Data Communication of S7-1200 Stations with TeleControl Server Basic V3.1

CP 1242-7 V2 / CP 1243-1 / TCSB V3.1

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1 Task

Introduction

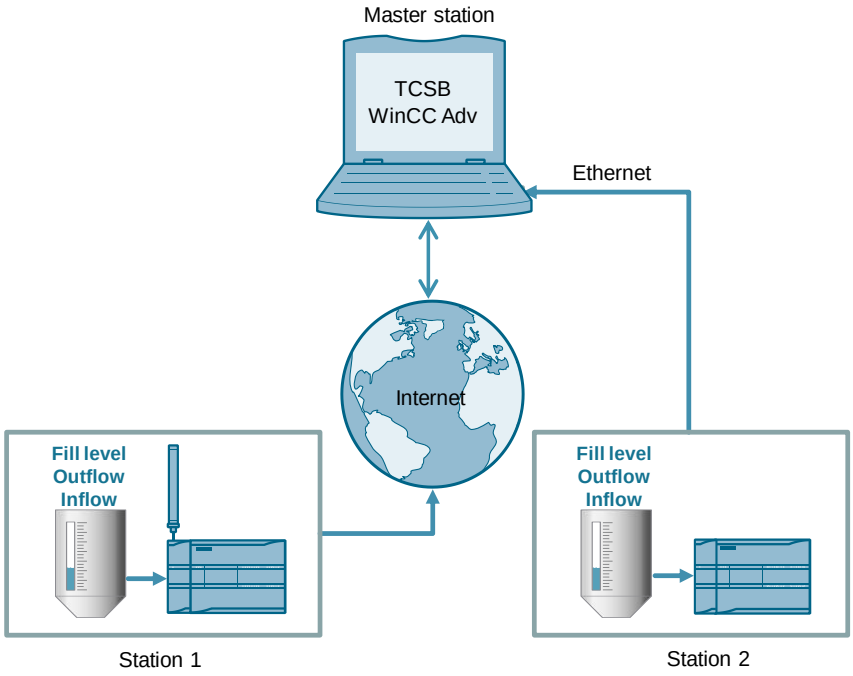
The infrastructure of a sewage treatment plant contains two SIMATIC S7-1200 substations. One station is to communicate with a master station via the cellular network and the other station is to communicate via Ethernet.

The TeleControl Server Basic V3.1 software is installed in the master station. Its OPC interface allows you to connect any OPC client, for example WinCC.

Overview of the automation task

The figure below provides an overview of the automation task.

Figure 1-1



Requirements

This application example is intended to meet the following requirements:

- Both remote stations send some process tags to the master station on a **"threshold-triggered"** basis.
- Both remote stations **cyclically** send important process tags to the master station.
- Both remote stations send some process tags to the master station on an **"event-triggered"** basis.
- The master station monitors the status of the connected remote stations.

The simulated process in the remote stations is to be operated and controlled with the aid of visualization software.

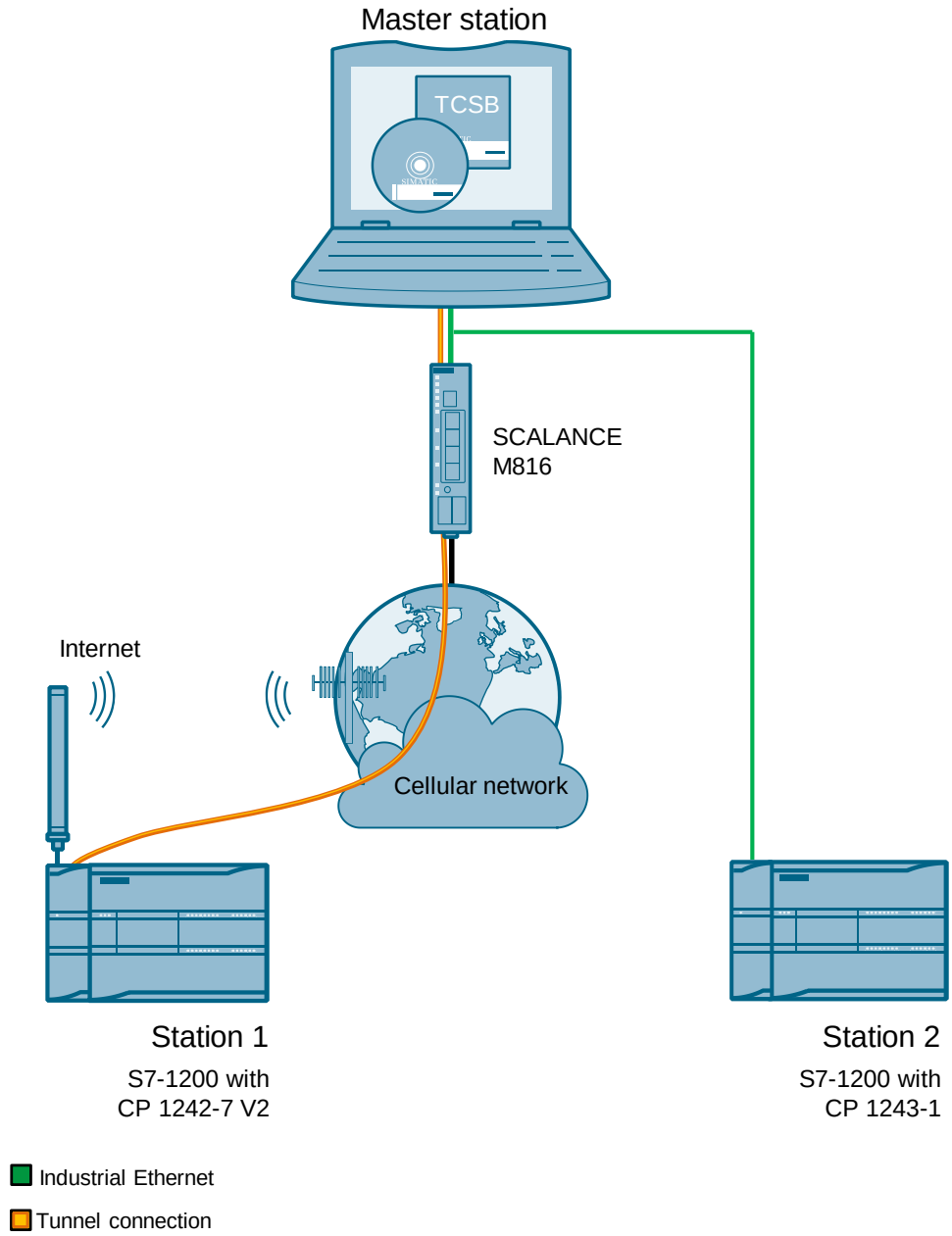
2 Solution

2.1 Overview

Diagrammatic representation

The diagrammatic representation below shows the most important components of the solution:

Figure 2-1



Configuration

TeleControl Server Basic V3.1 (TCSB) in the master station allows a direct connection to the S7-1200 stations.

Communication takes place via the following paths and communication modules:

- S7-1200 with CP 1242-7 V2: communication via the cellular network and the Internet.
- S7-1200 with CP 1243-1: communication via Ethernet. By using single-mode optical fiber technology, here, too, systems can span several kilometers.

Any OPC client visualizes the data via the integrated OPC UA server of TCSB V3.1. In this example, we demonstrate the functions using UaExpert and the WinCC Advanced SCADA system.

Advantages

The solution presented here offers the following advantages:

- TeleControl Server Basic V3.1 enables economic data communication between remote stations and a master station.
- The core application areas are industrial applications where the objective is to transmit data in a cost-effective way on a wireless basis, for example in water treatment plants, for water purification or in pumping stations.
- TCSB's OPC UA interfaces provide the data of the connected stations to one or more connected OPC UA clients.
- GPRS and Internet: Always-on functionality.
- To increase reliability, the CPs can, in the event of a connection failure, buffer the data of events of different classes and transfer the aggregated data to the TeleControl server.
- If there is a brief interruption on the connection between the OPC UA client and the TCSB OPC UA server, the data remains available in the data buffer. Once the connection has been re-established, all values that have not been transferred will be sent to the OPC UA client.

Scope

This application does not include a description of

- SIMATIC NET TeleControl Server Basic. See document \4\.
- SIMATIC HMI configuration
- the LAD/FBD/STL/SCL programming languages.

Basic knowledge of these topics is required.

2.2 Description of the core functionality

Functions implemented

The following core functions are implemented in the application example:

Threshold-triggered

Data is not transmitted until the current data has changed by a threshold compared to the last sent data.

Time-triggered

The data is transmitted from the CP to TCSB in a specified time frame.

Event-triggered

The data is transmitted when a configured trigger signal is triggered. The edge change (0 → 1) of a trigger tag set by the user program is evaluated as a signal. Once the data has been successfully transferred, the trigger tag will be reset.

Transfer after call by master station

The data is transmitted at the initiative of the master station.

Status monitoring

The master station monitors the status of the connected remote stations.

Note For a more detailed description of these functions, please refer to Chapter 3 and the following chapters.

2.3 Overview and description of the user interface

The application example is visualized with WinCC Advanced using two configured screens: "TCSB Communication" and "S7-1200 Application".

"TCSB Communication"

The "TCSB Communication" screen shows the status of the connection to the two substations. It additionally shows the process data sent from the stations.

Figure 2-2

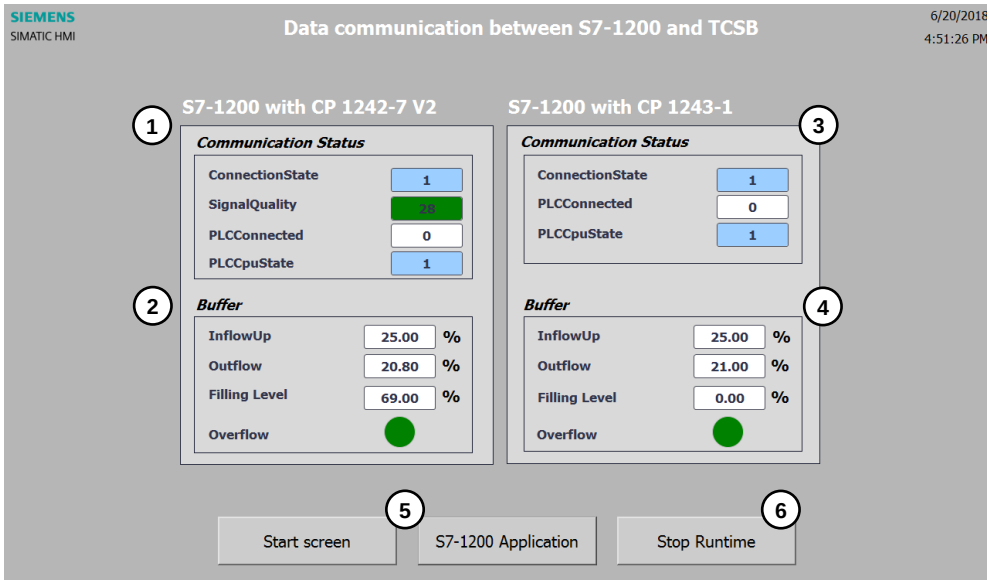


Table 2-1

No.	Item	Description
1.	Communication Status: • Connectionstate • SignalQuality • PLCConnected • PLCCpuState	Information about the communication status of Station 1 TCSB itself determines the values.
2.	Buffer	Maximum inflow, outflow and fill level of Station 1 that are saved in the master station. Overflow alarm: - green: no overflow - red: overflow
3.	Communication Status: • Connectionstate • PLCConnected • PLCCpuState	Information about the communication status of Station 2 TCSB itself determines the values.
4.	Buffer	Maximum inflow, outflow and fill level of Station 2 that are saved in the master station.
5.	Change screen	Click the buttons to display the appropriate screens.
6.	Stop Runtime	Clicking this button stops Runtime.

"S7-1200 Application"

The "S7-1200 Application" screen visualizes the processes of stations 1 and 2.

Figure 2-3

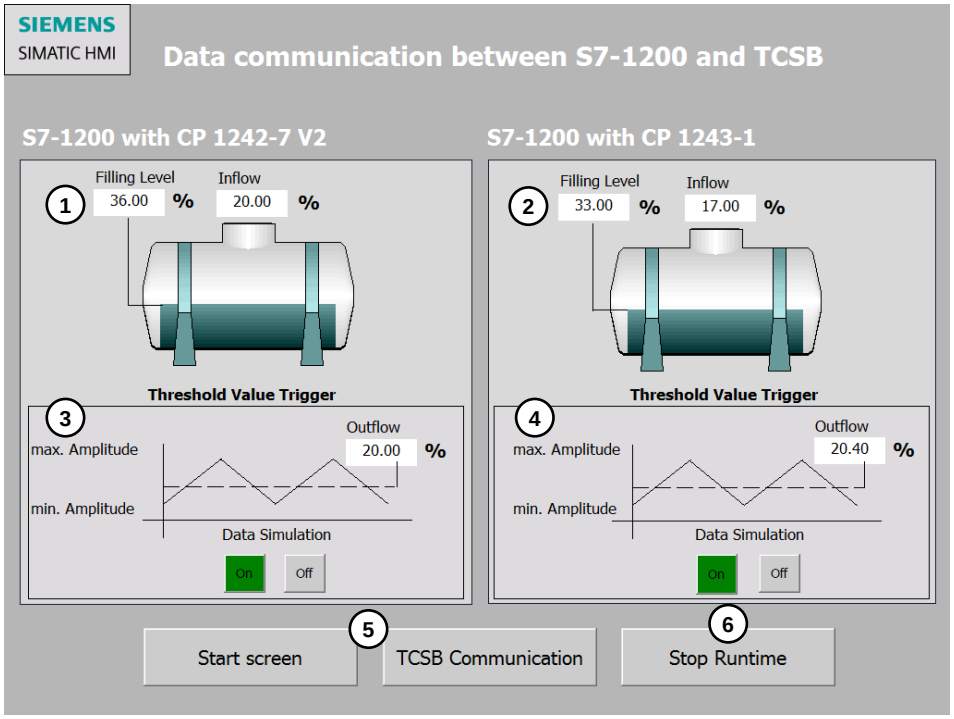


Table 2-2

No.	Item	Description
1.	Filling level and Inflow	Current fill level and inflow of Station 1.
2.	Filling level and Inflow	Current fill level and inflow of Station 2.
3.	Parameters for the threshold trigger process of Station 1.	• Outflow: current outflow • On: starts the data simulation • Off: stops the data simulation
4.	Parameters for the threshold trigger process of Station 2.	• Outflow: current outflow • On: starts the data simulation • Off: stops the data simulation
5.	Change screen	Click the buttons to display the appropriate screens.
6.	Stop Runtime	Clicking this button stops WinCC Runtime.

2.4 Hardware and software components

2.4.1 Validity

This application is valid for

- CP 1242-7 V2 (FW V3.1)
- CP 1243-1 (FW V3.1)
- STEP 7 V15.1
- S7-1200 CPU V4.1 or higher
- TCSB V3.1.0.1

Note For the STEP 7 V13 SP1 project, refer to the archive on the download page of the entry (see \2\).

To configure the SIMATIC CP 1243-1 module with STEP 7 V13 SP1, you need HSP 0170. (See \3\)

2.4.2 Components used

The application was created with the following components:

Station 1 hardware components

Table 2-3

Component	No.	Article number	Note
S7-1200 PM1207	1	6EP1332-1SH71	Power supply
SIMATIC S7-1200 CPU 1217C DC/DC/DC	1	6ES7217-1AG40-0XB0	Any S7-1200 CPU V4.1 or higher can be used.
CP 1242-7 V2 COMMUNICATIONS PROCESSOR	1	6GK7242-7KX31-0XE0	Firmware V3.1
ANT794-4MR ANTENNA	1	6NH9860-1AA00	GSM quad-band and UMTS and LTE (Europe)
SIMATIC Memory Card	1	6ES7954-8LF01-0AA0	Memory card for the S7-1200 CPU

Station 2 hardware components

Table 2-4

Component	No.	Article number	Note
S7-1200 PM1207	1	6EP1332-1SH71	Power supply
SIMATIC S7-1200 CPU 1217C DC/DC/DC	1	6ES7217-1AG40-0XB0	Any S7-1200 CPU V4.1 or higher can be used.
CP 1243-1 COMMUNICATIONS PROCESSOR	1	6GK7243-1BX30-0XE0	
SIMATIC Memory Card	1	6ES7954-8LF01-0AA0	Memory card for the S7-1200 CPU

Accessories

Table 2-5

Component	No.	Article number	Note
SIM card	1	Available from your mobile service provider	Enabled for data communication
DSL router & modem	1	Specialist retailers	SCALANCE M816
Static IP address for DSL or DynDNS	1	Can be requested from your Internet service provider	

Software components

Table 2-6

Component	No.	Article number	Note
SIMATIC STEP 7 V15.1	1	6ES7822-1AA05-0YA5	Trial download: The software is subject to export restrictions. The download is only available for registered users. (See \5\)
TCSB 8 V3.1.0.1 software (see \9\)	1	6NH9910-0AA31-0AA0	Number of connectable stations: 8. The product is available in other configurations and license options, see document \5\.
SIMATIC WinCC Advanced V15.1	1	6AV2102-0AA05-0AA7	Trial download: The software is subject to export restrictions. The download is only available for registered users. (See \5\)
UaExpert v1.4.4	1	Free download from Unified Automation	Requires registration with the vendor (see \8\)

Sample files and projects

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

Table 2-7

Component	Note
39863979_S7_1200_WinCC_Adv_PROJ_V20.zip	This zip file contains: • the STEP 7 / WinCC Advanced V15.1 project • TCSB project • UaExpert project
39863979_S7_1200_WinCC_Adv_DOC_V20_en.pdf	This document.

3 Mode of Operation

Key points of this application example:

- Configuration of an S7-1200 station with the CP 1242-7 V2 for data communication with the master station via the cellular network and the Internet.
- Configuration of an S7-1200 station with the CP 1243-1 for data communication with the master station via Ethernet.
- Configuration of TeleControl Server Basic in the master station.
- Data exchange between the stations and the master station.

3.1 Complete overview of the configuration

With the CP, it is not necessary to program program blocks in order to transfer data to the master station. The data areas in the memory of the S7-1200 CPU intended for communication with the master station are configured in the CP on a data point-related basis. In this configuration, each data point is linked to a PLC tag in the CPU.

In this example, the current fill level, outflow value and inflow of the station are read and transferred to the master station via the CP. The following transfer methods are set in the data configuration in STEP 7:

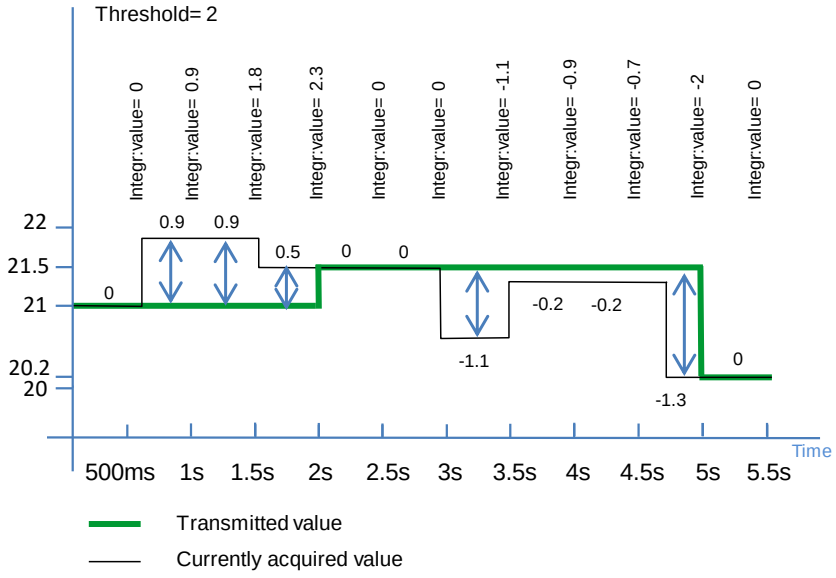
Threshold-triggered

The current outflow is transmitted to the master station if it has changed by a threshold compared to the last sent outflow.

The threshold calculation does not evaluate the absolute value of the current outflow value's deviation from the last saved outflow value, but the value of the integrated deviation.

Deviations of the current outflow value are totalized in each calculation cycle (500 ms). The trigger is not set and the current outflow is not transmitted until the totalized value reaches the configured threshold trigger value (here: 2).

Figure 3-1



Time-triggered

The current fill level is cyclically (here: 30s) transmitted to the master station.

Event-triggered

The inflow alarm bit (overflow) is transmitted to the master station if the trigger signal is triggered. The trigger signal is set by the user program if the current inflow is greater than the limit value. This transfer of the alarm bit resets the trigger signal.

The following figure shows the configuration of the S7-1200 stations for data communication with the master station.

Figure 3-2

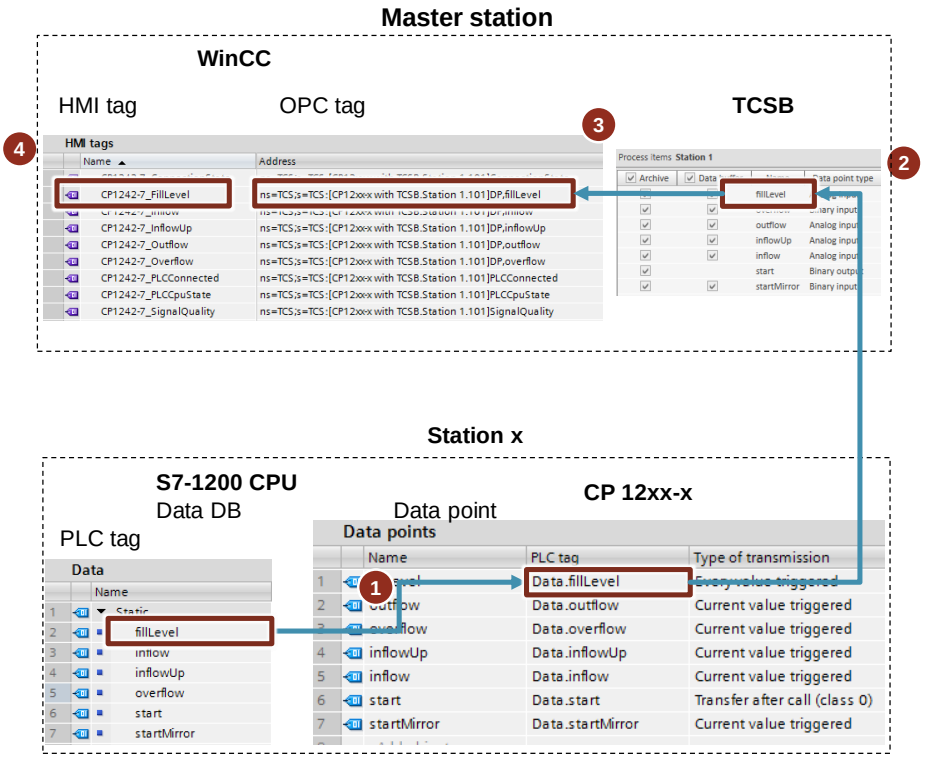


Table 3-1

No.	Station 1	Station 2
1.	In the CP, the "Data.fillLevel" PLC tag is used to configure the "FillLevel" data point.	
2.	The data point is sent to the master station when the transmission criteria are met.	
3.	It is then passed on to the WinCC OPC client as an OPC tag.	
4.	The OPC tag is used to configure the HMI tag.	

Station 1 / Station 2 program overview

The structure for the simulation program is identical for both stations. The figure below shows the most important elements.

Figure 3-3

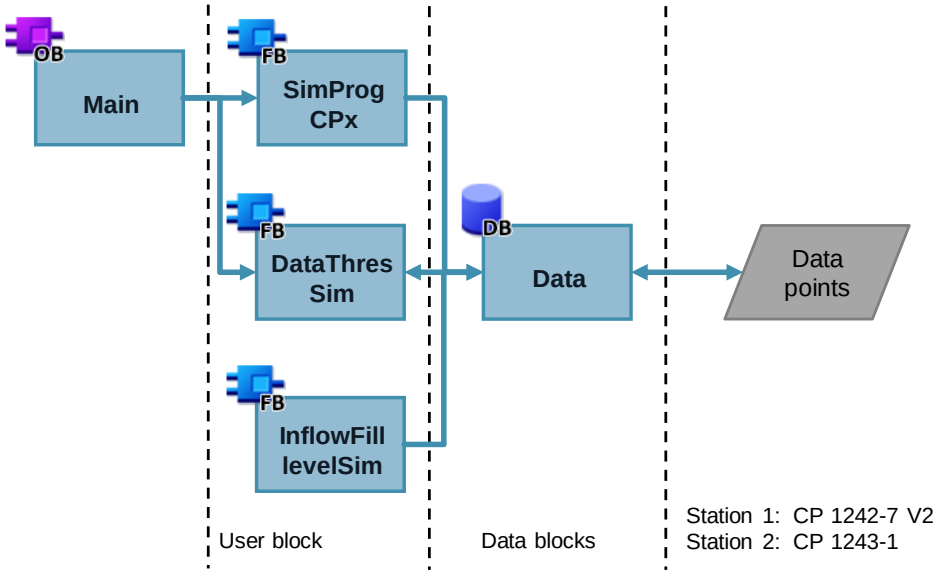


Table 3-2

Element	Symbolic name	Description
OB1	Main	Cyclic OB: call of the user program
FB1	SimProgCPx	The "SimProgCPx" FB contains the simulation for the event-triggered process (Table 3-1, step 4).
FB2	DataThresSim	The "DataThresSim" FB simulates the "outflow" for the threshold-triggered process.
FB3	InflowFilllevelSim	The "InflowFilllevelSim" FB simulates the "inflow" and "filllevel" parameters.
DB1	Data	Global data block for saving the data: • Send data • Status tags • Tags for the data simulation
Data points	Configured data points for data exchange between a station and the master station.	

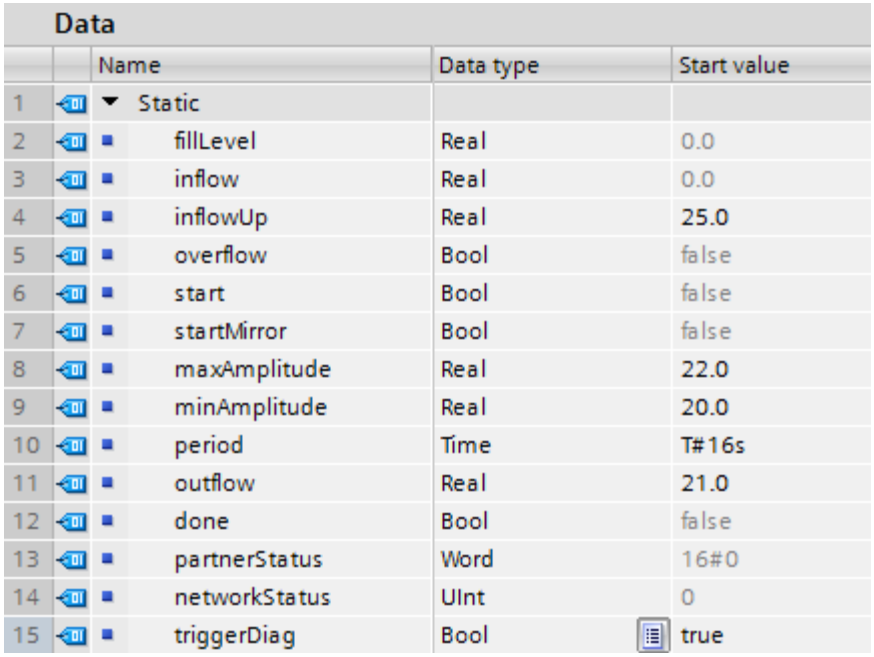
Global data block: "Data" (DB1)

The "Data" DB contains:

- The PLC tags required for the data configuration of the CP12xx-x,
- the PCL tags used for the data simulation for the threshold-triggered process,
- the status tags.

The structure of the global data block is identical for both stations.

Figure 3-4



Data

	Name	Data type	Start value
1	Static		
2	fillLevel	Real	0.0
3	inflow	Real	0.0
4	inflowUp	Real	25.0
5	overflow	Bool	false
6	start	Bool	false
7	startMirror	Bool	false
8	maxAmplitude	Real	22.0
9	minAmplitude	Real	20.0
10	period	Time	T#16s
11	outflow	Real	21.0
12	done	Bool	false
13	partnerStatus	Word	16#0
14	networkStatus	UInt	0
15	triggerDiag	Bool	true

Table 3-3

Name	Data type	Description
fillLevel	Real	Current fill level of Station 1 or Station 2.
inflow	Real	Current inflow of Station 1 / Station 2.
inflowUp	Real	Limit value of the inflow of Station 1 / Station 2. Start value: 25.0
overflow	Bool	Indicates the status of the current inflow. True: current inflow has exceeded limit value. False: current inflow less than limit value.

Name	Data type	Description
start	Bool	True: data simulation active. False: data simulation stopped.
startMirror	Bool	Mirrors the "start" tag.
maxAmplitude	Real	Maximum value for the implemented function in the simulation program, "DataThresSim" (triangle function) Start value: 22.0
minAmplitude	Real	Minimum value for the implemented function in the simulation program, "DataThresSim" (triangle function) Start value: 20.0
period	Time	Duration of the implemented function (start value: 16 s)
outflow	Real	Current value of the outflow of Station 1 / Station 2. Start value: 21.0
done	Bool	The data was successfully transferred to the CP.
partnerStatus	Word	Status of connection to TCSB (see Chapter 3-3).
networkStatus	UInt	Status of connection to data service in cellular network (see Chapter 3-4). Only relevant for CP1242-7 V2
triggerDiag	Bool	Diagnostics trigger tag. Set when the sample plant is started for the first time to enable the CP 1242-7 V2's advanced diagnostics (networkStatus). Only relevant for CP1242-7 V2.

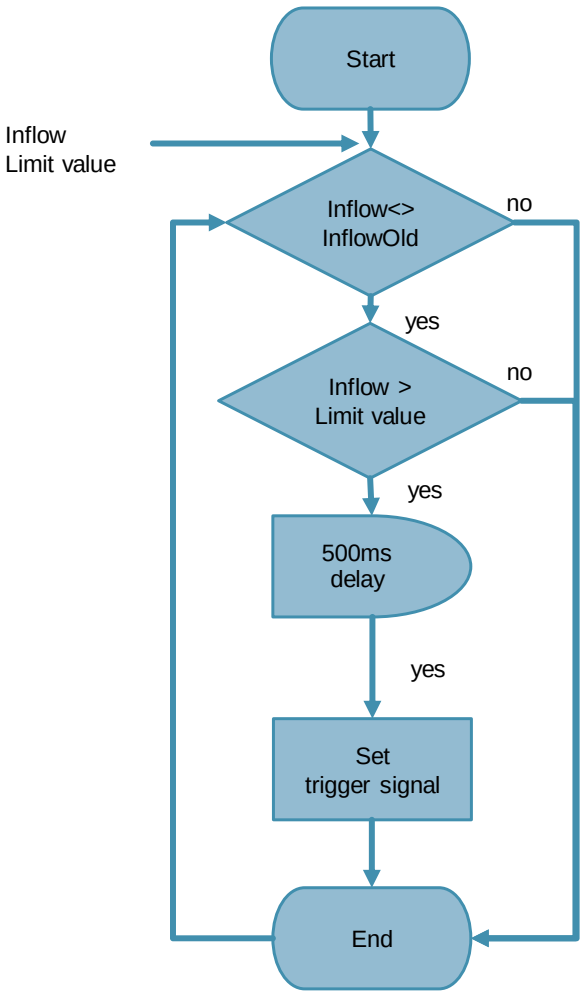
3.2 Functionality of Station 1 / Station 2

3.2.1 Program details about the "SimProgCP12xx" FB

The "SimProgCPxx" function block sets the trigger signal for sending an alarm bit ("overflow") to the master station if the current inflow of Station 1 or Station 2 is greater than the limit value (inflowUp).

The trigger signal is automatically reset when the data is transmitted to the CP.

Figure 3-5



If the inflow of Station 1 or Station 2 is greater than the limit value (inflow > inflowUp), a timer is started in the user program. When the time (500ms) has elapsed, the "statTriggerOverflow" trigger signal is set in the user program and the inflow status (Overflow) is sent to the master station.

Note It is recommended to set the trigger signal for the event-triggered process with a delay of approx. 500ms to ensure that the value change of the PLC tag is reliably applied to the appropriate data point.

Note

Each trigger signal should be linked to a **static** tag in the instance data block in the CPU.

If the trigger signal is interconnected with a global tag, it is possible that the trigger signal may not be automatically reset. This is due to runtime differences between the CPU cycle and the CP cycle.

The following figure and table show the call interface of the user block, FB "SimProgCP12xx" (FB1). It is identical for both stations.

Figure 3-6

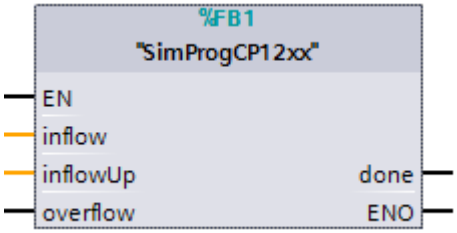


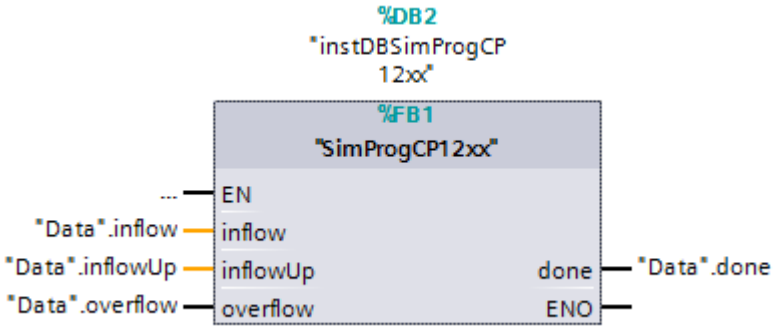
Table 3-4

	Name	Data type	Description
Input	inflow	Real	Current inflow of Station 1 or Station 2.
Input	inflowUp	Real	Limit value of the inflow of Station 1 / Station 2. Entered manually by the user. Start value: 25 %.
InOut	overflow	Bool	Indicates the status of the current inflow. True: current inflow has exceeded limit value. False: current inflow less than limit value.
Out	done	Bool	True: the data was successfully transferred to the CP. (only for one cycle)

3.2.2 Call of the "SimProgCP12xx" FB in OB1

The "SimProgCP12xx" FB (FB1) is called cyclically in OB1. The input and output parameters are stored in the global data block, "Data".

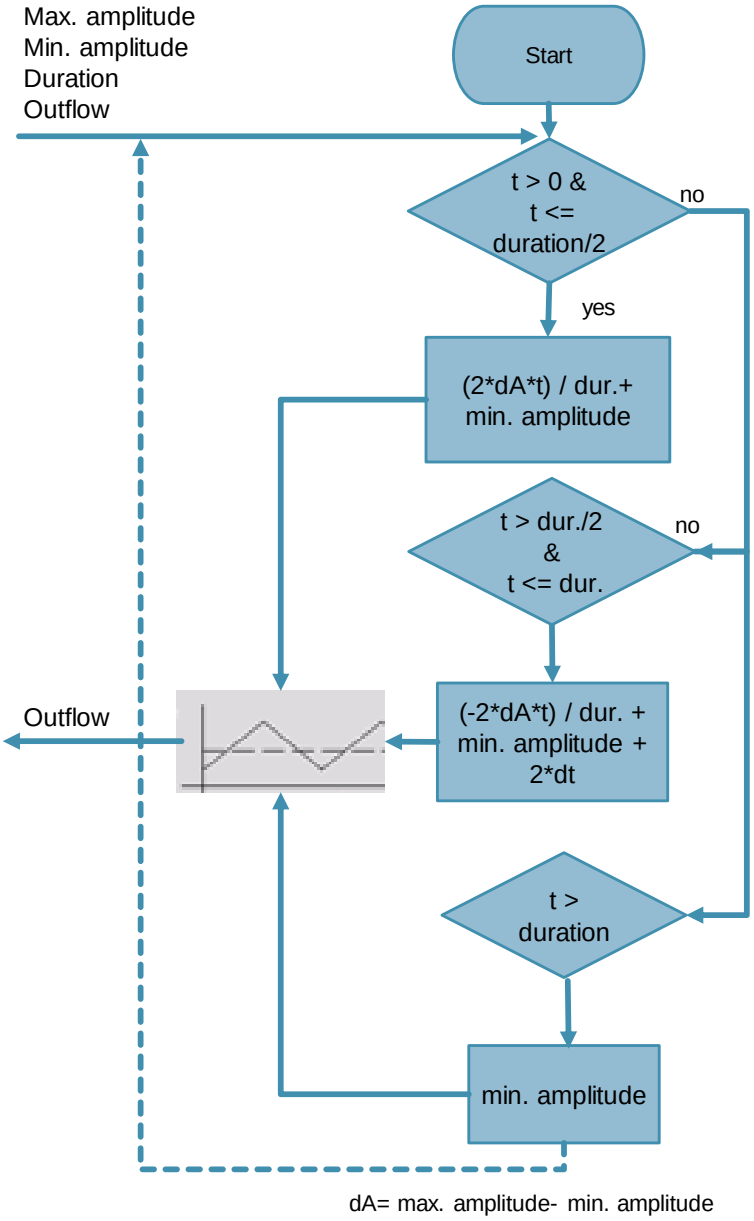
Figure 3-7



3.2.3 Program details about the "DataThresSim" FB

Using a cyclic triangle function, the "DataThresSim" function block simulates the "outflow" of the process.

Figure 3-8



The following figure and table show the call interface of the user block, FB "DataThresSim" (FB2). It is identical for both stations.

Figure 3-9

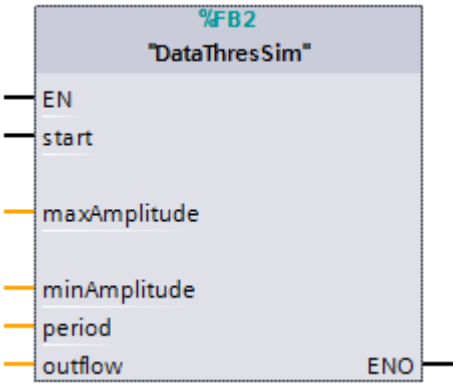


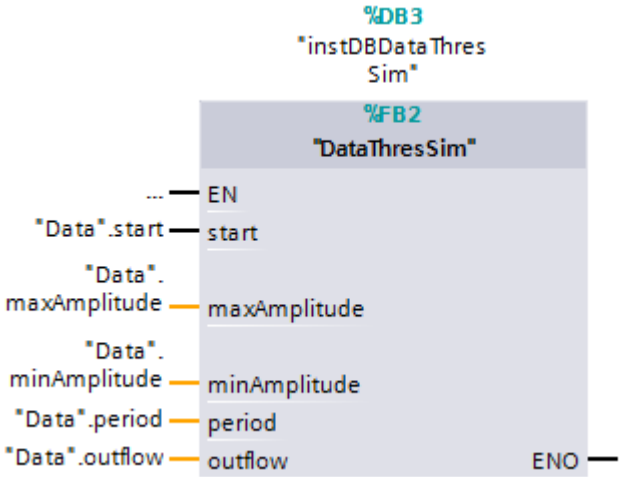
Table 3-5

	Name	Data type	Description
Input	start	Bool	True: The data simulation for the threshold-triggered process is active. False: The data simulation for the threshold-triggered process was stopped.
	maxAmplitude	Real	Maximum value for the implemented function in the simulation program, "DataThresSim" (triangle function) Start value: 22.0
	minAmplitude	Real	Minimum value for the implemented function in the simulation program, "DataThresSim" (triangle function) Start value: 20.0
	period	Time	Duration of the implemented function (start value: 16 s)
InOut	outflow	Real	Current value of the outflow of Station 1 / Station 2. Start value: 21.0

3.2.4 Call of the "DataThresSim" FB in OB1

The "DataThresSim" FB (FB2) is called cyclically in OB1. The input and output parameters are stored in the global data block, "Data".

Figure 3-10

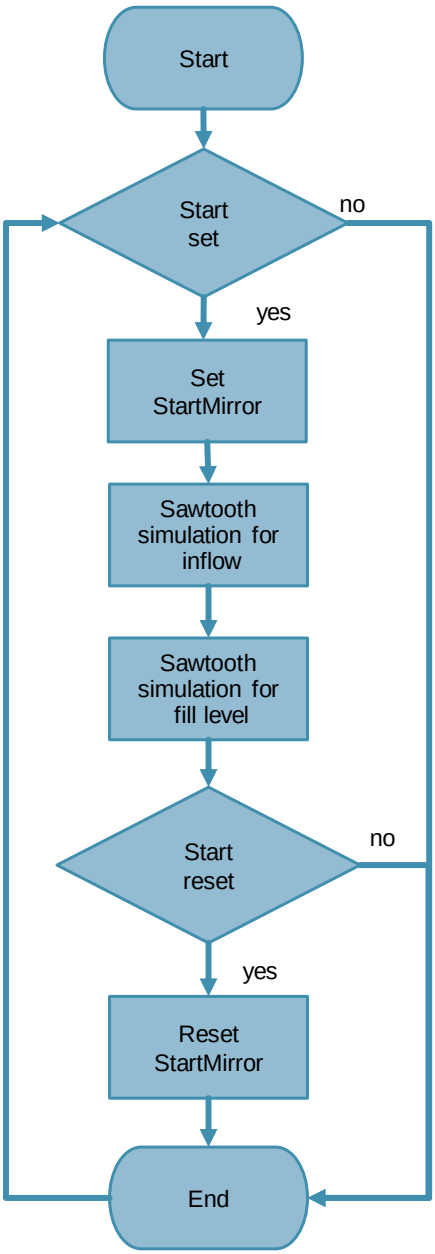


3.2.5 Program details about the "InflowFilllevelSim" FB

The "InflowFilllevelSim" function block simulates the values for the "Inflow" and "Filllevel" tags. The "LGF_Sawtooth" function block from the "LGF_Library" was used to generate a sawtooth signal.

In addition to this, the "Start" tag sent from the master station is relocated to the "StartMirror" tag and then sent back to the master station. As an acknowledgment mechanism, this procedure ensures that the values sent from the master station have been written in the CPU.

Figure 3-11



The following figure and table show the call interface of the user block, FB "DataThresSim" (FB2). It is identical for both stations.

Figure 3-12

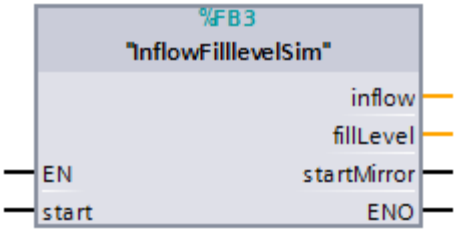


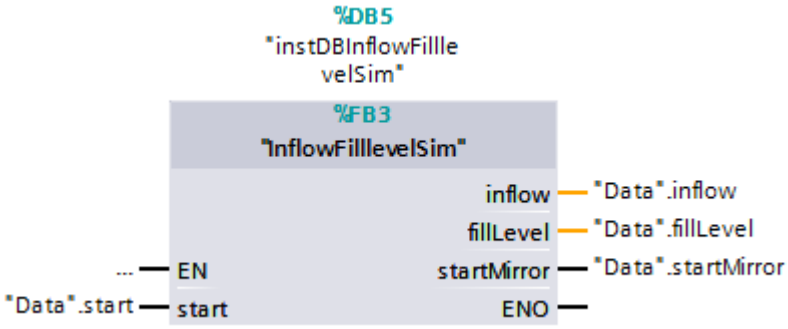
Table 3-6

	Name	Data type	Description
Input	start	Bool	True: The data simulation for the inflow and fill level is active. False: The data simulation for the inflow and fill level was stopped.
Output	inflow	Real	Current value of the inflow of Station 1 / Station 2.
	filllevel	Real	Current value of the fill level of Station 1 / Station 2.
	startMirror	Bit	Mirrors the "start" tag.

3.2.6 Call of the "InflowFilllevelSim" FB in OB1

The "InflowFilllevelSim" FB (FB3) is called cyclically in OB1. The input and output parameters are stored in the global data block, "Data".

Figure 3-13

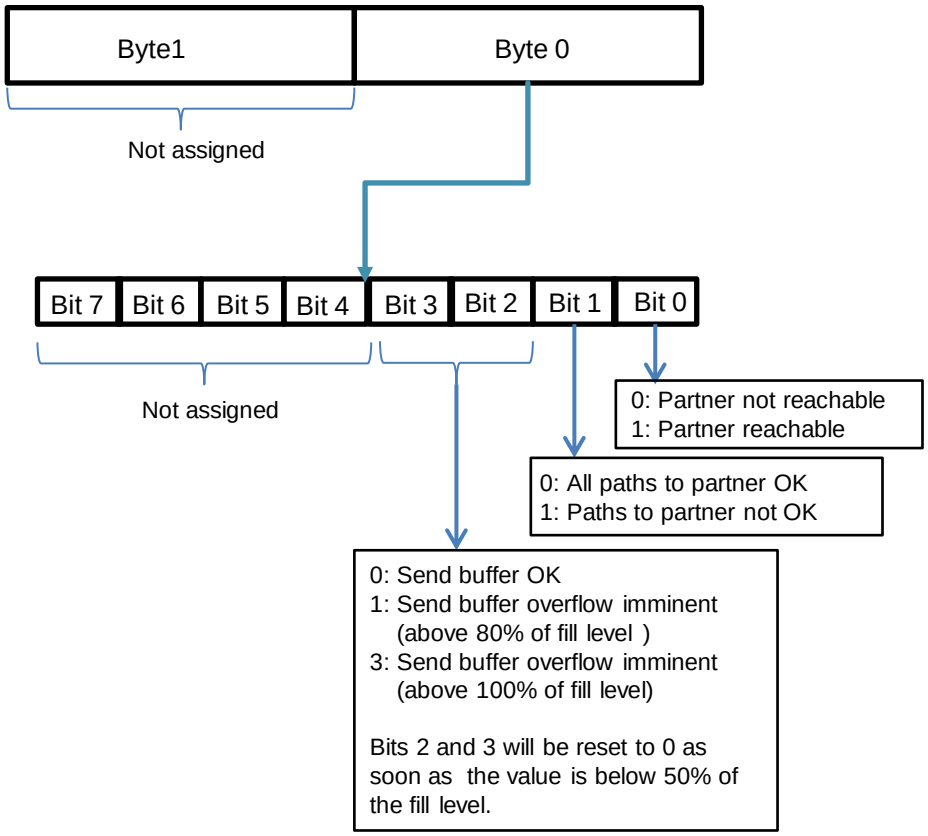


3.3 Partner status

Using the "Report partner status" function in the CP configuration, the CP signals the status of the connection to TCSB to the CPU. This information is written to the "partnerStatus" PLC tag in the "Data" DB.

The following figure shows the bit assignment of the "partnerStatus" tag (Word).

Figure 3-14



3.4 CP diagnostics

Advanced "CP diagnostics" in the CP 1242-7 configuration (see \5\) allow you to read the status of the connection to the data service in the cellular network from the CP.

This information is written to the "networkStatus" PLC tag (UInt) in the "Data" DB.

Table 3-7

networkStatus	Meaning
0	Cellular network status: not connected
1	Wrong PIN number
2	SIM card missing or defective
3	Waiting for PIN to be entered
4	Cellular network status: connected

4 Configuration and Project Engineering

Note In the project, the configuration and project engineering have already been fully implemented. This chapter is for information only.

The configuration is performed in the following configuration tools (first STEP 7, then TeleControl Server Basic):

- STEP 7 V15.1:
  - Configuring Station 1 (S7-1200 CPU with CP 1242-7 GPRS V2)
  - Configuring Station 2 (S7-1200 CPU with CP 1243-1)
  - Configuring the data points for both stations
- TeleControl Server Basic V3.1:
  - Creating and configuring the project
  - Creating and configuring connections
  - Configuring general parameters
- UaExpert
  - Establishing the connection to the server
  - Configuring OPC items
  - Creating the History Trend View

4.1 IP addresses in the application example

This application example uses the IP addresses shown in the following table.

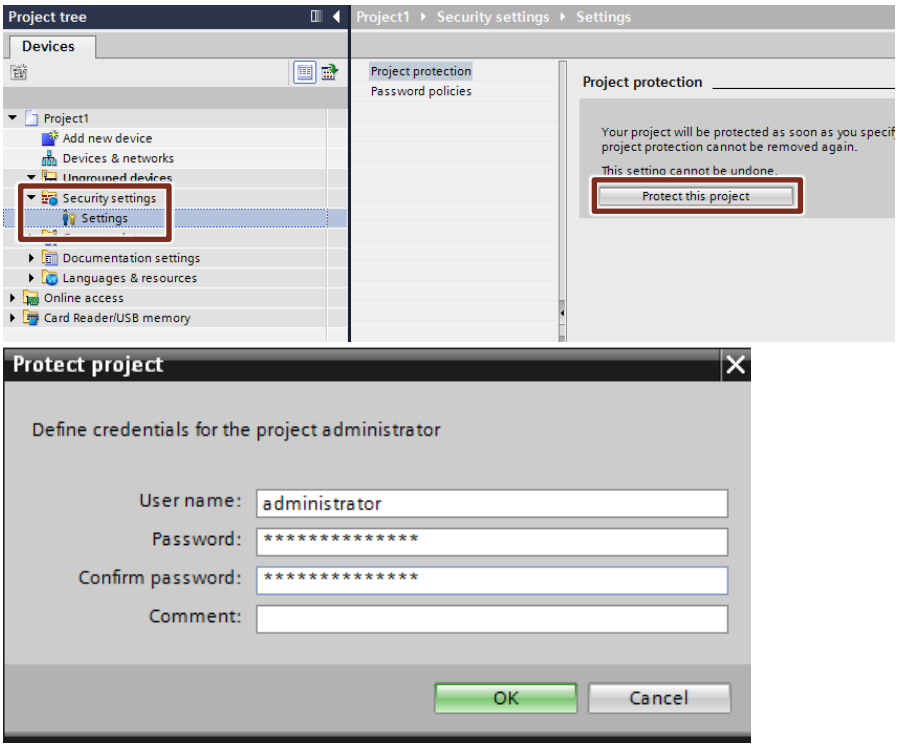
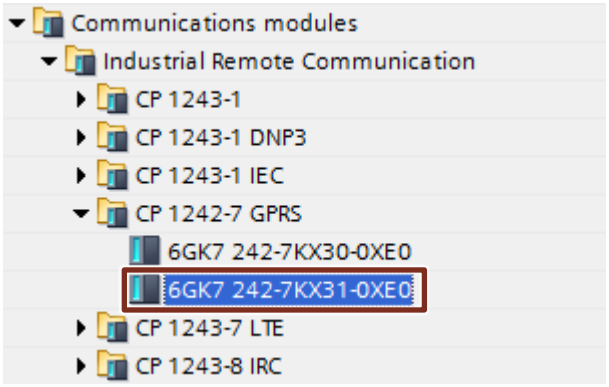
Table 4-1

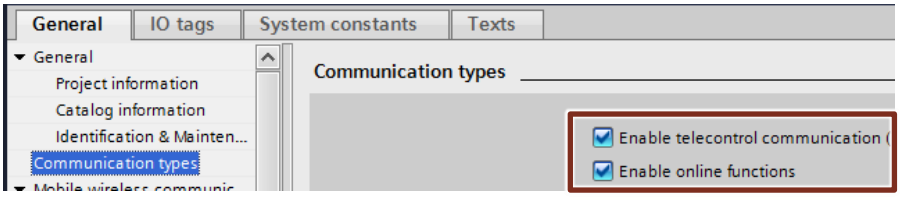
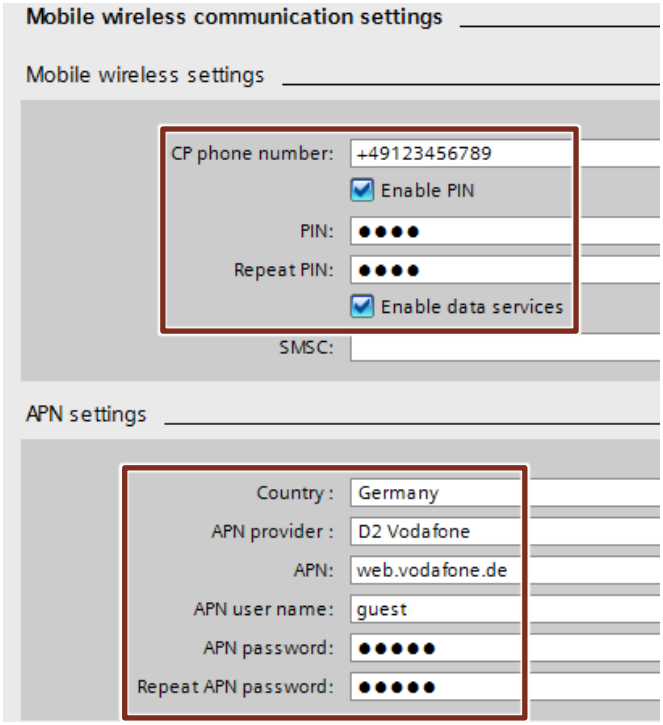
Station	Module	IP address	
		Internal	External
Master station	PG/PC	172.16.62.100/16	
Engineering station	PG/PC	192.168.0.100/24 (for loading the stations)	
DSL router	SCALANCE M816	172.16.0.1/16	Static IP address from provider or DynDNS
Station 1	CP 1242-7 V2	Dynamic IP address	
	CPU	192.168.0.1/24	
Station 2	CP 1243-1	172.16.62.1/16	
	CPU	192.168.0.2/24	

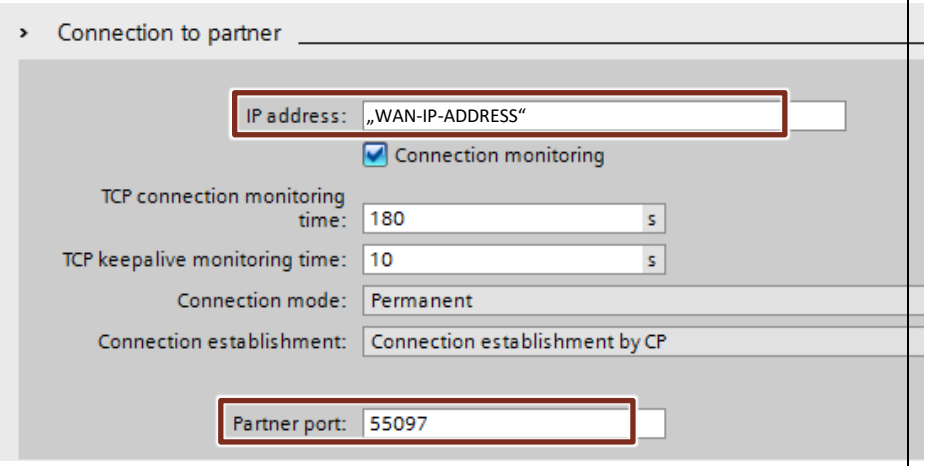
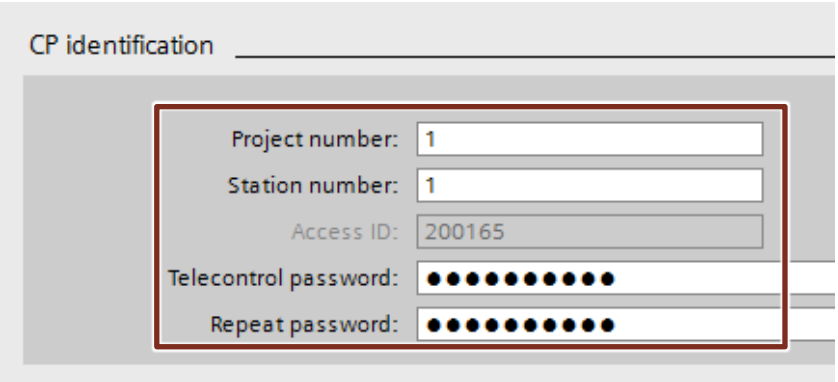
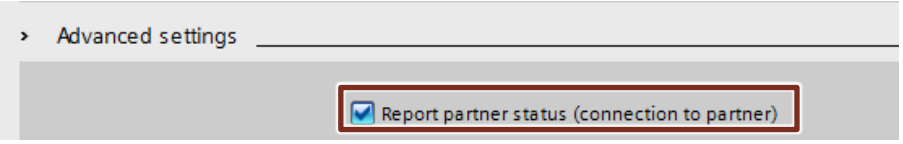
4.2 Configuring Station 1

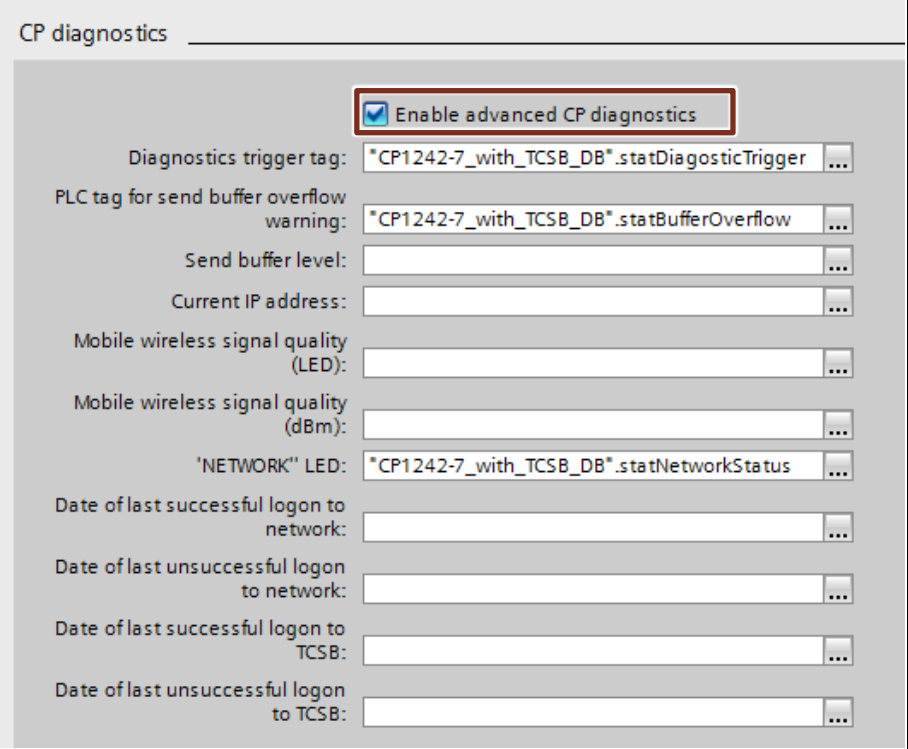
The following table shows you how to configure an S7-1200 station with the CP 1242-7 GPRS V2 for data communication with the master station via the cellular network and the Internet.

Table 4-2

No.	Action
1.	Create a STEP 7 V15.1 project.
2.	In the security settings, create a user with "administrator rights". 
3.	Add the S7-1200 CPU (V4.1 or higher) for SIMATIC Station 1.
4.	Insert the CP 1242-7 GPRS V2 into the station. 

No.	Action
5.	Enable telecontrol communication and S7 communication: "Properties > General > Communication types". 
6.	Make the required mobile wireless communications settings: "Properties > Mobile wireless communications settings": • Enable PIN • Enable data services • Make the APN settings / depend on the provider. 
7.	Enable the security functions. "Properties > Security > Security properties".

No.	Action
8.	Configure the CP parameters required to configure the TeleControl server: "Properties > Partner stations > Connection to partner" • Partner IP address (static IP address / depends on the provider) • Partner port  "Properties > Security > CP identification" • "Project number" • "Station number" • "Telecontrol password" (here: "CP1242-7")  The parameters assigned here must be identical to the parameters in TCSB.
9.	Check "Report partner status": "Properties > Partner stations > Advanced settings"  Link a PLC tag you have created in the user program.

No.	Action
10.	Check "Enable advanced CP diagnostics": "Properties > Communication with the CPU > CP diagnostics".  Link the "diagnostics trigger tag" and the PLC tags you want to read from the CP 1242-7 GPRS V2.
11.	Configure the desired data points (see Chapter 4.2).

4.3 Configuring the data points for Station 1 / Station 2

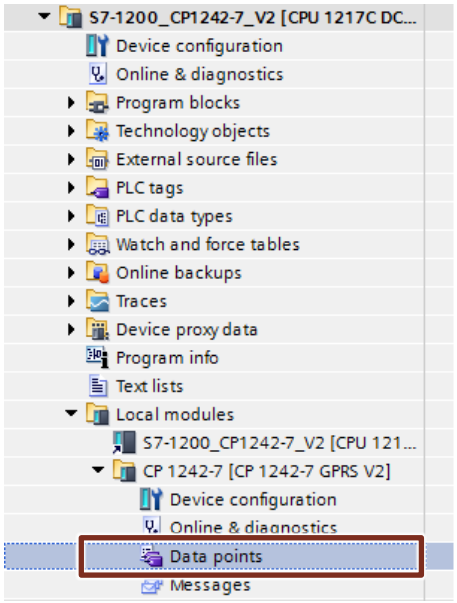
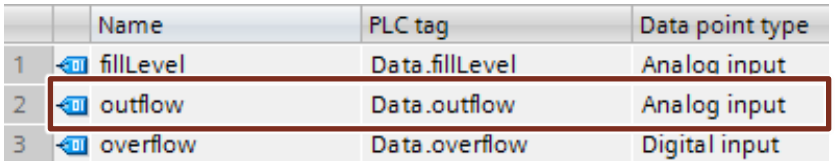
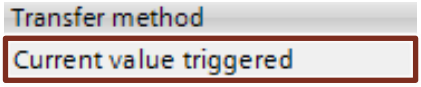
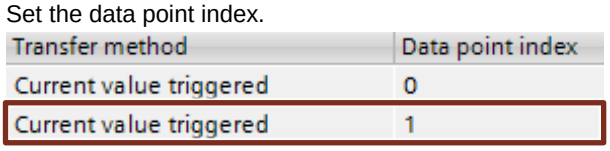
With the CP 1242-7 GPRS V2 or CP 1243-1, it is not necessary to program program blocks in order to transfer user data between station and master station. The data areas in the memory of the CPU intended for communication with the master station are configured in the CP 1242-7 GPRS V2 or CP 1243-1 on a data point-related basis. In this configuration, each data point is linked to a PLC tag in the CPU (see Figure 3-2).

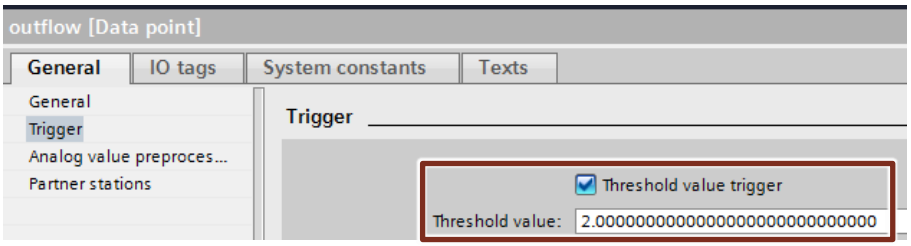
Threshold trigger

The value of the data point is transmitted when it reaches a certain threshold.

The threshold calculation does not evaluate the absolute value of the process value's deviation from the last saved value, but the value of the integrated deviation (see Figure 3-1).

Table 4-3

No.	Action
1.	Open the data point configuration editor. 
2.	Insert the "outflow" data point as an analog input and link it to the "Data.outflow" PLC tag. 
3.	Set the transfer method for this data point (here: Current value triggered). 
4.	Set the data point index.  **Note:** The index of a data point of the Input type must be unique across all data point types (digital inputs, analog inputs, etc.).

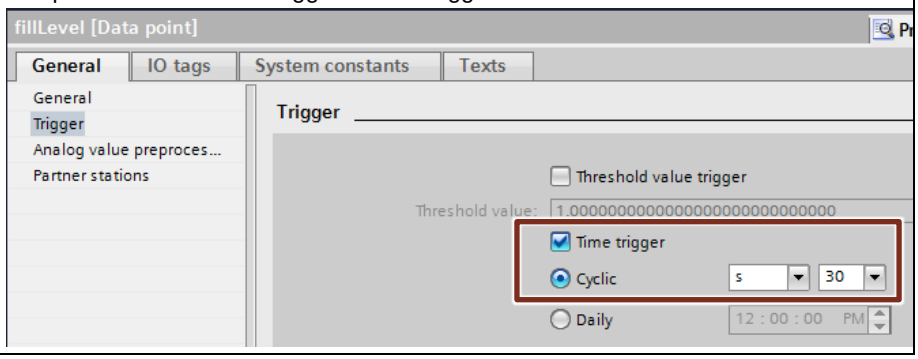
No.	Action
5.	As the communication partner, select "Telecontrol server". Data point index: 0 — Partner of data point: Telecontrol server 1 — Telecontrol server
6.	Configure the "threshold trigger": "Properties > General > Trigger > Threshold value trigger" 

Time trigger

The data point value is transmitted cyclically (30 s).

Table 4-4

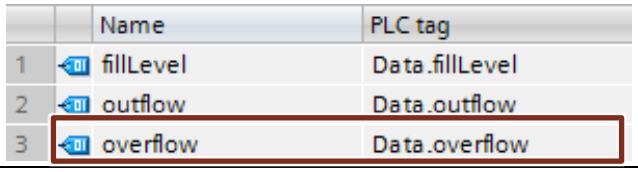
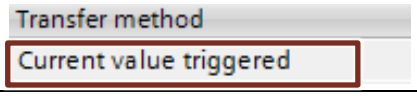
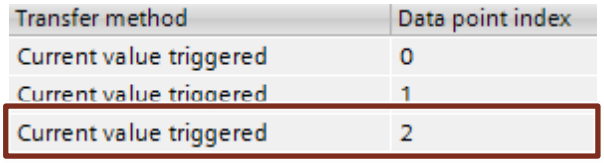
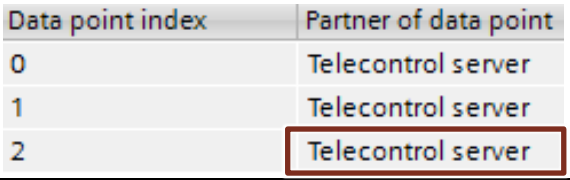
No.	Action
1.	In the data point configuration editor, insert the "fillLevel" data point as an analog input and link it to the "Data.fillLevel" PLC tag. 1 fillLevel — Data.fillLevel — Analog input 2 outflow — Data.outflow — Analog input 3 overflow — Data.overflow — Digital input
2.	Set the transfer method for this data point (here: Current value triggered). Transfer method: Current value triggered
3.	Set the data point index. Transfer method: Current value triggered — Data point index: 0 **Note:** The index of a data point of the Input type must be unique across all data point types (digital inputs, analog inputs, etc.).
4.	As the communication partner, select "Telecontrol server". Data point index: 0 — Partner of data point: Telecontrol server 1 — Telecontrol server

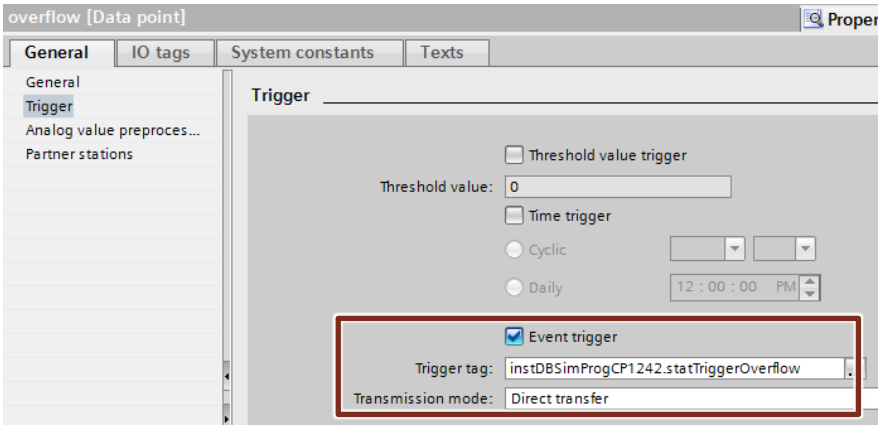
No.	Action
5.	Configure the "time trigger": "Properties > General > Trigger > Time trigger" 

Event trigger

The data point value is transmitted when a configured trigger signal is triggered.

Table 4-5

No.	Action
1.	In the data point configuration editor, insert the "overflow" data point as an analog input and link it to the "Data.overflow" PLC tag. 
2.	Set the transfer method for this data point (here: Current value triggered). 
3.	Set the data point index.  **Note:** The index of a data point of the Input type must be unique across all data point types (digital inputs, analog inputs, etc.).
4.	As the communication partner, select "Telecontrol Server". 

No.	Action
5.	Configure the "event trigger": "Properties > General > Trigger > Event trigger"  In the user program, create a trigger tag and link it to the "event trigger".

Note It is recommended to set the trigger tag with a delay of approx. 500 ms to ensure that the value change of the inflow is reliably applied to the appropriate data point.

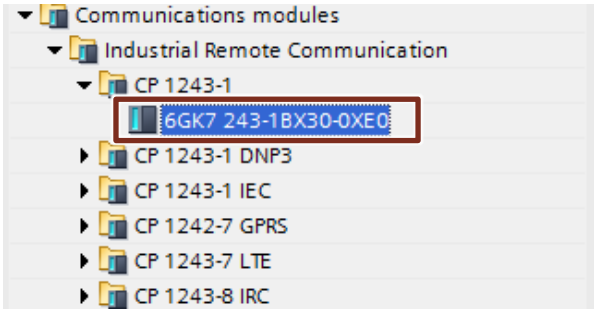
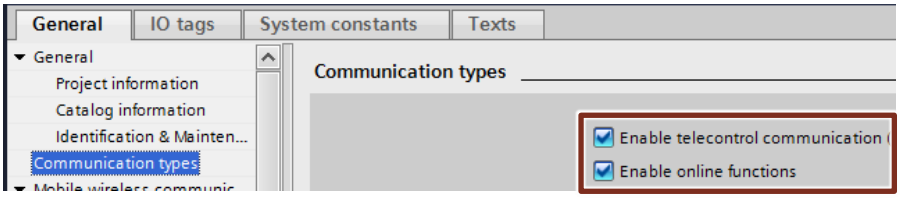
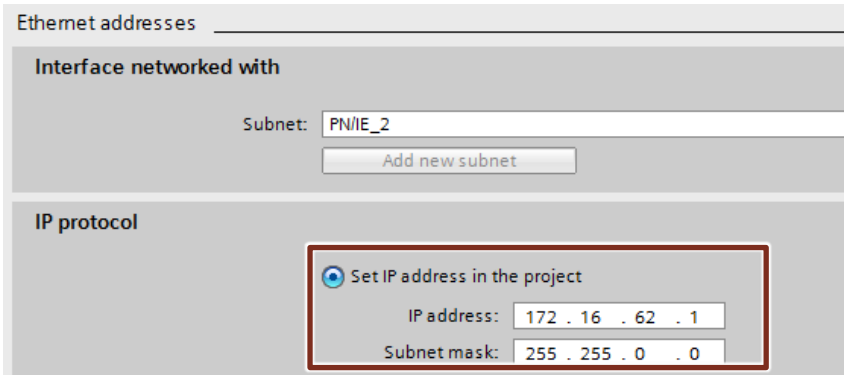
Note The trigger signal should be linked to a static tag in the instance data block in the CPU.

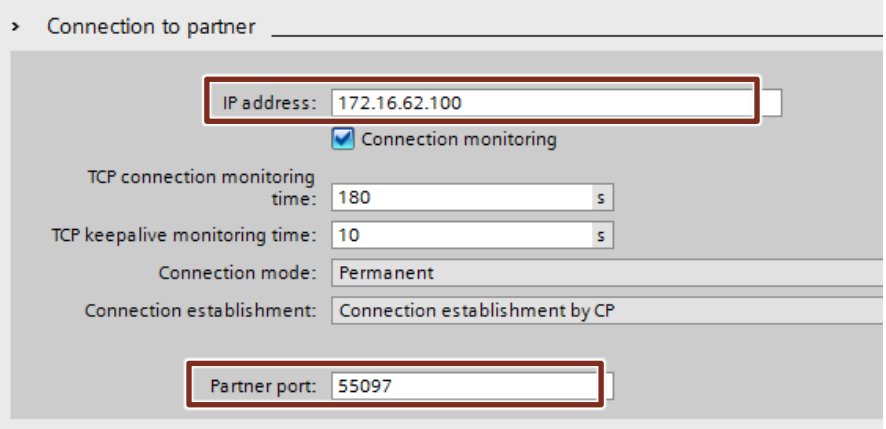
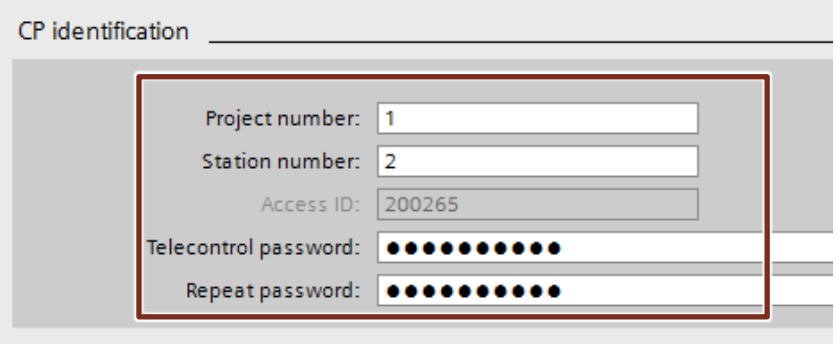
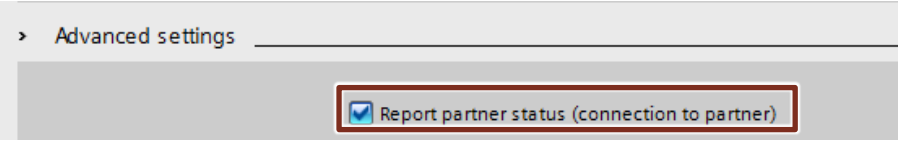
If the trigger signal is interconnected with a global tag, it is possible that the trigger signal may not be automatically reset. This is due to runtime differences between the CPU cycle and the CP cycle.

4.4 Configuring Station 2

The following table shows you how to configure an S7-1200 station with the CP 1243-1 for data communication with the master station via Ethernet.

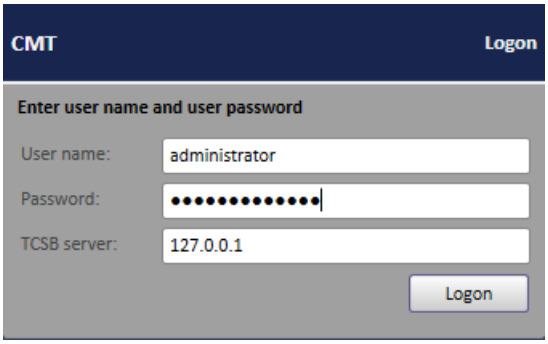
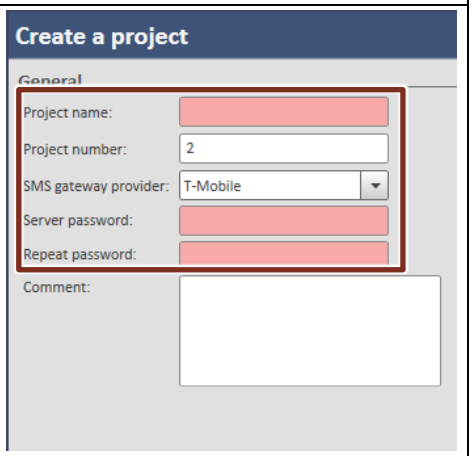
Table 4-6

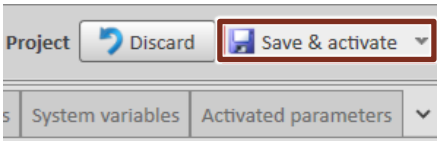
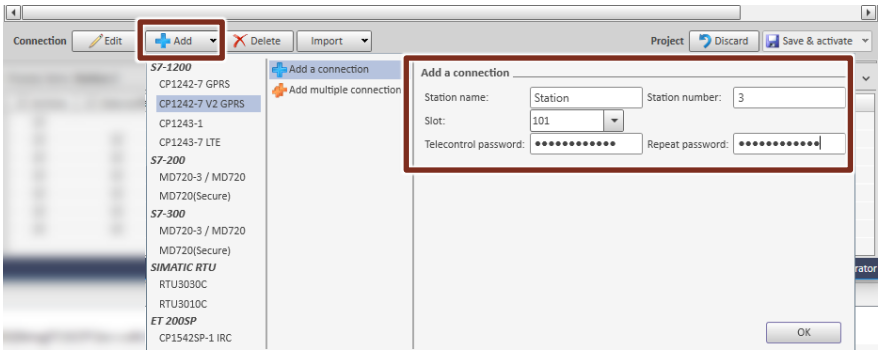
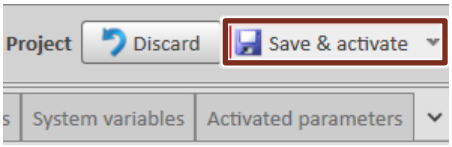
No.	Action
1.	Add a second S7-1200 CPU (V4.0 or higher) for SIMATIC Station 2.
2.	Insert the CP 1243-1 (V3.1) into the station. 
3.	Enable telecontrol communication and S7 communication: "CP 1243-1 Properties > General > Communication types" 
4.	Create an Ethernet network and connect the CP to the Ethernet network. "CP 1243-1 Properties > Ethernet interface" 
5.	Enable the security functions. "CP 1243-1 Properties > Security > Security properties"

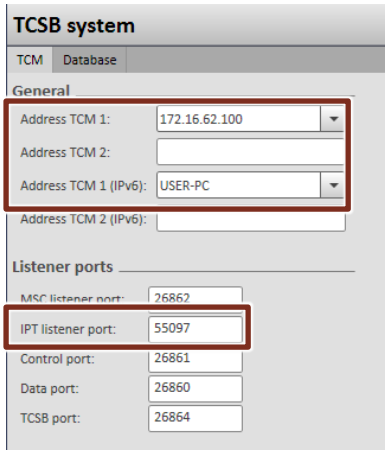
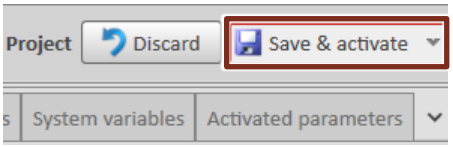
No.	Action
6.	Configure the CP parameters required to configure the TeleControl server: "CP 1243-1 Properties > Partner stations > Connection to partner" • Partner IP address • Partner port  "CP 1243-1 Properties > Security > CP identification" • "Project number" • "Station number" • "Telecontrol password" (here: "CP1243-1")  The parameters assigned here must be identical to the parameters in TCSB.
7.	Check Report partner status: "CP 1243-1 Properties > Partner stations > Advanced settings"  Link a PLC tag you have created in the user program.
8.	Configure the desired data points (see Chapter 4.2). The configuration is identical to that of Station 1.
9.	Download the project data to the station.

4.5 Configuring TeleControl Server Basic (TCSB)

Table 4-7

No.	Action
1.	Start the configuration and monitoring user interface of TCSB (CMT): "Windows Start menu > All Programs > Siemens Automation > SIMATIC > TCS Basic > Config and Monitoring Tool"
2.	After starting the program, the CMT Logon window opens.  Enter a configured user name or keep the default user name. • Enter the associated password. • Enter the IP address or the TeleControl server name resolvable by DNS. - Computer name or - IP address (default IP address: 127.0.0.1) Default logon data: User name: administrator Password: 0000
3.	Create a new project: • In the navigation pane, select the "Projects" item. • In the command bar, click the "Add" button. The new project appears in the navigation pane and in the object pane.
4.	Configure the new project: In the navigation pane or object pane, select the project and click the "Settings" tab.
5.	Enter the following project parameters: "Project name", "Project number", "Server password". Click "Create". 

No.	Action	
6.	"Save & activate" the configuration to activate the configuration data for connection establishment.	
7.	Create a new connection for Station 1: • In the navigation pane, select a project for which you want to create a new connection. • In the command bar, select the required connection type from the "Connection type" drop-down list. • In the object pane, select the "Add" button from the command bar. Select the desired CP. • Enter the "station name". • Enter the "station number". • Enter the "telecontrol password". **Note:** The parameters assigned here must be identical to the parameters in the STEP 7 project. • Click OK.  The new connection appears in the object pane.	
8.	Save the changes and activate the project.	
9.	Repeat steps 7 and 8 for Station 2.	

No.	Action	
10.	Configure the IP address and the ports of the TeleControl server: "TCSB system > "TCM" tab > General > Address TCM 1". 	
11.	Save the changes and activate the project.	

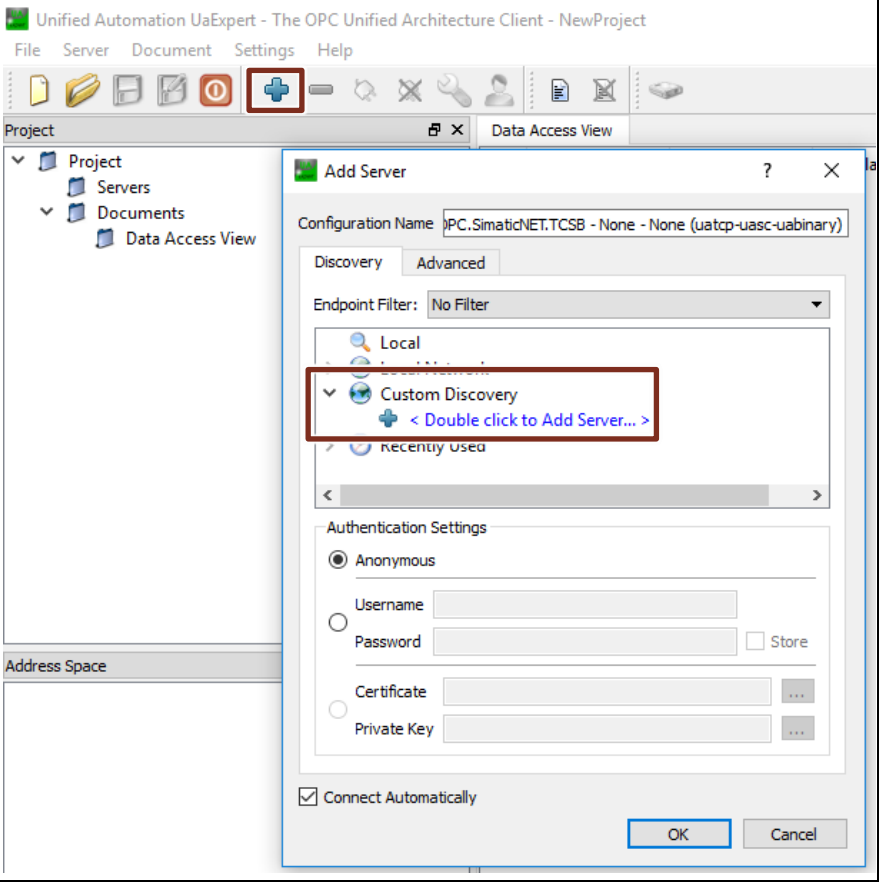
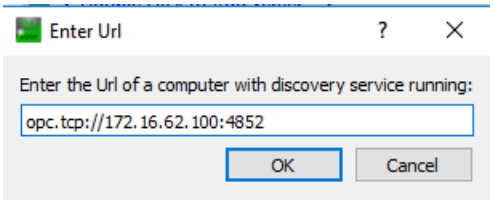
Note Once the stations have established a connection to TeleControl Server Basic, the configured data points are known to the server. Only then can you assign the "Archive" and "Data buffer" attributes to the data points.
Both attributes are necessary for this application.

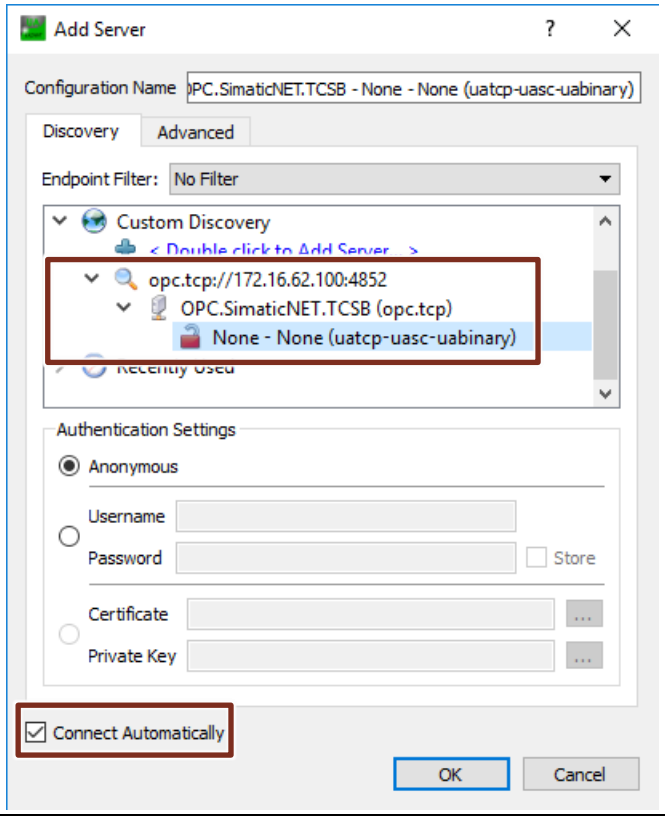
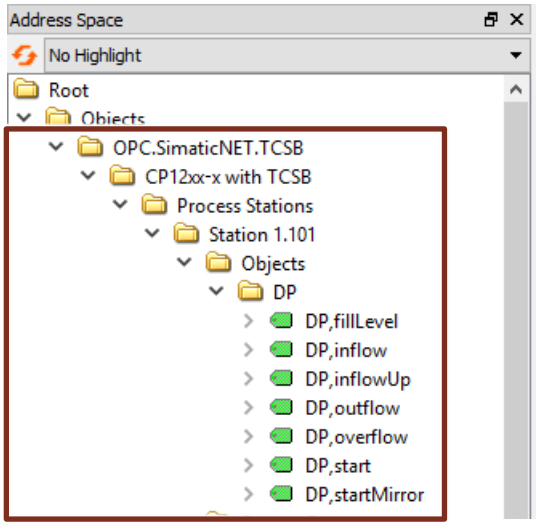
Note If you create a new TCSB project for this application example, modify the relevant HMI tags in the visualization software accordingly.

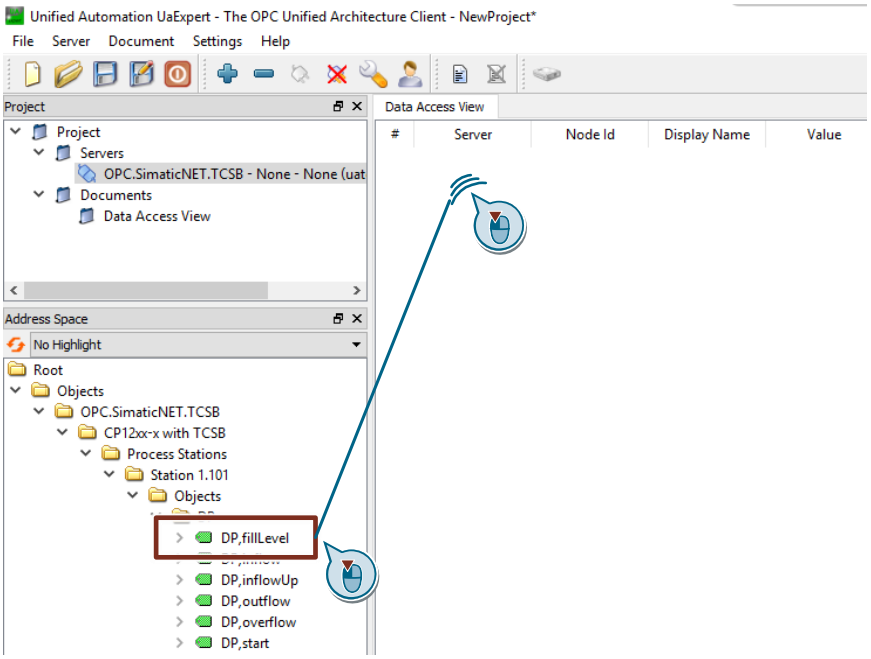
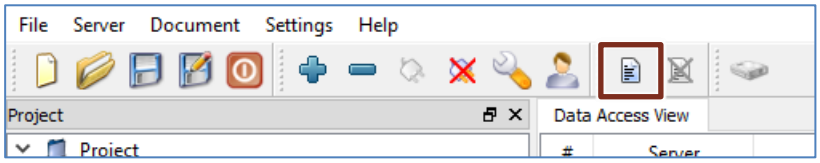
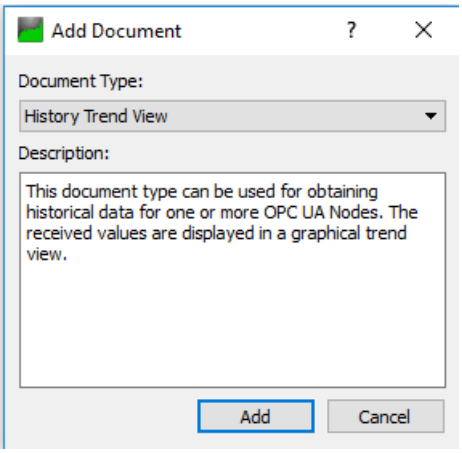
4.6 Configuring UaExpert

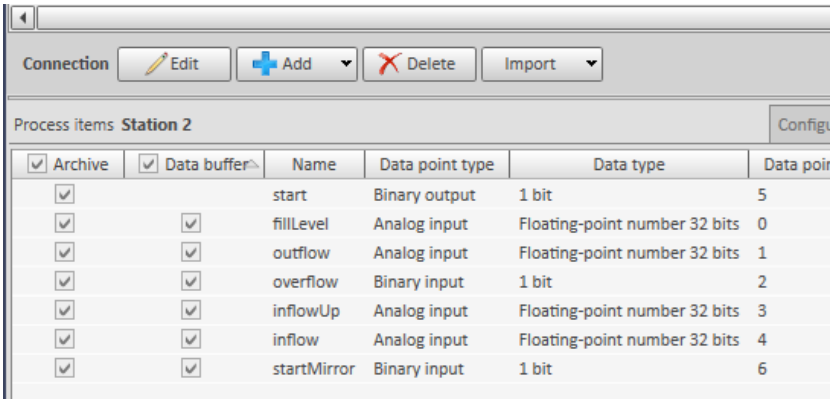
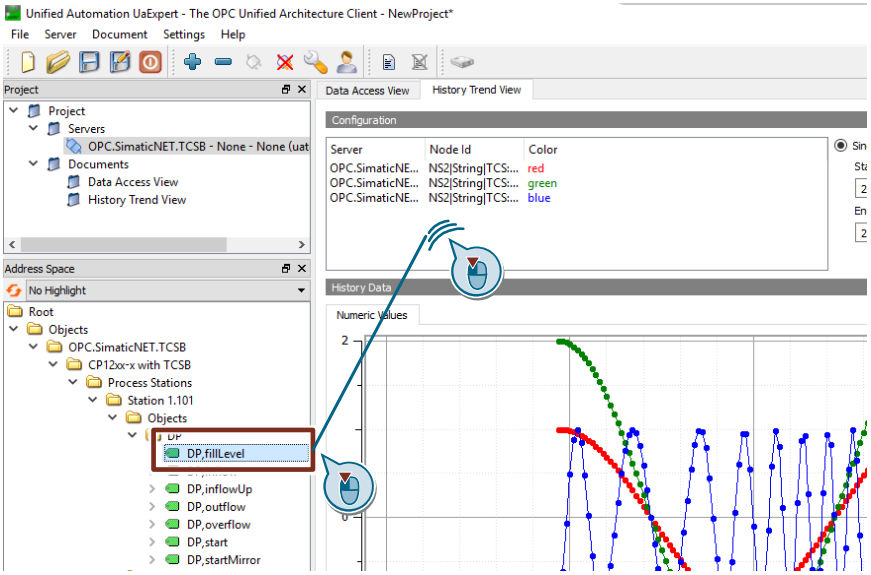
TCSB's OPC server enables OPC clients (UaExpert) to access process tags of the connected stations and status information of the individual connections. TCSB's OPC server is displayed with the name "OPC.SimaticNET.TCSB". Monitoring the OPC items requires an existing connection to TCSB.

Table 4-8

No.	Action
1.	Open UaExpert: "Windows Start menu > All Programs > Unified Automation > UaExpert"
2.	Insert the OPC server: 
3.	Enter the following URL: "opc.tcp://172.16.62.100:4852" 

No.	Action
4.	Select the OPC.SimaticNET.TCSB server and choose the desired authentication method (here: no authentication). Check "Connect Automatically": 
5.	Open the DP directory of the first station: "OPC.SimaticNET.TCSB > CP12xx-x with TCSB > Process Stations > Station 1.101 > Objects > DP". 

No.	Action
6.	Use drag and drop to move any data points to the "Data Access View" area. 
7.	Create a "History Trend View":  Select the "History Trend View" and click "Add" to confirm: 

No.	Action
8.	Check the data points' attributes in the CMT. Only data points with the "Archive" attribute can be monitored using the "History Trend View". 
9.	Use drag and drop to move any data points with the "Archive" attribute to the "Configuration" area: 
10.	Repeat steps 5, 6 and 9 for Station 2.

Note If you create a new project for this application example, modify the relevant HMI tags in the visualization software accordingly.

5 Installation and Startup

5.1 Installing the hardware

For the necessary hardware components, please refer to Chapter 2.4.

Note Always follow the installation guidelines for all components.

NOTICE **Before you switch on the power supply, complete and check the installation!**

5.1.1 Station 1 hardware configuration

The following figure shows the hardware configuration of Station 1: S7-1200 CPU with the CP 1242-7 GPRS V2.

Figure 5-1

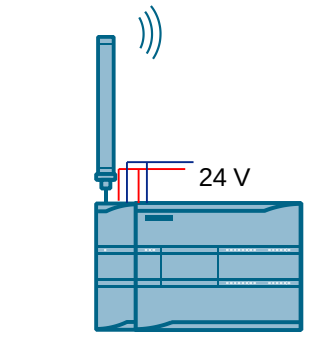


Table 5-1

No.	Action
1.	Insert your SIM card into the CP 1242-7 GPRS V2.
2.	Insert the SIMATIC Memory Card into the CPU.
3.	Connect the CPU to the CP 1242-7 GPRS V2 via the backplane bus.
4.	Attach the two modules to a suitable rack.
5.	Connect the antenna to the CP 1242-7 GPRS V2.
6.	Connect the CPU and the CP 1242-7 GPRS V2 to a 24 V DC power source.
7.	Connect the DC power source to the power grid (220 / 230 V AC).

5.1.2 Station 2 hardware configuration

The following figure shows the hardware configuration of Station 2: S7-1200 CPU with the CP 1243-1.

Figure 5-2

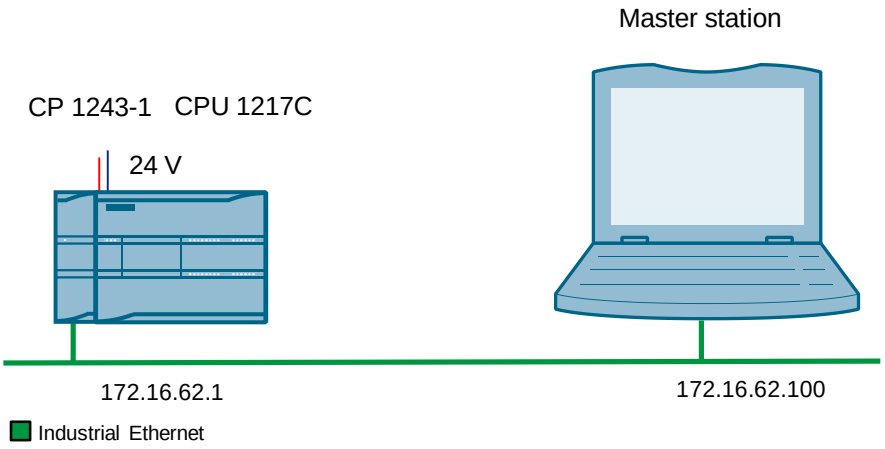


Table 5-2

No.	Action
1.	Insert the SIMATIC Memory Card into the CPU.
2.	Connect the CPU to the CP 1243-1 via the backplane bus.
3.	Attach the two modules to a suitable rack.
4.	Connect all relevant components to a 24 V DC power source.
5.	Connect the DC power source to the power grid (220 / 230 V AC).
6.	Connect the master station to the Ethernet interface of the CP 1243-1.

5.1.3 Master station hardware configuration

The following figure shows the hardware configuration of the master station.

Figure 5-3

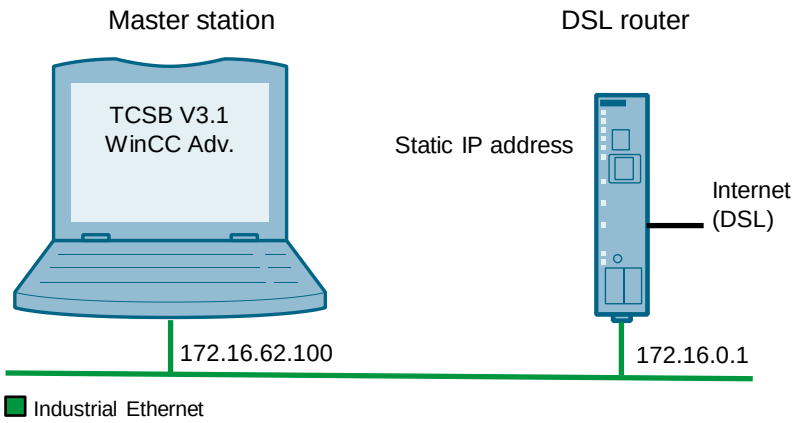


Table 5-3

No.	Action
1.	Connect your PC on which TeleControl Server Basic is installed to the router via Ethernet.
2.	If the DSL modem is not integrated in the router, connect the router to the DSL modem.

5.2 Installing the software

Engineering PC/PG

Table 5-4

No.	Action	Comment
1.	Install STEP 7 V15.1.	Follow the instructions of the installation program.
2.	Install WinCC Advanced V15.1.	

PC/PG as the master station

Table 5-5

No.	Action	Comment
1.	Install TeleControl Server Basic V3.1.0.1	Follow the instructions of the installation program.
2.	Install WinCC Advanced V15.1 Runtime.	
3.	Install UaExpert.	optional

5.3 Installing the application software

Unzip the "39863979_S7_1200_WinCC_Adv_PROJ_V20.zip" file. This folder contains:

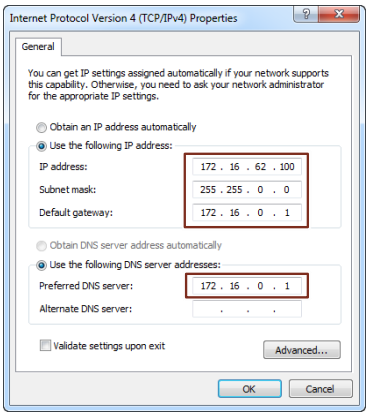
- The archived STEP 7 project, "39863979_S7-1200_WinCC_Adv_CODE_V20.ap15_1":
  - "S7-1200_CP1242-7" Station 1 project
  - "S7-1200_CP1243-1" Station 2 project
  - "Data communication TCSB" WinCC project
- "39863979_S7-1200_with_TCSB.bak" TCSB configuration file
- "39863979_S7-1200_with_TCSB.uap" UaExpert configuration file.

5.4 Startup

5.4.1 Assigning the IP address of the master station

The following table shows the network properties you must set for the master station.

Table 5-6

No.	Action
1.	Open the Internet Protocol (TCP/IP) Properties: "Start > Control Panel > Network and Internet > Network Connections > Local Connections"
2.	In the open window, select Internet Protocol (TCP/IPv4) and open Properties.
3.	Enter the IP address for your master station. In the "Default gateway" and "Preferred DNS server" fields, enter the DSL router's internal IP address. Select "OK" to close the window. 
4.	If your PG has a WLAN interface, disable it.

5.4.2 Configuring the DSL router

For the configuration, no specific router will be discussed as the screen forms will differ from router to router.

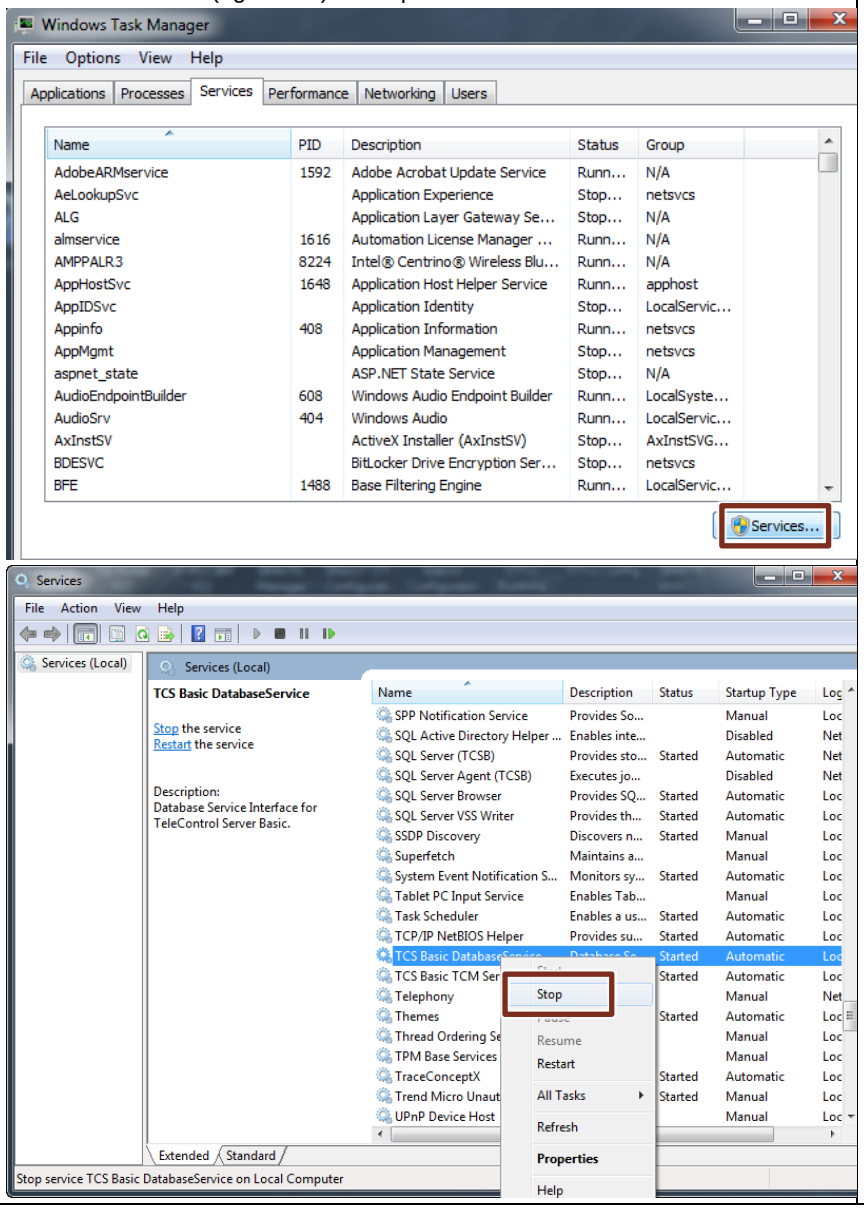
Table 5-7

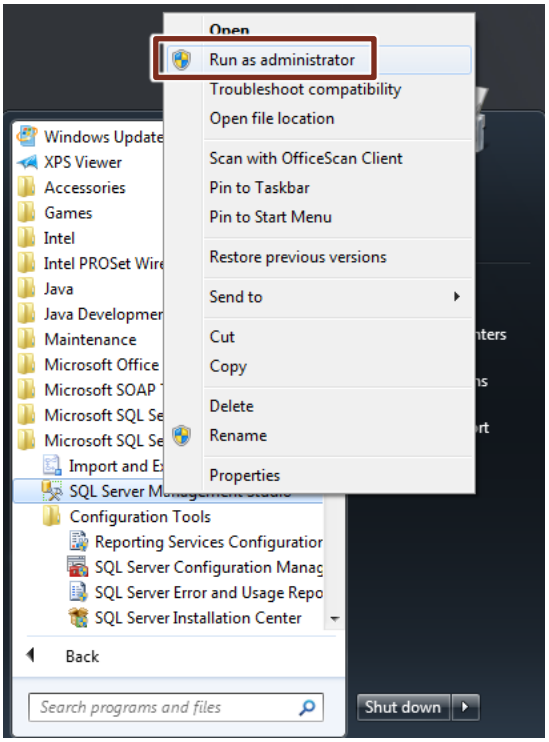
No.	Action	
1.	Open the router's configuration user interface.	This can be additional software, "Telnet" or a Web page.
2.	Enter the access data for your Internet account.	Login, password, etc. you received from your provider.
3.	Enter your DNS server.	The address is provided with your access data.
4.	Assign a LAN IP address to the router.	In this example: 172.16.0.1.
5.	Forward the partner port.	TCP port 55097 to port 55097 of 172.16.62.100.

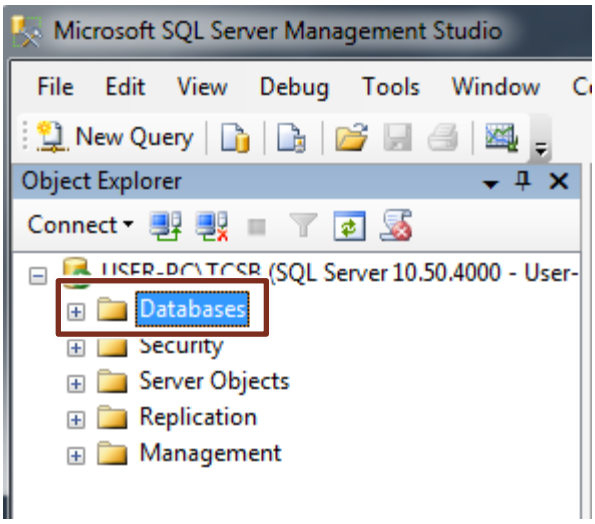
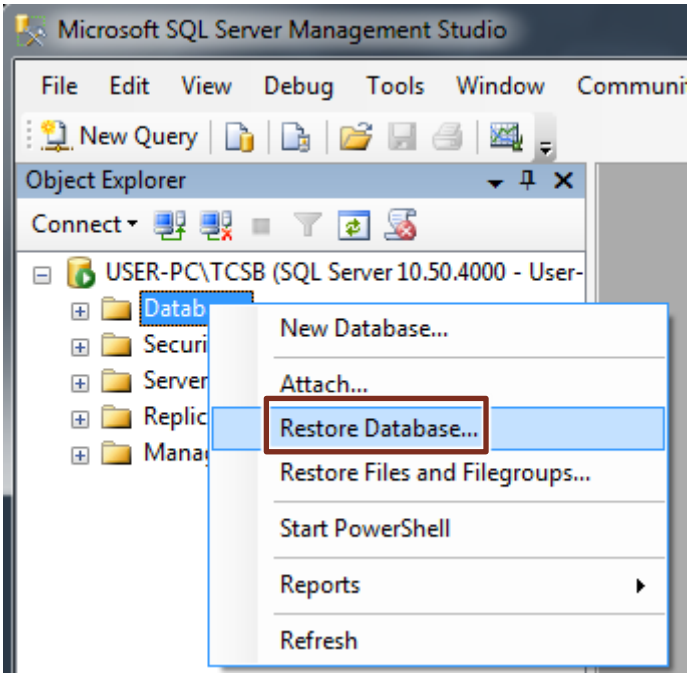
Note To configure the router, you have to assign an IP address to your PG/PC that is in the router's internal network.

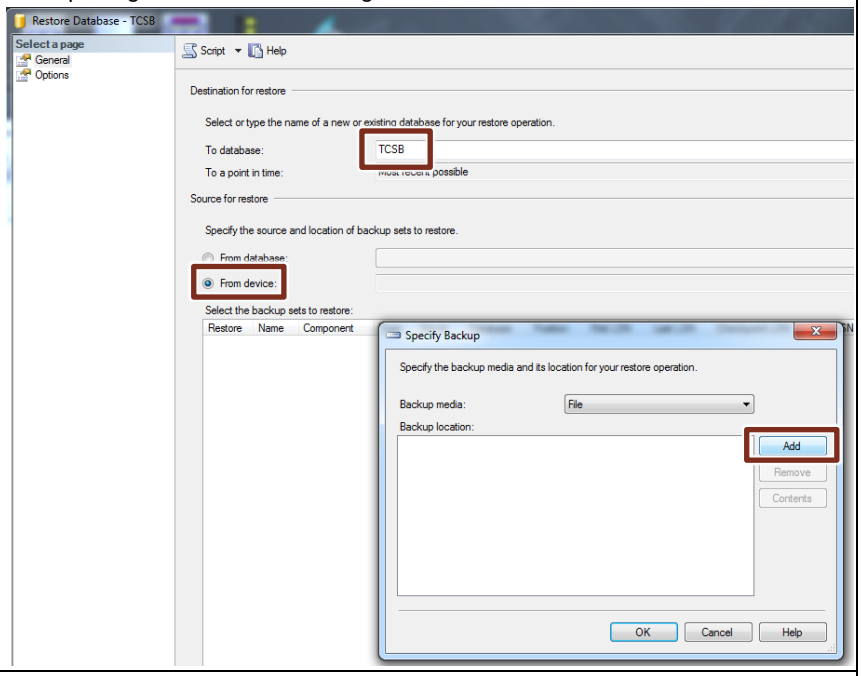
5.4.3 Inserting the "39863979_S7-1200_with_TCSB.bak" database backup copy into TCSB V3.1.0.1

Table 5-8

No.	Action
1.	Stop the existing database by selecting "Windows Task Manager" > "Services" tab > "Services" button > "TCS Basic Database Service" (right-click) > "Stop". 

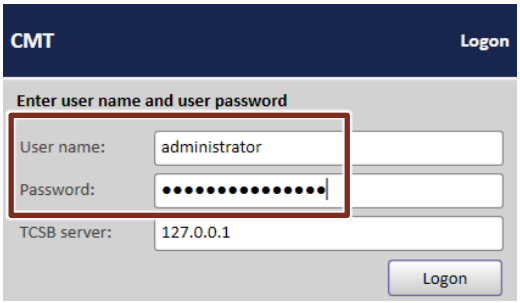
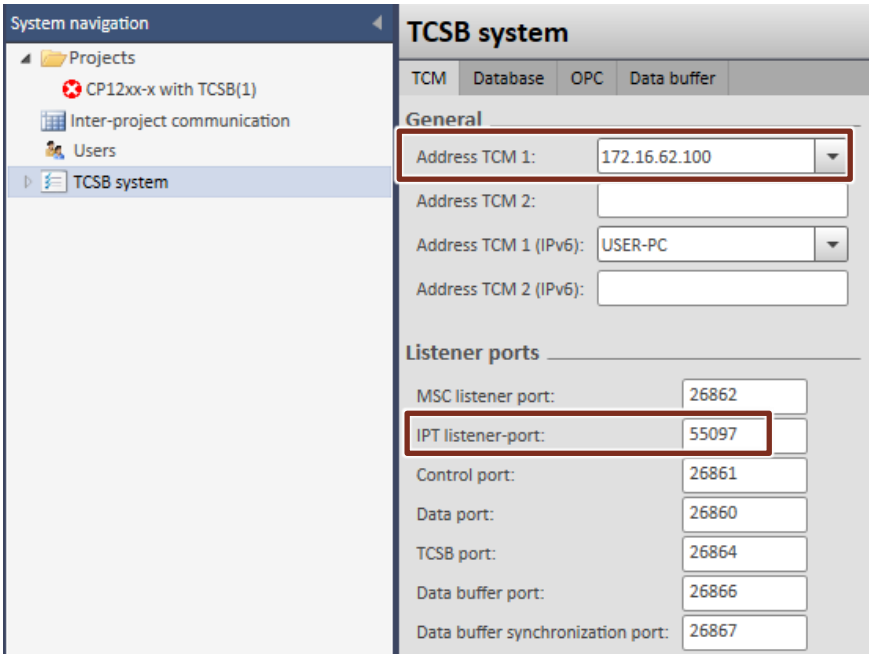
No.	Action
2.	Start SQL Server Management Studio as an administrator: "Start > All programs > Microsoft SQL Server 2008 R2 > SQL Server Management Studio (right-click) > Run as administrator"  The "Connect to Server" dialog opens with the following settings: • Server type: Database Engine • Server name: <PC name>\TCSB • Authentication: Windows Authentication
3.	Verify the server name; it must be as follows: "<PC name>\TCSB". Then click "Connect".  SQL Server Management Studio opens with the database's object navigation.

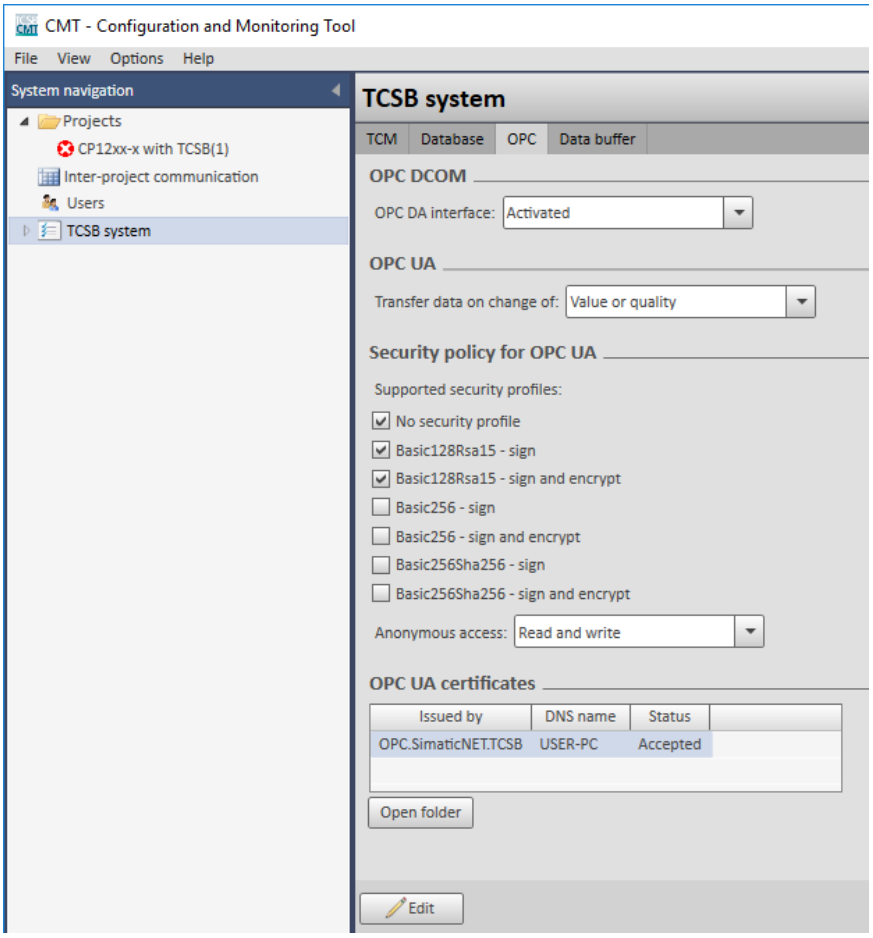
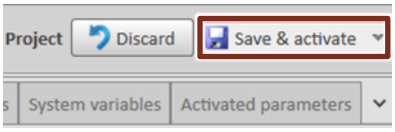
No.	Action
4.	Select the "Databases" item. 
5.	Select the context menu (right-click) "Restore Database...".  The "Restore Database…" dialog opens.

No.	Action
6.	• In the "Destination for restore" field, select the "TCSB" database ("To database"). • In the "Source for restore" field, select the "From device" option and use the "..." button to open the "Specify Backup" dialog. • Select the "39863979_S7-1200_with_TCSB.bak" backup copy by first opening the file browser using the "Add" button. 
7.	In the "Restore Database - TCSB" dialog, select the selected “backup set” in the "Restore" column and click "OK".
8.	Click "OK" to close Management Studio.
9.	Restart the computer.

5.4.4 Configuring the IP address and the ports of TeleControl Server Basic V3.1

Table 5-9

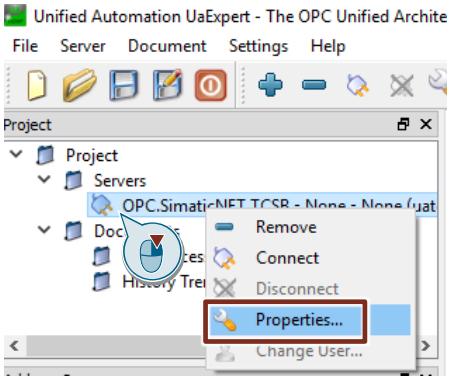
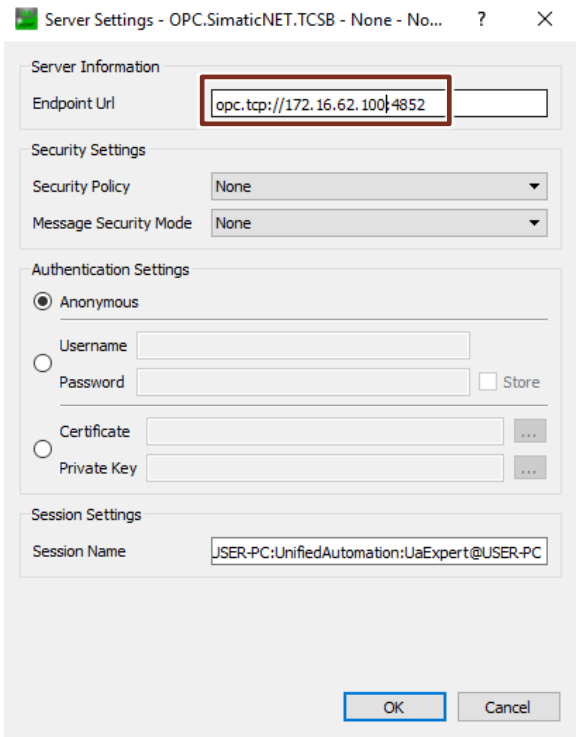
No.	Action
1.	Start the configuration and monitoring user interface of TCSB (CMT): "Windows Start menu > All Programs > Siemens Automation > SIMATIC > TCS Basic > Config and Monitoring Tool".
2.	After starting the program, the CMT Logon window opens.  • User name: administrator • Password: administrator • Enter the IP address or the TeleControl server name resolvable by DNS. – Computer name or – IP address (default IP address: 127.0.0.1)
3.	Configure the Telecontrol server's IP address by selecting: "TCSB system > Edit > Address TCM 1". Set "IPT listener-port" to 55097. 

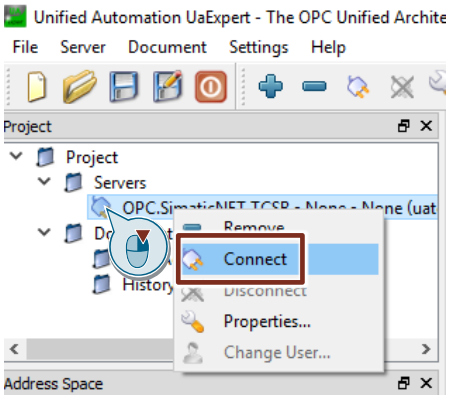
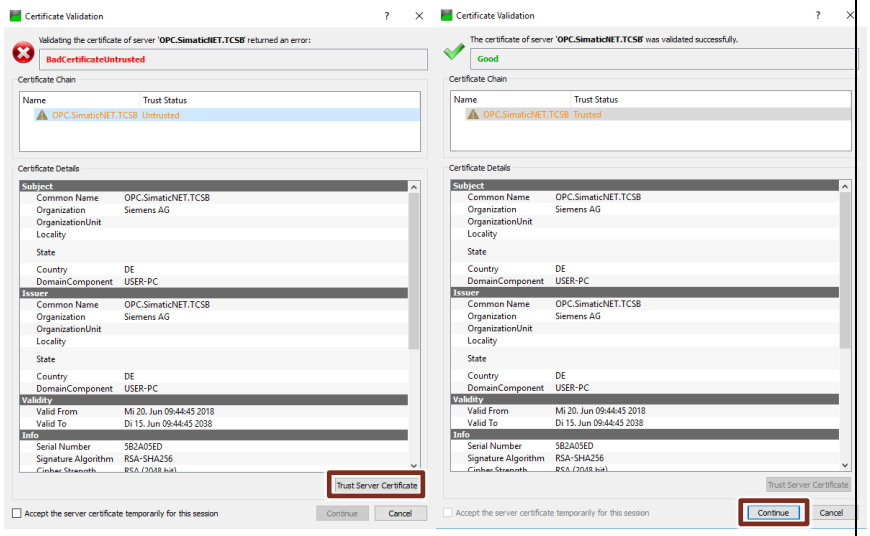
No.	Action
4.	Configure the settings for the integrated OPC server. 
5.	Save the changes and activate the project. 
6.	Restart the computer.

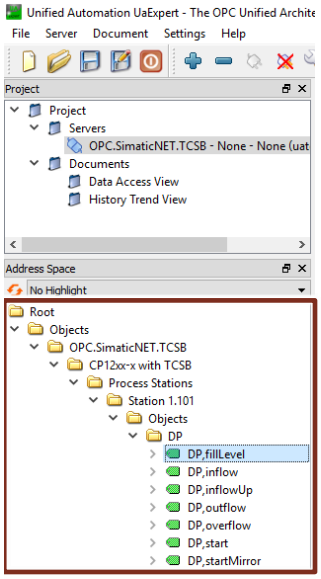
5.4.5 Opening the "39863979_S7-1200_with_TCSB.uap" UaExpert configuration file

To monitor the process data at the master station, you must open the "39863979_S7-1200_with_TCSB.uap" UaExpert configuration file included in the project.

Table 5-10

No.	Action
1.	Open UaExpert: "Windows Start menu > All Programs > Unified Automation > UaExpert"
2.	Open the "39863979_S7-1200_with_TCSB.uap" file: "File > Open …".
3.	Open the OPC server settings: 
4.	Enter the following endpoint URL: "opc.tcp://172.16.62.100:4852" Alternatively, you can enter the PC name instead of the IP address. 

No.	Action
5.	Connect UaExpert to the OPC UA server: 
6.	In the next dialog, select "Trust Server Certificate" to confirm the certificate and then click "Continue": 

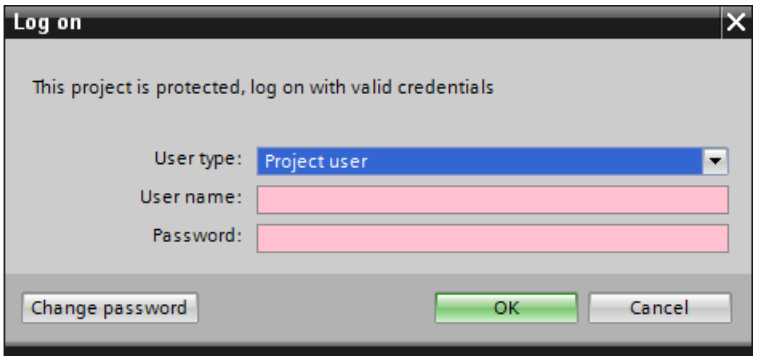
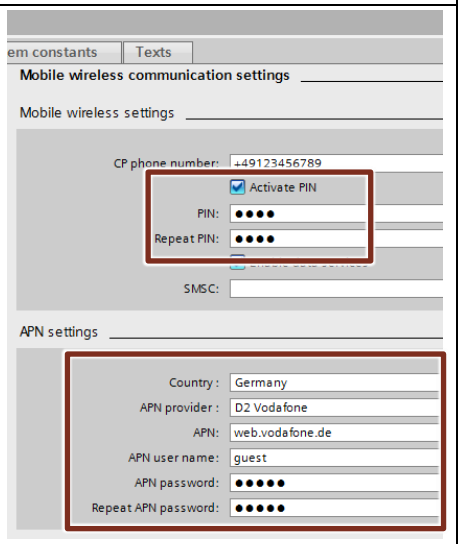
No.	Action
7.	Open the "OPC.SimaticNET.TCSB" server. If the connection to the server was successful, you will see the OPC items. 

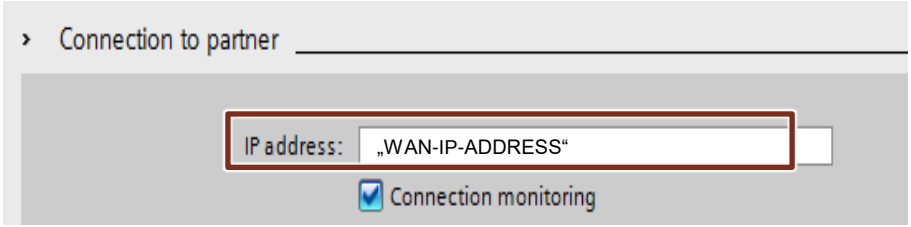
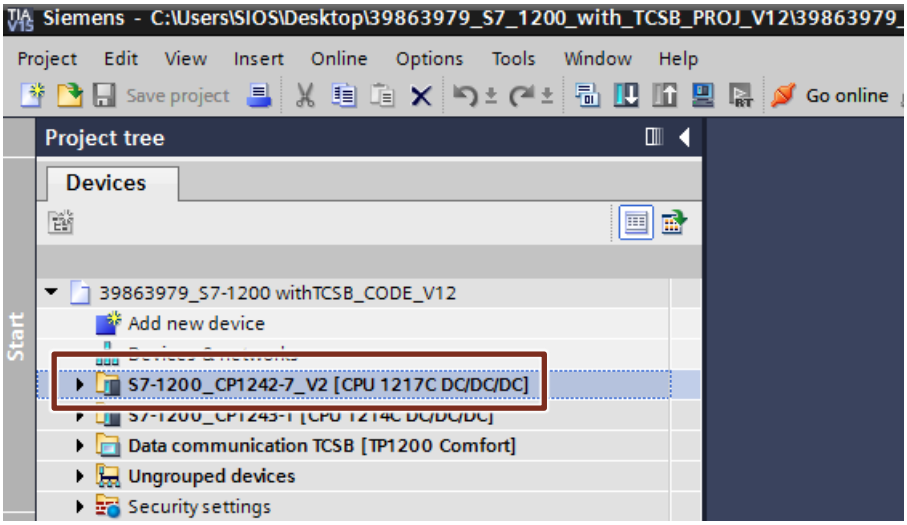
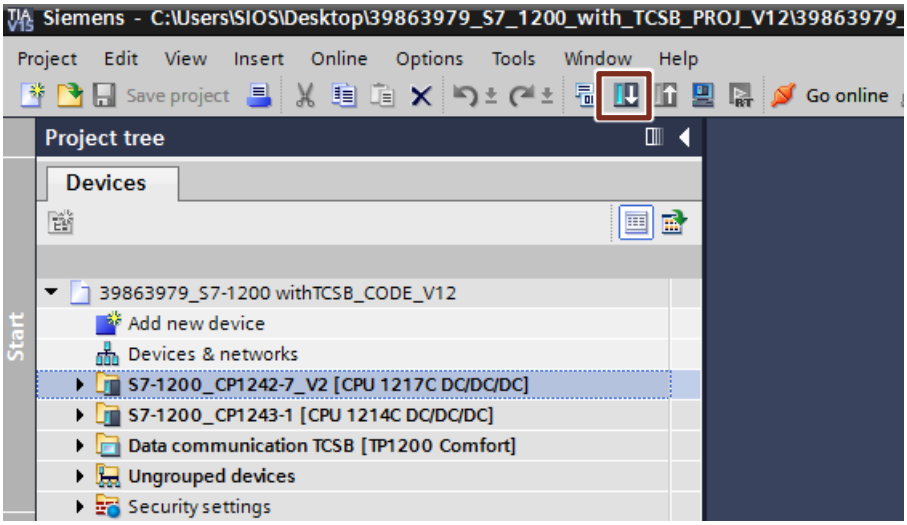
5.4.6 Loading Station 1 / Station 2

Requirements

- Connect your PG to the CPU.
- The CPU must be in a mode that allows downloading.
- Before downloading the user program, a general reset of the CPU should be performed to ensure that no "old" blocks are on the CPU.

Table 5-11

No.	Action
1.	Connect the engineering PG to the PROFINET interface of the S7 CPU.
2.	Unzip the "39863979_S7-1200_WinCC_Adv_PROJ_V20.zip" project.
3.	Open the following STEP 7 project: "39863979_S7-1200_WinCC_Adv_CODE_V20.ap15_1"
4.	Log on:  User name: administrator Password: administrator
5.	Customize the mobile wireless communications settings of the CP 1242-7 GPRS V2: "Properties > Mobile wireless communications settings": • Activate and enter the PIN • Change the APN settings **Note:** This step is only required for the CP 1242-7 GPRS V2.
	

No.	Action
6.	Change the partner IP address (static IP address of your DSL router) required for the connection to the TeleControl server in the master station: "Properties > Partner stations > Connection to partner"  **Note:** This step is only required for the CP 1242-7 GPRS V2.
7.	Compile and save the project.
8.	Select the "S7-1200_CP1242-7" or "S7-1200_CP1243-1" station. 
9.	Download the project to Station 1 or Station 2. 
10.	Configure the hardware as described in Chapter 5.1.

6 Operation of the Application

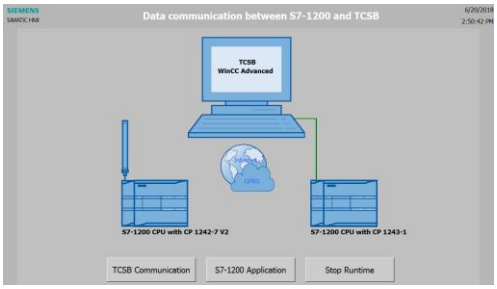
6.1 Overview

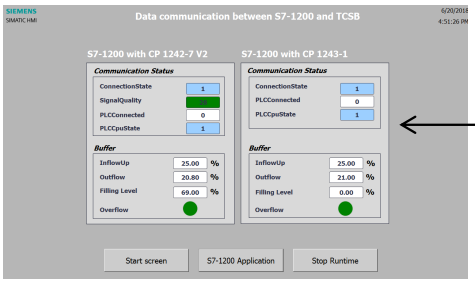
HMI menu

The application is visualized with WinCC Advanced using two configured screen forms: "TCSB Communication" and "S7-1200 Application".

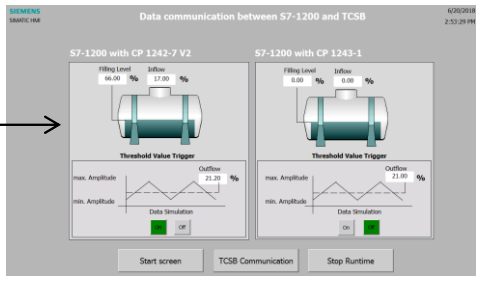
Figure 6-1

Start screen





TCSB Communication



S7-1200 Application

"Start screen" main menu

The "Start screen" main menu allows you to open the application example and toggle between "TCSB Communication" and "S7-1200 Application".

"TCSB Communication" screen

The "TCSB Communication" screen shows the status of the connection to the remote stations. It additionally provides information about data traffic. You can toggle between "Start screen" and "S7-1200 Application".

"S7-1200 Application" screen

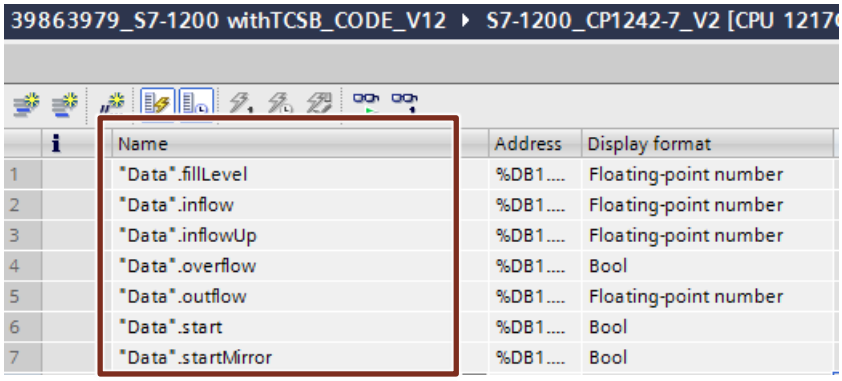
The "S7-1200 Application" screen visualizes the processes of stations 1 and 2. You can toggle between "Start screen" and "TCSB Communication".

Watch table of Station 1 / Station 2

The "WT_SetResetParameter" watch table also allows you to monitor or modify the tags of the "Data" DB directly in the CPU.

For a description of the tags, please refer to Table 3-3.

Figure 6-2



Note

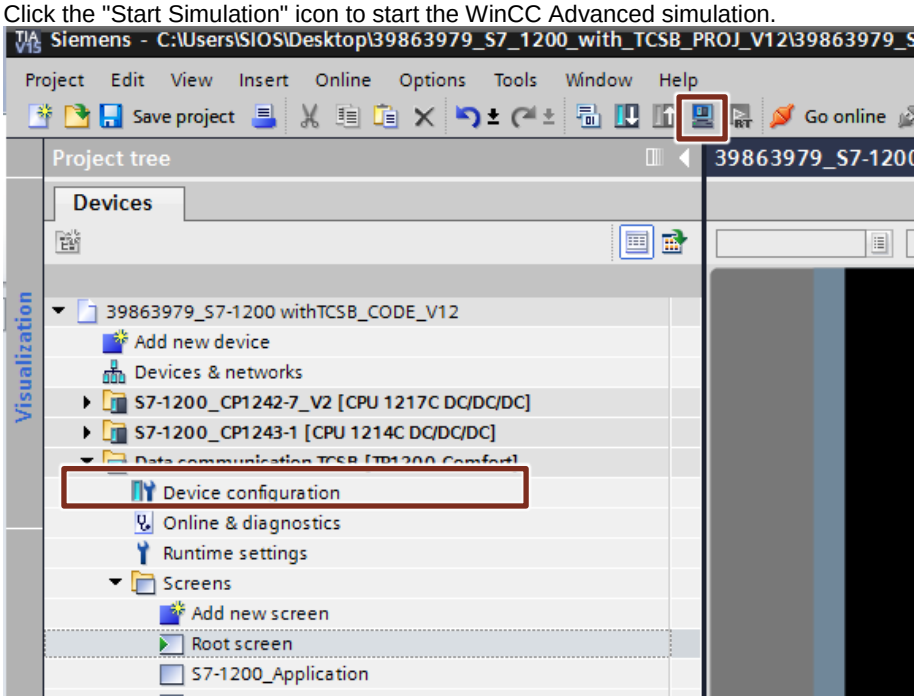
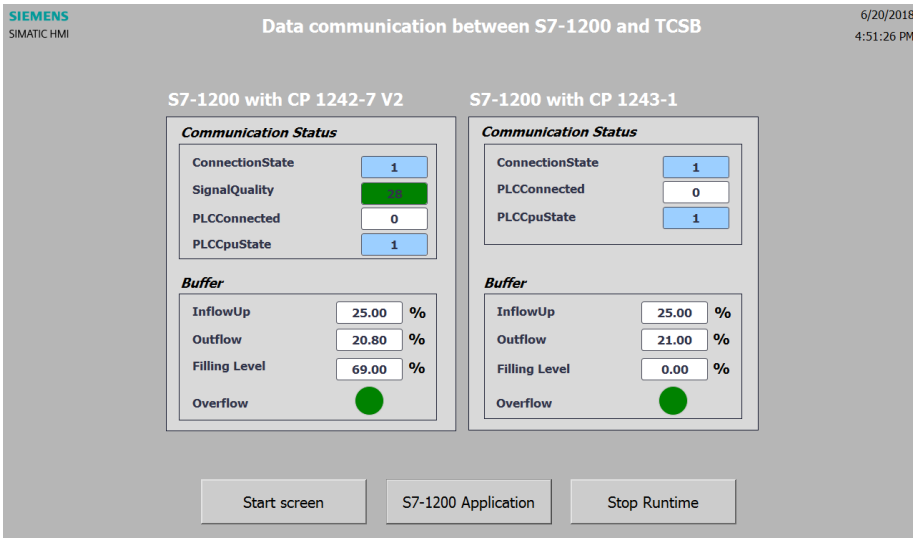
For Station 1 (CP 1242-7 GPRS), the TeleService function must be activated in order to monitor or modify the table's tags as the master station and the CP are not in the same IP network. (See \7\)

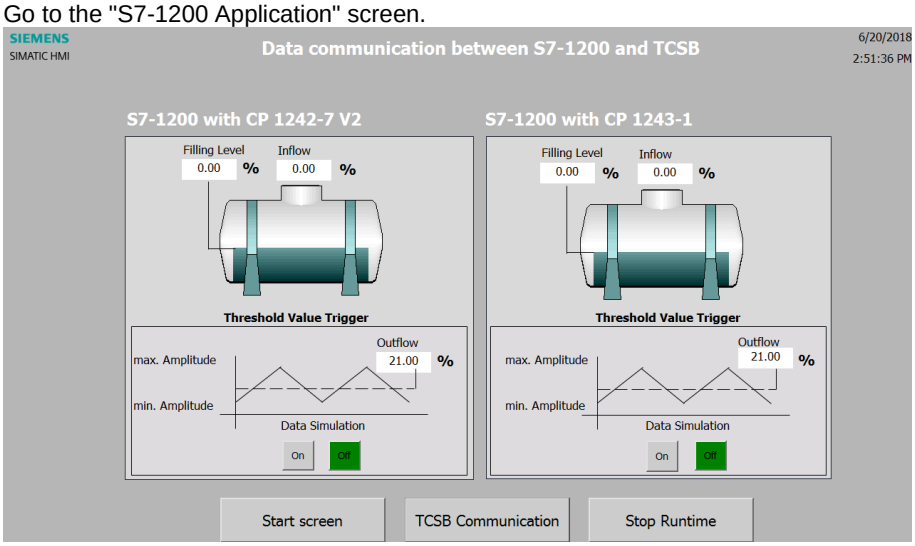
The TeleService function is not necessary for Station 2 as the master station and the CP are in the same IP network.

6.2 Starting / stopping the simulation

To start or stop the simulation, proceed as follows:

Table 6-1

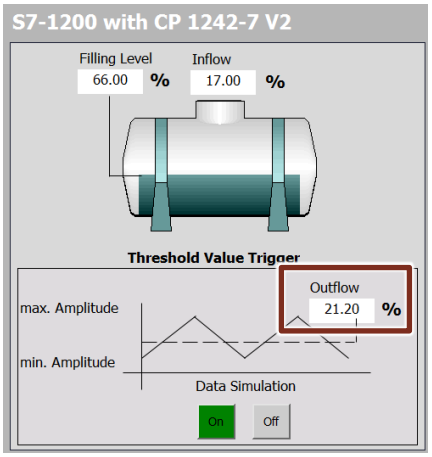
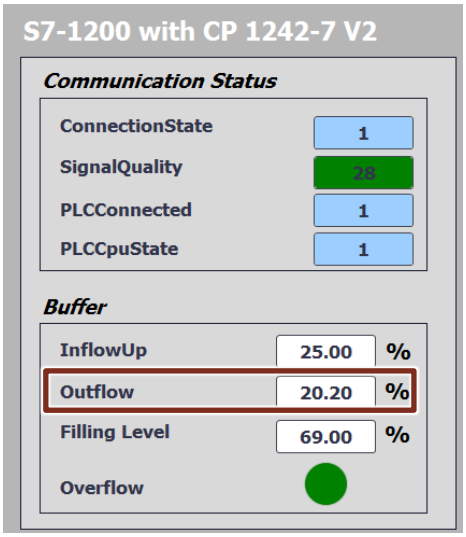
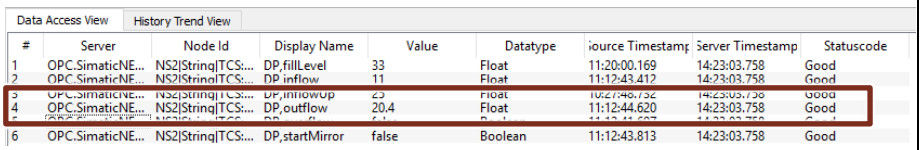
No.	Action
1.	Click the "Start Simulation" icon to start the WinCC Advanced simulation. 
2.	Go to the "TCSB Communication" screen.  Verify that both nodes have established a connection ("Connection = 1"). If this is not the case, check the hardware configuration and the configuration of both stations.

3.	Go to the "S7-1200 Application" screen. 
4.	Use the "On" button to start the data simulation for the respective station. The master station therefore sends a 'start data simulation' command to the station. The station reports that the data simulation has started. In the HMI system, the "On" button is displayed in green.
5.	To stop the data simulation, click the "Off" button.
6.	To stop WinCC Runtime, click "Stop Runtime".

6.3 Station 1 / Station 2 sends data to the master station on a "threshold-triggered" basis

Station 1 or Station 2 sends its outflow value to TeleControl Server Basic in the master station on a threshold-triggered basis.

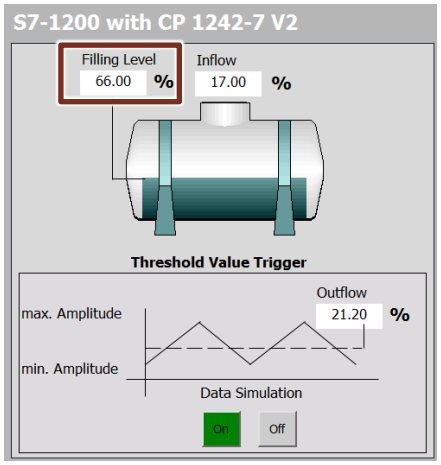
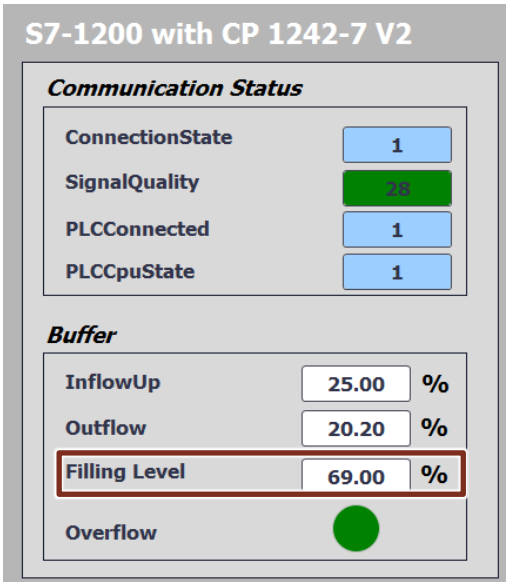
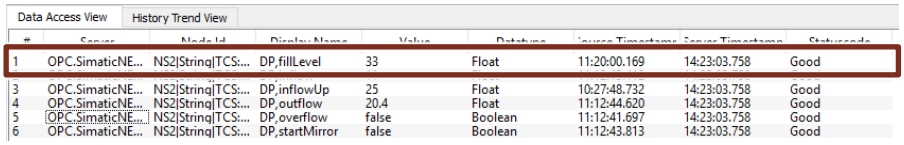
Table 6-2

No.	Action	
1.	When the threshold value "2" is reached (see Figure 3-1), the outflow value is sent to the master station. In the "S7-1200 Application" screen, the "Outflow" field displays the value the master station has received.	
2.	Go to the "TCSB Communication" screen. The outflow value received by the master station can also be monitored in this screen; it is displayed in the "Outflow" field.  Alternatively, you can monitor the data using UaExpert.  **Note:** "Threshold trigger"=2 was configured in the data point configuration (see Chapter 4-2).	
3.	Repeat the step for Station 2.	

6.4 Station 1 / Station 2 cyclically sends data to the master station

Station 1 or Station 2 sends its fill level value to TeleControl Server Basic in the master station at a defined interval. The following table provides instructions for this job.

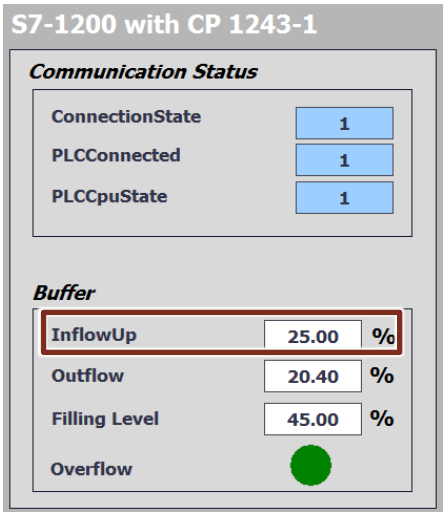
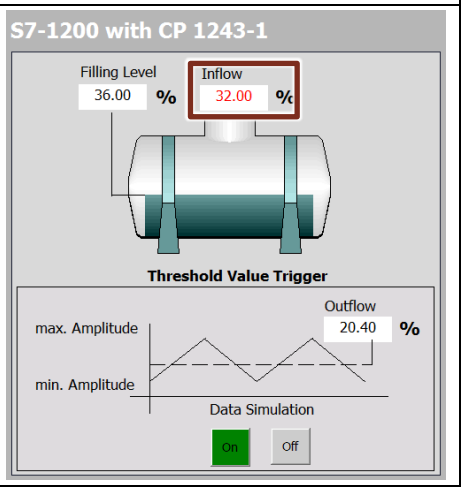
Table 6-3

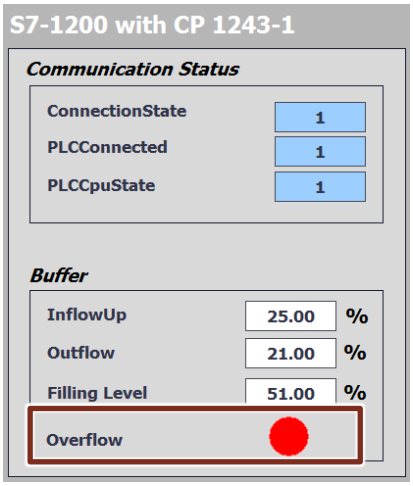
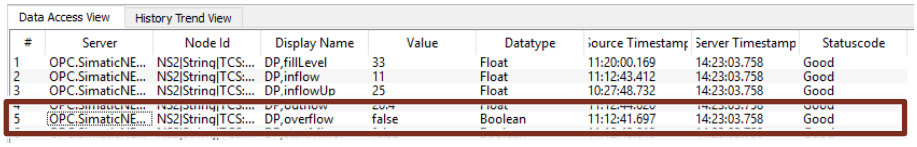
No.	Action
1.	Open the "S7 1200 Application" screen and monitor the current fill level value. The fill level value is updated after 30 seconds. 
2.	Go to the "TCSB Communication" screen. In this screen, you can also monitor the fill level value.  Alternatively, you can monitor the data using UaExpert. 
3.	Repeat the step for Station 2.

6.5 Station 1 / Station 2 sends data to the master station on an "event-triggered" basis

If the inflow of Station 1 or Station 2 exceeds a maximum value, the inflow value is sent to the master station. The following table provides instructions for this job.

Table 6-4

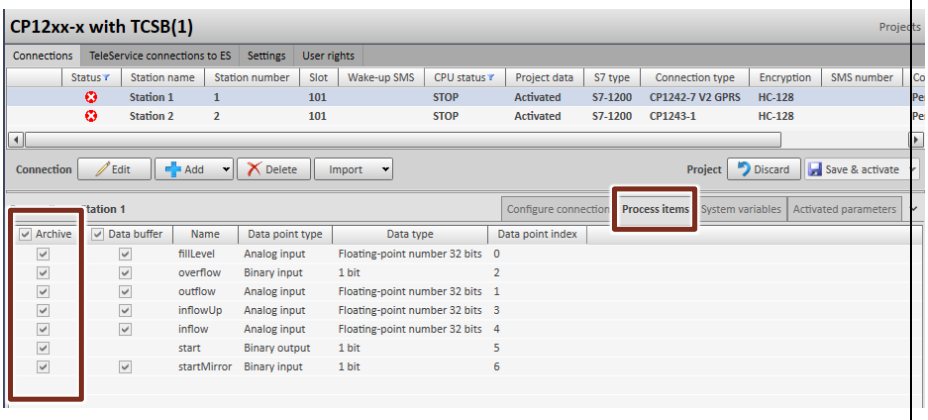
No.	Action	
1.	Open the "TCSB Communication" screen.	
2.	The "InflowUp" field displays the maximum inflow value. In the application example, the value in the program is set to 25%.	
3.	Open the "S7-1200 Application" screen. The "inflow" field displays the current inflow value. If this value exceeds the maximum inflow value (InflowUp) (e.g., 25%), an overflow alarm is sent to the master station.	

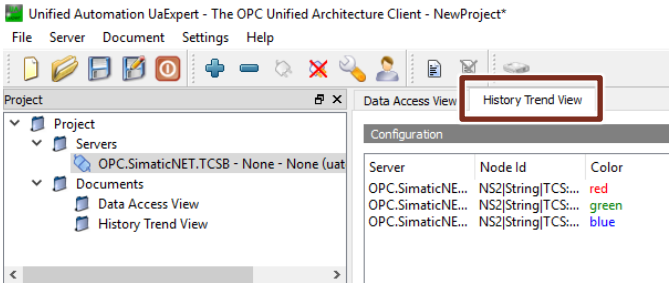
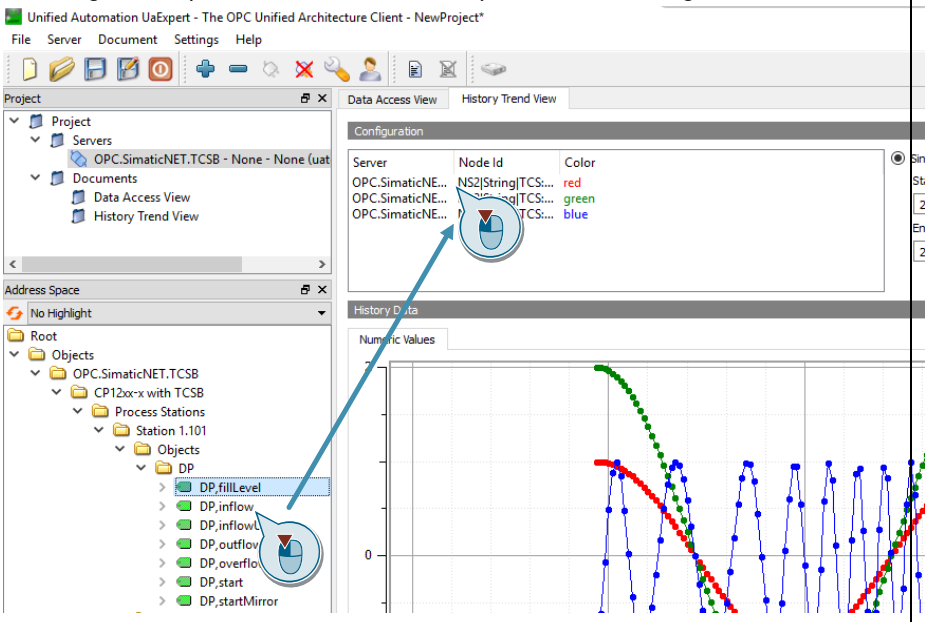
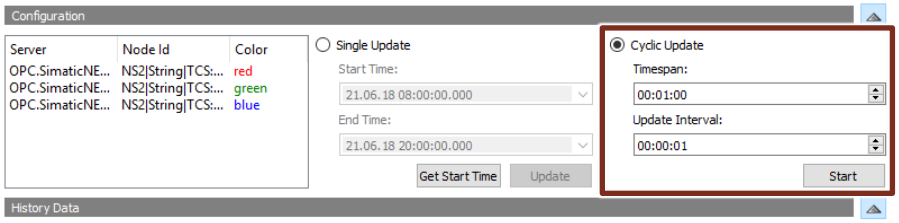
No.	Action
4.	The overflow alarm is displayed in the "TCSB Communication" screen.  Alternatively, you can monitor the data using UaExpert. 
5.	Repeat the step for Station 2.

6.6 Monitoring value changes in UaExpert

The "History Trend View" allows you to monitor value changes of data points. UaExpert graphically represents the trend.

Table 6-5

No.	Action
1.	Check the data points' attributes in the CMT. Only data points with the "Archive" attribute can be monitored using the "History Trend View". 

No.	Action
2.	Open the "History Trend View" in UaExpert. 
3.	Use drag and drop to move the desired data points to the "Configuration" area. 
4.	Select "Cyclic Update" and click "Start". 
5.	Go to WinCC and start the value simulation as described in Chapter 6.2. Now you can monitor the data points' trend. Alternatively, you can use the "Trend view" WinCC control. To this end, an optional screen is configured in the HMI.

7 Appendix

7.1 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.

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 with 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:
https://www.siemens.en/industry/supportrequest

SITRAIN – Training for Industry

With our globally available training courses for our products and services, we help you achieve these goals – 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:
https://www.siemens.en/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

8 Links & Literature

Table 8-1

	Topic
\1\	Siemens Industry Online Support http://support.industry.siemens.com
\2\	Download page of the entry https://support.industry.siemens.com/cs/ww/en/view/39863979
\3\	Support packages for the hardware catalog in the TIA Portal (HSP) https://support.industry.siemens.com/cs/ww/en/view/72341852
\4\	SIMATIC NET Industrial Remote Communication - TeleControl TeleControl Server Basic - Version V3.1 https://support.industry.siemens.com/cs/ww/en/view/109755138
\5\	SIMATIC STEP 7 V15.1 and WinCC V15.1 TRIAL Download https://support.industry.siemens.com/cs/ww/en/view/109752566
\6\	How do you read out advanced diagnostics data from the CP 1242-7 GPRS V2? https://support.industry.siemens.com/cs/ww/en/view/109480967
\7\	TeleService of an S7-1200 station via mobile network (Set 33) https://support.industry.siemens.com/cs/ww/en/view/56720905
\8\	UaExpert download page https://www.unified-automation.com/downloads/opc-ua-clients.html
\9\	Sales and delivery release TeleControl Server Basic V3.1 + Update 1 (V3.1.0.1) https://support.industry.siemens.com/cs/ww/en/view/109757071

9 History

Table 9-1

Version	Date	Modifications
V1.0	05/2016	First version
V1.1	02/2018	• Upgraded to STEP 7 V14. • New block and data point link for the simulation and transfer of fill level and inflow.
V1.2	06/2018	• Upgraded to STEP 7 V15. • New TCSB functions added. • OPC Scout replaced by UaExpert.
V2.0	09/2019	Upgraded to STEP 7 V15.1