

SCADAPack E-Series IEC 60870-5 Interoperability Profile Documents



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Table of Contents

Part I SCADAPack E-Series IEC 60870-5-101 Slave Interoperability Profile Document	4
1 Technical Support.....	5
2 Interoperability.....	5
2.1 Device Function & Network Configuration	6
2.2 Physical Layer	7
2.3 Link Layer	7
2.4 Application Layer	8
2.4.1 Transmission Mode, Common Address of ASDU, & Length of APDU.....	8
2.4.2 Information Object Address & Cause of Transmission.....	9
2.4.3 Process Information in the Monitor Direction.....	10
2.4.4 Process Information & Parameter in the Control Direction.....	11
2.4.5 System Information in the Monitoring & Control Direction.....	11
2.5 File Transfer	12
2.6 Cause of Transmission	13
2.6.1 Type Indicator.....	14
2.7 Basic Application Functions	16
2.7.1 Station Initialization & Interrogation.....	16
2.7.2 Clock Synchronization & Command Transmission.....	17
2.7.3 Read Procedure & Qualifier for Command Transmission.....	18
2.7.4 Counter Interrogation.....	19
2.7.5 File Transfer.....	20
Part II SCADAPack E-Series IEC 60870-5-104 Slave Interoperability Profile Document	21
1 Technical Support.....	22
2 Interoperability.....	22
2.1 System or Device & Network Configurations	23
2.2 Physical Layer	24
2.3 Link Layer	25
2.4 Application Layer	26
2.4.1 Transmission Mode for Application Data & File Transfer.....	26
2.4.2 Common Address of ASDU & Length of APDU.....	27
2.4.3 Information Object Address & Cause of Transmission.....	28
2.4.4 System Information in Monitor & Control Directions.....	29
2.4.5 Process Information & Parameter in Control Directions.....	30
2.4.6 Selection of Standard ASDUs.....	31
2.4.7 Type Identifier and Cause of Transmission Assignments.....	32
2.4.7.1 Type Identification Grid.....	33
2.5 Basic Application Functions	35
2.5.1 Station Initialization & Interrogation, & Read Procedure.....	36
2.5.2 Cyclic Data, Spontaneous, & Double Transmissions.....	37
2.5.3 Clock Synchronization & Command Transmission.....	38
2.5.4 Transmission of Integrated Totals.....	39
2.5.5 Parameter Loading & Activation, & Test Procedure.....	40

2.5.6 Definition of Time Outs & Background Scan..... 41
 2.5.7 File Transfer & Acquisition of Transmission Delay..... 42
 2.5.8 Portnumber & Maximum Number of Outstanding I Format APDUs..... 43
 2.5.9 Redundant Connections & RFC 2200 Suite..... 44

Part III SCADAPack E-Series IEC 60870-5-103 Master Interoperability Profile Document 44

1 Technical Support..... 46
 2 Interoperability..... 46
 2.1 Physical & Link Layer 47
 2.2 Application Layer 48
 2.2.1 Transmission Mode for Application Data & Common Address of ASDU..... 48
 2.2.2 Selection of Standard Information Numbers in Monitor Direction..... 49
 2.2.2.1 System & Generic Functions in Monitor Directions..... 49
 2.2.2.2 Status & Earth Fault Indications in Monitor Directions..... 50
 2.2.2.3 Supervision Indications & Measurands in Monitor Directions..... 51
 2.2.2.4 Fault & Auto-Reclosure Indications in Monitor Directions..... 52
 2.2.3 Selection of Standard Information Numbers in Control Direction..... 53
 2.2.4 Basic Application Functions..... 54
 2.2.5 Miscellaneous..... 54

I SCADAPack E-Series IEC 60870-5-101 Slave Interoperability Profile Document

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Control Microsystems

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2 Interoperability

This interoperability document 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.

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)
- 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. A black check box indicates that the option cannot be selected in this companion standard.

2.1 Device Function & Network Configuration

Device Function

- Controlling Station (Master)
- Controlled Station (Slave)

Network Configuration

- Multiple Point-to-Point
 - Multipoint-Partyline
 - Multipoint-Star
 - Redundant Communication Links
 - Redundant Communication Links
-

2.2 Physical Layer

Transmission Speed (Common for Both Directions)

Unbalanced interchange

Circuit V.24/V.28 Standard

	Speed			Speed
	100 bit/s		<input checked="" type="checkbox"/>	4800 bit/s
	200 bit/s		<input checked="" type="checkbox"/>	9,600 bit/s
	300 bit/s		<input checked="" type="checkbox"/>	19,200 bit/s
	600 bit/s		<input checked="" type="checkbox"/>	38,400 bit/s
<input checked="" type="checkbox"/>	1,200 bit/s			56,800 bit/s
<input checked="" type="checkbox"/>	2400 bit/s			64,000 bit/s

2.3 Link Layer

FT 1.2 Frame Format, Single Character 1 (0xE5) and fixed time out interval

Link Transmission Procedure

	Procedure	Remark
<input checked="" type="checkbox"/>	Balanced Transmission	
<input checked="" type="checkbox"/>	Send / No reply in the monitoring direction	
<input checked="" type="checkbox"/>	Unbalanced Transmission	
<input checked="" type="checkbox"/>	Number of Data Class 1 requests	Only for unbalanced transmission Default: 4
<input checked="" type="checkbox"/>	Number of Data Class 2 requests	
<input checked="" type="checkbox"/>	Max. length of message 255 octets	
<input checked="" type="checkbox"/>	Number of repeats: 1	

Address field of the link

- | | |
|---|--|
| <input checked="" type="checkbox"/> Not present (Can be omitted only for balanced transmission) | <input type="checkbox"/> Structured |
| <input checked="" type="checkbox"/> 1 Octet | <input checked="" type="checkbox"/> Unstructured |
| <input checked="" type="checkbox"/> 2 Octets | |

2.4 Application Layer

- [Transmission Mode for Application Data and File Transfer, Common Address of ASDU, & Length of APDU](#) ⁸
- [Information Object Address & Cause of Transmission](#) ⁹
- [Process Information in the Monitor Direction](#) ¹⁰
- [Process Information & Parameter in the Control Direction](#) ¹¹
- [System Information in the Monitoring & Control Direction](#) ¹¹

2.4.1 Transmission Mode, Common Address of ASDU, & Length of APDU

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 standard.

Common Address of ASDU

- 1 Octet
- 2 Octets

Length of APDU

Length of APDU: **252** octets

2.4.2 Information Object Address & Cause of Transmission

Information Object Address

- | | |
|--|--|
| <input type="checkbox"/> 1 Octet | <input type="checkbox"/> Structured |
| <input checked="" type="checkbox"/> 2 Octets | <input checked="" type="checkbox"/> Unstructured |
| <input type="checkbox"/> 3 Octets | |

Cause of Transmission

- | |
|---|
| <input checked="" type="checkbox"/> 1 Octet |
| <input type="checkbox"/> 2 Octets |

2.4.3 Process Information in the Monitor Direction

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

2.4.4 Process Information & Parameter in the Control Direction

Process Information in the Control Direction

<input checked="" type="checkbox"/>	<45>	C_SC_NA_1	Single command
<input checked="" type="checkbox"/>	<46>	C_DC_DA_1	Double command
<input checked="" type="checkbox"/>	<47>	C_RC_NA_1	Regulating step command
<input checked="" type="checkbox"/>	<48>	C_SE_NA_1	Set point command, normalized value
<input checked="" type="checkbox"/>	<49>	C_SE_NB_1	Set point command, scaled value
<input checked="" type="checkbox"/>	<50>	C_SE_NC_1	Set point command, short floating point value
	<51>	C_BO_NA_1	Bitstring of 32 bits

Parameter in the Control Direction

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

2.4.5 System Information in the Monitoring & Control Direction

System Information in the Monitoring Direction

<70> End of initialization

System Information in the Control Direction

<input checked="" type="checkbox"/>	<100>	C_IC_NA_1	Interrogation command
<input checked="" type="checkbox"/>	<101>	C_CI_NA_1	Counter interrogation command
	<102>	C_RD_NA_1	Read command
<input checked="" type="checkbox"/>	<103>	C_CS_NA_1	Clock synchronization command
<input checked="" type="checkbox"/>	<104>	C_TS_NA_1	Test command
<input checked="" type="checkbox"/>	<105>	C_RP_NA_1	Reset process command
	<106>	C_CD_NA_1	Delay acquisition command
	<107>	C_TS_TA_1	Test command with time tag CP56Time2a

2.5 File Transfer

- File Transfer in Monitoring Direction
- File Transfer in Control Direction

<120>	F_FR_NA_1	File ready
<121>	F_SR_NA_1	Section ready
<122>	F_SC_NA_1	Call directory, select file, call file, call section
<123>	F_LS_NA_1	Last section, last segment
<124>	F_AF_NA_1	Ack file, ack section
<125>	F_SG_NA_1	Segment
<126>	F_DR_TA_1	Directory

2.6 Cause of Transmission

Number	Cause of Transmission
<0>	Not used
<1>	Periodic, Cyclic
<2>	Background Scan
<3>	Spontaneous
<4>	Initialized
<5>	Request or Requested
<6 – 7>	Activation and Activation Confirmation (ACT, ACTCON)
<8 – 9>	Deactivation and Deactivation Confirmation (DEACT, DEACTCON)
<10>	Activation Termination (ACTTERM)
<11>	Return information caused by a Remote Command
<12>	Return information caused by a Local Command
<13>	File Transfer
<20 >	General interrogation
<37>	General Counter Request
<44>	Unknown type identification
<45>	Unknown cause of transmission
<46>	Unknown address of ASDU
<47>	Unknown information object address

2.6.1 Type Indicator

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47
<1>	M_SP_NA_1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<2>	M_SP_TA_1			<input checked="" type="checkbox"/>																
<3>	M_DP_NA_1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<4>	M_DP_TA_1			<input checked="" type="checkbox"/>																
<5>	M_ST_NA_1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<6>	M_ST_TA_1			<input checked="" type="checkbox"/>											<input checked="" type="checkbox"/>					
<7>	M_BO_NA_1																			
<8>	M_BO_TA_1																			
<9>	M_ME_NA_1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<10>	M_ME_TA_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<11>	M_ME_NB_1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<12>	M_ME_TB_1			<input checked="" type="checkbox"/>																
<13>	M_ME_NC_1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<14>	M_ME_TC_1			<input checked="" type="checkbox"/>																
<15>	M_IT_NA_1																		<input checked="" type="checkbox"/>	
<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																			<input checked="" type="checkbox"/>
<21>	M_ME_ND_1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>									<input checked="" type="checkbox"/>					
<30>	M_SP_TB_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<31>	M_DP_TB_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<32>	M_ST_TB_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<35>	M_ME_TE_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<36>	M_ME_TF_1			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>														
<37>	M_IT_TA_1																			
<38>	M_EP_TD_1																			
<39>	M_EP_TE_1																			
<40>	M_EP_TF_1																			
<45>	C_SC_NA_1									<input checked="" type="checkbox"/>										
<46>	C_DC_DA_1									<input checked="" type="checkbox"/>										
<47>	C_RC_NA_1									<input checked="" type="checkbox"/>										
		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47

		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47
<48>	C_SE_NA_1						<input checked="" type="checkbox"/>													
<49>	C_SE_NB_1						<input checked="" type="checkbox"/>													
<50>	C_SE_NC_1						<input checked="" type="checkbox"/>													
<51>	C_BO_NA_1																			
<70>	M_EI_NA_1				<input checked="" type="checkbox"/>															
<100>	C_IC_NA_1						<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>									
<101>	C_CI_NA_1						<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>									
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>												
<104>	C_TS_NA_1						<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>												
<105>	C_RP_NA_1																			
<106>	C_CD_NA_1																			
<110>	P_ME_NA_1																			
<111>	P_ME_NB_1																			
<112>	P_ME_NC_1																			
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_LS_NA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA_1																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	20	37	44	45	46	47

2.7 Basic Application Functions

- [Station Initialization & Interrogation](#) ¹⁶
- [Clock Synchronization & Command Transmission](#) ¹⁷
- [Read Procedure & Qualifier for Command Transmission](#) ¹⁸
- [Counter Interrogation](#) ¹⁹
- [File Transfer](#) ²⁰

2.7.1 Station Initialization & Interrogation

Station Initialization

- Remote initialization
- Cyclic data transmission

Station Interrogation

Type Ident <100>

<input checked="" type="checkbox"/>	global			
	group 1		group 7	group 13
	group 2		group 8	group 14
	group 3		group 9	group 15
	group 4		group 10	group 16
	group5		group 11	
	group 6		group 12	

2.7.2 Clock Synchronization & Command Transmission

Clock Synchronization

- Clock synchronization

Command Transmission

- Supervision of maximum delay in command direction

Maximum allowable delay of commands **Configurable**

<input checked="" type="checkbox"/>	Direct command transmission
<input checked="" type="checkbox"/>	Direct set point command transmission
<input checked="" type="checkbox"/>	Select and execute command
<input checked="" type="checkbox"/>	Select and execute set point command
<input checked="" type="checkbox"/>	C_SE ACTTERM used

2.7.3 Read Procedure & Qualifier for Command Transmission**Read Procedure**

- Read procedure
- Spontaneous transmission

Qualifier for Command Transmission

	QOC	
<input checked="" type="checkbox"/>	<0>	No additional definition
<input checked="" type="checkbox"/>	<1>	Short pulse duration
<input checked="" type="checkbox"/>	<2>	Long pulse duration
<input checked="" type="checkbox"/>	<3>	Persistent output

2.7.4 Counter Interrogation

Counter Interrogation

	Mode	
	Mode A	Local freeze with spontaneous transmission
	Mode B	Local freeze with counter interrogation
<input checked="" type="checkbox"/>	Mode C	Freeze and transmit by counter interrogation commands
	Mode D	Freeze by counter interrogation command, frozen values report spontaneously

<input checked="" type="checkbox"/>	Counter read
<input checked="" type="checkbox"/>	Counter freeze without reset
<input checked="" type="checkbox"/>	Counter freeze with reset
	Counter reset
<input checked="" type="checkbox"/>	General request counter
	Request counter group 1
	Request counter group 2
	Request counter group 3
	Request counter group 4

2.7.5 File Transfer

File transfer in monitor direction

Transparent file

Transmission of disturbance data of protection equipment

Transmission of sequence of events

Transmission of sequences of recorded analogue values

File transfer in control direction

Transparent file

.

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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)
- 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. A black check box indicates that the option cannot be selected in this companion standard.

2.1 System or Device & Network Configurations

System or Device

(system-specific parameter, indicate definition of a system or a device by marking one of the following with")

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

Network Configuration

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

- | | |
|---|---|
| <input checked="" type="checkbox"/> Point-to-Point | <input checked="" type="checkbox"/> Multipoint |
| <input checked="" type="checkbox"/> Multiple Point-to-Point | <input checked="" type="checkbox"/> Multipoint-Star |

2.2 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	Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s	Balanced interchange Circuit X.24/X.27
■ 100 bits/s	■ 2,400 bits/s	■ 2,400 bits/s ■ 56,000 bits/s
■ 200 bits/s	■ 4,800 bits/s	■ 4,800 bits/s ■ 64,000 bits/s
■ 300 bits/s	■ 9,600 bits/s	■ 9,600 bits/s
■ 600 bits/s	■	■ 19,200 bits/s
■ 1,200 bits/s	■	■ 38,400 bits/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
■ 100 bits/s	■ 2,400 bits/s	■ 2,400 bits/s ■ 56,000 bits/s
■ 200 bits/s	■ 4,800 bits/s	■ 4,800 bits/s ■ 64,000 bits/s
■ 300 bits/s	■ 9,600 bits/s	■ 9,600 bits/s
■ 600 bits/s	■	■ 19,200 bits/s
■ 1,200 bits/s	■	■ 38,400 bits/s

2.3 Link Layer

~~Frame format FT1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.~~

Link transmission

- Balanced transmission
- Unbalanced transmission

Address field of the link

- not present (balanced transmission only)
- One octet
- Two octet
- Structured

Frame length

- Maximum length L (number of octets)

- Unstructured

- ~~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).

2.4 Application Layer

- [Transmission Mode for Application Data & File Transfer](#) ²⁶
- [Common Address of ASDU & Length of APDU](#) ²⁷
- [Information Object Address & Cause of Transmission](#) ²⁸
- [System Information in Monitor & Control Directions](#) ²⁹
- [Process Information & Parameter in Control Directions](#) ³⁰
- [Selection of Standard ASDUs](#) ³¹
- [Type Identifier and Cause of Transmission Assignments](#) ³²

2.4.1 Transmission Mode for Application Data & File Transfer

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.

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).

<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 type="checkbox"/>	<126> = Directory {blank or X, only available in monitor (standard) direction}	F_DR_TA_1
<input type="checkbox"/>	<127> = Query Log – Request archive file	F_SC_NB_1

2.4.2 Common Address of ASDU & Length of APDU

CommonAddress of ASDU

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

- Oneoctet Twooctets

Lengthof 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
-

2.4.3 Information Object Address & Cause of Transmission

Information Object Address

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

- | | |
|--|--|
| <input type="checkbox"/> One octet | <input type="checkbox"/> Structured |
| <input type="checkbox"/> Two octets | <input checked="" type="checkbox"/> Unstructured |
| <input checked="" type="checkbox"/> Three octets | |

Cause of Transmission

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

- | | |
|------------------------------------|--|
| <input type="checkbox"/> One octet | <input checked="" type="checkbox"/> Two octets (with originator address).
Originator address is set to zero if not used |
|------------------------------------|--|
-

2.4.4 System Information in Monitor & Control Directions

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).

- <70> := End of initialization
M_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).

- | | |
|---|-----------|
| <input checked="" type="checkbox"/> <100> := Interrogation command | C_IC_NA_1 |
| <input checked="" type="checkbox"/> <101> := Counterinterrogation command | C_CI_NA_1 |
| <input checked="" type="checkbox"/> <102> := Read command | C_RD_NA_1 |
| <input checked="" type="checkbox"/> <103> := Clock synchronization command (option see 7.6) | 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_CD_NA_1 |
| <input checked="" type="checkbox"/> <107> := Test command with time tag CP56Time2a | C_TS_TA_1 |

2.4.5 Process Information & Parameter in Control Directions

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).

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

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

2.4.6 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).

<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, scale value	M_ME_NB_1
<input type="checkbox"/>	<12>	:= Measured value, scale 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_SP_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 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 type="checkbox"/>	<37>	:= Integrated totals with time tag CP56Time2a	M_IT_TB_1
<input type="checkbox"/>	<38>	:= Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
<input type="checkbox"/>	<39>	:= Packed start events of protection equipment with time tag CP56Time2a	M_IP_TE_1
<input type="checkbox"/>	<40>	:= Packed output circuit information of protection equipment with time tag CP54Time2a	M_EP_TF_1

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

2.4.7 Type Identifier and Cause of Transmission Assignments

(station-specific parameters)

<u>Number</u>	<u>Cause of Transmission</u>
<0>	Not used
<1>	Periodic, cyclic
<2>	Background Scan
<3>	Spontaneous
<4>	Initialized
<5>	Request or Requested
<6-7>	Activation and Activation Confirmation (ACT, ACTCON)
<8-9>	Deactivation and Deactivation Confirmation (DEACT, DEACTCON)
<10>	Activation Termination (ACTTERM)
<11>	Return information caused by a Remote Command
<12>	Return information caused by a Local Command
<13>	File tTransfer
<20>	General interrogation
<37<	General Counter Request
<44>	Unknown type identification
<45>	Unknown cause of transmission
<46>	Unknown address of ASDU
<47>	Unknown information object address

Shade 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.

2.4.7.1 Type Identification Grid

Type Identification		Cause of transmission																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	20 to 36	37 to 41	44	45	46	47
<1>	M_SP_NA_1		X	X	X										X					
<2>	M_SP_TA_1																			
<3>	M_DP_NA_1		X	X	X										X					
<4>	M_DP_TA_1																			
<5>	M_ST_NA_1		X	X	X										X					
<6>	M_ST_TA_1																			
<7>	M_BO_NA_1																			
<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				
<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	X	X	X		X									X					
<30>	M_SP_TB_1			X		X														
<31>	M_DP_TB_1			X		X														
<32>	M_ST_TB_1			X		X														
<33>	M_BO_TB_1																			
<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																			
<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
<46>	C_DC_NA_1						X			X							X	X	X	X
<47>	C_RC_NA_1						X			X							X	X	X	X

2.5 Basic Application Functions

- [Station Initialization & Interrogation, & Read Procedure](#) ³⁶
 - [Cyclic Data, Spontaneous, & Double Transmissions](#) ³⁷
 - [Clock Synchronization & Command Transmission](#) ³⁸
 - [Transmission of Integrated Totals](#) ³⁹
 - [Parameter Loading & Activation, & Test Procedure](#) ⁴⁰
 - [Definition of Time Outs & Background Scan](#) ⁴¹
 - [File Transfer & Acquisition of Transmission Delay](#) ⁴²
 - [Portnumber & Maximum Number of Outstanding I Format APDUs](#) ⁴³
 - [Redundant Connections & RFC 2200 Suite](#) ⁴⁴
-

2.5.1 Station Initialization & Interrogation, & Read Procedure

Station Initialization

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

- Remote initialization

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 type="checkbox"/> group 1 | <input type="checkbox"/> group 7 | <input type="checkbox"/> group 13 |
| <input type="checkbox"/> group 2 | <input type="checkbox"/> group 8 | <input type="checkbox"/> group 14 |
| <input type="checkbox"/> group 3 | <input type="checkbox"/> group 9 | <input type="checkbox"/> group 15 |
| <input type="checkbox"/> group 4 | <input type="checkbox"/> group 10 | <input type="checkbox"/> group 16 |
| <input type="checkbox"/> group 5 | <input type="checkbox"/> group 11 | Information object addresses
assigned to each group must be
shown in a separate table. |
| <input type="checkbox"/> group 6 | <input type="checkbox"/> group 12 | |

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
-

2.5.2 Cyclic Data, Spontaneous, & Double Transmissions

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

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
- j É-è ÉÇ ~à Éí=Üç=ñ ~ã Öçã ã ã ÄÉç |j b|k`|Nç |j b|q`|Nç |j b|qc|N

2.5.3 Clock Synchronization & Command Transmission

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

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).

- 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 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

configurable Maximum allowable delay of commands and set point commands

2.5.4 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 command
 - 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
 - Request counter group 1
 - Request counter group 2
 - Request counter group 3
 - Request counter group 4
-

2.5.5 Parameter Loading & Activation, & Test Procedure

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).

- 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).

- Test procedure
-

2.5.6 Definition of Time Outs & Background Scan

Definition of Time Outs

Parameter	Default value	Remarks	Selected value
t ₀	30 s	Time-out of connection establishment	
t ₁	15 s	Time-out of send or test APDUs	
t ₂	10 s	Time-out for acknowledges in case of no data messages $t_2 < t_1$	
t ₃	20 s	Time-out for sending test frames in case of a long idle state	

Maximum range for timeout t_2 : 1 s to 255 s, accuracy 1 s.

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

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).

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

2.5.7 File Transfer & Acquisition of Transmission Delay

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

Acquisition of Transmission Delay

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

- Acquisition of transmission delay
-

2.5.8 Portnumber & Maximum Number of Outstanding I Format APDUs

Portnumber

Parameter	Value	Remarks
Portnumber	2404	For Master session 1
Portnumber	2405	For Master session 2

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 variable	
w	8 APDUs	Latest acknowledge after receiving w I format APDUs	

Maximum range of values k : 1 to 32767 ($2^{15}-1$) 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).

2.5.9 Redundant Connections & RFC 2200 Suite

Redundant Connections

2 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.

III SCADAPack E-Series IEC 60870-5-103 Master Interoperability Profile Document

SCADAPack E-Series IEC 60870-5-103 Master Interoperability Profile Document

Revision 1.3
Aug 19, 2008



Control Microsystems

SCADA products... for the distance.

SCADAPack E-Series IEC 60870-5-103 Master Interoperability Profile Document

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2 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.

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)
- 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. A black check box indicates that the option cannot be selected in this companion standard.

2.1 Physical & Link Layer

Electrical Interface

- EIA RS-485
- Number of loads32..... For one protection equipment

Note: EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

Optical Interface

- Glass fibre
- Plastic fibre
- F-SMA type connector
- BFOC/2,5 type connector

Transmission Speed

- 9 600 bit/s
- 19 200 bit/s

Link Layer

There are no choices for the link layer.

2.2 Application Layer

- [Transmission Mode for Application Data & Common Address of ASDU](#) ^[48]
- [Selection of Standard Information Numbers in Monitor Direction](#) ^[49]
- [Selection of Standard Information Numbers in Control Direction](#) ^[53]
- [Basic Application Functions](#) ^[54]
- [Miscellaneous](#) ^[54]

2.2.1 Transmission Mode for Application Data & Common Address of ASDU

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

- One Common Address of ASDU (identical with station address)
 - More than one Common Address of ASDU
-

2.2.2 Selection of Standard Information Numbers in Monitor Direction

- [System & Generic Functions in Monitor Directions](#) ⁴⁹
- [Status & Earth Fault Indications in Monitor Directions](#) ⁵⁰
- [Supervision Indications & Measurands in Monitor Directions](#) ⁵¹
- [Fault & Auto-Reclosure Indications in Monitor Directions](#) ⁵²

2.2.2.1 System & Generic Functions in Monitor Directions

System Functions in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<0>	End of general interrogation
<input checked="" type="checkbox"/>	<0>	Time synchronization
<input checked="" type="checkbox"/>	<2>	Reset FCB
<input checked="" type="checkbox"/>	<3>	Reset CU
<input checked="" type="checkbox"/>	<4>	Start/restart
<input checked="" type="checkbox"/>	<5>	Power on

Generic Functions in Monitor Direction

	INF	Semantics
<input type="checkbox"/>	<240>	Read headings of all defined groups
<input type="checkbox"/>	<241>	Read values or attributes of all entries of one group
<input type="checkbox"/>	<243>	Read directory of a single entry
<input checked="" type="checkbox"/>	<244>	Read value or attribute of a single entry
<input checked="" type="checkbox"/>	<245>	End of general interrogation of generic data
<input type="checkbox"/>	<249>	Write entry with confirmation
<input type="checkbox"/>	<250>	Write entry with execution
<input type="checkbox"/>	<251>	Write entry aborted

2.2.2.2 Status & Earth Fault Indications in Monitor Directions

Status Indications in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<16>	Auto-recloser active
<input checked="" type="checkbox"/>	<17>	Teleprotection active
<input checked="" type="checkbox"/>	<18>	Protection active
<input checked="" type="checkbox"/>	<19>	LED reset
<input checked="" type="checkbox"/>	<20>	Monitor direction blocked
<input checked="" type="checkbox"/>	<21>	Test mode
<input checked="" type="checkbox"/>	<22>	Local parameter setting
<input checked="" type="checkbox"/>	<23>	Characteristic 1
<input checked="" type="checkbox"/>	<24>	Characteristic 2
<input checked="" type="checkbox"/>	<25>	Characteristic 3
<input checked="" type="checkbox"/>	<26>	Characteristic 4
<input checked="" type="checkbox"/>	<27>	Auxiliary input 1
<input checked="" type="checkbox"/>	<28>	Auxiliary input 2
<input checked="" type="checkbox"/>	<29>	Auxiliary input 3
<input checked="" type="checkbox"/>	<30>	Auxiliary input 4

Earth Fault indications in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<48>	Earth fault L1
<input checked="" type="checkbox"/>	<49>	Earth fault L2
<input checked="" type="checkbox"/>	<50>	Earth fault L3
<input checked="" type="checkbox"/>	<51>	Earth fault forward, i.e. line
<input checked="" type="checkbox"/>	<52>	Earth fault reverse, i.e. busbar

2.2.2.3 Supervision Indications & Measurands in Monitor Directions

Supervision Indications in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<32>	Measurand supervision I
<input checked="" type="checkbox"/>	<33>	Measurand supervision V
<input checked="" type="checkbox"/>	<35>	Phase sequence supervision
<input checked="" type="checkbox"/>	<36>	Trip circuit supervision
<input checked="" type="checkbox"/>	<37>	I>> back-up operation
<input checked="" type="checkbox"/>	<38>	VT fuse failure
<input checked="" type="checkbox"/>	<39>	Teleprotection disturbed
<input checked="" type="checkbox"/>	<46>	Group warning
<input checked="" type="checkbox"/>	<47>	Group alarm

Measurands in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<144>	Measurand I
<input checked="" type="checkbox"/>	<145>	Measurands I, V
<input checked="" type="checkbox"/>	<146>	Measurands I, V, P, Q
<input checked="" type="checkbox"/>	<147>	Measurands IN, VEN
<input checked="" type="checkbox"/>	<148>	Measurands IL1,2,3, V L1,2,3, P, Q, f

2.2.2.4 Fault & Auto-Reclosure Indications in Monitor Directions

Fault Indications in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<64>	Start /pick-up L1
<input checked="" type="checkbox"/>	<65>	Start /pick-up L2
<input checked="" type="checkbox"/>	<66>	Start /pick-up L3
<input checked="" type="checkbox"/>	<67>	Start /pick-up N
<input checked="" type="checkbox"/>	<68>	General trip
<input checked="" type="checkbox"/>	<69>	Trip L1
<input checked="" type="checkbox"/>	<70>	Trip L2
<input checked="" type="checkbox"/>	<71>	Trip L3
<input checked="" type="checkbox"/>	<72>	Trip I>> (back-up operation)
<input checked="" type="checkbox"/>	<73>	Fault location X in ohms
<input checked="" type="checkbox"/>	<74>	Fault forward/line
<input checked="" type="checkbox"/>	<75>	Fault reverse/busbar
<input checked="" type="checkbox"/>	<76>	Teleprotection signal transmitted
<input checked="" type="checkbox"/>	<77>	Teleprotection signal received
<input checked="" type="checkbox"/>	<78>	Zone 1
<input checked="" type="checkbox"/>	<79>	Zone 2
<input checked="" type="checkbox"/>	<80>	Zone 3
<input checked="" type="checkbox"/>	<81>	Zone 4
<input checked="" type="checkbox"/>	<82>	Zone 5
<input checked="" type="checkbox"/>	<83>	Zone 6
<input checked="" type="checkbox"/>	<84>	General start/pick-up
<input checked="" type="checkbox"/>	<85>	Breaker failure
<input checked="" type="checkbox"/>	<86>	Trip measuring system L1
<input checked="" type="checkbox"/>	<87>	Trip measuring system L2
<input checked="" type="checkbox"/>	<88>	Trip measuring system L3
<input checked="" type="checkbox"/>	<89>	Trip measuring system E
<input checked="" type="checkbox"/>	<90>	Trip I>
<input checked="" type="checkbox"/>	<91>	Trip I>>
<input checked="" type="checkbox"/>	<92>	Trip IN>
<input checked="" type="checkbox"/>	<93>	Trip IN>>

Auto-Reclosure Indications in Monitor Direction

	INF	Semantics
<input checked="" type="checkbox"/>	<128>	CB 'on' by AR
<input checked="" type="checkbox"/>	<129>	CB 'on' by long-time AR
<input checked="" type="checkbox"/>	<130>	AR blocked

2.2.3 Selection of Standard Information Numbers in Control Direction

System functions in control direction

	INF	Semantics
<input checked="" type="checkbox"/>	<0>	Initiation of general interrogation
<input checked="" type="checkbox"/>	<0>	Time synchronization

General commands in control direction

	INF	Semantics
<input checked="" type="checkbox"/>	<16>	Auto-recloser on/off
<input checked="" type="checkbox"/>	<17>	Teleprotection on/off
<input checked="" type="checkbox"/>	<18>	Protection on/off
<input checked="" type="checkbox"/>	<19>	LED reset
<input checked="" type="checkbox"/>	<23>	Activate characteristic 1
<input checked="" type="checkbox"/>	<24>	Activate characteristic 2
<input checked="" type="checkbox"/>	<25>	Activate characteristic 3
<input checked="" type="checkbox"/>	<26>	Activate characteristic 4

Generic functions in control direction

	INF	Semantics
<input type="checkbox"/>	<240>	Read headings of all defined groups
<input type="checkbox"/>	<241>	Read values or attributes of all entries in one group
<input type="checkbox"/>	<243>	Read directory of a single entry
<input type="checkbox"/>	<244>	Read value or attribute of a single entry
<input checked="" type="checkbox"/>	<245>	General interrogation of generic data
<input type="checkbox"/>	<248>	Write entry
<input type="checkbox"/>	<249>	Write entry with confirmation
<input checked="" type="checkbox"/>	<250>	Write entry with execution
<input type="checkbox"/>	<251>	Write entry abort

2.2.4 Basic Application Functions

- Test mode
- Blocking of monitor direction
- Disturbance data
- Generic services
- Private data

2.2.5 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e., for each measurand there is only one choice.

Measurand	Max. MVAL = rated value times		
	1,2	or	2,4
Current L1	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Current L2	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Current L3	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L1-E	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L2-E	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L3-E	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Active power P	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Reactive power Q	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Frequency f	<input type="checkbox"/>		<input checked="" type="checkbox"/>
Voltage L1 - L2	<input type="checkbox"/>		<input checked="" type="checkbox"/>

