the current direction of rotation. • While the actual value has not reached the setpoint, the “Difference S/A” message is displayed.	
3.	When interconnecting direction bit and setpoint, the current direction of rotation is as folllows:	

Setpoint entry	Direction entry	Current direction drive
Value > 0	0 (rev)	Reverse
Value >0	1 (fwd)	Forward
Value < 0	0 (rev)	Forward
Value < 0	1 (fwd)	Reverse

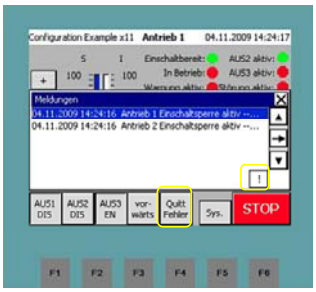
3.8.4 Removing the enable, stopping the motor

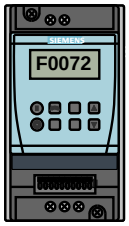
Table 3-13

Step	Action	Comment/picture
1.	There are three ways to remove the enable: • Remove OFF1 → the motor decelerates with the parameterized ramp-down time in the p1121 parameter; subsequently, the drive shuts down. • Enable OFF2 → the drive shuts down immediately and the motor slows down due to its inertia. • Enable OFF3 → the motor decelerates with the parameterized OFF3 ramp-down time in the p1135 parameter; subsequently, the drive shuts down.	
2.	To stop the motor, it is also possible to enter the setpoint “0”; the enable then remains unchanged. By using the STOP button, the setpoint “0” is entered for all drives.	

3.8.5 Displaying error messages, generating errors

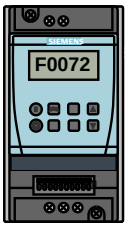
Table 3-14

Step	Action	Comment/picture
1.	If an error message is pending, it is output in a message display and in the status messages. There is a difference between warnings and messages requiring acknowledgement. Warnings are automatically hidden when they are no longer pending. Messages requiring acknowledgement are hidden only after they have been acknowledged. Warnings are: • Inverter overload • Motor overload • Motor current at limit • On inhibit active • Error on the USS_DRV block Messages requiring acknowledgement are: • Fault active	
2.	If the drive signals a fault, it is displayed on the BOP display. Such a fault can be acknowledged using the “ACK fault” button. The message is acknowledged via the “!” character in the message window.	For the meanings of the fault messages on the drive, please refer to the Sinamics G110 Manual.

Step	Action	Comment/picture
3.	To generate a fault, you can, for instance, briefly disconnect the drive from the controller: • Remove the connector from the communication module of the controller. • The drive's communication monitoring responds. • The "F0072" error code appears in the BOP display. • Reconnect the drive to the controller. • The "Fault active" message is displayed. • Acknowledge the message as described above.	
4.	To be able to evaluate pending errors on the USS_PORT, USS_DRV or USS_RMP/WPM blocks more accurately, please use the Watch table in STEP7 Basic.	 List of status values in the S7-1200 System Manual, chapter 6.3.1.

3.8.6 Read/write parameter

Table 3-15

Step	Action	Comment/picture
1.	To show the read/write parameter function, two parameters of drive 1 have been selected as examples. • Use F3 to go to the “Read/write parameter” screen.	
2.	The “Ramp-up time” parameter (p1120) is of the REAL data type. It can be read out using the “Read ramp-up time” button. It is indicated in milliseconds. • To change the parameter, enter a new value between 1.0 and 50.0 in the yellow I/O field. • Then select the “Write ramp-up time” button. To view the parameter change, enter a setpoint and enable the drive. Depending on how you have set the parameter, the drive reaches the setpoint faster or slower.	
3.	The “Active fault” parameter (p947[0]) is of the WORD data type. It can be read out using the “Read active fault” button and cannot be changed. It contains the error code that is currently pending in the drive (e.g., F0072)	

4 Code Elements

4.1 Preliminary remark

We offer you software examples with test code and test parameters as a download. The software examples support you during the first steps and tests with the Configuration Example.

The software examples are always assigned to the components used in the Configuration Example and show their basic interaction. However, they are not real applications in the sense of technological problem solving with definable properties.

4.2 Download

The software examples are available on the HTML page from which you downloaded this document.

Table 4-1

File name	Contents
CE_x11_S7-1200_v1d0.zip	STEP 7 Basic Project for S7-1200 CPU1211C and KTP600.
CE_x11_STARTER_S110_v1d0.zip	STARTER project Example for SINAMICS S110

5 History

Table 5-1

Version	Date	Modification
V1.0	12/04/09	First edition
V1.1	01/19/19	Changes in SINAMICS S110 commisioning