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Application Example • 03/2015

Connecting SIMATIC HMI Panel with SIMATIC S7-400H

WinCC (TIA Portal) V13 SP1 and STEP 7 V5.5

https://support.industry.siemens.com/cs/ww/de/96837136

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Table of Contents

1 Task

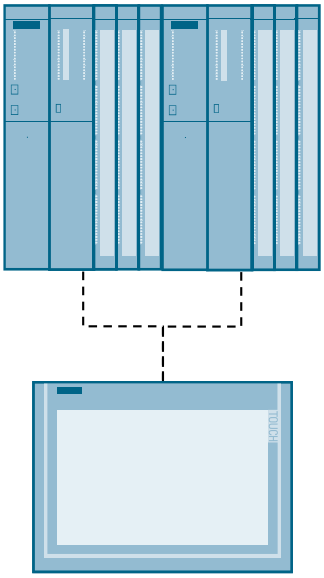
Introduction

You would like to connect SIMATIC HMI Panel with a SIMATIC H station.

Overview of the automation task

The figure below provides an overview of the automation task.

Figure 1-1

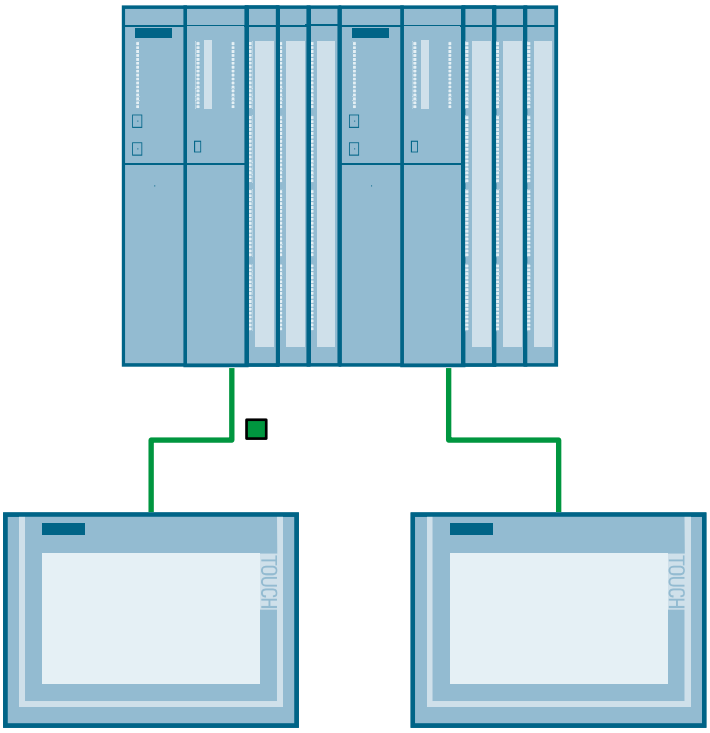


2 Solutions

2.1 Connecting redundant panels

Connect a panel to each H CPU.

Figure 2-1



2.2 Connecting a script-capable panel with a “software solution” with two H CPUs

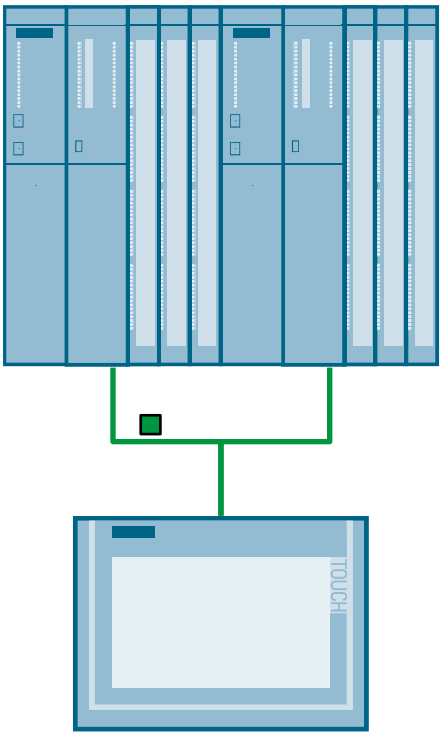
Connect an operator panel with two H CPUs.

With scripts it is specified with which H CPU the operator panel is connected.

In the event of an error, the connection is automatically switched over:

- STOP of the addressed CPU
- CP failure
- Cable fault
- EMC

Figure 2-2



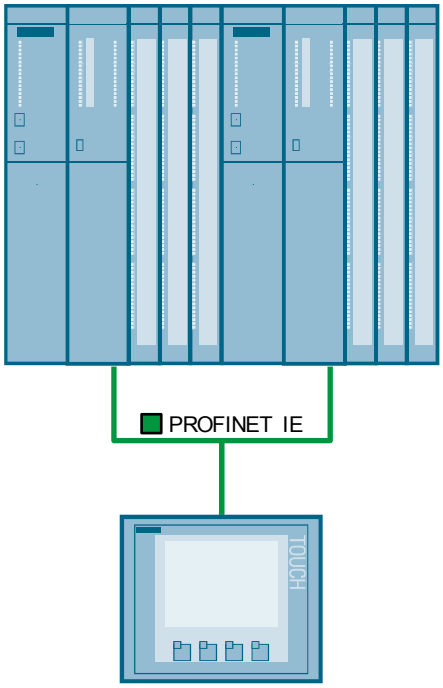
A precise description of this solution can be found in chapter Software Solution with Scripts.

2.3 Connecting a non-script-capable panel with a “software solution” with two H CPUs

Connect an operator panel with two H CPUs.

With the status of the H CPU (master/reserve) it is specified with which H CPU the operator panel is connected.

Figure 2-3



A precise description of this solution can be found in chapter Software Solution without Scripts.

2.4 Comparing the solutions

Table 2-1

Solution	Advantage	Disadvantage
2.1 Connecting redundant panels	High availability	Higher hardware costs
2.2 Connecting a script-capable panel with a “software solution” with two H CPUs	Lower hardware costs	Longer response times
2.3 Connecting a non-script-capable panel with a “software solution” with two H CPUs	Lower hardware costs	No switchover in the event of communication errors

3 Software Solution with Scripts

3.1 Components used

Hardware components

Table 3-1

Component	No.	Article number	Note
PS 407 10A	2	6ES7407-0KA02-0AA0	
CPU 416-5H PN/DP	2	6ES7416-5HS06-0AB0	
TP1200 Comfort	1	6AV2124-0MC01-0AX0	
SCALANCE X204-2	1	6GK5204-2BB10-2AA3	

Software components

Table 3-2

Component	No.	Article number	Note
STEP 7 V5.5 + SP4	1	6ES7810-4CC10-0YA5	
WinCC Comfort V13 SP1	1	6AV2101-0AA03-0AA5	

Example files and projects

Table 3-3

Component	Note
96837136_WinCC_TIA_redundant_communication_en.pdf	This document
96837136_Panel_H-PLC_Library.zip	This zip file includes a WinCC (TIA Portal) library

3.2 Mode of operation

The operator panel is connected with the two H CPUs. Scripts are used in the operator panel in order to check which of the controllers are accessible. If the connected H CPU or the communication to the H CPU fails, the connection is automatically switched to the other H CPU.

The following script templates can be found in the library “96837136_Panel_H-PLC_Library.zip”:

- connection_PLC1
- connection_PLC2
- connection_lost

Connection_PLC1 and connection_PLC2

The two scripts are functionally identical and only differ in terms of the connection parameters.

The following functions are performed in the scripts “connection_PLC1” and “connection_PLC2”:

1. Initializing:
   The connection that reaches the trigger describes the tag for the connection memory of the data connection with the connection name.
2. Resetting:
   The connection status tag is set to 1 in order to get the “OK” state.
3. Fault detection:
   The connection status tag of the other connection is increased. This process discovers an existing fault of the other connection after some cycles and checks a required switchover of the data connection.
4. Switchover:
   If the other connection cannot reset the connection status tag, it will reach a limit value. As a result, it will be checked whether the data connection in this failed connection is available.
   If this is the case, the connection is switched over.
5. Reentry:
   This section deals with the reentry after a complete disconnection. The first active connection switches the data connection to itself.

Connection_lost

In the event of a complete disconnection, there is no fast trigger available on the panel for the execution of scripts.

In order to be able to detect and display a total failure, the scheduler is used with a cycle of one minute. The script (connection_lost) used in the scheduler includes the following functions:

1. Fault marking:
   The connection status tag is set to 5 for both connections. If both connections are active, the access that is every minute, will have no effect. 5 corresponds to connection status “OK”.
2. Deactivating:
   If the connection status tags of the two connections are 5 or higher, they will be set to 100. 100 corresponds to connection status “deactivated”.
   “connection_lost” is written in the connection memory of the data connection.

Status of the connection status tags:

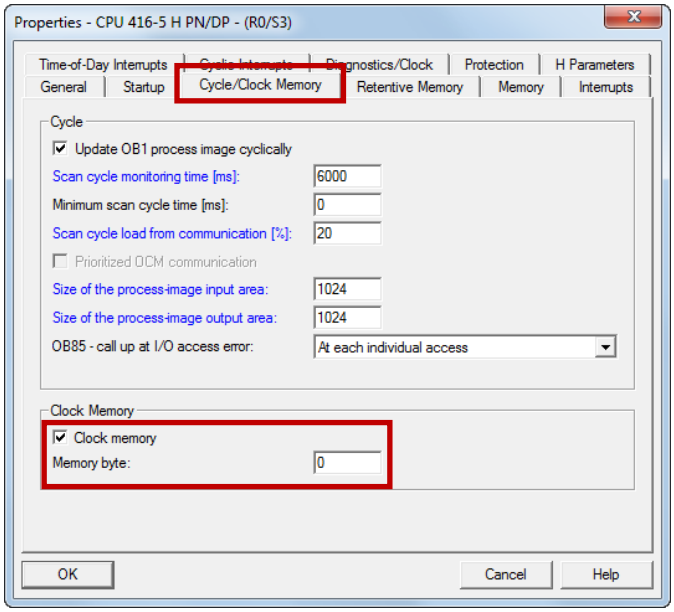
Table 3-4

Values	Status
0	Initialization, waiting for the first trigger
1 to 5	OK
6 to 10	Faulty
11 to 20	Failed
100	Deactivated

3.3 Configuration

3.3.1 STEP 7 configuration

Table 3-5

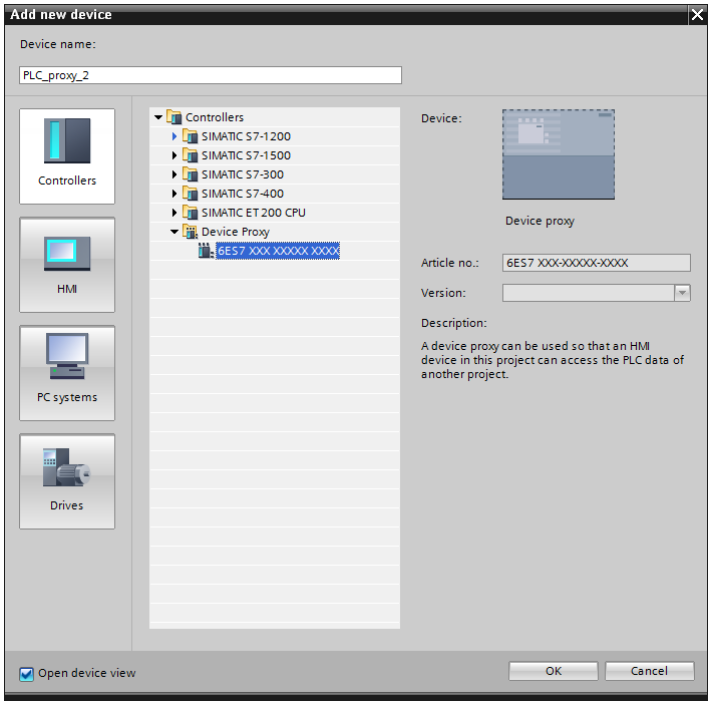
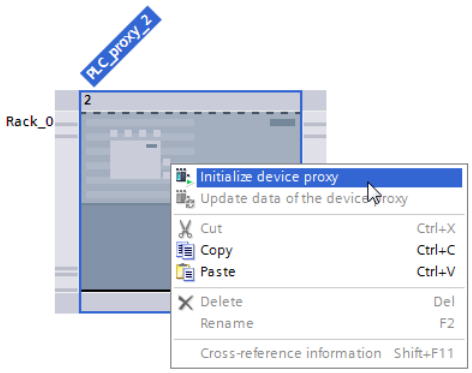
No.	Action
1.	Configure your H system as usual with STEP7 V5.x
2.	Open the properties of the H CPU.
3.	Enable the clock memory in the “Cycle/Clock Memory” tab and enter the desired memory byte. In the example the memory byte 0 is used. 

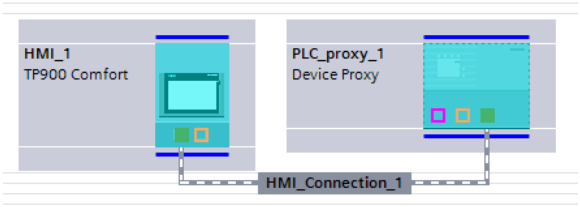
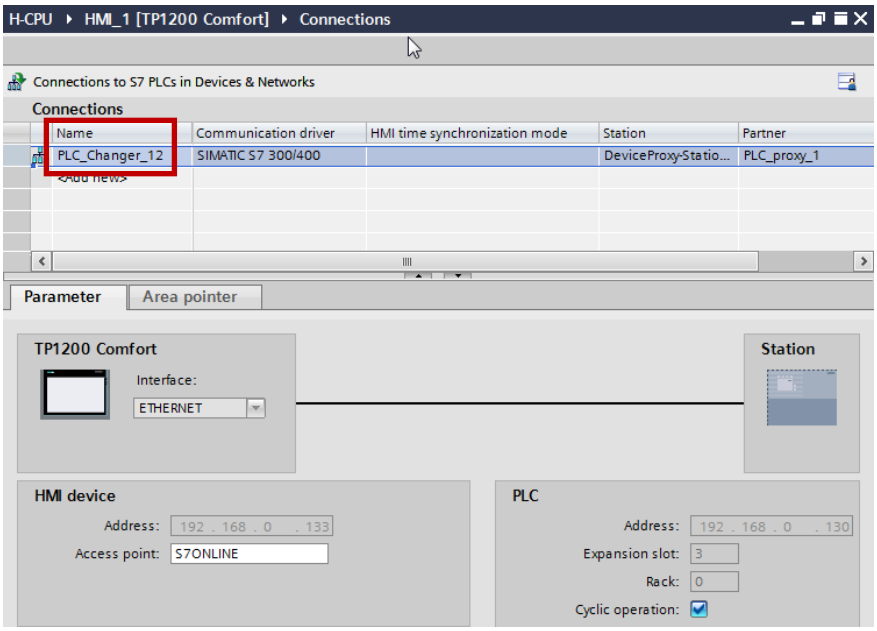
To connect the operator panel to the H CPU, the proxy PLC is used in WinCC (TIA Portal). This is why no further steps are required in the STEP 7 project.

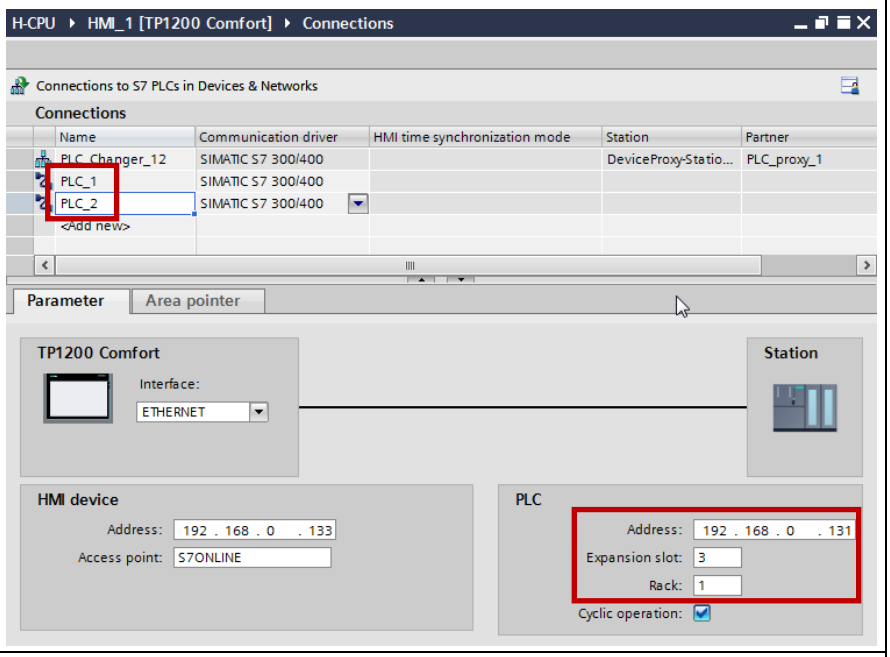
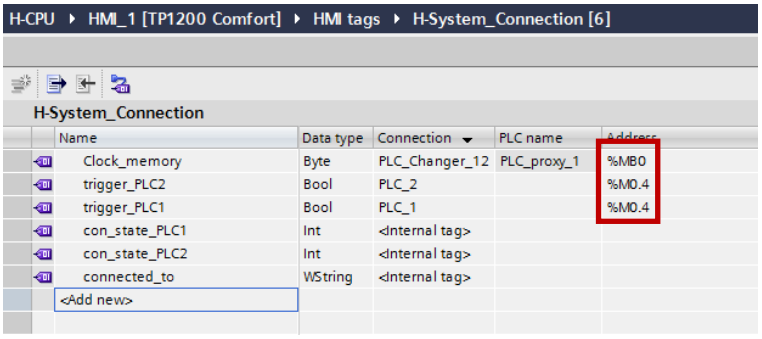
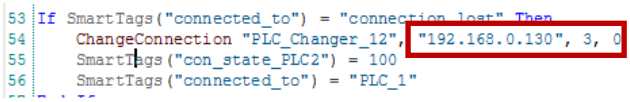
Prerequisite for the use of the proxy PLC is a consistent STEP 7 V5.x project. More detailed information on the use of the proxy PLC can be found in entry \3\.

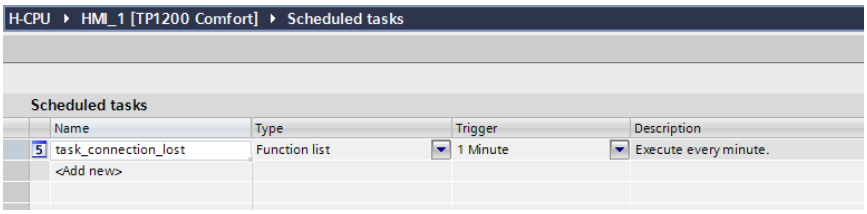
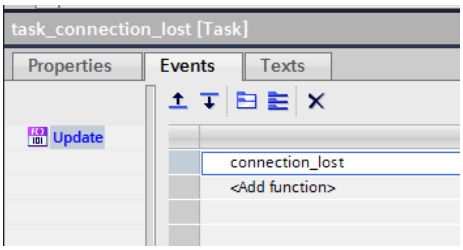
3.3.2 WinCC configuration

Table 3-6

No.	Action
4.	Open the WinCC (TIA Portal) project with the comfort panel which you would like to connect to the H CPU.
5.	Add a new device from the “device proxy” type. 
6.	Right click the proxy PLC and select “Initialize device proxy”. 
7.	Select the STEP 7 V 5.x project.

No.	Action
8.	Open the network view and create an HMI connection between the operator panel and the proxy PLC. 
9.	Open the “Connections” editor and rename the created connection to “PLC_Changer_12”.  The panel communicates via this connection with the H CPU.

No.	Action
10.	Create two further connections “PLC_1” and “PLC_2”. Set the connection settings (IP address, racks and slot number) of the two H CPUs. 
11.	Open the “96837136_Panel_H-PLC_library” global library that you can download from the download page of this entry. https://support.industry.siemens.com/cs/ww/de/96837136
12.	Drag the “H-System_Connection” tag table and the VB scripts via drag & drop into your project.
13.	Open the “H-System_Connection” tag table. Change the addresses of the tags “trigger_PLC1”, “trigger_PLC2” and “Clock_memory” if you do not wish to use the clock memory as memory byte 0. 
14.	Open the “connection_PLC1” script. Change the address parameter of the “PLC_Changer_12” connection in line 40 and line 54 to the address parameter of your “PLC1”. 

No.	Action
15.	Open the “connection_PLC2” script. Change the address parameters of the “PLC_Changer_12” connection in line 40 and line 54 to the address parameters of your “PLC2”. 53 If SmartTags("connected_to") = "connection_lost" Then 54 ChangeConnection "PLC_Changer_12", "192.168.0.131", 3, 1 55 SmartTags("con_state_PLC1") = 100 56 SmartTags("connected_to") = "PLC_2" 57 End If
16.	Open the scheduler. Add a new task with the trigger “1 Minute”.  Add the “connection_lost” script in “Events > Update”.  Calling the scripts “connection_PLC1” and “connection_PLC2” is already configured in the “value change” of the tags “trigger_PLC1” and “trigger_PLC2”.
17.	Download the project into your operator panel.

3.4 Example scenarios

Initialization

The connections “PLC_1” and “PLC_2” are both active.

According to the assignment, the connection “PLC_Changer_12” is switched to “PLC_1” (“connected_to” = PLC_1)

Fault detection and resetting

The scripts “connection_PLC1” and “connection_PLC2” are triggered by reading the triggers (“trigger_PLC1” and “trigger_PLC2”).

- “connection_PLC1” increments the connection status tag by 1 with each execution of the connection to PLC_2 and sets its own connection status tag to 1.
  - con_state_PLC2 = con_state_PLC2 + 1
  - con_state_PLC1 = 1
- “connection_PLC2” increments the connection status tag by 1 with each execution of the connection to PLC_1 and sets its own connection status tag to 1.
  - con_state_PLC1 = con_state_PLC1 + 1
  - con_state_PLC2 = 1

Scenario 1

The PLC_1 connection fails due to an error.

- The trigger can no longer be read through this connection
- The “connection_PLC1” script is not executed.
- The “connection_PLC2” script is still executed cyclically.

The connection status tag of the connection PLC_1 (“con_state_PLC1”) is no longer reset, this is why the connection status tag reaches the limit value 11 (see Table 3-4).

The “connection_PLC2” script checks the connection memory “connected_to”. Since this memory is set to PLC_1, the “ChangeConnection” function switches the data connection to the parameters of connection PLC_2. The connection memory is set to PLC_2.

- connected_to = PLC_2

Scenario 2

The connection PLC_2 also fails due to an error, therefore the “connection_PLC2” script can no longer be executed.

The “connection_lost” script is executed once every minute by the scheduler.

Both connection status tags are set to 5 in the first cycle.

- con_state_PLC1 = 5
- con_state_PLC2 = 5

Both connection status tags are set to 100 in the second cycle. The connection memory is set to “connection_lost”.

- con_state_PLC1 = 100
- con_state_PLC2 = 100
- connected_to = connection_lost

→ The connection is totally disconnected.

4 Software Solution without Scripts

4.1 Components used

Hardware components

Table 4-1

Component	No.	Article number	Note
PS 407 10A	2	6ES7407-0KA02-0AA0	
CPU 416-5H PN/DP	2	6ES7416-5HS06-0AB0	
KTP400 Basic PN	1	6AV2123-2DB03-0AX0	
SCALANCE X204-2	1	6GK5204-2BB00-2AA3	

Software components

Table 4-2

Component	No.	Article number	Note
STEP 7 V5.5 + SP4	1	6ES7810-4CC10-0YA5	
WinCC Comfort V13 SP1	1	6AV2101-0AA03-0AA5	As of WinCC Basic V13 SP1

4.2 Mode of operation

Through the evaluation of the status of the H CPU (master/reserve) as well as the internal system function “ChangeConnection” there is the option to connect a panel to an H CPU.

For this purpose, you have to set different addresses for the H CPUs.

If the SIMATIC H Station detects the failure of an H CPU (e.g. H-CPU_1), a connection to a different H CPU is created with the help of the “ChangeConnection” function.

The “ChangeConnection” function terminates the connection to the controller currently in use and establishes a new connection with the specified controller.

You have two options to use the “ChangeConnection” function:

- Manual switchover with a function button: Configure the “ChangeConnection” system function on the “Press” event.
- Automatic switchover: Automated call of “ChangeConnection”, e.g. on the “On exceeding” event of a process tag.

Note Please note that no switchover takes place for this solution in the event of communication errors.

4.3 Configuration

4.3.1 STEP 7 configuration

The FB523 function block allows the output of the modes “RUN/STOP” and of the status “Master/Reserve” of an H system.

Table 4-3

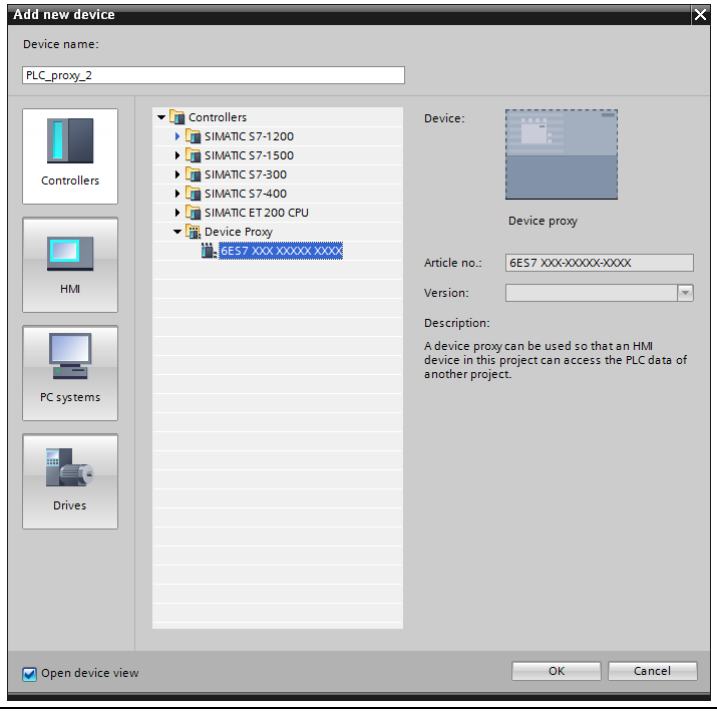
No.	Action
1.	Download the library from the link \4\ and add it to your project as described in the entry.
2.	Define tags for the outputs “R0_MSTR” and “R1_MSTR” (in this example: DB1.DBX4.0 and DB1.DBX5.0)

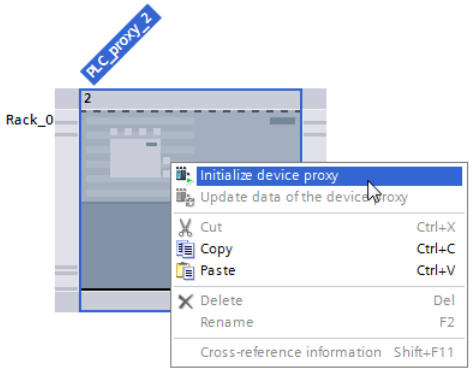
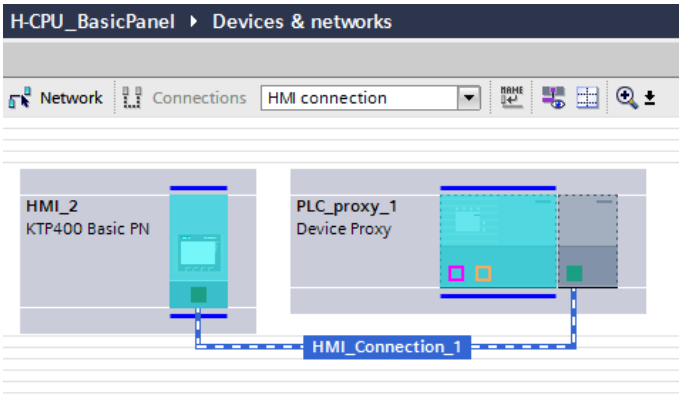
To connect the operator panel to the H CPU, the proxy PLC is used in WinCC (TIA Portal). This is why no further steps are required in the STEP 7 project.

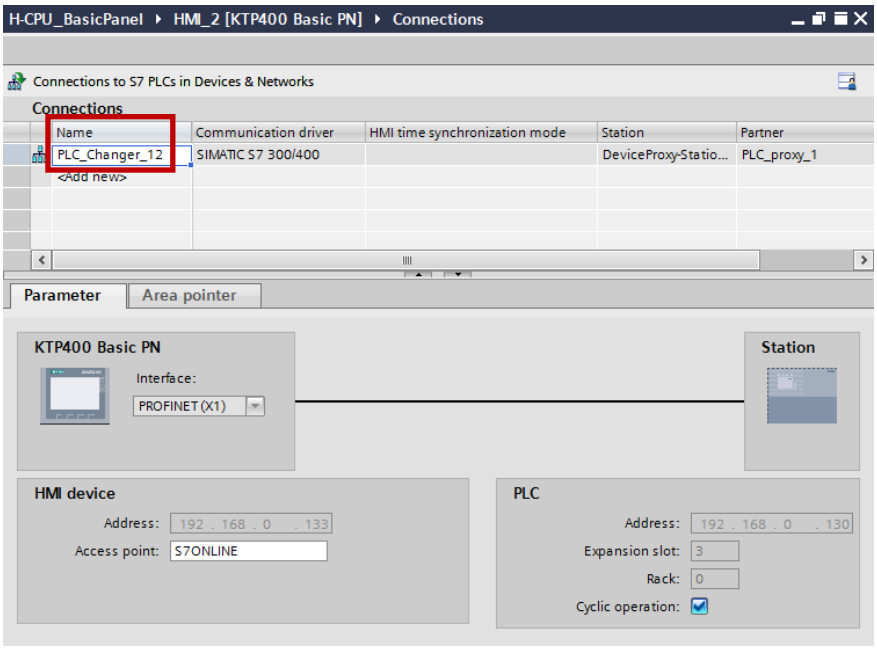
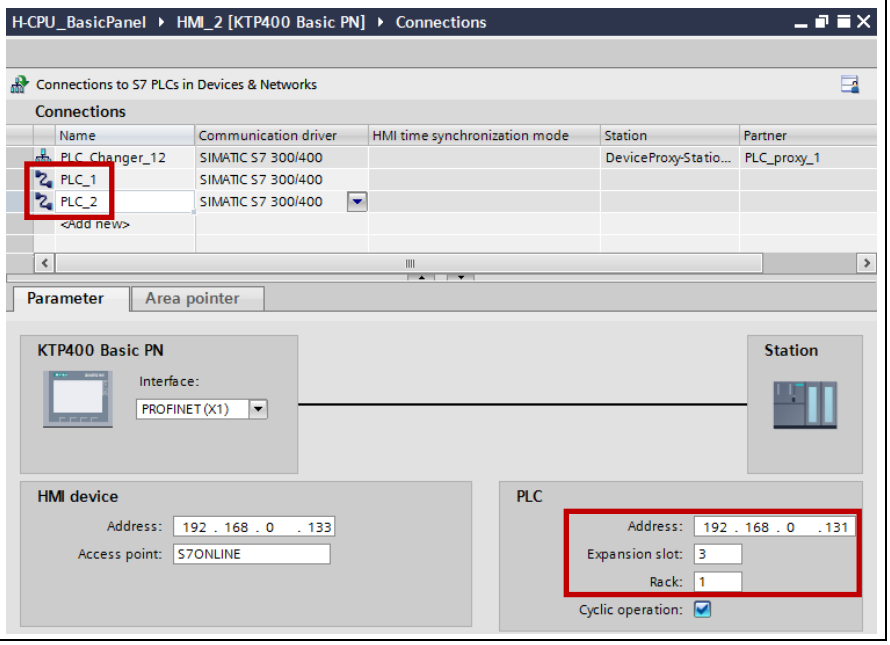
Prerequisite for the use of the proxy PLC is a consistent STEP 7 V5.x project. More detailed information on the use of the proxy PLC can be found in entry \3\.

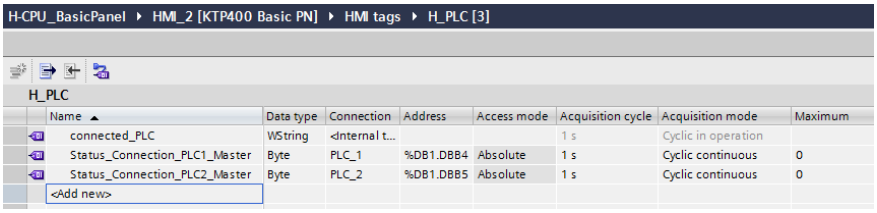
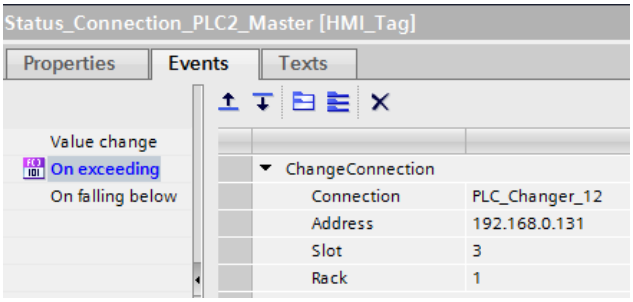
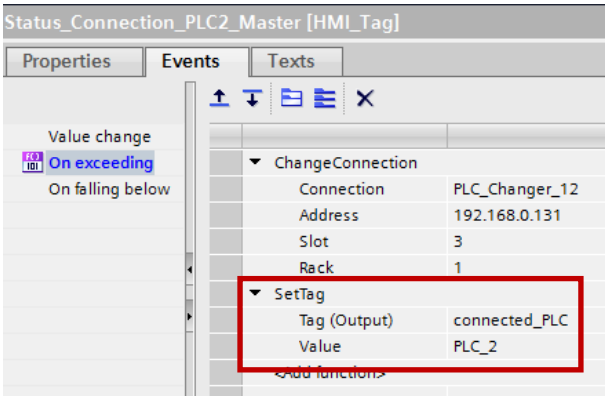
4.3.2 WinCC configuration

Table 4-4

No.	Action
1.	Open the WinCC (TIA Portal) project with the operator panel that you would like to connect to the H CPU.
2.	Add a new device from the “device proxy” type. 

No.	Action
3.	Right click the proxy PLC and select “Initialize device proxy”. 
4.	Select the STEP 7 V 5.x project.
5.	Open the network view and create an HMI connection between the operator panel and the proxy PLC. 

No.	Action
6.	Open the “Connections” editor and rename the created connection to “PLC_Changer_12”.  The panel communicates via this connection with the H CPU.
7.	Create two further connections “PLC_1” and “PLC_2”. Set the connection settings (IP address, racks and slot number) of the two H CPUs. 

No.	Action
8.	Open an HMI tag table and add the following tags. • **Status_Connection_PLC1_Master**: Data type: Byte, connection: PLC_1, address: DB1.DBB4, acquisition mode: Cyclic continuous, maximum: 0 • **Status_Connection_PLC2_Master**: Data type: Byte, connection: PLC_2, address: DB1.DBB5, acquisition mode: Cyclic continuous, maximum: 0 • **Connected_PLC**: Data type: WString, connection: Internal tag Length: 15 
9.	Configure the “ChangeConnection” system function for the tags “Status_Connection_PLC1_Master” and “Status_Connection_PLC2_Master” in “Events > On exceeding”. Enter the connection parameters for the respective connection “PLC_1” or “PLC_2” for the “PLC_Changer_12” connection. 
10.	In addition, configure the “SetTag” system function on the “On exceeding” event of the two tags. Describe the “connected_PLC” tag with the name of the respective controller. 

4.4 Example scenarios

Table 4-5

H CPU:	Address	Bit status	Result
PLC_1	DB1.DBX4.0	1	Master
PLC_2	DB1.DBX5.0	0	Reserve
PLC_1	DB1.DBX4.0	0	Reserve
PLC_2	DB1.DBX5.0	1	Master

PLC_1 is master

The operator panel evaluates the upper limit value of the “DB1.DBB4” tag (limit value: 0). If the “DB1.DBX4.0” bit is set, the limit value is exceeded and the “ChangeConnection” function is executed.

The connection changes from the specified connection of the “PLC_Changer_12” to the configured connection parameters of the “PLC_1”.

The connection to the PLC_1 is established.

PLC_2 is master

The operator panel evaluates the upper limit value of the “DB1.DBB5” tag (limit value: 0). If the “DB1.DBX5.0” bit is set, the limit value is exceeded and the “ChangeConnection” function is executed.

The connection changes from the specified connection of the “PLC_Changer_12” to the configured connection parameters of the “PLC_2”.

The connection to the PLC_2 is established.

Note You can switch the master CPU manually to STOP mode in order to test the function.

5 References

Table 5-1

	Topic	Title
\1\	Siemens Industry Online Support	http://support.automation.siemens.com
\2\	Download page of the entry	https://support.industry.siemens.com/cs/ww/de/96837136
\3\	Combined configuration with WinCC (TIA Portal) and STEP 7 V5.x	http://support.automation.siemens.com/WW/view/en/73502293
\4\	How do you read out the operating state and status of an H system?	http://support.automation.siemens.com/WW/view/en/19537149

6 History

Table 6-1

Version	Date	Modifications
V1.0	02/2015	First version