IEC 60870-5-101/104 Master

Datasheet

straton

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Content

1. IEC 60870-5-101/ 104

The IEC870 is an international standard for system monitoring and telecontrol in utilities for water distribution, gas and electricity distribution and energy power system. The straton IEC 870 stack supports both IEC 60870-5-101 (serial) and IEC 60870-5-104 (TCP/IP) slaves.

In the last few years, especially in the energy sector, a protocol standard has established itself which is now considered a "must-have" in substation automation and which is supported by virtually every component producer. We are talking about the international standards 60870-5-101 for serial communication, published in 1995 by the IEC, and 60870-5-104 for communication via TCP/IP, published in 2000.

Both protocols are identical on the application layer, this means they have the same reference data structure. Thanks to that, the configuration and implementation for both serial communication (-101) and TCP/IP networks (-104) is a unique configuration tool in straton.

The IEC 60870-5-10x protocol defines that messages and values must be sent from the Slave to the Master after a specific trigger (eg. spontaneous change), so there is no "polling" procedure. After establishing the connection, the Master sends a "general interrogation command" to the Slave to get the current state of all data points. From this time on, the Slave watches for changes of the data points and sends it only if required.

Configuring straton to be both 101 Master and 104 Client may lead to some delays in communication exchanges. The number of 101 connection is limited by the number of available COM ports. The number of 104 connection may be limited by the Operating System, IP stack, and available memory.

If you see in this document any limitation for your project, please feel free to contact us.

2. Requirements

The integration requires some tools from STRATON AUTOMATION.

Product:

▸ straton Runtime Development Kit: Necessary for the integration of the straton runtime on the required platforms.

▸ straton Driver Development Kit: Interface to integrate new protocols to the straton runtime.

▸ straton IEC60870 Client Tool Kit

Requirement:

▸ GCC 4.8.1 (2011 C++ standard)

▸ TLS library (option)

▸ NTP Server

▸ RAM > 2G

▸ Flash > 2G

▸ CPU at least 1GHz

Tested devices:

▸ X86 / Linux / Debian 3.16

▸ Arm / Linux / Raspbian

3. Major enhancements

We provide an integrated configuration tool for the IEC60870-5-101 Master based on the Driver Development Kit.

The result is a transparent integration of this additional Fieldbus in the straton IEC 61131-3 programming environment.

In the serial case, straton works as the Master in **unbalanced** communication mode.

IEC60870 Master

- ▶ Channel
    - ▪ Sector
        - – Variables

IEC60870-5-101 master:

Property	Description
Port number [101]	Port number of the serial interface which should be used for communication for all configured 101 devices. e.g. 1 for COM1
Baud rate [101]	Baud rate for all configured 101 devices.
Directory for file transfer	Target directory for file transfer (Function block IEC60870_FTGET).
Buffer each value change	Buffer all received values. Before each cycle the values are copied from the buffer. Note: If there is a response variable in the buffer for which in the current cycle a value has been allocated, the allocation is interrupted and is continued in the next cycle. This guaranties that each value change is processed.
Standard DCS/DPI mapping deactivated	Deactivate the standard mapping of DCS/DPI values. Inactive: The values OFF/ON of double messages (DPI and DCS) are adjusted to area 0/1. The driver converts the values of double messages (intermediate, off, on, fault in: 2, 0, 1, 3) so that in straton value 0 means OFF and value 1 means On. Active: The values of double messages are passed on to straton 1:1. Default: inactive.

Channel:

Property	Description
Protocol	Is defined once when creating the node (read-only).
Name	Name for the connection. It is also used as prefix for automatically created variables. Must be in accordance with the rules for variable naming.
Slave ID	Unique ID for this slave connection.
IP address [104]	Primary IP address of the slave.
TCP port [104]	Primary TCP address of the slave.
Redundant IP address [104]	Secondary IP address of the slave (optional).
Redundant TCP address [104]	Secondary TCP address of the slave (optional).
T1 [104]	Time-out for requests in ms.
T2 [104]	Time period in ms after which an acknowledgement must be sent.
T3 [104]	Time period in ms after which a TESTFR frame must be sent if no other data is sent.
K [104]	Number of request which can be sent without an acknowledge must be received. Maximum: 32767 default: 12
W [104]	Number of request after which an acknowledge must be sent. Maximum: 32767 default: 8 Note: The communication is carried out synchronized with the cycle. Therefor a maximum of K outgoing and W incoming telegrams can be processed. The values for K and W should be the same at the master and at the slave.
Link address [101]	Link address of the slave.
Size link address [101]	Size of the link address in byte. Value range: 1-2

Property	Description
Size COA	Byte size Value range: 1-2
Size IOA	Byte size Value range: 1-2
Size COT	Byte size Value range: 1-3

Sector:

Property	Description
Name	Freely definable name (optional)
COA	COA of the sector.

Variables:

Property	Description
Name	Name of the associated straton variable.
Type identification	IEC 60870 type identification
IOA	Information Object Address.

Note: Variable status and time stamp are stored in straton database if the option is activated and if the variable has a defined profile. Please refer to the section Variable status bits in the straton IDE online help.

Connection state:

Via a UINT variable of the type "internal state" (T00), COA 0 and IOA 0, you can request the current connection state to the control. If the value of this variable equals 5, a running connection exists and the general interrogation was completed successfully.

State of the DL layers

Via a variable of the type "internal state" (T00), COA 0 and IOA 1, you can read the state of the data link layer connection to the control. The variable refers to the data link layer and both connections of the redundancy if the secondary connection was defined in the driver configuration:

Bit	Description
Bit 0	Connection state of the primary connection.
Bit 1	Shows whether the primary connection is active (is used at the communication)
Bit 4	Connection state of the secondary connection.
Bit 5	Shows whether the secondary connection is active (is used at the communication)

4. Implementation of IEC60870-5-101/104

According to the configuration the straton IEC60870-5-101/104 driver will establish the connection and open all sessions. The refresh of data can be automatic according to the parameters in the Session.

Additional commands are available, these commands are function blocks in straton with the Session identifier as the first parameters.

Command:

IEC60870_SELECT

Input	Description
ENABLE (BOOL)	Activating the command; reacts on rising flank.
CANCEL (BOOL)	Deactivating the Select; reacts to rising flank. Note: ENABLE must be FALSE.
SLAVEID (UDINT)	ID of the slave connection as set in the driver configuration
TYPE (USINT)	Type ID (IEC60870 type identification).
COA (UINT)	Common Address of ASDU.
IOA (UDINT)	Information Object Address.
QUALIFIER (USINT)	Qualifier of Command or Qualifier of Interrogation.
VALUE (ANY)	Value.

Output	Description
PN (BOOL)	Positive/negative bit (P/N Bit as received from the slave); 1= negative.
COT (USINT)	Cause of transmission (as received from the slave)

IEC60870_EXEC (Execute)

Input	Description
ENABLE (BOOL)	Activating the command; reacts on rising flank.
SLAVEID (UDINT)	ID of the slave connection as set in the driver configuration
TYPE (USINT)	Type ID (IEC60870 type identification).
COA (UINT)	Common Address of ASDU.
IOA (UDINT)	Information Object Address.
QUALIFIER (USINT)	Qualifier of Command or Qualifier of Interrogation.
VALUE (ANY)	Value.

Output	Description
PN (BOOL)	Positive/negative bit (P/N Bit as received from the slave); 1= negative.
COT (USINT)	Cause of transmission (as received from the slave)

By creating command execute with TYPE=100, QUALIFIER=20 (VALUE=TRUE or FALSE), you can start a general interrogation manually.

Via type identification 103, the time synchronization is started.

5. Interoperability

This companion standard presents sets of parameters and alternatives from which subsets must be selected to implement 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.

5.1.   System or device

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

[   ]   System definition
[X]   Controlling station definition (Master)
[   ]   Controlled station definition (Slave)

5.2. Network Configuration

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

Configuration types	
▶ [X] Point-to-point	[X] Multipoint-partyline
▶ [X] Multiple point-to-point	[ ] Multipoint-star

5.3. 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	Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s	Balanced interchange Circuit X.24/X.27
[X] 100 bit/s	[X] 2400 bit/s	[ ] 2400 bit/s
[X] 200 bit/s	[X] 4800 bit/s	[ ] 4800 bit/s
[X] 300 bit/s	[X] 9600 bit/s	[ ] 9600 bit/s
[X] 600 bit/s		[ ] 19200 bit/s
[X] 1200 bit/s		[ ] 38400 bit/s
		[ ] 56000 bit/s
		[ ] 64000 bit/s

Transmission speed (monitor direction)

Unbalanced interchange Circuit V.24/V.28 Standard	Unbalanced interchange Circuit V.24/V.28 Recommended if >1 200 bit/s	Balanced interchange Circuit X.24/X.27
[X] 100 bit/s	[X] 2400 bit/s	[ ] 2400 bit/s
[X] 200 bit/s	[X] 4800 bit/s	[ ] 4800 bit/s
[X] 300 bit/s	[X] 9600 bit/s	[ ] 9600 bit/s
[X] 600 bit/s		[ ] 19200 bit/s
[X] 1200 bit/s		[ ] 38400 bit/s
		[ ] 56000 bit/s
		[ ] 64000 bit/s

5.4. 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	Frame length	Address field of the link
[ ] Balanced transmission	[255] Maximum length L (number of octets)	[ ] not present (balanced transmission only)
[X] Unbalanced transmission		[X] One octet
		[X] Two octets
		[X] Structured
		[X] 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

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).

5.5. 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 ')

ASDU Address	
[X] One octet	[X] Two octets

Information object address

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

[X] One octet	[X] Structured
[X] Two octets	[X] Unstructured
[X] Three octets	

Cause of transmission

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

Cause of transmission	
[X] One octet	[X] Two octets (with originator address). Originator address is set to zero if not used

Length of APDU

(system-specific parameter, all configurations that are used are to be marked ' X ')
The maximum length of the APDU is 253 (default). The maximum length may be reduced by the system.

Length of APDU
[   ]   Maximum length of APDU per system

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).

ASDUs		
[X] <1>	:= Single-point information	M_SP_NA_1
[X] <2>	:= Single-point information with time tag	M_SP_TA_1

ASDUs		
[X] <3>	:= Double-point information	M_DP_NA_1
[X] <4>	:= Double-point information with time tag	M_DP_TA_1
[X] <5>	:= Step position information	M_ST_NA_1
[X] <6>	:= Step position information with time tag	M_ST_TA_1
[X] <7>	:= Bitstring of 32 bit	M_BO_NA_1
[X] <8>	:= Bitstring of 32 bit with time tag	M_BO_TA_1
[X] <9>	:= Measured value, normalized value	M_ME_NA_1
[X] <10>	:= Measured value, normalized value with time tag	M_ME_TA_1
[X] <11>	:= Measured value, scaled value	M_ME_NB_1
[X] <12>	:= Measured value, scaled value with time tag	M_ME_TB_1
[X] <13>	:= Measured value, short floating point value	M_ME_NC_1
[X] <14>	:= Measured value, short floating point value with time tag	M_ME_TC_1
[X] <15>	:= Integrated totals	M_IT_NA_1
[X] <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

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

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).

[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
[X] <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
[X] <62>	:= Set point command, scaled value with time tag CP56Time2a	C_SE_TB_1
[X] <63>	:= Set point command, short floating point value with time tag CP56Time2a	C_SE_TC_1
[X] <64>	:= Bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1

Either the ASDUs of the set <45> − <51> or of the set <58> − <64> are used.

System information in monitor direction

(station-specific parameter, mark ' X ' if used)

[ ] <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).

[X] <100>	:= Interrogation command	C_IC_NA_1
[ ] <101>	:= Counter interrogation command	C_CI_NA_1
[ ] <102>	:= Read command	C_RD_NA_1
[B] <103>	:= Clock synchronization command (option see 5.6). Only supported by zenon master.	C_CS_NA_1
[ ] <104>	:= Test command	C_TS_NA_1
[ ] <105>	:= Reset process command	C_RP_NA_1
[ ] <106>	:= Delay acquisition command	C_CD_NA_1
[ ] <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).

[ ] <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

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

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 identification		*Cause of transmission*									10	11	12	13	20 to 36	37 to 41	44	45	46	47
		1	2	3	4	5	6	7	8	9										
<1>	M_SP_NA_1	▓			▓		▓	▓	▓	▓			▓		▓		▓	▓	▓	▓

<2>	M_SP_TA_1			■		■						■	■							
<3>	M_DP_NA_1		□	□		□						□	□		□					
<4>	M_DP_TA_1			■		■						■	■							
<5>	M_ST_NA_1		□	□		□						□	□		□					
<6>	M_ST_TA_1			■		■						■	■							
<7>	M_BO_NA_1		□	□		□							□							
<8>	M_BO_TA_1			■		■														
<9>	M_ME_NA_1	□	□	□		□							□							
<10>	M_ME_TA_1			■		■														
<11>	M_ME_NB_1	□	□	□		□							□							
<12>	M_ME_TB_1			■		■														
<13>	M_ME_NC_1	□	□	□		□							□							
<14>	M_ME_TC_1			■		■														
<15>	M_IT_NA_1			□											□					
<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			□		□						□	□							
<31>	M_DP_TB_1			□		□						□	□							
<32>	M_ST_TB_1			□		□						□	□							
<33>	M_BO_TB_1			□		□														
<34>	M_ME_TD_1			□		□														
<35>	M_ME_TE_1			□		□														

<36>	M_ME_TF_1
<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
<46>	C_DC_NA_1
<47>	C_RC_NA_1
<48>	C_SE_NA_1
<49>	C_SE_NB_1
<50>	C_SE_NC_1
<51>	C_BO_NA_1
<58>	C_SC_TA_1
<59>	C_DC_TA_1
<60>	C_RC_TA_1
<61>	C_SE_TA_1
<62>	C_SE_TB_1
<63>	C_SE_TC_1
<64>	C_BO_TA_1
<70>	M_EI_NA_1*
<100>	C_IC_NA_1
<101>	C_CI_NA_1
<102>	C_RD_NA_1
<103>	C_CS_NA_1
<104>	C_TS_NA_1
<105>	C_RP_NA_1

<106>	C_CD_NA_1
<107>	C_TS_TA_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*

* Blank or X only

5.6. 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)

[X]   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)

[X]   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).

[X] 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

[X] global		
[ ] group 5	[ ] group 11	
[ ] group 6	[ ] group 12	Information object addresses assigned to each group must be shown in a separate table.

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

optional

Command 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).

[X]   Direct command transmission
[X]   Direct set point command transmission
[X]   Select and execute command
[X]   Select and execute set point command
[   ]   C_SE ACTTERM used

[X]   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
[   ]   Maximum allowable delay of commands and set point commands

Transmission of integrated totals

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

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

[　] Counter read
[　] Counter freeze without reset
[　] Counter freeze with reset
[　] Counter reset

[　] General request counter
[　] Request counter group 1
[　] Request counter group 2
[　] Request counter group 3
[　] Request counter group 4

Parameter loading

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

[　] Threshold value
[　] Smoothing factor
[　] Low limit for transmission of measured values
[　] High limit for transmission of measured values

Parameter activation

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

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

Test procedure

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

[　] Test procedure

File transfer

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

File transfer in monitor direction

[　] Transparent file

[   ]   Transmission of disturbance data of protection 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).

[   ]   Background scan

Acquisition of transmission delay

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

[   ]   Acquisition of transmission delay

Definition of time outs

Parameters	Default value	Remarks	Selected value
t0	30s	Time-out of connection establishment	
t1	15s	Time-out of send or test APDUs	
t2	10s	Time-out for acknowledges in case of no data messages t2 < t1	
t3	20s	Time-out for sending test frames in case of a long idle state	

Maximum range of values for all time-outs: 1 to 255 s, accuracy 1 s.

Maximum number of outstanding I format APDUs k and latest acknowledge APDUs (w)

Parameters	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 (215–1) APDUs, accuracy 1 APDU

Maximum range of values w: 1 to 32767 APDUs, accuracy 1 APDU (Recommendation: w should not exceed two-thirds of k)

Port number

Parameters	Value	Remarks
Port number	2404	in all cases

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