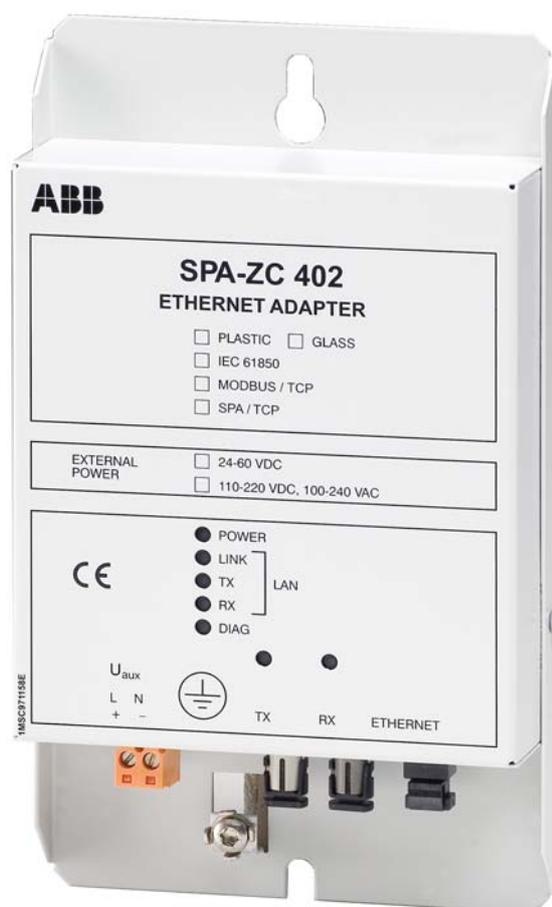


# SPA/ Ethernet Adapter SPA-ZC 402

SPA to IEC 61850 Gateway

Installation and Commissioning Manual





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## 1. Introduction

### 1.1. This manual

This manual provides thorough information on the SPA-ZC 402 Ethernet Adapter and the central concepts related to it. SPA-ZC 402 Ethernet is used for connecting any Intelligent Electronic Devices (IED), which provides fibre-optic SPA bus, to the IEC 61850 Station bus. In the manual you find information on SPA-ZC 402 and its components, an introduction to engineering tasks and a description of the basic operations.

The information in this manual is intended for application engineers, who install and configure SPA-ZC 402. As a prerequisite, you should have basic knowledge of IEC 61850 client and server architectures in general.

The IEC 61850 standards are available on IEC's web site (<http://www.iec.ch>).

### 1.2. Use of symbols

This publication includes the following icons that point out safety-related conditions or other important information:



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



The caution icon indicates important information or warning related to the concept discussed in the text. It might 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.

It should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to information or property loss. Therefore, comply fully with all notices.

### 1.3. Intended audience

This manual is intended for installation personnel, administrators and skilled operators to support installation of the software.

## 1.4. Product documentation

Name of the manual	Document ID
SPA-ZC 402 configuration CD	1MRS151049
CAP 505 User's Guide	1MRS752292-MUM
SPA-ZF Optical glass fibres, multimode graded index type	1MRS755371
Plastic-core fibre-optic cables, Features and instructions for mounting	1MRS752089
Connectivity Packages, User's Guide	1MRS755312
 <p>The Connectivity Packages can be downloaded on the ABB web site <a href="http://www.abb.com/substationautomation">http://www.abb.com/substationautomation</a>.</p>	

Related IEC 61850 standards:

- IEC 61850-6: Configuration description language for communication in electrical substations related to IEDs
- IEC 61850-7-2: Basic communication structure for substation and feeder equipment - Abstract communication service interface (ACSI)
- IEC 61850-7-3: Basic communication structure for substation and feeder equipment - Common data classes
- IEC 61850-7-4: Basic communication structure for substation and feeder equipment - Compatible logical node classes and data classes
- IEC 61850-8-1: Specific Communication Service Mapping (SCSM) - Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

Visit also the International Users Group (UCA) web page for more information about the IEC 61850 standard.

## 1.5. 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 dialog, 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 CTRL key. Although the Enter and Shift keys are not labeled they are written in capital letters, e.g. press ENTER.
- 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 ALT 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: **Menu Name > Menu Item > Cascaded Menu Item**. For example: select **File > Open > New Project**.
- The **Start** menu name always refers to the **Start** menu on the Windows Task Bar.
- 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.

You may be told 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

**1.6.****Revision history**

<b>Version</b>	<b>Date</b>	<b>History</b>
A	23.11.2004	Document created
B	30.12.2004	Ordering information updated
C	31.01.2005	Table 8.2.-2 Surge immunity updated
D	30.06.2006	SPA-ZC 402 2.0 additions
E	16.2.2007	SPA-ZC 402 2.1 additions
F	20.05.2009	SPA-ZC 402 2.1.2 additions



---

## 2. Safety information



Non-observance can result in death, personal injury or substantial property damage.

Only a competent electrician is allowed to carry out the electrical installation.

National and local electrical safety regulations must always be followed.



The device contains components which are sensitive to electrostatic discharge. Unnecessary touching of electronic components must therefore be avoided.



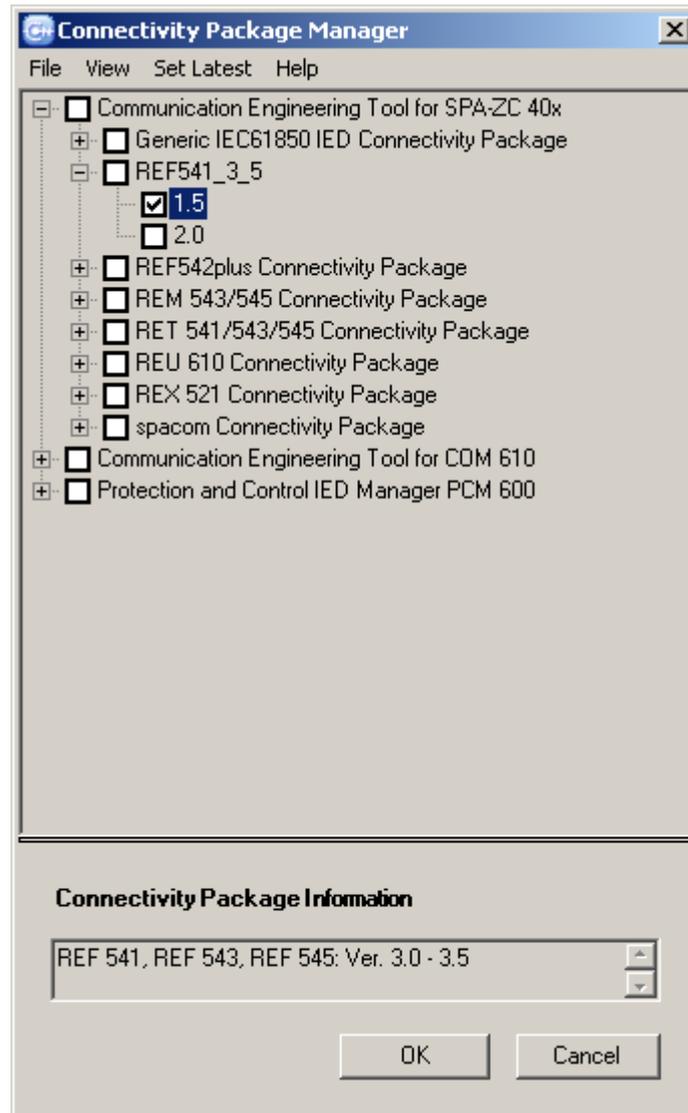
**3.****Quick start**

1. Install Communication Engineering Tool (CET) for SPA-ZC 40x and Connectivity Packages.

Download the latest Connectivity Packages on the ABB web site

<http://www.abb.com/substationautomation>.

2. Activate the appropriate Connectivity Package by using Connectivity Package Manager, see Fig. 3.-1.



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Fig. 3.-1 Connectivity Package Manager

3. Create a new project by selecting **File > Open/Manage Project** from CET for SPA-ZC 40x.
4. Install a new IEC 61850 device (SPA-ZC 40x) by right-clicking the project and selecting **New > IEC61850 > SPA-ZC 40x** (SPA-ZC40x\_v1x is for the previous version).

5. Install a new IED by right-clicking the IEC 61850 device and selecting **New > Communication**. Select the appropriate IED type and rename the IED with the unique name.



Each IEC 61850 name has to be unique in each level (IED, LD, LN, DO).

If you wish to import the existing IEC 61850 device CID file to the device, select Logical Device and import the CID file to it.

6. Import the IED application to logical device LD1 by right-clicking LD1 and selecting the AR file, which contains the IED application.
7. Set the IP address to SPA-ZC 40x in Object Properties panel.
  - Default Gateway
  - IP Address
  - SNTP Server 1 and 2
  - Subnet mask

Refer to Section 5.5.1. Changing computer's IP address.

8. Set Time Zone Correction.
9. Rename the IED, for example REF545\_F1.
10. Adjust IED SPA Communication parameters in the Object Properties panel.
11. Adjust network adapter's IP address to same subnet as SPA-ZC 402. To perform the operation, open Windows XP Network Connections in Control Panel.

If CID file exists, the IP address is read from the file. Otherwise, the default IP address of SPA-ZC 402 is 192.168.2.10.

Use IP Query Tool to find out an unknown IP address.

12. Use CID Export tool to transfer the configuration file to SPA-ZC 40x.
13. Export CID or ICD file for the IEC 61850 client.

## 4. Product overview

SPA-ZC 402 is used to connect one IED with the fibre-optic SPA bus to the IEC 61850 Station bus. The IEC 61850 standard defines the IEC 61850 communication and engineering specifications. SPA-ZC 402 offers also the possibility to access the device with the SPA protocol over the TCP/IP network using the same Ethernet link.

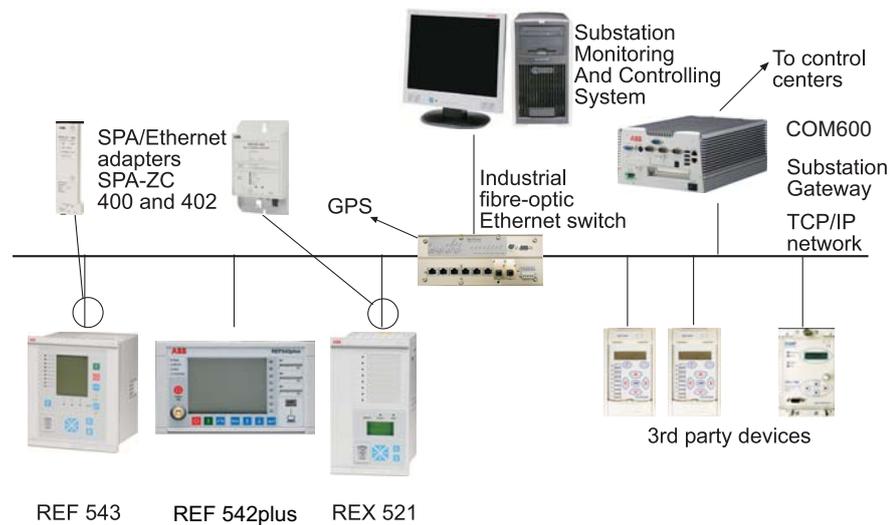


Fig. 4.-1 Conceptual picture of a typical system setup



It is not allowed to connect multiple SPA devices to SPA-ZC 402 in the SPA loop because of performance reasons. If SPA-ZC 402 is an integral part of a bigger rack, for example of a SPACOM 300 series rack, configure all devices under the same SPA-ZC 402. The SPACOM 300 series rack is one SPA device.

The mechanical and electrical connection of the Ethernet adapter to an IED interface is described in Section 5. Installation. The Ethernet adapter programming is described in Section 6. Engineering.

It is a prerequisite to understand the communication properties of Intelligent Electronic Devices (IED) before connecting to the Ethernet adapter. This information is available in the manual for the protection relay in question. It is also necessary to have basic understanding of the IEC 61850 system to which the IEDs will be connected.

ABB has tested the following third-party devices, which are recommended to be used with SPA-ZC 402:

Industrial 10/100 MBit switches:

- RuggedCom RS800
- RuggedCom RS1600

- RuggedCom RSG2100
- Westermo FST208

Media converters:

- RuggedCom RMC-100-MM
- IMC McBasic MM1300
- Allied Telesyn AT-MC302-20

More tested devices can be found on the ABB web site  
<http://www.abb.com/substationautomation>.

## 4.1.

### Features

SPA-ZC 402 has the following features:

- IEC 61850 connectivity for IED with fibre optic SPA bus
- Auxiliary power supply
- Easy-to-use configuration tool for the IEC 61850 data mapping
- Support of communication over TCP/IP

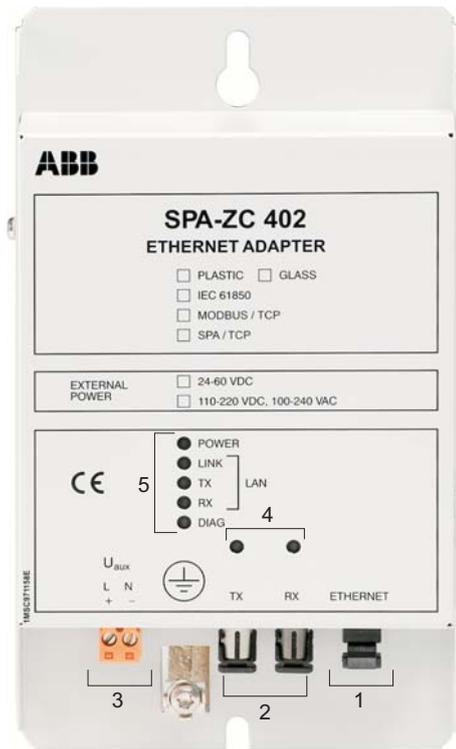
All relay data can be routed through SPA-ZC 402. The process data (status, measurements and commands) is routed through the IEC 61850 bus and the rest of the available data can be routed through SPA over TCP/IP.



Only one SPA client can be configured to poll SPA events from the device. By default SPA-ZC 402 is configured to poll SPA events, then it is not allowed to poll SPA events from another SPA client.

If the parallel IEC 61850 communication is configured for RE\_541/3/5 with two SPA-ZC 40x gateways, SPA event polls have to be disabled in another gateway.

If the parallel IEC 61850 communication is configured for RE\_541/3/5 with two SPA-ZC 402 gateways, SPA event polls has to be disabled in another gateway.



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Fig. 4.1.-1 Parts of SPA-ZC 402

- 1 Ethernet connector
- 2 Fibre-optic SPA bus connectors
- 3 Auxiliary power supply connector
- 4 SPA TX and RX LEDs
- 5 LAN and diagnostics LEDs

## 4.2. IEC 61850 standard

The IEC 61850 standard is a comprehensive and durable standard, which defines the communication between Intelligent Electronic Devices (IED) in substations. It is not dependent on any application and offers one protocol which answers to all requirements in substation. The configuration of the protocol is flexible. When using the IEC 61850 standard, it is possible to allocate the functions and integrate the functionality freely.

The IEC 61850 standard supports the following functions:

- Protection and control
- Integration of innovative sensor and switch technologies
- Metering, supervisory control and data acquisition (SCADA)
- Remote monitoring and fault diagnostics
- Automated dispatch and control
- Asset management
- Condition monitoring and diagnostics

The IEC 61850 standard provides:

- Standardized information models for all kinds of protection relays, controllers, circuit-breakers, transformers, and so on.
- Information exchange methods to access the information models' data: report sequences-of-events, log historical data, control devices, sampled value distribution, fast peer-to-peer process data exchange, and so on.
- A unified system configuration language (XML-based) and device online self-description.

Compared to other communication standards for substation automation, the IEC 61850 standard defines data modeling and communication services for this specific domain. Data modeling is mapped to a communication protocol, Manufacturing Message Specification (MMS, ISO 9506 protocol), which uses TCP/IP and Ethernet. In addition to the communication specifications, engineering information exchange is defined in Substation Configuration Language (SCL), which is an XML based language. SCL ensures that IEC 61850 compatible IEDs can be integrated in one system. For more information on the IEC 61850 standard documentation, see Section 1.4. Product documentation.

## 5. Installation

This chapter describes the installation of the SPA-ZC 402 module and the Communication Engineering Tool (CET) for SPA-ZC 40x. For additional information, such as technical data, maintenance and service, refer to Section 8. Technical data and Section 9. Maintenance and service.

### 5.1. Mechanical installation

Screw the SPA-ZC 402 module on the cubicle's bottom or wall near the protection relay. Pay attention to the length of the fibre-optic SPA cable when you are installing the SPA-ZC 402 module.

### 5.2. Installing communication cable

Connect the fibre-optic SPA bus cable between IED and SPA-ZC 402. Connect the LAN cable to the LAN connector of SPA-ZC 402. The other end of the cable is connected to the IEC 61850-8 station bus through the Ethernet switch.

#### 5.2.1. Auxiliary power connection

Voltage range for the external power connection ( $U_{aux}$ ) is

- 110-220 VDC, 100-240 VAC or
- 24-60 VDC

**Table 5.2.1.-1 Screw terminal of  $U_{aux}$  connection**

Screw terminal	AC	DC
1	L	+
2	N	-

In addition there is an earthing screw for the protective earth conductor beside the screw terminals in the casing.

### 5.3. Communication Engineering Tool for SPA-ZC 40x

#### 5.3.1. System requirements

Communication Engineering Tool (CET) for SPA-ZC 40x runs on Windows 2000, Windows XP and Windows Server 2003 operating systems. A PC capable of running one of these operating systems is sufficient also for CET for SPA-ZC 40x. For more information, refer to Section 1.4. Product documentation. The detailed system requirements can be seen below.

- 20 MB free hard disk space if Microsoft .NET Framework 1.1, which is required for running CET for SPA-ZC 40x, has already been installed.
- 100 MB free hard disk space, if the Microsoft .NET Framework 1.1 is not installed. It is installed automatically if it is not found.

---

**5.3.2.****Installing Communication Engineering Tool for SPA-ZC 40x**

1. Uninstall the previous version.
2. Close all the open programs and insert the Communication Engineering Tool (CET) for SPA-ZC 40x installation CD to the CD-ROM drive of your PC.
3. The Installation program starts automatically. If this is not the case, open the program by starting setup.exe on the CD drive.
4. The installation wizard extracts the installation files to your local computer.
5. The CET for SPA-ZC 40x Installation program starts. In this dialog, click **Next**.
  - With the **Back** button you can return to the previous dialog, and with the **Cancel** button, exit the installation wizard. This applies to all the dialogs in the installation wizard.
6. Read the License Agreement, select the option **I accept the license agreement** and click **Next** to continue the installation.
  - If the option **I do not accept the license agreement** is selected, the **Next** button is not available and you cannot continue the installation.
7. Select the folder in which the application is to be installed.
  - To select the default folder shown at the bottom of the dialog, click **Next**.
  - To select another folder, click **Browse**, choose the folder you want and click **Next**.
8. Both manuals are installed by default on your local hard drive. Click **Next** to continue the installation.
  - To install a manual, click the respective manual and select **Will be installed on local hard drive**.
  - To install the documentation feature, click the respective manual and select **Entire feature will be installed on local hard drive**.
  - To install the manual when required, click the respective manual and select **Feature will be installed when required**.
  - Not to install the manual, click the respective manual and select **Entire feature will be unavailable**.
9. Click **Next** to begin the installation.
10. Follow the progress of the installation in a dialog that also shows the directory path where the files are copied. At this point, you can still cancel the installation by clicking **Cancel**.
11. A dialog opens to show that the tool has been successfully installed. Close the dialog and finish the installation by clicking **Finish**.
12. When clicking **Finish**, the wizard also installs the Microsoft SQL Server automatically, if it is not installed already.
13. Start CET for SPA-ZC 40x by selecting **Start > Programs > Communication Engineering Tool for SPA-ZC 40x > Communication Engineering Tool**.



After installing a new CET for SPA-ZC 40x version or new Connectivity Packages, always activate the correct Connectivity Package version again by using the Connectivity Package Manager.

### 5.3.3. Uninstalling Communication Engineering Tool for SPA-ZC 40x

1. Open the Add or Remove Programs dialog by selecting **Start > Settings > Control Panel > Add or Remove Programs**.
2. Select Communication Engineering Tool (CET) for SPA-ZC 40x and click **Remove**.



Uninstall CET for SPA-ZC 40x in order to install a new version and to update the software. Uninstallation does not remove the Microsoft SQL Server and .NET Framework. Removing these programs can affect the functionality of the other ABB applications.



Detailed instructions for upgrading the software are provided when the upgrade is available.

### 5.4. Installing Connectivity Packages

1. Close all the open programs and insert the SPA-ZC 402 configuration CD to the CD-ROM drive of your PC.



The Connectivity Packages can be downloaded on the ABB web site <http://www.abb.com/substationautomation>.

Contact ABB to check the connectivity package's status for the Intelligent Electronic Device (IED) in question.

2. Double-click the Connectivity Package installation program and select the relevant IED (.msi) to start the installation.



Install the Connectivity Package after installing the Communication Engineering Tool (CET) for SPA-ZC 40x, see Section 5.3.2. Installing Communication Engineering Tool for SPA-ZC 40x. If this is not the case, re-install the Connectivity Package after installing the CET for SPA-ZC 40x.

3. The installation wizard extracts the installation files to your local computer.

4. The Connectivity Package Installation program starts. In this dialog, click **Next**.
  - With the **Back** button return to the previous dialog, and with the **Cancel** button, exit the installation wizard. This applies to all the dialogs in the installation wizard.
5. Read the License Agreement, select the option **I accept the license agreement** and click **Next** to continue the installation.
  - If the option **I do not accept the license agreement** is selected, the **Next** button is not available and you cannot continue the installation.
6. Select the folder in which the application is to be installed.
  - To select the default folder shown at the bottom of the dialog, click **Next**.
  - To select another folder, click **Browse**, choose the folder you want and click **Next**.
7. Click **Next** to begin the installation.
8. Follow the progress of the installation in a dialog, which also shows the directory path where the files are copied to. At this point, you can still cancel the installation by clicking **Cancel**.
9. A dialog opens to show that the Connectivity Package has been successfully installed. Close the dialog and finish the installation by clicking **Finish**.



After installing a new CET for SPA-ZC 40x version or new Connectivity Packages, always activate the correct Connectivity Package version again by using the Connectivity Package Manager.

#### 5.4.1.

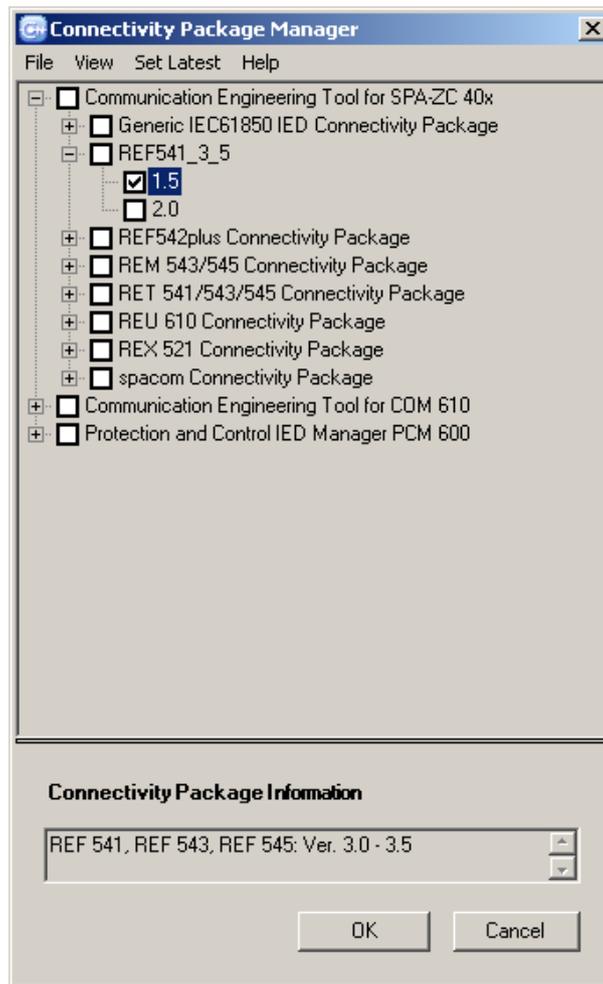
### Enabling Connectivity Packages

Use Connectivity Package Manager to enable the Connectivity Packages for SPA-ZC 402.



Only one version of each Connectivity Package can be enabled at a time.

1. Double-click the icon on the computer's desktop to start the Connectivity Package Manager.
2. Select the corresponding Connectivity Package to enable it for SPA-ZC 402.
3. Click **OK** to apply the selection, see Fig. 5.4.1.-1.



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*Fig. 5.4.1.-1 Connectivity Package Manager*

## 5.4.2. Uninstalling Connectivity Packages

1. Open the Add or Remove Programs dialog by selecting **Start > Settings > Control Panel > Add or Remove Programs**.
2. Select the relevant Connectivity Package and click **Remove**.

## 5.5. Connecting to SPA-ZC 402

The Sections 5.5.1. and 5.5.2. describe how to connect to SPA-ZC 402 from the Communication Engineering Tool (CET) for SPA-ZC 40x.

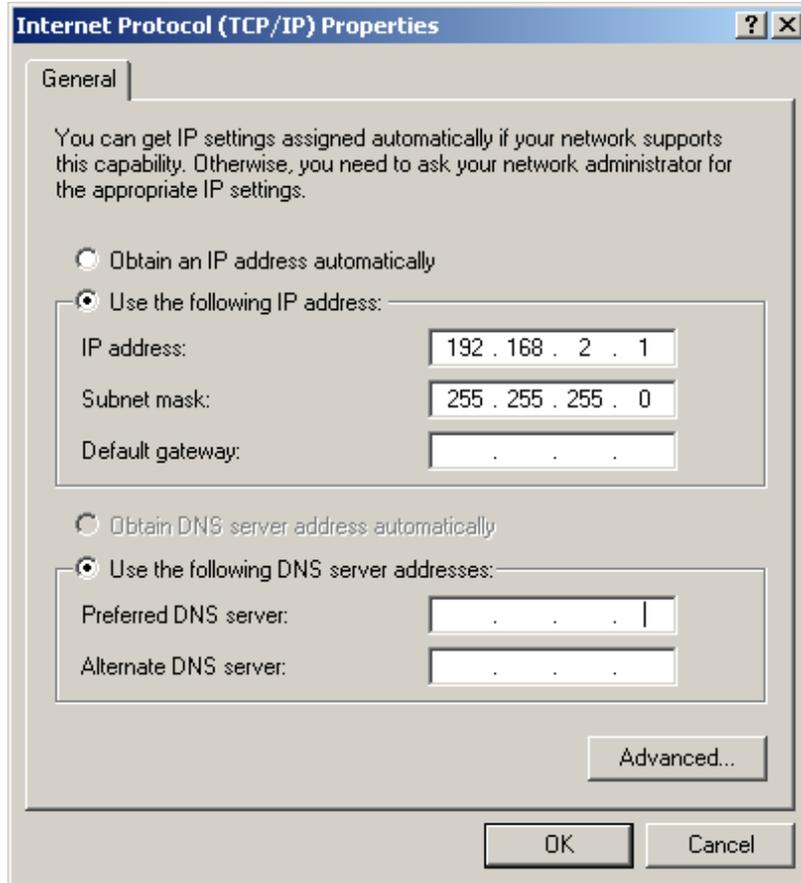
### 5.5.1. Changing computer's IP address

To connect SPA-ZC 402, the used computer and SPA-ZC 402 must use the same address space.

To change the computer's IP address space to be the same as in SPA-ZC 402:

1. Open the Network Connections in Control Panel.
2. Type, for example, the following IP address to the IP address box: 192.168.2.1. See Fig. 5.5.1.-1.

You must have system administration rights to perform the task.



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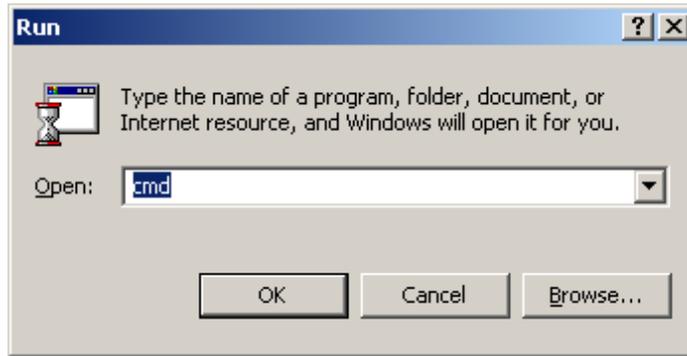
Fig. 5.5.1.-1 Changing IP address

### 5.5.2.

### Checking connection to SPA-ZC 402

Check the connection to SPA-ZC 402 by using the ping command:

1. Open the Run dialog.
2. Type cmd to the Open box, see Fig. 5.5.2.-1.



A060242

Fig. 5.5.2.-1 Starting command prompt

3. Click **OK** to run the command prompt.
4. Type ping 192.168.2.10, see Fig. 5.5.2.-2.

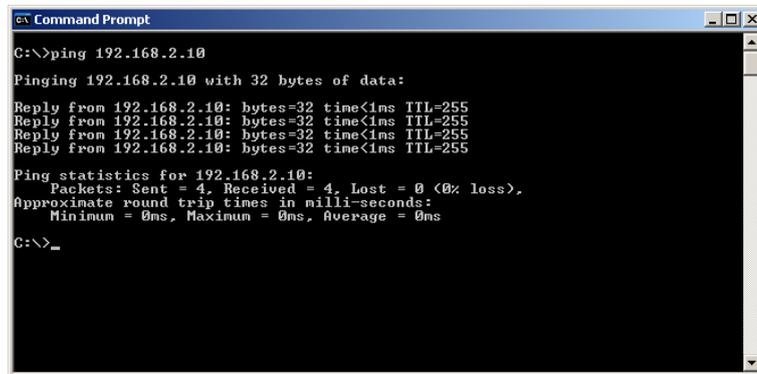


Fig. 5.5.2.-2 Pinging SPA-ZC 402

SPA-ZC 402 responds to the ping command if the computer and SPA-ZC 402 are on the same network.

5. If SPA-ZC 402 responds with the IP address, the connection is established between the computer and SPA-ZC 402.



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## 6. Engineering

This section guides when performing the engineering tasks required before using SPA-ZC 402.

For more information on the IEC 61850 data modeling, refer to the IEC 61850 standards listed in Section 1.4. Product documentation.



Note that all the possible engineering scenarios are not included in this manual. You must have engineering rights to be able to perform the tasks described in this section.

### 6.1. Overview of engineering

The engineering and maintenance of SPA-ZC 402 is done by using CET for SPA-ZC 40x functions or by importing the existing SPA-ZC 40x CID file. The device's communication structure is described in the Project Explorer dialog. The structure is built by using device objects. These objects have communication properties that can be accessed through the Object Properties dialog. These properties define for example the IP addresses, unit addresses, and descriptions.

The process data accessible on devices is modeled according to the IEC 61850 standard. The communication structure consists of:

- Logical devices (LD)
- Logical nodes (LN)
- Data objects (DO)
- Data attributes (DA)

The data model is imported from the preconfigured object types of devices, which have the objects defined and configured. These object types are defined in the standardized IED Connectivity Packages. The data model can also be created manually by using CET for SPA-ZC 40x functions.

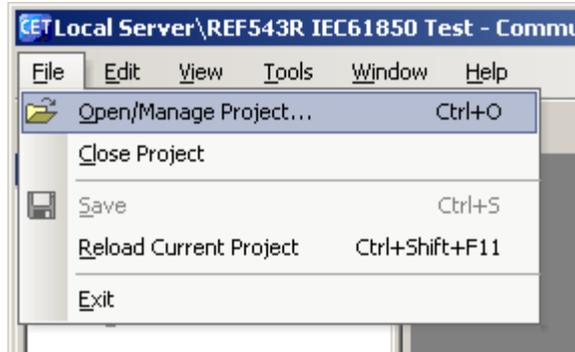
When the structure is complete and all the objects have been set up properly, the configuration is downloaded through FTP to SPA-ZC 402 by using the CID (Configured IED Description) Export function.

The engineering tasks are the following:

1. Building an object tree according to the IEC 61850 data model by importing the Connectivity Package or by adding the IEC 61850 data objects manually to the configuration
2. Configuring object properties, for example adding mapping to the SPA references in the IED (Intelligent Electronic Device)
3. Configuring IED TCP/IP addresses and parameters
4. Configuring SPA addresses and parameters
5. Exporting configuration data to SPA-ZC 402 and to the IEC 61850 system configuration tool

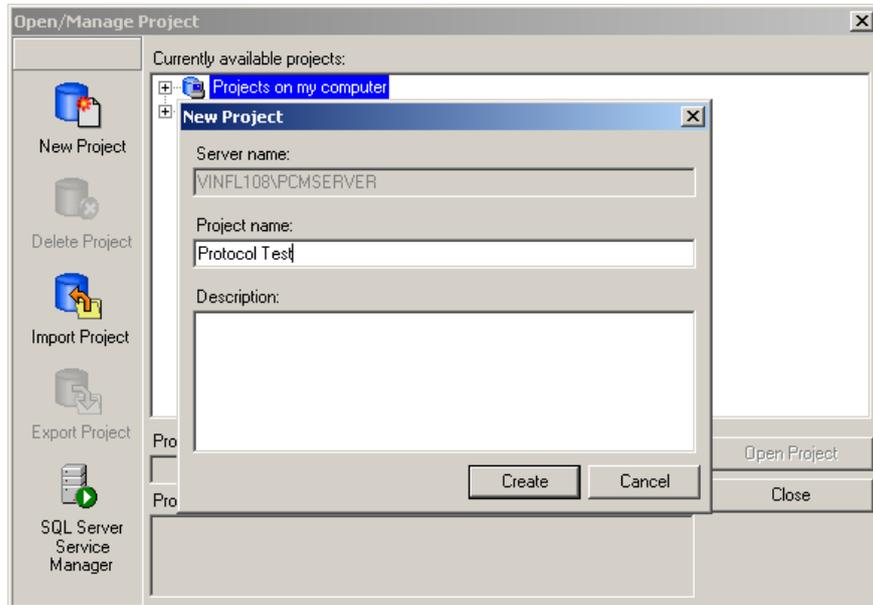
## 6.2. Creating project

You need to start the Communication Engineering Tool (CET) for SPA-ZC 40x to open and name a project, see Fig. 6.2.-1 and Fig. 6.2.-2.



A040013B

Fig. 6.2.-1 Opening a project



A040014B

Fig. 6.2.-2 Creating a new project

## 6.3. Restarting

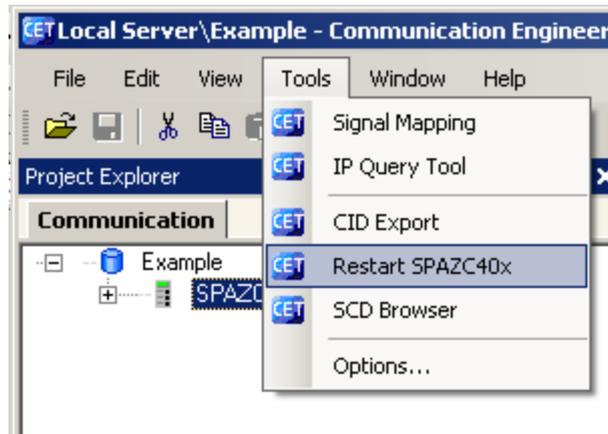
Use this function to restart the SPA-ZC 402 at runtime.

1. Select IED and **Tools > Restart SPAZC40x** to open the restart panel, see Fig. 6.3.-1
2. Click **Reset**.

The results are reported to the UI text box.



Do not use the restart function while downloading configuration to SPA-ZC 402. When download is finished, SPA-ZC 402 is restarted automatically.



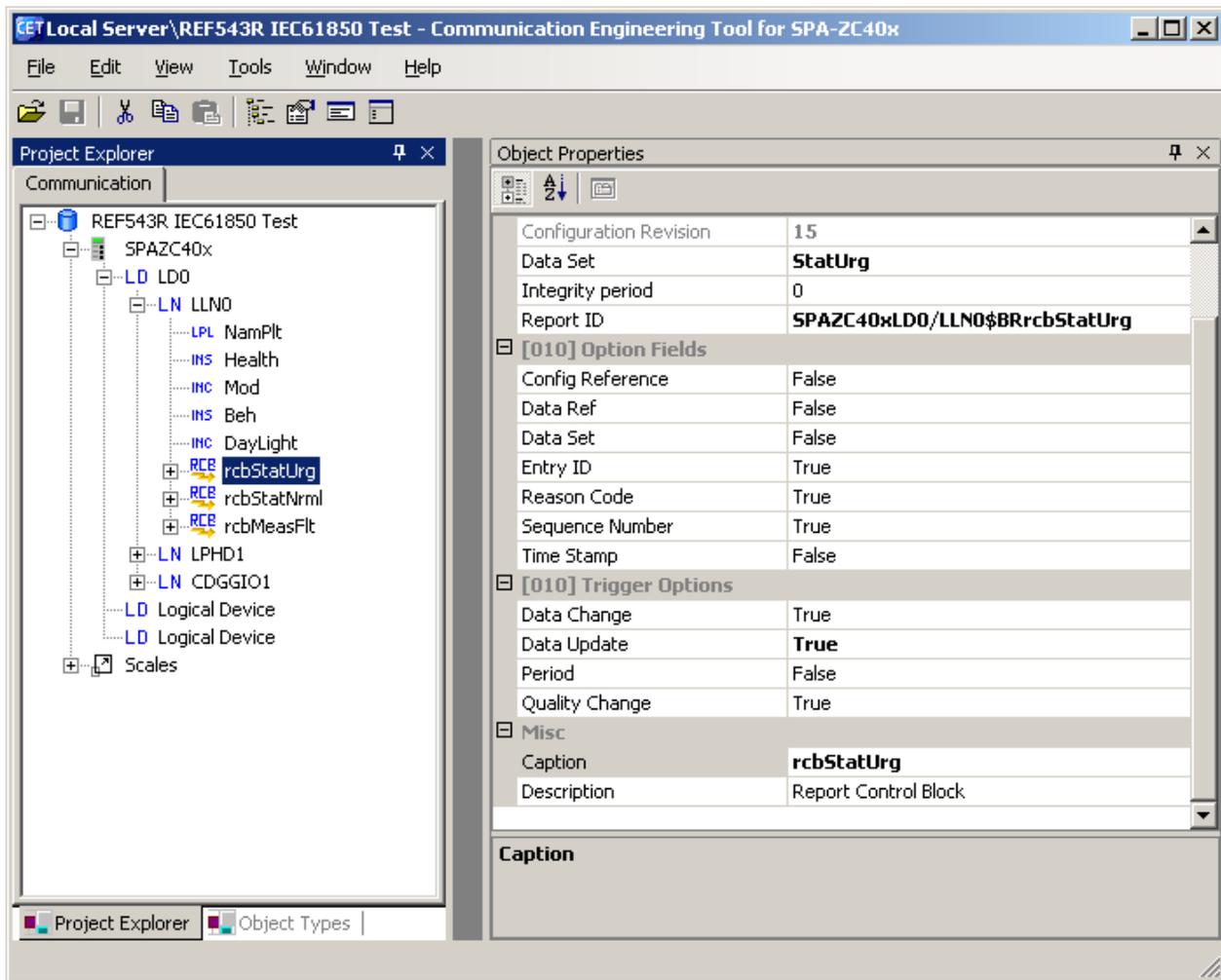
A060396

*Fig. 6.3.-1 Restarting*

## 6.4. Building object tree

After installing the Connectivity Package you need to build and configure an object tree in the Communication Engineering Tool (CET) for SPA-ZC 40x to define the communication structure.

Fig. 6.4.-1 shows an example of the object tree when it has been built. In the example tree you can see the SPA-ZC 402 object and its child objects as devices and data objects. Indentation is used to indicate the parent-child relationship between the objects.



A040137B

Fig. 6.4.-1 Example view of the SPA-ZC 40x Communication Engineering Tool

Add objects to the object tree in the communication structure by right-clicking the object to which you want to add a child object. Use LN and DOI wizards to create new objects.

Add the objects in the following order:

1. IEC 61850 Device object (SPA-ZC 40x)
2. Logical Device objects
3. Logical Node objects
4. Data objects
5. Datasets
6. Reporting control blocks
7. GOOSE control blocks
8. GOOSE inputs

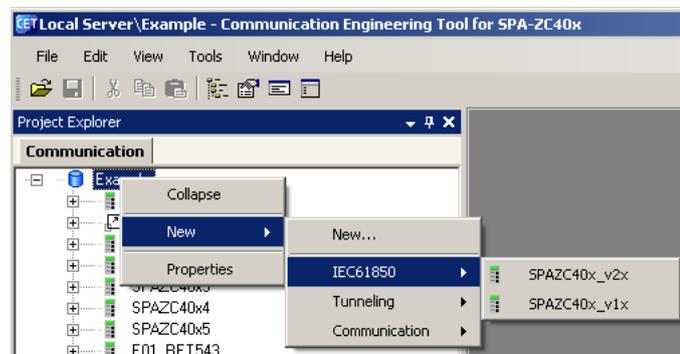
### 6.4.1. Adding Device object

To build the object tree:

1. Add an IEC 61850 Device object in the communication structure by selecting the project name.
2. Right-click Protocol Test
3. Select **New > IEC 61850 > SPAZC40x\_v2x**, see Fig. 6.4.1.-1.

Normally, the SPAZC40x\_v2x template from the menu is used. Only if the connected SPA-ZC 402 is an older version 1.1.1, you have to select its own IED template SPAZC40x\_v1x from the menu. This is illustrated in the following figure.

A project can contain several IEC 61850 device objects, for example all substation feeder configurations and exported communication must be done separately for each device.



A040023\_3

Fig. 6.4.1.-1 Adding an IEC 61850 Device object

Ensure that the new IED name is unique within the planned network by renaming the IED, for example REF545\_F1.



A Tunneling Device object cannot be configured for an IEC 61850 gateway.

The Logical Device LD0 describes SPA-ZC 402 and includes the data objects for diagnostics and description. All data sets and report control blocks (RCB) are collected to LLN0.

### 6.4.2. Adding Logical Device objects

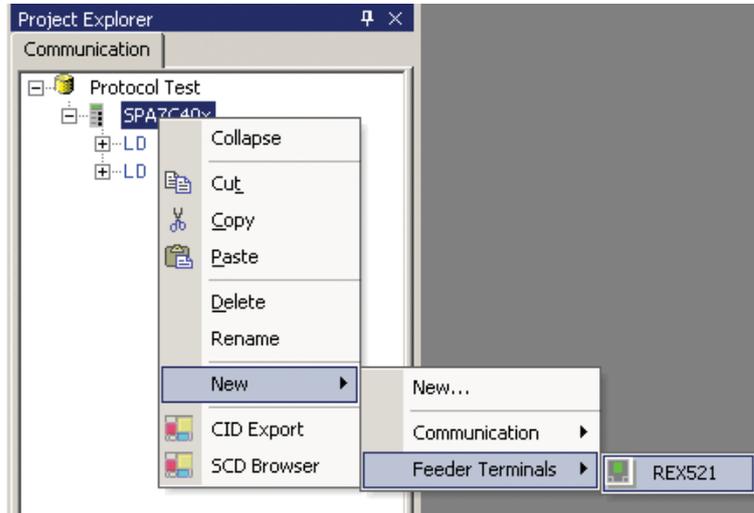
Communication Engineering Tool (CET) creates logical device LD0 automatically for SPA-ZC 402 when creating a new IED. All datasets and reporting control blocks (RCB) are grouped under LD0 for event handling. It has also basic logical nodes and data objects for diagnostics and device information.



Do not change the name of the LD0.

Adding a new Logical Device object (for example REX 521, see Fig. 6.4.2.-1) is possible only after you have installed Connectivity Packages to your computer. The IED's data model behind SPA-ZC 402 is described in the logical device LD1.

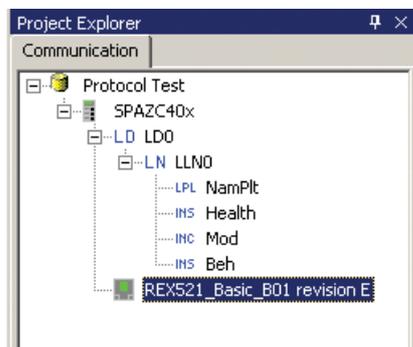
For more information about installing Connectivity Packages, refer to Section 5.4. Installing Connectivity Packages.



A040154

Fig. 6.4.2.-1 Adding Logical Device objects

The logical device object is now shown as a sub-object to the IEC 61850 Device object, see Fig. 6.4.2.-2.



A040155

Fig. 6.4.2.-2 Logical node is shown as sub-object



You should have at least one Logical Device object as a child object to each IEC 61850 Device Object.



You can have a maximum of seven Logical Device objects under one Device Object (LD0 and six IED logical nodes).

When the actual IEC 61850 data model is created, the logical device name has two parts:

- Device Object name
- Logical Device name

For example, REF543\_F1LD0.

### 6.4.3.

#### **Importing IEC 61850 data object model of IED**

1. Right-click to select a Logical Device created in Section 6.4.2. Adding Logical Device objects (for example, REX 521).
2. Import the data model by selecting the Generate Configuration function and by choosing the right IED type.

The imported file, which is in the specified directory, is a compressed archive file from CAP 505 Application Library with the file extension .AR.

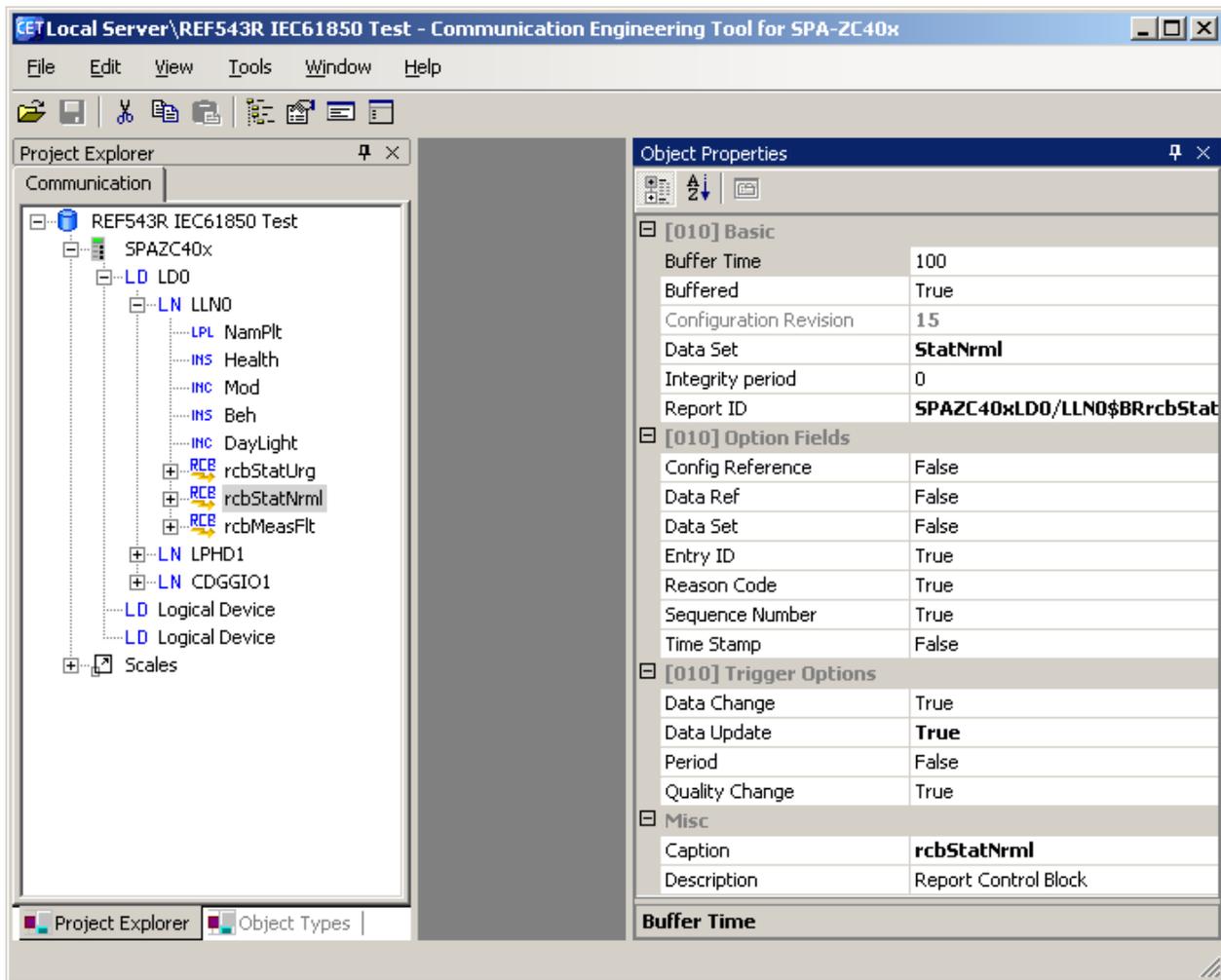
Communication Engineering Tool (CET) for SPA-ZC 40x converts the project files with the help of the Connectivity Packages to a IEC 61850 data object model.

The Connectivity Package does not necessarily support all the functions of IED. The functions, which are not mapped to the IEC 61850 structure, are reported after import.

The tool imports default data sets and report control blocks (RCB) to logical device LD0, see Fig. 6.4.3.-1. Data sets include a set of selected data attributes from IED's IEC 61850 data model. These data sets are used in the IEC 61850 event reporting model. If data attributes are selected to the data set and the same data set is used in report control block (RCB), the data set generates a spontaneous event which will be sent to the IEC 61850 client. If the data set is not defined in the RCB, the IEC 61850 client reads the data separately. You can modify data sets with Dataset Editor tool, see Section 6.5. Using Dataset Editor.



After adding a new relay, give the IED with the unique name in the network. Space is not allowed on the IED's name. Renaming can be done in the Project Explorer dialog, see Fig. 6.4.3.-1.



A040026B

Fig. 6.4.3.-1 Project Explorer dialog in the Communication Engineering Tool window

### 6.5. Using Dataset Editor

The dataset groups selected data so that a client can access it easily with a single read operation. Dataset is also the basic part of event reporting; data is linked to spontaneous event sending only via report control blocks (RCB) dataset definition. The client reads other data separately. Datasets definitions are located always under the logical device LD0 and logical node LLN0. The SPA-ZC 40x dataset maximum length is 320 data attributes. The tool warns the user if the dataset is too long.

You can modify dataset by using Dataset Editor. Open Dataset Editor by selecting the dataset and right-click to open Dataset Editor. Dataset has a set of data attributes: logical device instance name, optional prefix, logical node instance name, logical node class, data object name and functional constraint (FC). Functional constraint divides data attributes to groups, which have the same functional constraint, under the same data object. For example, functional constraint ST (status information) groups stVal, q and t data attributes together, and then you do not have to add data attributes one by one to the dataset. Data attributes are collected to the dataset in

groups, and functional constraint defines the data attributes. This is MMS protocol's naming feature, which is the basic part of naming and protocol definition in the IEC 61850 standard.

Delete the dataset by selecting the line and either pressing DELETE or selecting **Edit > Delete function**.



StatUrg - Dataset Editor						
	ldInst	prefix	InInst	InClass	doName	fc
	LD1		(null)	LLNO	Mod	ST
	LD1		(null)	LLNO	Beh	ST
	LD1		(null)	LLNO	Health	ST
	LD1		120	CILO	EnaOpn	ST
	LD1		120	CILO	EnaCls	ST
	LD1		120	CSWI	Loc	ST
	LD1		120	CSWI	Pos	ST
	LD1		120	XCBR	Loc	ST
	LD1		120	XCBR	OpCnt	ST
	LD1		120	XCBR	Pos	ST
	LD1		120	XCBR	BlkOpn	ST
	LD1		120	XCBR	BlkCls	ST
	LD1		120	XCBR	CBOpCap	ST
	*					

A040028

Fig. 6.5.-1 Dataset Editor

Dataset Editor columns:

- **ldInst**  
Instance of Logical Device to which referenced dataset belongs
- **Prefix**  
Freely configurable part of LN Caption
- **InInst**  
Instance of the LN type  
Class of the LN type
- **InClass**
- **doName**  
Name of the data object from which dataset is formed
- **daName**  
Name of the data attribute from which dataset is formed from
- **fc**  
Identifies the signal measurement type to MX, if the status is ST

Prefix, InClass and InInst define the object tree's caption. Caption is shown in the following way: Prefix + InClass + InInst = LN Caption.

## 6.6. Configuring by using imported CID file

If you have to configure several SPA-ZC 402 with the similar IEC 61850 data object model, it is possible to import a previously generated CID file and change the communication addresses, typically by changing the IP address.

1. Create the project and add the logical device LD0 like in Section 6.4. Building object tree.
2. Add a logical device to the SPA-ZC 40x Device object by right-clicking to select **SPA-ZC 40x > New > Communication > Logical Device**.
3. Select the CID import function by choosing a new empty logical node and then right-click to select the CID import function.

In the CID import dialog you can select the right CID file from the workstation directory and import it to a previously created logical node. LD0 contains the data sets and reporting control blocks. Other logical devices describe the data model of a connected IED.

## 6.7. Configuring communication parameters

SPA-ZC 402 communication parameters are located in the device properties. SPA-ZC 402 uses static IP addresses, which have to be defined in the planned network structure.

- IP Address

IP address identifies SPA-ZC 402 in Local Area Network (LAN). All communication via SPA-ZC 402 uses this address. The default value is 192.168.2.10 and it has to be changed to a unique address according to the planned network structure.

- Default Gateway

This IP address defines the gateway's address, which forwards IP traffic between the local subnet and outside world. The default value is 192.168.2.1 and it has to be changed according to the planned network structure.

- Subnet Mask

This subnet mask defines which addresses are not in the local subnet and must be accessed through the default gateway.

- SNTP Servers

SPA-ZC 402 uses SNTP for its own realtime clock. The time is used for synchronizing the IED with SPA time synchronization. One SNTP Server has to exist in the accessible network, otherwise the SPA-ZC 402 event time stamping is not working properly. The primary server is mainly in use. The secondary SNTP server is used, if the primary SNTP server cannot be reached. While using the secondary SNTP server, SPA-ZC 402 tries to change to the primary server in every third SNTP request attempt. The primary server is used, if the request is succeeded.

If both SNTP servers are offline, the event time stamps have the status: ClockNotSynchronized. If at least one SNTP server is online, but the server’s clock is not synchronized, the event time stamps have the status: ClockFailure. In addition, when a time synchronization message is not received during the startup, the time stamping starts at 00:00:00 01.01.1970. The time is requested from the SNTP server every 60 seconds.

- Time Zone Correction

Due to the SNTP time synchronization, a time offset must be added to the SPA time synchronization message depending on the time zone. It affects the IED HMI event list. The value (in minutes) is between - 720 and 780 and it is comparable to Coordinated Universal Time (UTC).

- OSI addresses are read-only and they are always the same. The IEC 61850 client uses these addresses to access SPA-ZC 402 over MMS.

An established IEC61850 connection uses the TCP keepalive functionality, if there is no other active communication ongoing. TCP keepalive is sent every 15 seconds. If the peer is not responding, it is considered to be time-outed and the TCP connection is closed.

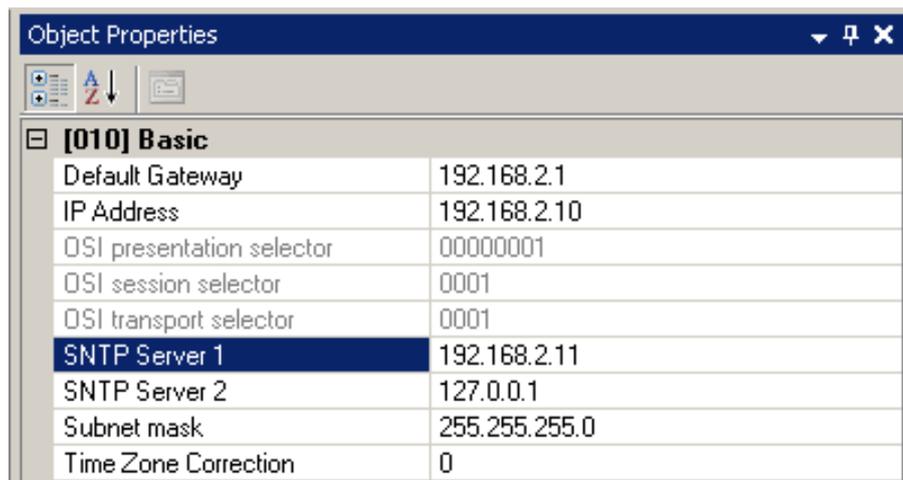


Fig. 6.7.-1 General communication parameters

**6.7.1.**

**SPA Communication parameters**

- SPA Address

SPA-ZC 402 needs also an IED SPA address to access the SPA data. Every logical device has SPA Communication Parameters Object properties except LD0, which describes the SPA-ZC 402. The SPA address object property has to be the same as the configured SPA unit number in IED.

- SPA Password

SPA password is used for commands and it has to be the same as the defined password in the IED. The password can be modified in the IED side with HMI or a specific tool.

SPA-ZC 402 has to know the SPA password to enable the control service with the connected IED. This value is written to the SPA parameter 0V160. The SPA password has to be the same as defined in IED MMI.

- Bit rate

The default value of the communication bit rate in the internal link between the IED and SPA-ZC 402 is 9600. Other possible values are 1200, 2400, 4800, 19200 and 38400 bits/s. Used value has to be same as the configured value in IED.

REF 541/3/5 3.5 has support for GOOSE horizontal communication. When protocol 2 mode is adjusted to the IEC 61850 mode, the serial port speed is set to 38400 bits/s. In this mode the special SPA for horizontal communication is used and it allows to use GOOSE.

- SPA time synchronization

SPA-ZC 402 has three different modes of the IED time synchronization. The mode is selected from the logical device object describing the IED, for example LD1.

- Enabled

This is the default operation mode. When the operation is selected, you can synchronize SPA-ZC 402 with SNTP as it is defined in the IEC 61850-8-1 standard, and SPA-ZC 402 is also synchronizing IED over SPA.

- Disabled

In this mode, you can only synchronize SPA-ZC 402 with SNTP and IED has a different source of time synchronization.

- Read from device if supported

When this operation mode is selected, the time for SPA-ZC 402 is read from IED over SPA. SNTP is not in use and the IED gets time synchronization from another source.

- SPA time synchronization parameter

The parameter describes the SPA parameter which SPA-ZC 402 uses when reading the time from the IED. Parameter is used when the previous parameter defines that the time source is IED. IED gets the time from external source.

- Event poll

If the parameter is disabled, SPA-ZC 402 does not poll events from IED and the IEC 61850 events are based on a continuous data poll. This feature could be used in systems where, for example the other REF 543 port is already used for the SPA communication. By default, event polls are used.

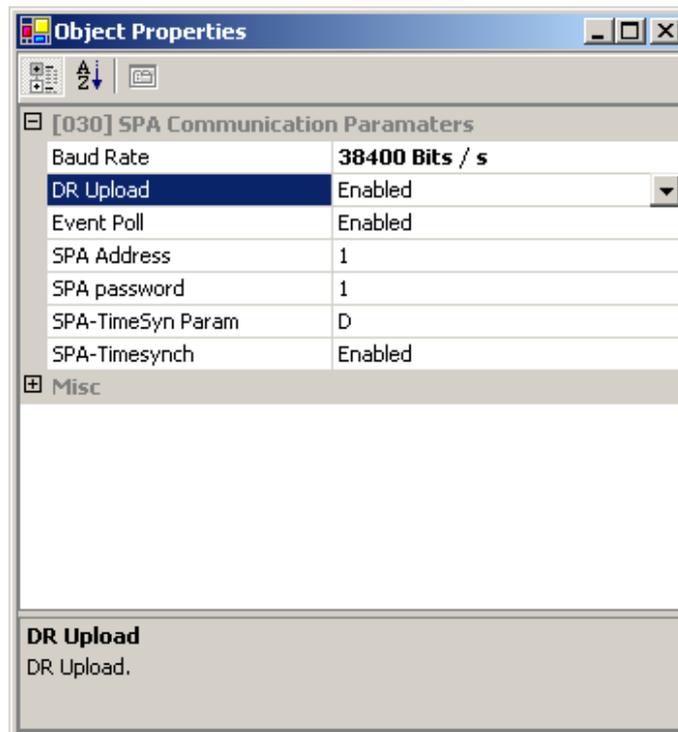


If the event polling is disabled, the timestamp accuracy depends on the IED configuration and the SPA bus speed.

- DR Upload

When this parameter is enabled, SPA-ZC 40x uploads disturbance recording files from the MEDREC function block to SPA-ZC 40x file system in COMTRADE format. IEC 61850 client can get these files when it receives an event from the RDRE logical node. This parameter is enabled by default and you should ensure that your system has an IEC 61850 client that is capable to use the IEC 61850 File Transfer protocol. For example, CAP 505 and PCM600 use SPA over TCP to upload the disturbance recording files. FTP is used by COM600 or RTU.

The parameter is valid with REF 541/3/5, REM 543/5, RET 541/3/5 and REX 521.



A040022

Fig. 6.7.1.-1 SPA Communication Parameters

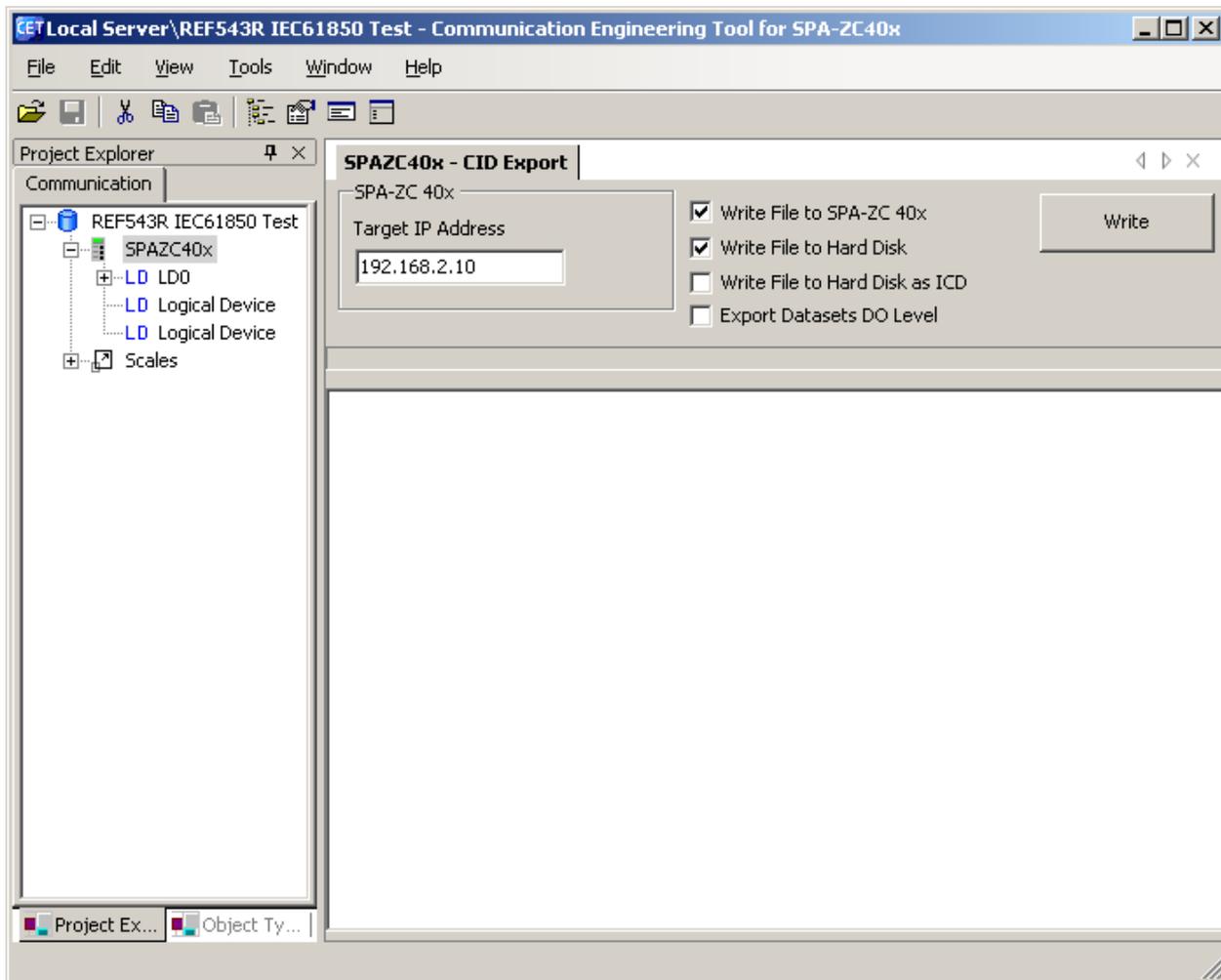
Locally, SPA-ZC 402 uses UTC (Coordinated Universal Time) time, which is received from the SNTP time synchronization by default. This time format does not use Daylight Saving Time. If you want that the IED and SPA communication uses this time format, the IEC 61850 client has to be programmed to write the minute offset of the UTC time to the LD0.LLN0. Daylight parameter at the defined date and time depending on the location.

## 6.8. Downloading configuration and exporting CID file

After you have built the IEC 61850 data model and done the communication addressing, you can download the configuration to SPA-ZC 402:

1. Select the IEC 61850 Device object and right-click to select the CID Export.
2. If you download configuration to SPA-ZC 402 the first time, change the IP address from default address (192.168.2.10) to new IP address according to the planned network structure.

When the new configuration to SPA-ZC 402 is downloaded, Communication Engineering Tool (CET) checks if the basic IP addresses are changed. If a change is detected, CET asks whether new addresses are taken into use. If the changes are not accepted, SPA-ZC 402 uses the old IP address from the previous configuration. The IP addresses can be verified with, for example, IP Query Tool. For more information about IP Query Tool, refer to Section 9.3. IP Query.



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Fig. 6.8.-1 Downloading the device's configuration

You can export a configuration in CID format from CID Export tool to hard drive. This SCL is usually used by System Configuration tool. It is possible to export a dataset in SCL files in different levels. If you select to export a dataset in FCD level, for example an information report from SPA-ZC 40x contains always value quality and time in one structure.

---

You can also export the CID or ICD file to your workstation's file system and use it in system level tools, for example to configure your IEC 61850 client.

### 6.8.1. IED application changes

If a new functionality is added to the IED application, the new IED application (AR file) import is needed. In this case, there are two options:

- Communication Engineering Tool (CET) for SPA-ZC 402 asks either the old SPA-ZC 402 application is overwritten or
- only the new functionality is added.

If the different logical nodes have the identical names in existing and in new application, the logical nodes are overwritten.

### 6.9. Configuring by using IEC 61850 data model components

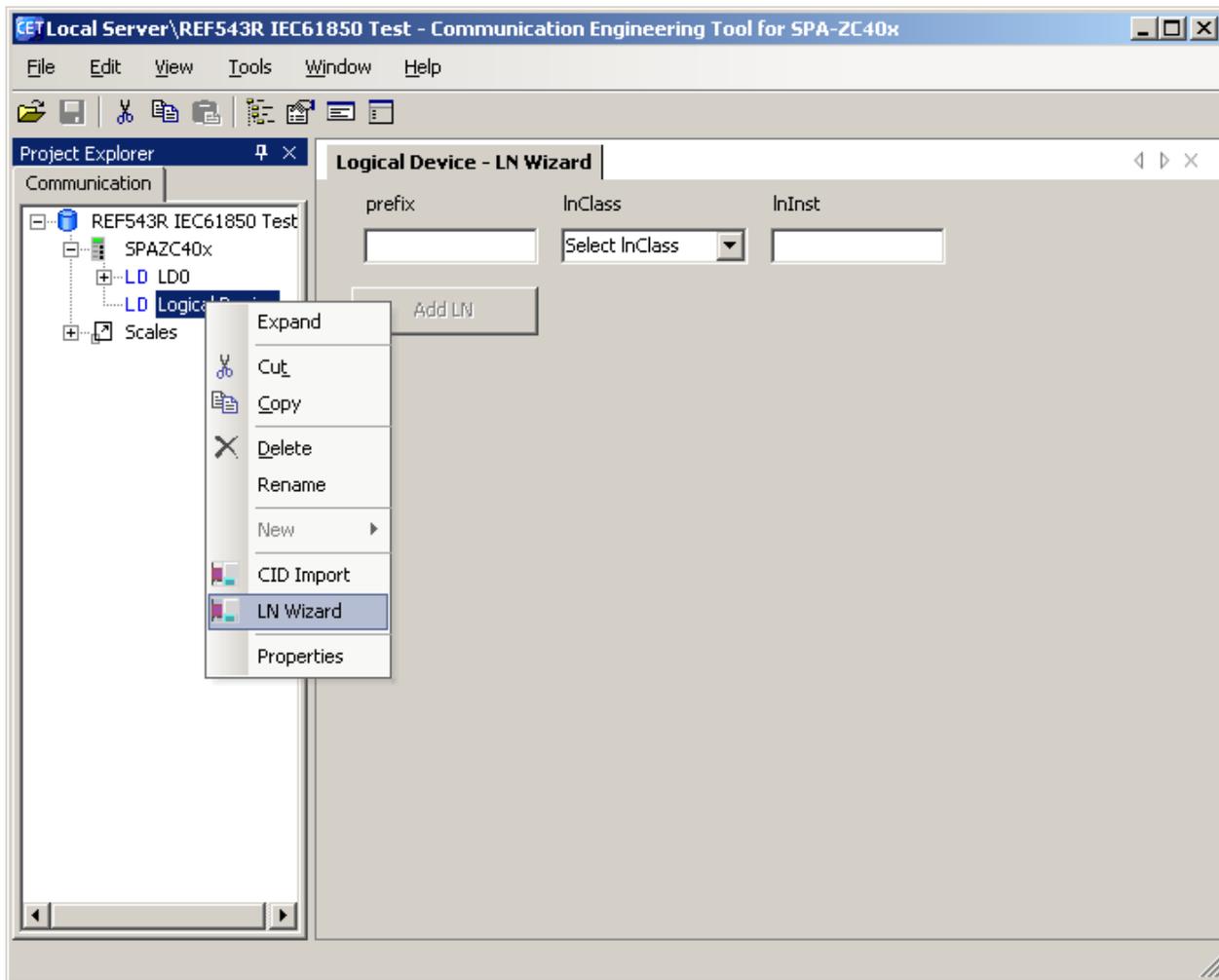
The IED model can be configured manually. You can start building the IEC 61850 data model by creating an empty logical device. For more information about adding logical device, refer to Section 6.4.2. Adding Logical Device objects. The IEC 61850 standard defines a mandatory logical node LLN0 for every device and its objects. For best practice, check some ready projects based on Connectivity Packages.

Adding and configuring logical nodes manually contains four main steps:

1. Add a logical node, for example CILO, for the circuit breaker objects with the LN Wizard, see Fig. 6.9.-1.
2. Add data objects.
3. Configure the new logical node with the DO Wizard.
4. Define object properties to the data objects.

In more detail:

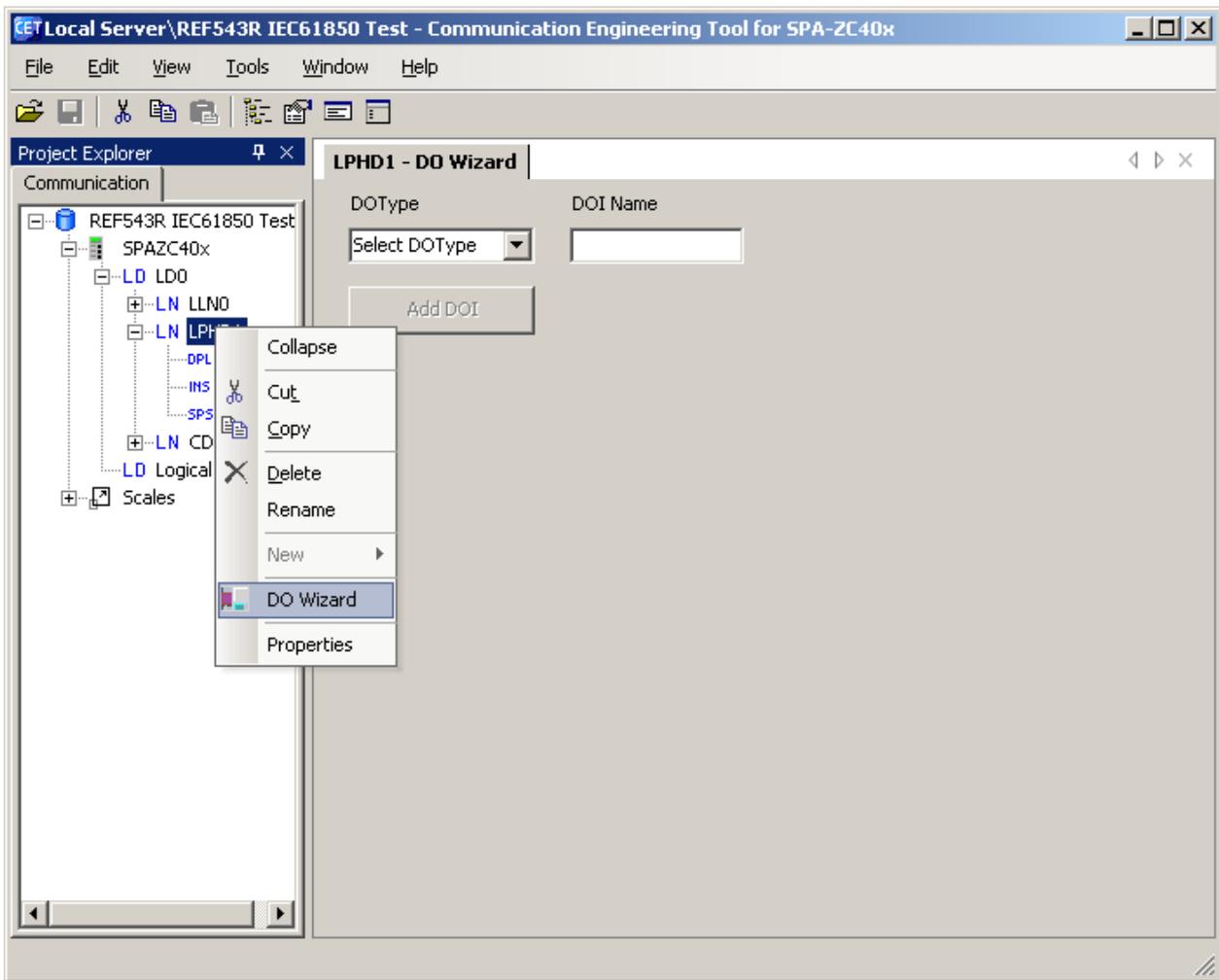
1. Select a logical node, for example LD1.
2. Right-click the logical node and select **LN Wizard** to start the LN Wizard, see Fig. 6.9.-1. The LN wizard contains three text boxes: prefix, lnClass and lnInst. Prefix and lnInst are user-definable, while lnClass contains a list of logical nodes that can be selected.
3. Type the appropriate information. The lnInst number has to be unique.
4. Click the **Add LN** button. The new logical node is added to the project.



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Fig. 6.9.-1 LN wizard

5. Select the new logical node in the project tree.
6. Right-click the logical node and select **DO Wizard** to start the DO Wizard, see Fig. 6.9.-2.
7. Select the DOType. Depending on the DOType selected, corresponding data attributes are automatically added.
8. Type the DOI name.
9. Click **Add DOI** button for every data object you add.



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Fig. 6.9.-2 DO Wizard

10. Start with the mandatory data objects and then add the process data. Mandatory data objects are Mod, Beh, Health and NamPlt.

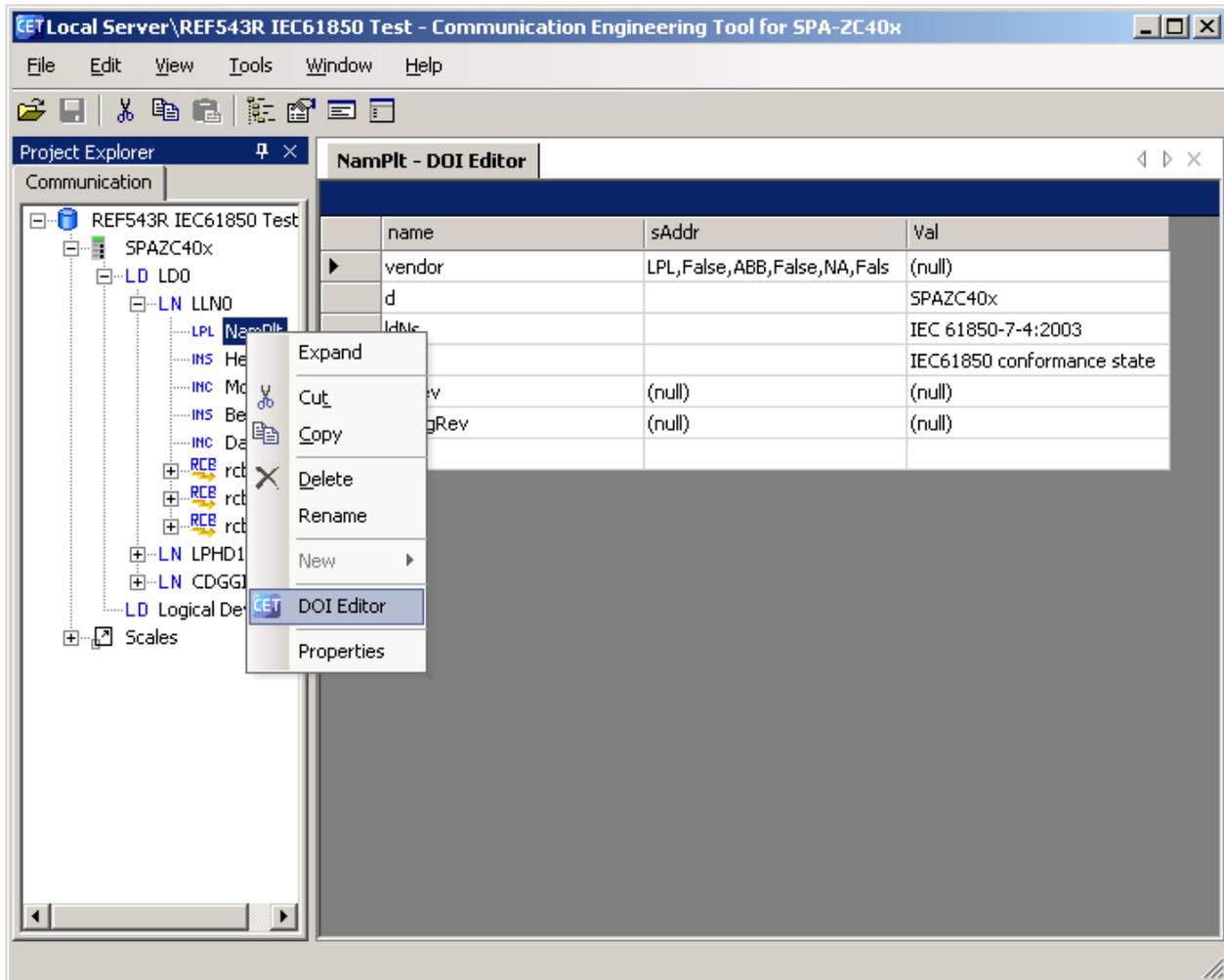
DO type	DOI name
INC_diag	Mod
INS_beh	Beh
INS_health	Health
LPL_simple	NamPlt
INC_simple	test

For more information about data objects refer to Section 11.2. Model conformance statement.

- 11. Define properties to the data objects. In order to map the added IEC 61850 data objects to the SPA data model, you have to define the properties for each data object.
- 12. Right-click the data object to select **Properties** from the shortcut menu to activate the Object Properties window.

13. Select the data object again and right-click to start the DOI Editor. The Data Object Instance Editor window is shown, see Fig. 6.9.-3.
14. Define the properties and SPA variable definitions for each data object in the Object Properties window. The stVal field in the DOI editor is automatically updated with the data entered in the Object Properties.

Follow the same procedure for all data objects that you have added to the LN object.



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Fig. 6.9.-3 Data Object Instance Editor

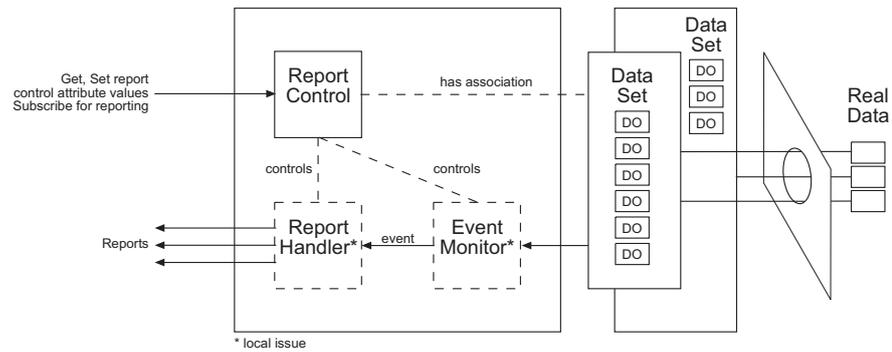
The SPA point data is written to the sAddr in the CID file for the selected data object. SPA-ZC 402 uses this field to poll data and events from the IED.



In order to get automatic updating of the process objects, you should add those data objects of interest to the dataset group. Refer to Section 6.5. Using Dataset Editor.

## 6.10. Configuring report control blocks

Report control block (RCB) controls spontaneous event reporting. A client can modify the report sending behavior by setting RCB attributes. The RCB attributes have suitable default values for the following ABB products: COM600 and MicroSCADA Pro IEC 61850 client. RCBs are located under the logical device LD0 and logical node LLN0.



A060032

Fig. 6.10.-1 Reporting model

RCB's have the following properties. To edit the properties, right-click the dataset and select **Properties**.

- Buffered reporting

IEC 61850 buffers events also during a communication break. The same buffering mechanism should be used by all the IED report control blocks.

- Buffer Time

The default value for buffered reporting is 100 milliseconds (ms). With this value, RCB waits 100 ms for other events after the first change before sending the report. Value 0 means that a new change is immediately reported to the client without waiting for any additional changes. In practice, the buffer time can be from 0 to a few seconds without a notable effect on the client's event notification delays. The default values are suitable in most cases.

- Dataset

The Dataset property defines the data set to be sent as time tagged events with buffered or unbuffered reporting. Notice that there are few restrictions in the IED dataset usage to minimize the event load in the IEC 61850 station bus. One dataset can be used only by one report control block. Additionally, different datasets used for event reporting should not share the same data objects.

- Integrity Period

The default value for Integrity Period is 0 ms. If this attribute has a value  $> 0$  ms, SPA-ZC 402 sends a report with all data listed in a linked data set with this period. By default, this feature is not enabled, because it generates an unnecessary load to the server and network. If this feature is used, the properties of Period Trigger Option in RCB need to be enabled.

- Report ID

By default, this attribute is empty and SPA-ZC 402 uses it for RCB MMS address. If this string is left empty, a default report control block MMS path name is used.

- Option Field

Defines what information is sent with the report

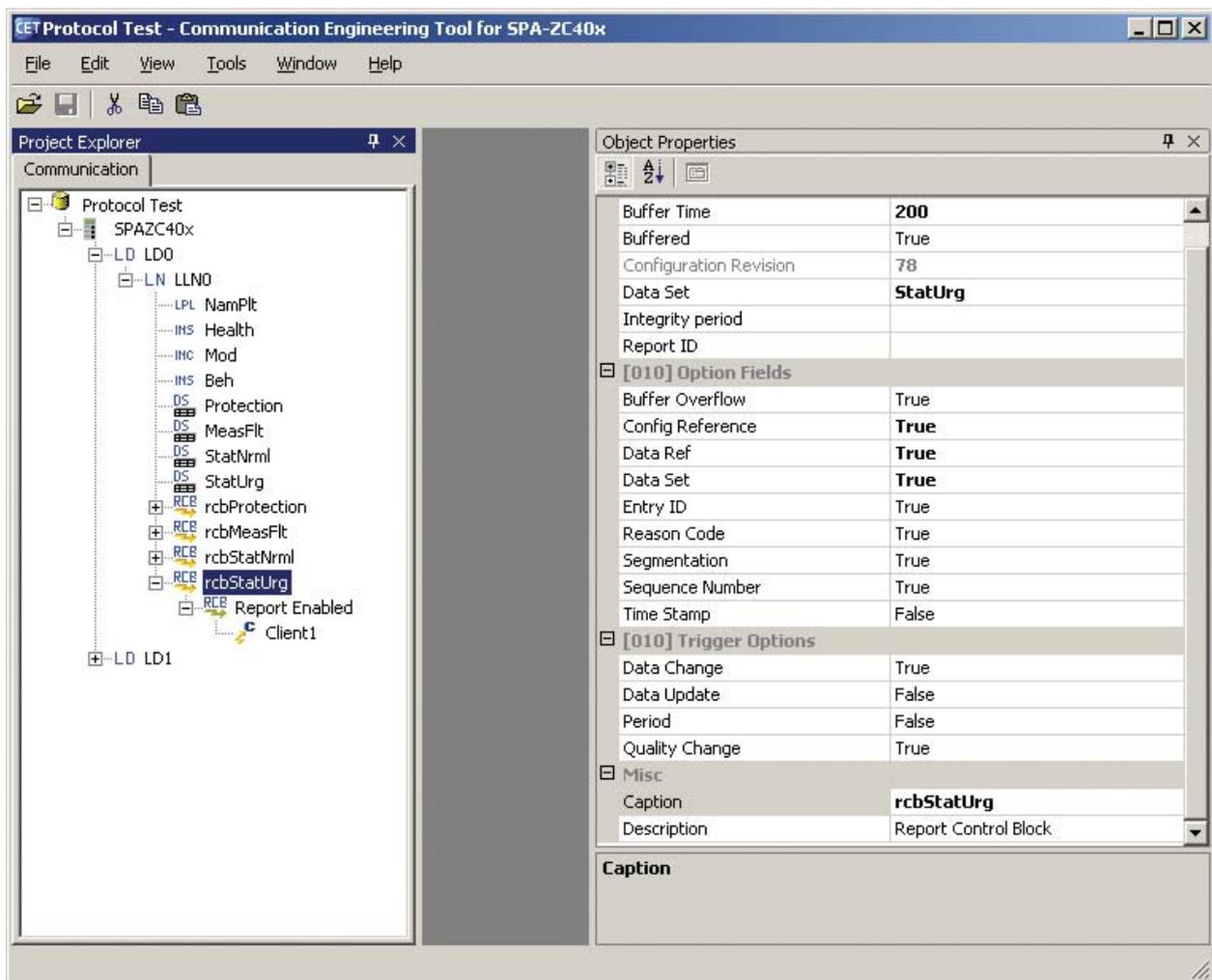
By default, SPA-ZC 402 adds buffer over-flow information, a report entryID and a sequence number, and allows segmentation. Other fields are the RCB configuration version, data reference in MMS address format, the name of the used data set and the report sending time.

- Max property

Defines how many clients are using this RCB, that is, the number of needed RCB instances. If you define two clients for buffered reporting, Max has to be 2. SPA-ZC 402 creates two instances of RCB name, for example, rcbStatNrml01 and rcbStatNrml02. For unbuffered reporting, Max has to be same as the number of defined clients or higher. This is defined in the IEC 61850 standard.

- Trigger Options

Data Change, Data Update and Quality Change triggers are used by default (changes in value and quality generates information reports). Period trigger is not used by default.



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Fig. 6.10.-2 Report Control Block

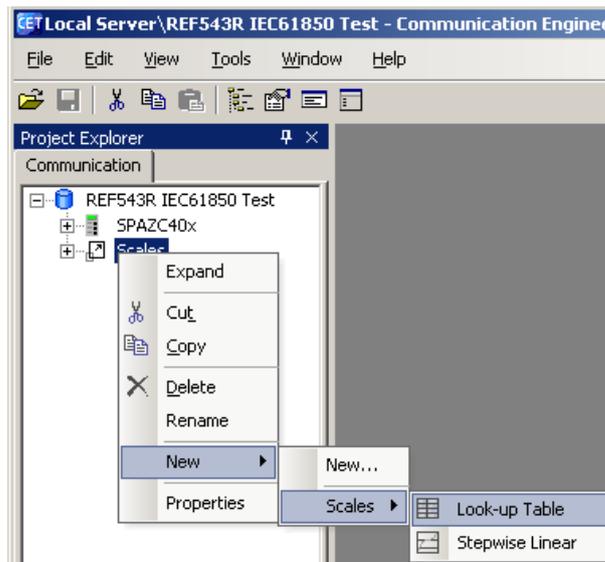
Buffered reporting needs mandatory Report Client definitions. Report Client definitions link a certain RCB to a certain client. The client can import the CID file to check which RCB instance it has to use. If the Max property is defined to 2, the configuration must have two clients with buffered reporting. In the list, the client who is defined first uses the first RCB instance (rcb name ...01) and the second RCB uses second instance (rcb name ...02 ). It is not mandatory to define clients in unbuffered reporting, but it is recommended for the sake of clarity. Client IED Name has to match with the client name in Substation Configuration description Language (SCL).

Every modification in the Dataset referenced in RCB increases the RCB Configuration Revision property by one. The IEC 61850 client can verify the deviations between the received configuration revision in the information report and the imported configuration revision. If the configuration revisions do not match, the client may discard the received information reports.

**6.11.****Scales**

To create a scale:

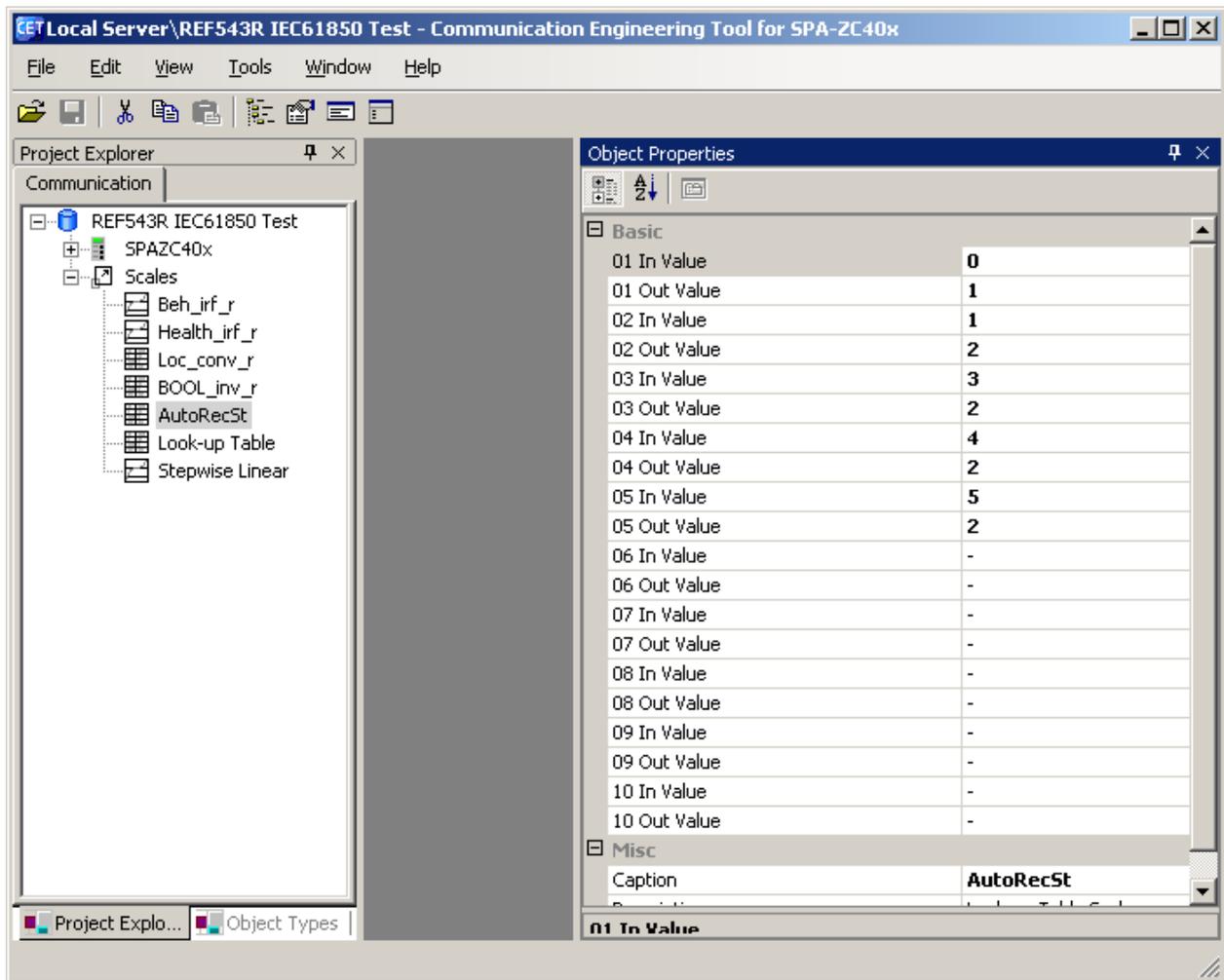
1. If a Scales object does not exist in the object tree, add the object by right-clicking the project and selecting **New > Communication > Generic ScaleGroup Object** or import a Connectivity Package or a CID file. If the Connectivity Package or the CID file is imported, the Scales object is created automatically.
2. Right-click Scales in the Project Explorer pane and select **New > Scales**, see Fig. 6.11.-1.



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Fig. 6.11.-1 Adding a new scale

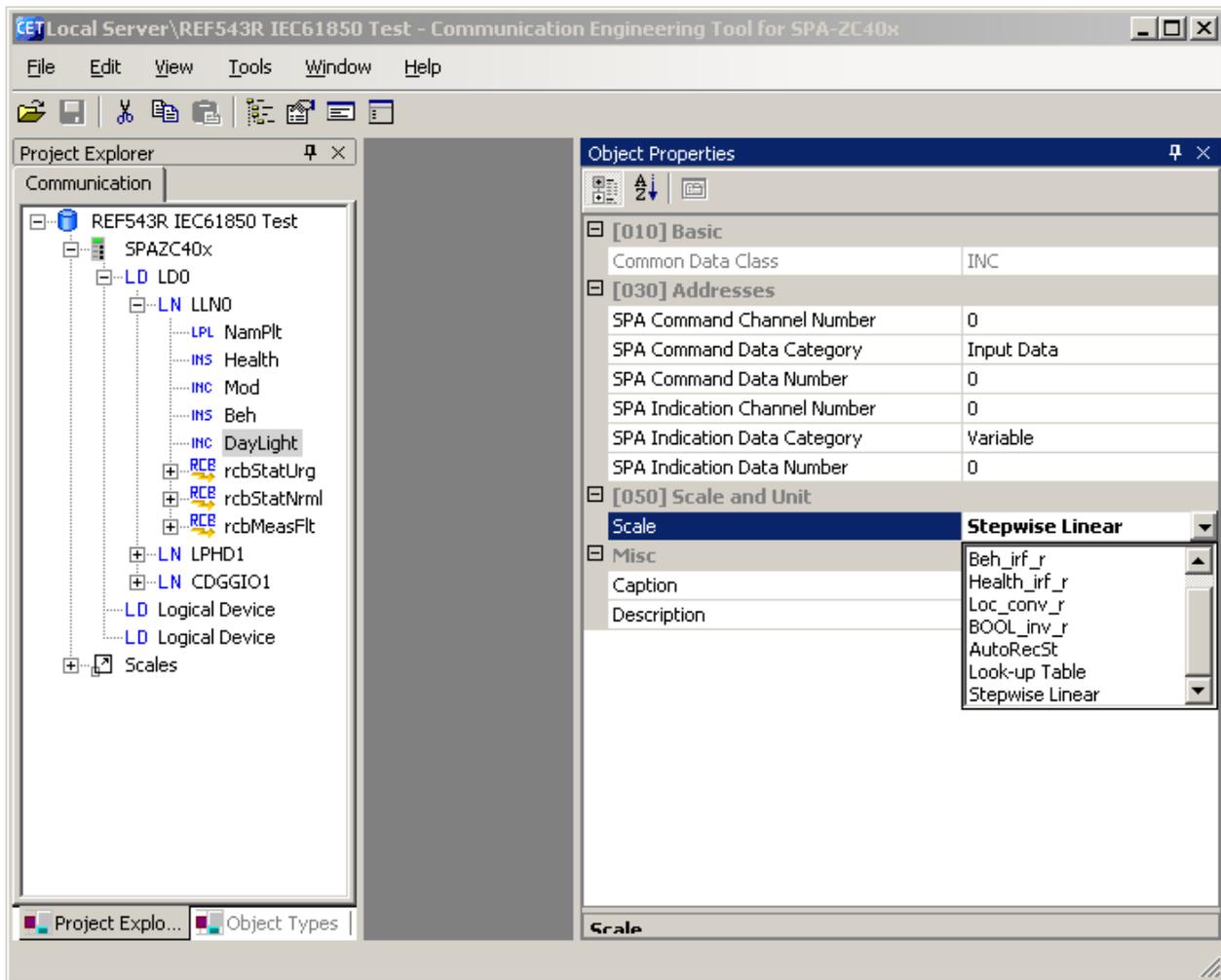
3. Select the Scales type: Look-up Table or Stepwise Linear
4. Configure the selected scale's properties, see Fig. 6.11.-2



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Fig. 6.11.-2 Configuring properties

5. Create reference to scale at DO level in object tree, see Fig. 6.11.-3



A060133

Fig. 6.11.-3 Referring scale in DO

## 6.12. Using Disturbance Recorder files

In case of, for example, abnormal events on the electric line, the protection relay can generate data for a graphical presentation of the detected phenomenon. These presentations are stored by MEDREC16, the Disturbance Recorder function block of the relay. When connected to a relay with the MEDREC16 version K or newer, SPA-ZC 402 can load the recorded data and convert it to standard COMTRADE files (in year 1999 format). The conversion is done automatically and the Disturbance Recorder Ready signal is sent to IEC 61850 client after new files are ready to be read.

A relay with compatible MEDREC16 function block notifies SPA-ZC 402 when it has new recordings ready. SPA-ZC 402 reads the actual data from the relay as a background process and stores the data as COMTRADE files in its own file system under the directory C:\COMTRADE.

When the IEC 61850 client has been notified of the incoming record, the client should read the COMTRADE files from SPA-ZC 402 by using FTP or IEC 61850 File Transfer connection. The client must remove the files after successful reading to maintain free space for forthcoming records. The files are named as follows:

File name	Example	Description
yymmddnn.cfg	70010104.cfg	Configuration file
yymmddnn.dat	70010104.dat	Data file
yymmddnn.inf	70010104.inf	Information file

The filename consists of the following parts:

Part	Format	Description
yy	00 – 99	Record creation timestamp, year
mm	01 – 12	Record creation timestamp, month
dd	01 – 31	Record creation timestamp, date
nn	00 - 99	Running serial number of the records of the same day. The Configuration, Data and Information files related to one record have the same serial number.



---

## 7. Commissioning

The downloaded CID file is taken into use when SPA-ZC 402 is restarted automatically.

Normally, the device is reset automatically after the configuration is downloaded with Communication Engineering Tool (CET) for SPA-ZC 40x.

After downloading the configuration you can check the basic TCP/IP functionality with the ping command in command prompt:

```
c:\>ping x.x.x.x.
```

The IEC 61850 communication is checked from the IEC 61850 client either by using the exported CID or ICD file or by browsing the SPA-ZC 402IEC 61850 namespace.

You can see how the configuration process is progressing from the diagnostic LEDs. When the SPA-ZC 402 configuration is completed, the green LED is on.

If SPA-ZC 402 is online with the IEC 61850 client, you can check the general configuration status of SPA-ZC 402 from the data model LD0.LLN0.Health.stVal:

1. OK - configuration is completed successfully.
2. Warning - no clock synchronization.
3. Alarm - connection to the IED could not be established, or errors appear during the data model configuration.

If the configuration fails, check the error log files from the SPA-ZC 402 file system. The status and error logs are located in the /log directory. For more information about maintenance, refer to Chapter 9. Maintenance and service.

### 7.1. Checking error situations on IEC61850

An internal relay fault (IRF) in REF 54x affects Health, Mod and Beh in all logical nodes under LD1 in the following way:

- Mod.stVal gets the value 5 (Off)
- Beh.stVal gets the value 5 (Off)
- Health.stVal gets the value 3 (a severe problem, no operation possible)



Other devices may behave differently, depending on which SPA parameters are connected to Mod, Beh and Health.

### Communication quality handling

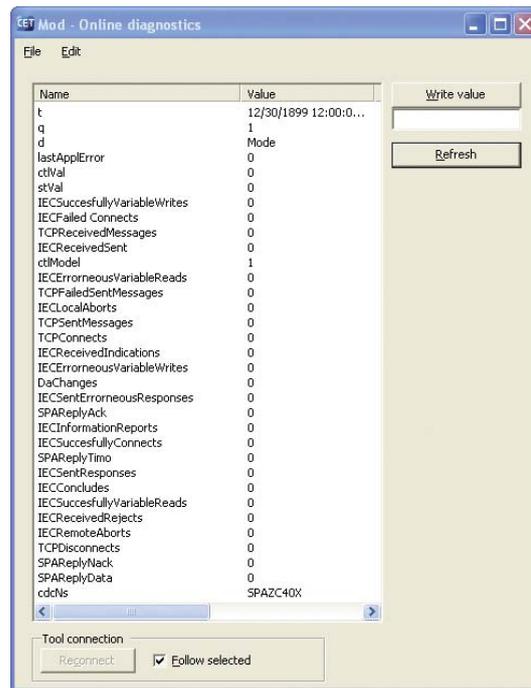
- If there is a communication loss between IED and SPA-ZC 40x, all qualities get the value 3 under LD1, including LD1.LLN0.Health.stVal = 3 (Error).
- In case of a time synchronization loss, LD0.LLN0.Health.stVal gets the value 2 (Warning).
- In case of an error in the configuration, LD0.LLN0.Health.stVal gets the value 3 (Alarm).

For more information, refer to Section 7. Commissioning

### 7.2. Checking SPA communication

If the configuration is completed successfully, you can check the resettable diagnostic counters through the IEC 61850 data model.

SPA-ZC 402 Diagnostic counters are part of the LD0.CDGGIO1 logical node. The data object type is ABB-specific extension in IEC 61850 data model and contains the counters as data attributes. It is possible to reset the counters by writing 1 into ctIVal. It is not recommended to put the counters into the data set because the counter values are updated only during a read operation.



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Fig. 7.2.-1 Diagnostic counters seen on MicroSCADA Pro IEC 61850 client



The q attribute reflects the status of data. If the data is properly updated, the data object's quality value is GOOD. If this is not the case, configurations between SPA-ZC 402 and IED are not identical. If all the data objects have INVALID quality, the SPA communication is not running.



---

## **8. Technical data**

### **8.1. Interfaces**

#### **IED interface**

- ST multimode glass fibre transmitter/receiver pair or
- Snap-in multimode plastic fibre transmitter/receiver pair

#### **Ethernet interface**

- LC fibre-optic multimode LAN connector
- MT-RJ fibre-optic multimode LAN connector
- RJ-45 (STP CAT5e) galvanic LAN connector

#### **Optical fibres**

- See fibre-optic guides:
  - SPA-ZF Optical glass fibres, multimode graded index type
  - Plastic-core fibre-optic cables, features and instructions for mounting

For more information, see Section 1.4. Product documentation.

#### **Diagnostic LEDs**

SPA-ZC 402 common diagnostic LEDs

- Power
- Diagnostic
  - Red
  - Green
  - Yellow

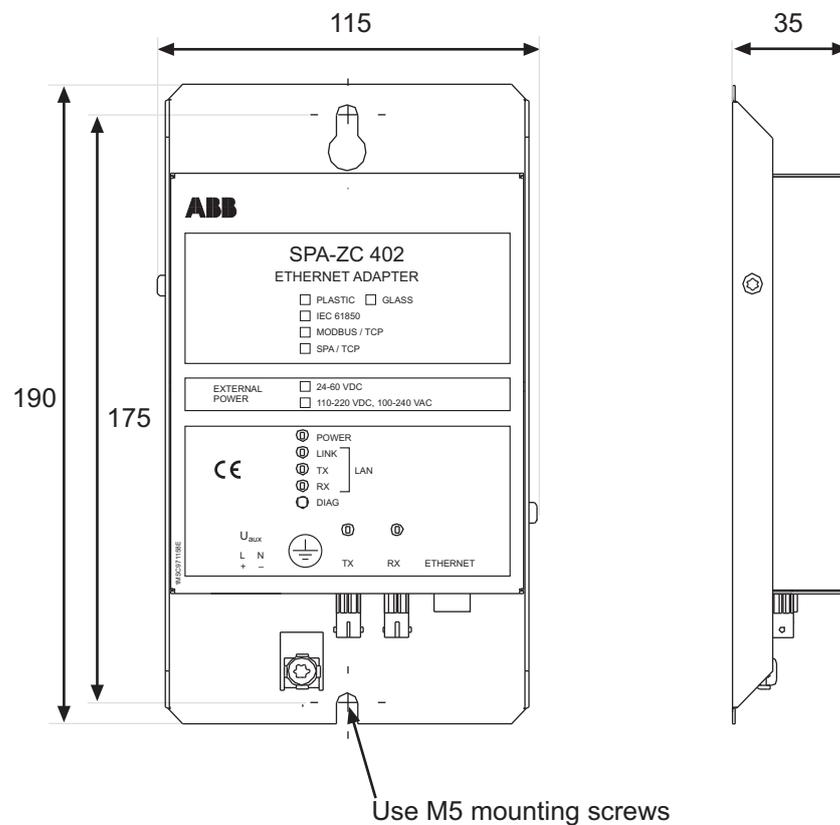
#### **LAN diagnostic LEDs**

- LINK
- TX
- RX

#### **SPA diagnostic LEDs**

- TX
- RX

### Dimensions and weight



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Fig. 8.1.-1 Dimensions of the SPA-ZC 402 module

Table 8.1.-1 Dimensions and weight

Type	Dimensions [mm]	Weight [g]
SPA-ZC 402	190 x 115 x 35	510

## 8.2.

### Test and conditions

SPA-ZC 402 fulfills IEC 61850-3 Communication networks and systems in substations.

## General requirements

**Table 8.2.-1 Environmental test and conditions**

Recommended service temperature range (continuous)	-10...+55°C
Limited temperature range (short-term)	-40...+85°C
Transport and storage temperature range	-40...+70°C according to the IEC 60068-2-48
Dry heat test	According to the IEC 60068-2-2
Dry cold test	According to the IEC IEC 60068-2-1
Damp heat test, cyclic	According to the IEC 60068-2-30

**Table 8.2.-2 Electromagnetic compatibility tests**

EMC immunity test level meets the requirements listed below.	
1 MHz burst disturbance test, class III <ul style="list-style-type: none"> <li>• Common mode</li> <li>• Differential mode</li> </ul>	According to the IEC 60255-22-1 2.5 kV 1.0 kV
Electrostatic discharge test, class III <ul style="list-style-type: none"> <li>• For contact discharge</li> <li>• For air discharge</li> </ul>	According to the IEC 61000-4-2 and IEC 60255-22-2 8 kV Not applicable
Radio frequency interference tests <ul style="list-style-type: none"> <li>• Conducted, common mode</li> <li>• Radiated, amplitude-modulated</li> <li>• Radiated, pulse-modulated</li> </ul>	According to the IEC 61000-4-6 and IEC 60255-22-6 10 V (rms), f=150 kHz...80 MHz According to the IEC 61000-4-3 and IEC 60255-22-3 10 V/m (rms), f=80...2700 MHz According to the ENV 50204 and IEC 60255-22-3 10 V/m, f=900 MHz
Fast transient disturbance tests <ul style="list-style-type: none"> <li>• All terminals</li> </ul>	According to the IEC 60255-22-4 and IEC 61000-4-4 4 kV
Surge immunity test <ul style="list-style-type: none"> <li>• Power supply, SPA-ZC402xxxA</li> <li>• Power supply, SPA-ZC402xxxC</li> <li>• RJ45-Cable</li> </ul>	According to the IEC 60255-22-5 and IEC 61000-4-5 4 kV line-to-earth, 2 kV line-to-line 2 kV line-to-earth, 1 kV line-to-line 2 kV line-to-earth
Power frequency (50 Hz) magnetic field IEC 61000-4-8	300 A/m continuous
Electromagnetic emission tests <ul style="list-style-type: none"> <li>• Conducted, RF-emission (Mains terminal)</li> </ul> Radiated RF-emission	According to the EN 55011 EN 55011, class A, IEC 60255-25 EN 55011, class A, IEC 60255-25
CE approval	Complies with the EMC directive 2004/108/EC and the LV directive 2006/95/EC

**Table 8.2.-3 Standard tests**

<b>Mechanical tests</b>	
Vibration tests (sinusoidal)	According to the IEC 60255-21-1, class I
Shock and bump test	According to the IEC 60255-21-2, class I

**Table 8.2.-4 Auxiliary power supplies**

Type	SPA-ZC 402 xxxA	SPA-ZC 402 xxxC
Input voltage AC	110/120/220/240 V	-
Input voltage DC	110/125/220 V	24/48/64 V
Voltage variation	AC 85...110%, DC 80...120% of rated value	DC 80...120% of rated value
Burden	<4 W	
Ripple in DC auxiliary voltage	Max. 12% of the rated DC value (IEC 60255-11)	
Interruption time in auxiliary DC voltage without resetting	110 V <40 ms	24 V <24 ms

## 9. Maintenance and service

If the SPA-ZC 402 module or a part of it is found to be faulty, the normal service operation is to replace the entire module.

For more details, refer to Section 13. Ordering information.

### 9.1. LED indicators

**Table 9.1.-1 LED indicators**

LED	Color		State		Sequence number	Description
Power	Green		On			Power on
Link LAN	Green		On			Indication for LAN link OK
RX LAN	Green		On			Indication for incoming LAN traffic
TX LAN	Green		On			Indication for outgoing LAN traffic
RX SPA	Green		On			Indication for incoming SPA traffic
TX SPA	Green		On			Indication for outgoing SPA traffic
DIAG	Green	Red	Off	On	1	Bootloader booting
			Flashing	On	2	Bootloader, missing boot image
			On	On	3	Starting
			Flashing	Off	4	OK, missing configuration
			On	Off	5	OK, configuration in use
			Off	Flashing	6	Configuration error

Possible sequences are:

- |           |                               |
|-----------|-------------------------------|
| 1 → 3 → 5 | Normal situation              |
| 1 → 2     | Missing boot image            |
| 1 → 3 → 4 | Configuration file is missing |
| 1 → 3 → 6 | Configuration error           |



If configuration error is detected because of the mismatches in downloaded the CID file, download a simpler configuration. Check also the log file in SPA-ZC 402.

### 9.2. Communication settings

SPA addresses in sAddr are not properly defined if

- Diagnostic counter SPAREplyTimo increases constantly and SPAREplyData remains 0 in the LD0.CDGGIO1 logical node. These diagnostic counters are readable from the IEC 61850 client.
- Quality of the data is INVALID.

The following IED-specific settings have to be checked when setting up REF 541/3/5, REM 543/5 or RET 541/3/5:

- SPA baud rate and SPA slave number in IED

Baud rate and slave number have to be according to the SPA-ZC 402 configuration in X3.2/Communication 2.

9.3.

IP Query

By using the IP Query Tool in Communication Engineering Tool (CET) for SPA-ZC 40x, it is possible to see all connected SPA-ZC 40x, devices, their communication parameters and version information.

Example:

```

Sending IP query 1
RECEIVED MESSAGE FROM 10.58.125.151:
  Mac Address: 00-0C-02-B0-04-89
  Subnet Mask: 255.255.255.0
  Default Gateway: 10.58.125.150
  SNTP servers:10.58.125.150 127.0.0.1
  SW_SPATYPE: SPA-ZC40x
  SW_NUMBER: 1MRS118533
  SW_BUILD: 110
  SW_REVISION: B
  Compiler DATE_TIME: Nov 28 2005 12:38:02

```

To use the IP Query Tool:

1. Select **Tools > IP Query Tool** to start the tool, see Fig. 9.3.-1.

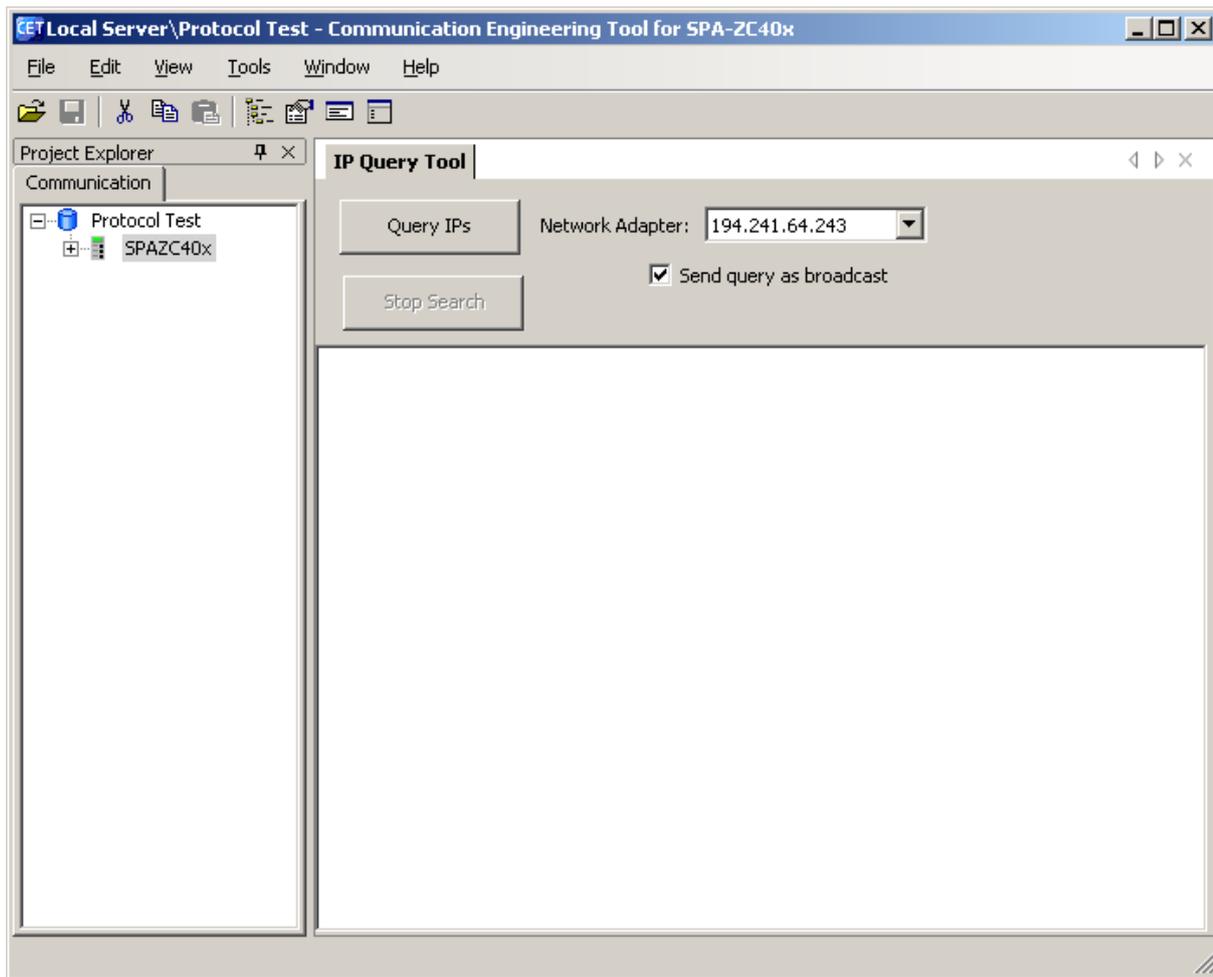
Query activates devices from the network until it is stopped.



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Fig. 9.3.-1 Starting the IP Query Tool

2. Select the Network adapter to send a query, see Fig. 9.3.-2.



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Fig. 9.3.-2 Selecting Network adapter

3. Click **Start** to start the query.
4. Click **Stop** to stop the query.

Connected devices are displayed in the Output pane, Fig. 9.3.-2.

Additional information depends on the SPA-ZC 40x version. If version 1.1.1 is used, only MAC address is displayed. If version 2.0 is used, MAC address, other address and revision information is displayed.

## 9.4. Identification

If contacting the Customer Service, it is necessary to send the following information by request:

- Version of Connectivity Packages  
 The version can be checked from the Connectivity Package Manager.
- Version information of Communication Engineering Tool (CET) for SPA-ZC 40x

Select **Help > About** to view the version information.

- SPA-ZC 402 version information

The version information can be read from the device's label. If the device is updated afterwards, use CET's IP query to get the correct version information from the device memory. For more information about IP query, refer to Section 9.3. IP Query.

## 9.5.

### Obtaining error logs

The following session transfers error.log file through ftp.

```
C:\>ftp x.x.x.x
```

```
User: abb
```

```
Password: abb
```

```
ftp> cd log  
ftp> get error.log  
ftp> quit
```

## 10. Troubleshooting

### Communication to SPA-ZC 40x is not working

If communication problems occur, check the firewall configurations. Table 10.-1 shows the ports that have to be open in firewall.

**Table 10.-1 TCP/IP and UDP ports**

	<b>TCP</b>	<b>UDP</b>
SPA Over TCP and CET tool IP Query port	7001	7001
FTP file transfer protocol ports	21, 20	
IEC 61850 communication protocol port	102	
Network time management protocol port	123	
Modbus TCP port	502	

A firewall may prevent the FTP and IP Query to work. In case of problems, adjust the firewall settings so that the ports listed in Table 10.-1 are open. IP Query uses the broadcast address 255.255.255.255 to which the query is sent and which may also be blocked.



Windows XP SP 2 contains a built-in firewall.



## 11. Technical reference

This chapter defines the compliance to IEC 61850 in terms of service, modeling, engineering interfaces and also exceptions and local adaptations. The information gives you a detailed explanation of the IEC 61850 capabilities of a product.

This chapter provides information about the following issues:

- ACSI conformance statement
- Model conformance statement
- SCL conformance statement
- SCL control block
- Protocol implementation conformance statement

The ACSI conformance statement describes the abstract service interfaces, which are normally mapped to specific communication service (SCSM) and therefore indirectly stated in the protocol implementation conformance statement. The conformance statements and documents are referred to as Protocol Implementation Conformance Statement (PICS) and Model Implementation Conformance Statement (MICS).

For the following clauses, the following definitions apply:

**Table 11.-1 Notations**

M/m	Mandatory support. The item must be implemented.
C/c	Conditional support. The item must be implemented if the stated condition exists.
O/o	Optional support. The implementation may decide to implement the item.
x	The implementation must not implement this item (excluded).
i	The implementation of the item is not within the scope of this product (out-of-scope).
F/S	Functional Standard. Should be applied.
Base	Must be applied in any application claiming conformance to this standard.

**11.1. ACSI conformance statement**

*Table 11.1.-1 ACSI basic conformance statement*

		Client/ Subscriber	Server/ Publisher	SPA-ZC 402/ Comments
<b>Client-Server roles</b>				
B11	Server side (of TWO-PARTY-APPLICATION-ASSOCIATION)	–	a	Supported
B12	Client side (of TWO-PARTY-APPLICATION-ASSOCIATION)	a	–	
<b>SCSMs supported</b>				
B21	SCSM: IEC 61850-8-1 used			Supported
B22	SCSM: IEC 61850-9-1 used			Not Supported
B23	SCSM: IEC 61850-9-2 used			Not Supported
B24	SCSM: other			
<b>Generic substation event model (GSE)</b>				
B31	Publisher side	–	O	Supported
B32	Subscriber side	O	–	Supported
<b>Transmission of sampled value model (SVC)</b>				
B41	Publisher side	–	O	Not Supported
B42	Subscriber side	O	–	Not Supported

**11.2. Model conformance statement**

In this chapter the Model Implementation Conformance Statement (MICS) is defined detailing the standard data object model elements supported by SPA-ZC 402 . It is also possible to export the information in MICS to a CID file. The CID file can be used in the system tool, see Safety information. Some of the data cannot be retrieved from the IED, but it is the default value in the SPA-ZC 402.

**11.2.1. Common data attribute classes**

**11.2.1.1. Quality****Table 11.2.1.1.-1 Quality**

Quality Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/ Comments
	PACKED LIST			
validity	CODED ENUM	good   invalid   reserved   questionable	M	Supported
detailQual	PACKED LIST		M	Supported
overflow	BOOLEAN		M	Defaulted
outOfRange	BOOLEAN		M	Supported
badReference	BOOLEAN		M	Defaulted
oscillatory	BOOLEAN		M	Defaulted
failure	BOOLEAN		M	Defaulted
oldData	BOOLEAN		M	Supported
inconsistent	BOOLEAN		M	Defaulted
inaccurate	BOOLEAN		M	Defaulted
source	CODED ENUM	process   substituted DEFAULT process	M	Supported
test	BOOLEAN	DEFAULT FALSE	M	Defaulted
operatorBlocked	BOOLEAN	DEFAULT FALSE	M	Defaulted



The DEFAULT value must be applied, if the functionality of the related attribute is Not Supported. The mapping may specify to exclude the attribute from the message, if it is Not Supported or if the DEFAULT value applies.

**11.2.1.2. Analogue value****Table 11.2.1.2.-1 Analogue value**

AnalogueValue Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/ Comments
l	INT32	integer value	GC_1	Not Supported
f	FLOAT 32	floating point value	GC_1	Supported

**11.2.1.3. Configuration of analogue value****Table 11.2.1.3.-1 Configuration of analogue value**

ScaledValueConfig Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/ Comments
scaleFactor	FLOAT 32		M	Not Supported
offset	FLOAT 32		M	Not Supported

**11.2.1.4. Range configuration****Table 11.2.1.4.-1 Range configuration**

RangeConfig Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/Comments
hhLim	AnalogueValue		M	Supported
hLim	AnalogueValue		M	Supported
lLim	AnalogueValue		M	Supported
llLim	AnalogueValue		M	Supported
min	AnalogueValue		M	Supported
max	AnalogueValue		M	Supported

**11.2.1.5. Step position with transient indication****Table 11.2.1.5.-1 Step position with transient indication**

ValWithTrans Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/Comments
posVal	INT8	-64 ... 63	M	Supported
transInd	BOOLEAN		O	Not Supported

### 11.2.1.6. Originator

**Table 11.2.1.6.-1 Step position with transient indication**

OriginatorType Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/ Comments
orCat	ENUMERATED	not-supported   bay-control   station-control   remote-control   automatic-bay   automatic-station   automatic-remote   maintenance   process	M	Supported
orIdent	OCTET STRING64		M	Supported

**Table 11.2.1.6.-2 Values for orCat**

Value	Explanation
bay-control	Control operation issued from an operator using a client located at bay level
station-control	Control operation issued from an operator using a client located at station level
remote-control	Control operation from a remote operator outside the substation (e.g. network control center)
automatic-bay	Control operation issued from an automatic function at bay level
automatic-station	Control operation issued from an automatic function at station level
automatic-remote	Control operation issued from an automatic function outside of the substation
maintenance	Control operation issued from a maintenance / service tool
process	Status change occurred without control action (e.g. external trip of a circuit breaker or failure inside the breaker)

### 11.2.1.7. Unit definition

**Table 11.2.1.7.-1 Unit**

Unit Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/ Comments
SIUnit	ENUMERATED	According to table in Annex A	M	Supported
multiplier	ENUMERATED	According to table in Annex A	O	Supported

**11.2.1.8. Vector definition****Table 11.2.1.8.-1 Vector**

Vector Type Definition				
Attribute Name	AttributeType	Value/ Value Range	M/O/C	SPA-ZC 402/ Comments
mag	AnalogueValue		M	Supported
ang	AnalogueValue		O	Not Supported

**11.2.1.9. CTxInt**

Context specific Integer. The type depends on the DO usage. Enum type is used with the Mod, Beh and Health Data Objects, otherwise Int32 is used.

**11.2.2. Common data classes****11.2.2.1. Single point status (SPS)**

Table 11.2.2.1.-1 defines the common data class of single point status.

**Table 11.2.2.1.-1 Single point status (SPS)**

SPS class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Status</b>						
stVal	BOOLEAN	ST	dchg	TRUE   FALSE	M	Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported
<b>Substitution</b>						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	BOOLEAN	SV		TRUE   FALSE	PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
<b>Configuration, description and extension</b>						
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported

### 11.2.2.2. Double point status (DPS)

The table 11.2.2.2.-1 defines the common data class of double point status.

**Table 11.2.2.2.-1 Double point status (DPS)**

DBS class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Status						
stVal	CODED ENUM	ST	dchg	intermediate-state   off   on   bad-state	M	Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported
Substitution						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	INT32	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
Configuration, Description and extension						
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported

### 11.2.2.3. Integer status (INS)

Table 11.2.2.3.-1 defines the common data class of integer status.

**Table 11.2.2.3.-1 Integer status (INS)**

INS class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Status						
stVal	CtxInt	ST	dchg		M	Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported

INS class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
<b>Substitution</b>						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	CtxInt	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
<b>Configuration, Description and Extension</b>						
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.4. Protection activation information (ACT)**

Table 11.2.2.4.-1 defines the common data class of protection activation information.

**Table 11.2.2.4.-1 Protection activation information (ACT)**

ACT class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Status</b>						
general	BOOLEAN	ST	dchg		M	<u>Supported</u>
phsA	BOOLEAN	ST	dchg		O	Supported
phsB	BOOLEAN	ST	dchg		O	Supported
phsC	BOOLEAN	ST	dchg		O	Supported
neut	BOOLEAN	ST	dchg		O	Supported
q	Quality	ST	qchg		M	<u>Supported</u>
t	TimeStamp	ST			M	<u>Supported</u>
<b>Configuration, Description and Extension</b>						
operTm	TimeStamp	CF			O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

ACT class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

**11.2.2.5. Directional protection activation information (ACD)**

Table 11.2.2.5.-1 defines the common data class of directional protection activation information.

**Table 11.2.2.5.-1 Directional protection activation information (ACD)**

ACD class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Status</b>						
general	BOOLEAN	ST	dchg		M	<u>Supported</u>
dirGeneral	ENUMERATED	ST	dchg	unknown   forward   backward   both	M	<u>Supported</u>
PhsA	BOOLEAN	ST	dchg		GC_2 (1)	Supported
dirPhsA	ENUMERATED	ST	dchg	unknown   forward   backward	GC_2 (1)	Supported
PhsB	BOOLEAN	ST	dchg		GC_2 (2)	Supported
dirPhsB	ENUMERATED	ST	dchg	unknown   forward   backward	GC_2 (2)	Supported
PhsC	BOOLEAN	ST	dchg		GC_2 (3)	Supported
dirPhsC	ENUMERATED	ST	dchg	unknown   forward   backward	GC_2 (3)	Supported
Neut	BOOLEAN	ST	dchg		GC_2 (4)	Supported
dirNeut	ENUMERATED	ST	dchg	unknown   forward   backward	GC_2 (4)	Supported
q	Quality	ST	qchg		M	<u>Supported</u>
t	TimeStamp	ST			M	<u>Supported</u>
<b>Configuration, Description and Extension</b>						
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>

ACD class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

### 11.2.2.6. Security violation counting (SEC)

Table 11.2.2.6.-1 defines the common data class of security violation counting.

**Table 11.2.2.6.-1 Security violation counting (SEC)**

SEC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
<b>DataAttribute</b>						
<b>Status</b>						
cnt	INT32U	ST	dchg		M	Not Supported
sev	ENUMERATED	ST		unknown   critical   major   minor   warning	M	Not Supported
T	TimeStamp	ST			M	Not Supported
addr	OCTET STRING64	ST			O	Not Supported
addInfo	VISIBLE STRING64	ST			O	Not Supported
<b>Configuration, Description and Extension</b>						
D	VISIBLE STRING255	DC			O	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

### 11.2.2.7. Binary counter reading (BCR)

Table 11.2.2.7.-1 defines the common data class of binary counter reading.

**Table 11.2.2.7.-1 Binary counter reading (BCR)**

BCR class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Status						
actVal	INT128	ST	dchg		M	Supported
frVal	INT128	ST	dupd		GC_2 (1)	Not Supported
frTm	TimeStamp	ST	dupd		GC_2 (1)	Not Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported
Configuration, Description and Extension						
units	Unit	CF		see Annex A	O	Not Supported
pulsQty	FLOAT32	CF			M	Supported
frEna	BOOLEAN	CF			GC_2 (1)	Not Supported
strTm	TimeStamp	CF			GC_2 (1)	Not Supported
frPd	INT32	CF			GC_2 (1)	Not Supported
frRds	BOOLEAN	CF			GC_2 (1)	Not Supported
d	VISIBLE STRING255	DC			O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

### 11.2.2.8. Measured value (MV)

Table 11.2.2.8.-1 defines the common data class of measured value.

**Table 11.2.2.8.-1 Measured value (MV)**

MV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Measured Values						
instMag	AnalogueValue	MX			O	Not Supported
mag	AnalogueValue	MX	dchg		M	Supported

MV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
range	ENUMERATED	MX	dchg	normal   high   low   high-high   low-low   ...	O	Supported
q	Quality	MX	qchg		M	<u>Supported</u>
t	TimeStamp	MX			M	<u>Supported</u>
Substitution						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	AnalogueValue	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
Configuration, Description and Extension						
units	Unit	CF		see Annex A	O	Supported
db	INT32U	CF		0...100 000	O	Not Supported
zeroDb	INT32U	CF		0...100 000	O	Not Supported
sVC	ScaledValue-Config	CF			AC_SCAV	Not Supported
rangeC	RangeConfig	CF			GC_CON	Not Supported
smpRate	INT32U	CF			O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

**11.2.2.9. Complex measured value (CMV)**

Table 11.2.2.9.-1 defines the common data class of measured value.

**Table 11.2.2.9.-1 Complex measured value (CMV)**

<b>CMV class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Measured Values</b>						
instCVal	Vector	MX			O	Not Supported
cVal	Vector	MX	dchg		M	<u>Supported</u>
range	ENUMERATED	MX	dchg	normal   high   low   high-high   low-low   ...	O	Supported
q	Quality	MX	qchg		M	<u>Supported</u>
t	TimeStamp	MX			M	<u>Supported</u>
<b>Substitution</b>						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subCVal	Vector	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
<b>Configuration, Description and Extension</b>						
units	Unit	CF		see Annex A	O	Supported
db	INT32U	CF		0...100 000	O	Not Supported
zeroDb	INT32U	CF		0...100 000	O	Not Supported
rangeC	RangeConfig	CF			GC_CON	Supported
magSVC	ScaledValue-Config				AC_SCAV	Not Supported
angSVC	ScaledValue-Config				AC_SCAV	Not Supported
angRef	ENUMERATED	CF		V   A   other ...	O	Not Supported
smpRate	INT32U	CF			O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

**11.2.2.10. WYE**

Table 11.2.2.10.-1 defines the common data class of WYE.

**Table 11.2.2.10.-1 WYE**

SAV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
Data						
phsA	CMV				GC_1	Supported
phsB	CMV				GC_1	Supported
phsC	CMV				GC_1	Supported
neut	CMV				GC_1	Supported
net	CMV				GC_1	Not Supported
res	CMV				GC_1	Not Supported
DataAttribute						
Configuration, Description and Extension						
angRef	ENUMERATED	CF		Va   Vb   Vc   Aa   Ab   Ac   Vab   Vbc   Vca   Vother   Aother	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the CMV type variant.

**11.2.2.11. Delta (DEL)**

Table 11.2.2.11.-1 defines the common data class of delta.

**Table 11.2.2.11.-1 Delta (DEL)**

SAV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
Data						
phsAB	CMV				GC_1	Supported
phsBC	CMV				GC_1	Supported
phsCA	CMV				GC_1	Supported
DataAttribute						
Configuration, Description and Extension						
angRef	ENUMERATED	CF		Va   Vb   Vc   Aa   Ab   Ac   Vab   Vbc   Vca   Vother   Aother	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the CMV type variant.

**11.2.2.12. Sequence (SEQ)**

Table 11.2.2.12.-1 defines the common data class of sequence.

**Table 11.2.2.12.-1 Sequence (SEQ)**

SAV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
Data						
c1	CMV				M	Supported
c2	CMV				M	Supported
c3	CMV				M	Supported
DataAttribute						
Measured values						
seqT	ENUMERATED	CF		pos-neg-zero   dir-quad-zero	M	Supported
M Configuration, Description and Extension						

SAV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
phsRef	ENUMERATED	CF		A   B   C   ...	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.13. Harmonic Value (HMV)**

Table 11.2.2.13.-1 defines the common data class of harmonic value.

**Table 11.2.2.13.-1 Harmonic Value (HMV)**

HMV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
<b>DataAttribute</b>						
<b>Measured Values</b>						
<b>Basics</b>						
q	Quality	MX	qchg		M	Not Supported
t	TimeStamp	MX			M	Not Supported
<b>Harmonics and Interharmonics</b>						
har	ARRAY[0.. numHar] OF Vector	MMX	dchg, dupd		M	Not Supported
<b>Configuration, Description and Extension</b>						
numHar	INT16U	CF		>1	M	Not Supported
numCycl	INT16U	CF		>0	M	Not Supported
evalTim	INT16U	CF			M	Not Supported
units	Unit	CF		see Annex A	O	Not Supported
smpRate	INT32U	CF			O	Not Supported
frequency	FLOAT32U	CF		fundamental frequency	M	Not Supported
hvRef	ENUMERATED	CF		fundamental   rms   absolute	O	Not Supported
rmsTim	INT32U	CF			AC_RMS_M	Not Supported
d	VISIBLE STRING255	DC		Text	O	Not Supported

HMV class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Harmonics for a single circuit have phase angles (optional) but need no reference for the angle (angRef) since by convention the reference is always the fundamental frequency (index 1).

**11.2.2.14. Harmonic value for WYE (HWYE)**

Table 11.2.2.14.-1 defines the common data class of harmonic value for WYE.

**Table 11.2.2.14.-1 Harmonic value for WYE (HWYE)**

HWYE class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
<b>DataAttribute</b>						
<b>Measured Values</b>						
<b>Basics</b>						
q	Quality	MX	qchg		M	Not Supported
t	TimeStamp	MX			M	Not Supported
<b>Harmonics and Interharmonics</b>						
phsAHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		M	Not Supported
phsBHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
phsCHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
neutHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
netHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported

HWYE class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
resHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
Configuration, Description and Extension						
numHar	INT16U	CF		>1	M	Not Supported
numCycl	INT16U	CF		>0	M	Not Supported
evalTim	INT16U	CF			M	Not Supported
units	Unit	CF		see Annex A	O	Not Supported
angRef	ENUMERATED	CF		Va   Vb   Vc   Aa   Ab   Ac   Vab   Vbc   Vca   Vother   Aother	O	Not Supported
smpRate	INT32U	CF			O	Not Supported
frequency	FLOAT32U	CF		fundamental frequency	M	Not Supported
hvRef	ENUMERATED	CF		fundamental   rms   absolute	O	Not Supported
rmsTim	INT32U	CF			AC_RMS_M	Not Supported
d	VISIBLE STRING255	DC		Text	O	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLND_A_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLND_A_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.15. Harmonic value for DEL (HDEL)**

Table 11.2.2.15.-1 below defines the common data class of harmonic value for DEL.

**Table 11.2.2.15.-1 Harmonic value for DEL (HDEL)**

HDEL class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Measured Values						
Basics						
q	Quality	MX	qchg		M	Not Supported
t	TimeStamp	MX			M	Not Supported
Harmonics and Interharmonics						
phsABHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		M	Not Supported

<b>HDEL class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
pHsBChar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
pHsCAHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
<b>Configuration, Description and Extension</b>						
numHar	INT16U	CF		>1	M	Not Supported
numCycl	INT16U	CF		>0	M	Not Supported
evalTim	INT16U	CF			M	Not Supported
units	Unit	CF		see Annex A	O	Not Supported
angRef	ENUMERATED	CF		Va   Vb   Vc   Aa   Ab   Ac   Vab   Vbc   Vca   Vother   Aother	O	Not Supported
smpRate	INT32U	CF			O	Not Supported
frequency	FLOAT32U	CF		fundamental frequency	M	Not Supported
hvRef	ENUMERATED	CF		fundamental   rms   absolute	O	Not Supported
rmsTim	INT32U	CF			AC_RMS_M	Not Supported
d	VISIBLE STRING255	DC		Text	O	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

### 11.2.2.16. Controllable single point (SPC)

Table 11.2.2.16.-1 defines the common data class of controllable single point.

**Table 11.2.2.16.-1 Controllable single point (SPC)**

<b>SPC class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Control and Status</b>						
ctlVal	BOOLEAN	CO		off (FALSE)   on (TRUE)	AC_CO_M	Supported
operTm	TimeStamp	CO			AC_CO_O	Not Supported
origin	Originator	ST			AC_CO_O	Not Supported
ctlNum	INT8U	ST		0..255	AC_CO_O	Not Supported

SPC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
stVal	BOOLEAN	ST	dchg	FALSE   TRUE	AC_ST	<u>Supported</u>
q	Quality	ST	qchg		AC_ST	<u>Supported</u>
t	TimeStamp	ST			AC_ST	<u>Supported</u>
stSeld	BOOLEAN	ST	dchg		AC_CO_O	Not Supported
Substitution						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	BOOLEAN	SV		FALSE   TRUE	PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRIN64	SV			PICS_SUBST	Not Supported
Configuration, Description and Extension						
pulseConfig	PulseConfig	CF			AC_CO_O	Not Supported
ctlModel	ENUMERATED	CF		Status-only   direct-with-normal-security   sbo-with-normal-security   direct-with-enhanced-security   sbo-with-enhanced-security	M	<u>Supported</u>
sboTimeout	INT32U	CF			AC_CO_O	Not Supported
sboClass	ENUMERATED	CF		operate-once   operate-many	AC_CO_O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

**11.2.2.17. Controllable double point (DPC)**

Table 11.2.2.17.-1 defines the common data class of controllable double point.

**Table 11.2.2.17.-1 Controllable double point (DPC)**

<b>SPC class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
DataName	Inherited from Data Class (see IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Control and Status</b>						
ctlVal	BOOLEAN	CO		off (FALSE)   on (TRUE)	AC_CO_M	Supported
operTm	TimeStamp	CO			AC_CO_O	Not Supported
origin	Originator	ST			AC_CO_O	Supported
ctlNum	INT8U	ST		0..255	AC_CO_O	Supported
stVal	CODED ENUM	ST	dchg	intermediate-state   off   on   bad-state	M	<u>Supported</u>
q	Quality	ST	qchg		M	<u>Supported</u>
t	TimeStamp	ST			M	<u>Supported</u>
stSeld	BOOLEAN	ST	dchg		AC_CO_O	Supported
<b>Substitution</b>						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	CODED ENUM	SV		intermediate-state   off   on   bad-state	PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
<b>Configuration, Description and Extension</b>						
pulseConfig	PulseConfig	CF			AC_CO_O	Not Supported
ctlModel	ENUMERATED	CF		status-only   direct-with-normal-security   sbo-with-normal-security   direct-with-enhanced-security   sbo-with-enhanced-security	M	<u>Supported</u>
sboTimeout	INT32U	CF			AC_CO_O	Not Supported
sboClass	ENUMERATED	CF		operate-once (0)   operate-many (1)	AC_CO_O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

**11.2.2.18. Controllable integer status (INC)**

Table 11.2.2.18.-1 defines the common data class of controllable integer status.

**Table 11.2.2.18.-1 Controllable integer status (INC)**

INC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Control and Status						
ctlVal	CtxInt	CO			AC_CO_M	Supported
operTm	TimeStamp	CO			AC_CO_O	Not Supported
origin	Originator	ST			AC_CO_O	Not Supported
ctlNum	INT8U	ST		0..255	AC_CO_O	Not Supported
stVal	INT32	ST	dchg		M	<u>Supported</u>
q	Quality	ST	qchg		M	<u>Supported</u>
t	TimeStamp	ST			M	<u>Supported</u>
stSeld	BOOLEAN	ST	dchg		AC_CO_O	Not Supported
Substitution						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	ValWithTrans	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
Configuration, Description and Extension						
persistent	BOOLEAN	CF			M	Not Supported
ctlModel	ENUMERATED	CF		Status-only   direct-with-normal-security   sbo-with-normal-security   direct-with-enhanced-security   sbo-with-enhanced-security	M	<u>Supported</u>
sboTimeout	INT32U	CF			AC_CO_O	Not Supported
sboClass	ENUMERATED	CF		operate-once   operate-many	AC_CO_O	Not Supported
minVal	INT8	CF			O	Not Supported

<b>INC class</b>						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
maxVal	INT8	CF			O	Not Supported
stepSize	INT8U	CF		1 ... (maxVal - minVal)	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Supported <sup>a)</sup>
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

<sup>a)</sup> cdcNs is only used for the LD0.Mod diagnostics. It is not possible to change it.



Different variants of the type exist based on the connectivity package short address information (sAddr). Underlined information indicates the basic type.

### 11.2.2.19. Binary controlled step position information (BSC)

Table 11.2.2.19.-1 defines the common data class of binary controlled step position information.

**Table 11.2.2.19.-1 Binary controlled step position information (BSC)**

<b>BSC class</b>						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Control and Status</b>						
ctlVal	ENUMERATED	CO		stop   lower   higher   reserved	AC_CO_M	Supported
operTm	TimeStamp	CO			AC_CO_O	Not Supported
origin	Originator	ST			AC_CO_O	Not Supported
ctlNum	INT8U	ST		0..255	AC_CO_O	Not Supported
valWTr	ValWithTrans	ST	dchg		AC_ST	<u>Supported</u>
q	Quality	ST	qchg		AC_ST	<u>Supported</u>
t	TimeStamp	ST			AC_ST	<u>Supported</u>
stSeld	BOOLEAN	ST	dchg	FALSE   TRUE	AC_CO_O	Not Supported
<b>Substitution</b>						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	ValWithTrans	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported

BSC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
Configuration, Description and Extension						
persistent	BOOLEAN	CF			M	<u>Supported</u>
ctlModel	ENUMERATED	CF		Status-only   direct-with-normal-security   sbo-with-normal-security   direct-with-enhanced-security   sbo-with-enhanced-security	M	<u>Supported</u>
sboTimeout	INT32U	CF			AC_CO_O	Not Supported
sboClass	ENUMERATED	CF		operate-once   operate-many	AC_CO_O	Not Supported
minVal	INT8	CF			O	Not Supported
maxVal	INT8	CF			O	Not Supported
stepSize	INT8U	CF		1 ... (maxVal - minVal)	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	<u>Supported</u>
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Different variants of the type exist based on the control model (ctlModel) and connectivity packet short address information. Underlined information indicates the basic type.

**11.2.2.20. Integer controlled step position information (ISC)**

Table 11.2.2.20.-1 defines the common data class of integer controlled step position information.

**Table 11.2.2.20.-1 Integer controlled step position information (ISC)**

ISC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (see IEC 61850-7-2)					Not Supported
<b>DataAttribute</b>						
<b>Control and Status</b>						
ctlVal	INT8	CO		-64 ... 63	AC_CO_M	Not Supported
operTm	TimeStamp	CO			AC_CO_O	Not Supported
origin	Originator	CO ST			AC_CO_O	Not Supported
ctlNum	INT8U	CO ST		0..255	AC_CO_O	Not Supported
valWTr	ValWithTrans	ST	dchg		AC_ST	Supported
q	Quality	ST	qchg		AC_ST	Supported
t	TimeStamp	ST			AC_ST	Not Supported
stSeld	BOOLEAN	ST	dchg		AC_CO_O	Not Supported
<b>Substitution</b>						
subEna	BOOLEAN	SV			PICS_SUBST	Not Supported
subVal	ValWithTrans	SV			PICS_SUBST	Not Supported
subQ	Quality	SV			PICS_SUBST	Not Supported
subID	VISIBLE STRING 64	SV			PICS_SUBST	Not Supported
<b>Configuration, Description and Extension</b>						
ctlModel	ENUMERATED	CF		Status-only   direct-with-normal-security   sbo-with-normal-security   direct-with-enhanced-security   sbo-with-enhanced-security	M	Supported
sboTimeout	INT32U	CF			AC_CO_O	Not Supported
sboClass	ENUMERATED	CF		operate-once   operate-many	AC_CO_O	Not Supported
minVal	INT8	CF			O	Not Supported
maxVal	INT8	CF			O	Not Supported
stepSize	INT8U	CF			O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



Status-only is supported for the ctlModel.

### 11.2.2.21. Controllable analogue set point information (APC)

Table 11.2.2.21.-1 defines the common data class of controllable analogue set point information.

**Table 11.2.2.21.-1 Controllable analogue set point (APC)**

APC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setpoint and measured values						
setMag	AnalogueValue	SP MX	dchg		M	Not Supported
origin	Originator	SP MX			O	Not Supported
operTm	TimeStamp	SP			O	Not Supported
q	Quality	ST	qchg		M	Not Supported
t	TimeStamp	ST			M	Not Supported
Configuration, Description and Extension						
ctlModel	ENUMERATED	CF		direct-with-normal-security	M	Not Supported
units	Unit	CF		see Annex A	O	Not Supported
sVC	ScaledValue-Config	CF			AC_SCAV	Not Supported
minVal	AnalogueValue	CF			O	Not Supported
maxVal	AnalogueValue	CF			O	Not Supported
stepSize	AnalogueValue	CF		1 ... (maxVal-minVal)	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

### 11.2.2.22. Single point setting (SPG)

Table 11.2.2.22.-1 defines the common data class of single point setting.

**Table 11.2.2.22.-1 Single point setting (SPG)**

APC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setVal	BOOLEAN	SP		off (FALSE)   on (TRUE)	AC_NSNG_M	Not Supported
setVal	BOOLEAN	SQSE		off (FALSE)   on (TRUE)	AC_SG_M	Not Supported
Configuration, Description and Extension						
d	VISIBLE STRING255	DC		Text	O	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.23. Integer status setting (ING)**

Table 11.2.2.23.-1 defines the common data class of integer status setting.

**Table 11.2.2.23.-1 Integer status setting (ING)**

APC class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (see IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setVal	INT32	SP			AC_NSNG_M	Not Supported
setVal	INT32	SG SE			AC_SG_M	Not Supported
Configuration, Description and Extension						
minVal	INT32	CF			O	Not Supported
maxVal	INT32	CF			O	Not Supported
stepSize	INT32	CF		1 ... (maxVal - minVal)	O	Not Supported
D	VISIBLE STRING255	DC		Text	O	Not Supported
CdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.24. Analogue setting (ASG)**

Table 11.2.2.24.-1 defines the common data class of analogue setting.

**Table 11.2.2.24.-1 Analogue setting (ASG)**

ASG class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setMag	AnalogueValue	SP			AC_NSNG_M	Not Supported
setMag	AnalogueValue	SG SE			AC_SG_M	Not Supported
Configuration, Description and Extension						
units	Unit	CF		see Annex A	O	Not Supported
sVC	ScaledValue-Config	CF			AC_SCAV	Not Supported
minVal	AnalogueValue	CF			O	Not Supported
maxVal	AnalogueValue	CF			O	Not Supported
stepSize	AnalogueValue	CF		1 ... (maxVal - minVal)	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Not Supported
CdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.25. Setting curve (CURVE)**

Table 11.2.2.25.-1 defines the common data class of setting curve.

**Table 11.2.2.25.-1 Setting curve (CURVE)**

ASG class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setCharact	ENUMERATED	SP			AC_NSNG_M	Not Supported
setParA	FLOAT32	SP			AC_NSNG_O	Not Supported
setParB	FLOAT32	SP			AC_NSNG_O	Not Supported
setParC	FLOAT32	SP			AC_NSNG_O	Not Supported
setParD	FLOAT32	SP			AC_NSNG_O	Not Supported
setParE	FLOAT32	SP			AC_NSNG_O	Not Supported

<b>ASG class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
setParF	FLOAT32	SG SE			AC_NSNG_O	Not Supported
setCharact	ENUMERATED	SG SE			AC_NSNG_M	Not Supported
setParA	FLOAT32	SG SE			AC_NSNG_O	Not Supported
setParB	FLOAT32	SG SE			AC_NSNG_O	Not Supported
setParC	FLOAT32	SG SE			AC_NSNG_O	Not Supported
setParD	FLOAT32	SG SE			AC_NSNG_O	Not Supported
setParE	FLOAT32	SG SE			AC_NSNG_O	Not Supported
setParF	FLOAT32	SG SE			AC_NSNG_O	Not Supported
<b>Configuration, Description and Extension</b>						
d	VISIBLE STRING255	DC		Text	O	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.2.2.26. Device name plate (DPL)**

Table 11.2.2.26.-1 defines the common data class of device name plate.

**Table 11.2.2.26.-1 Device name plate (DPL)**

<b>ASG class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Configuration, Description and Extension</b>						
vendor	VISIBLE STRING255	DC			M	Supported
hwRev	VISIBLE STRING255	DC			O	Supported
swRev	VISIBLE STRING255	DC			O	Supported
serNum	VISIBLE STRING255	DC			O	Supported
model	VISIBLE STRING255	DC			O	Not Supported
location	VISIBLE STRING255	DC			O	Supported

ASG class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

### 11.2.3. Logical node name plate (LPL)

Table 11.2.3.-1 defines the common data class of logical node name plate.

**Table 11.2.3.-1 Logical node name plate (LPL)**

ASG class						
Attribute Name	Attribute Type	FC	TrgOp	Value/ Value range	M/O/C	SPA-ZC 402/ Comments
DataName	Inherited from Data Class (see IEC 61850-7-2)					Supported
<b>DataAttribute</b>						
<b>Configuration, Description and Extension</b>						
vendor	VISIBLE STRING255	DC			M	Supported
hwRev	VISIBLE STRING255	DC			M	Supported
d	VISIBLE STRING255	DC		Text	M	Supported
configRev	VISIBLE STRING255	DC			AC_LN0_M	Supported
ldNs	VISIBLE STRING255	EX		must be included only in LLN0	AC_LN0_M	Supported
lnNs	VISIBLE STRING255	EX			AC_DLD_M	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported



For lnNs the value (val) needs to be set after specific short address (sAddr).

**11.2.3.1. Curve shape description (CSD)**

Table 11.2.3.1.-1 defines the common data class of curve shape description.

**Table 11.2.3.1.-1 Curve shape description (CSD)**

<b>CSD class</b>						
<b>Attribute Name</b>	<b>Attribute Type</b>	<b>FC</b>	<b>TrgOp</b>	<b>Value/ Value range</b>	<b>M/O/C</b>	<b>SPA-ZC 402/ Comments</b>
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
<b>DataAttribute</b>						
<b>Configuration, Description and Extension</b>						
xUnit	Unit	DC			M	Not Supported
xD	VISIBLE STRING255	DC			M	Not Supported
yUnit	Unit	DC			M	Not Supported
yD	VISIBLE STRING255	DC			M	Not Supported
numPts	INT16U	DC			M	Not Supported
crvPts	ARRAY[1.. numPt] OF				M	Not Supported
	xVal	FLOAT32	DC			
	xVal	FLOAT32	DC			
d	VISIBLE STRING255	DC			M	Not Supported
cdcNs	VISIBLE STRING255	EX			AC_DLN- DA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLN- DA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

**11.3. SCL conformance statement**

Table 11.3.-1 defines the support of Substation Configuration Language.

**Table 11.3.-1 SCL conformance degrees**

SCL conformance		Client-CR			Server-CR		
		Base	F/S	Value/Range	Base	F/S	SPA-ZC 402/ Comments
SCL.1	SCL File for Implementation Available (offline)				m	m	Supported, CID file export
SCL.2	SCL File available from implementation online	O	o		o	o	Supported, CID file can be retrieved online with FTP from the device
SCL.3	SCL implementation reconfiguration supported online	O	o		o	o	Supported <sup>a)</sup>

<sup>a)</sup> The CID file is used to configure the device. Notice that you have to preserve the SPA-ZC 40x Communication Engineering Tool's (CET) private sections to configure a device again. CET for SPA-ZC 40x knows product limitations and it is recommended to use only for the configuration.

Implementations claiming conformance to SCL.2 or SCL.3 may support the ACSI services defined in Table 11.3.-2.

**Table 11.3.-2 Supported ACSI services for SCL.2 and SCL.3**

SCL conformance		Client-CR			Server-CR		
		Base	F/S	Value/Range	Base	F/S	SPA-ZC 402/ Comments
ACSI Services							Not Supported
	GetFileAttributeValues	O	o		o	m	Supported
	GetFile	O	<sup>a)</sup>		o	<sup>a)</sup>	Supported
	SetFile	O	<sup>b)</sup>		o	<sup>b)</sup>	Supported
	DeleteFile	O	o		o	<sup>b)</sup>	Supported
	GetDataValues	O	<sup>c)</sup>		o	<sup>c)</sup>	Not Supported
	SetDataValues	O	<sup>a)</sup>		o	<sup>a)</sup>	Not Supported
	SCL Control Block	I	i		o	<sup>b)</sup>	Not Supported
	SCL File Structure	I	m		i	m	Not Supported
	Remote Creation of SCL File	I	o		i	o	Not Supported

<sup>a)</sup> Must be m if support for SCL.2 is declared.

<sup>b)</sup> Must be m if support for SCL.3 is declared.

<sup>c)</sup> Must be m if support for SCL.2 or SCL.3 is declared.

The additional MMS services, defined Table 11.3.-3, must be supported if support for SCL.2 or SCL.3 is declared.

**Table 11.3.-3 Additional MMS services for SCL.2 and SCL.3**

SCL conformance		Client-CR			Server-CR		
		Base	F/S	Value/Range	Base	F/S	SPA-ZC 402/Comments
MMS Services							Not Supported
	GetCapability-List	O	i		o	i	Supported
	GetDomainAttributes	O	o		o	m	Not Supported
	LoadDomain	O	a)		o	a)	Not Supported
	StoreDomain	O	b)		o	b)	Not Supported

a) Must be m if support SCL.3 is declared.

b) Must be m if support for remote creation of a SCL is declared.

## 11.4. SCL control block

The SCL control block must have a functional constraint of SC. This control block must occur in LLN0 only.

The SCL control block must be a structured MMS type definition that contains the ordered named components defined in Table 11.4.-1.

**Table 11.4.-1 Definition of SCL control block**

IEC 61850-8-1 Component Name	MMS Type Description	r/w	m/o	Comments	SPA-ZC 402/Comments
validate	VISIBLE-STRING size of 64 octets	rw	mo	Must be m if support for remote activation of an SCL is declared.	N/A for TP client
valState	Unsigned Integer - 8 bits	r	m	(0) - NOT-VALIDATED (1) - VALIDATION-ERROR (2) - VALIDATED (3) - VALIDATION-IN-PROGRESS (4) - NOT-SUPPORTED (5) - VALIDATE-FILE-PRESENT	N/A for TP client
activate	VISIBLE-STRING size of 64 octets	rw	mo	Must be m if support for remote activation of an SCL is declared.	N/A for TP client

## 11.5. Protocol implementation conformance statement

In the following tables basic protocol conformance statements (PICS) are defined.

### 11.5.1. Profile conformance

**Table 11.5.1.-1 A-profile support**

		Client		Server		SPA-ZC 402/ Comments
		F/S		F/S		
A1	Client/Server A-Profile	a)		a)		Supported
A2	GOOSE/GSE Management A-Profile	b)		b)		Not Supported
A3	GSSE A-Profile	c)		c)		Not Supported
A4	TimeSync A-Profile	d)		d)		Supported

- a) Must be m if support for any service specified for Client/S are declared within the ACSI basic conformance.
- b) Must be m if support for any service specified for GOOSE/GSE Management are declared within the ACSI basic conformance.
- c) Must be m if support for any service specified for GSSE A-Profile are declared within the ACSI basic conformance.
- d) Support for at least one other A-Profile must be declared (e.g. in A1-A3) in order to claim conformance to IEC 61850-8-1.

**Table 11.5.1.-2 A-profile support**

		Client		Server		SPA-ZC 402/ Comments
		F/S		F/S		
T1	TCP/IP T-Profile	a)		a)		Supported
T2	OSI T-Profile	b)		b)		Not Supported
T3	GOOSE/GSE T-Profile	c)		c)		Supported
T4	GSSE T-Profile	d)		d)		Not Supported
T5	TimeSync T-Profile	o		o		Supported

- a) Must be m if support for A1 is declared. Otherwise, must be i.
- b) Must be o if support for A1 is declared. Otherwise, must be i.
- c) Must be m if support for A2 is declared. Otherwise, must be i.
- d) Must be m if support for A3 is declared. Otherwise, must be i.

**11.5.1.1. MMS conformance**

All needed services supporting the ACSI services stated to be supported in paragraph 2 are supported by the MMS stack used.

**11.5.1.2. GOOSE services**

Table 11.5.1.2.-1 below defines the conformance of the GOOSE service.

**Table 11.5.1.2.-1 GOOSE conformance**

	Subscriber	Publisher	SPA-ZC 402/Comments
GOOSE Services	a)	a)	Supported
SendGOOSEMessage	M	m	Supported
GetGoReference	O	b)	Not Supported
GetGOOSEElementNumber	O	b)	Not Supported
GetGoCBValues	O	o	Not Supported
SetGoCBValues	O	o	Not Supported

	<b>Subscriber</b>	<b>Publisher</b>	<b>SPA-ZC 402/Comments</b>
GSENotSupported	b)	c)	Not Supported
GOOSE Control Block (GoCB)	O	o	Not Supported

a) Must be m if support is declared within ACSI basic conformance.

b) Must be m if ACSI basic conformance support for either GetGoReference or GetGOOSEElementNumber is declared.

c) Must be m if ACSI basic conformance support for either GetGoReference, GetGOOSEElementNumber, or GOOSE is declared.

**Table 11.5.1.2.-2 GSSE conformance**

	<b>Subscriber</b>	<b>Publisher</b>	<b>SPA-ZC 402/Comments</b>
GSSE Services	a)	a)	Not Supported
SendGSSEEMessage	M	m	Not Supported
GetGsReference	O	b)	Not Supported
GetGSSEDataOffset	O	b)	Not Supported
GetGsCBValues	O	o	Not Supported
SetGsCBValues	O	o	Not Supported
GSENotSupported	b)	o	Not Supported
GSSE Control Block (GsCB)	O	o	Not Supported

a) Must be m if support is declared within ACSI basic conformance.

b) Must be m if ACSI basic conformance support for either GetGsReference or GetGSSEDataOffset is declared.



**12. KEMA certificate**



**IEC 61850 Certificate Level A<sup>1</sup>**

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Issued to:  
 ABB Oy  
 Distribution Automation  
 Muottitie 2 A  
 FI-65101 Vaasa  
 Finland

No. 30810022-Consulting 08-1269

For the product:  
 REF 545 V3.5  
 With SPA-ZC 400 V2.1.2



The product has not shown to be non-conforming to:

**IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1**

Communication networks and systems in substations

The conformance test has been performed according to IEC 61850-10 with product's protocol, model and technical issue implementation conformance statements: "IEC 61850 Conformance Statement for RE\_54\_ and SPA-ZC 400, version 1.0", "IEC 61850 Tissues Conformance Statement for RE\_54\_ and SPA-ZC 400, version 1.0" and product's extra information for testing: "IEC 61850 Protocol Implementation extra Information for Testing (PIXIT) for RE\_54\_ and SPA-ZC 400, version 1.0".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases as defined in the UCA International Users Group Device Test procedures v1.1):

1 Basic Exchange (15/23)	9b GOOSE Subscribe (9/9)
2 Data Sets (2/5)	12a Direct Control (5/11)
5 Unbuffered Reporting (10/13)	12d Enhanced SBO Control (10/17)
6 Buffered Reporting (13/15)	13 Time Synchronization (3/4)
9a GOOSE Publish (7/11)	14 File Transfer (5/6)

This Certificate includes a summary of the test results as carried out at ABB Oy in Finland with UniCASim 61850 version 3.17.01 with test suite 3.17.02 and UniCA 61850 analyzer 4.17.01. The test is based on the UCA International Users Group Device Test Procedures version 1.1. This document has been issued for information purposes only, and the original paper copy of the KEMA report: No. 30810022-Consulting 08-1268 will prevail.

The test has been carried out on one single specimen of the products as referred above and submitted to KEMA by ABB Oy. The manufacturer's production process has not been assessed. This Certificate does not imply that KEMA has certified or approved any product other than the specimen tested.

Amhem, June 5, 2008

W. Strabbing  
 Manager Intelligent Networks and Communication

M. Fichil  
 Test Engineer

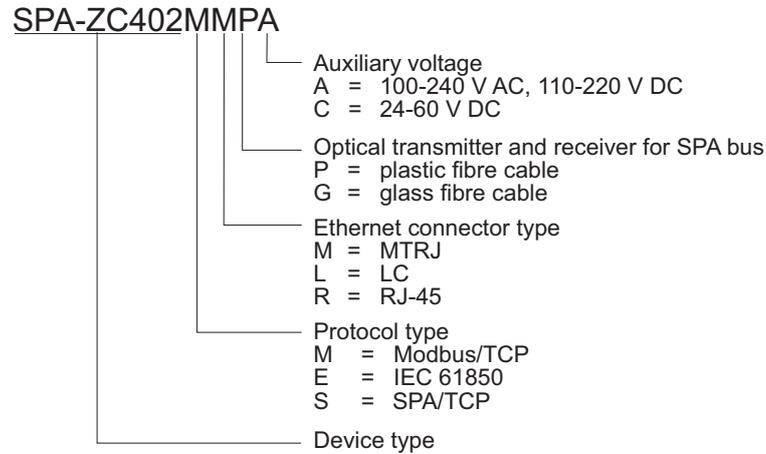
1 Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System

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## 13. Ordering information



A060159

Fig. 13.-1 Ordering information for SPA-ZC 402

### SPA-ZC402CD

- SPA-ZC 402 configuration CD
  - Engineering tool, Communication Engineering Tool (CET) for SPA-ZC 40x



Order at least one SPA-ZC 402 configuration CD with your delivery to get the Communication Engineering Tool. The SPA-ZC 402 package does not include the configuration CD by default.



The Connectivity Packages can be downloaded on the ABB web site <http://www.abb.com/substationautomation>.

Select the appropriate product from the **Distribution products** drop-down list and click **OK**. Then select Download tab and from the **Document kind** drop-down list, select Software. Finally, click the Connectivity Package link to download it.

**Table 13.-1 Compatibility between IEC 61850 SPA-ZC 402, CET, Connectivity Packages and IEDs**

SPA-ZC 40x version	CET version	Connectivity Package versions, devices and release					
		REX521 1.0 or later Release C, E and F	REF610 Release G	REU610	REM610	SPACOM	
1.0	1.0	-	-	-	-	-	-
1.1.1	1.1.1	1.0 or later	1.1 or later	2.0 or later	2.0 or later	2.0 or later	-
2.0	2.0	1.0 or later	1.1 or later	2.0 or later	2.0 or later	2.0 or later	-
2.1	2.1	2.0 or later	2.0 or later	2.0 or later	2.0 or later	2.0 or later	2.0 or later
2.1.2	2.1.2	2.0 or later	2.0 or later	2.0 or later	2.0 or later	2.0 or later	2.0 or later



## 14. Terminology

Term	Description
Communication Engineering Tool	Also known as CET. Software for configuring and monitoring communication gateways or communication front ends.
Functional constraint	Property of a data-attribute that indicates the services for example read value, write value, substitute value, etc. that may be applied to that data attribute
Intelligent Electronic Device	Also known as IED. Devices containing advanced logics such as meters, protection and control relays and trip units.
Logical Device	Representation of a group of functions. Each function is defined as a logical node. A physical device has one or several LDs.
RJ-45	Galvanic connector type
sAddr	Short Address Information The sAddr attribute allows the allocation of a short address to DO attributes. Short addresses can be used within the communication to be more efficient either in the communication, or in the handling of messages at client or server. Furthermore, they can be used as IED internal identification for the attribute.
Snap-in	Connector type for plastic fibre cable
SPA	Data communication protocol developed by ABB



## 15. Abbreviations

Abbreviation	Description
ACSI	Abstract communication service interface
AR	Auto reclosure
CD	Change detect; compact disk
CET	Communication Engineering Tool
CID	Configured IED description
DA	Data attribute
DC	Direct current
DO	Data object
DOI	Data object instance
EMC	Electromagnetic compatibility
FC	Functional constraint
FTP	File transfer protocol
GSSE	Generic substation status event
HMI	Human-machine interface
ICD	IED capability description
IED	Intelligent electronic device
IP	Internet protocol
IRF	Internal relay fault
LAN	Local area network
LD	Logical device
LED	Light-emitting diode
LN	Logical node
MICS	Model implementation conformance statement
MMS	Manufacturing message specification
MV	Medium voltage
OSI	Open System Interconnection
PC	Personal computer
PICS	Protocol implementation conformance statement
RCB	Report Control Block
SCADA	Supervision, control and data acquisition
SCL	Substation configuration description language (defined by IEC 61850)
SNTP	Simple Network Time Protocol
SPA	Data communication protocol developed by ABB
SQL	Structured query language
ST	Straight-tip; a connector type for fibre optic cable
STP	Shielded twisted pair
UTC	Universal time clock
XML	Extensible markup language



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