Grid Automation Controller COM600 4.0
SPA Router (OPC) User's Manual

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Contents:

1. About this manual

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1.2. Trademarks

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1.3. General

This manual provides thorough information on the SPA Router (OPC) Client 1.0 (later referred to as SPA Router) and the central concepts related to it. You find instructions on how to take it into use. The basic operation procedures are also discussed.

The information in this user's manual is intended for application engineers who configure SPA Router to establish communication between SPA master system and process devices connected to Grid Automation Controller COM600 (later referred to as COM600).

As a prerequisite, you should understand the main principles of SPA communication and the basic procedures in Station Automation Builder 600 (later referred to as SAB600).

This user's manual is divided into following sections:

Introduction

This section gives an overview of the SPA Router and states the system requirements to be met when using the SPA Router.

Configuration

In this section you find an overview of the configuration tasks and instructions on how to create and configure SPA Router related objects.

Operation

This section covers the basic operation procedures you can carry out when transferring or activating the COM600 computer with new configurations.

You are also given instructions on how to monitor and control the SPA Router communication.

Technical reference

This section contains a list of status codes and information on attributes. TCP/SPA tunnel specification ia also included in this section.

1.4. Document conventions

The following conventions are used for the presentation of material:
- The words in names of screen elements (for example, the title in the title bar of a window, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the ENTER key.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the space bar, comma key, and so on.
- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- Press ESC E C indicates that you press and release each key in sequence (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.
  - The following convention is used for menu operations: **MenuName > MenuItem > CascadedMenuItem**. For example: select **File > New > Type**.
  - The **Start** menu name always refers to the **Start** menu on the Windows taskbar.
- System prompts/messages and user responses/input are shown in the Courier font. For example, if you enter a value out of range, the following message is displayed:

```
Entered value is not valid. The value must be 0 - 30  .
```

- You can be asked to enter the string MIF349 in a field. The string is shown as follows in the procedure:

  MIF349

- Variables are shown using lowercase letters:

  sequence name

1.5. Use of symbols

This publication includes warning, caution, and information icons that point out safety-related conditions or other important information. It also includes tip icons to point out useful information to the reader. The corresponding icons should be interpreted as follows.

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

The caution icon indicates important information or warning related to the concept discussed in the text. It may indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader to relevant facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

1.6. Terminology

Term	Description
Alarm	An abnormal state of a condition.

Term	Description
Alarms and Events; AE	An OPC service for providing information about alarms and events to OPC clients.
Data Access; DA	An OPC service for providing information about process data to OPC clients.
Data Object; DO	Part of a logical node object representing specific information, for example, status, or measurement. From an object-oriented point of view, a data object is an instance of a class data object. DOs are normally used as transaction objects; that is, they are data structures.
Data Set	The data set is the content basis for reporting and logging. The data set contains references to the data and data attribute values.
Device	A physical device that behaves as its own communication node in the network, for example, protection relay.
Event	Change of process data or an OPC internal value. Normally, an event consists of value, quality, and timestamp.
Intelligent Electronic Device	A physical IEC 61850 device that behaves as its own communication node in the IEC 61850 protocol.
Logical Device; LD	Representation of a group of functions. Each function is defined as a logical node. A physical device consists of one or several LDs.
Logical Node; LN	The smallest part of a function that exchanges data. An LN is an object defined by its data and methods.
LON	A communication protocol developed by Echelon.
LON Application Guideline for substation automation; LAG	A proprietary method of ABB on top of the standard LON protocol.
OPC	Series of standards specifications aiming at open connectivity in industrial automation and the enterprise systems that support industry.
OPC item	Representation of a connection to the data source within the OPC server. An OPC item is identified by a string <object path>:<property name>. Associated with each OPC item are Value, Quality, and Time Stamp.
Property	Named data item.
Report Control Block	The report control block controls the reporting processes for event data as they occur. The reporting process continues as long as the communication is available.
SPA	ABB proprietary communication protocol used in substation automation.
SPA device	Protection and/or Control Product supporting the SPA protocol version 2.5 or earlier.
Substation Configuration Language; SCL	XML-based description language for configurations of electrical substation IEDs. Defined in IEC 61850 standard.

1.7. Abbreviations

Abbreviation	Description
AE	Alarms and Events
ASDU	Application Service Data Unit
BRCB	Buffered Report Control Block
DA	Data Access
DMCD	Data Message Code Definition
DO	Data Object
GW	Gateway, component connecting two communication networks together
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
LAG	LON Application Guideline for substation automation
LAN	Local Area Network
LD	Logical Device
LMK	LonMark interoperable device communicating in LonWorks network. In this document, the term is used for devices that do not support the ABB LON/LAG communication.
LN	Logical Node
LSG	LON SPA Gateway
NCC	Network Control Center
NUC	Norwegian User Convention
NV	Network Variable
OLE	Object Linking and Embedding
OPC	OLE for Process Control
P&C	Protection & Control
PLC	Programmable Logic Controller
POU	Program Organization Unit
RTS	Request To Send
SA	Substation Automation
SCD	Substation Configuration Description
SCL	Substation Configuration Language
SFC	Sequential Function Chart
SLD	Single Line Diagram
SNMP	Simple Network Management Protocol

Abbreviation	Description
SNTP	Simple Network Time Protocol
SOAP	Simple Object Access Protocol
RCB	Report Control Block
URCB	Unbuffered Report Control Block
XML	eXtended Markup Language

1.8.   Related documents

Name of the manual	MRS number
COM600 User's Manual	1MRS756125

1.9.   Document revisions

Document version/date	Product revision	History
A/10.3.2005	1.0	Document created
B/16.10.2006	3.0	Document revised
C/21.12.2007	3.1	Document revised
D/17.6.2008	3.2	Document revised
E/13.2.2009	3.3	Document revised
F/06.11.2009	3.4	Document revised
G/30.06.2011	3.5	Document revised
H/31.5.2012	4.0	Document revised

2. Introduction

2.1. Functional overview

The SPA Router protocol interface of the COM600 is intended for P&C device tools (e.g. CAP5xx and SMS5xx) using SPA protocol to access SPA parameters on devices connected to COM600. Via SPA Router the tools can access e.g. IED protection settings and disturbance recorder files using SPA parameter read and write. SPA Router cannot be used for realtime update of process data, such as events.

The devices connected to COM600 must support SPA parameter access using for example, SPA, LON, or IEC61850 (SPA over TCP/IP) protocol. Each device is seen as an own SPA slave device through the SPA Router interface, with SPA unit address configured using the SPA Cross References tool in SAB600.

SPA Router handles the routing of the messages between the SPA master and the device. Only event poll messages are responded directly by the SPA Router, they are not sent to the device as they could disturb the event handling. If the device communication is working properly, the SPA Router responds to the event poll with "no-events" message. If the device is not communicating with COM600, the event poll is not responded, which informs the master about the communication problem. SPA Router supports both serial (RS-232) and LAN (SPA over TCP/IP) communication with the SPA master.
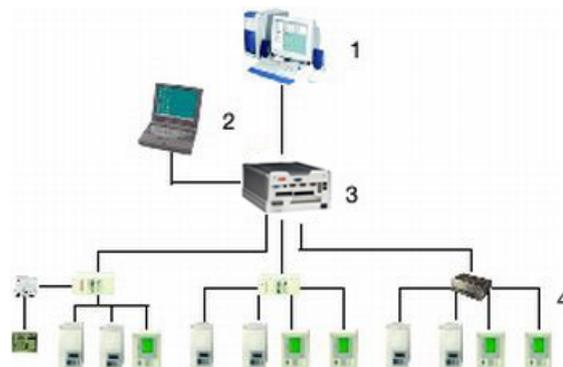
A040288.jpg

Figure 2.1-1 Overview of COM600 with SPA Router

The SPA Router is configured using SAB600. SAB600 can also be used for diagnosing and controlling the operation of the SPA Router. COM600 has a web server that can be used for remote diagnostic of COM600 including the SPA Router.

Before you can start using the SPA Router, configure at least one OPC server to provide access to the process devices. In this manual, the term SPA Device is used for a virtual device in the COM600 representing the slave device visible to the SPA master system.

2.2.   SPA Router features

- Supports SPA master connection using serial line (COM port) or TCP/IP (Ethernet port).
- Routes SPA read and write requests from SPA master to destination devices connected to COM600 OPC Servers (for example, SPA, LON, IEC61850).
- Event polls are not routed to the destination device, but are responded internally by the SPA Router.
- Time Synchronization messages **are not** handled by the SPA Router.

3.   Configuration

3.1.   About this section

This section guides you in the configuration tasks required before you can start using the SPA Router. For information on the IEC 61850 data modeling, refer to COM600 User's Manual.

Start Station Automation Builder 600 (later referred to as SAB600) to open a project where at least one OPC server has been configured. You can also open and name a new project, where you configure at least one OPC server.

1.   Select **File > Open/Manage Project...**.
2.   In the Open/Manage Project dialog, select the required location for the project:
     •   Projects on my computer
     •   Projects on network
3.   Select **New Project** on the left.
     •   Enter a Project Name. The Description is optional.
4.   Click **Create**.
5.   Click **Open Project**.

3.2.   Overview of configuration

Before you can start using the SPA Router, build and configure an object tree in SAB600 to define the Communication structure within the Gateway object.

The possible objects are:
•   SPA Router OPC Client
•   SPA Router Serial Channel
•   SPA Router LAN Channel
•   SPA Router Device

The configuration work can basically be divided into two separate tasks:

1.   building an object tree, and
2.   configuring object properties.

First, build an object tree. This is done by adding objects to the object tree, see 3.3.1, General about building object tree. After you have added the necessary objects to the object tree in the Communication structure, configure them, see 3.4.1, General about configuring objects.

When configuring OPC servers the following characters cannot be used in object names: \ ` ' ' #

Table 3.2-1 describes the objects of the object tree.

Table 3.2-1 SPA Router related objects

Object	Description
SPA Router OPC Client	An object representing the SPA Router.
SPA Router Serial Channel	An object representing the SPA Router channel using serial communication via COM port.
SPA Router LAN Channel	An object representing SPA Router channel using TCP/IP communication via ethernet port.
SPA Device	SPA devices are used as virtual devices in COM600 representing the slave devices visible to the SPA master system.
Event Definitions	Event definitions are used for the diagnostic OPC A&E Server.

3.3.   Building object tree

3.3.1.   General about building object tree

The object tree is built in the Communication structure of SAB600 by adding objects in a logical order starting from the SPA Router OPC Client.

Before the SPA Router can be taken into use, configure an OPC server for the process communication. For more information on creating an OPC server, refer to COM600 User's Manual.

You have several possible ways to add objects to the object tree in the Communication structure:

• You can right-click the object to which you want to add a child object.
• You can copy the object.

Add the objects in the following order:

1. SPA Router OPC Client
2. SPA Router Serial Channel / SPA Router LAN Channel
3. SPA Device

For information on building a substation structure, see COM600 HMI Configuration Manual.

3.3.2.   Adding SPA Router Client

To start building the object tree, add the SPA Router OPC Client in the Communication structure by selecting the Gateway object, right-clicking it, and selecting **New > SPA Router > SPA Router OPC Client**.

3.3.3.   Adding SPA Router Channels

After the SPA Router OPC Client has been successfully added, you can continue building the object tree by adding either the SPA Router Serial Channel or the SPA Router LAN Channel.

To add SPA Router Channel
1.   Select **SPA Router OPC Client** and right-click it.
2.   Add **SPA Router Serial Channel** or **SPA Router LAN Channel**.
3.   Rename the new object. The names of the SPA Router Channels have to be unique.

3.3.4.   Adding SPA Device

After a channel has been successfully added, you can continue building the structure by adding the SPA Device objects. This is done with the Cross References tool as described below. With the tool it is possible to connect the devices connected to the OPC servers to the SPA Router.

To add SPA Device
1.   Select a channel object and right-click it.
2.   Select Cross References. The Cross References window appears.

A040291.jpg

Figure 3.3.4-1 The Cross References window

3.   Enter an address for each device into the Address of SPA Unit column in the Cross References window.
      The Cross References window shows the devices configured in the OPC servers that support transparent SPA communication. For each device, you must enter an address that the SPA master uses to access the device. The default view of the Cross References table (General tab) shows all the devices configured in the OPC servers that support transparent SPA communication. You can also view the devices of a certain OPC server by selecting the particular tab. There is also possibility to

exchange the cross reference information with Microsoft Excel with export and import functions.
4. After the addresses have been entered, click **Apply** to create the cross references information for the SPA Router.
SPA device objects now appear as child objects below the SPA Router Channel.

3.4.   Configuring objects

3.4.1.   General about configuring objects

After the objects have been added, configure the object properties. shows an example of how to use SAB600 to configure the object properties for SPA Router.

To configure an object:
1. Select an object in the object tree of the communication structure.
   •
2. Select the property you want to configure. Depending on the property value type, configuring is always done either by
   • selecting a predefined value from a drop-down menu, or
   • entering a text string or a numerical value in a text field.

The available properties for different objects are listed in the following subsections.

3.4.2.   Configuring SPA Router properties

Table 3.4.2-1 lists the configurable SPA Router properties and value ranges for them. The actual configuration by using SAB600 is performed as described in 3.4.1, General about configuring objects.

Table 3.4.2-1 SPA Router properties

Property / Para-meter	Value or Value range/ Default	Description
Basic		
Prog ID AE		Instance identification of diagnostic OPC alarm and event server.
ProgID DA		Instance identification of diagnostic OPC data access server.

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3.4.3. **Configuring SPA Router Channel properties**

3.4.3.1. **Configuring SPA Router Serial Channel properties**

The SPA Router Serial Channel properties that can be configured, and value ranges for them, can be found in Table 3.4.3.1-1. The actual configuration by using SAB600 is performed as described in 3.4.1, General about configuring objects.

Table 3.4.3.1-1 SPA Router Serial Channel properties

Property / Parameter	Value or Value range/ Default	Description
Basic		
In Use	True False Default: True	Specifies whether the channel is initially in use or not.
Communication Port		
Bit Rate	300 bits/s 600 bits/s 1200 bits/s 2400 bits/s 4800 bits/s 9600 bits/s 19200 bits/s 38400 bits/s 56000 bits/s 57600 bits/s 115200 bits/s 256000 bits/s Default: 9600 bits/s	Transmission rate used on the channel.
Device Name	COM1... COM8 Default: COM1	Defines the communication port used. Number of ports depends on the used hardware.

| 3.4.3.2. | **Configuring SPA Router LAN Channel properties** |

The SPA Router LAN Channel properties that can be configured and value ranges for them can be found in Table 3.4.3.2-1. The actual configuration by using SAB600 is performed as described in 3.4.1, General about configuring objects.

Table 3.4.3.2-1 SPA Router LAN Channel properties

Property / Parameter	Value or Value range/ Default	Description
Basic		
In Use	False True Default: True	Specifies whether channel is initially in use.
Communication Port		
Local Address	Default: 127.0.0.1	The IP address of ethernet interface in COM600 used for the SPA Router.
Port	Default: 7001	Port for SPA communication over TCP.

| 3.5. | **Configuring SPA Device properties** |

Table 3.5-1 lists the configurable properties for SPA Device and value ranges for these properties. The actual configuration by using SAB600 is performed as described in 3.4.1, General about configuring objects.

Table 3.5-1 SPA Device properties

Name	Value/Value range	Description
Basic		
In use	In use Not in use Default: In use	Specifies whether the device is in use or not.
Diagnostics Enabled	True False Default: True	Defines if the diagnostics are enabled or disabled.
Addresses		
Address of SPA Unit	0...899 Default:1	Defines the SPA unit address visible to the SPA master.
Server Name		Defines the OPC server which has the cross-referenced OPC items.

Name	Value/Value range	Description
Device Connection Status OPC Item Id		Specifies the path to the device connection status OPC item.
Transparent SPA OPC Item Id		Specifies the path to the Transparent SPA OPC item.

4.   Operation

4.1.   About this section

This section describes the basic operation procedures you can carry out after the object properties for the SPA Router have been configured.

After this, you can, for example, monitor and control the condition of connections in network. This is done by using the Online diagnostics function in SAB600.

4.2.   Activating COM600 with new configurations

For information about activating COM600 with new configuration, see COM600 User's Manual.

4.3.   SPA Router diagnostics

To view version information on SPA Router or to monitor and control the state of the client, right-click the SPA Router and select **Online diagnostics**, see Figure 4.3-1.
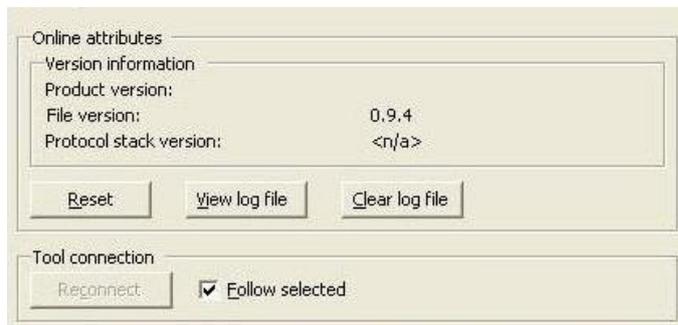
A040294.jpg

Figure 4.3-1 SPA Router Online diagnostics

In Online diagnostics box you can:
- reset SPA Router
- view the event log file, see Figure 4.3-2
- clear the event log file
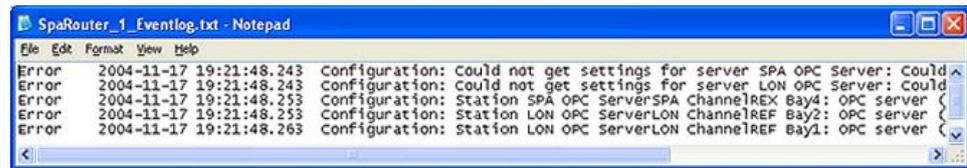
A040295.jpg

Figure 4.3-2 Event log file

4.4. SPA Router Channel diagnostics

The SPA Router Channel activity can be monitored with the Online diagnostics function.

You can also take a channel into use or out of use as described in this section.

To monitor and control SPA Router Channel activity:
1. Select the channel you want to monitor in the object tree of SAB600.
2. Right-click the channel.
3. Select **Online diagnostics**.

In the Diagnostic counters field, you can monitor the channel activity. To reset Diagnostic counters, click **Reset counters**.

You can take a SPA Router Channel into use by marking the **In use** check box. If you unmark the check box, the channel is taken out of use. To manually update diagnostic counters, click **Refresh**.

4.5. SPA Device diagnostics

The SPA Device communication can be monitored with the Online diagnostics function. You can also take a device into use or out of use as described in this section.

To monitor and control SPA Device communication:
1. Select the device you want to monitor in the object tree of SAB600.
2. Right-click the device.
3. Select **Online diagnostics**.

In the Status information field, you can monitor the device status.

The Diagnostic counters field provides information on device activity. To reset diagnostic counters, click **Reset counters**.

You can take a SPA Device into use by marking the **In use** check box. If you unmark the check box, the device is taken out of use. To manually update diagnostic counters, click **Refresh**.
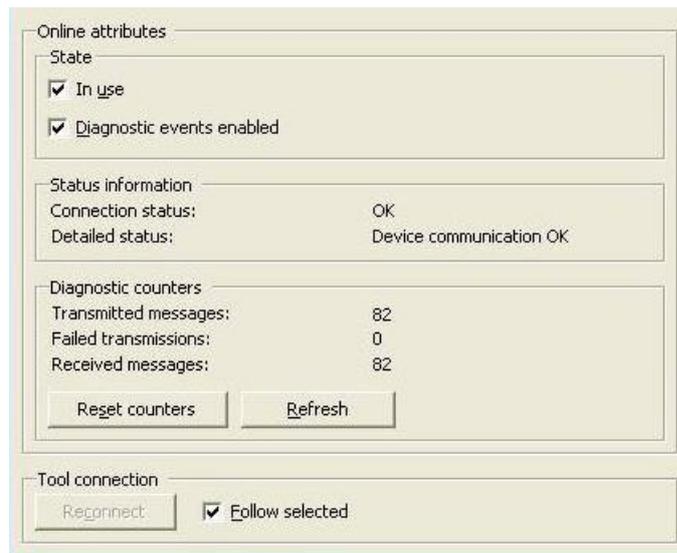
A040297.jpg

Figure 4.5-1 SPA Device Online Diagnostics

4.6.   Signal diagnostics

The SPA Router has a diagnostic function which makes it possible to monitor the flow of SPA messages transferred via the SPA Router. The diagnostic function is activated by marking the *Diagnostic events enabled* check box, located in the Online function of the SPA Device. When the diagnostic function is activated, the SPA Router Alarm and Event server generates events with information about SPA handled by the SPA Router.

To view the event list:
1. Select the SPA Router OPC Client in the object tree of SAB600.
2. Right-click the SPA Router OPC Client.
3. Select **Diagnostic AE client**.

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A040298.jpg

Figure 4.6-1 SPA Router Diagnostic AE client

5.   Technical reference

5.1.   About this section

This section provides reference information about:
- Status codes
- Attributes
- TCP/SPA tunnel specification.

5.2.   Status codes

The following status codes are defined for the SPA Router protocol. Some typical reasons for some of the status codes are also given.

Link layer status codes

0	OK
50001	Not in use.

Application layer status codes

0	OK
50001	Device not in use.
50011	Not connected to an OPC server.
50012	Channel not in use.

5.3.   Attributes

5.3.1.   General about attributes

In addition to item tags for process data (indications and commands), the OPC servers and clients also provide some item tags for controlling the devices and retrieving status information from them. These item tags are called attributes.

There are three categories of attributes: SPA Router attributes, SPA Router Channel attributes, and SPA Device attributes. These attributes are described in the following subsections.

5.3.2. SPA Router attributes

Table 5.3.2-1 SPA Router attributes

Property / Parameter	Value or Value range/ Default	Description
Protocol Stack Version	Value: Version information (read-only)	The version information of the Protocol Stack.
Reset	1 = Reset the SPA Router. 2 = Clear the log file.	Makes it possible for OPC clients to reset the SPA Router program. A reset means that the SPA Router stops all SPA communication, disconnects from the servers and reloads the configuration file.
File version	Value: Version information (read-only)	The file version number of the SPA Router EXEfile.
Product version	Value: Version information (read-only)	The version (revision) of the package that the SPA Router belongs to.

5.3.3. SPA Router Channel attributes

Table 5.3.3-1 Channel attributes

Property / Parameter	Value or Value range/Default	Description
Basic		
In use	0 = Not in use, the channel communication is stopped. Default: 1 (In use	The state of the channel - whether it is in use or not. When a channel is not in use, no data can be transmitted on it, and no data is received from it.
Object status	A status code: 0 = OK (communication works properly) 50001 = Not in use (read-only) For more information, see 5.2, Status codes.	Indicates the detailed information about the channel status.
Diagnostic counters		
Transmitted messages		The number of transmitted messages.
Transmitted NAK messages		The number of transmitted NAK messages.
Failed transmissions		The number of failed transmissions.

Property / Parameter	Value or Value range/Default	Description
Received messages		The number of received messages.
Received invalid messages		The number of invalid messages.
Received unknown messages		The number of received unknown messages.
Skipped messages		Number of SPA messages discarded due to reason that new SPA request is received before previous transaction was completed.

5.3.4.   SPA Router Device attributes

Table 5.3.4-1 SPA Router Device attributes

Property / Parameter	Value or Value range/ Default	Description
In use	0 = Out of use 1 = In use Default: 1	The operational status of the device - in use or out of use. Taking the device out of use with this attribute stops all data communication with the device. All operations that would result in a data exchange are disabled. The device itself is not affected by the attribute, only the protocol stack's image of the device. Setting In use to 1 is allowed only if the device address is legal.
Object Status	A status code: 0 = OK (communication works properly) 50001 = Not in use 50011 = Slave not connected to an OPC server 50012 = Channel not in use For more information, see 5.2, Status codes.	Indicates the detailed information about the station device status.
Device Connection Status	True = Device connection OK False = Device connection suspended.	Indicates the status of the device connection.

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Property / Para-meter	Value or Value range/ Default	Description
Diagnostic Events Enabled	True = Diagnostic events enabled False = Diagnostic events disabled	This attribute enables or disables diagnostic events.
Diagnostic counters		
Transmitted messages		The number of transmitted messages.
Failed transmissions		The number of failed transmissions.
Received messages		The number of received messages.

5.3.5. TCP/SPA tunnel specification

The TCP/IP based SPA tunnel stream transfers SPA messages across the TCP/IP connection. It can be used for several different IEDs, that is, the provided (SPA node) subaddress identifies the IED. The value depends on how the TCP/IP tunnel distributes the message further. If it is terminated within a bay level IED, such as RE.316 or REF 541, it is the normal IED SPA node address. If it is passed on for example to a serial connection, then it is the IED SPA address at this serial connection.

Set the destination IP address when initializing the stream. The default port number is 7001.

This stream transfers full SPA telegrams including checksum and frame (CR, LF). Any server or client is required to check the SPA checksum of received telegrams, to allow implementation of TCP/IP servers, which multiplex the TCP tunnel to a serial interface.

Note that the SPA application layer is based on complete SPA (application layer) telegrams, while within TCP/IP a sent message can be cut and sent in pieces. Therefore, a receiving application has to assemble the pieces to complete SPA telegrams and check the checksum before it passes on the application layer content.

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