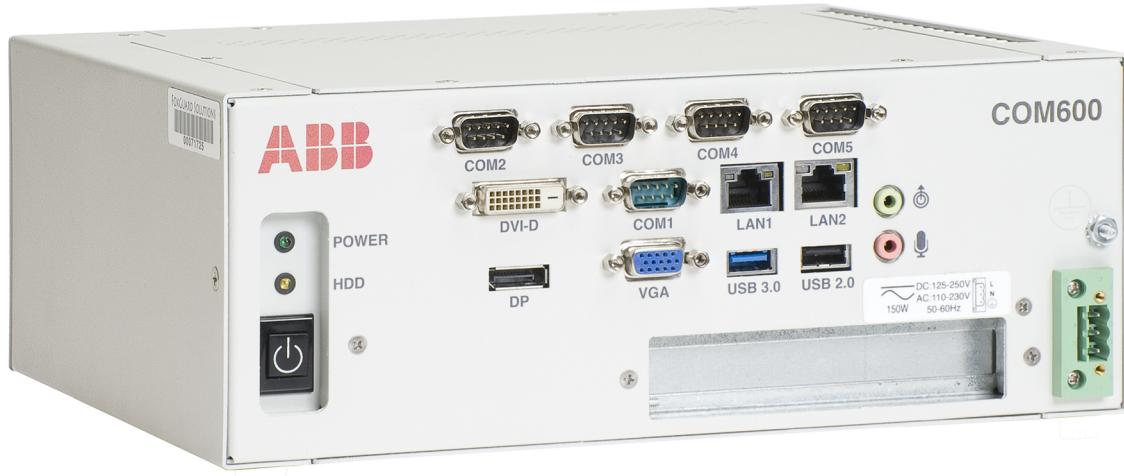


# **COM600 series 5.1**

Slave Protocols (Ethernet) and Applications  
Technical Reference Manual





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### 1.2. Disclaimer

The data, examples and diagrams in this manual are included solely for the concept or product description and are not to be deemed as a statement of guaranteed properties. All persons responsible for applying the equipment addressed in this manual must satisfy themselves that each intended application is suitable and acceptable, including that any applicable safety or other operational requirements are complied with. In particular, any risks in applications where a system failure and/ or product failure would create a risk for harm to property or persons (including but not limited to personal injuries or death) shall be the sole responsibility of the person or entity applying the equipment, and those so responsible are hereby requested to ensure that all measures are taken to exclude or mitigate such risks.

This product is designed to be connected and to communicate information and data via a network interface, which should be connected to a secure network. It is sole responsibility of person or entity responsible for network administration to ensure a secure connection to the network and to establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB is not liable for damages and/or losses related to such security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.

This document has been carefully checked by ABB but deviations cannot be completely ruled out. In case any errors are detected, the reader is kindly requested to notify the manufacturer. Other than under explicit contractual commitments, in no event shall ABB

be responsible or liable for any loss or damage resulting from the use of this manual or the application of the equipment.

## 1.3.

### Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series.

## 1.4.

### Trademarks

ABB is a registered trademark of ABB Group. All other brand or product names mentioned in this document may be trademarks or registered trademarks of their respective holders.

## 1.5.

### General information

This manual provides thorough information on all the Ethernet-based Slave protocols supported by the COM600 and and their central concepts. You will find instructions on how to configure the related objects belonging to the different Ethernet-based slave 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 slave protocols and the IEC 61850 standard.

## 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
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.

Term	Description
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

Abbreviation	Description
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

Documentversion/date	Product revision	History
A/24.5.2017	5.0	Document created
B/22.3.2018	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

COM600 supports multiple slave communication protocols by which it exchanges data with field devices such as protection and control IEDs, meters or other devices such as 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 slave 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
2. Serial interface-based protocols
  - IEC 60870-5-101
  - DNP 3.0 Serial
  - Modbus

COM600 converts all field data, acquired using the communication protocols listed above, 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 slave 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 slave protocols have two common aspects

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

### **3. IEC 61850 Proxy server**

#### **3.1. ACSI conformance statement**

##### **3.1.1. ACSI conformance statement**

ACSI conformance statements shall be used to provide an overview and details about a device claiming conformance with ACSI:

- 3.1.2, ACSI basic conformance statement
- 3.1.3, ACSI models conformance statement
- 3.1.4, ACSI service conformance statement

These statements are used to specify the communication features mapped to an SCSM. The following tables provide the ACSI conformance statements for the COM600 IEC 61850 Proxy Server. The tables are according to IEC 61850-7-2.

##### **3.1.2. ACSI basic conformance statement**

**Table 3.1.2-1 Basic conformance statement**

		Client/Subscriber	Server/Publisher	Value/Comments
	<b>Client-Server roles</b>			
B11	Server side (of TWO-PARTY-APPLICATION-ASSOCIATION)	-	c1	SUPPORTED
B12	Client side of (TWO-PARTY-APPLICATION-ASSOCIATION)	c1	-	
	<b>SCSMs supported</b>			
B21	SCSM: IEC 6185-8-1 used			SUPPORTED
B22	SCSM: IEC 6185-9-1 used			-
B23	SCSM: IEC 6185-9-2 used			-
B24	SCSM: other			-
	<b>Generic substation event model (GSE)</b>			
B31	Publisher side	-	O	SUPPORTED
B32	Subscriber side	O	-	-
	<b>Transmission of sampled value model (SVC)</b>			
B41	Publisher side	-	O	-
B42	Subscriber side	O	-	-

c1 – shall be ‘M’ if support for LOGICAL-DEVICE model has been declared.

O – Optional

M – Mandatory

### 3.1.3.

### ACSI models conformance statement

*Table 3.1.3-1 ACSI models conformance statement*

		Client/Subscriber	Server/Publisher	Value/Comments
	<b>If Server side (B1) supported</b>			
M1	<b>Logical device</b>	c2	c2	SUPPORTED
M2	<b>Logical node</b>	c3	c3	SUPPORTED
M3	<b>Data</b>	c4	c4	SUPPORTED
M4	<b>Data set</b>	c5	c5	SUPPORTED
M5	<b>Substitution</b>	O	O	-
M6	<b>Setting group control</b>	O	O	-
	<b>Reporting</b>			
M7	<b>Buffered report control</b>	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	BuTm			
M7-9	IntgPd			
M7-10	GI			
M7-11	conf-revision			
M8	<b>Unbuffered report control</b>	O	O	SUPPORTED
M8-1	sequence-number			
M8-2	report-time-stamp			
M8-3	reason-for-inclusion			
M8-4	data-set-name			
M8-5	data-reference			

		<b>Client/Sub-scriber</b>	<b>Server/Pub-lisher</b>	<b>Value/Comments</b>
M8-6	BufTm			
M8-7	IntgPd			
M8-8	GI			
M8-9	conf-revision			
	Logging	O	O	-
M9	<b>Log control</b>	O	O	-
M9-1	IntgPd			
M10	<b>Log</b>	O	O	-
M11	<b>Control</b>	M	M	SUPPORTED
	If GSE (B31/32) is supported			
	<b>GOOSE</b>	O	O	SUPPORTED (send)
M13	<b>GSSE</b>	O	O	
	If SVC (41/42) is supported			
M14	Multicast SVC	O	O	-
M15	Unicast SVC	O	O	-
M16	<b>Time</b>	M	M	-
M17	<b>File Transfer</b>	O	O	-

c1 – shall be ‘M’ if support for LOGICAL-DEVICE model has been declared.

c2 – shall be ‘M’ if support for LOGICAL-NODE model has been declared.

c3 – shall be ‘M’ if support for DATA model has been declared.

c4 – shall be ‘M’ if support for DATA-SET, Substitution, Report, Log Control, or Time model has been declared.

c5 – shall be ‘M’ if support for Report, GSE, or SMV models has been declared.

M - Mandatory

### 3.1.4.

### **ACSI service conformance statement**

The ACSI service conformance statement shall be as defined in Table 3.1.4-1 (depending on the statements in Table 3.1.3-1).

**Table 3.1.4-1 ACSI service Conformance statement**

	<b>Services</b>	<b>AA: TP/MC</b>	<b>Client/Sub- scriber</b>	<b>Server/Pub- lisher</b>	<b>Value/Comments</b>
	<b>Server</b>				
S1	ServerDirectory	TP		M	SUPPORTED
	<b>Application association</b>				
S2	Associate		M	M	SUPPORTED
S3	Abort		M	M	SUPPORTED
S4	Release		M	M	SUPPORTED
	<b>Logical device</b>				
S5	LogicalDeviceDirectory	TP	M	M	SUPPORTED
	<b>Logical node</b>				
S6	LogicalNodeDirectory	TP	M	M	SUPPORTED
S7	GetAllDataValues	TP	O	M	SUPPORTED
	<b>Data</b>				
S8	GetDataValues	TP	M	M	SUPPORTED
S9	SetDataValues	TP	O	O	SUPPORTED
S10	GetDataDirectory	TP	O	M	SUPPORTED
S11	GetDataDefinition	TP	O	M	SUPPORTED
	<b>Data set</b>				
S12	GetDataSetValue	TP	O	M	SUPPORTED
S13	SetDataSetValues	TP	O	O	-
S14	CreateDataSet	TP	O	O	-
S15	DeleteDataSet	TP	O	O	-
S16	GetDataSetDirectory	TP	O	O	SUPPORTED
	<b>Substitution</b>				
S17	SetDataValues	TP	M	M	SUPPORTED
	<b>Setting group control</b>				
S18	SelectActiveSG	TP	O	O	-
S19	SelectEditSG	TP	O	O	-
S20	SetSGValues	TP	O	O	-
S21	ConfirmEditSGValues	TP	O	O	-
S22	GetSGValues	TP	O	O	-
S23	GetSGCBValues	TP	O	O	-
	<b>Reporting</b>				

	<b>Services</b>	<b>AA: TP/MC</b>	<b>Client/Sub- scriber</b>	<b>Server/Pub- lisher</b>	<b>Value/Comments</b>
	Buffered report control block (BRCB)				
S24	Report	TP	c6	c6	SUPPORTED
S24-1	data-change (dchg)				
S24-2	qchg-change (qchg)				
S24-3	data-update (dupd)				
S25	GetBRCBValues	TP	c6	c6	SUPPORTED
S26	SetBRCBValues	TP	c6	c6	SUPPORTED
	Unbuffered report control block (URCB)				
S27	Report	TP	c6	c6	SUPPORTED
S27-1	data-change (dchg)				
S27-2	qchg-change (qchg)				
S27-3	data-update (dup)				
S28	GetURCBValues	TP	c6	c6	SUPPORTED
S29	SetURCBValues	TP	c6	c6	SUPPORTED
	<b>Logging</b>				
	Logging control block				
S30	GetLCBValues	TP	M	M	-
S31	SetLCBValues	TP	O	M	-
	Log				
S32	QueryLogByTime	TP	c7	M	-
S33	QueryLogByEntry	TP	c7	M	-
S34	GetLogStatusValues	TP	M	M	-
	<b>Generic substation event model (GSE)</b>				
	GOOSE-CONTROL-BLOCK				
S35	SendGOOSEMessage	MC	c8	c8	SUPPORTED
S36	GetReference	TP	O	c9	-
S37	GetGOOSEElementNumber	TP	O	c9	-
S38	GetGoCBValues	TP	O	O	-
S39	SetGoCBValues	TP	O	O	-
	<b>GSSE-CONTROL-BLOCK</b>				
S40	SendGSSEMessage	MC	c8	c8	-
S41	GetReference	TP	O	c9	-

	Services	AA: TP/MC	Client/Sub- scriber	Server/Pub- lisher	Value/Comments
S42	GetGSSElementNumber	TP	O	c9	-
S43	GetGsCBValues	TP	O	O	-
S44	SetGsCBValues	TP	O	O	-
	<b>Transmission of sampled value model (SVC)</b>				
	Multicast SVC				
S45	SendMSVMessage	MC	c10	c10	-
S46	GetMSVCBValues	TP	O	O	-
S47	SetMSVCBValues	TP	O	O	-
	Unicast SVC				
S48	SendUSVMessage	TP	c10	c10	-
S46	GetUSVCBValues	TP	O	O	-
S47	SetUSVCBValues	TP	O	O	-
	<b>Control</b>				
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	-
	<b>File transfer</b>				
S57	GetFile	TP	O	M	-
S58	SetFile	TP	O	O	-
S59	DeleteFile	TP	O	O	-
S60	GetFileAttributeValue	TP	O	M	-
	<b>Time</b>				
T1	Time resolution of internal clock				(nearest negative power of 2 in seconds)
T2	Time accuracy of internal clock				T0
					T1
					T2
					T3
					T4

	<b>Services</b>	<b>AA: TP/MC</b>	<b>Client/Sub- scriber</b>	<b>Server/Pub- lisher</b>	<b>Value/Comments</b>
					T5
T3	supported TimeStamp resolution				(nearest negative power of 2 in seconds)

c6 – shall declare support for at least one (BRCB or URCB).

c7 – shall declare support for at least one (QueryLogByTime or QueryLogByEntry).

c8 – shall declare support for at least one (SendGOOSEMessage or SendGSSEMessage).

c9 – shall declare support if TP association is available.

c10 – shall declare support for at least one (SendMSVMessage or SendUSVMessage).

## 3.2. **SCL conformance**

### 3.2.1. **SCL conformance statement**

The SCL conformance statement defines several degrees of conformance for which implementations may declare support of the substation configuration language. [1]

**Table 3.2.1-1 SCL conformance degrees**

	<b>SCL Conformance</b>		<b>Client-CR</b>			<b>Server-CR</b>	
		Base	F/S	Value/Range	Base	F/S	Value/Range
SCL.1	SCL File for Implementation Available (offline)				M	M	SUPPOR-TED
SCL.2	SCL File available from implementation online	O	O		O	O	-
SCL.3	SCL implementation reconfiguration supported online	O	O		O	O	-

## 3.3. **PICS - protocol conformance statement**

### 3.3.1. **Profile conformance**

Table 3.3.1-1 and Table 3.3.1-2 define the basic conformance statement.

**Table 3.3.1-1 PICS for A-Profile support**

		Client		Server		Value/Comment
		F/S		F/S		
A1	Client/Server A-Profile	c1		c1		SUPPORTED
A2	GOOSE/GSE Management A-Profile	c2		c2		SUPPORTED
A3	GSSE A-Profile	c3		c3		-
A4	TimeSync A-Profile	c4		c4		-

c1 – shall be ‘m’ if support for any service specified for Client/S are declared within the ACSI basic conformance statement.

c2 – shall be ‘m’ if support for any service specified for GOOSE/GSE Management are declared within the ACSI basic conformance statement.

c3 – shall be ‘m’ if support for any service specified for GSSE A-Profile are declared within the ACSI basic conformance statement.

c4 – support for at least one other A-Profile shall be declared (e.g. in A1-A3) in order to claim conformance to IEC 61850-8-1.

**Table 3.3.1-2 PICS for T-Profile support**

		Client		Server		Value/Comment
		F/S		F/S		
T1	TCP/IP T-Profile	c1		c1		SUPPORTED
T2	OSI T-Profile	c2		c2		-
T3	GOOSE/GSE T-Profile	c3		c3		SUPPORTED
T4	GSSE T-Profile	c4		c4		-
T5	TimeSync T-Profile	o		o		-

c1 – shall be ‘m’ if support for A1 is declared. Otherwise, shall be “i”

c2 – shall be “o” if support for A1 is declared. Otherwise, shall be “i”.

c3 – shall be ‘m’ if support for A2 is declared. Otherwise, shall be “i”.

c4 – shall be ‘m’ if support for A3 is declared. Otherwise, shall be “i”.

### 3.3.2.

### MMS Conformance

MMS conformance is guaranteed by MMS stack vendor, i.e. Systems Integration Specialists Company, Inc. (SISCO).

All required IEC 61850 services for supporting the ACSI services stated to be supported are supported by the used MMS stack MMS-EASE Light.

## 4. IEC 104 OPC slave

### 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 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 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 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

**4.2.5. Enumerated Status (ENS)**

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	ENUMERATED		M		
q	Quality		M		VT_I4
t	Timestamp		M	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	Mandatory/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	Mandatory/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	Mandatory/Optional	Protocol information 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	Mandatory/Optional	Protocol information 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	Mandatory/Optional	Protection information 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	AnalogueValue		M	SVA, NVA	VT_R4
phsA.q	Quality		M	OV, BL, SB, NT, IV	VT_I4
phsA.t	TimeStamp		M	CP24Time2A	VT_DATE
phsB.cVal.mag	AnalogueValue		O	SVA, NVA	VT_R4
phsB.q	Quality		O	OV, BL, SB, NT, IV	VT_I4
phsB.t	TimeStamp		O	CP24Time2A	VT_DATE
phsC.cVal.mag	AnalogueValue		O	SVA, NVA	VT_R4
phsC.q	Quality		O	OV, BL, SB, NT, IV	VT_I4
phsC.t	TimeStamp		O	CP24Time2A	VT_DATE
neut.cVal.mag	AnalogueValue		O	SVA, NVA	VT_R4
neut.q	Quality		O	OV, BL, SB, NT, IV	VT_I4
neut.t	TimeStamp		O	CP24Time2A	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	Mandatory/Optional	Protocol information 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	Mandatory/Optional	Protocol information 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	Mandatory/Optional	Protocol information element	OPC data types
ctlOperOn	SPI	FALSE   TRUE	O	SCO	VT_BOOL
ctlOperOff		FALSE   TRUE	O	SCO	VT_BOOL

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion 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	Mandat- ory/Optional	Protocol informa- tion 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)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
ctlVal	ENUMERATED		M	NVA	VT_I4
stVal	ENUMERATED		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

**4.2.17. 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	AnalogValue		M		VT_R4

## 4.3. Status codes

### 4.3.1. Introduction

The following status codes are defined for the IEC 60870-5-104 slave 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_REPLY_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.

### General information about attributes

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

There are three categories of attributes: IEC104 Slave OPC Client attributes, IEC104 Channel attributes and IEC104 Device attributes. These attributes are described in the following subsections.

**4.4.2.****Client attributes*****Table 4.4.2-1 Client attributes***

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

**4.4.3.****Channel attributes*****Table 4.4.3-1 Channel attributes***

Property / Parameter	Value or Value range/ Default	Description
<b>Basic</b>		
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.
<b>Diagnostic Counters</b>		
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.

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

**4.4.4.****Device attributes****Table 4.4.4-1 Device attributes**

<b>Property / Parameter</b>	<b>Value or Value range/ Default</b>	<b>Description</b>
<b>Basic</b>		
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.
<b>Status Information</b>		
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	<p>When written: 1 = Re-transmit system message</p> <p>When read: A status code, for example 0 = OK (communication works properly) 13863 = Device suspended.</p> <p>For more information, see 4.3, Status codes.</p>	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.
Pending Updates		Indicates the current number of pending updates between the client and the protocol stack.
Max Pending Updates		Indicates the maximum number of pending updates between the client and the protocol stack.

## **5. DNP3 LAN/WAN OPC slave**

### **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 is described in this section.

For each data class, there is a table giving a detailed description about the relation between the 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.

#### **5.2.2. Single point status (SPS)**

Name	Type	Value/Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	BOOLEAN	TRUE   FALSE	M	state (1=ON, 0=OFF)	VT_BOOL
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.3. Double point status (DPS)

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	state (0=OFF, 1=ON)	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.4. Integer controlled step position information (ISC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	INTEGER	-64 ... 63	M	Control Value	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	DNP status	V_I4
t	TimeStamp		M	<none>   Time of occurrence	V_DATE

### 5.2.5. Enumerated Status (ENS)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	ENUMERATED		M		
q	Quality		M		VT_I4
t	Timestamp		M	CP56Time2a	VT_DATE
d	Description	Text	O		VT_BSTR

ENS represents DMCD M\_ME\_NA\_1, M\_ME\_TA\_1, M\_ME\_TD\_1.

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

ACT phases information is mapped in the same way as SPS stVal.

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	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_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

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

The ACT-related directional protection activation information is processed like ACT.

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	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_I4
t	TimeStamp		M	<none>   Time of occurrence	

### 5.2.8. Binary counter reading (BCR)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
actVal	INTEGER		M	Value   Frozen value   Current value	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.9. Measured value (MV)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protection informa- tion element	OPC data types
mag	AnalogueValue		M	CurrentValue	VT_R4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.10. Complex measured value (CMV)

CMV is configured in the same way as MV. The only difference is that, instead of a mag tag, there is a cVal node containing a mag tag in the OPC namespace structure.

### 5.2.11. WYE

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
phsA.cVal.mag	AnalogueValue		M	Phase A Current Value	VT_R4
phsA.q	Quality		M	DNP status	VT_I4
phsA.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE
phsB.cVal.mag	AnalogueValue		O	Phase B Current Value	VT_R4
phsB.q	Quality		O	DNP status	VT_I4
phsB.t	TimeStamp		O	<client provided if none>	VT_DATE

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
phsC.cVal.mag	AnalogueValue		O	Phase C Current Value	VT_R4
phsC.q	Quality		O	DNP status	VT_I4
phsC.t	TimeStamp		O	<none>   Time of occurrence	VT_DATE
neut.cVal.mag	AnalogueValue		O	Neutral Current Value	VT_R4
neut.q	Quality		O	DNP status	VT_I4
neut.t	TimeStamp		O	<none>   Time of occurrence	VT_DATE
net.cVal.mag	AnalogValue		O	Net current value	VT_R4
net.q	Quality		O	DNP status	VT_I4
net.t	Timestamp		O	<client provided if none>	VT_DATE
res.cVal.mag	AnalogValue		O	Res current value	VT_R4
res.q	Quality		O	DNP status	VT_I4
res.t	Timestamp		O	<client provided if none>	VT_DATE

### 5.2.12. Delta (DEL)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
phsAB. cVal.mag t	AnalogueValue		M	Phase AB Current Value	VT_R4
phsAB.q	Quality		M	DNP status	VT_I4
phsAB.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE
phsBC.cVal.mag q	AnalogueValue		M	Phase BC Current Value	VT_R4
phsBC.q	Quality		M	DNP status	VT_I4
phsBC.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
phsCA.cVal.mag q	AnalogueValue		M	Phase CA Current Value	VT_R4
phsCA.q	Quality		M	DNP status	VT_I4
phsCA.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.13. Controllable single point (SPC)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
ctlVal	SPI		M	Control Code	VT_BOOL
stVal		FALSE   TRUE	M	State (0=OFF, 1=ON)	VT_BOOL
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.14. Controllable double point (DPC)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
ctlOperOn	SPI	FALSE   TRUE	O	Control Code	VT_BOOL
ctlOperOff		FALSE   TRUE	O	Control Code	VT_BOOL
ctlSelOn		FALSE   TRUE	O	Control Code	VT_BOOL
ctlSelOff		FALSE   TRUE	O	Control Code	VT_BOOL
stVal	ENUMERATED	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		M	<none>   Time of occurrence	VT_DATE
ctlCan	BOOLEAN	FALSE   TRUE	O	-	VT_BOOL

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stSelD	BOOLEAN	FALSE   TRUE	O	State (0=OFF, 1=ON)	VT_BOOL

### 5.2.15. Controllable integer status (INC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	INTEGER		M	Control Value	VT_I4
stVal	INTEGER		M	Current Value	VT_I4
q	Quality		M	DNP status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.16. 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
t	Timestamp		M	<none>   Time of occurrence	VT_DATE

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

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	ENUMERATED	stop (0) lower (1) higher (2) reserved (3)	M	Control Value	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	DNP status	VT_I4

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 5.2.18. Integer controlled step position information (ISC)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
ctlVal	INTEGER	-64 ... 63	M	Control Value	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	DNP status	V_I4
t	TimeStamp		M	<none>   Time of occurrence	V_DATE

### 5.2.19. Analogue set point (APC)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
ctlVal	AnalogueValue		M	Control Value	VT_R4

## 5.3. Status codes

### 5.3.1. Introduction

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

### 5.3.2. Link layer status codes

- |       |   |
|-------|---|
| 17650 | The Data Flow Control ( DFC) bit of the messages from the master is set for more than 15 seconds.               |
| 17651 | The DCD or CTS signal or the end of the transmitted message is not received in correct time.                    |
| 17652 | Timeout while waiting for an acknowledgment to a request.   |
| 17654 | The application level sends a command before the communication between the master and the slave is established. |

17655	The Data Flow Control bit of the messages from the master is set for too long.
17656	The slave does not receive a reply from the master.
17657	The channel has been set in use.
17658	The channel has been set out of use.
17659	The protocol stack out of buffers error.
17670	The value written to one of the channel properties is incorrect.

**5.3.3.****Application layer status codes**

13901	The value set to a property of the device is incorrect.
13904	No more events can be written to one of the unsolicited message queues since the queue is full.
13905	Internal message buffer full error.
13906	Internal message filling error.
13907	The used data object type is not supported.
13909	Internal data overflow error.
13910	The device is in the suspended state. The reason for this can be that the link is not properly established (for example incorrect cable wiring) or the master station does not respond.
13911	Internal message sending error.
13913	A command is sent to a channel with a non-established communication.
13914	Internal out of buffers error.
13918	The device has been set out of use.
13919	The device has been set in use.
13924	Internal buffer error.
13925	There is not any preceding command with the address given when confirming a command. Either the address is incorrect or the command has not been received.
13926	Internal software error.
13927	The channel to which the device is created is incorrect.
13931	The CODE item of a received control block message is unknown.

## 5.4.

## Attributes

### 5.4.1.

### General information about attributes

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

There are three categories of attributes: DNP LAN Slave OPC Client attributes, DNP LAN Channel attributes and DNP LAN IED attributes. These attributes are described in the following subsections.

The attributes are not updated automatically by the server according to the update rate of the OPC group. Instead, it is required that the client explicitly refreshes the group or requests a read of single attributes to retrieve the latest values. This does not matter for most attributes, since they do not change value spontaneously. The exceptions are the diagnostic counters and object status attributes. Object status attributes are updated automatically by system messages, so in practice only diagnostic counters are affected by this rule. It was introduced to avoid overloading the communication link between the protocol stack and OPC server.

### 5.4.2.

### DNP LAN Slave OPC Client attributes

**Table 5.4.2-1 DNP LAN Slave OPC Client attributes**

Property / Parameter	Value or Value range/ Default	Description
Protocol Stack Version	Value: Version information	Data type: Text Access: Read-only  The version information of the Protocol Stack.

**5.4.3.****DNP LAN Channel attributes*****Table 5.4.3-1 DNP LAN Channel attributes***

Property / Parameter	Value or Value range/ Default	Description
In Use	0 = Not in use, the channel communication is stopped 1 = In use Default: 0	Data type: Integer  Access: No limitations  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 polling of the station in turn is completed.
Diagnostic Counters (TCP/IP, UDP/IP channel)		
	Default: TCP/IP	Data type: Integer  Access: No limitations
Transmitted Telegrams		The number of transmitted telegrams.
Failed Transmissions		The number of failed transmissions.
Transmitted Commands		The number of transmitted commands.
Transmitted Replies		The number of transmitted replies.
Received Messages		The number of received data messages.
Buffer Overflow Errors		The number of times there has been a buffer overflow.
TCP Connect		Incremented each time a TCP connect request is received.
TCP Accept		Incremented each time a TCP connect request is accepted.
TCP Close		Incremented each time a TCP connection is closed.

**5.4.4.****DNP LAN IED attributes****Table 5.4.4-1 DNP LAN IED attributes**

<b>Property / Parameter</b>	<b>Value or Value range/ Default</b>	<b>Description</b>
In Use	0 = Out of use 1 = In use Default: 0	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 a data exchange are disabled. The device itself is not affected by the attribute, only the protocol stack's image of the device. Setting In use to 1 is allowed only if the device address is legal.
Object Status	When written: 1 = Re-transmit system message  When read: A status code, for example, 0 = OK (communication works properly) 13910 = Device suspended  For more information, see 5.3.2, Link layer status codes and 5.3.3, Application layer status codes.	Data type: Integer  Access: No limitations  Indicates the detailed information about the station device status. Writing to the Object Status attribute (Object Status = 1) of a device makes the protocol stack to re-transmit the latest system message caused by the device. Possible "Stopped" and "Suspended" messages cause old marking of OPC items. By reading the Object Status attribute, the status code of the system message can be read.
Device Connection Status	True = Device connection OK False = Device connection suspended	Data type: Boolean  Access: Read-only  Indicates the status of the device connection.  (Does not exist in Configuring Micro-SCADA for DNP slave.)
Diagnostic Counters		
		Data type: Integer  Access: No limitations
Suspension Counter		Indicates the number of times the connection has been suspended.

<b>Property / Parameter</b>	<b>Value or Value range/ Default</b>	<b>Description</b>
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.
<b>Queue Diagnostics</b>		
		Data type: Integer Access: No limitations
Size of APDU in-queue		
Size of APDU out-queue		
Size of TSDU in-queue		
Size of TSDU out-queue		
Size of WAIT CONFIRM queue		
Size of OPC Client transition queue		
Size of Confirmation transition queue		
Size of Select transition queue		
Size of Free APDU queue		
Size of Free events queue		
Size of Free OPC Client transitions queue		

## 6. Modbus TCP slave

### 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 following sections describe the relationship between the IEC 61850 data modeling and general\_about\_data\_modeling\_MSLAN. There is a table for each data class giving a detailed description about the relationship 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.
- **Modbus information element** specifies the Modbus information element related to the attribute/service.
- **OPC data types** specify the OPC data type used for the OPC item.

#### 6.2.2. Single point status (SPS)

Name	Type	Value/Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	BOOLEAN	TRUE   FALSE	M		VT_BOOL
q	Quality		M		VT_I4
t	TimeStamp		M		VT_DATE

**6.2.3. Double point status (DPS)**

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	state (0=OFF, 1=ON)	VT_I4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

**6.2.4. Integer status (INS)**

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stVal	INTEGER		M	Current value	VT_I4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

**6.2.5. 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	Modbus status	VT_I4
t	Timestamp		M	<none>   Time of occurrence	VT_DATE

ENS represents DMCD M\_ME\_NA\_1, M\_ME\_TA\_1, M\_ME\_TD\_1.

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

ACT phases information is mapped in the same way as SPS stVal.

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	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	Modbus status	
t	TimeStamp		M	<none>   Time of occurrence	

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

The ACT-related directional protection activation information is processed like ACT.

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	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	Modbus status	
t	TimeStamp		M	<none>   Time of occurrence	

**6.2.8. Binary counter reading (BCR)**

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
actVal	INTEGER		M	Value   Frozen value   Current value	VT_I4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

**6.2.9. Measured value (MV)**

Name	Type	Value/ Value range	Mandatory/Optional	Protection information element	OPC data types
mag	AnalogueValue		M	CurrentValue	VT_R4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

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

CMV is configured in the same way as MV. The only difference is that, instead of a mag tag, there is a cVal node containing a mag tag in the OPC namespace structure.

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data type
cVal.mag	AnalogueValue		M	CurrentValue	VT_R4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 6.2.11. WYE

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
phsA.cVal.mag	AnalogueValue		M	Phase A Current Value	VT_R4
phsA.q	Quality		M	Modbus status	VT_I4
phsA.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE
phsB.cVal.mag	AnalogueValue		O	Phase B Current Value	VT_R4
phsB.q	Quality		O	Modbus status	VT_I4
phsB.t	TimeStamp		O	<client provided if none>	VT_DATE
phsC.cVal.mag	AnalogueValue		O	Phase C Current Value	VT_R4
phsC.q	Quality		O	Modbus status	VT_I4
phsC.t	TimeStamp		O	<none>   Time of occurrence	VT_DATE
neut.cVal.mag	AnalogueValue		O	Neutral Current Value	VT_R4
neut.q	Quality		O	Modbus status	VT_I4
neut.t	TimeStamp		O	<none>   Time of occurrence	VT_DATE

### 6.2.12. Delta (DEL)

Name	Type	Value/ Value range	Mandat- ory/Optional	Protocol informa- tion element	OPC data types
phsAB. cVal.mag t	AnalogueValue		M	Phase AB Current Value	VT_R4
phsAB.q	Quality		M	Modbus status	VT_I4
phsAB.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE
phsBC.cVal.mag q	AnalogueValue		M	Phase BC Current Value	VT_R4
phsBC.q	Quality		M	Modbus status	VT_I4
phsBC.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
phsCA.cVal.mag q	AnalogueValue		M	Phase CA Current Value	VT_R4
phsCA.q	Quality		M	Modbus status	VT_I4
phsCA.t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 6.2.13. Controllable single point (SPC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	SPI		M	Control Code	VT_BOOL
stVal		FALSE   TRUE	M	State (0=OFF, 1=ON)	VT_BOOL
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 6.2.14. Controllable double point (DPC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlOperOn	SPI	FALSE   TRUE	O	Control Code	VT_BOOL
ctlOperOff		FALSE   TRUE	O	Control Code	VT_BOOL
ctlSelOn		FALSE   TRUE	O	Control Code	VT_BOOL
ctlSelOff		FALSE   TRUE	O	Control Code	VT_BOOL
stVal	ENUMERATED	intermediate-state (0) off (1) on (2) bad-state (3)	M	State (0=OFF, 1=ON)	VT_I4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE
ctlCan	BOOLEAN	FALSE   TRUE	O	-	VT_BOOL

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
stSel	BOOLEAN	FALSE   TRUE	O	State (0=OFF, 1=ON)	VT_BOOL

### 6.2.15. Controllable integer status (INC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	INTEGER		M	Control Value	VT_I4
stVal	INTEGER		M	Current Value	VT_I4
q	Quality		M	Modbus status	VT_I4
t	TimeStamp		M	<none>   Time of occurrence	VT_DATE

### 6.2.16. 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	Modbus status	VT_I4
t	Timestamp		M	<none>   Time of occurrence	VT_DATE

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

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	ENUMERATED	stop (0) lower (1) higher (2) reserved (3)	M	Control Value	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	Modbus 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

### 6.2.18. Integer controlled step position information (ISC)

Name	Type	Value/ Value range	Mandatory/Optional	Protocol information element	OPC data types
ctlVal	INTEGER	-64 ... 63	M	Control Value	VT_I1
valWTr	ValWithTrans		M	State	VT_I4
q	Quality		M	Modbus status	V_I4
t	TimeStamp		M	<none>   Time of occurrence	V_DATE

### 6.2.19. Analogue set point (APC)

Name	Type	Range / 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	Modbus status	V_I4
t	Timestamp		M	<none>   Time of occurrence	VT_DATE

## 6.3. Attributes

### 6.3.1. General information about attributes

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

There are three categories of attributes:

1. Modbus TCP Slave OPC Client attributes
2. Modbus TCP Channel attributes
3. Modbus TCP IED attributes.

These attributes are described in the following subsections.

The server does not automatically update the attributes according to the update rate of the OPC group. Instead, the client must explicitly refresh the group, or request a read of single attributes to retrieve the latest values. This is not necessary for most attributes, since they do not change their value spontaneously. The exceptions are the diagnostic counters and object status attributes. Object status attributes are updated automatically by system messages, so in practice only diagnostic counters are affected by this rule. It was introduced to avoid overloading the communication link between the protocol stack and the OPC server.

### 6.3.2. Modbus TCP Slave OPC Client attributes

**Table 6.3.2-1 Modbus TCP Slave OPC Client attributes**

Property / Parameter	Value or Value range/ Default	Description
Protocol Stack Version	Value: Version information	Data type: Text. Access: Read-only. The version information of the Protocol Stack.
Reset		The <b>Reset</b> button for resetting the OPC Client.
File Version		File version of the executable OPC Client.
Product Version		Version information of the installed OPC Client.

**6.3.3.****Channel attributes****Table 6.3.3-1 Modbus TCP Channel attributes**

<b>Property / Parameter</b>	<b>Value or Value range/ Default</b>	<b>Description</b>
In Use	0 = Not in use, the channel communication is stopped  1 = In use  Default: 0	Data type: Integer.  Access: No limitations.  Specifies whether the channel 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. 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.
<b>Diagnostic Counters (TCP/IP)</b>		
Transmitted Telegrams		The number of transmitted telegrams.
Failed Transmissions		The number of failed transmissions.
Transmitted Commands		The number of transmitted commands.
Transmitted Replies		The number of transmitted replies.
Received Messages		The number of received data messages.
Buffer Overflow Errors		The number of times there has been a buffer overflow.
TCP Connect		Incremented each time a TCP connect request is received.
TCP Accept		Incremented each time a TCP connect request is accepted.
TCP Close		Incremented each time a TCP connection is closed.

### 6.3.4.

### IED attributes

**Table 6.3.4-1 IED attributes**

Property / Parameter	Value or Value range/ Default	Description
In Use	0 = Out of use 1 = In use Default: 0	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 a data exchange are disabled. The device itself is not affected by the attribute, only the protocol stack's image of the device. Setting In use to 1 is allowed only if the device address is legal.
Object Status	When written: 1 = Re-transmit system message  When read: 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 Object Status attribute (Object Status = 1) of a device makes the protocol stack to re-transmit the latest system message caused by the device. Possible "Stopped" and "Suspended" messages cause old marking of OPC items. By reading the Object Status attribute, the status code of the system message can be read.
Device Connection Status	True = Device connection OK  False = Device connection suspended	Data type: Boolean  Access: Read-only  Indicates the status of the device connection.
<b>Diagnostic Counters</b>		
		Data type: Integer  Access: No limitations
Suspension Counter		Indicates the number of times the connection has been suspended.

Property / Parameter	Value or Value range/ Default	Description
Transmitted Messages		The number of transmitted messages.
Received Messages		The number of received messages.

## Appendix 1

### Interoperability list for IEC104 Slave OPC Client

- 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 telecontrol 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 requires 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)
- Function or ASDU is used in reverse mode
- Function or ASDU is used in standard and reverse mode
- Function or ASDU may 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)**

- |                                     |                         |                                     |                      |
|-------------------------------------|-------------------------|-------------------------------------|----------------------|
| <input checked="" type="checkbox"/> | Point to point          | <input checked="" type="checkbox"/> | Multipoint partyline |
| <input checked="" type="checkbox"/> | Multiple point to point | <input checked="" type="checkbox"/> | 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 |
|---|--|--|

- |  |  |   |
|--|--|---|
| <input checked="" type="checkbox"/> 400 bit/s  | <input checked="" type="checkbox"/> 2400 bit/s | <input checked="" type="checkbox"/> 2400 bit/s  |
| <input checked="" type="checkbox"/> 200 bit/s  | <input checked="" type="checkbox"/> 4800 bit/s | <input checked="" type="checkbox"/> 4800 bit/s  |
| <input checked="" type="checkbox"/> 300 bit/s  | <input checked="" type="checkbox"/> 9600 bit/s | <input checked="" type="checkbox"/> 9600 bit/s  |
| <input checked="" type="checkbox"/> 600 bit/s  |  | <input checked="" type="checkbox"/> 19200 bit/s |
| <input checked="" type="checkbox"/> 4200 bit/s |  | <input checked="" type="checkbox"/> 38400 bit/s |
|  |  | <input checked="" type="checkbox"/> 56000 bit/s |
|  |  | <input checked="" type="checkbox"/> 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, signal 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)**

- |                                     |           |                          |            |
|-------------------------------------|-----------|--------------------------|------------|
| <input checked="" type="checkbox"/> | One octet | <input type="checkbox"/> | Two octets |
|-------------------------------------|-----------|--------------------------|------------|

### **Information object address (system-specific parameter)**

- |                                     |              |                          |              |
|-------------------------------------|--------------|--------------------------|--------------|
| <input checked="" type="checkbox"/> | One octet    | <input type="checkbox"/> | structured   |
| <input checked="" type="checkbox"/> | Two octets   | <input type="checkbox"/> | unstructured |
| <input checked="" type="checkbox"/> | Three octets |                          |              |

### **Cause of transmission (system-specific parameter)**

- |                                     |           |                          |                                      |
|-------------------------------------|-----------|--------------------------|--------------------------------------|
| <input checked="" type="checkbox"/> | One octet | <input type="checkbox"/> | Two octets (with originator address) |
|-------------------------------------|-----------|--------------------------|--------------------------------------|

### **Length of APDU (system-specific parameter)**

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

- |   |                                   |
|---|-----------------------------------|
| <input checked="" type="checkbox"/> 253 | Maximum length of APDU per system |
|---|-----------------------------------|

## **Selection of standard ASDUs**

### **Process information in monitor direction (station-specific parameter)**

- |   |  |           |
|---|--|-----------|
| <input checked="" type="checkbox"/> <1> | :=Single-point information               | M_SP_NA_1 |
| <input checked="" type="checkbox"/> <2> | :=Single-point information with time tag | M_SP_TA_1 |
| <input checked="" type="checkbox"/> <3> | :=Double-point information               | M_DP_NA_1 |
| <input checked="" type="checkbox"/> <4> | :=Double-point information with time tag | M_DP_TA_1 |
| <input checked="" type="checkbox"/> <5> | :=Step position information              | M_ST_NA_1 |

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

<input type="checkbox"/>	<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)**

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

<input checked="" type="checkbox"/>	<70>	:=End of initialization	M_EI_NA_1
-------------------------------------	------	-------------------------	-----------

**System information in control direction (station-specific parameter)**

<input checked="" type="checkbox"/>	<100>	:=Interrogation command	C_IC_NA_1
<input checked="" type="checkbox"/>	<101>	:=Counter interrogation command	C_CI_NA_1
<input checked="" type="checkbox"/>	<102>	:=Read command	C_RD_NA_1
<input checked="" type="checkbox"/>	<103>	:=Clock synchronization command	C_CS_NA_1
<input type="checkbox"/>	<104>	:=Test command	C_TS_NA_1
<input checked="" type="checkbox"/>	<105>	:=Reset process command	C_RP_NA_1
<input type="checkbox"/>	<106>	:=Delay acquisition command	C_CD_NA_1
<input checked="" type="checkbox"/>	<107>	:=Test command with time tag CP56Time2a	C_TS_TA_1

**Parameter in control direction (station-specific parameter)**

<input type="checkbox"/>	<110>	:=Parameter of measured value, normalized value	P_ME_NA_1
<input type="checkbox"/>	<111>	:=Parameter of measured value, scaled value	P_ME_NB_1
<input type="checkbox"/>	<112>	:=Parameter of measured value, short floating point value	P_ME_NC_1
<input type="checkbox"/>	<113>	:=Parameter activation	P_AC_NA_1

**File transfer (station-specific parameter)**

<input checked="" type="checkbox"/>	<120>	:=File ready	F_FR_NA_1
<input checked="" type="checkbox"/>	<121>	:=Section ready	F_SR_NA_1
<input checked="" type="checkbox"/>	<122>	:=Call directory, select file, call file, call section	F_SC_NA_1
<input checked="" type="checkbox"/>	<123>	:=Last section, last segment	F_LS_NA_1
<input checked="" type="checkbox"/>	<124>	:=Ack file, ack section	F_AF_NA_1
<input checked="" type="checkbox"/>	<125>	:=Segment	F_SG_NA_1
<input checked="" type="checkbox"/>	<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				
<2>	M_SP_TA_1																			
<3>	M_DP_NA_1		X	X		X											X			
<4>	M_DP_TA_1																			
<5>	M_ST_NA_1		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													
<31>	M_DP_TB_1				X		X													
<32>	M_ST_TB_1				X		X													
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1				X		X													
<35>	M_ME_TE_1																			
<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					A	A	A

Type identification	Cause of transmission													
<46> C_DC_NA_1				X	X	X	X	X			A	A	A	A
<47> C_RC_NA_1				X	X	X	X	X			A	A	A	A
<48> C_SE_NA_1				X	X	X	X	X			A	A	A	A
<49> C_SE_NB_1				X	X	X	X	X			A	A	A	A
<50> C_SE_NC_1				X	X	X	X	X			A	A	A	A
<51> C_BO_NA_1														
<58> C_SC_TA_1				X	X	X	X	X			A	A	A	A
<59> C_DC_TA_1				X	X	X	X	X			A	A	A	A
<60> C_RC_TA_1				X	X	X	X	X			A	A	A	A
<61> C_SE_TA_1				X	X	X	X	X			A	A	A	A
<62> C_SE_TB_1				X	X	X	X	X			A	A	A	A
<63> C_SE_TC_1				X	X	X	X	X			A	A	A	A
<64> C_BO_TA_1														
<70> M_EI_NA_1 <sup>a</sup>		X												
<100> C_IC_NA_1				X	X			X						
<101> C_CI_NA_1				X	X			X						
<102> C_RD_NA_1			X											
<103> C_CS_NA_1	X				X	X								
<104> C_TS_NA_1														
<105> C_RP_NA_1				X	X									
<106> C_CD_NA_1														
<107> C_TS_TA_1					X	X					A	A	A	A
<110> P_ME_NA_1														
<111> P_ME_NB_1														
<112> P_ME_NC_1														
<113> P_AC_NA_1														
<120> F_FR_NA_1										X				
<121> F_SR_NA_1										X				
<122> F_SC_NA_1										X				
<123> F_DR_TA_1										X				
<124> F_AF_NA_1										X				
<125> F_SG_NA_1										X				
<126> F_DR_TA <sup>b</sup>		X		X										

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 may 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\_NA\_1, 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

<input checked="" type="checkbox"/>	group 3	<input checked="" type="checkbox"/>	group 9	<input checked="" type="checkbox"/>	group 15
<input checked="" type="checkbox"/>	group 4	<input checked="" type="checkbox"/>	group 10	<input checked="" type="checkbox"/>	group 16
<input checked="" type="checkbox"/>	group 5	<input checked="" type="checkbox"/>	group 11		
<input checked="" type="checkbox"/>	group 6	<input checked="" type="checkbox"/>	group 12		



Information Object Addresses assigned to each group must be defined.

### 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.  
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
- General request counter
- Request counter group 1
- Request counter group 2
- Request counter group 3
- Request counter group 4



Addresses per group have to be defined.

### **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 $t_2 < t_1$	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 second 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 must 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 user of this standard must select the suitable selection of documents from RFC 2200 defined in this standard for given projects.

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

## Appendix 2

### Device profile

**Table A2-1 Device profile describing the implementation of DNP V3.00 slave protocol in COM600 SUBSET 2: the default subset**

DNP V3.00DEVICE PROFILE DOCUMENT	
Vendor Name: ABB Oy Substation Automation Products	
Device Name: COM600	
Highest DNP Level Supported:	
For Requests: Subset Level 2	Device Function: [ ] Master [x] Slave
For Responses: Subset Level 2	
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.	
<b>Maximum Data Link Frame Size (octets):</b>	<b>Maximum Application Fragment Size (octets):</b>
Transmitted: 58...292	Transmitted: 255...2048
Received: (must be 292)	Received : 2048
<b>Maximum Data Link Re-tries:</b>	<b>Maximum Application Layer Re-tries:</b>
[ ] None	[ ] None
[ ] Fixed at _____	
[x] Configurable, range 0 to 10	[x] Configurable, range 0 to 5
<b>Requires Data Link Layer Confirmation:</b>	
[ ] Never	
[ ] Always	
[ ] Sometimes If 'Sometimes', when? _____	
[x] Configurable	
<b>Requires Application Layer Confirmation:</b>	
[ ] Never	
[ ] Always (not recommended)	
[ ] When reporting Event Data (Slave devices only)	
[ ] When sending multi-fragment responses (Slave devices only)	
[ ] Sometimes. If 'Sometimes', when? _____	

<b>Requires Data Link Layer Confirmation:</b>			
[x] Configurable			
Timeouts while waiting for:			
Data Link Confirm			
[ ] None	[ ] Fixed at _____	[ ] Variable	[x] Configurable
Complete Appl. Fragment			
[ ] None	[ ] Fixed at _____	[ ] Variable	[x] Configurable
Application Confirm			
[ ] None	[ ] Fixed at _____	[ ] Variable	[x] Configurable
Complete Appl. Response			
[ ] None	[ ] Fixed at _____	[ ] Variable	[x] Configurable
<b>Others:</b>			
Retransmission after a collision			
Complete data link frame			
Sends/Executes Control Operations:			
WRITE Binary Outputs			
[x] Never	[ ] Always	[ ] Sometimes	[ ] Configurable
[x] Never	[ ] Always	[ ] Sometimes	[ ] Configurable
SELECT/OPERATE			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable
DIRECT OPERATE			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable
DIRECT OPERATE - NO ACK			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable
Count > 1			
[x] Never	[ ] Always	[ ] Sometimes	[ ] Configurable
Pulse On			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable
Pulse Off			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable
Latch On			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable

<b>Sends/Executes Control Operations:</b>			
Latch Off			
[ ] Never	[x] Always	[ ] Sometimes	[ ] Configurable
Queue			
[x] Never	[ ] Always	[ ] Sometimes	[ ] Configurable
Clean Queue			
[x] Never	[ ] Always	[ ] Sometimes	[ ] Configurable

<b>FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</b>	
<b>Reports Binary Input Change Events when no specific variation requested:</b>	<b>Reports time-tagged Binary Input Change Events when no specific variation requested:</b>
[ ] Never	[ ] Never
[ ] Only time-tagged	[ ] Binary Input Change With Time
[ ] Only non-time-tagged	[ ] Binary Input Change With Relative Time
[x] Configurable to send one or the other, depends on data point init	[x] Configurable, depends on data point initialization
<b>Sends Unsolicited Responses:</b>	<b>Sends Static Data in Unsolicited Responses:</b>
[ ] Never	[X] Never
[x] Configurable, depends on data point initialization	[ ] When Device Restarts (depends on data point initialization)
[ ] Only certain objects	[ ] When Status Flags Change (depends on data point initialization)
[ ] Sometimes (attach explanation)	No other options are permitted
[ ] ENABLE/DISABLE UNSOLICITED function codes supported	
<b>Default Counter Object/ Variation:</b>	<b>Counters Roll Over at:</b>
[ ] No Counters Reported	[ ] No Counters Reported
[x] Configurable, depends on data point initialization	[ ] Configurable (attach explanation)
[ ] Default Object_____	[ ] 16 bit
[ ] Default Variation_____	[x] 32 Bits, roll-over bits not set
[ ] Point-by-point list attached	[ ] Other Value_____
	[ ] Point-by-point list attached
<b>Sends Multi-Fragment Responses:</b>	
[x] Yes	
[ ] No	

**Supported function codes**

**Table A2-2 Supported function codes**

<b>CODE</b>	<b>FUNCTION</b>	<b>DESCRIPTION</b>	<b>Supported</b>
<b>Transfer Function Codes</b>			
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
<b>Control Function Codes</b>			
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
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
<b>Freeze Function Codes</b>			
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

CODE	FUNCTION	DESCRIPTION	Supported
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
<b>Application Control Function Codes</b>			
13	Cold Restart	Perform desired reset sequence  Respond with a time object	Yes
14	Warm Restart	Perform desired partial reset operation  Respond with a time object	Yes
15	Initialize Data to Defaults	Initialize the specified data to default  Respond with status of operation	No
16	Initialize Application	Prepare the specified application to run  Respond with status of operation	No
17	Start Application	Start the specified application to run  Respond with status of operation	No
18	Stop Application	Stop the specified application to run  Respond with status of operation	No
<b>Configuration Function Codes</b>			
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
<b>Time Synchronization Function Codes</b>			

<b>CODE</b>	<b>FUNCTION</b>	<b>DESCRIPTION</b>	<b>Supported</b>
23	Delay Measurement	Perform propagation delay measurement	Yes
24	Record current time	Used in a network application to allow the Master station and the Outstation to record their time at the same instant	Yes
<b>Response Function Codes</b>			
0	Confirm	Message fragment confirmation	Yes
129	Response	Response to requested message	Yes
130	Unsolicited Message	Spontaneous message without request	Yes

### Supported objects

**Table A2-3 Supported objects**

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse)</b>	<b>Qual Codes (hex)</b>
			<b>Func Codes (dec)</b>		<b>Func Codes</b>	
1	0	Binary Input - All Variations	1	06		
1	1	Binary Input	1	<b>00,01,06</b>	129, 130	00, 01
1	2	Binary Input with Status	1	<b>00,01,06</b>	129, 130	00, 01
2	0	Binary Input Change - All Variations	1	06,07,08		
2	1	Binary Input Change without Time	1	06,07,08	129, 130	17, 28
2	2	Binary Input Change with Time	1	06,07,08	129, 130	17, 28
2	3	Binary Input Change with Relative Time	1	06,07,08	129, 130	17, 28
10	0	Binary Output - All Variations	1	06		
10	1	Binary Output				
10	2	Binary Output Status	1	<b>00,01,06</b>	129, 130	00, 01

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse) Func Codes (dec)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse) Func Codes</b>	<b>Qual Codes (hex)</b>
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 27,28	129	echo of request + status
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	1, 7, 8, 9, 10	06		
20	1	32-Bit Binary Counter	<b>1</b>	<b>00,01,06</b>	129, 130	00, 01
20	2	16-Bit Binary Counter			129, 130	00, 01
20	3	32-Bit Delta Counter			129, 130	00, 01
20	4	16-Bit Binary Counter			129, 130	00, 01
20	5	32-Bit Binary Counter without Flag	<b>1</b>	<b>00,01,06</b>	129, 130	00, 01
20	6	16-Bit Binary Counter without Flag			129, 130	00, 01
20	7	32-Bit Delta Counter without Flag			129, 130	00, 01
20	8	16-Bit Delta Counter without Flag			129, 130	00, 01
21	0	Frozen Counter - All Variations	<b>1</b>	<b>06</b>		
21	1	32-Bit Frozen Counter			129, 130	00, 01
21	2	16-Bit Frozen Counter			129, 130	00, 01
21	3	32-Bit Frozen Delta Counter				
21	4	16-Bit Frozen Delta Counter				

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse)</b>	<b>Qual Codes (hex)</b>
			<b>Func Codes (dec)</b>		<b>Func Codes</b>	
21	5	32-Bit Frozen Counter with Time of Freeze				
21	6	16-Bit Frozen Counter with Time of Freeze				
21	7	32-Bit Frozen Delta Counter with Time of Freeze				
21	8	16-Bit Frozen Delta Counter with Time of Freeze				
21	9	32-Bit Frozen Counter without Flag			129, 130	00, 01
21	10	16-Bit Frozen Counter without Flag			129, 130	00, 01
21	11	32-Bit Frozen Delta Counter without Flag				
21	12	16-Bit Frozen Delta Counter without Flag				
22	0	Counter Change Event - All Variations	1	06,07,08		
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
22	3	32-Bit Delta Counter Change Event without Time				

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OBJECT Obj	Var	Description	REQUEST (slave must parse) Func Codes (dec)	Qual Codes(hex)	RESPONSE (master must parse) Func Codes	Qual Codes (hex)
22	4	16-Bit Delta Counter Change Event without Time				
22	5	32-Bit Counter Change Event with Time				
22	6	16-Bit Counter Change Event with Time				
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				
23	0	Frozen Counter Event - All Variations				
23	1	32-Bit Frozen Counter Event without Time				
23	2	16-Bit Frozen Counter Event without Time				
23	3	32-Bit Frozen Delta Counter Event without Time				
23	4	16-Bit Frozen Delta Counter Event without Time				
23	5	32-Bit Frozen Counter Event with Time				
23	6	16-Bit Frozen Counter Event with Time				
23	7	32-Bit Frozen Delta Counter Event with Time				

OBJECT Obj	Var	Description	REQUEST (slave must parse)	Qual Codes(hex)	RESPONSE (master must parse)	Qual Codes (hex)
			Func Codes (dec)		Func Codes	
23	8	16-Bit Frozen Delta Counter Event with Time				
30	0	Analog Input - All Variations	1	06		
30	1	32-Bit Analog Input			129, 130	00, 01
30	2	16-Bit Analog Input	<b>1</b>	<b>00,01,06</b>	129, 130	00, 01
30	3	32-Bit Analog Input without Flag			129, 130	00, 01
30	4	16-Bit Analog Input without Flag	<b>1</b>	<b>00,01,06</b>	129, 130	00, 01
31	0	Frozen Analog Input - All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input with Time of Freeze				
31	4	16-Bit Frozen Analog Input with Time of Freeze				
31	5	32-Bit Frozen Analog Input without Flag				
31	6	16-Bit Frozen Analog Input without Flag				
32	0	Analog Change Event - All Variations	1	06,07,08		

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse)</b>	<b>Qual Codes (hex)</b>
			<b>Func Codes (dec)</b>		<b>Func Codes</b>	
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
32	3	32-Bit Analog Change Event with Time				
32	4	16-Bit Analog Change Event with Time				
33	0	Frozen Analog Event - All Variations				
33	1	32-Bit Frozen Analog Event without Time				
33	2	16-Bit Frozen Analog Event without Time				
33	3	32-Bit Frozen Analog Event with Time				
33	4	16-Bit Frozen Analog Event with Time				
40	0	Analog Output Status - All Variations	1	06		
40	1	32-Bit Analog Output Status				
40	2	16-Bit Analog Output Status			129, 130	00, 01
41	0	Analog Output Block - All Variations				
41	1	32-Bit Analog Output Block				
41	2	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request + status

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse)</b>	<b>Qual Codes (hex)</b>
			<b>Func Codes (dec)</b>		<b>Func Codes</b>	
50	0	Time and Date - All Variations				
50	1	Time and Date	2	<b>06</b>  <b>07</b> quantity = 1		
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO			129, 130	07, quantity=1
51	2	Unsynchronized Time and Date CTO			129, 130	07, quantity=1
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse			129	07, quantity=1
52	2	Time Delay Fine			129	07, quantity=1
60	0					
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1	06,07,08		
60	3	Class 2 Data	1	06,07,08		
60	4	Class 3 Data	1	06,07,08		
70	1	File Identifier				
80	1	Internal Indications	1 2	All 00,index=7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				

OBJECT Obj	Var	Description	REQUEST (slave must parse) Func Codes (dec)	Qual Codes(hex)	RESPONSE (master must parse) Func Codes	Qual Codes (hex)
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
		No Object	13			
		No Object	23			

*Table A2-4 Device profile describing the implementation of DNP V3 slave protocol in COM600 SUBSET 3: the used subset is selected using the IED's subset property*

DNP V3.00DEVICE PROFILE DOCUMENT	
Vendor Name: ABB Oy Substation Automation Products	
Device Name: COM600	
Highest DNP Level Supported:	Device Function:
For Requests: Subset Level 3	[ ] Master [x] Slave
For Responses: Subset Level 3	
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 3 are shaded in the accompanying implementation tables. Default subset is 2, but if the master makes a subset request, the used subset level is automatically raised.	
Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted: 58...292	Transmitted: 255...2048
Received: (must be 292)	Received : 2048

<b>DNP V3.00 DEVICE PROFILE DOCUMENT</b>	
<b>Maximum Data Link Re-tries:</b>	<b>Maximum Application Layer Re-tries:</b>
[ ] None	[ ] None
[ ] Fixed at _____	
[x] Configurable, range 0 to 10	[x] Configurable, range 0 to 5

<b>Requires Data Link Layer Confirmation:</b>
[ ] Never
[ ] Always
[ ] Sometimes If 'Sometimes', when? _____
[x] Configurable
<b>Requires Application Layer Confirmation:</b>
[ ] 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

<b>Timeouts while waiting for:</b>		
Data Link Confirm		
[ ] None	[ ] Fixed at _____ [ ] Variable	[x] Configurable
Complete Appl. Fragment		
[ ] None	[ ] Fixed at _____ [ ] Variable	[x] Configurable
Application Confirm		
[ ] None	[ ] Fixed at _____ [ ] Variable	[x] Configurable
Complete Appl. Response		
[ ] None	[ ] Fixed at _____ [ ] Variable	[x] Configurable
<b>Others:</b>		
Retransmission after a collision		
Complete data link frame		

<b>Timeouts while waiting for:</b>		
<b>Sends/Executes Control Operations:</b>		
WRITE Binary Outputs		
[x] Never	[ ] Always [ ] Sometimes	[ ] Configurable
SELECT/OPERATE		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
DIRECT OPERATE		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
DIRECT OPERATE - NO ACK		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
Count > 1		
[x] Never	[ ] Always [ ] Sometimes	[ ] Configurable
Pulse On		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
Pulse Off		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
Latch On		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
Latch Off		
[ ] Never	[x] Always [ ] Sometimes	[ ] Configurable
Queue		
[x] Never	[ ] Always [ ] Sometimes	[ ] Configurable
Clear Queue		

<b>Timeouts while waiting for:</b>		
[x] Never	[ ] Always [ ] Sometimes	[ ] Configurable

<b>FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</b>	
<b>Reports Binary Input Change Events when no specific variation requested:</b>	<b>Reports time-tagged Binary Input Change Events when no specific variation requested:</b>
[ ] Never	[ ] Never
[ ] Only time-tagged	[ ] Binary Input Change With Time
[ ] Only non-time-tagged	[ ] Binary Input Change With Relative Time
[x] Configurable to send one or the other, depends on data point initialization.	[x] Configurable, depends on data point initialization.
<b>Sends Unsolicited Responses:</b>	<b>Sends Static Data in Unsolicited Responses:</b>
[ ] Never	[x] Never
[x] Configurable, depends on data point initialization	[ ] When Device Restarts (depends on data point initialization)
[ ] Only certain objects	[ ] When Status Flags Change (depends on data point initialization)
[ ] Sometimes (attach explanation)	No other options are permitted
[x] ENABLE/DISABLE UNSOLICITED function codes supported	
<b>Default Counter Object/ Variation:</b>	<b>Counters Roll Over at:</b>
[ ] No Counters Reported	[ ] No Counters Reported
[x] Configurable, depends on data point initialization	[ ] Configurable (attach explanation)
[ ] Default Object _____	[ ] 16 bit
[ ] Default Variation _____	[x] 32 Bits, roll-over bits not set
[ ] Point-by-point list attached	[ ] Other Value _____
	[ ] Point-by-point list attached
<b>Sends Multi-Fragment Responses:</b>	
[x] Yes	
[ ] No	

**Table A2-5 Supported function codes**

CODE	FUNCTION	DESCRIPTION	Supported
<b>Transfer Function Codes</b>			
0	Confirm	Message fragment confirmation No response	Yes

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CODE	FUNCTION	DESCRIPTION	Supported
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
<b>Control Function Codes</b>			
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
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
<b>Freeze Function Codes</b>			
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

CODE	FUNCTION	DESCRIPTION	Supported
<b>Application Control Function Codes</b>			
13	Cold Restart	Perform desired reset sequence Respond with a time object	Yes
14	Warm Restart	Perform desired partial reset operation Respond with a time object	Yes
15	Initialize Data to Defaults	Initialize the specified data to default Respond with status of operation	No
16	Initialize Application	Prepare the specified application to run Respond with status of operation	No
17	Start Application	Start the specified application to run Respond with status of operation	No
18	Stop Application	Stop the specified application to run Respond with status of operation	No
<b>Configuration Function Codes</b>			
19	Save configuration	Save the configuration Respond with status of operation	No
20	Enable Unsolicited Messages	Enable Unsolicited Messages Respond with status of operation	Yes
21	Disable Unsolicited Messages	Disable Unsolicited Messages Respond with status of operation	Yes
22	Assign Class	Assign specified objects to a class Respond with status of operation	Yes
<b>Time Synchronization Function Codes</b>			
23	Delay Measurement	Perform propagation delay measurement	Yes
24	Record current time	Used in a network application to allow the Master station and the Outstation to record their time at the same instant	Yes
<b>Response Function Codes</b>			

CODE	FUNCTION	DESCRIPTION	Supported
0	Confirm	Message fragment confirmation	Yes
129	Response	Response to requested message	Yes
130	Unsolicited Message	Spontaneous message without request	Yes

**Supported objects****Table A2-6 Supported objects**

OBJECT Obj	Var	Description	REQUEST (slave must parse)  Func Codes (dec)	Qual Codes(hex)	RESPONSE (master must parse)  Func Codes	Qual Codes (hex)
1	0	Binary Input - All Variations	1,22	00,01,06		
1	1	Binary Input	1	00,01,06	129, 130	00, 01
1	2	Binary Input with Status	1	00,01,06	129, 130	00, 01
2	0	Binary Input Change - All Variations	1	06,07,08		
2	1	Binary Input Change without Time	1	06,07,08	129, 130	17, 28
2	2	Binary Input Change with Time	1	06,07,08	129, 130	17, 28
2	3	Binary Input Change with Relative Time	1	06,07,08	129, 130	17, 28
10	0	Binary Output - All Variations	1	00,01,06		
10	1	Binary Output				
10	2	Binary Output Status	1	00,01,06	129, 130	00, 01
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 27,28	129	echo of request
12	2	Pattern Control Block	5, 6	17, 28	129	echo of request
12	3	Pattern Mask	5, 6	00,01	129	echo of request

OBJECT Obj	Var	Description	REQUEST (slave must parse)	Qual Codes(hex)	RESPONSE (master must parse)	Qual Codes (hex)
			Func Codes (dec)		Func Codes	
20	0	Binary Counter - All Variations	1, 7, 8, 9, 10, 22	00,01,06		
20	1	32-Bit Binary Counter	1	00,01,06	129, 130	00, 01
20	2	16-Bit Binary Counter	1	00,01,06	129, 130	00, 01
20	3	32-Bit Delta Counter	1	00,01,06	129, 130	00, 01
20	4	16-Bit Binary Counter	1	00,01,06	129, 130	00, 01
20	5	32-Bit Binary Counter without Flag	1	00,01,06	129, 130	00, 01
20	6	16-Bit Binary Counter without Flag	1	00,01,06	129, 130	00, 01
20	7	32-Bit Delta Counter without Flag	1	00,01,06	129, 130	00, 01
20	8	16-Bit Delta Counter without Flag	1	00,01,06	129, 130	00, 01
21	0	Frozen Counter - All Variations	1,22	00,01,06		
21	1	32-Bit Frozen Counter	1	00,01,06	129, 130	00, 01
21	2	16-Bit Frozen Counter	1	00,01,06	129, 130	00, 01
21	3	32-Bit Frozen Delta Counter	1	00,01,06	129, 130	00, 01
21	4	16-Bit Frozen Delta Counter	1	00,01,06	129, 130	00, 01
21	5	32-Bit Frozen Counter with Time of Freeze				
21	6	16-Bit Frozen Counter with Time of Freeze				

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## Slave Protocols (Ethernet) and Applications Technical Reference Manual

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse) Func Codes (dec)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse) Func Codes</b>	<b>Qual Codes (hex)</b>
21	7	32-Bit Frozen Delta Counter with Time of Freeze				
21	8	16-Bit Frozen Delta Counter with Time of Freeze				
21	9	32-Bit Frozen Counter without Flag	1	00,01,06	129, 130	00, 01
21	10	16-Bit Frozen Counter without Flag	1	00,01,06	129, 130	00, 01
21	11	32-Bit Frozen Delta Counter without Flag				
21	12	16-Bit Frozen Delta Counter without Flag				
22	0	Counter Change Event - All Variations	1	06,07,08		
22	1	32-Bit Counter Change Event without Time	1	06,07,08	129, 130	17, 28
22	2	16-Bit Counter Change Event without Time	1	06,07,08	129, 130	17, 28
22	3	32-Bit Delta Counter Change Event without Time	1	06,07,08	129, 130	17, 28
22	4	16-Bit Delta Counter Change Event without Time	1	06,07,08	129, 130	17, 28
22	5	32-Bit Counter Change Event with Time				

OBJECT Obj	Var	Description	REQUEST (slave must parse)	Qual Codes(hex)	RESPONSE (master must parse)	Qual Codes (hex)
			Func Codes (dec)		Func Codes	
22	6	16-Bit Counter Change Event with Time				
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				
23	0	Frozen Counter Event - All Variations	1	06,07,08		
23	1	32-Bit Frozen Counter Event without Time	1	06,07,08	129, 130	17, 28
23	2	16-Bit Frozen Counter Event without Time	1	06,07,08	129, 130	17, 28
23	3	32-Bit Frozen Delta Counter Event without Time	1	06,07,08	129, 130	17, 28
23	4	16-Bit Frozen Delta Counter Event without Time	1	06,07,08	129, 130	17, 28
23	5	32-Bit Frozen Counter Event with Time				
23	6	16-Bit Frozen Counter Event with Time				
23	7	32-Bit Frozen Delta Counter Event with Time				
23	8	16-Bit Frozen Delta Counter Event with Time				
30	0	Analog Input - All Variations	1,22	00,01,06		
30	1	32-Bit Analog Input	1	00,01,06	129, 130	00, 01

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse) Func Codes (dec)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse) Func Codes</b>	<b>Qual Codes (hex)</b>
30	2	16-Bit Analog Input	1	<b>00,01,06</b>	129, 130	00, 01
30	3	32-Bit Analog Input without Flag	1	00,01,06	129, 130	00, 01
30	4	16-Bit Analog Input without Flag	1	<b>00,01,06</b>	129, 130	00, 01
31	0	Frozen Analog Input - All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input with Time of Freeze				
31	4	16-Bit Frozen Analog Input with Time of Freeze				
31	5	32-Bit Frozen Analog Input without Flag				
31	6	16-Bit Frozen Analog Input without Flag				
32	0	Analog Change Event - All Variations	1	06,07,08		
32	1	32-Bit Analog Change Event without Time	1	06,07,08	129,130	17, 28
32	2	16-Bit Analog Change Event without Time	1	06,07,08	129,130	17, 28
32	3	32-Bit Analog Change Event with Time				

OBJECT Obj	Var	Description	REQUEST (slave must parse)	Qual Codes(hex)	RESPONSE (master must parse)	Qual Codes (hex)
			Func Codes (dec)		Func Codes	
32	4	16-Bit Analog Change Event with Time				
33	0	Frozen Analog Event - All Variations				
33	1	32-Bit Frozen Analog Event without Time				
33	2	16-Bit Frozen Analog Event without Time				
33	3	32-Bit Frozen Analog Event with Time				
33	4	16-Bit Frozen Analog Event with Time				
40	0	Analog Output Status - All Variations	1	00,01,06		
40	1	32-Bit Analog Output Status	1	00,01,06	129, 130	00, 01
40	2	16-Bit Analog Output Status	1	00,01,06	129, 130	00, 01
41	1	32-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	00, 01
41	2	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
50	0	Time and Date - All Variations				
50	1	Time and Date	2 (see 4.14) 1	07 quantity = 1 07 quantity = 1	129	07 quantity = 1
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO			129, 130	07, quantity=1

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse) Func Codes (dec)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse) Func Codes</b>	<b>Qual Codes (hex)</b>
51	2	Unsynchronized Time and Date CTO			129, 130	07, quantity=1
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse			129	07, quantity=1
52	2	Time Delay Fine			129	07, quantity=1
60	0					
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1  20, 21, 22	06,07,08  06		
60	3	Class 2 Data	1  20, 21, 22	06,07,08  6		
60	4	Class 3 Data	1  20, 21, 22	06,07,08  06		
70	1	File Identifier				
80	1	Internal Indications	1  2	00,01  00 index = 7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				

<b>OBJECT Obj</b>	<b>Var</b>	<b>Description</b>	<b>REQUEST (slave must parse)</b>	<b>Qual Codes(hex)</b>	<b>RESPONSE (master must parse)</b>	<b>Qual Codes (hex)</b>
			<b>Func Codes (dec)</b>		<b>Func Codes</b>	
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
		No Object	13			
		No Object	23			



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