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**NUOTOLINIO VALDYMO ĮRENGINIŲ IR SISTEMŲ  
PERDAVIMO PROTOKOLŲ ĮDIEGIMAS  
AB RYTŲ SKIRSTOMUOSIUOSE TINKLUOSE  
PAGAL LST EN 60870-5-101:2003 (IEC 60870-5-101)  
STANDARTĄ**

**TECHNINIAI REIKALAVIMAI**



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**Protocol Implementation Document (PID)  
for IEC 60870-5-101**

Arnhem, 15 juli 2005

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# Rytu Skirstomieji Tinklai AB

## Protocol Implementation Document

### for IEC 60870-5-101

**Final version**

#### Change log

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# 1 INTRODUCTION

The interpretation of the IEC60870-5-101 protocol standard can vary from supplier to supplier. This document will describe the use of the IEC 60870-5-101 protocol within Rytu Skirstomieji Tinklai AB, Lithuania.

The IEC Technical Committee 57 (Working Group 03) have developed a protocol standard for telecontrol, teleprotection, and associated telecommunications for electric power systems.

The result of this work is IEC 60870-5. Five documents specify the base IEC 60870-5.

These documents are:

- IEC 60870-5-1 Transmission Frame Formats
- IEC 60870-5-2 Data Link Transmission Services
- IEC 60870-5-3 General Structure of Application Data
- IEC 60870-5-4 Definition and coding of Information Elements
- IEC 60870-5-5 Basic Application Functions

The IEC Technical Committee 57 have also generated a companion standard IEC 60870-5-101 and IEC 60870-5-101 ed.2. IEC 60870-5-101 is based of the five documents IEC 60870-5-1 till 5.

The Rytu Skirstomieji Tinklai AB Protocol Implementation Document for IEC60870-5-101 is based on these standards. Besides these standards also detailed requirements and specifications of Rytu Skirstomieji Tinklai AB are incorporated in this PID.

In this document all the additions from the above mentioned standards are gathered together to form the Rytu Skirstomieji Tinklai AB Protocol Implementation Document for IEC101, further called RST PID101.

However the authors have written this document with great care, possible indistinctness, inaccuracy, etc can be crept into the document. It is the responsibility of the vendor to identify possible indistinctness, inaccuracy, etc in this document and the consistency between the RST PID101 and related IEC60870-5 standards. If indistinctness, inaccuracy, etc or inconsistency between the RST PID101 and the related IEC60870-5 standard are identified it is the responsibility of the vendor to contact the contact person within Rytu Skirstomieji Tinklai AB to discuss these issues.

## 2 PROTOCOL ARCHITECTURE

### 2.1 Communication Protocol

Communication Protocols are the grammars through which computer-based devices communicate with one another - the way they organise, and transmit the bits and bytes of electronic on-off (binary) signals whose patterns encode data. Simply, a protocol is a set of rules that governs how message containing data and control information are assembled at a source for their transmission across the network and then dissembled when they reach their destination.

### 2.2 Anatomy of a communication Protocol

Most standards organisations use a layered model or stack to develop protocol specifications, with each layer performing some very specific functions and services.

#### The open Systems Interconnect Reference Model

The Open Systems Interconnect (OSI) reference model is a layered set of protocols to facilitate open communications between computer networks. It was developed by the International Organisation for Standardisation (ISO) in conjunction with the Consultative Committee on International Telegraphy and Telephony (CCITT).

The purpose of the OSI communication model is to make multivendor networking easy to implement, thereby reducing the overall costs and enhancing the level of system integration that normally could be realised with constantly changing and expanding protocol solutions.

#### The 7 - Layer Stack

The 7-Layer stack is based on established international ISO protocol standards. The architecture intended to provide full communications functionality based on the OSI Reference Model and is capable of supporting the majority and the industry data communication requirements.

#### The 3 - Layer Stack

The 3 - layer stack is also based on stable international standards. The 3 - layer stack provides a simpler mechanism for data communication and is based on the “Enhanced Performance Architecture” (EPA) as specified in clause 4 of IEC 870-5-3.

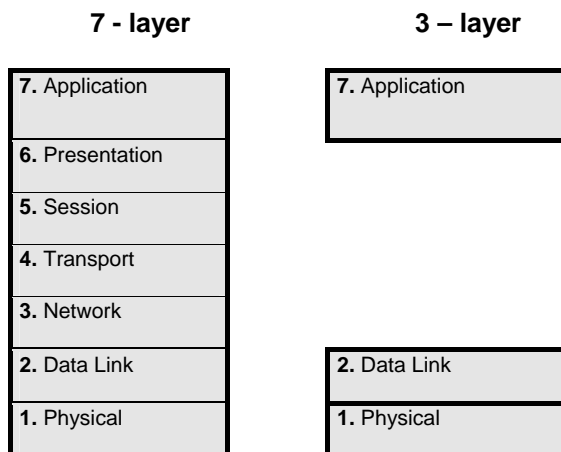


Table 1 Anatomy of communication protocol

## 2.3 Scope and Object of IEC 60870-5-101

### 2.3.1 Introduction

IEC 60870-5-101 provides a communication profile for sending basic telecontrol messages between a central telecontrol station (**controlling station**) and telecontrol outstations (**controlled stations**), which uses permanent directly connected data circuits between the central station and individual outstations.

### 2.3.2 Scope

The defined telecontrol companion standard IEC 60870-5-101 utilizes standards of the series IEC 60870-5.

## 2.4 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 60870-5. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 60870-5 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

- IEC 50(371): 1984, International Electrotechnical Vocabulary (IEV)-  
Chapter 371: Telecontrol
- IEC 60870-1-1: 1988, Telecontrol equipment and systems - Part 1:  
General considerations - Section One: General principles
- IEC 60870-1-3: 1997 Ed. 2, Telecontrol equipment and systems - Part 1:  
General considerations - Section Three: Glossary
- IEC 60870-1-4: 1994, Telecontrol equipment and systems - Part 1:  
General considerations - Section 4: Basic aspects of telecontrol data transmission  
and organization of standards of IEC 60870-5 and IEC 60870-6
- IEC 60870-5-3: 1992, Telecontrol equipment and systems - Part 5:  
Transmission protocols - Section 3: General structure of application data
- IEC 60870-5-4: 1993, Telecontrol equipment and systems - Part 5:  
Transmission protocols - Section 4: Definition and coding of application information  
elements
- IEC 60870-5-5: 1995, Telecontrol equipment and systems - Part 5:  
Transmission protocols - Section 5: Basic application functions
- IEC 60870-5-101 ed.2: 2000, Telecontrol equipment and systems - Part 5:  
Transmission protocols - Section 101: Companion standard for basic telecontrol  
tasks
- ISO/IEC 8208: 1990, Information technology - Data communications - X.25 packet layer protocol for  
data terminal equipment



## 2.5 Definitions

### **Companion standard**

A companion standard adds semantics to the definitions of the basic standard or a functional profile. This may be expressed by defining particular uses for information objects or by defining additional information objects, service procedures and parameters of the basic standard.

### **Group (of information objects)**

A group (of information objects) is a selection of COMMON ADDRESSES or INFORMATION ADDRESSES which is specifically defined for a particular system.

### **Unbalanced transmission**

Unbalanced transmission procedures are used in supervisory control and data acquisition (SCADA) systems in which a master station controls the data traffic by polling outstations sequentially. In this case the master station (master) is the primary station that initiates all message transfers while outstations are secondary stations (slaves) that may transmit only when they are polled.

The unbalanced mode procedure can be used generally, but must be used in party line «multidrop» configuration.

### **Balanced transmission**

If balanced transmission procedures are used, each station may initiate message transfers.

The balanced mode procedure is restricted to the configurations "point to point or multiple point to point".

Balanced mode the most effective way of communication on «point to point or multiple point to point».

Balanced transmission can be used in full duplex mode. A balanced system thus contains a primary and a secondary side. In the RST PID101 balanced mode is not mentioned.

### **Controlling Station (Master station)**

A location at which telecontrol of outstations is performed (IEV 371-06-01).

### **Controlled Station (Outstation, Remote station, Remote terminal unit (RTU), Slave station)**

A station which is monitored or commanded by a master station (IEV 371-06-04).

### **Control direction**

The direction of transmission from the controlling station, typical a SCADA system, to a controlled station, typical a station control system or a RTU.

### **Monitor direction**

The direction of transmission from a controlled station to the controlling station.

### **Primary station**

The station which starts the communication procedure, the master. In unbalanced transmission this is fixed, in balanced transmission the primary station is alternating.

### **Secondary station**

The station which respond on the communication procedure, the slave. In unbalanced transmission this is fixed, in balanced transmission the secondary station is alternating.

### 3 Protocol structure

The physical layer uses ITU-T recommendations that provide binary symmetric and memory less transmission on the required medium in order to preserve the high level of data integrity of the defined block encoding method in the link layer.

The link layer consists of a number of link transmission procedures using explicit LINK PROTOCOL CONTROL INFORMATION (LPCI) that are capable of carrying APPLICATION SERVICE DATA UNITS (ASDU's) as link-user data. The link layer uses a selection of frame formats to provide the required integrity/efficiency and convenience of transmission.

The application user layer contains a number of "Application Functions" that involve the transmission of APPLICATION SERVICE DATA UNITS (ASDU's) between source and destination.

The application layer of this companion standard does not use explicit APPLICATION PROTOCOL CONTROL INFORMATION (APCI). This is implicit in the contents of the ASDU DATA UNIT IDENTIFIER field and in the type of link service used.

Selected application functions of IEC/DIS 870-5-5	<b>User process</b>
Selected application information elements of IEC 870-5-4	<b>Application (layer 7)</b>
Selected application service data units of IEC 870-5-3	
Selected link transmission procedures of IEC 870-5-2	<b>Link (layer 2)</b>
Selected transmission frame formats of IEC 870-5-1	
Selected ITU-T recommendations	<b>Physical (layer 1)</b>

Table 2 Selected standard provisions of the defined Telecontrol companion standard

### 3.1 Physical layer

The companion standard specifies ITU-T recommendations which define the interfaces between data circuit terminating equipment (DCE) and data terminating equipment (DTE) of the controlling and the controlled station (see Table 3).

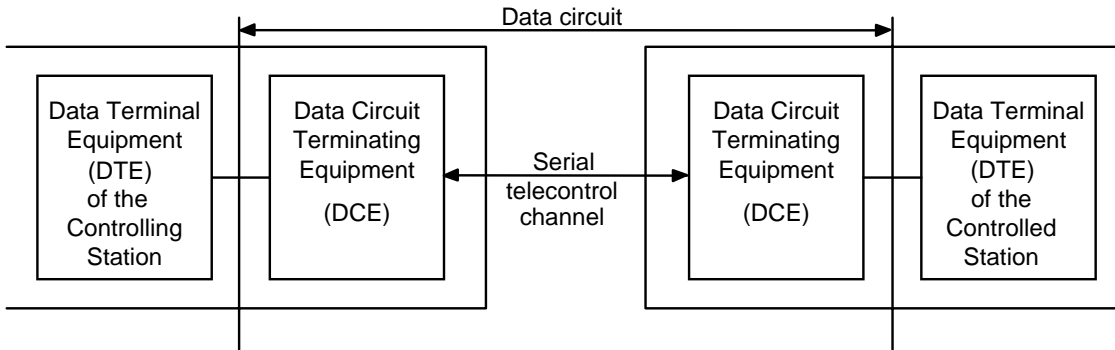


Table 3 Interfaces and connections of controlling and controlled stations

The standard interface between DTE and DCE is the asynchronous ITU-T V.24/ITU-T V.28 interface. The use of the required interface signals depends on the operational mode of the used transmission channel

### 3.2 Link layer

IEC 870-5-2 offers a selection of link transmission procedures using a control field and the optional address fields.

### 3.3 Application layer

A companion standard or user conventions shall define appropriate ASDU's (telegram types) from a given general structure in IEC 870-5-3 and specifications in IEC 870-5-4.

### 3.4 Selection of ASDUs defined in IEC 60870-5-101 and additional ASDUs

The following ASDUs defined in IEC 60870-5-101 ed.2 and ASDUs for process information in control direction with time tag (defined in IEC 60870-5-104) are valid:

Table 1 - Process information in monitor direction

TYPE IDENTIFICATION := UI8[1..8]<0..44>		
<0>	:= not defined	
<1>	:= single-point information	M_SP_NA_1
<2>	:= single-point information with time tag	M_SP_TA_1
<3>	:= double-point information	M_DP_NA_1
<4>	:= double-point information with time tag	M_DP_TA_1
<5>	:= step position information	M_ST_NA_1
<6>	:= step position information with time tag	M_ST_TA_1
<7>	:= bitstring of 32 bit	M_BO_NA_1
<8>	:= bitstring of 32 bit with time tag	M_BO_TA_1
<9>	:= measured value, normalized value	M_ME_NA_1
<10>	:= measured value, normalized value with time tag	M_ME_TA_1
<11>	:= measured value, scaled value	M_ME_NB_1
<12>	:= measured value, scaled value with time tag	M_ME_TB_1
<13>	:= measured value, short floating point number	M_ME_NC_1
<14>	:= measured value, short floating point number with time tag	M_ME_TC_1
<15>	:= integrated totals	M_IT_NA_1
<16>	:= integrated totals with time tag	M_IT_TA_1
<17>	:= event of protection equipment with time tag	M_EP_TA_1
<18>	:= packed start event 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_PS_NA_1
<21>	:= measured value, normalized value without quality descriptor	M_ME_ND_1
<22..29>	:= reserved for further compatible definitions	
<30>	:= single-point information with time tag CP56Time2a	M_SP_TB_1
<31>	:= double-point information with time tag CP56Time2a	M_DP_TB_1
<32>	:= step position information with time tag CP56Time2a	M_ST_TB_1
<33>	:= bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
<34>	:= measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
<35>	:= measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
<36>	:= measured value, short floating point number with time tag CP56Time2a	M_ME_TF_1
<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
<41..44>	:= reserved for further compatible definitions	

Table 2 - Process information in control direction

TYPE IDENTIFICATION := UI8[1..8]&lt;45..69&gt;

<b>CON</b>	<45>	:= single command	C_SC_NA_1
<b>CON</b>	<46>	:= double command	C_DC_NA_1
<b>CON</b>	<47>	:= regulating step command	C_RC_NA_1
<b>CON</b>	<48>	:= set point command, normalized value	C_SE_NA_1
<b>CON</b>	<49>	:= set point command, scaled value	C_SE_NB_1
<b>CON</b>	<50>	:= set point command, short floating point number	C_SE_NC_1
<b>CON</b>	<51>	:= bitstring of 32 bit	C_BO_NA_1

&lt;52..57&gt; := reserved for further compatible definitions

ASDUs for process information in control direction with time tag:

<b>CON</b>	<58>	:= single command with time tag CP56Time2a	C_SC_TA_1 **)
<b>CON</b>	<59>	:= double command with time tag CP56Time2a	C_DC_TA_1 **)
<b>CON</b>	<60>	:= regulating step command with time tag CP56Time2a	C_RC_TA_1 **)
<b>CON</b>	<61>	:= set point command, normalized value with time tag CP56Time2a	C_SE_TA_1 **)
<b>CON</b>	<62>	:= set point command, scaled value with time tag CP56Time2a	C_SE_TB_1 **)
<b>CON</b>	<63>	:= set point command, short floating point number with time tag CP56Time2a	C_SE_TC_1 **)
<b>CON</b>	<64>	:= bitstring of 32 bit with time tag CP56Time2a	C_BO_TA_1 **)

&lt;65..69&gt; := reserved for further compatible definitions

Process information in control direction may be sent with or without a time tag, but must not be mixed when sending to a given station.

*Note:*

- ASDUs marked (**CON**) in control direction are confirmed application services and may be mirrored in monitor direction with different causes of transmission. These mirrored ASDUs are used for positive/negative acknowledgements (verifications).

\*\*) ... ASDUs defined in IEC 60870-5-104

**ASDUs selected in the RYTU SKIRSTOMIEJI TINKLAI AB PID 101 are described in Chapter 4.**

Table 3 - System information in monitor direction

TYPE IDENTIFICATION := UI8[1..8]<70..99>		
<70>	:= end of initialization	M_EI_NA_1
<71..99>	:= reserved for further compatible definitions	

Table 4 - System information in control direction

TYPE IDENTIFICATION := UI8[1..8]<100..109>			
<b>CON</b>	<100>	:= interrogation command	C_IC_NA_1
<b>CON</b>	<101>	:= counter interrogation command	C_CI_NA_1
<b>CON</b>	<102>	:= read command	C_RD_NA_1
<b>CON</b>	<103>	:= Clock synchronization command	C_CS_NA_1
<b>CON</b>	<104>	:= test command	C_CS_NA_1
<b>CON</b>	<105>	:= reset process command	C_RP_NA_1
<b>CON</b>	<106>	:= delay aquisition command	C_CD_NA_1
<107..109>	:= reserved for further compatible definitions		

Table 5 - Parameter in control direction

TYPE IDENTIFICATION := UI8[1..8]<110..119>			
<b>CON</b>	<110>	:= parameter of measured value, normalized value	P_ME_NA_1
<b>CON</b>	<111>	:= parameter of measured value, scaled value	P_ME_NB_1
<b>CON</b>	<112>	:= parameter of measured value, short floating point number	P_ME_NC_1
<b>CON</b>	<113>	:= parameter activation	P_AC_NA_1
<114..119>	:= reserved for further compatible definitions		

Table 6 - File transfer

TYPE IDENTIFICATION := UI8[1..8]<120..127>			
<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	F_DR_TA_1	
<127>	:= reserved for further compatible definitions		

Note

- ASDUs marked (**CON**) in control direction are confirmed application services and may be mirrored in monitor direction with different causes of transmission. These mirrored ASDUs are used for positive/negative acknowledgements (verifications).

\*\*) ... ASDUs defined in IEC 60870-5-104

Table 9 - Semantics of CAUSE OF TRANSMISSION

Cause	:= UI6[1..6]<0..63>	
<0>	:= not used	
<1>	:= periodic, cyclic	per/cyc
<2>	:= background scan*	back
<3>	:= spontaneous	spont
<4>	:= initialised	init
<5>	:= request or requested	req
<6>	:= activation	act
<7>	:= activation confirmation	actcon
<8>	:= deactivation	deact
<9>	:= deactivation confirmation	deactcon
<10>	:= activation termination	actterm
<11>	:= return information caused by a remote command	retrem
<12>	:= return information caused by a local command	retloc
<13>	:= file transfer	file
<14..19>	:= reserved for further compatible definitions	
<20>	:= interrogated by general interrogation	inrogen
<21>	:= interrogated by group 1 interrogation	inro1
<22>	:= interrogated by group 2 interrogation	inro2
<23>	:= interrogated by group 3 interrogation	inro3
<24>	:= interrogated by group 4 interrogation	inro4
<25>	:= interrogated by group 5 interrogation	inro5
<26>	:= interrogated by group 6 interrogation	inro6
<27>	:= interrogated by group 7 interrogation	inro7
<28>	:= interrogated by group 8 interrogation	inro8
<29>	:= interrogated by group 9 interrogation	inro9
<30>	:= interrogated by group 10 interrogation	inro10
<31>	:= interrogated by group 11 interrogation	inro11
<32>	:= interrogated by group 12 interrogation	inro12
<33>	:= interrogated by group 13 interrogation	inro13
<34>	:= interrogated by group 14 interrogation	inro14
<35>	:= interrogated by group 15 interrogation	inro15
<36>	:= interrogated by group 16 interrogation	inro16
<37>	:= requested by general counter request	reqcogen
<38>	:= requested by group 1 counter request	reqco1
<39>	:= requested by group 2 counter request	reqco2
<40>	:= requested by group 3 counter request	reqco3
<41>	:= requested by group 4 counter request	reqco4
<44>	:= unknown type identification	
<45>	:= unknown cause of transmission	
<46>	:= unknown common address of ASDU	
<47>	:= unknown information object address	

\* Used in monitor direction to synchronise the process information of the controlling and controlled stations on a low priority continuous basis.

Cause of transmission possibilities for each ASDU used in the RYTU SKIRSTOMIEJI TINKLAI AB PID101 are described in chapter 4.

## 4 Application layer telegram formats

### 4.1 Interoperability list

This companion standard presents sets of parameters and alternatives from which subsets have to be selected to implement particular telecontrol systems. Certain parameter values, such as the number of octets in the COMMON ADDRESS of ASDUs represent mutually exclusive alternatives. This means that only one value of the defined parameters is admitted per system. Other parameters, such as the listed set of different process information in command and in monitor direction allow the specification of the complete set or subsets, as appropriate for given applications. This clause summarises the parameters of the previous clauses to facilitate a suitable selection for a specific application. If a system is composed of equipment stemming from different manufacturers it is necessary that all partners agree on the selected parameters.

The selected parameters should be crossed in the white boxes.

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.

- Optionally, not in these conventions
- Required

#### Implemented transmission system

- Unbalanced system
- Balanced system

#### Network configuration

(Network - specific parameter)

- Point-to-point
- Multiple point to point
- Redundant lines
- Multidrop (Multipoint-partyline)
- Multi-point-star

#### Physical layer

(Network - specific parameter)

##### Transmission speed

Unbalanced interchange circuit V.24/V.28

- |  |   |
|--|---|
| <input type="checkbox"/> 100 bit/s             | <input checked="" type="checkbox"/> 2400 bit/s  |
| <input type="checkbox"/> 200 bit/s             | <input checked="" type="checkbox"/> 4800 bit/s  |
| <input type="checkbox"/> 300 bit/s             | <input checked="" type="checkbox"/> 9600 bit/s  |
| <input type="checkbox"/> 600 bit/s             | <input checked="" type="checkbox"/> 19200 bit/s |
| <input checked="" type="checkbox"/> 1200 bit/s |   |



**Link layer**

(Network-specific parameter)

Frame format FT 1.2, single character 1 and the fixed time out interval are used exclusively in this companion standard.

Link transmission procedure

- Balanced transmission
- Unbalanced transmission
- Maximum no. of retries<sup>1</sup>

Address field of the link

- not present (balanced systems only)
- One octet (unbalanced systems only)
- Two octets (unbalanced systems only)

Frame length

- Maximum length L (number of octets)
- Structured (to be defined by customer)
- Unstructured

*The maximum frame length can be selected per Controlled Station up to 255*

**Application layer****Transmission mode for application data**

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard. Before the implementation is necessary to define which addresses Common addresses of ASDU and Information object addresses are containing which data. This is also needed for the Interconnectivity Type Test. Preferred is to add this in a data file that is generated by the supplier.

**Common address of ASDU**

(system-specific parameter)

- One octet
- Two octets

**Information object address**

(system-specific parameter)

- One octet
- Two octets
- Three octets
- structured (to be defined by the customer)
- unstructured

**Cause of transmission**

(system-specific parameter)

- One octet
- Two octets (with originator address)

<sup>1</sup> Configurable

## Selection of standard ASDUs

### Process information in monitor direction

(station-specific parameter)

<input checked="" type="checkbox"/> <1> := Single-point information	M_SP_NA_1
<input checked="" type="checkbox"/> <2> := Single-point information with time tag <sup>2</sup>	M_SP_TA_1
<input checked="" type="checkbox"/> <3> := Double-point information	M_DP_TA_1
<input checked="" type="checkbox"/> <4> := Double-point information with time tag <sup>2</sup>	M_DP_TA_1
<input checked="" type="checkbox"/> <5> := Step position information	M_ST_NA_1
<input checked="" type="checkbox"/> <6> := Step position information with time tag <sup>2</sup>	M_ST_TA_1
<input 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, normalised value	M_ME_NA_1
<input checked="" type="checkbox"/> <10> := Measured value, normalised value with time tag <sup>2</sup>	M_ME_TA_1
<input checked="" type="checkbox"/> <11> := Measured value, scaled value	M_ME_NB_1
<input checked="" type="checkbox"/> <12> := Measured value, scaled value with time tag <sup>2</sup>	M_ME_TB_1
<input checked="" type="checkbox"/> <13> := Measured value, short floating point value	M_ME_NC_1
<input checked="" type="checkbox"/> <14> := Measured value, short floating point value with time tag <sup>2</sup>	M_ME_TC_1
<input 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_TA1
<input type="checkbox"/> <18> := Packed start events of protection equipment with time tag	M_EP_TB1
<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 time tag	M_PS_NA_1
<input type="checkbox"/> <21> := Measured value, normalised value without quality descriptor	M_ME_ND_1
<input checked="" type="checkbox"/> <30> := Single point information with full time <sup>2</sup>	M_SP_TB_1
<input checked="" type="checkbox"/> <31> := Double point information with full time <sup>2</sup>	M_DP_TB_1
<input checked="" type="checkbox"/> <32> := Step position information with full time <sup>2</sup>	M_ST_TB_1
<input type="checkbox"/> <33> := Bitstring of 32 bit with full time	M_BO_TB_1
<input checked="" type="checkbox"/> <34> := Measured value, normalised value with full time <sup>2</sup>	M_ME_TD_1
<input checked="" type="checkbox"/> <35> := Measured value, scaled value with full time <sup>2</sup>	M_ME_TE_1
<input checked="" type="checkbox"/> <36> := Measured value, short floating point value with full time <sup>2</sup>	M_ME_TF_1
<input type="checkbox"/> <37> := Integrated totals with full time	M_IT_TB_1
<input type="checkbox"/> <38> := Event of protection equipment with full time	M_EP_TD_1
<input type="checkbox"/> <39> := Packed start events of protection equipment with full time	M_EP_TE_1
<input type="checkbox"/> <40> := Packed tripping events of protection equipment with full time	M_EP_TF_1

<sup>2</sup> Per project need to be decided if long or short time tags will be used. If there are no other explanations, short time tags must be used by default.

**Process information in control direction**

(station-specific parameter)

<input checked="" type="checkbox"/> <45> := Single command <sup>3</sup>	C_SC_NA_1
<input checked="" type="checkbox"/> <46> := Double command <sup>3</sup>	C_DC_NA_1
<input checked="" type="checkbox"/> <47> := Regulating step command <sup>3</sup>	C_RC_NA_1
<input type="checkbox"/> <48> := Set point command, normalised value	C_SE_NA_1
<input type="checkbox"/> <49> := Set point command, scaled value	C_SC_NB_1
<input type="checkbox"/> <50> := Set point command, short floating point value	C_SC_NC_1
<input type="checkbox"/> <51> := Bitstring of 32 bit	C_BO_NA_1

Because the use of the below mentioned ASDU's (58 till 64) is project specific, it is the responsibility of the vendor to verify if these ASDU's are required.

<input checked="" type="checkbox"/> <58> := Single command with time tag CP56Time 2a <sup>3</sup>	C_SC_TA_1
<input checked="" type="checkbox"/> <59> := Double command with time tag CP56Time 2a <sup>3</sup>	C_DC_TA_1
<input checked="" type="checkbox"/> <60> := Regulating step command with time tag CP56Time 2a <sup>3</sup>	C_RC_TA_1
<input type="checkbox"/> <61> := Set point command, normalized value with time tag CP56Time 2a	C_SE_TA_1
<input type="checkbox"/> <62> := Set point command, scaled value with time tag CP56Time 2a	C_SE_TB_1
<input type="checkbox"/> <63> := Set point command, short floating point value with time tag CP56Time 2a	C_SE_TC_1
<input type="checkbox"/> <64> := Bitstring of 32 bit with time tag CP56Time 2a	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)

<input checked="" type="checkbox"/> <70> := End of initialisation	M_EI_NA_1
---	-----------

**System information in control direction**

(station-specific parameter)

<input checked="" type="checkbox"/> <100> := Interrogation command	C_IC_NA_1
<input type="checkbox"/> <101> := Counter interrogation command	C_CI_NA_1
<input checked="" type="checkbox"/> <102> := Read command	C_RD_NA_1
<input checked="" type="checkbox"/> <103> := Clock synchronisation command	C_CS_NA_1
<input type="checkbox"/> <104> := Test command	C_TS_NB_1
<input checked="" type="checkbox"/> <105> := Reset process command	C_RP_NC_1
<input checked="" type="checkbox"/> <106> := Delay acquisition command <sup>4</sup>	C_CD_NA_1

**Parameter in control direction**

(station-specific parameter)

<input type="checkbox"/> <110> := Parameter of measured value, normalised 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

<sup>3</sup> Per project need to be decided if long or short time tags will be used. If there are no other explanations, short time tags must be used by default.

<sup>4</sup> The use of this ASDU is project specific, it is the responsibility of the vendor to verify if this ASDU will be required.

**File Transfer**

(station-specific parameter)

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

**Type identifier and cause of transmission assignments for IEC101**

Shaded boxes are not required. Blank = function or ASDU is not used.

Mark type identification/cause of transmission combinations:

'X' if used only in the standard direction

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					
<2>	M_SP_TA_1			X <sup>5</sup>								X <sup>b</sup>	X <sup>b</sup>							
<3>	M_DP_NA_1					X									X					
<4>	M_DP_TA_1			X <sup>5</sup>								X <sup>b</sup>	X <sup>b</sup>							
<5>	M_ST_NA_1					X									X					
<6>	M_ST_TA_1			X <sup>5</sup>								X <sup>b</sup>	X <sup>b</sup>							
<7>	M_BO_NA_1																			
<8>	M_BO_TA_1																			
<9>	M_ME_NA_1	X				X									X					
<10>	M_ME_TA_1			X <sup>5</sup>																
<11>	M_ME_NB_1	X				X									X					
<12>	M_ME_TB_1			X <sup>5</sup>																
<13>	M_ME_NC_1	X				X									X					
<14>	M_ME_TC_1			X <sup>5</sup>																
<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			X <sup>5</sup>								X <sup>b</sup>	X <sup>b</sup>							
<31>	M_DP_TB_1			X <sup>5</sup>								X <sup>b</sup>	X <sup>b</sup>							
<32>	M_ST_TB_1			X <sup>5</sup>								X <sup>b</sup>	X <sup>b</sup>							
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1			X <sup>5</sup>																
<35>	M_ME_TE_1			X <sup>5</sup>																
<36>	M_ME_TF_1			X <sup>5</sup>																
<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 <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>							X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>
<46>	C_DC_NA_1					X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>							X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>
<47>	C_RC_NA_1					X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>							X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>	X <sup>b</sup>
<48>	C_SE_NA_1																			
<49>	C_SE_NB_1																			

<sup>5</sup> Per project need to be decided if long or short time tags will be used. If there are no other explanations, short time tags must be used by default.

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
<50>	C_SE_NC_1																			
<51>	C_BO_NA_1																			
<58>	C_SC_TA_1						X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>						X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>
<59>	C_DC_TA_1						X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>						X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>
<60>	C_RC_TA_1						X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>						X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>	X <sup>5</sup>
<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				X															
<100>	C_IC_NA_1						X	X			X						X	X	X	X
<101>	C_CI_NA_1																			
<102>	C_RD_NA_1					X											X	X	X	X
<103>	C_CS_NA_1						X	X									X	X	X	X
<104>	C_TS_NA_1																			
<105>	C_RP_NA_1						X	X									X	X	X	X
<106>	C_CD_NA_1						X <sup>6</sup>	X <sup>6</sup>									X <sup>6</sup>	X <sup>6</sup>	X <sup>6</sup>	X <sup>6</sup>
<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															X				
<121>	F_SR_NA_1															X				
<122>	F_SC_NA_1					X										X				
<123>	F_LS_NA_1															X				
<124>	F_AF_NA_1															X				
<125>	F_SG_NA_1															X				
<126>	F_DR_TA_1*			X		X														

<sup>5</sup> Per project need to be decided if long or short time tags will be used. If there are no other explanations, short time tags must be used by default.

<sup>6</sup> The use of this ASDU is project specific, it is the responsibility of the vendor to verify if this ASDU will be required.

**Basic application functions****Station initialisation**

(Station - specific parameter)

- Station initialisation for unbalanced systems
- Station initialisation for balanced systems
- Remote initialisation

**Data acquisition by polling (only in unbalanced systems)**

(System - or station - specific parameter)

- first procedure: "request user data class 1".
- second procedure: "request user data class 2".

**Read procedure**

- for Unbalanced systems C\_RD\_DATA
- for Balanced systems C\_RD\_DATA

**Cyclic data transmission**

(station - specific parameter)

- cyclic data transmission

**Acquisition of events**

(system - or station-specific parameter)

For unbalanced systems:

- case 1: spontaneous data is NOT available
- case 2: spontaneous data is available
- case 3: spontaneous data is available from more than one station

For balanced systems:

- spontaneous data is available

**General interrogation**

(system - or station-specific parameter)

- Interrogation procedure for unbalanced systems
- Interrogation procedure for balanced systems
- Interrogation procedure for events arrive between interrogation responses

 Global

- |   |                                   |                                   |
|---|-----------------------------------|-----------------------------------|
| <input checked="" type="checkbox"/> group 1 | <input type="checkbox"/> group 7  | <input type="checkbox"/> group 13 |
| <input checked="" 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 |                                   |
| <input type="checkbox"/> group 6            | <input type="checkbox"/> group 12 |                                   |

**Clock synchronisation**

(station - specific parameter)

- Clock synchronisation for unbalanced systems  
 Clock synchronisation for balanced systems

**Command transmission**

(object - specific parameter)

- Command procedure for unbalanced systems  
 Command procedure for balanced systems

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Direct single command transmission     | <input checked="" type="checkbox"/> Select and execute single command     |
| <input checked="" type="checkbox"/> Direct double command transmission     | <input checked="" type="checkbox"/> Select and execute double command     |
| <input checked="" type="checkbox"/> Direct regulation command transmission | <input checked="" type="checkbox"/> Select and execute regulation command |
| <input type="checkbox"/> Direct set point command transmission             | <input type="checkbox"/> Select and execute set point command             |
|  | <input checked="" type="checkbox"/> ACTTERM is 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

**Transmission of integrated totals**

(Station - or object-specific parameter)

- |  |  |
|--|--|
| <input type="checkbox"/> Transmission integrated totals procedure for unbalanced systems |  |
| <input type="checkbox"/> Transmission integrated totals procedure for balanced systems   |  |
| <input type="checkbox"/> Counter request   | <input type="checkbox"/> General request counter |
| <input type="checkbox"/> Counter freeze without reset                                    | <input type="checkbox"/> Request counter group 1 |
| <input type="checkbox"/> Counter freeze with reset                                       | <input type="checkbox"/> Request counter group 2 |
| <input type="checkbox"/> Counter reset   | <input type="checkbox"/> Request counter group 3 |
|  | <input type="checkbox"/> Request counter group 4 |

**Note**

In case it is used the addresses per group have to be defined by the user.

**Parameter loading**

(Object - specific parameter)

- Parameter procedure for unbalanced systems  
 Parameter procedure for balanced systems  
 Threshold value  
 Smoothing factor  
 Low limit for transmission of measured value  
 High limit for transmission of measured value



**Parameter activation**

(Object - specific parameter)

- Activate or deactivate previous loaded parameters of the addressed objects

**Test procedure**

(Object - specific parameter)

- Test procedure for unbalanced systems  
 Test procedure for balanced systems

**File transfer**

(Station - specific parameter)

- File transfer in monitor direction  
 File transfer in control direction

**Acquisition of transmission delay**

(Station - specific parameter)

- Acquisition transmission delay

**custom application procedures****Login procedure**

(Station - specific parameter)

- login procedure for unbalanced systems  
 login procedure for balanced systems

**Exception procedures**

(Station - specific parameter)

- exception procedures for unbalanced systems  
 exception procedures for balanced systems

**Redundant lines**

(Station - specific parameter)

- Redundant line procedures for unbalanced systems  
 Redundant line procedures for balanced systems

---

<sup>7</sup> The use of this ASDU is project specific, it is the responsibility of the vendor to verify if this ASDU will be required.

## class 1 AND 2 data definition

### Class 1 data

are messages with spontaneous transmission, high priority and events  
(the semantics have to be defined by the user before the implementation)  
such as, \_\_\_\_\_  
\_\_\_\_\_

other definition, \_\_\_\_\_  
\_\_\_\_\_

### Class 2 data

are messages send with cyclic or periodic transmission, low priority and measurements  
(the semantics have to be defined by the user before the implementation)  
\_\_\_\_\_

other definition, \_\_\_\_\_  
\_\_\_\_\_

## **4.2 Definition and presentation of the specific ASDUs**

In the following all ASDUs for use within RYTU Skirstomieji Tinklai AB are defined.

The LPDUs of the link are defined in chapter 4. These definitions are not repeated in this section.

## 4.2.1 ASDUs for process information in monitor direction

### 4.2.1.1 Single-point information without time tag

TYPE IDENT 1: M\_SP\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<5> := request or requested  
<20> := interrogated by general interrogation

Single-point information (IEV 371-02-07) with quality descriptor

**SIQ** := CP8{SPI,RES,BL,SB,NT,IV}

SPI := BS1[1]<0..1>

<0> := OFF

<1> := ON

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

#### Quality descriptor

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.2 Single-point information with time tag

TYPE IDENT 2: M\_SP\_TA\_1

T := Test  
 P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous  
 <11> := return information caused by a remotecommand  
 <12> := return information caused by a local command

Single-point information (IEV 371-02-07) with quality descriptor

**SIQ** := CP8{SPI,RES,BL,SB,NT,IV}  
 SPI := BS1[1]<0..1>  
     <0> := OFF  
     <1> := ON  
 RES = RESERVE := BS3[2..4]<0>  
 BL := BS1[5]<0..1>  
     <0> := not blocked  
     <1> := blocked  
 SB := BS1[6]<0..1>  
     <0> := not substituted  
     <1> := substituted  
 NT := BS1[7]<0..1>  
     <0> := topical  
     <1> := not topical  
 IV := BS1[8]<0..1>  
     <0> := valid  
     <1> := invalid

#### Quality descriptor

**BL** = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

**SB** = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

**NT** = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

**IV** = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.3 Double-point information without time tag

TYPE IDENT 3 := M\_DP\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<5> := request or requested  
<20> := interrogated by general interrogation

Double-point information (IEV 371-02-08) with quality descriptor

**DIQ** := CP8{DPI,RES,BL,SB,NT,IV}  
**DPI** := UI2[1..2]<0..3>  
     <0> := indeterminate or intermediate state  
     <1> := determined state OFF  
     <2> := determined state ON  
     <3> := indeterminate state  
**RES = RESERVE** := BS2[3..4]<0>  
**BL** := BS1[5]<0..1>  
     <0> := not blocked  
     <1> := blocked  
**SB** := BS1[6]<0..1>  
     <0> := not substituted  
     <1> := substituted  
**NT** := BS1[7]<0..1>  
     <0> := topical  
     <1> := not topical  
**IV** := BS1[8]<0..1>  
     <0> := valid  
     <1> := invalid

#### Quality descriptor

**BL** = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

**SB** = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

**NT** = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

**IV** = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.4 Double-point information with time tag

TYPE IDENT 4 := M\_DP\_TA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

<11> := return information caused by a remotecommand

<12> := return information caused by a local command

Double-point information (IEV 371-02-08) with quality descriptor

**DIQ** := CP8{DPI,RES,BL,SB,NT,IV}  
**DPI** := UI2[1..2]<0..3>  
     <0> := indeterminate or intermediate state  
     <1> := determined state OFF  
     <2> := determined state ON  
     <3> := indeterminate state  
**RES = RESERVE** := BS2[3..4]<0>  
**BL** := BS1[5]<0..1>  
     <0> := not blocked  
     <1> := blocked  
**SB** := BS1[6]<0..1>  
     <0> := not substituted  
     <1> := substituted  
**NT** := BS1[7]<0..1>  
     <0> := topical  
     <1> := not topical  
**IV** := BS1[8]<0..1>  
     <0> := valid  
     <1> := invalid

#### Quality descriptor

**BL** = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

**SB** = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

**NT** = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

**IV** = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.5 Step position information

TYPE IDENT 5 := M\_ST\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<5> := request or requested  
<20> := interrogated by general interrogation

VTI := CP8{Value,Transient}

Value := I7[1..7]<-64..+63>

Negative numbers are presented in two's complement

Transient := BS1[8]

<0> := equipment is not in transient state

<1> := equipment is in transient state

#### Quality descriptor:

QDS := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.



IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.6 Step position information with time tag

TYPE IDENT 6 := M\_ST\_TA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

<11> := return information caused by a remotecommand

<12> := return information caused by a local command

VTI := CP8{Value,Transient}

Value := I7[1..7]<-64..+63>

Negative numbers are presented in two's complement

Transient := BS1[8]

<0> := equipment is not in transient state

<1> := equipment is in transient state

#### Quality descriptor:

QDS := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.7 Measured value, normalised value

TYPE IDENT 9: M\_ME\_NA\_1

T := Test  
P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<1> := periodic, cyclic  
<5> := request or requested  
<20> := interrogated by general interrogation

NVA := F16[1..16]<-1..+1-2<sup>-15</sup>>

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero.  
Negative numbers are presented in two's complement.

#### Quality descriptor:

QDS := CP8{OV,RES,BL,SB,NT,IV}  
OV := BS1[1]<0..1>  
<0> := no overflow  
<1> := overflow  
RES = RESERVE := BS3[2..4]<0>  
BL := BS1[5]<0..1>  
<0> := not blocked  
<1> := blocked  
SB := BS1[6]<0..1>  
<0> := not substituted  
<1> := substituted  
NT := BS1[7]<0..1>  
<0> := topical  
<1> := not topical  
IV := BS1[8]<0..1>  
<0> := valid  
<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.8 Measured value, normalised value with time tag

TYPE IDENT 10: M\_ME\_TA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

NVA := F16[1..16]<-1..+1-2<sup>-15</sup>>

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero. Negative numbers are presented in two's complement.

#### Quality descriptor:

QDS := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.9 Measured value, scaled value

TYPE IDENT 11: M\_ME\_NB\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<1> := periodic, cyclic  
 <5> := request or requested  
 <20> := interrogated by general interrogation

SVA :=  $116[1..16] < -2^{-15} .. +2^{15} - 1 >$

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero.

Range and position of decimal points are fixed parameters

#### Quality descriptor:

QDS := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.



IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.10 Measured value, scaled value with time tag

TYPE IDENT 12: M\_ME\_TB\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

**SVA** :=  $116[1..16] < -2^{-15} .. +2^{15} - 1 >$

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero.  
Range and position of decimal points are fixed parameters

#### Quality descriptor:

**QDS** := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.11 Measured value, short floating point value

TYPE IDENT 13 := M\_ME\_NC\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<1> := periodic, cyclic  
<5> := request or requested  
<20> := interrogated by general interrogation

**R32-IEEE STD 754** := R32.23{Fraction, Exponent, Sign}

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero.

Floating point number :=  $R_{i,j}$  (Fraction, Exponent, Sign)  $i=32=$  total size of floating point number  
Fraction :=  $F := U_{ij}[1..j] < 0..1 \cdot 2^{-j} >$   $j=23=$  size of fraction  
Exponent :=  $E := U_{ii-j-1}[j+1..i-1] < 0..2^{i-j-1} >$   $i-j-1=7=$  size of exponent  
Sign :=  $S := BS1[i]$   $S < 0 > :=$  positive  
 $S < 1 > :=$  negative

#### Quality descriptor:

**QDS** := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1] < 0..1 >

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4] < 0 >

BL := BS1[5] < 0..1 >

<0> := not blocked

<1> := blocked

SB := BS1[6] < 0..1 >

<0> := not substituted

<1> := substituted

NT := BS1[7] < 0..1 >

<0> := topical

<1> := not topical

IV := BS1[8] < 0..1 >

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.12 Measured value, short floating point value with time tag

TYPE IDENT 14 := M\_ME\_TC\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

**R32-IEEE STD 754** := R32.23{Fraction, Exponent, Sign}

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero.

Floating point number :=  $R_{i,j}$  (Fraction, Exponent, Sign)  $i=32$ = total size of floating point number

Fraction :=  $F := U_{ij}[1..j] < 0..1 \cdot 2^{-j} >$   $j=23$ = size of fraction

Exponent :=  $E := U_{ii-j-1}[j+1..i-1] < 0..2^{i-j-1} >$   $i-j-1=7$ = size of exponent

Sign :=  $S := BS1[i]$   $S < 0 > :=$  positive  
 $S < 1 > :=$  negative

#### Quality descriptor:

**QDS** := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.13 Single-point information with time tag CP56Time2a

TYPE IDENT 30:= M\_SP\_TB\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous  
<11> := return information caused by a remotecommand  
<12> := return information caused by a local command

Single-point information (IEV 371-02-07) with quality descriptor

**SIQ** := CP8{SPI,RES,BL,SB,NT,IV}

**SPI** := BS1[1]<0..1>

<0> := OFF

<1> := ON

**RES = RESERVE** := BS3[2..4]<0>

**BL** := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

**SB** := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

**NT** := BS1[7]<0..1>

<0> := topical

<1> := not topical

**IV** := BS1[8]<0..1>

<0> := valid

<1> := invalid

#### Quality descriptor

**BL** = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

**SB** = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

**NT** = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

**IV** = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.14 Double-point information with time tag CP56Time2a

TYPE IDENT 31:= M\_DP\_TB\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

<11> := return information caused by a remotecommand

<12> := return information caused by a local command

Double-point information (IEV 371-02-08) with quality descriptor

DIQ := CP8{DPI,RES,BL,SB,NT,IV}

DPI := UI2[1..2]<0..3>

<0> := indeterminate or intermediate state

<1> := determined state OFF

<2> := determined state ON

<3> := indeterminate state

RES = RESERVE := BS2[3..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

#### Quality descriptor

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.



#### 4.2.1.15 Step position information with time tag CP56Time2a

TYPE IDENT 32:= M\_ST\_TB\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

<11> := return information caused by a remotecommand

<12> := return information caused by a local command

**VTI** := CP8{Value,Transient}

Value := I7[1..7]<-64..+63>

Negative numbers are presented in two's complement.

Transient := BS1[8]

<0> := equipment is not in transient state

<1> := equipment is in transient state

#### Quality descriptor

**QDS** := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

#### Quality descriptor

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.16 Measured value, normalised value with time tag CP56Time2a

TYPE IDENT 34: M\_ME\_TD\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

NVA := F16[1..16]<-1..+1-2<sup>-15</sup>>

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero. Negative numbers are presented in two's complement.

#### Quality descriptor

QDS := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

#### 4.2.1.17 Measured value, scaled value with time tag CP56Time2a

TYPE IDENT 35: M\_ME\_TE\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous

**SVA** :=  $116[1..16]<- 2^{-15}..+2^{-15}-1>$

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero. Range and position of decimal point are fixed parameters.

#### Quality descriptor

**QDS** := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

OV = OVERFLOW/NO OVERFLOW

The value of the INFORMATION OBJECT is beyond a predefined range of value (mainly applicable to analogue values).

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

### 4.2.1.18 Measured value, short floating point value with time tag CP56Time2a

TYPE IDENT 36:= M\_ME\_TF\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<3> := spontaneous  
 <11> := return information caused by a remotecommand  
 <12> := return information caused by a local command

**R32-IEEE STD 754** := R32.23{Fraction,Exponent,Sign}

The resolution of measured values is not defined. If the resolution of the measured value is coarser than the unit of the LSB, then the least significant bits are set to zero.

Floating point number	:=	Ri.j (Fraction, Exponent, Sign)	i = total size of floating point number
Fraction	:=	$F := U_{ij}[1..j]<0..1-2^{-j}>$	j = size of fraction
Exponent	:=	$E := U_{ii-j-1}[j+1..i-1]<0..2^{i-j-1}>$	i-j-1 = size of exponent
Sign	:=	S := BS1[i] S<0> := positive S<1> := negative	

#### Quality descriptor

**QDS** := CP8{OV,RES,BL,SB,NT,IV}

OV := BS1[1]<0..1>

<0> := no overflow

<1> := overflow

RES = RESERVE := BS3[2..4]<0>

BL := BS1[5]<0..1>

<0> := not blocked

<1> := blocked

SB := BS1[6]<0..1>

<0> := not substituted

<1> := substituted

NT := BS1[7]<0..1>

<0> := topical

<1> := not topical

IV := BS1[8]<0..1>

<0> := valid

<1> := invalid

BL = BLOCKED/NOT BLOCKED

The value of the INFORMATION OBJECT is blocked for transmission; the value remains in the state that was acquired before it was blocked. Blocking and deblocking may be initiated e.g. by a local lock or a local automatic cause.

SB = SUBSTITUTED/NOT SUBSTITUTED

The value of the INFORMATION OBJECT is provided by input of an operator (dispatcher) or by an automatic source.

NT = NOT TOPICAL/TOPICAL

A value is topical if the most recent update was successful. It is not topical if it was not updated successfully during a specified time interval or it is unavailable.

IV = INVALID/VALID

A value is valid if it was correctly acquired. After the acquisition function recognises abnormal conditions of the information source (missing or non operating updating devices) the value is then marked invalid. The value of the INFORMATION OBJECT is not defined under this condition. The mark INVALID is used to indicate to the destination that the value may be incorrect and cannot be used.

## 4.2.2 ASDUs for process information in control direction

### 4.2.2.1 Single command

TYPE IDENT 45:= C\_SC\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

### CAUSE OF TRANSMISSION

in control direction:

<6> := activation  
<8> := deactivation

in monitor direction:

<7> := activation confirmation  
<9> := deactivation confirmation  
<10> := activation termination  
<44> := unknown type identification  
<45> := unknown cause of transmission  
<46> := unknown common address of ASDU  
<47> := unknown information object address

**SCO** := CP8{SCS,BS1,QOC}

SCS=Single command state := BS1[1]<0..1>

<0> := OFF

<1> := ON

BS1[2]<0>OC := CP6[3..8]{QU,S/E}

**QOC** := CP6{QU, S/E}

QU := UI5[3..7]<0..31>

<0> := no additional definition \*

<1> := short pulse duration (f.e. circuit-breaker), duration determined by a system parameter in the outstation

<2> := long duration pulse, duration determined by a system parameter in the outstation

<3> := persistent output

<4..8> := reserved for standard definitions of this companion standard (compatible range)

<9..15> := reserved for the selection of other predefined functions \*\*

<16..31>:= reserved for special use (private range)

S/E := BS1[8]<0..1>

<0> := Execute

<1> := Select

### 4.2.2.2 Double command

TYPE IDENT 46:= C\_DC\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

### CAUSE OF TRANSMISSION

in control direction:

<6> := activation  
<8> := deactivation

in monitor direction:

<7> := activation confirmation  
<9> := deactivation confirmation  
<10> := activation termination  
<44> := unknown type identification  
<45> := unknown cause of transmission  
<46> := unknown common address of ASDU  
<47> := unknown information object address

**DCO** := CP8{DCS,QOC}  
DCS=Double command state := UI2[1..2]<0..3>  
<0> := not permitted  
<1> := OFF  
<2> := ON  
<3> := not permitted

QOC := CP6[3..8]{QU,S/E}

**QOC** := CP6{QU, S/E}  
QU := UI5[3..7]<0..31>  
<0> := no additional definition \*  
<1> := short pulse duration (f.e. circuit-breaker), duration determined by a system parameter in the outstation  
<2> := long duration pulse, duration determined by a system parameter in the outstation  
<3> := persistent output  
<4..8> := reserved for standard definitions of this companion standard (compatible range)  
<9..15> := reserved for the selection of other predefined functions \*\*  
<16..31>:= reserved for special use (private range)

S/E := BS1[8]<0..1>  
<0> := Execute  
<1> := Select

### 4.2.2.3 Regulating step command

TYPE IDENT 47:= C\_RC\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation  
<8> := deactivation

in monitor direction:

<7> := activation confirmation  
<9> := deactivation confirmation  
<10> := activation termination  
<44> := unknown type identification  
<45> := unknown cause of transmission  
<46> := unknown common address of ASDU  
<47> := unknown information object address

**RCO** := CP8{RCS,QOC}

RCS=Regulating step

command state := UI2[1..2]<0..3>

<0> := not permitted  
<1> := next step LOWER  
<2> := next step HIGHER  
<3> := not permitted

QOC := CP6[3..8]{QU,S/E}

**QOC** := CP6{QU, S/E}

QU := UI5[3..7]<0..31>

<0> := no additional definition \*  
<1> := short pulse duration (circuit-breaker), duration determined by a system parameter in the outstation  
<2> := long duration pulse, duration determined by a system parameter in the outstation  
<3> := persistent output  
<4..8> := reserved for standard definitions of this companion standard (compatible range)  
<9..15> := reserved for the selection of other predefined functions \*\*  
<16..31>:= reserved for special use (private range)

S/E := BS1[8]<0..1>

<0> := Execute  
<1> := Select



#### 4.2.2.4 Single command with time tag CP56Time2a

TYPE IDENT 58 := C\_SC\_TA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation  
<8> := deactivation

in monitor direction:

<7> := activation confirmation  
<9> := deactivation confirmation  
<10> := activation termination  
<44> := unknown type identification  
<45> := unknown cause of transmission  
<46> := unknown common address of ASDU  
<47> := unknown information object address

**SCO** := CP8{SCS,BS1,QOC}

SCS=Single command state := BS1[1]<0..1>

<0> := OFF  
<1> := ON

BS1[2]<0>OC := CP6[3..8]{QU,S/E}

**QOC** := CP6{QU, S/E}

QU := UI5[3..7]<0..31>

<0> := no additional definition \*  
<1> := short pulse duration (circuit-breaker), duration determined by a system parameter in the outstation  
<2> := long duration pulse, duration determined by a system parameter in the outstation  
<3> := persistent output  
<4..8> := reserved for standard definitions of this companion standard (compatible range)  
<9..15> := reserved for the selection of other predefined functions \*\*  
<16..31>:= reserved for special use (private range)

S/E := BS1[8]<0..1>

<0> := Execute  
<1> := Select

#### 4.2.2.5 Double command with time tag CP56Time2a

TYPE IDENT 59:= C\_DC\_TA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation  
<8> := deactivation

in monitor direction:

<7> := activation confirmation  
<9> := deactivation confirmation  
<10> := activation termination  
<44> := unknown type identification  
<45> := unknown cause of transmission  
<46> := unknown common address of ASDU  
<47> := unknown information object address

**DCO** := CP8{DCS,QOC}

DCS=Double command state := UI2[1..2]<0..3>

<0> := not permitted  
<1> := OFF  
<2> := ON  
<3> := not permitted

QOC := CP6[3..8]{QU,S/E}

**QOC** := CP6{QU, S/E}

QU := UI5[3..7]<0..31>

<0> := no additional definition \*  
<1> := short pulse duration (circuit-breaker), duration determined by a system parameter in the outstation  
<2> := long duration pulse, duration determined by a system parameter in the outstation  
<3> := persistent output  
<4..8> := reserved for standard definitions of this companion standard (compatible range)  
<9..15> := reserved for the selection of other predefined functions \*\*  
<16..31> := reserved for special use (private range)

S/E := BS1[8]<0..1>

<0> := Execute  
<1> := Select

#### 4.2.2.6 Regulating step command with time tag CP56Time2a

TYPE IDENT 60 := C\_RC\_TA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation  
<8> := deactivation

in monitor direction:

<7> := activation confirmation  
<9> := deactivation confirmation  
<10> := activation termination  
<44> := unknown type identification  
<45> := unknown cause of transmission  
<46> := unknown common address of ASDU  
<47> := unknown information object address

**RCO** := CP8{RCS,QOC}

RCS=Regulating step

command state := UI2[1..2]<0..3>

<0> := not permitted  
<1> := next step LOWER  
<2> := next step HIGHER  
<3> := not permitted

QOC := CP6[3..8]{QU,S/E}

**QOC** := CP6{QU, S/E}

QU := UI5[3..7]<0..31>

<0> := no additional definition \*  
<1> := short pulse duration (circuit-breaker), duration determined by a system parameter in the outstation  
<2> := long duration pulse, duration determined by a system parameter in the outstation  
<3> := persistent output  
<4..8> := reserved for standard definitions of this companion standard (compatible range)  
<9..15> := reserved for the selection of other predefined functions \*\*  
<16..31>:= reserved for special use (private range)

S/E := BS1[8]<0..1>

<0> := Execute  
<1> := Select

## 4.2.3 ASDUs for system information in monitor direction

### 4.2.3.1 End of initialisation

TYPE IDENT 70 := M\_EI\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

<4> := initialised

COI := CP8{UI7[1..7],BS1[8]}  
UI7[1..7]<0..127>

<0> := local power switch on

<1> := local manual reset

<2> := remote reset

<3..31> := reserved for standard definitions of this companion standard (compatible range)

<32..127>:= reserved for special use (private range)

BS1[8]<0..1>

<0> := initialisation with unchanged local parameters

<1> := initialisation after change of local parameters

## 4.2.4 ASDUs for system information in control direction

### 4.2.4.1 Interrogation command

TYPE IDENT 100 := C\_IC\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation

in monitor direction:

<7> := activation confirmation

<10> := activation termination

<44> := unknown type identification

<45> := unknown cause of transmission

<46> := unknown common address of ASDU

<47> := unknown information object address

QOI := UI8[1..8]<0..255>

<20> := Station interrogation (global)

#### 4.2.4.2 Reset process command

TYPE IDENT 105 := C\_RP\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation

in monitor direction:

<7> := activation confirmation

<44> := unknown type identification

<45> := unknown cause of transmission

<46> := unknown common address of ASDU

<47> := unknown information object address

QRP := UI8[1..8]<0..255>

<0> := not used

<1> := general reset of process

<2> := reset of pending information with time tag of the event buffer

### 4.2.4.3 Delay acquisition delay

TYPE IDENT 106 := C\_CD\_NA\_1

T := Test

P/N := The P/N bit indicates positive or negative confirmation of activation requested by the primary application function. In the case of irrelevance the P/N-bit is zero.

#### CAUSE OF TRANSMISSION

in control direction:

<6> := activation

in monitor direction:

<7> := activation confirmation

<44> := unknown type identification

<45> := unknown cause of transmission

<46> := unknown common address of ASDU

<47> := unknown information object address

#### CP162A

This time tag format (short time tag) is defined in IEC60870-5-101 ed.2 paragraph 7.2.6.20.

## 5 Communication procedures

Table 5.1 shows a list of all basic communication procedures (basic application functions) that are offered in IEC 60870-5-5. The subset of these procedures that are applicable to the IEC 870-5-101 standard and to the RST PID 101 are listed in bold types.

Table 5.1 Basic Application Functions specified in IEC 60870-5-5

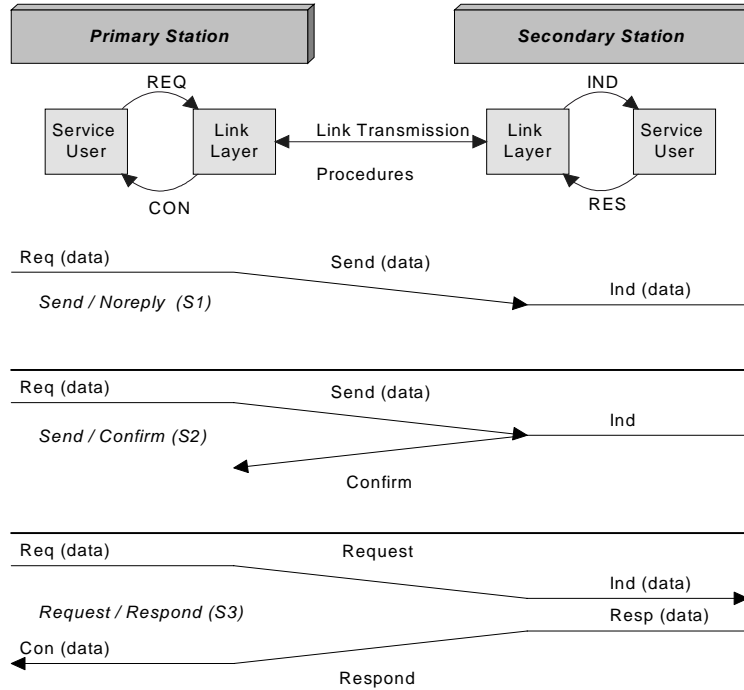
1. **Station initialisation**
2. **Data acquisition by polling**
3. **Cyclic data transmission**
4. **Acquisition of events**
5. **General Interrogation**
6. **Command transmission**
7. Transmission of integrated totals
8. Parameter loading
9. Test procedure
10. **File transfer**
11. **Acquisition of transmission delay**

The relevant application functions are further described in the subsequent sections.



## 5.1 Station initialisation

Only the DTE (controlling station) is able to initiate a transmission procedure. This requires unbalanced (peer-to-peer) communication over a point-to-point connection. The Primary and Secondary role of the connection is strict and cannot change in this so-called Master-Slave configuration.



After a link has been established the controlling station starts the GI procedure and the Clock synchronisation procedure.

## 5.2 Data acquisition by polling

Complete function, defined in IEC 60870-5-5, 6.2, is used.

The polling procedure is supported by the link layer which requests user data of classes 1 and 2. ASDUs containing the causes of transmission periodic/cyclic are assigned to be transmitted with the link layer data class 2 and all spontaneously transmitted ASDUs are assigned to be transmitted with the link layer data class 1. Other ASDUs with other causes of transmission of low priority may also be assigned to data class 2 and must be listed in the interoperability document. For a detailed overview of class 1 and class 2 data see paragraph 4.1.

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

When using the read command, specific information objects may be requested by interrogating their respective information object addresses. The requested information objects are returned with the cause of transmission <5> requested.

## **5.3 Cyclic data transmission**

Complete function, defined in IEC60870-5-5, paragraph 6.3 is used.

## 5.4 Acquisition of events

Events occur spontaneously at the application level of the local (controlled) station. The local process requires an event buffer to collect events that may appear faster than their transmission to the remote (controlling) station can be accomplished.

Events that arrive in the controlled station are transmitted to the controlling station as soon as possible after they appear. Events that arrive faster than transmission to the controlling station can be accomplished are buffered in the controlled station. Events are transmitted with class 1 data priority.

The buffer size must be configured in a way that the amount of events configured in a station multiplied with a factor 5 and a minimum of 1000 events can be stored in case that no connection is available.

## 5.5 General interrogation

The general interrogation application function is used to update the controlling station after the internal station initialisation procedure or when the controlling station detects a loss of information.

The general interrogation function of the controlling station requests the controlled station to transmit the actual values of all its process variables. The interrogation procedure completes when the controlling station receives an End of Interrogation message.

The interrogation procedure can be interrupted by events that may eventually occur in the controlled station. The controlled station will indicate this by setting the ACD bit. GI information will be transmitted as class 2 data.

The information transfer is triggered by an INTERROGATION command message from the controlling station to the controlled station, which responds with an INTERROGATION confirmation message. Receiving an ASDU 70 (Initialized) from the controlled station can trigger this INTERROGATION command message. The controlled station transmits the interrogated information by means of one or more monitored information ASDUs. The last information ASDU is then followed by an INTERROGATION termination message (End Of Interrogation), indicating that all information has been transferred.

## 5.6 Clock synchronisation

The clock synchronisation command is used to synchronise the time in the controlled station with the time in the controlling station. RST can decide per location to choose for clock synchronisation via the clock synchronisation command (ASDU 103) or via an external clock (f.e. GPS).

The clock synchronisation command function will be send when an IEC101 connection is established. Besides that, it should also be configurable up to 1 day (f.e. in steps of one hour) to send the clock synchronisation command function.

## 5.7 Command transmission

### 5.7.1 General

Commands are used in telecontrol systems to cause a change of state of operational equipment. There are two standard procedures for command transmission:

1. Select and execute command
2. Direct command

Select/execute and direct commands may be assigned individually and independently to each commanded object (IOA) in the controlled station (by system configuration parameters in the controlling station).

### 5.7.2 Select and execute command

The select and execute command is used by the controlling station to:

- Prepare for a specific control operation in the controlled station
- Check that the control operation has been prepared (may be performed by the operator).
- Execute the prepared operation if checks are positive

In case of a select and execute command, the controlling station sends a SELECT command message to the controlled station, which responds by a SELECT confirmation message if it is ready to accept the announced command. This procedure is non interruptible and the time from the SELECT command to the SELECT confirmation is controlled by a configurable time-out interval.

A successful select procedure may then be deactivated by a "Break off command". This command is transmitted by a BREAK OFF command message and the controlled station responds by a BREAK OFF confirmation message. The time between these messages is controlled by a timeout.

If appropriate, an EXECUTE command message is sent to the controlled station, which responds by an EXECUTE confirmation message (positive if the specified control action is about to begin, otherwise negative). This procedure is also non interruptible and the time from the EXECUTE command to the EXECUTE confirmation is controlled by a configurable time-out interval.

An EXECUTE termination message is issued from the controlled station when the command application procedure is completed successfully. The addressed equipment should now change its state, and the new state is indicated to the controlling station by a spontaneous data message (return information caused by a command) when reached.

The RYTU SKIRSTOMIEJI TINKLAI AB PID 101 does not specify in which sequence the termination message and the change of state event should arrive. Hence the application in the controlling station must check that the command has been properly executed.

If an EXECUTE command message is not received in the controlled station within a certain time interval after a SELECT message, the select/execute procedure will time out in the controlled station. This time-out interval shall be configurable to a maximum of 60 seconds.

### 5.7.3 Direct commands

Direct commands are used for immediate control operations, and the sequential procedure is identical to the procedure that starts with the EXECUTE command message.

Having received the EXECUTE command message, the application function of the controlled station checks whether the addressed command output is not blocked, i.e. that it is ready for execution. If the check is positive, a positive EXECUTE confirmation message is returned and the operation starts. Otherwise a negative confirmation message is returned.

The application in the controlling station must check that the command has been properly executed.

### 5.7.4 Delayed commands

If commands with time tag are used, the time tag of a command must always be checked by the receiving station to determine if the command is excessively delayed. In case of a delayed command no command confirmation is to be returned by the protocol, and the command is not executed.

NOTE: Preferable an indication is sent to the control center to indicate that a delayed command is received in the controlled station. In the controlling center then (f.e.) a counter is recording the number of times delayed commands have been received.

### 5.7.5 General comments

While waiting for a SELECT / BREAK OFF / EXECUTE confirmation no new SELECT / BREAK OFF / EXECUTE command is sent. This rule is applicable per controlled station.

When a select and execute command (single, double command, etc) has been given by the user process, no new select and execute or direct command is treated by the protocol until the ongoing select and execute command has reached any of the following states:

1. The SELECT command is completed and has been followed by an EXECUTE
2. Timeout between the command and the command confirmation has occurred in any of the stages
3. A negative command confirmation has been received
4. The select and execute command has been deactivated (BREAK OFF command given)

These rules are also applicable per controlled station. The aim is to have only one selected point in a controlled station at a time, for security reasons.



## **5.8 File transfer**

Reference is made to sec. 6.12 in document IEC 870-5-5.

File transfer with IEC101 will be used in both monitor and control direction for all in paragraph 4.1 selected options.

## 6 Functions

This chapter contains additional information about functionality that is not necessarily covered by the standard. However, the functions described in this chapter are functions needed for within RYTU SKIRSTOMIEJI TINKLAI AB, and thus they should be implemented as described in this chapter.

### 6.1 General

It may never appear that the protocol implementation goes in a stop/halt/abort state as a result of a not correct received or erroneous data-frame/quality flag etc. The implementation should log the event with additional relevant data in the system event list for maintenance engineers.

#### 6.1.1 Load balancing

In the RST PID101 redundancy on IEC101 level is not specified. Therefore it is not allowed that both front-ends are managing active lines at the same moment to (f.e.) perform load balancing.

#### 6.1.2 Performance

Under normal conditions a general interrogation of a substation with 2000 information object addresses must be terminated within 1 minute.

#### 6.1.3 Transfer of data from Controlled Station to Controlling Station

In the RST PID 101 Indications, Measurands and Pulse Counters are transferred from Controlled Station to Controlling Station on event basis. Events, caused by a trip or a (remote) command, will have higher priority than General Interrogation. Events can interrupt an ongoing General Interrogation. The Controlled Station algorithm must guarantee that the end-state of all data points after a general Interrogation is correct.

#### 6.1.4 Event Buffers

The buffer size must be configured in a way that the amount of events configured in a station multiplied with a factor 5 and a minimum of 1000 events can be stored in case that no connection is available.

#### 6.1.5 Indications

After a change of state of an Indication the event is transferred **once** with or without time-stamp. The default function will be without time-stamp as a response to a General Interrogation request and with time-stamp after a change of state event. Events will be sent to the controlling station as class 1 data.

#### 6.1.6 Measurands

Measurands can be sent to the Controlling Station with or without time-stamp. For each project it is the responsibility of the vendor to verify with RYTU SKIRSTOMIEJI TINKLAI AB if measurements with COT = spontaneous (events) are transmitted with or without time tag. Measurements will be sent to the controlling station as class 2 data.

## 6.2 Addressing

### 6.2.1 Link layer transmission

This PID specifies IEC101 unbalanced transmission.

The address field of the link must be configurable to handle **1 and 2 octet(s)**.

### 6.2.2 Common Address of ASDU

The Common Address of ASDU is common number used for all objects in one Controlled Station. One Controlled Station can be either an entire Station Control System or only a part of it. The CAA address must be configurable to handle **1 and 2 octet(s)**. The RST PID101 specifies that the broadcast address for the Common address of ASDU (FFFF) is not used.

### 6.2.3 Information Object Address

The Information Object Address is a number given to each data point or object within one Controlled Station and is common for all data types. The IOA address must be configurable to handle **2 and 3 octets**. All the addresses can be set to any valid number, but these rules must be noted:

- Under one logical link from a Controlling Station the total address built together by the Common Address of ASDU and Information Object Address shall be a unique identifier for all data points (objects).

## 6.3 Internal events

In the controlled station it could be integrated a lot of system events.

If the system events should be transferred to the controlling station it has to be done with standard ASDUs. It is not reserved special frames for internal events in the IEC 870-5-101 protocol.

The RST PID 101 does not specify any system events from controlled station.

## 6.4 Quality bits

The protocol implementations must always support all quality bits. Vendors of stations that issue monitoring data should implement the quality bits in the application to a largest possible extent, in accordance with the definitions. Vendors of stations that receive monitoring data should submit to the project how the quality bits are utilised (e.g. logged or flagged) in the application.

## 6.5 Gateways

When gateways are used, quality bits and addressing have to be implemented to a largest possible extend.

## 6.6 Time tags

Within RYTU SKIRSTOMIEJI TINKLAI AB the time to be exchanged is UTC+2 time. This means that all time tagged data that is transferred over "the line" contains UTC+2 time. For this reason the summertime bit within the CP56Time2a timetag will not be used and therefore the time in the time tag is always wintertime.

Both local and central HMI applications can translate (if desirable in the project) the UTC+2 time to the local time and display this local time on the HMI to the operators.

It is the responsibility of the vendor that there will be no mismatch in the time tags when displaying time tagged data, exchange time tagged data and storing this time tagged data.

## 7 “High level” test criteria

The test criteria will describe the tests to be performed to prove that the protocol implementation delivered by the vendor is according to the IEC standards and the RST PID 101.

The test criteria will consist of a:

- Conformance test
- FAT test
- SAT test

### 7.1 Conformance testing

Conformance testing, is the process of verifying that an implementation performs in accordance with the applicable documents as the IEC standard, PID, etc. A manufacturer may claim: “*my equipment conforms to standard ISO/IEC xxx-x*”. Conformance testing enables such a claim to be investigated and assessed by an objective and independent third party test institute, to establish its validity. The conformance test may result in certification by means of an Attestation of Conformity, for the tested implementation version in that equipment.

### 7.2 Factory Acceptance Test

It is in the power of RST to decide if and how the FAT will be organized and which functionality will be tested.

### 7.3 Side Acceptance test

It is in the power of RST to decide if and how the SAT will be organized and which functionality will be tested.

### 7.4 Test requirements

Conformance testing enables thus the claim of a vendor being conform according the referenced documents, which need to be investigated and assessed by an objective and independent institute to establish its validity.

- An objective and (supplier) independent third party test institute must perform the conformance test. The test institute will be organized according the international standard ISO.IEC17025. Besides this standard the test organisation and test procedures must follow a quality system according ISO9001/9002. If requested RYTU SKIRSTOMIEJI TINKLAI AB can supply contact information of at least one independent test institute.
- The conformance test must be performed for all to be delivered types of controlling and controlled station protocol implementations.
- The conformance test will be performed against a conformance test plan that, before the conformance test will be performed, need to be approved by RYTU SKIRSTOMIEJI TINKLAI AB.
- If necessary a retest must be done. When the test results are according the requirements the test institute will issue an Attestation of Conformance.
- An Attestation of Conformance remains valid as long as the vendor guarantees that no changes in communication hard- and software have been made that can influence the certified protocol implementation. If changes have been made, a retest is mandatory to update the Attestation of Conformity and to assure conformance.

A paper version of the Attestation of Conformance must be handed over to RYTU SKIRSTOMIEJI TINKLAI AB. The supplier shall also provide the belonging test reports, model numbers, software and firmware references, etc. as necessary, to clearly identify the functionality covered by the protocol implementation. All this documents, information etc. must be handed over prior to the FAT.