Ethernet Adapter SPA-ZC 400

SPA to IEC 61850 Gateway

Installation and Commissioning Manual

Contents

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1. Introduction

1.1. This manual

This manual provides thorough information on the SPA-ZC 400 Ethernet Adapter and the central concepts related to it. SPA-ZC 400 Ethernet Adapter is used for connecting REF 541/3/5, REM 543/5 and RET 541/3/5 Intelligent Electronic Devices (IED) to the IEC 61850 Station bus. In the manual you find information on SPA-ZC 400 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 400. 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 400 configuration CD	1MRS151048
CAP 505 User's Guide	1MRS752292-MUM
SPA-ZF Optical glass fibres, multimode granded index type	1MRS755371
Plastic-core fibre-optic cables, Features and instructions for mounting	1MRS752089
Connectivity Packages, User's Guide  The Connectivity Packages can be downloaded on the ABB web site http://www.abb.com/substationautomation.	1MRS755312

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

Version	Date	History
A	06.10.2004	Document created
B	11.10.2004	Document updated
C	30.12.2004	Ordering information changed
D	30.06.2006	SPA-ZC 400 2.0 additions
E	16.2.2007	SPA-ZC 400 2.1 additions
F	27.06.2008	REM54_ and RET54_support additions
G	20.05.2009	SPA-ZC 400 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.

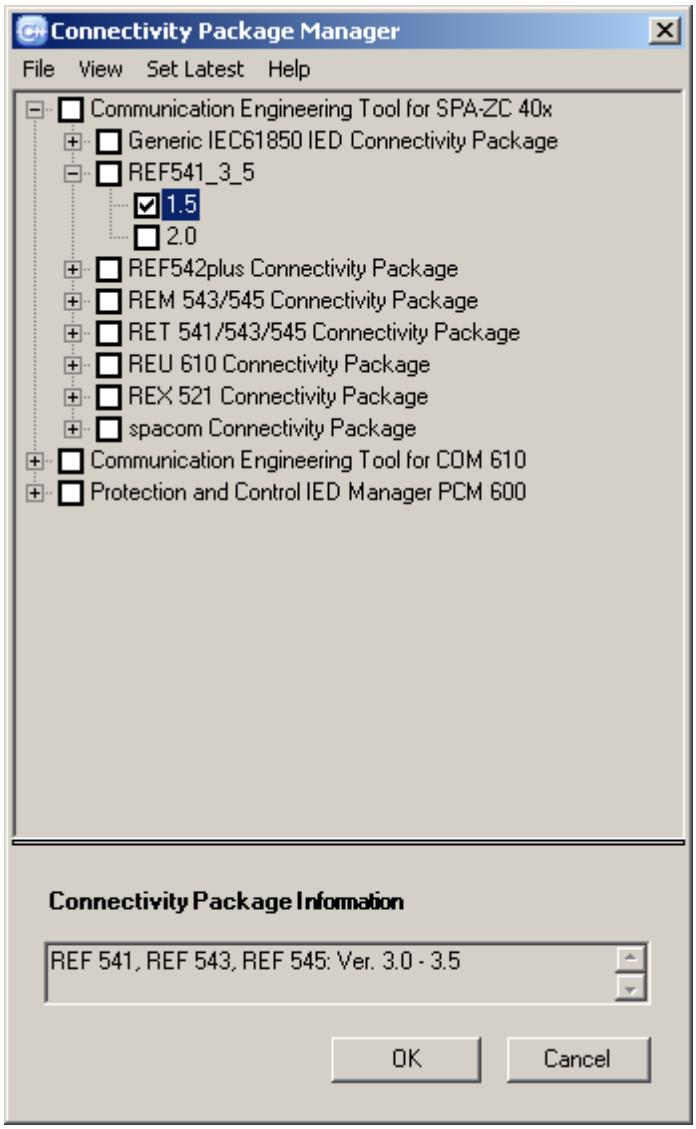

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Fig. 3.-1 Connectivity Package Manager

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** (SPAZC40x_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 5.4.1. 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 400. 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 400 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 400 is used to connect one REF 541/3/5, REM 543/5 or RET 541/3/5 device to the IEC 61850 Station bus. The IEC 61850 standard defines the IEC 61850 communication and engineering specifications. In addition to the IEC 61850 communication, SPA-ZC 400 provides simultaneous dual port communication for fibre-optic SPA and LON. SPA-ZC 400 offers also the possibility to access the device with the SPA protocol over the TCP/IP network using the same Ethernet link.

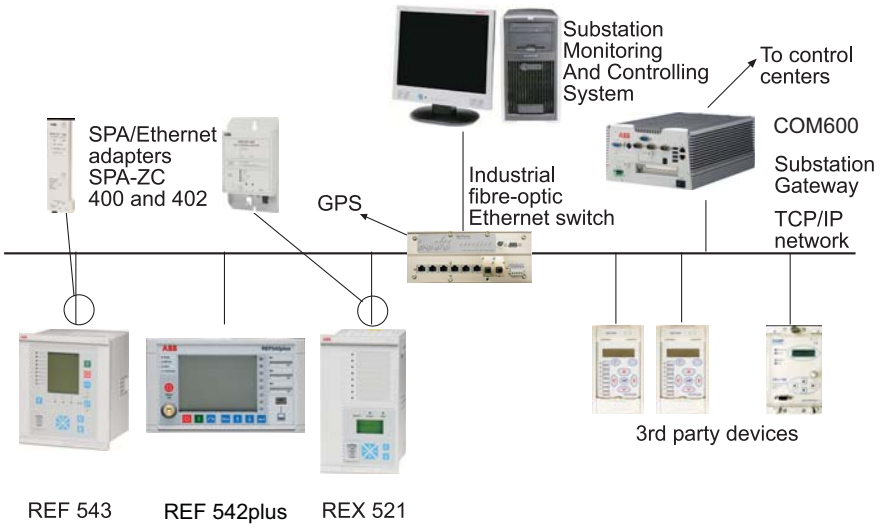

Fig. 4.-1 Conceptual picture of a typical system setup

The mechanical and electrical connection of the Ethernet adapter to a REF 541/3/5, REM 543/5 or RET 541/3/5 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 400:

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. SPA-ZC 400 and optional LON/SPA interface

The optional interface provides a connection between the REF 541/3/5, REM 543/5 or RET 541/3/5 device and the fibre-optic SPA and LON. The bus connection module converts incoming optical signals from the SPA and LON bus to electrical RS-485 signals for the REF 541/3/5, REM 543/5 and RET 541/3/5 devices and vice versa. It contains a service pin for LON nodes.

The optional interface can be used in loop- and star-type bus topologies. It is possible to select the idle state of module line. The light can be turn on or off. The jumpers select the bus topology (loop or star) depending on whether the light is turned on or off.

In the loop topology, the interface receives the message from the fibre-optic interface and passes it both to the fibre-optic transmitter and to the RS-485 interface. In the star topology, the interface receives the message from the fibre-optic receiver and passes it only to the RS-485 interface. If the message is received from the RS-485 interface, it is passed to the fibre-optic transmitter in both bus topologies.

The SPA bus communication uses loop and light off modes, when the module jumpers are in loop- and light off- positions. The LON bus communication uses star and light off modes, when the module jumpers are in star- and light off-positions.

In the LON bus communication the optional interface supports collision detection. The service pin is connected via the RS-485 interface to the device's Neuron chip, which is connected to the interface.

Table 4.1.-1 Settings of the jumper

Topology	Light on/off	Protocol
Star	Light off	LON/SPA
Star	Light on	Not supported
Loop	Light off	LON/SPA
Loop	Light on	Not supported

4.2. Features

SPA-ZC 400 has the following features:

- IEC 61850 connectivity for REF 541/3/5 , REM 543/5 and RET 541/3/5
- Easy-to-use configuration tool for the IEC 61850 data mapping

- Simultaneous dual port communication (plastic and fiber optic connections) for IEC 61850 and LON/SPA (excluding event polling)
- Support of communication over TCP/IP

All relay data can be routed through SPA-ZC 400. 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 400 is configured to poll SPA events, then it is not allowed to poll SPA events from another SPA client.

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Fig. 4.2.-1 Parts of SPA-ZC 400

1 Ethernet connector
2 LON/ SPA bus connector (optional)
3 LON/ SPA Rx LED
4 LON service pin
5 LAN and diagnostics LEDs

4.3. 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 400 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

Connect the SPA-ZC 400 module to REF 541/3/5, REM 543/5 or RET 541/3/5 and screw SPA-ZC 400 to the 9-pin type D-connectors. Connect the LAN cable to the LAN connector of SPA-ZC 400. The other end of the cable is connected to the IEC 61850 Station bus through the Ethernet switch.

5.2. Communication Engineering Tool for SPA-ZC 40x

5.2.1. 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.

5.2.2. 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.

5.2.3. 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.

5.3. Installing Connectivity Packages

1. Close all the open programs and insert the SPA-ZC 400 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 5.2.2. 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.

5.3.1. Enabling Connectivity Packages

Use Connectivity Package Manager to enable the Connectivity Packages for SPA-ZC 400.

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 400.
3. Click **OK** to apply the selection, see Fig. 5.3.1.-1.

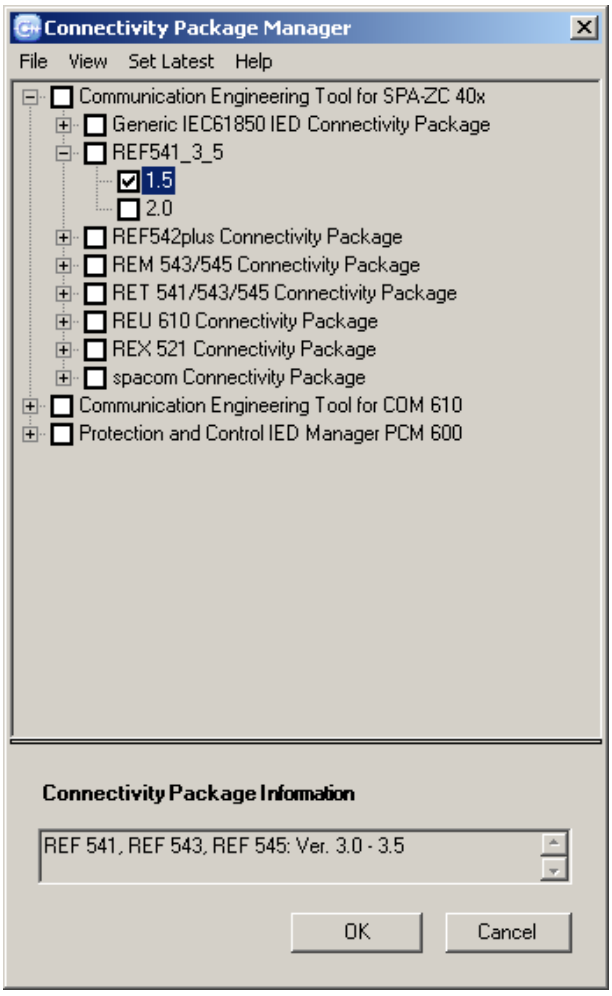

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Fig. 5.3.1.-1 Connectivity Package Manager

5.3.2. 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**.

5.4. Connecting to SPA-ZC 400

The Sections 5.4.1. and 5.4.2. describe how to connect to SPA-ZC 400 from the Communication Engineering Tool (CET) for SPA-ZC 40x.

5.4.1. Changing computer's IP address

To connect SPA-ZC 400, the used computer and SPA-ZC 400 must use the same address space.

To change the computer's IP address space to be the same as in SPA-ZC 400:

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. 5.4.1.-1.

You must have system administration rights to perform the task.

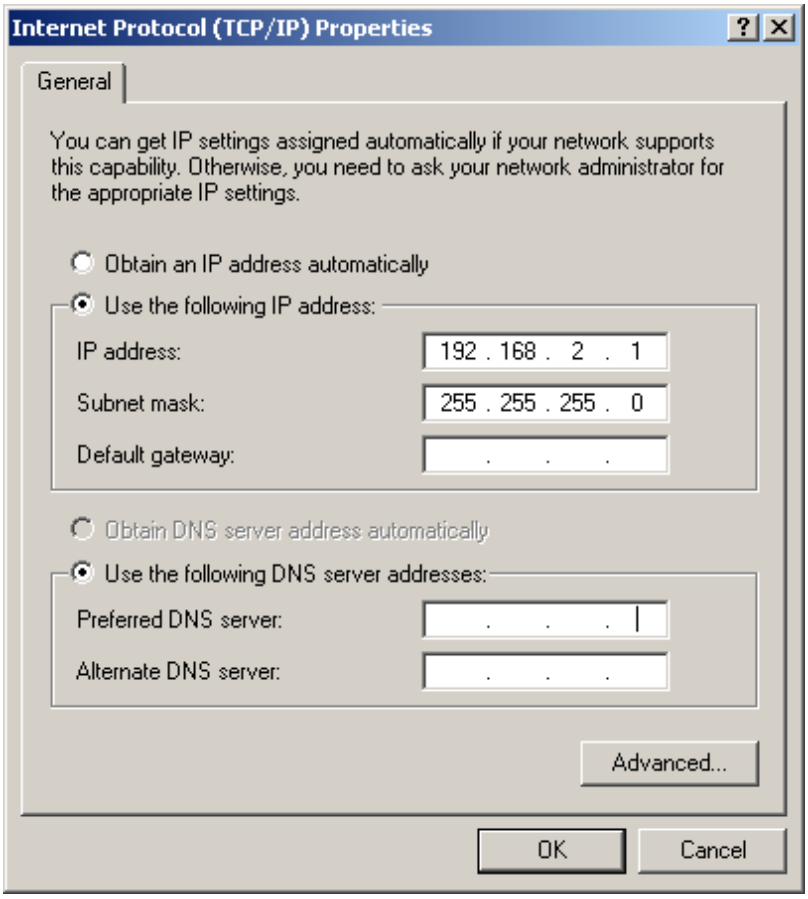

Fig. 5.4.1.-1 Changing IP address

5.4.2. Checking connection to SPA-ZC 400

Check the connection to SPA-ZC 400 by using the ping command:

1. Open the Run dialog.
2. Type `cmd` to the Open box, see Fig. 5.4.2.-1.

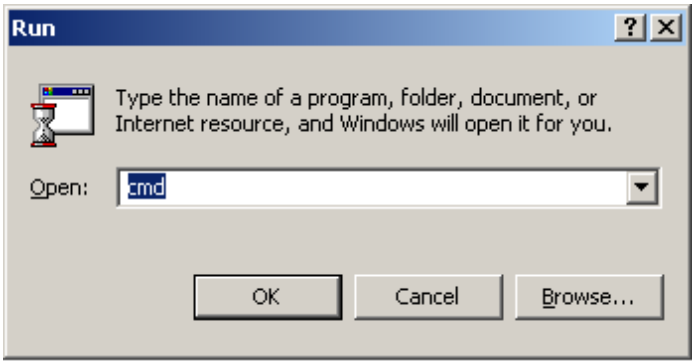

Fig. 5.4.2.-1 Starting command prompt

3. Click **OK** to run the command prompt.

4. Type `ping 192.168.2.10`, see Fig. 5.4.2.-2.

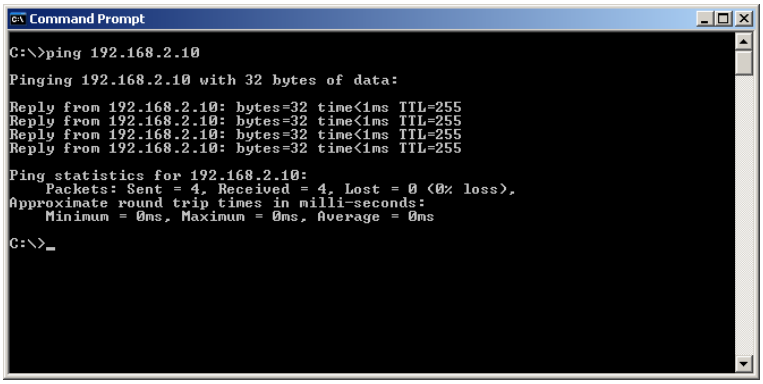

Fig. 5.4.2.-2 Pinging SPA-ZC 400

SPA-ZC 400responds to the ping command if the computer and SPA-ZC 400 are on the same network.

5. If SPA-ZC 400 responds with the IP address, the connection is established between the computer and SPA-ZC 400.

6. Engineering

This section guides when performing the engineering tasks required before using SPA-ZC 400.

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 400 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 400 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
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 400 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.

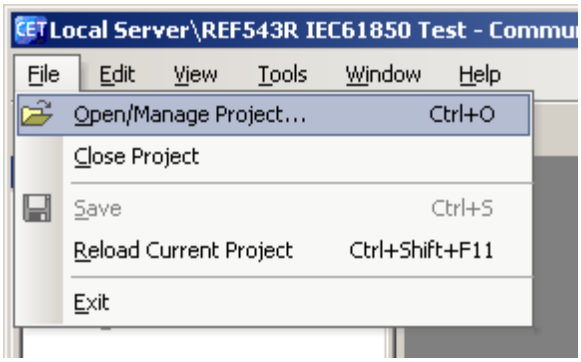

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Fig. 6.2.-1 Opening a project

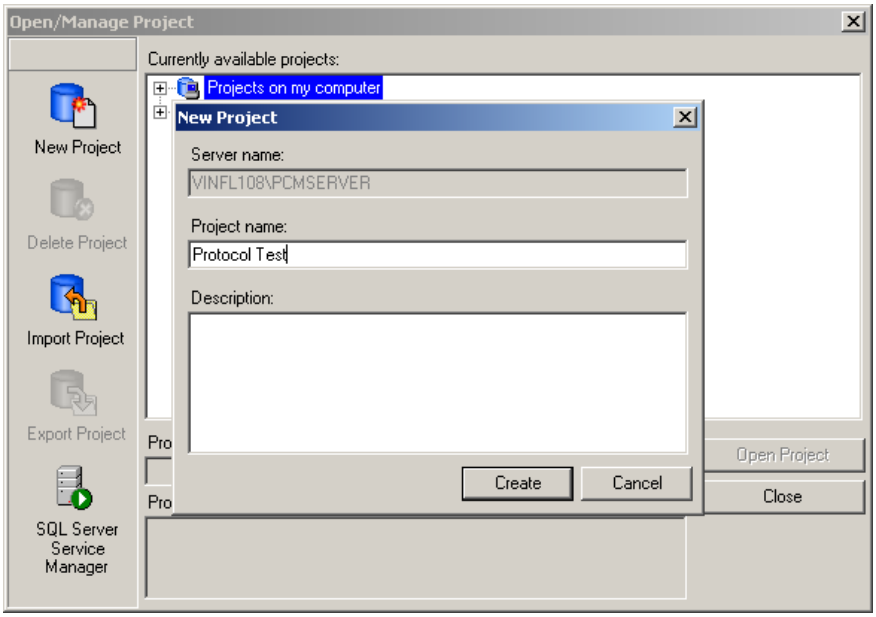

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Fig. 6.2.-2 Creating a new project

6.3. Restarting

Use this function to restart the SPA-ZC 400 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 400. When download is finished, SPA-ZC 400 is restarted automatically.

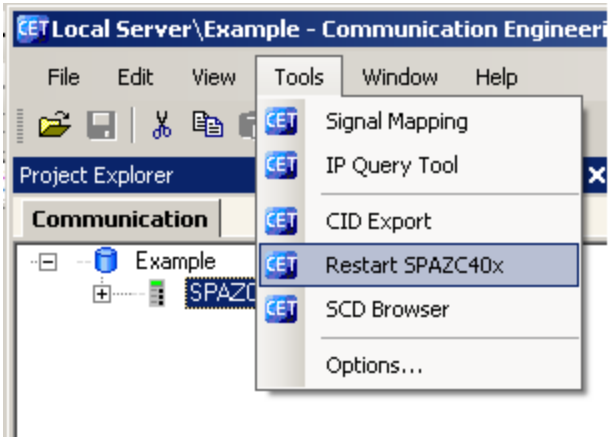


Fig. 6.3.-1 Restarting

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 400 object and its child objects as devices and data objects. Indentation is used to indicate the parent-child relationship between the objects.

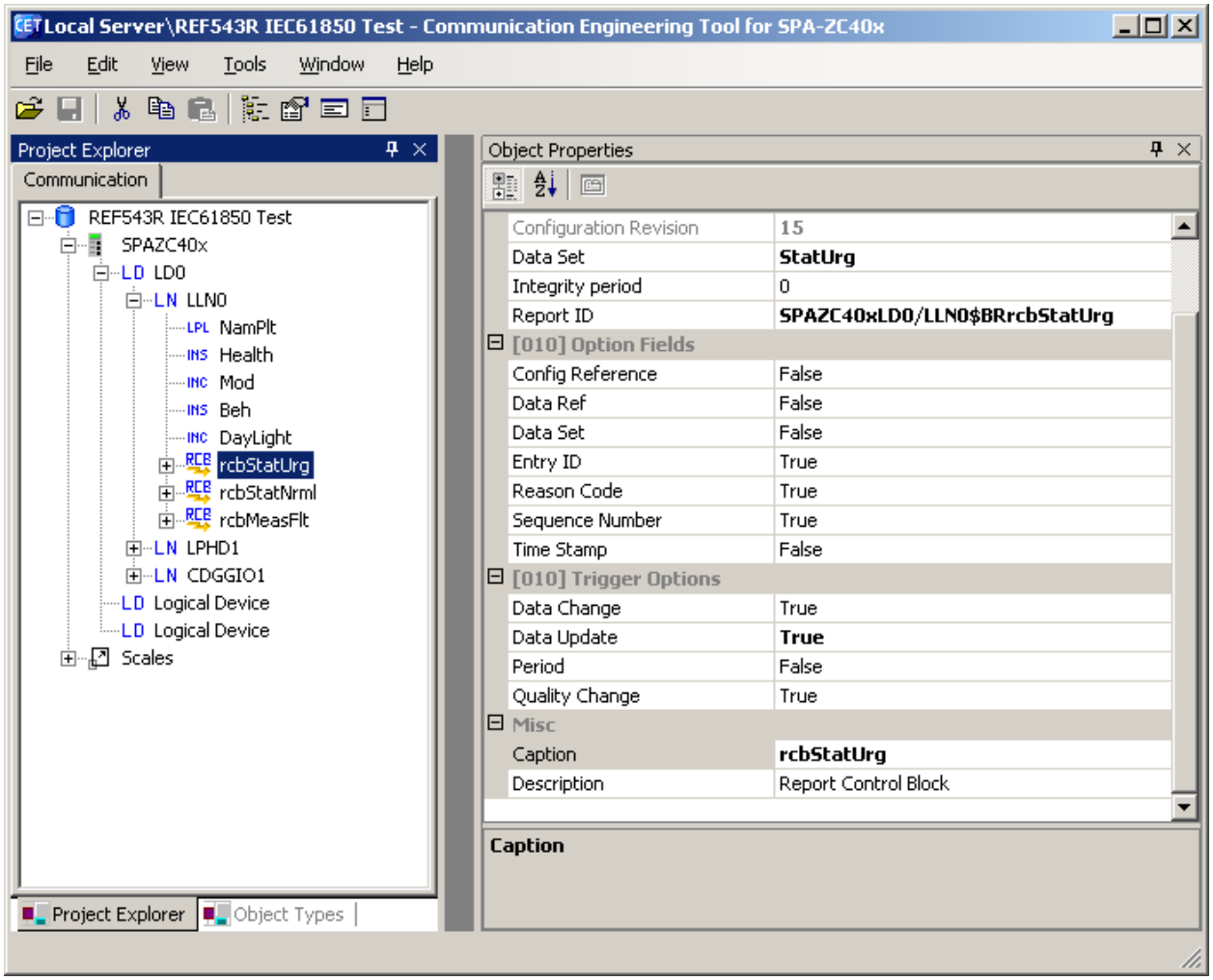


Fig. 6.4.-1 Example view of the SPA-ZC 40x Communication Engineering Tool

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

- You can use the right mouse button (right-click) to select the object to which you want to add a child object.
- You can copy the object.
- You can select the object using a drag-and-drop operation

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 400 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.

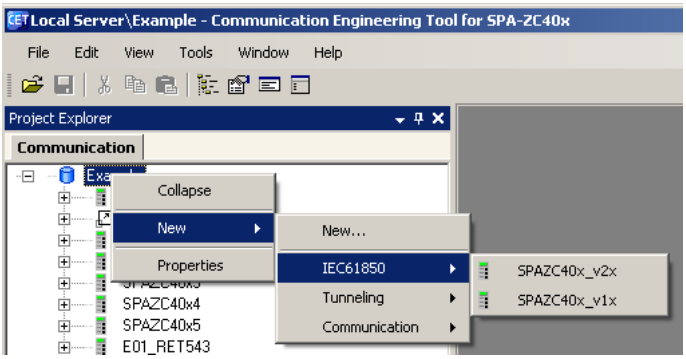


Fig. 6.4.1.-1 Adding an IEC 61850 Device object

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 400 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 400 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 (REF 541/3/5, 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 400 is described in the logical device LD1.

For more information about installing Connectivity Packages, refer to Section 5.3. Installing Connectivity Packages.

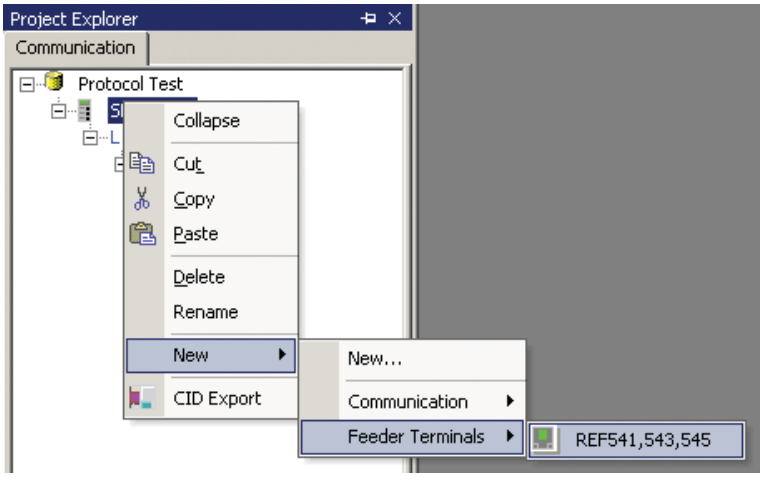


Fig. 6.4.2.-1 Adding Logical Device objects

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

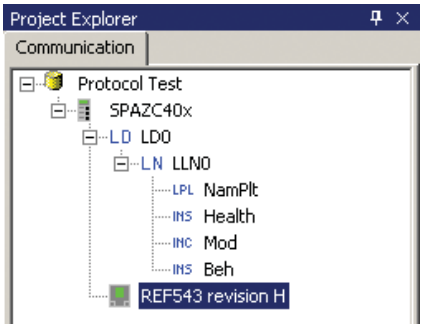


Fig. 6.4.2.-2 Logical node is shown as sub-object

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 two Logical Device objects under one Device Object (LD0 and one IED logical node).

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, REF 541/3/5).
2. Import the project created with CAP 505, the Relay Product Engineering Tools software.

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.

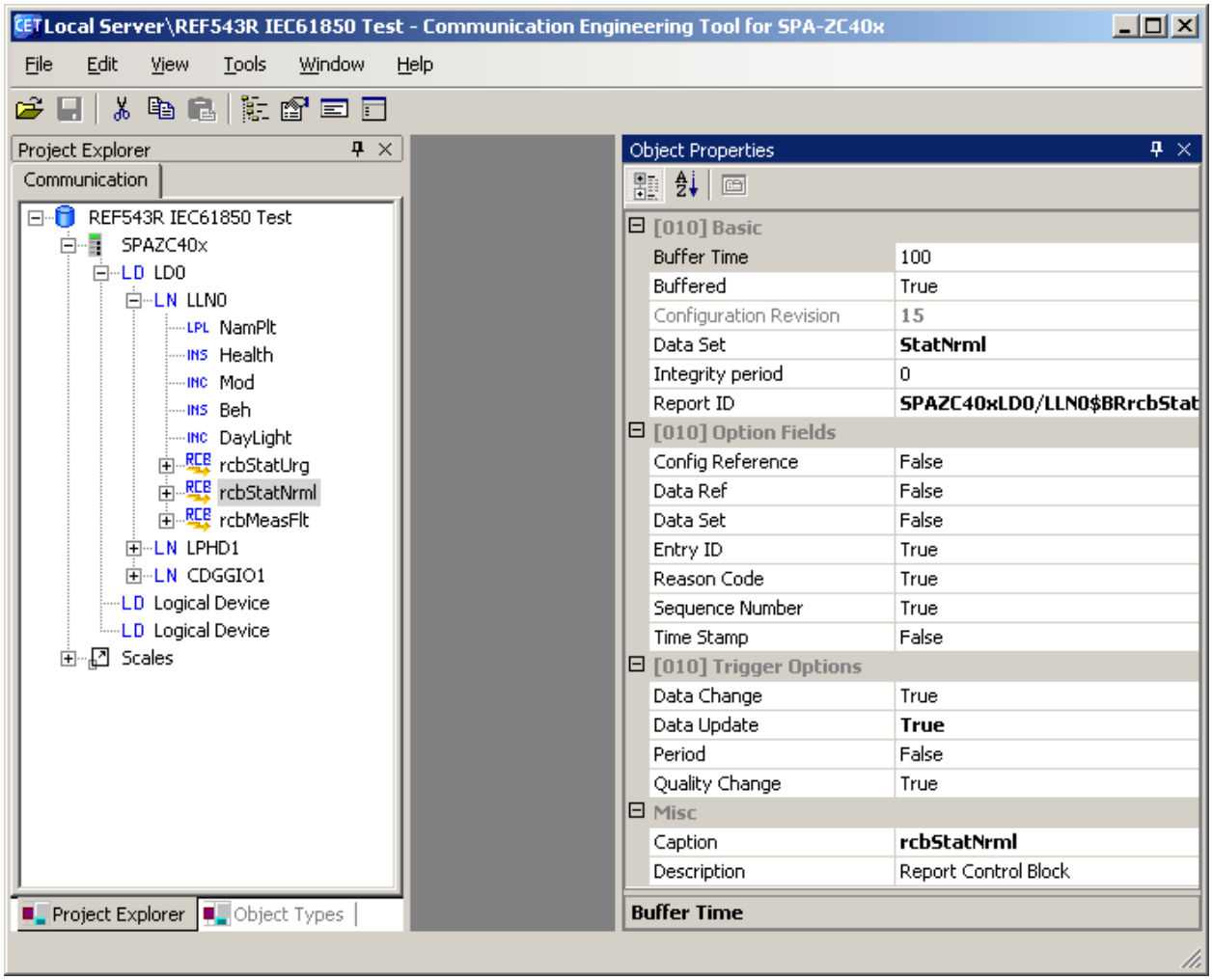


Fig. 6.4.3.-1 Project Explorer dialog in the Communication Engineering Tool window

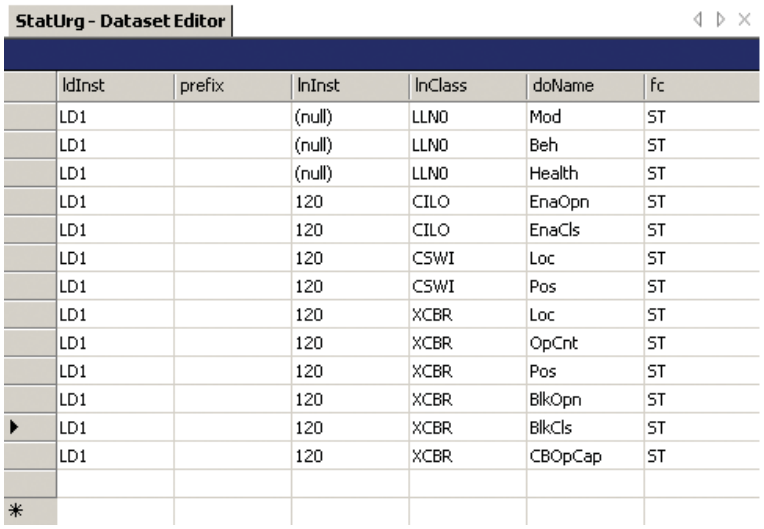
6.5. Using Dataset Editor

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**.



IdInst	prefix	lnInst	lnClass	doName	fc
LD1		(null)	LLN0	Mod	ST
LD1		(null)	LLN0	Beh	ST
LD1		(null)	LLN0	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

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Fig. 6.5.-1 Dataset Editor

Dataset Editor columns:

- IdInst

  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 400 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 400 communication parameters are located in the device properties. SPA-ZC 400 uses static IP addresses, which have to be defined in the planned network structure.

- IP Address

  IP address identifies SPA-ZC 400 in Local Area Network (LAN). All communication via SPA-ZC 400 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 400 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 400 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 400 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 additon, 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 Greenwich Mean Time (GMT).

- OSI addresses are read-only and they are always the same. The IEC 61850 client uses these addresses to access SPA-ZC 400 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.

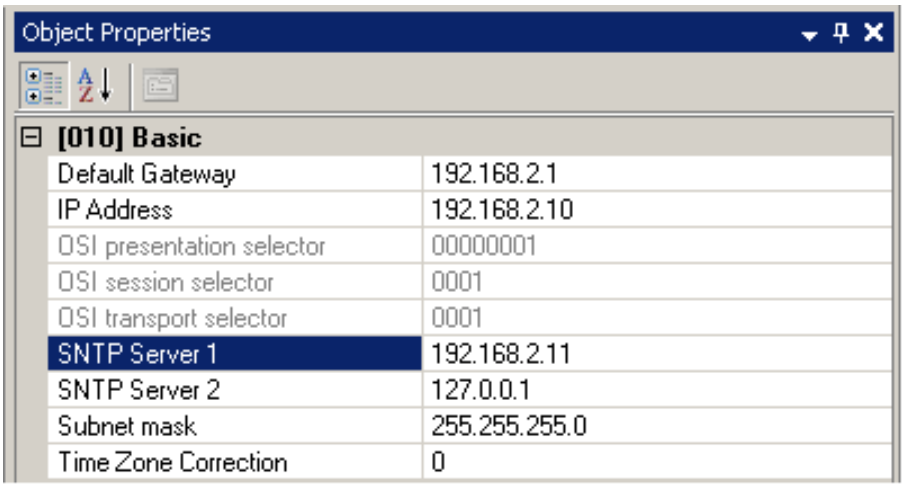

Fig. 6.7.-1 General communication parameters

6.7.1. SPA Communication parameters

- SPA Address

  SPA-ZC 400 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 400. 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 400 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

  SPA-ZC 400 uses default bit rate 9600 bit/s. Other possible values are 1200, 2400, 4800, 19200 and 38400 bits/s. The used value has to be same as the configured value in IED.

  REF 541/3/5 3.5 and the latest patch releases of RET 541/3/5 3.0 and REM 543/5 2.5 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 400 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 400 with SNTP as it is defined in the IEC 61850-8-1 standard, and SPA-ZC 400 is also synchronizing IED over SPA.

  - Disabled

    In this mode, you can only synchronize SPA-ZC 400 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 400 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 400 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 400 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.

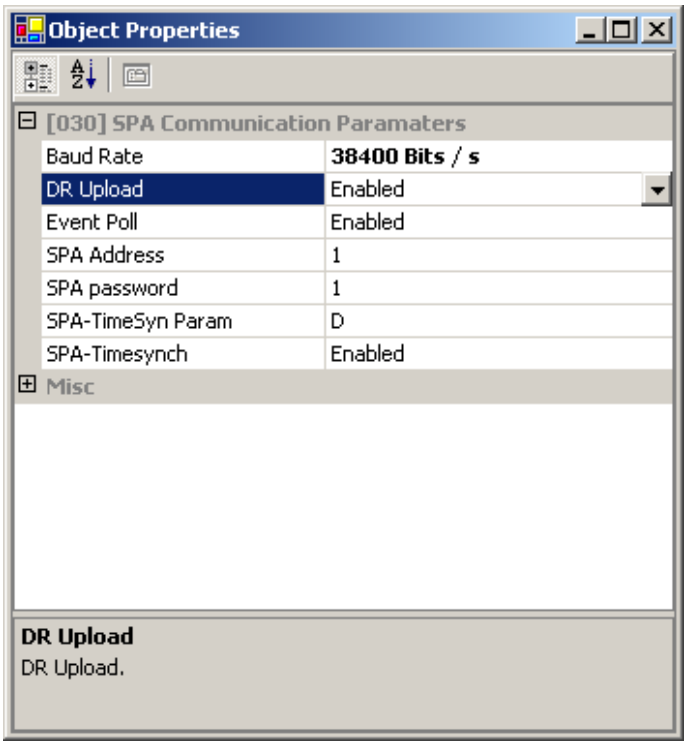

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Fig. 6.7.1.-1 SPA Communication Parameters

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 400:

1. Select the IEC 61850 Device object and right-click to select the CID Export.
2. If you download configuration to SPA-ZC 400 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 400 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 400 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.

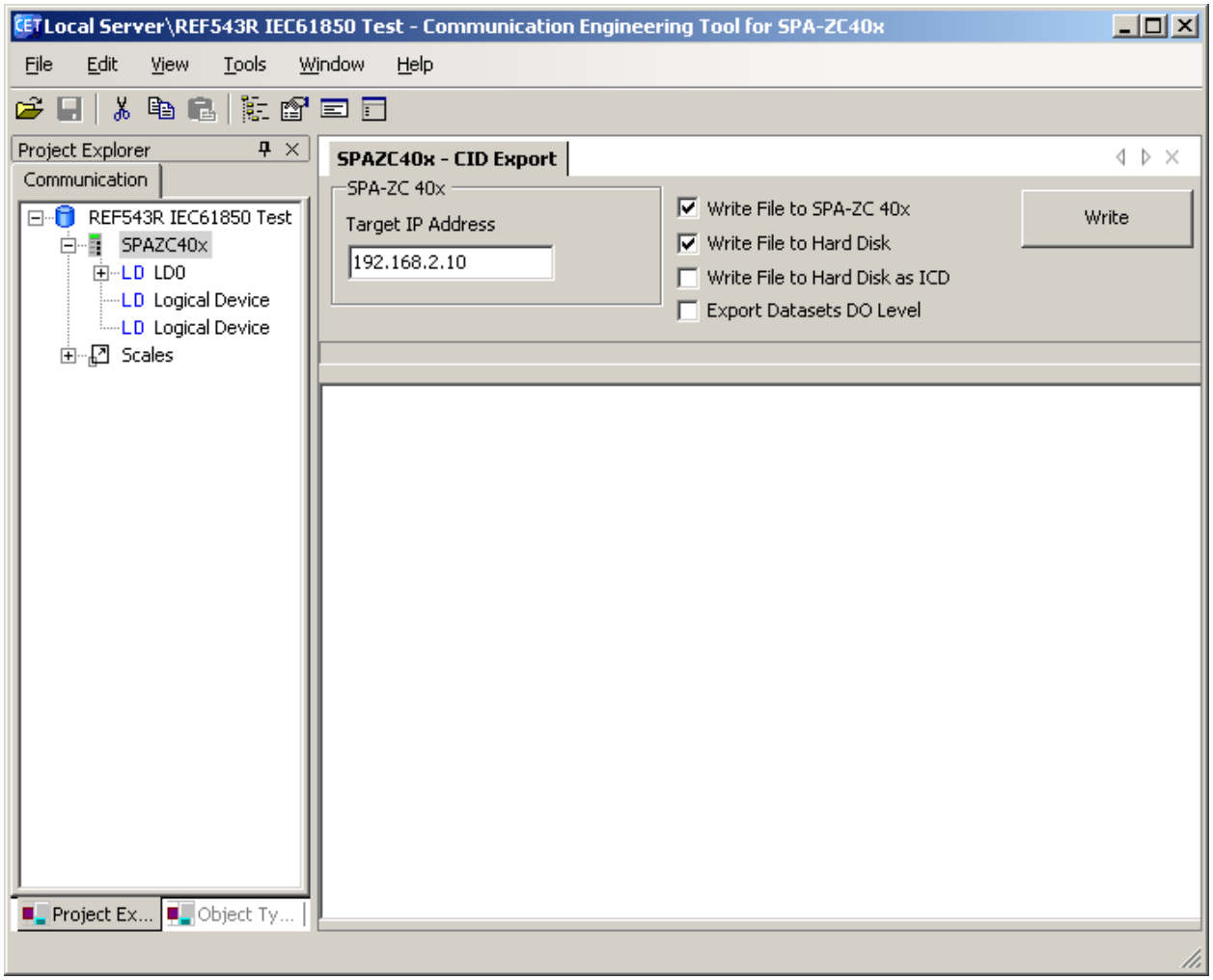

Fig. 6.8.-1 Downloading the device's configuration

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 400 asks either the old SPA-ZC 400 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.

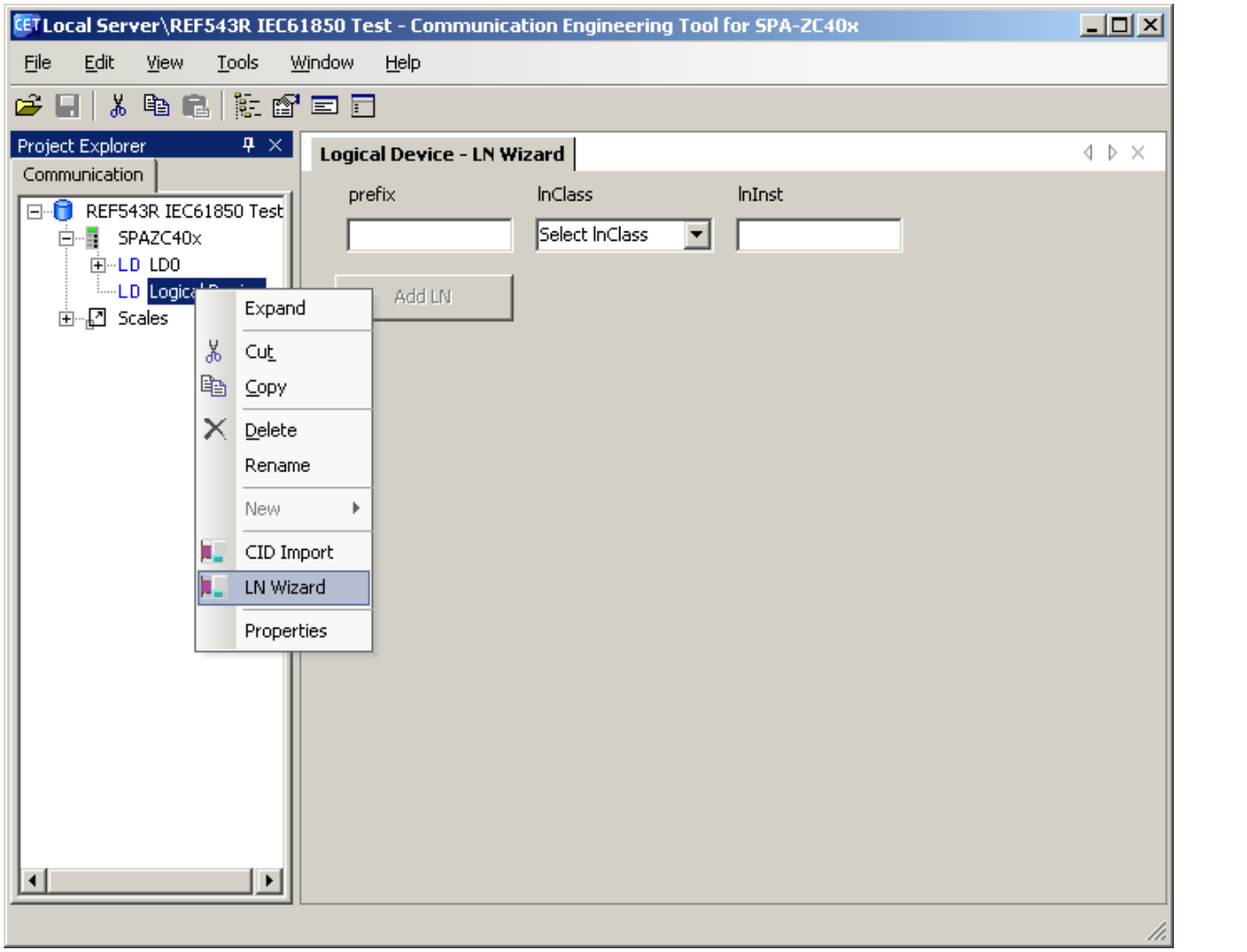

Fig. 6.9.-1 LN wizard

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.

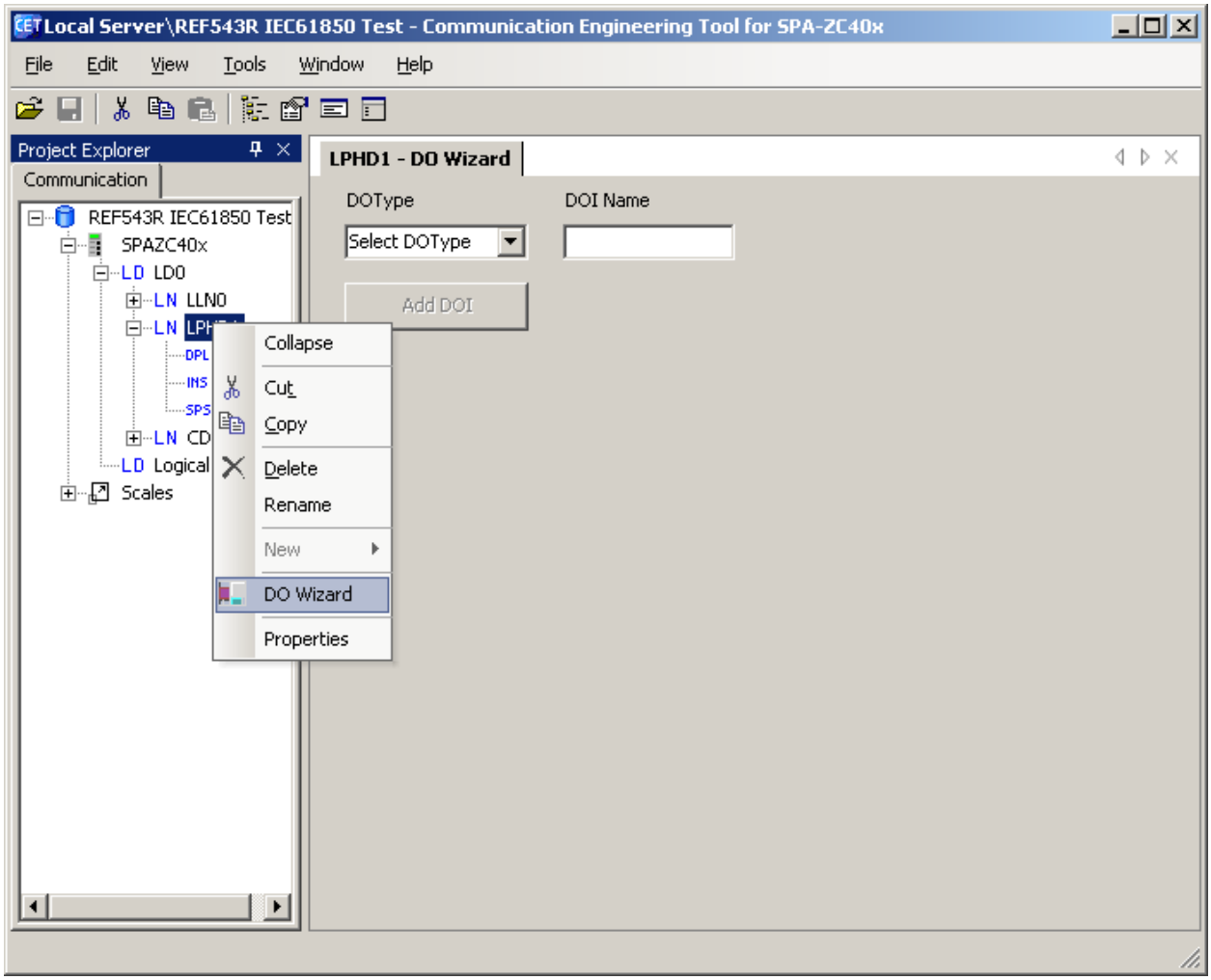

Fig. 6.9.-2 DO Wizard

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.

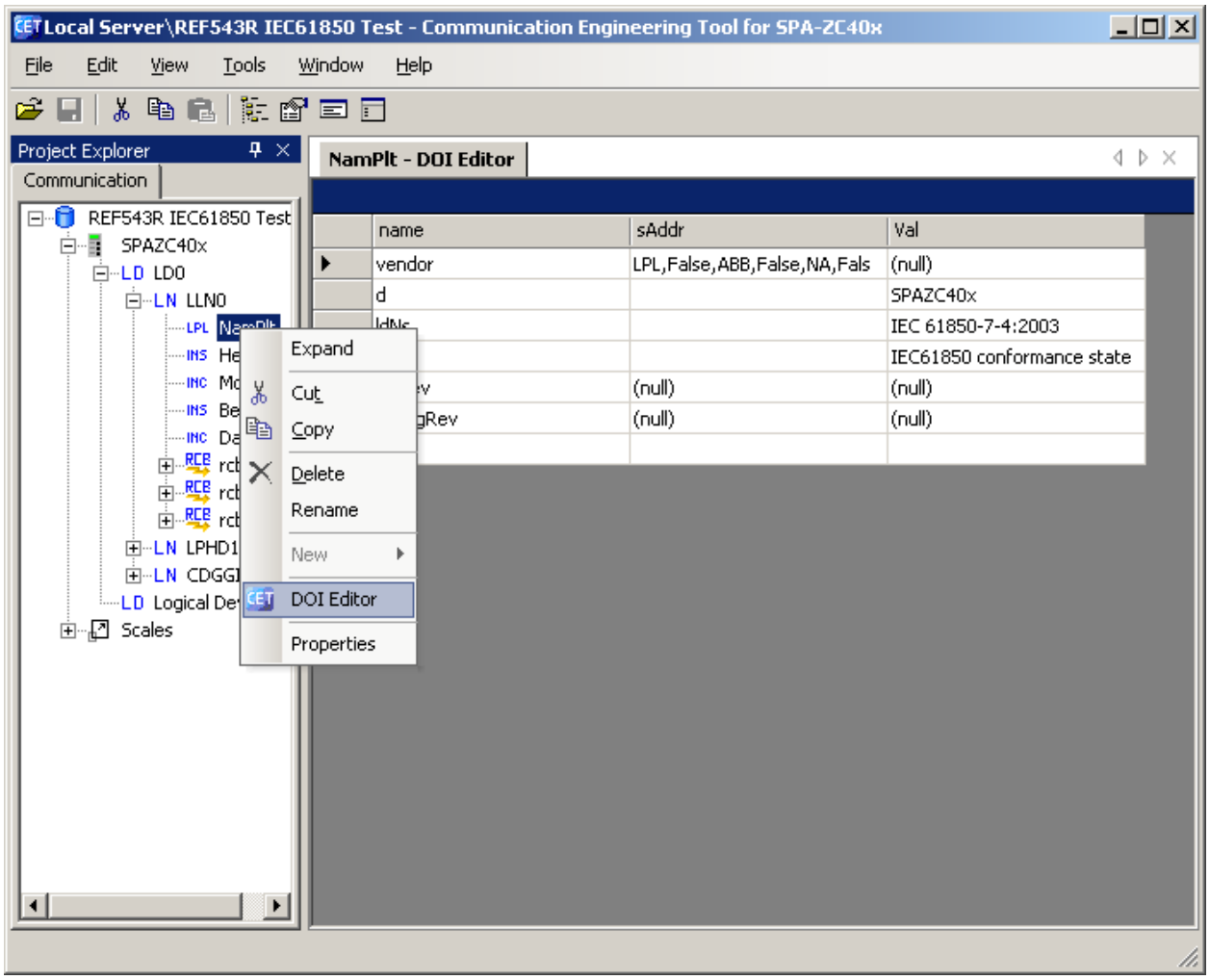

Fig. 6.9.-3 Data Object Instance Editor

The SPA point data is written to the sAddr in the CID file for the selected data object. SPA-ZC 400 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.

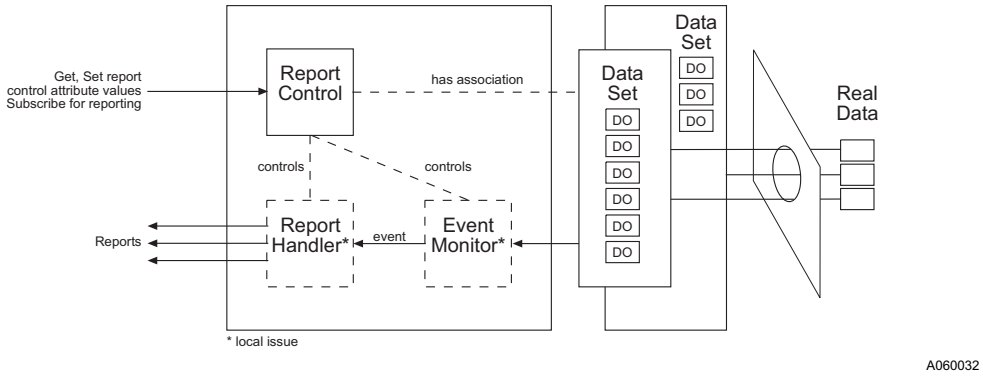

Fig. 6.10.-1 Reporting model

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 400 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 400 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 400 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 400 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.

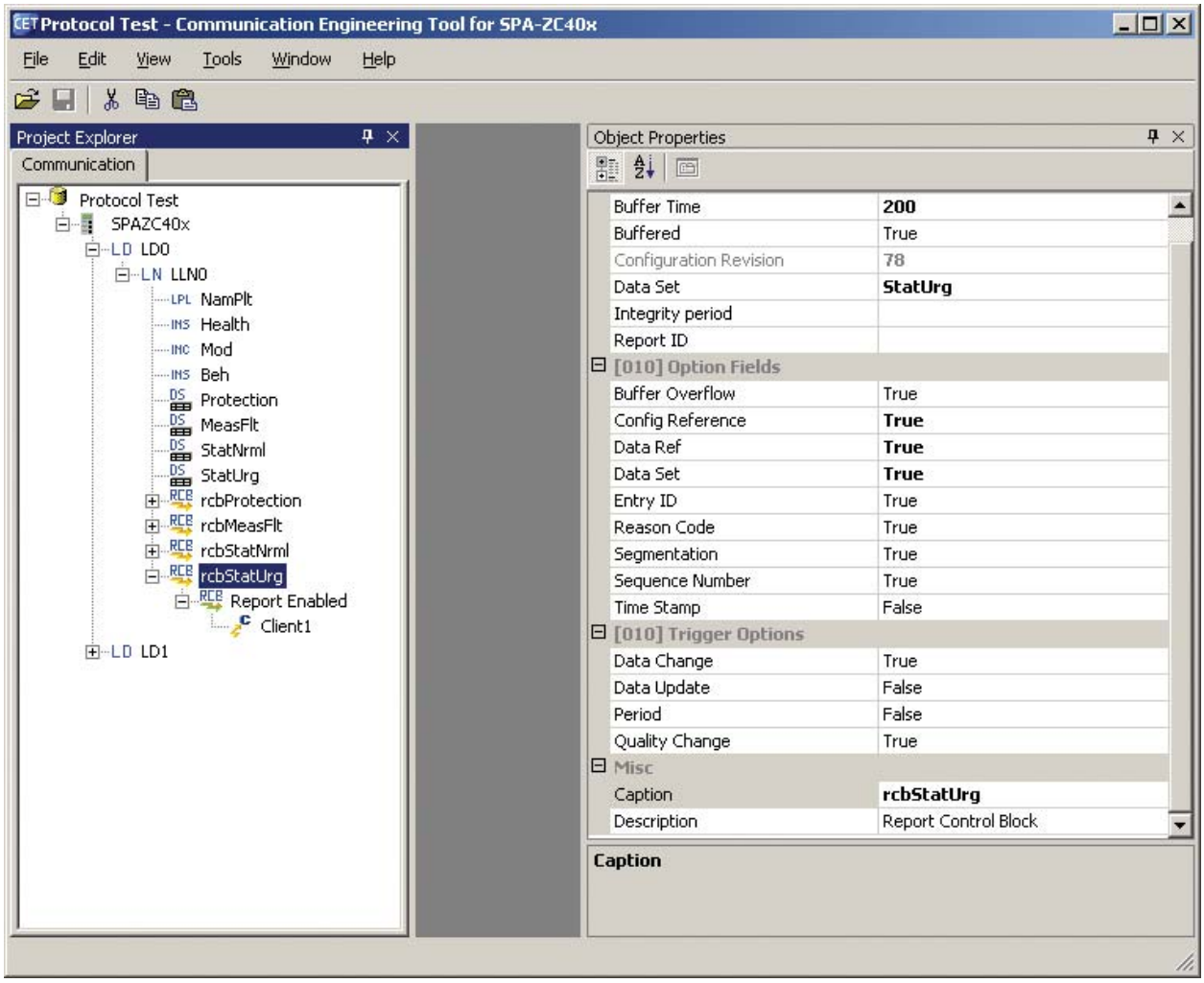

Fig. 6.10.-2 Report Control Block

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. GOOSE

GOOSE is used in substation automation for fast horizontal communication between IEDs. It can be used to exchange, for example, interlocking and blocking information. According to the IEC 61850-8-1 standard, GOOSE uses a publisher/subscriber profile, which means that information is shared from one IED to one or several IEDs using Ethernet multicast messages. A message is an image of a sent MMS dataset that is defined in the CID configuration. The configuration is based on a standard CID file created in CET for SPA-ZC 40x.

The GOOSE data is sent periodically in 802.1Q multicast frames over the local network. When data changes, the GOOSE frame is sent several times in a fast cycle to prevent data losses.

The GOOSE support is available in REF 541/3/5 3.5 and latest patch releases of RET 541/3/5 3.0 and REM 543/5 2.5 and SPA-ZC 400. To guarantee the best possible performance using a private extension to the SPA protocol, the communication bit rate is also increased. Older versions of REFs, including REMs and RETs, can be used, but only in a low performance mode and for sending data only. The configuration of GOOSE is done with the Communication Engineering Tool (CET) for SPA-ZC 40x, together with CAP 505 for the RE_54_ application.

Using SPA-ZC 400 with RE_54_, the performance class P1/1B can be achieved. It is defined to be 100 ms from application to application response time.

The GOOSE configuration can be used only for binary, double point and data quality signals in SPA-ZC 400 and RE_ 54_.

Horizontal information is based on the RE_ 54_ application and its COMM_IN/COMM_OUT 31 and COMM_IN/COMM_OUT 32 bits. These in/out 32/32 bits of data can be configured in a RE_ 54_ application. The data is sent between IED and SPA-ZC 400. Therefore, it is possible to send and receive 32 single bits of horizontal data.

In GOOSE, the data sent is based on the dataset and GOOSE Control Block (GoCB). The dataset defines what type of data is sent in the GOOSE frame. GoCB links the GOOSE Control Block structure and its information to the data.

The GoCB attributes are:

- Multicast address

  A multicast addressing scheme is used when sending GOOSE messages. A multicast address can be shared by several sending devices or it can be IED-specific.

- Ethernet frame specific information (802.1 tagging info: APPID, priority and VLAN)

  Application Identifier (APPID) is the GoCB-specific integer which identifies the sender GoCB and its data. This should be unique in the system.

- Priority and VLAN

Priority and VLAN group can be used according to the local network priority scheme, but the default value can be used normally. The VLAN group can be used to filter messages in a subnet.

- GoCB name
- ConfRev

  ConfRev increases when the referenced Dataset is modified. Both the GOOSE sender and the receiver must have the same ConfRev value.

6.11.1. Configuring horizontal data

Horizontal communication configuration consists of GoCB, dataset and GOOSE input block configuration. The result of the configuration work is a standard SCL file, a CID file.

1. Create a GOOSE Control Block (GoCB) under LD0.LLN0.

The names of the GoCB and the dataset should be unique within the IED. The maximum length is 10 characters.

2. Right-click LLN0 and select **New > GOOSE > GoCB** to link an existing dataset to it from the Object properties. Both the GOOSE Control Block and the dataset should be located under LLN0. After creating a GOOSE Control Block, the CET for SPA-ZC 40x creates automatically the following logical nodes:

- CIGGIO31/32
- COGGIO31/32

Additonally, a dataset called GooseDS is automatically created.

Information on the logical nodes can be accessed through the RE_ 54_ application. The internal variables COMM_IN31, COMM_IN32, COMM_OUT31 and COMM_OUT32 of the RE_ 54_application are used for the information exchange. For example, LD0.LNN0.COGGIO32.Ind13 refers to COMM_OUT32 bit 13 and the value of LD0.LNN0.CIGGIO31.Ind2 is seen as the 2nd bit in COMM_IN31.

6.11.1.1. Sending GOOSE data

SPA-ZC 400 can send any type of data in the GOOSE messages from its IEC 61850 data model. However, the best and guaranteed performance is only for single bit data which is connected internally to global horizontal communication variables on the RE_54_ application: COMM_IN31 and 32, as well as COMM_OUT31 and 32. These two groups of 16 bits of data can be programmed into the RE_54_ application. These variables are mapped into two predefined LNs: COGGIO31 and COGGIO32, which have the corresponding data in objects Ind1...Ind16 using the SPS common data class.

The response time for other data is the same as in vertical communication, that is, it depends on the load situation and can, in the worst case, be in the range of hundreds of milliseconds.

6.11.1.2. Defining GOOSE dataset

To send GOOSE data, you must first define the sending dataset used by the GOOSE control block. One dataset is defined automatically, when you create the CoCB. To build a dataset:

1. Create the dataset or use the GooseDS already defined. Rename it if you plan to use several different sets of data (refer to Section 6.5. Using Dataset Editor).
2. Drag and drop the data objects in Dataset Editor. It is recommended to build a horizontal communication dataset of the data in COGGIOs, because updating normal event-based polled data is slow in load situations.

The data attributes that are not needed must be deleted in this phase, for example the t attribute which is normally not needed in horizontal communication.

The GOOSE dataset is exported to the Data Attribute level; therefore, the Data Object structures are not sent. When sending COGGIO.Ind single point information, only the stVal status attribute is normally sent, because the time information is not accessible from REF 54_ COMM_OUT. Quality can be handled separately.

In DPC Data Objects, for example in CSWI, the boolean stSeld Data Attribute is generated inside the SPA-ZC 40x command handler. It is a faster way to send blocking data.

It is not recommended to build horizontal data of normal event-based polled data because it is slow in load situations.

6.11.1.3. Defining GOOSE Control Block properties

After creating the sending dataset, the next step is to configure the GOOSE Control Block (GoCB):

1. Modify the dataset to be sent with GOOSE. The default is GooseDS.
2. Define a GoCB APPID (Application Identifier) which is unique within the system. It identifies the purpose of this particular dataset.
3. Define a multicast address to which the specific GOOSE data is sent. The receiving IED understands which frames with a specific multicast address are the interesting ones and starts to process them. It is recommended to have one unique multicast address per GoCB. In a wider system, with over 30 IEDs in one subnet, the efficiency of multicast filtering decreases. In that case, the multicast addresses can be used as a group address. In this way, the SPA-ZC 40x-specific

multicast message filtering works and uninteresting frames are not processed. The address can be unique or shared by many IEDs (for example, enter “interlock” to the MAC-Address field Grouping).

4. If the system uses VLAN, it is possible to define the GOOSE message priority (0-7). The VLAN priority indicates the priority of GOOSE messages in Ethernet. The default priority is 0, which is the lowest. The recommendation is to set a higher value, for example 4.

Other properties of CoCB are the following:

- Default GoID is the unique GoCB path in the system.
- MaxTime and MinTime fields are configurable. MinTime indicates the maximum response time in milliseconds to data change. This time can be used by the receiver to discard messages that are too old. In principle, the MinTime can vary depending on the data type, but for SPA-ZC 400 , the value is always 100 ms for sent data. Furthermore, the MaxTime indicates the background "heartbeat" cycle time in milliseconds; the value is 10000 ms. If there are no data changes, SPA-ZC 400 still re-sends the message with a heartbeat cycle, to enable the receiver to detect communication losses.
- The confRev property is increased automatically if the linked dataset in GoCB is edited. This integer value is sent in every GOOSE message. The receiver checks it for configuration mismatches. ConfRev is also a writable property. It can be changed for example if the receiver configuration needs another confRev value in the sent GOOSE data.
- VLAN-ID and VLAN-PRIORITY properties can be used in the Network supporting Virtual LANs. The priority is used with network switches. The default value for GOOSE is 4. The default VLAN Identifier is 0.

6.11.2. Configuring receiving GOOSE data

For receiving data, you have to create the GOOSE control block with CET. At the same time, CET automatically creates a CIGGIO for the received data, with 16 SPS-type signals. These signals are called Ind1...16 and they are meant for Boolean or quality data. If you want to use double point data, the signals have to be created manually. For example, if COMM_IN31 bits 1 and 2 are dedicated for double point data, you must delete Ind1 and Ind2 single point objects and replace them with a single DPCSO1 object. In DOWizard, you have to choose a DPC_simple type of DO.

Note that the order of the CIGGIO data objects does not follow the order of the COMM_IN/OUT bits after deleting and adding data objects. The data object index shows the bit(s) used.

To receive data, you also need to create a GSEInput object under LD0.LLN0 in order to map the CIGGIO data.

There are limitations on the receiving capabilities of SPA-ZC 400 and RE_54_. Only the following types of data can be received from GOOSE:

- BOOLEAN type of data, 0 or 1.
- CODED ENUM attributes from double point data (DPC, DPS CDCs)
  - intermediate-state | off | on | bad-state interpreted as consecutive bits "00", "01", "10", "11"
  - default value is always 3 in inputs
- q, Quality attribute type of data [2]
  - good | invalid | reserved | questionable interpreted as "0", "1", "1", "1"
  - additionally, if the communication supervision has noticed a failure, it is indicated as bad status, that is "1"
  - default value is always "1"
  - values of q cannot be multiplexed

These types of attributes can be forwarded to internal global variables called COMM_IN31 and COMM_IN32. Therefore, it is possible to receive 32 single bits of horizontal data. Note that receiving double point data occupies two consecutive bits.

To extend the limited space of the 32 bits, inputs can be multiplexed in the following way: first, a default value is defined for the input signal. When assigning several signals to the same input, logical OR operation is applied. A logical TRUE (1) in any incoming signal turns the input to TRUE. See the example below:

Select	IEDName	LDInst	Prefix	LNClass	LNInst	DOName	daName	SourceOrdinal	TargetDAPath	ConfigRev	DefaultInput
☑	comt2	LD0	CO	GGIO	31	Ind4	stVal	1	LD0.CIGGIO31.Ind8.stVal	2	0
☑	comt2	LD0	CO	GGIO	31	Ind5	stVal	4	LD0.CIGGIO31.Ind8.stVal	2	0
☑	comt2	LD0	CO	GGIO	31	Ind6	stVal	7	LD0.CIGGIO31.Ind8.stVal	2	0
☑	comt2	LD0	CO	GGIO	31	Ind7	stVal	10	LD0.CIGGIO31.Ind8.stVal	2	0
☑	tyrann	LD1	CB	CSWI	120	Pos	stVal	1		3	0
☑	tyrann	LD1	CB	CSWI	120	Pos	stSeld	4	LD0.CIGGIO31.Ind16.stVal	3	0
☑	tyrann	LD1	ESW	CSWI	127	Pos	stVal	5	LD0.CIGGIO31.Ind2.stVal	3	0

Fig. 6.11.2.-1 GOOSE input tool

Note that DefaultInput must be the same for all signals on this scheme. Correspondingly, if you define TRUE (1) as the default value, a FALSE (0) in any incoming signal turns the input to FALSE, implementing a simple and logical function. Assigning the DefaultInput value and combining multiple sources are only applicable for BOOLEAN attributes, not quality or double point attributes. In case of double point inputs, the attributes must always be set to "3" and with quality inputs to "1". For an example, see the figure above.

Note that the values of q cannot be multiplexed and the input tool does not prevent overlapping allocations.

6.11.2.1. Configuring GOOSE inputs

GOOSE inputs are edited with the Inputs Editor for the GSEInput object under LD0. LLN0 as follows:

To configure inputs

1. Create a GSEInput object under LD0.LLN0 by right-clicking the LLN0 node.
2. Select **New > GOOSE > GSEInput**.

Empty inputs are not allowed to be exported to an IED.

3. To attach inputs to a selected IED, drag-and-drop a sending GoCB from another IED directly to Inputs Editor. Note the limitations for the received data explained in Section 6.11.2. Configuring receiving GOOSE data.

   Alternatively, Signal Mapping Tool can be started from the main menu. This tool shows IEDs and GoCBs in a matrix in which the rows represent all possible GoCBs and the columns represent IEDs in the currently open project.

   To receive specific data to a specific IED, select the GoCB check box under the desired IED. Selecting the check box opens the Inputs Editor for the GoCB.

   A third alternative is to import GOOSE definitions from another type of IED or system. This is done in Input Editor with the Import function. The configured IED (CID) or the System Configuration Description (SCD) files can be opened. Again, note the receiving limitations explained in Section 6.11.2. Configuring receiving GOOSE data.

   In Inputs Editor, select the attributes needed in the receiving IED from the selected GoCB by clicking the first column "Select".

4. Define where the received data is written. This is done by drag-and-dropping the selected CIGGIO data object to the DATargetPath field, for example LD0.LNN0. CIGGIO31.Ind4.stVal, if the received data is status data.

   When configuring double point data, you have to manually enter the TargetDAPath field, as shown in the figure below. DPCSO1 corresponds to bits 1 and 2 in the COMM INxx variable. DPCSO15 corresponds to bits 15 and 16.

   When configuring quality data, you have to manually change the receiver attribute from stVal to q. The destination data attribute must match the source data attribute.

	Select	IEDName	LDInst	Prefix	LNClass	LNInst	DOName	daName	SourceMulticast	SourceApplID	SourceOrdinal	TargetDAPath	Config	Defau
▶	☑	REF543TX	LD1	CB	CSWI	120	Pos	stVal	01-0C-CD-01-00-FF	0100	1	LD0.CIGGIO31.DPCSO1.stVal	3	3
	☑	REF543TX	LD1	CB	CSWI	120	Pos	q	01-0C-CD-01-00-FF	0100	2	LD0.CIGGIO31.Ind3.q	3	1
	☑	REF543TX	LD1	CB	CSWI	120	Pos	stSeld	01-0C-CD-01-00-FF	0100	3	LD0.CIGGIO31.Ind4.stVal	3	0

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Fig. 6.11.2.1.-1 GOOSE inputs for quality and double point data

Only CIGGIO31 or CIGGIO32 logical node data objects can receive GOOSE. The tool does not prevent any misuse.

5. Pay special attention to the following fields on the input entries:

- DefaultInput: if the value is not available, for example due to a communication failure, the default value is used. Note that for double point information, the default value is 3 and for quality data, the default value is 1.
- The received ConfRev must match the ConfRev on the sending side, otherwise the messages are rejected.

6. Click **Add** to open a dialog, in which you can add information required for adding or editing tool rows.

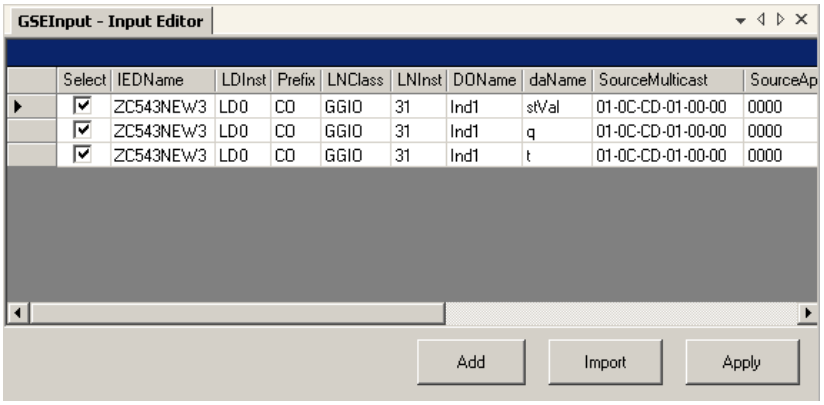

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Fig. 6.11.2.1.-2 Adding new information to GOOSE Input Editor

The dialog opens with empty text fields. After adding the required information (some fields may be left empty), the **Apply** button becomes active. By clicking **Apply**, the added information turns into a row in the Input Editor.

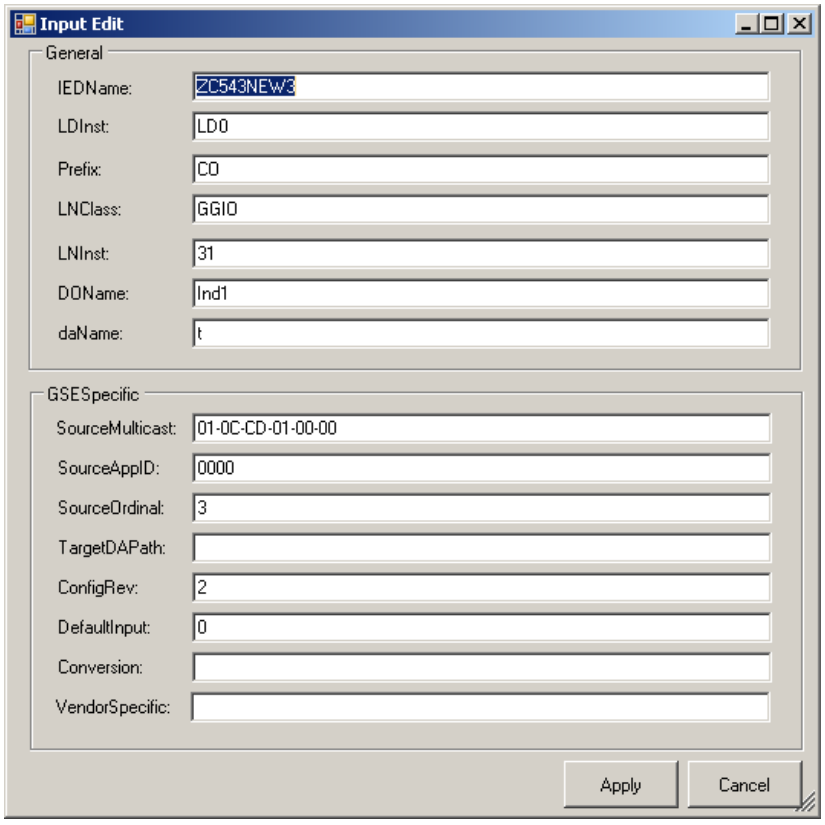

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Fig. 6.11.2.1.-3 Dialog box for adding information to GOOSE Input Editor

You can edit an existing row by activating the row and clicking **Edit**. This is the same button as in **Add**, but the text on the button changes when a row becomes active.

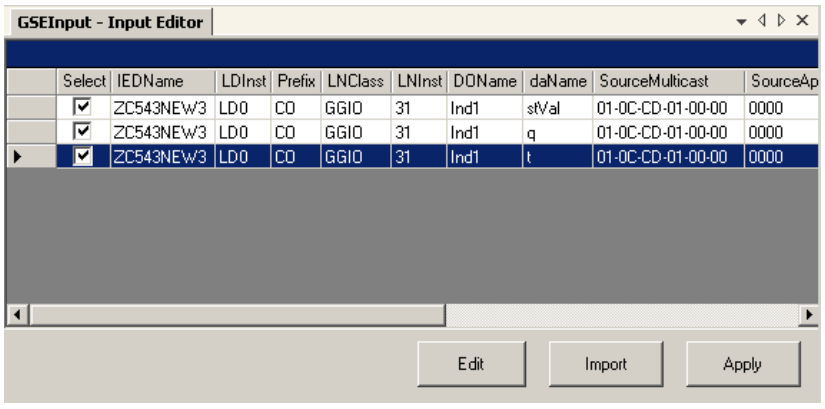

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Fig. 6.11.2.1.-4 Editing an existing row in GOOSE Input Editor

You can change information using the same dialog as when adding information.

7. Click **Apply** to make the configuration changes valid or **Cancel** to discard the changes.

6.11.2.2. Remarks on receiving GOOSE data

The value received from GOOSE can be verified from the IEC 61850 client reading the specific CIGGIO data objects. The value and time stamp are updated according to the value in GOOSE.

A GOOSE frame is not accepted if the frame has the Test bit or the Needs Commission bit set. The test mode is not supported in SPA-ZC 40x.

A GOOSE frame is not accepted if the received confRev deviates from the one in the configuration.

6.11.2.3. GOOSE supervision

For the reliability and availability of the application, the GOOSE communication must be supervised and the application designed to handle communication losses, for example if the service IED is not on or if there are problems in the communication system.

If there are no data changes, SPA-ZC 400 resends the message with a heartbeat cycle to enable the receiver to detect communication losses. The heartbeat cycle is predefined to 10000 ms by the Maxtime property on GoCB and it cannot be changed. Every GOOSE frame has a Time Allowed to Live (TAL) field which shows how long the frame is valid until the next heartbeat frame. This value is set to 10000 ms and cannot be changed.

Other devices may have their own TAL values. Nevertheless, all TAL values under 1000 ms are rounded up to 1000 ms on the receiving side.

If no frames are received during 2xTAL, that is, if at least two consecutive frames are lost, the receiver defines the quality of the whole received dataset as "bad" and sets the input value to the default value stated in the DefaultInput field in the GSEInput object. Note that this has to be taken into account when designing the application.

Assigning the DefaultInput value is only applicable for BOOLEAN attributes, not quality or double point attributes, since they are predefined to values "1" and "11". In other words, for the q attributes received, a communication fault sets the input to "1", which means faulty. A communication fault for double point data sets the input to "11", in contrast to BOOLEAN data, which uses the configured default value in case of a communication fault.

In the worst case, it can take up to 20 seconds before a communication loss is detected.

If more comprehensive supervision is needed, it must be programmed to the application, with for example cyclical sending of "I'm alive" data. One way to save the data and the application work is to create a loop through the IEDs with GOOSE. In a failure situation, all IEDs receive information about the problem.

A drawback means that the system does not tolerate single failures or non-existing devices, for example in service situations.

Both GOOSE input and output Logical Nodes can be monitored with any IEC 61850 client tool, since they are visible on the data model in the same way as all other LNs.

6.12. 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. 6.12.-1.

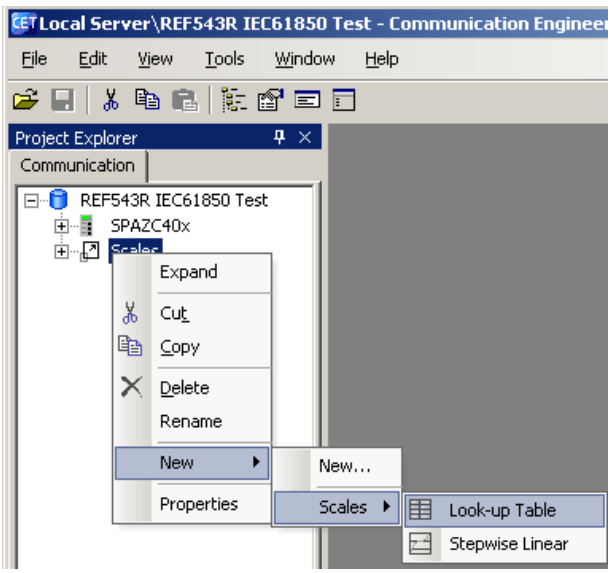

Fig. 6.12.-1 Adding a new scale

3. Select the Scales type: Look-up Table or Stepwise Linear
4. Configure the selected scale's properties, see Fig. 6.12.-2

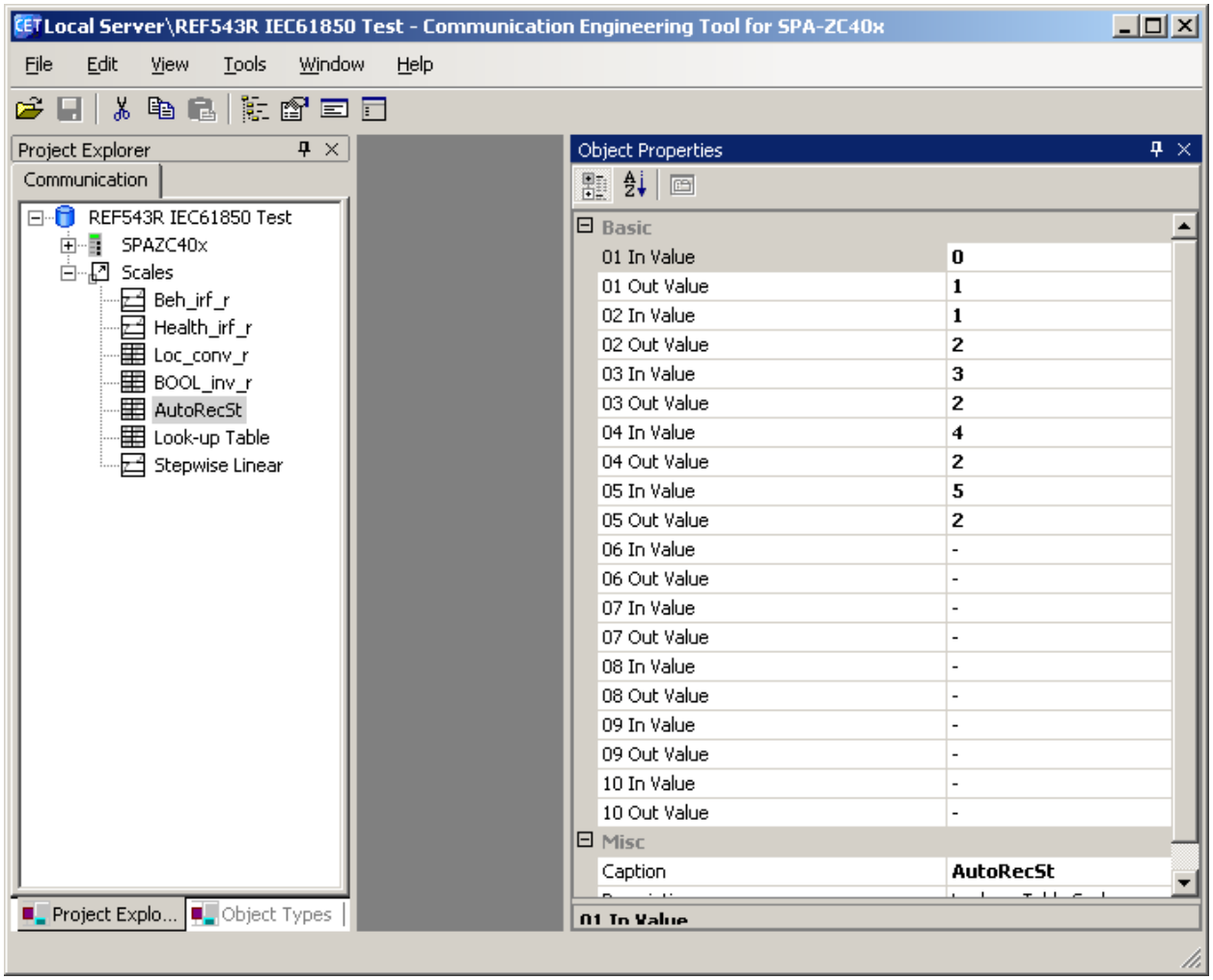

Fig. 6.12.-2 Configuring properties

5. Create reference to scale at DO level in object tree, see Fig. 6.12.-3

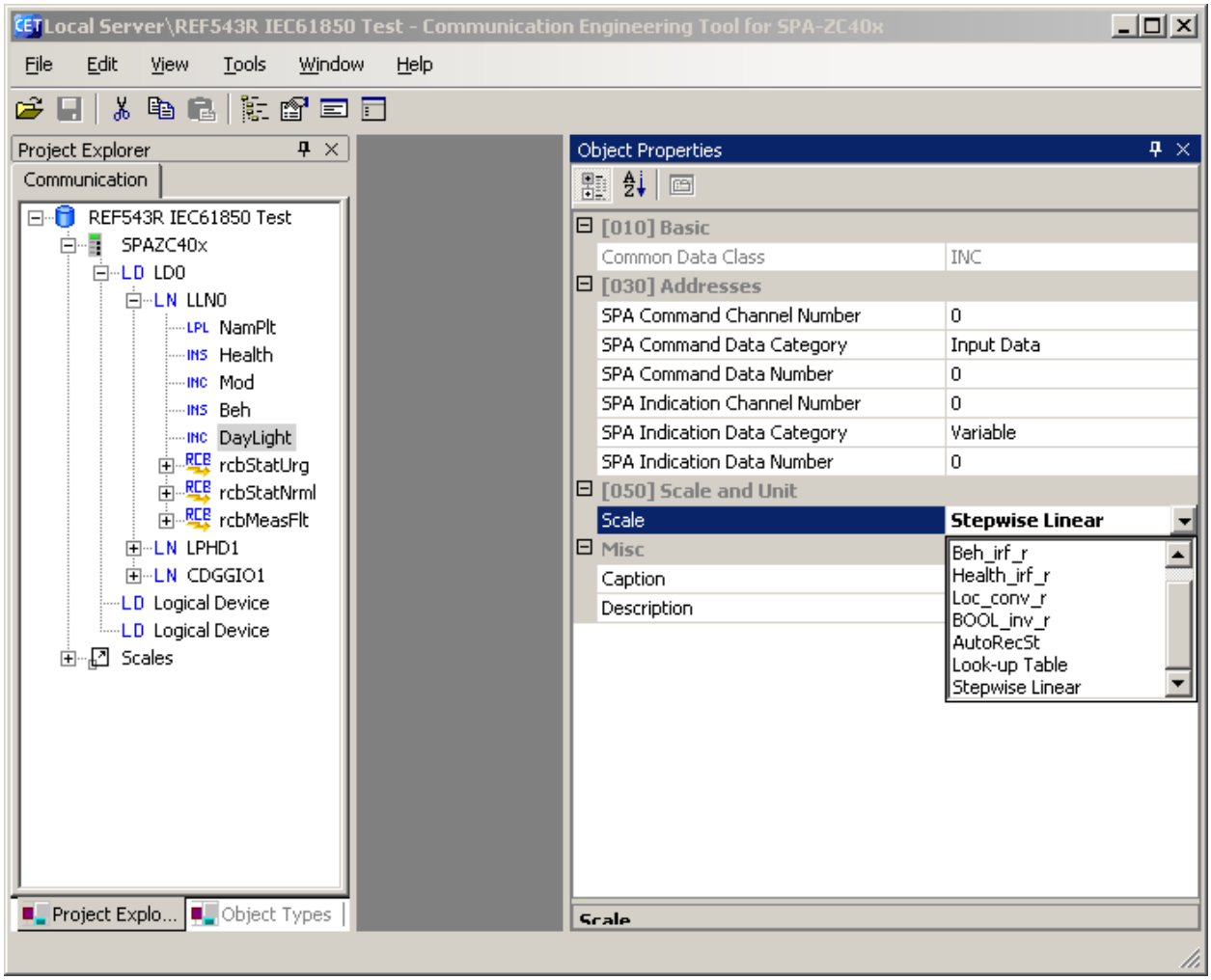

Fig. 6.12.-3 Referring scale in DO

6.13. 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 400 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 400 when it has new recordings ready. SPA-ZC 400 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 400 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 400 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 400IEC 61850 namespace.

You can see how the configuration process is progressing from the diagnostic LEDs. When the SPA-ZC 400 configuration is completed, the green LED is on.

If SPA-ZC 400 is online with the IEC 61850 client, you can check the general configuration status of SPA-ZC 400 from the data model LD0.LLN0.Health.stVal:

1. OK - configuration is completed successfully.
2. Warning - no clock synchronization.
3. Alarm - during the configuration appeared errors.

If the configuration fails, check the error log files from the SPA-ZC 400 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 400 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 ctlVal. It is not recommended to put the counters into the data set because the counter values are updated only during a read operation.

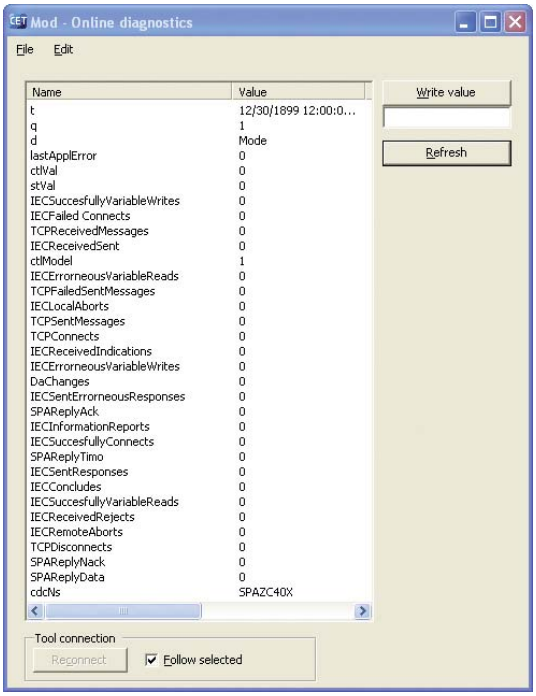

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Fig. 7.2.-1 Diagnostic counters seen on MicroSCADA Pro IEC 61850 client

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 400 and REF 541/3/5, REM 543/5 or RET 541/3/5 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

- Fixed mechanics and fixed connectors for REF 541/3/5, REM 543/5 and RET 541/3/5 protection relays
  - D-type subminiature connector for IEC 61850 traffic
  - D-type subminiature connector for simultaneous dual port communication (optional, see Table 4.1.).

Ethernet interface

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

LON/SPA interface (Optional)

- Fibre-optic connector options
  - ST multimode glass fibre transmitter/receiver pair or
  - Snap-in multimode plastic fibre transmitter/receiver pair

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 400 common diagnostic LEDs

- Power
- Diagnostic
  - Red
  - Green
  - Yellow

LAN diagnostic LEDs

- LINK
- TX
- RX

LON/SPA diagnostic LED

- RX

Dimensions and weight

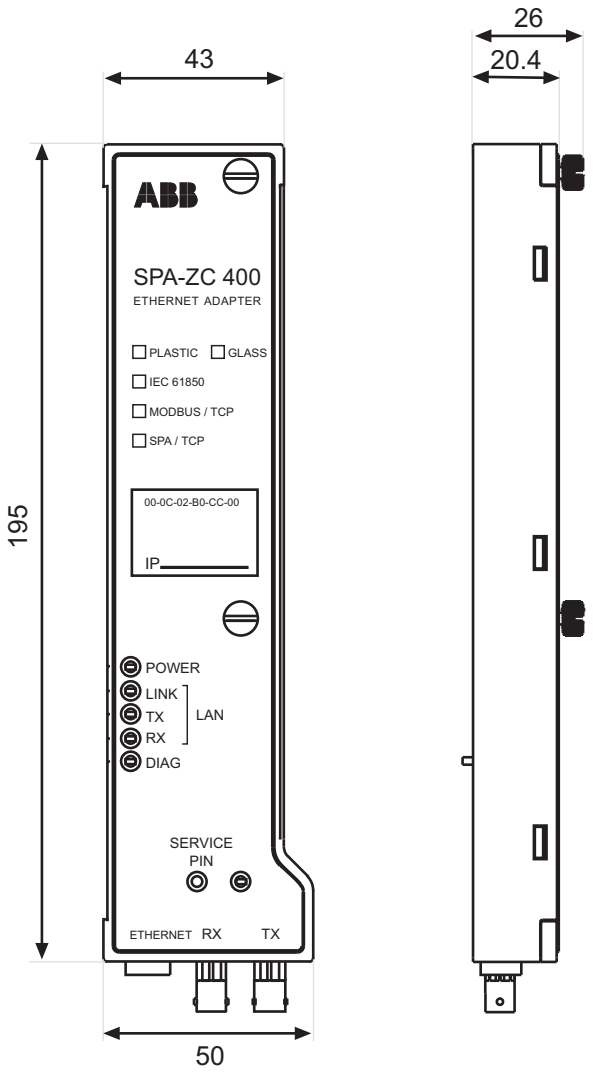


Fig. 8.1.-1 Dimensions of the SPA-ZC 400 module

Table 8.1.-1 Dimensions and weight

Type	Dimensions [mm]	Weight [g]
SPA-ZC 400	195 x 50 x 26	130

8.2. Test and conditions

Table 8.2.-1 Environmental test and conditions

Recommended service temperature range (continuous)	-10...+55˚C
Transport and storage temperature range	-40...+85˚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	According to the IEC 60255-22-1
• Common mode	2.5 kV
• Differential mode	1.0 kV
Electrostatic discharge test, class III	According to the IEC 61000-4-2 and IEC 60255-22-2
• For contact discharge	6 kV
• For air discharge	8 kV
Radio frequency interference tests	
• Conducted, common mode	According to the IEC 61000-4-6 and IEC 60255-22-6 10 V (rms), f=150 kHz...80 MHz
• Radiated, amplitude-modulated	According to the IEC 61000-4-3 and IEC 60255-22-3 10 V/m (rms), f=80...2700 MHz
• Radiated, pulse-modulated	According to the ENV 50204 and IEC 60255-22-3 10 V/m, f=900 MHz
Fast transient disturbance tests	According to the IEC 60255-22-4 and IEC 61000-4-4
• All terminals	4 kV
Surge immunity test	According to the IEC 61000-4-5
• Power supply	4 kV line-to-earth, 2 kV line-to-line
Power frequency (50 Hz) magnetic field IEC 61000-4-8	300 A/m continuous
Electromagnetic emission tests	According to the EN 55011
• Conducted, RF-emission (Mains terminal)	EN 55011, class A, IEC 60255-25
Radiated RF-emission	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

Mechanical tests	
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 Standard tests

Supply current consumption	
Running	340 mA
Start up	430 mA

9. Maintenance and service

If the SPA-ZC 400 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
DIAG	Green Green Green Green Green Green	Red Red Red Red Red Red	Off Flashing On Flashing On Off	On On On Off Off Flashing	1 2 3 4 5 6	Bootloader booting Bootloader, missing boot image Starting OK, missing configuration OK, configuration in use Configuration error
RX	Green		On			Indication for incoming LON traffic (LON and SPA)

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 400.

9.2. Communication settings

REF 541/3/5, REM 543/5 and RET 541/3/5 addresses or baud rates 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:

- Protocol selection for SPA-ZC 400

Table 9.2.-1 explains the possible port configurations of REF 541/3/5, REM 543/5 or RET 541/3/5.

The protocol selection is active only after rebooting the relay. For more information, see Technical Reference Manuals of REF 541/3/5, REM 543/5 and RET 541/3/5 .

Table 9.2.-1 Protocol selection for REF 541/3/5, REM 543/5 and RET 541/3/5

Connectors/Communication parameters		
X3.2/Protocol 2	**X3.3/Protocol 3**	**Front connector**
SPA (SMS)	LON	SPA
SPA (SMS)	SPA	-
IEC 60870-5-103[a)]	LON	SPA
IEC 60870-5-103[b)]	SPA (SMS)	-
IEC 60870-5-103[c)]	-	SPA
DNP 3.0[d)]	LON	SPA
DNP 3.0[e)]	SPA (SMS)	-
DNP 3.0[f)]	-	SPA
Modbus	LON	SPA
Modbus	SPA (SMS)	-
Modbus	-	SPA
-	SPA	SPA
IEC 61850	LON	SPA
IEC 61850	SPA	-

[a)] Not included in REM 543/5
[b)] Not included in REM 543/5
[c)] Not included in REM 543/5
[d)] Not included in REM 543/5
[e)] Not included in REM 543/5
[f)] Not included in REM 543/5

Only one SPA client can be configured to poll SPA events from the device. By default SPA-ZC 400 is configured to poll SPA events. In this case, it is not allowed to poll SPA events from another SPA client.

- SPA command timeout in IED

SPA command timeout should be < 1 second when LON interlocking is not in use.

- SPA baud rate and SPA slave number in IED

Baud rate and slave number have to be according to the SPA-ZC 400 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.

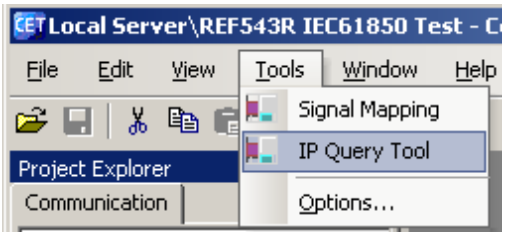
Example:

```
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.



A060127

Fig. 9.3.-1 Starting the IP Query Tool

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

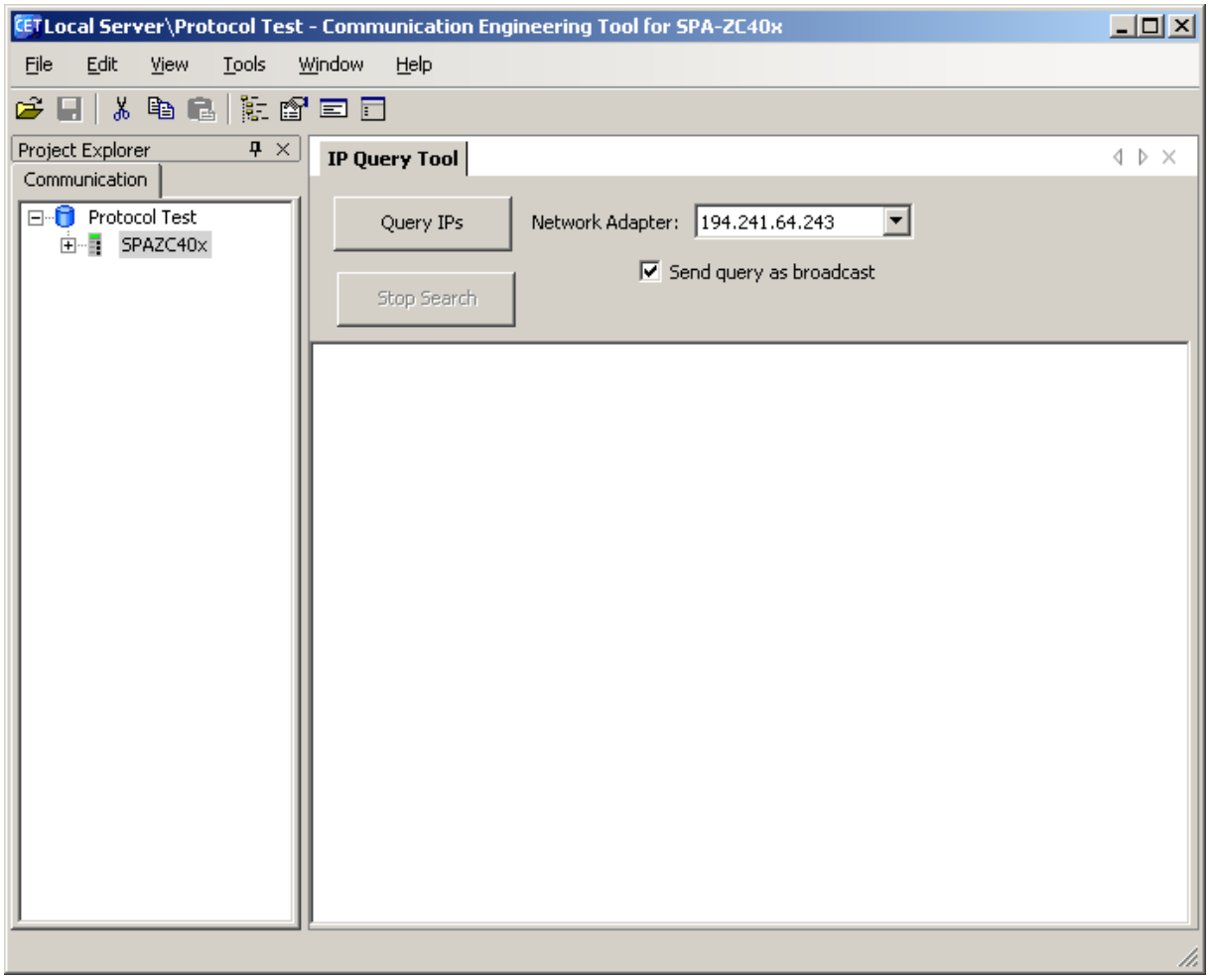


Fig. 9.3.-2 Selecting Network adapter

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 400 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

	TCP	UDP
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 400/ Comments
Client-Server roles				
B11	Server side (of TWO-PARTY-APPLICATION-ASSOCIATION)	–	a	Supported
B12	Client side (of TWO-PARTY-APPLICATION-ASSOCIATION)	a	–	
SCSMs supported				
B21	SCSM: IEC 6185-8-1 used			Supported
B22	SCSM: IEC 6185-9-1 used			Not Supported
B23	SCSM: IEC 6185-9-2 used			Not Supported
B24	SCSM: other			
Generic substation event model (GSE)				
B31	Publisher side	–	O	Supported
B32	Subscriber side	O	–	Supported
Transmission of sampled value model (SVC)				
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 400 . 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 400.

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 400/ 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
	badRefererence	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 400/ Comments**
I	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 400/ 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 400/Comments
hhLim	AnalogueValue		M	Supported
hLim	AnalogueValue		M	Supported
ILim	AnalogueValue		M	Supported
IILim	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 400/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 400/ 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 operater 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 400/ 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 400/ 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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Status						
stVal	BOOLEAN	ST	dchg	TRUE | FALSE	M	Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported
Substitution						
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
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

11.2.2.2. 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 400/ 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 400/ 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 400/ Comments**
Substitution						
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
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_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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Status						
general	BOOLEAN	ST	dchg		M	Supported
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	Supported
t	TimeStamp	ST			M	Supported
Configuration, Description and Extension						
operTm	TimeStamp	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

ACT class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ 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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Status						
general	BOOLEAN	ST	dchg		M	Supported
dirGeneral	ENUMERATED	ST	dchg	unknown | forward | backward | both	M	Supported
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	Supported
t	TimeStamp	ST			M	Supported
Configuration, Description and Extension						
d	VISIBLE STRING255	DC		Text	O	Supported

ACD class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ 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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Status						
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
Configuration, Description and Extension						
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 400/ 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 400/ 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 400/ Comments**
range	ENUMERATED	MX	dchg	normal | high | low | high-high | low-low | …	O	Supported
q	Quality	MX	qchg		M	Supported
t	TimeStamp	MX			M	Supported
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	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 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)

CMV class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Measured Values						
instCVal	Vector	MX			O	Not Supported
cVal	Vector	MX	dchg		M	Supported
range	ENUMERATED	MX	dchg	normal | high | low | high-high | low-low | …	O	Supported
q	Quality	MX	qchg		M	Supported
t	TimeStamp	MX			M	Supported
Substitution						
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
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
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	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 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 400/ 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 400/ 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 400/ 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 400/ 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 400/ 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						
har	ARRAY[0.. numHar] OF Vector	MMX	dchg, dupd		M	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
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 400/ 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 400/ 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						
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 400/ 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_DLNDA_M	Not Supported
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

11.2.2.15. 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 400/ 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

HDEL class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
phsBCHar	ARRAY[0.. numHar] OF Vector	MX	dchg, dupd		O	Not Supported
phsCAHar	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_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)

SPC class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Control and Status						
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 400/ Comments**
stVal	BOOLEAN	ST	dchg	FALSE | TRUE	AC_ST	Supported
q	Quality	ST	qchg		AC_ST	Supported
t	TimeStamp	ST			AC_ST	Supported
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	Supported
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	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 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)

SPC class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
DataName	Inherited from Data Class (see IEC 61850-7-2)					Supported
DataAttribute						
Control and Status						
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	Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported
stSeld	BOOLEAN	ST	dchg		AC_CO_O	Supported
Substitution						
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
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	Supported
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	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 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 400/ 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	Supported
q	Quality	ST	qchg		M	Supported
t	TimeStamp	ST			M	Supported
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	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

INC class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
maxVal	INT8	CF			O	Not Supported
stepSize	INT8U	CF		1 ... (maxVal - minVal)	O	Not Supported
d	VISIBLE STRING255	DC		Text	O	Supported
cdcNs	VISIBLE STRING255	EX			AC_DLNDA_M	Supported[a)]
cdcName	VISIBLE STRING255	EX			AC_DLNDA_M	Not Supported
dataNs	VISIBLE STRING255	EX			AC_DLN_M	Not Supported

[a)] 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)

BSC class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Control and Status						
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	Supported
q	Quality	ST	qchg		AC_ST	Supported
t	TimeStamp	ST			AC_ST	Supported
stSeld	BOOLEAN	ST	dchg	FALSE | TRUE	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

BSC class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
subID	VISIBLE STRING64	SV			PICS_SUBST	Not Supported
Configuration, Description and Extension						
persistent	BOOLEAN	CF			M	Supported
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		1 ... (maxVal - minVal)	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 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 400/ Comments**
DataName	Inherited from Data Class (see IEC 61850-7-2)					Not Supported
DataAttribute						
Control and Status						
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
Substitution						
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
Configuration, Description and Extension						
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 400/ 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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setVal	BOOLEAN	SP		off (FALSE) | on (TRUE)	AC_NSG_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 400/ Comments**
DataName	Inherited from Data Class (see IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setVal	INT32	SP			AC_NSG_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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setMag	AnalogueValue	SP			AC_NSG_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 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute						
Setting						
setCharact	ENUMERATED	SP			AC_NSG_M	Not Supported
setParA	FLOAT32	SP			AC_NSG_O	Not Supported
setParB	FLOAT32	SP			AC_NSG_O	Not Supported
setParC	FLOAT32	SP			AC_NSG_O	Not Supported
setParD	FLOAT32	SP			AC_NSG_O	Not Supported
setParE	FLOAT32	SP			AC_NSG_O	Not Supported

ASG class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
setParF	FLOAT32	SG SE			AC_NSG_O	Not Supported
setCharact	ENUMERATED	SG SE			AC_NSG_M	Not Supported
setParA	FLOAT32	SG SE			AC_NSG_O	Not Supported
setParB	FLOAT32	SG SE			AC_NSG_O	Not Supported
setParC	FLOAT32	SG SE			AC_NSG_O	Not Supported
setParD	FLOAT32	SG SE			AC_NSG_O	Not Supported
setParE	FLOAT32	SG SE			AC_NSG_O	Not Supported
setParF	FLOAT32	SG SE			AC_NSG_O	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

11.2.2.26. 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)

ASG class						
Attribute Name	**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
DataName	Inherited from Data Class (refer to IEC 61850-7-2)					Supported
DataAttribute						
Configuration, Description and Extension						
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 400/ 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 400/ Comments**
DataName	Inherited from Data Class (see IEC 61850-7-2)					Supported
DataAttribute						
Configuration, Description and Extension						
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 InNs 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)

CSD class							
Attribute Name		**Attribute Type**	**FC**	**TrgOp**	**Value/ Value range**	**M/O/C**	**SPA-ZC 400/ Comments**
DataName		Inherited from Data Class (refer to IEC 61850-7-2)					Not Supported
DataAttribute							
Configuration, Description and Extension							
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 400/ 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[a)]

a) 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 400/ Comments
ACSI Services							Not Supported
	GetFileAttributeValues	O	o		o	m	Supported
	GetFile	O	a)		o	a)	Supported
	SetFile	O	b)		o	b)	Supported
	DeleteFile	O	o		o	b)	Supported
	GetDataValues	O	c)		o	c)	Not Supported
	SetDataValues	O	a)		o	a)	Not Supported
	SCL Control Block	I	i		o	b)	Not Supported
	SCL File Structure	I	m		i	m	Not Supported
	Remote Creation of SCL File	I	o		i	o	Not Supported

a) Must be m if support for SCL.2 is declared.
b) Must be m if support for SCL.3 is declared.
c) 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 400/ Comments
MMS Services							Not Supported
	GetCapability-List	O	i		o	i	Supported
	GetDomainAt-tributes	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 61850-8-1Component Name	MMS TypeDescription	r/w	m/o	Comments	SPA-ZC 400/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 400/ 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)		Not 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 toIEC 61850-8-1.

Table 11.5.1.-2 A-profile support

		Client		Server		SPA-ZC 400/ 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 400/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

	Subscriber	Publisher	SPA-ZC 400/Comments
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

	Subscriber	Publisher	SPA-ZC 400/Comments
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[1]

No. 30810022-Consulting 08-1269

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

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

Issued by: KEMA

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.

Arnhem, June 6, 2008

W. Strabbing
Manager Intelligent Networks and Communication

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Test Engineer

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

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A060010

13. Ordering information

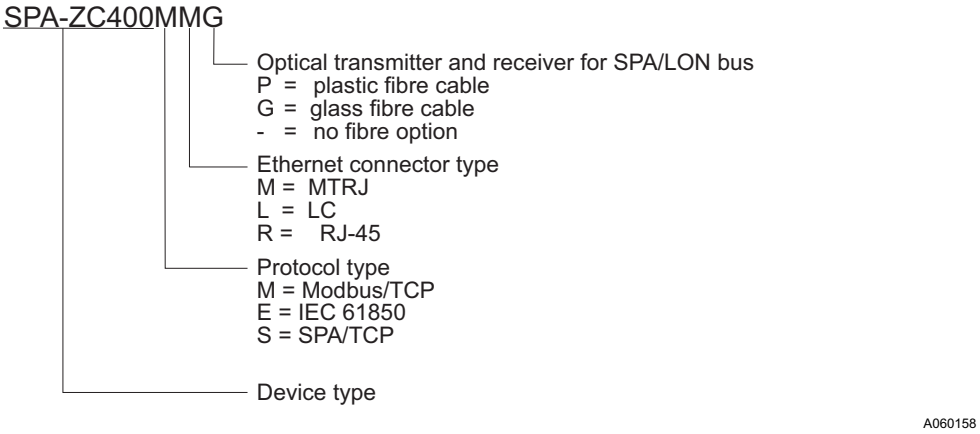

Fig. 13.-1 Ordering information for SPA-ZC 400

SPA-ZC400CD

- SPA-ZC 400 configuration CD
  - Engineering tool, Communication Engineering Tool (CET) for SPA-ZC 40x

Order at least one SPA-ZC 400 configuration CD with your delivery to get the Communication Engineering Tool. The SPA-ZC 400 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 400, CET, Connectivity Packages and IEDs

SPA-ZC 40x version	CET version	Connectivity Package versions, devices and release			
		REF 541/543/545		REM 543/545	RET 541/543/545
		Release 3.0	Release 3.5	Release 2.5	Release 3.0
1.0	1.0	1.0 to 1.2	1.2	1.0 to 1.1	1.0
1.1.1	1.1.1	1.3 or 1.4	1.3 or 1.4	1.2 or later	1.1 or later
2.0	2.0	1.3 or later	1.2 or later	1.2 or later	1.1 or later
2.1	2.1	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

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 InformationThe 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
ST	Connector type for glass fibre cable

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
LON	Local operating network
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
SCD	System configuration description
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
TAL	Time Allowed to Live

VLAN	Virtual local area network
XML	Extensible markup language

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