TRACK MORE WITH LESS

FRAUSCHER SENSOR TECHNOLOGY

System documentation Frauscher Advanced Counter FAdC R2

D21001
Version 4

Classified
Language: EN
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This document is the translation of the German original.

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Review list

Version	Date	Prepared by	Modified sections	Modifications
1	2014-12-17	Anita Ecker	all	initial version
2	2015-07-01	Anita Ecker	all	wording, terminology, formatting
			bibliography	D1916: version 4 D21004: version 2
			chapter 1.1.2, 1.2, 1.3, 1.4, 3.3.1, 3.3.2, 3.4.4, 3.5.2, 3.5.3, 3.5.4, 4.1.1, 4.2, 5.1.2.1, 5.4.4.18	additions
			chapter 3.4.1, 3.4.2, 3.5.2.1, 3.5.2.2, 3.5.4.1, 3.6.1.3, 3.6.2.3, 4.1.1.2, 4.5, 4.6.1.1, 5.2.2.3, 5.4.4.2, 5.4.4.3, 5.4.4.5, 5.4.4.7, 5.4.4.9, 5.4.4.11 to 5.4.4.15, 5.4.4.18, 5.4.4.19, 5.4.4.21, 5.5.2.2, 5.5.2.4, 5.5.2.11, 5.5.2.14, 7.2, 7.3, 7.4.1.2, 9.1.3.2, 10.2.2.3, 10.2.2.4, 10.2.3, 10.2.4.3, 10.2.5.1, 10.2.5.2, 10.2.5.3, 10.3	revision
			chapter 3.5.4.4, 3.5.4.5, 5.4.1	new chapters
			chapter 4.5.7, table 4.11, table 5.2, table 8.2	correction of values
			SAB: FAdC100_65, FAdC100_104	correction of values
			SAB: FAdC100_16, FAdC100_41, FAdC100_46, FAdC100_86, FAdC100_89, FAdC100_93, FAdC100_96, FAdC100_109, FAdC100_116, FAdC100_140, FAdC100_150, FAdC100_160, FAdC100_165, FAdC100_180, FAdC100_182, FAdC100_184, FAdC100_190, FAdC100_197, FAdC100_198, FAdC100_199, FAdC100_205	wording
			FAdC100_123	content removed
			SAB: FAdC100_113, FAdC100_39	content added
			SAB: FAdC100_67, FAdC100_80, FAdC100_97, FAdC100_117, FAdC100_162, FAdC100_168, FAdC100_177, FAdC100_194, FAdC100_202	terminology
			SAB: FAdC100_47, FAdC100_210	Formatting

Version	Date	Prepared by	Modified sections	Modifications
3	2017-02-24	Anita Ecker	bibliography	D20005 added, D3164: title and version modified, D21006: title modified
			chapter 1.2	units of measurement added
			chapter 1.3, 1.4	abbreviations and terms and definitions added; revised
			chapter 2.1	1st paragraph added
			chapter 2.3	revised
			chapter 3.5.3.1	table 3.11 added; figure 3.54 revised; actuation sequence revised; last paragraph added
			chapter 3.5.3.2	revised; 3rd paragraph added
			chapter 3.5.4.2	revised
			chapter 4.1.1	structure modified; table 4.4 revised
			chapter 4.2	2nd formula added; revised
			chapter 4.6.4	revised
			chapter 4.8.1	table 4.11: value corrected
			chapter 5.2.2, 5.2.2.2	revised
			chapter 5.2.2.3	table 5.5: number of bits of entry “VERIFY” corrected
			chapter 5.4.4.7	6th bullet point: content added; 8th bullet point added; revised
			chapter 5.4.4.8	8th bullet point added
			chapter 5.4.4.9	entry “OCC_EXT”: content removed
			chapter 5.4.4.11, 5.4.4.12	7th bullet point added; revised
			chapter 5.4.4.15	1st bullet point: content added
			chapter 5.4.4.21	entry “ID” revised
			chapter 5.4.4.22	entry “TIMEOUT_VALUE” revised; last paragraph added
			chapter 5.5.2.10, 5.5.2.11	9th bullet point : IP address range corrected
			chapter 5.5.2.12	entry “UDP_PORT_INT_MULTI”: binary value corrected; re-vised

Version	Date	Prepared by	Modified sections	Modifications
4 [1]	2017-10-04	Bertold Wöss	bibliography	D1912, D4181, D21006 updated
			chapter 1.4	definition of “last axle counted out” and “last axle counted in” revised
			chapters 2.1, 2.3	terminology revised
			chapter 3.3.3	reference modified
			chapter 3.3.6	new AMB figure inserted
			chapter 3.5.2.1	entry “DIR_EXT” changed to “DIR_LENGTH”
			chapter 3.5.5.3	Auto MDI-X, data transmission rate, half duplex or full duplex configurable via DIP-no. 12, footnote added
			chapter 3.5.5.4	content revised, crossover cable requirements added
			chapter 4.1.1	content revised, table 4.3 revised
			chapter 4.1.1.2	content revised, table 4.4 revised
			chapter 4.1.2	terminology revised
			chapter 4.5	value modified (4900 mA instead of 5 A), content added, 3rd bullet point revised
			chapter 5.3.2	new function for DIP-no. 12 added, footnote added
			chapter 5.4.2	content revised, content added to recommendation and to examples
			chapter 5.4.3	content revised
			chapter 5.4.4.4	content added
			chapter 5.4.4.5	terminology revised, content added to entry “SUPERVIS_COUNT”
			chapter 5.4.4.8	content revised, content added to entry “BEHAV_IOEXB”
			chapters 5.4.4.11, 5.4.4.12	note added
			chapter 5.4.4.19	terminology revised

[1] New equipment version GS02 for COM-AdC101

Version	Date	Prepared by	Modified sections	Modifications
			chapter 5.4.4.20	wording revised
			chapter 5.4.4.21	footnote added
			chapter 5.5.2.14	content revised and added (broadcast storm), footnote added
			chapter 5.5.2.16	entry “IP_SWTCH” changed to “IP_SWITCH”
			chapter 5.5.2.17	new chapter added
			chapter 5.5.2.20	entry “VERSION_VERIFY” changed to “CHECK_VERSION”, content added
			chapter 6.2.3	terminology revised, reference modified
			chapters 7.4.1.1, 7.4.1.2	content revised and added (sensor current drift), footnote added
			chapters 9.1.3.1, 9.1.3.2	content revised and added (sensor current drift), footnote added
			chapter 10.2	wording of recommendation revised
			chapter 10.2.2.1	wording revised; table 10.3: error analogue double usage revised table 10.4: value corrected (20 mV instead of 200 mV), content added
			chapter 10.2.2.4	wording revised; error codes 28, 31, 50, 51, 86, 91, 105 revised; footnote revised
			chapter 10.2.4.10	entries “wrong project number” added, wording revised
			chapter 10.2.5.2	wording revised; table 10.47: error code 8 / 25: “VERSION_VERIFY” changed to “CHECK_VERSION”, error codes 8 / 38 to 8 / 45 added

Translation list

Version	Date	Prepared by	Modified sections	Modifications
1	2014-12-17	Anita Ecker	all	initial English version
2	2015-07-01	Anita Ecker	see review list additionally: SAB FAdC100_2 SAB: FAdC100_45, FAdC100_69, FAdC100_94, FAdC100_114, FAdC100_132, FAdC100_133, FAdC100_166, FAdC100_179, FAdC100_181, FAdC100_183, FAdC100_185, FAdC100_195, FAdC100_196, FAdC100_197, FAdC100_205, FAdC100_206, FAdC100_207	update to version 2 (see review list) correction of value wording, terminology
3	2017-02-24	Anita Ecker	see review list all	update to version 3 (see review list) wording, terminology
4	2017-10-04	Bertold Wöss	bibliography, chapters 1.4, 2.1, 2.3, 3.3.3, 3.3.6, 3.5.2.1, 3.5.5.3, 3.5.5.4, 4.1.1, 4.1.1.2, 4.1.2, 4.5, 5.3.2, 5.4.2, 5.4.3, 5.4.4.4, 5.4.4.5, 5.4.4.8, 5.4.4.11, 5.4.4.12, 5.4.4.19, 5.4.4.20, 5.4.4.21, 5.5.2.14, 5.5.2.16, 5.5.2.17, 5.5.2.20, 6.2.3, 7.4.1.1, 7.4.1.2, 9.1.3.1, 9.1.3.2, 10.2, 10.2.2.1, 10.2.2.4, 10.2.4.10, 10.2.5.2 chapters 1.1.2, 1.2, 1.3, 1.4, 3.5.3.2, 10.2.2.2 tables 10.3, 10.11, 10.20 SAB FAdC100_49	update to version 4 (see review list) wording, terminology wording, terminology wording revised

Bibliography

D-Number	Title	Version[2]
D1413	Application guide for wheel sensor type RSR180	2
D1414	Mounting and commissioning of wheel sensor type RSR180	3
D1912	Mounting, commissioning and maintenance wheel sensor RSR180 with rail claw SK420	12
D1916	Mounting, commissioning and maintenance manual wheel sensor type RSR123	4
D2346	Mounting instruction for overvoltage protection board BSI004	2
D2390	Project planning guide for wheel sensor type RSR123	2
D2764	Mounting instruction for overvoltage protection board BSI005	2
D2860	Brief instruction testing plate PB200 GS03	4
D2950	Limits of the sensitive detection range for wheel sensors	2
D3164	Mounting of wheel sensor RSR180 with the rail claws SK140-008, SK140-009, SK140-010, SK140-015, SK140-016, SK140-017 (Supplement to D1414)	7
D4181	Design and application of supervisor sections for axle counting system FAdC R2	2
D4182	Reset options for the axle counting system FAdC® R2	1
D4183	Design and application of Counting Head Control for axle counting system FAdC® R2	1
D20005	Brief description Advanced Checksum Calculator ACC	1
D21000	Brief description Frauscher Advanced Counter FAdC® R2	1
D21004	Brief description Advanced Service Display ASD101	2
D21006	Frauscher Diagnostic System FDS101 for FAdC R2 and FAdCi R2	2
D21101	System outline Frauscher Advanced Counter FAdC R2 with COM-FSE	1

2 The stated or a higher version is valid.

1 About this documentation

The following documentation provides the required information for the use of the system Frauscher Advanced Counter FAdC R2.

1.1 Typographical conventions

The following typographical conventions are applied in this documentation:

1.1.1 Pictograms

Safety-related application conditions (SAB)

Safety-related application conditions define rules, conditions and restrictions that must be observed and complied with by the user and/or by the subsequent system in the life cycle phases after the development. Only by this, a safe and fault-free operation can be ensured.

Safety-related application conditions are shown as follows:

SAB number:

Description

The SAB number is a number assigned by Frauscher to uniquely identify an SAB. The SAB numbers are not consecutive in the documentation.

Symbol and text indicate situations or incorrect operations that could immediately endanger human life and/or product.

Important notes

Important notes contain information and instructions regarding the availability and the safe operation of the system.

Important information and notes are shown as follows:

Description

Recommendations and tips

Recommendations and tips contain information that facilitates the handling of the system for the user.

Recommendations and tips are shown as follows:

➡ Description

1.1.2 Styles of writing and other formal principles

Orders

- Contents (descriptions, figures, tables, etc.) are generally described in this documentation "from left to right" and "from top to bottom".

Numbers

- Decimal places of decimal numbers are separated by a comma (,) (e.g. 123,45).
- For reasons of better readability, digits of four- or multi-figure decimal numbers are arranged from right to left with thousands separators in groups of three digits (e.g. 1 234).

Bits and bytes

- Bits and bytes are numbered beginning with ‘0’.
- The LSB (least significant bit) is always on the right, the MSB (most significant bit) is always on the left. This also applies in case several consecutive bytes are transmitted.

Bit no.	7	6	5	4	3	2	1	0
Binary number	1	0	0	1	0	1	1	0
Bit significance	MSB							LSB

Table 1.1: LSB and MSB of an 8-bit number

Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary number	1	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0
Bit significance	MSB							LSB	MSB							LSB

Table 1.2: LSB and MSB of a 16-bit number

Ellipsis

An ellipsis (“…”) designates text parts, single words, numbers and/or ranges of numbers that are left out. It is used to show contents in a short form.

Examples for an ellipsis in case of a range of numbers:

0
…
15

In this example, the range of numbers from 0 to 15 is shown. The ellipsis represents the numbers 1 to 14.

b7 … b0

In this example, the bit positions from b7 to b0 are shown. The ellipsis represents the bit positions b6 to b1.

1.2 Units of measurement

In this document, the following units of measurement are used:

"	inch (1" = 2,54 cm)
°C	degree in Celsius
A	ampere
B	byte (1 B = 8 bit)
bit	bit
bit/S	bit per sample
dB	decibel
h	hour
Hz	hertz
kB	kilobyte (= 10^3 B)
km	kilometre
km/h	kilometre per hour
kS	10^3 samples
kS/s	10^3 samples per second
m	metre
mA	milliampere
Mbit/s (= Mbps)	megabit per second
µF	microfarad
µs	microsecond
min	minute
mm	millimetre
mm^2	square millimetre
ms	millisecond
mV	millivolt

Ω	ohm
s	second
V	volt
W	watt

1.3 Abbreviations

In this document, the following abbreviations are used:

0b	prefix of a binary number
0x	prefix of a hexadecimal number
A	measurement A, vertical mounting position of the wheel sensor
AC	alternating current
ACC	Advanced Checksum Calculator
AEB	Advanced Evaluation Board
AMB	Adjustment and Maintenance Box
ANSI	American National Standards Institute
ASD	Advanced Service Display
ASP	tripping level
B	measurement B, horizontal mounting position of the wheel sensor
BBK	clamping bolt (is used e.g. with rail claw SK140)
BGT	board rack
BGT07	board rack, type BGT07
BGT08	board rack, type BGT08
BP-EXB	Backplane for Extension Boards
BP-PWR	Backplane for Power Supply
BSI	overvoltage protection board
BSI004	overvoltage protection board, type BSI004
BSI005	overvoltage protection board, type BSI005
CAN	Controller Area Network (serial bus system)
CF	CompactFlash (CF memory card)
CH	channel
CHC	Counting Head Control

COM	Communication board (generic term for the different communication boards)
COM-AdC	Communication board for Advanced Counter
COM-xxx	Communication board (generic term for a specific communication board with vital software interface)
CRC	cyclic redundancy check (checksum)
d	diameter
DBV	dynamic occupied status extension
DC	direct current
DIN	German Institute for Standardization
DIP	Dual In-line Package (DIP-switch)
EMC	electromagnetic compatibility
EN	European standard
ESD	electrostatic discharge
ESP	trigger level
FAdC	Frauscher Advanced Counter
FAdC R1	Frauscher Advanced Counter, Release 1
FAdC R2	Frauscher Advanced Counter, Release 2
FAT	File Allocation Table (file system)
FDS	Frauscher Diagnostic System
Fm	clear indication contact/clear indication output
FMA	track section, synonyms: counting circuit, counting section
GAK	trackside connection box
G_B	Ground, Benign; environmental conditions according to MIL-HDBK-217F
GE	reset restriction
G_F	Ground, Fixed; environmental conditions according to MIL-HDBK-217F
GND	ground
GS	equipment version

HE	height unit (1 HE = 44,45 mm), synonym: U
ID	identifier
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IO-EXB	Input/Output Board
I/O	input/output
IPxx	International Protection (protection type, e.g. IP65)
IP	Internet Protocol
ISO	International Organization for Standardization
IXL	safety system (e.g. interlocking)
KA	cable terminating frame
LB	soldering jumper
LED	light-emitting diode
LSB	least significant bit
MDI	Medium Dependent Interface
MSB	most significant bit
NTFS	New Technology File System
Occ	occupied indication contact/occupied indication output
PB	testing plate
PE	polyethylene
PSC	Power Supply with Crowbar
PUR	polyurethane
PWR	Power supply
RFC	Request for Comments (Internet standards)
RJ45	Registered Jack (standardised connectors/sockets for data transmission in networks)
RSR	wheel sensor
RSR123	wheel sensor, type RSR123

RSR180	wheel sensor, type RSR180
S	sample (analogue signal per sampling value)
SAB	safety-related application condition
S_d	wheel flange thickness
S_h	wheel flange height
SIL	Safety Integrity Level
SMD	Surface Mounted Device
SK	rail claw
SK140	rail claw, type SK140
SK150	rail claw, type SK150
SK420	rail claw, type SK420
SOK	top of rail
SPS	Programmable Logic Controller (PLC)
STS	Supervisor Track Section
Sys	system of a wheel sensor
TE	pitch unit (1 TE = 5,08 mm), synonym: HP
U	electric voltage
UDP	User Datagram Protocol
ÜSP	overcurrent level
v	speed
V_{CC}	positive supply voltage
VDE	Association for Electrical, Electronic & Information Technologies
ZP	counting head

1.4 Terms and definitions

argument	Safety-relevant or non-safety-relevant digital information (IO data at data transmission) that is input to and/or output by an IO-EXB.
tripping level	If the sensor current exceeds the tripping level for a time > digital filtering time, then the sensor system is considered to be “not damped”.
interference voltage	Voltage that may occur at the ends of outdoor equipment cables as a result of inductive or capacitive influences to earth.
damped	One or two sensor systems of a wheel sensor indicate an occupancy (generally in case of traversing by a train wheel or when damped by a testing plate).
rated voltage	Value of a voltage, which is specified by the manufacturer for a component, a device or operating resources and which the operating and performance characteristics refer to (EN 60664-1:2007). The rated voltage is the maximum voltage range, by which the system FAdC may be supplied.
occupied	Status of the axle counting system if at least one sensor system is damped or if one or more axles are located in the track section.
digital filtering time	The digital filtering time is the time for which the sensor current must fall below the trigger level or exceed the tripping level, before the sensor system is considered to be “damped” or “not damped”.
double usage	Use of a common counting head in 2 adjacent track sections (FMA).
dynamic occupied status extension (DBV)	Special functionality to improve the counting of wheels (e.g. with small wheel diameters).
trigger level	If the sensor current falls below the trigger level for a time > digital filtering time, then the sensor system is considered to be “damped”.
clear	Status of the axle counting system after a successful reset or if all axles counted into the track section have been counted out again and there is no fault.

clearing of track	In the case of clearing of track, at least two axles must be counted in and out at one or two different counting heads, depending on the configuration. The clearing of track is generally part of the reset procedure.
track section (FMA)	Section of track between the counting heads belonging to an axle counting system. This may be a track, a set of points, an intersection, a line or a combination of these elements. Synonyms: counting circuit, counting section
reset	Procedure to bring a track section into “clear” status.
reset restriction	Prevention of a reset due to technical (e.g. safety-relevant error) or operational (e.g. “last axle counted in”, “last axle counted out”) situations.
top-hat rail	rail with hat-shaped cross-section according to DIN EN 60715, type TH 35-7.5, perforated
identifier	Number to clearly identify each CAN bus participant.
commissioning	Test on an item carried out on site, to prove that it is correctly installed and can operate correctly (IEC 60050-151-16-24).
maintenance	Combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it again to, a state in which it can perform a required function (IEC 60050-191-07-01).
maintenance, corrective	The maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function (IEC 60050-191-07-08). Synonym: repair
maintenance, preventive	The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item (IEC 60050-191-07-07). Synonym: servicing

repair	The maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function (IEC 60050-191-07-08). Synonym: corrective maintenance
last axle counted out	When a rail vehicle exits a track section from inside to outside, axles are counted out. In this case, the last counting procedure was an axle leaving the track section.
last axle counted in	When a rail vehicle enters a track section from outside to inside, axles are counted in. In this case, the last counting procedure was an axle entering the track section.
nominal voltage	The value, specified by the manufacturer, of the electrical voltage of an electrical load or a voltage source in normal operation. The detail of the nominal voltage for the system FAdC is added with a maximum permitted tolerance range and is stated as rated voltage.
partial traversing	Partial traversing signifies that one or both sensor system(s) of a wheel sensor are damped without complete traversing.
normal operating sensor current (RSR180)	The sensor current is referred to as “normal operating sensor current” if the wheel sensor is correctly mounted on the rail and not damped.
normal operating sensor current (RSR123)	The sensor current is referred to as “normal operating sensor current” if the wheel sensor is correctly mounted on the rail, successfully adjusted and not damped.
failsafe status	Status which poses no hazard, e.g. an occupied or fault status. In case of a communication fault, the receiver must set and/or enter the failsafe status.
fault	An error that can be rectified with a configured reset procedure, provided that the fault is not present any more.

supervisor section	A supervisor section consists of several consecutive track sections (FMA). In case this function is used, axle counting errors, which occurred on a track section (FMA) of the supervisor section, are reset automatically.
synchronisation	In case of synchronisation, one physical track section (FMA) is evaluated by at least 2 different AEB boards.
overcurrent level	If the sensor current exceeds the overcurrent level for a time > overcurrent suppression time, then the evaluation board identifies the behaviour as "overcurrent".
maintenance, servicing	The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item (IEC 60050-191-07-07). Synonym: preventive maintenance
counting head	In functional terms, a counting head consists of a wheel sensor, an overvoltage protection board and an evaluation board.
Counting Head Control	The Counting Head Control CHC is a patented functionality of Frauscher to control the output of a counting head using a control input. By using Counting Head Control, the availability of the system can be increased, e.g. in case of track maintenance work, for light rail applications or when using two-way vehicles.

1.5 Target group

This documentation is intended for project engineers and technicians (personnel for commissioning, operation and maintenance) with subject-specific knowledge regarding track clear detection systems and their construction, operation and maintenance.

In the following table the chapters of this documentation are assigned to their respective target groups:

No.	Chapter	Project engineer	Personnel for commissioning	Personnel for operation	Personnel for maintenance
1	About this documentation	X	X	X	X
2	Safety	X	X	X	X
3	Structure and function	X	X	X	X
4	Basic conditions for the installation	X	X		
5	Configuration	X			
6	Installation	X	X		
7	Commissioning	X	X		
8	Operation	X		X	X
9	Maintenance	X			X
10	Repair	X	X		X
11	Removal from service	X		X	

Table 1.3: Assignment of the chapters to their respective target groups

2 Safety

2.1 General protective provisions

Frauscher components must be used in the original condition (= characteristics and functions as described in the respective documentation).
Only the settings described in the respective documentation may be carried out. Apart from that, unauthorised modifications of the components are not permitted.
If nevertheless modifications of a component are required, then Frauscher must be consulted in any case and in advance.

All operational protective provisions of the railway operator must be observed.

SAB FAdC100_42:
The operator must ensure that only authorised personnel or people in the company of authorised personnel have access to the safety system.

SAB FAdC100_85:
When using the system FAdC, it must be checked if the hazard rates of the respective functions are ≤ the tolerable hazard rate.

SAB FAdC100_208:
For the respective hazard rate, the traversing cycle (every day or every 2 years) must be complied with.

2.2 Qualified personnel

SAB FAdC100_150:
The design and planning and configuration of the system FAdC may only be executed by personnel with training certificate and respective knowledge in the railway safety technology (proof of competence).

SAB FAdC100_49:
Any work on the system FAdC (mounting, commissioning, maintenance and repair work) may only be carried out by trained, skilled personnel.

2.3 Safety-conscious working

- The railway operator is responsible for occupational safety.
- The system may only be operated in proper condition.
- All actions carried out on the system must not impair the safety of people or the function of the system.
- Unauthorised alterations and modifications of the system are not allowed.

2.4 Intended use

The Frauscher Advanced Counter FAdC is used for axle detection and train detection for rail-bound vehicles with wheels made of iron material (e.g. steel).

Furthermore, the FAdC can be used for the transmission of digital arguments.

If the FAdC is applied outside the intended use described, or in the case of non-compliance with compulsory requirements and safety measures, no warranty and/or liability shall apply.
The FAdC is intended for continuous operation. In the event that the FAdC is not to be operated on a permanent basis but switched off on a cyclical basis, Frauscher must be contacted.

3 Structure and function

3.1 Principle of axle counting

The prerequisite for the railway operation is to ensure safety. An axle counting system serves as a failsafe monitoring of defined sections of track or set of point sections, the so-called track sections (FMA).
The functioning of an axle counting system is based on the counting in and counting out of axles in/out of (a) track section(s) (FMA).

If the axle of a rail vehicle traverses the wheel sensor at the beginning of a track section (FMA), the axle counting system increases the counter reading of the respective track section (FMA) by 1 axle.
If the axle of a rail vehicle traverses the wheel sensor at the end of a track section (FMA), the axle counting system decreases the counter reading of the respective track section (FMA) by 1 axle.
This procedure works in both travel directions.

By the comparison of the number of axles counted in and counted out, it is possible to make a statement about the status of the track section (FMA) ("clear" or "occupied").

Dependent on the counter reading and/or the status of the track section (FMA) a clear or occupied indication is output:

- If the counter reading of a track section (FMA) is '0', the evaluation board outputs the status "clear" for this track section (FMA), provided that no other fault statuses are present.
- If the counter reading of a track section (FMA) is > '0', the evaluation board outputs the status "occupied" for this track section (FMA).
- If the counter reading of a track section (FMA) is negative, the evaluation board outputs the status "occupied" or "faulty" (failsafe status) as well as an error indication.
- If the track section (FMA) is faulty, independent of the counter reading, the evaluation board outputs the status "faulty".

The axle counting system is designed modularly and can be used among other things in the following application fields:

- stations
- level crossings
- block sections
- high-speed applications
- shunting yards
- wheel detection
- main and secondary lines
- light rails
- underground rails
- industrial lines

3.2 Structure and function of the FAdC

In each case at the beginning and at the end of each track section (FMA) is a wheel sensor, which forms the counting head together with the overvoltage protection board BSI and the evaluation board AEB. This detects all axles of the rail vehicles which drive on the track as well as their driving direction by means of 2 electronic sensor systems.

All components of the FAdC have 2 channels. Furthermore, the system can be designed redundantly.

The axle information of the wheel sensor is transmitted via a four-wire signalling cable to the AEB, which is connected with other AEB boards via a CAN bus. After evaluation of the axle information, the AEB generates either a clear or an occupied indication. This clear or occupied indication is transmitted from the AEB to the COM boards which are also connected to the CAN bus. The clear or occupied indication can be output for further processing by means of a vital protocol via an Ethernet interface on the COM. The clear and occupied indication can also be output via voltage-free relay contacts from an IO-EXB that is connected to an AEB.

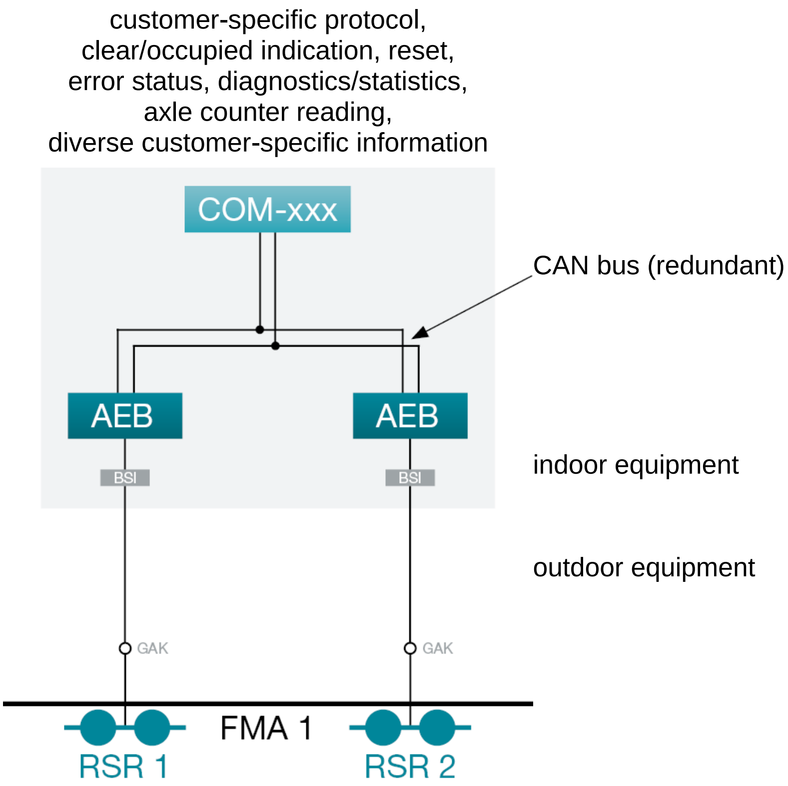


Figure 3.1: Functional principle of the FAdC

3.3 Components of the outdoor equipment

3.3.1 Wheel sensor RSR180 and rail claw SK140

Figure 3.2: Wheel sensor RSR180 with rail claw SK140

Figure 3.3: Rail claw SK140

The wheel sensor RSR180 consists of 2 sensor systems. Viewed from the type label, sensor system 1 is on the left-hand side and sensor system 2 is on the right-hand side. The sensor systems are symmetrical in design. On the wheel sensor there is a moulded 4-wire cable with a standard length of 5 m. One wire is assigned to each sensor system in which the sensor system signal is transmitted to the evaluation board. The 2 other wires are used to supply the wheel sensor.

It is recommended to use a protection tube for the wheel sensor cable.

The rail claw SK140 is used to fix the wheel sensor RSR180 to the rail. Advantages are that fixation can be carried out quickly and that moving the wheel sensors to a new position is a simple process (e.g. change of rail, dismantling during tamping work, maintenance work, etc.). Using the clamping bolts BBK, the rail claw SK140 can be adjusted to all common rail profiles.

3.3.2 Wheel sensor RSR123 and rail claw SK150


Figure 3.4: Wheel sensor RSR123 with rail claw SK150


Figure 3.5: Rail claw SK150

The wheel sensor RSR123 consists of 2 sensor systems. Viewed from the plug side, sensor system 1 is on the left-hand side and sensor system 2 is on the right-hand side. The sensor systems are symmetrical in design and are galvanically separated. On the wheel sensor there is a 4-wire cable that is connected via a plug connection, with a standard length of 5 m. 2 wires are allocated to each sensor system.

➡ It is recommended to use a protection tube for the wheel sensor cable.

The rail claw SK150 is used to fix the wheel sensor RSR123 to the rail. Advantages are that fixation can be carried out quickly and that moving the wheel sensors to a new position is a simple process (e.g. replacement of rail, dismantling during tamping work, maintenance work, etc.). The rail claw SK150 can be adjusted to all common rail profiles.

3.3.3 Rail claw SK420


Figure 3.6: Rail claw SK420

The rail claw SK420 is used to fix the wheel sensor RSR180 to a grooved rail (e.g. in case of light rail applications). Further information can be found in document D1912 “Mounting, commissioning and maintenance wheel sensor RSR180 with rail claw SK420”.

3.3.4 Trackside connection box GAK

Figure 3.7: Trackside connection box GAK

In the trackside connection box GAK, the wheel sensor cable is connected with the cable that is routed to the indoor equipment. The trackside connection box only serves as a clamping unit and does not contain any electronic at all. Typically, one trackside connection box (e.g. Quante) is used for each wheel sensor. In the standard version up to 4 wheel sensors can be connected in a trackside connection box if this is possible, based on the length of the wheel sensor cables (e.g. at points). On the top of the trackside connection box, an aluminium plate is mounted, which can be marked or engraved as appropriate. The trackside connection box can optionally be replaced with a plug connection.

3.3.5 Testing plate PB200

The testing plate PB200 is used to check the occupancy detection capability of a wheel sensor and/or to simulate a traversing.

Figure 3.8: Testing plate PB200

3.3.6 Adjustment and Maintenance Box AMB001

When combined with a conventional voltmeter, the Adjustment and Maintenance Box AMB001 serves to provide automatic adjustment of the wheel sensor RSR123.

Figure 3.9: Adjustment and Maintenance Box AMB001

3.4 Components of the indoor equipment

The system is designed modularly and can consist of the following components:

3.4.1 Power Supply with Crowbar PSC

Figure 3.10: Power supply board PSC

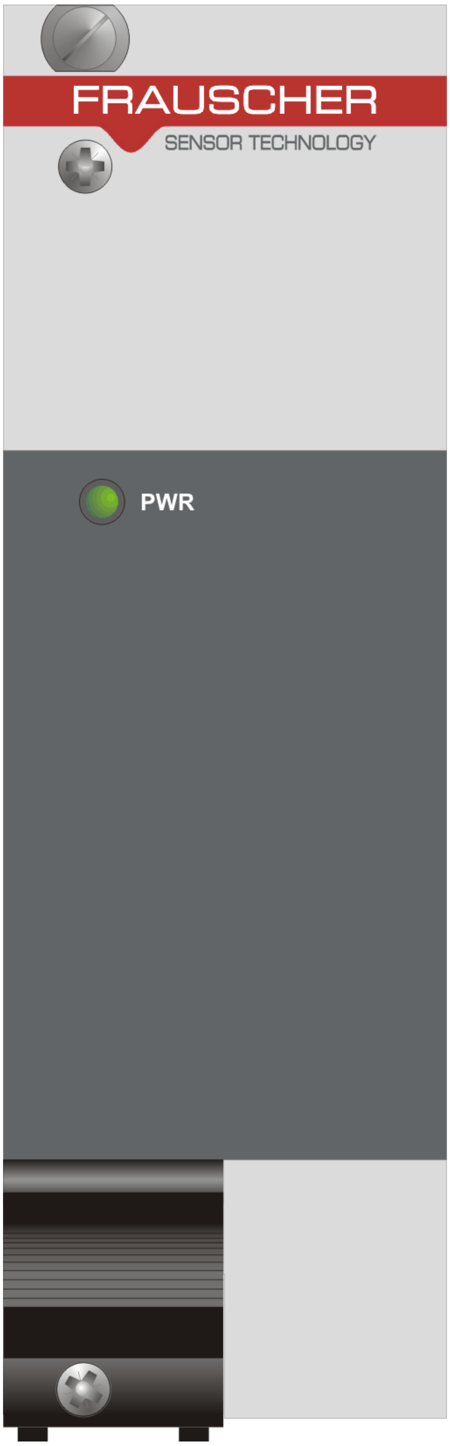
The power supply board PSC supplies the power for the components of the system and furthermore, protects the components against overvoltage.
The PSC does not have to be configured, but can be used immediately.
In order to increase the availability of the system, the supply can be designed redundantly (= with 2 PSC boards).

3.4.1.1 Safety information for the PSC

SAB FAdC100_15:

Operational actions must not be deduced from the displayed information of the LEDs, the display or the diagnostic data.

3.4.1.2 Front panel elements of the PSC



Element	Description
PWR (LED)	status indicator of the power supply

Type key (on the top of the handle):

PSC101	board identification
GSxx	equipment version (beginning with 01)

Figure 3.11: Front panel of the PSC

The PSC measures 3 HE in height and 8 TE in width.

Further information regarding the status indicator of the power supply can be taken from the chapter “LED indications on the PSC”.

3.4.2 Advanced Evaluation Board AEB

Figure 3.12: Evaluation board AEB

The evaluation board AEB is used to supply and evaluate a wheel sensor RSR180 or RSR123. The digital counting head information is output for further processing. Moreover, the tasks of the AEB also include to count axles and to generate the failsafe clear and occupied indication for up to 2 track sections (FMA).

A track section (FMA) can consist of up to 16 counting heads (see following figure).

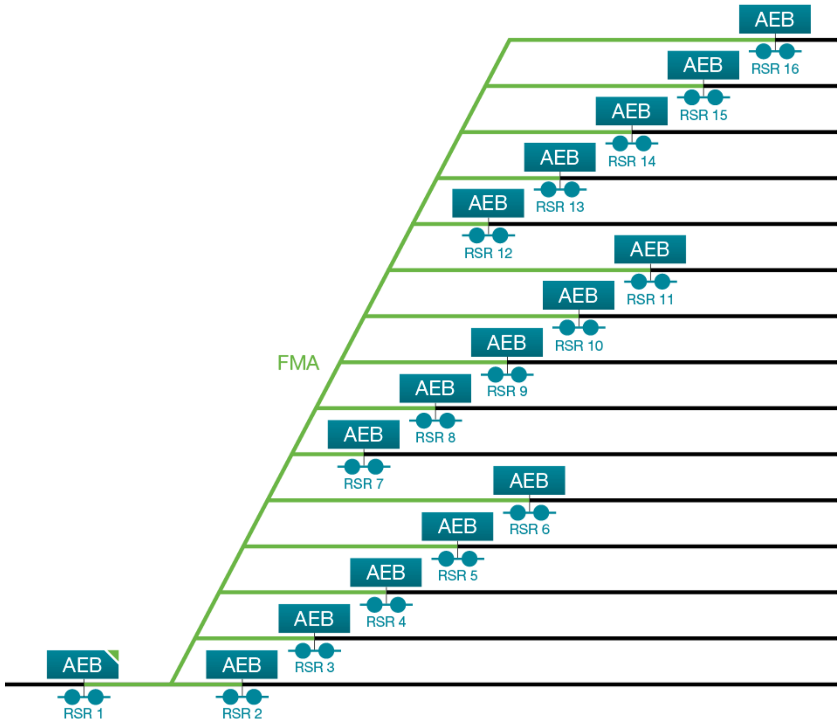


Figure 3.13: Maximum number of AEB boards, evaluation of a track section (FMA)

If 2 track sections (FMA) are evaluated by one AEB, then up to 20 AEB boards can be added as counting heads to the own counting head and the track sections (FMA) must be configured accordingly (see following figure).

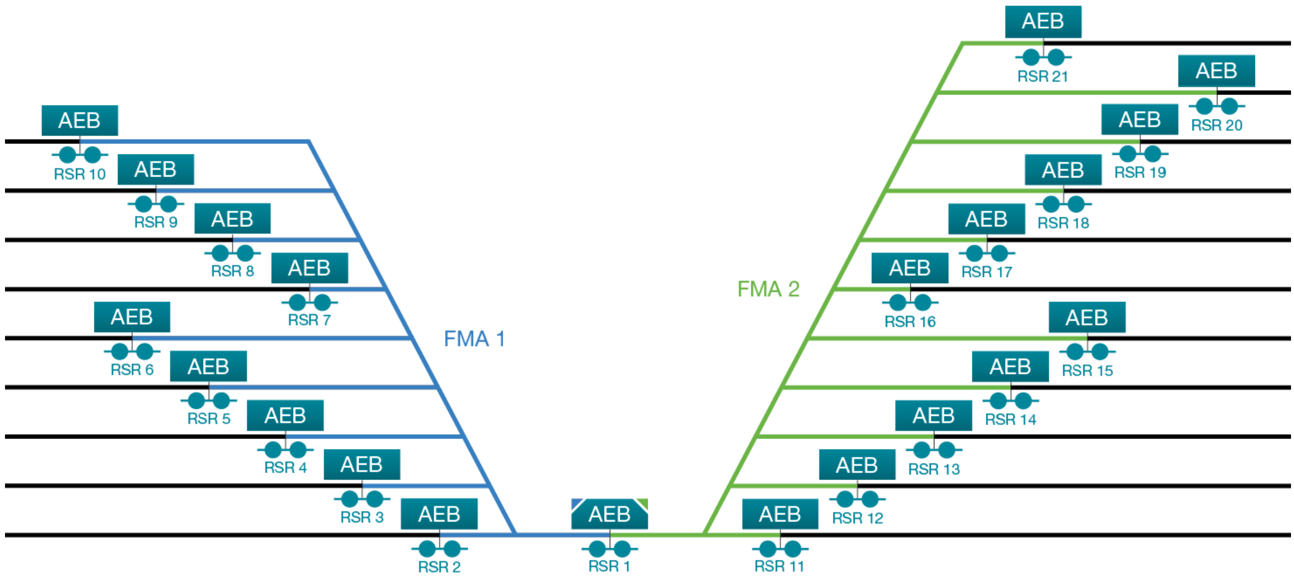


Figure 3.14: Maximum number of AEB boards, evaluation of 2 track sections (FMA)

The maximum number of axles in a track section (FMA) is 8 191.
An AEB can trigger up to 8 IO-EXB boards and can output up to 8 track sections (FMA) (via 4 IO-EXB boards that are configured for axle counting output).

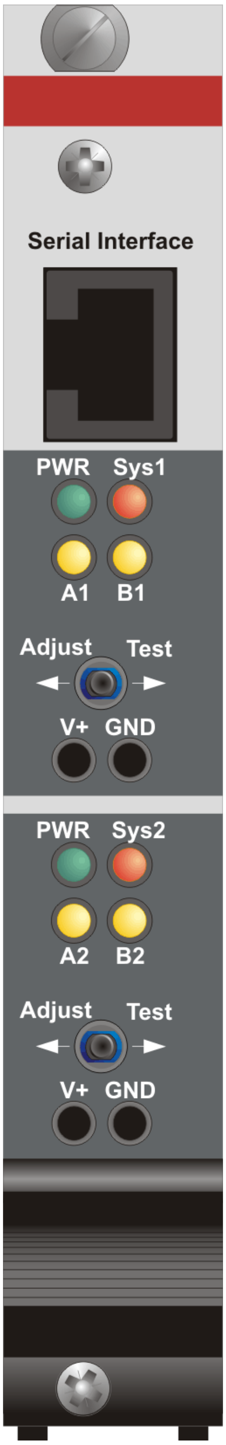
Before using the AEB, it must be configured according to the design and planning documents and according to chapter “Configuration of the evaluation board AEB”. If requested and ordered by the customer, Frauscher can configure the AEB. The configuration will be created based on customer information. Hence, it must be ensured by the customer that the information is complete and correct.

3.4.2.1 Safety information for the AEB

SAB FAdC100_15:

Operational actions must not be deduced from the displayed information of the LEDs, the display or the diagnostic data.

3.4.2.2 Front panel elements of the AEB



Element	Description
Serial Interface (RJ45-socket)	connection socket for diagnostic interface (ASD)
Channel 1:	
PWR (LED)	status indicator of power supply of channel 1
Sys1 (LED)	status indicator of system 1
A1 (LED)	status indicator of FMA 1 or Counting Head Control
B1 (LED)	status indicator of configuration and data traffic
Adjust, Test (toggle switch 1)	adjustment of the wheel sensor connected to the AEB or of an AEB carrying out a reset operation, carrying out coding of plug socket simulation of occupancy of system 1
V+, GND (2 mm sockets)	test sockets for voltage metering: metered voltage corresponds to the analogue wheel sensor current via a 100 Ω shunt
Channel 2:	
PWR (LED)	status indicator of power supply of channel 2
Sys2 (LED)	status indicator of system 2
A2 (LED)	status indicator of FMA 2 or Counting Head Control
B2 (LED)	status indicator of configuration and data traffic
Adjust ,Test (toggle switch 1)	adjustment of the wheel sensor connected to the AEB or of an AEB carrying out a reset operation, carrying out coding of plug socket, simulation of occupancy of system 2
V+, GND (2 mm sockets)	test sockets for voltage metering: metered voltage corresponds to the analogue wheel sensor current via a 100 Ω shunt
Type key (on the top of the handle):	
AEB101	board identification
GSxx	equipment version (beginning with 01)

Figure 3.15: Front panel of the AEB

The AEB measures 3 HE in height and 4 TE in width.

Further information regarding the status indicator of the LEDs can be taken from the chapter “LED indications on the AEB”.

Further information regarding the operation with the toggle switches can be taken from the chapters “Coding of the AEB”, “Adjustment of the AEB”, “Reset operation with the toggle switches on the front panel of the AEB” and “Simulation of traversings”.

3.4.3 Input/Output Board IO-EXB

Figure 3.16: Input/Output board IO-EXB

The Input/Output board IO-EXB can only be used in combination with an AEB. Up to 8 IO-EXB boards can be triggered by 1 AEB. The IO-EXB must not be configured; it receives the configuration from the AEB and works accordingly.

Depending on the requirements, an IO-EXB can be configured via configuration of the AEB with one of the following 3 functionalities (see chapter “Switching outputs of the IO-EXB”):

- **Axle counting output** (0 to 4 IO-EXB boards per AEB):
  In case of axle counting output, the IO-EXB outputs failsafely the clear/occupied status of up to 2 track sections (FMA) via voltage-free relay contacts.

- **Data transmission** (0 to 8 IO-EXB boards per AEB):
  In case of data transmission, the IO-EXB reads in and outputs failsafe or non-failsafe digital arguments (dependent on the configuration: QUAD/DUAL/SINGLE).

- **Counting head output** (0 to 8 IO-EXB boards per AEB):
  In case of counting head output, the IO-EXB outputs counting head information (direction and system information) of the directly connected AEB.

If an error occurs, the IO-EXB displays error codes (corresponding to its functionality).

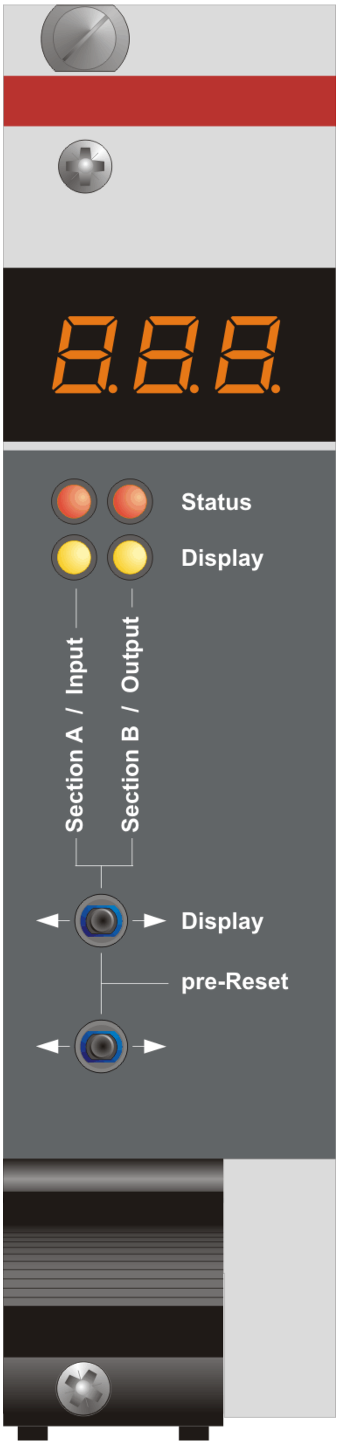
3.4.3.1 Safety information for the IO-EXB

SAB FAdC100_15:

Operational actions must not be deduced from the displayed information of the LEDs, the display or the diagnostic data.

In case of the display indication “0” (axle counter reading) on the IO-EXB, it is not guaranteed that no axles are in the track section.

3.4.3.2 Front panel elements of the IO-EXB



Element	Description
Display (3-digit seven segment display)	information of axle counter readings, error codes, statuses of input/output data, etc.
Status (LED)	status indicator of the • track sections (FMA) (in case of axle counting) or • inputs and outputs (in case of data transmission)
Display (LED)	status indicator of the display: • “Section A / Input” or • “Section B / Output”
Display (toggle switch)	selection of information to be shown in the display: • status of FMA 1 (= “Section A”) or status of FMA 2 (= “Section B”) (in case of axle counting) • inputs (= “Input”) or outputs (= “Output”) (in case of data transmission)
pre-Reset (toggle switch)	carrying out of a reset operation, dependent on configuration (see chapter “Reset axle counting via IO-EXB”)

Type key (on the top of the handle):

IO-EXB101	board identification
GSxx	equipment version (beginning with 01)

Figure 3.17: Front panel of the IO-EXB

The IO-EXB measures 3 HE in height and 6 TE in width.

Further information regarding the display of the IO-EXB can be taken from the chapter “Operation of the Input/Output Board IO-EXB”.

Further information regarding the status indicator of the LEDs can be taken from the chapters “LED indications in case of axle counting”, “LED indications in case of data transmission”, “LED indications in case of counting head output with system outputs” and “LED indications in case of counting head output with direction outputs”.

Further information regarding the operation with the toggle switches can be taken from the chapter “Reset operation with the toggle switches on the front panel of the IO-EXB”.

3.4.4 Communication board COM

Figure 3.18: Communication board COM

The system FAdC can be operated with a communication board COM-AdC or a COM-xxx.
The COM-xxx has the same functionalities as the COM-AdC and furthermore, provides a customer-specific protocol. Via that protocol vital information can be exchanged with an interlocking.

If in the following the contents apply for COM-AdC as well as for COM-xxx boards, the two boards are not referred to individually, but summarised under the term COM.

The main task of the COM board is to forward counting head information via a network, which can be designed redundantly (= 2 Ethernet connections) as well as reading out and providing the configuration data (from the CF card) for AEB and COM boards. In addition, the COM boards can forward non-failsafe diagnostic data (e.g. for the FDS or another diagnostic system). The absence of feedback between the vital network and the diagnostic systems can be configured. In this case, one Ethernet connection of the COM is used for the safety-relevant communication and the 2nd Ethernet connection of the COM for the forwarding of the diagnostic data.

Before using a COM, it must be configured according to the design and planning documents and according to chapter “Configuration of the communication board COM”. If requested and ordered by the customer, Frauscher can configure the COM. The configuration will be created based on customer information. Hence, it must be ensured by the customer that the information is complete and correct. The CF cards are included in the scope of delivery.

It is recommended to use exclusively CF cards that were checked by Frauscher.

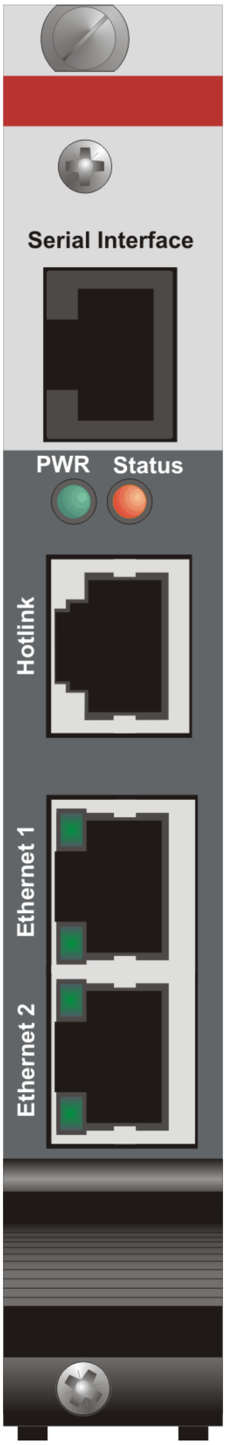
In order to reach a higher availability of the system, the COM board can be designed redundantly (= 2 COM boards). Further information regarding redundantly designed COM boards can be taken from the chapters “Interface ‘Hotlink’” and “Redundant communication”.

3.4.4.1 Safety information for the COM

SAB FAdC100_15:

Operational actions must not be deduced from the displayed information of the LEDs, the display or the diagnostic data.

3.4.4.2 Front panel elements of the COM



Element	Description
Serial Interface (RJ45-socket)	connection socket for diagnostic interface (ASD)
PWR (LED)	status indicator of power supply (active board)
Status (LED)	status indicator of board status
Hotlink (RJ45-socket)	connection socket for synchronisation between redundant boards
Ethernet 1 (RJ45-socket)	connection socket for connection to network 1
Link (upper LED)	status indicator of data transmission
Speed (lower LED)	status indicator of data transmission speed
Ethernet 2 (RJ45-socket)	connection socket for connection to network 2
Link (upper LED)	status indicator of data transmission
Speed (lower LED)	status indicator of data transmission speed

Type key (on the top of the handle):

COM-AdC101	board identification
GSxx	equipment version (beginning with 01)

Figure 3.19: Front panel of the COM

The COM measures 3 HE in height and 4 TE in width.

Further information regarding the status indicator of the LEDs can be taken from the chapter “LED indications on the COM”.

3.4.5 Backplane BP-PWR

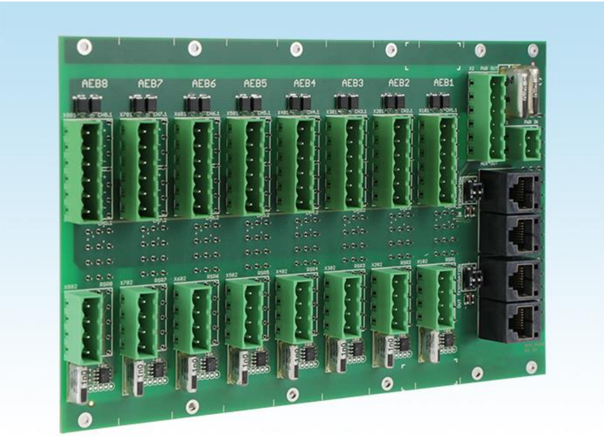


Figure 3.20: Backplane BP-PWR (in this case: BP-PWR101-8)

The backplane BP-PWR is used to connect up to 8 AEB and/or COM boards with 1 PSC. The PSC provides the power supply for the AEB and COM boards.

It is recommended to fill the BP-PWR with boards from left to right.

The order of the boards or any empty plug sockets, however, does not have any bearing on the function of the system.

How many AEB and/or COM boards can be used per PSC depends on the following factors:

- power supply of the system
- current consumption of the boards, which are supplied by the PSC
- wheel sensor type

3.4.5.1 Safety information for the BP-PWR

The pin coding of the boards PSC, AEB and COM must not be changed. In case the pin coding on the BP-PWR must be changed in order to be able to plug the boards AEB and COM variable, then this can only be done by skilled personnel and if the design and planning documents are taken into account. It must be observed that the coding pins are not bent or broken.

3.4.5.2 Designs and plug sockets of the BP-PWR

The backplane BP-PWR is available in 3 different designs:

- BP-PWR101-8:
  - plug sockets for 1 PSC and 8 AEB and/or COM boards
  - height: 3 HE, width: 40 TE
- BP-PWR101-4:
  - plug sockets for 1 PSC and 4 AEB and/or COM boards
  - height: 3 HE, width: 24 TE
- BP-PWR101-0:
  - plug socket for 1 PSC and 0 AEB and/or COM boards
  - height: 3 HE, width: 8 TE

In the following, the BP-PWR101-8 is pictured exemplarily. The BP-PWR101-4 is reduced by 4 AEB plug sockets.

Plug sockets on the front side

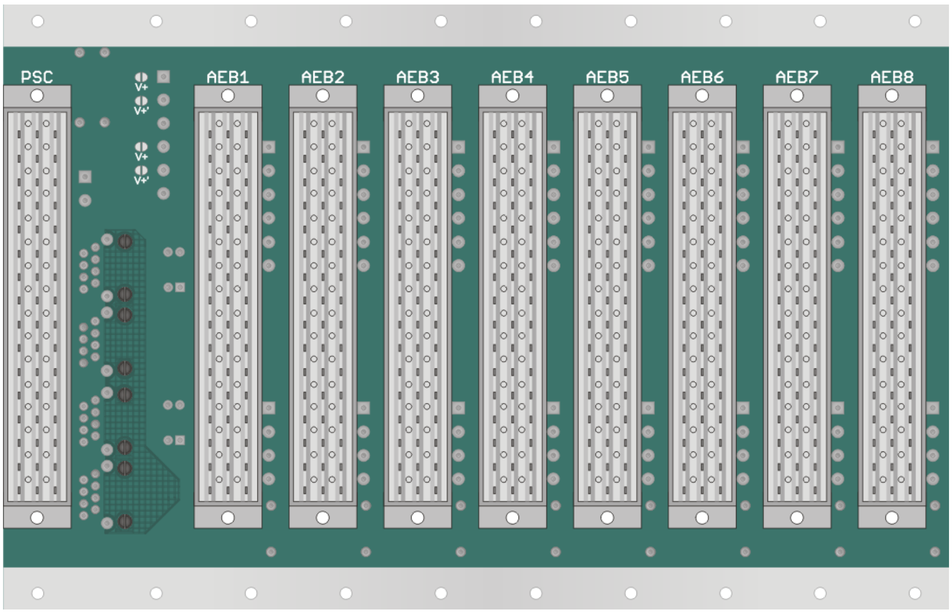


Figure 3.21: Front side of the BP-PWR101-8

On the front side of the BP-PWR101-8 there are the following plug sockets:

Designation	Interface	Additional information
“PSC”	power supply	48-pin female multipoint connector, type F
“AEB1” to “AEB8”	AEB and/or COM	48-pin female multipoint connectors, type F

Table 3.1: Plug sockets on the front side of the BP-PWR101-8

Plug sockets on the rear side

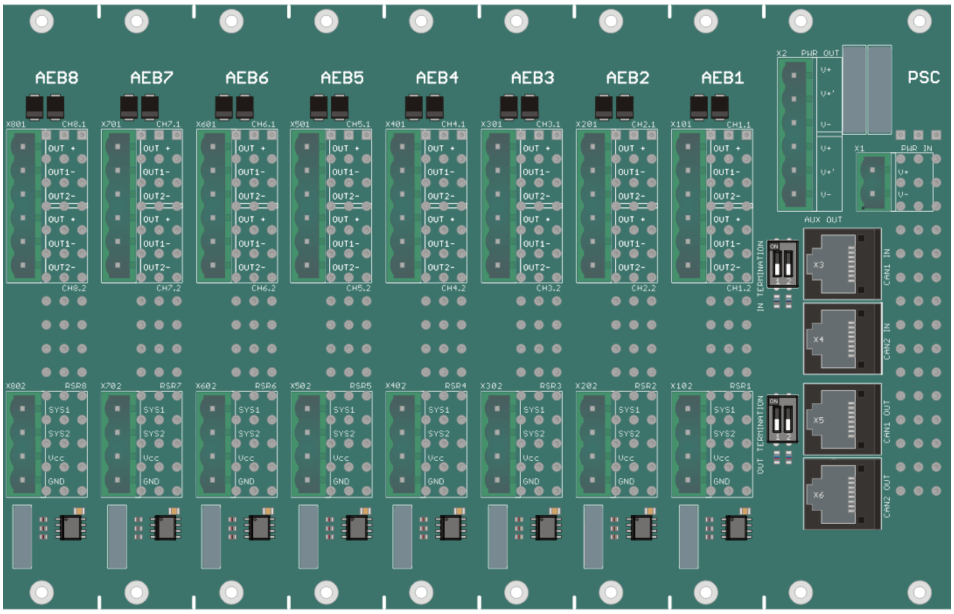


Figure 3.22: Rear side of the BP-PWR101-8, without cage clamp terminals

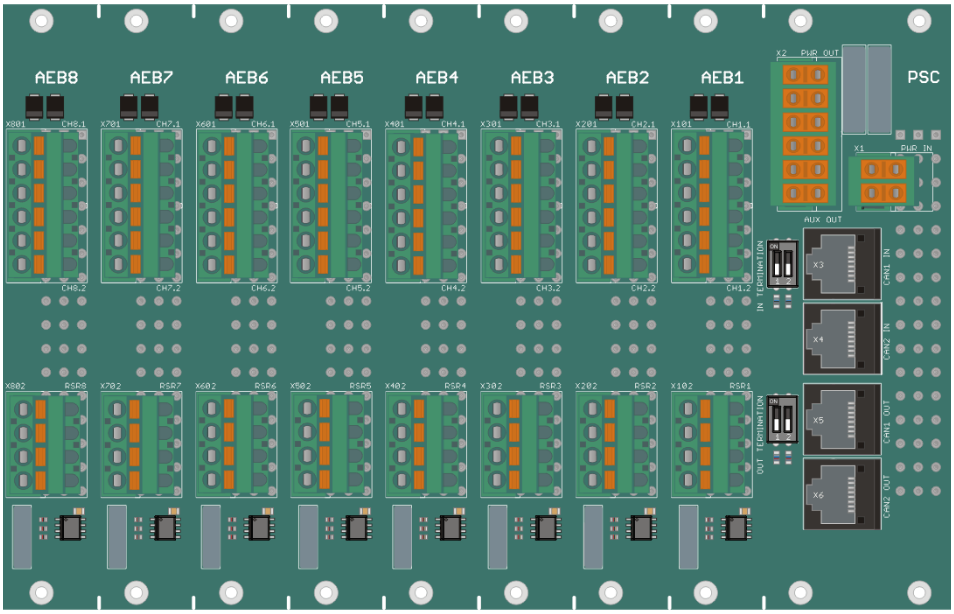


Figure 3.23: Rear side of the BP-PWR101-8, with cage clamp terminals

On the rear side of the BP-PWR101-8 there are the following plug sockets:

Designation	Interface	Additional information
"AEB1": X101 to "AEB8": X801	counting head outputs	pluggable cage clamp terminals for cross-sections up to 1,5 mm^2
"AEB1": X102 = "RSR1" to "AEB8": X802 = "RSR8"	wheel sensor	pluggable cage clamp terminals for cross-sections up to 1,5 mm^2
"PSC": X1 = "PWR IN", X2 = "PWR OUT"	power supply	pluggable cage clamp terminals for cross-sections up to 1,5 mm^2
X3 = "CAN1 IN", X4 = "CAN2 IN", X5 = "CAN1 OUT", X6 = "CAN2 OUT"	CAN	RJ45-sockets

Table 3.2: Plug sockets on the rear side of the BP-PWR101-8

A wheel sensor may only be connected to the interface "wheel sensor" if an AEB is present in the associated plug socket on the front side of the BP-PWR. Otherwise, the wheel sensor signal is not evaluated.

The BP-PWR101-0 can be used for a redundant power supply or for the power supply of IO-EXB boards.

Plug socket on the front side

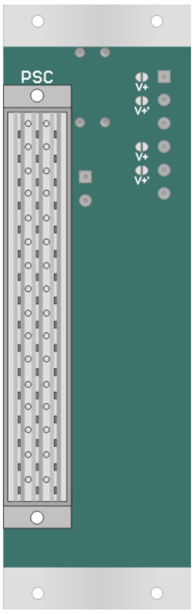


Figure 3.24: Front side of the BP-PWR101-0

On the front side of the BP-PWR101-0 there is the following plug socket:

Designation	Interface	Additional information
“PSC”	power supply	48-pin female multipoint connector, type F

Table 3.3: Plug socket on the front side of the BP-PWR101-0

Plug sockets on the rear side

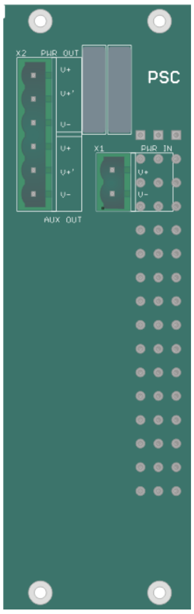


Figure 3.25: Rear side of the BP-PWR101-0, without cage clamp terminals

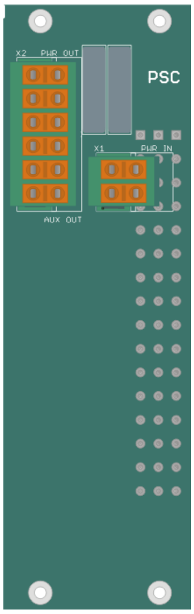


Figure 3.26: Rear side of the BP-PWR101-0, with cage clamp terminals

On the rear side of the BP-PWR101-0 there are the following plug sockets:

Designation	Interface	Additional information
"PSC": X1 = "PWR IN", X2 = "PWR OUT"	power supply	pluggable cage clamp terminals for cross-sections up to 1,5 mm²

Table 3.4: Plug sockets on the rear side of the BP-PWR101-0

3.4.5.3 Pin codings on the BP-PWR

Since the boards PSC, AEB and COM are equipped with a type dependant coding (= 5 drillings on the male multipoint connector), the plug sockets on the backplane BP-PWR also need an appropriate pin coding. Thereto, 5 coding pins are inserted into the corresponding drillings on the female multipoint connector.

For the plug sockets "AEB1" to "AEB8" the following applies:
The position of the single coding pins on the female multipoint connectors depends on which board is plugged into the corresponding plug socket.

If the board rack configuration is already known when ordering, the pin coding of the BP-PWR can be carried out by Frauscher prior to delivery if requested and ordered by the customer.
If the board rack configuration is not yet known when ordering, the coding pins are delivered separately, so that the pin coding can be carried out after delivery.

It must be observed that the coding pins are not bent or broken.

In the following figures, the position of the coding pins on the female multipoint connectors of the BP-PWR is marked with a red dot.

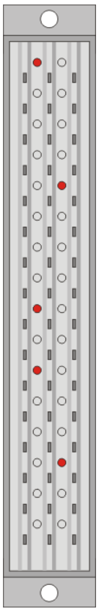


Figure 3.27:
Pin coding for PSC101

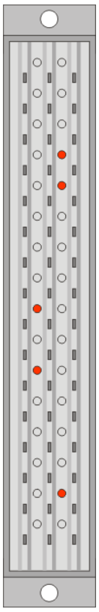


Figure 3.28:
Pin coding for AEB101

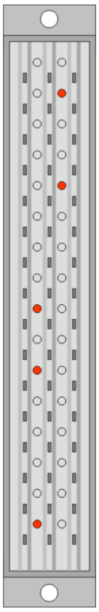


Figure 3.29:
Pin coding for
COM-AdC101

To avoid that an AEB is plugged into a wrong plug socket, an electronic coding must be carried out during initial commissioning, see chapter “Coding of the AEB”.

3.4.6 Backplane BP-EXB

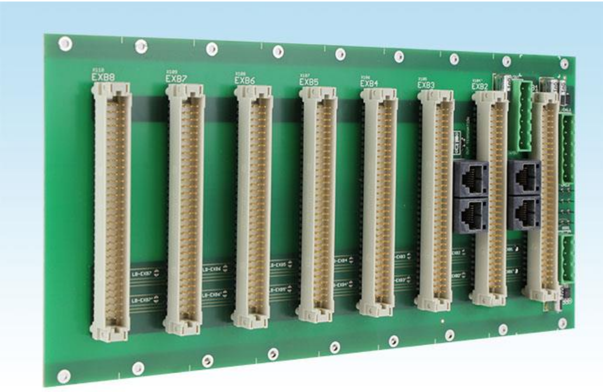


Figure 3.30: Backplane BP-EXB (in this case: BP-EXB101-8)

The backplane BP-EXB is used to connect 1 AEB with up to 8 IO-EXB boards.

On the BP-EXB, the plug sockets for the IO-EXB must be filled from left to right. If IO-EXB boards within the system are used for axle counting output, for data transmission and for counting head output (see chapter “Configuration”), then the IO-EXB boards are also arranged on the BP-EXB in this order.

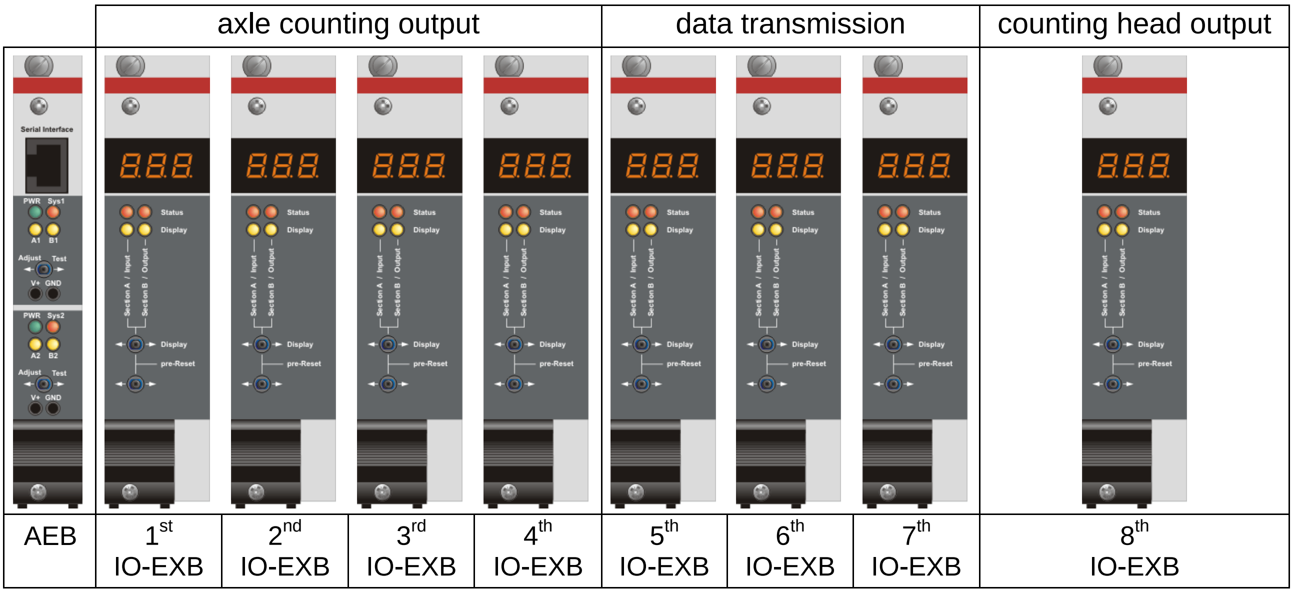


Figure 3.31: Order of the IO-EXB boards dependent on their functionality (example, here: BP-EXB101-8)

The number of IO-EXB boards per functionality is variable (see chapter “Input/Output Board IO-EXB”). Altogether, a maximum of 8 IO-EXB boards can be used per AEB.
For axle counting output, a maximum of 4 IO-EXB boards can be used.
For data transmission and counting head output, a maximum of 8 IO-EXB boards each can be used.

3.4.6.1 Safety information for the BP-EXB

The pin coding of the boards PSC, AEB and COM as well as of the mating connector on the BP-EXB must not be changed.

3.4.6.2 Designs and plug sockets of the BP-EXB

The backplane BP-EXB is available in 4 different designs:

- BP-EXB101-8:
  - plug sockets for 1 AEB and 8 IO-EXB boards
  - height: 3 HE, width: 52 TE

- BP-EXB101-4:
  - plug sockets for 1 AEB and 4 IO-EXB boards
  - height: 3 HE, width: 28 TE

- BP-EXB101-2:
  - plug sockets for 1 AEB und 2 IO-EXB boards
  - height: 3 HE, width: 16 TE

- BP-EXB101-1:
  - plug sockets for 1 AEB and 1 IO-EXB
  - height: 3 HE, width: 10 TE

In the following, the BP-EXB101-8 is pictured exemplarily. The BP-EXB101-4 and BP-EXB101-2 are shortened by 4 and 6 IO-EXB plug sockets.

Plug sockets on the front side

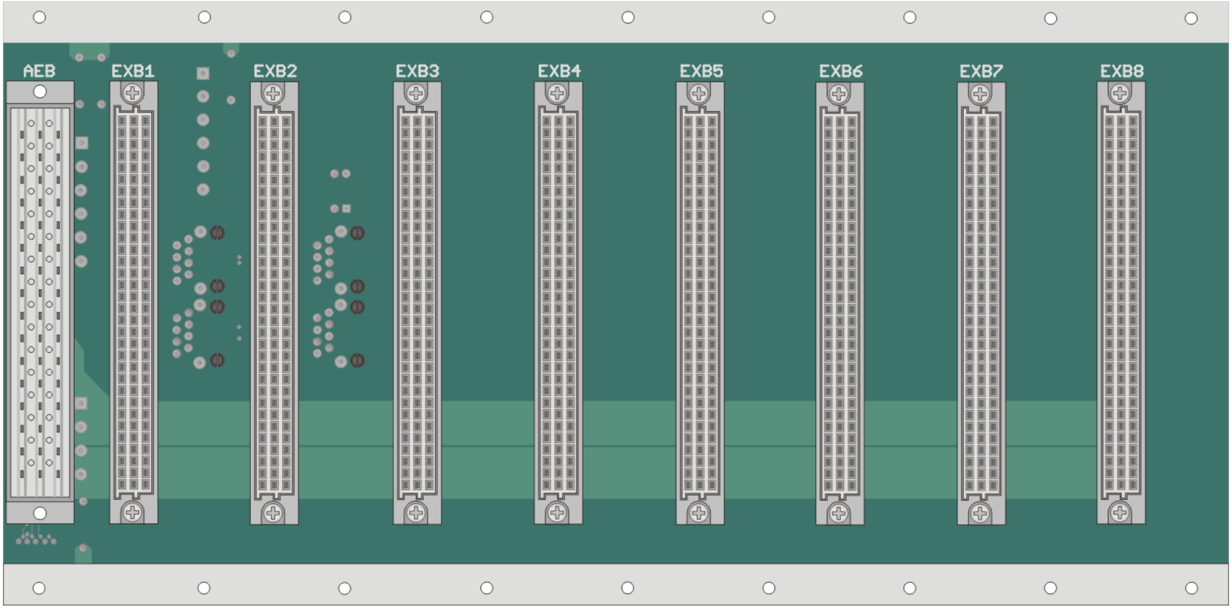


Figure 3.32: Front side of the BP-EXB101-8

On the front side of the BP-EXB101-8 there are the following plug sockets:

Designation	Interface	Additional information
"AEB"	AEB	48-pin female multipoint connector, type F
"EXB1" to "EXB8"	IO-EXB	96-pin female multipoint connectors, type C

Table 3.5: Plug sockets on the front side of the BP-EXB101-8

Plug sockets on the rear side

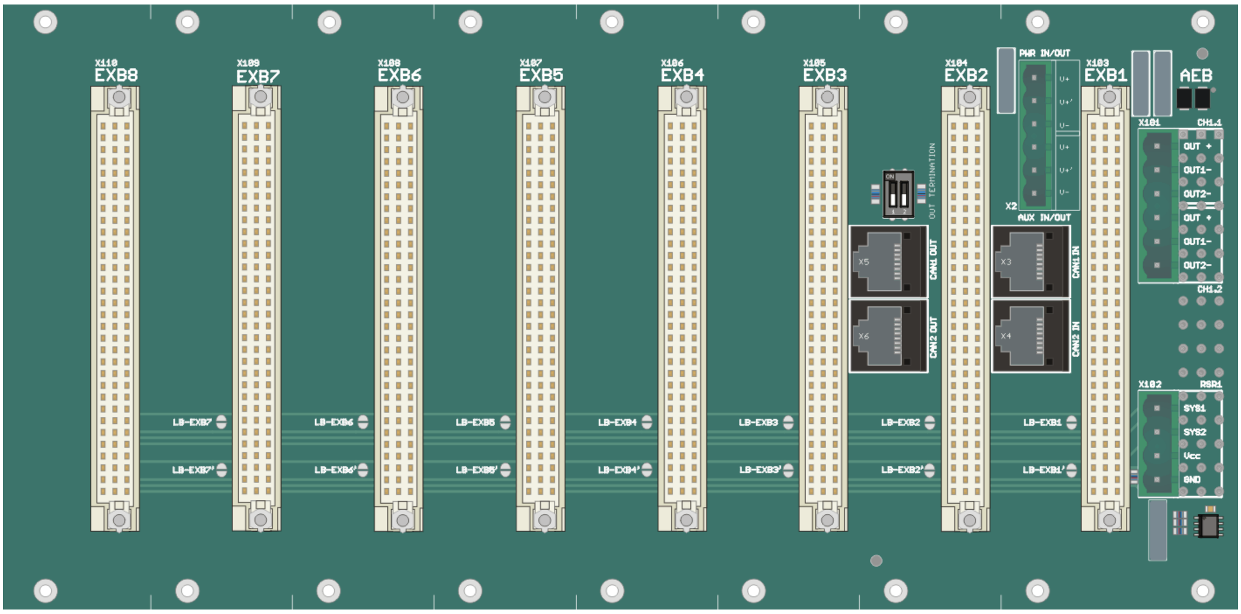


Figure 3.33: Rear side of the BP-EXB101-8, without cable housings and cage clamp terminals

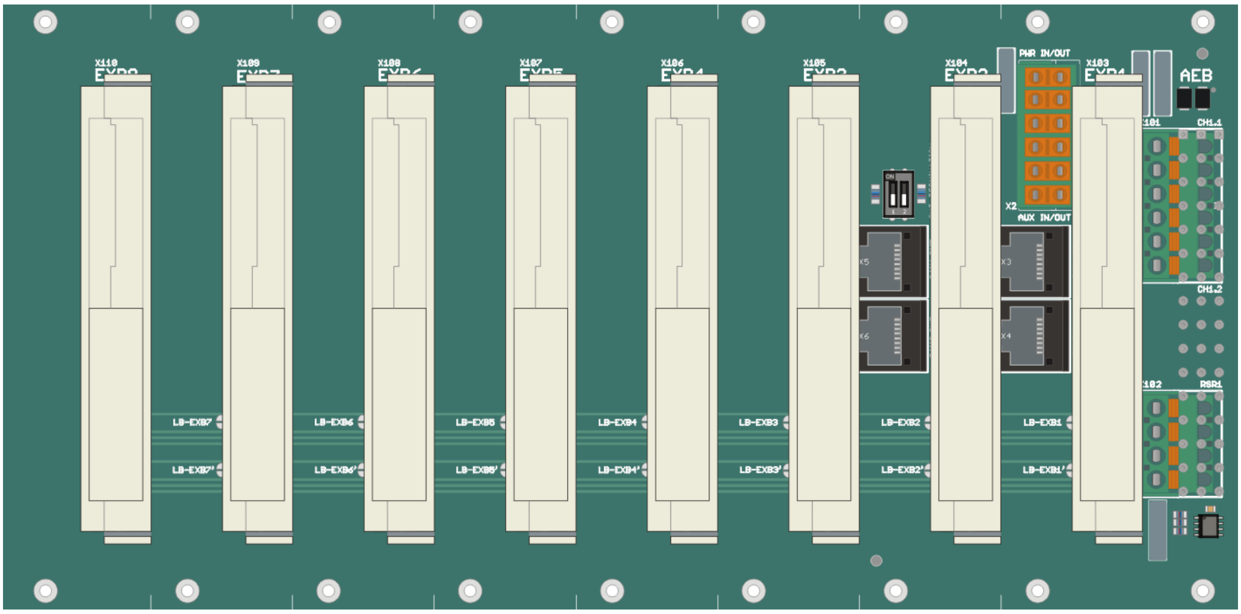


Figure 3.34: Rear side of the BP-EXB101-8, with cable housings and cage clamp terminals

On the rear side of the BP-EXB101-8 there are the following plug sockets:

Designation	Interface	Additional information
X103 = “EXB1” to X110 = “EXB8”	IO-EXB	96-pin male multipoint connectors, type C
X3 = “CAN1 IN” X4 = “CAN2 IN” X5 = “CAN1 OUT” X6 = “CAN2 OUT”	CAN	RJ45-sockets
X2 = “PWR IN/OUT”	power supply	pluggable cage clamp terminal for cross-sections up to 1,5 mm²
“AEB”: X101	counting head outputs	pluggable cage clamp terminal for cross-sections up to 1,5 mm²
“AEB”: X102 = “RSR1”	wheel sensor	pluggable cage clamp terminal for cross-sections up to 1,5 mm²

Table 3.6: Plug sockets on the rear side of the BP-EXB101-8

In the following, the BP-EXB101-1 is pictured.

Plug sockets on the front side

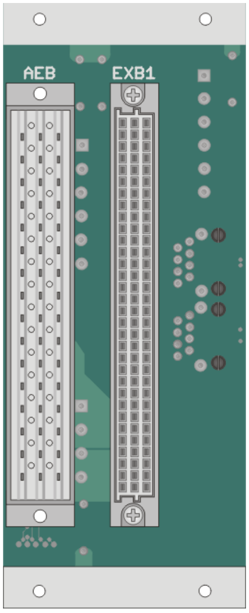


Figure 3.35: Front side of the BP-EXB101-1

On the front side of the BP-EXB101-1 there are the following plug sockets:

Designation	Interface	Additional information
“AEB”	AEB	48-pin female multipoint connector, type F
“EXB1”	IO-EXB	96-pin female multipoint connector, type C

Table 3.7: Plug sockets on the front side of the BP-EXB101-1

Plug sockets on the rear side

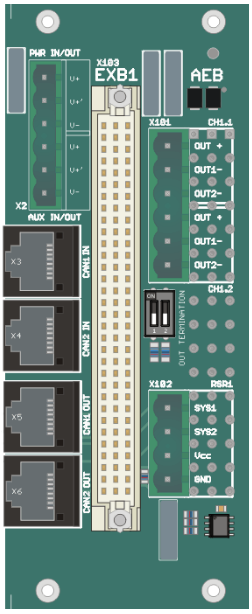


Figure 3.36: Rear side of the BP-EXB101-1, without cable housings and cage clamp terminals

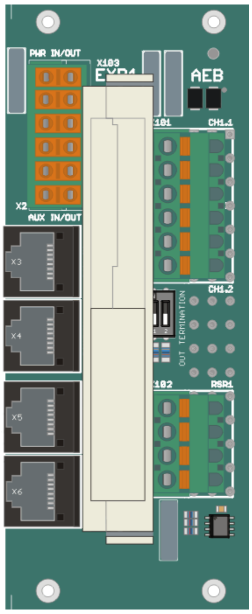


Figure 3.37: Rear side of the BP-EXB101-1, with cable housings and cage clamp terminals

On the rear side of the BP-EXB101-1 there are the following plug sockets:

Designation	Interface	Additional information
X103 = "EXB1"	IO-EXB	96-pin male multipoint connector, type C
X3 = "CAN1 IN" X4 = "CAN2 IN" X5 = "CAN1 OUT" X6 = "CAN2 OUT"	CAN	RJ45-sockets
X2 = PWR IN/OUT	power supply	pluggable cage clamp terminal for cross-sections up to 1,5 mm²
"AEB": X101	counting head outputs	pluggable cage clamp terminal for cross-sections up to 1,5 mm²
"AEB": X102 = "RSR1"	wheel sensor	pluggable cage clamp terminal for cross-sections up to 1,5 mm²

Table 3.8: Plug sockets on the rear side of the BP-EXB101-1

When ordering, it must be announced, whether the cable housings for the connectors "X103" to "X110" are needed with soldering lugs or with crimp contacts.

In order to avoid that an AEB is plugged into a wrong plug socket, an electronic coding during commissioning must be carried out, see chapter "Coding of the AEB".

3.4.7 Board racks BGT

Board racks BGT consist of an aluminium housing and are equipped with a label bar. They are used to house the boards and as mechanical protection. If the exact board rack configuration is already known when ordering, the backplanes and boards will be installed accordingly.

SAB FAdC100_70:

The components of the system FAdC (exception: wheel sensors and overvoltage protection boards) must be installed in a board rack, which offers protection from direct contact of the electronics (protection class IP20) on the one hand and which enables heat dissipation through air circulation on the other hand.

SAB FAdC100_153:

Unassigned plug sockets in the board rack must be covered with appropriate cover plates (e.g. dummy plates).

SAB FAdC100_154:

The rear side of the board rack must be protected from direct contact of the electronics with appropriate measures (e.g. installation in a cubicle).

SAB FAdC100_158:

The board rack of the system FAdC must be earthed according to operational guidelines.

3.4.7.1 Board rack BGT07

The board rack BGT07 measures 3 HE in height and 84 TE in width, and is therefore suitable for 19" frames. During design and planning and during installation of the board rack, the required space for the label bar must be taken into account. The dimensions required for mounting are shown in the following figures.

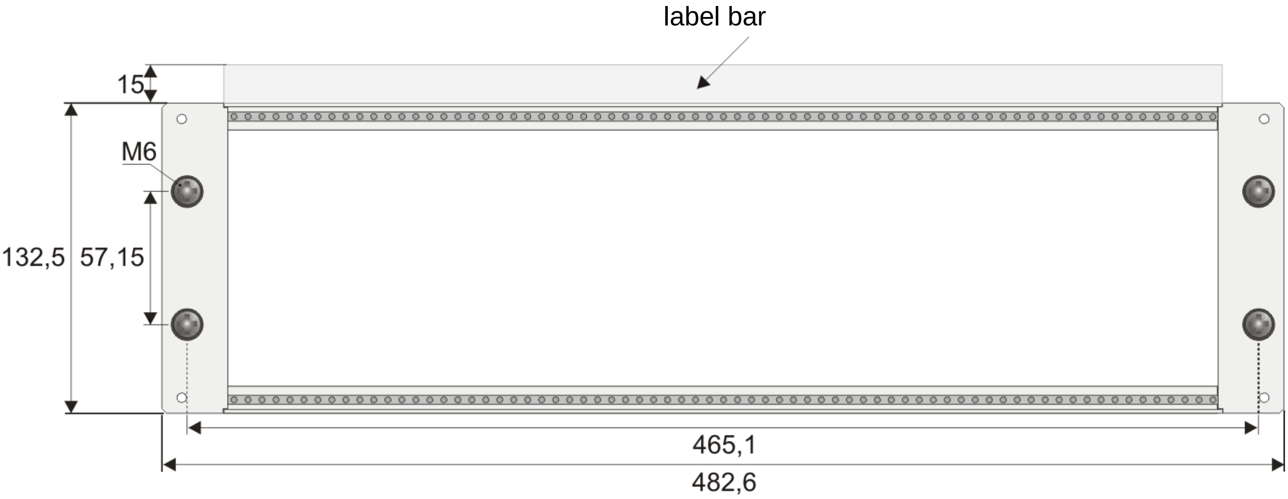


Figure 3.38: Front view of the board rack BGT07 with label bar, measurements in mm

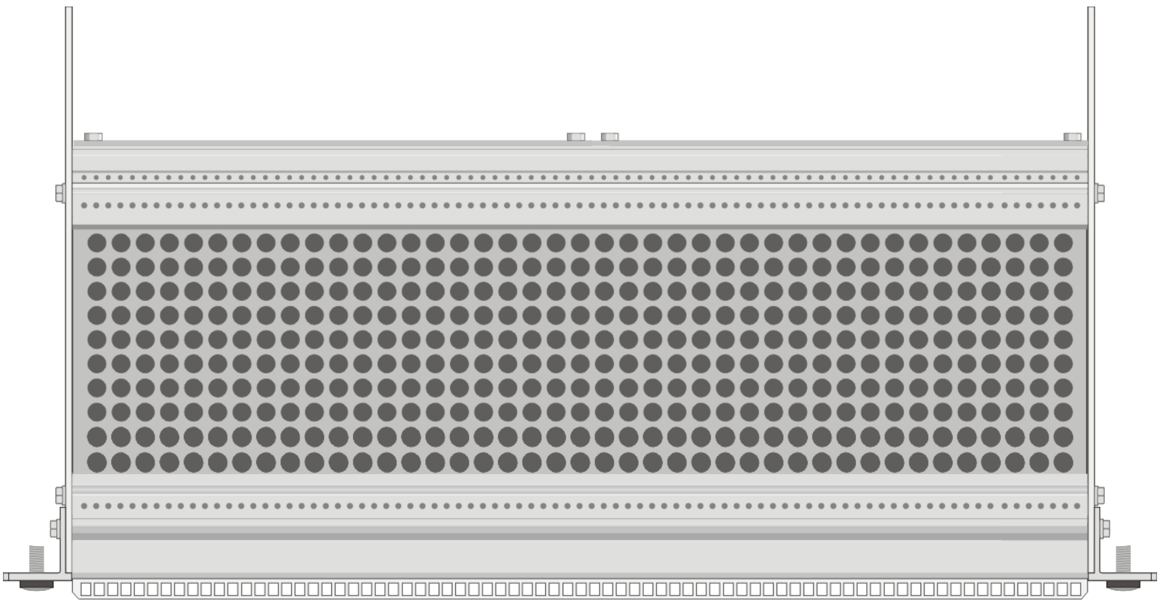


Figure 3.39: Top view of the board rack BGT07 with label bar

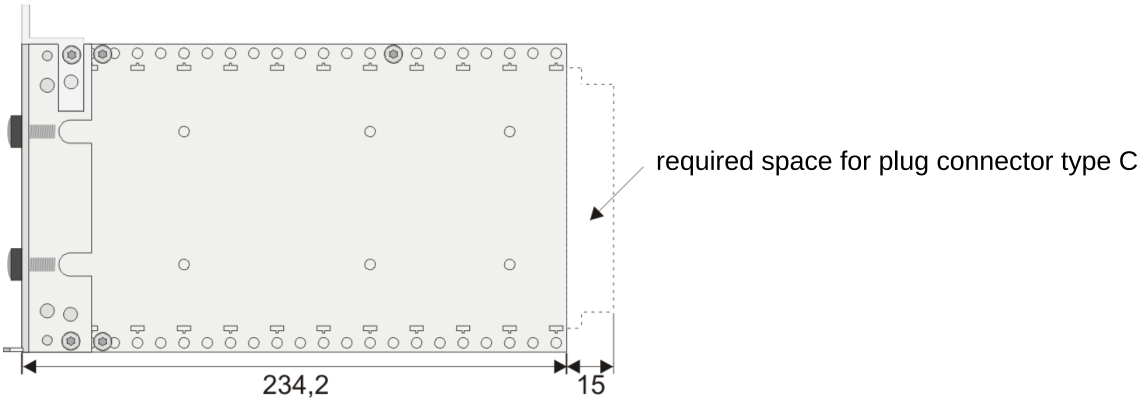


Figure 3.40: Side view of the board rack BGT07 with label bar, measurements in mm

3.4.7.2 Board rack BGT08

The board rack BGT08 measures 3 HE in height and 42 TE in width, and is therefore suitable for ½ 19" frames. During design and planning and during installation of the board rack, the required space for the label bar must be taken into account. The dimensions required for mounting are shown in the following figures.

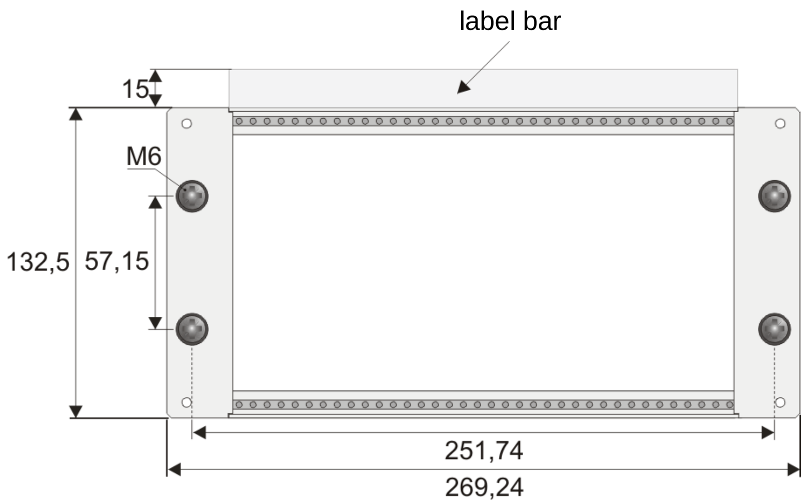


Figure 3.41: Front view of the board rack BGT08 with label bar, measurements in mm

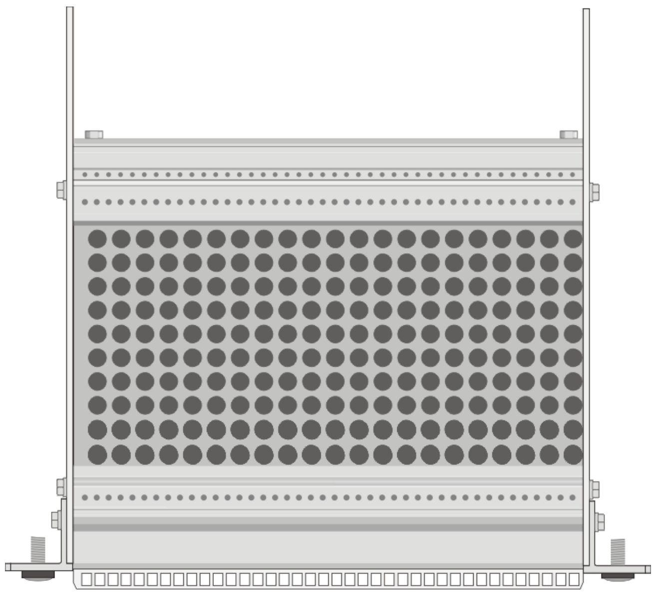


Figure 3.42: Top view of the board rack BGT08 with label bar

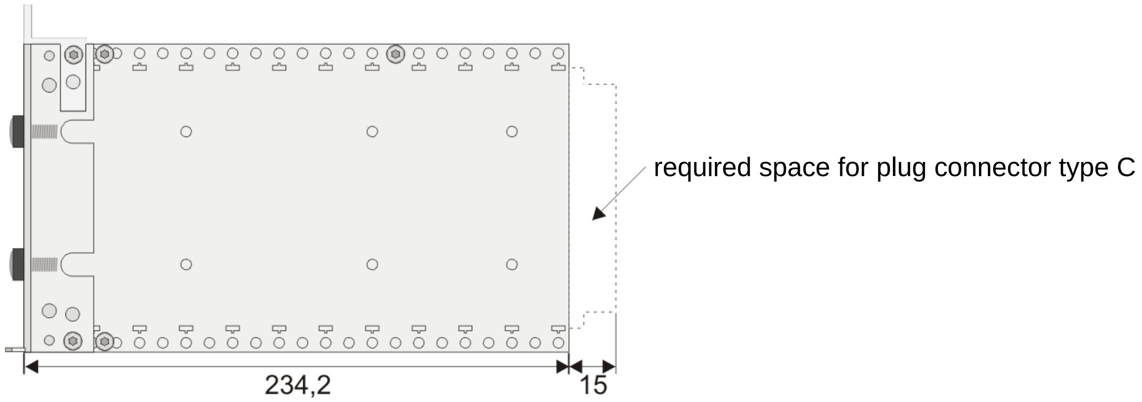


Abbildung 3.43: Side view of the board rack BGT08 with label bar, measurements in mm

3.4.8 Overvoltage protection board BSI

3.4.8.1 Overvoltage protection board BSI004

Figure 3.44: Overvoltage protection board BSI004

The overvoltage protection board BSI004 protects the indoor equipment from interference voltages that could have an impact on the cable between the wheel sensor RSR180 and the cable terminating frame KA (and/or the overvoltage protection board) in the event of a lightning strike or overhead contact line short-circuit. The overvoltage protection board BSI004 is connected between the evaluation board and the wheel sensor RSR180. Typically, the overvoltage protection board is mounted on a top-hat rail in the indoor equipment.

3.4.8.2 Overvoltage protection board BSI005

Figure 3.45: Overvoltage protection board BSI005

The overvoltage protection board BSI005 protects the indoor equipment from interference voltages that could have an impact on the cable between the wheel sensor RSR123 and the cable terminating frame KA (and/or the overvoltage protection board) in the event of a lightning strike or overhead contact line short-circuit. The overvoltage protection board BSI005 is connected between the evaluation board and the wheel sensor RSR123. Typically, the overvoltage protection board is mounted on a top-hat rail in the indoor equipment.

3.5 Interfaces

3.5.1 Interface "wheel sensor"

The power supply required to operate the wheel sensor is provided at the interface "wheel sensor". Furthermore, the sensor system information of the wheel sensors is read in. The voltage output here is galvanically separated from the power supply of the system. An overvoltage protection board BSI004 (for wheel sensor RSR180) or BSI005 (for wheel sensor RSR123), and optionally a cable distributor and/or a cable terminating frame KA, must be between the trackside connection box GAK and the backplane BP-PWR. The trackside connection box can be replaced with a plug connection. Further information regarding the pin assignment of the connectors "X102" to "X802" on the BP-PWR (dependent on the number of wheel sensors) and on the BP-EXB can be taken from the chapters "Connectors on the backplane BP-PWR" and "Connectors on the backplane BP-EXB".

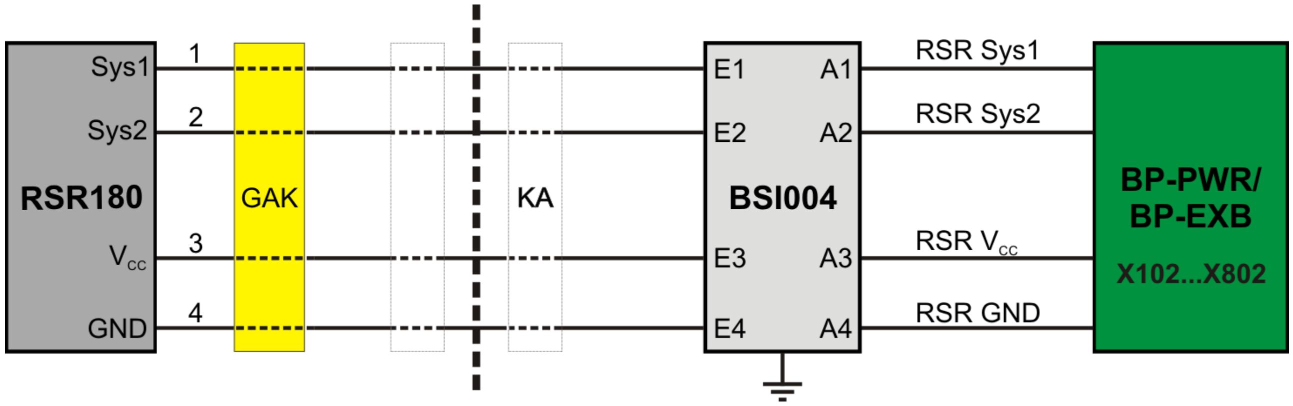


Figure 3.46: Connection diagram of the wheel sensor RSR180 to the indoor equipment

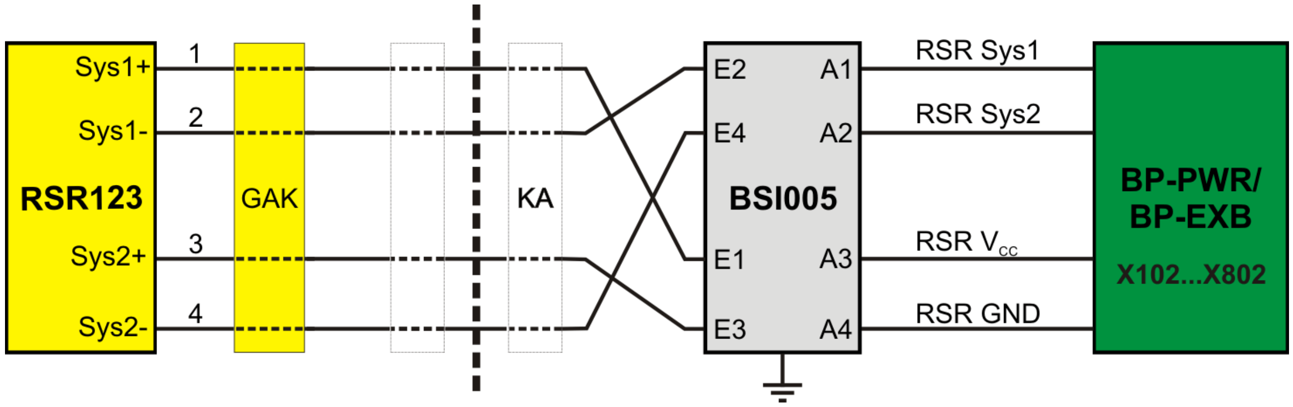


Figure 3.47: Connection diagram of the wheel sensor RSR123 to the indoor equipment

SAB FAdC100_8:

If using a wheel sensor RSR180, an overvoltage protection board BSI004 must be used.

SAB FAdC100_9:

If using a wheel sensor RSR123, an overvoltage protection board BSI005 must be used.

SAB FAdC100_68:

Protective measures against dangerous contact voltages must be provided when working on the overvoltage protection board BSI004 (e.g. insulated tools).

SAB FAdC100_59:

Protective measures against dangerous contact voltages must be provided when working on the overvoltage protection board BSI005 (e.g. insulated tools).

SAB FAdC100_69:

The wheel sensor RSR180 and the indoor equipment must be connected to the overvoltage protection board BSI004 as shown in following figure:

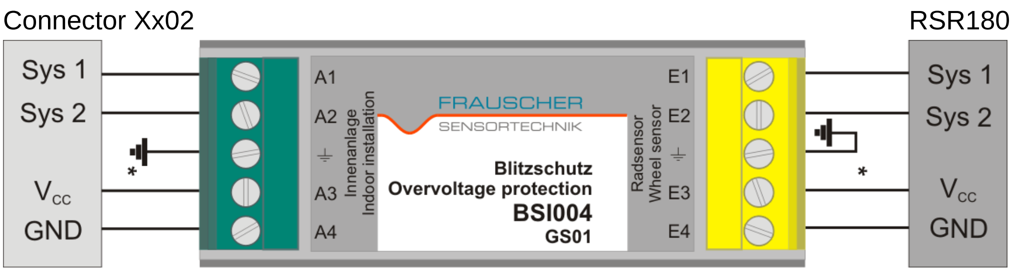


Figure 3.48: Wiring diagram of BSI004

* The earth connection can take place with either the yellow or the green terminal.

SAB FAdC100_60:

The wheel sensor RSR123 and the indoor equipment must be connected to the over-voltage protection board BSI005 as shown in following figure:

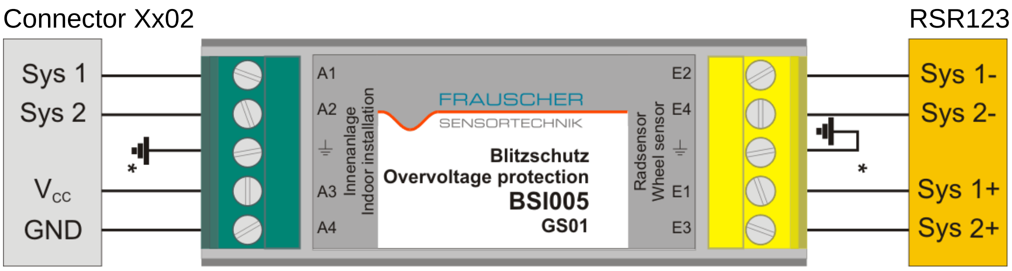


Figure 3.49: Wiring diagram of BSI005

* The earth connection can take place with either the yellow or the green terminal.

All parts of the signalling cable, the distributor, the cable terminating frame and the connection cable between the FAdC and the evaluation board may be subject to interference voltage. Correspondingly, this must be observed before touching the wires and test sockets.

3.5.2 Interface “counting head outputs”

There are 4 counting head outputs available on the AEB (optocoupler outputs) and there are 3 switching outputs available at one IO-EXB each (relay outputs, see chapter “Switching outputs of the IO-EXB”). These counting head outputs and switching outputs can be configured as either system or direction outputs.
Further information regarding the pin assignment of the connectors “X102” to “X802” on the backplane BP-PWR (dependent on the number of wheel sensors) and on the BP-EXB can be taken from the chapters “Connectors on the backplane BP-PWR” and “Connectors on the backplane BP-EXB”.

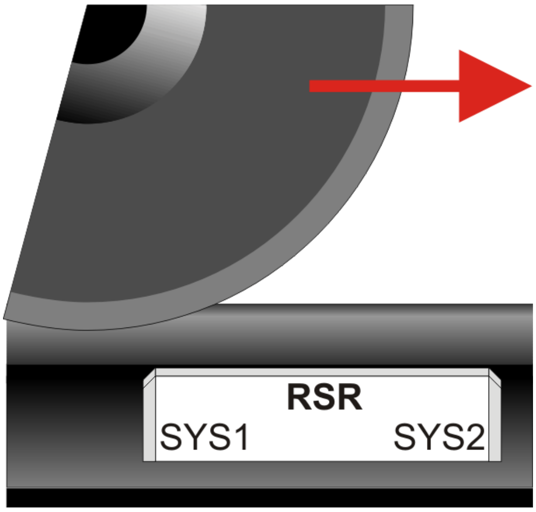


Figure 3.50: Traversing direction 1

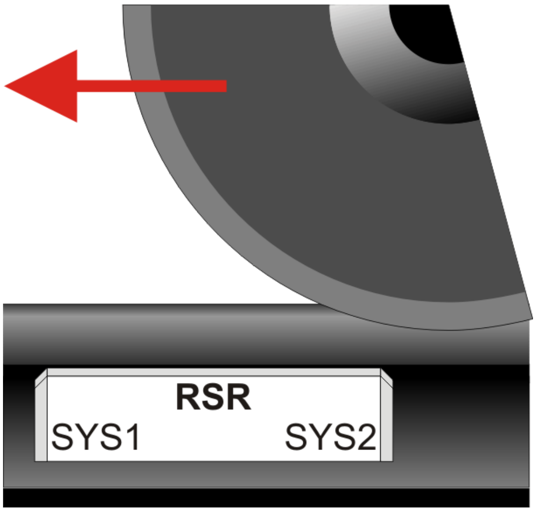


Figure 3.51: Traversing direction 2

In general the travel direction of the wheel at the counting head outputs and the switching outputs is defined with “direction 1” and “direction 2”. It is decisive, which system of the wheel sensor is damped first. If system 1 is damped first, and then system 2, we refer to “direction 1”. In the opposite case, we refer to “direction 2”.

Load values for the interface “counting head outputs”

SAB FAdC100_13:

The switching voltage on the counting head outputs must not exceed 72 V DC.
The switching current on the counting head outputs must not exceed 17 mA DC.

A change of status on the counting head outputs can last for a maximum of 425 µs. This must be tolerated by the safety system. If this time is not tolerated, faults may occur.

Sample configuration of a counting head output

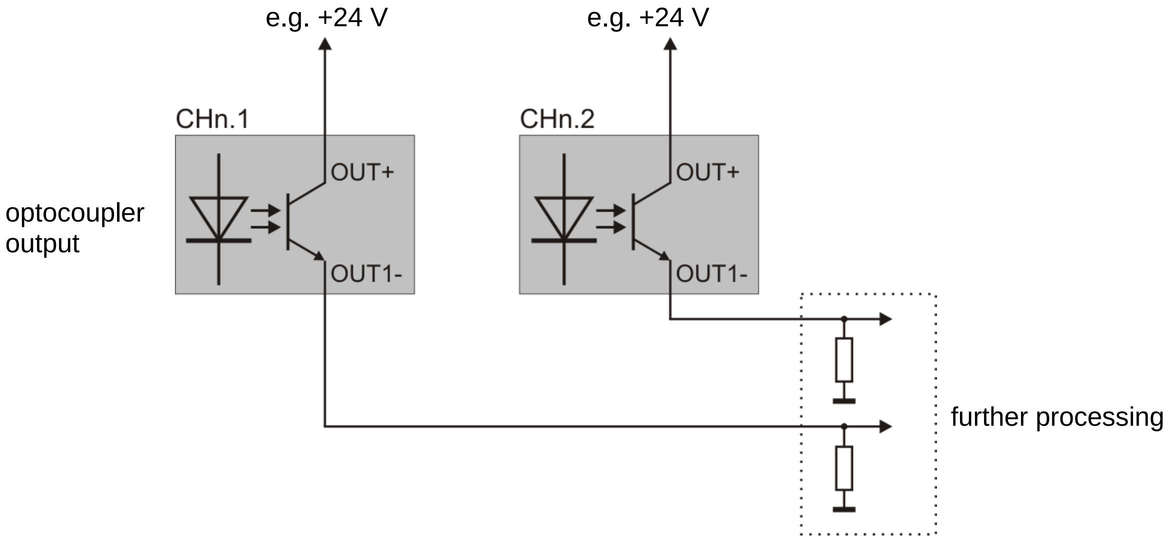


Figure 3.52: Sample configuration of a counting head output

Assignment of the indicators of the configuration word “Output of counting head outputs of the AEB via optocoupler”to the respective connectors on the BP-PWR and/or the BP-EXB:

“X101” to “X801” (BP-PWR) and/or “X101” (BP-EXB)		Indicator in the configuration word
CHn.1 (n = 1 – 8)	OUT +	
	OUT1 -	ZP-OUT1_O
	OUT2 -	ZP-OUT2_O
CHn.2 (n = 1 – 8)	OUT +	
	OUT1 -	ZP-OUT3_O
	OUT2 -	ZP-OUT4_O

Table 3.9: Assignment of the counting head outputs

For CHn.1 OUT2 - and CHn.2 OUT2 - the figure “Sample configuration of a counting head output” can be considered analogously.

If the wheel sensor is connected correctly to the interface “wheel sensor” (“X102” to “X802”, dependant on the number of wheel sensors) and a traversing takes place at this wheel sensor, the voltage that is applied to OUT + (e.g. 24 V) is output at OUT1 -.
For further processing, e.g. an SPS can be connected.

3.5.2.1 Direction outputs (counting head outputs of the AEB)

By means of the two sensor systems of the wheel sensor, the direction of a traversing can be determined. By configuring the counting head outputs as direction outputs, this information regarding the traversing can be output.

A distinction is made between 4-edges direction pulse and 1-edge direction pulse. The 4-edges direction pulse is typically used for applications, where information about the travel direction is needed. The 1-edge direction pulse is typically needed for wheel detection, i.e. to determine whether or not a wheel traverses a wheel sensor.

The duration of the output of a direction pulse at the counting head outputs can be configured in the entry “DIR_LENGTH” (default = 500 ms) of the configuration word “Parameters switching outputs”.

The normal status of the direction outputs is present under the following conditions:

- wheel sensor mounted correctly
- wheel sensor or AEB adjusted correctly
- no occupancy of the wheel sensor
- no error

SAB FAdC100_166:

If the direction pulses are output at the switching outputs, it must be checked if the delayed output of the direction detection of a maximum of 32 ms has impacts on the safe operation.

SAB FAdC100_155:

The safety system must be able to safely process the output of the direction information within the time $t_{\text{DIRECTION EXTENSION}}$.

1-edge direction pulse

An output of the 1-edge direction pulse with direction 1 takes place at the beginning of a traversing, where sensor system 1 is traversed first, and then sensor system 2 is traversed. An output of the 1-edge direction pulse with direction 2 takes place at the beginning of a traversing, where sensor system 2 is traversed first and then sensor system 1 is traversed. If the normal status is configured with “closed”, the 1-edge direction pulse is also output in case an error occurs.

A failsafe output of the direction pulses according to SIL 4 takes place if the normal status of the output is closed in case of 1-edge direction pulse (see configuration words “Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB” and “Output of counting head outputs of the AEB via optocoupler”).

SAB FAdC100_180:

In case of safety-relevant applications of the 1-edge direction pulse, the 1-edge direction pulse must be output as follows and evaluated by the safety system:

- at least at 2 counting head outputs
  - connector “Xn01” on the BP-PWR:
    1 output from CHn.1 and 1 output from CHn.2
  - connector “X101” on the BP-EXB:
    1 output from CH1.1 and 1 output from CH1.2
- or 1 switching output (4 contacts)

SAB FAdC100_181:

In case of safety-relevant applications of the 1-edge direction pulse, the normal status of both outputs must be configured with “closed”.

SAB FAdC100_164:

When using the 1-edge direction pulse, the wheel sensor must be traversed error-free with more than 12 axles within the cycle of traversing.

SAB FAdC100_163:

When using the 1-edge direction pulse, the safety system must enter and keep the failsafe status in case the 1-edge direction pulse is output (output open).

SAB FAdC100_190:

In safety-relevant applications, the (untimely) output of the 1-edge direction pulse must not lead to a dangerous status due to following faults:

- wire break
- overcurrent
- wire short-circuit
- harmonics
- simultaneous system occupancy
- simultaneous change of both systems in the clear status
- permanent system occupancies
- non-countable signal models
- defective sensor system

4-edges direction pulse

An output of the 4-edges direction pulse with direction 1 takes place at the end of a correct traversing, where sensor system 1 is traversed first, and then sensor system 2 is traversed. An output of the 4-edges direction pulse with direction 2 takes place at the end of a correct traversing, where sensor system 2 is traversed first, and then sensor system 1 is traversed. If the normal status is configured with “open”, the 4-edges direction pulse is not output in case an error occurs (e.g. wire break, overcurrent).

A failsafe output of the direction pulses according to SIL 4 takes place if the normal status of the output is open in case of 4-edges direction pulse (see configuration words “Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB” and “Output of counting head outputs of the AEB via optocoupler”).

SAB FAdC100_182:

In case of safety-relevant applications of the 4-edges direction pulse, the 4-edges direction pulse must be output as follows and evaluated by the safety system:

- at least at 2 counting head outputs
  - connector “Xn01” on the BP-PWR:
    1 output from CHn.1 and 1 output from CHn.2
  - connector “X101” on the BP-EXB:
    1 output from CH1.1 and 1 output from CH1.2
- or 1 switching output (4 contacts)

SAB FAdC100_183:

In case of safety-relevant applications of the 4-edges direction pulse, the normal status of both outputs must be configured with “open”.

SAB FAdC100_165:

In safety-relevant applications, the absence of the 4-edges direction pulse must not lead to a dangerous status due to following faults:

- wire break
- overcurrent
- wire short-circuit
- harmonics
- simultaneous system occupancy
- simultaneous change of both systems in the clear status
- permanent system occupancies
- non-countable signal models
- defective sensor system

3.5.2.2 System outputs (counting head outputs of the AEB)

By the configuration of the counting head outputs as system outputs, information regarding the status of the sensor systems (damped, not damped or faulty) can be output.

In order to failsafe output every occupancy and/or every failure of a sensor system according to SIL 4, the system outputs must be closed in normal status (see configuration words “Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB” and “Output of counting head outputs of the AEB via optocoupler”).

To differ between occupancy and fault, for each system pulse (system 1 and system 2) an additional output can be configured, which is open in normal status.

The output of a system pulse takes places for the duration of the actual occupancy of the sensor system. The extension of this output can be configured in the entry “SYS_EXT” (default = 500 ms) of the configuration word “Parameters switching outputs”.

The normal status of the system outputs is present under following conditions:

- wheel sensor mounted correctly
- wheel sensor or AEB adjusted correctly
- no occupancy of the wheel sensor
- no error

SAB FAdC100_184:

In case of safety-relevant applications of the system pulses, both system pulses (system 1 and system 2) must be output as follows and evaluated by the safety system:

- at least at 2 counting head outputs
  - connector “Xn01” on the BP-PWR:
    1 output from CHn.1 and 1 output from CHn.2
  - connector “X101” on the BP-EXB:
    1 output from CH1.1 and 1 output from CH1.2

SAB FAdC100_185:

In case of safety-relevant applications of the system pulses, the normal status of both outputs for the system pulses must be configured with “closed”.

SAB FAdC100_204:

In case of safety-relevant applications of the system pulses a system pulse (system 1 or system 2) must be output on a switching output (4 contacts) and must be evaluated by the safety system.

SAB FAdC100_159:

When evaluating the system pulses, the safety system must enter and keep the failsafe status in case of a system pulse (output open).

SAB FAdC100_160:

In case of a direction-related evaluation of the system pulses, the safety system must change into the failsafe status if one of the following situations occur:

- a permanent occupancy of one system
- a simultaneous occupancy of both systems or
- a missing overlap of the system pulses when traversing a wheel sensor

SAB FAdC100_161:

In case the system pulses are output on the switching outputs, it must be checked if the delayed output of the occupied indication of a maximum of 32 ms has impact on the safe operation.

SAB FAdC100_156:

The safety system must be able to safely process the output of the system pulses within the time $t_{OCCUPANCY}$ (duration of system occupancy)+ $t_{SYSTEM\ EXTENSION}$.

SAB FAdC100_162:

In order to receive a countable signal of the system pulses, the axle distance a_a must comply with the following minimum dimensions:

$a_{a\ min} > v_{max} * (t_{SYSTEM\ EXTENSION} + 1\ ms) / 3{,}6 + 0{,}2 * d + 370\ mm$

$a_{a\ min}$: minimum axle distance in mm
d: wheel diameter in mm
v_{max}: maximum speed of vehicle in km/h

3.5.3 Switching inputs of the IO-EXB

Dependent on the configuration, the switching inputs of the IO-EXB can be used as follows:

- reset inputs (see chapter “Reset inputs”)
- Counting Head Control inputs (see chapter “Counting Head Control inputs”)
- digital inputs for data transmission (see chapter “Digital inputs for data transmission”)

Input voltage for status low:	0 to +4 V DC
Input voltage for status high:	+12 to +72 V DC
Maximum input current high:	1 mA at 19 to 72 V DC
Maximum permitted insulation voltages to adjacent interfaces:	see chapter “Insulating distanc-es between the interfaces”
Maximum current in case of reverse polarity or defect of switching input:	3 mA at 72 V DC

Table 3.10: Limit values of the switching inputs of the IO-EXB

The switching inputs are protected against reverse polarity and interference voltages according to EN 50124-1 and have an internal circuit for current limitation.

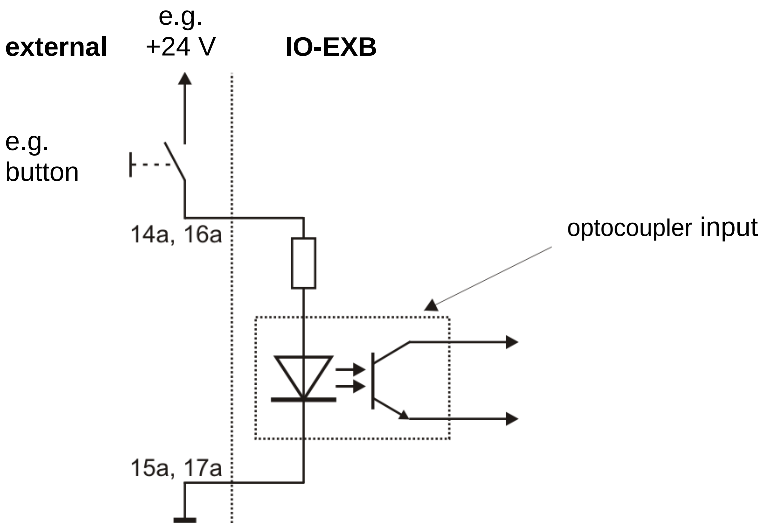


Figure 3.53: Sample configuration of a basic circuit for an optocoupler input, e.g. the interface “reset inputs”

SAB FAdC100_22:

The maximum input voltage on the switching inputs must not exceed 72 V DC.

SAB FAdC100_157:

When using the IO-EXB for the transmission of logical statuses (high/low) or switching statuses (on/off), the statuses must apply for at least 30 ms.

At an input voltage of 72 V, a maximum input current of 1 mA flows.

If the inputs of the IO-EXB are used as reset inputs, then for each reset input the following inputs must be used in common:

- BEHAV_INPUT1_A and BEHAV_INPUT1_B
- BEHAV_INPUT2_A and BEHAV_INPUT2_B
- BEHAV_INPUT3_A and BEHAV_INPUT3_B
- BEHAV_INPUT1_A‘ and BEHAV_INPUT1_B‘
- BEHAV_INPUT2_A‘ and BEHAV_INPUT2_B‘
- BEHAV_INPUT3_A‘ and BEHAV_INPUT3_B‘

3.5.3.1 Reset inputs

The following 7 reset types can be configured (see configuration word “Reset axle counting via IO-EXB”):

Reset type	Description
direct reset	The direct reset is always carried out and does not depend on the last axle (last axle counted in or last axle counted out).
restricted reset	The restricted reset is only carried out in the status “last axle counted out”.
preparatory direct reset	The preparatory direct reset is carried out independently from the last axle (last axle counted in or last axle counted out). The track section (FMA) only enters the status “clear”, if a correct traversing with a train (clearing of track) has occurred.
preparatory restricted reset	The preparatory restricted reset is only carried out in the status “last axle counted out”. The track section (FMA) only enters the status “clear”, if a correct traversing with a train (clearing of track) has occurred.
auxiliary reset	The status of the track section (FMA) is set from “last axle counted in” to “last axle counted out”.
pre-Reset	This reset type ensures the compatibility with the system FAdC R1. The configuration is carried out in the configuration word “Options for a track section (FMA)” with the entries “RESET_IN” and “RESET_OUT”.
Reset	This reset type ensures the compatibility with the system FAdC R1. The configuration is carried out in the configuration word “Options for a track section (FMA)” with the entries “RESET_IN” and “RESET_OUT”.

Table 3.11: Configurable reset types

A reset of the system can be carried out as follows:

- by actuation of the toggle switches on the front panel of the AEB (see chapter “Reset operation with the toggle switches on the front panel of the AEB”),
- by actuation of the toggle switches on the front panel of the IO-EXB (see chapter “Reset operation with the toggle switches on the front panel of the IO-EXB”),
- by triggering the IO-EXB inputs with the designation “Input” on the rear side of the BP-EXB),
- or by software interface.

To request a reset by triggering the IO-EXB inputs, the following actuation sequence must be complied with:

1. Apply signal “high” at input 1 and input 2 simultaneously within the configured reset operation time ($T_{RESET\_OP\_TIME}$).
2. Signal “high” must apply at input 1 and input 2 at least for the duration of the configured reset operation time ($T_{RESET\_OP\_TIME}$).
3. Apply signal “low” at input 1 and input 2 simultaneously within the configured reset operation time ($T_{RESET\_OP\_TIME}$).

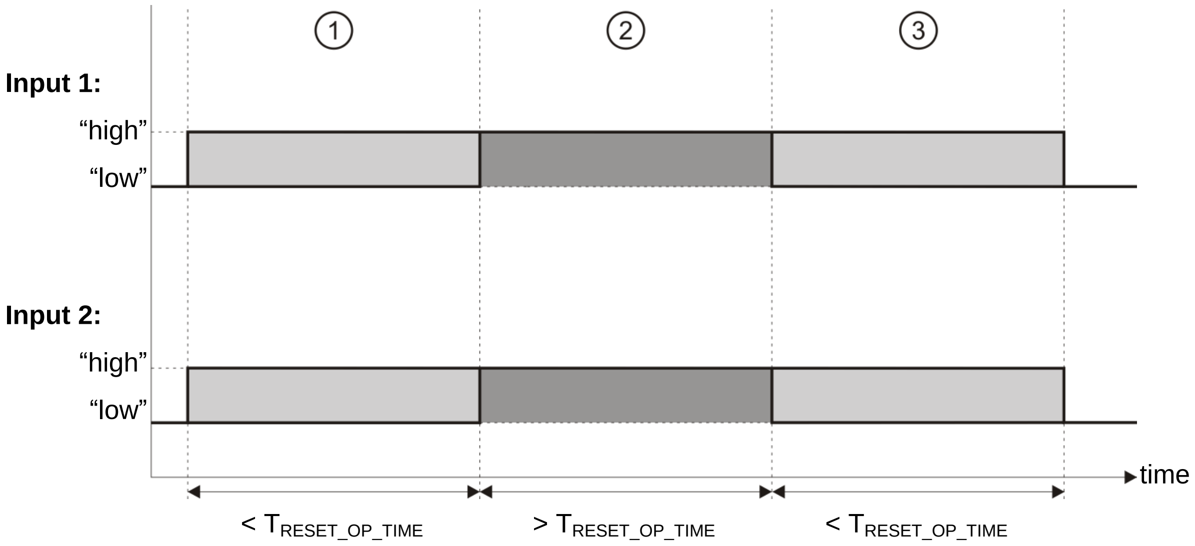


Figure 3.54: Switching times for reset inputs

The reset operation time can be configured in the configuration word “Parameters reset”, entry “RESET_OP_TIME”.

The duration of the actuation sequence (1) to (3) must not exceed 30 s. If the actuation sequence takes longer than 30 s, then the reset is rejected and the actuation sequence (1) to (3) must be started again from the beginning.

3.5.3.2 Counting Head Control inputs

With the Counting Head Control, the counting head remains in full working order and activated, however, no occupied indication is output in the event of an untimely occupancy. This increases the availability, as no faults result e.g. because of maintenance work (metal of tools temporarily above a wheel sensor). The principle of Counting Head Control is that individual connected counting heads are only desensitised as long as all adjacent track sections (FMA) indicate “clear”. If an adjacent track section (FMA) changes to the status “occupied” or “faulty”, the connected counting head is sensitised. It must be observed that in case of a fault or several configurable axles traversing the wheel sensor, the evaluation board changes the status (track section (FMA) and/or evaluation board changes into the occupied or the fault status) despite of an active Counting Head Control.

The required operational measures, which may be necessary, are to be defined according to the specifications from the respective rail operator.

If the Counting Head Control is triggered via the inputs of the IO-EXB (see configuration word “Reset axle counting via IO-EXB”, entry “BEHAV_INPUT3”), then a time of at least 232 ms is necessary for a change of status from “high” to “low” or from “low” to “high”.
This time is composed as follows:

- 100 ms bounce time
- 100 ms filtering time (minimum duration to recognise the status “high” or “low”)
- 32 ms processing time of the IO-EXB

Further information can be taken from the documentation D4183 “Design and application of Counting Head Control for axle counting system FAdC® R2”.

SAB FAdC100_140:

When the function Counting Head Control is used, then all adjacent track sections (FMA) must be used for the desensitisation of the counting head.

SAB FAdC100_129:

For all track sections (FMA), which are adjacent to the desensitised counting head it must be checked if the desensitised counting head is sensitised, as soon as one of these adjacent track sections (FMA) changes in the occupied status.

If the counting head is sensitised, can be checked via a traversing with a rail vehicle, by means of the testing plate or via counting in and out by means of toggle switches.

SAB FAdC100_97:

If the function Counting Head Control is used, then one of the following conditions must be proven:

- A traversing with rail vehicles over the desensitised counting head can be excluded.
- Every rail vehicle, which traverses the counting head, has more axles than the configured number of system occupancies (entry “SYSTEM_COUNT” of the configuration word “Parameters counting head and FMA”).
- Despite the fact that a rail vehicle is in a track section (FMA) that is indicated as “clear”, the hazard resulting from this can be tolerated.

SAB FAdC100_98:

If the IO-EXB is used as a Counting Head Control input, then 4 inputs (14b - 21b [IN2A - IN2D]) must be used and interconnected together in parallel.

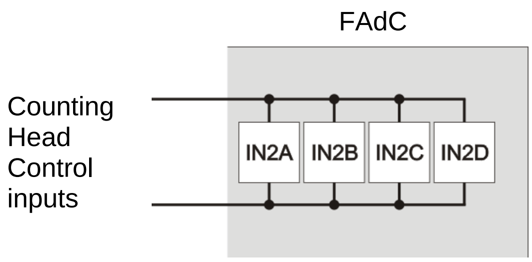


Figure 3.55: Counting Head Control inputs of the IO-EXB

3.5.3.3 Digital inputs for data transmission

If the IO-EXB is used for data transmission, the digital inputs of the IO-EXB can be used to read in up to 24 digital arguments (data bits) per AEB. These read in data are sent by the AEB via the CAN bus. Depending on the configuration, up to 12 digital inputs per IO-EXB are available for data transmission.

The switching times of this interface are shown in the following figures:

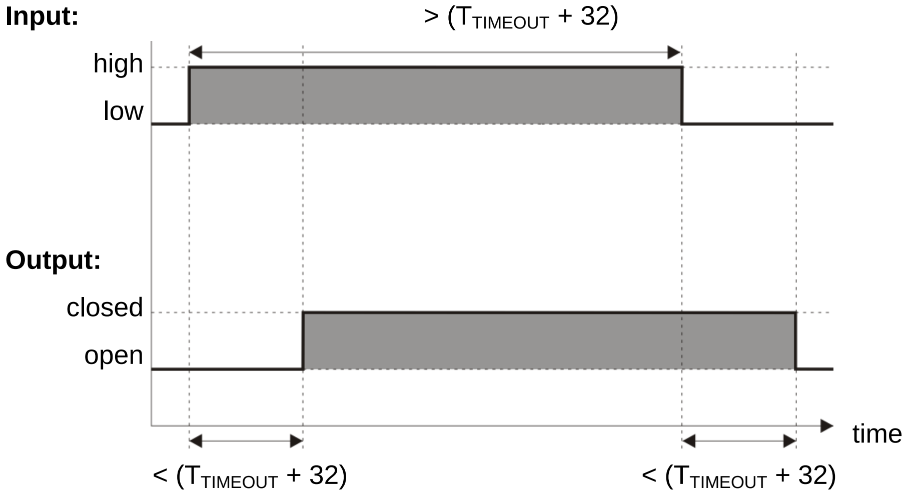


Figure 3.56: Switching times of the interface digital inputs for data transmission, time data in ms

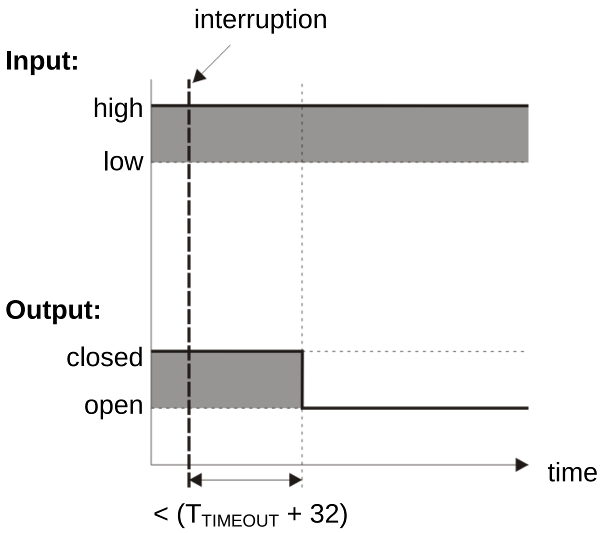


Figure 3.57: Switching times of the interface digital inputs if the data transmission is interrupted, time data in ms

The switching time $T_{TIMEOUT}$ is described in the chapter “Delay periods and time-out of the FAdC”.

The inputs can be configured as QUAD, DUAL or SINGLE inputs (see chapter “Pin assignment of the interface ‘EXB1’ to ‘EXB8’ (data transmission)”):

QUAD input

In a QUAD input configuration, a single input argument is multiply read in using 4 physically separated inputs and thereby according to the safety level SIL 4. The inputs A, B, C and D of IN1, IN2 or IN3 must be used (e.g. IN1A, IN1B, IN1C and IN1D). The configuration as a QUAD input is used for vital data transmission without external monitoring. For this, 4 physical inputs must be connected in such a way, so that they can receive similar signals. Hence, this results in 3 logical inputs and at each of them 1 data bit of the AEB can be read in.

DUAL input

In a DUAL input configuration, a single input argument is multiply read in using 2 physically separated inputs and thereby according to the safety level SIL 4. The inputs A and B or C and D of IN1, IN2 or IN3 must be used (e.g. IN1A and IN1B or e.g. IN2C and IN2D). The configuration as a DUAL input is also used for vital data transmission, however with external monitoring. For this, 2 physical inputs must be connected in such a way, so that they can receive similar signals. Hence, this results in 6 logical inputs and at each of them 1 data bit of the AEB can be read in.

SINGLE input

The configuration as SINGLE input is used for a non-vital data transmission (see following figure). There are 12 inputs available at which 1 data bit each of the AEB can be read in.

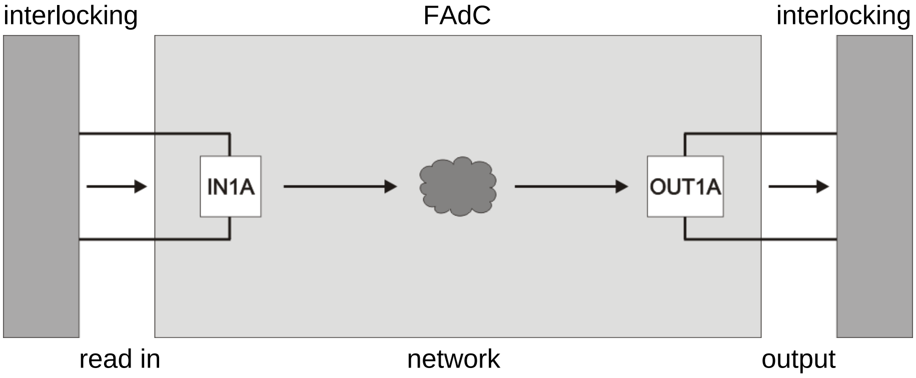


Figure 3.58: Connection of a SINGLE input (here: IN1A) with a SINGLE output (here: OUT1A)

SAB FAdC100_39:

In case of safety-relevant applications in the range of SIL 4

- 4 inputs of the IO-EXB must be triggered similarly (QUAD) and
- 4 outputs of the IO-EXB must be evaluated similarly (QUAD)
  (For improvement of the failure detection, an external comparator can compare the respective 2 and 2 outputs with each other.)

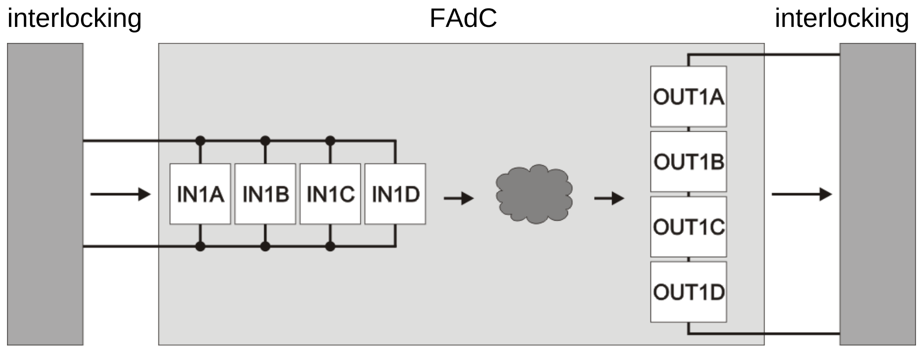


Figure 3.59: Connection of a QUAD input (here: IN1A, IN1B, IN1C, IN1D) with a QUAD output (here: OUT1A, OUT1B, OUT1C, OUT1D)

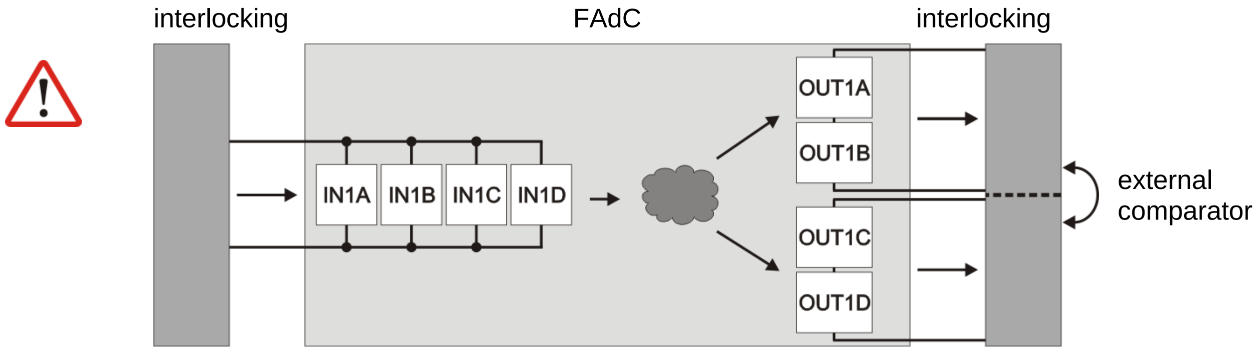


Figure 3.60: Connection of a QUAD input (here: IN1A, IN1B, IN1C, IN1D) with 2 DUAL outputs (here: OUT1A and OUT1B and OUT1C and OUT1D)

OR

- 2 inputs of the IO-EXB must be triggered similarly (DUAL) and
- 2 outputs of the IO-EXB must be evaluated similarly (DUAL) and
- the 2 outputs must be compared by an external channel comparator and
- the 2 inputs and the 2 outputs must be checked for their functionality within the maintenance cycle (2 years).

Following switching statuses must be applied on both used inputs:
high-high, low-high, high-low, low-low.
This guarantees that each of both inputs works correctly.

At each output of both used outputs, it must be checked if it can enter the failsafe status (low status).

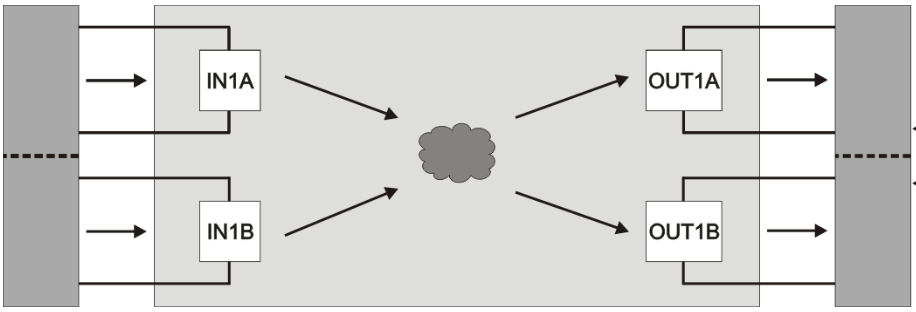


Figure 3.61: Connection of a DUAL input (here: IN1A, IN1B) with a DUAL output (here: OUT1A, OUT1B)

SAB FAdC100_205:

When combining the inputs and outputs it must be observed that only following combinations are allowed:

QUAD:

- IN1A and IN1B and IN1C and IN1D or
  IN2A and IN2B and IN2C and IN2D or
  IN3A and IN3B and IN3C and IN3D
- OUT1A and OUT1B and OUT1C and OUT1D or
  OUT2A and OUT2B and OUT2C and OUT2D or
  OUT3A and OUT3B and OUT3C and OUT3D

DUAL:

- IN1A and IN1B or
  IN1C and IN1D or
  IN2A and IN2B or
  IN2C and IN2D or
  IN3A and IN3B or
  IN3C and IN3D
- OUT1A and OUT1B or
  OUT1C and OUT1D or
  OUT2A and OUT2B or
  OUT2C and OUT2D or
  OUT3A and OUT3B or
  OUT3C and OUT3D

SAB FAdC100_38:

When using the IO-EXB for data transmission, it must be checked if the delayed output of the failsafe status (low) no later than
30 ms + transmission time (configured time-out of the AEB and of the COM) + 32 ms has impact on the safe operation.

Dependent on the configuration of the inputs and/or outputs (QUAD, DUAL, SINGLE), the 24 digital arguments of the AEB which can be read in via the digital inputs and/or output via the digital outputs are divided as follows:

<table>
<tr><th rowspan="2">Arguments of the AEB (Bits)</th><th colspan="3">Number of IO-EXB boards</th></tr>
<tr><th>QUAD</th><th>DUAL</th><th>SINGLE</th></tr>
<tr><td>0</td><td rowspan="3">1</td><td rowspan="6">1</td><td rowspan="12">1</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="3">2</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td><td rowspan="3">3</td><td rowspan="6">2</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td rowspan="3">4</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td><td rowspan="3">5</td><td rowspan="6">3</td><td rowspan="12">2</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td rowspan="3">6</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td><td rowspan="3">7</td><td rowspan="6">4</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td rowspan="3">8</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
</table>

Table 3.12: Division of the digital arguments of the AEB

<table>
<tr><th>Arguments of the AEB (Bits)</th><th>Number of IO-EXB boards</th></tr>
<tr><td>0</td><td rowspan="3">1st IO-EXB: QUAD</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="12">2nd IO-EXB: SINGLE</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td rowspan="6">3rd IO-EXB: DUAL</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td rowspan="3">4th IO-EXB: QUAD</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
</table>

Table 3.13: Example of a division of the digital arguments of the AEB

According to this division, the number of IO-EXB boards used for data transmission must also be selected.

If the positioning of the arguments is carried out automatically or not automatically (manually), can be configured in the configuration word “Input/output data transmission”.

3.5.4 Switching outputs of the IO-EXB

Dependent on the configuration, the switching outputs of the IO-EXB can perform the following functionalities:

Axle counting output
- clear/occupied output (see chapter “Clear/occupied output”)
- output of the auxiliary outputs (see chapter “Auxiliary outputs”)

Data transmission
- output of data transmission (see chapter “Digital outputs for data transmission”)

Counting head output
- output of the direction outputs or of the system outputs (dependent on configuration, see chapter “Direction outputs (switching outputs of the IO-EXB)” and/or “System outputs (switching outputs of the IO-EXB)”)

Maximum switching voltage:	110 V DC, 120 V AC
Minimum switching load:	1 mA at 5 V DC[3]
Maximum switching current:	dependent on the maximum switching voltage: 50 mA (inductive) at 110 V DC
Maximum permitted switching frequency:	see SAB FAdC100_20
Maximum permitted insulation voltages to adjacent interfaces:	see chapter “Insulating distances between the interfaces”

Table 3.14: Basic conditions of the switching outputs of the IO-EXB

In case of information is output on several outputs, it must be considered that the outputs can take up different statuses for a time of 10 ms.

3 The specifications of minimum switching load are reference values.

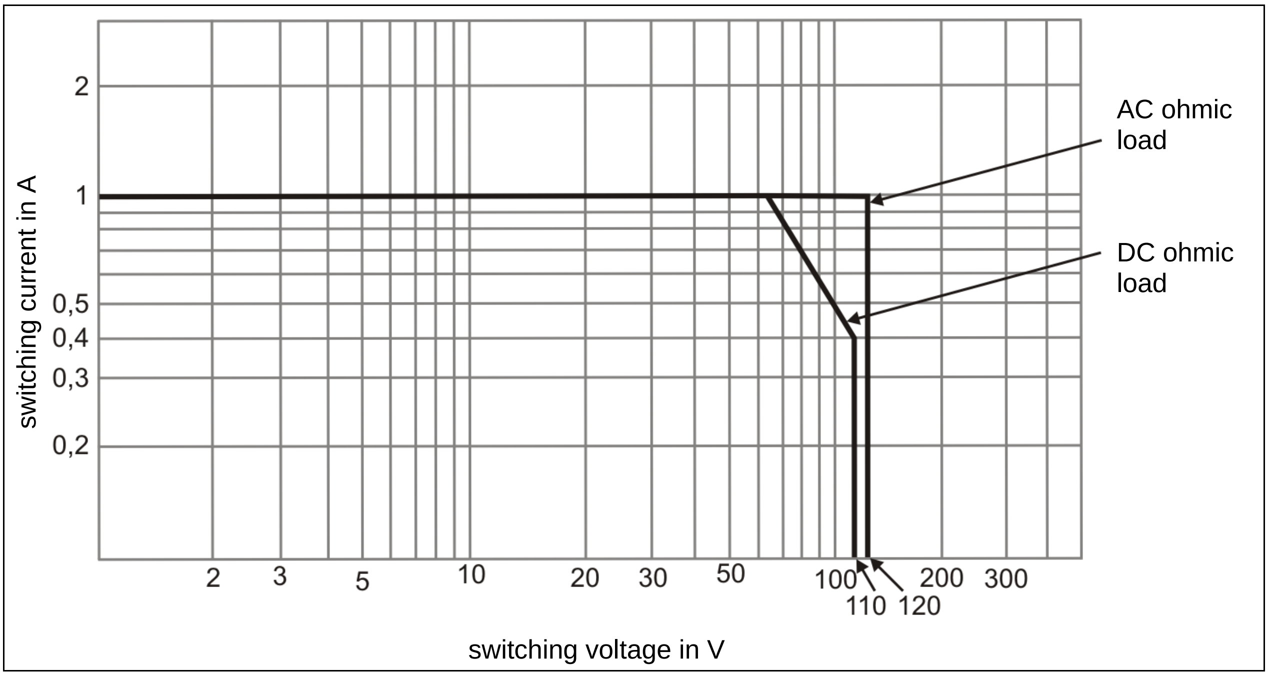


Figure 3.62: Maximum switching capacity of the switching outputs of the IO-EXB

There is no internal wiring of the relay outputs with spark suppression elements. If triggering inductive loads via relay outputs of the IO-EXB, appropriate measures must be taken to carry out the spark suppression on the load. Appropriate measures can be taken from the following figure.

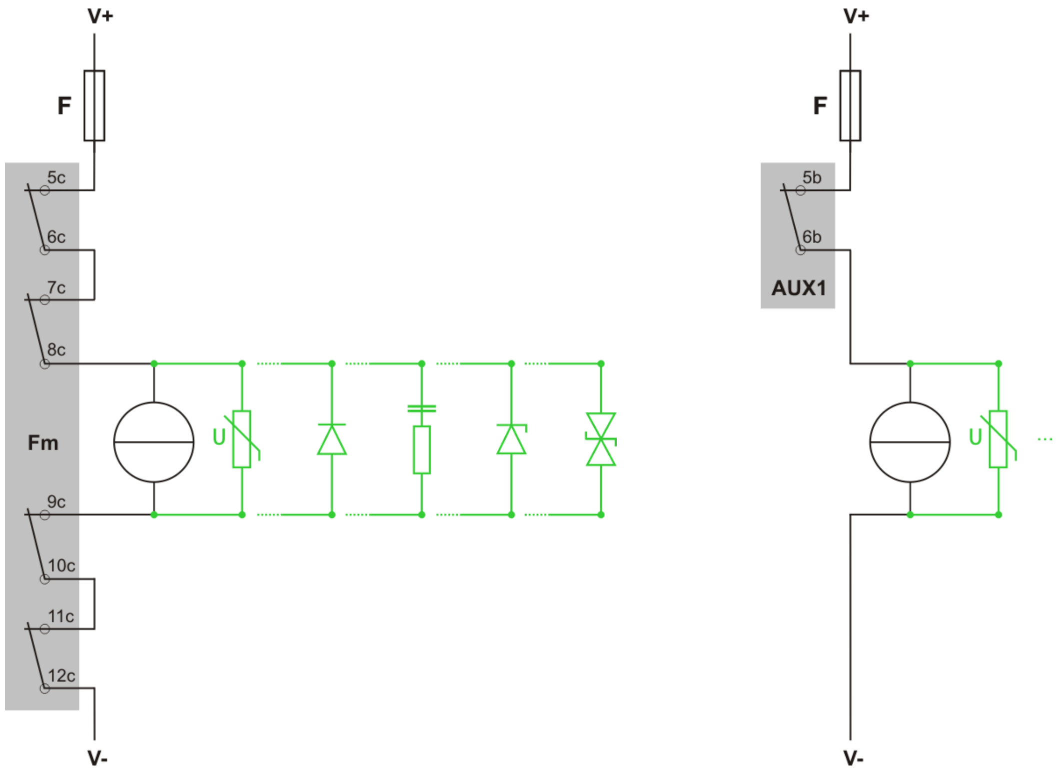


Figure 3.63: Different possibilities for the spark suppression at the load

SAB FAdC100_19:

In case of open switching outputs of the IO-EXB, the safety system must enter the failsafe status.

SAB FAdC100_20:

Dependent on switching voltage and switching current, the following switching cycles can be reached:

Switching voltage	Switching current (ohmic/inductive)	Number of switching cycles	Years (with 240 switching cycles/day)
24 V DC	150 mA	$1{,}5 \times 10^6$	approx. 17 years
60 V DC	100 mA	$0{,}75 \times 10^6$	approx. 8,5 years
110 V DC	50 mA	2×10^6	approx. 22 years

Table 3.15: Switching cycles dependent on switching voltage and switching current

The minimum switching current is 1 mA at 5 V DC.

If output information is output on 2 outputs, then it must be observed that only the following combinations are allowed:

- OUT2A and OUT2B
- OUT2C and OUT2D

OUT1 and OUT3 are reserved for the 2 track sections (FMA).

The downstream system must process the statuses of the outputs of the IO-EXB of the system FAdC in such a way that in case of open and/or currentless status, a failsafe status is entered.

3.5.4.1 Clear/occupied output

The information about the status (clear/occupied) of the track section (FMA) is output by 4 voltage-free relay contacts at the outputs of the IO-EXB for further processing. There are an “Fm” output (failsafe clear indication) and an “Occ” output (occupied indication) available.

Per half of the IO-EXB one output is available, which can be configured as clear and/or occupied output (see configuration word “Output axle counting via IO-EXB”). Dependent on the number of the track sections (FMA) to be output on one IO-EXB, either one output or both outputs can be used.
If only 1 track section (FMA) is output per IO-EXB, the “Fm” contact **and** the “Occ” contact can be used.
If 2 track sections (FMA) are output per IO-EXB, **either** the “Fm” contact **or** the “Occ” contact can be used.

For failsafe processing according to SIL 4, the 4 “Fm” contacts must be connected in series.

The safety integrity level SIL 4 can be achieved only if the “Fm” output is used or if the “Occ” output is used **in combination** with the “Fm” output.

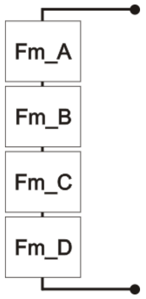


Figure 3.64: “Fm” output (serial connection of the 4 “Fm” contacts)

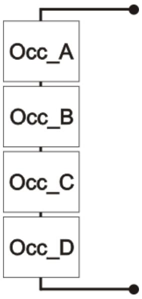


Figure 3.65: “Occ” output (serial connection of the 4 “Occ” contacts)

The “Fm” and “Occ” outputs of the interface “clear/occupied output” behave as shown in the following figure and described in the following table. The track section (FMA) must be physically occupied at least for the time $T_{TIMEOUT}$ + T_{OCC_DELAY} by a rail vehicle (see chapter “Minimum length of a track section (FMA)”). The switching times $T_{TIMEOUT}$, T_{OCC_DELAY} and T_{OCC_EXT} can be configured (see configuration word “Time-out FAdC”, entry “TIMEOUT_VALUE” and configuration word “Occupied status extension and occupied status delay”, entries “OCC_DELAY” and “OCC_EXT”).

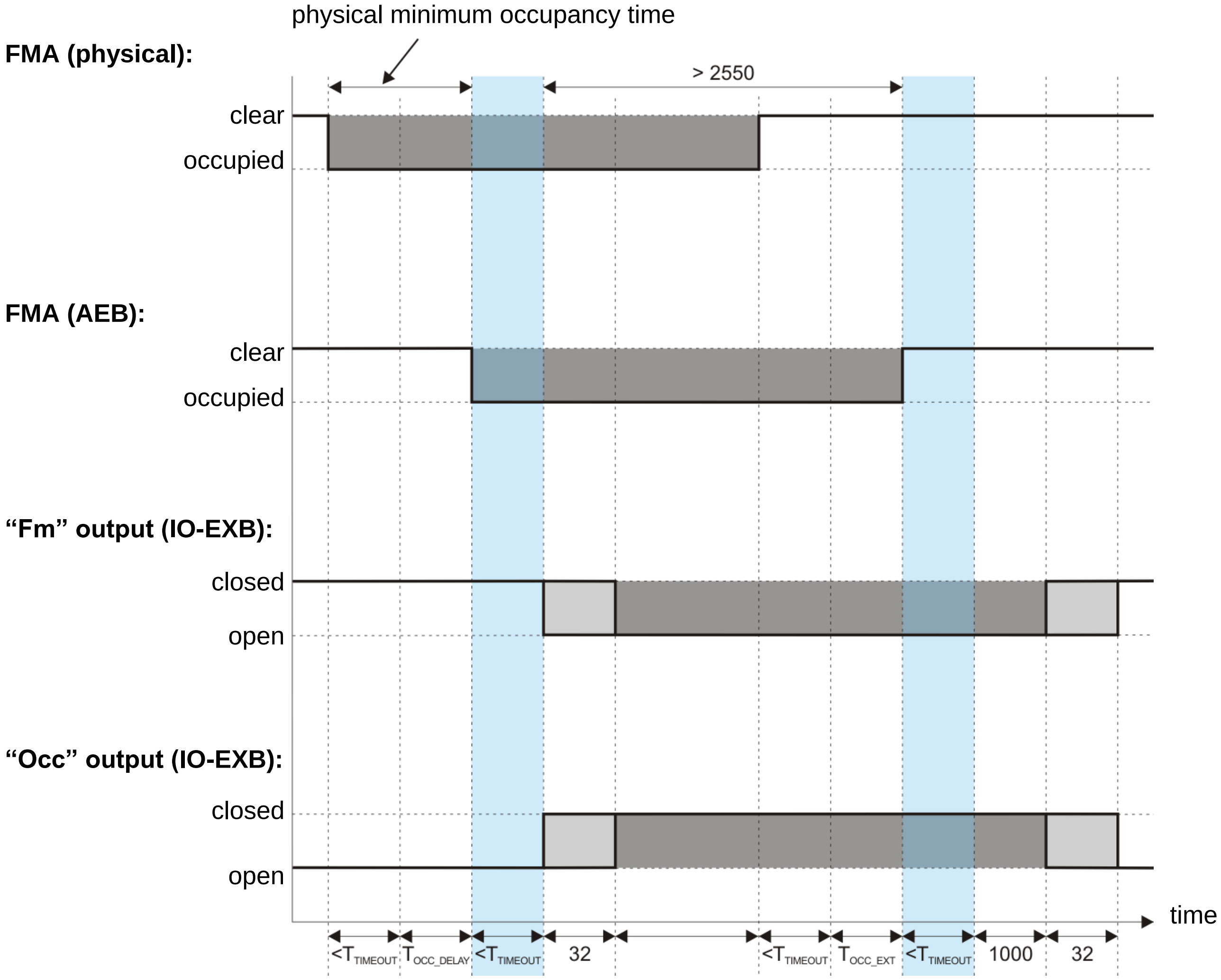


Figure 3.66: Switching behaviour of the IO-EXB-outputs “Fm” and “Occ”, time data in ms

The first time depicted in the figure, $T_{TIMEOUT}$, is valid for the counting head information of the AEB and is determined in the configuration word “Counting head FMA 1” and/or “Counting head FMA 2”.

The time $T_{TIMEOUT}$ highlighted in blue only occurs at detached IO-EXB boards[4]. This time $T_{TIMEOUT}$ is determined in the configuration word “Output axle counting via IO-EXB”.

Operating status	“Fm” output	“Occ” output
faulty	open	open
occupied	open	closed
clear	closed	open
inadmissible operating status	closed	closed

Table 3.16: Relay outputs of the interface “output clear/occupied”

4 A “detached” IO-EXB is an IO-EXB, which is not directly connected to that AEB, which evaluates the track section (FMA) and provides the information.

The occurrence of the operating status “faulty” can have the following causes:

- FAdC de-energised (not in operation)
- board error at the AEB, which evaluates or outputs the track section (FMA)
- wheel sensor error (e.g. wire break)
- operational error (e.g. communication error, partial traversing, negative counting, …)

SAB FAdC100_86:

If the clear indication is used in combination with automatic switching operations, then additional measures (e.g. short delay of the clear indication) must be taken to prevent a hazard due to an untimely clear indication.

SAB FAdC100_29:

In case of an occupancy of a counting head, the occupied indication of a track section (FMA) is output on the outputs of the IO-EXB no later than this time:
Occupied status delay + transmission times (configured time-outs of AEB and COM) + 32 ms
It must be checked whether the delay of the output of the occupied indication has an impact on safe operation.

SAB FAdC100_31:

For the clear indication of a track section (FMA), either 4 contacts or 2 x 2 contacts of the interface “switching outputs IO-EXB” must be connected in series and evaluated by the safety system (see following figure).

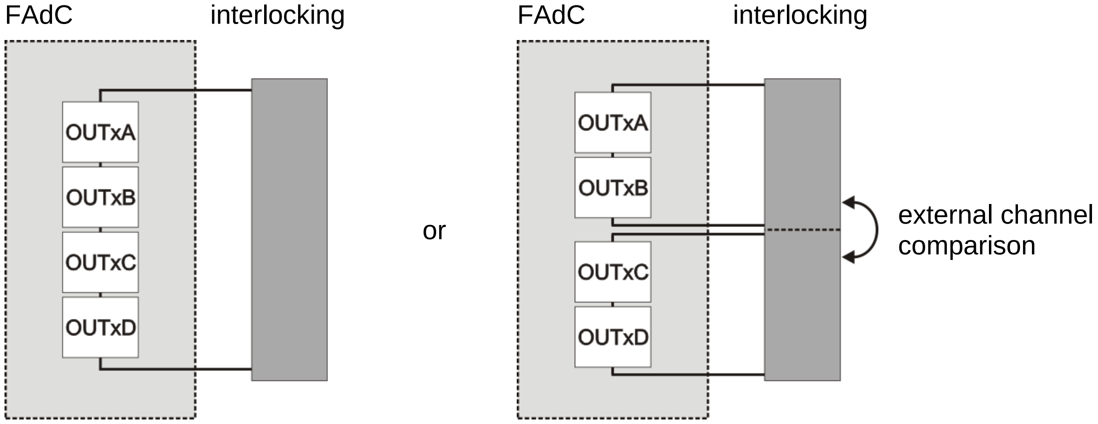


Figure 3.67: Interconnection of the “Fm” contacts

SAB FAdC100_212:

For the 4 contacts or 2 x 2 contacts of the interface “switching outputs IO-EXB” only the following contacts may be interconnected:
5c – 12c [OUT1A – OUT1D] and/or
5a – 12a [OUT3A – OUT3D]

3.5.4.2 Auxiliary outputs

For the interface “auxiliary outputs”, 2 or 4 relay outputs (dependent on the number of the track sections (FMA) to be output)[5] are available on the IO-EXB.

The information which is output on the auxiliary outputs is not safety-relevant and therefore not failsafe according to SIL 4.

Dependent on the configuration (see configuration word “Output axle counting via IO-EXB”), one of the following information (“operating statuses”) can be output on an auxiliary output:

- reset restriction
- reset ability
- error or communication error
- clearing of track or partial traversing error
- occupied status or fault
- reset accepted [6]
- reset rejected [7]

Whether the auxiliary outputs are “open” or “closed” in normal status, can also be determined in the configuration word “Output axle counting via IO-EXB”.

5 2 auxiliary outputs if the associated IO-EXB outputs 2 FMA,
4 auxiliary outputs if the associated IO-EXB outputs 1 FMA.

6 The output of this operating status is available for GS02 or higher of the AEB101.

7 The output of this operating status is available for GS02 or higher of the AEB101.

In the following example the normal status of the auxiliary output is “closed”:

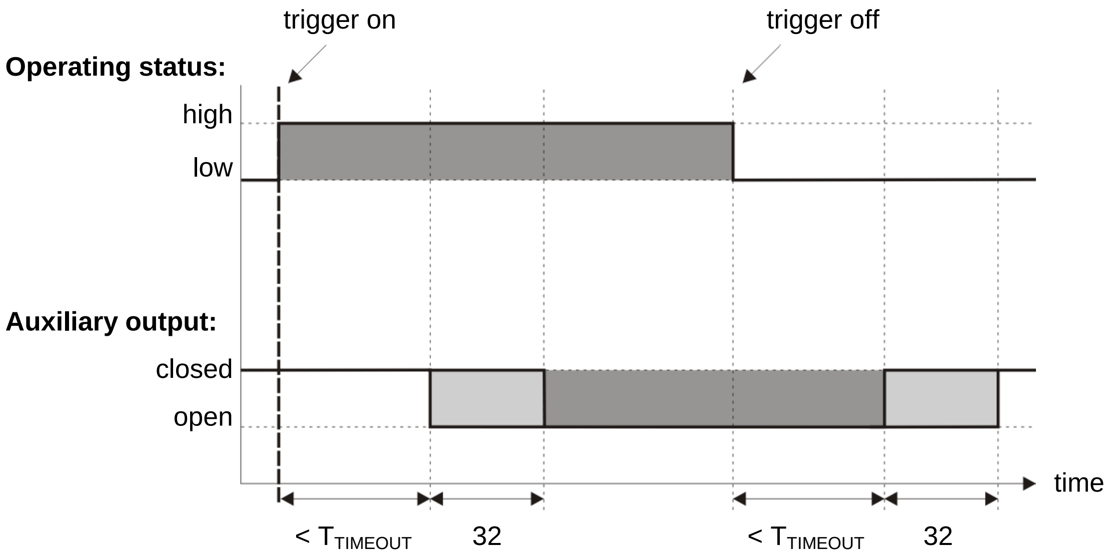


Figure 3.68: Switching behaviour of the interface “auxiliary outputs”, time data in ms

3.5.4.3 Digital outputs for data transmission

If the IO-EXB is used for data transmission, up to 24 digital arguments (data bits) can be output with the digital outputs of the IO-EXB of one or several AEB boards.

The switching times of this interface are shown in the following figures:

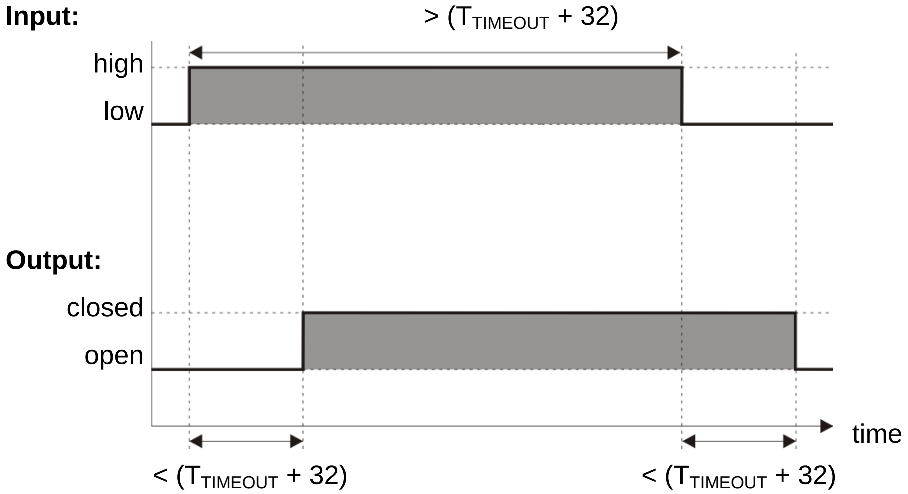


Figure 3.69: Switching times of the interface digital outputs for data transmission, time data in ms

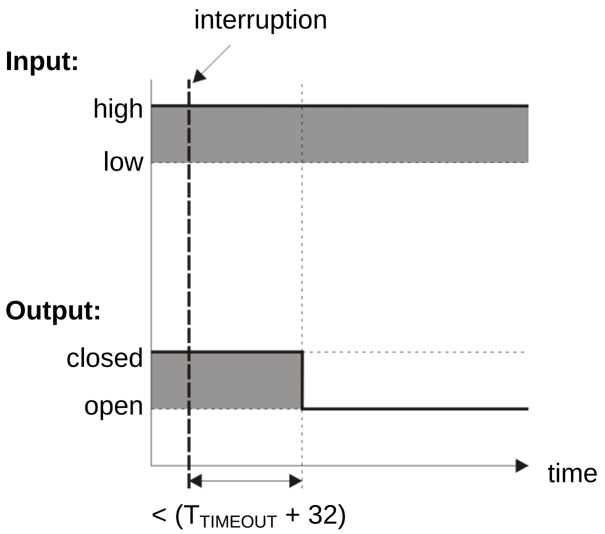


Figure 3.70: Switching times of the interface digital outputs if the data transmission is interrupted, time data in ms

The outputs can be configured as QUAD, DUAL or SINGLE outputs (see chapter “Pin assignment of the interface ‘EXB1’ to ‘EXB8’ (data transmission)”).

QUAD output

In a QUAD output configuration, a single output argument is multiply output using 4 physically separate outputs and thereby according to the safety level SIL 4. The outputs A, B, C and D of OUT1, OUT2 or OUT3 must be used (e.g. OUT1A, OUT1B, OUT1C and OUT1D). The configuration as a QUAD output is used for vital data transmission without external monitoring. For this, 4 physical outputs must be connected in such a way, so that they can receive similar signals. Hence, this results in 3 logical outputs and at each of them 1 data bit of the AEB can be output.

DUAL output

In a DUAL output configuration, a single output argument is multiply output using 2 physically separated outputs and thereby according to the safety level SIL 4. The outputs A and B or C and D of OUT1, OUT2 or OUT3 must be used (e.g. OUT1A and OUT1B or e.g. OUT2C and OUT2D). The configuration as a DUAL output is also used for vital data transmission, however with external monitoring. For this, 2 physical outputs must be connected in such a way, so that they can receive similar signals. Hence, this results in 6 logical outputs and at each of them 1 data bit of the AEB can be output.

SINGLE output

The configuration as a SINGLE output is used for a non-vital data transmission (see following figure). There are 12 outputs available at which 1 data bit each of the AEB can be output.

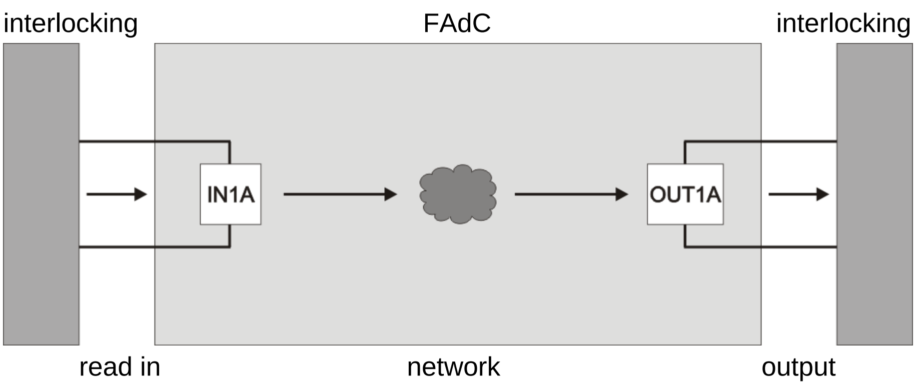


Figure 3.71: Connection of a SINGLE input (here: IN1A) with a SINGLE output (here: OUT1A)

SAB FAdC100_39:

In case of safety-relevant applications in the range of SIL 4

- 4 inputs of the IO-EXB must be triggered similarly (QUAD) and
- 4 outputs of the IO-EXB must be evaluated similarly (QUAD)
  (For improvement of the failure detection, an external comparator can compare the respective 2 and 2 outputs with each other.)

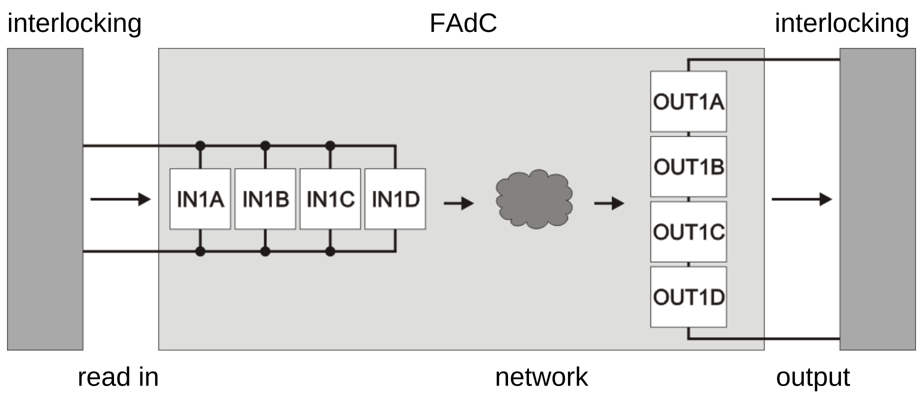


Figure 3.72: Connection of a QUAD input (here: IN1A, IN1B, IN1C, IN1D) with a QUAD output (here: OUT1A, OUT1B, OUT1C, OUT1D)

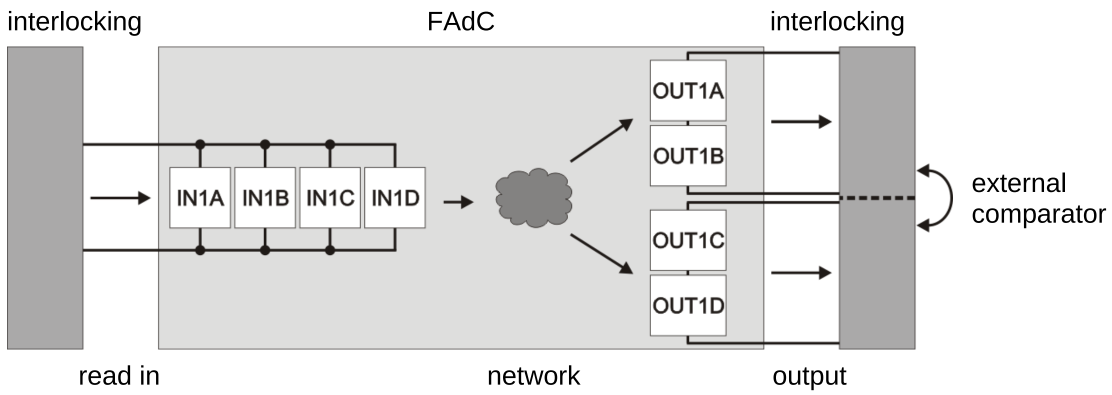


Figure 3.73: Connection of a QUAD input (here: IN1A, IN1B, IN1C, IN1D) with 2 DUAL outputs (here: OUT1A and OUT1B and OUT1C and OUT1D)

OR

- 2 inputs of the IO-EXB must be triggered similarly (DUAL) and
- 2 outputs of the IO-EXB must be evaluated similarly (DUAL) and
- the 2 outputs must be compared by an external channel comparator and
- the 2 inputs and the 2 outputs must be checked for their functionality within the maintenance cycle (2 years).

Following switching statuses must be applied on both used inputs:
high-high, low-high, high-low, low-low.
This guarantees that each of both inputs works correctly.

At each output of both used outputs, it must be checked if it can enter the failsafe status (low status).

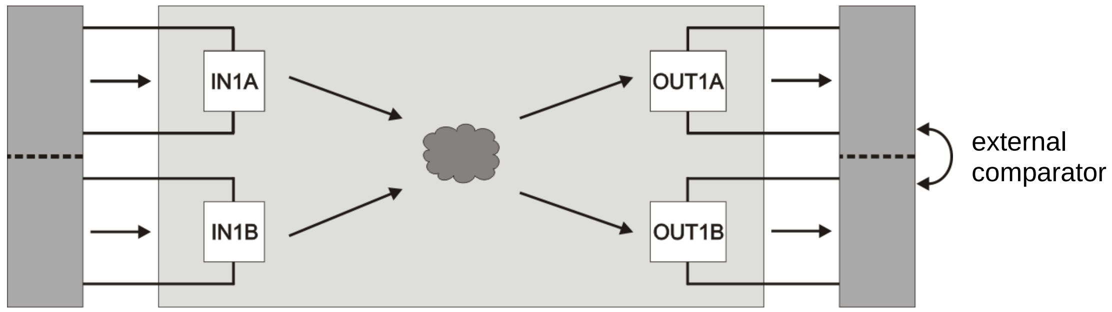


Figure 3.74: Connection of a DUAL input (here: IN1A, IN1B) with a DUAL output (here: OUT1A, OUT1B)

SAB FAdC100_205:

When combining the inputs and outputs it must be observed that only following combinations are allowed:

QUAD:

- IN1A and IN1B and IN1C and IN1D or
  IN2A and IN2B and IN2C and IN2D or
  IN3A and IN3B and IN3C and IN3D
- OUT1A and OUT1B and OUT1C and OUT1D or
  OUT2A and OUT2B and OUT2C and OUT2D or
  OUT3A and OUT3B and OUT3C and OUT3D

DUAL:

- IN1A and IN1B or
  IN1C and IN1D or
  IN2A and IN2B or
  IN2C and IN2D or
  IN3A and IN3B or
  IN3C and IN3D
- OUT1A and OUT1B or
  OUT1C and OUT1D or
  OUT2A and OUT2B or
  OUT2C and OUT2D or
  OUT3A and OUT3B or
  OUT3C and OUT3D

SAB FAdC100_38:

When using the IO-EXB for data transmission, it must be checked if the delayed output of the failsafe status (low) no later than
30 ms + transmission time (configured time-out of the AEB and of the COM) + 32 ms has impact on the safe operation.

Dependent on the configuration of the inputs and/or outputs (QUAD, DUAL, SINGLE), the 24 digital arguments of the AEB which can be read in via the digital inputs and/or output via the digital outputs are divided as follows:

<table>
<tr><th rowspan="2">Arguments of the AEB (Bits)</th><th colspan="3">Number of IO-EXB boards</th></tr>
<tr><th>QUAD</th><th>DUAL</th><th>SINGLE</th></tr>
<tr><td>0</td><td rowspan="3">1</td><td rowspan="6">1</td><td rowspan="12">1</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="3">2</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td><td rowspan="3">3</td><td rowspan="6">2</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td rowspan="3">4</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td><td rowspan="3">5</td><td rowspan="6">3</td><td rowspan="12">2</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td rowspan="3">6</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td><td rowspan="3">7</td><td rowspan="6">4</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td rowspan="3">8</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
</table>

Table 3.17: Division of the digital arguments of the AEB

<table>
<tr><th>Arguments of the AEB (Bits)</th><th>Number of IO-EXB boards</th></tr>
<tr><td>0</td><td rowspan="3">1st IO-EXB: QUAD</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="12">2nd IO-EXB: SINGLE</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td rowspan="6">3rd IO-EXB: DUAL</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td rowspan="3">4th IO-EXB: QUAD</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
</table>

Table 3.18: Example of a division of the digital arguments of the AEB

According to this division, the number of IO-EXB boards used for data transmission must also be selected.

If the positioning of the arguments is carried out automatically or not automatically (manually), can be configured in the configuration word “Input/output data transmission”.

3.5.4.4 Direction outputs (switching outputs of the IO-EXB)

Further information on the direction outputs can be taken from the chapter “Direction outputs (counting head outputs of the AEB)”.

3.5.4.5 System outputs (switching outputs of the IO-EXB)

Further information on the system outputs can be taken from the chapter “System outputs (counting head outputs of the AEB)”.

3.5.5 Communication interfaces

The system has the following communication interfaces:

- “Serial Interface” (on the front panel of AEB and COM boards)
- “CAN” (on the rear side of BP-PWR and BP-EXB)
- “Ethernet” (on the front panel of COM boards)
- “Hotlink” (on the front panel of COM boards)

3.5.5.1 Diagnostic interface “Serial Interface”

The diagnostic interface “Serial Interface” is designed as an RJ45-socket on AEB and COM boards (see chapter “Front panel elements of the AEB” and “Front panel elements of the COM”). It is used to read out diagnostic information, e.g. using ASD.

It must be observed that no Ethernet and no Hotlink cable must be connected to the diagnostic interface “Serial Interface”.

SAB FAdC100_11:

When handling the diagnostic interface “Serial Interface”, safety precautions against dangerous contact voltages must be taken. (At the diagnostic interface “Serial Interface” an interference voltage against earth can be present.)

SAB FAdC100_143:

Only Frauscher measurement and diagnostic systems (e.g. ASD) may be connected to the diagnostic interface “Serial Interface”.
(Frauscher measurement and diagnostic systems have captive characteristics of the measurement inputs with respect to galvanic separation, short-circuit immunity, external voltage immunity and ground immunity as well as an EMC test according to EN 50121-4.)

3.5.5.2 Interface “CAN”

The interface “CAN” is an internal interface via which the AEB and COM boards are connected and communicate with one another. The CAN bus is linear in design and must not exceed a total length of 20 m within a CAN segment. Per AEB plug socket on a backplane BP-PWR or BP-EXB 40 mm must be added to the length of a CAN bus.
The CAN bus is designed redundantly within the backplanes (BP-PWR and BP-EXB). For the operation of the CAN bus, the CAN interfaces of both CAN buses on the backplanes must be connected with RJ45 patch cables according to chapter “CAN bus”.

Every CAN segment must be terminated at the ends per DIP-switches according to chapter “CAN bus”.

3.5.5.3 Interface “Ethernet”

The interface “Ethernet” is designed as an RJ45-socket on the COM. It was developed according to RFC 768, RFC 791 and IEEE 802.3 and the preconditions and requirements according to these standards are complied with and/or must be complied with by the user.

When connecting the FAdC to a network or modem, the following conditions must apply amongst others:

- Ethernet 10 BASE-T or 100 BASE-TX
- UDP/IP
- IPv4
- Possibility of static IP addresses

If the DIP-switch with DIP-no. 12 on the COM circuit board[8] (see chapter “DIP-switches of the COM”) is set to “ON”, then the following settings and restrictions apply:

- The Auto MDI-X function is deactivated.
- The data transmission rate is 10 Mbit/s.
- Data is transmitted in full duplex operation.
- If the interface “Ethernet” is connected to a switch, then the connected switch must be manually set to 10 Mbit/s and full duplex operation.
- If the interface “Ethernet” is not connected to the downlink port of a network component, then a crossover cable must be used.

8 This function is available for GS02 or higher of the COM-AdC101. If a COM-AdC101 GS01 is used, then the DIP-switch with DIP-no. 12 has no function and must be set to “OFF”. For COM-xxx, see technical documentation of the respective COM-xxx.

If the DIP-switch with DIP-no. 12 is set to “OFF”, then the following settings apply:

- The Auto MDI-X function is activated.
- The data transmission rate is set automatically (10 or 100 Mbit/s).
- The data transmission mode is set automatically (full duplex or half duplex).

The FAdC was developed for networks according to category 2 of the EN 50159:210.

SAB FAdC100_16:

If for diagnostic devices that are connected to the interface “Ethernet”, an access by third parties cannot be excluded (e.g. connection to a network of category 3 of EN 50159:2010), then the input filter in the configuration word “Input filter for diagnostic data” must be set for the respective Ethernet interface of the COM board.

SAB FAdC100_43:

If the board COM-AdC is connected to a network of category 3 (according to EN 50159:2010) in order to forward the data, then additional protective measures (“cryptographical methods”) must be added.

For the connection to the interface “Ethernet”, the specifications 10 BASE-T or 100 BASE-TX according to IEEE 802.3-2008 must be complied with. A shielded cable must be used.

3.5.5.4 Interface “Hotlink”

The interface “Hotlink” is a shielded RJ45 socket on the front panel of the COM and is used to synchronise 2 redundant COM boards.

For this purpose, the 2 COM boards must be connected with a crossover cable at the interface “Hotlink”. Crossover cables can be ordered separately from Frauscher. They are available in lengths of 0,5 m, 1 m and 2 m.

If the crossover cable is not ordered from Frauscher, then a crossover cable must be used that fulfils the following requirements:

- The maximum cable length is 2 m.
- The cable must have individual shields and an overall shield (e.g. S/FTP).
- All 4 wire pairs must be fully crossed.
- The cable must be a Cat 5, Cat 5e or Cat 6 cable.

Only two COM boards of the same type in the same CAN segment may be connected to each other via the interface “Hotlink”.

3.6 Pin assignments on the backplanes

3.6.1 Connectors on the backplane BP-PWR

3.6.1.1 Connector “supply”

The power supply must be connected to the connector “X1” on the rear side of the BP-PWR. The connector “X2” is used to supply one or several BP-EXB or for the connection of redundant supply.

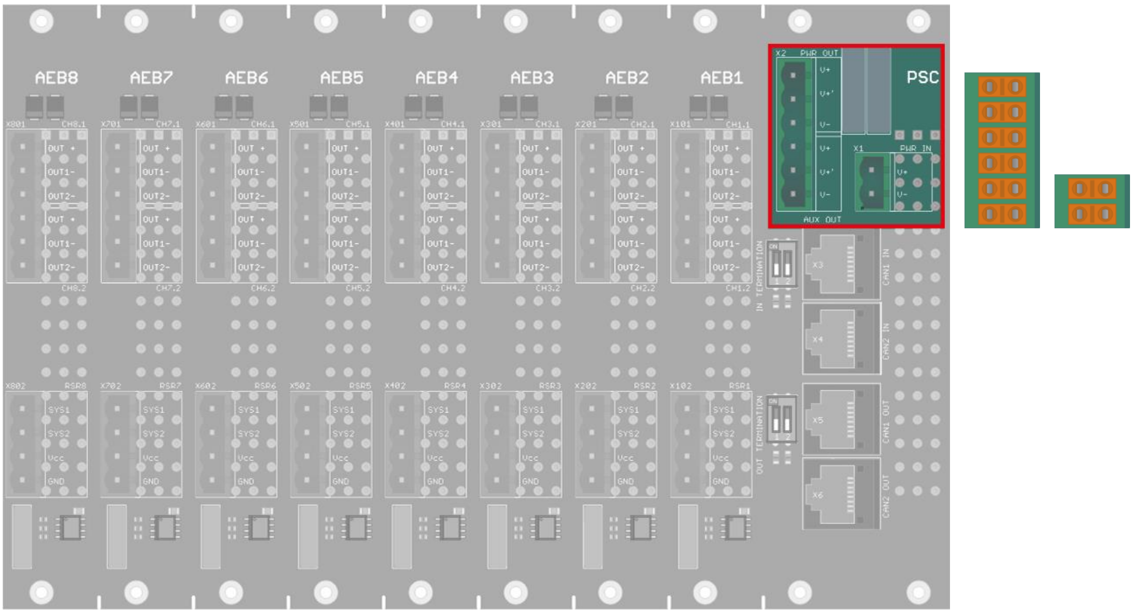


Figure 3.75: Connector “supply”

“X1”	
V+	power supply of the PSC
V-	GND

Table 3.19: External power supply

“X2” in case of redundant supply		
V+	supply of the AEB boards	power supply PSC 1
V+‘		power supply PSC 2
V-		GND
V+	supply of the CAN bus	power supply CAN 1
V+‘		power supply CAN 2
V-		GND

Table 3.20: Internal power supply in case of redundant supply (= 2 PSC boards) and redundant communication (= 2 CAN buses)

“X2” in case of non-redundant supply		
V+ V+‘ V-	supply of the AEB boards	power supply PSC 1 - GND
V+ V+‘ V-	supply of the CAN bus	power supply CAN 1 power supply CAN 2 GND
In case of non-redundant power supply, the status of the soldering jumpers must match the configuration variant C (see chapter “Soldering jumpers on the backplane BP-PWR”).		

Table 3.21: Internal power supply in case of non-redundant supply

3.6.1.2 Connectors “wheel sensor”

The connectors for wheel sensors can be found on the rear side of the BP-PWR (“X102” to “X802”, the number of connectors depends on the design of the BP-PWR).

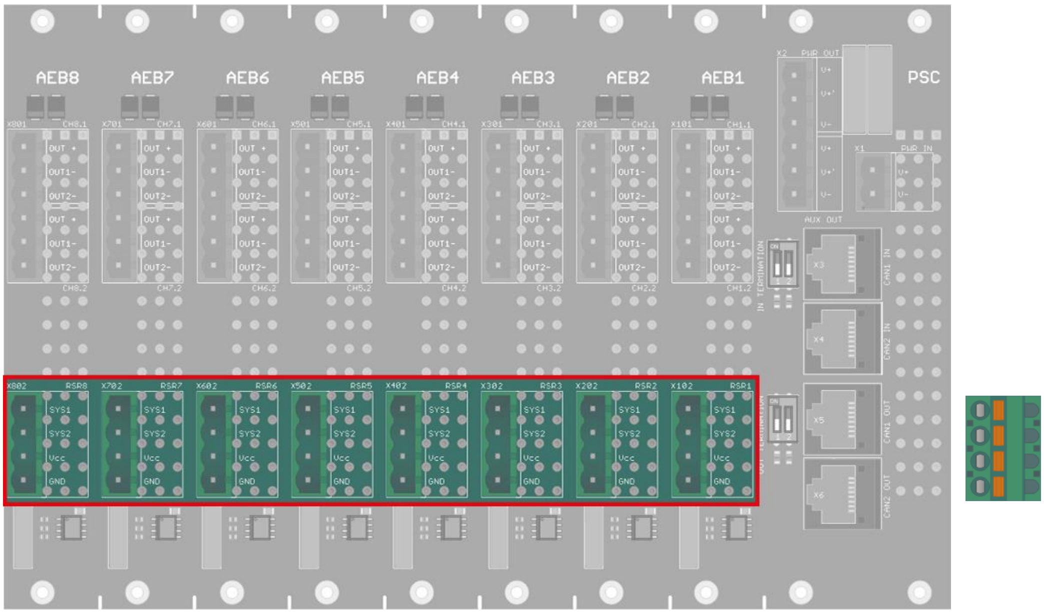


Figure 3.76: Connectors “wheel sensor” (here: BP-PWR101−8)

Wheel sensor	Connectors “wheel sensor” (“X102” to “X802”)	Output clamps at the BSI	Input clamps at the BSI	Wire of the RSR cable
RSR180	SYS1	A1	E1	Sys1
	SYS2	A2	E2	Sys2
	V_{CC}	A3	E3	V_{CC}
	GND	A4	E4	GND
RSR123	SYS1	A1	E2	Sys1-
	SYS2	A2	E4	Sys2-
	V_{CC}	A3	E1	Sys1+
	GND	A4	E3	Sys2+

Table 3.22: Connection diagram of the wheel sensors RSR180 and RSR123

3.6.1.3 Connector “counting head output”

The connectors for the counting head outputs can be found on the rear side of the BP-PWR (“X101” to “X801”, the number of connectors depends on the design of the BP-PWR). Counting head information is output at the counting head outputs.

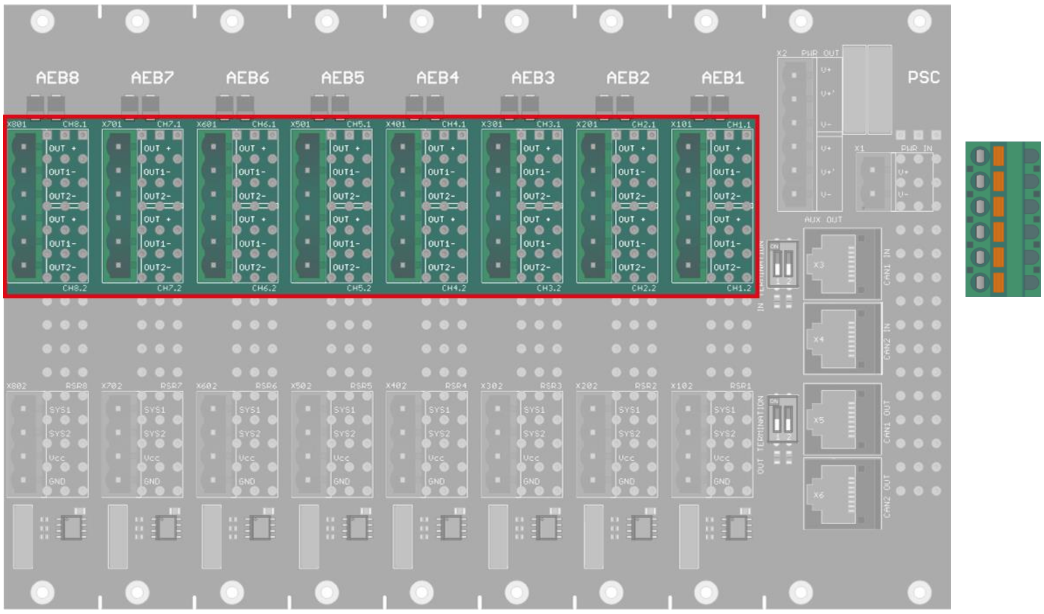


Figure 3.77: Connectors “counting head output” (here: BP-PWR101−8)

“X101” to “X801”		Indicator in the configuration word
CHn.1 (n = 1 – 8)	OUT +	
	OUT 1 -	ZP-OUT1_O
	OUT 2 -	ZP-OUT2_O
CHn.2 (n = 1 – 8)	OUT +	
	OUT 1 -	ZP-OUT3_O
	OUT 2 -	ZP-OUT4_O

Table 3.23: Counting head output (Assignment of the indicators)

The different options for the configuration of the counting head outputs can be taken from the configuration word “Output of counting head outputs of the AEB via optocoupler”.

3.6.1.4 Connectors “CAN bus”

The CAN bus connectors (“X3” to “X6”) can be found on the rear side of the BP-PWR.
They are used to wire the CAN bus. The CAN interfaces must be connected from one BP-PWR and/or BP-EXB to another BP-PWR and/or BP-EXB from “CANx OUT” to “CANx IN” (x = 1 or 2) with RJ45 patch cables.

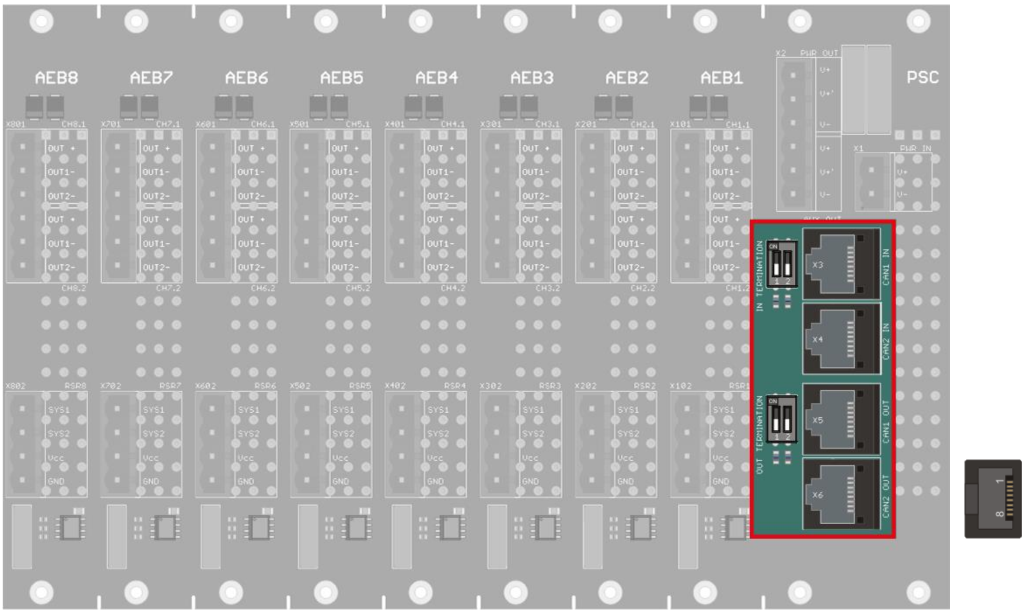


Figure 3.78: Connectors “CAN bus”

3.6.2 Connectors on the backplane BP-EXB

3.6.2.1 Connector “supply”

The power supply must be connected to the connector “X2” on the rear side of the BP-EXB.
The BP-EXB is powered via the BP-PWR. For this, the connector “X2” must be used and directly through-wired.

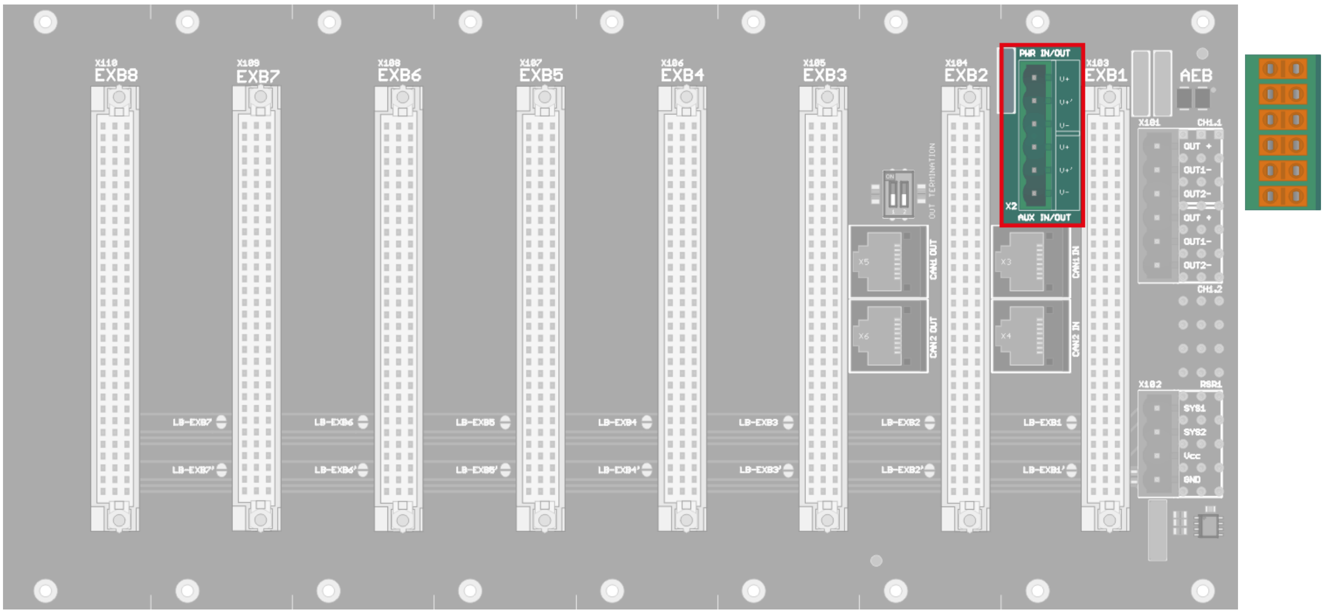


Figure 3.79: Connector “supply”

“X2” in case of redundant supply		
V+	supply of the AEB boards	power supply PSC 1
V+‘		power supply PSC 2
V-		GND
V+	supply of the CAN bus	power supply CAN 1
V+‘		power supply CAN 2
V-		GND

Table 3.24: Internal power supply in case of redundant supply (= 2 PSC boards) and redundant communication (= 2 CAN buses)

“X2” in case of non-redundant supply		
V+ V+‘ V-	supply of the AEB boards	power supply PSC 1 - GND
V+ V+‘ V-	supply of the CAN bus	power supply CAN 1 power supply CAN 2 GND
In case of non-redundant power supply, the status of the soldering jumpers must match the configuration variant C (see chapter “Soldering jumpers on the backplane BP-PWR”)		

Table 3.25: Internal power supply in case of non-redundant supply

3.6.2.2 Connector “wheel sensor”

The connector for a wheel sensor can be found on the rear side of the BP-EXB (“X102”).

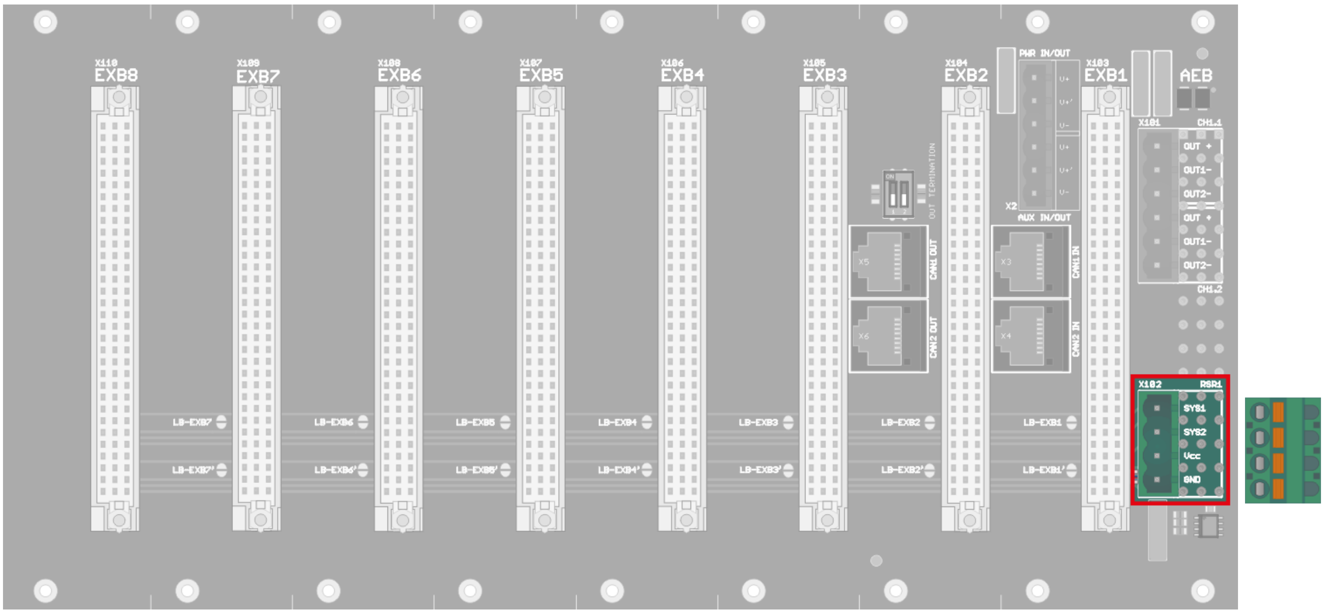


Figure 3.80: Connector “wheel sensor”

Wheel sensor	**Connector “wheel sensor” (“X102”)**	**Output clamps at the BSI**	**Input clamps at the BSI**	**Wire of the RSR cable**
RSR180	SYS1	A1	E1	Sys1
	SYS2	A2	E2	Sys2
	V_{CC}	A3	E3	V_{CC}
	GND	A4	E4	GND
RSR123	SYS1	A1	E2	Sys1-
	SYS2	A2	E4	Sys2-
	V_{CC}	A3	E1	Sys1+
	GND	A4	E3	Sys2+

Table 3.26: Connection diagram of the wheel sensors RSR180 and RSR123

3.6.2.3 Connector “counting head output”

The connector for the counting head output can be found on the rear side of the BP-EXB (“X101”). Counting head information is output at the counting head output.

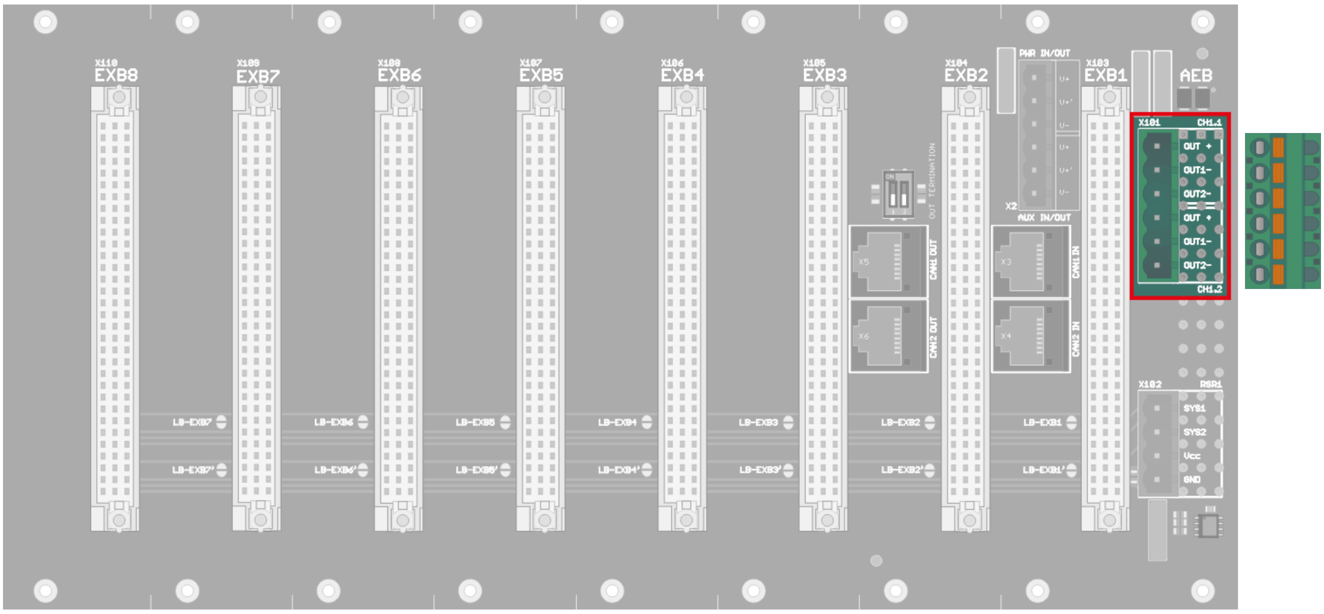


Figure 3.81: Connector “counting head output”

“X101”		Indicator in the configuration word
CH1.1	OUT +	
	OUT 1 -	ZP-OUT1_O
	OUT 2 -	ZP-OUT2_O
CH1.2	OUT +	
	OUT 1 -	ZP-OUT3_O
	OUT 2 -	ZP-OUT4_O

Table 3.27: Counting head output (assignment of the indicators)

The different options for the configuration of the counting head outputs can be taken from the configuration word “Output of counting head outputs of the AEB via optocoupler”.

3.6.2.4 Connectors “CAN bus”

The CAN bus connectors (“X3” to “X6”) can be found on the rear side of the BP-EXB.
They are used to wire the CAN bus. The CAN interfaces must be connected from one BP-PWR and/or BP-EXB to another BP-PWR and/or BP-EXB from “CANx OUT” to “CANx IN” (x = 1 or 2) with RJ45 patch cables.

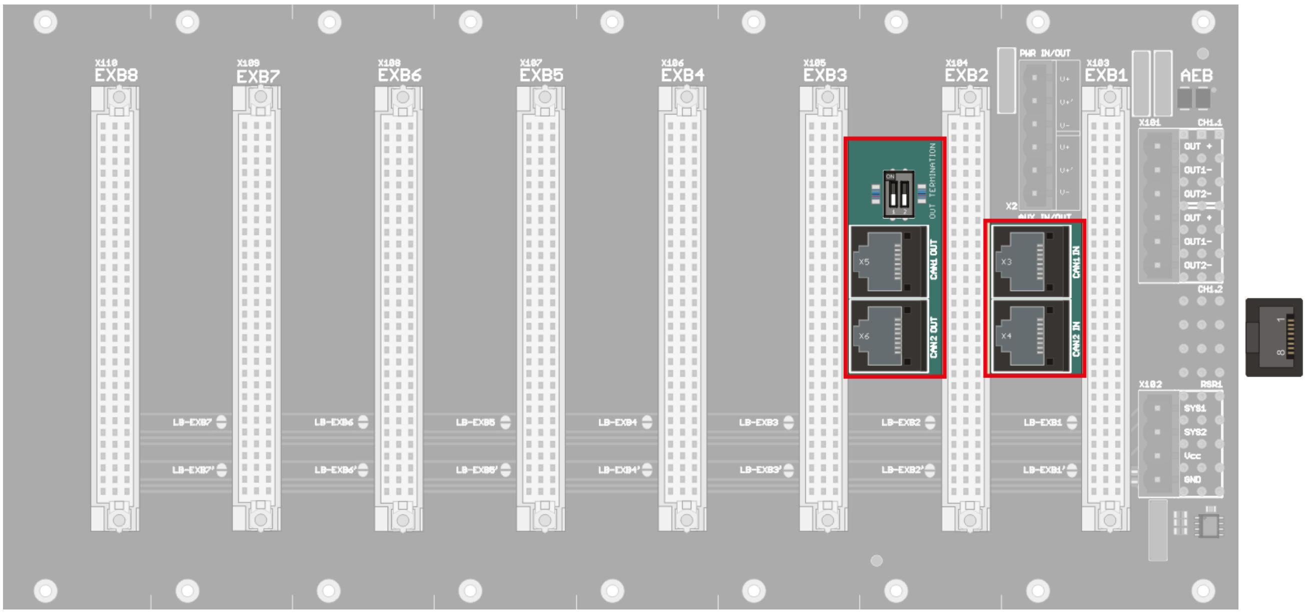


Figure 3.82: Connectors “CAN bus”

3.6.2.5 Connectors “EXB1” to “EXB8”

The connectors for the switching outputs of the IO-EXB can be found on the rear side of the BP-EXB (EXB1 = “X103” to EXB8 = “X110”, number of connectors depends on the design of the BP-EXB). Depending on the configuration, they are used for axle counting output, data transmission or counting head output.

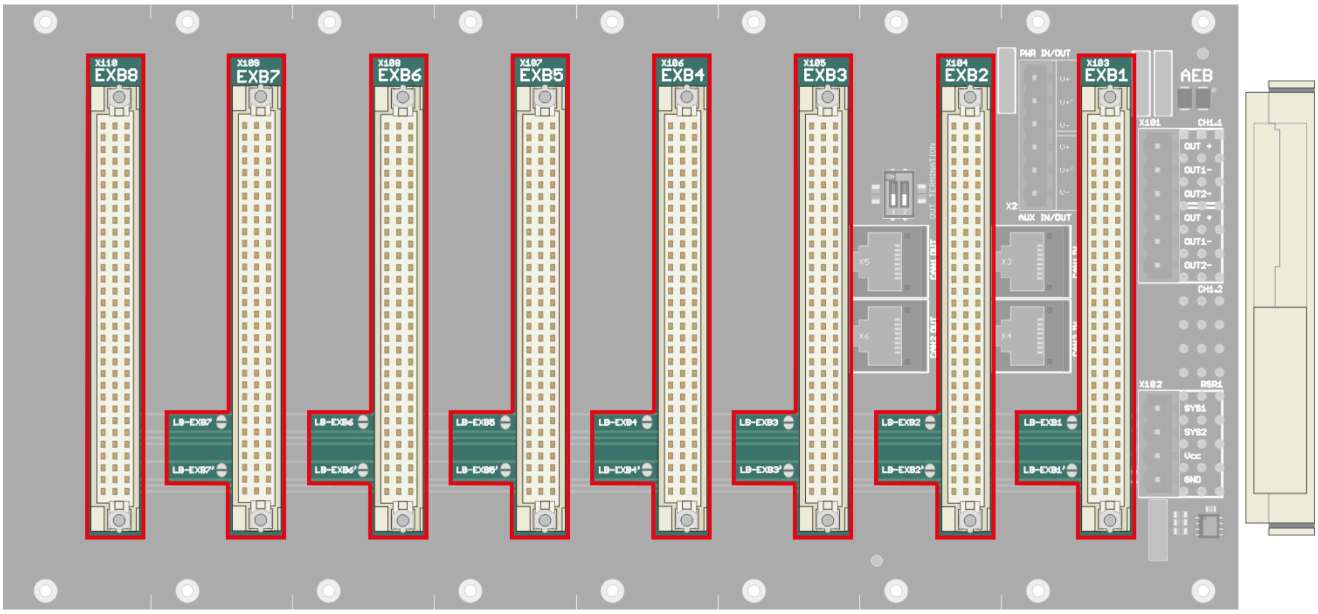


Figure 3.83: Connectors “EXB1” to “EXB8”, (here: BP-EXB101-8)

3.6.2.6 Pin assignment of the interface “EXB1” to “EXB8” (axle counting output)

Pin	Pin assignment			Pin	Pin assignment	Pin	Pin assignment		
1c	do not use			1b	do not use	1a	do not use		
2c	not assigned			2b	not assigned	2a	not assigned		
3c	not assigned			3b	not assigned	3a	not assigned		
4c	not assigned			4b	not assigned	4a	not assigned		
5c	Fm_A +/~	or	Occ_A +/~	5b	AUX1_OUT +/~	5a	Fm_A’ +/~	or	Occ_A’ +/~
6c	Fm_A -/~		Occ_A -/~	6b	AUX1_OUT -/~	6a	Fm_A’ -/~		Occ_A’ -/~
7c	Fm_B +/~		Occ_B +/~	7b	AUX2_OUT +/~	7a	Fm_B’ +/~		Occ_B’ +/~
8c	Fm_B -/~		Occ_B -/~	8b	AUX2_OUT -/~	8a	Fm_B’ -/~		Occ_B’ -/~
9c	Fm_C +/~		Occ_C +/~	9b	AUX1_OUT’ +/~	9a	Fm_C’ +/~		Occ_C’ +/~
10c	Fm_C -/~		Occ_C -/~	10b	AUX1_OUT’ -/~	10a	Fm_C’ -/~		Occ_C’ -/~
11c	Fm_D +/~		Occ_D +/~	11b	AUX2_OUT’ +/~	11a	Fm_D’ +/~		Occ_D’ +/~
12c	Fm_D -/~		Occ_D -/~	12b	AUX2_OUT’ -/~	12a	Fm_D’ -/~		Occ_D’ -/~
13c	not assigned			13b	not assigned	13a	not assigned		
14c	BEHAV_INPUT1_A +			14b	BEHAV_INPUT3_A +	14a	BEHAV_INPUT1_A’ +		
15c	BEHAV_INPUT1_A -			15b	BEHAV_INPUT3_A -	15a	BEHAV_INPUT1_A’ -		
16c	BEHAV_INPUT1_B +			16b	BEHAV_INPUT3_B +	16a	BEHAV_INPUT1_B’ +		
17c	BEHAV_INPUT1_B -			17b	BEHAV_INPUT3_B -	17a	BEHAV_INPUT1_B’ -		
18c	BEHAV_INPUT2_A +			18b	BEHAV_INPUT3_A’ +	18a	BEHAV_INPUT2_A’ +		
19c	BEHAV_INPUT2_A -			19b	BEHAV_INPUT3_A’ -	19a	BEHAV_INPUT2_A’ -		
20c	BEHAV_INPUT2_B +			20b	BEHAV_INPUT3_B’ +	20a	BEHAV_INPUT2_B’ +		
21c	BEHAV_INPUT2_B -			21b	BEHAV_INPUT3_B’ -	21a	BEHAV_INPUT2_B’ -		
22c	not assigned			22b	not assigned	22a	not assigned		
23c	not assigned			23b	not assigned	23a	not assigned		
24c	not assigned			24b	not assigned	24a	not assigned		
25c	do not use			25b	do not use	25a	do not use		
26c	do not use			26b	do not use	26a	do not use		
27c	do not use			27b	do not use	27a	do not use		
28c	do not use			28b	do not use	28a	do not use		
29c	do not use			29b	do not use	29a	do not use		
30c	do not use			30b	do not use	30a	do not use		
31c	do not use			31b	do not use	31a	do not use		
32c	do not use			32b	do not use	32a	do not use		

(blue)	outputs and auxiliary outputs of the IO-EXB of track section 1 (FMA 1) (see configuration word “Output axle counting via IO-EXB”)
(green)	outputs and auxiliary outputs of the IO-EXB of track section 2 (FMA 2) (see configuration word “Output axle counting via IO-EXB”)
(light blue)	inputs of the IO-EXB for track section 1 (FMA 1) (see configuration word “Reset axle counting via IO-EXB”)
(light green)	inputs of the IO-EXB for track section 2 (FMA 2) (see configuration word “Reset axle counting via IO-EXB”)

Table 3.28: Pin assignment of the connectors “EXB1” to “EXB8” (axle counting output) on the rear side of the BP-EXB

The following pin assignment is valid if Counting Head Control is configured:

Pin	Pin assignment			Pin	Pin assignment	Pin	Pin assignment		
1c	do not use			1b	do not use	1a	do not use		
2c	not assigned			2b	not assigned	2a	not assigned		
3c	not assigned			3b	not assigned	3a	not assigned		
4c	not assigned			4b	not assigned	4a	not assigned		
5c	Fm_A +/~		Occ_A +/~	5b	AUX1_OUT +/~	5a	Fm_A’ +/~		Occ_A’ +/~
6c	Fm_A -/~		Occ_A -/~	6b	AUX1_OUT -/~	6a	Fm_A’ -/~		Occ_A’ -/~
7c	Fm_B +/~		Occ_B +/~	7b	AUX2_OUT +/~	7a	Fm_B’ +/~		Occ_B’ +/~
8c	Fm_B -/~	or	Occ_B -/~	8b	AUX2_OUT -/~	8a	Fm_B’ -/~	or	Occ_B’ -/~
9c	Fm_C +/~		Occ_C +/~	9b	AUX1_OUT’ +/~	9a	Fm_C’ +/~		Occ_C’ +/~
10c	Fm_C -/~		Occ_C -/~	10b	AUX1_OUT’ -/~	10a	Fm_C’ -/~		Occ_C’ -/~
11c	Fm_D +/~		Occ_D +/~	11b	AUX2_OUT’ +/~	11a	Fm_D’ +/~		Occ_D’ +/~
12c	Fm_D -/~		Occ_D -/~	12b	AUX2_OUT’ -/~	12a	Fm_D’ -/~		Occ_D’ -/~
13c	not assigned			13b	not assigned	13a	not assigned		
14c	BEHAV_INPUT1_A +			14b	BEHAV_INPUT3_A +	14a	BEHAV_INPUT1_A’ +		
15c	BEHAV_INPUT1_A -			15b	BEHAV_INPUT3_A -	15a	BEHAV_INPUT1_A’ -		
16c	BEHAV_INPUT1_B +			16b	BEHAV_INPUT3_B +	16a	BEHAV_INPUT1_B’ +		
17c	BEHAV_INPUT1_B -			17b	BEHAV_INPUT3_B -	17a	BEHAV_INPUT1_B’ -		
18c	BEHAV_INPUT2_A +			18b	BEHAV_INPUT3_A’ +	18a	BEHAV_INPUT2_A’ +		
19c	BEHAV_INPUT2_A -			19b	BEHAV_INPUT3_A’ -	19a	BEHAV_INPUT2_A’ -		
20c	BEHAV_INPUT2_B +			20b	BEHAV_INPUT3_B’ +	20a	BEHAV_INPUT2_B’ +		
21c	BEHAV_INPUT2_B -			21b	BEHAV_INPUT3_B’ -	21a	BEHAV_INPUT2_B’ -		
22c	not assigned			22b	not assigned	22a	not assigned		
23c	not assigned			23b	not assigned	23a	not assigned		
24c	not assigned			24b	not assigned	24a	not assigned		
25c	do not use			25b	do not use	25a	do not use		
26c	do not use			26b	do not use	26a	do not use		
27c	do not use			27b	do not use	27a	do not use		
28c	do not use			28b	do not use	28a	do not use		
29c	do not use			29b	do not use	29a	do not use		
30c	do not use			30b	do not use	30a	do not use		
31c	do not use			31b	do not use	31a	do not use		
32c	do not use			32b	do not use	32a	do not use		

	outputs and auxiliary outputs of the IO-EXB of track section 1 (FMA 1) (see configuration word “Output axle counting via IO-EXB”)
	outputs and auxiliary outputs of the IO-EXB of track section 2 (FMA 2) (see configuration word “Output axle counting via IO-EXB”)
	inputs 1 and 2 of the IO-EXB for track section 1 (FMA 1) (see configuration word “Reset axle counting via IO-EXB”)
	inputs 1 and 2 of the IO-EXB for track section 2 (FMA 2) (see configuration word “Reset axle counting via IO-EXB”)
	input 3 of the IO-EXB (for Counting Head Control, see configuration word “Reset axle counting via IO-EXB”)

Table 3.29: Pin assignment of the connectors “EXB1” to “EXB8” (Counting Head Control) on the rear side of the BP-EXB

SAB FAdC100_32:

No cables/wires must be connected to the pins 1 – 4, 13 and 22 – 32 a/b/c.

3.6.2.7 Pin assignment of the interface “EXB1” to “EXB8” (counting head output)

Pin	Pin assignment	Pin	Pin assignment	Pin	Pin assignment
1c	do not use	1b	do not use	1a	do not use
2c	not assigned	2b	not assigned	2a	not assigned
3c	not assigned	3b	not assigned	3a	not assigned
4c	not assigned	4b	not assigned	4a	not assigned
5c	ZP-OUT1_R_A +/~	5b	ZP-OUT2_R_A +/~	5a	ZP-OUT3_R_A +/~
6c	ZP-OUT1_R_A -/~	6b	ZP-OUT2_R_A -/~	6a	ZP-OUT3_R_A -/~
7c	ZP-OUT1_R_B +/~	7b	ZP-OUT2_R_B +/~	7a	ZP-OUT3_R_B +/~
8c	ZP-OUT1_R_B -/~	8b	ZP-OUT2_R_B -/~	8a	ZP-OUT3_R_B -/~
9c	ZP-OUT1_R_C +~/	9b	ZP-OUT2_R_C +/~	9a	ZP-OUT3_R_C +/~
10c	ZP-OUT1_R_C -/~	10b	ZP-OUT2_R_C -/~	10a	ZP-OUT3_R_C -/~
11c	ZP-OUT1_R_D +/~	11b	ZP-OUT2_R_D +/~	11a	ZP-OUT3_R_D +/~
12c	ZP-OUT1_R_D -/~	12b	ZP-OUT2_R_D -/~	12a	ZP-OUT3_R_D -/~
13c	not assigned	13b	not assigned	13a	not assigned
14c	INPUT1 (no function)	14b	INPUT3 (no function)	14a	INPUT5 (no function)
15c		15b		15a	
16c		16b		16a	
17c		17b		17a	
18c	INPUT2 (no function)	18b	INPUT4 (no function)	18a	INPUT6 (no function)
19c		19b		19a	
20c		20b		20a	
21c		21b		21a	
22c	not assigned	22b	not assigned	22a	not assigned
23c	not assigned	23b	not assigned	23a	not assigned
24c	not assigned	24b	not assigned	24a	not assigned
25c	do not use	25b	do not use	25a	do not use
26c	do not use	26b	do not use	26a	do not use
27c	do not use	27b	do not use	27a	do not use
28c	do not use	28b	do not use	28a	do not use
29c	do not use	29b	do not use	29a	do not use
30c	do not use	30b	do not use	30a	do not use
31c	do not use	31b	do not use	31a	do not use
32c	do not use	32b	do not use	32a	do not use

	switching outputs of the IO-EXB (see configuration word “Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB”)
	inputs of the IO-EXB (in case of configuration for counting head output, the inputs have no function.)

Table 3.30: Pin assignment of the connectors “EXB1” to “EXB8” (counting head output) on the rear side of the BP-EXB

SAB FAdC100_32:

No cables/wires must be connected to the pins 1 – 4, 13 and 22 – 32 a/b/c.

3.6.2.8 Pin assignment of the interface “EXB1” to “EXB8” (data transmission)

The following pin assignment is valid if QUAD outputs and QUAD inputs are configured:

Pin	Pin assignment	Pin	Pin assignment	Pin	Pin assignment
1c	do not use	1b	do not use	1a	do not use
2c	not assigned	2b	not assigned	2a	not assigned
3c	not assigned	3b	not assigned	3a	not assigned
4c	not assigned	4b	not assigned	4a	not assigned
5c	OUT1A +/~	5b	OUT2A +/~	5a	OUT3A +/~
6c	OUT1A -/~	6b	OUT2A -/~	6a	OUT3A -/~
7c	OUT1B +/~	7b	OUT2B +/~	7a	OUT3B +/~
8c	OUT1B -/~	8b	OUT2B -/~	8a	OUT3B -/~
9c	OUT1C +/~	9b	OUT2C +/~	9a	OUT3C +/~
10c	OUT1C -/~	10b	OUT2C -/~	10a	OUT3C -/~
11c	OUT1D +/~	11b	OUT2D +/~	11a	OUT3D +/~
12c	OUT1D -/~	12b	OUT2D -/~	12a	OUT3D -/~
13c	not assigned	13b	not assigned	13a	not assigned
14c	IN1A +	14b	IN2A +	14a	IN3A +
15c	IN1A -	15b	IN2A -	15a	IN3A -
16c	IN1B +	16b	IN2B +	16a	IN3B +
17c	IN1B -	17b	IN2B -	17a	IN3B -
18c	IN1C +	18b	IN2C +	18a	IN3C +
19c	IN1C -	19b	IN2C -	19a	IN3C -
20c	IN1D +	20b	IN2D +	20a	IN3D +
21c	IN1D -	21b	IN2D -	21a	IN3D -
22c	not assigned	22b	not assigned	22a	not assigned
23c	not assigned	23b	not assigned	23a	not assigned
24c	not assigned	24b	not assigned	24a	not assigned
25c	do not use	25b	do not use	25a	do not use
26c	do not use	26b	do not use	26a	do not use
27c	do not use	27b	do not use	27a	do not use
28c	do not use	28b	do not use	28a	do not use
29c	do not use	29b	do not use	29a	do not use
30c	do not use	30b	do not use	30a	do not use
31c	do not use	31b	do not use	31a	do not use
32c	do not use	32b	do not use	32a	do not use

		QUAD outputs 1 to 3 of the IO-EXB (see configuration word “Input/output data transmission”)
		QUAD inputs 1 to 3 of the IO-EXB (see configuration word “Input/output data transmission”)

Table 3.31: Pin assignment of the connectors “EXB1” to “EXB8” (data transmission with QUAD outputs and QUAD inputs) on the rear side of the BP-EXB

The following pin assignment is valid if DUAL outputs and DUAL inputs are configured:

Pin	Pin assignment	Pin	Pin assignment	Pin	Pin assignment
1c	do not use	1b	do not use	1a	do not use
2c	not assigned	2b	not assigned	2a	not assigned
3c	not assigned	3b	not assigned	3a	not assigned
4c	not assigned	4b	not assigned	4a	not assigned
5c	OUT1A +/~	5b	OUT2A +/~	5a	OUT3A +/~
6c	OUT1A -/~	6b	OUT2A -/~	6a	OUT3A -/~
7c	OUT1B +/~	7b	OUT2B +/~	7a	OUT3B +/~
8c	OUT1B -/~	8b	OUT2B -/~	8a	OUT3B -/~
9c	OUT1C +/~	9b	OUT2C +/~	9a	OUT3C +/~
10c	OUT1C -/~	10b	OUT2C -/~	10a	OUT3C -/~
11c	OUT1D +/~	11b	OUT2D +/~	11a	OUT3D +/~
12c	OUT1D -/~	12b	OUT2D -/~	12a	OUT3D -/~
13c	not assigned	13b	not assigned	13a	not assigned
14c	IN1A +	14b	IN2A +	14a	IN3A +
15c	IN1A -	15b	IN2A -	15a	IN3A -
16c	IN1B +	16b	IN2B +	16a	IN3B +
17c	IN1B -	17b	IN2B -	17a	IN3B -
18c	IN1C +	18b	IN2C +	18a	IN3C +
19c	IN1C -	19b	IN2C -	19a	IN3C -
20c	IN1D +	20b	IN2D +	20a	IN3D +
21c	IN1D -	21b	IN2D -	21a	IN3D -
22c	not assigned	22b	not assigned	22a	not assigned
23c	not assigned	23b	not assigned	23a	not assigned
24c	not assigned	24b	not assigned	24a	not assigned
25c	do not use	25b	do not use	25a	do not use
26c	do not use	26b	do not use	26a	do not use
27c	do not use	27b	do not use	27a	do not use
28c	do not use	28b	do not use	28a	do not use
29c	do not use	29b	do not use	29a	do not use
30c	do not use	30b	do not use	30a	do not use
31c	do not use	31b	do not use	31a	do not use
32c	do not use	32b	do not use	32a	do not use

		DUAL outputs 1 to 6 of the IO-EXB (see configuration word "Input/output data transmission")
		DUAL inputs 1 to 6 of the IO-EXB (see configuration word "Input/output data transmission")

Table 3.32: Pin assignment of the connectors "EXB1" to "EXB8" (data transmission with DUAL outputs and DUAL inputs) on the rear side of the BP-EXB

The following pin assignment is valid if SINGLE outputs and SINGLE inputs are configured:

Pin	Pin assignment	Pin	Pin assignment	Pin	Pin assignment
1c	do not use	1b	do not use	1a	do not use
2c	not assigned	2b	not assigned	2a	not assigned
3c	not assigned	3b	not assigned	3a	not assigned
4c	not assigned	4b	not assigned	4a	not assigned
5c	OUT1A +/~	5b	OUT2A +/~	5a	OUT3A +/~
6c	OUT1A -/~	6b	OUT2A -/~	6a	OUT3A -/~
7c	OUT1B +/~	7b	OUT2B +/~	7a	OUT3B +/~
8c	OUT1B -/~	8b	OUT2B -/~	8a	OUT3B -/~
9c	OUT1C +/~	9b	OUT2C +/~	9a	OUT3C +/~
10c	OUT1C -/~	10b	OUT2C -/~	10a	OUT3C -/~
11c	OUT1D +/~	11b	OUT2D +/~	11a	OUT3D +/~
12c	OUT1D -/~	12b	OUT2D -/~	12a	OUT3D -/~
13c	not assigned	13b	not assigned	13a	not assigned
14c	IN1A +	14b	IN2A +	14a	IN3A +
15c	IN1A -	15b	IN2A -	15a	IN3A -
16c	IN1B +	16b	IN2B +	16a	IN3B +
17c	IN1B -	17b	IN2B -	17a	IN3B -
18c	IN1C +	18b	IN2C +	18a	IN3C +
19c	IN1C -	19b	IN2C -	19a	IN3C -
20c	IN1D +	20b	IN2D +	20a	IN3D +
21c	IN1D -	21b	IN2D -	21a	IN3D -
22c	not assigned	22b	not assigned	22a	not assigned
23c	not assigned	23b	not assigned	23a	not assigned
24c	not assigned	24b	not assigned	24a	not assigned
25c	do not use	25b	do not use	25a	do not use
26c	do not use	26b	do not use	26a	do not use
27c	do not use	27b	do not use	27a	do not use
28c	do not use	28b	do not use	28a	do not use
29c	do not use	29b	do not use	29a	do not use
30c	do not use	30b	do not use	30a	do not use
31c	do not use	31b	do not use	31a	do not use
32c	do not use	32b	do not use	32a	do not use
		SINGLE outputs 1 to 12 of the IO-EXB (see configuration word “Input/output data transmission”)			
		SINGLE inputs 1 to 12 of the IO-EXB (see configuration word “Input/output data transmission”)			

Table 3.33: Pin assignment of the connectors “EXB1” to “EXB8” (data transmission with SINGLE outputs and SINGLE inputs) on the rear side of the BP-EXB

SAB FAdC100_32:

No cables/wires must be connected to the pins 1 – 4, 13 and 22 – 32 a/b/c.

4 Basic conditions for the installation

4.1 Vehicle parameters and mounting position of the wheel sensor

4.1.1 Vehicle parameters

Dependent on the application (e.g. main line or light rail), there are different parameters, which must be complied with the associated values. These values can be taken from the respective data sheet.

SAB FAdC100_1:

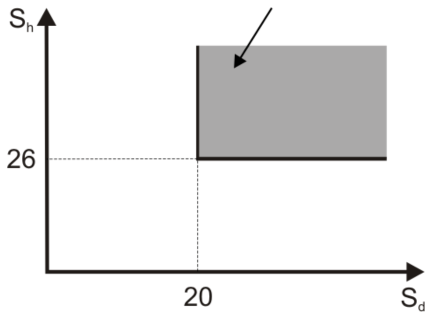
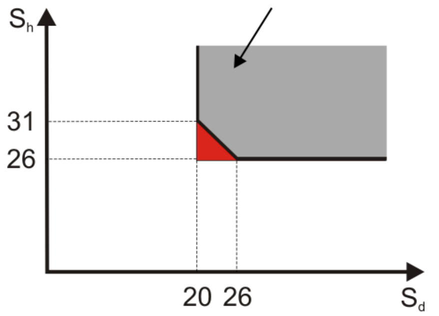
Dependent on the maximum speed v_{max}, the wheels must comply with the following wheel diameters d:

$[v_{max}]$ = km/h
[d] = mm

$v_{max} < 150$ km/h:	$d \geq 300$ mm
$v_{max} \geq 150$ km/h:	$d \geq (v_{max}$ / (km/h) * 2) mm

SAB FAdC100_2:

In case of a type protection code of 0x0000 0000, the following limit values for the wheel flange dimensions must be complied with at the respective mounting position of the wheel sensor RSR180:

Wheel diameter d	Measurement A	Measurement B	Wheel flange
≥ 840 mm	40 mm	2,5 to 8 mm	area of detection capability 
	40 mm 42,5 to 45 mm	0 mm 2,5 to 8 mm	At these mounting positions only a wheel flange with the following dimensions may be used: area of detection capability 

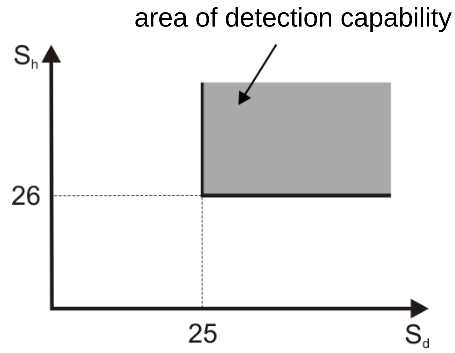
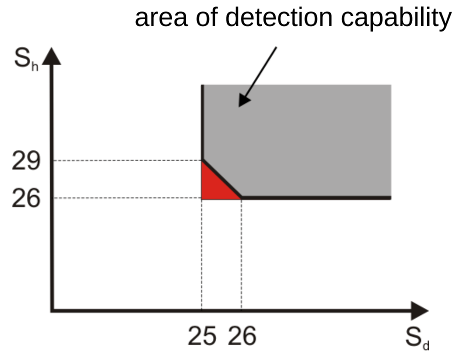
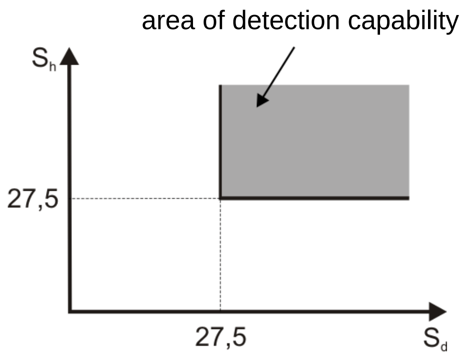
Wheel diameter d	Measurement A	Measurement B	Wheel flange
≥ 760 mm	40 to 42,5 mm	0 to 8 mm	
	45 mm	1 to 8 mm	
	45 mm	0 mm	At these mounting positions only a wheel flange with the following dimensions may be used: 
≥ 330 mm	40 to 45 mm	0 to 8 mm	

Table 4.1: Limit values for the wheel flange dimensions when using a RSR180, measurements in mm

SAB FAdC100_90:

The wheel sensor RSR180 can be used for traversal speeds up to 310 km/h. Higher speeds (up to 450 km/h) are possible, but must then be verified in the corresponding case by field tests.

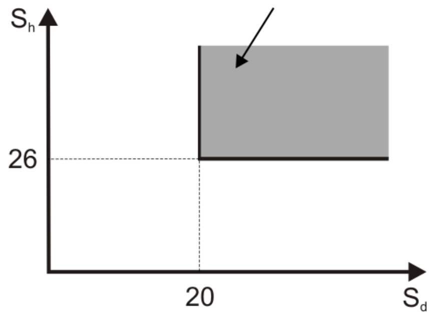
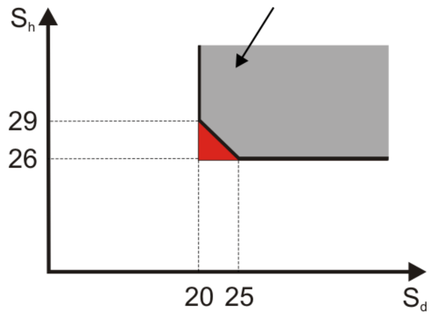
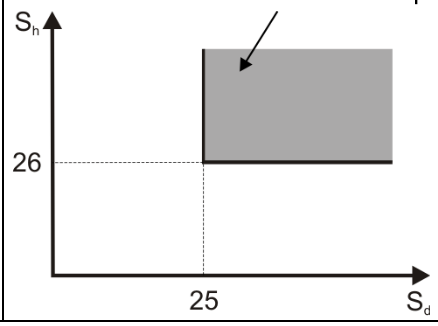
At speeds above 310 km/h consult Frauscher.

If the wheel sensor RSR180 should work with axle counting quality, then the wheel sensor RSR180 must not be used on tracks where the eddy current brakes act as the service brake.

The wheel sensor RSR180 is only permitted on tracks with magnetic track brakes, which are used as service brake, if the magnetic track brake suppression is activated.

SAB FAdC100_177:

In case of a type protection code of 0x0000 0000, the following limit values for the wheel flange dimensions must be complied with at the respective mounting position of the wheel sensor RSR123:

Wheel diameter d	Measurement A	Measurement B	Wheel flange
≥ 840 mm	40 to 42,5 mm	2,5 to 8 mm	area of detection capability 
	45 mm	2,5 to 8 mm	At these mounting positions only a wheel flange with the following dimensions may be used: area of detection capability 
≥ 760 mm	40 to 45 mm	0 to 8 mm	area of detection capability 

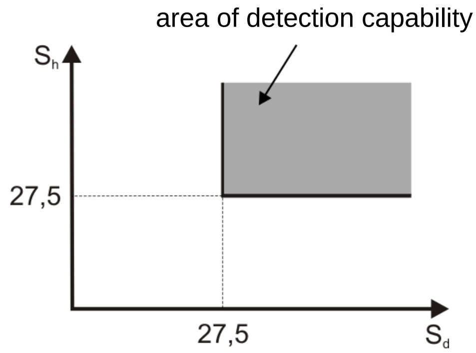
Wheel diameter d	Measurement A	Measurement B	Wheel flange
≥ 330 mm	40 to 45 mm	0 to 8 mm	

Table 4.2: Limit values for the wheel flange dimensions when using a RSR123, measurements in mm

SAB FAdC100_91:

The wheel sensor RSR123 can be used for traversal speeds up to 290 km/h. Higher speeds (up to 450 km/h) are possible, but must be verified in the corresponding case by field tests.

At speeds above 290 km/h consult Frauscher.

Parameter	Unit	Description
Traversing:		
Acceleration a	[m/s²]	acceleration when traversing the wheel sensor
Speed v	[km/h]	speed when traversing the wheel sensor
Vehicle geometry:		
Wheel diameter d	[mm]	wheel diameter of rail vehicle
Wheel flange thickness S_d	[mm]	see figure “Wheel profile (main line)”
Wheel flange height S_h *	[mm]	see figure “Wheel profile (main line)”
Distance between axles a_a	[mm]	distance between the axles of a rail vehicle
Angle α	[°]	see figure “Overview of the wheel flange dimensions (light rail)”
Angle β	[°]	
Lateral wheel displacement	[mm]	range in which a wheel flange moves laterally to the rail
Mounting position:		
Measurement A	[mm]	vertical mounting position of the wheel sensor for Vignole rail or grooved rail
Measurement B	[mm]	horizontal mounting position of the wheel sensor for Vignole rail or grooved rail

Table 4.3: Description of the vehicle parameters

* In connection with the parameter wheel flange height S_h, there are additional specifications and/or restrictions regarding the permitted mounting position of the wheel sensor (measurement A). Further information can be taken from the respective project-specific documentation.

4.1.1.1 Vehicle parameters for main line

Wheel flange dimension and wheel flange form of the used wheel profiles must correspond to the following figure.

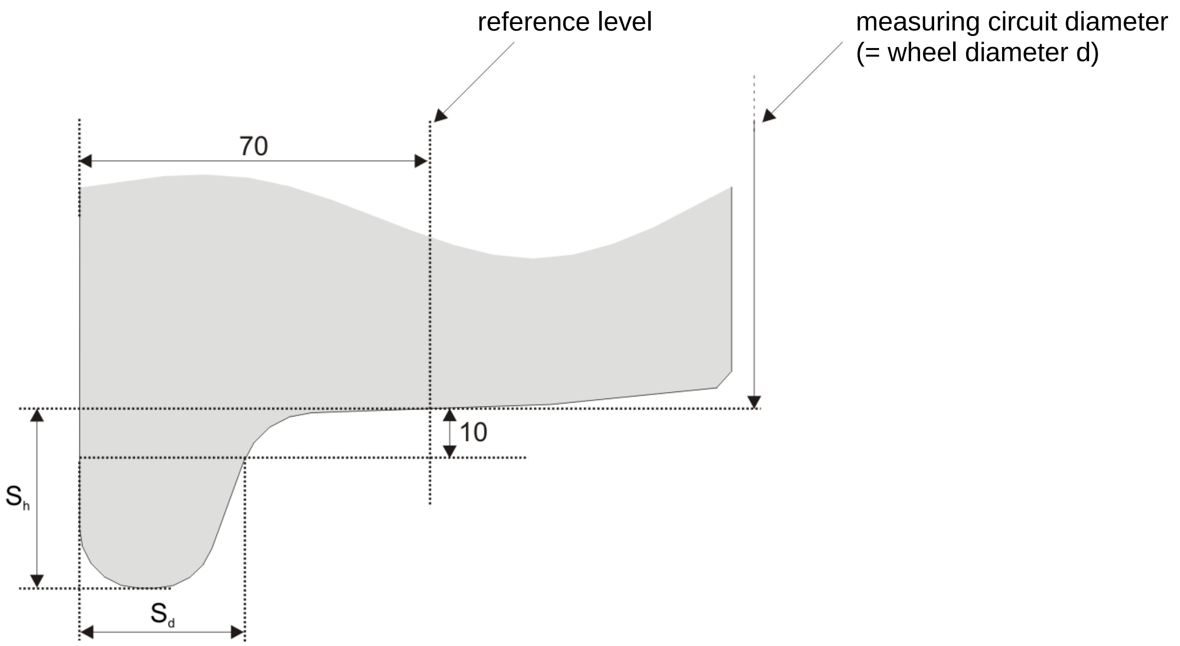


Figure 4.1: Wheel profile (main line), measurements in mm

4.1.1.2 Vehicle parameters for light rail

The following figure shows the wheel specific parameters:

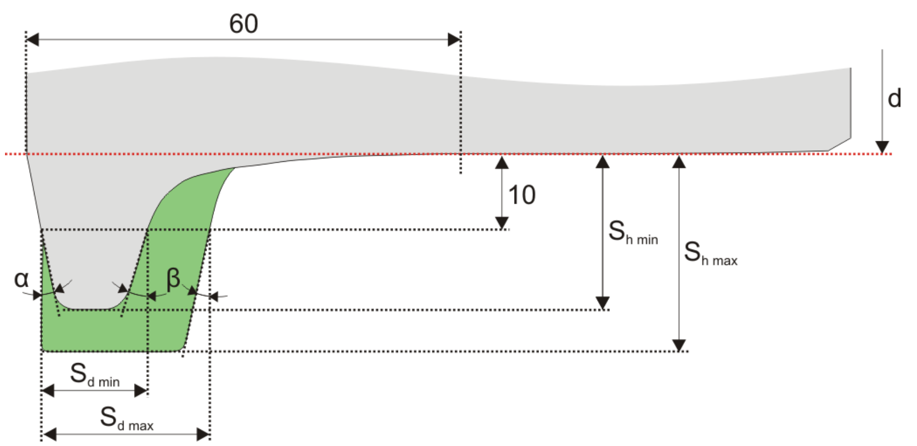


Figure 4.2: Overview of the wheel flange dimensions (light rail), measurements in mm

The following parameters are valid if magnetic track brakes are used:

Parameter	Unit	Description
Magnetic track brake:		
Distance h	[mm]	distance between magnetic track brake (not engaged) and top of rail (SOK)
$\lvert h_1 – h_2 \rvert$	[mm]	difference between h_1 and h_2
Overhang s	[mm]	distance between outer edge of the magnetic track brake and the lateral edge of rail head
$\lvert s_1 – s_2 \rvert$	[mm]	difference between s_1 and s_2
Distance u	[mm]	distance between centre of the wheel and magnetic track brake; defines the area between wheel and magnetic track brake in which no metal parts may be located
Length l	[mm]	length of the magnetic track brake
Height H	[mm]	defines the area between wheel and magnetic track brake in which no metal parts may be located

Table 4.4: Description of the vehicle parameters if magnetic track brakes are used

If a differing bogie is used that does not correspond to the following figures, then Frauscher must be consulted.

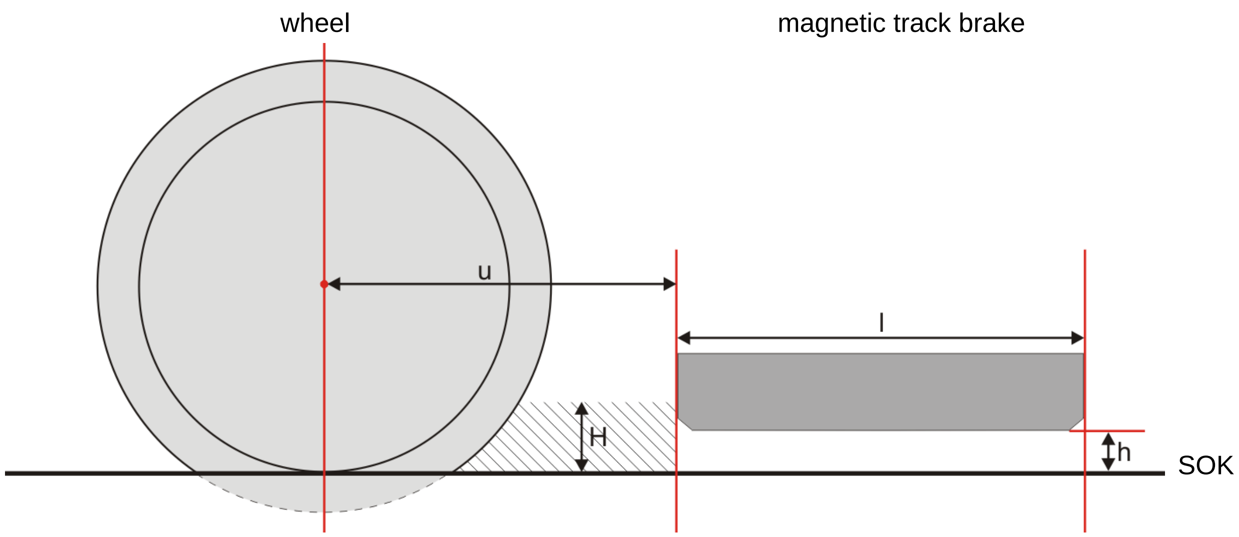


Figure 4.3: Distance between wheel and magnetic track brake (side view)

Measurement H defines the area between wheel and magnetic track brake in which no metallic parts may be located in order for the magnetic track brake to be identified correctly.

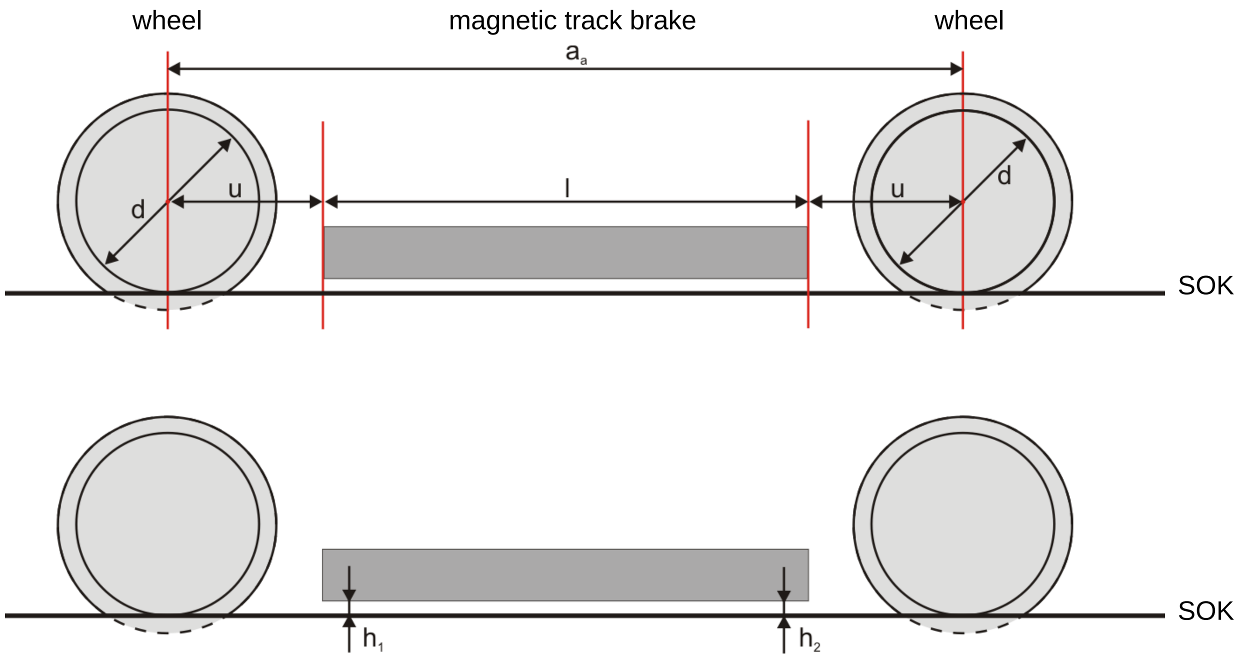


Figure 4.4: Bogie and magnetic track brake (side view)

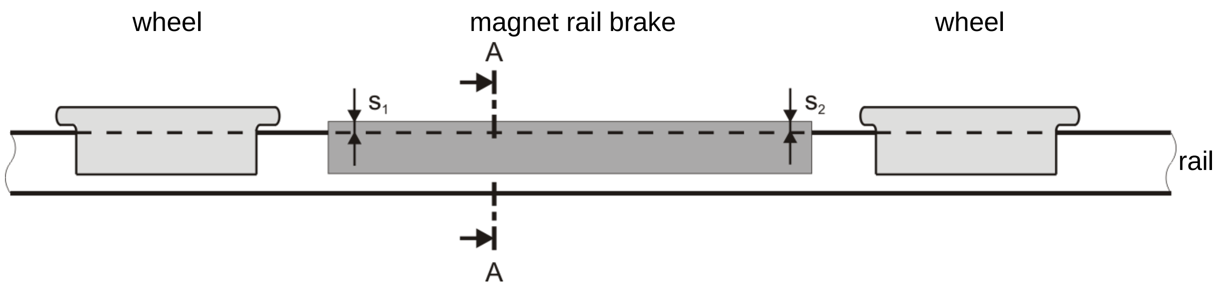


Figure 4.5: Bogie and magnetic track brake (top view)

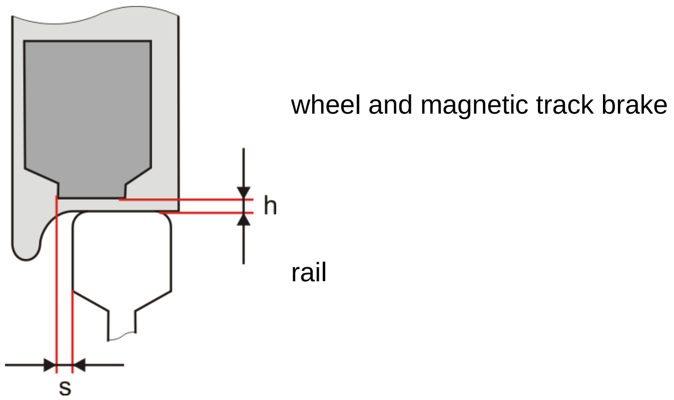


Figure 4.6: Wheel, magnetic track brake and rail (cross section A-A)

4.1.2 Mounting position of the wheel sensor

The mounting position of the wheel sensor (measurement A and measurement B) depends on vehicle type, wheel profile and application (main line or light rail). The precise values can be taken from the corresponding project-specific documentation and from the specifications of the respective vehicle type. By compliance with these values, it is ensured that the wheel flanges are detected by the wheel sensor and that no mechanical contact occurs between wheel flange and wheel sensor.

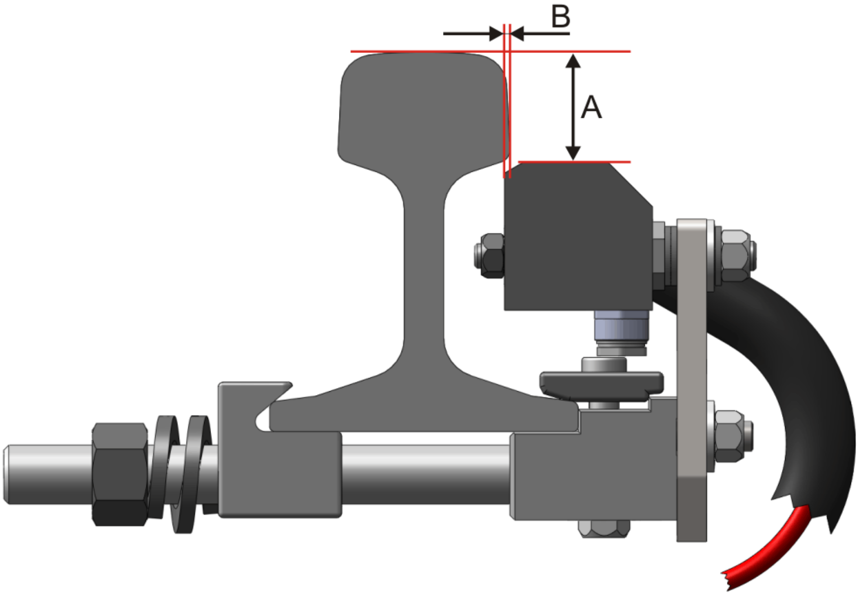


Figure 4.7: Definition of measurement A and measurement B, valid for Vignole rail

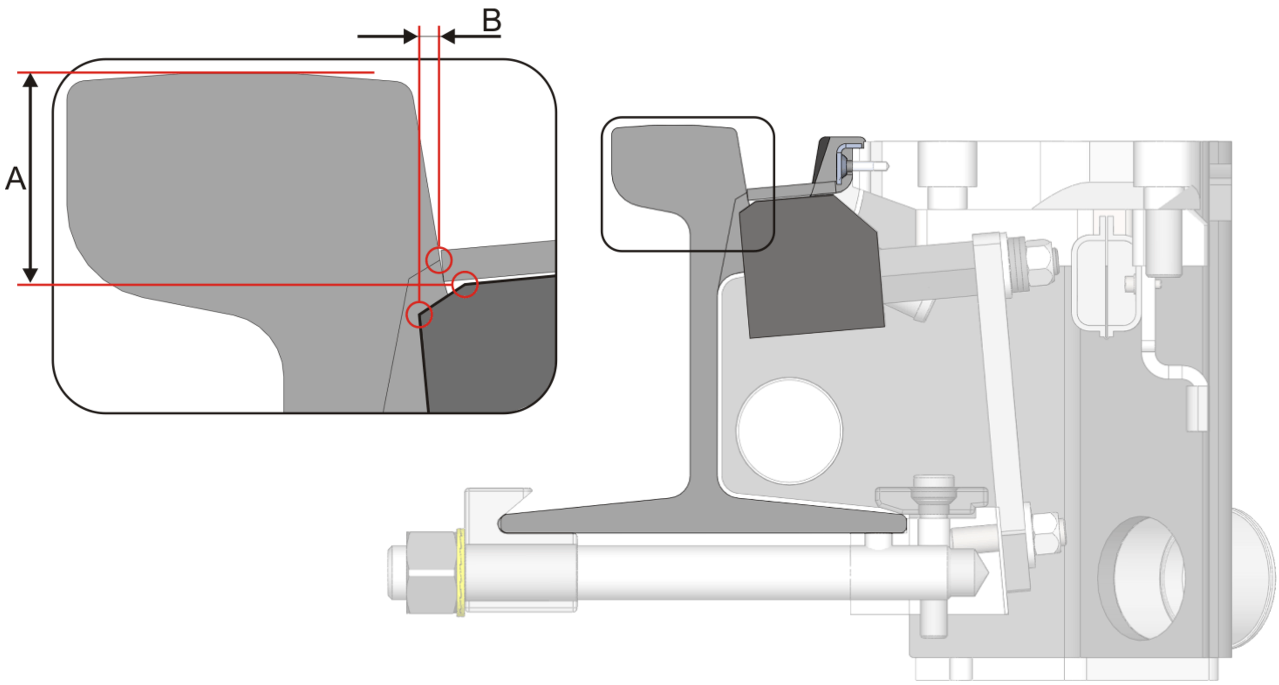


Figure 4.8: Definition of measurement A and measurement B, valid for grooved rail

4.2 Minimum length of a track section (FMA)

The minimum length of a track section ($L_{min\ FMA}$) depends on the maximum axle distance and the maximum speed of the rail vehicle and/or the permitted speed on the section (v_{max}), and on the times $T_{TIMEOUT}$ and T_{OCC_DELAY}, which can be configured.

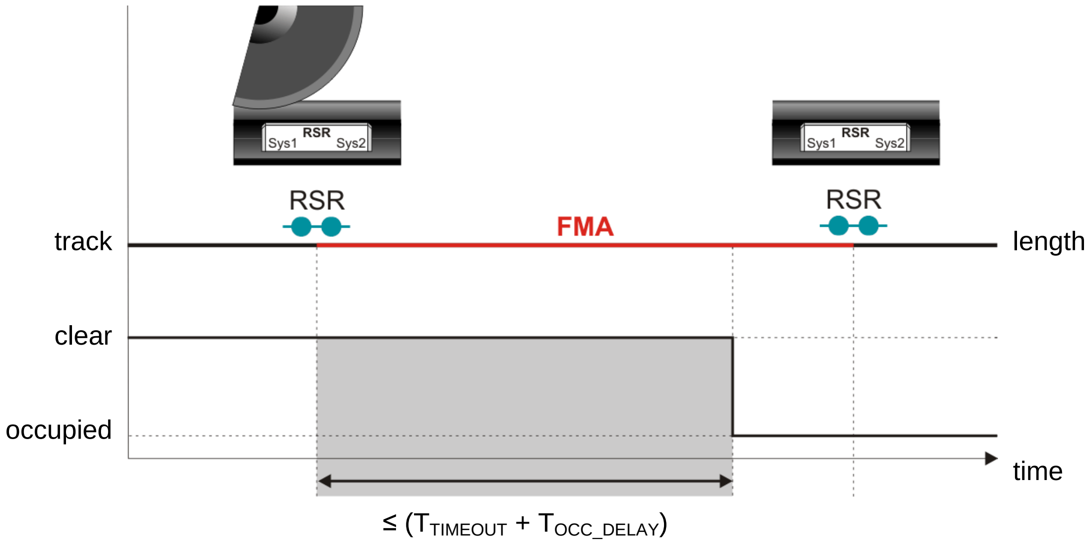


Figure 4.9: Minimum length of a track section (FMA)

The minimum length of a track section (FMA) can be calculated as follows:

$\mathbf{L_{min\ FMA} = v_{max} * (T_{TIMEOUT} + T_{OCC\_DELAY})}$

In case the “Counting Head Control” function is used, the minimum length of a track section (FMA) can be calculated as follows:

$$\mathbf{L_{min\ FMA} = v_{max} * (T_{TIMEOUT} + T_{OCC\_DELAY} + T_{TIMEOUT\_CHC})}$$

[$L_{min\ FMA}$]:	m
[v_{max}]:	m/s
[$T_{TIMEOUT}$]:	time-out of the FAdC, time in s (is configured in the configuration word “Time-out FAdC”; in the entry “CFG_TIMEOUT”, the values configured in the entry “TIMEOUT_VALUE” are assigned to one of the up to 8 possible time-outs)
[T_{OCC_DELAY}]:	occupied status delay, time in s (configured in the configuration word “Occupied status extension and occupied status delay” in the entry “OCC_DELAY”)
[$T_{TIMEOUT\_CHC}$]:	time-out of the FAdC if the “Counting Head Control” function is used, time in s (is configured in the configuration word “Time-out FAdC”; in the entry “CFG_TIMEOUT” the values configured in the entry “TIMEOUT_VALUE” are assigned to one of the up to 8 possible time-outs and then used in the configuration word “Counting Head Control”, entry “SLCT_TIMEOUT”)

Which time-outs are used for the counting heads of a track section (FMA) is configured in the configuration words “Counting head FMA 1” and/or “Counting head FMA 2” in the entry “SLCT_TIMEOUT” (time-outs 0 to 7).
For the calculation of the minimum length of a track section (FMA), the time-outs of all counting heads, which build a track section (FMA), must be observed. The biggest of all time-outs used must be considered for the minimum length of a track section.

In case of a transmission of data of an AEB, which builds the track section (FMA), to an AEB, which outputs the track section (FMA) via a detached IO-EXB[9], the time-out, which was configured in the entry “SLCT_TIMEOUT” of the configuration word “Output axle counting via IO-EXB”, must be added to the biggest used time-out.

SAB FAdC100_24:

The minimum length of a track section (FMA) depends on

- the maximum speed of travel,
- the data transmission times (configured time-outs),
- the configured occupied status delay and
- the maximum distance of axles within a rail vehicle.

SAB FAdC100_211:

During design and planning of the track sections (FMA) the accordance with the respective input data, as e.g. track layout, must be observed.

9 A “detached” IO-EXB is an IO-EXB, which is not directly connected to that AEB, which evaluates the track section (FMA) and provides the information.

4.3 Environmental conditions

SAB FAdC100_111:

In case of locations from a height > 2 000 m the following points must be observed:
The power supplies must not exceed 36 V.
The voltage on the interface “switching outputs” and on the interface “counting head outputs” must not exceed 36 V.

SAB FAdC100_104:

The outdoor equipment of the system FAdC may be used in the temperature range of -40 °C to +85 °C (corresponds to the classification of environment “Outdoors” TX of EN 50125-3).

SAB FAdC100_209:

The maximum annual average temperature outdoors (for the wheel sensors) must not exceed 25 °C.

SAB FAdC100_109:

If the indoor equipment of the system FAdC is operated near the track, then the distance from the track must be ≥ 3 m.

SAB FAdC100_103:

The indoor equipment of the system FAdC may be used in the temperature range of -40 °C to +70 °C (corresponds to the classification of environment “In the cubicle” T2 of EN 50125-3).

SAB FAdC100_210:

For the respective hazard rates, the annual average temperatures and the environmental conditions for the indoor equipment must be complied with.
(The annual average temperature is 30 °C in case of G_B and 40 °C in case of G_F.)

SAB FAdC100_51:

At the indoor equipment of the system FAdC condensation and ice formation must not occur.

SAB FAdC100_105:

For the indoor equipment of the system FAdC the following degree of pollution must be complied with:

- non-conductive dust deposit
- protected against sand
- protected against mould and sponge growth
- protected against rodents and other animal pests
- air pollution typically in this day and age in densely populated areas in which industrial facilities are spread throughout the entire area or in which there is a high volume of traffic

(This corresponds to the degree of pollution PD2 of EN 50124-1 and/or the classes 3C2, 3B1, 3S1 of EN 60721-3-3.)

SAB FAdC100_50:

The system FAdC may be used up to a maximum height of 3 000 m.

SAB FAdC100_141:

The components of the system FAdC must be stored and transported in respective ESD packaging.

SAB FAdC100_151:

For the storage the same environmental conditions apply as for the operation.

SAB FAdC100_152:

For the transportation the same environmental conditions apply as for the operation.

4.4 Insulating distances between the interfaces

An EMC type test according to EN 50121-4 was carried out successfully at the outdoor and indoor equipment of the FAdC.

In order to avoid faults of the wheel sensors, emissions (e.g. by traction converter) in the direct vicinity of the wheel sensors as well as in the frequency range of the sensor systems, which exceed the limit values according to the documentation D2950 “Limits of the sensitive detection range for wheel sensors” must be excluded.

In order to avoid faults of the sensors, the emission limit values according to the frequency management of the TS EN 50238-3 must be complied with by the rail vehicles.

All further information regarding the following safety-related application conditions can be taken from EN 50124-1. The details of EN 50124 -1 must be complied with.

SAB FAdC100_144:

Electrical operating resources, which are connected to the interface “supply”, may only be supplied from power supply circuits inside of buildings and/or AC-230 V primary circuit of operating resources.

SAB FAdC100_148:

Electrical operating resources, which are connected to the interface “Counting Head Outputs”, may only be supplied from supply circuits inside of buildings and/or AC-230 V primary circuit of operating resources.

SAB FAdC100_147:

Electrical operating resources, which are connected to the interface “switching inputs IO-EXB”, may only be supplied from the power supply circuits inside of buildings and/or AC-230 V primary circuit of operating resources.

SAB FAdC100_146:

Electrical operating resources, which are connected to the interface “switching outputs IO-EXB”, may only be supplied from power supply circuits inside of buildings and/or AC-230 V primary circuit of operating resources.

SAB FAdC100_149:

Electrical operating resources, which are connected to the interface “Ethernet”, may only be supplied from current circuits inside of buildings.

4.5 Power supply of the boards

- The power supply must be uninterruptible.
- The power supply must be in the range of +19 to +72 V DC.
- In case of cyclic shutdowns, the system FAdC must be in continuous operation for at least 6 hours between shutdowns.[10]
- The power supply must be connected to the interface “supply” on the rear side of the backplane BP-PWR. This interface has a pluggable cage clamp terminal for cross-sections up to 1,5 mm².
- The current consumption depends on the applied power supply and the number of connected boards.

It is recommended to use a cable with a current carrying capacity of 10 A for the connection between the power supply unit and the interface “power supply”.

The power supply of the system must be dimensioned in such a way that sufficient current according to the requirements of the boards is available.

The following criteria must be met (for each PSC):

1. Depending on the applied **power supply U** (+19 to +72 V DC), the **current consumptions I** of all boards supplied by one PSC must be added together. The total current consumption (∑I) of one PSC must not exceed **4 900 mA.** If this value cannot be complied with, several PSC boards must be used and must be divided up on the respective number of BP-PWR backplanes.
2. AEB, COM and IO-EXB boards also load the 5 V side of a PSC. Therefore, these **current consumptions I_{5V}** must be added together for each PSC as well. The total current consumption ($\sum I_{5\,V}$) on the 5 V side of a PSC must not exceed **2 500 mA**.

The respective values of the boards are specified in the following chapters.

The power supply unit of the system must be dimensioned as follows:

- The **nominal current I_N** of the power supply unit must be higher than the total current consumption (∑I) of all boards, which should be supplied by this power supply unit.
- The **power-up current I_V**, which must be provided for a short period by the power supply unit must be higher than the sum of the **maximum power up currents I_{max}** of all boards, which should be supplied by this power supply unit.

10 Exception: During commissioning, several power-ups can be carried out.

With following formula the **time t** can be calculated, for which the power supply unit must be able to provide the power-up current I_V:

It applies:	$\sum I$	<	I_N (dependent on power supply unit)
	$\sum I_{max}$	<	I_V (dependent on power supply unit)
	t	<	t_V (dependent on power supply unit)

$\sum I$:	total current consumption of all boards
$\sum I_{max}$:	sum of the maximum power-up currents
t:	time, for which the power supply unit must provide the power-up current I_V
t_V:	time, for which the power supply unit is able to provide the power-up current I_V
U:	nominal power supply
n:	number of PSC boards
m:	number of AEB boards

C_{PSC} = 800 µF
C_{AEB} = 10 µF

$$t = \frac{(n * C_{PSC} + m * C_{AEB}) * U}{I_V - \sum I_{max}}$$

SAB FAdC100_41:

If the system FAdC is shutdown cyclically for operational reasons, it must be observed that a shutdown may happen no earlier than after 6 hours of uninterrupted use.

The maximum supply current depends on the number of boards in the system FAdC. The maximum supply current per CAN segment must not exceed 4 900 mA.

For a high availability, the maximum voltage must be limited to 60 V (+20 %).

For a high availability, the minimum voltage must be limited to 24 V (-20 %).

4.5.1 Ripple

- The rated voltage of +19 to +72 V DC must be complied with at any time in spite of ripple. If these values are not complied with, the system changes to fault status.
- The maximum permitted ripple is shown in the following figure.

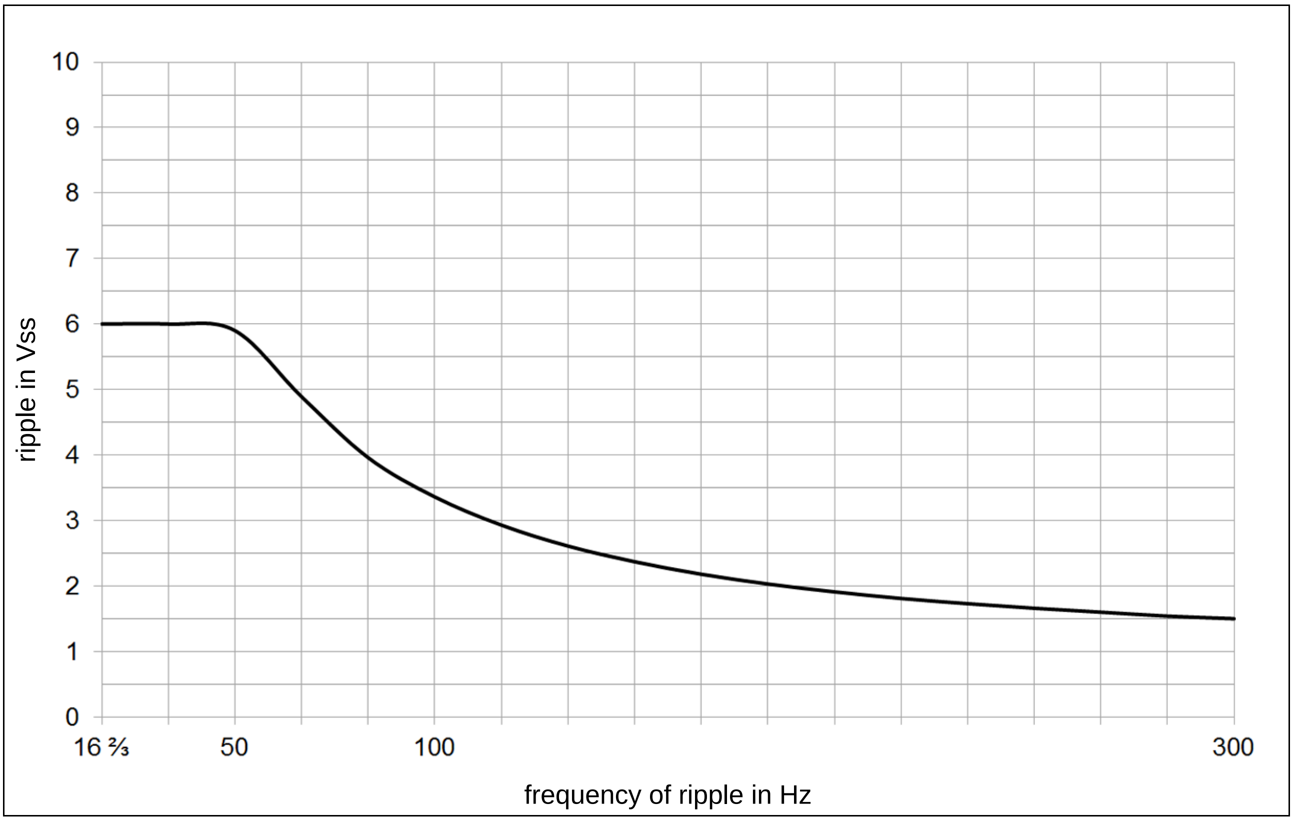


Figure 4.10: Maximum permitted ripple on the rated voltage

4.5.2 Current consumption of the PSC

The current consumption of the PSC can be taken from following figure.

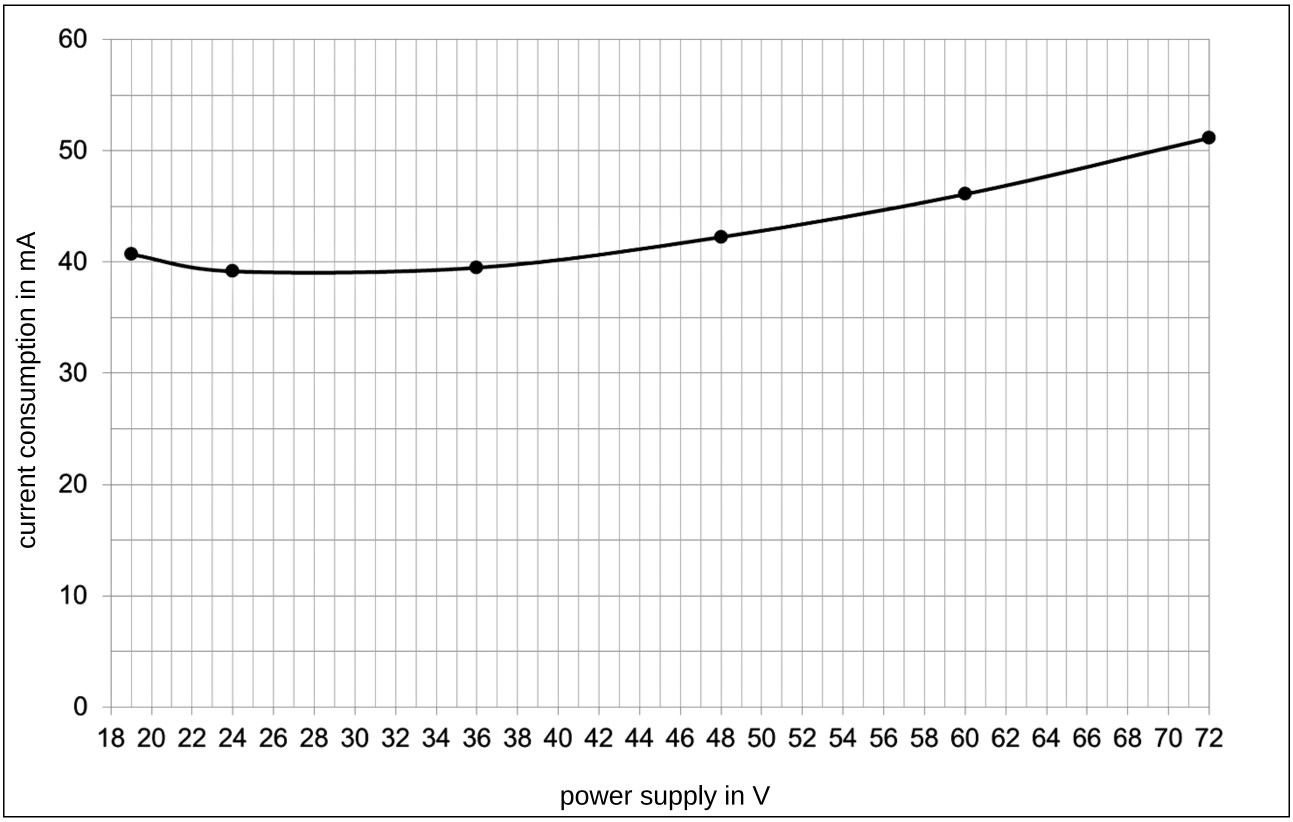


Figure 4.11: Current consumption of the PSC

The maximum power-up current of the PSC is: I_{max} = 42,9 mA

4.5.3 Current consumption of the AEB with connected RSR180

The current consumption of the AEB with connected wheel sensor RSR180 can be taken from following figure.

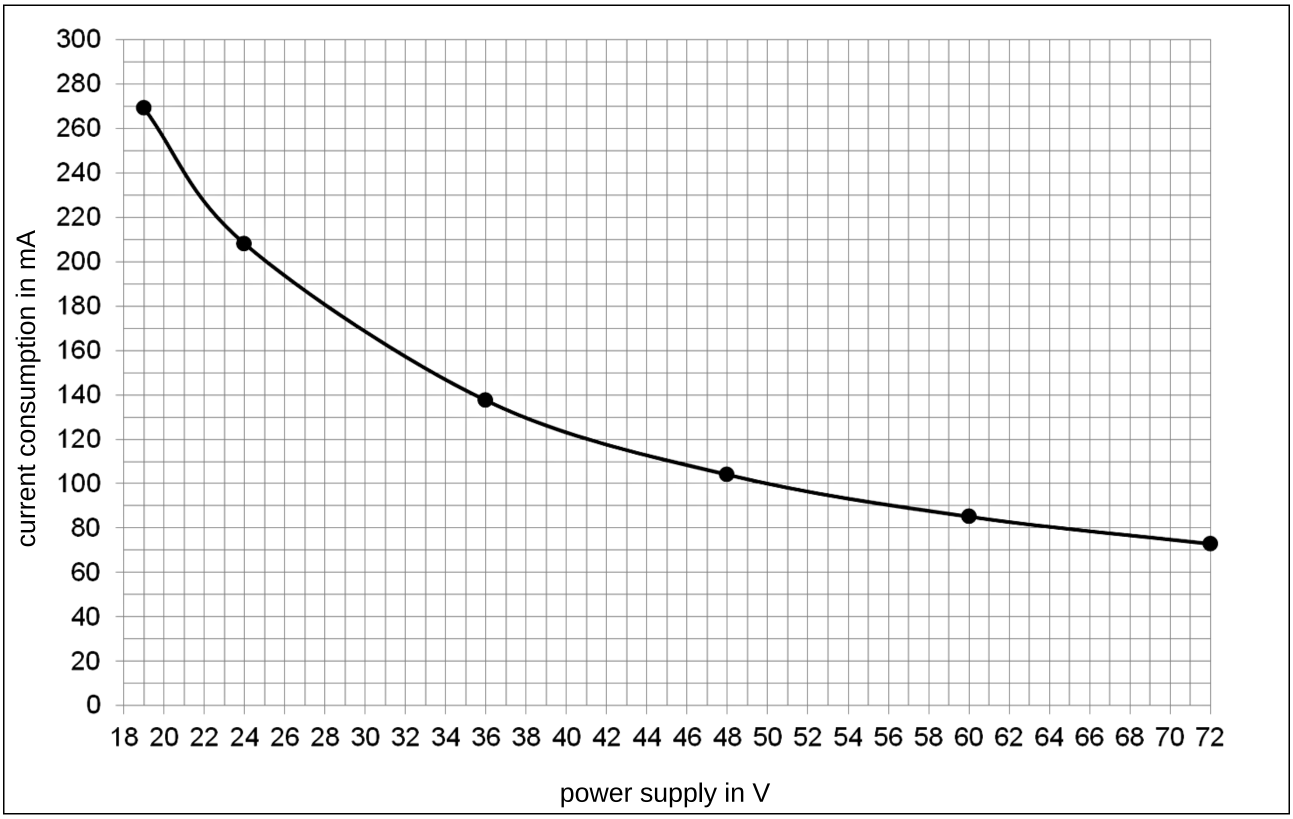


Figure 4.12: Current consumption of the AEB with connected RSR180

The maximum power-up current of the AEB with connected RSR180 is:	I_{max} = 278 mA
The current consumption of the AEB on the 5-volt side of the PSC is:	$I_{5\,V}$ = 15,4 mA

4.5.4 Current consumption of the AEB with connected RSR123

The current consumption of the AEB with connected wheel sensor RSR123 can be taken from following figure.

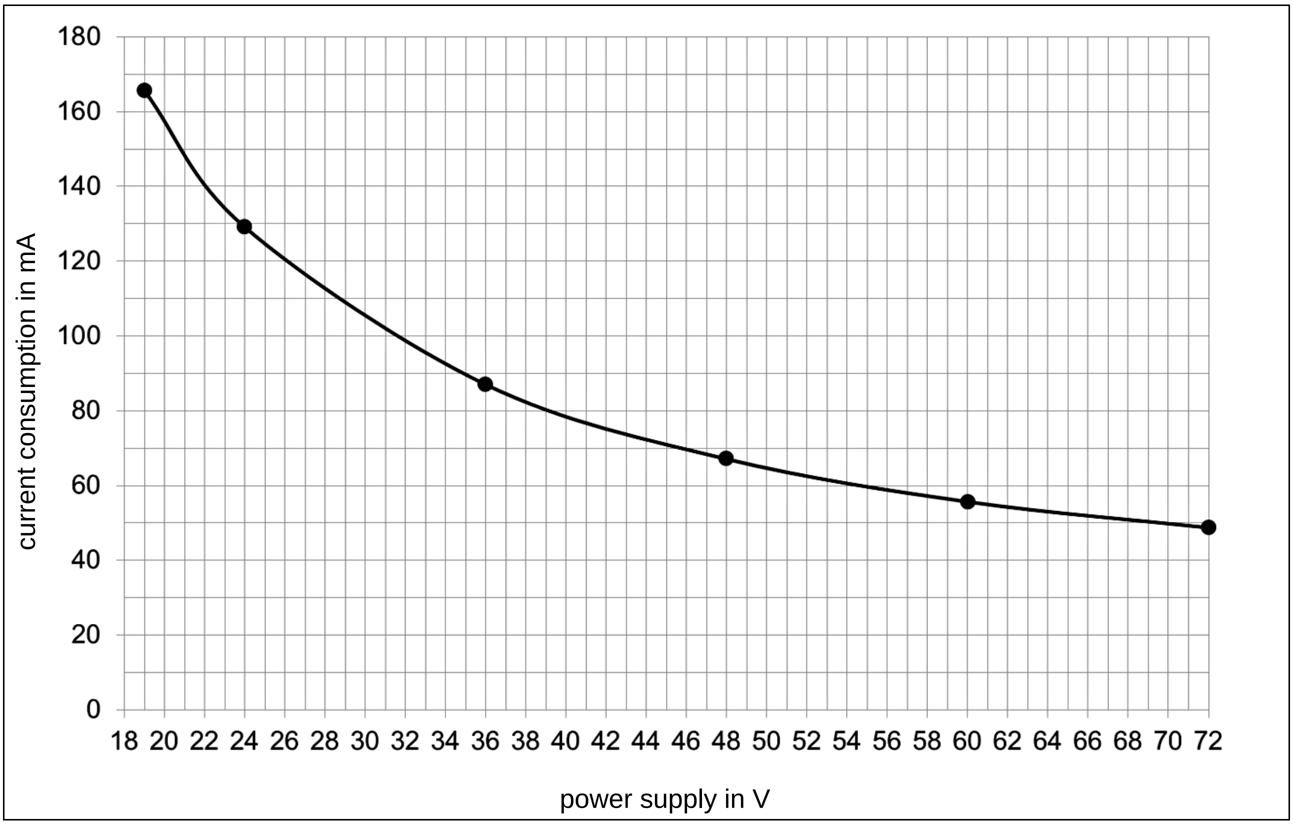


Figure 4.13: Current consumption of the AEB with connected RSR123

The maximum power-up current of the AEB with connected RSR123 is: I_{max} = 165 mA

The current consumption of the AEB on the 5-volt side of the PSC is: $I_{5\ V}$ = 15,4 mA

4.5.5 Current consumption of the IO-EXB

The current consumption of the IO-EXB can be taken from following figure.

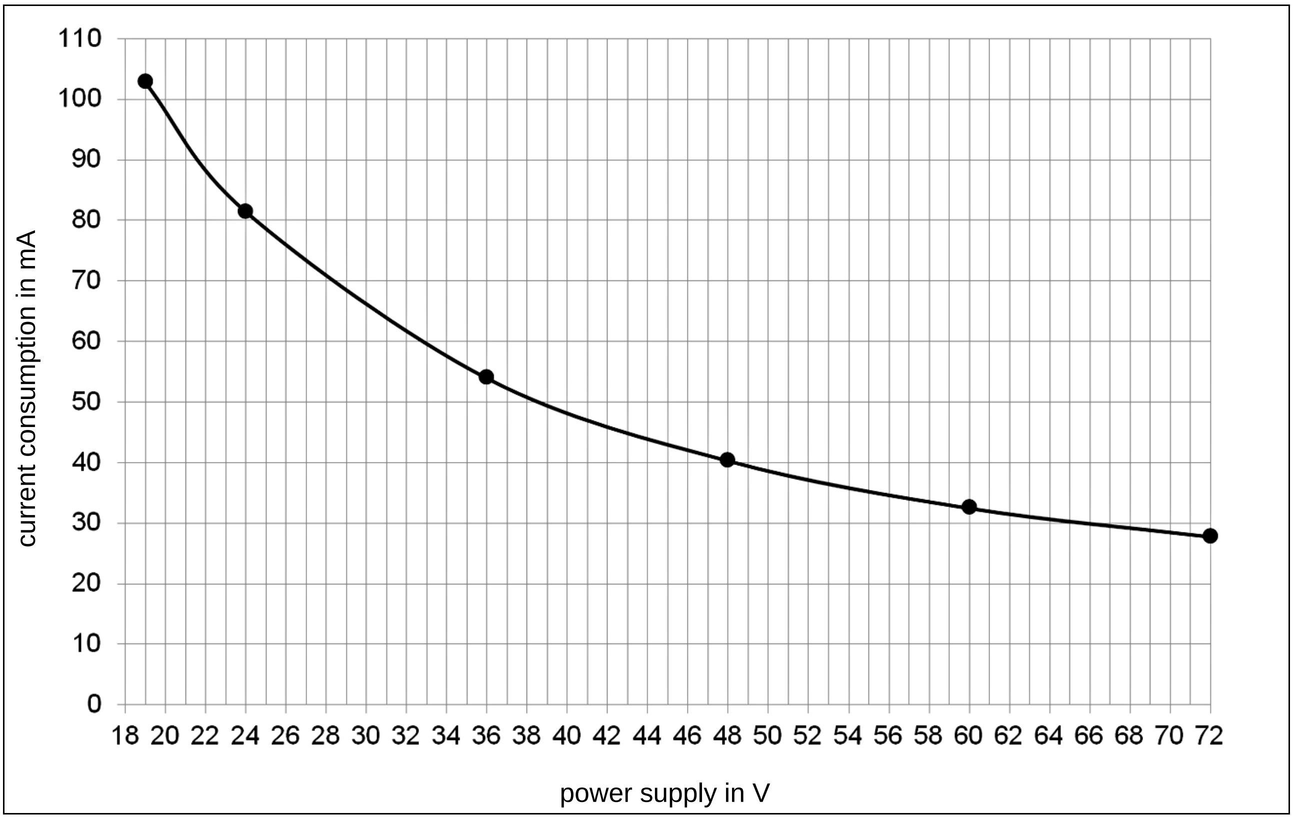


Figure 4.14: Current consumption of the IO-EXB

The maximum power-up current of the IO-EXB is:	I_{max} = 5,5 mA
The current consumption of the IO-EXB on the 5-volt side of the PSC is:	$I_{5\,V}$ = 309,4 mA

4.5.6 Current consumption of the COM

The current consumption of the COM can be taken from following figure.

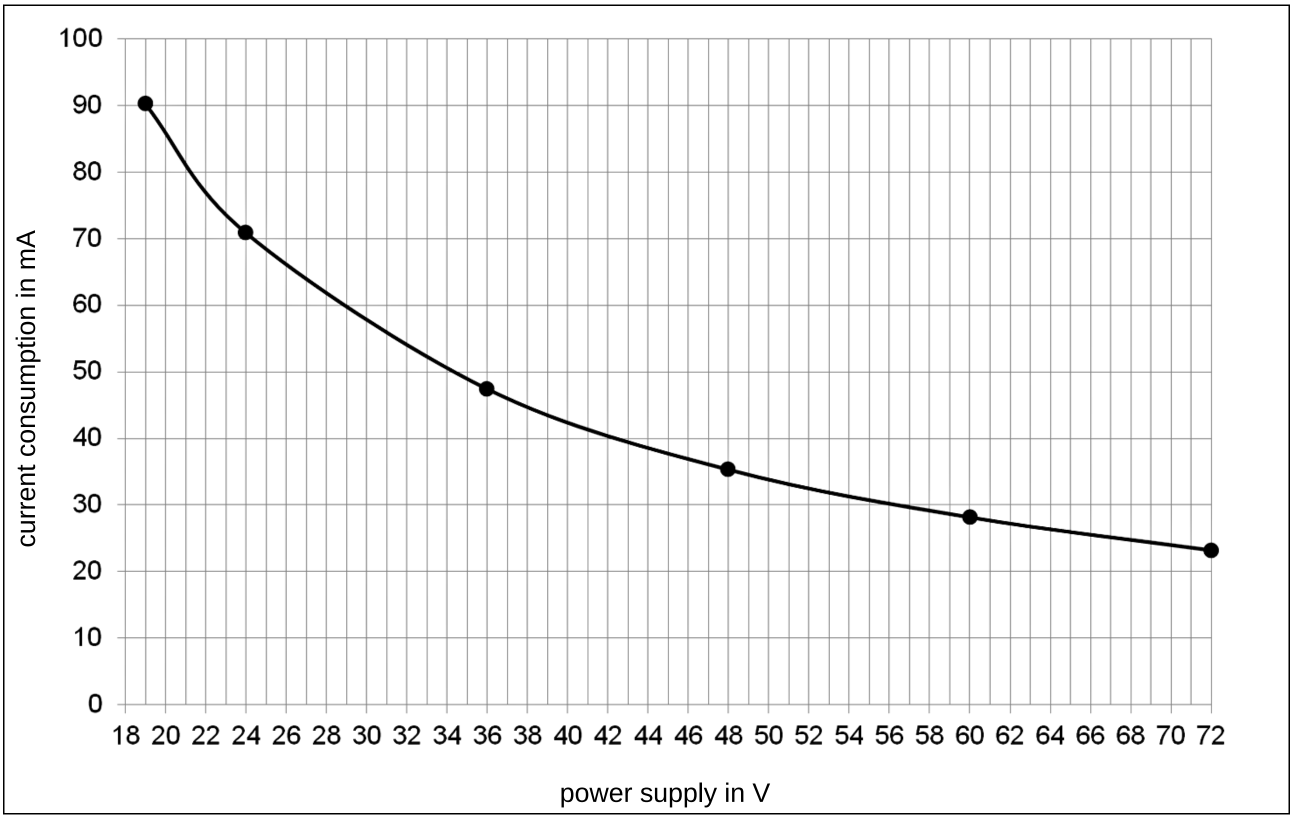


Figure 4.15: Current consumption of the COM

The maximum power-up current of the COM is:	I_{max} = 95,7 mA
The current consumption of the COM on the 5-volt side of the PSC is:	$I_{5\,V}$ = 341,0 mA

4.5.7 Model calculation for the dimensioning of the supply

For this model calculation, the following assumptions are made:

- Applied power supply: $U = 24$ V
- Nominal current of the power supply unit: $I_N = 650$ mA
- Power-up current of the power supply unit: $I_V = 800$ mA for $t_V = 1$ s

In this example following boards are contained to the complete system FAdC:

- 1 PSC
- 2 AEB boards in combination with RSR180
- 1 IO-EXB
- 1 COM

Whether the supply of the system is dimensioned correctly, can be checked as follows:

1. Criterion 1: Sum of current consumptions I (24 V):

1 PSC:		1 * 39 mA		
2 AEB boards:		2 * 209 mA		
1 IO-EXB:		1 * 81 mA		
1 COM:		1 * 71 mA		
	=	609 mA	**< 4 900 mA**	→ criterion 1 is met

2. Criterion 2: Sum of current consumptions $I_{5\ V}$:

2 AEB boards:		2 * 15,4 mA		
1 IO-EXB:		1 * 309,4 mA		
1 COM:		1 * 341,0 mA		
	=	681,2 mA	**< 2 500 mA**	→ criterion 2 is met

In this example both criteria are met, therefore the power supply of this system is dimensioned correctly.

Whether the power supply unit is dimensioned correctly, can be checked as follows:

Sum of current consumptions I (24 V):

$\sum I$ (24 V): 609 mA < 650 mA → **$\sum I$ (24 V) < I_N** is met

Addition of the maximum power-up currents I_{max}:

1 PSC:	1 * 42,9 mA
2 AEB boards:	2 * 278,0 mA
1 IO-EXB:	1 * 5,5 mA
1 COM:	1 * 95,7 mA
=	700,1 mA

= 700,1 mA < 800 mA → **$\sum I_{max}$ < I_V** is met

$$t = \frac{(1 * 800\ \mu F + 2 * 10\ \mu F) * 24\ V}{800\ mA - 700,1\ mA} = 0{,}384\ s < 1\ s$$

→ **$t < t_V$** is met

4.6 Cabling

- The cabling and the connection to clamps must be carried out professionally.
- Preferable, wheel sensor cables must be laid so that they are separate from electric power lines, motor lines, lines in which transients occur due to switching operations, etc., in order to minimise electromagnetic interference. Raised interference levels, caused by crosstalk, result in a reduced availability of the system.
- Several wheel sensor signals are possible in a single cable (only signals of Frauscher wheel sensors).
- Preferable, cables before and after the overvoltage protection board BSI must be laid separately (EMC).
- Cables in the indoor equipment must be laid via the shortest route.
- When laying the cable, the regulations of the cable manufacturer and the operator must be observed.
- When laying the earth connection (e.g. overvoltage protection board BSI, board rack BGT), a low transfer resistance and a low inductance (i.e. avoid loops and bends) must be observed especially.

SAB FAdC100_75:

The “X2” connector on the backplanes may only be used for power supply of the system FAdC.

SAB FAdC100_76:

The cable between overvoltage protection board and AEB must be laid so that interwire shorts or earth faults can be excluded.

SAB FAdC100_77:

The cables/wires connected to the interface “switching outputs” must be laid so that interwire shorts or earth faults can be excluded.

SAB FAdC100_78:

The cables/wires connected to the interface “counting head outputs” must be laid so that interwire shorts or earth faults can be excluded.

SAB FAdC100_102:

The cables/wires between 2 AEB boards in case of analogue double usage must be laid so that interwire shorts or earth faults can be excluded.

The connection between an overvoltage protection board and the ground (earth conductor) must exhibit a cross-section of at least 6 mm².

4.6.1 Cable types

- In order to ensure high availability, Frauscher recommends that a star-quad signalling cable is used for the wheel sensor cabling between cable terminating frame KA(and/or overvoltage protection board BSI) and backplane BP-PWR and/or BP-EXB. This cable must have an electric strength of at least 100 V between the wires.
- For the CAN bus cabling, a shielded 8-pin cable of type S/FTP and of category CAT5, CAT5e or CAT6 must be used.
- For the interface “Ethernet”, a shielded 8-pin cable of type S/FTP and at least of category CAT5, CAT5e or CAT6 according to ISO/IEC 11801 must be used.

4.6.1.1 Cable between wheel sensor and cable terminating frame (and/or overvoltage protection board)

Wheel sensor cable

A cable with PUR outer coating and coloured marked wires is present at the wheel sensor. The wheel sensor cable of the wheel sensor RSR180 is moulded in the wheel sensor. The wheel sensor cable of the wheel sensor RSR123 is designed pluggable.
The wheel sensor cable has a standard length of 5 m, if needed, special lengths are available. In this case, contact Frauscher.

➡ It is explicitly recommended to additionally protect the wheel sensor cable mechanically by means of a protection tube.

The protection tube can be ordered separately from Frauscher. The wires of the wheel sensor cable are connected to the ongoing signalling cable in a trackside connection box GAK, by means of clamps. The trackside connection box can optionally be replaced by a plug connection.

Signalling cable

In order to ensure a high availability, Frauscher recommends to use star-quad signalling cables with PE insulation and PE coating (e.g. according to the Technical Performance Specifications 416.0115 and the Engineering Specifications 416.0116 or according to DIN VDE 0816 Part 2) for the cabling between trackside connection box and cable terminating frame (and/or overvoltage protection board).

If other cables are used in existing and/or new systems, this may impair the availability of the system.
When laying the cables from the wheel sensor to the overvoltage protection board BSI, it must be observed that no signals except those from the wheel sensors of Frauscher are transmitted in the signalling cable. However, signals from various Frauscher wheel sensors may be transmitted in one signalling cable.

In case the wheel sensor RSR180 is used, the wires of the signalling cable must be arranged as follows:

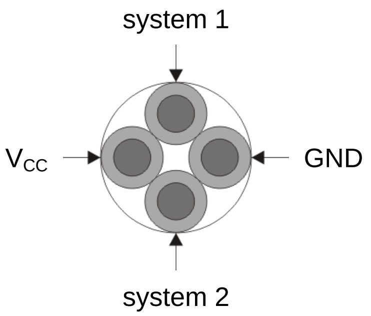


Figure 4.16: Arrangement of the wires when using a star-quad signalling cable, valid for RSR180

In case the wheel sensor RSR123 is used, the wires of the signalling cable must be arranged as follows (2 diametrically-opposed wires form one loop in each case):

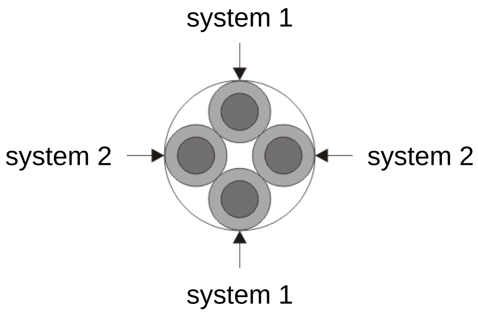


Figure 4.17: Arrangement of the wires when using a star-quad signalling cable, valid for RSR123

4.6.2 Colouring of the patch cables

For the cabling of the system with patch cables, Frauscher uses the following colours as standard:

Interface	Colour of patch cable
CAN	green
diagnostic interface	yellow
Ethernet	grey

Table 4.5: Colouring of the patch cables

4.6.3 Maximum cable lengths

In the following the maximum cable lengths are specified for the different interfaces.

SAB FAdC100_81:

The total length of the CAN bus must not exceed 20 m.

SAB FAdC100_84:

The cable length on the diagnostic interface “Serial Interface” must not exceed 3 m.

SAB FAdC100_83:

The cable length on the test sockets must not exceed 3 m.

SAB FAdC100_82:

The cable length on the interface “counting head outputs” must not exceed 30 m.

SAB FAdC100_80:

The cable length on the interface “internal supply voltage” (connector “X2”) must not exceed 30 m.

Interface	Maximum cable length
CAN bus	≤ 20 m (total length)
diagnostic interface (“Serial Interface”) (front panel of the AEB and COM)	≤ 3 m
test sockets (front panel of the AEB)	≤ 3 m
Hotlink (front panel of the COM)	≤ 2 m
Ethernet (front panel of the COM)	≤ 100 m (total length)
clear/occupied (IO-EXB)	≤ 10 km
reset inputs (IO-EXB)	≤ 10 km
Counting Head Control inputs (IO-EXB)	≤ 10 km
digital inputs/outputs (IO-EXB)	≤ 10 km
power supply (external)	≤ 10 km
power supply (internal, between BP-PWR and BP-EXB)	≤ 30 m
counting head outputs (AEB)	≤ 30 m
wheel sensor (dependent on the loop resistance of the cable)	≤ 10 km (see following tables)

Table 4.6: Overview of the maximum cable lengths for the respective interfaces

Wire diameter	Loop resistance/km	Maximum cable length
0,4 mm	300,0 Ω	0,8 km
0,6 mm	130,0 Ω	1,9 km
0,8 mm	73,2 Ω	3,4 km
0,9 mm	56,6 Ω	4,4 km
1,4 mm	23,4 Ω	10 km

Table 4.7: Maximum cable length of the wheel sensor cable with different wire diameters, valid for wheel sensor RSR180

The projected loop resistance of the cable between RSR180 and AEB must not exceed 250 Ω.

Wire diameter	Loop resistance/km	Maximum cable length
0,4 mm	300,0 Ω	1,6 km
0,6 mm	130,0 Ω	3,8 km
0,8 mm	73,2 Ω	6,8 km
0,9 mm	56,6 Ω	8,8 km
1,4 mm	23,4 Ω	10 km

Table 4.8: Maximum cable length of the wheel sensor cable with different wire diameters, valid for wheel sensor RSR123

The projected loop resistance of the cable between RSR123 and AEB must not exceed 500 Ω.

4.6.4 Shielding concept for cables between wheel sensor and evaluation board

If the cables are equipped with a shielding, then this shielding must be earthed according to the applicable railway regulations. If there are no applicable railway regulations available on this matter, then the shielding can be earthed one-sided in the indoor equipment. In case of double-sided earthing the compensation currents and return currents must be taken into account. The use of a shielded cable is not mandatory.

4.7 Delay periods and time-out of the FAdC

In general, the transmission and/or delay times of the CAN segment and of the Ethernet connection must be taken into account in the configuration of the FAdC.

Dependent on the requirement up to 8 different time-outs can be configured.

The duration of a time-out depends on the following factors:

- communication of all participants on the same CAN segment or forwarding via COM boards
- configured transmission interval (time-out ≥ configured transmission interval)
- number of transmissions (data packets)
- number of CAN segment participants
- network delays (only in case of forwarding via COM boards)

In case of communication of all participants on the same CAN segment, a “short” time-out is sufficient, in case of forwarding via COM boards, a “longer” time-out is necessary.

The following table contains suitable values for time-outs per transmission interval. These can be configured in the configuration word “Time-out FAdC”.

Transmission interval	Time-out for participants on the same CAN segment	Time-out for forwardings via COM boards
10 ms	80 ms	115 ms + 2 * T_{delay}
40 ms	190 ms	270 ms + 2 * T_{delay}
80 ms	340 ms	480 ms + 2 * T_{delay}
160 ms	500 ms	640 ms + 2 * T_{delay}
T_{delay} = network delay		

Table 4.9: Time-outs for participants at the same CAN segment and for forwardings via COM boards

The values for the time-out are configurable in steps of 10 ms and must be rounded up accordingly.

In case of time-critical applications, the time-outs can be optimised. In this case, consult Frauscher.

For the data transmission applies:
After resumption and synchronisation of the communication, the information from this board can be processed further.

For the clear indication applies:
After resumption and synchronisation of communication within 30 days, the information from this board can be processed further.
If the 30 days expire, the track sections (FMA), which are evaluated by this AEB, change to fault status. This fault status can be removed by a reset after resumption of communication (dependent on the configured reset procedure).

4.8 Bandwidth requirement on the interface “Ethernet” and participants per CAN segment

4.8.1 Bandwidth requirement on the interface “Ethernet”

Internal bandwidth requirement per AEB:
2 data packets with a maximum of 93 bytes each (inclusive overhead Ethernet) per transmission interval

Transmission interval	Data transmission rate[11]
10 ms	18 600 bytes/s
40 ms	4 650 bytes/s
80 ms	2 325 bytes/s
160 ms	1 162,5 bytes/s

Table 4.10: Data transmission rates per AEB

Bandwidth requirement per AEB or COM for transmission to the FDS:
1 data packet with a maximum of 73 bytes (dependent on the amount of diagnostic information)

Transmission interval	Data transmission rate[12]
10 ms	7 300 bytes/s
40 ms	1 825 bytes/s
80 ms	912,5 bytes/s
160 ms	456,25 bytes/s

Table 4.11: Data transmission rates per AEB for transmission to the FDS

Bandwidth requirement for timestamp requests:
2 data packets with a maximum of 93 bytes each
In case data are evaluated by a forwarded AEB, then a timestamp request to this AEB takes place every 24 s. If the timestamp request is not answered, then the timestamp request takes place in a 2 s interval.

11 Inclusive overhead Ethernet and under consideration of both data packets

12 The stated values are the maximum values, which are technically possible.

4.8.2 Participants per CAN segment

Within a project up to 4 095 participants with the same project number, which are spread on several CAN segments, can be present.

For the calculation of the maximum participants per CAN segment it is distinguished between
- actual participants (boards) and
- virtual participants (forwarded boards).

The maximum number of participants per CAN segment is limited by the following 2 factors:
- physical load (all boards connected to the CAN segment)
- temporal utilisation (amount of data)

The physical load per CAN segment is limited with a maximum of 80 boards in case of a transmission interval of 80 ms or 160 ms, whereas the following must be observed:
- one AEB counts as a single participant
- one COM counts as a double participant
- redundant COM boards count as 4-times participant

At the temporal utilisation which is dependent of the transmission interval, the following limits are valid:
- one AEB counts as a single participant
- one AEB, which is configured for data transmission counts as 1,5-times participant
- one COM counts as a single participant
- redundant COM boards (= 2 COM boards) count as a single participant
- one forwarded AEB counts as a single participant
- one forwarded AEB, which is configured for data transmission counts as 1,5-times participant

The number of the maximum participants (actual and virtual) when considering the temporal utilisation at the CAN segment depends on the transmission interval.

Transmission interval	Number of actual and virtual participants
10 ms	10
40 ms	40
80 ms	80
160 ms	80

Table 4.12: Number of actual and virtual participants per CAN segment dependent on transmission interval

4.8.3 Maximum number of the AEB boards in case of data transmission via the interfaces “CAN” and “Ethernet”

The sum of the axle counting data at the CAN bus as well as the data received via Ethernet must not exceed the following specified values.

Transmission interval	Maximum number AEB boards
10 ms	10
40 ms	40
80 ms	80
160 ms	110

Table 4.13: Maximum number of the AEB boards per transmission interval in case of data transmission via the interfaces “CAN” and “Ethernet”

5 Configuration

5.1 Concept of configuration

5.1.1 Independent data generation and verification

The tasks described in the following chapters must be carried out by 2 independent persons. One is the originator, the other is the verifier.

The originator transfers the configuration data from input documents (e.g. track layout) into a configuration file (e.g. by means of a text editor).

The verifier checks if the configuration data was correctly transferred from the input documents and records successful transfer with various statements in a verification protocol.

Data generation and verification must take place independently from each other.

5.1.2 Configuration process

By means of the defined requests of the user (e.g. track layouts or other track descriptions) the following must be determined:

- number of wheel sensors and track sections (FMA)
- unique designation of counting heads according to track layout
- unique designation of track sections (FMA) according to track layout
- number and ID of boards (evaluation and communication boards)
- assignment of wheel sensors and track sections (FMA) to the indoor equipment (communication boards)
- software and/or hardware interface to the interlocking
- data transmission (IO-EXB, forwardings)
- system FAdC redundant or not redundant (power supply, communication via Ethernet)

The FAdC can either be configured by Frauscher, if requested and ordered by the customer or by the user, according to his requirements.

The AEB and the COM boards are hereinafter described as boards to be configured.

At the configuration a configuration file is created for each board to be configured, e.g. via text editor. The configuration file contains the configuration words and the configuration parameters set for each configuration word.
All boards to be configured, which have the same project number, must be identifiable by a unique address (ID). For this purpose, an individual ID is configured in the configuration file. This ID must

be set via DIP-switches and must be checked against the verification protocol during commissioning.

The configuration files of all boards to be configured within the same CAN segment are saved on the CF cards of 1 or 2 (= redundant) COM board(s). The COM functions as a configuration server in case the DIP-switches are set respectively.

After each power-up, the board to be configured checks after reception of the configuration data the safety features contained in the configuration file, e.g. the ID, the identification of component, the checksum as well as that the verification entry “VERIFY” is available and greater than the creation entry “VERSION” (see chapter “Structure of a configuration file for AEB and COM”). Afterwards, it is checked in regular intervals if the configuration data of the configuration server have changed. If this is the case, the failsafe status “faulty” will be entered.

The operator must ensure that the configuration files on all COM boards are valid and identical per ID within a CAN segment.

If all checks are successful, the boards to be configured analyse the parameters contained therein and operate accordingly.
If the checks are not successful, the received data are discarded and the configuration is re-requested (potentially from another COM). If no valid configuration has been received after 10 minutes, then the board takes up the error status and still outputs the failsafe status “faulty”.

5.1.2.1 Creation

The originator transfers the details from approved documents (e.g. track layout) and creates manually a configuration file in a text editor for each board to be configured. The used text editor must be set to ANSI character encoding.
The configuration files of all boards to be configured within one CAN segment are saved on 1 or 2 CF card(s). The CF cards must be formatted in the file system FAT16 or FAT32 and withstand the requirements according to chapter “Environmental conditions”.

➡ It is recommended to use exclusively CF cards which were checked by Frauscher.

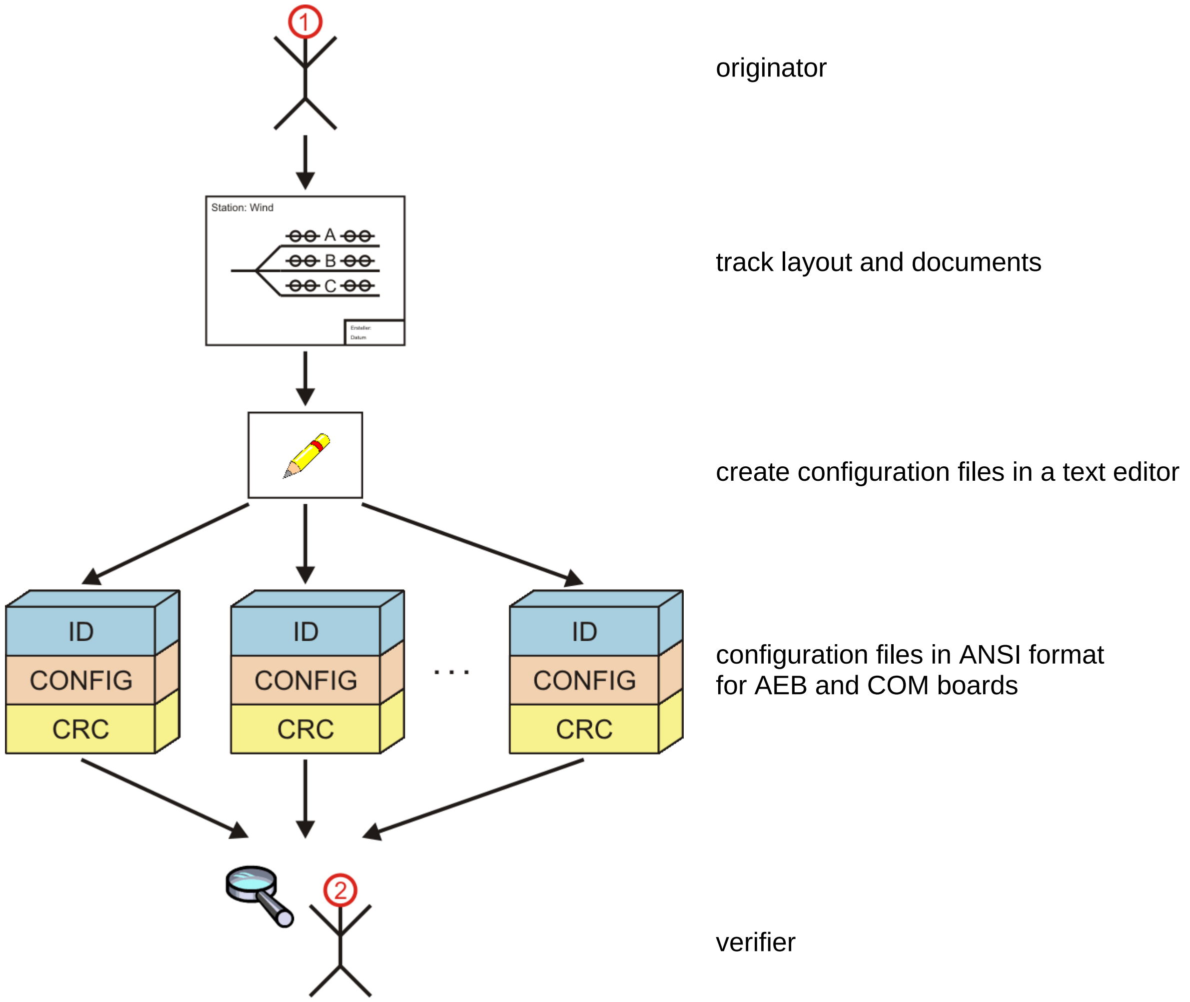


Figure 5.1: Creation of the configuration

5.1.2.2 Verification

Before the configuration is completed, it must be checked whether all necessary parameters were configured. This check can be carried out with a checklist (example see following table).

	Yes	No
Do all boards to be configured have a unique ID within a/their project number?		
Have all counting heads been assigned correctly to track sections according to the track layout?		
Is the track section information according to the track layout available to the downstream system?		
Are all information to be transmitted via IO-EXB configured with the correct information with regard to source, destination and safety level?		
Do the configured time-outs match the projected time-outs?		

Table 5.1: Example for a check list for the creation of the configuration

The verifier checks the configuration files, on basis of the track layouts and documents, whether or not the data was created correctly. All data must be checked, except for the checksum.

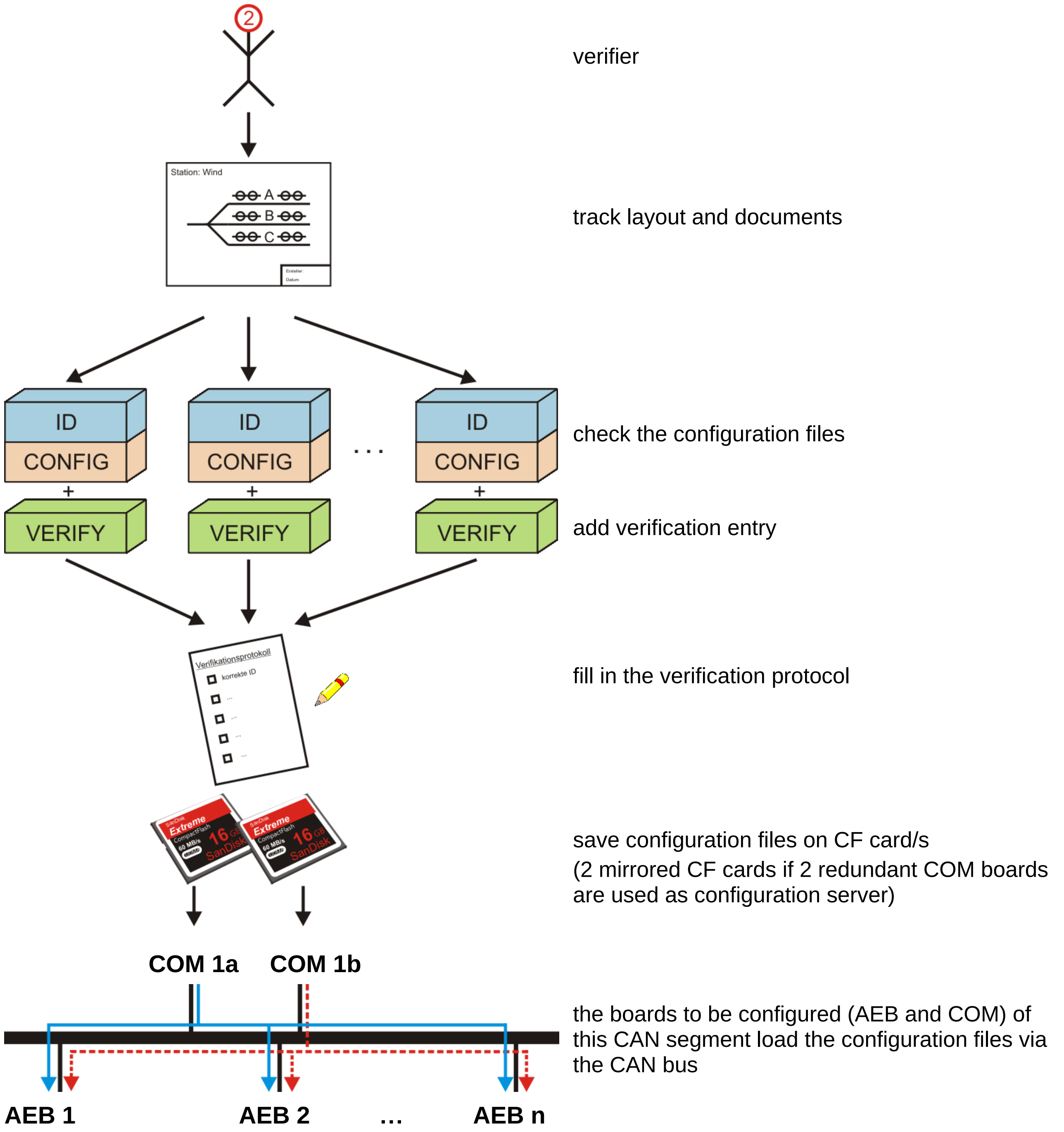


Figure 5.2: Verification of the configuration

If the data are correct, the verifier notes the time of successful verification at the end of the configuration file (see chapter “Structure of a configuration file for AEB and COM”). The verifier notes the details given below for each board to be configured in a verification protocol (example see following table):

- file name
- type of board
- unique designation relating to the track layout (e.g. name of counting heads and name of the track sections (FMA))
- unique ID of the board
- creation entry “VERSION” of the configuration
- verification entry “VERIFY” of the configuration
- checksum of the configuration
- position of the DIP-switches (see chapter “Setting of the DIP-switches”),
- type protection code(s) of the AEB

Parameters to be checked	Values of the parameters to be checked		
File name:	C0059_00.ADC	C0060_00.ADC	C0100_00.ADC
Type of board:	AEB	AEB	COM
Designation relating to the track layout:	ZP01	ZP02	COM01
ID of the board:	0059	0060	0100
Creation entry (“VERSION”):	0x201405081337	0x201405091314	0x201405100945
Verification entry (“VERIFY”):	0x201405081621	0x201405091527	0x201405101152
Checksum of the configuration (“CRC”):	0xA112C235	0xDEA1DFF5	0xC1E5616E
Position of the DIP-switches[13]:	0b0110	0b0111	0b1000
Type protection code for safety-critical configuration words, which are set by Frauscher (“TYPE_PRTCT_CODE”):	0x00000000	0x00000000	-
Type protection code for project specific configuration words, which are set by the user (“TYPE_PRTCT_CODE”):	0xC7DB3E86	0x8C41FF0E	-
Name/signature of the verifier:	XY	XY	XY

Table 5.2: Proposed verification protocol for configuration

SAB FAdC100_88:

The originator of the configuration and the verifier of the configuration must not be the same person.

13 In this example, the position of the DIP-switches was read out with the help of the ASD.

5.2 Configuration file

5.2.1 File name and directory of configuration files

5.2.1.1 File name of configuration files

The file name of a configuration file must be structured as follows:

C	ID of board	_	00	.	ADC
capital letter	4-digit in decimal notation with leading zeros	underscore	channel, 2 zeros in decimal notation	full stop	file extension in capital letters

Table 5.3: Structure of the file name of a configuration file

Example of a file name:
C0014_00.ADC

The configuration file is valid for both channels.

5.2.1.2 Directory of configuration files on the CF card

The configuration files must be saved on the CF card in a folder with the name “CONFIG”.

It is recommended to save in the “CONFIG” folder of a CF card only current and valid configuration files that are really required on the respective CAN segment.

Not too many other files (e.g. PDF) should be stored in the root directory of the CF card. It is recommended to save such files collected in a separate folder.

In the event of non-compliance with this recommendation the duration of uploading the configuration may be extended, which may result in a time-out.

SAB FAdC100_200:
On the CF card there may be only configuration data, which are relevant for the respective project.

SAB FAdC100_201:
In case of redundant configuration servers (2 COM boards with a CF card each) it must be ensured that the configuration data on both CF cards are identical.

5.2.2 Structure of a configuration file for AEB and COM

Each configuration file consists of several blocks.
Each block consists of a **keyword** and at least one **entry**.

There are 3 different keywords: "**[IDENTIFICATION]**", "**[CONFIG]**" and "**[PROTECTION]**".
They must be arranged in precisely this order in the configuration file. The keywords are always written in square brackets and in capital letters and occupy each their own line.

Each entry occupies its own line and consists of an optional indicator, the number of bits of the value, a colon, the value and an optional comment.

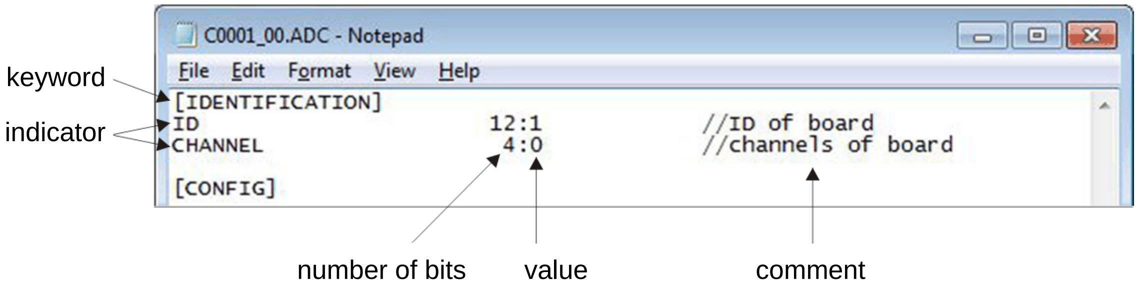


Figure 5.3: Elements of a configuration file

Indicators must not include spaces and must not start with a digit. The order of the individual entries (lines) within a configuration word is fundamental and must not be changed (see chapter "Configuration words of the AEB" and "Configuration words of the COM"). Indicators only serve for better readability and have no impact on the configuration.

➡ It is recommended that configuration files are structured by means of these indicators as they facilitate the creation and verification.

The **number of bits** of the respective entry follows the indicator. Indicator and number of bits (in decimal notation) must be delimited by a space or via tabulator. There must be no spaces or tabulators between the bit number, the **colon** and the value.

Values can be written in the following spellings:

- With the prefix "**0b**" binary numbers are characterised.
- With the prefix "**0x**" hexadecimal numbers are characterised.
- If no prefix is specified, this is a decimal number.

All "**reserved**" values (indicator "RESERVED") must be configured with '0'. In case of non-observance of this specification, it is possible that functions and availability of the FAdC are affected.

All “**not allowed**” values of an entry must not be used. In case of non-observance of this specification, the AEB outputs an error code and the configuration must be amended.

Leading zeros in values can be disregarded (e.g.: 4:**0b**00**10** corresponds to 4:0b10).

If there is only 1 value specified in an entry, then this value must be configured in the configuration word exactly like this.
If there are several values (different configuration options) stated in an entry, exactly 1 value of these can be selected and configured.
Empty cells in the column “value” must be filled with project specific values.

A **comment** can be added after the value (separated from the preceding value by a space or tabulator) or in its own empty line.
A comment is introduced with “//” and ends with the end of the line. Comments only serve for better understanding and have no impact on the configuration.

➡ It is recommended, not to insert too long comments into configuration files, because this can extend the loading duration of the configuration.

keyword **[IDENTIFICATION]**			
indicator	**number of bits**	**: value**	//comment
indicator	**number of bits**	**: value**	//comment

keyword **[CONFIG]**			
indicator	**number of bits**	**: value**	//comment
indicator	**number of bits**	**: value**	//comment
.	.	.	.
.	.	.	.
.	.	.	.

keyword **[CONFIG]**			
indicator	**number of bits**	**: value**	//comment
indicator	**number of bits**	**: value**	//comment
.	.	.	.
.	.	.	.
.	.	.	.

.
.
.

keyword **[PROTECTION]**			
indicator	**number of bits**	**: value**	//comment
indicator	**number of bits**	**: value**	//comment
indicator	**number of bits**	**: value**	//comment
indicator	**number of bits**	**: value**	//comment

Figure 5.4: Structure of a configuration file

In the following chapters, the accurate structure of the different configuration blocks is described in tabular form.

5.2.2.1 "[IDENTIFICATION]" block

The first block in a configuration file is introduced with the keyword "**[IDENTIFICATION]**".

- This block is **mandatory** and appears exactly **1 time at the beginning** of the configuration file.
- This block consists of 2 entries with a total of **2 bytes.**
- Channel '0' must be selected when configuring an AEB because the configuration file of an AEB applies to both channels.
- Channel '0' must be selected when configuring a COM because the configuration file of a COM applies to both channels.
- The details in the "**[IDENTIFICATION]**" block (ID of the board and channel) must match with the information in the file name of this configuration file.
  If this is not the case, an error indication is output when applying the ACC.

It is recommended to write the entries “ID” and “CHANNEL” decimally.

Indicator	Bits	No. of bits	:	Value decimal	Description
ID	b15 ... b4	**12**	**:**		ID of board (AEB or COM) (1 to 4 095)
CHANNEL	b3 ... b0	**4**	**:**	**0**	channels of board

Table 5.4: “[IDENTIFICATION]” block

5.2.2.2 “[CONFIG]” blocks

After that, one or several block(s) introduced with the keyword “**[CONFIG]**” follow.

- These blocks in the **AEB** and **COM** configuration consist of **2 to 5 bytes** each.
- The order of the individual/different “**[CONFIG]**” blocks is fundamental and must not be defined arbitrarily (see chapter “Configuration of the evaluation board AEB”, “Output axle counting via IO-EXB” and “Configuration of the communication board COM”).
- If a configuration word is configured, **all bits** of the configuration word (all bits within this “**[CONFIG]**” block) must be defined in the specified order.
- The precise structure and the contents of these “**[CONFIG]**” blocks are described in the chapters “Configuration words of the AEB” and “Configuration words of the COM”.

5.2.2.3 “[PROTECTION]” block

The final block in a configuration file is introduced with the keyword “**[PROTECTION]**”.

- This block is **mandatory** and appears exactly **1 time at the end** of the configuration file.
- This block consists of 4 entries with a total of **17 bytes.**
- The value of “VERIFY” must be greater than the value of “VERSION”.
- When creating a configuration file, the originator may only write the first two entries (“COMPONENT” and “VERSION”).
- After saving this file, the originator must carry out the calculation of the checksum (CRC) with the aid of the application ACC. The ACC enters the CRC automatically into the file. Thereby, no write protection of the configuration file may be activated before the checksum is entered.
- In the final step, the verifier must enter the time of the data verification (“VERIFY”) as confirmation of the accuracy of the configuration at the end of the configuration file.

It is recommended to write the entry “COMPONENT” decimally.

The entries “VERSION” and “VERIFY” must be written hexadecimally (0x). The spelling of the date and time format (0xYYYYMMDDhhmm) is mandatory. Therefore, the concept of configuration is complied with. Furthermore, this ensures the correct display of date and time in the ASD.

Indicator	Bits	No. of bits	:	Value decimal	Value hexadecimal	Description
COMPONENT	b135 … b128	**8**	**:**	**2** **105**		identification of component: AEB COM-AdC[14]
VERSION	b127 ... b80	**48**	**:**			creation entry: time of data generation (date and time in format: 0xYYYYMMDDhhmm, digit by digit hexadecimal)
CRC	b79 ... b48	**32**	**:**			checksum (is written by ACC hexadecimally)
VERIFY	b47 ... b0	**48**	**:**			verification entry: time of data verification (date and time in format: 0xYYYYMMDDhhmm, digit by digit hexadecimal)

Table 5.5: “[PROTECTION]” block

Example for the entry “VERSION”:
When the configuration is generated on the 3rd of January 2017 at 1:37 p.m., the following hexadecimal value must be written in the entry “VERSION”: 0x201701031337

SAB FAdC100_45:

In the configuration each AEB board must be assigned with a unique ID. Hence, within a project (same project number) an ID may be allocated only 1 time.

SAB FAdC100_46:

In the configuration each COM board must be assigned with a unique ID. Hence, within a project (same project number) an ID may be allocated only 1 time.
EXCEPTION: If two COM boards are in redundant operation, then for both COM boards the ID must be set identically.

14 identification of component of a COM-xxx board, see relevant documentation for the COM-xxx

SAB FAdC100_89:

The verifier of the configuration must check the following:

- accordance of the configuration of the track sections (FMA) with the design and planning
- protection of the configuration via check sum (at the end of the configuration file)
- accordance of the type protection code with the used configuration type

5.3 Setting of the DIP-switches

When setting the DIP-switches, the following applies:

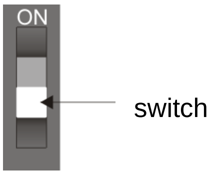


Figure 5.5: DIP-switch position “OFF”

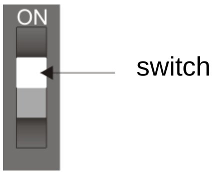


Figure 5.6: DIP-switch position “ON”

For DIP-switches applies:

- The DIP-switch position “OFF” corresponds to the binary value of ‘0’.
- The DIP-switch position “ON” corresponds to the binary value of ‘1’.
- In order to change the position of the switch, a suitable object is required, e.g. a flat-blade screwdriver with a blade thickness of ≤ 1 mm or another small tool with a fine tip.
- When delivered the DIP-switches are set to “OFF” (exception: DIP-switches for double usage).
- If requested and ordered by the customer, the DIP-switches of the boards can be set by Frauscher.
- DIP-switches without a function must be set to “OFF”.

5.3.1 DIP-switches of the AEB

On the circuit board of the AEB, the DIP-switches for the double usage, for the ID of the AEB, and for the direction inversion must be set.

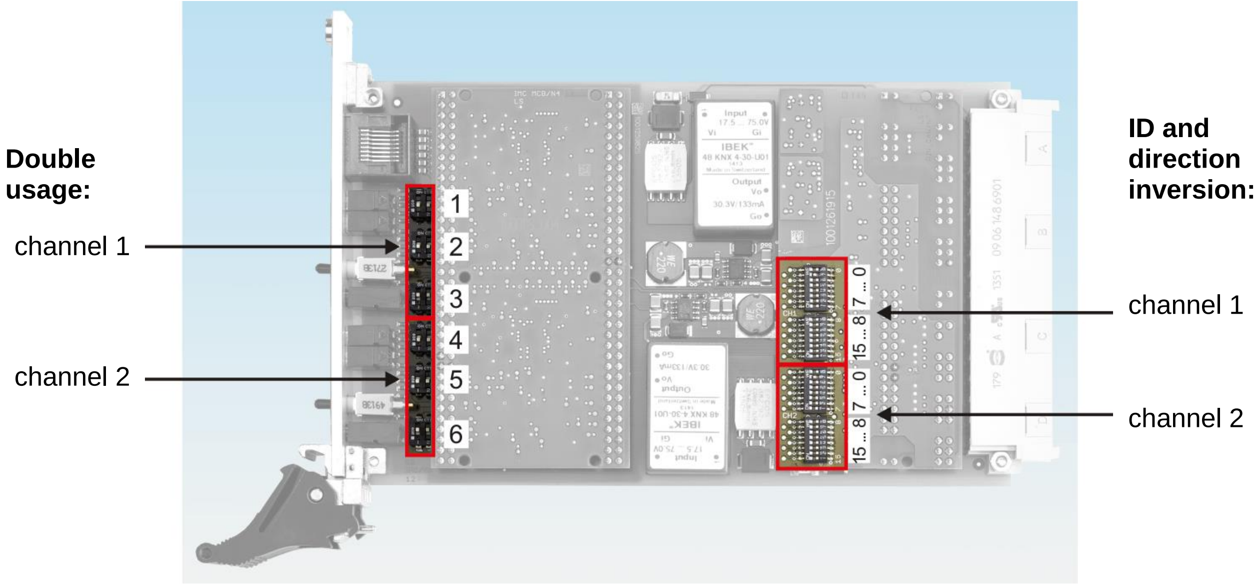


Figure 5.7: DIP-switches of the AEB

The DIP-switches for channel 1 and channel 2 must be set identically.

The DIP-switches for the double usage of a wheel sensor RSR180 are on the left side of the circuit board of the AEB.
Channel 1 is configured with the first 3 DIP-rows, channel 2 is configured with the remaining 3 DIP-rows (counting from top to bottom).

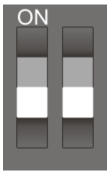
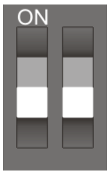
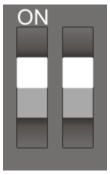
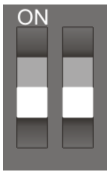
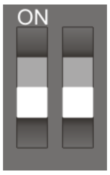
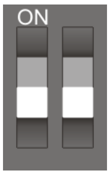
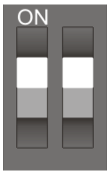
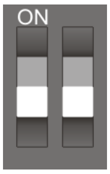
Channel	DIP-row	DIP-switches		Setting		Function
channel 1	1	DIP101		OFF	OFF	no function
	2	DIP102		OFF	OFF	no function
	3	DIP103		ON	ON	analogue double usage disabled (condition when delivered)
				OFF	OFF	analogue double usage enabled
channel 2	4	DIP201		OFF	OFF	no function
	5	DIP202		OFF	OFF	no function
	6	DIP203		ON	ON	analogue double usage disabled (condition when delivered)
				OFF	OFF	analogue double usage enabled

Table 5.6: DIP-switches for double usage (channel 1 and channel 2)

The double usage may only be enabled with the wheel sensor RSR180.

SAB FAdC100_92:

If using a wheel sensor RSR123, the DIP-switches DIP103 and DIP203 must be set to "ON".

The DIP-switches for the ID of the AEB and for the direction inversion are on the right side of the circuit board of the AEB.

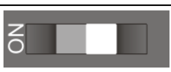
Channel	DIP-no.	DIP-switches		Possible settings	Function
channel 1/ channel 2	0		LSB	OFF/ON	ID of the AEB (ID 1 to 4 095)
	1			OFF/ON	
	2			OFF/ON	
	3			OFF/ON	
	4			OFF/ON	
	5			OFF/ON	
	6			OFF/ON	
	7			OFF/ON	
	8			OFF/ON	
	9			OFF/ON	
	10			OFF/ON	
	11		MSB	OFF/ON	
	12			OFF	no function
	13			OFF	no function
	14			OFF	no direction inversion
				ON	direction inversion
	15			OFF	no function

Table 5.7: DIP-switches for the ID of the AEB and direction inversion (channel 1 and channel 2)

ID 0 (DIP-no. 0 to 11 set to "OFF") is not allowed as an ID of the AEB.

SAB FAdC100_45:

In the configuration each AEB board must be assigned with a unique ID. Hence, within a project (same project number) an ID may be allocated only 1 time.

5.3.2 DIP-switches of the COM

On the circuit board of the COM, the DIP-switches for the ID of the COM and further functions must be set. These DIP-switches are on the left side of the circuit board of the COM.

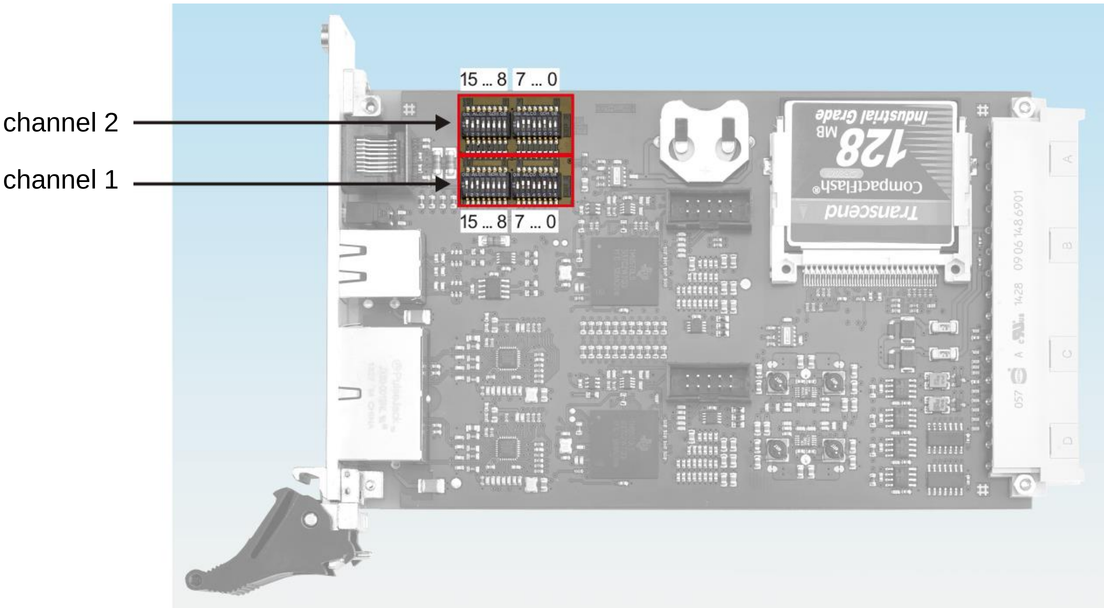


Figure 5.8: DIP-switches of the COM

The DIP-switches for channel 1 and channel 2 of the COM must be set identically.

Channel	DIP-no.	DIP-switches		Possible settings	Function
channel 1/ channel 2	0		LSB	ON/OFF	ID of the COM (ID 1 to 4 095)
	1			ON/OFF	
	2			ON/OFF	
	3			ON/OFF	
	4			ON/OFF	
	5			ON/OFF	
	6			ON/OFF	
	7			ON/OFF	
	8			ON/OFF	
	9			ON/OFF	
	10			ON/OFF	
	11		MSB	ON/OFF	
	12			OFF	no protection against broadcast storm[15]
				ON	protection against broadcast storm
	13			OFF	no configuration server
				ON	configuration server
	14			OFF	master COM
				ON	slave COM
	15			OFF	no redundant operation
				ON	redundant operation

Table 5.8: DIP-switches for the ID of the COM and further functions (channel 1 and channel 2)

ID 0 (DIP-switch with DIP-no. 0 to 11 set to “OFF”) is not allowed as ID of the COM.

15 This function is available for GS02 or higher of the COM-AdC101. If a COM-AdC101 GS01 is used, then the DIP-switch with DIP-no. 12 has no function and must be set to “OFF”. For COM-xxx, see technical documentation of the respective COM-xxx.

With the DIP-switch with DIP-no. 12, a protection against broadcast storm can be activated or deactivated. Detailed information can be found in chapter “Interface ‘Ethernet’”.

In case of non-redundant communication, 1 COM per CAN segment may be configured as configuration server; in case of redundant communication, the 2 redundant COM boards may be configured as configuration server (DIP-no. 13).

The DIP-switch positions of 2 redundant COM boards differ only in DIP-no. 14 (master COM/slave COM). If only 1 COM is used, then the DIP-switch with DIP-no. 14 must be set to “OFF”.

SAB FAdC100_46:

In the configuration each COM board must be assigned with a unique ID. Hence, within a project (same project number) an ID may be allocated only 1 time.
EXCEPTION: If two COM boards are in redundant operation, then for both COM boards the ID must be set identically.

5.4 Configuration of the evaluation board AEB

The evaluation board AEB is configured with configuration words, which are written into a configuration file. Additionally, DIP-switches must be set on the circuit board of the AEB.

5.4.1 Maximum number of the communication participants per AEB

One AEB can communicate with up to 20 other AEB boards, independent from their configured function, and evaluate their data. This means that, in addition to the own ID, a maximum of 20 different IDs can be used in a configuration file of an AEB.

The following configuration words of the AEB have an entry “ID”:

- “Counting head FMA 1”
- “Counting head FMA 2”
- “Output axle counting via IO-EXB”
- “Supervisor section for FMA 1”
- “Supervisor section for FMA 2”
- “Synchronisation FMA 1”
- “Synchronisation FMA 2”
- “Counting Head Control”
- “Input/output data transmission”

5.4.2 Locking a configuration word

All configuration words of the AEB that have an entry “ID” can be locked. When a configuration word is locked, it cannot be used again in the corresponding configuration file.

In order to lock a configuration word, it must be configured in the entry “ID” with ‘0’. Therefore, the configuration word must be used at least 1 time.

In this case, it is recommended to also configure all other entries of the configuration word with ‘0’. This excludes the first entry of a configuration word “CFG_...”. This entry must always be configured with the stated value.

Examples for locking a configuration word:

- The configuration word “Counting head FMA 1” is used 4 times to add 4 counting heads to a track section. In order to avoid that further counting heads are added to this track section, the configuration word is used a 5th time and is configured with ‘0’ in the entry “ID” (as well as in all other entries except “CFG_ZP_FMA1”). This ensures that no further counting heads can be added to this track section.

- In order to avoid that supervisor sections are used in a project, the configuration words “Supervisor section for FMA 1” and “Supervisor section for FMA 2” are used once each in every configuration file. In the entries “ID” (as well as in all other entries except “CFG_SUPERVIS_FMA1” and “CFG_SUPERVIS_FMA2”), both configuration words are configured with ‘0’. This ensures that within this project no supervisor sections can be configured.

5.4.3 Type protection of the configuration

The type protection is used to simplify the configuration. Furthermore, it protects safety-relevant and project specific parameters, which have to be entered into the configuration words, against unwanted changes.

For some configuration words, a type protection is mandatory. The parameters of the following configuration words are considered to be safety-critical and are therefore set by Frauscher:

- “Type protection”
- “Wheel sensor switching levels”
- “Wheel sensor overcurrent”
- “Magnetic track brake suppression”
- “Parameters of magnetic track brake suppression”
- “Digital filtering time”

If these configuration words are not configured, then the stated default values apply and the type protection code (see chapter “Type protection (set and type-protected by Frauscher)”) must be set to ‘0’.

The parameters of the remaining configuration words can be configured by the user himself. Whether or not these configuration words should be type-protected can be chosen by the user in the respective configuration word.

A type protection guarantees that the same parameters are used within a project or for the same applications. The calculation of the type protection codes (TSC) is carried out by Frauscher for all type-protected configuration words. Hence, the user cannot change type-protected configuration words unnoticed.

Type-protected and not type-protected configuration words have to be written into the configuration in a specific order (see the following figure).

[IDENTIFICATION]	
[CONFIG] …	safety-critical configuration words, which are set and type-protected by Frauscher
[CONFIG] CFG_TYPE_PRTCT	configuration word “Type protection” with type protection code
[CONFIG] …	project specific configuration words, which are set by the user and type-protected by Frauscher (optionally)
[CONFIG] CFG_TYPE_PRTCT	configuration word “Type protection” with type protection code (optionally)
[CONFIG] …	not type-protected configuration words
[PROTECTION]	

Figure 5.9: Order of the configuration words in the configuration file

5.4.4 Configuration words of the AEB

5.4.4.1 Type protection (set and type-protected by Frauscher)

This configuration word is used to configure the type protection code for the type-protected configuration words.

This configuration word
- is **mandatory**,
- must be configured **at least 1 time**,
- consists of **3 entries** with a total of **5 bytes**,
- contains the type protection code that was calculated by Frauscher.

- If the configuration words, which were set and type-protected by Frauscher, are used with the default settings and therefore no configuration blocks, which were type-protected by Frauscher, are written in the configuration file, the type protection code must be set to ‘**0x**0000000**0**’ (hexadecimal) or ‘**0**’ (decimal).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_TYPE_PRTCT	b39 … b33	**7**	**:**	**0b1111111**	**127**	configuration type protection
TYPE_PRTCT	b32	**1**	**:**			type protection:
				0b0	**0**	not allowed
				0b1	**1**	type-protected
TYPE_PRTCT_CODE	b31 … b0	**32**	**:**			type protection code (calculated and provided by Frauscher)

Table 5.9: Type protection

5.4.4.2 Counting head FMA 1

This configuration word is used to add counting heads (wheel sensors) to track section 1 (FMA 1).

This configuration word
- is **mandatory** in case the function axle counting is used,
- can be configured **up to 16 times** (1 time for each counting head of track section 1 (FMA 1)),
- consists of **5 entries** with a total of **3 bytes**,
- is valid for the counting head (whose ID is configured in this configuration word), which should be evaluated for this track section (FMA).

- A track section (FMA) can be built also with only one counting head (wheel sensor) (dead end track).
- Track section 1 (FMA 1) can be configured without track section 2 (FMA 2), but track section 2 (FMA 2) cannot be configured without track section 1 (FMA 1).
- If the AEB (entry “ID”), whose data should be used for the evaluation of track section 1 (FMA 1) and the AEB, which is configured in this configuration word, are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB, whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ZP_FMA1	b23 … b17	**7**	**:**	**0b**000000**1**	**1**	configuration counting head track section 1 (FMA 1)
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
DIR_INV	b15	**1**	**:**			direction inversion (change of counting direction):
				0b0	**0**	no direction inversion
				0b1	**1**	direction inversion

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 … b12	**3**	**:**			selection of time-out between this AEB and the AEB, which provides the counting head information (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 … b0	**12**	**:**			sender ID 1 to 4 095 of the counting head, which should be evaluated for this track section (FMA):
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.10: Counting head FMA 1

5.4.4.3 Counting head FMA 2

This configuration word is used to add counting heads (wheel sensors) to track section 2 (FMA 2).

This configuration word
- is **mandatory** in case the function axle counting is used,
- can be configured **up to 16 times** (1 time for each counting head of track section 2 (FMA 2)),
- consists of **5 entries** with a total of **3 bytes**,
- is valid for the counting head (whose ID is configured in this configuration word), which should be evaluated for this track section (FMA).

- A track section (FMA) can be built also with only one counting head (wheel sensor) (dead end track).
- Track section 1 (FMA 1) can be configured without track section 2 (FMA 2), but track section 2 (FMA 2) cannot be configured without track section 1 (FMA 1).
- If the AEB (entry “ID”), whose data should be used for the evaluation of track section 2 (FMA 2) and the AEB, which is configured in this configuration word, are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB, whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ZP_FMA2	b23 ... b17	**7**	**:**	**0b**00000**10**	**2**	configuration counting head track section 2 (FMA 2)
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
DIR_INV	b15	**1**	**:**			direction inversion (change of counting direction):
				0b0	**0**	no direction inversion
				0b1	**1**	direction inversion

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 … b12	**3**	**:**			selection of time-out between this AEB and the AEB, which provides the counting head information (see chapter "Time-out FAdC"):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 ... b0	**12**	**:**			sender ID 1 to 4 095 of the counting head, which should be evaluated for this track section (FMA):
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.11: Counting head FMA 2

5.4.4.4 Options for a track section (FMA)

This configuration word is used to configure a track section and its characteristics.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **8 entries** with a total of **3 bytes**,
- is valid for track section 1 and for track section 2 of this AEB.

- The behaviour of the track section after loss of communication (“COMM_FAIL”) refers to the axle counting according to the configuration words “Counting head FMA 1”, “Counting head FMA 2”, “Synchronisation FMA 1”and “Synchronisation FMA 2”.
- The behaviour of the track section after loss of communication (“COMM_FAIL”) is not valid for the output of a detached[16] IO-EXB. The detached IO-EXB always takes up normal operation after loss of communication to the AEB that evaluates the track section, independent from this configuration, provided that the track section was clear when the loss of communication occurred.
- If a reset is carried out automatically (e.g. in case of supervisor track sections), then it must be checked if the default values can be used with regard to safety.
- If there are points in a supervisor track section, then the entry “BEHAV_GE” must not be configured with the default value ‘1’. In this case, the entry must be configured with ‘0’ or ‘2’.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_SECTION	b23 ... b17	**7**	**:**	**0b**0001**100**	**12**	configuration options for a track section
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
COMM_FAIL	b15	**1**	**:**			behaviour of the track section after loss of communication:
				0b0	**0**	continue normal operation (default)
				0b1	**1**	take up fault status

16 A “detached” IO-EXB is an IO-EXB that is not directly connected to the AEB that evaluates the track section and provides the information.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
BEHAV_GE	b14 ... b13	**2**	**:**			reset restriction at fault and/or power-up:
				0b00	**0**	in case of power-up, no reset restriction; in case of fault, reset restriction depending on last axle
				0b01	**1**	in case of power-up, no reset restriction; in case of fault, no reset restriction (default)
				0b10	**2**	in case of power-up, reset restriction; in case of fault, reset restriction depending on last axle
				0b11	**3**	not allowed
CLR_TRACK	b12 ... b11	**2**	**:**			clearing of track (must be carried out with at least 2 axles):
				0b00	**0**	clearing of track at at least 2 different counting heads if more than 1 counting head is configured (at a dead end track clearing of track at 1 counting head) (default)
				0b01	**1**	clearing of track at 1 counting head sufficient
				0b10	**2**	clearing of track at all counting heads configured
				0b11	**3**	not allowed
RESERVED	b10 ... b8	**3**	**:**	**0b000**	**0**	reserved

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
						pre-Reset/Reset combinations in case of active reset restriction[17]:
				0b0000	**0**	not allowed
				0b0001	**1**	Reset
				0b0010	**2**	(Reset + clearing of track)
				0b0011	**3**	pre-Reset
				0b0100	**4**	(pre-Reset + clearing of track)
				0b0101	**5**	(pre-Reset + Reset) (default)
				0b0110	**6**	(pre-Reset + Reset + clearing of track)
				0b0111	**7**	Reset or pre-Reset
RESET_IN	b7 ... b4	**4**	**:**	0b**1000**	**8**	Reset or (pre-Reset + clearing of track)
				0b1001	**9**	not allowed
				0b1010	**10**	Reset or (pre-Reset + Reset + clearing of track)
				0b1011	**11**	(Reset + clearing of track) or pre-Reset
				0b1100	**12**	(Reset + clearing of track) or (pre-Reset + clearing of track)
				0b1101	**13**	(Reset + clearing of track) or (pre-Reset + Reset)
				0b1110	**14**	not allowed
				0b1111	**15**	not allowed

17 "or" means that either the 1st or the 2nd reset procedure (consisting of 1 to 3 different steps of reset) can be carried out.
"+" means that the different steps of reset must be carried out sequently. The reset is only carried out successfully in case of correct sequence and combination of the different steps of reset.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
						pre-Reset/Reset combinations in case of inactive reset restriction[18]:
				0b0000	**0**	not allowed
				0b0001	**1**	Reset (default)
				0b0010	**2**	(Reset + clearing of track)
				0b0011	**3**	pre-Reset
				0b0100	**4**	(pre-Reset + clearing of track)
				0b0101	**5**	(pre-Reset + Reset)
				0b0110	**6**	(pre-Reset + Reset + clearing of track)
				0b0111	**7**	Reset or pre-Reset
RESET_OUT	b3 ... b0	**4**	**:**	**0b1000**	**8**	Reset or (pre-Reset + clearing of track)
				0b1001	**9**	not allowed
				0b1010	**10**	Reset or (pre-Reset + Reset+ clearing of track)
				0b1011	**11**	(Reset + clearing of track) or pre-Reset
				0b1100	**12**	(Reset + clearing of track) or (pre-Reset + clearing of track)
				0b1101	**13**	(Reset + clearing of track) or (pre-Reset + Reset)
				0b1110	**14**	not allowed
				0b1111	**15**	not allowed

Table 5.12: Options for a track section (FMA)

18 "or" means that either the 1st or the 2nd reset procedure (consisting of 1 to 3 different steps of reset) can be carried out.
"+" means that the different steps of reset must be carried out sequently. The reset is only carried out successfully in case of correct sequence and combination of the different steps of reset.

5.4.4.5 Parameters counting head and FMA

This configuration word is used to configure the parameters of a counting head and of a track section.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per counting head/AEB**,
- consists of **10 entries** with a total of **3 bytes**.

- The number of permitted resets by a supervisor section (“SUPERVIS_COUNT”) is valid for track section 1 and track section 2 of this AEB.
- The number of permitted occupancies of a sensor system (“SYSTEM_COUNT”), short “system occupancies”, is valid for all counting heads of track section 1 and track section 2 of this AEB.
- The number of partial traversings to cause a permanent occupied indication (“PARTIAL_COUNT”) is valid for all counting heads of track section 1 and track section 2 of this AEB.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ZP	b23 ... b17	**7**	**:**	**0b**0001**101**	**13**	configuration parameters counting head and FMA
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
INTERVAL	b15 ... 14	**2**	**:**			transmission interval (valid for counting head and track section):
				0b00	**0**	10 ms
				0b01	**1**	40 ms
				0b10	**2**	80 ms
				0b11	**3**	160 ms (default)
RESERVED	b13 ... 12	**2**	**:**	**0b**00	**0**	reserved

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SUPERVIS_COUNT	b11 ... b9	**3**	**:**			number of permitted resets by a clear supervisor section (only carried out resets are counted; a correct traversing of the own track section as well as a power-up + reset of the track section will set back the reset counter of the counting head to 0):
				0b000	**0**	the number of permitted resets by the supervisor section is limited to 100
				0b001	**1**	1 reset by supervisor section permitted
				0b010	**2**	2 resets by supervisor section permitted (default)
				…	**…**	…
				0b111	**7**	7 resets by supervisor section permitted
RESERVED	b8	**1**	**:**	**0b0**	**0**	reserved
SYSTEM_COUNT	b7 ... b5	**3**	**:**			number of allowed system occupancies that are suppressed per minute in case of active Counting Head Control (a correct traversing of all track sections that are used for Counting Head Control will set back the system occupancy counter of the counting head to 0):
				0b000	**0**	system occupancy counter inactive (maximum of 100 system occupancies)
				0b001	**1**	1 system occupancy does not yet sensitise the counting head
				0b010	**2**	2 system occupancies of a sensor system do not yet sensitise the counting head (default)
				…	**…**	…
				0b111	**7**	7 system occupancies do not yet sensitise the counting head
RESERVED	b4	**1**	**:**	**0b0**	**0**	reserved

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
PARTIAL_COUNT	b3 ... b1	**3**	**:**			number of partial traversings to cause a permanent occupied indication (a correct traversing of the counting head will set back the partial traversing counter to 0):
				0b000	**0**	partial traversing counter inactive (maximum of 100 partial traversings)
				0b001	**1**	the 1st partial traversing causes a permanent occupied indication (default)
				…	**…**	…
				0b111	**7**	the 7th partial traversing causes a permanent occupied indication
RESERVED	b0	**1**	**:**	**0b0**	**0**	reserved

Table 5.13: Parameters counting head and FMA

SAB FAdC100_47:

If the default value (= 1) of the counter of partial traversing is not used, then due to a blind sensor system, a rail vehicle with [counter of partial traversing – 1] axles could be in a track section (FMA) and the axle counter could indicate the track section (FMA) as “clear”.
It must be checked if due to the value of the counter of partial traversing, the respective safety objective can be reached.

SAB FAdC100_170:

The configured number of allowed partial traversings must match with the projected number.

SAB FAdC100_179:

The configured number of the allowed system occupancies in the desensitised status must match the projected number.

5.4.4.6 Parameters reset

This configuration word is used to configure the parameters which are necessary for a reset (see chapter “Output axle counting via IO-EXB” and “Switching inputs of the IO-EXB”).

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **3 bytes**.

- The reset operation time (“RESET_OP_TIME”) is the time in which a reset must apply at the inputs of the IO-EXB with an input voltage from +12 to +72 V DC (high).
- The reset operation time (“RESET_OP_TIME”) is valid for the physical reset inputs (DUAL inputs) of the IO-EXB. On both inputs, an input voltage from +12 to+72 V DC (high) must apply.
- The reset lead time (“RESET_LD_TIME”) is the time prior to a reset in which no wheel sensor may be traversed by an axle. If a wheel sensor was traversed by an axle within this time, the reset is ignored.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_RESET	b23 ... b17	**7**	**:**	**0b**0110000	**48**	configuration parameters reset
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
RESET_OP_TIME	b15 … b8	**8**	**:**			reset operation time, to be configured in steps of 10 ms (from 50 to 2 550 ms):
				0b0000000**0**	**0**	not allowed
				…	**…**	not allowed
				0b00000**101**	**5**	50 ms
				…	**…**	…
				0b00**110010**	**50**	500 ms = 0,5 s (default)
				…	**…**	…
				0b11111111	**255**	2 550 ms = 2,55 s

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
						reset lead time, to be configured in steps of 100 ms (from 100 to 25 500 ms):
RESET_LD_TIME	b7 ... b0	**8**	**:**	**0b**0000000**0**	**0**	not allowed
				0b0000000**1**	**1**	100 ms = 0,1 s (default)
				…	**…**	…
				0b11111111	**255**	25 500 ms = 25,5 s

Table 5.14: Parameters reset

5.4.4.7 Output axle counting via IO-EXB

This configuration word is used to configure the outputs of the IO-EXB for the axle counting output. Depending on the configuration of the functionality, the IO-EXB boards are arranged in a specific order on the BP-EXB. Further information can be taken from the chapter “Backplane BP-EXB”.

This configuration word
- is **mandatory** in case the function axle counting output via IO-EXB is used,
- can be configured **up to 8 times** (2, 4, 6 or 8 times for 1, 2, 3 or 4 IO-EXB board(s),
- consists of **11 entries** with a total of **5 bytes**.

- If this configuration word is configured several times, then the 1st and the 2nd configuration word is valid for the 1st IO-EXB, which is used for axle counting output. The 3rd and the 4th configuration word is valid for the 2nd IO-EXB, which is used for axle counting output and so forth. This order must be complied with in the configuration file.
- If only information for 1 track section (FMA) should be output, this configuration word must be used 2 times and the entries “ID” as well as “SECTION” of both configuration words must be configured the same.
- If the entry “CLR_OCC” is configured with ‘1’ (occupied indication), then it is recommended to use this configuration word a 2nd time and to configure the entry “CLR_OCC” with ‘0’ (failsafe clear indication). For a failsafe clear indication the “Fm” contact (entry “CLR_OCC”) must be evaluated. Further details about the “Fm” contact can be taken from the chapter “Clear/occupied output”.
- The value for the extension of the output of the occupied indication on an IO-EXB, configured in the entry “OCC_EXT” in the configuration word “Occupied status extension and occupied status delay”, is extended by 1 s.
- If the entries “AUX1_OUT” and/or “AUX2_OUT” are configured with ‘5’ (reset accepted) or ‘6’ (reset rejected), then the output takes place for 1 s.
- If the AEB (entry “ID”) whose data should be used and the AEB which is configured in this configuration word are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM also must be configured for the AEB whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).
- Further details about the configuration of the auxiliary outputs (“AUX1_OUT”, “AUX2_OUT”) can be taken from the chapter “Auxiliary outputs”.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_SECTION_OUT	b39 ... b33	**7**	**:**	**0b**0001**000**	**8**	configuration axle counting output via IO-EXB
TYPE_PRTCT	b32	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
CLR_OCC	b31	**1**	**:**			configuration output:
				0b0	**0**	failsafe clear indication (recommended by Frauscher)
				0b1	**1**	occupied indication
RESERVED	b30 ... b24	**7**	**:**	**0b**000000**0**	**0**	reserved
AUX1_OUT	b23 ... b21	**3**	**:**			configuration auxiliary output 1:
				0b000	**0**	reset restriction
				0b001	**1**	reset ability
				0b010	**2**	error or communication error (recommended by Frauscher)
				0b011	**3**	clearing of track or partial traversing error (partial traversing error only when counter reading = 0)
				0b100	**4**	occupied status or fault (“P” contact)
				0b101	**5**	reset accepted [19]
				0b110	**6**	reset rejected [20]
AUX1_NO_NC	b20	**1**	**:**			normal status auxiliary output 1:
				0b0	**0**	open in normal status
				0b1	**1**	closed in normal status

19 The output of this operating status is available for GS02 or higher of the AEB101. If the AEB101 GS01 is used, then this value must not be configured.

20 The output of this operating status is available for GS02 or higher of the AEB101. If the AEB101 GS01 is used, then this value must not be configured.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
AUX2_OUT	b19 ... b17	**3**	**:**			configuration auxiliary output 2:
				0b000	**0**	reset restriction
				0b001	**1**	reset ability
				0b010	**2**	error or communication error
				0b011	**3**	clearing of track or partial traversing error (partial traversing error only when counter reading = 0)
				0b100	**4**	occupied status or fault (“P” contact) (recommended by Frauscher)
				0b101	**5**	reset accepted [21]
				0b110	**6**	reset rejected [22]
AUX2_NO_NC	b16	**1**	**:**			normal status auxiliary output 2:
				0b0	**0**	open in normal status
				0b1	**1**	closed in normal status
SECTION	b15	**1**	**:**			output of track section 1 (FMA 1) or track section 2 (FMA 2) of the AEB with the sender ID which was configured in the section “ID”:
				0b0	**0**	track section 1 (FMA 1)
				0b1	**1**	track section 2 (FMA 2)
SLCT_TIMEOUT	b14 ... b12	**3**	**:**			selection of time-out between the AEB to which the IO-EXB is directly connected and the AEB which evaluates the counting head whose information should be output (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7

21 The output of this operating status is available for GS02 or higher of the AEB101. If the AEB101 GS01 is used, then this value must not be configured.

22 The output of this operating status is available for GS02 or higher of the AEB101. If the AEB101 GS01 is used, then this value must not be configured.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
ID	b11 ... b0	**12**	**:**			sender ID 1 to 4 095 of the AEB which evaluates the counting head whose information should be output:
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.15: Axle counting output via IO-EXB

The auxiliary outputs and their normal statuses are not safety-relevant. If the normal statuses are configured according to following table, then failures of power supply are disclosed:

Auxiliary output 1 or 2		Recommended configuration of the normal status		Conditions for the normal status
Value decimal	**AUXx_OUT**	**Value decimal**	**AUXx_NO_NC**	
0	reset restriction	**1**	closed	no reset restriction
1	reset ability	**1**	closed	no reset ability
2	error or communication error	**1**	closed	no error or communication error
3	clearing of track or partial traversing error (partial traversing error only when counter reading = 0)	**0**	open	no clearing of track, no partial traversing error
4	occupied status or fault	**0**	open	clear status
5 [23]	reset accepted	**0**	open	no reset accepted
6 [24]	reset rejected	**0**	open	no reset rejected

Table 5.16: Recommended configuration of normal statuses for auxiliary outputs

23 The output of this operating status is available for GS02 or higher of the AEB101. If the AEB101 GS01 is used, then this value must not be configured.

24 The output of this operating status is available for GS02 or higher of the AEB101. If the AEB101 GS01 is used, then this value must not be configured.

5.4.4.8 Reset axle counting via IO-EXB

This configuration word is used to configure the IO-EXB inputs. Further information regarding the various reset types can be taken from the documentation D4182 “Reset options for the axle counting system FAdC® R2”.

This configuration word

- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per counting head/AEB**,
- consists of **10 entries** with a total of **3 bytes**,
- is valid for all track sections that are output by this AEB via IO-EXB (see chapter “Output axle counting via IO-EXB”).

- If this configuration word is used, then the outputs of the IO-EXB must be configured for the function axle counting.
- If the entry “BEHAV_INPUT3” is configured with ‘7’ (Counting Head Control), then the AEB, which is connected directly with this IO-EXB, must output a track section.
- If the entry “BEHAV_INPUT3” is configured with ‘7’ (Counting Head Control), then all 4 inputs of input 3 must be used.
- If the entry “BEHAV_INPUT3” is configured with ‘7’ (Counting Head Control), then a time of at least 232 ms is necessary for a change of status from “high” to “low” or from “low” to “high”.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_AXCNT	b23 ... b17	**7**	**:**	**0b**0001**110**	**14**	configuration reset axle counting via IO-EXB
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
BEHAV_INPUT1	b15 ... b13	**3**	**:**			behaviour input 1:
				0b000	**0**	direct reset
				0b001	**1**	restricted reset (default)
				0b010	**2**	preparatory direct reset
				0b011	**3**	preparatory restricted reset
				0b100	**4**	auxiliary reset
				0b101	**5**	pre-Reset
				0b110	**6**	Reset
				0b111	**7**	not allowed
RESERVED	b12	**1**	**:**	**0b0**	**0**	reserved
BEHAV_INPUT2	b11 ... b9	**3**	**:**			behaviour input 2:
				0b000	**0**	direct reset
				0b001	**1**	restricted reset
				0b010	**2**	preparatory direct reset
				0b011	**3**	preparatory restricted reset
				0b100	**4**	auxiliary reset (default)
				0b101	**5**	pre-Reset
				0b110	**6**	Reset
				0b111	**7**	not allowed
RESERVED	b8	**1**	**:**	**0b0**	**0**	reserved
BEHAV_INPUT3	b7 ... b5	**3**	**:**			behaviour input 3:
				0b000	**0**	direct reset (default)
				0b001	**1**	restricted reset
				0b010	**2**	preparatory direct reset
				0b011	**3**	preparatory restricted reset
				0b100	**4**	auxiliary reset
				0b101	**5**	pre-Reset
				0b110	**6**	Reset
				0b111	**7**	Counting Head Control (only at the 1st IO-EXB)
RESERVED	b4	**1**	**:**	**0b0**	**0**	reserved

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
BEHAV_IOEXB	b3 ... b1	**3**	**:**			selection of behaviour of the toggle switches on the front panel of the IO-EXB in relation to reset:
				0b000	**0**	direct reset
				0b001	**1**	restricted reset
				0b010	**2**	preparatory direct reset
				0b011	**3**	preparatory restricted reset
				0b100	**4**	auxiliary reset (default)
				0b101	**5**	pre-Reset
				0b110	**6**	Reset
				0b111	**7**	toggle switches disabled
RESERVED	b0	**1**	**:**	**0b0**	**0**	reserved

Table 5.17: Reset axle counting via IO-EXB

SAB FAdC100_48:

The reset procedure must be projected according to the operator’s specifications.

5.4.4.9 Occupied status extension and occupied status delay

This configuration word is used to configure the parameters of the occupied status extension and of the occupied status delay.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **3 bytes**,
- is valid for track section 1 (FMA 1) and for track section 2 (FMA 2),
- is valid for the AEB which evaluates the track section (FMA),
- is valid for the output on IO-EXB boards which are directly connected to an AEB which evaluates a track section (FMA),
- is valid for the output via protocol.

- The occupied status extension (“OCC_EXT”) is the time by which the output of an occupied indication is extended, before a clear indication is output.
- In case of output of axle counting data via IO-EXB the configured occupied status extension is extended by 1 s.
- The occupied status delay (“OCC_DELAY”) is the time by which the output of an occupied indication is delayed.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_OCC	b23 ... b17	**7**	**:**	**0b**0101110	**46**	configuration occupied status extension and occupied status delay
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
OCC_EXT	b15 ... b8	**8**	**:**			occupied status extension, to be configured in steps of 100 ms (from 0 to 25 500 ms):
				0b0000000**0**	**0**	0 ms
				0b0000000**1**	**1**	100 ms = 0,1 s
				…	**…**	…
				0b000**11**0**1**0	**26**	2 600 ms = 2,6 s (default)
				…	**…**	…
				0b11111111	**255**	25 500 ms = 25,5 s

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
OCC_DELAY	b7 ... b0	**8**	**:**			occupied status delay, to be configured in steps of 100 ms (from 0 to 25 500 ms):
				0b0000000**0**	**0**	0 ms (default)
				0b0000000**1**	**1**	100 ms = 0,1 s
				…	**…**	…
				0b11111111	**255**	25 500 ms = 25,5 s

Table 5.18: Occupied status extension and occupied status delay

SAB FAdC100_171:

The configured delay period of the occupied status must match the projected delay period of the occupied status.

5.4.4.10 Toggle switches of the AEB

This configuration word is used to configure the behaviour of the toggle switches on the front panel of the AEB.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **6 entries** with a total of **2 bytes**,
- is valid for track section 1 (FMA 1) and for track section 2 (FMA 2) of this AEB.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_BEHAV_TGGL	b15 ... b9	**7**	**:**	**0b**000**1111**	**15**	configuration toggle switches AEB
TYPE_PRTCT	b8	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
BEHAV_RESET	b7 ... b5	**3**	**:**			behaviour of the toggle switches of the AEB in relation to reset:
				0b000	**0**	direct reset
				0b00**1**	**1**	restricted reset
				0b0**1**0	**2**	preparatory direct reset
				0b0**11**	**3**	preparatory restricted reset
				0b100	**4**	auxiliary reset (default)
				0b10**1**	**5**	pre-Reset
				0b110	**6**	Reset
				0b111	**7**	disabled
RESERVED	b4	**1**	**:**	**0b0**	**0**	reserved
BEHAV_SIMUL	b3	**1**	**:**			behaviour of the toggle switches of the AEB in relation to simulation of an occupancy (valid for the counting head):
				0b0	**0**	simulation of an occupancy enabled (default)
				0b1	**1**	simulation of an occupancy disabled
RESERVED	b2 ... b0	**3**	**:**	**0b**000	**0**	reserved

Table 5.19: Toggle switches of the AEB

5.4.4.11 Supervisor section for FMA 1

This configuration word is used to determine which track sections (FMA) are used as supervisor sections for track section 1 (FMA 1) of this AEB and how track section 1 (FMA 1) should behave.

The configuration of a supervisor section enables to reset automatically axle counting errors, which occur within a supervisor section. If a clear indication is recognized on a configured supervisor section, whereas the own track section (FMA) is occupied, the own track section (FMA) is reset. Further information to supervisor sections can be taken from the documentation D4181 “Design and application of supervisor sections for axle counting system FAdC R2”.

This configuration word

- is **mandatory** in case the function supervisor is used,
- can be configured **up to 4 times per track section 1 (FMA 1)**, [25]
- consists of **9 entries** with a total of **5 bytes**.

- If this configuration word is used more than 1 time, then the entries “LOGIC_TYPE”, “RESET_TYPE” and “RESET_DELAY” must be configured identically.
- If the type of logic operation in the entry “LOGIC_TYPE” is configured with ‘0’ (OR) and either one supervisor section indicates “clear” or all supervisor sections indicate “clear”, then the own track section (FMA) is reset.
- If the type of logic operation in the entry “LOGIC_TYPE” is configured with ‘1’ (AND) and all supervisor sections indicate “clear”, then the own track section (FMA) is reset.
- If this configuration word is used only 1 time, then the entry “LOGIC_TYPE” can be configured either with ‘0’ or with ‘1’.
- The type of reset (“RESET_TYPE”) defines how the own track section (FMA) is reset if the supervisor sections indicate “clear”.
- The reset delay (“RESET_DELAY”) is the time, for which the supervisor section must indicate “clear”, before a reset can be carried out on the own track section (FMA) of the supervisor section.
- If the AEB (entry “ID”) whose data should be used for the evaluation of supervisor track section 1 (FMA 1) and the AEB which is configured in this configuration word are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

25 If an AEB101 GS01 is used, then this configuration word can be configured up to 2 times per track section 1 (FMA 1).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_SUPERVIS_FMA1	b39 ... b33	**7**	**:**	**0b0000011**	**3**	configuration supervisor for track section 1 (FMA 1)
TYPE_PRTCT	b32	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
LOGIC_TYPE	b31	**1**	**:**			type of logic operation in case of more than 1 supervisor ID:
				0b0	**0**	OR
				0b1	**1**	AND
RESET_TYPE	b30 ... b29	**2**	**:**			type of reset (in case supervisor section(s) is/are clear):
				0b00	**0**	direct reset
				0b01	**1**	restricted reset
				0b10	**2**	preparatory direct reset
				0b11	**3**	preparatory restricted reset
RESERVED	b28 ... b24	**5**	**:**	**0b00000**	**0**	reserved
RESET_DELAY	b23 ... b16	**8**	**:**			reset delay, to be configured in steps of 1 s (from 3 to 255 s):
				0b00000000	**0**	not allowed
				…	**…**	not allowed
				0b00000011	**3**	3 s
				…	**…**	…
				0b11111111	**255**	255 s
SECTION	b15	**1**	**:**			supervisor section track section 1 (FMA 1) or track section 2 (FMA 2) of the AEB with the sender ID which was configured in the section "ID":
				0b0	**0**	track section 1 (FMA 1)
				0b1	**1**	track section 2 (FMA 2)

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 ... b12	**3**	**:**			selection of time-out between the AEB which evaluates the track section (FMA) and the AEB which evaluates the supervisor section (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 ... b0	**12**	**:**			sender ID 1 to 4 095 of the AEB which evaluates the supervisor section of this track section (FMA):
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.20: Supervisor section for FMA 1

SAB FAdC100_93:

If the function supervisor is used, then a supervisor section must at least cover the area of the track section (FMA) to be reset.

SAB FAdC100_94:

A supervisor section must not be configured across several tracks (“track harp”), which runs in parallel.

SAB FAdC100_95:

The number of trains within the traversing cycle (= failure detection) must be higher than the allowed number of resets by a supervisor section.

SAB FAdC100_96:

If a supervisor section is configured, then the reset procedure for the supervisor section must be configured according to the operator’s specifications.

If there are points within a supervisor track section, then the entry “RESET_TYPE” must be configured with ‘1’ or ‘3’.

5.4.4.12 Supervisor section for FMA 2

This configuration word is used to determine which track sections (FMA) are used as supervisor sections for track section 2 (FMA 2) of this AEB and how track section 2 (FMA 2) should behave.

The configuration of a supervisor section enables to reset automatically axle counting errors, which occur within a supervisor section. If a clear indication is recognized on a configured supervisor section, whereas the own track section (FMA) is occupied, the own track section (FMA) is reset. Further information to supervisor sections can be taken from the documentation D4181 “Design and application of supervisor sections for axle counting system FAdC R2”.

This configuration word
- is **mandatory** in case the function supervisor is used,
- can be configured **up to 4 times per track section 2 (FMA 2)**, [26]
- consists of **9 entries** with a total of **5 bytes**.

- If this configuration word is used more than 1 time, then the entries “LOGIC_TYPE”, “RESET_TYPE” and “RESET_DELAY” must be configured identically.
- If the type of logic operation in the entry “LOGIC_TYPE” is configured with ‘0’ (OR) and either one supervisor section indicates “clear” or all supervisor sections indicate “clear”, then the own track section (FMA) is reset.
- If the type of logic operation in the entry “LOGIC_TYPE” is configured with ‘1’ (AND) and all supervisor sections indicate “clear”, then the own track section (FMA) is reset.
- If this configuration word is used only 1 time, then the entry “LOGIC_TYPE” can be configured either with ‘0’ or with ‘1’.
- The type of reset (“RESET_TYPE”) defines how the own track section (FMA) is reset if the supervisor sections indicate “clear”.
- The reset delay (“RESET_DELAY”) is the time, for which the supervisor section must indicate “clear”, before a reset can be carried out on the own track section (FMA) of the supervisor section.
- If the AEB (entry “ID”) whose data should be used for the evaluation of supervisor track section 2 (FMA 2) and the AEB which is configured in this configuration word are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

26 If an AEB101 GS01 is used, then this configuration word can be configured up to 2 times per track section 2 (FMA 2).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_SUPERVIS_FMA2	b39 ... b33	**7**	**:**	**0b**0000**100**	**4**	configuration supervisor for track section 2 (FMA 2)
TYPE_PRTCT	b32	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
LOGIC_TYPE	b31	**1**	**:**			type of logic operation in case of more than 1 supervisor ID:
				0b0	**0**	OR
				0b1	**1**	AND
RESET_TYPE	b30 ... b29	**2**	**:**			type of reset (in case supervisor section(s) is/are clear):
				0b00	**0**	direct reset
				0b01	**1**	restricted reset
				0b10	**2**	preparatory direct reset
				0b11	**3**	preparatory restricted reset
RESERVED	b28 ... b24	**5**	**:**	**0b**0000**0**	**0**	reserved
RESET_DELAY	b23 … b16	**8**	**:**			reset delay, to be configured in steps of 1 s (from 3 to 255 s):
				0b0000000**0**	**0**	not allowed
				…	**…**	not allowed
				0b000000**11**	**3**	3 s
				…	**…**	…
				0b11111111	**255**	255 s
SECTION	b15	**1**	**:**			supervisor section track section 1 (FMA 1) or track section 2 (FMA 2) of the AEB with the sender ID which was configured in the section “ID”:
				0b0	**0**	track section 1 (FMA 1)
				0b1	**1**	track section 2 (FMA 2)

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 ... b12	**3**	**:**			selection of time-out between the AEB which evaluates the track section (FMA) and the AEB which evaluates the supervisor section (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 ... b0	**12**	**:**			sender ID 1 to 4 095 of the AEB which evaluates the supervisor section of this track section (FMA):
				0b000000000000	**0**	sender ID 0 locks this configuration word
				0b000000000001	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.21: Supervisor section for FMA 2

SAB FAdC100_93:

If the function supervisor is used, then a supervisor section must at least cover the area of the track section (FMA) to be reset.

SAB FAdC100_94:

A supervisor section must not be configured across several tracks (“track harp”), which runs in parallel.

SAB FAdC100_95:

The number of trains within the traversing cycle (= failure detection) must be higher than the allowed number of resets by a supervisor section.

SAB FAdC100_96:

If a supervisor section is configured, then the reset procedure for the supervisor section must be configured according to the operator’s specifications.

If there are points within a supervisor track section, then the entry “RESET_TYPE” must be configured with ‘1’ or ‘3’.

5.4.4.13 Synchronisation FMA 1

This configuration word is used to configure the parameters required for a track section synchronisation (related to the output of occupied and fault indications, reset restriction and reset).

In case of synchronisation, 1 physical track section (FMA) is evaluated and generated by at least 2 different AEB boards (synchronisation partners).
This enables that e.g. after a reset on the 1st synchronisation partner, all the other synchronisation partners react the same and not every board has to be reset. The synchronisation should always be configured mutually for the track sections (FMA) (e.g. block sections).

This configuration word
- is **mandatory** in case the function synchronisation is used,
- can be configured **2 times per track section 1 (FMA 1)**,
- consists of **5 entries** with a total of **3 bytes**.

- If the AEB (entry "ID"), whose data should be used for the synchronisation of track section 1 (FMA 1) and the AEB, which is configured in this configuration word, are not located on the same local CAN segment, then the configuration word "Forwarding axle counting data" of the COM must also be configured for the AEB, whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter "Maximum number of the communication participants per AEB").

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_SYNC_FMA1	b23 ... b17	**7**	**:**	**0b**0000**101**	**5**	configuration synchronisation track section 1 (FMA 1)
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
SECTION	b15	**1**	**:**			synchronisation partner track section 1 (FMA 1) or track section 2 (FMA 2) of the AEB with the sender ID, which was configured in the section "ID":
				0b0	**0**	track section 1 (FMA 1)
				0b1	**1**	track section 2 (FMA 2)

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 ... b12	3	:			selection of time-out between the AEB of track section 1 (FMA 1) and the AEB of the track section (FMA) with which it should be synchronised (see chapter “Time-out FAdC”):
				0b000	0	time-out 0
				…	…	…
				0b111	7	time-out 7
ID	b11 ... b0	12	:			sender ID 1 to 4 095 of the AEB of the track section (FMA), with which it should be synchro-nised:
				0b000000000000	0	sender ID 0 locks this configu-ration word
				0b000000000001	1	1
				…	…	…
				0b111111111111	4 095	4 095

Table 5.22: Synchronisation FMA 1

SAB FAdC100_167:

The synchronisation of two AEB boards may only be configured if these two AEB boards evaluate the same track section (FMA).

5.4.4.14 Synchronisation FMA 2

This configuration word is used to configure the parameters required for a track section synchronisation (related to the output of occupied and fault indications, reset restriction and reset).

In case of synchronisation, 1 physical track section (FMA) is evaluated and generated by at least 2 different AEB boards (synchronisation partners).
This enables that e.g. after a reset on the 1st synchronisation partner, all the other synchronisation partners react the same and not every board has to be reset. The synchronisation should always be configured mutually for the track sections (FMA) (e.g. block sections).

This configuration word
- is **mandatory** in case the function synchronisation is used,
- can be configured **2 times per track section 2 (FMA 2)**,
- consists of **5 entries** with a total of **3 bytes**.

- If the AEB (entry “ID”), whose data should be used for the synchronisation of track section 2 (FMA 2), and the AEB, which is configured in this configuration word, are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB, whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_SYNC_FMA2	b23 ... b17	**7**	**:**	**0b**0000**110**	**6**	configuration synchronisation track section 2 (FMA 2)
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
SECTION	b15	**1**	**:**			synchronisation partner track section 1 (FMA 1) or track section 2 (FMA 2) of the AEB with the sender ID, which was configured in the section “ID”:
				0b0	**0**	track section 1 (FMA 1)
				0b1	**1**	track section 2 (FMA 2)

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 ... b12	3	:			selection of time-out between the AEB of track section 2 (FMA 2) and the AEB of the track section (FMA) with which it should be synchronised (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 ... b0	12	:			sender ID 1 to 4 095 of the AEB of the track section (FMA), with which it should be synchronised:
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.23: Synchronisation FMA 2

SAB FAdC100_167:

The synchronisation of two AEB boards may only be configured if these two AEB boards evaluate the same track section (FMA).

5.4.4.15 Counting Head Control

This configuration word is used to define the parameters required for Counting Head Control. Further information regarding Counting Head Control can be taken from the documentation D4183 “Design and application of Counting Head Control for axle counting system FAdC® R2”.

This configuration word
- is **mandatory** in case the function Counting Head Control is used and the triggering is carried out via protocol,
- can be configured **up to 2 times per counting head/ AEB**,
- consists **of 5 entries** with a total of **3 bytes**.

- In the configuration word “Reset axle counting via IO-EXB”, the inputs of the IO-EXB can be configured for Counting Head Control.
- The number of permitted system occupancies, which are suppressed in case of active Counting Head Control, can be configured in the entry “SYSTEM_COUNT” of the configuration word “Parameters counting head and FMA”.
- If the AEB (entry “ID”), whose data should be used for desensitising the counting head and the AEB, which is configured in this configuration word, are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB, whose data should be used.
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_CONTROL	b23 ... b17	**7**	**:**	**0b**0000**111**	**7**	configuration Counting Head Control
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
SECTION	b15	**1**	**:**			Counting Head Control with track section 1 (FMA 1) or track section 2 (FMA 2) of the AEB with the sender ID, which was configured in the section “ID”:
				0b0	**0**	track section 1 (FMA 1)
				0b1	**1**	track section 2 (FMA 2)

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 ... b12	**3**	**:**			selection of time-out between this AEB and the AEB with whose track section (FMA) the counting head should be desensitised (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 ... b0	**12**	**:**			sender ID 1 to 4 095 of the AEB with whose track section (FMA) the counting head should be desensi-tised.
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.24: Counting Head Control

5.4.4.16 Wheel sensor type

This configuration word is used to define which wheel sensor type (RSR180, RSR123) is used.

This configuration word

- is **optional** (i.e. if this configuration word is not configured, then the specified **default value** applies),
- can be configured **1 time per counting head/AEB**,
- consists of **4 entries** with a total of **2 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_RSR_TYPE	b15 ... b9	**7**	**:**	**0b**0101000	**40**	configuration wheel sensor type
TYPE_PRTCT	b8	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
RSR_TYPE	b7 ... b6	**2**	**:**			wheel sensor type:
				0b00	**0**	no evaluation of wheel sensor
				0b01	**1**	RSR180 (default)
				0b10	**2**	not allowed
				0b11	**3**	RSR123
RESERVED	b5 ... b0	**6**	**:**	**0b**000000	**0**	reserved

Table 5.25: Wheel sensor type

SAB FAdC100_168:

The configured wheel sensor type must match the projected wheel sensor type.

5.4.4.17 Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB

This configuration word is used to configure the relay switching outputs of the IO-EXB. Depending on the configuration of the functionality, the IO-EXB boards are arranged in a specific order on the BP-EXB. Further information can be taken from the chapter “Backplane BP-EXB”.

This configuration word
- is **mandatory** in case the function output of counting head outputs of the AEB via relay switching outputs of the IO-EXB is used,
- can be configured **up to 8 times** (1 time per IO-EXB),
- consists of **9 entries** with a total of **3 bytes**.

- If this configuration word is used, the inputs have no function.
- In case of not used (= open) switching outputs the configuration of the normal status has no function.
- If this configuration word is configured several times, then the 1st configuration word is for the 1st IO-EXB, which is used for the counting head output, the 2nd for the 2nd IO-EXB, which is used for the counting head output and so forth. This order must be complied with in the configuration file.
- The redundancy error output is used to output communication failures and/or failures of power supply within a CAN segment.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ZP-OUT_IO	b23 ... b17	**7**	**:**	**0b**0001**010**	**10**	configuration switching outputs IO-EXB
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
ZP-OUT1_R	b15 ... b13	**3**	**:**			switching output 1 (in error status always open):
				0b000	**0**	switching output not used (= switching output open)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT1_NO_NC_R	b12	**1**	**:**			normal status switching output 1:
				0b0	**0**	open in normal status
				0b1	**1**	closed in normal status
ZP-OUT2_R	b11 ... b9	**3**	**:**			switching output 2 (in error status always open):
				0b000	**0**	switching output not used (= switching output open)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT2_NO_NC_R	b8	**1**	**:**			normal status switching output 2:
				0b0	**0**	open in normal status
				0b1	**1**	closed in normal status

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
ZP-OUT3_R	b7 ... b5	**3**	**:**			switching output 3 (in error status always open):
				0b000	**0**	switching output not used (= switching output open)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT3_NO_NC_R	b4	**1**	**:**			normal status switching output 3:
				0b0	**0**	open in normal status
				0b1	**1**	closed in normal status
RESERVED	b3 ... b0	**4**	**:**	**0b0000**	**0**	reserved

Table 5.26: Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB

In order to attain SIL 4, the following normal statuses must be configured per switching output and dependent on the configuration of the switching output:

Switching output 1, 2 or 3		Configuration of the normal status		Conditions for the normal status
Value decimal	**ZP-OUTx_R**	**Value decimal**	**ZP-OUTx_NO_NC_R**	
1	1-edge direction pulse, direction 1	**1**	closed	no output of 1-edge direction pulse, direction 1
2	4-edges direction pulse, direction 1	**0**	open	no output of 4-edges direction pulse, direction 1
3	1-edge direction pulse, direction 2	**1**	closed	no output of 1-edge direction pulse, direction 2
4	4-edges direction pulse, direction 2	**0**	open	no output of 4-edges direction pulse, direction 2
5	system output 1	**1**	closed	sensor system 1 not damped
6	system output 2	**1**	closed	sensor system 2 not damped

Table 5.27: Configuration of the normal statuses of the switching outputs

5.4.4.18 Output of counting head outputs of the AEB via optocoupler

This configuration word is used to configure the optocoupler outputs of the AEB.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per counting head/AEB**,
- consists of **10 entries** with a total of **3 bytes**.

- In case of not used (= open) counting head outputs, the configuration of the normal status has no function.
- The redundancy error output is used to output communication failures and/or failures of power supply within a CAN segment.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ZP-OUT_AEB	b23 ... b17	**7**	**:**	**0b0001011**	**11**	configuration counting head outputs AEB
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
ZP-OUT1_O	b15 ... b13	**3**	**:**			counting head output 1 (connection to CHn.1/OUT1- on the BP-PWR and/or BP-EXB) (in error status always open):
				0b000	**0**	counting head output not used (= counting head output open) (default)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT1_NO_NC_O	b12	**1**	**:**			normal status counting head output 1:
				0b0	**0**	open in normal status (default)
				0b1	**1**	closed in normal status

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
ZP-OUT2_O	b11 ... b9	**3**	**:**			counting head output 2 (connection to CHn.1/OUT2- on the BP-PWR and/or BP-EXB) (in error status always open):
				0b000	**0**	counting head output not used (= counting head output open) (default)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT2_NO_NC_O	b8	**1**	**:**			normal status counting head output 2:
				0b0	**0**	open in normal status (default)
				0b1	**1**	closed in normal status
ZP-OUT3_O	b7 ... b5	**3**	**:**			counting head output 3 (connection to CHn.2/OUT1- on the BP-PWR and/or BP-EXB) (in error status always open):
				0b000	**0**	counting head output not used (= counting head output open) (default)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT3_NO_NC_O	b4	**1**	**:**			normal status counting head output 3:
				0b0	**0**	open in normal status (default)
				0b1	**1**	closed in normal status

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
ZP-OUT4_O	b3 ... b1	**3**	**:**			counting head output 4 (connection to CHn.2/OUT2- on the BP-PWR and/or BP-EXB) (in error status always open):
				0b000	**0**	counting head output not used (= counting head output open) (default)
				0b001	**1**	1-edge direction pulse, direction 1
				0b010	**2**	4-edges direction pulse, direction 1
				0b011	**3**	1-edge direction pulse, direction 2
				0b100	**4**	4-edges direction pulse, direction 2
				0b101	**5**	system output 1
				0b110	**6**	system output 2
				0b111	**7**	redundancy error output
ZP-OUT4_NO_NC_O	b0	**1**	**:**			normal status counting head output 4:
				0b0	**0**	open in normal status (default)
				0b1	**1**	closed in normal status

Table 5.28: Output of counting head outputs of the AEB via optocoupler

In order to attain SIL 4, the following normal statuses must be configured per counting head output and dependent on the configuration of the counting head output:

Counting head output 1, 2, 3 or 4		**Configuration of the normal status**		**Conditions for the normal status**
Value decimal	**ZP-OUTx_O**	**Value decimal**	**ZP-OUTx_NO_NC_O**	
1	1-edge direction pulse, direction 1	**1**	closed	no output of 1-edge direction pulse, direction 1
2	4-edges direction pulse, direction 1	**0**	open	no output of 4-edges direction pulse, direction 1
3	1-edge direction pulse, direction 2	**1**	closed	no output of 1-edge direction pulse, direction 2
4	4-edges direction pulse, direction 2	**0**	open	no output of 4-edges direction pulse, direction 2
5	system output 1	**1**	closed	sensor system 1 not damped
6	system output 2	**1**	closed	sensor system 2 not damped

Table 5.29: Configuration of the normal statuses of the counting head outputs

SAB FAdC100_180:

In case of safety-relevant applications of the 1-edge direction pulse, the 1-edge direction pulse must be output as follows and evaluated by the safety system:

- at least at 2 counting head outputs
  - connector “Xn01” on the BP-PWR:
    1 output from CHn.1 and 1 output from CHn.2
  - connector “X101” on the BP-EXB:
    1 output from CH1.1 and 1 output from CH1.2
- or 1 switching output (4 contacts)

SAB FAdC100_182:

In case of safety-relevant applications of the 4-edges direction pulse, the 4-edges direction pulse must be output as follows and evaluated by the safety system:

- at least at 2 counting head outputs
  - connector “Xn01” on the BP-PWR:
    1 output from CHn.1 and 1 output from CHn.2
  - connector “X101” on the BP-EXB:
    1 output from CH1.1 and 1 output from CH1.2
- or 1 switching output (4 contacts)

SAB FAdC100_184:

In case of safety-relevant applications of the system pulses, both system pulses (system 1 and system 2) must be output as follows and evaluated by the safety system:

- at least at 2 counting head outputs
  - connector “Xn01” on the BP-PWR:
    1 output from CHn.1 and 1 output from CHn.2
  - connector “X101” on the BP-EXB:
    1 output from CH1.1 and 1 output from CH1.2

5.4.4.19 Parameters switching outputs

This configuration word is used to configure the parameters for the output at the relay switching outputs of the IO-EXB and at the optocoupler outputs of the AEB.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **5 bytes**,
- is valid for the configuration words "Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB" and "Output of counting head outputs of the AEB via opto-coupler".

- The system extension ("SYS_EXT") is the time by which the output of the system pulse at the outputs is extended.
- The direction pulse length ("DIR_LENGTH") is the minimum time for which a direction pulse is output at the outputs.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ZP-OUT_EXT	b39 ... b33	**7**	**:**	**0b**0101111	**47**	configuration parameters switching outputs (output times of switching outputs)
TYPE_PRTCT	b32	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
SYS_EXT	b31 ... b16	**16**	**:**			system extension, to be configured in steps of 1 ms (from 0 to 65 535 ms):
				0b000000000000000**0**	**0**	0 ms
				…	**…**	…
				0b0000000**111110100**	**500**	500 ms = 0,5 s (default)
				…	**…**	…
				0b1111111111111111	**65 535**	65 535 ms = 65,535 s

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
DIR_LENGTH	b15 ... b0	**16**	**:**			direction pulse length, to be configured in steps of 1 ms (from 0 to 65 535 ms):
				0b000000000000000**0**	**0**	0 ms
				…	**…**	…
				0b0000000**111110100**	**500**	500 ms = 0,5 s (default)
				…	**…**	…
				0b1111111111111111	**65 535**	65 535 ms = 65,535 s

Table 5.30: Parameters switching outputs

5.4.4.20 Dynamic occupied status extension

This configuration word is used to configure the dynamic occupied status extension (DBV). It is used to improve the counting of wheels in limit ranges. If the dynamic occupied status extension is configured with ‘1’ (on), then Frauscher must be consulted.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **2 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_DBV	b15 ... b9	**7**	**:**	**0b**0101100	**44**	configuration dynamic occupied status extension
TYPE_PRTCT	b8	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
DBV	b7 ... b6	**2**	**:**			dynamic occupied status extension:
				0b00	**0**	off (default)
				0b01	**1**	on, procedure 1
				0b10	**2**	not allowed
				0b11	**3**	not allowed
RESERVED	b5 ... b0	**6**	**:**	**0b**00000**0**	**0**	reserved

Table 5.31: Dynamic occupied status extension

5.4.4.21 Input/output data transmission

This configuration word is used to configure the inputs and outputs of the IO-EXB for data transmission. Depending on the configuration of the functionality, the IO-EXB boards are arranged in a specific order on the BP-EXB. Further information can be taken from the chapter “Backplane BP-EXB”. Further information about inputs and/or outputs can be taken from the chapters “Digital inputs for data transmission” and “Digital outputs for data transmission”.

This configuration word
- is **mandatory** in case the function data transmission is used,
- can be configured **up to 8 times** (1 time per IO-EXB),
- consists of **9 entries** with a total of **4 bytes**.

- If this configuration word is configured several times, then the 1st configuration word is for the 1st IO-EXB which is used for data transmission, the 2nd for the 2nd IO-EXB which is used for data transmission and so forth. This order must be complied with in the configuration file.
- If the safety level of the outputs in the entry “SAFETY_LEVEL_OUT” is configured with ‘0’ (outputs not used), then the entries “AUTO_POSITION” and “POSITION” must also be configured with ‘0’ (no automatic positioning and position 0 to position 2/5/11). In this case, a different ID as the ID of the own AEB must be entered in the entry “ID”.
- If the automatic positioning of the output information in the entry “AUTO_POSITION” is configured with ‘1’ (automatic positioning), then the entry “POSITION” must be configured with ‘0’ (position 0 to position 2/5/11).
- If the AEB (entry “ID”) whose inputs should be output and the AEB that is configured in this configuration word are not located on the same local CAN segment, then the configuration word “Forwarding axle counting data” of the COM must also be configured for the AEB whose data should be used.
- In case this configuration word is used, the maximum permitted number of AEB boards per CAN segment is reduced as an AEB which reads out and transmits data, counts as a 1,5-times participant. The maximum permitted number of AEB boards allowed per CAN segment depends on the configured transmission interval (see chapter “Interface ‘CAN’”).
- One AEB can communicate with up to 20 other AEB boards (see chapter “Maximum number of the communication participants per AEB”).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_DATA_IO	b31 ... b25	**7**	**:**	**0b0001001**	**9**	configuration input/output data transmission
TYPE_PRTCT	b24	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
SAFETY_LEVEL_IN	b23 ... b22	**2**	**:**			safety level of inputs:
				0b00	**0**	inputs not used (= inputs open)
				0b01	**1**	SINGLE inputs
				0b10	**2**	DUAL inputs
				0b11	**3**	QUAD inputs
SAFETY_LEVEL_OUT	b21 ... b20	**2**	**:**			safety level of outputs:
				0b00	**0**	outputs not used (= outputs open)
				0b01	**1**	SINGLE outputs
				0b10	**2**	DUAL outputs
				0b11	**3**	QUAD outputs
AUTO_POSITION	b19	**1**	**:**			automatic positioning of the output information:
				0b0	**0**	no automatic positioning
				0b1	**1**	automatic positioning
POSITION	b18 ... b16	**3**	**:**			position of the output information in the sender ID data packet (in triple steps)
				0b000	**0**	position 0 to position 2/5/11 (depending on output type QUAD/DUAL/SINGLE):
				0b001	**1**	position 3 to position 5/8/14
				0b010	**2**	position 6 to position 8/11/17
				0b011	**3**	position 9 to position 11/14/20
				0b100	**4**	position 12 to position 14/17/23
				0b101	**5**	position 15 to position 17/20/-
				0b110	**6**	position 18 to position 20/23/-
				0b111	**7**	position 21 to position 23/-/-
RESERVED	b15	**1**	**:**	**0b0**	**0**	reserved

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
SLCT_TIMEOUT	b14 ... b12	**3**	**:**			selection of time-out between the AEB to which the IO-EXB is directly connected and the AEB whose inputs should be output (see chapter “Time-out FAdC”):
				0b000	**0**	time-out 0
				…	**…**	…
				0b111	**7**	time-out 7
ID	b11 ... b0	**12**	**:**			sender ID 1 to 4 095 of the AEB whose inputs should be output (and/or if outputs not used: another ID than the own AEB)[27]:
				0b00000000000**0**	**0**	sender ID 0 locks this configuration word
				0b00000000000**1**	**1**	1
				…	**…**	…
				0b111111111111	**4 095**	4 095

Table 5.32: Input/output data transmission

27 If IO data from the interlocking should be transmitted via a COM-xxx, then the ID of the COM-xxx must be configured here instead of the ID of the AEB.

5.4.4.22 Time-out FAdC

This configuration word is used to configure up to 8 various time-outs, dependent on the require-ments. Every time-out (time-out 0 to time-out 7) has a unique value for identification (see entry “CFG_TIMEOUT”).
Further information regarding the time-out and the calculation of the time-out can be taken from the chapter “Delay periods and time-out of the FAdC”.

This configuration word
- is **mandatory** in case the AEB communicates with other boards (i.e. in case the configuration file of this AEB contains a configuration word with an entry “ID”, even if its own ID is configured in this entry),
- can be configured **up to 8 times per AEB**,
- consists of **3 entries** with a total of **2 bytes**,
- is not necessary in case the AEB is only used to output its own counting head information.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_TIMEOUT	b15 ... 9	**7**	**:**			configuration time-out FAdC:
				0b0100000	**32**	time-out 0
				…	**…**	…
				0b0100111	**39**	time-out 7
TYPE_PRTCT	b8	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
TIMEOUT_VALUE	b7 ... b0	**8**	**:**			time-out, to be configured in steps of 10 ms (from 10 to 2 550 ms):
				0b0000000**0**	**0**	not allowed
				0b0000000**1**	**1**	10 ms
				…	**…**	…
				0b11111111	**255**	2 550 ms = 2,55 s

Table 5.33: Time-out FAdC

The configuration of the time-out depends on several factors such as the configured transmission interval. Further information can be taken from the chapter “Delay periods and time-out of the FAdC”. Suitable values for the time-outs can be taken from the table “Time-outs for participants at the same CAN segment and for forwardings via COM boards” in the same chapter.

SAB FAdC100_169:

The configured time-out must match the projected time-out.

5.4.4.23 Project number

The configuration word “Project number” is used to assign the configurable boards of the FAdC (AEB and COM) uniquely to a project.
This configuration word acts to encapsulate boards within a network.
Boards with different project numbers cannot communicate with one another. This means that different independent projects can be located on the same network. Different projects can share the same ID because boards are uniquely assigned to a project by the project number. But within a CAN segment there may only be boards and configuration files with the same project number.
The network operator must ensure that each project number is allocated only 1 time within the network. If there are several FAdC projects in a network, the project number ‘0’ may not be allocated.

This configuration word
- is **optional**, (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **4 bytes**.

- If this configuration word is used, then the project number ‘0’ (default) must not be allocated.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_PROJECT_AEB	b31 ... b25	**7**	**:**	**0b**0010000	**16**	configuration project number
TYPE_PRTCT	b24	**1**	**:**			type protection:
				0b0	**0**	not type-protected
				0b1	**1**	type-protected
RESERVED	b23 … b20	**4**	**:**	**0b**0000	**0**	reserved
PROJECT_NUMBER	b19 ... b0	**20**	**:**			project number (default = 0)

Table 5.34: Project number

5.4.4.24 Wheel sensor switching levels (set and type-protected by Frauscher)

This configuration word is used to configure the parameters of the wheel sensor switching levels.

This configuration word
- is set and type-protected by Frauscher as it contains safety-critical parameters,
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **6 entries** with a total of **5 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_ESP_ASP	b39 ... b33	**7**	**:**	**0b**0101001	**41**	configuration wheel sensor switching levels
TYPE_PRTCT	b32	**1**	**:**			type protection:
				0b0	**0**	not allowed
				0b1	**1**	type-protected
ESP	b31 ... b24	**8**	**:**			trigger level ESP, to be configured in steps of % (from 50 to 94 %):
				0b0000000**0**	**0**	not allowed
				…	**…**	not allowed
				0b00110010	**50**	50 %
				…	**…**	…
				0b01001011	**75**	75 % (default for RSR123 and RSR180)
				…	**…**	…
				0b01011110	**94**	94 %
				…	**…**	not allowed
				0b11111111	**255**	not allowed

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
ASP	b23 ... b16	8	:			tripping level ASP, to be configured in steps of % (from 51 to 95 %):
				0b00000000	**0**	not allowed
				…	**…**	not allowed
				0b00110011	**51**	51 %
				…	**…**	…
				0b01010110	**86**	86 % (default for RSR123 and RSR180)
				…	**…**	…
				0b01011111	**95**	95 %
				…	**…**	not allowed
				0b11111111	**255**	not allowed
ESP_DBV	b15 ... b8	8	:			trigger level ESP in case of dynamic occupied status extension DBV, to be configured in steps of % (from 50 to 94 %):
				0b00000000	**0**	not allowed
				…	**…**	not allowed
				0b00110010	**50**	50 %
				…	**…**	…
				0b01010101	**85**	85 % (default for RSR123)
				…	**…**	…
				0b01011000	**88**	88 % (default for RSR180)
				…	**…**	…
				0b01011110	**94**	94 %
				…	**…**	not allowed
				0b11111111	**255**	not allowed
ASP_DBV	b7 ... b0	8	:			tripping level ASP in case of dynamic occupied status extension DBV, to be configured in steps of % (from 51 to 95 %):
				0b00000000	**0**	not allowed
				…	**…**	not allowed
				0b00110011	**51**	51 %
				…	**…**	…
				0b01011010	**90**	90 % (default for RSR123 and RSR180)
				…	**…**	…
				0b01011111	**95**	95 %
				…	**…**	not allowed
				0b11111111	**255**	not allowed

Table 5.35: Wheel sensor switching levels

5.4.4.25 Wheel sensor overcurrent (set and type-protected by Frauscher)

This configuration word is used to configure the parameters of the wheel sensor overcurrent levels (high and low).

This configuration word
- is set and type-protected by Frauscher as it contains safety-critical parameters,
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **3 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_USP	b23 ... b17	**7**	**:**	**0b**0101010	**42**	configuration wheel sensor overcurrent ÜSP
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not allowed
				0b1	**1**	type-protected
USP_LOW	b15 ... b8	**8**	**:**			overcurrent ÜSP low, to be configured in steps of % (from 104 to 119 %):
				0b0000000**0**	**0**	not allowed
				…	**…**	not allowed
				0b01101000	**104**	104 %
				…	**…**	…
				0b01101100	**108**	108 % (default)
				…	**…**	…
				0b01110111	**119**	119 %
				…	**…**	not allowed
				0b11111111	**255**	not allowed
USP_HIGH	b7 ... b0	**8**	**:**			overcurrent ÜSP high, to be configured in steps of % (from 105 to 120 %):
				0b0000000**0**	**0**	not allowed
				…	**…**	not allowed
				0b01101001	**105**	105 %
				…	**…**	…
				0b01101110	**110**	110 % (Default)
				…	**…**	…
				0b01111000	**120**	120 %
				…	**…**	not allowed
				0b11111111	**255**	not allowed

Table 5.36: Wheel sensor overcurrent

5.4.4.26 Magnetic track brake suppression (set and type-protected by Frauscher)

This configuration word is used to configure the magnetic track brake suppression.

This configuration word
- is set and type-protected by Frauscher as it contains safety-critical parameters,
- is **optional** (i.e. if this configuration word is not configured, then the specified **default value** applies),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **2 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MG	b15 ... b9	**7**	**:**	**0b**0101011	**43**	configuration magnetic track brake suppression
TYPE_PRTCT	b8	**1**	**:**			type protection:
				0b0	**0**	not allowed
				0b1	**1**	type-protected
MG_SUPP	b7 ... b6	**2**	**:**			magnetic track brake suppression:
				0b00	**0**	off (default)
				0b01	**1**	on, procedure 1
				0b10	**2**	not allowed
				0b11	**3**	not allowed
RESERVED	b5 ... b0	**6**	**:**	**0b**00000**0**	**0**	reserved

Table 5.37: Magnetic track brake suppression

5.4.4.27 Parameters of magnetic track brake suppression (set and type-protected by Frauscher)

This configuration word is used to configure the parameters of the magnetic track brake suppression.

This configuration word
- is set and type-protected by Frauscher as it contains safety-critical parameters,
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **4 entries** with a total of **3 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MG_VALUE	b23 ... b17	**7**	**:**	**0b0101101**	**45**	configuration parameters magnetic track brake suppression
TYPE_PRTCT	b16	**1**	**:**			type protection:
				0b0	**0**	not allowed
				0b1	**1**	type-protected
MAX_DUR_OCC	b15 ... b8	**8**	**:**			maximum occupied status duration, to be configured in steps of 10 ms (from 0 to 2 550 ms):
				0b00000000	**0**	not allowed
				0b00000001	**1**	10 ms
				…	**…**	…
				0b00010100	**20**	200 ms = 0,2 s (default)
				…	**…**	…
				0b11111111	**255**	2 550 ms = 2,55 s
MG_SUPP_FACTOR	b7 ... b0	**8**	**:**			multiplication factor for magnetic track brake suppression, to be configured in steps of 0,125 (from 0 to 31,875):
				0b00000000	**0**	not allowed
				0b00000001	**1**	0,125
				…	**…**	…
				0b00011000	**24**	3 (default)
				…	**…**	…
				0b11111111	**255**	31,875

Table 5.38: Parameters of magnetic track brake suppression

5.4.4.28 Digital filtering time (set and type-protected by Frauscher)

This configuration word is used to configure the parameters for the digital filtering time.

This configuration word
- is set and type-protected by Frauscher as it contains safety-critical parameters,
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per AEB**,
- consists of **3 entries** with a total of **2 bytes**.

- The digital filtering time (see entry “FILTER”) is the time, in which the sensor signal must fall below the trigger level ESP and/or exceed the tripping level ASP before the system is considered to be “occupied” and/or “not occupied”.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_FILTER	b15 ... b9	7	:	0b0110001	49	configuration digital filtering time
TYPE_PRTCT	b8	1	:			type protection:
				0b0	0	not allowed
				0b1	1	type-protected
FILTER	b7 ... b0	8	:			digital filtering time, to be configured in steps of 0,1 ms (from 0,1 to 25,5 ms):
				0b00000000	0	not allowed
				0b00000001	1	0,1 ms
				...	...	…
				0b00001111	15	1,5 ms (default)
				...	...	…
				0b11111111	255	25,5 ms

Table 5.39: Digital filtering time

5.5 Configuration of the communication board COM

The communication board COM is configured with configuration words. Additional DIP-switches must be set on the circuit board of the COM. The specific configuration words for the COM-xxx boards can be taken from the respective COM-xxx specific documentation.

5.5.1 Redundant communication

In order to increase the availability, the communication can be designed redundantly. Basically, a distinction between network redundancy and board redundancy can be made.

5.5.1.1 Network redundancy

Every COM has 2 Ethernet connections, which are connected to 1 network each.

5.5.1.2 Board redundancy

In order to increase the availability of the system, 2 COM boards are used. This means that there is a redundant configuration server, forwardings happen redundantly and the connection to an interlocking is also designed redundantly (in case of COM-xxx boards).

In this case, the following must be observed:

- 2 COM boards with the same ID must be used.
- Both COM boards must be connected via a crossover cable at the interface “Hotlink”.
- One of the 2 COM boards must be set via DIP-switch as master COM (“OFF”), the other must be configured via DIP-switch as slave COM (“ON”).
- The DIP-switch for the redundant operation must be set to “ON” on both COM boards.
- The DIP-switch for the configuration server must be set identically on both COM boards (both to “ON” or both to “OFF”).
- Both COM boards must each have a CF card with identical configuration files.
- Both redundant COM boards use the same configuration data. In there, different IP addresses can be included for both COM boards.

In an error-free operation always one of both redundant COM boards is active and the other one is passive. The active COM can be recognized by its illuminated LED “PWR” (on the front panel). Only the active COM sends data to the CAN bus. The passive COM does not send data, but has the same internal statuses as the active COM.

If the passive COM cannot receive data, neither via the Hotlink connection nor from the active COM via the CAN bus, then the passive COM will change into the active status.
In case a CAN bus failed and the active COM also fails (i.e. the passive COM becomes the active COM), then a communication interruption (< 1 s) can occur between AEB and AEB.

5.5.2 Configuration words of the COM

5.5.2.1 Own IP address master COM for network 1

This configuration word is used to configure the own IP address of the master COM for network 1. The network operator must ensure that each IP address is allocated only 1 time within the network.

This configuration word
- is **mandatory** if the connection “Ethernet 1” is used,
- must be configured **1 time per master COM** (in case of redundant operation),
- must be configured **1 time per COM** (in case of single operation),
- must be configured **1 time per COM** in case IP-Switching is used,
- consists of **5 entries** with a total of **5 bytes**.

- The connections “Ethernet 1” and “Ethernet 2” of the COM can have different IP addresses.
- The own IP address for the master COM for network 1 must not be in the range of IP addresses, which are reserved for multicast (224.0.0.0 to 239.255.255.255).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MY_IP_NW1	b39 ... b32	**8**	**:**	**0b**0000000**1**	**1**	configuration own IP address master COM, network 1
MY_IP_NW1_B1	b31 ... b24	**8**	**:**			own IP address, network 1, byte 1
MY_IP_NW1_B2	b23 ... b16	**8**	**:**			own IP address, network 1, byte 2
MY_IP_NW1_B3	b15 ... b8	**8**	**:**			own IP address, network 1, byte 3
MY_IP_NW1_B4	b7 ... b0	**8**	**:**			own IP address, network 1, byte 4

Table 5.40: Own IP address master COM for network 1

5.5.2.2 Own IP address master COM for network 2

This configuration word is used to configure the own IP address of the master COM for network 2. The network operator must ensure that each IP address is allocated only 1 time within the network.

This configuration word
- is **mandatory** if the connection “Ethernet 2” is used,
- must be configured **1 time per master COM** (in case of redundant operation),
- must be configured **1 time per COM** (in case of single operation),
- must be configured **1 time per COM** in case IP-Switching is used,
- consists of **5 entries** with a total of **5 bytes.**

- The connections “Ethernet 1” and “Ethernet 2” of the COM can have different IP addresses.
- The own IP address for the master COM for network 2 must not be in the range of IP addresses, which are reserved for multicast (224.0.0.0 to 239.255.255.255).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MY_IP_NW2	b39 ... b32	**8**	**:**	**0b**000000**10**	**2**	configuration own IP address master COM, network 2
MY_IP_NW2_B1	b31 ... b24	**8**	**:**			own IP address, network 2, byte 1
MY_IP_NW2_B2	b23 ... b16	**8**	**:**			own IP address, network 2, byte 2
MY_IP_NW2_B3	b15 ... b8	**8**	**:**			own IP address, network 2, byte 3
MY_IP_NW2_B4	b7 ... b0	**8**	**:**			own IP address, network 2, byte 4

Table 5.41: Own IP address master COM for network 2

5.5.2.3 Own IP address slave COM for network 1 in redundant operation

This configuration word is used to configure the own IP address of the slave COM in redundant operation for network 1. The network operator must ensure that each IP address is allocated only 1 time within the network.

This configuration word
- is **mandatory** in redundant operation if IP switching is off (see chapter “IP switching”) and if the connection “Ethernet 1” is used,
- must be configured **1 time per slave COM**,
- consists of **5 entries** with a total of **5 bytes**,
- must not be used in case of single operation or if IP switching is on (see chapter “IP switching”).

- The connections “Ethernet 1” of the slave COM and “Ethernet 1” of the master COM are intended to be connected to the same network. Therefore, the network portion of the IP addresses of slave COM and master COM must be equal.
- The own IP address for the slave COM for network 1 must not be in the range of IP addresses, which are reserved for multicast (224.0.0.0 to 239.255.255.255).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MY_IP_NW1_R	b39 ... b32	**8**	**:**	**0b**00000**11**	**3**	configuration own IP address slave COM, network 1 in redundant operation
MY_IP_NW1_R_B1	b31 ... b24	**8**	**:**			own IP address, network 1 in redundant operation, byte 1
MY_IP_NW1_R_B2	b23 ... b16	**8**	**:**			own IP address, network 1 in redundant operation, byte 2
MY_IP_NW1_R_B3	b15 ... b8	**8**	**:**			own IP address, network 1 in redundant operation, byte 3
MY_IP_NW1_R_B4	b7 ... b0	**8**	**:**			own IP address, network 1 in redundant operation, byte 4

Table 5.42: Own IP address slave COM for network 1 in redundant operation

5.5.2.4 Own IP address slave COM for network 2 in redundant operation

This configuration word is used to configure the own IP address of the slave COM in redundant operation for network 2. The network operator must ensure that each IP address is allocated only 1 time within the network.

This configuration word
- is **mandatory** in redundant operation if IP switching is off (see chapter “IP switching”) and if the connection “Ethernet 2” is used,
- must be configured **1 time per slave COM**,
- consists of **5 entries** with a total of **5 bytes**,
- must not be used in case of single operation or if IP switching is on (see chapter “IP switching”).

- The connections “Ethernet 2” of the slave COM and “Ethernet 2” of the master COM are intended to be connected to the same network. Therefore, the network portion of the IP addresses of slave COM and master COM must be equal.
- The own IP address for the slave COM for network 2 must not be in the range of IP addresses, which are reserved for multicast (224.0.0.0 to 239.255.255.255).

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MY_IP_NW2_R	b39 ... b32	**8**	**:**	**0b**00000**100**	**4**	configuration own IP address slave COM, network 2 in redundant operation
MY_IP_NW2_R_B1	b31 ... b24	**8**	**:**			own IP address, network 2 in redundant operation, byte 1
MY_IP_NW2_R_B2	b23 ... b16	**8**	**:**			own IP address, network 2 in redundant operation, byte 2
MY_IP_NW2_R_B3	b15 ... b8	**8**	**:**			own IP address, network 2 in redundant operation, byte 3
MY_IP_NW2_R_B4	b7 ... b0	**8**	**:**			own IP address, network 2 in redundant operation, byte 4

Table 5.43: Own IP address slave COM for network 2 in redundant operation

5.5.2.5 Own subnet mask

This configuration word is used to configure the own subnet mask.

This configuration word
- is **mandatory**, if “Ethernet 1” or “Ethernet 2” is used,
- must be configured **1 time per network**,
- consists of **5 entries** with a total of **3 bytes**.

- For the connections “Ethernet 1” and “Ethernet 2”, the same subnet mask can be configured (subnet mask in abbreviated form, see table “Number of bits for network address”).
- The connections “Ethernet 1” of the master COM and the slave COM must be connected to network 1.
- The connections “Ethernet 2” of the master COM and the slave COM must be connected to network 2.
- The same subnet mask is used for the connections “Ethernet 1” of the master COM and the slave COM.
- The same subnet mask is used for the connections “Ethernet 2” of the master COM and the slave COM.
- If only network 1 is configured, ‘0’ must be entered in the entry “MY_MASK_NW2”.
- If only network 2 is configured, ‘0’ must be entered in the entry “MY_MASK_NW1”.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_MY_MASK	b23 ... b16	**8**	**:**	**0b**00000**101**	**5**	configuration own subnet mask
RESERVED	b15 ... b13	**3**	**:**	**0b**000	**0**	reserved
MY_MASK_NW1	b12 ... b8	**5**	**:**			number of bits for network address, network 1
RESERVED	b7 ... b5	**3**	**:**	**0b**000	**0**	reserved
MY_MASK_NW2	b4 ... b0	**5**	**:**			number of bits for network address, network 2

Table 5.44: Own subnet mask

Subnet mask	No. of bits for network address
0.0.0.0	0
128.0.0.0	1
192.0.0.0	2
224.0.0.0	3
240.0.0.0	4
248.0.0.0	5
252.0.0.0	6
254.0.0.0	7
255.0.0.0	8
255.128.0.0	9
255.192.0.0	10
255.224.0.0	11
255.240.0.0	12
255.248.0.0	13
255.252.0.0	14
255.254.0.0	15
255.255.0.0	16
255.255.128.0	17
255.255.192.0	18
255.255.224.0	19
255.255.240.0	20
255.255.248.0	21
255.255.252.0	22
255.255.254.0	23
255.255.255.0	24
255.255.255.128	25
255.255.255.192	26
255.255.255.224	27
255.255.255.240	28
255.255.255.248	29
255.255.255.252	30
255.255.255.254	31

Table 5.45: Number of bits for network address

5.5.2.6 Default gateway IP address

This configuration word is used to configure the default gateway IP address.

This configuration word

- is **mandatory**, in case a default gateway is used,
- must be configured **1 time per network**,
- consists of **5 entries** with a total of **5 bytes**.

- The connections “Ethernet 1” of the master COM and the slave COM must be connected to network 1.
- The connections “Ethernet 2” of the master COM and the slave COM must be connected to network 2.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_DFLT_GTWY_IP	b39 ... b32	**8**	**:**			configuration default gateway IP address:
				0b0001**0010**	**18**	gateway network 1
				0b0001**0011**	**19**	gateway network 2
DFLT_GTWY_IP_B1	b31 ... b24	**8**	**:**			gateway IP address, byte 1
DFLT_GTWY_IP_B2	b23 ... b16	**8**	**:**			gateway IP address, byte 2
DFLT_GTWY_IP_B3	b15 ... b8	**8**	**:**			gateway IP address, byte 3
DFLT_GTWY_IP_B4	b7 ... b0	**8**	**:**			gateway IP address, byte 4

Table 5.46: Default gateway IP address

5.5.2.7 Gateway IP address

This configuration word is used to configure the gateway IP address.

This configuration word
- is **mandatory**, in case a gateway is used,
- must be configured **1 time per network and Gateway**, (except Default Gateway IP address)
- consists of **5 entries** with a total of **5 bytes**.

- The connections "Ethernet 1" of the master COM and the slave COM must be connected to network 1.
- The connections "Ethernet 2" of the master COM and the slave COM must be connected to network 2.
- The configuration word "Gateway IP address" must be used in combination with the configuration words "Gateway Destination network" and "Gateway subnet mask Destination network".

Indicator	Bits	No. of Bits	:	Value binary	Value decimal	Description
CFG_GTWY_IP	b39 ... b32	**8**	**:**			configuration gateway IP address:
				0b00010100	**20**	gateway 1, network 1
				0b00010101	**21**	gateway 2, network 1
				0b00010110	**22**	gateway 1, network 2
				0b00010111	**23**	gateway 2, network 2
CFG_GTWY_IP_B1	b31 ... b24	**8**	**:**			gateway IP address, byte 1
CFG_GTWY_IP_B2	b23 ... b16	**8**	**:**			gateway IP address, byte 2
CFG_GTWY_IP_B3	b15 ... b8	**8**	**:**			gateway IP address, byte 3
CFG_GTWY_IP_B4	b7 ... b0	**8**	**:**			gateway IP address, byte 4

Table 5.47: Gateway IP address

5.5.2.8 Gateway Destination network

This configuration word is used to configure the gateway Destination network.

This configuration word
- is **mandatory**, in case a gateway Destination network is used,
- must be configured **1 time per configured gateway** in the configuration word "Gateway IP address",
- consists of **5 entries** with a total of **5 bytes**.

- The connections "Ethernet 1" of the master COM and the slave COM must be connected to network 1.
- The connections "Ethernet 2" of the master COM and the slave COM must be connected to network 2.
- For Destination network gateway 1, Destination network gateway 2 and the own network the ranges of the IP addresses must not overlap.
- This configuration word must be used in combination with the configuration words "Gateway IP address" and "Gateway subnet mask Destination network".

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_GTWY_DEST	b39 ... b32	**8**	**:**			configuration gateway Destination network:
				0b000**11000**	**24**	gateway 1, network 1
				0b000**11001**	**25**	gateway 2, network 1
				0b000**11010**	**26**	gateway 1, network 2
				0b000**11011**	**27**	gateway 2, network 2
GTWY_DEST_IP_B1	b31 ... b24	**8**	**:**			gateway Destination network IP address, byte 1
GTWY_DEST_IP_B2	b23 ... b16	**8**	**:**			gateway Destination network IP address, byte 2
GTWY_DEST_IP_B3	b15 ... b8	**8**	**:**			gateway Destination network IP address, byte 3
GTWY_DEST_IP_B4	b7 ... b0	**8**	**:**			gateway Destination network IP address, byte 4

Table 5.48: Gateway Destination network

5.5.2.9 Gateway subnet mask Destination network

This configuration word is used to configure the gateway subnet mask Destination network.

This configuration word
- is **mandatory**, in case a gateway subnet mask Destination network is used,
- must be configured **1 time per configured gateway** in the configuration word “Gateway IP address”,
- consists of **3 entries** with a total of **2 bytes**.

- The connections “Ethernet 1” of the master COM and the slave COM must be connected to network 1.
- The connections “Ethernet 2” of the master COM and the slave COM must be connected to network 2.
- This configuration word must be used in combination with the configuration words “Gateway IP address” and “Gateway Destination network”.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_GTWY_MASK_DEST	b15 ... b8	**8**	**:**			configuration gateway subnet mask Destination network:
				0b000**111**00	**28**	gateway 1, network 1
				0b000**11101**	**29**	gateway 2, network 1
				0b000**11110**	**30**	gateway 1, network 2
				0b000**11111**	**31**	gateway 2, network 2
RESERVED	b7 ... b5	**3**	**:**	**0b**000	**0**	reserved
GTWY_MASK_DEST	b4 ... b0	**5**	**:**			number of bits for network address gateway (see table in the configuration word “Own subnet mask”)

Table 5.49: Gateway subnet mask Destination network

5.5.2.10 Destination IP address network 1 for internal forwarding

This configuration word is used to configure the Destination IP address of network 1 for the internal forwarding.

This configuration word
- is **mandatory** in case internal forwarding via “Ethernet 1” is used,
- must be configured **1 time per internal Destination ID for multicast** if the connection “Ethernet 1” is used,
- can be configured **up to 2 times per internal Destination ID for unicast** if the connection “Ethernet 1” is used,
- consists of **5 entries** with a total of **5 bytes**.

- The internal Destination ID acts as an abbreviation for the IP addresses to which the data should be forwarded or where they come from.
- If 1 FDS is used, 1 internal Destination ID is required. If 2 FDS are used, 2 internal Destination IDs are required.
- If a redundant transmission is configured for a COM, then for connection “Ethernet 1” and for connection “Ethernet 2” at least 1 IP address each must be configured with the same internal Destination ID.
- If redundant transmission is not required, then the respective internal Destination ID may be configured only for one of the two networks.
- Via the configuration in the multicast IP range of addresses, the transmission mode multicast is activated. The range of IP addresses from 244.0.0.0 to 239.255.255.255 is reserved for multicast. Within that range of IP addresses, the IP addresses from 224.0.0.0 to 224.0.0.255 must not be used as Destination IP addresses.
- The internal Destination ID is used in the following configuration words:
  “UDP port Destination”, “Forwarding axle counting data” and “Forwarding diagnostic messages”.
- The Destination IP address for network 1 for internal forwarding must also be configured for the COM which receives the data.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_INT_ID_DEST_NW1	b39 ... b32	**8**	**:**	**0b00100000** **…** **0b00101111**	**32** **…** **47**	configuration Destination IP address network 1, internal Destination ID (socket): 0 … 15
DEST_IP_INT_ID_NW1_B1	b31 ... b24	**8**	**:**			Destination IP address, byte 1
DEST_IP_INT_ID_NW1_B2	b23 ... b16	**8**	**:**			Destination IP address, byte 2
DEST_IP_INT_ID_NW1_B3	b15 ... b8	**8**	**:**			Destination IP address, byte 3
DEST_IP_INT_ID_NW1_B4	b7 ... b0	**8**	**:**			Destination IP address, byte 4

Table 5.50: Destination IP address network 1 for internal forwarding

Example for forwarding:

Internal Destination ID	"Ethernet 1"	"Ethernet 2"	Transmission mode
0	192.168.1.10	192.168.2.10	redundant transmission (network redundancy)
1	192.168.1.11	-	non-redundant transmission
2	192.168.1.12	-	non-redundant transmission
3	192.168.1.13	192.168.2.13	redundant transmission (network redundancy)
4	192.168.1.14 (master COM) 192.168.1.15 (slave COM)	192.168.2.14 (master COM) 192.168.2.15 (slave COM)	redundant transmission to redundant receiver (network redundancy and boards redundancy)

Table 5.51: Example for forwarding (redundant or non-redundant transmission)

5.5.2.11 Destination IP address network 2 for internal forwarding

This configuration word is used to configure the Destination IP address of network 2 for the internal forwarding.

This configuration word

- is **mandatory** in case internal forwarding via “Ethernet 2” is used,
- must be configured **1 time per internal Destination ID for multicast** if the connection “Ethernet 2” is used,
- can be configured **up to 2 times per internal Destination ID for unicast** if the connection “Ethernet 2” is used,
- consists of **5 entries** with a total of **5 bytes**.

- The internal Destination ID acts as an abbreviation for the IP addresses to which the data should be forwarded or where they come from.
- If 1 FDS is used, 1 internal Destination ID is required. If 2 FDS are used, 2 internal Destination IDs are required.
- If a redundant transmission is configured for a COM, then for connection “Ethernet 1” and for connection “Ethernet 2” at least 1 IP address each must be configured with the same internal Destination ID.
- If redundant transmission is not required, then the respective internal Destination ID may be configured only for one of the two networks.
- Via the configuration in the multicast IP range of addresses, the transmission mode multicast is activated. The range of IP addresses from 244.0.0.0 to 239.255.255.255 is reserved for multicast. Within that range of IP addresses, the IP addresses from 224.0.0.0 to 224.0.0.255 must not be used as Destination IP addresses.
- The internal Destination ID is used in the following configuration words:
  “UDP port Destination”, “Forwarding axle counting data” and “Forwarding diagnostic messages”.
- The Destination IP address for network 2 for internal forwarding must also be configured for the COM which receives the data.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_INT_ID_DEST_NW2	b39 ... b32	**8**	**:**	**0b**00**110000** **…** **0b**00**111111**	**48** **…** **63**	configuration Destination IP address network 2, internal Destination ID (socket): 0 … 15
DEST_IP_INT_ID_NW2_B1	b31 ... b24	**8**	**:**			Destination IP address, byte 1
DEST_IP_INT_ID_NW2_B2	b23 ... b16	**8**	**:**			Destination IP address, byte 2
DEST_IP_INT_ID_NW2_B3	b15 ... b8	**8**	**:**			Destination IP address, byte 3
DEST_IP_INT_ID_NW2_B4	b7 ... b0	**8**	**:**			Destination IP address, byte 4

Table 5.52: Destination IP address network 2 for internal forwarding

5.5.2.12 UDP port internal communication

This configuration word is used to configure the UDP port for the internal communication of the COM boards.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per COM**,
- consists of **3 entries** with a total of **5 bytes**,
- is valid for the connections “Ethernet 1” and “Ethernet 2”.

- The configured UDP port for internal communication (“UDP_PORT_INT_UNI” or “UDP_PORT_INT_MULTI”) must not be used for the connection to an interlocking.
- The UDP ports for unicast and multicast must be configured differently.
- If Destination IP addresses network 1/network 2 for internal forwarding are used from the multicast range of addresses, then the multicast UDP port is used, otherwise the unicast UDP port is used.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_UDP_PORT_INT	b39 ... b32	**8**	**:**	**0b**00000**111**	**7**	configuration UDP port internal communication
UDP_PORT_INT_UNI	b31 ... b16	**16**	**:**	 **0b**000000000000000**0** **…** **0b**0000000000**101101** **…** **0b1111111111111110** **0b1111111111111111**	 **0** **…** **45** **…** **65 534** **65 535**	UDP port unicast for internal communication: 0 … 45 (default) … 65 534 not allowed
UDP_PORT_INT_MULTI	b15 … b0	**16**	**:**	 **0b**000000000000000**0** **…** **0b**0000000000**101110** **…** **0b1111111111111110** **0b1111111111111111**	 **0** **…** **46** **…** **65 534** **65 535**	UDP port multicast for internal communication: 0 … 46 (default) … 65 534 not allowed

Table 5.53: UDP port internal communication

5.5.2.13 UDP port Destination

This configuration word is used to configure the UDP port Destination.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the used UDP port for internal communication applies as the **default value** for the UDP port Destination (see chapter “UDP port internal communication”),
- can be configured **1 time per Destination ID**,
- consists of **4 entries** with a total of **4 bytes**,
- is valid for “Ethernet 1” and “Ethernet 2”.

- In case both networks are used, the UDP port Destination is used for both networks.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_UDP_PORT_DEST	b31 ... b24	**8**	**:**	**0b**0000**1000**	**8**	configuration UDP port Destination
RESERVED	b23 ... b20	**4**	**:**	**0b**0000	**0**	reserved
INT_ID_DEST	b19 … b16	**4**	**:**	**0b**000**0** **…** **0b1111**	**0** **…** **15**	internal Destination ID (socket): 0 … 15
UDP_PORT_DEST	b15 ... b0	**16**	**:**	**0b**000000000000000**0** **…** **0b1111111111111111**	**0** **…** **65 535**	UDP port Destination (default: used UDP port internal communi-cation): 0 … 65 535

Table 5.54: UDP port Destination

5.5.2.14 Forwarding axle counting data

This configuration word is used to configure the forwarding of the axle counting data (e.g. from an AEB that evaluates a counting head to an AEB that evaluates a track section (FMA)).

This configuration word
- is **mandatory** in case forwarding axle counting data is used,
- can be configured **up to 20 times per COM** in case of a transmission interval of 40 ms, 80 ms or 160 ms,
- can be configured **up to 16 times per COM** in case of a transmission interval of 40 ms, 80 ms or 160 ms, with both multicast and protection against broadcast storm[28] activated,
- can be configured **up to 10 times per COM** in case of a transmission interval of 40 ms, 80 ms or 160 ms if data is sent twice on every network (redundant operation),
- can be configured **up to 5 times per COM** in case of a transmission interval of 10 ms,
- can be configured **up to 2 times per COM** in case of a transmission interval of 10 ms if data is sent twice on every network (redundant operation),
- consists of **3 entries** with a total of **3 bytes**.

1 COM can receive data of a maximum of 100 different AEB boards (IDs), including timestamp requests.

Depending on the configuration (multicast, transmission interval, protection against broadcast storm, redundant operation), further limitations must be considered.

If **multicast is not activated**, then the following limitations apply:

- 1 COM can receive periodic axle counting data from a maximum of 30 different boards (IDs) in case of a transmission interval of 40 ms, 80 ms or 160 ms. A maximum of 20 forwardings from Ethernet to CAN is possible.
- 1 COM can receive periodic axle counting data from a maximum of 20 different boards (IDs) in case of a transmission interval of 40 ms, 80 ms or 160 ms, with **both redundant operation and protection against broadcast storm activated**. A maximum of 18 forwardings from Ethernet to CAN is possible.
- 1 COM can receive periodic axle counting data from a maximum of 7 different boards (IDs) in case of a **transmission interval of 10 ms**. A maximum of 5 forwardings from Ethernet to CAN is possible.

If **Multicast is activated**, then the following limitations apply:

- 1 COM can receive periodic axle counting data from a maximum of 20 different boards (IDs) in case of a transmission interval of 40 ms, 80 ms or 160 ms, **with multicast activated**. A maximum of 20 forwardings from Ethernet to CAN is possible.

28 This function is available for GS02 or higher of the COM-AdC101. See chapter “DIP-switches of the COM” and chapter “Interface ‘Ethernet’”. For COM-xxx, see technical documentation of the respective COM-xxx.

- 1 COM can receive periodic axle counting data from a maximum of 20 different boards (IDs) in case of a transmission interval of 40 ms, 80 ms or 160 ms, with **both multicast and protection against broadcast storm activated**. A maximum of 16 forwardings from Ethernet to CAN is possible.
- 1 COM can receive periodic axle counting data from a maximum of 5 different boards (IDs) in case of a **transmission interval of 10 ms with multicast activated**. A maximum of 5 forwardings from Ethernet to CAN is possible.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_FWRD_ACD	b23 ... b16	**8**	**:**	**0b**0000**1001**	**9**	configuration forwarding axle counting data
INT_ID_DEST	b15 ... b12	**4**	**:**	 **0b**000**0** **…** **0b1111**	 **0** **…** **15**	internal Destination ID (socket): 0 … 15
CAN_TX_ID	b11 ... b0	**12**	**:**	 **0b**00000000000**0** **0b**00000000000**1** **…** **0b111111111111**	 **0** **1** **…** **4 095**	sender ID of the AEB whose data should be sent: not allowed 1 … 4 095

Table 5.55: Forwarding axle counting data

5.5.2.15 Forwarding diagnostic messages

This configuration word is used to configure the forwarding of diagnostic messages of the boards to be configured (AEB and COM) to the FDS and the forwarding of the commands “diagnostic requests” and “describe diagnostic address”.

This configuration word
- is **mandatory**, in case forwarding of diagnostic messages is used,
- can be configured **up to 4 times per COM**,
- consists of **3 entries** with a total of **2 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_FWRD_DIAG	b15 ... b8	**8**	**:**	**0b**0000**1011**	**11**	configuration forwarding diagnostic messages
RESERVED	b7 ... b4	**4**	**:**	**0b**000**0**	**0**	reserved
INT_ID_DEST	b3 ... b0	**4**	**:**	**0b**000**0** **…** **0b1111**	**0** **…** **15**	internal Destination ID (socket): 0 … 15

Table 5.56: Forwarding diagnostic messages

5.5.2.16 IP switching

This configuration word is used to turn on or off the IP switching. IP switching is only possible in case of redundant operation. In case the IP switching is turned on, a redundant pair of COM boards has only 1 IP address per network. In the error-free operation each board uses a different network (one board uses “Ethernet 1”; the other one uses “Ethernet 2”). In case of an error, the Ethernet connection is changed and the one with the better status is used in order to maintain the highest possible availability.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default value** applies),
- can be configured **1 time per COM**,
- consists of **3 entries** with a total of **2 bytes.**

- If the entry “IP_SWITCH” is configured with ‘1’ (on), only the own master COM IP address for network 1 and network 2 may be configured (see chapter “Own IP address master COM for network 1” and “Own IP address master COM for network 2”), the own slave COM IP addresses for network 1 and network 2 in redundant operation must not be configured in this case.

Indicator	Bits	No. of bits.	:	Value binary	Value decimal	Description
CFG_IP_SWITCH	b15 ... b8	**8**	**:**	**0b**00000**110**	**6**	configuration IP switching
RESERVED	b7 ... b1	**7**	**:**	**0b**000000**0**	**0**	reserved
IP_SWITCH	b0	**1**	**:**			IP-switching:
				0b0	**0**	off (default)
				0b1	**1**	on

Table 5.57: IP switching

5.5.2.17 Switchover time in case of IP switching

This configuration word is used to configure the switchover time in case of IP switching. The switchover time is the time that passes after a switch of the IP address between redundant COM boards **on one network** before the IP address is switched between redundant COM boards **on the other network** (see configuration word “IP switching”). This configuration word is only required if the function “IP switching” is used.

This configuration word

- is **optional**, (i. e. if this configuration word is not configured, then the specified **default value** applies),
- can be configured **1 time per COM** if the entry “IP_SWITCH” in the configuration word “IP switching” is configured with ‘1’,
- consists of **2 entries** with a total of **3 bytes**.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_IP_SWITCH_TIME	b23 ... b16	**8**	**:**	**0b**0000**1010**	**10**	Configuration switch-over time IP switching
IP_SWITCH_TIME	b15 ... b0	**16**	**:**			minimum duration of the switchover time, to be configured in steps of 1 s (from 1 to 600 s):
				0b000000000000000**1**	**1**	1 s
				…	**…**	
				0b000000000000**1010**	**10**	10 s (default)
				…	**…**	
				0b000000**1001011000**	**600**	600 s

Table 5.58: Switchover time in case of IP switching

5.5.2.18 Transmission interval

This configuration word is used to configure the transmission interval with which the COM sends data to the CAN bus.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default value** applies),
- can be configured **1 time per COM**,
- consists of **3 entries** with a total of **2 bytes**.

The transmission interval of the COM should match the value of the transmission interval configured for the AEB (typically) or should be smaller (see chapter “Parameters counting head and FMA”, entry “INTERVAL”).

It is recommended not to configure different transmission intervals within a CAN segment.

Indicator	**Bits**	**No. of bits**	**:**	**Value binary**	**Value decimal**	**Description**
CFG_INTERVAL	b15 ... b8	**8**	**:**	**0b**0000**1110**	**14**	configuration transmission interval
RESERVED	b7 ... b2	**6**	**:**	**0b**00000**0**	**0**	reserved
INTERVAL	b1 ... b0	**2**	**:**			transmission interval:
				0b00	**0**	10 ms
				0b01	**1**	40 ms
				0b10	**2**	80 ms
				0b11	**3**	160 ms (default)

Table 5.59: Transmission interval

5.5.2.19 Input filter for diagnostic data

This configuration word is used to configure the input filter for the diagnostic data.

This configuration word
- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per COM**,
- consists of **4 entries** with a total of **2 bytes**.

- Setting the input filter guarantees the absence of feedback at this Ethernet connection. This means that only the requests “diagnostic requests” and “write diagnostic” are accepted at this input, however, no safety-relevant data. Output data are not filtered.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_FILTER_DIAG	b15 ... b8	**8**	**:**	**0b**0000**1100**	**12**	configuration input filter for diagnostic data
RESERVED	b7 ... b2	**6**	**:**	**0b**00000**0**	**0**	reserved
FILTER_DIAG1	b1	**1**	**:**			input filter for diagnostic data Ethernet connection 1:
				0b0	**0**	no input filter (default)
				0b1	**1**	input filter set
FILTER_DIAG2	b0	**1**	**:**			input filter for diagnostic data Ethernet connection 2:
				0b0	**0**	no input filter (default)
				0b1	**1**	input filter set

Table 5.60: Input filter for diagnostic data

SAB FAdC100_16:

If for diagnostic devices that are connected to the interface “Ethernet”, an access by third parties cannot be excluded (e.g. connection to a network of category 3 of EN 50159:2010), then the input filter in the configuration word “Input filter for diagnostic data” must be set for the respective Ethernet interface of the COM board.

5.5.2.20 Project number

The configuration word “Project number” is used to assign the configurable boards of the FAdC (AEB and COM) uniquely to a project.
This configuration word is used to encapsulate boards within a network. Boards with different project numbers cannot communicate with each other. This means that independent projects can be located in the same network. Different projects can share the same ID because boards are uniquely assigned to a project by the project number. But within a CAN segment there may only be boards and configuration files with the same project number.
The network operator must ensure that each project number is allocated only 1 time within the network. If there are several FAdC projects in a network, the project number ‘0’ must not be allocated.

This configuration word

- is **optional** (i.e. if this configuration word is not configured, then the specified **default values** apply),
- can be configured **1 time per COM**,
- consists of **4 entries** with a total of **4 bytes**.

- The entry “CHECK_VERSION” may only be configured with ‘1’ if this COM is used as the configuration server.
- If the entry “CHECK_VERSION” is configured with ‘1’, then all requested configuration files are checked for whether all entries for “VERSION” are identical (same date and same time). If this is not the case, then the COM will take up the error status.

Indicator	Bits	No. of bits	:	Value binary	Value decimal	Description
CFG_PROJECT_COM	b31 ... b24	**8**	**:**	**0b**0000**1101**	**13**	configuration project number
RESERVED	b23 ... b21	**3**	**:**	**0b**000	**0**	reserved
CHECK_VERSION	b20	**1**	**:**			check entry “VERSION”:
				0b0	**0**	do not check (default)
				0b1	**1**	check
PROJECT_NUMBER	b19 ... b0	**20**	**:**			project number (default = 0)

Table 5.61: Project number

6 Installation

6.1 Handling of boards

When handling the boards, the following must be observed:

- Before touching a board, always charge balancing must be carried out by touching a bare metal surface of the frame, rack or cubicle. This charge balancing prevents the discharge from passing through the electronic circuit components.
- Only remove boards using the handle.
- Do not touch board connections, circuit board tracks, components and male multipoint connectors.
- Only hold boards at the edge, at the front panel or at the handle.
- Boards that are not installed must always be stored in an antistatic packaging.
- Always transport boards in an antistatic packaging.
- If boards without packaging are handed from one person to another, hands of the participants must be touched to balance potential before handover.

In case of a failure or a defect, the error code and the special conditions of the failure behaviour must be noted (if possible), and after having consulted Frauscher, must be send back to Frauscher together with the defect board.

SAB FAdC100_10:

When handling the test sockets, safety precautions (e.g. insulated tools) against dangerous contact voltages must be taken.

SAB FAdC100_142:

In case of measurements at the test sockets, faults can occur in the system FAdC. Therefore, measurements at the test sockets should be coordinated operationally. Measurements at the test sockets during regular operation and without supervision must be carried out only with Frauscher measurement and diagnostic systems. (Frauscher measurement and diagnostic systems have captive characteristics of the measurement inputs with respect to galvanic separation, short-circuit immunity, external voltage immunity and ground immunity as well as an EMC test according to EN 50121-4.)

6.2 Outdoor equipment

Prior to and during works on the track, safety measures must be carried out according to the applicable railway regulations.

Installation works may only be carried out during periods in which there are no trains in the relevant track section (FMA).

6.2.1 Required tools

Information regarding the required tools can be taken from one of the following documentations, dependant on the wheel sensor type:

- D1414 “Mounting and commissioning of wheel sensor type RSR180”
- D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”

6.2.2 Arrangement of the sensors

Information regarding the arrangement of the sensors can be taken from one of the following documentations, dependent on the wheel sensor type:

- D1414 “Mounting and commissioning of wheel sensor type RSR180”
- D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”

In addition, the following must be observed:

- The distance between a wheel sensor and immovable metal parts (e.g. equipment on the trackside, which is permanently near the wheel sensor), must be at least 250 mm. If this is not the case, one or both sensor system(s) can be influenced and thereby disturb the axle counting system.
- No lateral wear and cracks on the head of rail are allowed at the position where the wheel sensor is mounted.

Furthermore, the following must be observed in case of light rail applications:

- The wheel sensor should not be mounted on locations where people cross the rail (metal walking stick/umbrella), and/or cars/lorries/bicycles cross/travel over the rail.
- Furthermore, at the mounting locations of the wheel sensor, rail vehicles should not stop regularly/scheduled and/or fall below the minimum speed (see specifications according to chapter “Vehicle parameters and mounting position of the wheel sensor”) (e.g. light rail stops, cross street).
- The rail claw for grooved rails needs sufficient drainage. Hollows e.g. depressions, where water and dirt may accumulate, must be avoided. It is necessary to protect the wheel sensor from rail cleaning devices.

6.2.3 Preparation and mounting

Mounting and commissioning of the wheel sensor RSR180 must be carried out according to the documentation D1414 “Mounting and commissioning of wheel sensor type RSR180”.

Mounting and commissioning of the wheel sensor RSR123 must be carried out according to the documentation D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”.

In addition to the general mounting instructions of the wheel sensor RSR180 in the documentation D1414 “Mounting and commissioning of wheel sensor type RSR180” (Vignole rail) and/or in the documentation D1912 “Mounting, commissioning and maintenance wheel sensor RSR180 with rail claw SK420” (grooved rail), it is recommended to use a rail claw.
The mounting position depends on the vehicle type and wheel profile. Further information about this can be found in chapter “Mounting position of the wheel sensor”.

6.3 Indoor equipment

6.3.1 Required tools

When installing the indoor equipment the following tools are required:

- screwdriver (2,8 mm x 0,6 mm)
- soldering iron (soldering tip 1 mm)
- wire stripper
- side cutter
- electronic flat-nosed pliers
- knife for cable coating
- solder (diameter 0,75 mm or 1 mm)
- fixing material for installation of a 19" board rack in the support or frame and appropriate tools

6.3.2 Soldering jumpers

The condition of the soldering jumpers is shown as follows:

or	soldering jumper open
or	soldering jumper closed

Table 6.1: Condition of the soldering jumpers

6.3.2.1 Soldering jumpers on the backplane BP-PWR

On the front side of the backplane BP-PWR, there are the following soldering jumpers on the top left side (counted from top to bottom):
The 1st and the 2nd soldering jumper (“V+” and “V+’ ”) supply the AEB boards.
The 3rd and the 4th soldering jumper (“V+” and “V+‘ ”) supply the CAN bus.

There are the following 3 valid configuration variants of the soldering jumpers on the BP-PWR:

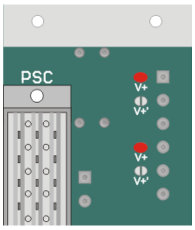
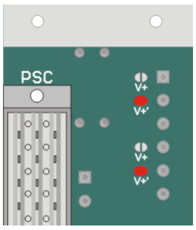
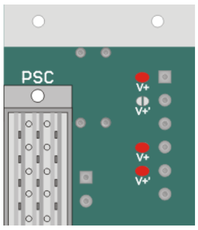
Configuration variant A	Configuration variant B	Configuration variant C
		
1st soldering jumper (“V+”) closed 2nd soldering jumper (“V+‘ ”) open 3rd soldering jumper (“V+”) closed 4th soldering jumper (“V+‘ ”) open	1st soldering jumper (“V+”) open 2nd soldering jumper (“V+‘ ”) closed 3rd soldering jumper (“V+”) open 4th soldering jumper (“V+‘ ”) closed	1st soldering jumper (“V+”) closed 2nd soldering jumper (“V+‘ ”) open 3rd soldering jumper (“V+”) closed 4th soldering jumper (“V+‘ ”) closed

Table 6.2: Configuration variants of the soldering jumpers on the BP-PWR

The configuration of the soldering jumpers on the BP-PWR depends on the fact whether the supply is designed redundantly (= 2 PSC boards) or non-redundantly.

Configuration for redundant supply:

One of the redundant BP-PWR must be configured according to configuration variant A and the other BP-PWR must be configured according to configuration variant B.

Configuration for non-redundant supply:

The BP-PWR must be configured according to configuration variant C.

6.3.2.2 Soldering jumpers on the backplane BP-EXB

Dependent on the design of the BP-EXB with n plug sockets on the front side, there are also (n – 1) pairs of soldering jumpers (“LB-EXB1” to “LB-EXB (n – 1)” and “LB-EXB1‘ ” to “LB-EXB (n – 1)‘ ”) on the rear side of the BP-EXB.
The BP-EXB with one IO-EXB plug socket does not have any soldering jumpers.
Dependent on the number of available plug sockets on the BP-EXB and the number of the actually used IO-EXB boards, soldering jumpers on the rear side of the BP-EXB must be closed. If there are more plug sockets available on the BP-EXB than IO-EXB boards are used, then the two soldering jumpers (“LB-EXBx” and “LB-EXBx‘ ”) left of the last used IO-EXB plug socket must be closed.

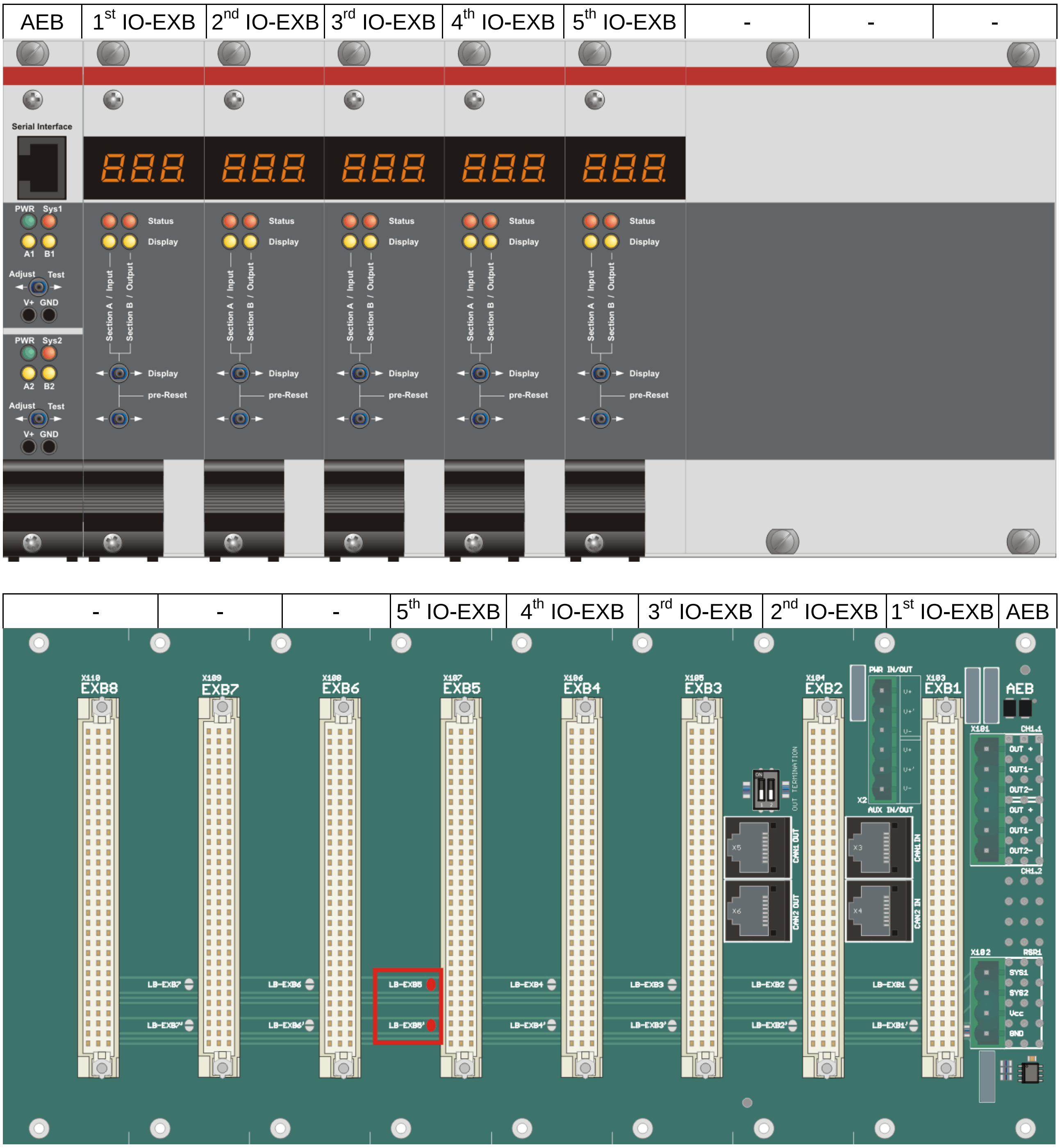


Figure 6.1: BP-PWR101-8 with 1 AEB and 5 IO-EXB boards; front side (top) and rear side incl. soldering jumpers (below)

6.3.3 Power supply

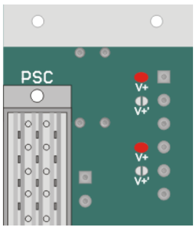
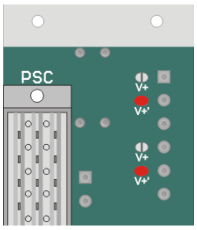
The connectors for the power supply “X1” and “X2” are on the rear side of the backplanes BP-PWR and BP-EXB.

The external power supply must be connected to the connector “X1” (“PWR IN”).

The connector “X2” is used to wire the internal power supply from a BP-PWR and/or BP-EXB to another BP-PWR and/or BP-EXB. The internal power supply must be directly through-wired with cables from “X2” (“PWR OUT”) of the one BP-PWR to “X2” (“PWR OUT”) of the other BP-PWR or from “X2” (“PWR OUT”) of the one BP-PWR to “X2” (“PWR IN/OUT”) of the BP-EXB.

If the power supply of the system should be redundant, then also the external power supply is to be carried out redundantly.

Front side:

BP-EXB	BP-PWR	BP-PWR
no soldering jumpers for the power supply	 soldering jumpers configuration variant A	 soldering jumpers configuration variant B

Rear side:

BP-EXB	BP-PWR	BP-PWR

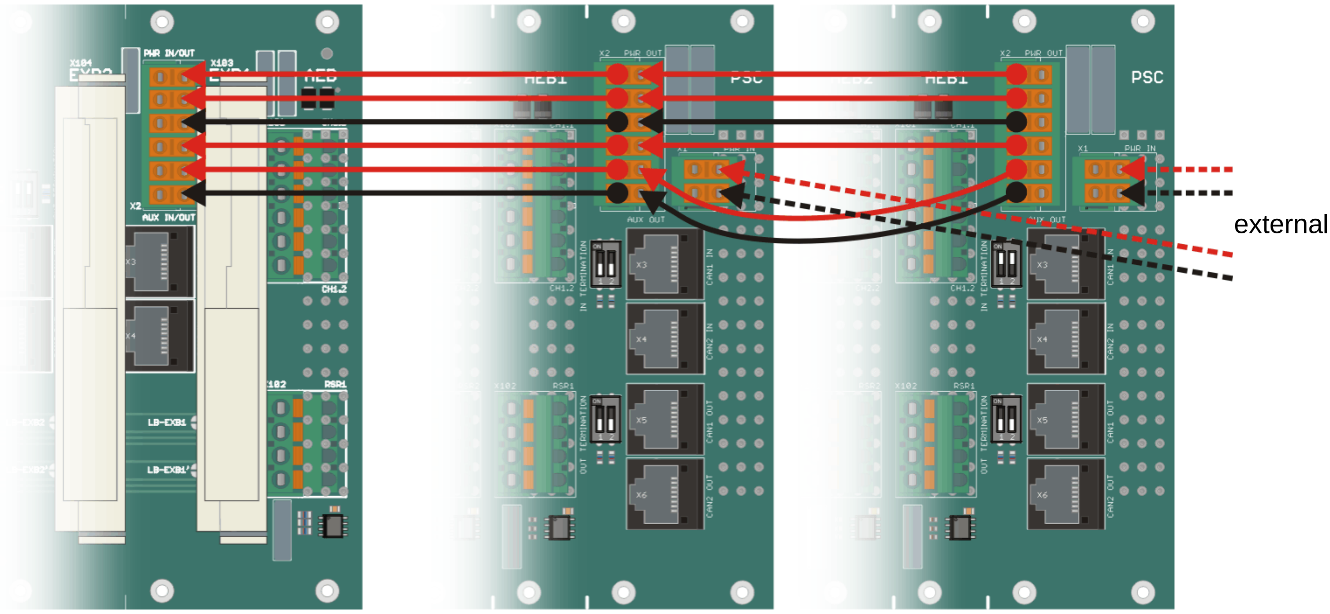
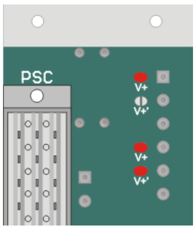


Figure 6.2: Wiring of two BP-PWR and a BP-EXB in case of redundant power supply

Front side:

BP-EXB	BP-PWR
no soldering jumpers for the power supply	 soldering jumpers configuration variant C

Rear side:

BP-EXB	BP-PWR

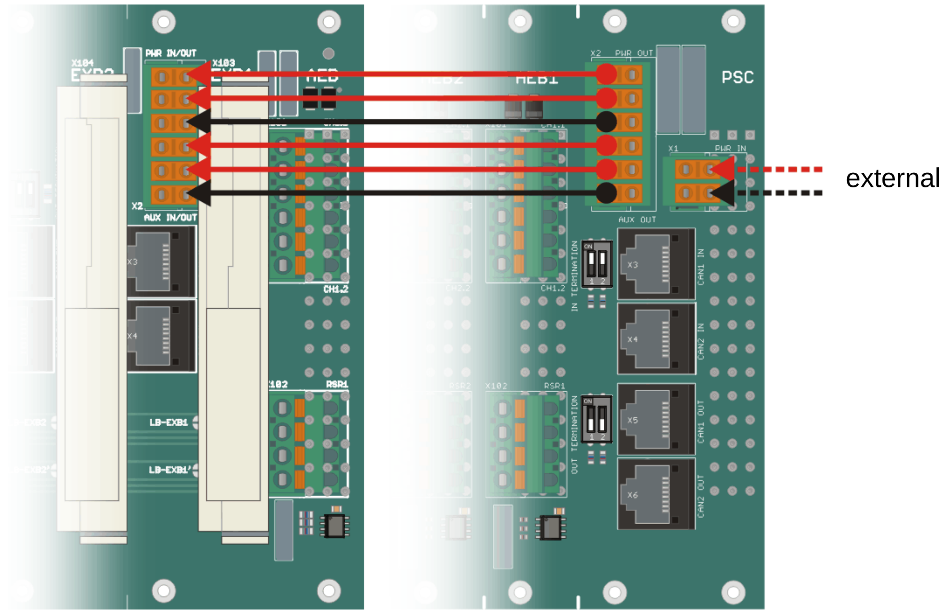


Figure 6.3: Wiring of a BP-PWR to a BP-EXB in case of non-redundant power supply

It is not permitted to connect the connectors “X2” of two non-redundant BP-PWR.

6.3.4 CAN bus

The connectors for the CAN bus “X3”, “X4”, “X5” and “X6” are on the rear side of the backplanes BP-PWR and BP-EXB. They are used to wire the CAN bus from a BP-PWR and/or BP-EXB to another BP-PWR and/or BP-EXB.

The CAN interfaces must be connected with RJ45 patch cables from “CAN1 OUT” of the one backplane to “CAN1 IN” of the other backplane and/or from “CAN2 OUT” of the one backplane to “CAN2 IN” of the other backplane.

If the CAN bus is not continued, it must be terminated. For this, the DIP-switches “OUT TERMINATION” and/or “IN TERMINATION” on the BP-PWR or the DIP-switch “OUT TERMINATION” on the BP-EXB must be set to “ON”.

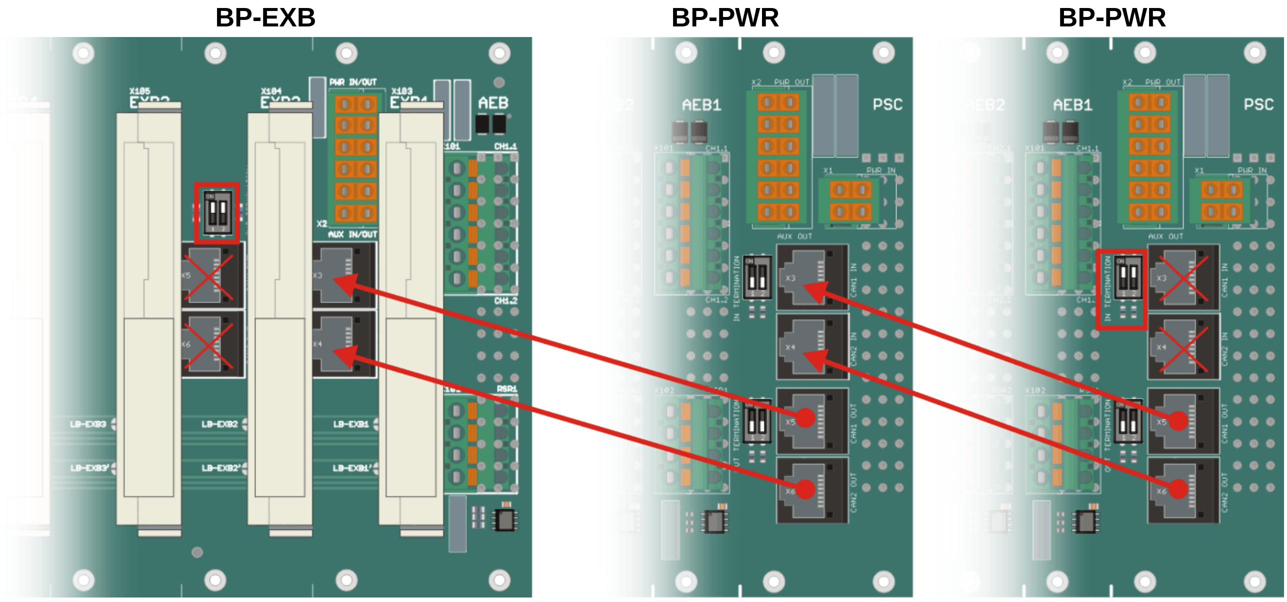


Figure 6.4: Wiring of the CAN bus

6.3.5 Preparation and mounting

The following must be observed during preparation and mounting:

- The cable types as well as the cable routing must comply with the details in chapter “Cabling”.
- The yellow-green earth cable (at least 6 mm^2) from the BSI004/BSI005 must be connected to an earthing terminal via the shortest possible route. Attention must be given to low transfer resistances.
- The board rack BGT must be earthed.
- When laying the earth connection, low transfer resistances and a low inductance (i.e. avoid loops and bends) must be observed especially.
- The 19" board rack must be fixed to a support or frame.
- Protective measures against falling conductive parts must be taken.
- When several board racks are installed above one another, it must be observed that the separation distance is at least 15 mm (typically 1 to 3 HE).
- An adequate air circulation must be ensured, if necessary with forced ventilation, so that the rising heat from the boards can be discharged.
- It must be ensured that the permitted environmental conditions according to chapter “Environmental conditions” are not exceeded by power dissipation (emitted thermal losses). This applies in particular for closed cubicles.

7 Commissioning

7.1 General

The FAdC may only be put into operation in proper and checked condition.

During the commissioning
- no wheel sensor may be damped or traversed and
- no axles may be in the track section (FMA).

Prior to the start of the commissioning, the following checks must be carried out:

- check of the wheel sensor mounting according to the documentations D1414 “Mounting and commissioning of wheel sensor type RSR180” and/or D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”
- check of the normal operating sensor current of the wheel sensor according to chapter “Sensor current of the wheel sensor RSR180” and/or “Sensor current of the wheel sensor RSR123”
- check of cabling according to the design and planning documents
- check of configuration according to chapter “Configuration”
- check of the CF cards and/or check of the configuration files according to chapter “Configuration”
- check of assembly of the board rack BGT according to the design and planning documents
- check of the position of the DIP-switches on the circuit board of AEB and COM according to the design and planning documents
- check of the soldering jumpers and DIP-switches on the backplanes BP-PWR and BP-EXB according to the design and planning documents
- check of the cabling of the network according to the design and planning documents
- in case of redundant communication: check of the specifications according to the design and planning documents and according to chapter “Redundant communication”

The following checks can be carried out by either the ASD or in the course of the functional checks.

SAB FAdC100_117:

The installed components (number and type) must be checked according to the design and planning documents.

SAB FAdC100_202:

The boards PSC, AEB and COM must be plugged into their configured position in the board rack.

SAB FAdC100_172:

If using a redundant configuration server (2 COM boards), it must be checked if the Hotlink cable is plugged in and if the Hotlink connection works.

SAB FAdC100_120:

It must be checked if the position of the DIP-switches DIP103 and DIP203 corresponds to the design and planning documents.

SAB FAdC100_176:

It must be checked if the number of counting heads to every track section (FMA) corresponds to the design and planning documents.

SAB FAdC100_188:

It must be checked if the reset on the toggle switches of the AEB corresponds to the design and planning documents.

SAB FAdC100_126:

It must be checked if the assignment of the track section (FMA) to the safety system corresponds to the design and planning documents.

SAB FAdC100_128:

It must be checked if the reset on the inputs of the IO-EXB corresponds to the design and planning documents.

SAB FAdC100_135:

It must be checked if the reset on the toggle switches of the IO-EXB corresponds to the design and planning documents.

During commissioning, the following actions must be carried out:

- measure the power supply at the supply voltage (+19 to +72 V DC) and apply the power supply to the FAdC according to chapter “Power supply” and “Integration into safety systems”
- commissioning of the wheel sensor according to the documentations D1414 “Mounting and commissioning of wheel sensor type RSR180” and/or D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”
- electronic coding of the AEB according to chapter “Coding of the AEB”
- measure the sensor currents at the wheel sensors according to chapter “Measuring sensor currents”
- adjustment of the AEB according to chapter “Adjustment of the AEB”
- reset according to chapter “Reset”
- functional checks according to chapter “Functional checks”

SAB FAdC100_173:

It must be checked if every AEB board was adjusted to the normal operating sensor current of the connected wheel sensor RSR180.

SAB FAdC100_174:

It must be checked if every wheel sensor RSR123 was adjusted.

7.1.1 Integration into safety systems

For the cables to the interfaces “Clear/occupied output” and/or “Reset inputs” and for the cables between the overvoltage protection board BSI and the BP-PWR and/or BP-EXB the following failures must be excluded:

- short circuit between the wires
- short circuit between wire and ground

The connectors included in the scope of delivery must be used.

7.1.2 Supply

It must be checked if the requirements of the design and planning of the FAdC were complied with.

These include, among other things:

- rated voltage in the range of +19 to +72 V DC
- maximum permitted ripple (see chapter “Ripple”)
- current consumption of the boards (see chapter “Power supply of the boards”)

7.2 Configuration

SAB FAdC100_122:

It must be checked if the position of the DIP-switches on the COM corresponds to the design and planning documents.

The check of the DIP-switch setting can be carried out as follows:

- by means of the ASD (via the diagnostic interface “Serial Interface” on the front panel of the AEB; further information can be taken from the documentation D21004 “Brief description Advanced Service Display ASD101”)
- by means of the FDS (if available; further information can be taken from the documentation D21006 “Frauscher Diagnostic System FDS101 for FAdC R2 and FAdCi R2”).
- by means of a visual inspection (unplug the board and carry out a visual inspection of the DIP-switches)

SAB FAdC100_121:

It must be checked, if the configuration version, the CRC of the configuration and the type protection code of each AEB correspond to the design and planning documents.

SAB FAdC100_123:

It must be checked if the configuration version and the CRC of the configuration of each COM correspond to the design and planning documents.

The check of the creation entry, the checksum and the type protection codes of a configuration file can be carried out as follows:

- by means of the ASD (via the diagnostic interface “Serial Interface” on the front panel of the AEB; further information can be taken from the documentation D21004 “Brief description Advanced Service Display ASD101”)
- by means of the FDS (if available; further information can be taken from the documentation D21006 “Frauscher Diagnostic System FDS101 for FAdC R2 and FAdCi R2”)

If the configuration must be changed after initial commissioning, the following must be observed:

In case the configuration is changed, the voltage of all boards on the CAN bus must be interrupted after the insertion of the CF card into the COM. Afterwards, a check as during commissioning must be carried out.

7.3 Coding of the AEB

In order to avoid that an AEB is plugged into a wrong plug socket, an electronic coding must be carried out during initial commissioning. By means of the toggle switches on the front panel, the ID of the AEB is saved on a microchip. The microchip is at the respective plug socket on the back-plane BP-PWR and/or on the BP-EXB. In case of a power-up, the AEB compares its own ID with the ID, which is saved on the microchip. If the IDs do not match or no coding was carried out during the initial commissioning, the AEB outputs an error code.

Before the plug socket coding is carried out, the ID must be set on the AEB by means of the DIP-switches and must be read out with the ASD.

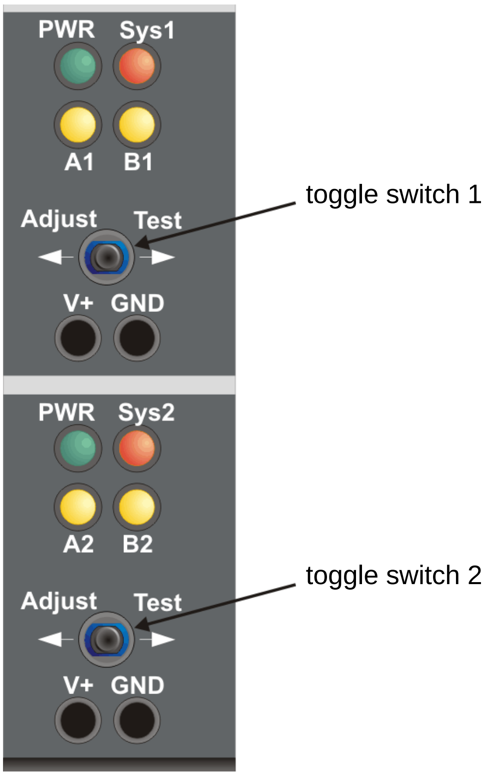


Figure 7.1: Toggle switches on the front panel of the AEB for Sys1 and Sys2

To request the coding process the following actuation sequence must be complied with:

1. Push toggle switch 1 to the left ("Adjust") and keep it in that position for at least 0,5 s, then release toggle switch 1.
2. Keep toggle switches 1 and 2 in the neutral position for a maximum of 2 s.
3. Push toggle switch 1 to the right ("Test") and keep it in that position for at least 0,5 s, then release toggle switch 1.
4. Keep toggle switches 1 and 2 in the neutral position for a maximum of 2 s.
5. Push toggle switch 2 to the left ("Adjust") and keep it in that position for at least 0,5 s, then release toggle switch 2.
6. Keep toggle switches 1 and 2 in the neutral position for a maximum of 2 s.
7. Push toggle switch 2 to the right ("Test") and keep it in that position for at least 0,5 s, then release toggle switch 2.

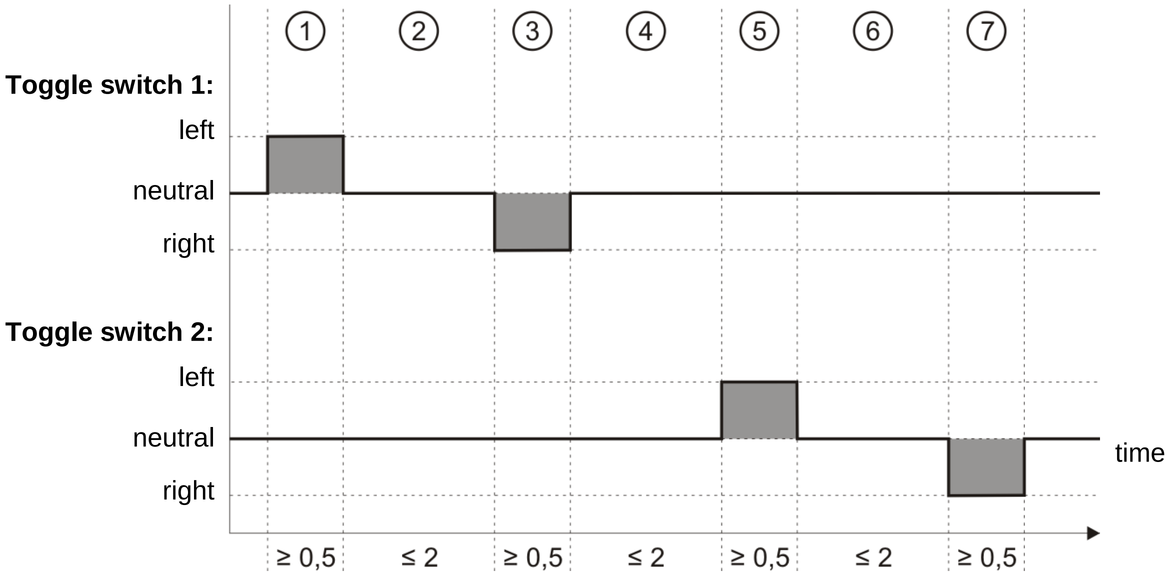


Figure 7.2: Actuation sequence to request a coding process, time data in s

By means of the actuation sequence an unwanted coding process due to accidental actuation of the toggle switches is prevented.

After the correct initiation of the actuation sequence, the execution of the coding process is displayed for approx. 15 s by illuminated LEDs "Sys1" and "Sys2". Once the coding process has been carried out correctly, the LEDs "Sys1" and "Sys2" will go out again.

If the actuation of both toggle switches deviates from the predetermined sequence or takes longer than 30 s, no coding process is carried out and the actuation of the toggle switches is inhibited for approx. 6 s. The wrong actuation of the toggle switches is indicated through a flashing of the LEDs "Sys1" and "Sys2" (at first the LEDs flash fast for 2 s, then the LEDs flash slowly whereas the number of the slow flashing corresponds to the number of the error code, see chapter "Error codes when adjusting the wheel sensor"). After the LEDs go out, the actuation of the toggle switches is inhibited for further 2 s. If the toggle switches are actuated again during the inhibiting, the toggle switch actuations are rejected and the inhibiting is extended (process starts again with the fast flashing of the LEDs).

In order to request another coding process, the actuation sequence must be started again from the beginning with (1) to (7) after the end of the inhibiting.

7.4 Current measurements

7.4.1 Measuring sensor currents

All operating actions on the AEB must be carried out according to chapter “Handling of boards”.

The sensor currents of the wheel sensor are read out via the diagnostic interface “Serial Interface” with the ASD (see documentation D21004 “Brief description Advanced Service Display ASD101”) or via FDS (see documentation D21006 “Frauscher Diagnostic System FDS101 for FAdC R2 and FAdCi R2”). Alternatively, the sensor currents can be measured at the test sockets of the AEB.

The voltage proportional to the current is measured via a 100 Ω shunt, 100 mV therefore correspond to 1 mA sensor current.

Depending on the connected wheel sensor (RSR180 or RSR123), the sensor currents must exhibit the corresponding values (see chapter “Sensor current of the wheel sensor RSR180” and/or chapter “Sensor current of the wheel sensor RSR123”).

If the measured values do not correspond to the referenced values, the wheel sensor mounting must be checked and if necessary, an adjustment on the evaluation board must be carried out (see chapter “Adjustment of the AEB”).

It is recommended to document the measured values.

Required tools and measuring equipment:

- voltmeter: range 1 000 mV DC, ±0,5 % basic accuracy
- 2 test leads with 2 mm connectors
- Advanced Service Display ASD inclusive Service Display Cable

7.4.1.1 Sensor current of the wheel sensor RSR180

The sensor currents of system 1 and system 2 must fulfil the following requirements:

- The normal operating sensor current of both systems must be in the following range:
  - between **2,8 and 5,0 mA** (280 to 500 mV) for Vignole rails
  - between **2,8 and 6,0 mA** (280 to 600 mV) for grooved rails

- The difference between the normal operating sensor current of system 1 and of system 2 must not exceed:
  - **0,2 mA** (20 mV) for Vignole rails
  - **0,2 mA or 5 %** (whichever is greater) for grooved rails

- The difference between the adjustment sensor current and the normal operating sensor current of each system must **not exceed 5 %**. These two values can be read out via the ASD.

If one of the requirements above is not fulfilled, then the following measures must be performed in the indicated order:

1. Check mounting of the RSR180 and correct it, if necessary.
2. Check the RSR180 for excessive dirt and clean it, if necessary.
3. Check the RSR180 for visible damages and replace it, if necessary.
4. If the mounting had to be corrected and/or the RSR180 had to be cleaned and/or replaced, then an adjustment of the AEB (see chapter “Adjustment of the AEB”) must be carried out additionally.

The mounting of the RSR180 must be checked according to document D1414 “Mounting and commissioning of wheel sensor type RSR180”.

If the requirements are still not met after performing the indicated measures, then the wheel sensor must be replaced with a wheel sensor of the same type or, in case of special mounting conditions, Frauscher must be contacted.

Afterwards, the wheel sensor RSR180 must be commissioned according to the documentation D1414 “Mounting and commissioning of wheel sensor type RSR180”.

7.4.1.2 Sensor current of the wheel sensor RSR123

The normal operating sensor current of system 1 and system 2 must be in the following range[29]:

- between **4,85 and 5,15 mA** (485 to 515 mV) immediately after an adjustment
- between **4,75 and 5,25 mA** (475 to 525 mV) during maintenance

29 The lower value displayed on the voltmeter applies.

If the normal operating currents are not in the specified range, then the following measures must be performed in the indicated order:

1. Check mounting of the RSR123 and correct it, if necessary.
2. Check the RSR123 for excessive dirt and clean it, if necessary.
3. Check the RSR123 for visible damages and replace it, if necessary.
4. If the mounting had to be corrected and/or the RSR123 had to be cleaned and/or replaced, then an adjustment of the RSR123 must be carried out additionally.

The mounting check and the adjustment of the RSR123 must be performed according to document D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”.

If the requirements are still not met after performing the indicated measures, then the wheel sensor must be replaced with a wheel sensor of the same type or, in case of special mounting conditions, Frauscher must be contacted.

Afterwards, the wheel sensor RSR123 must be commissioned according to the documentation D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”.

7.5 Adjustment of the AEB

The sensor currents must be measured prior to the adjustment process (see chapter “Measuring sensor currents”). The adjustment process is carried out by means of the toggle switches on the front panel of the AEB.

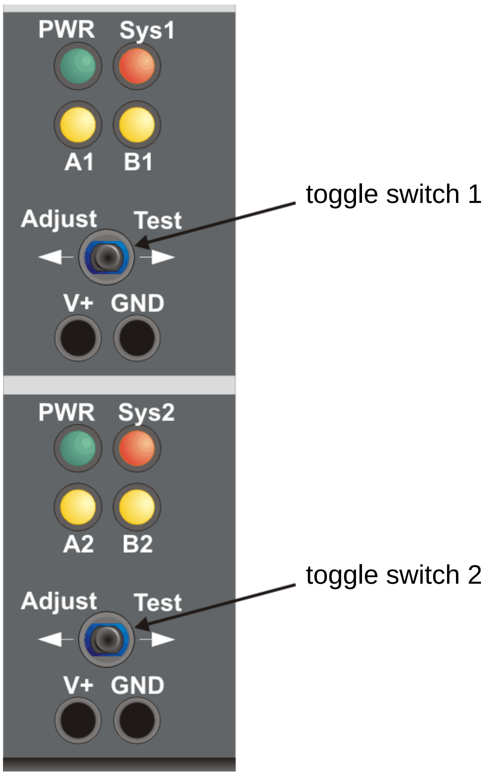


Figure 7.3: Toggle switches on the front panel of the AEB for Sys1 and Sys2

To request the adjustment process the following actuation sequence must be complied with:

1. Push both toggle switches to the left within 0,5 s (“Adjust”).
2. Keep both toggle switches in this position for at least 0,5 s.
3. Release both toggle switches within 0,5 s.
4. Keep both toggle switches in the neutral position for a maximum of 2 s.
5. Push both toggle switches to the right within 0,5 s (“Test”).
6. Keep both toggle switches in this position for at least 0,5 s.
7. Release both toggle switches within 0,5 s.

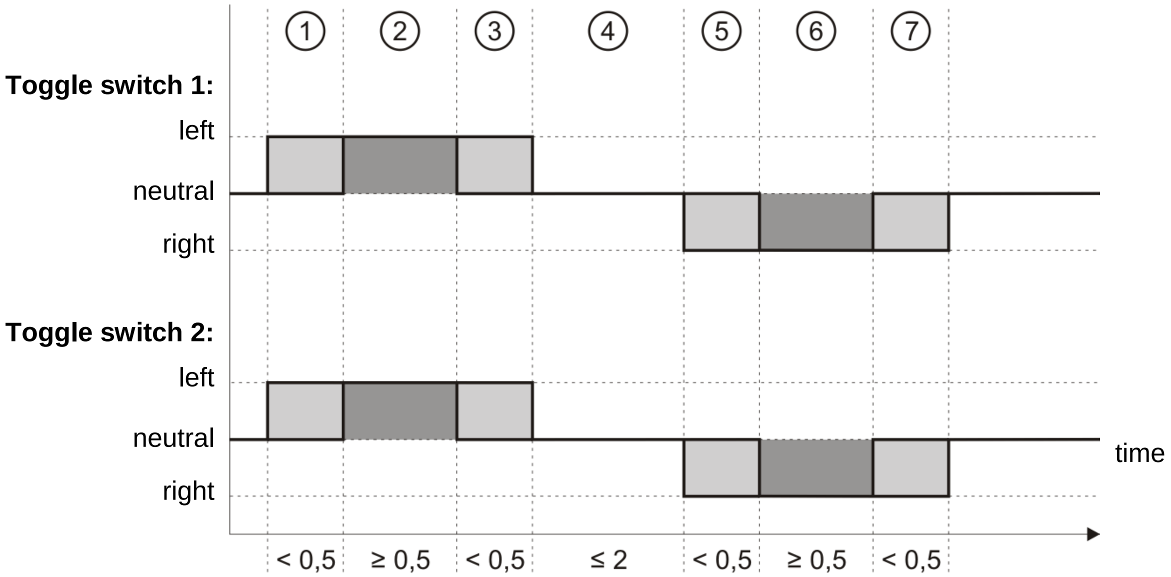


Figure 7.4: Actuation sequence to request an adjustment process, time data in s

By means of the actuation sequence an unwanted adjustment process due to accidental actuation of the toggle switches is prevented.

The outputs of the AEB do not switch during the self-dependent adjustment process.
After the correct initiation of the actuation sequence, the adjustment process will be displayed by illuminated LEDs “Sys1” and “Sys2” for approx. 2 s (RSR180) and for 20 to 30 s but for a maximum of 80 s (RSR123). Once the adjustment has been carried out correctly, the LEDs “Sys1” and “Sys2” will go out again.

An adjustment that was not carried out is indicated by fast flashing of the LEDs of “Sys1” and “Sys2” for 2 s.

If the actuation of both toggle switches deviates from the predetermined sequence or takes longer than 30 s, no adjustment process is carried out and the actuation of the toggle switches is inhibited for approx. 6 s. The wrong actuation of the toggle switches is indicated via a flashing of the LEDs “Sys1” and “Sys2” (at first the LEDs flash fast for 2 s, then the LEDs flash slowly whereas the number of the slow flashing corresponds to the number of the error code, see chapter “Error codes when adjusting the wheel sensor”). After the LEDs go out, the actuation of the toggle switches is inhibited for further 2 s. If the toggle switches are actuated again during the inhibiting, the toggle switch actuations are rejected and the inhibiting is extended (process starts again with the fast flashing of the LEDs).

In order to request another adjustment process, the actuation sequence must be started again from the beginning with (1) to (7) after the end of the inhibiting.

In case of using a wheel sensor RSR123 a check of the occupancy detection capability must be carried out by means of the testing plate, after successful adjustment process.

Mounting and commissioning must be concluded with an error-free traversing of the counting head.

SAB FAdC100_65:

Before the adjustment of the AEB board to the normal operating sensor current of the wheel sensor RSR180 is carried out,

- the correct mounting must be checked,
- it must be observed that no metal objects e.g. tool box or shovel are within a range of 0,5 m as shown in following figures (exception: equipment on the trackside, which is permanently near the wheel sensor).

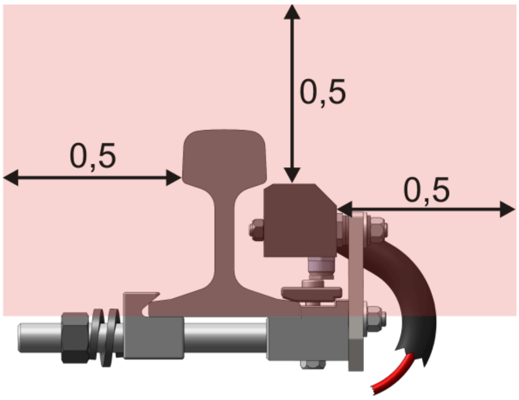


Figure 7.5: Range in which no metal objects may be present (side view), measurements in m

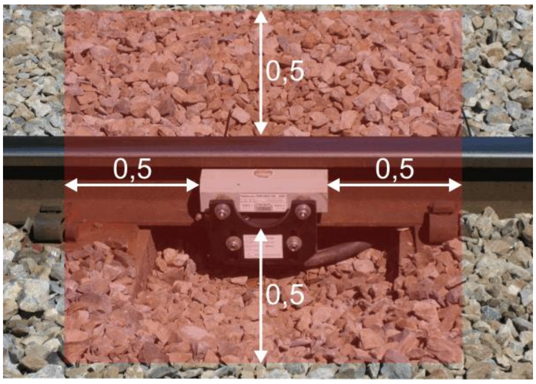


Figure 7.6: Range in which no metal objects may be present (top view), measurements in m

SAB FAdC100_192:

An adjustment of the AEB to the sensor currents of the wheel sensor RSR180 must be carried out in case of

- replacement of a wheel sensor,
- re-mounting of a wheel sensor, which was dismounted due to track works,
- change of the cable connection and
- change of mounting position.

Afterwards, the occupancy detection capability of both sensor systems must be checked.

SAB FAdC100_193:

An adjustment of the wheel sensor RSR123 must be carried out in case of

- replacement of a wheel sensor,
- re-mounting of a wheel sensor, which was dismounted due to track works and
- change of mounting position.

Afterwards, the occupancy detection capability of both sensor systems must be checked.

SAB FAdC100_67:

After the correct mounting and the adjustment, the occupancy detection capability of both sensor systems must be checked by means of a traversing with a wheel or by placing the testing plate PB200 on the wheel sensor RSR180.

7.6 Reset

A reset is required in the following cases:

- during or after commissioning
- after a power-up of the axle counting system
- after an error of the axle counting system (e.g. the track section (FMA) is in the occupied status after a communication error although the communication error is rectified)
- after checking and/or maintaining of the axle counting system

The following conditions must be met when carrying out a reset of the FAdC:

- No wheel sensor must be damped or traversed.
- No axles must be in the track section (FMA).
- No wheel sensor errors, no board errors and no communication errors must be present.
- A reset may only be carried out under the conditions specified by the operator.

SAB FAdC100_27:

The guarantee that a track section (FMA) is only reset if it is clear of vehicles and obstacles must happen by appropriate checks that were determined operationally.

SAB FAdC100_28:

If reset operations are necessary several times within a couple of train journeys, then the cause for the reset operations must be clarified and eliminated.

SAB FAdC100_48:

The reset procedure must be projected according to the operator’s specifications.

7.6.1 Reset via hardware

A reset operation must be carried out according to the applicable railway regulations.

7.6.1.1 Reset operation with the toggle switches on the front panel of the AEB

A reset operation can be carried out with the toggle switches on the front panel of the AEB. The precondition for this is that the front panel elements of the AEB are not configured as “disabled” in the configuration word “Toggle switches of the AEB”. The type of reset operation is also defined in this configuration word. In case a reset operation is carried out with the toggle switches and no FMA is configured, this reset is ignored.

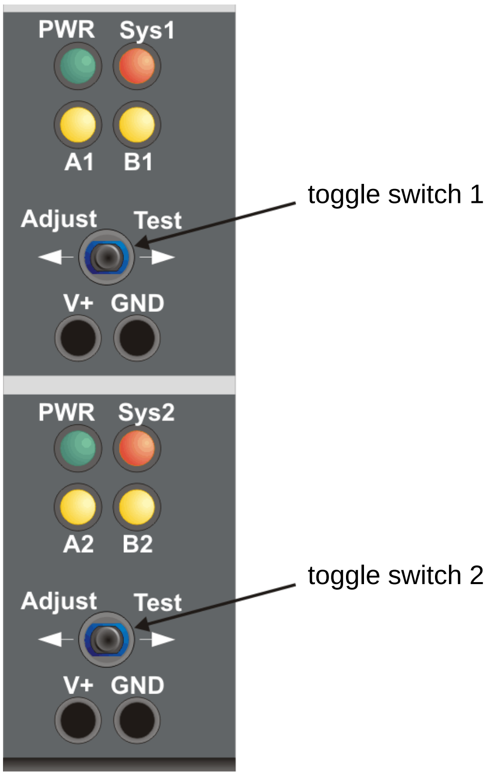


Figure 7.7: Toggle switches on the front panel of the AEB for Sys1 and Sys2

To request a reset for track section 1 (FMA 1) the following actuation sequence must be complied with:

1. Push toggle switch 1 to the left (“Adjust”) and within 2 s push toggle switch 2 to the right (“Test”).
2. Keep toggle switch 1 and 2 for at least 0,5 s in the respective position.
3. Release both toggle switches within 0,5 s.

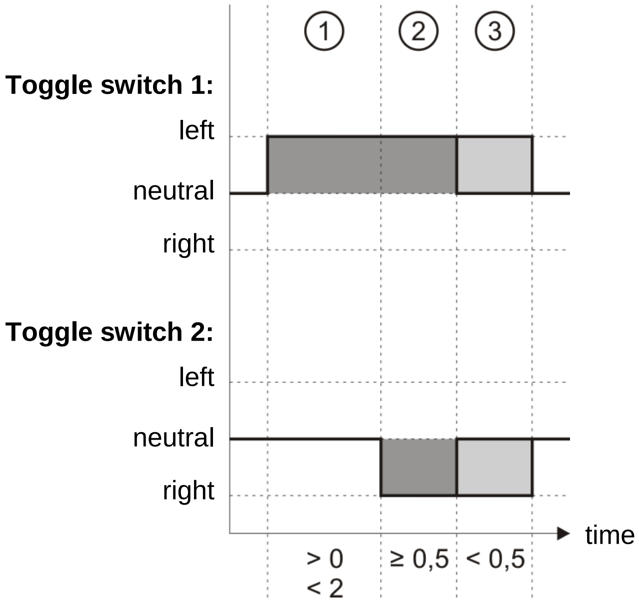


Figure 7.8: Reset operation with the toggle switches on the front panel of the AEB for FMA 1, time data in s

To request a reset for track section 2 (FMA 2) the following actuation sequence must be complied with:

1. Push toggle switch 2 to the left ("Adjust") and within 2 s push toggle switch 1 to the right ("Test").
2. Keep toggle switch 1 and 2 for at least 0,5 s in the respective position.
3. Release both toggle switches within 0,5 s.

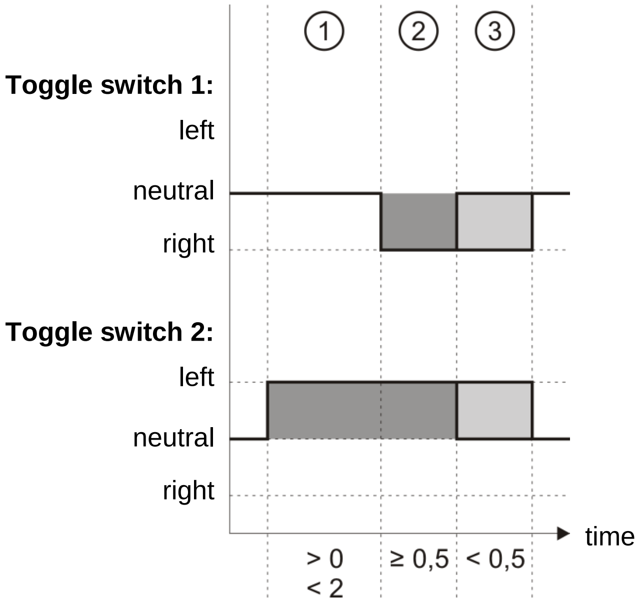


Figure 7.9: Reset operation with toggle switches on the front panel of the AEB for FMA 2, time data in s

If the actuation of both toggle switches deviates from the predetermined sequence or takes longer than 30 s, no reset is carried out and the actuation of the toggle switches is inhibited for approx. 6 s. The wrong actuation of the toggle switches is indicated via a flashing of the LEDs "Sys1" and "Sys2" (at first the LEDs flash fast for 2 s, then the LEDs flash slowly whereas the number of the slow flashing corresponds to the number of the error code, see chapter "Error codes when adjusting the wheel sensor"). After the LEDs go out, the actuation of the toggle switches is inhibited for further 2 s. If the toggle switches are actuated again during the inhibiting, the toggle switch actuations are rejected and the inhibiting is extended (process starts again with the fast flashing of the LEDs).

In order to request another reset, the actuation sequence must be started again from the beginning with (1) to (3) after the end of the inhibiting.

7.6.1.2 Reset operation with the toggle switches on the front panel of the IO-EXB

A reset operation can be carried out with the toggle switches on the front panel of the IO-EXB. The precondition for this is that the front panel elements of the IO-EXB are not configured as “disabled” in the configuration word “Reset axle counting via IO-EXB”. The type of reset operation is also defined in this configuration word.

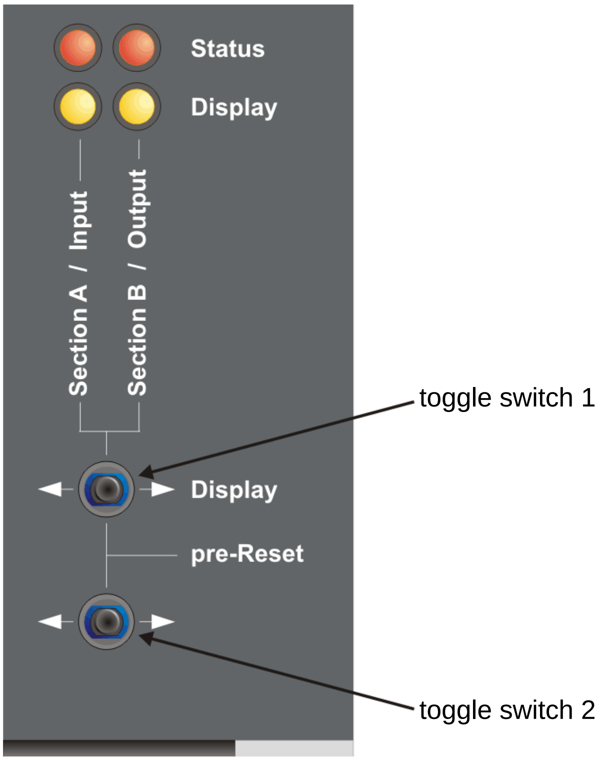


Figure 7.10: Toggle switches on the front panel of the IO-EXB

To request a reset for track section 1 (FMA 1) the following actuation sequence must be complied with:

1. Push both toggle switches to the left (“Section A”) within 0,5 s.
2. Keep both toggle switches in this position for at least 0,5 s.
3. Release both toggle switches within 0,5 s.

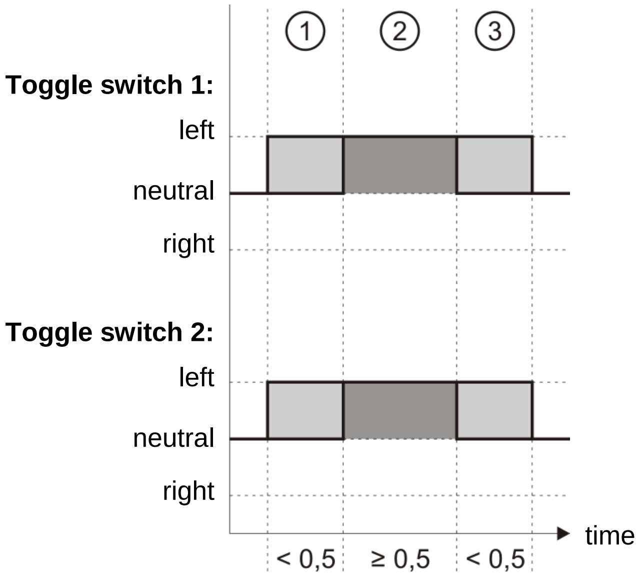


Figure 7.11: Reset operation with the toggle switches on the front panel of the IO-EXB for FMA 1, time data in s

To request a reset for track section 2 (FMA 2) the following actuation sequence must be complied with:

1. Push both toggle switches to the right (“Section B”) within 0,5 s.
2. Keep both toggle switches in this position for at least 0,5 s.
3. Release both toggle switches within 0,5 s.

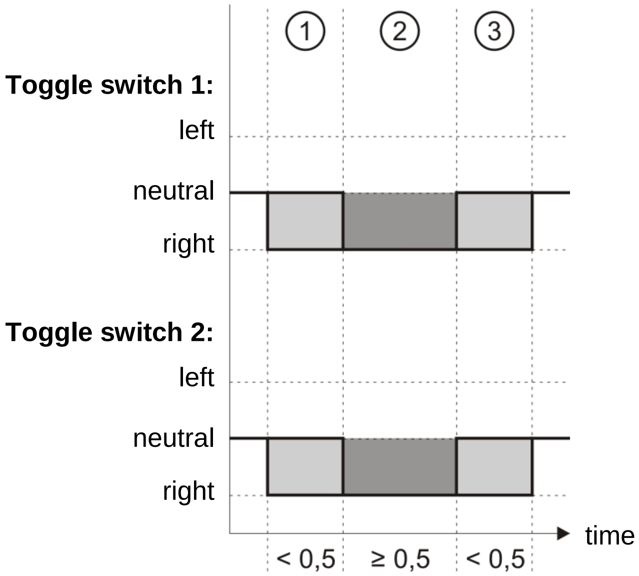


Figure 7.12: Reset operation with the toggle switches on the front panel of the IO-EXB for FMA 2, time data in s

If the actuation of both toggle switches deviates from the predetermined sequence, no reset is carried out.

In order to request another reset, the actuation sequence must be started again from the beginning with (1) to (3) and carried out correctly.

7.6.2 Reset via software interface

A reset via software interface is carried out through the higher-ranking system (e.g. interlocking) and according to its instructions and/or according to the operator's instructions.

7.7 Functional checks

The functional checks must be carried out at the initial commissioning and after any physical modifications.

The functional checks consist of:

- a check of occupancy detection capability
- an assignment check
- a check of the counting direction

It may be necessary to carry out a reset between the single functional checks.

After carrying out a Reset, the associated AEB must react.

The check of the AEB functionality can be done by traversing, by testing plate or by actuating the toggle switches 1 and 2 (see figure in chapter "Simulation of traversings").

At the initial commissioning of the IO-EXB the functionality of all inputs and outputs must be checked.

SAB FAdC100_132:

In case of safety-relevant applications it must be checked if during the evaluation of system pulses the respective counting head outputs or switching outputs are closed in normal status.

SAB FAdC100_133:

It must be checked if the transfer of the system pulses to the safety system corresponds to the design and planning documents.

SAB FAdC100_206:

In case of safety-relevant applications it must be checked if during the evaluation of the 1-edge direction pulses the respective counting head outputs or switching outputs are closed in normal status.

SAB FAdC100_207:

In case of safety-relevant applications it must be checked if during the evaluation of the 4-edges direction pulses the respective counting head outputs or switching outputs are open in normal status.

7.7.1 Check of the occupancy detection capability

The check of the occupancy detection capability can be carried out in 2 ways:

- **Check with a rail vehicle:**
  - The wheel sensor must be traversed error-free with a rail vehicle (traversing both, system 1 and system 2).
  - For this the associated counting head outputs of the AEB or the switching outputs of the IO-EXB must switch correctly (in case of a counting head) and/or at least 1 axle must be correctly counted in and/or out (in case of a track section (FMA)).

- **Check with the testing plate PB200:**
  - At least 1 counting procedure over system 1 and system 2 must be executed correctly with the help of the testing plate PB200 (see documentation D2860 “Brief instruction of testing plate PB200 GS03”).
  - For this the associated counting head outputs of the AEB or the switching head outputs of the IO-EXB must switch correctly (in case of a counting head) and/or at least 1 axle must be correctly counted in and/or out (in case of an track section (FMA)).

The check of occupancy detection capability must not be carried out by an actuation of the toggle switches on the front panel of the AEB.

SAB FAdC100_175:

It must be checked if a check of occupancy detection capability was carried out at every sensor system.

SAB FAdC100_129:

For all track sections (FMA), which are adjacent to the desensitised counting head it must be checked if the desensitised counting head is sensitised, as soon as one of these adjacent track sections (FMA) changes in the occupied status.

7.7.2 Assignment check

The assignment of the counting heads must be checked at the initial commissioning of the axle counting system. The association of the wheel sensors for each counting head associated to a track section (FMA) must be checked.

- Apply testing plate PB200 to wheel sensor.
- LED “Sys1” and LED “Sys2” of the associated AEB must be illuminated.
- The associated AEB boards must indicate “occupied”.

The condition of the soldering jumpers of the backplane BP-PWR and/or BP-EXB must be checked at the initial commissioning of the axle counting system, according to the design and planning documents.

SAB FAdC100_124:

It must be checked if the assignment of a connected wheel sensor to the AEB corresponds to the design and planning documents.

SAB FAdC100_125:

It must be checked if the assignment of the counting heads to a track section (FMA) corresponds to the design and planning documents.

SAB FAdC100_130:

It must be checked if the assignment of the supervisor sections to the track section (FMA) corresponds to the design and planning documents.

SAB FAdC100_189:

It must be checked if the assignment of the synchronisation section to the track section (FMA) corresponds to the design and planning documents.

SAB FAdC100_131:

It must be checked if the assignment of the information from the inputs to the outputs corresponds to the design and planning documents.

7.7.3 Check of the counting direction

The counting direction of the FAdC must be checked as follows:

- Move one or more axle(s) into the track section (FMA) (axles can also be simulated with the help of testing plate PB200). The FAdC indicates “occupied” and the number of axles is output on the display of the IO-EXB or via protocol. The number of the axles can also be read out by means of the ASD or FDS.
- Afterwards, these axles have to be moved out of the track section (FMA). The FAdC indicates “clear” and ‘0’ appears on the display of the IO-EXB or is output according to the specifications of the customer.

This process must be repeated for every wheel sensor associated with a track section (FMA). If the counting direction is incorrect, the counting direction must be changed accordingly.

Whether the AEB counts in or out when the axles traverse over the wheel sensor depends on the following factors:

- side of the rail, on which the wheel sensor is mounted
- direction, from which the axles traverse over the counting head
- position of the DIP-switch on the AEB
- configuration of the AEB
- wiring of sensor systems

A direction inversion is possible by:

- position of the DIP-switch on the AEB
- configuration of the AEB
- cross-bonding of the cabling of the sensor systems
- changing the mounting side (if not prohibited by the mounting and commissioning instructions for the wheel sensor)

SAB FAdC100_127:

It must be checked if the counting direction of a counting head corresponds to the design and planning documents.

8 Operation

8.1 Operating statuses

8.1.1 Operating statuses of the PSC

The PSC can take up and display various operating statuses during regular operation. These operating statuses can be taken from the chapter “LED indications on the PSC”.

8.1.2 Operating statuses of the AEB

The AEB can take up and display various operating statuses during regular operation. These operating statuses can be taken from the chapter “LED indications on the AEB”.

8.1.3 Operating statuses of the IO-EXB

The IO-EXB can take up and display various operating statuses during regular operation dependent on the configuration. These operating statuses can be taken from the chapters “LED indications in case of axle counting”, “LED indications in case of data transmission”, “LED indications in case of counting head output with system outputs” and “LED indications in case of counting head output with direction outputs”.

8.1.4 Operating statuses of the COM

The COM can take up and display various operating statuses during regular operation. These operating statuses can be taken from the chapter “LED indications on the COM”.

8.2 Operation

8.2.1 Operation of the Advanced Evaluation Board AEB

By means of the two toggle switches on the front panel of the AEB various operational actions can be carried out.

- coding of the plug sockets (see chapter “Coding of the AEB”)
- adjustment (see chapter “Adjustment of the AEB”)
- reset (see chapter “Reset operation with the toggle switches on the front panel of the AEB”)
- simulation of traversings (see chapter “Simulation of traversings”)

The precondition for this is that the front panel elements of the AEB are not configured as “disabled” in the configuration word “Toggle switches of the AEB”.

8.2.1.1 Simulation of traversings

To simulate a traversing with the toggle switches, a wheel sensor must be connected to the respective AEB. The actuation of the toggle switches has the same effect as occupancy of the respective sensor system.

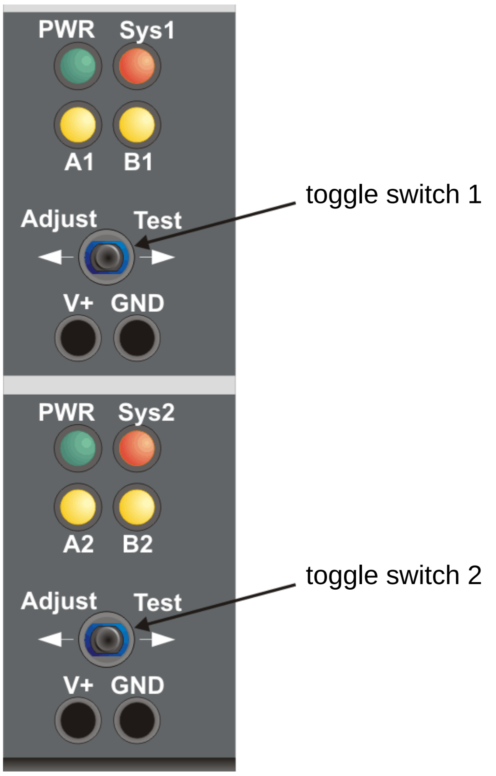


Figure 8.1: Toggle switches on the front panel of the AEB for Sys1 and Sys2

Simulation of a traversing without direction inversion

The traversing without direction inversion can be simulated with the following actuation sequence:

Counting in:
1. Push toggle switch 1 to the right ("Test") and keep toggle switch in this position.
2. Push toggle switch 2 to the right ("Test") and keep toggle switch in this position.
3. Release toggle switch 1.
4. Release toggle switch 2.

Counting out:
1. Push toggle switch 2 to the right ("Test") and keep toggle switch in this position.
2. Push toggle switch 1 to the right ("Test") and keep toggle switch in this position.
3. Release toggle switch 2.
4. Release toggle switch 1.

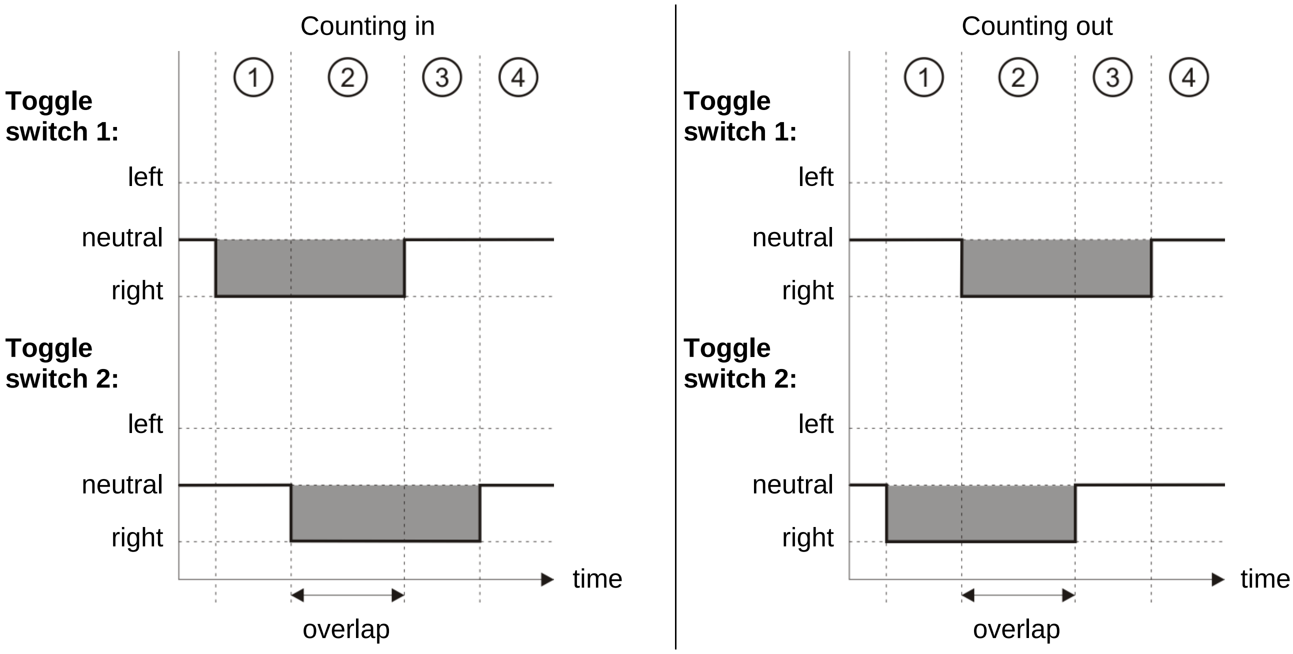


Figure 8.2: Actuation sequence for a traversing without direction inversion

Simulation of a traversing with direction inversion

The traversing with direction inversion can be simulated with the following actuation sequence:

Counting in:
1. Push toggle switch 2 to the right (“Test”) and keep toggle switch in this position.
2. Push toggle switch 1 to the right (“Test”) and keep toggle switch in this position.
3. Release toggle switch 2.
4. Release toggle switch 1.

Counting out:
1. Push toggle switch 1 to the right (“Test”) and keep toggle switch in this position.
2. Push toggle switch 2 to the right (“Test”) and keep toggle switch in this position.
3. Release toggle switch 1.
4. Release toggle switch 2.

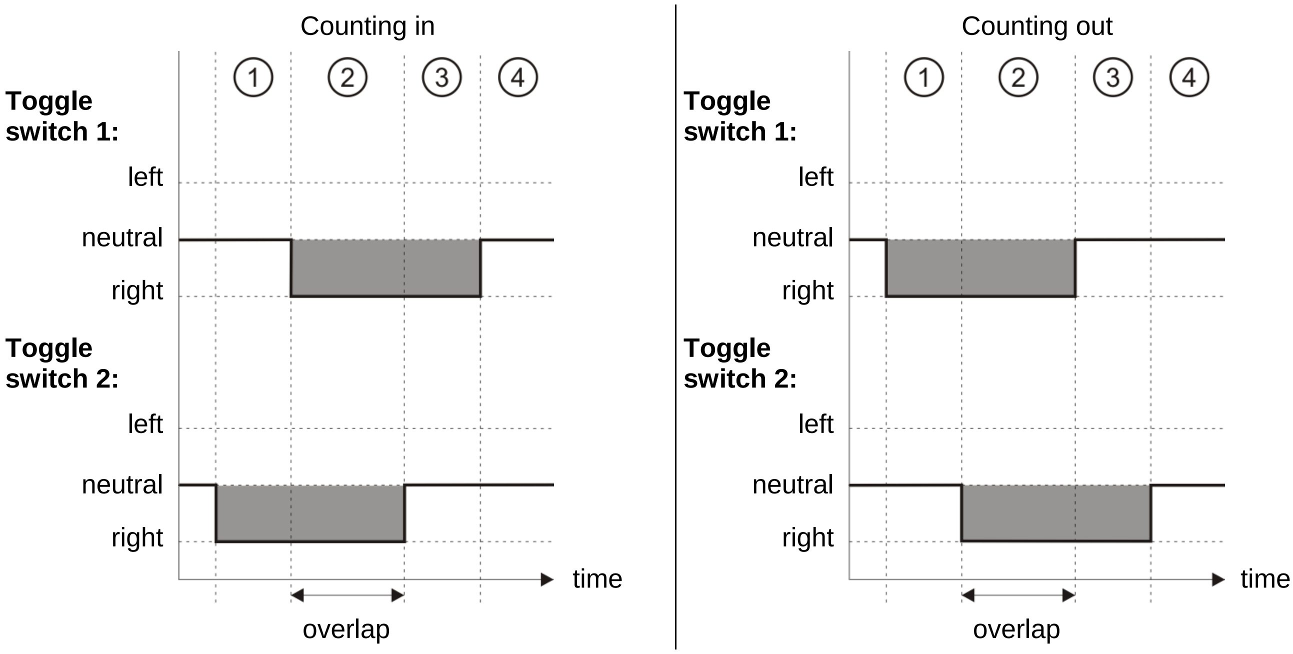


Figure 8.3: Actuation sequence for a traversing with direction inversion

For this, the actuation time is negligible but an overlap is required. Dependent on the actuation of the toggle switches and the configuration of the counting direction, an axle is counted in or out.

If the actuation of both toggle switches deviates from the predetermined sequence, no simulation of a traversing is carried out and the actuation of the toggle switches is inhibited for approx. 6 s. The wrong actuation of the toggle switches is indicated via a flashing of the LEDs “Sys1” and “Sys2” (at first the LEDs flash fast for 2 s, then the LEDs flash slowly whereas the number of the slow flashing corresponds to the number of the error code, see chapter “Error codes when adjusting the wheel sensor”). After the LEDs go out, the actuation of the toggle switches is inhibited for further 2 s. If the toggle switches are actuated again during the inhibiting, the toggle switch actua-

tions are rejected and the inhibiting is extended (process starts again with the fast flashing of the LEDs).
In order to request another simulation of traversing, the actuation sequence must be started again from the beginning with (1) to (3) after the end of the inhibiting.

8.2.2 Operation of the Input/Output Board IO-EXB

If the IO-EXB was configured for axle counting, 1 of the 7 configurable reset operations can be carried out by means of the two toggle switches on the front panel of the IO-EXB. The precondition for this is that the front panel elements of the IO-EXB are not configured as “disabled” in the configuration word “Reset operation with the toggle switches on the front panel of the IO-EXB”.

Dependent on the configuration the “Display” toggle switch is used to switch between the indication of the counter reading of track section 1 (FMA 1) and track section 2 (FMA 2) in case of axle counting or to switch between the indication of the inputs and outputs in case of data transmission. If the IO-EXB was configured for counting head output, both toggle switches have no function.

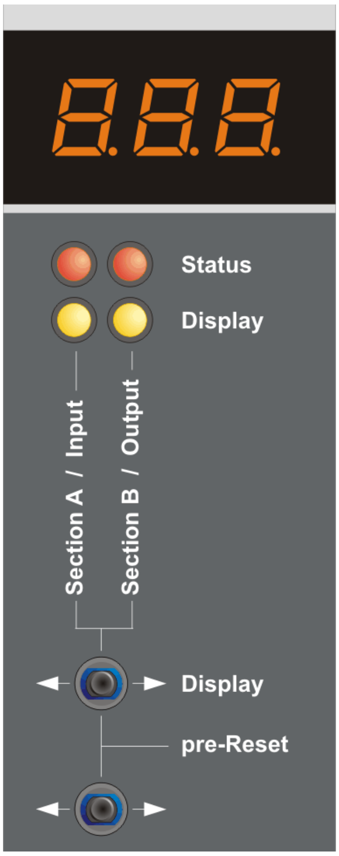


Figure 8.4: Display, LEDs and toggle switches on the front panel of the IO-EXB

8.2.2.1 Description of the IO-EXB's display in case of axle counting

Dependent on the operating status, the display of the IO-EXB shows the following:

Display indication			Operating status
1st	2nd	3rd	
		0	section clear (selection of the track section (FMA) with the “Display” toggle switch on the front panel)
-	-	0	less than 4 edges in the track section (FMA), last axle counted out (selection of track section (FMA) with the “Display” toggle switch on the front panel)
-	-	0.	less than 4 edges in the track section (FMA), last axle counted in (selection of track section (FMA) with the “Display” toggle switch on the front panel)
1	2	3	track section (FMA) occupied, output of counter status (e.g. 123 axles in a track section (FMA)), last axle counted out (selection of the track section (FMA) with the “Display” toggle switch on the front panel)
1	2	3.	track section (FMA) occupied, output of counter status (e.g. 123 axles in a track section (FMA)), last axle counted in (selection of the track section (FMA) with the “Display” toggle switch on the front panel)
9	9	9	999 or more axles in a track section (FMA), last axle counted out (selection of the track section (FMA) with the “Display” toggle switch on the front panel)
9	9	9.	999 or more axles in a track section (FMA), last axle counted in (selection of the track section (FMA) with the “Display” toggle switch on the front panel)

Table 8.1: Description of the IO-EXB's display in case of axle counting

8.2.2.2 Description of the IO-EXB's display in case of data transmission

Dependent on the operating status, the display of the IO-EXB shows the following:

Display indication			Operating status
1st	2nd	3rd	
			selection of the input statuses by means of the "Display" toggle switch on the front panel (actuation to the left), indication in a hexadecimal form:
0	**0**	**0**	all inputs low
1	**1**	**1**	SINGLE inputs 1 (IN1A), 5 (IN2A) and 9 (IN3A) high DUAL inputs 1 (IN1A and IN1B), 3 (IN2A and IN2B) and 5 (IN3A and IN3B) high QUAD inputs 1 (IN1A to IN1D), 2 (IN2A to IN2D) and 3 (IN3A to IN3D) high
3	**3**	**3**	SINGLE inputs 1 (IN1A), 2 (IN1D), 5 (IN2A), 6 (IN2B), 9 (IN3A) and 10 (IN3B) high DUAL inputs 1 (IN1A and IN1B), 2 (IN1C and IN1D), 3 (IN2A and IN2B), 4 (IN2C and IN2D), 5 (IN3A and IN3B) and 6 (IN3C and IN3D) high
F	**F**	**F**	all SINGLE inputs high
			selection of the output statuses by means of the "Display" toggle switch on the front panel (actuation to the right), indication in a hexadecimal form:
0	**0**	**0**	all outputs low
1	**1**	**1**	SINGLE outputs 1 (OUT1A), 5 (OUT2A) and 9 (OUT3A) high DUAL outputs 1 (OUT1A and OUT1B), 3 (OUT2A and OUT2B) and 5 (OUT3A and OUT3B) high QUAD outputs 1 (OUT1A to OUT1D), 2 (OUT2A to OUT2D) and 3 (OUT3A to OUT3D) high
3	**3**	**3**	SINGLE outputs 1 (OUT1A), 2 (OUT1B), 5 (OUT2A), 6 (OUT2B), 9 (OUT3A) and 10 (OUT3B) high DUAL outputs 1 (OUT1A and OUT1B), 2 (OUT1C and OUT1D), 3 (OUT2A and OUT2B), 4 (OUT2C and OUT2D), 5 (OUT3A and OUT3B) and 6 (OUT3C and OUT3D) high
F	**F**	**F**	all SINGLE outputs high

Table 8.2: Description of the IO-EXB's display in case of data transmission

In case of data transmission, the bit status of the inputs and outputs is output hexadecimal. Each of the 3 positions on the display corresponds to a relay switching output of the IO-EXB and each position shows 4 bits of the 12 inputs and outputs. Those 4 bits can take up to 16 various statuses in total. By conversion to a binary number, the data can be read out.

Hexadecimal indication at position 1, 2 or 3	1st position output 3 (bits 0 … 3)	2nd position output 2 (bits 4 … 7)	3rd position output 1 (bits 8 … 11)
0	0000	0000	0000
1	0001	0001	0001
2	0010	0010	0010
3	0011	0011	0011
4	0100	0100	0100
5	0101	0101	0101
6	0110	0110	0110
7	0111	0111	0111
8	1000	1000	1000
9	1001	1001	1001
A	1010	1010	1010
B	1011	1011	1011
C	1100	1100	1100
D	1101	1101	1101
E	1110	1110	1110
F	1111	1111	1111

Tabelle 8.3: Possible bit statuses in case of data transmission

8.2.2.3 Description of the IO-EXB's display in case of counting head output

The positions 1 to 3 on the display of the IO-EXB correspond to the relay switching outputs of the IO-EXB. The 1st position corresponds to output 3, the 2nd position corresponds to output 2 and the 3rd position corresponds to output 1 of the IO-EXB. The respective operating status is displayed for the outputs, to which it applies.

Dependent on the operating status, the display of the IO-EXB shows the following:

Display indication			Operating status
1st	**2nd**	**3rd**	
0	**0**	**0**	normal status on all outputs: no direction pulse, no system pulse, no redundancy error (all outputs low)
1	**1**	**1**	active status on all outputs: current, applied status: “clear”, “occupied” or “faulty” (all outputs high)
E	**E**	**E**	errors on all outputs (redundancy errors are not indicated)
-	**-**	**-**	outputs were not configured (see chapter “Error codes in case of counting head output with system outputs” and “Error codes in case of counting head output with direction outputs”)

Table 8.4: Description of the IO-EXB's display in case of counting head output

9 Maintenance

SAB FAdC100_116:

After a service life of 30 years (exception: IO-EXB), the components of the system FAdC must be underwent to an extensive functional check.

Prior to and during works on the track, safety measures must be carried out according to the applicable railway regulations.

Maintenance works may only be carried out during periods in which there are no trains in the relevant track section (FMA).

9.1 Check operations during the maintenance

In order to not impact the safe operation, the carrying out of maintenance and all actions in the course of maintenance must be coordinated operationally.

When carrying out maintenance, the details in the chapter “Handling of boards” must be observed.

During maintenance, only the actions described in the following chapters should be carried out. If there are still other actions that must be carried out, e.g. the replacement of a board because of a defect or if faults and errors with unclear causes occur, the respective repair measures must be carried out immediately (see chapter “Repair”).

In the course of a regular maintenance, boards do not have to be removed from the board rack BGT.

9.1.1 Required tools and measuring equipment

For the checks during maintenance, the following tools and measuring equipment are required:

- measuring tape
- voltmeter: range 1 000 mV DC, ±0,5 % basic accuracy
- 2 test leads with 2 mm connectors (for connection of AEB with voltmeter)
- testing plate PB200
- Advanced Service Display ASD inclusive Service Display Cable

9.1.2 Mechanical and visual inspection of the wheel sensors

The cycle of mechanical and visual inspection of the wheel sensors for dirt, wear etc. depends on the operator's maintenance strategy.

SAB FAdC100_113:

At the wheel sensor, the following maintenance work must be carried out, adapted to the conditions of the track (but at least every 2 years):

- a visual and mechanical check
  - check wheel sensor for heavy dirt, remove loose dirt dryly
  - check wheel sensor for external mechanical damages
  - check fixing elements of the wheel sensor for correct fitting
  - check protection tube for mechanical damage
  - check cable connecting terminals for correct fitting
- a check of measurement A

In this context, particularly the spacing between the top face of the wheel sensor and the top of the rail (measurement A) must be checked and corrected if necessary (see the documentation D1414 “Mounting and commissioning of wheel sensor type RSR180” and/or D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”).

The mechanical and visual inspection of the wheel sensor RSR180 is described in the documentation D1414 “Mounting and commissioning of wheel sensor type RSR180” and must be carried out accordingly.

The mechanical and visual inspection of the wheel sensor RSR123 is described in the documentation D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123” and must be carried out accordingly.

9.1.3 Check of the sensor currents of the wheel sensor

The check of the sensor currents must be carried out according to chapter "Measuring sensor currents".

Adapted to the condition of the track (but at least every 2 years), the sensor currents of the wheel sensor must be measured, when the wheel sensor is mounted correctly and not damped.

9.1.3.1 Sensor current of the wheel sensor RSR180

The sensor currents of system 1 and system 2 must fulfil the following requirements:

- The normal operating sensor current of both systems must be in the following range:
  - between **2,8 and 5,0 mA** (280 to 500 mV) for Vignole rails
  - between **2,8 and 6,0 mA** (280 to 600 mV) for grooved rails

- The difference between the normal operating sensor current of system 1 and of system 2 must not exceed:
  - **0,2 mA** (20 mV) for Vignole rails
  - **0,2 mA or 5 %** (whichever is greater) for grooved rails

- The difference between the adjustment sensor current and the normal operating sensor current of each system must **not exceed 5 %**. These two values can be read out via the ASD.

If one of the requirements above is not fulfilled, then the following measures must be performed in the indicated order:

1. Check mounting of the RSR180 and correct it, if necessary.
2. Check the RSR180 for excessive dirt and clean it, if necessary.
3. Check the RSR180 for visible damages and replace it, if necessary.
4. If the mounting had to be corrected and/or the RSR180 had to be cleaned and/or replaced, then an adjustment of the AEB (see chapter "Adjustment of the AEB") must be carried out additionally.

The mounting of the RSR180 must be checked according to document D1414 "Mounting and commissioning of wheel sensor type RSR180".

If the requirements are still not met after performing the indicated measures, then the wheel sensor must be replaced with a wheel sensor of the same type or, in case of special mounting conditions, Frauscher must be contacted.

9.1.3.2 Sensor current of the wheel sensor RSR123

The normal operating sensor current of system 1 and system 2 must be in the following range[30]:

- between **4,85 and 5,15 mA** (485 to 515 mV) immediately after an adjustment
- between **4,75 and 5,25 mA** (475 to 525 mV) during maintenance

If the normal operating currents are not in the specified range, then the following measures must be performed in the indicated order:

1. Check mounting of the RSR123 and correct it, if necessary.
2. Check the RSR123 for excessive dirt and clean it, if necessary.
3. Check the RSR123 for visible damages and replace it, if necessary.
4. If the mounting had to be corrected and/or the RSR123 had to be cleaned and/or replaced, then an adjustment of the RSR123 must be carried out additionally.

The mounting check and the adjustment of the RSR123 must be performed according to document D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”.

If the requirements are still not met after performing the indicated measures, then the wheel sensor must be replaced with a wheel sensor of the same type or, in case of special mounting conditions, Frauscher must be contacted.

30 The lower value displayed on the voltmeter applies.

9.1.4 Check of the occupancy detection capability

The check of the occupancy detection capability can be carried out in 2 ways:

- **Check with a rail vehicle:**
  - The wheel sensor must be traversed error-free with a rail vehicle (traversing both, system 1 and system 2).
  - For this the associated counting head outputs of the AEB or the switching outputs of the IO-EXB must switch correctly (in case of a counting head) and/or at least 1 axle must be correctly counted in and/or out (in case of a track section (FMA)).

- **Check with the testing plate PB200:**
  - At least 1 counting procedure over system 1 and system 2 must be executed correctly with the help of the testing plate PB200 (see documentation D2860 “Brief instruction of testing plate PB200 GS03”).
  - For this the associated counting head outputs of the AEB or the switching head outputs of the IO-EXB must switch correctly (in case of a counting head) and/or at least 1 axle must be correctly counted in and/or out (in case of an track section (FMA)).

The check of occupancy detection capability must not be carried out by an actuation of the toggle switches on the front panel of the AEB.

SAB FAdC100_114:

If a wheel sensor is not traversed for longer than the maximum permitted cycle of traversing, then the following checks must be carried out prior to the first train run:

- occupancy detection capability of the counting head,
- correct clear and/or occupied indication of the axle counter and
- in case the counting head outputs are used: check for correct switching of the counting head outputs

9.1.5 Check on the IO-EXB

Excerpt from SAB FAdC100_39:

The 2 inputs and the 2 outputs of the IO-EXB must be checked for their functionality within the maintenance cycle (2 years).
In order to do so, the following switching statuses must be applied at the two used inputs:
high-high, low-high, high-low, low-low.
This guarantees that each of the two inputs functions correctly. At each output of the two used outputs it must be checked if this can enter the failsafe status (low status).

10 Repair

10.1 Diagnostics

The following diagnostic options are available for the axle counting system and/or the individual components:

- LED indications on the front panel of the PSC
- LED indications and test sockets on the front panel of the AEB
- LED indications and display on the front panel of the IO-EXB
- LED indications on the front panel of the COM
- ASD (is connected to the diagnostic interface “Serial Interface” on the front panels of the AEB and COM)
- FDS (diagnostic system)

SAB FAdC100_15:

Operational actions must not be deduced from the displayed information of the LEDs, the display or the diagnostic data.

10.2 Troubleshooting

When troubleshooting, it is recommended to proceed as follows:

- start troubleshooting with the indoor equipment
- identify faulty board by means of the LED indication (red LED is illuminated or red LED flashes)
- connect ASD via the diagnostic interface “Serial Interface” with the board
- read out error code and carry out the necessary measures to rectify the error

Troubleshooting can also be carried out via FDS.

In case of errors, it is recommended to note down the error codes in order to improve the traceability of occurred errors and/or faults.

SAB FAdC100_191:

Defective components must be replaced or removed from service as soon as possible. The maximum permitted period of time for the repair is 7 days.

SAB FAdC100_194:

Defective components must not be repaired, but must be replaced by components of the same type, which were checked by Frauscher.

10.2.1 Troubleshooting on the PSC

Troubleshooting can be carried out via the LED indication on the front panel of the PSC.

Figure 10.1: LED on the front panel of the PSC

10.2.1.1 LED indications on the PSC

LED "PWR"

In case the LED "PWR" is off, this indicates an error status:

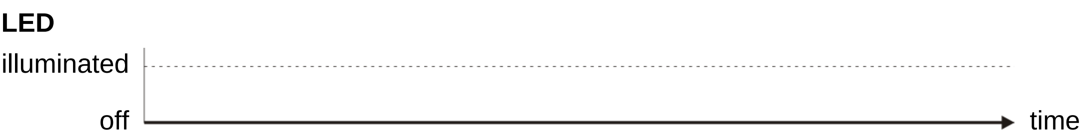


Figure 10.2: LED "PWR" off

Meaning	Possible measure(s)
no power supply	apply power supply
SMD fuse broken	send the PSC for repair to Frauscher

Table 10.1: LED "PWR" off

In case the LED “PWR” is illuminated, this indicates an operating status:

Figure 10.3: LED “PWR” illuminated

Meaning	Possible measure(s)
power supply applies	-

Table 10.2: LED “PWR” illuminated

10.2.2 Troubleshooting on the AEB

The troubleshooting on the AEB can be carried out as follows:

- by means of ASD (via diagnostic interface “Serial Interface” on the front panel of the AEB; further information can be taken from the documentation D21004 “Brief description Advanced Service Display ASD101”)
- by means of FDS (if available; further information can be taken from the documentation D21006 “Frauscher Diagnostic System FDS101 for FAdC R2 and FAdCi R2”)
- with the LED indication on the front panel of the AEB (see chapter “LED indications on the AEB”)
- with measurements on the test sockets of the AEB (see chapter “Measurements on the AEB with connected wheel sensor RSR180” or “Measurements on the AEB with connected wheel sensor RSR123”)
- if using an IO-EXB: with the display of the IO-EXB (see chapter “Troubleshooting on the display of the IO-EXB”)

10.2.2.1 Measurements on the AEB with connected wheel sensor RSR180

The normal operating sensor currents of the wheel sensor RSR180 are read out with the ASD and displayed in mA. Furthermore, the normal operating sensor currents can be measured at the test sockets on the front panel of the AEB with the voltmeter.

Measure voltage at the test sockets for Sys1 and/or for Sys2:

- required value for Vignole rail = 280 to 500 mV DC
- required value for grooved rail = 280 to 600 mV DC

The measured voltage corresponds to the sensor current via a 100-Ω shunt (100 mV correspond to 1 mA sensor current). When measuring the voltage, the RSR180 must not be damped.

The normal operating sensor current of the wheel sensor RSR180 depends on:

- the mounting position
- the type of mounting (rail claw mounting, rail web mounting, etc.)
- the rail profile (large e.g. UIC60, small e.g. VST36)

ASD indication[31]	**Voltmeter indication**	**Meaning**	**Possible measure(s)**
Vignole rail: 1 – 2,8 mA and/or 5 – 7 mA grooved rail: 6 – 7 mA	Vignole rail: 100 – 280 mV and/or 500 – 700 mV grooved rail: 600 – 700 mV	metal parts near RSR180 RSR180 not mounted centrally between the sleepers RSR180 mounted incorrectly incorrect clamping bolts used in case of rail claw mounting RSR180 damped (traversed)	remove metal parts mount RSR180 centrally between the sleepers mount RSR180 correctly replace clamping bolts -
> 7 mA	> 700 mV	wire short-circuit RSR180 connected incorrectly	rectify wire short-circuit connect RSR180 correctly
0 mA	0 mV	no RSR180 connected wire break wire short-circuit BSI004, RSR180 or AEB defective in case of analogue double usage: AEB configured as slave board and master board not connected	connect RSR180 check wiring and connections rectify wire short-circuit replace BSI004, RSR180 or AEB; in case of replacement of BSI004, check cables for earth fault reconnect master board; check wiring and connections

Table 10.3: Measurements on the AEB with connected RSR180

Difference of current and/or voltage between Sys1 and Sys2		**Meaning**	**Possible measure(s)**
Vignole rail	**Grooved rail**		
> 0,2 mA (> 20 mV)	> 0,2 mA (> 20mV) or > 5 % (whichever is greater)	RSR180 mounted incorrectly RSR180 not mounted centrally between the sleepers metal parts below RSR180 a sensor system defective BSI004 defective	mount RSR180 correctly mount RSR180 centrally between the sleepers remove metal parts replace RSR180 replace BSI004, check cables for earth fault

Table 10.4: Difference of current and/or voltage between Sys1 and Sys2 of RSR180

31 In the ASD, only the value measured at the moment of data request is shown.

10.2.2.2 Measurements on the AEB with connected wheel sensor RSR123

The normal operating sensor currents of the wheel sensor RSR123 are read out with the ASD and displayed in mA. Furthermore, the normal operating sensor currents can be measured at the test sockets on the front panel of the AEB with the voltmeter.

Measure voltage at the test sockets for Sys1 and/or Sys2:

- required value = 500 mV DC ±5 %

The measured voltage corresponds to the sensor current via a 100-Ω shunt (100 mV correspond to 1 mA sensor current). When measuring the voltage, the RSR123 must not be damped.

The normal operating sensor current of the wheel sensor RSR123 depends on:

- the mounting position
- the type of mounting (rail claw mounting, web of rail mounting etc.)
- the rail profile (large e.g. UIC60, small e.g. VST36)

ASD indication[32]	Voltmeter indication	Meaning	Possible measure(s)
< 4,75 mA > 5,25 mA	< 475 mV > 525 mV	RSR123 not adjusted	adjust RSR123
		RSR123 mounted incorrectly	mount RSR123 correctly
		RSR123 damped (traversed)	-
< 3,75 mA > 5,5 mA	alternating < 375 mV > 550 mV	RSR123 has dropped off the rail	check mounting of wheel sensor and correct it if necessary, interrupt power supply, carry out adjustment again
		adjustment failed	check mounting of wheel sensor and correct it if necessary, interrupt power supply, carry out adjustment again
		check of occupancy detection capability not passed	check mounting of wheel sensor and correct it if necessary, interrupt power supply, carry out adjustment again
		check of overcurrent detection capability not passed	check mounting of wheel sensor and correct it if necessary, interrupt power supply, carry out adjustment again
		RSR123 defective	replace RSR123
> 6 mA	> 600 mV	wire short-circuit: wire 1 with 2 or wire 3 with 4	rectify wire short-circuit
		RSR123 connected incorrectly	connect RSR123 correctly
0 mA	0 mV	wire break wire 1, 2, 3 or 4	check cabling and connections
		no RSR123 connected	connect RSR123

Table 10.5: Measurements on the AEB with connected RSR123

32 In the ASD only the value is shown, which is measured at the moment of data request.

10.2.2.3 LED indications on the AEB

Figure 10.4: LEDs on the front panel of the AEB

LED “PWR”

In case the LED “PWR” is off, this indicates an error status:

Figure 10.5: LED “PWR” off

Meaning	Possible measure(s)
no power supply	apply power supply

Table 10.6: LED “PWR” off

In case the LED “PWR” is illuminated, this indicates an operating status:

Figure 10.6: LED “PWR” illuminated

Meaning	Possible measure(s)
power supply applies	-

Table 10.7: LED “PWR” illuminated

LED “Sys1”and/or “Sys2”

In case the LED “Sys1” and/or “Sys2” is off, this indicates an operating status:

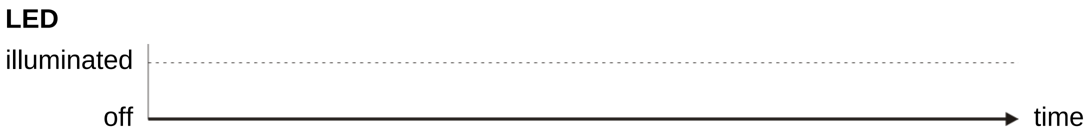


Figure 10.7: LED “Sys1” and/or “Sys2” off

Meaning	Possible measure(s)
end of an operating action on the AEB	-
configuration loaded, but no wheel sensor config-ured	-
wheel sensor not damped	-
no error at the wheel sensor	-

Table 10.8: LED “Sys1”and/or “Sys2” off

In case the LED “Sys1” and/or “Sys2” is illuminated, this indicates an operating status:

Figure 10.8: LED “Sys1” and/or “Sys2” illuminated

Meaning	Possible measure(s)
configuration not yet loaded	-
wheel sensor damped	-
toggle switch actuated	-

Table 10.9: LED “Sys1” and/or “Sys2” illuminated

In case the LED “Sys1” and/or “Sys2” flashes slowly, this indicates an error status:

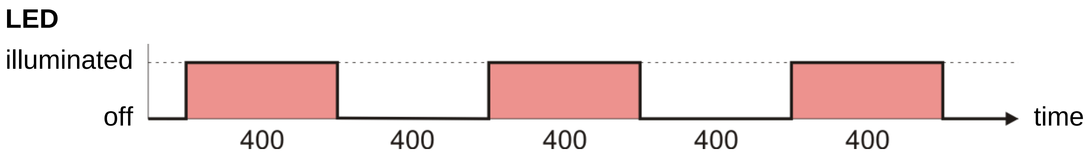


Figure 10.9: LED “Sys1” and/or “Sys2” flashes slowly, time data in ms

Following error statuses can be narrowed down via ASD or FDS:

Meaning	Possible measure(s)
RSR123/AEB not adjusted	adjust RSR123/AEB
wire break in the wheel sensor cable e.g. due to: interrupted cable connection between outdoor and indoor equipment defective overvoltage protection board defective wheel sensor wire short-circuit in the wheel sensor cable	 check cable connection between outdoor and indoor equipment replace overvoltage protection board replace wheel sensor rectify short-circuit
overcurrent e.g. due to: cable short-circuit wheel sensor adjusted incorrectly defective wheel sensor normal operating sensor current overlaid with harmonics	 rectify short-circuit adjust wheel sensor correctly replace wheel sensor determine and rectify cause (carry out measurements), contact Frauscher if necessary

Table 10.10: LED “Sys1”and/or “Sys2” flashes slowly

In case the LED “Sys1” and/or “Sys2” flashes fast, this indicates an error status:

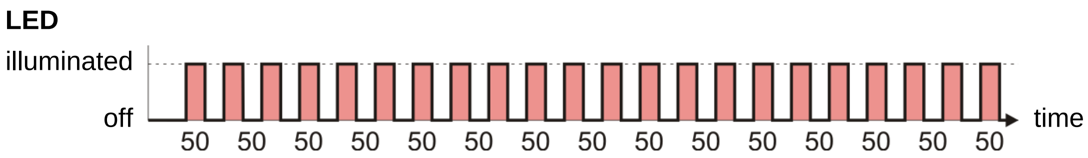


Figure 10.10: LED “Sys1” and/or “Sys2” flashes fast, time data in ms

Meaning	Possible measure(s)
adjustment process, coding process, reset or simulation of a traversing was terminated (flash duration 2 s, then slow flashing (see figure “LED ‘Sys1’ and/or ‘Sys2’ flashes slowly”), whereas the number of the slow flashing corresponds to the number of the error code)	carry out adjustment, coding, reset or simulation of a traversing again
invalid actuation sequence was initialised (flash duration 2 s, then slow flashing (see figure “LED ‘Sys1’ and/or ‘Sys2’ flashes slowly”), whereas the number of the slow flashing corresponds to the number of the error code)	carry out actuation sequence correctly
board error of AEB[33]	read out error code via ASD

Table 10.11: LED “Sys1” and/or “Sys2” flashes fast

In case the LED “Sys1” and/or “Sys2” flashes shortly, this indicates an error status:

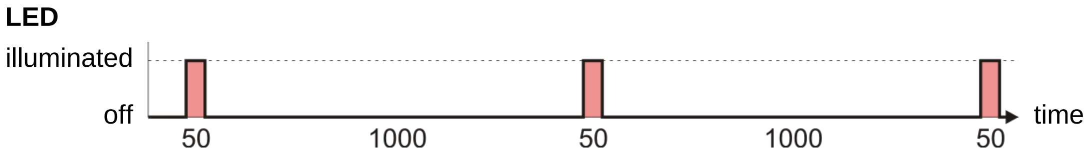


Figure 10.11: LED “Sys1” and/or “Sys2” flashes shortly, time data in ms

Following error statuses can be narrowed down via ASD or FDS:

Meaning	Possible measure(s)
no life-signal of RSR123 (indication after 1 min) e.g. due to:	
defective wheel sensor cable	replace wheel sensor cable
defective wheel sensor	replace wheel sensor
normal operating sensor current drift of RSR180/RSR123 (indication after 1 min)	check wheel sensor mounting, carry out adjustment

Table 10.12: LED “Sys1” and/or “Sys2” flashes shortly

33 This error status can be narrowed down via ASD or FDS.

LED “A1” and/or “A2”

In case the LED “A1” and/or “A2” is off, this indicates an operating status:

Figure 10.12: LED “A1” and/or “A2” off

Meaning	Possible measure(s)
track section (FMA) is clear	-
no track section (FMA) configured	-
in case of Counting Head Control: counting head is sensitised and the track section (FMA) is clear	-
in case of Counting Head Control: counting head is sensitised, no track section (FMA) configured	-

Table 10.13: LED “A1” and/or “A2” off

In case the LED “A1” and/or “A2” is illuminated, this indicates an operating status:

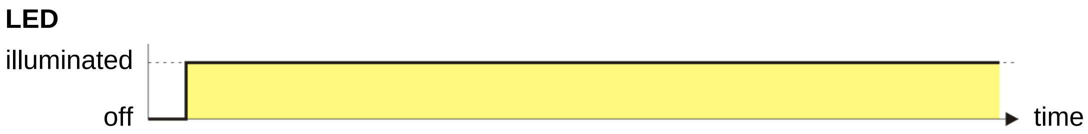


Figure 10.13: LED “A1” and/or “A2” illuminated

Meaning	Possible measure(s)
track section (FMA) is occupied	-
in case of Counting Head Control: counting head is sensitised and the track section (FMA) is occupied	-

Table 10.14: LED “A1” and/or “A2” illuminated

In case the LED “A1” and/or “A2” flashes slowly, this indicates an error status:

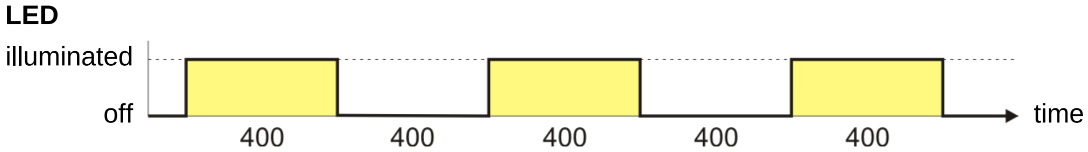


Figure 10.14: LED “A1” and/or “A2” flashes slowly, time data in ms

Following error statuses can be narrowed down via ASD or FDS:

Meaning	Possible measure(s)
track section 1 (FMA 1) or track section 2 (FMA 2) faulty	carry out reset
communication error	check communication path between AEB and wheel sensor

Table 10.15: LED “A1” and/or “A2” flashes slowly

In case the LED “A1” and/or “A2” flashes shortly, this indicates an operating status:

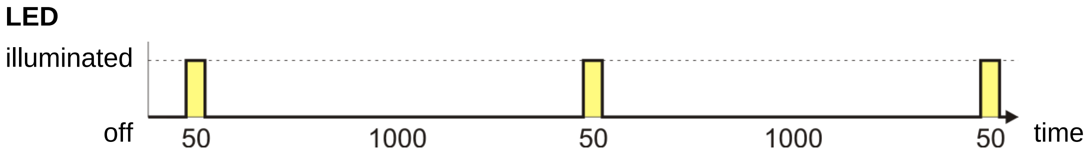


Figure 10.15: LED “A1” and/or “A2” flashes shortly, time data in ms

Meaning	Possible measure(s)
in case of Counting Head Control: counting head is desensitised and the track section (FMA) is clear	-
in case of Counting Head Control: counting head is desensitised and no track section (FMA) configured	-

Table 10.16: LED “A1” and/or “A2” flashes shortly

In case the LED “A1” and/or “A2” shortly goes off, this indicates an operating status:

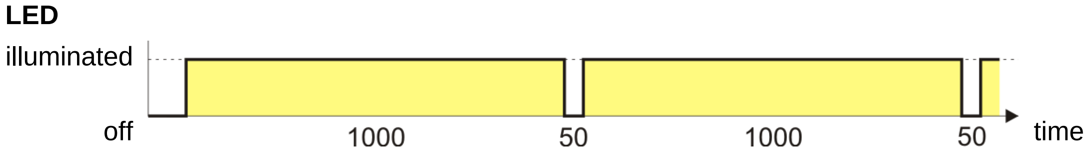


Figure 10.16: LED “A1” and/or “A2” shortly goes off, time data in ms

Meaning	Possible measure(s)
in case of Counting Head Control: counting head is desensitised and the track section (FMA) is occupied	-

Table 10.17: LED “A1” and/or “A2” shortly goes off

LED “B1” and/or “B2”

In case the LED “B1” and/or “B2” is off, this indicates an operating status:

Figure 10.17: LED “B1” and/or “B2” off

Meaning	Possible measure(s)
error-free communication on the CAN bus	-

Table 10.18: LED “B1”and/or “B2” off

In case the LED “B1” and/or “B2” is illuminated, this indicates an error status:

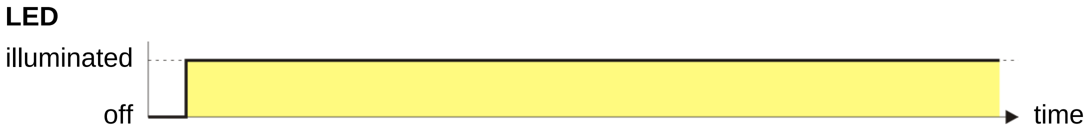


Figure 10.18: LED “B1” and/or “B2” illuminated

Meaning	Possible measure(s)
faulty communication on the CAN bus e.g. due to:	
defective PSC	replace PSC
defective AEB	replace AEB
cabling not correct	check cabling

Table 10.19: LED “B1” and/or “B2” illuminated

10.2.2.4 Error codes of the AEB

The AEB outputs error codes in case of an error and/or an invalid configuration that are described in the following table. The error codes can be read out with the diagnostic tools ASD and FDS. Furthermore, the output of the error codes can take place on the display of an IO-EXB, which is connected to the respective AEB. In case an error code regarding configuration occurs, the configuration must be amended by the project engineer. The error that has occured first is indicated. If subsequent errors occur, then further measures might be necessary. In case a hardware error occurs, it must be preceded according to the possible measures.

Error code	Meaning	Possible measure(s)
1 to 10	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
11 to 18	channel comparison for occupancy or overcurrent failed	check wheel sensor signal
19 to 23	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
24	incompatible protocol version number between several AEB boards (old and new AEB boards mixed)	within a system only AEB boards of the type AEB10x may be used
25	project number between the communication participants does not match	amend configuration in the configuration word “Project number”

Error code	Meaning	Possible measure(s)
26	invalid configuration answer from the configuration server	check configuration file and amend it if necessary
27	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
28	no valid configuration file available configuration on the CF cards of redundant COM boards not identical wrong CRC (configuration was modified but no new CRC was calculated)	check CF cards and/or amend configuration check CF cards and/or amend configuration calculate new CRC
29	wrong identification of component configured	amend configuration in the entry “COMPONENT” in the [PROTECTION] block
30	verification entry ≤ creation entry	amend configuration in the entries “VERSION” and “VERIFY” in the [PROTECTION] block: the value of “VERIFY” must be bigger than the value of “VERSION”
31	unknown configuration word (unknown value of entry “CFG_...”) “[CONFIG]” is missing in the configuration file one or both square brackets of a keyword are missing	amend configuration
32	incorrect length (bytes) of a configuration word with an entry “ID”	amend configuration
33	maximum allowed number (in this case > 1) of a configuration word exceeded	amend configuration
34	maximum number of external participants (20 per AEB) exceeded	amend configuration in the configuration word “Counting head FMA 1” and/or “Counting head FMA 2”
35	incorrect length (bytes) of a configuration word without an entry “ID”	amend configuration
36	maximum allowed number (in this case = 1) of a configuration word exceeded	amend configuration
37	wrong CRC[34]	amend configuration
38	in at least one of the configuration words that are set and type-protected by Frauscher the entry “TYPE_PRTCT” was configured with ‘0’	amend configuration or consult Frauscher

34 This error code is indicated from the AEB after 8 min.

Error code	Meaning	Possible measure(s)
39	invalid type protection code in the entry "TYPE_PRTCT_CODE" of the configuration word "Type protection"	amend this configuration word or consult Frauscher
40	configuration word "Counting head FMA 1" used despite locking	amend configuration
41	configuration word "Counting head FMA 2" used despite locking	amend configuration
42	configuration word "Supervisor section for FMA 1" used despite locking	amend configuration
43	configuration word "Supervisor section for FMA 2" used despite locking	amend configuration
44	configuration word "Synchronisation FMA 1" used despite locking	amend configuration
45	configuration word "Synchronisation FMA 2" used despite locking	amend configuration
46	configuration word "Counting Head Control" used despite locking	amend configuration
47	configuration word "Output axle counting via IO-EXB" used despite locking	amend configuration
48	configuration word "Input/output data trans-mission" used despite locking	amend configuration
49	incorrect order of type-protected and not type-protected configuration words in the configu-ration file	amend order in the configuration file
50	all configuration requests without success (e.g. CAN connection interrupted)	check DIP-switches for the configuration server on the COM, check function of COM and CAN bus, check CF card
51	all CRC requests without success[35]	check DIP-switches for the configuration server on the COM, check function of COM and CAN bus, carry out a power-up
52	not configured time-out used in the configura-tion word "Counting head FMA 1" and/or "Counting head FMA 2"	amend configuration

35 This error is generated by the AEB after 12 min. Therefore, a restart of the configuration server (e.g. when the configuration is modified) must be performed within 12 min.

Error code	Meaning	Possible measure(s)
53	not configured time-out used in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”	amend configuration
54	not configured time-out used in the configuration word “Synchronisation FMA 1” and/or “Synchronisation FMA 2”	amend configuration
55	not configured time-out used in the configuration word “Counting Head Control”	amend configuration
56	not configured time-out used in the configuration word “Output axle counting via IO-EXB”	amend configuration
57	not configured time-out used in the configuration word “Input/output data transmission”	amend configuration
58	in case of inactive outputs, the entries “AUTOMATIC_POSITION” or “POSITION” in the configuration word “Input/output data transmission” are not configured with ‘0’	amend this configuration word
59	automatic positioning is active and the entry “POSITION” in the configuration word “Input/output data transmission” is not configured with ‘0’	amend this configuration word
60	track section 2 (FMA 2) configured without track section 1 (FMA 1)	amend configuration in the configuration word “Counting head FMA 1” and/or “Counting head FMA 2”
61	different types of logic operation configured in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”	amend these configuration words
62	no reset delay (0 s) configured in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”	amend these configuration words
63	different reset types configured in the configuration word “Supervisor section for FMA 1” or “Supervisor section for FMA 2”	amend these configuration words
64	supervisor section configured without associated track section (FMA)	amend configuration in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”

Error code	Meaning	Possible measure(s)
65	synchronisation section configured without associated track section (FMA)	amend configuration in the configuration word “Synchronisation FMA 1” and/or “Synchronisation FMA 2”
66	number of IO-EXB boards does not match the configuration	amend configuration in the configuration word “Output axle counting via IO-EXB” and/or “Input/output data transmission” and/or “Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB”
67	different positioning procedures configured in the configuration word “Input/output data transmission”	amend this configuration word
68	maximum bit position exceeded in the configuration word “Input/output data transmission”	amend this configuration word
69	reserved configuration sections in the configuration word “Options for a track section (FMA)” not configured with ‘0’	amend this configuration word
70	project number in the configuration word “Project number” configured with ‘0’	amend this configuration word
71	reserved configuration sections in the configuration word “Output axle counting via IO-EXB” not configured with ‘0’	amend this configuration word
72	entry “TIMEOUT_VALUE” in the configuration word “Time-out FAdC” configured with ‘0’	amend this configuration word
73	not supported wheel sensor type	amend configuration in the configuration word “Wheel sensor type”
74	invalid parameter of the configuration word “Wheel sensor switching levels (set and type-protected by Frauscher)”	consult Frauscher
75	invalid parameter of the configuration word “Wheel sensor overcurrent (set and type-protected by Frauscher)”	consult Frauscher
76	invalid parameter of the configuration word “Magnetic track brake suppression (set and type-protected by Frauscher)”	consult Frauscher
77	invalid parameter of the configuration word “Dynamic occupied status extension”	amend this configuration word

Error code	Meaning	Possible measure(s)
78	invalid parameter of the configuration word “Parameters of magnetic track brake suppression (set and type-protected by Frauscher)”	consult Frauscher
79	invalid parameter of the configuration word “Digital filtering time (set and type-protected by Frauscher)”	consult Frauscher
80	configuration word “Type protection” for safety-critical and/or project-specific configuration words not configured	amend configuration or consult Frauscher
81	supervisor section cannot be directed to itself	amend configuration in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”
82	a track section (FMA) must not be configured for itself as a supervisor section	amend configuration in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”
83	synchronisation section cannot be directed to itself	amend configuration in the configuration word “Synchronisation FMA 1” and/or “Synchronisation FMA 2”
84	no track section (FMA) was configured at the AEB, with which this AEB should be synchronised	amend configuration in the configuration word “Synchronisation FMA 1” and/or “Synchronisation FMA 2”
85	track section (FMA) that should be used for desensitising not configured on the own ID	amend configuration in the configuration word “Counting Head Control”
86	input/output section not configured on the own ID or wrong ID configured	amend configuration in the configuration word “Output axle counting via IO-EXB”
87	input/output data transmission with own ID not possible	amend configuration in the configuration word “Input/output data transmission”
88	reserved configuration sections in the configuration word “Reset axle counting via IO-EXB” not configured with ‘0’	amend this configuration word
89	“Reset axle counting via IO-EXB” configured without “Output axle counting via IO-EXB”	amend configuration in the configuration word “Output axle counting via IO-EXB”
90	entry “RESET_OP_TIME” in the configuration word “Parameters Reset” configured with a value < 50 ms	amend this configuration word
91	IO-EXB not configured completely; even number (2, 4, 6, 8) of the configuration words “Output axle counting via IO-EXB” required	amend this configuration word

Error code	Meaning	Possible measure(s)
92	different reset delay configured in the configuration word “Supervisor section for FMA 1” and/or “Supervisor section for FMA 2”	amend these configuration words
93	entry “RESET_LD_TIME” in the configuration word “Parameters reset” configured with a value < 100 ms	amend this configuration word
94	evaluation of counting head of the own counting head configured without evaluation of wheel sensor	amend configuration in the configuration word “Wheel sensor type”
95	Counting Head Control configured without evaluation of wheel sensor	amend configuration in the configuration word “Wheel sensor type”
96	number of IO-EXB boards does not match the configuration	amend configuration in the configuration word “Output axle counting via IO-EXB” and/or “Input/output data transmission” and/or “Output of counting head outputs of the AEB via relay switching outputs of the IO-EXB”
97 to 98	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
99	ID of the AEB is set to 0 (DIP-no. 0 to 11 set to “OFF”)	amend DIP-switch setting
100 to 104	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available

Error code	Meaning	Possible measure(s)
105	wrong electronic coding or electronic coding not carried out yet	check plug socket of the AEB and/or carry out electronic coding
106 to 136	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
137	adjacent channel disturbed (only 1 channel of the AEB disturbed)	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
138 to 139	different DIP-switch setting on the circuit board between channel 1 and channel 2	amend DIP-switch setting
140	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
141	different DIP-switch setting on the circuit board between channel 1 and channel 2	amend DIP-switch setting
142 to 167	hardware error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available
168 to 255	internal error	note the error code; interrupt power supply by unplugging and plugging in the AEB; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective AEB if another AEB of the same type is available

Table 10.20: Error codes of the AEB

10.2.3 Measurements using oscilloscope or other recording device

The measurement is carried out on the test sockets of the AEB “V+” and “GND”, respectively for Sys1 (channel 1) and/or for Sys2 (channel 2). For this, the chapter “Current measurements” must also be observed.

Recording device requirements:

- at least 2 channels
- sampling rate with approx. 2 kS/s is adequate
- recording depth may vary between 5 and 30 seconds depending on train length and speed (at 10 kS and 8 bit/S this equals 60 kB memory per channel)

SAB FAdC100_142:

In case of measurements at the test sockets, faults can occur in the system FAdC. Therefore, measurements at the test sockets should be coordinated operationally. Measurements at the test sockets during regular operation and without supervision must be carried out only with Frauscher measurement and diagnostic systems. (Frauscher measurement and diagnostic systems have captive characteristics of the measurement inputs with respect to galvanic separation, short-circuit immunity, external voltage immunity and ground immunity as well as an EMC test according to EN 50121-4.)

10.2.4 Troubleshooting on the display of the IO-EXB

Troubleshooting can be carried out via the error code display on the display and via the LED indication on the front panel of the IO-EXB. Dependent on the configured function of the IO-EXB (axle counting, data transmission or counting head output) different error codes are output.

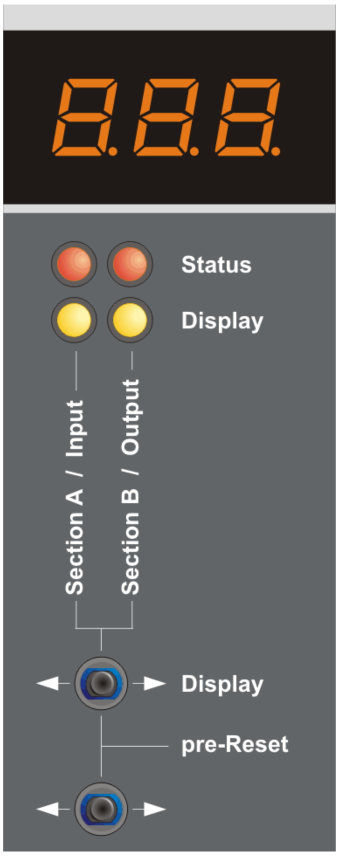


Figure 10.19: Display, LEDs and toggle switches on the front panel of the IO-EXB

10.2.4.1 Error codes of the AEB (displayed on the IO-EXB)

The error codes of the AEB are described in the chapter “Error codes of the AEB”. If an AEB is used in combination with an IO-EXB, this IO-EXB can output the error codes of the AEB. If several IO-EXB boards were connected to an AEB, the AEB error codes are displayed on the first IO-EXB. The display of the IO-EXB shows alternately “Er1” - error code of AEB channel 1 - “Er2” – error code of AEB channel 2.
The indication of the AEB error codes takes precedence over the indication of the axle counting error codes, data transmission error codes and counting head output error codes.

10.2.4.2 LED indications in case of axle counting

LED “Status”

In case a LED “Status” is off, this indicates an operating status:

Figure 10.20: LED “Status” is off

Meaning	Possible measure(s)
track section 1 (FMA 1) or track section 2 (FMA 2) is clear	-

Table 10.21: LED “Status” is off

In case a LED “Status” is illuminated, this indicates an operating status:

Figure 10.21: LED “Status” is illuminated

Meaning	Possible measure(s)
track section 1 (FMA 1) or track section 2 (FMA 2) is occupied	-

Table 10.22: LED “Status” illuminated

In case a LED “Status” flashes slowly, this indicates an error status:

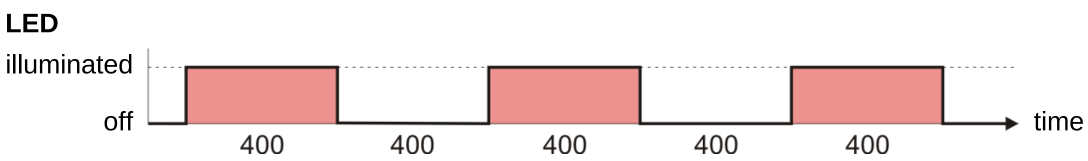


Figure 10.22: LED “Status” flashes slowly, time data in ms

Meaning	Possible measure(s)
track section 1 (FMA 1) or track section 2 (FMA 2) faulty	read out error code on the display, carry out reset

Table 10.23: LED “Status” flashes slowly

LED “Display”

In case a LED “Display” is illuminated, this indicates an operating status:

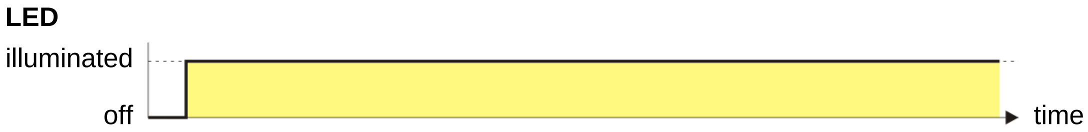


Figure 10.23: LED “Display” illuminated

Meaning	Possible measure(s)
selection of “Section A” (track section 1 (FMA 1)) or “Section B” (track section 2 (FMA 2)) with the “Display” toggle switch	-

Table 10.24: LED “Display” illuminated

10.2.4.3 Error codes in case of axle counting

In case the IO-EXB is configured for axle counting, following error codes can be output on the display of the IO-EXB:

Error code on the display			Meaning	Possible measure(s)
1st	2nd	3rd		
P.	**code of the wheel sensor causing the error (see chapter "Error codes of the AEB on the display of the IO-EXB in case of axle counting")**		partial traversing (selection of the track section (FMA) with the "Display" toggle switch on the front panel)	determine cause for error and/or carry out reset
F.	**axle number, display to maximum 99 axles**[36]		waiting for clearing of track (selection of the track section (FMA) with the "Display" toggle switch on the front panel)	no measure(s) required
E.	**decimal error code (see chapter "Error codes of the AEB on the display of the IO-EXB in case of axle counting")**		fault (selection of the track section (FMA) with the "Display" toggle switch on the front panel)	Measures can be taken from the chapter "Error codes of the AEB on the display of the IO-EXB in case of axle counting".
C.	**code of the wheel sensor causing the error (see chapter "Error codes of the AEB on the display of the IO-EXB in case of axle counting")**		communication error in case of axle counting (selection of the track section (FMA) with the "Display" toggle switch on the front panel)	Measures can be taken from the chapter "Error codes of the AEB on the display of the IO-EXB in case of axle counting".

Table 10.25: Troubleshooting on the IO-EXB in case of axle counting

36 no error

10.2.4.4 LED indications in case of data transmission

LED “Status”

In case a LED “Status” is off, this indicates an operating status:

Figure 10.24: LED “Status” is off

Meaning	Possible measure(s)
no errors in case of data transmission	-

Table 10.26: LED “Status” is off

In case a LED “Status” flashes slowly, this indicates an error status:

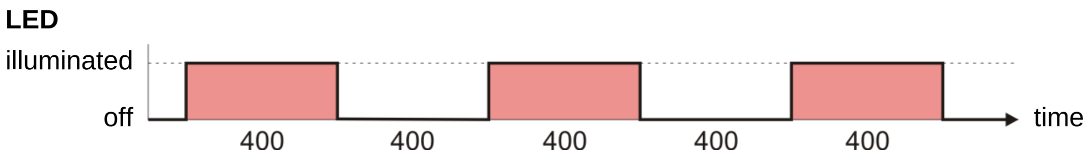


Figure 10.25: LED “Status” flashes slowly, time data in ms

Meaning	Possible measure(s)
error in case of data transmission	read out error code on the display

Table 10.27: LED “Status” flashes slowly

LED “Display”

In case a LED “Display” is illuminated, this indicates an operating status:

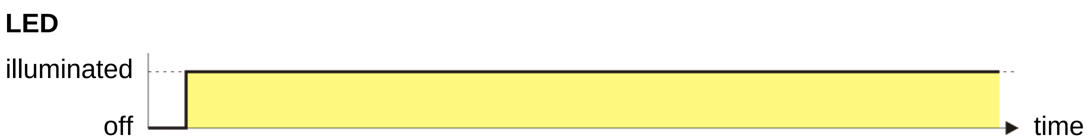


Figure 10.26: LED “Display” illuminated

Meaning	Possible measure(s)
selection of “Input” or “Output” with the “Display” toggle switch	-

Table 10.28: LED “Display” illuminated

10.2.4.5 Error codes in case of data transmission

In case the IO-EXB is configured for data transmission, the following error codes can be output on the display of the IO-EXB:

Error code on the display			Meaning	Possible measure(s)
1st	2nd	3rd		
C.		**1**	communication error	check communication path between AEB and wheel sensor
E.		**0**	Input error: Different signals were applied at the own input (relevant for QUAD and DUAL inputs).	check input signals and if necessary establish signal equality, if necessary replace board
E.		**1**	Received error: Different signals were applied at the input of the board, which should output the data (relevant for QUAD and DUAL inputs).	check input signals and if necessary establish signal equality, if necessary replace board
E.	**2**	**1**	Transmission quality when triggering the outputs is not sufficient.	increase bandwidth of the communication path, check configured time-out

Table 10.29: Troubleshooting on the IO-EXB in case of data transmission

10.2.4.6 LED indications in case of counting head output with system outputs

LED “Display”

In case the LED “Display” is off, this indicates an operating status:

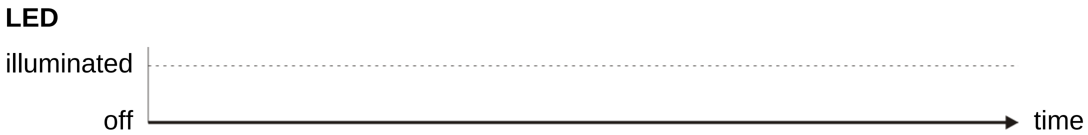


Figure 10.27: LED “Display” off

Meaning	Possible measure(s)
normal operating status in case of configuration of the IO-EXB for counting head output (toggle switches have no function)	-

Table 10.30: LED “Display” off

10.2.4.7 Error codes in case of counting head output with system outputs

The positions 1 to 3 on the display of the IO-EXB correspond to the relay switching outputs of the IO-EXB. The 1st position corresponds to output 3, the 2nd position corresponds to output 2 and the 3rd position corresponds to output 1 of the IO-EXB. An error (display "E") is indicated for those outputs to which it applies. Errors can be read out via a connected diagnostic system.

In case the IO-EXB is configured for counting head output with system outputs, the following error codes can be output on the display of the IO-EXB:

Error code on the display			Meaning	Possible measure(s)
1st	2nd	3rd		
E.	E.	E.	overcurrent e.g. due to:	
			cable short-circuit	rectify short-circuit
			incorrect wheel sensor adjustment	adjust wheel sensor correctly
			defective wheel sensor	replace wheel sensor
			wire break e.g. due to:	
			interrupted cable connection between the outdoor and the indoor equipment	check cable connection between the outdoor and the indoor equipment
			defective overvoltage protection board	replace overvoltage protection board
			defective wheel sensor	replace wheel sensor
			harmonics e.g. due to:	
			another cable near the wheel sensor cable	determine and rectify causes (carry out measurements), consult Frauscher if necessary
			no life signal of the RSR123 e.g. due to:	
			defective wheel sensor cable	replace wheel sensor cable
			defective wheel sensor	replace wheel sensor
			partial traversing	no measure(s) necessary
-	-	-	output not configured	configure output if required

Table 10.31: Troubleshooting on the IO-EXB in case of configuration of system outputs

10.2.4.8 LED indications in case of counting head output with direction outputs

LED “Display”

In case the LED “Display” is off, this indicates an operating status:

Figure 10.28: LED “Display” off

Meaning	Possible measure(s)
normal operating status in case of configuration of the IO-EXB for counting head output (toggle switches have no function)	-

Table 10.32: LED “Display” off

10.2.4.9 Error codes in case of counting head output with direction outputs

The positions 1 to 3 on the display of the IO-EXB correspond to the relay switching outputs of the IO-EXB. The 1st position corresponds to output 3, the 2nd position corresponds to output 2 and the 3rd position corresponds to output 1 of the IO-EXB. An error (display "E") is displayed for those outputs to which it applies. Errors can be read out via a connected diagnostic system.

In case the IO-EXB is configured for counting head output with direction outputs, the following error codes can be output on the display of the IO-EXB:

Error code on the display			Meaning	Possible measure(s)
1st	2nd	3rd		
E.	E.	E.	overcurrent e.g. due to: cable short-circuit incorrect wheel sensor adjustment defective wheel sensor	 rectify short-circuit adjust wheel sensor correctly replace wheel sensor
			wire break e.g. due to: interrupted cable connection between outdoor and indoor equipment defective overvoltage protection board defective wheel sensor	 check cable connection between outdoor and indoor equipment replace overvoltage protection board replace wheel sensor
			permanent system occupancy (is output if the occupancy lasts longer than 10 s) e.g. due to: a rail vehicle over the wheel sensor defective wheel sensor	 wait until the rail vehicle traverses the wheel sensor replace wheel sensor
			simultaneous system occupancy e.g. due to: an object which is on the wheel sensor defective wheel sensor	 remove object on-site replace wheel sensor
			partial traversing	no measure(s) necessary
-	-	-	output not configured	configure output if required

Table 10.33: Troubleshooting on the IO-EXB in case of configuration of direction outputs

10.2.4.10 Error codes of the AEB on the display of the IO-EXB in case of axle counting

The error codes of the AEB regarding track sections (FMA) can be read out with the diagnostic tools ASD and FDS. Furthermore, the error codes are indicated on the display of the IO-EXB, which is connected to the respective AEB and used for axle counting. Should a reset be necessary as a possible measure in order to rectify an error, this must be carried out with the respective configured reset procedure.

Error code on the display			**Meaning**	**Possible measure(s)**
1st	**2nd**	**3rd**		
C.		**0**	communication error at the transmission of the FMA information (output on a detached[37] IO-EXB)	check communication path between the outputting IO-EXB and the AEB of the track section
			wrong project number	amend configuration if in the configuration word “Options for a track section (FMA)” the entry “COMM_FAIL” is configured with ‘0’ (continue normal operation), then no reset is necessary after the error is recti-fied
C.		**1**	communication error at the transmission of counting head information of counting head 1 – 16 present (behaviour of track section after loss of communication is config-ured with “continue normal operation”, see entry “COMM_FAIL” in chapter “Options for a track section (FMA)”)	check communication path between the AEB that evaluates the track section and the AEB that provides the counting head information for the track section
to				
C.	**1**	**6**		
			wrong project number	amend configuration if in the configuration word “Options for a track section (FMA)” the entry “COMM_FAIL” is configured with ‘0’ (continue normal operation), then no reset is necessary after the error is recti-fied

37 A “detached” IO-EXB is an IO-EXB that is not directly connected to the AEBthat evaluates the track section and provides the information.

Error code on the display			Meaning	Possible measure(s)
1^{st}	2^{nd}	3^{rd}		
C.	**4**	**1**	communication error at the 1^{st} synchronisation wrong project number	check communication path between the AEB that evaluates the track section and the AEB with whose track section the synchronisation should be performed amend configuration if in the configuration word “Options for a track section (FMA)” the entry “COMM_FAIL” is configured with ‘0’ (continue normal operation), then no reset is necessary after the error is rectified
C.	**4**	**2**	communication error at the 2^{nd} synchronisation wrong project number	check communication path between the AEB that evaluates the track section and the AEB with whose track section the synchronisation should be performed amend configuration if in the configuration word “Options for a track section (FMA)” the entry “COMM_FAIL” is configured with ‘0’ (continue normal operation), then no reset is necessary after the error is rectified
E.		**0**	board error of the AEB that evaluates the track section that is output here (output on a detached IO-EXB)	read out error code of AEB that evaluates the track section that is output here; rectify error there, see chapter “Error codes of the AEB”
E.		**1**	error at the counting head 1 – 16	check sensor system signal at the respective counting head and/or carry out reset
to				
E.	**1**	**6**		
E.	**1**	**7**	negative counting	check sensor system signal at the respective counting head and/or carry out reset

Error code on the display			Meaning	Possible measure(s)
1st	2nd	3rd		
E.	**1**	**8**	channel comparison failed	carry out reset
E.	**1**	**9**	communication error no longer present (behaviour of FMA after loss of communication is configured with “take up fault status”, see entry “COMM_FAIL” in chapter “Options for a track section (FMA)”)	carry out reset
E.	**2**	**0**	transmission quality of the track section information (output on a detached IO-EXB) not sufficient	increase bandwidth of the communication path, check configured time-out
E.	**2**	**1**	transmission quality of the counting head information of counting head 1 – 16 not sufficient	increase band width of communication path, check configured time-out and/or carry out reset
to				
E.	**3**	**6**		
E.	**4**	**1**	transmission quality of the 1st synchronisation not sufficient	increase band width of communication path, check configured time-out and/or carry out reset
E.	**4**	**2**	transmission quality of the 2nd synchronisation not sufficient	increase band width of communication path, check configured time-out and/or carry out reset
E.	**5**	**1**	transmission quality of the 1st supervisor section not sufficient	increase band width of communication path, check configured time-out and/or carry out reset
E.	**5**	**2**	transmission quality of the 2nd supervisor section not sufficient	increase band width of communication path, check configured time-out and/or carry out reset
E.	**6**	**1**	loss of communication to the counting head 1 – 16	carry out reset
to				
E.	**7**	**6**		
E.	**8**	**1**	communication error at the 1st synchronisation	carry out reset
E.	**8**	**2**	communication error at the 2nd synchronisation	carry out reset
P.		**1**	partial traversing on counting head 1 – 16	determine cause for error and/or carry out reset
to				
P.	**1**	**6**		
-	-	-	display in case of power-up[38] and after changing of the current status (“clear”, “occupied” or “faulty”) (display in the ASD: “E.99”)	carry out reset

Table 10.34: Error codes of the AEB on the display of the IO-EXB

38 In case of power-up, the error code E.99 is output at the ASD until the reset.

10.2.5 Troubleshooting on the COM

Troubleshooting on the COM can be carried out as follows:

- by means of the ASD (via diagnostic interface “Serial Interface” on the front panel of the COM; further information can be taken from the documentation D21004 “Brief description Advanced Service Display ASD101”)
- by means of the FDS (if available; further information can be taken from the documentation D21006 “Frauscher Diagnostic System FDS101 for FAdC R2 and FAdCi R2”)
- with the LED indication on the front panel of the COM (see chapter “LED indications on the COM”)

10.2.5.1 LED indications on the COM

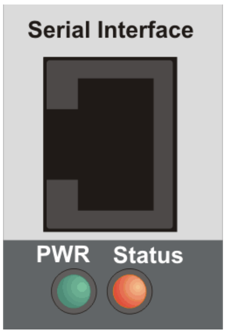


Figure 10.29: LEDs on the front panel of the COM

LED “PWR”

In case the LED “PWR” is off, this indicates an error status (active COM) or an operating status (passive COM):

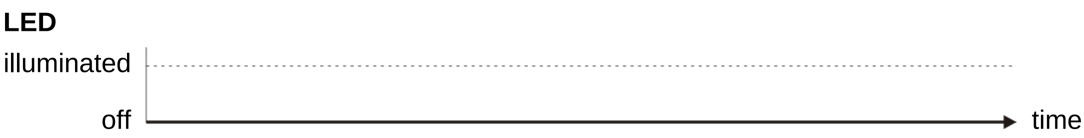


Figure 10.30: LED “PWR” off

Meaning	Possible measure(s)
COM is passive or no power supply	apply power supply

Table 10.35: LED “PWR” off

In case the LED “PWR” is illuminated, this indicates an operating status (active COM):

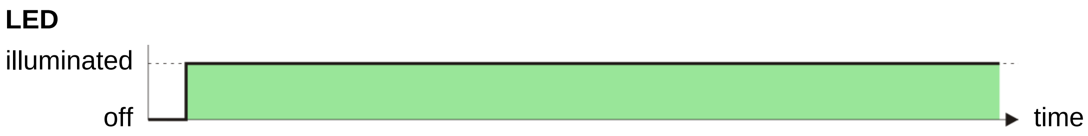


Figure 10.31: LED “PWR” illuminated

Meaning	Possible measure(s)
COM is active, power supply applied	-

Table 10.36: LED “PWR” illuminated

LED “Status”

In case the LED “Status” is off, this indicates an operating status:

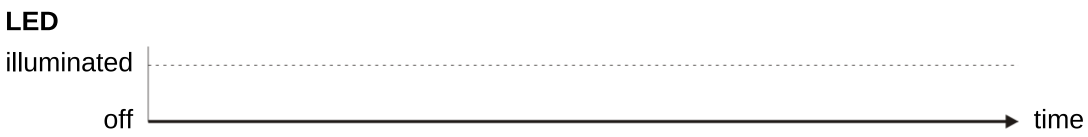


Figure 10.32: LED “Status” off

Meaning	Possible measure(s)
no fault (normal operating status)	-

Table 10.37: LED “Status” off

In case the LED “Status” is illuminated, this indicates an operating status:

Figure 10.33: LED “Status” illuminated

Meaning	Possible measure(s)
configuration not yet loaded (COM not yet ready for operation, e.g. immediately after power-up)	-

Table 10.38: LED “Status” illuminated

In case the LED “Status” flashes slowly, this indicates an error status:

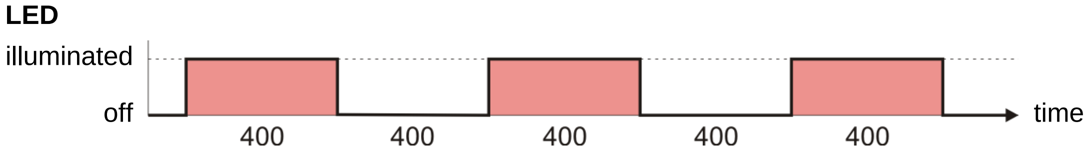


Figure 10.34: LED “Status” flashes slowly, time data in ms

Following errors occur only in case of a COM-xxx:

Meaning	Possible measure(s)
communication error to the AEB e.g. due to: 2 AEB boards have the same ID or configuration not correct AEB to be evaluated not in operation data from the AEB to be evaluated are not forward-ed failure of both networks in case of forwarding failure of both CAN buses	 amend configuration put AEB into operation configure forwarding check network connection check cables and terminating resistors on the CAN buses
defective AEB	replace AEB
no connection to the interlocking e.g. due to: failure of the interlocking failure of the network to the interlocking connection to the interlocking configured incorrectly	 check interlocking check network connection check configuration

Table 10.39: LED “Status” flashes slowly

In case the LED “Status” flashes fast, this indicates an error status:

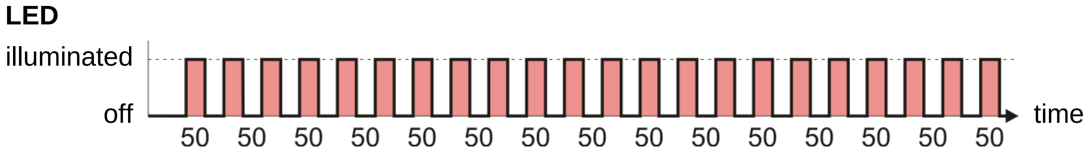


Figure 10.35: LED “Status” flashes fast, time data in ms

Meaning	Possible measure(s)
board error	see chapter “Error codes of the COM”

Table 10.40: LED “Status” flashes fast

In case the LED “Status” flashes shortly, this indicates a warning status:

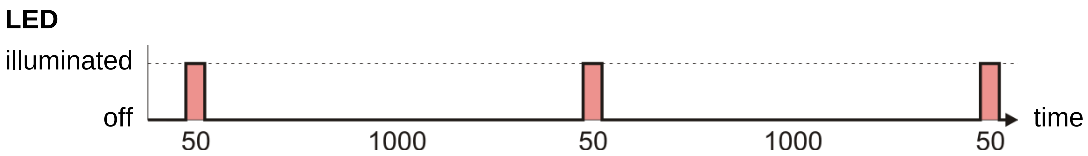


Figure 10.36: LED “Status” flashes shortly, time data in ms

Meaning	Possible measure(s)
warning status (operation not affected, but availability reduced) e.g. due to:	
not connected network	connect network
no CF card in the configuration server	insert CF card into configuration server
hotlink cable not connected	connect hotlink cable
defective hotlink cable	replace hotlink cable
failure of a CAN bus	check cables and terminating resistors on the CAN bus
failure of the redundant COM	check redundant COM, read out error code and proceed according to the “Possible measures” in the chapter “Error codes of the COM”

Table 10.41: LED “Status” flashes shortly

LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs)

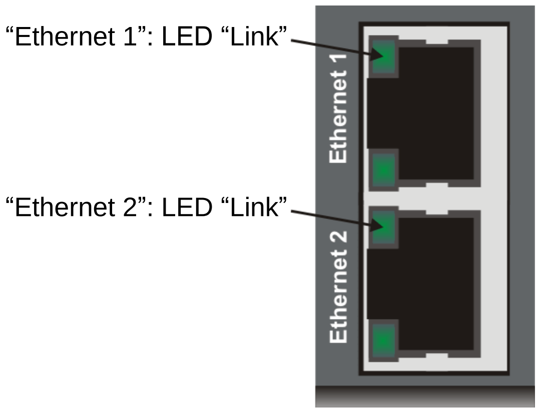


Figure 10.37: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs)

In case the LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) is off, this indicates an error status:

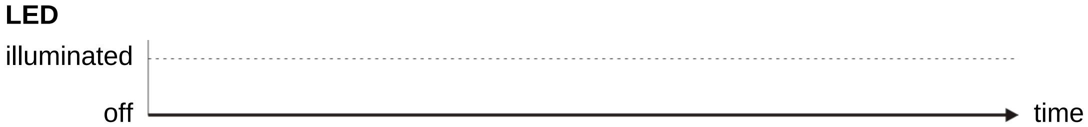


Figure 10.38: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) off

Meaning	Possible measure(s)
no connection to the next network component (switch, hub or network participant)	establish network connection

Table 10.42: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) off

In case the LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) is illuminated, this indicates an operating status:

Figure 10.39: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) illuminated

Meaning	Possible measure(s)
connection to the next network component (switch, hub or network participant) established	-

Table 10.43: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) illuminated

In case the LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) flashes, this indicates an operating status:

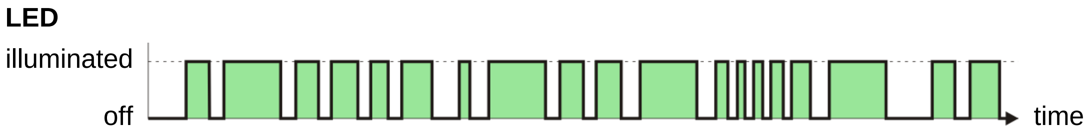


Figure 10.40: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) flashes, flashing behaviour depends on the amount of data

Meaning	Possible measure(s)
data transmission (The LED “Link” basically flashes when receiving data. In case of half duplex operation (connection via hub) the LED “Link” flashes also when sending data, because the data sent are received simultaneously.)	-

Table 10.44: LED “Link” (“Ethernet 1” and “Ethernet 2”, upper LEDs) flashes

LED “Speed” (“Ethernet 1” und “Ethernet 2”, lower LEDs)

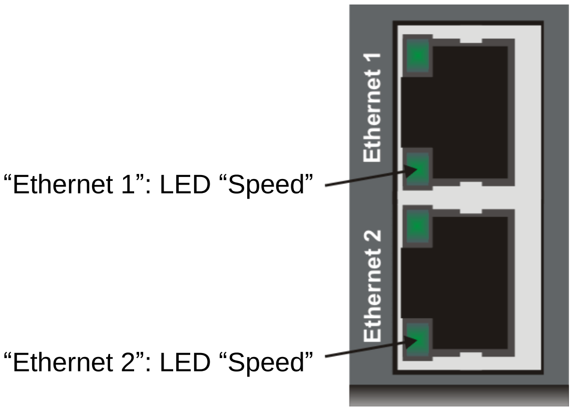


Figure 10.41: LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs)

In case the LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs) is off, this indicates an operating status:

Figure 10.42: LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs) off

Meaning	Possible measure(s)
data transmission speed of 10 Mbits/s	-

Table 10.45: LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs) off

In case the LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs) is illuminated, this indicates an operating status:

Figure 10.43: LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs) illuminated

Meaning	Possible measure(s)
data transmission speed of 100 Mbits/s	-

Table 10.46: LED “Speed” (“Ethernet 1” and “Ethernet 2”, lower LEDs) illuminated

10.2.5.2 Error codes of the COM

In case of an error or an invalid configuration, the COM outputs error codes that are described in the following table. The error codes can be read out with the diagnostic tools ASD and FDS. In case an error code regarding configuration occurs, the configuration must be amended by the project engineer. The error that has occurred first is indicated. If subsequent errors occur, then further measures might be necessary. If internal errors occur, then the stated possible measures must be carried out. An error code of the COM consists of a category (number in front of the slash) and an error code within this category (number behind the slash).

Error code	Meaning	Possible measure(s)
Category 1: Internal errors		
1 / 1 to 1 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 2: Internal errors		
2 / 1 to 2 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 3: Internal errors		
3 / 1 to 3 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 4: Internal errors		
4 / 1 to 4 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available

Error code	Meaning	Possible measure(s)
Category 5: Errors at the position of the DIP-switches		
5 / 1	not allowed DIP-switch position: no redundant operation + slave COM	amend DIP-switch positions
5 / 2	not allowed DIP-switch position of the DIP-switch without function (DIP-switch = ON)	amend DIP-switch position
5 / 3	error at the cyclic check of the DIP-switches (DIP-switches must not be changed during operation)	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
5 / 4	error at the cyclic channel comparison of the DIP-switches	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
5 / 5	DIP-switches of the board ID configured with '0'	amend DIP-switch positions
Category 6: Temperature monitoring		
6 / 1	environmental temperature too high	the local conditions have to be changed in such a way so that the predetermined environmental conditions are complied with
6 / 2	environmental temperature too low	the local conditions have to be changed in such a way so that the predetermined environmental conditions are complied with
Category 7: Errors during loading of the configuration file		
7 / 1	error during loading of the configuration: negative answer (configuration not available)	check CF card (configuration file available on the CF card, file name written correctly); configuration on the CF cards in case of redundant COM boards must be identical; recalculate CRC
	error regarding environmental temperature on the configuration server (see error codes 6 / 1 or 6 / 2)	the local conditions have to be changed in such a way so that the predetermined environmental conditions are complied with
	error code 8 / 25 at the configuration server	see "Possible measure(s)" of the error code 8 / 25

Error code	Meaning	Possible measure(s)
7 / 2	negative CRC answer (cyclic) during operation (configuration not available)	check CF card (configuration file available on the CF card, file name written correctly); configuration on the CF cards in case of redundant COM boards must be identical; recalculate CRC
	error regarding environmental temperature on the configuration server (see error codes 6 / 1 or 6 / 2)	the local conditions have to be changed in such a way so that the predetermined environmental conditions are complied with
	error code 8 / 25 at the configuration server	see “Possible measure(s)” of the error code 8 / 25
7 / 3	invalid CRC	recalculate CRC
7 / 4	wrong identification of component configured	amend configuration in the entry “COMPONENT” in the [PROTECTION] block
7 / 5	verification entry ≤ creation entry	amend configuration in the entries “VERSION” and “VERIFY” in the [PROTECTION] block: the value of “VERIFY” must be bigger than the value of “VERSION”; check spelling: 0xJJJJMMTThhmm
7 / 6	internal error	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 8: Errors in the contents of the configuration (configuration words)		
8 / 1	configuration word “IP switching” configured more than 1 time	amend configuration
8 / 2	IP switching is on in non-redundant operation	amend configuration in the configuration word “IP switching”: IP switching only possible in case of redundant operation
8 / 3	configuration word “Own IP address master COM for network 1” and/or “Own IP address master COM for network 2” configured more than 1 time or the number of the configuration words “Own subnet mask” is not correct (one subnet mask is required per network with configured ID)	amend configuration
8 / 4	configuration word “Own IP address slave COM for network 1 in redundant operation” and /or “Own IP address slave COM for network 2 in redundant operation” configured more than 1 time or the number of the configuration words “Own subnet mask” is not correct (one subnet mask is required per network with configured ID)	amend configuration

Error code	Meaning	Possible measure(s)
8 / 5	configuration word “Default gateway IP address” configured more than 1 time for network 1 and/or network 2	amend configuration
8 / 6	number of the configuration words “Gateway IP address”, “Gateway subnet mask Destination network” und “Gateway Destination network” is not the same (for gateway 1)	amend configuration
8 / 7	number of the configuration words “Gateway IP address”, “Gateway subnet mask Destination network” und “Gateway Destination network” is not the same (for gateway 2)	amend configuration
8 / 8	redundant IP addresses configured in non-redundant operation	amend configuration
8 / 9	redundant IP addresses configured when IP switching is on	remove configuration in the configuration word “IP switching” or “Own IP address slave COM for network 1 in redundant operation” and /or “Own IP address slave COM for network 2 in redundant operation”
8 / 10	more than 2 IP addresses configured in the configuration word “Destination IP address network 1 for internal forwarding” and/or “Destination IP address network 2 for internal forwarding” for this internal Destination ID (socket)	amend these configuration words
8 / 11	invalid value configured in the entry “SLCT_TIMEOUT” of the configuration word “Time-out FAdC”	amend this configuration word
8 / 12	not allowed value configured in the entry “TIMEOUT_VALUE” of the configuration word “Time-out FAdC” or used time-out not configured	amend this configuration word or configure the used time-out
8 / 13	configuration word “Forwarding diagnostic messages” configured more than 4 times	amend configuration
8 / 15	configuration word “Project number” configured more than 1 time	amend configuration
8 / 16	invalid value (< 2) configured in the entry “TIMEOUT_VALUE” of the configuration word “Time-out FAdC”	amend this configuration word
8 / 17	error code specific for COM-xxx	see technical documentation of the respective COM-xxx
8 / 18	entry “ID” of the configuration word “Forwarding axle counting data” configured with ‘0’	amend this configuration word
8 / 19	internal error	interrupt power supply by unplugging and plugging in the COM; in case the error persists, note the error code, consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available

Error code	Meaning	Possible measure(s)
8 / 20	the configuration word “Forwarding axle counting data” configured more than 30 times	amend configuration
8 / 21 to 8 / 22	internal error	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
8 / 23	too many internal Destination IDs (sockets) configured in the configuration word “Forwarding diagnostic messages”	amend this configuration word
8 / 24	ID configured 2 times in case the configuration word “Application data FAdC”[39] is used several times	amend this configuration word
8 / 25	different version of the configuration files on the configuration server (this error code is output only if the entry “CHECK_VERSION” in the configuration word “Project number” of the configuration server is configured with ‘1’.	amend configuration (all entries “VERSION” in the [PROTECTION] block must be identical)
8 / 26	maximum permitted number of AEB boards exceeded	amend configuration in the configuration word “Application data FAdC”[40]
8 / 27	(redundant) own IP address slave COM not in the same network as the own IP address master COM	amend configuration in the configuration words “Own IP address master COM for network 1” and/or “Own IP address master COM for network 2” and “Own IP address slave COM for network 1 in redundant operation” and/or “Own IP address slave COM for network 2 in redundant operation”
8 / 28	default gateway not in the same network as the own IP address	amend configuration in the configuration word “Own IP address master COM for network 1” and/ or “Own IP address master COM for network 2” and “Default gateway IP address”
8 / 29	gateway 1 not in the same network as the own IP address	amend configuration in the configuration word “Own IP address master COM for network 1” and/or “Own IP address master COM for network 2” and “Gateway IP address”
8 / 30	gateway 2 not in the same network as the own IP address	amend configuration in the configuration word “Own IP address master COM for network 1” and/or “Own IP address master COM for network 2” and “Gateway IP address”

39 error code specific for COM-xxx; see documentation of the respective COM-xxx

40 error code specific for COM-xxx; see documentation of the respective COM-xxx

Error code	Meaning	Possible measure(s)
8 / 31	Gateway Destination network (gateway 1): subnet mask does not match the network address	amend configuration in the configuration words “Gateway Destination network” and “Gateway subnet mask Destination network”
8 / 32	Gateway Destination network (gateway 2): subnet mask does not match the network address	amend configuration in the configuration words “Gateway Destination network” and “Gateway subnet mask Destination network”
8 / 33	UDP ports for internal communication are configured identically for multicast and unicast	amend configuration in the configuration word “UDP port internal communication”
8 / 34	more than only 1 Destination IP address per internal Destination ID (socket) is configured for multicast	amend configuration in the configuration word “Destination IP address network 1 for internal forwarding” and/ or “Destination IP address network 2 for internal forwarding”
8 / 35	own IP address master COM for network 1 and/or network 2 is a multicast address	amend configuration in the configuration word “Own IP address master COM for network 1” and/or “Own IP address master COM for network 2”
8 / 36	own IP address slave COM for network 1 and/or network 2 in redundant operation is a multicast address	amend configuration in the configuration word “Own IP address slave COM for network 1 in redundant operation” and/or “Own IP address slave COM for network 2 in redundant operation”
8 / 37	Destination IP address for multicast is in the not-allowed range	amend configuration in the configuration word “Destination IP address 1 for internal forwarding” and/or “Destination IP address network 2 for internal forwarding”
8 / 38	error code specific for COM-xxx	see technical documentation of the respective COM-xxx
8 / 39	not used	-
8 / 40	error code specific for COM-xxx	see technical documentation of the respective COM-xxx
8 / 41	UDP-Port 65 535 was configured for internal communication	amend configuration in the configuration word “UDP port internal communication”
8 / 42	error code specific for COM-xxx	see technical documentation of the respective COM-xxx
8 / 43	switchover time in case of IP switching < 1 s or > 600 s	amend configuration in the configuration word “Switchover time in case of IP switching”
8 / 44	internal error	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available

Error code	Meaning	Possible measure(s)
8 / 45	internal error	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 9: Internal errors		
9 / 1 to 9 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 10: Internal errors		
10 / 1 to 10 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available
Category 11: Internal errors		
11 / 1 to 11 / 255	internal errors	note the error code; interrupt power supply by unplugging and plugging in the COM; in case the error persists consult Frauscher and if necessary send the board back to Frauscher; replace the defective COM if another COM of the same type is available

Table 10.47: Error codes of the COM

10.2.5.3 Error codes regarding the CF card

The error codes regarding the CF card can be read out with the diagnostic tools ASD and FDS.

Error code	Meaning	Possible measure(s)
1	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
2	CF card not formatted	format CF card
3	invalid directory (folder for the configuration files misnamed or folder name misspelled)	folder must be named "CONFIG"
4	invalid folder name of configuration file (file misnamed or file name misspelled)	file name must be structured as follows and written without spaces between the single elements: • "C" (as capital letter) • ID of board (4-digit in decimal notation with leading zeros) • "_" (underscore) • "00" (2 zeros in decimal notation) • "." (full stop) • ADC (file extension in capital letters)
5	no configuration file available	save configuration file on CF card
6	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
7	full storage of CF card	increase storage capacity or use CF card with a larger storage
8 to 11	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
12	configuration file cannot be opened (already opened otherwise)	save configuration file again on CF card
13	COM cannot access CF card	save configuration file again on CF card, reformat CF card

Error code	Meaning	Possible measure(s)
14 to 15	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
16	CF card was removed	insert CF card in COM
17	CF card defective	replace defective CF card with new one
18	CF card defective	replace defective CF card with new one
19	file system damaged	reformat CF card
20	CF card defective	replace defective CF card with new one
21	not supported CF card	use CF cards recommended by Frauscher
22 to 23	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
24	file system not supported (CF card formatted with FAT12 or NTFS)	format CF card with FAT16 or FAT32
25 to 26	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
27	CF card formatted incorrect	format CF card with FAT16 or FAT32
28	internal error	interrupt power supply by unplugging and plugging in the COM; format the CF card and save the configuration on the CF card; in case the error persists consult Frauscher
29	configuration file cannot be opened	save configuration file again on CF card

Table 10.48: Error codes regarding the CF card

10.2.6 Troubleshooting on the BP-PWR

Troubleshooting can be carried out via the LED display on the front panel of the AEB. Further information can be taken from the chapter “LED indications on the AEB”.

LED indication	Meaning	Possible measure(s)
LED “B1” and/or “B2” on the AEB illuminated	communication error on the CAN bus due to:	
	incorrect DIP-switch setting of the DIP-switches “OUT TERMINATION” and “IN TERMINATION” on the BP-PWR (not set to “ON”, see chapter “CAN bus”)	set DIP-switches to “ON”
LED “Sys1” and “Sys2” on the AEB flashing	communication failure between AEB and RSR due to:	
	loose plugs on the BP-PWR	check plugs on the BP-PWR

Table 10.49: Troubleshooting on the BP-PWR

10.2.7 Troubleshooting on the BP-EXB

Troubleshooting can be carried out via the LED display on the front panel of the AEB and/or via the LED display and the display of the IO-EXB. Further information can be taken from the chapter “LED indications on the AEB”.

LED indication	Meaning	Possible measure(s)
LED “B1” and/or “B2” on the AEB illuminated	communication error on the CAN bus due to:	
	incorrect setting of the DIP-switch “OUT TERMINATION” on the BP-EXB (not set to “ON”, see chapter “CAN bus”)	set DIP-switch to “ON”
all LEDs on the IO-EXB illuminated (IO-EXB display is off)	soldering jumpers (“LB-EXB1”/“LB-EXB1‘ ” to “LB-EXB7”/“LB-EXB7‘ ”) for the IO-EXB on the BP-EXB not closed, see chapter “Soldering jumpers on the backplane BP-EXB”	close soldering jumpers

Table 10.50: Troubleshooting on the BP-EXB

10.2.8 Measurements at BSI004

- Voltage metering between the clamps E3 and E4:
  12 to 28 V DC (with connected wheel sensor RSR180)
  In case the measured value is outside of the stated range, the overvoltage protection board is defective and must be replaced.

- Current measurement at the wire E3:
  57 to 65 mA (with connected wheel sensor RSR180)
  In case the measured value is outside of the stated range, the overvoltage protection board or the wheel sensor is defective and must be replaced.

10.2.9 Measurements at BSI005

- Voltage metering between the clamps E1 and E2:
  24 to 31 V DC (with connected wheel sensor RSR123)
  In case the measured value is outside of the stated range, the overvoltage protection board is defective and must be replaced.

- Voltage metering between the clamps E3 and E4:
  24 to 31 V DC (with connected wheel sensor RSR123)
  In case the measured value is outside of the stated range, the overvoltage protection board is defective and must be replaced.

10.2.10 Measurements at trackside connection box GAK with connected RSR180

After opening the cover of the trackside connection box, the current is measured on the wires and the voltage is measured on the clamps.

Following values must be complied with:

- current in wire 1 and/or 2: 2,8 to 5 mA (Vignole rail)
  2,8 to 6 mA (grooved rail)
- current in wire 3: 57 to 65 mA
  If the current is < 57 mA, the loop resistance must be checked.

- voltage between wire 3 and 4: 12 to 14 V
  If the voltage is < 12 V DC, the loop resistance must be checked.

The maximum loop resistance of the cable from the trackside connection box GAK to the backplanes BP-PWR/BP-EXB is 250 Ω.

10.2.11 Measurements at trackside connection box GAK with connected RSR123

After opening the cover of the trackside connection box, the current is measured on the wires and the voltage is measured on the clamps.

Following values must be complied with:

- current in wire 1 and/or 3: 4,75 to 5,25 mA

- voltage between wire 1 and 2 (system 1): 12 to 31 V DC
  voltage between wire 3 and 4 (system 2): 12 to 31 V DC
  If the voltage is < 12 V DC, the loop resistance must be checked.

The maximum loop resistance of the cable from the trackside connection box GAK to the backplanes BP-PWR/BP-EXB is 500 Ω.

10.2.12 Troubleshooting at the wheel sensor

10.2.12.1 Wheel sensor mounting

The wheel sensor mounting of the respective wheel sensor must be checked according to the documentations D1414 “Mounting and commissioning of wheel sensor type RSR180” and/or D1916 “Mounting, commissioning and maintenance manual wheel sensor type RSR123”.

10.2.12.2 Error codes when adjusting the wheel sensor

When adjusting the wheel sensor, the AEB outputs error codes in case of an error, which are shown in the following table. The error codes can be read out with the diagnostic tools ASD and FDS. Furthermore, these errors are displayed on the LEDs “Sys1” and/or “Sys2” of the AEB. At first, the LEDs flash fast for 2 s, then the LEDs flash slowly whereas the number of the slow flashing corresponds to the number of the error code.

Error code	Meaning	Possible measure(s)
1	error in adjacent channel	read out the error code in the adjacent channel
2	wrong actuation sequence on the toggle switches on the front panel of the AEB	carry out the actuation sequence of the toggle switches correctly
3	RSR123: adjustment failed	check mounting of wheel sensor, correct it if necessary, carry out adjustment again
4	adjustment attempt at an AEB, which has not been configured yet	carry out adjustment only at the configured AEB
	actuation of a reset via toggle switches on the front panel of the AEB, however axle counting not configured	amend configuration
	duration of the actuation sequence of the toggle switches > 30 s	carry out actuation sequence of the toggle switches correctly
5	adjustment took place only at 1 channel	carry out adjustment again
6	RSR180: harmonics (the wheel sensor signal is overlapped by disturbing signals)	determine and rectify cause (carry out measures) and if necessary consult Frauscher
7	RSR180: difference of both sensor currents too big, e.g. due to:	
	metal parts under the wheel sensor	remove metal parts
	wheel sensor mounting incorrectly	mount wheel sensor correctly
	defective wheel sensor	replace wheel sensor

Error code	Meaning	Possible measure(s)
8	RSR180: at least one sensor current too small or too big, e.g. due to:	
	wire short-circuit	rectify wire short-circuit
	wheel sensor connected incorrectly	connect wheel sensor correctly
	wheel sensor mounting incorrectly	mount wheel sensor correctly
9	RSR180: current source error due to:	
	cable too long	check cable length
	wire short-circuit in the cable	rectify short-circuit
10	internal error	consult Frauscher and if necessary send the wheel sensor back to Frauscher

Table 10.51: Error codes when adjusting the wheel sensor

10.2.12.3 Error codes of the wheel sensor RSR123

The AEB outputs error codes in case of an error of the wheel sensor RSR123, which are shown in the following table. The error codes can be read out with the diagnostic tools ASD and FDS.

Error code	Meaning	Possible measure(s)
Bit 0	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 1	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 2	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 3	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 4	RSR123 dropped off the rail	check mounting of wheel sensor and correct it if necessary, carry out adjustment again
Bit 5	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 6	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 7	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 8	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 9	hardware error	consult Frauscher and if necessary send the wheel sensor back to Frauscher
Bit 10	0 (reserved bit), no error	-
Bit 11	0 (reserved bit), no error	-
Bit 12	adjustment failed	check mounting of wheel sensor and correct it if necessary, carry out adjustment again
Bit 13	check of occupancy detection capability not passed	check mounting of wheel sensor and correct it if necessary, carry out adjustment again
Bit 14	check of overcurrent detection capability not passed	check mounting of wheel sensor and correct it if necessary, carry out adjustment again
Bit 15	0 (reserved bit), no error	-

Table 10.52: Error codes of the wheel sensor RSR123

10.3 Replacement of components

The protective provisions according to chapter “General protective provisions” and the details in the chapter “Handling of boards” must be observed.

10.3.1 Replacement of PSC

A defect PSC can be replaced by a new PSC. No further checks are necessary.

10.3.2 Replacement of AEB

In case of a replacement of an AEB or after a fault, it must be checked after recommissioning if all functions undertaken by this board are carried out correctly. In case of replacement of an AEB with double usage, the reset of both (adjacent) track sections (FMA) is required. In case of unknown failure cause, the AEB and the associated overvoltage protection board BSI are to be replaced and forwarded to Frauscher for checking.

SAB FAdC100_196:

During the replacement of an AEB, the following checks and/or actions must be carried out:

- check congruity of all DIP-switch positions on the new AEB with the DIP-switch positions on the defective AEB
- if connecting an RSR180: adjust the AEB
- measure the sensor currents on the test sockets of the AEB
- check occupancy detection capability of both sensor systems

SAB FAdC100_192:

An adjustment of the AEB to the sensor currents of the wheel sensor RSR180 must be carried out in case of

- replacement of a wheel sensor,
- re-mounting of a wheel sensor, which was dismounted due to track works,
- change of the cable connection and
- change of mounting position.

Afterwards, the occupancy detection capability of both sensor systems must be checked.

10.3.3 Replacement of IO-EXB

A defective IO-EXB can be replaced by a new IO-EXB. No further checks are necessary.

10.3.4 Replacement of COM

In case of replacement of a COM (respectively, also in case of replacement of a defective CF card), it must be observed that the used CF card contains the correct configuration according to the design and planning documents. If there are no configuration files available, they must be regenerated according to the design and planning documents for the FAdC and must be saved on the CF card. In this case, the checks according to chapter “Commissioning” must be carried out.

SAB FAdC100_197:

During the replacement of a COM, the following must be carried out:

- check congruity of all DIP-switch positions on the new COM with the DIP-switch positions on the defective COM
- insert the CF card of the defective COM into the new COM
- insert the Hotlink connection in case of redundant COM boards

SAB FAdC100_203:

After the replacement of a CF card, the following must be carried out:

- reading out the configuration version, the CRC of the configuration and the type protection code of the AEB boards
- reading out the configuration version and the CRC of the configuration of the COM boards

10.3.4.1 Replacement of redundant COM boards

In case of replacement of redundant COM boards, the following must be observed:

- Remove the defect COM from the board rack BGT and only afterwards unplug the Hotlink cable from the Hotlink socket.
- Insert the new COM into the board rack and plug the Hotlink cable again.

In case of replacement of CF cards in redundant COM boards, the following must be observed:

- The Hotlink cable of the redundant COM boards must be plugged into the Hotlink sockets.

SAB FAdC100_172:

If using a redundant configuration server (2 COM boards), it must be checked if the Hotlink cable is plugged in and if the Hotlink connection works.

10.3.5 Replacement of BP-PWR and BP-EXB

When replacing a backplane BP-PWR and/or backplane BP-EXB, the boards must be plugged in again as before. The correct order must be checked.

The status of the soldering jumpers (open or closed) must be checked according to the design and planning documents.
The DIP switches on the backplanes must be set again as before.

When replacing a BP-PWR or a BP-EXB, the plug socket coding of the AEB must be carried out again.

The external interfaces “counting head outputs” and “wheel sensors” on the rear side of the backplanes must be wired again as before.

In order to ensure this, it is recommended to uniquely label the connectors for the external interfaces and for the cable housings (only on the BP-EXB) or that the assignment of the external interfaces and cable housings to their plug sockets is documented in such a way that, so that they are traceable in case of a replacement of a backplane.

SAB FAdC100_198:

During the replacement of the backplane BP-PWR, the following must be carried out:

- check of the assignment of the wheel sensor connectors according to the design and planning documents
- check of the assignment of the boards in the board rack according to the design and planning documents
- check of the assignment of the counting head outputs according to the design and planning documents

If these checks are not possible, then the following must be carried out:

- check of the assignment of every wheel sensor to the associated AEB
- check of the assignment of the counting head outputs and the safety system

SAB FAdC100_199:

During the replacement of the backplane BP-EXB, the following must be carried out:

- check of the assignment of the cable housings (switching outputs and switching inputs) according to the design and planning documents

If this check is not possible, then the following must be carried out:

- check of the assignment of the switching outputs and the switching inputs as well as of the safety system

10.3.6 Replacement of overvoltage protection board BSI

SAB FAdC100_195:

After the replacement of a defective overvoltage protection board (BSI), the sensor currents and the occupancy detection capability of the associated wheel sensor on the associated AEB must be checked.

11 Removal from service

Decommissioning and disposal

Defective components, which are not returned to the manufacturer according to chapter “Handling of boards”, are to be disposed in correspondence to the national regulations. Planning and performance of a decommissioning as well as the disposal of components and parts fall under the responsibility of each railway operator. If one or more components of a safety system are decommissioned, the operator is responsible to maintain the safety of the operation with appropriate measures.