IEC60870-5-101 & IEC60870-5-104

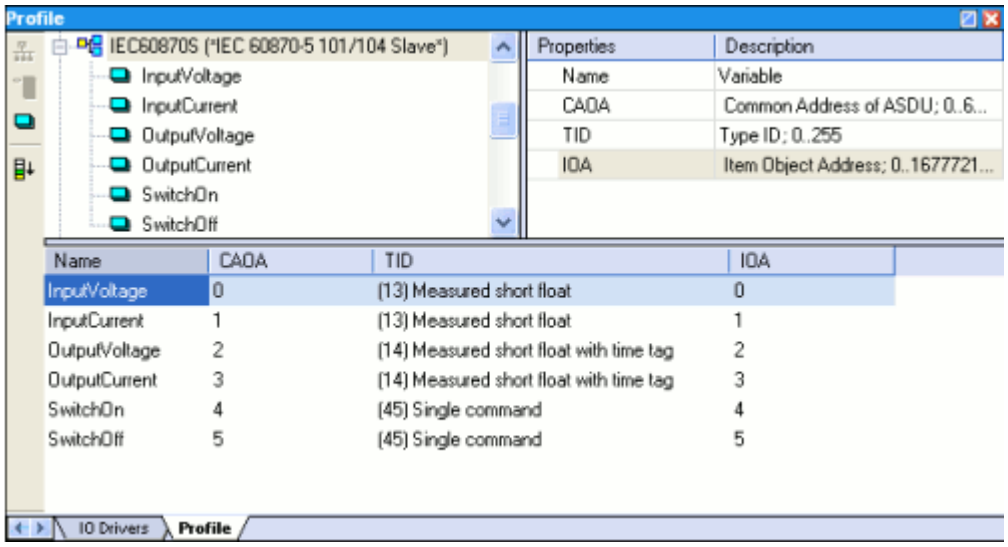
The IEC60870 is an international standard for system monitoring and telecontrol in utilities for water distribution, gas and electricity distribution and energy power system. The RightWON IEC60870 stack supports both IEC60870-5-101 (serial) and IEC60870-5-104 (TCP/IP) slaves.

In the last few years, especially in the energy sector, a protocol standard has established itself which is now considered a "must-have" in substation automation and which is supported by virtually every component producer. We are talking about the international standards 60870-5-101 for serial communication, published in 1995 by the IEC, and 60870-5-104 for communication via TCP/IP, published in 2000.

Both protocols are identical on the application layer, this means they have the same reference data structure. Thanks to that, the configuration and implementation for both serial communication [-101] and TCP/IP networks [-104] is an unique configuration tool in the RightWON Configuration Suite.

The protocol IEC60870-5-10x defines that messages and values must be sent spontaneously from Slave (Controller) to Master (PC) after a change, so there is no Polling procedure. After establishing the connection, the master sends a "general interrogation command" to the slave in order to get the current state of all data points. From this time on, the Slave watches for changes of the data points and sends only if required.

The configuration tool is totally integrated in the RightWON workbench. The declaration of the variables is done through a powerful variables editor and/or through .csv files using the import/export feature.



IEC60870 configuration tool

IEC 60870 Slave Interoperability

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

The interoperability list is defined as in IEC60870-5-101 and extended with parameters used in this standard. The text descriptions of parameters which are not applicable to this companion standard are strike-through (corresponding check box is marked black).

NOTE: In addition, the full specification of a system may require individual selection of certain parameters for certain parts of the system, such as the individual selection of scaling factors for individually addressable measured values.

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

[ ] Function or ASDU is not used
[X] 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, X, R, or B) is specified for each specific clause or parameter. A black check box indicates that the option cannot be selected in this companion standard.

2.1. 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)
[X] Controlled station definition (Slave)

2.2. Network Configuration: 101 only

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

[X] Point-to-point	[X] Multipoint
[X] Multiple point to point	[ ] Multipoint-star

2.3. Physical Layer: 101 only

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

2.3.1. 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 [ ] 200 bit/s [X] 300 bit/s [X] 600 bit/s [X] 1200 bit/s	[X] 2400 bit/s [X] 4800 bit/s [X] 9600 bit/s [X] 19200 bit/s [X] 38400 bit/s [X] 56000 bit/s [X] 57600 bit/s [X] 115200 bit/s [ ] 128000 bit/s [ ] 256000 bit/s	[ ] 2400 bit/s [ ] 4800 bit/s [ ] 9600 bit/s [ ] 19200 bit/s [ ] 38400 bit/s [ ] 56000 bit/s [ ] 64000 bit/s

2.3.2. 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 [ ] 200 bit/s [X] 300 bit/s [X] 600 bit/s [X] 1200 bit/s	[X] 2400 bit/s [X] 4800 bit/s [X] 9600 bit/s [X] 19200 bit/s [X] 38400 bit/s [X] 56000 bit/s [X] 57600 bit/s [X] 115200 bit/s [ ] 128000 bit/s [ ] 256000 bit/s	[ ] 2400 bit/s [ ] 4800 bit/s [ ] 9600 bit/s [ ] 19200 bit/s [ ] 38400 bit/s [ ] 56000 bit/s [ ] 64000 bit/s

2.4. Link layer: 101 only

(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	**Frame length [octets]**	**Address field of the link**
[ ] Balanced transmission	[255] Maximum length L (both directions)*	[ ] not present (balanced transmission only)
[X] Unbalanced transmission		[X] One octet [X] Two octets [X] Structured [X] Unstructured

*may be reduced by the system

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

[ ] The standard assignment of ASDUs to class 2 messages is used as follows:

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

[X] A special assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission
120 - 126	All (as specified in the standard)

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.

2.5. Application Layer

2.5.1. Transmission mode for application data

Mode 1 (Least significant octet first), as defined in 4.10 of IEC60870-5-4, is used exclusively in this companion standard.

2.5.2. Common address of ASDU

(System-specific parameter, all configurations that are used are to be marked 'X')

ASDU Adress	
[X] One octet	[X] Two octet

2.5.3. Information object address

(System-specific parameter, all configurations that are used are to be marked 'X')

ASDU Adress	
[X] One octet	[X] Structured
[X] Two octets	[X] Unstructured
[X] Tree octets	

2.5.4. Cause of transmission

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

Cause of transmission	
[X] One octet	[X] Two octet (with originator address) Originator address is set to zero if not used.

2.5.5. Length of APDU: 104 only

(system-specific parameter, specify the maximum length of the APDU per system) The maximum length of APDU for both directions is 253. The maximum length may be reduced by the system.

[253] Maximum length of APDU per system

2.5.6. Selection of standard ASDUs

2.5.6.1. 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).

Mark	Parameter	Type
[X]	<1>: = Single-point information	M_SP_NA_1
[X]	<2>: = Single-point information with time tag	M_SP_TA_1
[X]	<3>: = Double-point information	M_DP_NA_1
[X]	<4>: = Double-point information with time tag	M_DP_TA_1
[X]	<5>: = Step position information	M_ST_NA_1
[X]	<6>: = Step position information with time tag	M_ST_TA_1
[X]	<7>: = Bitstring of 32 bit	M_BO_NA_1
[X]	<8>: = Bitstring of 32 bit with time tag	M_BO_TA_1
[X]	<9>: = Measured value, normalized value	M_ME_NA_1
[X]	<10>: = Measured value, normalized value with time tag	M_ME_TA_1
[X]	<11>: = Measured value, scaled value	M_ME_NB_1
[X]	<12>: = Measured value, scaled value with time tag	M_ME_TB_1
[X]	<13>: = Measured value, short floating point value	M_ME_NC_1
[X]	<14>: = Measured value, short floating point value with time tag	M_ME_TC_1
[X]	<15>: = Integrated totals	M_IT_NA_1
[X]	<16>: = Integrated 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_EP_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
[X]	<30>: = Single-point information with time tag CP56Time2a	M_SP_TB_1
[X]	<31>: = Double-point information with time tag CP56Time2a	M_DP_TB_1
[X]	<32>: = Step position information with time tag CP56Time2a	M_ST_TB_1
[X]	<33>: = Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
[X]	<34>: = Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
[X]	<35>: = Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
[X]	<36>: = Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
[X]	<37>: = Integrated totals with time tag CP56Time2a	M_IT_TB_1
[ ]	<38>: = Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
[ ]	<39>: = Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
[ ]	<40>:= Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

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

2.5.6.2. 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).

Mark	Parameter	Type
[X]	<45>: = Single command	C_SC_NA_1
[X]	<46>: = Double command	C_DC_NA_1
[X]	<47>: = Regulating step command	C_RC_NA_1
[X]	<48>: = Set point command, normalized value	C_SE_NA_1
[X]	<49>: = Set point command, scaled value	C_SE_NB_1
[X]	<50>: = Set point command, short floating point value	C_SE_NC_1
[X]	<51>: = Bitstring of 32 bit	C_BO_NA_1
[X]	<58>: = Single command with time tag CP56Time2a	C_SC_TA_1
[X]	<59>: = Double command with time tag CP56Time2a	C_DC_TA_1
[X]	<60>: = Regulating step command with time tag CP56Time2a	C_RC_TA_1
[X]	<61>: = Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1
[X]	<62>: = Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
[X]	<63>: = Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1
[X]	<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.

2.5.6.3. System information in monitor direction

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

Mark	Parameter	Type
[X]	<70> : = End of initialization	M_EI_NA_1

2.5.6.4. 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).

Mark	Parameter	Type
[X]	<100>: = Interrogation command*	C_IC_NA_1
[X]	<101>: = Counter interrogation command	C_CI_NA_1
[X]	<102>: = Read command	C_RD_NA_1
[X]	<103>: = Clock synchronization command *	C_CS_NA_1
[ ]	<104>: = Test command	C_TS_NA_1
[X]	<105>: = Reset process command	C_RP_NA_1
[ ]	<106>: = Delay acquisition command	C_CD_NA_1
[ ]	<107>: = Test command with time tag CP56Time2a	C_TS_TA_1

*also Broadcast (with Common Address of ASDU = 0xFF or 0xFFFF)

2.5.6.5. Paramete r 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).

Mark	Parameter	Type
[ ]	<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

2.5.6.6. 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).

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

2.5.6.7. Type identifier and Cause of transmission assignments

(Station-specific parameters)

Shaded boxes: option not required.
Blank: functions or ASDU not used.
Mark Type Identification/Cause of transmission combinations:
'X' if only used in standard direction;
'R' if only used in the reversed direction;
'B' if only used in both direction.

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		X	X		X									X					
<2>	M_SP_TA_1			X																
<3>	M_DP_NA_1		X	X		X									X					
<4>	M_DP_TA_1			X																
<5>	M_ST_NA_1		X	X		X									X					
<6>	M_ST_TA_1			X																
<7>	M_BO_NA_1		X	X		X									X					
<8>	M_BO_TA_1			X																
<9>	M_ME_NA_1	X	X	X		X									X					
<10>	M_ME_TA_1			X																
<11>	M_ME_NB_1	X	X	X		X									X					
<12>	M_ME_TB_1			X																
<13>	M_ME_NC_1	X	X	X		X									X					
<14>	M_ME_TC_1			X																
<15>	M_IT_NA_1			X		X									X1	X				
<16>	M_IT_TA_1			X		X										X				
<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																			

Type identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<30>	M_SP_TB_1			X		X														
<31>	M_DP_TB_1			X		X														
<32>	M_ST_TB_1			X		X														
<33>	M_BO_TB_1			X		X														
<34>	M_ME_TD_1			X		X														
<35>	M_ME_TE_1			X		X														
<36>	M_ME_TF_1			X		X														
<37>	M_IT_TB_1			X		X										X				
<38>	M_EP_TD_1																			
<39>	M_EP_TE_1																			
<40>	M_EP_TF_1																			
<45>	C_SC_NA_1						X	X	X2	X2	X								X	X
<46>	C_DC_NA_1						X	X	X2	X2	X								X	X
<47>	C_RC_NA_1						X	X	X2	X2	X								X	X
<48>	C_SE_NA_1						X	X	X2	X2	X								X	X
<49>	C_SE_NB_1						X	X	X2	X2	X								X	X
<50>	C_SE_NC_1						X	X	X2	X2	X								X	X
<51>	C_BO_NA_1						X	X	X2	X2	X								X	X
<58>	C_SC_TA_1						X	X	X2	X2	X									
<59>	C_DC_TA_1						X	X	X2	X2	X									
<60>	C_RC_TA_1						X	X	X2	X2	X									
<61>	C_SE_TA_1						X	X	X2	X2	X									
<62>	C_SE_TB_1						X	X	X2	X2	X									
<63>	C_SE_TC_1						X	X	X2	X2	X									
<64>	C_BO_TA_1						X	X	X2	X2	X									
<70>	M_EI_NA_1*				X															
<100>	C_IC_NA_1						X	X	X	X	X								X	
<101>	C_CI_NA_1						X	X			X								X	
<102>	C_RD_NA_1					X												X	X	X
<103>	C_CS_NA_1			X														X	X	
<104>	C_TS_NA_1																			
<105>	C_RP_NA_1						X	X										X	X	
<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													X					X	

Type identification		Cause of transmission																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<121>	F_SR_NA_1													X					X	
<122>	F_SC_NA_1					X								X				X	X	
<123>	F_LS_NA_1													X					X	
<124>	F_AF_NA_1													X				X	X	
<125>	F_SG_NA_1													X					X	
<126>	F_DR_TA_1*			X		X														

* Blank or X only

1 Optional.

2 Slave confirms deactivations of write command (TI <45> ... <64>) but corresponding activation is already transferred to execution; actcon and actterm were already sent.

COT	Cause of Transmission	
<0>	not used	
<1>	periodic, cyclic	per/cyc
<2>	background scan	back
<3>	spontaneous	spont
<4>	initialized	init
<5>	request or requested	req
<6>	activation	act
<7>	activation confirmation	actcon
<8>	deactivation	deacts
<9>	deactivation confirmation	deactcon
<10>	activation termination	actterm
<11>	return information caused by a remote command	retrem
<12>	return information caused by a local command	retloc
<13>	file transfer	file
<14...19>	reserved	
<20>	interrogated by station interrogation	inrogen
<21...36>	interrogated by interrogation of the group 1..16	
<37>	requested by general counter request	reqcogen
<38...41>	requested by counter interrogation of the group 1 ... 4	
<42, 43>	reserved	
<44>	unknown type identification	
<45>	unknown cause of transmission	
<46>	unknown common address of ASDU	
<47>	unknown information object address	
<48, 63>	for special use (private range)	

2.6. Basic application functions

2.6.1. Station initialization

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

[ ] Remote initialization

2.6.2. Cyclic data transmission

(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)

[X] Cyclic data transmission

2.6.3. Read 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)

[X] Read procedure

2.6.4. Spontaneous transmission

(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)

[B] Spontaneous transmission

2.6.5. 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 a monitored 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

2.6.6. 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).

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

2.6.7. 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
[ ] Day of week used
[ ] RES1, GEN (time tag substituted/ not substituted) used
[B] SU-bit (summertime) used

2.6.8. Command transmission

(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).

[X] Direct command transmission
[X] Direct set point command transmission
[X] Select and execute command
[X] Select and execute set point command
[ ] C_SE ACTTERM used
[X] No additional definition

[X] Short-pulse duration (duration determined by a system parameter in the outstation)
[X] Long-pulse duration (duration determined by a system parameter in the outstation)
[X] Persistent output
[ ] Supervision of maximum delay in command direction of commands and set point commands
[ ] Maximum allowable delay of commands and set point commands

2.6.9. Transmission of integrated totals

(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).

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

[X] Counter read
[X] Counter freeze without reset
[ ] Counter freeze with reset
[ ] Counter reset

[X] General request counter
[ ] Request counter group 1
[ ] Request counter group 2
[ ] Request counter group 3
[ ] Request counter group 4

2.6.10. Parameter loading

(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).

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

2.6.11. Parameter activation

(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).

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

2.6.12. 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

2.6.13. File transfer

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

File transfer in monitor direction

[X*] Transparent file
[ ] Transmission of disturbance data of protection equipment
[X] Transmission of sequences of events
[ ] Transmission of sequences of recorded analogue values
*a data can be transparently transported by the system but not generated or evaluated. Maximum file size is 16711680 bytes.

File transfer in control direction

[ ] Transparent file

2.6.14. 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).

[X] Background scan

2.6.15. 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

2.6.15.1. Definition of timeouts: 104 only

Parameters	Default value	Remarks	Selected value
t0	30 s	Timeout of connection establishment	not fixed
t1	15 s	Timeout of send or test APDUs	not fixed
t2	10 s	Timeout for acknowledges in case of no data messages; t2 < t1	not fixed
t3	20 s	Timeout for sending test frames in case of a long idle state; t3 > t1	not fixed

Recommended range for timeouts t0 -t2: 1s to 255s, accuracy 1s

Recommended range for timeout t3: 0s to 48hrs, accuracy 1s

Long timeouts for t3 may be needed in special cases where satellite links or dialup connections are used (e.g. to establish connection and collect values only once per day or week). For dialup

connections it may be necessary to give up the connection supervision completely. This is achievable by setting the timeout t3 to zero.

2.6.15.2. Maximum number of outstanding I format APDUs (k) and latest acknowledge APDUs (w): 104 only

Parameter	Default value	Remarks	Selected value
k	12 APDUs	Maximum difference receive sequence number to send state variable	not fixed
w	8 APDUs	Latest acknowledge after receiving w I format APDUs	not fixed

Recommended range of values k: 1 to 32767 (215–1) APDUs, accuracy 1 APDU

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

2.6.15.3. Port number: 104 only

Parameter	Default value	Remarks
Portnumber	2404	not fixed

2.6.15.4. Redundant connections

[ ] Number N of redundancy group connections used

2.7. 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:

List of valid documents from RFC 2200:
1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. etc.