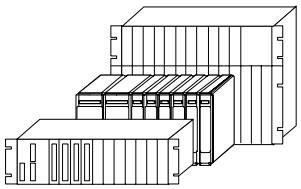
Ax 1703



Firmware Description

103M00

Interfacing of Digital Protective Devices as per IEC 870-5-103 in Multi-Point Traffic (unbalanced primary)

HW-Type: 2541 / FW-Type: 2529

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

103M00 Rev. 01 and higher

Version	Revision	Date	Change
A, 1	00	17.12.01	first issue
A, 1	01	17.01.02	Chap. 2.2.2.4. Common Address of the ASDU
A, 1	02	05.03.03	Appendix "103M99 RWE specific Expansions" removed; RWE specific firmware information now in firmware description 103M99, Chap. 2.3.1.4.1. Disturbance Record Container - Konfiguration
A, 1	03	02.06.03	Generic Data, Control Location Input, Parameter Documentation new
A, 1	04	21.07.03	Blocked start events and tripping of protection, Parameter Documentation new
A, 1	05	12.08.03	Chap. 2.3.2.2. Binary Information with Relative Time – Type identifier event of protection equipment
A, 1	06	04.11.03	Chap. 2.3.1.2. Control Location Input – single command
A, 1	07	24.02.04	Chap. 2.3.2. Message Conversion in Receive Direction ... Chap. 2.3.2.11. Blocked Start Events and Tripping of Protection Appendix E: Parameter Documentation
A, 1	08	23.06.04	Chap. 2.3.1. Message Conversion in Send Direction, Chap. 2.3.1.3. Control Location Input (new) Chap. 2.3.2. Message Conversion in Receive Direction Chap. 2.3.2.1. Binary Information with Time Mark (TYPE information) Chap. 2.3.2.3. Measured Values (TYPE measured value)

About this Document:

author / editor:	G. Pany, M. Posch / E. Josefik
server\service:	\\VIE001\ENT_TDOK
directory:	\Ax1703\FW\103M00\
file name(s):	103M00.DOC
file format:	Word 97

created		last change		released	
on	by	on	by	on	by
17.12.01	SW-AUT/P	23.06.04	SW-AUT/POM	23.06.04	SW-AUT/POM

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1. System Overview

1.1. Short Description

The 103M00 firmware is used for the coupling of Ax 1703 system components to digital protective devices with an interface in accordance with IEC 60870-5-103.

The implementation of the firmware is done in accordance with IEC 60870-5-103 Compatibility Status 2.

The data communication control used for this firmware is unbalanced primary (multi-point traffic central station).

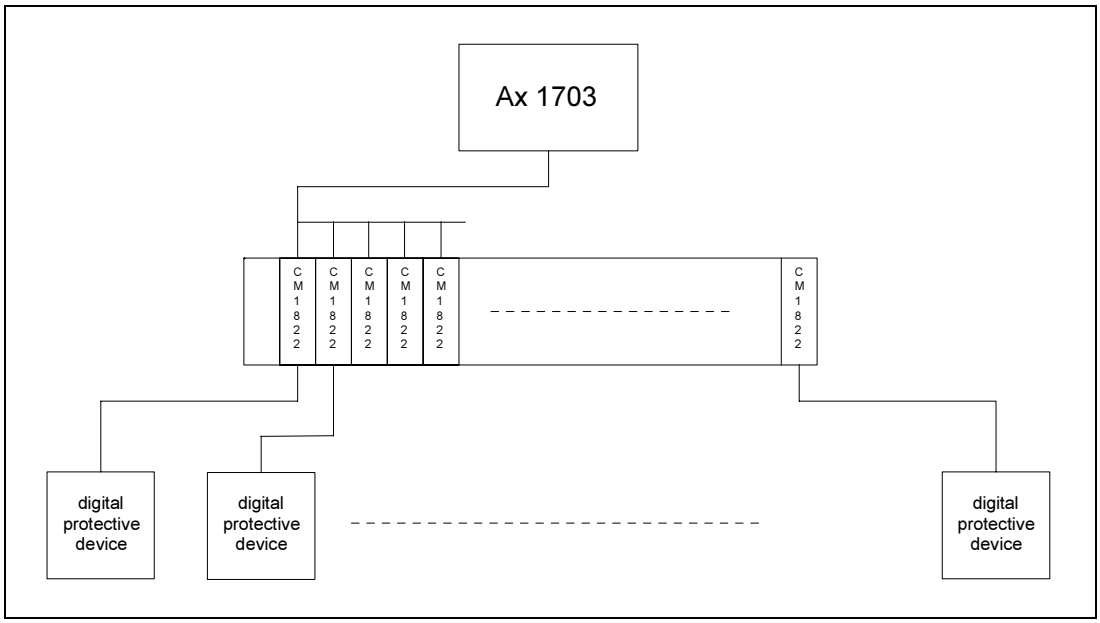
1.2. Technical Data

- Modulation: PCM byte-asynchronous
- Transmission speed: 50 - 64000 baud
- Bit transmission sequence: LSB (lowest significant bit) is transmitted first
- Message protection: HA = 4
- Up to 100 protective devices

1.3. Restrictions

- Only the single character E5 is supported.
- Transmission causes are only supported to a restricted degree.
- Only the FT1-2 message format is used.
- generic data are reduced supported

1.4. Configuration



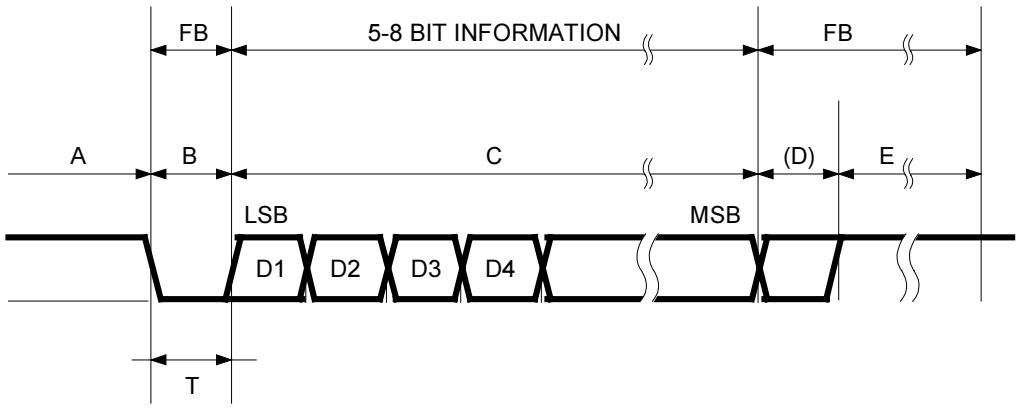
2. Protocol Description

2.1. PCMBA Modulation Method

The data are pulse-code modulated in groups of 8 bits and transmitted asynchronously. In the process, a USART module in asynchronous mode provides each byte with a byte frame (BR).

This byte frame contains: 1 start bit
8 data bits
1 parity bit (even)
1 stop bit

By means of the start and stop bits of the byte frame, the synchronization of the receiver is redone with every byte.



A: Empty state of the line (binary information "1"), at least 33 bits between two messages (in event of error)
B: Start bit ("0")
C: 8-bit data (possibly frame data or message data), LSB (least significant bit) is transmitted first
D: Parity bit (EVEN PARITY)
E: 1 stop bit
T: Time for the transmission of a bit (1/transmission speed)
FB: Framing bits of the USART module

2.2. Message Description

The message structure corresponds to the standards:

- IEC 870-5-1 "Transmission frame formats"
- IEC 870-5-2 "Link transmission procedures"
- IEC 870-5-3 "General structure of application data"
- IEC 870-5-4 "Definition and Coding of Application Information Elements"
- IEC 870-5-5 "Basic Application Function"

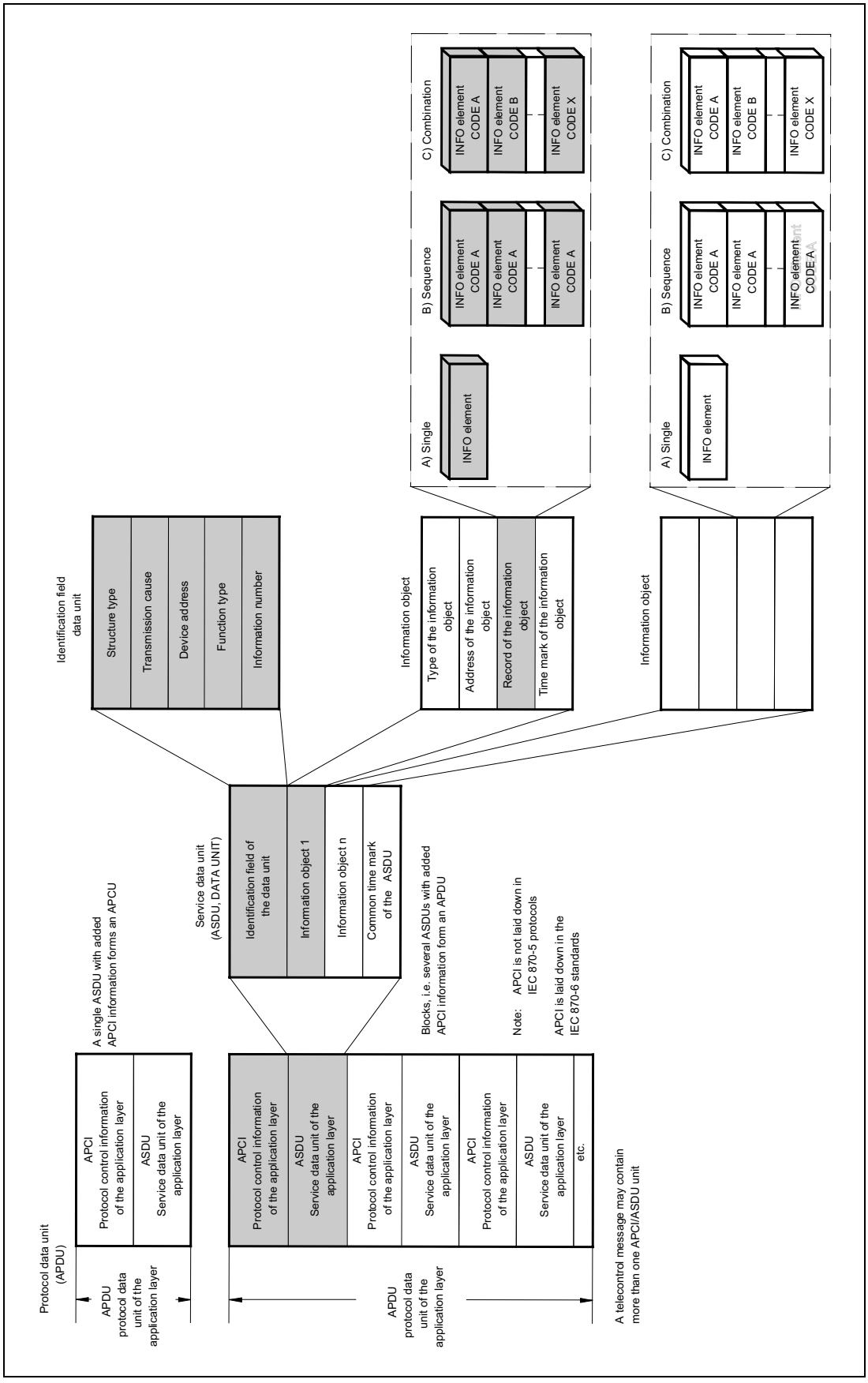
Only the FT 1.2 format is supported.

There are *three* different message types:

- Messages with variable length (long record) for the actual information transmission
- Messages with fixed length (short record) for the protocol control, such as data call-up
- Single characters, only one byte long, as acknowledgement without additional information

Message structure	
Message part	**Laid down in**
Header of the message Header of the data unit } Data Unit Information part } Conclusion of the message	IEC 870-5-2 IEC 870-5-103 IEC 870-5-103 IEC 870-5-2

Message structure at the application level according to IEC 870-5-103



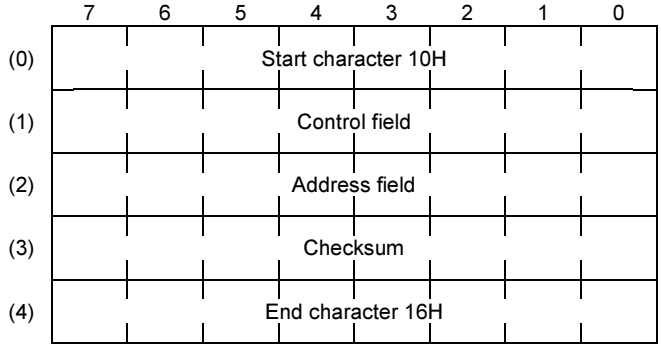
2.2.1. Message Formats

The message formats and rules relate to the IEC 60870-5-2 standard. Formats are defined for fixed and variable message lengths as well as single characters.

2.2.1.1. Messages with Fixed Block Length

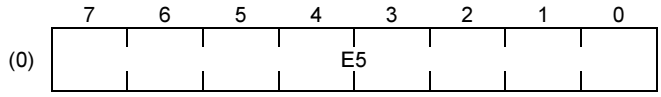
a) Block length <> 0

The message has a fixed length of 5 bytes and consists of a start character, a control field, an address field, a checksum and an end character.



b) Single characters (Block length = 0)

The single character consists of only one byte E5H.



c) Transmission rules for messages with fixed block lengths

R1 Idle state on the line corresponds to a 1 signal.

R2 Each character has a start bit (0 signal), 8 information bits, an even parity bit and a stop bit (1 signal).

R3 No idle states are permitted between the characters of a message.

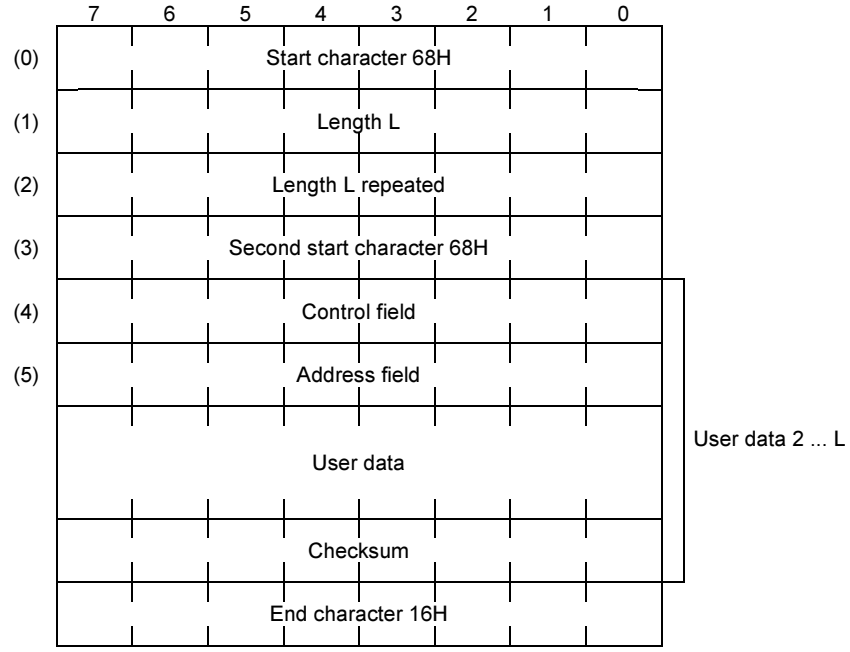
R4 If an error is detected in accordance with rule R6, a minimum gap of 33 bits is required in the idle state.

R5 The sequence of the user data characters is terminated by an 8-bit checksum (CS). The checksum is the arithmetic sum of all user data without taking account of the carry.

R6 The receiver checks:
Per character: Start bit, stop bit and an even parity bit
Per message: Start character, message checksum and end character as well as the duration of the idle state after detection of an error as given in R4. If one of these checks yields a negative result, the message is to be discarded, otherwise it is to be released to the user.

2.2.1.2. Messages with Variable Block Lengths

The format consists of an initial start character, two equal characters in which the number L of the user data is transmitted, a second start character, the checksum and the stop character. The number of user data bytes lies in the range 0 ... 255.



Transmission rules:

R1 Idle state on the line corresponds to a 1 signal.

R2 Each character has a start bit (0 signal), 8 information bits, an even parity bit and a stop bit (1 signal).

R3 No idle states are permitted between the characters of a message.

R4 If an error is detected in accordance with rule R6, a minimum gap of 33 bits is required in the idle state.

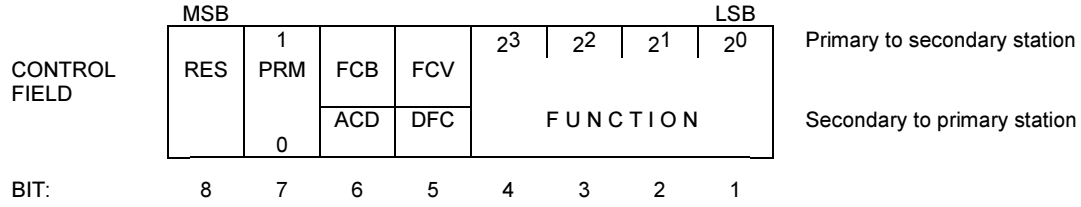
R5 The sequence of the user data characters is terminated by an 8-bit checksum (CS). The checksum is the arithmetic sum of all user data without taking account of the carry.

R6 The receiver checks:
Per character: Start bit, stop bit and an even parity bit
Per message:
- The start character laid down at the start and end of the message header
- The equality of the two length inputs L
- Whether the number of the received characters is equal to L + 6
- The message checksum
- The end character
- After detection of an error, the duration of the idle state as given in R4.

If one of these checks yields a negative result, the message is to be discarded, otherwise it is to be released to the user.

2.2.1.3. The Control Field

The control field contains information which indicates the direction of the message and the type of the intended service as well as information which supports the control functions in order to prevent loss or duplication of messages.



RES: Reserved

FCB: Message sequence bit (Frame Count Bit): 0, 1 = Alternating value for sequential SEND/CONFIRM or REQUEST/RESPOND services for each station.
The message sequence bit is used in order to prevent loss and duplication of messages: the primary station inverts the FCB on every new SEND/CONFIRM or REQUEST/RESPOND transmission service which is directed to the same secondary station. This is why the primary station keeps a copy of the message sequence bit for each secondary station. If an expected answer is mutilated or the time monitoring for it has expired (is absent) then the same SEND/CONFIRM or REQUEST/RESPOND service is repeated with the same message sequence bit.
By means of standardizing commands, FCB is always zero and, after receipt of these commands, the secondary station always expects that the next message of the primary to the secondary station with a valid FCB (FCV = 1) contains the complementary value of the FCB, i.e. FCB equals one.

FCV: Message sequence bit valid: 0 = Alternating function of the FCB is invalid
(Frame Count Bit valid) 1 = Alternating function of the FCB is valid

SEND/NO REPLY service, messages to all and other transmission services which tolerate the duplication or loss of information details do not change the FCB and show this by an FCB set to zero.

DFC: Data flow control: 0 = Further messages are accepted
(Data Flow Control) 1 = Further messages could cause a data overflow

Secondary (replying) stations indicate - to the primary station originating a message - that the immediate consequence of a further message could be a buffer overflow.

ACD: Access demand: Two classes of data are provided for transmission, namely Class 1 and Class 2
0 = No access demand on transmission of data of Class 1
1 = Access demand on transmission of data of Class 1

Secondary stations indicate to the primary station their desire to transmit data of Class 1.

PRM: Primary message: 0 = Message from a secondary (replying) station
(Frame Count Bit valid) 1 = Message from a primary (originating) station

Function codes of the control field in messages of the primary station (PRM = 1)

Function code no.	Message type	Service function	FCV
0	SEND-CONFIRM expected	Standardization of the connection layer of the secondary station	0
1	SEND-CONFIRM expected	Standardization of the user process	0
2	SEND-CONFIRM expected	Reserved for symmetrical transmission procedure	-
3	SEND-CONFIRM expected	User data	1
4	SEND-NO-REPLY expected	User data	0
5		Reserved	-
6 to 7		Reserved for special application as agreed	-
8	REQUEST after access demand	The access demand is laid down in the expected reply	0
9	REQUEST-RESPOND expected	Interrogation of the state of the connection layer	0
10	REQUEST-RESPOND expected	Interrogation of user data Class 1	1
11	REQUEST-RESPOND expected	Interrogation of user data Class 2	1
12 to 13		Reserved	-
14 to 15		Reserved for special application as agreed	-

Function codes of the control field in messages of the secondary station (PRM = 0)

Function code no.	Message type	Service function
0	CONFIRM	ACK; Positive acknowledgement
1	CONFIRM	NACK; Message not accepted, connection layer busy
2 to 5		Reserved
6 to 7		Reserved for special application as agreed
8	RESPOND	User data
9	RESPOND	NACK; interrogated data not available
10		Reserved
11	RESPOND	State of the connection layer or access demand
12		Reserved
13		Reserved for special application as agreed
14	—	Connection layer not working
15	—	Connection layer not present

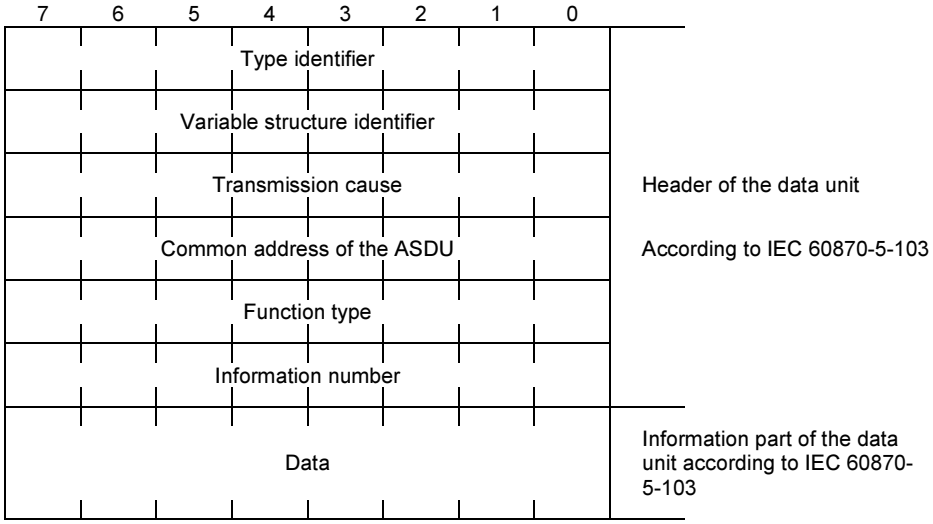
2.2.1.4. The Address Field

The address field contains the station address. It is transmitted in messages from stations which initiate a data transport service ("primary station") to receiving stations ("secondary stations") and contains the destination address. In messages which are transmitted from secondary stations, the address field contains the source address.

Address range: 0 ... 254
Address in messages to all stations: 255

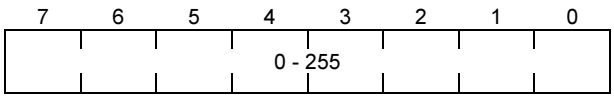
2.2.2. User Data

The user data (data unit) are constructed according to IEC 60870-5-103 as follows:



2.2.2.1. Type Identifier

The type identifier defines the format of the subsequent information objects.



Signalling direction (receive direction)

Type identifier	Name	Supported	
1	Realtime information, status information	X	
2	Realtime information with relative time	X	
3	Measured values I	X	
4	Realtime values with relative time	X	
5	Identification information	X	
6	Time synchronization, binary information	X	
8	GI end information	X	
9	Measured values II	X	
10	Generic data	X	1)
11	Generic identification		
23	Fault overview	X	
26	Ready for transmission of fault data	X	
27	Ready for transmission of a channel	X	
28	Ready for transmission of marks	X	
29	Transmission of marks	X	
30	Transmission of fault values	X	
31	End of the transmission	X	

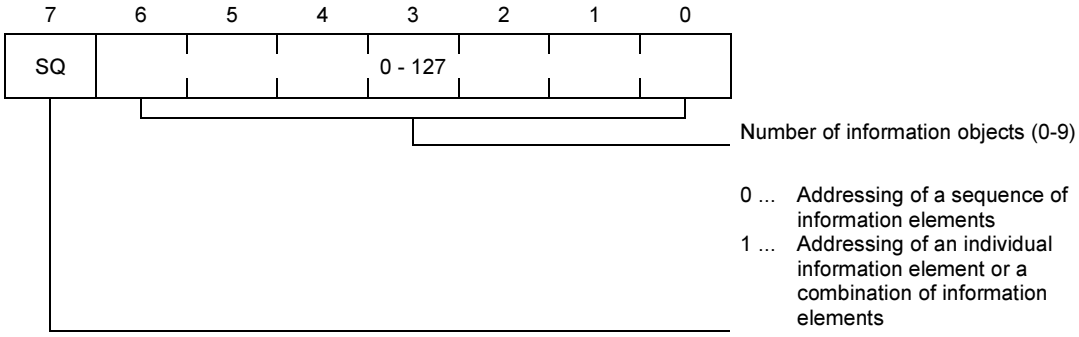
1) only data type = 7 (floating point) is supported

Command direction (send direction)

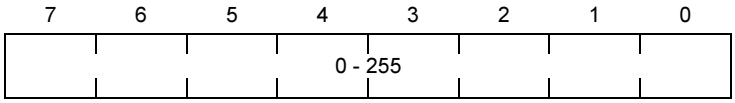
Type identifier	Name	Supported	
6	Time synchronization, command	X	
7	GI initiation	X	
10	Generic data	X	1)
20	General command	X	
21	Generic command	X	2)
24	Command for fault data transmission	X	
25	Acknowledgement for fault data transmission	X	

1) only data type = 7 (floating point) is supported
2) only for general interrogation command for generic data

2.2.2.2. Variable Structure Identifier



2.2.2.3. Transmission Cause



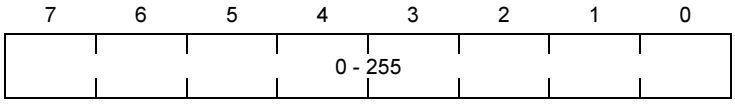
Signalling direction

Name	Transmission cause	Supported
Spontaneous	1	X
Cyclic	2	X
Standardizing information - FCB	3	X
Standardizing information - KE	4	X
Start/restart information	5	X
Initial start information	6	X
Test mode	7	X
Time synchronization, binary information	8	X
General interrogation	9	X
GI end information	10	X
On-site operation	11	
Remote operation	12	X
Status information to remote command positive	20	X
Status information to remote command negative	21	
Fault data transmission	31	X
Status information to generic write command positive	40	
Status information to generic write command negative	41	
Generic read; data valid	42	X
Generic read; data invalid	43	
Acknowledgement of a generic write command	44	

Command direction

Name	Transmission cause	Supported
Time synchronization, command	8	X
GI initiation	9	X
General command	20	X
Fault data transmission	31	X
Generic write command	40	X
Generic read command	42	

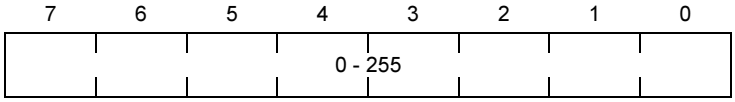
2.2.2.4. Common Address of the ASDU (Device Address)



0..... Not used
1 - 254 ..... Station number
255..... Station number "to all "

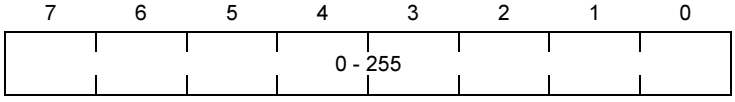
The IEC 60870-5-103 allows a different parameter setting of the CASDU and the link address (station number), therefore there are two parameter in the detailed routing (OPM, because it can be, that a protective device has several CASDU's and is reachable above the same link address (station number). However the CASDU and the link address can be parameterized in the same way.

2.2.2.5. Function Type



2.2.2.6. Information Number

A data point is uniquely addressed by means of the function type and the information number.



2.3. Message Conversion

The transformation of the message formats Ax 1703 ↔ IEC 60870-5-103 and the changing of the address information is know as message conversion.
The changing of the address information is done by means of the OPM (object-oriented process data manager) protocol fine routing.

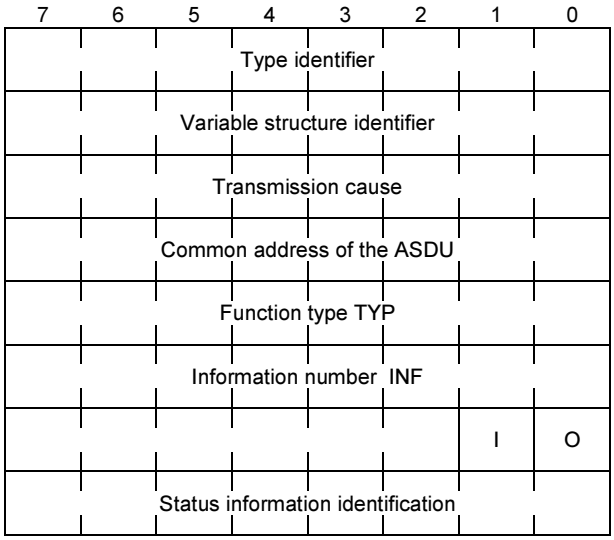
2.3.1. Message Conversion in the Send Direction: SAT Ax 1703 → IEC 60870-5-103

SAT Ax 1703		IEC 60870-5-103		
TI	**Name**	**Name**	**Type identifier**	
45 46	Single command Double command	General command Command to Alstom protective device Command with select before operate Command without select before operate	20 232 45, 46 45, 46	
45 46	Single command Double command	Resetting of the error locations	—	1)
50	Setpoint command, short floating point number	Setpoint, generic	10	
	General interrogation request	General interrogation command	7	
		General interrogation command, generic data	21	
142	User data container	—	—	
		Time synchronization	6	2)

1) Message is only assessed by the SIP and is not transmitted on the line.
2) Message is formed independently on the SIP.

2.3.1.1. General Command (TK = 20)

Message format IEC 60870-5-103:



1) Command coding

IEC 60870-5-103		Description
I	O	
0	0	Not relevant
0	1	OFF
1	0	ON
1	1	Not relevant

2) No special status information procedure is supported.

Supported SAT 1703 message formats:

- Single command (TI = 45)
- Double command (TI = 46)

Address conversion SAT 1703 → IEC 60870-5-103:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Send_command" is made available for this with the following entries.

SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 source address

Possible: 0 - 255

TI: Type identifier
Possible: 45 = Single command
46 = Double command

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 – 254

CAASDU: Common address of the ASDU
Possible: 0 – 254

FUN: Function type
Possible: 0 – 255

INF: Information number
Possible: 0 – 255

RII: Status information identification
Possible: 0 – 255

Additional info: Command type on the line
Possible: 0 = Command acc. to IEC 60870-5-103 (Type identifier = 20)
1 = Command to Alstom protective device with type identifier 232
2 = Command to Alstom protective device with type identifiers 45 and 46 with Select-Before-Operate
3 = Command to Alstom protective device with type identifiers 45 and 46 without Select-Before-Operate

Transpositions: Transposition of double commands
Possible: 0 = Do not transpose double command
1 = Transpose double command

RM_ÜW_t: Time for timeout for the command state information
The status information for the command output is timeout-monitored. If this timeout expires then the command is acknowledged with the transmission cause "Activation Confirmation Negative (URS = 7)" or "Activation Termination (URS = 10)".
Prerequisite for this monitoring is an identical address for the command and status information.
Possible: 0 = No monitoring
1 – 255 seconds

2.3.1.2. Control Location Input (old)

Control location over single command TI 45 not before revision 8.

With this message the control location can be adjusted.
The value of the measured value will be compared with the origin address of command, does it agree, the command will be further processed.
If an error occurs the command will be not further processed and a negative confirmation will be generated in control system direction.
Further several control locations can be set per station over the single command. With the "ON" command the control location is set and with the "OFF" command it is reset again.

Control location:

TI 45, in case of origin address
TI 35, in case of measured value

The confirmation/termination of this single command for the control location input is positive.

Supported SAT 1703 message formats:

- measured value, scaled value with time tag (TI = 35)
- single command (TI = 45)

Address conversion SAT 1703 → IEC 60870-5-103:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol detail routing the detail routing type "Send_control_location" is made available for this with the following entries.

SAT 1703 address:

CASDU1 CASDU2 IOA1 IOA2 IOA3	5-stage freely parameterizable SAT 1703 source address Possible: 0 - 255

TI: Type identifier
Possible: 35 = measured value, scaled value with time tag
45 = single command

IEC 60870-5-103 address

LINK address: For this link address the control location input is activated
Possible: 0 – 254

2.3.1.3. Control Location Input (new)

from revision 008.03

From this Revision it is possible to specify the control location over the system relevant protocol control (PST).
For further details see description DA0-048-1 (PST).

2.3.1.4. Resetting the Error Location Values

With this message, all routed measured values with relative time (error location values) of a link address can be reset to an initial value (parameterizable). The message is not sent on the line but is needed for the processing on the SIP.

Supported SAT 1703 message formats:

- Single command (TI = 45)
- Double command (TI = 46)

Address conversion SAT 1703 → IEC 60870-5-103:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Send_command_reset_Error locations" is made available for this with the following entries.

SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 source address
Possible: 0 - 255

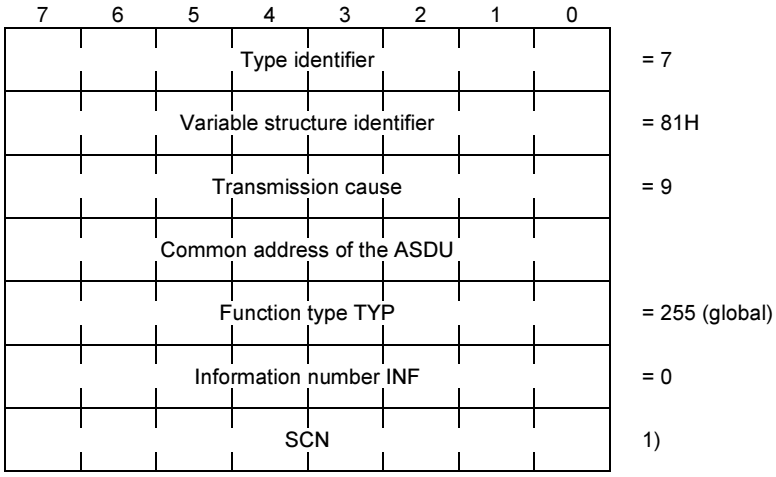
TI: Type identifier
Possible: 45 = Single command
46 = Double command

IEC 60870-5-103 address

LINK address: For this link address all error location values are reset to the initial value.
Possible: 0 – 254

2.3.1.5. General Interrogation Command

Message format IEC 60870-5-103:



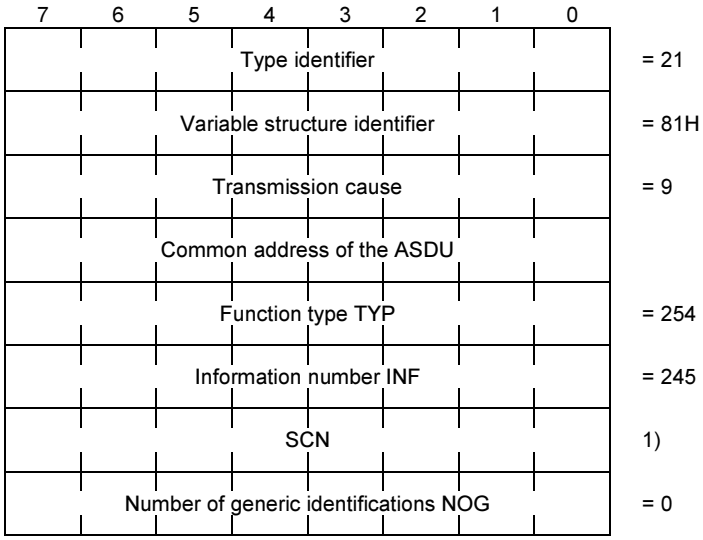
1) SCN: Cycle number
The cycle number is incremented - starting at 0 - with every GI initiation message. The protection device then issues all binary information items with URS = GI with the transferred cycle identifier. The cycle identifier in the binary information items, however, is not evaluated by the master.

The GI initiation is sent selectively for each CAASDU of the LINK address.

Supported SAT 1703 message formats:

- General interrogation request (Function Code 155)

2.3.1.6. General Interrogation Command, Generic Data



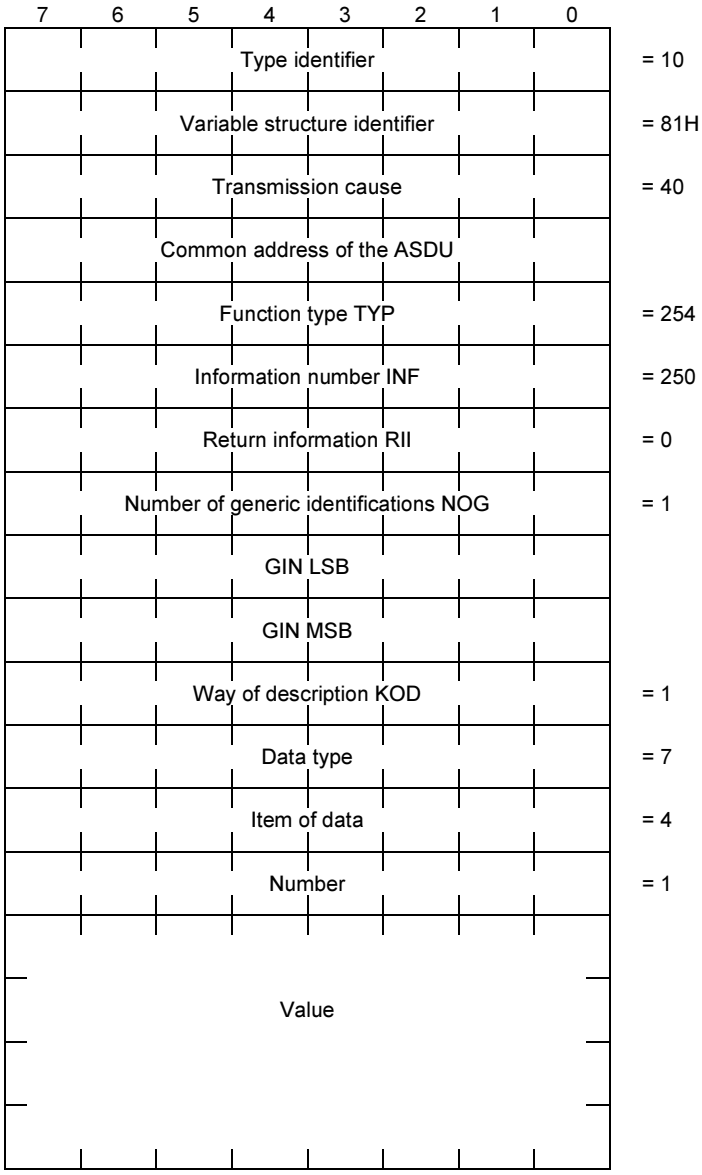
1) SCN: Cycle number
The cycle number is incremented - starting at 0 - with every GI initiation message. The protection device then issues all binary information items with URS = GI with the transferred cycle identifier. The cycle identifier in the binary information items, however, is not evaluated by the master.

The GI initiation is sent selectively for each CAASDU of the LINK address.

Supported SAT 1703 message formats:

- General interrogation request (Function Code 155)

2.3.1.7. Setpoint Command, Generic



Supported SAT 1703 message formats:

- Setpoint command, floating point (TI = 50)

2.3.1.8. Container Messages

The container messages are used for the transparent channelling through of IEC 60870-5-103 messages by the SAT 1703 system.

Supported SAT 1703 message formats:

- User data container (TI = 142)

Address conversion SAT 1703 → IEC 60870-5-103:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Send_container " is made available for this with the following entries.

SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 source address
Possible: 0 - 255

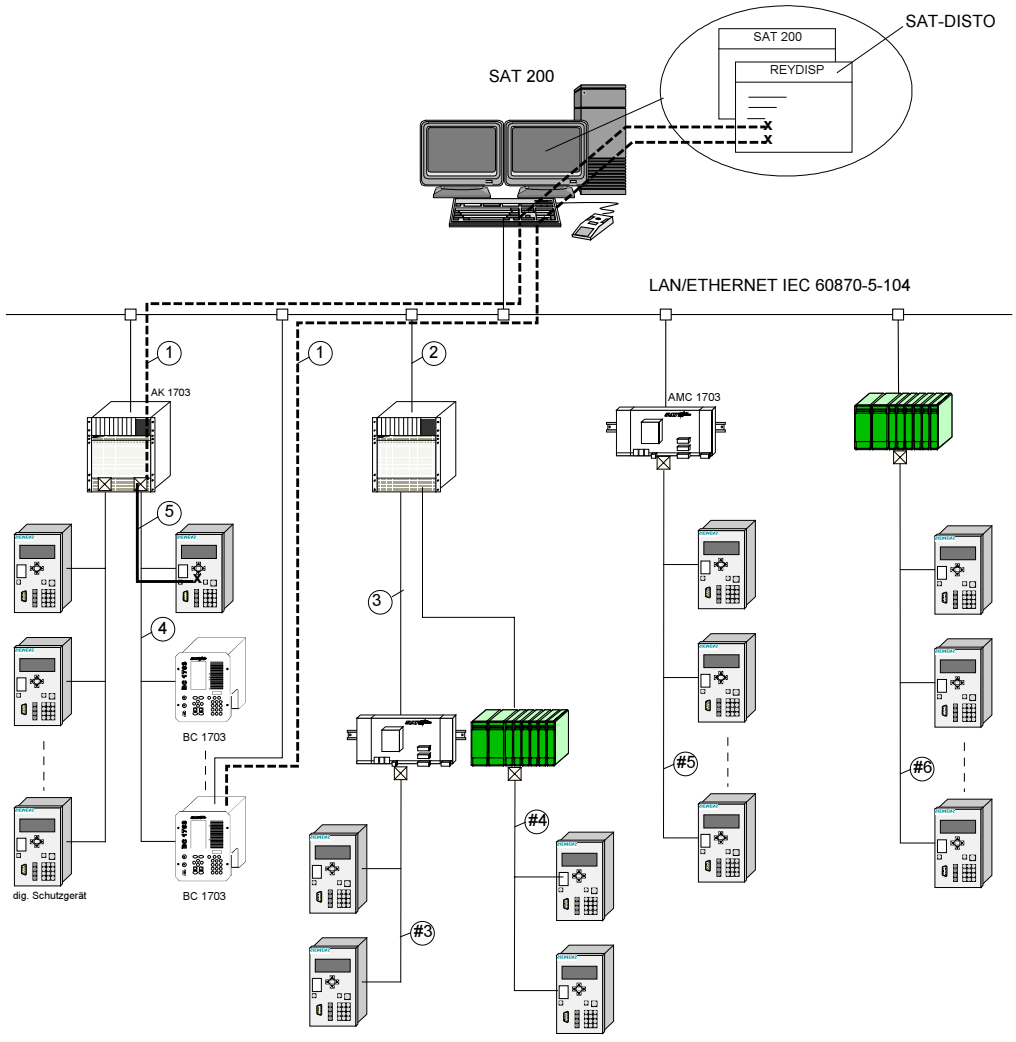
TI: Type identifier
Possible: 142 = User data container

IEC 60870-5-103 address

Container type: The container type must be parameterized here
Possible: 0 = Disturbance record container
1 = Reydisp container (see Appendix C)

2.3.1.8.1. Disturbance Record Container

Konfiguration:



(1) Transmission of disturbance records according to IEC 60870-5-103 with "Ax 1703 user data container" as a SAT internal transport telegram with IEC 60870-5-103 formats.
User data container = Ax 1703 user data container SK 1703 format (TI = 128)

(2) IEC870-5-104

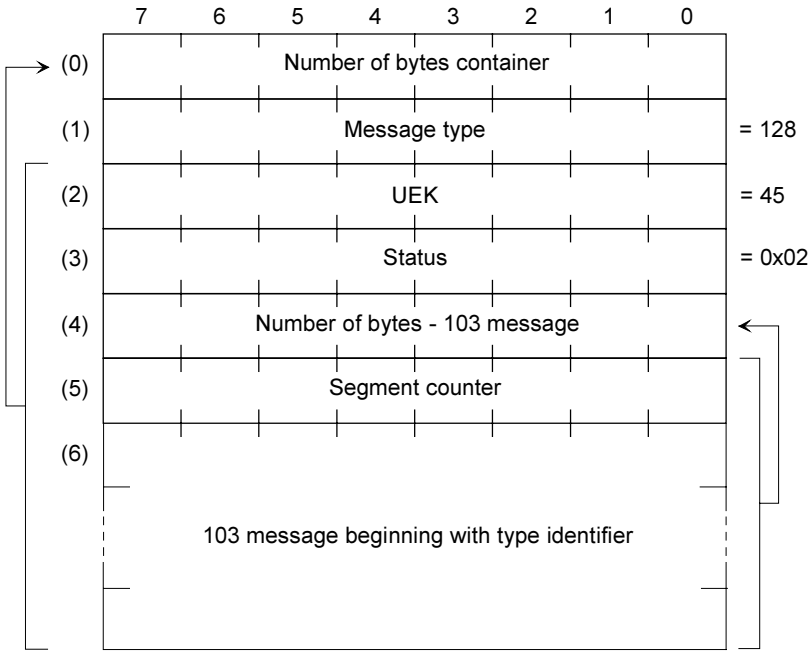
(3) i.e.: IEC870-5-101

(4) IEC870-5-103

(5) Disturbance record transmission according to IEC 60870-5-103

☒ 103M00 firmware

The user data of a SAT 1703 disturbance record container are structured as follows:

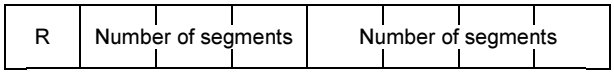


Number of bytes container: Number of user data bytes of the container beginning from UEK

Message type: 128 = SAT standard format

Number of bytes - 103 message: Number of user data bytes of the 103 message + 1

Segment counter: The segment counter is used for dividing 103 messages over 50 bytes into several user data containers.



R = Direction bit ..... 0 = Send direction (Ax 1703 → Protective device)
1 = Receive direction (Protective device → Ax 1703)

Number of segments..... Total number of the segments which are to be transmitted

Segment number..... Sequential number of the segment

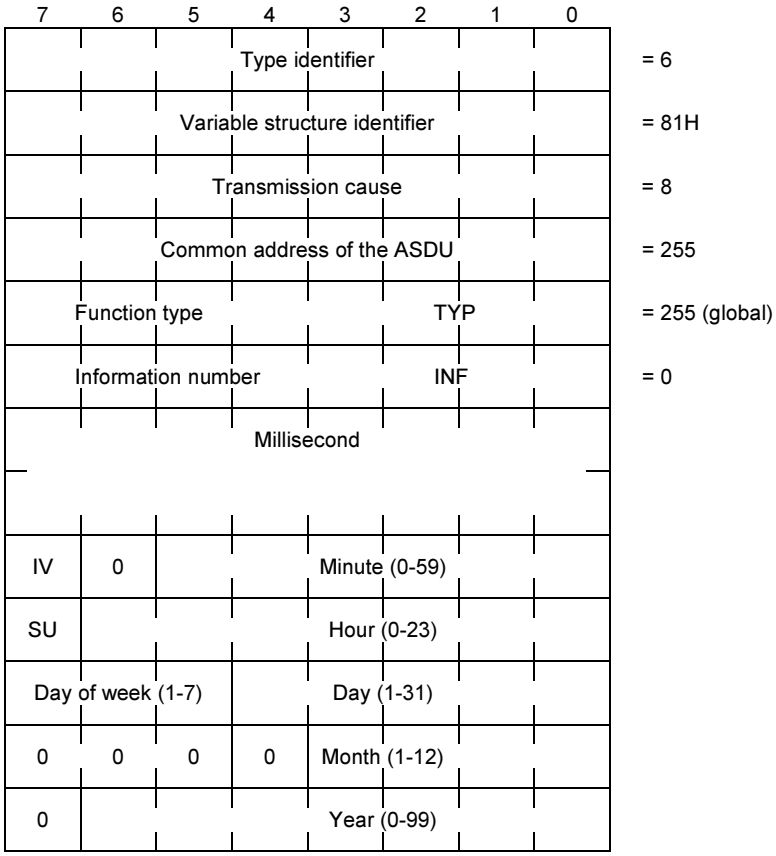
In the send direction, each message is always transmitted in only one segment (Number of bytes ≤ 50), i.e. the segment number usually has the value 11H.

2.3.1.8.2. Reydisp Container

See Appendix C

2.3.1.9. Time Synchronization

Message format IEC 60870-5-103:



SU....Summertime identifier

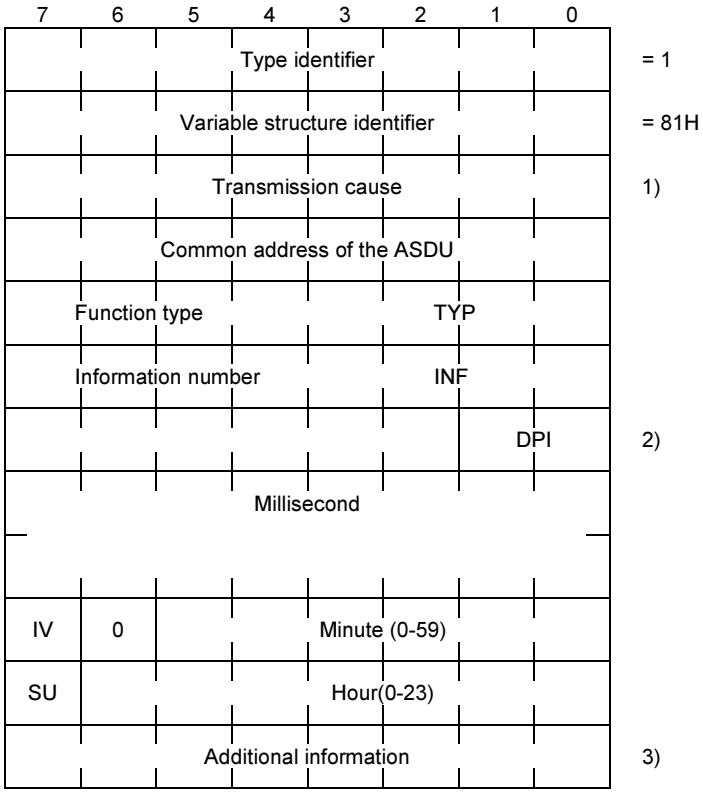
The time synchronization is always sent "To all" as SEND/NO REPLY in a parameterizable cyclic grid.

2.3.2. Message Conversion in the Receive Direction: IEC 60870-5-103 → SAT Ax 1703

IEC 60870-5-103		SAT 1703	
Type identifier	**Name**	**Name**	**TI**
1	Binary information with time mark	Single-point information with time tag Double-point information with time tag Event of protection equipment with time tag Packed start events of protection equipment with time tag Packed output circuit information of protection equipment with time tag	30 31 38 39 40
2	Binary information with relative time	Single-point information with time tag Double-point information with time tag Measured value, short floating point number Event of protection equipment with time tag Packed start events of protection equipment with time tag Packed output circuit information of protection equipment with time tag	30 31 36 38 39 40
3	Measured values I	Measured value, normalized value with time tag Measured value, scaled value with time tag Measured value, short floating point number	34 35 36
4	Realtime measured values with relative time	Measured value, normalized value with time tag Measured value, scaled value with time tag Measured value, short floating point number	34 35 36
5	Identification information	Single-point information with time tag Double-point information with time tag	30 31
6	Time synchronization, binary information	—	—
8	General interrogation end	—	—
9 140	Measured values II Measured values Siemens	Measured value, normalized value with time tag Measured value, scaled value with time tag Measured value, short floating point number	34 35 36
10	Generic data	Measured value, short floating point number with time tag	36
11	Generic identification	—	—
23	Fault event overview	User data container	142
26	Ready for transmission of fault data	User data container	142
27	Ready for transmission of a channel	User data container	142
28	Ready for transmission of marks	User data container	142
29	Transmission of marks	User data container	142
30	Transmission of fault values	User data container	142
31	Transmission end	User data container	142
205	Siemens Siprotech 28 bit measured value	Measured value, short floating point number with time tag Integrated totals with time tag	36 37
204	Reinhausen TAPCON 240 Measured value - short floating point	Measured value, short floating point number with time tag	36
33	Single point information with real-time SEG protective device	Single-point information with time tag Double-point information with time tag	30 31
65, 66 67, 68	Alstom single-point information RT/NRT Alstom double-point information RT/NRT	Single-point information with time tag Double-point information with time tag	30 31

2.3.2.1. Binary Information with Time Mark

Message format IEC 60870-5-103:



1) Conversion of the transmission cause:

IEC 60870-5-103		SAT 1703	
URS	**Name**	**URS**	**Name**
1	Spontaneous	3	Spontaneous
9	General interrogation	20	Interrogated by general interrogation
11	Local operation	12	Status information caused by a local command
12	Remote operation	11	Status information caused by a remote command

All binary information items with other transmission causes are discarded by the firmware.

2) Binary information coding:

IEC 60870-5-103	Ax 1703	
DPI	**DPI**	**Description**
0	0	Intermediate pos.
1	1	OFF
2	2	ON
3	3	Faulty position

3) Not evaluated:

Supported SAT 1703 message formats:

- Single-point information with time tag (TI = 30)
- Double-point information with time tag (TI = 31)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Receive_binary_information" is made available for this with the following entries.

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 - 254

CASDU: Common address of the ASDU
Possible: 0 – 254

FUN: Function type
Possible: 0 – 255

INF: Information number
Possible: 0 – 255

TYPE information: Definition of the converted data part
Possible: 0 = Realtime information
1 = Binary information for realtime information with relative time
2 = Relative time for realtime information with relative time
3 = Fault event number for realtime information with relative time

When routing a message with type identifier 1 (binary information with time mark), type identifier 33, 65, 66, 67, 68 (private TI from non SAT protective device), only type 0 (realtime information) is valid.

Additional info: Binary information type
Possible: 0 = Binary information coming/going
The routed binary information is forwarded according to its state.
1 = Binary information only coming
After forwarding of the received coming binary information, the going binary information is generated independently by the firmware with a time offset of + 1 ms.
2 = In accordance with the default setting (see Appendix A)

GI initiation: Initiation of a general interrogation command on receipt of this binary information
Possible: 0 = Do not initiate a GI based on this binary information
1 = Initiate GI on coming edge
2 = Initiate GI on going edge

Double-point information allocation:

With this parameterization, 2 received single-point information items can be converted to a double-point information.

Possible: 0 = Forward binary information according to protocol fine routing
1 = Allocate single-point information to Bit 0 of the double-point information
2 = Allocate single-point information to Bit 1 of the double-point information.

Caution: If 2 single-point information items are routed to a double-point information item then, for both single-point information items, the same SAT 1703 address must be parameterized.

Int./Fault suppression _t: Intermediate/fault suppression time

On receipt of an intermediate or fault position a monitoring time is started and the double-point information is not forwarded immediately. If, within the monitoring time, a switching state (ON or OFF) is received then this state is forwarded, the intermediate or fault position is discarded and the monitoring time is stopped. If no new switching state is received within the running monitoring time then, after it expires, the intermediate or fault position is transmitted.

Possible: 0 = No intermediate or fault position suppression time
1 – 255 (n * 100 ms)

SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

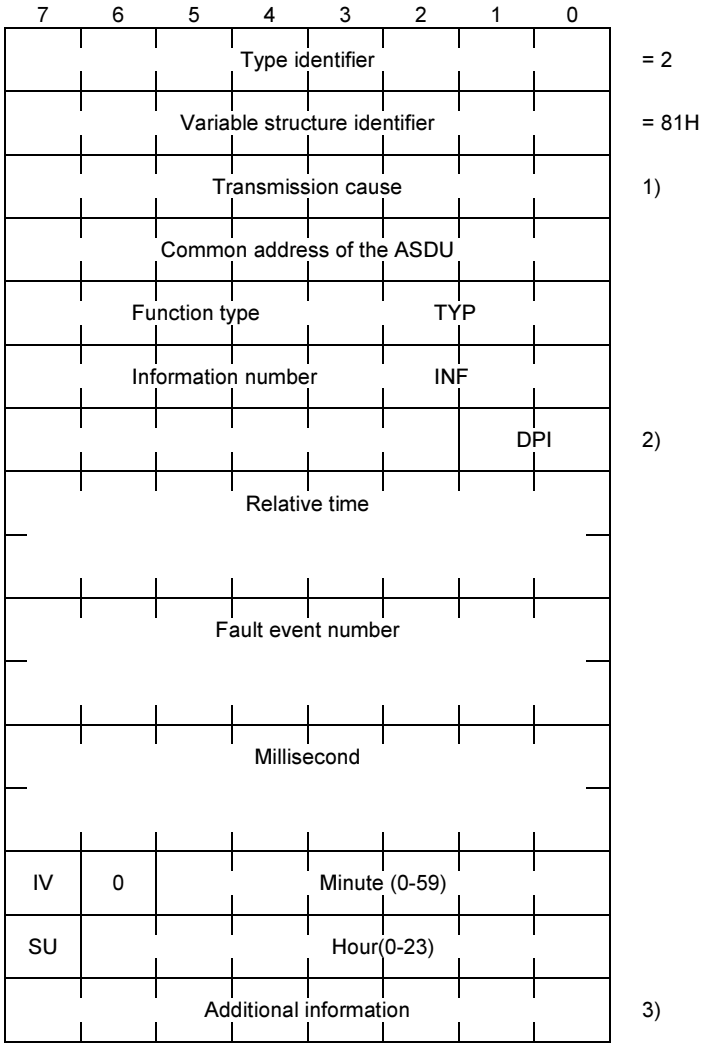
5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

TI: Type identifier

Possible: 30 = Single-point information with time tag
31 = Double-point information with time tag
38 = Event of protection equipment with time tag

2.3.2.2. Binary Information with Relative Time

Message format IEC 60870-5-103:



1) Conversion of the transmission cause:
   For transmission as realtime information: see Binary information with Time Mark,
   for transmission of the relative time or fault event number: for transmission cause not equal to general interrogation (= 9) always forward with URS = 3 (spontaneous). Messages with general interrogation as the transmission cause are discarded.
2) Binary information coding: see Binary information with Time Mark
3) Not evaluated.

Supported SAT 1703 message formats:

- Single-point information with time tag (TI = 30)
- Double-point information with time tag (TI = 31)
- Measured value, short floating point number with time tag (TI = 36)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing, as for binary information items with time marks, the fine routing type "Receive_binary_information" is made available for this with the following entries.

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 - 254

CASDU: Common address of the ASDU
Possible: 0 – 254

FUN: Function type
Possible: 0 – 255

INF: Information number
Possible: 0 – 255

TYPE information: Definition of the converted data part
Possible: 0 = Realtime information
1 = Binary information for realtime information with relative time
2 = Relative time for realtime information with relative time
3 = Fault event number for realtime info. with relative time

When routing a message with Type Identifier 2 (binary information with relative time) only types 1-3 are valid. If, for binary information with relative time, both the binary information and the relative time plus the fault event number should be transmitted, then 3 fine routing records must be generated.

Additional info: Binary information type
Possible: 0 = Binary information coming/going
The routed binary information is forwarded according to its state.
1 = Binary information only coming
After forwarding of the received coming binary information, the going binary information is generated independently by the firmware with a time offset of + 1 ms.
2 = In accordance with the default setting (see Appendix A)

This parameterization only applies to routing records for binary information items (not for relative time and fault event number).

GI initiation: Initiation of a general interrogation command on receipt of this binary information
Possible: 0 = Do not initiate a GI based on this binary information
1 = Initiate GI on coming edge
2 = Initiate GI on going edge

This parameterization only applies to routing records for binary information (not for relative time and fault event number).

Double-point information allocation: With this parameterization, 2 received single-point information items can be converted to a double-point information.
Possible: 0 = Forward binary information according to protocol fine routing
1 = Allocate single-point information to Bit 0 of the double-point information
2 = Allocate single-point information to Bit 1 of the double-point information.

Caution: If 2 single-point information items are routed to a double-point information then the same SAT 1703 address must be parameterized for both single-point information items,.

This parameterization only applies to routing records for binary information (not for relative time and fault event number)

Int./Fault suppression _t: Intermediate/fault suppression time
On receipt of an intermediate or fault position a monitoring time is started and the double-point information is not forwarded immediately. If, within the monitoring time, a switching state (ON or OFF) is received then this state is forwarded, the intermediate or fault position is discarded and the monitoring time is stopped. If no new switching state is received within the running monitoring time then, after it expires, the intermediate or fault position is transmitted.
Possible: 0 = No intermediate or fault position suppression time
1 – 255 (n * 100 ms)

This parameterization only applies to routing records for binary information (not for relative time and fault event number)

SAT 1703 address:

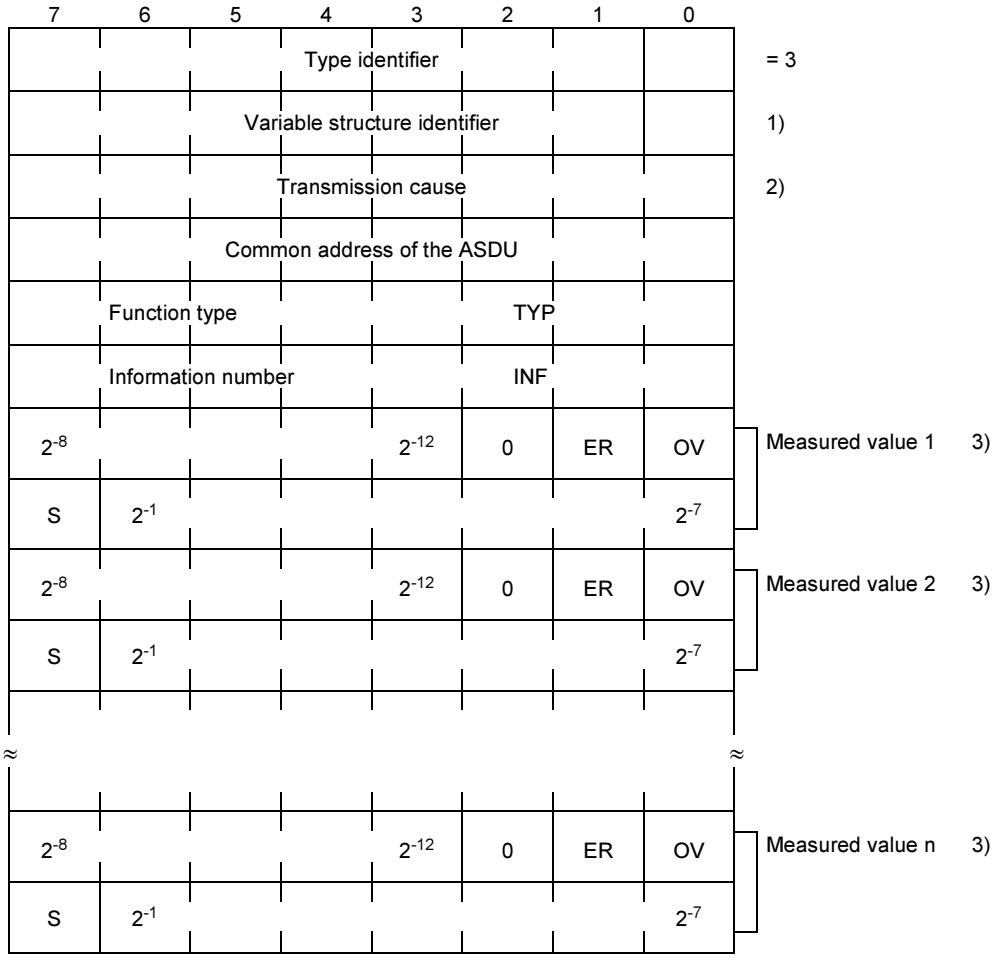
CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

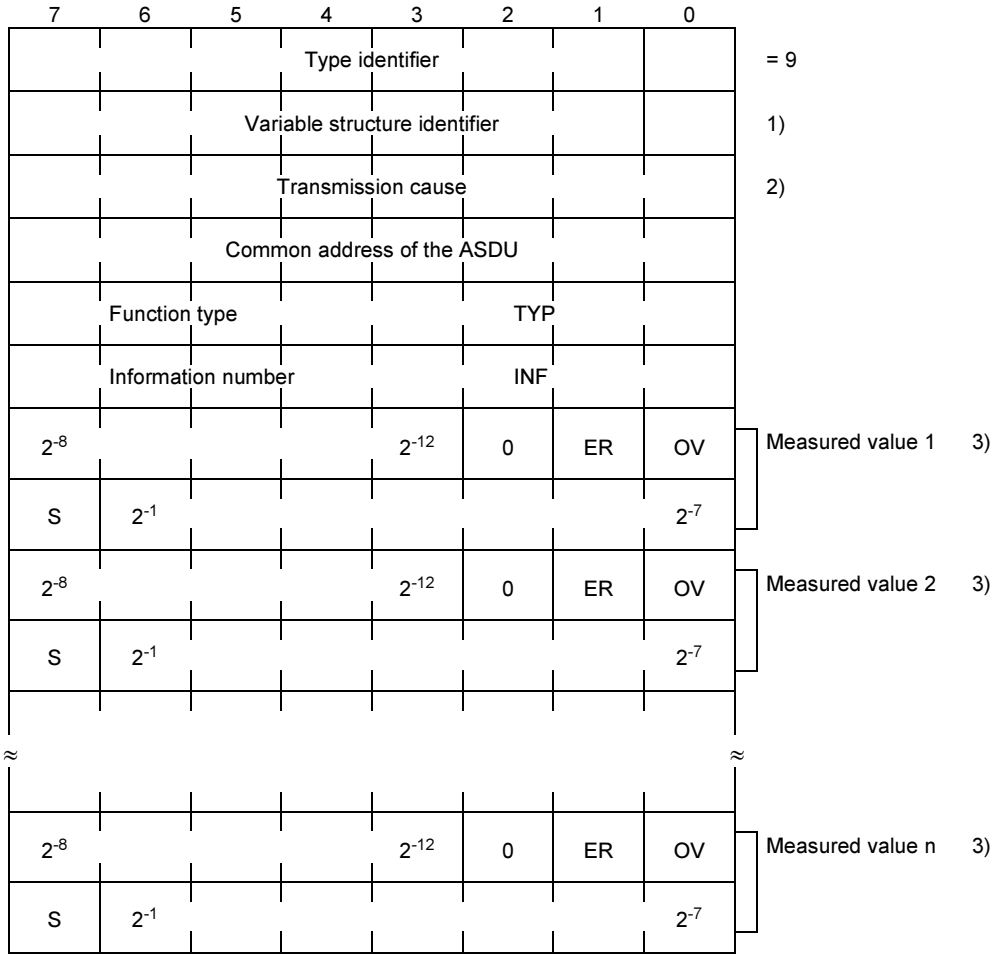
TI: Type identifier
Possible: 30 = Single-point information with time tag
31 = Double-point information with time tag
36 = Measured value, short floating point number with time tag
38 = event of protection equipment with time tag

2.3.2.3. Measured Values

Message format IEC 60870-5-103 for measured values I:



Message format IEC 60870-5-103 for measured values II:



1) Bit 8 = 0, Bit 1–7 according to number
2) Transmission cause is not evaluated
3) OV.....Overflow: Converted into an overflow of the data point quality descriptor of the Ax 1703 message
ER.....Error: Converted into an invalid of the data point quality descriptor of the Ax 1703 message
S.....Sign (0 = pos., 1 = neg.): values are in two's complement

Supported SAT 1703 message formats:

- Measured value, normalized value with time tag (TI = 34)
- Measured value, scaled value with time tag (TI = 35)
- Measured value, short floating point number with time tag (TI = 36)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Receive_measured_value " is made available for this with the following entries.

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 - 254

CASDU: Common address of the ASDU
Possible: 0 – 254

FUN: Function type
Possible: 0 – 255

INF: Information number
Possible: 0 – 255

TYP measured value: Definition of the converted data part
Possible: 0 = Measured Value I or Measured Value II
1 = Measured value for realtime value with relative time
2 = Relative time for realtime value with relative time
3 = Fault event number for realtime value with relative time

When routing a message with Type Identifier 3 (Measured Value I) or Type Identifier 9 (Measured Value II) or type identifier 140 (measured values Siemens), only Type 0 (Measured Value I or Measured Value II) is valid.

Sub-value: The sub-value defines the position of the measured value within the message
Possible: 0 – 255

Threshold_additive: Allocation of the thresholds for additive change monitoring.
On the SIP, 16 different thresholds can be parameterized for the additive change monitoring. At this place, one of these 16 thresholds can be allocated to the measured value (see also "General Protocol Functions - Change Monitoring ")
Possible: 0 – 15

Factor_k and Offset_d: Measured value adaption
With these values, a measured value adaption can be carried out in accordance with the formula k . x + d.

SAT 1703 address:

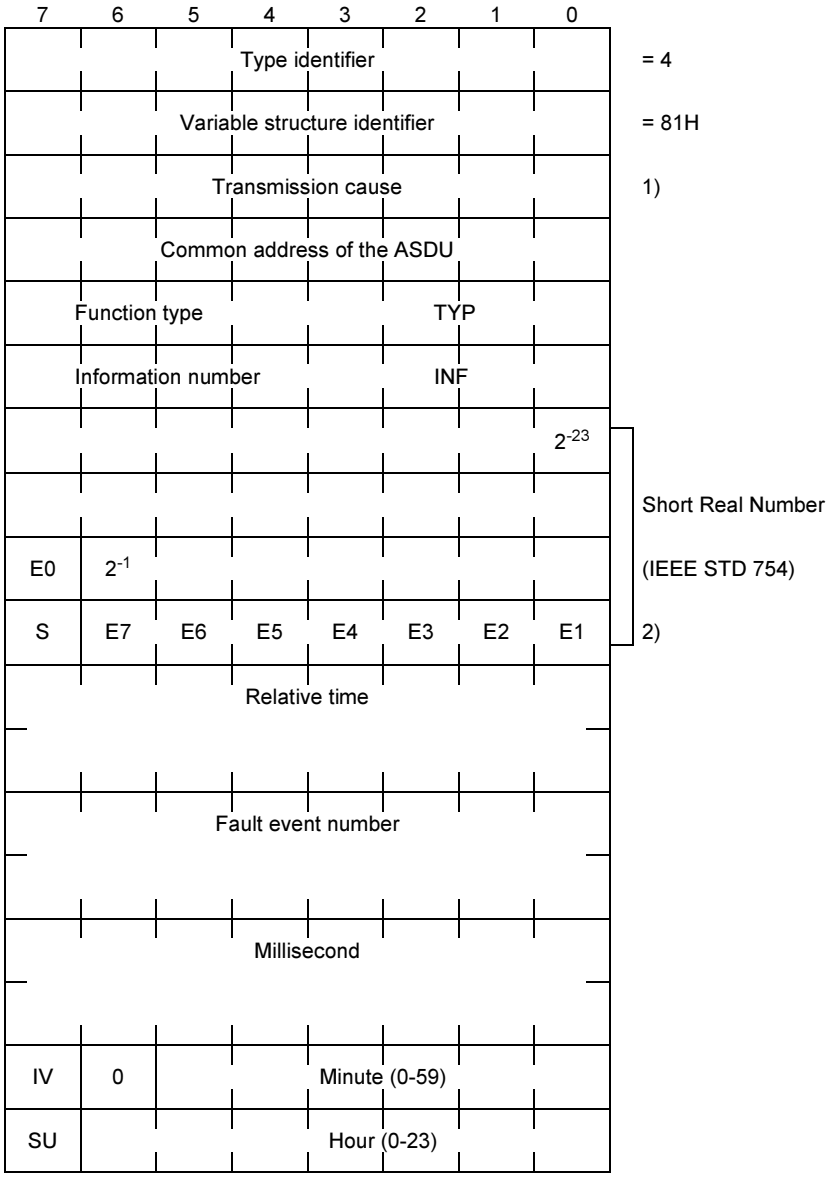
CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

TI: Type identifier
Possible: 34 = Measured value, normalized value with time tag
35 = Measured value, scaled value with time tag
36 = Measured value, short floating point number with time tag

2.3.2.4. Realtime Measured Value with Relative Time

Message format IEC 60870-5-103:



1) Transmission cause is not evaluated
2) S ... Sign (0 = pos., 1 = neg.): values are in two's complement

Supported SAT 1703 message formats:

- Measured value, normalized value with time tag (TI = 34)
- Measured value, scaled value with time tag (TI = 35)
- Measured value, short floating point number with time tag (TI = 36)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Receive_measured_value " is made available for this with the following entries.

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 - 254

CASDU: Common address of the ASDU
Possible: 0 – 254

FUN: Function type
Possible: 0 – 255

INF: Information number
Possible: 0 – 255

TYP measured value: Definition of the converted data part
Possible: 0 = Measured Value I or Measured Value II
1 = Measured value for realtime value with relative time
2 = Relative time for realtime value with relative time
3 = Fault event number for realtime value with relative time

When routing a message with Type Identifier 4 (realtime measured value with relative time) only types 1-3 are valid. If, for a realtime measured value with relative time, both the measured value and the relative time and the fault event number should be transmitted then 3 fine routings must be generated.

Sub-value: Of no significance for the fine routing of realtime measured values with relative time.

Threshold _additive: Of no significance for the fine routing of realtime measured values with relative time.

Factor_k and Offset_d: Measured value adaption
With these values, a measured value adaption can be carried out in accordance with the formula k . x + d.

This parameterization only applies to routing records for measured values (not for relative time and fault event number).

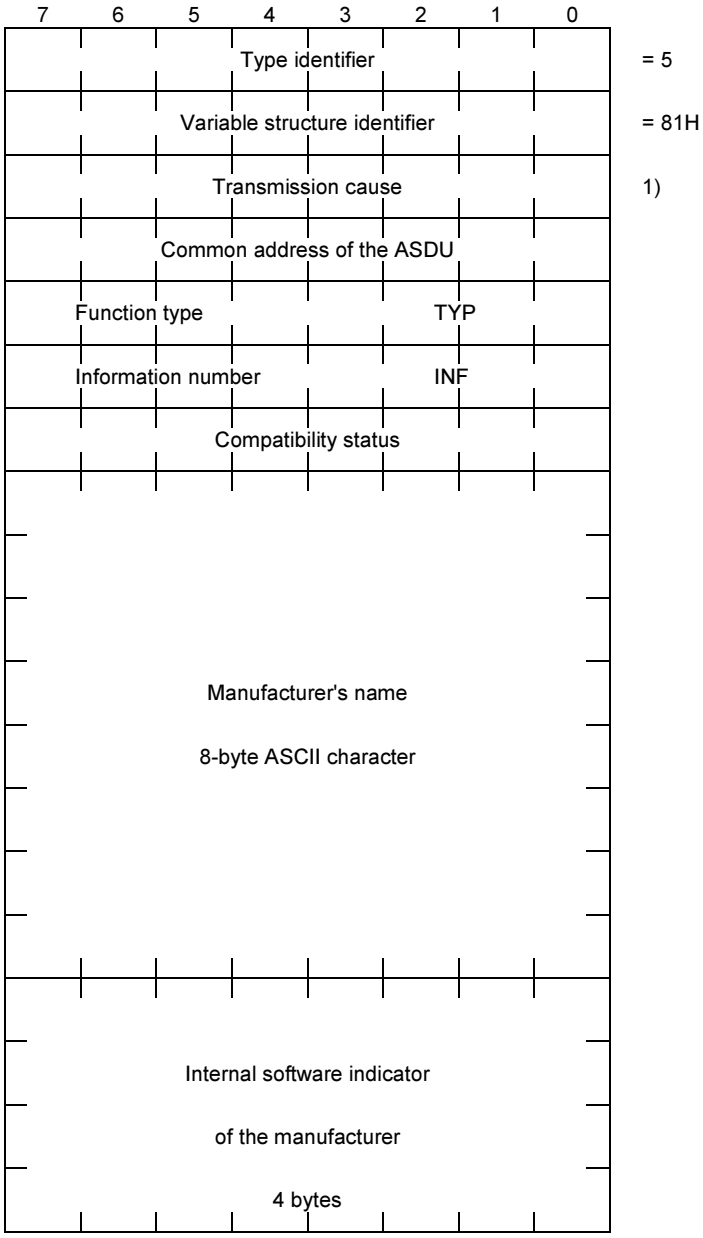
SAT 1703 address:

CASDU1 CASDU2 IOA1 IOA2 IOA3	5-stage freely parameterizable SAT 1703 destination address Possible: 0 - 255

TI: Type identifier
Possible: 34 = Measured value, normalized value with time tag
35 = Measured value, scaled value with time tag
36 = Measured value, short floating point number with time tag

2.3.2.5. Identification Information

Message format IEC 60870-5-103:



1) For supported transmission cause - see Message Conversion

Supported SAT 1703 message formats:

- Single-point information with time tag (TI = 30)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing the fine routing type "Receive_ID_binary_information " is made available for this with the following entries.

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 - 254

CASDU: Common address of the ASDU
Possible: 0 – 254

TYPE information: Definition of the converted message
Possible: 0 = Identification information
A coming/going information is generated with the entered SAT 1703 destination address.
Caution: The conversion to an identification information is only done for received transmission cause "Start/restart information (URS = 5)" and "Initial start information (URS = 6)"
1 = Compatibility status comparison information
The compatibility status entered in the message is compared with that entered in the fine routing (field: Comp_status). If the compatibility status entered in the message is lower than the parameterized one then a coming information item is generated, if it is higher or equal a going information item is generated.

Comp_status: Compatibility status with which the one entered in the message is compared.

SAT 1703 address:

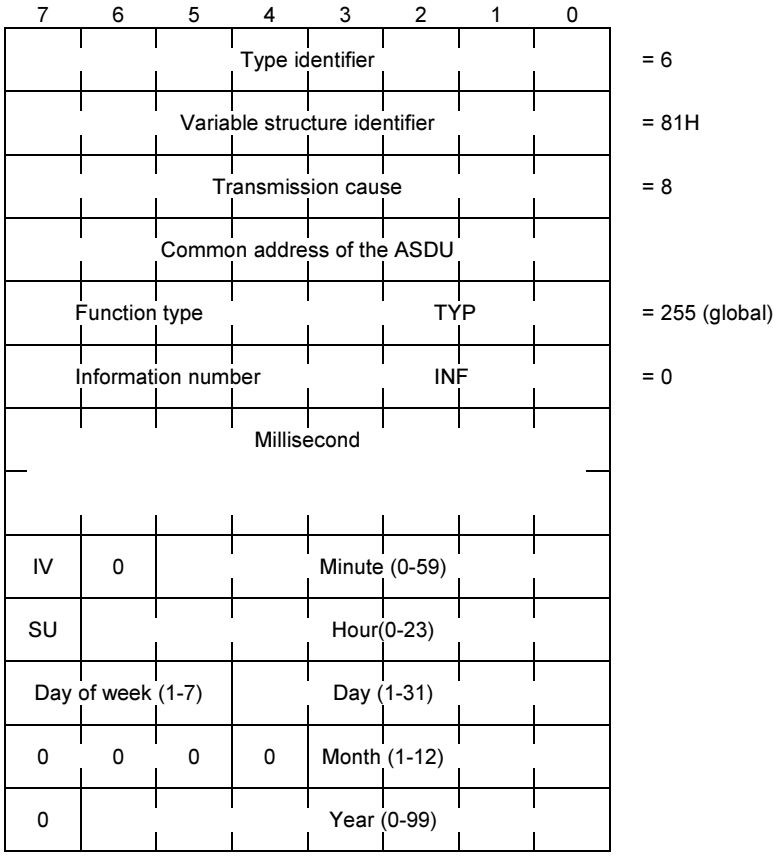
CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

TI: Type identifier
Possible: 30 = Single-point information with time tag

2.3.2.6. Time Synchronization, Binary Information

Message format IEC 60870-5-103:

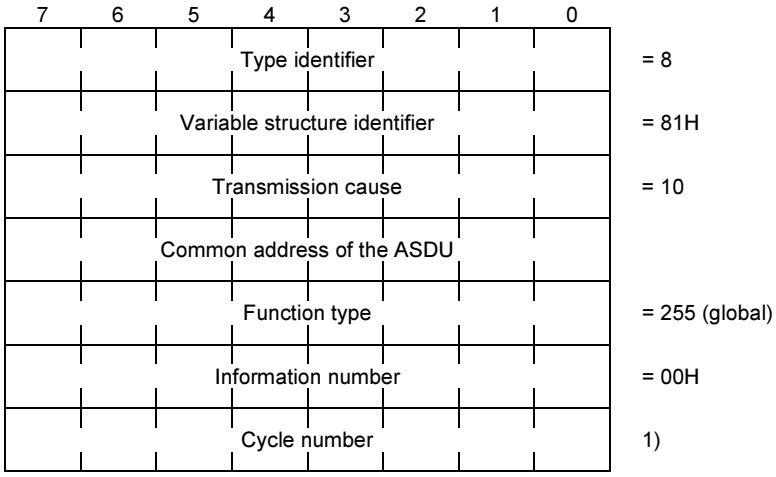


SU ... Summertime identifier

This message is not forwarded into the SAT 1703 system.

2.3.2.7. General Interrogation End

Message format IEC 60870-5-103:



1) From the GI initiation message

This message is not forwarded into the SAT 1703 system.

2.3.2.8. Disturbance Record Messages

The following disturbance record messages are supported by the firmware:

- Fault event overview (TK = 23)
- Ready for transmission of fault data (TK = 26)
- Ready for transmission of a channel (TK = 27)
- Ready for transmission of marks (TK = 28)
- Transmission of marks (TK = 29)
- Transmission of fault values (TK = 30)
- Transmission end (TK = 31)

Message format IEC 60870-5-103: see standard

Supported SAT 1703 message formats:

- User data container (TI = 142)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing, the fine routing type "Receive_container " is made available for this with the following entries.

Container type: The container type must be parameterized here.
Possible: 0 = Disturbance record container
3 = Reydisp container (see appendix C)

TYP: Type identifier for which the container should be transmitted
(only for IEC 60870-5-103 container)
Possible: 1 = Binary information with time mark
2 = Binary information with relative time
3 = Measured Value I
4 = Realtime measured value with relative time
9 = Measured Values II

The type identifier is not used for the transmission of disturbance record messages.

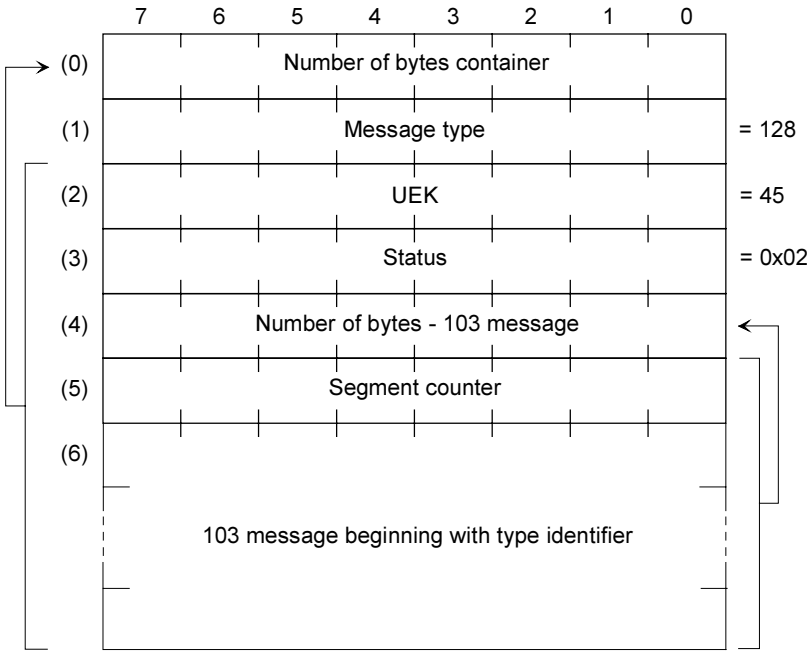
SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

TI: Type identifier
Possible: 142 = User data container

The user data of a SAT 1703 disturbance record container are converted as follows:

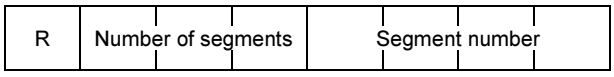


Number of bytes - container: Number of user data bytes of the container starting from UEK

Message type: 128 = SAT standard format

Number of bytes - 103 message: Number of user data bytes of the 103 message + 1

Segment counter: The segment counter is used for dividing 103 messages over 50 bytes into several user data containers.



R = Direction bit..... 0 = Send direction (Ax 1703 → Protective device)
1 = Receive direction (Protective device → Ax 1703)

Number of segments.... Total number of segments to be transmitted

Segment number..... Sequential number of the segment

2.3.2.9. IEC 60870-5-103 Container Messages (Event Information)

The following 103 messages can be forwarded as IEC 60870-5-103 container messages:

- Binary information with time mark (TI = 1)
- Binary information with relative time (TI = 2)
- Measured Values I (TI = 3)
- Realtime measured value with relative time (TI = 4)
- Measured Values II (TI = 9)

In this process, the 103 messages are routed onwards transparently in a user data container.

Supported SAT 1703 message formats:

- User data container (TI = 142)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing, the fine routing type "Receive_container " is made available for this with the following entries.

Container type: The container type must be parameterized here.
Possible: 2 = IEC 60870-5-103 container

TYP: Type identifier for which the container should be transmitted
Possible: 1 = Binary information with time mark
2 = Binary information with relative time
3 = Measured Value I
4 = Realtime measured value with relative time
9 = Measured Values II

If all type identifiers should be transmitted then 5 fine routing records must be generated, however these can have the same address.

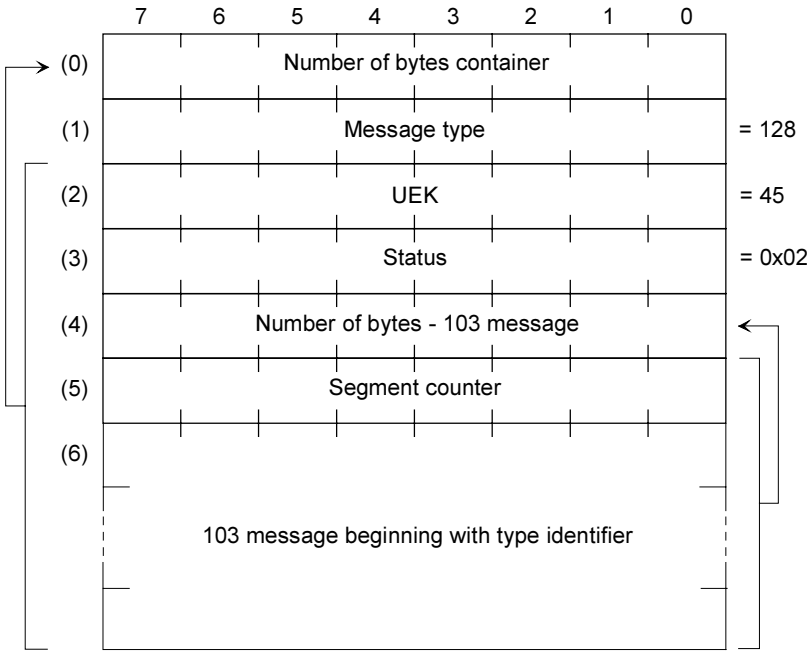
SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

TI: Type identifier
Possible: 142 = User data container

The user data of a SAT 1703 IEC 60870-5-103 container are converted as follows:

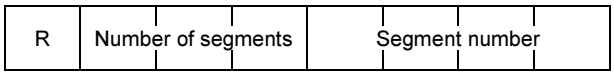


Number of bytes - container: Number of user data bytes of the container starting from UEK

Message type: 128 = SAT standard format

Number of bytes - 103 message: Number of the user data bytes of the 103 message + 1

Segment counter: The segment counter is used for dividing 103 messages over 50 bytes into several user data containers.

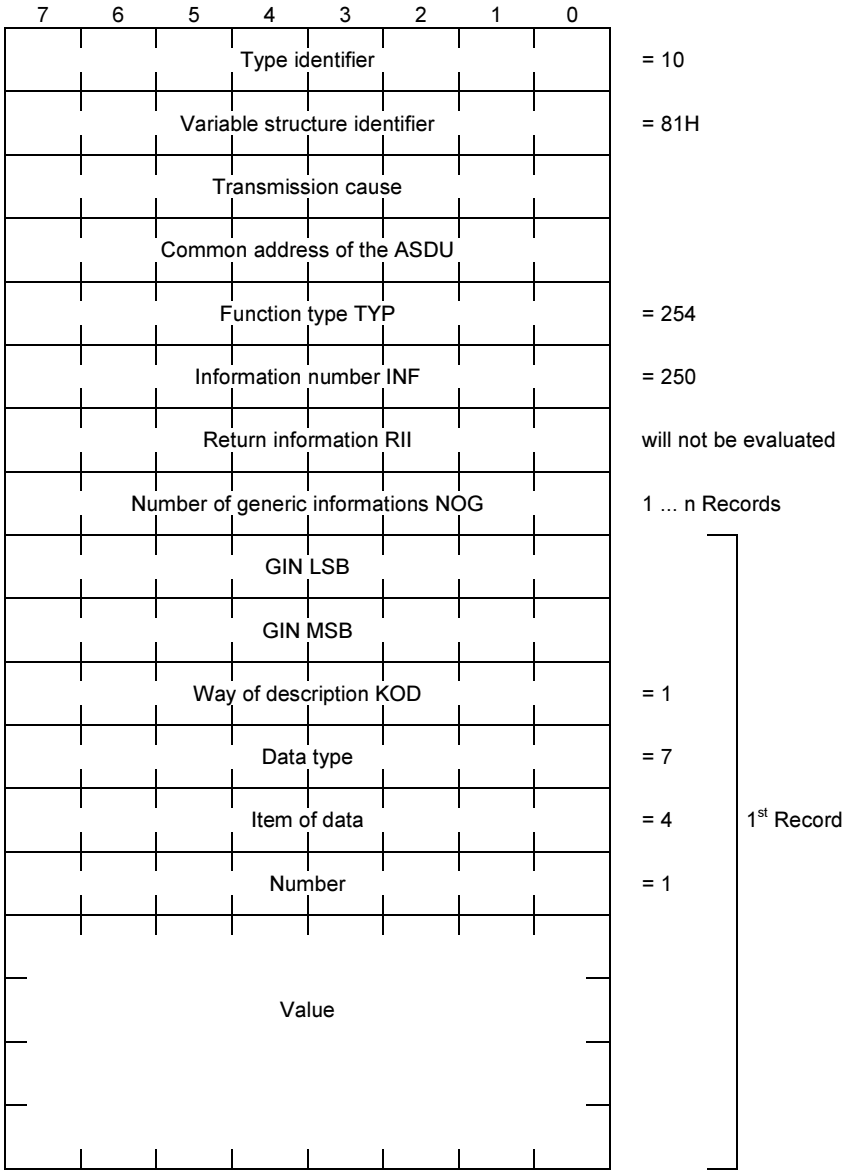


R = Direction bit..... 0 = Send direction (Ax 1703 → Protective device)
1 = Receive direction (Protective device → Ax 1703)

Number of segments.... Total number of segments to be transmitted

Segment number..... sequential number of the segment

2.3.2.10. Measured Value, Generic



Supported SAT 1703 message formats:

- Measured value, short floating point number with time tag (TI = 36)

2.3.2.11. Blocked Start Events and Tripping of Protection

There are 2 variations of conversion (system-technical parameter).

Variation 1:

The packed start events of protection equipment or packed output circuit of protection equipment will be passed with every change of an single event within the telegram. The relative time is the respective relative time from the protection device

Variation 2:

The packed start events of protection equipment or packed output circuit of protection equipment will be passed only after receiving the falling edge of the general start of operation or general command to output circuit. The relative time is the relative time from the protection device within the telegram of the falling edge of general start of operation or general command to output circuit. If there is no falling edge the telegram will be passed after a timeout of 60 seconds. The relative time is the relative time of the last change in the telegram.

Note: According to IEC 60870-5-103 the general trip/pick-up is only a raising edge binary information.
→ In this case the telegram is always passed only after 60 seconds.

Supported SAT 1703 message formats:

- Packed start events of protection equipment with time tag (TI = 39)
- Packed output circuit information of protection equipment with time tag (TI = 40)

Address conversion IEC 60870-5-103 → SAT 1703:

The address conversion is parameterized by means of the OPM (object-oriented process data manager). In the protocol fine routing, the fine routing type "Rec_packed_start_event_output_circuit" is made available for this with the following entries.

IEC 60870-5-103 address

LINK address: Link address on the line
Possible: 0 - 254

CASDU: Common address of the ASDU
Possible: 0 – 254

FUN: Function type
Possible: 0 – 255

INF: Information number
Possible: 0 – 255

SPI-bit (103): There it can be choosen, which bit is meant in message TI39 or TI40.
- general start of operation (only TI39)
- start of operation L1 (only TI39)
- start of operation L2 (only TI39)
- start of operation L3 (only TI39)
- start of operation in reverse direction (only TI39)
- general command to output circuit (only TI40)
- command to output phase L1 (only TI40)
- command to output phase L2 (only TI40)
- command to output phase L3 (only TI40)

SAT 1703 address:

CASDU1
CASDU2
IOA1
IOA2
IOA3

5-stage freely parameterizable SAT 1703 destination address
Possible: 0 - 255

TI: Type identifier
Possible: 39 = Packed start events of protection equipment with time tag
40 = Packed output circuit information of protection equipment with time tag

3. General Protocol Functions

3.1. Station Initialization

According to IEC 60870-5-103

Whether only a "Normed KE" or "Normed KE and "Normed FCB" should be sent can be parameterized (in this case, a switch is made from "Normed FCB" to "Normed KE" after an interface fault and after expiry of a parameterized time).

3.2. General Interrogation

The GI request is sent to all CASDUs of the addressed link address.

3.3. Acknowledgement Behaviour

Each other message (e.g. "Single command") must be actively acknowledged by the receiver if it has been recognized as being error-free.

Only positive acknowledgement is made. Negative acknowledgements correspond to an absence of the acknowledgement within a certain time (acknowledgement expectation time).

Accepted as an acknowledgement is:

- a short record (with additional information in the control field)
- a single character (E5H)

3.4. Retry Behaviour

If the acknowledgement for a message is absent when the line is not faulty, this message is repeated n-times (n = configurable number).

The FCB bit (record sequence bit) is used for the retry handling. In normal operation, the FCB bit is complemented for each message.

3.5. Interface Monitoring

The interface monitoring is ensured by the polling structure.

3.6. Redundancy

By means of the Ax redundancy it is possible to set the firmware into standby operation. In the standby situation, all services running on the SIP are cancelled and all messages which are on the SIP or are newly arriving are positively acknowledged by the BSE.
In addition, all messages received via the interface are forwarded in the SAT 1703 system.

3.7. Measured Value Change Monitoring

So as not to load the transmission equipment unnecessarily, the values are monitored in accordance with the following rules:

- The value determined first is transmitted immediately
- Each change in the status of the measured value (valid/invalid/overrange) triggers an immediate transmission
- For valid measured values, the additive threshold value method is used for the change monitoring.

Additive threshold method:

For this method, 2 thresholds can be set:

- Large threshold, and
- Additive threshold

If the deviation from the last transmitted value is greater than the large threshold then the new value is transmitted immediately.

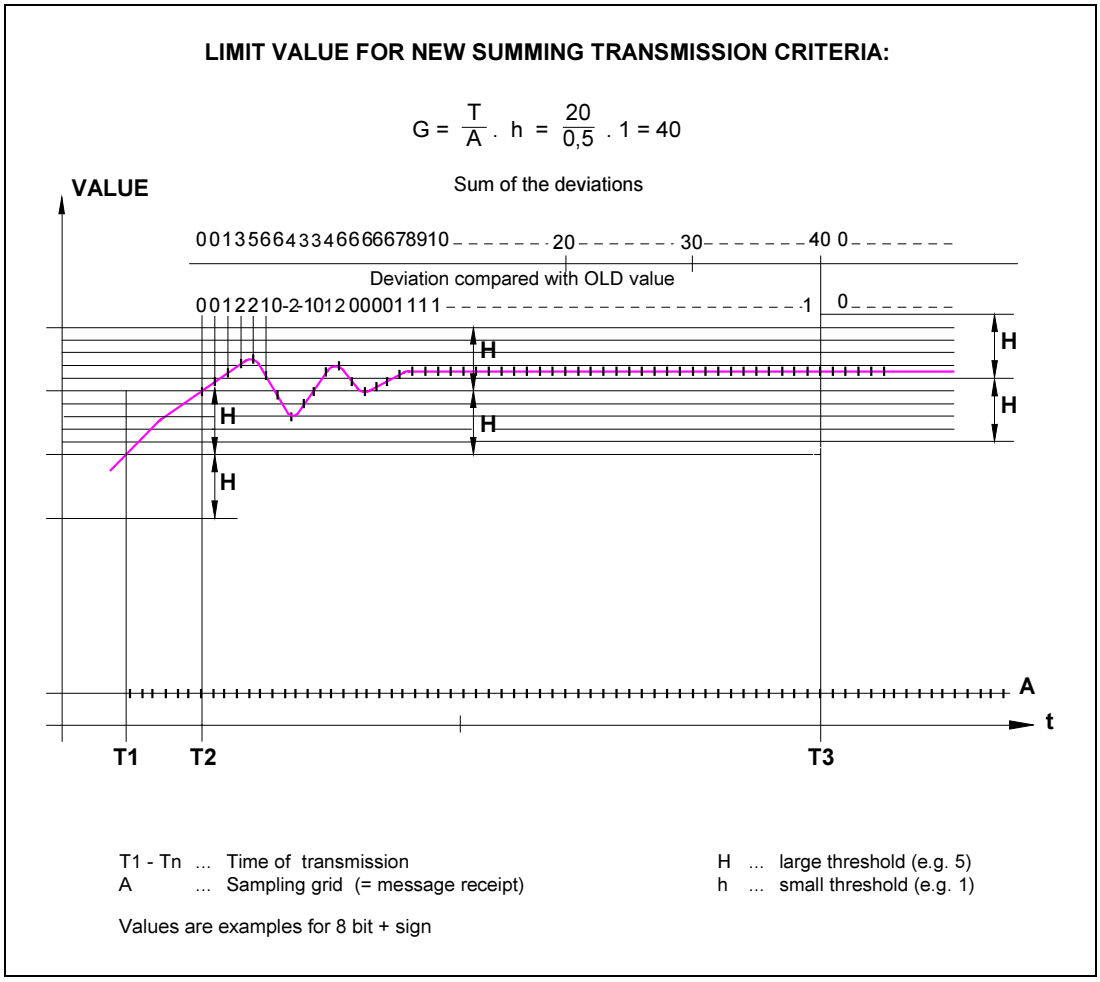
Otherwise, the deviations from the last transmitted value are added according to sign at each sampling time. Only if this total exceeds the set limit value (additive threshold) is a transmission with the current (new) value initiated.

The advantage of this method is that the time to the next transmission of the value is proportional to the average change, i.e. values with greater change are transmitted earlier than values with less change.

Additive change monitoring

In operational stress situations it gives:

- firstly, all large alterations spontaneously for transmission, and
- only afterwards, the precise last state of the measured amounts with simultaneous suppression of measured value fluctuations to reduce the line loading.



A. Appendix: Definition of the "Coming/Going" Binary Information Assignment According to IEC 60870-5-103

The "coming/going" binary information assignment is predefined according to IEC 60870-5-103 in the firmware for the default function types and default information numbers:

Default function types:

Function type	Name
128	Distance protection - medium voltage
144	Distance protection - high voltage
160	UMZ / AMZ
176	Transformer differential protection
192	Line differential protection
208	Busbar protection

Default information numbers:

Information number	Name	Come / go
16	AR switched on	Come / go
17	Protection signal transmission on	Come / go
18	Protection effective	Come / go
19	Display reset	Come
20	Signal / measured value disabling	Come / go
21	Check/test mode	Come / go
22	On-site parameterization running	Come / go
23	Characteristic 1	Come / go
24	Characteristic 2	Come / go
25	Characteristic 3	Come / go
26	Characteristic 4	Come / go
27	Binary information 1 from peripheral	Come / go
28	Binary information 2 from peripheral	Come / go
29	Binary information 3 from peripheral	Come / go
30	Binary information 4 from peripheral	Come / go
32	Measured value monitoring I	Come / go
33	Measured value monitoring U	Come / go
35	Rotary field monitoring U	Come / go
36	Output circuit monitoring	Come / go
37	UMZ emergency operation	Come / go
38	U-circuit miniature circuit breaker tripping	Come / go
39	Signal transmission section faulty	Come / go
46	Warning sum information	Come / go
47	Fault sum information	Come / go
48	Earth fault - L1	Come / go
49	Earth fault - L2	Come / go
50	Earth fault - L3	Come / go
51	Earth fault - Direction forwards / line	Come / go
52	Earth fault - Direction backwards / busbar	Come / go
64	Activation - L1	Come / go
65	Activation - L2	Come / go
66	Activation - L3	Come / go
67	Activation - N	Come / go
68	General off	Come
69	Off command - L1	Come
70	Off command - L2	Come
71	Off command - L3	Come
72	Off via UMZ-emergency	Come
74	Error - Forwards/line	Come
75	Error - Backwards/busbar	Come
76	Protection signal - Signal sent	Come
77	Protection signal - Signal received	Come
78	Time step t1 distance protection	Come
79	Time step t2 distance protection	Come
80	Time step t3 distance protection	Come
81	Time step t4 distance protection	Come
82	Time step t5 distance protection	Come
83	Time step t6 distance protection	Come
84	General activation	Come / go
85	Switch failure protection responded	Come
86	Measuring system L1 OFF	Come
87	Measuring system L2 OFF	Come
88	Measuring system L3 OFF	Come
89	Measuring system LE OFF	Come
90	Off I >	Come
91	Off I >>	Come
92	Off In >	Come
128	AR – On remote	Come
129	Long time AR – On remote	Come
130	AR disabled	Come / go

B. Appendix: Bibliography

The following documents are recommended to supplement the "103M00" description:

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

DIN EN 60870-5-101 "Fernwirkeinrichtungen und Fernwirksysteme" [Telecommunications equipment and telecommunications systems]
Section 103: Application-related standards for the information interface of protection devices

German version 1996

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

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

SAT Description: "IEC 60870-5-103 Interoperability"
Item number: DA0-063-r.xx

DIN 19244 "Fernwirkeinrichtungen und Fernwirksysteme" [Telecommunications equipment and telecommunications systems]
Part 10: Message Formats

DIN 19244 "Fernwirkeinrichtungen und Fernwirksysteme" [Telecommunications equipment and telecommunications systems]
Part 52: Transmission Procedures of the Connection Layer

DIN 19244 "Fernwirkeinrichtungen und Fernwirksysteme" [Telecommunications equipment and telecommunications systems]
Part 53: Transmission Protocol
Main section 3: General Structure of the Application Data

C. Appendix: REYDISP Container

C.1. General Technical Concept

The integration of Reyrolle protective devices and the SAT automation/control centre system consists essentially of the following functions:

- IEC 870-5-103 in Reyrolle ARGUS and MODULAR-II
  In Reyrolle protective devices of the "ARGUS, MODULAR-II" series, the IEC 870-5-103 protocol implementation is expanded by the following items:

  — All data in the "private range" in accordance with IEC 870-5-103 (GENERIC SERVICES are not used)
  — Disturbance record in accordance with IEC 870-5-103

  Note: The parameterization of the Reyrolle protective devices is still carried out in the proprietary Reyrolle format in the private range.

- Reyrolle REYDISP
  For the parameterization of Reyrolle protective devices, REYDISP is used under Windows-NT/2000. REYDISP should be capable of being used on SAT-200 and transmit the parameter data from/to the protective devices via special "parameter containers" transparently via SAT-250 and SAT-1703.

  Expansions required:

  — "REYDISP parameter container mode" via TCP/IP socket interface to SAT-200
  — CLI interface
  — WEB-browser-capable

- SAT-200
  For the parameterization of Reyrolle protective devices, REYDISP is used under Windows-NT. REYDISP should be capable of being used on Windows-based SAT-200 control centre systems and transmit the parameter data from/to the protective devices via special "parameter containers" transparently via SAT-200 and SAT-1703.

  Expansions required:

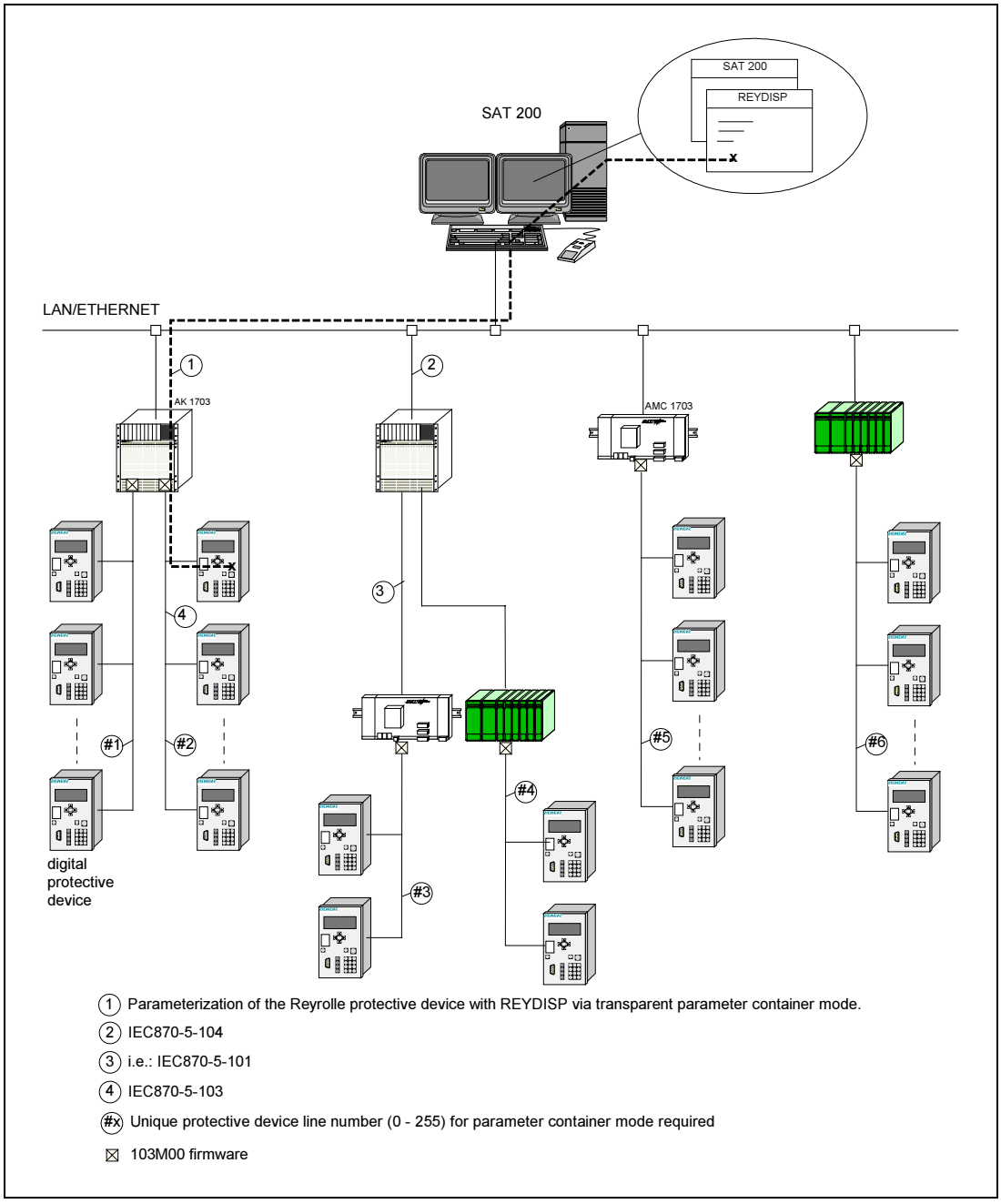
  — Parameter container mode via TCP/IP socket interface in SAT-200
  — WEB-browser technology

- SAT-1703
  For the parameterization of Reyrolle protective devices, a transparent "parameter container mode" is to be implemented in the SAT Ax-1703 protocol firmware "IEC 870-5-103 master protocol".

  Expansions required:

  — "REYDISP parameter container mode" in "103M00" protocol firmware

Configuration:



Comment:
In this requirements document, SAT-200 is used as the "general term" for SAT control centre systems. In the following chapters, the respective control centre system (SAT-250, SAT-230) is then specially gone into in detail.

AM-1703 with "Network-Interface Ethernet 10/100TX (SM1554)" and *AMC-1703 "Data nodes" are not yet available at the current time! (see Product Deadlines)!*

C.1.1. Restrictions

- REYDISP parameter container mode is not supported by SK-1703.
- REYDISP parameter container mode cannot be used on the SAT-250 workstation (SUN Solaris).
  (REYDISP is only available as a WINDOWS application)
- REYDISP supports only the "single user concept".
  (only 1 REYDISP can be active at any one time)

C.2. IEC 60870-5-103 in Reyrolle ARGUS and MODULAR-II

In the following Reyrolle protective devices, the IEC 870-5-103 protocol implementation is expanded:

- ARGUS series
- MODULAR-II series (inc. MICRO TAPP)
- Solkor-N (new protective device series - currently under development)

The IEC 870-5-103 protocol implementation in Reyrolle protective devices is expanded by the following items:

- All data in the "private range" in accordance with IEC 870-5-103
  Comment:
  GENERIC SERVICES are not used for the transmission of data in the "private range". The "private data" of the protective devices are to be transmitted with the “type identifiers” defined in IEC 870-5-103:
  Monitor direction:
  <01> := time tagged message
  <02> := time tagged message with relative time
  <04> := time tagged measurand with relative time
  <09> := measurands II

- Disturbance records in accordance with IEC 870-5-103
  The disturbance records are to be transmitted with the “type identifiers” and "procedures" defined in IEC 870-5-103:
  Control direction:
  <24> := order for disturbance data transmission
  <25> := acknowledgement for disturbance data transmission
  Monitor direction:
  <23> := list of recorded disturbances
  <26> := ready for transmission of disturbance data
  <27> := ready for transmission of a channel
  <28> := ready for transmission of tags
  <29> := transmission of tags
  <30> := transmission of disturbance values
  <31> := end of transmission

- Parameterization of Reyrolle protective devices
  The parameterization of the Reyrolle protective devices is still carried out in the proprietary Reyrolle format in the "private range".
  Control direction:
  <254> := REYDISP parameter frames
  <255> := REYDISP parameter "last frame“
  Monitor direction:
  <253> := REYDISP termination of private data response frame
  <254> := REYDISP parameter frames
  <255> := REYDISP parameter "last frame“

C.3. Parameter Container in SAT Ax 1703

For the serial interfacing of protective devices in SAT Ax-1703 the new Ax-1703 protocol firmware IEC870-5-103 "Master" (Firmware: 103M00) is used.

For the parameterization of Reyrolle protective devices with "parameter containers" the "REYDISP parameter container mode" is to be implemented in the SAT Ax-1703 protocol firmware 103M00 (IEC 870-5-103 master protocol).
Parallel to the "disturbance record containers (for the transparent transmission of IEC 870-5-103 messages to SAT-DISTO)" a "parameter container" is managed for each line for parameter data from/to Reyrolle protective devices.
All data sent from REYDISP to a protective device via parameter container mode are sent out by the protocol firmware at the next possible moment and, for station-selective addressed data, the subsequent reply from the protective device is likewise sent back to REYDISP via parameter container.
Parameter containers to non-parameterized station addresses are not sent out by the protocol firmware.
In addition, all ASDUs received from the protective devices which are not recognized in the receive direction are transmitted transparently in parameter containers to REYDISP.
For the parameterization of Reyrolle protective devices, this is all messages with type identification <253>, <254> and <255>.

Message format for REYDISP parameter container:

- Ax 1703: "user data container" TYPE IDENTIFICATION 142
  (The user data container is used for the channelling through of non-SAT computer messages).

  In the SAT Ax-1703 system, REYDISP parameter containers are transmitted as "user data containers".

Address parameter container:

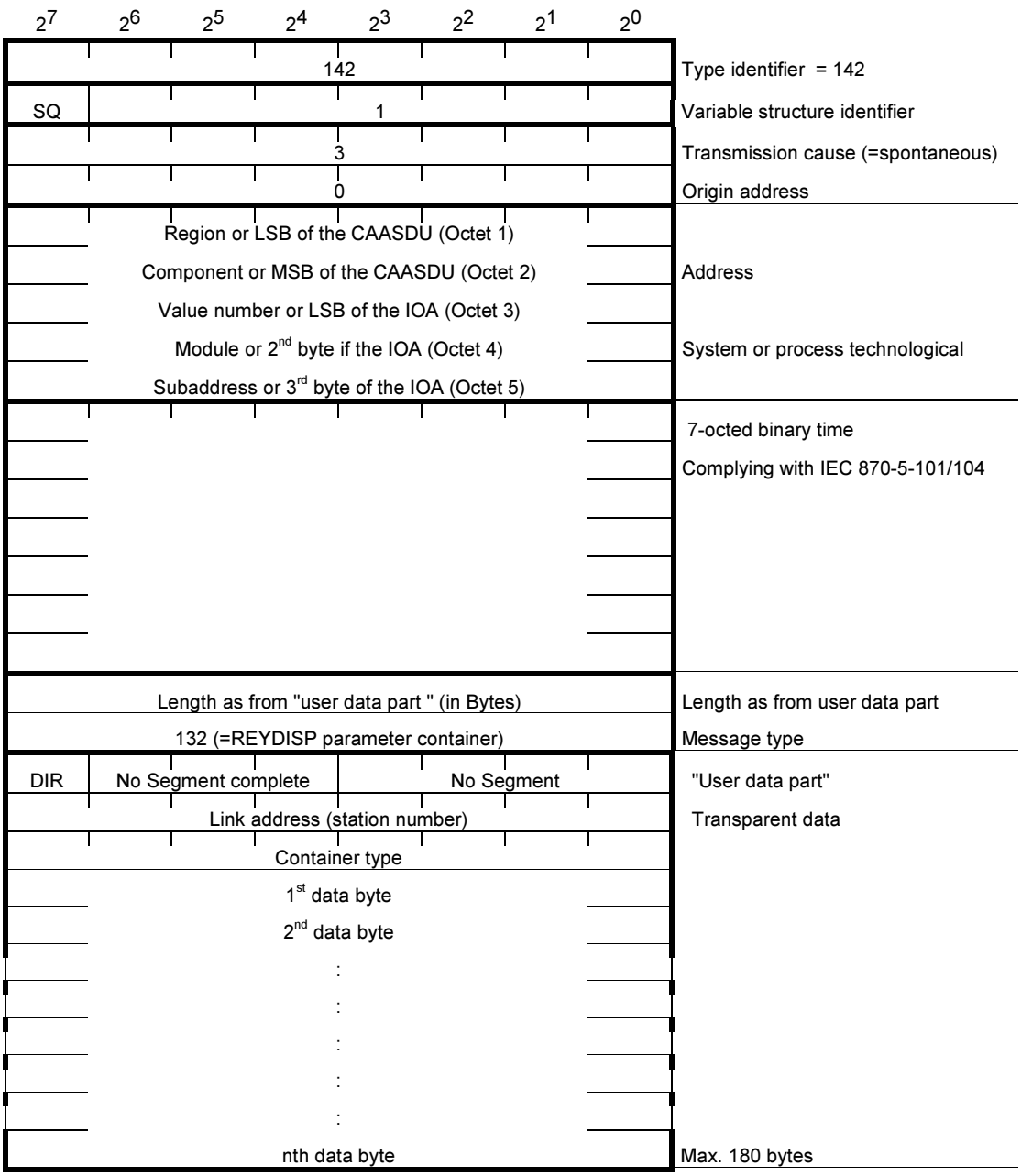
- SAT-1703 ↔ SAT-200
  The address information of the REYDISP parameter containers (5-stage address) is parameterized for each line and direction in SAT-200 and in the SAT Ax-1703 protocol firmware (103M00).

For the integration of Reyrolle REYDISP, only SAT-200 is used in connection with SAT Ax-1703.

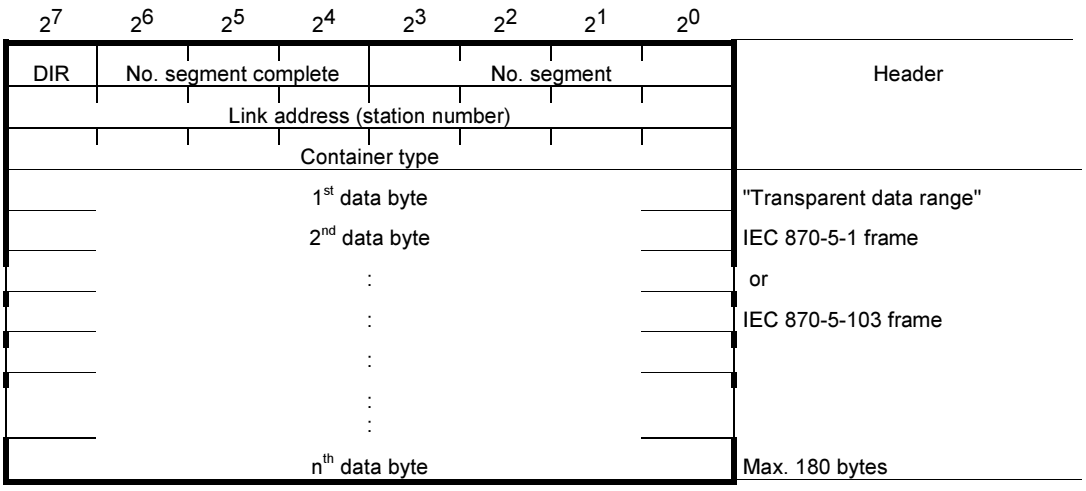
– AM-1703/Ax mode (CP1001) can be fitted with "2x SM1543" or "1x SM1543 and 1x SM-1554 Network-Interf.Ethernet 10/100TX".
Please note SM-1554 product schedule!

– AMC-1703 "data nodes" (CP4003) can be fitted with "2x SM2541" or "1x SM2541 and 1x SM-2542 Network-Interface Token Ring, Ethernet".
Please note AMC-1703 "data nodes" product schedule!

REYDISP parameter container (Ax-1703↔SAT-200): "User data container“



REYDISP parameter container (detail)



DIR ..... Direction
0 = REYDISP → SAT
1 = SAT→ REYDISP
No. segment ..... Actual segment number of the parameter container transmission (beginning with 1)
No. segments complete ..... Number of segments of the parameter container
LINK address ..... Station number of the protective device
Container type ..... 0 = "IEC 870-5-103 frame" in the transparent data range
1 = "IEC 870-5-1/FT1-2 frame with fixed block length " in the transparent data range
2 = "IEC 870-5-1/FT1-2 frame "individual character" in the transparent data range

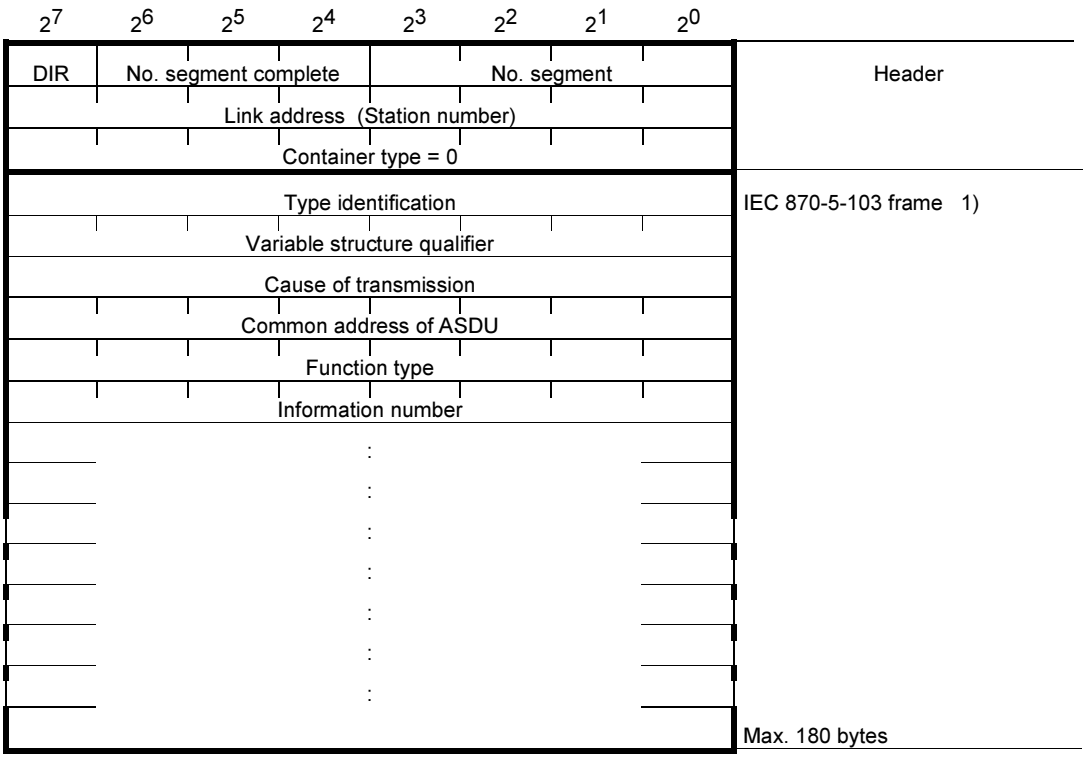
Sequencing:
As with Ax-1703 user data containers, only 180 bytes of transparent data can be transmitted per parameter container, REYDISP parameter messages have to be segmented between SAT-200 and the Ax-1703 protocol firmware "103M00".
Comment: REYDISP parameter messages can attain a maximum length of 256 bytes.

In Ax-1703 the segmented parameter containers are put together again by the 103M00 protocol firmware and then transmitted "transparently" to the addressed protective device.

Parameter messages from the protective devices are segmented by the 103M00 protocol firmware and transmitted to SAT 200 with REYDISP parameter containers.
In SAT-200 the segmented parameter messages are put together again and transmitted to REYDISP via a TCP/IP socket interface.

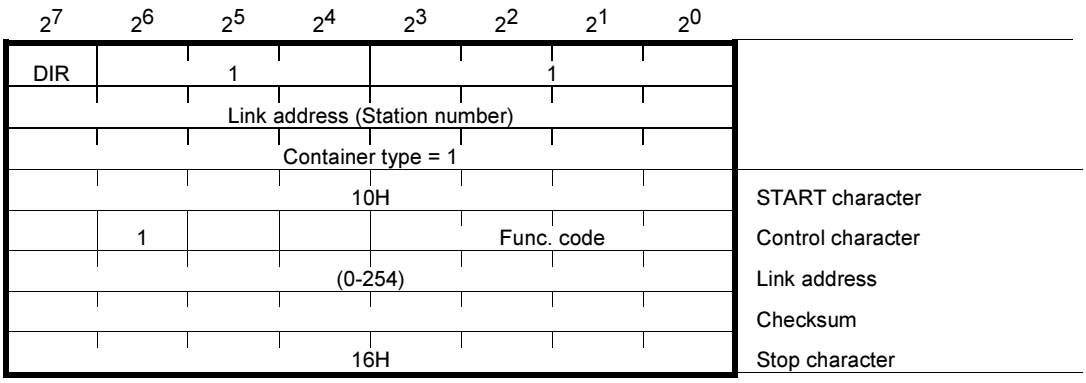
On sequence errors, a partly received message is discarded without error information..
Automatic retries are carried out by the TIMEOUT handling in REYDISP.

Example 1: Parameter container with "Container Type=0" (=IEC 870-5-103 frame)



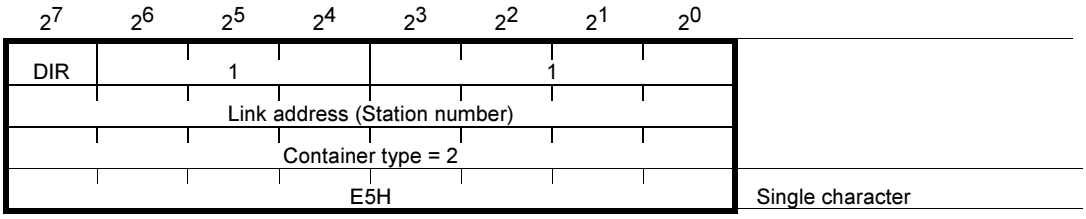
1) The IEC 870-5-1 and IEC 870-5-2 frames are not transmitted, they are added again on transmission of the 103M00 firmware (i.e. 68xx, xx, 68xx, Control CS, Stop Character are not transmitted).

Example 2: Parameter container with "Container Type=1“ (=IEC 870-5-1 frame)



Restriction:
For the transparent transmission of IEC 870-5-1 frames (FT1.2) only those with the function code <9> … Request Status of Link are supported at the moment.

Example 3: Parameter container with "Container Type=2“ (=IEC 870-5-1 frame "Single character ")



Restriction:
The transparent transmission of IEC 870-5-1 frames (FT1.2) for "Single character " is only supported in the SAT→ REYDISP direction .

D. Appendix: Diagnostic

Overview:

legend category: I ... internal
E ... external
C ... communication
T ... test
W ... warning
B ... board/module failure
S ... startup

category	record (rel.)	record (abs.)	meaning
I	0	0	Internal error in the operating system
	2	2	Parameter error ZSE
	3	3	ZSE format conversion error
	4	4	Parameter errors of the protocol-specific application layer
E	0	20	DFC-Bit Timeout for the station nos. 0 - 15
	1	21	DFC-Bit Timeout for the stations nos. 16 - 31
	2	22	DFC-Bit Timeout for the station nos. 32 - 47
	3	23	DFC-Bit Timeout for the station nos. 48 - 63
	4	24	DFC-Bit Timeout for the station nos. 64 -79
	5	25	DFC-Bit Timeout for the station nos. 80 -95
	6	26	DFC-Bit Timeout for the station nos. 96 -99
C	2	42	Communication error to station nos. 0 - 15
	3	43	Communication error to Station nos. 16 - 31
	4	44	Communication error to station nos. 32 - 47
	5	45	Communication error to station nos. 48 - 63
	6	46	Communication error to station nos. 64 - 79
	7	47	Communication error to station nos. 80 - 95
	8	48	Communication error to station nos. 96 - 99
T	0	50	Test mode of the operating and base systems

```
category:    I
record:      0
meaning:     Internal error in the operating system

  Bit 00 ... RAM error
  Bit 01 ... STACK error
                 The defined stack range has been exceeded;
                 Replace system element or notify SAT.
  Bit 02 ... Firmware shut down
                   Diagnosis:
                   - Read out system diagnostics ring (command ID R)
                     in ST emulation (possibly store to file)
  Bit 03 ... Too little 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.
  Bit 04 ...
  Bit 05 ...
  Bit 06 ...
  Bit 07 ...
  Bit 08 ... CPU 80186 error
  Bit 09 ...
  Bit 10 ...
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ...
```

```
category:    I
record:      2
meaning:     Parameter error ZSE

  Bit 00 ... Parameter error detected by SIP
  Bit 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
                 - Octet count cause of transmission (COT) <> 2
                 - Octet count common address of ASDU (CAASDU) <> 2
                 - Octet count information object address (IOA) <> 3
                 - Octet count time stamp <> 7
  Bit 02 ... Parameter error ZSE general
  Bit 03 ... Parameter setting with LINK-Adr.
              Diagnosis: Same link address is used more then once.


  Bit 04 ... Parameter setting with invalid station number.
              Diagnosis: Same station number is used more then once.
  Bit 05 ... Invalid Parameters for IEC870 link-layer
  Bit 06 ... Invalid Parameters for IEC870 application layer
  Bit 07 ... Invalid Parameters for Redundancy
  Bit 08 ... Invalid Parameters for transmit detailed routing
  Bit 09 ... Parameter errors - receive detailed routing
  Bit 10 ... General parameter errors
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ... Parameter setting for time zone not valid
```

```
category:    I
record:      3
meaning:     ZSE format conversion error

  Bit 00 ... Format conversion error in the transmit direction
  Bit 01 ...
  Bit 02 ... Errors in format conversion in receive direction
  Bit 03 ...
  Bit 04 ...
  Bit 05 ...
  Bit 06 ...
  Bit 07 ...
  Bit 08 ...
  Bit 09 ...
  Bit 10 ...
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ... Error was detected in the conversion of a PST control message
                 Diagnosis:
                  - Read out system diagnostics ring (Command ID R)
                    in ST emulation (possibly save on file)
```

```
category:    I
record:      4
meaning:     Parameter errors of the protocol-specific application layer

  Bit 00 ... Errors in processing of routing information
  Bit 01 ...
  Bit 02 ...
  Bit 03 ...
  Bit 04 ...
  Bit 05 ...
  Bit 06 ...
  Bit 07 ...
  Bit 08 ...
  Bit 09 ...
  Bit 10 ...
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ...
```

```
category:    E
record:      0
meaning:     DFC-Bit Timeout for the station nos. 0 - 15

  Bit 00 ... DFC-Bit Timeout for the station no. 0
  Bit 01 ... DFC-Bit Timeout for the station no. 1
  Bit 02 ... DFC-Bit Timeout for the station no. 2
  Bit 03 ... DFC-Bit Timeout for the station no. 3
  Bit 04 ... DFC-Bit Timeout for the station no. 4
  Bit 05 ... DFC-Bit Timeout for the station no. 5
  Bit 06 ... DFC-Bit Timeout for the station no. 6
  Bit 07 ... DFC-Bit Timeout for the station no. 7
  Bit 08 ... DFC-Bit Timeout for the station no. 8
  Bit 09 ... DFC-Bit Timeout for the station no. 9
  Bit 10 ... DFC-Bit Timeout for the station no. 10
  Bit 11 ... DFC-Bit Timeout for the station no. 11
  Bit 12 ... DFC-Bit Timeout for the station no. 12
  Bit 13 ... DFC-Bit Timeout for the station no. 13
  Bit 14 ... DFC-Bit Timeout for the station no. 14
  Bit 15 ... DFC-Bit Timeout for the station no. 15
```

```
category:    E
record:      1
meaning:     DFC-Bit Timeout for the stations nos. 16 - 31

  Bit 00 ... DFC-Bit Timeout for the station no. 16
  Bit 01 ... DFC-Bit Timeout for the station no. 17
  Bit 02 ... DFC-Bit Timeout for the station no. 18
  Bit 03 ... DFC-Bit Timeout for the station no. 19
  Bit 04 ... DFC-Bit Timeout for the station no. 20
  Bit 05 ... DFC-Bit Timeout for the station no. 21
  Bit 06 ... DFC-Bit Timeout for the station no. 22
  Bit 07 ... DFC-Bit Timeout for the station no. 23
  Bit 08 ... DFC-Bit Timeout for the station no. 24
  Bit 09 ... DFC-Bit Timeout for the station no. 25
  Bit 10 ... DFC-Bit Timeout for the station no. 26
  Bit 11 ... DFC-Bit Timeout for the station no. 27
  Bit 12 ... DFC-Bit Timeout for the station no. 28
  Bit 13 ... DFC-Bit Timeout for the station no. 29
  Bit 14 ... DFC-Bit Timeout for the station no. 30
  Bit 15 ... DFC-Bit Timeout for the station no. 31
```

```
category:    E
record:      2
meaning:     DFC-Bit Timeout for the station nos. 32 - 47

  Bit 00 ... DFC-Bit Timeout for the station no. 32
  Bit 01 ... DFC-Bit Timeout for the station no. 33
  Bit 02 ... DFC-Bit Timeout for the station no. 34
  Bit 03 ... DFC-Bit Timeout for the station no. 35
  Bit 04 ... DFC-Bit Timeout for the station no. 36
  Bit 05 ... DFC-Bit Timeout for the station no. 37
  Bit 06 ... DFC-Bit Timeout for the station no. 38
  Bit 07 ... DFC-Bit Timeout for the station no. 39
  Bit 08 ... DFC-Bit Timeout for the station no. 40
  Bit 09 ... DFC-Bit Timeout for the station no. 41
  Bit 10 ... DFC-Bit Timeout for the station no. 42
  Bit 11 ... DFC-Bit Timeout for the station no. 43
  Bit 12 ... DFC-Bit Timeout for the station no. 44
  Bit 13 ... DFC-Bit Timeout for the station no. 45
  Bit 14 ... DFC-Bit Timeout for the station no. 46
  Bit 15 ... DFC-Bit Timeout for the station no. 47
```

```
category:    E
record:      3
meaning:     DFC-Bit Timeout for the station nos. 48 - 63

  Bit 00 ... DFC-Bit Timeout for the station no. 48
  Bit 01 ... DFC-Bit Timeout for the station no. 49
  Bit 02 ... DFC-Bit Timeout for the station no. 50
  Bit 03 ... DFC-Bit Timeout for the station no. 51
  Bit 04 ... DFC-Bit Timeout for the station no. 52
  Bit 05 ... DFC-Bit Timeout for the station no. 53
  Bit 06 ... DFC-Bit Timeout for the station no. 54
  Bit 07 ... DFC-Bit Timeout for the station no. 55
  Bit 08 ... DFC-Bit Timeout for the station no. 56
  Bit 09 ... DFC-Bit Timeout for the station no. 57
  Bit 10 ... DFC-Bit Timeout for the station no. 58
  Bit 11 ... DFC-Bit Timeout for the station no. 59
  Bit 12 ... DFC-Bit Timeout for the station no. 60
  Bit 13 ... DFC-Bit Timeout for the station no. 61
  Bit 14 ... DFC-Bit Timeout for the station no. 62
  Bit 15 ... DFC-Bit Timeout for the station no.
```

```
category:    E
record:      4
meaning:     DFC-Bit Timeout for the station nos. 64 -79

  Bit 00 ... DFC-Bit Timeout for the station no. 64
  Bit 01 ... DFC-Bit Timeout for the station no. 65
  Bit 02 ... DFC-Bit Timeout for the station no. 66
  Bit 03 ... DFC-Bit Timeout for the station no. 67
  Bit 04 ... DFC-Bit Timeout for the station no. 68
  Bit 05 ... DFC-Bit Timeout for the station no. 69
  Bit 06 ... DFC-Bit Timeout for the station no. 70
  Bit 07 ... DFC-Bit Timeout for the station no. 71
  Bit 08 ... DFC-Bit Timeout for the station no. 72
  Bit 09 ... DFC-Bit Timeout for the station no. 73
  Bit 10 ... DFC-Bit Timeout for the station no. 74
  Bit 11 ... DFC-Bit Timeout for the station no. 75
  Bit 12 ... DFC-Bit Timeout for the station no. 76
  Bit 13 ... DFC-Bit Timeout for the station no. 77
  Bit 14 ... DFC-Bit Timeout for the station no. 78
  Bit 15 ... DFC-Bit Timeout for the station no. 79
```

```
category:    E
record:      5
meaning:     DFC-Bit Timeout for the station nos. 80 -95

  Bit 00 ... DFC-Bit Timeout for the station no. 80
  Bit 01 ... DFC-Bit Timeout for the station no. 81
  Bit 02 ... DFC-Bit Timeout for the station no. 82
  Bit 03 ... DFC-Bit Timeout for the station no. 83
  Bit 04 ... DFC-Bit Timeout for the station no. 84
  Bit 05 ... DFC-Bit Timeout for the station no. 85
  Bit 06 ... DFC-Bit Timeout for the station no. 86
  Bit 07 ... DFC-Bit Timeout for the station no. 87
  Bit 08 ... DFC-Bit Timeout for the station no. 88
  Bit 09 ... DFC-Bit Timeout for the station no. 89
  Bit 10 ... DFC-Bit Timeout for the station no. 90
  Bit 11 ... DFC-Bit Timeout for the station no. 91
  Bit 12 ... DFC-Bit Timeout for the station no. 92
  Bit 13 ... DFC-Bit Timeout for the station no. 93
  Bit 14 ... DFC-Bit Timeout for the station no. 94
  Bit 15 ... DFC-Bit Timeout for the station no. 95
```

```
category:    E
record:      6
meaning:     DFC-Bit Timeout for the station nos. 96 -99

  Bit 00 ... DFC-Bit Timeout for the station no. 96
  Bit 01 ... DFC-Bit Timeout for the station no. 97
  Bit 02 ... DFC-Bit Timeout for the station no. 98
  Bit 03 ... DFC-Bit Timeout for the station no. 99
  Bit 04 ...
  Bit 05 ...
  Bit 06 ...
  Bit 07 ...
  Bit 08 ...
  Bit 09 ...
  Bit 10 ...
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ...
```

```
category:    C
record:      2
meaning:     Communication error to station nos. 0 - 15

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

```
category:    C
record:      3
meaning:     Communication error to Station nos. 16 - 31

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

```
category:    C
record:      4
meaning:     Communication error to station nos. 32 - 47

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

```
category:    C
record:      5
meaning:     Communication error to station nos. 48 - 63

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

```
category:    C
record:      6
meaning:     Communication error to station nos. 64 - 79

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

```
category:    C
record:      7
meaning:     Communication error to station nos. 80 - 95

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

```
category:    C
record:      8
meaning:     Communication error to station nos. 96 - 99

  Bit 00 ... Communication error to station no. 96
  Bit 01 ... Communication error to station no. 97
  Bit 02 ... Communication error to station no. 98
  Bit 03 ... Communication error to station no. 99
  Bit 04 ...
  Bit 05 ...
  Bit 06 ...
  Bit 07 ...
  Bit 08 ...
  Bit 09 ...
  Bit 10 ...
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ...
```

```
category:    T
record:      0
meaning:     Test mode of the operating and base systems

  Bit 00 ... Memory test disabled
  Bit 01 ...
  Bit 02 ...
  Bit 03 ...
  Bit 04 ...
  Bit 05 ...
  Bit 06 ...
  Bit 07 ...
  Bit 08 ...
  Bit 09 ...
  Bit 10 ...
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ...
```

E. Appendix: Parameter Documentation

The firmware parameters are described in so-called **PD forms** (parameter documentation forms).

- The parameters described in the PD form are available for parameterization with the PSR Configuring and Service Computer of a SAT TOOLBOX
    - The PD Form describes
        - all parameters that are available for a given firmware and as of which firmware revision they are effective
        - parameter functions and their value ranges
- This appendix documents the parameters for the firmware set forth in the present document in the shape of a blank form filled with default values
- The current state of parameters of a firmware of a certain system element can be documented with the PSR Configuring and Service Computer of a SAT TOOLBOX

Parameterizing with PD forms is supported by both SAT TOOLBOX (PSR) and SAT TOOLBOX II (PSR II).

```
------------------------------------------------------------------------------------


REVISION OF PARAMETER DOCUMENTATION FORM

      created                      last changed                  released
-------------------------------------------------------------------------------
   on                 by        on                   by       on                  by
   08-01-01    ENT-SW/POM       23-02-04    ENT-SW/POM       23-02-04    ENT-SW/POM


PHYSICAL INTERFACE

   Baud rate:
   ----------
   Possible:     50,   75,  100,  110, 134.5,  150,   200,  300,    600,  1050
              1200, 1800, 2000, 2400,  4800, 9600, 19200, 38400, 64000

   Transmit baud rate:      9600 bd                          CT command: SPS 000(/D)
   Receive baud rate:       9600 bd                          CT command: SPS 001(/D)


   Interface Modem:
   ----------------
   Possible:
   5 = OPTICAL
   8 = NULL-Modem interface (RS-485)
   0 = user definable modem

   Interface Modem: OPTICAL                                  CT Command: SPH 0A (/D)

   When using a "user definable modem" - parameter setting must be done in the chapter
   "user definable modem"!
   When using a predefined modem for the interface modem a fix set of parameters for
   time parameters is used (for information see chapter "user definable modem").



================================================================================
                  c o n t i n u i n g   p a r a m e t e r s
================================================================================
MONITORING TIMES

   Times:    0-32767[ms]; 0-4095[bits]
   Time base:0=bits; 1=ms
             CAUTION: Parameterized times in "bits" are dependent on the
                      set baud rate!


   Idle monitoring time: (Monitoring of the quiescent state of the line)
   ---------------------
   After transmission faults or message interruption, the line is monitored for
   quiescent state. After expiry of this monitoring time, the "resynchronization
   of the receiver" takes place. By using the DCD input, faster
   resynchronization can be achieved.

   Idle monitoring time:      33 [bit]                  CT command: SPS 00E/7FFF(/D)
   Time base:                     bit                   CT command: SPS 00E/8000(/D)


   Character monitoring time: (Message interruption monitoring)
   --------------------------
   Maximum pause between sequential bytes of a message.
   After a message interruption was detected, the idle monitoring time is started.

   Character monitoring time:     33 [bit]              CT command: SPS 00F/7FFF(/D)
   Time base:                         bit               CT command: SPS 00F/8000(/D)
```

Reply reaction monitoring time:

The reply reaction monitoring time serves for the rapid detection of a replying station. This monitoring time is stopped by the receipt of the 1st character of the reply message. In this way the interrogation cycle is optimized in the event of failed stations.
Possible: 0-255 (n * 100[ms]) = 0-25.5[secs]

Reply reaction monitoring time: 0,00 [secs] CT command: SPH 2D0 (/D)

USER DEFINABLE MODEM

Overview "Default time parameters":

These parameters are used when selecting a predefined modem.

Interface Modem	Mode	RTS-Fix	tp	tv	tn	tdis	DCD	tbs	tstab	tcl	tcldly
OPTICAL	RS-232	NO	0	1	0	0	NO	0	0	0	0
NULL Modem	RS-485	NO	0	1	0	0	NO	0	0	0	0

All time parameters are in n * 1ms

CORRECTION FACTOR FOR EXPECTED ACKNOWLEDGEMENT TIME

The expected acknowledgement time is determined automatically (pause/set-up/message/reset times are taken into account). Signal runtimes and other delay times are to be taken account of in the "Correction factor for expected acknowledgement time".
Possible: 0-65535 (n * 10[ms]) = 0.00[secs]-10.9[mins]

Correction factor: 0,01 secs CT command: SPS 003 (/D)

MESSAGE REPETITIONS (NUMBER OF RETRIES)

The maximum number of message repetitions (retries) to be carried out can be set for some types of message.
Possible: 0-255

Retries for INIT messages (after RESET): 1 CT command: SPL 009 (/D)
Retries for station sel. data messages: 2 CT command: SPL 008 (/D)
Retries for data messages "unacknowledged to all": 0 CT command: SPH 008 (/D)

CALL CYCLE/STATION PARAMETER SETTING

Continuous cycle:

Possible: 0=not enabled; 1=enabled

Continuous cycle: enabled CT command: SPL 020/01(/D)

Station call prioritization: "Number of stations called until change of level"

Possible: 0-99
Number of station calls in the high priority level: 1 SPL 021 (/D)
Number of station calls in the middle priority level: 1 SPH 021 (/D)
Number of station calls in the low priority level(A): 1 SPL 022 (/D)
Number of station calls in the low priority level(B): 1 SPH 022 (/D)

Station parameterization:

Possible:

Station number (Stat. no.)	0-99; 255=not used
Link address	0-65535;
Enabling (Station in the cycle)	0=no; 1=yes
"Report" station failure.....	0=no; 1=yes
Priority level	0=High priority 1=Middle priority; 2=Low priority(A) 3=Low priority(B)
Number of calls (until station change).	1-63
class II data	0=enable; 1=disable

Station parameterization

No.	Stat no.	Link addr	Enabl.	"Report" fail	Priority level	No. of calls	Cl.II data
0	255	65535	ys	ys	HI-prior.	1	enable
1	255	65535	ys	ys	HI-prior.	1	enable
2	255	65535	ys	ys	HI-prior.	1	enable
3	255	65535	ys	ys	HI-prior.	1	enable
4	255	65535	ys	ys	HI-prior.	1	enable
5	255	65535	ys	ys	HI-prior.	1	enable
6	255	65535	ys	ys	HI-prior.	1	enable
7	255	65535	ys	ys	HI-prior.	1	enable
8	255	65535	ys	ys	HI-prior.	1	enable
9	255	65535	ys	ys	HI-prior.	1	enable
10	255	65535	ys	ys	HI-prior.	1	enable
11	255	65535	ys	ys	HI-prior.	1	enable
12	255	65535	ys	ys	HI-prior.	1	enable
13	255	65535	ys	ys	HI-prior.	1	enable
14	255	65535	ys	ys	HI-prior.	1	enable
15	255	65535	ys	ys	HI-prior.	1	enable
16	255	65535	ys	ys	HI-prior.	1	enable
17	255	65535	ys	ys	HI-prior.	1	enable
18	255	65535	ys	ys	HI-prior.	1	enable
19	255	65535	ys	ys	HI-prior.	1	enable
20	255	65535	ys	ys	HI-prior.	1	enable
21	255	65535	ys	ys	HI-prior.	1	enable
22	255	65535	ys	ys	HI-prior.	1	enable
23	255	65535	ys	ys	HI-prior.	1	enable
24	255	65535	ys	ys	HI-prior.	1	enable
25	255	65535	ys	ys	HI-prior.	1	enable
26	255	65535	ys	ys	HI-prior.	1	enable
27	255	65535	ys	ys	HI-prior.	1	enable
28	255	65535	ys	ys	HI-prior.	1	enable
29	255	65535	ys	ys	HI-prior.	1	enable
30	255	65535	ys	ys	HI-prior.	1	enable
31	255	65535	ys	ys	HI-prior.	1	enable
32	255	65535	ys	ys	HI-prior.	1	enable
33	255	65535	ys	ys	HI-prior.	1	enable
34	255	65535	ys	ys	HI-prior.	1	enable
35	255	65535	ys	ys	HI-prior.	1	enable
36	255	65535	ys	ys	HI-prior.	1	enable
37	255	65535	ys	ys	HI-prior.	1	enable
38	255	65535	ys	ys	HI-prior.	1	enable
39	255	65535	ys	ys	HI-prior.	1	enable
40	255	65535	ys	ys	HI-prior.	1	enable
41	255	65535	ys	ys	HI-prior.	1	enable
42	255	65535	ys	ys	HI-prior.	1	enable
43	255	65535	ys	ys	HI-prior.	1	enable
44	255	65535	ys	ys	HI-prior.	1	enable
45	255	65535	ys	ys	HI-prior.	1	enable
46	255	65535	ys	ys	HI-prior.	1	enable
47	255	65535	ys	ys	HI-prior.	1	enable
48	255	65535	ys	ys	HI-prior.	1	enable

49	255	65535	ys	ys	HI-prior.	1	enable
50	255	65535	ys	ys	HI-prior.	1	enable
51	255	65535	ys	ys	HI-prior.	1	enable
52	255	65535	ys	ys	HI-prior.	1	enable
53	255	65535	ys	ys	HI-prior.	1	enable
54	255	65535	ys	ys	HI-prior.	1	enable
55	255	65535	ys	ys	HI-prior.	1	enable
56	255	65535	ys	ys	HI-prior.	1	enable
57	255	65535	ys	ys	HI-prior.	1	enable
58	255	65535	ys	ys	HI-prior.	1	enable
59	255	65535	ys	ys	HI-prior.	1	enable
60	255	65535	ys	ys	HI-prior.	1	enable
61	255	65535	ys	ys	HI-prior.	1	enable
62	255	65535	ys	ys	HI-prior.	1	enable
63	255	65535	ys	ys	HI-prior.	1	enable
64	255	65535	ys	ys	HI-prior.	1	enable
65	255	65535	ys	ys	HI-prior.	1	enable
66	255	65535	ys	ys	HI-prior.	1	enable
67	255	65535	ys	ys	HI-prior.	1	enable
68	255	65535	ys	ys	HI-prior.	1	enable
69	255	65535	ys	ys	HI-prior.	1	enable
70	255	65535	ys	ys	HI-prior.	1	enable
71	255	65535	ys	ys	HI-prior.	1	enable
72	255	65535	ys	ys	HI-prior.	1	enable
73	255	65535	ys	ys	HI-prior.	1	enable
74	255	65535	ys	ys	HI-prior.	1	enable
75	255	65535	ys	ys	HI-prior.	1	enable
76	255	65535	ys	ys	HI-prior.	1	enable
77	255	65535	ys	ys	HI-prior.	1	enable
78	255	65535	ys	ys	HI-prior.	1	enable
79	255	65535	ys	ys	HI-prior.	1	enable
80	255	65535	ys	ys	HI-prior.	1	enable
81	255	65535	ys	ys	HI-prior.	1	enable
82	255	65535	ys	ys	HI-prior.	1	enable
83	255	65535	ys	ys	HI-prior.	1	enable
84	255	65535	ys	ys	HI-prior.	1	enable
85	255	65535	ys	ys	HI-prior.	1	enable
86	255	65535	ys	ys	HI-prior.	1	enable
87	255	65535	ys	ys	HI-prior.	1	enable
88	255	65535	ys	ys	HI-prior.	1	enable
89	255	65535	ys	ys	HI-prior.	1	enable
90	255	65535	ys	ys	HI-prior.	1	enable
91	255	65535	ys	ys	HI-prior.	1	enable
92	255	65535	ys	ys	HI-prior.	1	enable
93	255	65535	ys	ys	HI-prior.	1	enable
94	255	65535	ys	ys	HI-prior.	1	enable
95	255	65535	ys	ys	HI-prior.	1	enable
96	255	65535	ys	ys	HI-prior.	1	enable
97	255	65535	ys	ys	HI-prior.	1	enable
98	255	65535	ys	ys	HI-prior.	1	enable
99	255	65535	ys	ys	HI-prior.	1	enable

CALL PROCEDURE per type identifier (re-call)

After a message to a selective station, it can be continuously interrogated for a parameterizable time (=continuous calling).
In this way, for example, the effects after a command (binary information or measured value change) are rapidly transmitted.

Possible:
Type identifier 0-255
Continuous calling time ... 1-60000 (n *100[ms]) = 0.1[secs]-100[mins];
0=no continuous call

	Type identifier	Cont. call time [secs]

No.	Current	CT command	Current	CT command
0	255	SPL 2A0 (/D)	0,0	SPS 2A1 (/D)
1	255	SPL 2A2 (/D)	0,0	SPS 2A3 (/D)
2	255	SPL 2A4 (/D)	0,0	SPS 2A5 (/D)
3	255	SPL 2A6 (/D)	0,0	SPS 2A7 (/D)
4	255	SPL 2A8 (/D)	0,0	SPS 2A9 (/D)
5	255	SPL 2AA (/D)	0,0	SPS 2AB (/D)
6	255	SPL 2AC (/D)	0,0	SPS 2AD (/D)
7	255	SPL 2AE (/D)	0,0	SPS 2AF (/D)
8	255	SPL 2B0 (/D)	0,0	SPS 2B1 (/D)
9	255	SPL 2B2 (/D)	0,0	SPS 2B3 (/D)
10	255	SPL 2B4 (/D)	0,0	SPS 2B5 (/D)
11	255	SPL 2B6 (/D)	0,0	SPS 2B7 (/D)
12	255	SPL 2B8 (/D)	0,0	SPS 2B9 (/D)
13	255	SPL 2BA (/D)	0,0	SPS 2BB (/D)
14	255	SPL 2BC (/D)	0,0	SPS 2BD (/D)

AX-1703 REDUNDANCY

Behavior when redundancy state is "PASSIVE":

Possible: 0 = Interface "TRISTATE"
1 = Interface "ACTIVE", Listening mode (=STANDBY)
3 = Interface "ACTIVE", Calling mode (=OPERATION)

Behavior: TRISTATE CT command: SPL 2E0/03 (/D)

Delay time when switching from STANDBY->ACTIVE:

Possible: 1-2000 [secs]; 0=no switching delay

Delay time: 1 Seconds CT command: SPS 2E1 (/D)

Receive timeout in STANDBY mode:

Possible: 0-60000 (n *1[sec]) = 1[secs] - 16[hrs]40[mins]; 0=no monitoring

Receive timeout: 0 [secs] CT command: SPS 011 (/D)

DFC (DATA FLOW CONTROL) VERHALTEN

DFC Timeout:

Possible: 0-60000 (n *1[sec]) = 1[sec] - 16[std]40[min]; 0=not used!

DFC-Timeout: 30 sec CT command: SPS 290 (/D)

Enabling DFC callup time:

Possible: 0 = not enabled ; 1 = enabled

Enabling DFC callup time: enabled CT command: SPH 291/01 (/D)

DFC callup time:

When a DFC bit has been set for the remote station, "request status of link"
messages will be transmitted in this parameterizable interval.

Possible : 0 = non inquiry
1 - 255 (n * 100 ms)
Callup time: 0 CT command: SPL 291 (/D)

PROTOCOL ENABLES

Generic data:

If this option is enabled, after a general interrogation, transmit automatically a general interrogation for generic data.
Possible: 0 = not enabled ; 1 = enabled

Generic data: not enabled CT command: SPL 2E8/01 (/D)

Transmitting the error location values (TK 4) during a general interrogation:

If this option is enabled, error location values (TK 4) will be emulated directly from the internal process image.
Possible: 0 = not enabled ; 1 = enabled

Transmit error loc. values during GI: not enabled CT command: SPL 2E8/02 (/D)

Subsequent transmitting of initial values:

If this option is enabled, the same message including the parameterized initial value are transmitted after every transmitted measured value.
Possible: 0 = not enabled ; 1 = enabled

Subsequent transmitting of initial values: not enabled CT command: SPL 2E8/04 (/D)

send ASDU23 (List of recorded disturbances) without disturbance:

Possible: 0 = not enabled ; 1 = enabled

send ASDU23 (List of recorded disturbances): enabled CT command: SPL 2E8/08 (/D)

TIMEOUT FOR INTERFACE INITIALIZATION

This is where a timeout can be configured which is started after an interface fault and which, when elapsing, starts the initialization "Normalize KE" (Function code 0). If this timeout has not elapsed yet, the remote station will be initialized with "Normalize FCB" (Function code 7).
If this parameter is set to 0, a "Normalize KE" (Function code 0) will be sent in each of the cases.
Upon startup, a "Normalize KE" (Function code 0) will always be sent.

Function code	Meaning in protective device
Normalize KE (Fct 0)	- FCB bit is initialized - Transmit buffer is deleted (pending binary information is deleted)
Normalize FCB (Fct 7)	- FCB bit is initialized

Possible : 1 - 65535 (secs) ; 0 = always normalize KE

Timeout for interface init.: 30 CT command: SPS 2E9 (/D)

TEST BIT RELEASE PER STATION

It can be released per station whether binary information or measured values with test bits into the system is to be passed on!

Possible: 0=not enabled; 1=enabled

```
    Station-Nr.:   15 14 13 12 11 10  9  8  7  6  5  4  3  2  1  0
                  +-----------------------------------------------+
    Current     : | 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F0(/B)

    Station-Nr.:   31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16
                  +-----------------------------------------------+
    Current     : | 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F1(/B)

    Station-Nr.:   47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32
                  +-----------------------------------------------+
    Current     : | 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F2(/B)

    Station-Nr.:   63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48
                  +-----------------------------------------------+
    Current     : | 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F3(/B)

    Station-Nr.:   79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64
                  +-----------------------------------------------+
    Current     : | 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F4(/B)

    Station-Nr.:   95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80
                  +-----------------------------------------------+
    Current     : | 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F5(/B)

    Station-Nr.:                                     99 98 97 96
                  +-----------------------------------------------+
    Current     : |                        0  0  0  0  0  0  0  0 |
                  +-----------------------------------------------+
                   SPS 2F6/B)


CYCLE TIME OF TIME SYNCHRONIZATION

   Possible: 1 - 65535 = time grid for cyclic time setting in seconds
             0         = no cyclic time setting

   Cycle time for time setting:    20 sec                  CT command: SPS 2EB (/D)


RESETTING OF ERROR LOCATION VALUES

   Error location values can be reset by means of the following functions:
      1.) Automatically through a configurable time
      2.) Through command messages (see configured OPM parameters)

   Resetting after a configurable time:
   ------------------------------------
   Upon receipt of an error location, the error location will be reset
   automatically to the initial value after the conf. time elapses.
   Possible: 1 - 65535 secs; 0 = no automatic resetting

   Time for automatic resetting: no automat. resetting      CT command: SPS 2EF (/D)


INITIAL VALUE FOR MEASURED VALUES

   This is where the initial value for meas. vals must be conf. per transfer format.
```

```
   It is used for: - Resetting of error loc. values via a command
                     message
                   - When the option is enabled: subsequ. transmitting of init vals.

   Initial value for transfer format "Floating Point":
   ---------------------------------------------------
   Possible: -32767 - +32767

   Initial value for Floating Point:     0                  CT commmand: SPS 2EC (/S)

   Initial value for transfer format "16-bit scaled":
   --------------------------------------------------
   Possible: -32767 - +32767

   Initial value for 16-bit scaled:     0                   CT commmand: SPS 2ED (/S)

   Initial value for transfer format "16-bit normalized":
   ------------------------------------------------------
   Possible: -100% - +100%

   Initial value for 16-bit normalized:   0%                CT commmand: SPS 2EE (/S)


TRANSMIT GENERAL INTERROGATION DELAYED

   Possible: 1 - 255 = transmit delay for general interrogation in seconds
             0       = no delay

   delay:   0  sec                                          CT commmand: SPH 2F6 (/D)

TRANSMIT DELAY FOR DATA IN RECEIVE DIRECTION

   Possible: 0 - 2,55 sec (n * 0,01 sec)

   delay: 0,00 sec                                          CT commmand: SPH 2EA (/D)

ACTIVATION TIME FOR SELECTED CONTROL LOCATION

   This time indicates, like for a long time the control location
   default remains stored!
   At expiration of this time with receipt of the command a negative CON is generated.

   Possible: 0 - 255 sec

   time:   0  sec                                           CT commmand: SPL 2FC (/D)

FRACTIONAL DIGITS FOR TRANSMISSION OF ERROR LOCATION IN RECEIVE DIRECTION

    Since under the IEC870-5-103 profile the error location (reactance) is
    transmitted in the floating-point format and since it is passed on as binary
    value in the SAT 1703 direction, this is where you have to configure the
    number of fractional digits required for evaluation.
    Then, the error location will be multiplied accordingly.

    Note:     This parameter setting applies to all measured values transmitted with
              data unit 4 (measured value with relative time).

    Example:  Error location (reactance) = 2.25 ohms
              --> i.e., 2 fractional digits are configured
              --> the value = 225 is transmitted.


    Possible      : 0 - 5
    Current value :   2                                     CT commmand: SPH 2FC (/D)


BAHAVIOUR FOR PACKED START EVENTS OF PROTECTION EQUIPMENT, PACKED OUTPUT CIRCUIT OF
PROTECTION EQUIPMENT
```

Possible : 0 = The packed start events of protection equipment or packed output circuit of protection equipment will be passed with every change of an single event within the telegram. The relative time is the respective relative time from the protection device
1 = The packed start events of protection equipment or packed output circuit of protection equipment will be passed only after receiving the falling edge of the general start of operation or general command to output circuit. The relative time ist the relative time from the protection device within the telegram of the falling edge of general start of operation or general command to output circuit.
If there is no falling edge the telegram will be passed after a timeout of 60 seconds.

Current value : 0 CT commmand: SPL 2FD (/D)

MEASURED-VALUE CHANGE MONITORING

In order to transmit large changes in measured values immediately and small changes only after a certain time, this is where a measured-value change monitoring function can be configured.
Every received measured value is adapted and entered into a process image. In the configured time grid, every measured value is then checked for the magnitude of the change. If the change is greater than the configured large threshold, the value will be transmitted immediately. If it is smaller, the changes over the most recent transmitted value are added without polarity signs (i.e., absolute value of the change) and transmitted when this added change is greater than the configured additive threshold. This method is called "additive measured-value change monitoring".
In the detailed routing function, every measured value can be assigned one of the 16 configured thresholds.

Time grid for measured-value change monitoring:

In the following configured time grid, all measured values are handled once by additive measured-value change monitoring. The time grid should be adapted to the number of configured measured values.
A rule of thumb: time grid in secs = number of measured values / 50

Possible: 1 - 25.5 sec (n * 0.1 sec)

Time grid: 1,0 sec CT command: SPL 2EA (/D)

Measured-value thresholds:

Possible: 0 - 9999 (n * 0,1%)

Threshold no.	Large threshold	CT command	Additive threshold	CT command
0	0,0 %	SPS 308 (/D)	0,0 %	SPS 30A (/D)
1	0,5 %	SPS 30D (/D)	2,0 %	SPS 30F (/D)
2	1,0 %	SPS 312 (/D)	4,0 %	SPS 314 (/D)
3	1,5 %	SPS 317 (/D)	7,0 %	SPS 319 (/D)
4	2,0 %	SPS 31C (/D)	12,0 %	SPS 31E (/D)
5	3,0 %	SPS 321 (/D)	15,0 %	SPS 323 (/D)
6	5,0 %	SPS 326 (/D)	20,0 %	SPS 328 (/D)
7	7,5 %	SPS 32B (/D)	30,0 %	SPS 32D (/D)
8	10,0 %	SPS 330 (/D)	50,0 %	SPS 332 (/D)
9	15,0 %	SPS 335 (/D)	70,0 %	SPS 337 (/D)
10	20,0 %	SPS 33A (/D)	80,0 %	SPS 33C (/D)
11	30,0 %	SPS 33F (/D)	90,0 %	SPS 341 (/D)
12	40,0 %	SPS 344 (/D)	100,0 %	SPS 346 (/D)
13	60,0 %	SPS 349 (/D)	100,0 %	SPS 34B (/D)
14	80,0 %	SPS 34E (/D)	100,0 %	SPS 350 (/D)
15	100,0 %	SPS 353 (/D)	100,0 %	SPS 355 (/D)

```
   +----------+----------+--------------+-----------+--------------+


SOFTWARE TEST POINTS AND SETTINGS

   CAUTION! These parameters may only be altered after consultation
            with the software developer.

   Debugger settings:
   ------------------

    Data and acknowledgement between BSE:   no              CT command: SPL 01C/01 (/D)
    Handshake RTS,GPB (ASCII mode)      :   no              CT command: SPL 01C/02 (/D)
    Mask for LOCK data collection       :   no              CT command: SPL 01C/04 (/D)
    Levels lock station lock            :   no              CT command: SPL 01C/08 (/D)
    Handshake RTS,GPB (HEX mode)        :   no              CT command: SPL 01C/10 (/D)
    Master-Standby switchover           :   no              CT command: SPL 01C/40 (/D)
    Init-End handling                   :   no              CT command: SPL 01C/80 (/D)
    Signal delay correction RTRS        :   no              CT command: SPL 01D/01 (/D)
    (RTRS ... real time remote synchronization)
    STOP of the serial test recording
    after communication error           :   no              CT command: SPH 01C/80 (/D)
    ZDT-Filter                          :   no              CT command: SPH 01C/04 (/D)
```