

# Freyr SCADA & Embedded Solutions

## IEC 60870-5-104 Server Stack Interoperability

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Stack Version: 16.07.001

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## 1. 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 IEC 60870-5-101 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
- 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 s

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.

### 1.1 System or device

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

- System definition
- Controlling station definition (master)
- Controlled station definition (slave)

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## 1.2 Network configuration

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

- |  |  |
|--|--|
| <input type="checkbox"/> Point-to-point          | <input type="checkbox"/> Multipoint-party line |
| <input type="checkbox"/> Multiple-point-to-point | <input type="checkbox"/> Multipoint-star       |

## 1.3 Physical layer

(Network-specific parameter, all interfaces and data rates that are used are to be marked with an "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
<input type="checkbox"/> 100-bit/s	<input type="checkbox"/> 2 400-bit/s	<input type="checkbox"/> 56 000-bit/s
<input type="checkbox"/> 200-bit/s	<input type="checkbox"/> 4 800-bit/s	<input type="checkbox"/> 64 000-bit/s
<input type="checkbox"/> 300-bit/s	<input type="checkbox"/> 9 600-bit/s	
<input type="checkbox"/> 600-bit/s	<input type="checkbox"/> 19 200-bit/s	
<input type="checkbox"/> 1 200-bit/s	<input type="checkbox"/> 38 400-bit/s	

### 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
<input type="checkbox"/> 100-bit/s	<input type="checkbox"/> 2 400-bit/s	<input type="checkbox"/> 56 000-bit/s
<input type="checkbox"/> 200-bit/s	<input type="checkbox"/> 4 800-bit/s	<input type="checkbox"/> 64 000-bit/s
<input type="checkbox"/> 300-bit/s	<input type="checkbox"/> 9 600-bit/s	
<input type="checkbox"/> 600-bit/s	<input type="checkbox"/> 19 200-bit/s	
<input type="checkbox"/> 1 200-bit/s	<input type="checkbox"/> 38 400-bit/s	

## 1.4 Link layer

(Network-specific parameter, all options that are used are to be marked with an "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.

<p><b>Link transmission procedure</b></p> <p><input type="checkbox"/> Balanced transmission</p> <p><input type="checkbox"/> Unbalanced transmission</p> <p><b>Frame length</b></p> <p><input type="checkbox"/> Maximum length L (number of octets)</p>	<p><b>Address field of the link</b></p> <p><input type="checkbox"/> not present (balanced transmission only)</p> <p><input type="checkbox"/> one octet</p> <p><input type="checkbox"/> two octets</p> <p><input type="checkbox"/> Structured</p> <p><input type="checkbox"/> Unstructured</p>
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When using an unbalanced link layer, the following ASDU types are returned in class 2 Messages (low priority) with the indicated causes of transmission:

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

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

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

Type identification	Cause of Transmission

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).

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## 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 with an "X")

One octet       two octets

#### Information object address

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

One octet       Structured  
 Two octets       Unstructured  
 Three octets

#### Cause of transmission

(System-specific parameter, all configurations that are used are to be marked with an "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 APDU for both directions is 253. It is a fixed system parameter.

Maximum length of APDU per system in control direction

Maximum length of APDU per system in monitor direction

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## Selection of standard ASDUs

### Process information in monitor direction

(Station-specific parameter, mark each type ID with an "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)

<input checked="" type="checkbox"/>	<1>:= Single-point information	M_SP_NA_1
<input type="checkbox"/>	<2>:= Single-point information with time tag	M_SP_TA_1
<input checked="" type="checkbox"/>	<3>:= Double-point information	M_DP_NA_1
<input type="checkbox"/>	<4>:= Double-point information with time tag	M_DP_TA_1
<input checked="" type="checkbox"/>	<5>:= Step position information	M_ST_NA_1
<input type="checkbox"/>	<6>:= Step position information with time tag	M_ST_TA_1
<input checked="" type="checkbox"/>	<7>:= Bitstring of 32 bit	M_BO_NA_1
<input type="checkbox"/>	<8>:= Bitstring of 32 bit with time tag	M_BO_TA_1
<input checked="" type="checkbox"/>	<9>:= Measured value, normalized value	M_ME_NA_1
<input type="checkbox"/>	<10>:= Measured value, normalized value with time tag	M_ME_TA_1
<input checked="" type="checkbox"/>	<11>:= Measured value, scaled value	M_ME_NB_1
<input type="checkbox"/>	<12>:= Measured value, scaled value with time tag	M_ME_TB_1
<input checked="" type="checkbox"/>	<13>:= Measured value, short floating point value	M_ME_NC_1
<input type="checkbox"/>	<14>:= Measured value, short floating point value with time tag	M_ME_TC_1
<input checked="" type="checkbox"/>	<15>:= Integrated totals	M_IT_NA_1
<input type="checkbox"/>	<16>:= Integrated totals with time tag	M_IT_TA_1
<input type="checkbox"/>	<17>:= Event of protection equipment with time tag	M_EP_TA_1
<input type="checkbox"/>	<18>:= Packed start events of protection equipment with time tag	M_EP_TB_1
<input type="checkbox"/>	<19>:= Packed output circuit information of protection equipment with time tag	M_EP_TC_1
<input type="checkbox"/>	<20>:= Packed single-point information with status change detection	M_PS_NA_1
<input checked="" type="checkbox"/>	<21>:= Measured value, normalized value without quality descriptor	M_ME_ND_1
<input checked="" type="checkbox"/>	<30>:= Single-point information with time tag CP56Time2a	M_SP_TB_1
<input checked="" type="checkbox"/>	<31>:= Double-point information with time tag CP56Time2a	M_DP_TB_1
<input checked="" type="checkbox"/>	<32>:= Step position information with time tag CP56Time2a	M_ST_TB_1
<input checked="" type="checkbox"/>	<33>:= Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
<input checked="" type="checkbox"/>	<34>:= Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
<input checked="" type="checkbox"/>	<35>:= Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
<input checked="" type="checkbox"/>	<36>:= Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
<input checked="" type="checkbox"/>	<37>:= Integrated totals with time tag CP56Time2a	M_IT_TB_1
<input checked="" type="checkbox"/>	<38>:= Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
<input checked="" type="checkbox"/>	<39>:= Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
<input checked="" type="checkbox"/>	<40>:= Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

In this companion standard only the use of the set <30> – <40> for ASDUs with time tag is permitted.

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## Process information in control direction

(Station-specific parameter, mark each type ID with an "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)

<input checked="" type="checkbox"/>	<45>:= Single command	C_SC_NA_1
<input checked="" type="checkbox"/>	<46>:= Double command	C_DC_NA_1
<input checked="" type="checkbox"/>	<47>:= Regulating step command	C_RC_NA_1
<input checked="" type="checkbox"/>	<48>:= Set point command, normalized value	C_SE_NA_1
<input checked="" type="checkbox"/>	<49>:= Set point command, scaled value	C_SE_NB_1
<input checked="" type="checkbox"/>	<50>:= Set point command, short floating point value	C_SE_NC_1
<input checked="" type="checkbox"/>	<51>:= Bitstring of 32 bit	C_BO_NA_1
<input checked="" type="checkbox"/>	<58>:= Single command with time tag CP56Time2a	C_SC_TA_1
<input checked="" type="checkbox"/>	<59>:= Double command with time tag CP56Time2a	C_DC_TA_1
<input checked="" type="checkbox"/>	<60>:= Regulating step command with time tag CP56Time2a	C_RC_TA_1
<input checked="" type="checkbox"/>	<61>:= Set point command, normalized value with time tag CP56Time2a	C_SE_TA_1
<input checked="" type="checkbox"/>	<62>:= Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
<input checked="" type="checkbox"/>	<63>:= Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1
<input checked="" type="checkbox"/>	<64>:= Bitstring of 32 bit command 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 with an "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)

<input checked="" type="checkbox"/>	<70>:= End of initialisation	M_EI_NA_1
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## System information in control direction

(Station-specific parameter, mark with an "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)

<input checked="" type="checkbox"/>	<100>:= Interrogation command	C_IC_NA_1
<input checked="" type="checkbox"/>	<101>:= Counter interrogation command	C_CI_NA_1
<input checked="" type="checkbox"/>	<102>:= Read command	C_RD_NA_1
<input checked="" type="checkbox"/>	<103>:= Clock synchronization command	C_CS_NA_1
<input type="checkbox"/>	<104>:= Test command	C_TS_NA_1
<input checked="" type="checkbox"/>	<105>:= Reset process command	C_RP_NA_1
<input type="checkbox"/>	<106>:= Delay acquisition command	C_GD_NA_1
<input checked="" type="checkbox"/>	<107>:= Test command with time tag CP56Time2a	C_TS_TA_1

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### Parameter in control direction

(Station-specific parameter, mark each type ID with an "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)

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

### File transfer

(Station-specific parameter, mark each type ID with an "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)

<input checked="" type="checkbox"/> <120>:= File ready	F_FR_NA_1
<input checked="" type="checkbox"/> <121>:= Section ready	F_SR_NA_1
<input checked="" type="checkbox"/> <122>:= Call directory, select file, call file, call section	F_SC_NA_1
<input checked="" type="checkbox"/> <123>:= Last section, last segment	F_LS_NA_1
<input checked="" type="checkbox"/> <124>:= Ack file, ack section	F_AF_NA_1
<input checked="" type="checkbox"/> <125>:= Segment	F_SG_NA_1
<input checked="" type="checkbox"/> <126>:= Directory (blank or X, only available in monitor (standard) direction)	F_DR_TA_1
<input checked="" type="checkbox"/> <127>:= Query Log – Request archive file	F_SC_NB_1



**Type identification and cause of transmission assignments**  
(Station-specific parameters)

**Shaded boxes:** option not required.

**Black boxes:** option not permitted in this companion standard

**Blank** = function or ASDU is not used.

**Mark** type identification/cause of transmission combinations:

“X” if used only in the standard direction;

“R” if used only in the reverse direction;

“B” if used in both directions.

Type identification		Cause of transmission																		
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote cmd	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter request	unknown type identification	unknown cause of transmission	unknown common address of ASDU	unknown information object address
		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	X		X					
<2>	M_SP_TA_1																			
<3>	M_DP_NA_1		X	X		X						X	X		X					
<4>	M_DP_TA_1																			
<5>	M_ST_NA_1		X	X		X						X	X		X					
<6>	M_ST_TA_1																			
<7>	M_BO_NA_1		X	X		X										X				
<8>	M_BO_TA_1																			
<9>	M_ME_NA_1	X	X	X		X										X				
<10>	M_ME_TA_1																			
<11>	M_ME_NB_1	X	X	X		X										X				
<12>	M_ME_TB_1																			
<13>	M_ME_NC_1	X	X	X		X										X				
<14>	M_ME_TC_1																			
<15>	M_IT_NA_1			X													X			
<16>	M_IT_TA_1																			
<17>	M_EP_TA_1																			
<18>	M_EP_TB_1																			
<19>	M_EP_TC_1																			
<20>	M_PS_NA_1		X	X		X										X				
<21>	M_ME_ND_1	X	X	X		X										X				
<30>	M_SP_TB_1			X		X						X	X							
<31>	M_DP_TB_1			X		X						X	X							
<32>	M_ST_TB_1			X		X						X	X							
<33>	M_BO_TB_1			X		X														
<34>	M_ME_TD_1			X		X														

Type identification		Cause of transmission														interrogated by group <number>		request by group <n> counter request		unknown type identification		unknown cause of transmission		unknown common address of ASDU		unknown information object address	
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote cmd	return info caused by a local cmd	file transfer	20 to 36	37 to 41	44	45	46	47							
<35>	M_ME_TE_1			X	X																						
<36>	M_ME_TF_1			X	X																						
<37>	M_IT_TB_1			X													X										
<38>	M_EP_TD_1																										
<39>	M_EP_TE_1																										
<40>	M_EP_TF_1																										
<45>	C_SC_NA_1						X	X	X	X	X							X	X	X	X						
<46>	C_DC_NA_1						X	X	X	X	X							X	X	X	X						
<47>	C_RC_NA_1						X	X	X	X	X							X	X	X	X						
<48>	C_SE_NA_1						X	X	X	X	X							X	X	X	X						
<49>	C_SE_NB_1						X	X	X	X	X							X	X	X	X						
<50>	C_SE_NC_1						X	X	X	X	X							X	X	X	X						
<51>	C_BO_NA_1						X	X			X							X	X	X	X						
<58>	C_SC_TA_1						X	X	X	X	X							X	X	X	X						
<59>	C_DC_TA_1						X	X	X	X	X							X	X	X	X						
<60>	C_RC_TA_1						X	X	X	X	X							X	X	X	X						
<61>	C_SE_TA_1						X	X	X	X	X							X	X	X	X						
<62>	C_SE_TB_1						X	X	X	X	X							X	X	X	X						
<63>	C_SE_TC_1						X	X	X	X	X							X	X	X	X						
<64>	C_BO_TA_1						X	X			X							X	X	X	X						
<70>	M_EI_NA_1*				X																						
<100>	C_IC_NA_1						X	X	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	X						
<104>	C_TS_NA_1																										
<105>	C_RP_NA_1						X	X										X	X	X	X						
<106>	C_CD_NA_1																										
<107>	C_TS_TA_1						X	X										X	X	X	X						
<110>	P_ME_NA_1						X	X								X		X	X	X	X						
<111>	P_ME_NB_1						X	X								X		X	X	X	X						
<112>	P_ME_NC_1						X	X								X		X	X	X	X						
<113>	P_AC_NA_1						X	X	X	X								X	X	X	X						
<120>	F_FR_NA_1														X			X	X	X							
<121>	F_SR_NA_1														X			X	X	X							

Type identification		Cause of transmission																		
		periodic, cyclic	background scan	spontaneous	initialized	request or requested	activation	activation confirmation	deactivation	deactivation confirmation	activation termination	return info caused by a remote cmd	return info caused by a local cmd	file transfer	interrogated by group <number>	request by group <n> counter request	unknown type identification	unknown cause of transmission	unknown common address of ASDU	unknown information object address
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<122>	F_SC_NA_1					X								X			X	X	X	
<123>	F_LS_NA_1													X			X	X	X	
<124>	F_AF_NA_1													X			X	X	X	
<125>	F_SG_NA_1													X			X	X	X	
<126>	F_DR_TA_1*			X	X															
<127>	F_SC_NB_1*					X								X			X	X	X	

\* Blank or X only

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## 1.6 Basic application functions

### Station initialization

(Station-specific parameter, mark with an "X" if function is used)

- Remote initialization

### Cyclic data transmission

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

- Cyclic data Transmission

### Read Procedure

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

- Read procedure

### Spontaneous transmission

(Station-specific parameter, mark with an "X" if function is used only in the standard direction, "R" if used only 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 with an "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, see 7.2.1.1)
- 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

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### Station interrogation

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

- |   |  |  |
|---|--|--|
| <input checked="" type="checkbox"/> global  |  |  |
| <input checked="" type="checkbox"/> group 1 | <input checked="" type="checkbox"/> group 7  | <input checked="" type="checkbox"/> group 13 |
| <input checked="" type="checkbox"/> group 2 | <input checked="" type="checkbox"/> group 8  | <input checked="" type="checkbox"/> group 14 |
| <input checked="" type="checkbox"/> group 3 | <input checked="" type="checkbox"/> group 9  | <input checked="" type="checkbox"/> group 15 |
| <input checked="" type="checkbox"/> group 4 | <input checked="" type="checkbox"/> group 10 | <input checked="" type="checkbox"/> group 16 |
| <input checked="" type="checkbox"/> group 5 | <input checked="" type="checkbox"/> group 11 |  |
| <input checked="" type="checkbox"/> group 6 | <input checked="" type="checkbox"/> group 12 |  |

Information object addresses assigned to each group must be shown in a separate table

### Clock synchronization

(Station-specific parameter, mark with an "X" if function is used only in the standard direction, "R" if used only 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
- SU-bit (summertime) used

### Command transmission

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

- Direct command transmission
- Direct set point command transmission
- Select and execute command
- Select and execute set point command
- C\_SE ACTTERM used
- No additional definition
- Short-pulse duration (duration determined by a system parameter in the controlled station)
- Long-pulse duration (duration determined by a system parameter in the controlled station)
- Persistent output
- Supervision of maximum delay of command direction of commands and set point commands

**Configurable** Maximum allowable delay of commands and set point commands

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### Transmission of integrated totals

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

- Threshold value
- Smoothing factor
- Low limit for transmission of measured value
- High limit for transmission of measured

### Parameter activation

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

- Test procedure

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## File transfer

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

- Background scan

## Acquisition of transmission delay

(Station-specific parameter, mark with an "X" if function is used only in the standard direction, "R" if used only 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	Configurable
$t_1$	15 s	Time-out of send or test APDUs	Configurable
$t_2$	10 s	Time-out for acknowledges in case of no data messages $t_2 < t_1$	Configurable
$t_3$	20 s	Time-out for sending test frames in case of a long idle state	Configurable

Maximum range for time-outs  $t_0$  to  $t_1$ : 1 s to 255 s, accuracy 1 s.

Recommended range for timeout  $t_3$ : 1 s to 48h, resolution 1s.

Long timeouts for  $t_3$  may be needed in special cases where satellite links or dialup connections are used (for instance to establish connection and collect values only once per day or week).



**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 number to send state	Configurable
w	8 APDUs	Maximum difference receive sequence number to send state	Configurable

Maximum range of values k: 1 to 32767 (2<sup>15</sup>-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).

**Port number**

Parameter	Default value	Remarks
Portnumber	2404	In all cases(Configurable)

**Redundant connections**

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

List of valid documents from RFC 2200

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