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# SIMATIC S7-based telecontrol via the IEC 60870-5 protocol

CP 1243-1, CP 1542SP-1 IRC, TIM 1531 IRC

https://support.industry.siemens.com/cs/ww/en/view/87447188

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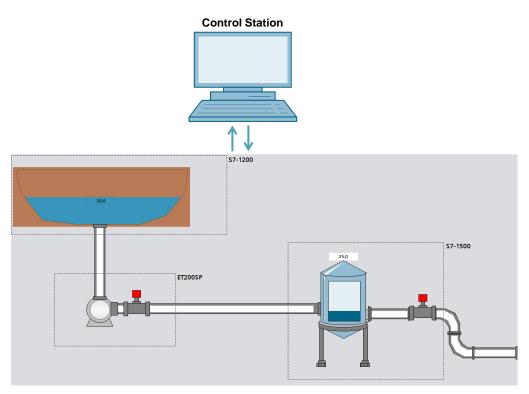
# 1 The task

#### Overview of the automation task

The outstations "rain overflow basin", "pump station" and "elevated tank" are connected to a central control station.

The following figure gives an overview of the automation task.

Figure 1-1



#### Description of the automation task

An elevated tank that, for example, is responsible for supplying water to a town, is monitored by a SIMATIC S7-1500. If the level falls below the minimum, the pumping station is activated until the elevated tank is completely filled again.

The pumping station is monitored and controlled by an ET 200SP.

The stormwater overflow tank is monitored by a SIMATIC S7-1200. The level is transmitted to the control station, as is an alarm if the minimum or maximum level is reached.

#### The requirements based on the automation task

- 1. The control center must be able to request process data from the outstations.
- 2. The control station must be able to send commands and setpoints spontaneously to the outstations.
- 3. The outstations must be able to send process data spontaneously to the control station.
- 4. Process data must be stored in the outstations and sent to the master when the connection is re-established in the event of a disconnection.
- 5. A standardized protocol must be used for the implementation.

# 2 Solution

### 2.1 Overview

The control station communicates with the external stations via the telecontrol protocol IEC 60870-5 via Ethernet (IEC 60870-5-104).

In the application example, the following types of data points have been configured.

- Commands (Single Command)
- Measured values (Measured value, short floating point number)
- Binary Messages (Single-point information)

In the example, all data points are provided with time stamps.

The integration of TeleControl configuration into the TIA Portal V17 simplifies engineering. In addition, cross-communication between the outstations is now possible:

- S7-1200 with
  - CP 1243 1 or
  - CP 1243 7 LTE or
  - CP 1243-8 IRC
- ET 200SP with CP 1542SP-1 IRC
- S7-1500 with TIM 1531 IRC
- **NOTE** The scenario is typically put into operation with VPN tunnels. The configuration required for this is not covered in this document.

#### Diagram

The following diagram shows the most important components of the configured solution: Figure 2-1

S7-1200 with CP 1243-1 S7-1500 TIM 1531 IRC

The outstations are available in 3 versions:

- S7-1500 with TIM 1531 IRC
- S7-1200 with CP 1243-1
- ET 200SP (based on S7-1500) with CP 1542SP-1 IRC

The WinCC TeleControl software is installed at the control station, making the control station the IEC master.

A SIMATIC S7-1500 CPU with the TIM 1531 IRC as IEC station is installed on the outstation "elevated tank".

The outstation "rain overflow basin" consists of a SIMATIC S7-1200 CPU and a CP 1243-1 installed as IEC station.

The outstation "pump station" consists of a SIMATIC ET 200SP CPU and a CP 1542SP-1 IRC installed as IEC station.

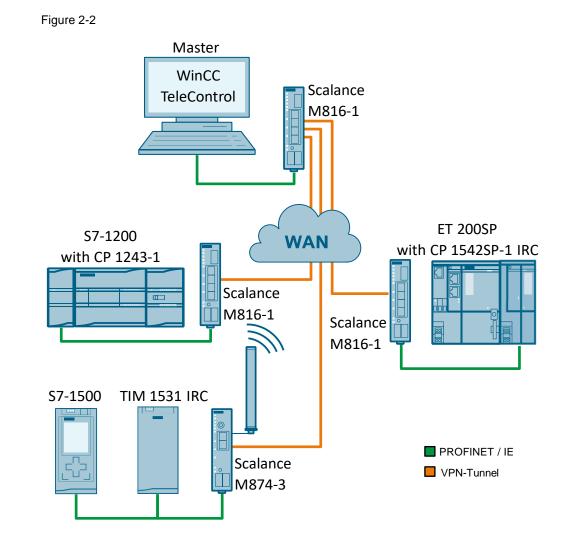
#### Advantages

The solution presented here offers you the following advantages:

- Use of the standardized IEC 60870-5 protocol
- Efficient and safe monitoring and control of process plants
- Homogeneous SIMATIC solution, as the SIMATIC portfolio offers software and hardware for IEC 60875-5 masters and outstations
- Connection to all standardized IEC 60875-5 master systems.

#### Typical configuration with VPN tunnels

It is also possible to secure communication via VPN tunnels. The hardware structure could look like the following figure:

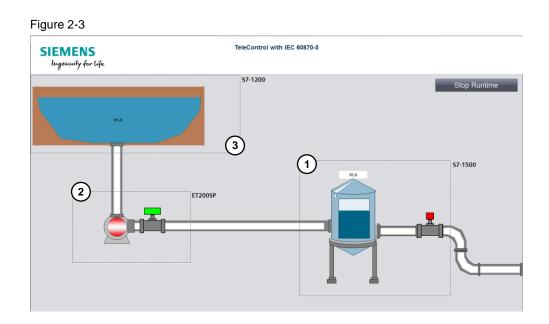


# **NOTE** The configuration is not described further in this application example. An overview document of the various configuration options can be found under the following link:

https://support.industry.siemens.com/cs/ww/en/view/26662448

#### Scenario

The application example is operated via the WinCC Runtime. The user interface is shown in the following figure.



- The filling level is simulated in the station "elevated tank" (S7-1500). This is transferred to the master when changes are made. If the level falls below a minimum (<=10%), an alarm is sent to the master. The pumping station must be activated by the operator to fill the elevated tank. If the maximum is reached (>= 90%), an alarm is sent again to the operator that intervention is required to prevent the elevated tank from overflowing. The operator can drain water from the elevated tank via a valve.
- In the station "Pumpstation" (ET 200SP) a valve can be controlled by the operator. Depending on the valve position, the pump is activated or deactivated.
- 3. In the station "stormwater overflow tank" (S7-1200) the filling level is simulated and if there is a value change it is sent to the master.

# 2.2 Components used

This application example has been created with the following hardware and software components: Table 2-1

Component	Num ber	Article number	Note
SIMATIC Field PG M6	1	6ES7718-00	
CPU 1511-1 PN	1	6ES7511-1AK01-0AB0	Firmware V2.6 or higher
TIM 1531 IRC	1	6GK7543-1MX00-0XE0	Firmware V2.0 or higher
CPU 1214C DC/DC/DC	1	6ES7214-1AG40-0XB0	Firmware V3.0 or higher
CP 1243-1	1	6GK7243-1BX30-0XE0	Firmware V3.1 or higher It can also be a CP 1243-7 LTE (Firmware V3.3 or higher) or a CP 1243-8 IRC (Firmware V3.0 or higher).
CPU 1510SP-1 PN	1	6ES7512-1DJ01-0AB0	Firmware V2.6 or higher
CP 1542SP-1 IRC	1	6GK7542-6VX00-0XE0	Firmware V2.0 or higher
WinCC V7.5 SP1	1	6AV6381-2CB07-5AX0	Service Pack 1 for WinCC V7.5 : <u>https://support.industry.si</u> <u>emens.com/cs/ww/en/vie</u> <u>w/109772879</u>
SIMATIC TeleControl 7.4 for WinCC Basic Engineering	1	6DL5000-7AA47-0XA5	
SIMATIC TeleControl 7.4 for WinCC Server Runtime (6 Stations)	1	6DL5002-7AA47-0XA0	
TeleControl IEC Driver	1	6DL5101-8EX00-0XB0	Patch 2 https://support.industry.si emens.com/cs/ww/en/vie w/109774012
STEP 7 PROF V17	1	6ES7822-1AA07-0YA5	

#### Example files and projects

This application example consists of the following components:

Table 2-2

Component	File name	Note
Documentation	87447188_IEC_Telecontrol_DOC_V40_en.pdf	This document
Project	87447188_IEC_Telecontrol_CODE_V40.zip	This compressed file contains: • STEP 7 V17 Project • WinCC 7.5 SP1 Project

# 3 Basics of IEC 60870-5

IEC 60870-5 is a telecontrol protocol that enables the transmission of process data via serial (IEC 60870-5-101) or IP-based (IEC 60870-5-104) communication.

The most important aspect of standard protocols is the high compatibility and interoperability between devices from different manufacturers.

#### ASDU Addresses

The IEC protocol defines a master, e.g. the computer from which the service personnel can operate and monitor the plant, and the outstations, the remote stations, often also called RTU (Remote Terminal Unit).

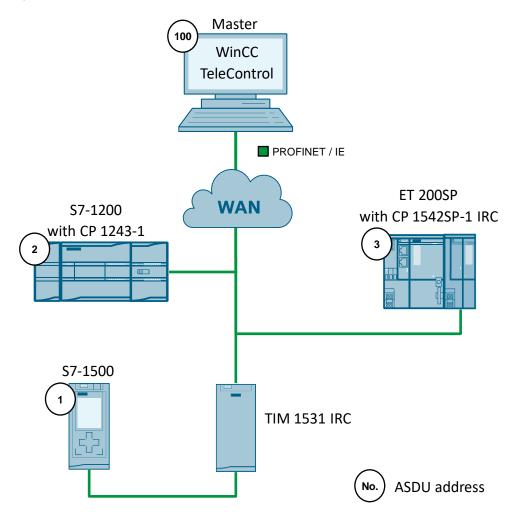
Each IEC device must have a unique address. Using this address, the message frames can be sent to the correct partner.

The source and destination addresses (ASDU addresses) of a telegram are sent with the process data, so the receiver knows to whom it must respond.

In this application example, process data is sent and received between four devices. The communication takes place between the master and the S7-1500 Station / S7-1200 Station / ET 200SP Station.

The addresses are assigned in this application example as shown in the following figure.

Figure 3-1



You can select an address between 1 and 65535.

**NOTE** The configuration of the master is done in the WinCC Explorer. The configuration of the stations is carried out in the TIA Portal. During the connection configuration the configured master address must be specified.

# 4 Program overview

This chapter briefly explains the program structure of the application example. The supplied code contains the following files:

- STEP 7 V17 project
- WinCC V7.5 SP1 project

### 4.1 STEP 7 V17 projects (IEC stations)

The IEC stations are configured in the STEP 7 project. The focus of the application example is on the configuration of the devices in the TIA Portal. The configuration of the devices is described in <u>chapter 5</u>. To illustrate the functions of the IEC 60870-5 protocol, a simulation was created that is based on a water/wastewater application (greatly simplified).

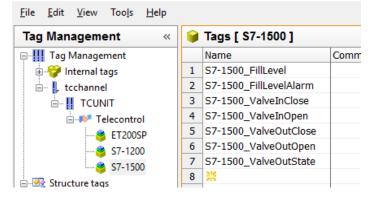
**NOTICE** This application example can only be used for test purposes!

### 4.2 WinCC project (IEC master)

The HMI system is configured in SIMATIC WinCC. In addition, the add-on software WinCC TeleControl is used to configure the IEC master. The IEC configuration of the master is described in detail in <u>chapter 6</u>. For the process data, a group was created for each station in the "Tag Management". The names of the tags do not have to match the names of the objects in the station configuration, but it is important that the configuration of the objects matches the station (group, variation, class, etc.).

Figure 4-1

III Tag Management - WinCC Configuration Studio



### 4.3 Overview of data points

The following tables provide an overview of the data points that are configured in this application example.

The data points of the IEC master are provided with a prefix.

The data point type indicates which objects/data points are commands, binary or analog values. The class indicates whether they are static data or events.

#### Data points S7-1200

Table 4-1: Data points station S7-1200

STEP 7	WinCC	Data point type	Index
FillLevel	S7-1200_FillLevel	Measured value, short floating point number with time tag CP56Time2a <36>	1
ValveOutOpen	S7-1200_ ValveOutOpen	Single command with time tag CP56Time2a <58>	2
ValveOutClose	S7-1200_ ValveOutClose	Single command with time tag CP56Time2a <58>	3

#### Data points S7-1500

Table 4-2: Data points station S7-1500

STEP 7	WinCC	Data point type	Index
FillLevel	S7-1500_FillLevel	Measured value, short floating point number with time tag CP56Time2a <36>	1
FillLevelAlarm	S7-1500_ FillLevelAlarm	Single-point information with time tag CP56Time2a <30>	2
ValveOutOpen	S7-1500_ ValveOutOpen	Single command with time tag CP56Time2a <58>	3
ValveOutClose	S7-1500_ ValveOutClose	Single command with time tag CP56Time2a <58>	4
ValveOutState	S7-1500_ ValveOutState	Single-point information with time tag CP56Time2a <30>	5
ValveInOpen	S7-1500_ValveInOpen	Single command with time tag CP56Time2a <58>	6
ValveInClose	S7-1500_ValveInCose	Single command with time tag CP56Time2a <58>	7
ValveInState	S7-1500_ValveInState	Single-point information with time tag CP56Time2a <30>	8

#### Data points ET 200SP

Table 4-3: Data points station ET 200SP

STEP 7	WinCC	Data point type	Index
PumpActivated	ET200SP_PumpActivated	Single-point information with time tag CP56Time2a <30>	1
ValveInOpen	ET200SP_ValveInOpen	Single command with time tag CP56Time2a <58>	2
ValveInClose	ET200SP_ValveInClose	Single command with time tag CP56Time2a <58>	3
ValveInState	ET200SP_ValveInState	Single-point information with time tag CP56Time2a <30>	4

# 4.4 Addresses in the example

The following IP and ASDU addresses are used to configure the example in the LAN:

Station	Module	•	IP address	Subnet mask	ASDU address
IEC master	SIMATIC PC st	ation	192.168.1.100	255.255.255.0	100
S7-1500	TIM 1531 IRC X1		192.168.0.11	255.255.255.0	1
	X2		192.168.1.1	255.255.255.0	
		Х3	192.168.2.1	255.255.255.0	
S7-1200	CP 1243-1		192.168.1.2	255.255.255.0	2
ET 200SP	CP 1542SP-1 I	RC	192.168.1.3	255.255.255.0	3

Table 4-4: IP- / ASDU Adresses

# 5 IEC configuration in the TIA Portal

The configuration of the hardware and the IEC configuration for the clients takes place in STEP 7 V17. No additional tool is required.

## 5.1 Device configuration

In the "Device configuration" both the hardware and the IEC parameters that are relevant for the entire station are configured. Make the settings as follows:

**NOTE** The following description assumes that the WinCC runtime is started on the programming computer.

#### 5.1.1 WinCC V7.5 as an IEC master

1. Add a "PC station" to your project.

Hardware catalog	<b>- - -</b>	
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☑ Filter Profile: <all></all>	- 📑	catalog
PC general     PC station		ĝ
SIMATIC Controller Application		2
SIMATIC HMI application		
User applications		Online
Communications modules		ne to

2. Add a communication module "IE general".

Hardwar	e catalog		<b>I</b> 🗉 🕨	
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		er Application		
	АПС НМІ арр			0
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1	🛚 IE general			F
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3. Add a user application "Application"

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~	Catalog	Hardware catalog
	fini (ini	re c
	Filter Profile: <ali></ali>	atal
►	🛄 PC general	g
•	SIMATIC Controller Application	
•	🙀 SIMATIC HMI application	ų,
-	🐻 User applications	
	OPC server	nli
	Application	ne
•	Communications modules	Online tools

 Network the communication module with a new subnet "IEC 60870-5" "IE general > Properties > Ethernet addresses > Interface networked with > Add new subnet").

		2	Topology view	h Network	view 📑 Devi	ce view	
IEC_Master [SIMATIC PC Static							
	toprovi which a top						
SIMATIC PC station			3 100		<b>.</b>	~	Device data
PROFINET interface [Module]		10	Properties	🗓 Info 🔒 🖞			Ŧ
	stem constants Texts				, bragnostato		
General Options	Ethernet addresses						*
Ethernet addresses	Interface networked with						-
<ul> <li>Advanced options</li> </ul>	Subnet:	lot networked Add new subne	2			•	
			9)				

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		Add new subnet			
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4		08 -00 -06 -01 -00 -00			
	Internet protocol version 4 (If	∿4)			
	Use IP pro	192.168.1       .100         255.255.255.0	]		

5. Adjust the IP address and subnet mask according to Table 4-4.

6. Give the PC station a meaningful name and translate the PC station "SIMATIC PC station > General > Computer name".

		🚽 Topology view 🛔	Network view 📑 Device view
IEC_Master [SIMATIC PC Statio	- 📰 🖭 🚄 🖽 🛄 🔍 ±		II.
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SIMATIC PC station	Application	> 100%	
SIMATIC PC station [Rail]			Info 😧 🗓 Diagnostics 📃 🗆 🗉
	stem constants Texts		
SIMATIC PC Station     General     XDB configuration	General		
	Name: IEC_Master Computer name: DESKTOP	identical to PC station name	
	Author: DIL Comment:	2	

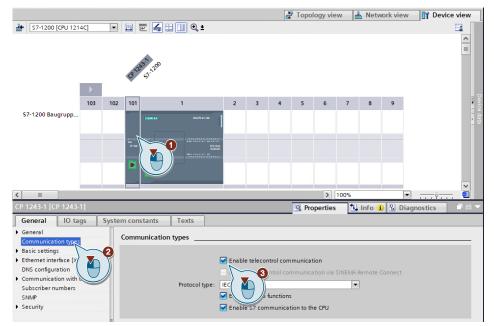
#### 5.1.2 Station S7-1200 with CP 1243-1 or ET 200SP with CP 1542SP-1 IRC

In order for an S7-1200 or an ET 200SP CPU to work as an IEC station, some settings must be observed. These are described in the following chapter using an S7-1200 as an example.

#### Hardware configuration

- 1. Add your SIMATIC S7-1200 CPU with a CP 1243-1 to the project "Communication modules > Industrial Remote Communication > CP 1243-1".
- 2. Activate the "Telecontrol communication"

"CP 1243-1 > Properties > Communication types > Enable telecontrol communication".



- 3. Select "IEC 60870-5" from the "Protocol type" drop-down list.
- 4. Enable the online functions

"CP 1243-1 > Properties > Communication types > Enable online functions".

С	P 1243-1 [C	P 1243-1]				🧟 Propertie	s 🗓 Ini	fo 追 🗓 Diagnostics	1
Γ	General	IO tags	Syst	tem constants	Texts				
•	General Communicat	tion types		Communication	types				
	Basic setting								
•	Ethernet inte DNS configur					Enable telecontrol communication		ate Connect	l
•		tion with the CPL	,		Protocol type	· · · · · · · · · · · · · · · · · · ·		te connect	
	Subscriber n SNMP	umbers			i i otocor type	Enable online functions			
Þ	Security					Menable S7 communication to the CPU		•	

Add the "Ethernet interface [X1] to the subnet "IEC 60870-5"
 "CP 1243-1 > Properties > Ethernet interface [X1] > Interface networked with".

CP 1243-1 [CP 1243-1]		Q Properties	🚺 Info 🔒 🔮 Diagnostics 📃 🗏
General IO tags Sys	stem constants Texts		
General     Communication types	Ethernet interface [X1]		-
Basic settings     Ethernet interface [X1]	General		
DNS configuration Communication wit Subscriber number:	Name: E Comment:	thernet interface	
Security			V
	Interface networked with		
	Subnet: I	EC 60870-5 Add new subnet	2
	Internet protocol version 4 (IPv	4)	
	(	Set IP address in the project	
		IP address: 192 . 168 . 1 . 2	
		Subnet mask: 255 . 255 . 255 . 0	

6. Adjust the IP address and subnet mask according to Table 4-4.

CP 1243-1 [CP 1243-1]		🖳 Propert	ies 🔄 🗓 Info 🔒 🗓 Diagnostics	
General IO tags Sys	tem constants Texts			
General     Communication types	Ethernet interface [X1]			*
Basic settings	General			
Ethernet interface [X1]				
DNS configuration				
Communication with the CPU	Name:	Ethernet interface		
Subscriber numbers	Comment:			~
SNMP				
<ul> <li>Security</li> </ul>				
				~
	Ethernet addresses			
	Interface networked with			
ļ.		,		
	Subnet:	IEC 60870-5		-
		Add new subnet		
	Internet protocol version 4 (I	Pv4)		
		Set IP address in the project		
		IP address: 192 . 168 . 1	. 2	
		Subnet mask: 255 . 255 . 25	5.0	

7. Enter an ASDU address for the IEC station (e.g. 2)

"CP 1243-1 > Properties > Subscriber numbers > ASDU address".

CP 1243-1 [CP 1243-1]		🔍 Properties	🗓 Info 🔒 📱 Diagnostics	
General IO tags Syst	tem constants Texts			
General	Subscriber numbers			
Communication types				
<ul> <li>Basic settings</li> </ul>				
Ethernet interface [X1]	ASDU address: 2			
DNS configuration				
Communication with the CPU				
Subscriber numbers				
SNMP				
Security	Ŭ			

**NOTE** The ASDU address assigned here must be entered in the configuration of the master station.

#### Configuring the TeleControl connection

- 1. Change to the network view.
- 2. Open the "Network data" editor and switch to the "TeleControl" tab.
- 3. Now switch to the "IEC 60870" tab and add a new connection.

IEC_Telecontrol ► Devices	& networks					×
			_	🛃 Topology view	📥 Network view	Y Device view
Network overview	Connections I/O com	munication VPN TeleControl			E	J/
ST7 DNP3 IE	C 60870-5		J /			
2						
Telecontrol connecti			2			
Connection	Start point	Start subscriber Start interface	Lint		led partn Partner list	Enu interface/add
Y <mark>x</mark>	•	• • •	*	• *	Ŧ	
<8rd news	Ň					

- 4. Select the S7-1200 station as start point and the CP 1243-1 as start interface.
- 5. Select the application of the PC station as the end point and the IE interface of the PC station as the end interface.
- 6. Enter the end subscriber number (e.g. 100). This number is the subscriber number of the master station.
- 7. Under partner list, enter the subscriber number of the S7-1200.

#### **Result:**

The TeleControl connection is now configured for the client station.



#### Data point configuration

- 1. Create a data block that contains all variables that are to be exchanged with the IEC master.
- 2. Open the data point settings via the project navigation "S7-1200 > Local modules > CP 1243-1" and double-click on "Data points".
- 3. Add a new data point. Link it to a tag of the previously created data block.

**NOTE** The "Datapoint index" is assigned automatically. You need the index number for the configuration of the variable on the IEC master.

- 4. Assign the desired type to the data point and activate value monitoring so that the type of transmission (class) can be selected. The IEC type is displayed in brackets next to the data point type.
- 5. Select the IEC master as partner of the data point.

									🔢 Data	points	🛃 Messag	ges
to	<b>→ +</b>											
D	Data points							_			_	
	Name	PLC tag	Data point type		Type of transmission		Datapoint index	Partne	er of the data point			
	🖬 FillLevel		Measured value, short floating p			-	1	WinCo	V7.4 TeleControl	-		
_	🔟 OpenValve		Single command with time tag				2					
3 ┥		"CP Data".CloseValve	Single command with time tag	CP56T	Transfer after call (class 0)		3	WinCO	V7.4 TeleControl			
4	<add></add>											
	<											
FillL	evel [Data po	pint]					🧟 Proper	ties	🗓 Info 🔒 📱	Diagnos	tics	
Ge	eneral IO	tags System of	onstants Toxts									
Ge	eneral		neral									
Tri	igger	Ger	neral			_						- 1
	nalog value prep	processing										
	utput options		Name:	FillLevel	l							
Pa	rtner stations		PLC tag:	"CP Data	a".FillLevel							
			Datapoint type:	Measur	ed value, short floating poir	it nu	mber with time t	ag CP56	oTime2a <36>		•	•
			Datapoint index:	1								
			Type of transmission:	Everyva	alue triggered							-
			Read cycle:	Normal	cycle							-
				Rer D	onse to general request							

6. Adjust the options under "Trigger" and "Output options".

**NOTE** The settings made here must match the data point configuration in the IEC master.

- 7. Repeat the configuration for all required data points.
- 8. Compile and load the configuration into your device.
- **NOTE** The configuration of the ET 200SP is analogous to the S7-1200.

#### 5.1.3 Station S7-1500 with TIM 1531 IRC

To operate an S7-1500 as an IEC station, you need a TIM 1531 IRC. The TIM is not configured like a classic CP, but as an independent device.

#### **Device configuration**

- 1. Add a S7-1500 CPU and a TIM 1531 IRC to your project.
- Connect the S7-1500 to a TIM interface (e.g. in the network view of the device configuration). Connect another interface of the TIM with the subnet "IEC 60870-5".

			🛃 Topology view 🛛 🛔 Network view	w 📑 Device view
twork 🔡 Connections 🛛 HM connection	- 🗹 👯 🗐 🖽 🛄 Q. ±			
				2
C_Master MATIC PC Stat				
	IEC 60870-5			
TIM_1 TIM 1531 IRC	ET 2005P CPU 15125P-1 PN	57-1200 CPU 1214C		
PN/IE_1				
57-1500 CPU 1511-1 PN				

- Activate the "Telecontrol communication" ("TIM 1531 IRC > Properties > Communication types > Enable telecontrol communication").
- 4. Select "IEC 60870-5" from the "Protocol type" drop-down list.

		🛃 Topology view	📩 Network view	Device view
11M_1 (TIM 1531 IRC)	- 🖽 😇 🍊 🖽 💷 Q.±			
		> 100		
TIM_1 [TIM 1531 IRC]			💈 Info 🔒 💆 Diag	
	tem constants Texts Communication types Enable telecontrol communication C 600705			

- 5. Switch to "Ethernet interface [X2]"
- 6. Under "WAN settings" select "IEC 60870-5" as the network type and "Station" as the network node type.
- 7. Add the interface to the "IEC 60870-5" subnet.
- 8. Adjust the IP address and subnet mask according to the Table 4-4.

TIM_1 [TIM 1531 IRC]			🔍 Properties 🚺 Info 🚺 🗓 Diagnostics	
General IO tags Sys	tem constants Tex	s		
General	WAN settings			
Communication types				
<ul> <li>Basic settings</li> </ul>		MAN type:	IP-based	
<ul> <li>Ethernet interface [X1]</li> </ul>				-
Ethernet interface [X2]	Net	vork type:	IEC 60870-5	
Ethernet inte ce [X3]	Network	ode type:	Station	-
<ul> <li>Serial interfact</li> </ul>				_
Webserver	Ethernet addresses			
Web diagnosti				_
DNS configuratio	Interface networke	with		_
Communication with the CPU				
Time-of-day synchronization		Subnet:	IEC 60870-5	
E-mail configuration			Add new subnet	
Subscriber numbers				
SNMP	IP protocol			
Certificate manager				
Protection .			Set IP address in the project	
-			IP address: 192.168.1.1	
	•			
-			Subnet mask: 255 . 255 . 0	

- 9. Switch to "Subscriber numbers".
- 10. Select the S7-1500 as "Assigned CPU".
- 11. Assign an ASDU address ("ASDU address") (e.g. 1).

TIM_1 [TIM 1	1531 IRC]					Reperties
	1551 mc]			V	2	
General	IO tags	Syst	tem constants	Texts		
General			Subscriber nur			
Communicat	tion types		Subscriber nur	nbers		
Basic setting	gs.					
Ethernet inte	erface [X1]			Assigned	CPU: \$7-1500	
Ethernet interview	erface [X2]			ASDU add	ress: 1	
Ethernet interint	erface [X3]					
<ul> <li>Serial interfa</li> </ul>	ce [X4]					
Web server						
Web diagnos	stics					
DNS configu	ration					
Communication	tion with the CPI	U				
Time-of-days	synchronization					
E-mail config	guration					
Subscriber n	umbers					
SNMP						
Certificate m	anager 🌔 🍋					
Protection		/ •				
	$\smile$					

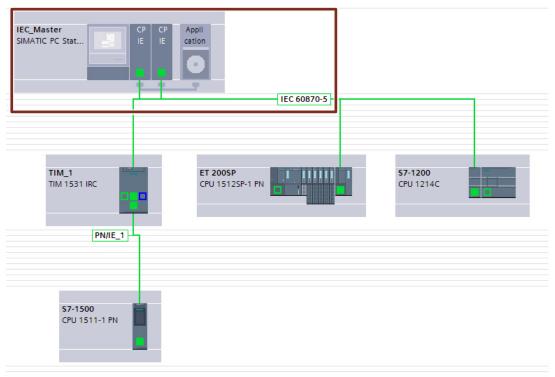
# **NOTE** The ASDU address assigned here must be entered in the configuration of the master station.

The configuration of the TeleControl connection and the configuration of the data points is identical to the S7-1200 or ET 200SP. Use the configuration steps in <u>chapter 5.1.2</u>.

### 5.2 Server Redundancy Setup

If you want to create server redundancy, you can do so as follows.

 Create an IEC master with 2 Ethernet interfaces and network them with the subnet " IEC 60870-5". A detailed description of this can be found in <u>chapter 5.1.1</u>.



- 2. Change to the network view.
- 3. Open the "Network data" editor and switch to the "TeleControl" tab.
- 4. Now switch to the "IEC 60870-5" tab and add a new connection.



- 5. Select the S7-1200 station as start point and the CP 1243-1 as start interface.
- 6. Select the application of the PC station as the end point.

Ne	etwork overvie	w Conned	ctions I/O c	ommunication	VPN TeleC	ontrol			
ST	ST7 DNP3 IEC 60870-5								
1									
Т	elecontrol cor	nections							
	Connection	Start point	Start subscriber	Start interface	Start interface (red.)	End point	End subscriber		
Ť	\$7-1200	<b>57-1200</b>	2	СР 1243-1 💌	-	IEC_Master.WinCC V7.4 💌	100		

7. Start the "Add connection path" dialog.

Network	overviev	v Conne	ctions	I/O co	mmunication	VPN	TeleC	ontrol		
ST7	ST7 DNP3 IEC 60870-5									
1										
1-1	trol con	nections								
	ction !	Start point	Start sub	scriber	Start interface	Start interface	(red.)	End point		End subscriber
Vx V		*	*	-	T			*	•	*
L 37-1.	200	S7-1200	2		CP 1243-1 💌		-	IEC_Master.WinCC V7.4	-	100
<add< th=""><td>new&gt;</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></add<>	new>									

#### **Result:**

Two connection paths are displayed.

8. Select the first connection path and add it.

Module				Subscriber	number		Networks			
	> CP 1243-1 > WinCC \	V7.4 TeleControl		2 > 2 > 100			Backplane > IEC	60870-5		
	> CP 1243-1 > WinCC \			1.00			Backplane > IEC			
57 1200							buenplane > ies			
Connec	tion path									
Position	Module name	Subscriber num	Station name	In	terface		Interface type	Mode	Network	
<b>.</b>	\$7-1200	2	S7-1200-Stat	tion_1				None	Backplane	
	CP 1243-1	2	\$7-1200-Stat	tion_1				None	Backplane	
<b>.</b>	CP 1243-1	2	\$7-1200-Stat	tion_1 E	Ethernet interface [X1]		[X1] IEC	Station	IEC 60870-5	
	IE general_2		IEC_Master	P	ROFINET interfa	ce [X1]	Ethernet	Neutral	IEC 60870-5	
Preview										
	point Start inter			End point	Partner list		erface/address			
\$7-1	200 CP 1243-1	- Ethernet interface (X1		WinCC V7.4 Tel	100	IEC_Ma	aster - IE general_2	2 - PROFINE	Tinterface (X1)	
<				<u></u>						
	ormation									
		ted. Number of updated								
M)	-1200, Row was updat	ted. Number of updated	rows: 1.							:

9. Repeat this procedure for the second connection path.

#### Result:

Both routes are created and the interfaces are entered automatically.

1	Network overview Connections I/O communication VPN TeleControl											
ST7 DNP3 IEC 60870-5												
2												
	Tel	lecontrol cor	nections									
_		Connection	Start point	S	Start interface	Start interface (red.)		End point	End	Partner list	End interface/address	End interface/address (red.)
Y <sub>×</sub>	-	*	*				Ŧ	*	*	•	-	<b>•</b>
	Ľ	\$7-1200	57-1200 ·	- 2	CP 1243-1 💌	CP 1243-1 - Ethe	•	🚟 IEC_Master.WinC 💌	100	100	IEC_Master - IE general_1 💌	IEC_Master - IE general_2 💌
		<add new=""></add>										

10. Perform these steps for the other devices as well.

# 6 IEC configuration for the IEC master

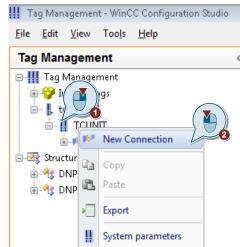
The IEC configuration of the master takes place in the SIMATIC WinCC Explorer. The WinCC TeleControl add-on software is required for this. Make the settings in WinCC as described in the following chapters.

### 6.1 Inserting the IEC driver

- 1. Open WinCC Explorer and create a new project.
- 2. Open the Task Management.
- 3. Add the TeleControl channel "tcchannel".



#### 4. Add a new connection.



5. Open the connection configuration.

🛄 Tag Management -	WinC	C Configuration Studio	
<u>F</u> ile <u>E</u> dit <u>V</u> iew T	oo <u>l</u> s	<u>H</u> elp	
Tag Managemen	t		«
🖃 📶 Tag Manageme			
annel			
Tele	۵ 🥞	New Group	
🛓 🕀 DNPCONN		Сору	
🗄 🖓 DNPRTU	ß	Paste	
		Delete	
		Rename	
	>	Export	
	161	Connection Parameters	

#### **Result:**

The "Connection configuration" window opens.

6. Switch to the "PC Station View" tab.

Connection Configuration	
AS View PC Station View /alidation Results	
Components	
	Apply OK Cancel Help
	Apply <u>QK</u> <u>Cancel</u> Help

7. Adjust the ASDU address Table 4-4.

🔣 Connection Configu	iration*			- 🗆 ×	
Help					
AS View PC Station View	Validation Results				
IEC_TeleControl	Name	Value	Category	Description	
🗄 🖳 DESKTOP	Section 1 Port	20000	DNP	LAN1 Listen P	
	LAN 2 Port	20000	DNP	LAN2 Listen P	
	聲 Originator Ad	100	IEC	Originator Addr	
	📺 ОЗ Піте ма…		SINAUT	OB TIME Master	
	Subscriber N	2001	SINAUT	ST7 Subscribe	
]	,	Apply	<u>O</u> K <u>C</u> a	ncel Help	

8. Then switch to the AS View tab.

Con Configu Help AS View PC Station View	uration*			- 🗆 X
□   IEC_TeleControl	Name	Value	Category	Description
🗄 🖳 DESKTOP	Section 1 Port	20000	DNP	LAN1 Listen P
	KAN 2 Port	20000	DNP	LAN2 Listen P
	Section Address	100	DNP	DNP3 Link Ad
	😽 Originator Ad	100	IEC	Originator Addr
	塔 OS Time Ma	yes	SINAUT	OS Time Master
	Subscriber N	2001	SINAUT	ST7 Subscribe
·	,	Apply	<u>o</u> k	Cancel Help

9. Create an IEC connection ("IECCONN" node) for the CP of the S7-1200 station.

😥 Connection Configurat	ion*	
Help		
AS View PC Station View	Validation Results	
Components		
	Add 'TIM' AS Source Node Add 'STNALITETL' AS Source Node Add 'IECCONN' AS Source Node Ada IECGATEWAY AS Source Add 'IECRTU' AS Source Node Add 'DNPRTU' AS Source Node Add 'DNPCONN' AS Source Node Add 'DNPGATEWAY' AS Source Node Edit DNP Polling Groups Edit DNP Clusters Edit DNP Chains	<u>Cancel</u> Help

10. Select "104" as the protocol type and open the connection configuration.

📟 PCS 7 - IECCO	NN (IEC) AS Properties	×
General AS Node Name:	CP_1243-1	-1
	Protocol Type	
		!

- 11. Enter the IP address of the CP 1243-1 (192.168.1.2).
- 12. Select "Unstructured" as the object structure so that the object addressing does not have to be specified in octets.
- 13. Confirm twice with "OK".

TODALLaria		T:	
Connection Address 192.168.1.2		Timeouts TCP Connection	15 sec
Connection Port 2404		Offline Poll Period	10000 ms
,		Timer t1	15000 ms
Parameters		Timer t2	10000 ms
Max UnAcked Transmitted APDUs	12 k	Timer t3	30000 ms
Max UnAcked Received APDUs	8 w		
Common Address of ASDU Size	2 Octets 💌		
Information Object Address Size	3 Octets 🚽		
Information Object Address Structure			
Cause of Transmission Size	2 Octets 👻	S	

14. Now add a node for the RTU "S7-1200" (IECRTU).

🗱 Connection Configuration*		_		×
Help				
AS View PC S w Validation Results				
Components				Ī
CP_1243-1				
Add 'TIM' AS Source Node				
Add 'SINAUTRTU' AS Source Node				
Add 'IECCONN' AS Source Node				
Add 'IECGATEWAY' AS Source Node				
Add 'IECRTU' AS Source Node				
Add 'DNPRTU' AS Source Node				
Add 'DNPCONN' AS Source Node	ок	Cancel	ŀ	Help
Add 'DNPGATEWAY' AS Source Node				
Edit Object Properties				
Delete				

15. Assign a node name and enter the ASDU address. Then open the connection configuration.

📟 PCS 7 - IECRT	TU (IEC) AS Properties	×
General		
AS Node Name:	\$7-1200 AI	
	Identification Common Address of ASDU 2	
	Configure Connection Configure Parameters	
	<u> </u>	cel

- 16. Select "Direct" as the connection type.
- 17. Select the previously created connection ("CP\_1243-1") from the drop-down list.
- 18. Confirm the settings twice with "OK".

Configure IEC RTU Connections	$\times$
Connection Type Direct Gateway	
Connection1	
CP_1243-1 🔽 CP_1243-1	
Connection2	
Default Connection	
Master OS	
87447188_IEC_Telecontrol_WinCC	
<u> </u>	

- 19. Repeat the project engineering for each additional IEC station.
- 20. Close all windows with "OK".
- **NOTE** The system tags are created automatically after the TIM (or CP) and CPU have been configured in the System Parameters tab. The description of these tags can be found in the "User Manual for WinCC TeleControl", which is delivered with the WinCC TeleControl software.

## 6.2 Tag configuration

In order for the data points to be sent and received by the master, they must be configured in WinCC "Tag Management". Make the settings for this as follows:

- 1. Open WinCC Tag Management.
- 2. Create a new tag by double-clicking on it and assign it a unique name.

« 🤤	Tags [ Telecontrol ]				
	Name	Comment	Data type	Length	Format adaptati
43	S7-1200.TMC_S		Unsigned 32-bit value	4	DwordToUnsign
44	S7-1200.TMI		Unsigned 32-bit value	4	DwordToUnsign
45	S7-1200.TMI_S		Unsigned 32-bit value	4	DwordToUnsign
46			Binary Tag	1	
47	× N				
48					
49					
	43 44 45 46 47 48		Name         Comment           43         S7-1200.TMC_S           44         S7-1200.TMI           45         S7-1200.TMI           46         S7-1200.TMC           47         X           48         X	Name         Comment         Data type           43         57-1200.TMC_S         Unsigned 32-bit value           44         57-1200.TMI         Unsigned 32-bit value           45         57-1200.TMLS         Unsigned 32-bit value           46         57-1200.TMC         Binary Tag           47         #         48	Name         Comment         Data type         Length           43         57-1200.TMC_S         Unsigned 32-bit value         4           44         57-1200.TMI         Unsigned 32-bit value         4           45         57-1200.TMLS         Unsigned 32-bit value         4           46         57-1200.TMLS         Unsigned 32-bit value         4           47         27         28         1

#### 3. Select the data type and then open the address configuration.

🧃 Tags [ Telecontrol ]							Find		Q
Name	Comment	Data type	Length	Format adaptation	Connection	Group	Address	Linear scaling	AS
15 S7-1500.TMI_S		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:2:R0:TMI_S:7:0/0://:0: : :		
16 S7-1500_FillLevel		Floating-point number 32-bit IEEE	4	FloatToFloat	Telecontrol	S7-1500	2:2:RP: :8:1/1:36/VALUE/:0: : :		
17 S7-1500_FillLevelAlarm		Binary Tag	1		Telecontrol	S7-1500	2:2:RP: :1:1/2:30/VALUE/:0: : :		
18 S7-1500_ValveInClose		Binary Tag	1		Telecontrol	S7-1500	2:2:WP: :1:1/7:58/QOC/EX:0: : :		
19 S7-1500_ValveInOpen		Binary Tag	1		Telecontrol	S7-1500	2:2:WP: :1:1/6:58/QOC/EX:0: : :		
20 S7-1500_ValveInState		Binary Tag	1		Telecontrol	S7-1500	2:2:RP: :1:1/8:30/VALUE/:0: : :		
21 S7-1500_ValveOutClose		Binary Tag	1		Telecontrol	S7-1500	2:2:WP: :1:1/4:58/QOC/EX:0: : :		
22 S7-1500_ValveOutOpen		Binary Tag	1		Telecontrol	S7-1500	2:2:WP: :1:1/3:58/QOC/EX:0: : :		
23 S7-1500_ValveOutState		Binary Tag	1		Telecontrol	S7-1500	2:2:RP: :1:1/5:30/VALUE/:0: : :		
24 TIM_1531.CCE_M		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:1:RO:CCE_M:7:0/0://:0: : :		
25 TIM_1531.CCE_S		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:1:R0:CCE_S:7:0/0://:0: : :		
26 TIM_1531.CCO_M		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:1:R0:CC0_M:7:0/0://:0: : :		
27 TIM_1531.CCO_S		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:1:R0:CC0_S:7:0/0://:0: : :		
28 TIM_1531.CCR_M		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:1:R0:CCR_M:7:0/0://:0: : :		
29 TIM_1531.CCR_S		Unsigned 32-bit value	4	DwordToUnsignedDword	Telecontrol		2:1:R0:CCR_S:7:0/0://:0::::		
30 TIM_1531.CS_M		Unsigned 8-bit value	1	ByteToUnsignedByte	Telecontrol		2:1:RO:CS_M:3:0/0://:0: : :		
31 TIM_1531.CS_S		Unsigned 8-bit value	1	ByteToUnsignedByte	Telecontrol		2:1:RO:CS_S:3:0/0://:0: : :		
32 TIM_1531.RCC		Binary Tag	1		Telecontrol		2:1:WO:RCC:1:0/0://:0: : :		
33 S7_1200_ValveOutOpen		Binary Tag	1		Telecontrol		4		
34 💥			~	0		0-			
35			-	V		9.		1	
36								1)	
37								1	

4. Adjust the settings to the configuration of the corresponding data point in the CPU.

😭 System Configuratio	n	×
_ Variable Addressing Info	rmation	
40.4		
	Node \$7-1200	
Data Processing M	tode WP Output Signal (Command or Setpoint) written to RTU	
Organizational Data 1	Гуре	
Variable Address		
RTU Data Type		
Flag	QOC - Qualifier of Command	
	QOC - Qualifier of Command       EX - Execute Only	
Mode		
	Object Address 2	
Data Encoding	<b>↑</b>	
	OK Help	
L		
ValveOutOpen [Data point]	Properties 🚺 Info 😮 🗓 Diagnostics	-
General IO tags Syste	em constants Texts	
General Trigger	General	- =
Analog value preprocessing		
Output options     Partner stations	Name: ValveOutOpen PLC tag: "CP Data".ValveOutOpen Bl	
	Datapoint type: Single command with time tag CP56Time2a <38>	
	Datapoint index: 3	
•	Master function Type of transmission: Transfer after call (class 0)	
•	type of dominiation. In inster and can (class of	

- 5. Repeat steps 2 to 4 for the other data points.
- **NOTE** Tag Management offers you a grouping of tags. This increases the clarity for a large number of tags.

Tag Management					
🗈 🍄 Internal tags					
🖃 - 📙 tcchannel					
E IN Telecontrol					
😤 ET200SP					
S7-1200					
🥞 S7-1500					
🗄 🖓 Structure cags					

### 6.3 Setting up the Tag Logging

To ensure that the DNP3 objects can be completely archived and displayed by the master, you have to make some settings in the WinCC.

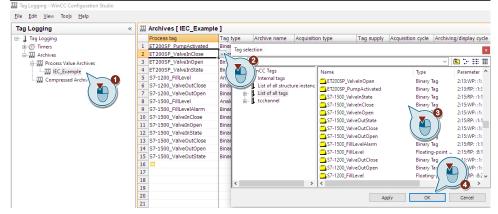
1. Open the WinCC "Tag Logging".

MinCCExplorer - C:\Users\Administrator\Desktop\87447188\_IEC\_Telecontrol\_CODE\_V3

2. Create a new "Process Value Archive". Further settings are not necessary. Tag Logging - WinCC Configuration Studio

<u>File E</u> dit <u>V</u> iew Too <u>l</u> s <u>H</u> elp					
Tag Logging	~		Archives [ Process \	/alue Archiv	/es]
🖃 🖳 Tag Logging			Archive name	Comment	Archivir
Timers		1	IEC_Example		
Archives		2			
Process Value Archives		3			
IEC_Example		4			
Compressed Archives		5			
		6			

3. Open the archive you have just created and add the variables to be archived.



	Archives [ IEC_Example	e]			_			
	Process tag	Tag type	Archive name	Acquisition type	Tag supply	Acquisition cycle	Archiving/display cycle	1
1	ET200SP_PumpActivated	Binary	IEC_Example	After every change	System	500 ms	1 day	¢
2	ET200SP_ValveInClose	Binary	IEC_Example	After every change	System	500 ms	1 day	e
3	ET200SP_ValveInOpen	Binary	IEC_Example	and the second s	System	500 ms	A day	e e
4	ET200SP_ValveInState	Binary	IEC_Example	After every change	System	500 ms	1 day	¢
5	S7-1200_FillLevel	Analog	IEC_Example	After every change	System	500 ms	1 day	
6	S7-1200_ValveOutClose	Binary	IEC_Example	After every change	System	500 ms	1 day	¢
7	S7-1200_ValveOutOpen	Binary	IEC_Example	After every change	System	500 ms	1 day	¢
8	S7-1500_FillLevel	Analog	IEC_Example	After every change	System	500 ms	1 day	
9	S7-1500_FillLevelAlarm	Binary	IEC_Example	After every change	System	500 ms	1 day	e

### 4. Adjust the "Acquisition type" and the "Archiving/display cycle".

# 7 Installation

This chapter provides installation instructions for the hardware and software required to operate this example application.

### 7.1 Hardware installation

The hardware components can be found in <u>chapter 2.2</u>. Proceed as follows for the hardware setup:

- 1. Mount the individual modules on a suitable carrier.
- 2. Connect the components to a 24 V DC power source.

- 3. Connect all components to the power supply.
- **NOTE** The CP 1243-1 is supplied via the CPU.
  - 4. When all stations are configured and loaded, they connect the devices according to the configuration as described in <u>Figure 2-1</u>.
- **NOTE** Only switch on the power supply after you have completed and checked the assembly!
- **NOTE** The installation guidelines for the installation of all components must generally be observed.

### 7.2 Installing the software

In this application example, the configuration computer is also used as IEC master at the same time.

If you use separate computers for project engineering and for the IEC master, the following software must be installed on the IEC master computer:

- SIMATIC WinCC Server Runtime V7.5 SP1
- SIMATIC TeleControl Server V7.4 with Patch 2

#### Installation sequence

Install the software listed in <u>Table 2-1</u>. Make sure that WinCC TeleControl cannot be installed until SIMATIC WinCC has been installed.

### 7.3 Installing the application software

Follow the steps below to install the sample code.

- 1. Download the code for this application example from the corresponding article page.
- 2. Unzip the file "87447188\_IEC\_Telecontrol\_CODE\_V40.zip" and open the project. The project is located in the subfolder "TIA Portal".
- 3. Log in with the following user data:
  - User name: "administrator"
  - Password: "administrator"

**NOTE** Follow the instructions for installing the software in the manuals for the respective software.

# 8 Commissioning

Download the zipped project file from the article page and unzip it.

#### **Downloading stations**

Load the configurations into the stations and into the TIM 1531 IRC as described.

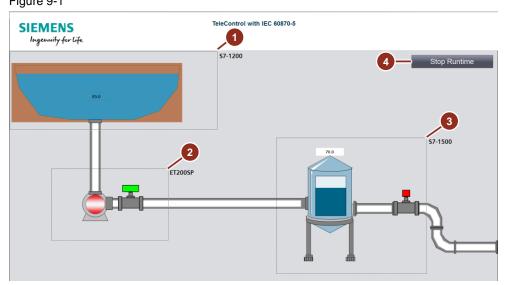
- 1. Assign the IP address to your IEC master from Table 4-4.
- 2. Open the TIA Portal project.
- 3. Load the S7 stations.

**NOTE** The ER-LED of the CP 1542SP-1 IRC flashes RED until a TeleControl connection is established.

### 9

# Operation of the application example

If the stations are configured and loaded, the application example can be operated. Open the WinCC project in the WinCC Editor and start the WinCC Runtime. Figure 9-1



1. Outstation "stormwater overflow tank"

This is controlled/simulated by a SIMATIC S7-1200. The filling level fills up automatically to 100 %. When the pumping station is activated, water is taken from the tank. There is no direct operating option.

2. Outstation "pumping station"

This is controlled/simulated by a ET 200SP. The valve can be activated to fill the elevated tank. The pump is controlled according to the valve status and flashes red when it is active.

3. Outstation "elevated tank"

This is controlled/simulated by a SIMATIC S7-1500. The valve can be activated to empty the elevated tank. If the level drops below 10% or rises above 90%, an alarm is sent to the server and the level indicator flashes red.

4. End the runtime

# 10 Appendix

### 10.1 Service and support

#### **Industry Online Support**

Do you have any questions or need assistance?

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

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

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

#### **Technical Support**

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

Please send queries to Technical Support via Web form:

siemens.com/SupportRequest

#### SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry 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 our web page:

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#### 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 web page:

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 iOS and Android:

support.industry.siemens.com/cs/ww/en/sc/2067

## 10.2 Industry Mall



The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location: mall.industry.siemens.com

### 10.3 Links and literature

No.	Торіс
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/87447188
\3\	Overview: Secure Remote Access with VPN https://support.industry.siemens.com/cs/ww/en/view/26662448
\4\	SIMATIC TeleControl V7.4 use with WinCC V7.5 SP1 https://support.industry.siemens.com/cs/ww/en/view/109774012
\5\	SIMATIC NET: S7-1500 - TeleControl TIM 1531 IRC https://support.industry.siemens.com/cs/ww/en/view/109748454
\6\	SIMATIC NET: ET 200SP - Industrial Ethernet CP 1542SP-1, CP 1542SP-1 IRC and CP 1543SP-1 https://support.industry.siemens.com/cs/ww/en/view/109741690
\7\	SIMATIC NET: S7-1200 - TeleControl CP 1243-1 https://support.industry.siemens.com/cs/ww/en/view/103948898
\8\	WinCC V7.5 SP1: Working with WinCC https://support.industry.siemens.com/cs/ww/en/view/109773058
\9\	Service Pack 1 for WinCC V7.5 : https://support.industry.siemens.com/cs/ww/en/view/109772879

Table 10-1

# 10.4 Change documentation

Table 10-2

Version	Date	Modifications
V1.0	05/2014	First version
V2.0	09/2019	Complete revision. Creation of a variant with IEC 60870-5- 104 protocol
V3.0	01/2021	Update to TIA Portal V16 and addition of chapter 5.2
V3.1	02/2021	New chapter 6.3
V4.0	11/2022	Update to TIA Portal V17 and WinCC 7.5 SP1