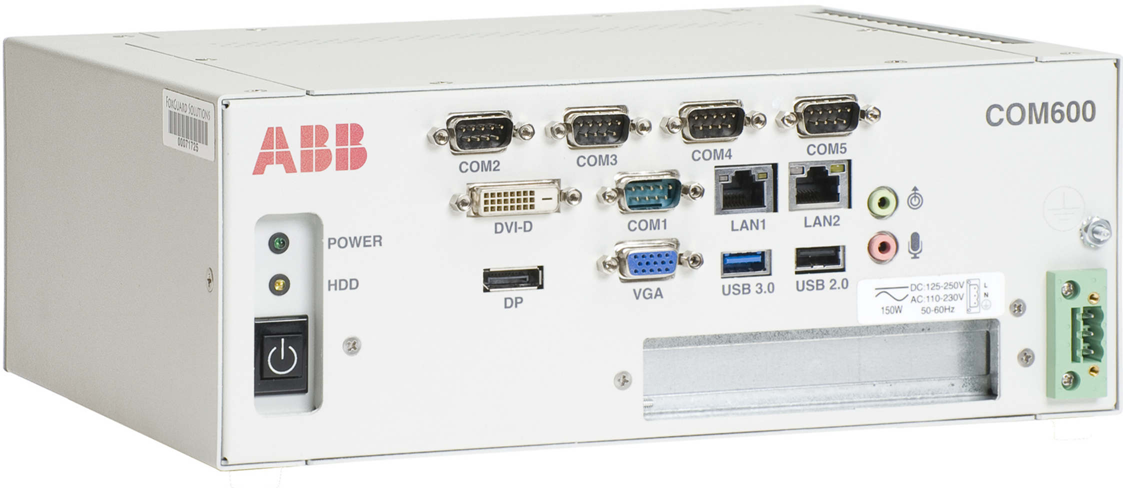
COM600 series 5.1

Master Protocols (Ethernet) and Applications
Technical Reference Manual



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1. About this manual

1.1. Copyright

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1.4. Trademarks

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1.5. General information

This manual provides thorough information on all the Ethernet-based Master protocols supported by the COM600 and and their central concepts. You find instructions on how to configure the related objects belonging to the different Ethernet-based master protocol servers. The basic operation procedures are also discussed.

Information in this user’s manual is intended for application engineers.

As a prerequisite, you should understand the basic principles of the different Ethernet-based master protocols and the IEC 61850 standard.

This user’s manual is divided into following sections:

Introduction

This section gives an overview of the Ethernet based master protocol servers and their features.

Configuration

In this section you will find an overview of configuration. You are given instructions on how to configure Master Protocol OPC Server related objects and the model of a substation or system.

Operation

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

You are also given instructions on how to monitor and control the conditions of substation communication network.

Technical reference

This section contains a list of status codes and information about the IEC 61850 data modeling.

1.6. Document conventions

The following conventions are used for the presentation of material:

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

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

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

MIF349

- Variables are shown using lowercase letters:

sequence name

1.7. Use of symbols

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

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

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

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

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

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

1.8. Terminology

Term	Description
Alarm	An abnormal state of a condition.
Alarms and Events; AE	An OPC service for providing information about alarms and events to OPC clients.
COM600 Series; COM600	COM600 as a generic name for COM600S IEC and COM600F ANSI products

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

1.9. Abbreviations

The following is a list of abbreviations associated with COM600 that you should be familiar with. See also 1.8, Terminology.

Abbreviation	Description
AE	Alarms and Events
ASDU	Application Service Data Unit
BRCB	Buffered Report Control Block
DA	Data Access
DMCD	Data Message Code Definition
DO	Data Object
GW	Gateway, component connecting two communication networks together
WebHMI	Web Human Machine Interface
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
LAN	Local Area Network
LD	Logical Device
LN	Logical Node
NCC	Network Control Center
NUC	Norwegian User Convention
OLE	Object Linking and Embedding
OPC	OLE for Process Control
P&C	Protection & Control
PLC	Programmable Logic Controller
POU	Program Organization Unit
RTS	Request To Send
SA	Substation Automation
SCD	Substation Configuration Description
SCL	Substation Configuration Language
SFC	Sequential Function Chart
SLD	Single Line Diagram
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
RCB	Report Control Block
URCB	Unbuffered Report Control Block
XML	eXtended Markup Language

1.10. Related documents

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

1.11. Document revisions

Document version/date	**Product revision**	**History**
A/24.5.2017	5.0	Document created
B/12.4.2018	5.1	Document revised

2. Introduction

2.1. General information about the COM600 series

The COM600 product series are versatile Substation Management Units that help realize smart substation and grid automation solutions in industrial and utility distribution networks.

They get deployed together with protection and control IEDs, substation devices such as RTUs, meters and PLCs in dedicated cabinets and switchgear.

The COM600 product is an all-in-one unit that functions as:
- Communication gateway
- Web Human Machine Interface (WebHMI)
- Automation controller
- Real-time and historical data management unit

The COM600 product series use process information and device data, acquired over Ethernet or serial communication protocol interfaces to execute specific substation functions and applications. Thus, they are critical building blocks to realize substation secondary system solutions and in the process solving diverse customer needs.

2.2. COM600 product series variants and rationale

To facilitate substation and grid automation solutions in IEC and ANSI market areas, a variant-based system similar to Relion® 615 and 620 series is being followed from COM600 5.0 release.

The main reasons for such an approach are the following:

- To ensure all COM600 product series features are advantageously used in end-customer projects in the medium voltage substation automation domain.
- To ensure an optimum feature set to be bundled together to realize specific applications required in IEC and ANSI market areas.
- To ensure a future-proof product approach.

This release then comprises of two variants, based on the primary intent or application are defined as follows:
- COM600S IEC – COM600 for substation automation, analysis and data management (for IEC markets)
  - COM600S IEC is a substation automation, analyzer and data management unit that integrates devices, facilitates operations, manages communication and runs analysis applications pertinent to equipment or operations in utility or industrial distribution substations.
- COM600F ANSI – COM600 as distribution automation controller (for ANSI markets)

- COM600F is a dedicated distribution automation controller unit that runs distributed grid and feeder applications for ANSI power networks and inherits all core features of the COM600 series.

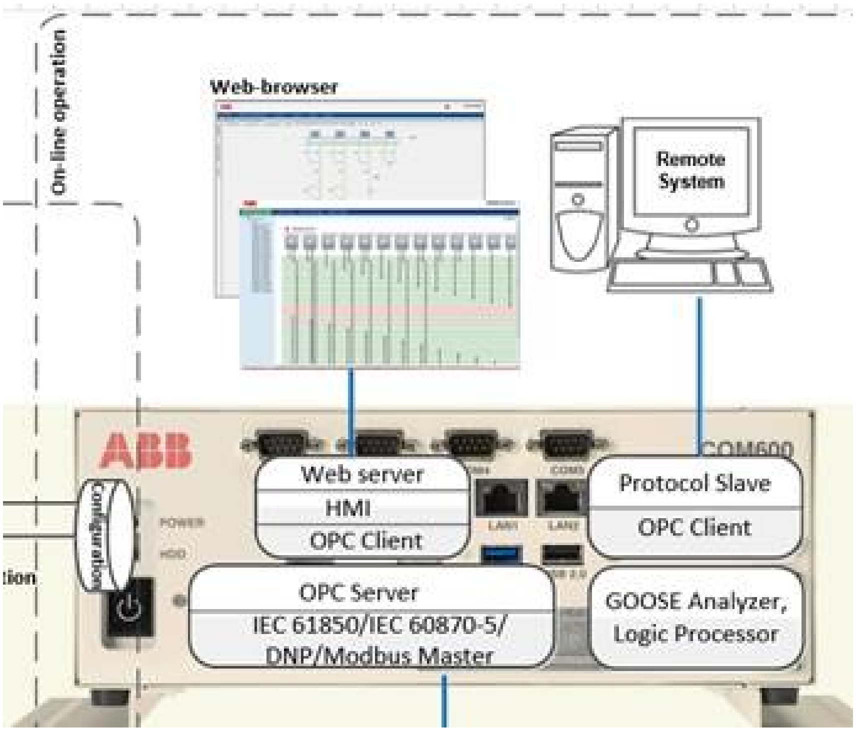
2.3. Functional overview

The COM600 supports multiple master communication protocols by which it exchanges data with field devices such as protection and control IEDs, meters or other devices such station controllers, Ethernet switches and WebHMIs. The data communication can be accomplished using Ethernet or serial interfaces such as RS 232 or RS 485. The following master protocols are supported by the COM600:

1. Ethernet-based protocols
   - IEC 61850-8-1
   - IEC 60870-5-104
   - DNP 3.0 LAN/WAN
   - Modbus
   - OPC
   - SNMP
2. Serial interface-based protocols
   - IEC 60870-5-101
   - IEC 60870-5-103
   - DNP 3.0 Serial
   - Modbus
   - SPA

The COM600 converts all field data, acquired using above communication protocols, into OPC. An OPC server is dedicated to every supported protocol. This OPC server enables other OPC clients (internal) to access process data from slave devices.

This manual specifically covers the above listed Ethernet based master protocols.



SysConf.bmp

Figure 2.3-1 System overview

1. Network Control Center (NCC), Distributed Control System (DCS)
2. Station Automation Builder 600 (SAB600)
3. COM600 with Ethernet-based OPC Server (IEC 61850/IEC 60878-5-104/DNP3.0-LAN/MODBUS-TCP/OPC/SNMP/SNTP)
4. Ethernet switch (SNMP compliant)
5. Field devices like protection and control devices, meters etc. using respective master protocols.

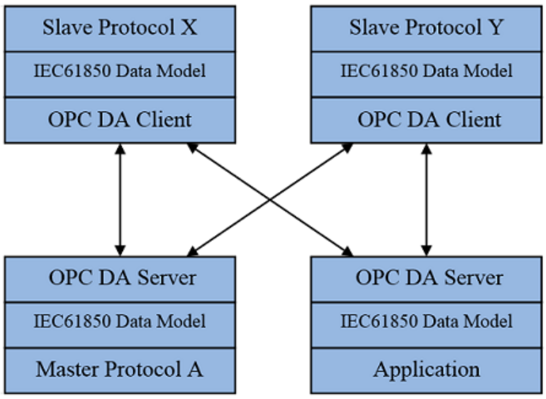
The protocol handling, that is, configuration and operation aspects comprise of generic and specific aspects. These generic and specific parts will be described separately in this manual.

Handling in brief:

All master (client) protocols have two common aspects

- An OPC server layer
- Data modeling based on IEC 61850

While the OPC server layer provides access to data from the slave devices, the IEC 61850 data model creates a common and protocol-independent data interface between the OPC server and the Master protocol (client) layer. All the 3 layers together are referred as a ‘Master protocol OPC server’. Each master protocol OPC server is a separate identity.



handling_in_brief.png

Figure 2.3-2

The master protocol and OPC server layers are runtime software components. The IEC 61850 data model is built based on the imported SCL file using Station Automation Builder 600 (SAB600). To simplify the protocol conversion and the signal mapping, each master protocol OPC server uses the same common data modeling (common data classes and services) specified in the IEC 61850 standard. The COM600 configuration data is also in SCL (XML-based) format.

After the master protocol OPC server is launched, it reads the configuration data and establishes communication with the slave devices through the master (client) protocol stack. Configured slave devices and their data are then exposed to OPC clients (Web Server, slave protocols etc.) through the master protocol OPC server. The slave devices' reported data changes together with Data Access subscription are reported to the subscribing OPC clients.

The Master protocol OPC server component handles the data transfer and conversion between the underlying master protocol communication stack and OPC interfaces.

2.4. Master protocol OPC server features

2.4.1. IEC 61850 OPC Server features

The IEC 61850 standard is a set of specifications, which detail a layered approach to substation communication architecture. It specifies the usage of Manufacturing Message Specification (MMS, ISO 9506) between the IEC 61850 server (slave devices) and IEC 61850 client (IEC 61850 OPC Server, master). The COM600 IEC 61850 OPC server can subscribe to both MMS and GOOSE based data. However, it can only send MMS based command information to the slave devices.

The IEC 61850 OPC Server supports the following features:

- OPC Data Access v. 1.0/2.0
- OPC Alarms and Events specifications v. 1.10
- Communication diagnostics
- IEC 61850 data modeling
- System supervision:
    - IEC 61850 device communication
- Command handling:
    - The IEC 61850 OPC Server supports the IEC 61850 command services.
- • SPS, DPS, INS, ACT, ACD, SEC, BCR, MV, CMV, SAV, WYE, DEL, SEQ, SPC, DPC, BSC, ISC, APC, SPG, ING, ASG, CURVE, DPL, LPL.
- IEC 61850 buffered and unbuffered reporting services
- IEC 61850 File Transfer
- IEC 61850 GOOSE receive (received GOOSE data updated to OPC)
- Automatic Disturbance Recording upload using IEC 61850 file transfer or FTP
- SPA TCP
- SPA Parameter access (configured with Parameter Filtering Tool)
- Time synchronization:
    - The IEC 61850 OPC Server can act as an SNTP client and server for time synchronization. When the IEC 61850 OPC Server is configured for receiving time synchronization, it updates the operating system time of the PC.
- Multiple instance support
- GOOSE Analyzer support

2.4.2. IEC 60870-5-104 OPC Server features

The IEC 60870-5-104 (IEC 104) protocol is a standard for power system monitoring, control and associated communications for telecontrol, protection and associated telecommunications for electric power systems. The IEC 104 master protocol implementation in the COM600 uses a TCP/IP interface for substation LAN (Local Area Network) connectivity and thereby to field slave devices supporting IEC 104. The application layer of IEC 104 is preserved same as that of IEC 101.

The IEC 104 OPC Server supports the following features:

- OPC Data Access v. 1.0/2.0
- OPC Alarms and Events specification v. 1.10
- IEC 61850 data modeling
- System supervision:
    - IEC 104 channel supervision
    - IEC 104 device communication
- Supported IEC 60870-5-104 data types and functions.

2.4.3. DNP 3.0 OPC Server features

DNP3 (Distributed Network Protocol) is a de-facto communication protocol for communication between SCADA master stations (control centres), RTUs, protection and control devices and meters. It is used mainly in electric and water utilities. The COM600 incorporates the DNP 3.0 master LAN/WAN for Ethernet based communication with station devices.

The DNP LAN/WAN OPC Server supports the following features:
- OPC Data Access v. 1.0/2.0
- OPC Alarms and Events specifications v. 1.10
- IEC 61850 data modeling
- System supervision:
    - DNP channel communication
    - DNP device communication
- Level of DNP implementation

2.4.4. Modbus OPC Server features

Modbus is a de-facto standard communication protocol used in electrical and industrial process data exchange between substation devices such as IEDs, meters or PLCs with COM600.

The Modbus OPC Server is intended for connecting simple Modbus devices like energy meters and input/ouput modules. As the protocol is based on scanning the state of the inputs of the device, it depends on the scan rate how short signal transients are registered. No events or time stamps are supported.

The Modbus messaging service provides a client/server communication between devices connected on an Ethernet TCP/IP network. This model is based on four types of messages: request, confirmation, indication, and response.

A system using Modbus TCP/IP can include different types of devices. There can be ModbusTCP/IP client and server devices connected to an TCP/IP network. There can also be devices such as bridges, routers and gateways for connections between the TCP/IP network and a serial line sub-network, permitting connections to Modbus serial line client and server end devices.

The Modbus OPC Server supports the following features:

- OPC Data Access v. 1.0/2.0
- OPC Alarms and Events specifications v. 1.10
- IEC 61850 data modeling
- System supervision:
    - Modbus channel communication
    - Modbus device communication

Supported transmission modes:
- Modbus RTU
- Modbus ASCII

Table 2.4.4-1 The function codes supported by Modbus OPC Server

Function code	Description	Memory area
01	Read coil status	00001 - 09999
02	Read input status	10001 - 19999
03	Read holding register	40001 - 49999
04	Read input registers	30001 - 39999
05	Force single coil	00001 - 09999
06	Write single register	40001 - 49999
16	Write multiple registers	40001 - 49999
21	Write General Reference	60001 - 65535

The following data formats are supported:
- Bit, one coil, or input status
- Word, one register in IED's memory. The data is used in an unsigned form
- Integer, one register in IED's memory. The MSB bit is used as a sign bit
- Long MSW last, signed 32-bit object, which needs two registers from IED's memory in lsw-msw order
- Long MSW first, signed 32-bit object which needs two registers from IED's memory in msw-lsw order.
- Float MSW last, floating point type which needs two input registers from IED's memory in lsw-msw order
- Float MSW first, floating point type which needs two input registers from IED's memory in msw-lsw order.

2.4.5. External OPC Server features

OPC Data Access is used for continuous, real-time data communication between PLC/DCS systems and COM600 communicating real-time data from data acquisition devices such as PLCs to display and interface devices like Web Human-Machine Interfaces (WebHMI). OPC DA is also used for inter-process communication in COM600.

2.4.6. SNMP features

The Simple Network Management Protocol (SNMP) is used to manage network connectivity of substation devices in the substation LAN network.

The SNMP OPC Server is intended for providing methods for OPC clients to monitor network-attached devices.

The SNMP OPC Server supports the following features:
- SNMP V1, SNMPv2c and SNMPV3 network monitoring

- IEC 61850 data modeling
- System supervision
  - SNMP channel communication
  - SNMP device communication

2.4.7. SNTP features

The Simple Network Time Protocol (SNTP) is used for clock synchronization between substation devices. Specifically, COM600 can act as an SNTP master to synchronize the internal clocks of the protection and control IEDs (SNTP slaves), in the absence of a dedicated GPS (SNTP server).

The SNTP OPC Server supports the following features:

- OPC Data Access Server v. 1.0/2.0
- OPC Alarms and Events server v. 1.10
- SNTP client and server for time synchronization

3. IEC 61850 Master

3.1. About this section

This document describes how IEC 61850 data objects according to IEC 61850-7-3 are mapped to OPC nodes and item tags.

In general it is done by using an OPC node to represent an IEC 61850 object, and OPC item tags to represent the attributes of the object. Most objects are single-level (that is, use only on node) but some are hierarchical and use several nodes.

This section provides reference information about the following issues:
- IEC 61850 data object modeling
- IEC 61850 OPC Server data object modeling
- Attributes
- Status codes

3.2. IEC 61850 OPC server data object modeling

3.2.1. Common data attribute types

The following sections describe how the IEC 61850 data object attributes and services are presented on the OPC server name space.

The columns in the tables have the following content types:
- **Name** specifies the OPC item name of the attribute or service.
- **Type** specifies the IEC 61850 type of the attribute.
- **Value/Value range** specifies the allowed values and ranges of the attribute or service.
- **Mandatory/Optional** specifies whether the attribute is considered as mandatory or optional according to the IEC 61850 standard.
- **OPC data type** specifies the OPC data type used for the OPC item.
- **Bit** specifies how many bits the attribute takes.
- **Description** describes the data type and access and gives useful information.

3.2.2. IEC 61850 quality

The following table defines the mapping of quality in MMS (IEC 61850 7-3). Only 14 bits (LSB) in quality are valid.

Table 3.2.2-1 IEC 61850 quality

Name	Type	Value/Value range	M/O/C	Bit
validity	2bit	good (0) | invalid (1) | reserved (2) | questionable (3)	M	0-1
overflow	1bit	FALSE (0) | TRUE (1)	M	2
outOfRange	1bit	FALSE (0) | TRUE (1)	M	3
badReference	1bit	FALSE (0) | TRUE (1)	M	4
oscillatory	1bit	FALSE (0) | TRUE (1)	M	5
failure	1bit	FALSE (0) | TRUE (1)	M	6
oldData	1bit	FALSE (0) | TRUE (1)	M	7
inconsistent	1bit	FALSE (0) | TRUE (1)	M	8
inaccurate	1bit	FALSE (0) | TRUE (1)	M	9
source	2bit	process (0) | substituted (1)	M	10-11
test	1bit	FALSE (0) | TRUE (1)	M	12
operatorBlocked	1bit	FALSE (0) | TRUE (1)	M	13

3.2.3. Mapping quality value to OPC

The value of validity is presented as the value of the quality attribute. The other values are presented as OPC properties of the quality in the OPC namespace.

Table 3.2.3-1 Mapping quality value to OPC

Name	Type	Value/ Value range	M/O/C	OPC Data Type
Validity		good (0) | invalid (1) | reserved (2) | questionable (3)	M	VT_I4
DetailQuality		DetailedQuality	M	VT_I4
Source		process (0) | substituted (1)	M	VT_I4

Name	Type	Value/ Value range	M/O/C	OPC Data Type
Test		FALSE (0) | TRUE (1)	M	VT_BOOL
OperatorBlocked		FALSE (0) | TRUE (1)	M	VT_BOOL

3.2.4. Mapping of DetailedQuality

The value of DetailQuality is mapped to a DetailedQuality bitmap.

Table 3.2.4-1 Mapping of DetailedQuality

Name	Type	Value/ Value range	M/O/C	Bit
overflow	1bit	FALSE (0) | TRUE (1)	M	0
outOfRange	1bit	FALSE (0) | TRUE (1)	M	1
badReference	1bit	FALSE (0) | TRUE (1)	M	2
oscillatory	1bit	FALSE (0) | TRUE (1)	M	3
failure	1bit	FALSE (0) | TRUE (1)	M	4
oldData	1bit	FALSE (0) | TRUE (1)	M	5
inconsistent	1bit	FALSE (0) | TRUE (1)	M	6
inaccurate	1bit	FALSE (0) | TRUE (1)	M	7

Example:

DetailQuality = 1d = 00000001b > overflow = true

DetailQuality = 16d = 00010000b > failure = true

3.2.5. Analogue value (AnalogueValue)

Analogue values are always presented as 32-bit float values (VT_R4) so that the .f and .i extensions are discarded from the attribute names to simplify the OPC namespace. If a device only supports integer values, the value is converted to a floating point presentation of the value according to its configuration and the following formula, refer to 3.2.6, Configuration of analogue value (ScaledValueConfig).

$f \times 10^{units.multiplier} = (i \times scaleFactor) + offset$

Table 3.2.5-1 Analogue value (AnalogueValue)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
i	INT32	integer value	Not Used	Not Used
f	FLOAT32	floating point value	Not Used	Not Used

Example:

MV: mag.f (VT_R4) & mag.i (VT_I4) > mag (VT_R4)

3.2.6. Configuration of analogue value (ScaledValueConfig)

The following table defines the mapping of configuration of analogue value (ScaledValue-Config).

Table 3.2.6-1 Configuration of analogue value (ScaledValueConfig)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
scaleFactor	FLOAT32	floating point value	M	VT_R4
offset	FLOAT32	floating point value	M	VT_R4

3.2.7. Range configuration (RangeConfig)

The following table defines the mapping of range configuration (RangeConfig).

Table 3.2.7-1 Range configuration (RangeConfig)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
hhLim	AnalogueValue	floating point value	M	VT_R4
hLim	AnalogueValue	floating point value	M	VT_R4
lLim	AnalogueValue	floating point value	M	VT_R4
llLim	AnalogueValue	floating point value	M	VT_R4
min	AnalogueValue	floating point value	M	VT_R4

Name	Type	Value/ Value range	M/O/C	OPC Data Type
max	AnalogueValue	floating point value	M	VT_R4

hhLim, hLim, lLim, llLim: These attributes are configuration parameters used in the context with the range attribute.

min: The min (minimum) attribute represents the minimum process measurement for which values of i or f are considered within process limits.

max: The max (maximum) attribute represents the maximum process measurement for which values of i or f are considered within process limits.

3.2.8. Step position with transient indication (ValWithTrans)

The following table defines the mapping of Step position with transient indication (ValWithTrans).

Table 3.2.8-1 Step position with transient indication (ValWithTrans)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
posVal	INT8	-64 ... 63	M	VT_I4
transInd	BOOLEAN	TRUE | FALSE	M	VT_BOOL

3.2.9. Pulse configuration (PulseConfig)

The table following table defines the mapping of pulse configuration (PulseConfig).

Table 3.2.9-1 Pulse configuration (PulseConfig)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
cmdQual	ENUMERATED	pulse(0) | persistent(1)	M	VT_I4
onDur	INT32U		M	VT_I4
offDur	INT32U		M	VT_I4
numPls	INT32U		M	VT_I4

3.2.10. Originator

The following table defines the mapping of originator (Originator).

Table 3.2.10-1 Originator

Name	Type	Value/ Value range	M/O/C	OPC Data Type
orCat	ENUMERATED	not-supported(0) | bay-control(1) | station-control(2) | remote-control(3) | automatic-bay(4) | automatic-station(5) | automatic-remote(6) | maintenance(7) | process(8)	M	VT_I4
orident	OCTET STRING64	TRUE | FALSE	M	VT_BSTR

3.2.11. Unit

The following table defines the mapping of unit (Unit).

Table 3.2.11-1 Unit

Name	Type	Value/ Value range	M/O/C	OPC Data Type
SIUnit	ENUMERATED		M	VT_I4
multiplier	ENUMERATED		O	VT_I4

3.2.12. Vector

The following table defines the mapping of vector (Vector).

Table 3.2.12-1 Vector

Name	Type	Value/ Value range	M/O/C	OPC Data Type
mag	AnalogueValue	floating point value	M	VT_R4
ang	AnalogueValue	floating point value	O	VT_R4

3.2.13. TimeStamp

The timestamp OPC attributes are presented as OPC type VT_DATE. It is implemented using an 8-byte floating-point number. Days are represented by whole number increments starting with 30 December 1899, midnight as time zero. Hour values are expressed as the absolute value of the fractional part of the number.

3.2.14. AbbCommandBitmask

The following table defines the mapping of AbbCommandBitmask. This ABB-specific control value is a bitmask value of a command to a device. This value is applicable to ABB extension control attributes.

Table 3.2.14-1 AbbCommandBitmask

Name	Type	Value/ Value range	M/O/C	Bit Position
NormalControl	1bit	FALSE (0) | TRUE (1)	M	0
InterlockOverride	1bit	FALSE (0) | TRUE (1)	M	1
Synchrocheck-Override	1bit	FALSE (0) | TRUE (1)	M	2
TestCommand	1bit	FALSE (0) | TRUE (1)	M	3
Originator	4bit	not-supported(0) | bay-control(1) | station-control(2) | remote-control(3) | automatic-bay(4) | automatic-station(5) | automatic-remote(6) | maintenance(7) | process(8)	M	4-7
ControlValue	nbit		M	8-31

NormalControl: True = normal operation, false = inverse operation (for example, On > Off).

InterlockOverride: True = interlockcheck > false

SynchrocheckOverride : True = syncrocheck > false

TestCommand: True = test command

Originator: Command originator (= Originator.orCat)

3.2.15. Common data class specifications for status information

3.2.15.1. Single point status (SPS)

The following table defines the common data class of single point status.

Table 3.2.15.1-1 Single point status (SPS)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	BOOLEAN	ST	TRUE | FALSE	M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	BOOLEAN	SV	TRUE | FALSE	O	VT_BOOL
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
d	VISIBLE STRING64	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.15.2. Double point status (DPS)

The following table defines the common data class of double point status.

Table 3.2.15.2-1 Double point status (DPS)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	CODED ENUM	ST	intermediate-state (0) | off (1) | on (2) | bad-state (3)	M	VT_I4
q	Quality	ST		M	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
t	TimeStamp	ST		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	CODED ENUM	SV	intermediate-state (0) | off (1) | on (2) | bad-state (3)	O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.15.3. Integer status (INS)

The following table defines the common data class of integer status.

Table 3.2.15.3-1 Integer status (INS)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	INT32	ST		M	VT_I4
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
d	VISIBLE STRING255	DC		O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.15.4. Enumerated Status (ENS)

Name	Type	FC	Value/Value range	M/O	OPC data type
stVal	ENUMER-ATED	ST		M	
q	Quality	ST		M	VT_I4
t	Timestamp	ST		M	VT_I4
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR
d	VISIBLE STRING 255	DC	Text	O	VT_BSTR
dU	UNICODE STRING 255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING 255	EX		O	VT_BSTR
cdcName	VISIBLE STRING 255	EX		O	VT_BSTR
dataNs	VISIBLE STRING 255	EX		O	VT_BSTR

3.2.15.5. Protection activation information (ACT)

The following table defines the common data class of protection activation information.

Table 3.2.15.5-1 Protection activation information (ACT)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
general	BOOLEAN	ST		M	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
phsA	BOOLEAN	ST		O	VT_BOOL
phsB	BOOLEAN	ST		O	VT_BOOL
phsC	BOOLEAN	ST		O	VT_BOOL
neut	BOOLEAN	ST		O	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
operTm	TimeStamp	CF		O	VT_DATE
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.15.6. Directional protection activation information (ACD)

The following table defines the common data class of directional protection activation information.

Table 3.2.15.6-1 Directional protection activation information (ACD)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
general	BOOLEAN	ST		M	VT_BOOL
dirGeneral	ENUMER-ATED	ST	unknown (3) | forward (1) | backward (2)	M	
phsA	BOOLEAN	ST		O	VT_BOOL
dirPhsA	ENUMER-ATED	ST	unknown (3) | forward (1) | backward (2)	O	
phsB	BOOLEAN	ST		O	VT_BOOL
dirPhsB	ENUMER-ATED	ST	unknown (3) | forward (1) | backward (2)	O	
phsC	BOOLEAN	ST		O	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dirPhsC	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	O	
neut	BOOLEAN	ST		O	VT_BOOL
dirNeut	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	O	
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.15.7. Security violation counter (SEC)

The following table defines the common data class of security violation counting.

Table 3.2.15.7-1 Security violation counting (SEC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
cnt	INT32U	ST		M	VT_I4
sev	ENUMERATED	ST	unknown (0) | critical (1) | major (2) | minor (3) | warning (4)	M	VT_I4
t	TimeStamp	ST		M	VT_DATE
addr	OCTET STRING64	ST		O	VT_BSTR
addInfo	VISIBLE STRING64	ST		O	VT_BSTR
d	VISIBLE STRING255	DC	Text	O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.15.8. Binary counter reading (BCR)

The following table defines the common data class of binary counter reading.

Table 3.2.15.8-1 Binary counter reading (BCR)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
actVal	INT128	ST		M	VT_I4
frVal	INT128	ST		O[a]	VT_I4
frTm	TimeStamp	ST		O[a]	VT_DATE
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
units	Unit	CF		O	VT_R4
pulsQty	FLOAT32	CF		M	VT_BOOL
frEna	BOOLEAN	CF		O [a]	VT_DATE
strTm	TimeStamp	CF		O [a]	VT_I4
frPd	INT32	CF		O [a]	VT_BOOL
frRds	BOOLEAN	CF		O [a]	VT_BSTR
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. All or none of these items must be present.

3.2.16. Common data class specifications for measured information

3.2.16.1. Measured value (MV)

The following table defines the common data class of measured value.

Table 3.2.16.1-1 Measured value (MV)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
instMag	Analogue-Value	MX		O	VT_R4
mag	Analogue-Value	MX		M	VT_R4
range	ENUMER-ATED	MX	normal (0) | high (1) | low (2) | high-high (3) | low-low (4) | ...	O	VT_I4
q	Quality	MX		M	VT_I4
t	TimeStamp	MX		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	Analogue-Value	SV		O	VT_R4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
units	Unit	CF		O	
db	INT32U	CF	0...100 000	O	VT_I4
zeroDb	INT32U	CF	0...100 000	O	VT_I4
sVC	ScaledValue-Config	CF		O	
rangeC	RangeConfig	CF		O	
smpRate	INT32U	CF		O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.16.2. Complex measured value (CMV)

The following table defines the common data class of measured value.

Table 3.2.16.2-1 Complex measured value (CMV)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
instCVal	Vector	MX		O	
cVal	Vector	MX		M	
range	ENUMER-ATED	MX	normal (0) | high (1) | low (2) | high-high (3) | low-low (4) | ...	O	VT_I4
q	Quality	MX		M	VT_I4
t	TimeStamp	MX		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	Vector	SV		O	
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
units	Unit	CF		O	
db	INT32U	CF	0...100 000	O	VT_I4
zeroDb	INT32U	CF	0...100 000	O	VT_I4
rangeC	RangeConfig	CF		O	
magSVC	ScaledValue-Config			O	
angSVC	ScaledValue-Config			O	
angRef	ENUMER-ATED	CF	V | A | other ...	O	VT_I4
smpRate	INT32U	CF		O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.16.3. Sampled value (SAV)

The following table defines the common data class of sampled value.

Table 3.2.16.3-1 Sampled value (SAV)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
instMag	Analogue-Value	MX		M	VT_R4
q	Quality	MX		M	VT_I4
t	TimeStamp	MX		M	VT_DATE
units	Unit	CF		O	
sVC	ScaledValue-Config	CF		O	
min	Analogue-Value	CF		O	VT_R4
max	Analogue-Value	CF		O	VT_R4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.16.4. WYE

The following table defines the common data class of WYE. This class is a collection of simultaneous measurements of values in a three phase system that represent phase to ground values.

Table 3.2.16.4-1 WYE

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
phsA	CMV	MX		O[a]	
phsB	CMV	MX		O[a]	
phsC	CMV	MX		O[a]	
neut	CMV	MX		O[a]	
net	CMV	MX		O[a]	
res	CMV	MX		O[a]	
angRef	ENUMER-ATEDe	CF	Va (0) | Vb (1) | Vc (2) | Aa (3) | Ab (4) | Ac (5) | Vab (6) | Vbc (7) | Vca (8) | Vother (9) | Aother (10)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. One or more of these items (1 - 6) must be present.

3.2.16.5. Delta (DEL)

The following table defines the common data class of delta. This class is a collection of measurements of values in a three phase system that represent phase to phase values.

Table 3.2.16.5-1 Delta (DEL)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
phsAB	CMV	MX		O [a]	
phsBC	CMV	MX		O [a]	
phsCA	CMV	MX		O [a]	
angRef	ENUMER-ATED	CF	Va (0) | Vb (1) | Vc (2) | Aa (3) | Ab (4) | Ac (5) | Vab (6) | Vbc (7) | Vca (8) | Vother (9) | Aother (10)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. One or more of these groups (1 - 3) must be present.

3.2.16.6. Sequence (SEQ)

The following table defines the common data class of sequence.

Table 3.2.16.6-1 Sequence (SEQ)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
c1	CMV	MX		O [a]	
c2	CMV	MX		O [a]	
c3	CMV	MX		O [a]	
seqT	ENUMER-ATED	CF	pos-neg-zero (0) | dir-quad-zero (1)	O	VT_I4
phsRef	ENUMER-ATED	CF	A (0) | B (1) | C (2) | ...		VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. One or more of these groups (1 - 3) must be present.

3.2.17. Common data class specifications for controllable status information

3.2.17.1. Controllable single point (SPC)

The following table defines the common data class of controllable single point.

Table 3.2.17.1-1 Controllable single point (SPC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 3.2.22, Application error codes		VT_I4
ctlVal	BOOLEAN	CO	off (FALSE) | on (TRUE)	M	VT_BOOL
operTm	TimeStamp	CO		O	VT_DATE
origin	Originator	CO, ST			
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
stVal	BOOLEAN	ST	FALSE | TRUE	M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
subVal	BOOLEAN	SV	FALSE | TRUE	O	VT_BOOL
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRIN64	SV		O	VT_BSTR
pulseConfig	PulseConfig	CF		O	
ctlModel	ENUMERATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:

ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:

- ctlVal: MMS Write.request to ctlVal with value. IEC 61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:

- tlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:

- ctlVal: MMS Write.request to ctlVal with value. IEC 61850 OPC Server will do the select before operate.

3.2.17.2. Controllable double point (DPC)

The following table defines the common data class of controllable double point.

Table 3.2.17.2-1 Controllable double point (DPC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
ctlSelOn	AbbCommand-Bitmask			M	VT_I4
ctlSelOff	AbbCommand-Bitmask			M	VT_I4
ctlOperOn	AbbCommand-Bitmask			M	VT_I4
ctlOperOff	AbbCommand-Bitmask			M	VT_I4
ctlCan	AbbCommand-Bitmask			M	VT_I4
ctlOper	AbbCommand-Bitmask			M	VT_I4
lastApplError	ApplicationErrorCode		Refer to 3.2.22, Application error codes		VT_I4
ctlVal	BOOLEAN	CO	off (FALSE) | on (TRUE)	M	VT_BOOL
operTm	TimeStamp	CO		O	VT_DATE
origin	Originator	CO, ST		O	
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
stVal	CODED ENUM	ST	intermediate-state (0) | off (1) | on (2) | bad-state (3)	M	VT_I1
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
subVal	CPT	SV	intermediate-state (0) | off (1) | on (2) | bad-state (3)	O	VT_I1
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
pulseConfig	PulseConfig	CF		O	
ctlModel	ENUMER-ATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMER-ATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

ctlOperOn: This attribute shall determine the control activity operation in direction On/Close.

ctlOperOff: This attribute shall determine the control activity operation in direction Off/Open.

ctlSelOn: This attribute shall determine the selection with direction On/Close.

ctlSelOff; This attribute shall determine the selection with direction Off/Open.

ctlCan: This attribute shall determine the cancellation of the selection

ctlOper: This attribute shall determine the selection with direction (direction got from previous select). Only applicable for controls with SBO.

Mapping of controls

Direct Control with Normal Security:
- ctlSelOn: (not used)
- ctlSelOff: (not used)
- ctlOperOn: MS Write.request to Oper structure with value ON.
- ctlOperOff: MMS Write.request to Oper structure with value OFF.
- ctlCan: (not used)
- ctlOper: (not used)

The ctlSelOn, ctlSelOff, ctlCan, selCause, cmdTermCause, stSeld and the bits in ControlValues are not applicable.

SBO with Normal Security:
- ctlSelOn: MMS Read.request to SBO structure (to perform select).
- ctlSelOff: MMS Read.request to SBO structure (to perform select).
- ctlOperOn: MMS Write.request to Oper structure with value ON (to operate).
- ctlOperOff: MMS Write.request to Oper structure with value OFF (to operate).
- ctlCan: MMS Write.request ro Cancel structure
- ctlOper: MMS Write.request to Oper structure with value ON/OFF according to previous direction of select.

Direct Control with Enhanced Security:
- ctlSelOn: (not used)
- ctlSelOff: (not used)
- ctlOperOn: MMS Write.request to Oper structure with value ON.
- ctlOperOff: MMS Write.request to Oper structure with value OFF.
- ctlCan: MMS Write.request ro Cancel structure
- ctlOper: (not used)

SBO with Enhanced Security:
- ctlSelOn: MMS Read.request to SBOw structure.
- ctlSelOff: MMS Read.request to SBOw structure.
- ctlOperOn: MMS Write.request to Oper structure with value ON.
- ctlOperOff: MMS Write.request to Oper structure with value OFF.
- ctlCan: MMS Write.request ro Cancel structure
- ctlOper: MMS Write.request to Oper structure with value ON/OFF according to previous direction of select.

3.2.17.3. Controllable integer status (INC)

The following table defines the common data class of controllable integer status.

Table 3.2.17.3-1 Controllable integer status (INC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 3.2.22, Application error codes		VT_I4
ctlVal	INT32	CO		M	VT_I4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMERATED			O	VT_I4
orIdent	OCTET STRING64			O	VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
stVal	INT32	ST		M	VT_I4
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR
ctlModel	ENUMERATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
minVal	INT32	CF		O	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
maxVal	INT32	CF		O	VT_I4
stepSize	INT32U	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC 61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC 61850 OPC Server will do the select before operate.

3.2.17.4. Controllable Enumerated Status (ENC)

Name	Type	FC	Value/Value range	M/O	OPC data type
lastApplError	ApplicationErr-orCode		Refer to 5.2.22 Application error codes	M	VT_I4
ctlVal	ENUMER-ATED	CO		M	VT_I4
operTm	Timestamp	CO		O	VT_DATE

Name	**Type**	**FC**	**Value/Value range**	**M/O**	**OPC data type**
orCat	ENUMERATED			O	VT_I4
orIdent	OCTET STRING64			O	VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
stVal	ENUMERATED	ST		M	VT_I4
q	Quality	ST		M	VT_I4
t	Timestamp	ST		M	VT_I4
stSeld	BOOLEAN	ST	FALSE|TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR
ctlModel	ENUMERATED	CF	Status-only(0)|direct-with-normal-security(1)| sbo-with-normal-security(2) | direct-with-enhanced-security(3)| sbo-with-enhanced-security(4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	Operate-once(0) | operate-many(1)	O	VT_I4
operTimeout	INT32U	CF		O	VT_I4
d	VISIBLE STRING 255	DC	Text	O	VT_BSTR
dU	UNICODE STRING 255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING 255	EX		O	VT_BSTR
cdcName	VISIBLE STRING 255	EX		O	VT_BSTR

Name	Type	FC	Value/Value range	M/O	OPC data type
dataNs	VISIBLE STRING 255	EX		O	VT_BSTR

3.2.17.5. Binary controlled step position information (BSC)

The following table defines the common data class of binary controlled step position information.

Table 3.2.17.5-1 Binary controlled step position information (BSC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	Application-Erro rCode		Refer to 3.2.22, Application error codes		VT_I4
ctlVal	ENUMERATED		stop (0) | lower (1) | higher (2) | reserved (3)	M	VT_I4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMERATED		not-supported | bay-control | station-control | remote-control | automatic-bay | automatic-station | automatic-remote | maintenance | process	O	VT_I4
orIdent	OCTET STRING64				VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
valWTr.posVal	INT8	ST		M	VT_I4
valWTr.transInd	BOOLEAN	ST		M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	M	VT_I4
q	Quality	ST		O	VT_BOOL
t	TimeStamp	ST		M	VT_DATE

Name	**Type**	**FC**	**Value/ Value range**	**M/O**	**OPC Data Type**
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR
				O	
ctlModel	ENUMER-ATED	CF	Status-only (0) | direct-withnormal- security (1) | sbo-with-normal- security (2) | direct-withenhanced-security (3) | sbo-withenhanced- security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMER-ATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
minVal	INT8	CF		O	VT_I4
maxVal	INT8	CF		O	VT_I4
stepSize	INT8	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:

- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC 61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC 61850 OPC Server will do the select before operate.

3.2.17.6. Integer controlled step position information (ISC)

The following table defines the common data class of integer controlled step position information.

Table 3.2.17.6-1 Integer controlled step position information (ISC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 3.2.22, Application error codes		VT_I4
ctlVal	INT8	CO	-64 … 63	M	VT_I4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMERATED		not-supported | bay-control | station-control | remote-control | automatic-bay | automatic-station | automatic-remote | maintenance | process	O	VT_I4
orIdent	OCTET STRING64			O	VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
valWTr.posVal	INT8	ST		M	VT_I4
valWTr.transInd	BOOLEAN	ST		M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL

Name	**Type**	**FC**	**Value/ Value range**	**M/O**	**OPC Data Type**
				O	
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VisibleString	SV	Text	O	VT_BSTR
				O	
ctlModel	ENUMERATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
minVal	INT8	CF		O	VT_I4
maxVal	INT8	CF		O	VT_14
stepSize	INT8	CF	1 ... (maxVal - minVal)	O	VT_14
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:

- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value.
  IEC 61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.
  IEC 61850 OPC Server will do the select before operate.

3.2.18. Common data class specifications for controllable analogue information

3.2.18.1. Analog set point (APC)

Table 3.2.18.1-1 Analogue set point (APC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 3.2.22, Application error codes Application error codes		VT_I4
ctlVal	Analogue-Value	CO		M	VT_R4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMERATED			O	VT_I4
orIdent	OCTET STRING64			O	VT_BSTR
ctlNum	INT8U	MX	0..255	O	VT_I4
mxVal	Analogue-Value	MX		M	VT_R4
q	Quality	MX		M	VT_I4
t	Timestamp	MX		M	VT_I4
stSeld	BOOLEAN	MX	FALSE|TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR
ctlModel	ENUMERATED	CF	Status-only(0)|direct-with-normal-security(1)| sbo-with-normal-security(2) | direct-with-enhanced-security(3)| sbo-with-enhanced-security(4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	Operate-once(0) | operate-many(1)	O	VT_I4
units	Unit	CF		O	
db	INT32U	CF	0… 100000	O	
sVC	ScaledValue-Config	CF		O	
minVal	Analogue-Value	CF		O	
maxVal	Analogue-Value	CF		O	
stepSize	Analogue-Value	CF		O	
operTimeout	INT32U	CF		O	
d	VISIBLE STRING 255	DC	Text	O	VT_BSTR
dU	UNICODE STRING 255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING 255	EX		O	VT_BSTR
cdcName	VISIBLE STRING 255	EX		O	VT_BSTR
dataNs	VISIBLE STRING 255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:
- setMag: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- setMag: MMS Write.request to Oper structure with value. IEC 61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- setMag: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- setMag: MMS Write.request to Oper structure with value. IEC 61850 OPC Server will do the select before operate.

3.2.19. Common data class specifications for status settings

3.2.19.1. Single point setting (SPG)

The following table defines the common data class of single point setting.

Table 3.2.19.1-1 Single point setting (SPG)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setVal	BOOLEAN	SP	off (FALSE) | on (TRUE)	M	VT_BOOL
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.19.2. Integer status setting (ING)

The following table defines the common data class of integer status setting.

Table 3.2.19.2-1 Integer status setting (ING)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setVal	INT32	SP		M	VT_I4
minVal	INT32	CF		O	VT_I4
maxVal	INT32	CF		O	VT_I4
stepSize	INT32	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.20. Common data class specifications for analogue settings

3.2.20.1. Analogue setting (ASG)

The following table defines the common data class of analogue setting.

Table 3.2.20.1-1 Analogue setting (ASG)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setMag	Analogue-Value	SP		M	VT_I4
units	Unit	CF		O	
sVC	ScaledValue-Config	CF		O	
minVal	Analogue-Value	CF		O	VT_I4
maxVal	Analogue-Value	CF		O	VT_I4
stepSize	Analogue-Value	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.20.2. Setting curve (CURVE)

The following table defines the common data class of setting curve.

Table 3.2.20.2-1 Setting curve (CURVE)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setCharact	ENUMER-ATED	SP		M	VT_I4
setParA	FLOAT32	SP		O	VT_R4
setParB	FLOAT32	SP		O	VT_R4
setParC	FLOAT32	SP		O	VT_R4
setParD	FLOAT32	SP		O	VT_R4
setParE	FLOAT32	SP		O	VT_R4
setParF	FLOAT32	SP		O	VT_R4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.21. Common data class specifications for description information

3.2.21.1. Device name plate (DPL)

The following table defines the common data class of device name plate. Data of this common data class are used to identify entities like primary equipment or physical devices.

Table 3.2.21.1-1 Device name plate (DPL)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
vendor	VISIBLE STRING255	DC		M	VT_BSTR
hwRev	VISIBLE STRING255	DC		O	VT_BSTR
swRev	VISIBLE STRING255	DC		O	VT_BSTR
serNum	VISIBLE STRING255	DC		O	VT_BSTR
model	VISIBLE STRING255	DC		O	VT_BSTR
location	VISIBLE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX			VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.21.2. Logical node name plate (LPL)

The following table defines the common data class of logical node name plate. Data of this common data class are used to identify logical nodes.

Table 3.2.21.2-1 Logical node name plate (LPL)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
vendor	VISIBLE STRING255	DC		M	VT_BSTR
hwRev	VISIBLE STRING255	DC		M	VT_BSTR
d	VISIBLE STRING255	DC	Text	M	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dU	UNICODE STRING255	DC		O	VT_BSTR
configRev	VISIBLE STRING255	DC		O	VT_BSTR
ldNs	VISIBLE STRING255	EX	will be included only in LLN0	O	VT_BSTR
lnNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

3.2.22. Application error codes

Command Error codes of lastApplError attribute. The attribute is valid only for command data classes and its value presents the status of the last command. It is updated when command responses are received from devices.

The status code is received by adding the additional status code to main status code.

Example: 1003 = Unknown, select failed

Table 3.2.22-1 Main status codes

0	OK
1000	Unknown
2000	Timeout test not ok
3000	Operator test not ok

Table 3.2.22-2 Additional status codes

0	Unknown
1	Not supported
2	Blocked by switching hierarchy
3	Select failed
4	Invalid position
5	Position reached
6	Parameter change in execution

7	Step limit
8	Blocked by mode
9	Blocked by process
10	Blocked by interlocking
11	Blocked by synchrocheck
12	Command already in execution
13	Blocked by health
14	1 of n control
15	Abortion by cancel
16	Time limit over
17	Abortion by trip
18	Object not selected

3.3. Attributes

3.3.1. General information about attributes

In addition to attributes for process data (indications and commands), the OPC Server also provides some attributes for controlling the devices and retrieving status information from them. These attributes are available for the OPC access client.

3.3.2. Server attributes

Table 3.3.2-1 Server attributes

Name	Value or Value range/ Default	Description
Protocol stack version	Version information	Data type: Text Access: Read-only The version information of the Protocol Stack
Configuration version	Version information	Data type: Text Access: Read-only The version information of the current configuration file.

Name	Value or Value range/ Default	Description
Reset	By writing 1 the server is reset. By writing 2 the log file is cleared. Other values are currently ignored.	Data type: Integer Access: No limitations Makes it possible for clients to reset the OPC server. A reset means that the server disconnects all clients and reloads the configuration file. When the last client is disconnected the server usually shuts down. The server does not shut down if it was not started by the COM runtime or if it is running as a Windows service. In that case the configuration file is not reloaded.
File version	Version information	Data type: Text Access: Read-only The file version number of the OPC server/client exe file.
Product version	Version information	Data type: Text Access: Read-only The version (revision) of the package that the server/client belong to.
Timesync client		
In use	0 = Not in use 1 = In use Default: 1	Data type: Integer Access: No limitations Status of the integrated SNTP clients time synchronization routine. Value is 0 when not in use and 1 when in use. By writing 0 the client is started and by writing 1 it is stopped. The client can be started only if configuration parameters are given in a configuration file.
Timesync status	False = Not synchronised True = Synchronised OK	Data type: Boolean Access: Read-only Status of the integrated SNTP client time synchronization routine. Value is false when synchronization is not received and true when synchronization received and local time set OK.
Timesync server		

Name	Value or Value range/ Default	Description
In use	0 = Not in use 1 = In use Default: 1	Data type: Integer Access: No limitations Status of the integrated SNTP servers time synchronization routine. Value is 0 when not in use and 1 when in use. By writing 0 the client is started and by writing 1 it is stopped.
Timesync status	False = Failure True = OK	Status of the integrated SNTP servers time synchronization routine. Value is false when operation fails and true when operating OK.

3.3.3. IEC 61850 subnetwork attributes

Table 3.3.3-1 IEC 61850 subnetwork attributes

Name	Value or Value range/ Default	Description
In use	0 = Not in use, the subnetwork communication is stopped 1 = In use Default: 1	Data type: Integer Access: No limitations The state of the subnetwork whether it is in use or not. When a subnetwork is not in use, no data can be transmitted on it, and no data is received from it. When a subnetwork is stopped by setting the in use attribute to 0, all data transmission on the subnetwork ceases and all open connections to the devices will be closed. Single devices in use attribute may be set to 1 and this operation also takes the subnetwork in use. Now only the one device is in use. If the subnetwork in use is set to 1, the rest of the devices are taken in use. The in use attribute has no affect on devices in simulation mode.
Object status	89 = Initialize error 90 = Not connected 91 = Initializing 100 = Ready 101 = Suspended (=Not in use) 102 = Simulated	Data type: Integer Access: Read-only Indicates the operating status of the device

Name	Value or Value range/ Default	Description
Diagnostic events enabled	False = Diagnostic events disabled True = Diagnostic events enabled	Data type: Boolean Access: No limitations Enables/disables diagnostic events
Diagnostic events level	0 = Disabled 1 = Level1 (main operation and errors) 2 = Level2 (+ time synchronization error) 3 = Level3 (+ time synchronization done) 4 = Level4 5 = Level5	Data Type: Integer Access: No limitations Sets the maximum level for events coming from devices. Limits the lower level events to pass through.
Diagnostic counters		
Sent connection request		Data type: Integer Access: No limitations Connect requests sent to devices
Received connection replies ok		Data type: Integer Access: No limitations Successful connect replies from devices
Received connection replies error		Data type: Integer Access: No limitations Failed connect replies from devices
Sent connection concludes		Data type: Integer Access: No limitations Connections closed by IEC 61850 OPC server
Received connection concludes		Data type: Integer Access: No limitations Received connection concludes
Received connection aborts		Data type: Integer Access: No limitations Connections refused and aborted by devices

Name	Value or Value range/ Default	Description
Received rejects		Data type: Integer Access: No limitations Request rejected by devices (usually if device could not decode the request or they do not support the used service)
Sent requests		Data type: Integer Access: No limitations Request sent to devices
Received replies ok		Data type: Integer Access: No limitations Successful requests to devices (received success responses)
Received replies error		Data type: Integer Access: No limitations Failed requests to devices (received error responses)
Received variable read replies ok		Data type: Integer Access: No limitations Variable read success responses from devices
Received variable read replies error		Data type: Integer Access: No limitations Variable read failure responses from devices
Received variable write replies ok		Data type: Integer Access: No limitations Variable write success responses from devices
Received variable write replies error		Data type: Integer Access: No limitations Variable read failure responses from devices
Received information reports		Data type: Integer Access: No limitations Information reports received from devices

Name	Value or Value range/ Default	Description
Received status requests		Data type: Integer Access: No limitations Unsolicited status requests received from devices

3.3.4. IEC 61850 device attributes

Table 3.3.4-1 IEC 61850 device attributes

Name	Value or Value range/ Default	Description
In use	0 = Out of use 1 = In use Default: 1	Data type: Integer Access: No limitations The operational status of the device whether it is in use or out of use. Taking the device out of use with this attribute stops all data communication with the device and closes the connection. All operations that would result in a data exchange are disabled. Setting in use to 1 will take the device back in use and tries to reestablish the connection to a physical device. The device itself is not affected by the attribute, only protocol stack’s image of the device. The in use attribute has no affect on devices in simulation mode.

Name	Value or Value range/ Default	Description
Object status	94 = Init (checking configuration version for single rcb) 95 = init (checking rcb attributes for single rcb) 96 = Init (reading rcb variable list for single rcb) 97 = Init (enabling reporting for single rcb) 98 = Init (rcb init ok for single rcb) 100 = Ready 101 = Suspended (= not in use) 102 = Device simulated 86 = Report control block initialization error (restarting rcb init) 88 = Configuration version error (device is suspended) 89 = error (not specified) 90 = Device not connected 91 = Initializing 92 = Initializing rcb (after error in reporting init or information report flow) 93 = Reinitialize (after reconnection if init done)	Data type: Integer Access: Read-only Indicates the operating status of the device Data type: Integer Access: Read-only Indicates the operating status of the device
Device connection status	False = Device connection suspended True = Device connection OK	Data type: Boolean Access: Read-only Indicates the status of the device connection.
Diagnostic events enabled	False = Diagnostic events disabled True = Diagnostic events enabled	Data type: Boolean Access: No limitations Enables/disables diagnostic events

Name	Value or Value range/ Default	Description
Diagnostic events level	0 = Disabled 1 = Level1 (main operation, error replies, errors) 2 = Level2 (+ Information Reports, OK replies, RCB init) 3 = Level3 (+ sent requests (connect,read,write), transparent SPA messages) 4 = Level4 (+ reported local updates) 5 = Level5 (+ reported unconfigured updates)	Data Type: Integer Access: No limitations Sets diagnostics event level
IP address	0.0.0.0 - 255.255.255.255	Data type: Text Access: Read-only (configuration) IP address of the physical device
Configuration version	Version information	Data type: Text Access: Read-only The version information of the current configuration for this device.
Transparent XSAT		See 3.3.5, Transparent XSAT.
Diagnostic counters		
Sent connection requests		Data type: Integer Access: No limitation Connection requests sent to device
Received connection replies ok		Data type: Integer Access: No limitation Success connection replies received from device (connection accepted)
Received connection replies error		Data type: Integer Access: No limitation Failure connection replies received from device (connection refused).

Name	Value or Value range/ Default	Description
Sent connection concludes		Data type: Integer Access: No limitation Connection to the device closed by IEC 61850 OPC Server.
Received connection concludes		Data type: Integer Access: No limitation Connections closed by device.
Sent requests		Data type: Integer Access: No limitation Additional requests (variable list, access attributes) sent to device
Received replies ok		Data type: Integer Access: No limitation Success replies to additional requests from device.
Received replies error		Data type: Integer Access: No limitation Failure replies to additional requests from device
Sent variable read requests		Data type: Integer Access: No limitation Variable read requests sent to device
Received variable read replies ok		Data type: Integer Access: No limitation Success replies to variable reads from device
Received variable read replies error		Data type: Integer Access: No limitation Failure replies to variable reads from device
Sent variable write requests		Data type: Integer Access: No limitation Variable write requests sent to device

Name	Value or Value range/ Default	Description
Received variable write replies ok		Data type: Integer Access: No limitation Success replies to variable write from device
Received variable write replies error		Data type: Integer Access: No limitation Failure replies to variable write from device
Received information reports		Data type: Integer Access: No limitation Information reports received from device
Received status replies		Data type: Integer Access: No limitation Successful replies to Status requests received from device

3.3.5. Transparent XSAT

The Transparent XSAT attribute can be used to read and write IEC 61850 attributes, which are not configured to the OPC namespace of the IEC 61850 OPC Server. For example, the transparent XSAT attribute can be used for setting group controlling. The Transparent XSAT attribute is used through an OPC client. The attribute uses the OPC data type BSTR, which is a variant of VT_BSTR data type.

The Transparent XSAT attribute passes on request the IEC 61850 servers and their attributes outside the IEC 61850 OPC servers namespace. The IEC 61850 OPC server does not check the outgoing attributes. Therefore the IEC 61850 OPC clients which are using the Transparent XSAT attribute know what attributes they are accessing. The Transparent XSAT attribute only supports read and write requests.

The Transparent XSAT attribute uses synchronic data access in the IEC 61850 OPC server. When an IEC 61850 OPC client writes a request, the IEC 61850 OPC server parses and sends the request to the IEC 61850 server.

The Transparent XSAT attribute returns and releases the request after it has received reply from the IEC 61850 server. The reply is written in the Transparent XSAT attribute as an XSAT string.

XSAT Read Request

Attribute Data Type Unknown

The data type of the attribute is not known, because it is not included in the IEC 61850 OPC Server configuration (SCL). The Transparent XSAT attribute asks first the required data type, before reading the data from an IEC 61850 server.

If the Transparent XSAT attribute receives a success message, the data type is saved. If the Transparent XSAT attribute receives an error message, an XSAT error string is sent to the IEC 61850 OPC client.

The IEC 61850 OPC server request for the data type with a ReadVariableData service. The results are written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.

Attribute Data Type Known

The attribute data type is known from a previous request or the attribute is included in the IEC 61850 OPC Server configuration (SCL). The IEC 61850 OPC server directly uses a ReadVariableData service to complete the request. The reply message is written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.

XSAT Write Request

Attribute Data Type Unknown

The data type of the attribute is not known, because it is not included in the IEC 61850 OPC Server configuration (SCL). The Transparent XSAT attribute first asks the required data type, before writing the data from an IEC 61850 server.

If the Transparent XSAT attribute receives a success message, the data type is saved. If the Transparent XSAT attribute receives an error message, an XSAT error string is sent to the IEC 61850 OPC client.

The IEC 61850 OPC server requests for the data type with a WriteVariableData service. The results are written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.

Attribute Data Type Known

The attribute data type is known from a previous request or the attribute is included in the IEC 61850 OPC Server configuration (SCL). The IEC 61850 OPC server directly uses a WriteVariableData service to complete the request. The reply message is written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.’

XSAT Formats

- *XSAT Read Request*
  GetDataValue&result={name|noname}&LDInst=””&FunConstr=””&LNName=””[&DORef=””&Attr=””]]
- *XSAT Write Request*
  SetDataValue&LDInst=””&FunConstr=””&LNName=””[&DORef=””[&Attr=””]]&v=””
- *XSAT Read Reply*
  Success with names (result=name)
  <?xml version="1.0"?><!DOCTYPE XSAT SYSTEM "xsat-004.dtd"><XSAT>
  <Response><DO><LDInst>…</LDInst><LNName>…</LNName><DORef>…</DORef>
  <At><n>…</n><v>…</v><FunConstr>…</FunConstr></At> … </DO> …
  </Response> </XSAT>
  Success without names (result=noname)
  <?xml version="1.0"?><!DOCTYPE XSAT SYSTEM "xsat-004.dtd"><XSAT>
  <Response><Values> <v>…</v> … </Values></Response></XSAT>
  Failure
  <?xml version=\"1.0\"?><!DOCTYPE XSAT SYSTEM \"xsat-004.dtd\"> <XSAT>
  <Response> <Result>failure</Result></Response></XSAT>
- *XSAT Write Reply*
  Success
  <?xml version=\"1.0\"?><!DOCTYPE XSAT SYSTEM \"xsat-004.dtd\"> <XSAT>
  <Response> <Result>ok</Result> </Response> </XSAT>
  Failure
  <?xml version=\"1.0\"?><!DOCTYPE XSAT SYSTEM \"xsat-004.dtd\"> <XSAT>
  <Response> <Result>failure</Result> </Response> </XSAT>
  EXAMPLE 1 (Read request + success reply)
  IEC 61850 Path:
  LD1$PTOC1$ST
  Request:
  GetDataValue&result=name&LDInst=LD1&LNName=PTOC1&FunConstr=ST
  Reply OK:
  <?xml version="1.0"?> <!DOCTYPE XSAT SYSTEM "xsat-004.dtd"> <XSAT>
  <Response>
  <DO><LDInst>LD1</LDInst><LNName>PTOC1</LNName><DORef>Str</DORef>
  <At><n>general</n><v>False</v><FunConstr>ST</FunConstr></At>
  <At><n>t</n><v>1.1.1970</v><FunConstr>ST</FunConstr></At>
  <At><n>q</n><v>12288</v><FunConstr>ST</FunConstr></At> </DO>
  <DO><LDInst>LD1</LDInst><LNName>PTOC1</LNName><DORef>Op</DORef>
  <At><n>general</n><v>False</v><FunConstr>ST</FunConstr></At>
  <At><n>t</n><v>1.1.1970</v><FunConstr>ST</FunConstr></At>
  <At><n>q</n><v>68</v><FunConstr>ST</FunConstr></At> </DO> </Response>
  </XSAT>
  EXAMPLE 2 (Write request + failure reply)
  IEC 61850 Path:
  LD1$LLN0$BR$brcbStatUrg02&RptEna

Request:
SetDataValue&LDInst=LD1&LNName=LLN0&DORef=brcbStat-Urg02&Attr=RptEna&FunConstr=BR&v=False
Reply OK:
<?xml version="1.0"?><!DOCTYPE XSAT SYSTEM "xsat-004.dtd"> <XSAT> <Response> <Result>failure</Result> </Response> </XSAT>

3.3.6. IEC 61850 logical device attributes

Table 3.3.6-1 IEC 61850 logical device attributes

Name	Value or Value range/ Default	Description
Transparent SPA	The contents of a valid SPA request	Data type: Text Access: No limitations Makes it possible to communicate with SPA unit by sending SPA message and reading the reply as text in SPA format from this item. The communication is passed through a TCP/SPA tunnel, where this attribute acts as an independent TCP/SPA client and is connected to a TCP/SPA server. The TCP/SPA server is then responsible for forwarding the SPA messages to and from the SPA devices. The SPA/TCP client handles its own communication separately from other communication. No checks are done on command or reply contents they are simply passed on. This parameter is available only by configuration. This attribute must be enabled by setting the Transparent SPA Address. For example: SPA address = 1 SPA command RF must we written in format RF: and sent in format 1RF:. The reply is received in format >1D:REF543 :.

3.4. IEC 61850 File transfer

3.4.1. General information about IEC 61850 File Transfer

This section defines how the IEC 61850 file transfer services between the IEC 61850 OPC Server and the IEC 61850 devices are used through OPC DA. Since it is not possible to pass files through OPC, the IEC 61850 OPC Server is used as a file storage. The received and sent files are stored locally in the computer running the OPC server.

File transfer services are controlled by an OPC DA client through the OPC attributes under the IED\Attributes\File transfer node. For more information about the file transfer attributes, refer to 3.4.2, File Transfer attributes.

The supported file transfer services are GetFile, SetFile, DeleteFile, GetFileAttributes, GetFileAttributesEx, RenameFile, and Cancel. For more information about the file transfer services, refer to 3.4.3, File Transfer services.

Make sure that the devices support the file transfer services.

3.4.2. File Transfer attributes

Table 3.4.2-1 File transfer attributes

Name	Value or Value range/ Default	Description
Remote file name		Data type: Text Access: No limitations File name of the remote file.
Remote file directory		Data type: Text Access: No limitations File directory of the remote directory.
Local file name		Data type: Text Access: No limitations File name of the local file.
Local file directory		Data type: Text Access: No limitations File directory of the local directory.
File size in bytes		Data type: Text Access: No limitations The remote file’s size is received in bytes.

Name	Value or Value range/ Default	Description
Received bytes		Data type: Integer Access: No limitations Current remote file size is received in bytes. The IEC 61850 file transfer receives the file part by part in maximum size of the MMS messages. This attribute shows the size of the file that has been received. Value increases while the file transfer continues.
Status	1000 - 10000 For more information about valid status values, refer to 3.4.4, File Transfer service codes.	Data type: Integer Access: Read-only Status of the currently requested or last finished service.
Output		Data type: Text Access: Read-only The GetFileAttributeValues and GetFileAttributeValuesEx services print the requested file structure's output to this attribute. For more information about the output format, refer to 3.4.3, File Transfer services.
Control file reception	0 = Cancel 1 = GetFile 2 = GetFileAttributeValues 3 = GetFileAttributeValuesEx 4 = RenameFile 5 = SetFile 6 = DeleteFile	Data type: Text Access: Write-only This attribute controls the file transfer services. For more information about control codes for specific services, refer to 3.4.3, File Transfer services.

3.4.3. File Transfer services

The file transfer services are controlled through the OPC DA attributes, see Table 3.4.2-1. To initiate a service, first the required parameters are written to respective OPC attributes and then the service is started by writing the service control code to the file transfer control attribute.

The file transfer control attribute uses synchronous data access for OPC. When an OPC client writes a service request, the corresponding IEC 61850 file transfer service on the device is called. When the service is finished or an error occurs, the OPC request is released.

The status of the latest service is available in the Status attribute. After a service is started, the status changes to the specific service status code. If the service is completed successfully, the status code is set to Ready (see Table 3.4.4-2). For more information about service failure status codes, refer to Table 3.4.4-3 and Table 3.4.4-4. Only one service can be called at a time.

GetFile

You can copy a specified file from a remote device to the local file storage with the GetFile service. Through IEC 61850, this is done in three phases. First, the remote file is opened, then read, and finally closed. Remote file parameters identify the remote file. During this operation, the Status, Received bytes and File size in bytes attributes are updated as the file is moved (in max MMS message size parts). The copied file is renamed and placed to the local file storage according to local file parameters.

Required parameters:	Remote file name
	Remote file directory
	Local file name
	Local file directory
Control code:	1
Service status codes:	1100
	1120
	1140
Failure status codes:	91xx
The remote file name:	Remote file directory + Remote file name
The local file name:	Local file directory + Local file name

GetFileAttributeValues

The GetFileAttributeValues service obtains the name of a file or group of files in the remote file storage. Received file attributes are printed to the Output attribute. This service prints only file names.

Required parameters:	Remote file name
	Remote file directory
Control code:	2
Service status codes:	1200
Failure status codes:	92xx

The remote file or directory name: Remote file directory + Remote file name

To request file attributes for a remote directory, set parameter Remote file name to empty. For example, space and tabulator are accepted as empty parameter.

Output

The format of the result string is printed to the Output attribute in the following format:

```
{} = optional
filename1{, filename2{, filename3{...}}}
```

Example:

```
StdOut.txt
```

```
StdOut.txt, Eventlog.log, config.icd
```

GetFileAttributeValuesEx

The GetFileAttributeValuesEx service obtains the name and the attributes of a file or group of files in the remote file storage. Received file attributes are printed to the Output attribute. This service prints the file names, file sizes, and last modification dates if these are available.

Required parameters:	Remote file name
	Remote file directory
Control code:	3
Service status codes:	1300
Failure status codes:	93xx

The remote file or directory name: Remote file directory + Remote file name

To request file attributes for a remote directory, set parameter Remote file name to empty. For example, space and tabulator are accepted as empty parameter.

Output

The format of the result string is printed to the Output attribute in a following format:

```
{} = optional

filename1[size{;d.m.Y H:M:S}]{, filename2[size{;d.m.Y H:M:S}]

{ ,fn3[...]}}}
```

filename	= string
size	= bytes
d	= Day of month as decimal number (01 - 31)
m	= Month as decimal number (01 - 12)
Y	= Year with century, as decimal number
H	Hour in 24-hour format (00 - 23)
M	= Minute as decimal number (00 - 59)
S	= Second as decimal number (00 - 59)

Example:

```
StdOut.txt[12445;02.03.2004]

StdOut.txt[12445], Eventlog.log[53422], config.icd[2773]
```

RenameFile

You can rename or move a file in the remote file storage with the RenameFile service.

Required parameters:	Remote file name
	Remote file directory
	Local file name
	Local file directory
Control code:	4
Service status codes:	1400
Failure status codes:	94xx
The remote file name to be renamed:	Remote file directory + Remote file name
The new name for the remote file:	Local file directory + Local file name

SetFile

The SetFile service initiates the remote device to obtain a file from the local file storage to the remote file storage. The service triggers an IEC 61850 device to call the IEC 61850 clients GetFile service and during this, the IEC 61850 client acts as a file server. During this operation, the Status, Received bytes and File size in bytes attributes are updated as the file is moved (in max MMS message size parts). The local file parameters identify the local file and the copied file is placed to the remote file storage according to remote file parameters.

Required parameters:	Remote file name
	Remote file directory
	Local file name
	Local file directory
Control code:	5
Service status codes:	1500
	1520
	1540
	1560
Failure status codes:	94xx
The remote file name:	Remote file directory + Remote file name
The local file name:	Local file directory + Local file name

DeleteFile

You can delete a file from the remote file storage with the DeleteFile service.

Required parameters:	Remote file name
	Remote file directory
Control code:	6
Service status codes:	1600
Failure status codes:	96xx
The remote file name:	Remote file directory + Remote file name

Cancel

You can cancel the current service with the Cancel service. The Cancel service sets the status to Ready and clears for the following attribute values: File size in bytes, Received bytes and Status.

Control code: 0

3.4.4. File Transfer service codes

Status codes can be read from the Status attribute. The status indicates the current service status and the service result.

Table 3.4.4-1 Service control codes

0	Cancel
1	GetFile
2	GetFileAttributeValues
3	GetFileAttributeValuesEx
4	Rename File
5	SetFile
6	DeleteFile

In the service status codes, the first number indicates success (1) or failure (9). The second number indicates currently requested service (0 - 6). If a local service is requested in multiple parts for the remote device, the third number indicates the currently called remote service (1 - 3). The fourth number gives a detailed failure code (0 - 3).

Example:

9601 = parameters error, remote file delete error

9123 = remote service error, remote file read error

Table 3.4.4-2 Success

1000	Ready
1100	Opening remote file
1120	Reading remote file
1140	Closing remote file
1200	Requesting remote directory file details
1300	Requesting remote directory file details
1400	Renaming remote file
1500	Requesting remote device to obtain local file
1520	Remote device requested to open local file
1540	Remote device requested to read local file
1560	Remote device requested to close local file
1600	Deleting remote file
1000	Service done

The failure status code indicates a failure in requested service. The failure status code can also include a more detailed error code indicating the failure type, which can be local or remote failure (see Table 3.4.4-3).

Table 3.4.4-3 Failure

9000	Unspecified error
9100	Remote file open error
9120	Remote file read error
9140	Remote file close error
9200	Remote directory details error
9300	Remote directory details error
9400	Remote file rename error
9500	Error in remote obtaining local file
9520	Error in remote opening local file
9540	Error in remote reading local file
9560	Error in remote closing local file
9600	Remote file delete error

Table 3.4.4-4 Failure details

0	No error details
1	Service parameters error (user error) Reason: required name attribute is empty Recovery: check the attribute values and try again
2	Local service error (IEC 61850 OPC Server internal error) Reason: not connected, too much network traffic, and so on Recovery: check connection and try again
3	Remote service error (remote device error) Reason: remote device is not supporting service, wrong parameters, no such file, connection failed, and so on Recovery: check remote device services support, check parameters (file names), check connection and try again

3.5. ACSI conformance statement

3.5.1. General information about ACSI conformance statement

This section defines the compliance to IEC 61850 in terms of service, modeling, and engineering interfaces and gives detailed explanation of IEC 61850 capabilities of a product. ACSI conformance statement describes the abstract services interfaces, which are normally mapped to certain SCSM (Specific communication service mapping) and therefore indirectly stated in PICS (Protocol Implementation Conformance Statement).

3.5.2. ACSI basic conformance statement

Table 3.5.2-1 ACSI basic conformance statement

		Client/ Subscriber	Server/ Publisher	Value/ Comments
	Client-Server roles			
B11	**Server** side (of TWO-PARTY-APPLICATION-ASSOCIATION)	-	a	
B12	**Client** side of (TWO-PARTY-APPLICATION-ASSOCIATION)	a	-	Supported
	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	
B32	**Subscriber** side	O	-	Supported
	Transmission of sampled value model (SVC)			
B41	**Publisher** side	-	O	
B42	**Subscriber** side	O	-	Not supported

a. Will be M if support for LOGICAL DEVICE model has been declared.

3.5.3. ACSI models conformance statement

Table 3.5.3-1 ACSI models conformance statement

		Client/ Subscriber	Server/ Publisher	Value/ Comments
	Server (If B1 side supported)			
M1	**Logical device**	a	a	Supported

		Client/ Subscriber	Server/ Publisher	Value/ Comments
M2	**Logical node**	b	b	Supported
M3	**Data**	c	c	Supported
M4	**Data set**	d	d	Supported
M5	**Substitution**	O	O	Supported
M6	**Setting group control**	O	O	Supported (through Transparent XSAT)
	Reporting			
M7	**Buffered report control**	O	O	Supported
M7-1	sequence-number			
M7-2	report-time-stamp			
M7-3	reason-for-inclusion			
M7-4	data-set-name			
M7-5	data-reference			
M7-6	buffer-overflow			
M7-7	EntryID			
M7-8	BufTim			
M7-9	IntgPd			
M7-10	GI			
M8	**Unbuffered report control**	M	M	Supported
M8-1	sequence-number			
M8-2	report-time-stamp			
M8-3	reason-for-inclusion			
M8-4	data-set-name			
M8-5	data-reference			
M8-6	BufTim			
M8-7	IntgPd			
	Logging	**O**	**O**	Not supported
M9	**Log control**	**O**	**O**	Supported (through Transparent XSAT)
M9-1	IntgPd			
M10	**Log**	**O**	**O**	Not supported
M11	**Control**	**M**	**M**	Supported

		Client/ Subscriber	Server/ Publisher	Value/ Comments
	GSE (if B31/B32 is supported)			
	GOOSE	**O**	**O**	Supported
M12-1	EntryID			
M12-2	DataRefInc			
M13	**GSSE**	**O**	**O**	Not supported
	SVC (if 41/42 is supported)			
M14	Multicast SVC	**O**	**O**	Not supported
M15	Unicast SVC	**O**	**O**	Not supported
M16	**Time**	**M**	**M**	Supported (Time source with required accuracy will be available)
M17	**File transfer**	**O**	**O**	Supported

a. Will be M if support for LOGICAL NODE model has been declared.

b. Will be M if support for DATA model has been declared.

c. Will be M if support for DATA SET, Substitution, Report, Log Control, or Time model has been declared.

d. Will be M if support for Report, GSE, or SMV models has been declared.

3.5.4. ACSI service conformance statement

The ACSI service conformance statement is defined in Table 3.5.4-1 (depending on the statements in Table 3.5.2-1).

Table 3.5.4-1 ACSI service conformance statement

		AA: TP/MC	Client (C)	Server (S)	Comments
	Server				
S1	ServerDirectory	TP		M	
	Application Association				
S2	Associate		M	M	Supported
S3	Abort		M	M	Supported
S4	Release		M	M	Supported
	Logical device				

		AA: TP/MC	Client (C)	Server (S)	Comments
S5	LogicalDeviceDirectory	TP	M	M	Supported
	Logical node				
S6	LogicalNodeDirectory	TP	M	M	Supported
S7	GetAllDataValues	TP	O	M	Not supported
	Data				
S8	GetDataValues	TP	M	M	Supported
S9	SetDataValues	TP	O	O	Supported
S10	GetDataDirectory	TP	O	M	Supported
S11	GetDataDefinition	v	O	M	Supported
	Data set				
S12	GetDataSetValues	TP	O	M	Supported
S13	SetDataSetValues	TP	O	O	Not supported
S14	CreateDataSet	TP	O	O	Supported
S15	DeleteDataSet	TP	O	O	Not supported
S16	GetDataSetDirectory	TP	O	O	Supported
	Substitution				
S17	SetDataValues	TP	M	M	Supported
	Setting up control				
S18	SelectActiveSG	TP	O	O	Supported
S19	SelectEditSG	TP	O	O	Supported
S20	SetSGValues	TP	O	O	Supported (through Transparent XSAT)
S21	ConfirmEditSGValues	TP	O	O	Supported
S22	GetSGValues	TP	O	O	Supported (through Transparent XSAT)
S23	GetSGCBValues	TP	O	O	Supported
	Reporting				
	Buffered report control block (BRCB)				
S24	Report	TP	a	a	Supported
S24-1	data-change (dchg)				
S24-2	qchg-change (qchg)				
S24-3	data-update (dupd)				

		AA: TP/MC	Client (C)	Server (S)	Comments
S25	GetBRCBValues	TP	a	a	Supported
S26	SetBRCBValues	TP	a	a	Supported
	Unbuffered report control block (URBC)				
S27	Report	TP	a	a	Supported
S27-1	data-change (dchg)				
S27-2	qchg-change (qchg)				
S27-3	data-update (dupd)				
S28	GetURCBValues	TP	a	a	Supported
S29	SetURCBValues	TP	a	a	Supported
	Logging				
	Log control block				
S30	GetLCBValues	TP		M	Supported (through Transparent XSAT)
S31	SetLCBValues	TP		M	Supported (through Transparent XSAT)
	Log				
S32	QueryLogByTime	TP	b	M	Not supported
S33	QueryLogByEntry	TP	b	M	Not supported
S34	GetLogStatusValues	TP		M	Supported (through Transparent XSAT)
	Generic substation event model (GSE)				
	GOOSE-CONTROL-BLOCK				
S35	SendGOOSEMessage	MC	c	c	Not supported
S36	GetReference	TP	O	d	Not supported
S37	GetGOOSEElement-Number	TP	O	d	Not supported
S38	GetGoCBValues	TP	O	O	Supported
S39	SetGoCBValues	TP	O	O	Supported
S40	SendGSSEMessage	MC	c	c	Not supported
S41	GetReference	TP	O	d	Not supported

		AA: TP/MC	Client (C)	Server (S)	Comments
S42	GetGSSEElementNumber	TP	O	d	Not supported
S43	GetGsCBValues	TP	O	O	Supported (through Transparent XSAT)
S44	SetGsCBValues	TP	O	O	Supported (through Transparent XSAT)
	Transmission of sampled value model (SVC)				
	Multicast SVC				
S45	SendMSVMessage	MC	e	e	Not supported
S46	GetMSVCBValues	TP	O	O	Supported (through Transparent XSAT)
S47	SetMSVCBValues	TP	O	O	Supported (through Transparent XSAT)
	Unicast SVC				
S48	SendUSVMessage	TP	e	e	Not supported
S49	GetUSVCBValues	TP	O	O	Supported (through Transparent XSAT)
S50	SetUSVCBValues	TP	O	O	Supported (through Transparent XSAT)
	Control				
S51	Select		M	M	Supported
S52	SelectWithValue	TP	M	M	Supported
S53	Cancel	TP	O	M	Supported
S54	Operate	TP	M	M	Supported
S55	Command-Termination	TP	M	M	Supported
S56	TimeActivated-Operate	TP	O	O	Not supported
	File transfer				
S57	GetFile	TP	O	M	Supported

		AA: TP/MC	Client (C)	Server (S)	Comments
S58	SetFile	TP	O	O	Supported
S59	DeleteFile	TP	O	O	Supported
S60	GetFileAttributeValues	TP	O	M	Supported
	Time				
T1	Time resolution of internal clock				(nearest negative power of 2 in seconds)
T2	Time accuracy of internal clock			T0	
				T1	
				T2	
				T3	
				T4	
				T5	
T3	supported TimeStamp resolution			(nearest negative power of 2 in seconds)	

a. Will declare support for at least one (BRCB or URCB).

b. Will declare support for at least one (QueryLogByTime or QueryLogByEntry).

c. Will declare support for at least one (SendGOOSEMessage or SendGSSEMessage).

d. Will declare support if TP association is available.

e. Will declare support for at least one (SendMSVMessage or SendUSVMessage).

4. IEC 104 OPC server

4.1. About this section

This section provides reference information about the following issues:

- IEC 61850 data modeling
- Attributes
- Status codes

4.2. IEC 61850 data modeling

4.2.1. General information about IEC 61850 data modeling

The relationship between the IEC 61850 data modeling and IEC104 OPC Server is described in this section.

For each data class, there is a table giving a detailed description about the relation between the IEC104 data and IEC 61850 data object attributes and services. The tables also describe how the data is presented on the OPC Server name space.

The columns in the tables have the following content types:

- **Name** specifies the OPC item name of the attribute/service.
- **Type** specifies the IEC 61850 type of the attribute.
- **Value/ Value range** specifies the allowed values and ranges of the attribute/service.
- **Mandatory/Optional** specifies whether the attribute is considered as mandatory or optional according to the IEC 61850 standard.
- **IEC104 information element** specifies the IEC104 information element related to the attribute/service.
- **OPC data types** specify the OPC data type used for the OPC item.

4.2.2. Single point status (SPS)

Name	Type	Value/Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	BOOLEAN	TRUE | FALSE	M	SPI(0=ON, 1=OFF)	VT_BOOL
q	Quality		M	BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2a CP56Time2a	VT_DATE

4.2.3. Double point status (DPS)

DPS represents DMCD M_DP_NA_1, M_DP_TA_1, M_DP_TB_1.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	ENUMERATED	Intermediate-state (0) off (1) on (2) bad-state (3)	M	DPI	VT_I4
q	Quality		M	BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2a CP56Time2a	VT_DATE

4.2.4. Integer status (INS)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	INTEGER		M	NVA, COI	VT_I4
q	Quality		M	OV, BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2a CP56Time2a	VT_DATE

4.2.5. Enumerated Status (ENS)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	ENUMERATED		M	NVA, COI	VT_I4
q	Quality		M	OV, BL, SB, NT, IV	VT_I4
t	Timestamp		M	CP24Time2a CP56Time2a	VT_DATE
d	Description	Text	O		VT_BSTR

ENS represents DMCD M_ME_NA_1, M_ME_TA_1, M_ME_TD_1

4.2.6. Protection activation information (ACT)

ACT represents DMCD M_SP_NA_1, M_SP_TA_1, M_SP_TB_1, M_DP_NA_1, M_DP_TA_1, M_DP_TB_1.

Name	Type	Value/ Value range	Mandat-ory/Optional	Protocol information element	OPC data types
general	BOOLEAN		M	SPI	VT_BOOL
phsA	BOOLEAN		O	SPI	VT_BOOL
phsB	BOOLEAN		O	SPI	VT_BOOL
phsC	BOOLEAN		O	SPI	VT_BOOL
neut	BOOLEAN		O	SPI	VT_BOOL
q	Quality		M	EI, BL, SB, NT, IV	VT_I4

4.2.7. Directional protection activation information (ACD)

ACD represents M_SP_NA_1, M_SP_TA_1, M_SP_TB_1, M_DP_NA_1, M_DP_TA_1, M_DP_TB_1.

Name	Type	Value/ Value range	Mandat-ory/Optional	Protocol information element	OPC data types
general	BOOLEAN		M	SPI	VT_BOOL
dirGeneral	ENUMERATED	unknown forward backward	M		VT_I4
phsA	BOOLEAN		O	SPI	VT_BOOL
dirPhsA	ENUMERATED	unknown forward backward	O		VT_I4
phsB	BOOLEAN		O	SPI	VT_BOOL
dirPhsB	ENUMERATED	unknown forward backward	O		VT_I4
phsC	BOOLEAN		O	SPI	VT_BOOL
dirPhsC	ENUMERATED	unknown forward backward	O		VT_I4
neut	BOOLEAN		O	SPI	VT_BOOL

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
dirNeut	ENUMERATED	unknown forward backward	O		VT_I4
q	Quality		M	EI, BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2a, CP56Time2a	VT_DATE
d	Description	Text	O		VT_BSTR

4.2.8. Binary counter reading (BCR)

BCR represent DMCD M_IT_NA_1, M_IT_TA_1, M_IT_TB_1.

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
actVal	INTEGER		M	BCR	VT_I4
q	Quality		M	CY, CA, IV	VT_I4
t	TimeStamp		M	CP24Time2a CP56Time2a	VT_DATE
d	Description	Text	O		VT_BSTR

4.2.9. Measured value (MV)

MV represents DMCD M_ME_NA_1, M_ME_TA_1, M_ME_TD_1, M_ME_NB_1, M_ME_TB_1, M_ME_NC_1, M_ME_TC_1, M_ME_TF_1.

Name	Type	Value/ Value range	Mandat- ory/Optional	Protection inform- ation element	OPC data types
mag	AnalogueValue		M	SVA, NVA, IEEE STD 754	VT_R4
range	Range		O	L1, L2, L3, L4	VT_I4
q	Quality		M	OV, BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2a CP56Time2a	VT_DATE
hhLim	REAL		O		VT_R4
hLim	REAL		O		VT_R4
lLim	REAL		O		VT_R4
llLim	REAL		O		VT_R4

Name	Type	Value/ Value range	Mandatory/Optional	Protection information element	OPC data types
min	REAL		O		VT_R4
max	REAL		O		VT_R4
unit	SiUnit		O	Config	VT I4
d	Description	Text	O		VT_BSTR

4.2.10. Complex measured value (CMV)

CMV is configured in the same way as MV. The only difference is that instead of a ‘mag’ item, there is a ‘cVal’ node containing a ‘mag’ item.

4.2.11. WYE

WYE represent DMCD M_ME_NA_1, M_ME_TA_1, M_ME_TD_1, M_ME_NB_1, M_ME_TB_1, M_ME_NC_1, M_ME_TC_1, M_ME_TF_1.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
phsA.cVal.mag phsA.q phsA.t	AnalogueValue Quality TimeStamp		M M M	SVA, NVA OV, BL, SB, NT, IV CP24Time2A	VT_R4 VT_I4 VT_DATE
phsB.cVal.mag phsB.q phsB.t	AnalogueValue Quality TimeStamp		O O O	SVA, NVA OV, BL, SB, NT, IV CP24Time2A	VT_R4 VT_I4 VT_DATE
phsC.cVal.mag phsC.q phsC.t	AnalogueValue Quality TimeStamp		O O O	SVA, NVA OV, BL, SB, NT, IV CP24Time2A	VT_R4 VT_I4 VT_DATE
neut.cVal.mag neut.q neut.t	AnalogueValue Quality TimeStamp		O O O	SVA, NVA OV, BL, SB, NT, IV CP24Time2A	VT_R4 VT_I4 VT_DATE

4.2.12. Delta (DEL)

DEL represents DMCD M_ME_NA_1, M_ME_TA_1, M_ME_TD_1, M_ME_NB_1, M_ME_TB_1, M_ME_NC_1, M_ME_TC_1, M_ME_TF_1.

Name	Type	Value/ Value range	Mandat-ory/Optional	Protocol informa-tion element	OPC data types
phsAB. cVal.mag t	AnalogueValue		M	SVA, NVA	VT_R4
phsAB.q	Quality		M	OV, BL, SB, NT, IV	VT_I4
phsAB.t	TimeStamp		M	CP24Time2A	VT_DATE
phsBC.cVal.mag q	AnalogueValue		M	SVA, NVA	VT_R4
phsBC.q	Quality		M	OV, BL, SB, NT, IV	VT_I4
phsBC.t	TimeStamp		M	CP24Time2A	VT_DATE
phsCA.cVal.mag q	AnalogueValue		M	SVA, NVA	VT_R4
phsCA.q	Quality		M	OV, BL, SB, NT, IV	VT_I4
phsCA.t	TimeStamp		M	CP24Time2A	VT_DATE

4.2.13. Controllable single point (SPC)

SPC represents DMCD C_SC_NA_1, C_DC_NA_1, M_SP_NA_1, M_SP_TA_1, M_SP_TB_1, M_DP_NA_1, M_DP_TA_1, M_DP_TB_1.

Name	Type	Value/ Value range	Mandat-ory/Optional	Protocol informa-tion element	OPC data types
ctlVal	SPI		M	SCO	VT_BOOL
stVal		FALSE | TRUE	M	SPI	VT_BOOL
q	Quality		M	BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2A	VT_DATE
d	Description	Text	O		VT_BSTR

4.2.14. Controllable double point (DPC)

DPC represents DMCD C_SC_NA_1, C_DC_NA_1, M_SP_NA_1, M_SP_TA_1, M_SP_TB_1, M_DP_NA_1, M_DP_TA_1, M_DP_TB_1.

Name	Type	Value/ Value range	Mandat-ory/Optional	Protocol informa-tion element	OPC data types
ctlOperOn	SPI	FALSE | TRUE	O	SCO	VT_BOOL
ctlOperOff		FALSE | TRUE	O	SCO	VT_BOOL

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlSelOn		FALSE | TRUE	O	SCO	VT_BOOL
ctlSelOff		FALSE | TRUE	O	SCO	VT_BOOL
stVal	ENUMERATED	intermediate-state (0) off (1) on (2) bad-state (3)	M	DPI	VT_I4
q	Quality		M	BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24TIME2A	VT_DATE
ctlCan	BOOLEAN	FALSE | TRUE	O	SCO	VT_BOOL
stSeld	BOOLEAN	FALSE | TRUE	O	SPI	VT_BOOL

4.2.15. Controllable integer status (INC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	INTEGER		M	NVA	VT_I4
stVal	INTEGER		M	VAI32	VT_I4
q	Quality		M	BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24TIME2A	VT_DATE
d	Description	Text	O		VT_BSTR

4.2.16. Controllable Enumerated Status (ENC)

ENC represents DMCD M_ME_NA_1, M_ME_TA_1, M_ME_TD_1, M_ME_NB_1, M_ME_TB_1, C_SE_NA, C_SE_NB_1.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	ENUMERATED		M	NVA	VT_I4
stVal	ENUMERATED		M	VAI32	VT_I4
q	Quality		M	BT, SB, NT, IV	VT_I4
t	Timestamp		M	CP24Time2a	VT_DATE
d	Description	Text	O		VT_BSTR

4.2.17. Binary controlled step position information (BSC)

BSC represents DMCD M_ST_NA_1, M_ST_TA_1, M_ST_TB_1, M_RC_NA_1.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	ENUMERATED	stop (0) lower (1) higher (2) reserved (3)	M	RCO	VT_I1
valWTr	ValWithTrans		M	VTI	VT_I4
q	Quality		M	BL, SB, NT, IV	VT_I4
t	TimeStamp		M	CP24Time2a	VT_DATE
d	Description	Text	O		VT_BSTR

4.2.18. Integer controlled step position information (ISC)

ISC represents C_SE_NA_1, C_SE_NB_1, M_ST_NA_1, M_ST_TA_1, M_ST_TB_1.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	INTEGER	-64 ... 63	M	NVA	
valWTr	ValWithTrans		M	VTI	VT_I4
q	Quality		M	BL, SB, NT, IV	V_I4
t	TimeStamp		M	CP24TIME2A	V_DATE
d	Description	Text	O		VT_BSTR

4.2.19. Analogue set point (APC)

APC represents DMCD C_SE_NC_1.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	AnalogueValue		M		VT_R4

4.3. Status codes

4.3.1. Introduction

The following status codes are defined for the IEC 60870-5-104 master protocol. Some typical reasons for some of the status codes are also given.

4.3.2. Link layer status codes

17800	ITCP_REMOTE_HOST_CONTINUOUSLY_BUSY. Not used at the moment.
17801	ITCP_LINE_INITIALISING. Line status value before the initialisation of the TCP interface for the protocol is completed.
17802	ITCP_LINE_INITIALISATION_FAILED. Line status value when the initialisation of the TCP interface failed.
17803	ITCP_REMOTE_HOST_BUSY. Device status is set to this value when the data transfer is disabled due to received ‘stopdt’ frame.
17804	ITCP_REMOTE_HOST_NOT_RESPONDING. Device status is set to this value when the connection to a remote host is not established.
17805	ITCP_LINE_NOT_CONNECTED. Line status is set to this value when there is no connection to any configured host.
17806	ITCP_LINE_STOPPED. Line status value when the line is taken out of use.
17807	ITCP_RECEIVER_OUT_OF_BUFFERS. Internal error situation.
17808	ITCP_REMOTE_HOST_NOT_READY. Returned to SCIL in case there is no connection to the host.
17820	ITPC_ILLEGAL_ATTRIBUTE_VALUE. Returned to SCIL when the attribute value given is out of range.

4.3.3. Application layer status codes

13851	ICCC_INVALID_ATTRIBUTE_VALUE. The value set to an attribute of an IEC station is incorrect, for example, one of the elements of the vector written to the SD attribute is out of range.
13852	ICCC_INVALID_INDEX_RANGE. The index range used when accessing an attribute of an IEC station is incorrect.
13853	ICCC_INVALID_ATTRIBUTE. The STA object attribute used is not valid for the IEC slave protocol.
13854	ICCC_ASDU_TABLE_NOT_CREATED. Internal software error.
13855	ICCC_UNKNOWN_ASDU_NAME. The name of the ASDU written to the SD or EV attribute is not supported.
13856	ICCC_ASDU_QUEUE_FULL. No more events can be written to one of the queues by using the SD or EV attribute since the queue is full.

13857	ICCC_MESSAGE_BUFFER_FULL. Internal software error. The value of the ML attribute may be too small.
13858	ICCC_MESSAGE_FILLING_ERROR. Internal software error. The value of the ML attribute may be too small.
13859	ICCC_UNKNOWN_ASDU. The number of the ASDU written to the SD or EV attribute is not supported.
13860	ICCC_NO_ACTIVE_COMMAND. There is no preceding command with the given address when confirming a command by using the CF attribute. Either the address is incorrect or the command has not been received.
13861	ICCC_INVALID_QUEUE_NUMBER. The index of the SD or EV attribute is incorrect.
13862	ICCC_SC_DATA_OVERFLOW. Internal software error.
13863	ICCC_DEVICE_SUSPENDED. The IEC station is in the suspended state. The reason for this could be that the link is not properly established (for example, incorrect cable wiring) or the master does not respond.
13864	ICCC_MESSAGE_SENDING_ERROR. Internal software error. This may be the result of a problem in wiring or hardware.
13865	ICCC_REMOTE_DEVICE_REPLIES_WITH_NACK. The master did not accept the message but responded with a negative acknowledgment instead. Not used in the unbalanced mode.
13866	ICCC_LINK_NOT_READY. A message is sent to a line with a non-established communication.
13868	ICCC_OUT_OF_BUFFERS. Internal software error. Operation could not be completed since the buffer pool has run out of buffers.
13869	ICCC_DONT_REPLY. Internal software error.
13872	ICCC_DEVICE_STOPPED. The station has been set out of use by using the IU attribute.
13873	ICCC_NO_ADDRESS_IN_ACP. Internal software error.
13875	ICCC_UNEXPECTED_TYPE_IN_ACP. Internal software error.

4.4. Attributes

4.4.1. Server attributes

Table 4.4.1-1 IEC 104 OPC Server attributes

Property / Parameter	Value or Value range/ Default	Description
Protocol Stack Version	Value: Version information	The version information of the Protocol Stack.

4.4.2. Channel attributes

Table 4.4.2-1 Channel attributes

Property / Parameter	Value or Value range/ Default	Description
Basic		
In use	0 = Not in use, the channel communication is stopped. 1 = In use.	The state of the channel - whether it is in use or not. When a channel is not in use, no data can be transmitted on it, and no data is received from it. The channel attributes can be read as usual. Generally, a channel must be taken out of use by setting this attribute to 0 before the channel attributes can be written. When a channel is stopped by setting the In use attribute to 0, all data transmission on the channel ceases. However, before that, the protocol stack executes to the end all on-going data transactions. For example, the of the station in turn is completed.
Diagnostic Counters		
Transmitted telegrams		The number of transmitted data messages.
Failed transmissions		The number of failed transmissions.
Timeout errors		The number of transmitted commands.
Transmitted I format messages		The number of transmitted information messages.
Transmitted S format messages		The number of transmitted supervisory messages.
Transmitted U format messages		The number of transmitted unnumbered messages.
Received I format messages		The number of received information messages.
Received S format messages		The number of received supervisory messages.
Received U format messages		The number of received unnumbered messages.
Received messages		The number of received messages.
TCP Connect count		The count of TCP connect request.
TCP Accept count		The count of accepted TCP connect request.
TCP Close count		The count of closed TCP connection.

Property / Parameter	Value or Value range/ Default	Description
Duplicates and losses		The number of times duplicates and losses has occurred.
Buffer overflow errors		The number of times there as been a buffer overflow.

4.4.3. Device attributes

Table 4.4.3-1 Device attributes

Property / Parameter	Value or Value range/ Default	Description
Basic		
In use	0 = Out of use 1 = In use Default: 1	The operational status of the device - in use or out of use. Taking the device out of use with this attribute stops all data communication with the device. All operations that would result in a data exchange are disabled. The device itself is not affected by the attribute, only the protocol stack's image of the device. Setting In use to 1 is allowed only if the device address is legal.
Diagnostic Events Enabled	True = Diagnostic events enabled False = Diagnostic events disabled	This attribute enables or disables diagnostic events.
Status Information		
Connection Status	True = Device connection OK False = Device connection suspended.	Indicates the status of the device connection.

Property / Parameter	Value or Value range/ Default	Description
Detailed Status	When written: 1 = Re-transmit system message When read: A status code, e.g. 0 = OK (communication works properly) 13863 = Device suspended. For more information, see 4.3.2, Link layer status codes and 4.3.3, Application layer status codes.	Indicates the detailed information about the station device status. Setting Detailed Status of a device to 1 makes the protocol stack to re-transmit the last system message caused by the device. Possible 'Stopped' and 'Suspended' messages cause old marking of OPC items.
Diagnostic counters		
Suspensions		Indicates the number of times the connection has been suspended.
Transmitted Data Messages		The number of transmitted data messages.
Transmitted Command Messages		The number of transmitted command messages.
Transmitted Confirmation Messages		The number of transmitted confirmation messages.
Received Data Messages		The number of received data messages.
Received Command Messages		The number of received command messages.
Received Confirmation Messages		The number of received confirmation messages.
Received Unknown Messages		The number of unknown messages received.

5. DNP3 LAN/WAN OPC server

5.1. About this section

This section provides reference information about the following issues:

- IEC 61850 data modeling
- Attributes
- Status codes

5.2. IEC 61850 data modeling

5.2.1. General information about IEC 61850 data modeling

The relationship between the IEC 61850 data modeling and DNP LAN Slave OPC Client is described in this section.

For each data class, there is a table giving a detailed description about the relation between the DNP data and IEC 61850 data object attributes and services. The tables also describe how the data is presented on the OPC Server name space.

The columns in the tables have the following content types:

- **Name** specifies the OPC item name of the attribute/service.
- **Type** specifies the IEC 61850 type of the attribute.
- **Value/ Value range** specifies the allowed values and ranges of the attribute/service.
- **Mandatory/Optional** specifies whether the attribute is considered as mandatory or optional according to the IEC 61850 standard.
- **DNP information element** specifies the DNP information element related to the attribute/service.
- **OPC data types** specify the OPC data type used for the OPC item.

5.2.2. Single point status (SPS)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
stVal	BOOLEAN	TRUE | FALSE	M		VT_BOOL
q	Quality		M		VT_I4
t	TimeStamp		M		VT_DATE

5.2.3. Double point status (DPS)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
stVal	CPT	Intermediate-state (0) | off (1) | on (2) | bad-state (3)	M	state (0=OFF, 1=ON)	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp	Full Timestamp	M	<server provided if none> | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O		VT_BSTR

5.2.4. Integer status (INS)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
stVal	INTEGER		M	Current value	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.5. Enumerated Status (ENS)

Table 5.2.5-1 Enumerated Status (ENS)

Name	Type	Value/Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	ENUMERATED		M	Current value	VT_I4
q	Quality		M	DNP status	VT_I4
t	Timestamp		M	<server provided if none> | Time of occurrence	VT_DATE
d	Description	Text	O		VT_BSTR

5.2.6. Protection activation information (ACT)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
general	BOOLEAN		M	state (0=OFF, 1=ON)	VT_BOOL
phsA	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
phsB	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
phsC	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
neut	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
q	Quality		M	DNP status	VT_14
t	TimeStamp		M	<server provided if none> | Time of occurrence	VT_Date
d	Description	Text	O	-	VT_Date

5.2.7. Directional protection activation information (ACD)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
general	BOOLEAN		M	state (0=OFF, 1=ON)	VT_BOOL
phsA	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
phsB	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
phsC	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
neut	BOOLEAN		O	state (0=OFF, 1=ON)	VT_BOOL
q	Quality		M	DNP status	VT_14
t	TimeStamp		M	<server provided if none> | Time of occurrence| MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.8. Binary counter reading (BCR)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
actVal	INTEGER		M	Value | Frozen value | Current value	VT_I4
siUnit	Integer		O	Config	VT_14
multiplier	Integer		O	Config	VT_14
unit	Integer		O	Config	VT_BSTR
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence | MSCE	VT_DATE

5.2.9. Device name plate (DPL)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
vendor	VisibleString		M	-	VT_BSTR
hwRevision	VisibleString		O	-	VT_BSTR
swRevision	VisibleString		O	-	VT_BSTR
serNum	VisibleString		O	-	VT_BSTR
location	VisibleString		O	-	VT_BSTR

5.2.10. Logical node name plate (LPL)

Name	Type	Value/Value range	Mandatory/Optional	DNP information element	OPC data types
vendor	VisibleString		M	Separate signal	VT_BSTR
swRev	VisibleString		M	Separate signal	VT_BSTR
d	VisibleString		M	Separate signal	VT_BSTR

5.2.11. Measured value (MV)

Table 5.2.11-1 Measured value (MV) information

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
mag	AnalogueValue		M	Current value	VT_R4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	server provided if none | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR
hhLim	REAL		O	-	VT_R4
llLim	REAL		O	-	VT_R4
lLim	REAL		O	-	VT_R4
min	REAL		O	-	VT_R4
max	REAL		O	-	VT_R4
siUnit	Integer		O	Config	VT_I4
multiplier	Integer		O	Config	VT_I4
unit	String		O	Config	VT_BSTR
numOfDec	Integer		O	Config	VT_I4
range	Range		O	-	VT_I4

5.2.12. Complex measured value (CMV)

CMV is configured in the same way as MV.

5.2.13. WYE

Name	Type	Value/Value range	Mandatory/Optional	DNP information element	OPC data types
phsA. mag	AnalogueValue		M	Phase A Current Value	VT_R4
phsA.q	Quality		M	on-line, com lost	VT_I4
phsA.t	TimeStamp		M	–	VT_DATE
phsA.range	Range		O	Separate Signal	VT_I4
phsA.hhLim	REAL		O	Separate signal	VT_R4
phsA.hLim	REAL		O	Separate signal	VT_R4
phsA.lLim	REAL		O	Separate signal	VT_R4
phsA.llLim	REAL		O	Separate signal	VT_R4
phsA.min	REAL		O	Separate signal	VT_R4
phsA.max	REAL		O	Separate signal	VT_R4
phsA.siUnit	ENUMRATED		O	Separate signal	VT_I4
phsA.multiplier	ENUMERATED		O	Separate signal	VT_I4
phsA.unit	String		O	Separate signal	VT_BSTR
phsB. mag	AnalogueValue		O	Phase B Current Value	VT_R4
phsB.q	Quality		O	on-line, com lost	VT_I4
phsB.t	TimeStamp		O	–	VT_DATE
phsB.range	Range		O	Separate Signal	VT_I4
phsB.hhLim	REAL		O	Separate signal	VT_R4
phsB.hLim	REAL		O	Separate signal	VT_R4
phsB.lLim	REAL		O	Separate signal	VT_R4
phsB.llLim	REAL		O	Separate signal	VT_R4
phsB.min	REAL		O	Separate signal	VT_R4
phsB.max	REAL		O	Separate signal	VT_R4
phsB.siUnit	ENUMERATED		O	Separate signal	VT_I4
phsB.multiplier	ENUMERATED		O	Separate signal	VT_I4
phsB.unit	String		O	Separate signal	VT_BSTR

Name	Type	Value/Value range	Mandatory/Optional	DNP information element	OPC data types
phsC. mag	AnalogueValue		O	Phase C Current Value	VT_R4
phsC.q	Quality		O	on-line, com lost	VT_I4
phsC.t	TimeStamp		O	–	VT_DATE
phsC.range	Range		O	Separate Signal	VT_I4
phsC.hhLim	REAL		O	Separate signal	VT_R4
phsC.hLim	REAL		O	Separate signal	VT_R4
phsC.lLim	REAL		O	Separate signal	VT_R4
phsC.llLim	REAL		O	Separate signal	VT_R4
phsC.min	REAL		O	Separate signal	VT_R4
phsC.max	REAL		O	Separate signal	VT_R4
phsC.siUnit	ENUMERATED		O	Separate signal	VT_I4
phsC.multiplier	ENUMERATED		O	Separate signal	VT_I4
phsC.unit	String		O	Separate signal	VT_BSTR
neut. mag	AnalogueValue		O	Neutral Current Value	VT_R4
neut.q	Quality		O	on-line, com lost	VT_I4
neut.t	TimeStamp		O	-	VT_DATE
neut.range	Range		O	Separate Signal	VT_I4
neut.hhLim	REAL		O	Separate signal	VT_R4
neut.hLim	REAL		O	Separate signal	VT_R4
neut.lLim	REAL		O	Separate signal	VT_R4
neut.llLim	REAL		O	Separate signal	VT_R4
neut.min	REAL		O	Separate signal	VT_R4
neut.max	REAL		O	Separate signal	VT_R4
neut.siUnit	ENUMERATED		O	Separate signal	VT_I4
neut.multiplier	ENUMERATED		O	Separate signal	VT_I4
neut.unit	String		O	Separate signal	VT_BSTR
d	Description		O	Separate signal	VT_BSTR

Name	Type	Value/Value range	Mandatory/Optional	DNP information element	OPC data types
net.mag	AnalogValue		M	Net current value	VT_R4
net.q	Quality		M	Online, com lost	VT_R4
net.t	Timestamp		M	-	VT_DATE
net.range	Range		O	Separate Signal	VT_R4
net.hhLim	REAL		O	Separate Signal	VT_R4
net.hLim	REAL		O	Separate Signal	VT_R4
net.lLim	REAL		O	Separate Signal	VT_R4
net.llLim	REAL		O	Separate Signal	VT_R4
net.min	REAL		O	Separate Signal	VT_R4
net.max	REAL		O	Separate Signal	VT_R4
net.siUnit	ENUMERATED		O	Separate Signal	VT_R4
net.multiplier	ENUMERATED		O	Separate Signal	VT_R4
net.unit	String		O	Separate Signal	VT_BSTR
res.mag	AnalogValue		M	Res current value	VT_R4
res.q	Quality		M	Online, com lost	VT_R4
res.t	Timestamp		M	-	VT_DATE
res.range	Range		O	Separate Signal	VT_R4
res.hhLim	REAL		O	Separate Signal	VT_R4
res.hLim	REAL		O	Separate Signal	VT_R4
res.lLim	REAL		O	Separate Signal	VT_R4
res.llLim	REAL		O	Separate Signal	VT_R4
res.min	REAL		O	Separate Signal	VT_R4
res.max	REAL		O	Separate Signal	VT_R4
res.siUnit	ENUMERATED		O	Separate Signal	VT_R4
res.multiplier	ENUMERATED		O	Separate Signal	VT_R4
res.unit	String		O	Separate Signal	VT_BSTR

5.2.14. Delta (DEL)

Name	Type	Value/Value range	Mandatory/Optional	DNP information element	OPC data types
phsAB. mag	AnalogueValue		M	Phase AB Current Value	VT_R4
phsAB.q	Quality		M	on-line, com lost	VT_I4
phsAB.t	TimeStamp		M	server provided if none	VT_DATE
phsAB.range	Range		O	Separate Signal	VT_I4
phsAB.hhLim	REAL		O	Separate signal	VT_R4
phsAB.hLim	REAL		O	Separate signal	VT_R4
phsAB.lLim	REAL		O	Separate signal	VT_R4
phsAB.llLim	REAL		O	Separate signal	VT_R4
phsAB.min	REAL		O	Separate signal	VT_R4
phsAB.max	REAL		O	Separate signal	VT_R4
phsAB.siUnit	ENUMRATED		O	Separate signal	VT_I4
phsAB.multiplier	ENUMERATED		O	Separate signal	VT_I4
phsAB.unit	String		O	Separate signal	VT_BSTR
phsBC. mag	AnalogueValue		O	Phase BC Current Value	VT_R4
phsBC.q	Quality		O	on-line, com lost	VT_I4
phsBC.t	TimeStamp		O	-	VT_DATE
phsBC.range	Range		O	Separate Signal	VT_I4
phsBC.hhLim	REAL		O	Separate signal	VT_R4
phsBC.hLim	REAL		O	Separate signal	VT_R4
phsBC.lLim	REAL		O	Separate signal	VT_R4
phsBC.llLim	REAL		O	Separate signal	VT_R4
phsBC.min	REAL		O	Separate signal	VT_R4
phsBC.max	REAL		O	Separate signal	VT_R4
phsBC.siUnit	ENUMERATED		O	Separate signal	VT_I4
phsBC.multiplier	ENUMERATED		O	Separate signal	VT_I4
phsBC.unit	String		O	Separate signal	VT_BSTR

Name	Type	Value/Value range	Mandatory/Optional	DNP information element	OPC data types
phsCA. mag	AnalogueValue		O	Phase CA Current Value	VT_R4
phsCA.q	Quality		O	on-line, com lost	VT_I4
phsCA.t	TimeStamp		O	-	VT_DATE
phsCA.range	Range		O	Separate Signal	VT_I4
phsCA.hhLim	REAL		O	Separate signal	VT_R4
phsCA.hLim	REAL		O	Separate signal	VT_R4
phsCA.lLim	REAL		O	Separate signal	VT_R4
phsCA.llLim	REAL		O	Separate signal	VT_R4
phsCA.min	REAL		O	Separate signal	VT_R4
phsCA.max	REAL		O	Separate signal	VT_R4
phsCA.siUnit	ENUMERATED		O	Separate signal	VT_I4
phsCA.multiplier	ENUMERATED		O	Separate signal	VT_I4
phsCA.unit	String		O	Separate signal	VT_BSTR
d	Description		O	Separate signal	VT_BSTR

5.2.15. Controllable single point (SPC)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
ctVal	BOOLEAN	FALSE | TRUE	M	Control Code	VT_BOOL
stVal	BOOLEAN	FALSE | TRUE	M	State (0:OFF, 1:ON)	VT_BOOL
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.16. Controllable double point (DPC)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
stVal	BOOLEAN	FALSE | TRUE	M	State (0:OFF, 1:ON)	VT_BOOL
ctlOperOn	BOOLEAN	FALSE | TRUE	O	Control Code	VT_BOOL
ctlOperOff	BOOLEAN	FALSE | TRUE	O	Control Code	VT_BOOL
ctlSelOn	BOOLEAN	FALSE | TRUE	O	Control Code	VT_BOOL
ctlSelOff	BOOLEAN	FALSE | TRUE	O	Control Code	VT_BOOL
ctlCan	BOOLEAN	FALSE | TRUE	O	-	VT_BOOL
stSelt	BOOLEAN	FALSE | TRUE	O	Control Code	VT_BOOL
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.17. Controllable integer status (INC)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
ctlVal	INTEGER	-	M	Control Code	VT_I4
stVal	BOOLEAN	FALSE | TRUE	M	Current Value	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.18. Controllable Enumerated Status (ENC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	ENUMERATED		M	Control Value	VT_I4
stVal	ENUMERATED		M	Current value	VT_I4
q	Quality		M	DNP status	VT_I4

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
t	Timestamp		M	<none> | Time of occurrence	VT_DATE
d	Description		O		VT_BSTR

5.2.19. Binary controlled step position information (BSC)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
ctlVal	ENUMERATED	stop (0) | lower (1) | higher (2) | reserved (3)	M	Control Code	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.20. Integer controlled step position information (ISC)

Name	Type	Value/Value range	Mandatory/Optional	DNP data object field	OPC data types
ctlVal	INTEGER	-64 … 63	M	Control Code	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<server provided if none> | Time of occurrence | MSEC	VT_DATE
d	Description	Text	O	-	VT_BSTR

5.2.21. Analogue set point (APC)

Name	Type	Value / Value range	Mandatory / Optional	Protocol information element	OPC data types
ctlVal	AnalogueValue		M	Control Value	VT_R4
mxVal	AnalogueValue		M	Current value	VT_R4

q	Quality		M	DNP status	VT_I4
t	Timestamp		M	<none> | Time of occurrence	VT_DATE
d	Description		O		VT_BSTR

6. MODBUS TCP server

6.1. About this section

This section provides reference information about the following issues:
- IEC 61850 data modeling
- Attributes
- Status codes

6.2. IEC 61850 data modeling

6.2.1. General information about IEC 61850 data modeling

The relationship between the IEC 61850 data modeling and Modbus OPC Server is described in this section.

For each data class, there is a table giving a detailed description about the relation between the Modbus data and IEC 61850 data object attributes and services. The tables also describe how the data is presented on the OPC Server name space.

The columns in the tables have the following content types:
- **Name** specifies the OPC item name of the attribute/service.
- **Type** specifies the IEC 61850 type of the attribute.
- **Value/ Value range** specifies the allowed values and ranges of the attribute/service.
- **Mandatory/Optional** specifies whether the attribute is considered as mandatory or optional according to the IEC 61850 standard.
- **OPC data types** specify the OPC data type used for the OPC item.

6.2.2. Data objects for status information

6.2.2.1. Single point status (SPS)

Table 6.2.2.1-1 Single point status (SPS) information

Name	Type	Value/ Value range	Mandatory /Optional	Protocol information element	OPC data types
stVal	BOOLEAN	TRUE | FALSE	M	0x, 1x, 3x, 4x	VT_BOOL
q	Quality		M	generated by OPC Server	VT_I4
t	TimeStamp		M	generated by OPC Server	VT_DATE

Name	Type	Value/ Value range	Mandatory /Optional	Protocol information element	OPC data types
d	Description	Text	O	-	VT_BSTR

6.2.2.2. Double point status (DPS)

Table 6.2.2.2-1 Double point status (DPS) information

Name	Type	Value/ Value range	Mandatory/ Optional	Protocol information element	OPC data types
stVal	CPT	Intermediate-state (0) optional off(1) on(2) bad-state (3) optional	M	0x, 1x, 3x, 4x	VT_I4
q	Quality		M	generated by OPC Server	VT_I4
t	TimeStamp		M	generated by OPC Server	VT_DATE
d	Description	Text	O		VT_BSTR

6.2.2.3. Integer status (INS)

Table 6.2.2.3-1 Integer status (INS) information

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	INTEGER		M	3x, 4x	VT_I4
q	Quality		M	generated by OPC Server	VT_I4
t	TimeStamp		M	generated by OPC Server	VT_DATE
d	Description	Text	O		VT_BSTR

6.2.2.4. Enumerated Status (ENS)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	ENUMERATED		M		

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
q	Quality		M		VT_I4
t	Timestamp		M		VT_DATE
d	Description	Text	O		VT_BSTR

6.2.2.5. Protection activation information (ACT)

Modbus value	Value from stack	OPC/IEC 61850 value
0: OFF	0: OFF	FALSE
1: ON	1: ON	TRUE

Table 6.2.2.5-1 Proptection activation information (ACT)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
general	BOOLEAN		M	0x, 1x	VT_BOOL
phsA	BOOLEAN		O	0x, 1x	VT_BOOL
phsB	BOOLEAN		O	0x, 1x	VT_BOOL
phsC	BOOLEAN		O	0x, 1x	VT_BOOL
neut	BOOLEAN		O	0x, 1x	VT_BOOL
t	TimeStamp		M	generated by OPC Server	
d	Description	Text	O	Separate signal	VT_BSTR

6.2.2.6. Binary counter reading (BCR)

BCR information is obtained from any valid Modbus register. Consult the Modbus protocol document for the register address and if they are available for each relay.

Table 6.2.2.6-1 Binary counter reading (BCR) information

Name	Type	Value/ Value range	Mandatory/Optional	Modbus register	OPC data types
actVal	INTEGER		M	3x, 4x	VT_I4
siUnit	Integer		O	Config	VT_I4
multiplier	Integer		O	Config	VT_I4
unit	String		O	Config	VT_BSTR
q	Quality		M	generated by OPC Server	VT_I4

Name	Type	Value/ Value range	Mandatory/Optional	Modbus register	OPC data types
t	TimeStamp		M	generated by OPC Server	VT_DATE
d	Description	Text	O		VT_BSTR

6.2.2.7. Device name plate (DPL)

Table 6.2.2.7-1 Device name plate (DPL) information

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
vendor	VisibleString		M	Internal config	VT_BSTR
hwRev	VisibleString		O	Internal config	VT_BSTR
swRev	VisibleString		O	Internal config	VT_BSTR
serNum	VisibleString		O	Internal config	VT_BSTR
location	VisibleString		O	Internal config	VT_BSTR

6.2.2.8. Logical node name plate (LPL)

Information numbers 2 - 5 are received for identification data.

Table 6.2.2.8-1 Logical node name plate (LPL) information

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
vendor	VisibleString		M	Internal config	VT_BSTR
swRev	VisibleString		O	Internal config	VT_BSTR
d	VisibleString		O	Internal config	VT_BSTR

6.2.3. Data objects for measured information

6.2.3.1. Measured value (MV)

Table 6.2.3.1-1 Measured value

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
mag	AnalogueValue		M	3x, 4x register	VT_R4
range	Range		O	Separate Signal	VT_I4

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
q	Quality		M	generated by OPC Server	VT_I4
t	TimeStamp		M	generated by OPC Server	VT_DATE
d	Description	Text	O	Internal config	VT_BSTR
hhLim	REAL		O	Internal config	VT_R4
hlim	REAL		O	Internal config	VT_R4
llLim	REAL		O	Internal config	VT_R4
lLim	REAL		O	Internal config	VT_R4
min	REAL		O	Internal config	VT_R4
max	REAL		O	Internal config	VT_R4
siUnit	Integer		O	Internal config	VT_I4
multiplier	Integer		O	Internal config	VT_I4
unit	String		O	Internal config	VT_BSTR
numOfDec	Integer		O	Internal config	VT_I4

6.2.3.2. WYE

WYE values are extracted using the same method as MV.

Table 6.2.3.2-1 WYE

Name	Type	Value/ Value range	M/O	Protocol information element	OPC data types
phsA.mag	AnalogueValue		M	3x, 4x	VT_R4
phsA.ang	AnalogueValue		M	3x, 4x	VT_R4
phsA.q	Quality		M	set by OPC server	VT_I4
phsA.t	TimeStamp		M	set by OPC server	VT_DATE
phsA.range	Range		O	Internal config	VT_I4
phsA.hhLim	REAL		O	Internal config	VT_R4
phsA.hLim	REAL		O	Internal config	VT_R4
phsA.lLim	REAL		O	Internal config	VT_R4
phsA.llLim	REAL		O	Internal config	VT_R4
phsA.min	REAL		O	Internal config	VT_R4
phsA.max	REAL		O	Internal config	VT_R4
phsA.siUnit	ENUMRATED		O	Internal config	VT_I4

Name	Type	Value/ Value range	M/O	Protocol information element	OPC data types
phsA.multiplier	ENUMERATED		O	Internal config	VT_I4
phsA.unit	String		O	Internal config	VT_BSTR
phsB.mag	AnalogueValue		O	3x, 4x	VT_R4
	AnalogueValue		O	3x, 4x	VT_R4
phsB.q	Quality		O	set by OPC server	VT_I4
phsB.t	TimeStamp		O	set by OPC server	VT_DATE
phsB.range	Range		O	Internal config	VT_I4
phsB.hhLim	REAL		O	Internal config	VT_R4
phsB.hLim	REAL		O	Internal config	VT_R4
phsB.lLim	REAL		O	Internal config	VT_R4
phsB.llLim	REAL		O	Internal config	VT_R4
phsB.min	REAL		O	Internal config	VT_R4
phsB.max	REAL		O	Internal config	VT_R4
phsB.siUnit	ENUMRATED		O	Internal config	VT_I4
phsB.multiplier	ENUMERATED		O	Internal config	VT_I4
phsB.unit	String		O	Internal config	VT_BSTR
phsC.mag	AnalogueValue		O	3x, 4x	VT_R4
phsC.ang	AnalogueValue		O	3x, 4x	VT_R4
phsC.q	Quality		O	set by OPC server	VT_I4
phsC.t	TimeStamp		O	set by OPC server	VT_DATE
phsC.range	Range		O	Internal config	VT_I4
phsC.hhLim	REAL		O	Internal config	VT_R4
phsC.hLim	REAL		O	Internal config	VT_R4
phsC.lLim	REAL		O	Internal config	VT_R4
phsC.llLim	REAL		O	Internal config	VT_R4
phsC.min	REAL		O	Internal config	VT_R4
phsC.max	REAL		O	Internal config	VT_R4
phsC.siUnit	ENUMRATED		O	Internal config	VT_I4
phsC.multiplier	ENUMERATED		O	Internal config	VT_I4
phsC.unit	String		O	Internal config	VT_BSTR
neut.mag	AnalogueValue		O	3x, 4x	VT_R4
neut.ang	AnalogueValue		O	3x, 4x	VT_R4
neut.q	Quality		O	set by OPC server	VT_I4

Name	Type	Value/ Value range	M/O	Protocol information element	OPC data types
neut.t	TimeStamp		O		VT_DATE
neut.range	Range		O	Internal config	VT_I4
neut.hhLim	REAL		O	Internal config	VT_R4
neut.hLim	REAL		O	Internal config	VT_R4
neut.lLim	REAL		O	Internal config	VT_R4
neut.llLim	REAL		O	Internal config	VT_R4
neut.min	REAL		O	Internal config	VT_R4
neut.max	REAL		O	Internal config	VT_R4
neut.siUnit	ENUMRATED		O	Internal config	VT_I4
neut.multiplier	ENUMERATED		O	Internal config	VT_I4
neut.unit	String		O	Internal config	VT_BSTR
d	Description		O	Internal config	VT_BSTR

6.2.3.3. Delta (DEL)

DEL values are extracted using the same method as MV.

Table 6.2.3.3-1 Delta

Name	Type	Value/ Value range	M/O	Modbus register	OPC data types
phsAB.mag	AnalogueValue		M	3x, 4x register	VT_R4
phsAB.ang	AnalogueValue		M	3x, 4x register	VT_R4
phsAB.q	Quality		M	set by OPC server	VT_I4
phsAB.t	TimeStamp		M	set by OPC server	VT_DATE
phsAB.range	Range		O	Internal config	VT_I4
phsAB.hhLim	REAL		O	Internal config	VT_R4
phsAB.hLim	REAL		O	Internal config	VT_R4
phsAB.lLim	REAL		O	Internal config	VT_R4
phsAB.llLim	REAL		O	Internal config	VT_R4
phsAB.min	REAL		O	Internal config	VT_R4
phsAB.max	REAL		O	Internal config	VT_R4
phsAB.siUnit	ENUMRATED		O	Internal config	VT_I4
phsAB.multiplier	ENUMERATED		O	Internal config	VT_I4
phsAB.unit	String		O	Internal config	VT_BSTR

Name	Type	Value/ Value range	M/O	Modbus register	OPC data types
phsBC.mag	AnalogueValue		M	3x, 4x register	VT_R4
phsBC.ang	AnalogueValue		M	3x, 4x register	VT_R4
phsBC.q	Quality		M	set by OPC server	VT_I4
phsBC.t	TimeStamp		M	set by OPC server	VT_DATE
phsBC.range	Range		O	Internal config	VT_I4
phsBC.hhLim	REAL		O	Internal config	VT_R4
phsBC.hLim	REAL		O	Internal config	VT_R4
phsBC.lLim	REAL		O	Internal config	VT_R4
phsBC.llLim	REAL		O	Internal config	VT_R4
phsBC.min	REAL		O	Internal config	VT_R4
phsBC.max	REAL		O	Internal config	VT_R4
phsBC.siUnit	ENUMRATED		O	Internal config	VT_I4
phsBC.multiplier	ENUMERATED		O	Internal config	VT_I4
phsBC.unit	String		O	Internal config	VT_BSTR
phsCA.mag	AnalogueValue		M	3x, 4x register	VT_R4
phsCA.ang	AnalogueValue		M	3x, 4x register	VT_R4
phsCA.q	Quality		M	set by OPC server	VT_I4
phsCA.t	TimeStamp		M	set by OPC server	VT_DATE
phsCA.range	Range		O	Internal config	VT_I4
phsCA.hhLim	REAL		O	Internal config	VT_R4
phsCA.hLim	REAL		O	Internal config	VT_R4
phsCA.lLim	REAL		O	Internal config	VT_R4
phsCA.llLim	REAL		O	Internal config	VT_R4
phsCA.min	REAL		O	Internal config	VT_R4
phsCA.max	REAL		O	Internal config	VT_R4
phsCA.siUnit	ENUMRATED		O	Internal config	VT_I4
phsCA.multiplier	ENUMERATED		O	Internal config	VT_I4
phsCA.unit	String		O	Internal config	VT_BSTR
d	Description	Text	O	Internal config	VT_BSTR

6.2.4. Data objects for controllable status information

6.2.4.1. Controllable single point (SPC)

The command sequence for controlling points is specific to each relay. In the 2000 R products, for example, SPC is implemented using a bit mask.

TRUE/FALSE values are sent with 1 and 0 values.

Underlying protocol converter stack uses Motorola convention in binary value usage. Used OPC Server sees OFF data with value 0 and ON data with value 1 from stack.

Modbus value	Value from stack	OPC/IEC 61850 value
0 (OFF default)	0:OFF	FALSE
1 (ON default)	1:ON	TRUE

Name	Type	Value / Value range	M/O		OPC Data Type
ctlVal	BOOLEAN	FALSE | TRUE	M	0x, 4x	VT_BOOL
stVal	BOOLEAN	FALSE | TRUE a>	M	0x, 1x, 3x, 4x	VT_BOOL
q	Quality		M	generated by OPC Server	VT_I4
t	TimeStamp		M	generated by OPC Server	VT_DATE
d	Description	Text	O	Internal config	VT_BSTR

6.2.4.2. Controllable double point (DPC)

Table 6.2.4.2-1 Controllable double point

Name	SCO	Value / Value Range	M/O	Modbus information element	OPC Data Types
ctlOperOn	SPI	FALSE|TRUE	O	0x, 4x	VT_BOOL
ctlOperOff		FALSE|TRUE	O	0x, 4x	VT_BOOL
ctlSelOn		FALSE|TRUE	O	0x, 4x	VT_BOOL
ctlSelOff		FALSE|TRUE	O	0x, 4x	VT_BOOL
stVal	CPT	Intermediate-state (0) | off (1) | on (2) | bad-state (3)	M	0x, 1x, 3x, 4x	VT_I4
q	Quality		M	4x register	VT_I4

Name	SCO	Value / Value Range	M/O	Modbus information element	OPC Data Types
t	TimeStamp		M	generated by OPC Server	VT_DATE
ctlCan	BOOLEAN	FALSE|TRUE	O	0x, 4x	VT_BOOL
stSeld	BOOLEAN	FALSE|TRUE	O	generated by OPC Server	VT_BOOL
d	Description	Text	O	Separate signal	VT_BSTR

6.2.4.3. Controllable integer status (INC)

Table 6.2.4.3-1 Controllable integer status (INC) information

Name	Type	Value/ Value range	Mandatory/Optional	Modbus register	OPC data types
ctlVal	INTEGER		M	4x	VT_I4
stVal	INTEGER		M	3x, 4x	VT_I4
q	Quality		M	Generated by OPC server	VT_I4
t	TimeStamp		M	Generated by OPC server	VT_DATE
d	Description	Text	O	Internal config	VT_BSTR

6.2.4.4. Controllable Enumerated Status (ENC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	ENUMERATED		M	4x	VT_I4
stVal	ENUMERATED		M	3x, 4x	VT_I4
q	Quality		M	generated by OPC server	VT_I4
t	Timestamp		M	generated by OPC server	VT_DATE
d	Description	Text	O		VT_BSTR

6.2.4.5. Binary controlled step position information (BSC)

Table 6.2.4.5-1 Binary controlled step position information (BSC)

Name	Type	Value/ Value range	M/O	Modbus register	OPC data types
ctlVal	ENUMERATED	stop (0) | lower (1) | higher (2) | reserved (3)	M	0x	VT_I1
valWTr	ValWithTrans		M	3x, 4x	
q	Quality		M	Generated by OPC server	VT_I4
t	TimeStamp		M	Generated by OPC server	VT_DATE
d	Description	Text	O	Internal config	VT_BSTR

6.2.4.6. Integer controlled step position information (ISC)

Table 6.2.4.6-1 Integer controlled step position information (ISC)

Name	Type	Value/ Value range	Mandatory/Optional	Modbus register	OPC data types
ctlVal	INTEGER	-64 ... 63	M	4x	VT_I1
valWTr	ValWithTrans		M	3x, 4x	VT_I4
q	Quality		M	Generated by OPC server	VT_I4
t	TimeStamp		M	Generated by OPC server or INC copy	VT_DATE
d	Description	Text	O	Internal config	VT_BSTR

6.2.5. Data objects for controllable analogue information

6.2.5.1. Analogue set point (APC)

Table 6.2.5.1-1 Analogue set point (APC) information

Name	Type	Value/ Value range	Mandatory/Optional	Modbus register	OPC data types
spMag	INTEGER		M	4x	VT_REAL
q	Quality		M	Generated by OPC server	VT_I4

Name	Type	Value/ Value range	Mandatory/Optional	Modbus register	OPC data types
t	TimeStamp		M	Generated by OPC server	VT_DATE
d	Description	Text	O	Internal config	VT_BSTR

6.3. Attributes

6.3.1. Server attributes

Table 6.3.1-1 Server attributes

Name	Value or Value range/ Default	Description
Protocol stack version	Value: Version information	Data type: Text Access: Read-only Version information of the protocol stack
Reset		The **Reset** button for resetting the OPC Server
File version		File version of the executable OPC Server
Product version		Version information of the installed OPC Server

6.3.2. Modbus channel attributes

Table 6.3.2-1 Modbus channel attributes

Name	Value or Value range/ Default	Description
In use	0 = Not in use, the line communication is stopped 1 = In use Default: 1	Data type: Integer Access: No limitations The state of the line - whether it is in use or not. When a line is not in use, no data can be transmitted on it, and no data is received from it. The line attributes can be read as usual. Generally, a line must be taken out of use by setting this attribute to 0 before the line attributes can be written. When a line is stopped by setting the IU attribute = 0, all data transmission on the line ceases. However, before that, the protocol stack executes to the end all on-going data transactions. For example, the polling of the station in turn is completed.
Diagnostic counters(TCP channel)		Data type: Integer Access: Read-only
Transmitted telegrams		The number of transmitted telegrams.
Failed transmissions		Incremented each time a message transmission to the Modbus channel fails for some reason.
Transmitted commands		The number of transmitted commands.
Transmitted replies		The number of transmitted replies.
Received messages		Incremented each time the Modbus OPC Server receives a message from the Modbus channel.
Buffer overflow errors		The number of times there has been a buffer overflow.
TCP connect		Number of TCP connection requests.
TCP accept		Number of accepted TCP connection requests

Name	Value or Value range/ Default	Description
TCP close		Number of TCP connection close requests

6.3.3. Modbus Device attributes

Table 6.3.3-1 Modbus device attributes

Name	Value or Value range/ Default	Description
In use	0 = Out of use 1 = In use Default: 1	Data type: Integer Access: No limitations The operational status of the device - in use or out of use. Taking the device out of use with this attribute stops all data communication with the device. All operations that would result in data exchange are disabled. The device itself is not affected by the attribute, only the protocol stack's image of the device. Setting IU to 1 is allowed only if the device address is legal.
Object status	1 = Re-transmit system message A status code, for example: 0 = OK (communication works properly) 13801 = Device suspended	Data type: Integer Access: No limitations Indicates the detailed information about the station device status. Writing to the OS attribute (OS = 1) of a device makes the protocol stack to re-transmit the last system message caused by the device. Possible "Stopped" and "Suspended" messages cause old marking of OPC items. By reading the OS attribute, the status code of the system message can be read. See the *Status Codes* manual for detailed information.
Device connection status	True = Device connection OK False = Device connection suspended	Data type: Boolean Access: Read-only Indicates the status of the device connection.

Name	Value or Value range/ Default	Description
Suspension counter		Indicates the number of times the connection has been suspended.
Transmitted poll messages		The number of transmitted poll messages.
Transmitted command messages		The number of transmitted command messages.
Received update messages		The number of received update messages.
Received exception messages		The number of received exception messages.
Received event messages		Incremented each time a Modbus event message is received.
Command errors		The number of times a command error has occurred.

6.4. Status codes

6.4.1. Status codes

13800	PLCP_IN_INITIALIZE_DB_STATE
13801	PLCP_DEVICE_SUSPENDED
13802	PLCP_STOPPED
13803	PLCP_STARTTED
13804	PLCC_MESSAGE_FILLING_ERROR
13805	PLCC_INVALID_OBJECT_TYPE
13806	PLCC_INVALID_ADDRESS
13807	PLCC_INVALID_DATA
13808	PLCC_INVALID_OBJECT_INDEX
13809	PLCC_NOT_IMPLENTED_FUNCTION
13810	PLCC_NOT_EXPECTED_FUNCTION_CODE_FROM_PLC
13811	PLCC_ILLEGAL_PLC_FUNCTION
13812	PLCC_ILLEGAL_PLC_DATA_ADDRESS
13813	PLCC_ILLEGAL_PLC_DATA_VALUE
13814	PLCC_SLAVE_DEVICE_FAILURE
13815	PLCC_ACKNOWLEDGE
13816	PLCC_SLAVE_DEVICE_BUSY

13817	PLCC_NEGATIVE_ACKNOWLEDGE
13818	PLCC_MEMORY_PARITY_ERROR
13819	PLCC_UNKNOWN_DIAGNOSTIC_COUNTER
13820	PLCC_INVALID_TOPIC_NUMBER
13821	PLCC_INVALID_OBJECT_ADDRESS
13822	PLCC_INVALID_OBJECT_FORMAT
13823	PLCC_SC_DATA_OVERFLOW
13824	PLCC_INVALID_INDEX_RANGE
13825	PLCC_UNKNOWN_ATTRIBUTE
13826	PLCC_LOCAL_RESPONSE
13827	PLCP_TIMEOUT_WHILE_WAITING_RESPONSE
13828	PLCP_EVENT_BUFFER_OK
13829	PLCP_EVENT_BUFFER_OVERFLOW
13830	PLCP_EVENT_BUFFER_ERROR
13831	PLCC_UNKNOWN_FUNCTION
13832	PLCC_NO_ADDITIONAL_DATA_AVAILABLE
13833	PLCC_INVALID_ATTRIBUTE_VALUE
13834	PLCC_INTERNAL_ERROR

7. Redundant OPC server

7.1. Introduction

The Redundant OPC server allows the user to have Redundant IED objects, where each Redundant IED object encapsulates the data of two source IED objects with identical data object configuration.

One of the source IEDs is set as the active source of the Redundant IED, which will then act as if it was that source IED. The Redundant IED forwards indication and measurement data from the active source IED, and sends received commands to it.

It's possible for the user to switch the active source between the two source IEDs on demand, for example when the currently active source IED loses connection or have some other mishap, or is simply taken down for maintenance.

The source OPC server and IEDs are required to follow the common IEC-61850 data object model used in COM600, otherwise there are no limitations. There is special support in SAB600 for making redundant configurations with SSC600, though.

7.2. Redundant OPC Server Properties

Table 7.2-1 Redundant OPC Server Properties

Redundant OPC Server	Default	Description
Caption		
Description		
Use Remote Node Names	**False**	Enables the use of remote node names

7.3. Redundant Subnet Properties

Redundant Subnet	Default	Description
Caption		
Description		
In Use	**In Use** Not In Use	Controls if the device communication is initially in use or not

7.4. Redundant IED Properties

Redundant IED	Default	Description
Caption		
Description		
Diagnostics Enabled	**False** True	Specifies whether diagnostics are enabled.
In Use	**In Use** Not In Use	Specifies whether IED is in use or not.
Simulation Mode	**False** True	Defines whether IED is used in simulation mode.
Source 1		
Source 1 IED Path		OPC item path for source 1 IED
Source 1 ProgID		ProgID of source 1 OPC Server
Source 1 Remote Node Name	**localhost**	Remote node name of source 1
Source 1 Server Initialization Time	**0**(0-65535)	Initialization time for source 1 OPC Server
Source 1 Tree Delimiter	\	Tree delimiter of source 1 OPC Server
Source 2		
Source 2 IED Path		OPC item path for source 2 IED
Source 2 ProgID		ProgID of source 2 OPC Server
Source 2 Remote Node Name	**localhost**	Remote node name of source 2
Source 2 Server Initialization Time	**0**(0-65535)	Initialization time for source 2 OPC Server
Source 2 Tree Delimiter	\	Tree delimiter of source 2 OPC Server
Active Source		
Active Source Default	**0**(0-1)	Default value for active source. Value 0 refers to Source 1 and Value 1 refers to Source 2.
Active Source Event Class	**ActiveSourceSwitch**	Event reference for active source switch
Active Source Refresh Interval	**0** (0-65535)	Refresh interval for active source indication
Active Source Input Signal		

Redundant IED	**Default**	**Description**
Active Source Input Initialization Time	**0** (0-65535)	Initialization time in seconds for OPC server containing active source input signal
Active Source Input Item Path		OPC Item path for active source external input signal
Active Source Input ProgID		ProgID for OPC server containing the active source input signal.
Active Source Input Remote Node name	**localhost**	Remote node name for OPC server containing the active source input signal
Active Source Input Scale		Scale for active source input signal
Consistency Checking		
Consistency Change Quality	**True** False	Specifies whether the quality of the data is changed (downgraded) when consistency check fails
Consistency Checking Enabled	**False** True	Enables consistency checking.
Consistency Compare Value For	**ACT,ACD,SPC,DPC**	By default, compare value for the specified CDCs.
Consistency Compare Value-Quality For		By default, compare value and quality for the specified CDCs.
Consistency Compare Value-Quality-Timestamp For		By default, compare value, quality and time for the specified CDCs.
Consistency Default Time Epsilon	**20**	The default timestamp epsilon in milliseconds.
Consistency Event Severity	**500**(0-65535)	The severity of generated consistency failure events.
Consistency Generate Substation	**True** False	Specifies if the generated consistency failure events targets the substation structure or not.
Consistency Minimum Check Age	900	The minimum time in seconds that must elapse before a new update can be checked.
Consistency Status Alarm Class	**ConsistencyStatus**	The alarm/event definition to use for failed consistency checking status. Will be activated when there is inconsistent data.
Alarm and Event		

Redundant IED	**Default**	**Description**
Device Connection Status Class	**Device Connection Status**	Device Connection Status

7.5. Redundant Data Object Properties

Common		
Data Object Path		OPC source path for the date object. Can be left empty if the source IEDs use same namespace structure as the Redundant IED.
SubType	**REDUNDANT**	Object subtype
Update Rate	**0** (0-65535)	Defines how often the value is updated.
Consistency Checking Mode	Disabled Compare value Compare value and quality Compare value, quality and timestamp **Use CDC default mode**	Consistency checking mode for this data object.
Consistency Checking Time Epsilon	**0** (0-65535)	The largest time difference in milliseconds allowed before two time stamps are considered inconsistent. Will use the default time epsilon value configured in the IED when zero.
ACD/ACT		
Mapped Event for Phase A/B/C/general/neut		Indication event mapping
Indication Scale (A/B/C/general/neut)		Scale for phase signal
DPS/ENS/INS/SPS/BCR		
Indication Event		Mapped event for indication signal.
Indication Scale		Scale for Indication signal.
ENC/INC/SPC		
Command Event		Command event mapping

Common		
Indication Event		Indication event mapping
Indication Scale		Scale for indication
Control Scale		Scale for control
DPC		
Command Event		Command event mapping
Indication Event		Indication event mapping
Control Scale (Cancel/Operate Off/Operate On/Select Off/Select On)		Scale for control SBO
Measurements		
Consistency Checking Mode	Disabled Compare value Compare value and quality **Use CDC default mode**	Consistency checking mode for this data object.
Consistency Checking Value Epsilon	**0.5** (0-65535)	The largest value difference allowed before two values are considered inconsistent. Only checks the raw values without taking unit and multiplier into account.
SEQ/DEL/WYE/CMV		
Mapped Event for (Phase name)		Mapped event for phase signal
Indication Scale (Phase name ang/mag)		Indication scale for phase signal
MV		
Indication Event		Mapped event for indication signal.
Indication Scale		Indication scale.

Appendix 1

Interoperability list for IEC104 OPC Server

☐	Not supported
■	Supported
▩	Supported, may need additional engineering

This companion standard presents sets of parameters and alternatives from which subsets must be selected to implement particular tele control systems. Certain parameter values, such as the choice of “structured“ or “unstructured“ fields of the Information Object Address (IOA) of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information types in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for the applications. This clause summarizes the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers, it is necessary that all partners agree on the selected parameters.

The interoperability list is defined as in the IEC 60870-5-104 protocol and extended with parameters used in this standard. The text descriptions of parameters which are not applicable to this companion standard are struck out (the corresponding check box is marked black).

The full specification of a system can require individual selection of certain parameters for certain parts of the system, for example, individual selection of scaling factors for individually addressable measured values.

Application layer telegram formats

☐	Function or ASDU is not used
☒	Function or ASDU is used as standardized (default)
R	Function or ASDU is used in reverse mode
B	Function or ASDU is used in standard and reverse mode
A	Function or ASDU can need some additional application level work

The possible selection (blank, X, R, B or A) is specified for each specific clause or parameter. A black check box indicates that the option cannot be selected in this companion standard.

Device function (system-specific parameter)

☐ System definition

☒ Controlling station (Master)

☐ Controlled station (Slave)

Network configuration (network-specific parameter)

■ ~~Point to point~~	■ ~~Multipoint partyline~~
■ ~~Multiple point to point~~	■ ~~Multipoint star~~

Physical layer (network-specific parameter)

Transmission speed (control direction)

Unbalanced interchange circuit V.24/V.28 Standard	Unbalanced interchange circuit V.24/V.28 Recommended if > 1200 bit/s	Balanced interchange circuit X.24/X.27
■ ~~400 bit/s~~	■ ~~2400 bit/s~~	■ ~~2400 bit/s~~
■ ~~200 bit/s~~	■ ~~4800 bit/s~~	■ ~~4800 bit/s~~
■ ~~300 bit/s~~	■ ~~9600 bit/s~~	■ ~~9600 bit/s~~
■ ~~600 bit/s~~		■ ~~19200 bit/s~~
■ ~~4200 bit/s~~		■ ~~38400 bit/s~~
		■ ~~56000 bit/s~~
		■ ~~64000 bit/s~~

Transmission speed (monitor direction)

Unbalanced interchange circuit V.24/V.28 Standard	**Unbalanced interchange circuit V.24/V.28 Recommended if > 1200 bit/s**	**Balanced interchange circuit X.24/X.27**
■ ~~400 bit/s~~	■ ~~2400 bit/s~~	■ ~~2400 bit/s~~
■ ~~200 bit/s~~	■ ~~4800 bit/s~~	■ ~~4800 bit/s~~
■ ~~300 bit/s~~	■ ~~9600 bit/s~~	■ ~~9600 bit/s~~
■ ~~600 bit/s~~		■ ~~19200 bit/s~~
■ ~~4200 bit/s~~		■ ~~38400 bit/s~~
		■ ~~56000 bit/s~~
		■ ~~64000 bit/s~~

Link layer (network-specific parameter)

~~Frame format FT 1.2, signel character 1 and the fixed time out interval are used exclusively in this companion standard.~~

Link transmission procedure	Address field of the link
■ ~~Balanced transmission~~	■ ~~not present (balanced transmission only)~~
■ ~~Unbalanced transmission~~	■ ~~One octet~~
	■ ~~Two octet~~
Frame length	■ structured
■ Maximum length L (number of octets)	■ unstructured

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

■ ~~The standard assignment of ASDUs to class 2 messages is used as follows:~~

Type identification	~~**Cause of transmission**~~
9, 11, 13, 21	<1>

■ ~~A special assignment of ASDUs to class 2 messages is used as follows:~~

Type identification	~~**Cause of transmission**~~

Application layer

Transmission mode for application data

Mode 1 (the least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU (system-specific parameter)

■	~~One octet~~	☒	~~Two octets~~

Information object address (system-specific parameter)

■	~~One octet~~	☐	structured
■	~~Two octets~~	☐	unstructured
☒	~~Three octets~~		

Cause of transmission (system-specific parameter)

■	~~One octet~~	☒	Two octets (with originator address)

Length of APDU (system-specific parameter)

The maximum length of the APDU is 253 (default). The maximum length can be reduced per system.

253	Maximum length of APDU per system

Selection of standard ASDUs

Process information in monitor direction (station-specific parameter)

☒	<1>	:=Single-point information	M_SP_NA_1
■	~~<2>~~	~~:=Single-point information with time tag~~	~~M_SP_TA_1~~
☒	<3>	:=Double-point information	M_DP_NA_1
■	~~<4>~~	~~:=Double-point information with time tag~~	~~M_DP_TA_1~~
☒	<5>	:=Step position information	M_ST_NA_1

■	~~<6>~~	~~:=Step position information with time tag~~	~~M_ST_TA_1~~
A	<7>	:=Bitstring of 32 bit	M_BO_NA_1
■	~~<8>~~	~~:=Bitstring of 32 bit with time tag~~	~~M_BO_TA_1~~
☒	<9>	:=Measured value, normalized value	M_ME_NA_1
■	~~<10>~~	~~:=Measured value, normalized value with time tag~~	~~M_ME_TA_1~~
☒	<11>	:=Measured value, scaled value	M_ME_NB_1
■	~~<12>~~	~~:=Measured value, scaled value with time tag~~	~~M_ME_TB_1~~
☒	<13>	:=Measured value, short floating point value	M_ME_NC_1
■	~~<14>~~	~~:=Measured value, short floating point value with time tag~~	~~M_ME_TC_1~~
☒	<15>	:=Integrated totals	M_IT_NA_1
■	~~<16>~~	~~:=Integrated totals with time tag~~	~~M_IT_TA_1~~
☐	~~<17>~~	~~:=Event of protection equipment with time tag~~	~~M_EP_TA1~~
■	~~<18>~~	~~:=Packed start events of protection equipment with time tag~~	~~M_EP_TB1~~
■	~~<19>~~	~~:=Packed output circuit information of protection equipment with time tag~~	~~M_EP_TC_1~~
☐	<20>	:=Packed single point information with time tag	M_PS_NA_1
☐	<21>	:=Measured value, normalized value without quality descriptor	M_ME_ND_1
☒	<30>	:=Single-point information with time tag CP56Time2a	M_SP_TB_1
☒	<31>	:=Double-point information with time tag CP56Time2a	M_DP_TB_1
☒	<32>	:=Step position information with time tag CP56Time2a	M_ST_TB_1
☐	<33>	:=Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
☒	<34>	:=Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
☐	<35>	:=Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
☒	<36>	:=Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
☒	<37>	:=Integrated totals with time tag CP56Time2a	M_IT_TB_1
☐	<38>	:=Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
☐	<39>	:=Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1

☐	<40>	:=Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

Either the ASDUs of the set <2>, <4>, <6>, <8>, <10>, <12>, <14>, <16>, <17>, <18>, <19> or of the set <30> - <40> are used.

Process information in control direction (station-specific parameter)

☒	<45>	:=Single command	C_SC_NA_1
☒	<46>	:=Double command	C_DC_NA_1
☒	<47>	:=Regulating step command	C_RC_NA_1
☒	<48>	:=Set point command, normalized value	C_SE_NA_1
☒	<49>	:=Set point command, scaled value	C_SC_NB_1
☒	<50>	:=Set point command, short float point value	C_SC_NC_1
A	<51>	:=Bitstring of 32 bit	C_BO_NA_1
☐	<58>	:=Single command with time tag CP56Time2a	C_SC_TA_1
☐	<59>	:=Double command with time tag CP56Time2a	C_DC_TA_1
☐	<60>	:=Regulating step command with time tag CP56Time2a	C_RC_TA_1
☐	<61>	:=Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1
☐	<62>	:=Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
☐	<63>	:=Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1
☐	<64>	:=Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1

Either the ASDUs of the set <45> - <51> or of the set <58> - <64> are used.

System information in monitor direction (station-specific parameter)

☒	<70>	:=End of initialization	M _EI_NA_1

System information in control direction (station-specific parameter)

☒	<100>	:=Interrogation command	C_IC_NA_1
☐	<101>	:=Counter interrogation command	C_CI_NA_1
☐	<102>	:=Read command	C_RD_NA_1
☒	<103>	:=Clock synchronization command	C_CS_NA_1
■	~~<104>~~	~~:=Test command~~	~~C_TS_NA_1~~
☐	<105>	:=Reset process command	C_RP_NA_1
■	~~<106>~~	~~:=Delay acquisition command~~	~~C_CD_NA_1~~
☐	<107>	:=Test command with time tag CP56Time2a	C_TS_TA_1

Parameter in control direction (station-specific parameter)

☐	<110>	:=Parameter of measured value, normalized value	P_ME_NA_1
☐	<111>	:=Parameter of measured value, scaled value	P_ME_NB_1
☐	<112>	:=Parameter of measured value, short floating point value	P_ME_NC_1
☐	<113>	:=Parameter activation	P_AC_NA_1

File transfer (station-specific parameter)

☐	<120>	:=File ready	F_FR_NA_1
☐	<121>	:=Section ready	F_SR_NA_1
☐	<122>	:=Call directory, select file, call file, call section	F_SC_NA_1
☐	<123>	:=Last section, last segment	F_LS_NA_1
☐	<124>	:=Ack file, ack section	F_AF_NA_1
☐	<125>	:=Segment	F_SG_NA_1
☐	<126>	:=Directory (blank or X, only available in monitor (standard) direction)	F_DR_TA_1

Type identifier and cause of transmission assignments (station-specific parameters)

- Shaded boxes are not required
- Black boxes are not permitted in this companion standard
- Blank = Function or ASDU is not used
- Mark Type identification/Cause of transmission combinations:

- **‘X’** if supported only in the standard direction
- **‘R’** if supported only in the reverse direction
- **‘B’** if supported in both directions

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 10 36	37 10 41	44	45	46	47
<1>	M_SP_NA_1		X	X		X						X	X		X					
~~<2>~~	~~M_SP_TA_1~~																			
<3>	M_DP_NA_1		X	X		X						X	X		X					
~~<4>~~	~~M_DP_TA_1~~																			
<5>	M_ST_NA_1		X	X		X						X	X							
~~<6>~~	~~M_ST_TA_1~~																			
<7>	M_BO_NA_1																			
~~<8>~~	~~M_BO_TA_1~~																			
<9>	M_ME_NA_1	X	X	X		X									X					
~~<10>~~	~~M_ME_TA_1~~																			
<11>	M_ME_NB_1	X	X	X		X									X					
~~<12>~~	~~M_ME_TB_1~~																			
<13>	M_ME_NC_1	X	X	X		X									X					
~~<14>~~	~~M_ME_TC_1~~																			
<15>	M_IT_NA_1			X												X				
~~<16>~~	~~M_IT_TA_1~~																			
~~<17>~~	~~M_EP_TA_1~~																			
~~<18>~~	~~M_EP_TB_1~~																			
~~<19>~~	~~M_EP_TC_1~~																			
<20>	M_PS_NA_1																			
<21>	M_ME_ND_1																			
<30>	M_SP_TB_1			X		X						X	X							
<31>	M_DP_TB_1			X		X						X	X							
<32>	M_ST_TB_1			X		X						X	X							
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														
<36>	M_ME_TF_1			X		X														
<37>	M_IT_TB_1			X												X				
<38>	M_EP_TD_1																			
<39>	M_EP_TE_1																			
<40>	M_EP_TF_1																			
<45>	C_SC_NA_1						X	X	X	X	X						X	X	X	X

Type identification		Cause of transmission																		
<46>	C_DC_NA_1						X	X	X	X	X						X	X	X	X
<47>	C_RC_NA_1						X	X	X	X	X						X	X	X	X
<48>	C_SE_NA_1						X	X	X	X	X						X	X	X	X
<49>	C_SE_NB_1						X	X	X	X	X						X	X	X	X
<50>	C_SE_NC_1						X	X	X	X	X						X	X	X	X
<51>	C_BO_NA_1																			
<58>	C_SC_TA_1																			
<59>	C_DC_TA_1																			
<60>	C_RC_TA_1																			
<61>	C_SE_TA_1																			
<62>	C_SE_TB_1																			
<63>	C_SE_TC_1																			
<64>	C_BO_TA_1																			
<70>	M_EI_NA_1[a]				X															
<100>	C_IC_NA_1						X	X	X	X	X									
<101>	C_CI_NA_1																			
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1			X			X	X												
~~<104>~~	~~C_TS_NA_1~~																			
<105>	C_RP_NA_1																			
~~<106>~~	~~C_CD_NA_1~~																			
<107>	C_TS_TA_1																			
<110>	P_ME_NA_1																			
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<113>	P_AC_NA_1																			
<120>	F_FR_NA_1																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_DR_TA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA[b]																			

a. blank or X only
b. blank or X only

Basic application functions

Station limitations (station-specific parameter)

☐ Remote initialization

An indication ASDU “Controlling Station Initialized” sent to the Controlled Station is not used.

Cyclic data transmission (station-specific parameter)

☐ Cyclic data transmission

Read procedure (station-specific parameter)

☐ Read procedure

Spontaneous transmission (station-specific parameter)

☐ Spontaneous transmission

Double transmission of information objects with cause of spontaneous transmission (station-specific parameter)

The following type identifications can be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

☐ Single-point information M_SP_NA1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1

☐ Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1

☐ Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1

☐ Bitstring of 32 bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)

☐ Measured value, normalized value M_ME_NA_2, M_ME_TA_1, M_ME_ND_ 1 and M_ME_TD_1

☐ Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1

☐ Measured value, short floating point number M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station interrogation (system parameter or station-specific parameter)

☒ global

☐	group 1	☐	group 7	☐	group 13
☐	group 2	☐	group 8	☐	group 14
☐	group 3	☐	group 9	☐	group 15
☐	group 4	☐	group 10	☐	group 16
☐	group 5	☐	group 11		
☐	group 6	☐	group 12		

Clock synchronization (station-specific parameter)

☒ Clock synchronization

Command transmission (object-specific parameter)

☒ Direct command transmission

☒ Direct set point command transmission

☒ Select and execute command

☒ Select and execute set point command

☒ C_SE ACTTERM used

☒ No additional information

☐ Short pulse duration (duration determined by a system parameter in the outstation)

☐ Long pulse duration (duration determined by a system parameter in the outstation)

☐ Persistent output

☒ Supervision of maximum delay in command direction of commands and set point commands.

255 s Maximum allowable delay of commands and set point commands

Transmission of integrated totals (station parameter or object-specific parameter)

- ☐ Mode A: Local freeze with spontaneous transmission
- ☐ Mode B: Local freeze with counter interrogation
- ☐ Mode C: Freeze and transmit by counter interrogation commands
- ☐ Mode D: Freeze by counter interrogation command, frozen values reported spontaneously
- ☐ Counter read
- ☐ Counter freeze without reset
- ☐ Counter freeze with reset
- ☐ Counter reset
- ☐ General request counter
- ☐ Request counter group 1
- ☐ Request counter group 2
- ☐ Request counter group 3
- ☐ Request counter group 4

Define addresses per group.

Parameter loading (object-specific parameter)

- ☐ Threshold value
- ☐ Smoothing factor
- ☐ Low limit for transmission of measured value
- ☐ High limit for transmission measured value

Parameter activation (object-specific parameter)

- ☐ Act / deact of persistent cyclic or periodic transmission of the addressed object

Test procedure (object-specific parameter)

☒ Test procedure

File transfer (station-specific parameter)

File transfer in monitor direction

☐ Transparent file

☐ Transmission of disturbance data of protection equipment

☐ Transmission of sequences of events

☐ Transmission of sequences of recorded analogue values

File transfer in control direction

☐ Transparent file

Background scan (station-specific parameter)

☐ Background scan

Acquisition of transmission delay (station-specific parameter)

■ ~~Acquisition of transmission delay~~

Definition of time-outs

Parameter	~~**Default value**~~	**Remarks**	~~**Selected value**~~
t_0	30 s	Time-out of connection establishment	1 - 255 s
t_1	15 s	Time-out of send or test APDUs	1 - 255 s
t_2	10 s	Time-out for acknowledges in case of no data messages t2 < t1	1 - 255 s
t_3	20	Time-out for sending test frames in case of a long idle state	1 - 255 s

Maximum range of values for all the time-outs: 1 seconds to 255 seconds , accuracy 1 s.

Maximum number of outstanding I format APDUs (k) and the latest acknowledgment (w)

Parameter	~~Default value~~	Remarks	~~Selected value~~
k	12 APDU	Maximum difference receive sequence number to send state variable	1-32767 s
w	8 APDUs	Latest acknowledgment after receiving w I-format APDUs	1-32767 s

Maximum range of values k: 1 to 32767 (215-1) APDUs, accuracy 1 APDU.

Maximum range of values w: 1 to 32767 APDUs, accuracy 1 APDU

(Recommendation: w should not exceed 2/3 of k).

Port number

Parameter	~~Default value~~	Remarks
Port number	2404	In all cases

RFC 2200 suite

RFC 2200 is an official Internet standard which describes the state of standardization of protocols used on the Internet as determined by the Internet Architecture Board (IAB). It offers a broad spectrum of actual standards used in the Internet. The suitable selection of documents from RFC 2200 defined in this standard for given projects must be chosen by the user of this standard.

- [x] Ethernet 802.3
- [ ] Serial X.21 interface
- [ ] Other selection RFC 2200:

List of valid documents from RFC 2200

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. and so on

Appendix 2

Device profile

Table A2-1 The device profile describing the implementation of the DNP 3.0 master protocol in COM600

DNP 3.0 **DEVICE PROFILE DOCUMENT**	
Vendor Name: ABB Oy Distribution Automation	
Device Name: COM600 3.4	
Highest DNP Level Supported: For Requests: Subset Level 2 For Responses: Subset Level 2	Device Function: [x] Master [ ] Slave
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): Additions to level 2 are shaded in the accompanying implementation tables.	
Maximum Data Link Frame Size (octets):	**Maximum Application Fragment Size (octets):**
Transmitted: <292 Received: (must be 292)	Transmitted: <250 (Single fragments only) Received : 2048
Maximum Data Link Re-tries:	**Maximum Application Layer Re-tries:**
[ ] None [ ] Fixed at ________________________	[ ] None [ ] [x] Configurable, range 0 to 5, IED Application Message Retries property

Requires Data Link Layer Confirmation:
[ ] Never [ ] Always [ ] Sometimes. If 'Sometimes', when? ____ [x] Configurable, Channel Link Layer Confirmations Enabled property
Requires Application Layer Confirmation:

Requires Data Link Layer Confirmation:
[ ] Never [ ] Always (not recommended) [ ] When reporting Event Data (Slave devices only) [ ] When sending multi-fragment responses (Slave devices only) [ ] Sometimes. If 'Sometimes', when? ____ [x] Configurable, Process Data Confirmation IED property
Timeouts while waiting for:
Data Link Confirm [ ] None [ ] Fixed at _________ [ ] Variable [x] Configurable, Channel Header Timeout
Complete Appl. Fragment [ ] None [ ] Fixed at _________ [ ] Variable [x] Configurable, IED Transport Timeout, Reply Timeout
Application Confirm [ ] None [ ] Fixed at _________ [ ] Variable [x] Configurable, CT IED Confirmation Timeout
Complete Appl. Response [ ] None [ ] Fixed at _________ [ ] Variable [x] Configurable, AT IED Application Timeout
Others: Complete data link frame: Channel Response Timeout Response to a request: IED Reply Timeout, Application Response Timeout
Sends/Executes Control Operations:
WRITE Binary Outputs [x] Never [ ] Always [ ] Sometimes [ ] Configurable
SELECT/OPERATE [ ] Never [ ] Always [ ] Sometimes [x] Configurable
DIRECT OPERATE [ ] Never [ ] Always [ ] Sometimes [x] Configurable
DIRECT OPERATE - NO ACK [ ] Never [ ] Always [ ] Sometimes [x] Configurable
Count > 1 [x] Never [ ] Always [ ] Sometimes [ ] Configurable
Pulse On [ ] Never [ ] Always [ ] Sometimes [x] Configurable

Requires Data Link Layer Confirmation:
Pulse Off [ ] Never [ ] Always [ ] Sometimes [x] Configurable
Latch On [ ] Never [ ] Always [ ] Sometimes [x] Configurable
Latch Off [ ] Never [ ] Always [ ] Sometimes [x] Configurable
Queue [x] Never [ ] Always [ ] Sometimes [ ] Configurable
Clear Queue [x] Never [ ] Always [ ] Sometimes [ ] Configurable
FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:
Expects Binary Input Change Events:
[x] Either time-tagged or non-time-tagged for a single event [ ] Both time-tagged and non-time-tagged for a single event [ ] Configurable (attach explanation)

Supported function codes

Table A2-2 Supported function codes (= CO attribute is needed)*

Code	Function	Description	Supported
		Transfer Function Codes	
0	Confirm	Message fragment confirmation No response	Yes
1	Read	Request objects from outstation Respond with requested objects	Yes
2	Write	Store the specified objects to outstation Respond with status of operation	Yes
		Control Function Codes	
3	Select	Select the output point of outstation Respond with status of control point	Yes
4	Operate	Set the output that has previously been selected Respond with status of control point	Yes

Code	Function	Description	Supported
5	Direct operate	Set the output directly Respond with status of control point	Yes
6	Direct operate - no ack	Set the output directly No respond	Yes
		Freeze Function Codes	
7	Immediate Freeze	Copy the specified objects to freeze buffer Respond with status of operation	Yes
8	Immediate Freeze -no ack	Copy the specified objects to freeze buffer No respond	Yes
9	Freeze and Clear	Copy the specified objects to freeze buffer and clear objects Respond with status of operation	Yes
10	Freeze and Clear - no ack	Copy the specified objects to freeze buffer and clear objects No respond	Yes
11	Freeze with time	Copy the specified objects to freeze buffer at specified time Respond with status of operation	No
12	Freeze with time - no ack	Copy the specified objects to freeze buffer at specified time No respond	No
		Application Control Function Codes	
13	Cold Restart Perform the desired reset sequence Respond with a time object Yes		
14	Warm Restart	Perform the desired partial reset operation Respond with a time object	Yes
15	Initialise Data to Defaults	Initialise the specified data to default Respond with the status of operation	No
16	Initialise Application	Prepare the specified application to run Respond with the status of operation	No
17	Start Application	Start the specified application to run Respond with the status of operation	No
18	Stop Application	Stop the specified application to run Respond with the status of operation	No
		Configuration Function Codes	

Code	Function	Description	Supported
19	Save configuration	Save the configuration Respond with status of operation	No
20	Enable Unsolicited Messages	Enable Unsolicited Messages Respond with status of operation	No
21	Disable Unsolicited Messages	Disable Unsolicited Messages Respond with status of operation	No
22	Assign Class	Assign specified objects to a class Respond with status of operation	No
		Time Synchronization Function Codes	
23	Delay Measurement	Perform propagation delay measurement	Yes
24	Record current time	Used in a network application to allow the Master station and the Out station to record their time at the same instant	Yes
		Response Function Codes	
0	Confirm	Message fragment confirmation	Yes
129	Response	Response to requested message	Yes
130	Unsolicited Message	Spontaneous message without request	Yes

Level of Implementation

DNP has three subset levels, each of which includes a specific subset of DNP message types and functionality. In COM600 the DNP protocol has been implemented according to the Subset Level 2 of the protocol as presented in Table A2-3.

Table A2-3 Data object types and variations supported

Data object type	Variation	Description	Function code of Request message	Qualifier code of Request message	Function code of Response message	Qualifier code of Response message
1	0	Binary input, all variations	1	6		
1	1	Binary input			129,130	0,1
1	2	Binary input with status			129,130	0,1
2	0	Binary input change, all variations	1	6,7,8		

Data object type	Variation	Description	Function code of Request message	Qualifier code of Request message	Function code of Response message	Qualifier code of Response message
2	1	Binary input change without time	1	6,7,8	129,130	17,28
2	2	Binary input change with time	1	6,7,8	129,130	17,28
2	3	Binary input change with relative time	1	6,7,8	129,130	17,28
10	0	Binary output, all variations	1	6		
10	1	Binary output status			129,130	0,1
12	1	Control relay output block	3,4,5,6	17,28	129	echo
20	0	Binary counter, all variations	1,7,8,9,10	17,28		
20	1	32-bit binary counter			129,130	0,1
20	2	16-bit binary counter			129,130	0,1
20	3	32-bit delta counter			129,130	0,1
20	4	16-bit delta counter			129,130	0,1
20	5	32-bit binary counter without flag			129,130	0,1
20	6	16-bit binary counter without flag			129,130	0,1
20	7	32-bit delta counter without flag			129,130	0,1
20	8	16-bit delta counter without flag			129,130	0,1
21	0	Frozen counter, all variations	1	6		
21	1	32-bit frozen counter			129,130	0,1

Data object type	Variation	Description	Function code of Request message	Qualifier code of Request message	Function code of Response message	Qualifier code of Response message
21	2	16-bit frozen counter			129,130	0,1
21	9	32-bit frozen counter without flag			129,130	0,1
21	10	16-bit frozen counter without flag			129,130	0,1
22	0	Counter change event, all variations	1	6,7,8		
22	1	32-bit counter change event without time			129,130	17,28
22	2	16-bit counter change event without time			129,130	17,28
30	0	Analog input, all variations	1	6		
30	1	32-bit analog input			129,130	0,1
30	2	16-bit analog input			129,130	0,1
30	3	32-bit analog input without flag			129,130	0,1
30	4	16-bit analog input without flag	1	0,1,6	129,130	0,1
32	0	Analog change event, all variations	1	6,7,8		
32	1	32-bit analog change event without time			129,130	17,28
32	2	16-bit analog change event without time			129,130	17,28
40	0	Analog output status, all variations	1	6	129,130	0,1
40	2	16-bit analog output status				

Data object type	Variation	Description	Function code of Request message	Qualifier code of Request message	Function code of Response message	Qualifier code of Response message
41	2	16-bit analog output block	3,4,5,6	17,28	129	echo
50	1	Time and date	2	7		
51	1	Time and date CTO			129,130	7
51	2	Unsynchronised time and date CTO			129,130	7
52	1	Time and date coarse			129	7
52	2	Time delay fine			129	7
60	1	Class 0 data	1	6		
60	2	Class 1 data	1	6,7,8		
60	3	Class 2 data	1	6,7,8		
60	4	Class 3 data	1	6,7,8		
80	1	Internal indications	2	0		
		No object	13			
		No object	23			

- Obj. is the data object type.
- Var. is the variation.
- Func. is the function code of the message.
- Qual. is the qualifier code of the message in hexadecimal.
- Echo means that the response is the request mirrored.

TCP/UDP additions for LAN/WAN network

DNP LAN/WAN OPC Server uses the default IP address provided by the operating system. A created DNP Master line reserves a port number *2501+linenumber* for its internal use.

In TCP/IP mode (connection-oriented), the connection is established to the port 20000 (default) of the slave device. Only one connection to each master station is established at the same time. The IP address of the master is configured with the Internet Address property of the IED object.

The remote port number can be configured by using an option in the IED property Internet Address.

In UDP/IP mode (connectionless) all data is sent and received through the port 20000. The slave device must receive messages from this port only. All messages that are sent by the slave device must be sent to this port of the master. The IP address of the slave is configured with the Internet Address property of the IED object.

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