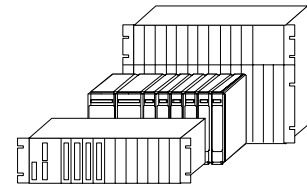


**Ax 1703**



## **Firmware Description**

# **BPP00**

**Balanced Point to Point Protocol**

**HW-Type: 2541 / FW-Type: 2512**

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

BPP00

Rev. 01 and higher

Version	Revision	Date	Change
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A, 1	01	14.07.03	Parameter documentation reworked
A, 1	02	05.11.03	Chap. 2.7. Traction-specific Settings new Appendix A: Diagnostic revised Appendix B: Parameter Documentation revised
A, 1	03	14.01.04	Chap. 2.8. Control Messages
A, 1	04	16.07.04	Diagnoses and Parameterdocumentation revised

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## **1. System Overview**

### **1.1. Short Description**

The BPP00 firmware is used for the serial coupling of two Ax 1703 components in accordance with IEC 870-5-101.

The functions supported by IEC 870-5-101 are laid down in the interoperability list of Ax 1703.

The message formats used correspond to the IEC 870-5-101 standard and the Ax 1703 Data Formats description.

The data communication control used for this firmware is balanced (symmetrical, point-to-point), i.e. the hardware line which is available must be designed for full-duplex traffic.



## 2. Protocol-specific Functions

### 2.1. Interface Fault

After an interface fault has been detected, a communications fault is signalled and no further data are fetched from the BSE.

⇒ An appropriate dwell period must be parameterized on the BSE for each type identifier.

### 2.2. DFC Bit (Data Flow Control)

If a set DFC bit is received from the remote station, a corresponding warning is output and no further data are fetched from the BSE.

In addition, a time can be parameterized after which an interface fault is signalled.

⇒ An appropriate dwell period must be parameterized on the BSE for each type identifier.

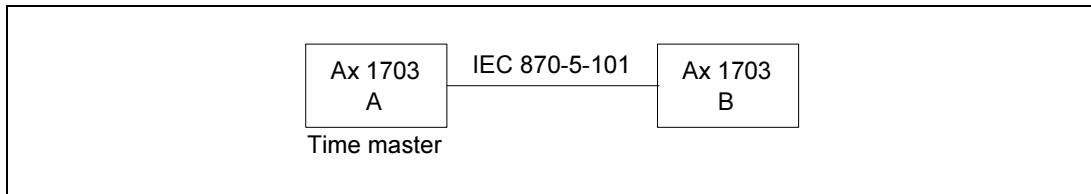
### 2.3. Master/Standby Function

The Master/Standby function is done by the redundancy function in Ax 1703. If the firmware is in standby operation, it does not send any messages. However, in contrast, all received messages are forwarded to the superordinate BSE. In order to synchronize the firmware - which is in standby operation - to the same FCB (Frame Count Bit) as the active one, the current FCB is either taken from the monitored Reset of Remote Link or from a valid long message.

## 2.4. Time Synchronization

A cyclic time synchronization is carried out by the firmware at least once a minute.

### Configuration (Station A is time master)



The time synchronization message sent by Station A is always sent at such a time so that it arrives at Station B before a minute change.

This time of sending is calculated based on the baud rate, message length, number of retries and any message which may possibly be on the line just at that moment.

The earliest time is the twentieth second and the latest the fiftieth second.

The time synchronization message is sent out exactly at 10 ms, i.e. the clock time in the message corresponds to the first bit on the line and is exact to 10 ms.

⇒ The runtime correction of the message must be done in Station B.

*Runtime correction:*

The runtime correction is made up of the following times:

- a) Message runtime
- b) Line delay time

re. a) The message runtime arises from  $(1/\text{Baud rate}) * 11 * \text{Number of bytes}$

re. b) The line delay time (e.g. by WT or DMS) is done with the help of the IEC 870-5-5 function "Acquisition of the message runtime" (Type Identification 106) and is then sent spontaneously to Station B.  
In order to detect line alterations, this function is carried out cyclically every 2 minutes.

## 2.5. Chaining

Contrary to the IEC 870-5-101 standard, a chaining function can be parameterized. With this function, IEC 870-5-101 ASDUs are chained independently of the type identifier and the transmission cause.



## **2.6. Description of Transparent Mode**

### **2.6.1. General**

In "transparent mode" all validly received messages are packed into a "user data container" and forwarded in the direction of the control system. All process data and system data messages which are to be sent are already prepared in the IEC 870-5-101 format by the control system and likewise made ready for the protocol in a "user data container" for sending out.

In "transparent mode" the firmware does only the data communication control. If the remote station should be supplied with the time, then this is to be enabled by parameterization.

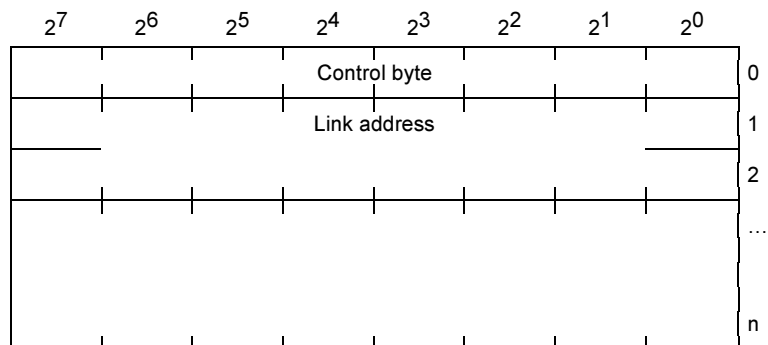
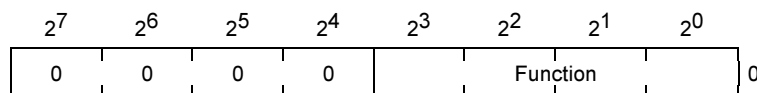
The transmission of the user data container takes place with Type Identifier 142 in the private range of IEC-60870-5-101 or IEC-60870-5-104.

2.6.2. User Data Container

2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>	
				142				Type identifier
				1				Variable structure identifier
								Transmission cause
								Origin address
								Common address of the ASDU
								Information object address
								7-octet binary time according to IEC 870-5-101 / 104
								Length of user data part in octets
				128				Message type (fixed)
				SAT internally reserved = 45				UEK
				SAT internally reserved = 02				Status
				SAT internally reserved				Number of bytes
				Interface number				Process channel
Total number of segments				Sequential segment number				Segmentation field = 11H
				1				Protocol type
								Reserve
								Length of the message data in bits
								Message data

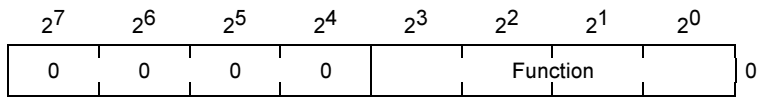
*Description of the contents:*

Transmission cause ....	Monitoring direction = Spontaneous (3) Control direction = Activation (6)
Common address of the ASDU ...	1 <sup>st</sup> octet = Region number of the connected station 2 <sup>nd</sup> octet = Component number of the connected station
Information object address...	1 <sup>st</sup> octet = 255 2 <sup>nd</sup> octet = 255 3 <sup>rd</sup> octet = 191 (sub-address)
Binary time ...	Earliest possible acquisition time of a message in the AK 1703. Time tagging on the base system element (BSE)
Length of user data in octets...	Exclusive message type
Number of bytes...	Length of the message data (in bytes) + 6
Segmentation field...	4-bit total number of the segments Total size = 15 segments of 50 octets each 4-bit sequential number of the segment (the first segment has Segment Number 1)
Length of the message data in bits...	Always the total length in all segments

*Structure of the message data:**Control byte - Control system → IEC 870-5-101*

Function	Description
3	User data SEND / CONFIRM
4	User data SEND / NO REPLY

*Control byte - IEC 870-5-101 → Control system*



Function	Description
3	User data SEND / CONFIRM
4	User data SEND / NO REPLY

*Link address*

The length of the link address (0, 1, 2 bytes) is always determined by a parameter in the protocol.

## 2.7. Traction-specific Settings

This function is activated by means of a system-engineering parameter.  
With function enabled, the message format 32-bit bit pattern (TK 33) is converted to the traction-specific format (TK 150).

### 2.7.1. Message Structure

Byte	Bit	e7	e6	e5	e4	e3	e2	e1	e0	IEC-Designation
1	ASDU	Type identifier = 150								Type identifier
2		SQ	Number of Info objects							Variable structure identifier
3		T	PN	Cause of transmission						Cause of transmission
4		Station								Originator address
5										Common address ASDU
6		N	Address							Information object address
7		Technological								
8		1	Code (TC)							
9		0	Bay address							
10		SK 8	SK 7	SK 6	SK 5	SK 4	SK 3	SK 2	SK 1	Protection criteria (BDK)
11										Protection criteria reserve
12		0 – 255								Fault code (AK of SLT)
13		2 ms – Code (0 – 255)								Switch delay
14		IV	NT	SB	BL				DPI	DIQ of DOM
15		Originator time (represents TL SCHINA, DB_Network) CP56Time2a								Dual time,  7 octets
16										
17										
18										
19										
20										
21										

## 2.7.2. Conversion of the Messages in Transmit- and Receive Direction

Transmit direction:

The type identifier 33 is converted as follows:

Cause of transmission	IEC-Parameter	Octets time	Type identifier
Spontaneous	-	-	150
GI	with time	3	4
GI	with time	7	31
GI	without time	-	3

Receive direction:

In the receive direction, the type identifier 150 is converted to a type identifier 33!

The TK 150 is only available with 7 Byte time, 3 Byte IOA, 2 Byte CASDU, 2 Byte URS!

Furthermore, also no double transmission NET + ET is supported!

## 2.8. Control Messages

Different functions can be enabled and disabled with Control Messages.

Description	Function
START data type filter in transmit direction	0
STOP data type filter in transmit direction	1
START data type filter in receive direction	2
STOP data type filter in receive direction	3

## A. Appendix: Diagnostic

### A.1. Class internal

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

Bit	Description
00	RAM error
01	STACK error The defined stack range has been exceeded; Replace system element or notify SAT.
02	Firmware shut down Diagnosis: - Read out system diagnostic ring (command ID R) in ST emulation (possibly store to file)
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.
08	CPU 80386 error Occurs on internal software error.

#### Class internal - Record 1 : Internal error in the base system

Bit	Description
00	Check sum error in the parameter area The check sum for the parameter is not correct. --> Reload parameters.

#### Class internal - Record 2 : SIP parameter error

Bit	Description
00	Parameter detected by SIP
01	Parameter error of the LOCAL parameter block no. 06
02	Parameter error ZSE general
03	Parameter setting with invalid stationnumber. Diagnosis: Selected stationnumber is greater than 100 and also not a broadcast-station number.

Bit	Description
04	Parameter setting with invalid station number. Diagnosis: Same station number is used more than once.

#### **Class internal - Record 3 : SIP format conversion error**

Bit	Description
00	Format conversion error in the transmit direction
02	Format conversion error in the receive direction

### **A.2. Class communication**

#### **Class communication - Record 2 : Communication error**

Bit	Description
00	Communication failure to the master

### **A.3. Class test**

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

Bit	Description
00	Memory test disabled
01	Online debugger running (breakpoints possibly set)

### **A.4. Class warning**

#### **Class warning - Record 0 : Warning on communication**

Bit	Description
00	DFC - Bit (Data Flow Control)



## B. Appendix: Parameter Documentation

### B.1. Common settings

Parameter	Description	Values/Ranges
asynchron_isochron	asynchronous (V.24/V.28, 16 x bit timing) or isochron (X.24/X.27 1 x bit timing)	[0] asynchronous "V.24/V.28" (16 x bit timing) [1] Isochron "X.24/X.27" (single bit timing)
baud rate receiving direction	baud rate receiving direction	[50] 50 [Bd] [75] 75 [Bd] [100] 100 [Bd] [110] 110 [Bd] [134] 134,5 [Bd] [150] 150 [Bd] [200] 200 [Bd] [300] 300 [Bd] [600] 600 [Bd] [1050] 1050 [Bd] [1200] 1200 [Bd] [1800] 1800 [Bd] [2000] 2000 [Bd] [2400] 2400 [Bd] [4800] 4800 [Bd] [9600] 9600 [Bd] [19200] 19200 [Bd] [38400] 38400 [Bd] [56000] 56000 [Bd] [57600] 57600 [Bd] [64000] 64000 [Bd]
baud rate transmit direction	baud rate transmit direction	[50] 50 [Bd] [75] 75 [Bd] [100] 100 [Bd] [110] 110 [Bd] [134] 134,5 [Bd] [150] 150 [Bd] [200] 200 [Bd] [300] 300 [Bd] [600] 600 [Bd] [1050] 1050 [Bd] [1200] 1200 [Bd] [1800] 1800 [Bd] [2000] 2000 [Bd] [2400] 2400 [Bd] [4800] 4800 [Bd] [9600] 9600 [Bd] [19200] 19200 [Bd] [38400] 38400 [Bd] [56000] 56000 [Bd] [57600] 57600 [Bd] [64000] 64000 [Bd]
electrical interface	electrical interface	[0] RS232 (V.24/V.28)

Parameter	Description	Values/Ranges
		[1] RS422 (V.11)
station type	station type At the remote station the other station type has to be parametrized.	[0] Station A [1] Station B

## B.2. Common settings | advanced time settings

Parameter	Description	Values/Ranges
Bit timing: (only for "Isochronous")	Bit timing: (only for "Isochronous") either external (from RXC-inpu) or intern (at TXC-output)	[0] extern (bit timing from RXC input) [1] internal (bit timing at the TXC-output)
DCD assessment	DCD assessment	[0] Not enabled [1] Enabled
Transm.delay contin.lvl tr.line(tcldly)	A further message transmission is carried out for "continuous level", at the latest, after expiry of the "Transmission delay".	Float [####.#] 0.1 to 6553.5 [s] 0 [s]
bounce suppression time (tbounce)	bounce suppression time (tbounce)	Integer [#####] 0 to 65535 [ms]
continuous level monitoring time (tcl)	continuous level monitoring time (tcl)	Float [####.#] 0.1 to 6553.5 [s] 0 [s]
disable time (tdis)	disable time after a received message	Integer [#####] 0 to 32767 [ms / Bit]
disable time time base (tdis)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
pause time (tp)	Before a message transmission the set pause time is waited before switching on the transmit level (RTS).	Integer [#####] 0 to 32767 [ms/Bit]
pause time_time base (tp)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
run-out time (tn)	After the end of the message transmission, the transmit level(RTS) is only switched off after expiry of the reset time.	Integer [#####] 0 to 32767 [ms / Bit]
run-out time_time base (tn)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms /Bit] [1] ms [ms /Bit]
set up time (tv)	After switching on the transmit level (RTS) the message transmission is started after expiry of the set-up time. Note: For "tv=0" there is no carrier switching (RTS=OFF)!	Integer [#####] 0 to 32767 [ms / Bit]
set up time_time base (tv)	Parametrized times in bits depend on the the baudrate!	[0] Bit [ms / Bit] [1] ms [ms / Bit]
stability monitoring time (tstab)	stability monitoring time (tstab)\ The "new" DCD state is only utilized\ after expiry of the stability monitoring time\ for the message synchronisation.	Integer [#####] 0 to 65535 [ms]

### B.3. Message retries

Parameter	Description	Values/Ranges
Retries for INIT-messages SEND/CONFIRM	Number of max. message retrys	Integer [###] 0 to 255
Retries for data message SEND/CONFIRM	Number of max. message retrys	Integer [###] 0 to 255
Retries for data message SEND/NO REPLY	Number of max. message retrys	Integer [###] 0 to 255

### B.4. Redundancy

Parameter	Description	Values/Ranges
Delay time standby=>active	delay time in case of sitch over from STANDBY->ACTIVE 0 = switch without delay	Integer [####] 0 to 2000 [s]
behavior if passive	behavior if passive	[0] interface "TRISTATE" [1] "interface "ACTIVE", listening mode (=STANDBY) [3] "interface "ACTIVE", calling mode (=OPERATION)
receive timeout standby	receive timeout in standby mode 0 = no monitoring!	Float [####.#] 0.0 to 6000.0 [s]

### B.5. Advanced parameters

Parameter	Description	Values/Ranges
Message conversion receive direction	Message conversion receive direction	[0] SAT AX1703 Mode [1] Container mode
Message conversion transmit direction	Message conversion transmit direction	[0] SAT AX1703 Mode [1] Container mode
Monitoring message cycle	monitoring message testing function of the link layer 0 = no monitoring	Integer [#####] 0 to 65535 [s]
real time remote synchronization	RT remote synchronzation of remote station	[0] Not enabled [1] Enabled
train-specific parameter settings		[0] Not enabled [1] Enabled

## B.6. Advanced parameters | IEC-parameter

Parameter	Description	Values/Ranges
Acknowledgement at IEC870-5-2 layer		[0] single character E5 [1] fixed length telegram ACK
Activation Confirmation for Commands		[0] ACTCON, ACTTERM from System [1] ACTCON from SIP, ACTTERM from System
Confirmation at time setting		[0] no send [1] send immediately [2] send to minute change
Confirmation imitate		[0] Not enabled [1] Enabled
DFC- calling time	data flow control behavior If DFC-Bit of the remote station is set, request status of link messages are sent in this parametrized intervals. 0 = permanent requests.	Float [##.#] 0.0 to 25.5 [s]
DFC-timeout	receive timeout in standby mode 0 = no monitoring!	Float [####.] 0 to 60000 [s]
GI command (T1100) always convert to CASDU=broadcast		[0] NO [1] YES
Link address	Link address	Integer [#####] 0 to 65534
Redundancy operating mode		[0] AX1703 [1] Norwegian User Conventions (NUC)
number of bytes linkaddress	Number of bytes linkaddress	[1] 1 Byte [2] 2 Byte
set originator address in transmit direction always up 0		[0] NO [1] YES

## B.7. Advanced parameters | IEC-parameter | ACTCON and ACTTERM for commands

Parameter	Description	Values/Ranges
CASDU1	1st byte of common address of ASDU (LSB)	Integer [###] 0 to 255
CASDU2	2nd byte of common address of ASDU (MSB)	Integer [###] 0 to 255
IOA1		Integer [###] 0 to 255
IOA2		Integer [###] 0 to 255
IOA3		Integer [###] 0 to 255
TI		[0] ACTCON, ACTTERM from System [45] Single command (TI 45) [46] Double command (TI 46) [47] Step-by-step adjusting command (TI 47) [48] Setpoint val. positioning comm. stand. (TI 48) [49] Setpoint val. positioning comm. scaled (TI 49) [50] Setpoint val. positioning comm. short floating point (TI 50) [51] Bit pattern 32 bit (TI 51)
Überwachungszeit ACT -> ACTCON		Integer [###] 0 to 255 [s]
Überwachungszeit ACTCON -> ACTTERM		Integer [###] 0 to 255 [s]

## B.8. Advanced parameters | IEC-parameter | Summertime bit, Weekday in the real-time stamp(transmission)

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

## B.9. Advanced parameters | Software test points

Parameter	Description	Values/Ranges
Handshake RTS,GPB (ASCII-Mode)	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
Handshake RTS,GPB (HEX-Mode)	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
Init-end processing	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
ZDT-filter	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
data and acknowledgement between BSE	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
level locking station locking	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
mask for blocking data pick-up	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES
master-standby switchover	The change of this parameter required profoundness communication knowledge. A specialist should be contacted before.	[0] NO [1] YES

## B.10. Advanced parameters | compatibility\_parameter

Parameter	Description	Values/Ranges
Address type at TCS100	Parametrization, in which byte of the CASDU the Reg#, and in which byte of the CASDU the Comp# is entered. Note: In case of changing of this parameter all addresses are changed!	[0] 1st byte CAASDU = Reg. No. / 2nd byte CAASDU = Comp. No. [1] 1st byte CAASDU = Comp. No. / 2nd byte CAASDU = Reg. No.
Remote station type	Remote station type necessary for remote parametrization and remote diagnostic functions.	[0] BPP00 (SAT AX1703) [1] TCS100 (SAT SK1703 or SAT AX1703)

## B.11. Advanced parameters | monitoring times

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

## B.12. Advanced parameters | train-specific parameter settings

Parameter	Description	Values/Ranges
origin address in transmit direction		Integer [###] 0 to 255
switch delay in transmit direction		Integer [###] 0 to 255

