S7 communication between SIMATIC S7-1200 and SIMATIC S7-1500

STEP 7 V16 / PUT /GET

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1 Introduction

You can use the S7 Communication, for example, for data transfer via the integrated PROFINET interface and Industrial Ethernet interface of the S7-1500 CPUs and S7-1200 CPUs.

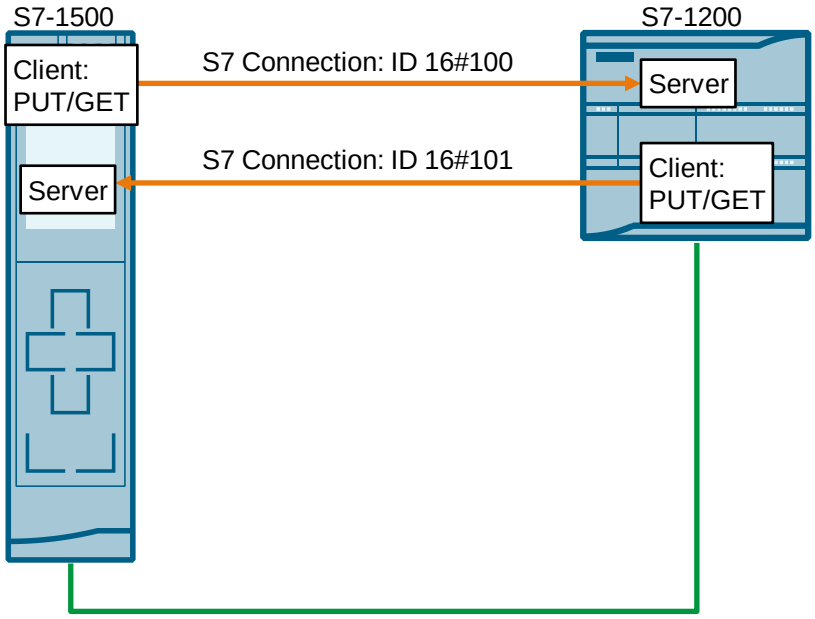
The following instructions are available for S7 Communication:

- PUT for sending data
- GET for receiving data

In STEP 7 V16 (TIA Portal) you will find the above-mentioned instructions in the "Instructions" task card under "Communication > S7 Communication".

The example describes how to configure an S7 connection between an S7-1500 CPU and an S7-1200 CPU to exchange data between the S7-1500 CPU and the S7-1200 CPU using the PUT and GET instructions.

Figure 1-1



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User data size

With the "PUT" and "GET" instructions, the volume of data to be transferred must not exceed a certain user data size. The maximum user data size depends on the communication partner.

The following minimum user data size for an instruction with 1 – 4 variables is guaranteed:

- Partner: S7-1500 CPU: 880 bytes
- Partner: S7-1200 CPU: 160 bytes

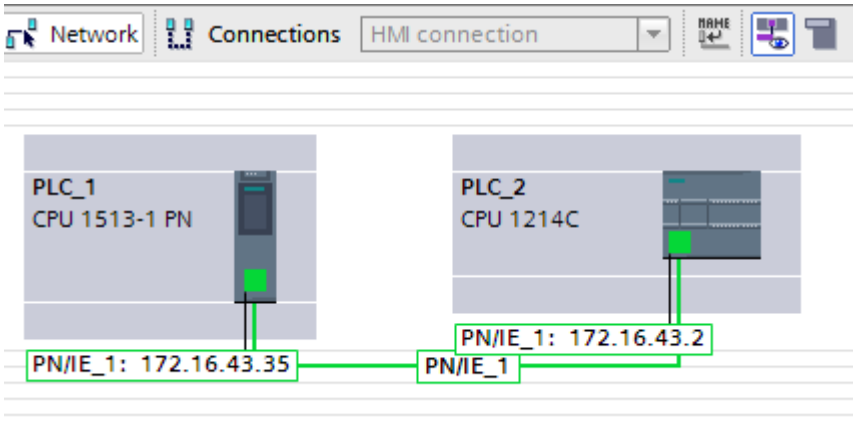
Note The example can also be used for exchanging data between two S7-1500 CPUs or two S7-1200 CPUs.

2 Configuration

2.1 Configuration of the Hardware

1. In the network view of the "Devices & networks" editor you create the connection partners, an S7-1500 CPU and an S7-1200 CPU, for example.
2. Network the connection partners and set the IP addresses as follows for example:
   - S7-1500 CPU: 172.16.43.35
   - S7-1200 CPU: 172.16.43.2

Figure 2-1



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2.2 Configuration of the S7 Connection

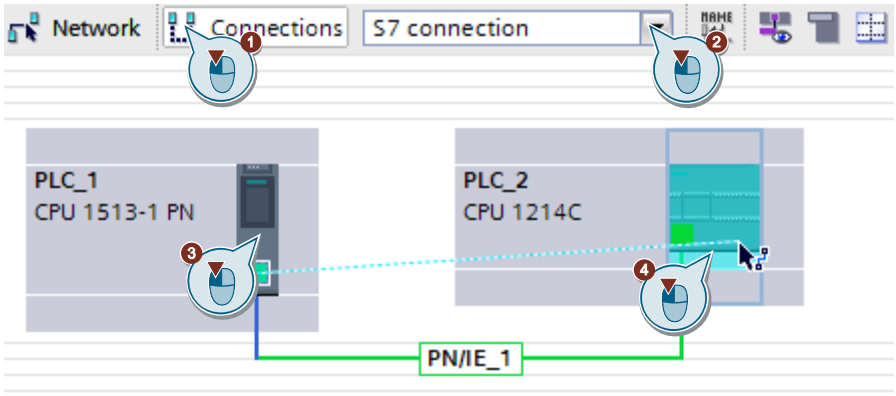
2.2.1 Configuring the S7 Connection Bilaterally

Requirements

To create the S7 connection graphically the communication partners have to be configured in the same project. If you create the S7 connection graphically, the connection is configured on both sides.

Instructions

Figure 2-2



1. In the Network view you click the "Connections" icon to enable the Connection mode.
2. Select "S7 connection" as the connection type in the adjacent drop-down list box.
   In the Network view, all devices that are available for an S7 connection are highlighted in color.
3. With the button held down drag the mouse cursor from the module (CPU, CP or CM) where the S7 connection is to start (active connection establishment) to the module (CPU, CP or CM) where the S7 connection is to finish (passive connection establishment).
4. Release the mouse button when the cursor is on the target device to create the S7 connection between the communication partners.

Result

- An S7 connection configured on both sides is created.
- The connection path is displayed highlighted in the graphical area of the Network view.

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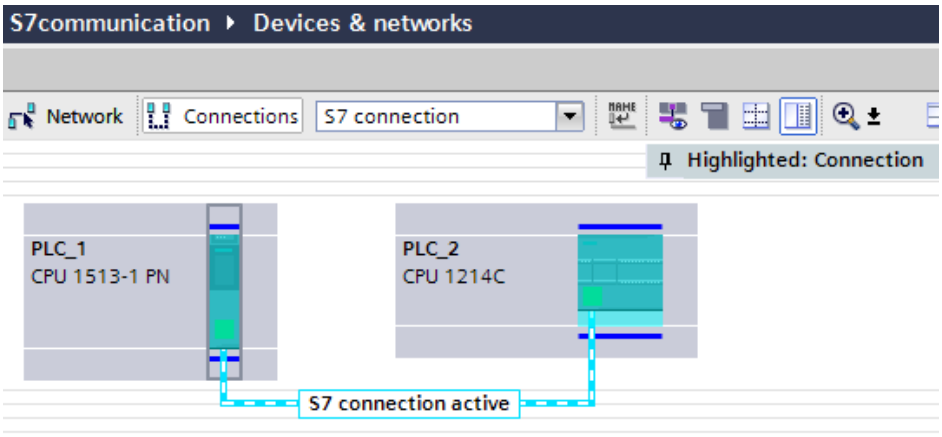
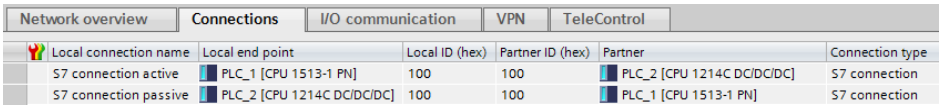


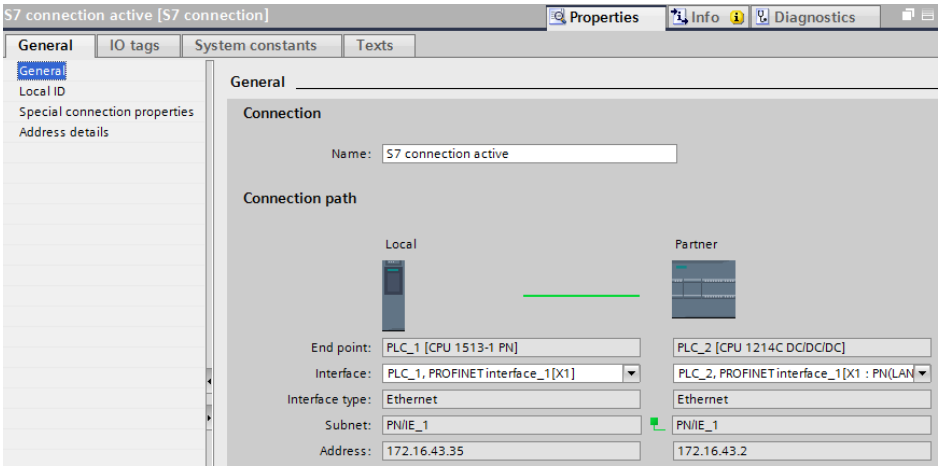
- The S7 connection is entered in the "Connections" table in the table area of the Network view. Since the S7 connection is configured on both sides two connections are created:
  - One S7 connection uses the S7-1500 CPU as local endpoint. This sets up the S7 connection actively.
  - The second S7 connection uses the S7-1200 CPU as local endpoint. This participates passively in establishing the connection.



Local connection name	Local end point	Local ID (hex)	Partner ID (hex)	Partner	Connection type
S7 connection active	PLC_1 [CPU 1513-1 PN]	100	100	PLC_2 [CPU 1214C DC/DC/DC]	S7 connection
S7 connection passive	PLC_2 [CPU 1214C DC/DC/DC]	100	100	PLC_1 [CPU 1513-1 PN]	S7 connection

Setting the connection parameters

1. In the connection table, mark the S7 connections that have the S7-1500 CPU as their local endpoint.
   The Properties of the S7 connection are displayed in the inspector window.
2. Under "General" the "General" tab displays the general connection parameters that identify the local endpoint.
   You can assign the connection route and specify the connection route in full.



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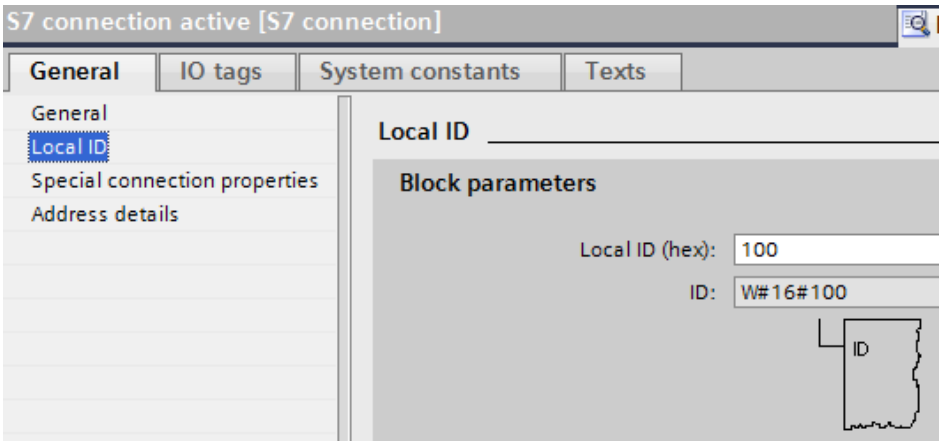
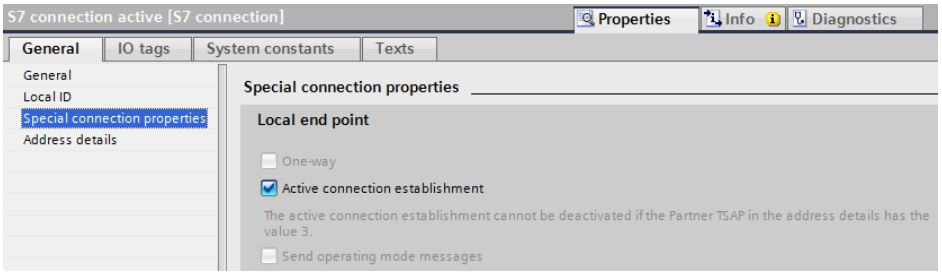
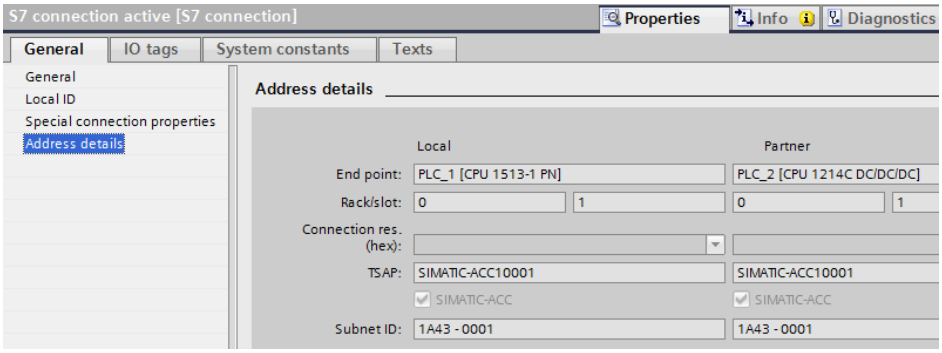
3. In the “General” tab under “Local ID” you see the local ID of the module from which the connection is viewed (local partner). You can change the local ID. You specify the local ID later at the "ID" input parameter of the "PUT" or "GET" instruction.
   In this example we use the local ID with the value 100 (hex).



4. In the "General” tab under "Special connection properties" you can set which connection partner can actively establish the connection as well as actively send and receive.



5. The address details of the S7 connection are displayed here. The values are taken from the current configuration and cannot be changed.



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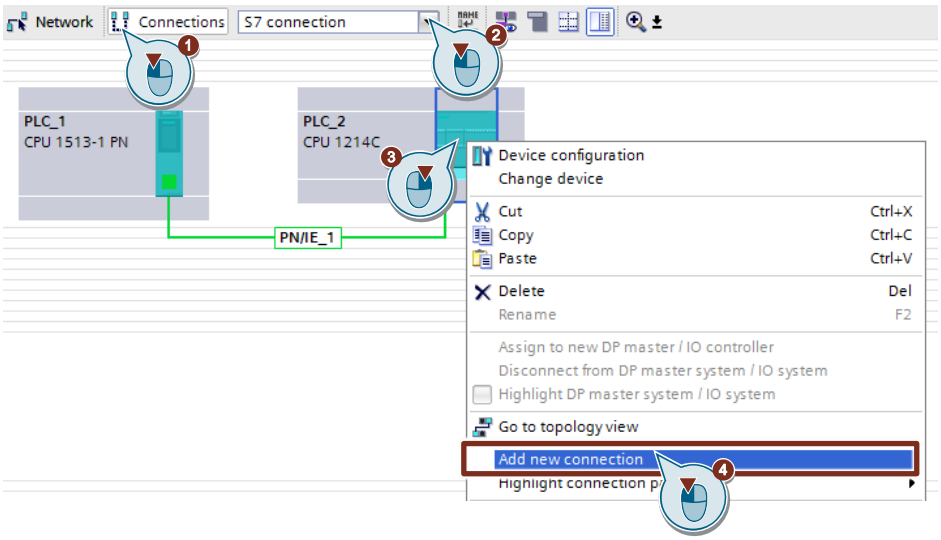
2.2.2 Configure S7 Connection Unilaterally with Unspecified Partner

If you are using the communication services "PUT" and "GET" for data exchange, you can create the S7 connection unilaterally with unspecified partner, for instance when communication partners are configured in different projects. Create the S7 connection in the active S7 CPU.

Instructions

1. In the Network view you click the "Connections" icon to enable the Connection mode.
2. Select "S7 connection" as the connection type in the adjacent drop-down list box.
   In the Network view, all devices that are available for an S7 connection are highlighted in color.
3. Right-click the S7 CPU that actively establishes the connection, S7-1200 CPU, for example.
   The pop-up menu opens.
4. Select the "Add new connection" item.
   The "Add new connection" dialog opens.



5. Specify the following connection partner: "Unspecified".
6. Select the local interface. In this example, the integrated interface of the S7-1200 CPU is used. If the S7 connection is to be established via a CP, select the CP.
7. Enter the local ID for the S7 connection, 101 (hex), for example.
8. Click the "Add" button to add the unspecified S7 connection.
9. Click the "Close" button to end the dialog.

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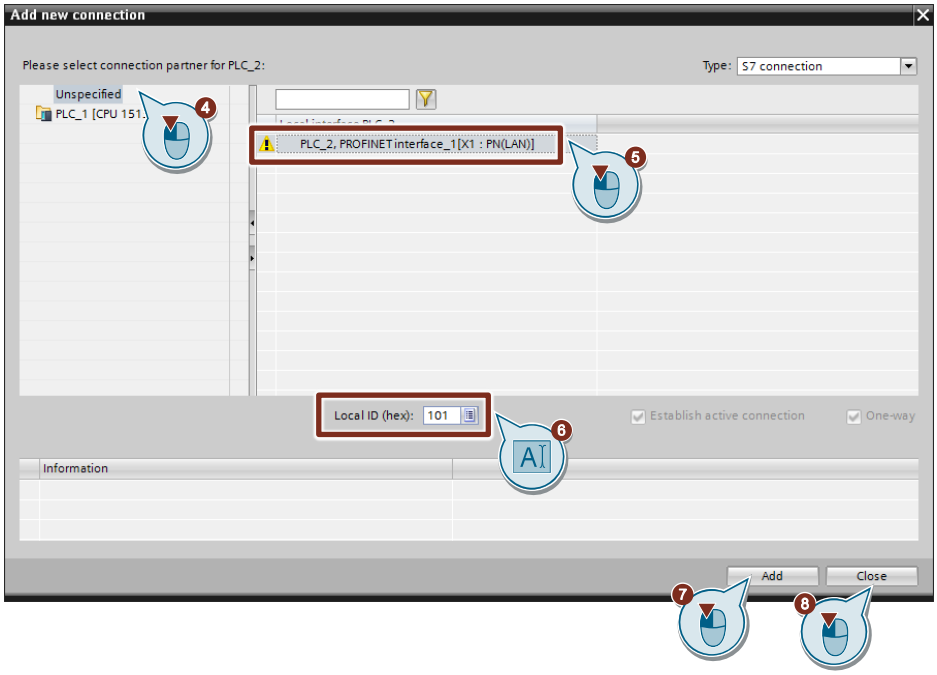
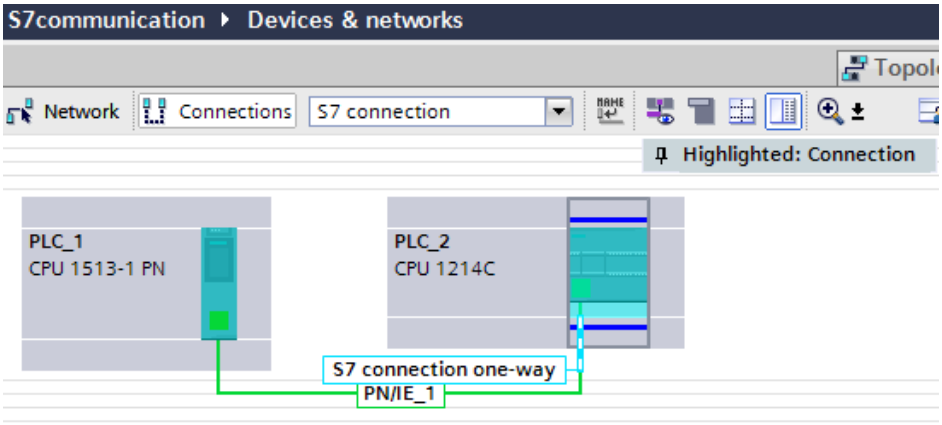
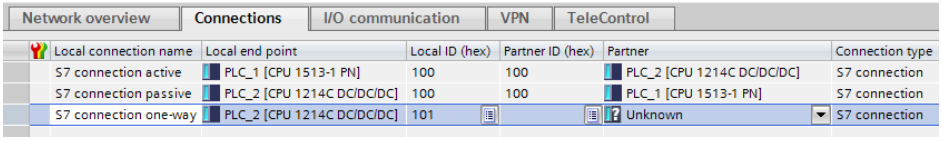


Result

- An unspecified S7 connection is created.
- The connection path is displayed highlighted in the graphical area of the Network view.



- The S7 connection is entered in the "Connections" table in the table area of the Network view.



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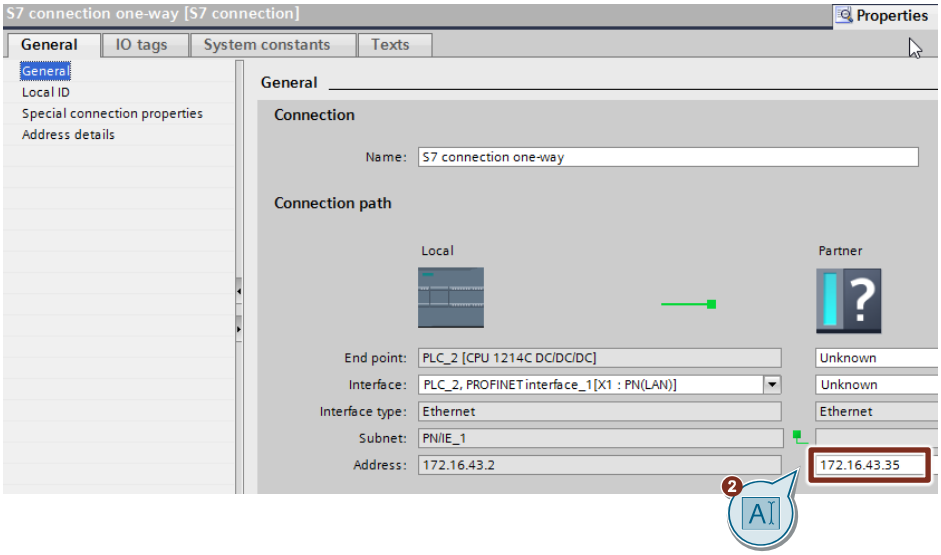
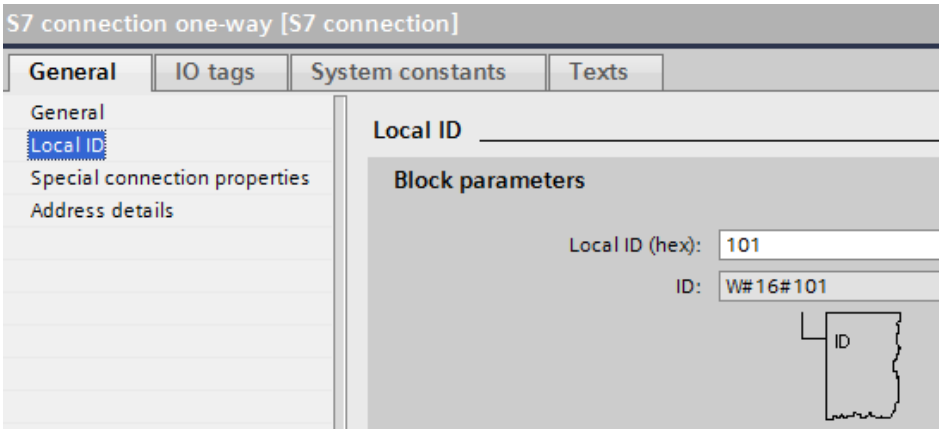
Setting the connection parameters

1. In the “Connections” table, mark the unspecified S7 connections.
   The Properties of the S7 connection are displayed in the inspector window.
2. Under "General" the "General" tab displays the general connection parameters that identify the local endpoint. Enter the IP address of the communication partner, for example 172.16.43.35 (IP address of the S7-1500 CPU).



3. In the “General” tab under “Local ID” you see the local ID of the module from which the connection is viewed (local partner). You can change the local ID. You specify the local ID later at the "ID" input parameter of the "PUT" or "GET" instruction.
   In this example we use the local ID with the value 101 (hex).



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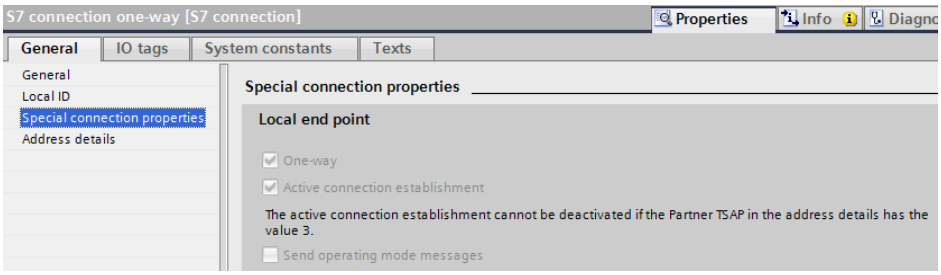
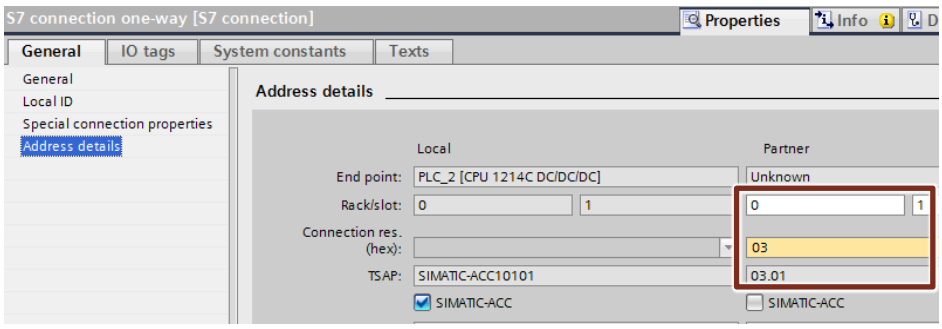
4. In the "General" under "Special connection properties" you see that the S7 connection is configured unilaterally. Unilaterally means that the connection partner is server for this connection and cannot actively send or receive. The S7 CPU that is used as the local endpoint for the S7 connection, actively establishes the S7 connection as a client and actively sends and receives.



5. In the "General" tab under "Address details" you enter the partner TSAP. Since the S7 connection is configured unilaterally to an unspecified partner, the partner TSAP is composed as follows:
   03 <slot of CPU or CP/CM>, for example:
   - S7-1500 CPU in slot 1: 03.01
   - S7-1200 CPU in slot 1: 03.01



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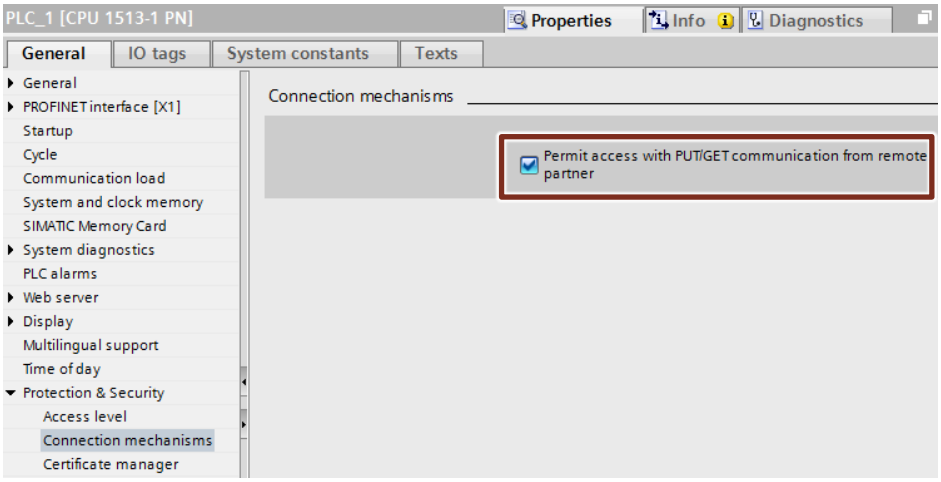
2.3 Permit Access with PUT/GET Communication from Remote Partner

In the S7-1200 CPU and in the S7-1500 CPU you enable the function "Permit access with PUT/GET communication from remote partner". This enables the partner CPU to access the data in the S7-1200 CPU or S7-1500 CPU using the "PUT" and "GET" instructions.

1. In the Device view or Network view of the “Devices & networks” editor you mark the S7 CPU.
2. In the "General" tab, under "Protection & Security > Connection mechanisms" you enable the "Permit access with PUT/GET communication from remote partner" function.

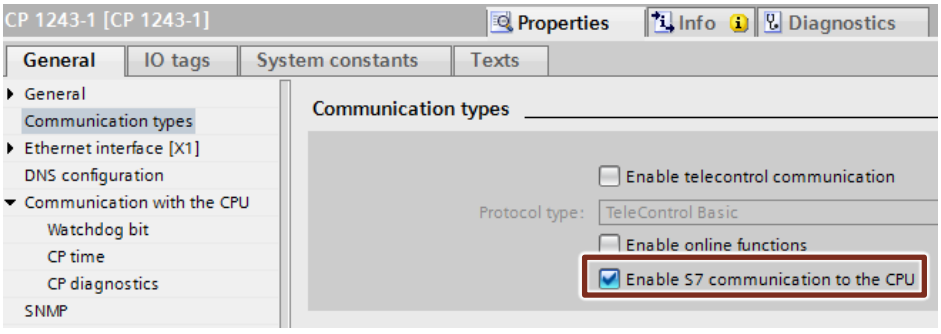


2.4 Enable S7 communication to the CPU

With the S7-1200, enable S7 communication to the CPU in the CP. In order to release the function of S7 communication with the assigned CPU and the S7 routing.

If you configure an S7 connection that runs via the CP of the S7-1200, then you have to activate this option.

1. In the Device view or Network view of the “Devices & networks” editor you mark the CP in the S7-1200.
2. In the "General" tab, under "Communication types" you enable the "Enable S7 communication to the CPU" option.



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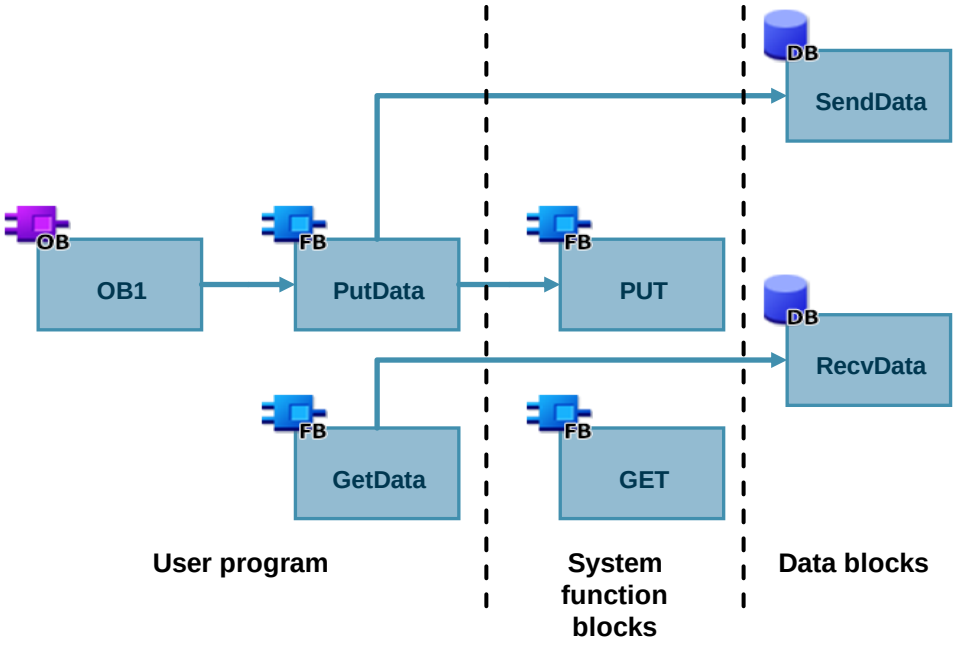
3 User Program of the Active S7 CPU

3.1 Overview

The following figure shows an overview of the user program of the active S7 CPU.

Figure 3-1



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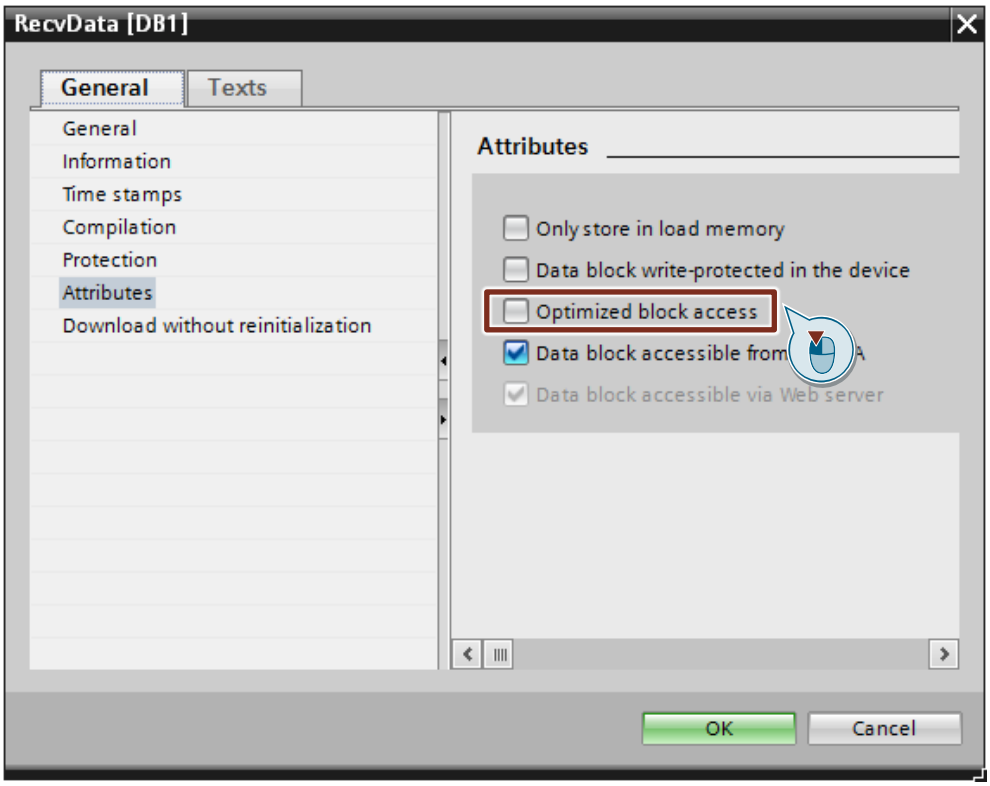
3.2 Create Send and Receive Data Areas

3.2.1 DB1 "RecvData"

The data read from the partner CPU is stored in the data block DB1 "RecvData" of the active S7 CPU.

In the Properties of the DB1 "RecvData", under "Attributes" you disable the "Optimized block access" function.

Figure 3-2



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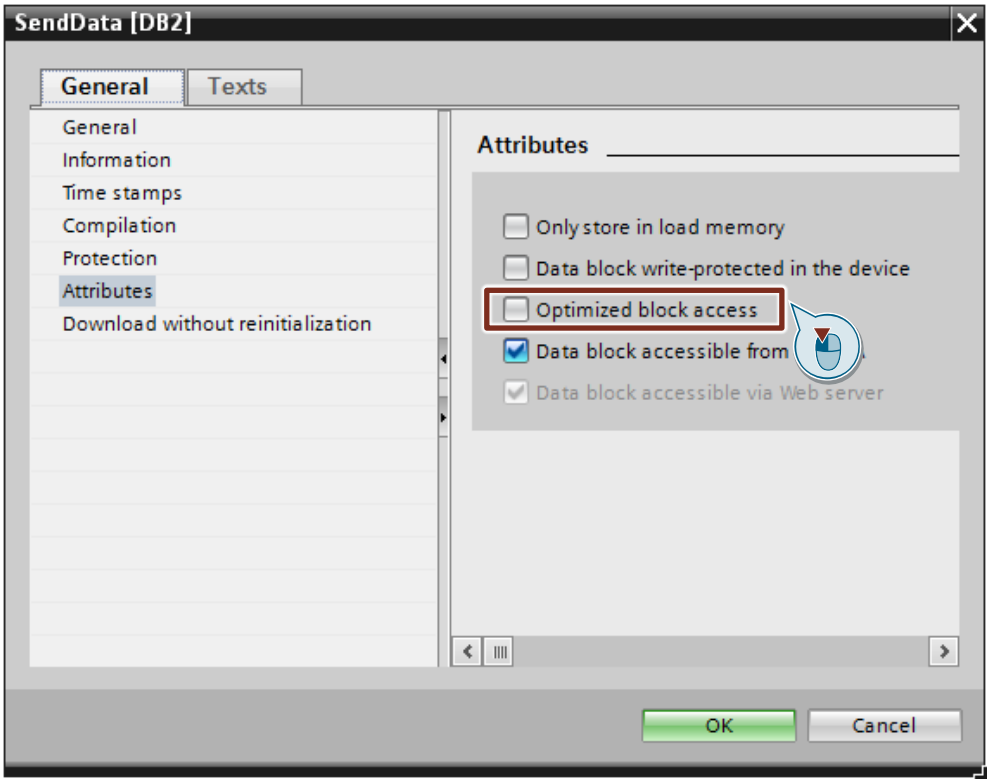
3.2.2 DB2 "SendData"

The data that is transferred to the partner CPU is stored in the data block DB2 "SendData" of the active S7 CPU.

In the Properties of the DB2 "SendData", under "Attributes" you disable the "Optimized block access" function.

Figure 3-3



3.3 Create Variables for Parameters of Function Blocks "PutData" and "GetData"

Create the following variables in DB10 "GeneralData" to assign the input and output parameters of the function blocks "PutData" and "GetData". PLC data types are used as data type.

Table 3-1

Variable	PLC data type	Description
put	typePut	Variables for parameterizing FB12 "PutData”.
get	typeGet	Variables for parameterizing FB13 "GetData”.
diagnostic	typeDiagnostic	Variables to store the status of FBs "PutData" and "GetData" in case of error.

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3.3.1 PLC Data Type "typePut"

The following table shows the structure of "typePut" data type.

Table 3-2

Parameter	Data type	Start value	Description
execute	Bool	false	Control parameter for FB12 "PutData".
connectionId	Word	16#0	Addressing parameter for specifying the connection to the communication partner.
done	Bool	false	Status parameters
busy	Bool	false	Status parameters
error	Bool	false	Status parameters
status	Word	16#0	Status parameters

3.3.2 PLC Data Type "typeGet"

The following table shows the structure of the "typeGet" data type.

Table 3-3

Parameter	Data type	Start value	Description
execute	Bool	false	Control parameter for FB13 "GetData".
connectionId	Word	16#0	Addressing parameter for specifying the connection to the communication partner.
done	Bool	false	Status parameters
busy	Bool	false	Status parameters
error	Bool	false	Status parameters
status	Word	16#0	Status parameters

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3.3.3 PLC Data Type "typeDiagnostic"

The following table shows the structure of the "typeDiagnostic" data type.

Table 3-4

Parameter	Data type	Start value	Description
statusPut	Word	16#0	Parameter to store the status of FB12 "PutData".
statusGet	Word	16#0	Parameter to store the status of FB13 "GetData".

3.4 FB12 "PutData”

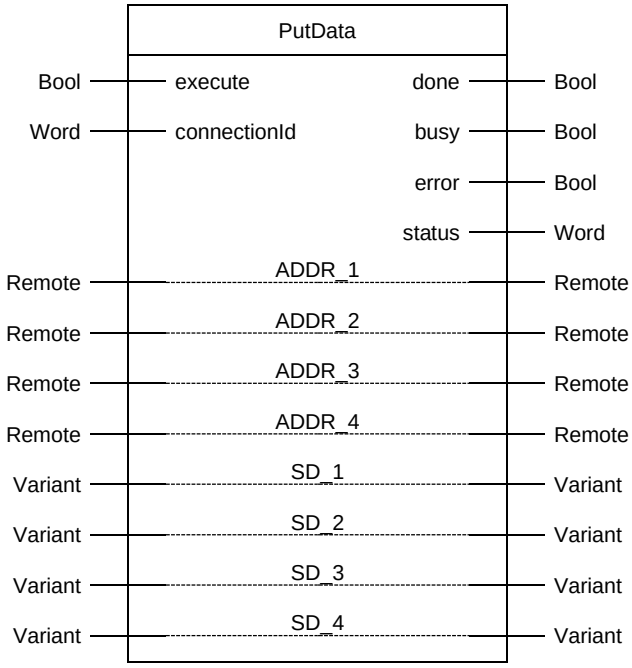
The FB12 "PutData" calls the "PUT" instruction to execute the following functions:

- Send data to the partner via the configured connection as soon as the input "execute" recognizes a positive edge. When the Write job is running, it is not possible to trigger a new Write job.
- Output the status of the FB and data transmission at the "status" output.

FB12 "PutData” is called cyclically in OB1.

The following figure shows the call of the FB12 "PutData” in OB1.

Figure 3-4



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3.4.1 Parameters of FB12 "PutData"

The following table shows the parameters of FB12 "PutData".

Table 3-5

Name	P type	Data type	Comment
execute	IN	Bool	Control parameter: Enables the Write job on a rising edge.
connectionId	IN	Word	Local ID: Addressing parameter for specifying the connection to the partner CPU. **Note** The local ID is available in the Properties of the configured S7 connection. The following local IDs are used in this example: • S7-1500 CPU: 100 (hex) • S7-1200 CPU: 101 (hex)
done	OUT	Bool	TRUE: The Write job was executed error-free.
busy	OUT	Bool	TRUE: The Write job is running.
error	OUT	Bool	Status parameters "error" and "status": • "error" = 0: - "status" = 0000 (hex): neither warning nor error - "status" <> 0000 (hex): Warning The "status" parameter provides detailed information. • "error" = 1: An error has occurred. The "status" parameter provides detailed information about the type of error.
status	OUT	Word	
ADDR_1	IN_OUT	Remote	Pointer to the area to be written to in the partner CPU. **Note** The following parameters are hidden and are preset with the value "NULL": • "ADDR_2" • "ADDR_3" • "ADDR_4"
ADDR_2	IN_OUT	Remote	
ADDR_3	IN_OUT	Remote	
ADDR_4	IN_OUT	Remote	
SD_1	IN_OUT	Variant	Pointer to the area in your own S7 CPU that contains the data to be sent. **Note** The following parameters are hidden and are preset with the value "NULL": • "SD_2" • "SD_3" • "SD_4"
SD_2	IN_OUT	Variant	
SD_3	IN_OUT	Variant	
SD_4	IN_OUT	Variant	

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Assign the variables created in section 3.3 to the parameters of FB12 "PutData".

The following table shows the assignment of the parameters of the "put" variable to the parameters of FB12 "PutData".

Table 3-6

Parameters of FB12 "PutData"	Parameters of the "put" variable	Start value	Note
execute	execute	false	Set the "execute" parameter to the value "TRUE" to start the Write job. The Write job is started on a rising edge. Reset the "execute" parameter to the value "FALSE" if the Write job is completed with "done" = true or "error" = true.
connectionId	connectionId	16#100	Enter the local ID of the connection that you defined during the connection configuration.
done	done	false	–
busy	busy	false	–
error	error	false	–
status	status	16#0	–
ADDR_1	–	P#DB1.DBX0.0 BYTE 100	Only absolute addressing is permitted.
SD_1	–	P#DB2.DBX0.0 BYTE 100	–

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3.5 FB13 "GetData"

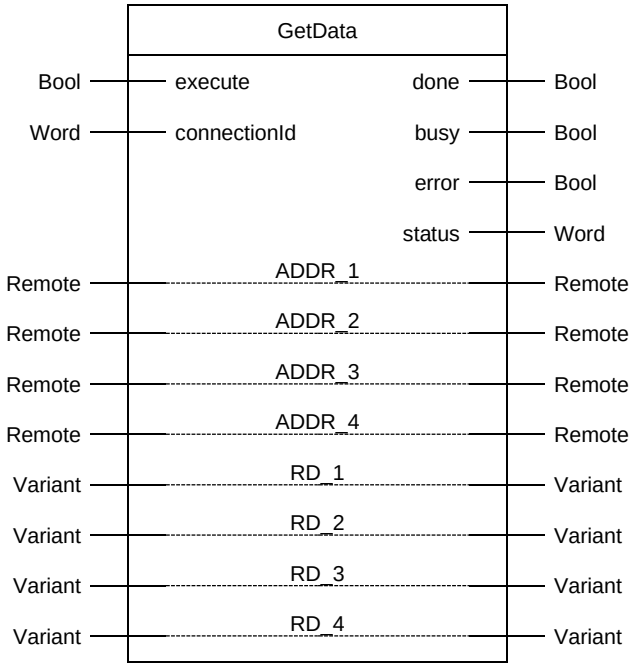
The FB13 "GetData" calls the "GET" instruction to execute the following functions:

- Receive data from the partner via the configured connection as soon as the input "execute" recognizes a positive edge. When the Read job is running, it is not possible to trigger a new Read job.
- Output the status of the FB and data transmission at the "status" output.

FB13 "GetData" is called cyclically in OB1.

The following figure shows the call of the FB13 "GetData" in OB1.

Figure 3-5



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3.5.1 Parameters of FB13 "GetData"

The following table shows the parameters of FB13 "GetData".

Table 3-7

Name	P type	Data type	Comment
execute	IN	Bool	Control parameter: Enables the Read job on a rising edge.
connectionId	IN	Word	Local ID: Addressing parameter for specifying the connection to the partner CPU. **Note** The local ID is available in the Properties of the configured S7 connection. The following local IDs are used in this example: • S7-1500 CPU: 100 (hex) • S7-1200 CPU: 101 (hex)
done	OUT	Bool	TRUE: The Read job was executed error-free.
busy	OUT	Bool	TRUE: The read job is running.
error	OUT	Bool	Status parameters "error" and "status": • "error" = 0: - "status" = 0000 (hex): neither warning nor error - "status" <> 0000 (hex): Warning The "status" parameter provides detailed information. • "error" = 1: An error has occurred. The "status" parameter provides detailed information about the type of error.
status	OUT	Word	
ADDR_1	IN_OUT	Remote	Pointer to the area to be read in the partner CPU. **Note** The following parameters are hidden and are preset with the value "NULL": • "ADDR_2" • "ADDR_3" • "ADDR_4"
ADDR_2	IN_OUT	Remote	
ADDR_3	IN_OUT	Remote	
ADDR_4	IN_OUT	Remote	
RD_1	IN_OUT	Variant	Pointer to the area in your own S7 CPU in which the read data is stored. **Note** The following parameters are hidden and are preset with the value "NULL": • "RD_2" • "RD_3" • "RD_4"
RD_2	IN_OUT	Variant	
RD_3	IN_OUT	Variant	
RD_4	IN_OUT	Variant	

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Assign the variables created in section 3.3 to the parameters of FB13 "GetData".

The following table shows the assignment of the parameters of the "get" variable to the parameters of FB13 "GetData".

Table 3-8

Parameters of FB13 "GetData"	Parameters of the "get" variable	Start value	Note
execute	execute	false	Set the "execute" parameter to the value "TRUE" to start the Read job. The Read job is started on a rising edge. Reset the "execute" parameter to the value "FALSE" if the Read job is completed with "done" = true or "error" = true.
connectionId	connectionId	16#100	Enter the local ID of the connection that you defined during the connection configuration.
done	done	false	–
busy	busy	false	–
error	error	false	–
status	status	16#0	–
ADDR_1	–	P#DB2.DBX0.0 BYTE 100	Only absolute addressing is permitted.
RD_1	–	P#DB1.DBX0.0 BYTE 100	–

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3.6 Function

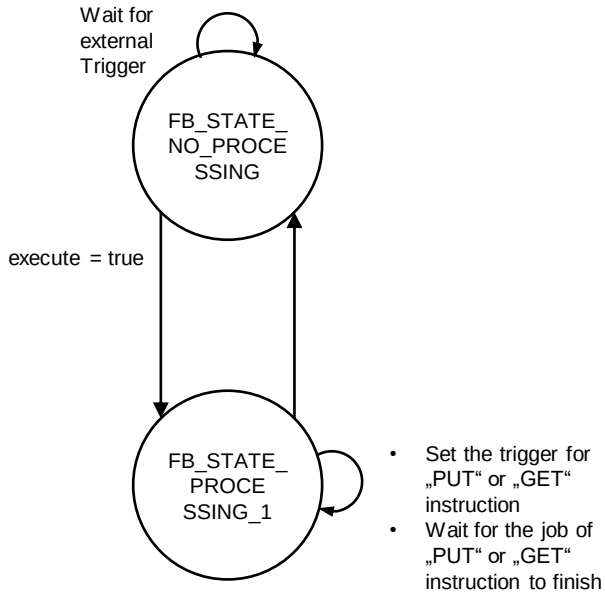
The FBs "PutData" and "GetData" are implemented as state machine. The design model of a state machine is particularly suitable for modeling more complex asynchronous processes, such as communication between partners, which can extend over several cycles.

A certain state is run through cyclically until a transition condition is fulfilled and the machine switches to the next subsequent state. This not only improves the clarity compared to conventional link control, but also makes it easier to find any errors in the program logic more quickly.

3.6.1 Overview

The following figure shows the call of the FBs "PutData" and "GetData".

Figure 3-6



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3.6.2 Description of the States

FB12 "PutData”

The following table describes the implemented states and the possible transitions of FB12 "PutData”.

Table 3-9

State	Description	Transition
FB_STATE_NO_ PROCESSING	In this state the FB has the following properties: • No Write job is active. • The value 16#7000 is output at the "status" output of the FB.	The FB switches to the state "FB_STATE_PROCESSING_1" when a positive edge is detected at the "execute" input of the FB.
FB_STATE_ PROCESSING_1	In this state the FB executes the following actions: • The FB starts the Write job with the "PUT” instruction. • The FB monitors whether the "PUT" instruction has terminated successfully (DONE = true) or with an error (ERROR = true).	The state is exited when the Write job is completed successfully or with an error. • If the Write job is completed successfully, the following actions are performed: - The "done" output is set to the value "true" for one cycle. - The FB switches to the state "FB_STATE_ NO_PROCESSING" • If the Write job is completed with an error, the following actions are performed: - The "error" output is set to the value "true" for one cycle. - The status display of the "PUT" instruction is output at the "status" output. - The FB switches to the state "FB_STATE_ NO_PROCESSING"

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FB13 "GetData"

The following table describes the implemented states and the possible transitions of FB13 "GetData".

Table 3-10

State	Description	Transition
FB_STATE_NO_ PROCESSING	In this state the FB has the following properties: • No Read job is active. • The value 16#7000 is output at the "status" output of the FB.	The FB switches to the state "FB_STATE_PROCESSING_1" when a positive edge is detected at the "execute" input of the FB.
FB_STATE_ PROCESSING_1	In this state the FB executes the following actions: • The FB starts the Read job with the "GET" instruction. • The FB monitors whether the "GET" instruction has terminated successfully (NDR = true) or with an error (ERROR = true).	The state is exited when the Read job is completed successfully or with an error. • If the Read job is completed successfully, the following actions are performed: - The "done" output is set to the value "true" for one cycle. - The FB switches to the state "FB_STATE_ NO_PROCESSING" • If the Read job is completed with an error, the following actions are performed: - The "error" output is set to the value "true" for one cycle. - The status display of the "GET" instruction is output at the "status" output. - The FB switches to the state "FB_STATE_ NO_PROCESSING"

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3.7 Error Handling

3.7.1 FB12 "PutData”

If an error occurs in FB12 "PutData”, the cause of the error is written to the "status" output parameter.

Table 3-11

error	status	Description	Remedy
0	16#7000	FB12 "PutData" is not active.	Status information Enable FB12 "PutData” by setting the "execute" input to "true".
0	16#7001	FB12 "PutData" is initialized.	Status information
0	16#7002	Write job is running.	Status information
1	<>16#0000	Status display of the "PUT” instruction.	Detailed information is available in the STEP 7 Online Help or in the following manual: "SIMATIC STEP 7 Basic/Professional V16 and SIMATIC WinCC V16".

3.7.2 FB13 "GetData"

If an error occurs in FB13 "GetData”, the cause of the error is written to the "status" output parameter.

Table 3-12

error	status	Description	Remedy
0	16#7000	FB13 "GetData” is not active.	Status information Enable FB13 "GetData" by setting the "execute" input to "true".
0	16#7001	FB13 "GetData” is initialized.	Status information
0	16#7002	Read job is running.	Status information
1	<>16#0000	Status display of the "GET” instruction.	Detailed information is available in the STEP 7 Online Help or in the following manual: "SIMATIC STEP 7 Basic/Professional V16 and SIMATIC WinCC V16".

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4 User Program of the Passive S7 CPU

No instructions for data transfer are called in the user program of the passive S7 CPU.

All you need are data blocks in which the sent and received data is stored.

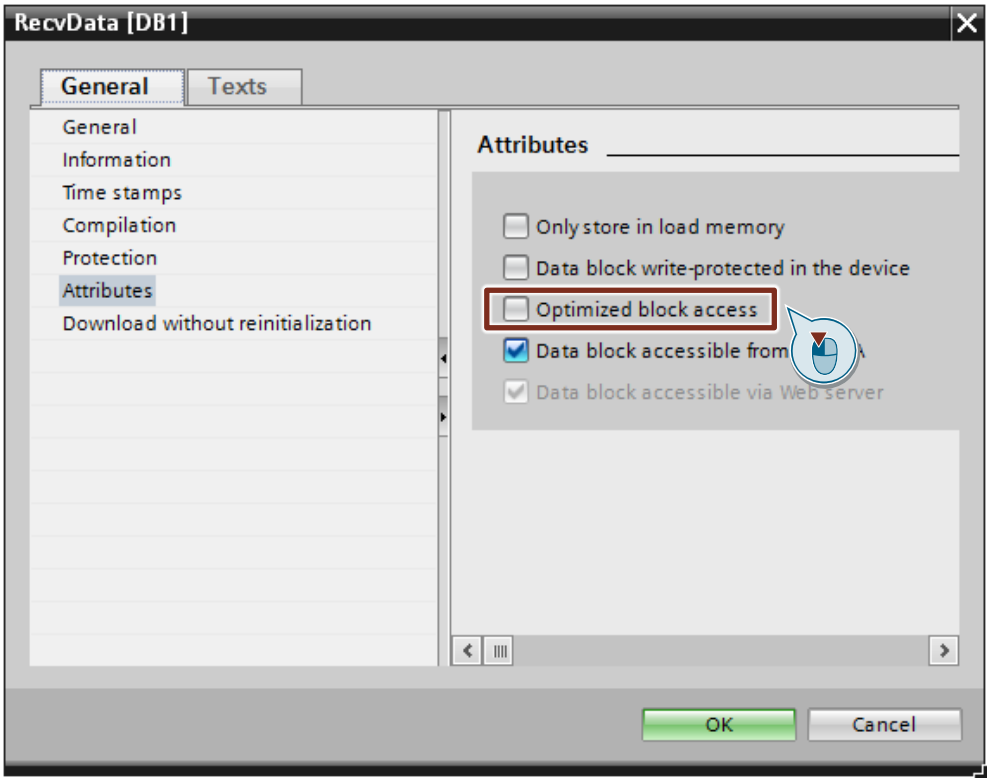
4.1 Create Send and Receive Data Areas

4.1.1 DB1 "RecvData"

The data written by the partner CPU is stored in the data block DB1 "RecvData" of the passive S7 CPU.

In the Properties of the DB1 "RecvData", under "Attributes" you disable the "Optimized block access" function.

Figure 4-1



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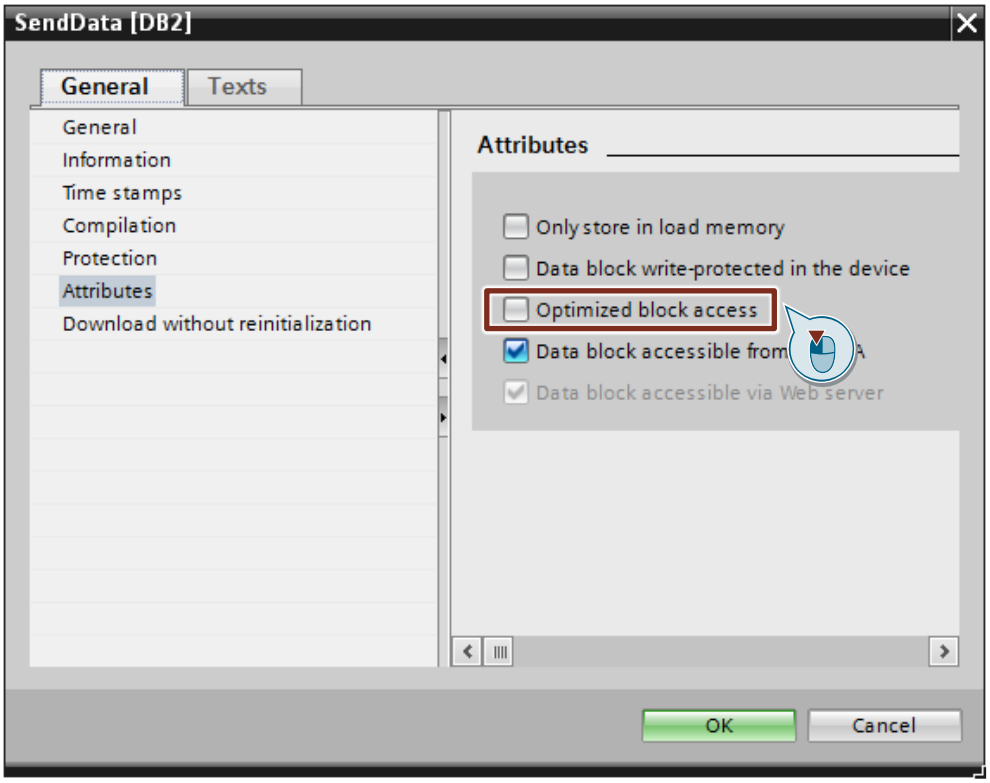
4.1.2 DB2 "SendData"

The data that is read by the partner CPU is stored in the data block DB2 "SendData" of the passive S7 CPU.

In the Properties of the DB2 "SendData", under "Attributes" you disable the "Optimized block access" function.

Figure 4-2



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5 Information

5.1 "PUT" Instruction

The "PUT" instruction is called in FB12 "PutData". This is to be found in the "Instructions" task card under "Communication".

You use the "PUT" instruction to write data to the partner CPU.

Note

This is only possible if the function "Permit access with PUT/GET communication from remote partner" has been enabled for the partner CPU in the Properties of the CPU under "Protection & Security > Connection mechanisms".

With the "PUT" instruction you cannot access blocks that have been created with the "optimized" type of access.

Detailed information about the "PUT" instruction is given in the manual entitled "SIMATIC STEP 7 Basic/Professional V16 and SIMATIC WinCC V16".

5.2 "GET" Instruction

The "GET" instruction is called in FB13 "GetData". This is to be found in the "Instructions" task card under "Communication > S7 Communication".

You use the GET instruction to read data from the partner CPU.

Note

This is only possible if the function "Permit access with PUT/GET communication from remote partner" has been enabled for the partner CPU in the Properties of the CPU under "Protection & Security > Connection mechanisms".

With the "GET" instruction you cannot access blocks that have been created with the "optimized" type of access.

Detailed information about the "GET" instruction is given in the manual entitled "SIMATIC STEP 7 Basic/Professional V16 and SIMATIC WinCC V16".

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5.3 Configuration of the "PUT" and "GET" Instructions

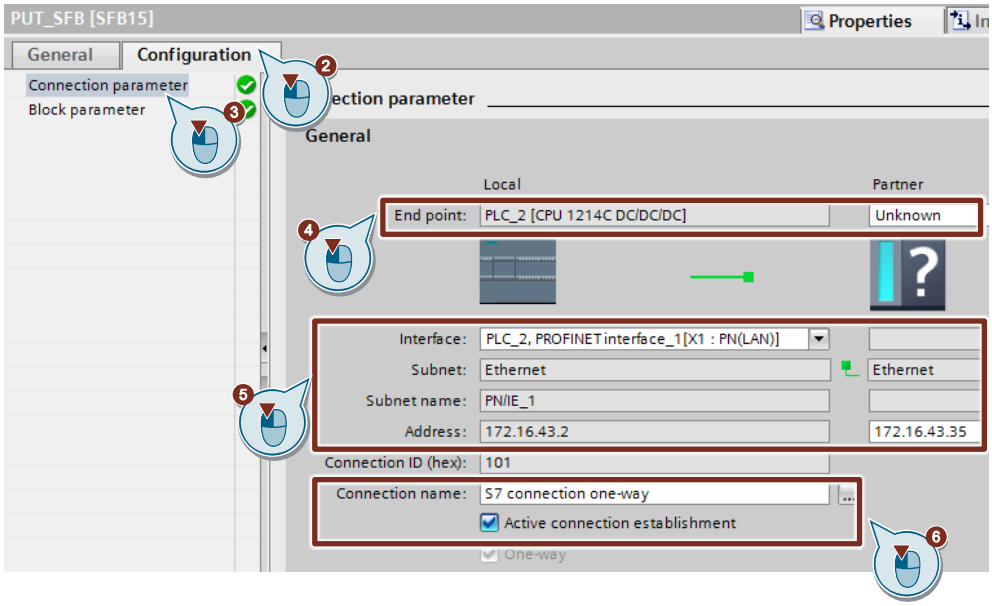
Note If you use FB "PutData" and FB "GetData", you specify the connection ID of the configured S7 connection at the input parameter "connectionId". The connection ID is used internally in the FB on the instructions "PUT" and "GET".

You have the option of having the connection ID entered automatically by TIA Portal at the input parameter "ID" of the "PUT" and "GET" instructions.

You configure the "PUT" and "GET" instructions in the inspector window of the program editor. Proceed as instructed below:

1. Mark the call of the "PUT" or "GET" instruction.
2. Open the "Configuration" tab in the inspector window.
3. In the area navigation of the "Configuration" tab you select the "Connection parameter" group. This group includes the connection parameters.
4. Define the connection endpoints of the S7 connection via which the data will be sent and received.
5. The following parameters of the communication partners are entered automatically once you have defined the connection endpoint.
   - Interface
   - Subnet
   - Subnet name
   - Address
6. Select the name of the S7 connection via which the data is to be transferred.

Figure 5-1



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