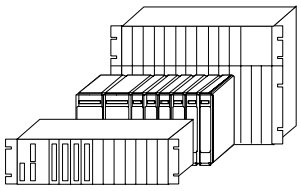
Ax 1703



Firmware Description

UMPM98

IEC 870-5-101 Multi-Point Traffic MASTER
STATKRAFT

HW-Type: 2541 / FW-Type: 2545

This document is applicable to the following product(s):

UMPM98	Rev. 01 and higher

Version	Revision	Date	Change
A, 1	00	21.06.04	first issue

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Table of Contents

1. General

Type:	Protocol firmware
Firmware designation:	UMPM98 (HW: 2541/FW: 2545)
Protocol element designation:	- (Special protocol element)

- Basis firmware:
  Additional module (SIP): SM2541-B
  Prom-Type: FLASH-File

2. Technical Data

The protocol firmware is designed for the communication of Ax 1703 system components and 3rd party RTU´s using IEC 60870-5-101 protocol (called RTU-101 in the following) at Statkraft / PROSAM project.
UMPM98 protocol firmware implement specific functionality defined in NUC (Norwegian User Conventions Revision 2.0) which is not available as Ax-1703 standard functionality or can not be realized using CAEx.

- UMPM98 protocol firmware emulates IEC 60870-5-101 MASTER function (UNBALANCED PRIMARY)
- supported basic functions of UMPM98 see "IEC 60870-5-101" and "Norwegian IEC870-5-101 User Conventions Revision 2.0" (IEC 60870-5-101 interoperability included in this document)
- IEC address conversion (CASDU, IOA) for selected type identifications in receive and transmit direction
  - 1 message SAT internal can be converted to 1 message to the RTU with different address (and different type identifications if supported)
  - 1 message received from the RTU can be converted to 1 messages to SAT internal with different address (and different type identifications if supported)
- format conversion for short floating point, normalized and scaled values for selected type identifications in receive and transmit direction
- special handling for setpoint commands to avoid different values for ACTCON ACTTERM (if format conversion is used)
- special handling for "originator address" (commands and setpoints) ACTCON / ACTTERM have to send back only to that controlling station (SCADA system) which has sent the command/setpoint
- "1 out of n" handling for commands and setpoints
- assignment for command address to return information address for ACTTERM simulation.
- Intermediate -/ faulty state suppression handling for double-point information in monitor direction

This protocol element implements, as an adaptation to non-SAT systems, only a part of the functionality and the data formats of the non-SAT interface. For a concrete case of application, it is therefore to be checked, to what extent the real requirements correspond with the functionality implemented here and to what extent additional expansions or adaptations are required.
Note:
All screen shots in this document will show you examples for possible parameter settings. The parameters, names for system-technical-plant and names for parameter range will be different from your parameters.

2.1. IEC 60870-5-101 Interoperability of ACP 1703 using SM2541 (SIP) with Firmware UMPM98 (unbalanced master)

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

Note:
This IEC 60870-5-101 interoperability specify the functionality to the serial connected RTU-101´s.

The selected parameters should be marked in the white boxes as follows:

☐ Function or ASDU is not used

☒ Function or ASDU is used as standardized (default)

☐ R Function or ASDU is used in reverse mode

☐ B Function or ASDU is used in standard and reverse mode

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

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.

☐ ? Function or ASDU is planned, please contact the product management

☐ Function or ASDU is used in a specific project

2.1.1. System or Device Function

(system-specific parameter, indicate the system's or station's function by marking one of the following with '**X**')

- [ ] System definition
- [X] Controlling Station (Master)
- [ ] Controlled Station (Slave)

2.1.2. Network Configuration

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

- [X] Point to point
- [X] Multiple point to point
- [X] Redundant lines
- [X] Multipoint-partyline
- [ ] Multipoint-star

(as defined in Norwegian IEC870-5-101 User Conventions Revision 2.0)

2.1.3. Physical Layer

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

Transmission speed (control direction)

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

Transmission speed (monitor direction)

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

2.1.4. Link Layer

(network-specific parameter, all options that are used are to be marked '**X**'. Specify the maximum frame length. If a non-standard assignment of class 2 messages is implemented for unbalanced transmission, indicate the Type ID and COT of all messages assigned to class 2.)

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

Link transmission procedure

- [ ] Balanced transmission
- [X] Unbalanced transmission

Address filed of the link

- [ ] not present (balanced transmission only)
- [X] 1 Octet
- [X] 2 Octets
- [X] structured
- [X] unstructured

Frame length

- [ ] Maximum length L (number of octets, posiible 9-255)

When using an unbalanced link layer, the following ASDU types are returned in class 2 messages (low priority) with the indicated causes of transmission:

- [ ] The standard assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission
9, 11, 13, 21	<1>

- [X] A special assignment of ASDUs to class 2 messages is used as follows:

Type identification	Cause of transmission
all	all

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

2.1.5. Application Layer

Transmission mode for application data

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

Common address of ASDU
(system-specific parameter, all configurations that are used are to be marked „**X**“)

[X] 1 Octet	[X] 2 Octets

Information object address
(system-specific parameter, all configurations that are used are to be marked „**X**“)

[X] 1 Octet	[X] structured
[X] 2 Octets	[X] unstructured
[X] 3 Octets	

Cause of transmission
(system-specific parameter, all configurations that are used are to be marked „**X**“)

[X] 1 Octet	[ ] 2 Octets (with originator address) (1)

(1) RTU-101 use only 1 byte for COT – so originator address is not used on communication link to RTU-101.

Selection of standard ASDUs

Process information in monitor direction
(station-specific parameter, mark each Type ID „**X**“ if it is only used in the standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

X	<1>	:=	Single-point information	M_SP_NA_1
X	<2>	:=	Single-point information with time tag	M_SP_TA_1
X	<3>	:=	Double-point information	M_DP_NA_1
X	<4>	:=	Double-point information with time tag	M_DP_TA_1
X	<5>	:=	Step position information	M_ST_NA_1
X	<6>	:=	Step position information with time tag	M_ST_TA_1
	<7>	:=	Bitstring of 32 bit	M_BO_NA_1
	<8>	:=	Bitstring of 32 bit with time tag	M_BO_TA_1
X	<9>	:=	Measured value, normalized value	M_ME_NA_1
X	<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
X	<13>	:=	Measured value, short floating point value	M_ME_NC_1
X	<14>	:=	Measured value, short floating point value with time tag	M_ME_TC_1
	<15>	:=	Integrated totals	M_IT_NA_1
X	<16>	:=	Integrated totals with time tag	M_IT_TA_1
	<17>	:=	Event of protection equipment with time tag	M_EP_TA_1
	<18>	:=	Packed start events of protection equipment with time tag	M_EP_TB_1
	<19>	:=	Packed output circuit information of protection equipment with time tag	M_EP_TC_1
	<20>	:=	Packed single-point information with status change detection	M_PS_NA_1
	<21>	:=	Measured value, normalized value without quality descriptor	M_ME_ND_1
X	<30>	:=	Single-point information with time tag CP56Time2a	M_SP_TB_1
X	<31>	:=	Double-point information with time tag CP56Time2a	M_DP_TB_1
X	<32>	:=	Step position information with time tag CP56Time2a	M_ST_TB_1
	<33>	:=	Bitstring of 32 bit with time tag CP56Time2a	M_BO_TB_1
X	<34>	:=	Measured value, normalized value with time tag CP56Time2a	M_ME_TD_1
	<35>	:=	Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
X	<36>	:=	Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
X	<37>	:=	Integrated totals with time tag CP56Time2a	M_IT_TB_1
	<38>	:=	Event of protection equipment with time tag CP56Time2a	M_EP_TD_1
	<39>	:=	Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
	<40>	:=	Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

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

Process information in control direction
(station-specific parameter, mark each Type ID „**X**“ if it is only used in the standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

X	<45>	:=	Single command	C_SC_NA_1
X	<46>	:=	Double command	C_DC_NA_1
X	<47>	:=	Regulating step command	C_RC_NA_1
X	<48>	:=	Set point command, normalized value	C_SE_NA_1
	<49>	:=	Set point command, scaled value	C_SE_NB_1
	<50>	:=	Set point command, short floating point	C_SE_NC_1
	<51>	:=	Bitstring of 32 bit	C_BO_NA_1

System information in monitor direction
(station-specific parameter, mark „X“ if used)

X	<70>	:=	End of initialization	M_EI_NA_1

System information in control direction
(station-specific parameter, mark each Type ID „**X**“ if it is only used in the standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

X	<100>	:=	Interrogation command	C_IC_NA_1
	<101>	:=	Counter interrogation command	C_CI_NA_1
	<102>	:=	Read command	C_RD_NA_1
X	<103>	:=	Clock synchronization command	C_CS_NA_1
X	<104>	:=	Test command	C_TS_NA_1
X	<105>	:=	Reset process command	C_RP_NA_1
	<106>	:=	Delay acquisition command	C_CD_NA_1

Parameter in control direction
(station-specific parameter, mark each Type ID „**X**“ if it is only used in the standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

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

File transfer
(station-specific parameter, mark each Type ID „**X**“ if it is only used in the standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

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

Type identifier and Cause of Transmission Assignments
(station-specific parameter)

Shaded boxes are not required.
Black boxes are not permitted in this companion standard
Blank = Function or ASDU is not used.
Mark Type Identification/Cause of transmission combinations:
'**X**' if only used in the standard direction
'**R**' if only used in the reverse direction
'**B**' if used in both directions

Type Identification		**Cause of transmission**																	
		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																
<3>	M_DP_NA_1			X								X	X		X					
<4>	M_DP_TA_1			X								X	X							
<5>	M_ST_NA_1			X								X	X		X					
<6>	M_ST_TA_1			X								X	X							
<7>	M_BO_NA_1																			
<8>	M_BO_TA_1																			
<9>	M_ME_NA_1			X											X					
<10>	M_ME_TA_1			X																
<11>	M_ME_NB_1																			
<12>	M_ME_TB_1																			
<13>	M_ME_NC_1			X											X					
<14>	M_ME_TC_1			X																
<15>	M_IT_NA_1																			
<16>	M_IT_TA_1			X												X				
<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																
<31>	M_DP_TB_1			X								X	X							
<32>	M_ST_TB_1			X								X	X							
<33>	M_BO_TB_1																			
<34>	M_ME_TD_1			X																
<35>	M_ME_TE_1																			
<36>	M_ME_TF_1			X																
<37>	M_IT_TB_1			X												X				
<38>	M_EP_TD_1																			
<39>	M_EP_TE_1																			
<40>	M_EP_TF_1																			
<45>	C_SC_NA_1						X	X	X	X	X									
<46>	C_DC_NA_1						X	X	X	X	X									
<47>	C_RC_NA_1						X	X												
<48>	C_SE_NA_1						X	X	X	X										
<49>	C_SE_NB_1																			

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																			
<70>	M_EI_NA_1*)				X															
<100>	C_IC_NA_1						X	X			X									
<101>	C_CI_NA_1																			
<102>	C_RD_NA_1																			
<103>	C_CS_NA_1						X	X												
<104>	C_TS_NA_1						X	X												
<105>	C_RP_NA_1						X	X												
<106>	C_CD_NA_1																			
<110>	P_ME_NA_1																			
<111>	P_ME_NB_1																			
<112>	P_ME_NC_1																			
<113>	P_AC_NA_1																			
<120>	F_FR_NA_1																			
<121>	F_SR_NA_1																			
<122>	F_SC_NA_1																			
<123>	F_LS_NA_1																			
<124>	F_AF_NA_1																			
<125>	F_SG_NA_1																			
<126>	F_DR_TA_1*)																			

*) blank or X only

Semantics of CAUSE OF TRANSMISSION
note: see IEC60870-5-101 standard for cause of transmission definition – COT numbers included in the interoperability document is not standard but helpful in UMPM98 protocol document.

<0> := not used
<1> := periodic, cyclic
<2> := background scan
<3> := spontaneous
<4> := initialized
<5> := request or requested
<6> := activation
<7> := activation confirmation
<8> := deactivation
<9> := deactivation confirmation
<10> := activation termination
<11> := return information caused by a remote command
<12> := return information caused by a local command
<13> := file transfer
<14..19> := reserved for further compatible definitions

<20> := interrogated by station interrogation
<21> := interrogated by group 1 interrogation
<22> := interrogated by group 2 interrogation
<23> := interrogated by group 3 interrogation
<24> := interrogated by group 4 interrogation
<25> := interrogated by group 5 interrogation
<26> := interrogated by group 6 interrogation
<27> := interrogated by group 7 interrogation
<28> := interrogated by group 8 interrogation
<29> := interrogated by group 9 interrogation
<30> := interrogated by group 10 interrogation
<31> := interrogated by group 11 interrogation
<32> := interrogated by group 12 interrogation
<33> := interrogated by group 13 interrogation
<34> := interrogated by group 14 interrogation
<35> := interrogated by group 15 interrogation
<36> := interrogated by group 16 interrogation

<37> := requested by general counter request
<38> := requested by group 1 counter request
<39> := requested by group 2 counter request
<40> := requested by group 3 counter request
<41> := requested by group 4 counter request
<42..43> := reserved for further compatible definitions

<44> := unknown type identification
<45> := unknown cause of transmission
<46> := unknown common address of ASDU
<47> := unknown information object address

<48..63>:= for special use (private range)

2.1.6. Basic Application Functions

Station initialization
(station-specific parameter, mark „**X**“ if function is used)

[X] Remote initialization

Cyclic data transmission
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

[ ] Cyclic data transmission

Read procedure
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

[ ] Read procedure

Spontaneous transmission
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

[B] Spontaneous transmission

Note:
No spontaneous transmission (blank field) is not supported

Double transmission of information objects with cause of transmission spontaneous
(station-specific parameter, mark each information type ‘**X**’ where both a Type ID without time and corresponding Type ID with time are issued in response to a single spontaneous change of a monitored object)

The following type identifications may be transmitted in succession caused by a single status change of an information object. The particular information object addresses for which double transmission is enabled are defined in a project-specific list.

[ ] Single-point information M_SP_NA_1, M_SP_TA_1, M_SP_TB_1 and M_PS_NA_1
[ ] Double-point information M_DP_NA_1, M_DP_TA_1 and M_DP_TB_1
[ ] Step position information M_ST_NA_1, M_ST_TA_1 and M_ST_TB_1
[ ] Bitstring of 32 bit M_BO_NA_1, M_BO_TA_1 and M_BO_TB_1 (if defined for a specific project)
[ ] Measured value, normalized value M_ME_NA_1, M_ME_TA_1, M_ME_ND_1 and M_ME_TD_1
[ ] Measured value, scaled value M_ME_NB_1, M_ME_TB_1 and M_ME_TE_1
[ ] Measured value, short floating point value M_ME_NC_1, M_ME_TC_1 and M_ME_TF_1

Station interrogation
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

B	global				
	group 1		group 7		group 13
	group 2		group 8		group 14
	group 3		group 9		group 15
	group 4		group 10		group 16
	group 5		group 11		
	group 6		group 12		

Information Object Addresses assigned to each group must be shown in a separate table.

Clock synchronization
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

X	Clock synchronization

Command transmission
(object-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

B	Direct command transmission (1)
B	Direct set point command transmission (3)
B	Select and execute command (2)
	Select and execute set point command (4)
	C_SE ACTTERM used

B	No additional definition
B	Short pulse duration (duration determined by a system parameter in the outstation)
B	Long pulse duration (duration determined by a system parameter in the outstation)
	Persistent output

(1) direct command transmission is used only for regulating step commands <TI=47> to RTU-101 !
(2) Select and execute command transmission is used only for single-/double commands <TI=45,46> to RTU-101 !
(3) Direct setpoint command transmission is used only for <TI=48> to RTU-101 !
(4) Select and execute setpoint command transmission is not used to RTU-101 !
note: set point command from control station (or CAEx) to UMPM98 is direct or select-before-operate.

Transmission of integrated totals
(station- or object-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

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

	Counter read
B	Counter freeze without reset
	Counter freeze with reset
	Counter reset

B	General request counter
B	Request counter group 1
B	Request counter group 2
B	Request counter group 3
B	Request counter group 4

Parameter loading
(object-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

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

Parameter activation
(object-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

☐ act/deact of persistent cyclic or periodic transmission of the addressed object

Test procedure
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

☒ Test procedure

File transfer
(station-specific parameter, mark each used function „**X**“)

File transfer in monitor direction

☐ Transparent file
☐ Transmission of disturbance data of protection equipment
☐ Transmission of sequences of events
☐ Transmission of sequences of recorded analog values

File transfer in control direction

☐ Transparent file

Background scan
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

☐ Background scan

Note: used for data which are transmitted caused by a self-initiated general interrogation

Acquisition of transmission delay
(station-specific parameter, mark „**X**“ if function only used in standard direction, „**R**“ if only used in the reverse direction, and „**B**“ if used in both directions)

☐ Acquisition of transmission delay

2.2. Limitations

- UMPM98 implement only "unbalanced primary" (= MASTER) of IEC 60870-5-101
- UMPM98 implements only a subset of IEC 60870-5-101
  (see Norwegian User conventions 2.0)
- max. 100 RTU-101´s can be connected to UMPM98
- max. 3500 data points in transmit- / receive direction

  note:
  calculation of possible combinations of datapoints:
  - Total free memory of SM2541/UMPM98 (Rev.001) protocol firmware ... 141000 bytes
  - each datapoint requires 38 bytes of memory
  - each datapoint with linearization parameter requires additional 10 bytes of memory

  → e.g. 3500 datapoints ..... 3500 x 38 bytes = 133000 bytes
  800 datapoints (of the 3500 above) are with linearization parameters ... 800 x 10 = 8000 bytes
  total = 141000 bytes
- max. 20 different regulating step commands <TI=47> running at the same time
- max. 20 different setpoint commands <TI=48,49,50> running at the same time
- no retry suppression for command handling in UMPM98 protocol firmware !

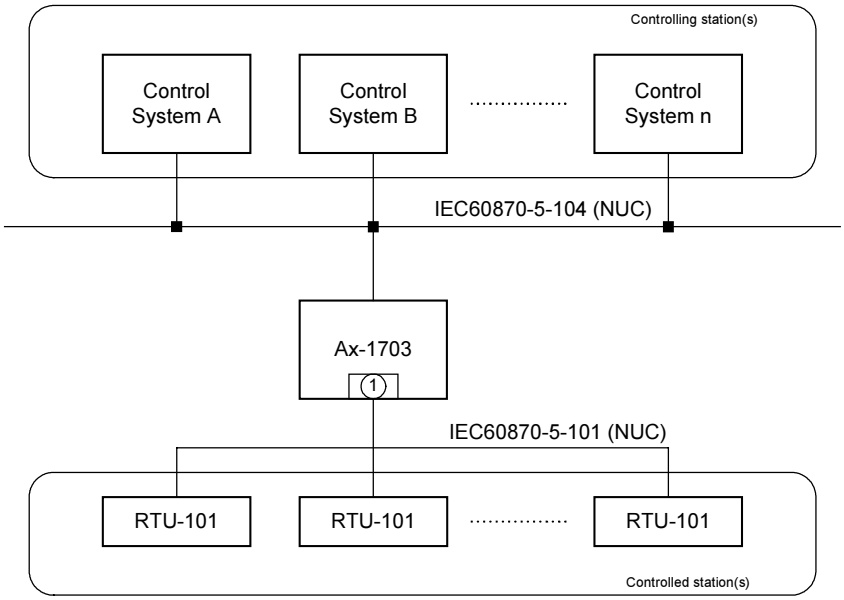
  Note:
  Retry suppression handling is a standard functionality of IEC60870-5-101/-104.
- <TI=7> "bitstring of 32 bit" is not supported by UMPM98 !
- <TI=110> "parameter of measured value, normalized value" and
  <TI=112> "parameter of measured value, short floating point value"
  (Parameter loading "Threshold value", "Smoothing factor") are not supported by UMPM98 !

  Note:
  Parameter in control direction will be supported by AK-1703 connected to controlling station using IEC 60870-5-104
- <TI = 51> "bitstring of 32 bit" is not supported by UMPM98 !
- Blocking in control direction is not supported by UMPM98 !
- no inversion for double point information or double commands.

  Note:
  Inversion is "changing of the state".
- suppression for "faulty state position" or "intermediate state position" for max. 20 double-point information in monitoring direction at the same time.
- Non-linear linearization for conversion of measured values and setpoint commands is not supported by UMPM98 protocol firmware !

  Note:
  CAEx can also not be used for non-linear linearization of setpoint commands!
  (see special handling for setpoint commands to avoid different values for ACTCON, ACTTERM)

2.3. Configuration



1 UMPM98 protocol firmware

2.4. Used Interface Lines

In V.24 Mode the following interface lines are used:

TXD	<103>	Transmit Data
RXD	<104>	Receive Data
DCD	<109>	Data Carrier Detect
RTS	<105>	Request To Send
GND	<102>	System Ground

Note:
For Statkraft / PROSAM project RTS and DCD will not be used !

3. Protocol Description

See IEC 60870-5-101.

4. Message Conversion

The conversion of the message formats from Ax 1703 (internal) ↔ RTU-101 and the changing of the address information is called "message conversion".
The conversion of the address information will be parameterized using the OPM (object-oriented process data manager) SIP message address conversion for UMPM98 protocol firmware.

ATTENTION:
Only messages included in the SIP message address conversion will be sent to the RTU-101 or received from the RTU-101. All other messages not included in the SIP message address conversion will be ignored without an warning or error indication!

The selected parameters are marked in the white boxes as follows:

☐ conversion is not supported

☒ conversion is supported

4.1. Address Conversion

The conversion of the address information will be parameterized using the OPM (object-oriented process data manager) SIP message address conversion for UMPM98 protocol firmware.
IEC address conversion (CASDU, IOA) for selected type identifications in control and monitor direction.

- 1 message SAT internal can be converted to 1 message to the RTU with different address (and different type identifications if supported)
- 1 message received from the RTU can be converted to 1 messages to SAT internal with different address (and different type identifications if supported)

SAT 1703 address (internal IEC address):

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 address
possible: 0 - 255

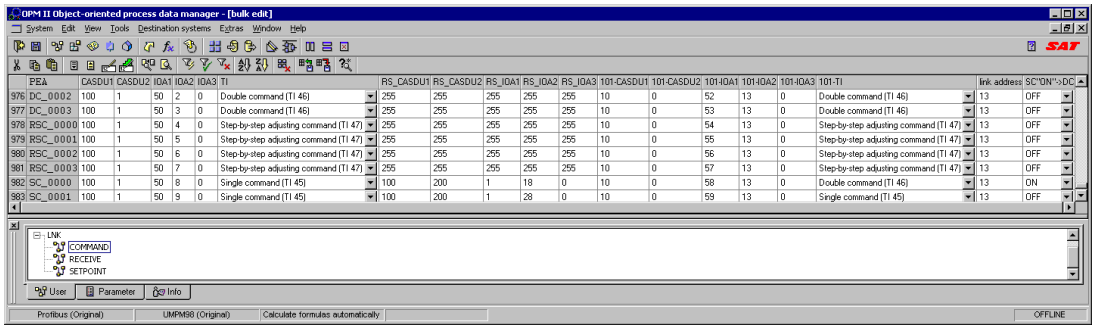
note:
SAT internal IEC address is always full size (2 byte CASDU, 3 byte IOA) and must be unique in the SIP message address conversion.

RTU-101 IEC address (external IEC address):

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 new address
possible: 0 - 255

note:
Number of bytes used for CASDU and for IOA is to be parameterized in the IEC parameter block of the BSE (SAT internal) for each communication interface individually.
The external IEC address must be unique in the SIP message address conversion.



Example for "SIP message address conversion" for UMPM98 in control direction

4.2. Linearization

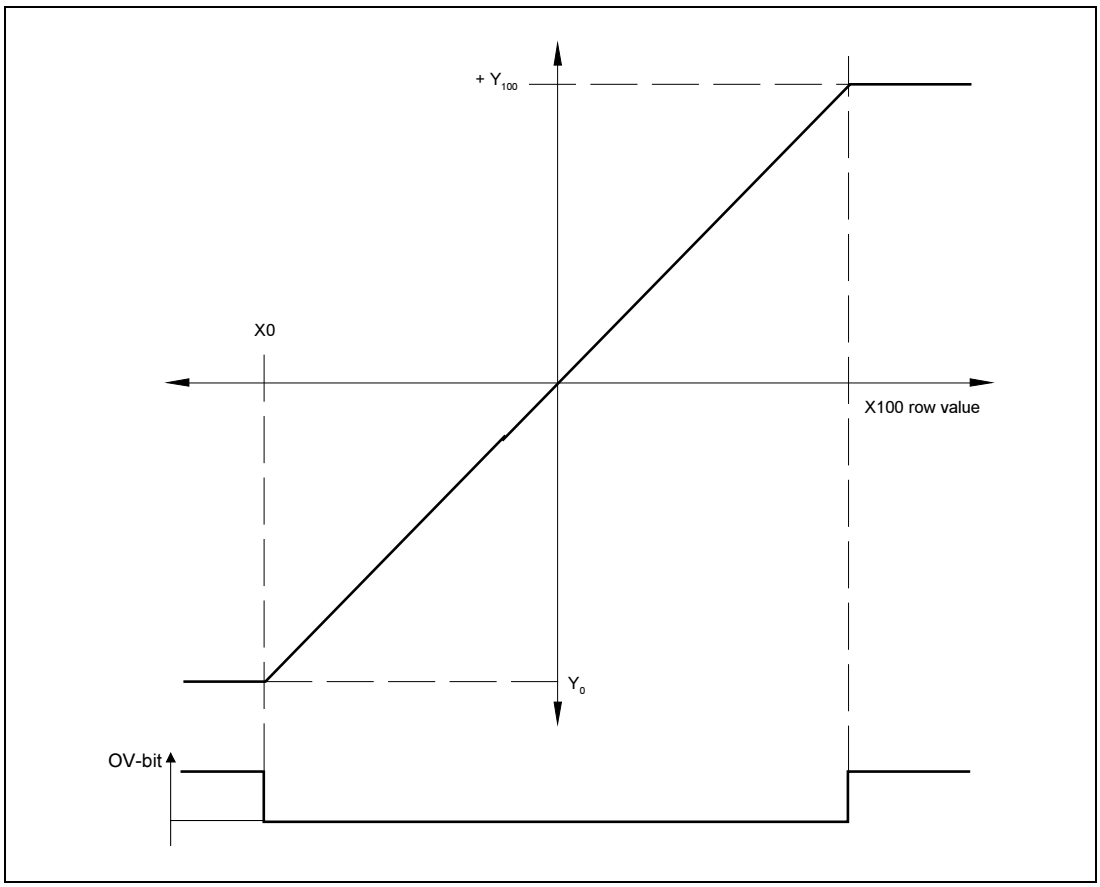
The conversion of type identifications will be parameterized using the OPM (object-oriented process data manager) SIP message address conversion for UMPM98 protocol firmware.
For supported conversions of TI´s see chapter "message conversion in control direction" and "message conversion in monitor direction".
The linearization will be used only for conversion of measured values and setpoint commands.

The linearization is defined by

X0	raw value 0 %	
X100	raw value 100 %	Y = k . x + d
Y0	engineering value 0 %	where k = (Y100 – Y0)/(X0 – X100)

- For all kind of measurements the "OV-bit" is set if received value is smaller than X0 or greater than X100. Calculated value is set to Y0 if received value is smaller than X0. Calculated value is set to Y100 if received value is greater than X100.
- IV-bit will not be modified

The parameters for linearization can be defined for each entry in the OPM-Parameters for UMPM98 (SIP message address conversion).
Non-linear linearization is not supported by UMPM98 protocol firmware!



4.3. Message Conversion of Process Information in Control Direction (SAT Ax 1703 → RTU-101)

One message of a specific type identification from SAT internal can be converted to one message of a specific type identification to the RTU IEC 60870-5-101.

Type Identification (SAT internal)			**Type identification to RTU-101**							
			45	46	47	48	49	50	51	
TI (104)	TI (101)	(101)								
<58>	<45>	C_SC_NA_1	X	X						
<59>	<46>	C_DC_NA_1		X						
<60>	<47>	C_RC_NA_1			X					
<61>	<48>	C_SE_NA_1				X				
<62>	<49>	C_SE_NB_1								
<63>	<50>	C_SE_NC_1				X				
<64>	<51>	C_BO_NA_1								

Note:
- "TI-101" is the type identification used SAT internal from BSE → SIP and to the RTU-101 on communication line.
- "TI-104" is the type identification used SAT-internal and from control center (IEC60870-5-104 NUC).

UMPM98 protocol firmware will accept only messages <TI=45..50> with <COT=6,8> (=activation, deactivation) - all another messages will be ignored !
Note:
If a command will be received from control center with illegal COT this will be confirmed with "ACTCON neg" by BSE !

4.3.1. Single / Double Commands

Following special handling is implemented in UMPM98 protocol firmware for
single commands <TI=45> (<TI=58> on 104) and
double commands <TI=46> (<TI=59> on 104):

- "1 out of n" for each link address
  Only one command is possible at the same time for each link address (=RTU-101 station address) on a communication line.
  If more than one communication interface is used with RTU-101 or 3rd party RTU´s connected to one AK-1703, "1 out of n" will be handled for each communication link individually.
  (=no "1 out of n" for total AK-1703).
  ACTCON neg. will be sent for commands from UMPM98 protocol firmware if another command is in progress.

- address conversion for CASDU and IOA in transmit direction
  (see chapter address conversion)

- ACTCON (ACTTERM) will be sent back only to the one control center which has sent the single- / double command.

  note:
  The Originator address is not used on IEC60870-5-104(NUC) - the originator address is assigned AK-1703 internally (AK-1703 topology parameter setting).
  UMPM98 protocol firmware will send the ACTCON (ACTTERM) with the originator address assigned and the control center´s address of the single- / double command (=the not converted address).
  ACTCON pos. will be sent to the control center only if the ACTCON pos. received from the RTU-101 is valid (correct CASDU, IOA, COT) – otherwise an ACTCON neg. will be sent to the control center.

- mapping of single-/double commands 104 → RTU-101:
  - select-before-execute (104) → select-before-execute (101)

- optional mapping of single command to double command:
  - <TI=45> "ON" → <TI=46> "ON" (can be parameterized in OPM)
  - <TI=45> "ON" → <TI=46> "OFF" (can be parameterized in OPM)
  - <TI=45> "OFF" → <TI=46> "OFF" (fixed implementation in UMPM98)

- As DEACTIVATION is not supported by RTU-101 and a selected command in the RTU-101 can not be deselected – a DEACTIVATION command will always be confirmed with ACTCON neg. by UMPM98 protocol firmware.
  A selected command will stay selected in the RTU-101 until timeout in RTU-101 expires and the command will also stay selected in UMPM98 protocol firmware until timeout in UMPM98 expires.

- As ACTTERM is not supported by RTU-101 – ACTERM will be simulated by UMPM98 protocol firmware.
  If a return information is assigned to the command, ACTTERM pos. will be simulated if the return information will be received with the correct state from the RTU-101 within the timeout. The timeout will not be stopped in UMPM98 if the return information will be received with intermediate -/ faulty- / or opposite state and therefore the command will be still selected.

  If no return information is assigned to the command – ACTTERM pos. will be simulated immediately after valid ACTCON pos. was received from the RTU-101.

  If a single command <TI=45>(<TI=58> on 104) is mapped to a double command <TI=46> (101) the return information from RTU-101 must be an single point information.
  The return information for a double command must be a double point information.

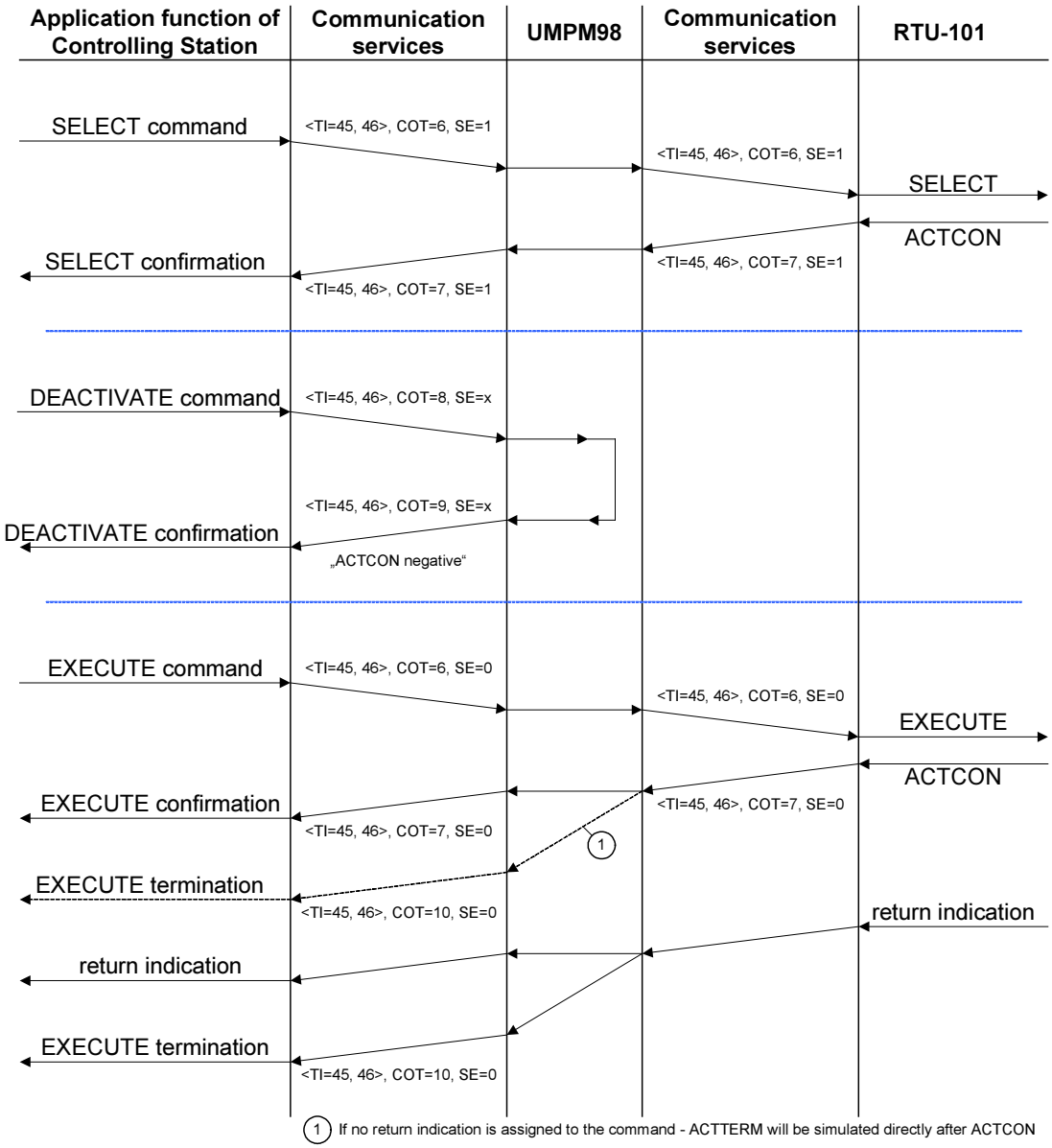
  note:
  The return information address (= SAT internal IEC address = 104 address) will be assigned to the commands address in the OPM-parameters (SIP message address conversion in control direction).

- ACTCON neg. will be sent by UMPM98 protocol firmware (or BSE) in following cases:
  - protocol element failed or RTU-101 link address failed (ACTCON neg. from BSE)
  - command not included in OPM message address conversion in transmit direction or detail routing on BSE (ACTCON neg. from BSE)
  - always for a DESELECT single-/double command
  - this command or another command is already selected or running "1 out of n"
  - EXECUTE for not selected command or EXECUTE from an other control center as SELECT command (selected command will stay selected)
  - CASDU, IOA, COT, DCS (double command state) or SCS (single command state) and QU of the EXECUTE command is not equal to the SELECT command
  - not permitted double command state (DCS)
  - not supported QU (QU > 2 is not supported)
  - ACTCON from the RTU-101 is missing
  - ACTCON neg. received from RTU-101 for SELECT or EXECUTE
  - ACTCON pos. received from RTU-101 for SELECT or EXECUTE command with not expected CASDU , IOA, COT, DCS and QU or SCS and QU.

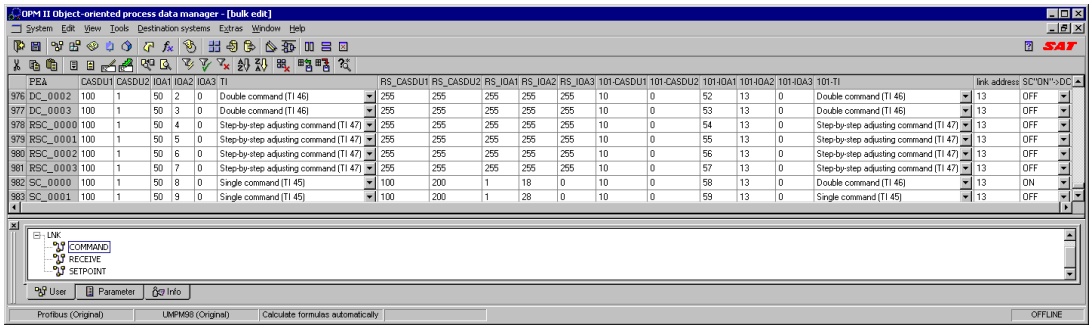
    → The command in the UMPM98 protocol firmware will be canceled (command is not longer selected).
    The command in the RTU-101 could be is still selected.

    → If the same command will be selected again from the control center within the SELECT-EXECUTE timeout in the RTU-101 – an ACTCON neg. will be sent from the RTU-101.

  note:
  If UMPM98 protocol firmware will receive an ACTCON (pos. or neg.) from the RTU-101 without an command in progress, this ACTCON will be ignored by UMPM98.


Application function of Controlling Station
Communication services
UMPM98
Communication services
RTU-101
SELECT command
<TI=45, 46>, COT=6, SE=1
<TI=45, 46>, COT=6, SE=1
SELECT
ACTCON
SELECT confirmation
<TI=45, 46>, COT=7, SE=1
<TI=45, 46>, COT=7, SE=1
DEACTIVATE command
<TI=45, 46>, COT=8, SE=x
<TI=45, 46>, COT=9, SE=x
DEACTIVATE confirmation
„ACTCON negative“
EXECUTE command
<TI=45, 46>, COT=6, SE=0
<TI=45, 46>, COT=6, SE=0
EXECUTE
ACTCON
EXECUTE confirmation
<TI=45, 46>, COT=7, SE=0
<TI=45, 46>, COT=7, SE=0
1
EXECUTE termination
<TI=45, 46>, COT=10, SE=0
return indication
return indication
EXECUTE termination
<TI=45, 46>, COT=10, SE=0
1 If no return indication is assigned to the command - ACTTERM will be simulated directly after ACTCON

4.3.1.1. Parameterization



Example for "SIP message address conversion" for UMPM98 in control direction for single-double commands

note:
there is only one parameter category defined in the OPM for commands – in this chapter only the relevant settings for single-/double commands will be described.

Supported SAT 1703 message formats:

- Single command <TI=45> (<TI=58> on 104)
- Double command <TI=46> (<TI=59> on 104)

Address conversion SAT 1703 → RTU-101:

- *CASDU1,CASDU2, IOA1, IOA2, IOA3 ...* 5-stage freely parameterizable SAT 1703 internal IEC address (=source address) of single-/double command.
  possible: 0 – 255

- TI ... type identification (SAT internal BSE → SIP)
  possible: 45,46

- *RS-CASDU1, RS-CASDU2, RS-IOA1, RS-IOA2, RS-IOA3 ...* 5-stage freely parameterizable internal IEC address (=104 address) of the return information.
  note: if no return information is available - CASDU and IOA must be set to 255 !
  possible: 0 – 255

- *101-CASDU1, 101-CASDU2, 101-IOA1, 101-IOA2, 101-IOA3 ...* 5-stage freely parameterizable RTU101 IEC address of the single-/double command
  possible: 0 – 255

- 101-TI ... type identification for RTU-101
  possible: 45,46

- link address ... link address of RTU-101 (station address)
  possible: 0 – 254

- SC "ON" → DC (mapping of single commands)
  possible: OFF, ON

4.3.2. Regulating Step Commands

Following special handling is implemented in UMPM98 protocol firmware for regulating step commands <TI=47> (<TI=60> on 104).

- Up to 20 different regulating step commands can be used at the same time on a communication line and also for the same link address (RTU-101 station address)
  → no "1 out of n" for regulating step commands!

  note:
  A regulating step command with the same RTU-101 address can only be active once.

- address conversion for CASDU and IOA in transmit direction
  (see chapter address conversion)

- ACTCON will be sent back only to the control center which has sent the regulating step command

  note:
  Originator address is not used on IEC60870-5-104(NUC) - the originator address is assigned according the AK-1703 topology parameter setting.
  UMPM98 protocol firmware will send the ACTCON with the originator address assigned and the control center´s address of the regulating step command (=the not converted address).

- SELECT / DESELECT is not supported for regulating step commands.
  SELECT command or DESELECT command will always be confirmed from UMPM98 protocol firmware with ACTCON neg.

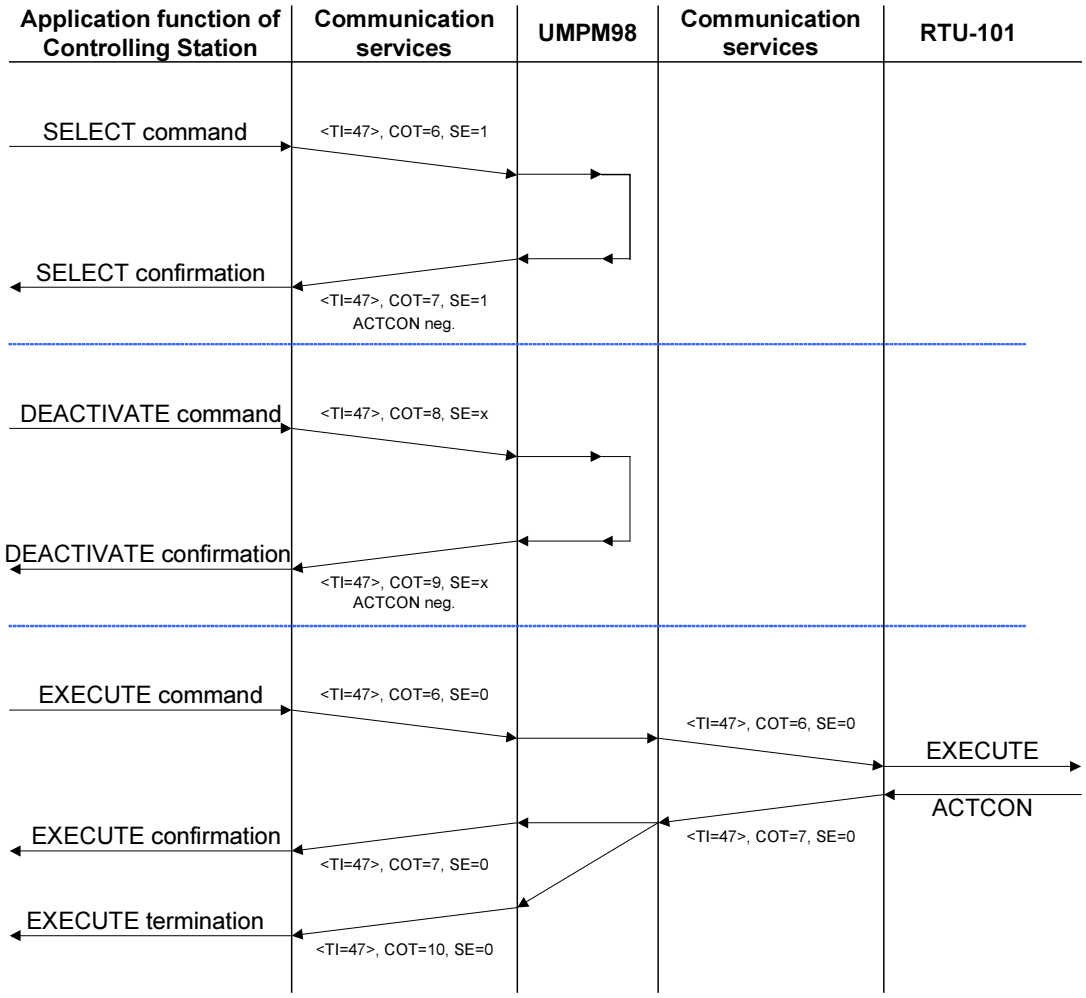
- mapping of regulating step commands 104 → RTU-101:
  - direct-operate (104) → direct-operate (101)

- As ACTTERM is not supported by RTU-101 – ACTERM will be simulated by UMPM98 protocol firmware.
  ACTTERM will be simulated immediately after valid ACTCON pos. was received from the RTU-101.

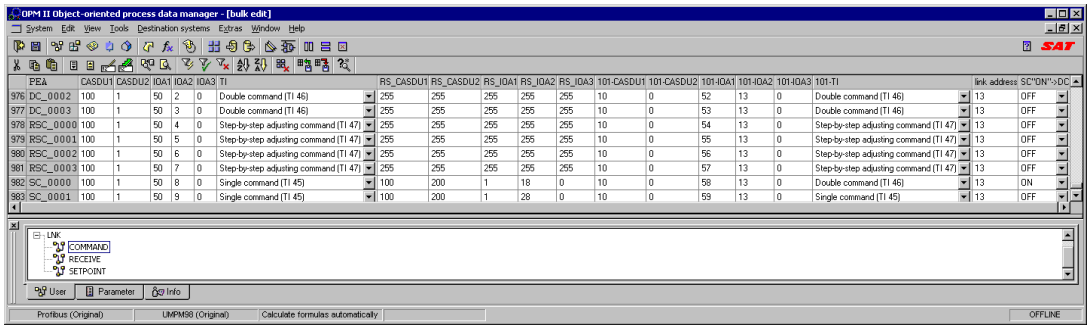
- ACTCON neg. will be sent by UMPM98 protocol firmware (or BSE) in following cases:
  - protocol element failed or RTU-101 link address failed (ACTCON neg. from BSE)
  - command not included in OPM message address conversion in transmit direction or detail routing on BSE (ACTCON neg. from BSE)
  - always for a SELECT regulating step command or DESELECT regulating step command
  - max. number of supported regulating step commands actually running
  - EXECUTE for regulating step command with the same CASDU and IOA is still running
  - not permitted RCS (regulating step command state)
  - not supported QU (QU > 2 is not supported)
  - ACTCON from the RTU-101 for EXECUTE regulating step command is missing
  - ACTCON neg. received from RTU-101 for EXECUTE regulating step command
  - ACTCON pos. received from RTU-101 for EXECUTE regulating step command with expected CASDU and IOA but not expected COT, RSC, QU.

    → If ACTCON pos. will be received from RTU-101 for EXECUTE regulating step command with different CASDU or IOA this ACTCON will be ignored by the UMPM98 protocol firmware.
    Other actually running regulating step commands will not be affected !

    note:
    If ACTCON will be received from the RTU-101 without an regulating step command in progress, this ACTCON will be ignored from the UMPM98 protocol firmware.


Application function of Controlling Station
Communication services
UMPM98
Communication services
RTU-101
SELECT command
<TI=47>, COT=6, SE=1
SELECT confirmation
<TI=47>, COT=7, SE=1
ACTCON neg.
DEACTIVATE command
<TI=47>, COT=8, SE=x
DEACTIVATE confirmation
<TI=47>, COT=9, SE=x
ACTCON neg.
EXECUTE command
<TI=47>, COT=6, SE=0
<TI=47>, COT=6, SE=0
EXECUTE
ACTCON
EXECUTE confirmation
<TI=47>, COT=7, SE=0
<TI=47>, COT=7, SE=0
EXECUTE termination
<TI=47>, COT=10, SE=0

4.3.2.1. Parameterization



Example for "SIP message address conversion" for UMPM98 in control direction for regulating step commands

note:
there is only one parameter category defined in the OPM for commands – in this chapter only the relevant settings for regulating step commands will be described.
(e.g. return information is not used for regulating step commands)

Supported SAT 1703 message formats:

— Regulating step command <TI=47> (<TI=60> on 104)

Address conversion SAT 1703 → RTU-101:

- *CASDU1,CASDU2, IOA1, IOA2, IOA3 ...* 5-stage freely parameterizable
  SAT 1703 internal IEC address (=source address) for regulating step command
  possible: 0 – 255

- TI ... type identification (SAT internal BSE → SIP)
  possible: 47

- *101-CASDU1, 101-CASDU2, 101-IOA1, 101-IOA2, 101-IOA3 ...* 5-stage freely parameterizable RTU101 IEC address of the regulating step command
  possible: 0 – 255

- 101-TI ... type identification for RTU-101
  possible: 47

- link address ... link address of RTU-101 (station address)
  possible: 0 – 254

4.3.3. Setpoint Commands

Following special handling is implemented in UMPM98 protocol firmware for setpoint commands <TI=48> (<TI=61,63> on 104).

- Up to 20 different setpoint commands can be used at the same time on a communication line and also for the same link address (RTU-101 station address)
  → no "1 out of n" for regulating step commands !

  note:
  A setpoint command with the same RTU-101address can only be active once.

- address conversion for CASDU and IOA in transmit direction (see chapter address conversion)

- ACTCON for the setpoint command will be sent back only to the control center which has sent the setpoint command.

  note:
  As format conversion is used for setpoint commands it is not possible to use the setpoint value received in ACTCON from the RTU-101 because there can be an difference caused by format conversion and linearization. To eliminate this problem the UMPM98 protocol firmware will store all the received setpoint command information from the control center for the supported number of setpoint commands.
  If "ACTCON pos" will be received from the RTU-101 with expected values – "ACTCON pos" to the control center will be sent using the previous received values for the setpoint command from the control center.
  → If "ACTCON pos" will be received from the RTU-101 with different value for setpoint – "ACTCON neg" will be sent to the control center with setpoint value received from the control center.

- ACTTERM is not supported for setpoint commands !

- As SELECT and DESELECT is not supported by RTU-101 → SELECT and DESELECT will be simulated by UMPM98 protocol firmware only for setpoint commands configured as select-before-execute in OPM (SIP message address conversion).

- mapping of setpoint commands 104 → RTU-101:
  - select-before-execute (104) → direct-execute (101)
  - direct-execute(104 or from CAEx) → direct-execute (101)

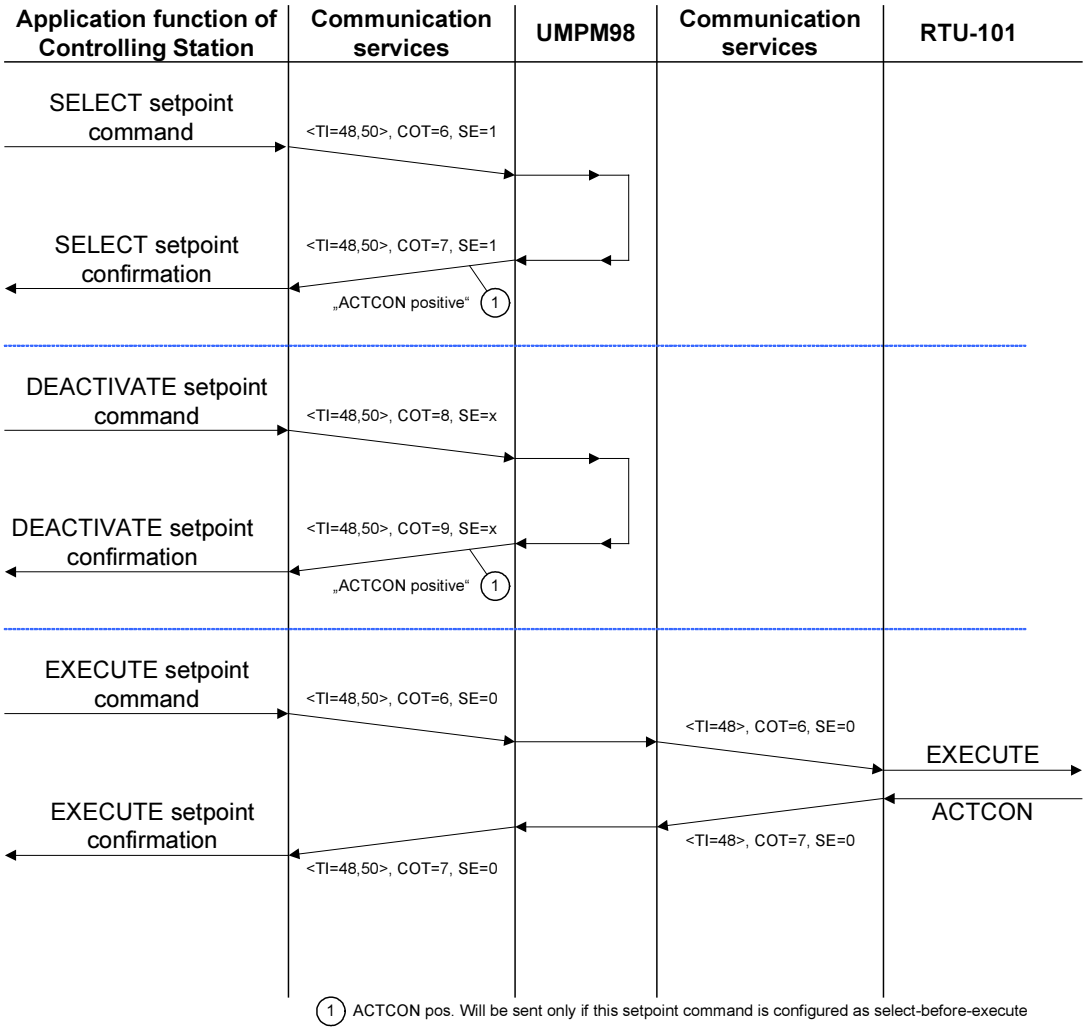
  Mapping of setpoint commands can be configured for each setpoint commands in the OPM (SIP message address conversion for UMPM98).

- ACTCON neg. will be sent by UMPM98 protocol firmware (or BSE) in following cases:
  - protocol element failed or RTU-101 link address failed (ACTCON neg. from BSE)
  - setpoint command not included in OPM message address conversion in transmit direction or detail routing on BSE (ACTCON neg. from BSE)
  - max. number of supported setpoint commands actually running
  - EXECUTE setpoint command received for not selected setpoint command configured as select-before-execute
  - EXECUTE setpoint command received from an other control center as SELECT setpoint command.

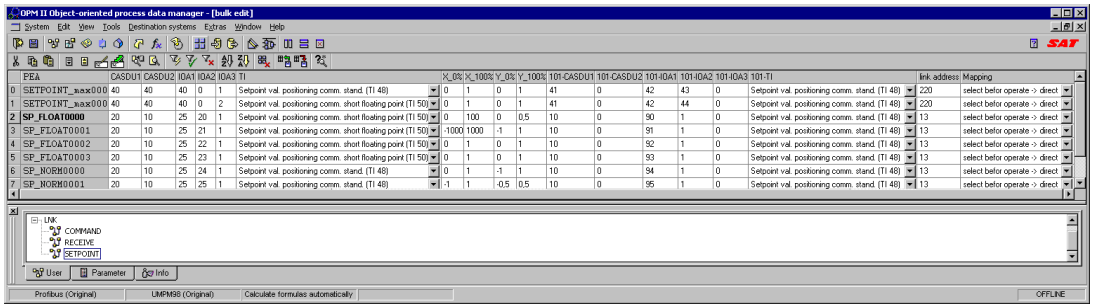
    note: selected setpoint command on UMPM98 will stay selected
    (only if command is configured as select-before-execute)
  - EXECUTE setpoint command received with CASDU, IOA, COT, setpoint value, QL not equal to the SELECT setpoint command
    (only if command is configured as select-before-execute)
  - ACTCON from the RTU-101 for EXECUTE is missing
  - ACTCON neg. received for EXECUTE setpoint command from RTU-101
  - ACTCON pos. received from RTU-101 for EXECUTE setpoint command with expected CASDU and IOA but not expected COT, setpoint value, QL.

    → If ACTCON pos. will be received from RTU-101 for EXECUTE setpoint command with different CASDU or IOA this ACTCON will be ignored by the UMPM98 protocol firmware.
    Other actually running setpoint commands will not be affected !

    note:
    If UMPM98 protocol firmware will receive an ACTCON (pos. or neg.) from the RTU-101 without an setpoint command in progress, this ACTCON will be ignored by UMPM98.


Application function of Controlling Station
Communication services
UMPM98
Communication services
RTU-101
SELECT setpoint command
<TI=48,50>, COT=6, SE=1
SELECT setpoint confirmation
<TI=48,50>, COT=7, SE=1
„ACTCON positive“
1
DEACTIVATE setpoint command
<TI=48,50>, COT=8, SE=x
DEACTIVATE setpoint confirmation
<TI=48,50>, COT=9, SE=x
„ACTCON positive“
1
EXECUTE setpoint command
<TI=48,50>, COT=6, SE=0
<TI=48>, COT=6, SE=0
EXECUTE
ACTCON
EXECUTE setpoint confirmation
<TI=48>, COT=7, SE=0
<TI=48,50>, COT=7, SE=0
1 ACTCON pos. Will be sent only if this setpoint command is configured as select-before-execute

4.3.3.1. Parameterization



Example for "SIP message address conversion" for UMPM98 in control direction for setpoint commands

Supported SAT 1703 message formats:

- Set point command, normalized value <TI=48> (<TI=61> on 104)
- Set point command, short floating point <TI=50> (<TI=63> on 104

Address conversion SAT 1703 → RTU-101:

- *CASDU1,CASDU2, IOA1, IOA2, IOA3 ...* 5-stage freely parameterizable SAT 1703 internal IEC address (=source address) of setpoint command
  possible: 0 – 255

- TI ... type identification (SAT internal BSE → SIP)
  possible: 48, 50

- linearization
  X_0%, X_100%, Y_0%, Y_100%
  possible: normalized: -1..+1
  short floating point: ±1.175494E-38 to ±3.402823E+38

- *101-CASDU1, 101-CASDU2, 101-IOA1, 101-IOA2, 101-IOA3 ...* 5-stage freely parameterizable RTU101 IEC address for setpoint command
  possible: 0 – 255

- 101-TI ... type identification for RTU-101
  possible: 48

- link address ... link address of RTU-101 (station address)
  possible: 0 – 254

- mapping
  possible: select-before-operate -> direct,
  direct -> direct

4.4. Message Conversion of System Information in Control Direction (SAT Ax 1703 → RTU-101)

System messages in control direction <TI=100,103,104> must not be included in the OPM parameters for SIP message address conversion in transmit direction.

Type Identification (SAT internal)			**Type identification to RTU-101**							
			100	101	102	103	104	105	106	
TI (104)	TI (101)	(101)								
<58>	<100>	C_IC_NA_1	X							
	<103>	C_CS_NA_1				X				
	<104>	C_TS_NA_1					X			
<58>	<45>	C_SC_NA_1						X		

note:
- "TI-101" is the type identification used SAT internal from BSE → SIP and to the RTU-101 on communication line.
- "TI-104" is the type identification used SAT-internal and from control center (IEC60870-5-104 NUC).

Station interrogation command <TI=100> from control center via IEC60870-5-104 / NUC interface will be handled directly from the AK 1703 data base of the BSE with the 104 interface.
Station interrogation command <TI=100> from control center will not be forwarded to RTU-101.
Communication interface specific "general interrogation command " will be possible using <TI=58> on IEC60870-5-104 / NUC.
→ see also chapter Statkraft/PROSAM specific "general interrogation command" for a specific communication interface.

Clock synchronization command <TI=103>
Clock synchronization of the AK-1703 will be done via AK´s IEC 60870-5-104 interface (=NIP) according RFC1305 (NTP).
note: NTP use IP/UDP protocol.
After restart of AK-1703 the NIP request the time from the NTP-Server. After AK`s time is set the NIP request the actual time every minute from the NTP-Server.

The time synchronization of the RTU-101 will be done by UMPM98 protocol firmware using <TI=103> clock synchronization command. This will be sent spontaneous from AK-internal time management to the UMPM98 protocol firmware after restart of AK-1703 (or restart of the BSE) if time will be set or changed.

The periodic time setting of the RTU-101 will be done by the protocol firmware UMPM98.

Test command <TI=104>
The test command function can be parameterized in AK 1703 for each communication interface on BSE / L06 "IEC 870-5-101/104" parameter block in the chapter "parameter for test command".

Parameters:
– cycle time to transmit the test command
– monitoring time for confirmation of the test command

The test command will be generated by communication function on BSE (AK-1703 internal) and sent using <TI=104> test command to each link address parameterized for the specific communication interface.
The <TI=104> test command will be sent by UMPM98 protocol without modification to RTU-101.

Reset process command <TI=105> from control center via IEC60870-5-104 / NUC interface will be handled directly from the AK-1703.
Reset process command <TI=105> from control center will not be forwarded to RTU-101.
Reset process command for RTU-101 from control center via IEC60870-5-104 / NUC interface will be possible using <TI=58> on IEC60870-5-104 NUC.
→ see also chapter Statkraft/PROSAM specific "Reset RTU command" for a specific RTU-101.

4.4.1. General Interrogation Command

A Statkraft/PROSAM specific "general interrogation command for a specific communication interface in AK-1703" (GI-command) is sent from the control center as a DIRECT command <TI=45> to CAEx (in AK 1703).
CAEx will send always ACTCON pos. and ACTTERM pos. immediately for this command to the control center (without a closed loop to the protocol application).
ACTTERM pos. will be sent directly after ACTCON pos. from CAEx.

This GI-command from the control center will be converted by CAEx to a SAT internal command <TI=45>. This SAT internal command is converted by the PST function (PST control message) to a "communication line specific" interrogation command <TI=100> (global to all stations).

This Message is sent out to the RTU-101 from the UMPM98 protocol firmware.
The RTU-101 will send back the data assigned to the GI in the following polling cycle.
If ACTCON and ACTTERM will be received from the RTU-101 this will be forwarded to AK-1703 intern but as ACTCON / ACTTERM is not expected from the RTU-101 this will be discarded within AK-1703.

Data sent by the RTU with <COT=20> (interrogated by station interrogation) will be converted in AK-1703 to <COT=2> (background scan). It can be configured in AK-1703 if this "background scan data" should be sent via IEC60870-5-104 interface to the controlling station. ACTCON / ACTERM received from the RTU-101 will not be forwarded to the AK´s IEC60870-5-104 interface.

note:
- No "1 out of n" handling for this specific "GI-command" on CAEx or UMPM98 protocol firmware !
- A general interrogation <TI=100> sent from the controlling station to AK-1703 will be answered directly from the database of the BSE of the IEC60870-5-104 interface.

4.4.2. Reset RTU Command

A Statkraft/PROSAM specific "reset RTU command for a specific RTU" is sent from the control center as a DIRECT command <TI=45> to CAEx (in AK-1703).

CAEx will send always ACTCON pos. and ACTTERM pos. immediately for this command to the control center (without a closed loop to the protocol application).
ACTTERM pos. will be sent directly after ACTCON pos. from CAEx.

This reset RTU command will be converted by CAEx to a SAT internal command <TI=45> and sent to the UMPM98 protocol firmware.
Using <TI=105> for this command in the field "101-TI" in the OPM message address conversion in transmit direction (for commands) will activate an specific function on UMPM98 protocol firmware.

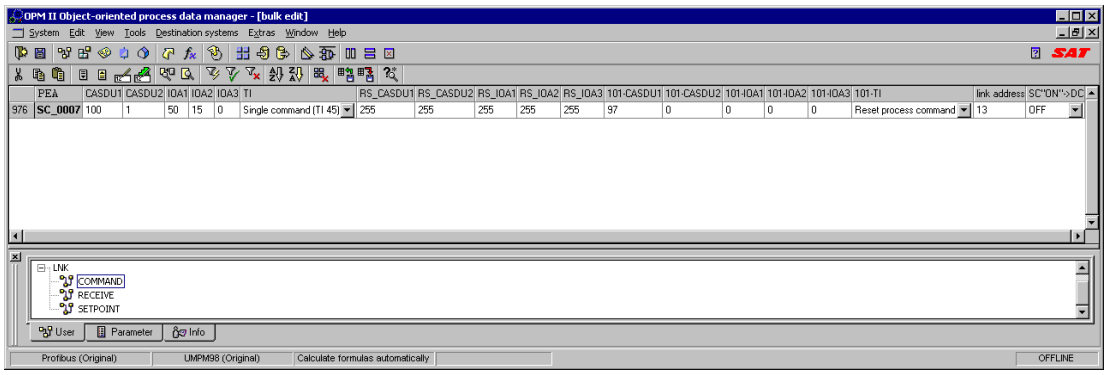
- no select-before-execute for this single command (only direct)
- no "1 out of n" handling on UMPM98 protocol firmware
- no handling for return information
- no ACTCON / ACTERM by UMPM98 protocol firmware
- <COT=6> cause of transmission must be "<6>:=activation"
- <SCS=1> single command state must be "ON"
- <S/E=0> "EXECUTE"

This Message is sent out to the RTU-101 as <TI=105> "Reset process command" from the UMPM98 protocol firmware.
The RTU-101 will perform the reset RTU command (if supported).
If ACTCON and ACTTERM will be received from the RTU-101 this will be forwarded to AK-1703 intern but as ACTCON / ACTTERM is not expected from the RTU-101 this will be discarded within AK-1703.

Note:
The reset RTU command is sent to the RTU-101 as reset process command <TI=105> with the parameters for CASDU assigned in the OPM parameters and IOA = 0 and <QRP=1> (=general reset of Process).

4.4.2.1. Parameterization

This specific reset RTU command using <TI=45> single command must be included in the detail routing and in the OPM message address conversion for UMPM98 protocol firmware.



Example for "SIP message address conversion" for UMPM98 in control direction for reset RTU command

note:
there is only one parameter category defined in the OPM for commands – in this chapter only the relevant settings for reset RTU command using <TI=45> single command will be described.

Supported SAT 1703 message formats:

- Single command <TI=45>

Address conversion SAT 1703 → RTU-101:

- *CASDU1,CASDU2, IOA1, IOA2, IOA3 ...* 5-stage freely parameterizable
  SAT 1703 internal IEC address (=CAEx source address) of reset RTU command
  possible: 0 – 255

- TI ... type identification (SAT internal BSE → SIP)
  possible: 45

- *101-CASDU1, 101-CASDU2, 101-IOA1, 101-IOA2, 101-IOA3 ...* 5-stage parameterizable RTU-101 address for reset RTU command
  possible: CASDU ... 0 – 255, IOA = 0

- 101-TI ... type identification for RTU-101
  possible: 105

- link address ... link address of RTU-101 (station address)
  possible: 0 – 254

4.5. Message Conversion of Process Information in Monitor Direction (RTU-101 → SAT Ax 1703)

One message of a specific type identification from RTU-101 can be converted to 1 message of the supported type identifications to SAT internal with different new address.

Type Identification (SAT internal)			**Type identification from RTU-101**																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
TI (104)	TI (101)	(101)																			
<1>	<1>	M_SP_NA_1																			
<2>	<2>	M_SP_TA_1																			
<3>	<3>	M_DP_NA_1																			
<4>	<4>	M_DP_TA_1																			
<5>	<5>	M_ST_NA_1																			
<6>	<6>	M_ST_TA_1																			
<7>	<7>	M_BO_NA_1																			
<8>	<8>	M_BO_TA_1																			
<9>	<9>	M_ME_NA_1																			
<10>	<10>	M_ME_TA_1																			
<11>	<11>	M_ME_NB_1																			
<12>	<12>	M_ME_TB_1																			
<13>	<13>	M_ME_NC_1																			
<14>	<14>	M_ME_TC_1																			
<15>	<15>	M_IT_NA_1																			
<16>	<16>	M_IT_TA_1																			
<17>	<17>	M_EP_TA_1																			
<18>	<18>	M_EP_TB_1																			
<19>	<19>	M_EP_TC_1																			
<20>	<20>	M_PS_NA_1																			
<21>	<21>	M_ME_ND_1																			
<30>	<30>	M_SP_TB_1	X	X																	
<31>	<31>	M_DP_TB_1			X	X															
<32>	<32>	M_ST_TB_1					X	X													
<33>	<33>	M_BO_TB_1																			
<34>	<34>	M_ME_TD_1									X	X			X	X					
<35>	<35>	M_ME_TE_1																			
<36>	<36>	M_ME_TF_1									X	X			X	X					
<37>	<37>	M_IT_TB_1																X			
<38>	<38>	M_EP_TD_1																			
<39>	<39>	M_EP_TE_1																			
<40>	<40>	M_EP_TF_1																			

Type Identification (SAT internal)			**Type identification from RTU-101**												
			20	21	30	31	32	33	34	35	36	37	38	39	40
TI (104)	TI (101)	(101)													
<20>	<20>	M_PS_NA_1													
<21>	<21>	M_ME_ND_1													
<30>	<30>	M_SP_TB_1			X										
<31>	<31>	M_DP_TB_1				X									
<32>	<32>	M_ST_TB_1					X								
<33>	<33>	M_BO_TB_1													
<34>	<34>	M_ME_TD_1							X		X				
<35>	<35>	M_ME_TE_1													
<36>	<36>	M_ME_TF_1							X		X				
<37>	<37>	M_IT_TB_1										X			
<38>	<38>	M_EP_TD_1													
<39>	<39>	M_EP_TE_1													
<40>	<40>	M_EP_TF_1													

note:

- "TI(101)" is the type identification used from the RTU-101 on communication line and SAT internal from SIP → BSE.

- "TI(104)" is the type identification used to control center (IEC60870-5-104 NUC).

- SAT internal always "long time format" CP56Time2a is used !

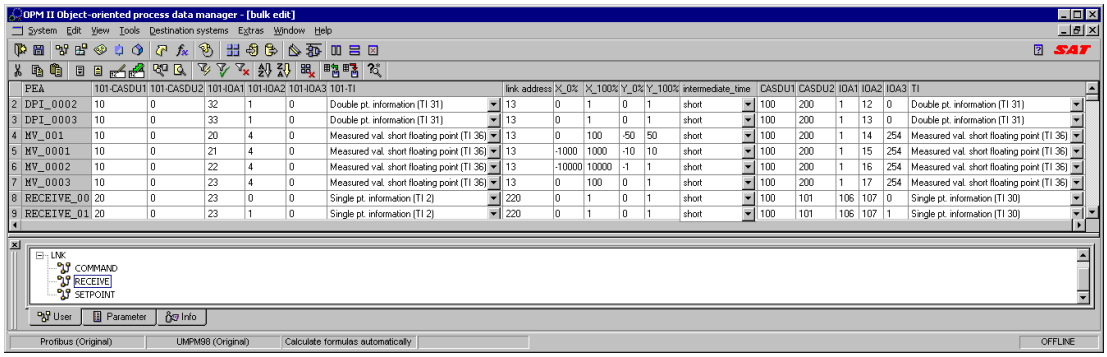
- If type identification with time tag is used in monitor direction this TI must be parameterized in the OPM parameters (SIP message address conversion). The corresponding type identification used for general interrogation will be supported automatic (this TI must not be included in the OPM parameters).
  → If type identification without time tag is used in monitor direction this type identification must be parameterized in the OPM parameters (SIP message address conversion).
  e.g.: (1) <TI=2> is used in monitor direction for spontaneous data
  → <TI=2> must be parameterized in OPM
  → <TI=1> will be supported automatic (not to be parameterized in OPM)

  (2) <TI=1> is used in monitor direction for spontaneous data
  → <TI=1> must be parameterized in OPM

Corresponding type identifications spontaneous - GI:

	corresponding type identification (GI)		spontaneous type identification
<TI=1>	Single-point information	<TI=2>	Single-point information with time tag
<TI=3>	Double-point information	<TI=4>	Double-point information with time tag
<TI=9>	Measured value, normalized value	<TI=10>	Measured value, normalized value with time tag
<TI=13>	Measured value, short floating point value	<TI=14>	Measured value, short floating point value with time tag
<TI=1>	Single-point information	<TI=30>	Single-point information with time tag CP56Time2a
<TI=3>	Double-point information	<TI=31>	Double-point information with time tag CP56Time2a
<TI=5>	Step position information	<TI=32>	Step position information with time tag CP56Time2a
<TI=9>	Measured value, normalized value	<TI=34>	Measured value, normalized value with time tag CP56Time2a
<TI=13>	Measured value, short floating point value	<TI=36>	Measured value, short floating point value with time tag CP56Time2a

4.5.1. Parameterization



Example for "SIP message address conversion" for UMPM98 in monitoring direction

Supported SAT 1703 message formats:

- Single-point information with time tag CP56Time2a <TI=30>
- Double-point information with time tag CP56Time2a <TI=31>
- Step position information with time tag CP56Time2a <TI=32>
- Measured value, normalized value with time tag CP56Time2a <TI=34>
- Measured value, short floating point value with time tag CP56Time2a <TI=36>
- Integrated totals with time tag CP56Time2a <TI=37>

Address conversion RTU-101 → SAT 1703:

- link address ... link address of RTU-101 (station address)
  possible: 0 – 254

- *CASDU1, CASDU2, IOA1, IOA2, IOA3 ...* 5-stage freely parameterizable SAT 1703 address
  possible: 0 – 255

- TI ... type identification
  possible: 30, 31, 32, 34, 36, 37

- linearization (only for <TI=9, 10, 13, 14, 34, 36>)
  X_0%, X_100%, Y_0%, Y_100%
  possible: normalized: -1..+1
  short floating point: ±1.175494E-38 to ±3.402823E+38

- intermediate time (only for double-point information)
  possible: short, long

- *101-CASDU1, 101-CASDU2, 101-IOA1, 101-IOA2, 101-IOA3 ...* 5-stage freely parameterizable RTU101 address of the data point
  possible: 0 – 255

- 101-TI ... type identification of RTU-101
  possible: 1, 2, 3, 4, 5, 6, 9, 10, 13, 14, 16, 30, 31, 32, 34, 36, 37

4.5.2. Conversion of Time Format

All type identifications received from RTU-101 (monitor direction) will be sent from SIP → BSE with 7 octet binary time format "CP56Time2a" (= long time format).

- information from RTU-101 "without time tag":
  Time stamp SIP → BSE: AK 1703 internal time (CP56Time2a) at receiving time

- information from RTU-101 with time tag "CP24Time2a":
  Time stamp SIP → BSE: received time from RTU-101 converted from "CP24Time2a" to CP56Time2a according "conversion of time format"

- information from RTU-101 with time tag CP56Time2a:
  Time stamp SIP → BSE: CP56Time2a received from RTU-101

CP24Time2a : = CP24{milliseconds,minutes,res1,invalid}
(3 octet binary time =short time format)

CP56Time2a : = CP56{milliseconds, minutes, res1, invalid, hours, res2, summer time, day of month, day of week, months, res3, years, res4}
(7 octet binary time = long time format)

CP24Time2a format does not include the hour and date - this date and time information will be added by the UMPM98 protocol firmware.

- When the AK1703 internal time is not set (e.g. after RESET or POWER UP), the invalid bit of the time tag will be set and the actual hour and date will be added without modification for all received messages with time tag CP24Time2a until the AK1703´s time is set correctly.

- When the AK1703 internal time is set correctly, the actual hour and date will be added without modification for all received messages with time tag CP24Time2a except in following cases:

  — the actual minute of AK1703 is in the range of "0..5" and the received minute is in the range of "55..59" → 1 hour will be subtracted from the CP56Time2a

  — the actual minute of AK1703 is in the range of "55..59" and the received minute is in the range of "0..5" → 1 hour will be added to the CP56Time2a

The RTU-101 will be clock synchronized from UMPM98 protocol firmware with <TI=103> clock synchronization command in the following cases:

– periodically / default: once per minute
(this can be configured by system technical parameter / chapter advanced parameters)

– spontaneous / when time or date changes or after restart of AK-1703 after 1st time setting of UMPM98 protocol firmware

Restriction:
If the communication link is broken and the RTU-101 does not clear the RTU internal transmit data base, the hour and date can not be assigned correctly for old data stored in the RTU-101 by UMPM98 protocol firmware.
Also the invalid bit for time stamp will not be set!

Note:
IEC60870-5-101 does not define an procedure to clear data stored in the transmit data base of the RTU-101.

4.5.3. Intermediate state / faulty state suppression

The protocol firmware UMPM98 implements a suppression of intermediate state ("00") and faulty state ("11") for double-point information in monitoring direction.

The suppression will be supported for max. 20 different double-point information with "intermediate state" or "faulty state" at the same time with a time resolution of 1 sec.

If the suppression handling is running for 20 double-point information - other double-point information with "intermediate state" or "faulty state" will be sent to BSE without an suppression handling.

System technical parameters for intermediate-/faulty state suppression:
- faulty position suppression time
- intermediate position suppression time - short
- intermediate position suppression time - long

In the OPM parameters (SIP message address conversion in monitoring direction) the intermediate time suppression "short" or "long" can be selected for each double-point information individually.

When the parameter "faulty position suppression time" is set to "0" - no faulty state suppression will be done by UMPM98 protocol firmware.
When the parameter for the assigned "intermediate position suppression time - short or long" is set to "0" - no intermediate state suppression will be done by UMPM98 protocol firmware.

Double-point information received from RTU-101 with "intermediate state" or "faulty state" will be sent after suppression timeout with following time stamp to the BSE:

<TI=3> double point information (without time tag)
Time stamp: AK 1703 internal time (CP56Time2a) at receiving time.

<TI=4> double point information with time tag (CP24Time2a)
Time stamp: received time from RTU-101 converted from "CP24Time2a" to CP56Time2a according "conversion of time format" at receiving time.

<TI=31> double point information with time tag CP56Time2a
Time stamp: CP56Time2a received from RTU-101

If an intermediate state ("00") or faulty state ("11") for double-point information will be received from RTU-101 with <COT = 20..36> (station interrogation) no suppression for intermediate state or faulty state will be done by UMPM98 protocol firmware.

When the double-point information changes from state "OFF" → "intermediate or faulty" and than back to "OFF" the intermediate or faulty state will be suppressed but the "OFF" state will be forwarded again from SIP → BSE.
When the double-point information changes from state "ON" → "intermediate or faulty" and than back to "ON" the intermediate or faulty state will be suppressed but the "ON" state will be forwarded again from SIP → BSE.

When the double-point information changes permanently from "intermediate state" ↔ "faulty state" the suppression time will always be retriggered – in this state the double-point information will also not be forwarded if any bit in the status will change (e.g. NT, IV,...) .

5. Protocol-specific Functions

5.1. Redundancy Function

The protocol firmware UMPM98 can be switched to STANDBY- / or ACTIVE-mode using the AK 1703 internal redundancy control messages.

The ACTIVE Master is polling all the connected RTU´s according station call prioritization defined in the system technical parameters. Data messages will be sent spontaneous to the RTU´s.
If data messages will be sent continually to the RTU – UMPM98 protocol firmware will send alternate 1 data message and then 1 station poll message.

The function of the STANDBY-mode can be defined in the system technical parameters:

– interface "TRISTATE" ... no polling of RTU´s = "listening mode (1)"

– interface "ACTIVE" ..... no polling of RTU´s = "listening mode (1)"

– interface "ACTIVE" ..... polling of RTU´s
The detailed operation in this mode can be parameterized in the system technical parameters "advanced parameters / Redundancy operation mode" of the UMPM98 protocol firmware.

(a) AX1703 redundancy mode
Standard polling of RTU´s – all received messages will be forwarded to BSE.
Received messages from STANDBY Master will be marked with P-Bit (P = passiv) SAT internally.

(b) Norwegian User Conventions (NUC) redundancy mode
Polling mode only using "REQUEST STATUS of LINK".
Data messages will not be sent to / requested from RTU-101.
RTU´s not answering will be set as faulty.

Data messages will not be forwarded AK-1703 internal from BSE to interfaces in STANDBY mode.

Notes:
(1) Listening mode: All received messages will be forwarded to the BSE.
In order to synchronize the firmware - which is in standby operation - to the same FCB (Frame Count Bit) as the active one, the current FCB is either taken from the monitored Reset of Remote Link or from a valid long message.

5.2. Data acquisition by Polling (station polling)

The transmission of the data from the RTU´s to the MASTER station is done only on station-selective station interrogation (polling). Spontaneous transmission of the data from the RTU is, therefore, not possible. Altered data remain stored in the RTU and, on a station interrogation of this station, are transmitted to the MASTER station.

RTU´s which have a large amount of data to be transmitted can be interrogated by the MASTER station several times immediately one after the other before a station change is made.

Data from the MASTER station to the RTU are spontaneously transmitted after the end of the running message transmission of the interrogation cycle. Following this, the interrupted interrogation cycle is continued.

The interrogation cycle can be made either continuously or just on request. The interrogation cycle counts as having ended if the configured number of station calls has been executed for the last station.

The station interrogation does not automatically guarantee that the entire amount of data which is initiated for transmission is transmitted in one interrogation cycle.

By configuration of the station interrogation in the MASTER station (Number of calls until station change), "getting stuck" at a station with continuously changing data can be prevented.

Stations which have not stored any data for the transmission are not removed from the interrogation cycle. To optimize the interrogation cycle, for such stations (independent of the "Number of station calls until station change" configuration) a station change is carried out immediately after one call.

Faulty stations likewise continue to be interrogated in the interrogation cycle but for such stations no message repeating (retries) is carried out during the station interrogation.

5.3. Clock Synchronization of RTU´s

5.3.1. Time Setting

Clock synchronization of the AK-1703 (Statkraft/PROSAM project) will be done via AK´s IEC 60870-5-104 interface (=NIP) according RFC1305 (NTP).
note: NTP use IP/UDP protocol.
After restart of AK-1703 the NIP request the time from the NTP-Server. After AK`s time is set the NIP request the actual time every minute from the NTP-Server.

The time synchronization of the RTU-101 will be done by UMPM98 protocol firmware using <TI=103> clock synchronization command. This will be sent spontaneous from AK-internal time management to the UMPM98 protocol firmware after restart of AK-1703 (or restart of the BSE) if time will be set or changed.
UMPM98 protocol firmware will include the total actual time (format: CP56Time2a) corrected by an parameter-settable correction value (only if "free definable" interface modem will be selected).

Time value in <TI=103> = t_{akt} + t_{corr} + t_{msg}

t_{akt}... actual time of AK-1703
t_{corr}.. correction time
see advanced parameters / real time remote synchronization
"correction time of message transfer time"

Note:
- If the time value in <TI=103> should have the time when sending the 1st bit of the time synchronization message - the correction time must include the tp + tv.
  (tmsg = 0)
- If the time value in <TI=103> should have the time when receiving the last bit of the time synchronization message in the RTU - the correction time must include the tp + tv + tmsg

t_{msg} . transmission time for time sync message
(depends on used baudrate, number of bytes for Link address, CASDU, COT, IOA)
tmsg = (1/ baudrate) *11 * (7 + 9 + n)
n = no_link + no_CASDU + no_IOA + no_COT
no_link .....number of octets for address field of the link
no_CASDU.....number of octets for CASDU
no_IOA .....number of octets for IOA
no_COT .....number of octets for Cause of transmission

The periodic time setting (=clock synchronization) of the RTU-101 will be done by the protocol firmware UMPM98.

At start up, the time setting of the RTU´s is discarded by the UMPM98 firmware until the protocol element internal time is set correctly so that the current ms can be correctly entered into the time setting message.

The MASTER will sent the clock synchronization message always as BROADCAST message so that this message will be received by the RTU´s within the same minute. Binary information stored in the data base of the RTU will be sent with the "old time" if time changes after clock synchronization.

Note:
If all parameterized RTU´s are faulty – no clock synchronization message will be sent by UMPM98 protocol firmware. If at least one of the parameterized RTU´s are OK the clock synchronization message will be sent as BROADCAST message by UMPM98 protocol firmware.

The time setting message is also used for time synchronization.

If lower precision of the real time data is sufficient, the synchronization of the RTU´s can also take place via the serial communications line.

The RTU-101 will be clock synchronized from UMPM98 protocol firmware with <TI=103> clock synchronization command in the following cases:

– periodically / default: once per minute
(this can be configured by system technical parameter / chapter advanced parameters)

– spontaneous / when time or date changes or after restart of AK-1703 after 1st time setting of UMPM98 protocol firmware

5.4. Handling of faulty Stations

Faulty RTU´s will be detected by the MASTER in the normal polling cycle.
Faulty RTU´s will be polled once in the interrogation cycle (without retry handling) using "request status of link".

5.4.1. Retry Handling

If the acknowledgement for a message which was sent out from the MASTER station will not be received, this message is repeated n times (n = configurable number). If the MASTER will not receive an answer from the RTU during these retries, the RTU (SAT internal station address) is marked as faulty and the interface failure is also displayed on LED´s.

The acknowledgement timeout is calculated per automatically according the actual parameter setting.
If the used communication system or an additional reaction delay of the RTU will cause additional delays this can be adjusted in the parameter t_{Signal} = Signal runtime of the message (= Correction factor).

5.4.2. Interface Fault

When a RTU does not answer to a polling message of the MASTER after parameterized retry count – this RTU (SAT internal station address) will be set as faulty (if parameterized).

If all parameterized RTU´s will be detected as faulty by the MASTER the communication interface in AK-1703 will be indicated as faulty – in this state only "request status of link" will be sent for the parameterized RTU´s (also no clock synchronization will be sent).

5.5. Transmission Device (Modem)

It is possible to use a transmission device with preset time; the use of a "user setting" is also possible.

Default times:

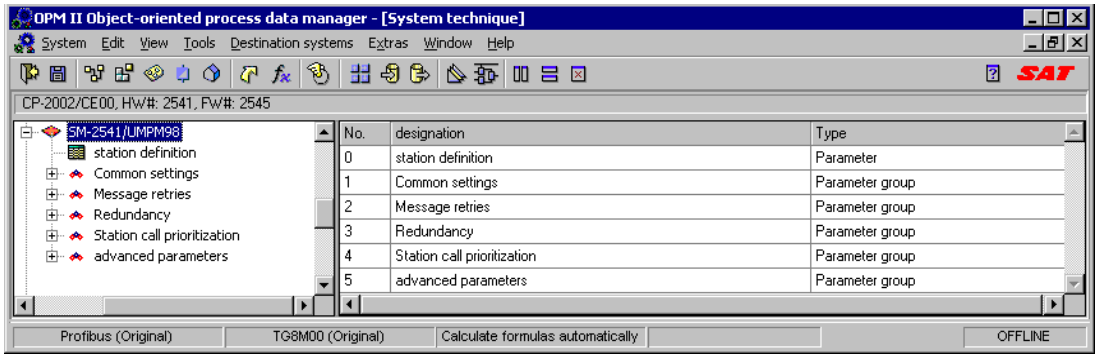
Transmission medium	Operating mode	RTS fixed	tp	tv	tn	tdis	DCD	t-bounce	t-stab	t-duration	t-delay
4-wire	RS-232	YES	0	0	3 bit	35	YES	5	5	10000	200
2-wire	RS-232	NO	0	30	3 bit	35	YES	5	5	10000	200
DMS 1)	RS-232	YES	0	0	5 bit	0	NO	0	0	0	0
DMS 2)	RS-232	NO	0	50	5 bit	35	YES	5	5	10000	200
OPTICAL	RS-232	NO	0	1	0	0	NO	0	0	0	0
RADIO - Digital	RS-232	NO	30	100	11 bit	50	YES	10	5	0	200
RADIO - Analog	RS-232	NO	50	300	50	100	YES	10	5	0	200
Direct conn.	RS-485	NO	0	1	0	0	NO	0	0	0	0
DLC modem	RS-232	NO	0	1 bit	1 bit	0	NO	0	0	0	0
4-wire SAT CE701	RS-232	YES	0	0	3 bit	0	YES	5	5	10000	200
2-wire SAT CE701	RS-232	NO	22	30	3 bit	0	YES	5	5	10000	200
free definable	**RS-232**	**NO**	**30**	**100**	**11 bit**	**0**	**NO**	**--**	**--**	**--**	**--**

All times are n*1 ms.

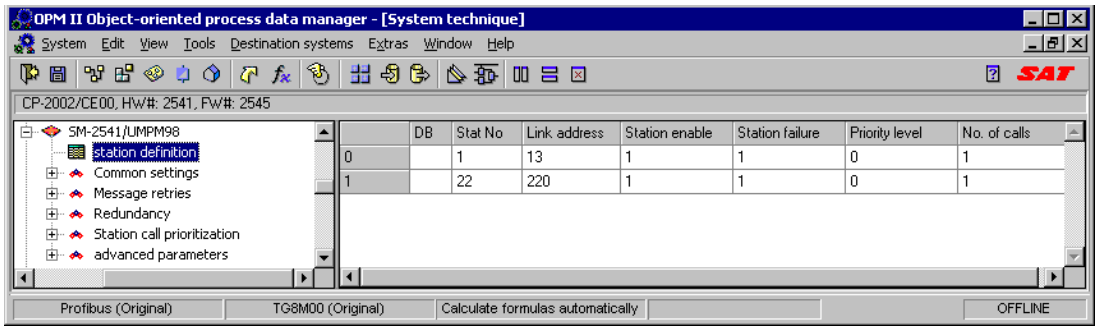
1) DMS in ring configuration.
2) DMS with WT in ring configuration.

6. System Technical Parameters

6.1. Overview

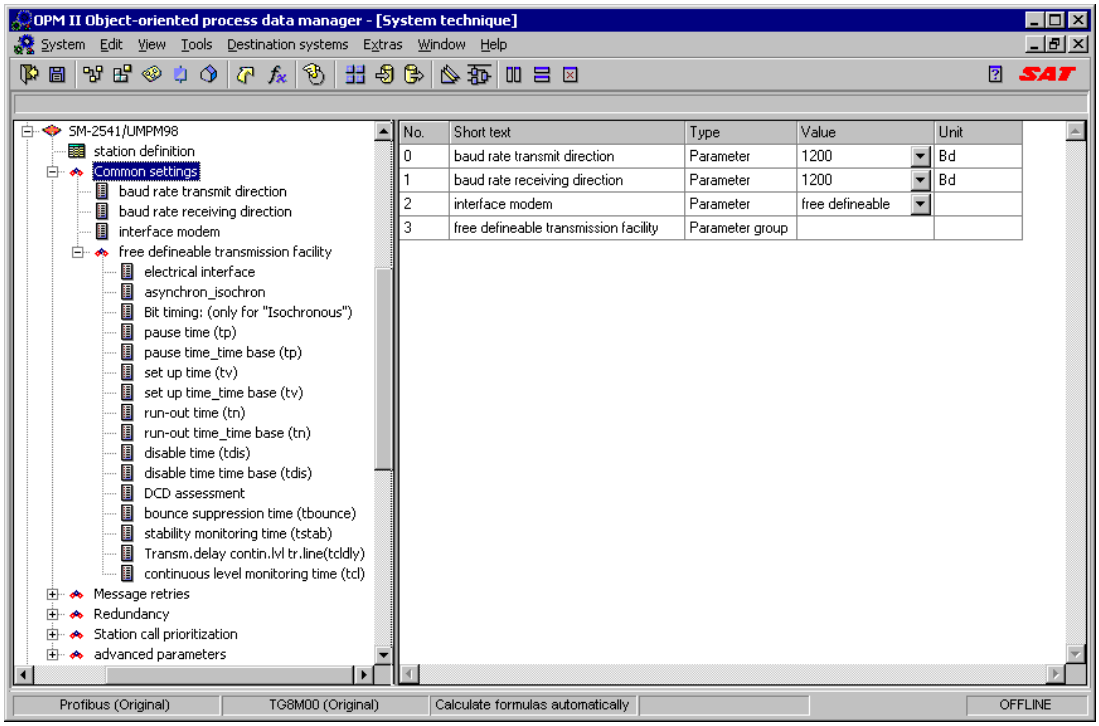


6.1.1. Station Definition



- Stat-No.
  Parameter settings: 0-99 (SAT internal station address)
  default: 255 (not used)
- Link-address (on the communication line)
  Parameter settings: 0-254 (link address for RTU-101)
  default: 0
- station enable
  Parameter settings: 0 = disabled; **default: 1 = enabled**
- station failure
  Parameter settings: 0 = do not notify station failure,
  default: 1 = notify station failure
- Priority level
  Parameter settings: **default: 0 = high priority**
  1 = medium priority, 2 = low priority (A), 3 = low priority (B)
- No. of calls (max. number of calls for specific link address before change to next station address)
  Parameter settings: 0, **default:1** , 2 , 3

6.1.2. Common Settings



- Baud rate in transmit direction

  Parameter settings: 100, 200, 300, 600, **default: 1200**, 2400, 4800, 9600, 19200

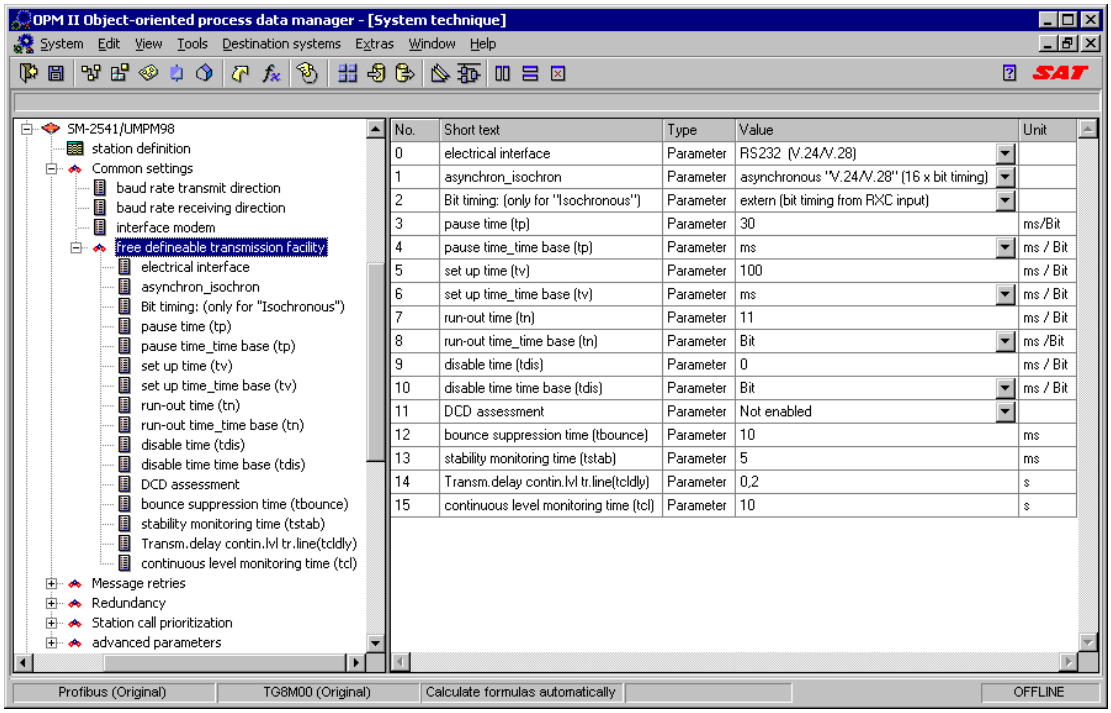
- Baud rate in receive direction

  Parameter settings: 100, 200, 300, 600, **default: 1200**, 2400, 4800, 9600, 19200

- interface modem

  Parameter settings:
  - free definable
  - **default: SAT Modem "4-wire circuit transmission line"** (SAT-VFM,-WT,-WTK,-WTK-S,-CE0700)
  - SAT Modem "2-wire circuit transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,-CE0700)
  - SAT-DMS (ring configuration)
  - SAT-DMS (ring configuration; AU remote via WT)
  - optical
  - radio digital
  - radio analog
  - Null modem interface (RS-485)
  - SAT DLC-Modem (CE0740,CE0741, CE0742, LA0740, LA0741)
  - SAT Modem "4-wire circuit transmission line" (SAT-CE0701)
  - SAT Modem "2-wire circuit transmission line" (SAT-CE0701)
  - SAT Modem "2-wire circuit transmission line" (SAT-CE0701 over modem)
  - SAT Modem "2-wire circuit transmission line" (SAT-CE0701 over Westermo TD-32)
  - SAT Modem "2-wire circuit transmission line" (SAT-CE0701 over Westermo GD-01)
  - Null modem interface (RS-232) only if one RTU-101 has to be connected
  - SATTELINE 2ASxE time slot radio modem

6.1.2.1. Free definable Transmission Facility



- Electrical interface
  Parameter settings: **default: RS232 (V.24/V.28),**
  RS422 (V.11), RS485 (V.11)

- Asynchron_isochron
  Parameter settings: **default: asynchronous "V.24/V.28" (16x bit timing)**,
  isochron "X.24/X.27" (single bit timing)

- Bit timing (only for Isochronous):
  Parameter settings: extern (bit timing from RXC input),
  internal (bit timing at the TXC-output)

- Pause time (tp)
  Parameter settings: 0-32767[ms/Bit] **default: 0**

- Pause time Time Base (tp)
  Parameter settings: **default: ms,** bit

- Set up time (tv)
  Parameter settings: 0-32767[ms/Bit] **default: 0**

- Set up time Time Base (tv)
  Parameter settings: **default: ms,** bit

- Run out time (tn)
  Parameter settings: 0-32767[ms/Bit] **default: 0**

- Run out time Time Base (tn)
  Parameter settings: ms, **default: Bit**

- Disable time (tdis)
  Parameter settings: 0-32767[ms/Bit] **default: 0**

- Disable time Time Base (tv)
  Parameter settings: ms, **default: Bit**

- DCD assessment
  Parameter settings: not enabled; **default: enabled**

- Bounche suppression time (tbounce)
  Parameter settings: 0-65535[ms] **default: 0**

- Stability monitoring time (tstab)
  Parameter settings: 0-65535[ms] **default: 0**

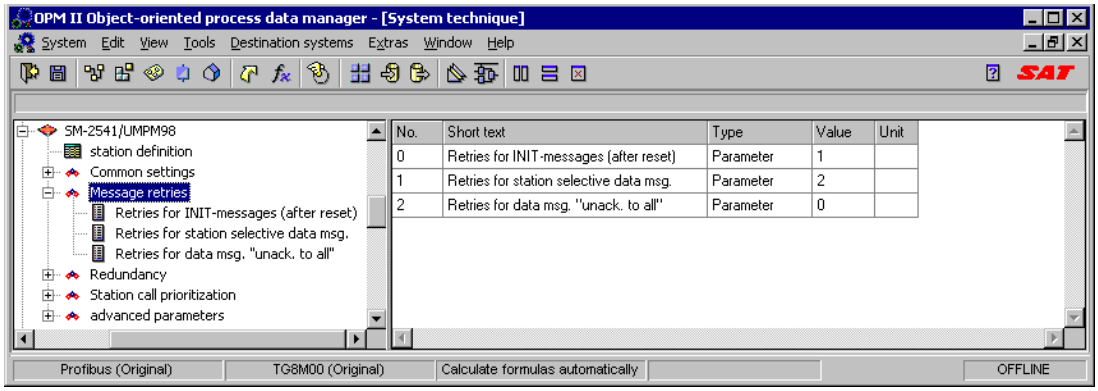
- Transmission delay continuous level transmission line (tcldly)
  Parameter settings: 0-65535[sec] **default: 0**

- Continuous level monitoring time (tcl)
  Parameter settings: 0.1-6553.5[sec] **default: 0**

Note:
For Statkraft/PROSAM project RTS and DCD will not be used – so all the Parameters for "free definable transmission facility" can be set to defaults !

→ "free definable transmission facility" must be parameterized for Statkraft/PROSAM projects to activate the correct time synchronization algorithm as defined for Statkraft/PROSAM. (see also chapter "Time synchronization of RTU´s")

6.1.3. Message Retries

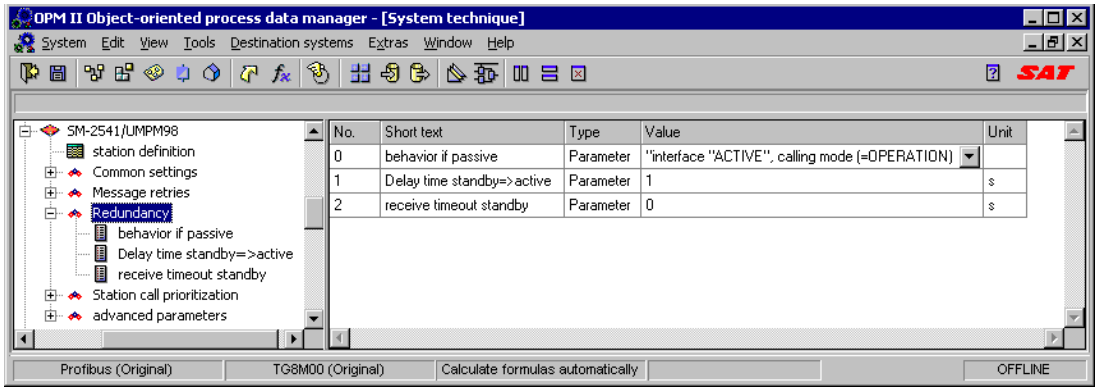


- Retries for init-messages (after reset)
  Number of retransmissions for init-message of the master.
  Parameter settings: 0 – 255; **default: 2**

- Retries for station selective data message
  Number of retransmissions for station selective message Master → Slave.
  Parameter settings: 0 – 255; **default: 2**

- Retries for data messages "unacknowledged to all"
  Number of retransmissions for data messages "unacknowledged to all" (Master → Slave)
  Parameter settings: 0 – 255; **default: 2**

6.1.4. Redundancy



- Behavior if passive

  Parameter settings: **default: interface "TRISTATE"**
  interface "ACTIVE", listening mode (=STANDBY)
  interface "ACTIVE", calling mode (=OPERATION)

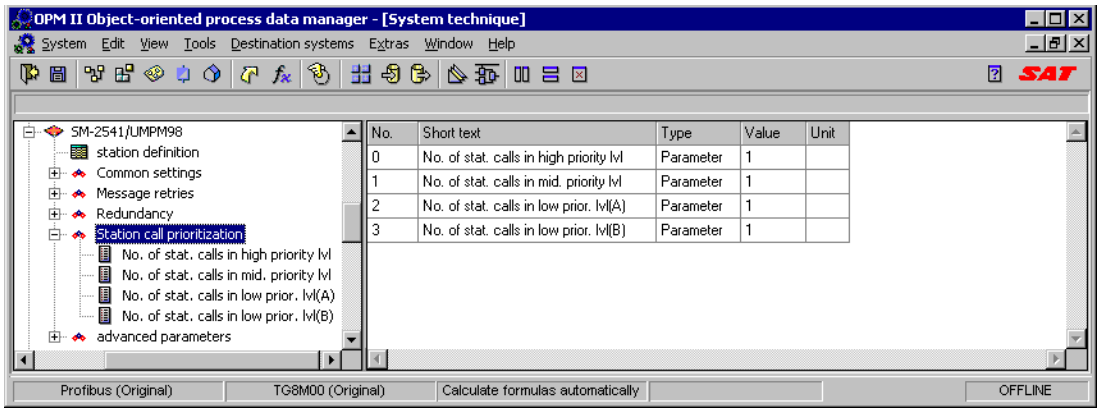
- Delay time standby → active

  Parameter settings: 0 – 2000 sec;
  default: 1 sec

- Receive timeout standby

  Parameter settings: 0 – 60000 sec; 0 ... no monitoring

6.1.5. Station Call Prioritization



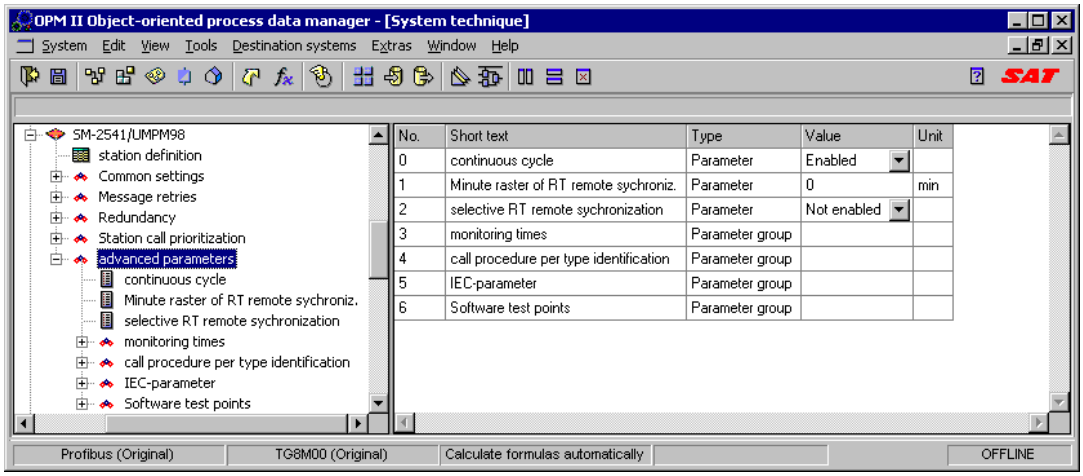
- No. of station calls in high priority level
  Parameter settings: 0, **default: 1**, 2..99

- No. of station calls in medium priority level
  Parameter settings: 0, **default: 1**, 2..99

- No. of station calls in low priority level (A)
  Parameter settings: 0, **default: 1**, 2..99

- No. of station calls in low priority level (B)
  Parameter settings: 0, **default: 1**, 2..99

6.1.6. Advanced Parameters



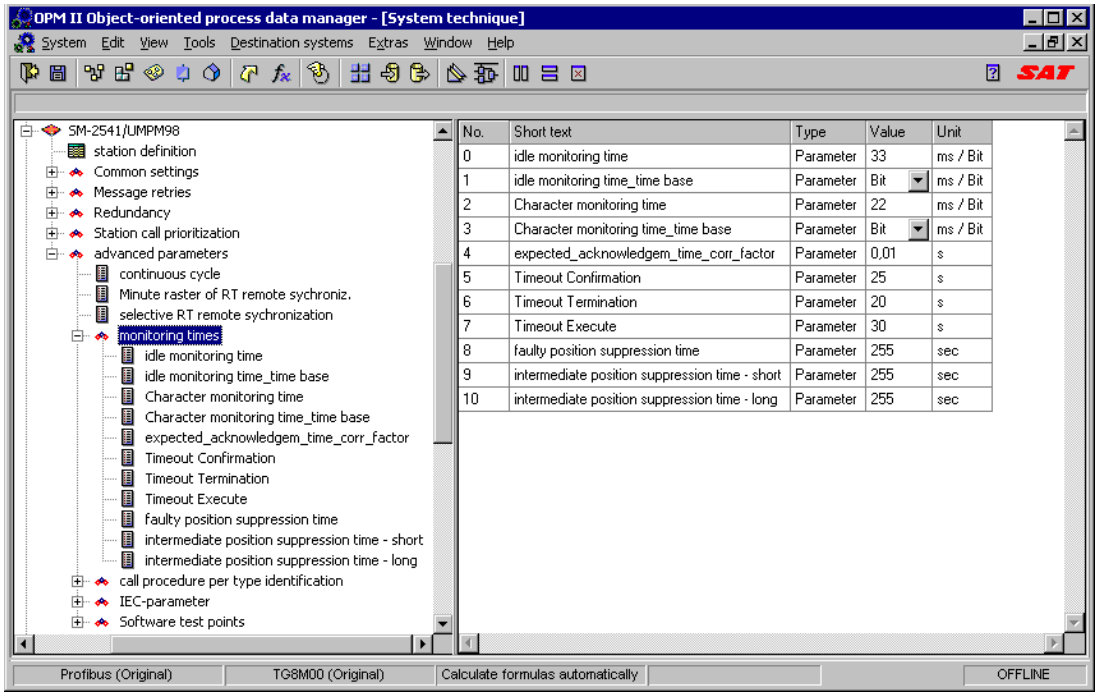
- Continuous Cycle
  Parameter settings: **default: Enabled**, not Enabled

- Minute raster of RT remote synchronization
  Parameter settings: **default: 0**, 1 – 255
  note: 0 = 1 minute raster (fixed)

- selective RT remote synchronization
  Parameter settings: Enabled, **default: not Enabled**

Note:
For Statkraft/PROSAM project "selective RT remote synchronization" must be enabled !

6.1.6.1. Monitoring times



- idle monitoring time
  Parameter settings: 0...32767

- idle monitoring time time base
  Parameter settings: Bit, ms

- Character monitoring time
  Parameter settings: 0...32767

- Character monitoring time time base
  Parameter settings: Bit, ms

- expected acknowledgem_time_corr_factor
  Parameter settings: 0...655,35

- Timeout Confirmation
  Parameter settings: 1...255 sec

- Timeout Termination
  Parameter settings: 1...255 sec

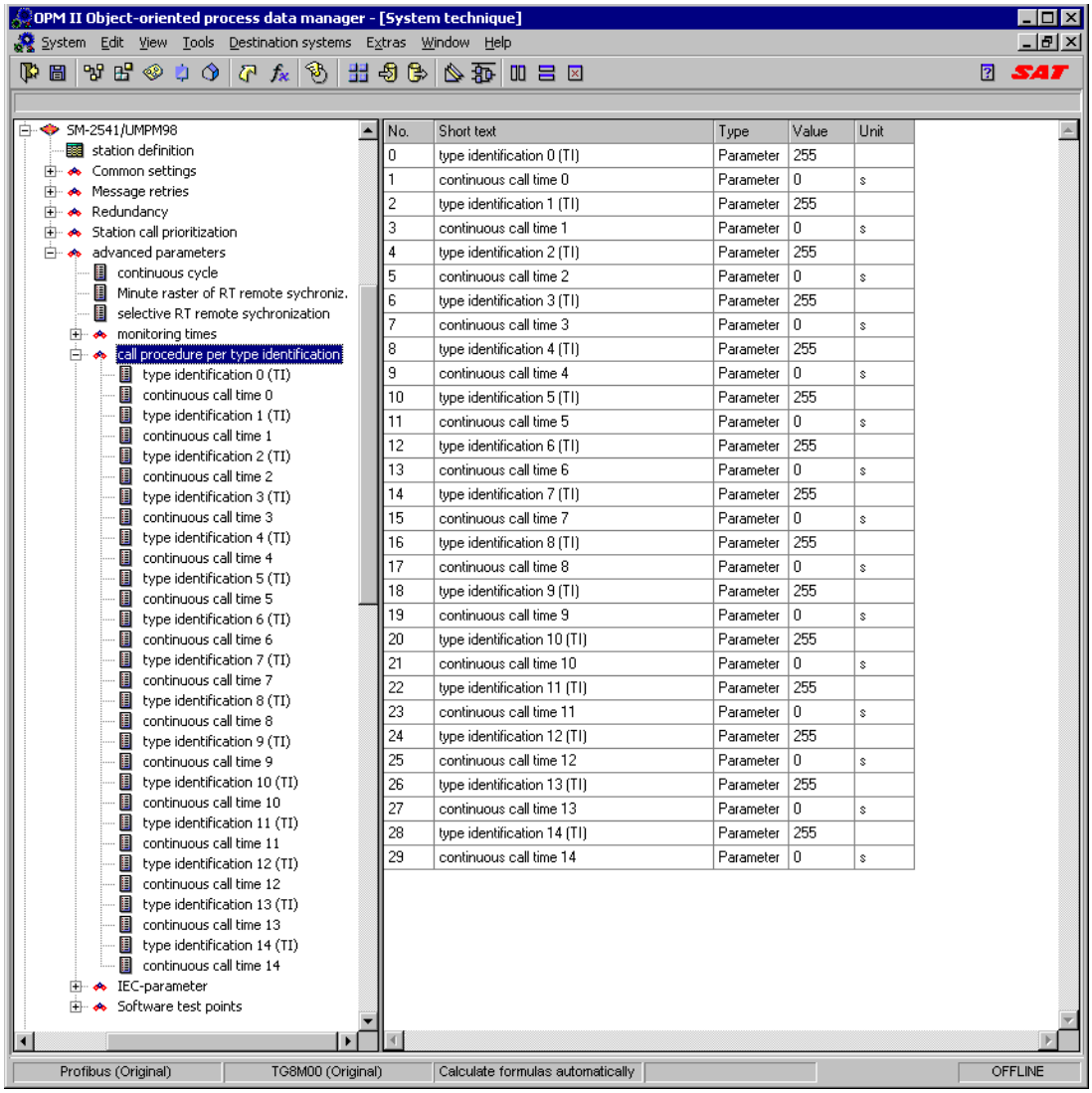
- Timeout Execution
  Parameter settings: 1...255 sec

- faulty position suppression time
  Parameter settings: 1...255 sec

- intermediate suppression time – short
  Parameter settings: 1...255 sec

- intermediate suppression time – long
  Parameter settings: 1...255 sec

6.1.6.2. Call Procedure per Type Identification

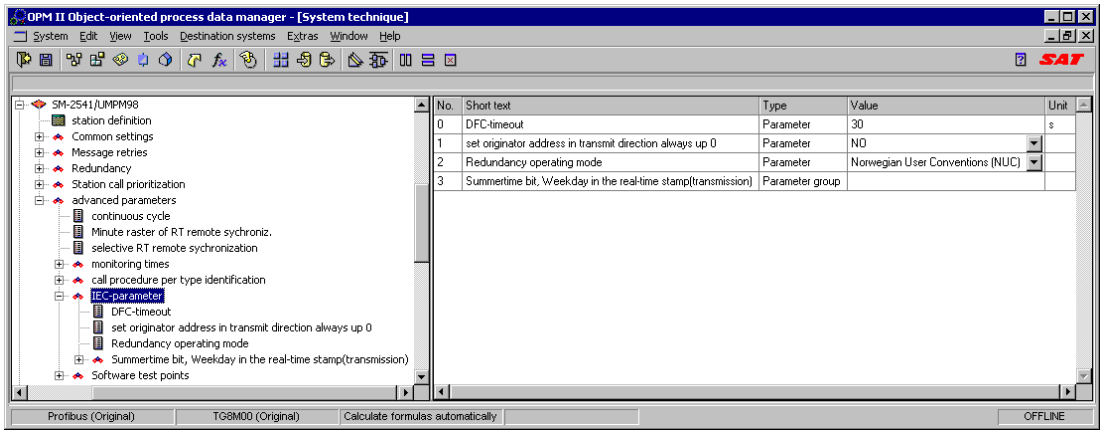


No.	Short text	Type	Value	Unit
0	type identification 0 (TI)	Parameter	255	
1	continuous call time 0	Parameter	0	s
2	type identification 1 (TI)	Parameter	255	
3	continuous call time 1	Parameter	0	s
4	type identification 2 (TI)	Parameter	255	
5	continuous call time 2	Parameter	0	s
6	type identification 3 (TI)	Parameter	255	
7	continuous call time 3	Parameter	0	s
8	type identification 4 (TI)	Parameter	255	
9	continuous call time 4	Parameter	0	s
10	type identification 5 (TI)	Parameter	255	
11	continuous call time 5	Parameter	0	s
12	type identification 6 (TI)	Parameter	255	
13	continuous call time 6	Parameter	0	s
14	type identification 7 (TI)	Parameter	255	
15	continuous call time 7	Parameter	0	s
16	type identification 8 (TI)	Parameter	255	
17	continuous call time 8	Parameter	0	s
18	type identification 9 (TI)	Parameter	255	
19	continuous call time 9	Parameter	0	s
20	type identification 10 (TI)	Parameter	255	
21	continuous call time 10	Parameter	0	s
22	type identification 11 (TI)	Parameter	255	
23	continuous call time 11	Parameter	0	s
24	type identification 12 (TI)	Parameter	255	
25	continuous call time 12	Parameter	0	s
26	type identification 13 (TI)	Parameter	255	
27	continuous call time 13	Parameter	0	s
28	type identification 14 (TI)	Parameter	255	
29	continuous call time 14	Parameter	0	s

- Type identification xx (TI)
  Parameter settings: 0...255

- Continuous call time xx
  Parameter settings: 0...6000,0

6.1.6.3. IEC Parameter

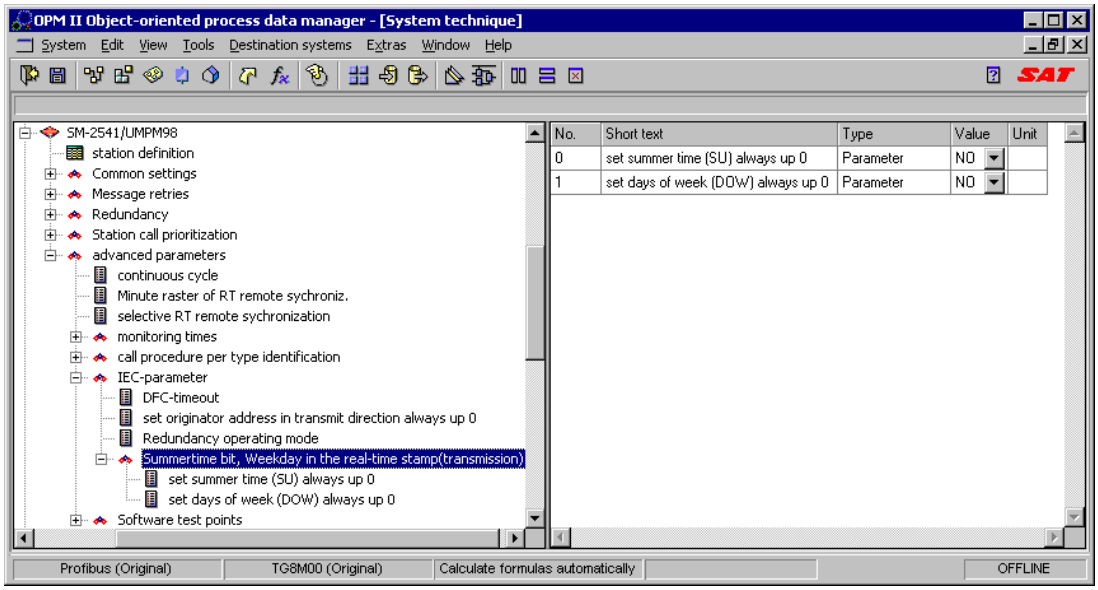


- DFC timeout
  Parameter settings: 0...60000

- set originator address in transmit direction always up 0
  Parameter settings: NO, YES

- Redundancy operating mode
  Parameter settings: - AX1703
  - Norwegian User Conventions (NUC)

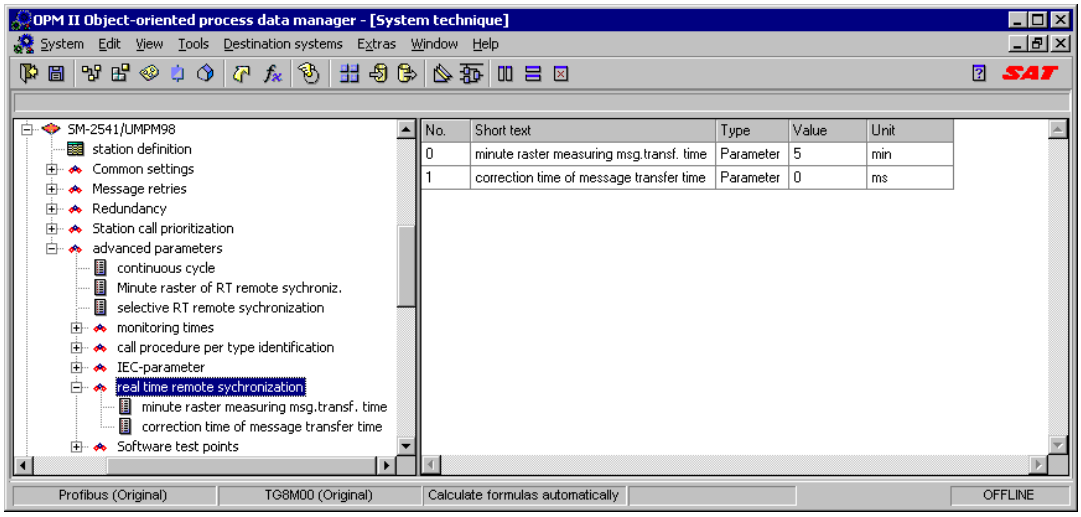
Summertime bit, day of week in the time tag (transmission)



- set summer time (SU) -/ set days of week (DOW) always up 0
  Parameter settings: Yes, **default: NO**

6.1.6.4. Real Time Remote Synchronization

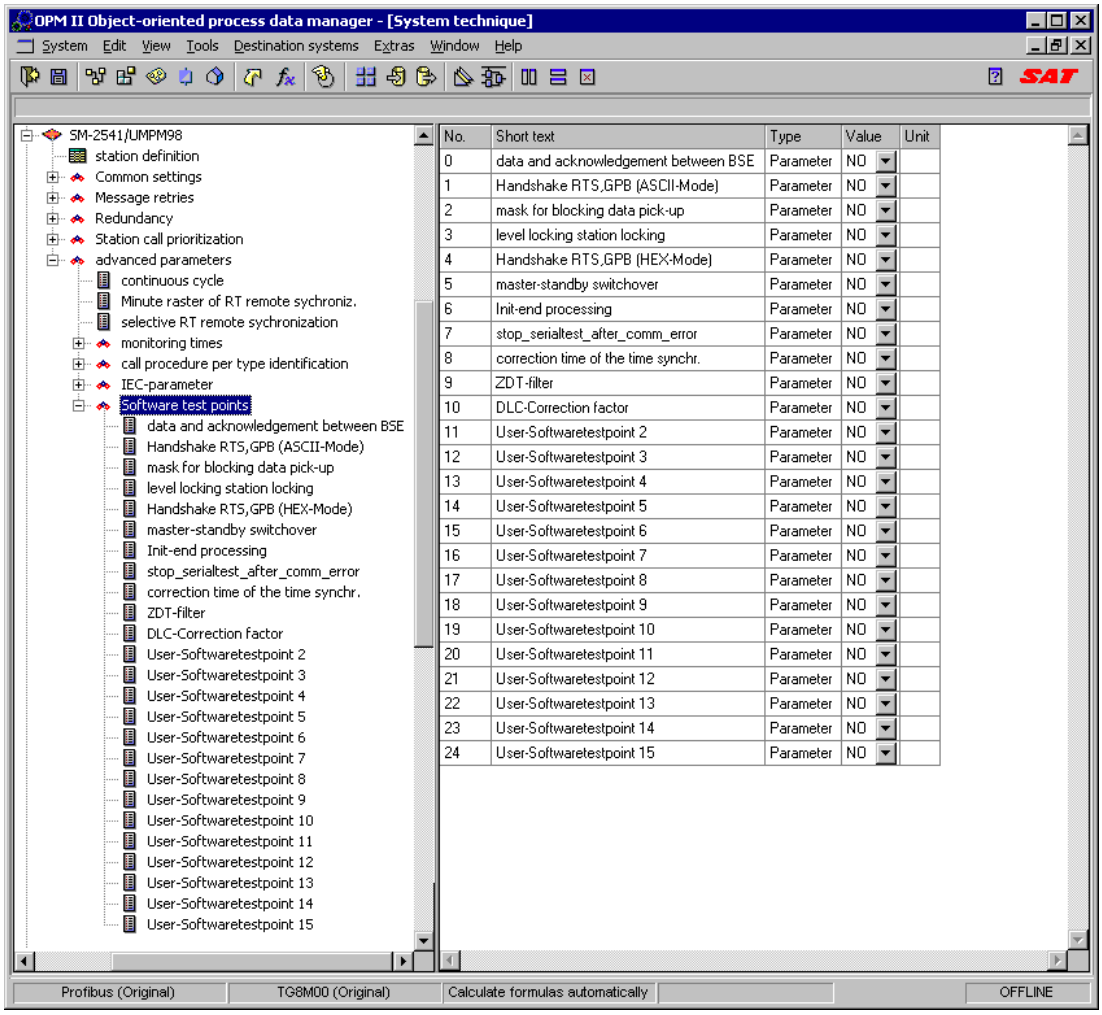
This parameters will be visible only if "selective RT remote synchronization" is enabled.



- Minute raster measuring message transmission time
  Parameter settings: 0-255, **default: 5**

- Correction time of message transfer time
  Parameter settings: 0-65535, **default: 0**

6.1.6.5. Software Test Points



No.	Short text	Type	Value	Unit
0	data and acknowledgement between BSE	Parameter	NO	
1	Handshake RTS,GPB (ASCII-Mode)	Parameter	NO	
2	mask for blocking data pick-up	Parameter	NO	
3	level locking station locking	Parameter	NO	
4	Handshake RTS,GPB (HEX-Mode)	Parameter	NO	
5	master-standby switchover	Parameter	NO	
6	Init-end processing	Parameter	NO	
7	stop_serialtest_after_comm_error	Parameter	NO	
8	correction time of the time synchr.	Parameter	NO	
9	ZDT-filter	Parameter	NO	
10	DLC-Correction factor	Parameter	NO	
11	User-Softwaretestpoint 2	Parameter	NO	
12	User-Softwaretestpoint 3	Parameter	NO	
13	User-Softwaretestpoint 4	Parameter	NO	
14	User-Softwaretestpoint 5	Parameter	NO	
15	User-Softwaretestpoint 6	Parameter	NO	
16	User-Softwaretestpoint 7	Parameter	NO	
17	User-Softwaretestpoint 8	Parameter	NO	
18	User-Softwaretestpoint 9	Parameter	NO	
19	User-Softwaretestpoint 10	Parameter	NO	
20	User-Softwaretestpoint 11	Parameter	NO	
21	User-Softwaretestpoint 12	Parameter	NO	
22	User-Softwaretestpoint 13	Parameter	NO	
23	User-Softwaretestpoint 14	Parameter	NO	
24	User-Softwaretestpoint 15	Parameter	NO	

Note: not relevant for user (only for developer) !

6.2. Details

Common settings

Parameter	Description	Values/Ranges
baud rate receiving direction	baud rate receiving direction	[50] 50 [Bd] [75] 75 [Bd] [100] 100 [Bd] [110] 110 [Bd] [134] 134,5 [Bd] [150] 150 [Bd] [200] 200 [Bd] [300] 300 [Bd] [600] 600 [Bd] [1050] 1050 [Bd] [1200] 1200 [Bd] [1800] 1800 [Bd] [2000] 2000 [Bd] [2400] 2400 [Bd] [4800] 4800 [Bd] [9600] 9600 [Bd] [19200] 19200 [Bd]
baud rate transmit direction	baud rate transmit direction	[50] 50 [Bd] [75] 75 [Bd] [100] 100 [Bd] [110] 110 [Bd] [134] 134,5 [Bd] [150] 150 [Bd] [200] 200 [Bd] [300] 300 [Bd] [600] 600 [Bd] [1050] 1050 [Bd] [1200] 1200 [Bd] [1800] 1800 [Bd] [2000] 2000 [Bd] [2400] 2400 [Bd] [4800] 4800 [Bd] [9600] 9600 [Bd] [19200] 19200 [Bd]

Parameter	Description	Values/Ranges
interface modem	Selection of the interface modem. Most of the parameters for the predefined interface modems are standardized and not changeable.	[0] free defineable [1] SAT Modem "4-wire circuit transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,-CE0700) [2] SAT Modem "2-wire circuit transmission line" (SAT-VFM,-WT,-WTK,-WTK-S,-CE0700) [3] SAT-DMS (ring configuration) [4] SAT-DMS (ring configuration; AU remote via WT) [5] OPTICAL [6] radio digital [7] radio analogue [8] NULL-Modem interface (RS-485) [9] SAT-DLC-Modem (CE0740,-CE0741,-CE0742,-LA0740,-LA0741) [10] SAT Modem "4-wire circuit transmission line" (SAT-CE0701) [11] SAT Modem "2-wire circuit transmission line" (SAT-CE0701) [12] SAT Modem "2-wire circuit transmission line" (SAT-CE0701 over modem) [13] SAT Modem "2-wire circuit transmission line" (SAT-CE0701 over Westermo TD-32) [14] SAT Modem "2-wire circuit transmission line" (SAT-CE0701 over Westermo GD-01) [15] NULL-Modem interface (RS-232) [100] SATTELLINE 2ASxE time slot radio modem

Common settings | SAT-DLC-Modem

Parameter	Description	Values/Ranges
DIP switch S1/1	The internal Baudrate at the DLC-Modem must be parametrized via DIP-Switches direct at the DLC-Modem and must accord to this parametrization.	[0] OFF [1] ON
DIP switch S1/2	The internal Baudrate at the DLC-Modem must be parametrized via DIP-Switches direct at the DLC-Modem and must accord to this parametrization.	[0] OFF [1] ON
DIP switch S1/3	The internal Baudrate at the DLC-Modem must be parametrized via DIP-Switches direct at the DLC-Modem and must accord to this parametrization.	[0] OFF [1] ON
DIP switch S1/4	The internal Baudrate at the DLC-Modem must be parametrized via DIP-Switches direct at the DLC-Modem and must accord to this parametrization.	[0] OFF [1] ON

Parameter	Description	Values/Ranges
frequency range		[0] 10-30kHz [1] 30-90kHz

Common settings | Time slot radio modem (SATTELLINE 2ASxE)

Parameter	Description	Values/Ranges
failure monitoring		Integer [###] 0 to 255 [min]
length of time slot		Integer [##] 1 to 59 [s]
start second of time slot		Integer [##] 0 to 59 [s]

Common settings | free defineable transmission facility

Parameter	Description	Values/Ranges
Bit timing: (only for "Isochronous")	Bit timing: (only for "Isochronous") either external (from RXC-inpu) or intern (at TXC-output)	[0] extern (bit timing from RXC input) [1] internal (bit timing at the TXC-output)
DCD assessment	DCD assessment	[0] Not enabled [1] Enabled
Transm.delay contin.lvl tr.line(tcldly)	A further message transmission is carried out for "continuous level", at the latest, after expiry of the "Transmission delay".	Float [####.#] 0.1 to 6553.5 [s] 0 [s]
asynchron_isochron	asynchronous (V.24/V.28, 16 x bit timing) or isochron (X.24/X.27 1 x bit timing)	[0] asynchronous "V.24/V.28" (16 x bit timing) [1] Isochron "X.24/X.27" (single bit timing)
bounce suppression time (tbounce)	bounce suppression time (tbounce)	Integer [#####] 0 to 65535 [ms]
continuous level monitoring time (tcl)	continuous level monitoring time (tcl)	Float [####.#] 0.1 to 6553.5 [s] 0 [s]
disable time (tdis)	disable time after a received message	Integer [#####] 0 to 32767 [ms / Bit]
disable time time base (tdis)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
electrical interface	electrical interface	[0] RS232 (V.24/V.28) [1] RS422 (V.11) [2] RS485 (V.11)
pause time (tp)	Before a message transmission the set pause time is waited before switching on the transmit level (RTS).	Integer [#####] 0 to 32767 [ms/Bit]
pause time_time base (tp)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]

Parameter	Description	Values/Ranges
run-out time (tn)	After the end of the message transmission, the transmit level(RTS) is only switched off after expiry of the reset time.	Integer [#####] 0 to 32767 [ms / Bit]
run-out time_time base (tn)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms /Bit] [1] ms [ms /Bit]
set up time (tv)	After switching on the transmit level (RTS) the message transmission is started after expiry of the set-up time. Note: For "tv=0" there is no carrier switching (RTS=OFF)!	Integer [#####] 0 to 32767 [ms / Bit]
set up time_time base (tv)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
stability monitoring time (tstab)	stability monitoring time (tstab)\ The "new" DCD state is only utilized\ after expiry of the stability monitoring time\ for the message synchronisation.	Integer [#####] 0 to 65535 [ms]

Message retries

Parameter	Description	Values/Ranges
Retries for INIT-messages (after reset)	Number of max. message retrys	Integer [###] 0 to 255
Retries for data msg. "unack. to all"	Number of max. message retrys	Integer [###] 0 to 255
Retries for station selective data msg.	Number of max. message retrys	Integer [###] 0 to 255

Redundancy

Parameter	Description	Values/Ranges
Delay time standby=>active	delay time in case of sitch over from STANDBY->ACTIVE 0 = switch without delay	Integer [####] 0 to 2000 [s]
behavior if passive	behavior if passive	[0] interface "TRISTATE" [1] "interface "ACTIVE", listening mode (=STANDBY) [3] "interface "ACTIVE", calling mode (=OPERATION)
receive timeout standby	receive timeout in standby mode 0 = no monitoring!	Float [####.] 0 to 60000 [s]

Station call prioritization

Parameter	Description	Values/Ranges
No. of stat. calls in high priority lvl	Number of station calls until level change	Integer [##] 0 to 99
No. of stat. calls in low prior. lvl(A)	Number of station calls until level change	Integer [##] 0 to 99
No. of stat. calls in low prior. lvl(B)	Number of station calls until level change	Integer [##] 0 to 99

Parameter	Description	Values/Ranges
No. of stat. calls in mid. priority lvl	Number of station calls until level change	Integer [##] 0 to 99

Advanced parameters

Parameter	Description	Values/Ranges
Minute raster of RT remote sychroniz.	0 = each minute	Integer [###] 0 [min] 1 to 255 [min]
continuous cycle	continuous cycle	[0] Not enabled [1] Enabled
selective RT remote sychronization		[0] Not enabled [1] Enabled

Advanced parameters | IEC-parameter

Parameter	Description	Values/Ranges
DFC-timeout	receive timeout in standby mode 0 = no monitoring!	Float [####.] 0 to 60000 [s]
Redundancy operating mode		[0] AX1703 [1] Norwegian User Conventions (NUC)
set originator address in transmit direction always up 0		[0] NO [1] YES

Advanced parameters | IEC-parameter | Summertime bit, Weekday in the real-time stamp(transmission)

Parameter	Description	Values/Ranges
set days of week (DOW) always up 0		[0] NO [1] YES
set summer time (SU) always up 0		[0] NO [1] YES

Advanced parameters | Software test points

Parameter	Description	Values/Ranges
DLC-Correction factor		[0] NO [1] YES
Handshake RTS,GPB (ASCII-Mode)	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
Handshake RTS,GPB (HEX-Mode)	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES

Parameter	Description	Values/Ranges
Init-end processing	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
User-Softwaretestpoint 10		[0] NO [1] YES
User-Softwaretestpoint 11		[0] NO [1] YES
User-Softwaretestpoint 12		[0] NO [1] YES
User-Softwaretestpoint 13		[0] NO [1] YES
User-Softwaretestpoint 14		[0] NO [1] YES
User-Softwaretestpoint 15		[0] NO [1] YES
User-Softwaretestpoint 2		[0] NO [1] YES
User-Softwaretestpoint 3		[0] NO [1] YES
User-Softwaretestpoint 4		[0] NO [1] YES
User-Softwaretestpoint 5		[0] NO [1] YES
User-Softwaretestpoint 6		[0] NO [1] YES
User-Softwaretestpoint 7		[0] NO [1] YES
User-Softwaretestpoint 8		[0] NO [1] YES
User-Softwaretestpoint 9		[0] NO [1] YES
ZDT-filter	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
correction time of the time synchr.	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
data and acknowledgement between BSE	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
level locking station locking	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
mask for blocking data pick-up	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES

Parameter	Description	Values/Ranges
master-standby switchover	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
stop_serialtest_after_comm_error	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES

Advanced parameters | call procedure per type identification

Parameter	Description	Values/Ranges
continuous call time 0	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 1	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 10	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 11	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 12	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 13	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 14	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 2	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 3	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 4	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 5	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 6	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 7	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]

Parameter	Description	Values/Ranges
continuous call time 8	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
continuous call time 9	When a message is transmitted to a selective station, this station can be interrogated permanent for a definable time. (0=no perman	Float [####.#] 0.0 to 6000.0 [s]
type identification 0 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 1 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 10 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 11 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 12 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 13 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 14 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 2 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 3 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 4 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 5 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 6 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 7 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255
type identification 8 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255

Parameter	Description	Values/Ranges
type identification 9 (TI)	After a message is transmitted to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).	Integer [###] 0 to 255

Advanced parameters | monitoring times

Parameter	Description	Values/Ranges
Character monitoring time	Maximum pause between sequential bytes of a message. After a message interruption was detected, the idle monitoring time is started.	Integer [#####] 0 to 32767 [ms / Bit]
Character monitoring time_time base	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
Timeout Confirmation		Integer [###] 1 to 255 [s]
Timeout Execute		Integer [###] 1 to 255 [s]
Timeout Termination		Integer [###] 1 to 255 [s]
expected_acknowledgem_time_corr_factor	The expected acknowledgement time is determined automatically. Signal transfer times and other delays must be considered in the "expected acknowledgement time correction factor."	Float [###.##] 0 to 655.35 [s]
faulty position suppression time		Integer [###] 0 to 255 [sec]
idle monitoring time	After transmission faults or message interruption, the line is monitored for quiescent state. After expiry of this monitoring time, the resynchronisation of the receiver takes place. By using the DCD input, faster resynchronisation can be achieved.	Integer [#####] 0 to 32767 [ms / Bit]
idle monitoring time_time base	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
intermediate position suppression time - long		Integer [###] 1 to 255 [sec]
intermediate position suppression time - short		Integer [###] 1 to 255 [sec]

Advanced parameters | real time remote sychronization

Parameter	Description	Values/Ranges
correction time of message transfer time		Integer [#####] 0 to 65535 [ms]
minute raster measuring msg.transf. time	0= 1 minute cycle	Integer [###] 0 to 255 [min]

A. Appendix: Diagnostic

A.1. Class internal

Class internal - Record 0 : Internal error in the operating system

Bit	Description
00	RAM error
01	STACK error The defined stack range has been exceeded; Replace system element or notify SAT.
02	Firmware shut down Diagnosis: - Read out system diagnostics ring (command ID R) in ST emulation (possibly store to file)
03	Too less free space There is not enough free RAM memory available for the dynamic memory management; Diagnosis: - Change parameterization of size definitions (e.g. realtime rings, pool size) - Notify SAT.
08	CPU 80186 error Occurs on an internal software error.

Class internal - Record 2 : Parameter error ZSE

Bit	Description
00	Parameter error detected by SIP
01	Parameter error of the LOCAL parameter block no. 06 Diagnosis: - TI 38-40 and 136-143 requires parameter setting with time - TI 160 requires parameter setting without time - transmission of the objects on GI with/without time; value > 3 - number of octets for cause of transmission (COT) <> 2 - number of octets for common address of ASDU (CASDU) <> 2 - number of octets for information object address (IOA) <> 3 - number of octets for time stamp <> 7
02	Parameter error ZSE general
03	Parameterized station number is invalid. Diagnosis: Selected station number is greater than 100 and also not a BROADCAST station number.
04	Parameterized station number is invalid. Diagnosis: Same station number is used more then once.
05	Invalid Parameters for IEC870 link-layer
06	Invalid Parameters for IEC870 application layer
07	Invalid Parameters for Redundancy
15	Parameter setting for time zone is not valid

Class internal - Record 3 : ZSE format conversion error

Bit	Description
00	Format conversion error in the transmit direction
02	Format conversion error in the receive direction
15	Conversion error in PST-control-messages Diagnosis: - Read out system diagnostics ring (command ID R) in ST emulation (if possible store to file)

Class internal - Record 4 : Invalid Parameters for protocol specific application layer

Bit	Description
00	Error when preparing the routing information
01	General parameter error of multi-point-protocol

Class internal - Record 10 : Parameter error dedected by ZSE

Bit	Description
10	Parameter error in detail routing in receive direction
11	Parameter error in detail routing in transmit direction

A.2. Class external

Class external - Record 0 : DFC-Bit Timeout for the Stations Nr. 0 - 15

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 0
01	DFC-Bit Timeout for the Stations Nr. 1
02	DFC-Bit Timeout for the Stations Nr. 2
03	DFC-Bit Timeout for the Stations Nr. 3
04	DFC-Bit Timeout for the Stations Nr. 4
05	DFC-Bit Timeout for the Stations Nr. 5
06	DFC-Bit Timeout for the Stations Nr. 6
07	DFC-Bit Timeout for the Stations Nr. 7
08	DFC-Bit Timeout for the Stations Nr. 8
09	DFC-Bit Timeout for the Stations Nr. 9
10	DFC-Bit Timeout for the Stations Nr. 10
11	DFC-Bit Timeout for the Stations Nr. 11
12	DFC-Bit Timeout for the Stations Nr. 12
13	DFC-Bit Timeout for the Stations Nr. 13
14	DFC-Bit Timeout for the Stations Nr. 14
15	DFC-Bit Timeout for the Stations Nr. 15

Class external - Record 1 : DFC-Bit Timeout for the Stations Nr. 16 - 31

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 16
01	DFC-Bit Timeout for the Stations Nr. 17
02	DFC-Bit Timeout for the Stations Nr. 18
03	DFC-Bit Timeout for the Stations Nr. 19
04	DFC-Bit Timeout for the Stations Nr. 20
05	DFC-Bit Timeout for the Stations Nr. 21
06	DFC-Bit Timeout for the Stations Nr. 22
07	DFC-Bit Timeout for the Stations Nr. 23
08	DFC-Bit Timeout for the Stations Nr. 24
09	DFC-Bit Timeout for the Stations Nr. 25
10	DFC-Bit Timeout for the Stations Nr. 26
11	DFC-Bit Timeout for the Stations Nr. 27
12	DFC-Bit Timeout for the Stations Nr. 28
13	DFC-Bit Timeout for the Stations Nr. 29
14	DFC-Bit Timeout for the Stations Nr. 30
15	DFC-Bit Timeout for the Stations Nr. 31

Class external - Record 2 : DFC-Bit Timeout for the Stations Nr. 32 - 47

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 32
01	DFC-Bit Timeout for the Stations Nr. 33
02	DFC-Bit Timeout for the Stations Nr. 34
03	DFC-Bit Timeout for the Stations Nr. 35
04	DFC-Bit Timeout for the Stations Nr. 36
05	DFC-Bit Timeout for the Stations Nr. 37
06	DFC-Bit Timeout for the Stations Nr. 38
07	DFC-Bit Timeout for the Stations Nr. 39
08	DFC-Bit Timeout for the Stations Nr. 40
09	DFC-Bit Timeout for the Stations Nr. 41
10	DFC-Bit Timeout for the Stations Nr. 42
11	DFC-Bit Timeout for the Stations Nr. 43
12	DFC-Bit Timeout for the Stations Nr. 44
13	DFC-Bit Timeout for the Stations Nr. 45
14	DFC-Bit Timeout for the Stations Nr. 46
15	DFC-Bit Timeout for the Stations Nr. 47

Class external - Record 3 : DFC-Bit Timeout for the Stations Nr. 48 - 63

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 48
01	DFC-Bit Timeout for the Stations Nr. 49
02	DFC-Bit Timeout for the Stations Nr. 50
03	DFC-Bit Timeout for the Stations Nr. 51
04	DFC-Bit Timeout for the Stations Nr. 52
05	DFC-Bit Timeout for the Stations Nr. 53
06	DFC-Bit Timeout for the Stations Nr. 54
07	DFC-Bit Timeout for the Stations Nr. 55
08	DFC-Bit Timeout for the Stations Nr. 56
09	DFC-Bit Timeout for the Stations Nr. 57
10	DFC-Bit Timeout for the Stations Nr. 58
11	DFC-Bit Timeout for the Stations Nr. 59
12	DFC-Bit Timeout for the Stations Nr. 60
13	DFC-Bit Timeout for the Stations Nr. 61
14	DFC-Bit Timeout for the Stations Nr. 62
15	DFC-Bit Timeout for the Stations Nr.

Class external - Record 4 : DFC-Bit Timeout for the Stations Nr. 64 -79

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 64
01	DFC-Bit Timeout for the Stations Nr. 65
02	DFC-Bit Timeout for the Stations Nr. 66
03	DFC-Bit Timeout for the Stations Nr. 67
04	DFC-Bit Timeout for the Stations Nr. 68
05	DFC-Bit Timeout for the Stations Nr. 69
06	DFC-Bit Timeout for the Stations Nr. 70
07	DFC-Bit Timeout for the Stations Nr. 71
08	DFC-Bit Timeout for the Stations Nr. 72
09	DFC-Bit Timeout for the Stations Nr. 73
10	DFC-Bit Timeout for the Stations Nr. 74
11	DFC-Bit Timeout for the Stations Nr. 75
12	DFC-Bit Timeout for the Stations Nr. 76
13	DFC-Bit Timeout for the Stations Nr. 77
14	DFC-Bit Timeout for the Stations Nr. 78
15	DFC-Bit Timeout for the Stations Nr. 79

Class external - Record 5 : DFC-Bit Timeout for the Stations Nr. 80 -95

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 80
01	DFC-Bit Timeout for the Stations Nr. 81
02	DFC-Bit Timeout for the Stations Nr. 82
03	DFC-Bit Timeout for the Stations Nr. 83
04	DFC-Bit Timeout for the Stations Nr. 84
05	DFC-Bit Timeout for the Stations Nr. 85
06	DFC-Bit Timeout for the Stations Nr. 86
07	DFC-Bit Timeout for the Stations Nr. 87
08	DFC-Bit Timeout for the Stations Nr. 88
09	DFC-Bit Timeout for the Stations Nr. 89
10	DFC-Bit Timeout for the Stations Nr. 90
11	DFC-Bit Timeout for the Stations Nr. 91
12	DFC-Bit Timeout for the Stations Nr. 92
13	DFC-Bit Timeout for the Stations Nr. 93
14	DFC-Bit Timeout for the Stations Nr. 94
15	DFC-Bit Timeout for the Stations Nr. 95

Class external - Record 6 : DFC-Bit Timeout for the Stations Nr. 96 -99

Bit	Description
00	DFC-Bit Timeout for the Stations Nr. 96
01	DFC-Bit Timeout for the Stations Nr. 97
02	DFC-Bit Timeout for the Stations Nr. 98
03	DFC-Bit Timeout for the Stations Nr. 99

A.3. Class communication

Class communication - Record 2 : Communication error to Station no. 0 - 15

Bit	Description
00	Communication error to Station no. 0
01	Communication error to Station no. 1
02	Communication error to Station no. 2
03	Communication error to Station no. 3
04	Communication error to Station no. 4
05	Communication error to Station no. 5
06	Communication error to Station no. 6
07	Communication error to Station no. 7
08	Communication error to Station no. 8
09	Communication error to Station no. 9
10	Communication error to Station no. 10
11	Communication error to Station no. 11
12	Communication error to Station no. 12
13	Communication error to Station no. 13
14	Communication error to Station no. 14
15	Communication error to Station no. 15

Class communication - Record 3 : Communication error to Station no. 16 - 31

Bit	Description
00	Communication error to Station no. 16
01	Communication error to Station no. 17
02	Communication error to Station no. 18
03	Communication error to Station no. 19
04	Communication error to Station no. 20
05	Communication error to Station no. 21
06	Communication error to Station no. 22
07	Communication error to Station no. 23
08	Communication error to Station no. 24
09	Communication error to Station no. 25
10	Communication error to Station no. 26
11	Communication error to Station no. 27
12	Communication error to Station no. 28
13	Communication error to Station no. 29
14	Communication error to Station no. 30
15	Communication error to Station no. 31

Class communication - Record 4 : Communication error to Station no. 32 - 47

Bit	Description
00	Communication error to Station no. 32
01	Communication error to Station no. 33
02	Communication error to Station no. 34
03	Communication error to Station no. 35
04	Communication error to Station no. 36
05	Communication error to Station no. 37
06	Communication error to Station no. 38
07	Communication error to Station no. 39
08	Communication error to Station no. 40
09	Communication error to Station no. 41
10	Communication error to Station no. 42
11	Communication error to Station no. 43
12	Communication error to Station no. 44
13	Communication error to Station no. 45
14	Communication error to Station no. 46
15	Communication error to Station no. 47

Class communication - Record 5 : Communication error to Station no. 48 - 63

Bit	Description
00	Communication error to Station no. 48
01	Communication error to Station no. 49
02	Communication error to Station no. 50
03	Communication error to Station no. 51
04	Communication error to Station no. 52
05	Communication error to Station no. 53
06	Communication error to Station no. 54
07	Communication error to Station no. 55
08	Communication error to Station no. 56
09	Communication error to Station no. 57
10	Communication error to Station no. 58
11	Communication error to Station no. 59
12	Communication error to Station no. 60
13	Communication error to Station no. 61
14	Communication error to Station no. 62
15	Communication error to Station no. 63

Class communication - Record 6 : Communication error to Station no. 64 - 79

Bit	Description
00	Communication error to Station no. 64
01	Communication error to Station no. 65
02	Communication error to Station no. 66
03	Communication error to Station no. 67
04	Communication error to Station no. 68
05	Communication error to Station no. 69
06	Communication error to Station no. 70
07	Communication error to Station no. 71
08	Communication error to Station no. 72
09	Communication error to Station no. 73
10	Communication error to Station no. 74
11	Communication error to Station no. 75
12	Communication error to Station no. 76
13	Communication error to Station no. 77
14	Communication error to Station no. 78
15	Communication error to Station no. 79

Class communication - Record 7 : Communication error to Station no. 80 - 95

Bit	Description
00	Communication error to Station no. 80
01	Communication error to Station no. 81
02	Communication error to Station no. 82
03	Communication error to Station no. 83
04	Communication error to Station no. 84
05	Communication error to Station no. 85
06	Communication error to Station no. 86
07	Communication error to Station no. 87
08	Communication error to Station no. 88
09	Communication error to Station no. 89
10	Communication error to Station no. 90
11	Communication error to Station no. 91
12	Communication error to Station no. 92
13	Communication error to Station no. 93
14	Communication error to Station no. 94
15	Communication error to Station no. 95

Class communication - Record 8 : Communication error to Station no. 96 - 99

Bit	Description
00	Communication error to Station no. 96
01	Communication error to Station no. 97
02	Communication error to Station no. 98
03	Communication error to Station no. 99

A.4. Class test

Class test - Record 0 : Test mode of the operating and base systems

Bit	Description
00	Memory test disabled

B. Appendix: Literature Index

The following documents are recommended to supplement the " UMPM98" description:

IEC 870-5-1, "Transmission Frame Formats"
(1st issue, February 1990)

IEC 870-5-2, "Link Transmission procedures"
(1st edition, June 1992)

DIN EN 60870-5-5 "Fernwirkeinrichtungen und Fernwirksysteme" [Telecommunications equipment and telecommunications systems]
Part 5: Transmission protocol
Main section 5: Fundamental application functions
(IEC 870-5-5: 1995) German version EN 870-5-5: 1995

DIN EN 60870-5-101 "Fernwirkeinrichtungen und Fernwirksysteme" [Telecommunications equipment and telecommunications systems]
Part 5: Transmission protocol
Main section 101: Application-related standards for basic telecommunications tasks
(IEC 870-5-101: 1995) German version EN 870-5-101: 1995

Norwegian IEC870-5-101 User Conventions, Preliminary Version Revision no.: 1.4

Norwegian IEC870-5-101 User Conventions, Preliminary Version Revision no.: 2.0

SAT Description: "Ax 1703 Data Formats"
Item number: MA0-000-x.xx