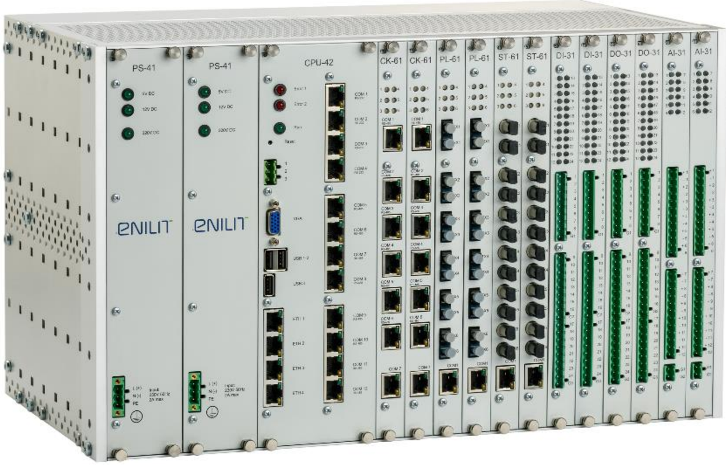
Enilit RTU



User manual

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1. INTRODUCTION

1.1 User manual

This document is a helpful resource for electric engineers who design, implement, commission, and test or provide daily service to the substations with Enilit RTU (remote terminal unit). It is intended for the readers who have the knowledge of substation automation equipment and applications.

This document provides a detailed technical manual of the remote terminal unit 'Enilit RTU' – hereinafter referred to as Enilit RTU.

The document is organized as follows:

1. Contents: this section outlines the contents of this document.
2. Introduction: this section provides a short overview of this document and introduces the main functions and possible applications of Enilit RTU.
3. Safety: this section introduces safety instructions of working with Enilit RTU system.
4. Hardware: this section elaborates the constituents of Enilit RTU hardware.
5. Software: this section provides an overview of Enilit RTU software.

Note. The user manual for this device gives instructions for its installation, commissioning, and operation. However, the user manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact UAB Enilit support and request the necessary information. Please see contact information.

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1.2 Enilit RTU

The automation technology is rapidly advancing. New communication techniques, devices and standard protocol interfaces combined with the immense computing power of today's hardware components open the way to new concepts in automation. At the same time, the growing demands of utility owners for more cost-effective control systems must be met.

Enilit RTU is our solution for automation applications. The modular, scalable and open structure of Enilit RTU system sets a wide range of applications:

- Electric power generation plants;
- Electricity transmission and distribution networks;
- Monitoring and control of chemical and petrochemical plants, pipelines and other large industries.

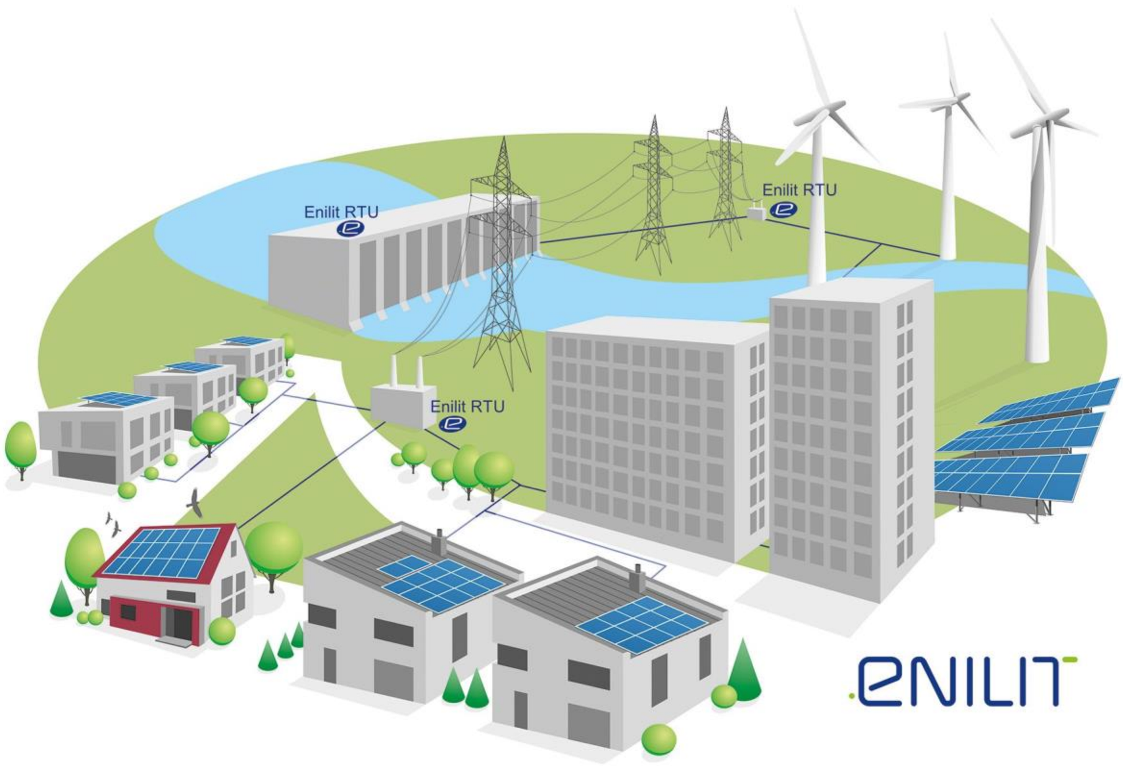


Figure 1. Control of electric power supply with Enilit RTU

Main functions of Enilit RTU:

- Control and monitoring of a system from a control centre via reliable remote data transmission protocols;
- Multitude of communication possibilities via various transmission media (LAN, radio relay system and etc.);
- Fast time-sequential processing of digital and analogue process data with high resolution time marking (1 millisecond);
- Secure process inputs / outputs with high isolation voltage (2,5 kV);
- Pre-processing and compressing of acquired process data (e.g. metered value formation, threshold value processing, initiation delay, debouncing, signal damping);
- Optimized flow of remote data transmission (spontaneous, cyclic or on-demand transmission, differentiated interrogation lists, priority improvement, general interrogation, selective message repeat command);
- Time-saving, user-optimized parameterization with minimum efforts due to Configuration and Management Software Enilit CMS based on Microsoft Windows operating system (currently supported version) or Linux;
- Open interfaces that permit the connection of peripheral units (e.g. printer or operator panel).

2. SAFETY

2.1 Introduction

This documentation includes information for qualified technical personnel. It describes the safety, handling, packing and unpacking procedures applicable to Enilit RTU hardware and software tools.

2.2 Health and safety

THIS SAFETY SECTION SHOULD BE READ BEFORE COMMENCING ANY WORK ON THE EQUIPMENT.

The information in the Safety section of the product documentation is intended to ensure that the products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety section.

To preclude the possibility of personal danger, the following safety requirements must be fulfilled at any time:

1. The operating voltage specified in technical documentation must never be exceeded.
2. Always disconnect the device before changing the system or signalling wiring.
3. The housing does not contain any operation-relevant elements. The device must never be opened.
4. Do not operate the device in explosive or inflammable environments.
5. Do not expose the device to rain or humidity.
6. With regard to the location of the installation, take care that the ventilation is sufficient to make sure that the permissible operating temperature is not exceeded.
7. For wiring, please make sure that the cables used are able to withstand temperatures of at least 85ºC.
8. Please ensure that non-isolated line ends are not exposed in order to minimize the danger of electric shocks or short circuits.

2.2.1 Service and maintenance

The device should be installed in a dry, clean environment. To ensure its proper functioning, it is necessary to make sure that the specified ambient conditions are fulfilled.

If there is an unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electrical shock or energy hazards.

The device is maintenance-free and has no rotating parts. It is not necessary to clean the device after installation. But if cleaning is necessary, the device must be switched off and wiped off with a soft, clean and dry piece of cloth. Any detergents for cleaning must not be used.

2.2.2 Electrical connections

Connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

2.2.3 Earthing

Before powering the equipment, it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in case of plug-connected equipment.

Omitting or disconnecting the equipment's earthing may cause a safety hazard.

In terms of safety and EMC protection, it is important to pay attention that the connection must be as short as possible to the system earth. The recommended minimum size of the earth wire is 2.5 mm².

2.2.4 Power supply connection

This device does not have its own mains switch and starts operation immediately after the application of system voltage. Hence, a switch must be included in the wiring scheme which must be labelled appropriately and which must be installed in the vicinity of the device and within the operator's reach. The switch has to fulfil the requirements according to the standards IEC 947-1 and IEC 947-3.

The recommended maximum rating of the external protective fuse for this equipment is in the table 1 below.

Table 1. Maximum rating of the external protective fuse

SUPPLY VOLTAGE	FUSE, A
24/48VDC	6
110VDC	4
220VDC	2
230VAC	2

Cables with 1.5 mm² cross section are to be used for the supply of the feeder voltage.

2.2.5 Terminals

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated. For the clamping rage of wires that can be used for the connection in the terminals, please refer in the table below.

Table 2. Clamping range

TERMINALS	WIRE, mm2
Power supply module	0.5 ... 2.5
Central processor unit module	0.2 ... 2.5
Input, output modules	0.2 ... 2.5

2.2.6 Data transmission cables

Telecommunications cables made of twisted-pair double-core cables with braided shielding (effective core diameter: 0.6/0.8 mm2, optical cover of the screen > 80%) according to VDE0815/ VDE0816 shall be used for data transmission. The cable shield has to be laid planar on a bonding jumper / earth circuit connector (central earthing point).

2.3 Decommissioning and disposal

2.3.1 Decommissioning

The auxiliary supply circuit in Enilit RTU may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, the supplies to Enilit RTU (both poles of any DC supply) must be completely isolated then the capacitors should be safely discharged via the external terminals prior to decommissioning.

2.3.2 Disposal

It is recommended that incineration and disposal to watercourses is avoided. The product should be disposed of in a safe manner. Any products containing batteries must have them removed before disposal, in order to avoid short circuits. Particular regulations within the country of operation may apply to the disposal of lithium batteries.

2.4 Declaration of conformity

The device being the subject of this instruction was constructed, prepared and manufactured for the purpose of use in the industrial environment. The design and manufacturing process of the device complies with the norms that ensure the realization of specific rules and precautions, provided that the user obeys the given guidelines of the device installation, start, and operation. This device complies with the following EU directive resolutions provided in the table below.

Table 3. EU directive resolutions

NAME	DESCRIPTION
2014/30/EU	Electromagnetic Compatibility Directive (EMC)
2014/35/EU	Compliance with Low Voltage Directive (LVD)

The compliance to the above-mentioned directives was confirmed by measurement and research laboratories and development centres independent from the manufacturer.

Table 4. EU directive resolutions and tests.

NAME	DESCRIPTION
Low Voltage Directive:	
EN 60950-1:2006/A1 1:2009	Information technology equipment – Safety Part 1: General requirements
Electromagnetic disturbances:	
EN 55022:2010 (CISPR 22:2008)	Conducted disturbance at the mains ports
	Conducted disturbance at the telecommunication ports
	Radiated disturbance to 1 GHz
EN 61000-3-2:2006 EN 61000-3-2:2006/A1:2009 EN 61000-3-2:2006/A2:2009	Harmonic current emission
Electromagnetic immunity:	
EN 61000-4-3:2006 EN 61000-4-3:2006/A1:2008 EN 61000-4-3:2006/A2:2010	Radiated RF electromagnetic field immunity test
EN 55024:2010 EN 61000-4-2:2009	Electrostatic discharge immunity test
EN 55024:2010 EN 61000-4-4:2012	Electrical fast transients/burst immunity test (power port)
EN 55024:2010 EN 61000-4-4:2012	Electrical fast transients/burst immunity test (signal ports)
EN 55024:2010 EN 61000-4-5:2006	Surges immunity test (power port)
EN 55024:2010 EN 61000-4-5:2006	Surges immunity test (signal ports)
EN 55024:2010 EN 61000-4-6:2014	Conduced disturbances, induced by radio-frequency fields (power ports)
EN 55024:2010 EN 61000-4-6:2014	Conduced disturbances, induced by radio-frequency fields (signal ports)
EN 55024:2010 EN 61000-4-8:2010	Power frequency magnetic field immunity test
EN 61000-4-16:2016	Main frequency voltage (power ports)
EN 61000-4-17:2011	Ripple on d. c. power supply (power ports)
EN 61000-4-18:2011	Damped oscillatory wave (power ports) Common mode Differential mode
EN 61000-4-29:2004	Voltage dips (power ports)
Environmental tests:	
EN 60068-2-2:2007	Dry heat (70°C for 24h)

NAME	DESCRIPTION
EN 60068-2-6:2008	Vibration (2g, 10-500Hz, 1octave/min, 10 sweep cycles)
EN 60068-2-78:2013	Damp heat, steady state (95% RH and 40°C for 48h)
Control Management Software (CMS) tested by DNV GL:	
IEC 61850 Edition 2 Parts 6, 7-1, 7-2, 7-3, 7-4 and 8-1	Communication networks and systems for power utility automation
IEC 60870-5-104 Edition 2 (IS 2006)	Network Access for IEC 60870-5-104 using standard transport profiles in Standard direction and the Enilit default Protocol Implementation Document for IEC 60870-5-104 v.3.
IEC 60870-5-101 Edition 2 (IS 2003)	Companion Standard for basic telecontrol tasks in Standard direction and the UAB Enilit IEC 60870-5-101 Master and Slave Station Unbalanced Interoperability Checklist (Version 1.2, 2019).

2.5 Handling of electronic equipment

A person's normal movements can easily generate electrostatic potentials of several thousand volts.

The discharge of these voltages into semiconductor devices when handling circuits can cause serious damage which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of UAB Enilit products are immune to the relevant levels of electrostatic discharge when housed in their cases. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices.

However, if it becomes necessary to withdraw a module, the following precautions should be taken in order to preserve high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure the user is of the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.
3. Do not pass the module to any person without first ensuring that both persons are at the same electrostatic potential. Shaking hands achieves equipotential.
4. Place the module on an antistatic surface or conducting surface which is at the same potential as the user.
5. Store or transport the module in a conductive bag.

If measurements are being made on the internal electronic circuitry of any equipment in service, it is preferable that the user is earthed to the case with a conductive wrist strap.

Wrist straps should have a resistance to ground between 500k–10M Ohms. If a wrist strap is not available, a regular contact with the case should be maintained to prevent the build-up of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in IEC 60147-0F and BS5783.

2.6 Warnings regarding the use of UAB Enilit products

UAB Enilit products are not designed with components tested for the level of reliability suitable for the use in connection with surgical implants or as critical components in any life support systems, whose failure to perform can reasonably be expected to cause significant injuries to a human.

In any application including the above, the reliability of operation of the software products can be impaired by adverse factors, including – but not limited – to fluctuations in electrical power supply, computer hardware malfunctions, computer operating system, software fitness, fitness of compilers and development software used to develop an application, installation errors, software and hardware compatibility problems, malfunctions or failures of electronic monitoring or control devices, transient doubles of electronic systems (hardware and/or software), unanticipated uses or misuses, or errors from a user or applications designer (adverse factors such as these are collectively termed 'System failures').

Any application where a system failure would create a risk of harm to property or persons (including the risk of bodily injuries and death) should not be reliant solely upon one form of electronic system due to the risk of system failure to avoid damage, injury or death. The user or application designer must take reasonable steps to protect against system failure, including – but not limited – to back-up or shut-down mechanisms, not because end-user system is customized and differs from UAB Enilit testing platforms but also the user or application designer may use UAB Enilit products in combination with other products.

These actions cannot be evaluated or contemplated by UAB Enilit; Thus, the user or application designer is ultimately responsible for verifying and validating the suitability of UAB Enilit products whenever they are incorporated in a system or application, even without the limitation of the appropriate design, process and safety levels of such a system or application.

2.7 Guarantees

UAB Enilit guarantees that the information in this document is accurate. The document has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, UAB Enilit reserves the right to make changes to subsequent editions of this document without prior notice to the holders of this edition. The reader should consult UAB Enilit if errors are suspected. In no event shall UAB Enilit be liable for any damages arising out of or related to this document or the information contained in it.

The media, on which UAB Enilit software is received, is guaranteed not to fail executing programming instructions due to defects in materials and workmanship, for a period of 90 days from the date of shipment, as evidenced by receipts or other documentation. UAB Enilit will, at its option, repair or replace software media that do not execute programming instructions if UAB Enilit receives notice of such defects during the warranty period determined in the purchase agreement.

Disclaimer of Warranties. UAB Enilit makes no and disclaims all warranties, express or implied, including the implied warranties of merchantability, fitness for a particular purpose and non-infringement, with respect to the product, to the extent permitted by applicable law. UAB Enilit makes no representations or warranties as to the quality, suitability or adequacy of the product for any purpose or use.

Customer's rights to recover damages caused by fault or negligence on the part UAB Enilit shall be limited to the amount therefore paid by the customer. UAB Enilit will not be liable for damages resulting from the loss of data, profits, use of products or incidental or consequential damages even if advised of the possibility thereof. This limitation of the liability of UAB Enilit will apply regardless of the form of action, whether in contract or tort, including negligence. Any action against UAB Enilit must be brought within one year after the cause of action accrues. UAB Enilit shall not be liable for any delay in performance due to causes beyond its reasonable control. The warranty provided herein does not cover damages, defects, malfunctions, or service failures caused by owner's failure to follow the UAB Enilit installation, operation, or maintenance instructions.

Owner's modification of the product; owner's abuse, misuse, or negligent acts; and power failure or surges, fire, flood, accident, actions of third parties, or other events outside reasonable control.

2.8 Copyright

3. ENILIT RTU HARDWARE

3.1 System conception

Enilit RTU is a modular, freely scalable remote control and automation device. Manufacturer ensures technical support for all hardware parts for at least 10 years period.

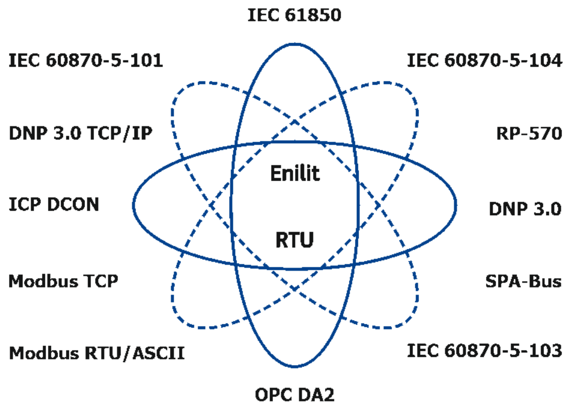
The field of its application covers fully automatic monitoring and control of decentralized process stations or RTUs (e.g. in medium voltage switch bays). Plug-in I/O modules serve for process connection, and communication modules are available for the additional connection of subsystems (e.g. for serial connection of sensors and actuators).

Communication between different RTUs and between RTUs and the control centre can take place via different media, for instance:

- dedicated lines (private or leased lines) based on copper cables or glass FO cables;
- dial-up connections via analogue telephone network, digital ISDN network and GSM networks (900 MHz, e.g. D1 or D2);
- serial interfaces V.24/V.28 in combination with transmission systems like PCM30, PDH or SDH systems, or with private radio networks;
- LAN/WAN connections via 10/100/1000 MB/s-Ethernet and TCP/IP.

It supports the following communication protocols:

- IEC 60870-5-101
- IEC 60870-5-103
- IEC 60870-5-104
- DNP3 serial
- DNP3 TCP/IP
- IEC 61850 ed.2
- Modbus RTU/ASCII
- Modbus TCP
- RP-570
- OPC DA2
- SPA-Bus
- ICP DCON



In its standard form, data transmission takes place via IEC 60870-5-101 protocol (symmetrical and asymmetrical procedure). Protection equipment can be connected via IEC 60870-5-103, Modbus RTU, DNP3, IEC 61850 ed.2, SPA-Bus and RP570 protocols.

Network interfaces enable communication via IEC 60870-5-104, DNP3 (possibility to use DNP3 with secure authentication) and Modbus TCP protocol.

It is possible to use secure connections (SSL/TLS). Enilit RTU can use X.509 certificates for authentication. The functionalities of RADIUS and LDAP are constituent parts of OS Windows and both of them are enabled by default or could be disabled, if unnecessary.

Enilit RTU has the integrated firewall and possibility to install security updates for better protection against internal and external damage.

Enilit RTU supports Syslog protocol what allows event logs to be sent to a remote Syslog server. The feature is installed by default in all RTU. All the logs with exact time, event type (level), sources are gathered from OS. Automation tasks are integrated by the means of the optional PLC (programable logic controller) functionality according to IEC 61131-3. Configuration and management can be carried out either locally via the software or via the network from a remote computer.

3.2 Rack mounting and frame

The frame of Enilit RTU consists of the components of a metal housing, an internal bus system and a plug-in system.

A standard RTU includes at least a power supply module and a central processor module. There can be up to 12 I/O and/or communication modules installed by the RTU.

More I/O modules can be achieved by connecting extended frame to a standard one. The extension frame should have at least one power supply and can have up to 16 I/O or communication modules of any type. The frames are connected with an external cable for communication between the CPU and the modules of the extension frame. Expanding Enilit RTU with the extension frame, will result in there being a total of 28 module slots.

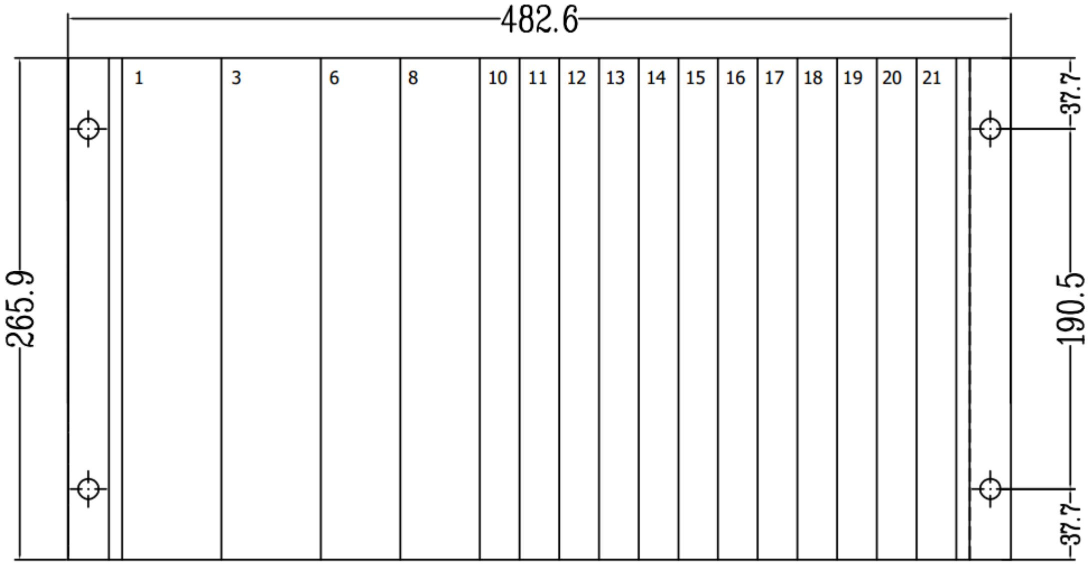
Note: Extension may only be connected to a standard sized frame.

For smaller installations where the CPU and only 4 or less I/O modules are needed, a small frame could be utilized which may either have redundant or non-redundant power supplies which changes the number of module slots allowed as shown in table 5.

In the table 5 below, all possible frame configurations are shown.

Table 5. Frame sets

RACK TYPE	SLOTS FOR POWER SUPPLY	SLOTS FOR CPU	SLOTS FOR I/O or COMMUNICATION MODULES
Standard	2 pcs.	2 pcs.	12 pcs.
Extended	2 pcs.	0 pcs.	16 pcs.
Small	a)2 or b)1 pc.	a)2 or b)1 pc.	a)1 or b)6 pcs.



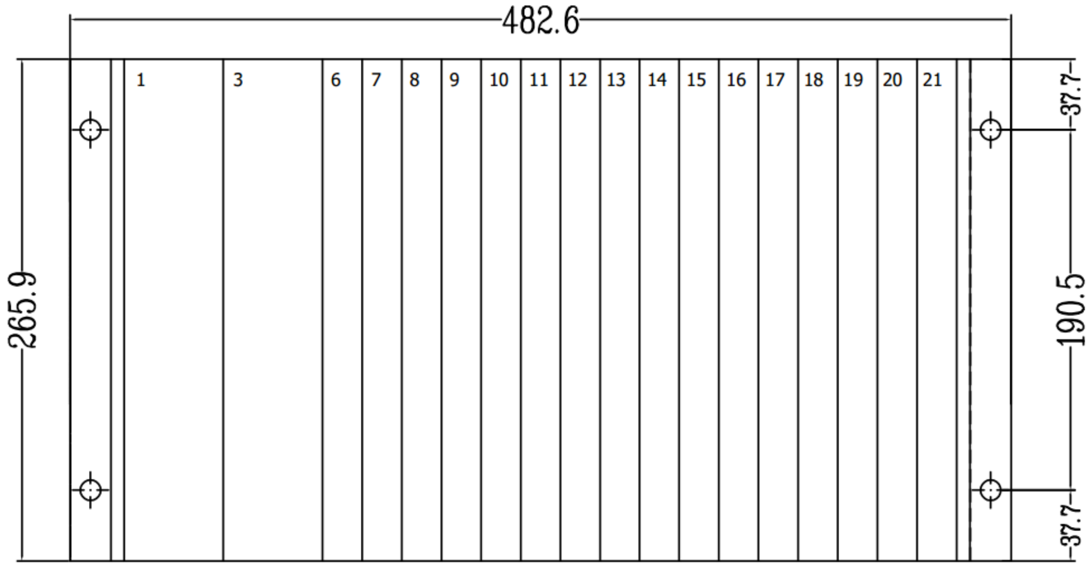


Figure 2. Standard and extended frame, Front view

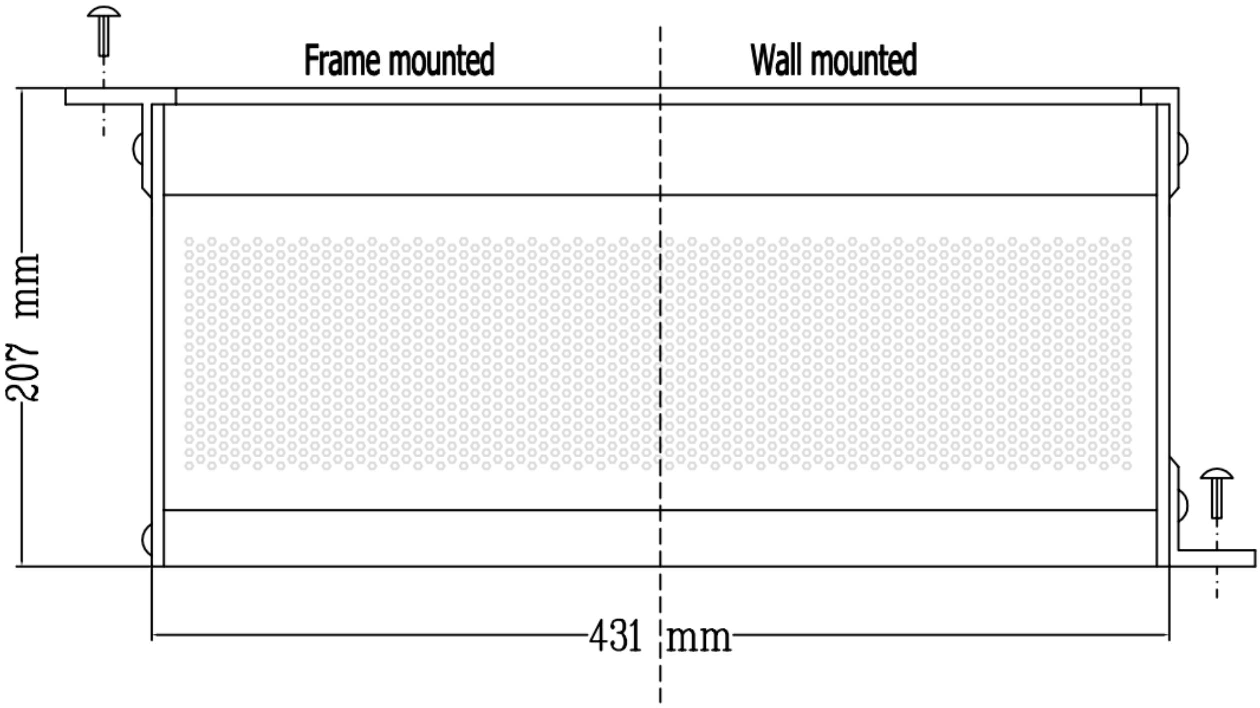


Figure 3. Standard or extended frame, Top view

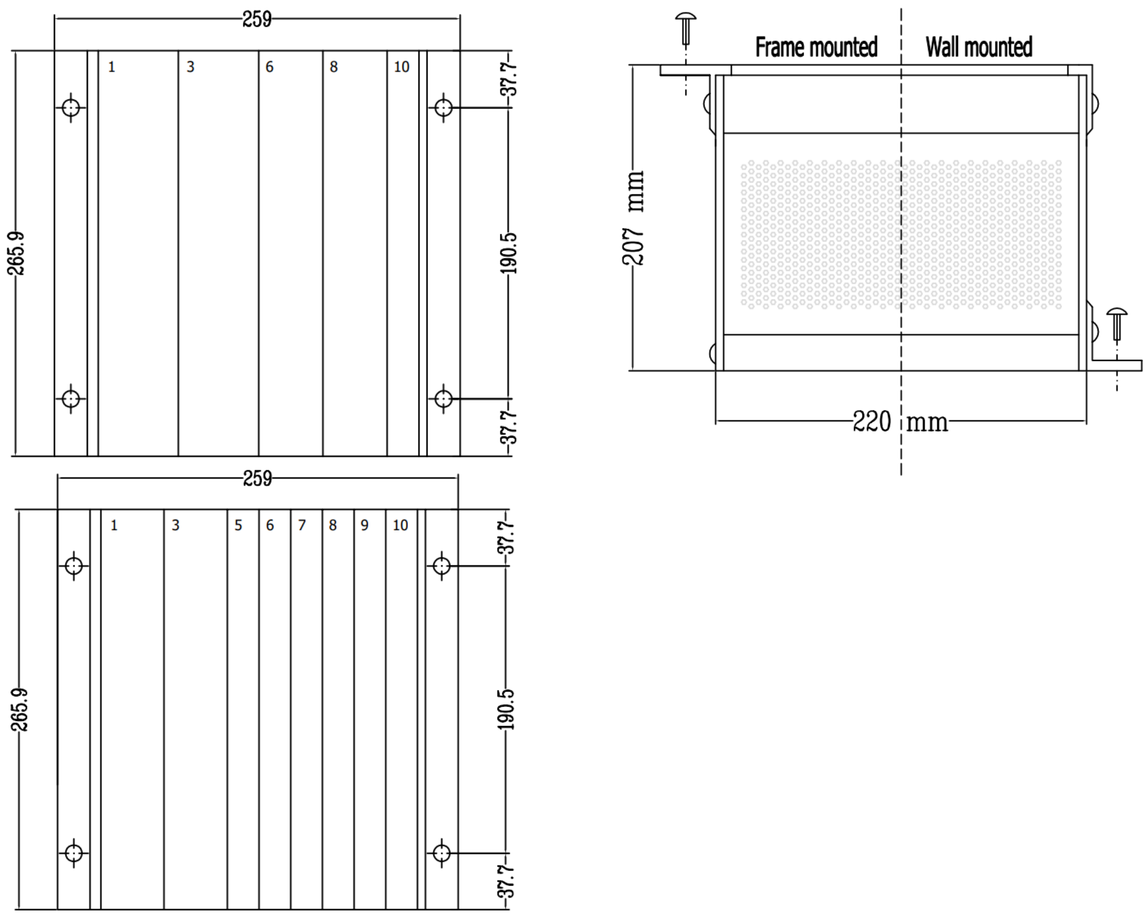


Figure 4. Small frame, Front and top view

3.3 Short hardware review

The remote terminal unit Enilit RTU comes in a standard 6U frame system under the protection class IP-20. A single frame can include:

- Up to two power supply modules;
- Up to two central processor (CPU) modules (unless extended option is selected);
- Number of I/O and communication modules depends on which type of frame is selected, there is no difference for Enilit RTU in which sequence or type (DI, DO, AI, ST, PL, CD, CK or LAN) the modules are installed in the rack. Refer to table 5 for the number of modules, meanwhile refer to Figure 5 to view all the RTU frame content options based on power supply and size/type of the frame.

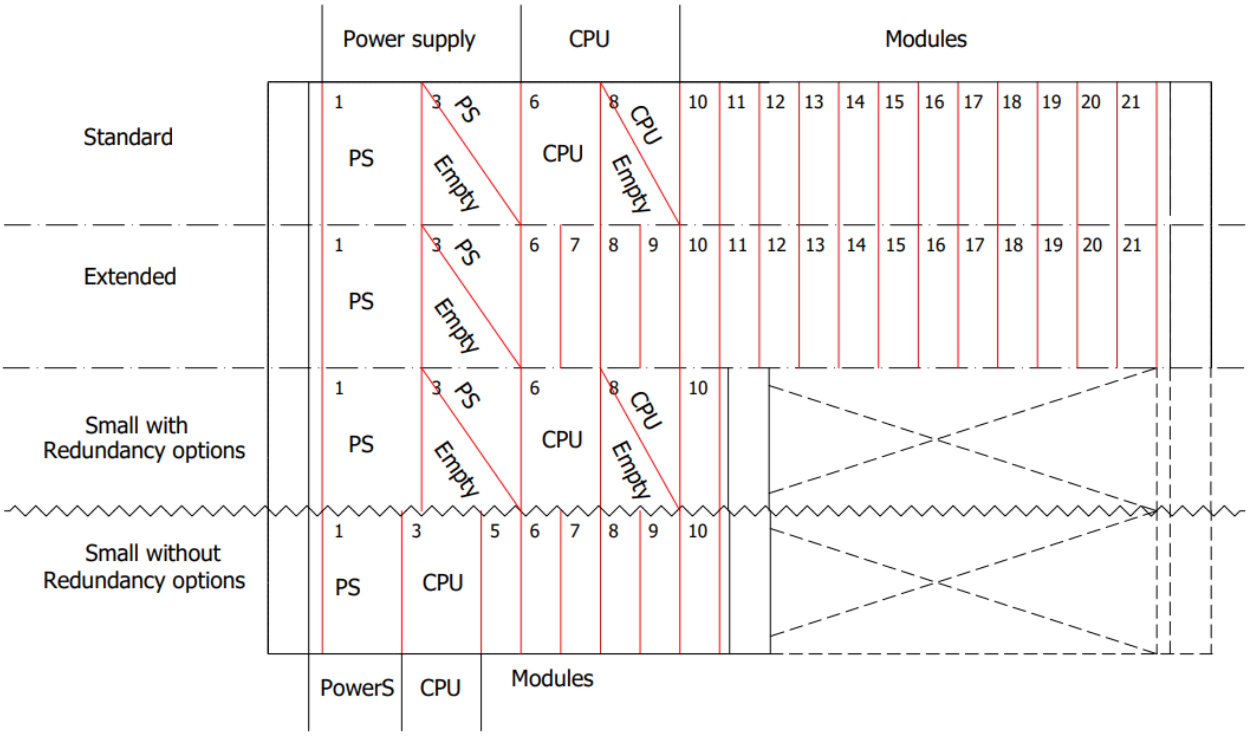


Figure 5. Enilit RTU, Front view

Note: Enilit will add PS and/or CPU redundancy upon special request

3.3.1 Power supply module

The types of power supply modules available are listed in the table 6 below.

Table 6. Types of power supply modules

APPLICATION	MODULE
Input for nominal voltage 230V AC/220V DC	PS-21
Input for nominal voltage 110V DC	PS-31
Input for nominal voltage 48V or 24V DC	PS-51

Note: A power supply module of any range of AC or DC input is available on special request.

3.3.2 Central processor module

The central processor module is in charge of the operation of the communication interface, I/O modules, the acquisition and archiving of process information and the execution of PLC functions.

The following central processor module available in the standard version is provided in table 7 below.

Table 7. Central processor module

MODULE	COMMUNICATION INTERFACES
CPU-412	4 Ethernet (RJ45), 12 Serial links (RJ45)
CPU-484	4 Ethernet (RJ45), 8 Serial links (RJ45) plus 2 MM TX/RX with 820 nm Wavelength.

Note: Since 2024 Enilit RTU is only sold with newest version of CPU-412 or CPU-484.

3.3.3 I/O modules

Depending on the scope of process data, it is possible to fit free slots with the necessary I/O modules irrespectively of the signal type.

The I/O modules available are listed in the table 8 below.

Table 8. I/O modules

APPLICATION	MODULE	I/O	DESCRIPTION
Digital input module	DI-11	24	24VDC
Digital input module	DI-21	24	48VDC
Digital input module	DI-31	24	110VDC
Digital input module	DI-41	24	220VDC
Digital output module	DO-31	24	DC13, 250VDC, 0.2A
Analogue input module	AI-31	12	-20mA ... +20mA or -10V ... 10V
Analogue output module	AO-31	8	-24mA ... +24mA or -12V ... 12V

3.3.4 Communication extension modules

Depending on the scope of process data, it is possible to fit free slots with the necessary communication extension modules. The communication extension modules available are listed in table 9 below.

Table 9. Communication extension modules

APPLICATION	MODULE	PORTS	DESCRIPTION
Glass fibre optic module	ST-61	6	6 x FO (ST type)
Plastic fibre optic module	PL-61	6	6 x FO (PL type)
Communication module	CD-61	6	6 x RS-232
Communication module	CK-61	6	6 x RS-485
Ethernet communication module	LAN-21	2	2xLAN

3.4 Additional features

An external DP compatible monitor, keyboard and mouse or can be used for monitoring, management and configuration of Enilit RTU.

An external touch screen monitor can be used for visualization and control of one or several feeders (HMI).

A computer with SCADA can be used for local substation management.

Enilit RTU can be used as a protocol converter (gateway).

3.5 Central processor unit (CPU) module

There are two types of CPUs which get installed into Enilit RTU, which are modules CPU-412 and CPU-484. Communication interfaces which it features are:

Table 10. Communication ports of CPUs

CPU	
CPU-412	**CPU-484**
4 x Ethernet (RJ45)	
12 x Universal Serial links (RJ45)	8 x Universal Serial links (RJ45) Serial links
	2 x Fiber optic pairs where data speed is adjustable (see table 61).

Any of the 12/8 universal Serial links (COM 1-12/8) can be used as either RS485 or RS232. The CPU module serves for the operation of communication interfaces, the control of I/O and communication extension modules, the acquisition and archiving of process information, and the execution of PLC programs. Explanation of all of the interface components can be found in Table 11.

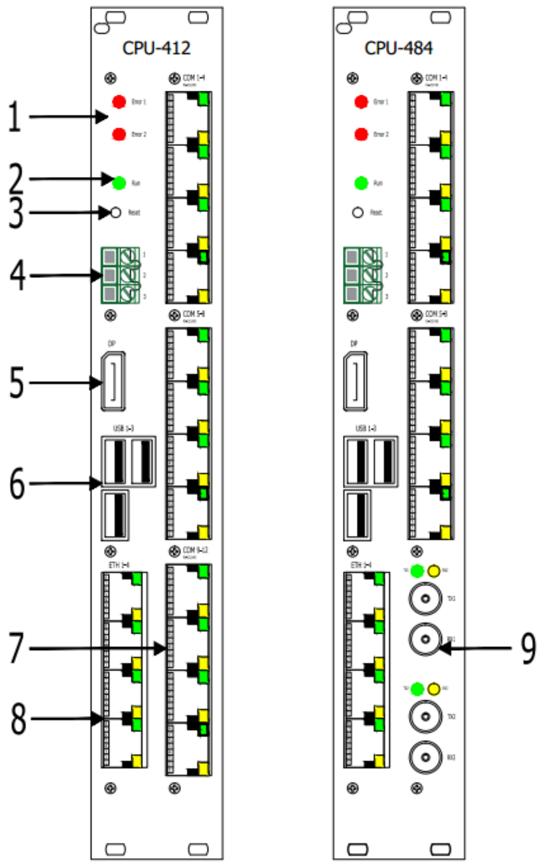


Figure 6. Central processor module, Front view

Note: Since 2024 Enilit RTU CPUs only use universal ports. Although it is possible to order non-universal ports upon request.

Table 11. Constituents of central processor unit module and their assignment

No.	EXPLANATION	NOTE	FUNCTION	LED INDICATION
1	LED indicator	Error1	Hardware configuration status	LED is blinking – there is a mistake in the hardware configuration.
		Error2	User defined	
2	LED indicator	Run	CPU status	LED is blinking – the device is running alright.
3	Push button	Reset	Manually reset device by pushing	
4	Connection terminals		Watchdog	
5	VGA or DP socket	Since October 2022 used DP socket	Socket to connect LCD monitor	
6	USB socket	USB1-USB4	Socket to connect keyboard, mouse, USB stick and etc.	
7	Serial communication interface socket RJ-45	COM1-COM12 COM1-COM8	Connects to other RTUs, IEDs or protection devices.	
8	Ethernet communication interface socket RJ-45	ETH1-ETH4	Connect control centres or protection devices.	
9	2 MM TX/RX with 820 nm Wavelength	RX1;2/TX1;2	Connects to other RTUs, IEDs or protection devices.	

Note. If Error1 and Error2 LEDs light up and the RUN LED is OFF, it means the CPU module is in failure or the system is in the starting up mode.

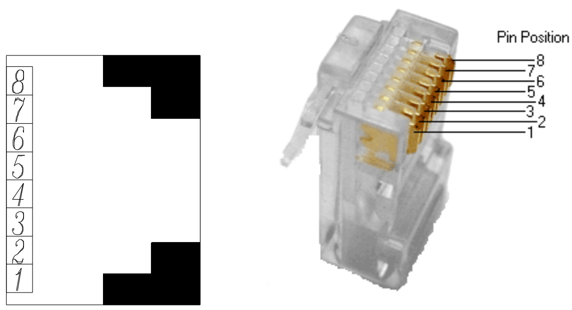
3.5.1 Serial communication interface (RJ-45) integrated in CPU module

CPU-412 has 12 serial communication ports and CPU-484 has 8 serial communication ports. The serial communication interfaces (RS232/485) are designed as 8-pole RJ45 connectors with integrated LEDs. The DTR, DCD, RTS, CTC could be added by special request.

Table 12. CPU module RJ-45 (COM) connector pin assignment for RS232/422/485

PIN	DESIGNATION		
	RS-232	RS-485 (full duplex)	RS-485 (half duplex)
1	Not used	Not used	Not used
2	RXD	RX+	Data+
3	TXD	TX-	Data-
4	Not used	Not used	Not used
5	GND	GND	GND
6	Not used	Not used	Not used
7	RTS	TX+-	Data+
8	CTS	RX- -	Data-

Note: Data+ (2 and 7 wires) and Data- (3 and 8 wires) need to be connected together at the end device.



a) RTU side b) Cable side

Figure 7. RJ45 connector

The status of each communication interface is shown via the two software-controlled LEDs that are installed in the connectors.

The yellow LED is activated during the transmission of data in the transmission direction. The green LED is activated during the transmission of data in the receive direction.

3.5.2 Ethernet interface (RJ-45) integrated in CPU module

Ethernet communication interfaces are designed as 8-pole RJ45 connectors with integrated LEDs.

Table 13. Pin assignment

PIN	DESIGNATION
1	-TX
2	+TX
3	+RX
4	BI_DC+
5	BI_DC-
6	-RX
7	BI_DD+
8	BI_DD-

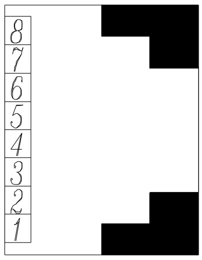


Figure 8. RJ45 connector

The status of each communication interface is shown via the two software-controlled LEDs that are installed in the connectors:

The green LED lights up if there is a physical connection to the device, i.e. if the connection layer is in operation. The yellow LED is activated during the transmission of data in the transmission or the receive direction.

3.5.3 Parallel Redundancy Protocol (PRP)

Parallel Redundancy Protocol (PRP) is supported by Enilit RTU and no additional equipment is required. PRP is a network protocol standard according to IEC62439-3 standard for the Ethernet that provides a seamless failover against a failure of any network component.

More in depth in Chapter 4.16 Redundancy.

3.5.4 Technical data

Table 14. Technical data of central processor unit

FEATURE	VALUE
Fanless cooling processor	64-bit microprocessor – 1.6 ... 1.8GHz. internal watchdog; 4 GB Dynamic memory DRAM; 32 GB eMMC (for software, databases, events, waveforms, parameters);
Communication interfaces	RS232 RS485 / RJ45 socket (8-pin socket); DTE / max. speed: 115,2Kb;

FEATURE	VALUE
Ethernet interface	Ethernet (10/100/1000 Base-TX) / RJ45 socket (8-pin socket) Twisted-pair cable CAT5 / speed: 10/100/1000Mbps
Working temperature	-25 ~ +85°C, the range can be extended on request
Working humidity	5 ~ 95% RH non-condensing

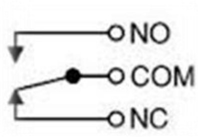
3.5.5 Watchdog

Table 15. Watchdog functioning of Enilit RTU

WATCHDOG STATE	DESCRIPTION
Normal	Device is turned on, Enilit CMS is working, RTU hardware configuration state has no abnormal card states.
Normal	Device is starting. The period of timeout in the watchdog relay has not expired yet.
Error	Device is turned off.
Error	Configuration and management software Enilit CMS is closed and the period of timeout in the watchdog relay has expired.
Error	RTU hardware configuration window shows abnormal card states.
Error	RTU has detected a hardware error.

Table 16. Contacts of watchdog relay

TERMINAL	FUNCTION
1	NO
2	COM
3	NC



3.6 Power supply module

There are five types of power supply modules available as listed in the table below. All the types of power supply modules have protections against overvoltage, overload, short circuit, overheating.

Table 17. Power supply modules

APPLICATION	MODULE
Input nominal voltage 230VAC/220VDC	PS-21
Input nominal voltage 110VDC	PS-31
Input nominal voltage 24VDC or 48VDC	PS-51

In one Enilit RTU, one (non-redundant) or two (redundant) power supply modules can be installed. When redundant option is used, either of the Power supplies can be supplied by different voltage sources: e.g., one from an AC and another from a DC supply voltage at the same time.

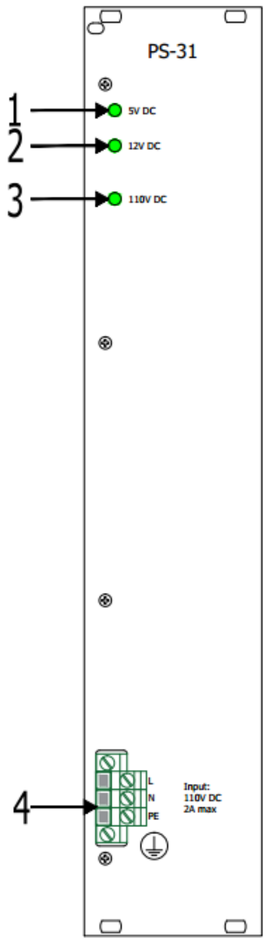


Figure 9. Power supply module, Front view

Table 18. Constituents of PS module and their assignment

No	EXPLANATION	NOTE	FUNCTION	LED INDICATION
1	LED indicator	5V	PS output voltage status	LED is ON – voltage is OK
2	LED indicator	12V	PS output voltage status	LED is ON – voltage is OK
3	LED indicator	24VDC 48VDC 110VDC 230VAC 220VDC	PS input voltage status	LED is ON – voltage is OK
4	Input voltage connection terminals			

3.6.1 Wiring

Table 19. Pin assignment of input socket in PS module

TERMINAL	FUNCTION	
	AC Voltage	DC Voltage
L(+)	L1	+
N(-)	N	-
PE	Ground	Ground

3.6.2 Technical data

Table 20. Technical data of PS module

FEATURE	VALUE
Input voltage range: - Input voltage range PS 21 - Input voltage range PS 31 - Input voltage range PS 51	 176 ~ 264VAC/176 ~ 264VDC 43 ~ 160VDC 16.5 ~ 75VDC
Frequency range	47 ~ 63Hz
Maximum power consumption	70W
Working temperature	-25 ~ +85°C
Working humidity	0 ~ 95% RH non-condensing
Removable Internal fuses: -PS 21 -PS 31 -PS 51	 2A 4A 6A

3.7 Digital input (DI) module

Digital input (DI) module serves for the processing of up to 24 digital input signals.

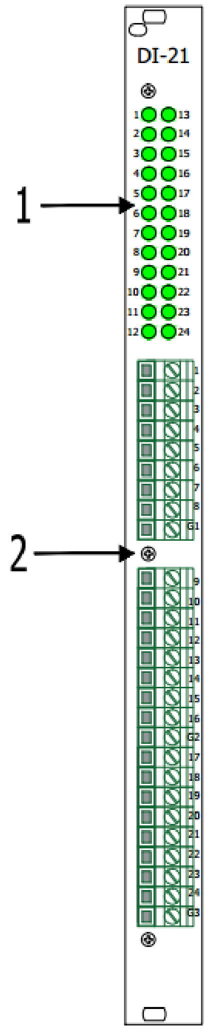


Figure 10. Digital input (DI) module, Front view

Table 21. Constituents of DI module and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	LED indicators for each digital input	Digital input status	LED is ON – the input is active; LED is OFF – the input is inactive; ALL LEDS are blinking together – there is no connection with CPU or there is an error at the digital input module.
2	Connection terminals	See table 21 and wiring diagram in Fig. 11	-

3.7.1 Wiring diagram

Table 22. Pin assignment of DI module

TERMINAL	FUNCTION
1	DI 1
2	DI 2
3	DI 3
4	DI 4
5	DI 5
6	DI 6
7	DI 7
8	DI 8
G1	COM
9	DI9
10	DI10
11	DI11
12	DI12
13	DI13
14	DI14
15	DI15
16	DI16
G2	COM
17	DI17
18	DI18
19	DI19
20	DI20
21	DI21
22	DI22
23	DI23
24	DI24
G3	COM

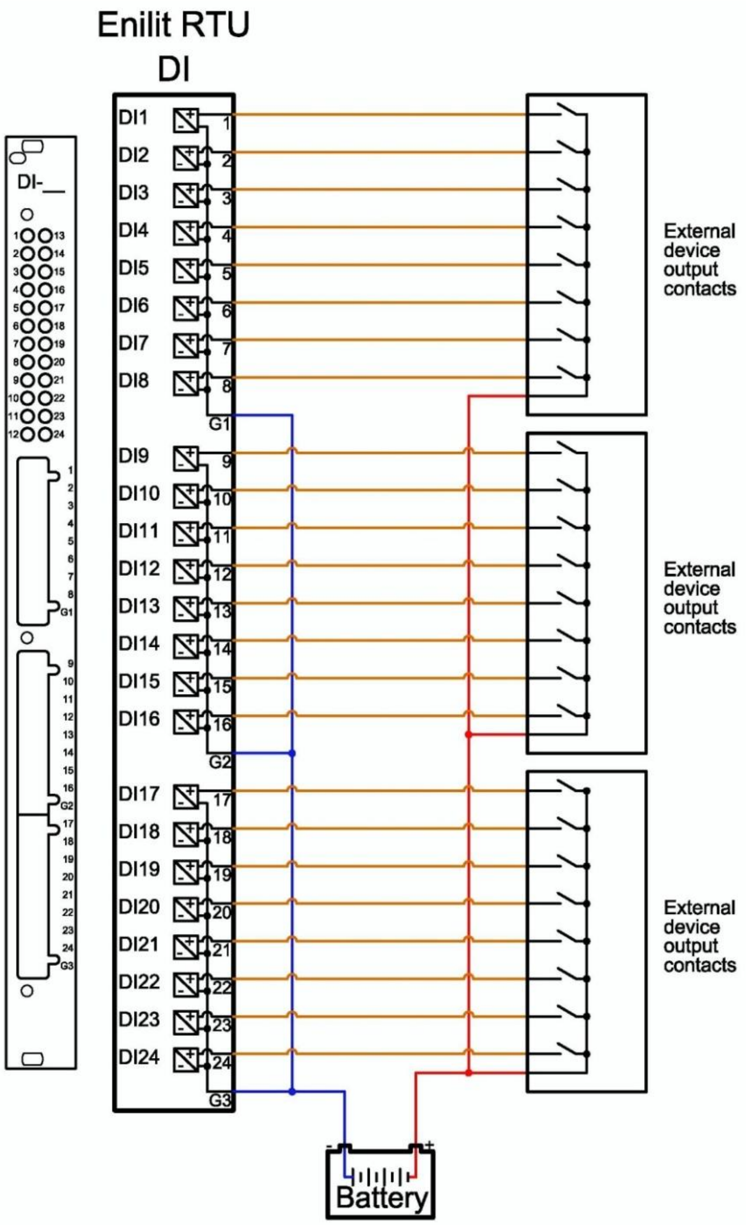


Figure 11. Digital input module, Wiring diagram

3.7.2 Technical data

Table 23. Technical data of DI module

FEATURE	VALUE
Number of inputs	24
Time tag	1ms
Galvanic isolation - from system electronics - of the channels from one another	Yes (optocoupler) No (groups of 8 channels share a common ground)
Signalling-circuit voltage - Input voltage range DI 11 - Input voltage range DI 21 - Input voltage range DI 31 - Input voltage range DI 41	16 ... 30VDC 34 ... 72VDC 80 ... 150VDC 150 ... 264VDC
Increased insulation resistance according to IEC 60255-5 - power-frequency withstand voltage - surge voltage	2.5kV; 50Hz; 1min 4.4kV; 1.2/50μs; 0.5J
Power consumption for active binary input ‘’	1 – 3mA (depending on the used voltage)

3.8 Digital output (DO) module

Digital output (DO) module serves for the processing of up to 24 digital outputs.

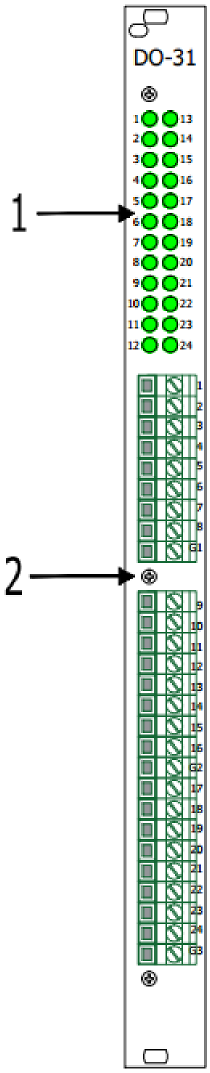


Figure 12. Digital output (DO) module, Front view

Table 24. Constituents of DO module and their assignment

No.	DESCRIPTION	FUNCTION	LED INDICATION
1	LED indicators for each digital output	Digital output status	LED is ON – output is active; LED is OFF – output is inactive; ALL LEDS are blinking together – no connection with CPU or digital output board error.
2	Connection terminals	See table 24 and wiring diagram in Fig. 13 below.	-

3.8.1 Wiring diagram

Table 25. Pin assignment of DO module

TERMINAL	FUNCTION
1	DO1
2	DO2
3	DO3
4	DO4
5	DO5
6	DO6
7	DO7
8	DO8
G1	COM
9	DO9
10	DO10
11	DO11
12	DO12
13	DO13
14	DO14
15	DO15
16	DO16
G2	COM
17	DO17
18	DO18
19	DO19
20	DO20
21	DO21
22	DO22
23	DO23
24	DO24
G3	COM

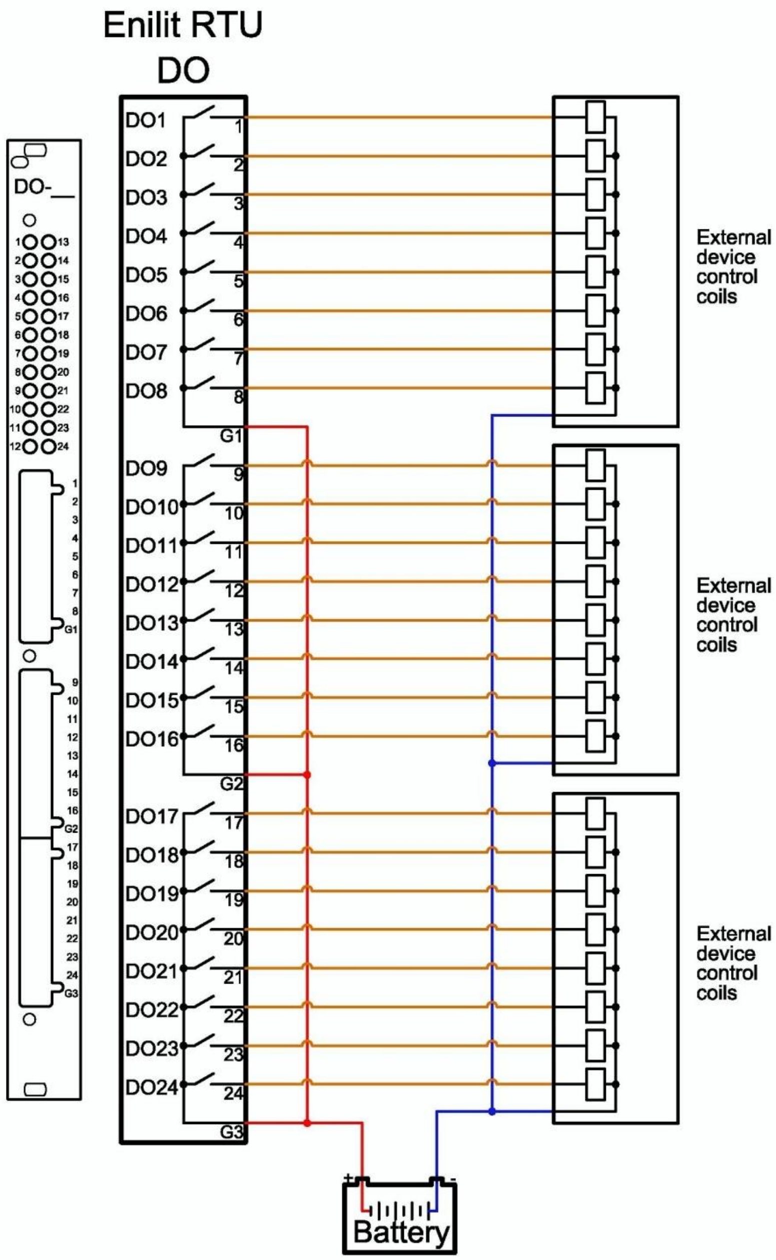


Figure 13. Digital output module, Wiring diagram

3.8.2 Technical data

Table 26. Technical data of DO module

FEATURE	VALUE
Number of outputs	24
Galvanic isolation: - from system electronics; - of channels from one another.	 Yes (optocoupler) Yes
Switching capacity by default: AC1 AC15 AC3 DC1 DC13	 8A / 250VAC 3A / 120V; 1,5A / 240V (B300) 0,37kW; 240VAC (single-phase motor) 8A / 24VDC 0,22A / 120V; 0,1A / 250V (R300)
Voltage (control circuit of the relay): - rated value; - operating range.	 12VDC 3 ... 220V
Increased insulation resistance according to IEC 60255-5: - power-frequency withstand voltage; - surge voltage.	 2.5kV; 50Hz, 1min 4.4kV; 1.2/50µs; 0.5J

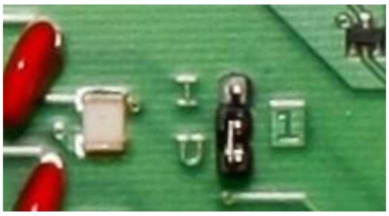
Note: Any auxiliary relays with larger disconnection capacity can be installed on customer request.

3.9 Analogue input module AI-31

Analogue input module AI-31 serves for the processing of up to twelve analogues, current or voltage input signals.

Note. Measuring current or voltage can be selected for each input separately by the internal jumper position.

Current -20mA to +20mA measuring



Voltage -10V to +10V measuring

Figure 14. Analogue input switch position

Table 27. Constituents of analogue input module AI-31 and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	LED indicators for each analogue input	Analogue input status	LED is OFF – normal measured value; LED is ON – measured value is under or over range; ALL LEDS are blinking together – there is no connection with CPU or there is an error in the analogue input module.
2	Connection terminals	See table 27 and wiring diagram in Fig. 16 below	-

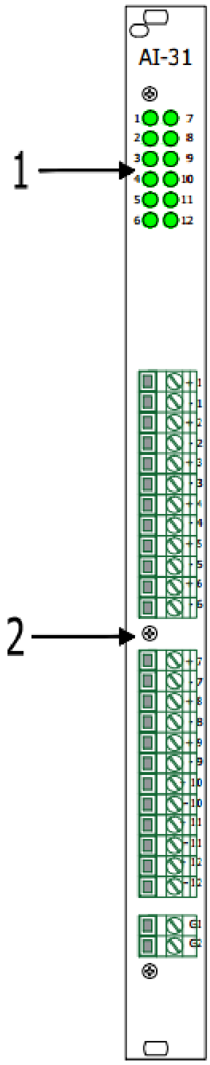


Figure 15. Analogue input module, Front view

3.9.1 Wiring diagram

Table 28. Pin assignment of AI-31 module

TERMINAL	FUNCTION
+1	Analogue input 1+
-1	Analogue input 1-
+2	Analogue input 2+
-2	Analogue input 2-
+3	Analogue input 3+
-3	Analogue input 3-
+4	Analogue input 4+
-4	Analogue input 4-
+5	Analogue input 5+
-5	Analogue input 5-
+6	Analogue input 6+
-6	Analogue input 6-
+7	Analogue input 7+
-7	Analogue input 7-
+8	Analogue input 8+
-8	Analogue input 8-
+9	Analogue input 9+
-9	Analogue input 9-
+10	Analogue input 10+
-10	Analogue input 10-
+11	Analogue input 11+
-11	Analogue input 11-
+12	Analogue input 12+
-12	Analogue input 12-
G1	Ground
G2	Ground

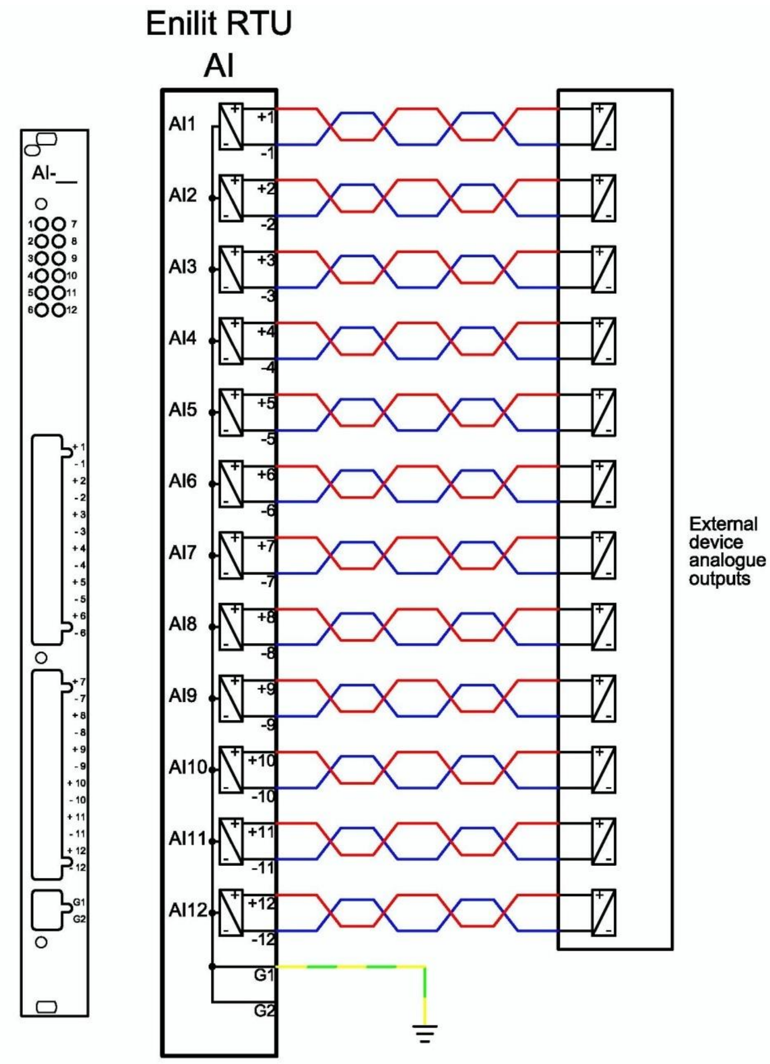


Figure 16. Analogue input module AI-31, Wiring diagram

3.9.2 Technical Data

Table 29. Technical data of analogue input module AI-31

FEATURE	VALUE
Number of inputs	12
Galvanic isolation: -from system electronics; -of the channels from one another.	 Yes (optocoupler) Yes
Measuring ranges (standard fitting)	Configurable via switch
Resolution in all ranges	16 bit
Acquisition cycle maximum	100ms
Increased insulation resistance according to IEC 60255-5: -power-frequency withstand voltage; -surge voltage.	 2.5kV; 50Hz, 1min 4.4kV; 1.2/50µs; 0.5J

3.10 Analogue Output module AO-31

Analogue Output module AO-31 serves for the processing of up to eight analogues, current or voltage output signals.

Table 30. Constituents of analogue output module AO-31 and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	LED indicators for each analogue output	Analogue output status	LED is OFF – normal output; LED is ON – abnormal output, short circuit, open loop; ALL LEDS are blinking together – there is no connection with CPU or there is an error in the analogue output module.
2	Connection terminals	See table 30 and wiring diagram in Fig. 18 below	-

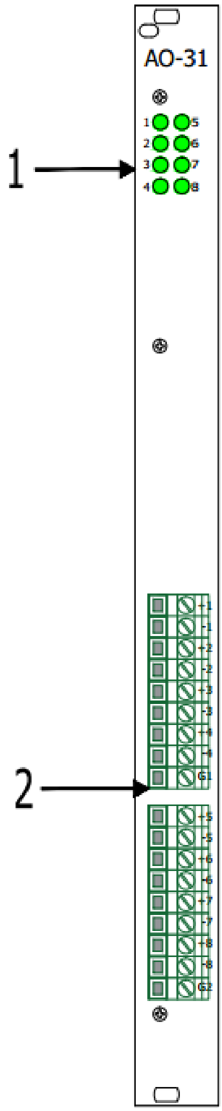


Figure 17. Analogue output module, Front view

3.10.1 Wiring diagram

Table 31. Pin assignment of AO-31 module

TERMINAL	FUNCTION
+1	Analogue output 1+
-1	Analogue output 1-
+2	Analogue output 2+
-2	Analogue output 2-
+3	Analogue output 3+
-3	Analogue output 3-
+4	Analogue output 4+
-4	Analogue output 4-
+5	Analogue output 5+
-5	Analogue output 5-
+6	Analogue output 6+
-6	Analogue output 6-
+7	Analogue output 7+
-7	Analogue output 7-
+8	Analogue output 8+
-8	Analogue output 8-
G1	Ground
G2	Ground

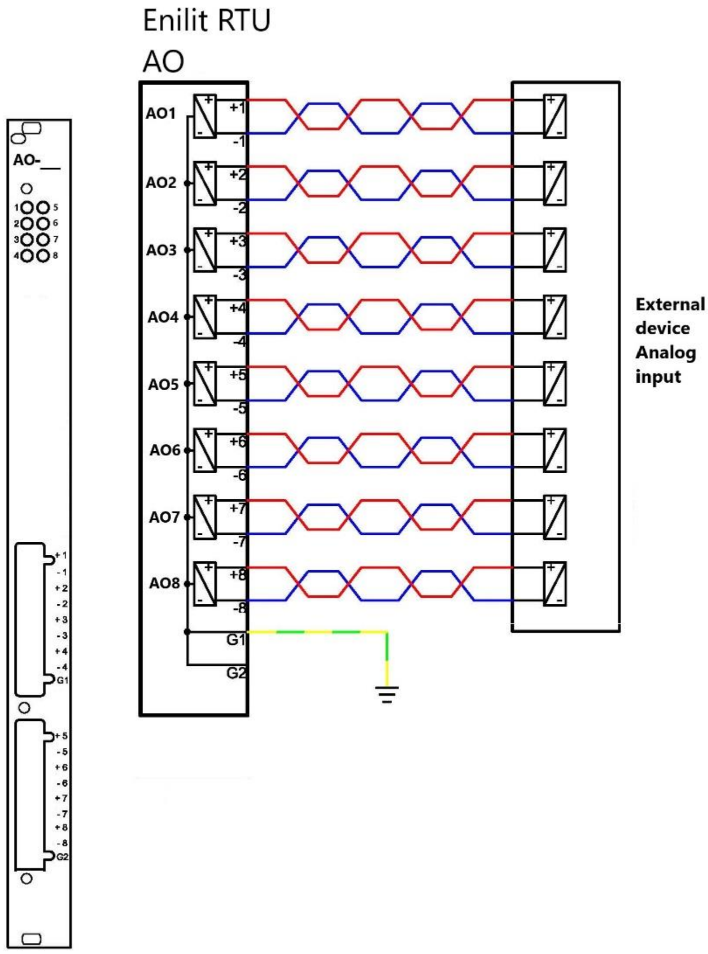


Figure 18. Analogue Output module AO-31, Wiring diagram

3.10.2 Technical Data

Table 32. Technical data of analogue output module AO-31

FEATURE	VALUE
Number of inputs	8
Galvanic isolation: -from system electronics; -of the channels from one another.	 Yes (optocoupler) Yes
Resolution in all ranges	16 bit

Analog output types:	Current 0 ..20 mA Current 0 ..24 mA Current 3.5 ..23.5 mA Current 4 ..20 mA Current -24 ..24 mA Voltage 0 ..5 V Voltage 0 ..6 V Voltage 0 ..10 V Voltage 0 .. 12 V Voltage -5 ..5 V Voltage -6 ..6 V Voltage -10 ..10 V Voltage -12 ..12 V

3.11 Glass fibre optic module ST-61

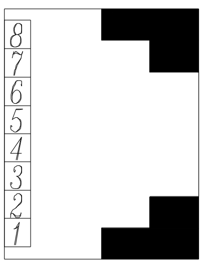
Glass fibre optic module ST-61 is designed to provide communication from six glass fibre optic ports to one RS-422/RS-485 serial port at the bottom for communication with the CPU module. In order to connect the modules to CPU, external jumper cable is used.

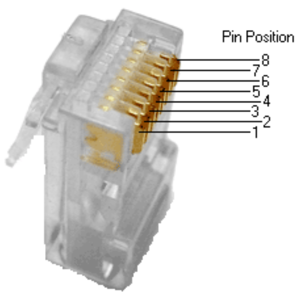
ST-61 uses a separate LED emitters and photo-detectors operating at an 820nm wavelength. Almost any multimode glass fibre can be used including 50/125µm, 62.5/125µm, 100/140µm, and 200µm with ST type connectors. Two fibres are required between the two devices, one for each direction of data.

The serial communication interfaces (RS-422/RS-485) are designed as 8-pole RJ45 connectors.

Table 33. ST-61 module RJ-45 (COM) connector pin assignment for 422/485

<table>
<tr><th rowspan="2">PIN</th><th colspan="4">DESIGNATION</th></tr>
<tr><th>RS-422</th><th>RS-485 (4 WIRE)</th><th colspan="2">RS-485 (2 WIRE)</th></tr>
<tr><td>1</td><td>Not used</td><td>Not used</td><td colspan="2">Not used</td></tr>
<tr><td>2</td><td>RX +</td><td>RB +</td><td>DB +</td><td rowspan="2">2 - 3 pins should be linked together</td></tr>
<tr><td>3</td><td>TX +</td><td>TB +</td><td>DB +</td></tr>
<tr><td>4</td><td>GND</td><td>GND</td><td colspan="2">GND</td></tr>
<tr><td>5</td><td>RX -</td><td>RA -</td><td>DA -</td><td rowspan="2">5 - 6 pins should be linked together</td></tr>
<tr><td>6</td><td>TX -</td><td>TA -</td><td>DA -</td></tr>
<tr><td>7</td><td>Not used</td><td>Not used</td><td colspan="2">Not used</td></tr>
<tr><td>8</td><td>Not used</td><td>Not used</td><td colspan="2">Not used</td></tr>
</table>





a) ST-61 side b) Cable side

Figure 19. RJ45 connector

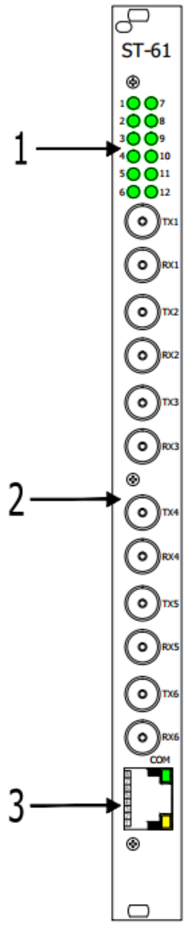


Figure 20. Glass fibre optic module, Front view

Table 34. Constituents of glass fibre optic module ST-61 and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	LED indicators for each glass fibre optic port	Glass fibre optic port status	LED is blinking – the port is transmitting or receiving data; LED is OFF – the input is inactive; ALL LEDS are blinking together – there is no connection with CPU or there is an error at the glass fibre optic module.
2	LED emitters and photo-detectors	Communicates with IEDs by fibre optic multimode cable	-
3	RS232 or RS422/485 serial port	Communicates with the CPU module	-

3.12 Plastic fibre optic module PL-61

Plastic fibre optic module PL-61 is designed to provide communication from six plastic fibre optic ports (2) to one RS-422/RS-485 serial port at the bottom (3) for communication with the CPU module. In order to connect the module to CPU, external jumper cable is used.

PL-61 uses a separate LED emitters and photo-detectors (2) operating at a 660nm wavelength. Two fibres are required between the two devices, one for each direction of data.

The serial communication interfaces (RS-422/RS-485) are designed as 8-pole RJ45 connectors.

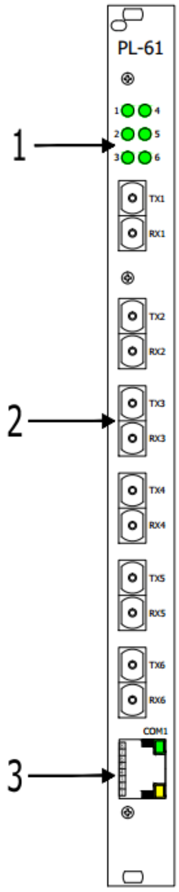


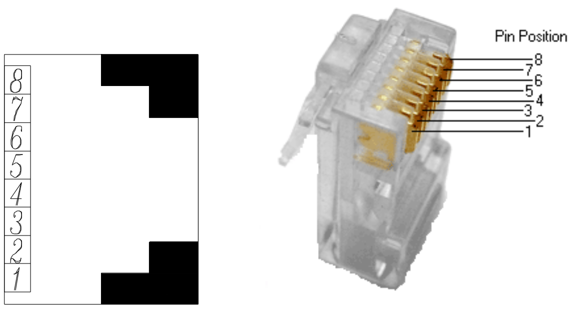
Figure 21. Plastic fibre optic module, Front view

Table 35. Constituents of plastic fibre optic module PL-61 and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	LED indicators for each plastic fibre optic port	Plastic fibre optic port status	LED is blinking – the port is transmitting or receiving data; LED is OFF – the input is inactive; ALL LEDS are blinking together – there is no connection with CPU or there is an error at the glass fibre optic module.
2	LED emitters and photo-detectors	Communicates with IEDs by plastic optic multimode cable	-
3	RS232 or RS422/485 serial port	Communicates with the CPU module	-

Table 36. Plastic fibre optic module PL-61 RJ-45 (COM) connector pin assignment for 422/485

PIN	DESIGNATION			
	RS-422	RS-485 (4 WIRE)	RS-485 (2 WIRE)	
1	Not used	Not used	Not used	
2	RX +	RB +	DB +	2 - 3 pins should be linked together
3	TX +	TB +	DB +	
4	GND	GND	GND	
5	RX -	RA -	DA -	5 - 6 pins should be linked together
6	TX -	TA -	DA -	
7	Not used	Not used	Not used	
8	Not used	Not used	Not used	



a) PL-61 side b) Cable side

Figure 22. RJ45 connector

3.13 Communication modules CD-61 and CK-61

Communication extension modules CD-61 and CK-61 are designed to provide communication from six RS-232 ports (2; CD-61 module) or from six RS-485 ports (2; CK-61 module) to a single RS-422/RS-485 serial port at the bottom (3) for communication with the CPU module. In order to connect the modules to CPU, external jumper cable is used.

The serial communication interfaces Figure 23. 2 depending on the module type (RS-232 or RS-422/RS-485) are designed as 8-pole RJ45 connectors.

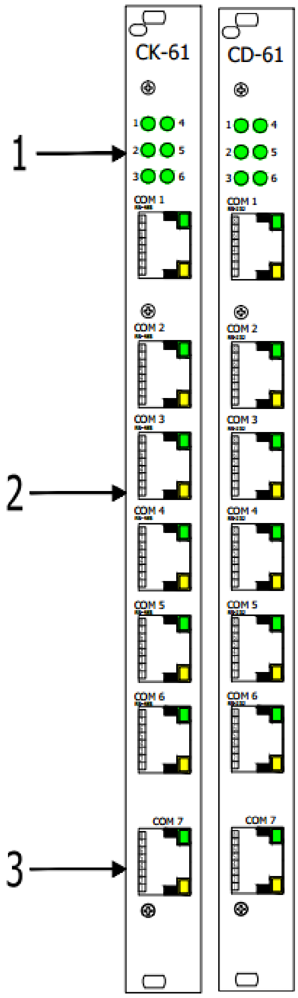


Figure 23. Communication module CK-61, CD-61, Front view

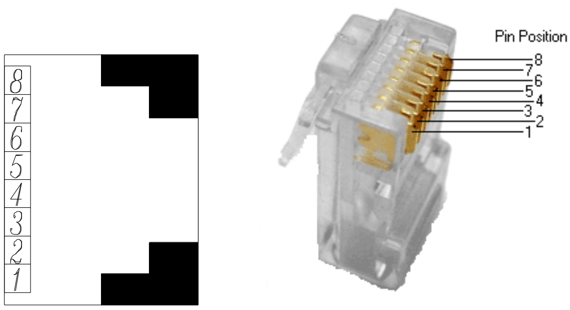
Table 37. Constituents of communication modules CK-61, CD-61 and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	LED indicators for each RS-232 or RS-485 port	RS-232 or RS-485 port status	LED is blinking – the port is transmitting or receiving data; LED is OFF – the input is inactive; ALL LEDS are blinking together – there is no connection with CPU or there is an error at the glass fibre optic module.

No.	EXPLANATION	FUNCTION	LED INDICATION
2	RS-232/RS-485	Communicates with IEDs by Ethernet type of cable	-
3	RS-422/ RS-485 serial port	Communicates with the CPU module	-

Table 38. Communication extension modules CK-61 and CD-61 RJ-45 (COM1) connector pin assignment for RS-232/485

PIN	DESIGNATION	
	RS-232	RS-485 (4 wire)
1	Not used	Not used
2	RX	RB +
3	TX	TB +
4	Not used	GND
5	GND	RA -
6	Not used	TA -
7	Not used	Not used
8	Not used	Not used



a) RTU side b) Cable side

Figure 24. RJ45 connector

The status of each communication interface is shown via the six software-controlled LEDs that are installed on the top of the card.

The yellow LED is activated during the transmission of data in the transmission direction. The green LED is activated during the transmission of data in the receive direction.

3.14 Ethernet communication module LAN-21

Ethernet communication extension module LAN-21 is designed to provide communication from two Ethernet ports to one USB port for communication with the CPU module. External jumper cable is used for this (USB to USB).

The Ethernet interfaces are designed as 8-pole RJ45 connectors. There is an option with four Ethernet ports available on request. Each Ethernet port has a separate MAC address.

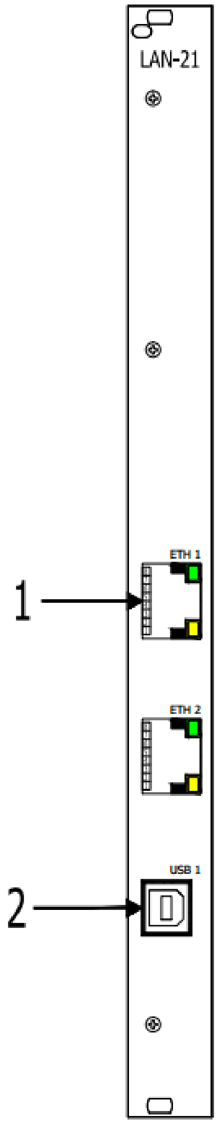


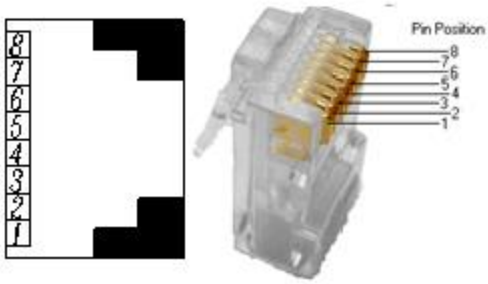
Figure 25. Ethernet communication module LAN-21, Front view

Table 39. Constituents of Ethernet communication modules LAN-21 and their assignment

No.	EXPLANATION	FUNCTION	LED INDICATION
1	Ethernet ports	Communicates with IEDs by Ethernet	The status of each communication interface is shown via the two software-controlled LEDs that are installed in the connectors: • green LED lights up if there is a physical connection to a device, i.e. if the connection layer is in operation; • yellow LED is activated during the transmission of data in the transmission or the receive direction.
2	USB port	Communicates with the CPU module	-

Table 40. Pin assignment of Ethernet communication module LAN-21

PIN	DESIGNATION
1	-TX
2	+TX
3	+RX
4	BI_DC+
5	BI_DC-
6	-RX
7	BI_DD+
8	BI_DD-



a) RTU side b) Cable side

Figure 26. RJ45 connector

3.15 Installation of system housing

Multi-frame systems of RTUs are usually installed in a cabinet (horizontal installation). The height between two pieces of equipment must be six height units (U), i.e. 266mm. It is important to leave the empty space of one U between two devices in order to allow for sufficient ventilation.

Another possibility is to install RTUs in a swing frame or on a mounting plate.

Note. RTUs should be installed in a dry, clean environment with an ambient temperature range of -10 ... + 60°C (standard) and air humidity of 5 … 95% (non-condensation).

3.16 Order-book

Order book/generator is an excel tool which is almost fully automatic only requiring user to manually select parts that their RTU requires. Instructions on how to use are listed below.

3.16.1 Frame selection menu

Once the excel file is launched you will be given a choice to pick between 3 frame options. Click on the option you need; it will take you towards the page for creating an order for the RTU.

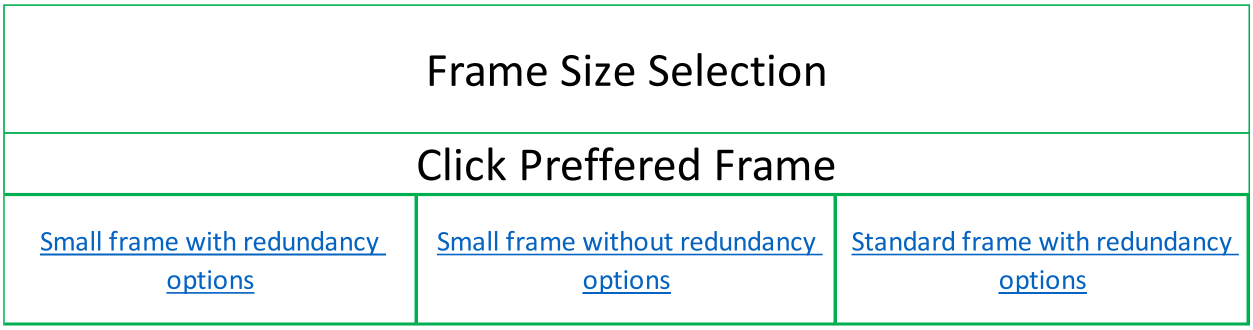
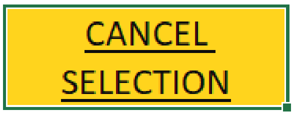


Figure 27. Frame size selection

In case you pick wrongly you may click “Cancel selection” at top left which will take you back to the first page.



3.16.2 Ordering frames:

To create your order code, select each option necessary by clicking on arrow key next to outlined options, the code will change automatically.

Once you are satisfied with your order details, copy the full order number.

Example of order code: Enilit RTU F-PS12-C20-P0-0-11111-0

Some options require additional information to be added in the order message. If the outputs with larger disconnection capacity are ordered, please define necessary values in the order.
Any additions of modules for already in-service Enilit RTU must be aligned with the manufacturer.

3.16.3 Order generator tables:

CANCEL SELECTION	Select your choice in the outlined slots, then copy the order number.					
Order number	**Enilit RTU F-11-C20-P0-0-11111-0**					
Slot No.		1	3	6	8	10
Mounting	19"/2 Frame mounting					
Power supply		PS-21 (input voltage 230VAC/220VDC)	PS-21 (input voltage 230VAC/220VDC)			
Centrol proccesor unit (CPU) module				CPU-412	Not used	
Input / output or communication extension modules						Not used
Communications (Yes/No)						
IEC 60870-5-101 Master/Slave protocol						Yes
IEC 60870-5-104 Master/Slave protocol						Yes
IEC 61850 Client protocol						Yes
IEC 60870-5-103 Master protocol						Yes
DNP3, Modbus, SPA-Bus, RP-570						Yes
Logic (Internal logic is included)						
Add ISaGRAF Logic						No
(CPU COM 5-12) Do you need any of RS-485 ports to be changed to RS-232?						
If so, how many of the ports need to be changed?						None

Figure 28. Small frame with redundancy options.

CANCEL SELECTION	Select your choice in the outlined slots, then copy the order number.								
Order number	**Enilit RTU F-NR1-C20-P0-000000-11111-0**								
Slot No.		1	3	5	6	7	8	9	10
Mounting	19"/2 Frame mounting								
Power supply		PS-21 (input voltage 230VAC/220VDC)							
Centrol proccesor unit (CPU) module			CPU-412						
Input / output or communication extension modules				Not used	Not used	Not used	Not used	Not used	Not used

Communications (Yes/No)	
IEC 60870-5-101 Master/Slave protocol	Yes
IEC 60870-5-104 Master/Slave protocol	Yes
IEC 61850 Client protocol	Yes
IEC 60870-5-103 Master protocol	Yes
DNP3, Modbus, SPA-Bus, RP-570	Yes
Logic (Internal logic is included)	
Add ISaGRAF Logic	No
(CPU COM 5-12) Do you need any of RS-485 ports to be changed to RS-232?	
If so, how many of the ports need to be changed?	None

Figure 29. Small frame without redundancy options.

CANCEL SELECTION	Select your choice in the outlined slots, then copy the order number.																
Order number	**Enilit RTU F-31-C40-P0-000000000000-11111-0**																
Slot No.		1	3	6	8	10	11	12	13	14	15	16	17	18	19	20	21
Mounting	19" Frame mounting																
Power supply		PS-51 (input voltage 24VDC/48VDC)	PS-21 (input voltage 230VAC/220VDC)														
Centrol proccesor unit (CPU) module				CPU-484	Not used												
Input / output or communication extension modules						Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used

Communications (Yes/No)	
IEC 60870-5-101 Master/Slave protocol	Yes
IEC 60870-5-104 Master/Slave protocol	Yes
IEC 61850 Client protocol	Yes
IEC 60870-5-103 Master protocol	Yes
DNP3, Modbus, SPA-Bus, RP-570	Yes
Logic (Internal logic is included)	
Add ISaGRAF Logic	No
(CPU COM 5-12/8) Do you need any of RS-485 ports to be changed to RS-232?	
If so, how many of the ports need to be changed?	None

If you need frame extension, click below
Extension

Figure 30. Standard frame.

CANCEL SELECTION	CANCEL EXTENSION	Select your choice in the outlined slots, then copy the order number.																	
Order number	**Enilit RTU F-31-C40-P0-000000000000-11111-0-EXTENSION:W-11-0000000070000000**																		
Slot No.		1	3	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Mounting	Wall(Backplate) mounting																		
Power supply		PS-21 (input voltage 230VAC/220VDC)	PS-21 (input voltage 230VAC/220VDC)																
Input / output or communication extension modules				Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used	AO-31 (8xAO)	Not used	Not used	Not used	Not used	Not used	Not used	Not used

Figure 31. Extended frame

4. ENILIT RTU SOFTWARE

4.1 Introduction

Enilit Configuration and Management Software (CMS) is the tool for simple and straightforward configuration, maintenance, management.

In the course of RTU configuration, the user can specify communication protocols and define the relationships between master and slave protocols. Also, it allows defining the relationships between hardware connections and slave protocols. The supported protocols are as follows:

- control direction:
  - IEC 60870-5-101
  - IEC 60870-5-103
  - IEC 60870-5-104
  - DNP3 serial
  - DNP3 TCP
  - IEC 61850
  - Modbus RTU/ASCII
  - Modbus TCP
  - SPA-BUS
  - RP-570
  - ICP DCON
  - Syslog

- monitor direction:
  - IEC 60870-5-101
  - IEC 60870-5-104
  - DNP3 serial
  - DNP3 IP
  - SPA-BUS
  - RP-570
  - ICP DCON

Enilit RTU can be used as a gateway between the IEC61850 substation bus and SCADA protocols IEC 60870-5-101 and -104.

4.2 System capabilities

Enilit CMS capabilities include:

- the database of above 50000 information objects;
- not less than 1000 events per second;
- up to 96 serial slave devices.

4.3 Licensing

Enilit CMS software is included by default. Linux or Windows operating system license is included in the price of Enilit RTU. ISaGRAF license can be added on customer request.

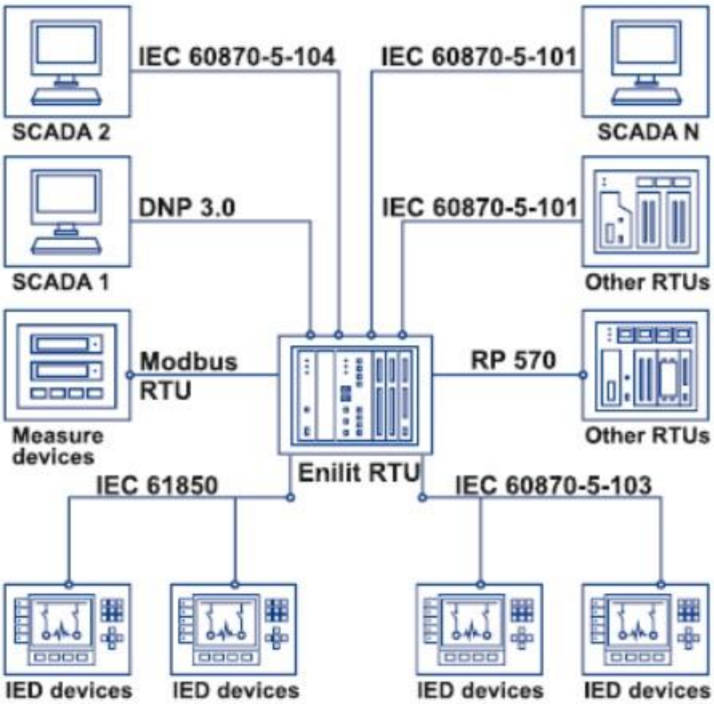


Figure 32. Concept of Enilit RTU Substation and SCADA system

4.4 User interface

The figure below shows the main window of Enilit CMS.

The user can choose one of the buttons to configure master protocols, slave protocols, hardware, own logic, ISaGRAF logic, enter TAG manager or tag states. The main architectural concept is realized in such a sequence that firstly the user creates some points in the master protocols from the IED devices. Then, tags are created with TAG Manager and connected to the master protocols points. After that, the user can create points in the slave protocols and connect them to the tags which have been created before. As a result, some points from the controlled device will go to SCADA or some other controlling device.

One of the main advantages of Enilit CMS is that adding or making changes in protocols (like adding points) or tag manager can be done on line, so the user does not need to upload the configuration or restart the device. Changes can be made on a working system without losing connection to other systems. In the main window, Enilit RTU configuration can be saved to the hard disk.

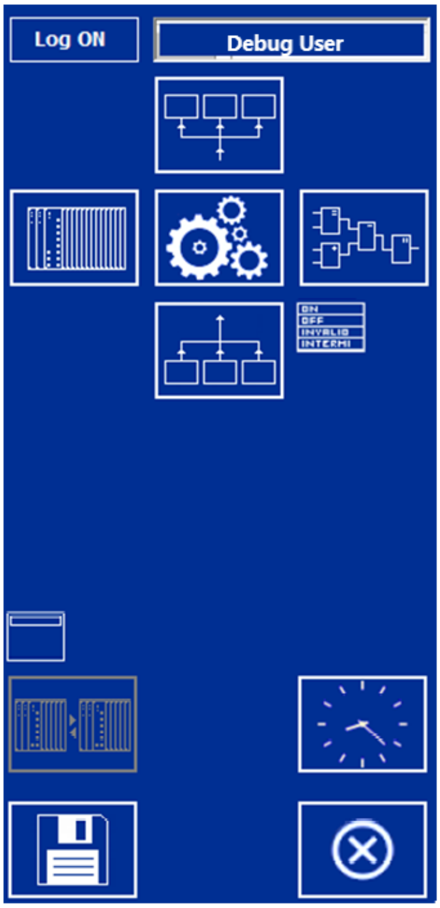
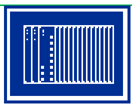
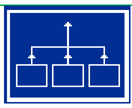
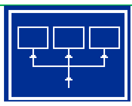
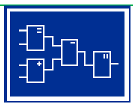
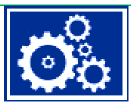
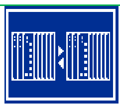
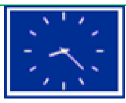
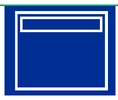


Figure 33. Main window of Enilit CMS

Table 41. Functional icons on the main window

MENU ITEM	DESCRIPTION
Log ON	Click to log on as a user.
	Click to open Hardware manager.
	Click to open Master protocols.
	Click to open Slave protocols.
	Click to open PLC programming interface.
	Click to open TAG manager.
	Click to open TAG states window.
	Click to open Redundancy management window (the button is visible only if Redundancy is used).
	Click to open Time management window.
	Click to open Console window.
	Click to save a configuration.
	Click to close Enilit CMS software.

The following figure shows a standard perspective of the program window of Enilit CMS. The display and work area are subdivided into several views. As it is usual with all Windows applications, all windows can be resized, moved or closed.

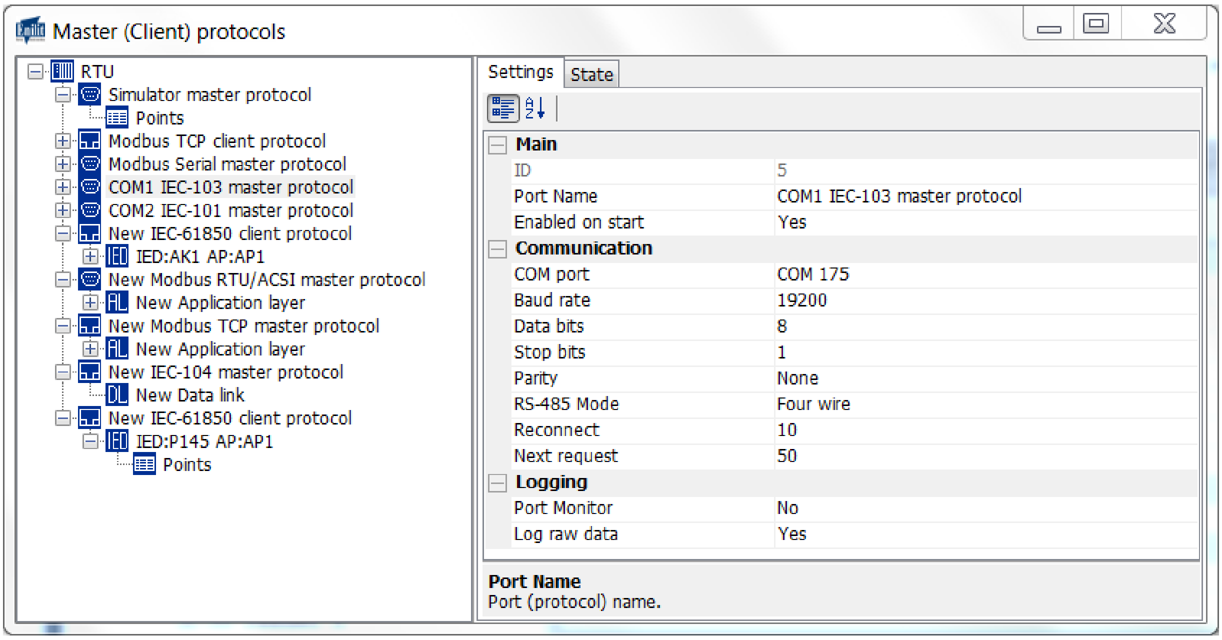


Figure 34. Standard application window

Table 42. Description of the program window

SIDE	DESCRIPTION
Left side	Communications tree. RTU of a project and its respective communications are shown in the form of a structured tree diagram. In this view, '+' and '-' characters can be used, respectively, to open and close different branches of the tree. By clicking the left button of the mouse on a tree item, the user opens the settings window in the right side of the application. When clicking on a tree item with the right button of the mouse, a corresponding popup menu enables the access to further functions available for this tree item.
Right side	Settings Table When clicking on a tree item on the left side of the window, the corresponding Settings table is opened, enabling the user to view and edit the settings.
Help section	Help section is located at the bottom of the right side. The help section contains information about the parameter on which the cursor is currently positioned.

Table 43. Popup menu of the first tree item (CPU)

MENU ITEM	DESCRIPTION
Expand All	Expand all tree branches
Collapse All	Collapse all tree branches
Create New Communication Port	Shows the window in which a protocol can be chosen. The keyboard shortcut is *Ctrl+N*.

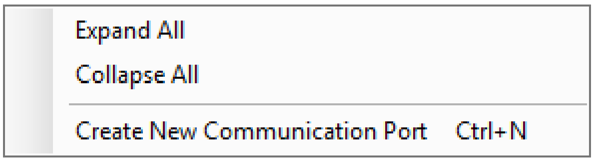


Figure 35. CPU popup menu

The menu item *Create New Communication Port* opens the following figure. Then, the user can select a protocol. The new tree item will appear in the communications tree. The Popup menu helps to create RTU communications fast and simple.

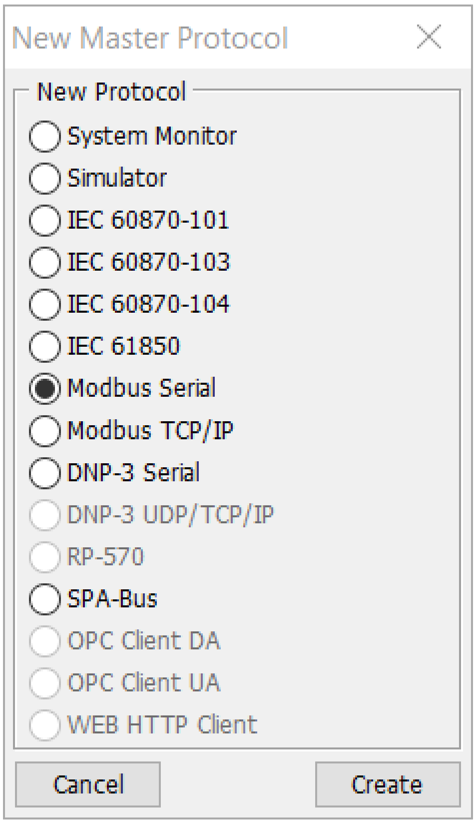


Figure 36. *New Master Protocol* window

The following *New Slave Protocol* window allows selecting a protocol.

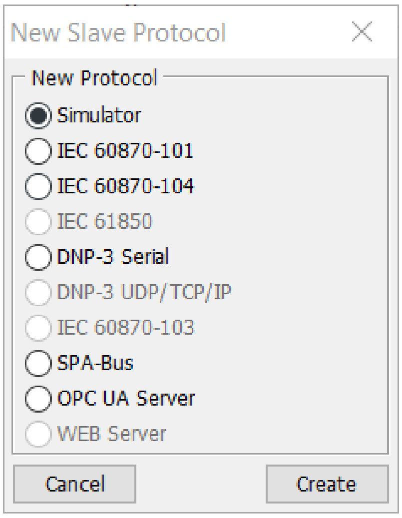


Figure 37. *New Slave Protocol* window

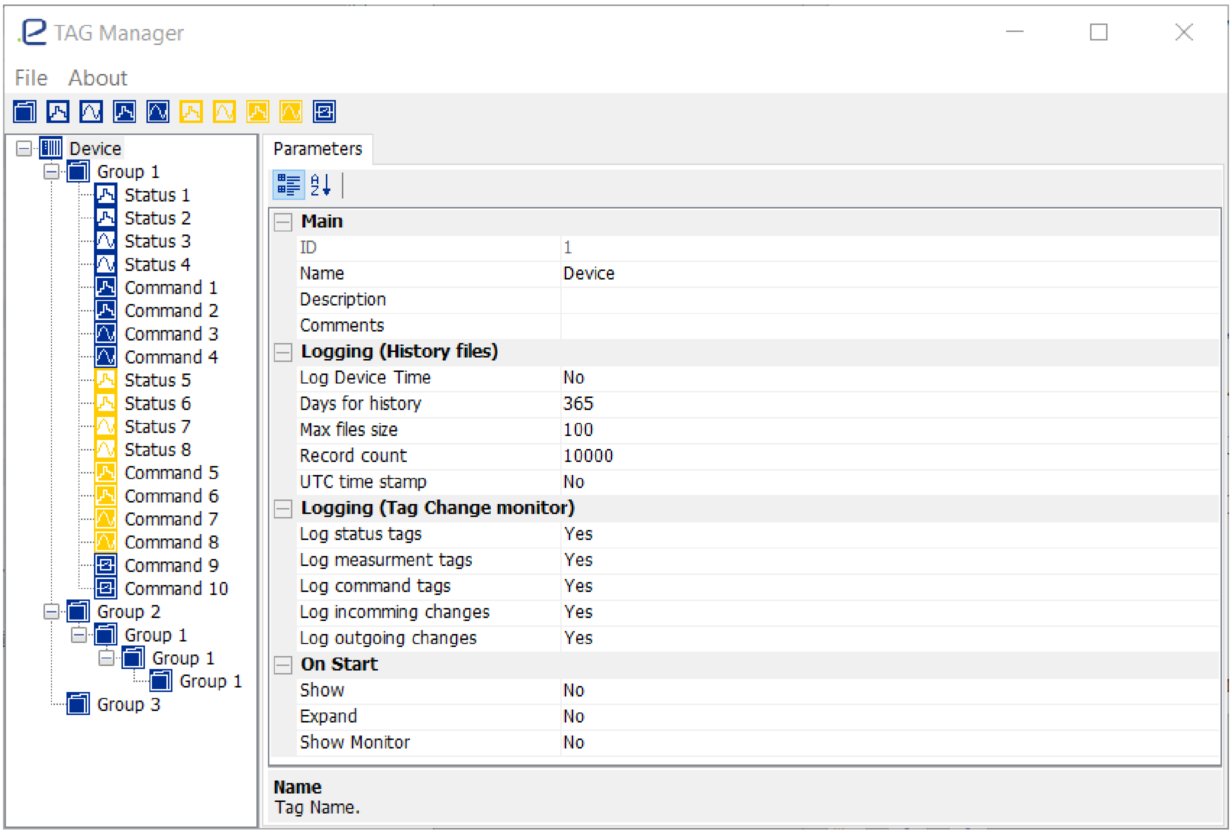


Figure 38. *TAG Manager* window

4.5 Configurator

With the help of *Enilit Configurator,* initial system parameters can be changed which manage the functions of CPU, Serial ports, Ethernet ports, OPC, IsaGRAF, Redundancy Service, Graphics, Logs, Debug and other.

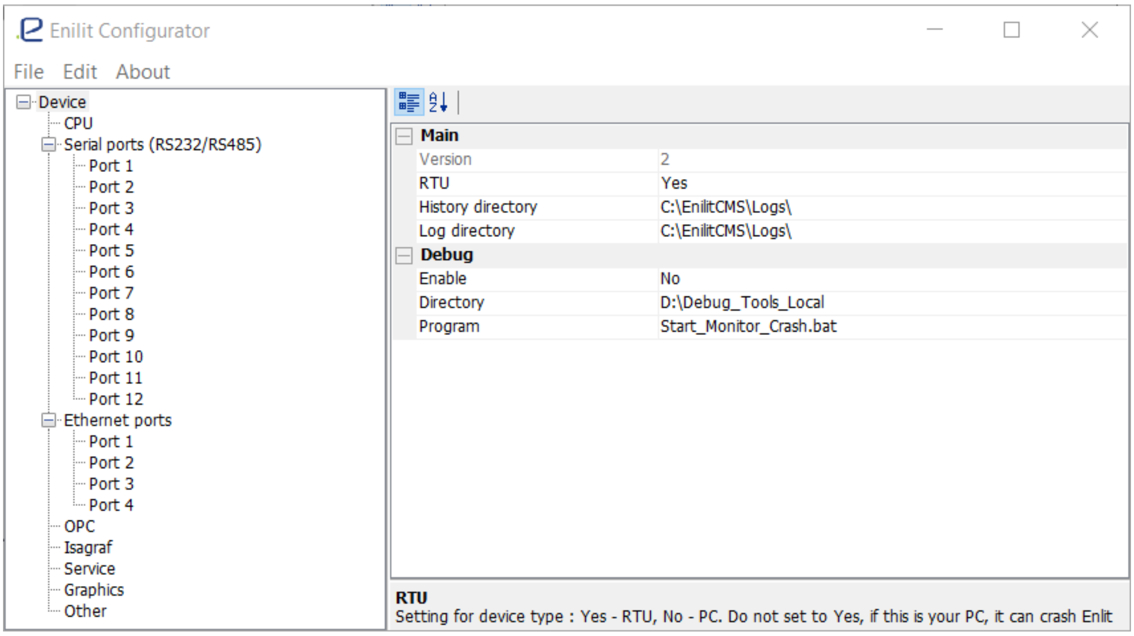


Figure 39. *Configurator* window

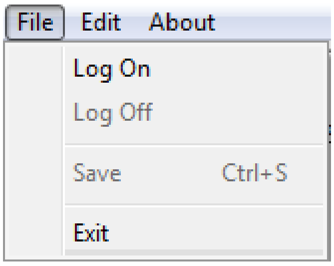


Figure 40. *File* menu

Table 44. Menu of *Configurator* window

MENU ITEM	DESCRIPTION
Log On	Log on as a user
Log Off	Log off the currently logged user
Save (Ctrl+S)	Save configuration
Exit	Exit Configurator

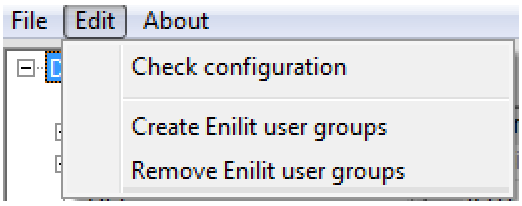


Figure 41. *File* menu

Table 45. User group management menu

MENU ITEM	DESCRIPTION
Check configuration	Checks RTU description file
Create Enilit user groups	Creates Enilit user groups in the list of Windows user groups
Remove Enilit user groups	Removes Enilit user groups from the list of Windows user groups

4.5.1 User groups

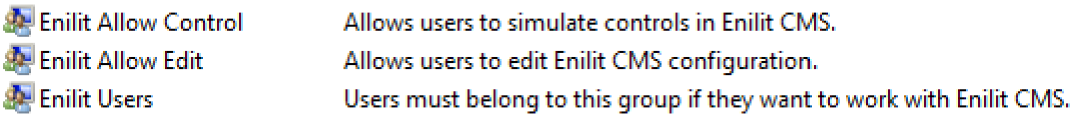


Figure 42. Created user groups in the list of Windows user groups

Table 46. Groups of users

MENU ITEM	DESCRIPTION
Enilit Users	Users must belong to this group if they want to work with Enilit CMS
Enilit Allow Control	Allows users to simulate controls in Enilit CMS
Enilit Allow Edit	Allows users to edit Enilit CMS configuration

4.5.2 Create user groups

The first step to start working with Enilit CMS software is to *Create Enilit user groups* from *Enilit Configurator*.

It is advised to use *Enilit Configurator* to create *Enilit user groups* in *Windows user group list*. Run *Enilit Configurator* program and select from the menu *Edit*, then *Create Enilit user groups.* Successful creation shows the following figure. This function can be used without log in.

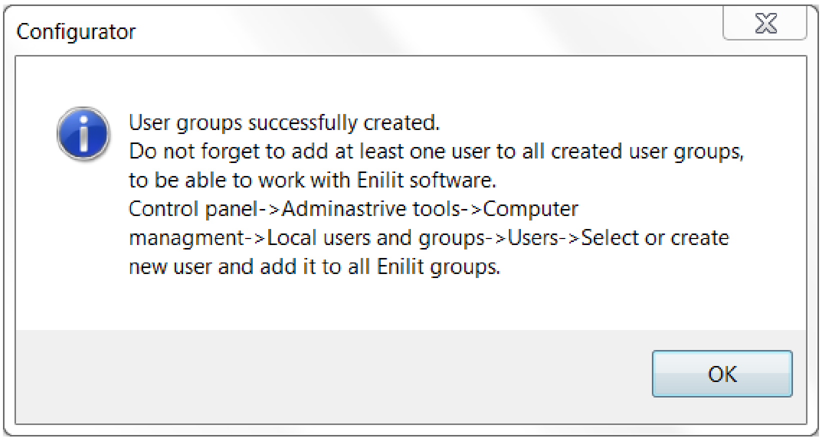


Figure 43. Successfully created User groups

4.5.3 Create a user with rights

At the second step, open *Computer Management* tool from *Control Panel*, *Administrative Tools*. *Go to Local Users and Groups*. Create a new user in the *Users* folder, like shown in following figure.

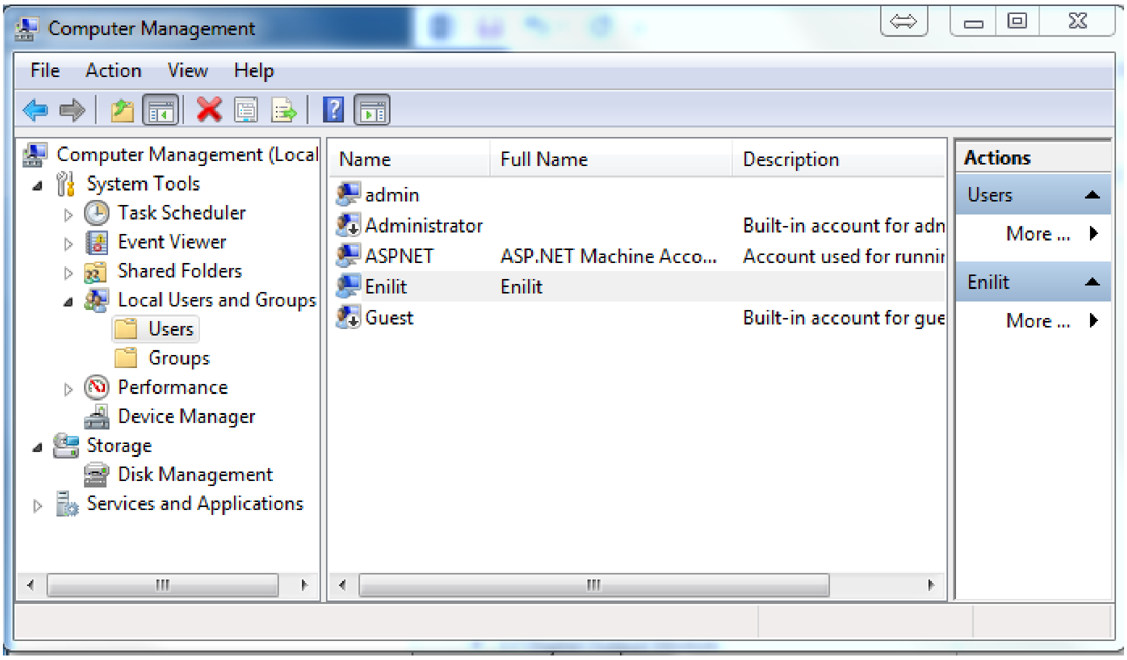


Figure 44. *Computer Management* window

In the General tab of *Enilit User* properties, uncheck the checkbox *User must change password at next logon* and check the checkbox *Password never expires*.

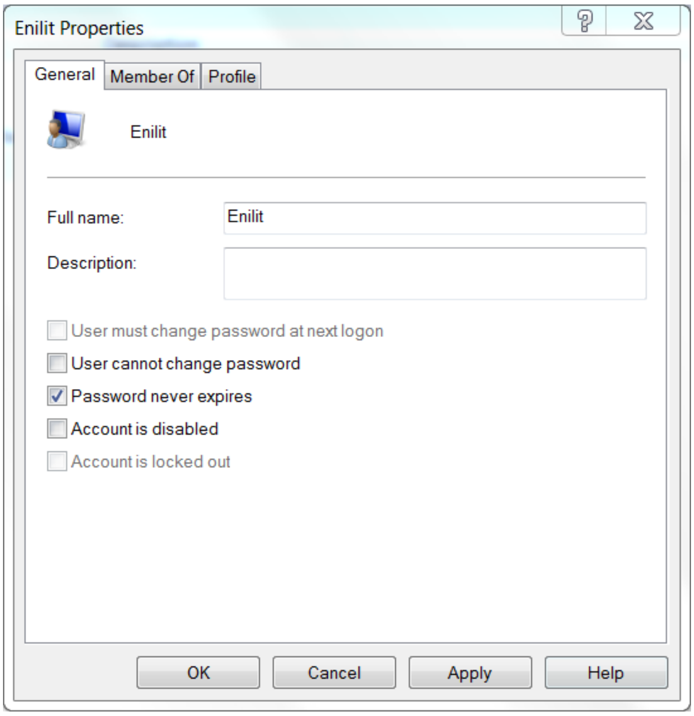


Figure 45. Enilit user password options

After that, open the created window *User Properties* and click the tab *Member Of*, then click *Add* which will allow adding new groups.

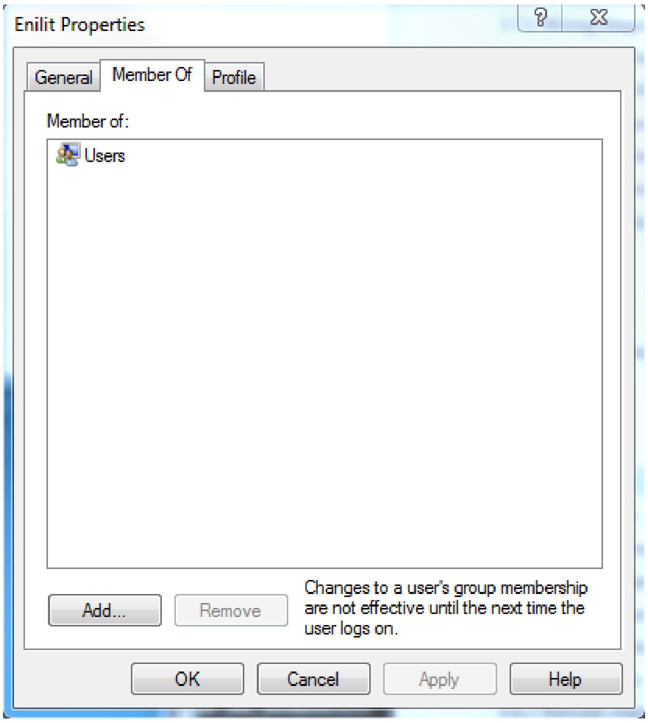


Figure 46. *Enilit User Properties* window

Then, click *Advanced*.

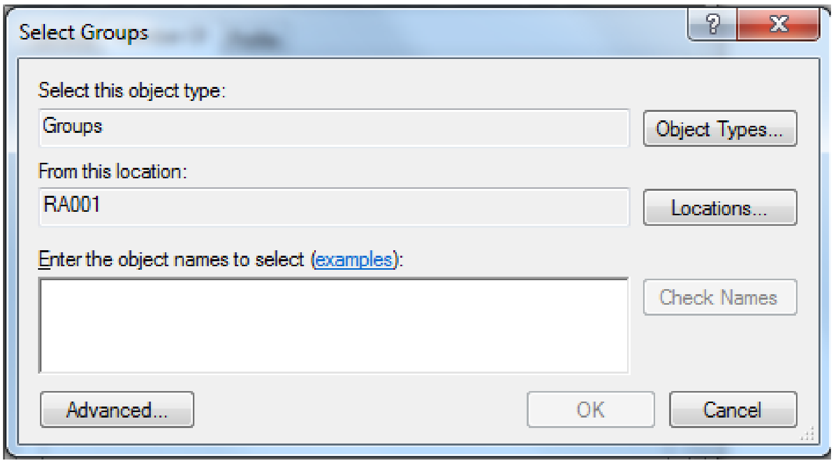


Figure 47. *Select Groups* window

Select all Enilit user groups and click *OK*.

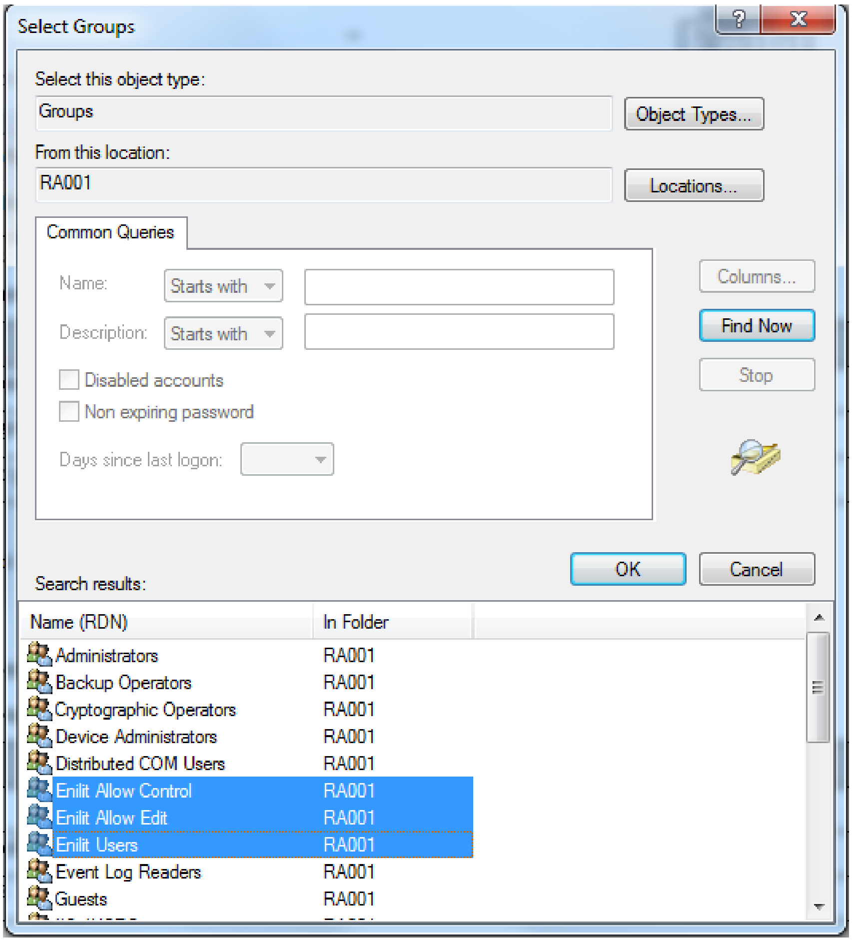


Figure 48. Advanced *Select Groups* window

The following figure shows how the *Member Of* tab should look in the last step. Clicking *OK* will finalise the creation of the user with the rights to log in, configure and control *Enilit Configurator*, *Enilit Project Manager* and *Enilit CMS*. The user with all three groups will have full access to Enilit CMS software. However, if the users with different access level are necessary, *Enilit Users* or *Enilit Allow Edit* can be added.

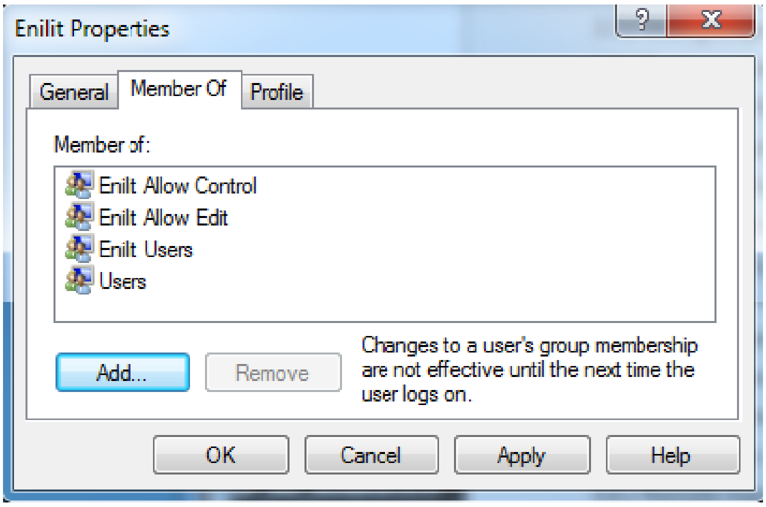


Figure 49. User *Member Of* tab

4.6 User authentication

After running of *Enilit Configurator, Project Manager or CMS,* a user must authenticate oneself with the personal user name and password.

Figure 50. *Log on* window

Without the registration, a user can only review a configuration but will not be able to perform any action. Without logging on, a user cannot manually start or stop RTU with the current configuration. After logging on, the name of the user will be shown in the Main window.

The following figure shows the logged-on user – Enilit.

Figure 51. Logged on user

4.7 Project manager

4.7.1 Information

Enilit Project Manager helps the user to manage Enilit RTU configurations. It allows importing/exporting projects of Enilit RTU configuration. It is possible to have here many projects and start Enilit CMS with a specific RTU configuration.

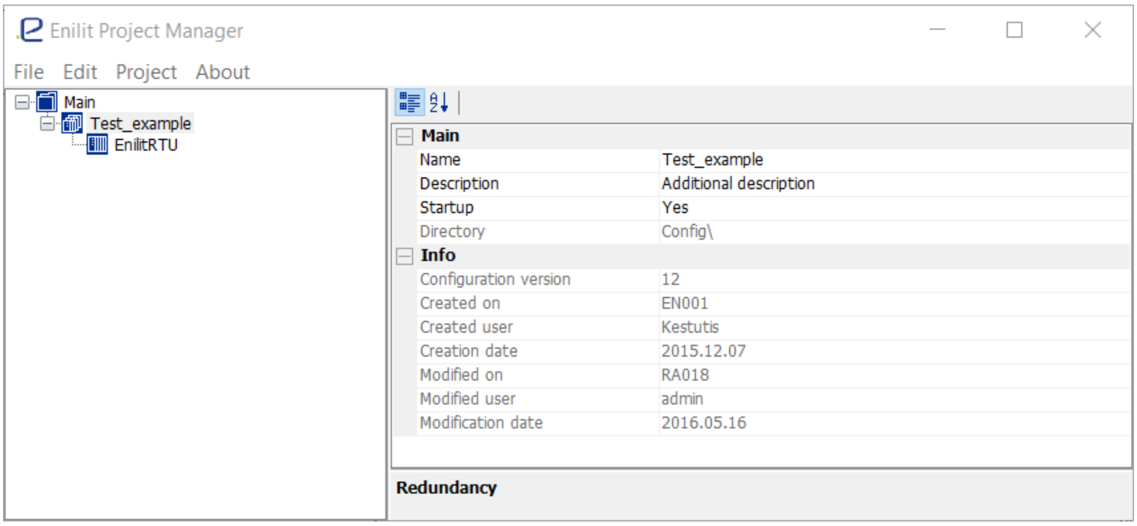


Figure 52. Project parameters in *Enilit Project Manager* window

Table 47. Fields of *Enilit Project Manager* window

MENU ITEM	DESCRIPTION
Name	Project name
Description	Additional project description
Startup	If the value is 'yes', then a project is a startup project
Directory	Project's directory (read-only). Change is possible only in Projects.xml file in the *Enilit CMS* directory.
Configuration version	Version of project configuration
Created on	Computer name on which the project was created
Created user	User who created the project
Creation date	Date when the project was created
Modified on	Computer name on which the last modification was made
Modified user	User who made the last modification
Modification date	Date when the last modification was made

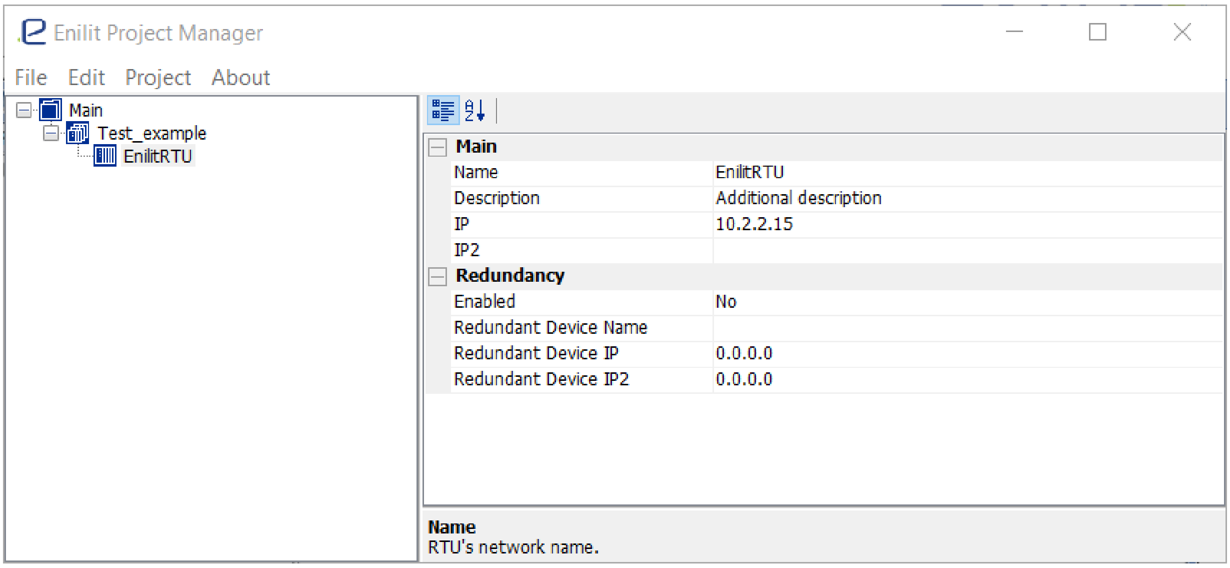


Figure 53. RTU parameters in *Enilit Project Manager* window

Table 48. Fields of RTU parameters in *Enilit Project Manager* window

MENU ITEM	DESCRIPTION	DEFAULT VALUE
Name	Name of RTU	EnilitRTU
Description	Additional description	Additional description
IP	IP address to connect to RTU	127.0.0.1
IP2	Second IP address to connect to RTU	Empty
Enabled	The function enables redundancy.	No
Redundant RTU Name	Name of the redundant RTU	Empty
Redundant RTU IP	IP address of the redundant RTU	Empty
Redundant RTU IP2	Second IP address of the redundant RTU	Empty

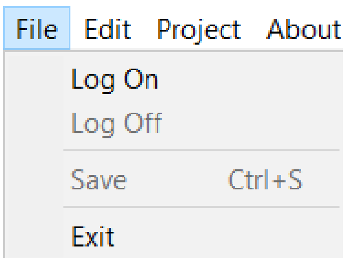


Figure 54. Figure 4.23 *Enilit Project Manager<File* menu

Table 49. Table 4.9 Fields of *Enilit Project Manager File* window

MENU ITEM	DESCRIPTION
Log On	Log on as a user
Log Off	Log off the currently logged user
Save (Ctrl+S)	Save Project Manager configuration
Exit	Exit Project Manager

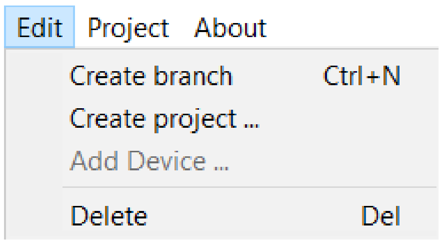


Figure 55. *Enilit Project Manager<Edit menu*

Table 50. Fields of *Enilit Project Manager Edit* window

MENU ITEM	DESCRIPTION
Create branch *(Ctrl+N)*	In this field a branch in the tree is created.
Create project…	Create a project in the selected branch
Add RTU…	Add RTU to the selected project
Delete	Delete a branch, project or RTU

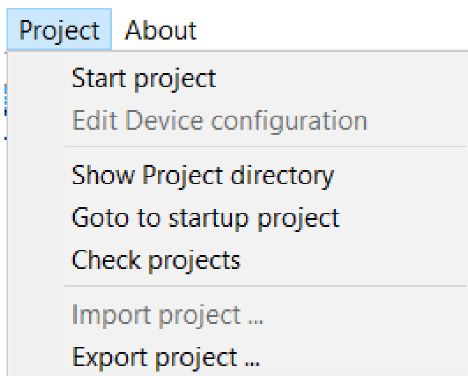


Figure 56. *Enilit Project Manager<Project* menu

Table 51. Fields of *Enilit Project Manage Project* menu

MENU ITEM	DESCRIPTION
Start project	Starts Enilit CMS with the selected project
Edit RTU configuration	Edits Enilit RTU configuration with CMS
Show Project directory	Opens a project directory
Go to startup project	Selects startup RTU in the projects tree
Check projects	Validates projects
Import project	Imports a project from an ezip file (Enilit ZIP)
Export project	Exports a project to an ezip file (Enilit ZIP)

4.7.2 Import project

Import project feature allows importing a project from an external network or other storage.

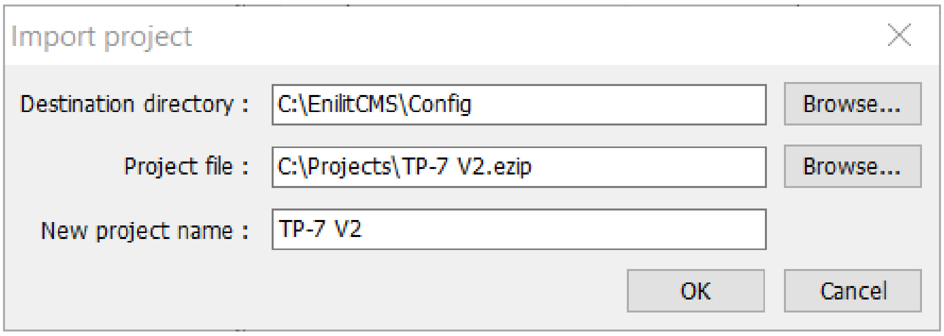


Figure 57. *Enilit Project Manager<Project<Import project* window

Table 52. Fields of *Import project* window

MENU ITEM	DESCRIPTION
Destination directory	Directory in which the imported projects are saved
Project file	Ezip file of the imported projects
New project name	Name of a newly imported project

4.7.3 Export project

Export project feature is designed to export a project to an external network or other storage for configuration backup.

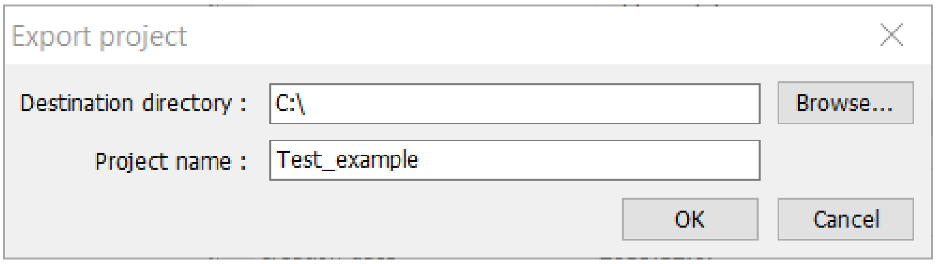


Figure 58. *Enilit Project Manager<Project<Export project* window

Table 53. Fields of *Export project* menu

MENU ITEM	DESCRIPTION
Destination directory	Directory in which the exported projects are saved
Project name	File name of the exported project (in the example above: Test_example)

4.8 Main configuration

Enilit RTU can have Windows Operating System. The user can configure the parameters of the network configuration with default Windows applications without the need of any additional applications.

Note: Windows Operating System is used to provide exclusively Enilit RTU functionality.

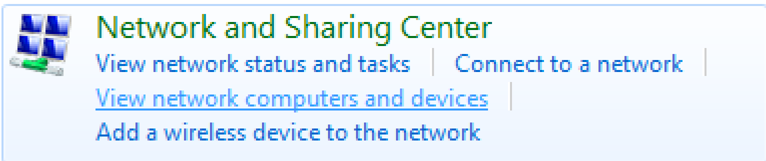
4.8.1 IP addresses

Enilit RTU has four Network adapters by default. The Network adapters are independent and each has its own MAC address. In this case, all Network adapters can have a different IP address with a different gateway. The user can also choose a Static IP address or obtain it by DHCP. To configure a Static IP address for one of the four Enilit RTU Network adapters, work through the following steps:

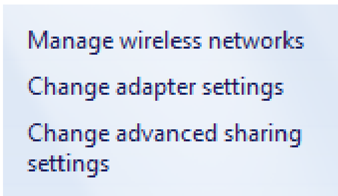
1. Launch *Control Panel.*

2. Click on *Network and Internet.*

3. Click on *Network and Sharing Center.*

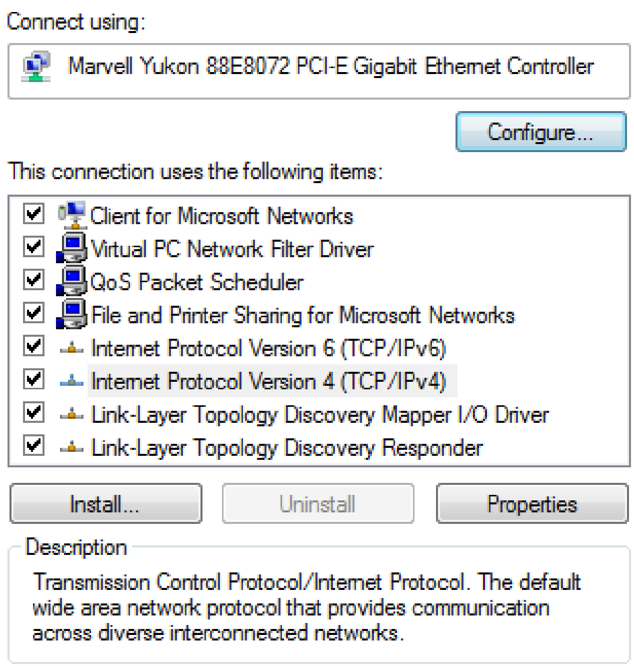


4. On the left pane, click on *Change adapter settings.*



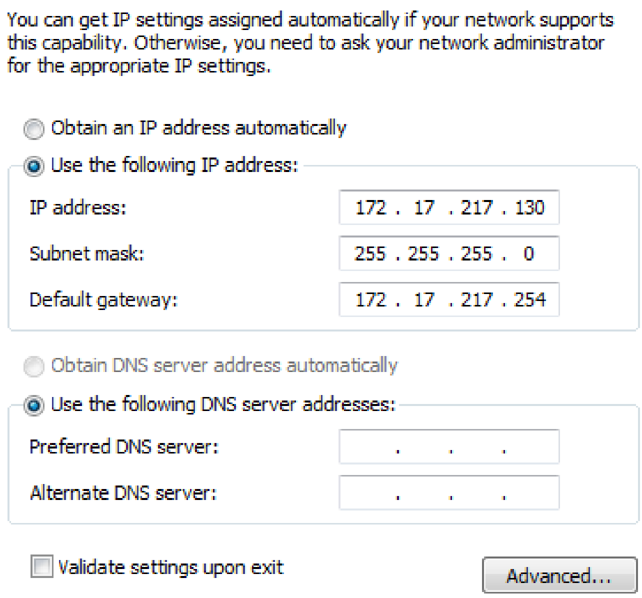
5. Click on the right button of the mouse on the icon of the targeted network adapter and select *Properties.*

6. Select *Internet Protocol Version 4 (TCP/IPv4)* and click on *Properties*.



7. Select *Use the following IP address* and enter the following IP address and subnet mask:

IP address:	172.17.217.130
Subnet mask:	255.255.255.0
Gateway:	172.17.217.254



4.8.2 Remote management

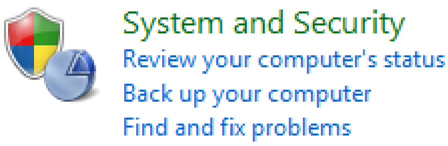
Enilit RTU can be configured and managed not only locally but also remotely. If the user has TCP/IP connection to Enilit RTU, he or she can connect to it with Remote Desktop Connection application from Windows Operating System or using Web Browser HTTPS (Internet Explorer, Google Chrome etc.) when UltraVNC server or similar software is installed in Enilit RTU. Remotely the user can do everything what can be done locally: Enilit RTU self-control and diagnosis, change the configuration, import/export a project, and configure Windows OS. In order to establish even more secure connection to the RTU unit, VPN (virtual private network) services can be used. However, a VPN client and server is already a built-in service in Windows OS.

Remote Desktop is not enabled by default. The user has to enable it to allow remote access to the Enilit RTU. When it is enabled, the configured member of the Administrators group can connect to the Enilit RTU.

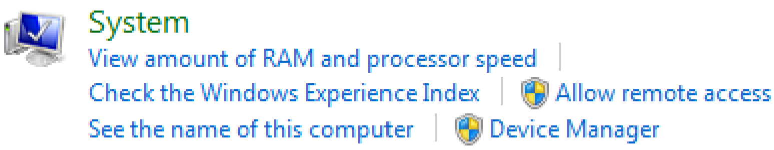
4.8.2.1 To configure Windows based remote access

To configure remote access, work out the following steps:

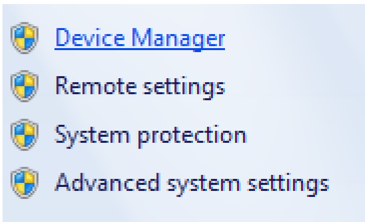
1. In *Control Panel*, click *System and Security*.



2. Then click *System*.

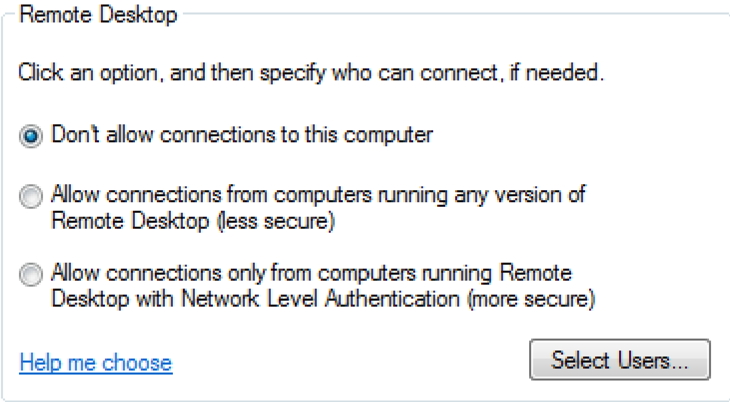


3. On the *System* page, click *Remote Settings* in the left pane. This opens the *System Properties* dialog box to the *Remote* tab.



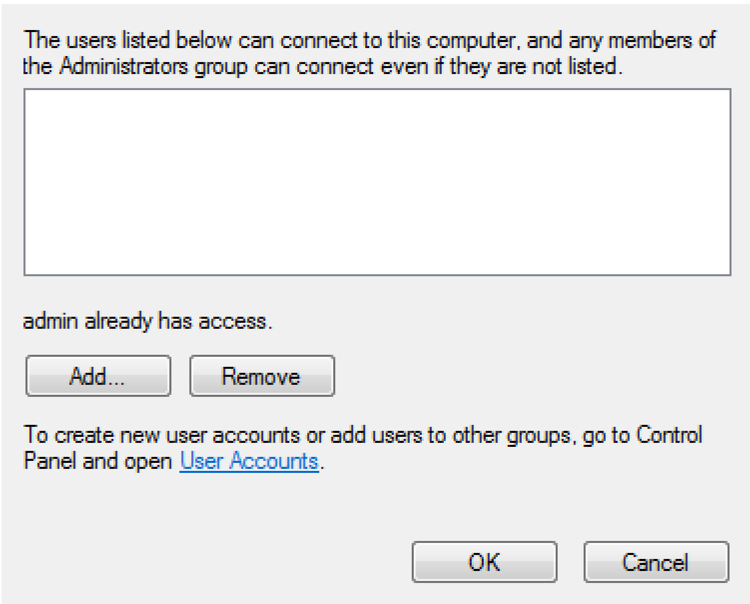
4. To enable *Remote Desktop*, there are two options:

- Select *Allow Connections from Computers Running Any Version of Remote Desktop* to allow connections from any version of Windows.
- Select *Allow Connections Only from Computers Running Remote Desktop with Network Level Authentication* to allow connections from Windows 7 or later computers (and computers with secure network authentication) only.



5. Click *Select Users*. This displays the dialog box *Remote Desktop Users*.

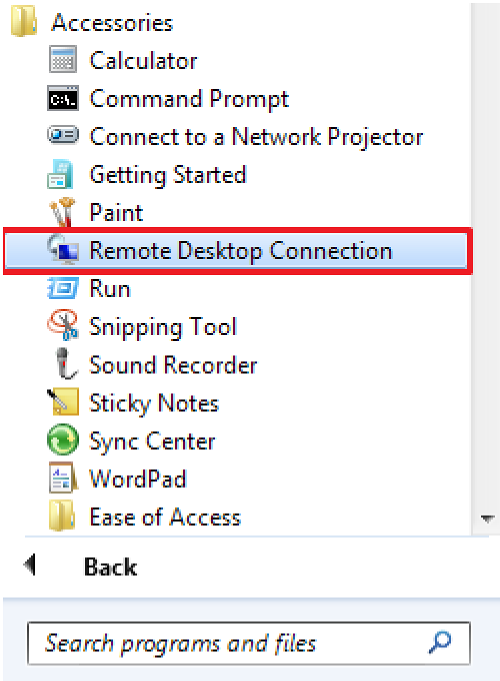
6. To grant *Remote Desktop* access to a user, click *Add*. This opens the dialog box *Select Users*. In the *Select Users* dialog box, click *Locations* to select the computer or domain in which the users you want to work with are located. Type the name of a user you want to work within the field *Enter the Object Names to Select*, and then click *Check Names*. If matches are found, select the account you want to use and then click *OK*. If no matches are found, update the name you entered and try searching again. Repeat this step as necessary, and then click *OK*.



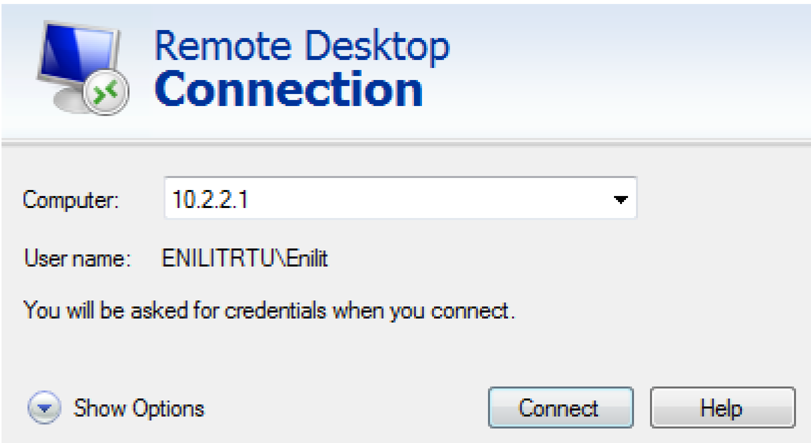
7. Click *OK* twice to finish the configuration of remote access.

4.8.2.2 To connect to Enilit RTU

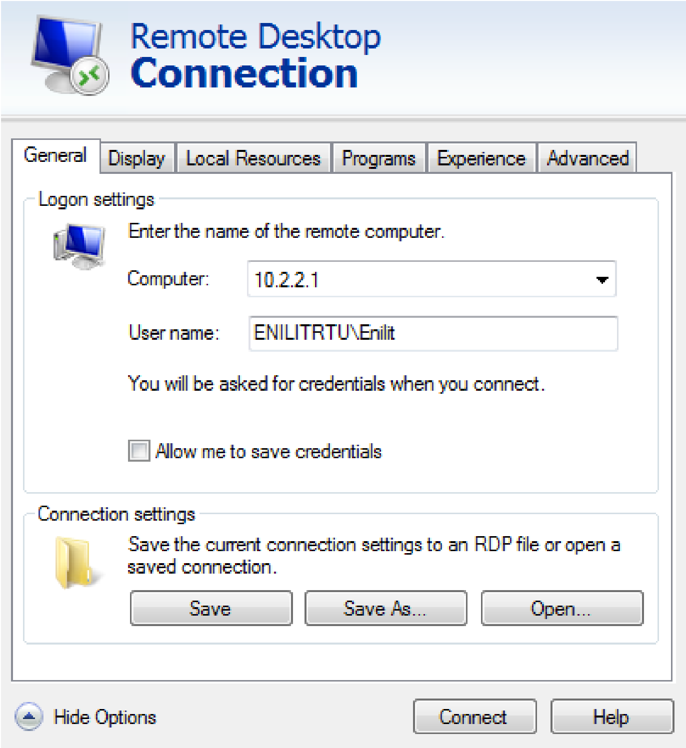
1. Go to *Start>All Programs>Accessories>Remote Desktop Connection*



2. Enter the *Computer Name* or *IP address* of the Enilit RTU you wish to connect to.

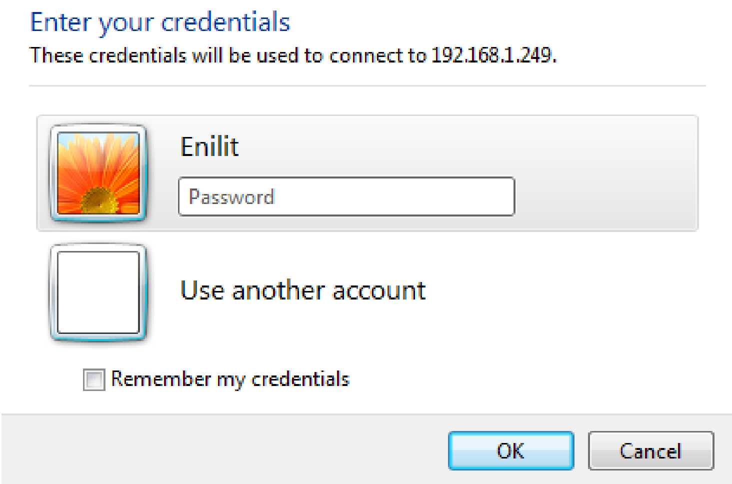


3. For more connection options, click on *Show Options*. Here the user can save the connection profile, adjust display properties, run specified programs upon connection, adjust connection bandwidth, etc. For more information on specific tabs, click on *Help*.



4. Click on *Connect.*

5. Enter the log in credentials of a user account on the Enilit RTU that is allowed to do a remote desktop connection.



Default username: EnilitRemote
Default password: Enilit123

4.8.3 Hardware configuration

The main Hardware configuration window is shown in the figure below. On the left side, *RTU Card Slots* and *Hardware Tags* trees are displayed. The *RTU Card Slots* and *Hardware Tags* can be configured automatically or manually. If an automatic configuration was selected, the RTU will check its slots and configure the slot according to the found module. After that, RTU creates Hardware points with default names.

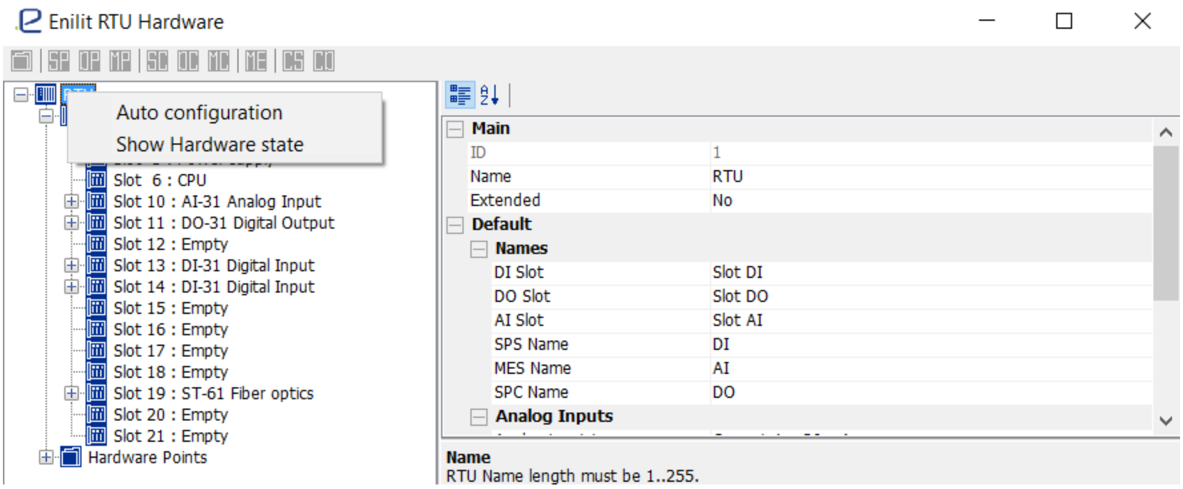


Figure 59. Hardware Auto configuration

There is another possibility to create hardware configuration manually. In the *Card Slots,* it is possible to configure which module is mounted on the particular slot. *Hardware Tags* enables to configure signal, measurement, command, and counter items and connect them to the RTU hardware. In the right pane, the parameters of the selected branch items are displayed.

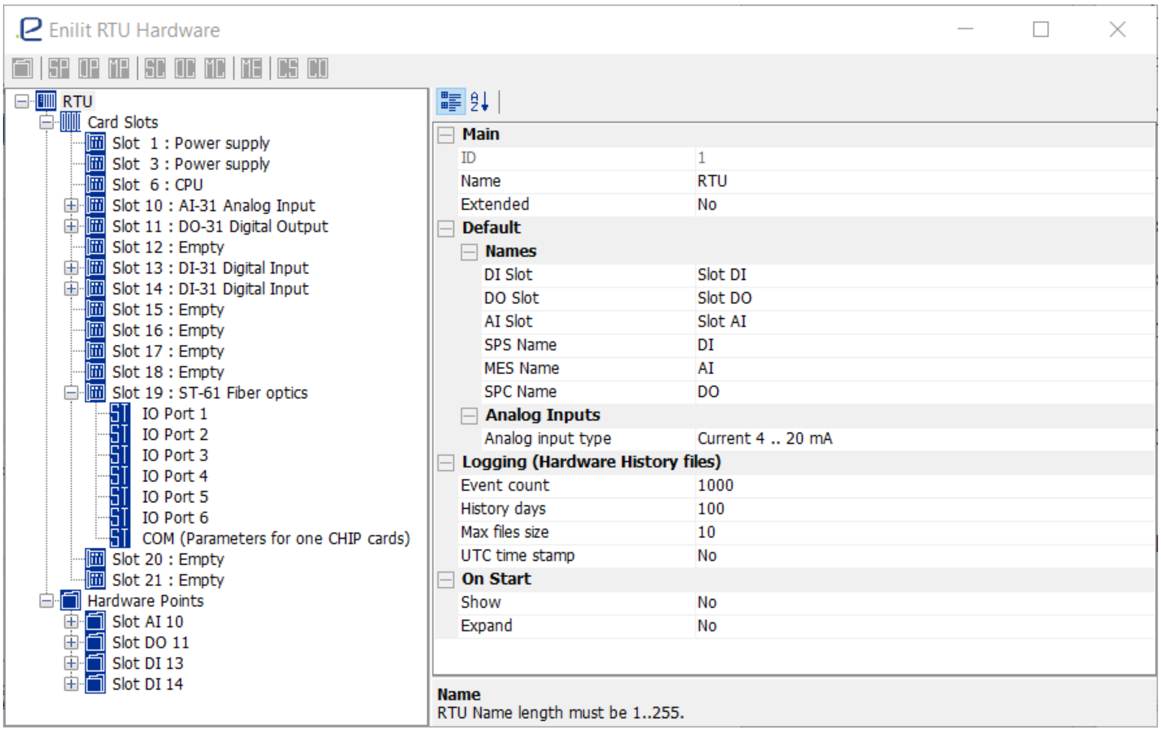


Figure 60. *Enilit RTU Hardware* configuration window

Table 54. Fields of *Enilit RTU Hardware* configuration window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Unique identification number of RTU Range of values: 1 … 65535	1
Name	Name of RTU, for example, 'Substation 1'	RTU
Extended	Defines if RTU contains an extension rack	No
DI Slot	Default DI slot name created in the *Hardware Points* branch	Slot DI
DO Slot	Default DO slot name created in the *Hardware Points* branch	Slot DO
AI Slot	Default AI slot name created in the *Hardware Points* branch	Slot AI
AO Slot	Default AO slot name created in the *Hardware Points* branch	Slot AO
SPS Name	Default SPS name created in the *Hardware Points* branch	DI
MES Name	Default MES name created in the *Hardware Points* branch	AI
SPC Name	Default SPC name created in the *Hardware Points* branch	DO
Analogue input type	Configuration allows setting the analogue input type to the measuring range. Range of values: Current 0 … 1mA Current -1 … 1mA Current 0 … 5mA Current -5 … 5mA Current 0 … 10mA Current -10 … 10mA Current 4 … 20mA Current 0 … 20mA Current -20 … 20mA Voltage -10 … 10V Voltage -5 … 5V Voltage -2,5 … 2,5V Voltage -1,25 … 1,25V	Current 4 … 20mA

Analogue output type	Configuration allows setting the analogue output type to the measuring range. Range of values: Current 0 … 20mA Current 0 … 24mA Current 3,5 … 23,5mA Current 4 … 20mA Current -24 … 24mA Voltage 0 … 5V Voltage 0 … 6V Voltage 0 … 10V Voltage 0 … 12V Voltage -5 … 5V Voltage -6 … 6V Voltage -10 … 10V Voltage -12 … 12V	Current 4 … 20mA
Event count	Number of events to keep in a file Range of values: 100 … 100000	1000
History days	Number of days to keep files in history Range of values: 1 … 1000	100
Max files size	Maximum size of log files Range of values: 1 … 100Mb	10
UTC time stamp	Allows choosing the time stamp used in the log files Values: Yes; No	No
Show	Shows this window on startup	No
Expand	Expands all *Tree Nodes* on startup	No

4.8.4 Power supply

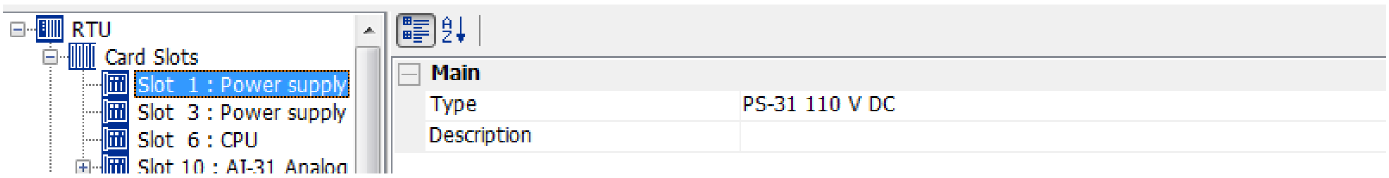


Figure 61. Power supply parameters

Table 55. Fields of *Power supply* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Configuration allows setting the type of power supply. Range of values: Not used PS-21 230 V AC PS-31 110 V DC PS-51 24/48 V DC	Not used
Description	Description or comment of the user	

4.8.5 Central Processing Unit (CPU)

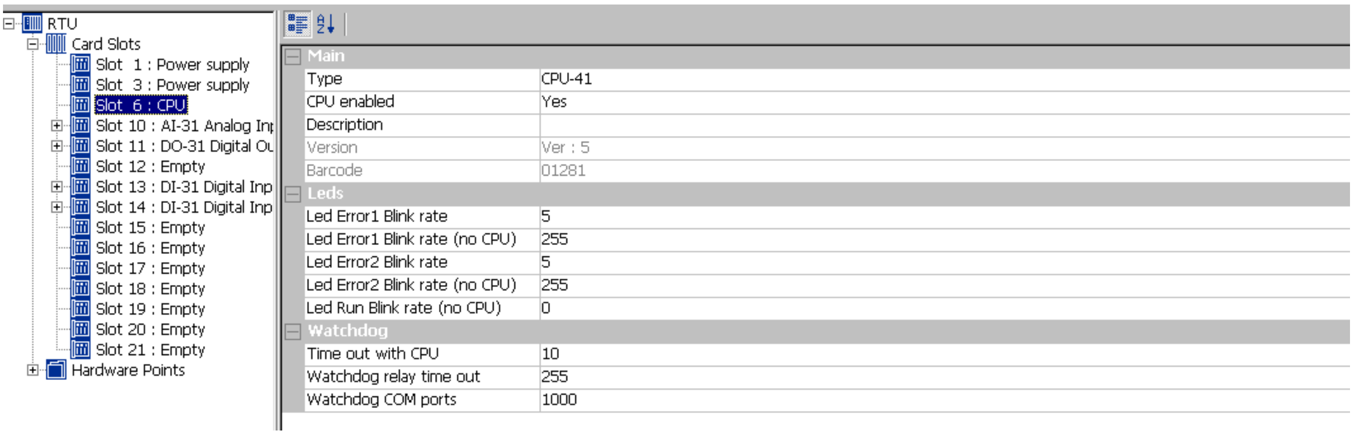


Figure 62. CPU parameters

Note: Since 2024 Enilit RTU is only sold with newest version of CPU-42

Table 56. Fields of *Central Processor Unit* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Configuration allows setting the type of CPU. Range of values: CPU-31, CPU-32, CPU-33, CPU-34, CPU-41, CPU-42, CPU-43, CPU-44	CPU-31
CPU enabled	Enables CPU on the system startup Values: Yes; No	Yes
Description	Description or comment of the user	
Version	Hardware and software version of the module	
Barcode	Barcode of the installed module	
Led Error1 Blink rate	Led Error1 blink rate in 100ms Range of values: 1 … 254	5
Led Error1 Blink rate (no CPU)	Led Error1 blink rate in 100ms when there is no communication with CPU Range of values: 0 … 255 0 – means always OFF	255
Led Error2 Blink rate	Led Error2 blink rate in 100ms Range of values: 1 … 254	5
Led Error2 Blink rate (no CPU)	Led Error2 blink rate in 100ms when there is no communication with CPU Range of values: 0 … 255 0 – means always OFF	255
Led Run Blink rate (no CPU)	Led Run blink rate in 100ms when there is no communication with CPU Range of values: 0 … 255 0 – means always OFF	0
Time out with CPU	Communication time out with CPU in 100ms. The period of time when no activity was received from the main CPU. Range of values: 10 … 255	10
Watchdog relay time out	Watchdog relay time out in seconds. The period of time when no activity was received from the main CPU (Operating system or Enilit CMS is not running or loading). Range of values: 1 … 255	20
Watchdog COM ports	COM communication ports will be disabled after the set time of milliseconds. Range of values: 0 … 65535 0 – communication ports will never be disabled	3000

4.8.6 Card slots

The following figure shows the tree of *Card Slots*. Here the user can assign hardware modules to a particular slot. The type of the module is written on the top of the front panel of the module.

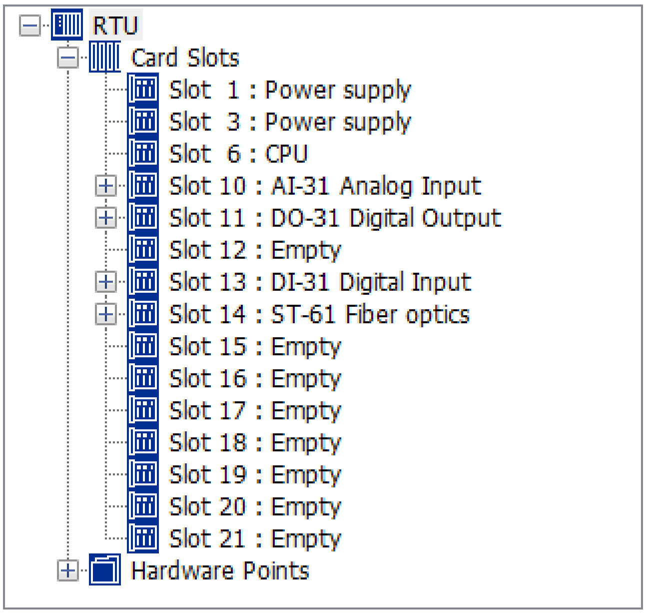


Figure 63. RTU Slots tree

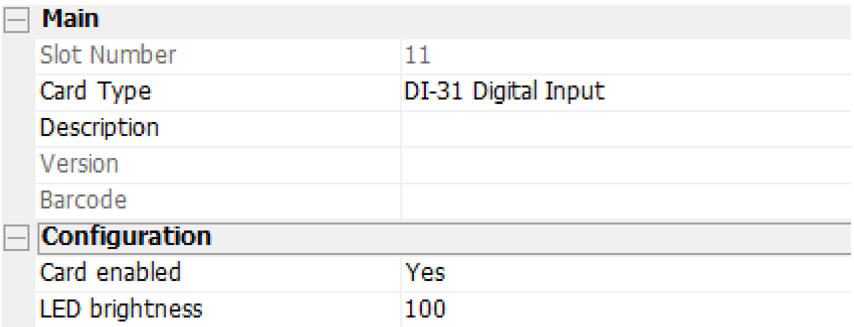


Figure 64. Slot parameters pane

Table 57. Fields of *Card Slots* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Slot number	Number of RTU slot for internal use only	Depends on the slot number
Card enabled	Enables the card	Yes
Card Type	Selects the type of the module Values: DI-31 Digital Input, DO-31 Digital Output, AI-31 Analogue Input, ST-61 Fibre optics, AO-31 Analogue Output	Empty
Description	Description of the card	
Version	Hardware and software version of the card	
Barcode	Barcode of the installed card	
LED brightness	Regulates LED brightness on a particular module Range of values: 0 … 100 %	100

4.8.7 Hardware items parameters

4.8.7.1 Digital input

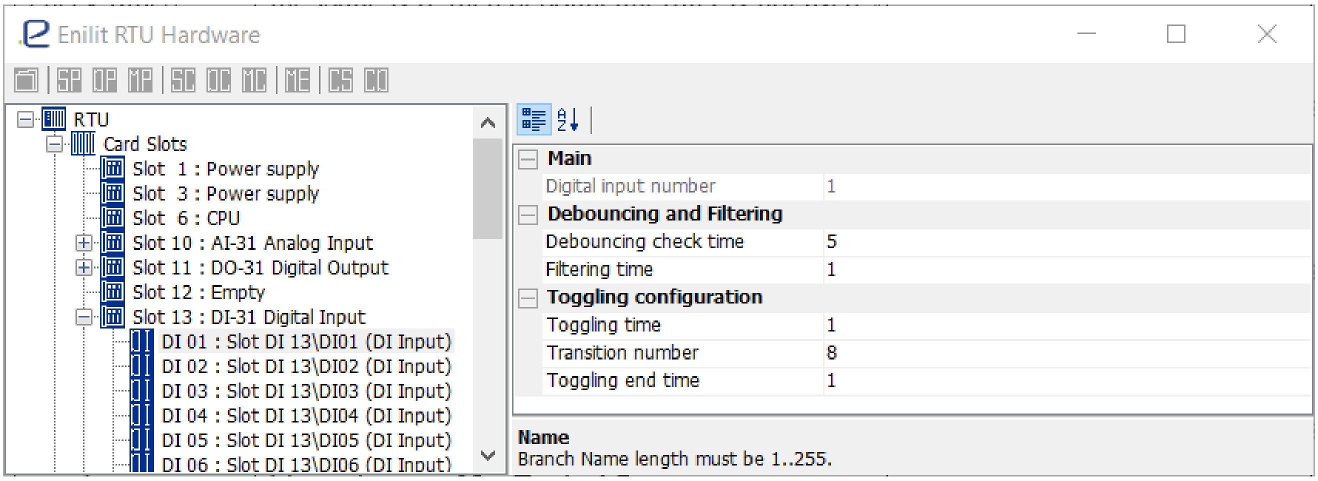


Figure 65. Digital input parameters

Table 58. Fields of *Digital input* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Digital input number	Number of digital inputs for internal use only	Depends on digital input
Debouncing check time	Debouncing checking time in milliseconds. If the value is 0, then debouncing filter is not used. Range of values: 0 … 255ms	5
Filtering time	Filter checking time in milliseconds. If the value is 0, then filtering is not used. Range of values: 0 … 255ms	1
Toggling time	Toggling checking time. If the value is 0, then toggling is not used. Range of values: 0 … 60s	1
Transition number	Counting transitions in toggling time to set the quality of the binary input to *Not Topical*. Range of values: 2 … 60	8
Toggling end time	Time delay period after which no changes are detected. Range of values: 0 … 60s	1

4.8.7.2 Digital output

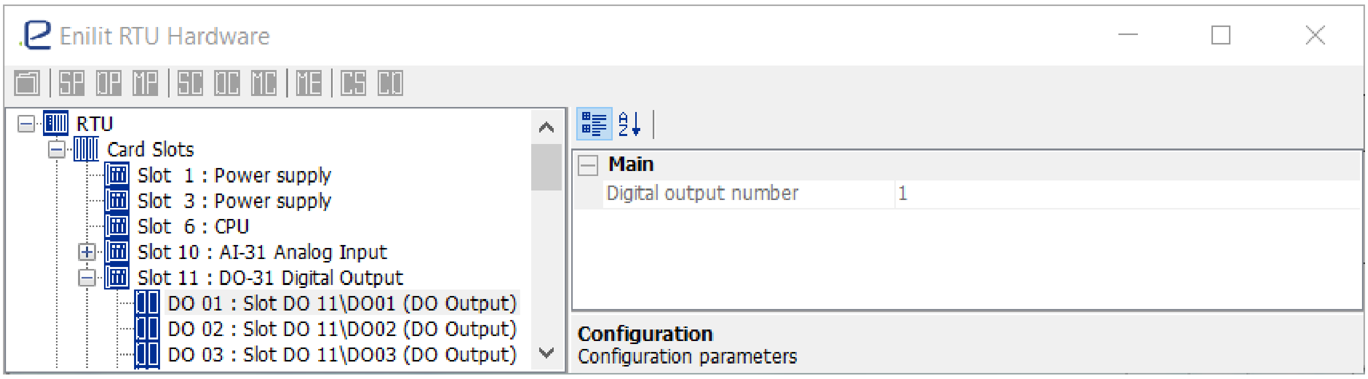


Figure 66. Digital output parameters

Table 59. Fields of *Digital output* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Digital output number	Number of digital outputs for internal use only, for example: 1 … 24	Depends on digital output

4.8.7.3 Analogue input

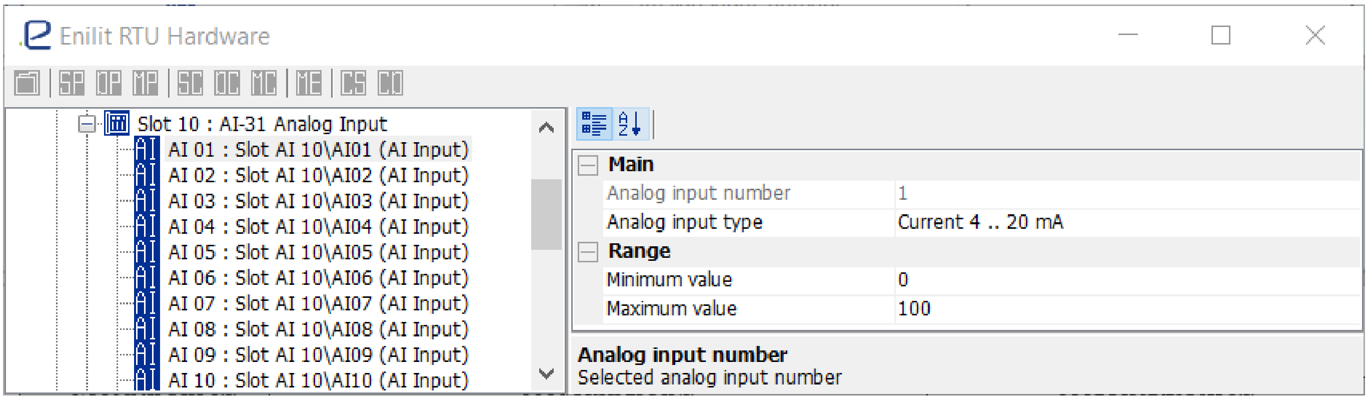


Figure 67. Analogue input parameters

Table 60. Fields of *Analogue input* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Analogue input number	Number of analogue inputs, for internal use only.	Depends on analogue input
Analogue input type	Configuration allows setting the type of analogue input to the measuring range. Range of values: Current 0 … 1mA Current -1 … 1mA Current 0 … 5mA Current -5 … 5mA Current 0 … 10mA Current -10 … 10mA Current 4 … 20mA Current 0 … 20mA Current -20 … 20mA Voltage -10 … 10V Voltage -5 … 5V Voltage -2,5 … 2,5V Voltage -1,25 … 1,25V	Current 4 … 20mA
Maximum value	Maximum raw value of analogue input for the conversation to normalized measured value. Range of values: - 99999999999999 … 99999999999999	100
Minimum value	Minimum raw value of analogue input for the conversation to the normalized measured value. Range of values: - 99999999999999 … 99999999999999	0

4.8.7.4 Fibre optics

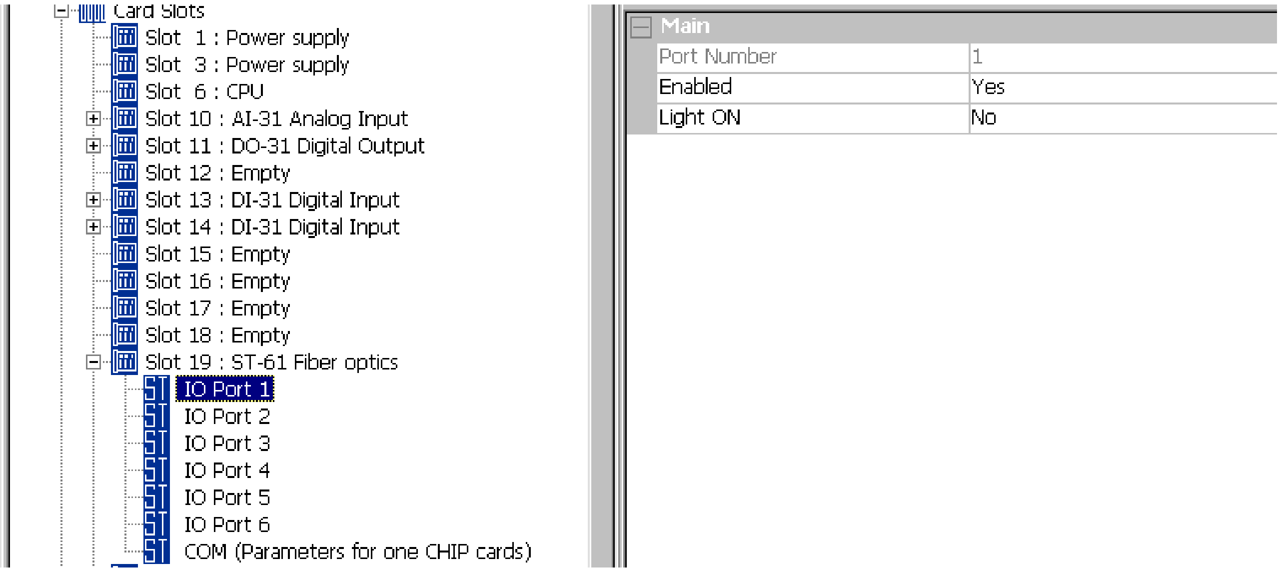


Figure 68. Fibre optics *IO Port* parameters

Table 61. Fields of *IO Ports* in *Fibre optics* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Port Number	Physical port number from the top of the module Range of values: 1 … 6	Depends on *IO Port* number
Enabled	Turns on or off fibre optic port Values: No; Yes	Yes
Light ON	Lights on or off fibre optic port Values: No; Yes	No

In the following window the baud rate of COM (parameters for one CHIP card) should be the same as of the communication port connected from CPU to ST-61 module.

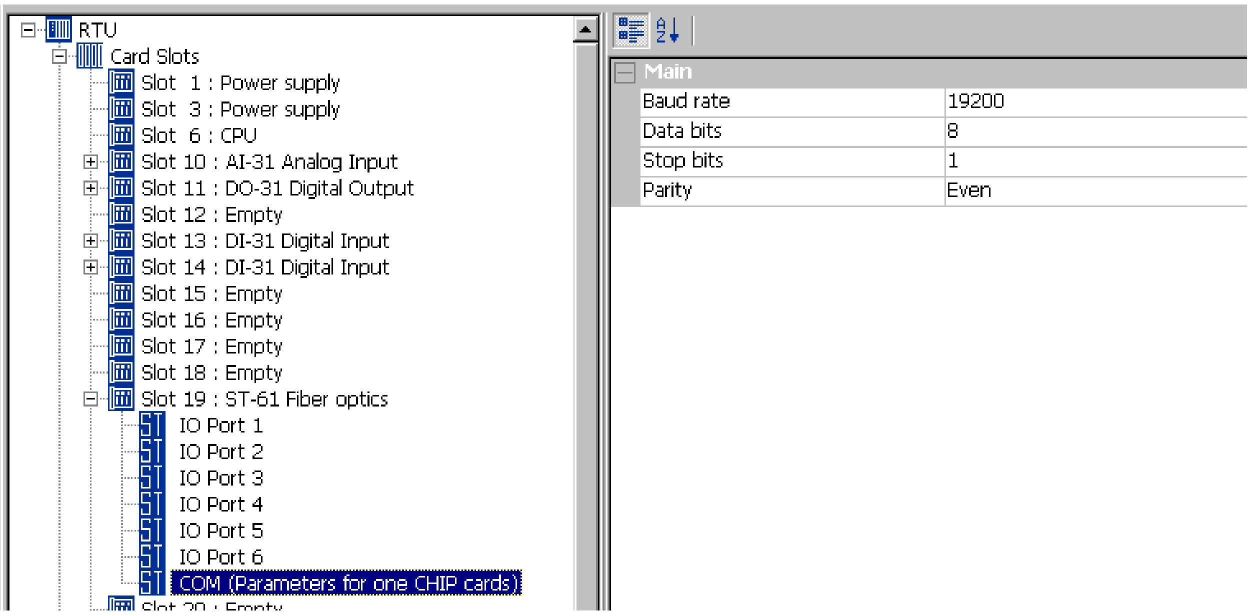


Figure 69. COM (Parameters for one CHIP cards)

Table 62. Fields of *COM* in *Fibre optics* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Baud rate	Serial port baud rate Range of values: 110 … 921600	19200
Data bits	Serial port data bits Values: 7,8 bits	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None

4.8.7.5 Analogue output

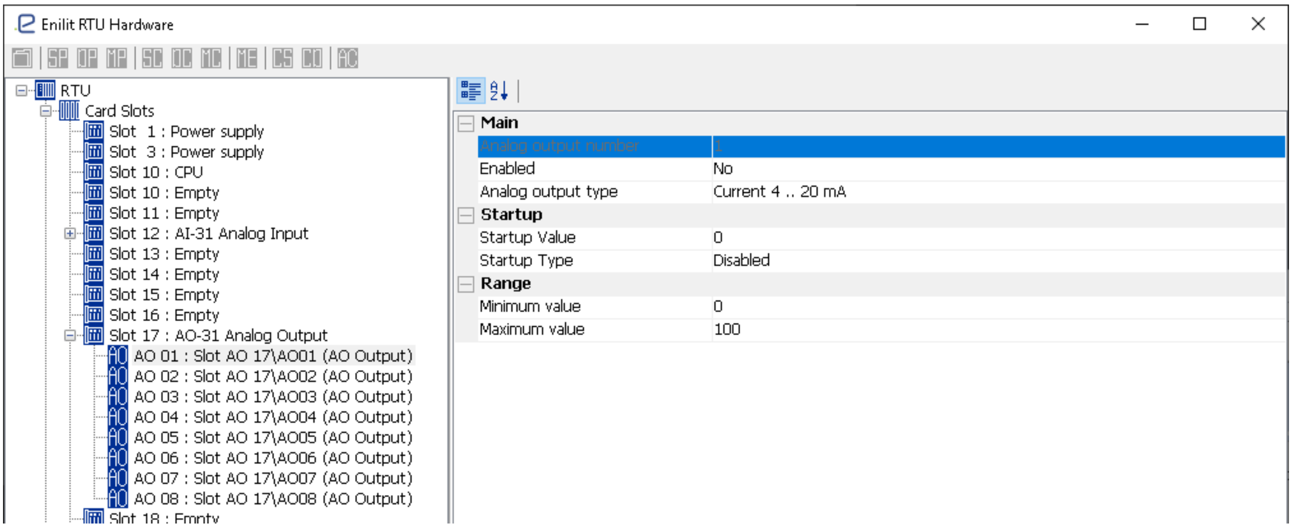


Figure 70. Analogue output parameters

Table 63. Fields of *Analogue output* card slot window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Analogue output number	Number of analogue outputs, for internal use only.	Depends on analogue output
Enabled	The output is enabled to generate mA or V. Range of values: Yes; No	No
Analogue output type	Configuration allows setting the type of analogue input to the measuring range. Range of values: Current 0 … 20mA Current 0 … 24mA Current 3,5 … 23,5mA Current 4 … 20mA Current -24 … 24mA Voltage 0 … 5V Voltage 0 … 6V Voltage 0 … 10V Voltage 0 … 12V Voltage -5 … 5V Voltage -6 … 6V Voltage -10 … 10V Voltage -12 … 12V	Current 4 … 20mA
Startup Value	Value set after AO board startup or power on.	0
Startup Type	Startup type after board power on. Range of values: Disabled, Minimum,	Disabled

	Middle, Maximum, Startup Value	
Maximum value	Maximum raw value of analogue input for the conversation to normalized measured value. Range of values: - 99999999999999 … 99999999999999	100
Minimum value	Minimum raw value of analogue input for the conversation to the normalized measured value. Range of values: - 99999999999999 … 99999999999999	0

4.8.8 Hardware points

In the window of Enilit RTU *Hardware Points,* the user creates points, which are to be connected to hardware digital inputs, analogue inputs, and command outputs.

The following figure shows the popup menu of *Hardware Points*, which allows creating *Hardware Points* tree. After that, tags can be created like a single point status, double point status, multi point status, single commands, double commands, multi point commands, measurements, and counter single, counter doubles, Analog command.

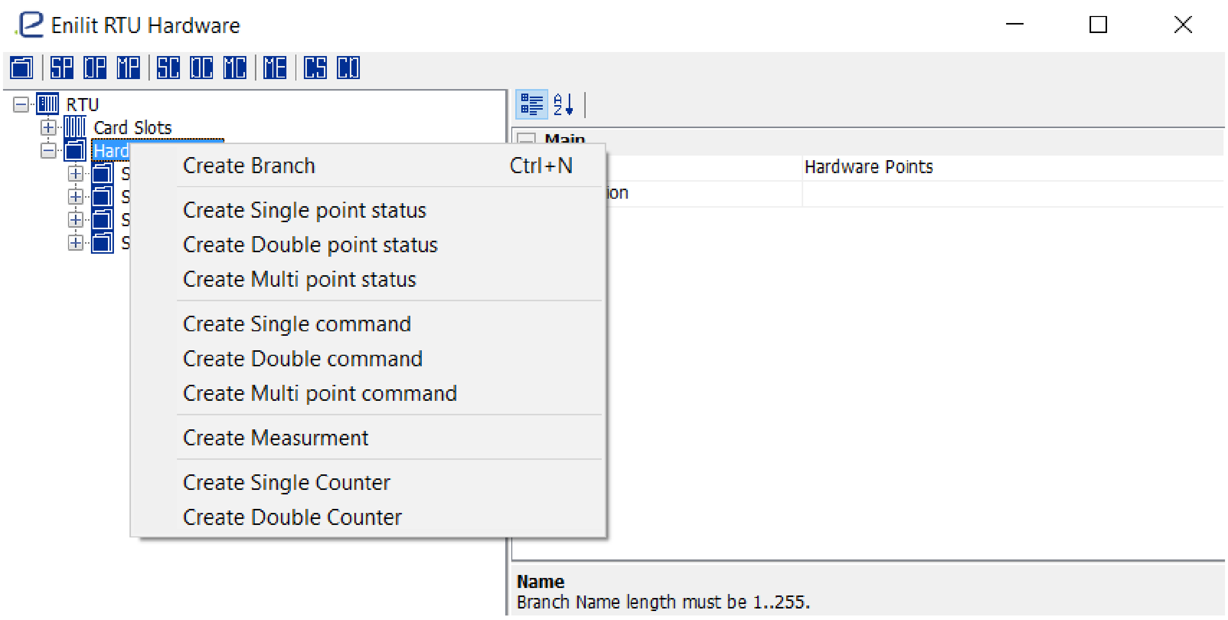


Figure 71. Popup menu of *Hardware Points*

4.8.8.1 Single point parameters

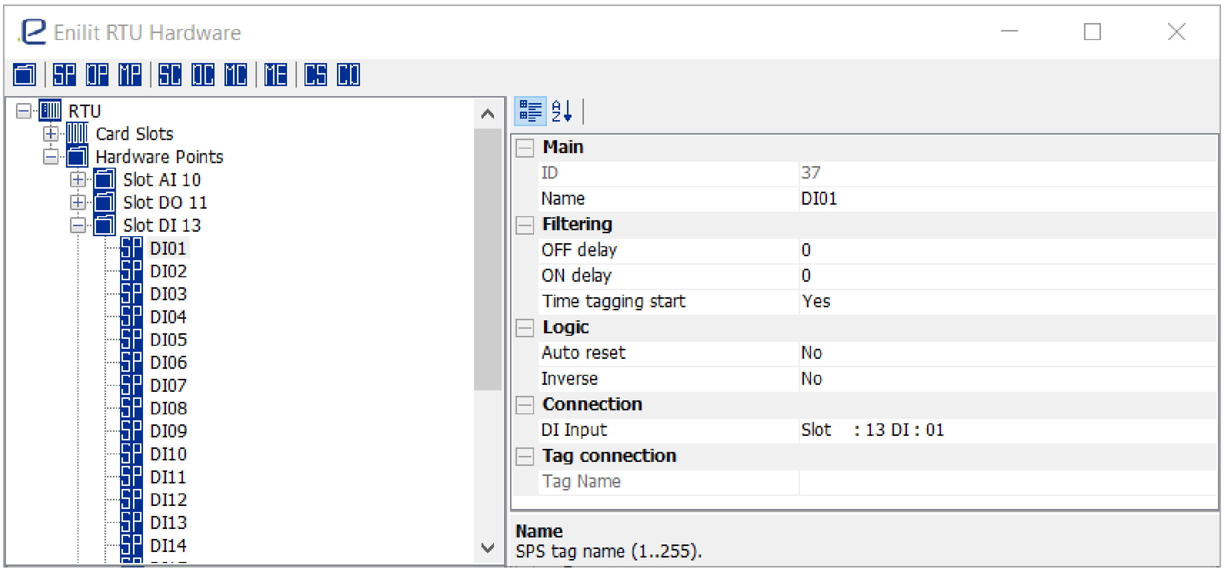


Figure 72. *Hardware Points* tree and single point parameters

Table 64. Fields of single point parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Identification number of a hardware tag for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, ‘IED fault’ Length: 1 … 255	Item SPS1
DI input	Allows connecting a hardware tag to the binary input. For example, Slot: 13 DI: 01	Not set
OFF delay	Delay on a stable state after which the hardware tag is set to OFF. (100ms) Range of values: 0 … 1000	0
ON delay	Delay on a stable state after which the hardware tag is set to ON. (100ms) Range of values: 0 … 1000	0
Time tagging start	Type of a tag timestamp. An event can be with the start or end of filtering timestamp. Values: Yes; No	Yes
Auto reset	Automatic resetting of a hardware tag from ON to OFF Values: Yes; No	No
Inverse	Invert of a hardware tag Values: Yes; No	No
Tag Name	Hardware tag connection to *TAG Manager*. *TAG Manager* tag name.	-

4.8.8.2 Double point parameters

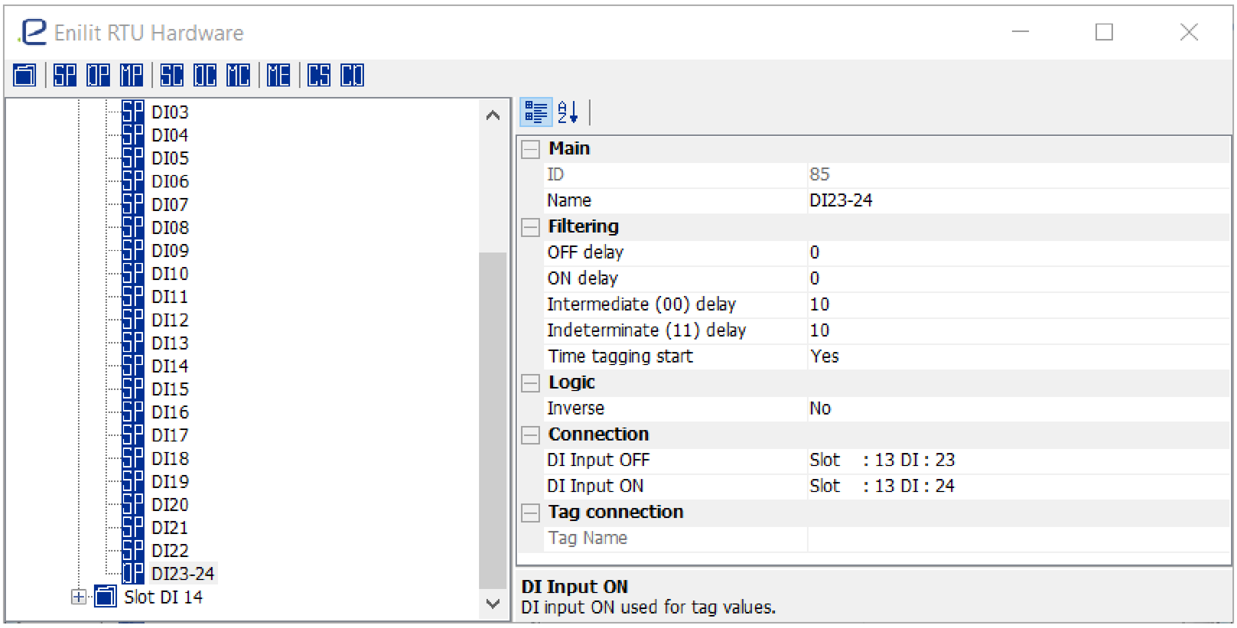


Figure 73. *Hardware Points* tree and double point parameters

Table 65. Fields of double point parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on a tag
Name	Hardware tag name, for example, 'Item DPS1' Length: 1 … 255	Item DPS1
DI input OFF	The function allows connecting a hardware tag to the binary input, for example, Slot: 13 DI: 04	Not set
DI input ON	Allows connecting a hardware tag to a binary input, for example, Slot: 13 DI: 05	Not set
Intermediate (00) delay	Delay on stable state after which the hardware tag is set to Jammed (both inputs are not active). (100ms) Range of values: 0 … 1000	0
OFF delay	Delay on the stable state after which the hardware tag is set to OFF. (100ms) Range of values: 0 … 1000	0
ON delay	Delay on the stable state after which the hardware tag is set to ON. (100 ms) Range of values: 0 … 1000	0

Indeterminate (11) delay	Delay on the stable state after which the hardware tag is set to Undefined (both inputs are active). (100ms) Range of values: 0 … 1000	0
Time tagging start	Type of a tag timestamp. An event can be with the start or end of a filtering timestamp. Range of values: Yes; No	Yes
Inverse	Invert of a hardware tag Range of values: Yes; No	No
Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name.	-

4.8.8.3 Multipoint status

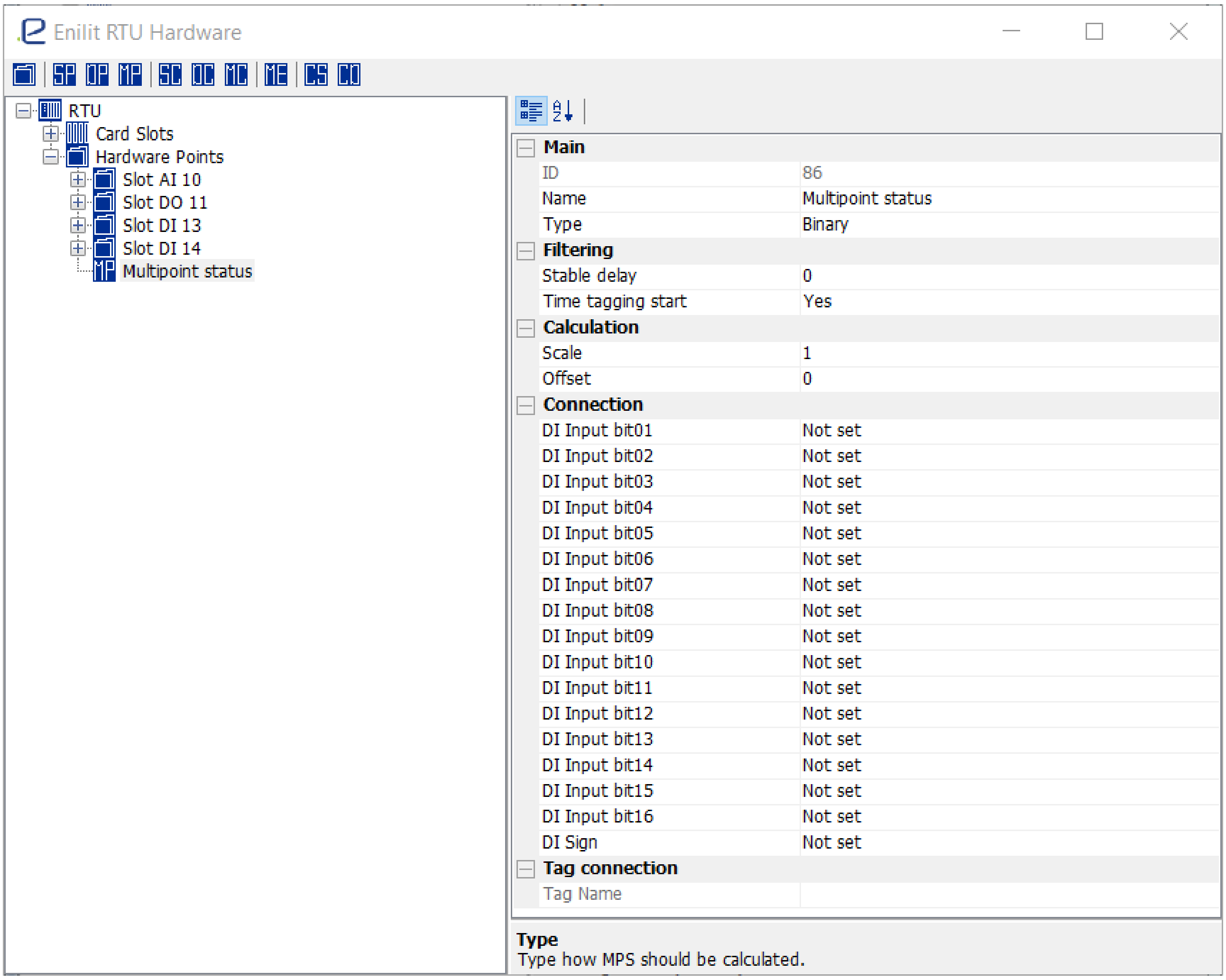


Figure 74. *Hardware Points* tree and multipoint status parameters

Table 66. Fields of multipoint status parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Item MPS1' Length: 1 … 255	Item MPS1
Type	Selects the type of the multipoint status Range of values: Binary, BCD, 1 from N bits, Gray	Binary
DI Input bit01 … DI Input bit16	Allows connecting one of the multipoint status items to the binary input, for example, Slot: 13 DI: 04	Not set
DI Sign	Allows connecting the binary input used for the multipoint status sign. For example, Slot: 13 DI: 04	Not set
Stable delay	Delay on the stable state before changing the tag's value in 100 ms. Range of values: 0 … 1000	0
Time tagging start	Type of a tag timestamp. An event can be with the start or end of the filtering timestamp. Range of values: Yes; No	Yes
Offset	Offset value for conversion Range of values: 0 … 100	0
Scale	Scale value for conversion Range of values: 0 … 100	1
Tag Name	Hardware tag connection to *TAG Manager.* *TAG Manager* tag name	-

4.8.8.4 Single command parameters

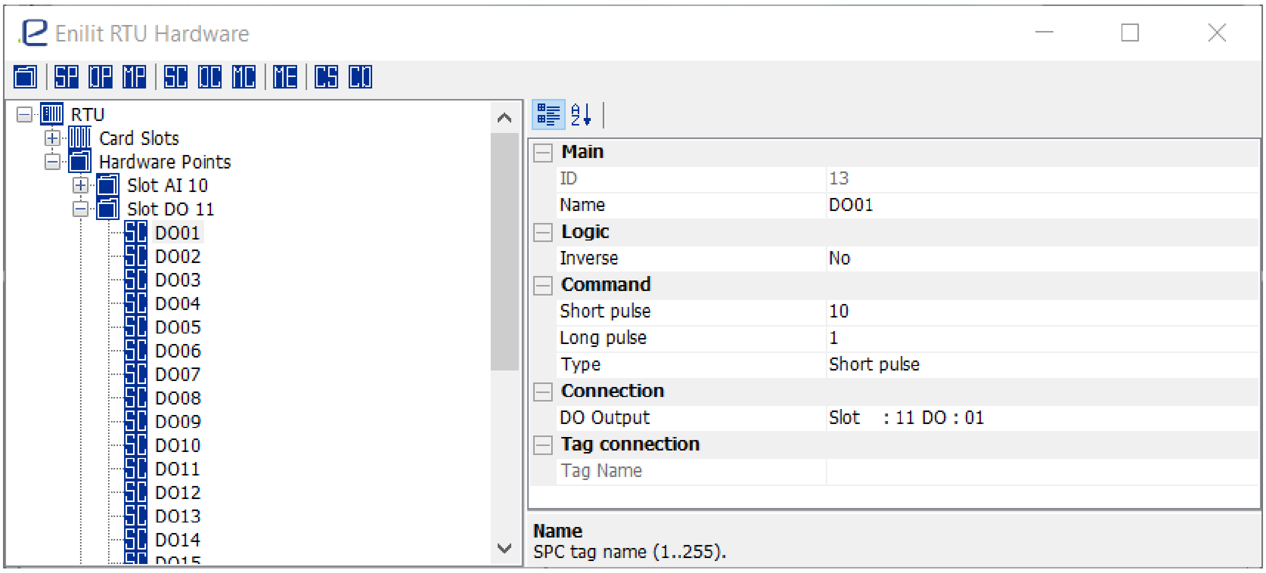


Figure 75. *Hardware Points* tree and single command parameters

Table 67. Fields of single command parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Long pulse	Length of the long pulse in seconds Range of values: 1 … 600s	1
Short pulse	Length of the short pulse in 10 milliseconds Range of values: 10 … 6000ms	10
Type	If a command was received with an unknown or undefined type, it will be overridden with this type of pulse. Range of values: Pulse short, Pulse long, Persistent	Pulse short
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Item SPC1' Length: 1 … 255	Item SPC1
DO output	Allows connecting a hardware tag to the digital output For example, Slot : 11 DO : 01	Not set
Inverse	Invert of a hardware tag Range of values: Yes; No	No

Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name	-

4.8.8.5 Double command parameters

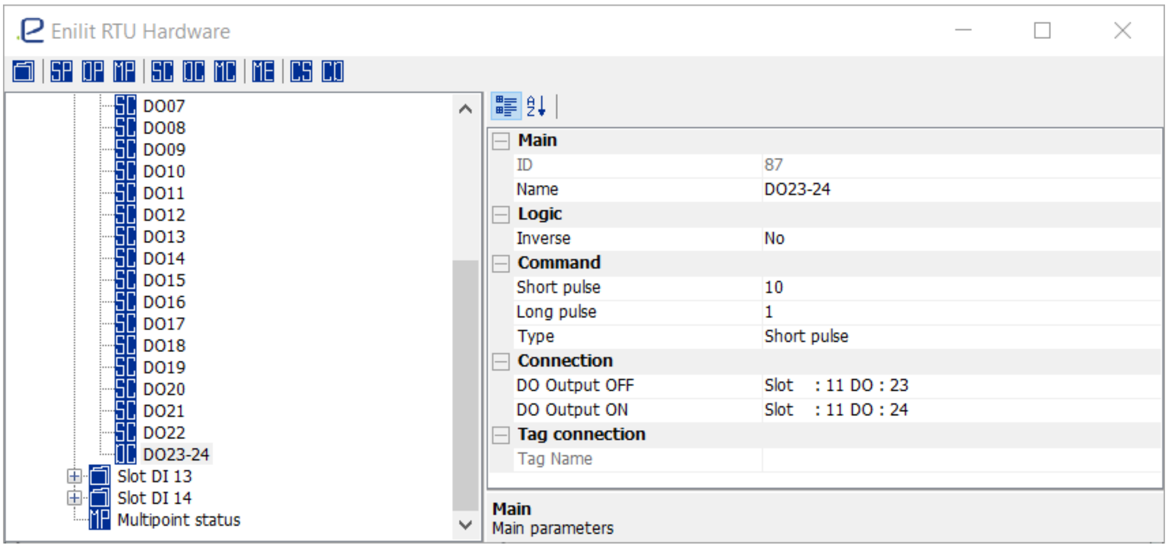


Figure 76. *Hardware Points* tree and double command parameters

Table 68. Fields of double command parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Long pulse	Length of the long pulse in seconds Range of values: 1 … 600s	1
Short pulse	Length of the short pulse in 10 milliseconds Range of values: 10 … 6000ms	10
Type	If a command was received with an unknown or undefined type, it will be overridden with this type of pulse. Range of values: Pulse short, Pulse long, Persistent	Pulse short
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Item DPC1' Length: 1 … 255	Item DPC1
DO output OFF	Allows connecting a hardware tag to the digital output, for example, Slot: 11 DO: 04	Not set
DO output ON	Allows connecting a hardware tag to the digital output, for example, Slot: 11 DO: 05	Not set
Inverse	Invert of a hardware tag Range of values: Yes; No	No
Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name.	-

4.8.8.6 Multipoint command

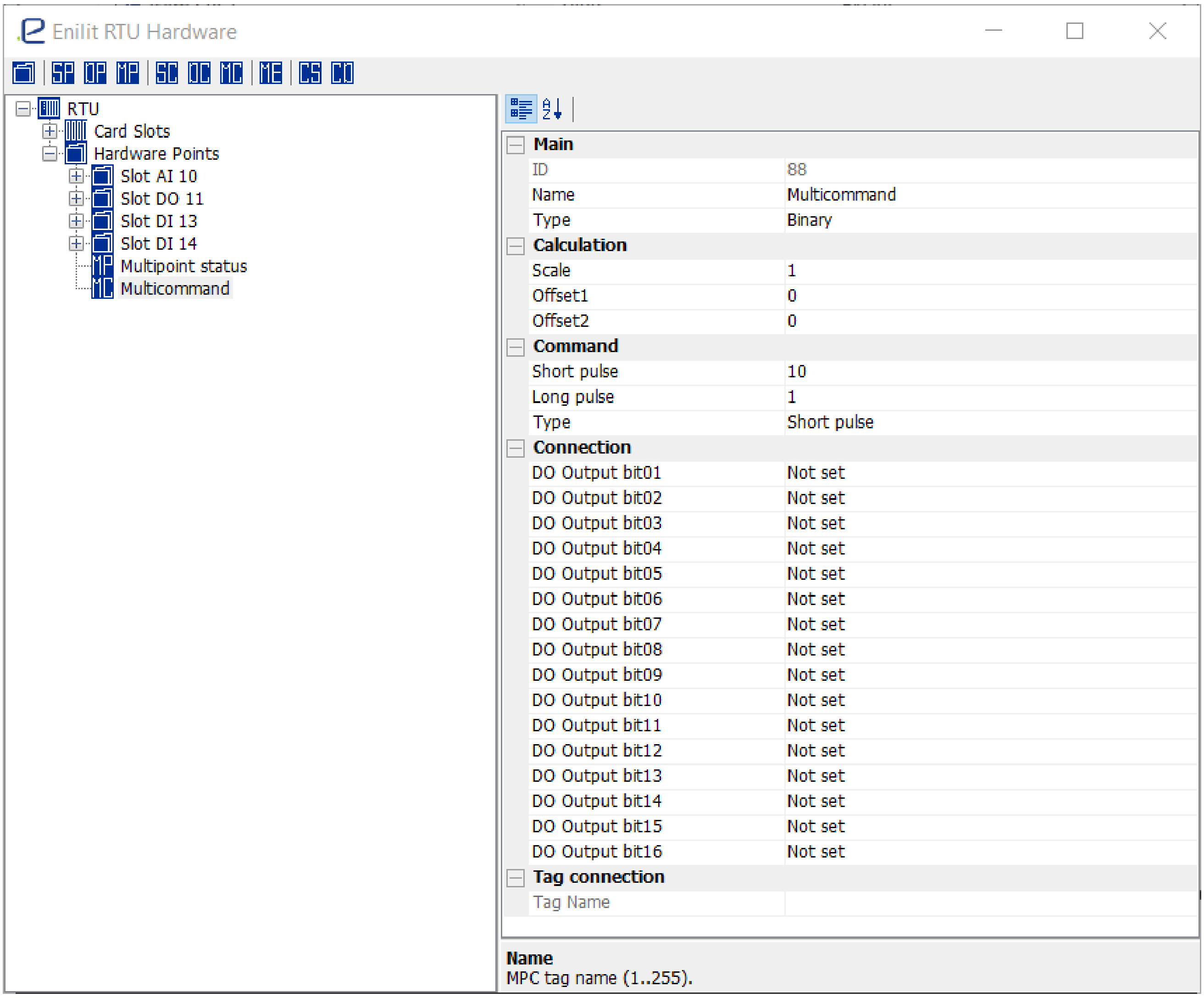


Figure 77. *Hardware Points* tree and multipoint command parameters

Table 69. Fields of multipoint command parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Long pulse	Length of the long pulse in seconds Range of values: 1 … 600s	1
Short pulse	Length pf the short pulse in 10 milliseconds Range of values: 10 … 6000ms	10
Type	Identify the type of pulse which will be overwritten on a command received of an unknown or undefined type. Range of values: Pulse short, Pulse long, Persistent	Pulse short

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Item MPC1' Length: 1 … 255	Item MPC1
Type	Select the type of a multipoint command Range of values: Binary, BCD, 1 from N bits, Gray	Binary
DO Output bit01 … DO Output bit16	Allows connecting one of the multipoint command items to the binary output, for example, Slot: 13 DO: 04	Not set
Offset1	Offset value for conversion Range of values: 0 … 100	0
Offset2	Offset value for conversion Range of values: 0 … 100	0
Scale	Scale value for conversion Range of values: 0 … 100	1
Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name	-

4.8.8.7 Measurement parameters

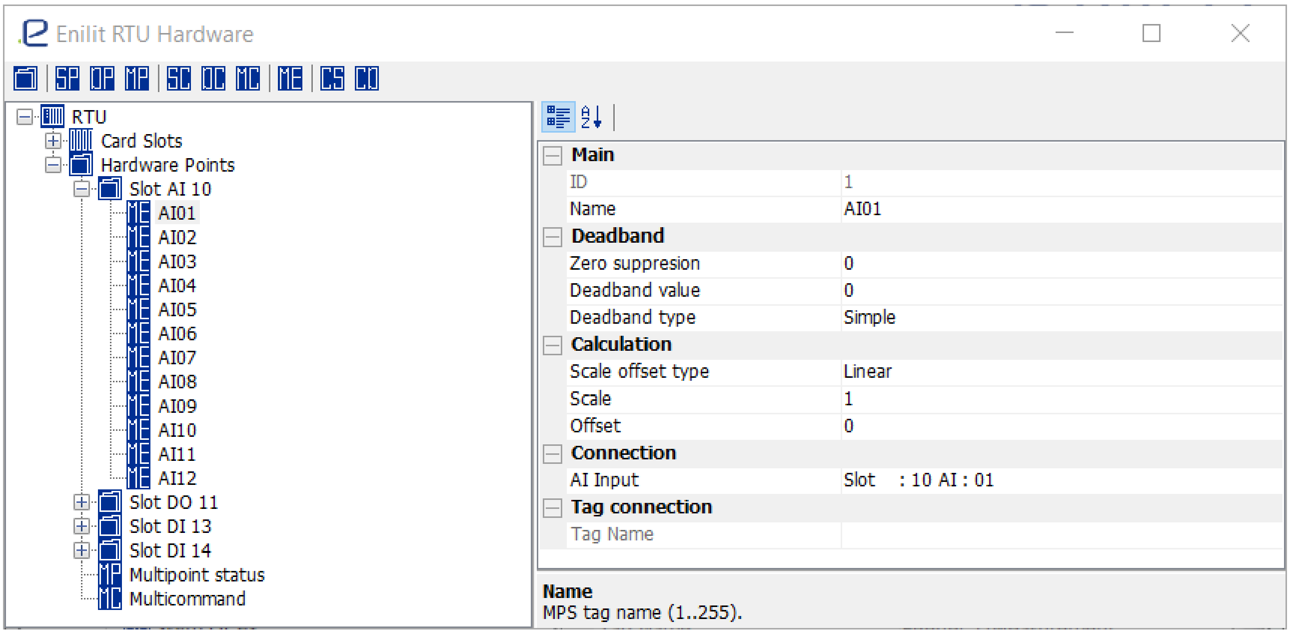


Figure 78. *Hardware Points* tree and measurement parameters

Table 70. Fields of measurement parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Voltage U1' Length: 1 … 255	Item MV1
AI input	Allows connecting a hardware tag to the analogue input, for example, Slot: 15 AI: 01	Not set
Deadband type	Type of a measurement dead band Range of values: Simple, Integrated Type 1, Integrated Type 2	Simple
Deadband value	Change of the measurement is sent if a new value exceeds the deadband value. If the value is 0, then all changes are sent. Range of values: 0 … 32767	0
Zero suppression	Set measurement to zero if it reaches below this parameter's value. Range of values: 0 … 32767	0
Offset	Offset value for conversion Range of values: 0 … 100	0
Scale	Scale value for conversion Range of values: 0 … 100	1
Scale offset type	Type of conversion Range of values: Linear, Quadratic	Linear
Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name	-

4.8.8.8 Single counter parameters

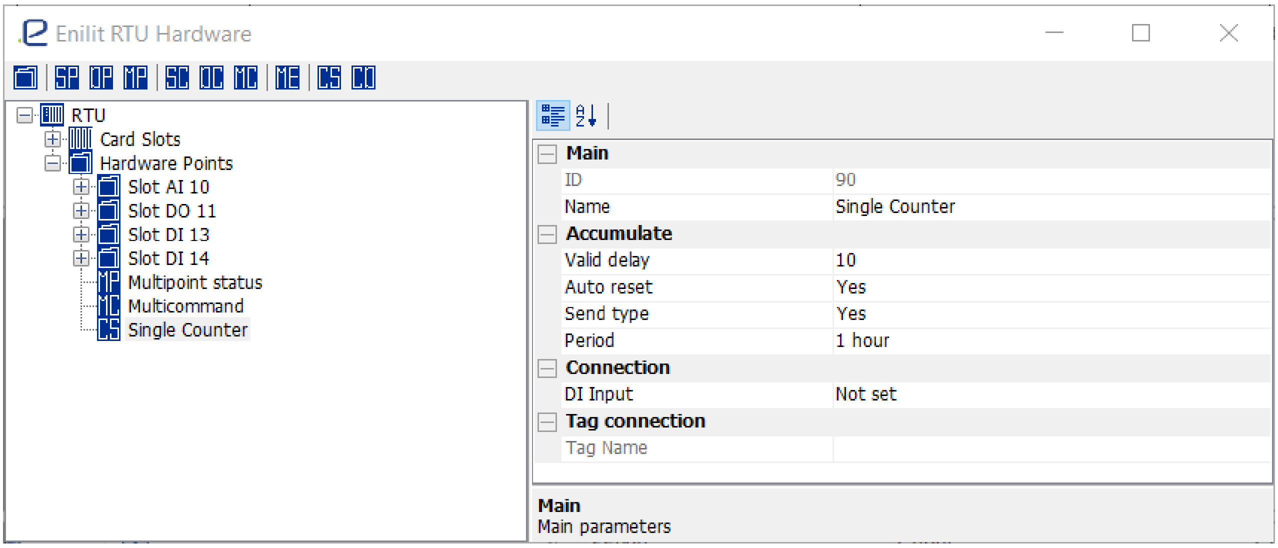


Figure 79. *Hardware Points* tree and single counter parameters

Table 71. Fields of single counter parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Auto reset	Automatically reset counter value after the accumulation period Values: Yes; No	Yes
Period	Period during which the accumulation has to be proceeded Range of values: 1 min … 12h	1 hour
Send type	Yes – the counter value is sent only at the end of the period No – the counter value is sent at the end of the period and every second Values: Yes; No	Yes
Valid delay	Stable ON delay before increasing a tag's value Range of values: 0 … 1000ms	10
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Counter C1' Length: 1 … 255	Item SCT1
DI input	Allows connecting a hardware tag to the digital input, for example, Slot: 12 DI: 01	Not set

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name	-

4.8.8.9 Double counter parameters

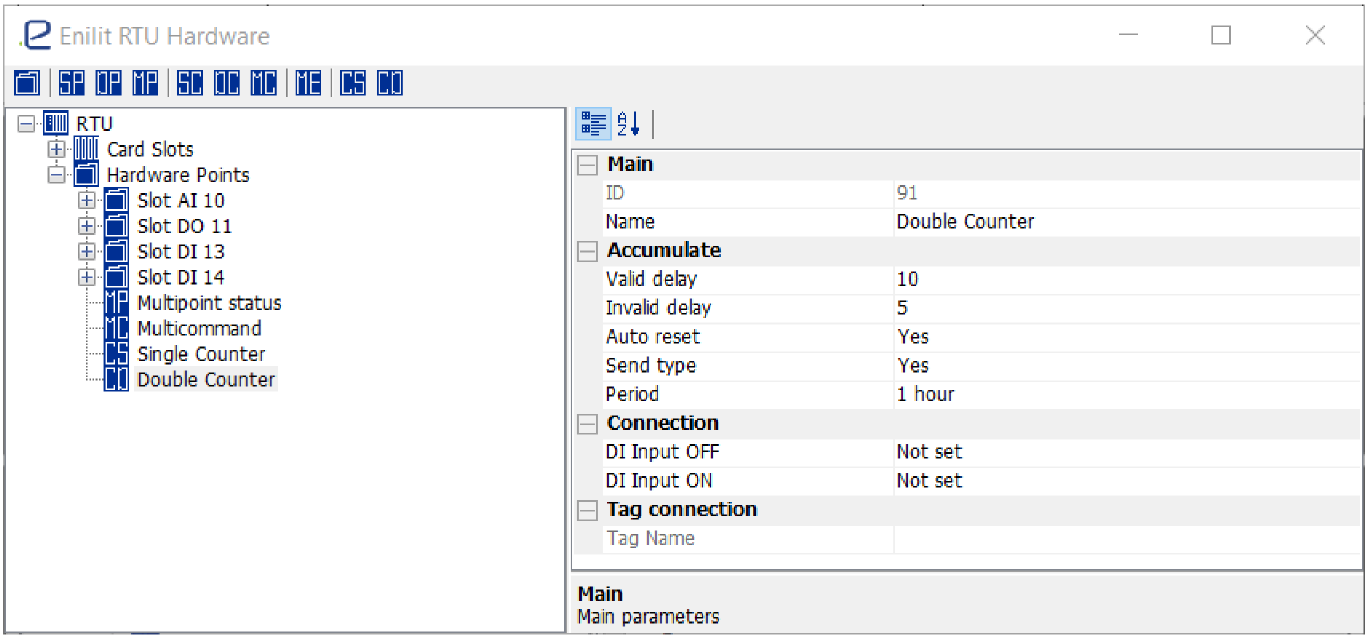


Figure 80. *Hardware Points* tree and double counter parameters

Table 72. Fields of double counter parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Auto reset	Automatically reset counter value after the accumulation period Values: Yes; No	Yes
Invalid delay	Delay after which binary inputs do not return to the normal state. The tags' value is not increased. Range of values: 0 … 1000 ms	5
Period	Period during which the accumulation has to be proceeded Range of values: 1 min … 12 h	1 hour
Send type	Yes – the counter value is sent only at the end of the period No – the counter value is sent at the end of the period and every second Values: Yes; No	Yes
Valid delay	Stable ON delay before increasing a tag's value Range of values: 0 … 1000 ms	10
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Counter C1' Length: 1 … 255	Item DCT1
DI input OFF	Allows connecting a hardware tag to the digital input. DI input used for OFF counting, for example, Slot: 12 DI: 01	Not set
DI input ON	Allows connecting a hardware tag to the digital input. DI input used for ON counting, for example, Slot: 12 DI: 01	Not set
Tag Name	Hardware tag connection to *TAG Manager*. *TAG Manager* tag name	-

4.8.8.10 Analog output parameters

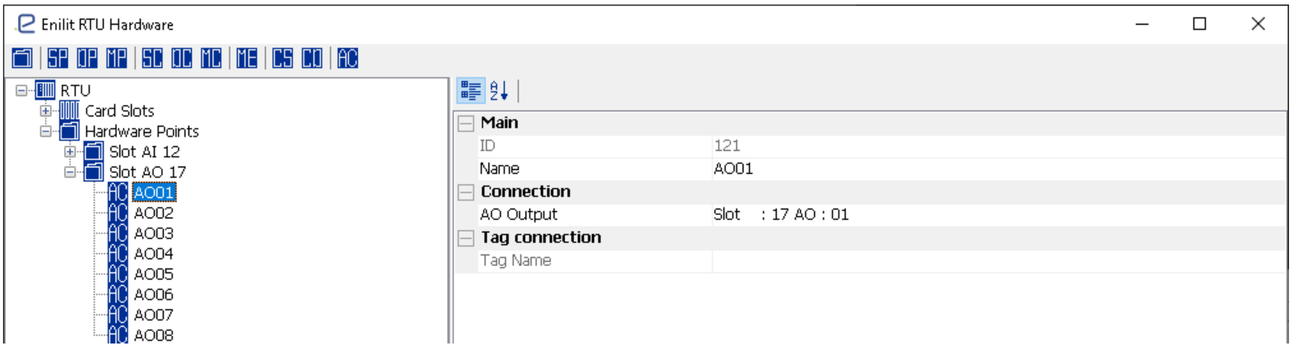


Figure 81. *Hardware Points* tree and Analog output parameters

Table 73. Fields of measurement parameters window in *Hardware Points* card slot

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	Identification number of a hardware tag, for internal use only Range of values: 1 … 65535	Depends on tag
Name	Hardware tag name, for example, 'Voltage U1' Length: 1 … 255	AC01
AO output	Allows connecting a hardware tag to the analogue output, for example, Slot: 17 AO: 01	Not set
Tag Name	Hardware tag connection to *TAG Manager. TAG Manager* tag name	-

4.9 Master protocols

4.9.1 IEC 60870-5-103 configuration

4.9.1.1 Communication port parameters

Main	
ID	5
Port Name	COM1 IEC-103 master protocol
Enabled on start	Yes
Communication	
COM port	COM 175
Baud rate	19200
Data bits	8
Stop bits	1
Parity	None
RS-485 Mode	Four wire
Reconnect	10
Next request	50
Logging	
Port Monitor	No
Log raw data	Yes

Figure 82. *Communication port* parameters in IEC 60870-5-103 protocol

Table 74. Fields of *Communication port* parameters window in IEC 60870-5-103 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Name of the port and protocol, for example, 'COM1 IEC103 master protocol'	New IEC-103 master protocol
Enabled on start	Port enabled on the system startup Values: Yes; No	No
Com port	Communication port number	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7,8 bits	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity Values: None; Odd; Even; Mark; Space	None

FIELD NAME	DESCRIPTION	DEFAULT VALUE
RS-485 Mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Range of values: four wires, two wires	Four wires
Reconnect	Time interval of reconnection attempt while communication is not established Range of values:1 … 600 s	10
Next request	Time interval before sending the next request Range of values: 0 … 1000 ms	50
Port Monitor	Shows the port monitor on the system startup Values: Yes; No	No
Log raw data	Logs raw communication data Values: Yes; No	Yes

4.9.1.2 Data link layer parameters

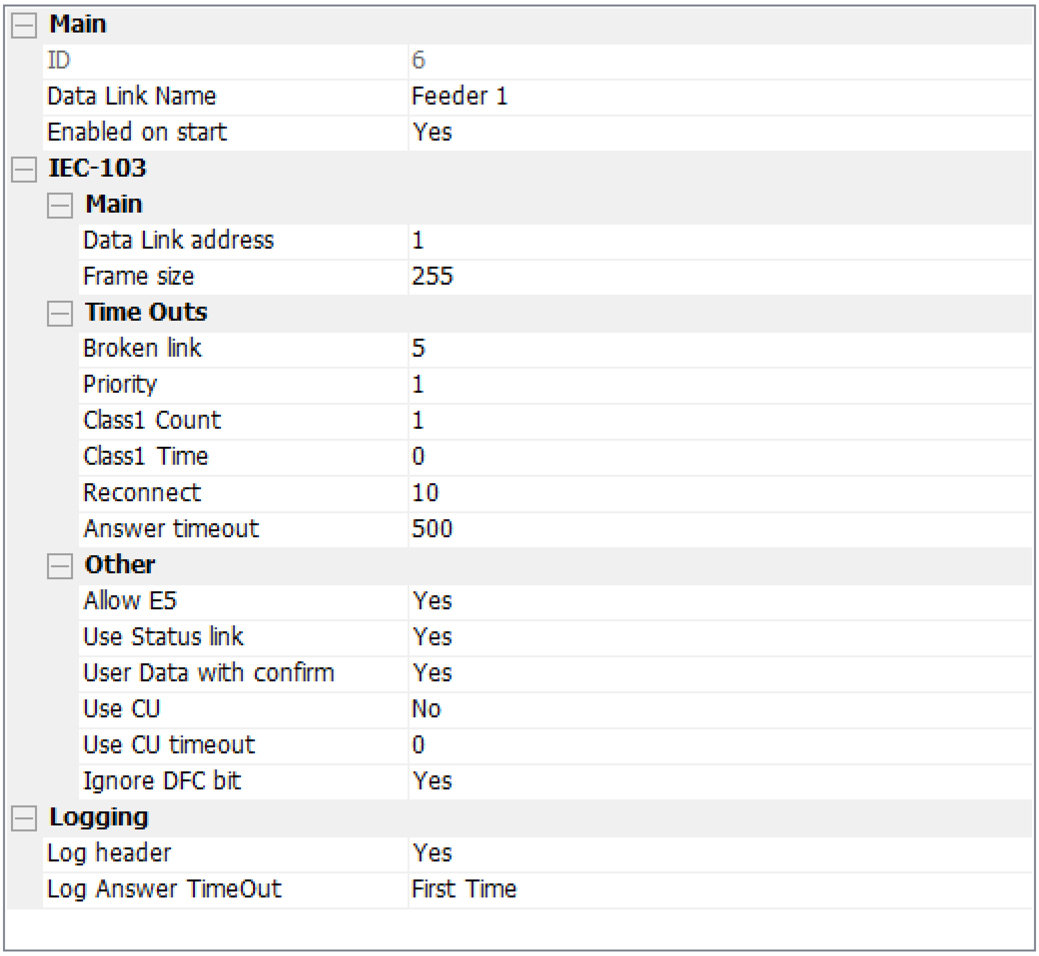


Figure 83. *Data link layer* parameters in IEC 60870-5-103 protocol

Table 75. Fields of *Data link layer* parameters window in IEC 60870-5-103 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data link name	Data link layer name, for example, 'Feeder 1'	New Data Link
Enabled on start	Enables or disables data link on start Values: Yes; No	No
Data link address	Data link address Range of values: 0 … 254	0
Frame size	Maximum frame length Range of values: 50 … 255 bytes	255
Broken link	Number of retries to determine if the connection is broken Range of values: 1 … 10	3
Priority	Requests data at every cycle. Relevant only if more than one data link layer exists Range of values: 1 … 255	1
Class1 Count	Number of requests for the same data link layer, if there are Class1 events. 0 – requests until no Class1 events or Class1 timer expires Range of values: 0 … 255	1
Class1 Time	Time interval of requesting for the same data link layer, if there are Class1 events. 0 – time is not checked. Range of values: 0 … 255000ms	0
Reconnect	Time interval of reconnection attempt while communication is not established Range of values: 1 … 600s	10
Answer timeout	Time period for response from the controlled device Range of values: 50 … 30000ms	500
Allow E5	Enables or disables E5 response from the controlled device. Values: Yes; No	Yes
Use Status link	Enables or disables using the Status of link frame before the Reset Link is sent. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
User Data with confirm	Sends User Data with the confirmation request. Values: Yes; No	Yes
Use CU	Enables to use the Reset Communication Unit. Values: Yes; No	No
Use CU timeout	Uses the Reset CU command if there is no link more than this timeout. This parameter has no effect if 'Use CU' is disabled. Range of values: 0 … 43200 minutes	0 – always use
Ignore DFC bit	Enables to ignore DFC bit. Values: Yes; No	No
Log header	Logs data link header. Values: Yes; No	Yes
Log Answer Timeout	Logs data link answer timeouts to the system log. Values: Never; First time; Always	First Time

4.9.1.3 Application layer parameters

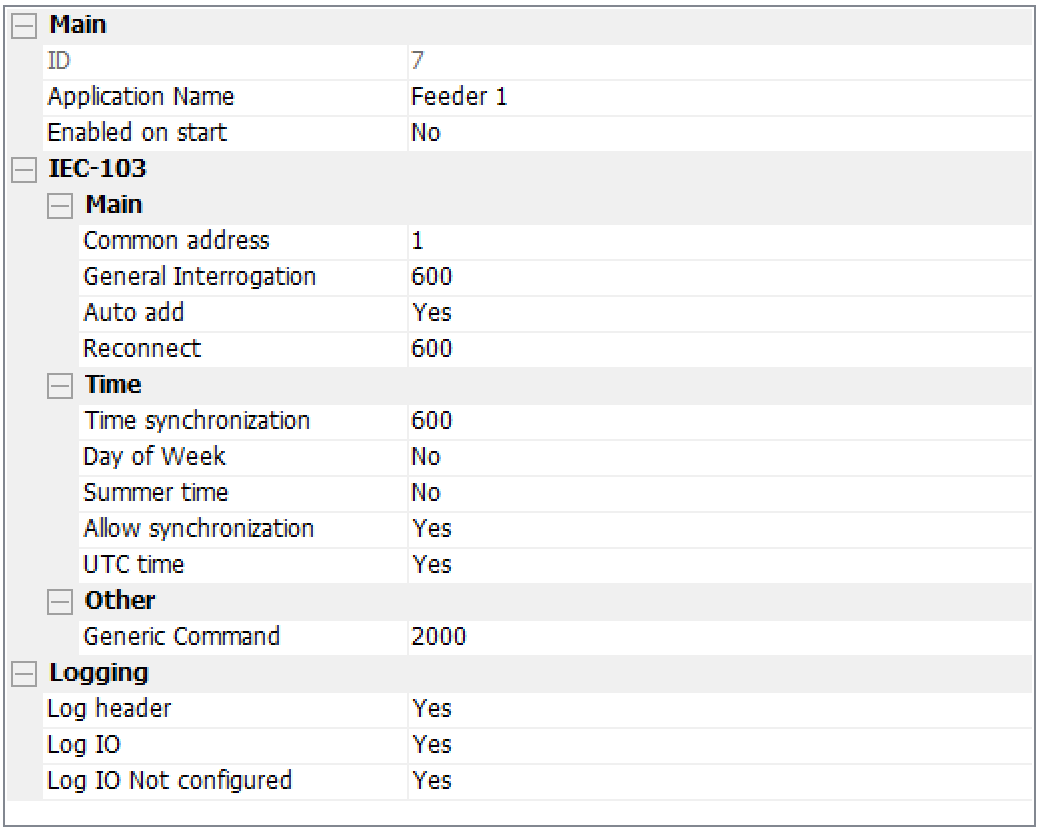


Figure 84. *Application layer* parameters in IEC 60870-5-103 protocol

Table 76. Fields of *Application layer* parameters window in IEC 60870-5-103 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application layer name	Application layer name, for example, 'Feeder 1'	New Application
Enabled on start	Enables or disables the application layer on start Values: Yes; No	No
Common address	Common address of a data unit Range of values: 1 … 254	1
General Interrogation	Cycle time of the general interrogation to the controlled device Range of values: 1 … 86400s	1800
Auto add	Automatically adds all data points received after general interrogation responses from the controlled device. Values: Yes; No	Yes
Reconnect	Time interval of reconnection to the remote application. The application is considered as connected, after receiving any application data from the remote device. Range of values: 1 … 3600s	600
Time synchronization	Cycle time of the clock synchronization to the controlled device Range of values: 1 … 86400s	600
Day of Week	In requests with a timestamp, use Day of Week bit. Values: Yes; No	No
Summer time	In requests with a timestamp, use summer time bit. Values: Yes; No	No
Allow synchronization	Yes – always synchronize, No – synchronize only if RTU internal clock is synchronized	Yes
UTC time	In requests and responses, use UTC time. Values: Yes; No	Yes
Generic command	Refresh rate of the generic data request Range of values: 500 … 600000ms	2000
Log header	Logs the headers of frames in the protocol log. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Log IO	Logs the configured information objects to the protocol log. Values: Yes; No	Yes
Log IO not configured	Logs non-configured points to the protocol log. Values: Yes; No	Yes

4.9.1.4 Points

The application layer has the branch *Points* where signals and measurements are managed from the controlled device and the commands can be sent to the controlled device. Points can be added manually or using the function *Auto Add* in the application layer, which will add all data points to the list. However, commands must be added manually anyway, hence commands are not included in the *General Interrogation*.

The following figure shows the *Points* popup menu which can be run with the right mouse button. The user can perform the following actions: *Add Status point*, *Edit Status point*, *Delete Status point*, *Select All* status points or commands. Also, it allows to *Connect to Tag* or *Remove connection to the Tag*. Removing the connection to the source is possible from the *TAG Manager*. All menu items have keyboard shortcuts which simplify and quicken the work with the software.

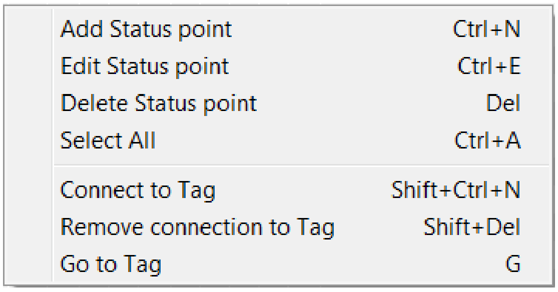


Figure 85. *Points* popup menu

The following figure shows the dialog window *Create new status point*. The parameters which can be specified on the IEC 60870-5-103 protocol are proposed in the figure below.

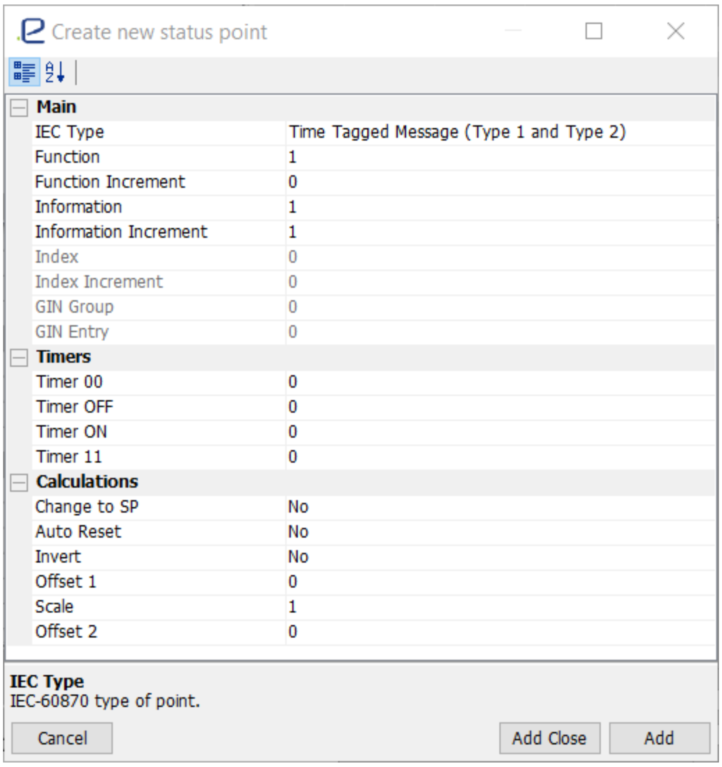


Figure 86. *Create new status point*

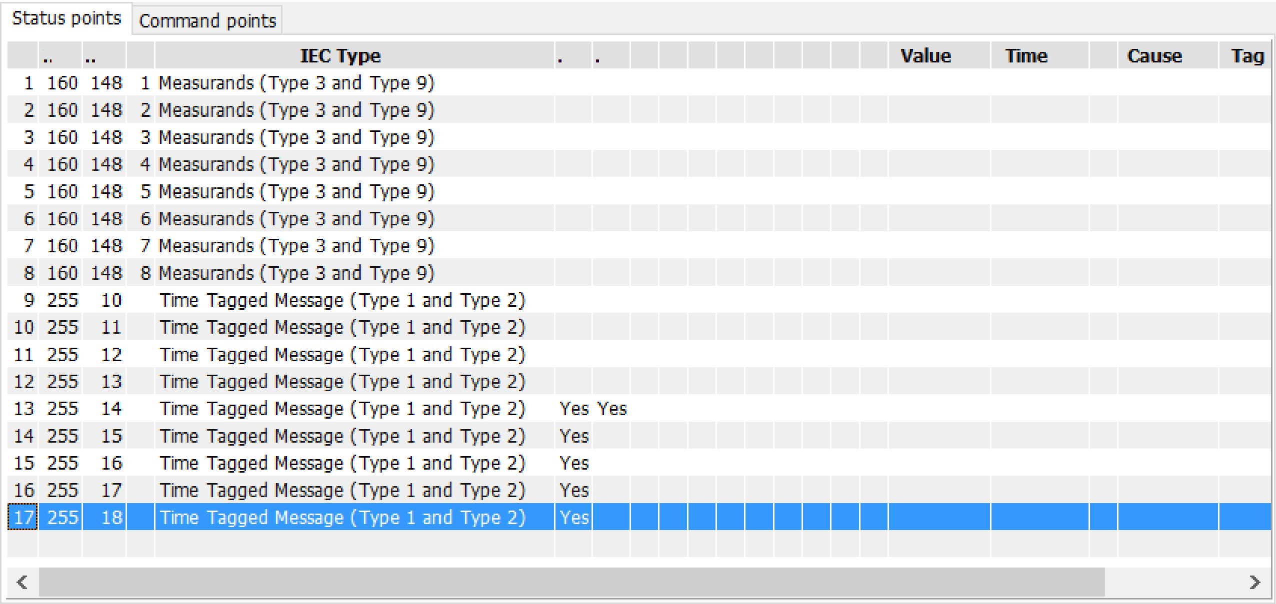
Table 77. Fields of *Create new status point* window in IEC 60870-5-103 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of data in IEC 60870-5-103 protocol Values: Time Tagged Message (Type 1 and Type 2), Measurement (Type 3 and Type 9), Measurement (Type 4), Time Tagged Message (Type 1 and Type 2) Double, Generic Command.	Time Tagged Message (Type 1 and Type 2)
Function	Defines the function type of the employed protection equipment. The list below provides the meaning of some of the function types: 128: Distance protection 160: Overcurrent time protection 176: Transformer-differential protection 192: Line differential protection 254: Generic function type 255: Global function type For a complete list of all function types, please refer to the IEC 60870-5-103 norm Range of values: 0 ... 255	1
Function Increment	Used only for configuration. After adding a new status point function, it will be automatically incremented by the set value.	0

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Information	Specifies the information number. Ranges for information numbers in the monitoring direction: 0 ... 15 System functions 16 ... 31 Status 32 ... 47 Monitoring 48 ... 63 Earth faults 64 ... 127 Short circuits 128 ... 143 Automatic reclosing 144 ... 159 Measured values 240 ... 255 Generic functions Ranges for information numbers in the control direction: 0 ... 15 System functions 16 ... 31 General commands 240 ... 255 Generic functions For a complete list of all information numbers, please refer to the IEC 60870-5-103 norm. Range of values: 0 … 255	1
Information Increment	Used only for configuration. After adding a new status point, the function will be automatically incremented by the set value.	1
Index	Parameter is relevant only with IEC Type Measurement (Type 3 and Type 9). Range of values: 0 … 255	1
Index Increment	After adding a new point, the Index will be automatically incremented by the set value.	
GIN Group	Generic Identification Number Group Range of values: 0 … 255	0
GIN Entry	Generic Identification Number Entry Range of values: 0 … 255	0
Timer 00	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If the received value is intermediate and the timer is set to the value other than zero, it will be delayed for the set time, and if some data change occurs, it will be ignored. Range of values: 0 … 3600s, 0 – not used	0
Timer OFF	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If the received value is OFF and the timer is set to the value other than zero, it will be delayed for the set time, and if some data change occurs, it will be ignored. Range of values: 0 … 3600s, 0 – not used	0

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Timer ON	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If the received value is ON and the timer is set to the value other than zero, it will be delayed for the set time, and if some data change occurs, it will be ignored. Range of values: 0 … 3600s, 0 – not used	0
Timer 11	This parameter is relevant only if IEC Type is Time Tagged Message (Type 1 and Type 2) Double. If the received value is indeterminate and the timer is set to the value other than zero, it will be delayed for the set time, and if some data change occurs, it will be ignored. Range of values: 0 … 3600s, 0 – not used	0
Change to SP	In the IEC-60870-5-103 protocol, all status signals are double points. If a single point signal in the upper direction (IEC 60870-5-101 or IEC 60870-5-103 slave protocols) is to be used, then this checkbox must be checked. Values: Checked, Unchecked	Unchecked
Auto reset	In the IEC 60870-5-103 protocol, the data Type 2 are transient signals, which means that the slave device transmits only the start of a signal but never transmits the end of it. In case, the transmission of the end of the signal is important, you must check this checkbox. Values: Checked, Unchecked	Unchecked
Invert	Inversion of the signals of Type 1 and Type 2 Values: Checked; Unchecked	Unchecked
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

The following figure shows the list of the status points and commands. A double click allows editing data or a command point. The user can select many points as well and then edit them using the keyboard shortcut Ctrl+E.



	..	..		IEC Type	.	.	Value	Time	Cause	Tag
1	160	148	1	Measurands (Type 3 and Type 9)						
2	160	148	2	Measurands (Type 3 and Type 9)						
3	160	148	3	Measurands (Type 3 and Type 9)						
4	160	148	4	Measurands (Type 3 and Type 9)						
5	160	148	5	Measurands (Type 3 and Type 9)						
6	160	148	6	Measurands (Type 3 and Type 9)						
7	160	148	7	Measurands (Type 3 and Type 9)						
8	160	148	8	Measurands (Type 3 and Type 9)						
9	255	10		Time Tagged Message (Type 1 and Type 2)						
10	255	11		Time Tagged Message (Type 1 and Type 2)						
11	255	12		Time Tagged Message (Type 1 and Type 2)						
12	255	13		Time Tagged Message (Type 1 and Type 2)						
13	255	14		Time Tagged Message (Type 1 and Type 2)	Yes	Yes				
14	255	15		Time Tagged Message (Type 1 and Type 2)	Yes					
15	255	16		Time Tagged Message (Type 1 and Type 2)	Yes					
16	255	17		Time Tagged Message (Type 1 and Type 2)	Yes					
17	255	18		Time Tagged Message (Type 1 and Type 2)	Yes					

Figure 87. List of *Status points*

The columns between the *Function* and *Offset 2* are the status point configuration parameters. *Value, Time, Quality,* and *Cause* show real-time data from the controlled device.

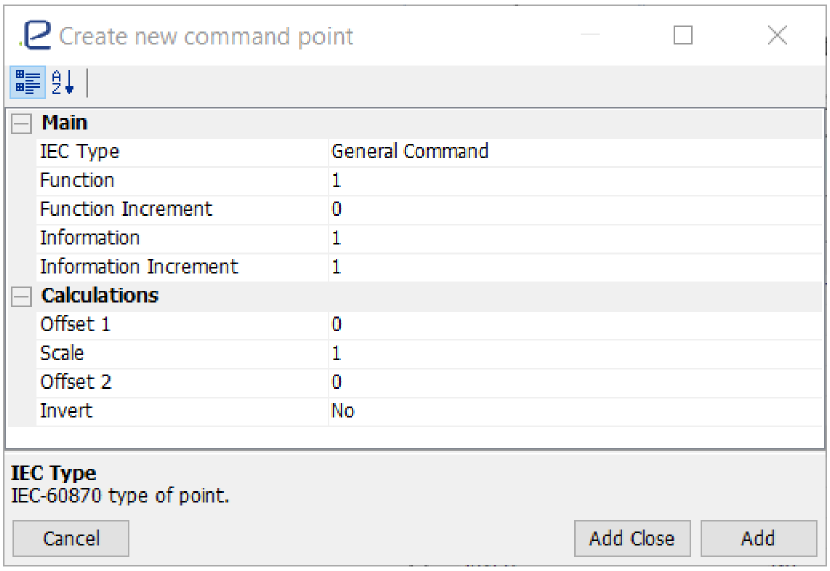


Figure 88. *Create new command point* window

Table 78. Fields of *Create new command point* window in IEC 60870-5-103 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of data in IEC 60870-5-103 protocol Values: General Command General Command Double (composed from to General Commands addressed in a row)	General Command
Function	The function type of the employed protection equipment should be defined. For a complete list of all function types, please refer to the IEC 60870-5-103 standard. Range of values: 0...255	1
Function Increment	Used only for configuration. After adding a new command, the function will be automatically incremented by the set value.	0
Information	Specifies the information number. Ranges for information numbers in the monitoring direction: 0 … 255	1
Information Increment	Used only for configuration. After adding a new command, the function will be automatically incremented by the set value.	1
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of the signals of Type 1 and Type 2 Values: Yes; No	No

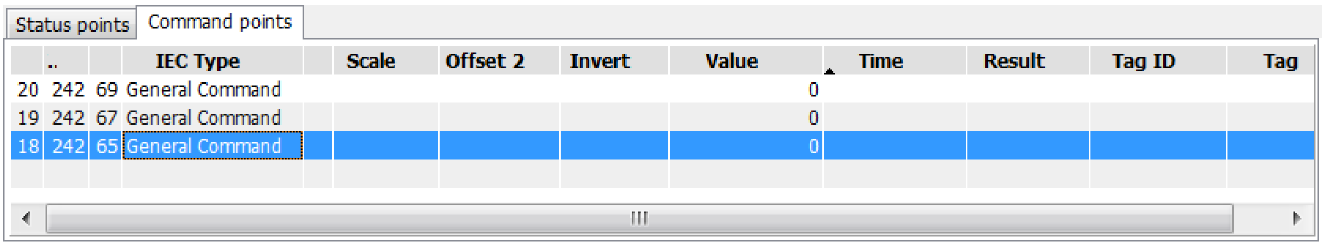


Figure 89. List of *Command points*

In the *Command points* window the columns of *Value*, and *Time* show the last transmitted command data. The column of *Result* shows the response from the controlled device.

4.9.1.5 Calculation of the measured information coefficient

Sometimes it is hard to understand how the Scale parameter is calculated to get the real value of the measurement. Most of relays use coefficients 1.2 or 2.4 for the measurement transmission (according to IEC-60870-103 standard). Later in the document, it is referred to as COF.

According to the IEC-60870-103 standard, measurements are transmitted in range from -4096 to 4096.

ScaleI=Inom* COF/4096;

ScaleU=Unom* COF/4096;

ScaleUL=Unom* COF*$\sqrt{3}$/4096;

ScaleP= Inom*Unom* COF*$\sqrt{3}$/4096;

ScaleQ= Inom*Unom* COF*$\sqrt{3}$/4096.

Remember if kilovolts are used in equations, then kilowatts will be used for power and so on.

4.9.2 IEC 60870-5-101 configuration

4.9.2.1 Communication port parameters

Main	
ID	3
Port Name	New IEC-101 master (client) protocol
Enabled on start	No
Communication	
Listen Mode	No
COM port	Not assigned
Baud rate	9600
Data bits	8
Stop bits	1
Parity	None
RS-485 Mode	Four wire
Reconnect	10
Next request	50
IEC-101	
Data Link address size	1
Logging	
Port Monitor	No
Log raw data	Yes

Figure 90. *Communication port* parameters in IEC 60870-5-101 protocol

Table 79. Fields of *Communication port* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Name of the port and protocol, for example, 'COM2 IEC-101 master protocol'	New IEC-101 master protocol
Enabled on start	Port enabled on the system startup Values: Yes; No	No
Listen Mode	Communication port will only receive data but it will not make any transmits. Use it only for testing proposes. Values: Yes; No.	No
Com port	Communication port number	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7, 8	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 Mode	If two wires are used, mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Range of values: Four wires, Two wires	Four wires
Reconnect	Time interval of reconnection attempt while communication is not established. Range of values: 1 … 600s	10
Next request	Wait time before sending the next request Range of values: 0 … 1000ms	50
Data link address size	Data link layer address size in bytes Range of values: 0 … 2 bytes	1
Port monitor	Shows the port monitor on the system startup Values: Yes; No	No
Log raw data	Logs raw communication data Values: Yes; No	Yes

4.9.2.2 Data link layer parameters

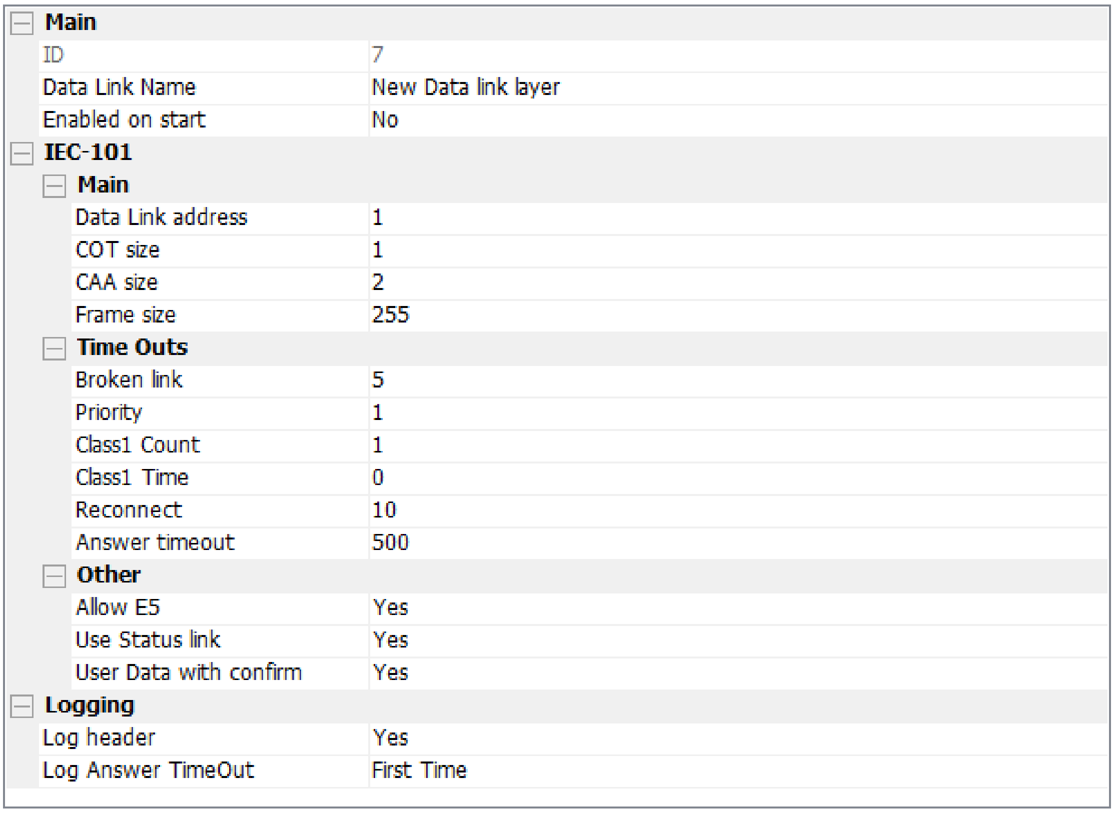


Figure 91. *Data link layer* parameters in IEC 60870-5-101 protocol

Table 80. Fields of *Data link layer* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data link name	Data link layer name, for example, 'Measurements data controller'	New Data Link
Enabled on start	Enables or disables data link on start Values: Yes; No	No
Data link address	Data link address Range of values: 1 … 65534 (if Data link address length is set to 2), 1 … 254 (if Data link address length is set to 1), If Data link address length is set to 0, this parameter is not used	1
COT size	Size of cause of transmission Range of values: 1 … 2 bytes	1

FIELD NAME	DESCRIPTION	DEFAULT VALUE
CAA size	Size of common address Range of values: 1 … 2 bytes	2
Frame size	Maximum frame length Range of values: 50 … 255 bytes	255
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 10	3
Priority	Data is requested every cycle. It is relevant only if more than one data link layer exists. Range of values: 1 … 255	1
Class1 Count	Number of requests for the same data link layer, if there are Class1 events. 0 – requests are sent until no Class1 events, or Class1 timer expires. Range of values: 0 … 255	1
Class1 Time	Time intervals for the request to be sent for the same data link layer, if there are Class1 events. 0 – time is not checked. Range of values: 0 … 255000ms	0
Reconnect	Time interval of reconnection attempt while communication is not established. Range of values: 1 … 600s	10
Answer timeout	Time period for response from the controlled device Range of values: 50 … 30000ms	500
Allow E5	Enables or disables E5 response from the controlled device. Values: Yes; No	Yes
Use Status link	Enables or disables using the Status of link frame before the Reset Link is sent. Values: Yes; No	Yes
User Data with confirm	Sends User Data with confirmation request. Values: Yes; No	Yes
Log header	Logs data link header. Values: Yes; No	Yes
Log Answer Timeout	Logs data link answer timeouts to the system log. Values: Never; First time; Always.	First Time

4.9.2.3 Application layer parameters

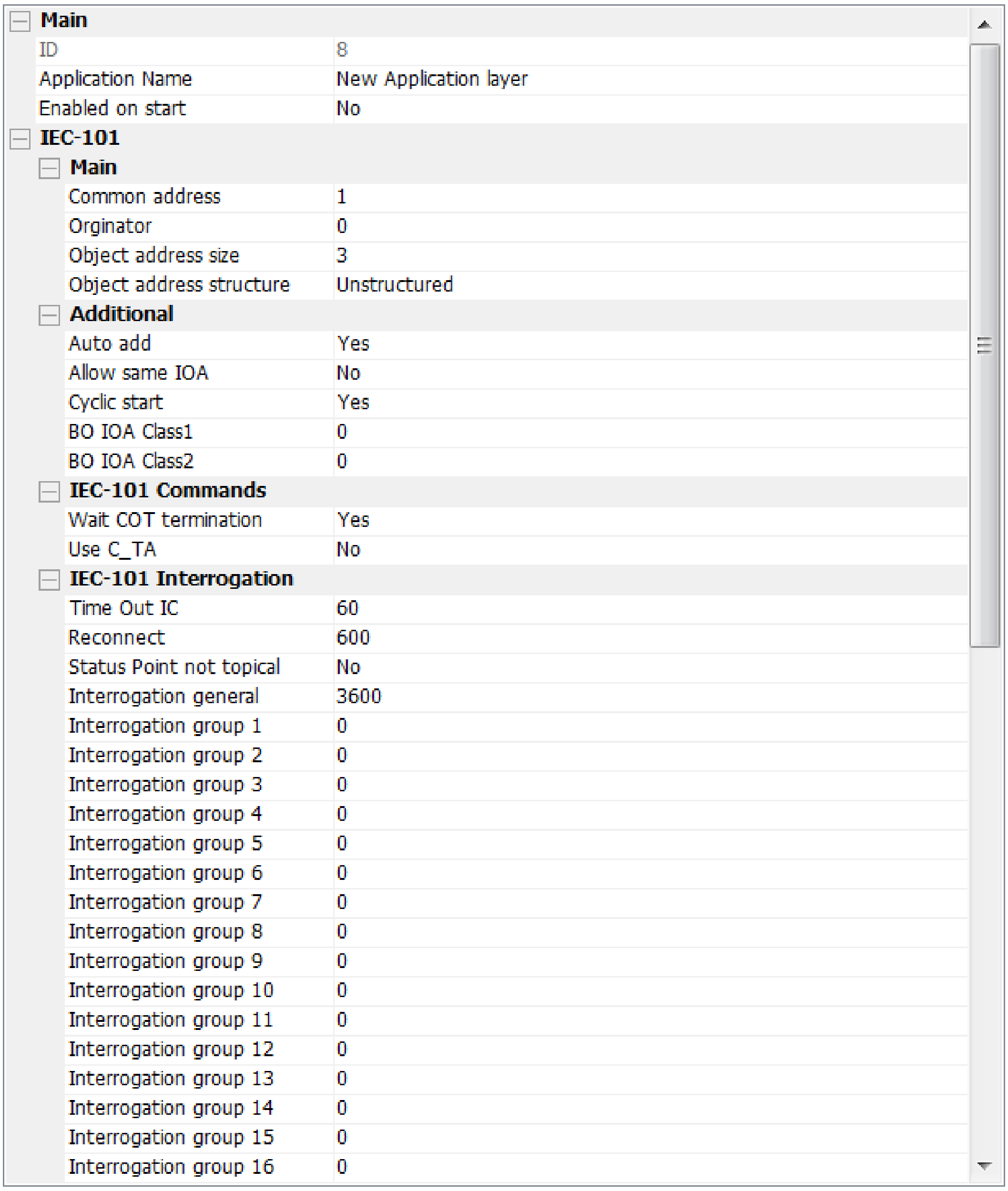


Figure 92. *Application layer* parameters in IEC 60870-5-101 protocol

Table 81. Fields of *Application layer* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application name	Name of the application link layer, for example, 'Measurements data controller'	New Application
Enabled on start	Enables or disables application on start Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Common address	Common address of a data unit Range of values: 1 … 254	1
Originator	Originator Range of values: 0 … 255	0
Object address size	Size of the information object address Range of values: 1 … 3	3
Object address structure	Structure of the object address shows the format in which the information object address is entered in the configuration. Range of values: Unstructured, Structured 8.8.8, Structured 8.16, Structured 16.8, Structured 8.8	Unstructured
Auto add	Automatically adds all data points received after the General Interrogation to the controlled device. Values: Yes; No	Yes
Allow same IOA	Allows having the same information object address for the status and command points. Values: Yes; No	No
Cyclic start	Yes – the next cyclic operation time is calculated at the end of the operation. No – the next cyclic operation time is calculated at the start of the operation. Values: Yes; No	Yes
BO IOA Class1	Information object address of the buffer overflow for Class1 Range of values: 0 - 16777215	0 – not used
BO IOA Class2	Information object address of the buffer overflow for Class2 Range of values: 0 - 16777215	0 – not used
Wait COT termination	Wait for the response of the activation termination for the set points Values: Yes; No	Yes
Use C_TA	Enables to use commands with a timestamp. Values: Yes; No	No
Timeout IC	Timeout for the interrogation commands Range of values: 1 … 3600s	60
Reconnect	Time interval of reconnection attempt while the application layer is not connected Range of values: 1 … 3600s	10

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Interrogation general	Cycle time of General Interrogation to the controlled device Range of values: 1 … 86400s	3600
Interrogation group 1 … 16	Cycle time of Group Interrogation to the controlled device Range of values: 0 … 86400s	0 – disabled Group Interrogation

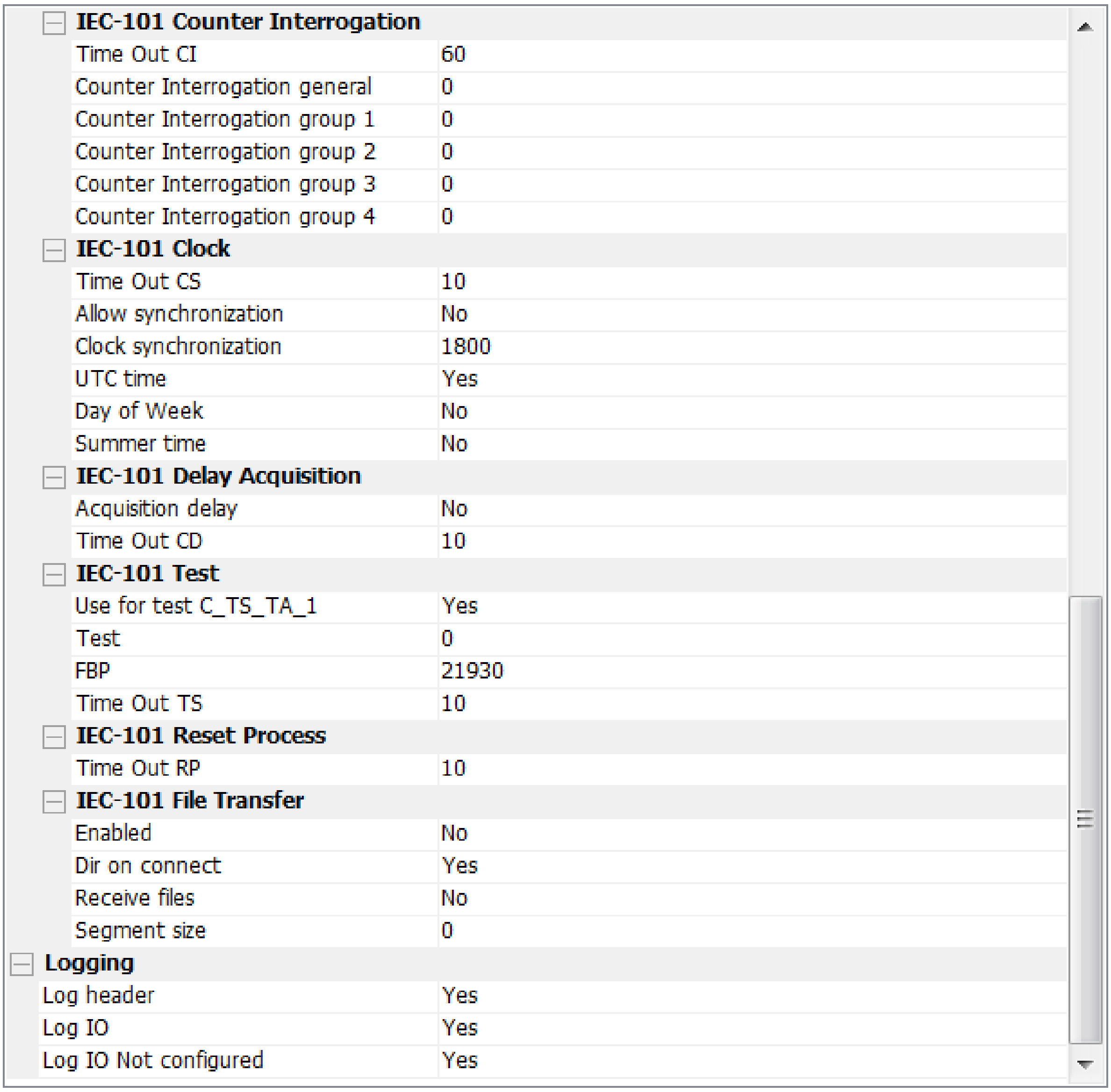


Figure 93. *Application layer* parameters in IEC 60870-5-101 protocol

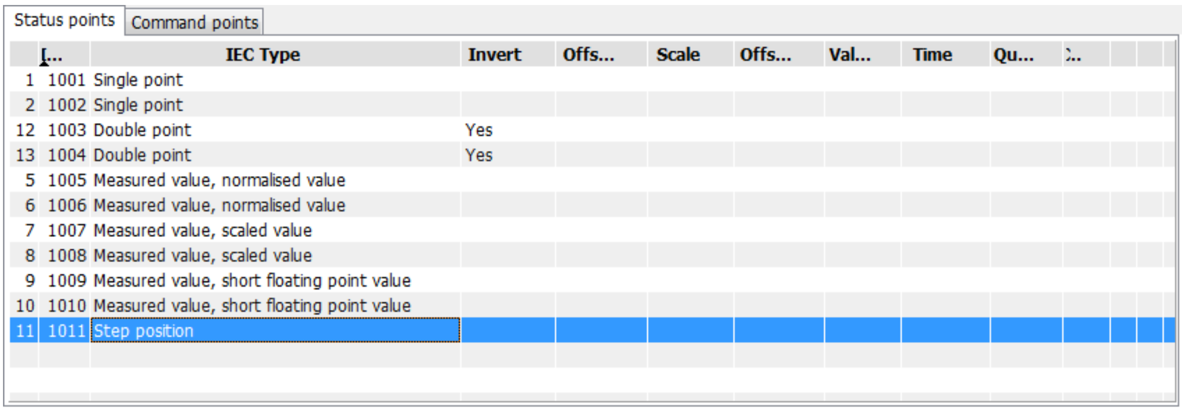
Table 82. Fields of *Application layer* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Timeout CI	Timeout for Counter Interrogation requests Range of values: 0 … 3600s	60
Counter Interrogation general	Cycle time of Counter Interrogation to the controlled device Range of values: 0 … 86400s	0 – disabled Counter Interrogation
Counter Interrogation group 1 … 4	Cycle time of Counter Interrogation group to the controlled device Range of values: 0 … 86400s	0 – disabled Counter Interrogation
Timeout CS	Timeout for the clock synchronization Range of values: 1 … 3600s	10
Allow synchronization	Yes – always synchronize, No – synchronize only if the internal clock of RTU is synchronized	Yes
Clock synchronization	Cycle time of the clock synchronization to the controlled device Range of values: 1 … 86400s	600
UTC time	Enables to use UTC time in requests and responses Values: Yes; No	Yes
Day of Week	In request with a timestamp, use Day of Week bit. Values: Yes; No	No
Summer time	In request with a timestamp, use summer time bit. Values: Yes; No	No
Acquisition delay	Uses the acquisition delay before sending the clock synchronization. (C_CD_NA_1) Values: Yes; No	No
Timeout CD	Timeout for the delay acquisition Range of values: 1 … 3600s	10
Use for test C_TS_TA_1	Uses the test frame format C_TS_TA_1 Values: Yes; No	Yes
Test	Cycle time of the test frame. This parameter is not used when the value of *Is test frame used* is 'No'. Range of values: 1 … 86400s	0 - disabled
FBP	Fixed test bit pattern Range of values: 0 … 32768	21930
Timeout TS	Timeout for the test command Range of values: 1 … 3600s	10

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Timeout RP	Timeout for reset process Range of values: 1 … 3600s	10
Enabled	Enables the file transfer function. Values: Yes; No	No
Dir on connect	Requests the directory after the connection starts. Values: Yes; No	Yes
Receive files	After receives the list of files, downloads all files from the controlled device. Values: Yes; No	No
Segment size	Segment size to be used in the file transfer. 0 – the segment size is calculated from maximum frame length. If the segment size plus headers makes more than maximum frame length, the segment size will be calculated from the maximum frame length. Range of values: 0 … 255 bytes	0
Log header	Logs application layer header Values: Yes; No	Yes
Log IO	Logs information objects Values: Yes; No	Yes
Log IO not configured	Logs not configured information objects Values: Yes; No	Yes

4.9.2.4 Points

The following figure shows the Status points of the IEC 60870-5-101 protocol.


Status points | Command points

	I...	IEC Type	Invert	Offs...	Scale	Offs...	Val...	Time	Qu...	...
1	1001	Single point								
2	1002	Single point								
12	1003	Double point	Yes							
13	1004	Double point	Yes							
5	1005	Measured value, normalised value								
6	1006	Measured value, normalised value								
7	1007	Measured value, scaled value								
8	1008	Measured value, scaled value								
9	1009	Measured value, short floating point value								
10	1010	Measured value, short floating point value								
11	1011	Step position								

Figure 94. *Status points* table in IEC 60870-5-101 protocol

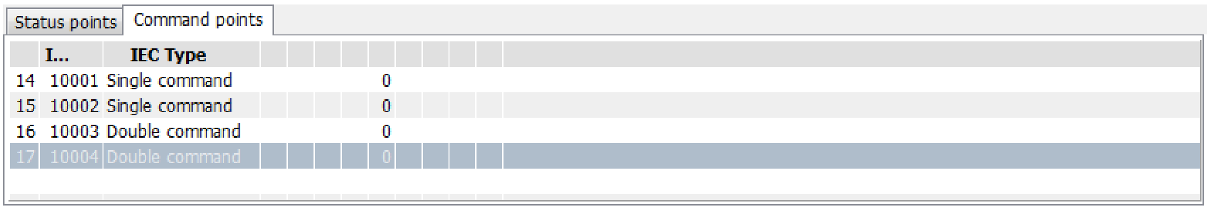


Figure 95. *Command points* table in IEC 60870-5-101 protocol

The following figure shows how to add new data points of the IEC 60870-5-101 protocol. The function of the *IOA Increment* can be employed to do that. For example, if the user needs to configure a few points with the information addresses in the interval between 1001 and 1010, then the user configures the first point with 1001 address and then changes *IOA Increment*'s value to 1. Then, click the button *Add,* which will not close the dialog but automatically configure the information address with 1002. In this way, it is possible to get 10 points with only 10 mouse clicks.

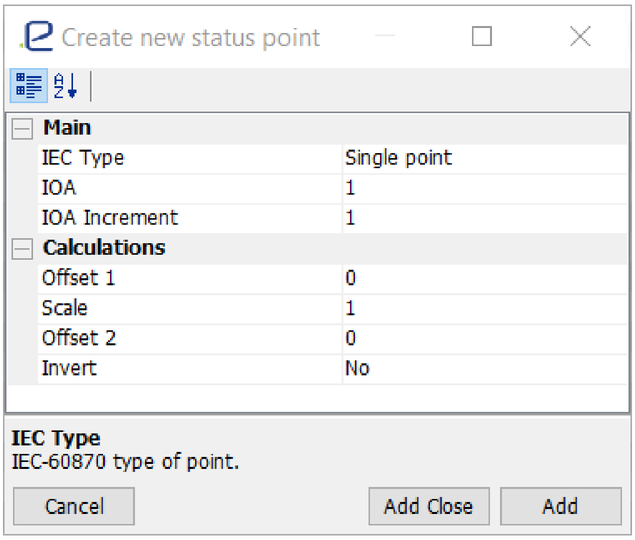


Figure 96. *Create new data point* in IEC 60870-5-101 protocol

Table 83. Fields of *Create new data point* window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of data in IEC 60870-5-101 protocol Values: Single point Double point Step position Bit string of 32 bits Measured value, normalized value Measured value, scaled value Measured value, short floating-point value	Single Point
IOA	Specifies the information address. The range of information address depends on the length of the information object address in the application layer parameter. Range of values: 0 … 16777215	1
IOA Increment	After adding a new point, IOA will be automatically incremented by the set value.	1

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of the signals of Type 1 and Type 2 Values: Yes; No	No

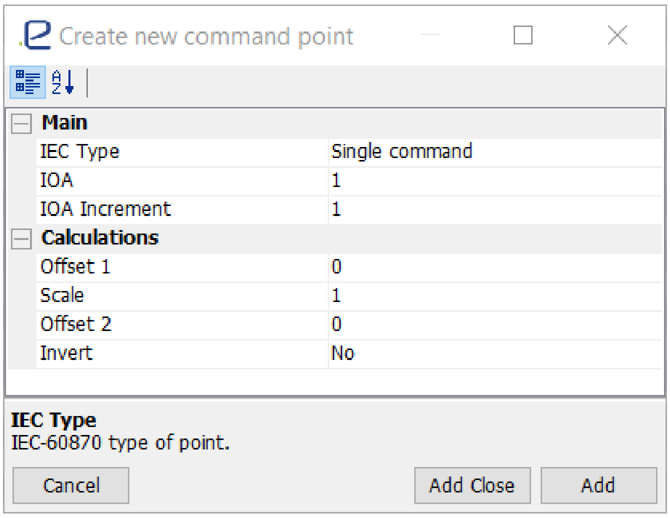


Figure 97. *Create new command point* in IEC 60870-5-101 protocol

Table 84. Fields of *Create new command point* window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of command in IEC 60870-5-101 protocol Values: Single command Double command Regulating step command Setpoint normalized command Setpoint scaled command Setpoint short float command Bitstring command	Single Command
IOA	Specifies the information address. The range of information address depends on the length of the information object address in the application layer parameter. Range of values: 0 … 16777215	1
IOA Increment	After adding a new point, IOA will be automatically incremented by the set value.	1

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of a command Values: Yes; No	No

4.9.3 IEC 60870-5-104 configuration

4.9.3.1 Communication port parameters

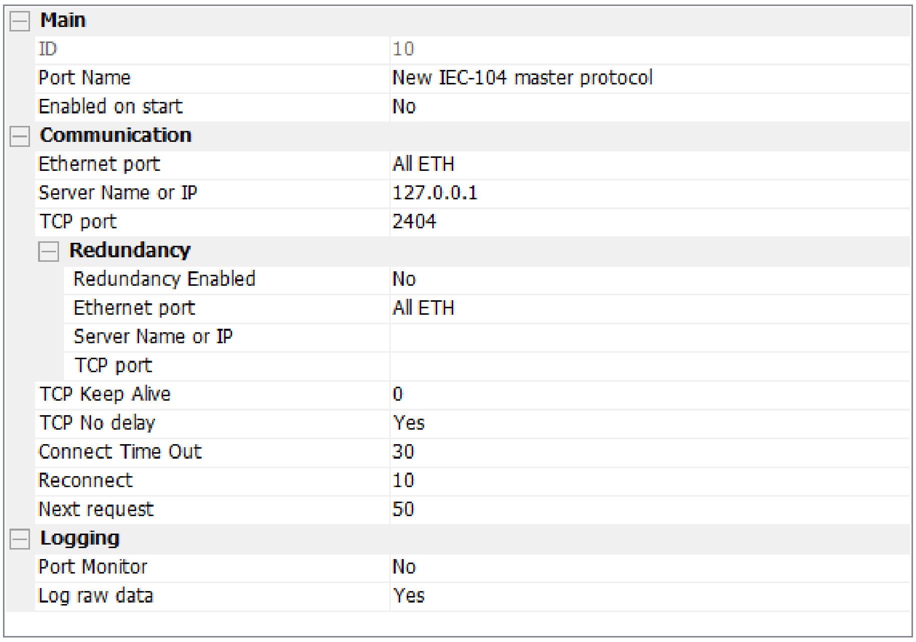


Figure 98. *Communication port* parameters in IEC 60870-5-104 protocol

Table 85. Fields of *Communication port* parameters window in IEC 60870-5-104 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Port name, for example, 'IEC-104 master 172.29.37.113'	New IEC-104 master protocol
Enabled on start	Enables or disables a communication port on start. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Ethernet port	Specifies the Ethernet port to be used for the connection to the server. Values: All ETH, ETH1, ETH2, ETH3, ETH4	All ETH
Server name or IP	Name or IPv4 address of the host	127.0.0.1
TCP port	TCP port Range of values: 1 … 65535	2404
Redundancy enabled	Enables or disables redundant communication. Values: Yes; No	No
Ethernet port	Redundant Ethernet port to be used for the connection to the server Values: All ETH, ETH 1, ETH 2, ETH 3, ETH4	All ETH
Server name or IP	Name or IPv4 address of the redundant host	
TCP port	Redundant TCP port Range of values: 1 … 65535	
TCP Keep Alive	It is not advised to set low values because it will add overhead to communication. Range of values: 0 … 2147483647ms; 0 – disabled	10000
TCP No delay	TCP No delay disables the Nagle Algorithm. Values: Yes; No	No
Connect Timeout	Time interval to establish connection Range of value: 1 … 255s	30
Reconnect	Time interval of reconnection attempt while communication is not established. Range of values: 1...600s	10
Next request	Time interval before sending the next request Range of values: 0 … 2000ms	0
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.9.3.2 Data link layer parameters

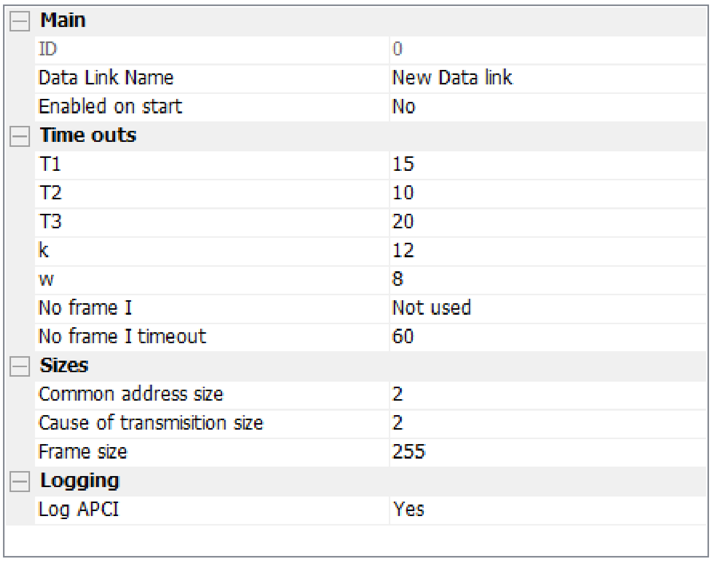


Figure 99. *Data link layer* parameters in IEC 60870-5-104 protocol

Table 86. Fields of *Data link layer* parameters window in IEC 60870-5-104 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data link name	Data link name, for example, 'Data link'	New Data link
Enabled on start	Enables or disables the communication port on start. Values: Yes; No	No
T1	Acknowledgement timeout 1 Range of values: 1...600s	15
T2	Acknowledgement timeout 2 Range of values: 1...600s	10
T3	Connection test timeout Range of values: 1...600s	20
k	Maximum number of unacknowledged ADPUs Range of values: 1...32,767	12
w	Maximum number of the received ADPUs for acknowledgment Range of values: 1...32,767	8
No frame I	Changes behaviour of frame I. Values: Not used, Send STOP DT, Disconnect	Not used

FIELD NAME	DESCRIPTION	DEFAULT VALUE
No frame I timeout	Timeout of frame I Range of values: 1...600 s	60
Common address size	Common address size Range of values: 1 … 2 bytes	2
Cause of transmission size	Cause of transmission size Range of values: 1 … 2 bytes	2
Frame size	Maximum frame size. All start, stop, checksum and other bytes are included. Range of values: 50 … 255 bytes	255
Log APCI	Log Application Protocol Control Information Values: Yes; No	Yes

4.9.3.3 Application layer parameters

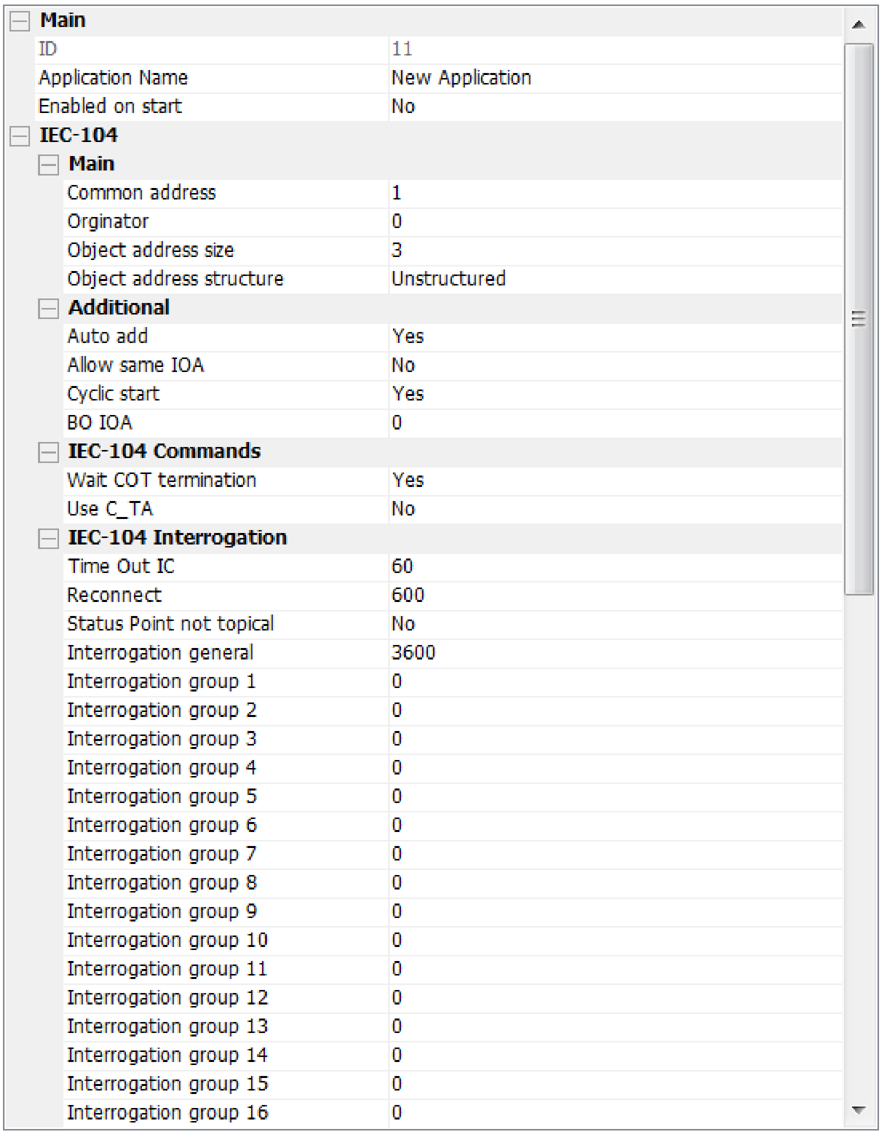


Figure 100. *Application layer* parameters in IEC 60870-5-104 protocol

Table 87. Fields of *Application layer* parameters window in IEC 60870-5-104 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application name	Application layer name, for example, ‘Other RTU’	New Application
Enabled on start	Enables or disables application on start. Values: Yes; No	No
Common address	Common address of a data unit Range of values: 1 … 65534	1
Originator	Originator Range of values: 0 … 255	0

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Object address size	Size of the information object address Range of values: 1 … 3	3
Object address structure	Structure of the object address shows the format in which the information object address is entered in the configuration. Range of values: Unstructured, Structured 8.8.8, Structured 8.16, Structured 16.8, Structured 8.8	Unstructured
Auto add	Automatically adds all data points received after the General Interrogation to the controlled device. Values: Yes; No	Yes
Allow same IOA	Allows having the same information object address for status and command points. Values: Yes; No	No
Cyclic start	Yes – the next cyclic operation time is calculated at the end of the operation. No – the next cyclic operation time is calculated at the start of the operation. Values: Yes; No	Yes
BO IOA	Information object address of a buffer overflow Range of values: 0 - 16777215	0 – not used
Wait COT termination	Wait for the response of activation termination for the set points Values: Yes; No	Yes
Use C_TA	Enables to use commands with a timestamp. Values: Yes; No	No
Timeout IC	Timeout for interrogation commands Range of values: 1 … 3600s	60
Reconnect	Time interval of reconnection attempt while the application layer is not connected Range of values: 1 … 3600s	10
Status Point not topical	Point will be set to the state *not topical*, if it was not found in the response list of the general interrogation. Values: Yes; No	No
Interrogation general	Cycle time of the general interrogation to the controlled device Range of values: 1 … 86400s	3600
Interrogation group 1 … 16	Cycle time of the group interrogation to the controlled device Range of values: 0 … 86400s	0 – disabled Group Interrogation

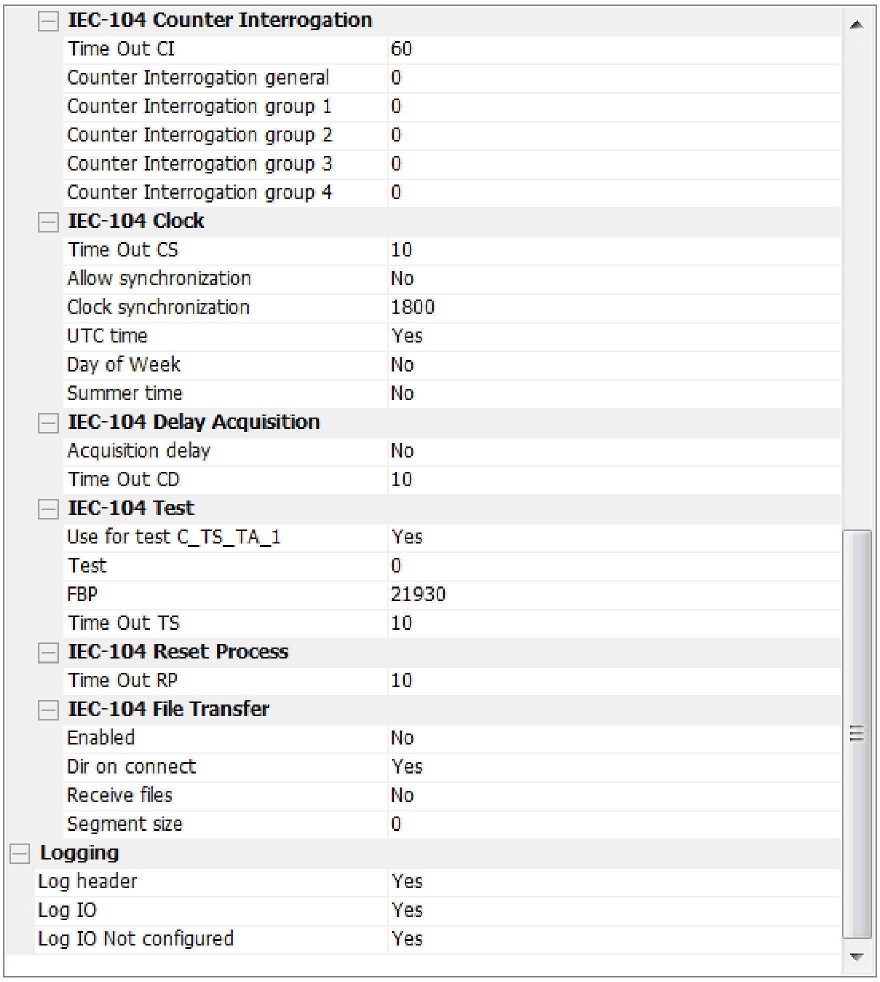


Figure 101. *Application layer* parameters in IEC 60870-5-104 protocol

Table 88. Fields of *Application layer* parameters window in IEC 60870-5-104 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Timeout CI	Timeout for the counter interrogation requests Range of values: 0 … 3600s	60
Counter Interrogation general	Cycle time of counter interrogation to the controlled device Range of values: 0 … 86400s	0 – disabled Counter Interrogation
Counter Interrogation group 1 … 4	Cycle time of the counter interrogation group to the controlled device Range of values: 0 … 86400s	0 – disabled Counter Interrogation
Timeout CS	Timeout for the clock synchronization Range of values: 1 … 3600s	10
Allow synchronization	Yes – always synchronize, No – synchronize only if the internal clock of RTU is synchronized.	No
Clock synchronization	Cycle time of the clock synchronization to the controlled device Range of values: 1 … 86400s	1800

FIELD NAME	DESCRIPTION	DEFAULT VALUE
UTC time	Enables to use UTC time in requests and responses. Values: Yes; No	Yes
Day of Week	In request with a timestamp, use Day of Week bit. Values: Yes; No	No
Summer time	In request with a timestamp, use Summer time bit. Values: Yes; No	No
Acquisition delay	Use the acquisition delay before sending the clock synchronization (C_CD_NA_1). Values: Yes; No	No
Timeout CD	Timeout for the delay acquisition Range of values: 1 … 3600s	10
Use for test C_TS_TA_1	Use test frame format C_TS_TA_1 Values: Yes; No	Yes
Test	Cycle time of the test frame. This parameter is not used when *Is test frame* is set to the value 'No'. Range of values: 1 … 86400s	0 - disabled
FBP	Fixed test bit pattern Range of values: 0 … 32768	21930
Timeout TC	Timeout for the test command Range of values: 1 … 3600s	10
Timeout RP	Timeout for the reset process Range of values: 1 … 3600s	10
Enabled	Enables the file transfer function. Values: Yes; No	No
Dir on connect	Requests the directory after connection starts. Values: Yes; No	Yes
Receive files	After receives the list of files, downloads all files from the controlled device. Values: Yes; No	No
Segment size	Segment size to be used in the file transfer. 0 – segment size is calculated from the maximum frame length. If the segment size plus headers makes more than the maximum frame length, the segment size will be calculated from the maximum frame length. Range of values: 0 … 255 bytes	0
Log header	Enables to log application layer header. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Log IO	Enables to log information objects. Values: Yes; No	Yes
Log IO not configured	Enables to log not configured information objects. Values: Yes; No	Yes

4.9.3.4 Points

Status points | Command points

ID	IOA	IEC Type	Inv...	Offs...	Sc...	Offs...	Val...	Ti...	Quali...	Ca...	Tag ID
1	900	Single point									
2	901	Single point									
3	902	Double point									
4	903	Double point									
5	904	Measured value, normalised value									
6	905	Measured value, normalised value									
7	906	Measured value, scaled value									
8	907	Measured value, scaled value									
9	908	Measured value, short floating point value									
10	909	Measured value, short floating point value									

Figure 102. *Status points* table in IEC 60870-5-104 protocol

Status points | Command points

ID	IOA	IEC Type	Offs...	Scale	Offs...	Invert	Val...	Time	Result	Tag ID	Tag
11	5001	Single command					0				
12	5002	Single command					0				
13	5003	Double command					0				
14	5004	Double command					0				
15	5005	Set point short float co...					0				
16	5006	Regulating step command					0				

Figure 103. *Command points* table in IEC 60870-5-104 protocol

Configuration of IEC 60870-5-104 protocol data and command points is the same like in IEC 60870-5-101 protocol. Refer to chapter 4.9.2.4. Points.

4.9.4 IEC 61850 client

Enilit RTU also supports IEC 61850 client protocol. It is possible to connect IED devices via 61850 protocol standards. The main requirement is the need to extract the SCD (Substation Configuration Description) file from the IED device configuration software. The SCD file is a part of the Substation Configuration Language (SCL).

4.9.4.1 Communication port

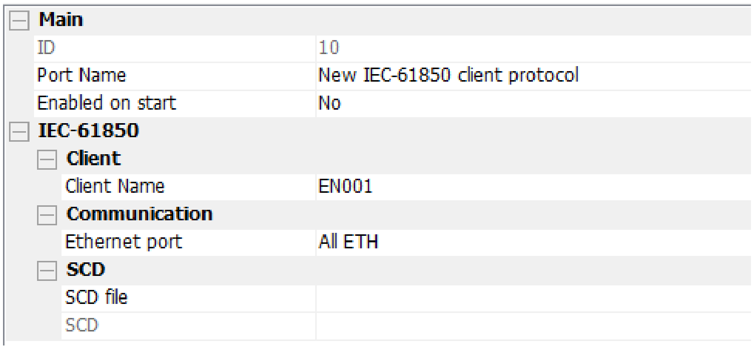


Figure 104. *Communication port* parameters in IEC 61850 protocol

Table 89. Fields of *Communication port* parameters window in IEC 61850 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	IEC 61850 port name, for example, 'IEC-61850 client protocol'	New IEC 61850 client protocol
Enabled on start	Enables or disables the port on start. Values: Yes; No	No
Client Name	Name to be used for the client in IEC61850 communication	
Ethernet port	Specifies the Ethernet port to be used for the connection to the server. Values: All ETH, ETH1, ETH2, ETH3, ETH4	All ETH
SCD file	SCD file of the substation. The file can be browsed with *Open file* dialog button . Values: File name and path	
SCD	Enilit CMS saves the file in the Projects SCD folder.	

When the user selects a SCD file, the main parameters like *IP address, Gateway, Subnet mask* are taken from the SCD file automatically. After that, the following figure with the IEDs in use will be seen.

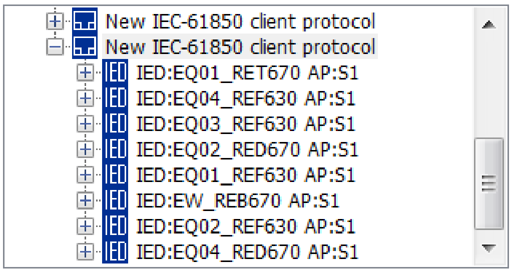


Figure 105. Imported IED devices from a SCD file

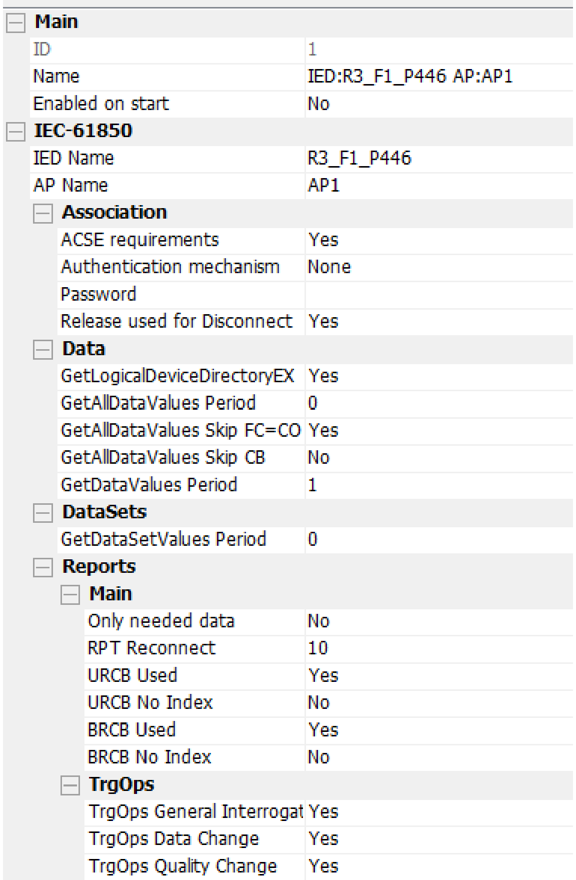


Figure 106. IED device parameters window in IEC 61850 protocol

Table 90. Fields of IED device parameters window in IEC 61850 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Name	Name of IED	After import from SCD file name will be concatenated from IED Name and AP Name
Enabled on start	IED is enabled on the system startup. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IED Name	IED name in the SCD file	
AP Name	Access point name in the SCD file	
ACSE requirements	ACSE requirements are used. (some IEDs do not support them, disable when necessary)	Yes
Authentication mechanism	Authentication mechanism is used for connection to IED.	None
Password	Password used for connection to IED	
Release used for Disconnect	Release used for Disconnect. In other case, use Abort.	Yes
GetLogicalDeviceDirectoryEX	Use the extended GetLogicalDeviceDirectoryEX function instead of lots of GetLogicalNodeDirectory calls	Yes
GetAllDatsValues Period	Warning: use only for testing purpose – select other methods for data polling. 0 – the function is not used.	0
GetAllDataValues Skip FC=CO	Do not read data for functional constrains CO.	Yes
GetAllDataValues Skip CB	Do not read data for control blocks like SGCB, GoCB, LCB and etc.	No
GetDataValues Period	If some status points do not belong to any report control block, GetDataValues function will be executed at the set interval of 0 ... 3600s. 0 – the function is not used.	1
GetDataSetValues Period	If a DataSet does not belong to any report control, the GetDataSetValues function will be executed at the set interval of 0 ... 3600s. 0 – the function is not used.	0
Only needed data	Starts only the buffered and unbuffered reports which contain the needed data.	No
RPT Reconnect	Time interval of reconnection attempt to the report control while communication is not established Range of values: 1 ... 60s	10
URCB Used	Set this parameter to the value 'No', if you do not want to use the unbuffered reports.	Yes
URCB No Index	In SCL configuration file, it is set that it is indexed, but there is no index appended in IED. Use the same instance of URCB for all indexes.	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
BRCB Used	Set this parameter to the value 'No', if you do not want to use the buffered reports.	Yes
BRCB No Index	In SCL configuration file, it is set that it is indexed, but there are no index appended in IED. Use the same instance of BRCB for all indexes.	No
TrgOps General Interrogation	If a SCL file does not set General Interrogation Bit, overwrite this setting with the value 'TRUE'. General Interrogation is needed for normal communication.	Yes
TrgOps Data Change	If a SCL file does not set Data Change Bit, overwrite this setting with the value 'TRUE'. Data Change is needed for normal communication.	Yes
TrgOps Quality Change	If a SCL file does not set Quality Change Bit, overwrite this setting with the value 'TRUE'. Quality Change is needed for normal communication.	Yes

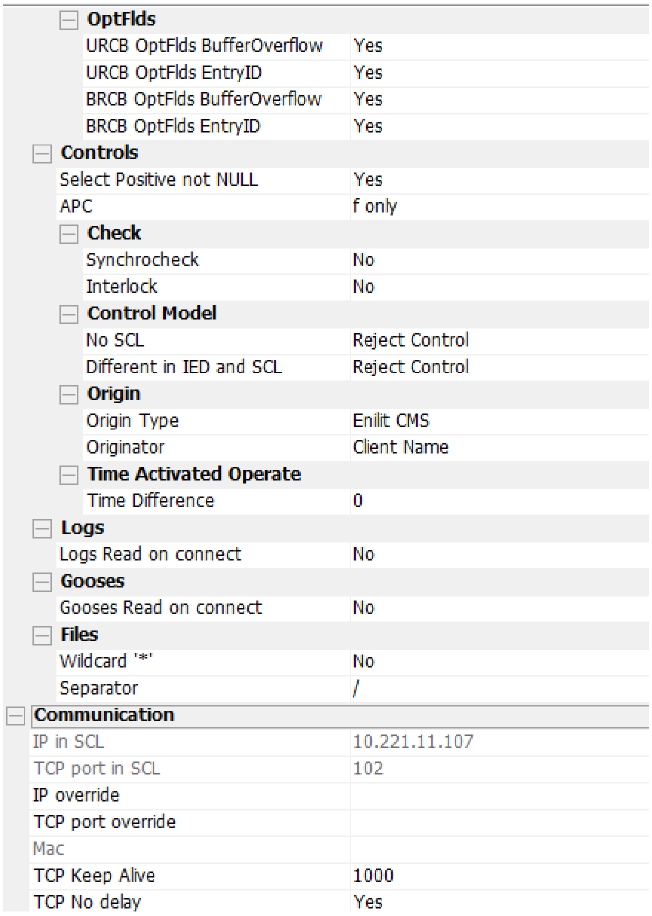


Figure 107. IED device parameters window in IEC 61850 protocol

Table 91. Fields of IED device parameters window in IEC 61850 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
URCB OptFlds BufferOverflow	If a SCL file specifies for URCB BufferOverflow, try to overwrite this setting with the value 'FALSE'. BufferOverflow is not needed for the Unbuffered Reports.	Yes
URCB OptFlds EntryID	If a SCL file specifies for URCB EntryID, try to overwrite this setting with the value 'FALSE'. EntryID is not needed for the Unbuffered Reports.	Yes
BRCB OptFlds BufferOverflow	If a SCL file does not specify BRCB BufferOverflow, try to overwrite this setting with the value 'TRUE'. It is not mandatory but BufferOverflow should be used for the Buffered Reports.	Yes
BRCB OptFlds EntryID	If a SCL file does not specify BRCB EntryID, try to overwrite this setting with the value 'TRUE'. It is not mandatory but EntryID should be used for the Buffered Reports.	Yes
Select Positive not NULL	Yes – if the received normal security select response does not bear the value 'NULL', it is considered as successful (for the backward compatibility). NO – if the received response <CO_CtrlObjectRef> is considered as a positive response, everything else is negative (Tissue 1178 – future implementation guidance).	Yes
APC	Control type for APC commands	F only
Synchrocheck	Synchrocheck value for controls. Select individual values for controls in the Point configuration.	No
Interlock	Interlock value for controls. Select individual values for controls in the Point configuration.	No
No SCL	Action taken when the Control Model is not set in the SCL.	Reject Control
Different in IED and SCL	Action taken when the Control Model in the IED and SCL are different.	Reject Control
Origin Type	Enables to control the Origin Type while executing control.	Enilit CMS
Originator	Originator to be used for control commands	Client Name

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Time Difference	Value of Time Activated Operate in milliseconds. Use negative values only for testing purpose. Range of values: -3600000 ... 3600000ms	0
Logs Read on connect	Checks values and state on connect for LCB and Log control blocks.	No
Gooses Read on connect	Checks values and state on connect for GOOSE control blocks.	No
Wildcard '*'	Use the Wildcard '*' in the GetServerDirectory (FILE) request.	No
Separator	Separator is used in a directory and file names.	/
IP in SCL	IP Address of IED in the SCL configuration file	
TCP port in SCL	TCP port of IED in the SCL configuration file	
IP override	Field is used if you want to overwrite the IP address of IED from an SCL file. In other cases, leave the field empty, the SCL value will be used.	
TCP port override	Field is used, if you want to overwrite the TCP port of IED from a SCL file. In other cases, leave the field empty, the SCL value will be used.	
Mac	Used for PRP1 communication monitoring on which LANs IED is visible.	
TCP Keep Alive	Do not set low values, because it will add overhead to communication. Range of values: 0 ... 2147483647ms 0 – disabled	1000
TCP No delay	Disables the Nagle Algorithm.	Yes

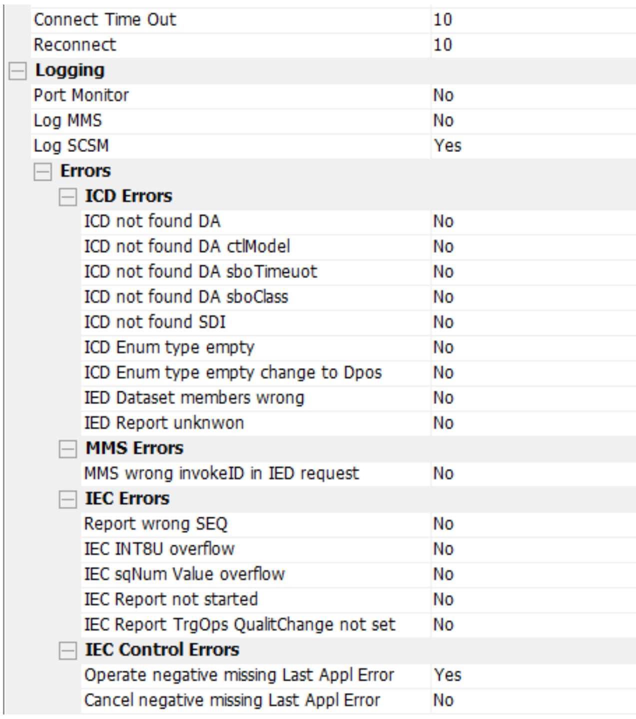


Figure 108. IED device parameters window in IEC 61850 protocol

Table 92. Fields of IED device parameters window in IEC 61850 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Connect Timeout	Time interval of attempt to establish connection Range of values: 1 ... 255s	10
Reconnect	Time interval of reconnection attempt to IED while communication is not established Range of values: 1 ... 60s	10
Port Monitor	Shows the port monitor on the system startup.	No
Log MMS	Partially logs MMS communication.	No
Log SCSM	Logs SCSM communication.	Yes
ICD not found DA	Disable this error, if this error message is not important for the user.	No
ICD not found DA CtlModel	Disable this error, if this error message is not important for the user.	No
ICD not found DA sboTimeuot	Disable this error, if this error message is not important for the user.	No
ICD not found DA sboClass	Disable this error, if this error message is not important for the user.	No
ICD not found SDI	Disable this error, if this error message is not important for the user.	No
ICD Enum type empty	Disable this error, if this error message is not important for the user.	No
ICD Enum type empty change to Dpos	Disable this error, if this error message is not important for the user.	No
IED Dataset members wrong	Disable this error, if this error message is not important for the user.	No
IED Report unknown	Disable this error, if this error message is not important for the user.	No
MMS wrong invokeID in IED request	Disable this error, if this error message is not important for the user.	No
Report wrong SEQ	Disable this error, if this error message is not important for the user.	No
IEC INT8U overflow	Disable this error, if this error message is not important for the user.	No
IEC sqNum Value overflow	Disable this error, if this error message is not important for the user.	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Report not started	Disable this error, if this error message is not important for the user.	No
IEC Report TrgOps QualitChange not set	Disable this error, if this error message is not important for the user.	No
Operate negative missing Last Appl Error	For the enhanced security controls only. Disable this error, if this error message is not important for the user.	Yes
Cancel negative missing Last Appl Error	For the enhanced security controls only. Disable this error, if this error message is not important for the user.	No

4.9.4.2 Points

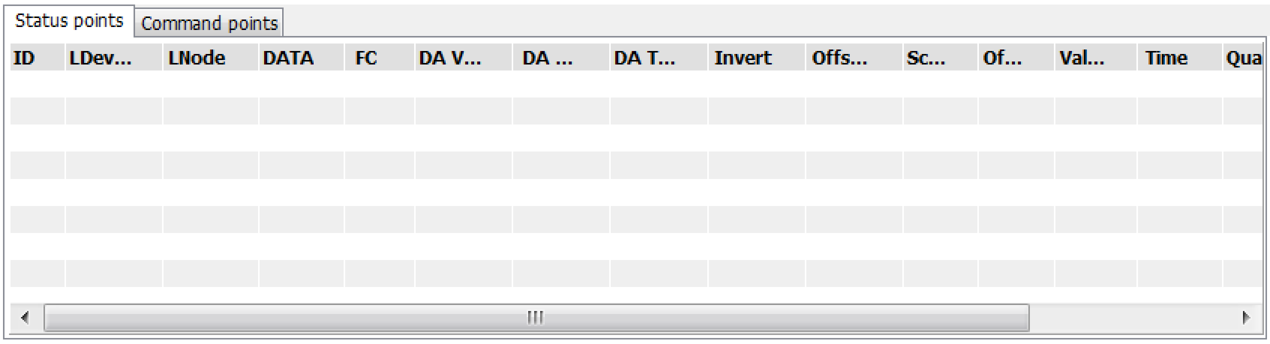


Figure 109. *Status points* window in IEC 61850 protocol

The following figure shows the popup menu of *Add data point*. With it the user can *Browse ICD, Add data point, Edit data point, Delete data point, Select All* data points and *Remove connection to Tag*, *Import* and *Export points*.

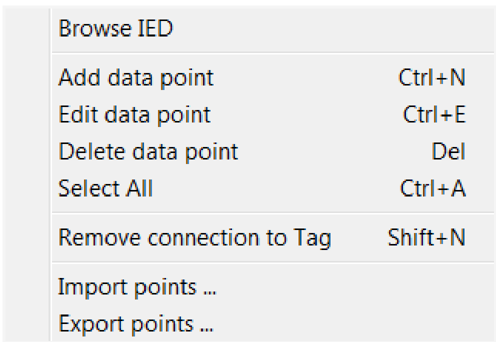


Figure 110. *Data points* popup menu in IEC 61850

If you select from the above menu the *Browse IED* file, the IED file window, as shown in the following figure, will open. In this window, it is possible to choose which data point to add to the data points list. This is an automated way to create data points in the IEC 61850 protocol. The user has to browse the data point needed and to double click to add it to the points list.

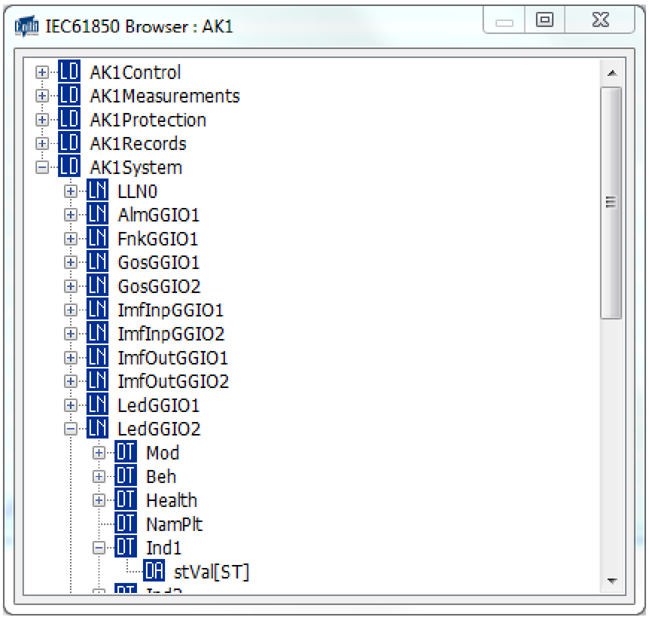


Figure 111. *Add new data points* from IEC 61850 ICD file

If the user chooses to *Add data point* manually, the following dialog box will be displayed. It is necessary to enter information in the fields like *Logical device, Logical node, Data object, Functional constraint, Data attribute, Time attribute, Quality attribute, Invert* and *Value variables*.

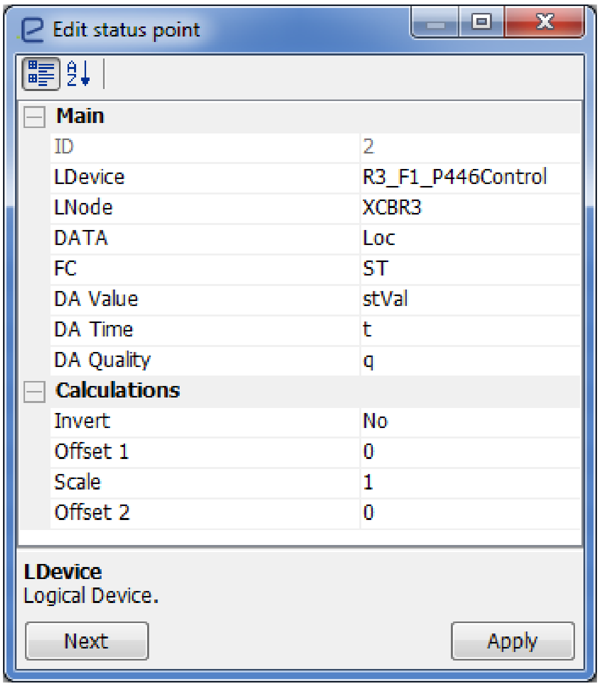


Figure 112. *Add new data points* manually in IEC 61850 protocol

Table 93. Fields of *Add new data points* manually window in IEC 61850 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
LDevice	Logical device name of IEC 61850 structure, for example, 'System'	
LNode	Logical device node of IEC 61850 structure. Each logical device contains one or more logical nodes. A logical node is a named grouping of data and associated services that are logically related to some function of the power system, for example, 'LLN0'.	
DATA	Data object name of IEC 61850 structure. Each logical node contains one or more elements of data. Each element of data has a unique name. These data names are determined by the standard and are functionally related to the purpose of the power system, for example, 'DPC'.	
FC	Functional constraints for status (ST) attributes, substituted value (SV) attributes, description (DC) attributes, measurement attributes (MX), and extended definition (EX) attributes Values: MX, ST	
DA Value	Data attribute for Value, for example, 'stVal'	
DA Time	Data attribute for Time, for example, 't'	
DA Quality	Data attribute for Quality, for example, 'q'	
Offset 1		0
Scale	New value = (Old value + Offset1) * Scale + Offset2	1
Offset 2		0
Invert	Inversion of command Values: Yes; No	No

The following figure shows the manual creation of new command points for the IEC 61850 protocol.

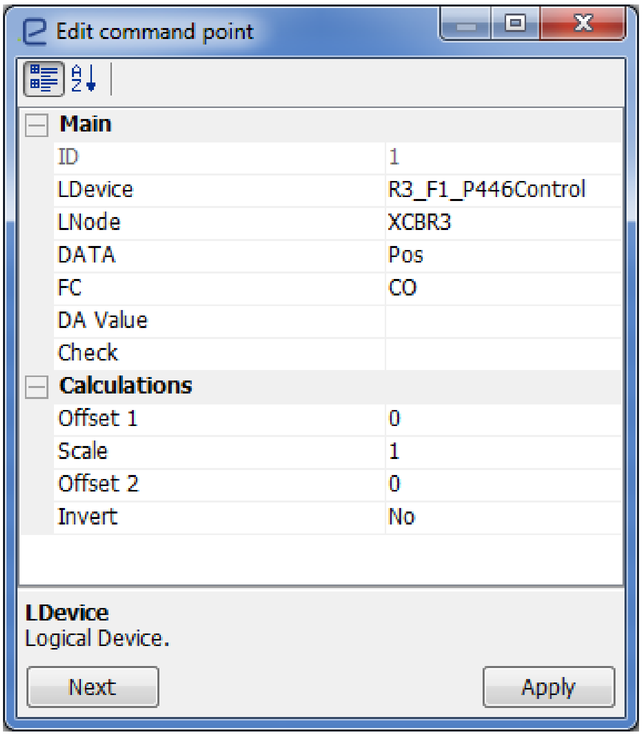


Figure 113. Creation of *Edit command point* manually in IEC 61850 protocol

Table 94. Fields of *Edit command point* window in IEC 61850 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
LDevice	Logical device name of IEC 61850 structure, for example, 'System'	
LNode	Logical device node of IEC 61850 structure. Each logical device contains one or more logical nodes. A logical node is a named grouping of data and associated services that are logically related to some function of the power system, for example 'LLN0'.	
DATA	Data object name of IEC 61850 structure. Each logical node contains one or more elements of data. Each element of data has a unique name. These Data Names are determined by the standard and are functionally related to the purpose of the power system, for example, 'DPC'.	

FIELD NAME	DESCRIPTION	DEFAULT VALUE
FC	Functional constraints for status (ST) attributes, substituted value (SV) attributes, description (DC) attributes, measurement attributes (MX), extended definition (EX) attributes and command (CO) attributes. Values: MX, ST, CO	
DA Value	Data attribute for Value, for example, ‘Oper’	
Check	Specifies the bits to be checked in a command. Values: Default, None, Synchrocheck, Interlock-check, Synchrocheck and Interlock-check	Default
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of a command Values: Yes; No	No

4.9.5 Modbus RTU/ASCII

4.9.5.1 Communication port parameters

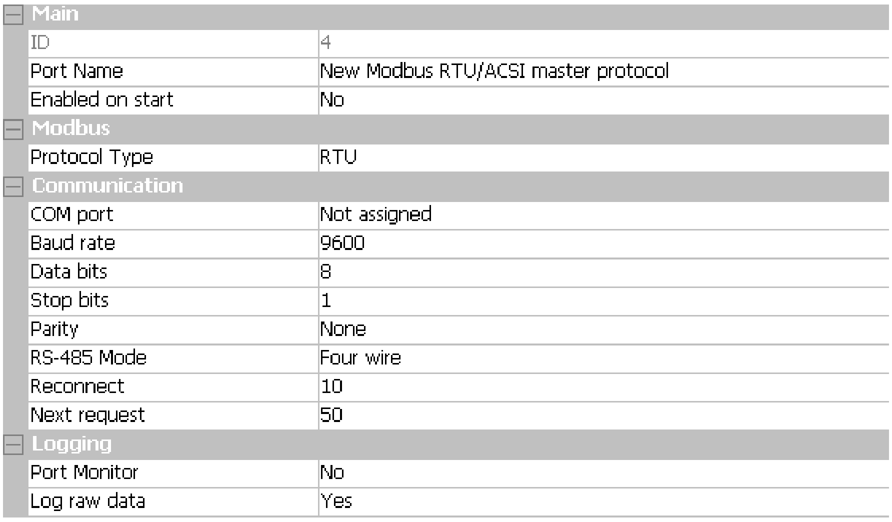


Figure 114. *Communication port* parameters in Modbus RTU/ASCII protocol

Table 95. Fields of *Communication port* parameters window in Modbus RTU/ASCII protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Port name	Name of the port and protocol, for example, 'COM1 Modbus master'	New Modbus RTU/ASCII master protocol
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
Protocol type	Enables to select a protocol version. Values: RTU, ASCII	RTU
Com port	Communication port number Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7,8	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Values: Two wires, Four wires	Four wires
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Next request	Time interval before sending the next request Range of values: 0 … 1000ms	10
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.9.5.2 Application layer parameters

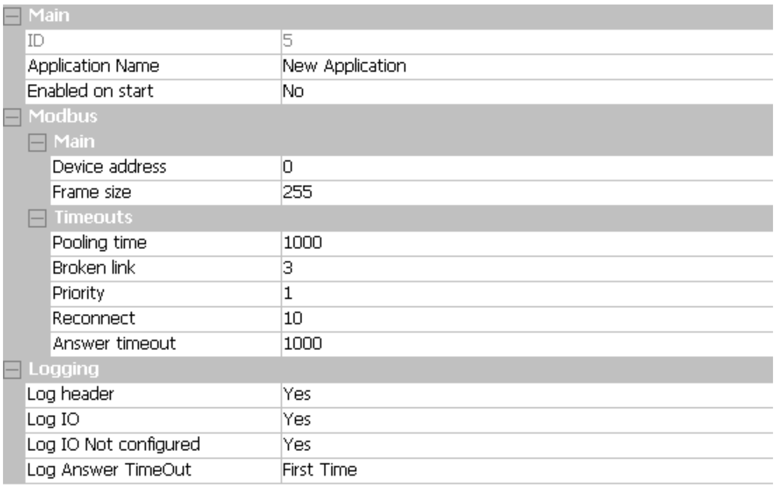


Figure 115. *Application layer* parameters in Modbus RTU/ASCII protocol

Table 96. Fields of *Application layer* parameters window in Modbus RTU/ASCII protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application name	Application layer name, for example, 'Application layer'	New Application
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No
Device address	Device link address Range of values: 0 … 255	0
Max PDU Size	Specifies the maximum PDU size in bytes. Range of values: 20 … 260	255
Pooling time	The time to pool the data Range of values: 0 … 65535ms	1000
Answer timeout	Time interval to wait for response after sending a request Range of values: 10 … 65535ms	1000
Broken link	Determines the connection as broken after the set number of retries. Range of values: 1 … 255	3
Priority	Data is requested every cycle. Relevant only if more than one application layer exists. Range of values: 1 … 255	1
Reconnect	Time interval of reconnection attempt while communication is not established Range of values: 1 … 3600s	10

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Answer timeout	Time interval to wait for response after sending a request Range of values: 50 … 30000ms	1000
Log header	Enables to log headers in the port monitor. Values: Yes; No	Yes
Log IO	Enables to log data and command points' information. Values: Yes; No	Yes
Log IO Not configured	Enables to log not configured information objects. Values: Yes; No	Yes
Log Answer Time Out	Enables to log application link answer timeouts to the system log. Values: Never, First Time, Always	First Time

4.9.5.3 Points

To create a new data or command point to the points list, it is necessary to call the popup menu in the Points window. With the following menu items, it is possible to *Add, Edit or Delete data points*, *Select all* or *Remove connection to the Tag*. *Import* and *Export* functionalities are included as well.

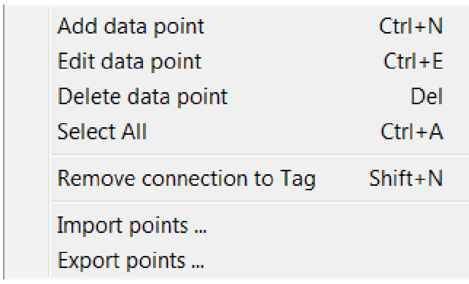


Figure 116. *Points* window popup menu

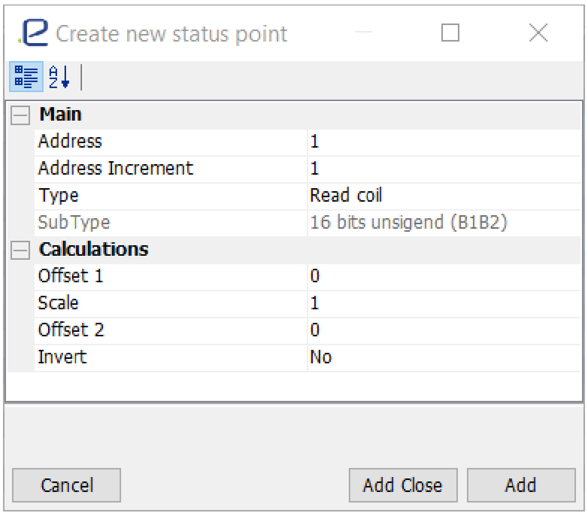
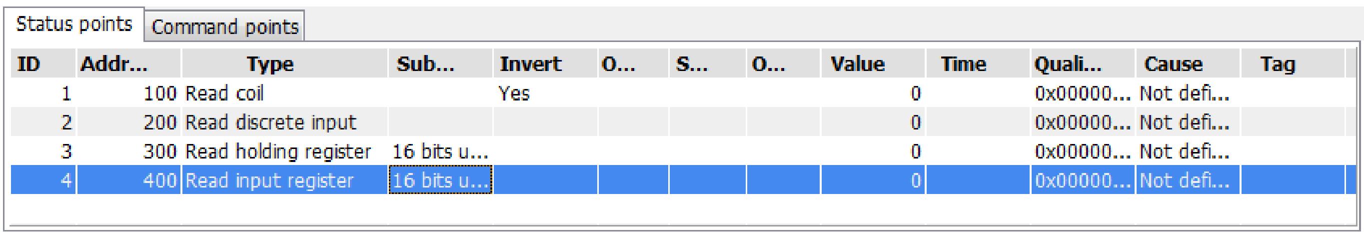


Figure 117. *Create new status point* window

Table 97. Fields of *Create new status point* window in Modbus RTU/ASCII protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Address	Information address Range of values: 0 … 65535	1
Address Increment	After adding a new point, the address will be automatically incremented by the set value.	1
Modbus type	Modbus data type Values: Read coil Read discrete input Read holding register Read input register	Read coil
Data subtype	Available only if Modbus type is Read holding register or Read input register Available data subtypes: 16 bits unsigned (B1B2), 16 bits unsigned (B2B1), 16 bits signed (B1B2), 16 bits signed (B2B1), 32 bits unsigned in one register (B1B2B3B4), 32 bits unsigned in one register (B4B3B2B1), 32 bits signed in one register (B1B2B3B4), 32 bits signed in one register (B4B3B2B1), 32 bits unsigned in two register (B1B2B3B4), 32 bits unsigned in two register (B4B3B2B1), 32 bits signed in two register (B1B2B3B4), 32 bits signed in two register (B4B3B2B1), 32 bits float in one register (B1B2B3B4), 32 bits float in one register (B4B3B2B1), 32 bits float in two register (B1B2B3B4), 32 bits float in two register (B4B3B2B1)	
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of a status Values: Yes; No	No



Status points | Command points

ID	Addr...	Type	Sub...	Invert	O...	S...	O...	Value	Time	Quali...	Cause	Tag
1	100	Read coil		Yes				0		0x00000...	Not defi...	
2	200	Read discrete input						0		0x00000...	Not defi...	
3	300	Read holding register	16 bits u...					0		0x00000...	Not defi...	
4	400	Read input register	16 bits u...					0		0x00000...	Not defi...	

Figure 118. Data points window

The columns between *Function* and *Offset 2* are data point configuration parameters. *Value, Time,* and *Quality* will show real-time data from the controlled device.

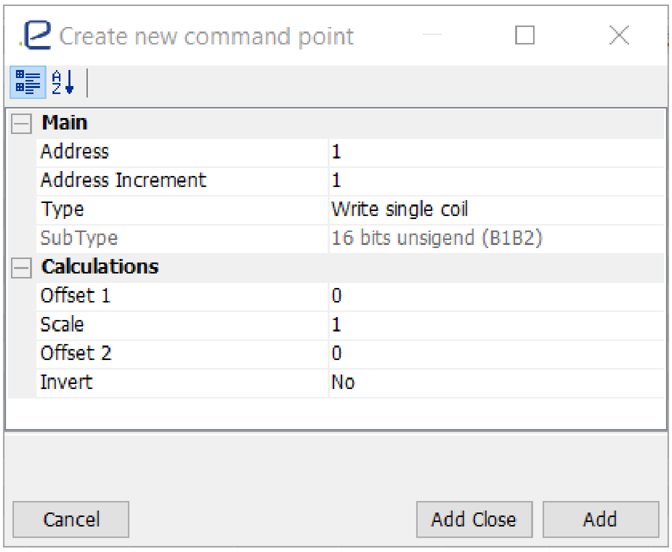


Figure 119. *Create new command point* window

Table 98. Fields of *Create new command point* window in Modbus RTU/ASCII protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Address	Information address Range of values: 0 … 65535	1
Address Increment	After adding a new point, the Address will be automatically incremented by the set value.	1
Modbus type	Modbus data type Values: Write single coil Write single register Write multiple coil Write multiple register	Write single coil
Data subtype	Available only if Modbus type is Write single register or Write multiple register. Available data subtypes: 16 bits unsigned (B1B2), 16 bits unsigned (B2B1), 16 bits signed (B1B2), 16 bits signed (B2B1)	
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of a command Values: Yes; No	No

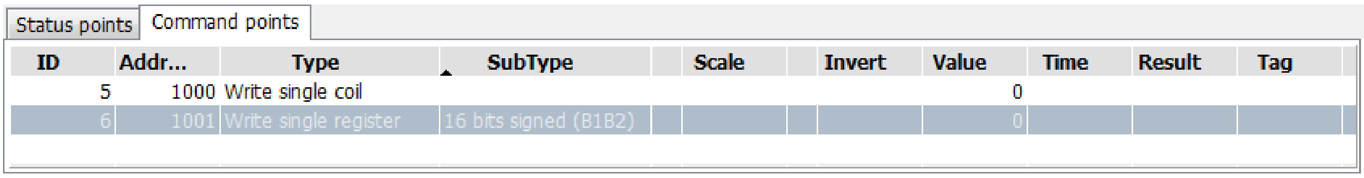


Figure 120. Command points window

In the *Command points* window *Value,* and *Time* will show the last transmitted command data. *Result* will show a response from the controlled device.

4.9.6 Modbus TCP client

4.9.6.1 Communication port parameters

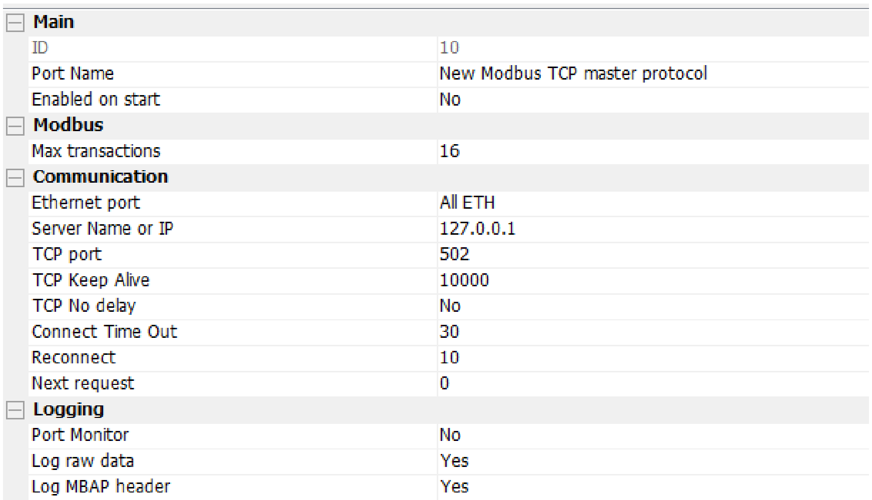


Figure 121. *Communication port* parameters in Modbus TCP protocol

Table 99. Fields of *Communication port* parameters window in Modbus TCP protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Name of the port and protocol for example, 'TCP Modbus client'	New Modbus TCP master protocol
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
Max transactions	Maximum transactions running at the same time Range of values: 1 ... 16	16
Ethernet port	Specifies the Ethernet port to be used for connection to the server. Values: All ETH, ETH1, ETH2, ETH3, ETH4	All ETH

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Server Name or IP	Server name or IP address Values: xxx.zzz.yyy.nnn	127.0.0.1
TCP Port	TCP port for TCP/IP connection. There must be the same port on the server side. Values: 1 … 65535	502
TCP Keep Alive	Forces the TCP activity when idling is too long. Do not set low values because it will add overhead to communication. Range of values: 0 … 2147483647	10000
TCP No delay	Enables or disables the Nagle algorithm. Values: Yes; No	Yes
Connect Timeout	TCP connect timeout Range of values: 1 … 60s	30
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1... 600s	10
Next request	Time interval before a new request is transmitted Range of values: 1 … 2000ms	0
Port Monitor	Shows the port monitor on the system startup.	No
Log raw data	Enables to log raw data in the port monitor. Values: Yes; No	Yes
Log MBAP header	Enables to log Modbus application headers in the port monitor. Values: Yes; No	Yes

4.9.6.2 Application layer parameters

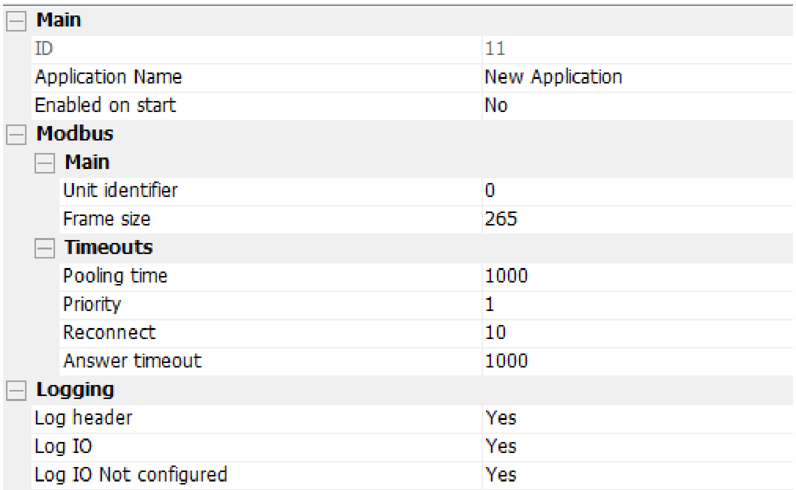


Figure 122. *Application layer* parameters in Modbus TCP protocol

Table 100. Fields of *Application layer* parameters window in Modbus TCP protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, ‘Application layer’	New Application
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No
Unit identifier	Slave Address (255 if not used) Range of values: 0 … 255	1
Frame size	Maximum frame size in bytes. All start, stop, checksum and other bytes are included. Range of values: 30..264 bytes	265
Pooling time	The time to pool the data Range of values: 50 … 65535ms	1000
Priority	Data is requested every cycle. Relevant only if more than one application layer exists. Range of values: 1 … 255	1
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1..3600s	10
Answer timeout	Answer timeout when there is no link Range of values: 50..30000ms	1000

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Log header	Enables to log headers in the port monitor. Values: Yes; No	Yes
Log IO	Enables to log data and command point information in the port monitor. Values: Yes; No	Yes
Log IO not configured	Enables to log not configured point information in the system log. Values: Yes; No	Yes

4.9.6.3 Points

Refer to chapter 4.9.5.3 'Points' in Modbus RTU/ASCII protocol.

4.9.7 DNP3 serial master configuration

4.9.7.1 Communication port parameters

Main	
ID	1
Port Name	New DNP3 master protocol
Enabled on start	No
Communication	
COM port	Not assigned
Baud rate	9600
Data bits	8
Stop bits	1
Parity	None
RS-485 Mode	Four wire
Reconnect	10
Next request	50
Logging	
Port Monitor	No
Log raw data	Yes

Figure 123. *Communication port* parameters in DNP3 serial protocol

Table 101. Fields of *Communication port* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Port name	Name of the port and protocol, for example, 'COM1 DNP3 master'	New DNP3 master protocol
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
Com port	Communication port number Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7,8	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Values: Two wires, Four wires	Four wires
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Next request	Time interval before sending the next request Range of values: 0 … 2000ms	50
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.9.7.2 Data link layer parameters

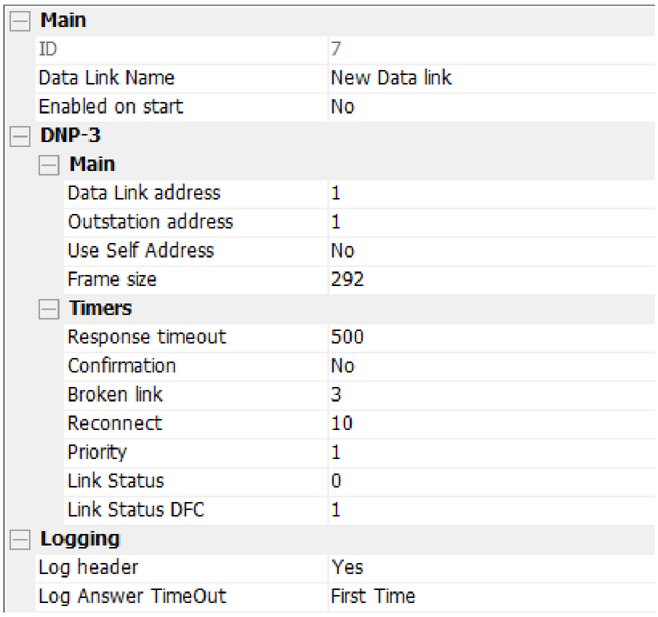


Figure 124. *Data link layer* parameters in DNP3 serial protocol

Table 102. Fields of *Data link layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Data Link Name	Data link name, for example, 'Data link'	'New Data link'
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
Data Link address	RTU's master address Range of values: 0 … 65519	1
Outstation address	IED slave address Range of values: 0 … 65519	1
Use Self Address	DNP3 specification recommends using self-address only to obtain the outstation address. In most cases, it should not be used. Values: Yes; No	No
Frame size	Maximum size of the data link frame Range of values: 14 … 292 bytes	292
Response timeout	Timeout interval of response from the controlled device Range of values: 50 … 60000ms	500

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Confirmation	Data link uses confirmations Values: Yes; No	No
Broken link	Number of retries to determine if the connection is broken Range of values: 1 … 255	3
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 3600s	10
Priority	Data is requested every cycle. Relevant only if more than one application layer exists. Range of values: 1 … 255	1
Link Status	Time interval of request attempt for the link status, if there is no data. Range of values: 0 … 86400s 0 – Link status is not used.	0
Link Status DFC	Time interval of checking attempt for DFC=0, if the value of DFC has been 1. Range of values: 1 … 86400 s	1
Log header	Enables to log headers in the port monitor. Values: Yes; No	Yes
Log Answer TimeOut	Enables to log application link answer timeouts to the system log. Values: Never, First Time, Always.	First Time

4.9.7.3 Transport layer parameters

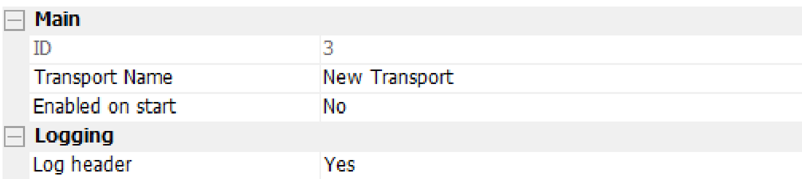


Figure 125. *Transport layer* parameters in DNP3 serial protocol

Table 103. Fields of *Transport layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Transport Name	Transport layer name, for example, 'Transport layer'	'New Transport'
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
Log header	Enables to log headers in the Port Monitor. Values: Yes; No	Yes

4.9.7.4 Application layer parameters

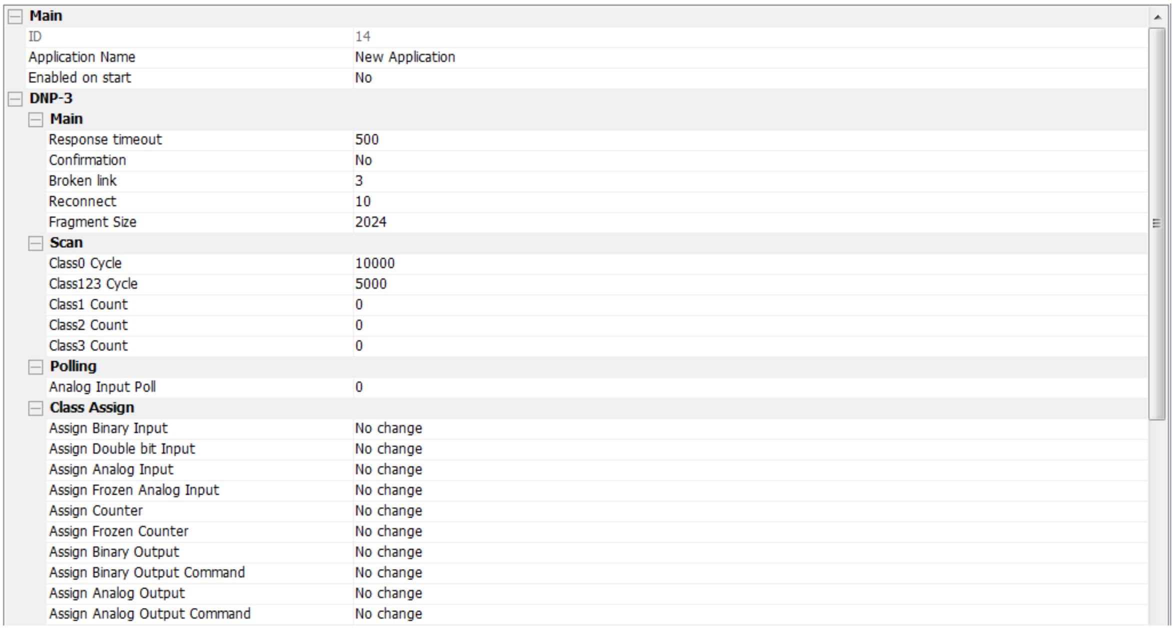


Figure 126. *Application layer* parameters in DNP3 serial protocol

Table 104. Fields of *Application layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Application Name	Application layer name, for example, 'Application layer'	'New Application'
Enabled on start	Port enabled on the system startup. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Response timeout	Response timeout Range of value: 50 … 60000ms	500
Confirmation	If the setting is 'Yes', the application layer must request confirmations. Values: Yes; No	No
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 255	3
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 3600s	10
Fragment Size	Maximum allowed size of the application layer fragment Range of values: 249 … 65535 bytes	2024
Class0 Cycle	Time interval of request attempt for static objects Range of values: 0 … 86400000ms 0 – only on connect or lost events	10000
Class123 Cycle	Time interval of request attempt for event objects Range of values: 0 … 86400000ms 0 – not used	5000
Class1 count	Number of event request in Class1. Range of values: 0 … 16777216 0 – request all events of this class.	0
Class2 count	Number of event request in Class2. Range of values: 0 … 16777216 0 – request all events of this class.	0
Class3 count	Number of event request in Class3. Range of values: 0 … 16777216 0 – request all events of this class.	0
Analogue input Poll	Time interval of request attempt for Analogue input data, if the slave device does not support the point assignment to classes Range of values: 0 … 86400000ms 0 – disabled	0
Assign Binary Input	Class assignment on connection for the Binary input. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Assign Double bit Input	Class assignment on connection for Double bit Input. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Analogue Input	Class assignment on connection for Analogue Input. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Frozen Analogue Input	Class assignment on connection for Frozen Analogue Input. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Counter	Class assignment on connection for Counter. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Frozen Counter	Class assignment on connection for Frozen Counter. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Binary Output	Class assignment on connection for Binary Output. There must be at least one point of such type in the configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Binary Output Command	Class assignment on connection for Binary Output Command. There must be at least one point of such type in configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Analogue Output	Class assignment on connection for Analogue Output. There must be at least one point of such type in configuration. Values: No change, Class0, Class1, Class2, Class3	No change
Assign Analogue Output Command	Class assignment on connection for Analogue Output Command. There must be at least one point of such type in configuration. Values: No change, Class0, Class1, Class2, Class3	No change

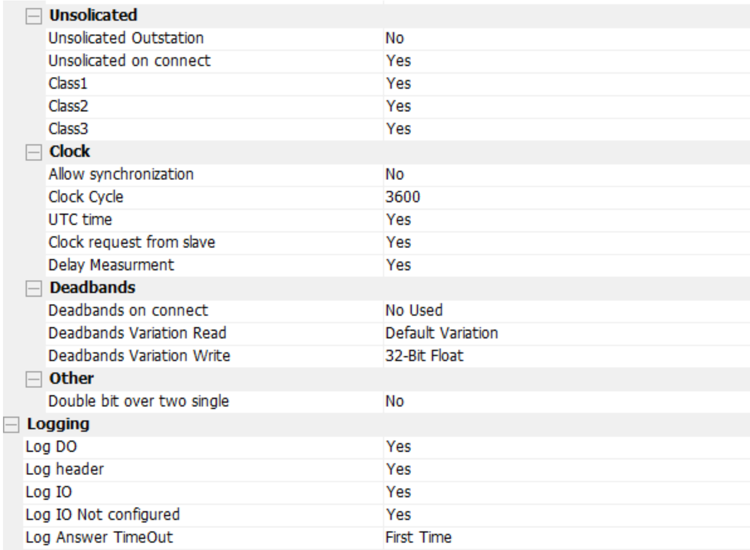


Figure 127. *Application layer* parameters in DNP3 serial protocol

Table 105. Fields of *Application layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Unsolicited Outstation	Set to the value ‘Yes’, if the outstation device supports unsolicited messages. According to the specification, after the device restart, the first message should disable unsolicited messages. Values: Yes; No	Yes
Unsolicited on connect	On connect, set classes to configured enabled or disabled unsolicited (spontaneous) messages. Values: Yes; No	Yes
Class1	Class1 events enabled for unsolicited messages. It is relevant only if ‘Unsolicited on connect’ is set to ‘Yes’. Values: Yes; No	Yes
Class2	Class2 events enabled for unsolicited messages. It is relevant only if ‘Unsolicited on connect’ is set to ‘Yes’. Values: Yes; No	Yes
Class3	Class3 events enabled for unsolicited messages. It is relevant only if ‘Unsolicited on connect’ is set to ‘Yes’. Values: Yes; No	Yes
Allow synchronization	Yes – always allow synchronizing, No – synchronize only if the internal clock of RTU is synchronized.	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Clock Cycle	Cycle time of the clock synchronization to the controlled device Range of values: 0 … 86400s 0 – synchronization is disabled	3600
UTC time	Enables to use UTC time in requests and responses. Values: Yes; No	Yes
Clock request from slave	Sends the clock synchronization when the slave sets its internal indications. Values: Yes; No	Yes
Delay Measurement	Use communication path delay calculation before time synchronization. Values: Yes; No	Yes
Deadbands on connect	Operation will be performed with deadbands on connection to the outstation device. Values: Not Used, Only Read, Write All, Read and Write All, Read and Write only different	Not Used
Deadbands Variation Read	Variation used for deadband read operations Values: Default Variation, 16-Bit, 32-Bit, 32-Bit Float	Default Variation
Deadbands Variation Write	Variation used for deadband write operations Values: 16-Bit, 32-Bit, 32-Bit Float	32-Bit
Double bit over two single	If the master station does not support Double Bit inputs, use the Binary input (Double) point type. This parameter sets which bit should be first transferred. If the values are set to 'NO' – the first is 'OFF', if it is set to 'YES' – the first is 'ON'.	No
Log DO	Enables to log Data Object information. Value: Yes; No	Yes
Log header	Enables to log headers in the port monitor. Values: Yes; No	Yes
Log IO	Enables to log status and command point information. Values: Yes; No	Yes
Log IO Not configured	Enables to log not configured information objects. Values: Yes; No	Yes
Log Answer Time Out	Log application link answer timeouts to the system log Values: Never, First Time, Always	First Time

4.9.7.5 Points

To add a new data or command point to the points list, it is necessary to call the popup menu in the Points window. With the following menu items it is possible to *Add Status point, Edit Status point, Delete Status point, Select all, Remove connection to the TAG Manager, Connect to the Tag* or *Go to Tag*. All the functions have keyboard shortcuts which will simplify and quicken the work with the software.

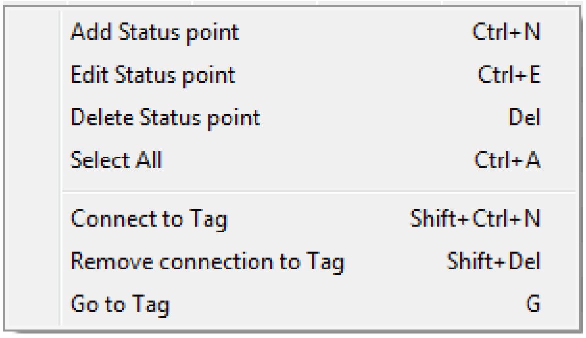


Figure 128. *Points* window popup menu in DNP3 serial protocol

The following figure shows the Create new status point dialog window. The parameters which can be specified on the DNP3 protocol are proposed in the next table.

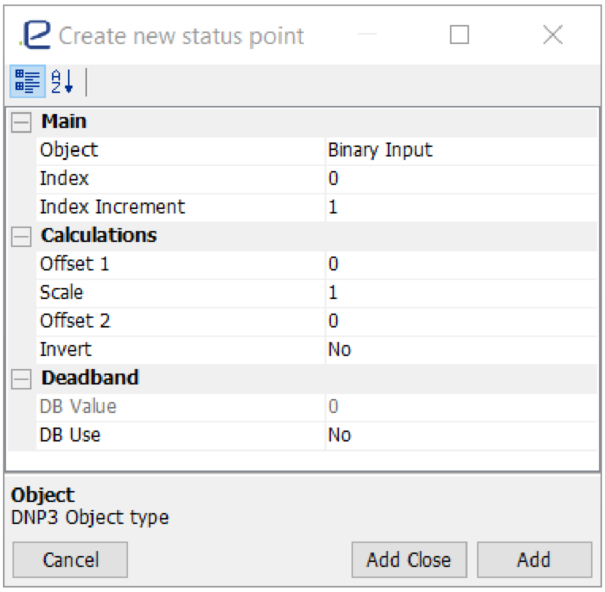


Figure 129. *Create new status point* window in DNP3 serial protocol

Table 106. Fields of *Create new status point* window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Object	DNP3 object type Values: Binary Input, Binary Input (Double), Double Bit Input, Binary Output, Analogue Input, Analogue Output	Binary Input

Index	Object index Range of values: 0 … 2147483647	1
Index Increment	After adding a new point, the Index will be automatically incremented by the set value.	1
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No
DB Value	Deadband value used to configure the outstation Range of values: 0 … 2147483647	0
DB Use	Use deadband value to set the outstation configuration. Value: Yes; No	No

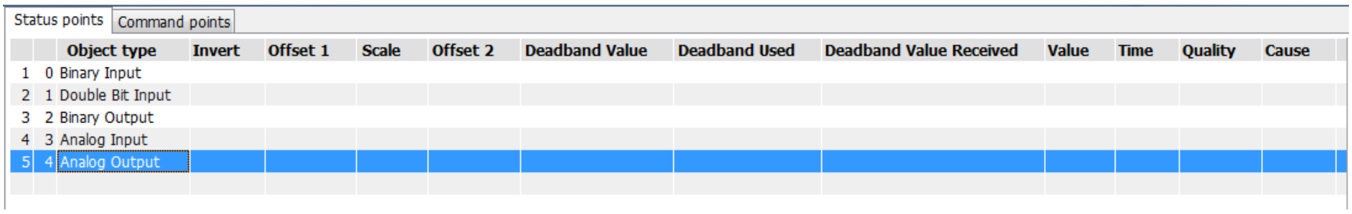


Figure 130. *Status points* window

The columns between Object type and Offset 2 are data point configuration parameters. Value, Time, Quality and others will show real-time data from the controlled device.

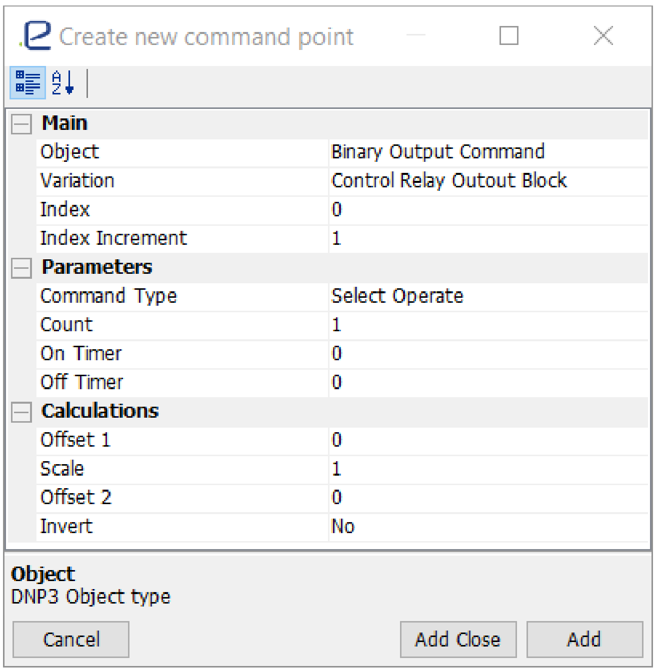


Figure 131. *Create new command point* window

Table 107. Fields of *Create new status point* window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Object	DNP3 object type Values: Binary Input, Double Bit Input, Binary Output, Analogue Input, Analogue Output	Binary Output Command
Variation	DNP3 Object Variation type Values: Control Relay Output Block, 32-Bit Integer, 16-Bit Integer, 32-Bit Float, 16-Bit Float	Control Relay Output Block
Index	Object index Range of values: 0 … 2147483647	1
Index Increment	After adding a new point, the Index will be automatically incremented by the set value.	1
Command Type	Command Type sent to the slave device Values: Select Operate, Direct Operate, Direct Operate No Acknowledgment, Write	Select Operate
Count	Number of cycles to execute the command Range of values: 0 … 255 0 – Cancel Command will be executed.	1
On Timer	Length of the pulse ON timer Range of values: 0 … 2147483647 ms	0
Of Timer	Length of the pulse OFF timer Range of values: 0 … 2147483647ms	0
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No

4.9.8 DNP3 UDP/TCP/IP client configuration

4.9.8.1 Communication port parameters

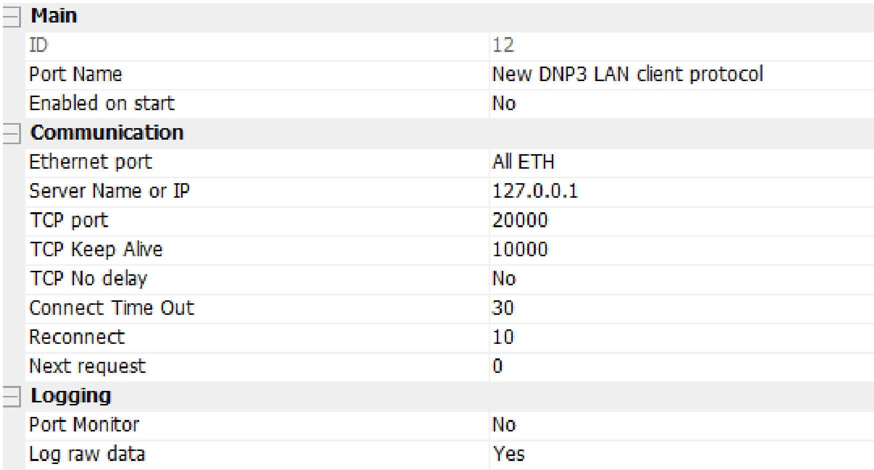


Figure 132. *Communication port* parameters in DNP3 UDP/TCP/IP protocol

Table 108. Fields of *Communication port* parameters window in DNP3 UDP/TCP/IP protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use only	
Port name	Name of the port and protocol, for example, 'DNP3 master'	'New DNP3 LAN client protocol'
Enabled on start	Port enabled on the system startup Values: Yes; No	No
Ethernet port	Specifies the Ethernet port to be used for connection to the server. Values: All ETH, ETH1, ETH2, ETH3, ETH4	All ETH
Server Name or IP	Server name or IP address Values: xxx.zzz.yyy.nnn	127.0.0.1
TCP Port	TCP port Range of values: 1 … 65535	20000
TCP Keep Alive	Force TCP activity when idling is too long. Do not set low values because it will add overhead to communication. Range of values: 0 … 2147483647	10000
TCP No delay	Enables or disables the Nagle algorithm. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Connect Timeout	TCP connect timeout Range of values: 1 … 60s	30
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 ... 600s	10
Next request	Time interval before a new request is transmitted Range of values: 1 … 2000ms	0
Port Monitor	Shows the port monitor on the system startup.	No
Log raw data	Enables to log raw data in the port monitor. Values: Yes; No	Yes

4.9.8.2 Data link layer parameters

Refer to chapter 4.9.7.2 'Data link layer parameters' in DNP3 serial protocol. The configuration is very similar.

4.9.8.3 Transport layer parameters

Refer to chapter 4.9.7.3 'Transport layer parameters' in DNP3 serial protocol. The configuration is very similar.

4.9.8.4 Application layer parameters

Refer to chapter 4.9.7.4 'Application layer parameters' in DNP3 serial protocol. The configuration is very similar.

4.9.8.5 Points

Refer to chapter 4.9.7.5 'Points' in DNP3 serial protocol. The configuration is very similar.

4.9.9 Simulator master configuration

Simulator interface is employed to simulate data points to the upper level protocols. It is very useful in testing environment. It is possible to use it to test SCADA system without IED devices.

4.9.9.1 Port parameters

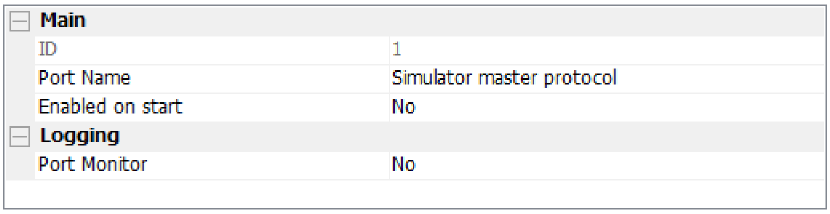


Figure 133. *Simulator port* parameters

Table 109. Fields of *Simulator port* parameters window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use only	
Port name	Simulator port name, for example, 'Simulator'	New Simulator master
Enabled on start	Enables or disables port on start. Values: Yes; No	No
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No

4.9.9.2 Points

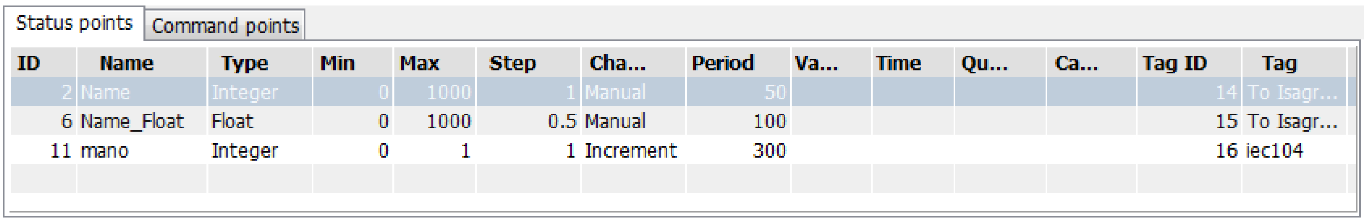


Figure 134. Simulator *Status points* window

The following figure shows the *Add new simulation point dialog* window. The user can specify some parameters like *Name, Value type, Change type, Min value, Max value, Step, Change every*.

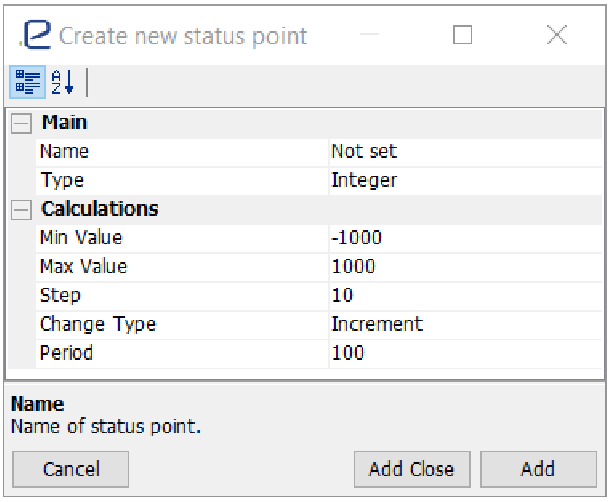


Figure 135. *Create new simulation status point*

Table 110. Fields of *Create new simulation status point* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Name	Name of status point, or example, 'Data Point 1'	Not set
Type	Type of data point Range of values: Integer, Float	Integer
Min value	Minimum value of a simulation data point Range of values: -100000 … 1000000	-1000
Max value	Maximum value of a simulation data point Range of values: -100000 … 1000000	1000
Step	Step size to change a simulation data point between Minimum and Maximum values Range of values: -100000 … 1000000	10
Change type	Type of the data point simulation Range of values: Increment, Decrement, Random, Manual	Increment
Period	Cycle time of data point change Range of values: 0 … 10000ms	100

If the user has configured *manual data point change type*, then he or she can change data points manually by entering the *Manual set value* dialog from the data point popup menu. The following figure shows this menu.

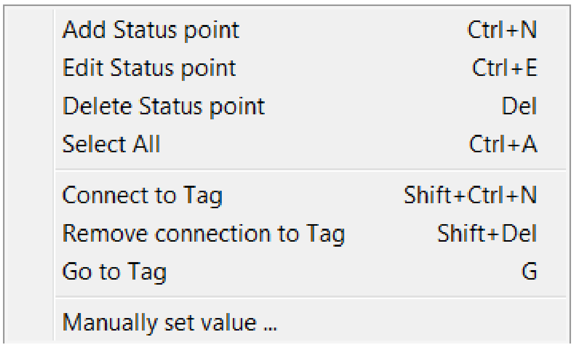


Figure 136. Simulator *Points* popup menu

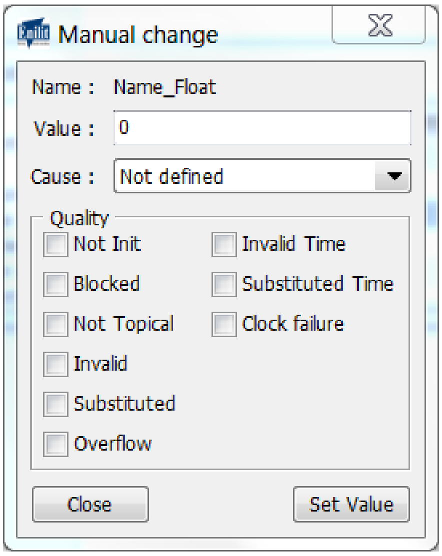


Figure 137. *Manual change* type dialog

With *Manual change type* it is also possible to simulate *Cause of transmission* and *Quality of data point*.

Cause of transmission can be: *Not defined, Initialize, Periodic, Background, Spontaneous, General Interrogation, Requested, Control local, Control remote, Disconnected source, Disabled source, Deleted source, Test mode, Calculated*.

The values of *Quality of data point* can be in the range: *Not Init, Blocked, Not Topical, Invalid, Substituted, Overflow, Invalid Time, Substituted time, Clock failure*.

4.9.10 RP-570 configuration

4.9.10.1 Communication port parameters

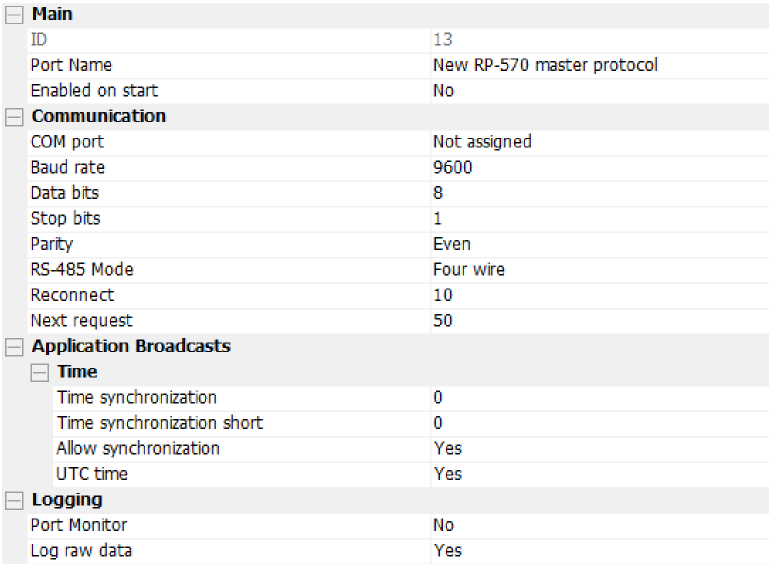


Figure 138. *Communication port* parameters in RP-570 protocol

Table 111. Fields of *Communication port* parameters window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Port name	Name of the port and protocol, for example, 'COM1 RP-570 master'	New RP-570 master protocol
Enabled on start	Port enabled on the system startup Values: Yes; No	No
Com port	Communication port number Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7,8	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important.	Four wires

FIELD NAME	DESCRIPTION	DEFAULT VALUE
	Values: Two wires, Four wires	
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Next request	Time interval before sending the next request Range of values: 0 … 2000ms	50
Time synchronization	Use time synchronization type every set interval of time. Range of values: 0 ... 86400s 0 – synchronization is disabled.	0
Time synchronization short	Use short time synchronization type every set interval of time. Range of values: 0 ... 600000ms 0 – synchronization is disabled.	0
Allow synchronization	Yes – always allow time synchronization False – only if the internal clock is synchronized	Yes
UTC time	In request UTC time is used	Yes
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.9.10.2 Application layer parameters

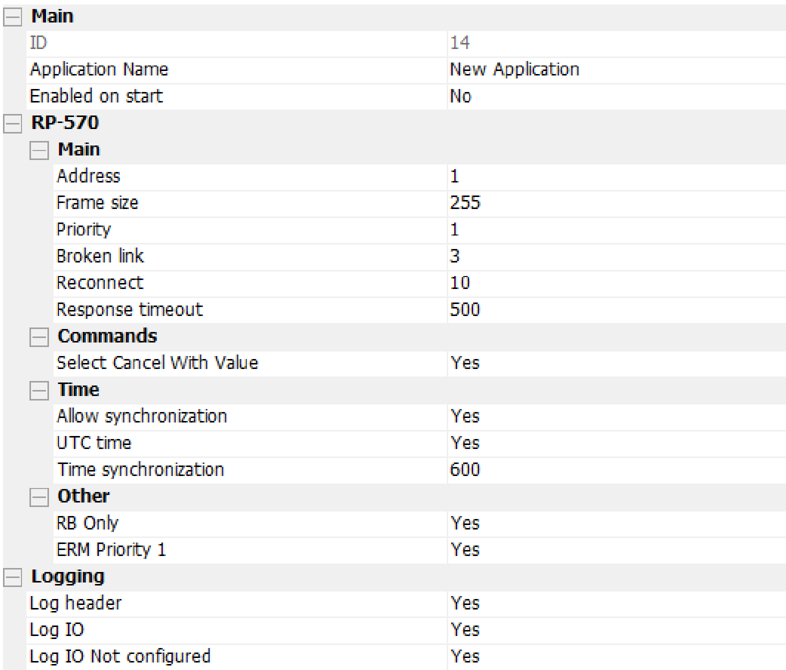


Figure 139. *Application layer* parameters in RP-570 protocol

Table 112. Fields of *Application layer* parameters window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, 'Application layer'	New Application
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No
Address	Slave address Range of values: 1 … 999, 900 – broadcast	1
Frame size	Maximum frame length Range of values: 48 … 255 bytes	255
Priority	Data is requested every cycle. Relevant only if more than one application layer exists. Range of values: 1 … 255	1
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 255	3
Reconnect	Time interval of reconnection attempt to the remote device while communication is not established Range of values: 1 … 600s	10
Response timeout	Timeout interval of response from the controlled device Range of values: 50 … 60000ms	500
Select Cancel With Value	Some master devices do not send the value with select and cancel commands. In this case, set this parameter to 'NO'.	Yes
Allow synchronization	Yes – always synchronize, No – synchronize only if the RTU internal clock is synchronized.	Yes
UTC time	Use UTC time in communication Values: Yes; No	Yes
Time synchronization	Cycle time of the clock synchronization to the controlled device Range of values: 1 … 86400s 0 - synchronization is disabled.	600
RB Only	For data request, use only RB. RA is a request for priority 1 data but for RB request, it is also allowed to resend with priority 1 data.	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ERM Priority 1	Allows ERM event message responses to RequestA (Priority 1) requests.	Yes
Log header	Enables to log application layer header. Values: Yes; No	Yes
Log IO	Enables to log information objects. Values: Yes; No	Yes
Log IO not configured	Enables to log not configured information objects. Values: Yes; No	Yes

4.9.10.3 Point

Application layer has the branch *Points* where the user can manage signals, measurements from the controlled device and commands to the controlled device. The following figure shows the *Points* popup menu which can be run with the right mouse button. It is possible to *Add data point, Edit data point, Delete data point, Select All data points* or *commands*, and *Remove connection to the Tag*. The user can *Remove connection to source* also from the *TAG Manager*. All menu items have keyboard shortcuts which will simplify and quicken the work with the software.

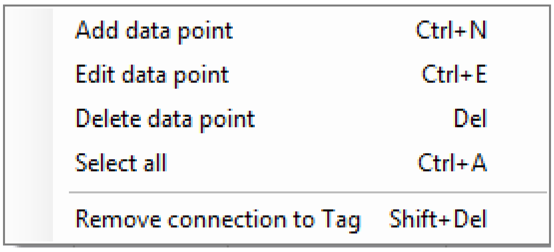


Figure 140. *Points* popup menu

The following figure shows *Create new status point* dialog window. The parameters which the user can specify on the RP-570 protocol are proposed in the next figure.

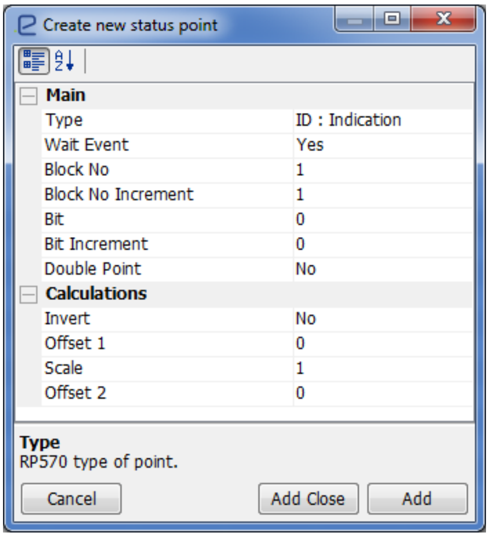


Figure 141. *Create new status point* window

Table 113. Fields of *Create new status point* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Type of a point under RP-570 protocol Range of values: ID: Indication, AV: Analogue Value, DV: Digital Value, FD: Fault Distance	ID: Indication
Wait Event	Set to 'NO' if the slave device does not support event transmission. By default only indications are supported.	Yes
Block No	Block number Range of values: 0 … 255	1
Block No Increment	After adding a new point, Block No will be automatically incremented by the set value.	1
Bit	Bit Number Range of values: 0 … 15	0
Bit Increment	After adding a new point, Bit Number will be automatically incremented by the set value.	1
Double Point	Indication double point	No
Invert	Inversion of status Values: Yes; No	No
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

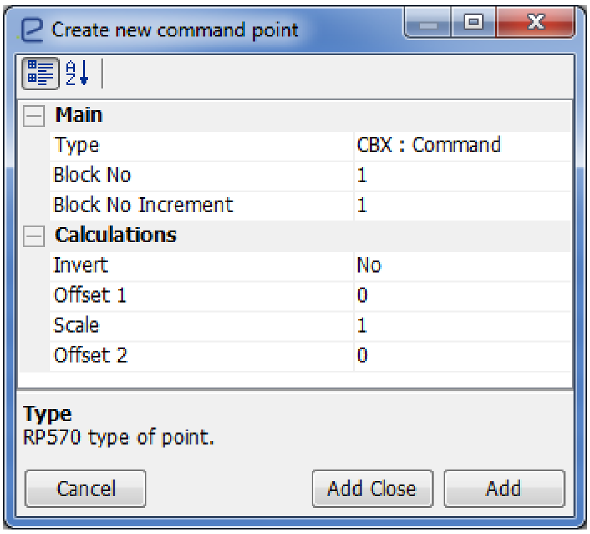


Figure 142. *Create new command point* window

Table 114. Fields of *Create new command point* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Type of a command under RP-570 protocol Range of values: CBX: Command, SPM: SetPoint, GOM: General Output	CBX: Command
Block No	Block number Range of values: 0 … 255	1
Block No Increment	After adding a new point, Block No will be automatically incremented by the set value.	1
Invert	Inversion of status Values: Yes; No	No
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

4.9.11 SPA-Bus configuration

4.9.11.1 Communication port parameters

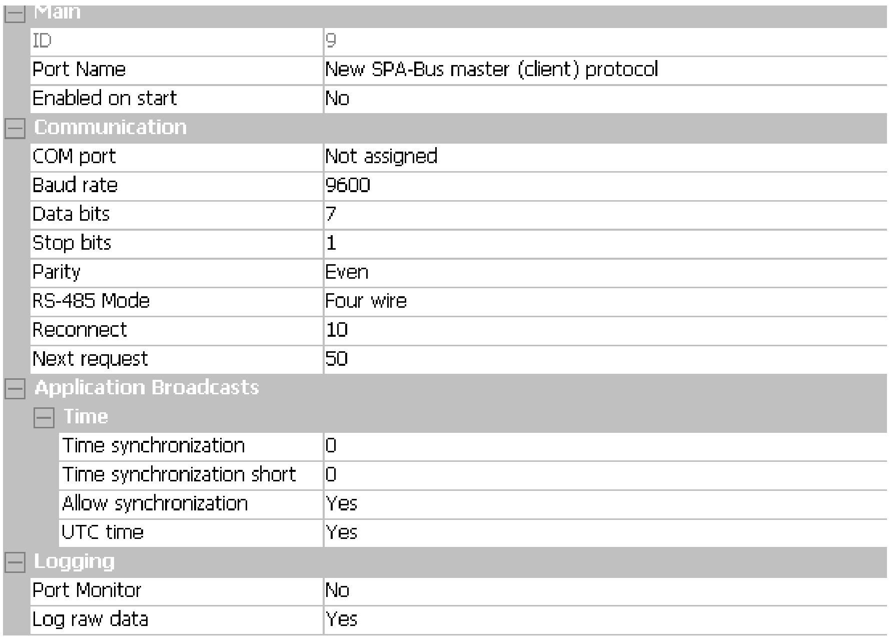


Figure 143. *Communication port* parameters in SPA-Bus protocol

Table 115. Fields of *Communication port* parameters window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Name of the port and protocol, for example, ‘COM1 SPA-Bus master’	New SPA-Bus master protocol
Port enabled	Port enabled on the system startup Values: Yes; No	No
Com port	Communication port number Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7, 8 bits	7
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	Even
RS-485 mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Values: Two wires, Four wires	Four wires
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Next request	Time interval before sending the next request Range of values: 0 … 2000ms	50
Time synchronization	Broadcast. Cycle time of the clock synchronization to the controlled device Range of values: 1 … 86400s 0 - synchronization is disabled	0
Time synchronization short	Broadcast. Cycle short time of the clock synchronization to the controlled device Range of values: 1 … 86400s 0 - synchronization is disabled	0
Allow synchronization	Yes – always synchronize, No – synchronize only if the RTU internal clock is synchronized.	Yes
UTC time	Use UTC time in communication Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.9.11.2 Application layer parameters

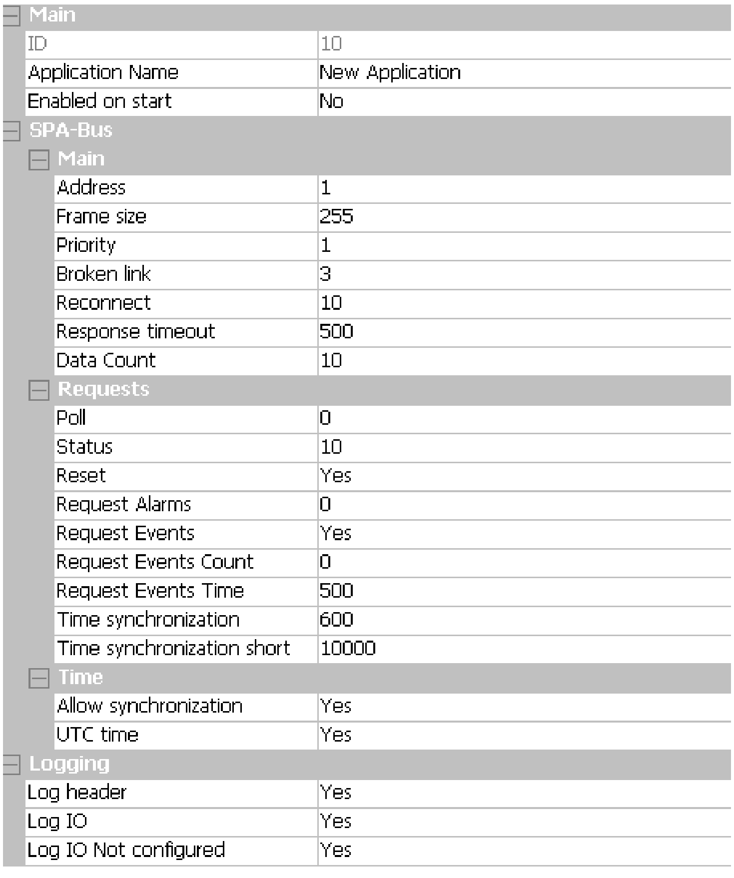


Figure 144. *Application layer* parameters in SPA-Bus protocol

Table 116. Fields of *Application layer* parameters window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, 'Application layer'	New Application
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Address	Slave address Range of values: 1 … 999 900 – broadcast.	1
Frame size	Maximum frame length Range of values: 48 … 255 bytes	255
Priority	Data is requested every cycle. Relevant only if more than one application layer exists. Range of values: 1 … 255	1
Broken link	Number of retries to determine if the connection is broken Range of values: 1 … 255	3
Reconnect	Time interval of reconnection attempt to the remote device while communication is not established Range of values: 1 … 600s	10
Response timeout	Timeout interval of response from the controlled device Range of values: 50 … 60000ms	500
Data Count	Request maximum data count Range of value: 1 …200	10
Poll	Request of data every time period Range of values: 0 … 600000ms	0
Status	Request of slave status every time period Range of values: 0 … 86400s 0 – use only while connecting	10
Reset	Reset status bit in the slave device. Set this parameter to 'NO' only if the slave device does not support such commands.	Yes
Request Alarms	Cycle of request alarms Range of values: 0 … 86400s 0 – disabled.	0
Request Events	Request events from the slave device. Set this parameter to 'NO' only if the slave device does not support such commands.	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Request Events Count	Relevant only if there is more than one application layer (from the remote device). Number of requests for events from the same application layer (from the remote device) if there are events Range of values: 0 … 255 0 – until there is any event.	0
Request Events time	Relevant only if there is more than one application layer (remote device). Cycle time of request events from the same application layer (from the remote device) Range of values: 0 … 60000ms 0 – this parameter is ignored.	500
Time synchronization	Cycle time of the clock synchronization to the controlled device Range of values: 1 … 86400s 0 - synchronization is disabled.	600
Time synchronization short	Cycle short time of the clock synchronization to the controlled device Range of values: 1 … 86400s 0 - synchronization is disabled.	10000
Allow synchronization	Yes – always synchronize, No – synchronize only if the RTU internal clock is synchronized	Yes
UTC time	Use UTC time in communication Values: Yes; No	Yes
Log header	Enables to log application layer header. Values: Yes; No	Yes
Log IO	Enables to log information objects. Values: Yes; No	Yes
Log IO not configured	Enables to log not configured information objects. Values: Yes; No	Yes

4.9.11.3 Points

Application layer has the branch of *Points* where the user can manage signals, measurements from the controlled device and commands to the controlled device. The following figure shows the points popup menu which can be run with the right mouse button. It is possible to *Add data point, Edit data point, Delete data point, Select All data points or commands*, and *Remove connection to the Tag*. The user can *Remove* *connection to source* also from the *TAG Manager*. All menu items have keyboard shortcuts which will simplify and quicken the work with the software.

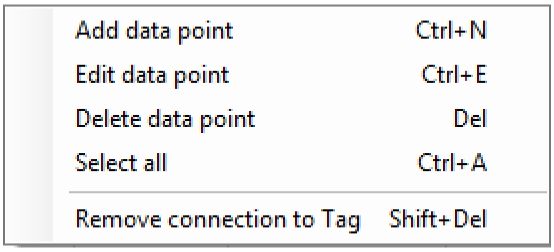


Figure 145. *Points* popup menu

The following figure shows *Create new status point* dialog window. The parameters which can be specified on the SPA-BUS protocol are proposed in the next figure.

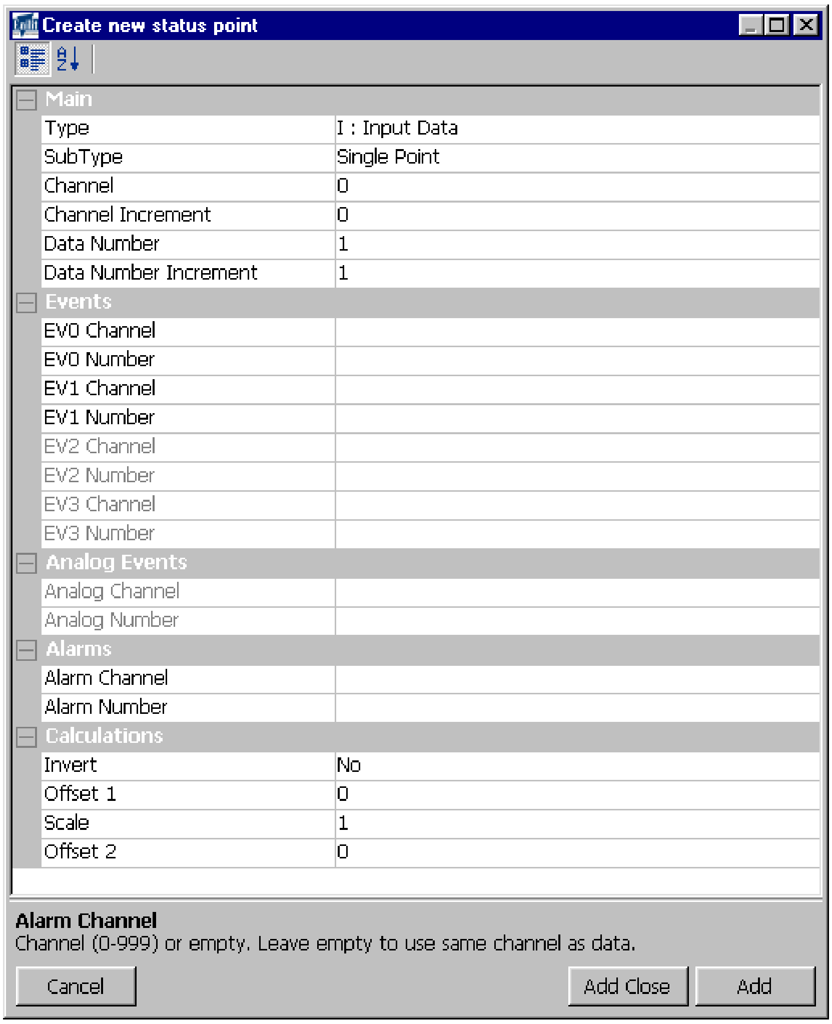


Figure 146. *Create new status point* window

Table 117. Fields of *Create new status point* window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Type of a point under SPA-Bus protocol Range of values: I: Input Data, O: Output Data, S: Setting Values, V: Variables, M: Memory Data	I: Input Data
SubType	Subtype of a point under SPA-Bus protocol Range of values: Single Point, Double Point, Integer, Float	Single Point
Channel	Channel Range of values: 0 … 999	0
Channel Increment	After adding a new point, Channel will be automatically incremented by the set value. Range of values: 0 … 999	0
Data Number	Data Number Range of values: 0 … 999999	1
Data Number Increment	After adding a new point, Data Number will be automatically incremented by the set value. Range of values: 0 … 999999	1
EV0 Channel	Leave empty to use the same channel as data. Range of values: Empty, 0 … 999	
EV0 Number	Leave empty to ignore events. Range of values: Empty, 0 … 64	
EV1 Channel	Leave empty to use the same channel as data. Range of values: Empty, 0 … 999	
EV1 Number	Leave empty to ignore events. Range of values: Empty, 0 … 64	
EV2 Channel	Leave empty to use the same channel as data. Range of values: Empty, 0 … 999	
EV2 Number	Leave empty to ignore events. Range of values: Empty, 0 … 64	
EV3 Channel	Leave empty to use the same channel as data. Range of values: Empty, 0 … 999	

FIELD NAME	DESCRIPTION	DEFAULT VALUE
EV3 Number	Leave empty to ignore events. Range of values: Empty, 0 … 64	
Analogue Channel	Leave empty to use the same channel as data. Range of values: Empty, 0 … 999	
Analogue Number	Leave empty to ignore events. Range of values: Empty, 0 … 64	
Alarm Channel	Leave empty to use the same channel as data. Range of values: Empty, 0 … 999	
Alarm Number	Leave empty to ignore alarms. Range of values: Empty, 0 … 64	
Invert	Inversion of status Values: Yes; No	No
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

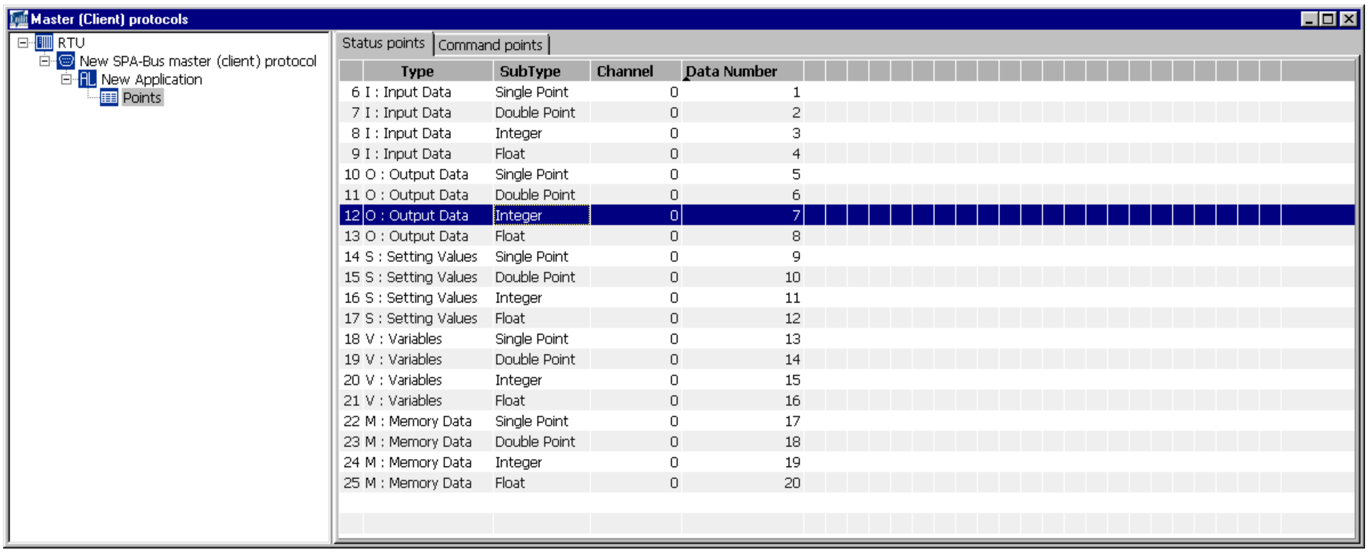


Figure 147. Data points

Columns *Value, Time, Quality, Cause* show real-time data from the controlled device.

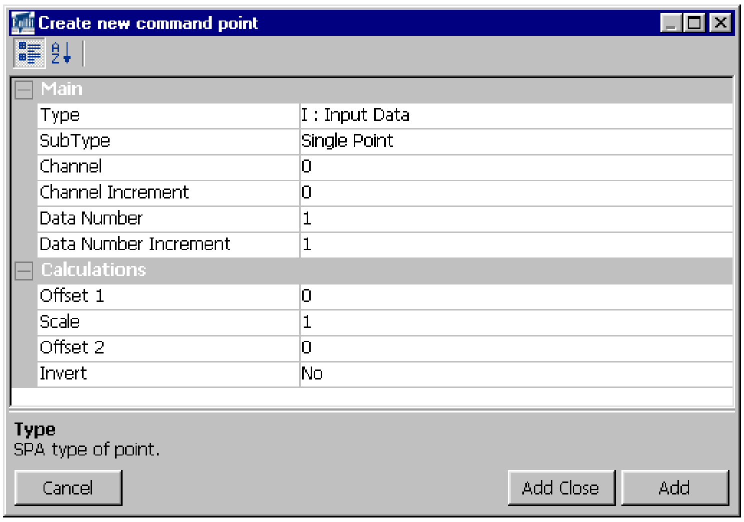
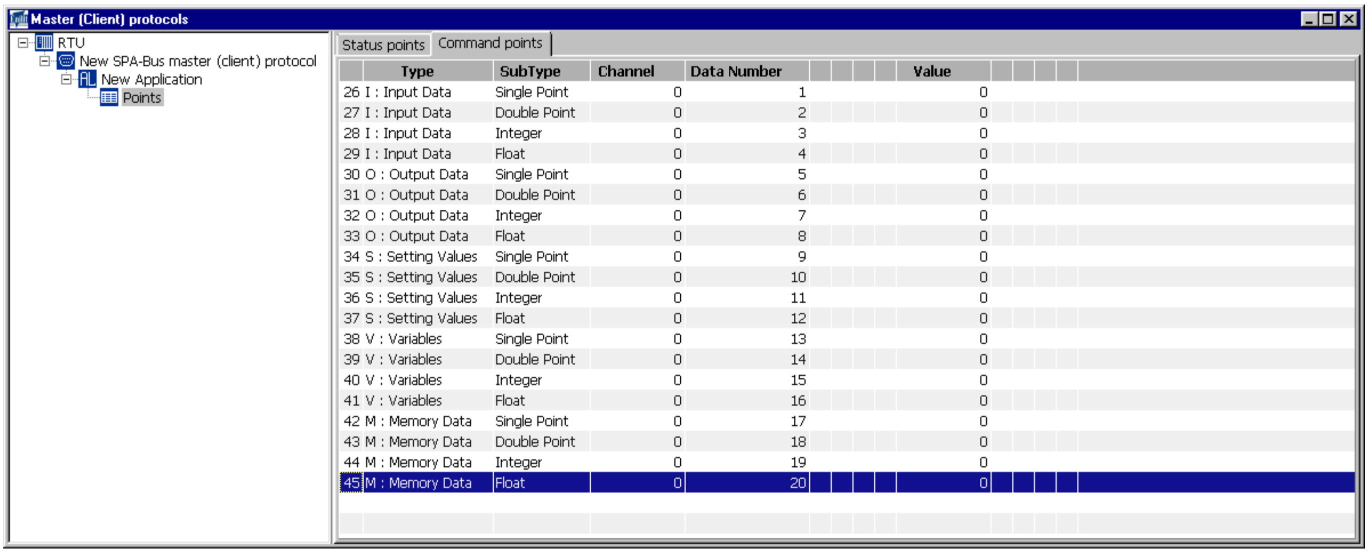


Figure 148. *Create new command point* in SPA-Bus protocol

Table 118. Fields of *Create new command point* window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Type of a point under SPA-Bus protocol Range of values: I: Input Data, O: Output Data, S: Setting Values, V: Variables, M: Memory Data	I: Input Data
SubType	Subtype of a point under SPA-Bus protocol Range of values: Single Point, Double Point, Integer, Float	Single Point
Channel	Channel Range of values: 0 … 999	0
Channel Increment	After adding a new point, the Channel will be automatically incremented by the set value. Range of values: 0 … 999	0
Data Number	Data Number Range of values: 0 … 999999	1
Data Number Increment	After adding a new point, the Data Number will be automatically incremented by the set value. Range of values: 0 … 999999	1
Offset 1		0

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Scale	New value = (Old value + Offset1) * Scale + Offset2	1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No



Type	SubType	Channel	Data Number	Value
26 I : Input Data	Single Point	0	1	0
27 I : Input Data	Double Point	0	2	0
28 I : Input Data	Integer	0	3	0
29 I : Input Data	Float	0	4	0
30 O : Output Data	Single Point	0	5	0
31 O : Output Data	Double Point	0	6	0
32 O : Output Data	Integer	0	7	0
33 O : Output Data	Float	0	8	0
34 S : Setting Values	Single Point	0	9	0
35 S : Setting Values	Double Point	0	10	0
36 S : Setting Values	Integer	0	11	0
37 S : Setting Values	Float	0	12	0
38 V : Variables	Single Point	0	13	0
39 V : Variables	Double Point	0	14	0
40 V : Variables	Integer	0	15	0
41 V : Variables	Float	0	16	0
42 M : Memory Data	Single Point	0	17	0
43 M : Memory Data	Double Point	0	18	0
44 M : Memory Data	Integer	0	19	0
45 M : Memory Data	Float	0	20	0

Figure 149. *Command points* window

4.9.12 System monitor

4.9.12.1 System monitor

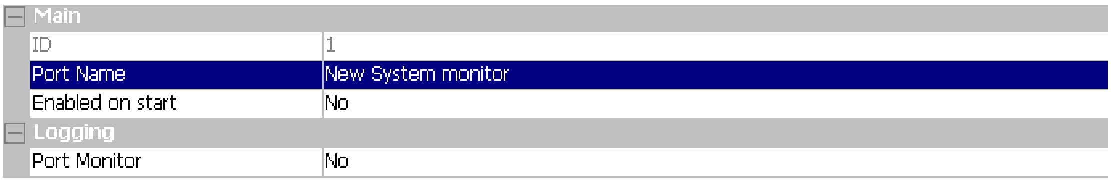


Figure 150. System monitor parameters

Table 119. Fields of System monitor parameters window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port (protocol) name, for example, 'System monitor'	New System monitor
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No

4.9.12.2 Points

Port name layer has the branch of *Points*. This protocol is used for the functions of RTU *Cyber security* and *Self diagnostic*. It receives data from the RTU hardware, Operating system and Enilit CMS. Points are created automatically. There is a possibility to change some parameters like *failed logon count*. If needed, there can be added additional features or points free of charge.

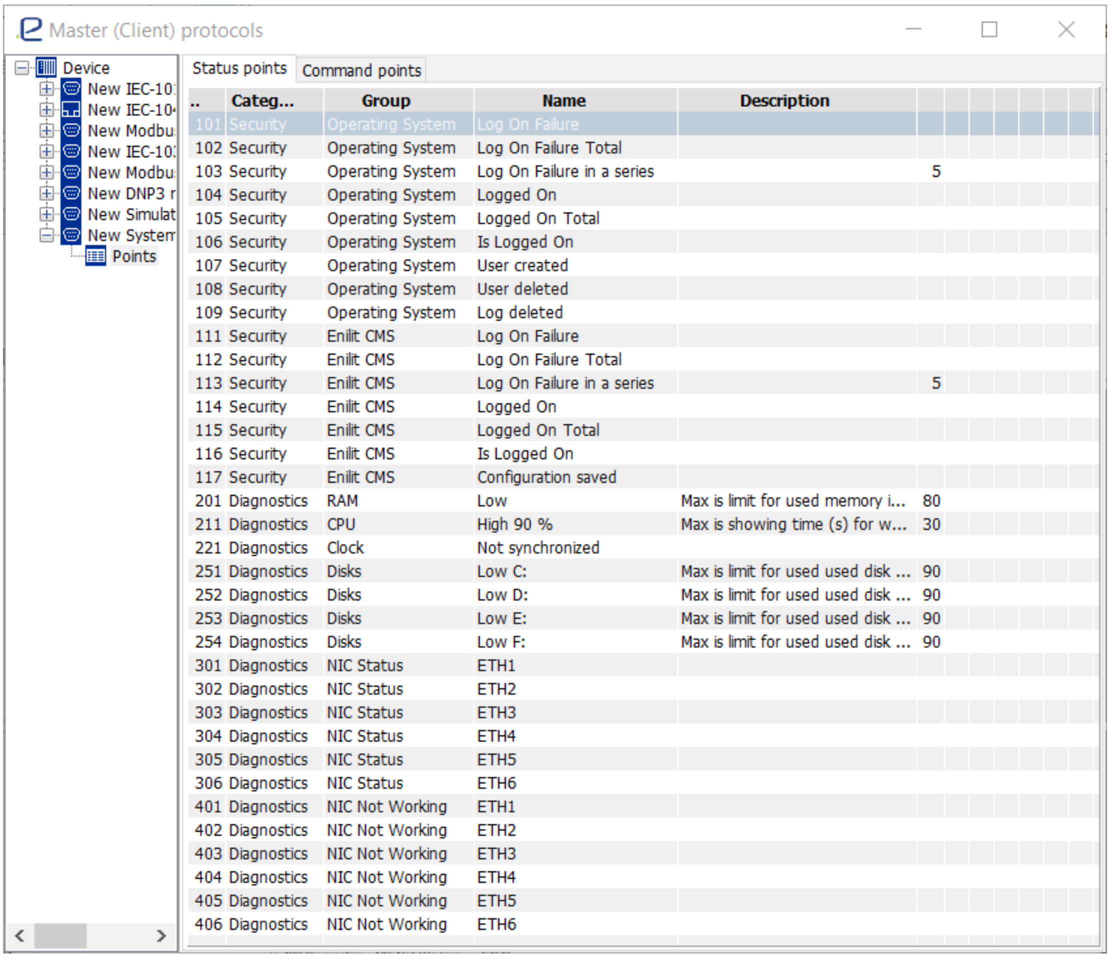


Figure 151. System monitor *Status points*

Table 120. Fields of System monitor *Status points* window

CATEGORY	GROUP	NAME	DESCRIPTION
Security	Operating System	Log On Failure	Failed user log on to the Operating system. Type Status. The signal activates and goes to normal
Security	Operating System	Log On Failure Total	Count of Failed user logons to the Operating system. Type Integer
Security	Operating System	Log On Failure in series	Count of Failed user logons to the Operating system in series. Type Status
Security	Operating System	Logged On	User is logging to the Operating system. Type Status. The signal activates only on logging to the Operating system and then goes to normal.
Security	Operating System	Logged On Total	Count of the users logging to the Operating system. Type Integer
Security	Operating System	Is Logged On	User is logged on to the Operating system. Type Status. The signal is active till a user is logged to the Operating system.
Security	Operating System	User created	Created a new user in the Operating system. Type Status. The signal activates on a new user creation and then goes to normal.
Security	Operating System	User deleted	Deleted user from the Operating system. Type Status. The signal activates on deletion of a user and then goes to normal.
Security	Operating System	Log deleted	Deleted Operating system log. Type Status. The signal activates on deletion of Operating system logs and then goes to normal.
Security	Enilit CMS	Log On Failure	Failed user log on to Enilit CMS. Type Status. Signal activates and goes to normal
Security	Enilit CMS	Log On Failure Total	Count of Failed user logons to Enilit CMS. Type Integer
Security	Enilit CMS	Log On Failure in series	Count of Failed user logons to Enilit CMS in series. Type Integer
Security	Enilit CMS	Logged On	User is logging to Enilit CMS. Type Status. The signal activates only on logging to Enilit CMS and then goes to normal.

CATEGORY	GROUP	NAME	DESCRIPTION
Security	Enilit CMS	Logged On Total	Count of users logging to Enilit CMS. Type Integer
Security	Enilit CMS	Is Logged On	User is logged on to Enilit CMS. Type Status. The signal is active till a user is logged to Enilit CMS.
Security	Enilit CMS	Configuration saved	Enilit CMS configuration saved. Type Status. The signal activates on Enilit CMS configuration saving process.
Diagnostics	RAM	Low	Limit for the used memory in percent. Limit range is configurable. Range of value: 0 … 100 Default value: 80
Diagnostics	CPU	High 90%	Time for which CPU is using too much of resources (90%). Time is configurable. Range value: 0 … 1000000s Default value: 30
Diagnostics	Clock	Not synchronized	RTU internal clock is not synchronized.
Diagnostics	Disks	Low C:	Limit for the used disk space in percent. Limit range is configurable. Range of value: 0 … 100
Diagnostics	Disks	Low D:	Limit for the used disk space in percent. Limit range is configurable. Range of value: 0 … 100
Diagnostics	Disks	Low E:	Limit for the used disk space in percent. Limit range is configurable. Range of value: 0 … 100
Diagnostics	Disks	Low F:	Limit for the used disk space in percent. Limit range is configurable. Range of value: 0 … 100
Diagnostics	NIC Status	ETH1 … 6	Ethernet Network interface controller status. Type Integer. Descriptions of status are in the table below.
Diagnostics	NIC Not Working	ETH1 … 6	Ethernet Network interface controller is disconnected.

Table 121. Ethernet Network interface controller (NIC) status table

NAME	DESCRIPTION	VALUE
NCS_DISCONNECTED	The connection is disconnected.	0
NCS_CONNECTING	The connection is in the process of connecting.	1
NCS_CONNECTED	The connection is in the connected state.	2
NCS_DISCONNECTING	The connection is in the process of disconnecting.	3
NCS_HARDWARE_NOT_PRESENT	The hardware for the connection, for example network interface card (NIC), is not present.	4
NCS_HARDWARE_DISABLED	The hardware for the connection is present, but is not enabled.	5
NCS_HARDWARE_MALFUNCTION	A malfunction has occurred in the hardware for the connection.	6
NCS_MEDIA_DISCONNECTED	The media, for example, the network cable, is disconnected.	7
NCS_AUTHENTICATING	The connection is waiting for authentication to occur.	8
NCS_AUTHENTICATION_SUCCEEDED	Authentication has succeeded on this connection.	9
NCS_AUTHENTICATION_FAILED	Authentication has failed on this connection.	10
NCS_INVALID_ADDRESS	The address is invalid.	11
NCS_CREDENTIALS_REQUIRED	Security credentials are required.	12

4.10 Slave protocols

4.10.1 IEC 60870-5-101 protocol configuration

4.10.1.1 Communication port parameters

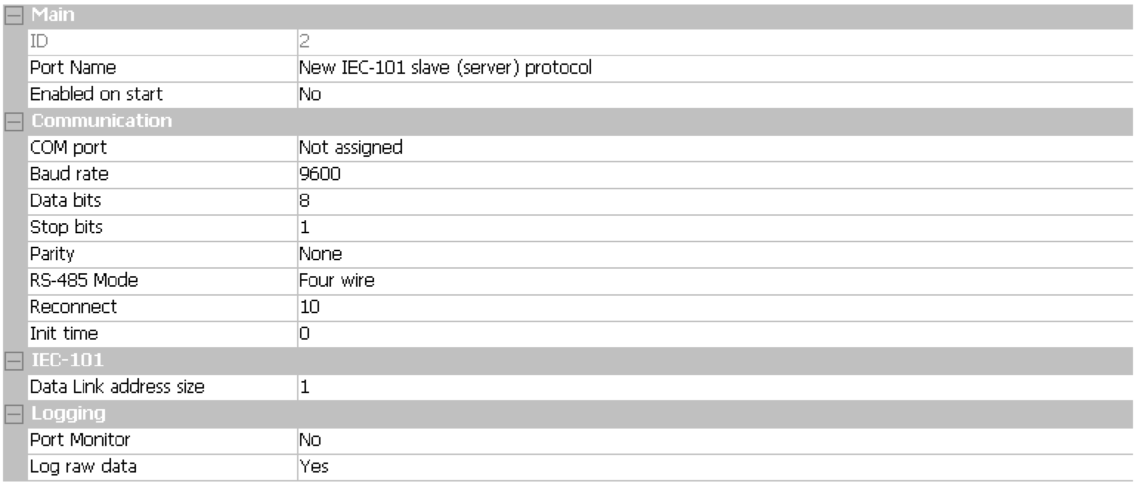


Figure 152. *Communication port* parameters in IEC 60870-5-101 protocol

Table 122. Fields of *Communication port* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Name of the port and protocol, for example, 'COM3 IEC-101 slave'	New IEC_101 slave protocol
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
COM port	Communication port number Range of values: COM 1 … COM 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7, 8	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None

FIELD NAME	DESCRIPTION	DEFAULT VALUE
RS-485 Mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Values: Two wires, Four wires	Four wires
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 0 … 600s 0 – Not used	0
Data Link address size	Data link address size Range of values: 0 … 2 bytes	1
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.10.1.2 Data link layer parameters

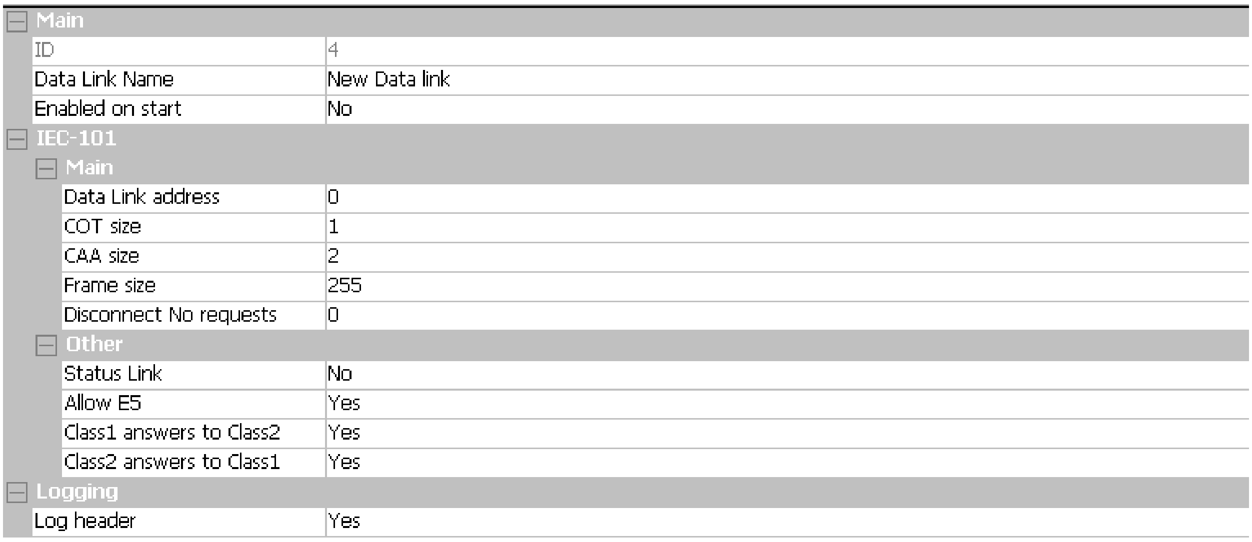
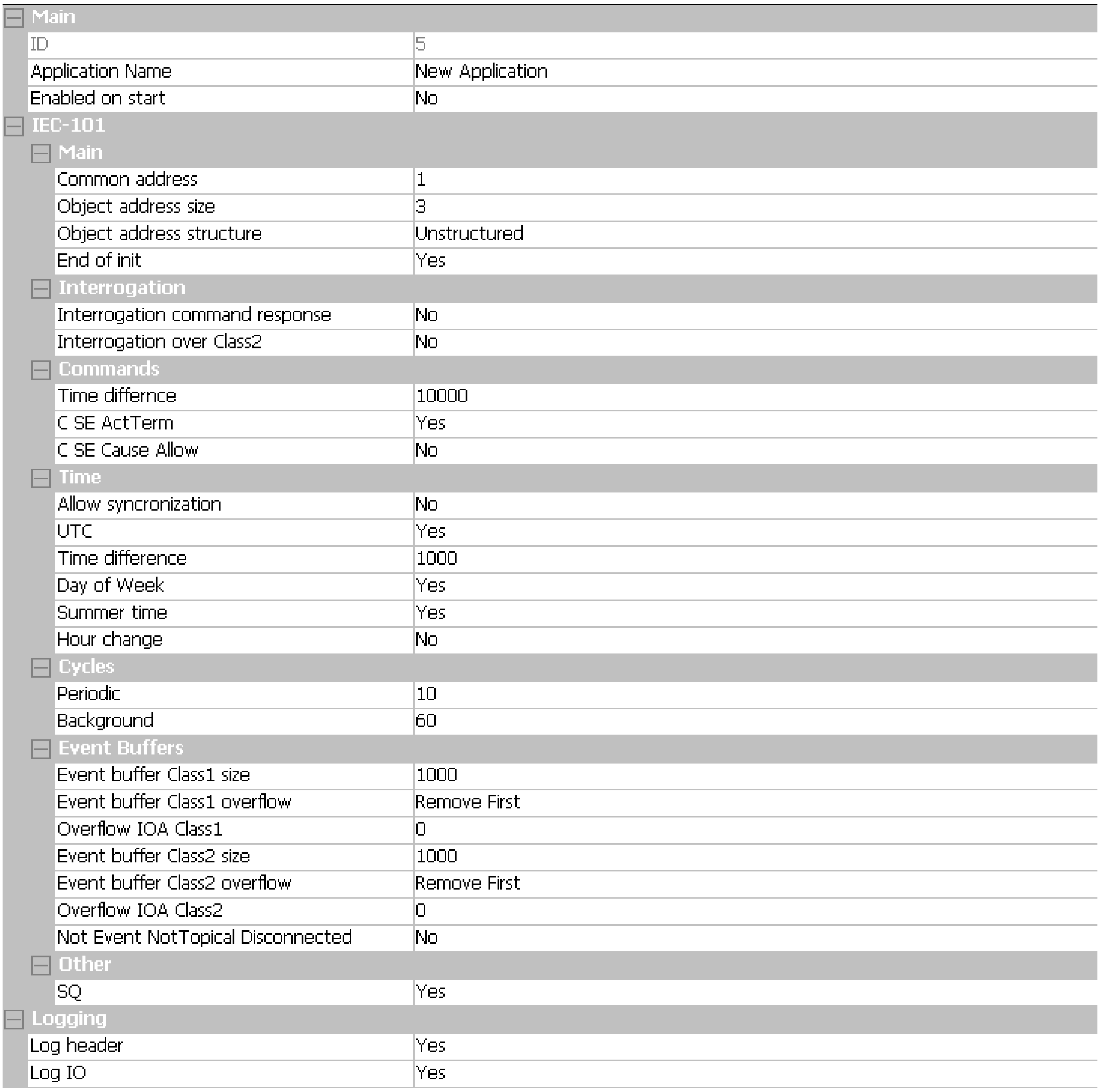


Figure 153. *Data link layer* parameters in IEC 60870-5-101 protocol

Table 123. Fields of *Data link layer* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data Link Name	Data link layer name, for example, 'Measurements data controller'	New Data Link
Enabled on start	Enables or disables data link on start. Values: Yes; No	No
Data link address	Data link address Range of values: 0 … 65534 (if the length of Data link address is set to 2), 0 … 254 (if the length of Data link address is set to 1), If the length of Data link address is set to 0, this parameter is not used.	0
COT size	Cause of transmission size Range of values: 1 … 2 bytes	1
CAA size	Common ASDU address size Range of values: 1 … 2 bytes	2
Frame size	Maximum frame size. All start, stop, checksum and other bytes are included. Range of values: 50 … 261 bytes	255
Disconnect No requests	Disconnect the data link layer, if no requests are received from the master for a specified time period. Range of values: 0 … 3600s 0 – disabled	0
Status Link	If status link is needed before reset link Values: Yes; No	No
Allow E5	Enables or disables E5 response to the controlling device. Values: Yes; No	Yes
Class1 answers to Class2	Enables or disables Class1 data response to Class2 requests. Values: Yes; No	Yes
Class2 answers to Class1	Enables or disables Class2 data response to Class1 requests. Values: Yes; No	Yes
Log header	Enables to log data link layers header Values: Yes; No	Yes

4.10.1.3 Application layer parameters



Main	
ID	5
Application Name	New Application
Enabled on start	No
IEC-101	
Main	
Common address	1
Object address size	3
Object address structure	Unstructured
End of init	Yes
Interrogation	
Interrogation command response	No
Interrogation over Class2	No
Commands	
Time differnce	10000
C SE ActTerm	Yes
C SE Cause Allow	No
Time	
Allow syncronization	No
UTC	Yes
Time difference	1000
Day of Week	Yes
Summer time	Yes
Hour change	No
Cycles	
Periodic	10
Background	60
Event Buffers	
Event buffer Class1 size	1000
Event buffer Class1 overflow	Remove First
Overflow IOA Class1	0
Event buffer Class2 size	1000
Event buffer Class2 overflow	Remove First
Overflow IOA Class2	0
Not Event NotTopical Disconnected	No
Other	
SQ	Yes
Logging	
Log header	Yes
Log IO	Yes

Figure 154. *Application layer* parameters in IEC 60870-5-101 protocol

Table 124. Fields of *Application layer* parameters window in IEC 60870-5-101 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, ‘SCADA 1’	New application
Enabled on start	Enables or disables data link on start. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Common address	Common address of data unit Range of values: 1 … 254	1
Object address size	Size of the information object address field Range of values: 1 … 3	3
Object address structure	The structure of Object address shows the format in which the information object address is entered in the configuration. Range of values: Unstructured, Structured 8.8.8, Structured 8.16, Structured 16.8, Structured 8.8	Unstructured
End of init	Enables or disables the station initialization frame transmission to the controlled station. Values: Yes; No	Yes
Interrogation command response	Specifies the command if a general interrogation command request is received but the general interrogation is already going. No – general interrogation is restarted. Values: Yes; No	No
Interrogation over Class2	Interrogation response will have higher priority than Class2 events Values: Yes; No	No
Time difference	Time difference to discard the execution of the command Range of values: 1 … 60000ms	10000
C SE ActTerm	Activation termination is used for set point commands. Values: Yes; No	Yes
C SE Cause Allow	Allows setting the local or remote command cause of transmission, in case the measurement point was changed by a command. Values: Yes; No	No
Allow synchronization	Allows the clock synchronization from the controlled station. Values: Yes; No	No
UTC	Time synchronization with the UTC timestamp Values: Yes; No	Yes
Time difference	Time difference to synchronize the internal RTU clock Range of values: 20 … 10000ms	1000
Day of Week	In responses with a timestamp, use Day of Week bit. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Summer time	In responses with a timestamp, use Summer time bit. Values: Yes; No	Yes
Hour change	Transmits the spontaneous clock synchronization command on hourly change. It is used only for the events with the CP24Time2a timestamp. Values: Yes; No	No
Periodic	Cycle time of data marked with Cyclic/Periodic COT Range of values: 10 … 10000s	10
Background	Cycle time of data marked with Background COT Range of values: 10 … 10000s	60
Event buffer Class1 size	Spontaneous Events buffer of Class 1 size. Change takes effect only after the system restart. Range of values: 10 … 10000 events	1000
Event buffer Class1 overflow	If the buffer of class 1 events overflows, with this parameter the user can select the event to remove from the queue. Range of values: Remove first, Remove all	Remove first
Overflow IOA Class1	Overflows the information object address for Class1. On the buffer, overflow IOA will be set to 1, and when there are free places in the buffer, it will be set to 0. When the value changes to 0, the controlling device should initiate general interrogation.	0 – not used
Event buffer Class2 size	Spontaneous Events buffer of Class 2 size. Change takes effect only after the system restart. Range of values: 10 … 10000 events	1000
Event buffer class2 overflow	If the buffer of class 2 events overflows, with this parameter the user can select the event to remove from the queue. Range of values: Remove first, Remove all	Remove first
Overflow IOA Class2	Overflows the information object address for Class2. On the buffer overflow IOA will be set to 1, and when there are free places in the buffer it will be set to 0. When the value changes to 0, the controlling device should initiate general interrogation.	0 – not used

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Not Event NotTopical Disconnected	If the event received from the main module has quality setting to 'Not Topical' and the cause of change is the Disconnected source, than no event will be generated to the upper system. Values: Yes; No	No
SQ	Use SQ bit. Recommended to use only if the most of information object addresses are incremented by one. Values: Yes; No	Yes
Log header	Enables to log application layer header. Values: Yes; No	Yes
Log IO	Enables to log information objects. Values: Yes; No	Yes

4.10.1.4 Points

Data points and command points are freely configurable in the monitoring direction. The user will connect all the configured data and command points to the tag which has already been connected to the data sources.

Status points | Command points

ID	Add...	IEC Type	Time Type	Inte...	On Cha...	Back...	Offs...	Scale
1	104410	Single-point information	Long Time (7 by...	General	Class1 Event			
2	104411	Single-point information	Long Time (7 by...	General	Class1 Event			
3	104412	Double-point information	Long Time (7 by...	General	Class1 Event			
4	104413	Double-point information	Long Time (7 by...	General	Class1 Event			
5	104414	Step position information	Long Time (7 by...	General	Class1 Event			
6	104415	Bitstring of 32 bits	Long Time (7 by...	General	Class1 Event			
7	104416	Measured value, normalized value	No time	General	Class1 Event			
8	104417	Measured value, normalized value	No time	General	Class1 Event			
9	104418	Measured value, scaled value	No time	General	Class1 Event			
10	104419	Measured value, scaled value	No time	General	Class1 Event			
11	104420	Measured value, short floating point ...	No time	General	Class1 Event			
12	104421	Measured value, short floating point ...	No time	General	Class1 Event			

Figure 155. *Status points* for IEC 60870-5-101 slave

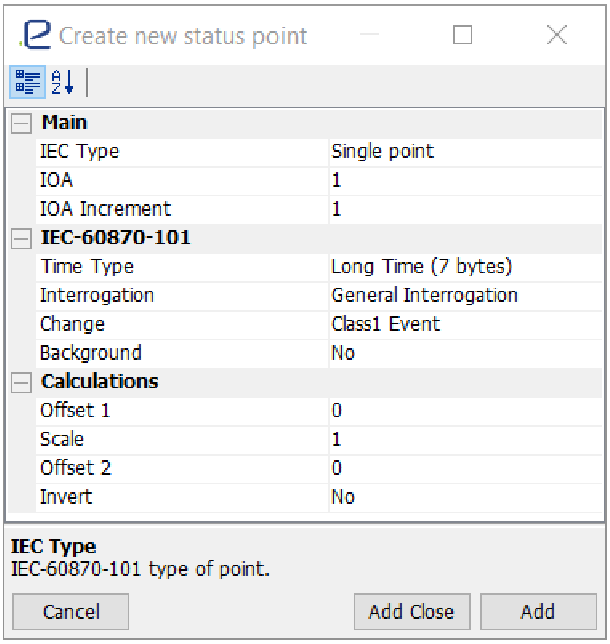
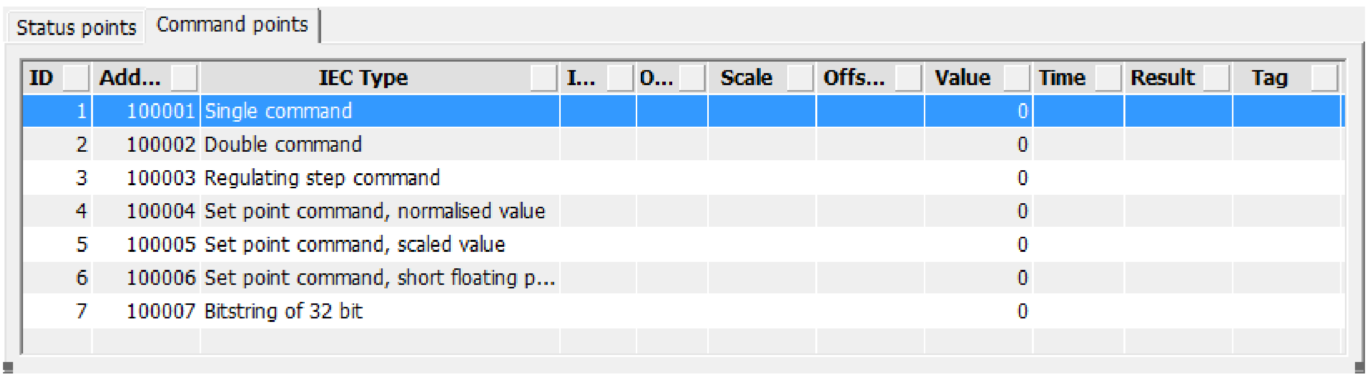


Figure 156. *Create new status point* dialog for IEC 60870-5-101 slave protocol

Table 125. Fields of *Create new status point* window in IEC 60870-5-101 slave protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of data under IEC 60870-5-101 protocol Values: Single point Double point Step position Bit string of 32 bits Measured value, normalized value Measured value, scaled value Measured value, short floating point value	Single Point
IOA	Information address Range of information address depends from the length of the Application layer parameter in the Information object address. Range of values: 0 … 16777215	1
IOA Increment	After adding a new data point, the address will be automatically incremented by the set value. It is used only for configuration.	1
Time type	Timestamp of a data point. Range of values: No time, Short time (3 bytes) Long time (7 bytes)	Long Time (7 bytes)

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Interrogation	Assign data point to the specific interrogation group. Range of values: General Interrogation, Interrogation Group 1 … 16	General Interrogation
Change	The user can specify the data point class or cause of transmission. If the user chooses Class1 Event or Class2 Event, the data point will be marked with the Spontaneous cause of transmission. Range of values: Class1 Event, Class1 Event, not buffered when there is no link, Class2 Event, Class2 Event, not buffered when there is no link, Send only on general interrogation request, Periodic	Class1 Event
Background	Data point is included in the background scan. Values: Yes; No	No
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No



ID	Add...	IEC Type	I...	O...	Scale	Offs...	Value	Time	Result	Tag
1	100001	Single command					0			
2	100002	Double command					0			
3	100003	Regulating step command					0			
4	100004	Set point command, normalised value					0			
5	100005	Set point command, scaled value					0			
6	100006	Set point command, short floating p...					0			
7	100007	Bitstring of 32 bit					0			

Figure 157. *Command points* for IEC 60870-5-101 slave protocol

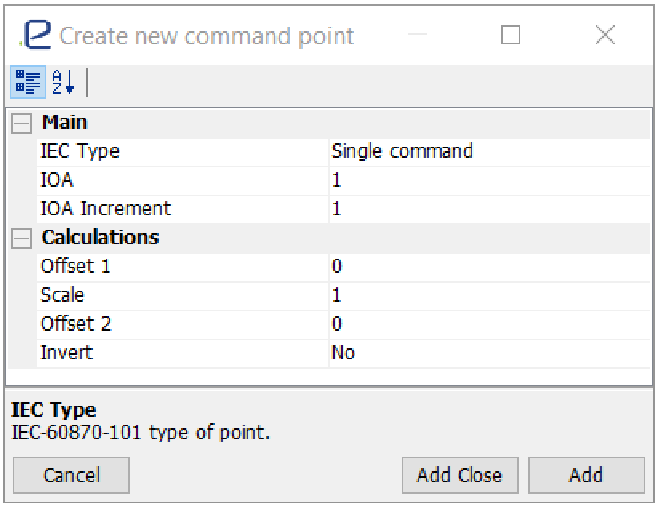


Figure 158. *Create a new command point* dialog for IEC 60870-5-101 slave protocol

Table 126. Fields of *Create new command point* window in IEC 60870-5-101 slave protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of a command under IEC 60870-5-101 protocol Values: Single command Double command Regulating step command Setpoint normalized command Setpoint scaled command Setpoint short float command Bitstring command	Single Command
IOA	Information address The range of information address depends from the length of the Application layer parameter in the Information object address. Range of values: 0 … 16777215	1
IOA Increment	After adding a new data point, the address will be automatically incremented by the set value. It is used only for configuration.	1
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of commands Values: Yes; No	No

The user can select some data points and then press *Ctrl+Shift+N* to connect all the selected data points to the tags in a row. If the tag icon is greyed out, it is not possible to connect to the slave status point or command point. It means if the user has to choose a Status point in the slave protocol; it is possible to connect only to the status tag. And if the user has to choose a Command point in the slave protocol, it is possible to connect only to the command tag.

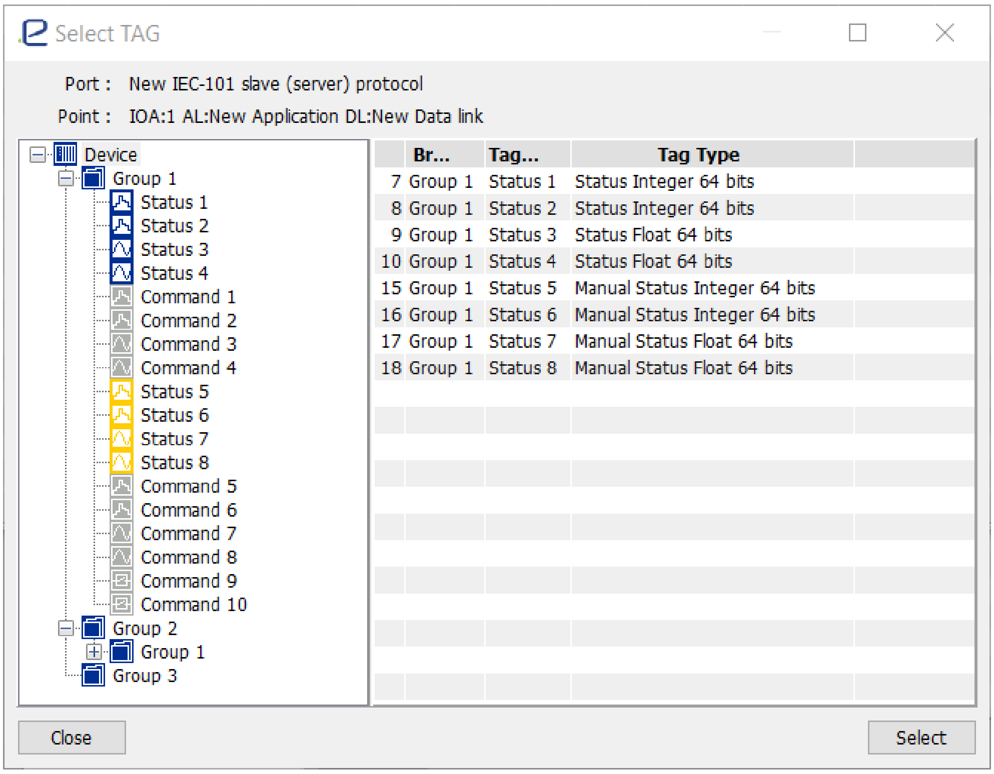


Figure 159. Status point connection to the tag dialog box

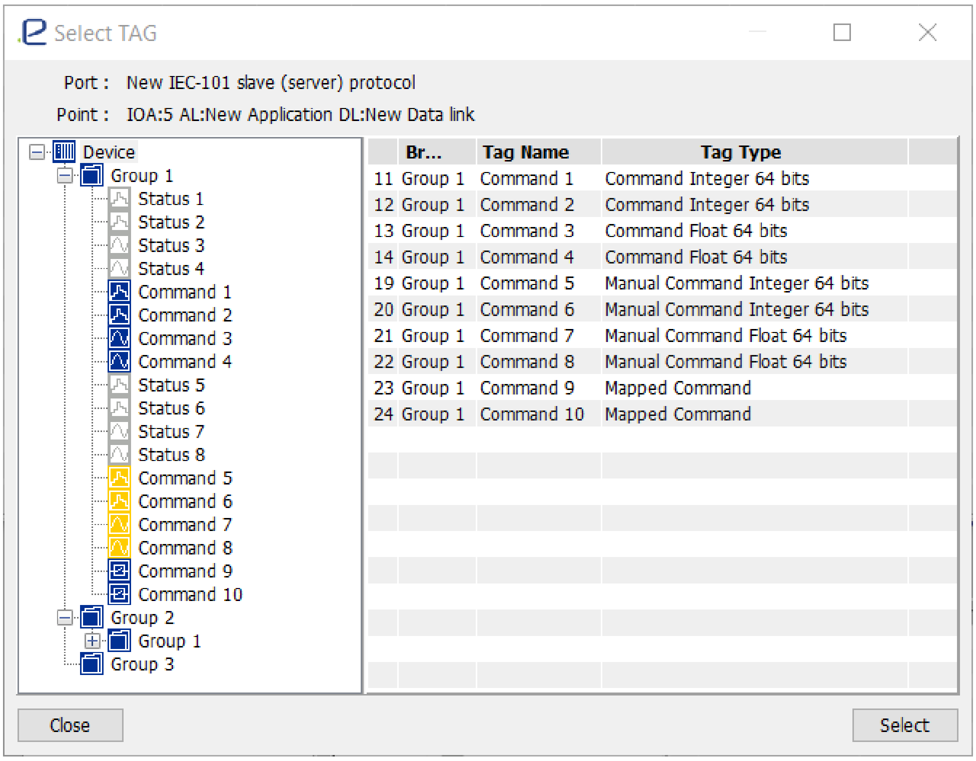


Figure 160. Command point connection to the tag dialog box

4.10.2 IEC 60870-5-104 protocol configuration

4.10.2.1 Communication port parameters

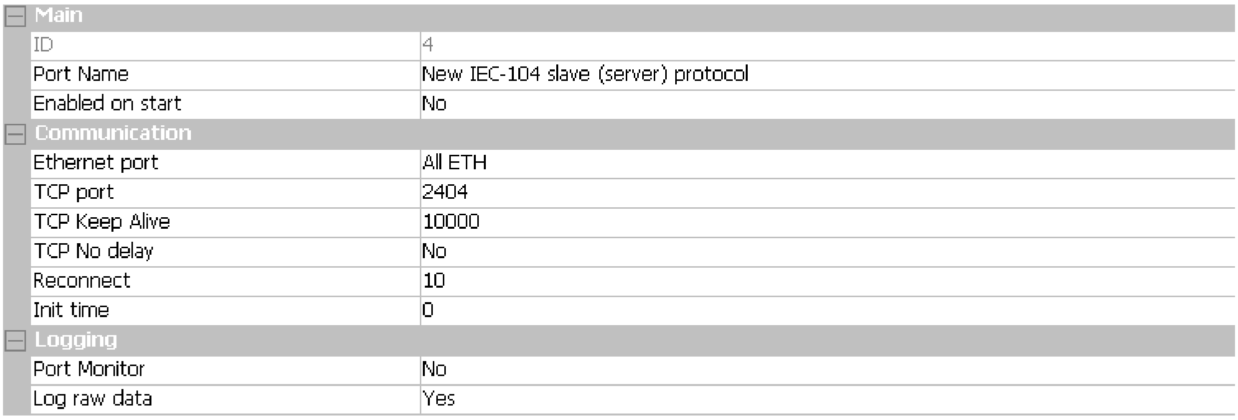


Figure 161. *Communication port* parameters in IEC 60870-5-104 slave protocol

Table 127. Fields of *Communication port* parameters window in IEC 60870-5-104 slave protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port name, for example, 'IEC-104 slave'	New IEC-104 slave protocol
Enabled on start	Enables or disables the communication port on start. Values: Yes; No	Yes
Ethernet port	Specifies the Ethernet port to be used to create the server. Values: All ETH, ETH 1, ETH 2, ETH 3, ETH4.	All ETH
TCP Port	TCP port Range of values: 1 … 65535	2404
TCP Keep Alive	Checks the connected socket and determines whether the connection is still up and running or if it has broken. Range of values: 1 … 2147483647ms 0 – disabled	10000
TCP No delay	Controls TCP packet batching Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 1 … 60	0
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.10.2.2 Data link parameters

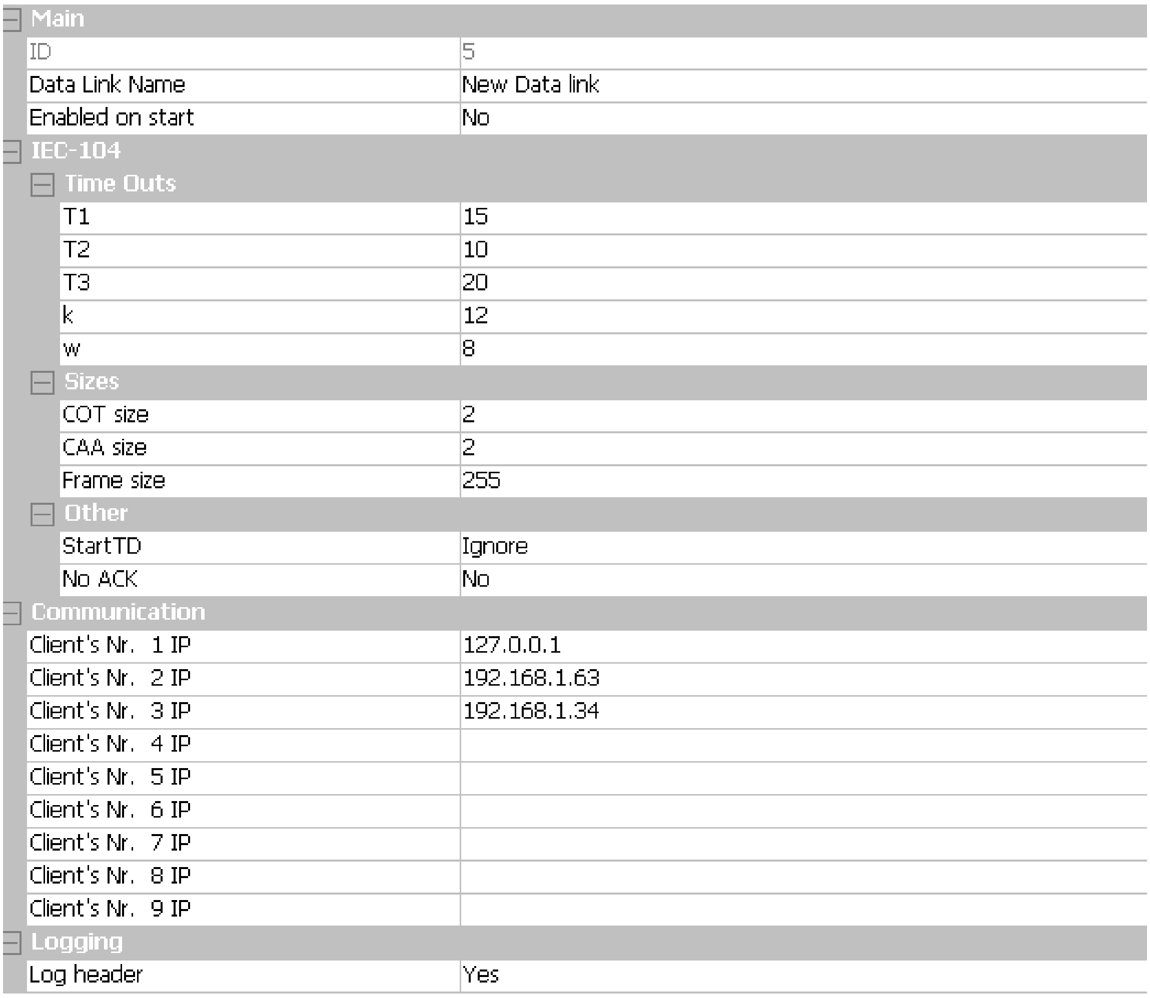


Figure 162. *Data link layer* parameters in IEC 60870-5-104 slave protocol

Table 128. Fields of *Data link layer* parameters window in IEC 60870-5-104 slave protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data Link Name	Data link layer name, for example, 'IEC-104 client'	New Data link
Enabled on start	Enables or disables a client on start. Values: Yes; No	No
T1	Acknowledgement timeout 1 Range of values: 1...255 s	15
T2	Acknowledgement timeout 2 Range of values: 1...255 s	10
T3	Connection test timeout Range of values: 1...255 s	20
k	Maximum number of unacknowledged I format ADPU's Range of values: 1...32767	12
w	Maximum number of I frame APDU's after which the acknowledgment is needed Range of values: 1...32767	8
COT size	Cause of transmission size Values: 1, 2 bytes	2
CAA size	Common size of ASDU address Values: 1, 2 bytes	2
Frame size	Maximum frame size. All start, stop, checksum and other bytes are included. Range of values: 50 … 261 bytes	255
StartTD	Action taken when the second StartTD has been received from another client Values: Ignore, Connect new client	Ignore
No ACK	Keep all sent but not acknowledged I frames after disconnection. All unacknowledged frames will be transmitted to a new connected client. Values: Yes; No	No
Clients Nr. 1 … 9 IP	Access list of clients IPs Range of values: xxx.xxx.xxx.xxx	127.0.0.1
Log header	Enables to log ACPI header values. Values: Yes; No	Yes

4.10.2.3 Application layer parameters

Figure 163. *Application layer* parameters in IEC 60870-5-104 slave protocol

Table 129. Fields of *Application layer* parameters window in IEC 60870-5-104 slave protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, 'SCADA 1'	New Application
Enabled on start	Enables or disables the data link on start. Values: Yes; No	No
Common address	Common address of a data unit Range of values: 1 … 254	1
Object address size	Size of information object address field Range of values: 1 … 3	3

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Object address structure	The structure of the object address shows the format in which the information object address is entered in the configuration. Range of values: Unstructured, Structured 8.8.8, Structured 8.16, Structured 16.8, Structured 8.8	Unstructured
End of init	Enables or disables station initialization frame transmission to the controlled station. Values: Yes; No	Yes
Interrogation command response	Specifies the command if general interrogation command request has been received but the general interrogation is already going. No – general interrogation is restarted. Values: Yes; No	No
Time difference	Time difference to discard the execution of a command Range of values: 1 … 60000 ms	10000
C SE ActTerm	Activation termination is used for the set point commands. Values: Yes; No	Yes
C SE Cause Allow	Allows setting the local or remote command cause of transmission, in case the measurement point was changed by the command. Values: Yes; No	No
Allow synchronization	Allows the clock synchronization from the controlled station. Values: Yes; No	No
UTC	Time synchronization with the UTC timestamp. Values: Yes; No	Yes
Time difference	Time difference to synchronize the internal RTU clock Range of values: 20 … 10000ms	1000
Day of Week	In responses with a timestamp, use Day of Week bit. Values: Yes; No	Yes
Summer time	In responses with a timestamp, use Summer time bit. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Hour change	Transmit spontaneous clock synchronization command on hourly change. It is used only for the events with the CP24Time2a timestamp. Values: Yes; No	No
Periodic	Cycle time of the data marked with Cyclic/Periodic COT Range of values: 10 … 10000s	10
Background	Cycle time of the data marked with Background COT Range of values: 10 … 10000s	60
Event buffer size	Spontaneous Events buffer size. The change takes effect only after the system restart. Range of values: 10 … 10000 events	1000
Event buffer overflow	If the buffer of events overflows, with this parameter the user can select the event to remove from the queue. Range of values: Remove first, Remove all	Remove first
Overflow IOA	Overflow information object address. On buffer overflow, IOA will be set to 1 and when there are free places in the buffer it will be set to 0. When the value changes to 0, the controlling device will initiate general interrogation.	0 – not used
Not Event NotTopical Disconnected	If the event received from the main module has quality setting to 'Not Topical' and the cause of change is the Disconnected source, than no event will be generated to the upper system. Values: Yes; No	No
SQ	Use SQ bit. It is recommended to use it only if the most of the information object addresses are incremented by one. Values: Yes; No	Yes
Log header	Enables to log application layer header. Values: Yes; No	Yes
Log IO	Enables to log information objects. Values: Yes; No	Yes

4.10.2.4 Points

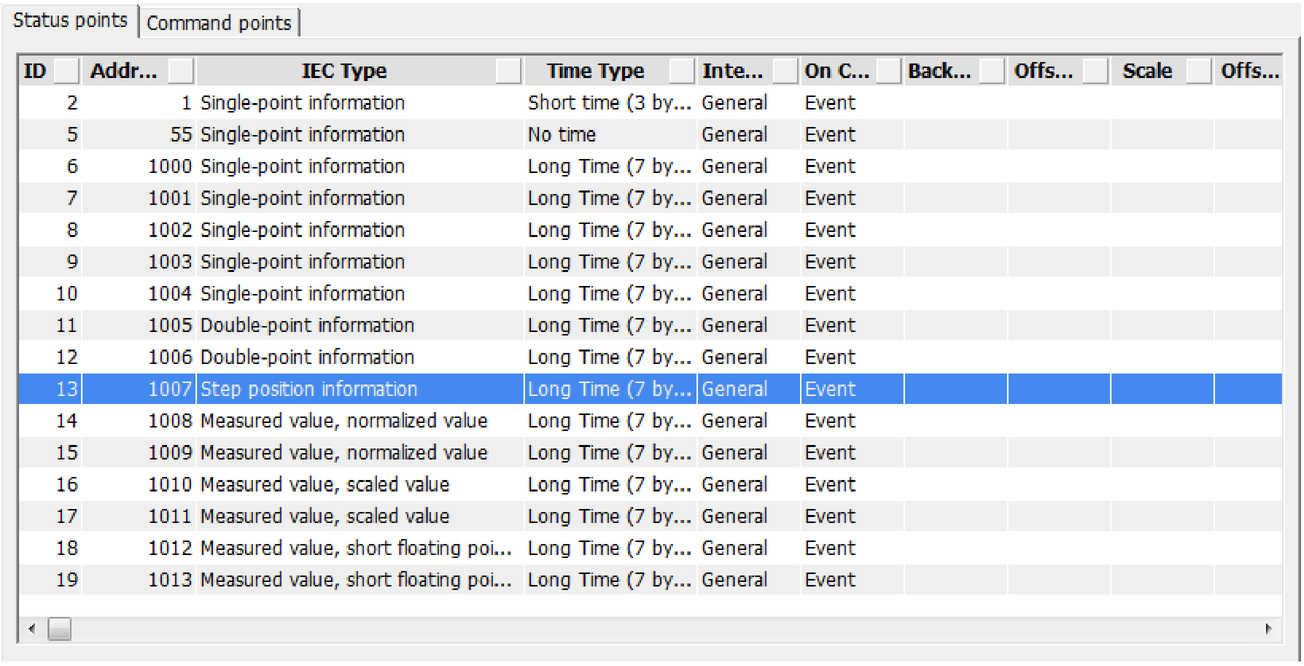


Figure 164. Status points window in IEC-60870-5-104

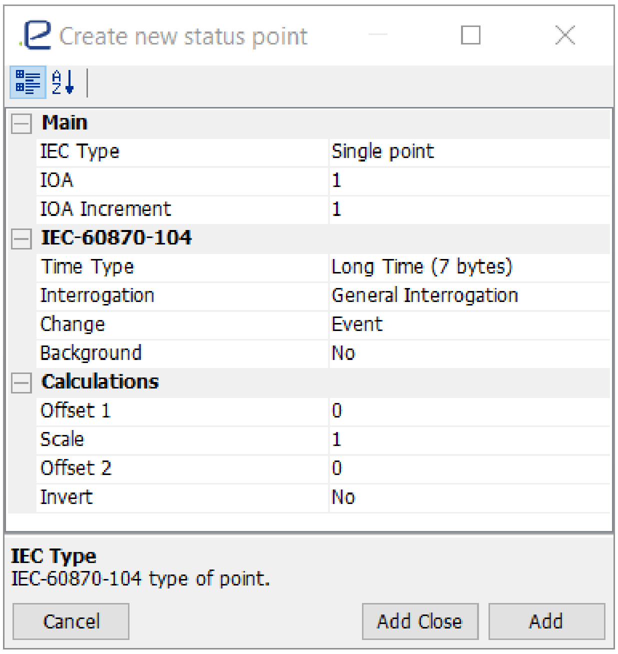


Figure 165. *Create new status point* dialog for IEC 60870-5-104 slave protocol

Table 130. Fields of *Create new status point* window in IEC 60870-5-104 slave protocol

<table>
<tr><th>FIELD NAME</th><th>DESCRIPTION</th><th>DEFAULT VALUE</th></tr>
<tr><td>IEC Type</td><td>Type of data under IEC 60870-5-104 protocol
Values:
Single point
Double point
Step position
Bit string of 32 bits
Measured value, normalized value
Measured value, scaled value
Measured value, short floating point value</td><td>Single Point</td></tr>
<tr><td>IOA</td><td>Information address
Range of the information address depends from the length of the Application layer parameter in the Information object address.
Range of values: 0 … 16777215</td><td>1</td></tr>
<tr><td>IOA Increment</td><td>After adding a new data point, the address will be automatically incremented by the set value. It is used only for configuration.</td><td>1</td></tr>
<tr><td>Time type</td><td>Timestamp of a data point
Range of values:
No time,
Short time (3 bytes)
Long time (7 bytes)</td><td>Long time (7 bytes)</td></tr>
<tr><td>Interrogation</td><td>Assigns a data point to the specific interrogation group.
Range of values:
General Interrogation,
Interrogation Group 1 … 6.</td><td>General Interrogation</td></tr>
<tr><td>On change</td><td>Specifies the data point cause of transmission.
Range of values:
Event,
Event, not buffered when no link,
Send only on general interrogation request,
Periodic</td><td>Event</td></tr>
<tr><td>Offset 1</td><td rowspan="3">New value = (Old value + Offset1) * Scale + Offset2</td><td>0</td></tr>
<tr><td>Scale</td><td>1</td></tr>
<tr><td>Offset 2</td><td>0</td></tr>
<tr><td>Invert</td><td>Inversion of status
Values: Yes; No</td><td>No</td></tr>
</table>

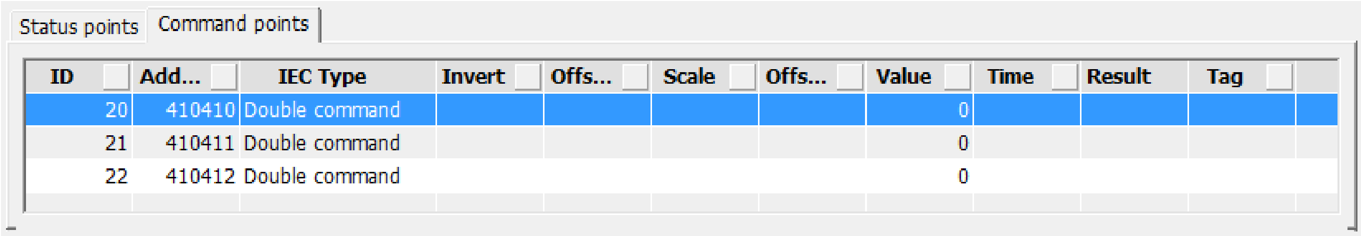


Figure 166. *Command points* for IEC 60870-5-104 slave

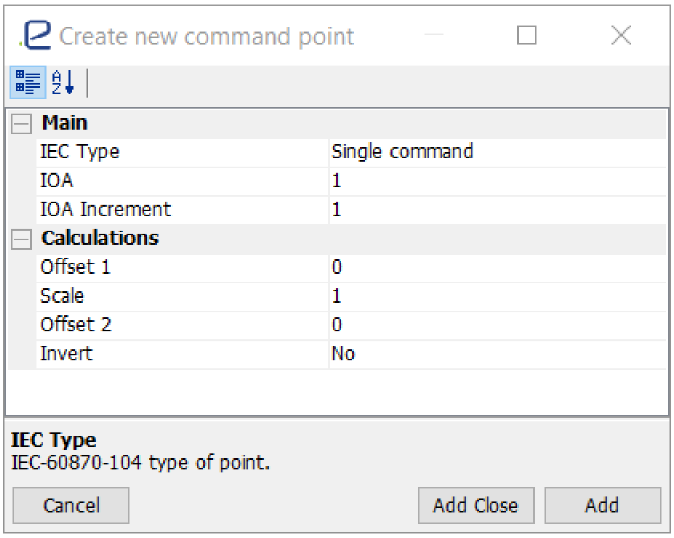


Figure 167. *Create new command point* dialog for IEC 60870-5-104 slave protocol

Table 131. Fields of *Create new command point* window in IEC 60870-5-104 slave protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IEC Type	Type of command under IEC 60870-5-104 protocol Values: Single command, Double command, Regulating step command, Setpoint normalized command, Setpoint scaled command, Setpoint short float command, Bitstring command	Single Command
IOA	Information address Range of the information address depends from the length of the Application layer parameter in the Information object address. Range of values: 0 … 16777215	1
IOA Increment	After adding a new data point, the address will be automatically incremented by the set value. It is used only for configuration.	1

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of a command Values: Yes; No	No

4.10.3 DNP3 serial slave configuration

4.10.3.1 Communication port parameters

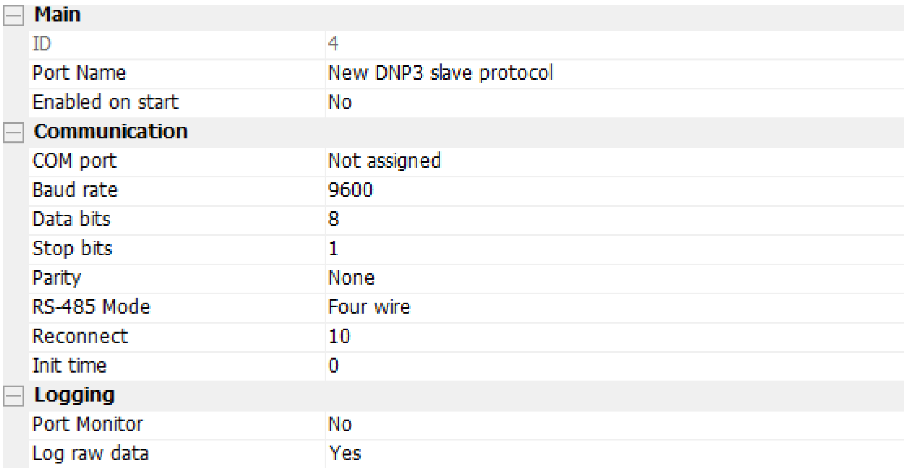


Figure 168. *Communication port* parameters in DNP3 serial protocol

Table 132. Fields of *Communication port* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Name of the port and protocol, for example, 'COM3 DNP3 slave'	New DNP3 slave protocol
Enabled on start	Port enabled on the system startup Values: Yes; No	No
COM port	Communication port number Range of values: Not assigned, COM 1 … 255	Not assigned

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7, 8	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 Mode	If two wires are used, the mirrored data checks should be used. If the serial port is RS-232, the parameter is not important. Values: Four wire, Two wire	Four wire
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 1 … 600 0 – Not used	0
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes
Log Unknown Data Link	Always set this parameter to 'No' in the multiple slave systems.	Yes

4.10.3.2 Data link layer parameters

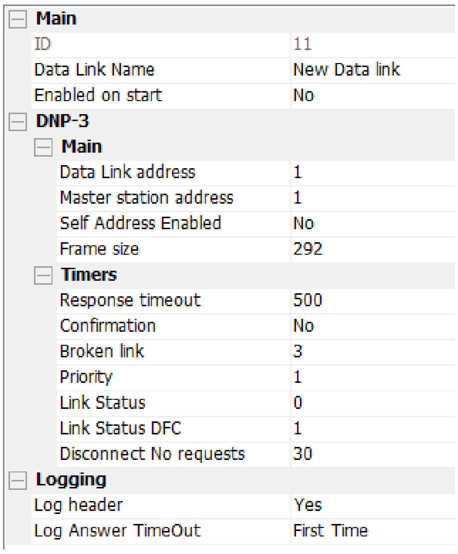


Figure 169. *Data link layer* parameters in DNP3 serial protocol

Table 133. Fields of *Data link layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data Link Name	Data link layer name, for example, 'DNP3 client'	New Data link
Enabled on start	Enables or disables a client on start. Values: Yes; No	No
Data Link address	RTU's slave address Range of values: 0 … 65519	1
Master station address	Master station address Range of values: 0 … 65519	1
Self Address Enabled	Set this parameter to 'Yes' only for testing purpose when the master does not know the outstation address. Values: Yes; No	No
Fragment Size	Maximum size of a data link fragment Range of values: 14 … 292 bytes	292
Response timeout	Response timeout Range of values: 50 … 60000 ms	500
Confirmation	Data link uses confirmations. Values: Yes; No	No
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 255	3

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Priority	Data is requested every cycle. It is relevant only if more than one data link layer exists. Range of values: 1 … 255	1
Link Status	Time interval of request attempt for the link status, if there is no data. Range of values: 0 … 86400s 0 – Link Status is not used.	0
Link Status DFC	Time interval of checking attempt for DFC=0, if the value of DFC has been 1. Range of values: 1 … 86400s	1
Disconnect No requests	Disconnects the data link layer, if no requests are received from the master for the specified time. Range of values: 0 … 3600s 0 – Not used.	30
Log header	Enables to log data link header. Values: Yes; No	Yes
Log Answer Time Out	Enables to log data link answer timeouts to the system log. Values: Never, First Time, Always	First Time

4.10.3.3 Transport layer parameters

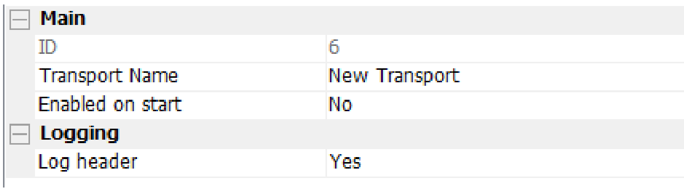


Figure 170. *Transport layer* parameters in in DNP3 serial protocol

Table 134. Fields of *Transport layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Transport Name	Transport layer name, for example, ‘Transport Layer’	‘New Transport’
Enabled on start	Enables or disables a client on start. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Log header	Enables to log Transport layer header. Values: Yes; No	Yes

4.10.3.4 Application layer parameters

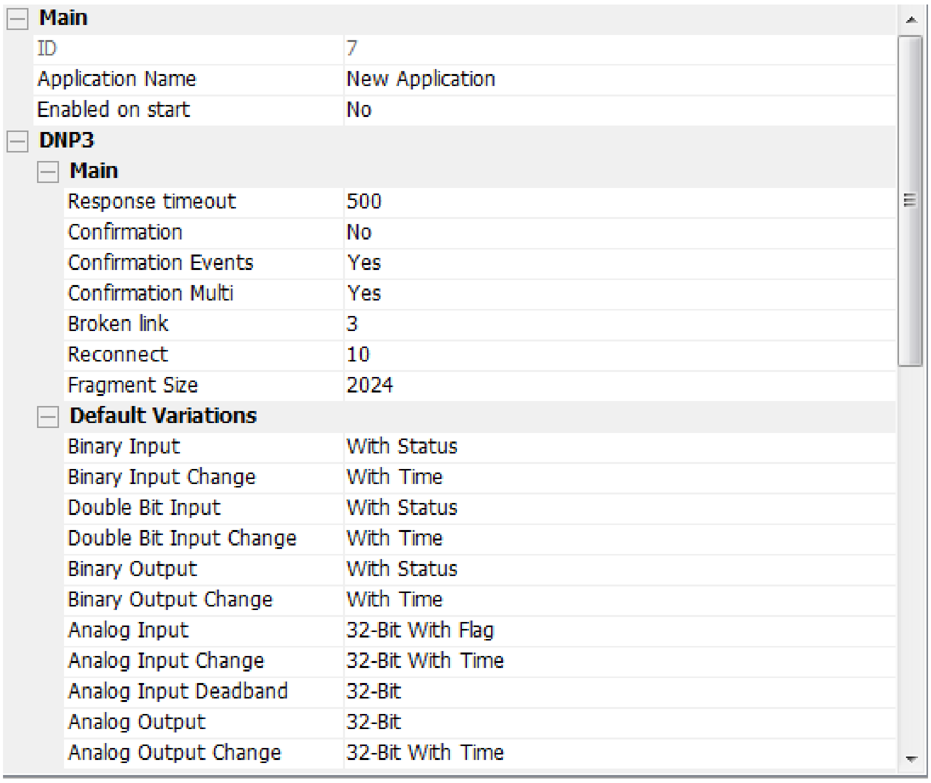


Figure 171. *Application layer* parameters in DNP3 serial protocol

Table 135. Fields of *Application layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	Read only
Application Name	Application layer name, for example, 'Application layer'	New Application
Enabled on start	Port enabled on the system startup. Values: Yes; No	No
Response timeout	Response timeout Range of value: 50 … 60000ms	500
Confirmation	Application layer requests confirmations Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Confirmation Events	Application layer requests confirmations for the responses which contain event data. Values: Yes; No	Yes
Confirmation Multi	Application layer requests confirmations for multi fragment responses (The last fragment does not count). Values: Yes; No	Yes
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 255	3
Reconnect	Time interval of reconnection attempt while communication is not established. Unsolicited NULL response will be sent at the specified time period. Range of values: 0 … 3600 s 0 – Unsolicited NULL is disabled.	10
Fragment Size	Maximum allowed size of the application layer fragment Range of values: 249 … 65535 bytes	2024
Binary Input	Default variation for a binary input Values: Single-Bit, With Status	With Status
Binary Input Change	Default variation for a binary input change Values: Without Time, With Time, Relative Time	With Time
Double Bit Input	Default variation for a double bit input Values: No Flags, With Status	With Status
Double Bit Input Change	Default variation for a double bit input change Values: Without Time, With Time, Relative Time	With Time
Binary Output	Default variation for a binary output Values: Single-Bit, With Status	With Status

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Binary Output Change	Default variation for a binary output change Values: Without Time, With Time	With Time
Analogue Input	Default variation for an analogue input Values: 32-Bit With Flag, 16-Bit With Flag, 32-Bit Without Flag, 16-Bit Without Flag, 32-Bit Float With Flag, 64-Bit Float With Flag	32-Bit With Flag
Analogue Input Change	Default variation for an analogue input change Values: 32-Bit With Time, 16-Bit With Time, 32-Bit Without Time, 16-Bit Without Time, 32-Bit Float With Time, 64-Bit Float With Time	32-Bit With Time
Analogue Input Deadband	Default variation for an analogue input deadband Values: 16-Bit, 32-Bit, 32-Bit Float	32-Bit
Analogue Output	Default variation for an analogue output Values: 16-Bit, 32-Bit, 32-Bit Float, 64-Bit Float	32-Bit
Analogue Output Change	Default variation for an analogue output change. Values: 32-Bit With Time, 16-Bit With Time, 32-Bit Without Time, 16-Bit Without Time, 32-Bit Float With Time, 64-Bit Float With Time, 32-Bit Float Without Time, 64-Bit Float Without Time	32-Bit With Time

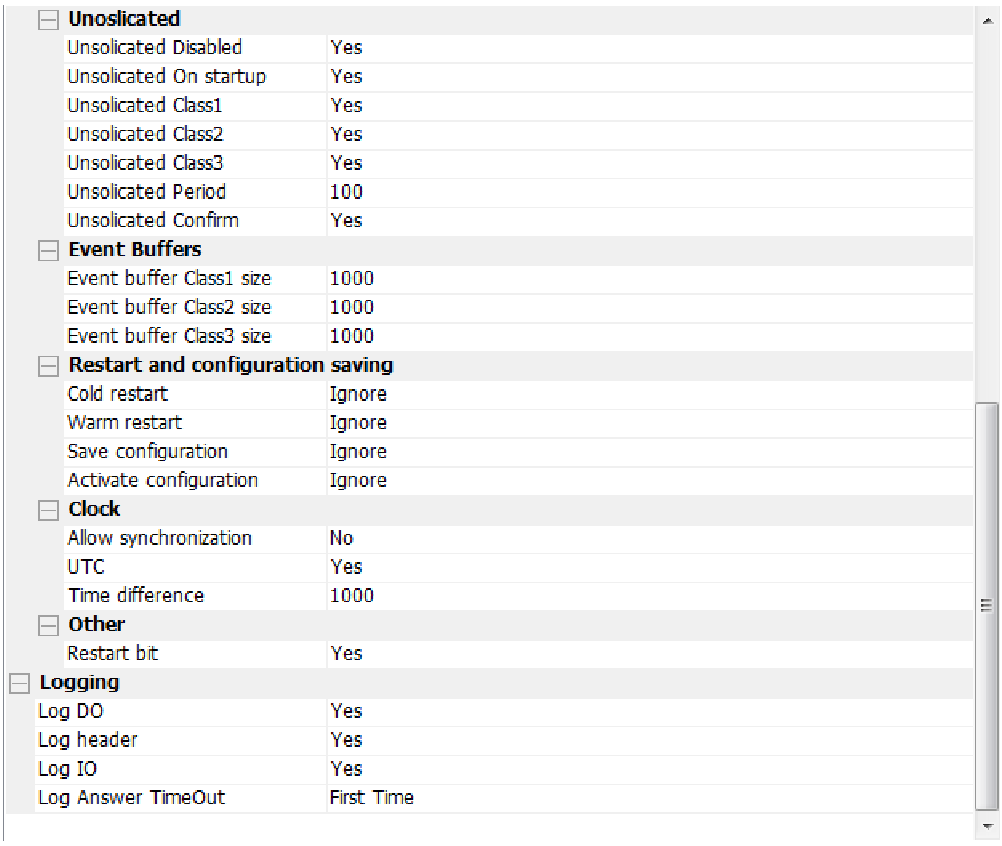


Figure 172. *Application layer* parameters in DNP3 serial protocol

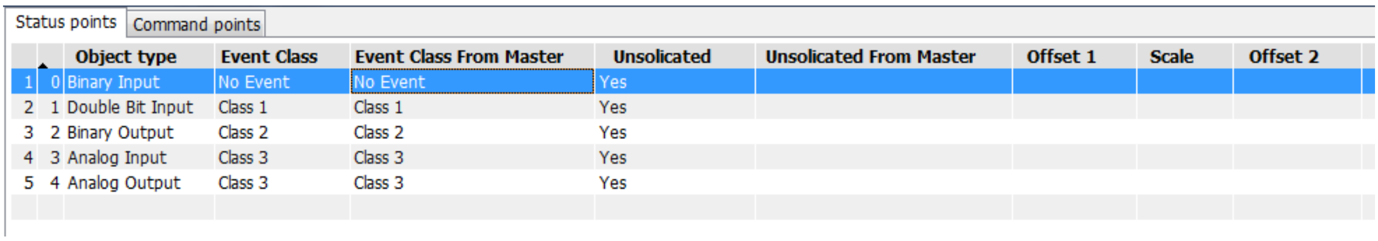
Table 136. Fields of *Application layer* parameters window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Unsolicited Disable	Unsolicited messages are totally disabled. Values: Yes; No	Yes
Unsolicited On startup	Send unsolicited 'NULL' response on startup, restart or enabling. Values: Yes; No	Yes
Unsolicited Class1	Unsolicited messages enabled for Class1 after startup or restart. Values: Yes; No	Yes
Unsolicited Class2	Unsolicited messages enabled for Class2 after startup or restart. Values: Yes; No	Yes
Unsolicited Class3	Unsolicited messages enabled for Class3 after startup or restart. Values: Yes; No	Yes
Unsolicited Period	Cycle of the transmission of unsolicited messages Range of values: 0 … 60000ms	100

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Unsolicited Confirm	Requests confirmation for unsolicited messages. Values: Yes; No	Yes
Event buffer Class1 size	Event buffer size of Class1. The change takes effect only after the system restart. Range of value: 10 … 10000	1000
Event buffer Class2 size	Event buffer size of Class2. The change takes effect only after the system restart. Range of value: 10 … 10000	1000
Event buffer Class3 size	Event buffer size of Class3. Change takes effect only after the system restart. Range of value: 10 … 10000	1000
Cold restart	Action performed on the received request FC13 cold restart. Values: Ignore, Discard, Software restart, Full Device restart	Ignore
Warm restart	Action performed on the received request FC14 warm restart. Values: Ignore, Discard, Restart	Ignore
Save configuration	Action performed on the received request FC19 save configuration. Values: Ignore, Discard, Save configuration	Ignore
Activate configuration	Action performed on the received request FC31 activate configuration. Values: Ignore, Discard, Save configuration	Ignore
Allow synchronization	Allows time synchronization from the DNP3 master. Values: Yes; No	No
UTC	Received clock synchronization APDU has UTC time. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Time difference	Time difference to allow synchronization. Range of values: 20 … 10000ms	1000
Restart bit	Sets the restart bit after the RTU restart or on enabling the DNP3 application layer. Values: Yes; No	Yes
Double bit over two single	If the master station does not support double bit inputs, use binary input (double) point type. This parameter specifies which bit should be first transferred. If the value is 'No' – the first is OFF, if 'Yes' – the first is ON.	No
Log DO	Enables to log data object information. Value: Yes; No	Yes
Log header	Enables to log headers in the port monitor. Values: Yes; No	Yes
Log IO	Enables to log data and command point information. Values: Yes; No	Yes
Log Answer Time Out	Enables to log application link answer timeouts to the system log. Values: Never, First Time, Always	First Time

4.10.3.5 Points


Status points | Command points

		Object type	Event Class	Event Class From Master	Unsolicated	Unsolicated From Master	Offset 1	Scale	Offset 2
1	0	Binary Input	No Event	No Event	Yes				
2	1	Double Bit Input	Class 1	Class 1	Yes				
3	2	Binary Output	Class 2	Class 2	Yes				
4	3	Analog Input	Class 3	Class 3	Yes				
5	4	Analog Output	Class 3	Class 3	Yes				

Figure 173. Object points for DNP-3 slave

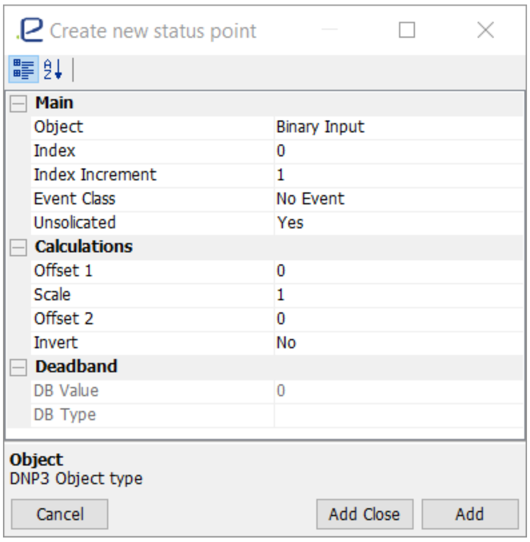


Figure 174. *Create new status point* window

Table 137. Fields of *Create new status point* window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Object	Type of object under DNP3 protocol Values: Binary Input, Binary Input (Double), Double Bit Input, Binary Output, Analogue Input, Analogue Output	Binary Input
Index	Object index Range of values: 0 … 2147483647	1
Index Increment	After adding a new point, the Index will be automatically incremented by the set value.	1
Event Class	Specifies which event class the data object belongs to. Values: No event, Class 1, Class 2, Class 3	No Event
Unsolicited	Unsolicited messages enabled for this point. If a/the class is disabled, this parameter is not important. Values: Yes; No	Yes
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Invert	Inversion of status Values: Yes; No	No
DB Value	Deadband value used for calculation Range of values: 0 … 2147483647	0
DB Type	Deadband type used for calculation. Value: Not used, Simple, Integrated	

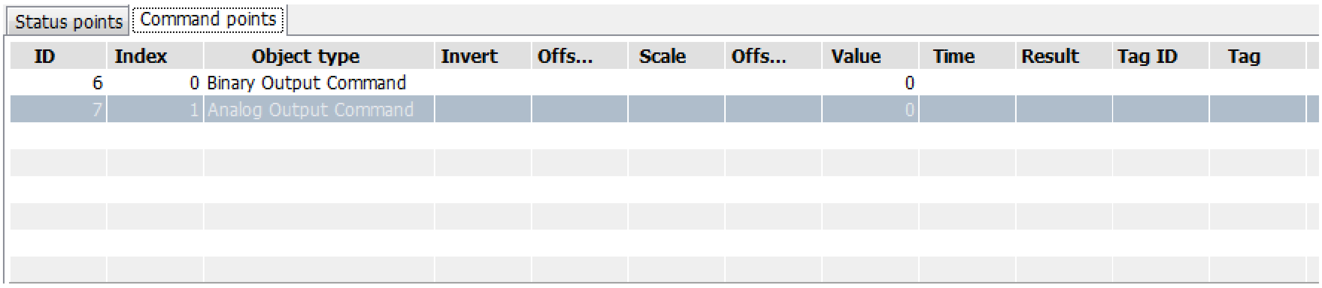


Figure 175. *Command points* for DNP-3 slave

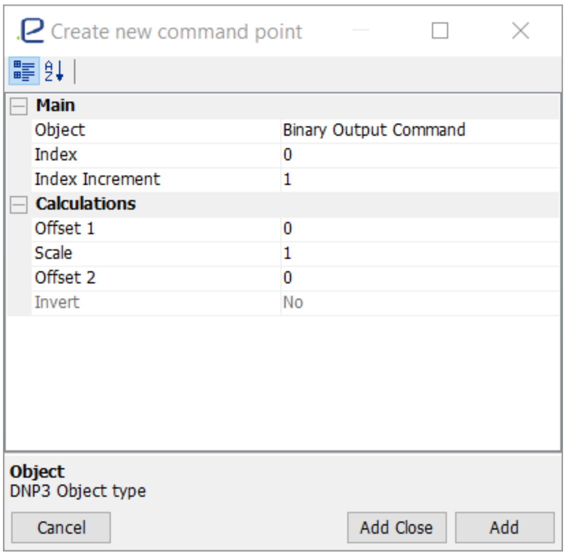


Figure 176. *Create new command point* window

Table 138. Fields of *Create new command point* window in DNP3 serial protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Object	DNP3 object type Values: Binary Output Command, Analogue Output Command	Binary Output Command

Index	Object index Range of values: 0 … 2147483647	1
Index Increment	After adding a new point, the Index will be automatically incremented by the set value.	1
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No

4.10.4 DNP3 UDP/TCP/IP server configuration

4.10.4.1 Communication port parameters

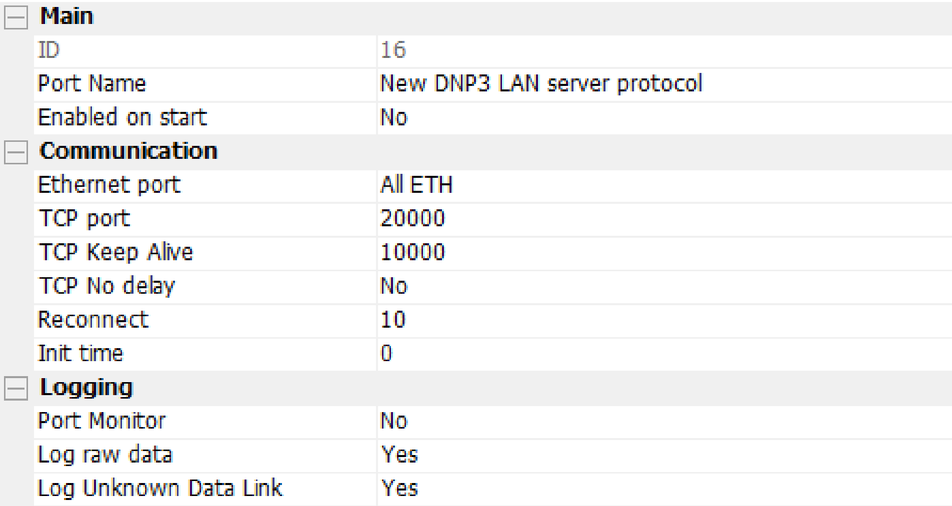


Figure 177. *Communication port* parameters in DNP3 UDP/TCP/IP protocol

Table 139. Fields of *Communication port* parameters window in DNP3 UDP/TCP/IP protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Name of the port and protocol, for example, 'DNP3 slave'	New DNP3 LAN server protocol
Enabled on start	Port enabled on the system startup Values: Yes; No	No
Ethernet port	Specifies the Ethernet port to be used to create the server. Values: All ETH, ETH 1, ETH 2, ETH 3, ETH4	All ETH
TCP Port	TCP port Range of values: 1 … 65535	20000
TCP Keep Alive	Checks the connected socket and determines whether the connection is still up and running or if it has broken. Range of values: 1 … 2147483647ms 0 – disabled	10000
TCP No delay	Controls TCP packet batching Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 1 … 60	0
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes
Log Unknown Data Link	Always set this parameter to ‘No’ in multiple slave systems.	Yes

4.10.4.2 Data link layer parameters

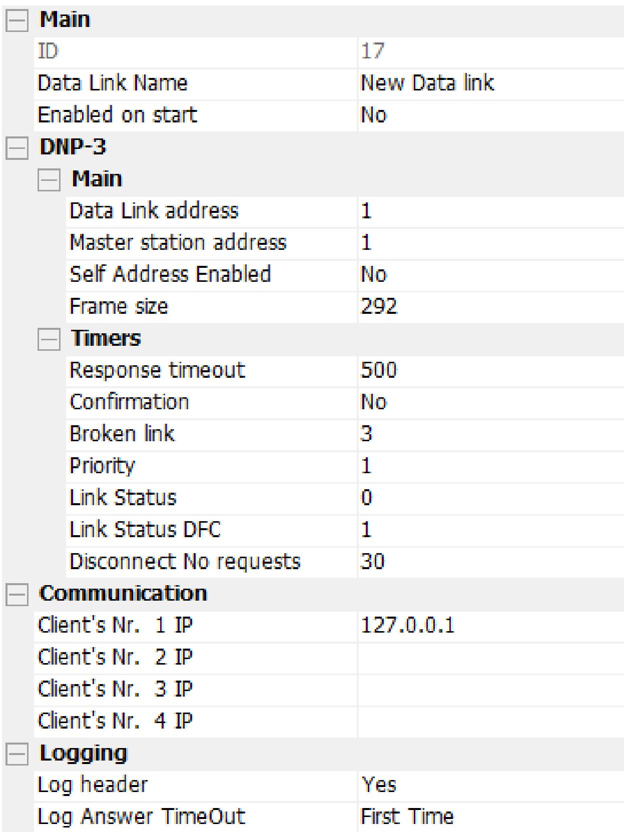


Figure 178. *Data link layer* parameters in DNP3 UDP/TCP/IP protocol

Table 140. Fields of *Data link layer* parameters window in DNP3 UDP/TCP/IP protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Data Link Name	Data link layer name, for example, 'DNP3 client'	New Data link
Enabled on start	Enables or disables a client on start Values: Yes; No	No
Data Link address	RTU's slave address Range of values: 0 … 65519	1
Master station address	Master station address Range of values: 0 … 65519	1
Self Address Enabled	Set this parameter to 'Yes' only for testing purpose when the master does not know the outstation address. Values: Yes; No	No
Fragment Size	Maximum size of a data link fragment Range of values: 14 … 292 bytes	292
Response timeout	Response timeout Range of values: 50 … 60000ms	500
Confirmation	Data link uses confirmations Values: Yes; No	No
Broken link	Number of retries to determine if the connection is broken. Range of values: 1 … 255	3
Priority	Data is requested every cycle. It is relevant only if more than one data link layer exists. Range of values: 1 … 255	1
Link Status	Time interval of request attempt for the link status, if there is no data. Range of values: 0 … 86400s 0 – Link Status is not used	0
Link Status DFC	Time interval of checking attempt for DFC=0, if the value of DFC has been 1. Range of values: 1 … 86400s	1
Disconnect No requests	Disconnect from the data link layer, if no requests are received from the master for the specified time. Range of values: 0 … 3600s 0 – Not used	30

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Client’s Nr. 1 IP ..4 IP	Access the list of clients’ IPs Range of values: xxx.xxx.xxx.xxx	127.0.0.1
Log header	Enables to log data link header. Values: Yes; No	Yes
Log Answer Time Out	Enables to log data link answer timeouts to the system log. Values: Never, First Time, Always	First Time

4.10.4.3 Transport layer parameters

Refer to chapter 4.10.3.3 ‘Transport layer parameters’ in DNP3 serial protocol. The configuration is very similar.

4.10.4.4 Application layer parameters

Refer to chapter 4.10.3.4 ‘Application layer parameters’ in DNP3 serial protocol. The configuration is very similar.

4.10.4.5 Points

Refer to chapter 4.10.3.5 ‘Points’ in DNP3 serial protocol. The configuration is very similar.

4.10.5 SPA-Bus configuration

4.10.5.1 Communication port parameters

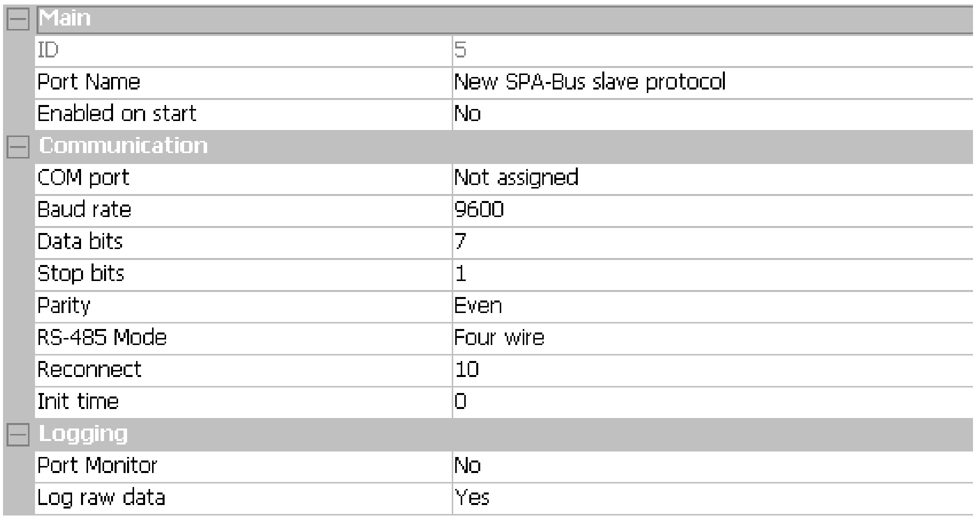


Figure 179. *Communication port parameters* in SPA-Bus protocol

Table 141. Fields of *Communication port parameters* window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Name of the port and protocol, for example, 'COM1 SPA-Bus slave'	New SPA-Bus slave protocol
Port enabled	Port enabled on the system startup Values: Yes; No	No
COM port	Communication port number Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7, 8 bits	7
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	Even

FIELD NAME	DESCRIPTION	DEFAULT VALUE
RS-485 mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Values: Two wires, Four wires	Four wires
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established. Range of values: 1 … 600s	10
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 1 … 60	0
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.10.5.2 Application layer parameters

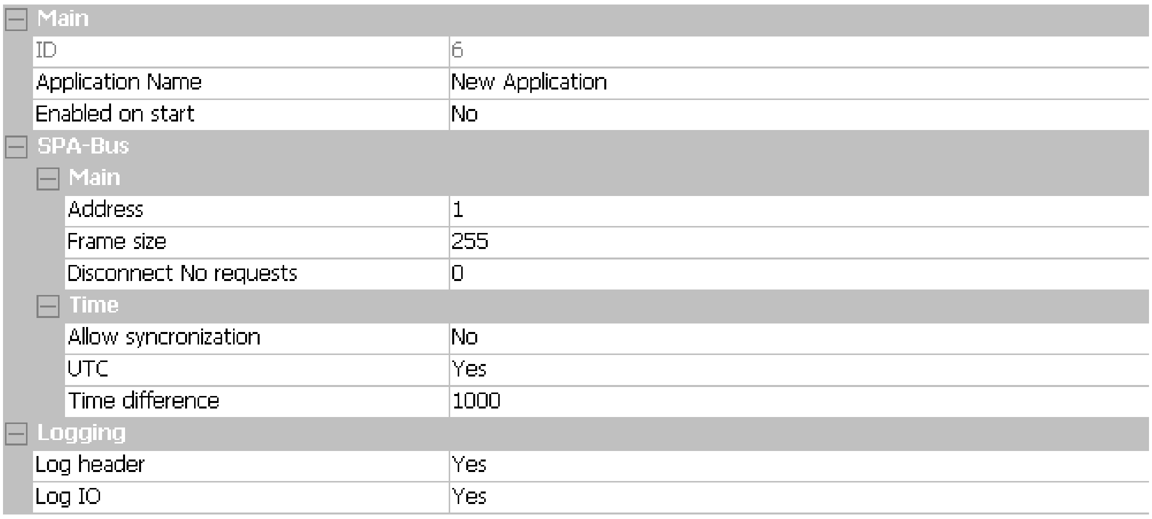


Figure 180. *Application layer parameters* in SPA-Bus protocol

Table 142. Fields of *Application layer parameters* window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, 'Application layer'	New Application
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No
Address	Slave address Range of values: 1 … 999 900 – is broadcast	1
Frame size	Maximum frame length Range of values: 48 … 255 bytes	255
Disconnect No requests	Disconnects the data link layer, if no requests are received from the master for the specified time. Range of values: 0 … 3600s 0 – not used	0
Allow synchronization	Yes – always synchronize, No – synchronize only if the RTU internal clock is synchronized.	Yes
UTC time	Use UTC time in communication Values: Yes; No	Yes
Time difference	Time difference to synchronize the internal RTU clock Range of values: 20 … 10000ms	1000
Log header	Enables to log application layer header. Values: Yes; No	Yes
Log IO	Enables to log information objects. Values: Yes; No	Yes

4.10.5.3 Points

Application layer has the branch of *Points* where the signals, measurements and commands are managed. The following figure shows the Points popup menu which can be run with the right mouse button. It is possible to *Add data point, Edit data point, Delete data point, Select All* data points or commands. The user can *Connect to Tag*, *Remove connection to the Tag*, *Go to Tag* in the *TAG Manager* as well. *Remove connection to source* is possible from the *TAG Manager*. All menu items have keyboard shortcuts which will simplify and quicken the work with the software.

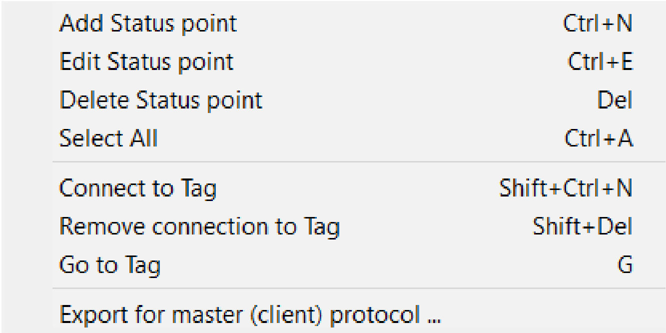


Figure 181. *Points* popup menu

The following figure shows *Create new status point* dialog window. The parameters which the user can specify on the SPA-Bus protocol are proposed in the next Table

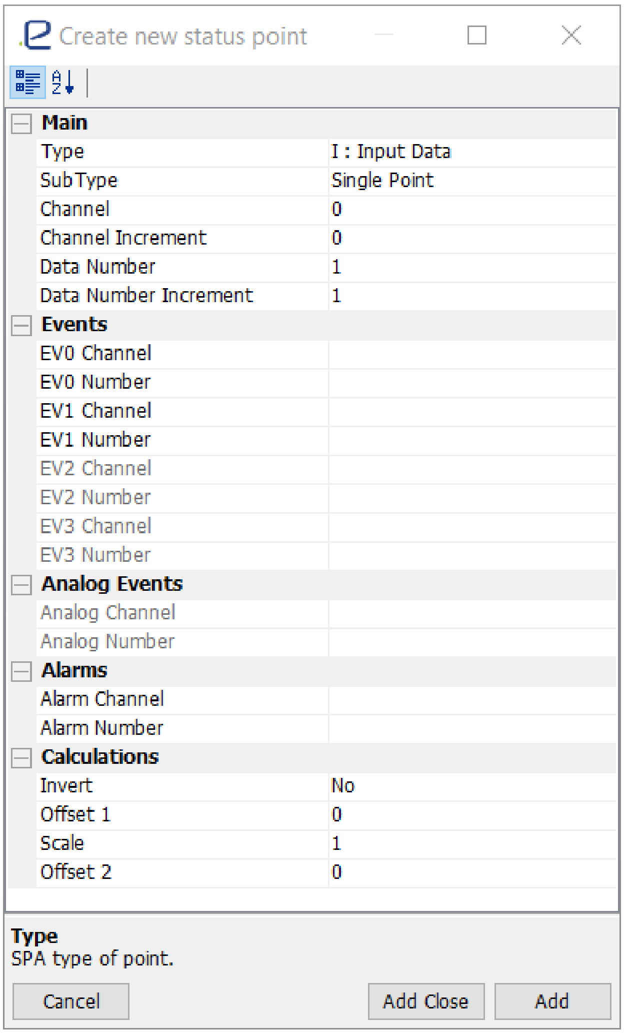


Figure 182. *Create new status point* window

Table 143. Fields of *Create new status point* window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	SPA type of point Range of values: I: Input Data, O: Output Data, S: Setting Values, V: Variables, M: Memory Data	I: Input Data
SubType	SPA sub type of point Range of values: Single Point, Double Point, Integer, Float	Single Point
Channel	Channel Range of values: 0 … 999	0
Channel Increment	After adding a new point, the Channel will be automatically incremented by the set value. Range of values: 0 … 999	0
Data Number	Data Number Range of values: 0 … 999999	1
Data Number Increment	After adding a new point, the Data Number will be automatically incremented by the set value. Range of values: 0 … 999999	1
EV0 Channel	Leave the field empty to use the same channel as data. Range of values: Empty, 0 … 999	
EV0 Number	Leave the field empty to ignore events. Range of values: Empty, 0 … 64	
EV1 Channel	Leave the field empty to use the same channel as data. Range of values: Empty, 0 … 999	
EV1 Number	Leave the field empty to ignore events. Range of values: Empty, 0 … 64	
EV2 Channel	Leave the field empty to use the same channel as data. Range of values: Empty, 0 … 999	

FIELD NAME	DESCRIPTION	DEFAULT VALUE
EV2 Number	Leave the field empty to ignore events. Range of values: Empty, 0 … 64	
EV3 Channel	Leave the field empty to use the same channel as data. Range of values: Empty, 0 … 999	
EV3 Number	Leave the field empty to ignore events. Range of values: Empty, 0 … 64	
Analogue Channel	Leave the field empty to use the same channel as data. Range of values: Empty, 0 … 999	
Analogue Number	Leave the field empty to ignore events. Range of values: Empty, 0 … 64	
Alarm Channel	Leave the field empty to use the same channel as data. Range of values: Empty, 0 … 999	
Alarm Number	Leave the field empty to ignore alarms. Range of values: Empty, 0 … 64	
Invert	Inversion of status Values: Yes; No	No
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0

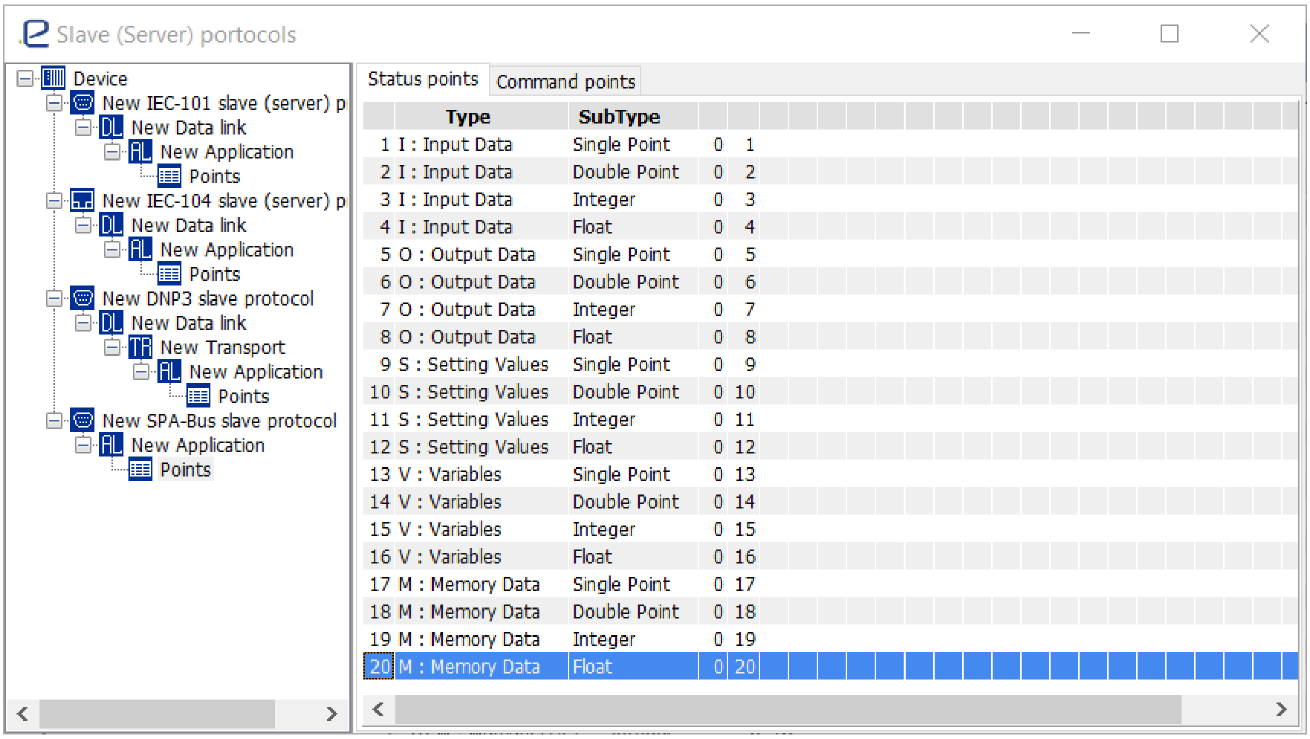


Figure 183. *Status points* window in SPA-Bus protocol

Columns *Value, Time, Quality, Cause* will show real-time data.

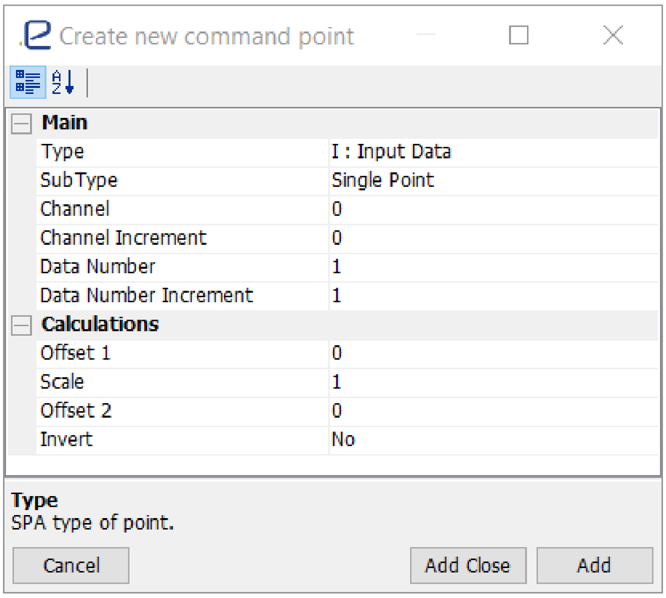


Figure 184. *Create new command point* in SPA-Bus protocol

Table 144. Fields of *Create new command point* window in SPA-Bus protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	SPA type of point. Range of values: I: Input Data, O: Output Data, S: Setting Values, V: Variables, M: Memory Data	I: Input Data
SubType	SPA sub type of point. Range of values: Single Point, Double Point, Integer, Float	Single Point
Channel	Channel Range of values: 0 … 999	0
Channel Increment	After adding a new point, the Channel will be automatically incremented by the set value. Range of values: 0 … 999	0
Data Number	Data Number Range of values: 0 … 999999	1
Data Number Increment	After adding a new point, the Data Number will be automatically incremented by the set value. Range of values: 0 … 999999	1
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No

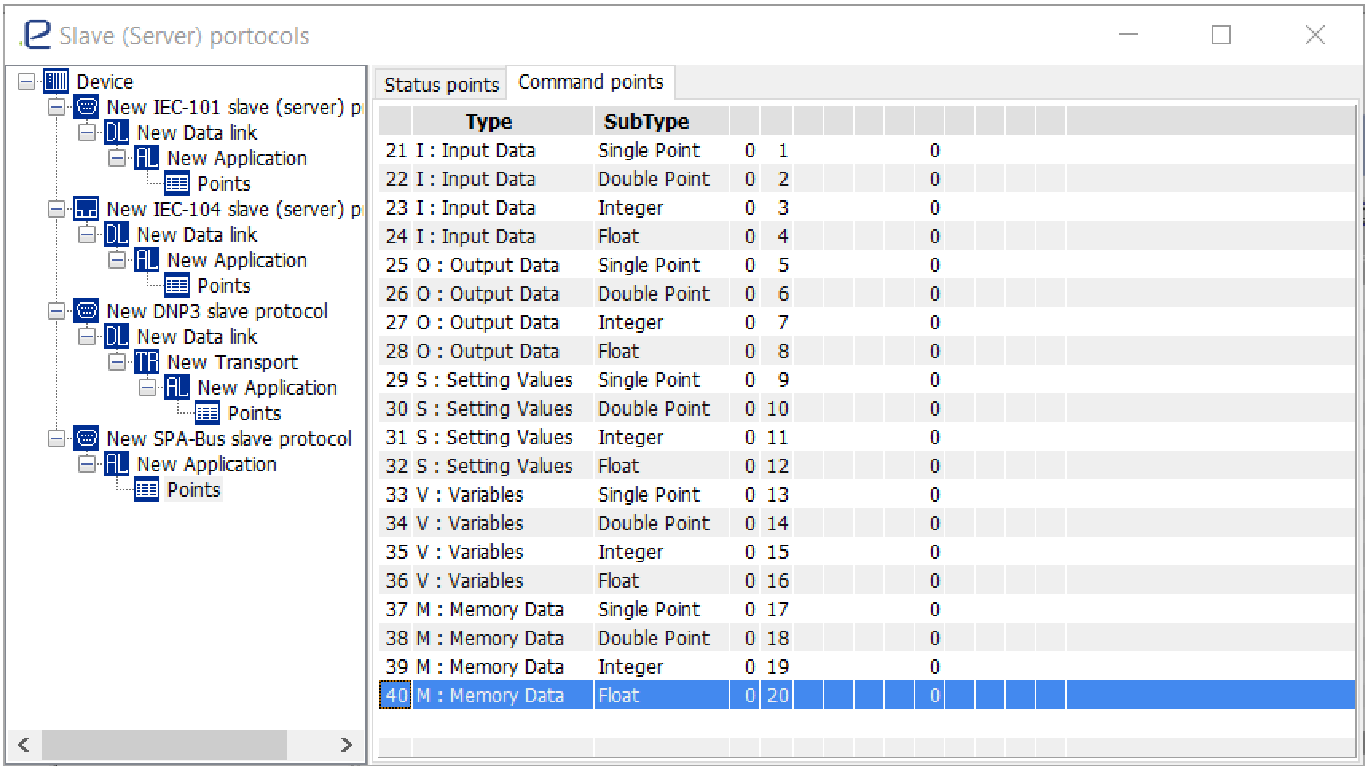
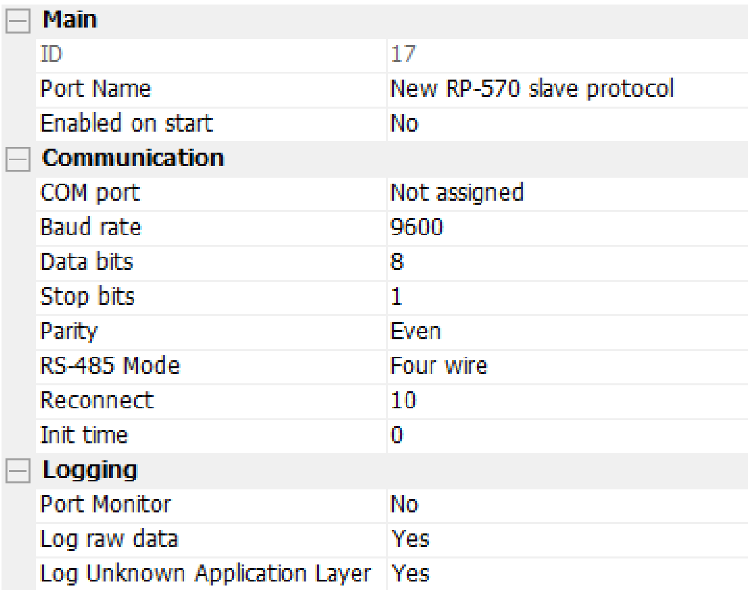


Figure 185. *Command points* window in SPA-Bus protocol

4.10.6 RP-570 configuration

4.10.6.1 Communication port parameters



Main	
ID	17
Port Name	New RP-570 slave protocol
Enabled on start	No
Communication	
COM port	Not assigned
Baud rate	9600
Data bits	8
Stop bits	1
Parity	Even
RS-485 Mode	Four wire
Reconnect	10
Init time	0
Logging	
Port Monitor	No
Log raw data	Yes
Log Unknown Application Layer	Yes

Figure 186. *Communication port parameters* in RP-570 protocol

Table 145. Fields of *Communication port parameters* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port name	Name of the port and protocol, for example, 'COM1 RP-570 slave'	New RP-570 slave protocol
Port enabled	Port enabled on the system startup. Values: Yes; No	No
COM port	Communication port number Range of values: COM 1 … 255	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7, 8 bits	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity. Values: None, Odd, Even, Mark, Space	Even
RS-485 mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Values: Two wires, Four wires	Four wires
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 1 … 600s	10
Init time	Protocol initialization time on startup. During this time no events will be generated. Range of values: 1 … 60	0
Port monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes
Log Unknown Application Layer	Always set this parameter to 'No' in the multiple slave system.	Yes

4.10.6.2 Application layer parameters

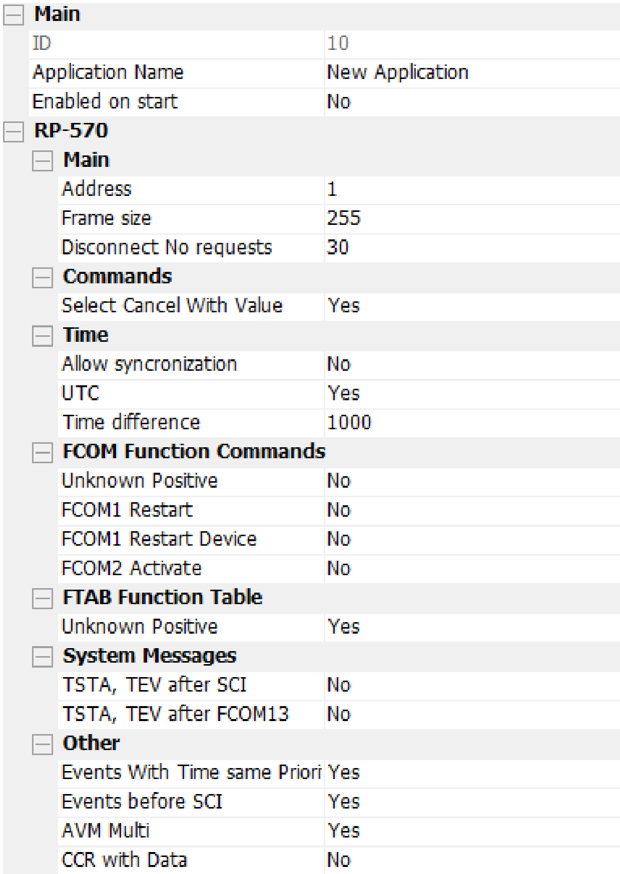


Figure 187. *Application layer parameters* in RP-570 protocol

Table 146. Fields of *Application layer parameters* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Application Name	Application layer name, for example, 'Application layer'	New Application
Enabled on start	Enables or disables the application layer on start. Values: Yes; No	No
Address	Slave address Range of values: 1 … 999. 900 – is broadcast	1
Frame size	Maximum frame length Range of values: 48 … 255 bytes	255

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Disconnect No requests	Disconnects the data link layer, if no requests are received from the master for the specified time. Range of values: 0 … 3600s 0 – not used	0
Select Cancel With Value	Some master devices do not send a value with select and cancel commands. In this case, set this parameter to 'No'.	Yes
Allow synchronization	Yes – always synchronize, No – synchronize only if the RTU internal clock is synchronized.	Yes
UTC	Use UTC time in communication. Values: Yes; No	Yes
Time difference	Time difference to synchronize the internal RTU clock Range of values: 20 … 10000 ms	1000
Unknown Positive	Responds to an unknown positive FCOM request	No
FCOM1 Restart	Allows the device to restart after receiving a FCOM1 Restart request.	No
FCOM1 Restart Device	Yes – fully restart the device. No – restart only CMS.	No
FCOM2 Activate	User data is transmitted only after a FCOM2 Activate request.	No
Unknown Positive	Unsupported or unknown FTAB messages will be acknowledged positive.	Yes
TSTA, TEV after SCI	Sends system messages after a SCI (General Interrogation) request.	No
TSTA, TEV after FCOM13	Sends system messages after a FCOM13 Device In/Out of service request.	No
Events With Time same Priority	Events with Time will be sent with the same priority as events with status; in other case the priority level will be lower. If the master supports RequestA, it will not possibly support this function.	Yes
Events before SCI	Event messages have higher priority than SCI responses.	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
AVM Multi	Allows multiple analogue values with the incrementing block number transmitting with the incrementing NCB.	Yes
CCR with Data	Allows setting CCR bit in responses with data to inform that there is no more data of the requested priority. Older masters may not support this feature.	No

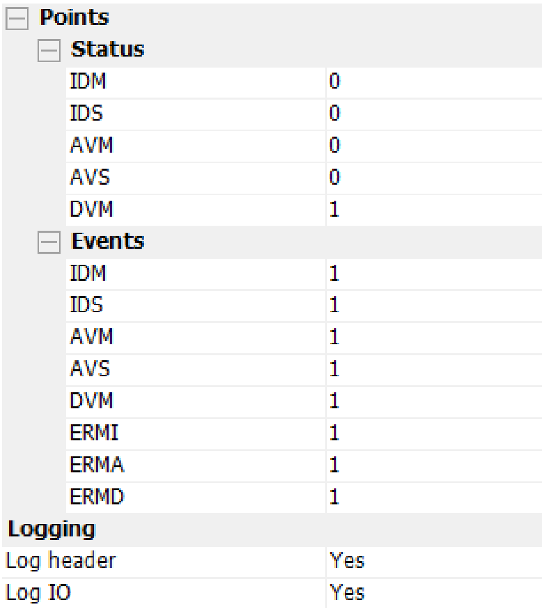


Figure 188. *Application layer parameters* in RP-570 protocol

Table 147. Fields of *Application layer parameters* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
IDM	Maximum count in one response (0..255). 0 – unlimited	0
IDS	Maximum count in one response (0..255). 0 – unlimited	0
AVM	Maximum count in one response (0..255). 0 – unlimited	0
AVS	Maximum count in one response (0..255). 0 – unlimited	0
DVM	Maximum count in one response (0..255). 0 – unlimited	1

IDM	Maximum count in one response (0..255). 0 – unlimited	1
IDS	Maximum count in one response (0..255). 0 – unlimited	1
AVM	Maximum count in one response (0..255). 0 – unlimited	1
AVS	Maximum count in one response (0..255). 0 – unlimited	1
DVM	Maximum count in one response (0..255). 0 – unlimited	1
ERMI	Maximum count in one response (0..255). 0 – unlimited	1
ERMA	Maximum count in one response (0..255). 0 – unlimited	1
ERMD	Maximum count in one response (0..255). 0 – unlimited	1
Log header	Enables to log application layer header. Values: Yes; No	Yes
Log IO	Enables to log information objects. Values: Yes; No	Yes

4.10.6.3 Points

Application layer has the branch *Points* where the user can manage the signals, measurements and commands. The following figure shows the Points popup menu which can be run with the right mouse button. It is possible *Add data point, Edit data point, Delete data point, Select All* data points or commands. The user can *Connect to Tag*, *Remove connection to the Tag*, *Go to Tag* in TAG Manager as well. *Remove connection to source* is possible from the *TAG Manager*. All menu items have keyboard shortcuts which will simplify and quicken the work with the software.

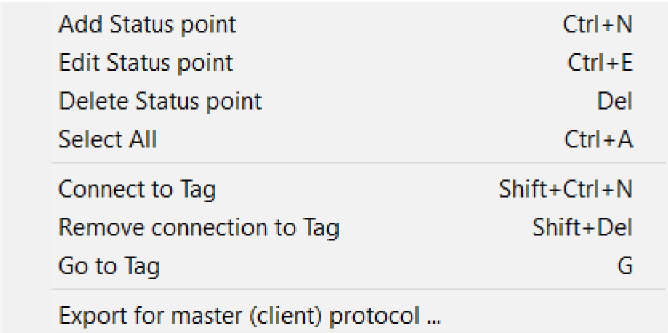


Figure 189. *Points* popup menu

The following figure shows the *Create new status point* dialog window. The parameters which the user can specify on the RP-570 protocol are proposed in the next Table

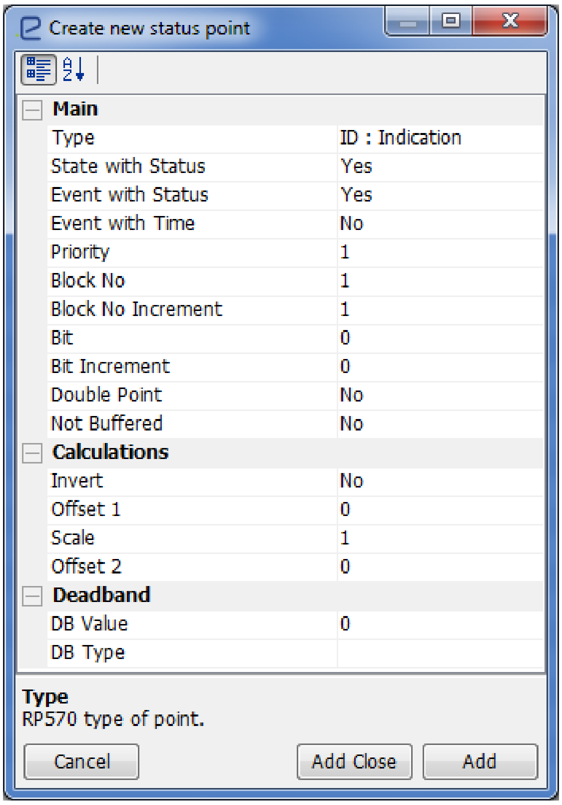


Figure 190. *Create new status point* window

Table 148. Fields of *Create new status point* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Type	Select the type of points of RP-570 protocol. Range of values: ID: Indication, AV: Analogue Value, DV: Digital Value, FD: Fault Distance	ID: Indication
State with Status	Responses to SCI requests are transmitted with the Status flag.	Yes
Event with Status	Events are transmitted with the Status flag.	Yes
Event with Time	Events are additionally transmitted with time. Some master devices may not support this function for AV and DV messages.	No
Priority	RP-570 priority of point	1
Block No	Block Number Range of values: 0 … 255	1
Block No Increment	After adding a new point, the Block No will be automatically incremented by the set value. Range of values: 0 … 255	1

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Bit	Bit Number Range of values: 0 … 15	0
Bit Increment	After adding a new point, the Bit number will be automatically incremented by the set value. Range of values: 0 … 255	1
Double Point	Indication of a double point	No
Not Buffered	Events are not buffered while the device is disconnected.	No
Invert	Inversion of status Values: Yes; No	No
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
DB Value	Deadband value used for calculation	0
DB Type	Deadband type used for calculation Values: Not used, Simple, Integrated	Not used

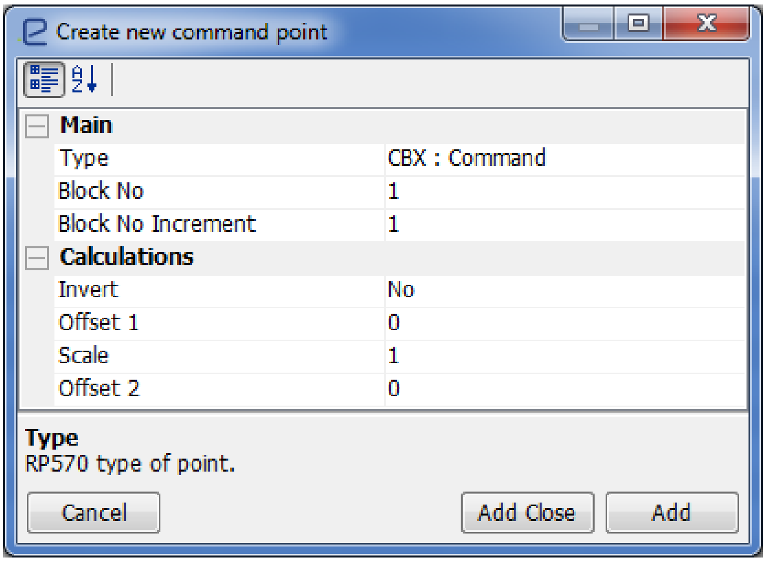


Figure 191. *Create new command point* in RP-570 protocol

Table 149. Fields of *Create new command point* window in RP-570 protocol

FIELD NAME	DESCRIPTION	DEFAULT VALUE

Type	Type of a point under RP-570 protocol Range of values: CBX: Command, SPM: SetPoint, GOM: General Output	CBX: Command
Block No	Block Number for CBX (0 ... 047), for SPM and GOM (0 ... 255)	0
Block No Increment	After adding a new point, the Block number will be automatically incremented by the set value. Range of values: 0 … 999	0
Offset 1	New value = (Old value + Offset1) * Scale + Offset2	0
Scale		1
Offset 2		0
Invert	Inversion of status Values: Yes; No	No

4.11 TAG Manager

TAG Manager is an intermediate software part which connects status and command points from the master to slave protocols or connects hardware tags to slave protocols. Either the user can create tags for internal logic or IsaGRAF programming. With the help of the tree structure, it is possible to create the structure of the substation for easier work with tags.

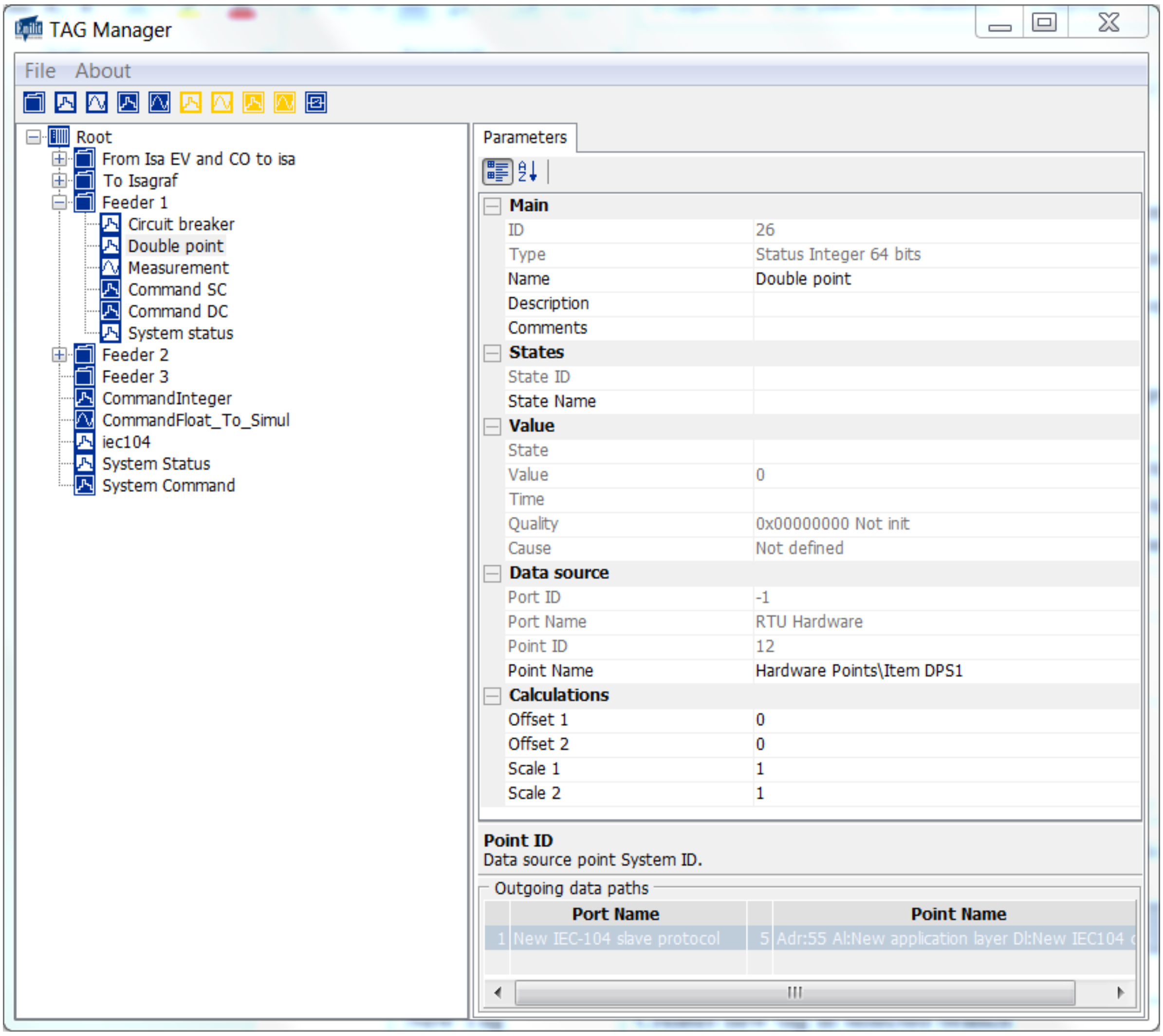


Figure 192. Main window of the *TAG Manager*

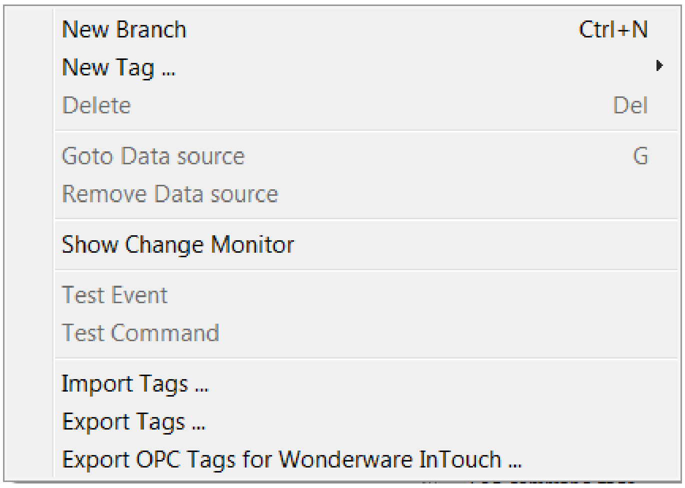
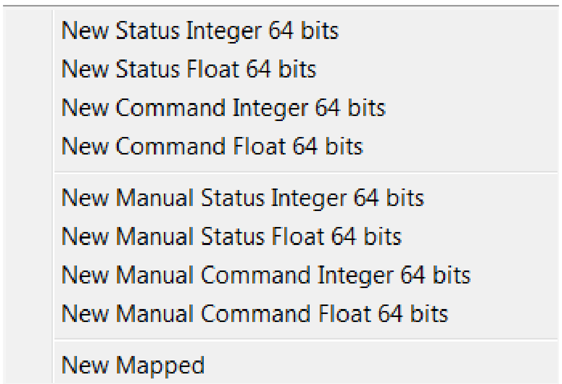


Figure 193. Active popup menu when a tree branch is selected

Table 150. Fields of the tree branch in the *TAG Manager*

NAME	DESCRIPTION	KEYBOARD SHORTCUT
New Branch	Creates a new branch in the tree structure.	Ctrl+N
New Tag	Creates a new tag in the selected branch. There are the following types of Tags for selection:  	
Delete	Deletes the selected branch.	Del
Go to Data source	If the Tag is selected, the user can reach the data source of the Tag.	G
Remove Data source	Disconnects the Data source from the Tag.	
Show Change Monitor	Opens the Change monitor window.	
Test event	Tests an event with the forced value and quality.	
Test command	Tests a command with the forced value and quality.	
Import Tags	Imports tags from the CSV file.	
Export Tags	Exports tags to the CSV file.	

NAME	DESCRIPTION	KEYBOARD SHORTCUT
Export OPC Tags for Wonderware InTouch	Exports tags to the CSV file for Wonderware InTouch FSGateway software.	

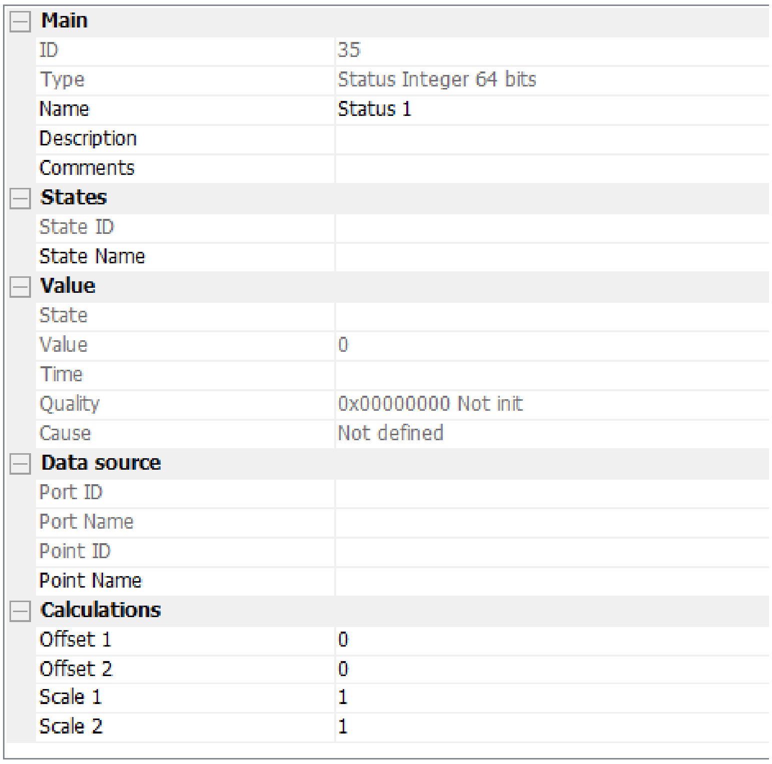


Figure 194. *Status Tag* edit window

Table 151. Fields of *Status Tag* edit window in the *TAG Manager*

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	ID number. For internal use only	Automatically increment value
Type	Tag data type. This value cannot be edited. The tag must be deleted first and then a new one can be created with the necessary type. Values: Status Integer 64 bits, Status Float 64 bits, Manual Status Integer 64 bits, Manual Status Float 64 bits	
Name	Name of the tag	Status 1
Description	Additional user description	
Comments	Additional user comments	
State ID	Tag states configuration ID.	Not connected

FIELD NAME	DESCRIPTION	DEFAULT VALUE
State Name	Tag states configuration Name.	Not connected
State	Real time state of the Tag	
Value	Real time value of the Tag	0
Time	Time of the last change	
Quality	Quality of the last change	0x00000000 Not init
Cause	Cause of transmission of the last change	Not defined
Port ID	Data source Port ID	Not connected
Port Name	Data source Port Name	Not connected
Point ID	Data source Point ID	Not connected
Point Name	Data source Point Name	Not connected
Offset 1	With these parameters the user can change the value from the data source. NewValue=((OldValue+Offset1)*Scale 1+Offset2)*Scale2	0
Offset 2		0
Scale 1		1
Scale 2		1

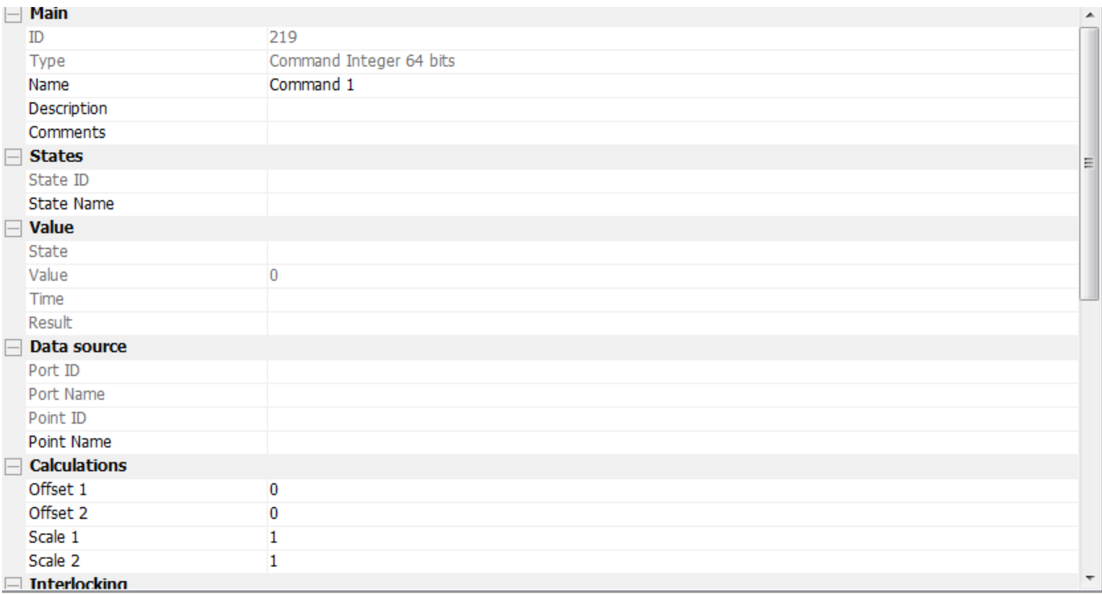


Figure 195. *Command Tag* edit window

Table 152. Fields of *Command Tag* edit window in the *TAG Manager*

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	ID number. For internal use only	Automatically increment value
Type	Tag data type. This value cannot be edited. The tag must be deleted first and then a new one can be created with the necessary type. Values: Status Command Integer 64 bits, Command Float 64 bits, Manual Command Integer 64 bits, Manual Command Float 64 bits, Mapped Command	
Name	Name of the tag	Command 1
State ID	Tag states configuration ID	Not connected
State Name	Tag states configuration Name	Not connected
State	Real time state of Tag	
Value	Real time value of Tag	0
Time	Time of the last change	
Quality	Quality of the last change	
Result	Result of the last command	
Port ID	Data source Port ID	Not connected
Port Name	Data source Port Name	Not connected
Point ID	Data source Point ID	Not connected
Point Name	Data source Point Name	Not connected
Offset 1	With those parameters the user can change the value from the data source. NewValue=((OldValue+Offset1)*Scale1+Offset2)*Scale2	0
Offset 2		0
Scale 1		1
Scale 2		1
ITag ID	Interlocking Tag ID	
Interlocking TAG	Tag used for the command interlocking	
Interlocking Type	Interlocking type. Range of values: ==, <>, <=, <, >=, >	Not used
Interlocking Value	Interlocking value. Range of values: -2147483648 … 2147483648	0

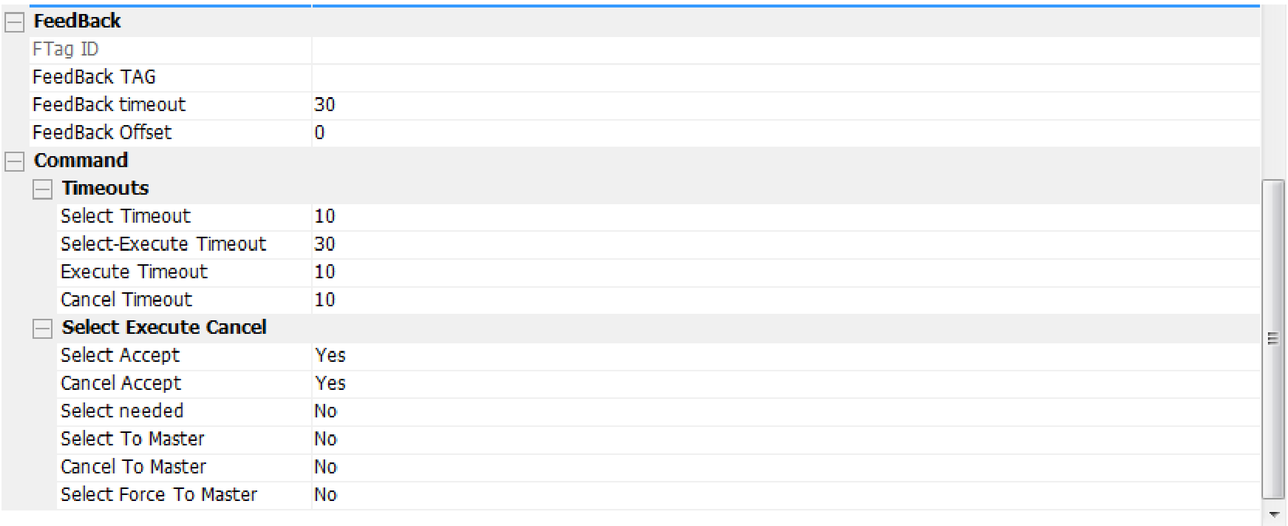


Figure 196. *Command Tag* edit window

Table 153. Fields of *Command Tag* edit window in the *TAG Manager*

FIELD NAME	DESCRIPTION	DEFAULT VALUE
FTag ID	FeedBack Tag ID	
FeedBack TAG	Tag used for checking the command feedback	
FeedBack timeout	Feedback timeout in seconds. If the value is set to 0 – the feedback is not used. Range of values: 0 … 600	30
FeedBack Offset	The value received as the feedback will be overwritten with the offset value for checking the result. Range of values: -2147483648 … 2147483647	0
Select Timeout	Select the command timeout in seconds. Range of values: 1 … 3600	10
Select-Execute Timeout	Command timeout between the select and execute commands in seconds. Range of values: 1 … 3600	30
Execute Timeout	Execute command timeout in seconds. Range of values: 1 … 3600	10
Cancel Timeout	Cancel command timeout in seconds. Range of values: 1 … 3600	10
Select Accept	Select command will be confirmed with a positive result. Values: Yes; No	Yes

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Cancel Accept	Cancel command will be confirmed with a positive result. Values: Yes; No	Yes
Select needed	Execute command will be executed only after selecting a command. Values: Yes; No	No
Select To Master	Received the select command will be sent to the master port. Values: Yes; No	No
Cancel to Master	Received command 'Cancel' will be sent to the master port. Values: Yes; No	No
Select Force To Master	In case the slave communication port does not have the command 'Select', it will be created and sent to the master port. Values: Yes; No	No

The following figure shows the *Connect Tag to data source* window. On the left side, the structure is displayed, which the user has created in the master protocols. The user can expand the tree and find a particular data point from the master protocols points. It is allowed to connect only one data or command point to the tag.

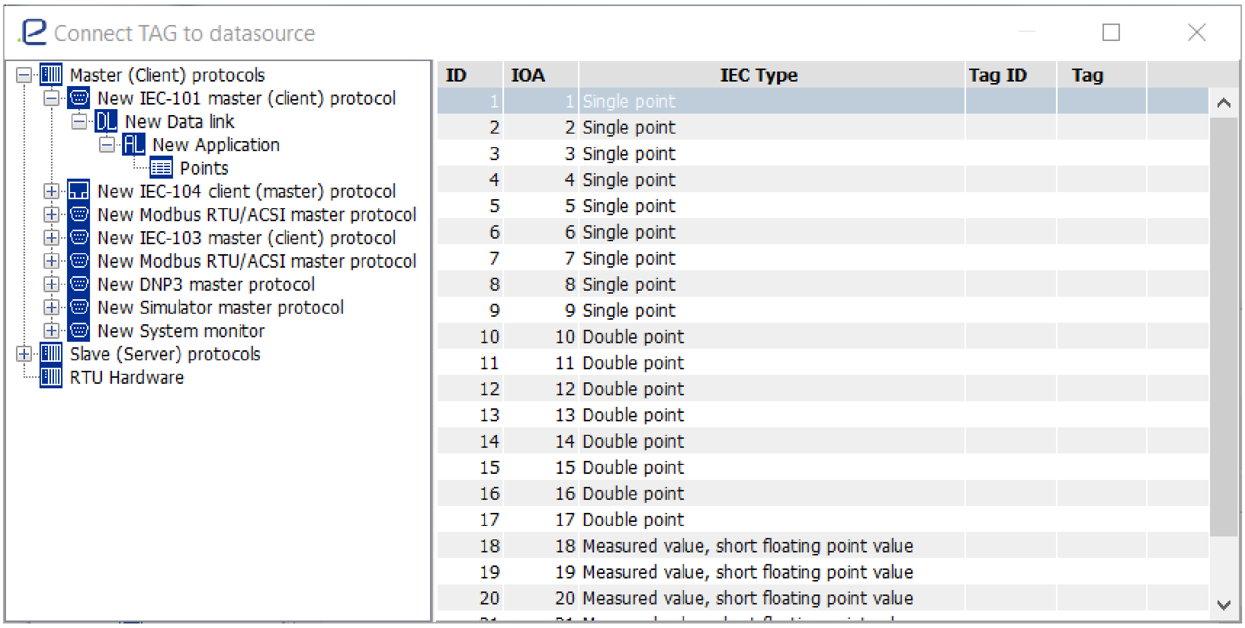


Figure 197. *Connect TAG to data source* window

In the figure above, in the right top corner, the user can choose a primary data source. It is possible to connect tags to the communication ports, RTU hardware points or PLC.

If the user has connected a tag to the data source and connected it also to the slave protocol, all the information regarding the linkage will be seen in the tag configuration of window. Also, the real-time value, state, timestamp, quality and cause of transmission of the selected tag will be displayed in this window.

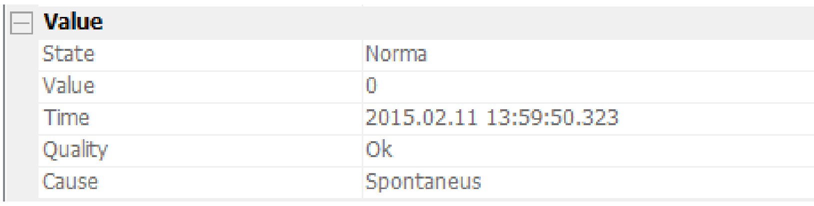


Figure 198. Signal monitoring

4.11.1 Tag states

Tag states configuration tool allows configuring a description to the tag values. If it is configured, then in the *Change Monitor,* the user can see the state of a signal or command, not only value. For example, it is possible to configure the description 'SET' if the value is 1 and 'RESET' if the value is 0.

Tag States dialogue has two types of states: 'Status State' and 'Command State'.

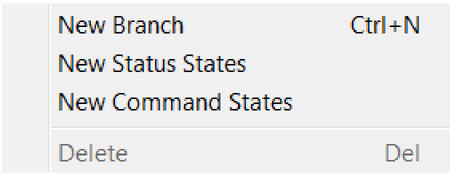


Figure 199. New Tag State window

The following figure shows the *Initial Tag States* window.

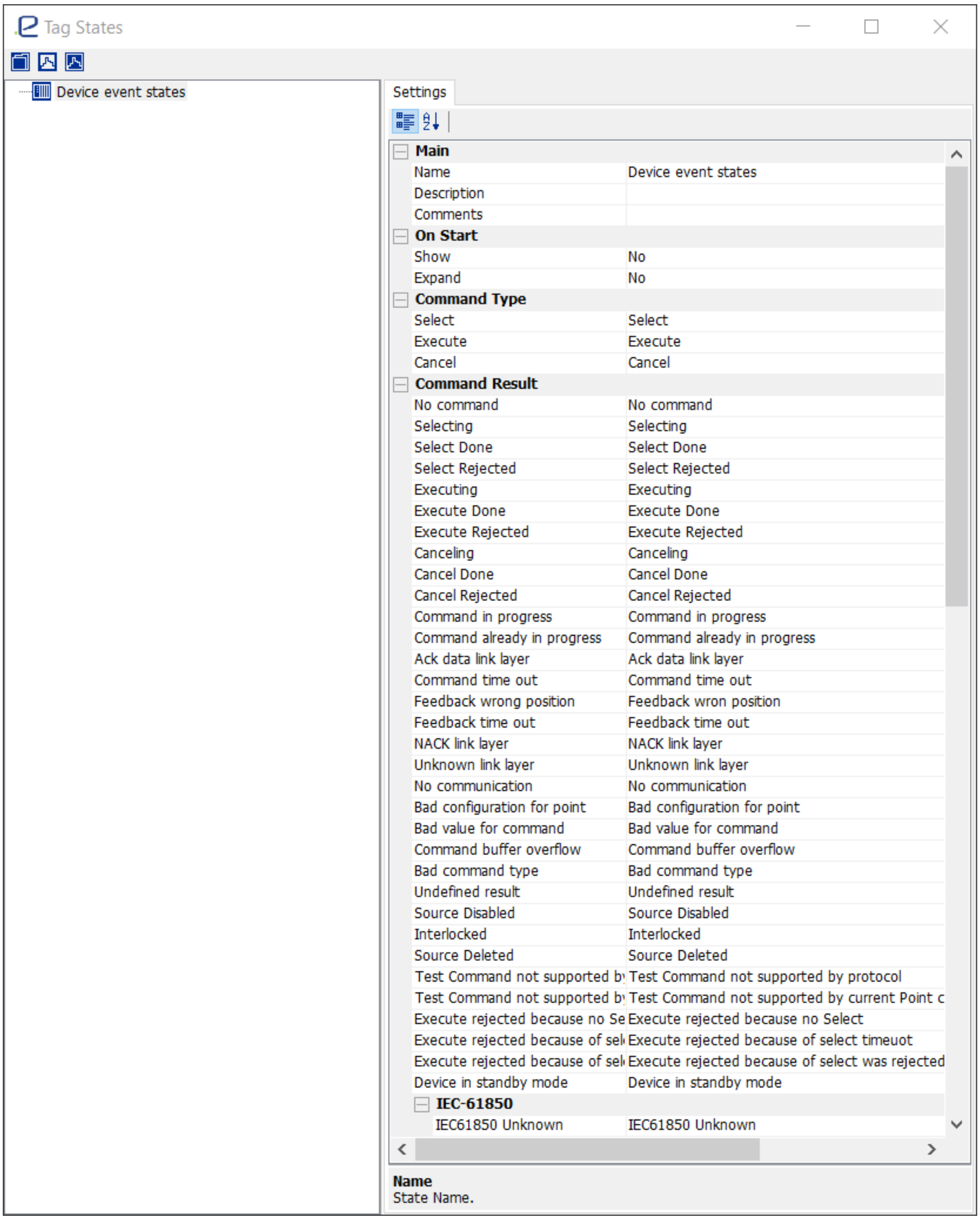


Figure 200. *Initial Tag states* window

When the user starts to configure a state for a status signal, it needs to add the priority '0', the type 'irrelevant' and the quality 'Not topical' with the value 'Yes'. Then normal states have to be added: like Reset = 0 and Set = 1. The following figure shows this configuration.

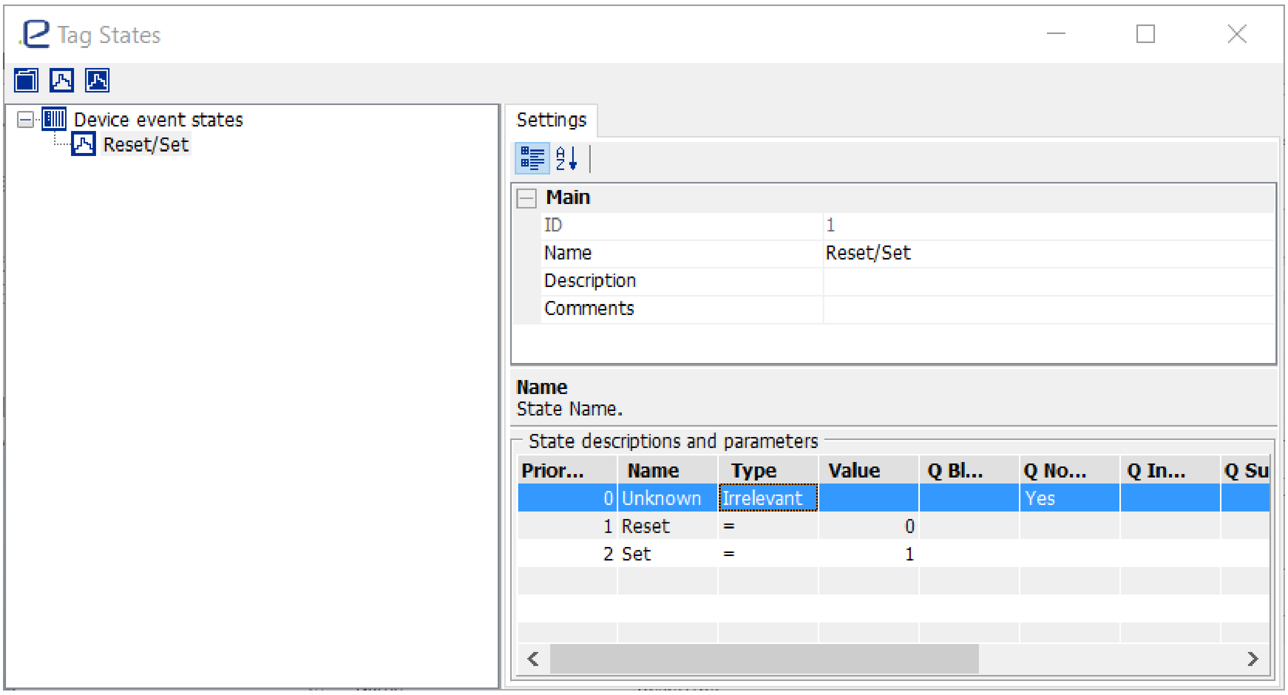


Figure 201. Configured status state Reset/Set

If the state is configured properly, then it is possible to assign the state to the signal or command in the *TAG Manager* window, like in the following picture.

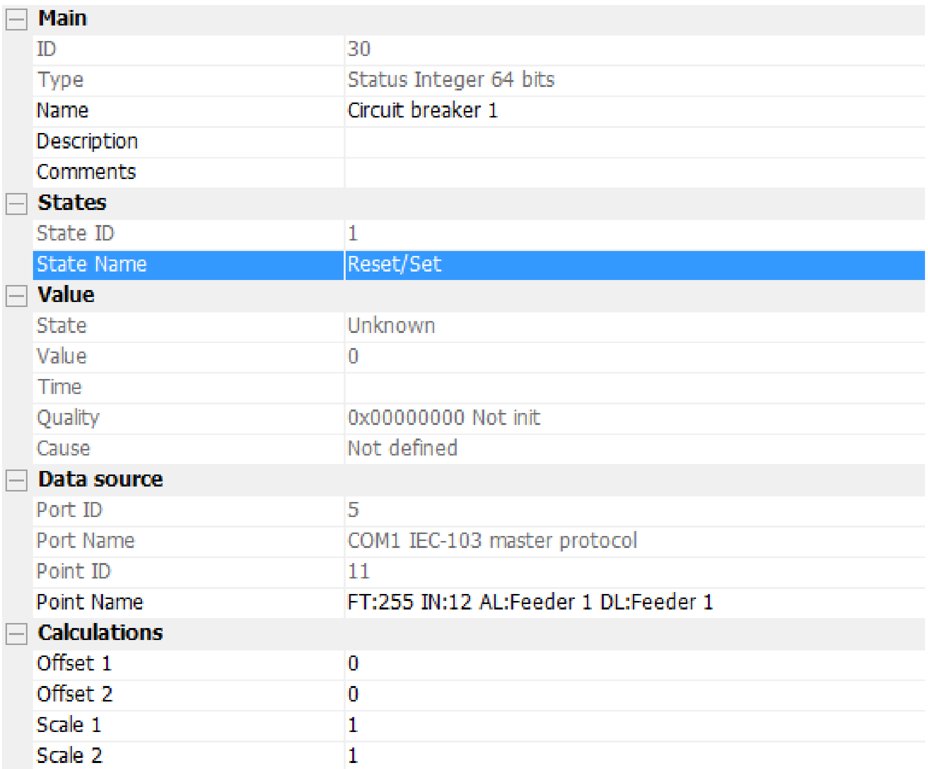


Figure 202. Configured tag with the assigned state

4.12 Internal programmable logic

Internal programmable logic is included in Enilit Configuration and Management Software (CMS) by default. It provides the opportunity to use fast and simple programmable logic. To use it, it is necessary to create tags of Manual Status Integer 64 bits or Manual Status Float 64 bits. After the creation of a manual tag, the user will see the Logic calculation area like in the following figure.

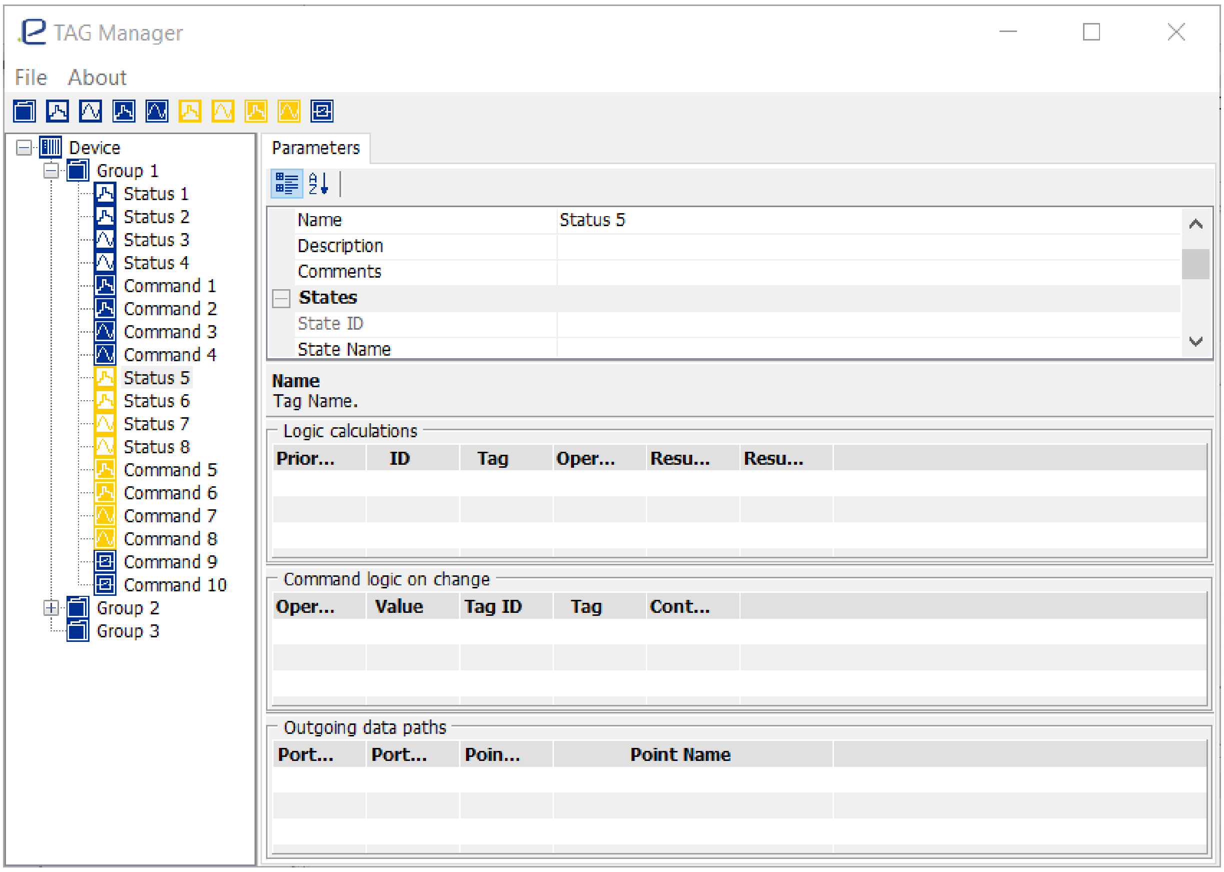


Figure 203. Manual status tag with logic calculations area

To create some logic, it is needed to add *Logic calculations* with the help of the right mouse button on the *Logic calculation* window like in the following figure.

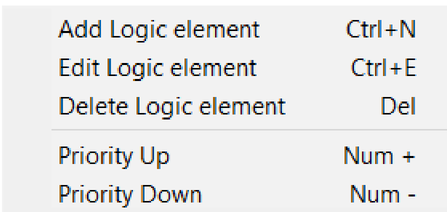


Figure 204. *Logic calculation* context menu

After clicking on *Add Logic element*, the user will get the following window.

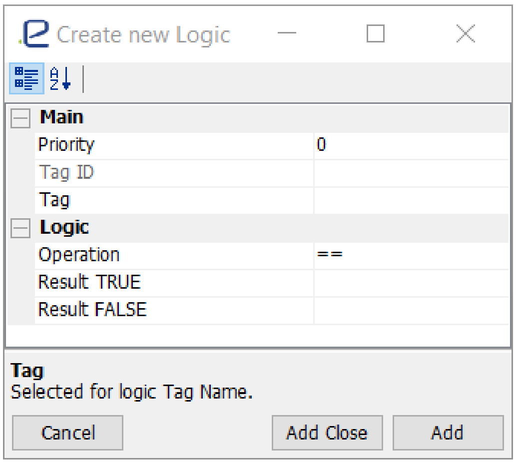


Figure 205. *Create new Logic* calculation

It requires to assign a tag from the *TAG Manager and Operation*, then, if the result is 'TRUE', it will give the value '1' to the next calculation; else if the result is 'FALSE', it will output the value '0' to the next calculation. With the parameters 'Result TRUE' and 'Result FALSE', it is possible to change the result values to the next logic calculation. The operation can be one of: = (assign), == (equal), <> (not equal), < (less), <= (less or equal), > (more), >= (more or equal), OR, OR bits, AND, AND bits, XOR, XOR bits, + (addition), - (subtraction), *(multiplication), / (division).

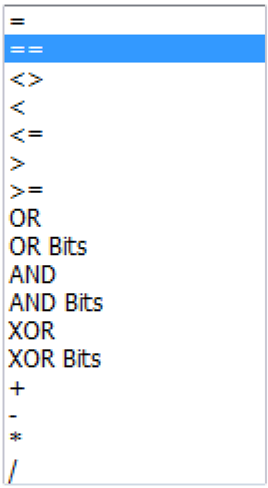


Figure 206. Integer type logic operations

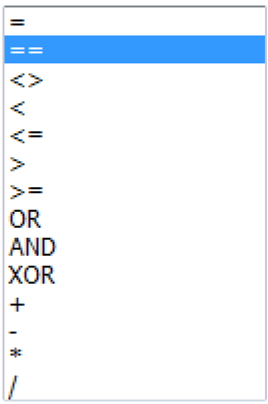


Figure 207. Float type logic operations

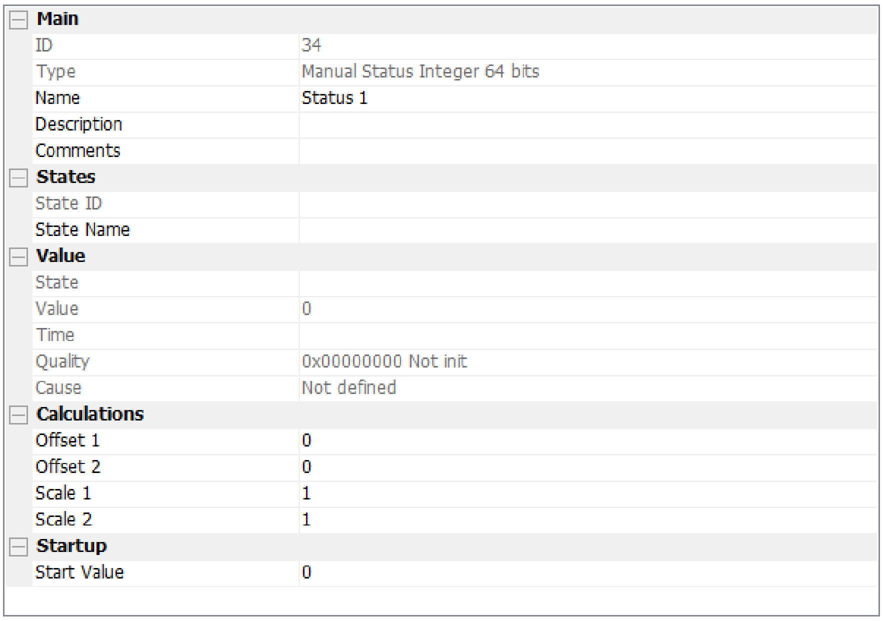


Figure 208. Integer type manual tag parameters

Table 154. Fields of Integer type manual tag parameters

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Type	Type of a Manual tag	
Name	Name of a Manual tag	Status 1
Description	Description of a Manual tag	Empty
Comments	Additional user comments	Empty
State ID	Tag state ID	
State Name	Assigned Tag State name	Not assigned
State	Actual state	
Value	Actual value	0
Time	Date/Time of the last change	
Quality	Actual quality	0x00000000 Not init
Cause	Actual cause	Not defined
Offset 1	With those parameters the user can change the value taken from the data source. NewValue=((OldValue+Offset1)*Scale1+Offset2)*Scale2	0
Offset 2		0
Scale 1		1
Scale 2		1
Start Value	Initial Value of a logic calculation with the first operation	0

4.13 Programmable logic IsaGRAF

Enilit CMS provides an interface to the IsaGRAF programming tool for the programming of an additional function for Enilit RTU. The following figure shows the interface which enables to create inputs and outputs for the programmable logic IsaGRAF.

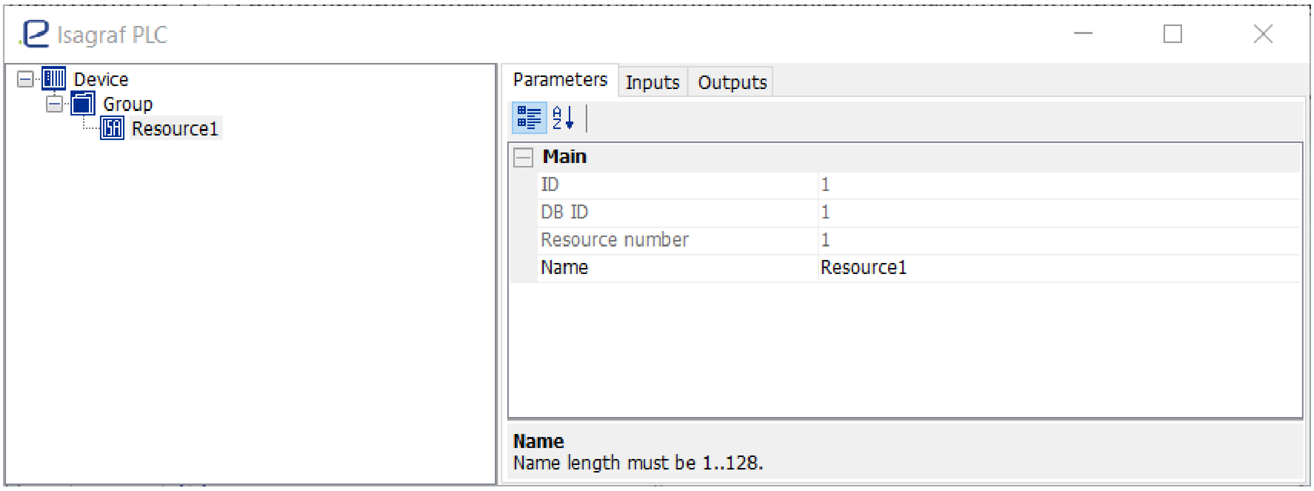


Figure 209. *IsaGRAF PLC* programming window

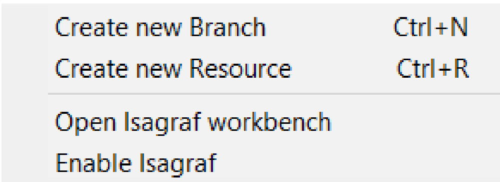


Figure 210. Popup menu

Table 155. Fields of *IsaGRAF PLC* popup menu

FIELD NAME	DESCRIPTION	ACTIVE
Create new Branch	Creates a new branch.	Branches
Create new Resource	Creates a new resource.	Branches
Open IsaGRAF workbench	Open the integrated programmable logic environment IsaGRAF by selecting this menu item.	Everywhere
Enable *IsaGRAF*	Enables IsaGRAF runtime.	Everywhere

IsaGRAF is IEC 61131 open control software for automation. For more information on all operating functions of IsaGRAF, please refer to the IsaGRAF User Manual which can be called up via IsaGRAF software.

4.13.1 IsaGRAF function blocks

Functional blocks are designed specifically for Enilit RTU. With these functional blocks, the user can manipulate events and commands.

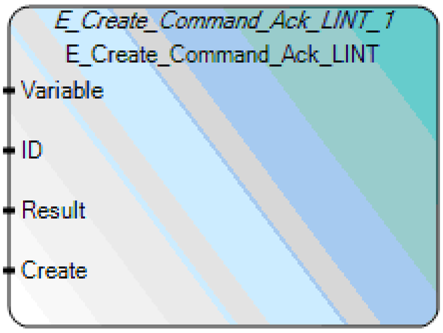


Figure 211. *E_Create_Command_Ack_LINT*

Creating an integer command acknowledgement.

Table 156. Fields of *E_Create_Command_Ack_LINT* window

FIELD NAME	DESCRIPTION
Variable	Input of a command Data type: ENILIT_OUT_COACK_LINT
ID	Command's identification number Data type: UDINT
Result	Command acknowledgement type: positive, negative, termination. Data type: BYTE
Create	Enables or disables acknowledgement. Data type: BOOL

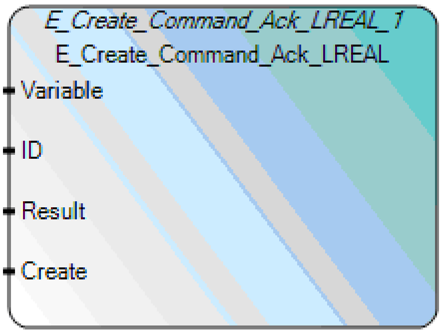


Figure 212. *E_Create_Command_Ack_LREAL*

Creating a float command acknowledgement.

Table 157. Fields of *E_Create_Command_Ack_LREAL* window

FIELD NAME	DESCRIPTION
Variable	Input of a command Data type: ENILIT_OUT_COACK_LREAL
ID	Command's identification number Data type: UDINT
Result	Command acknowledgement type: positive, negative, termination. Data type: BYTE
Create	Enables or disables acknowledgement. Data type: BOOL

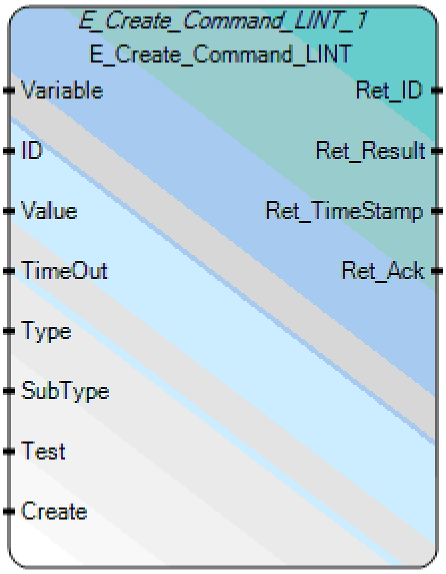


Figure 213. *E_Create_Command_LINT*

Creating an integer command.

Table 158. Fields of *E_Create_Command_LINT* window

FIELD NAME	DESCRIPTION
Variable	Output of a command to RTU Data type: ENILIT_IN_COACK_LINT
ID	Command's identification number Data type: UDINT
Value	Value of a command Data type: LINT
TimeOut	Time interval of a command acknowledgement Data type: TIME
Type	Type of a command: single, double Data type: BYTE

FIELD NAME	DESCRIPTION
SubType	Type of a command: activation, deactivation Data type: BYTE
Test	Command with the test flag Data type: BOOL
Create	Enables or disables acknowledgement. Data type: BOOL
Ret_ID	Identification number of a command acknowledgement Data type: UDINT
Ret_Result	Result of a command acknowledgement Data type: BYTE
Ret_TimeStamp	Timestamp of a command acknowledgement Data type: LINT
Ret_Ack	Acknowledgement positive or negative Data type: BOOL

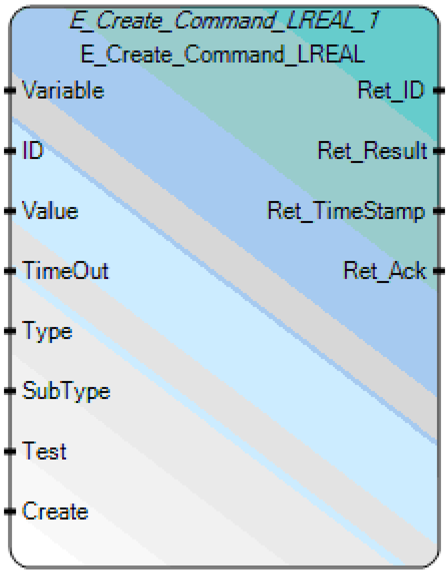


Figure 214. *E_Create_Command_LREAL*

Creating a float command.

Table 159. Fields of *E_Create_Command_LREAL* window

FIELD NAME	DESCRIPTION
Variable	Output of a command to RTU Data type: ENILIT_IN_COACK_LREAL
ID	Commands identification number Data type: UDINT
Value	Value of a command Data type: LREAL
TimeOut	Time interval of a command acknowledgement Data type: TIME
Type	Type of a command Data type: BYTE
SubType	Type of a command: activation, deactivation. Data type: BYTE
Test	Command with the test flag Data type: BOOL
Create	Enables or disables acknowledgement. Data type: BOOL
Ret_ID	Identification number of a command acknowledgement Data type: UDINT
Ret_Result	Result of a command acknowledgement Data type: BYTE
Ret_TimeStamp	Timestamp of a command acknowledgement Data type: LINT
Ret_Ack	Acknowledgement positive or negative Data type: BOOL

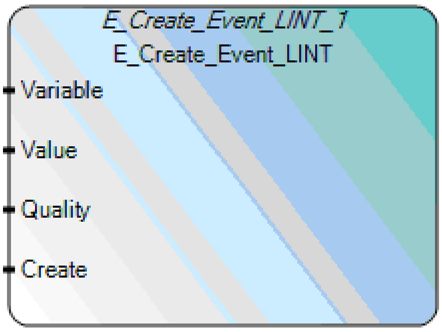


Figure 215. *E_Create_Event_LINT*

Creating an integer event.

Table 160. Fields of *E_Create_Event_LINT* window

FIELD NAME	DESCRIPTION
Variable	Output of an event to RTU Data type: ENILIT_OUT_EV_LINT
Value	Value of an event Data type: LINT
Quality	Quality of an event Data type: UINT
Create	Enables or disables creation of an event Data type: BOOL

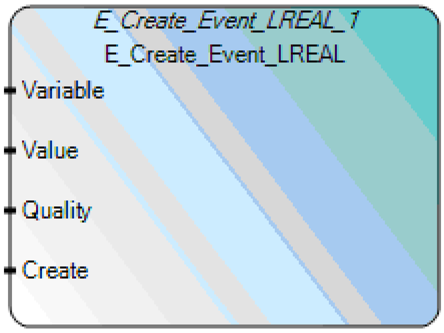


Figure 216. *E_Create_Event_LREAL*

Creating a float event.

Table 161. Fields of *E_Create_Event_LREAL* window

FIELD NAME	DESCRIPTION
Variable	Output of an event to RTU Data type: ENILIT_OUT_EV_LREAL
Value	Value of an event Data type: LREAL
Quality	Quality of an event Data type: UINT
Create	Enables or disables creation of an event Data type: BOOL

Figure 217. *E_Get_TimeStamp*

Getting a timestamp of RTU.

Table 162. Fields of *E_Get_TimeStamp* window

FIELD NAME	DESCRIPTION
TimeStamp	TimeStamp of RTU Data type: LINT

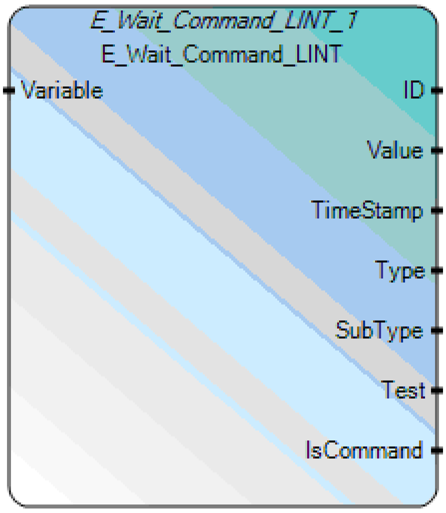


Figure 218. *E_Wait_Command_LINT*

Waiting for an integer command.

Table 163. Fields of *E_Wait_Command_LINT* window

FIELD NAME	DESCRIPTION
Variable	Input of a command from RTU Data type: ENILIT_OUT_COACK_LINT
ID	Commands identification number Data type: UDINT
Value	Value of a command Data type: LINT
TimeStamp	TimeStamp of a command Data type: LINT
Type	Type of a command Data type: BYTE
SubType	Type of a command: activation, deactivation Data type: BYTE
Test	Command with the test flag Data type: BOOL
IsCommand	If ‘Yes’, then a Command is active. Data type: BOOL

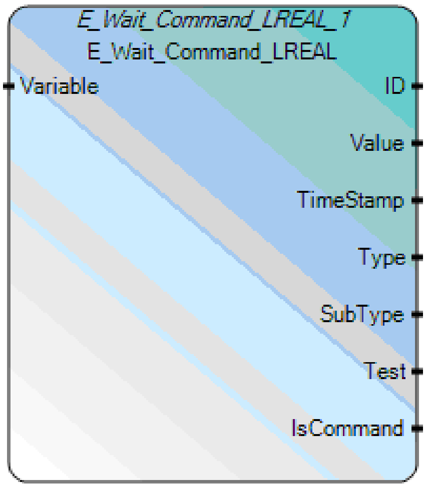


Figure 219. *E_Wait_Command_LREAL*

Waiting for an integer command.

Table 164. Fields of E_Wait_Command_LREAL window

FIELD NAME	DESCRIPTION
Variable	Input of a command from RTU Data type: ENILIT_OUT_COACK_LREAL
ID	Commands identification number Data type: UDINT
Value	Value of a command Data type: LREAL
TimeStamp	TimeStamp of a command Data type: LINT
Type	Type of a command Data type: BYTE
SubType	Type of a command: activation, deactivation Data type: BYTE
Test	Command with the test flag Data type: BOOL
IsCommand	If ‘Yes’, then a Command is active Data type: BOOL

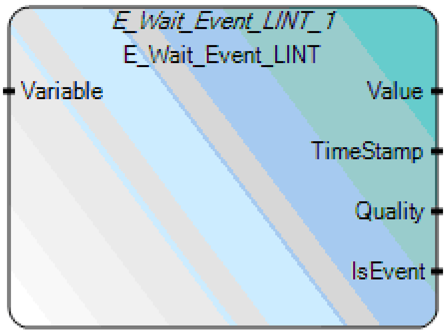


Figure 220. *E_Wait_Event_LINT*

Waiting for an integer event.

Table 165. Fields of *E_Wait_Event_LINT* window

FIELD NAME	DESCRIPTION
Variable	Input of an event from RTU Data type: ENILIT_IN_EV_LINT
Value	Value of an event Data type: LINT
TimeStamp	TimeStamp of an event Data type: LINT
Quality	Quality of an event Data type: UDINT
IsEvent	If 'Yes', then an Event is active. Data type: BOOL

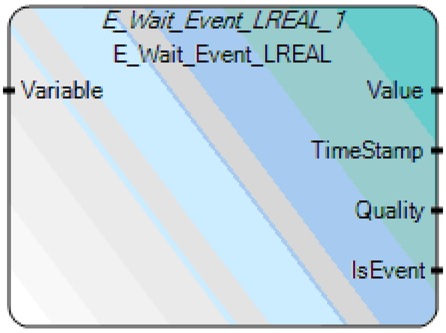


Figure 221. *E_Wait_Event_LREAL*

Waiting for a float event.

Table 166. Fields of *E_Wait_Event_LREAL* window

FIELD NAME	DESCRIPTION
Variable	Input of an event from RTU Data type: ENILIT_IN_EV_LREAL
Value	Value of an event Data type: LREAL
TimeStamp	TimeStamp of an event Data type: LINT
Quality	Quality of an event Data type: UDINT
IsEvent	If 'Yes', then an Event is active. Data type: BOOL

4.13.2 IsaGRAF data types

Table 167. Types of IsaGRAF data

FIELD NAME	DESCRIPTION
Command type	
E_CO_CANCEL	Deactivation
E_CO_EXECUTE	Execute
E_CO_SELECT	Select
E_CO_SELECT_EXECUTE	Select before Operate (SBO)
Command acknowledgement	
E_COACK_BAD_COMMAND_TYPE	Bad command type
E_COACK_BAD_CONFIGURATION	Bad configuration
E_COACK_BAD_VALUE	Bad value
E_COACK_CANCEL_DONE	Deactivation confirmation
E_COACK_CANCEL_REJECTED	Deactivation rejected
E_COACK_COMMAND_ALREADY_IN_PROGRESS	Command already in progress
E_COACK_COMMAND_IN_PROGRESS	Command in progress
E_COACK_COMMAND_QUEUE_FULL	Command queue full
E_COACK_EXECUTE_DONE	Activation confirmation
E_COACK_EXECUTE_REJECTED	Activation rejected
E_COACK_INTELOCKED	Interlocked
E_COACK_LINK_DISABLED	Link disabled
E_COACK_LINKLAYER_ACK	Link layer acknowledgement
E_COACK_LINKLAYER_NACK	Link layer no acknowledgement
E_COACK_LINKLAYER_UNKNOWN	Link layer unknown acknowledgement
E_COACK_NO_COMMAND	No command
E_COACK_NO_LINK	No link
E_COACK_SELECT_DONE	Select confirmation
E_COACK_SELECT_REJECTED	Select rejected
E_COACK_TIME_OUT	Command time out
E_COACK_UNDEFINED_RESULT	Command execution undefined result

Command quality	
E_COSUB_LONG_PULSE	Long pulse
E_COSUB_NOT_DEFINED	Not defined
E_COSUB_PERSISTENT	Persistent
E_COSUB_SHORT_PULSE	Short pulse
Quality of event	
E_QUAL_BLOCKED	Blocked
E_QUAL_GOOD	Good
E_QUAL_INVALID	Invalid
E_QUAL_INVALIDTIME	Invalid time
E_QUAL_NOTINIT	Not initialized
E_QUAL_NOTTOPICAL	Not topical
E_QUAL_OVERFLOW	Overflow
E_QUAL_SUBSTITUTED	Substituted

4.14 Time management

Enilit RTU time management supports SNTP Client/Server functionalities and time synchronisation based on master/slave protocols like IEC-104 and etc. The system allows to enable or disable summer time use.

4.14.1 SNTP client

In the *Time management* window the user can create a new SNTP client to synchronize RTU date and time with an external SNTP server.

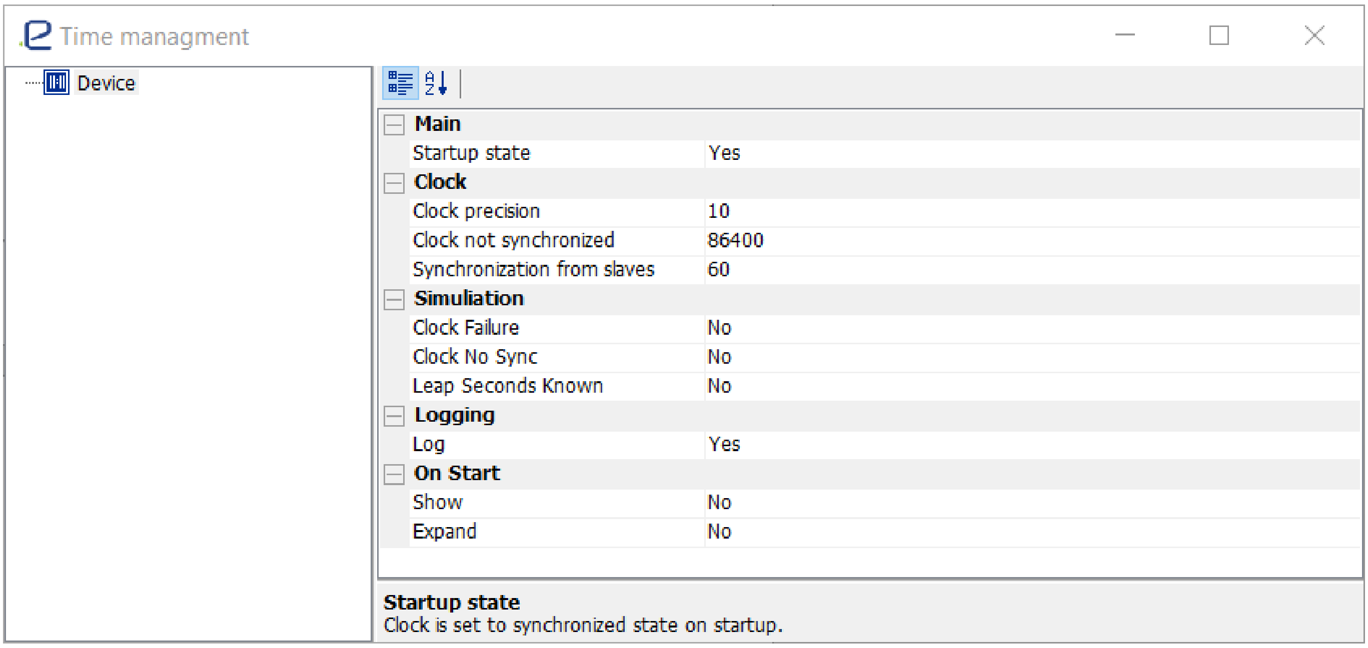


Figure 222. *SNTP client* window

Table 168. Fields of *SNTP client* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Startup state	Clock is synchronized on startup. Values: Yes; No	Yes
Clock precision	Clock will be synchronized only if the time offset is larger than the requested precision. Range of value: 1 … 60000ms	10
Clock not synchronized	If there was no clock synchronization for a particular time, it will be considered that the clock is not synchronized. Range of values: 1 … 86400s	86400

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Synchronization from slaves	Time interval after which synchronization is allowed from the slave communication protocols 0 – means always allow synchronizing, 1 – 86400s – when there was no time for synchronization from SNTP clients. Range of values: 1 … 86400s	60
Clock Failure	Simulates the clock failure. Use only for protocol testing or commissioning.	No
Clock No Sync	Simulates an unsynchronized clock. Use only for protocol testing or commissioning.	No
Leap Seconds Known	Simulates Leap Seconds Known. Use only for protocol testing or commissioning.	No
Log	Logs clock synchronizations from the slave communication protocol Values: Yes; No	Yes
Show	Shows this window on startup. Values: Yes; No	No
Expand	Expands all tree nodes on startup. Values: Yes; No	No

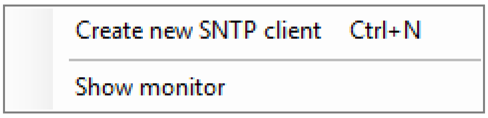


Figure 223. *Create new SNTP client*

If the user has created a new SNTP client, the following window with default parameters will be displayed.

Other opportunity is to run *Show monitor* window. The monitoring window will show the log data which the user has enabled in the SNTP client configuration with the parameters *Log Data, Log IP, Log Raw*.

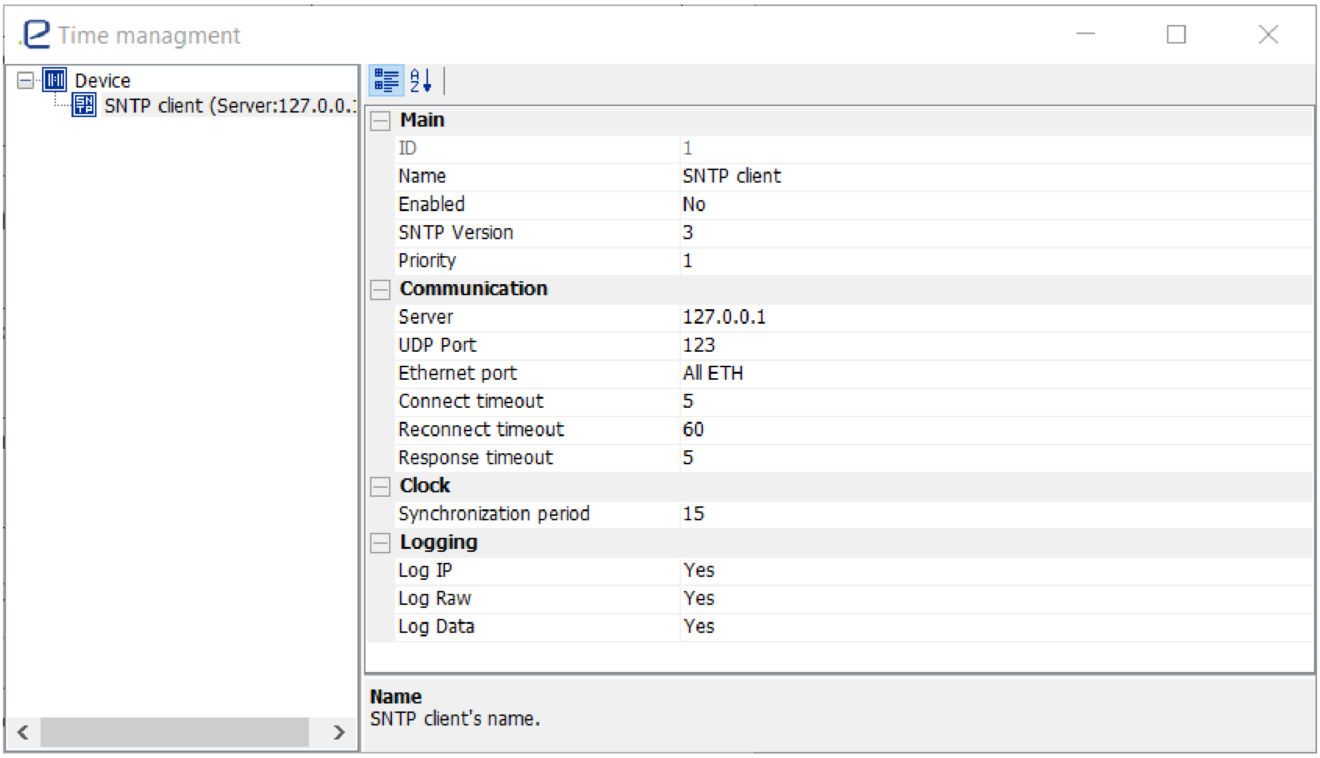


Figure 224. *SNTP client* window

Table 169. Fields of *SNTP client* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Name	Name of SNTP client, for example, 'SNTP1'	SNTP client
Enabled	Enables or disables a SNTP client Values: Yes; No	No
SNTP Version	Version of SNTP Values: 3, 4	3
Priority	If the user will configure more than one SNTP server, it is possible to rank servers in your order. Range of values: 1 … 255	1
Server	SNTP server IP address Values: xxx.zzz.yyy.nnn	127.0.0.1
UDP Port	UDP port to connect with the server Range of values: 1 … 65535	123
Ethernet port	Information address Range of values: All ETH, ETH1 … ETH4	All ETH

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Connect timeout	Connect timeout to the SNTP server Range of values: 1 … 60s	5
Reconnect timeout	Reconnect timeout if the connection failed Range of values: 1 … 86400s	60
Response timeout	Response timeout after the request has been sent Range of values: 1 … 86400s	5
Synchronization period	The time period to make synchronization Range of values: 1 … 86400s	15
Log IP	Enables to view an IP log Values: Yes; No	Yes
Log Raw	Enables to view a raw log Values: Yes; No	Yes
Log Data	Enables to view a data log Values: Yes; No	Yes

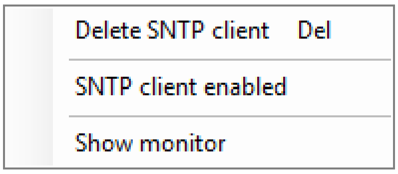


Figure 225. *SNTP client* popup menu window

With the *Show monitor*, it is possible to open the diagnostic tool for communication with the SNTP server. The following window shows *Time management monitor* window.

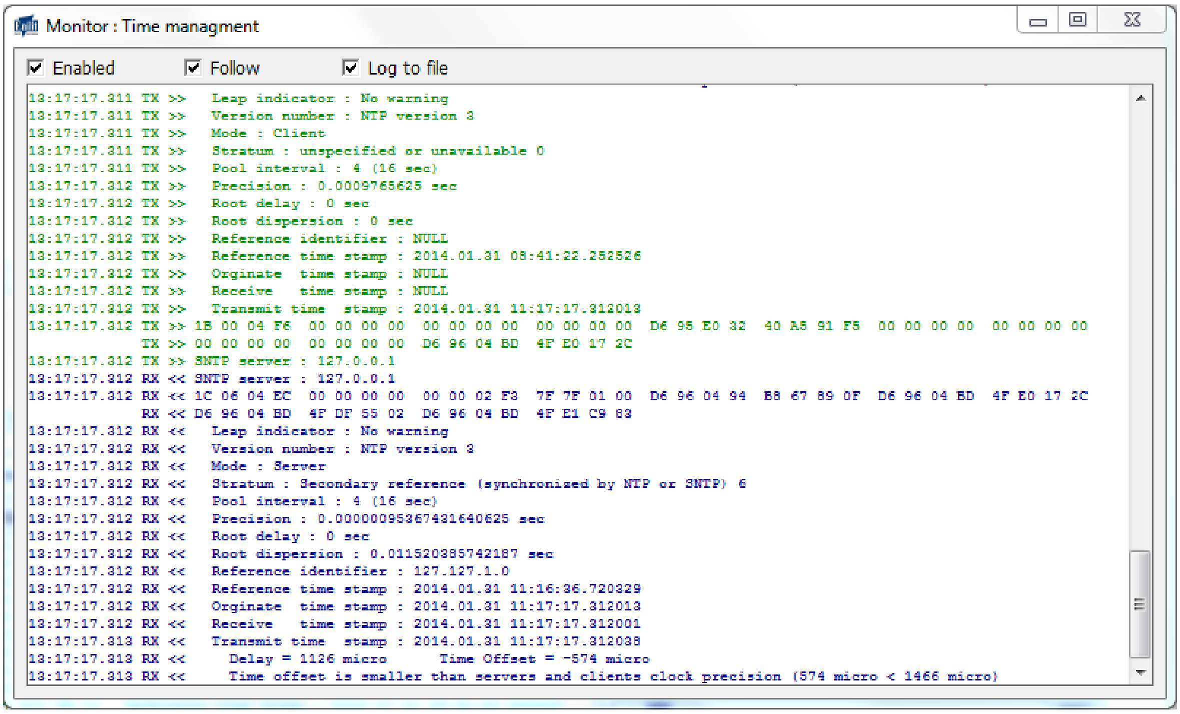


Figure 226. *Time management monitor* window

4.15 Self-control and diagnosis

Enilit CMS also provides diagnostic facilities which enable the user to view the hardware status of RTU with its configuration, to analyze and view serials and TCP protocols data, to monitor the current status of information objects, to test it and commands with the test values, to view and keep saved the system and events log.

4.15.1 Hardware monitoring

With the popup menu in *Enilit RTU Hardware* configuration window the user can run *Enilit RTU Hardware state* monitoring.

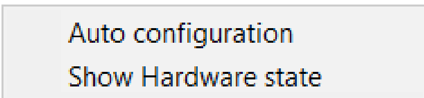


Figure 227. *Hardware* popup menu

When the user clicks *Show Hardware state*, the following figure will be seen. With this window the user can check if the hardware is well configured and working. In this hardware monitoring window, the following parameters are displayed: the current states of all modules, the output voltage of the power supply, CPU temperature, Watchdog status, binary inputs and command outputs states, measurements: current (mA) or voltage (V).

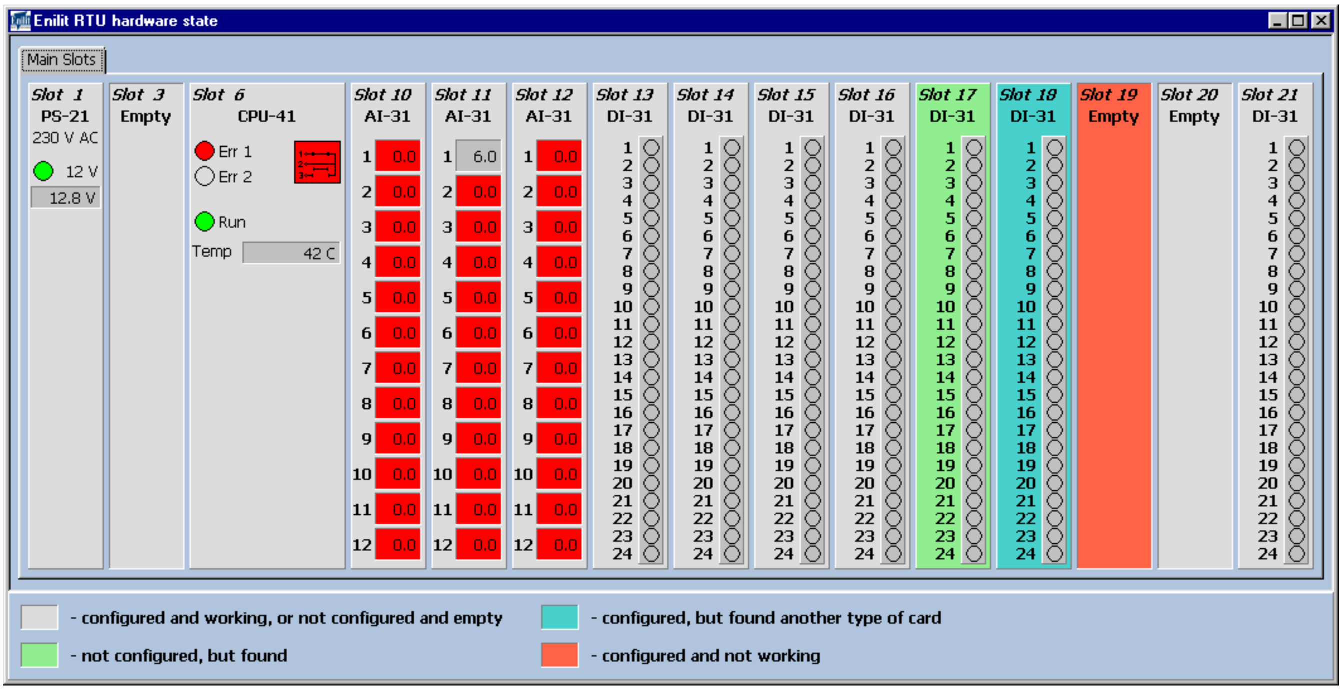


Figure 228. *Hardware state* window

- Configured and working, or not configured and empty.

- Not configured but found.

- Configured but found another type of module.

- Configured and not working.

4.15.1.1 Status signals, commands and measurements

Hardware status can be monitored via communication protocols. The user can connect hardware status signals to tags with the *TAG Manager*, also control hardware with the commands from SCADA. The following figure shows Hardware status signals, commands and measurements window.

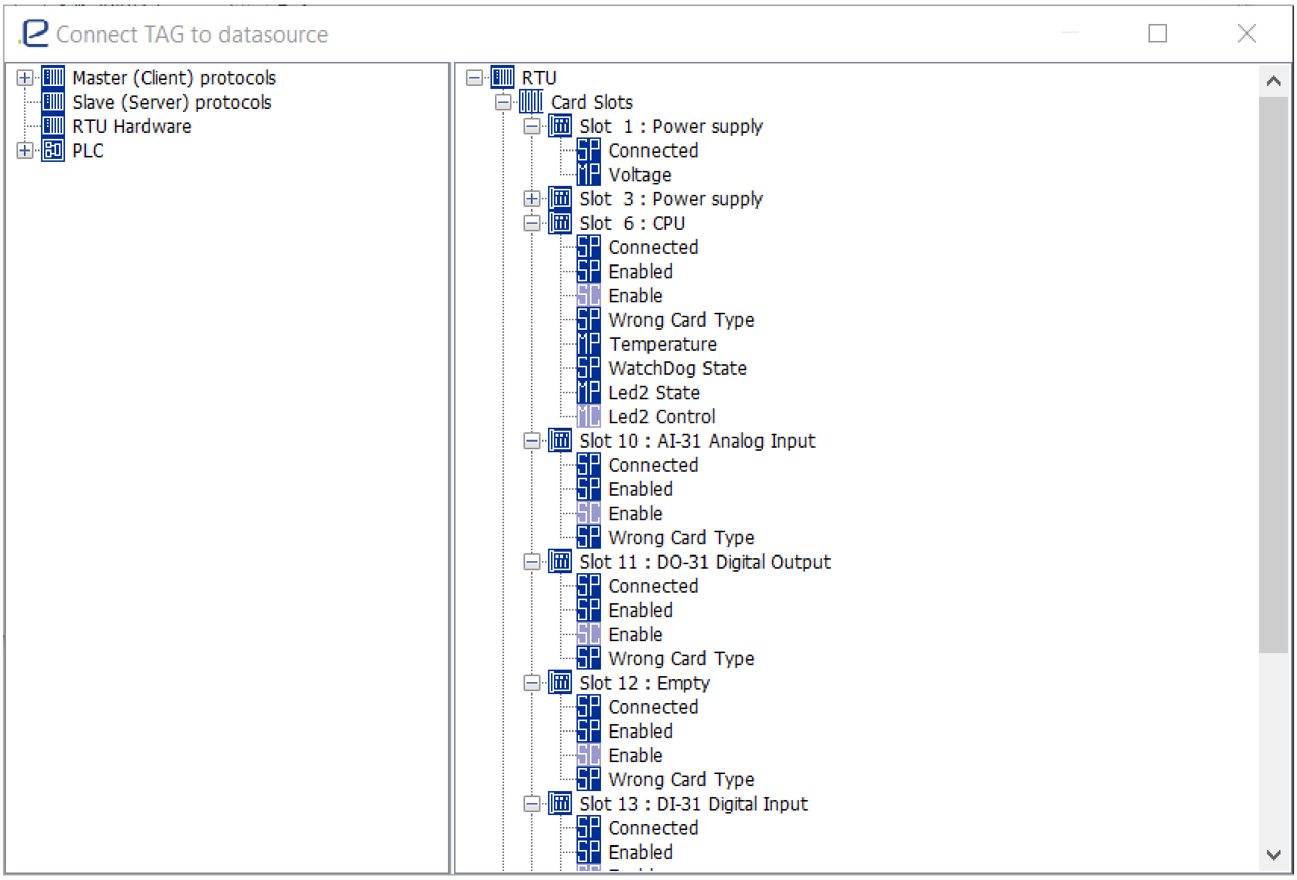


Figure 229. *Hardware status* signals, commands and measurements

Table 170. States and parameters of *Hardware status*

FIELD NAME	DESCRIPTION	CARD TYPES
Connected	Central processor communicates with the card. The card works without an error. Type: Status item 0 – Normal 1 – Fault	All
Voltage	Power supply voltage measurement Type: Status item	PS
Enabled	Enabled or disabled the card Type: Status item 0 – Enabled 1 – Disabled	All
Enable	Enables or disables communication of the central processor with the card. Type: Command item 0 – Disable command 1 – Enable command	All

FIELD NAME	DESCRIPTION	CARD TYPES
Wrong Card Type	Central processor detects a wrong card type. Type: Status item 0 – Ok, 1 – Fault	AI31, DI31, DO31, CPU
Temperature	Central processor temperature measurement Type: Status item	CPU
Watchdog state	Watchdog state 0 – Ok, 1 – Fault.	CPU
Led2 State	Central processor Led2 state Type: Status item 0 – Led2 off 1 – Led2 on	CPU
Led2 Control	Control of the central processor Led2 state Type: Command item 0 – Off 1 – On	CPU

4.15.2 Protocol monitoring and supervision

4.15.2.1 Monitoring

The following figure shows the communication port popup menu. With this popup menu the user can run the protocol monitoring tool *'Port monitor'*.

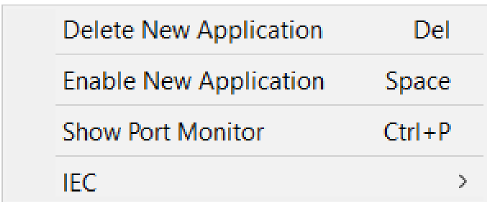


Figure 230. *Communication port* popup menu

The next figure shows the window in which the received and transmitted data through the communication port can be viewed. This window is for IEC 60870-5-103 protocol, but it is possible to use it for all serial or TCP protocols even for SNTP.

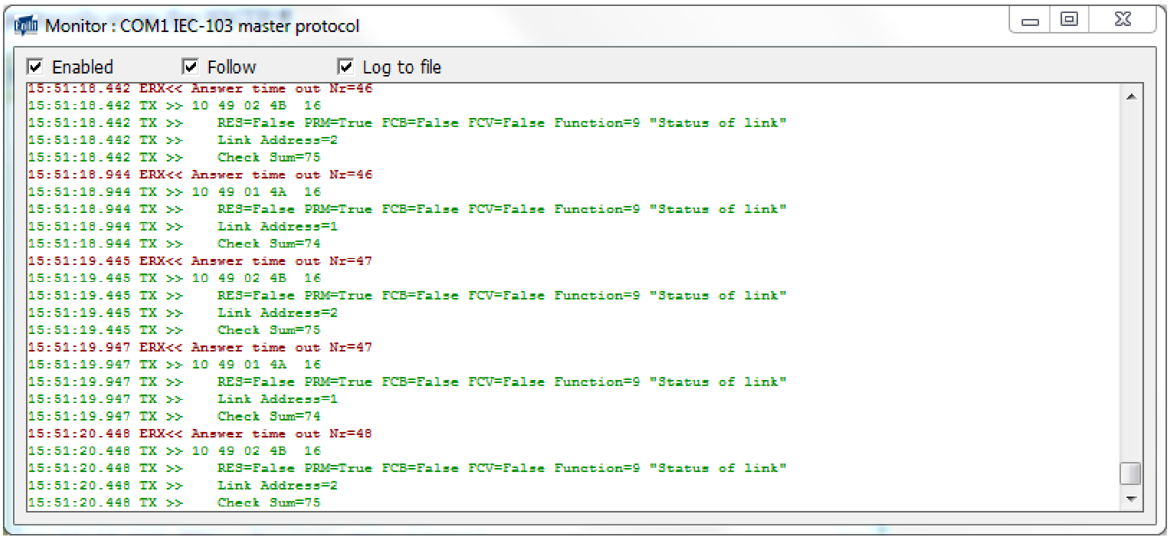


Figure 231. Standard *Master Protocol* monitor

Table 171. Types of data viewed in the standard *Master Protocol* monitor

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Enabled	Enables to view communication data. Values: Checked, Unchecked	Unchecked
Follow	Enables to follow the last communication data. Values: Checked, Unchecked	Unchecked
Log to file	Enables to log all data to the log file. Values: Checked, Unchecked	Unchecked

The next figure shows the communication data in monitoring direction either serial or TCP/IP between RTU and SCADA.

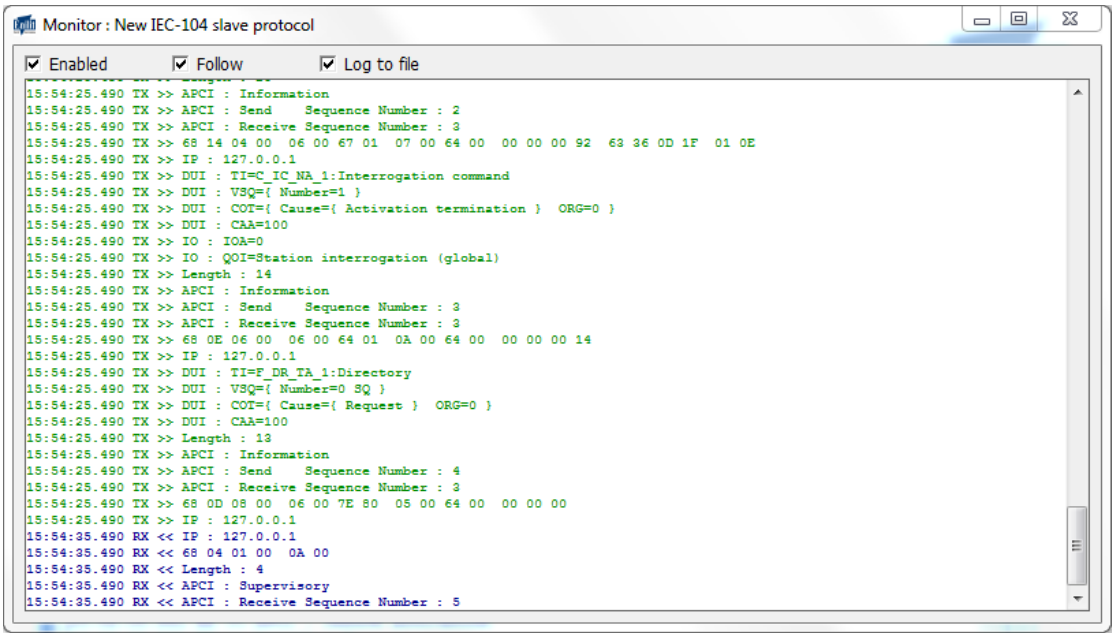


Figure 232. Standard *Slave Protocol* window

Table 172. States of standard *Slave Protocol* monitor window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Enabled	Enables to view communication data. Values: Checked, Unchecked	Checked
Follow	Enables to follow the last communication data. Values: Checked, Unchecked	Checked
Log to file	Enables to log all data to the log file. Values: Checked, Unchecked	Checked

This communication port monitoring tool is very useful at the stage of commissioning of the substation. A commissioning engineer does not need any additional testing software, or even additional hardware for the port monitoring and so on.

4.15.2.2 Supervision

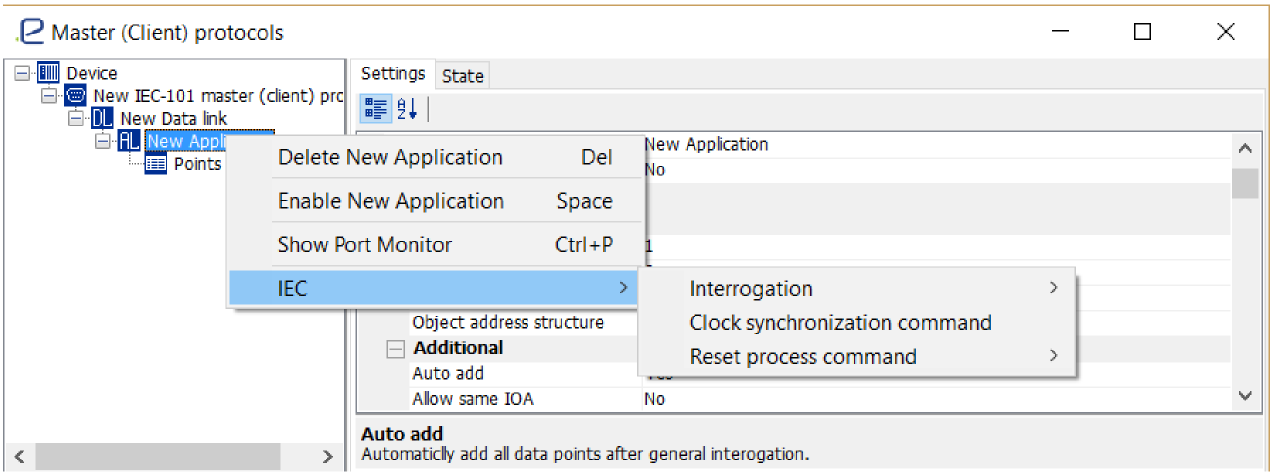


Figure 233. Protocol supervision popup window

For every IEC protocol in the controlling direction, the user can send commands like General Interrogation, Clock synchronization and Reset to process manually. It is very useful in the commissioning stage.

4.15.2.3 Status signals, commands and measurements

From every protocol in the controlling direction, the status signals and measurements of protocols can be used for monitoring in SCADA or HMI. The commands of protocols can be used as well for the protocol supervision.

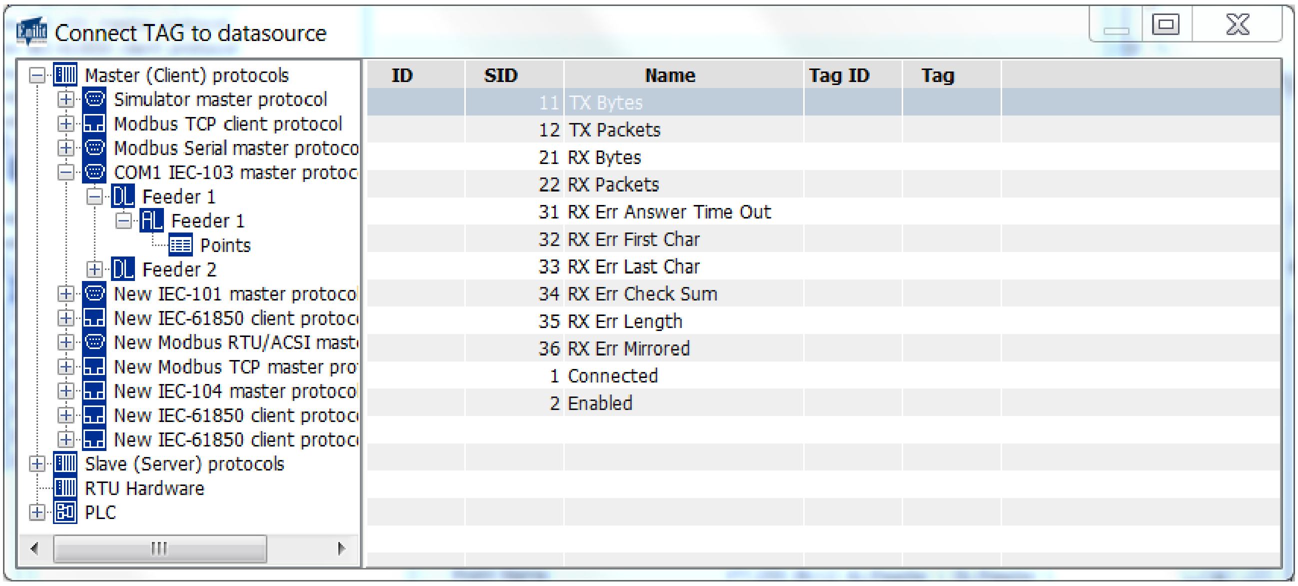


Figure 234. Standard protocol status items for master protocols

Table 173. Standard protocol status items for master protocols

FIELD NAME	DESCRIPTION	PROTOCOLS
Connected	Connected to the slave device. Type: Status item 0 – Normal 1 – Communication error	All
Enabled	Enabled or disabled communication protocol. Type: Status item 0 – Enabled 1 – Disabled	All
TX Bytes	Count of protocol transmitted bytes Type: Float	All
TX Packets	Count of protocol transmitted packets Type: Float	All
RX Bytes	Count of protocol received bytes Type: Float	All
RX Packets	Count of protocol received packets Type: Float	All
RX Err Answer Timeout	Type: Float	All serial protocols

FIELD NAME	DESCRIPTION	PROTOCOLS
RX Err First Char	Type: Float	All serial protocols
RX Err Last Char	Type: Float	All serial protocols
RX Err Check Sum	Type: Float	All serial protocols
RX Err Length	Type: Float	All serial protocols
RX Err Mirrored	Type: Float	All serial protocols
PRP-1 device is visible on Lan A	RTU has connection to the device over PRP-1 Lan A.	IEC 61850 Client
PRP-1 device is visible on Lan B	RTU has connection to the device over PRP-1 Lan B.	IEC 61850 Client

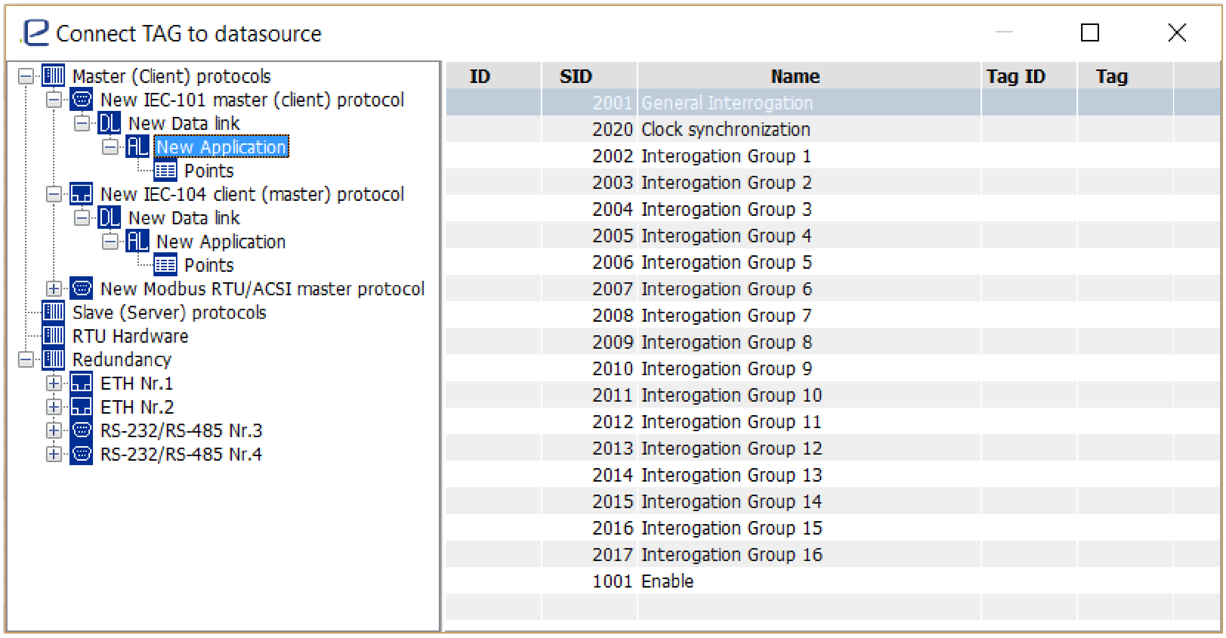


Figure 235. Standard protocol control items for IEC master protocols

4.15.3 System log

When Enilit CMS is started, the first window is *System log* window. The information in this window is also written to a file. The location of logs is described in the RTU description file.

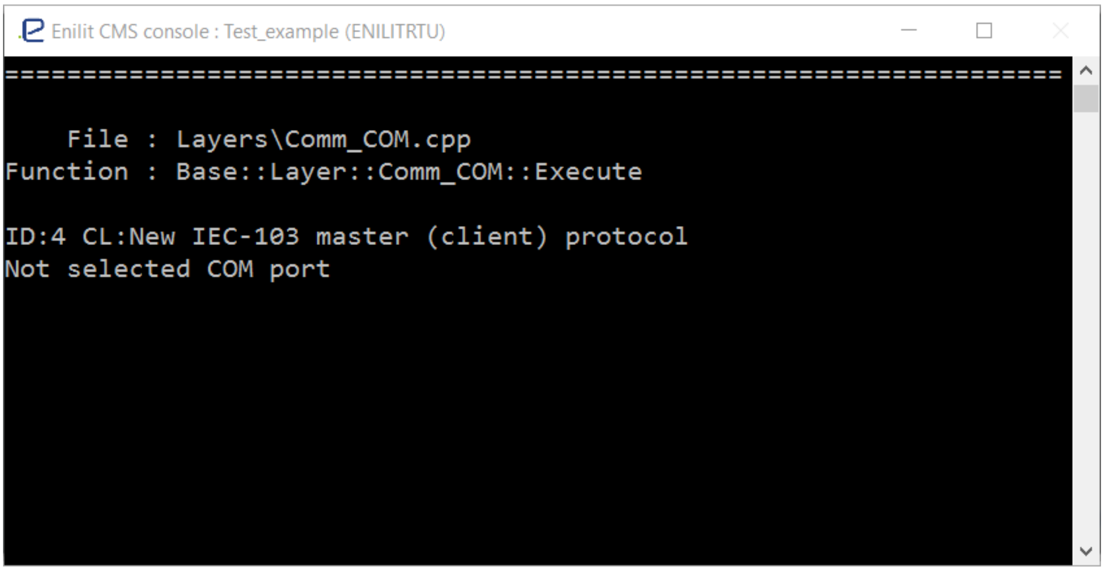


Figure 236. System log window

4.15.4 Events log

In the *TAG Manager* tool, the user can configure *Events log*. This window is also written to the file. By default, *Events log* files are stored in the RTU configuration directory *Logs*. The location of logs is described in the RTU description file.

To quickly open the *Events log*, the *TAG Manager* menu *File* and *Open Tag history file* can be used.

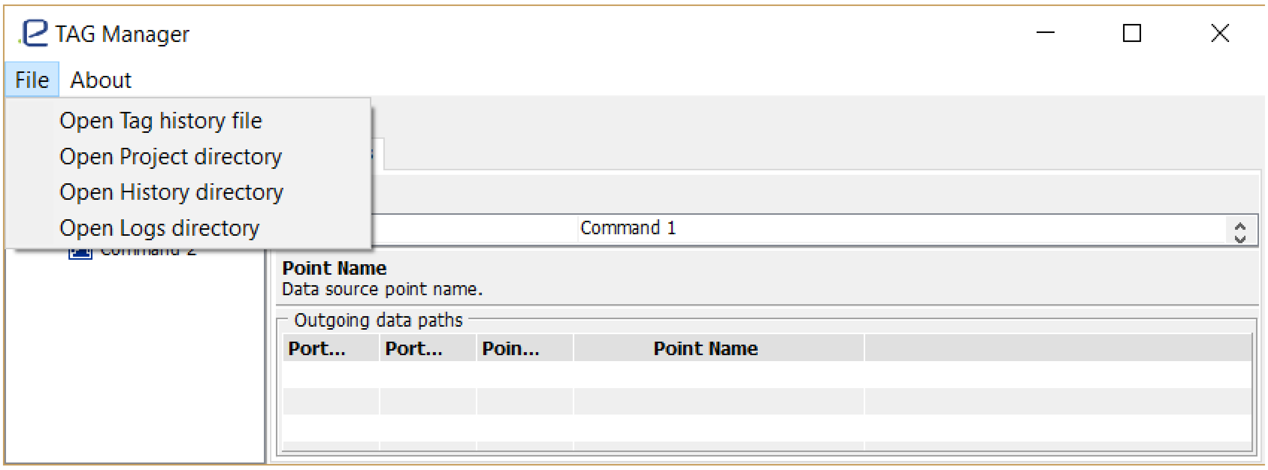


Figure 237. *TAG Manager* menu *File*

The configuration parameters for *Logs* can be found in the main branch *Device of the TAG Manager*.

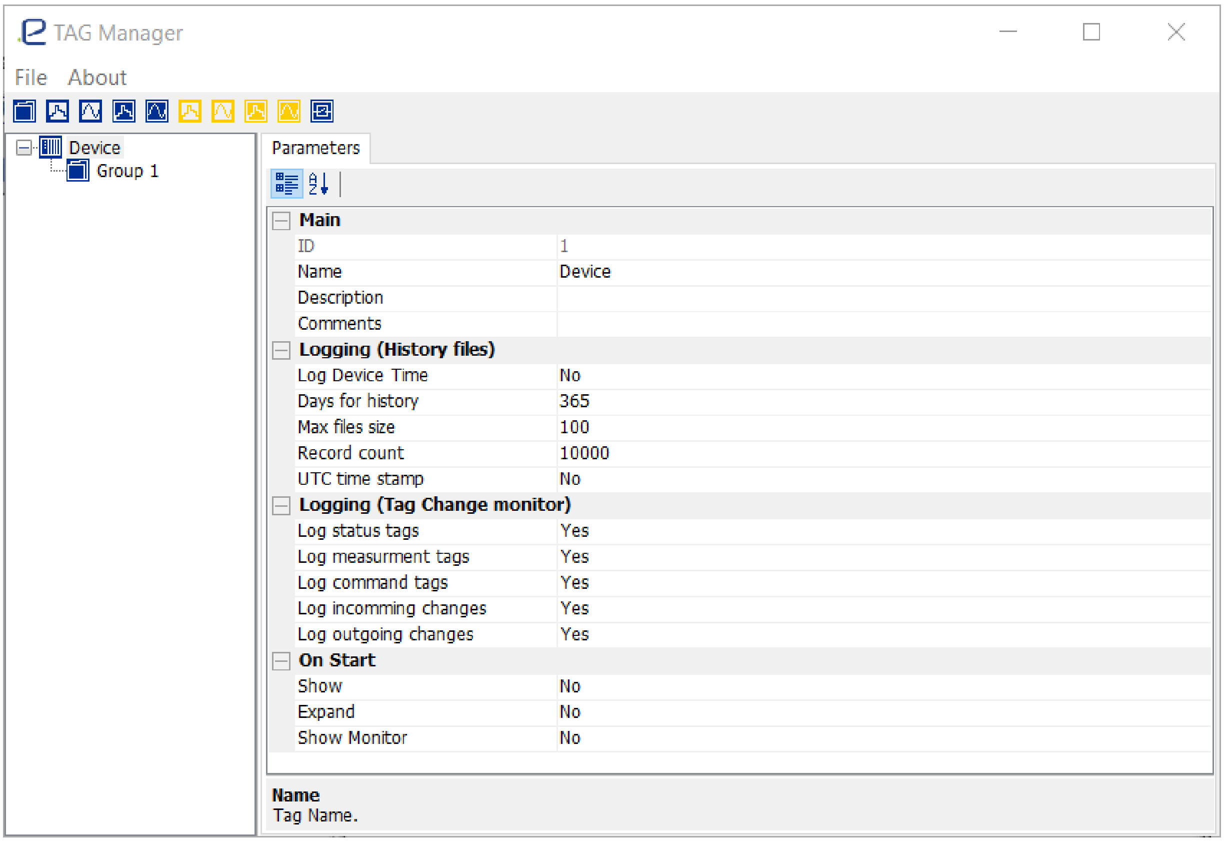


Figure 238. Main *TAG manager* window with *Logging* parameters

Table 174. Logging parameters of the branch *Device* in the main *TAG manager* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Name	Name of RTU, for example, 'Substation 1'	Device
Description	Free user description	
Comments	Free user comments	
Log RTU Time	Additional column will be added to history files which show the *event received time* in the TAG Manager. Values: Yes; No	No
Days for history	Number of days to keep events in Events list. Range of values: 10 … 1000 days	365
Max file size	Maximum size of all Events list files Range of values: 10 … 1000Mb	100
Record count	Record count in one Events list file Range of values: 1000 … 100000	10000

FIELD NAME	DESCRIPTION	DEFAULT VALUE
UTC time stamp	Time stamp of events to be saved in *Events list*. Values: Yes; No	No
Log status tags	Log status changes to Events list files. Values: Yes; No	Yes
Log measurements tags	Log measurements changes to Events list files. Values: Yes; No	Yes
Log command tags	Log commands changes to Events list files. Values: Yes; No	Yes
Log incoming changes	Log incoming changes to Events list files. Values: Yes; No	Yes
Log outgoing changes	Log outgoing changes to Events list files. Values: Yes; No	Yes
Show	Shows this window on startup.	No
Expand	Expand all tree nodes on startup.	No
Show Monitor	Shows the tag state change monitor on startup.	No

4.16 Redundancy

4.16.1 Redundancy support

Safety, reliability, high availability, and functionality are vital components of every control system in today's world. Enilit system utilizes:

- Dual RTU;
- Power supply redundancy;
- CPU redundancy

The system provides the automatic monitoring of primary and hot standby RTU and CPU. Failures are detected automatically and trigger a switchover from the Main RTU to hot Standby RTU or from main CPU to standby CPU. All communication channels are automatically switched from the Main unit. The switchover and data transfer are fast, thereby, ensuring that there is no interruption in the process control.

4.16.2 Redundancy methods for standby RTU or CPU

4.16.2.1 Cold-Standby

Cold-Standby is a method of redundancy in which the secondary RTU/CPU system is only called upon when the primary system fails. The system on cold standby receives scheduled data backups but less frequently than a warm standby. Cold standby systems are used for non-critical applications or in cases where data is changed infrequently.

4.16.2.2 Warm-Standby

Warm-Standby is a method of redundancy in which the secondary RTU/CPU system runs in the background of the primary system. The data is mirrored to the secondary RTU/CPU at regular intervals, which means that there are times when both servers do not contain the same data.

4.16.2.3 Hot-Standby

Hot-Standby is a method of redundancy in which the primary RTU/CPU and secondary RTU/CPU systems run simultaneously. The data is mirrored to the secondary RTU/CPU in real time so that both systems contain identical information. This method lets fast switchover from the Main to Standby RTU/CPU, because both of RTUs/CPUs have the same data. Hot-standby redundancy is used in Enilit RTU by default but on customer request it can be changed to Cold-Standby or Warm-Standby. Further description is mostly about this type of redundancy.

4.16.3 Connection diagram

To support redundancy, RTUs or CPUs must be connected one with other using LAN or/and Universal (RS-485/RS-232) interfaces. These communication paths are used to exchange real time data between the active and standby RTU. It is possible to use the maximum of 4 redundant connections between RTU’s.

- RS-485/RS-232 (COM1-COM12/8)
- RS-485/ RS-232 (COM1-COM12/8)
- LAN (ETH1-ETH4)
- LAN (ETH1-ETH4)

To create redundancy, realistically only 1 connection is required but they both have their drawbacks.

- LAN connection will be created faster but will transfer data slower
- RS connection will take longer but will transfer data faster

It is recommended to use at least 1 Ethernet connection and 1 RS connection. Ethernet connection is much faster so the first one of these connections will be used for data exchange. In case when there are no Ethernet connections, a serial will be selected. Even if the serial selected, by default 115,200 kbs speed it is possible to transfer about 500 events per second between RTUs. On request, speed can be increased for serial connections.

RTU redundancy is only meant to enable reservation of communication with IED devices but if you wish to have the RTU’s DI modules, be reserved you need to connect them duplicating the connection to the standby RTU as shown in Figure 234.

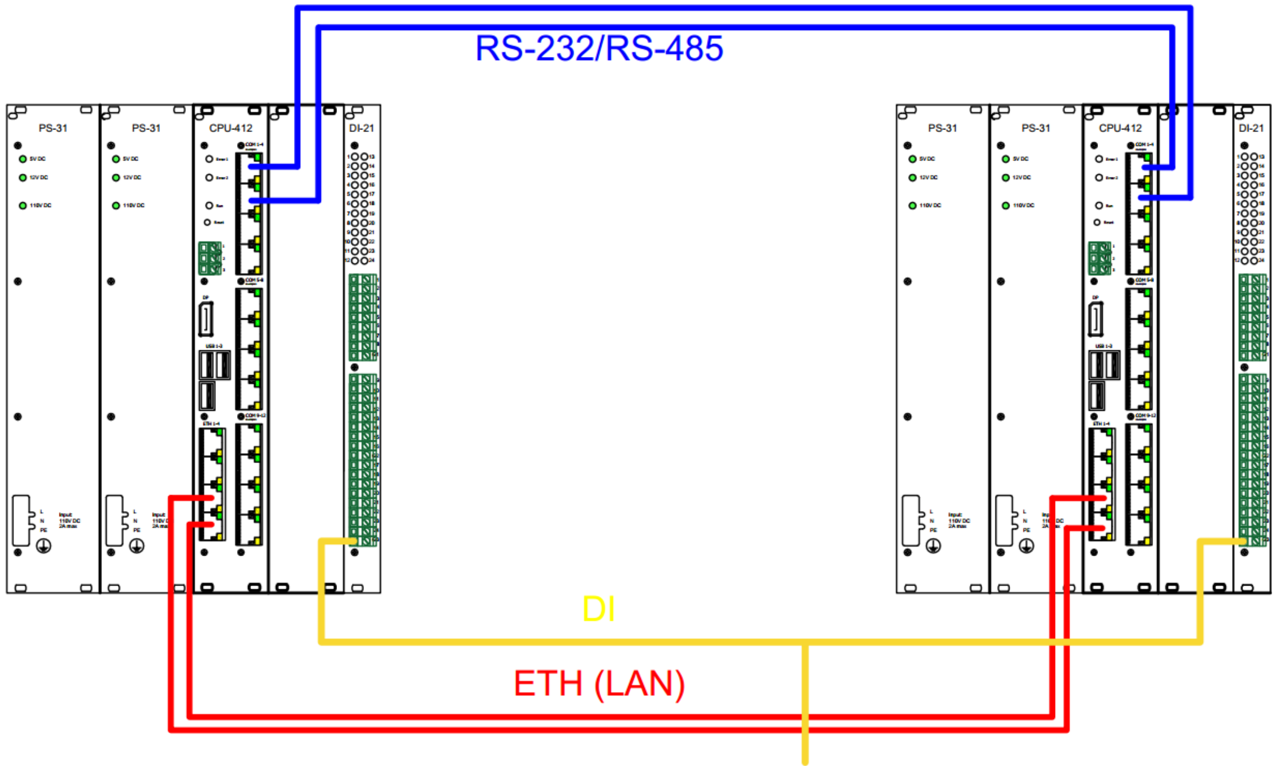


Figure 239. Example of connections between redundant RTUs

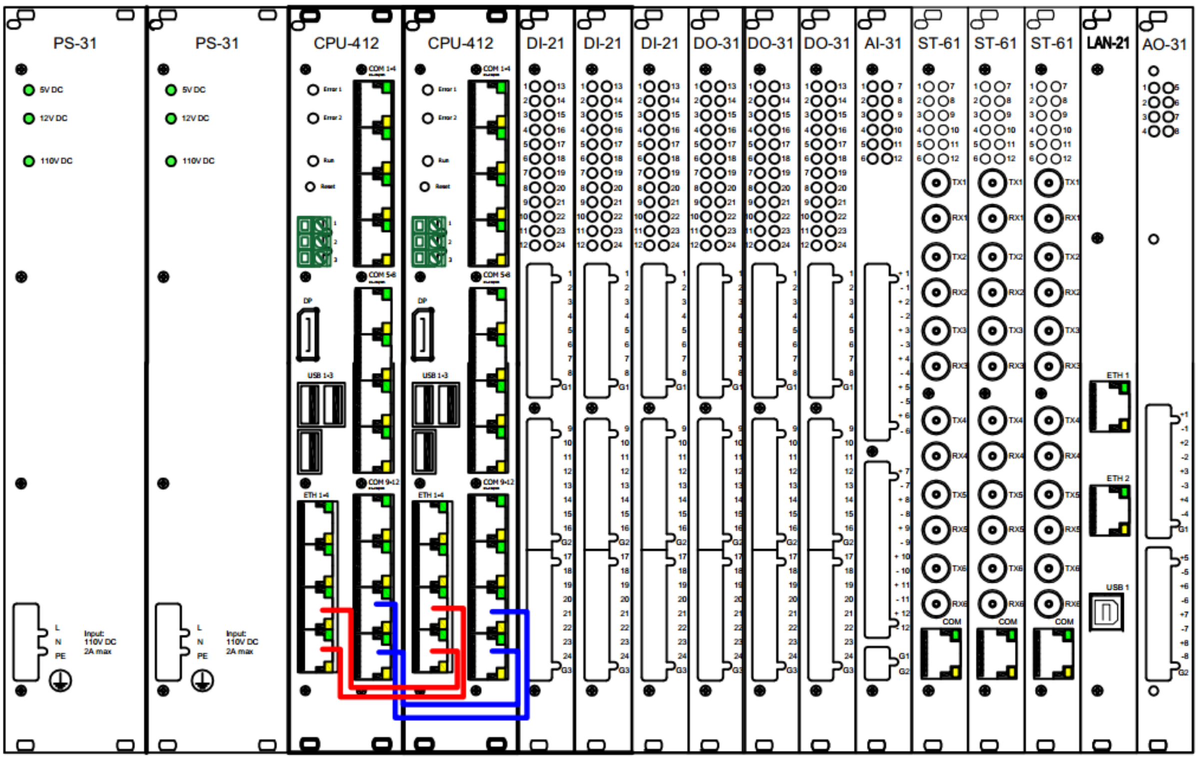


Figure 240. Example of connections between redundant CPUs

Only one of these connections is used for data exchange. Others are used for health monitoring of the active system. In case of broken data communication path, other active connection will be selected.

Note: It is also *possible* to use 1 USB port on each CPU with 2 USB-RJ45 converters to substitute a LAN connection.

4.16.4 Enilit RTU redundancy principles

Enilit redundancy system consists of two RTUs/CPUs. One of them is called the Main RTU/CPU and another is the Standby RTU/CPU. At any time, there can be only one Main RTU or CPU.

The Main RTU/CPU is responsible for:

- data acquisition from the slave and server devices,
- command transmission to the slave and server devices,
- PLC logic,
- process information transmission to the upper communication levels,
- process information transmission to the Standby RTU/CPU.

The Standby RTU/CPU is responsible for:

- data acquisition from the Main RTU/CPU,
- process information transmission to the upper communication levels,
- monitoring of connections to the Main RTU/CPU.

If the Standby device is healthy and running, it receives all process information from the Main device so it can transmit all necessary data to the upper communication levels. No matter how many redundant connections are configured between the Active and Standby systems, if there is at least one connection healthy, the Standby RTU/CPU knows that the Main RTU/CPU is running correctly. If there is no connection between the Standby and Main RTU/CPU, the Standby RTU/CPU changes its state to the Main. The switchover can be also executed manually. In this case the Standby RTU/CPU will change to the Active RTU/CPU, and the Active RTU/CPU will change to the Standby RTU/CPU. As the Standby RTU/CPU always acquires process information from the Active RTU/CPU, the switchover is fast. The key difference is that if standby CPU is used instead of RTU it can also perform gathering of information from modules within the same RTU.

4.16.5 Monitored fault locations

This section describes what can be monitored and used for the automatic switchover form the Standby to Main. Most of this monitored information is user selectable from the system self-control and diagnosis Tags (See description about 4.13 Self-control and diagnosis). Monitored information:

- Communication paths between the Main and Standby RTU/CPU (this is done by default and is not user selectable),
- RS-485, RS-232 port hardware errors and state,
- Ethernet port hardware errors and state,
- Cards hardware errors and state,
- Inner voltages and temperatures.
- Main CPU state,
- Power supply state,
- Main Watchdog relay on the CPU card (Digital Input type card will be needed on both of RTUs to check the relay state),
- Other specifics can be added on customer request.

All this monitored information can be used for the configuration of automatic switchovers, according to user needs.

4.16.6 Redundancy configuration

For Redundancy configuration the user should use the *Redundancy Manager*.

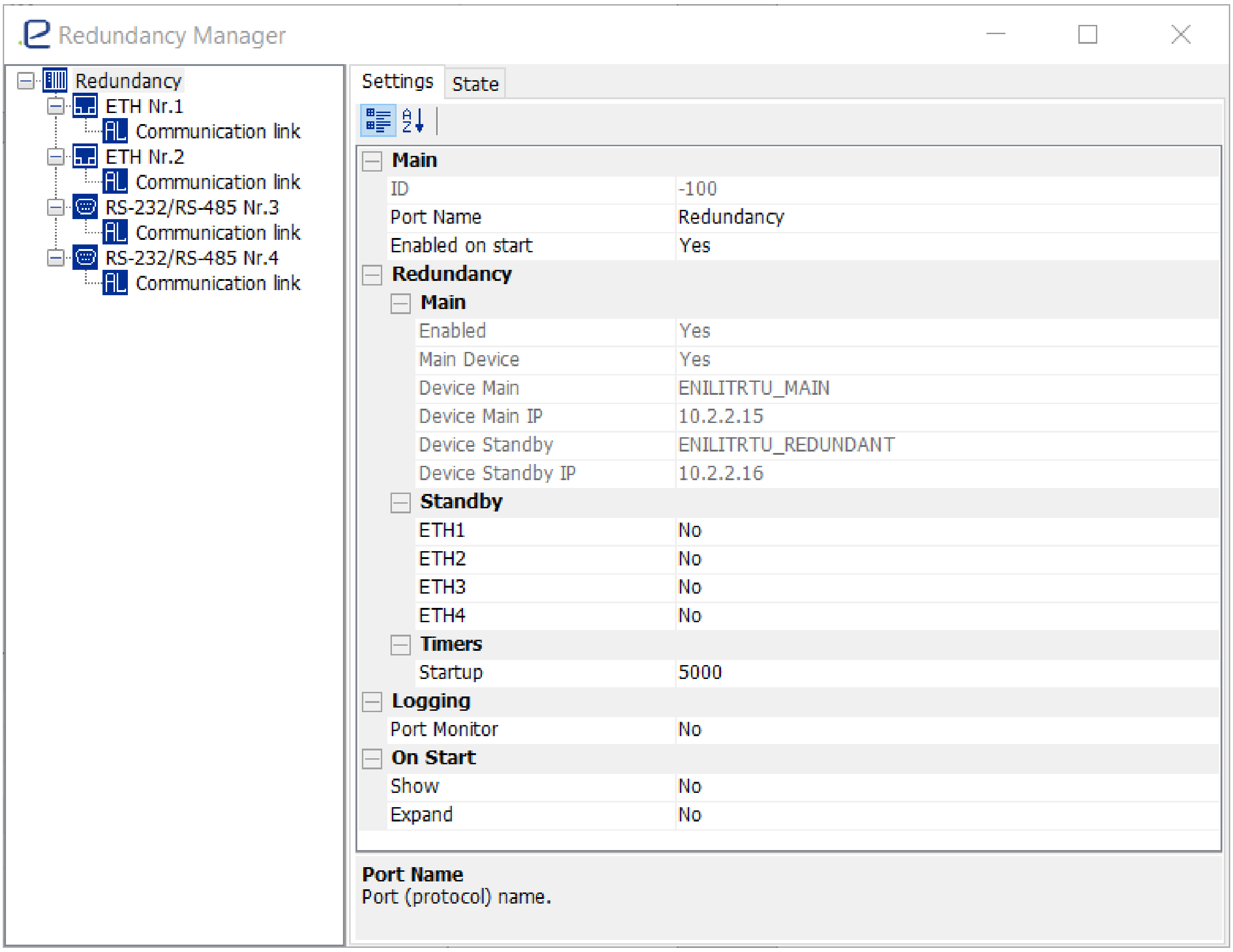


Figure 241. Redundancy parameters

Table 175. Fields of *Redundancy manager* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port name	Redundancy
Enabled on start	Enables or disables redundancy on start. Values: Yes; No	No

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Enabled	Shows if redundancy is enabled. To change this parameter, use *Enilit Project Manager.*	No
Main Device	Shows if this device is the Main device.	No
Device Main	Main device name. To change this parameter, use *Enilit Project Manager*.	
Device Main IP	Main device IP address. To change this parameter, use *Enilit Project Manager.*	
Device Standby	Standby device name. To change this parameter, use *Enilit Project Manager.*	
Device Standby IP	Standby device IP address. To change this parameter, use *Enilit Project Manager.*	
ETH1 … ETH4	If the device is going to the standby state, the communication port can be disabled with this parameter.	No
Startup	On startup the device waits for connections from the redundant device, if there are no connections for the specified time, this device will be set to the main mode. Range of values: 100…60000ms	5000
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Show	Shows this window on startup.	No
Expand	Expands all *Tree Nodes* on startup.	No

4.16.7 Communication channel configuration

4.16.7.1 Redundancy Connection LAN1 parameters

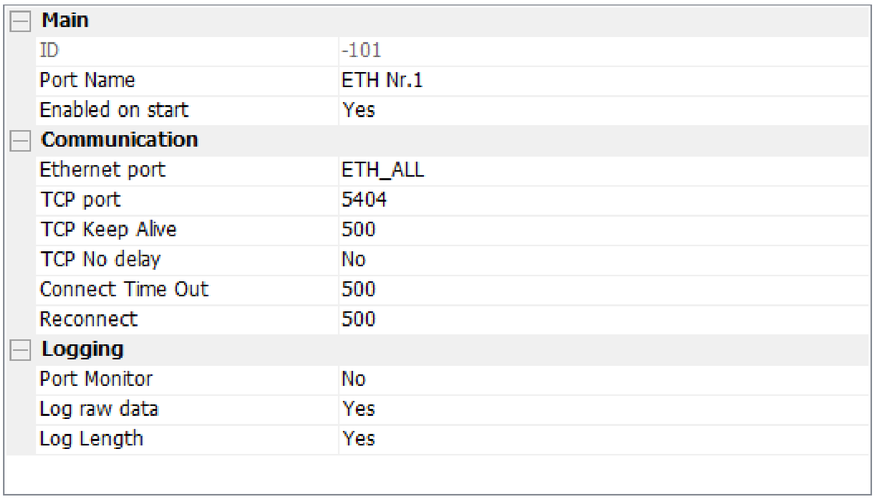


Figure 242. Redundancy connection LAN1 parameters

Table 176. Parameters of redundancy connection LAN1 in the *Redundancy manager* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port Name	ETH Nr.1
Enabled on start	Enables or disables connection on start. Values: Yes; No	No
Ethernet port	Choose the RTU Ethernet port. Values: ETH1, ETH2, ETH3, ETH4	Not assigned
TCP Port	TCP/IP communication port.	5404
TCP Keep Alive	TCP Keep Alive. Do not set low values because it will add overhead to communication. Range of values: 0 … 2147483647ms 0 – disabled	500
TCP No delay	TCP No delay disables the Nagle Algorithm. Values: Yes; No	No
Connect Time Out	Communication timeout. In case if this is the last connection between RTUs and it is timed out, then switchover from the Standby RTU to Active happens.	500

FIELD NAME	DESCRIPTION	DEFAULT VALUE
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 50…60000ms	500
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes
Log Length	Enables to log sent packet length. Values: Yes; No	Yes

4.16.7.2 Redundancy Connection LAN2 parameters

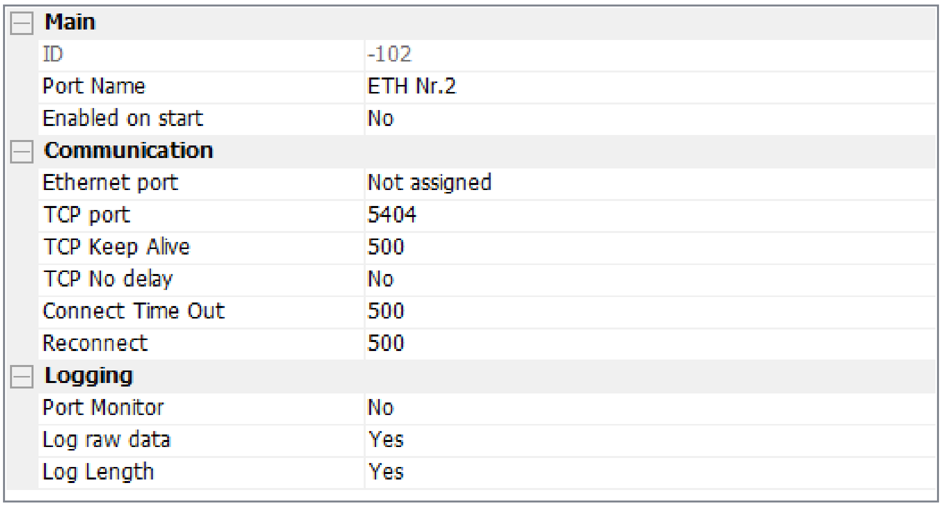


Figure 243. Redundancy connection LAN2 parameters

Table 177. Parameters of redundancy connection LAN2 in the *Redundancy manager* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port Name	ETH Nr.2
Enabled on start	Enables or disables connection on start. Values: Yes; No	No
Ethernet port	Choose RTU Ethernet port. Values: ETH1, ETH2, ETH3, ETH4	Not assigned
TCP Port	TCP/IP communication port	5404

FIELD NAME	DESCRIPTION	DEFAULT VALUE
TCP Keep Alive	TCP Keep Alive. Do not set low values, because it will add overhead to communication. Range of values: 0 … 2147483647ms 0 – disabled	500
TCP No delay	TCP No delay disables the Nagle Algorithm. Values: Yes; No	No
Connect Time Out	Communication timeout. In case if this is the last connection between RTUs and it is timed out, then the switchover from the Standby RTU to Active happens.	500
Reconnect	Time interval of reconnection attempt to the communication port while communication is not established Range of values: 50…60000ms	500
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes
Log Length	Enables to log sent packet length. Values: Yes; No	Yes

4.16.7.3 Redundancy Connection RS-232/RS-485 No. 3 parameters

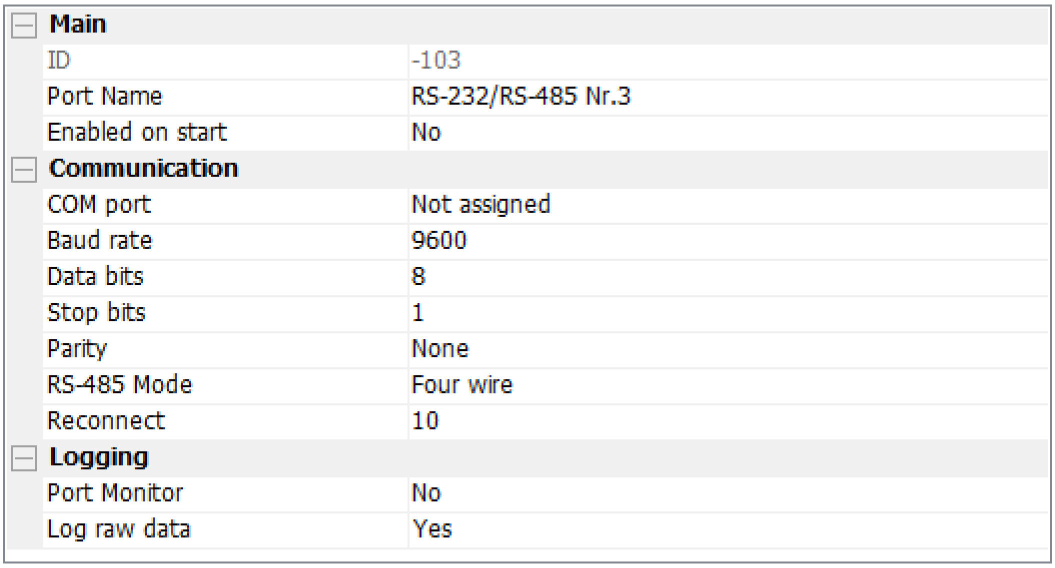


Figure 244. Redundancy connection RS-232/RS-485 No. 3 parameters

Table 178. Parameters of redundancy connection RS-232/RS-485 No. 3 in the *Redundancy manager* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port Name	RS-232/RS-485 No. 3
Enabled on start	Enables or disables connection on start. Values: Yes; No	No
Com port	Communication port number.	Not assigned
Baud rate	Serial port baud rate. Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7,8 bits	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 Mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Range of values: Four wires, Two wires	Four wire
Reconnect	Time interval of reconnection attempt while communication is not established. Range of values: 1 … 600s	10
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data Values: Yes; No	Yes

4.16.7.4 Redundancy Connection RS-232/RS-485 No. 4 parameters

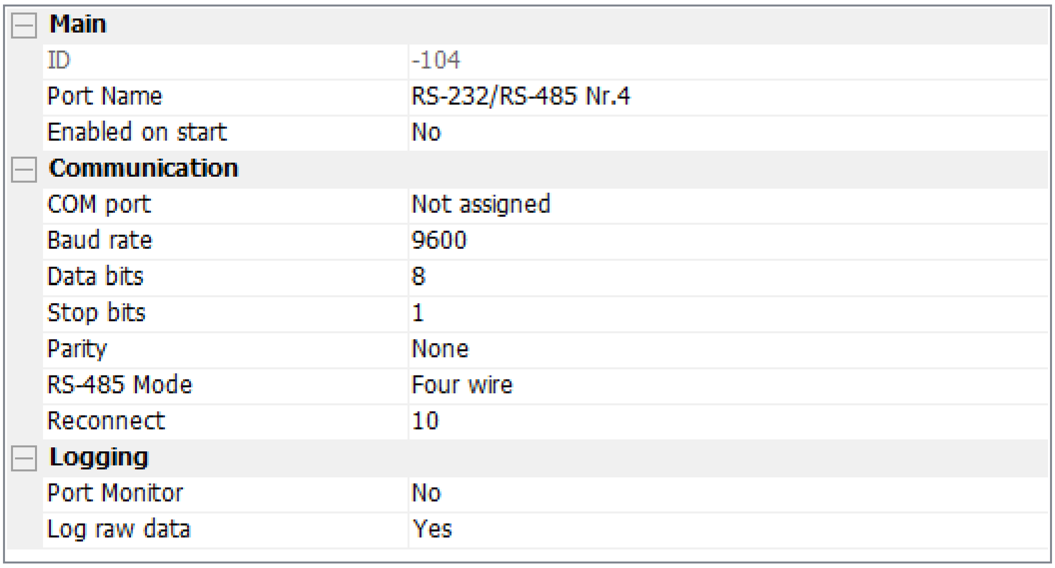


Figure 245. Redundancy connection RS-232/RS-485 No. 4 parameters

Table 179. Parameters of redundancy connection RS-232/RS-485 No. 4 in the *Redundancy manager* window

FIELD NAME	DESCRIPTION	DEFAULT VALUE
ID	For internal use	
Port Name	Port Name	RS-232/RS-485 No. 4
Enabled on start	Enables or disables connection on start. Values: Yes; No	No
Com port	Communication port number	Not assigned
Baud rate	Serial port baud rate Range of values: 110 … 921600	9600
Data bits	Serial port data bits Values: 7,8 bits	8
Stop bits	Serial port stop bits Values: 1, 1.5, 2 bits	1
Parity	Serial port parity Values: None, Odd, Even, Mark, Space	None
RS-485 Mode	If two wires are used, the mirrored data check should be used. If the serial port is RS-232, the parameter is not important. Range of values: Four wires, Two wires	Four wire

Reconnect	Time interval of reconnection attempt while communication is not established. Range of values: 1 … 600s	10
Port Monitor	Shows the port monitor on the system startup. Values: Yes; No	No
Log raw data	Enables to log raw communication data. Values: Yes; No	Yes

4.16.8 Status signals, commands and measurements

The user can connect every system status signal for redundancy to the upper communication link and send to SCADA. The control of the main and standby devices can be issued from SCADA as well.

4.16.8.1 Status items for redundancy

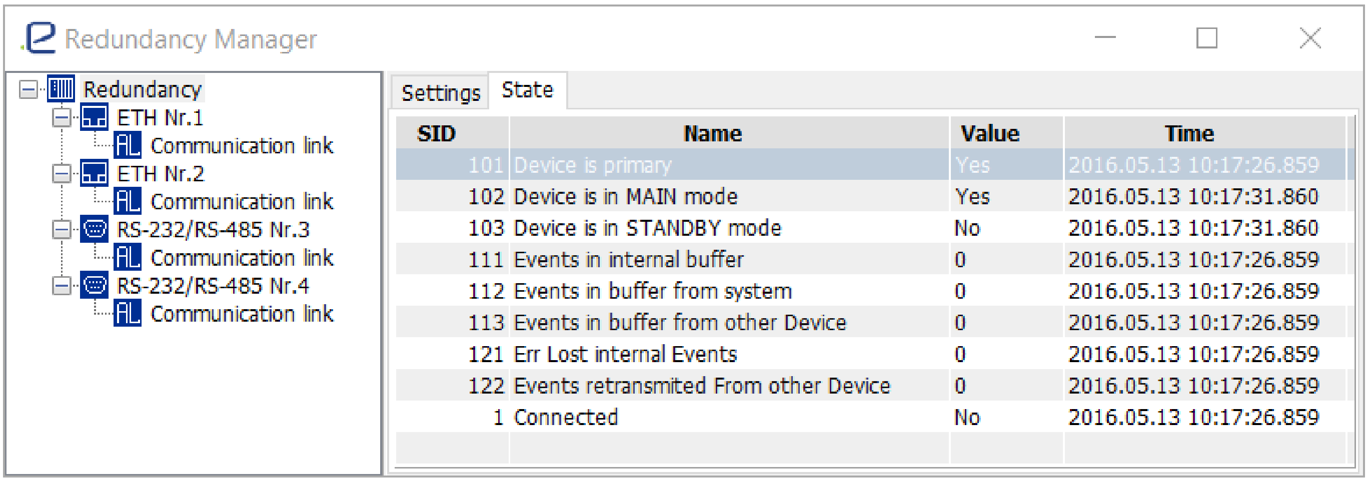


Figure 246. System status items for redundancy

Table 180. System status items for *Redundancy* in the *Redundancy Manager* table *'State'*

FIELD NAME	DESCRIPTION
Device is primary	Device is primary. The name of the Device in your project shows that this device is primary.
Device is in MAIN mode	Current Device is now in the MAIN mode.
Device is in STANDBY mode	Current Device is now in the STANDBY mode.
Events in internal buffer	Total events in the internal buffer.
Events in buffer from system	Total events in the system buffer.

Events in buffer from other device	Total events in the buffer from the other Device.
Err Lost internal Events	Total error lost internal events.
Events retransmitted from other device	Events retransmitted from the other Device.
Connected	Redundant connection is connected.

4.16.8.2 Status items for ETH connections

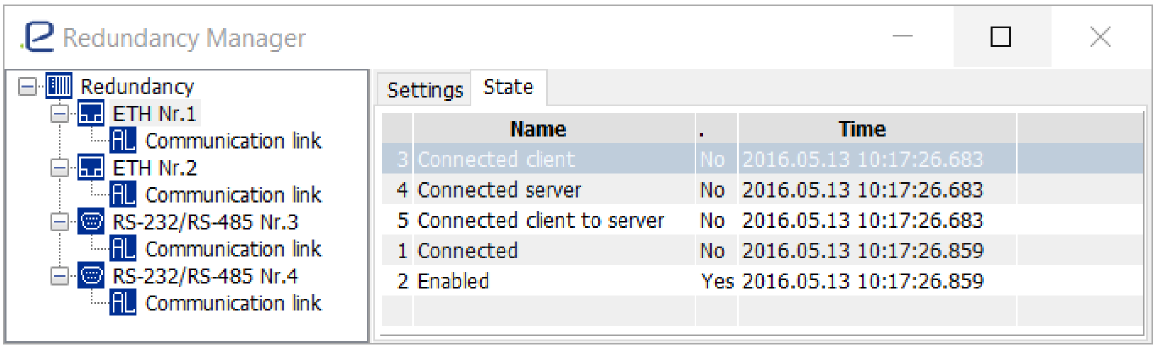


Figure 247. Status items for ETH connections

Table 181. Status items for ETH connections in the *Redundancy Manager* table *'State'*

FIELD NAME	DESCRIPTION
Connected client	Other device is connected to this device
Connected server	Device redundancy server is ready for connections from the client.
Connected client to server	Device connected to the other device.
Connected	Redundancy communication link is working.
Enabled	Communication port is enabled.

4.16.8.3 Status items for RS-232/RS-485 connections

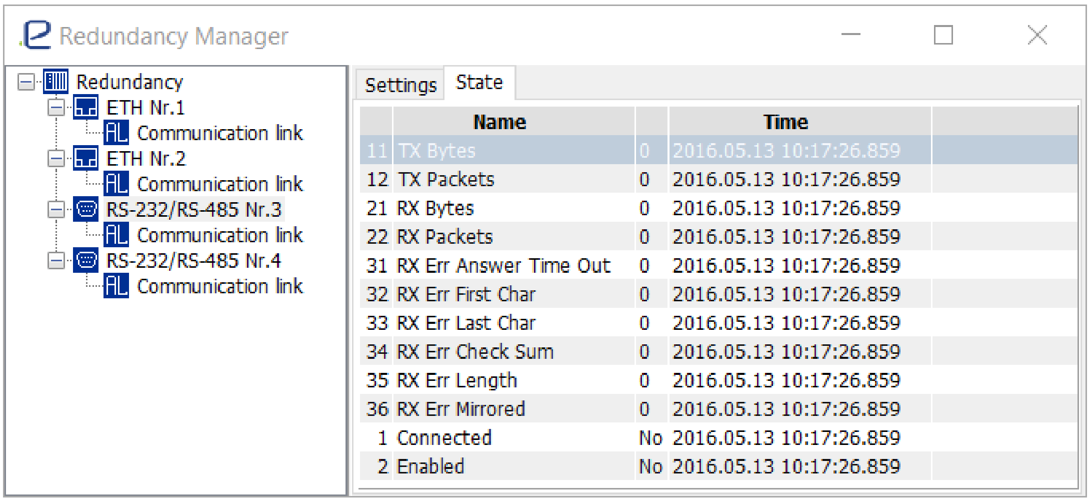


Figure 248. Status items for RS-232/RS-485 connections

Table 182. Status items for RS-232/RS-485 connections in the *Redundancy Manager* table *'State'*

FIELD NAME	DESCRIPTION
TX Bytes	Protocol transmitted bytes.
TX Requests	Protocol transmitted packets.
RX Bytes	Protocol received bytes.
RX Packets	Protocol received packets.
RX Err Answer Time Out	Error: Answer Time out
RX Err First Char	Error: Wrong first character
RX Err Last Char	Error: Wrong last character
RX Err Check Sum	Error: Wrong Check sum
RX Err Length	Error: Wrong Packet Length
RX Err Mirrored	Error: Got Mirrored data
Connected	Redundancy communication link is working.
Enabled	Communication port is enabled.

4.16.8.4 System status items for communication links

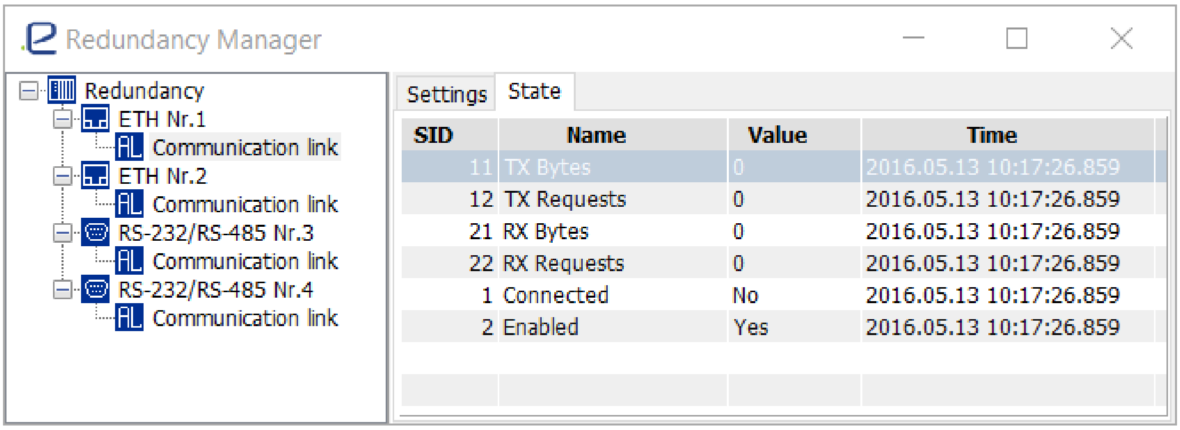


Figure 249. Communication link status items for redundant connection

Table 183. Communication link status items for redundant connection in the *Redundancy Manager* table *'State'*

FIELD NAME	DESCRIPTION
TX Bytes	Protocol transmitted bytes
TX Requests	Protocol transmitted packets
RX Bytes	Protocol received bytes
RX Packets	Protocol received packets
Connected	Connected to the redundant RTU. Values: 1 – Normal, 0 – Communication error
Enabled	Enabled or disabled redundant connection Values: 1 – Enabled, 0 – Disabled

4.17 Cyber security capabilities

4.17.1 Introduction

Cyber data security is a vital element of the system's reliability. It decreases cyber-crimes and increases the security and availability of the system's communication network.

The systems where RTUs are being used (e.g. power, water, and oil supply systems) are usually considered critical infrastructure. Security threats generally consist of attacks against the assets. These assets may not only be physical facilities, but also cyber information, databases, and software applications. Targets such as

IEDs, SCADA (Supervisory Control and Data Acquisition) systems, EMS (Energy Management Systems), databases, applications, and web services can be attacked. Even if the network is completely isolated and no remote equipment is connected, attacks may even be initiated by operational personnel who lack special training and awareness. In order to prevent from such attacks Enilit RTU has data cyber security capabilities according to the standard IEEE 1686-2013 (revision of IEEE 1686-2007), IEEE Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities, December 2013. Based on mentioned standards all the non-used functions are disabled. All not used interfaces could be also disabled if necessary.

IEEE 1686-2013 is a security standard for IEDs. It establishes the requirements for IED security in accordance with NERC CIP. This standard defines the functions and features to be provided in the substation IEDs to accommodate critical infrastructure protection programs.

The main cyber security capabilities of Enilit RTU are described in the chapters below. If some extra security functions are required, they could be added based on the client's request.

4.17.2 Electronic access control

All electronic access to Enilit RTU, either locally through a communication/diagnostic port with a test set or personal computer, or remotely through the communications media, is password protected. It is not possible to gain access to the device without a proper password that has been generated by the user.

4.17.2.1 Password defeat mechanisms

Enilit RTU has no means whereby the user-created password control can be defeated or circumvented. This includes such mechanisms and techniques such as:

- Vendor-embedded master password;
- Chip-embedded diagnostic routines made accessible by hardware or software failures;
- Hardware bypass capabilities such as jumpers and switch settings.

UAB Enilit guarantees that no such mechanisms exist, which would allow circumvention of the user-created password control.

4.17.2.2 Number of individual passwords supported

Thousands of unique user-access passwords could be created.

4.17.2.3 Password construction

User-created passwords follow a set of rules which must be adhered to in the creation of each password. A minimum of 8 characters is used. Password could consist of any number of characters requested by the client. The password characters should contain the following:

- At least one uppercase and one lower case letter;
- At least one number;
- At least one non-alphanumeric character (e.g., @%&*).

Any attempt to create a password that violates these rules is captured at the time of attempted creation and the user will be notified and prompted to choose another password that conforms to the rules.

For more information about user passwords see paragraph 4.5.3 of this document.

4.17.2.4 Authorization levels by password

Enilit RTU supports the ability to assign authorization to utilize Enilit RTU's functions and features based on the individual user-created passwords. At a minimum, the following functions and features shall have this assignability available:

- View Data – the ability to view operational data (voltage, current, power, energy, status, alarms, etc.);
- View Configuration Settings – the ability to view configuration settings of the Enilit RTU such as scaling, communications addressing, programmable logic routines;
- Force Values – the ability to manually overwrite real data with manually inputted data and/or the ability to cause a control output operation to occur;
- Configuration Change – the ability to download and upload configuration files to the unit and/or effect changes to the existing configuration;
- Password Management – the ability to create, delete or modify passwords and/or password authorization levels;
- Audit Log – the ability to view and download the audit log.

For more information about User groups (Roles of Users) see paragraph 4.5.2 of this document.

4.17.2.5 Password display

It is not possible to cause Enilit RTU access passwords to be displayed through any means, including configuration software connection and terminal access.

4.17.2.6 Access timeout

Enilit RTU has a timeout feature that revokes all access levels granted through password entry after a period of user inactivity. Inactivity shall be defined as the absence of input keystroke activity on a computer connected to the port of Enilit RTU. The period before the timeout feature activates is settable between 1 and 60 minutes by the user in the configuration of Enilit RTU.

4.17.3 Audit trail

Enilit RTU records events in the order in which they occur. This audit trail is in the form of a file which can be viewed on a computer attached to the diagnostic/maintenance port of Enilit RTU.

4.17.3.1 Storage capability

The audit trail facility has the capability to store more than 10 000 events before the circular buffer begins to overwrite the oldest event with the newest event. There is no capability to erase or modify the audit trail. It is not possible to remove the storage media of the audit trail without permanently damaging Enilit RTU beyond the capability of field repair.

4.17.3.2 Storage record

For each audit trail event, the following information is recorded:

- Event Record Number;
- Time & Date – Time and date of the event will be recorded in a yy/mm/dd/hh/mm format;
- User Identification – the user ID logged into Enilit RTU at the time of the event;
- Event Type.

4.17.3.3 Audit trail event types

The following events shall cause an entry into the Audit Trail record

- Log In – Successful log in;
- Manual Log Out – User Initiated;
- Timed Log Out – Log out of User after defined period of inactivity elapses;
- Value forcing – Operator action that overwrite real data with manual entry and/or causes a control operation;
- Configuration Access – Download of the configuration file;
- Configuration Change – Upload a new configuration file or keystroke entry of a new configuration parameter to Enilit RTU;
- Password Creation – Creation of a new password or modification of the password level of authorization;
- Password Revocation – Revocation of a password;
- Audit Log Access – User access of audit log for viewing or file download;
- Time/Date Change – User request to change time and date.

Keywords	Date and Time	Source	Event ID	Task Category
Audit Success	2013.12.04 08:24:56	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:56	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:55	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:55	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:54	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:54	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:51	Microsoft Windows securi...	4738	User Account Management
Audit Success	2013.12.04 08:24:51	Microsoft Windows securi...	4725	User Account Management
Audit Success	2013.12.04 08:24:47	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:47	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:46	Microsoft Windows securi...	4672	Special Logon
Audit Success	2013.12.04 08:24:46	Microsoft Windows securi...	4624	Logon
Audit Success	2013.12.04 08:24:47	Eventlog	1102	Log clear

Figure 250. *Audit Trial* log

Policy	Security Setting
Audit account logon events	Success, Failure
Audit account management	Success, Failure
Audit directory service access	Success, Failure
Audit logon events	Success, Failure
Audit object access	Success, Failure
Audit policy change	Success, Failure
Audit privilege use	Success, Failure
Audit process tracking	Success, Failure
Audit system events	Success, Failure

Figure 251. Settings of *Audit Trial*

Enilit CMS, independently from Linux or Windows operating systems, stores some of events in the System Log file. This is important if there is a need to send Security events through IEC or DNP communication protocols to SCADA.

4.17.4 Supervisory monitoring and control

In addition to the Audit Trail capability, Enilit RTU monitors security-related activity and makes the information available, through a real-time communication protocol, for transmission to a supervisory system. If serial communications are used for the configuration of Enilit RTU and the supervisory communications port, separate serial communication ports are provided for configuration and supervisory monitoring.

Configuration port activity neither interferes nor disables the supervisory monitoring port with the exception of a configuration. The information to be monitored and transmitted falls into two groups: Events and Alarms.

4.17.4.1 Events

Events are defined as authorized activities which can be expected to occur in the routine use and maintenance of Enilit RTU. All events can be monitored and transmitted to the supervisory system.

Event points have the momentary capability to detect changes so that the occurrence of an event will be reported on the next scan of Enilit RTU by the supervisory system. Enilit RTU reports each occurrence as an individual event.

4.17.4.2 Alarms

Alarms are defined as activities which may indicate an unauthorized activity. The following activities will cause an Alarm occurrence:

- Unsuccessful login attempt – defined as configured incorrect password entries in succession;
- Reboot;
- Attempted use of unauthorized configuration software.

4.17.5 Configuration software

Enilit RTU has an authentic configuration software. Enilit RTU could not be configured with any software except for those supported by UAB Enilit.

ENILIT RTU configuration software has the ability to assign features to specific users. At a minimum, the following functions and features could be assignable on an individual user basis:

- View Configuration Data – in this mode, a user can only view configuration data. No changes to the configuration can be made.
- Change Configuration Data – in this mode, the user can change and save configuration data to be uploaded to Enilit RTU at a later point in time.
- Full Access – in this mode, all functions, including password changes and user assignment levels can be made.

The configuration software is password controlled so that the software cannot be accessed without the proper password.

All communication ports on Enilit RTU can be enabled or disabled through configuration of Enilit RTU. When disabled through configuration, no communication will be possible through that port.

ABBREVIATIONS

ADU	Application Data Unit
APDU	Application Protocol Data Unit
CMS	Configuration and Management Software
CPU	Central processing unit
CS	Clock synchronization
DPC	Double point command
DPS	Double point signal
GI	General interrogation
ICD	IED Capability Description
IED	Intelligent Electronic Device
MV	Measurement value
PLC	Programmable logic controller
PRP	Parallel Redundancy Protocol
RTU	Remote terminal unit
SCADA	Supervisory control and data acquisition
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
SPC	Single point command
SPS	Single point signal
TCP	Transmission Control Protocol
UTC	Coordinated Universal Time

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