

### IEC60870-5-101 Interoperability Document

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
- **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.

#### 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 Network configuration

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



Point-to-point

X

Multipoint-partyline

X

- Multiple point-to-point
- Multipoint-star

# 3 Physical layer

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

Transmission speed (control direction)

Unbalanced interchange Circuit V.24/V.28 Standard			Unba Circa Reco	alanced uit V.24 ommeno	l interchange /V.28 ded if >1 200 bi	Bala Circ t/s	inced int uit X.24/	erchang X.27	je		
	100	bit/s	X	2 400	bit/s	X	2 400	bit/s		56 000	bit/s
	200	bit/s	X	4 800	bit/s	X	4 800	bit/s		64 000	bit/s
	300	bit/s	X	9 600	bit/s	X	9 600	bit/s			
	600	bit/s				X	19 200	bit/s			
X	1 200	bit/s				X	38 400	bit/s			
Trans	smissio	<u>n speed (mon</u>	itor d	irection	).						
Unbalanced interchange Circuit V.24/V.28 Standard			Unba Circa Reco	alanced uit V.24 ommeno	l interchange /V.28 ded if >1 200 bi	Bala Circ t/s	inced int uit X.24/	erchang X.27	je		
	100	bit/s	X	2 400	bit/s	X	2 400	bit/s	<u> </u>	56 000	bit/s
	200	bit/s	X	4 800	bit/s	X	4 800	bit/s		64 000	bit/s
	300	bit/s	X	9 600	bit/s	X	9 600	bit/s			
	600	bit/s				X	19 200	bit/s			
X	1 200	bit/s				X	38 400	bit/s			

# 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			Address field of the link		
X	Balanced transmission Unbalanced transmission	X X X	not present (balanced transmission only) One octet Two octets		

Frame length

255

Maximum length L (number of 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:

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

Χ

Х

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

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

Type identification	Cause of transmission
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	<3>
30, 31, 32, 33, 34, 35, 36, 37	<3>

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).

# 5 Application layer

# Transmission mode for application data

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

# Common address of ASDU

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

X



One octet

Two octets

## Information object address

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



One octet

Χ	
Χ	

Structured Unstructured

XTwo octetsXThree octets

## Cause of transmission

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



One octet

X 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.

253
253

Maximum length of APDU per system in control direction

Maximum length of APDU per system in monitor direction

# Selection of standard ASDUs

### Process information in monitor direction

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

В	<1>	:= Single-point information	M_SP_NA_1
Χ	<2>	:= Single-point information with time tag	M_SP_TA_1
В	<3>	:= Double-point information	M_DP_NA_1
Χ	<4>	:= Double-point information with time tag	M_DP_TA_1
В	<5>	:= Step position information	M_ST_NA_1
Χ	<6>	:= Step position information with time tag	M_ST_TA_1
В	<7>	:= Bitstring of 32 bit	M_BO_NA_1
Χ	<8>	:= Bitstring of 32 bit with time tag	M_BO_TA_1
В	<9>	:= Measured value, normalized value	M_ME_NA_1
Χ	<10>:=	Measured value, normalized value with time tag	M_ME_TA_1
В	<11>:=	Measured value, scaled value	M_ME_NB_1
Χ	<12> :=	Measured value, scaled value with time tag	M_ME_TB_1
В	<13>:=	Measured value, short floating point value	M_ME_NC_1
Χ	<14> :=	Measured value, short floating point value with time tag	M_ME_TC_1
В	<15> :=	Integrated totals	M_IT_NA_1
Χ	<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
Χ	<31> :=	Double-point information with time tag CP56Time2a	M_DP_TB_1
Χ	<32> :=	Step position information with time tag CP56Time2a	M_ST_TB_1
Χ	<33> :=	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
Χ	<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

In this companion standard only the use of the set  $\langle 30 \rangle - \langle 40 \rangle$  for ASDUs with time tag is permitted.

### 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).

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

X<70> := End of initializationM\_EI\_NA\_1

### System information in control direction

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

В	<100>:= Interrogation command	C_IC_NA_1
В	<101>:= Counter interrogation command	C_CI_NA_1
	<102>:= Read command	C_RD_NA_1
Χ	<103>:= Clock synchronization command (option see 7.6)	C_CS_NA_1
В	<104>:= Test command	C_TS_NA_1
Χ	<105>:= Reset process command	C_RP_NA_1
Χ	<106>:= Delav acquisition command	C CD NA 1
X	<107>:= Test command with time tag CP56Time2a	C_TS_TA_1

### Parameter in control direction

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

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

### File transfer

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

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

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

Shaded boxes: option not required.

Black boxes: option not permitted in this companion standard Blank: functions or ASDU not used.

Mark Type Identification/Cause of transmission combinations:

- "X" if only used in the standard direction;
- "R" if only used in the reverse direction;
- "B" if used in both directions.

Type ident	ification	Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47
															to	to				
															36	41				
<1>	M_SP_NA_1		В	В											В					
<2>	M_SP_TA_1			х																
<3>	M_DP_NA_1		В	В											В					
<4>	M_DP_TA_1			Х																
<5>	M_ST_NA_1		В	В											В					
<6>	M_ST_TA_1			Х																
<7>	M_BO_NA_1		В	В											В					
<8>	M_BO_TA_1			Х																
<9>	M_ME_NA_1	В	В	В											В					
<10>	M_ME_TA_1			Х																
<11>	M_ME_NB_1	В	в	В											В					
<12>	M_ME_TB_1			Х																

Type identification			Cause of transmission																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47
															to	to			ĺ	
															36	41				
<13>	M_ME_NC_1	В	В	В											В					L
<14>	M_ME_TC_1			Х																<u> </u>
<15>	M_IT_NA_1															В				
<16>	M_IT_TA_1															Х				
<del>&lt;17&gt;</del>	M_EP_TA_1																			
<del>&lt;18&gt;</del>	M_EP_TB_1																			
<del>&lt;19&gt;</del>	M_EP_TC_1																			
<20>	M_PS_NA_1																			
<21>	M_ME_ND_1																			
<30>	M_SP_TB_1			В																
<31>	M_DP_TB_1			В																
<32>	M_ST_TB_1			в																
<33>	M_BO_TB_1			в																
<34>	M_ME_TD_1			В																
<35>	M_ME_TE_1			В																
<36>	M_ME_TF_1			В																
<37>	M IT TB 1															х				
<38>	M EP TD 1																			
<39>	M EP TE 1																			
<40>	M EP TF 1																			
<45>	C SC NA 1						х	х	х	х	х									
<46>	C DC NA 1						х	х	х	х	х									
<47>	C RC NA 1						x	x	X	x	X									
<48>	C SE NA 1						x	x	x	x	x									
<40>	C SE NB 1						x	x	x	x	x									
<50>	C SE NC 1						X	x	x	X	X									H
<50>							X	x	~	~	x									
<51>							×	×	v	Y	× ×									
<00>	$C_3C_1A_1$						×	×	×	×	×									
<09>							×	×	×	×	×									
<00>								×		×	Ň									
<01>							~	~	~	~	~									
<62>							X	X	X	X	X									
<63>							X	X	X	X	X									
<64>							X	X			X									
0	M_EI_NA_1^						_	_	_	_	_								-	
<100>	C_IC_NA_1						в	В	в	в	в								1	
<101>	C_CI_NA_1						В	В			В									
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1						Х	х												
<104>	C_TS_NA_1						В	В												
<105>	C_RP_NA_1						Х	Х												
<del>&lt;106&gt;</del>	C_CD_NA_1																			
<107>	C_TS_TA_1						Х	Х											<u> </u>	
<110>	P_ME_NA_1						Х	Х											<u> </u>	
<111>	P_ME_NB_1						Х	Х											<u> </u>	
<112>	P_ME_NC_1						Х	Х												
<del>&lt;113&gt;</del>	P_AC_NA_1																			
<del>&lt;120&gt;</del>	F_FR_NA_1																			
<del>&lt;121&gt;</del>	F_SR_NA_1																			
< <u>122</u> >	F_SC_NA_1																			
< <del>123&gt;</del>	F_LS_NA_1																			
<del>&lt;124&gt;</del>	F_AF_NA_1																			
<125>	<u>F_SG_NA_1</u>		1																	

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Type identif	ication		Cause of transmission																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47
															to	to				
															36	41				
<del>&lt;126&gt;</del>	F_DR_TA_1*																			
<del>&lt;127&gt;</del>	F_SC_NB_1*																			
* Blank or X onl	y																			

# 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 transmission

### Double transmission of information objects with cause of transmission spontaneous

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

## 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).



### **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).



**X** Clock synchronization

Day of week used

RES1, GEN (time tag substituted/ not substituted) used

X SU-bit (summertime) used

optional, see 7.6

### **Command transmission**

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

- X
- Direct command transmission
- Х
  - Direct set point command transmission Select and execute command
- Х Х

Select and execute set point command

- X C\_SE ACTTERM used
- X No additional definition
- X 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

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

Maximum allowable delay of commands and set point commands

### Transmission of integrated totals

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

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

I	

counter read

- В Counter freeze without reset
- В Counter freeze with reset
- B Counter reset
- **B** General request

В Request counter group 1

В Request counter group 2

B Request counter group 3

B Request counter group 4

### Parameter loading

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



Х

Threshold value

Smoothing factor

Low limit for transmission of measured values

High limit for transmission of measured values

### Parameter activation

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



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

### Test procedure

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



B Test procedure

## File transfer

(station-specific parameter, mark "X" if function is used). File transfer in monitor direction

Transparent file

Transmission of disturbance data of protection equipment

Transmission of sequences of events

Transmission of sequences of recorded analogue values

File transfer in control direction

Transparent file

## **Background scan**

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

X

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).

Χ

Acquisition of transmission delay