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APPLICATION EXAMPLE

# Libraries for Communication for SIMATIC Controllers

SIMATIC Controllers, TIA Portal

SIEMENS

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# 1. Introduction

**Overview**

The Libraries for Communication are a collection of blocks for various communication tasks, functions, and protocols for SIMATIC Controllers.

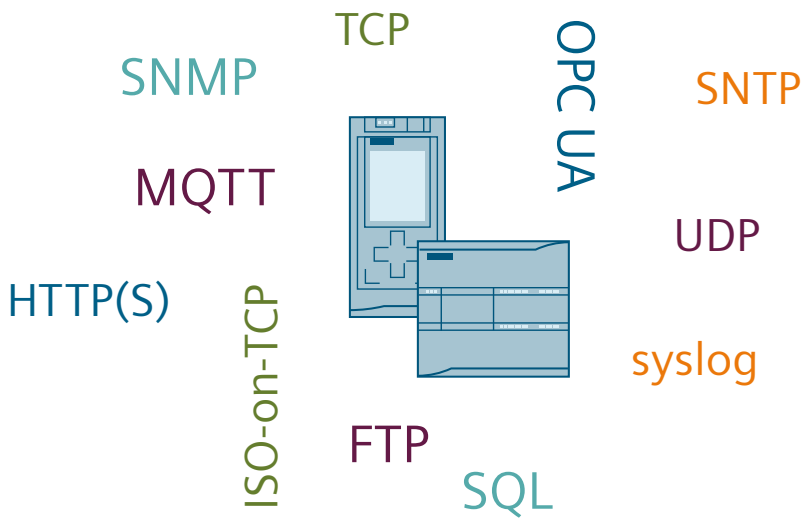



Figure 1-1

**Range of Functions**

The following libraries are included:

- LCom:
  This library enables communication based on TCP and provides additional communication functionalities using its own protocol (see chapter 2).
- LFTP:
  With this library, a controller can act as an FTP client (see chapter 3).
- LHTTP:
  This library enables data exchange with a web server in the local network or on the internet via HTTP or HTTPS (see chapter 4).
- LMQTT:
  This library enables the communication of a controller as MQTT Client (see chapter 5).
- LOpcUa:
  This library provides function blocks for OPC UA PubSub communication (see chapter 6).
- LSNMP:
  This library can be used to monitor and control SNMP-enabled network components from a controller or to send messages to a network management system (see chapter 7).
- LSNTP:
  With this library, a controller can act as an SNTP server to synchronize the time throughout different areas of the system (see chapter 8).
- LSQL:

  This library enables interacting with an SQL database directly from a user program of a controller (see chapter 9).
- LSyslog:
  This library allows sending syslog messages to a syslog server over UDP or TCP with optional TLS encryption (see chapter 10).

In addition, the library provides master copies that you can use to easily implement your own communication functions:

- Master copies for communication via TCP, UDP, and ISO-on-TCP (see chapter 11.1)
- Master copies for OPC UA methods
- Master copies for common OPC UA structured data types
- Constants for OPC UA status codes

**Application**

These libraries are available for TIA Portal V18 and higher.

All libraries included are valid for SIMATIC S7-1500 and S7-1200 controllers. If the respective library is also valid for other controllers, this is described in the section for the corresponding library.

# 2. LCom

## 2.1. Overview

### 2.1.1. Range of Functions

**Possible applications for the use of the LCom library**

The "LCom_Communication" function block of the LCom library is used to establish a point-to-point full duplex connection via Industrial Ethernet, based on the TCP standard.

The function block can be used for standard TCP communication to other devices (e.g. camera, controller).

Since the range of functions of the TCP transport protocol is not sufficient for many applications in the automation sector, a separate protocol (LCom protocol) has been defined and implemented in the LCom block library. The LCom protocol enables additional communication functionalities.

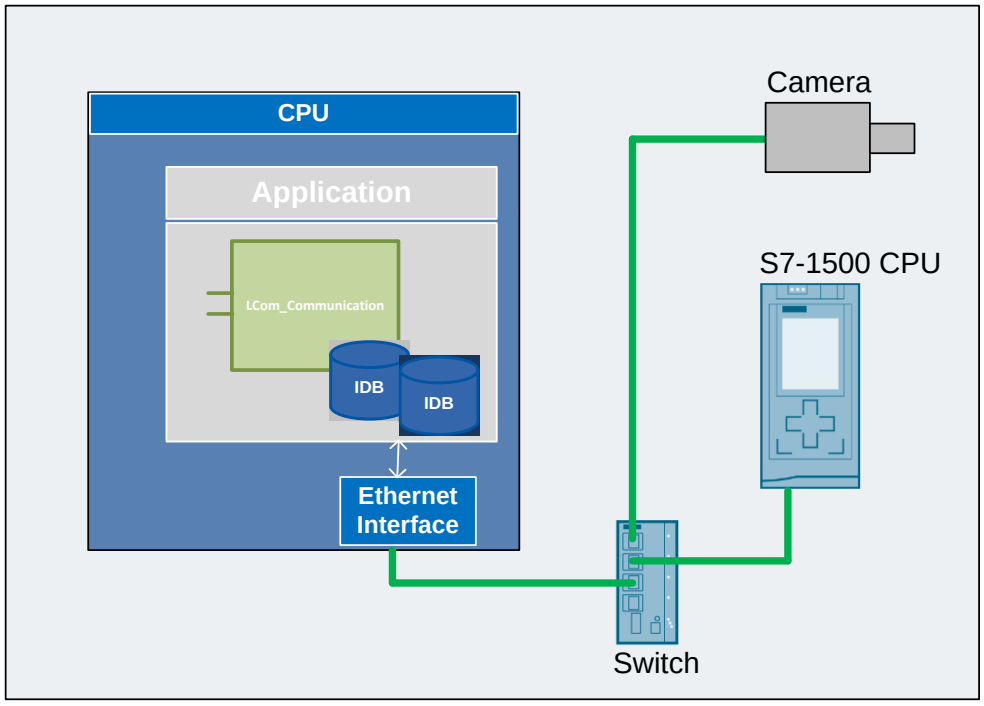



Figure 2-1: Application scenarios

Some scenarios for a possible use of the LCom library are shown below:

**Scenario 1**

The "LCom_Communication" function block is used for standard TCP communication. The TCP transport protocol ensures that a continuous flow of data is transferred. TCP is not packet-oriented and, therefore, does not permit the transmission of data records with a defined overall length.

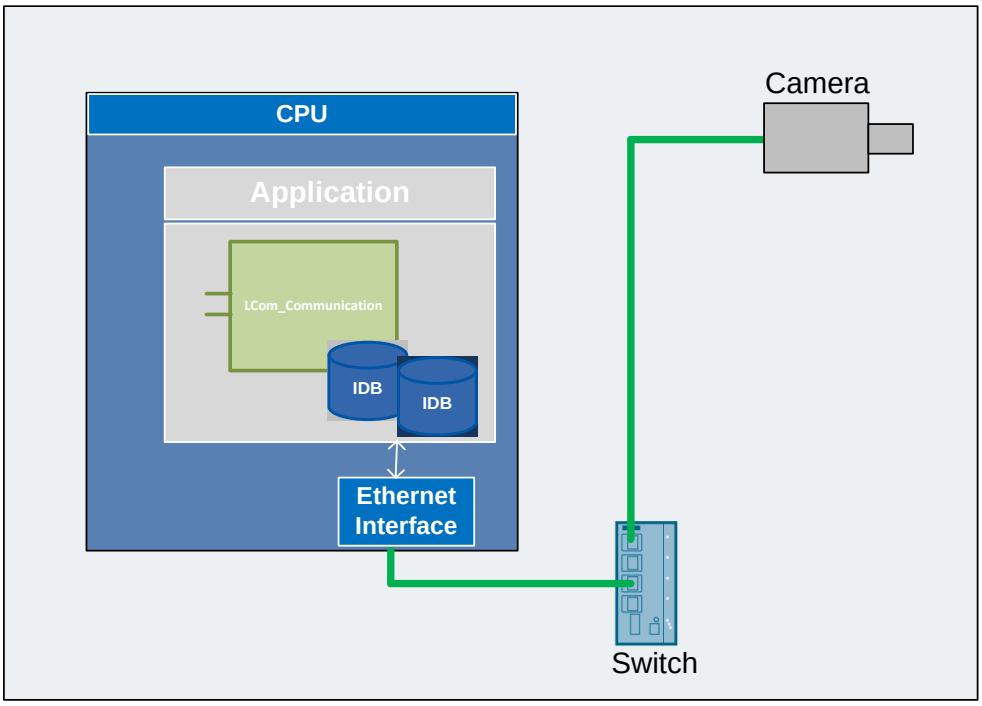



Figure 2-2: LCom_Communication – Standard TCP communication

The LCom library offers the following advantages:

- The user does not need to know and program the OUC system function to establish, send/receive, and terminate a connection
- In the event of errors/faults, the function block automatically closes the connection and attempts to reestablish it
- Cyclic data transmission, the user defines the cycle time
- One time data transmission
- Response from sender/receiver about successfully transmitted data at application level
- The function block contains a data structure for diagnostics

**Scenario 2**

When using the LCom protocol, data records of a defined total length can be sent and received consistently by the partner. In order to quickly detect a connection failure, cyclic vital signs are sent. The cycle time of the periodic vital signs is specified by the user.

To synchronize the time of two controllers, the current time of one controller can be sent to the partner and transferred there as the system time.

To use the additional communication functionalities, the communication partner (e.g. S7-1500 CPU) must support the LCom protocol.

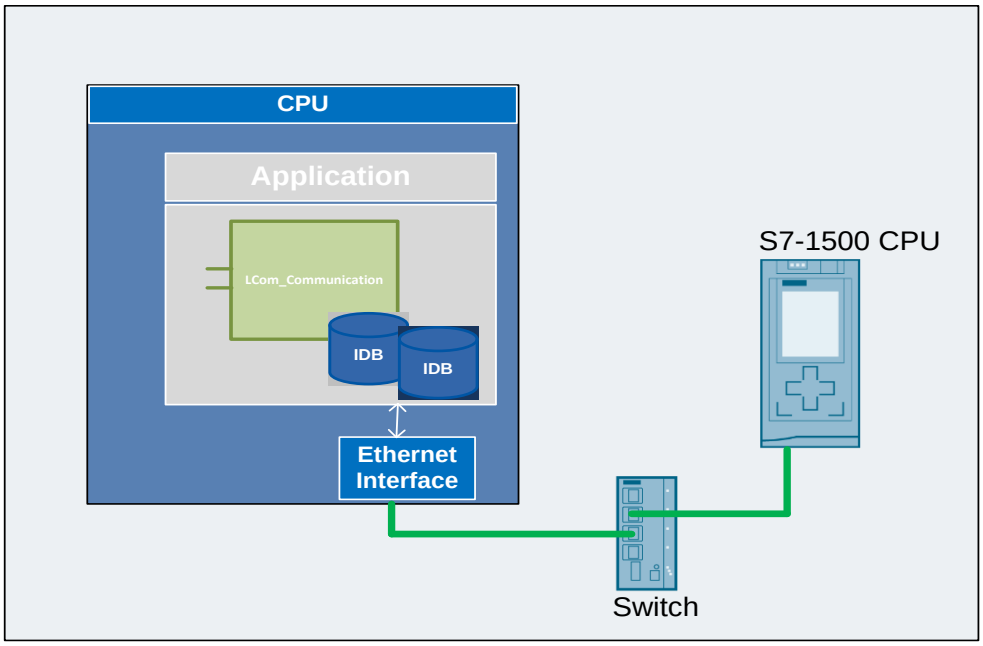



Figure 2-3: LCom_Communication – LCom protocol

The LCom library offers the following advantages:

- The user does not need to know and program the OUC system function to establish, send/receive, and terminate a connection
- In the event of errors/faults, the function block automatically closes the connection and attempts to reestablish it
- Cyclic data transmission, the user defines the cycle time
- One time data transmission
- Consistent data transmission
- Synchronizing the communication parameters
- Monitoring of the communication link by cyclically sending vital signs (fast response times in case of link failure). For pure TCP communication, this is typically in the range of seconds.
- Data records with defined length up to 64 kB with LCom protocol V1
- Data records with defined length up to 16 MB with LCom protocol V2
- Response from sender/receiver about successfully transmitted data at application level
- Simple time synchronization
- The function block contains a data structure for diagnostics

## 2.1.2. Components of the Library

The "LCom" library contains the following objects.

### Function blocks

Table 2-1: Function blocks of the library

| Name | Version | Description |
|---|---|---|
| LCom_Communication | V2.1.0 | Controls the communication between the controller and the partner. |

### PLC data types

Table 2-2: PLC library data types

| Name | Version | Description |
|---|---|---|
| LCom_typeConfig | V2.0.1 | Contains the necessary communication parameters. |
| LCom_typeDiagnostics | V2.0.1 | Provides a detailed diagnostic structure. |

### Master copies

An example how a configuration and execution of a communication with user defined data in connection with the "LCom_Communication" FB looks like is provided in the master copies templates.

In addition, constants are provided for gloabal usage. With help of that for example, the status and error codes of "LCom_Communication" FB can be processed more readable in user application program.

Table 2-3 Master copies templates

| Name | Type | Description |
|---|---|---|
| LCom_Example | OB | Implementation of an example communication with LCom |
| LCom_ExampleComData | DB | Data of example communication |
| LCom_ExampleComBuffers | DB | Send- and receive buffer |
| LCom_typeComUserData | Data type | User defined data type of example communication |
| LCom_Constants | PLC tags | LCom constants (i.e. status and error codes) for global usage in user application program |

## 2.1.3. Validity

This library is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.4
- CP 1543-1, CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V2.0

## 2.2. LCom_Communication

**Parameters**

Figure 2-4: LCom_Communication

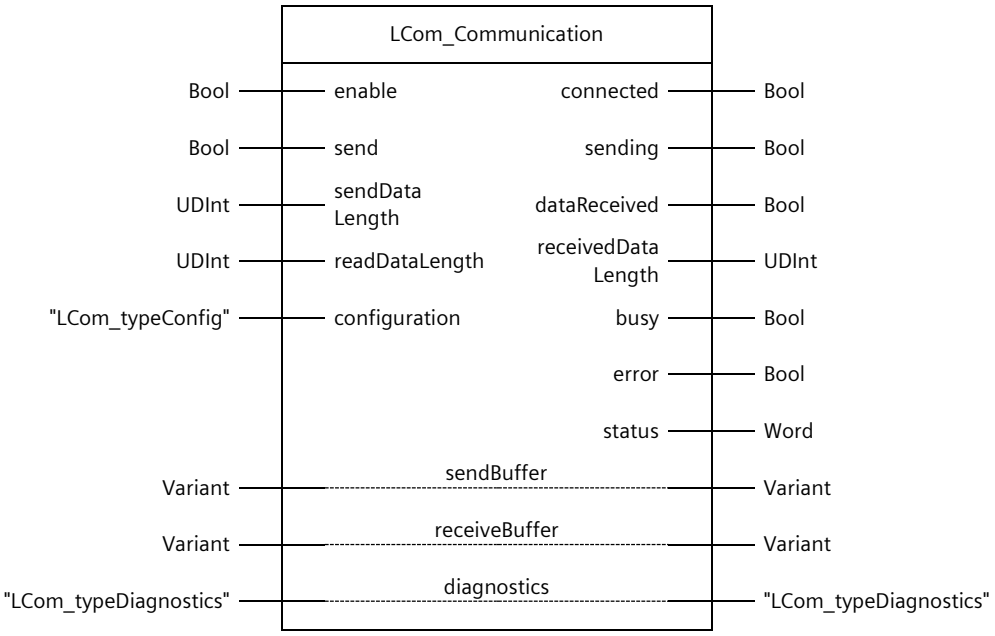



Table 2-4: Parameters of LCom_Communication

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | • TRUE: Starts the FB with a rising edge. The connection to the partner is established automatically.<br>• FALSE (default): With a falling edge, the connection is broken. |
| send | Input | Bool | • TRUE: Sends the data connected to the "sendBuffer" input parameter.<br>• FALSE (default): Data that is connected at the "sendBuffer" input parameter is not sent. |
| sendDataLength | Input | UDInt | Data length to be sent in bytes.<br>(default: 4294967295) |
| readDataLength | Input | UDInt | Without LCom protocol, ("configuration.connection.comService" = "LCOM_TCP_CONNECTION"):<br>• 0: Data from the TCP buffer is not read. FB, therefore, does not receive any data from the partner.<br>• 1..4294967294: Number of bytes that must be received by the interface before the output tag "dataReceived" = TRUE.<br>• 4294967295, 16#FFFFFF (default):<br>All data available at the interface is read (ad hoc mode).<br><br>With LCom protocol, ("configuration.connection.comService" = "LCOM_LCOM_CONNECTION"):<br>• 0: Data from the TCP buffer is not read. The FB therefore does not receive any data from the partner.<br>• 1..4294967295: Not relevant for the receiving behavior. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| configuration | Input | "LCom_typeConfig" | FB configuration |
| connected | Output | Bool | Without LCom protocol, ("configuration.connection.comService" = "LCOM_TCP_CONNECTION"):<br>• TRUE: The TCP connection to the partner is established.<br>• FALSE: The TCP connection to the partner is not established.<br><br>With LCom protocol, ("configuration.connection.comService" = "LCOM_LCOM_CONNECTION"):<br>• TRUE: TCP connection to partner is established and configuration data is negotiated successfully<br>• FALSE: TCP connection to partner is not established or waiting for negotiation of configuration data. |
| sending | Output | Bool | • TRUE: Sends the data connected to the "sendBuffer" input parameter. Do not change send data.<br>• FALSE: Data that is connected at the "sendBuffer" input parameter is not sent. |
| dataReceived | Output | Bool | • TRUE: New data was received. The value is present for one cycle.<br>• FALSE: No data is available for the user. |
| receivedDataLength | Output | UDInt | • Returns the received data length in bytes. |
| busy | Output | Bool | • TRUE: The block processing is done automatically. No intervention is required from the user.<br>• FALSE: There is no block processing. Intervention is required from the user. Passing parameters may be incorrect. More detailed information is provided by the output parameter "status" or the diagnostic buffer. |
| error | Output | Bool | • TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>• FALSE: No error has occurred. |
| status | Output | Word | Status of the FB, see chapter 2.5.2 |
| sendBuffer | InOut | Variant | Send data (array of bytes) |
| receiveBuffer | InOut | Variant | Receive data (array of bytes) |
| diagnostics | InOut | "LCom_typeDiagnostics" | Diagnostics information |

## 2.3. PLC Data Types

**LCom_typeConfig**

The following table shows the structure of the PLC data type "LCom_typeConfig".

Table 2-5: PLC data type LCom_typeConfig

| Name | Type | Start value | Comment |
|---|---|---|---|
| connection | Struct | | |
| interfaceID | HW_ANY | 64 | Hardware identifier of the local interface<br>• 0: if connectType = 10 (QDN) |
| connectionID | CONN_ANY | 16#0FFF | Reference to the connection<br>16#0001..16#0FFF |
| comService | USInt | 2 | Configuration of the communication protocol:<br>• 1: The standard TCP protocol is used.<br>• 2 (default): The LCom protocol is used. With the LCom protocol, additional communication functionalities are enabled |
| isClient | Bool | FALSE | • TRUE: Active connection establishment as TCP client.<br>• FALSE: Passive connection establishment as TCP server. |
| connectType | USInt | 1 | Connection type:<br>• 1 (default) = IPv4<br>• 10 = QDN (Qualified Domain Name) |
| localPort | UInt | 3456 | Local port, see system function TCON. |
| partnerPort | UInt | 3456 | Only when the connection is active ("configuration.connection.isClient" = TRUE):<br>Port of the partner-side, see system function TCON. |
| partnerIP | IP_V4 | - | IP address of the partner |
| partnerQDN | String [254] | '' | Fully qualified domain name<br>Must finish with "." |
| acceptUnknownPartner | Bool | TRUE | Only for passive connection establishment ("configuration.connection.isClient" = FALSE):<br>• TRUE: Previously not configured connection partner is accepted<br>• FALSE: Only the configured connection partner is accepted |
| lifeSignCycleTime | Time | T#1s | Vital signs cycle<br>T#1ms..T#24d20h30m20s630ms |
| sender | Struct | | |
| cycleTime | Time | T#1s | Send cycle<br>T#0ms..T#24d20h30m20s630ms |

| Name | Type | Start value | Comment |
|---|---|---|---|
| ackTimeout | Time | T#1s | Only relevant when using the LCom protocol ("configuration.connection.comService" = 2):<br>The tag "ackTimeout" determines the monitoring time after which an acknowledgement of the sent packet is expected at the latest. If this period is exceeded, the connection is closed and re-established.<br>T#1ms..T#24d20h30m20s630ms |
| timeSync | Struct | | Only relevant when using the LCom protocol ("configuration.connection.comService" = 2) |
| usePartnerTimestamps | Bool | FALSE | • TRUE: The received time is taken over as system time<br>• FALSE: Received time telegrams are ignored |
| sendMode | USInt | 0 | Send mode time synchronization:<br>• 0: Inactive<br>• 1: Cyclic time synchronization<br>• 2: Time when the time synchronization should take place |
| cycleTime | Time | T#1h | Only relevant if "sendMode" = 1;<br>Send cycle time of the timestamps<br>T#1ms..T#24d20h30m20s630ms |
| sendAtTimeOfDay | Time_Of_Day | TOD#05:00:0.000 | Only relevant with "sendMode" = 2;<br>Time at which a time synchronization telegram is sent. |

**LCom_typeDiagnostics**

The following table shows the structure of the PLC data type "LCom_typeDiagnostics".

Table 2-6: PLC data type LCom_typeDiagnostics

| Name | Type | Comment |
|---|---|---|
| localConfig | Struct | |
| connection | Struct | |
| interfaceID | HW_ANY | Hardware identifier of the local interface |
| connectionID | CONN_ANY | Reference to the local connection |
| comService | USInt | • 1: The standard TCP protocol is used<br>• 2: The LCom protocol is used |
| isClient | Bool | • TRUE: Active connection establishment as TCP client<br>• FALSE: Passive connection establishment as TCP server |
| connectType | USInt | • 1 = IPv4<br>• 10 = QDN (Qualified Domain Name) |
| localPort | UInt | Local port |
| localIP | IP_V4 | Local IP address |
| partnerPort | UInt | Partner-side port |

| Name | Type | Comment |
|---|---|---|
| partnerIP | IP_V4 | IP address of the partner |
| partnerQDN | String [254] | Fully qualified domain name |
| acceptUnknownPartner | Bool | • TRUE: Previously not configured connection partner is accepted<br>• FALSE: Only the configured connection partner is accepted |
| useLComProtocol | Bool | • TRUE: The LCom protocol is used<br>• FALSE: The LCom protocol is not used |
| lifeSignCycleTime | Time | Local vital signs cycle |
| sender | Struct | |
| cycleTime | Time | Local send cycle |
| ackTimeout | Time | The tag *ackTimeout* determines the local monitoring time after which an acknowledgement of the sent packet is expected at the latest. If this time is exceeded, the connection is closed and re-established. |
| timeSync | Struct | |
| usePartnerTimestamps | Bool | • TRUE: The received time is adopted as the system time.<br>• FALSE: Received time telegrams are ignored. |
| sendMode | USInt | Send mode time synchronization:<br>• 0: Inactive<br>• 1: Cyclic time synchronization<br>• 2: Time when the time synchronization should take place |
| cycleTime | Time | Send cycle time of the timestamps |
| sendAtTimeOfDay | Time_Of_Day | Time at which a synchronization telegram is sent |
| sizeOfSendBuffer | UDInt | Size of the local send buffer in bytes |
| sizeOfReceiveBuffer | UDInt | Size of the local receive buffer in bytes |
| partnerConfig | Struct | |
| connnection | Struct | |
| lifeSignCycleTime | Time | Partner vital signs cycle |
| sender | Struct | |
| cycleTime | Time | Partner send cycle |
| ackTimeout | Time | The tag *ackTimeout* determines the partner monitoring time after which an acknowledgement of the sent packet is expected at the latest. If this time is exceeded, the connection is closed by the partner and re-established. |
| timeSync | Struct | |
| usePartnerTimestamps | Bool | • TRUE: The received time is taken over as system time<br>• FALSE: Received time telegrams are ignored |

| Name | Type | Comment |
|---|---|---|
| sendMode | USInt | Send mode time synchronization:<br>• 0: Inactive<br>• 1: cyclic time synchronization.<br>• 2: Time when the time synchronization should take place |
| sizeOfSendBuffer | UDInt | Size of the send buffer in bytes of the partner |
| sizeOfReceiveBuffer | UDInt | Size of the receive buffer in bytes of the partner |
| statistics | Struct | Statistics |
| avgCallCycle | Real | Mean value between two FB calls [ms] |
| avgReceiveMsgCycle | Real | Mean value in which cycle data was received [ms] |
| maxReceiveMsgCycle | Time | Maximum occurred receive cycles |
| LComProtocolUsed | Bool | • TRUE: The LCom protocol is used. With the LCom protocol additional communication functionalities are enabled<br>• FALSE: The TCP transport protocol is used |
| activeLComVersion | USInt | Active LCom protocol version |
| avgMsgSendingTime | Real | Average value of how long a sending process (*sending* = TRUE) takes [ms] |
| maxMsgSendingTime | Time | Maximum value of a sending process (*sending* = TRUE) [ms] |
| avgMsgReceivingTime | Real | Mean value of how long a receiving process takes [ms] |
| maxMsgReceivingTime | Time | Maximum value of a receiving process [ms] |
| numberOfSentMessages | UDInt | Number of messages sent, since the L/H edge at the *enable* input |
| numberOfReceivedMessages | UDInt | Number of received messages, since the L/H edge at the *enable* input |
| totalAckTimeouts | UInt | Number of times the monitoring time was exceeded (diagnostics.localConfig.sender.ackTimeout*)* |
| totalSendCycleViolations | UInt | Number of times the send cycle is exceeded (diagnostics.localConfig.sender.cycleTime) |
| totalReceiveCycleViolations | UInt | Number of times the receive cycle is exceeded (*diagnostics.partnerConfig.sender.cycleTime*) |
| totalReconnects | UInt | Number of times the FB has reestablished the TCP connection |
| lastConnect | DTL | Time when the connection was successfully established to the partner |
| lastTimeSync | DTL | Time of the last time synchronization |
| bufferIndex | USInt | Index to the last diagnostic entry |
| buffer | Array[0..63] of Struct | Diagnostic buffer |
| status | Word | Status message from FB |

| Name | Type | Comment |
|---|---|---|
| timestamp | DTL | Timestamp at appearance of the message |
| isActive | Bool | • TRUE: State is still available<br>• FALSE: State is no longer available |
| subFunctionErrorID | Word | If necessary, Return value of a system function |
| additionalValue1 | Real | Additional value 1 |
| additionalValue2 | Real | Additional value 2 |
| additionalValue3 | Real | Additional value 3 |
| additionalValue4 | Time | Additional value 4 |

## 2.4. Integration into the User Project

You will find an application example for integrating the LCom blocks into your user application in the master copies of this library.

Additionally, you will find a detailed application example for the integration of the library into your user project in the Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/48955385

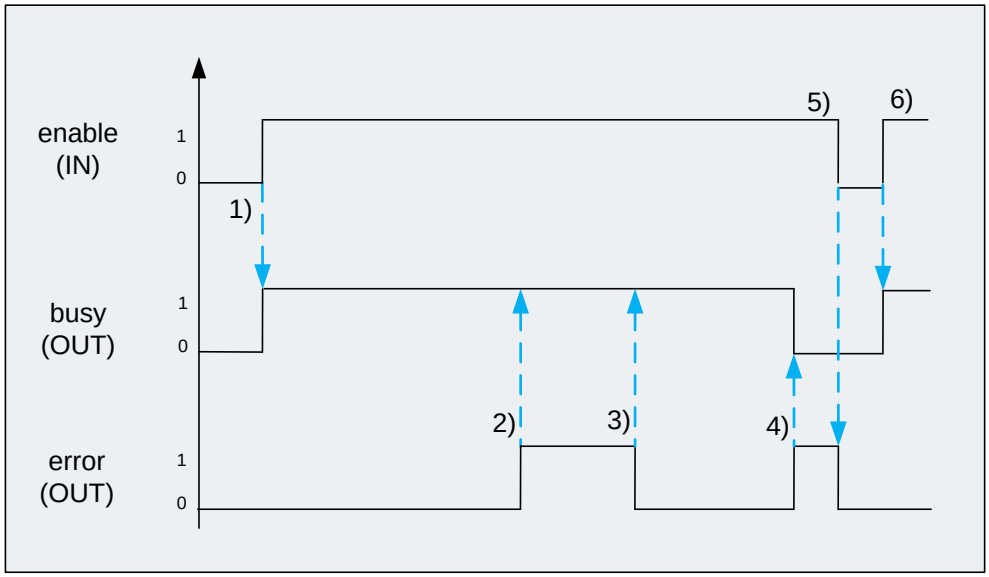
## 2.5. Error Handling

### 2.5.1. Status Outputs

An error is indicated by setting the boolean tag "error". A distinction must be made between whether the cause of the error can be remedied by the user or by the block. If it is an error that can be corrected by the block, "busy" remains set. If an error occurs that must be corrected by the user, "busy" is reset (block processing deactivated).

The following figure shows the two scenarios as a signal flow diagram.

Figure 2-5 Signal flow diagram error/busy




1. "busy" is set with a rising edge of "enable".
2. An error occurs and "error" is set. Since this is an error that can be corrected by the block itself, "busy" remains set.
3. After correcting the cause of the error (e.g. re-establishing the connection), "error" is reset.
4. An error that can only be corrected by the user occurs. Here "error" is set and "busy" is reset.
5. The pending error, which must be remedied by the user, can only be cleared with a falling edge at "enable".
6. The block is started again with a rising edge of "enable".

**Output parameters diagnostics**

In the output parameter "diagnostics", there are different substructures that are defined by the PLC data type "LCom_typeDiagnostics". The diagnostic buffer is discussed below. The complete description of the PLC data type "LCom_typeDiagnostics" can be found in chapter 2.3.

Various status and error messages are entered in the diagnostic buffer. The array is set to 64 entries. This array operates as a ring buffer. The tag "bufferIndex" points to the last (current) entry.

Each entry consists of the following elements:

- Status or error number
- Date and time of occurrence
- Current state of the error

The state when entering the buffer is always active. When resetting the error, the status in the buffer is set to inactive. The structure contains the return value of the system function as well as four additional values that can contain detailed information depending on the error that occurred.

Table 2-7 Structure of the diagnostic buffer

| Name | Data type | Description |
|---|---|---|
| bufferIndex | USInt | Index to last entry |
| buffer | Array [0..63] of Struct | Diagnostic buffer |
| status | Word | Status from FB |
| timestamp | DTL | Timestamp at appearance of the message |
| isActive | Bool | • TRUE: State is still present.<br>• FALSE: State is no longer present. |
| subFunctionErrorID | Word | If necessary, Return value of a system function |
| additionalValue1 | Real | Additional value 1 |
| additionalValue2 | Real | Additional value 2 |
| additionalValue3 | Real | Additional value 3 |
| additionalValue4 | Time | Additional value 4 |

### 2.5.2. Status Messages

Table 2-8: Status messages

| Code | Meaning |
|---|---|
| 16#7000 | No job in process.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7001 | First call after receipt of a new job (rising edge at *enable*).<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7002 | Follow-up call during active FB processing.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7003 | FB tries to connect as TCP client.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7004 | FB is configured as TCP server and waits for a TCP client request.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1...3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7005 | The TCP connection to the partner is established.<br><br>Diagnostic entry: |

| Code | Meaning | |
|---|---|---|
| | *timestamp:* | Time of the event |
| | *isActive:* | State |
| | *subFunctionErrorID:* | 16#0 |
| | *additionalValue1..3:* | 0.0 |
| | *additionalValue4* | T#0ms |

| Code | Meaning |
|---|---|
| 16#7006 | The FB has successfully exchanged configuration data with the partner via LCom protocol V1.<br>The maximum possible data length is 64 KByte.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#7007 | The FB has successfully established the connection and exchanged the configuration data (LCom protocol V2) with the partner.<br>The maximum possible data length is 16 MByte.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#7008 | The FB terminates the connection.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7008 | The FB terminates the connection.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3:* 0.0<br>*additionalValue4* T#0ms |
| 16#7600 | The specified send length (*sendDataLength*) is too large and is automatically limited by the FB.<br>The maximum possible send length is determined by the size of the own send buffer (*sendBuffer*).<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* sendDataLength<br>*additionalValue2:* sendBuffer<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#7610 | The specified time (*configuration.connection.lifeSignCycleTime*) for connection monitoring is too large and is automatically limited to 65535 ms. |

| Code | Meaning |
|---|---|
| | Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Limitation to 65535<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* Value of the user |
| 16#7611 | The specified time for the send cycle (*configuration.sender.cycleTime*) is too large and is automatically limited to 65535 ms.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Limitation to 65535<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* Value of the user |
| 16#7612 | The configured monitoring time (*configuration.sender.ackTimeout*) is too large and is automatically limited to 65535 ms<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Limitation to 65535<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* Value of the user |
| 16#7613 | The configured send cycle (*configuration.sender.CycleTime*) cannot be kept because the previous sending process has not yet been completed.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Value of the user<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* Previous time of the previous send job |
| 16#7614 | When using the LCom protocol (*configuration.connection.comService = 2*):<br>The specified send length (*sendDataLength*) is larger than the receive buffer of the partner.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* sendDataLength<br>*additionalValue2:* Receive buffer of the partner-side<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |

| Code | Meaning |
|---|---|
| | Without using the LCom protocol (*configuration.connection.comService = 1*):<br>The specified *readDataLength* at the FB is larger than the specified receive buffer (receiveBuffer). The *readDataLength* is limited to the size of the specified receive buffer.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* User-defined receive buffer<br>*additionalValue2:* readDataLength<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |

| Code | Meaning |
|---|---|
| 16#7615 | No time synchronization is performed.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..4:* 0.0 |
| 16#8200 | The specified communication service *(configuration.connection.comService)* is invalid → see system function TCON.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1* Value of the user<br>*additionalValue2...3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8201 | The specified connection reference (*configuration.connection.connectionID*) is invalid → see system function TCON.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1* Value of the user<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8202 | The specified hardware identifier for the local interface (*configuration.connection.interfaceID*) is invalid → see system function TCON.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1* Value of the user<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8203 | The specified local port (*configuration.connection.localPort*) is not allowed → see system function TCON.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* TCON status<br>*additionalValue1* Value of the user<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8204 | The specified partner IP address (*configuration.connection.partnerIP*) is invalid → see system function TCON. |

| Code | Meaning |
|---|---|
| | Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* TCON status<br>*additionalValue1* Value of the user<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8205 | The specified mode for time synchronization (*configuration.timeSync.sendMode*) is invalid.<br><br>Diagnostics entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1* Value of the user<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8206 | The specified cycle time for time synchronization (*configuration. timeSync.cycleTime*) is invalid.<br><br>Dianostics entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3* 0.0<br>*additionalValue4:* Value of the user |
| 16#8207 | The specified time for the time synchronization(*configuration.timeSync.sendAtTimeOfDay*) is invalid.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3* 0.0<br>*additionalValue4:* T#0ms |
| 16#8208 | The value passed to the input tag *sendBuffer* is not of type ARRAY of BYTE and is invalid.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3* 0.0<br>*additionalValue4:* T#0ms |
| 16#8209 | The value passed to the output tag *receiveBuffer* is not of type ARRAY of BYTE and is invalid.<br><br>Diagnostic entry: |

| Code | Meaning | |
|---|---|---|
| | *timestamp:* | Time of the event |
| | *isActive:* | State |
| | *subFunctionErrorID:* | 16#0 |
| | *additionalValue1..3* | 0.0 |
| | *additionalValue4:* | T#0ms |
| 16#8210 | The specified time (*configuration.connection.lifeSignCycleTime*) for connection monitoring is invalid:<br><br>Diagnostic entry: | |
| | *timestamp:* | Time of the event |
| | *isActive:* | State |
| | *subFunctionErrorID:* | 16#0 |
| | *additionalValue1..3* | 0.0 |
| | *additionalValue4:* | Value of the user |

| Code | Meaning |
|---|---|
| 16#8211 | The specified send cycle (*configuration.sender.cycleTime*) is invalid.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3* 0.0<br>*additionalValue4:* Value of the user |
| 16#8212 | The configured monitoring time (*configuration.sender.ackTimeout*) is invalid.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1..3* 0.0<br>*additionalValue4:* Value of the user |
| 16#8213 | The configured connection type (*configuration.connection.connectType*) is invalid<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1* Value of the user<br>*additionalValue2..3* 0.0<br>*additionalValue4:* T#0ms |
| 16#8600 | An error has occurred when using the TCON system function, see *subFunctionErrorID* in the diagnostic buffer and system documentation. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* TCON status<br>*additionalValue1:* 0.0<br>*additionalValue2:* 0.0<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8601 | An error has occurred when using the TCON system function, see *subFunctionErrorID* in the diagnostic buffer and system documentation. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* TCON status<br>*additionalValue1:* Local port<br>*additionalValue2:* 0.0<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |

| Code | Meaning |
|---|---|
| 16#8602 | An error occurred while using the system function TSEND, see *subFunctionErrorID* in the diagnostic buffer and system documentation. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* TSEND status<br>*additionalValue1:* 0.0<br>*additionalValue2:* Length of send data<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8603 | An error has occurred when using the TRCV system function, see *subFunctionErrorID* in the diagnostic buffer and system documentation. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* Status of TRCV<br>*additionalValue1..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8604 | An error has occurred when using the TDISCON system function, see *subFunctionErrorID* in the diagnostic buffer and system documentation. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* Status of TDISCON<br>*additionalValue1..3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8610 | The vital signs of the partner were not received in time. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Vital signs cycle<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* Time in which the FB has not received any data from the partner. |
| 16#8611 | The monitoring time of a sent data packet has expired without an acknowledgement being received from the partner. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Monitoring time<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* Time in which the FB has not received any data from the partner. |

| Code | Meaning |
|---|---|
| 16#8612 | An invalid acknowledge number was received from the partner, the connection will be re-established.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* Received acknowledge message number<br>*additionalValue2:* Send acknowledge message number<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8613 | The LCom (protocol) versions of the library LCom do not match the partner or an invalid (protocol) version was received. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* received version<br>*additionalValue2:* local, active version<br>*additionalValue3:* 0.0<br>*additionalValue4:* T#0ms |
| 16#8614 | A telegram was received which has an ID that was not expected. The connection is reestablished.<br><br>Diagnostic entry:<br><br>*timestamp:* Time of the event<br>*isActive:* State<br>*subFunctionErrorID:* 16#0<br>*additionalValue1:* received ID<br>*additionalValue2..3:* 0.0<br>*additionalValue4:* T#0ms |

If errors occur during parameterization (16#8200 to 16#83FF), intervention by the user is required. The user must replace the faulty value with a permissible value and restart the function block with a rising edge at the "enable" input.

In case of an internal error (16#8600 to 16#87FF) the function block will automatically close the connection and try to re-establish it. A new rising edge at the "enable" input is not necessary.

# 3. LFTP

## 3.1. Overview

### 3.1.1. Range of Functions

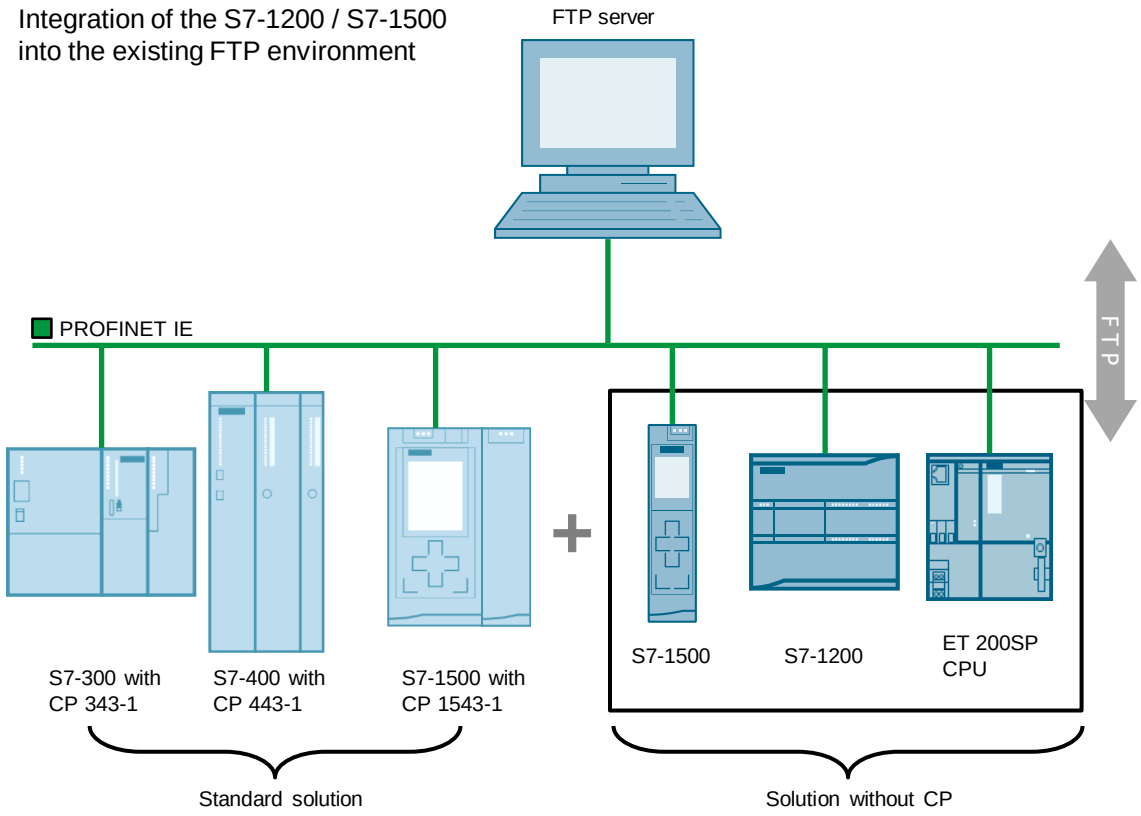
A simple protocol that works according to the client/server principle and which meets the demands of this task is the **F**ile **T**ransfer **P**rotocol (FTP).

FTP allows you to store data on server systems. FTP supports almost all server systems and operating systems.

The controllers from the SIMATIC S7-300, S7-400 and S7-1500 product families support FTP communication with the help of specialized communications processors (CPs).

With this library you can implement FTP communication with an S7-1200, S7-1500 or ET200SP CPU based on Open User Communication **without a special CP**.

Figure 3-1





## 3.1.2. Components of the Library

**Function blocks**

Table 3-1: Function blocks

| Name | Version | Description |
|---|---|---|
| LFTP_Client | V6.1.6 | Organizes connection setup of the FTP control connection and data connection as well as sending and receiving of files. |

**PLC data types**

Table 3-2: PLC data types

| Name | Version | Description |
|---|---|---|
| LFTP_typeConnParam | V1.0.0 | This data type describes all parameters of the connection to the FTP server. |
| LFTP_typeFtpParam | V1.0.0 | This data type describes all parameters of the FTP commands. |

## 3.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 controllers with firmware V2.9 or higher
- SIMATIC S7-1200 controllers with firmware V4.5 or higher
- SIMATIC ET 200SP Open Controllers with firmware V2.9 or higher
- CM 1542-1

# 3.2. LFTP_Client

## 3.2.1. Interface Description

**Description**

The FTP function block "LFTP_Client" implements FTP on the basis of Open User Communication. It can execute the following FTP commands:

- CONNECT (connect and log on)
- DISCONNECT (disconnect and log off)
- STORE (save data)
- APPEND (append data)
- RETRIEVE (retrieve data)
- DELETE (delete a file)

The FB supports both modes Active FTP and Passive FTP.

**Parameters**

Figure 3-2: LFTP_Client

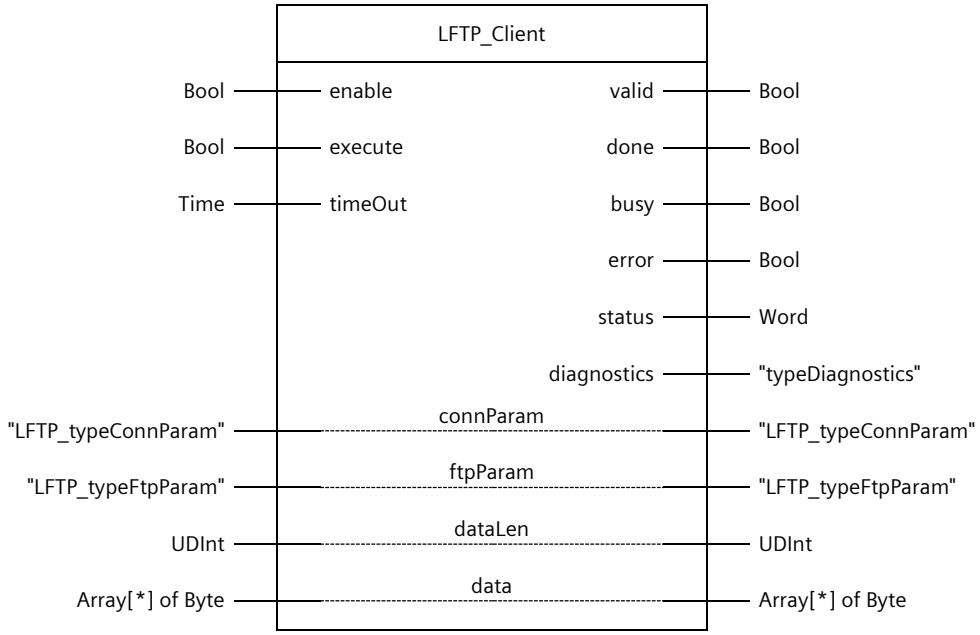



Table 3-3: Parameters of LFTP_Client

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | IN | Bool | TRUE = control connection to the FTP server is connected<br>FALSE = control connection is terminated |
| execute | IN | Bool | FTP job trigger on rising edge |
| timeOut | IN | Time | Time after which a job should be automatically canceled |
| valid | OUT | Bool | TRUE: The FB executes its function without error. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| done | OUT | Bool | TRUE: The current job (send message or activate shell) was completed successfully. |
| busy | OUT | Bool | TRUE: The FB is busy. |
| error | OUT | Bool | TRUE: An error has occurred.<br>If "busy" is TRUE at the same time, the block attempts to correct the error itself. |
| status | OUT | Word | Status and error codes (see chapter 3.2.2) |
| diagnostics | OUT | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| connParam | IN_OUT | "LFTP_typeConnParam" | Sets connection parameters. The hardware ID, URL of the FTP server, username and password are defined here. |
| ftpParam | IN_OUT | "LFTP_typeFtpParam" | FTP parameters |
| dataLen | IN_OUT | UDInt | Length of data to be sent or received |
| data | IN_OUT | Array[*] of Byte | Data to be sent or received |

## 3.2.2. Error Handling

Table 3-4: Status and error codes

| Status | Meaning |
|---|---|
| 16#0000 | FTP command successfully executed |
| 16#7000 | Idling, no active connections |
| 16#7001 | First call of the block |
| 16#7002 | Control connection is being established |
| 16#7003 | Control connection is being terminated |
| 16#7004 | Control connection is established, no job active |
| 16#7005 | FTP command is being executed |
| 16#8202 | Invalid URL |
| 16#8400 | Error received from FTP server. Some possible causes could be that the login credentials are wrong or that the file name does not exist.<br>The FTP-specific error code is output at "diagnostics.subfunctionStatus". The meaning of the FTP-specific error code can be found in the FTP specification. |
| 16#8600 | The FB is in an invalid state. |
| 16#8601 | Error in subordinate instruction "TCON"<br>The error code of the instruction is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8602 | Error in subordinate instruction "TSEND"<br>The error code of the instruction is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |

| Status | Meaning |
|---|---|
| 16#8603 | Error in subordinate instruction "TRCV"<br>The error code of the instruction is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8604 | Error in subordinate instruction "TCONSettings"<br>The error code of the instruction is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8605 | Error in subordinate instruction "MOVE_BLK_VARIANT"<br>The error code of the instruction is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8086 | Error in subordinate instruction "RDREC"<br>The error code of the instruction is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8D11 | Control connection not connected; data connection cannot be opened |
| 16#8D26 | Data connection cannot be opened |
| 16#8D28 | FTP server timeout |
| 16#8DF1 | Request timeout |
| 16#8DF2 | Unknown reply code |
| 16#8DF3 | Unknown command |
| 16#8DF4 | Port number below 2000 |
| 16#8F62 | Action aborted; data connection will be terminated |
| 16#8F69 | Connection attempt on existing connection |

**NOTE** If the FB outputs "done" but no data after a "RETRIEVE" command, this may be caused by the communication load being set too low. Increase the communication load in the device configuration.

## 3.3. PLC Data Types

**LFTP_typeConnParam**

This data type describes all the parameters required for the connection to the FTP server.

Table 3-5: Parameters of LFTP_typeConnParam

| Name | Type | Comment |
|---|---|---|
| hwID | HW_ANY | Hardware ID of the IE interface module |
| serverAddress | String | IP address or hostname of the FTP server |
| username | String | FTP user name |
| password | String | FTP user password |

**LFTP_typeFtpParam**

This data type describes all FTP parameters necessary for the data connection.

Table 3-6: Parameters of LFTP_typeFtpParam

| Name | Type | Comment |
|---|---|---|
| ftpActiveMode | BOOL | FTP mode; TRUE: active, FALSE: passive |
| portActiveMode | UInt | Local port for the FTP active mode, must be set to a value higher than 2000. |
| ftpCmd | Int | FTP command<br>• 2: STORE<br>• 3: RETRIEVE<br>• 4: DELETE<br>• 6: APPEND |
| filename | String | File name |

## 3.4. Integration into the user project

You will find a detailed application example for the integration of the library into your user project in Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/81367009

# 4. LHTTP

## 4.1. Overview

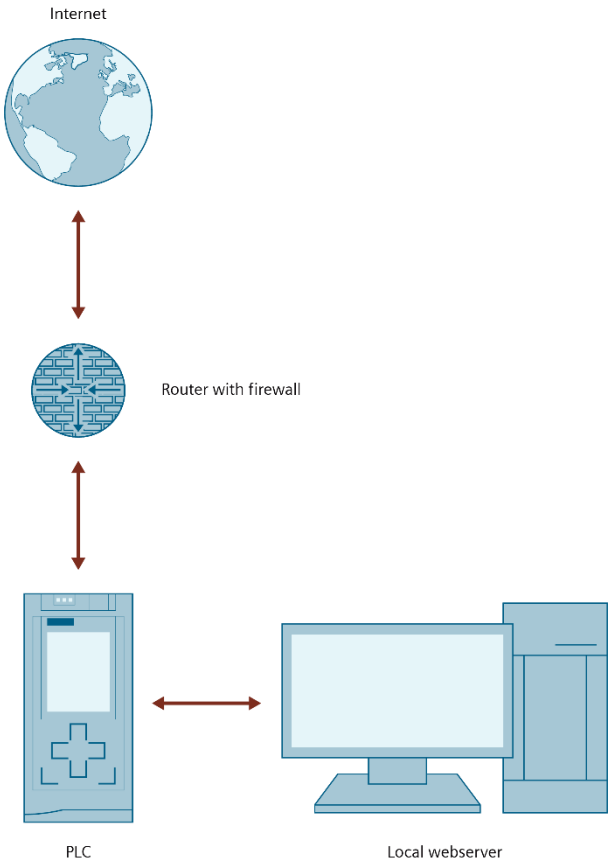
### 4.1.1. Range of Functions

The Hypertext Transfer Protocol (HTTP) is a data transfer protocol used primarily to load Web pages from the World Wide Web.

Due to the increasing networking of plants and the advancement of the Internet of Things (IoT), HTTP and HTTPS also play an increasingly important role in automation technology.

The library for HTTP communication (LHTTP) enables the data exchange of a SIMATIC S7-1200/1500 CPU via the integrated Ethernet interface with another device in the local network or a web server in the internet via HTTP respectively HTTPS.

Figure 4-1: Overview




The LHTTP library provides function blocks with which the most conventional HTTP request methods can be implemented in the user program:

- GET
- POST
- PUT

Due to the integrated certificate management in the TIA Portal, it is also possible to transfer data securely with HTTPS using the same blocks.

## 4.1.2. Components of the Library

**Blocks**

| Name | Type | Version | Description |
|---|---|---|---|
| LHTTP_Get | FB | V2.1.5 | Realizes the HTTP method GET |
| LHTTP_PostPut | FB | V2.1.7 | Realizes the HTTP methods POST and PUT |
| LHTTP_FindStringInArray | FC | V1.0.0 | Searches an array of chars for a given string |
| LHTTP_ExtractString FromArray | FC | V1.0.0 | Extracts a string between two specified text parts from an array of chars. |
| LHTTP_ExtractString FromArrayExt | FC | V1.0.0 | Same function as "LHTTP_ExtractStringFromArray" with advanced options |

Table 4-1: Blocks of the library

**PLC Data Types**

| Name | Version | Description |
|---|---|---|
| LHTTP_typeTLS | V1.0.0 | Data type for transferring certificates for secure communication via HTTPS |

Table 4-2: PLC library data types

## 4.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.4
- SIMATIC ET 200SP Open Controllers as of firmware V2.5
- SIMATIC S7-1500 Software Controllers as of firmware V2.5
- CP 1543-1 as of firmware V2.0
- CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V3.2

# 4.2. LHTTP_Get

## 4.2.1. Interface Description

### Description

The block implements the HTTP method GET to fetch data from a web server.

### Parameter

Figure 4-2: LHTTP_Get

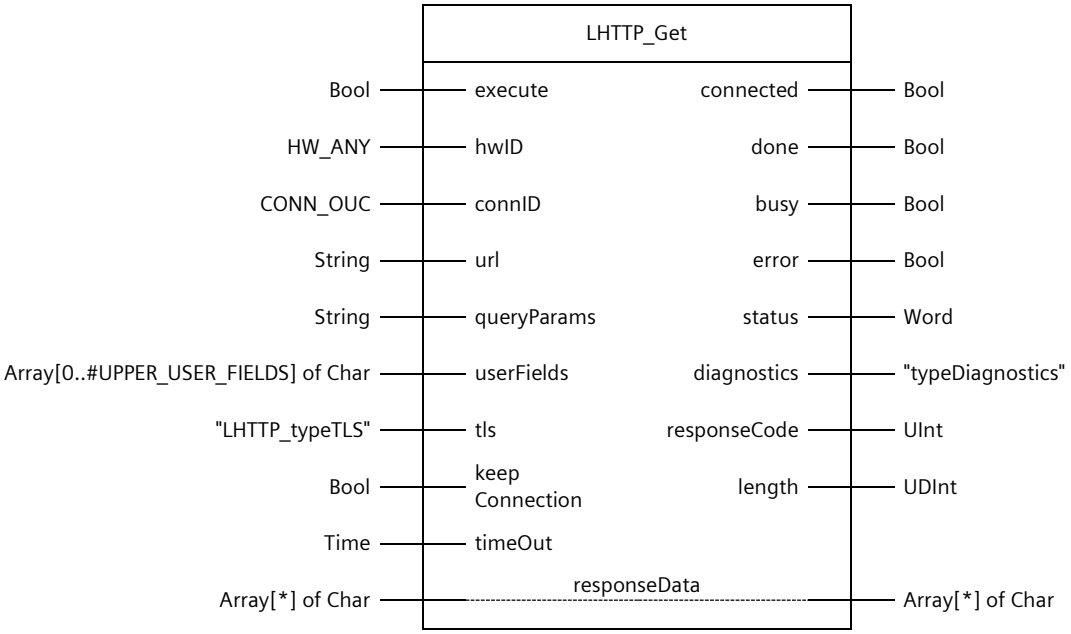



Table 4-3: Parameters of LHTTP_Get

| Name | Declaration | Data type | Description |
|---|---|---|---|
| execute | Input | Bool | With a positive edge, a connection to the web server is established and the HTTP request is sent. |
| hwID | Input | HW_ANY | Hardware identifier of the PN/IE interface for establishing the connection<br>If "0" is selected, a suitable one is selected automatically. |
| connID | Input | CONN_OUC | Unique connection ID |
| url | Input | String | URL, e.g. "https://httpbin.org/get"<br>HTTPS is used per default. To use HTTP "http://" must be explicitly specified in the URL. |
| queryParams | Input | String | Additional query parameters if parameter "url" is not long enough, i.e. "lang=en&q=simatic". |
| userFields | Input | Array[0..#UPPER_USER_FIELDS] of Char | Additional user-defined header fields<br>The header fields must be formatted according to HTTP and terminated with the "$00" character. |
| tls | Input | "LHTTP_typeTLS" | TLS certificates for secure data transmission (HTTPS)<br>For unsafe data transmission (HTTP) leave unconnected. |
| keepConnection | Input | Bool | TRUE: Keeps the connection established after the job has been executed |

| Name | Declaration | Data type | Description |
|---|---|---|---|
| timeOut | Input | Time | Time after which a job should be automatically canceled |
| connected | Output | Bool | TRUE: Connection to the web server is established |
| done | Output | Bool | TRUE: Job finished |
| busy | Output | Bool | TRUE: Job is being executed |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 4.8) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| responseCode | Output | UInt | Received HTTP status code (see Table 4-10) |
| length | Output | UDInt | Length of the received user data |
| responseData | InOut | Array[*] of Char | Received user data. The array must start at "0". |

### 4.2.2. Operation

The user specifies the requested resource in the form of a URL, e.g. "https://httpbin.org/get" or "http://192.168.0.1:80/index.html", at the "url" parameter. HTTPS is used per default. To use HTTP "http://" must be explicitly specified in the URL.

Optional parameters can be passed with two variants:

- Appended to the URL at the parameter "url" with a "?" in front, e.g. "http://httpbin.org/get?lang=en&q=simatic"
- At the separate parameter "queryParams", e.g. "lang=en&q=simatic"; "?" or "&" is inserted automatically in between "url" and "queryParameters".

With a rising edge at the "execute" parameter, the block requests the IP address belonging to the host at the configured DNS Server if necessary and establishes a connection to the web server.

If HTTPS is used, the certificate of the requested web server must be referenced at the "tls" parameter (see chapter 4.7). If the web server requires client authentication, the PLC's certificate must also be referenced.

The block creates the HTTP request from the specified URL and sends it to the web server.

The user data of the web server's response is output at the "responseData" parameter. The received HTTP status code is output at the "responseCode" parameter.
If the web server responds with an error (HTTP status code 4xx), no data is output.

**NOTE** The FB does not clear the receive area at "responseData" between two requests. The receive area might contain old data. Use the length of the received user data of the current request at the output "length" to only evaluate this data.

Depending on the parameter "keepConnection", the block terminates the connection to the web server after all telegrams have been successfully received or keeps it established for further requests.

**NOTE** The block outputs the HTTP status code received from the server with the first received telegram and writes the user data of each received telegram directly into the memory area connected to the parameter "responseData". Evaluate the user data only after the output "done" has been set.

**NOTE** The block does not support redirections. If the server responds with a redirection (HTTP status code 3xx), the block issues an error (see chapter 4.8).

Check the URL and correct it if necessary.

### User-defined header fields

The "userFields" input allows the user to insert additional header fields into the request. The user has 256 characters available in the form of an Array of Char.

The data must be formatted according to HTTP: Two header fields are separated by an end-of-line ("$R$L"). The end of the user-defined header fields is signaled to the FB with the character "$00". A closing line end is not necessary.

For example, the "Accept Language" and "Authorization" header fields can be inserted as follows:

```
Accept-Language: en$R$LAuthorization: Basic QWxhZGRpbjpvcGVuIHNlc2FtZQ==$00
```

If no user-defined header fields are required, the input is not connected.

**NOTE** If 256 characters are not enough, the array can be increased by adjusting the local constant "UPPER_USER_FIELDS".

### Keep connection established

If the parameter "keepConnection" is set, the connection is not broken after the completion of a job and can be used for further requests. Especially if there are many requests to the same web server over HTTPS, this shortens the required duration of subsequent requests.

The connection is then broken by resetting "keepConnection".

# 4.3. LHTTP_PostPut

## 4.3.1. Interface Description

### Description

The block implements the HTTP methods POST and PUT to transfer data to a web server.

### Parameter

Figure 4-3: LHTTP_PostPut

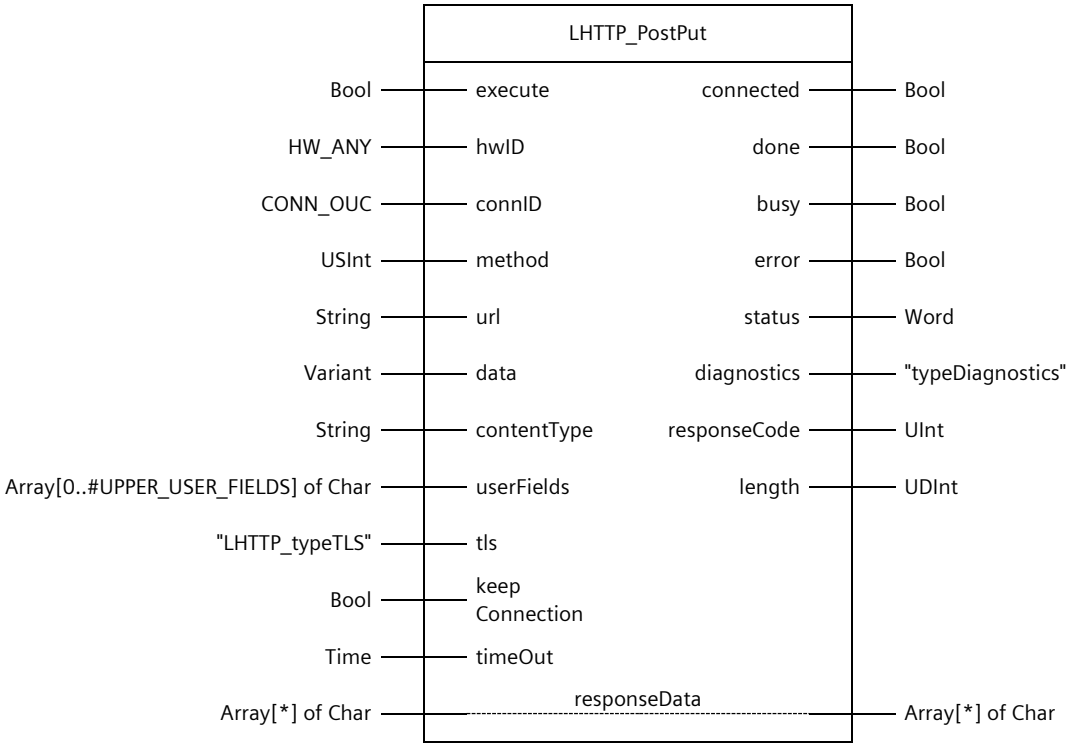



Table 4-4: Parameters of LHTTP_PostPut

| Name | Declaration | Data type | Description |
|---|---|---|---|
| execute | Input | Bool | With a positive edge, a connection to the web server is established and the HTTP request is sent. |
| hwID | Input | HW_ANY | Hardware identifier of the PN/IE interface for establishing the connection<br>If "0" is selected, a suitable one is selected automatically. |
| connID | Input | CONN_OUC | Unique connection ID |
| method | Input | USInt | HTTP method<br>0: POST<br>1: PUT |
| url | Input | String | URL, e.g. "https://httpbin.org/post"<br>HTTPS is used per default. To use HTTP "http://" must be explicitly specified in the URL. |
| contentType | Input | String | Content type of the body |

| Name | Declaration | Data type | Description |
|---|---|---|---|
| data | Input | Variant | Message body<br>Valid data types: String and Array of Char<br>In the case of Array of Char, the data must be terminated with the character "$00". |
| userFields | Input | Array[0..#UPPER_USER_FIELDS] of Char | Additional user-defined header fields<br>The header fields must be formatted according to HTTP and terminated with the "$00" character. |
| tls | Input | "LHTTP_typeTLS" | TLS certificates for secure data transmission (HTTPS)<br>For unsafe data transmission (HTTP) leave unconnected. |
| keepConnection | Input | Bool | TRUE: Keeps the connection established after the job has been executed |
| timeOut | Input | Time | Time after which a job should be automatically canceled |
| connected | Output | Bool | TRUE: Connection to the web server is established |
| done | Output | Bool | TRUE: Job finished |
| busy | Output | Bool | TRUE: Job is being executed |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 4.8) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| responseCode | Output | UInt | Received HTTP status code (see chapter 4.8) |
| length | Output | UDInt | Length of the received user data |
| responseData | InOut | Array[*] of Char | Received user data. The array must start at "0". |

### 4.3.2. Operation

The user specifies the requested resource in the form of a URL, e.g. "https://httpbin.org/post" or "http://192.168.0.1:80/index.html", at the "url" parameter. HTTPS is used per default. To use HTTP "http://" must be explicitly specified in the URL.

The user data can be passed as a string or, if 254 characters are not sufficient, as an array of chars at the "data" parameter. If Array of Char is used, the user data must be terminated with the character "$00".

The content type of the body depends on the webserver and can be set with the parameter "contentType". The content type defines the format of the body.

Via the "method" parameter the user chooses whether the HTTP method POST or PUT should be used.

With a rising edge at the "execute" parameter, the block requests the IP address belonging to the host at the configured DNS Server if necessary and establishes a connection to the web server.

If HTTPS is used, the certificate of the requested web server must be referenced at the "tls" parameter (see chapter 4.7). If the web server requires client authentication, the PLC's certificate must also be referenced.

The block creates the HTTP request from the specified URL and sends it to the server.

The user data of the server's response is output at the "responseData" parameter. The received HTTP status code is output at the "responseCode" parameter.
If the web server responds with an error (HTTP status code 4xx), no data is output.

**NOTE** The FB does not clear the receive area at "responseData" between two request. The receive area might contain old data. Use the length of the received user data of the current request at the output "length" to only evaluate this data.

Depending on the parameter "keepConnection", the block terminates the connection to the server after all telegrams have been successfully received or keeps it established for further requests.

**NOTE** The block outputs the HTTP status code received from the server with the first received telegram and writes the user data of each received telegram directly into the memory area connected to the parameter "responseData". Evaluate the user data only after the output "done" has been set.

**NOTE** The block does not support redirections. If the server responds with a redirection (HTTP status code 3xx), the block issues an error (see chapter 4.8).

Check the URL and correct it if necessary.

### User-defined header fields

The "userFields" input allows the user to insert additional header fields into the request. The user has 256 characters available in the form of an Array of Char.

The data must be formatted according to HTTP: Two header fields are separated by an end-of-line ("$R$L"). The end of the user-defined header fields is signaled to the FB with the character "$00". A closing line end is not necessary.

For example, the "Accept Language" and "Authorization" header fields can be inserted as follows:

```
Accept-Language: en$R$LAuthorization: Basic QWxhZGRpbjpvcGVuIHNlc2FtZQ==$00
```

If no user-defined header fields are required, the input is not connected.

**NOTE** If 256 characters are not enough, the array can be increased by adjusting the local constant "UPPER_USER_FIELDS".

### Keep connection established

If the parameter "keepConnection" is set, the connection is not broken after the completion of a job and can be used for further requests. Especially if there are many requests to the same web server over HTTPS, this shortens the required duration of subsequent requests.

The connection is then broken by resetting "keepConnection".

## 4.4. LHTTP_FindStringInArray

**Description**

The function "LHTTP_FindStringInArray" searches an Array of Char for a string and returns its position as return value.

**Parameter**

Figure 4-4: LHTTP_FindStringInArray

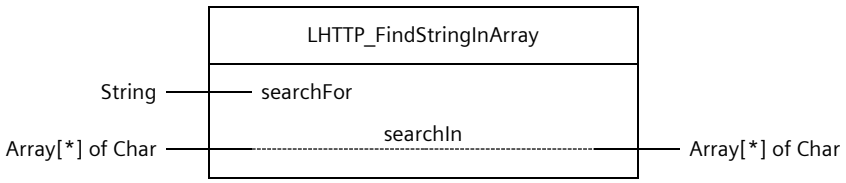



Table 4-5: Parameters of LHTTP_FindStringInArray

| Name | Declaration | Data type | Description |
|---|---|---|---|
| searchFor | Input | String | Text to search for. |
| searchIn | InOut | Array[*] of Char | Array of Char to be searched. |
| Ret_Val | Return | DInt | Position (index) of the searched string in the array.<br>-1: String was not found. |

## 4.5. LHTTP_ExtractStringFromArray

**Description**

The LHTTP_ExtractStringFromArray function extracts a string between two specified text parts from an array of chars.

**Parameter**

Figure 4-5: LHTTP_ExtractStringFromArray

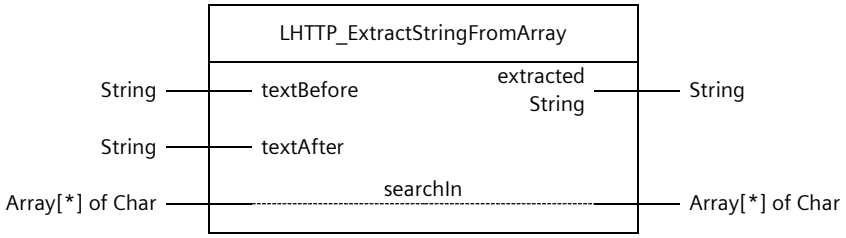



Table 4-6: Parameters of LHTTP_ExtractStringFromArray

| Name | Declaration | Data type | Description |
|---|---|---|---|
| textBefore | Input | String | Text part before the text that is to be extracted |
| textAfter | Input | String | Text part after the text that is to be extracted |
| extractedString | Output | String | Extracted Text |
| searchIn | InOut | Array[*] of Char | Array of Char to be searched |

| Name | Declaration | Data type | Description |
|---|---|---|---|
| Ret_Val | Return | Word | Return value:<br>16#0000: Successful, Text was found<br>16#9001: Only text before was found. String is output with max. length<br>16#9002: Neither text before nor after was found |

## 4.6. LHTTP_ExtractStringFromArrayExt

### Description

The function "LHTTP_ExtractStringFromArrayExt" extracts a string between two specified text parts from an array of char with extended options.

**NOTE** The function is part of the library to allow easy parsing of the received data, but is not used by the library blocks themselves.

### Parameter

Figure 4-6: LHTTP_ExtractStringFromArrayExt

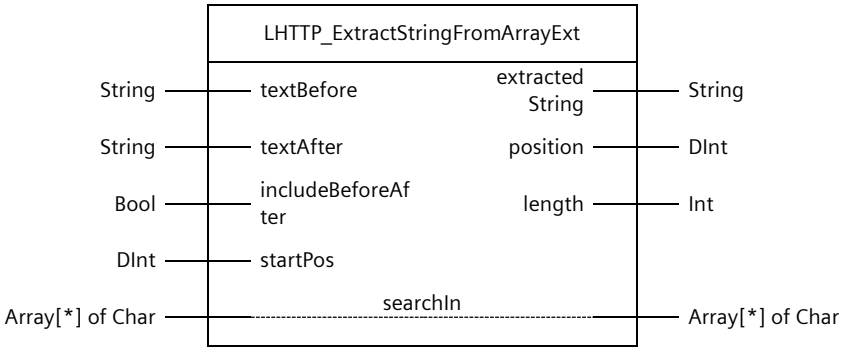



Table 4-7: Parameters of LHTTP_ExtractStringFromArrayExt

| Name | Declaration | Data type | Description |
|---|---|---|---|
| textBefore | Input | String | Text part before the text that is to be extracted |
| textAfter | Input | String | Text part after the text that is to be extracted |
| includeBeforeAfter | Input | Bool | If TRUE, the text parts before and after are extracted as well |
| startPos | Input | DInt | Position in the array from which the search is to be started |
| extractedString | Output | String | Extracted Text |
| position | Output | DInt | position (index) of the extracted text within the array |
| length | Output | Int | Length of the extracted text |
| searchIn | InOut | Array[*] of Char | Array of Char to be searched |

| Name | Declaration | Data type | Description |
|---|---|---|---|
| Ret_Val | Return | Word | Return value:<br>16#0000: Successful, Text was found<br>16#9001: Only text before was found. String is output with max. length<br>16#9002: Neither text before nor after was found |

## 4.7. PLC Data Types

### LHTTP_typeTLS

The PLC data type "LHTTP_typeTLS" references the certificates required for secure connections via HTTPS.

Table 4-8: Parameters of LHTTP_typeTLS

| Name | Data type | Description |
|---|---|---|
| validateServerIdentity | Bool | A set bit means that the client validates the subjectAlternateName in the server's X.509 V3 certificate to verify the server's identity. The certificates are checked when the connection is established. |
| serverCert | UDInt | ID of the X.509 V3 certificate (usually a CA certificate) used by the TLS client to validate the TLS server authentication.<br>If this parameter is "0", the TLS client uses all (CA) certificates currently loaded in the client's Certificate Store to validate the server authentication. |
| clientCert | UDInt | ID of your own X.509 V3 certificate.<br>This is only relevant if the TLS server requires client authentication and can otherwise remain set to "0". |

**NOTE** You will find an application example for the usage of certificates in TIA Portal in the Siemens Industry Online Support:
https://support.industry.siemens.com/cs/ww/en/view/109769068

## 4.8. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The following are the status and error codes specific to the "LHTTP" library.

The function blocks "LHTTP_Get" and "LHTTP_PostPut" output internal status and error codes describing the state of the function block as well as the HTTP status code received from the partner.

### Internal status codes

Table 4-9: Internal status codes

| Code | Description |
|---|---|
| 16#0000 | Job completed without errors |
| 16#0003 | Connection broken |
| 16#7000 | No job active |
| 16#7001 | First call of the command |
| 16#7002 | Follow-up call of the command |
| 16#7003 | Connection is broken |
| 16#7004 | Connection is established and monitored. FB is waiting for job. |
| 16#7005 | Request has been sent, response pending |

| Code | Description |
|---|---|
| 16#8201 | The array at the parameter "responseData" does not begin with "0". |
| 16#8202 | Invalid URL. Check the spelling. |
| 16#8203 | The host name in the URL is different from the host to which the current connection exists. Reset "keepConnection" and run the job again. |
| 16#8204 | Data type at parameter "data" is neither String nor Array of Char |
| 16#8205 | End of data could not be detected. The data must be terminated with the "$00" character. |
| 16#8206 | The end of the user-defined header fields at parameter "userFields" could not be detected. Terminate the header fields with the "$00" character. |
| 16#8210 | The internal send buffer is too small for the request to be transmitted. Adjust the size of the send buffer at the local constant "UPPER_REQUEST_ARRAY". |
| 16#8220 | The size of the array at the parameter "responseData" is not sufficient to store the received user data. The array was completely filled and the length of the received user data is output at the parameter "length". |
| 16#8403 | The web server responded with a redirection. Redirections are not supported by the LHTTP library. |
| 16#8404 | The web server responded with an error message. The received HTTP status code is output at the "responseCode" output. |
| 16#8405 | The header of the response telegram is invalid. |
| 16#8408 | Request timeout. Check the Ethernet connection of the PLC and the URL. |
| 16#84C4 | The connection to the web server was interrupted. Check the network connection. |
| 16#84C5 | Connection to the web server has broken. |
| 16#8600 | The FB is in an invalid state. |
| 16#8601 | Error in subordinate command "TSEND_C"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8603 | Error of subordinate command "TRCV"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8612 | Error in subordinate command "MOVE_BLK_VARIANT" when inserting user-defined header fields.<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8620 | Encoding of the received message could not be detected or is not supported. |
| 16#8630 | Error of subordinate command "MOV_BLK_VARIANT" in region "TE_IDENTITY".<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8640 | Chunk-coded message could not be decoded. |
| 16#8641 | Error of subordinate command MOV_BLK_VARIANT in region "TE_CHUNKED".<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |

### HTTP status codes

The following table lists common HTTP status codes:

Table 4-10: Common HTTP status codes

| Status code | Message | Meaning |
|---|---|---|
| 2xx - Successful operation | | |
| 200 | OK | The request was processed successfully. |
| 3xx - Redirection | | |
| 301 | Moved Permanently | The requested resource is now available at the address specified in the "Location" header field. The old address is no longer valid. |
| 304 | Not Modified | The content of the requested resource has not changed since the last request from the client and is therefore not transferred. |
| 4xx – Client error | | |
| 400 | Bad Request | The request message was structured incorrectly. |
| 401 | Unauthorized | The request cannot be performed without valid authentication. |
| 403 | Forbidden | The request was not executed due to lack of client authorization. |
| 404 | Not Found | The requested resource is not available in the required form. |
| 5xx – Server error | | |
| 500 | Internal Server Error | Unexpected service error. |
| 502 | Bad Gateway | The server could not fulfill its functionality as a gateway or proxy because it received an invalid response. |
| 503 | Service Unavailable | The server is temporarily unavailable. |
| 504 | Gateway Timeout | The server could not perform its function as a gateway or proxy because it did not receive a response from the servers or services it was using within a specified period of time. |

Further HTTP status codes can be found on Wikipedia, for example:

https://de.wikipedia.org/wiki/HTTP-Statuscode

# 5. LMQTT

## 5.1. Overview

### 5.1.1. Range of Functions

The library "LMQTT" provides you with a function block to implement the MQTT protocol in SIMATIC S7-1200/1500 controllers. The FB allows you to submit MQTT messages to a broker (publisher role) and to create subscriptions (subscriber role). The communication can be secured via a TLS connection.

### 5.1.2. Components of the Library

The "LMQTT" library contains the following objects.

**Blocks**

| Name | Type | Version | Description |
|---|---|---|---|
| LMQTT_Client | FB | V4.0.5 | Implements the MQTT Client function and allows to submit MQTT messages to a broker (Publisher role) and create subscriptions (Subscriber role). |
| LMQTT_ConvertToUtf8 | FC | V3.0.0 | Implements a function to convert a WCHAR to UTF-8 compliant formatting. |

Table 5-1: Blocks of the library

**PLC Data Types**

| Name | Version | Description |
|---|---|---|
| LMQTT_typeConnParam | V4.0.0 | Contains all information to establish a connection with the MQTT Broker. |

Table 5-2: PLC library data types

### 5.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.4
- SIMATIC ET 200SP Open Controllers as of firmware V2.5
- SIMATIC S7-1500 Software Controllers as of firmware V2.5
- CP 1543-1 as of firmware V2.0
- CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V3.2

# 5.2. LMQTT_Client

## 5.2.1. Interface Description

**Description**

The function block "LMQTT_Client" integrates the MQTT Client function and allows you to submit MQTT messages to a broker (Publisher role) and to create subscriptions (Subscriber role). The communication can be secured via a TLS connection.

**Parameter**


Figure 5-1: LMQTT_Client

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | • TRUE: The connection to the MQTT Broker is established and maintained<br>• FALSE: The connection is broken |
| publish | Input | Bool | Publish "publishMsgPayload" to "mqttTopic" with "retain" and "qos" |
| subscribe | Input | Bool | Subscribe to "mqttTopic" with "qos" |
| unsubscribe | Input | Bool | Unsubscribe from "mqttTopic" |
| retain | Input | Bool | • TRUE: The data is sent with the "retain" flag.<br>• FALSE: The data is sent without the "retain" flag. |
| qos | Input | USInt | Quality of Service<br>• 0: Messages are sent or subscribed with QoS 0<br>• 1: Messages are sent or subscribed with QoS 1<br>• 2: Messages are sent with QoS 2 (the FB does not support QoS 2 for subscriptions) |
| publishMsgLen | Input | UDInt | Current length of valid data in the "publishMsgPayload" array parameter |
| willMsgLen | Input | UInt | Current length of valid data in the array parameter "willMsgPayload" |
| timeOut | Input | Time | Optional parameter to configure time monitoring. After the time has expired, the current job will be considered as failed. |
| valid | Output | Bool | TRUE: The FB executes its function without error |
| done | Output | Bool | TRUE: The current job (publish/subscribe/unsubscribe) was executed successfully |
| busy | Output | Bool | TRUE: The FB is busy |
| error | Output | Bool | TRUE: An error has occurred<br>If "busy" is TRUE at the same time, the block attempts to correct the error itself. |
| status | Output | Word | Status and error codes (see chapter 5.2.2) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| receivedMsgStatus | Output | USInt | Indicates for one cycle at a time when a new message has been received (subscription):<br>• 0: No new message received<br>• 1: New valid message received<br>• 2: New message received, but the message is invalid or received data is larger than the memory area of the receive topic or the receive message |
| ReceivedMsgDataLen | Output | UDInt | Number of valid data at the "receivedMsgPayload" array parameter in Bytes |
| connParam | InOut | "LMQTT_typeConnParam" | Parameters to establish a connection to MQTT broker |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| clientIdentifier | InOut | WString | Client identifier used when establishing a connection |
| username | InOut | WString | Optional: Username for connection establishment |
| password | InOut | WString | Optional: Password for connection establishment |
| willtopic | InOut | WString | Optional: Topic to which the "Last Will" message is sent |
| willMsgPayload | InOut | Array [*] of bytes | Optional: Message sent as "Last Will". |
| mqttTopic | InOut | WString | Topic used for publish/subscribe/unsubscribe |
| publishMsgPayload | InOut | Array [*] of bytes | Message that is transmitted as user data during publishing |
| receivedTopic | InOut | WString | Subscribed topic on which a message was received. |
| receivedMsgPayload | InOut | Array [*] of bytes | User data received in the message of the subscribed topic. |

Table 5-3: Parameters of LMQTT_Client

**NOTE** While a job is being processed, the block does not accept any other jobs – this includes the period keep alive function. Wait until the existing job is completed by evaluating the status 16#7004 and then generate an edge at the respective input.

## 5.2.2. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

### Interaction of status outputs

The following table describes the interaction of the status outputs for the "LMQTT_Client" FB:

| valid | done | busy | error | Description |
|---|---|---|---|---|
| FALSE | FALSE | FALSE | FALSE | FB is inactive |
| TRUE | FALSE | TRUE | FALSE | FB performs its function without error |
| TRUE | TRUE | TRUE | FALSE | FB executes its function without error and current job (publish/subscribe/unsubscribe) has been completed successfully |
| FALSE | FALSE | TRUE | TRUE | An error has occurred that the FB is trying to fix automatically (for example, when the connection is lost) or the current job has failed, but FB can continue to function. |
| FALSE | FALSE | FALSE | TRUE | An error occurred that the FB is unable to fix automatically, and the FB has aborted the execution of its function (for example, in the case of invalid connection parameters).<br>After you have fixed the error, a new edge at the "enable" input is necessary. |

Table 5-4

**Status- and error codes**

The following are the status and error codes specific to the FB "LMQTT_Client" that are issued at the "status" output:

| Code | Description |
|---|---|
| 16#0000 | Last job (publish/subscribe/unsubscribe) successfully executed |
| 16#7000 | Block is idle/client not connected |
| 16#7001 | First call after "enable" = TRUE |
| 16#7002 | Block processes job |
| 16#7003 | Establishing connection to MQTT broker |
| 16#7004 | MQTT client connected and ready for job |
| 16#7005 | Ping is sent to the broker |
| 16#7006 | Publish job is executed |
| 16#7008 | Subscribe job is executed |
| 16#7010 | Unsubscribe job is executed |
| 16#8001 | Simultaneous input (rising edge) at publish/subscribe/unsubscribe inputs |
| 16#8200 | Client identifier is empty – client identifier must be at least 1 character long |
| 16#8201 | Broker's hostname or IP address is invalid |
| 16#8210 | Invalid array size:<br>• During connection establishment: invalid array size at the "willMsgLen" parameter<br>• During publish: invalid array size at the "publishMsgLen" parameter |
| 16#8220 | Invalid value at the "keepAlive" parameter |
| 16#8230 | Invalid value at parameter "qos" |
| 16#8300 | Topic empty or invalid (publish) |
| 16#8310 | Topic empty or invalid (subscribe) |
| 16#8320 | Topic empty or invalid (unsubscribe) |
| 16#8600 | Undefined state in the state machine |
| 16#8601 | Error of subordinate instruction "TCON"<br>The error code of the instruction is output at "diagnostics.subfunctionStatus". The meaning of the respective error code can be found in the TIA Portal Information System. |
| 16#8620 | Connection establishment timeout. If necessary, increase the "timeOut" value. |
| 16#8650 | Timeout during the processing of the job |
| 16#8670 | Timeout during MQTT connection setup with the MQTT broker |
| 16#8700 | Invalid length in received MQTT packet; new connection required |
| 16#8710 | Invalid QoS in received MQTT packet; new connection required |

| Code | Description |
|---|---|
| 16#8720 | Existing session at the MQTT broker; new connection required |
| 16#8730 | Connection rejected by MQTT broker; new connection required.<br>The error is specified at "diagnostics.subfunctionStatus":<br>• 1: The MQTT Broker does not support the MQTT protocol 3.1.1<br>• 2: The MQTT broker has rejected the client identifier.<br>• 3: The MQTT service at the MQTT broker is not reachable.<br>• 4: The data in the Username or Password field is corrupted.<br>• 5: The client is not authorized to connect (username or password incorrect)<br>• 6-255: unknown error. |
| 16#8740 | MQTT packet was acknowledged by the broker with invalid packet ID |
| 16#8750 | MQTT subscription rejected by the broker |
| 16#9000 | Connection to the MQTT broker lost; automatic reconnect in progress |

Table 5-5

### Receive messages

Messages can only be received if the block is successfully connected and at least one topic has been subscribed.

The following table explains the values of the "receivedMsgStatus" parameter depending on "done" and "busy" if there is no error.

| receivedMsgStatus | Description |
|---|---|
| 0 | Block connected, but no message received |
| 1 | Block connected, a new valid message has been received.<br>"receivedTopic", "receivedMsgPayload", and "receivedMsgDataLen" can be evaluated. |
| 2 | Block connected, a new invalid message was received.<br>"receivedTopic", "receivedMsgPayload" and "receivedMsgDataLen" contain incomplete or invalid data. |

Table 5-6

## 5.3. LMQTT_ConvertToUtf8

This FC converts a WChar into a UTF-8 compliant format, which is necessary for correct transmission in MQTT Topics.

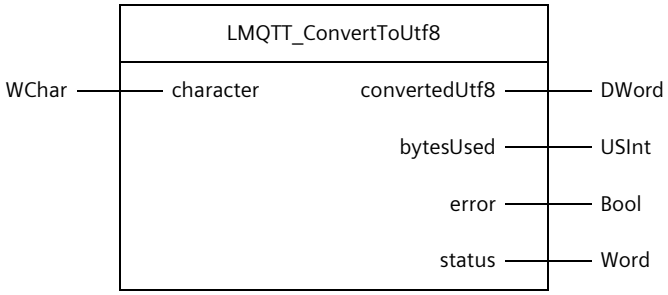



Figure 5-2: LMQTT_ConvertToUtf8

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| character | Input | WChar | Character to be transformed. |
| convertedUtf8 | Output | DWord | Single UTF-8 compliant bytes.<br>Bytes 0-2 are used.<br>Byte 3 is not used. |
| bytesUsed | Output | USInt | Number of bytes occupied by the conversion. |
| error | Output | Bool | Error in execution. |
| status | Output | Word | Status code for editing. |

Table 5-7: Parameters of LMQTT_ConvertToUtf8

## 5.4. PLC Data Types

**LMQTT_typeConnParam**

This data type stores all information required to establish the MQTT connection. You can set these parameters according to your specifications.

| Name | Data type | Description |
|---|---|---|
| hwId | HW_ANY | Hardware identifier of the PN/IE interface for establishing the connection<br>0: A suitable one is selected automatically. |
| connId | CONN_OUC | Connection ID for establishing the connection (1..4095) |
| broker | String | Hostname or IP address of the brokers. |
| port | UInt | MQTT-Port on the broker |
| tls | Struct | Parameters for TLS encryption |
| enableTls | Bool | • TRUE: Connection is secured with TLS<br>• FALSE: Unsecured connection |

| Name | Data type | Description |
|---|---|---|
| validateServerIdentity | Bool | • TRUE: The client validates the subject alternate name (SAN) in the certificate of the MQTT broker when the connection is established.<br>• FALSE: No validation of the SAN |
| brokerCert | UDInt | ID of the MQTT broker certificate<br>0: The client uses all CA certificates in the certificate store of the PLC to authenticate the MQTT broker. |
| clientCert | UDInt | ID of own certificate<br>0: No certificate is used for the authentication of the client |
| keepAlive | UInt | Keep-alive mechanism of MQTT in seconds<br>0: No keep-alive |

Table 5-8

**NOTE** You will find an application example for the usage of certificates in TIA Portal in the Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/109769068

## 5.5. Integration into the User Project

You will find a detailed application example for the integration of the library into your user project in the Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/109748872

# 6. LOpcUa

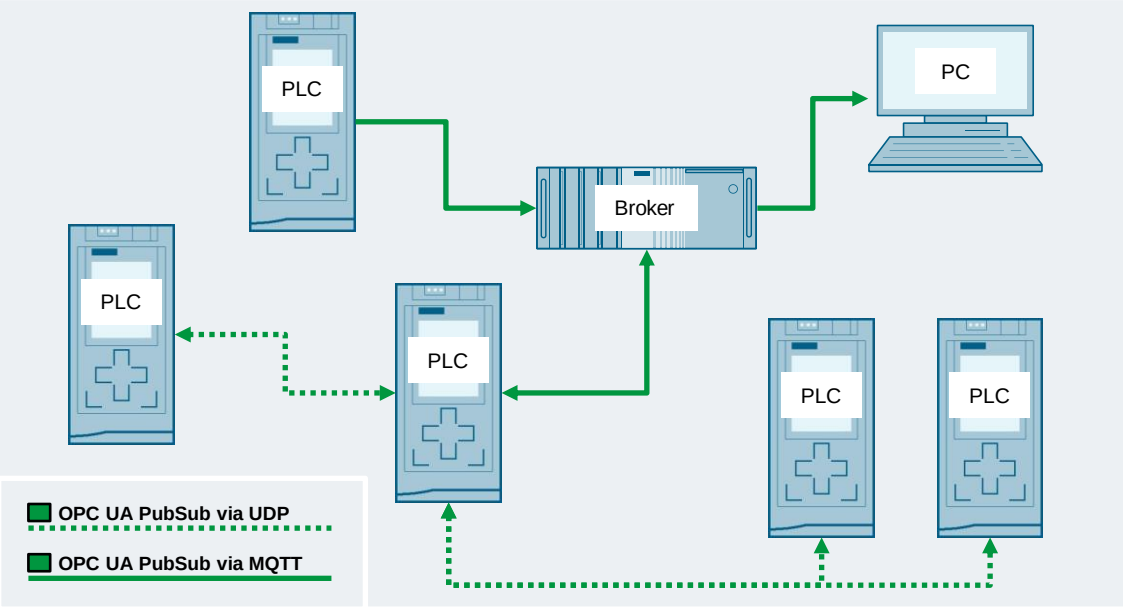
## 6.1. Overview

### 6.1.1. Range of Functions

Part 14 of the OPC UA specification introduced the "PubSub" communication mechanism. This mechanism is not based on the Client–Server principle as in conventional OPC UA communication (OPC 10000-4), but uses a "publish/subscribe" principle.

PubSub OPC UA applications, with their roles as "Publisher" (sender) and/or "Subscriber" (receiver), are decoupled from each other, which deviates from the Client–Server principle. The number of Subscribers is not important for the Publisher. Publishers and Subscribers also do not need to connect directly to each other, allowing not only uni- but also multi- or broadcasts. Additionally the communication is separated from the data storage.

Figure 6-1




The "LOpcUa" library provides function blocks that can be used to implement OPC UA PubSub on SIMATIC controllers:

- LOpcUa_PubUdp: Publisher via UDP (UADP encoding)
- LOpcUa_SubUdp: Subscriber via UDP (UADP decoding)
- LOpcUa_PubMqtt: Publisher via MQTT (UADP encoding
- LOpcUa_SubMqtt: Subscriber via MQTT (UADP decoding)
- LOpcUa_PubMqttJson: Publisher via MQTT (JSON-Encoding)
- LOpcUa_SubMqttJson: Subscriber via MQTT (JSON-Decoding)

**NOTE** The blocks "LOpcUa_PubUdp" and "LOpcUa_SubUdp" do not support security.

## 6.1.2. Components of the Library

The "LOpcUa" library contains the following objects.

### Blocks

Table 6-1: Blocks of the library

| Name | Type | Version | Description |
|---|---|---|---|
| LOpcUa_PubUdp | FB | V1.3.2 | Implements the OPC UA PubSub Publisher via UDP and enables process data to be transmitted to a Subscriber. |
| LOpcUa_SubUdp | FB | V1.3.2 | Implements the OPC UA PubSub Subscriber via UDP and enables process data to be received from a Publisher. |
| LOpcUa_PubMqttUadp | FB | V2.0.0 | Implements the OPC UA PubSub Publisher via MQTT and enables process data to be transmitted to a Subscriber. Uses "UADP" for encoding. |
| LOpcUa_SubMqttUadp | FB | V2.0.0 | Implements the OPC UA PubSub Subscriber via MQTT and enables process data to be received from a Publisher. Uses "UADP" for decoding. |
| LOpcUa_PubMqttJson | FB | V2.0.0 | Implements the OPC UA PubSub Publisher via MQTT and enables process data to be transmitted to a Subscriber. Uses "JSON" for encoding. |
| LOpcUa_SubMqttJson | FB | V2.0.0 | Implements the OPC UA PubSub Subscriber via MQTT and enables process data to be received from a Publisher. Uses "JSON" for decoding. |
| LOpcUa_Pub_Boolean | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Boolean to send buffer (byte array). |
| LOpcUa_Pub_Byte | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Byte to send buffer (byte array). |
| LOpcUa_Pub_Double | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Double to send buffer (byte array). |
| LOpcUa_Pub_Float | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Float to send buffer (byte array). |
| LOpcUa_Pub_Guid | FC | V1.0.1 | Encoding for "LOpcUa_PubX": GUID to send buffer (byte array). |
| LOpcUa_Pub_Int16 | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Int16 to send buffer (byte array). |
| LOpcUa_Pub_Int32 | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Int32 to send buffer (byte array). |
| LOpcUa_Pub_Int64 | FC | V1.0.1 | Encoding for "LOpcUa_PubX": Int64 to send buffer (byte array). |
| LOpcUa_Pub_SByte | FC | V1.0.1 | Encoding for "LOpcUa_PubX": SByte to send buffer (byte array). |
| LOpcUa_Pub_String | FC | V1.1.1 | Encoding for "LOpcUa_PubX": String to send buffer (byte array). |
| LOpcUa_Pub_UInt16 | FC | V1.0.1 | Encoding for "LOpcUa_PubX": UInt16 to send buffer (byte array). |
| LOpcUa_Pub_UInt32 | FC | V1.0.1 | Encoding for "LOpcUa_PubX": UInt32 to send buffer (byte array). |
| LOpcUa_Pub_UInt64 | FC | V1.0.1 | Encoding for "LOpcUa_PubX": UInt64 to send buffer (byte array). |

**PLC Data Types**

Table 6-2: PLC library data types

| Name | Version | Description |
|---|---|---|
| LOpcUa_typeDataSetWriter | V1.0.0 | Maps an OPC UA "DataSetWriter". |
| LOpcUa_typeDataSetReader | V1.0.3 | Maps an OPC UA "DataSetReader". |
| LOpcUa_typeGuid | V1.0.0 | Implements the "GUID" data type. |
| LOpcUa_typePublishedData | V1.0.0 | Implements the send buffer of the Publisher. |
| LOpcUa_typePublishedDataSet | V1.0.1 | Maps an OPC UA "PublishedDataSet". Contains the Publisher process values to be sent. |
| LOpcUa_typePublisherID | V1.0.4 | Maps an OPC UA "PublisherID". Serves to identify the Publisher. |
| LOpcUa_typeVariant | V1.0.1 | Implements the "Variant" data type and maps a "DataSetField". |
| LOpcUa_typeWriterGroup | V1.0.0 | Maps an OPC UA "WriteGroup". |
| LOpcUa_typeReaderGroup | V1.0.3 | Maps an OPC UA "ReaderGroup". |
| LOpcUa_typeSubscribedDataSet | V1.0.1 | Maps an OPC UA "SubscribedDataSet". Contains the received process values of the Publisher. |
| LOpcUa_typeConnParamMqtt | V2.0.0 | Connection parameters for "LOpcUa_PubMqtt" and "LOpcUa_SubMqtt". |
| LOpcUa_typeDataSetWriterJson | V1.0.0 | Maps an OPC UA "DataSetWriter" for JSON encoding. |
| LOpcUa_typeDataSetReaderJson | V1.0.0 | Maps an OPC UA "DataSetReader" for JSON decoding. |
| LOpcUa_typePublishedDataSet Json | V1.0.0 | Maps an OPC UA "PublishedDataSet" for JSON encoding. Contains the Publisher process values to be sent. |
| LOpcUa_typeSubscribedDataSet Json | V1.0.0 | Maps an OPC UA "SubscribedDataSet" for JSON decoding. Contains the received process values of the Publisher. |
| LOpcUa_typeWriterGroupJson | V1.0.0 | Maps an OPC UA "WriteGroup" for JSON encoding. |
| LOpcUa_typeReaderGroupJson | V1.0.0 | Maps an OPC UA "ReaderGroup" for JSON decoding. |

### 6.1.3. Validity

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC ET 200SP Open Controllers as of firmware V2.5
- SIMATIC S7-1500 Software Controllers as of firmware V2.5
- CP 1543-1, CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V2.0

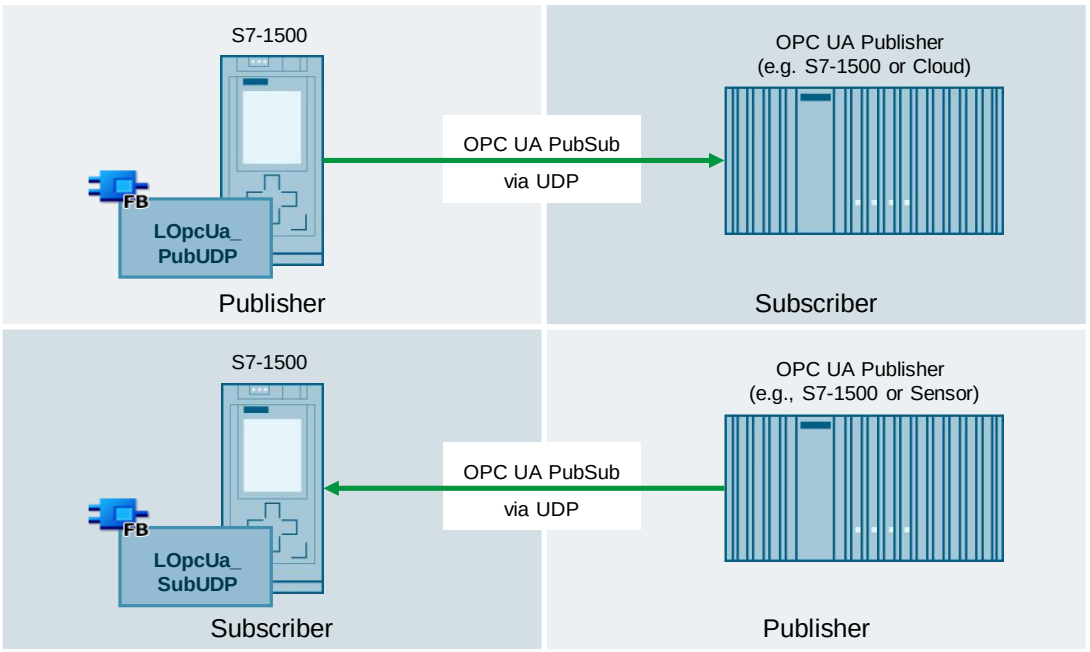
# 6.2. PubSub via UDP

## 6.2.1. Principle of Operation

### General information

The Publisher is implemented by the function block "LOpcUa_PubUdp" and the Subscriber by the block "LOpcUa_SubUdp", which are provided by the library "LOpcUa":

Figure 6-2



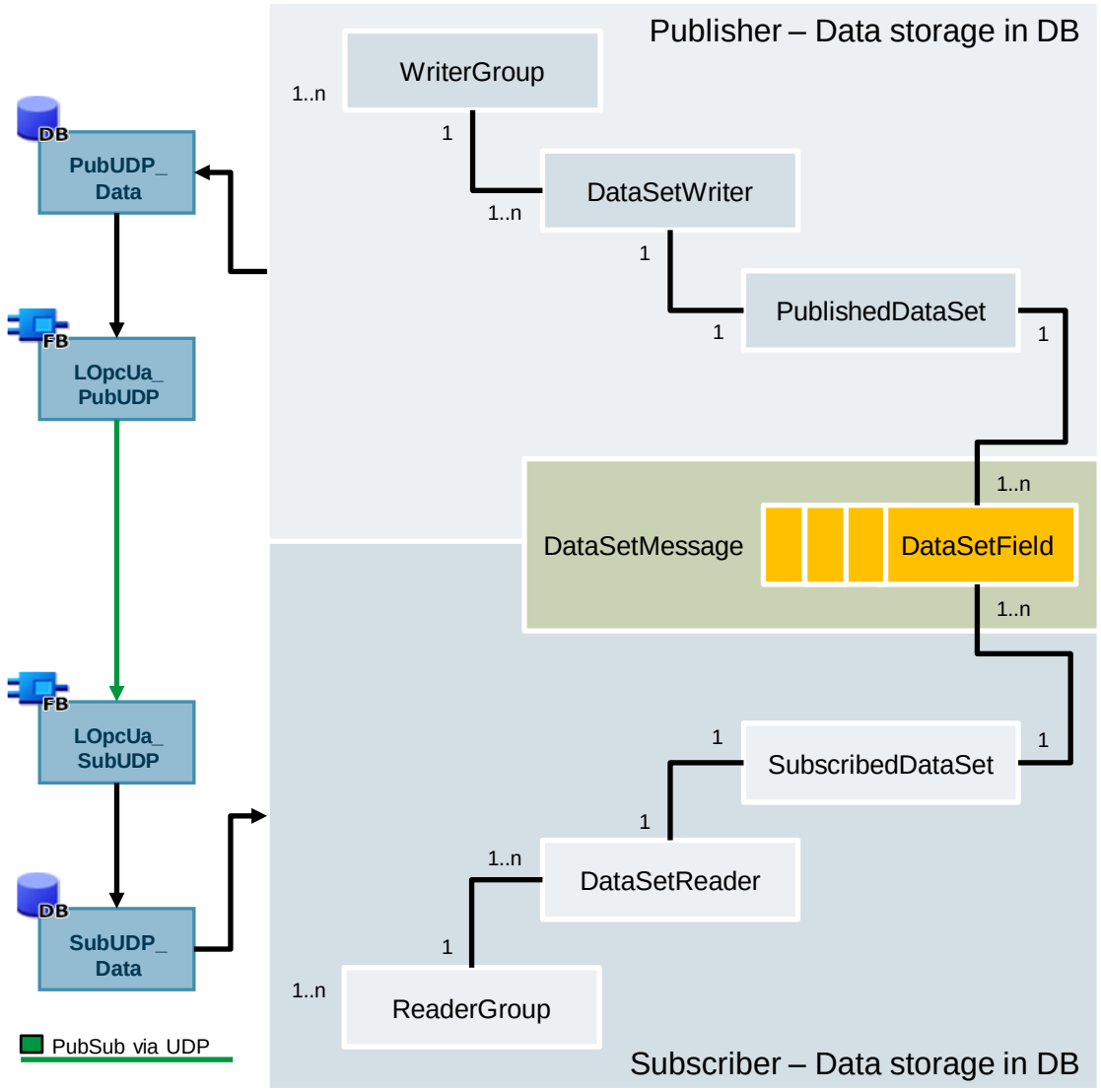

To generate the data storage in a data block, for the process data to be sent or received, the library provides prepared user-defined data types ("UDT"). The Publisher and Subscriber blocks access this data to implement the respective function.

**Schematic representation**

The following figure shows the most important relationships between the components involved in sending data from a Publisher to a Subscriber:

Figure 6-3




To map one or more "WriterGroups" or "ReaderGroups", both the Publisher and the Subscriber function blocks require a data block in which the PubSub data (metadata and process data) are provided according to the schema shown above.

To implement the individual components in data blocks, the library provides you with suitable PLC data types that map the required structures. If a component is required more than once ("1..n"), it must be created as an array in the data block.

The block "LOpcUa_PubUdp" accesses the "WriteGroups" and serializes the "DataSetMessage" from the data contained therein and sends ("Publish") this with the help of the system function block "TUSEND" to the Subscribers.

The block "LOpcUa_SubUdp" receives the "DataSetMessage" via the system function block "TURCV" and de-serializes the data to the data structure of the created "ReaderGroup".

## 6.2.2. LOpcUa_PubUdp

### Description

The block "LOpcUa_PubUdp" sends ("Publish") the PubSub data via UDP to the Subscribers. The block requires a data block in which the components "WriterGroup", "DataSetWriter", "PublishedDataSet", and "PublishedWriterGroup" are predefined.

In an internal sequencer of the block, the data packets are coded and sent via UDP with the help of the system function blocks "TCON", "TUSEND", and "TDISCON".

**NOTE** To ensure a consistent send clock, we recommend to call the block in a cyclic interrupt OB. The "PublishingInterval" is defined in the "WriterGroups".

### Parameter

Figure 6-4: LOpcUa_PubUdp

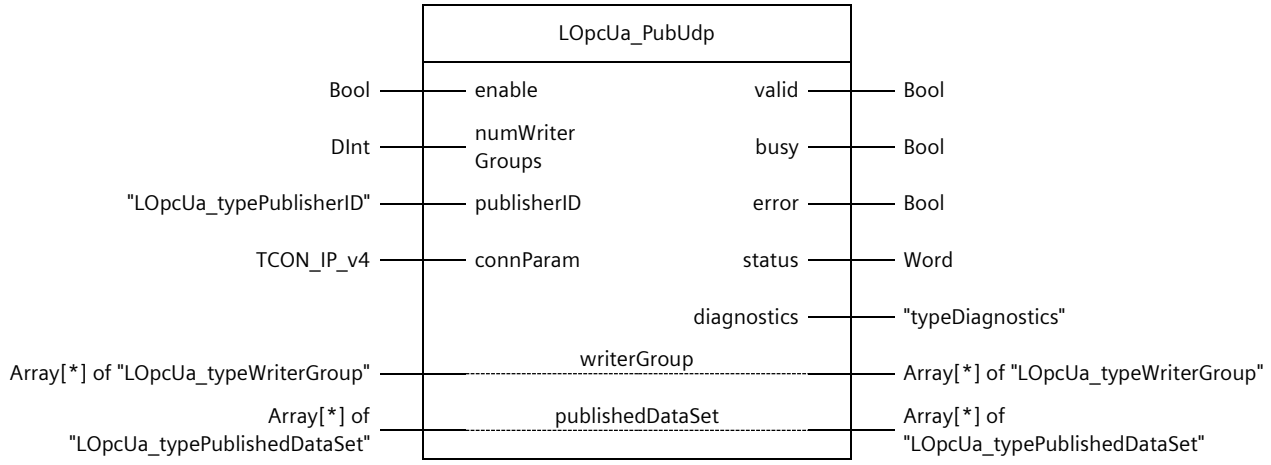



Table 6-3: Parameters of LOpcUa_PubUdp

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Control parameters<br>TRUE: Cyclic publishing active.<br>FALSE: Publishing disabled. |
| numWriterGroups | Input | DInt | Number of "WriteGroups" to be published. |
| publisherID | Input | WString | "PublisherID" to uniquely identify the publisher. |
| connParam | Input | TCON_IP_v4 | UDP connection parameters. |
| valid | Output | Bool | TRUE, if publishing is active at the block and no error occurs. |
| busy | Output | Bool | TRUE, if publishing is active at the block. |
| error | Output | Bool | TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>FALSE: No error occurred. |
| status | Output | Word | Status display<br>Information about the error that occurred in FB "LOpcUa_PubUdp" (see chapter 6.2.4). |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2). |
| writerGroup | InOut | Array[*] of "LOpcUa_typeWriterGroup" | Data structure for mapping one or more "WriterGroups". Contains metadata for PubSub communication. |
| publishedDataSet | InOut | Array[*] of "LOpcUa_typePublishedDataSet" | Data structure for mapping one or more "PublishedDataSets". This structure contains one process tag each, which is published. |

## 6.2.3. LOpcUa_SubUdp

### Description

The block "LOpcUa_SubUdp" receives ("Subscribe") the PubSub data via UDP from a Publisher. The block requires a data block in which the "ReaderGroup" component is predefined.

In an internal sequencer of the block, the data packets are received and decoded via the system function blocks "TCON", "TURCV", and "TDISCON" using UDP.

To receive the data with minimum delay we recommend to call the block in a cyclic OB.

### Parameter

Figure 6-5: LOpcUa_SubUdp

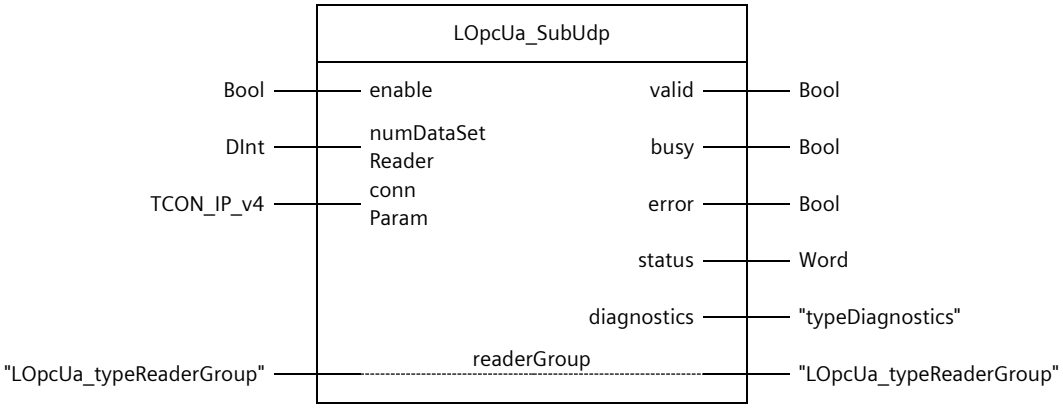



Table 6-4: Parameters of LOpcUa_SubUdp

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Control parameters<br>TRUE: Cyclic receiving active.<br>FALSE: Receive disabled. |
| numDataSetReader | Input | DInt | Number of "DataSetReaders" which should receive the data of the "DataSetWriters" of a Publisher. |
| connParam | Input | TCON_IP_v4 | UDP connection parameters. |
| valid | Output | Bool | TRUE if subscribing is active on the block and no error occurs. |
| busy | Output | Bool | TRUE if subscribing is active on the block. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| error | Output | Bool | TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>FALSE: No error occurred. |
| status | Output | Word | Status display<br>Information about the error that occurred in FB "LOpcUa_SubUdp" (see chapter 6.2.4). |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2). |
| readerGroup | InOut | "LOpcUa_type ReaderGroup" | Data structure for mapping a "ReaderGroup". Contains the structures of the "DataSetReader". |

**NOTE** The block "LOpcUa_SubUdp" supports only one "ReaderGroup".

## 6.2.4. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The status and error codes specific to the blocks "LOpcUa_PubUdp" and "LOpcUa_SubUdp" are listed below.

Table 6-5: Block output "status"

| Code | Description |
|---|---|
| 16#7000 | No error; block ready for execution. |
| 16#7002 | No error; publishing/subscribing via UDP active. |
| 16#8600 | Configuration error: Check whether enough "WriterGroups", related to the block input "numWriterGroups", have been created. In addition, check whether the fields of the structures are assigned correctly. |
| 16#8601 | Connection error for TCON: For more information, refer to the "diagnostics" block output. |
| 16#8602 | Receive error for TURCV: For more information, refer to the "diagnostics" block output. |
| 16#8603 | Send error for TUSEND: For more information, refer to the "diagnostics" block output. |
| 16#8604 | Error while encoding the data: Check the metadata on the "writerGroup" parameter. |
| 16#8605 | Error decoding the data: Received data type is not supported. Extend the function block or use a different data type with the Publisher. |

## 6.2.5. Integration into the User Project

You will find a detailed application example for the integration of the library into your user project and further information about OPC UA PubSub in the Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/109782455

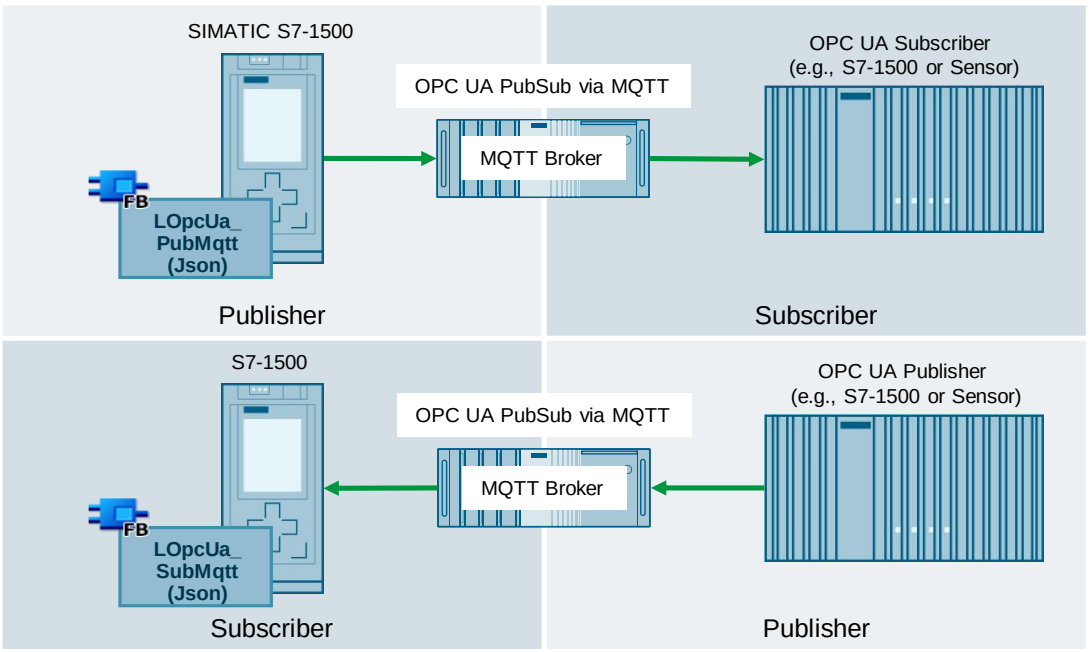
# 6.3. PubSub via MQTT

## 6.3.1. Principle of Operation

### General information

The Publisher is implemented by the function block "LOpcUa_PubMqtt" and the Subscriber is implemented by the function block "LOpcUa_SubMqtt", which is provided by the library "LOpcUa":

Figure 6-6



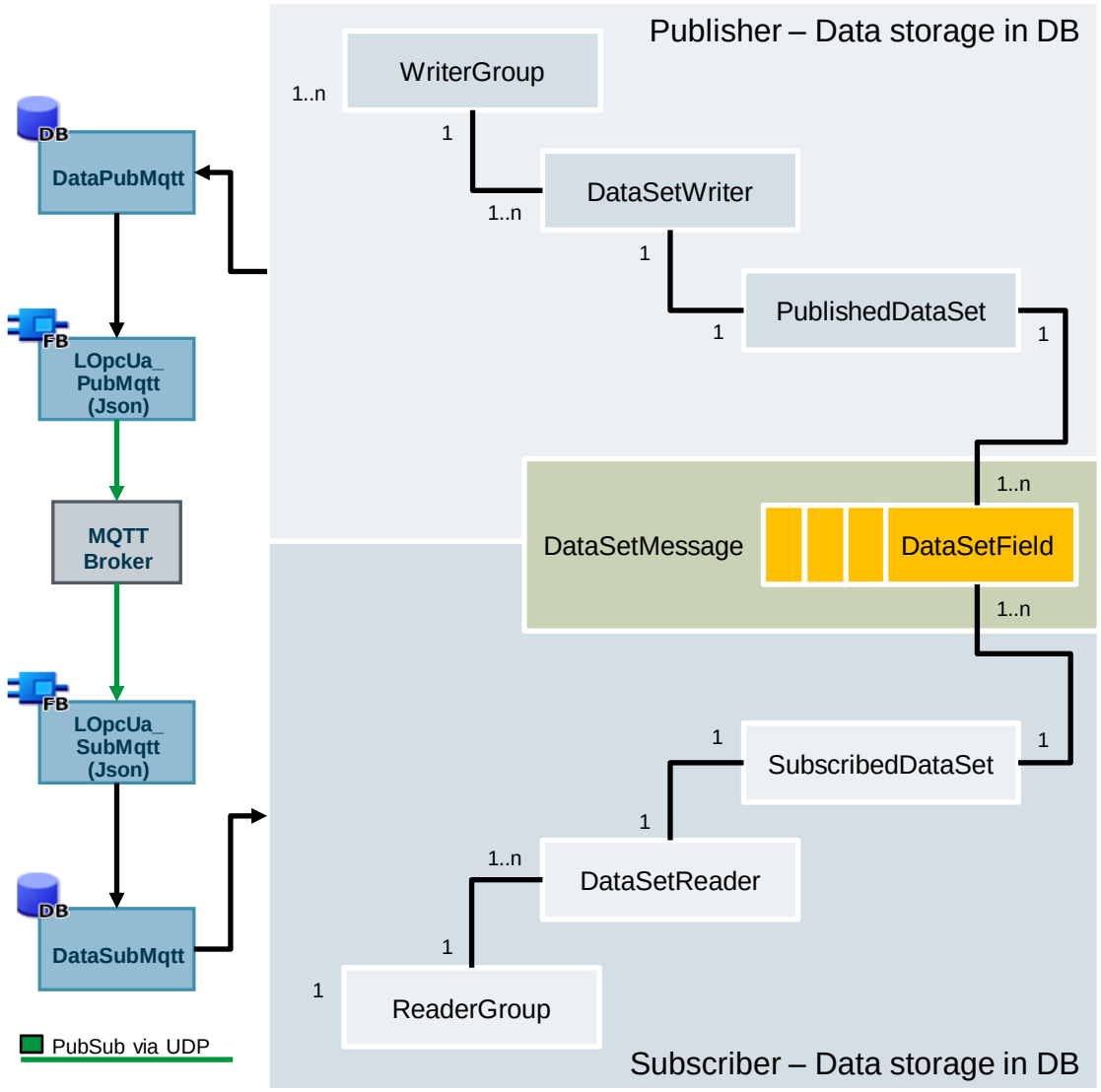

To generate the data storage in a data block, for the process data to be sent or received, the library provides prepared user-defined data types ("UDT"). The Publisher and Subscriber blocks access this data store in order to implement the respective function. Depending on the chose block the encoding is done via UADP or JSON.

**Schematic representation**

The following figure shows the most important relationships between the components involved in sending data from a Publisher to a Subscriber:

Figure 6-7




To map one or more "WriterGroups" or "ReaderGroups", both the Publisher and the Subscriber function blocks require a data block in which the PubSub data (metadata and process data) are provided according to the schema shown above.

To implement the individual components in data blocks, the library provides you with suitable PLC data types that map the required structures. If a component is required more than once ("1..n"), it must be created as an array in the data block.

The block "LOpcUa_PubUdp" accesses the "WriteGroups" and serializes the "DataSetMessage" from the data contained therein and sends ("Publish") this with the help of the system function block "TUSEND" to the Subscribers.

The block "LOpcUa_SubUdp" receives the "DataSetMessage" via the system function block "TURCV" and de-serializes the data to the data structure of the created "ReaderGroup".

## 6.3.2. LOpcUa_PubMqtt

### Description

The block "LOpcUa_PubMqtt" sends ("Publish") the PubSub data via MQTT to an MQTT Broker. The block requires a data block in which the components "WriterGroup", "DataSetWriter", "PublishedDataSet", and "PublishedWriterGroup" are predefined.

In an internal step chain of the block, the data packets are coded and sent via MQTT using the library block "LMQTT_Client" is used to send them via MQTT.

**NOTE** To ensure a consistent send clock, we recommend to call the block in a cyclic interrupt OB. The "PublishingInterval" is defined in the "WriterGroups".

### Parameter

Figure 6-8: LOpcUa_PubMqtt

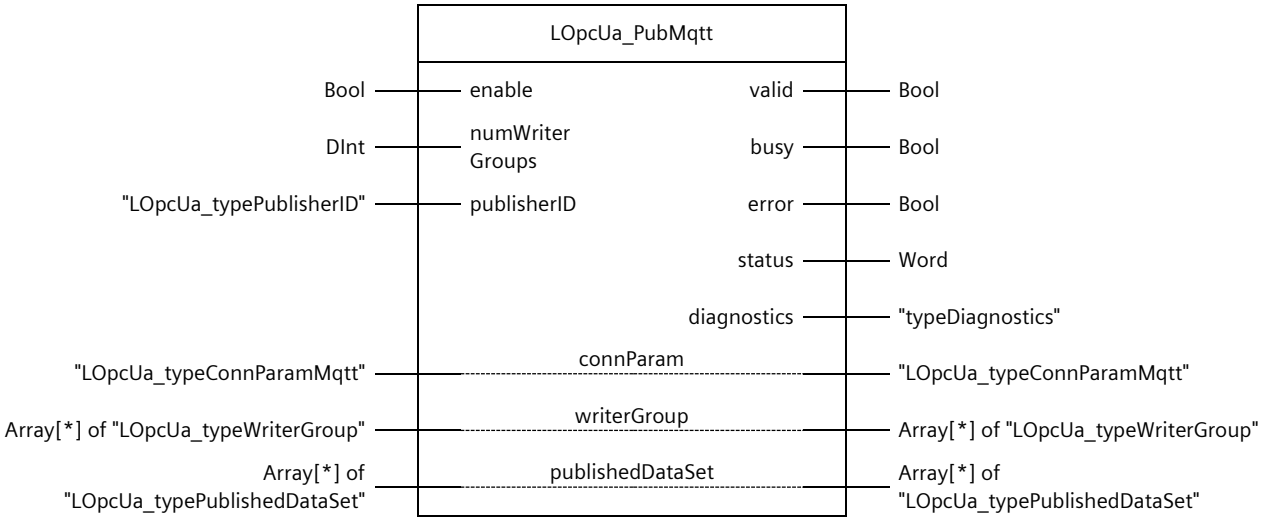



Table 6-6: Parameter of LOpcUa_PubMqtt

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Control parameters<br>TRUE: Cyclic publishing active.<br>FALSE: Publishing disabled. |
| numWriterGroups | Input | DInt | Number of "WriteGroups" to be published. |
| publisherID | Input | "LOpcUa_type PublisherID" | "PublisherID" to uniquely identify the publisher. |
| valid | Output | Bool | TRUE, if publishing is active at the block and no error occurs. |
| busy | Output | Bool | TRUE, if publishing is active at the block. |
| error | Output | Bool | TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>FALSE: No error occurred. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| status | Output | Word | Status display<br>Information about the error that occurred in FB "LOpcUa_PubUdp" (see chapter 6.3.6). |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2). |
| connParam | InOut | "LOpcUa_type ConnParamMqtt" | MQTT connection parameters. |
| writerGroup | InOut | Array[*] of "LOpcUa_type WriterGroup" | Data structure for mapping one or more "WriterGroups". Contains metadata for PubSub communication. |
| publishedDataSet | InOut | Array[*] of "LOpcUa_type PublishedDataSet" | Data structure for mapping one or more "PublishedDataSets". This structure contains one process tag each, which is published. |

## 6.3.3. LOpcUa_SubMqtt

### Description

The block "LOpcUa_SubMqtt" receives ("Subscribe") the PubSub data via MQTT from an MQTT Broker. The block requires a data block in which the "ReaderGroup" component is predefined.

In an internal step chain of the block, the data packets are received and decoded via MQTT using the library block "LMQTT_Client" library module to receive and decode the data packets via MQTT.

To receive the data with minimum delay we recommend to call the block in a cyclic OB.

### Parameter

Figure 6-9: LOpcUa_SubMqtt

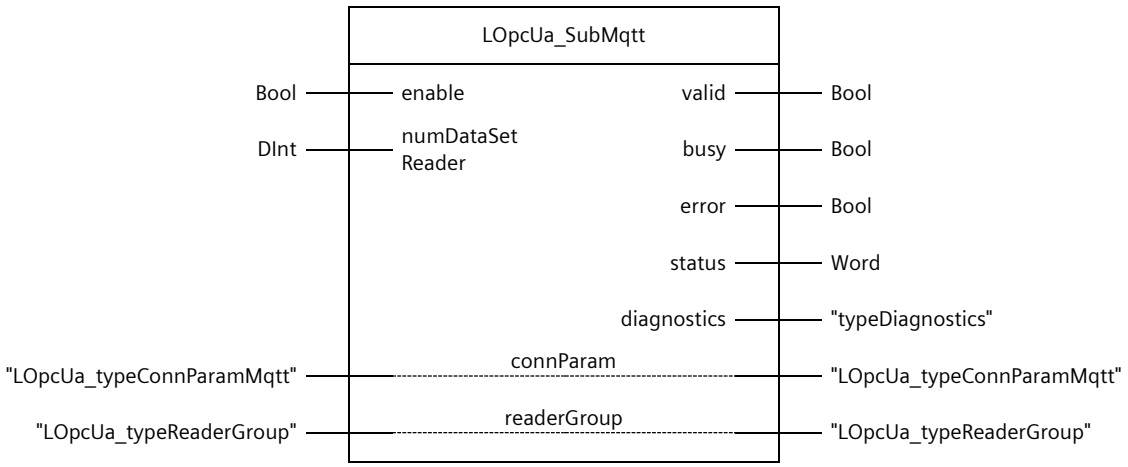



Table 6-7: Parameter of LOpcUa_SubMqtt

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Control parameters<br>TRUE: Cyclic receiving active.<br>FALSE: Receive disabled. |
| numDataSetReader | Input | DInt | Number of "DataSetReaders" which should receive the data of the "DataSetWriters" of a Publisher. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| valid | Output | Bool | TRUE if subscribing is active on the block and no error occurs. |
| busy | Output | Bool | TRUE if subscribing is active on the block. |
| error | Output | Bool | TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>FALSE: No error occurred. |
| status | Output | Word | Status display<br>Information about the error that occurred in FB "LOpcUa_SubUdp" (see chapter 6.3.6). |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2). |
| connParam | InOut | "LOpcUa_type ConnParamMqtt" | MQTT connection parameters. |
| readerGroup | InOut | "LOpcUa_type ReaderGroup" | Data structure for mapping a "ReaderGroup". Contains the structures of the "DataSetReader". |

**NOTE** The block "LOpcUa_SubMqtt" supports only one "ReaderGroup".

## 6.3.4. LOpcUa_PubMqttJson

### Description

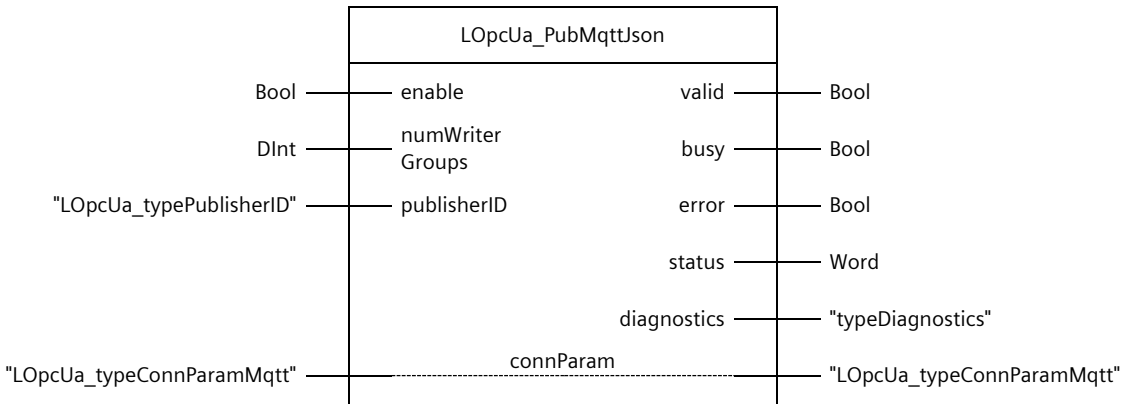
The block "LOpcUa_PubMqttJson" sends ("Publish") the PubSub data via MQTT to an MQTT Broker. The block requires a data block in which the components "WriterGroup", "DataSetWriter", "PublishedDataSet", and "PublishedWriterGroup" are predefined.

In an internal step chain of the block, the data packets are coded and sent via MQTT using the library block "LMQTT_Client" is used to send them via MQTT.

**NOTE** To ensure a consistent send clock, we recommend to call the block in a cyclic interrupt OB. The "PublishingInterval" is defined in the "WriterGroups".

### Parameter

Figure 6-10: LOpcUa_PubMqttJson



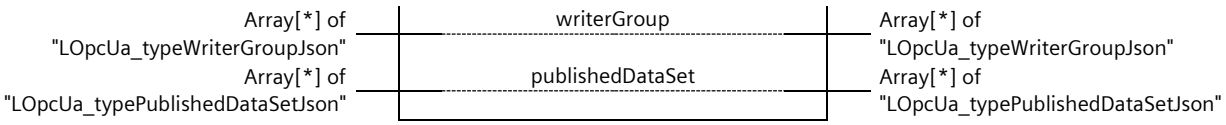



Table 6-8: Parameter of LOpcUa_PubMqtt

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Control parameters<br>TRUE: Cyclic publishing active.<br>FALSE: Publishing disabled. |
| numWriterGroups | Input | DInt | Number of "WriteGroups" to be published. |
| publisherID | Input | WString | "PublisherID" to uniquely identify the publisher. |
| valid | Output | Bool | TRUE, if publishing is active at the block and no error occurs. |
| busy | Output | Bool | TRUE, if publishing is active at the block. |
| error | Output | Bool | TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>FALSE: No error occurred. |
| status | Output | Word | Status display<br>Information about the error that occurred in FB "LOpcUa_PubUdp" (see chapter 6.3.6). |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2). |
| connParam | InOut | "LOpcUa_typeConnParamMqtt" | MQTT connection parameters. |
| writerGroup | InOut | Array[*] of "LOpcUa_typeWriterGroupJson" | Data structure for mapping one or more "WriterGroups". Contains metadata for PubSub communication. |
| publishedDataSet | InOut | Array[*] of "LOpcUa_typePublishedDataSetJson" | Data structure for mapping one or more "PublishedDataSets". This structure contains one process tag each, which is published. |

## 6.3.5. LOpcUa_SubMqttJson

### Description

The block "LOpcUa_SubMqttJson" receives ("Subscribe") the PubSub data via MQTT from an MQTT Broker. The block requires a data block in which the "ReaderGroup" component is predefined.

In an internal step chain of the block, the data packets are received and decoded via MQTT using the library block "LMQTT_Client" library module to receive and decode the data packets via MQTT.

To receive the data with minimum delay we recommend to call the block in a cyclic OB.

### Parameter

Figure 6-11: LOpcUa_SubMqttJson

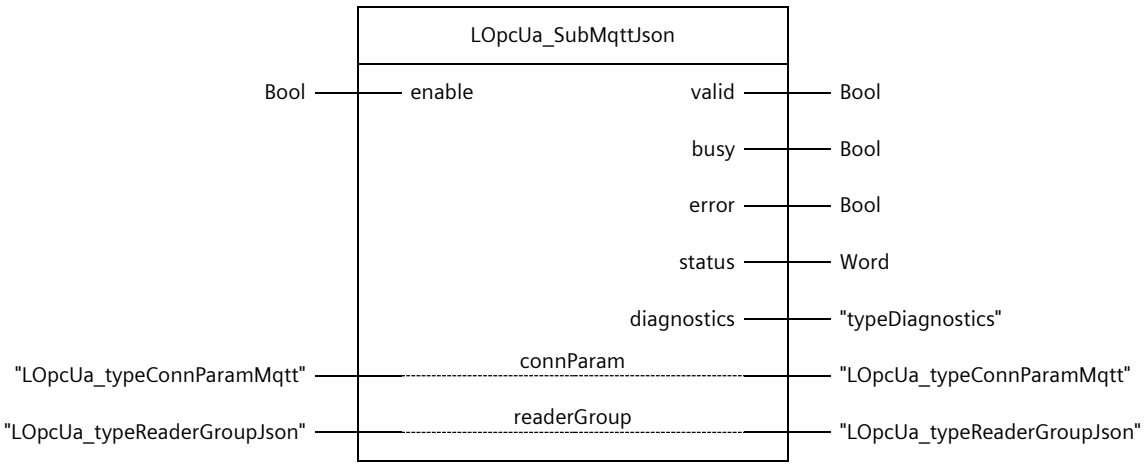



Table 6-9: Parameter of LOpcUa_SubMqtt

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Control parameters<br>TRUE: Cyclic receiving active.<br>FALSE: Receive disabled. |
| valid | Output | Bool | TRUE if subscribing is active on the block and no error occurs. |
| busy | Output | Bool | TRUE if subscribing is active on the block. |
| error | Output | Bool | TRUE: An error has occurred. More detailed information is provided by the output parameter "status" or the diagnostic buffer.<br>FALSE: No error occurred. |
| status | Output | Word | Status display<br>Information about the error that occurred in FB "LOpcUa_SubUdp" (see chapter 6.3.6). |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2). |
| connParam | InOut | "LOpcUa_typeConnParamMqtt" | MQTT connection parameters. |
| readerGroup | InOut | "LOpcUa_typeReaderGroupJson" | Data structure for mapping a "ReaderGroup". Contains the structures of the "DataSetReader". |

**NOTE** The block "LOpcUa_SubMqttJson" supports only one "ReaderGroup".

### 6.3.6. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The status and error codes specific to the blocks "LOpcUa_PubMqtt" and "LOpcUa_SubMqtt" are listed below.

Table 6-10: Block output "status"

| Code | Description |
|---|---|
| 16#7000 | No error; block ready for execution. |
| 16#7002 | No error; publishing/subscribing via UDP active. |
| 16#8600 | Configuration error: Check whether enough "WriterGroups", related to the block input "numWriterGroups", have been created. In addition, check whether the fields of the structures are assigned correctly. |
| 16#8601 | Connection error for "LMQTT_Client": For more information, refer to the "diagnostics" block output or check the "Status" parameter in the "instLMQTT_Client" multi-instance. |
| 16#8602 | Receive error for "LMQTT_Client": For more information, refer to the "diagnostics" block output or check the "Status" parameter in the "instLMQTT_Client" multi-instance. |
| 16#8603 | Send error for "LMQTT_Client": For more information, refer to the "diagnostics" block output or check the "Status" parameter in the "instLMQTT_Client" multi-instance. |
| 16#8604 | Error while encoding the data: Check the metadata on the "writerGroup" parameter. |
| 16#8605 | Error decoding the data: Received data type is not supported. Extend the function block or use a different data type with the Publisher. |

### 6.3.7. Integration into the User Project

You will find a detailed application example for the integration of the library into your user project and further information about OPC UA PubSub in the Siemens Industry Online Support:

- MQTT with UADP-Encoding
  https://support.industry.siemens.com/cs/ww/en/view/109797826
- MQTT with JSON-Encoding
  https://support.industry.siemens.com/cs/ww/en/view/109814033

## 6.4. PLC Data Types

The following descriptions explain the PLC data types that map the PubSub components for communication.

**LOpcUa_typePublisherID**

The PLC data type "LOpcUa_typePublisherID" is used to identify the Publisher.

Table 6-11: Parameters of "LOpcUa_typePublisherID"

| Name | Data type | Description |
|---|---|---|
| type | UDInt | Selects the data type to be used for the Publisher ID to be sent:<br>• "3": id8<br>• "5": id16<br>• "7": id32<br>• "9": id64<br>• "12": idString |
| id8 | USInt | The tag selected with "type" contains the Publisher ID that identifies your Publisher. You can choose the ID freely.<br>Example: *"type" = "7"* corresponds to *"id32 (UDInt)"* |
| id16 | UInt | |
| id32 | UDInt | |
| id64 | ULInt | |
| idString | WString | |

### LOpcUa_typeWriterGroup

The PLC data type "LOpcUa_typeWriterGroup" implements the WriterGroups.

Table 6-12: Parameters of "LOpcUa_typeWriterGroup"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "WriterGroup" (optional, will not be transferred). |
| priority | USInt | The priority for sorting (higher value = higher priority). |
| publishingInterval | USInt | The publishing interval for the configuration of the send clock. The transmission rate is given by the following formula:<br>*Send clock = OB cycle time * PublishingInterval* |
| resetInterval | USInt | Must contain the same value as the "PublishingInterval". |
| numDataSetWriter | USInt | Number of "DataSetWriters" you want to use. |
| dataSetWriter | Array [0..X] of "LOpcUa_typeDataSetWriter" | Implements the "DataSetWriter" per "WriterGroup". |

### LOpcUa_typeDataSetWriter

The PLC data type "LOpcUa_typeDataSetWriter" implements the DataSetWriter.

Table 6-13: Parameters of "LOpcUa_typeDataSetWriter"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "DataSetWriter" (optional, will not be transferred). |
| id | UInt | Identification number of the "DataSetWriter" (any). |
| sequenceNumber | UInt | Is not filled in (required by FB "LOpcUa_PubUdp"). |
| dataSet | UInt | Reference to the index of the "PublishedDataSet". Each "DataSet" refers to a different index of the "PublishedDataSets". |

### LOpcUa_typePublishedDataSet

The PLC data type "LOpcUa_typePublishedDataSet" implements the PublishedDataSets.

Table 6-14: Parameters of "LOpcUa_typePublishedDataSet"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "PublishedDataSet" (optional, will not be transmitted). |
| fieldCount | UInt | Number of "DataSetFields" in the "PublishedDataSet" to be published. |
| dataSetField | Array [0..X] of "LOpcUa_typeVariant" | Implements the "DataSetFields" which contain the individual process tags to be sent. |

### LOpcUa_typeVariant

The PLC data type "LOpcUa_typeVariant" implements the data type "Variant" for PubSub communication.

Table 6-15: Parameters of "LOpcUa_typeVariant"

| Name | Data type | Description |
|---|---|---|
| encodingMask | USInt | Specifies the data type of the process value to be sent or received. |
| value | Dependent on "encodingMask" | Used field according to the "encodingMask". Take the assignment between "encodingMask" and "Value" from the comments in the data type "LOpcUa_typeVariant". The corresponding field contains the process value that you can describe in your user program for sending.<br>Example: "encodingMask" = "1" corresponds to "boolean" |

### LOpcUa_typeReaderGroup

The PLC data type "LOpcUa_typeReaderGroup" implements the ReaderGroup.

Table 6-16: Parameters of "LOpcUa_typeReaderGroup"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "ReaderGroup" (optional). |

| Name | Data type | Description |
|---|---|---|
| dataSetReader | Array [0..X] of "LOpcUa_ typeDataSetReader" | Implements the "DataSetReader" per "ReaderGroup". |

### LOpcUa_typeDataSetReader

The PLC data type "LOpcUa_ typeDataSetReader" implements the DataSetReader.

Table 6-17: Parameters of "LOpcUa_typeDataSetReader"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "DataSetReader" (optional). |
| publisherID | "LOpcUa_type PublisherID" | The received PublisherID. |
| dataSetWriterID | UInt | The received DataSetWriterID. |
| sequenceNumber | UInt | Sequence number of the received PubSub packets |
| subscribedDataSet | "LOpcUa_type SubscribedDataSet" | Contains the "DataSetFields" of type "LOpcUa_typeVariant" in which the received process values are stored. |

### LOpcUa_typeSubscribedDataSet

The PLC data type "LOpcUa_typeSubscribedDataSet" implements the SubscribedDataSets.

Table 6-18: Parameters of "LOpcUa_typeSubscribedDataSet"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the SubscribedDataSet" (optional, will not be transmitted). |
| fieldCount | UInt | Number of "DataSetFields" in the "PublishedDataSet" to be published. |
| dataSetField | Array [0..X] of "LOpcUa_ typeVariant" | Implements the "DataSetFields" which contain the individual process tags to be sent. |

### LOpcUa_typeWriterGroupJson

The PLC data type "LOpcUa_typeWriterGroupJson" implements the WriterGroups.

Table 6-19: Parameters of "LOpcUa_typeWriterGroupJson"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "WriterGroup" (optional, will not be transferred). |
| priority | USInt | The priority for sorting (higher value = higher priority). |
| publishingInterval | USInt | The publishing interval for the configuration of the send clock. The transmission rate is given by the following formula:<br>*Send clock = OB cycle time * PublishingInterval* |
| resetInterval | USInt | Must contain the same value as the "PublishingInterval". |
| numDataSetWriter | USInt | Number of "DataSetWriters" you want to use. |

| Name | Data type | Description |
|---|---|---|
| dataSetWriter | Array [0..X] of "LOpcUa_ typeDataSetWriterJson" | Implements the "DataSetWriter" per "WriterGroup". |

### LOpcUa_typeDataSetWriterJson

The PLC data type "LOpcUa_typeDataSetWriterJson" implements the DataSetWriter.

Table 6-20: Parameters of "LOpcUa_typeDataSetWriterJson"

| Name | Data type | Description |
|---|---|---|
| id | WString | Identification number of the "DataSetWriter" (any). |
| sequenceNumber | UInt | Is not filled in (required by FB "LOpcUa_PubUdpJson"). |
| dataSet | UInt | Reference to the index of the "PublishedDataSet". Each "DataSet" refers to a different index of the "PublishedDataSets". |

### LOpcUa_typePublishedDataSetJson

The PLC data type "LOpcUa_typePublishedDataSetJson" implements the PublishedDataSets.

Table 6-21: Parameters of "LOpcUa_typePublishedDataSetJson"

| Name | Data type | Description |
|---|---|---|
| name | WString | The name of the "PublishedDataSet". |
| fieldCount | UInt | Number of "DataSetFields" in the "PublishedDataSet" to be published. |
| dataSetField | Array [0..X] of "LOpcUa_ typeVariant" | Implements the "DataSetFields" which contain the individual process tags to be sent. |

### LOpcUa_typeReaderGroupJson

The PLC data type "LOpcUa_typeReaderGroupJson" implements the ReaderGroup.

Table 6-22: Parameters of "LOpcUa_typeReaderGroupJson"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "ReaderGroup" (optional). |
| dataSetReader | Array [0..X] of "LOpcUa_ typeDataSetReaderJson" | Implements the "DataSetReader" per "ReaderGroup". |

### LOpcUa_typeDataSetReaderJson

The PLC data type "LOpcUa_ typeDataSetReaderJson" implements the DataSetReader.

Table 6-23: Parameters of "LOpcUa_typeDataSetReaderJson"

| Name | Data type | Description |
|---|---|---|
| name | String | The name of the "DataSetReader" (optional). |
| publisherID | WString | The received PublisherID. |
| dataSetWriterID | WString | The received DataSetWriterID. |
| sequenceNumber | UInt | Sequence number of the received PubSub packets |

| Name | Data type | Description |
|---|---|---|
| subscribedDataSet | "LOpcUa_type SubscribedDataSetJson" | Contains the "DataSetFields" of type "LOpcUa_typeVariant" in which the received process values are stored. |

### LOpcUa_typeSubscribedDataSetJson

The PLC data type "LOpcUa_typeSubscribedDataSetJson" implements the SubscribedDataSets.

Table 6-24: Parameters of "LOpcUa_typeSubscribedDataSetJson"

| Name | Data type | Description |
|---|---|---|
| name | WString | The name of the SubscribedDataSet" (optional, will not be transmitted). |
| fieldCount | UInt | Number of "DataSetFields" in the "PublishedDataSet" to be published. |
| dataSetField | Array [0..X] of "LOpcUa_typeVariant" | Implements the "DataSetFields" which contain the individual process tags to be sent. |

### LOpcUa_typeConnParamMqtt

The PLC data type "LOpcUa_typeConnParamMqtt" defines the connection parameters for the MQTT connection.

Table 6-25: Parameters of "LOpcUa_typeConnParamMqtt"

| Name | Data type | Description |
|---|---|---|
| mqttConnParam | "LMQTT_typeConnParam" | Basic MQTT connection parameters. |
| mqttClientIdentifier | WString | MQTT Client identifier used when establishing the connection. |
| mqttUserName | WString | Optional: Username for connection establishment. |
| mqttPassword | WString | Optional: Password for connection establishment. |
| mqttTopic | WString | MQTT topic used for publish/subscribe. |

# 7. LSNMP

## 7.1. Overview

### 7.1.1. Range of Functions

The status of SNMP-capable network components can be monitored and, if necessary, controlled via SNMP (Simple Network Management Protocol) by network management systems, such as SINEC NMS.

The blocks of the "LSNMP" library also allow a SIMATIC Controller with a PROFINET interface, acting as a simple SNMP manager, to query information from the network components and, if necessary, to control them as well, or to send SNMP traps to an SNMP manager as an SNMP agent.

The following functions are implemented in the library:

- Send SNMP GetRequests and output response
- Send SNMP GetNextRequests and output response
- Send SNMP GetBulkRequests and output response
- Send SNMP SetRequests
- Send SNMP traps
- Receive SNMP Traps

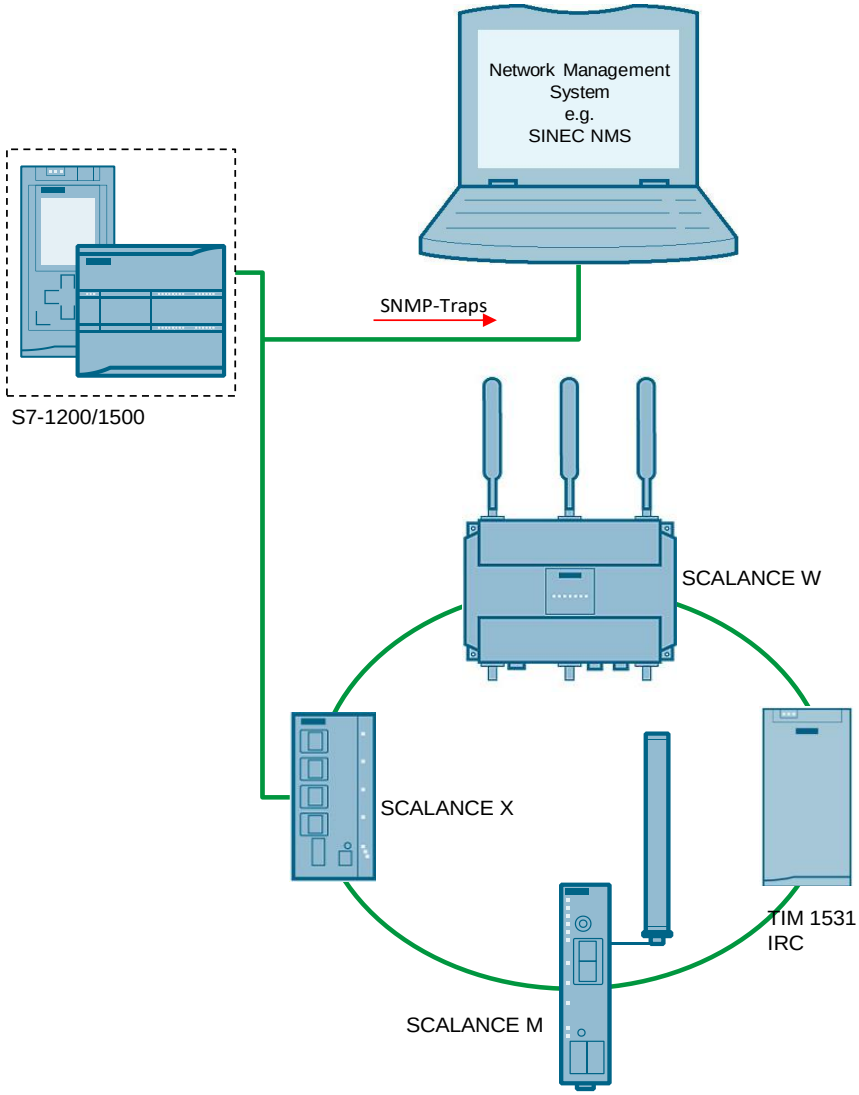
**NOTE** The blocks of this library support sending and receiving SNMP messages that do not exceed 486 bytes in total length.

**Diagram**

The following figure shows a possible constellation in which you can use the SNMP blocks of the "LSNMP" library.

Figure 7-1





## 7.1.2. Components of the Library

The "LSNMP" library contains the following objects:

**Blocks**

Table 7-1: Blocks of the library

| Name | Type | Version | Description |
|---|---|---|---|
| LSNMP_Get | FB | V5.0.4 | Request of an SNMP tag from an SNMP agent (SNMPv1) (GetRequest or GetNextRequest) |
| LSNMP_GetBulk | FB | V5.0.5 | Requesting large amounts of data from an SNMP agent with only a single response telegram (SNMPv2c) |
| LSNMP_Set | FB | V5.0.3 | Changing an SNMP tag of an SNMP agent (SNMPv1) |
| LSNMP_SendTrap | FB | V5.0.0 | Sends user-defined traps to an SNMP manager (SNMPv1) |
| LSNMP_ReceiveTrap | FB | V1.0.0 | Receiving SNMP traps. (Only valid from TIA Portal V18 and S7-1500 V2.6) |
| LSNMP_CalcCnt | FC | V1.0.0 | Used to calculate the number of bytes a BER encoded length takes in the packet (not relevant for the user) |
| LSNMP_DecodeLen | FC | V1.0.0 | Decodes a BER encoded length (not relevant for the user) |
| LSNMP_EncodeLen | FC | V1.0.0 | Encodes a length according to BER and inserts it into the packet (not relevant for the user) |

**PLC Data Types**

Table 7-2: PLC data types of the library

| Name | Version | Description |
|---|---|---|
| LSNMP_typeConnParam | V1.0.1 | Describes the connection parameters for all LSNMP blocks |
| LSNMP_typeDataSendTrap | V5.0.1 | Describes the data that is sent with "LSNMP_SendTrap" |
| LSNMP_typePacket | V1.0.1 | Structures parameters that are necessary for building the SNMP package within the blocks (not relevant for the user) |
| LSNMP_typeVarBind | V1.0.1 | Describes a tag binding to be sent or received |

## 7.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0 (SNMP_ReceiveTrap from Firmware V2.6)
- SIMATIC S7-1200 Controllers as of firmware V4.2 (SNMP_ReceiveTrap from Firmware V4.5)
- SIMATIC ET 200SP Open Controllers as of firmware V2.0 (SNMP_ReceiveTrap from Firmware V2.6)
- SIMATIC S7-1500 Software Controllers as of Firmware V2.0 (SNMP_ReceiveTrap from Firmware V2.6)
- CP 1543-1, CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V2.0
- SNMPv1/SNMPv2c

# 7.2. LSNMP_Get

**Description**

SNMP provides different data packets to request tags of an SNMP agent. Two of them are implemented in this block:

- GetRequest to request a specific tag
- GetNextRequest to request the next tag in the MIB tree

For this purpose, the block sends either an SNMP GetRequest or SNMP GetNextRequest command for a tag by means of an Object Identifier (OID) to an SNMP agent. The SNMP agent responds with an SNMP GetResponse telegram containing the requested data or an error message.

**Parameter**

Figure 7-2: LSNMP_Get

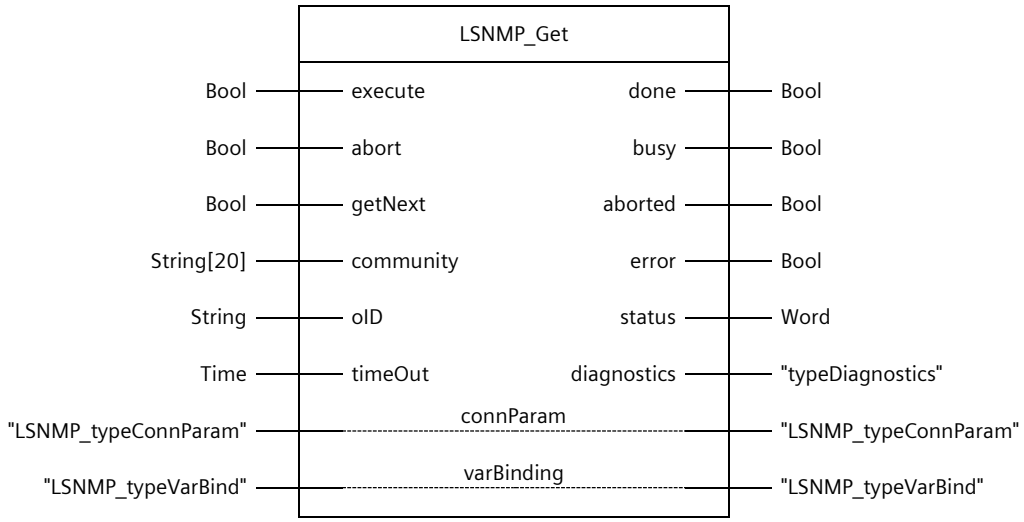



Table 7-3: Parameters of LSNMP_Get

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| execute | Input | Bool | The job is started with a positive edge.<br>"abort" must be FALSE. |
| abort | Input | Bool | With a positive edge, the current job is canceled.<br>The command is only accepted if the block is currently busy. |
| getNext | Input | Bool | FALSE: Requests the tag for the specified OID<br>TRUE: Requests the next tag in the MIB tree for the specified OID |
| community | Input | String[20] | Community |
| oID | Input | String | Object Identifier of the requested tag according to dot notation, e.g. '1.3.6.1.2.1.1.5.0' |
| timeOut | Input | Time | Time after which a job should be automatically canceled |
| done | Output | Bool | TRUE: Job successfully executed. The received data is available at the "varBinding" parameter. |
| busy | Output | Bool | TRUE: Job is being executed |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| aborted | Output | Bool | TRUE: Job was canceled |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 7.9) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| connParam | InOut | "LSNMP_typeConnParam" | Connection parameters |
| varBinding | InOut | "LSNMP_typeVarBind" | Received variable binding |

# 7.3. LSNMP_GetBulk

### Functional description

The block "LSNMP_GetBulk" is used to read out large amounts of data with only one response telegram.

The block "LSnmp_GetBulk" uses the SNMP GetBulk request command and requires SNMPv2 for this – an extension of SNMPv1.

The GetBulk command performs several GetNext queries in the SNMP agent. The maximum number of GetNext commands can be specified via a parameterizable repetition factor in the GetBulk telegram.

The return values of all queried objects are compiled in a single response telegram and transferred. The block "LSNMP_GetBulk" then outputs the received data stream divided into the individual tags.

### Parameter

Figure 7-3: LSNMP_GetBulk

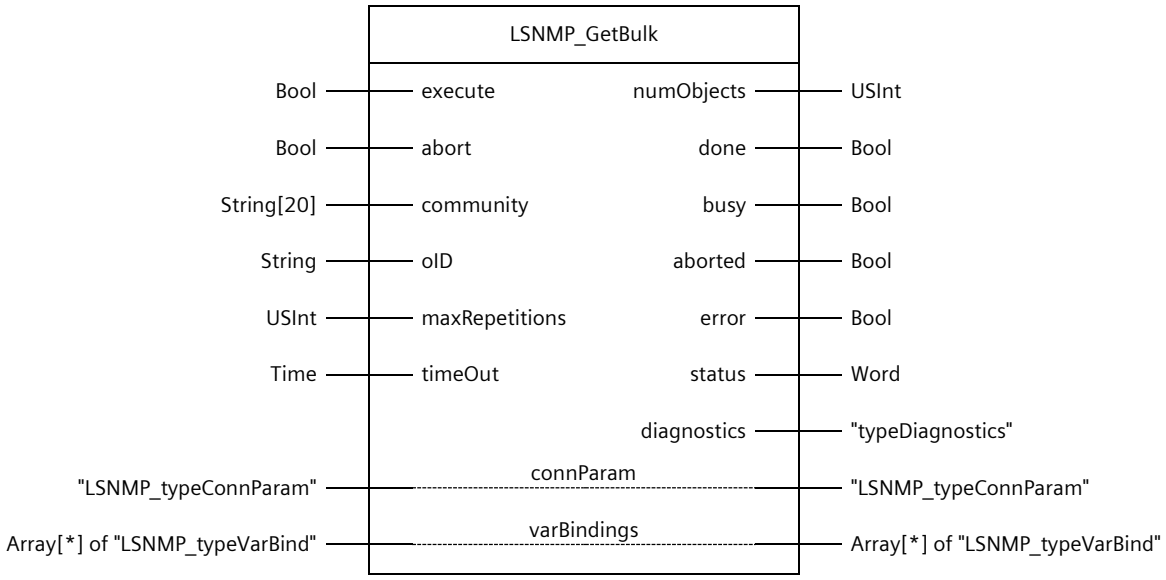



Table 7-4: Parameters of LSNMP_GetBulk

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| execute | Input | Bool | The job is started with a positive edge.<br>"abort" must be FALSE. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| abort | Input | Bool | With a positive edge, the current job is canceled.<br>The command is only accepted if the block is currently busy. |
| community | Input | String[20] | Community |
| oID | Input | String | Object Identifier of the first requested tag according to dot notation, e.g. '1.3.6.1.2.1.1.5.0' |
| maxRepetitions | Input | USInt | Max. number of objects to be returned |
| timeOut | Input | Time | Time after which a job should be automatically canceled |
| numObjects | Output | USInt | Number of objects received |
| done | Output | Bool | TRUE: Job successfully executed. The received data is available at the "varBindings" parameter. |
| busy | Output | Bool | TRUE: Job is being executed |
| aborted | Output | Bool | TRUE: Job was canceled |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 7.9) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| connParam | InOut | "LSNMP_typeConnParam" | Connection parameters |
| varBindings | InOut | Array[*] of "LSNMP_typeVarBind" | Received variable bindings |

# 7.4. LSNMP_Set

### Description

The "LSNMP_Set" block sends a write job to an SNMP agent via the SNMP SetRequest command for an SNMP tag.

In the SetResponse telegram the block receives the result of the write request from the SNMP agent. If the tag read in does not match the written value, an error will be read out. The Write job must be set again.

### Parameter

Figure 7-4: LSNMP_Set

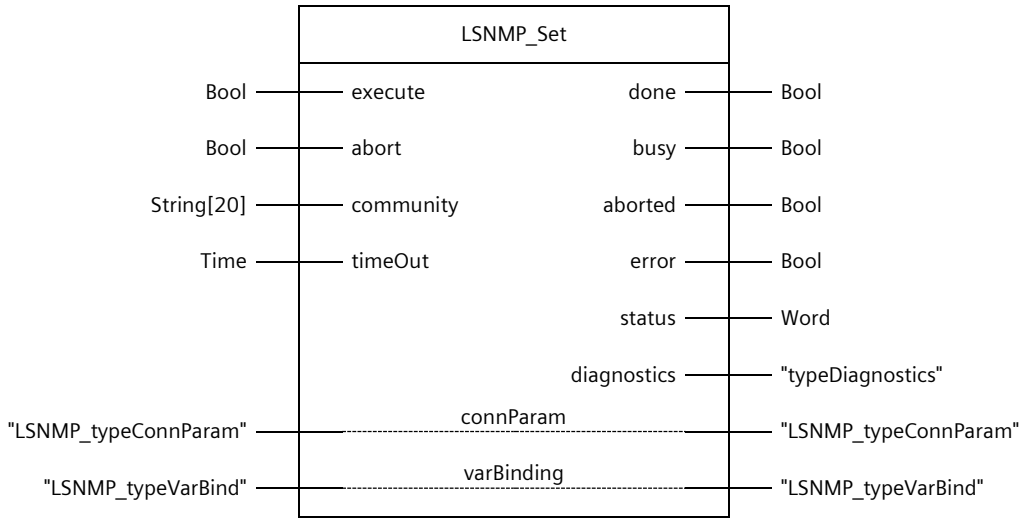



Table 7-5: Parameters of LSNMP_Set

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| execute | Input | Bool | The job is started with a positive edge.<br>"abort" must be FALSE. |
| abort | Input | Bool | With a positive edge, the current job is canceled.<br>The command is only accepted if the block is currently busy. |
| community | Input | String[20] | Community |
| timeOut | Input | Time | Time after which a job should be automatically canceled |
| done | Output | Bool | TRUE: Job successfully executed |
| busy | Output | Bool | TRUE: Job is being executed |
| aborted | Output | Bool | TRUE: Job was canceled |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 7.9) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| connParam | InOut | "LSNMP_typeConnParam" | Connection parameters |
| varBinding | InOut | "LSNMP_typeVarBind" | Tag binding to be sent |

# 7.5. LSNMP_SendTrap

### Description

SNMP agents (e.g. an S7 CPU) send messages to the network management system via SNMP traps to display changes in the network status.

The "LSNMP_SendTrap" block is a parameterizable function block for sending SNMP traps.

**NOTE** The SNMP agents do not receive acknowledgement for sent traps.

### Parameter

Figure 7-5: LSNMP_SendTrap

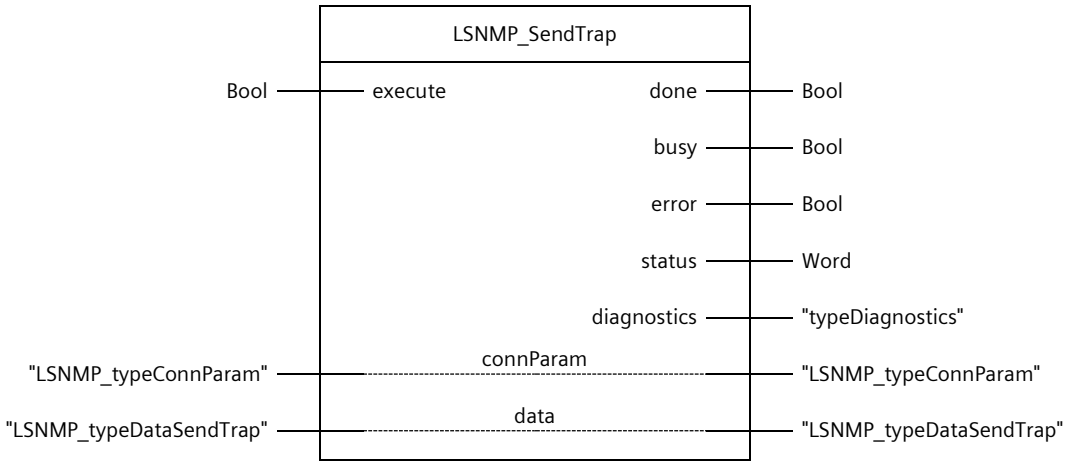



Table 7-6: Parameters of LSNMP_SendTrap

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| execute | Input | Bool | The job is started with a positive edge. |
| done | Output | Bool | TRUE: Job successfully executed |
| busy | Output | Bool | TRUE: Job is being executed |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 7.9) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| connParam | InOut | "LSNMP_typeConnParam" | Connection parameters |
| data | InOut | "LSNMP_typeDataSendTrap" | Data to be sent with the SNMP trap |

# 7.6. LSNMP_ReceiveTrap

**Description**

SNMP agents (e.g. an S7 CPU) send messages to the network management system via SNMP traps to display changes in the network status.

The "LSNMP_ReceiveTrap" block is a parameterizable function block for receiving SNMP traps.

**NOTE** The SNMP agents do not receive acknowledgement for received traps.

**Parameter**

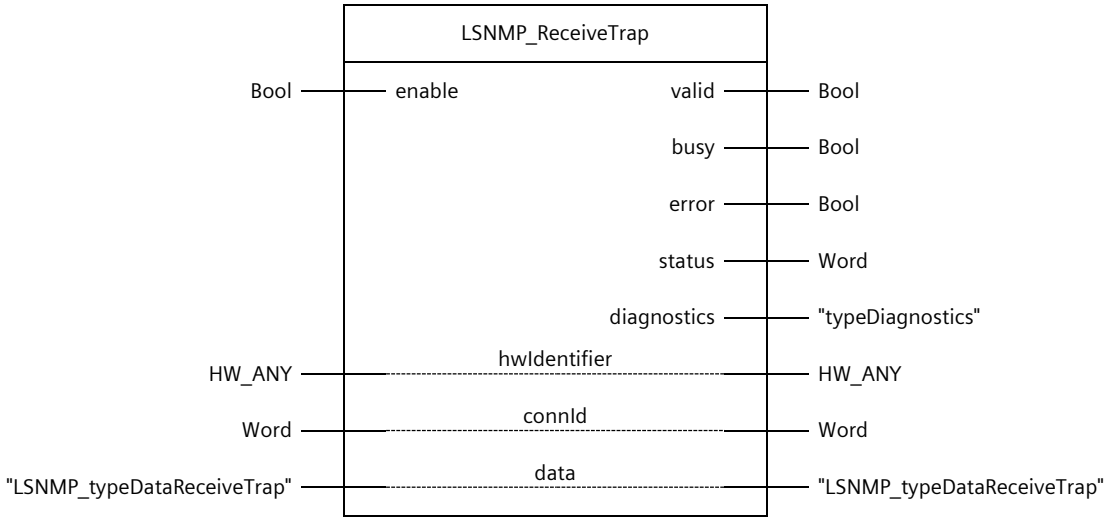



Figure 7-6: LSNMP_ReceiveTrap

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | IN | Bool | TRUE: Enable the function of the FB |
| valid | OUT | Bool | TRUE: Gültiger Satz von Ausgabewerten, die am FB verfügbar sind |
| busy | OUT | Bool | TRUE: FB ist noch nicht fertig und es können neue Ausgabewerte erwartet werden |
| error | OUT | Bool | TRUE: Bei der Ausführung des FB ist ein Fehler aufgetreten |
| status | OUT | Word | Status and error codes (see chapter 7.9) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| hwIdentifier | InOut | HW_ANY | Hardware-ID of the interface |
| connId | InOut | Word | Connection-ID |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| data | InOut | "LSNMP_typeDataReceiveTrap"LSNMP_typeDataSendTrap | Data to be sent with the SNMP trap |

# 7.7. PLC Data Types

### LSNMP_typeConnParam

The PLC data type "LSNMP_typeConnParam" contains parameters that are required to establish a connection to the partner.

Table 7-7: Parameters of LSNMP_typeConnParam

| Name | Data type | Comment |
|---|---|---|
| hwIdentifier | HW_ANY | Hardware identification of the Ethernet interface |
| connID | Word | Connection ID |
| ipAddress | IP_V4 | IP address of the partner |
| localPort | UInt | Local port |

**NOTE** If you want to run multiple blocks of the library or instances of the same block at the same time, the parameters "connID" and "localPort" must be unique for each instance.

### LSNMP_typeDataSendTrap

The PLC data type "LSNMP_typeDataSendTrap" contains all parameterizable data that can be sent to an SNMP manager with "LSNMP_SendTrap".

Table 7-8: Parameters of LSNMP_typeDataSendTrap

| Name | Data type | Comment |
|---|---|---|
| community | String[20] | Community |
| oID | String | Object Identifier of the agent generating the trap, in dot notation, e.g. '1.3.6.1.2.1.1.5.0' |
| ipAgent | IP_V4 | IP address of the agent generating the trap |
| genericTrap | Int | General Trap ID<br>• 0: Cold start (coldStart)<br>• 1: Warm start (warmStart)<br>• 2: Link Down (linkDown)<br>• 3: Link Up (linkUp)<br>• 4: Authentication failure (authenticationFailure)<br>• 5: EGP neighbor lost (egpNeighborLoss)<br>• 6: company-specific (enterpriseSpecific) |
| specificTrap | Int | Company specific trap ID<br>If the general trap ID "6" is selected, a company-specific trap ID can be sent with this parameter. Otherwise, the company-specific trap ID is "0". |
| varBinding | "LSNMP_typeVarBind" | Optional tag binding to be sent with the trap. In this case, the trap ID is considered sufficient information. |

**LSNMP_typeVarBind**

With SNMP, tags are transmitted as "tag bindings". A tag binding consists of the Object Identifier of the tag and the actual value. The PLC data type "LSNMP_typeVarBind" defines such a tag binding. So that the block or the user can interpret the value correctly, the data type and the length are also specified.

Table 7-9: Parameters of LSNMP_typeVarBind

| Name | Data type | Comment |
|---|---|---|
| oID | String | Object Identifier of the tag in dot notation, e.g. '1.3.6.1.2.1.1.5.0' |
| type | Byte | Data type of the tag<br>Common data types:<br>16#02: Integer<br>16#04: String<br>16#41: Counter<br>16#43: Timeticks |
| length | Int | Tag length |
| value | Array[0..255] of byte | Value of the tag |

## 7.8. Integration into the User Project

You will find a detailed application example for the integration of the library into your user project in the Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/57249109

## 7.9. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The following are the status and error codes specific to the "LSNMP" library.

Table 7-10: Status and error codes

| Code | Description |
|---|---|
| 16#0000 | Job completed successfully |
| 16#0FFF | Job was canceled |
| 16#7000 | No job active |
| 16#7001 | First call of the command |
| 16#7002 | Follow-up call of the command |
| 16#7003 | Cancels the job |
| 16#8107 | The received value is too large for the memory area at the "varBinding" or "varBindings" parameter. |
| 16#8109 | The received packet is too large for the internal reception area. |

| Code | Description |
|---|---|
| 16#8201 | The value at the parameter "maxRepetitions" is larger than the array at the parameter "varBindings". |
| 16#8401 | Malformed packet received. Possible reasons:<br>• Invalid header<br>• Packet contains invalid lengths |
| 16#8408 | Time-out: The job could not be completed within the specified time. Possible reasons:<br>• Partner is not available<br>• Community is wrong |
| 16#85xx | SNMP error received from partner. The SNMP error code is output in the lower byte and "diagnostics.subfunctionStatus". Descriptions of the SNMP error codes can be found online. |
| 16#8600 | The FB is in an invalid state. |
| 16#8601 | Error in subordinate command "TCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8602 | Error in subordinate command "TUSEND"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8603 | Error in subordinate command "TURCV"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |

# 8. LSNTP

## 8.1. Overview

### 8.1.1. Range of Functions

For automation cells or subsystems, it is often secondary to use the exact "atomic time". It is usually sufficient to have a common time base for all automation components.

The use of a SIMATIC S7 CPU as an SNTP server enables flexible and simple synchronization of systems and subsystems, for example, to obtain meaningful timestamps for error messages and logging data system-wide.

The library provides a function block that performs the following functions:

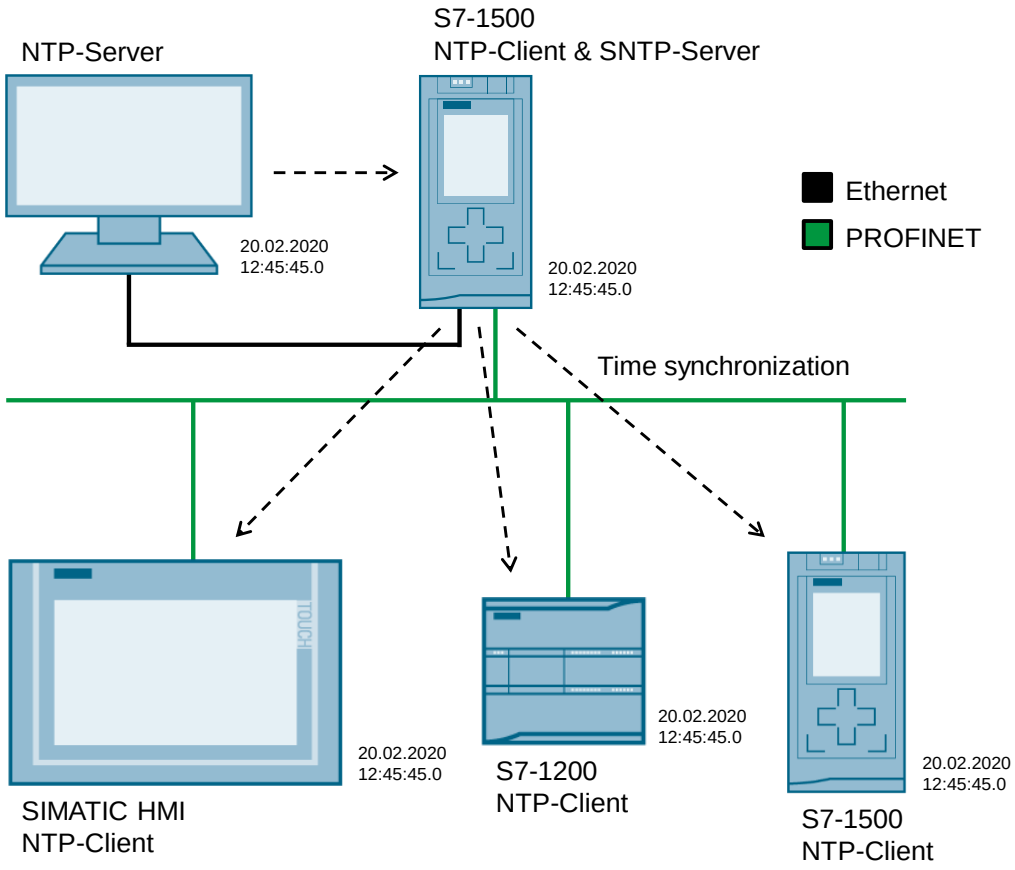
- Receiving and evaluating an NTP telegram from an (S)NTP Client
- Creating and sending an NTP telegram to the client for time synchronization

The inaccuracy of the SNTP server is less than 10 ms.

**Example scenario**

The following figure shows a possible example configuration with a SIMATIC S7-1500 CPU as the SNTP server. Here, the CPU synchronizes its time with an external NTP server. However, configurations with other clocks are also possible.

Figure 8-1: Example scenario





## 8.1.2. Components of the Library

The "LSNTP" library consists of the following blocks and data types.

### Function blocks

Table 8-1: Function blocks

| Name | Type | Version | Description |
|---|---|---|---|
| LSNTP_Server | FB | V4.0.0 | Realizes the function of the SNTP server. |

### PLC Data Types

Table 8-2: PLC data types

| Name | Type | Version | Description |
|---|---|---|---|
| LSNTP_typeTelegram | Data type | V1.0.0 | Describes the structure of the NTP telegram. |
| LSNTP_typeTimestamp | Data type | V1.0.0 | Describes the structure of the timestamp. |

## 8.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.2
- SIMATIC ET 200SP Open Controllers as of firmware V2.0
- SIMATIC S7-1500 Software Controllers as of Firmware V2.0
- CP 1543-1, CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V2.0

# 8.2. LSNTP_Server

## 8.2.1. Interface Description

### Description

The function block implements the function of the SNTP server.

### Parameter

Figure 8-2: LSNTP_Server

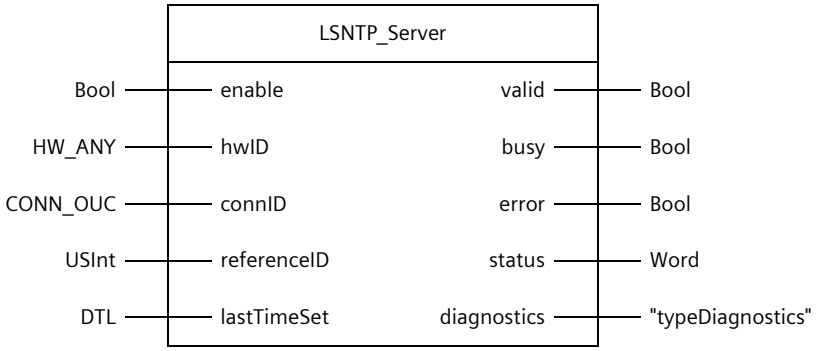



Table 8-3: Parameter of LSNTP_Server

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | TRUE: Activates the SNTP server |
| hwID | Input | HW_ANY | Hardware identifier of the PN/IE interface |
| connID | Input | CONN_OUC | Unique connection ID |
| referenceID | Input | USInt | The input specifies from which time source the server CPU obtains the time:<br>• 0: uncalibrated (set "by hand")<br>• 1: primary reference (e.g., DCF 77)<br>• 2: secondary reference (e.g., from GPS receiver)<br>The information is passed on to the NTP client in the SNTP protocol. |
| lastTimeSet | Input | DTL | Time specification when the time of the controller was last set.<br>This information is passed on to the NTP client in the SNTP protocol.<br>If the parameter is not assigned, the current time of the CPU is transferred instead. |
| valid | Output | Bool | TRUE: The block is working without error |
| busy | Output | Bool | TRUE: The block is processed |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 8.2.2) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |

### 8.2.2. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The status and error codes specific to the "LSNTP" library are listed below.

Table 8-4: Status and error codes

| Code | Description |
|---|---|
| 16#0000 | NTP telegram sent to an (S)NTP client |
| 16#0001 | NTP telegram of an (S)NTP client received |
| 16#7000 | The block is not executed |
| 16#7001 | First call of the command |
| 16#7002 | Follow-up call of the command |
| 16#7003 | Block is deactivated |
| 16#7F01 | Invalid package received |
| 16#8600 | The FB is in an invalid state. |
| 16#8601 | Error in subordinate command "TCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8602 | Error in subordinate command "TUSEND"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8603 | Error in subordinate command "TURCV"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |

# 9. LSQL

## 9.1. Overview

### 9.1.1. Range of Functions

The LSQL library enables the interaction with an SQL database directly from the user program of a controller by replicating the TDS protocol based on "Open User Communication". It enables the following actions:

- Establishing a connection and logging on to a Microsoft SQL Server database
- Transfer SQL statement
- Receiving read data

### 9.1.2. Components of the library

The LSQL library consists of the following objects:

**Function Blocks**

Table 9 1: Function blocks

| Name | Type | Version | Description |
|---|---|---|---|
| LSQL_Microsoft | FB | V4.0.0 | Organizes the sending and composing of telegrams. |
| LSQL_WriteData | FC | V1.0.3 | Converts a String to the data buffer |

Table 9 1: Function blocks

**PLC Data Types**

Table 9-1: PLC data types

| Name | Version | Beschreibung |
|---|---|---|
| LSQL_typeConnParam | V1.1.0 | This data type describes all the credentials required for authentication between the client and SQL Server. |
| LSQL_typeLoginInformation | V1.1.0 | This data type describes the authentication between the client and the SQL server. |

### 9.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 Controller ab Firmware V2.9
- SIMATIC S7-1200 Controller ab Firmware V4.5

# 9.2. LSQL_Microsoft

## 9.2.1. Interface Description

### Description

The module realizes the connection to the SQL server.

### Parameters

Figure 9-1: LSQL_Microsoft

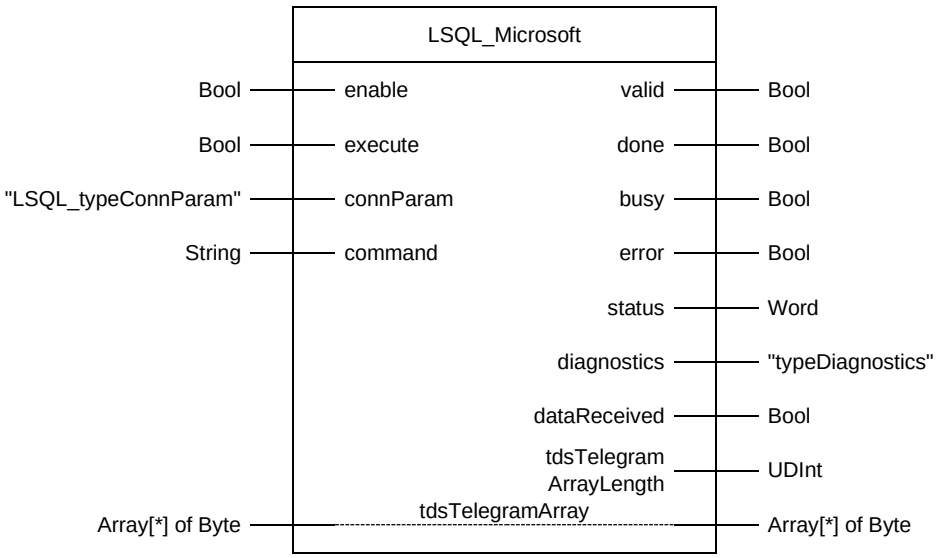



Table 9-2: Parameters of LSQL_Microsoft

| Name | Declaration | Data Type | Comment |
|---|---|---|---|
| enable | Input | Bool | TRUE: Enable functionality of FB |
| execute | Input | Bool | TRUE: execute SQL command once |
| connParam | Input | "LSQL_typeConnParam" | Connection parameters |
| command | Input | String | SQL command to execute when executeSqlBatch = TRUE |
| valid | Output | Bool | TRUE: Valid set of output values available at the FB |
| done | Output | Bool | TRUE: Command was executed successfully |
| busy | Output | Bool | TRUE: FB is not finished and new output values can be expected |
| error | Output | Bool | TRUE: An error occurred during the execution of the FB |
| status | Output | Word | Status and error codes (see chapter 9.2.2) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| dataReceived | Output | Bool | TRUE: new data have been received |
| tdsTelegramArrayLength | Output | UDInt | number of Bytes recieved in buffer area for reassembled TDS protocol |

| Name | Declaration | Data Type | Comment |
|---|---|---|---|
| tdsTelegramArray | InOut | Array[*] of Byte | array for reconstructed TDS protocol data |

### 9.2.2. Error handling

For general information on the status outputs and diagnostics of the building blocks of these libraries, see Chapter 12.2.

The following are the status and error codes specific to the LSQL library.

Table 9-3: Status and error codes

| Code | Description |
|---|---|
| 16#0000 | Job completed successfully |
| 16#7000 | No job is currently being processed. |
| 16#7001 | First call after incoming new job (rising edge at parameter "enable"). |
| 16#7002 | Subsequent call during active processing<br>without additional information. |
| 16#7003 | Establishing the TCP/IP Connection |
| 16#7004 | TCP/IP connection successfully established |
| 16#7005 | Sending a SQL Command |
| 16#7011 | "TDISCON" successfully executed |
| 16#8001 | Incorrect operation of the FB |
| 16#8200 | Errors during parameterization |
| 16#8400 | External error |
| 16#8600 | Internal Error |
| 16#8601 | Error in subordinate command "TCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8602 | Error in subordinate command "TSEND"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8603 | Error in subordinate command "TRCV"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8604 | Error in subordinate command "TDISCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8611 | Error while archiving in DB |
| 16#8613 | Error in converting the data for pre-login |
| 16#8614 | Error converting the login data. |

| Code | Description |
|---|---|
| 16#8615 | Error converting the data for the SQL command |
| 16#8800 | Error due to reserved area |
| 16#8900 | Error due to an undefined state in the state machine. |

## 9.3. PLC Data Types

### LSQL_typeConnParam

Table 9-4: Parameters of LSQL_typeConnParam

| Name | Data Type | Comment |
|---|---|---|
| interfaceSettings | TCON_IP_v4 | IPv4 connection parameters |
| loginInformation | "LSql_typeLoginInformation" | Login data for authentication between client and SQL server. |

### LSQL_typeLoginInformation

Table 9-5: Parameters of LSQL_typeLoginInformation

| Name | Data Type | Comment |
|---|---|---|
| hostName | String | Optional: Name of the local host |
| userName | String | Required: Username for logging in to the database |
| password | String | Required: Password for logging in to the database |
| appName | String | Optional: Name of the application connecting with the database. |
| serverName | String | Required: Server name of the database |
| libraryName | String | Optional: Name of the user interface |
| language | String | Optional: Language of the user interface. |
| databaseName | String | Required: Database being read or written. |
| sspi | String | Optional/not supported: Encryption via Security Support Provider Interface (SSPI) |
| attachDbfile | String | Optional: File name to be added during transmission. |
| changePassword | String | Optional: New password, should the old one be modified. |

## 9.4. Integration into the User Project

You will find a detailed application example for the integration of the library into your user project in the Siemens Industry Online Support: https://support.industry.siemens.com/cs/ww/en/view/109779336

The data types and function blocks required for the application example can be found in "master copies > LSQL_Example". See Chapter 11.4.

# 10. LSyslog

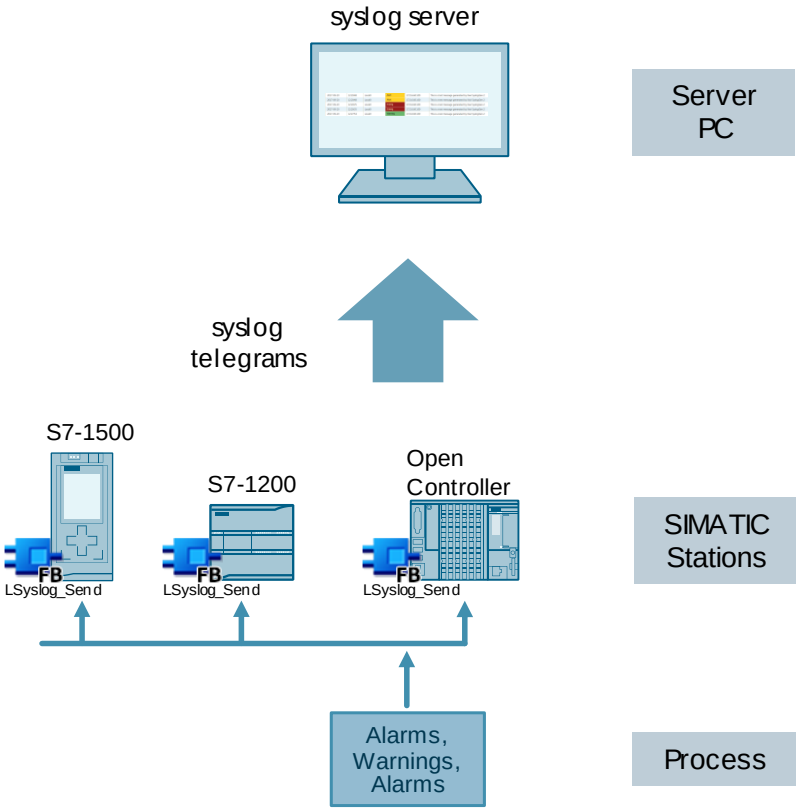
## 10.1. Overview

### 10.1.1. Range of Functions

With the simply designed syslog protocol, applications can send messages, warnings, or error conditions to a syslog server. syslog is typically used for computer system management and security monitoring and has now established itself as a standard (RFC 5424) in logging.

This library emulates the syslog protocol and offers the possibility to send messages via UDP or TCP with optional TLS encryption to a syslog server, such as SINEC INS.

Figure 10-1





## 10.1.2. Components of the Library

The "LSyslog" library contains the following objects.

**Function blocks**

Table 10-1: Function blocks

| Name | Version | Description |
|---|---|---|
| LSyslog_Send | V2.0.0 | Organizes the transmission and creation of the telegrams. |

**PLC Data Types**

Table 10-2: PLC data types

| Name | Version | Description |
|---|---|---|
| LSyslog_typeMessage | V1.1.0 | This data type describes all tag data of a syslog message. |

## 10.1.3. Validity

The library is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.4
- SIMATIC ET 200SP Open Controllers as of firmware V2.5
- SIMATIC S7-1500 Software Controllers as of firmware V2.5
- CP 1543-1, CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V2.0

# 10.2. LSyslog_Send

## 10.2.1. Interface Description

### Description

The FB "LSyslog_Send" establishes a connection to the syslog server via UDP or TCP with optional TLS encryption and sends syslog messages to the syslog server upon request. Afterwards, the connection is automatically broken again.

### Parameter

Figure 10-2: LSyslog_Send

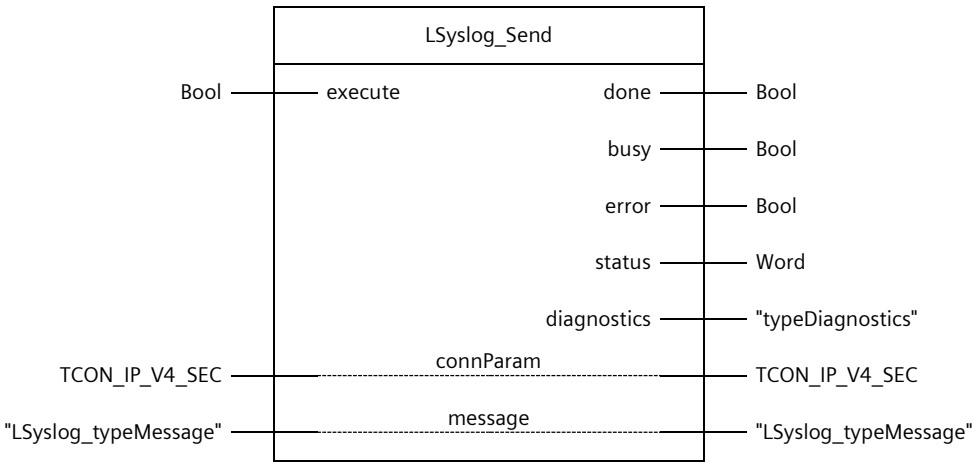



Table 10-3: Parameters of LSyslog_Send

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| execute | Input | Bool | With a positive edge, the connection to the syslog server is established and the syslog message is sent. |
| done | Output | Bool | TRUE: The send job was successfully executed |
| busy | Output | Bool | TRUE: The block is executed |
| error | Output | Bool | TRUE: An error has occurred |
| status | Output | Word | Status and error codes (see chapter 10.2.2) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| connParam | InOut | TCON_IP_V4_SEC | Connection parameters |
| message | InOut | "LSyslog_typeMessage" | syslog message to be sent |

**NOTE**

In the FB the octet stuffing method for syslog is implemented over TCP by appending a line feed to the end of the message.

The octet counting method is also implemented, but commented out.

If you want to use the octet counting method for your application instead, you can adjust the comments in the build message region accordingly.

**NOTE** You will find an application example for the usage of certificates in TIA Portal in the Siemens Industry Online Support:
https://support.industry.siemens.com/cs/ww/en/view/109769068

### 10.2.2. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The following are the status and error codes specific to the "LSyslog" library.

Table 10-4: Status and error codes

| Code | Description |
|---|---|
| 16#0000 | Job completed successfully |
| 16#7000 | No job active |
| 16#7001 | First call of the command |
| 16#7002 | Follow-up call of the command |
| 16#8408 | Time-out: The job could not be completed within the specified time.<br>Possible reasons for a time-out:<br>• Partner is not available |
| 16#8600 | The FB is in an invalid state. |
| 16#8601 | Error in subordinate command "TCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8602 | Error in subordinate command "TUSEND"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |
| 16#8603 | Error in subordinate command "TSEND"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system. |

## 10.3. PLC Data Types

**LSyslog_typeMessage**

The PLC data type describes all parameters of the syslog message to be sent.

Table 10-5: Parameters of LSyslog_typeMessage

| Name | Type | Comment |
|---|---|---|
| facility | Int | Facility (origin of the message)<br>• 0: kernel messages<br>• 1: user-level messages<br>• 2: mail system<br>• 3: system daemons<br>• 4: security/authorization messages<br>• 5: messages generated internally by syslogd<br>• 6: line printer subsystem<br>• 7: network news subsystem<br>• 8: UUCP subsystem<br>• 9: clock daemon<br>• 10: security/authorization messages<br>• 11: FTP daemon<br>• 12: NTP subsystem<br>• 13: log audit<br>• 14: log alert<br>• 15: clock daemon (note 2)<br>• 16-23: local0-local7 |
| severity | Int | Severity (severity of the message)<br>• 0: Emergency<br>• 1: Alert<br>• 2: Critical<br>• 3: Error<br>• 4: Warning<br>• 5: Notice<br>• 6: Informational<br>• 7: Debug |
| hostname | String | Host name that identifies the machine that originally sent the syslog message, e.g. FQDN, IP address, or PLC name.<br>If no host name is used, the tag must be set to "-". |
| appName | String | Application name that identifies the device or application that generated the message.<br>If no application name is used, the tag must be set to "-". |
| msgID | String | Message ID that identifies the type of message.<br>If no message ID is used, the tag must be set to "-". |
| message | String | Message text in free form |

## 10.4. Integration into the User Project

You will find a detailed application example for the integration of the library into your user project in the Siemens Industry Online Support:

https://support.industry.siemens.com/cs/ww/en/view/51929235

# 11. Master Copies

## 11.1. OUC Master Copies

### 11.1.1. Overview

#### 11.1.1.1. Range of Functions

TCP/IP-based Open User Communication (OUC) has become the standard for communication with SIMATIC Controllers.

In SIMATIC Controller OUC is implemented on the basis of commands (e.g. TCON, TSEND, TRCV, and TDISCON). The user parameterizes the commands in their user program and calls them in a error-tolerant manner.

To facilitate this, we offer function blocks in SCL as master copies.

The FBs call the OUC commands in the order and manner recommended in the manuals. In addition, FBs already contain the following mechanisms:

- Connection management with the commands "TCON" and "TDISCON"
- Send data to a partner
- Receive data from a partner

You can use the FBs as a template for your own communication projects or the implementation of other IP-based protocols.

#### 11.1.1.2. Components

The following FBs are available as master copies:

Table 11-1: Master copies

| Name | Description |
|---|---|
| IsoOnTcpTemplate | Master copy to implement communication via ISO-on-TCP protocol |
| TcpTemplate | Master copy to implement communication via TCP protocol |
| TcpSecTemplate | Master copy to implement secured communication via TCP protocol |
| UdpTemplate | Master copy to implement communication via UDP protocol |

#### 11.1.1.3. Validity

The master copies "IsoOnTcpTemplate", "TcpTemplate" and "UdpTemplate" are valid for:

- SIMATIC S7-1500 Controller as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.2
- SIMATIC ET 200SP Open Controllers as of firmware V2.5
- SIMATIC S7-1500 Software Controllers as of firmware V2.5
- SIMATIC S7-300 Controllers
- SIMATIC S7-400 Controllers
- CP 1543-1, CP 1542SP-1, CP 1542SP-1 IRC, CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V2.0

The master copy "TcpSecTemplate" is valid for:

- SIMATIC S7-1500 Controllers as of firmware V2.0
- SIMATIC S7-1200 Controllers as of firmware V4.4
- SIMATIC ET 200SP Open Controllers as of firmware V2.5
- SIMATIC S7-1500 Software Controllers as of firmware V2.5
- CP 1543-1 as of firmware V2.0
- CP 1543SP-1 as of firmware V1.0
- CP 1243-1, CP 1243-8 as of firmware V3.2

## 11.1.2. IsoOnTcpTemplate

**Functional description**

The FB "IsoOnTcpTemplate" implements a complete ISO-on-TCP communication relation to a partner. It encapsulates all OUC commands in a user-friendly shell to perform the following functions:

- Connection establishment and termination via the input "enable"
- Send user data of length "sendLen" to the partner via the "sendData" input as soon as the "send" input detects a positive edge.
- Receive data from a partner and output it in the receive area at the "rcvdData" parameter.
- Output the status of transmission and connection at the output parameter "status".

**NOTE** If the received data is stored in an optimized data block, the input parameter "rcvLen" must contain the value 0. For a standard data block, this input parameter must contain the number of bytes to be received.

**Parameter**

Figure 11-1

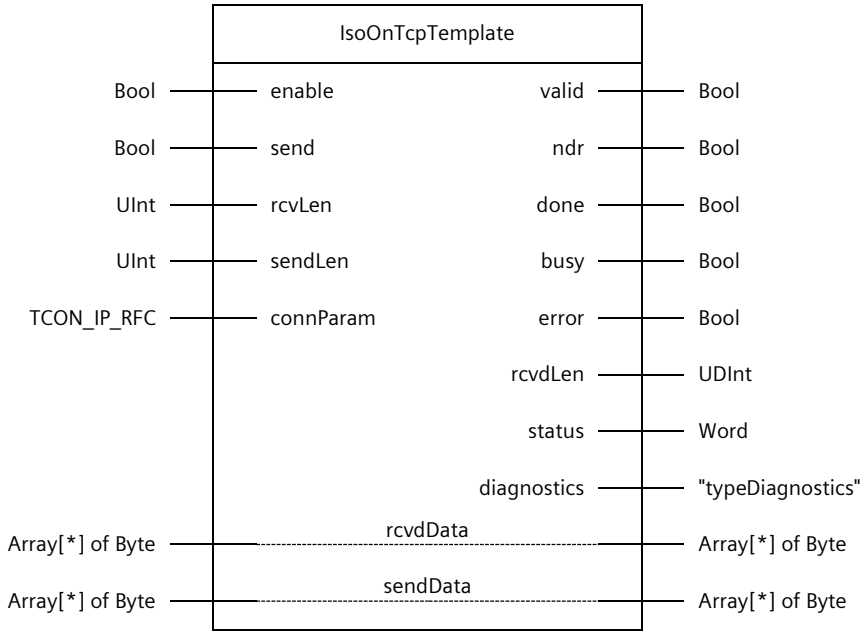


Table 11-2

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Release signal for connection setup and data exchange |
| send | Input | Bool | Triggering the send job |
| rcvLen | Input | UInt | Receive data length<br>If the receive data is stored in an optimized DB, then rcvLen = 0. |
| sendLen | Input | UInt | Maximum number of bytes sent with the job |
| connParam | Input | TCON_IP_RFC | Connection parameters |
| valid | Output | Bool | TRUE: The block executes its function without error |
| ndr | Output | Bool | TRUE: New data has been received |
| done | Output | Bool | TRUE: The send job was successfully executed |
| busy | Output | Bool | TRUE: The block is executed |
| error | Output | Bool | TRUE: An error has occurred |
| rcvdLen | Output | UDInt | Length of received data in bytes |
| status | Output | Word | Status and error codes (see chapter 11.1.6) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| rcvdData | InOut | Array[*] of Byte | Receive data range |
| sendData | InOut | Array[*] of Byte | Send data range |

## 11.1.3. TcpTemplate

**Functional description**

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

- Connection establishment and termination via the input "enable"
- Send user data of length "sendLen" to the partner via the "sendData" input as soon as the "send" input detects a positive edge.
- Receive data from a partner and output it in the receive area at the "rcvdData" parameter.
- Output the status of transmission and connection at the output parameter "status".

**NOTE** Enable the Adhoc mode to receive telegrams with dynamic data length. In this case the input parameter "rcvLen" is irrelevant.

Deactivate the Adhoc mode to receive telegrams with fixed data length. In this case you have to specify the number of bytes to be received at the input parameter "rcvLen".

**Parameter**

Figure 11-2

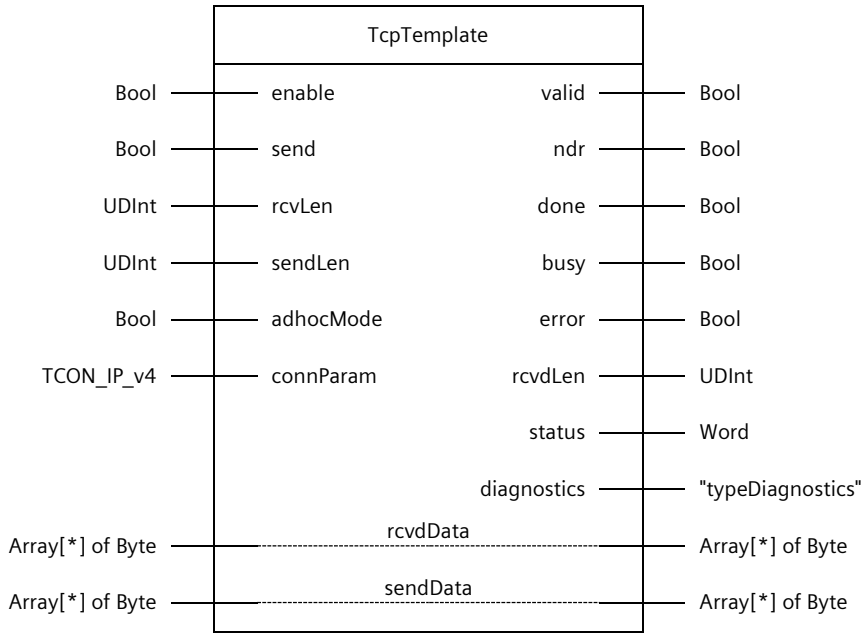



Table 11-3

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Release signal for connection setup and data exchange |
| send | Input | Bool | Triggering the send job |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| rcvLen | Input | UDInt | Receive data length<br>• S7-1500 CPUs: maximum 65536 bytes<br>• S7-1200 CPUs maximum 8192 bytes<br><br>**Note**<br>Parameter is irrelevant when Adhoc mode is enabled. As much data is read as is currently available. The max. data length is defined by the length of the receive area referenced by rcvData. |
| sendLen | Input | UDInt | Maximum number of bytes sent with the job.<br>• S7-1500 CPUs: maximum 65536 bytes<br>• S7-1200 CPUs maximum 8192 bytes |
| adhocMode | Input | Bool | TRUE (Adhoc enabled):<br>• The data is available immediately.<br>• Data reception with dynamic data length<br><br>FALSE (Adhoc disabled):<br>• The data is available as soon as the data length specified at parameter LEN has been received completely.<br>• Data reception with specified data length. |
| connParam | Input | TCON_IP_v4 | Connection parameters |
| valid | Output | Bool | TRUE: The block executes its function without error |
| ndr | Output | Bool | TRUE: New data has been received |
| done | Output | Bool | TRUE: The send job was successfully executed |
| busy | Output | Bool | TRUE: The block is executed |
| error | Output | Bool | TRUE: An error has occurred |
| rcvdLen | Output | UDInt | Length of received data in bytes |
| status | Output | Word | Status and error codes (see chapter 11.1.6) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information |
| rcvdData | InOut | Array[*] of bytes | Receive data area |
| sendData | InOut | Array[*] of bytes | Send data area |

## 11.1.4. TcpSecTemplate

**Functional description**

The FB "TcpSecTemplate" implements a complete TCP communication relationship to a partner.

With the FB "TcpSecTemplate" and with S7-1200 CPUs as of firmware V4.4 and S7-1500 CPUs from firmware V2.0, it is possible to parameterize the communication connections at TCP via IPv4 by means of Secure Communication.

It encapsulates all OUC commands in a user-friendly shell to perform the following functions:

- Connection establishment and termination via the input "enable"
- Send user data of length "sendLen" to the partner via the "sendData" input as soon as the "send" input detects a positive edge
- Receive data from a partner and output it in the receive area at the "rcvdData" parameter.
- Output the status of transmission and connection at the output parameter "status"

**NOTE**

Enable Adhoc mode to receive telegrams with dynamic data length. In this case the input parameter "rcvLen" is irrelevant.

Deactivate the Adhoc mode to receive telegrams with fixed data length. In this case you have to specify the number of bytes to be received at the input parameter "rcvLen".

**Parameter**

Figure 11-3

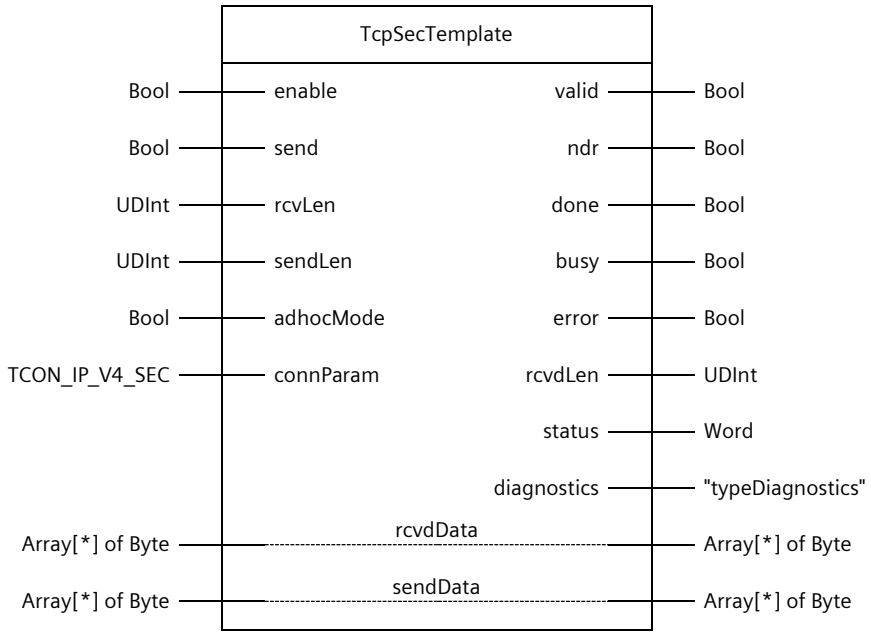




Table 11-4

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Release signal for connection setup and data exchange |
| send | Input | Bool | Triggering the send job |
| rcvLen | Input | UDInt | Receive data length<br>• S7-1500 CPUs: maximum 65536 bytes<br>• S7-1200 CPUs maximum 8192 bytes<br><br>**Note**<br>Parameter is irrelevant when Adhoc mode is enabled. As much data is read as is currently available. The max. data length is defined by the length of the receive area referenced by rcvData. |
| sendLen | Input | UDInt | Number of bytes sent with the job.<br>• S7-1500 CPUs: maximum 65536 bytes<br>• S7-1200 CPUs maximum 8192 bytes<br><br>**Note**<br>If the Adhoc mode is activated, the total length of the telegram is transmitted in the first 4 bytes. These additional 4 bytes must be taken into account at the "sendLen" parameter, i.e.<br>sendLen = 4 byte + user data |
| adhocMode | Input | Bool | TRUE (Adhoc enabled):<br>• The data is available immediately.<br>• Data reception with dynamic data length<br><br>FALSE (Adhoc disabled):<br>• The data is available as soon as the data length specified at parameter LEN has been received completely.<br>• Data reception with specified data length. |
| connParam | Input | TCON_IP_V4_SEC | Connection parameters (see TIA Portal information system) |
| valid | Output | Bool | TRUE: The block executes its function without error |
| ndr | Output | Bool | TRUE: New data has been received |
| done | Output | Bool | TRUE: The send job was successfully executed |
| busy | Output | Bool | TRUE: The block is executed |
| error | Output | Bool | TRUE: An error has occurred |
| rcvdLen | Output | UDInt | Length of received data in bytes |
| status | Output | Word | Status and error codes (see chapter 11.1.6) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| rcvdData | InOut | Array[*] of bytes | Receive data range |
| sendData | InOut | Array[*] of bytes | Send data range |

## 11.1.5. UdpTemplate

**Functional description**

The FB "UdpTemplate" implements a complete UDP communication relation to a partner. It encapsulates all OUC commands in a user-friendly shell module to perform the following functions:

- Connection establishment and termination via the input "enable"
- Send user data at the "sendData" input with the length "sendLen" to the partner as soon as the "send" input detects a positive edge
- Receive data from a partner and output it in the receive area at the "rcvdData" parameter
- Output the status of transmission and connection at the output parameter "status"

**Parameter**

Figure 11-4

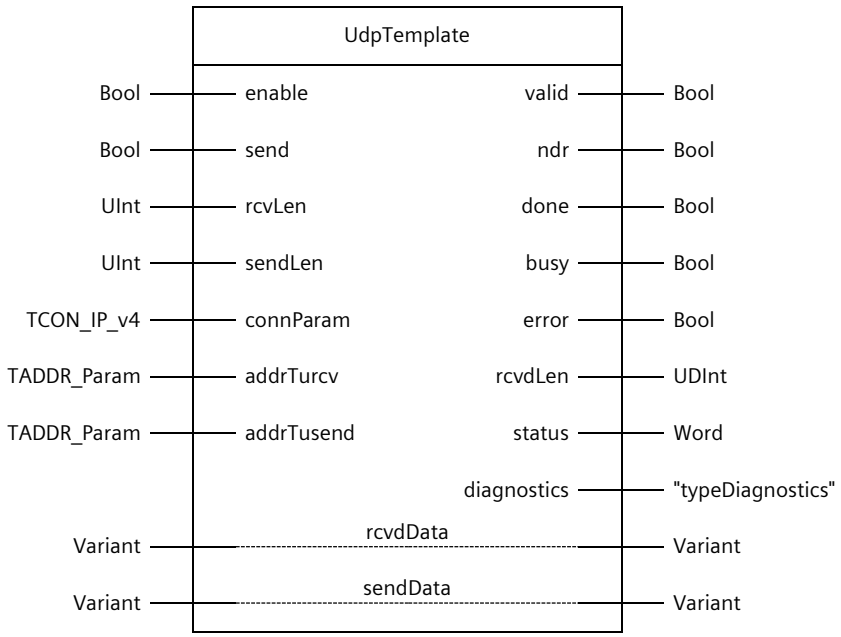



Table 11-5

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| enable | Input | Bool | Release signal for connection setup and data exchange |
| send | Input | Bool | Triggering the send job |
| rcvLen | Input | UInt | Length of the receive area in bytes:<br>Value range: 0 (recommended) or 1 to 1472 (as of firmware version V2.5 of the S7-1500 CPUs with Unicast or Multicast: 1 to 2048) |
| sendLen | Input | UInt | Number of bytes that are to be sent with the job<br>Value range: 1 to 1472 (as of firmware version V2.5 of the S7-1500 CPUs with Unicast or Multicast: 1 to 2048) |
| connParam | Input | TCON_IP_v4 | Connection parameters<br>Detailed information can be found in the TIA Portal information system. |

| Name | Declaration | Data type | Comment |
|---|---|---|---|
| addrTurcv | Input | TADDR_Param | Address information of the communication partner for the "TURCV" command<br>Detailed information can be found in the TIA Portal information system. |
| addrTusend | Input | TADDR_Param | Address information of the communication partner for the "TSEND" command<br>Detailed information can be found in the TIA Portal information system. |
| valid | Output | Bool | TRUE: The block executes its function without error |
| ndr | Output | Bool | TRUE: New data has been received |
| done | Output | Bool | TRUE: The send job was successfully executed |
| busy | Output | Bool | TRUE: The block is executed |
| error | Output | Bool | TRUE: An error has occurred |
| rcvdLen | Output | UDInt | Length of received data in bytes |
| status | Output | Word | Status and error codes (see chapter 11.1.6) |
| diagnostics | Output | "typeDiagnostics" | Advanced diagnostic information (see chapter 12.2) |
| rcvdData | InOut | Variant | Receive data area |
| sendData | InOut | Variant | Send data area |

**NOTE** When sending more than 1472 bytes, you must ensure that your receiver supports more than 1472 bytes. If this is not the case, you will not notice the failed reception on the transmitter side.

### 11.1.6. Error Handling

General information about the status outputs and the diagnostics of the blocks of these libraries can be found in chapter 12.2.

The following are the status and error codes specific to the OUC master copies.

Table 11-6: Status and error codes

| Code | Meaning |
|---|---|
| 16#0000 | Job completed successfully |
| 16#7000 | No job active |
| 16#7001 | First call of the command |
| 16#7002 | Follow-up call of the command |
| 16#8408 | Time-out: The job could not be completed within the specified time.<br>Possible reasons for a time-out:<br>• Partner is not available |
| 16#8600 | The FB is in an invalid state. |
| 16#8601 | Error in subordinate command "TCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system or the STEP 7 online help. |
| 16#8602 | Error in subordinate command "TSEND" or "TUSEND"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system or the STEP 7 online help. |
| 16#8603 | Error in subordinate command "TRCV" or "TURCV"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system or the STEP 7 online help. |
| 16#8604 | Error in subordinate command "TDISCON"<br>The error code of the command is output to "diagnostics.subfunctionStatus". For the meaning of the respective error code, refer to the TIA Portal information system or the STEP 7 online help. |

## 11.2. OPC UA structured data types

Under "Master Copies" you will find the folder "OPC UA data types", which provides you with pre-defined OPC UA structure data types as UDTs. This selection of structured data types is usually used as OPC UA properties and can be mapped using "SiOME" (\10\), for example.

## 11.3. OPC UA methods-templates

Under "Master copies" you will find the folder "OPC UA templates", which provides ready-made OPC UA methods for you. In the folder you will find two function modules. Both contain the necessary calls to the system function modules "OPC_UA_ServerMethodPre" and "OPC_UA_ServerMethodPost".

### Functional sequence

When an OPC UA method is called, the input parameters are passed to the system function "OPC_UA_ServerMethodPre". The system function then provides you with this in the user program. In addition, an interface parameter on the function module signals to you that the method was called by an OPC UA client. Execute your individual function code after the parameter is set. After processing the function code, you must pass the output parameters and the status code to the system function "OPC_UA_ServerMethodPost" and set an interface parameter to signal to the function that the code has been executed. This system function then transmits the output parameters and the status code to the OPC UA client.

### "OpcUaMethodTemplateSimple"

In addition to the two system functions, the function module "OpcUaMethodTemplateSimple" contains a predefined region for your individual function code. In addition, after executing the "OPC_UA_ServerMethodPost" system function, the static parameters "finished" and "result" are reset.

### "OpcUaMethodTemplateAdvanced "

The number of calls to the system function "OPC_UA_ServerMethodPre" is limited. How many calls are possible depends on the PLC. To reset this limit, the function module "OpcUaMethodTemplateAdvanced" contains an "Enable" handling that allows the function module to be activated and deactivated. In addition, you will find a state machine in the template.

After executing the "OPC_UA_ServerMethodPost" system function, the static parameters "finished" and "result" are reset.

### Method limits

| | **Small** | **Medium** | | **Large** | **Large** |
|---|---|---|---|---|---|
| | | S7-1514 SP/S7-1515 (all variants) | S7-1516 (all variants) | S7-1517 | S7-1518 |
| Available in address space | 20 | 50 | 50 | 4000 | 8000 |
| Parallel execution | 20 | 20 | 20 | 100 | 200 |

**NOTE** The specified limits apply to TIA Portal version V20.

## 11.4. LSQL_Examples

Under "Master copies" you will find the folder "LSQL_Example", which contains a ready-made configuration of the application example: https://support.industry.siemens.com/cs/ww/en/view/109779336 for LSQL.

The description of the respective Blocks and datatypes can be found in the documentation of the application example.

# 12. Useful Information

## 12.1. Libraries in TIA Portal

Most of the blocks are stored as types in the library. Thus, the blocks are versioned and can use the following advantages:

- Central update function for library elements
- Versioning of library elements

**NOTE** For information on library use in general, see the Guide to Library Use:
https://support.industry.siemens.com/cs/ww/en/view/109747503

**NOTE** All blocks in the library were created in accordance with the programming style guide:
https://support.industry.siemens.com/cs/ww/en/view/81318674

For more information on libraries in the TIA Portal:

- How do you open, edit and upgrade global libraries in the TIA Portal?
  https://support.industry.siemens.com/cs/ww/en/view/37364723
- TIA Portal in under 10 minutes: Time Savers – Global libraries
  https://support.industry.siemens.com/cs/ww/en/view/78529894
- Which elements from STEP 7 (TIA Portal) and WinCC (TIA Portal) can be stored in a library as a type or as a master copy?
  https://support.industry.siemens.com/cs/ww/en/view/109476862
- When starting the TIA Portal V13 and higher, how do you get a global library to open automatically and use it as corporate library, for example?
  https://support.industry.siemens.com/cs/ww/en/view/100451450

## 12.2. Diagnostics

The blocks use a uniform diagnostics concept according to the programming style guide for SIMATIC S7-1200/1500.

All blocks have the outputs "busy", "error", "status", and "diagnostics". Depending on the type of block (continuous or one-time asynchronous processing), it can also have an output of "valid" or "done".
If the block implements both continuous and one-time asynchronous functions (e.g. connection setup and monitoring and sending a message), it can also have both outputs.

The "valid" or "done", "busy", "error", and "status" outputs show the current status and errors, while the "diagnostics" output provides a diagnostic structure with detailed information in the event of an error.

**NOTE** **Reset behavior of the outputs for blocks with "execute"**

As long as the input "execute" is set, the outputs keep their value. If the "execute" input is reset before the processing of the FB is completed, the values of the output parameters are output for one cycle after the job is processed.

For more information, refer to the programming style guide for SIMATIC S7-1200/1500:

https://support.industry.siemens.com/cs/ww/en/view/81318674

**status**

The "status" output provides current information as well as errors according to the following value range.

Detailed information on the status/error codes can be found in the "Error Handling" chapter of the respective library.

Table 12-1: Value ranges for information

| Information | Value range |
|---|---|
| Job completed, no warning and no further details | 16#0000 |
| Job completed, further detailing | 16#0001..16#0FFF |
| No job in process (also initial value) | 16#7000 |
| First call after input of a new job (rising edge on "execute") | 16#7001 |
| Subsequent call during active processing without further details | 16#7002 |
| Follow-up call during active machining with further detail.<br>Occurred warnings that do not further affect the operation. | 16#7003..16#7FFF |

Table 12-2: Value ranges for errors

| Errors | Value range |
|---|---|
| Incorrect operation of the function block | 16#8001..16#81FF |
| Error in the parameterization | 16#8200..16#83FF |
| Faults when executing from outside<br>(e.g. wrong I/O signals, axis not referenced) | 16#8400..16#85FF |
| Faults when executing internally<br>(e.g. when a system function is called) | 16#8600..16#87FF |
| Reserved | 16#8800..16#8FFF |
| User-defined error classes | 16#9000..16#FFFF |

### diagnostics

In the event of an error, the "diagnostics" output gives detailed information about the pending error.

The values of the "diagnostics" output are only written when an error occurs and are retained until a new job is started or another error has occurred and overwrites the values.

Unless otherwise described, the "diagnostics" output uses the PLC data type "typeDiagnostics", which is structured as follows:

Table 12-3: PLC data type typeDiagnostics

| Name | Data type | Description |
|---|---|---|
| status | Word | Status of the FB at the time of the error. |
| subfunctionStatus | DWord | Status or returned value from internal commands or FBs where an error occurred.<br>For detailed information, refer to the online help for the respective command or the documentation of the respective FB. |
| stateNumber | DInt | State of the internal state machine in which the error occurred. |

# 13. Appendix

## 13.1. Service and Support

### SiePortal

The integrated platform for product selection, purchasing and support - and connection of Industry Mall and Online support. The SiePortal home page replaces the previous home pages of the Industry Mall and the Online Support Portal (SIOS) and combines them.

- Products & Services
  In Products & Services, you can find all our offerings as previously available in Mall Catalog.
- Support
  In Support, you can find all information helpful for resolving technical issues with our products.
- mySieportal
  mySiePortal collects all your personal data and processes, from your account to current orders, service requests and more. You can only see the full range of functions here after you have logged in.

You can access SiePortal via this address: sieportal.siemens.com

### Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.
Please send queries to Technical Support via Web form: support.industry.siemens.com/cs/my/src

### SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.
For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page: siemens.com/sitrain

### Industry Online Support app

You will receive optimum support wherever you are with the "Industry Online Support" app. The app is available for iOS and Android:



## 13.2. Links and Literature

Table 13-1

| No. | Topic |
|---|---|
| \1\ | Siemens Industry Online Support<br>https://support.industry.siemens.com |
| \2\ | Link to the entry page of the library<br>https://support.industry.siemens.com/cs/ww/en/view/109780503 |
| \3\ | Application example for library "LCom" as well as blocks for S7-300/400 and SIMOTION<br>https://support.industry.siemens.com/cs/ww/en/view/48955385 |
| \4\ | Application example for the "LMQTT" library<br>https://support.industry.siemens.com/cs/ww/en/view/109748872 |
| \5\ | Application example for the "LMindConn" library<br>https://support.industry.siemens.com/cs/ww/en/view/109772284 |
| \6\ | Application example for OPC UA PubSub UDP<br>https://support.industry.siemens.com/cs/ww/en/view/109782455 |
| \7\ | Application example for OPC UA PubSub MQTT<br>https://support.industry.siemens.com/cs/ww/en/view/109797826 |
| \8\ | Application example for the "LSNMP" library<br>https://support.industry.siemens.com/cs/ww/en/view/57249109 |
| \9\ | Application example for the "LSyslog" library<br>https://support.industry.siemens.com/cs/ww/en/view/51929235 |
| \10\ | Siemens OPC UA Modelling Editor (SiOME)<br>https://support.industry.siemens.com/cs/ww/en/view/109755133 |
| \11\ | Application example for the "LSQL_Microsoft" library<br>https://support.industry.siemens.com/cs/ww/en/view/109779336 |

## 13.3. Change Documentation

**NOTE** In addition to this change documentation, you'll find a detailed changelog in the respective block.

| Version | Date | Change |
|---|---|---|
| V2.3.0 | 05/2025 | • LSNMP_ReceiveTrap function block with corresponding data type added<br>• LOpcUa: Bug fix for LOpcUa_PubMqttJson<br>• Master copies:<br>- Added OpcUaMethodTemplateAdvanced<br>- Added OpcUaMethodTemplateSimple<br>- Added LSQL_Examples |
| V2.2.0 | 06/2024 | • Added "LSQL" library<br>• LMQTT: Minor bug fix |
| V2.1.0 | 04/2024 | • Added FC "IsIPAddress" to evaluate whether a partner address in the form of a String contains an IP address or a hostname and integrated it into LFTP, LHTTP & LMQTT<br>• LHTTP:<br>- Changed behavior that HTTPS is used per default<br>- Improved handling of unusual responses<br>• LMQTT: Fixed area length error when "willMsgLen" = "0"<br>• LOpcUa:<br>- Renamed LOpcUa_PubMqtt to LOpcUaPubMqttUadp and LOpcUa_SubMqtt to LOpcUa_SubMqttUadp<br>- Updated LMQTT_Client to V4.0.3 in LOpcUa_PubMqttUadp, LOpcUa_SubMqttUadp, LOpcUa_PubMqttJson and LOpcUa_SubMqttJson<br>- Enabled simulation support for LOpcUa_SubUdp<br>- Fixed inconsistencies in library<br>• LSNMP: Bug fixes in LSNMP_GetBulk<br>• Removed LMindConn |
| V2.0.1 | 09/2023 | Minor bug fix in LMQTT |
| V2.0.0 | 08/2023 | • LHTTP: Improved handling of unusual responses<br>• LMQTT:<br>- Combined addressing the broker with hostname or IP address in one parameter<br>- Bug fixes<br>• LSNMP: Improvements in LSNMP_Get, LSNMP_GetBulk & LSNMP_Set |
| V1.6.1 | 04/2023 | • LFTP: Bug fixes<br>• LOpcUa: Bug fix in "LOpcUa_PubUdp" and "LOpcUa_Pub_X" FCs |

| Version | Date | Change |
|---|---|---|
| V1.6.0 | 02/2023 | • LCom:<br>- Added QDN as connection type<br>- Added regions in FB "LCom_Communication"<br>• LHTTP: Bug fixes<br>• LMQTT: Bug fixes<br>• Master copies:<br>- Added PLC tags "LCom_Constants"<br>- Added OB "LCom_Example"<br>- Added DB "LCom_ExampleComData" and "LCom_ExampleComBuffers"<br>- Added data type "LCom_typeComUserData"<br>- Added OPC UA structured data types |
| V1.5.0 | 12/2022 | LOpcUa:<br>• Added "LOpcUa_PubMqttJson"<br>• Added "LOpcUa_SubMqttJson" |
| V1.4.0 | 11/2022 | • LFTP:<br>- Fixed incompatibility with S7-1200<br>- Fixed timeout bug<br>• LMQTT: Minor bug fix<br>• LOpcUa:<br>- Minor bug fixes<br>- Optimizations<br>• Deleted "LOpcUa_typeString" and replaced with "WString" |
| V1.3.0 | 05/2022 | Added library "LFTP" |
| V1.2.0 | 01/2022 | • LHTTP_Get: Renamed parameter "data" to "queryParams"<br>• LHTTP_PostPut: Added parameter "contentType" to make this header field adjustable<br>• Minor improvements to OPC UA method templates |
| V1.1.1 | 09/2021 | • Minor bug fixes in "LSNMP"<br>• Fixed references in library for TIA Portal V17 |
| V1.1.0 | 07/2021 | • Added library "LMindConn"<br>• Added library "LSNTP"<br>• Added FBs for PubSub via MQTT to library "LOpcUa"<br>• Master copies:<br>- Revised OUC templates<br>- Added FB "OpcUaMethodTemplateSimple"<br>- Bug fixes in "OpcUaMethodTemplateAdvanced"<br>- Added OPC UA status codes as global constants |
| V1.0.1 | 05/2021 | LHTTP:<br>• Bug fixes for chunked encoding<br>• Supported chunk size increased |
| V1.0.0 | 12/2020 | First version |

Table 13-2: Change documentation