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SIR-A

Feeder Protection and Recloser Control Relay



IEC 60870-5-104 PROTOCOL MANUAL

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IEC 60870-5-104 PROTOCOL FROM FW VERSION 1.11.00

This section of the document describes the IEC 60870-5-104 data points and structures available in the IED from the main FW version 1.11.00. The point lists describe a superset of all data available through the standard configuration/s.

1. IEC 60870-5-104 PROTOCOL INTEROPERABILITY FROM FW VERSION 1.11.00

The selected parameters should be marked in the white boxes as follows:

☐ Function or ASDU is not used

☒ Function or ASDU is used as standardized (default)

R Function or ASDU is used in reverse mode

B Function or ASDU is used in standard and reverse mode

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

1.1 System or device

(system-specific parameter, indicate definition of a system or a device by marking one of the following with "X")

☐ System definition

☐ Controlling station definition (Master)

☒ Controlled station definition (Slave)

1.2 Network configuration

(network-specific parameter, all configurations that are used are to be marked "X")

■ ~~point-to-point~~ ■ ~~Multipoint~~

■ ~~Multiple point-to-point~~ ■ ~~Multipoint-star~~

1.3 Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked "X")

Transmission speed (control direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s	Balanced interchange Circuit X.24/X.27	
■ ~~100 bit/s~~	■ ~~2400 bit/s~~	■ ~~2 400 bit/s~~	■ ~~56 000 bit/s~~
■ ~~200 bit/s~~	■ ~~4800 bit/s~~	■ ~~4 800 bit/s~~	■ ~~64 000 bit/s~~
■ ~~300 bit/s~~	■ ~~9600 bit/s~~	■ ~~9 600 bit/s~~	
■ ~~600 bit/s~~		■ ~~19 200 bit/s~~	
■ ~~1200 bit/s~~		■ ~~38 400 bit/~~	

Transmission speed (monitor direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if »1 200 bit/s	Balanced interchange Circuit X.24/X.27	
■ ~~100 bit/s~~	■ ~~2 400 bit/s~~	■ ~~2 400 bit/s~~	■ ~~56 000 bit/s~~
■ ~~200 bit/s~~	■ ~~4 800 bit/s~~	■ ~~4 800 bit/s~~	■ ~~64 000 bit/s~~
■ ~~300 bit/s~~	■ ~~9 600 bit/s~~	■ ~~9 600 bit/s~~	
■ ~~600 bit/s~~		■ ~~19 200 bit/s~~	
■ ~~1200 bit/s~~		■ ~~38 400 bit/s~~	

1.4 Link layer

(network-specific parameter, all options that are used are to be marked "X". Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

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

Link transmission

- ~~Balanced transmission~~
- ~~Unbalanced transmission~~

Frame length

- ~~Maximum length L (number of octets)~~

Address field of the link

- ~~not present (balanced transmission only)~~
- ~~One octet~~
- ~~Two octets~~
- ~~Structured~~
- ~~Unstructured~~

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

- ~~The standard assigment of ASDUs to class 2 message is used as follows~~:

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

- ~~A special assignment of ASDUs to class 2 message is used as follows~~:

Type identification	Cause of transmission

~~Note: (In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available)~~

1.5 Application layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked "X")

■ ~~One octet~~ ☒Two octets

Information object address

(system-specific parameter, all configurations that are used are to be marked "X")

■ ~~One octet~~
■ ~~Two octets~~
☒ Three octets

☐ Structured
☒ Unstructured

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked "X")

■ ~~One octet~~ ☒ Two octets (with originator address). Originator address is set to zero if not used

Length of APDU

(system-specific parameter, specify the maximum length of the APDU per system)

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

253	Maximum length of APDU per system

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒	<1> := Single-point information	M_SP_NA_1
■	~~<2> := Single-point information with time tag~~	~~M_SP_TA_1~~
☒	<3> := Double-point information	M_DP_NA_1
■	~~<4> := Double -point information with time tag~~	~~M_DP_TA_1~~
☐	<5> := Step position information	M_ST_NA_1
■	~~<6> := Step position information with time tag~~	~~M_ST_TA_1~~
☐	<7> := Bitstring of 32 bit	M_BO_NA_1
■	~~<8> := Bitstring of 32 bit with time tag~~	~~M_BO_TA_1~~
☒	<9> := Measured value, normalized value	M_ME_NA_1
■	~~<10> := Measured va ue, norma ized va ue with time tag~~	~~M_ME_TA_1~~
☒	<11> := Measured value, scaled value	M_ME_NB_1
■	~~<12> := Measured value, scaled value with time tag~~	~~M_ME_TB_1~~
☒	<13> := Measured value, short floating point value	M ME NC 1
■	~~<14> := Measured value, short floating point value with time tag~~	~~M_ME_TC_1~~
☒	<15> := Integrated totals	M_IT_NA_1
■	~~<16> = ntegrated totals with time tag~~	~~M_IT_TA_1~~
■	~~<17> = Event of protection equipment with time tag~~	~~M_EP_TA_1~~
■	~~<18> = Packed start events of protection equipment with time tag~~	~~M_E P_TB_1~~
■	~~<19> := Packed output circuit information of protection equipment with time tag~~	~~M_EP_TC_1~~
☐	<20> = Packed single-point information with status change detection	M_SP_NA_1
☐	<21> = Measured value, normalized value without quality descriptor	M_ME_ND_1
☒	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
☒	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
☐	<32> = Step position information with time tag CP56Time2a	M_ST_TB_1
☐	<33> = Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
☒	<34> = Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
☒	<35> = Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
☒	<36> = Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
☒	<37> = Integrated totals with time tag CP56Time2a	M_IT_TB_1

☐ <38> = Event of protection equipment with time tag CP56Time2a M_EP_TD_1

☐ <39> = Packed start events of protection equipment with time tag CP56Time2a M_E P_TE_1

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

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

Process information in control direction

station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ <45» := Single command C_ SC_NA_1

☒ <46» := Double command C_ DC_NA_ 1

☐ <47» := Regulating step command C_RC_NA_1

☐ <48> := Set point command, normalized value C_ SE_NA_1

☐ <49» := Set point command, scaled value C_ SE_NB_ 1

☐ «50» := Set point command, short floating point value C_SE_NC_1

☐ «51» := Bitstring of 32 bit C_BO_NA_1

☒ <58> := Single command with time tag CP56Time2a C_ SC_TA_1

☒ <59> := Double command with time tag CP56Time2a C_ DC_TA_ 1

☐ <60> := Regulating step command with time tag CP56Time2a C_RC_TA_1

☐ «61> := Set point command, normalized value with time tag CP56Time2a C_SE_TA_1

☐ <62> := Set point command, scaled value with time tag CP56Time2a C_SE_ TB_ 1

☐ <63» := Set point command, short floating point value with time tag CP56Time2a C_SE_TC_1

☐ <64> := Bitstring of 32 bit with time tag CP56Time2a C_BO_TA_1

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

System information in monitor direction

(station-specific parameter, mark "X" if used)

☐ <70> := End of initialization M EI_NA 1

System information in control direction

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ <100>:= Interrogation command C_IC_ NA_ 1

☒ <101>:= Counter interrogation command C_CI_NA_1

☒ <102>:= Read command C_RD_NA_1

☒ <103>:= Clock synchronization command (option see 7.6) C_CS_NA_1

■ <104>:= ~~Test command~~ C_TS_NA_1

☐ <105>:= Reset process command C_RP_NA_1

■ <106>:= ~~Delav acquisition command~~ C_CD_ NA_1

☐ <107>:= Test command with time tag CP56Time2a C_ TS_TA_1

Parameter in control direction

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction,"R" if only used in the reverse direction, and "B" if used in both directions).

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

File transfer

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

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

Shaded boxes: option not required.
Black boxes: option not permitted in this companion standard

Blank: functions or ASDU not used.

Mark Type Identification/Cause of transmission combinations:

"**X**" if only used in the standard direction;

"**R**" if only used in the reverse direction;

"**B**" if used in both directions.

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 … 36	37 … 41	44	45	46	47
<1>	M_SP_NA_1		X	X		X									20 - 24					
~~<2>~~	~~M_SP_TA_1~~			■		■						■	■							
<3>	M_DP_NA_1		X	X		X									20 - 24					
~~<4>~~	~~M_DP_TA_1~~			■		■						■	■							
<5>	M_ST_NA_1																			
~~<6>~~	~~M_ST_TA_1~~			■		■						■	■							

<7>	M_BO_NA_1																		
~~<8>~~	~~M_BO_TA_1~~																		
<9>	M_ME_NA_1	X	X	X		X								20 - 24					
~~<10>~~	~~M_ME_TA_1~~																		
<11>	M_ME_NB_1	X	X	X		X								20 - 24					
~~<12>~~	~~M_ME_TB_1~~																		
<13>	M_ME_NC_1	X	X	X		X								20 - 24					
~~<14>~~	~~M_ME_TC_1~~																		
<15>	M_IT_NA_1														37 - 39				
~~<16>~~	~~M_IT_TA_1~~																		
~~<17>~~	~~M_EP_TA_1~~																		
~~<18>~~	~~M_EP_TB_1~~																		
~~<19>~~	~~M_EP_TC_1~~																		
<20>	M_PS_NA_1																		
<21>	M_ME_ND_1																		
<30>	M_SP_TB_1			X		X													
<31>	M_DP_TB_1			X		X													
<32>	M_ST_TB_1																		
<33>	M_BO_TB_1																		
<34>	M_ME_TD_1			X		X													
<35>	M_ME_TE_1			X		X													
<36>	M_ME_TF_1			X		X													
<37>	M_IT_TB_1														37 - 39				
<38>	M_EP_TD_1																		
<39>	M_EP_TE_1																		
<40>	M_EP_TF_1																		
<45>	C_SC_NA_1						X	X			X						X	X	X	X
<46>	C_DC_NA_1						X	X			X						X	X	X	X
<47>	C_RC_NA_1																			
<48>	C_SE_NA_1																			
<49>	C_SE_NB_1																			

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 … 36	37 … 41	44	45	46	47
<50>	C_SE_NC_1																			
<51>	C_BO_NA_1																			
<58>	C_SC_TA_1						X	X			X						X	X	X	X
<59>	C_DC_TA_1						X	X			X						X	X	X	X
<60>	C_RC_TA_1																			
<61>	C_SE_TB_1																			
<62>	C_SE_TC_1																			
<63>	C_SE_TA_1																			
<64>	C_BO_NA_1																			
<70>	M_EI_NA_1*																			
<100>	C_IC_NA_1						X	X			X						X	X	X	X
<101>	C_CI_NA_1						X	X			X						X	X	X	X
<102>	C_RD_NA_1					X											X	X	X	X
<103>	C_CS_NA_1						X	X									X	X	X	X
~~<104>~~	~~C_TS_NA_1~~																			
<105>	C_RP_NA_1																			
~~<106>~~	~~C_CD_NA_1~~																			
<107>	C_TS_TA_1																			
<110>	P_ME_NA_1																			
<111>	P_ME_NB_1																			
<112>	P_ME_NC_1																			
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_LS_NA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA_1*																			
	* Blank or X only																			

1.6 Basic application functions

Station initialization

(station-specific parameter, mark "X" if function is used)

☐ Remote initialization

Cyclic data transmission

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions)

☒ Cyclic data transmission

Read procedure

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions)

☒ Read procedure

Spontaneous transmission

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions)

☒ Spontaneous transmission

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type "X" where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of amonitored object)

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

☐ Single-point information M SP NA 1, M SP TA 1, M SP TB 1 and M PS NA 1

☐ Double-point information M DP NA 1, M DP TA 1 and M DP TB 1

☐ Step position information M_ST_NA_1 , M_ST_TA_1 and M_ST_TB_1

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

☐ Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1

☐ Measured value, scaled value M_ME_NB_1 , M_ME_TB_1 and M_ME_TE_1

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

Station interrogation

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ global		
☒ group 1	☐ group 7	☐ group 13
☒ group 2	☐ group 8	☐ group 14
☒ group 3	☐ group 9	☐ group 15
☒ group 4	☐ group 10	☐ group 16
☐ group 5	☐ group 11	Information object addresses assigned to each
☐ group 6	☐ group 12	group must be shown in a separate table.

Clock synchronization

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Clock synchronization

optional, see 7.6 of the standard

Command transmission

(object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Direct command transmission (If “select timeout” setting is set to 0s)
☐ Direct set point command transmission
☒ Select and execute command (If “select timeout” setting is set from 1 to 300s)
☐ Select and execute set point command
☒ C_SE ACTTERM used

☒ No additional definition
☐ Short-pulse duration (duration determined by a system parameter in the outstation) **1*
☐ Long-pulse duration (duration determined by a system parameter in the outstation) **1*
☐ Persistent output **1*

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

30 s Maximum allowable delay of commands and set point commands **2*

**Note 1: Duration of the command configurable on the relay configuration.*

**Note 2: Maximum delay between select and execute by default, adjustable in settings.*

Transmission of integrated totals

(station- or object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☐ Mode A: Local freeze with spontaneous transmission
☒ Mode B: Local freeze with counter interrogation
☐ Mode C: Freeze and transmit by counter-interrogation commands
☐ Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously

☒ Counter read
☐ Counter freeze without reset
☐ Counter freeze with reset
☐ Counter reset

☒ General request counter
☒ Request counter group 1
☒ Request counter group 2
☐ Request counter group 3
☐ Request counter group 4

Parameter loading

(object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

Parameter activation

(object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

Test procedure

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Test procedure

File transfer

(station-specific parameter, mark "X" if function is used).

File transfer in monitor direction

☐ Transparent file
☐ Transmission of disturbance data of protection equipment
☐ Transmission of sequences of events
☐ Transmission of sequences of recorded analogue values

File transfer in control direction

☐ Transparent file

Background scan

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Background scan

Acquisition of transmission delay

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

■ ~~Acquisition of transmission delay~~

Definition of time outs

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

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

Maximum number of outstanding I format APDUs *k* and latest acknowledge APDUs (w)

Parameter	Default value	Remarks	Selected value
k	12 APDUs	Maximum difference receive sequence	12
w	8 APDUs	Latest acknowledge after receiving w I format APDUs	1

Maximum range of values *k*: 1 to 32767 (2^{15}-1) APDUs, accuracy 1 APDU

Maximum range of values *w*: 1 to 32767 APDUs, accuracy 1 APDU (Recommendation: *w* should not exceed two-thirds of *k*).

Portnumber

Parameter	value	Remarks
Portnumber	2404	Adjustable in settings

Redundant connections

0	Number N of redundancy group connections used

RFC 2200 suite

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

☒ Ethernet 802.3

☐ Serial X.21 interface

☐ Other selection from RFC 2200:

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. etc.

2. SETTINGS FOR FW VERSION 1.11.00

The following settings can be used to parametrize the communication:

Description	Minimun	Maximun	Step	Unit	Default
Rear TCP Communications					
Protocol	-	-	Modbus TCP, IEC 60870-5-104 or DNP3.0 TCP	-	Modbus TCP
IP Address	1.0.0.1	223.255.255.254	-	-	192.168.200.100
Subnet	255.0.0.0	255.255.255.252	-	-	255.255.255.0
Gateway	1.0.0.1	223.255.255.254	-	-	192.168.200.1
DNS – 1	0.0.0.0	255.255.255.255		-	0.0.0.0
DNS – 2	0.0.0.0	255.255.255.255		-	0.0.0.0

Description	Minimun	Maximun	Step	Unit	Default
IEC 60870-5-104					
Outstation Address	1	65534	1	-	3
TCP Port	1	65535	1	-	2404
T0	1	255	1	s	30
T1	1	255	1	s	15
T2	1	255	1	s	10
T3	1	255	1	s	20
k parameter	1	32767	1	-	12
w parameter	1	32767	1	-	8
Cyclic Period	0	300	1	s	30
Background Period	0	300	1	s	180
Spontaneous Enable	-	-	Yes/No	-	No
Buffering time	0.01	0.5	0.01	s	0.02
Maximum Command Delay	0	300	1	s	30
Select timeout	0	300	1	s	30
IP Address 1	0.0.0.0	255.255.255.255		-	0.0.0.0
IP Address 2	0.0.0.0	255.255.255.255		-	0.0.0.0

Setting	Description
Outstation Address	IEC 60870-5-104 station address for the device (COA)
TCP Port	TCP Port
T0	Time-out of connection establishment
T1	Time-out of send or test APDUs
T2	Time-out for acknowledges in case of no data messages $t_2 < t_1$
T3	Time-out for sending test frames in case of a long idle state
k parameter	Maximum number of Format I APDUs that can be sent without receiving an ACK
w parameter	Number of Format I APDUs that can be received before sending an ACK
Cyclic Period	Period for Cyclic messages
Background Period	Period for background messages
Spontaneous Enable	Determines whether the device can send a spontaneous signal to the master when the spontaneous COT (3) is configured
Buffering time	Period during which events will be accumulated before being communicated
Maximum Command Delay	maximum allowable time difference between the command message's time tag and the local time of the relay.
Select timeout	Time limit in SBO commands for accepting the execute message after the selection of the command. If select timeout is set to 0, direct commands will be accepted.
IP Address 1	IEC 60870-5-104 supports a maximum of 2 connections. The settings “IP Address 1” and “IP Address 2” defines the possible connections. If no IP is set in these settings, the relay will attend to any IP who enquires. The 2 connections will use the same mapping and settings.
IP Address 2	

3. STANDARD INFORMATION NUMBERS, CONTROL DIRECTION, FROM FW VERSION 1.11.00

Supported selection of standard information numbers in control direction:

Type	Description	Reference	Format	Valid COTs
Process information in control direction:				
45	Single command	C_SC_NA_1	SCO	6
46	Double command	C_DC_NA_1	DCO	6
58	Single Command with time tag CP56Time2a	C_ SC_TA_1	SCO + CP56Time2a	6
59	Double Command with time tag CP56Time2a	C_ DC_TA_1	DCO + CP56Time2a	6
System information in control direction:				
100	(General-) Interrogation command	C_IC_NA_1	QOI	6
101	Counter interrogation command	C_CI_NA_1	QCC	6
102	Read Command	C_RD_NA_1		5
103	Clock synchronization command	C_CS_NA_1	CP56Time2a	6

4. STANDARD INFORMATION NUMBERS, MONITOR DIRECTION

4.1 IEC 104 ASDU types, monitor direction

From firmware version M01.11.00 and C01.01.02 all the states, measurements, counters and commands of the relay can be configured to communicate on the IEC60870-5-104 protocol. The following type identification and cause of transmision are available to configure:

Type	Description	Reference	Format	Valid COTs
Process information in monitor direction:				
1	States - Single point information	M_SP_NA_1	SIQ	2, 3, 5, 20, 21-24
3	States - Double point information	M_DP_NA_1	DIQ	2, 3, 5, 20, 21-24
9	Measures - Measured value, normalized value	M_ME_NA_1	NVA + QDS	1, 2, 3, 5, 20, 21-24
11	Measures - Measured value, scaled value	M_ME_NB_1	SVA + QDS	1, 2, 3, 5, 20, 21-24
13	Measures - Measured value, short floating point number	M_ME_NC_1	IEEE STD 754 + QDS	1, 2, 3, 5, 20, 21-24
15	Counters - Integrated totals	M_IT_NA_1	BCR	37-39
30	States - Single-point information with time tag CP56Time2a	M_SP_TB_1	SIQ + CP56Time2a	3, 5
31	States - Double-point information with time tag CP56Time2a	M_DP_TB_1	DIQ + CP56Time2a	3, 5
34	Measures - Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1	NVA + QDS + CP56Time2a	3, 5
35	Measures - Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1	SVA + QDS + CP56Time2a	3, 5
36	Measures - Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1	IEEE STD 754 + QDS + CP56Time2a	3, 5
37	Counters - Integrated totals with time tag CP56Time2a	M_IT_TB_1	BCR + CP56Time2a	37-39

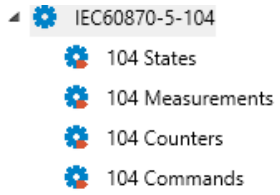
NOTE: For all the supported type id SQ=0. SQ=1 is not supported.

If a state, measure or counter is configured with more than one Cause of Transmission, it will communicate every time one of the causes activates.

5. PROTOCOL CONFIGURATION

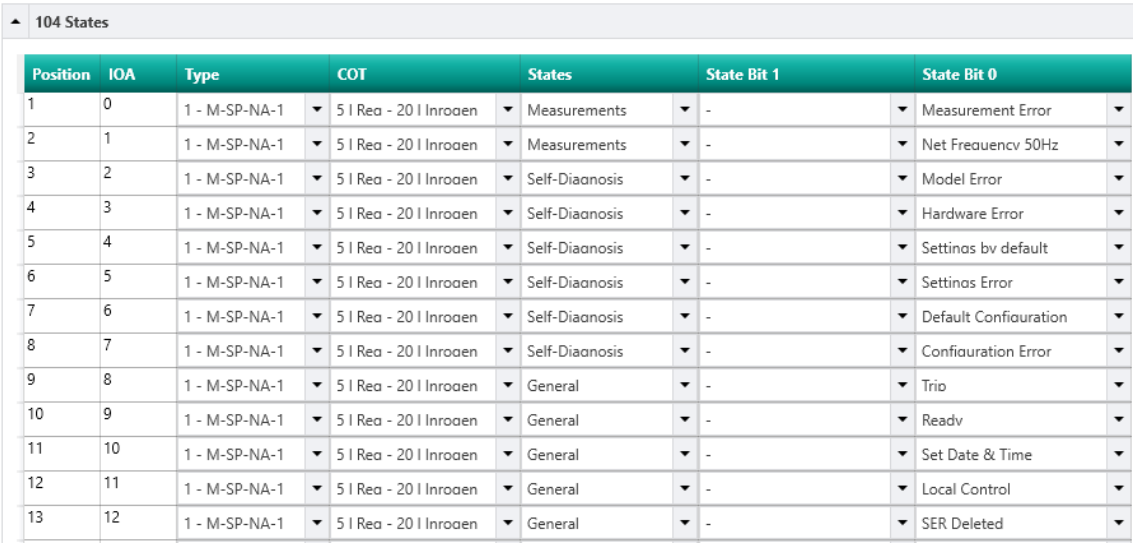
Connect the relay to the SICOM software and go to the “Configuration” menu.

On the configuration, click on the arrow of “IEC60870-5-104”, and all the configurable options will be shown.



5.1 States configuration

On the configuration, click on the arrow of “IEC60870-5-104”, and select the “104 States”. The following screen with the states map will be shown:



(Data on the image is only an indicative example)

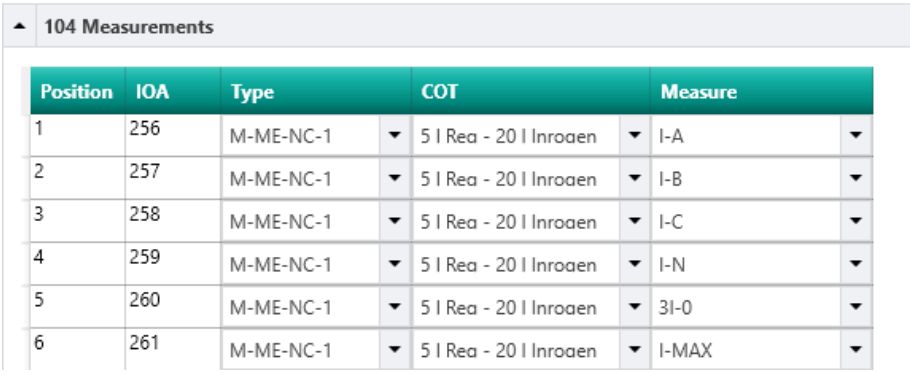
Name	Description
Position	Informative numeral to show the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Type	Selection of available type identifications for the states.
COT	Selection of the cause of transmission. The available COTs will be limited depending on the selected type id.
States	Selection of the criterion of the desired signal.
State Bit 1 **State Bit 0**	State Bit 0 is used in single and double point information. Selecting from the state to communicate from the states of the selected criterion. State Bit 1 is used only in double point information (types 3 and 31) to select a second state bit (from the same criterion).

State Bit 1	State Bit 0	DPI value
Deactivated	Deactivated	0
Deactivated	Activated	1
Activated	Deactivated	2
Activated	Activated	3

After configuring the desired states, send the configuration to the relay with “Send configuration” button on the top menu bar.

5.2 Measurements configuration

On the configuration, click on the arrow of “IEC60870-5-104”, and select the “104 Measurements”. The following screen will be shown:



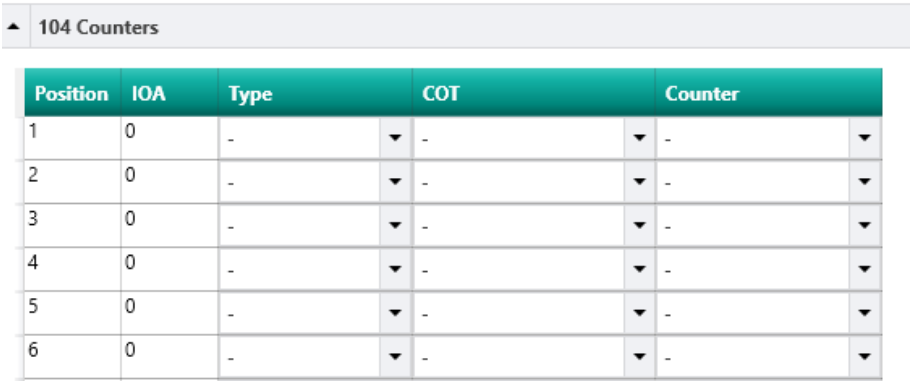
(Data on the image is only an indicative example)

Name	Description
Position	Informative numeral to show the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Type	Selection of available type identifications for the measures.
COT	Selection of the cause of transmission. The available COTs will be limited depending on the selected type id.
Measure	Selection of the desired signal.

After configuring the desired measurements, send the configuration to the relay with “Send configuration” button on the top menu bar.

5.3 Counters configuration

On the configuration, click on the arrow of “IEC60870-5-104”, and select the “104 Counters”. The following screen will be shown:



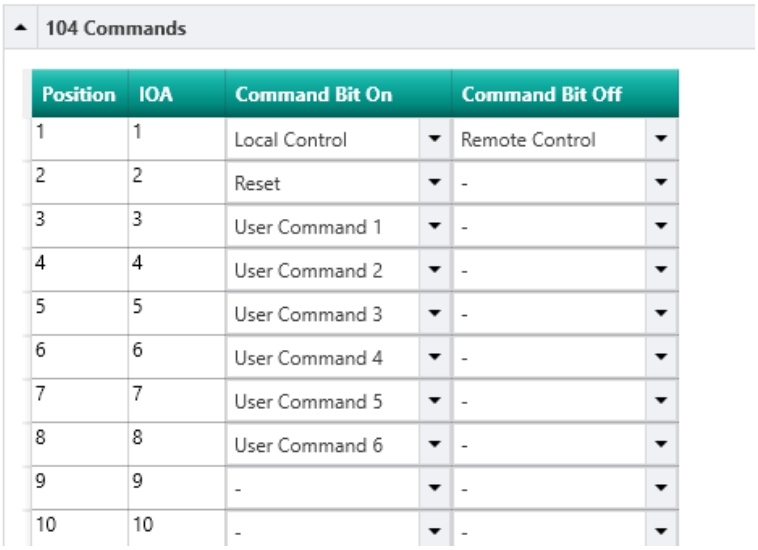
Name	Description
Position	Informative numeral to show the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Type	Selection of available type identifications for the counters.
COT	Selection of the cause of transmission. The available COTs will be limited depending on the selected type id.
Counter	Selection of the desired signal.

After configuring the desired counters, send the configuration to the relay with “Send configuration” button on the top menu bar.

5.4 Commands configuration

Connect the relay to the SICOM software and go to the “Configuration” menu.

On the configuration, click on the arrow of “IEC60870-5-104”, and select the “104 Commands”. The following screen will be shown:



(Data on the image is only an indicative example)

Name	Description
Position	Informative numeral to show the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Command Bit ON	Select the command to perform when a “ON” value is send to the relay in that IOA.
Command Bit OFF	Select the command to perform when a “OFF” value is send to the relay in that IOA.

After configuring the commands, send the configuration to the relay with “Send configuration” button on the top menu bar.

IEC 60870-5-104 PROTOCOL FROM FW VERSION 1.12.01

This section of the document describes the IEC 60870-5-104 data points and structures available in the IED from the main FW version 1.12.01. The point lists describe a superset of all data available through the standard configuration/s.

6. IEC 60870-5-104 PROTOCOL INTEROPERABILITY FROM FW VERSION 1.12.01

The selected parameters should be marked in the white boxes as follows:

☐ Function or ASDU is not used

☒ Function or ASDU is used as standardized (default)

R Function or ASDU is used in reverse mode

B Function or ASDU is used in standard and reverse mode

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

1.1 System or device

(system-specific parameter, indicate definition of a system or a device by marking one of the following with "X")

☐ System definition

☐ Controlling station definition (Master)

☒ Controlled station definition (Slave)

1.2 Network configuration

(network-specific parameter, all configurations that are used are to be marked "X")

■ ~~point-to-point~~ ■ ~~Multipoint~~

■ ~~Multiple point-to-point~~ ■ ~~Multipoint-star~~

1.3 Physical layer

(network-specific parameter, all interfaces and data rates that are used are to be marked "X")

Transmission speed (control direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s	Balanced interchange Circuit X.24/X.27	
■ ~~100 bit/s~~	■ ~~2400 bit/s~~	■ ~~2 400 bit/s~~	■ ~~56 000 bit/s~~
■ ~~200 bit/s~~	■ ~~4800 bit/s~~	■ ~~4 800 bit/s~~	■ ~~64 000 bit/s~~
■ ~~300 bit/s~~	■ ~~9600 bit/s~~	■ ~~9 600 bit/s~~	
■ ~~600 bit/s~~		■ ~~19 200 bit/s~~	
■ ~~1200 bit/s~~		■ ~~38 400 bit/~~	

Transmission speed (monitor direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if »1 200 bit/s	Balanced interchange Circuit X.24/X.27	
■ ~~100 bit/s~~	■ ~~2 400 bit/s~~	■ ~~2 400 bit/s~~	■ ~~56 000 bit/s~~
■ ~~200 bit/s~~	■ ~~4 800 bit/s~~	■ ~~4 800 bit/s~~	■ ~~64 000 bit/s~~
■ ~~300 bit/s~~	■ ~~9 600 bit/s~~	■ ~~9 600 bit/s~~	
■ ~~600 bit/s~~		■ ~~19 200 bit/s~~	
■ ~~1200 bit/s~~		■ ~~38 400 bit/s~~	

1.4 Link layer

(network-specific parameter, all options that are used are to be marked "X". Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

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

Link transmission

- ~~Balanced transmission~~
- ~~Unbalanced transmission~~

Frame length

- ~~Maximum length L (number of octets)~~

Address field of the link

- ~~not present (balanced transmission only)~~
- ~~One octet~~
- ~~Two octets~~
- ~~Structured~~
- ~~Unstructured~~

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

- ~~The standard assigment of ASDUs to class 2 message is used as follows~~:

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

- ~~A special assignment of ASDUs to class 2 message is used as follows~~:

Type identification	Cause of transmission

~~Note: (In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available)~~

1.5 Application layer

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

Common address of ASDU

(system-specific parameter, all configurations that are used are to be marked "X")

■ ~~One octet~~ ☒Two octets

Information object address

(system-specific parameter, all configurations that are used are to be marked "X")

■ ~~One octet~~
■ ~~Two octets~~
☒ Three octets

☐ Structured
☒ Unstructured

Cause of transmission

(system-specific parameter, all configurations that are used are to be marked "X")

■ ~~One octet~~ ☒ Two octets (with originator address). Originator address is set to zero if not used

Length of APDU

(system-specific parameter, specify the maximum length of the APDU per system)

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

253	Maximum length of APDU per system

Selection of standard ASDUs

Process information in monitor direction

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒	<1> := Single-point information	M_SP_NA_1
■	~~<2> := Single-point information with time tag~~	~~M_SP_TA_1~~
☒	<3> := Double-point information	M_DP_NA_1
■	~~<4> := Double -point information with time tag~~	~~M_DP_TA_1~~
☐	<5> := Step position information	M_ST_NA_1
■	~~<6> := Step position information with time tag~~	~~M_ST_TA_1~~
☐	<7> := Bitstring of 32 bit	M_BO_NA_1
■	~~<8> := Bitstring of 32 bit with time tag~~	~~M_BO_TA_1~~
☒	<9> := Measured value, normalized value	M_ME_NA_1
■	~~<10> := Measured va ue, norma ized va ue with time tag~~	~~M_ME_TA_1~~
☒	<11> := Measured value, scaled value	M_ME_NB_1
■	~~<12> := Measured value, scaled value with time tag~~	~~M_ME_TB_1~~
☒	<13> := Measured value, short floating point value	M ME NC 1
■	~~<14> := Measured value, short floating point value with time tag~~	~~M_ME_TC_1~~
☒	<15> := Integrated totals	M_IT_NA_1
■	~~<16> = ntegrated totals with time tag~~	~~M_IT_TA_1~~
■	~~<17> = Event of protection equipment with time tag~~	~~M_EP_TA_1~~
■	~~<18> = Packed start events of protection equipment with time tag~~	~~M_E P_TB_1~~
■	~~<19> := Packed output circuit information of protection equipment with time tag~~	~~M_EP_TC_1~~
☐	<20> = Packed single-point information with status change detection	M_SP_NA_1
☐	<21> = Measured value, normalized value without quality descriptor	M_ME_ND_1
☒	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
☒	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
☐	<32> = Step position information with time tag CP56Time2a	M_ST_TB_1
☐	<33> = Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
☒	<34> = Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
☒	<35> = Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
☒	<36> = Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
☒	<37> = Integrated totals with time tag CP56Time2a	M_IT_TB_1

☐ <38> = Event of protection equipment with time tag CP56Time2a M_EP_TD_1

☐ <39> = Packed start events of protection equipment with time tag CP56Time2a M_E P_TE_1

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

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

Process information in control direction

station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ <45» := Single command C_ SC_NA_1

☒ <46» := Double command C_ DC_NA_ 1

☐ <47» := Regulating step command C_RC_NA_1

☐ <48> := Set point command, normalized value C_ SE_NA_1

☐ <49» := Set point command, scaled value C_ SE_NB_ 1

☐ «50» := Set point command, short floating point value C_SE_NC_1

☐ «51» := Bitstring of 32 bit C_BO_NA_1

☒ <58> := Single command with time tag CP56Time2a C_ SC_TA_1

☒ <59> := Double command with time tag CP56Time2a C_ DC_TA_ 1

☐ <60> := Regulating step command with time tag CP56Time2a C_RC_TA_1

☐ «61> := Set point command, normalized value with time tag CP56Time2a C_SE_TA_1

☐ <62> := Set point command, scaled value with time tag CP56Time2a C_SE_ TB_ 1

☐ <63» := Set point command, short floating point value with time tag CP56Time2a C_SE_TC_1

☐ <64> := Bitstring of 32 bit with time tag CP56Time2a C_BO_TA_1

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

System information in monitor direction

(station-specific parameter, mark "X" if used)

☒ <70> := End of initialization M EI_NA 1

System information in control direction

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ <100>:= Interrogation command C_IC_ NA_ 1

☒ <101>:= Counter interrogation command C_CI_NA_1

☒ <102>:= Read command C_RD_NA_1

☒ <103>:= Clock synchronization command (option see 7.6) C_CS_NA_1

■ <104>:= ~~Test command~~ C_TS_NA_1

☐ <105>:= Reset process command C_RP_NA_1

■ <106>:= ~~Delav acquisition command~~ C_CD_ NA_1

☐ <107>:= Test command with time tag CP56Time2a C_ TS_TA_1

Parameter in control direction

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

File transfer

(station-specific parameter, mark each Type ID "X" if it is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

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

Shaded boxes: option not required.
Black boxes: option not permitted in this companion standard

Blank: functions or ASDU not used.

Mark Type Identification/Cause of transmission combinations:

"**X**" if only used in the standard direction;

"**R**" if only used in the reverse direction;

"**B**" if used in both directions.

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 … 36	37 … 41	44	45	46	47
<1>	M_SP_NA_1		X	X		X									20 - 24					
~~<2>~~	~~M_SP_TA_1~~																			
<3>	M_DP_NA_1		X	X		X									20 - 24					
~~<4>~~	~~M_DP_TA_1~~																			
<5>	M_ST_NA_1																			
~~<6>~~	~~M_ST_TA_1~~																			
<7>	M_BO_NA_1																			
~~<8>~~	~~M_BO_TA_1~~																			
<9>	M_ME_NA_1	X	X	X		X									20 - 24					
~~<10>~~	~~M_ME_TA_1~~																			
<11>	M_ME_NB_1	X	X	X		X									20 - 24					
~~<12>~~	~~M_ME_TB_1~~																			
<13>	M_ME_NC_1	X	X	X		X									20 - 24					
~~<14>~~	~~M_ME_TC_1~~																			
<15>	M_IT_NA_1															37 - 39				
~~<16>~~	~~M_IT_TA_1~~																			
~~<17>~~	~~M_EP_TA_1~~																			
~~<18>~~	~~M_EP_TB_1~~																			
~~<19>~~	~~M_EP_TC_1~~																			
<20>	M_PS_NA_1																			
<21>	M_ME_ND_1																			
<30>	M_SP_TB_1			X		X														
<31>	M_DP_TB_1			X		X														
<32>	M_ST_TB_1																			
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														
<36>	M_ME_TF_1			X		X														
<37>	M_IT_TB_1															37 - 39				
<38>	M_EP_TD_1																			
<39>	M_EP_TE_1																			
<40>	M_EP_TF_1																			
<45>	C_SC_NA_1						X	X			X						X	X	X	X
<46>	C_DC_NA_1						X	X			X						X	X	X	X
<47>	C_RC_NA_1																			
<48>	C_SE_NA_1																			
<49>	C_SE_NB_1																			

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 … 36	37 … 41	44	45	46	47
<50>	C_SE_NC_1																			
<51>	C_BO_NA_1																			
<58>	C_SC_TA_1						X	X			X						X	X	X	X
<59>	C_DC_TA_1						X	X			X						X	X	X	X
<60>	C_RC_TA_1																			
<61>	C_SE_TB_1																			
<62>	C_SE_TC_1																			
<63>	C_SE_TA_1																			
<64>	C_BO_NA_1																			
<70>	M_EI_NA_1*																			
<100>	C_IC_NA_1						X	X			X						X	X	X	X
<101>	C_CI_NA_1						X	X			X						X	X	X	X
<102>	C_RD_NA_1					X											X	X	X	X
<103>	C_CS_NA_1						X	X									X	X	X	X
~~<104>~~	~~C_TS_NA_1~~																			
<105>	C_RP_NA_1																			
~~<106>~~	~~C_CD_NA_1~~																			
<107>	C_TS_TA_1																			
<110>	P_ME_NA_1																			
<111>	P_ME_NB_1																			
<112>	P_ME_NC_1																			
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_LS_NA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA_1*																			

* Blank or X only

1.6 Basic application functions

Station initialization

(station-specific parameter, mark "X" if function is used)

☐ Remote initialization

Cyclic data transmission

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions)

☒ Cyclic data transmission

Read procedure

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions)

☒ Read procedure

Spontaneous transmission

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions)

☒ Spontaneous transmission

Double transmission of information objects with cause of transmission spontaneous

(station-specific parameter, mark each information type "X" where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of amonitored object)

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

☐ Single-point information M SP NA 1, M SP TA 1, M SP TB 1 and M PS NA 1

☐ Double-point information M DP NA 1, M DP TA 1 and M DP TB 1

☐ Step position information M_ST_NA_1 , M_ST_TA_1 and M_ST_TB_1

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

☐ Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1

☐ Measured value, scaled value M_ME_NB_1 , M_ME_TB_1 and M_ME_TE_1

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

Station interrogation

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ global		
☒ group 1	☐ group 7	☐ group 13
☒ group 2	☐ group 8	☐ group 14
☒ group 3	☐ group 9	☐ group 15
☒ group 4	☐ group 10	☐ group 16
☐ group 5	☐ group 11	Information object addresses assigned to each
☐ group 6	☐ group 12	group must be shown in a separate table.

Clock synchronization

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" ifonly used in the reverse direction, and "B" if used in both directions).

☒ Clock synchronization

optional, see 7.6 of the standard

Command transmission

(object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Direct command transmission (If “select timeout” setting is set to 0s)
☐ Direct set point command transmission
☒ Select and execute command (If “select timeout” setting is set from 1 to 300s)
☐ Select and execute set point command
☒ C_SE ACTTERM used

☒ No additional definition
☐ Short-pulse duration (duration determined by a system parameter in the outstation) **1*
☐ Long-pulse duration (duration determined by a system parameter in the outstation) **1*
☐ Persistent output **1*

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

30 s Maximum allowable delay of commands and set point commands **2*

**Note 1: Duration of the command configurable on the relay configuration.*

**Note 2: Maximum delay between select and execute by default, adjustable in settings.*

Transmission of integrated totals

(station- or object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☐ Mode A: Local freeze with spontaneous transmission
☒ Mode B: Local freeze with counter interrogation
☐ Mode C: Freeze and transmit by counter-interrogation commands
☐ Mode D: Freeze by counter-interrogation command, frozen values reported spontaneously

☒ Counter read
☐ Counter freeze without reset
☐ Counter freeze with reset
☐ Counter reset

☒ General request counter
☒ Request counter group 1
☒ Request counter group 2
☐ Request counter group 3
☐ Request counter group 4

Parameter loading

(object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

Parameter activation

(object-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

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

Test procedure

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Test procedure

File transfer

(station-specific parameter, mark "X" if function is used).

File transfer in monitor direction

☐ Transparent file
☐ Transmission of disturbance data of protection equipment
☐ Transmission of sequences of events
☐ Transmission of sequences of recorded analogue values

File transfer in control direction

☐ Transparent file

Background scan

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

☒ Background scan

Acquisition of transmission delay

(station-specific parameter, mark "X" if function is only used in the standard direction, "R" if only used in the reverse direction, and "B" if used in both directions).

■ ~~Acquisition of transmission delay~~

Definition of time outs

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

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

Maximum number of outstanding I format APDUs *k* and latest acknowledge APDUs (w)

Parameter	Default value	Remarks	Selected value
k	12 APDUs	Maximum difference receive sequence	12
w	8 APDUs	Latest acknowledge after receiving w I format APDUs	1

Maximum range of values *k*: 1 to 32767 (2^{15}-1) APDUs, accuracy 1 APDU

Maximum range of values *w*: 1 to 32767 APDUs, accuracy 1 APDU (Recommendation: *w* should not exceed two-thirds of *k*).

Portnumber

Parameter	value	Remarks
Portnumber	2404	Adjustable in settings

Redundant connections

0	Number N of redundancy group connections used

RFC 2200 suite

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

☒ Ethernet 802.3

☐ Serial X.21 interface

☐ Other selection from RFC 2200:

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. etc.

*NOTE: The IP fragmentation is not supported for messages with sides > 8000 bytes.

7. SETTINGS FOR FW VERSION 1.12.01

The following settings can be used to parametrize the communication:

Description	Minimun	Maximun	Step	Unit	Default
Rear TCP Communications					
Protocol	-	-	Modbus TCP, IEC 60870-5-104 or DNP3.0 TCP	-	Modbus TCP
IP Address	1.0.0.1	223.255.255.254	-	-	192.168.200.100
Subnet	255.0.0.0	255.255.255.252	-	-	255.255.255.0
Gateway	1.0.0.1	223.255.255.254	-	-	192.168.200.1
DNS – 1	0.0.0.0	255.255.255.255		-	0.0.0.0
DNS – 2	0.0.0.0	255.255.255.255		-	0.0.0.0
SNTP	-	-	0.es.pool.ntp.org	-	0.es.pool.ntp.org

Description	Minimun	Maximun	Step	Unit	Default
IEC 60870-5-104					
Outstation Address	1	65534	1	-	3
TCP Port	1	65535	1	-	2404
T0	1	255	1	s	30
T1	1	255	1	s	15
T2	1	255	1	s	10
T3	1	255	1	s	20
k parameter	1	32767	1	-	12
w parameter	1	32767	1	-	8
Cyclic Period	0	300	1	s	30
Background Period	0	300	1	s	180
Spontaneous Enable	-	-	Yes/No	-	No
Buffering time	0.01	0.5	0.01	s	0.02
Maximum Command Delay	0	300	1	s	30
Select timeout	0	300	1	s	30
IP Address 1	0.0.0.0	255.255.255.255		-	0.0.0.0
IP Address 2	0.0.0.0	255.255.255.255		-	0.0.0.0

Setting	Description
Outstation Address	IEC 60870-5-104 station address for the device (COA)
TCP Port	TCP Port
T0	Time-out of connection establishment
T1	Time-out of send or test APDUs
T2	Time-out for acknowledges in case of no data messages $t_2 < t_1$
T3	Time-out for sending test frames in case of a long idle state
k parameter	Maximum number of Format I APDUs that can be sent without receiving an ACK
w parameter	Number of Format I APDUs that can be received before sending an ACK
Cyclic Period	Period for Cyclic messages
Background Period	Period for background messages
Spontaneous Enable	Determines whether the device can send a spontaneous signal to the master when the spontaneous COT (3) is configured
Buffering time	Period during which events will be accumulated before being communicated
Maximum Command Delay	maximum allowable time difference between the command message's time tag and the local time of the relay.
Select timeout	Time limit in SBO commands for accepting the execute message after the selection of the command. If select timeout is set to 0, direct commands will be accepted.
IP Address 1	IEC 60870-5-104 supports a maximum of 2 connections. The settings “IP Address 1” and “IP Address 2” defines the possible connections. If no IP is set in these settings, the relay will attend to any IP who enquires. The 2 connections will use the same mapping and settings.
IP Address 2	

8. STANDARD INFORMATION NUMBERS, CONTROL DIRECTION, FROM FW VERSION 1.12.01

Supported selection of standard information numbers in control direction:

Type	Description	Reference	Format	Valid COTs
Process information in control direction:				
45	Single command	C_SC_NA_1	SCO	6
46	Double command	C_DC_NA_1	DCO	6
58	Single Command with time tag CP56Time2a	C_ SC_TA_1	SCO + CP56Time2a	6
59	Double Command with time tag CP56Time2a	C_ DC_TA_1	DCO + CP56Time2a	6
System information in control direction:				
100	(General-) Interrogation command	C_IC_NA_1	QOI	6
101	Counter interrogation command	C_CI_NA_1	QCC	6
102	Read Command	C_RD_NA_1		5
103	Clock synchronization command	C_CS_NA_1	CP56Time2a	6

9. STANDARD INFORMATION NUMBERS, MONITOR DIRECTION

9.1 IEC 104 ASDU types, monitor direction

From firmware version M01.12.01 and C01.04.00 all the states, measurements, counters and commands of the relay can be configured to communicate on the IEC60870-5-104 protocol. The following type identification and cause of transmision are available to configure:

Type	Description	Reference	Format	Valid COTs
Process information in monitor direction:				
1	States - Single point information	M_SP_NA_1	SIQ	2, 3, 5, 20, 21-24
3	States - Double point information	M_DP_NA_1	DIQ	2, 3, 5, 20, 21-24
9	Measures - Measured value, normalized value	M_ME_NA_1	NVA + QDS	1, 2, 3, 5, 20, 21-24
11	Measures - Measured value, scaled value	M_ME_NB_1	SVA + QDS	1, 2, 3, 5, 20, 21-24
13	Measures - Measured value, short floating point number	M_ME_NC_1	IEEE STD 754 + QDS	1, 2, 3, 5, 20, 21-24
15	Counters - Integrated totals	M_IT_NA_1	BCR	37-39
30	States - Single-point information with time tag CP56Time2a	M_SP_TB_1	SIQ + CP56Time2a	3, 5
31	States - Double-point information with time tag CP56Time2a	M_DP_TB_1	DIQ + CP56Time2a	3, 5
34	Measures - Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1	NVA + QDS + CP56Time2a	3, 5
35	Measures - Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1	SVA + QDS + CP56Time2a	3, 5
36	Measures - Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1	IEEE STD 754 + QDS + CP56Time2a	3, 5
37	Counters - Integrated totals with time tag CP56Time2a	M_IT_TB_1	BCR + CP56Time2a	37-39

NOTE: For all the supported type id SQ=0. SQ=1 is not supported.

If a state, measure or counter is configured with more than one Cause of Transmission, it will communicate every time one of the causes activates.

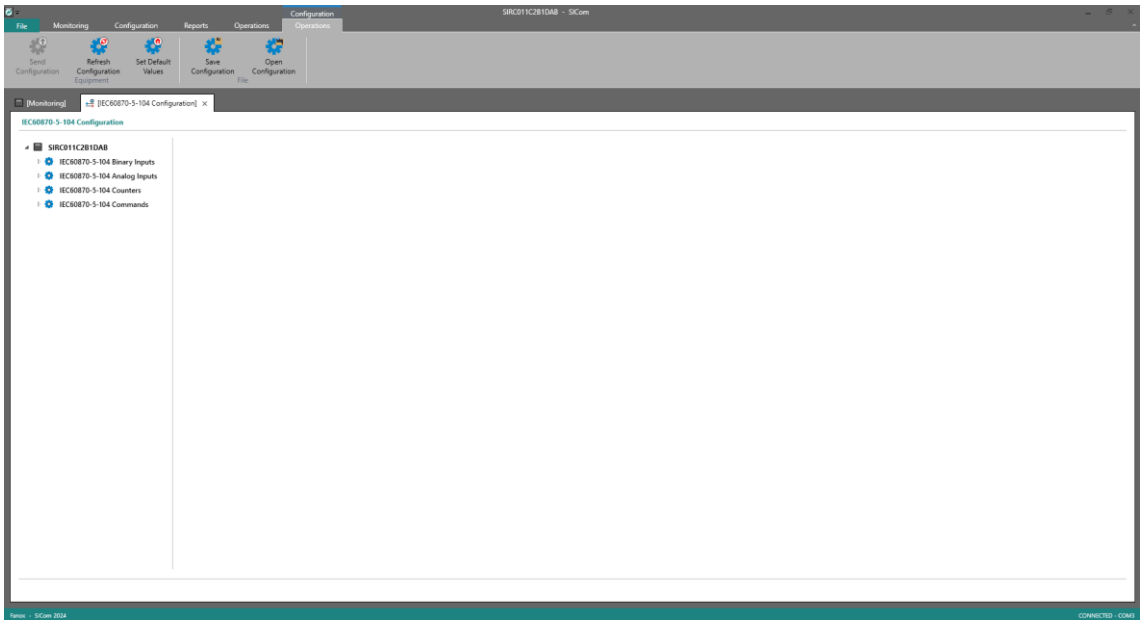
10. PROTOCOL CONFIGURATION

The configuration of the signals is done from the **SICom** software on **Configuration Menu/IEC-104:**



Once the protocol is selected, a new window appears with the different types of signals to be configured:

- IEC60870-5-104 Binary Inputs.
- IEC60870-5-104 Analog Inputs.
- IEC60870-5-104 Counters.
- IEC60870-5-104 Commands.

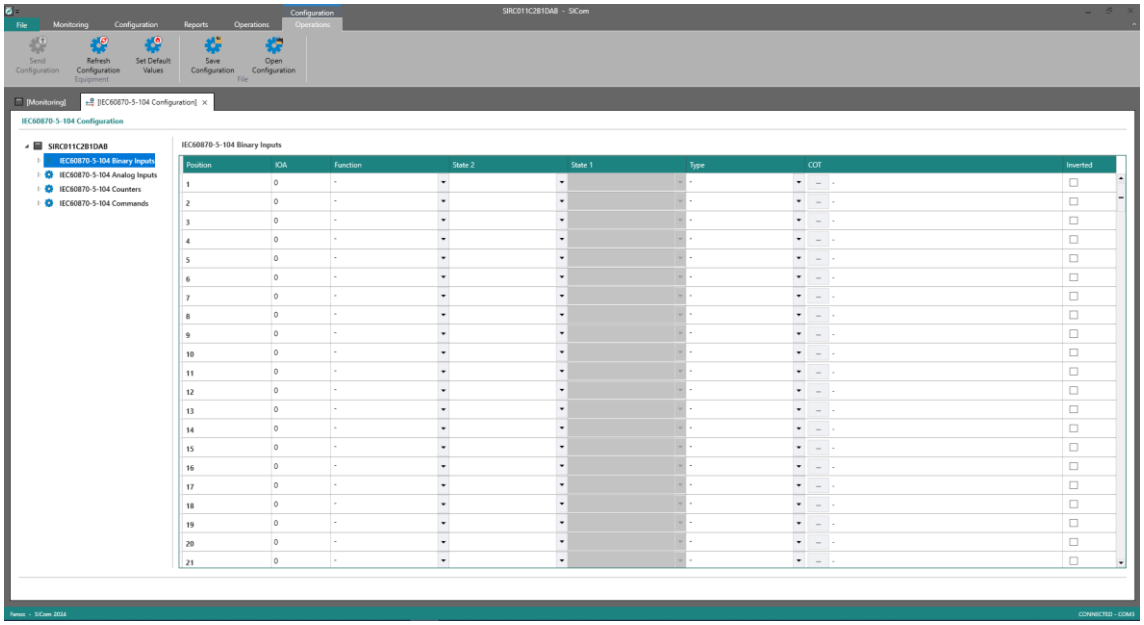


10.1 IEC60870-5-104 Binary Inputs

Binary Inputs include all digital signals, Single or double point, to be sent to the controlling station (Client).

Can be configured up to 256 signals in binary inputs database.

Selecting **IEC60870-5-104 Binary Inputs** opens the entire database table of binary signals, which is empty by default.



Where:

Name	Description
Position	Index of the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Function	Group of signals according to the relay model, selectable from a list.
State 2	Used only in double point information (types 3 and 31) to select a second state bit from the same function.
State 1	Used in single- and double-point information. Select the state of the criterion selected in “Function” column to communicate.
Type	Type identifications, selectable from a list.
COT	Selection of the cause of transmission. The available COTs will be limited depending on the selected type id.
Inverted	Inverted status of the point for sending to the master

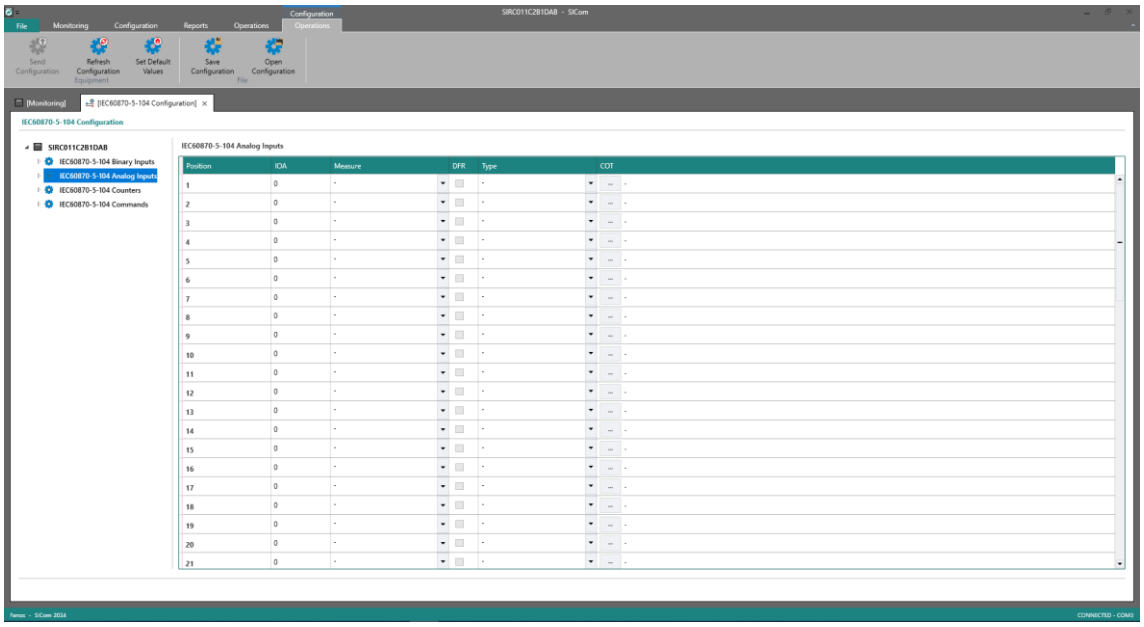
After configuring the desired states, send the configuration to the relay with “Send configuration” button on the top menu bar.

10.2 IEC60870-5-104 Analog Inputs

Analog Inputs include all measures signals to be sent to the controlling station (Client).

Can be configured up to 64 analog signals in analog inputs database.

Selecting **IEC60870-5-104 Analog Inputs** opens the entire database table of analog signals, which is empty by default.



Where:

Name	Description
Position	Informative numeral to show the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Measure	Analog signals according to the relay model, selectable from a list.
DFR	Allows the measurement to be included in the DFR to be sent to the Controlling station.
Type	Type identifications, selectable from a list.
COT	Cause of transmission, selectable from a list. The available COTs will be limited depending on the selected type id.

After configuring the desired measurements, send the configuration to the relay with “Send configuration” button on the top menu bar.

10.3 Range of the measured values

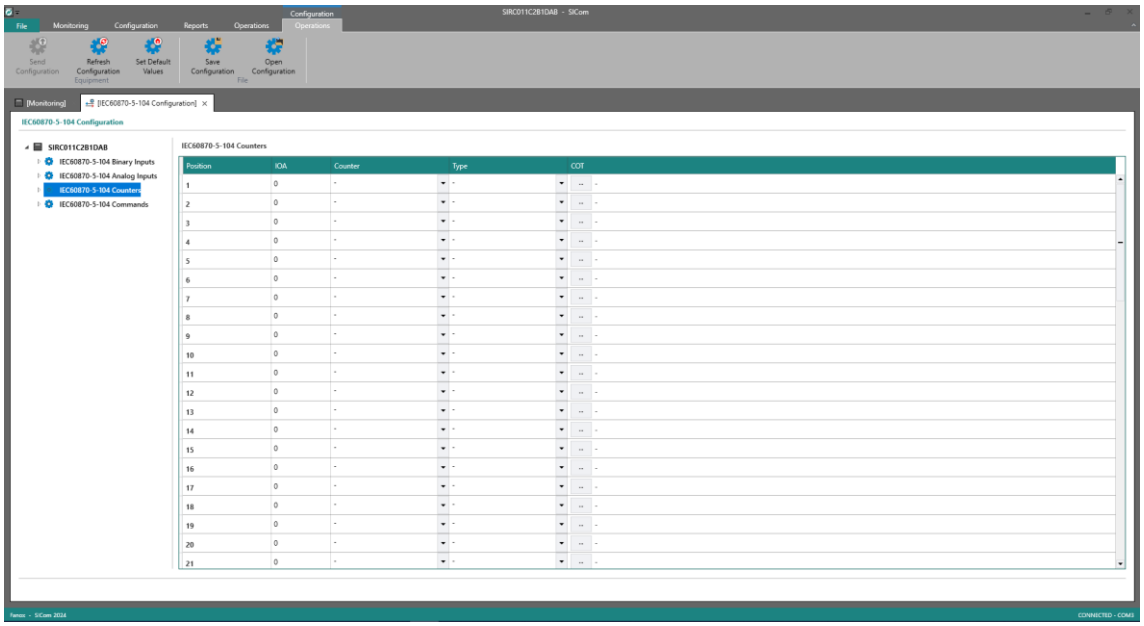
Type of Measure	Range values
Normalized	From 0 to 32767
Scaled	From 0 to 32767
Short Floating	30 times of nominal values

10.4 IEC60870-5-104 Counters

Internal equipment counters to be sent to the controlling station (Client).

Can be configured up to 64 counters signals in counter database.

Selecting **IEC60870-5-104 Counters** opens the entire database table of counters, which is empty by default.



Where:

Name	Description
Position	Index of the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Counter	Counter signal according to the relay model, selectable from a list
Type	Type identification, selectable from a list
COT	Cause of transmission, selectable from a list. The available COTs will be limited depending on the selected type id.

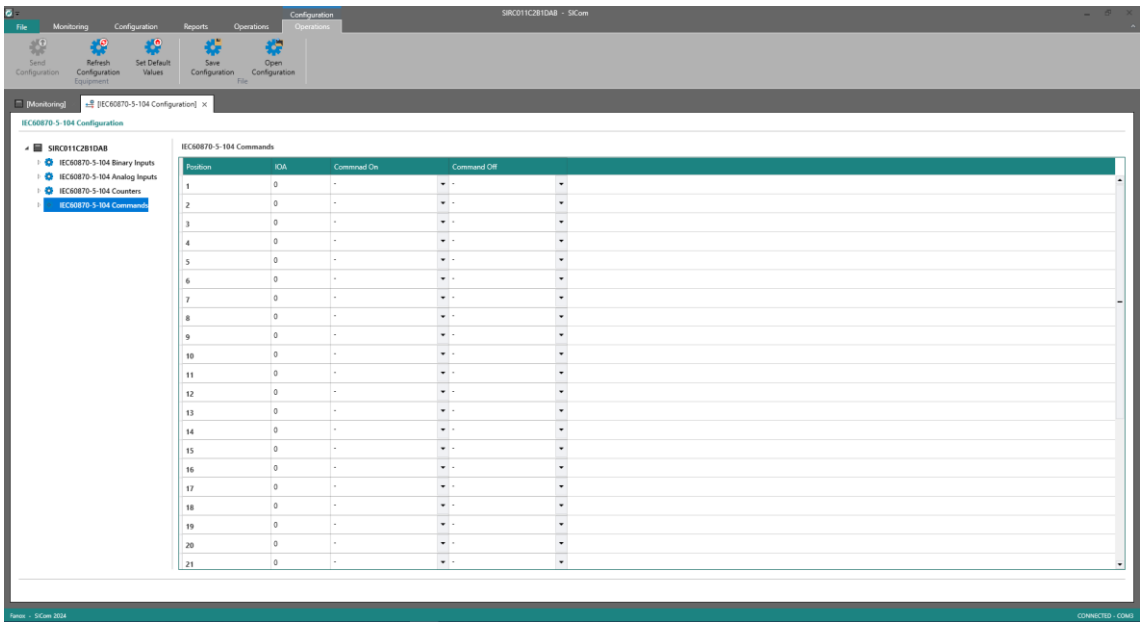
After configuring the desired counters, send the configuration to the relay with “Send configuration” button on the top menu bar.

10.5 IEC60870-5-104 Commands

Command includes all command signals, Single or double, to be sent to the controlling station (Client).

Can be configured up to 32 commands signals in command database.

Selecting **IEC60870-5-104 Command** opens the entire database table of command, which is empty by default.



Name	Description
Position	Informative numeral to show the position on the configuration table
IOA	Configurable Information Object Address. Is not recommended to assign the same IOA to different states or to repeat a state in different positions.
Command ON	Select the command to perform when a “ON” value is send to the relay in that IOA.
Command OFF	Select the command to perform when a “OFF” value is send to the relay in that IOA.

After configuring the commands, send the configuration to the relay with “Send configuration” button on the top menu bar.



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