



# **SG-Gateway**

## **IEC 60870-5-104 Interoperability**

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# 1 Document Information

## 1.1 Document History

Version	Date	Description
DRAFT	July 2017	Draft version
1.0	October 2017	First release

## 1.2 Conventions

This IEC 60870-5-104 Interoperability document for the IXXAT SG Gateway presents sets of parameters and alternatives from which subsets have to be selected to implement particular tel-control 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 are marked in the boxes as follows:

- Function or ASDU is not used.
- Function or ASDU is used as standardized (default).
- Function or ASDU is used in reverse direction.
- Function or ASDU is used in standard and in reverse direction.
- Function or ASDU is only used in servers in standard direction.
- Options cannot be selected (crossed out).

The possible selection (blank, X, R, or B) is specified for each specific Clause or parameter.

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**i** *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.*

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## 2 System or Device

System-specific parameter, indicates the definition of a system or a device.

- System definition
- Controlling station definition (Master)
- Controlled station definition (Slave)

### 3 Network Configuration

Network-specific parameter.

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

### 4 Physical Layer

Network-specific parameter

#### 4.1 Transmission Speed (Control Direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if >1200 bit/s	Balanced interchange Circuit V.24/V.27
<input type="checkbox"/> 100 bit/st	<input type="checkbox"/> 2400 bit/st	<input type="checkbox"/> 2400 bit/st
<input type="checkbox"/> 200 bit/st	<input type="checkbox"/> 4800 bit/st	<input type="checkbox"/> 4800 bit/st
<input type="checkbox"/> 300 bit/st	<input type="checkbox"/> 9600 bit/st	<input type="checkbox"/> 9600 bit/st
<input type="checkbox"/> 600 bit/st		<input type="checkbox"/> 19200 bit/st
<input type="checkbox"/> 1200 bit/st		<input type="checkbox"/> 38400 bit/st
		<input type="checkbox"/> 56000 bit/st
		<input type="checkbox"/> 64000 bit/st

#### 4.2 Transmission Speed (Monitor Direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if >1200 bit/s	Balanced interchange Circuit V.24/V.27
<input type="checkbox"/> 100 bit/st	<input type="checkbox"/> 2400 bit/st	<input type="checkbox"/> 2400 bit/st
<input type="checkbox"/> 200 bit/st	<input type="checkbox"/> 4800 bit/st	<input type="checkbox"/> 4800 bit/st
<input type="checkbox"/> 300 bit/st	<input type="checkbox"/> 9600 bit/st	<input type="checkbox"/> 9600 bit/st
<input type="checkbox"/> 600 bit/st		<input type="checkbox"/> 19200 bit/st
<input type="checkbox"/> 1200 bit/st		<input type="checkbox"/> 38400 bit/st
		<input type="checkbox"/> 56000 bit/st
		<input type="checkbox"/> 64000 bit/st

## 5 Link Layer

Network specific parameter. 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

### Frame Length

Maximum length L (control direction)

Maximum length L (monitor direction)

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

### 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 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
9, 11, 13, 21	<1>



*In response to a class 2 poll, a controlled station may respond with class 1 data when there is no class 2 data available.*

## 6 Application Layer

### 6.1 Transmission Mode for Application Data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 608070–5–4, is used exclusively in this companion standard.

### 6.2 Common Address of ASDU

System-specific parameter

One octet

Two octets

### 6.3 Information Object Address

System-specific parameter

One octet

Structured

Two octets

Unstructured

Three octets

### 6.4 Cause of Transmission

System-specific parameter

One octet

Two octets (with originator address), originator address is set to 0 if not used

### 6.5 Length of APDU

System-specific parameter, specifies 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.

Maximum length of APDU per system



## 6.6 Selection of Standard ASDUs

### 6.6.1 Process Information in Monitor Direction

Station-specific parameter

X	<1>	:= single-point information	M_SP_NA_1
	<2>	:= single-point information with time tag	M_SP_TA_1
X	<3>	:= double-point information	M_DP_NA_1
	<4>	:= double-point information with time tag	M_DP_TA_1
X	<5>	:= step position information	M_ST_NA_1
	<6>	:= step position information with time tag	M_ST_TA_1
X	<7>	:= bitstring of 32 bit	M_BO_NA_1
	<8>	:= bitstring of 32 bit with time tag	M_BO_TA_1
X	<9>	:= measured value, normalized value	M_ME_NA_1
	<10>	:= measured value, normalized value with time tag	M_ME_TA_1
	<11>	:= measured value, scaled value	M_ME_NC_1
	<12>	:= measured value, scaled value with time tag	M_ME_TC_1
X	<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
X	<15>	:= integrated totals	M_IT_NA_1
	<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 protections equipment with time tag	M_EP_TB_1
	<19>	:= packed output circuit information of protections equipment with time tag	M_EP_TC_1
	<20>	:= packed single-point information with status change detection	M_PS_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 ASDUs of the set <2>, <4>, <6>, <8>, <10>, <12>, <14>, <16>, <17>, <18>, <19> or of the set <30–40> are used.

## 6.6.2 Process Information in Control Direction

Station-specific parameter

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
	<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
	<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
X	<64>	:= bitstring of 32 bit command with time tag CP56Time2a	C_BO_TA_1

## 6.6.3 System Information in Monitor Direction

Station-specific parameter

	<70>	:= end of initialization	M_EI_NA_1
--	------	--------------------------	-----------

## 6.6.4 System Information in Control Direction

Station-specific parameter

X	<100>	:= interrogation command	C_IC_NA_1
X	<101>	:= counter interrogation command	C_CI_NA_1
S	<102>	:= read command	C_RD_NA_1
S	<103>	:= clock synchronization command	C_CS_NA_1
	<104>	<del>Test command</del>	<del>C_TS_NA_1</del>
	<105>	:= reset process command	C_RP_NA_1
	<106>	<del>Delay acquisition command</del>	<del>C_GD_NA_1</del>
S	<107>	:= test command with time tag CP56Time2a	C_TS_TA_1

## 6.6.5 Parameter in Control Direction

Station-specific parameter

	<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

## 6.7 File Transfer

Station-specific parameter

<120>	:= file ready	F_FR_NA_1
<121>	:= section ready	F_SR_NA_1
<122>	:= call directory, select file, call file, call selection	F_SC_NA_1
<123>	:= last action, last segment	F_LS_NA_1
<124>	:= ack file, ack section	F_AF_NA_1
<125>	:= segment	F_SG_NA_1
<126>	:= directory	F_DR_TA_1
<127>	:= query log — request archive file	F_SC_NB_1

## 6.8 Type Identification and Cause of Transmission Assignment

Station-specific parameters

- Shaded boxes: option not required.
- Black boxes: option not implemented.
- Blank: function or ASDU not used.

Mark Type Identification/Cause of transmission combinations:

- X: only used in the standard direction
- R: only used in reverse direction
- B: used in both directions

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					
<2>	M_SP_TA_1																			
<3>	M_DP_NA_1			X		X									X					
<4>	M_DP_TA_1																			
<5>	M_ST_NA_1			X		X									X					
<6>	M_ST_TA_1																			
<7>	M_BO_NA_1			X		X									X					
<8>	M_BO_TA_1																			
<9>	M_ME_NA_1	X		X		X									X					
<10>	M_ME_TA_1																			
<11>	M_ME_NB_1																			
<12>	M_ME_TB_1																			
<13>	M_ME_NC_1	X		X		X									X					
<14>	M_ME_TC_1																			
<15>	M_IT_NA_1			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																			
<21>	M_ME_ND_1																			
<30>	M_SP_TB_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
<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				
<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																			
<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																			
<100>	C_IC_NA_1						X	X			X									X
<101>	C_CI_NA_1						X	X			X									X
<102>	C_RD_NA_1					S													S	S
<103>	C_CS_NA_1						S	S												S
<104>	M_TS_NA_1																			
<105>	C_RP_NA_1																			X
<106>	M_CD_NA_1																			
<107>	C_TS_TA_1						S	S												X
<110>	P_ME_NA_1														X		X			
<111>	P_ME_NB_1														X		X			
<112>	P_ME_NC_1														X		X			
<113>	P_AC_NA_1																X			
<120>	F_FR_NA_1																X			
<121>	F_SR_NA_1																X			
<122>	F_SC_NA_1																X			
<123>	F_LS_NA_1																X			
<124>	F_AF_NA_1																X			
<125>	F_SG_NA_1																X			
<126>	F_DR_TA_1																			
<127>	F_SC_NB_1																X			

## 7 Basic Application Functions

### 7.1 Station Initialization

Station-specific parameter

Remote initialization

### 7.2 Cyclic Data Transmission

Station-specific parameter

Cyclic data transmission

### 7.3 Read Procedure

Station-specific parameter

Read procedure

### 7.4 Spontaneous Transmission

Station-specific parameter

Spontaneous transmission

### 7.5 Double Transmission of Information Objects with Cause of Transmission Spontaneous

Station-specific parameter, for information marked with X both a type ID without time and a 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\_NA1, 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

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

## 7.6 Station Interrogation

Station-specific parameter

- |   |  |  |
|---|--|--|
| <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 |  |

## 7.7 Clock Synchronization

Station-specific parameter

- Clock synchronization
- Day of week used
- RES1, GEN (time tag substituted/not substituted) used
- SU-bit (summertime) used

## 7.8 Command Transmission

Object-specific parameter

- 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
- Maximum allowable delay of commands and set point commands

## 7.9 Transmission of Integrated Totals

Station- or object-specific parameter

- 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

## 7.10 Parameter Loading

Object-specific parameter

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

## 7.11 Parameter Activation

Station-specific parameter

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

## 7.12 Test Procedure

Station-specific parameter

- Test procedure

## 7.13 File Transfer

### 7.13.1 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

### 7.13.2 File Transfer in Control Direction

- Transparent file

## 7.14 Background Scan

Station-specific parameter

- Background scan

## 7.15 Acquisition of Transmission Delay

Station-specific parameter

- Acquisition of transmission delay

## 7.16 Definition of Timeouts

Parameter	Default value	Remarks	Selected value
t0	30 s	Timeout of connection establishment	
t1	15 s	Timeout of send or test APDUs	
t2	10 s	Timeout for acknowledges in case of no data message $t2 < t1$	
t3	20 s	Timeout for sending test frames in case of a long idle state	

Maximum range of values for all timeouts: 1 to 255 s, accuracy 1 s.

## 7.17 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	
w	8 APDUs	Maximum difference receive sequence number to send state	

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.)



## 7.18 Portnumber

Parameter	Default value	Remarks	Selected value
Portnumber	2404	Configurable	

## 7.19 Redundant Connections

Number N of redundancy group connections used

## 7.20 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

