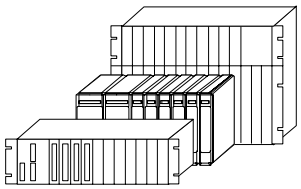
Ax 1703



Firmware Description

SPAM00

ABB SPA-Bus Master

HW-Type: 2541 / FW-Type: 2520

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

SPAM00	Rev. 01 and higher

Version	Revision	Date	Change
A, 1	00	03.05.01	First edition
A, 1	01	25.09.01	Expansion Parameterization OPM II, Expansion Parameter Docomentation

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1. System Overview

1.1. Brief Description

System element SPAM00 was conceived for communication between Ax 1703 system components and the SPA bus devices of the ABB company. The protocol operates according to the Unbalanced Multiple Point Master (Multipoint Traffic Central Station). A maximum of 40 substations can be connected to an Ax system element. When using numerous data points, it may be necessary to limit communication to a maximum of 20 substations, since only a maximum of 2000 data records in the receive direction and 1000 data records in the transmit direction are currently available for data point parameterization.

1.2. Technical Data

Modulation:	PCM – byte asynchronous		
Transmission rate:	50 – 19200 Bd		
USART byte frame:	7 Data bits 1 Parity bit (even parity) 1 Stop bit		
Bit end sequence:	LSB (lower-priority bit is transmitted first)		
Message protection:	HA = 4		
Message formats:	Command direction	→	Commands Setpoint values General interrogation Time synchronization
	Receive direction	→	Real-time information Measured values System information

This protocol element implements only a portion of the functionality and data formats of the external interface as an external system adjustment. Therefore, a check must be performed for a specific application to determine the extent to which the actual requirements coincide with the functionality implemented here, and the extent to which additional expansions or adjustments are needed.

1.2.1. Limitations

The firmware described in this specification supports only the Unbalanced Multiple Point Master (Multipoint Traffic Central Station) data communication mode.

- No redundancy
- No disturbance record data
- Data record numbers can only be parametrized from 0 to 65535
- Coupling in RS485 mode currently not possible

1.3. Used Interface Circuits

The following V.24 interface circuits are used:

TxD	<103>	Transmit data
RxD	<104>	Receive data
GND	<102>	Signal ground

In addition, the following V.24 circuit are used, but not according to the V.24 recommendation.

RTS	<105>	Used to activate the transmit signal level of the transmission facility
DCD	<109>	Used to detect the receive signal level of the transmission facility

1.4. Failure Concept

Protocol element SPAM00 detects a failure of the remote station from the absence of acknowledgment messages or response messages to data point interrogation.

1.5. General Interrogation

The SPA bus protocol cannot send any spontaneous data.

Each data point must be explicitly interrogated. Therefore, the system message general interrogation cannot be processed. The process data can be sent from the process image right after a general interrogation, or the general interrogation status is ascribed to the spontaneous data for the duration of a complete interrogation cycle of the necessary stations.

1.6. Redundancy

This protocol currently does not support any redundancy.

Since each data point must be interrogated with an address, and this address is no longer present in the response of the substation, it is not possible to generate the corresponding messages from the received data of the substation for the passive interface. To enable generation of these messages, the passive interface would have to monitor the calls of the active master. This firmware does not yet support this capability at its current level of development.

2. SPAM00 Protocol Description

2.1. Data Communication Control

Data communication control functions according to the MASTER/SLAVE principle.

After the data master have been interrogated, the called substation responds with the desired data. If the substation cannot transmit the data, or there is an error in the master message, the substation responds with a negative acknowledgment. The substation only sends a positive acknowledgment for commands and setpoint values.

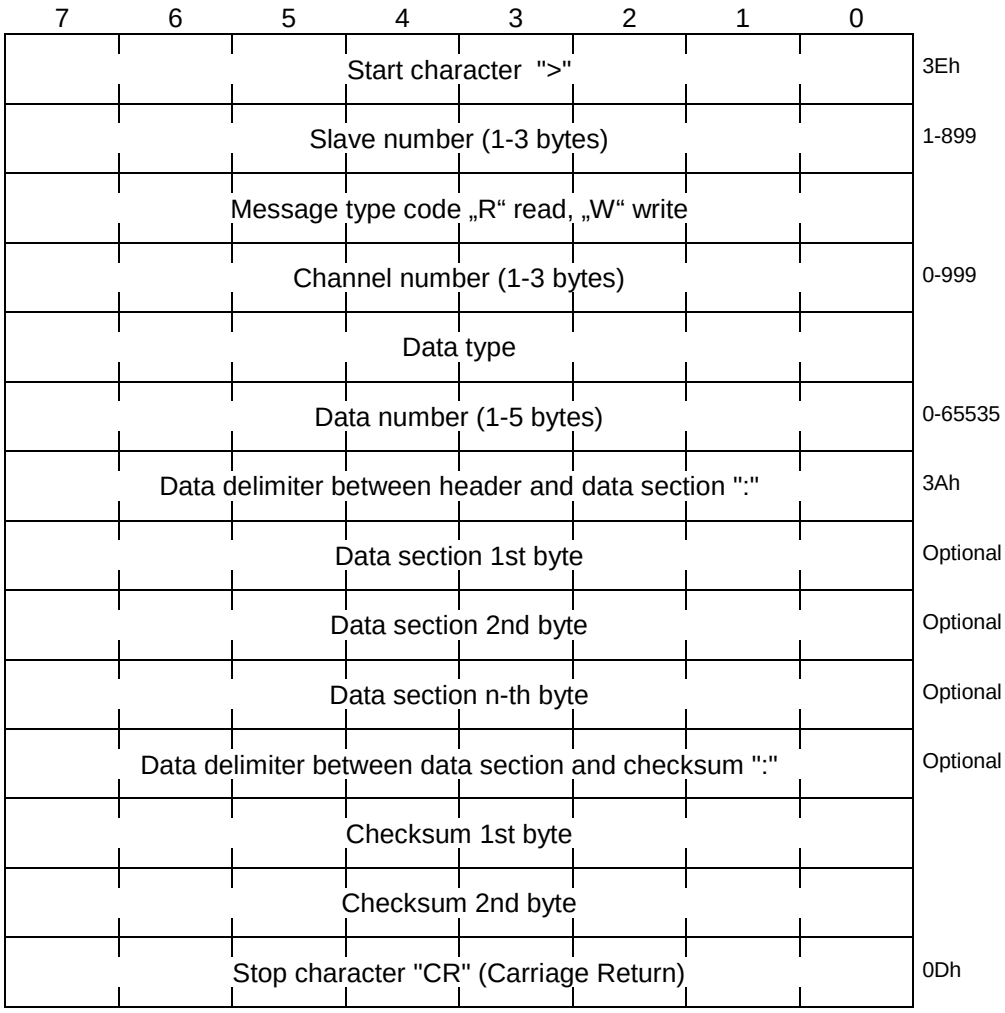
2.2. Station Types

Various SPA bus devices and device types of the ABB company can be connected to this firmware. These can include protective devices, bay control devices or simple input and output devices.

2.3. Message Description

Each message contains only printable ASCII characters (0Ah, 0Dh and 20h to 7Eh). In addition, each message consists of a start character, the header, the data section (optional), the checksum and the stop character. The maximum length of a message is 255 characters. In this case, one must make sure that the message formats of the master and slave are different.

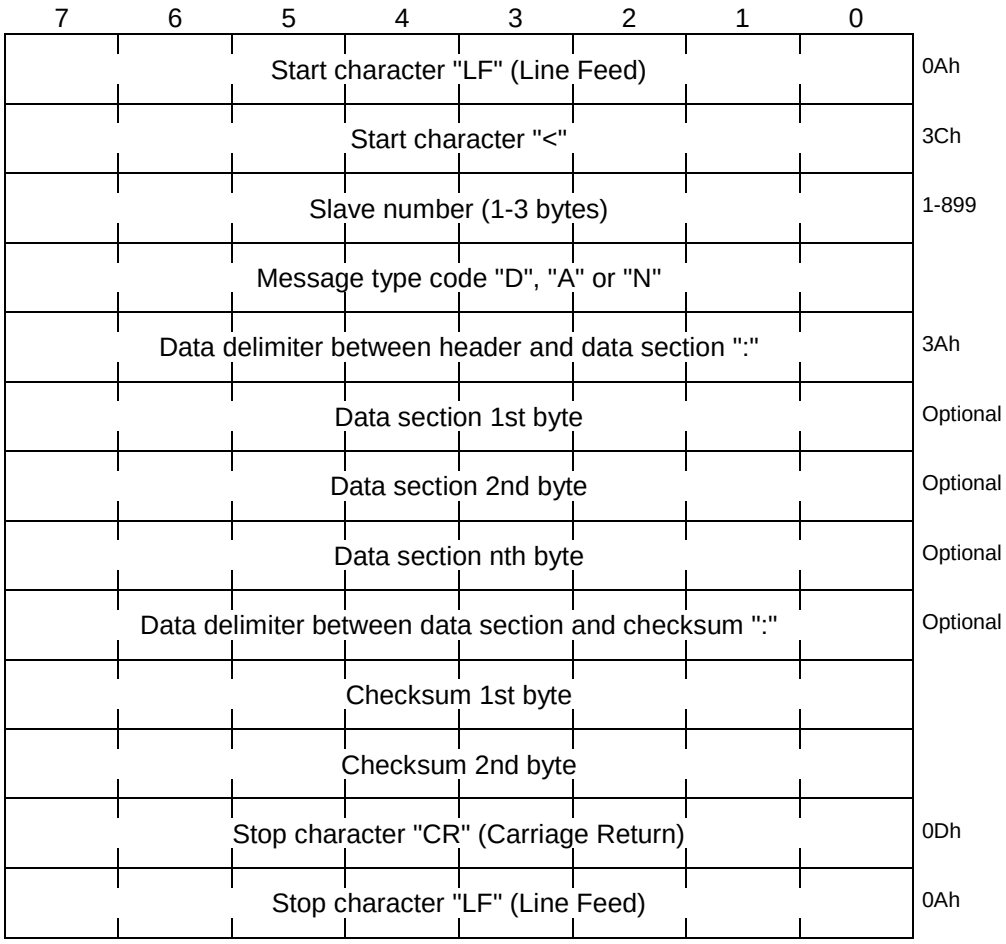
2.3.1. Message Format of Master



The data section in this message is only present for data with the type code „Write“.

According to the SPA bus specification, one message can also contain several data records, or several data records can be interrogated. However, the firmware does not support this, since the data points can only be parameterized individually.

2.3.2. Message Format of Slave



2.3.2.1. Message Type Code

"R"	Read data
"W"	Write data
"D"	Response of slave with value of interrogated data points
"N"	Negative acknowledgment with error information in data section
"A"	Positive acknowledgment

2.3.2.2. Data type

"I"	Input data (binary or analog inputs)	read only
"O"	Output data (commands or setpoint values)	read and write
"S"	Parameters (device settings)	read and write
"V"	Internal variables (e.g., calculated values)	read and write
"M"	Data in memory	not supported
"C"	Status of slave	read and write
"F"	Identification of slave	not supported
"T"	Time	write only
"D"	Date and time	write only
"L"	Last result (information or measured values)	write only
"B"	Repeat last event	write only
"A"	Active alarms	not supported

Many descriptions of the SPA bus devices refer to a combination of data type and data number.

e.g.: Channel number = 2, Code = S34
This involves channel number 2, data type S (parameter) and data number = 34

2.4. Address Conversion

Address conversion refers to the adjustment of address concepts of the two manufacturing companies.

The Ax address consists of 5 + 1 bytes:	1st octet of the CAASDU/ region number 2nd octet of the CAASDU/ component number 1st octet of the IOA/ module number 2nd octet of the IOA/ value number 3rd octet of the IOA/ sub-address Data type (process addressing) Station number
The external address consists of:	Slave number Data type Channel number Data number

The desired data can be parameterized via detailed routing in the transmit direction and receive direction to the protocol element. Only those data present in this detailed routing are converted.

This detailed routing is initiated with the OPMII tool, and inserted in the protocol parameters.

This data parameterization in the OPMII is the reason for the process addressing for this additional system element (process topology).

Description of Detailed Routing in Transmit Direction

SAT address QR/01 Source region QK/02 Source component number QB/03 Source module number QW/04 Source value number QSA/05 Source sub-address			**External address**					
Description	**TI (type code)**	**Com-mand number**	**Data type**	**Channel number**	**Data number**	**Para-meter-record setpoint value proces-sing**	**Com-mand value to be input**	**Time for ack-know-ledg-ment inter-roga-tion, sec.**
Possible values	0-255	0-15,255	0-15	0-999	0-65535	0-30,31	0-7	0-250
Commands	Direct control of output relay							
1 single command with output time	160	0-15	2 "O"	0-999	0-65535	31	0,1	0-250
1 single command	45	0,1	2 "O"	0-999	0-65535	31	0,1	0-250
1 double command	46	2,3,4,5	2 "O"	0-999	0-65535	31	0,1	0-250
	Control of output relay via selection and execution							
1 single command with output time	160	0-15	4 "V"	0-999	0-65535	31	0,1	0
1 single command	45	0,1	4 "V"	0-999	0-65535	31	0,1	0
1 double command	46	2,3,4,5	4 "V"	0-999	0-65535	31	0,1	0
	Writing of internal variables or parameters BINARY							
1 single command with output time	160	0-15	3 "S", 4 "V"	0-999	0-65535	31	0,1	0-250
1 single command	45	0,1	3 "S", 4 "V"	0-999	0-65535	31	0,1	0-250
1 double command	46	2,3,4,5	3 "S", 4 "V"	0-999	0-65535	31	0,1	0-250
	Writing of internal variables or parameters ANALOG							
1 setpoint command, standardized	48	255	3 "S", 4 "V"	0-999	0-65535	0-31	0	0-250
1 setpoint command, scaled	49	255	3 "S", 4 "V"	0-999	0-65535	0-31	0	0-250
1 setpoint command, short floating point	50	255	3 "S", 4 "V"	0-999	0-65535	0-31	0	0-250

Meaning:

Command number: Messages SK format (TI 160) 0-15 command number
Messages Ax format (TI 45/469)

0	Single command (TI 45)	SELECT	
1	Single command (TI45)	EXECUTE	
2	Double command(TI 46)	AUS	SELECT
3	Double command (TI46)	EIN	SELECT
4	Double command (TI 46)	AUS	EXECUTE
5	Double command (TI46)	EIN	EXECUTE

Data type

0	Data record not used
1	Input data (binary or analog inputs)
2	Output data (commands or setpoint values)
3	Parameters (device settings)
4	Internal variables (e.g., calculated values)
5	Data in memory
6	Invalid
7	Invalid
8	Invalid
9	Invalid
10	Events (information or measured values)
11	Invalid
12	Active alarms
13	Invalid
14	Error information/status information

Parameter record, setpoint processing 0-30
There are 31 parameter records available for measured value and setpoint treatment. These describe the conversion of SAT formats to the desired target format.

Command value to be input

0	ON or OFF, depending on application
1	ON or OFF, depending on application
2-7	Reserve

Time for acknowledgment interrogation 0-250 seconds
If the command is used for controlling output data, the corresponding acknowledgment (input data) is interrogated after this time has expired. this acknowledgment must be present with the same channel and data number and parameterized.
This also applies to the writing of internal variables or parameters.

2.4.1. Description of Detailed Ranging in Receive Direction

External address							SAT address QR/01 Source region QK/02 Source component number QB/03 Source module number QW/04 Source value number QSA/05 Source sub-address	
Data type	**Channel number**	**Data number**	**ana-log inptut pro-ces-sing**	**binary input pro-ces-sing**	**Object code event**	**Reserve**	**Description**	**TI (type code)**
0-15	0-999	0-65535	0-31	0,1	0-15	255	Possible values	
							Messages	
1,3,4,5, 12	0-999	0-65535	31	0,1	15	255	Single-point information	30
10	0-999	0-65535	31	0,1	0,1	255	Single-point information, event	30
14	0	0-15	31	0,1	15	255	Single-point information, error information	30
1,3,4,5	0-999	0-65535	31	0,1	15	255	Double-point information	31
10	0-999	0-65535	255	0,1	2,3,4,5	255	Double-point information, event	31
							Measured values	
1,3,4,5	0-999	0-65535	0-30	0	15	255	MW 15 bit + VZ standardized	34
1,3,4,5	0-999	0-65535	0-30	0	15	255	MW 15 bit + VZ scaled	35
1,3,4,5	0-999	0-65535	0-30	0	15	255	MW 31 bit + VZ	140
							Measured values, event	
10	0-999	0-65535	0-30	0	6	255	MW 15 bit + VZ standardized	34
10	0-999	0-65535	0-30	0	6	255	MW 15 bit + VZ scaled	35
10	0-999	0-65535	0-30	0	6	255	MW 31 bit + VZ	140

Meaning:

Data type

0	Data record not used
1	Input data (binary or analog inputs)
2	Output data (commands or setpoint values)
3	Parameters (device settings)
4	Internal variables (e.g., calculated values)
5	Data in memory
6	Invalid
7	Invalid
8	Invalid
9	Invalid
10	Events (information or measured values)
11	Invalid
12	Active alarms
13	Invalid
14	Error information/status information

Channel number: 0-999

The channel number addresses the data point.

Data number: 0-65535

The data number address the data point.

Analog input processing 0-30

There are 31 parameter records available for measured value and setpoint treatment. These describe the conversion of external formats to the desired target format.

Binary input processing 0,1

0 = no inversion of binary input
1 = inversion of binary input

Object code, event: 0-15

0	Single-point information ON
1	Single-point information OFF
2	Double-point information ON
3	Double-point information OFF
4	Double-point information DIFF
5	Double-point information STOER
6	Measured value
15	Not used

2.4.2. Parameterization of Error Information

It is possible to relay the error and status information of the devices as messages. To this end, data type 14, error information/status information, is used. A maximum of 16 possible information items are available. These information items are parameterized with data numbers 0-15.

Data number:	0	Error checksum or parity
	1	Slave is current unable to send data
	2	Data entry memory overflow
	3	Interrogation is too complex or contains too much data
	4	Reserve
	5	Error in message structure (content not defined)
	6	Data to be interrogated are not present
	7	Data cannot be written or read
	8	Data content of a command message is invalid
	9	Internal error in slave
	10	Reserve
	11	Reserve
	12	Reserve
	13	Reset of substation (all event data lost)
	14	Event memory overflow (new event data lost)
	15	Communications failure

2.4.3. Expanded Capabilities of Parameterization

2.4.3.1. Use of Identical Ax Target Adresses in Receive Detailed Ranging

If the same data point is to be interrogated in a normal manner and used as an event, it is possible to allocate a single Ax target address to these two data points. As a result, a double ranging of the messages can be avoided, and the data are acquired faster given the connection of several protective devices (events are cyclically interrogated, at least once per minute).

This type of parameterization is only possible for information.

2.4.3.2. Inversion of binary inputs

It is possible to invert single point and double point informations. In case of double point information every 4 possible conditions are inverted.

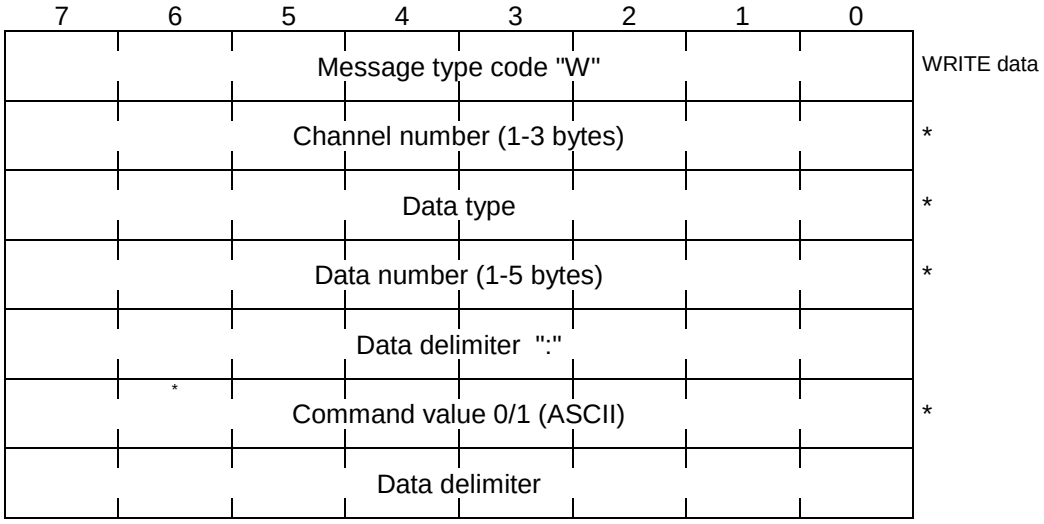
If the same Ax target address is used for an interrogated data point and an event commonly and the value of this Ax target address should be inverted, it is necessary that the values of both sourceaddresses are the same und also both of them have to be inverted. If not, it can happen that the different values of these sourceaddresses will overwrite each other.

3. Message Description

3.1. User Data Messages in Transmit Direction

3.1.1. Command Messages

The message start character, slave number, checksum and message stop character are not displayed.



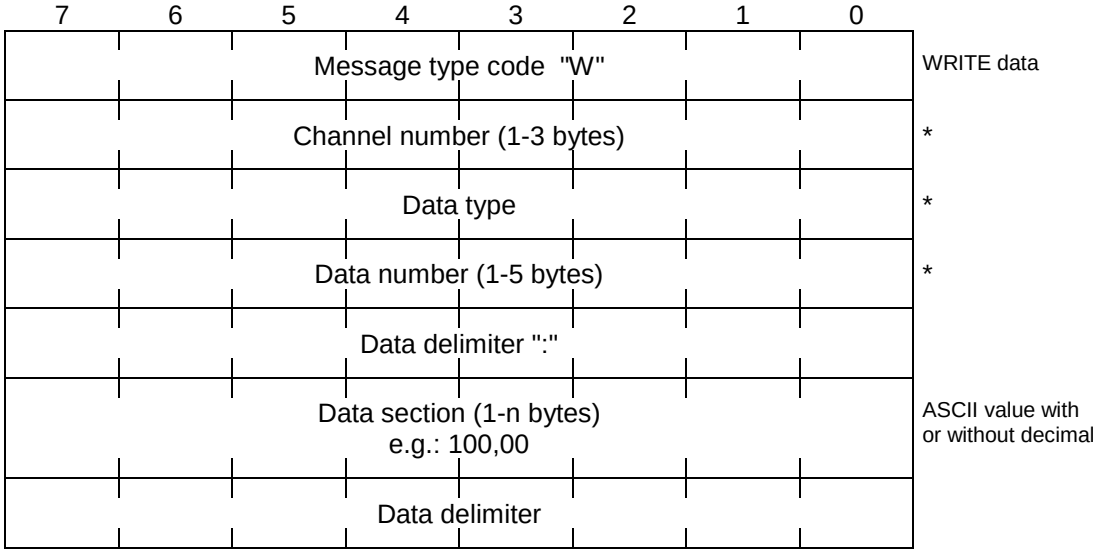
* Detailed routing parameter

Comment:

If individual commands with output time (SK format) are used, the output time contained therein ignored. The same holds true for the command times in the Ax formats.

3.1.2. Setpoint Value Message

The message start character, slave number, checksum and message stop character are not displayed.



* Detailed routing parameter

Comment:

Only the execute code is taken into account for setpoint values in Ax messages.

3.2. System Messages in Transmit Direction

3.2.1. Time Synchronization

3.2.2. Time Message

The checksum and message stop character are not displayed.

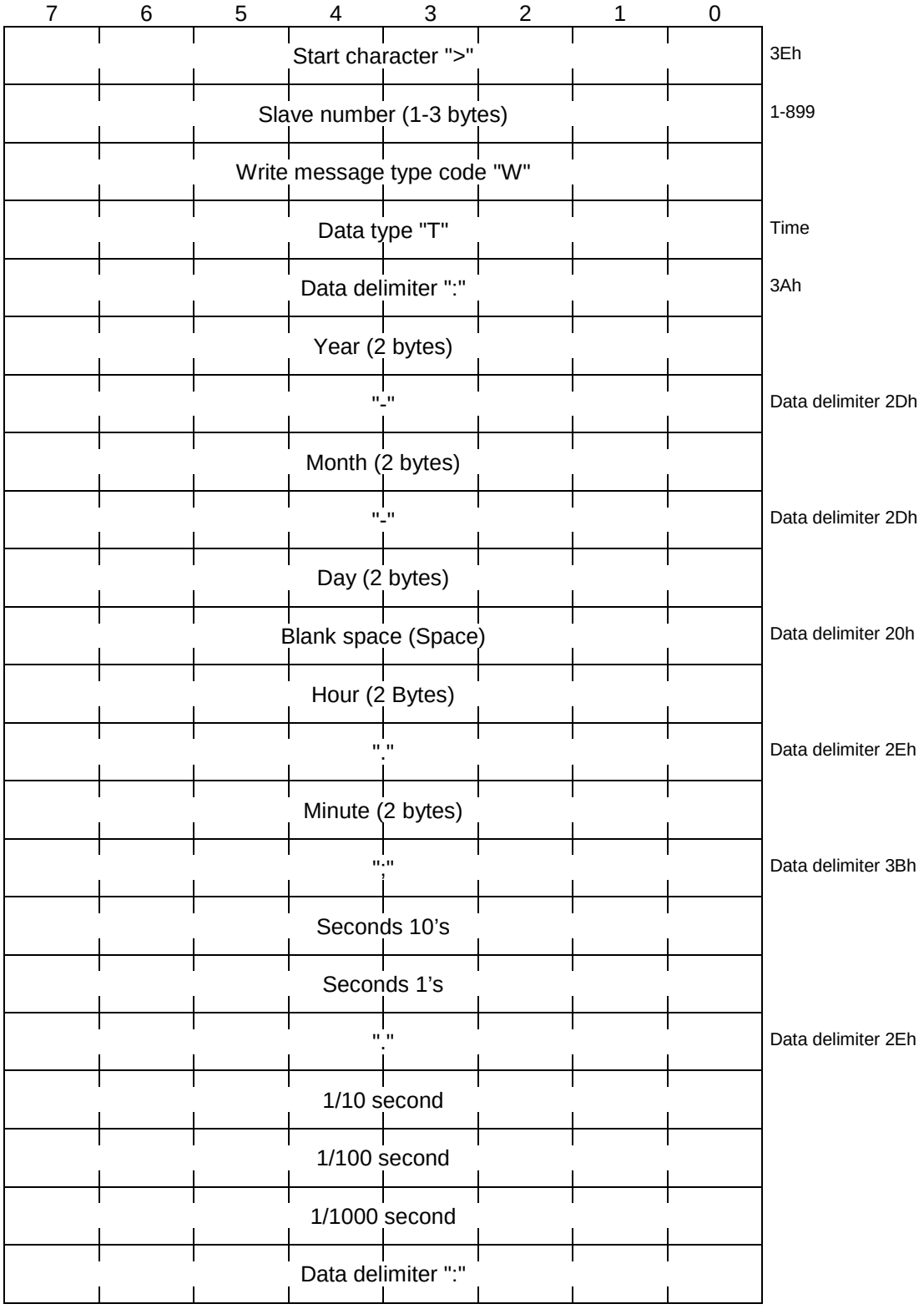
7	6	5	4	3	2	1	0	
Start character ">"								3Eh
Slave number (1-3 bytes)								1-899
Write message type code "W"								
Data type "T"								Time
Data delimiter ":"								3Ah
Seconds 10's								
Seconds 1's								
"."								Data delimiter 2Eh
1/10 second								
1/100 second								
1/1000 second								
Data delimiter ":"								

Comment:

This message is sent to everyone unacknowledged (slave number = 900).

3.2.3. Time and Date Message

The checksum and message stop character are not displayed.

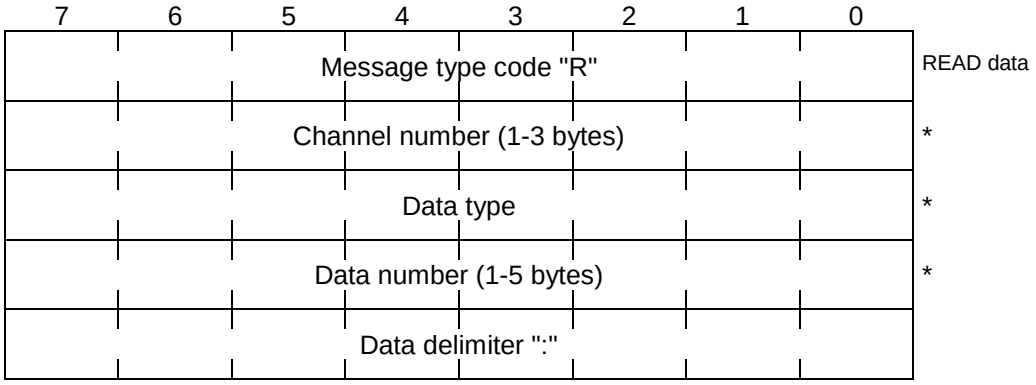


Comment: see time message!

3.3. Interrogation Messages in Transmit Direction

3.3.1. Interrogation of User Data

The message start character, slave number, checksum and message stop character are not displayed.



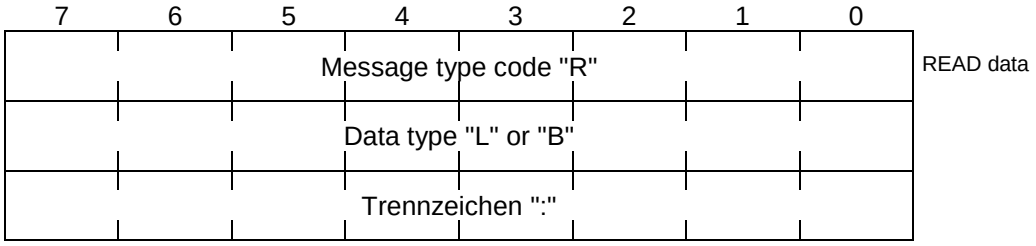
* Detailed routing parameter

Comment:

No data section is present.

3.3.2. Interrogation of Events

The message start character, slave number, checksum and message stop character are not displayed.

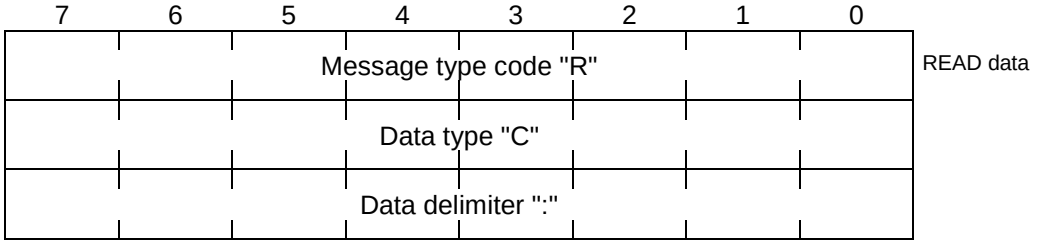


Comment:

No data section is present. Data type B is used to interrogate the events a second time if an error was detected during the first interrogation.

3.3.3. Interrogation of Slave Status

The message start character, slave number, checksum and message stop character are not displayed.

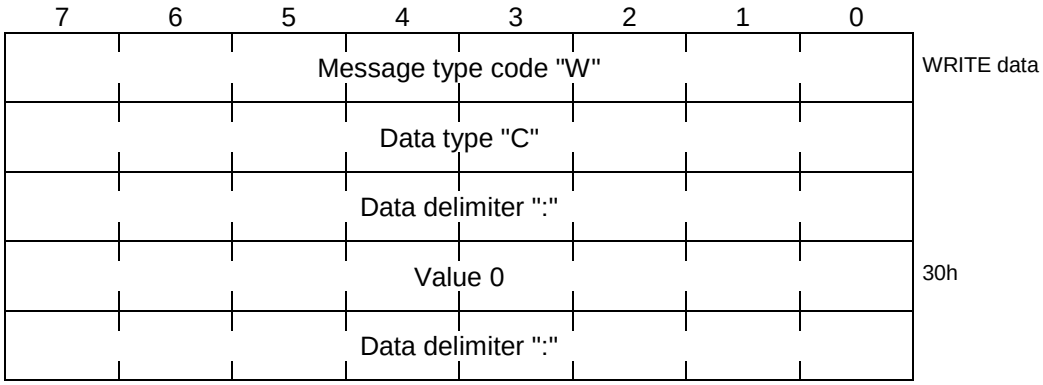


Comment:

No data section is present.

3.3.4. Reset of Slave Status

The message start character, slave number, checksum and message stop character are not displayed.



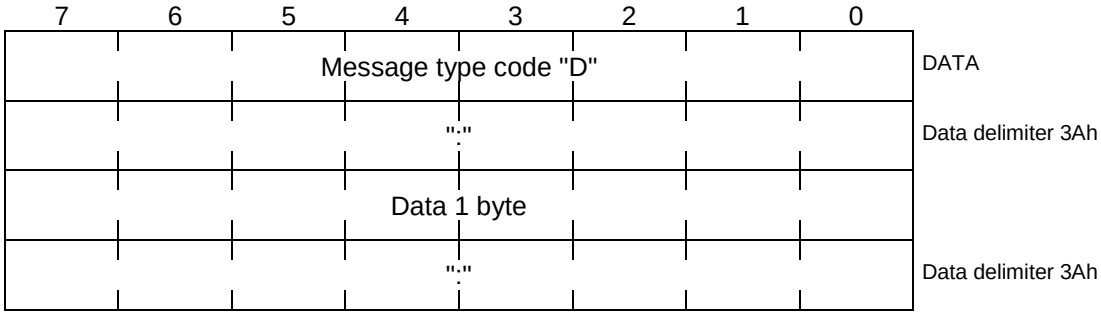
Comment:

This message is sent by the central station as soon as the response message of the status interrogation contains an error information.

3.4. User Data Messages in Receive Direction

3.4.1. Messages

The message start character, slave number, checksum and message stop character are not displayed.

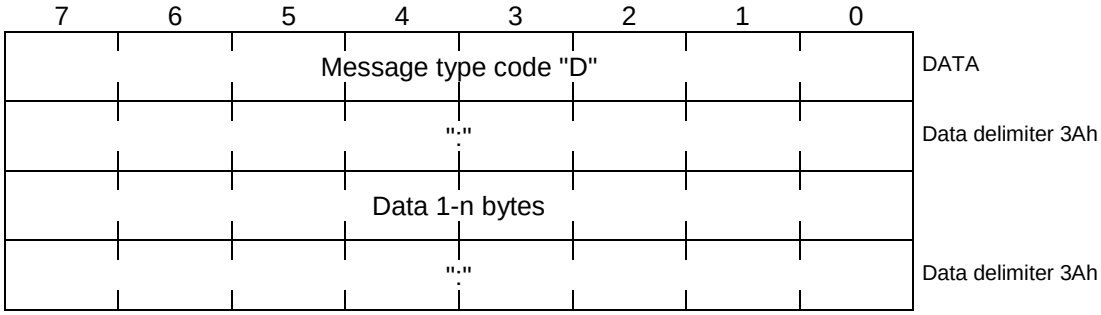


Comment:

Data content for single-point information 0 = OFF and 1 = ON
Data content for double-point information 0 = DIFF, 1 = OFF, 2 = ON and 3 = DIST

3.4.2. Measured Values

The message start character, slave number, checksum and message stop character are not displayed.

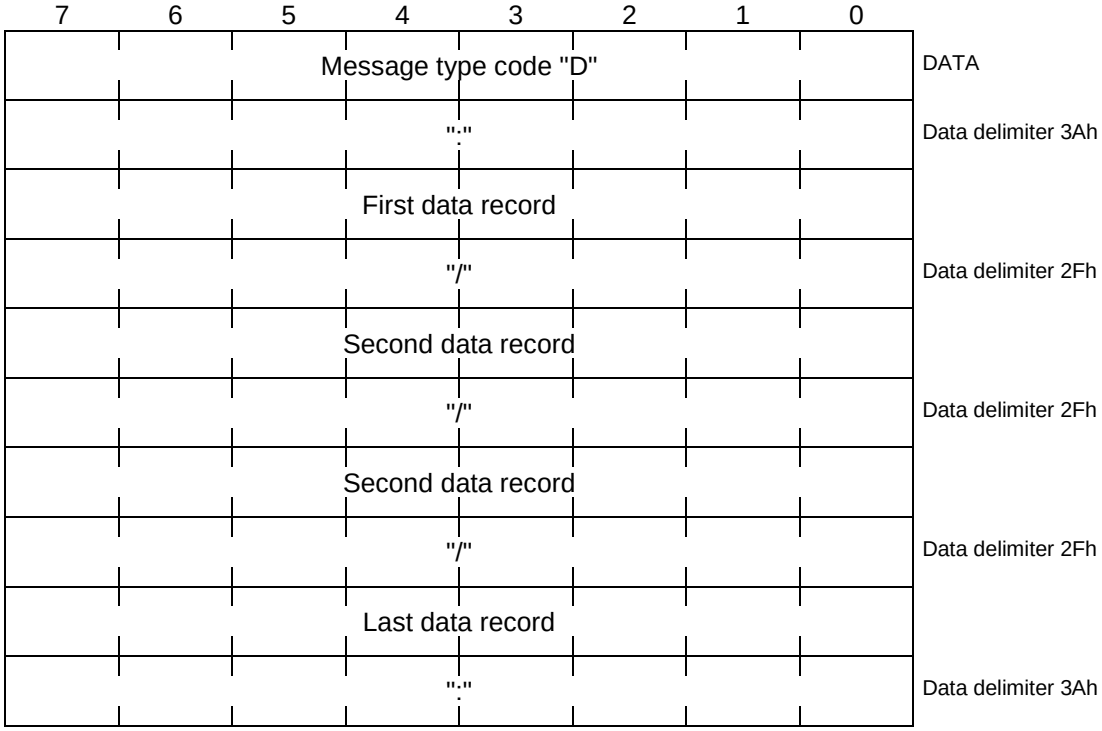


Comment:

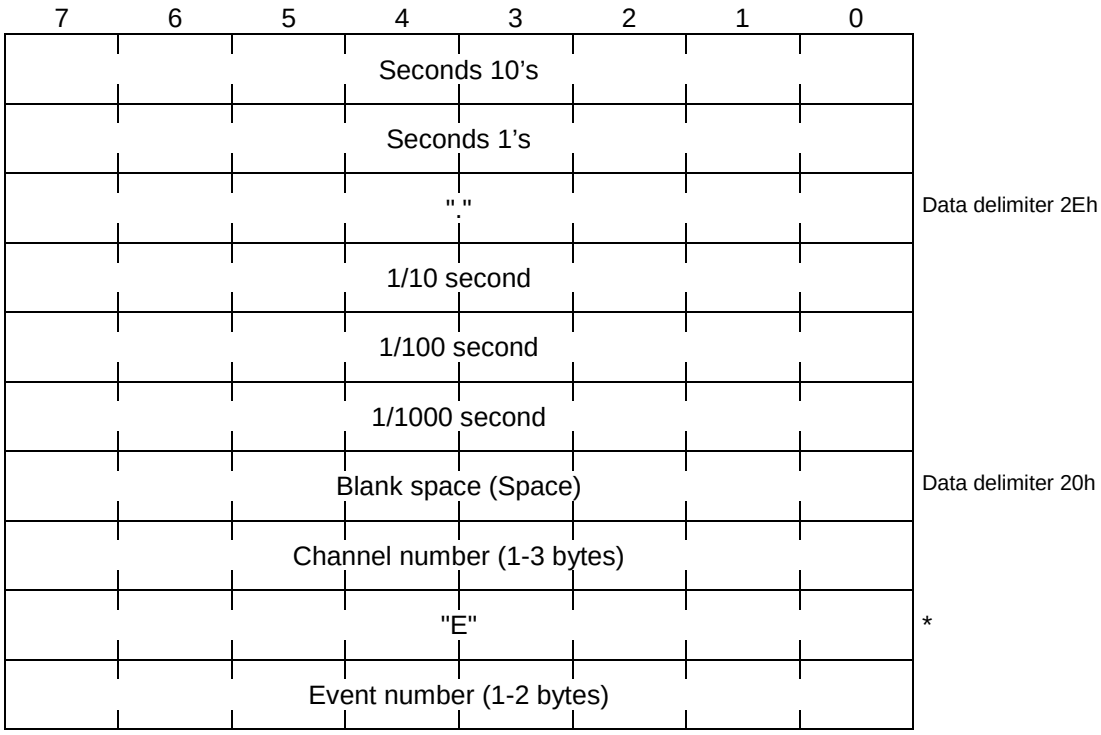
Example for data content: 1234.56 (each individual character as ASCII character)

3.4.3. Event Data

The message start character, slave number, checksum and message stop character are not displayed.



Structure of a Data Record for Information

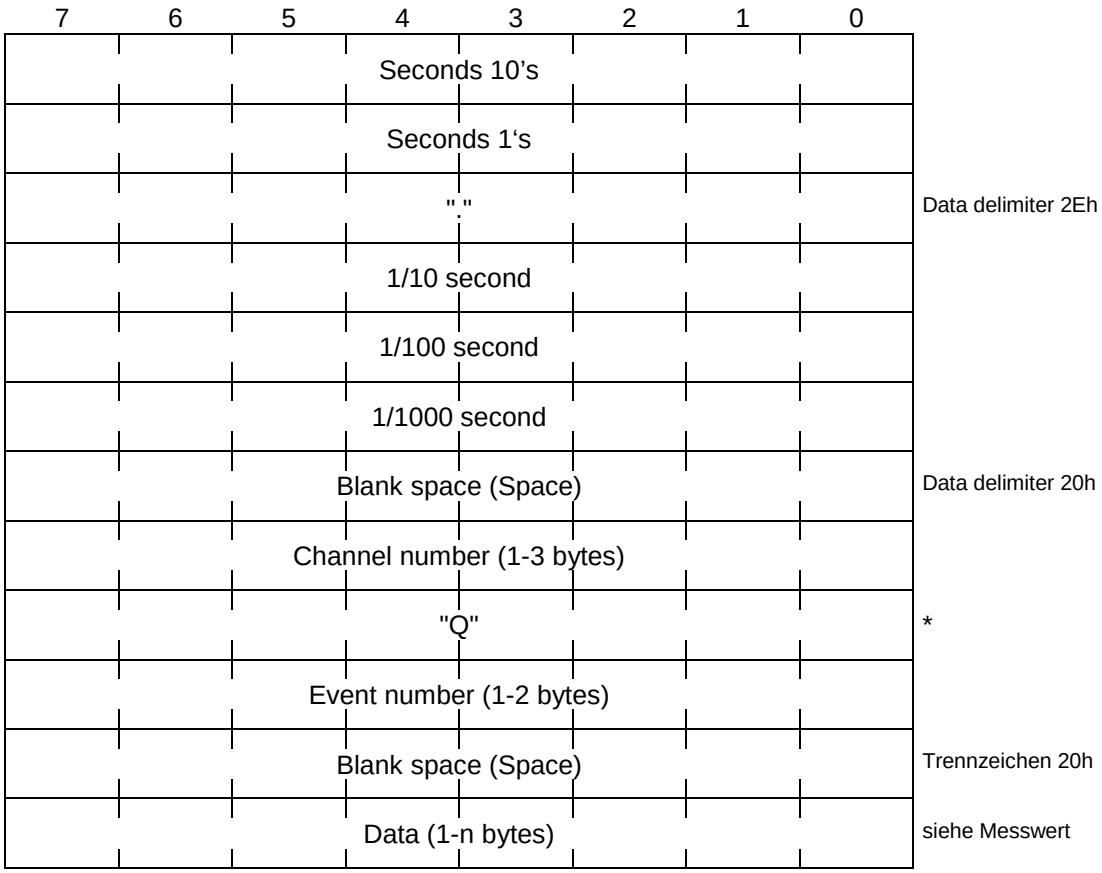


* Data type event information

Comment:

The event number varies by device, and can be gleaned from the corresponding manufacturer description.

Structure of a Data Record for Measured Values



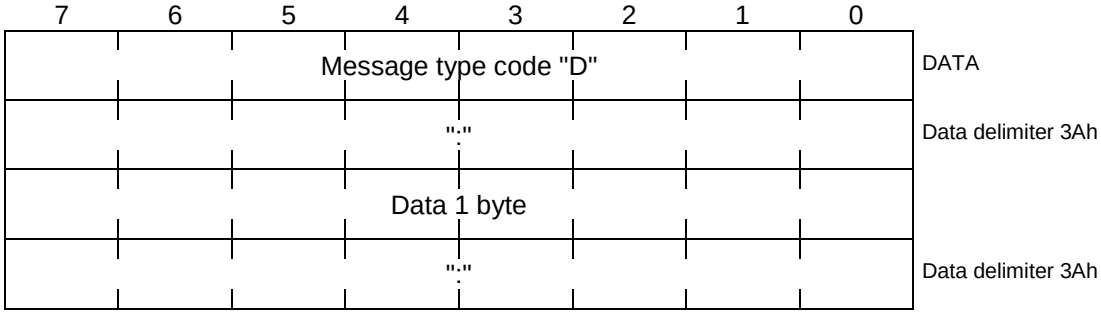
* Data type event measured value

Comment:

The event number varies by device, and can be gleaned from the corresponding manufacturer description.

3.4.4. Response to Status Interrogation

The message start character, slave number, checksum and message stop character are not displayed.



Comment:

The data byte can contain the values 0, 1, 2 or 3. These values are to be understood as bit values.

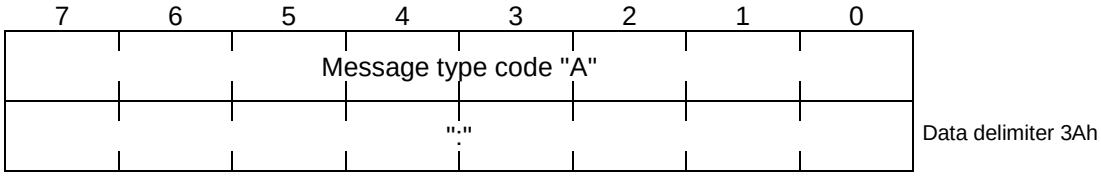
Value 1 or 3 Reset of substation (all event data lost)
Value 2 or 3 Overflow of event memory (new event data lost)

These two status messages can be relayed as single-point information.
The reset of substation information must be parameterized with data number 13, and overflow of event memory information must be parameterized with data number 14.

3.5. Acknowledgment Messages of Substation

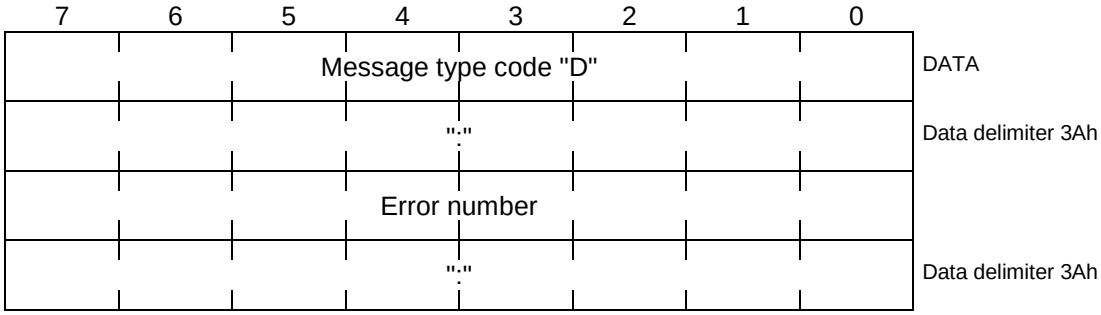
3.5.1. Positive Acknowledgment

The message start character, slave number, checksum and message stop character are not displayed.



3.5.2. Negative Acknowledgment

The message start character, slave number, checksum and message stop character are not displayed.



Error number:	0	Checksum or parity error
	1	Slave cannot send data at the moment
	2	Overflow of acquisition memory
	3	Interrogation is too complex or contains too much data
	4	Reserve
	5	Error in message structure (undefined content)
	6	Data to be interrogated are not present
	7	Cannot write or read data
	8	Data content of command message is invalid
	9	Internal error in slave

Comment:

These errors can be relayed as single-point information. The error number here corresponds to the data number to be parameterized.

4. Connection of Communication Interface

4.1. General Description

The SPA bus devices can be connected to the Ax system in various ways.

The SPA bus device interface is designed as a 9-pole sub-D socket connector. This socket connector has an RS232 interface and R485 interface.

In this case, there are the following possible connections, which can vary from device to device.

The RS232 interface must only be operated with a TTL level. This necessitates a conversion of SIP interface signals from RS232 V.24 level to RS232 TTL level. The MK-V.24 module can be used for this conversion.

The RS484 interface is provided as a 2-wire bus.

Pin assignment of interface:

Connection pin	RS 232	RS 485
1		DATA A data signal (+)
2	TxD transmit data	DATA B data signal (-)
3	RxD receive data	RTS A transmit request (+)
4		RTS B transmit request (-)
5		
6		
7	GND signal ground	GND signal ground
8	+5 V power supply	+5 V power supply
9	+8 V power supply	+8 V power supply

A. 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 errors in operating system
	1	1	Internal errors in base system
	2	2	Parameter errors SIP
	3	3	Error - format conversion SIP
	4	4	Parameter error of the protocol-specific application layer
C	2	42	Communication errors 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 operating and base system
W	0	55	Warning in communication

```
category:    I
record:      0
meaning:     Internal errors in operating system

  Bit 00 ... RAM error
  Bit 01 ... STACK error
               The defined stack range was 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 save in file)
  Bit 03 ... Not enough freespace
               There is not enough free RAM space for dynamic
               memory management;
               Diagnosis:
                 - Change configuration 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:      1
meaning:     Internal errors in base system

  Bit 00 ... Checksum error in parameter area
               The checksum across the parameters is not correct.
               --> Reload parameters.
  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:    I
record:      2
meaning:     Parameter errors SIP

  Bit 00 ...
  Bit 01 ...
  Bit 02 ... Parameter error ZSE general
  Bit 03 ... Configured station number is wrong.
              Reason: Station number is greater than 100 and it is no
                     broadcast station no., either

  Bit 04 ... Configured station number is wrong.
              Reason: Station number is already being used.
  Bit 05 ... Parameter error in IEC870 link layer
  Bit 06 ... Parameter error in IEC870 application layer
  Bit 07 ... Parameter error - redundancy
  Bit 08 ... Parameter error - receive detailed routing
  Bit 09 ... Parameter error - send detailed routing
  Bit 10 ... Parameter error - Application
  Bit 11 ...
  Bit 12 ...
  Bit 13 ...
  Bit 14 ...
  Bit 15 ...
```

```
category:    I
record:      3
meaning:     Error - format conversion SIP

  Bit 00 ... Error - format conversion in transmit direction
  Bit 01 ...
  Bit 02 ... Error - 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 ...
```

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

  Bit 00 ... Error in routing information processing
  Bit 01 ... General parameter errors of multipoint traffic.
  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:    C
record:      2
meaning:     Communication errors 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 operating and base system

  Bit 00 ... Memory test disabled
  Bit 01 ... Online debugger running (breakpoints may have been set)
  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:    W
record:      0
meaning:     Warning in communication

  Bit 00 ... DFC bit (data flow control)
  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 ...
```

B. Appendix: Documents Used and Reference Documents

The following document(s) is (are) recommended for a more complete description of the "SPAM00":

SAT Description "Ax 1702 Data Formats"
Item Number: MA0-000-r.xx

"SPA-Bus Communication Protocol"
ABB
V2.4 dated 02.21.1992

In addition, we urgently recommend that the appropriate descriptions of the SPA BUS devices to be connected be used. These descriptions can be found at the following ABB website. The descriptions outline the individual data points made available by this device.

http://fisub.abb.fi/products/clist.htm

C. 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 - PARAMETER DOCUMENTATION Form

      created                last changed               released
-------------------------------------------------------------------
on                  by   on                  by   on                  by
20-03-00     ENT-SW/SC   15-08-01     ENT-SW/SC   15-08-01     ENT-SW/SC

PHYSICAL INTERFACE (*)

   Baud rate:
   ---------
   Possible:     50,   75,  100,  110, 134.5,  150,   200,  300,    600,  1050
              1200, 1800, 2000, 2400,  4800, 9600, 19200, 38400, 56000, 57600, 64000

   Transmission baud rate:      9600 bd                       CT command: SPS 000(/D)
   Reception baud rate:         9600 bd                       CT command: SPS 001(/D)


   Electrical Interface:
   --------------------
   Possible: 0=RS232 (V.24/V.28)
             1=RS485 (V.11)

   Electrical interface:  RS232 (V.24/V.28)               CT command: SPH 002/04 (/D)


   Asynchronous/Isochronous:
   ------------------------
   Possible: 0=asynchronous "V.24/V.28" (16-fold bit timing)
             1=isochronous  "X.24/X.27" ( 1-fold bit timing)

   Bit timing:  asynchronous                              CT command: SPH 002/01 (/D)


   Bit timing: (only for "isochronous")
   -----------
   Possible: 0=external (bit timing from RXC input)
             1=internal (bit timing at TXC output)

   Bit timing:  external                                  CT command: SPH 002/02 (/D)


   Byte frame setting
   ------------------

     Number of data bits:
     -------------------
     Possible      : 00 = 5 bits
                     01 = 6 bits
                     10 = 7 bits
                     11 = 8 bits
     Number of data bits: 7 bits                       CT command: SPL 002 / 03 (/B)

     Number of stop bits:
     -------------------
     Possible      : 00 = 1   bit
                     01 = 1,5 bits
                     10 = 2   bits
                     11 = invalid
     Number of stop bits: 1   bit                      CT command: SPL 002 / 0C (/B)

     Parity:
     -------
     Possible      : 00 = no parity
                     01 = even parity
```

```
                    10 = odd parity
                    11 = invalid
     Parity: even parity                              CT command: SPL 002 / 30 (/B)


CORRECTION FACTOR FOR EXPECTED ACKNOWLEDGEMENT TIME

   Set the double runtime of the longest message in receive direction as
   minimum expected acknowledgement time.
   Longest message = 255 bytes * 2 * 10 bits * (1 / baud rate)
   The times for other transmission rates can be derived
   from it.
   Possible: 2-65535 (n * 10ms) = 0.02sec-10.9[min]

   Expected acknowledgement time:    0,80 sec              CT command: SPS 003 (/D)


MESSAGE RETRIES (NUMBER OF RETRIES)

   For some message types, the number of message retries to be carried out
   can be set.
   Possible:  0-255

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


TIME SETTINGS FOR TRANSMISSION CHANNELS

                  +=======================================+
                  |                                       |
   RTS   =========+        ++++++++++++++++++++          +============
         |        |        ||||||||||||||||||||          |
   TxD   ==================+++++++++++++++++++++=====================
         |        |        |       data         |          |
         |<- tp ->|<- tv ->|                    |<-- tn -->|

   Time:      0-32767 [ms]; 0-4095 [bit]
   Time base: 0=bit; 1=ms
              CAUTION! Times configured in "bit" depend on the
                       set baud rate!


   Pause time (tp): "Pause before transmission section ON"
   ---------------
   Prior to the transmission of a message, the set pause time will be allowed
   to elapse before the transmit signal level (RTS) is turned on.

   Pause time (tp):      0 [ ms]                        CT command: SPS 00B/7FFF(/D)
   Time base:              ms                           CT command: SPS 00B/8000(/D)


   Setup time (tv): "Transmission delay after transmission section ON"
   ---------------
   After the transmit signal level (RTS) has been turned ON, message transmission
   will be started after the setup time has elapsed.
   Note!  In the case of "tv=0", the level is not turned ON (RTS=OFF)!

   Setup time (tv):       0 [ ms]                       CT command: SPS 00C/7FFF(/D)
   Time base:               ms                          CT command: SPS 00C/8000(/D)


   Runout time (tn): "Pause until transmission section OFF"
   ----------------
   After the end of the message transmission, the transmit signal level (RTS) will
   only be turned OFF after the runout time has elapsed.

   Runout time (tn):       0 [bit]                      CT command: SPS 00D/7FFF(/D)
```

```
   Time base:                bit                          CT command: SPS 00D/8000(/D)


MONITORING TIMES

   Times:     0-32767 [ms]; 0-4095 [bit]
   Time base: 0=bit; 1=ms
              CAUTION! Times configured in "bit" depend on the
                       set baud rate!


   Idle monitoring time: (after "resynchronization of receiver" elapses)
   ---------------------
   By using the DCD input, one is able to accomplish a faster
   resynchronization.

   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)
   --------------------------
   When configuring the character monitoring time, the time for the transmission
   of one byte and the maximum pause between the bytes of a message must be
   taken into account.

   Character monitoring time:     22 [bit]               CT command: SPS 00F/7FFF(/D)
   Time base:                         bit                CT command: SPS 00F/8000(/D)


   Disable Time: (Disable Time after Receipt of a Message)
   -------------
   Disable time:      0 [bit]                            CT command: SPS 012/7FFF(/D)
   Time base:            bit                             CT command: SPS 012/8000(/D)


DCD RATING

   DCD active  +++++++==================================+++++++
               |||||||    |       |                    |||||||
   DCD idle ===++++++++    |       +-DCD valid       +++++++================
               |  tprell  | tstab |                    |  tprell  | tstab |
               |<-------->|<----->|    tdauer         |<-------->|<----->|
               |<-------------------------------------------------->|

   DCD-rating function enable:
   --------------------------
   Possible:  0=not enabled; 255=enabled

   DCD-rating:  not enabled                                 CT command: SPL 01A (/D)


   Bounce suppression time: (tprell)
   ------------------------
   Possible:  0-65535 (n * 1ms)

   Bounce suppression time:     10 [ms]                     CT command: SPS 013 (/D)


   Stability monitoring: (tstab)
   ---------------------
   The "new" DCD state will not be used for message synchronization until the
   stability monitoring time has elapsed.
   Possible:  0-65535 (n * 1ms)

   Stability monitoring time:      5 [ms]                   CT command: SPS 014 (/D)


   Transmission delay: "in case of continuous level on the transmission line" (tverz)
```

```
   ------------------
   Another message transmission will be carried out, in the case of "continuous level"
   no later than after the "transmission delay" elapses.
   Possible: 0-65535 (n * 100ms)

   Transmission delay in case of level:   0,00 [sec]          CT command: SPS 016 (/D)


   Continuous level monitoring time: (tdauer)
   ---------------------------------
   Possible:  0-65535 (n * 100ms)

   Continuous level monitoring time:  10,00 [sec]             CT command: SPS 015 (/D)


CALL CYCLE/STATION CONFIGURATION

   Continuous cycle:
   -----------------
   Possible:  0=not enabled; 255=enabled

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


   Station Call Prioritization: "number of called stations until change of levels"
   ----------------------------
   Possible: 0-99
   Number of station calls on high-priority level:     1      CT command: SPL 021 (/D)
   Number of station calls on mid-priority level:      1      CT command: SPH 021 (/D)
   Number of station calls on low-priority level(A):   1      CT command: SPL 022 (/D)
   Number of station calls on low-priority level(B):   1      CT command: SPH 022 (/D)


   Station Parameter Setting:
   -------------------------
   Possible:
   Station number (stat no) ............... 0-99; 255=not used!
   Enable (station in cycle) ............... 0=no; 1=yes
   Station failure "signaling"............. 0=no; 1=yes
   Priority level ......................... 0=high-priority     1=mid-priority;
                                            2=low-priority(A)   3=low-priority(B)
   Number of calls (to change of station)... 1-63
        +-------------------------------------------------------------------------+
        |                        Station Parameter Setting                        |
   +----+----------+----------+------------------+-----------------+--------------+
   | No.| Stat No. | Enable   |Failure"Signaling"| Priority Level  | No. of Calls |
   +====+==========+==========+==================+=================+==============+
   |  0 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  1 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  2 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  3 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  4 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  5 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  6 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  7 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  8 |   255    |    yes   |       yes        | hi-prior        |        1     |
   |  9 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 10 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 11 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 12 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 13 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 14 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 15 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 16 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 17 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 18 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 19 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 20 |   255    |    yes   |       yes        | hi-prior        |        1     |
   | 21 |   255    |    yes   |       yes        | hi-prior        |        1     |
```

22	255	yes	yes	hi-prior	1
23	255	yes	yes	hi-prior	1
24	255	yes	yes	hi-prior	1
25	255	yes	yes	hi-prior	1
26	255	yes	yes	hi-prior	1
27	255	yes	yes	hi-prior	1
28	255	yes	yes	hi-prior	1
29	255	yes	yes	hi-prior	1
30	255	yes	yes	hi-prior	1
31	255	yes	yes	hi-prior	1
32	255	yes	yes	hi-prior	1
33	255	yes	yes	hi-prior	1
34	255	yes	yes	hi-prior	1
35	255	yes	yes	hi-prior	1
36	255	yes	yes	hi-prior	1
37	255	yes	yes	hi-prior	1
38	255	yes	yes	hi-prior	1
39	255	yes	yes	hi-prior	1
40	255	yes	yes	hi-prior	1
41	255	yes	yes	hi-prior	1
42	255	yes	yes	hi-prior	1
43	255	yes	yes	hi-prior	1
44	255	yes	yes	hi-prior	1
45	255	yes	yes	hi-prior	1
46	255	yes	yes	hi-prior	1
47	255	yes	yes	hi-prior	1
48	255	yes	yes	hi-prior	1
49	255	yes	yes	hi-prior	1
50	255	yes	yes	hi-prior	1
51	255	yes	yes	hi-prior	1
52	255	yes	yes	hi-prior	1
53	255	yes	yes	hi-prior	1
54	255	yes	yes	hi-prior	1
55	255	yes	yes	hi-prior	1
56	255	yes	yes	hi-prior	1
57	255	yes	yes	hi-prior	1
58	255	yes	yes	hi-prior	1
59	255	yes	yes	hi-prior	1
60	255	yes	yes	hi-prior	1
61	255	yes	yes	hi-prior	1
62	255	yes	yes	hi-prior	1
63	255	yes	yes	hi-prior	1
64	255	yes	yes	hi-prior	1
65	255	yes	yes	hi-prior	1
66	255	yes	yes	hi-prior	1
67	255	yes	yes	hi-prior	1
68	255	yes	yes	hi-prior	1
69	255	yes	yes	hi-prior	1
70	255	yes	yes	hi-prior	1
71	255	yes	yes	hi-prior	1
72	255	yes	yes	hi-prior	1
73	255	yes	yes	hi-prior	1
74	255	yes	yes	hi-prior	1
75	255	yes	yes	hi-prior	1
76	255	yes	yes	hi-prior	1
77	255	yes	yes	hi-prior	1
78	255	yes	yes	hi-prior	1
79	255	yes	yes	hi-prior	1
80	255	yes	yes	hi-prior	1
81	255	yes	yes	hi-prior	1
82	255	yes	yes	hi-prior	1
83	255	yes	yes	hi-prior	1
84	255	yes	yes	hi-prior	1
85	255	yes	yes	hi-prior	1
86	255	yes	yes	hi-prior	1
87	255	yes	yes	hi-prior	1
88	255	yes	yes	hi-prior	1
89	255	yes	yes	hi-prior	1
90	255	yes	yes	hi-prior	1

91	255	yes	yes	hi-prior	1
92	255	yes	yes	hi-prior	1
93	255	yes	yes	hi-prior	1
94	255	yes	yes	hi-prior	1
95	255	yes	yes	hi-prior	1
96	255	yes	yes	hi-prior	1
97	255	yes	yes	hi-prior	1
98	255	yes	yes	hi-prior	1
99	255	yes	yes	hi-prior	1

Protocol - Parameters

ASSIGNMENT OF ABB STATION NUMBERS

The station numbers of the protective devices are within the range from 1 to 899.
Station number SAT (Stat no) 0-99

Possible:
Station number ABB (Slave no) ..... 0=not used, 1-899

Station Numbers on the Line		
Station Number SAT	SlaveNumber SPA-Bus	CT Command
0	0	SPS 110(/D)
1	0	SPS 111(/D)
2	0	SPS 112(/D)
3	0	SPS 113(/D)
4	0	SPS 114(/D)
5	0	SPS 115(/D)
6	0	SPS 116(/D)
7	0	SPS 117(/D)
8	0	SPS 118(/D)
9	0	SPS 119(/D)
10	0	SPS 11A(/D)
11	0	SPS 11B(/D)
12	0	SPS 11C(/D)
13	0	SPS 11D(/D)
14	0	SPS 11E(/D)
15	0	SPS 11F(/D)
16	0	SPS 120(/D)
17	0	SPS 121(/D)
18	0	SPS 122(/D)
19	0	SPS 123(/D)
20	0	SPS 124(/D)
21	0	SPS 125(/D)
22	0	SPS 126(/D)
23	0	SPS 127(/D)
24	0	SPS 128(/D)
25	0	SPS 129(/D)
26	0	SPS 12A(/D)
27	0	SPS 12B(/D)
28	0	SPS 12C(/D)
29	0	SPS 12D(/D)
30	0	SPS 12E(/D)
31	0	SPS 12F(/D)
32	0	SPS 130(/D)
33	0	SPS 131(/D)
34	0	SPS 132(/D)
35	0	SPS 133(/D)
36	0	SPS 134(/D)
37	0	SPS 135(/D)
38	0	SPS 136(/D)
39	0	SPS 137(/D)
40	0	SPS 138(/D)

	41	0	SPS 139(/D)
	42	0	SPS 13A(/D)
	43	0	SPS 13B(/D)
	44	0	SPS 13C(/D)
	45	0	SPS 13D(/D)
	46	0	SPS 13E(/D)
	47	0	SPS 13F(/D)
	48	0	SPS 140(/D)
	49	0	SPS 141(/D)
	50	0	SPS 142(/D)
	51	0	SPS 143(/D)
	52	0	SPS 144(/D)
	53	0	SPS 145(/D)
	54	0	SPS 146(/D)
	55	0	SPS 147(/D)
	56	0	SPS 148(/D)
	57	0	SPS 149(/D)
	58	0	SPS 14A(/D)
	59	0	SPS 14B(/D)
	60	0	SPS 14C(/D)
	61	0	SPS 14D(/D)
	62	0	SPS 14E(/D)
	63	0	SPS 14F(/D)
	64	0	SPS 150(/D)
	65	0	SPS 151(/D)
	66	0	SPS 152(/D)
	67	0	SPS 153(/D)
	68	0	SPS 154(/D)
	69	0	SPS 155(/D)
	70	0	SPS 156(/D)
	71	0	SPS 157(/D)
	72	0	SPS 158(/D)
	73	0	SPS 159(/D)
	74	0	SPS 15A(/D)
	75	0	SPS 15B(/D)
	76	0	SPS 15C(/D)
	77	0	SPS 15D(/D)
	78	0	SPS 15E(/D)
	79	0	SPS 15F(/D)
	80	0	SPS 160(/D)
	81	0	SPS 161(/D)
	82	0	SPS 162(/D)
	83	0	SPS 163(/D)
	84	0	SPS 164(/D)
	85	0	SPS 165(/D)
	86	0	SPS 166(/D)
	87	0	SPS 167(/D)
	88	0	SPS 168(/D)
	89	0	SPS 169(/D)
	90	0	SPS 16A(/D)
	91	0	SPS 16B(/D)
	92	0	SPS 16C(/D)
	93	0	SPS 16D(/D)
	94	0	SPS 16E(/D)
	95	0	SPS 16F(/D)
	96	0	SPS 170(/D)
	97	0	SPS 171(/D)
	98	0	SPS 172(/D)
	99	0	SPS 173(/D)

REAL-TIME, TIME AND DATE SYNCHRONIZATION

Synchronization:

Possible:
Cycle for time synchronization 10 to 60 seconds
Cycle for date synchronization 30 to 240 seconds

```
   Time synchronization every:   30 seconds                  CT command: SPL 1D8 (/D)
   Date synchronization every:  240 seconds                  CT command: SPH 1D8 (/D)

   Time Tagging of Events:
   -----------------------
   Possible:  0=time in message is used
            255=time of AK is used

   Time Tagging:  INVALID!                                   CT command: SPL 1D9 (/D)


CYCLE FOR EVENT INTERARROGATION

   Possible: 5 to 60 seconds

   Cycle for Event Interarrogation every:    0 seconds        CT command: SPL 1DA(/D)


GENERAL INTERROGATION

   To avoid problems in a process control system which during a GI
   checks the completeness of the data in a shorter time interval than the
   protective devices, the data can be sent immediately from the
   process image (image GI). If this is not desired, the queried data
   are tagged with the GI status.
   Possible: 0=image GI; 255=no image GI

   Type of general interrogation:  image GI                  CT command: SPH 1D9(/D)


MEASURED-VALUE ADAPTATION

   These parameters apply to both transmit and receive directions.
   Calculation in receive direction:
   The received secondary value is multiplied by the factor. If the value
   is to be passed on as binary value, one must also specify the maximum value
   at 100% of the measuring range (e.g. measured value 0.00 to 1.00 corresponds to
   400A primary current with overload range up to 800A the following Settings are valid
   Factor = 400 and max. value = 800, in the case of a received secondary value
   of 1.0 this yields 800 : (1.0 * 400) = 50% of measuring range)
   Calculation in transmit direction:
   If the value exists as binary value, it will be compared to the maximum value
   and transmitted (e.g. 25% of the measuring range and max. value = 2
   => 0,5 will be transmitted).
   Threshold value monitoring:
   The new received and calculated value (value x * factor) is compared to the old
   value in the process image. Only if the difference is greater than the configured
   threshold, this value will be transmitted to the C-CPU.
   The transmission threshold is specified in percent of the measuring range. It has
   a range of 0.01 to 100 percent.

   Possible:
   Multiplier                  (factor).........  0-65535
   Maximum value at 100%
   of measuring range          (max value)......  0-65535
   Transmission threshold      (threshold)......  0-10000
   Number of fractional digits (digit).........  0-3 (for command direction only!!!)


   +---+------+-----------+-------+-----------+-------+-----------+-----+-----------+
   |No.|Factor| CT Command|MaxVal | CT Command|TrThres| CT Command|Digit| CT Command|
   +===+======+===========+=======+===========+=======+===========+=====+===========+
   | 0 |    1 |SPS 200(/D)|     1 |SPS 201(/D)|   1,00|SPS 202(/D)|  1  |SPL 203(/D)|
   | 1 |    1 |SPS 204(/D)|     1 |SPS 205(/D)|   1,00|SPS 206(/D)|  1  |SPL 207(/D)|
   | 2 |    1 |SPS 208(/D)|     1 |SPS 209(/D)|   1,00|SPS 20A(/D)|  1  |SPL 20B(/D)|
   | 3 |    1 |SPS 20C(/D)|     1 |SPS 20D(/D)|   1,00|SPS 20E(/D)|  1  |SPL 20F(/D)|
   | 4 |    1 |SPS 210(/D)|     1 |SPS 211(/D)|   1,00|SPS 212(/D)|  1  |SPL 213(/D)|
   | 5 |    1 |SPS 214(/D)|     1 |SPS 215(/D)|   1,00|SPS 216(/D)|  1  |SPL 217(/D)|
   | 6 |    1 |SPS 218(/D)|     1 |SPS 219(/D)|   1,00|SPS 21A(/D)|  1  |SPL 21B(/D)|
```

7	1	SPS 21C(/D)	1	SPS 21D(/D)	1,00	SPS 21E(/D)	1	SPL 21F(/D)
8	1	SPS 220(/D)	1	SPS 221(/D)	1,00	SPS 222(/D)	1	SPL 223(/D)
9	1	SPS 224(/D)	1	SPS 225(/D)	1,00	SPS 226(/D)	1	SPL 227(/D)
10	1	SPS 228(/D)	1	SPS 229(/D)	1,00	SPS 22A(/D)	1	SPL 22B(/D)
11	1	SPS 22C(/D)	1	SPS 22D(/D)	1,00	SPS 22E(/D)	1	SPL 22F(/D)
12	1	SPS 230(/D)	1	SPS 231(/D)	1,00	SPS 232(/D)	1	SPL 233(/D)
13	1	SPS 234(/D)	1	SPS 235(/D)	1,00	SPS 236(/D)	1	SPL 237(/D)
14	1	SPS 238(/D)	1	SPS 239(/D)	1,00	SPS 23A(/D)	1	SPL 23B(/D)
15	1	SPS 23C(/D)	1	SPS 23D(/D)	1,00	SPS 23E(/D)	1	SPL 23F(/D)
16	1	SPS 240(/D)	1	SPS 241(/D)	1,00	SPS 242(/D)	1	SPL 243(/D)
17	1	SPS 244(/D)	1	SPS 245(/D)	1,00	SPS 246(/D)	1	SPL 247(/D)
18	1	SPS 248(/D)	1	SPS 249(/D)	1,00	SPS 24A(/D)	1	SPL 24B(/D)
19	1	SPS 24C(/D)	1	SPS 24D(/D)	1,00	SPS 24E(/D)	1	SPL 24F(/D)
20	1	SPS 250(/D)	1	SPS 251(/D)	1,00	SPS 252(/D)	1	SPL 253(/D)
21	1	SPS 254(/D)	1	SPS 255(/D)	1,00	SPS 256(/D)	1	SPL 257(/D)
22	1	SPS 258(/D)	1	SPS 259(/D)	1,00	SPS 25A(/D)	1	SPL 25B(/D)
23	1	SPS 25C(/D)	1	SPS 25D(/D)	1,00	SPS 25E(/D)	1	SPL 25F(/D)
24	1	SPS 260(/D)	1	SPS 261(/D)	1,00	SPS 262(/D)	1	SPL 263(/D)
25	1	SPS 264(/D)	1	SPS 265(/D)	1,00	SPS 266(/D)	1	SPL 267(/D)
26	1	SPS 268(/D)	1	SPS 269(/D)	1,00	SPS 26A(/D)	1	SPL 26B(/D)
27	1	SPS 26C(/D)	1	SPS 26D(/D)	1,00	SPS 26E(/D)	1	SPL 26F(/D)
28	1	SPS 270(/D)	1	SPS 271(/D)	1,00	SPS 272(/D)	1	SPL 273(/D)
29	1	SPS 274(/D)	1	SPS 275(/D)	1,00	SPS 276(/D)	1	SPL 277(/D)
30	1	SPS 278(/D)	1	SPS 279(/D)	1,00	SPS 27A(/D)	1	SPL 27B(/D)

ENABLES FOR DEVELOPMENT

These parameters change the function of the protocol. Therefore, they can be used for in-house purposes only.

Enables ..... Bit 0..... send messages in container mode
Bit 1..... disable cyclic polling
Bit 2..... disable synchronization
Bit 3..... disable event query
Bit 4..... disable status query
Bit 5..... reserve
Bit 6..... reserve
Bit 7..... reserve

Bit |7 6 5 4 3 2 1 0|	CT Command
|0 0 0 0 0 0 0 0|	SPL 37F(/B)

SOFTWARE TEST POINTS AND SETTINGS

CAUTION! These parameters may be changed only after having consulted the software developer.

Debugger settings:

Data and acknowledgement between BSE:	disabled	CT command:	SPL 01C/01(/B)
Handshake RTS,GPB (ASCII mode) :	disabled	CT command:	SPL 01C/02(/B)
Screen for DISABLE data retrieval :	disabled	CT command:	SPL 01C/04(/B)
Handshake RTS,GPB (HEX mode) :	disabled	CT command:	SPL 01C/10(/B)
Master/Standby switchover :	disabled	CT command:	SPL 01C/40(/B)
Stop of serial test in case of communication failure :	disabled	CT command:	SPH 01C/80(/B)