

# Freyr SCADA & Embedded Solutions

## IEC 60870-5-101 Server Stack Interoperability

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Stack Version: 16.07.001

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Online

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## 8 Interoperability

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON 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 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)
- Function or ASDU is used in reverse mode
- 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.

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.

### 8.1 System or device

(System-specific parameter, indicate the station's function by marking one of the following with "X")

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

### 8.2 Network Configuration

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

- Point-to-point
- Multiple point-to-point
- Multipoint-party line
- Multipoint-star

### 8.3 Physical Layer

(Network-specific parameter, all configurations 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
<input checked="" type="checkbox"/> 100 bit/s	<input checked="" type="checkbox"/> 2400 bit/s	<input checked="" type="checkbox"/> 2400 bit/s <input checked="" type="checkbox"/> 56000 bit/s
<input checked="" type="checkbox"/> 200 bit/s	<input checked="" type="checkbox"/> 4800 bit/s	<input checked="" type="checkbox"/> 4800 bit/s <input checked="" type="checkbox"/> 64000 bit/s
<input checked="" type="checkbox"/> 300 bit/s	<input checked="" type="checkbox"/> 9600 bit/s	<input checked="" type="checkbox"/> 9600 bit/s
<input checked="" type="checkbox"/> 600 bit/s		<input checked="" type="checkbox"/> 19200 bit/s
<input checked="" type="checkbox"/> 1200 bit/s		<input checked="" type="checkbox"/> 38400 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 checked="" type="checkbox"/> 100 bit/s	<input checked="" type="checkbox"/> 2400 bit/s	<input checked="" type="checkbox"/> 2400 bit/s <input checked="" type="checkbox"/> 56000 bit/s
<input checked="" type="checkbox"/> 200 bit/s	<input checked="" type="checkbox"/> 4800 bit/s	<input checked="" type="checkbox"/> 4800 bit/s <input checked="" type="checkbox"/> 64000 bit/s
<input checked="" type="checkbox"/> 300 bit/s	<input checked="" type="checkbox"/> 9600 bit/s	<input checked="" type="checkbox"/> 9600 bit/s
<input checked="" type="checkbox"/> 600 bit/s		<input checked="" type="checkbox"/> 19200 bit/s
<input checked="" type="checkbox"/> 1200 bit/s		<input checked="" type="checkbox"/> 38400 bit/s

**8.4 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 procedure**

- Balanced transmission
- Unbalanced transmission

**Address field of link**

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

**Frame length**

<input type="text" value="255"/>	Maximum length L (control direction)
<input type="text" value="255"/>	Maximum length L (monitor direction)

Time during which repetitions are permitted (Trp) or number of repetitions

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
1, 3, 5, 7, 9, 11, 13, 20, 21, 110, 111, 112	<2>

**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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## 8.5 Application Layer

### Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 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                       structured  
 Two octets                     unstructured  
 Three octets

### Cause of transmission

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

- One octet                       Two octets (with originator address)  
Set to zero in case of no originator address

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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 checked="" 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 checked="" 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 checked="" 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 checked="" 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 checked="" 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 checked="" 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 checked="" 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 checked="" type="checkbox"/> <16> := Integrated totals with time tag	M_IT_TA_1
<input checked="" type="checkbox"/> <17> := Event of protection equipment with time tag	M_EP_TA_1
<input checked="" type="checkbox"/> <18> := Packed start events of protection equipment with time tag	M_EP_TB_1
<input checked="" 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

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

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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

### 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 initialization	M_EI_NA_1
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### System 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"/> <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 checked="" type="checkbox"/> <104> := Test command	C_TS_NB_1
<input checked="" type="checkbox"/> <105> := Reset process command	C_RP_NC_1
<input checked="" type="checkbox"/> <106> := Delay acquisition command	C_CD_NA_1

### 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

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**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	F_DR_TA_1

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

Shaded boxes are not required.

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		X	X								X	X							
<3>	M_DP_NA_1	X	X	X								X	X	X						
<4>	M_DP_TA_1		X	X								X	X							
<5>	M_ST_NA_1	X	X	X								X	X	X						
<6>	M_ST_TA_1		X	X								X	X							
<7>	M_BO_NA_1	X	X	X										X						
<8>	M_BO_TA_1		X	X																
<9>	M_ME_NA_1	X	X	X	X									X						
<10>	M_ME_TA_1		X	X																
<11>	M_ME_NB_1	X	X	X	X									X						
<12>	M_ME_TB_1		X	X																
<13>	M_ME_NC_1	X	X	X	X									X						
<14>	M_ME_TC_1		X	X																
<15>	M_IT_NA_1		X												X					
<16>	M_IT_TA_1		X												X					
<17>	M_EP_TA_1		X																	
<18>	M_EP_TB_1		X																	
<19>	M_EP_TC_1		X																	
<20>	M_PS_NA_1																			
<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																

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
<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				
<38>	M_EP_TD_1			X																
<39>	M_EP_TE_1			X																
<40>	M_EP_TF_1			X																
<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	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						X	X									X	X	X	X
<105>	C_RP_NA_1						X	X									X	X	X	X
<106>	C_CD_NA_1			X			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	
<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															

\* Blank or X only

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## 8.6 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' if only 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' if only 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' if only used in the reverse direction, and 'B' if used in both directions)

- Spontaneous

### 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.

- 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

### 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)

- |   |  |  |
|---|--|--|
| <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 show in a separate table

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### 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
- 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
- No additional definition
- Short pulse duration (duration determined by a system parameter in the outstation)
- Long pulse duration (duration determined by a system parameter in the outstation)
- Persistent output
- Select and execute command
- Select and execute set point command
- C\_SE\_ACTTERM used

### 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)

- Mode A: Local freeze with spontaneous
- Mode B: Local freeze with counter
- Mode C Freeze and transmit by counter interrogation
- Mode C Freeze by counter-interrogation command, frozen values reported
- Counter read
- Counter freeze without reset
- Counter freeze without reset
- Counter reset
- General request counter
- Request counter group 1
- Request counter group 2
- Request counter group 3
- Request counter group 4

### 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 value
- High limit for transmission of measured value

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**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

**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  
 Transmission of sequences of events  
 Transmission of sequences of recorded analog 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