Examples of Open User Communication: TCP

Programmed TCP connection

https://support.industry.siemens.com/cs/ww/de/view/109747710

Siemens Industry Online Support

Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG (“Siemens”). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.

Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.

By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.

The Siemens terms of use (https://support.industry.siemens.com) shall also apply.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens’ products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit https://www.siemens.com/industrialsecurity.

Siemens’ products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer’s exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: http://www.siemens.com/industrialsecurity.

© Siemens AG 2018 All rights reserved

Table of Contents

© Siemens AG 2018 All rights reserved

1 Introduction

1.1 Overview

Content of the application example

The TCP/IP based Open User Communication (OUC) is now the standard in the communication with SIMATIC S7 CPUs.

In the S7 CPU, the OUC is implemented on the basis of instructions (for example, TCON, TSEND, TRCV and TDISCON). The user has to configure the instructions in their user program and in a fail-tolerant way. This task has to be rethought by each user again and again. In order to facilitate this, we offer a function block (FB) in SCL. The FB calls the OUC instructions in the order and in the way that is recommended in the manuals. The FB also includes the following mechanisms.

- Connection management with the instructions "TCON" and "TDISCON"
- Sending data to a partner CPU
- Receiving data from a partner CPU

You can use the FB as template for your own communication projects.

The application example provides the following information:

- Library for STEP 7 (TIA Portal) that contains the FB
- Description of the FB in order to send and receive fixed of dynamic frame lengths via a **programmed connection** with **TCP**

The application example shows in which places you can integrate your individual expansions in the code.

Overview of all OUC variants in this row

This application example is part of a larger series of basic examples for PLC communication.

Table 1-1 shows the variants of the OUC that are provided to the user in a series of basic examples. The variant described in this application example is highlighted in color.

© Siemens AG 2018 All rights reserved

Table 1-1

Protocol	Frame length	Programmed connection	Note
ISO-on-TCP	Dynamic	✓	• Fast data transmission rate • Transmission of medium to large data amounts. Information on the max. amount of CPU data can be found in the FAQ 18909487. • Mainly only applicable in SIMATIC-homogenous structures. • Acknowledged • Package-oriented data transmission, i.e. length and information on start and end of a frame are also transmitted.
TCP	Fixed	✓	• Fast data transmission rate. • Transmission of medium to large data amounts. Information on the max. amount of CPU data can be found in the FAQ 18909487. • It can be used flexibly with third-party systems. • Acknowledged • Data are transmitted as a data stream, i.e. length and information on start and end of a frame are not transmitted. The sender therefore has to define a message structure that can be interpreted by the receiver when transmitting dynamic frame lengths. **Note** Detailed information on the design of the message structure for the receipt of dynamic frame lengths can be found in Chapter 3.1.4.
	Dynamic	✓	

© Siemens AG 2018 All rights reserved

Protocol	Frame length	Programmed connection	Note
UDP	Dynamic	✓	• Very fast data transmission rate • Transmission of small to medium data volumes. Information on the max. amount of CPU data can be found in the FAQ 18909487. • It can be used flexibly with third-party systems • There is no guarantee that a sent data package will arrive at the receiver or that a sent data package will only arrive once. • The arrival sequence of the packets at the receiver cannot be predicted. • Data packets with incorrect checksum are rejected and not newly requested. • Package-oriented data transmission, i.e. length and information on start and end of a frame are also transmitted.

© Siemens AG 2018 All rights reserved

Note

The variants with the compact instructions for OUC (TSEND_C and TRECV_C) are not dealt with in this series.

More information can be found in the following FAQ:

https://support.industry.siemens.com/cs/ww/en/view/67196808

For each variant the OUC has its own FB that is used as communication template. All communication templates are summarized in the "LOpenUserComm" library. This application example only relates to the variant “programmed connection with TCP".

The function block for TCP is used to receive data with fixed and dynamic frame length.

1.2 Mode of operation

Realization as state machine

The FB for controlling the OUC instructions (TCON, TSEND, TRCV and TDISCON) is realized as state machine. The design model of a state machine is particularly suitable for the modeling of complex asynchronous processes, for example, the communication between partners that stretch over several cycles.

A certain state is cyclically run until a transition condition is fulfilled and the machine switches to the next subsequent state. This not only improves the clarity in comparison to a conventional logic controller but also facilitates finding possible errors in the program logic quicker.

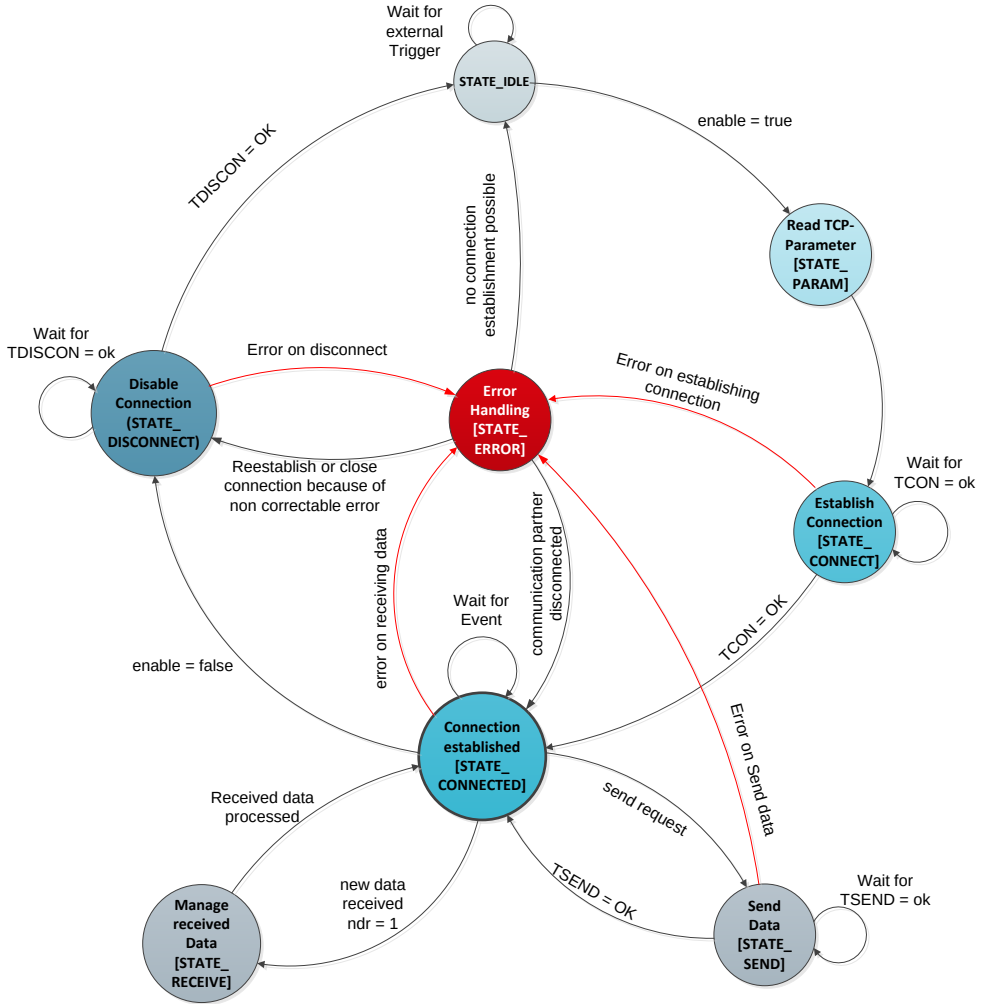
A detailed description of the state machine can be found in Chapter 2.7.

© Siemens AG 2018 All rights reserved

Status display in FB "LOpenUserComm_Tcp"

The figure below shows the states that are implemented in this FB.

Figure 1-1



© Siemens AG 2018 All rights reserved

Description of the states

The following table describes the realized states and the possible transitions. More information can be found in the documented code.

Table 1-2

State	Description	Transition condition
STATE_IDLE (1)	In the "STATE_IDLE" idle state the FB has the following characteristics: • No connection is active • Status tags are reset	The "STATE_IDLE" idle state is now left, if a connection is triggered via a parameter (enable).
STATE_PARAM (2)	The TCP connection parameters are read and the TCON instruction is assigned.	The FB goes straight to the "STATE_CONNECT" state without transition condition.
STATE_CONNECT (3)	The TCP connection to the partner is established.	The "STATE_CONNECT" state is left if one of the following conditions is fulfilled: • If the connection is still not established after the lapse of the watchdog timer (180s), the FB goes to "STATE_ERROR" state. • If the connection is established, the FB goes to "STATE_CONNECTED" state.
STATE_ CONNECTED (7)	In the "STATE_CONNECTED" state the FB performs the following actions: • It waits for the trigger of the send job to send the data via the connection. • It monitors whether the data has been received by the partner. • It monitors the connection to the partner.	The “STATE_CONNECTED" state is left when one of the following conditions is fulfilled: • If an error occurs when receiving the data, the FB goes to "STATE_ERROR" state. • When the connection is to be actively disconnected, the FB goes to “STATE_DISCONNECT" state. • When data is to be sent, the FB goes to "STATE_SEND" state.

© Siemens AG 2018 All rights reserved

State	Description	Transition condition
STATE_SEND (5)	In the "STATE_SEND" state, the FB performs the following actions: • It enables the parameters of the "TSEND" OUC instruction. • It waits until the "TSEND" OUC instruction is completed successfully (DONE=1) or with error (ERROR=1). • It disables the "TRCV" OUC instruction during the running send process.	The "STATE_SEND" state is left, if one of the following conditions is fulfilled: • When the send process is completed successfully, the FB goes back to the "STATE_CONNECTED" state. • If an error occurs during sending, the FB goes to "STATE_ERROR" state.
STATE_RECEIVE (6)	The "STATE_RECEIVE" state is used for an individual processing of the received data. This application example shows how to receive and process frames with fixed and dynamic data lengths.	After the processing of the received data has been completed, the FB goes straight back to the “STATE_CONNECTED" state without transition condition.
STATE_ DISCONNECT (4)	In the following cases, the FB disconnects the connection to the partner in the "STATE_DISCONNECT" state: • The disconnection is triggered by the user (enable). • The disconnection is triggered by the FB, if the connection has to be re-established or if an error that cannot be removed occurred.	The "STATE_DISCONNECT" state is left, if one of the following conditions is fulfilled: • When the connection was disconnected without error, the FB goes to “STATE_IDLE" state. • If an error occurs when disconnecting the connection, the FB goes to the "STATE_ERROR" state.
STATE_ERROR (8)	In the "STATE_ERROR" state, the FB performs the following actions: • It decides whether it autonomously attempted to remove an error within the FB by calling other states. • It supplies the output parameters with error information.	The "STATE_ERROR" state is left, if one of the following conditions is fulfilled. • The FB goes to the "STATE_IDLE" state if the connection has to be re-established or if an error occurred that cannot be removed. • If the partner discontinues the connection, the FB goes to the "STATE_CONNECTED" state.

© Siemens AG 2018 All rights reserved

1.3 Components used

This application example was created with the following hardware and software components:

Table 1-3

Component	Number	Article number	Note
CPU 1513-1 PN	1	6ES7513-1AL01-0AB0	Alternatively, you can use any other S7-1500 CPU from firmware V2.0, ET 200SP CPU, ET 200pro CPU or the following CPs and CMs: • CP 1543-1 (Article number: 6GK7543-1AX00-0XE0) • CM 1542-1 (Article number: 6GK7542-6VX00-0XE0) • CP 1542SP-1 (Article number: 6GK7542-6UX00-0XE0) • CP 1542SP-1 IRC (Article number: 6GK7542-6VX00-0XE0) • CP 1543SP-1 (Article number: 6GK7543-6WX00-0XE0)
CPU 1214C DC/DC/DC	1	6ES7214-1AG40-0AB0	Alternatively, you can use any S7-1200 CPU as of firmware V4.0 or following CPs as of firmware: V2.1: • CP 1243-1 (Article number: 6GK7243-1BX30-0XE0) • CP 1242-7 GPRS (Article number: 6GK7242-7KX31-0XE0) • CP 1243-7 LTE (Article number: 6GK7243-7KX30-0XE0) • CP 1243-8 IRC (Article number: 6GK7243-8RX30-0XE0)

© Siemens AG 2018 All rights reserved

Component	Number	Article number	Note
CPU 315-2 PN/DP	1	6ES7-2EH14-0AB0	Alternatively you can use any CPU 31x-2 PN/DP from V3.1 and CPU 31x-3 PN/DP from firmware V3.2. Alternatively, you can use any S7-400 CPU with integrated IE interface.
STEP 7 V14 update 5	1	Package: 6ES7822-0AA04-0YA5 Download: 6ES7822-0AE04-0YA5	

© Siemens AG 2018 All rights reserved

2 Engineering

2.1 Interface description for S7-1200 and S7-1500

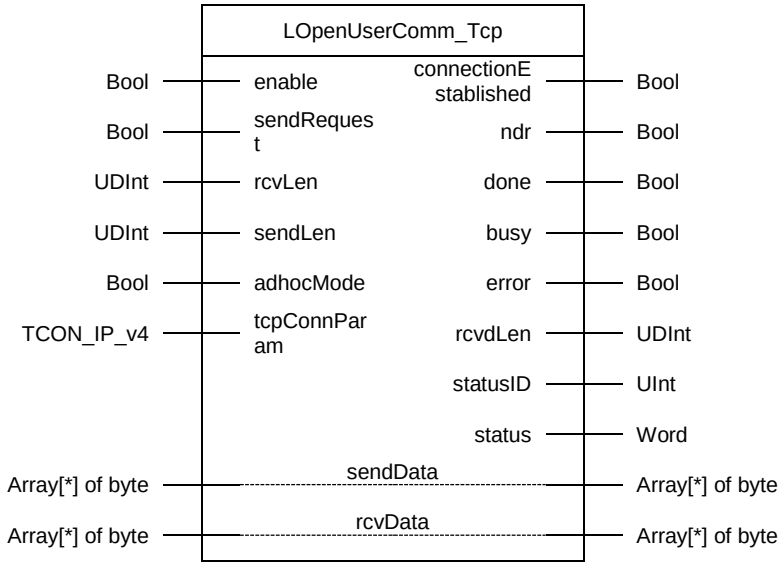
Function description

The FB "LOpenUserComm_Tcp" implements a complete TCP communication relationship to a partner. It encapsulates all OUC instructions in a user-friendly shell to perform the following functions:

- Management of establishing connection and disconnection using the "enable" input.
- Sending user data of the length "sendLen" via the "sendData" input to the partner as soon as the "sendRequest" input detects a positive edge.
- Receiving data from a partner and saving it in a storage area that is created on the "rcvData" parameter.
  Note
  - Enable the adhoc mode to receive frames with dynamic data length. In this case, the input parameter "rcvLen" is irrelevant.
  - Disable the adhoc mode to receive frames with fixed data length. In this case, you have to specify the number of bytes to receive at the input parameter "rcvLen".
- Outputting state of the transmission and connection on the "status" output parameter.

Block interface

Figure 2-1



© Siemens AG 2018 All rights reserved

Table 2-1

Name	P type	Data type	Comment
enable	IN	Bool	Release signal for the establishing the connection and the data exchange
sendRequest	IN	Bool	Trigger of a send job
rcvLen	IN	UDInt	Length of the receive data • S7-1500 CPUs: max. 65536 byte • S7-1200 CPUs: max. 8192 byte **Note** The parameter is irrelevant if the adhoc mode is enabled. All data that are currently available are read. The max. data length is defined by the length of the receive area referenced by rcvData.
sendLen	IN	UDInt	Maximum number of bytes that are sent with the job. • S7-1500 CPUs: max. 65536 byte • S7-1200 CPUs: max. 8192 byte
adhocMode	IN	Bool	1 (adhoc enabled): • The data are available immediately. • Receiving data with dynamic data length 0 (adhoc disabled): • The data are available as soon as the data length specified at LEN parameter have been received completely. • Receiving data with specified data length.
tcpConnParam	IN	TCON_IP_v4	Connection parameters
connectionEstablished	OUT	Bool	Status display: Connection has been established
ndr	OUT	Bool	Status display: Receive new data
done	OUT	Bool	Status display: Send job successfully completed
busy	OUT	Bool	FB in process
error	OUT	Bool	Error display
rcvdLen	OUT	UDInt	Length of received data (in byte)
statusID	OUT	UInt	Parameter shows which OUC instruction supplies the error (see Table 2-46).
status	OUT	Word	Status display of the OUC instructions

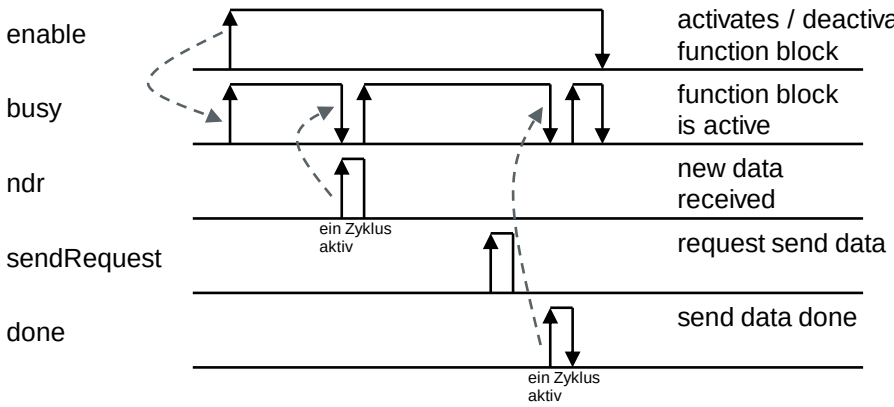
© Siemens AG 2018 All rights reserved

Name	P type	Data type	Comment
sendData	IN_OUT	Array[*] of byte	Send data area
rcvData	IN_OUT	Array[*] of byte	Receive data area

Function chart

The following function chart shows how the most important output parameters are set, depending on the input parameters.

Figure 2-2



2.2 Interface description for S7-300 and S7-400

Function description

The FB "LOpenUserComm_Tcp" implements a complete TCP communication relationship to a partner. It encapsulates all OUC instructions in a user-friendly shell to perform the following functions:

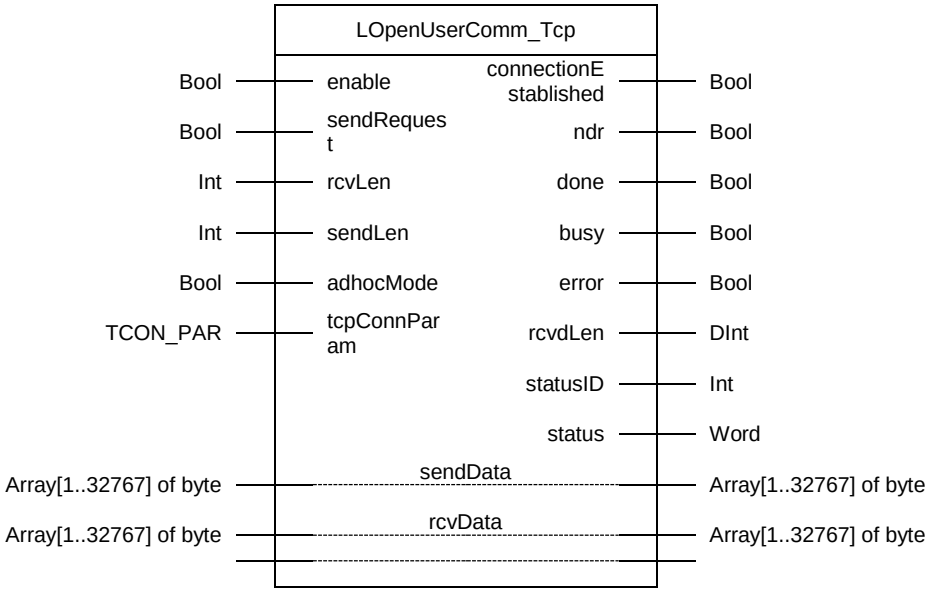
- Management of establishing connection and disconnection using the "enable" input.
- Sending user data of the length "sendLen" via the "sendData" input to the partner as soon as the "sendRequest" input detects a positive edge.
- Receiving data from a partner and saving it in a defined receive area. The receive area is defined by the following two dimensions:
  - Pointer at the beginning of the area
  - Length of the area

  Note
  - Enable the adhoc mode to receive frames with dynamic data length. In this case, the input parameter "rcvLen" is irrelevant.
  - Disable the adhoc mode to receive frames with fixed data length. In this case, you have to specify the number of bytes to receive at the input parameter "rcvLen".
- Outputting state of the transmission and connection on the "status" output parameter.

© Siemens AG 2018 All rights reserved

Block interface

Figure 2-3



The following table shows the inputs and outputs of the "LOpenUserComm_Tcp" function block for S7-300 and S7-400.

Table 2-2

Name	P type	Data type	Comment
enable	IN	Bool	Release signal for the establishing the connection and the data exchange
sendRequest	IN	Bool	Trigger of a send job
rcvLen	IN	Int	Length of receive data, max. 32767 byte for the following CPUs: • CPUs 31x-2 PN/DP from firmware V3.1 • CPUs 31x-3 PN/DP from firmware V3.2 • CPUs 412-2 PN • CPUs 41x-3 PN/DP • CPUs 41x-5H PN/DP **Note** The parameter is irrelevant if the adhoc mode is enabled. All data that are currently available are read. The max. data length is defined by the length of the receive area referenced by rcvData.

© Siemens AG 2018 All rights reserved

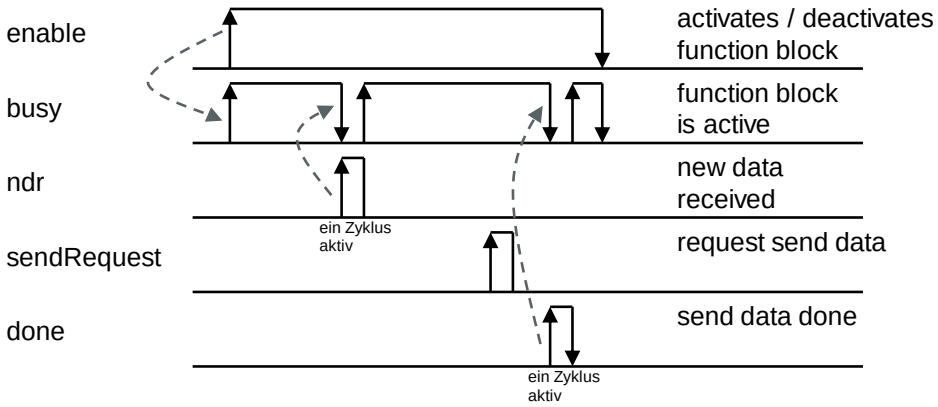
Name	P type	Data type	Comment
sendLen	IN	Int	Maximum number of bytes that are sent with the job. The following CPUs have a maximum of 32767 bytes: • CPUs 31x-2 PN/DP from firmware V3.1 • CPUs 31x-3 PN/DP from firmware V3.2 • CPUs 412-2 PN • CPUs 41x-3 PN/DP • CPUs 41x-5H PN/DP
adhocMode	IN	Bool	1 (adhoc enabled): • The data are available immediately. • Receiving data with dynamic data length 0 (adhoc disabled): • The data are available as soon as the data length specified at LEN parameter have been received completely. • Receiving data with specified data length.
tcpConnParam	IN	TCON_PAR	Connection parameters
connectionEstablished	OUT	Bool	Status display: Connection has been established
ndr	OUT	Bool	Status display: Receive new data
done	OUT	Bool	Status display: Send job successfully completed
busy	OUT	Bool	FB in process
error	OUT	Bool	Error display
rcvdLen	OUT	DInt	Length of received data (in byte)
statusID	OUT	Int	Parameter shows which OUC instruction supplies the error (see Table 2-46).
status	OUT	Word	Status display of the OUC instructions
sendData	IN_OUT	Array[1..32767] of byte	Send data area
rcvData	IN_OUT	Array[1..32767] of byte	Receive data area

© Siemens AG 2018 All rights reserved

Function chart

The following function chart shows how the most important output parameters are set, depending on the input parameters.

Figure 2-4



© Siemens AG 2018 All rights reserved

2.3 Integration into the user project

2.3.1 Opening library in STEP 7 (TIA Portal)

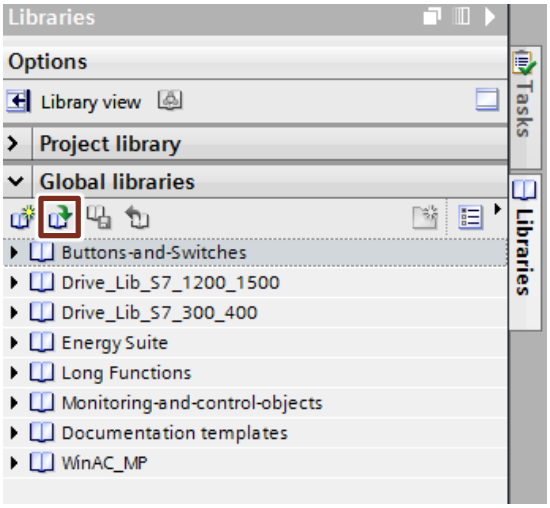
Proceed according to the following instruction in order to open the "LOpenUserComm" library in STEP 7 (TIA Portal).

Prerequisite

- STEP 7 (TIA Portal) is open.
- You have created a new project in STEP 7 (TIA Portal) or opened an already existing project.

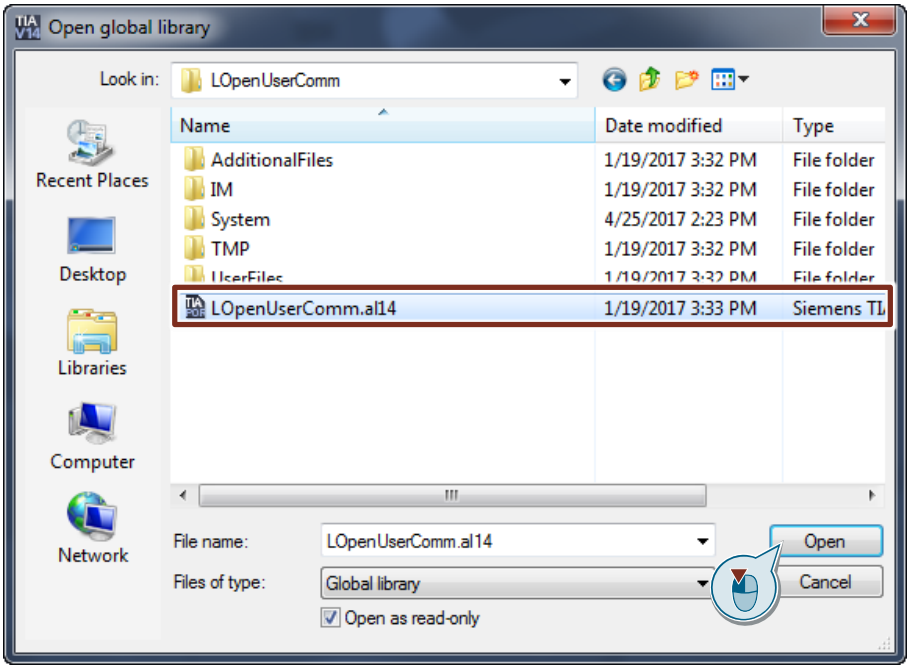
Instruction

1. Open the "Libraries" task card.
2. Click the "Open global library" button in the "Global libraries" palette. The “Open global library” dialog box opens.

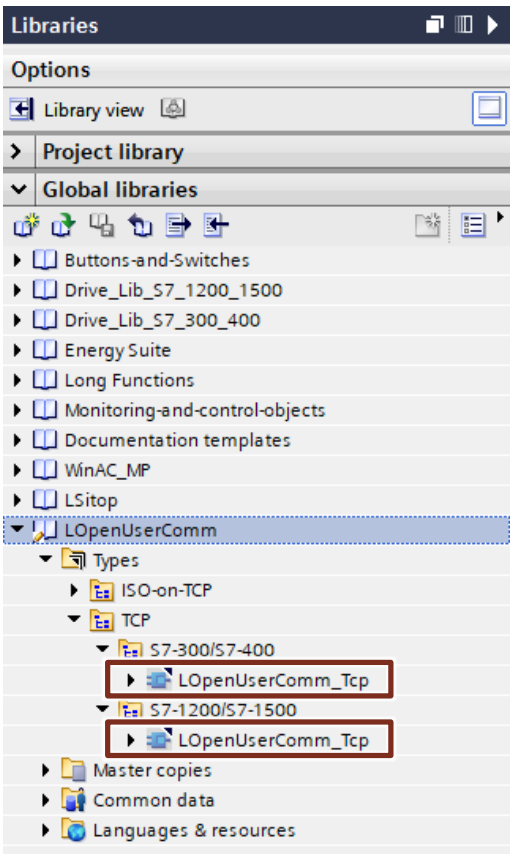


© Siemens AG 2018 All rights reserved

3. Select the "LOpenUserComm.al15" library and click the "Open" button. The "LOpenUserComm" library is opened in "Global libraries" palette.

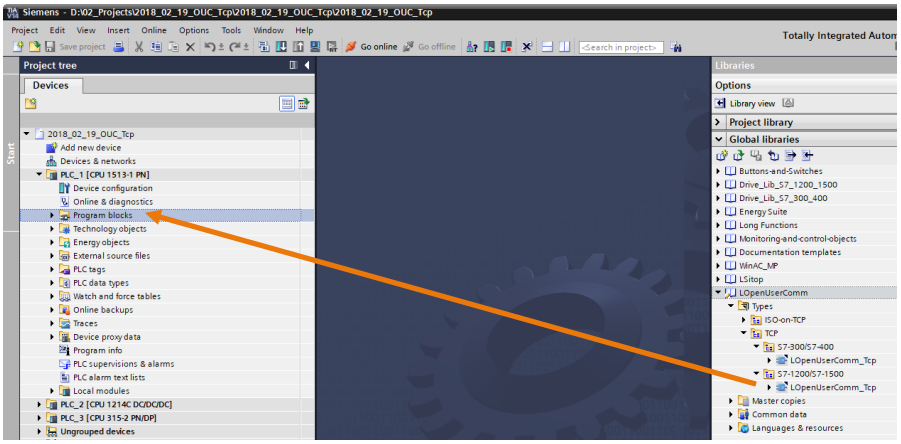


4. The "LOpenUserComm_Tcp" function blocks can be found in the "LOpenUserComm" library in "Types > TCP" > S7-300/S7-400 and in "Types > TCP" > S7-1200/S7-1500.



© Siemens AG 2018 All rights reserved

5. Add the "LOpenUserComm_Tcp" function block from the library to the "Program blocks" folder of your CPU, using drag-and-drop.



6. The "LOpenUserComm_Tcp" function block is shown in the "Program blocks" folder of your CPU.
7. Integrate the "LOpenUserComm_Tcp" function block into the user program of your CPU to establish a communication connection to the partner and to send and receive data (see Chapter 2.3.2).

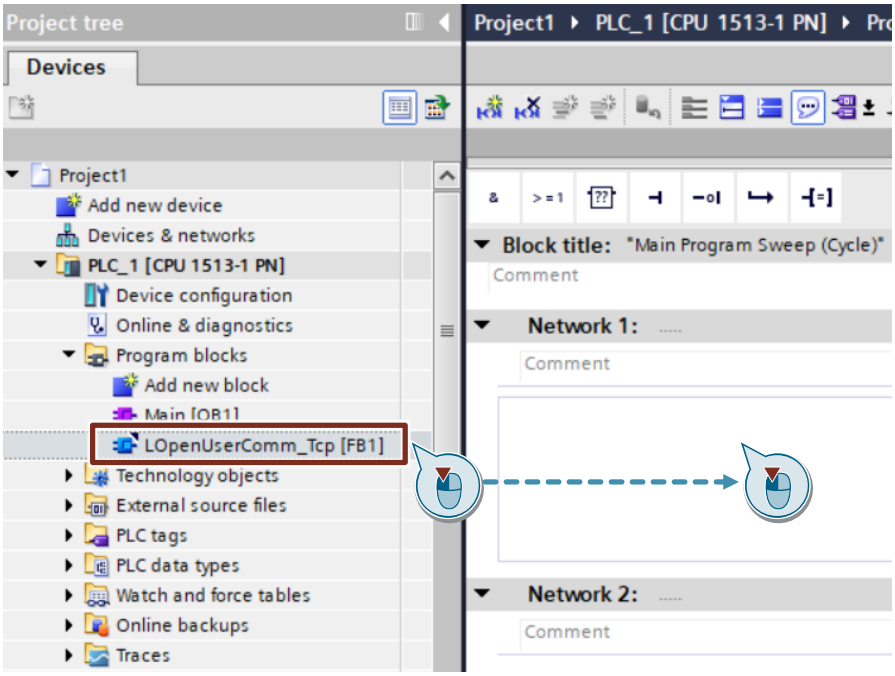
© Siemens AG 2018 All rights reserved

2.3.2 Integrating "LOpenUserComm_Tcp" function block into the user program

Proceed in accordance with the following instruction in order to integrate the "LOpenUseComm_Tcp" function block into the user program of your CPU.

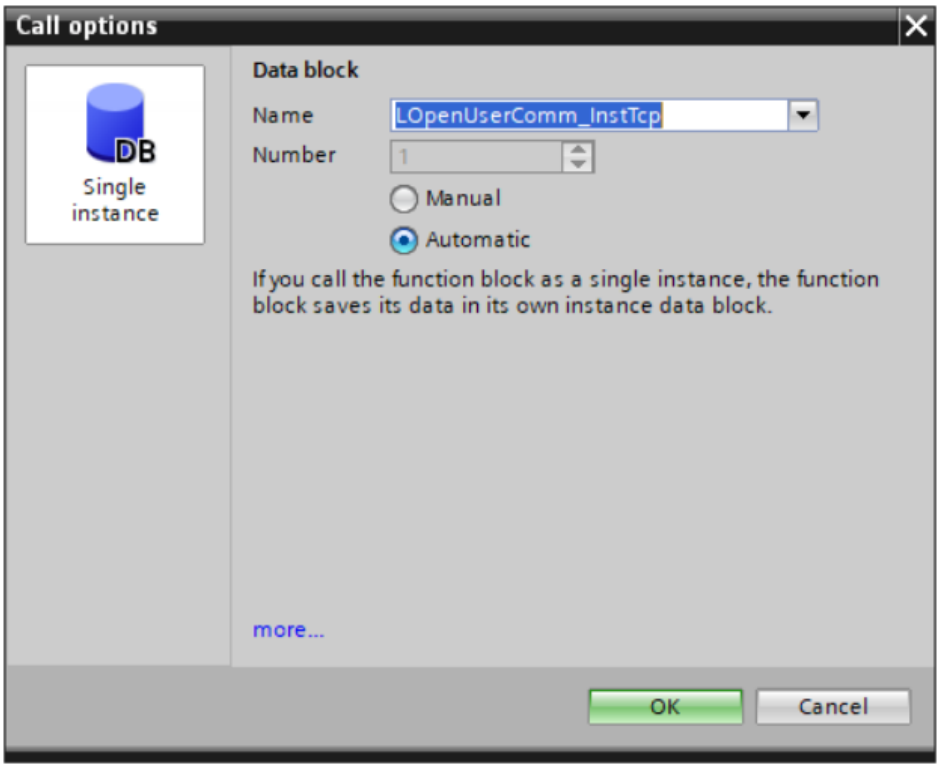
Cyclically call the "LOpenUserComm_Tcp" function block in OB 1.

1. Double-click the "Main [OB1]" block in the project tree in the "Program blocks" folder of the CPU. The OB 1 is opened in the workspace.
2. Select the "LOpenUserComm_Tcp" function block in the project tree in the "Program blocks" folder of your CPU and add it into a network of the OB 1, using drag-and-drop. The "Call options" dialog is opened automatically in order to create the instance data block of the "LOpenUserComm_Tcp" function block.

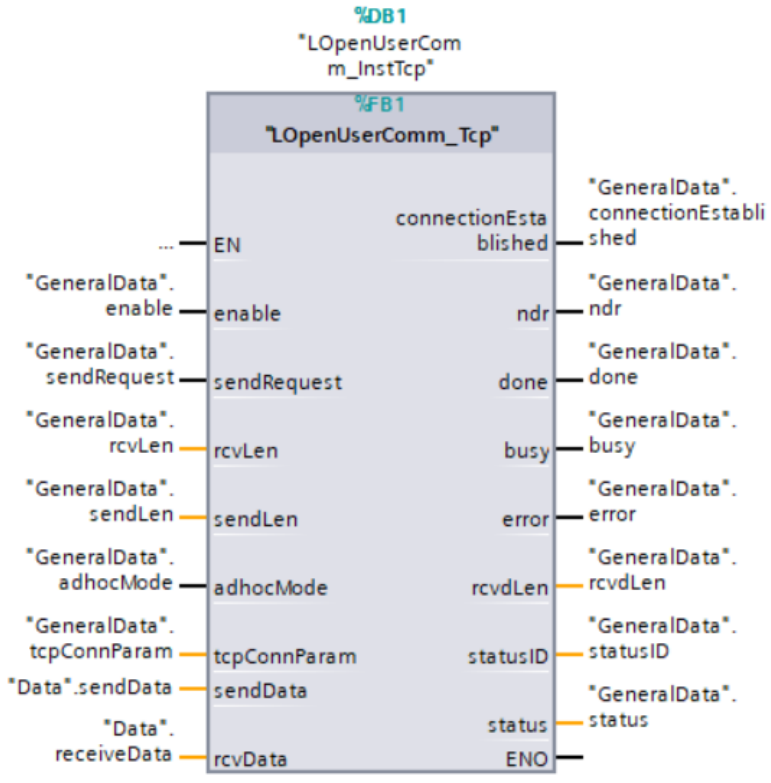


© Siemens AG 2018 All rights reserved

3. Enter the name of the instance DB, for example, "LOpenUserComm_InstTcp". Select the "Automatic" option so that the number of the instance DB is automatically assigned by STEP 7 (TIA Portal).



4. Assign the inputs and outputs of the "LOpenUserComm_Tcp" function block with the appropriate variables.

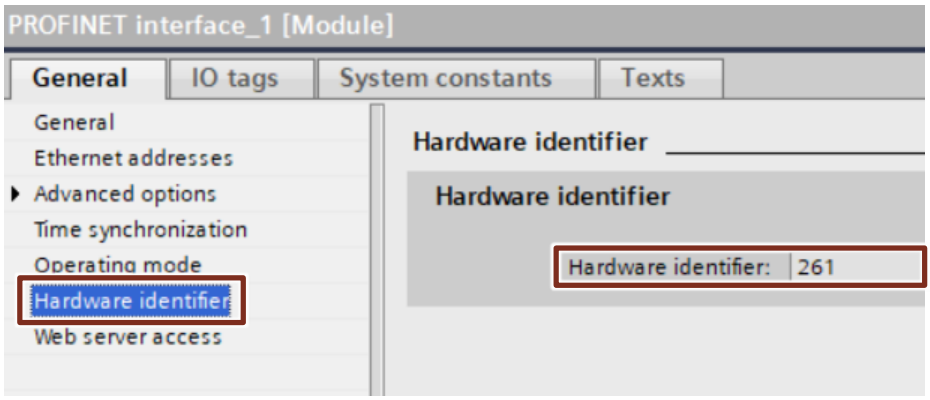


© Siemens AG 2018 All rights reserved

2.4 Determining hardware identifier of the CPU or CP/CM interface

1. In the network view or device view select the CPU or CP/CM interface to be used for TCP communication to determine its hardware identifier. The properties of the CPU or CP/CM interface are displayed in the inspector window.
2. Click the "Hardware identifier" entry in the "General" tab in order to display the hardware identifier of the interface.

Figure 2-5



© Siemens AG 2018 All rights reserved

2.5 Error handling S7-1200 and S7-1500

In FB "LOpenUserComm_Tcp" some error states are caught as an example and responses are programmed. However, you can also catch all error states that are supplied by the OUC instructions and implement your own responses according to this pattern depending on your requirements.

2.5.1 Error while establishing the connection

Connection partner cannot be reached (network error)

The connection partner cannot be reached, for example, when the network cable to the connection partner is not plugged in or broken.

When actively establishing a connection, the "TCON" instruction recognizes this error and outputs status 80C6 (hex). In this case the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-3

Output parameter	Value	Description	Remedy
status	16#80C6	Status display of the TCON instruction: The connection partner cannot be reached (network error).	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Note Because the values are output on the output parameters for only for one cycle, the values of "status" and "statusId" have to be saved if error=1.

© Siemens AG 2018 All rights reserved

When passively establishing a connection, the "TCON" instruction does not recognizes this error. In this case the watchdog timer is started. When the watchdog timer has lapsed after 180 min, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-4

Output parameter	Value	Description	Remedy
status	16#8102	Connection could not be established (watchdog timer lapsed (180 min)).	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Retrigger the connection establishment via the enable=1 parameter.
statusId	1	Internal error in function block	
error	1	Error display: 1: Error detected	

IP address of the partner end point of the connection invalid

If the IP address of the remote end point of the connection is invalid or it corresponds to the IP address of the local end point of the connection, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-5

Output parameter	Value	Description	Remedy
status	16#80A4	Status display of the TCON instruction	Check the IP address of the partner endpoint in the TCON_IP_V4 parameter data record. No broadcast and network addresses must be used. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Among others, invalid remote IP addresses are:

- Broadcast addresses, for example, 192.168.0.255
- Network addresses, for example, 192.168.0.0

© Siemens AG 2018 All rights reserved

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-6, if one of the following temporary communication errors occurs:

- The connection can currently not be established if, for example, the IP address of the partner endpoint is not correctly entered in the "TCON_IP_V4" parameter data record in "RemoteAddress".
- The connection cannot be established because the firewalls on the connection path are not released for the required ports.
- The interface is currently receiving new parameters.
- The configured connection is currently removed from a TDISCON instruction.

Table 2-6

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TCON instruction	Check the IP address of the partner endpoint in the “TCON_IP_V4” parameter data record. Enter the IP address of the partner endpoint at RemoteAddress in the "TCON_IP_V4" parameter data record. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Connection partner denies connection establishment

Connection partner denies connection establishment if the following conditions apply:

- Connection partner is passively involved in the connection establishment and does not initiate the connection establishment.
- Configuration of ports is not correct. The local port in communication partner A has to match the remote port in communication partner B and the remote port in communication partner A has to match the local port in communication partner B.

© Siemens AG 2018 All rights reserved

The output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-7

Output parameter	Value	Description	Remedy
status	16#80C5	Status display of the TCON instruction	Check if the passive communication partner initiates the connection establishment. Check the remote and local port as well as the connection number in the "TCON_IP_V4" parameter data record. Use the same port number for the local and the remote port. The FB starts the connection establishment again.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Length of the remote or local port is 0

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as in Table 2-8, if the following conditions apply:

- When the connection is established actively, the remote port “0” is specified in the parameter data record.
- When the connection is established passively, the local port “0” is specified in the parameter data record.
- In the "TCON_IP_V4" parameter data record the IP address of the partner endpoint is set to "0.0.0.0".

Table 2-8

Output parameter	Value	Description	Remedy
status	16#80B7	Status display of the TCON instruction	Use the same port number in the parameter data record "TCON_IP_V4" the local and the remote port. The valid value range is 1 to 49151. Enter the IP address of the partner endpoint at “RemoteAddress” in the "TCON_IP_V4" parameter data record. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Local or remote port is used by the system

When you define a port number for the local or remote port in the parameter data set "TCON_IP_V4" which is used by the system, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-9

Output parameter	Value	Description	Remedy
status	16#80A2	Status display of the TCON instruction	The following ports are reserved by the system: 20, 21, 80, 102, 135, 161, 162, 443, 34962, 34963, 34964 as well as the range from 49152 to 65535. Use a port number for the local and the remote port that is not reserved. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Connection or port is already occupied

Each connection is defined by the connection number and port number. If you use the same connection or port number for several connections, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-10

Output parameter	Value	Description	Remedy
Status	16#80A1	Status display of the TCON instruction	Use a different connection number and port number for each connection. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Hardware identifier in the connection parameters not correct

If the "InterfaceId" parameter of the "TCON_IP_V4" parameter data record does not reference a hardware identifier of a CPU or CM/CP interface or if it has the value "0", the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-11

Output parameter	Value	Description	Remedy
status	16#809B	Status display of the TCON instruction	Enter the hardware identifier of the local interface (value range: 0 to 65535) in the "TCON_IP_V4" parameter data record at "InterfaceId". Detailed information on the determination of the hardware identifier can be found in chapter 2.4. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Connection number is outside the permitted range

If the "id" parameter of the "TCON_IP_V4" parameter data record is outside the permitted range, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-12

Output parameter	Value	Description	Remedy
status	16#8086	Status display of the TCON instruction	Enter a value in the "TCON_IP_V4" parameter data record at "ID" that is in the value range from 1 to 4095. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Configuration error in “ConnectionType" parameter

If there is a configuration error in the "ConnectionType" parameter of the "TCON_IP_V4" parameter data record, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-13

Output parameter	Value	Description	Remedy
status	16#80B6	Status display of the TCON instruction	Enter the value 0x0B (hex) or 0x11 (hex) in the "TCON_IP_V4" parameter data record at "ConnectionType". Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Communication error: "TDISCON" was executed before "TCON" was ended

If the "TCON" instruction ended the connection establishment with DONE=1 or ERROR=1, a job for establishing a job may be triggered.

If the connection establishment is canceled prematurely by calling a "TDISCON", the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-14

Output parameter	Value	Description	Remedy
status	16#80A7	Status display of the TCON instruction	The connection is disconnected by the FB, since the connection establishment was prematurely canceled by calling a "TDISCON". Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Job for establishing a connection is triggered during the establishment of the connection

If a job to establish a connection is triggered, whilst the disconnection of a connection is running, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-15

Output parameter	Value	Description	Remedy
status	16#80A3	Status display of the TCON instruction	The connection is disconnected by the FB, since the job for establishing a connection was triggered during a running connection establishment. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

2.5.2 Error when receiving data

Configured length of the receive data invalid

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as in Table 2-16, if the following conditions apply:

- The configured length of the receive data is larger than the largest permitted value (for S7-1200: 8192 byte, for S7-1500: 65536 byte).
- The value of the "rcvLen" or "rcvData" parameter was modified after the first call.
- The parameters "rcvLen" and "rcvData" of FB "LOpenUserComm_Tcp" have the value "0".

Table 2-16

Output parameter	Value	Description	Remedy
status	16#8085	Status display of the TRCV instruction	Specify the length of the data to be received on the "rcvLen" parameter. Specify the receive area on the "rcvData" parameter. Detailed information regarding the max. number of user data that is to be transferred using TCP can be found in the following FAQ: 18909487. **Note** • Enable the adhoc mode to receive frames with dynamic data length. In this case, the input parameter "rcvLen" is irrelevant. • Disable the adhoc mode to receive frames with fixed data length. In this case, you have to specify the number of bytes to receive at the input parameter "rcvLen".
statusId	3	Error when receiving data using TRCV	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Receive area incorrectly configured

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as in Table 2-17, if the following conditions apply:

- Receive area too small.
- Value on "rcvLen" parameter larger than the receive area that is specified on the "rcvData" parameter.

Table 2-17

Output parameter	Value	Description	Remedy
status	16#8088	Status display of the TRCV instruction	Value on "rcvLen" parameter must not be larger than the receive area that is specified on the "rcvData" parameter.
statusId	3	Error when receiving data using TRCV	
error	1	Error display: 1: Error detected	

Length of the receive area smaller than the length of the sent data

If the length of the receive area is smaller than the length of the data that the communication partner sends, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-18

Output parameter	Value	Description	Remedy
status	16#80C9	Status display of the TRCV instruction	The receive area that you specify on the "rcvData" parameter has to have at least the size of the length of the data that is sent by the communication partner. The length that is specified on the "rcvLen" parameter has to have at least the size of the length of the data that the communication partner sends.
statusId	3	Error when receiving data using TRCV	
error	1	Error display: 1: Error detected	

Communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-19, if one of the following communication errors occurs:

- The specified connection has not been established yet.
- The specified connection is currently disconnected. Receive job not possible via this connection.
- The connection is currently reinitiated.

Table 2-19

Output parameter	Value	Description	Remedy
status	16#80A1	Status display of the TRCV instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	3	Error when receiving data using TRCV	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-20, if one of the following temporary communication errors occurs:

- Connection to the partner can currently not be established.
- The interface receives new parameter settings or the connection is established.

Table 2-20

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TRCV instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	3	Error when receiving data using TRCV	
error	1	Error display: 1: Error detected	

2.5.3 Error when sending data

Configured length of the send data invalid

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as in Table 2-21, if the following conditions apply:

- The configured length of the send data is larger than the largest permitted value.
- The parameters "sendLen" and "sendData" of FB "LOpenUserComm_Tcp" have the value "0".

Table 2-21

Output parameter	Value	Description	Remedy
status	16#8085	Status display of the TSEND instruction	Specify the length of the data to be sent on the "sendLen" parameter. Specify the send area on the "sendData" parameter. Detailed information regarding the max. number of user data that is to be transferred using TCP can be found in the following FAQ: 18909487.
statusId	4	Error when sending data using TSEND	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Send area incorrectly configured

The output parameters of "LOpenUserComm_Tcp" function block are set for one cycle as in Table 2-22, if the following conditions apply:

- Send area too small.
- Value on "sendLen" parameter larger than the send area that is specified on the “sendData" parameter.

Table 2-22

Output parameter	Value	Description	Remedy
status	16#8088	Status display of the TSEND instruction	Value on "sendLen" parameter must not be larger than the send area that is specified on the "sendData" parameter.
statusId	4	Error when sending data using TSEND	
error	1	Error display: 1: Error detected	

Communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-23, if one of the following communication errors occurs:

- The specified connection has not been established yet.
- The specified connection is currently disconnected. Send job not possible via this connection.
- The connection is currently reinitiated.

Table 2-23

Output parameter	Value	Description	Remedy
status	16#80A1	Status display of the TSEND instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	4	Error when sending data using TSEND	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-24, if one of the following temporary communication errors occurs:

- Connection to the partner can currently not be established.
- The interface receives new parameter settings or the connection is established.

Table 2-24

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TSEND instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	4	Error when sending data using TSEND	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

2.5.4 Error while disconnecting the connection

Connection does not exist or is already disconnected

If the connection that is referenced via the "ID" parameter of the "TCON_IP_V4" parameter data record does not exist or is already disconnected, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-25

Output parameter	Value	Description	Remedy
status	16#80A3	Status display of the TDISCON instruction	Retrigger the connection establishment via the enable=1 parameter.
statusId	5	Error while establishing the connection using TCON	
error	1	Error display: 1: Error detected	

Connection number is outside the permitted range

If the "id" parameter of the "TCON_IP_V4" parameter data record is outside the permitted range, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-26

Output parameter	Value	Description	Remedy
status	16#8086	Status display of the TDISCON instruction	Enter a value in the "TCON_IP_V4" parameter data record at "ID" that is in the value range from 1 to 4095.
statusId	5	Error while establishing the connection using TCON	
error	1	Error display: 1: Error detected	

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-27, if one of the following temporary communication errors occurs:

- Interface is reconfigured.
- Connection currently being set up.

Table 2-27

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TDISCON instruction	The FB tries to disconnect the connection again.
statusId	5	Error while establishing the connection using TCON	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

2.6 Error handling S7-300 and S7-400

2.6.1 Error while establishing the connection

Connection partner cannot be reached

The connection partner cannot be reached if, for example, the following conditions apply:

- Network cable to connection partner not plugged in or broken.
- The correct IP address of the partner endpoint was not entered in the "TCON_PAR" parameter data record at "rem_staddr".
- Configuration of the local or remote port is not correct. The local port in communication partner A has to match the remote port in communication partner B and the remote port in communication partner A has to match the local port in communication partner B.
- Connection partner is passively involved in the connection establishment and does not initiate the connection establishment.

In this case the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle:

Table 2-28

Output parameter	Value	Description	Remedy
status	16#8102	Connection could not be established (watchdog timer lapsed (3 min)).	• Check the network cable between the communication partners: Plug in the network cable or replace it, if required. • Check the IP address of the partner endpoint in the "TCON_PAR" parameter data record: Enter the IP address of the partner endpoint at rem_staddr in the "TCON_PAR" parameter data record. • Check the remote and local port in the "TCON_PAR" parameter data record: Use the same port number for the local and the remote port. • Check if the passive communication partner initiates the connection establishment. Retrigger the connection establishment via the enable=1 parameter.
statusId	1	Internal error in function block	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-29, if one of the following temporary communication errors occurs:

- The connection cannot be established because the firewalls on the connection path are not released for the required ports.
- The interface is currently receiving new parameters.
- The configured connection is currently removed from a TDISCON instruction.

Table 2-29

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TCON instruction	Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

Length parameter in parameter data record "TCON_PAR" incorrectly configured

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-30, if the following length parameters are incorrectly configured in the "TCON_PAR" parameter data record:

- block_length: Length of the parameter data record "TCON_PAR": 64 bytes (fixed)
- local_tsap_id_len: used length of the "local_tsap_id" parameter
  - 0 or 2
- rem_subnet_id_len: Parameter is currently not used: B#16#00
- rem_staddr_len: used length of the "rem_staddr" parameter
  - 0: unspecified, i.e. rem_staddr parameter is irrelevant
  - 4: valid IP address in rem_staddr parameter
- rem_tsap_id_len: used length of the "rem_tsap_id" parameter
  - 0 or 2
- next_staddr_len: used length of the next_staddr parameter

Table 2-30

Output parameter	Value	Description	Remedy
status	16#80B7	Status display of the TCON instruction	Check the length parameters in the "TCON_PAR" parameter data record. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

"local_device_id" does not match CPU

If the "local_device_id" that is specified in parameter data record "TCON_PAR" does not match the CPU, the output parameters of the FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-31

Output parameter	Value	Description	Remedy
status	16#809B	Status display of the TCON instruction	Check whether the "local_device_id" specified in the "TCON_PAR" parameter data record, matches the CPU. Detailed information on the "local_device_id" parameter is available in the following entry FAQ 51339682. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display 1: Error detected	

Connection number is outside the permitted range

If the "id" parameter of the "TCON_PAR" parameter data record is outside the permitted range, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-32

Output parameter	Value	Description	Remedy
status	16#8086	Status display of the TCON instruction	Enter a value in the "TCON_PAR" parameter data record at "id" that is in the value range from W#16#0001 to W#16#0FFF. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display 1: Error detected	

Configuration error in "connection_type" parameter

If there is a configuration error in the "connection_type" parameter of the "TCON_PAR" parameter data record, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-33

Output parameter	Value	Description	Remedy
status	16#80A7	Status display of the TCON instruction	Enter the value 16#11 or 16#ß1 in the "TCON_PAR" parameter data record at "connection_type". Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display: 1: Error detected	

© Siemens AG 2018 All rights reserved

Attempt to establish a connection of an existing connection

If you are trying to re-establish an existing connection, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-34

Output parameter	Value	Description	Remedy
status	16#80A3	Status display of the TCON instruction	Since you are trying to re-establish an existing connection, the connection is disconnected by the FB. Retrigger the connection establishment via the enable=1 parameter.
statusId	2	Error while establishing the connection with TCON	
error	1	Error display 1: Error detected	

2.6.2 Error when receiving data

Configured length of the receive data invalid

If the configured length of the receive data is larger than the largest permitted value, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-35

Output parameter	Value	Description	Remedy
status	16#8085	Status display of the TRCV instruction	Specify the length of the data to be received on the "rcvLen" parameter. Detailed information regarding the max. number of user data that is to be transferred using TCP can be found in the following FAQ 18909487.
statusId	3	Error when receiving data using TRCV	
error	1	Error display 1: Error detected	

Receive area incorrectly configured

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as in Table 2-36, if the following conditions apply:

- Receive area too small.
- Value on "rcvLen" parameter larger than the receive area that is specified on the "rcvData" parameter.

Table 2-36

Output parameter	Value	Description	Remedy
status	16#8088	Status display of the TRCV instruction	Value on "rcvLen" parameter must not be larger than the receive area that is specified on the "rcvData" parameter.
statusId	3	Error when receiving data using TRCV	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

Communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-37, if one of the following communication errors occurs:

- The specified connection has not been established yet.
- The specified connection is currently disconnected. Receive job not possible via this connection.
- The connection is currently reinitiated.

Table 2-37

Output parameter	Value	Description	Remedy
status	16#80A1	Status display of the TRCV instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	3	Error when receiving data using TRCV	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-38, if one of the following temporary communication errors occurs:

- Connection to the partner can currently not be established.
- The interface receives new parameter settings or the connection is established.
- Length of the receive area is smaller than the length of the data that the communication partner sends.

Table 2-38

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TRCV instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. The length of the receive area that you specify on the "rcvData" parameter has to have at least the size of the length of the data that is sent by the communication partner. The length that is specified on the "rcvLen" parameter has to have at least the size of the length of the data that the communication partner sends. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	3	Error when receiving data using TRCV	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

2.6.3 Error when sending data

Configured length of the send data invalid

If the configured length of the send data is larger than the largest permitted value, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-39

Output parameter	Value	Description	Remedy
status	16#8085	Status display of the TSEND instruction	Specify the length of the data to be sent on the "sendLen" parameter. Detailed information regarding the max. number of user data that is to be transferred using TCP can be found in the following FAQ 18909487.
statusId	4	Error when sending data using TSEND	
error	1	Error display 1: Error detected	

Send area incorrectly configured

The output parameters of "LOpenUserComm_Tcp" function block are set for one cycle as in Table 2-40, if the following conditions apply:

- Send area too small
- Value on "sendLen" parameter is larger than the send area that is specified on the “sendData" parameter

Table 2-40

Output parameter	Value	Description	Remedy
status	16#8088	Status display of the TSEND instruction	Value on "sendLen" parameter must not be larger than the send area that is specified on the "sendData" parameter.
statusId	4	Error when sending data using TSEND	
error	1	Error display 1: Error detected	

Communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-41, if one of the following communication errors occurs:

- The specified connection has not been established yet.
- The specified connection is currently disconnected. Receive job not possible via this connection.
- The connection is currently reinitiated.

Table 2-41

Output parameter	Value	Description	Remedy
Status	16#80A1	Status display of the TSEND instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	4	Error when sending data using TSEND	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

Temporary communication error

The output parameters of FB "LOpenUserComm_IsoOnTcp" are set for one cycle as shown in Table 2-42, if one of the following temporary communication errors occurs:

- Connection to the partner can currently not be established.
- The interface receives new parameter settings or the connection is established.

Table 2-42

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TSEND instruction	Check the network cable between the communication partners: Plug in the network cable or replace it, if required. Check if the communication partner has disconnected the establishment. If enable = 1, the connection is automatically re-established by the FB as soon as the communication error is removed.
statusId	4	Error when sending data using TSEND	
error	1	Error display 1: Error detected	

2.6.4 Error while disconnecting the connection

Connection does not exist or is already disconnected

If the connection that is referenced via the "ID" parameter of the "TCON_PAR" parameter data record does not exist or is already disconnected, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-43

Output parameter	Value	Description	Remedy
status	16#80A3	Status display of the TDISCON instruction	Retrigger the connection establishment via the enable=1 parameter.
statusId	5	Error while establishing the connection using TCON	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

Connection number is outside the permitted range

If the "id" parameter of the "TCON_PAR" parameter data record is outside the permitted range, the output parameters of FB "LOpenUserComm_Tcp" are set as follows for one cycle.

Table 2-44

Output parameter	Value	Description	Remedy
status	16#8086	Status display of the TDISCON instruction	Enter a value in the "TCON_PAR" parameter data record at "id" that is in the value range from W#16#0001 to W#16#0FFF.
statusId	5	Error while establishing the connection using TCON	
error	1	Error display 1: Error detected	

Temporary communication error

The output parameters of FB "LOpenUserComm_Tcp" are set for one cycle as shown in Table 2-45, if one of the following temporary communication errors occurs:

- Interface is reconfigured.
- Connection currently being set up.

Table 2-45

Output parameter	Value	Description	Remedy
status	16#80C4	Status display of the TDISCON instruction	The FB tries to disconnect the connection again.
statusId	5	Error while establishing the connection using TCON	
error	1	Error display 1: Error detected	

© Siemens AG 2018 All rights reserved

2.7 Explanations on the state machine

The state machine includes the following states:

- STATE_IDLE
- STATE_PARAM
- STATE_CONNECT
- STATE_CONNECTED
- STATE_RECEIVE
- STATE_SEND

STATE_IDLE

In the "STATE_IDLE" idle state all parameters (static tags and outputs of the FB "LOpenUserComm_Tcp") are reset.

The FB "LOpenUserComm_Tcp" waits in the "STATE_IDLE" state until it detects a positive edge on the "enable" input parameter.

STATE_CONNECT

The job to establish a connection is triggered, when the following conditions are met:

- The "enable" input parameter is set to "true", so that the FB detects a positive edge at the "enable" input parameter.
- The connection has not yet been established.
- In order for the FB to be able to rectify an error by itself, the process to establish the connection is started again internally.

If the connection is successfully established with "TCON", the FB "LOpenUserComm_Tcp" goes to the "STATE_CONNECTED" state. The connection remains established until it is disconnected by the "TDISCON".

If an error occurs while establishing the connection, the following actions are performed in FB "LOpenUserComm_Tcp":

- The error information is saved in the static "statStatus" tag of the "Word" data type.
- The state in which the error occurred is saved in the static "statStatusId" tag of the "UInt" data type.
- The FB changes into the "STATE_ERROR" state.

The values of the tags "statStatus" and "statStatusId" are transferred to the "status" and "statusId" output parameters of the FB "LOpenUserComm_Tcp" in the "STATE_ERROR" state.

Table 2-46 shows the values and meaning of the output parameters "status" and "statusId".

© Siemens AG 2018 All rights reserved

STATE_CONNECTED

The receipt of data using "TRCV" is released.

When new data is received with “TRCV”, the FB goes to "STATE_RECEIVE" state.

If an error occurs while receiving data using "TRCV", the following actions are performed in FB "LOpenUserComm_Tcp":

- The error information is saved in the static "statStatus" tag of the "Word" data type.
- The state in which the error occurred is saved in the static "statStatusId" tag of the "UInt" data type.
- The FB changes into the "STATE_ERROR" state.

The values of the tags "statStatus" and "statStatusId" are transferred to the "status" and "statusId" output parameters of the FB "LOpenUserComm_Tcp" in the "STATE_ERROR" state.

Table 2-46 shows the values and meaning of the output parameters "status" and "statusId".

STATE_RECEIVE

The received data can be processed individually.

This application example shows how to receive frames with static and dynamic data lengths.

To receive a fixed volume of data (static data lengths), make the following settings:

- Disable the adhoc mode by setting the parameter "adhocMode"=0.
- Define a fixed length for the receive data at the "rcvLen" parameter.

When receiving static data lengths, the following actions are performed when receiving new data with “TRCV”:

- The data volume defined in the "rcvLen" parameter is taken over to the receive buffer.
- The output parameters "ndr" and "busy" are set to the following values for one cycle:
  - ndr = 1
  - busy = 0

To receive dynamic data lengths, make the following settings:

- Enable the adhoc mode by setting the parameter “adhocMode”=1.
- The value at parameter "rcvLen" is irrelevant. The partner must transmit the total length of the frame in the first 4 bytes of the frame.

When the number of received data conforms to the total length of the frame, the frame has been received in completeness and the data is taken over to the receive buffer and the output parameters "ndr" and "busy" are set to the following values for one cycle:

- ndr = 1
- busy = 0

The FB changes back into the "STATE_CONNECTED" state.

© Siemens AG 2018 All rights reserved

STATE_SEND

A new send job is triggered, if the following conditions apply:

- positive edge on "sendRequest" input parameter
- no send job active

If a send job is active, the following actions are performed in FB "LOpenUserComm_Tcp":

- The receipt of data using "TRCV" is disabled.
- The new send job cannot be triggered.

If a send job was successfully completed using "TSEND", the following actions are performed in FB "LOpenUserComm_Tcp":

- The output parameters "done" and "busy" are set to the following values for one cycle:
  - done = 1
  - busy = 0
- The FB changes back into the "STATE_CONNECTED" state.

If an error occurs while sending data using "TSEND", the following actions are performed in FB "LOpenUserComm_Tcp":

- The error information is saved in the static "statStatus" tag of the "Word" data type.
- The state in which the error occurred is saved in the static "statStatusId" tag of the "UInt" data type.
- The FB changes into the "STATE_ERROR" state.

The values of the tags "statStatus" and "statStatusId" are transferred to the "status" and "statusId" output parameters of the FB "LOpenUserComm_Tcp" in the "STATE_ERROR" state.

Table 2-46 shows the values and meaning of the output parameters "status" and "statusId".

© Siemens AG 2018 All rights reserved

STATE_DISCONNECT

The job to close down a connection is triggered, when the following conditions are met:

- The "enable" input parameter is set back to "false", so that the FB detects a negative edge at the "enable" input parameter.
- Connection has been established.
- In order for the FB to be able to rectify an error by itself, the connection is closed down before it is established again internally.

If the connection is successfully disconnected, the FB "LOpenUserComm_Tcp" goes to the "STATE_IDLE" idle state.

If an error occurs while disconnecting the connection, the following actions are performed in FB "LOpenUserComm_Tcp":

- The error information is saved in the static "statStatus" tag of the "Word" data type.
- The state in which the error occurred is saved in the static "statStatusId" tag of the "UInt" data type.
- The FB changes into the "STATE_ERROR" state.

The values of the tags "statStatus" and "statStatusId" are transferred to the "status" and "statusId" output parameters of the FB "LOpenUserComm_Tcp" in the "STATE_ERROR" state.

Table 2-46 shows the values and meaning of the output parameters "status" and "statusId".

STATE_ERROR

The "ERROR" state evaluates the most important error information of the OUC instructions ("TCON", "TDISCON", "TSEND" and "TRCV") and shows the user how the can respond to this error information.

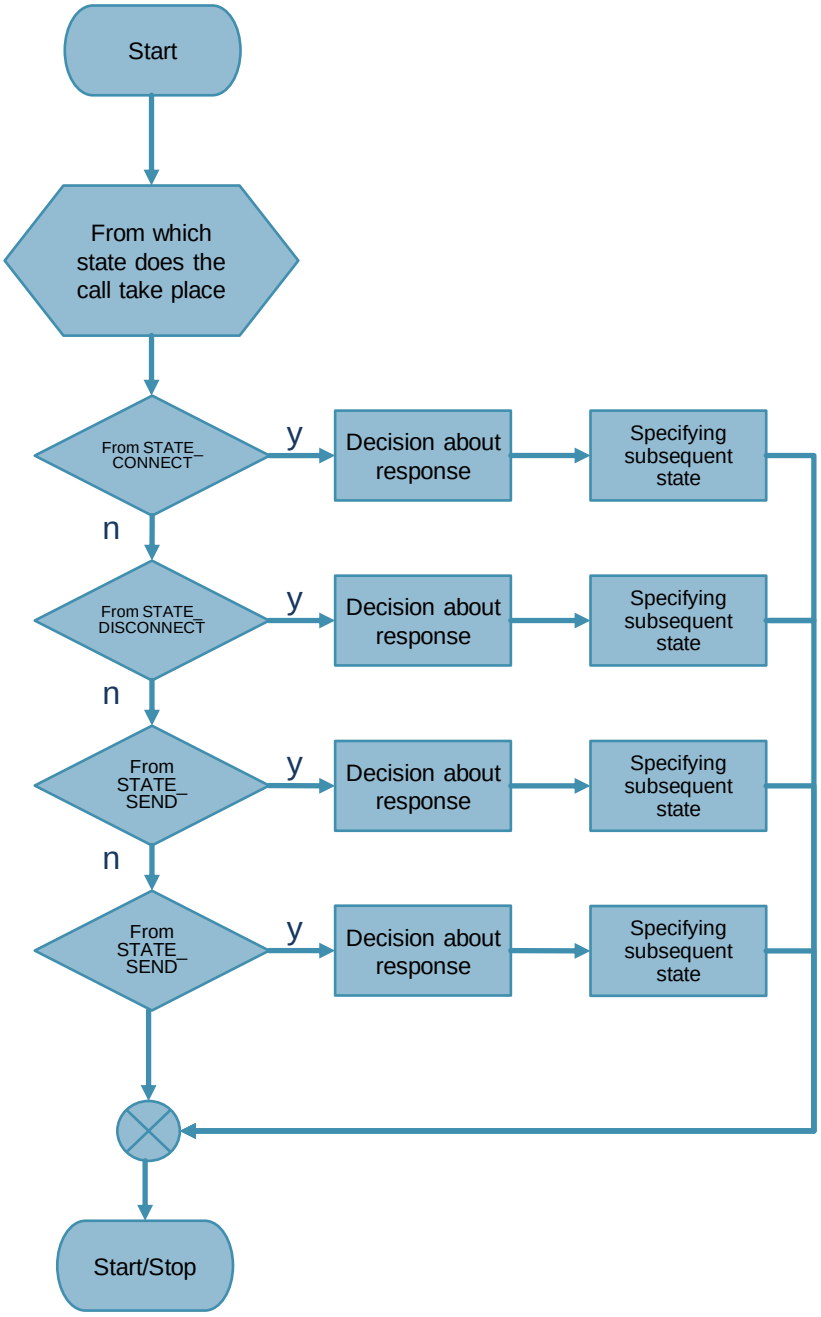
The user has the option to expand the "STATE_ERROR" state according to this pattern:

- Analyze other OUC error messages and realize individual responses.
- Create your own user-specific error analyzes, for example, if the received data does not correspond to what the program expects.

The following figure shows the general pattern according to which this state is realized.

© Siemens AG 2018 All rights reserved

Figure 2-6



© Siemens AG 2018 All rights reserved

In the "Decision about response" program block it is defined how the FB "LOpenUserComm_Tcp" will respond in the event of an error. The response depends on the state in which the error occurred. In this example, the following responses present themselves, depending on the cause of the error:

- If an error occurs while establishing the connection, the following responses are realized in FB "LOpenUserComm_Tcp":
  - In order to remove the error autonomously, the FB changes to the "STATE_DISCONNECT" or "STATE_CONNECT" state.
    If an established connection has to be disconnected first before the establishment of a connection can be started again internally, the FB changes to the "STATE_DISCONNECT" state.
    If the connection partner refuses the establishment of a connection or has actively disconnected the connection, the FB changes to the "STATE_CONNECT" state, in order to internally restart the connection establishment.
  - If an error occurs that has to be removed by the user, the FB changes to the "STATE_IDLE" idle state. This error occurs, for example, if the connection configuration is incorrect or there is a network error so that the connection partner cannot be reached. The user has to remove the error and then retrigger establishing a connection via the "enable" parameter.
- If an error occurs while sending or receiving data, the following responses are realized in FB "LOpenUserComm_Tcp":
  - If the connection partner cannot be reached or there is a temporary communication error, the FB changes to the "STATE_CONNECTED" state. A temporary communication error occurs, for example, if the network cable to the connection partner is not plugged in or broken.
  - If an error occurs that has to be removed by the user, the FB changes to the "STATE_DISCONNECT" state. This error occurs if the length is not correctly specified on the input parameters "rcvLen" or "sendLen" or the send or receive buffer on the input parameters "rcvData" or "sendData" are not correctly specified. The connection is disconnected. The user has to remove the error and then retrigger establishing a connection via the "enable" parameter.
  - If the connection was disconnected via the "enable" parameter, the FB goes to the "STATE_IDLE" idle state.
- If an error occurs while disconnecting the connection, the following responses are realized in FB "LOpenUserComm_Tcp":
  - In order to start another attempt to disconnect the connection, the FB changes to the "STATE_DISCONNECT" state. Once the connection has been successfully disconnected, it is waited in the "STATE_IDLE" state until a positive edge is detected on the "enable" input parameter.

Note If an error occurs, the "error" output parameter is set to the value "1" for one cycle and the respective error information is output on the "status" output parameter. Via the "statusId" output parameter you will receive information on the state in which the error occurred.

© Siemens AG 2018 All rights reserved

The following table shows the values and meaning of the output parameters "status" and "statusId" of the "LOpenUserComm_Tcp" function block.

Table 2-46

statusId value (dec)	Meaning	status Value (hex)	Comment
1	Internal error in function block	16#8101	Function block could not be activated
1	Internal error in function block	16#8102	Connection could not be established. The watchdog timer (180 s) has elapsed.
2	Error on TCON	–	The status of TCON is output on the "status" output parameter.
3	Error on TRCV	–	The status of TRCV is output on the "status" output parameter.
4	Error on TSEND	–	The status of TSEND is output on the "status" output parameter.
5	Error on TDISCON	–	The status of TDISCON is output on the "status" output parameter.

© Siemens AG 2018 All rights reserved

3 Valuable Information

3.1 Basics

3.1.1 Basics on the TCP protocol

For more information on the TCP protocol, please refer to the following FAQ:
https://support.industry.siemens.com/cs/ww/en/view/26171811

3.1.2 Structure of the "TCON_IP_V4" parameter data record

In order to configure the communication connections at TCP, a connection description DB with a structure according to "TCON_IP_V4" is used for the CPUs of S7-1200 as of V4.0 and S7-1500. The fixed data structure of the "TCON_IP_V4" contains the parameters required to establish the connection.

The "tcpConnParam" connection parameter of the FB "LOpenUserComm_Tcp" contains a reference to the data block used.

Table 3-1

Byte	Parameter	Data type	Start value	Description
0 to 1	InterfaceId	HW_ANY	64	Hardware identifier of the local interface (value range: 0 to 65535)
2 to 3	ID	CONN_OUC	1	Connection number (value range: 0 to 65535)
4	ConnectionType	BYTE	11	Connection type: • 11: TCP (11 dec = 0x0B hex)
5	ActiveEstablished	BOOL	False	Identifier for the type of connection establishment: • False: passive connection establishment • True: active connection establishment
6 to 9	RemoteAddress	ARRAY [1..4] of BYTE	–	IP address of the partner endpoint, for example, for 192.168.0.2
10 to 11	RemotePort	UINT	2000	Port address of the remote connection partner (value range: 1 to 49151)
12 to 13	LocalPort	UINT	2000	Port address of the local connection partner (value range: 1 to 49151)

Note We recommend using the same port for the local and remote connection partner.

© Siemens AG 2018 All rights reserved

3.1.3 Structure of the "TCCON_PAR" parameter data record

In order to configure the communication connections at TCP, create a DB for the CPUs of S7-300 and S7-400 that contains the data structure from UDT 65 "TCON_PAR". This data structure contains the parameters you need to establish the connection.

The "tcpConnParam" connection parameter of the FB "LOpenUserComm_Tcp" contains a reference to the data block used.

Table 3-2

Byte	Parameter	Data type	Start value	Description
0 to 1	block_length	WORD	W#16#40	Length of UDT 65: 64 bytes (fixed)
2 to 3	id	WORD	W#16#0001	Connection number (value range: W#16#0001 to W#16#0FFF)
4	connection_type	BYTE	11	Protocol variant: • B#16#11: TCP • B#16#01 TCP (compatibility mode)
5	active_est	BOOL	False	Identifier for the type of connection establishment: • False: passive connection establishment • True: active connection establishment
6	local_device_id	BYTE	B#16#02	Detailed information on the "local_device_id" parameter is available in entry 51339682.
7	local_tsap_id_len	BYTE	B#16#02	Used length of the "local_tsap_id" parameter The following values are possible at “connection_type" = B#16#11: • 0 or 2 active side: 0 or 2, passive side: 2) The following values are possible at “connection_type" = B#16#01: • 0 or 2 active side: 0, passive side: 2)
8	rem_subnet_id_len	BYTE	B#16#00	This parameter is currently not used. You have to assign it using B#16#00.

© Siemens AG 2018 All rights reserved

Byte	Parameter	Data type	Start value	Description
9	rem_staddr_len	BYTE	B#16#00	Length of the address of the remote connection endpoint: • 0: unspecified, i.e., "rem_staddr" parameter is irrelevant • 4: valid IP address in "rem_staddr" parameter
10	rem_tsap_id_len	BYTE	B#16#00	Used length of the "rem_tsap_id" parameter The following values are possible at "connection_type" = B#16#11: • 0 or 2 The following values are possible at "connection_type" = B#16#01: • 0 or 2, For the passive side, only the value B#16#00 is allowed
11	next_staddr_len	BYTE	B#16#00	Used length of the "next_staddr" parameter. This parameter is not relevant for TCP.
12 to 27	local_tsap_id	ARRAY [1..16] of BYTE	–	Local port number local_tsap_id[1] = high byte of the port number in hexadecimal representation local_tsap_id[2] = low byte of the port number in hexadecimal representation local_tsap_id[3-16] = B#16#00
28 to 33	rem_subnet_id	ARRAY [1..16] of BYTE	–	This parameter is currently not used. You have to assign it using B#16#00.
34 to 39	rem_staddr	ARRAY [1..6] of BYTE	–	IP address of the remote connection endpoint, for example, 192.168.0.1: rem_staddr[1] = B#16#C0 rem_staddr[2] = B#16#A8 rem_staddr[3] = B#16#0 rem_staddr[4] = B#16#1 rem_staddr[5] = B#16#00 rem_staddr[6] = B#16#00

© Siemens AG 2018 All rights reserved

Byte	Parameter	Data type	Start value	Description
40 to 55	rem_tsap_id	ARRAY [1..16] of BYTE	–	Port Number of the remote connection endpoint: rem_tsap_id[1] = high byte of the port number in hexadecimal representation rem_tsap_id[2] = low byte of the port number in hexadecimal representation rem_tsap_id[3-16] = B#16#00
56 to 61	next_staddr	ARRAY [1..6] of BYTE	–	This parameter is not relevant for TCP.
62 to 63	Spare	WORD	W#16#0000	Reserve Assign this parameter using W#16#0000.

3.1.4 Message structure for the receipt of dynamic data lengths

In order to receive dynamic data lengths with TCP, the adhoc mode must be enabled. In adhoc mode, the data are available immediately. All data that are currently available are read.

When receiving dynamic frame lengths, the length of the frame must be determined, as TCP does not transmit information about the end of a frame. The partner must transmit the total frame length in the first 4 bytes of the frame.

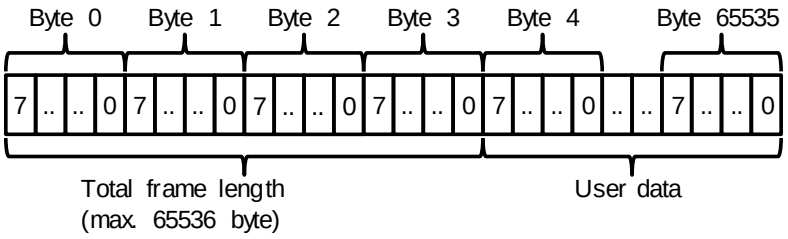
As long frames distribute the data to several subsequent frames, the received data must be buffered. Once all data have been fully received, the data are copied to the receive buffer.

© Siemens AG 2018 All rights reserved

S7-1500 CPU

The following figure shows the frame structure for receiving dynamic data lengths in the S7-1500 CPU. For S7-1500 CPUs, the max. frame length for TCP is 65536 bytes.

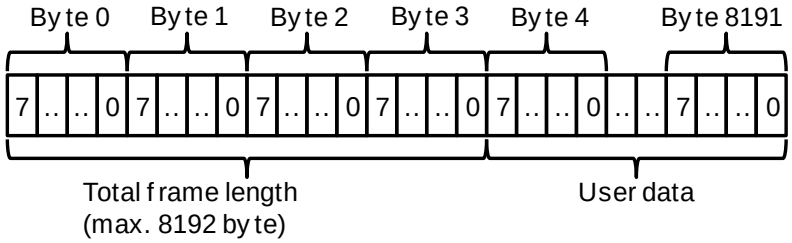
Figure 3-1



S7-1200 CPU

The following figure shows the frame structure for receiving dynamic data lengths in the S7-1200 CPU. For S7-1200 CPUs, the max. frame length for TCP is 8192 bytes.

Figure 3-2



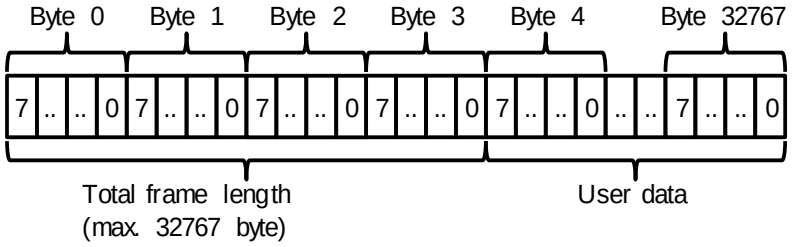
S7-300 and S7-400 CPUs

The following figure shows the frame structure for receiving dynamic data lengths in the S7-300 and S7-400 CPU.

For the following S7-300 and S7-400 CPUs, the max. frame length for TCP is 32767 bytes.

- CPUs 31x-2 PN/DP from firmware V3.1
- CPUs 31x-3 PN/DP from firmware V3.2
- CPUs 412-2 PN
- CPUs 41x-3 PN/DP
- CPUs 41x-5H PN/DP

Figure 3-3



3.1.5 Receiving fixed data lengths

When receiving fixed frame lengths, the frame length is defined at the "rcvLen" parameter of the FB "LOpenUseComm_Tcp". The data are available and are copied into the receive buffer as soon as the data length specified at rcvLen parameter have been received completely.

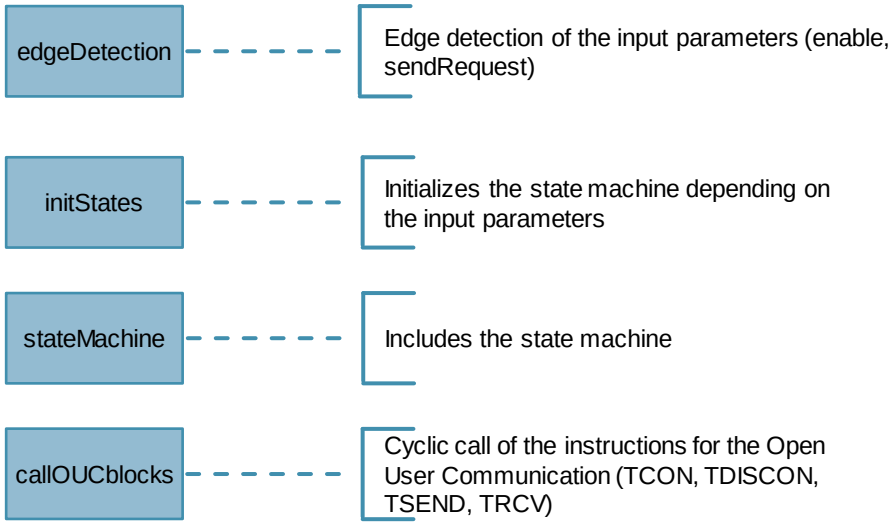
© Siemens AG 2018 All rights reserved

3.2 Details on the mode of operation

3.2.1 Structure of the program

The following figure shows the structure of FB "LOpenUserComm_Tcp". The program consists of four regions.

Figure 3-4



3.2.2 Explanation regarding the "edgeDetection" region

The "edgeDetection" region includes the edge evaluation of the following input parameters:

- "enable": positive and negative edge is evaluated
- "sendRequest": positive edge is evaluated

3.2.3 Explanation regarding the "initStates" region

If a positive edge is detected on the "enable" input parameter, the following actions are performed in FB "LOpenUserComm_Tcp":

- "busy" output parameter is set to value "1".
- State machine is initiated using the "STATE_PARAM" state, in order to read the connection parameters and to trigger a job to establish a connection.
- State machine is initialized using the "STATE_DISCONNECT" state in order to establish a connection if it could not be successfully established within 3 min.

If a negative edge is detected on the "enable" input parameter, the state machine is initialized using the "STATE_DISCONNECT" state in order to trigger a job to disconnect a connection.

If a positive edge is detected on the "sendRequest" input parameter and the connection is established, the state machine is initialized using the "STATE_SEND" state in order to trigger a send job.

© Siemens AG 2018 All rights reserved

4 Appendix

4.1 Service and Support

Industry Online Support

Do you have any questions or need support?

Siemens Industry Online Support offers access to our entire service and support know-how as well as to our services.

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

Product information, manuals, downloads, FAQs and application examples – all information is accessible with just a few mouse clicks at:
https://support.industry.siemens.com

Technical Support

Siemens Industry's Technical Support offers quick and competent support regarding all technical queries with numerous tailor-made offers – from basic support right up to individual support contracts.

Please address your requests to the Technical Support via the web form:
www.siemens.en/industry/supportrequest

© Siemens AG 2018 All rights reserved

SITRAIN – Training for Industry

With our globally available training courses for our products and solutions and using innovative teaching methods, we help you achieve your goals.

More information on the training courses offered as well as on locations and dates is available at:
www.siemens.de/sitrain

Service offer

Our service offer includes the following:

- Plant Data Services
- Spare Parts Services
- Repair Services
- On Site and Maintenance Services
- Retrofit and Modernization Services
- Service Programs and Agreements

Detailed information on our service offer is available in the Service Catalog:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

Thanks to the "Siemens Industry Online Support" app, you will get optimum support even when you are on the move. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

4.2 Links and literature

Table 4-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the application example https://support.industry.siemens.com/cs/ww/de/view/109747710
\3\	STEP 7 V14 SP1 https://support.industry.siemens.com/cs/ww/en/view/109747136

4.3 Change documentation

Table 4-2

Version	Date	Modification
V1.0	09/2018	First version

© Siemens AG 2018 All rights reserved