ITI overhead and underground cabinets

IEC 870-5-101 and IEC 870-5-104 protocols notice

4PR-F14-D

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General

- Before unpacking
> Verify that the product in its packaging has not been damaged during transport.
> Verify that the product is suitable for the intended installation.

- Before installation
> Carefully read the operation guide before installing or using this product.
> Perform the installation carefully, ensuring that the equipment remains clean throughout the operation.

- After installation
> If you are installing this product for someone else, leave the guide for the end user.
> Clean the work area after installation.

Legal notices

- The product may only be installed by a competent person with adequate training in the installation practices and with adequate knowledge of proper safety and installation practices for electrical equipment. If local regulations have requirements relating to this training or adequate knowledge in terms of the installation of electrical equipment, the aforementioned requirements must be complied with by this person.

- Ensto Novexia declines all liability for any property damage or personal injury caused by poor installation, mishandling, or failure to comply with safety recommendations.

WARNING

For the operation of this system in complete safety, it is essential that the installers, users and technicians follow the procedures and precautions described in this guide. Non-compliance with these instructions may cause damage to the products and/or serious or even fatal injury.

Contents

1 COMMISSIONING COMMUNICATION

1.1 GENERAL PRESENTATION OF COMMUNICATION

The IEC 870-5-104 type communication protocol functions in master-master mode (or balanced mode). It is used on an Ethernet type communication medium.

The IEC 870-5-101 type communication protocol can be configured in master-master mode (balanced) or master-slave mode (unbalanced). It is used on a serial link type communication medium.

The IEC 870 functions that are generally used are as follows:
- ASDU 100: General interrogation
  - ASDU 1: Single-point information
  - ASDU 20: Packed single-point information
  - ASDU 3: Double-point information
  - ASDU 9/11/13: Analog input information
- Remote alarms of the following types:
  - ASDU 30: Single-point information with time tag
  - ASDU 31: Double-point information with time tag
  - ASDU 34/35/36: Analog input information with time tag
- ASDU 46: Double command
- ASDU 45: Single command
- ASDU 103: Clock synchronisation command
- Service frames: Acknowledgement, link status, link test and link reset.

Other functions are available depending on the application.
- single point information
- double point information
- analog inputs
- single command
- double commands

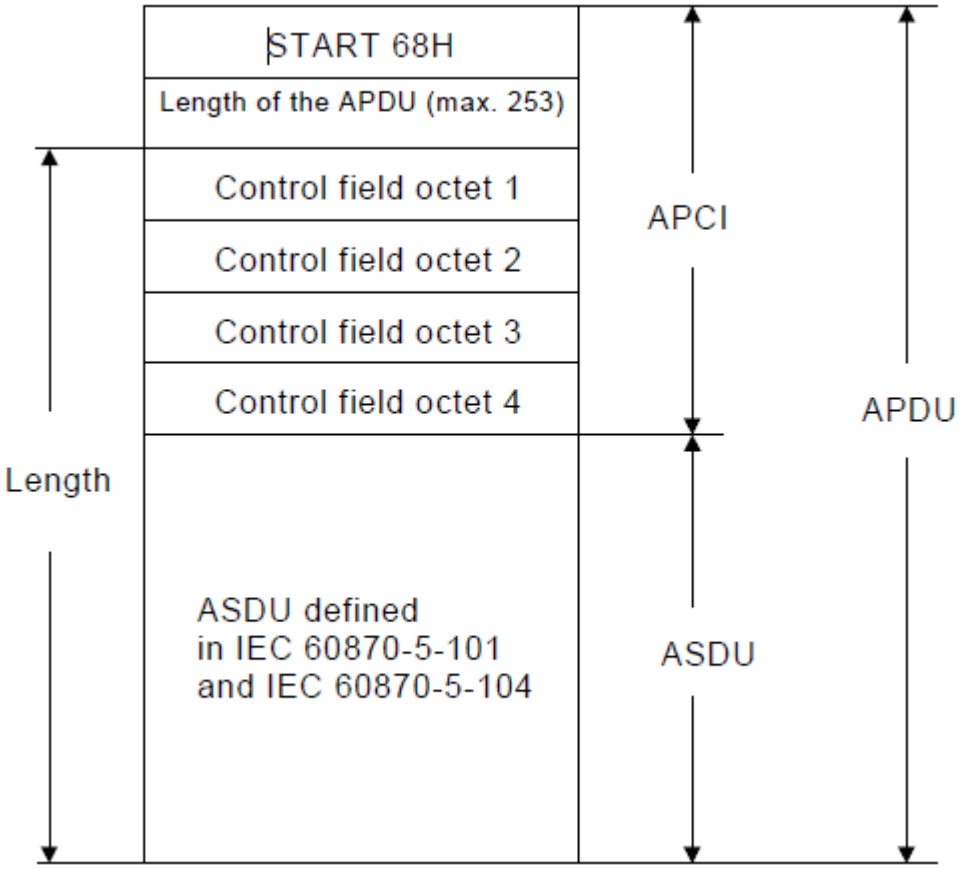
2 IEC 870 FRAME FORMAT

The frame format used is **FT 1.2**
Variable length and fixed length frames are used.

2.1 IEC 870-5-104

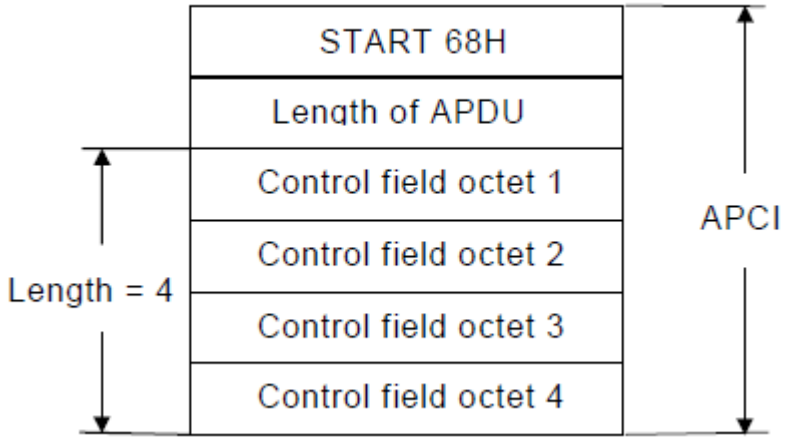
The transmission interface is formed by the TCP/IP interface. To detect the start and end of ASDUs, a start character, the length of the ASDU and a control field are defined for each APDU. Thus, it is possible to transfer a complete APDU (variable frame) or, for control purposes, the APCI fields only (fixed frame).

2.1.1 APDU



The specified data bytes are represented in hexadecimal notation as defined by IEC 870-5-1.

2.1.2 APCI



The specified data bytes are represented in hexadecimal notation as defined by IEC 870-5-1.
The fixed frame length is 6 bytes.

START 68H defines the start of data.
The length of the APDU defines the length of the APDU which contains the 4 control bytes of the APCI plus that of the ASDU.

2.1.3 Control field

The control field defines the information for protection against the loss or duplication of messages. Three types of formats are used for the control field, to allow numbered information (I-format), supervision functions (S-format) and non-numbered control functions (U-format) to be transferred.

The I-format is defined in the first byte of the control field, by bit 1 being set to 0. The I-format APDU always contains an ASDU.

Bit	8	7	6	5	4	3	2	1	
	Send Sequence Number N(S)						LSB	0	octet 1
	MSB	Send Sequence Number N(S)							octet 2
	Receive Sequence Number N(R)						LSB	0	octet 3
	MSB	Receive Sequence Number N(R)							octet 4

The S-format is defined in the first byte of the control field, by bit 1 being set to 1 and bit 2 being set to 0. S-format APDUs only contain the APCI.

Bit	8	7	6	5	4	3	2	1	
	0						0	1	octet 1
	0								octet 2
	Receive Sequence Number N(R)						LSB	0	octet 3
	MSB	Receive Sequence Number N(R)							octet 4

The U-format is defined in the first byte of the control field, by bit 1 being set to 1 and bit 2 being set to 1. U-format APDUs only contain the APCI.

Bit	8	7	6	5	4	3	2	1	
	TESTFR		STOPDT		STARTDT		1	1	octet 1
	con	act	con	act	con	act			
	0								octet 2
	0							0	octet 3
	0								octet 4

2.1.4 Frame examples

Example of a fixed frame:

68	Frame start
04	Length of the APDU in 1 byte
07 **00** **00** **00**	APCI control field encoded in 4 bytes U-format: "07" = StartDT ACT

Example of a variable frame:

68	Frame start
11	APDU length in 1 byte (max. 253 for variable frames)
02 **00** **02** **00**	APCI control field encoded in 4 bytes I-format: NS = 1, NR =1
 01 **84** **14** **00** **0A** **00**	User data ASDU 1: Type identification = 1 means "Single-point information" Variable structure qualifier: 84 Cause of transmission: P/N bit =0 "positive confirmation", T bit=0 "no test", cause = 0x14 "interrogated by a general interrogation" Common address of ASDUs = 10 (cabinet address) in 2 bytes
32 **00** **00** **00** **01** **00** **01**	Address Encoded in 3 bytes SPI values: SPI1 (50) = 0 SPI2 (51) = 1 SPI3 (52) = 0 SPI4 (53) = 1

2.2 IEC 870-5-101

Unique characters or “isolated command characters” can be used.

For other transmission media, each character forming the frames comprises 11 bits:
- 1 start bit “0”
- 8 data bits
- 1 even parity bit
- 1 stop bit “1”

For the TETRA radio network, each character forming the frames comprises 10 bits:
- 1 start bit “0”
- 8 data bits
- no parity
- 1 stop bit “1”

2.2.1 Variable length frame

Start 68 H	1 byte
L1	1 byte Field length: 3 to 248 (max. 40 char. for the TETRA network) L specifies the number of user data bytes, including the control field and the address field L = length C + A + D
L2	1 byte - Identical to L1
Start 68 H	1 byte
C	1 byte - Control field
A	1 or 2 bytes depending on the configuration - link address field
D	N bytes Link layer user data (LPDU) 1 LPDU contains 1 ASDU The ASDUs processed are listed in the interoperability sheet
Control character	1 byte - This frame control character is the modulo 256 sum of all the user data bytes:(C+A+D)
Stop 16 H	1 byte

The specified data bytes are represented in hexadecimal notation as defined by IEC 870-5-1.
The total number of characters in the frame is equal to L+6.

2.2.2 Fixed length frame

Start 10 H	1 byte
C	1 byte - Control field see chapter 2.3
A	1 or 2 bytes depending on the configuration - - address field -
D	0 byte No link layer user data
Control character	1 byte - This frame control character is the modulo 256 sum of all the user data bytes:(C+A+D)
Stop 16 H	1 byte

The specified data bytes are represented in hexadecimal notation as defined by IEC 870-5-1.
The fixed frame length is 5 bytes if the address is encoded in 1 byte.
The fixed frame length is 6 bytes if the address is encoded in 2 bytes.

2.2.3 Control field C

The control field contains information that characterises the message direction, the type of service provided and supports the control functions enabling message losses or duplications to be eliminated.

Control field C in unbalanced transmission:

Primary to secondary:

	MSB								LSB
	RES	**PRM(1)**	**FCB**	**FCV**	**Fonction**				
Bit:	8	7	6	5	4	3	2	1	0

Secondary to primary:

	MSB								LSB
	RES	**PRM(0)**	**ACD**	**DFC**	**Fonction**				
Bit:	8	7	6	5	4	3	2	1	0

The ACD and DFC bits relate to the control fields for secondary stations (instrumentation & control cabinet) to primary stations (SCADA). They are replaced by the FCB and FCV bits for exchanges from the primary station (SCADA) to the secondary station (instrumentation & control cabinet). See standard IEC 870-5-2.

Control field C in balanced transmission:

Primary to secondary:

	MSB								LSB
	DIR	**PRM**	**FCB**	**FCV**	**Function**				
Bit:	8	7	6	5	4	3	2	1	0

Secondary to primary:

	MSB								LSB
	DIR	**PRM**	**RES**	**DFC**	**Function**				
Bit:	8	7	6	5	4	3	2	1	0

The RES and DFC bits relate to control fields for secondary stations to primary stations. They are replaced by the FCB and FCV bits for exchanges from the primary station to the secondary station. See standard IEC 870-5-2.

RES: not used

DIR: Physical transmission direction: 1 = station A to station B
0 = station B to station A

PRM: primary message: 0 = message from the secondary station (responder)
1 = message from the primary station (initiator)

ACD: access demand, 2 message classes are provided: class 1 and class 2
0 = no access demand for class 1 data transmission
1 = access demand for class 1 data transmission
The secondary station (instrumentation & control cabinet) indicates to the primary station (SCADA) that it wishes to transmit class 1 data by setting ACD=1.
Class 1 data is typically used to transmit high-priority events and messages: data with a time tag (ASDU2, ASDU4, ASDU30, ASDU31) where it is selected.

DFC: Data flow control: 0 = further messages are acceptable
1 = further messages may cause a data overflow.
The secondary station (responder) indicates to the station initiating the message (primary station) that the immediate succession of an additional message could cause data overflows.

FCB: Frame count bit: alternates between 0 and 1, used for successive SEND/CONFIRM and REQUEST/RESPONSE services.

FCV: frame count bit valid: 0 = alternating function of FCB bit is invalid
1 = alternating function of FCB bit is valid

Function: see the function codes defined in standard IEC 870-5-2.

2.2.4 Address field A

The address field specifies the link address for the secondary station (instrumentation & control cabinet). This address is encoded in 1 or 2 bytes (standard). Its length and value can be configured.

The address space with i bytes extends from 0 to 2^{8i}-1
Broadcast address (message to all cabinets) = 255 if the address is encoded in one byte or 65535 if the address is encoded in two bytes.
It is important to check that the cabinet address and its length are entered correctly and identically in the SCADA system and the instrumentation & control cabinet.
Each cabinet linked to the same SCADA system must have a different address.

2.2.5 Frame examples

Example of fixed frames:

- positive acknowledgement frame transmitted by the cabinet in unbalanced (or asymmetric) mode:

10	Fixed frame start
00	Control field ACD, PRM, DFC bits=0, service function code = 0 means ACK: positive acknowledgement
05	Cabinet address = 05 encoded in 1 byte
05	Modulo 256 sum
16	Fixed frame stop

- class 2 request frame transmitted by the SCADA system in unbalanced (or asymmetric) mode:

10	Fixed frame start
5B	Control field PRM and FCV bits = 1, FCB bit =0 service function code = 11 (Bh) means “Request for class 2 user data”
05	Cabinet address = 05 encoded in 1 byte
60	Modulo 256 sum
16	Fixed frame stop

- class 1 request frame transmitted by the SCADA system in unbalanced (or asymmetric) mode:

10	Fixed frame start
5A	Control field PRM and FCV bits = 1, FCB bit =0 service function code = 10 (Ah) means “Request for class 1 user data”
05	Cabinet address = 0005 encoded in 2 bytes
00	
5F	Modulo 256 sum
16	Fixed frame stop

Example of variable length frames:

- "General interrogation command" frame C_IC_NA_1 (ASDU 100) transmitted by the SCADA system:

68	Variable frame start
0A	Number of user data bytes: 10 (Ah)
0A	Number of user data bytes: 10 (Ah)
68	2nd variable frame start byte
73	Control field PRM, FCB, FCV bits =1 service function code = 3 means "User data"
0A	Destination cabinet link address = 10 (000Ah) encoded in 2 bytes
00	
 64 **01** **06** **0A** **00** **00** **14**	User data ASDU 100: Type identification = 100 means "interrogation command" Variable structure qualifier: 01 Cause of transmission: P/N bit =0 "positive confirmation", T bit =0 "no test", cause = 6 "activation" Common address of ASDUs = 10 (cabinet address) in 2 bytes Information object address (= 0 for ASDU100) Interrogation qualifier = 20 "station interrogation" (global)
06	Modulo 256 sum
16	Frame stop

3 COMMON ADDRESS OF ASDU (CABINET ADDRESS)

By default, the address is encoded in 2 bytes.

Addresses (can be configured by the configuration software): 0 to 65534 (2 bytes)
Default address: 10

Broadcast address (broadcasting): **65535** (2 bytes)

4 OBJECT ADDRESSING PARAMETERS

Embedded software enables the size and addresses of objects exchanged by the telecontrol protocol IEC 60870 to be configured.
Family of objects managed by the application:
- single point information
- double point information
- single commands
- double commands
- analog inputs
- counters

By default, the object address length is: **3 bytes**
Address value: 3 bytes: 0 to 16777215

4.1 SINGLE POINT INFORMATION

These single point information are transmitted to the SCADA system by the ASDUs: 1 and 20 (information without a time tag), or 2 and 30 (information with a time tag)
It is transmitted on each status change and may be stored if the connection is not established (see TRFS setting in the description on the configuration page)

The address and assignment of SPI may be changed in the primary and second Communication Tabs, in the “IEC 104 variables” or “IEC 101 variables” section.

This list and the addresses are provided for information and may be adapted to the specification.

SPI address	Description	Comment
50	No AC power supply (Cabinet supply voltage) 0: AC voltage available 1: no AC voltage	
51	Local mode (Activated by pressing the button) 0: remote mode 1: local mode	
52	Earth fault current detection on channel A 0: no fault 1: indicates detection of a fault current on channel A	
53	Battery fault (Automatic test every 24h) 0: no fault 1: battery fault detection	
54	Board fault – RTU fault 0: no fault	Activation of this SPI could result in the invalidity bit of other

	1: Cabinet equipment fault, excluding the battery and AC power supply. Indicates an electronic module malfunction.	SPI and AIs being set to 1.

4.2 DOUBLE POINT INFORMATION

These double points information are transmitted to the SCADA system by the ASDUs: 3 (information without a time tag) or 31 (information with a time tag)

It is transmitted on each status change and may be stored if the connection is not established (see TRFS setting in the description on the configuration page)

The address and assignment of DPI may be changed in the primary and secondary Communication Tabs, in the “IEC 104 variables” or “IEC 101 variables” section.

The DPI1 (2 bits) is the copy of 2 primary position contacts,
- OPEN position contact: 1 = Switch open. 0 = Switch not open
- CLOSED position contact: 1 = Switch closed. 0 = Switch not closed

This list and the addresses are provided for information and may be adapted to the specification.

DPI address	**Description**
100	Open/Closed switch position channel A [01] 1: (OFF) switch Open channel A [10] 2: (ON) switch Closed channel A [00] 0 or [11] 3: invalid or non complementary statuses (connection error, sensor problem, etc.)
101	*Off or On status of the Automatic opening in response to a fault function* (ASF) [01] 1: (OFF) ASF off [10] 2: (ON) ASF on [00] 0 or [11] 3: invalid or non complementary statuses (configuration problem, etc.)
102	Open/Closed switch position channel C (If the cabinet has several channels) [01] 1: (OFF) switch Open channel C [10] 2: (ON) switched Closed channel C [00] 0 or [11] 3: invalid or non complementary statuses (connection error, sensor problem, etc.)

4.3 SINGLE COMMANDS

Single commands are transmitted with the ASDU 45. The command type is “Direct execution” or “Select and execute”. The maximum execution command period after selection is 30s (configurable value).

This list and the addresses are provided for information and may be adapted to the specification.

SC address	Description
300	Switch Opening and Closing command channel A [0]: Opening channel A [1]: Closing channel A
301	On or Off command for the *Automatic opening in response to a fault* function (ASF) [0]: ASF Off [1]: ASF On
302	Switch Opening and Closing command channel B (If the cabinet has several channels) [0]: Opening channel B [1]: Closing channel B

4.4 DOUBLE COMMANDS

Double commands are transmitted with the ASDU 46. The command type is “Direct execution” or “Select and execute”. The maximum execution command period after selection is 30s (configurable value).

This list and the addresses are provided for information and may be adapted to the specification.

DC address	Description
150	Switch Opening / Closing command channel A [01] 1: Opening channel A [10] 2: Closing channel A [00] 0 and [11] 3: command rejected
151	On or Off command for the *Automatic opening in response to a fault* function (ASF) [01] 1: ASF off [10] 2: ASF on [00] 0 and [11] 3: command rejected
152	Switch Opening / Closing command channel C (If the cabinet has several channels) [01] 1: Opening channel C [10] 2: Closing channel C [00] 0 and [11] 3: command rejected

Execution of a command to operate the switch:
- in Selection mode followed by Execution mode:
. Receipt of the operation Selection command
. Positive acknowledgement of the Selection command if the command is compatible with the position of the switch and if the cabinet is in Remote mode, otherwise selection and execution are rejected
. Receipt of the operation Execution command
. Positive acknowledgement and Execution if the command is transmitted within the period of less than 30 secs after selection (configurable period) and if the selection conditions are still present
. The time for operating the switch is variable, depending on the device
. Transmission of the DPI1, which indicates the new position of the switch at the end of the operation (if it is assigned)
. If, after a period of X sec (configured by the command monitoring timer), the switch has not yet changed position, the command is cancelled and a negative acknowledgement is transmitted.

- in Direct execution mode:
The same process without the selection phase.

4.5 ANALOG INPUT LIST AND ADDRESSES

These analog inputs are transmitted to the SCADA system by the ASDU: 9 (measured value, normalised value), 11 (measured value, scaled value), 13 (measured value, short floating point value) or the ASDU 34 (measured value, normalised value with time tag), 35 (measured value, scaled value with time tag CP56Time2a), 36 (measured value, short floating point value with time tag CP56 Time2a).
Standardised value format: 16 bits (15 bits +1 sign bit), F16 = [1..16] < -1..+1-2-15 > format type 4.1 (see standard IEC 870-5-4)

The number of analog input measurements and their assignments can be configured with the embedded software.
Measurements are taken as standard at a refresh frequency of 3s (configurable)

AI address	Description
200	Average load current of 3 mains phases channel A: (Current ph1 + Current ph2 + Current ph3) /3 Measuring range: 0 … 700 A rms (in the case of an overhead cabinet) Accuracy: ±3% ±2A
201	Current phase 1 channel A Measuring range: 0 … 700 A rms (in the case of an overhead cabinet)
202	Current phase 1 channel D (if the cabinet has several channels) Measuring range: 0 … 700 A rms
203	Cabinet supply voltage value. Measuring range: 0 …400V Accuracy: ±10% ±3V
204	Motor and cabinet supply voltage (12V battery) Measuring range: 0 … 16V Accuracy: ±2% ±-0.2V

Specification for current analog inputs, phase 1, phase 2, phase 3 and average of 3 phases:

The current value is transmitted to the SCADA system in response to a general interrogation, on the request of the SCADA system or when there is a current variation by spontaneous transmission from the cabinet.

This variation is determined by a configurable dead band:
- the dead band value calculated as a percentage can be configured from 1% to 100% (standard value: 20%)
- a minimum variation threshold for the dead band can be configured from 1A to 255A (standard value: 5A)
- it is always the higher of the 2 thresholds that is applied

E.g. 1: Last spontaneous AI: 15A, calculated threshold = 15x10% = 1.5A, with the minimum variation threshold at 10A and the dead band at 10%
==> Spontaneous AI if current< 5A or current > 25A
E.g. 2: Last spontaneous AI: 120A, calculated threshold: 120 x 10% = 12A, minimum variation threshold = 10A
==> Spontaneous AI if current<108A or current > 132A

Specification for voltage analog inputs

The dead band variations for AC voltage, the cabinet's 12V DC voltage and the mains voltage can be configured from 1 to 100%
A minimum variation threshold for the dead band for AC voltage can be configured from 1V to 255V.
It is always the higher of the 2 thresholds that is applied.

DC voltage AI ==> minimum variation threshold fixed at 1V
Mains voltage AI ==> minimum variation threshold fixed at 1000V

E.g.: In this example, the AI5 is the AC voltage transmitted in response to general interrogation or the last spontaneous AI: 230V, calculated threshold = 230x20% = 46V, minimum variation threshold = 10V
==> Spontaneous AI if voltage< 184V or voltage > 276V

Calculation of the actual value returned via protocol:

Actual value of the AI = (value received via protocol x full scales of the AI) /32767

Standard values for full scale analog inputs:
For current analog inputs: 700A
For AC voltage analog input: 400V
For the motor supply voltage analog input: 16V
E.g.: For a value received, via protocol, of the AC voltage analog input with a value of 18700.
The actual value is (18700 x 400) /32767 = 228V

4.6 COUNTER LIST AND ADDRESSES

These counters are transmitted to the SCADA system by the ASDUs: 15 (Integrated totals), 16 (Integrated totals with time tag), 37 (Integrated totals with time tag CP56Time2a).
Standardised value format: 16 bits (15 bits +1 sign bit), F16 = [1..16] < -1..+1-2-15 > format type 4.1 (see standard IEC 870-5-4)

The number of counters and their assignments can be configured with the embedded software.

Counter Address	Description
250	Total number of manual or electrical operations (Opening or Closing) performed on the switch channel A Measuring range: 0 … 32767 operations
251	Number of phase current faults detected on the electrical network channel A Measuring range: 0 … 32767 occurrences of fault currents

5 CONFIGURATION WITH THE CONFIGURATION SOFTWARE

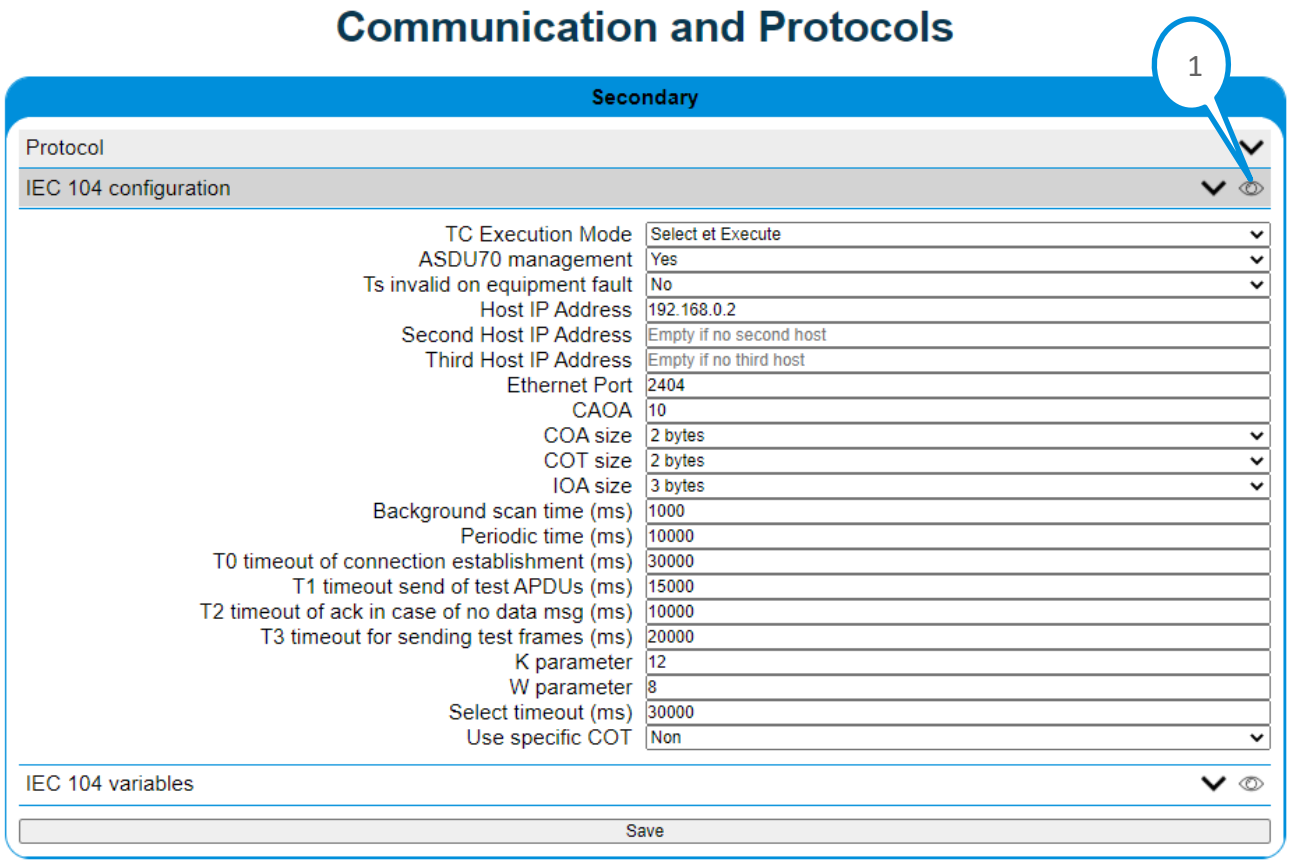
The necessary screens for configuration of the communication modules and protocols IEC 60870-5-104 and IEC 60870-5-101 are described in this chapter.

Configure the cabinet with the aid of the HTML pages integrated into the cabinet.
A standard configuration file can be supplied for configuration of the cabinets:
This file contains the standard settings used to validate the functioning of communication.
When this file is saved to the cabinets, all the settings are updated (communication, fault detection, ASF, etc.). You must ensure that these settings are compatible with the configuration of the electrical network.

5.1 RUNNING EMBEDDED SOFTWARE

See the installation and operation guide

5.2 CONFIGURATION OF THE PARAMETERS OF PROTOCOL IEC 870-5-104



An advanced mode is provided (1) for future upgrades or specific settings. The key settings are in normal mode.

- Command Execution Mode:

Allows the operating mode of ASDU 45 (Single command) and ASDU 46 (Double command) to be selected.
“Select and Execute”: a first command is transmitted by the SCADA system to SELECT the object (single or double command) to be operated, followed by a second command to EXECUTE the operation (opening/closing, on/off, etc.)
“Direct execution”: a single command is transmitted by the SCADA system to select the object and directly EXECUTE the operation (opening/closing, on/off, etc.)
Standard value: “Direct execution”

- ASDU70 management:

ASDU 70 (M_EI_NA_1) is returned to specify a reboot of the CPU

- Ts invalid on equipment fault:

In the event of a cabinet equipment fault, all the information can be set as invalid (validity bit for variables)

- Host IP Address:

This setting corresponds to the IP address interrogated by the CPU in IEC 104 (SCADA, server, etc.) This setting is mandatory for communication to function.

- Second Host IP Address:

In the case of communication performed by a second SCADA system or via backup communication, this setting corresponds to a 2nd IP address interrogated by the CPU in IEC 104 (SCADA or other). The configuration is identical for the 2 communications and can be performed simultaneously.

- Third Host IP Address:

In the case of communication performed by a 3rd SCADA system or via backup communication, this setting corresponds to a 3rd IP address interrogated by the CPU in IEC 104 (SCADA or other). The configuration is identical for the 3 communications and can be performed simultaneously.

- Ethernet port:

TCP port used for communication of protocol IEC 104 (default value 2404)

- CAOA:

The CAOA (Common Address Of ASDU) setting is the cabinet address.

- COA size:

The “COA size” setting corresponds to the size of the CAOA address (default value 2 bytes)

- COT size:

The “COT size” setting corresponds to the size of the “Cause Of Transmission” address (default value 2 bytes)

- IOA size:

The “IOA size” setting corresponds to the size of the ASDU address (default value 3 bytes)

- Background scan time:

In the case of variables with a TRFS assigned by “Background scan”, the data is returned cyclically on the basis of the time specified if no spontaneous data is returned.

- Periodic time:

In the case of variables with a TRFS assigned by “Cyclic”, the data is returned cyclically on the basis of the time specified.

- T0 timeout of connection establishment:

Period for establishing the connection (default value 30s)

- T1 timeout send of test APDUs:

Period for transmitting or testing the APDUs (default value 15s)

- T2 timeout of ack in case of no data msg:

Period for acknowledgement in the event that there is no data to transmit (T2 must be less than T1) (default value 10s)

- T3 timeout for sending test frames:

Period for transmitting S-frames in the case of a long standby state (default value 20s)

- K parameter:

Maximum difference between the number of sequences received and the number to be transmitted (k)
Maximum interval for the value of K: from 1 to 32767 APDUs, accuracy of 1 APDU
(Default value 12)

- W parameter

Last acknowledgement before receiving (W) I-format APDU
Maximum interval for the value of W: from 1 to 32767 APDUs, accuracy of 1 APDU (Recommendation: W should not exceed two thirds of the value of K).
(Default value 8)

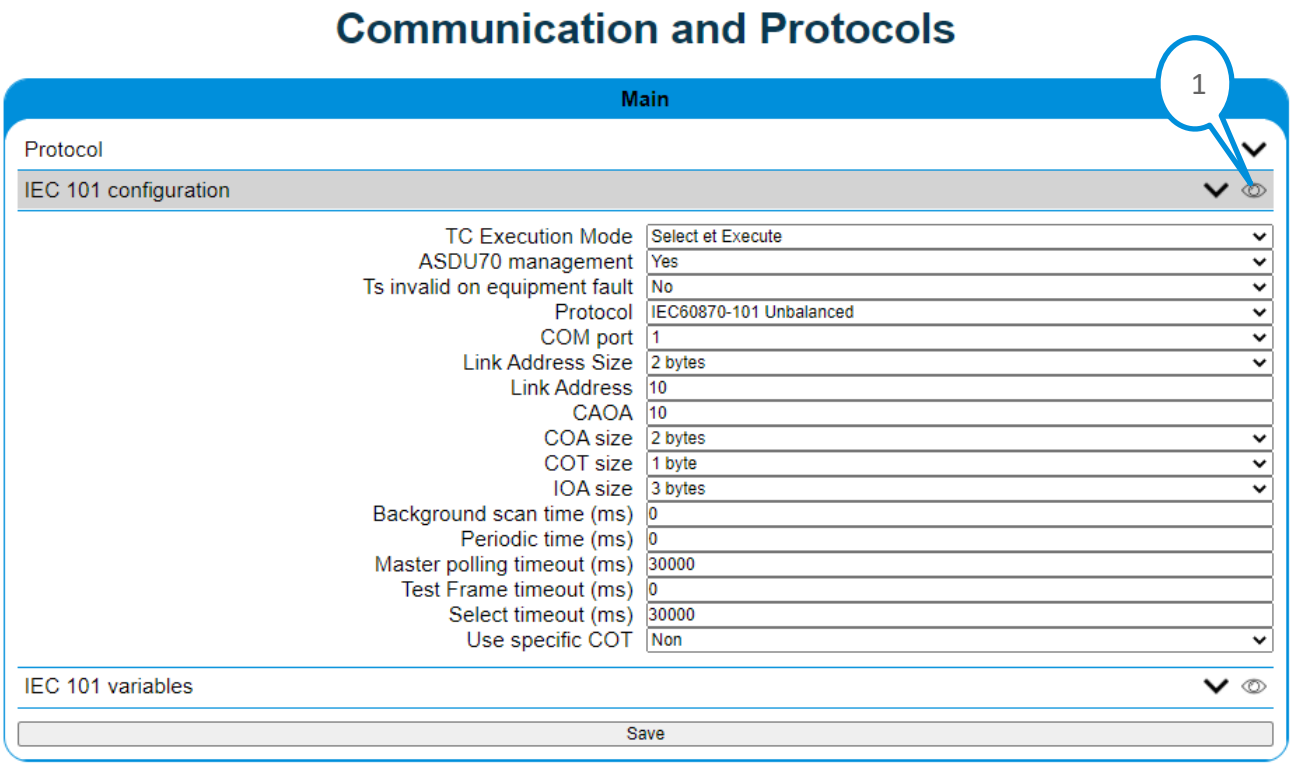
- Select timeout:

Maximum time between the SELECTION and EXECUTION of a command. Should this period elapse, the execution command will be cancelled (in the case of the Command Execution Mode as Select and Execute).
(Default value 30s)

- Use specific COT:

This setting enables the COT (Cause Of Transmission) 11 (feedback caused by a remote command) and 12 (feedback caused by a local command) to be managed.
(Default value no, the COT will be returned with the spontaneous value 3)

5.3 CONFIGURATION OF THE PARAMETERS OF PROTOCOL IEC 870-5-101



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- Command Execution Mode:

Allows the operating mode of ASDU 45 (Single command) and ASDU 46 (Double command) to be selected.
“Select and Execute”: a first command is transmitted by the SCADA system to SELECT the object (single or double command) to be operated, followed by a second command to EXECUTE the operation (opening/closing, on/off, etc.)
“Direct execution”: a single command is transmitted by the SCADA system to select the object and directly EXECUTE the operation (opening/closing, on/off, etc.)
Standard value: “Direct execution”

- ASDU70 management:

ASDU 70 (M_EI_NA_1) is returned to specify a reboot of the CPU

- Ts invalid on equipment fault:

In the event of a cabinet equipment fault, all the information can be set as invalid (validity bit for variables)

- Protocol:

IEC 60870-101 Unbalanced is a Master-Slave protocol, the data is only transferred following a request from the SCADA system.
IEC 60870-101 Balanced is a Master-Master protocol, the data is transferred spontaneously when the connection is established.

- COM port:

1: D-sub 25-pin serial port on the motherboard (The cabinets are generally supplied with a 25-pin/9-pin cable in the cabinet's radio compartment)
2: D-sub 9-pin serial port on the motherboard
(Default value: 1)

- Link Address Size:

The "Link Address Size" setting corresponds to the size of the "Link address" address (Cabinet link address)

- Link Address:

The "Link Address" setting corresponds to the cabinet link address.

- CAOA:

The CAOA (Common Address Of ASDU) setting is the cabinet address.

- COA size:

The "COA size" setting corresponds to the size of the CAOA address (default value 2 bytes)

- COT size

The "COT size" setting corresponds to the size of the "Cause Of Transmission" address (default value 2 bytes)

- IOA size

The "IOA size" setting corresponds to the size of the ASDU address (default value 3 bytes)

- Background scan time:

In the case of variables with a TRFS assigned by "Background scan", the data is returned cyclically on the basis of the time specified if no spontaneous data is returned.

- Periodic time

In the case of variables with a TRFS assigned by "Cyclic", the data is returned cyclically on the basis of the time specified.

- Master polling timeout:

This setting is used with the "Balanced" (Master-/Master) protocol, with a non-established link, to transmit a "Link status" frame. (Default value 30s)

- Test Frame timeout:

This setting is used with the “Balanced” (Master-Master) protocol, with an established link, it enables a link test frame to be transmitted (FC2).
(Default value: 0)

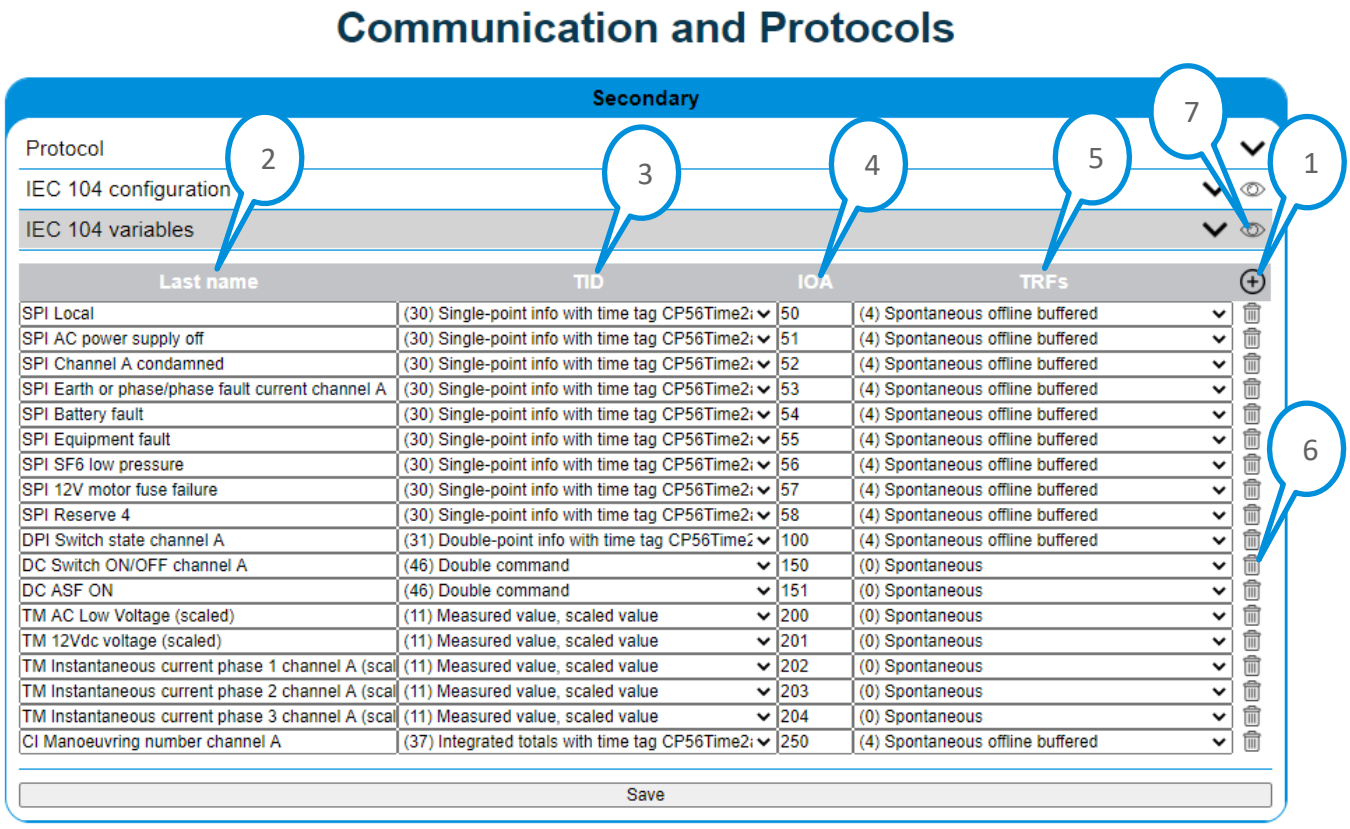
- Select timeout:

Maximum time between the SELECTION and EXECUTION of a command. Should this period elapse, the execution command will be cancelled (in the case of the Command Execution Mode as Select and Execute).
(Default value 30s)

- Use specific COT

This setting enables the COT (Cause Of Transmission) 11 (feedback caused by a remote command) and 12 (feedback caused by a local command) to be managed.
(Default value no, the COT will be returned with the spontaneous value 3)

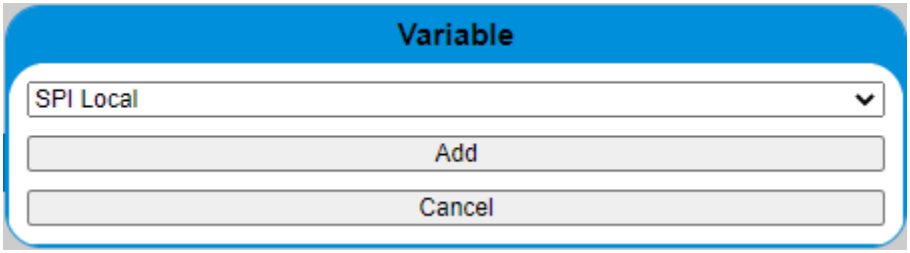
5.4 VARIABLE CONFIGURATION



An advanced mode is provided (7) for future upgrades or specific settings. The key settings are in normal mode.

To add a variable, press + (1) to display a window for selecting the variable. To erase a variable, click on the recycle bin (6) or set a TRFS to 3 (Off) for the variable.

Selecting the variable (2):



Select the variable to be assigned by using the drop-down menu, then click on the “Add” button.
The variables are organised by type (SPI, DPI, AI, etc.)

Selecting the TID (3):
This setting corresponds to the variable’s ASDU. Single-point information can be assigned to ASDUs 1,2,20,30. Double-point information can be assigned to ASDUs 3,4,31. An analog input can be assigned to ASDUs 11,12,35. A counter can be assigned to ASDUs 15,16,37. Pay attention to compatibility with the TRFS.

Selecting the IOA (4):
The IOA (Information Object Address) corresponds to the variable’s address. The variables must all have different addresses. The value 0 is not permitted in IEC 60870.
For an “IOA size” of:

- 3 bytes, the permitted values range from 1 to 16777215.
- 2 bytes, the permitted values range from 1 to 65535.
- 1 byte, the permitted values range from 1 to 255.

Selecting the TRFS (5):

- (0) Spontaneous: The values are transferred each time that the value of the variable changes
- (1) Background scan: The values are transferred cyclically on the basis of the time set in the “Background scan time” variable. The values are only transferred if no spontaneous value is transmitted during the “Background scan time” period. The values are only transferred if a time is set in the “Background scan time” setting (other than 0).
  The ASDUs supported are:
  M_SP_NA_1 (ASDU1: Single-point information)
  M_DP_NA_1 (ASDU3: Double-point information)
  M_ST_NA_1 (ASDU5: Step position information)
  M_BO_NA_1 (ASDU7: Bitstring of 32 bits)
  M_ME_NA_1 (ASDU9: Measured value, normalised value)
  M_ME_NB_1 (ASDU11: Measured value, scaled value)
  M_ME_NC_1 (ASDU13: Measured value, short floating point value)
  M_SP_NA_1 (ASDU20: Packed single-point information with status change detection)
- (2) Cyclic: The values are transferred cyclically and not spontaneously. The values are only transferred if a time is set in the “Periodic time” setting (other than 0).
  The ASDUs supported are:
  M_ME_NA_1 (ASDU9: Measured value, normalised value)
  M_ME_NB_1 (ASDU11: Measured value, scaled value)
  M_ME_NC_1 (ASDU13: Measured value, short floating point value)
- (3) Off: The values are not transferred. Setting to “Off” erases the variable from the list when saving
- (4) Spontaneous offline buffered: The values are saved when there is no communication. The values are transferred when communication is established.
  The ASDUs supported are:
  M_SP_TB_1: (ASDU30: single-point information with time tag CP56Time2a)
  M_DP_TB_1: (ASDU31: double-point information with time tag CP56Time2a)
  M_ST_TB_1: (ASDU32: step position information with time tag CP56Time2a)
  M_BO_TB_1: (ASDU33: Bitstring of 32 bits with time tag CP56Time2a)
  M_ME_TD_1: (ASDU34 : measured value, normalised value with time tag CP56Time2a)

M_ME_TE_1: (ASDU35 : measured value, scaled value with time tag CP56Time2a)
M_ME_TF_1: (ASDU36 : measured value, short floating point value with time tag CP56Time2a)
M_IT_TB_1: (ASDU37: Integrated totals with time tag CP56Time2a)

IMPORTANT: Having selected the "Communication and protocols" module settings, they need to be saved to the CPU and the changes applied.

6 GLOSSARY

ASF	Auto-Sectionalizing Function This function allows the automatic opening of the switch following the detection of one or more fault currents to be controlled.
ASDU	Application Service Data Unit
Auguste	Remotely controlled SF6 overhead load break switch for medium voltage networks, produced by Ensto Novexia.
Balanced mode	see Symmetrical Transmission
CEI	Commission Electrotechnique Internationale
CEM	Compatibilité ElectroMagnétique
EMC	ElectroMagnetic Compatibility
Balanced	see Symmetrical Transmission
IAT	Remotely controlled overhead load break switch for medium voltage networks
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LPDU	Link Protocol Data Unit
Master-slave	see Asymmetric Transmission
Master-master	see Symmetrical Transmission
Unbalanced	see Asymmetric Transmission
Satellite station, remotely controlled station, slave station	Station monitored and controlled by a remote control station. The terms "slave station", "secondary station" or "RTU" are sometimes used.
Protocol	Operating rules for a communication system, which must be followed in order for this communication to take place.
RTU	Remote Terminal Unit- see satellite station
SCADA	Supervisory Control And Data Acquisition Remote control system, Primary station.
DC	Double command - status change command represented by 2 bits, Value = 0, 1, 2, 3
AI	Analog input - Information or physical value represented by an unsigned integer, Value = 0 to 65535
Asymmetric Transmission	Transmission mode in which the primary station is able to trigger the transfer of messages. The secondary stations only transmits following a request from the primary station. In these systems, the remote stations are always secondary stations (slaves). The remote control centre is a primary station (master).

	The terms “unbalanced mode”, “master-slave” or “unbalanced” are sometimes used.
DPI	Double Point Indication (Signalling) - Status of a sensor or information represented by two bits, value = 0, 1, 2, 3
SPI	Single Point Indication (Signalling) - Status of a sensor or information represented by one bit, value = 0 or 1
CPU	Central Processing Unit, cabinet management module. It supports the memories, the peripherals and the microprocessor, which executes the application and communication programs.
IEV	International Electrotechnical Vocabulary

Note

Equipment return tracking form

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