D10041-01-2

Part I

Outline of documents

(Table of Contents, Bibliography, Definitions, Abbreviations)

Documentation of axle counting system

ACS2000

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Prepared:	J. Böttger	sign. Böttger	2012-04-16	**Part I: Outline of documents - Axle counting system ACS2000**	Classified
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Masthead

This document is the translation of the German original.

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D2799	Technical documentation for evaluation board IMC with RSR180	x			
D1912	Mounting of rail claw SK420	X		X	X

4 Standards, bibliography

[ ]	designation		issue
[1]	**Mü8004**	Technical principles for the licensing of safety installations	01.01.1999
[2]	**EN 60721-3-1**	Classification of environmental conditions/long-term storage	March 1997
[3]	**EN 60721-3-2**	Classification of environmental conditions/transportation	March 1997
[4]	**EN 60721-3-3**	Classification of environmental conditions/stationary installation, weatherproof	January 1995
[5]	**EN 60721-3-4**	Classification of environmental conditions/stationary installation, weatherproof	February 1995
[6]	**DIN 40050**	IP protection classes, protection of electrical equipment against accidental contact, foreign bodies and water ingress	May 1993
[7]	**EN 50121-4**	Railway applications, electromagnetic compatibility	March 2000
[8]	**EN 50124-1**	Railway applications, coordination of insulation	March 2001
[9]	**EN 50159-1**	Safety-relevant communication in closed-circuit transmission systems	March 2001
[10]	**EBO**	German federal regulation for the construction and operation of railways	1992
[11]	**EN 60715**	Dimensions of low-voltage switchgear and controlgear - Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations	2001
[12]	**UIC 790**	Use of axle counters	1975
[13]	**EN 50126**	Railway applications - The specification and demonstration of reliability, availability, maintainability and safety (RAMS)	1999
[14]	**EN 50128**	Railway applications - Communications, signalling and processing systems - Software for railway control and protection systems	2001
[15]	**EN 50129**	Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling	2004
[16]	**DIN 41612**	Special contacts for multi two-part connectors	1989
[17]	**DIN 41652**	Rack and panel connectors	1990
[18]	**IEC 60050**	International Electrotechnical Vocabulary	1990

5 Supporting documents

document	
D1413-2	Application guide for wheel sensor RSR180
D1414-3	Mounting and commissioning of wheel sensor RSR180
D2346-2	Mounting instructions for overvoltage protection BSI004
D2799-2	Technical documentation for evaluation board IMC and RSR180
D1912	Mounting of rail claw SK420

6 Definitions

Argument	Safety-related or non safety-related information, order or message that is transmitted to another interlocking with the aid of the input/output board (DIOB) and a modem.
Permanent voltage	Effective value of a withstand voltage that describes the typical, long-term resistance of the corresponding insulation [8].
Transient overvoltage	Short-term overvoltage of a few milliseconds or less, caused by current coupling (in line with "EN 50124-1" [8]).
Occupied	Status of an axle counting system when at least one wheel sensor system is occupied, when one or more axles are located in the track section or when the axle counter is faulty.
Double usage	Use of a shared counting head in two adjacent track sections. Double usage occurs by evaluating additional galvanically isolated, independent optocoupler outputs.
Basic reset	Reset if no reset restriction is present (can generally be carried out by the operating personnel).
Advanced reset	Reset (pre-reset) if a reset restriction is present (can generally be carried out by safety/operating personnel).
Clear	Status of the axle counter following a successful reset (basic or advanced) or when all axles counted in on the track section have been counted out again and no fault is present.
Track section (FMA)	Section grid between the counting heads belonging to an axle counter. Can be a track of point, a junction or a combination of all three elements.
Track section occupied	Status of an axle counter when at least one wheel sensor system is occupied, when one or more axles are located in the track section or when the axle counter is faulty.
Reset restriction	A basic reset is prevented due to technical situations (e.g. safety-relevant fault on the axle counting board) or operational situations (e.g. last axle counted in).
Top hat rail	TYPE TS35 x 7.5 drilled [11]
Commissioning	Test on a unit carried out on site, to prove that it is correctly installed and can operate correctly [18] (151-16-24).
Maintenance	Combination of all technical and administrative actions, including supervision measures, in order to retain an item in, or restore it to, a state in which it can perform a required function [18] (191-07-01).

Maintenance (corrective)	Maintenance carried out after fault recognition in order to put an item into a state in which it can perform a required function. Synonym: Repair [18] (191-07-08).
Repair	The maintenance carried out after fault recognition in order to put an item into a state in which it can perform a required function. Synonym: corrective maintenance [18] (191-07-08).
Maintenance (preventative)	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 a unit. Synonym: Servicing [18] (191-07-07).
Isolated operation	Monitoring of a track section by an axle counting board (ACB). All counting heads associated with the track section are connected to an axle counting board.
Minor error	A minor error can be rectified with a basic reset.
Modem operation	Monitoring of a track section by two axle counting boards (ACB). The exchange of the counting head information is carried out via a modem connection or via a null-modem cable in the case of very short sections (in the same operating location). Modem operation is required for longer track sections or to reduce the amount of cabling in outdoor equipment or to create a gridiron with more than 6 counting heads (12 maximum).
Serious error	A serious error can be rectified with an advanced reset.
Subsystem	Two subsystems are required for modem operation. The two subsystems are connected with one another via two modems or over very short sections (within the same operating location) without modems and with a null-modem cable.
Maintenance	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 a unit. Synonym: preventative maintenance [18] (191-07-07).
Counting head	In functional terms, a counting head consists of a wheel sensor and an evaluation board.
Counting head occupied	One or more counting head systems of a counting head report an occupied status.
Counting head system	A counting head consists of two sensor systems designated as Sys1 and Sys2.

7 Abbreviations

ABP	**A**xle counting **b**ack**p**lane
ACB	**A**xle **c**ounting **b**oard
ACS	**A**xle **c**ounting **s**ystem
BGT	board rack
BSI	overvoltage protection board for indoor equipment
DIOB	**D**igital **i**nput/**o**utput **b**oard
Dir/Dir`	**Dir**ection inversion and/or addressing DIP-switch for channels 1 and 2
DN/DN`	**DN-**DIP switch for channel 1 and channel 2 (for Double Usage)
EB	**E**valuation **B**oard (general abbreviation for evaluation board)
EdB	**E**isenbahnen **d**es **B**undes (German Federal Railways)
EMC	**E**lectro **M**agnetic **C**ompatibility
EN	European standard
ESTW	electronic interlocking
Fdl	traffic controller
Fm	clear indication relay contact
FMA	track section
GAK	trackside connection box
GE	reset restriction
GS	equipment version
HE	height unit (one height unit = 44.45 mm)
IMC	evaluation board with microcontroller (**i**ntegrated **m**icro**c**ontroller evaluation board)
KA	cable terminating frame
P	test relay contact
RSR180	wheel sensor type RSR180
SAB	safety-related application conditions
SIC	fuse board with crowbar driver
PLC	**P**rogrammable **l**ogic **c**ontroller
Stw	interlocking
Sys	sensor **Sys**tem of a wheel sensor
TE	pitch unit (one pitch unit = 5.08 mm)

ZP	counting head (**Z**ähl**p**unkt) (wheel sensor)

Only general abbreviations are used in this chapter. The exact designations of the boards can be found in Part V "Types of boards" and Part XII "Board specifications".

8 Your opinion matters

With your comments and suggestions you assist us in our aim of continually improving the quality and practical relevance of the documentation.

Please send suggestions for improvement to:

documentation@frauscher.com

Thank you for your feedback.

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FRAUSCHER
SENSOR TECHNOLOGY

D10041-02-2

Part II

System description

of the axle counting system

ACS2000

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Masthead

This document is the translation of the German original.

1 Functional description

1.1 General

The prerequisite for railway operation is ensuring safety. Safety systems create a protected area for rolling stock in track sections, where these vehicles can move around safely.

The microcomputer system that has been developed especially for this application forms the basis for the safe functioning of the ACS2000. It checks all safety-relevant messages and processes these over two channels.

The microcomputer system consists of two channels independent of one another, however the hardware is set up in an identical manner. The channels are supplied in parallel with the same input information and they always process the same tasks due to the identical set-up; therefore the requested output information is generated over two channels. Two comparing systems independent of one another only permit the output of the clear status when both results match up.

1.2 Designated use

The ACS2000 axle counting system is used for the safe monitoring of a track section.

With the ACS2000 axle counting system, the clear and occupied indications can be generated by a track section. The clear and occupied statuses are output by the voltage-free relay contacts.

The axle counting board ACB is able to evaluate counting head information provided by up to 6 independent evaluation boards.

For adjacent track sections, the counting head can be doubled at the separation and can even have a triple use depending on the configuration.

When using the IMC evaluation board, depending on the type, either a triple usage, a direction output or a counting head control may be present.

The ACS2000 axle counting system can be used both in isolated operation and in modem operation.

If the axle counting system is used in modem operation, an additional 16 digital arguments (e.g. information, messages, orders) can be transmitted bidirectionally via a modem. The arguments are input via the optocoupler and output via the voltage-free relay contacts.

The ACS2000 axle counting system has a modular construction and consists of the following components/boards in the complete version:

- outdoor equipment

  wheel sensor RSR

  rail claw with clamping bolts and protection tube

  trackside connection box GAK

- indoor equipment

  overvoltage protection board BSI

  board rack BGT

  backplane ABP

  fuse board SIC

  evaluation board EB

  axle counting board ACB

  DIOB input/output board (optional for modem operation)

Thanks to various software types, different reset procedures are available (see Part V "Types of boards").

1.3 Operating principle

At the start and end of each track section, there is a wheel sensor that acts as a counting head together with the evaluation board. This records all the axles of rolling stock travelling on this track and also their direction of travel, using two electronic sensor systems. Each wheel sensor is connected to an evaluation board by a four-wire signal cable. This connection provides the power supply to the wheel sensor and transmits the axle information to the evaluation board.

The ACB axle counting board of the axle counting system summarises the axle information from all connected counting heads into an overall result and compiles a clear or occupied indication for the relevant track section on the basis of this, which is output via the voltage-free relay contacts.

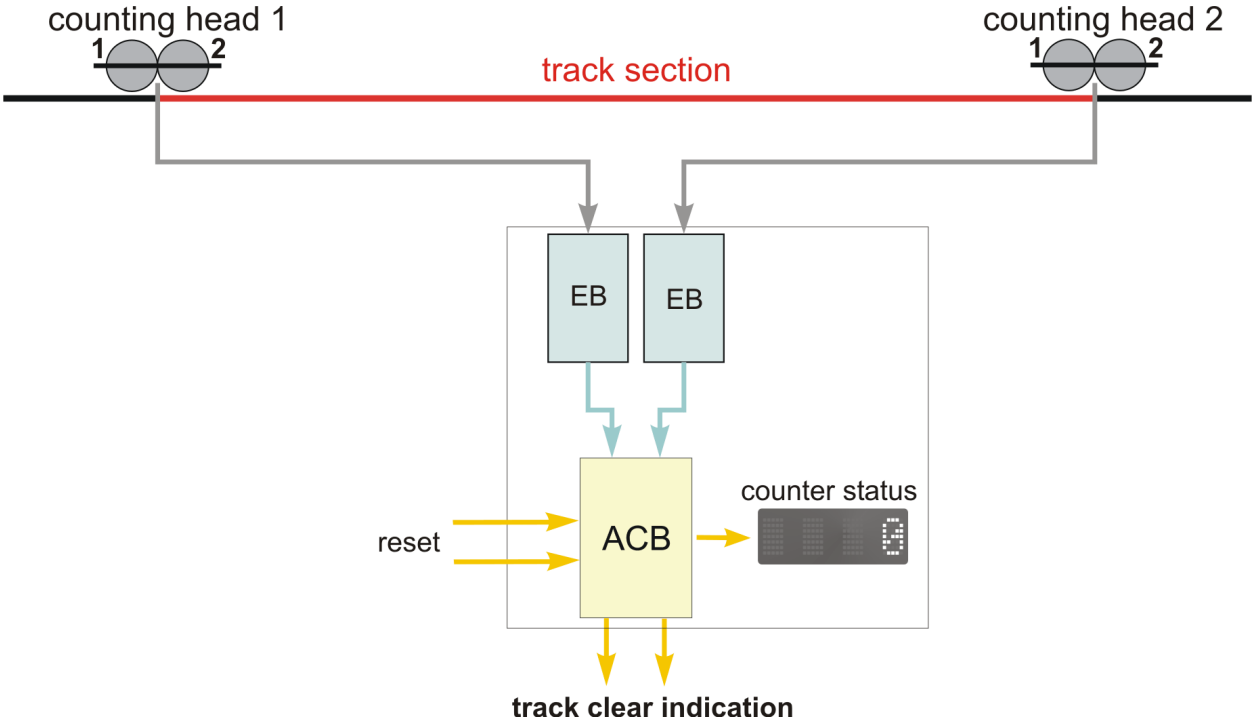


Figure 1.1: The ACS2000 block diagram in isolated operation (example)

For the defined reset of the axle counting system, the ACB axle counting board provides inputs for switching on the axle counting reset toggle switches.

Two toggle switches for "pre-Reset" are located on the front panel of the ACB axle counting board.

1.4 Block diagrams for the complete system (example)

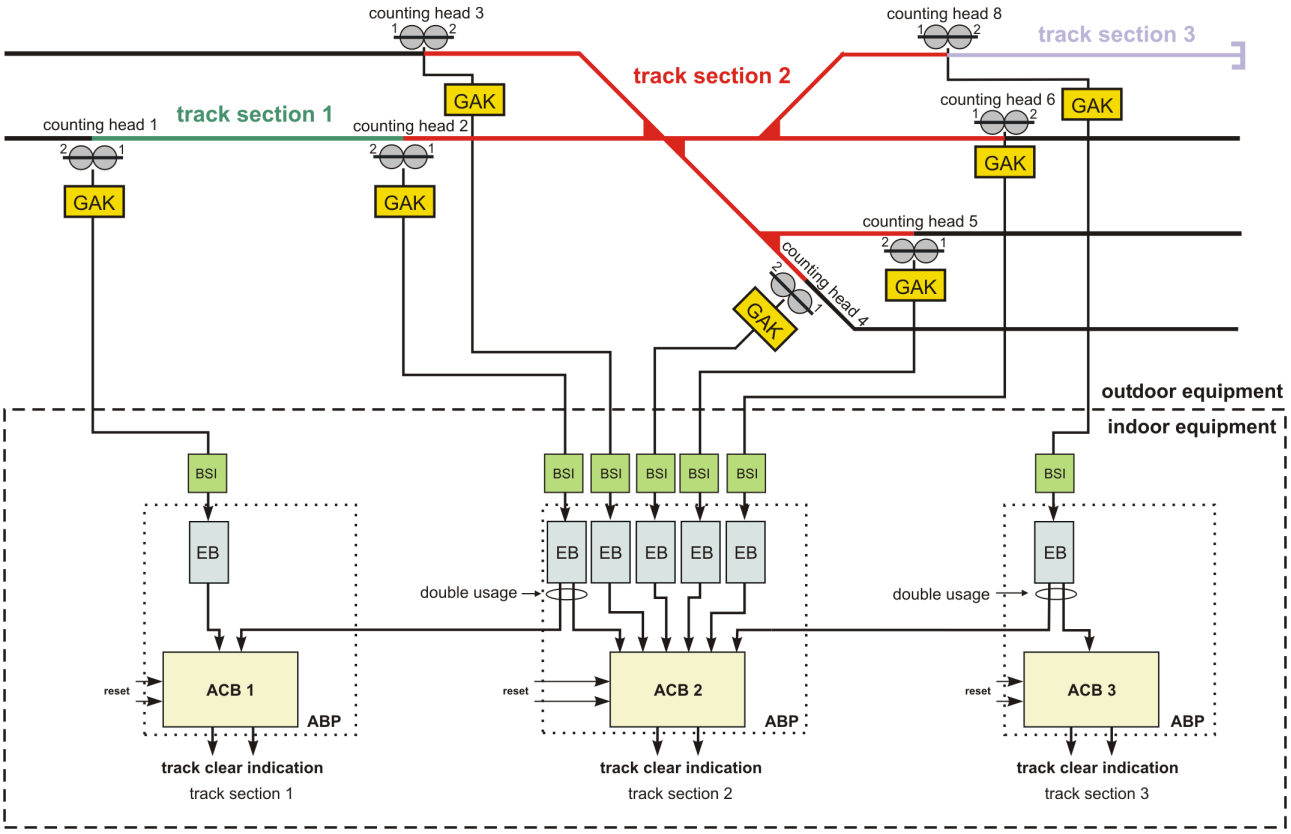


Figure 1.2: The ACS2000 block diagram in isolated operation (example)

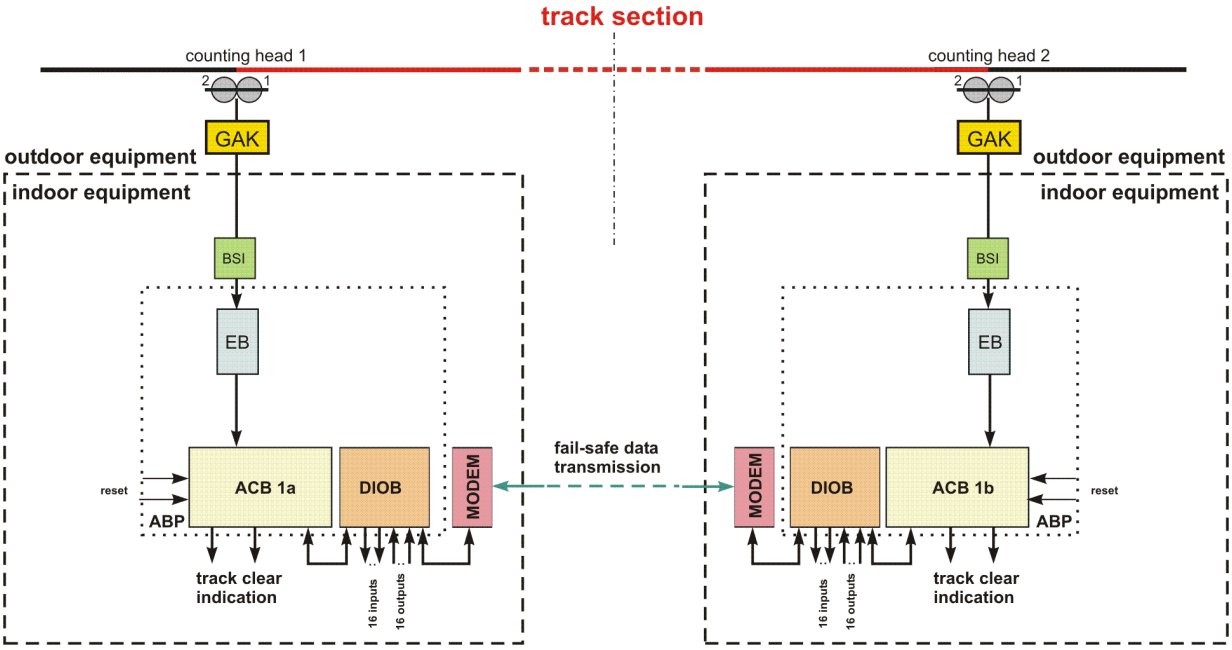


Figure 1.3: ACS2000 block diagram in modem operation with DIOB (example)

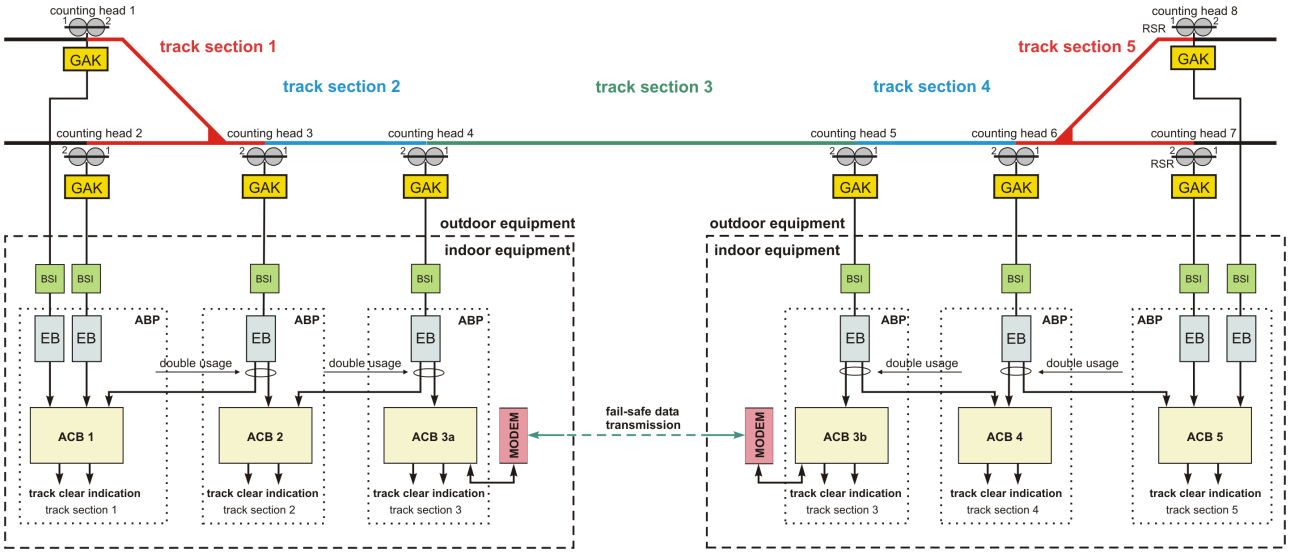


Figure 1.4: ACS2000 block diagram in modem operation without DIOB (example)

2 Brief description of the system components

2.1 Evaluation board IMC

The evaluation board IMC is used to supply and evaluate a wheel sensor with two sensor systems. The output switching signals are forwarded via the backplane ABP to the ACB axle counting board.

Description of the front panel elements

Display when illuminated/operating elements whilst actuated:

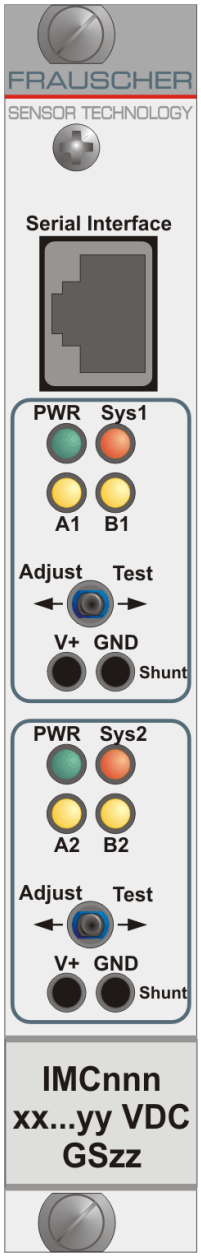


Figure 2.1:
Front panel of the evaluation board IMC

Serial Interface .....serial interface
IMC GS01: not in use;
IMC GS03: Diagnostic connection

PWR.....supply voltage channel 1 present

Sys1 .....system 1 occupied (illuminated) or faulty (flashes)

A1.....output direction 1 [1]

B1.....output system 1 [1]

Adjust .....required for IMC adjustment

Test .....required to adjust IMC/simulate an occupancy of system 1

V+, GND.....2 mm test sockets, voltage corresponds to the analogue wheel sensor current via a 100 Ω shunt

PWR.....supply voltage channel 2 present

Sys2 .....system 2 occupied (illuminated) or faulty (flashes)

A2.....output direction 2 [1]

B2.....output system 2 [1]

Adjust .....required for IMC adjustment

Test .....required to adjust IMC/simulate an occupancy of system 2

V+, GND.....2 mm test sockets, voltage corresponds to the analogue wheel sensor current via a 100 Ω shunt

Type key:

nnn .....board identification code beginning with 001

xx..yy .....operating voltage range

zz .....version beginning with 01

The evaluation board IMC requires a range of 4 TE in the board rack.

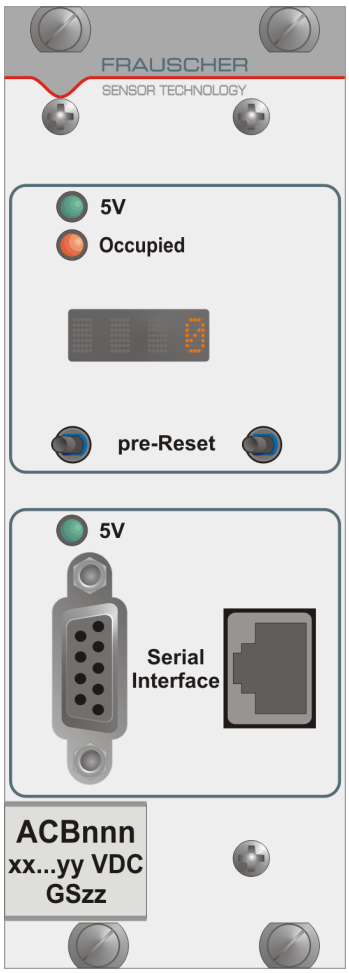
[1] The LEDs can fulfil other software related functions (see software and type related documentation)

2.2 Axle counting board ACB

The axle counting board ACB is used to process the counting head information provided by the evaluation boards. The clear/occupied status of the track section to be monitored is determined based on information from the evaluation boards and provided to the "clear/occupied" interface via the voltage-free relay contacts. The maximum number of axles in the track section is 8191.

Description of the front panel elements

Displays when illuminated/operating elements whilst actuated:



5 V..... voltage supply channel 1 present

Occupied..... track section occupied (LED illuminated)/faulty (LED flashes)

Display..... number of axles / information on status (error)

pre-Reset..... elimination of the reset restriction (actuated: causes the same function as HIGH level at the "pre-Reset" inputs)[2]

5 V..... voltage supply channel 2 present

Serial Interface..... D-SUB socket / RJ45 socket[2]

Type key:

nnn..... board identification code beginning with 001
xx...yy..... operating voltage range
zz ..... version beginning with 01

Figure 2.2:
Front panel of the axle counting board ACB

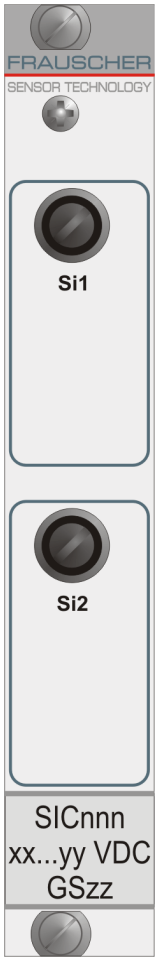
The axle counting board ACB requires a range of 9 TE in the board rack.

2 see Part IV "Project planning and construction"

2.3 Fuse board SIC

The fuse board SIC is used to protect the supply voltage for the ACS2000.

Description of the front panel elements



Si1..... fuse for the supply voltage of channel 1

Si2..... fuse for the supply voltage of channel 2

Type key:

nnn..... board identification code beginning with 001
xx...yy..... operating voltage range
zz.....version beginning with 01

Figure 2.3:
Front panel of the fuse board SIC

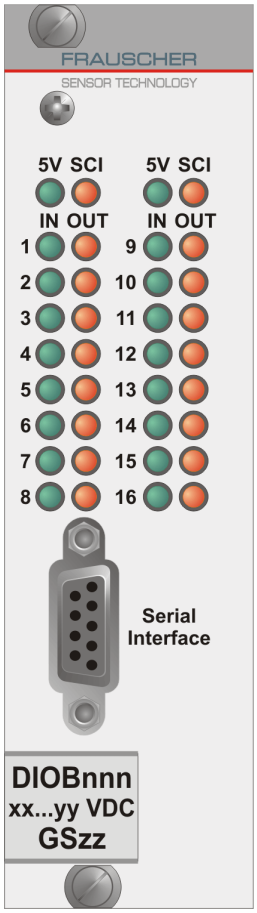
The fuse board SIC requires a range of 4 TE in the board rack.

2.4 Digital input/output board DIOB

The digital input/output board DIOB is used to transmit digital information via a modem. For non safety-related applications, up to 16 arguments can be transmitted; for safety-related applications up to 8 arguments can be transmitted. For a safety-related application of the DIOB, the inputs and outputs of both channels must be linked to one another accordingly (see Part IV "Project planning and construction"). The DIOB can only be used in modem operation and only works in combination with an ACB. The information of the DIOB is independent and in addition to axle counting information. Arguments (switching statuses) are input via an optocoupler, transmitted in series and output at the receiver via voltage-free relay contacts. The LEDs on the front panel of the board provide information regarding the status of the input/output.

Description of the front panel elements

Display illuminated:



5V.....voltage supply channel 1 present
SCI..... serial connection present
IN.....HIGH signal present at the relevant input
OUT.....relay contact closed at the relevant output

5V.....voltage supply channel 2 present
SCI..... serial connection present
IN..... HIGH signal present at the relevant input
OUT.....relay contact closed at the relevant output

Serial Interface..... D-SUB socket (see part IV “Project planning and construction”)

Type key:

nnn..... board identification code beginning with 001
xx...yy..... operating voltage range
zz.....version beginning with 01

Figure 2.4:
Front panel of a digital input/output board DIOB

The digital input/output board DIOB requires a range of 7 TE in the board rack.

2.5 Backplane ABP

The backplane ABP consists of two backplanes (housing rear/housing inside of the board rack) and is used to connect up to 6 evaluation boards, one axle counting board ACB, one fuse board and one digital input/output board DIOB.

Minimum configuration: ABP with plug sockets for two evaluation boards, one ACB and one fuse board.

Design of the interfaces:
Interfaces to the boards..... 48-pin multipole female connectors, F shape, [16]

"Modem" interface..... 9-pin D-SUB male connectors, [17]

“Supply” interface..... Screw terminal, maximum terminal cross-section: 2.5 mm²

Interfaces ST1 and ST4 to ST6 to the outside with 48-pin multipole male connector, F shape, [16]. Double usage, triple usage, counting head control inputs and outputs with RJ45 sockets.

The multipole female and male connectors are clearly protected against incorrect assembly by means of factory coding.

Information on the configuration of the backplane ABP, see Part IV "Project planning and construction".

The plug connectors with cable housing for the ST1, ST4 to ST6 plugs are supplied with the ABP.

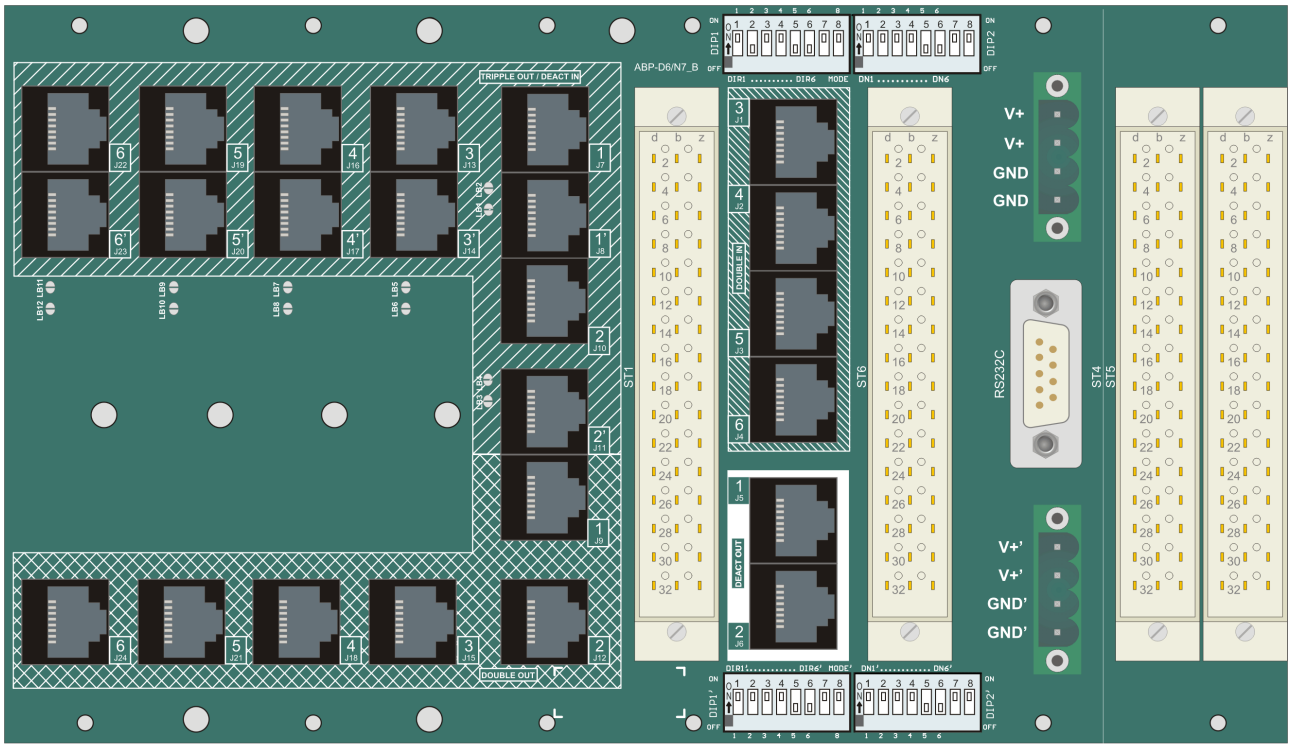


Figure 2.5: Rear (housing rear) of the backplane ABP002

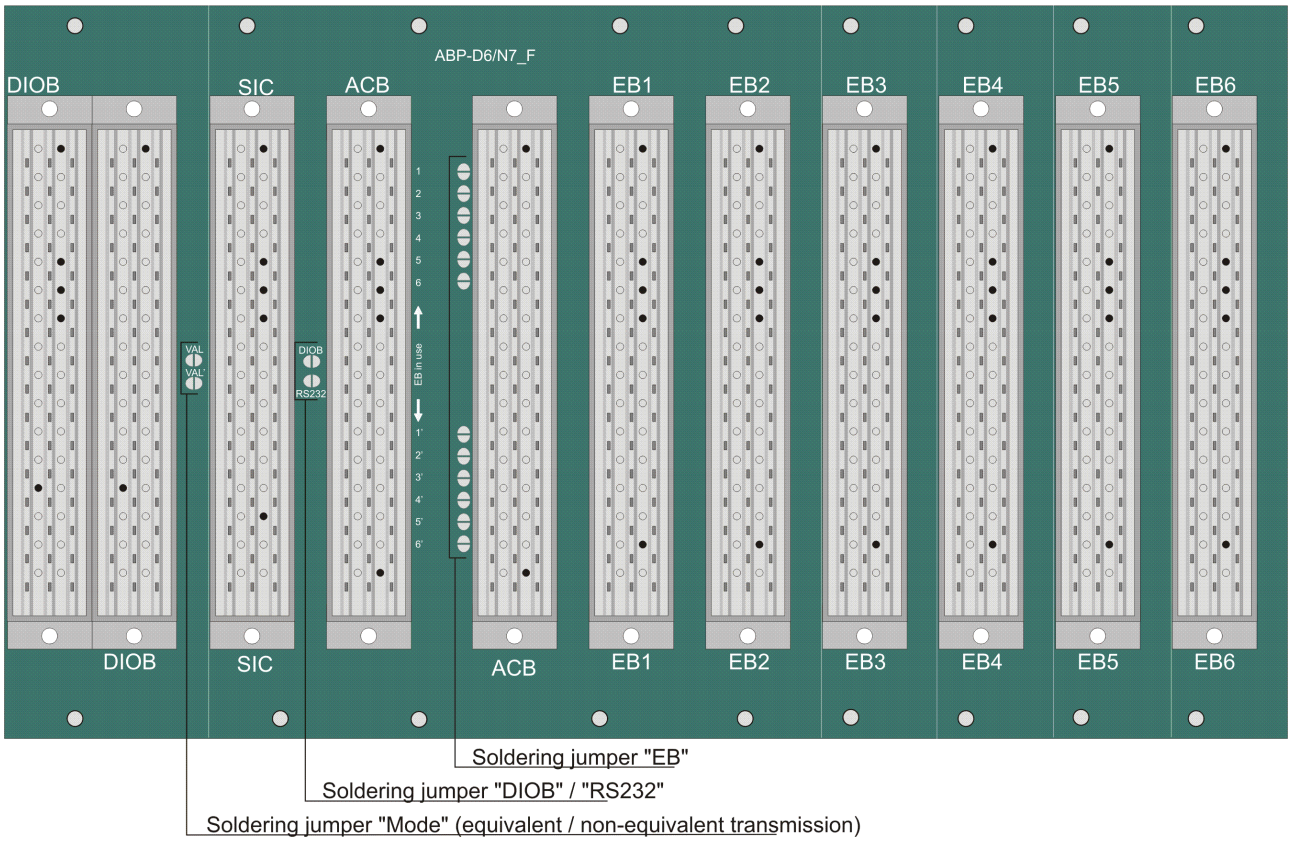


Figure 2.6: Front (housing inside) of the backplane ABP002

2.6 Board rack BGT

A board rack BGT is required for the boards of the axle counting system ACS2000. The board rack is used to house the boards and as mechanical protection. It consists of an aluminium housing and is equipped with a label bar.

2.7 Overvoltage protection board BSI

Figure 2.7:
View of the overvoltage protection board

The overvoltage protection board BSI protects the indoor equipment from transient overvoltages that could affect the cable between the wheel sensor and the cable termination (and/or the BSI) in the event of a lightning strike or overhead contact line short circuit. The overvoltage protection board BSI is connected between the evaluation board and the wheel sensor. The overvoltage protection board is mounted on a top-hat rail in the indoor equipment.

2.8 Wheel sensor RSR180

Figure 2.8:
View of the wheel sensor RSR180

The wheel sensor RSR180 consists of two sensor systems. Viewed from the rating plate, system 1, hereinafter referred to as Sys1 for short, is on the left-hand side and system 2, hereinafter referred to as Sys2 for short, is on the right-hand side.

Sys1 and Sys2 are symmetrical in design. A wire is allocated to each sensor system and transmits the sensor system signal to the evaluation board. The other two wires are used to provide the voltage supply to the wheel sensor. On the wheel sensor there is a cast-in four-wire cable, with a standard length of 5 or 10 metres.

The wheel sensor RSR180 works together with the evaluation board as a counting head. The wheel sensor is fixed using a rail claw. In exceptional cases, mounting can also be carried out directly on the rail web.

2.9 Trackside connection box GAK

Figure 2.9:
View of the trackside connection box GAK

In the trackside connection box, the wheel sensor cable (standard length = 5 m) is connected with the cable that is routed to the cable terminating frame and/or to the overvoltage protection board BSI.

Typically, a trackside connection box is required for each wheel sensor.

Up to 4 wheel sensors can be connected in a GAK (e.g. Quante). This configuration is used where this is possible due to the 5 m-long cable of the wheel sensors (e.g. at sets of points).

An aluminium plate is mounted to the top of the GAK, and this can be labelled or engraved as appropriate.

2.10 Modem

In order to be able to use an ACS2000 system in modem operation, a RS232-compatible modem is required (see Part IV "Project planning and construction").

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Part III

Performance parameters

of the axle counting system

ACS2000

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2	2012-08-01	A. Ecker	chapter 3.1, 3.2, 4.1,5	formatting

Masthead

This document is the translation of the German original.

1 General performance parameters

- A track section can be monitored using an ACB axle counting board.
- The clear and occupied indications are output by the voltage-free relay contacts.
- In isolated operation, the evaluation of up to a maximum of 6 independent counting heads is possible.
- Double usage of counting heads for adjacent track sections is possible.
- The maximum number of axles in the track section is 8191.
- The ACS2000 is suitable for modem operation, so that it can also be used on long track sections.
- In modem operation, the evaluation of up to a maximum of 12 independent counting heads is possible.
- If, for instance, more than 6 counting heads (12 counting heads maximum) are required for securing a gridiron, it is possible to replace the modem connection with a null-modem cable (maximum cable length = 3 m).
- Furthermore, with the aid of a digital input/output board DIOB, up to 16 (in safety-relevant applications, up to 8) digital arguments independent of the axle counting can be transmitted bidirectionally via modem.
- It is possible to use one direction output per counting head through the evaluation board.
- The requirements of the CENELEC standards [13], [14], [15], SSAS4, SIL4 on the ACS2000 product are considered to be fulfilled for application in accordance with the provisions.
- The indoor equipment of the ACS2000 and the wheel sensor (outdoor equipment) comply with EMC requirements pursuant to [7].

2 Checking and maintenance cycles

- IMC + wheel sensor RSR180: ≤ 2 years (measure sensor currents, test occupancy detection capability)
- axle counting board ACB: ≤ 2 years (count one axle in and then out again)
- DIOB: ≤ 1 year (switch from "In" status to "Out" status)

3 Environmental conditions

The permitted operating conditions and environmental conditions must be observed and complied with.

3.1 Indoor equipment

Operation in accordance with [4]

Components within the indoor equipment, mounted in buildings or close to the track, may only be operated with a maximum annual average temperature of 35 ºC. The components of the indoor equipment may only be exposed to dry, non-conductive dirt.

The boards may only be used up to a maximum height of 2000 m above sea level.

- Climatic environmental conditions..... 3K6, 3Z1, 3Z4, however without condensation or ice formation
- Biological environmental conditions..... 3B1
- Chemically-active substances..... 3C2, no salt fog
- Mechanically-active substances..... 3S1
- Mechanical environmental conditions..... 3M4
- IP20 in accordance with [6]

3K6: Temperature range -25 °C to +55 °C, humidity up to 100 %, condensation and ice formation.

Extension/restriction of standard: Temperature range extended to -25 °C to +70 °C, however without condensation or ice formation for the entire range.

3Z1: Heat radiation is negligible.

3Z4: Airflow up to 5 m/s.

3B1: Flora: Locations where the risk of mould or sponge growth is negligible or where protective measures have been taken.

Fauna: Locations where the impact of rodents or other animal pests, including termites, is negligible or where protective measures have been taken.

3C2: Locations in rural or even more densely populated areas and protected against salt fog.

3S1: Locations where dust is minimised by adequate measures. Not in the proximity of sandy sites.

3M4: Locations subject to only small vibrations are included.

Storage in accordance with [2]

- Climatic environmental conditions..... 1K4, however without condensation or ice formation
- Biological environmental conditions..... 1B1
- Chemically-active substances..... 1C2, no salt fog
- Mechanically-active substances..... 1S1
- Mechanical environmental conditions..... 1M3

1K4: Temperature range -25 °C to +55 °C, humidity up to 100 %.

Extension/restriction of standard: however without condensation or ice formation.

1B1: Storage locations where the risk of mould or sponge growth and the impact of rodents or other animal pests, including termites, is negligible or where protective measures have been taken.

1C2: Storage locations with air pollution typical of the present time, as occurring in densely populated areas where industrial facilities are spread across the entire area, or which have a high traffic density, and protected against salt fog.

1S1: Storage locations where dust is minimised by adequate measures. Not in the proximity of sandy sites.

1M3: Storage locations where noticeable impacts and vibrations occur are permitted.

Transport in accordance with [3]

- Climatic environmental conditions..... 2K3, however no precipitation
- Biological environmental conditions..... 2B1
- Chemically-active substances..... 2C2, no salt fog
- Mechanically-active substances..... 2S1
- Mechanical environmental conditions..... 2M3

2K3: Temperature range -25 °C to +70 ℃, humidity: 95 %.

Extension/restriction of standard: Humidity extended to 100 %, but no precipitation

2B1: Transport only in containers whose construction means that the risk of mould or sponge growth and the impact of rodents or other animal pests, including termites, is negligible or where protective measures have been taken.

2C2: Transport types where the product is protected against the effects of salt fog. Transport routes through areas with industrial plants, but not those emitting any chemical pollutants in high concentrations.

2S1: Transport types where the product is stored inside and protected against sand and dust.

2M3: All transport types are permitted, including those in areas with poor road conditions.

3.2 Outdoor equipment

Components in the outdoor equipment, mounted to the track, may only be operated with a maximum annual average temperature of 25 ºC and travelled over by rail vehicles for a maximum of 5 % of their service life.

Components of the outdoor equipment, which are mounted close to the track (e.g.: trackside connection boxes), may only be operated with a maximum annual average temperature of 25 °C.

Operation in accordance with [5]

- Climatic environmental conditions..... 4K4, 4Z2, 4Z5, 4Z8
- Biological environmental conditions..... 4B1
- Chemically-active substances..... 4C3
- Mechanically-active substances..... 4S3
- Mechanical environmental conditions..... 4M8
- GAK (trackside connection box, QUANTE): IP65 in accordance with [6]
- Wheel sensor RSR180: IP65 and IP68 in accordance with [6]

4K4: Temperature range -40 °C to +85 °C, climatic stresses caused by condensation, ice, snow and 100 % humidity.

4B1: Locations where mould growth may occur and animal pests, excluding termites, may have an impact.

4C3: Locations directly adjacent to industrial plants with chemical emissions.

4S3: Locations where sand or dust occurs as a result of procedures, or in geographical areas where the wind generally carries sand or dust.

4M8: Locations with high vibration levels and high-energy impacts are permitted. Additional individual impacts (accelerations) up to 1000 g.

Extension/restriction of standard:
shocks with 2000 g / 0.4 ms along Y-axis, shocks with 2000 g / 0.4 ms along Z-axis

oscillation, noise-shaped, with the following benchmark values along the Z-axis:

10 Hz 0.1 g²/Hz, 300 Hz 0.1 g²/Hz

810 Hz 0.6 g²/Hz, 977 Hz 1.2 g²/Hz

1295 Hz 15.3 g²/Hz, 1643 Hz 15.3 g²/Hz

1689 Hz 1.2 g²/Hz . 2000 Hz 1.2 g²/Hz

effective value: 90 grams

Along the X-axis, the load-bearing capacity is 15 dB less; along the Y-axis it is 11 dB less.

Note: X = longitudinal, Y = transversal, Z = vertical

4 Interface related performance parameters

- supply voltage: +19 to +72 V DC, interruption-free for each channel
- power consumption: see Part IV "Project planning and construction"

4.1 Axle counting board ACB

- relay outputs ("clear/occupied" interface):

  maximum switching voltage: 72 V AC/DC

  maximum switching current: 600 mA AC/DC
  (in the case of activation of the ohmic load)
  300 mA AC/DC
  (in the case of activation of the inductive load)

- optocoupler inputs ("Reset" and "pre-Reset" interface):

  input voltage for status LOW: 0 to 5 V DC

  input voltage for status HIGH: 20 to 72 V DC

  maximum HIGH input current: 4.0 mA

- RS232 interface

4.2 Evaluation board IMC

- optocoupler outputs for double usage, direction:

  The following applies to the IMC GS01:

  maximum switching voltage: 72 V DC

  maximum switching current: 10 mA

  The following applies to the IMC GS03:

  maximum switching voltage: 72 V DC

  maximum switching current: 17 mA

4.3 Digital input/output board DIOB (optional in modem operation)

- optocoupler inputs ("DIOB input" and "optional:Reset" interface):

input voltage for status LOW:	0 to 5 V DC
input voltage for status HIGH:	20 to 72 V DC
maximum HIGH input current:	4.0 mA

- relay outputs ("DIOB output" and "ERROR" interface):

maximum switching voltage	72 V AC/DC
maximum nominal switching current – ohmic	60 mA AC / 200 mA DC
maximum nominal switching current – inductive	30 mA AC / 100 mA DC
maximum number of switching cycles:	10^6

5 Wheel diameter, speeds

The information of the EBO [10] applies and the following limit values have also been set:

v... maximum speed of travel [km/h] d… wheel diameter [mm]

- minimum wheel diameter: 300 mm for v < 150 km/h
  (v * 2) mm for v ≥ 150 km/h
- maximum wheel diameter: 2100 mm
- minimum distance between axles: 1.7 * v + 0.2 * d + 370 mm

In order to ensure reliable axle counting, the minimum distance between axles must be observed. The information regarding the distance between axles applies to evaluation boards with an output extension time of 5 ms.

In the case of track sections on which the magnetic rail brake is used as the service brake, the information in the software and type related documentation must be observed and/or the manufacturer must be consulted. In the case of track sections on which the eddy current brake is used as the service brake, the manufacturer must be consulted.

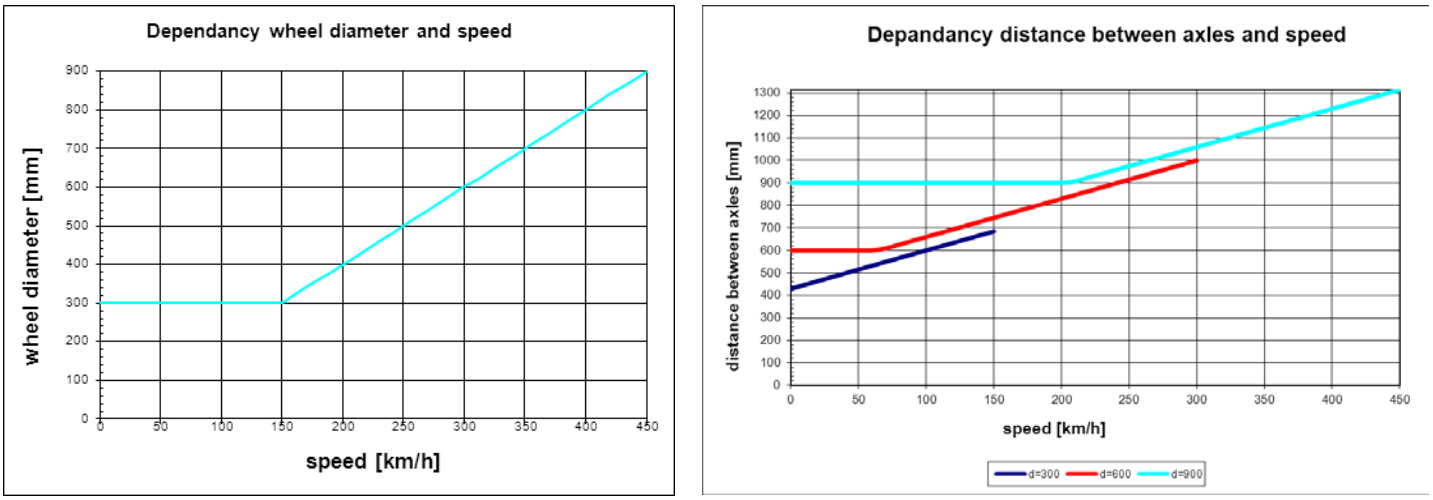

Figure 5.1: Dependence between wheel diameter/distance between axles and speed

- wheel flange measurements, see Table 5.1 below
- minimum traversing speed: 0 km/h (static)
- maximum traversing speed: 310 km/h (proven in field tests)
  450 km/h (proven in the laboratory)
- maximum lateral wheel tolerance: 60 mm

In the case of traversing speeds higher than 310 km/h and with dimensions outside the stated limits, please consult the manufacturer.

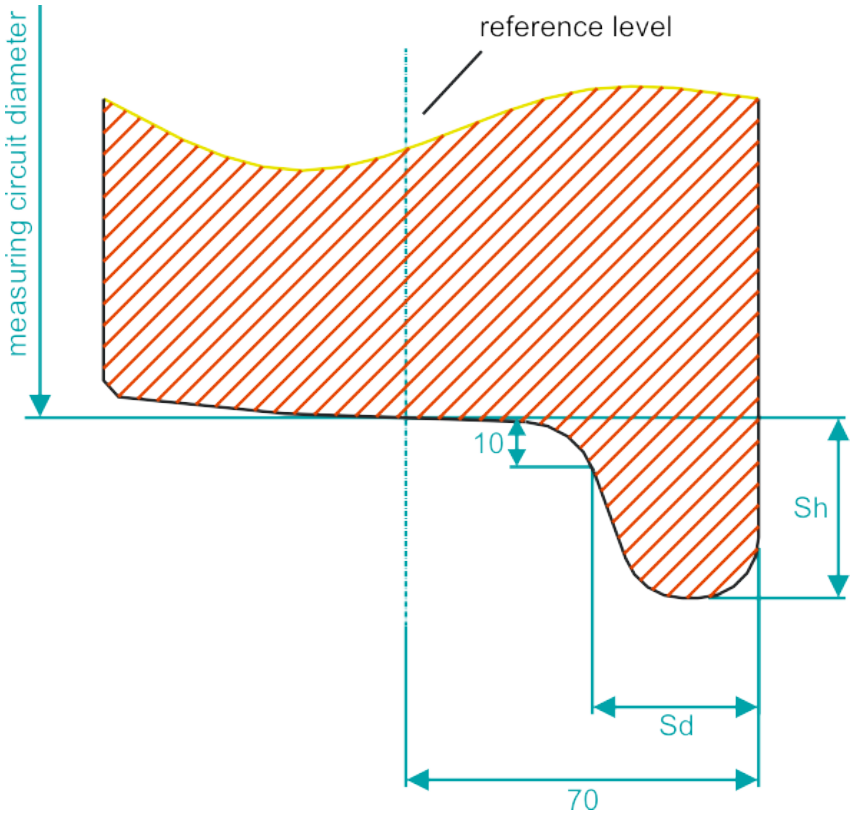

Figure 5.2: Wheel profile

designation	diameter of measuring circuit	minimum dimension	maximum dimension
wheel flange height Sh	300 to 760	32	38
wheel flange height Sh	760 to 2100	26	38
wheel flange thickness Sd	300 to 840	27.5	*
wheel flange thickness Sd	840 to 2100	20	*

*.... no maximum dimension specified

Table 5.1: Wheel flange dimensions, measurements in mm

Changes in the limit values for the wheel diameter, traversing speeds, lateral wheel tolerance and wheel flange dimensions may occur due to the software.

In this case, the information in the software and type related documentation must be observed.

6 Maximum cable lengths

6.1 Sensor and evaluation board

The information on the loop resistances is valid for all cables from the ABP to the GAK.

The maximum permitted loop resistance is 250 Ω.

6.2 Interfaces and activated evaluations or controls

counting head outputs:	< 30 m
counting head inputs:	< 30 m
RS232:	< 3 m
diagnostics:	< 3 m
clear/occupied interface:	< 10 km
reset interface:	< 10 km
DIOB (inputs and outputs):	< 10 km
power supply:	< 10 km
wheel sensor cabling:	< 10 km

For wheel sensor cables longer than 10 km, please consult the manufacturer!

7 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. The checking and maintenance cycles detailed in chapter 2 "Checking and maintenance cycles" must be observed and complied with.
2. The permitted operating conditions and environmental conditions detailed in chapter 3 "Environmental conditions" must be observed and complied with.
3. The permitted operating interface conditions detailed in chapter 4 "Interface related performance parameters" must be observed and complied with.
4. The limit values detailed in chapter 5 "Wheel diameter, speeds" must be observed and complied with.

FRAUSCHER
SENSOR TECHNOLOGY

D10041-04-2

Part IV

Project planning and construction

of the axle counting system

ACS2000

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	Name	Signature	Date	**Part IV: Project planning and construction of the axle counting system ACS2000**	Classified
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Checked:	R. Thalbauer	sign. Thalbauer	2012-03-30		D10041-04-2
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Review list

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2	2012-07-09	J. Böttger	all	new english version
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Masthead

1 Interfaces ACS2000

1.1 General

The interface conditions stated in this document must be observed.

The plug connections, a D-SUB plug for modem operation and the clamps for connection of the supply voltage are located on the backplane ABP (see chapter 1.7 “Power supply“ and chapter 1.8 “Pin assignment“).

1.2 Wheel sensor – ST1 plug

For detailed pin assignment of the ST1 plug, see chapter 1.8 “Pin assignment“.

The power supply required to operate a wheel sensor is provided at this interface. In addition, the sensor system information from the counting heads is input. The voltage output here is galvanically isolated from the supply voltage of the ACS2000.

The overvoltage protection board BSI and an optional cable termination KA are located between the trackside connection box GAK and the backplane ABP.

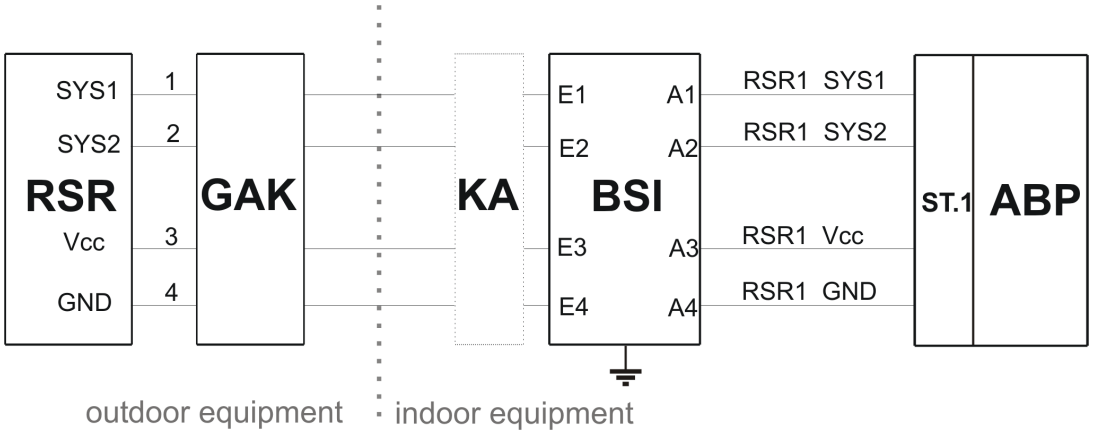


Figure 1.1: Wiring diagram of wheel sensor RSR180 connected to the ACS2000

1.3 Counting head outputs

For the assignment of the RJ45 sockets 1/J7 to 6/J24, see chapter 1.8 “Pin assignment“.

The cables connected to the counting head outputs must not exceed a maximum length of 30 m, and should be kept as short as possible.

If the requirements of the axle counting system ACS2000 exceed the axle counting (direction output, individual requirements), the manufacturer must be consulted. The relevant product-specific documentation of the evaluation boards must be requested and the safety-related application conditions (SABs) contained within, as well as any additional SABs, must be observed in switching applications. Information regarding the failure detection periods, measures and wiring in safety-relevant applications must be obtained from the manufacturer. Please contact the manufacturer in the event of non safety-relevant applications.

1.3.1 Double usage

The information regarding the state of the sensor systems (occupied/not occupied/fault) is output at this interface by the optocoupler for further processing. These outputs are used for a counting head double usage. Furthermore, these are connected to the counting head inputs of the ACB according to the desired configuration (see chapter 1.4.1 “"Counting head inputs" interface“) The output information of this interface can, alternatively, also be processed further for individual requirements, however in this case, safety-relevant aspects must be considered.

1.3.2 Direction output

The evaluation board IMC provides information with the direction output regarding the direction of travel, for further processing (see chapter 1.8 “Pin assignment“).

1.3.3 Output information for individual requirements

This can be wired for individual requirements, if an output of the evaluation board must not be used for the counting head double usage or direction output.

Thanks to this it is possible to receive information on the status of the sensor systems (occupied/not occupied/fault) or on the direction of travel, for further processing.

A sample configuration for individual applications is shown in Figure 1.2.

The following applies to the IMC GS01:

maximum switching voltage:	72 V DC
maximum switching current:	10 mA

The following applies to the IMC GS03:

maximum switching voltage:	72 V DC
maximum switching current:	17 mA

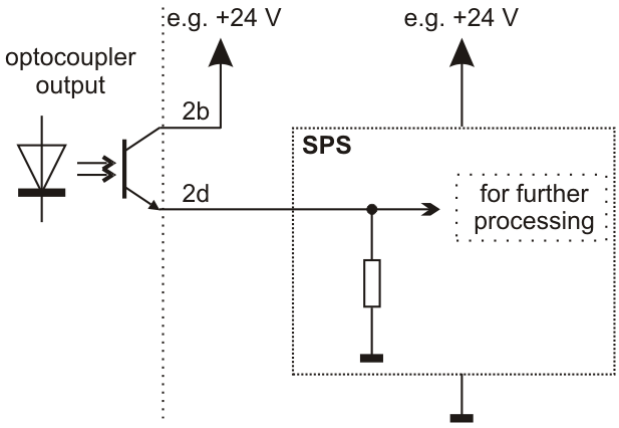


Figure 1.2: Sample configuration of a counting head output for individual applications

If the wheel sensor has been connected to the ST1 plug correctly (Sys1 to Sys1), when wheel sensor system 1 is occupied, the voltage of e.g. + 24 V that is applied to 2b is output at output 2d. For further processing, a PLC can be connected, for example.

1.4 ACB inputs/outputs

For detailed pin assignment of the ST6 plug and of the RJ45 sockets 3/J1 to 6/J4 and 1/J5 to 2/J6, see chapter 1.8 “Pin assignment“.

1.4.1 "Counting head inputs" interface

Counting head inputs 1 and 2 are connected to the ST6 plug. The other four inputs 3/J1 to 6/J4 are located between plugs ST1 and ST6 and are designed as RJ45 sockets. These inputs are used for the counting head double usage (see chapter 1.3 “Counting head outputs“).

For double usage, only counting head inputs that are not occupied by an evaluation board may be used. This means that for a track section with two evaluation boards (on the first and second plug socket), only counting head inputs 3 to 6 may be used for double usage.

Only system outputs of the evaluation boards IMC may be connected to the "counting head inputs" interface.

Only signals that are voltage-free to the earth may be connected to the counting head inputs interface.

There are no measures available to protect against overvoltage. The output voltages provided at the interface (+5 V and +5 V') may only be used for the wiring of the counting head double usage and not for the supply of other boards. Furthermore, it must be ensured that the independence of the channels is not lost in any of the boards when connecting the counting heads to the axle counter.

The output voltage of +5 V provided at the interface may only be used for channel 1 of the ACB, whereas the output voltage of +5 V' may only be used for channel 2 of the ACB.

The output voltages provided at the interface (+5 V and +5 V') may not be short-circuited. In the event of short circuit, the ACS2000 will report an error.

When using the patch cable provided by Frauscher for counting head double usage and for connecting the counting head inputs to the correct counting head outputs, the conditions mentioned above with regard to the independence of the channels and the separate voltage supply of the channels must be fulfilled.

The cables connected to the "counting head inputs" must not exceed a maximum length of 30 m, and should be kept as short as possible.

1.4.2 "Clear/occupied" interface

The information regarding the status of the axle counting section (clear/occupied/fault) is output by 4 voltage-free relay contact chains at the outputs of the axle counting board ACB, for further processing. These relay outputs are designated as 2 x Fm and 2 x P.

No internal protective circuit for the relay outputs with spark suppression elements is available! In the event that inductive loads are activated through the ACB relays, suitable measures must be taken to extinguish the sparks on the load! Spark suppression elements must not be connected in parallel to the relay contacts. For suitable measures see.Figure 1.3.

maximum switching voltage:	72 V AC/DC
minimum switching voltage:	10 V AC/DC
maximum switching current:	600 mA AC/DC (in the case of activation of the ohmic load)
	300 mA AC/DC (in the case of activation of the inductive load)
minimum switching current:	10 mA AC/DC
maximum permitted transient overvoltages:	1500 V AC

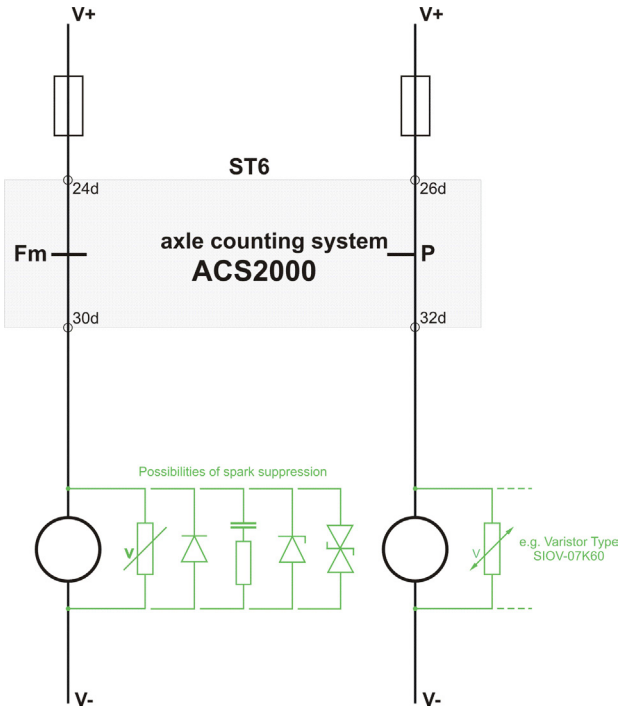


Figure 1.3: Potential spark suppression elements in the event of activation of inductive loads (example with ABP and ACB in occupied status)

The nominal load on the "clear/occupied" interface may not exceed, in the event of activation, 600 mA AC/DC under an ohmic load and 300 mA AC/DC under an inductive load. The maximum permitted voltage on the Fm and P interfaces of 72 V AC/DC must not be exceeded.

For the properties of the outputs of the "clear/occupied" interface with various system statuses, see Part V "Types of boards ".

Chapter 3 “Cable types and cable routing“ must be observed.

1.4.3 “Reset” interface

The reset of the ACS2000 is normally carried out by pushing the toggle switches connected to the inputs with the designation "Reset".

input voltage for status LOW:	0 to 5 V DC
input voltage for status HIGH:	20 to 72 V DC
maximum HIGH input current:	4 mA at +72 V DC
maximum permitted transient overvoltages:	1500 V AC

The inputs are protected against reverse polarity and transient overvoltages in accordance with [8] and have an internal series resistor for current limitation.

For more detailed information on the reset restriction and the reset procedure, see Part V "Types of boards".

The reset operation connected to the “Reset” interface must be designed in accordance with the applicable railway regulations.

1.4.4 “pre-Reset” interface

Elimination of the reset restriction is normally carried out by pushing the "pre-Reset" toggle switches on the front panel of the ACB or by pushing the toggle switches connected to the inputs with the designation "pre-Reset".

input voltage for status LOW:	0 to 5 V DC
input voltage for status HIGH:	20 to 72 V DC
maximum HIGH input current:	4 mA at +72 V DC
maximum permitted transient overvoltages:	1500 V AC

The inputs are protected against reverse polarity and transient overvoltages in accordance with [8] and have an internal series resistor for current limitation.

For more detailed information on the reset restriction and the reset procedure, see Part V "Types of boards".

If two ACS2000 systems (subsystems) operate in modem operation, the reset procedure (both Reset and pre-Reset) only needs to be carried out on one ACS2000 system. Resetting of the other ACS2000 system is carried out through the modem connection. It is also possible to carry out the Reset and pre-Reset separately (e.g. pre-Reset on the left subsystem and Reset on the right subsystem). For further details, see Part V "Types of boards".

The reset operation connected to the “pre-Reset” interface must be designed in accordance with the applicable railway regulations.

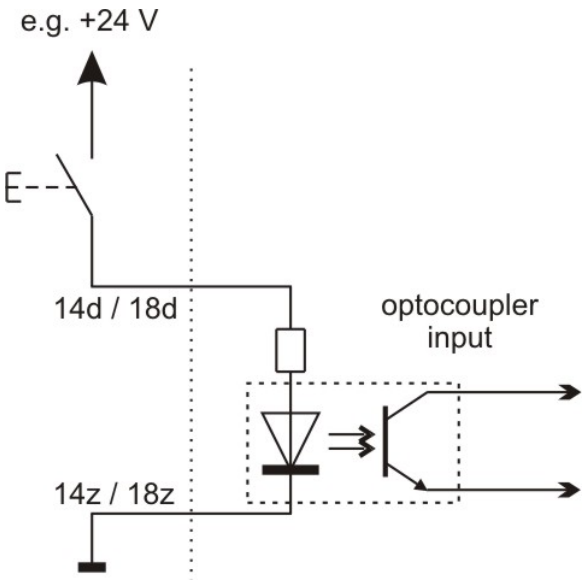


Figure 1.4: Sample configuration of a principle wiring for an optocoupler input e.g. "Reset" interface (ST6)

The principle wiring shown in Figure 1.4 for an optocoupler input is applicable for the following interfaces of the ACS2000:

- “Reset” interface
- “pre-Reset” interface
- DIOB inputs interface
- Optional interface: DIOB reset

All of the optocoupler inputs listed here are protected against reverse polarity and transient overvoltages in accordance with [8] and have an internal series resistor for current limitation.

If one of these functions is not required, the optocoupler inputs should not be connected (leave inputs open).

1.5 DIOB inputs/outputs –ST4 and ST5 plugs

For detailed pin assignment of ST4 and ST5 plugs, see chapter 1.8 “Pin assignment“.

The digital input/output board DIOB is used to transmit up to 16 arguments between two ACS2000 systems (subsystems) via modem. The information channels of the DIOB are independent of one another and also transmit axle counting information (see Part II "System description").

1.5.1 "DIOB inputs" interface

The switching statuses (HIGH or LOW) applied at the DIOB inputs are transmitted to the second DIOB in modem operation (see Table 1.1).

The levels are input through the optocoupler, galvanically isolated.

input voltage for status LOW:	0 to 5 V DC
input voltage for status HIGH:	20 to 72 V DC
maximum HIGH input current:	4 mA at +72 V DC
maximum permitted transient overvoltages:	1500 V AC

The inputs are protected against reverse polarity and the maximum permitted transient overvoltages in accordance with [8] and have an internal series resistor for current limitation.

The status of the inputs or outputs can also be read on the front panel of the DIOB (see Part II "System description").

For information on the transmission duration and activation, see chapter 1.5.3 “DIOB – Switching in safety-relevant applications“.

1.5.2 "DIOB outputs" interface

The switching statuses received in modem operation are output at this interface.

The switching statuses are output through voltage-free relay contacts. Relays are used to output logical statuses 0 = LOW (relay dropped, relay contact open) and 1 = HIGH (relay blocked, relay contact closed).

For the switching statuses LOW (= passive status) or HIGH (= active status), the following status definitions should be applied:

status LOW => OUT (1 to 16) = relay contact open
status HIGH => OUT (1 to 16) = relay contact closed

Opening of the DIOB outputs must be processed by the downstream board as a failsafe status.

No internal protective circuit for the relay outputs with spark suppression elements is available! In the event of the activation of inductive loads by the relays of the DIOB, suitable measures must be taken

to carry out the spark suppression on the load! Spark suppression elements must not be connected in parallel to the relay contacts. For suitable measures see Figure 1.3.

maximum switching voltage:	72 V AC/DC
minimum switching voltage:	10 V AC/DC
maximum nominal switching current - ohmic:	60 mA AC / 200 mA DC
maximum nominal switching current - inductive:	30 mA AC / 100 mA DC
minimum switching current:	10 mA AC/DC
type of contact:	N/O contact, A (see Figure 1.5)
actuation time:	1 ms
release time:	0.5 ms
duration of bounce:	0.5 ms (close) / 0,5 ms (open)
maximum number of switching cycles:	10^6

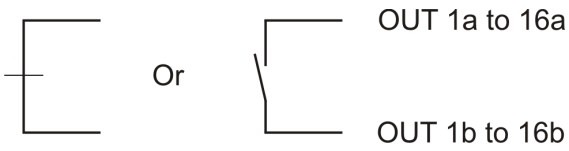


Figure 1.5: Type of relay contact: N/O contact, A

DIOB inputs ACS2000 system 1	serial transmission	**DIOB outputs ACS2000 system 2**
high	→	closed
low	→	open
DIOB outputs ACS2000 system 1	serial transmission	**DIOB inputs ACS2000 system 2**
closed	←	high
open	←	low

Table 1.1: Transmission scheme of the DIOB

Within one year, the outputs of the DIOB input/output board that have been used must be tested to check whether these open due to non-activation of the corresponding input. In the event of a failure, maintenance must be carried out within 24 hours.

1.5.3 DIOB – Switching in safety-relevant applications

In safety-relevant applications, each argument must be input in valent form over two channels ("DIOB Inputs" interface) and evaluated over two channels at the receiver ("DIOB outputs" interface) (see Figure 1.6). With regard to this, an input of channel 1 must be used with an input of channel 2 in each case. The same process must be carried out with the outputs.

The downstream signalling equipment must tolerate an antivalent status for a period of time of 10 ms. If the antivalent status of an argument lasts longer than 10 ms, this must be detected by the downstream signalling equipment as a fault. Until the error is resolved, the downstream equipment must remain in a failsafe status (the failsafe status is defined according to the specific application) (error memory). The error must be resolved within 24 hours. The downstream equipment must ensure that the failsafe status is preserved until the error is eliminated or until the defective board is replaced.

DIOB: The OUT status (= failsafe status) or IN status (= active status) must correspond to the input and output statuses shown in Table 1.3. This table refers to the case of safety-relevant applications.

For information on the transmission duration, see Part V "Types of boards".

2-channel valent

This switching type is characterised by two input contacts and two output relays.

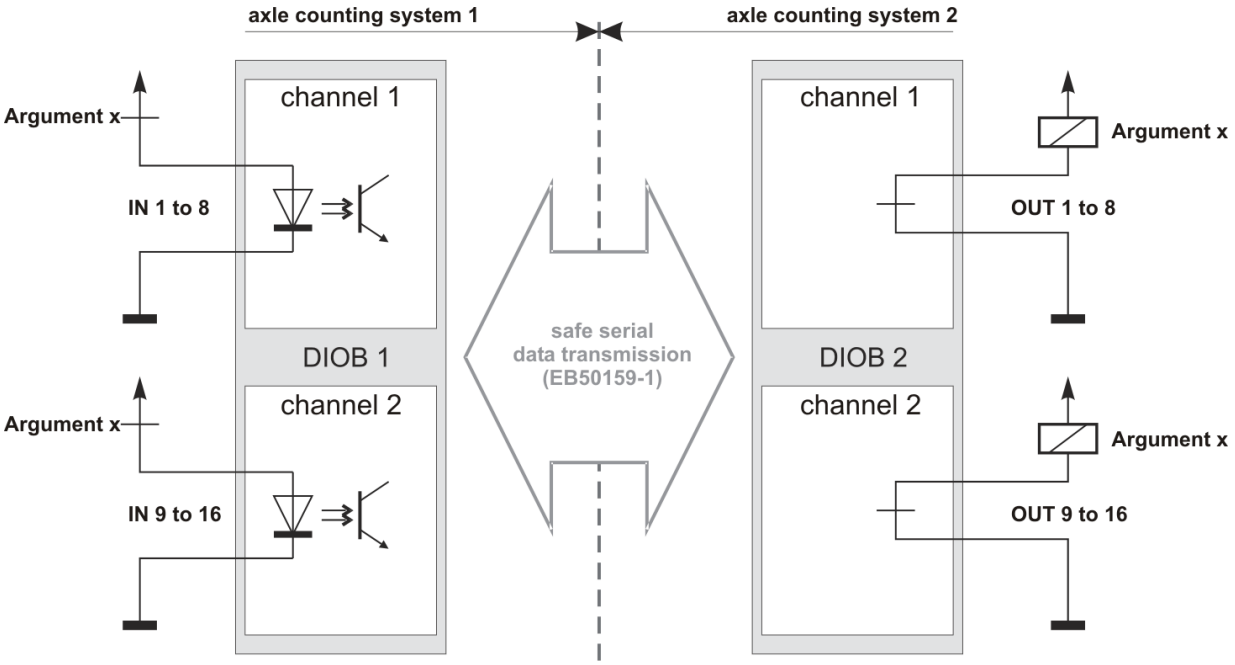


Figure 1.6: 2-channel valent (example)

In this switching type, up to a maximum of 8 failsafe arguments can be transmitted.

input channel 1	input channel 2
IN 1	IN 9
IN 2	IN 10
IN 3	IN 11
IN 4	IN 12
IN 5	IN 13
IN 6	IN 14
IN 7	IN 15
IN 8	IN 16

Table 1.2: Prescribed input connection

operating mode		**IN (1-8)**	**IN (9-16)**	**OUT (1-8)**	**OUT (9-16)**	**status**
2 channel	1	LOW	LOW	LOW	LOW	argument OFF *
valent	2	HIGH	HIGH	HIGH	HIGH	argument ON

* The OFF argument is deemed to be a failsafe status

Table 1.3: DIOB input/output statuses

All input and output statuses that deviate from the statuses shown in Table 1.3 must be rated as faults!

1.5.4 DIOB – Wiring in non safety-relevant applications

Arguments are transmitted with the DIOB in valent form as standard, as this is required for safety-related applications.

If the DIOB is used for non safety-related applications, it is also possible to transmit arguments in antivalent form.

The type of transmission of the DIOB (valent/antivalent) must be stated when ordering the ACS2000.

1.5.5 "ERROR" interface

In fault-free operation of the DIOB, the voltage-free relay outputs ERROR1 and ERROR2 are in the logical status HIGH (relay contact closed). If the DIOB detects an error (hardware, software or connection error), these outputs switch to the logical status LOW (relay contact open).

The technical specifications of this interface correspond to those of the "DIOB outputs" interface (chapter 1.5.2 “"DIOB outputs" interface“).

The two voltage-free relay outputs ERROR must not be used for safety-relevant applications, as these two outputs only open in the event of a data transmission fault or a hardware error and therefore the detection of failure of an error related relay that no longer opens cannot be guaranteed.

1.5.6 “Optional:Reset” interface

The two optocoupler inputs optional:Reset 1 and optional:Reset 2 are not currently used.

The technical specifications of this interface correspond to those of the "DIOB inputs" interface (chapter 1.5.1 “"DIOB inputs" interface“).

1.6 Serial communication

Serial communication of both ACS2000 systems (subsystems) in modem operation, or serial communication between the ACS2000 and a diagnostic unit takes place through this interface.

For more detailed information on cable types and cable routing, see chapter 3 “Cable types and cable routing“.

1.6.1 Modem

1.6.1.1 Requirements

The "RS232C" interface on the ABP is only used in modem operation. If a modem is connected to this interface, the following requirements must be taken into account:

- RS232-C (V24) compatible for point to point connection
- 4800 baud or 9600 baud, 1 stop and 1 start bit, 8 data bits
- asynchronous transmission
- no software initialisation
- no hardware or software handshake
- no data buffering
- full-duplex operation
- maximum delay time with 4800 baud or 9600 baud = 90 ms
- inputs isolated galvanically (2500 V AC)
- only the RxD, TxD and GND wires are required

If the modem is connected to the D-SUB socket (Serial Interface) of the ACB, diagnostics are no longer possible at this interface (see Part II "System description").

By delay time we mean the interval of time between when the data is received by the first modem and when the data is output by the second modem.

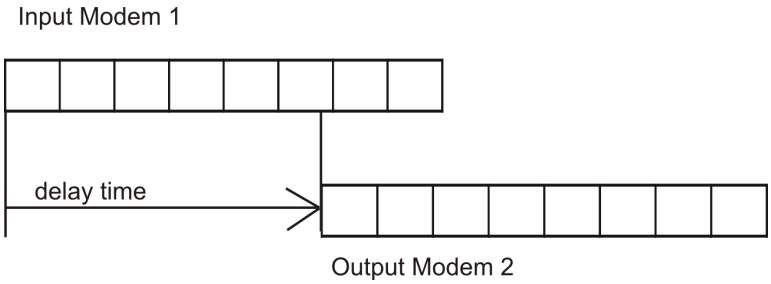


Figure 1.7: Delay time (8 bytes to 10 bytes)

Modems or external data evaluation systems may only be connected to a D-SUB socket or to a D-SUB plug if their interface is designed in accordance with EIA/TIA-232E .

The D-SUB plug for connection of a modem is available on the ABP and with the same function as the D-SUB socket on the ACB and DIOB. Simultaneous connection of modems to the D-SUB plug and to a D-SUB socket or to both D-SUB sockets is not permitted in order to set up a serial connection.

Only signals that are voltage-free to the earth may be connected to a D-SUB socket/plug. This also applies for both optocoupler outputs of the D-SUB socket of the ACB.

1.6.1.2 Serial transmission protocol

Serial transmission allows information to be exchanged between two axle counting boards. Furthermore, the data from the DIOB boards is also transmitted.

The serial transmission protocol used corresponds to [9].

Transmission in modem operation through the "Serial Communication" interface is designed only for use in closed transmission systems in accordance with [9]. Use in open transmission systems is possible with additional measures and with appropriate verification, provided the data for the ACB or DIOB are not modified.

Closed transmission system means: A set number or set maximum number of participants that are connected to one another through a transmission system with well-known and predetermined properties, in which the risk of unauthorised access can be considered negligible.

For more detailed information on transmission times, see Part V "Types of boards".

1.6.2 Diagnostics

The diagnostic interface is available on the ACB as a D-SUB socket and as a RJ45 socket. Simultaneous connection of evaluation systems to the diagnostic interface of the D-SUB socket and RJ45 socket of the ACB is not permitted.

The diagnostic input/output and the optocoupler outputs on the D-SUB socket or the RJ45 socket of the ACB may only be used for safety-relevant processes.

1.6.3 Connections for modem operation or diagnostics

1.6.3.1 D-SUB plug "RS232C" of the ABP

The "RS232C" interface on the ABP is only used in modem operation and allows communication between two ACS2000 systems (subsystems). The modem is connected to this interface.

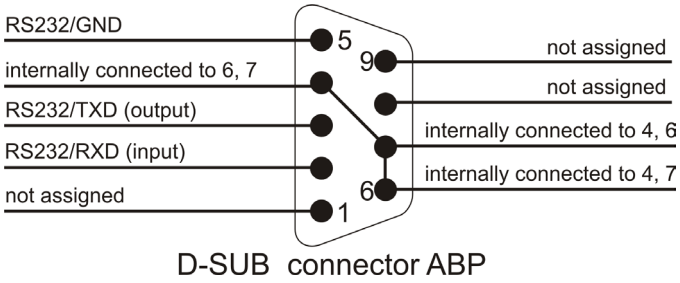


Figure 1.8: Pin assignment of the "RS232C" interface D-SUB plug on the ABP

1.6.3.2 D-SUB socket "Serial Interface" or RJ45 socket of the ACB

The "Serial Interface" interface D-SUB on the ACB is used for diagnostic purposes (Pin7 and Pin8 in Figure 1.9), however in modem operation it can also be used without DIOB for communication between two ACS2000 systems (subsystems) (Pin2 and Pin3 in Figure 1.9). However, it is preferable to use the "RS232C" interface on the ABP for this. The RJ45 socket on the ACB does not have any optocoupler outputs and can only be used for diagnostic purposes (see Figure 1.10).

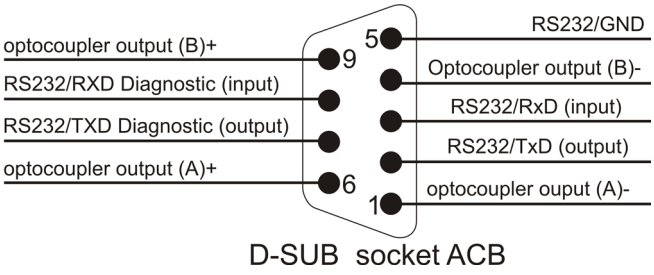


Figure 1.9: Pin assignment "Serial Interface" D-SUB

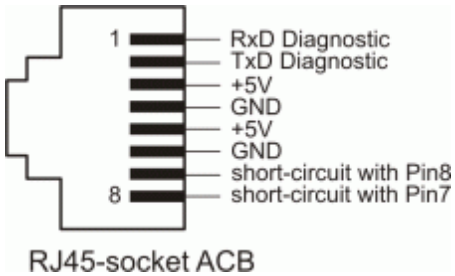


Figure 1.10: Pin assignment RJ45 socket

The simultaneous use of the interfaces "Serial Interface" D-SUB (Pin7 / Pin8) and RJ45 is not possible for diagnostic purposes. For more detailed information on diagnostics options, see Part IX "Diagnostics".

1.6.3.3 D-SUB socket "Serial Interface" of the DIOB

The interface "Serial Interface" on the DIOB has the same function as the interface "RS232C" on the ABP and can be used for communication between two ACS2000 systems (subsystems). However, it is preferable to use the "RS232C" interface on the ABP for this.

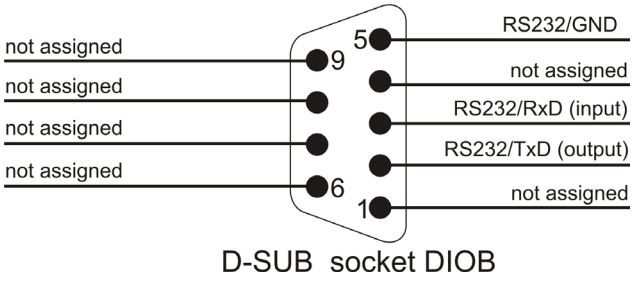


Figure 1.11: Pin assignment of the interface "Serial Interface" D-SUB socket on the DIOB

1.6.3.4 RJ45 socket "Serial Interface" of the IMC

The RJ45 socket on the IMC can only be used for diagnostic purposes.

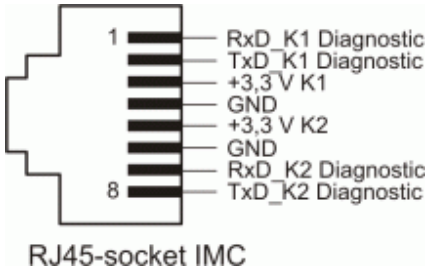


Figure 1.12: Pin assignment of the interface "Serial Interface" RJ45 socket on the IMC

The following applies to the IMC GS01:

The serial interface diagnostic connection on the front panel of the evaluation board IMC GS01 must not be used. In the event of maintenance works carried out by Frauscher GmbH or by a company appointed by it, personnel can connect wires here for measurement purposes.

The following applies to the IMC GS03:

Diagnostic data can be read off on the serial interface diagnostic connection on the front panel of the evaluation board IMC GS03.

Installation and maintenance personnel must observe that there is no galvanic separation between the serial interface and the electronics of the IMC, and no protection against overvoltage (maximum permanent voltage 250 V). Any equipment which is operated at the serial interface must have captive input characteristics, i.e. must be physically independent and have external voltage immunity and ground immunity.

If the Frauscher Diagnostic System FDS is being used, the captive properties mentioned above are fulfilled.

1.7 Power supply

The power supply must be uninterruptible.

The connections for the supply voltage of the ACS2000 are located on the ABP, whereby connections for channel 1 and channel 2 are designed to be separated.

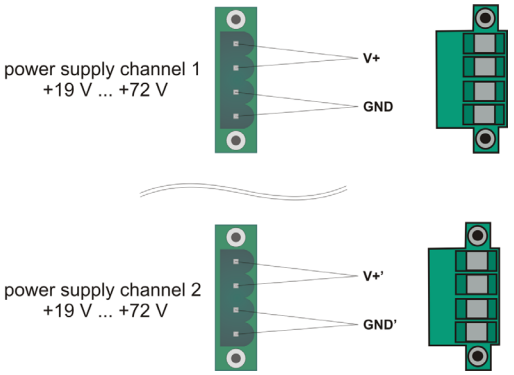


Figure 1.13: Clamps for the supply voltage

The GND connection must be viewed as the negative of the supply voltage (unequal earth potential).

The maximum terminal cross-section is 2.5 mm².

The required conductor cross-section, the laying procedure, the current carrying capacity and the temperature can be found in the operator regulations and standards.

The supply voltage of the ACS2000 must be in the range of +19 to +72 V DC. The power consumption is dependent on the supply voltage. The table below shows the typical values for power consumption of the individual boards with frequently used supply voltages. Furthermore, the power consumption is shown in Figure 1.14 to Figure 1.18.

power consumption per channel						
voltage		**24 V**	**36 V**	**48 V**	**60 V**	**initial current**
ACB		76 mA	54 mA	46 mA	38 mA	200 mA
IMC GS01	channel1 channel2	135 mA 39 mA	89 mA 26 mA	66 mA 21 mA	54 mA 17 mA	172 mA 50 mA
IMC GS03	channel1 channel2	154 mA 52 mA	103 mA 38 mA	79 mA 29 mA	63 mA 23 mA	200 mA 68 mA
DIOB all inputs **HIGH**, all relay contacts closed		65 mA	43 mA	33 mA	27 mA	200 mA
DIOB all inputs **LOW**, all relay contacts open		18 mA	13 mA	11 mA	10 mA	200 mA

Table 1.4: The power consumption of a board per channel

The typical initial current per channel is shown in the Table 1.4. This must be taken into consideration when planning the installation. The initial current is independent of the power supply.

The supply voltage may not exceed or fall short of +19 to +72 V DC at any time as a result of ripple. For the maximum permitted ripple see Figure 1.18.

The power supply of the system must be sufficient to ensure adequate current is available according to the requirements of the boards.

The power consumption must be determined at the lower tolerance limits of the operating voltage (= maximum current).

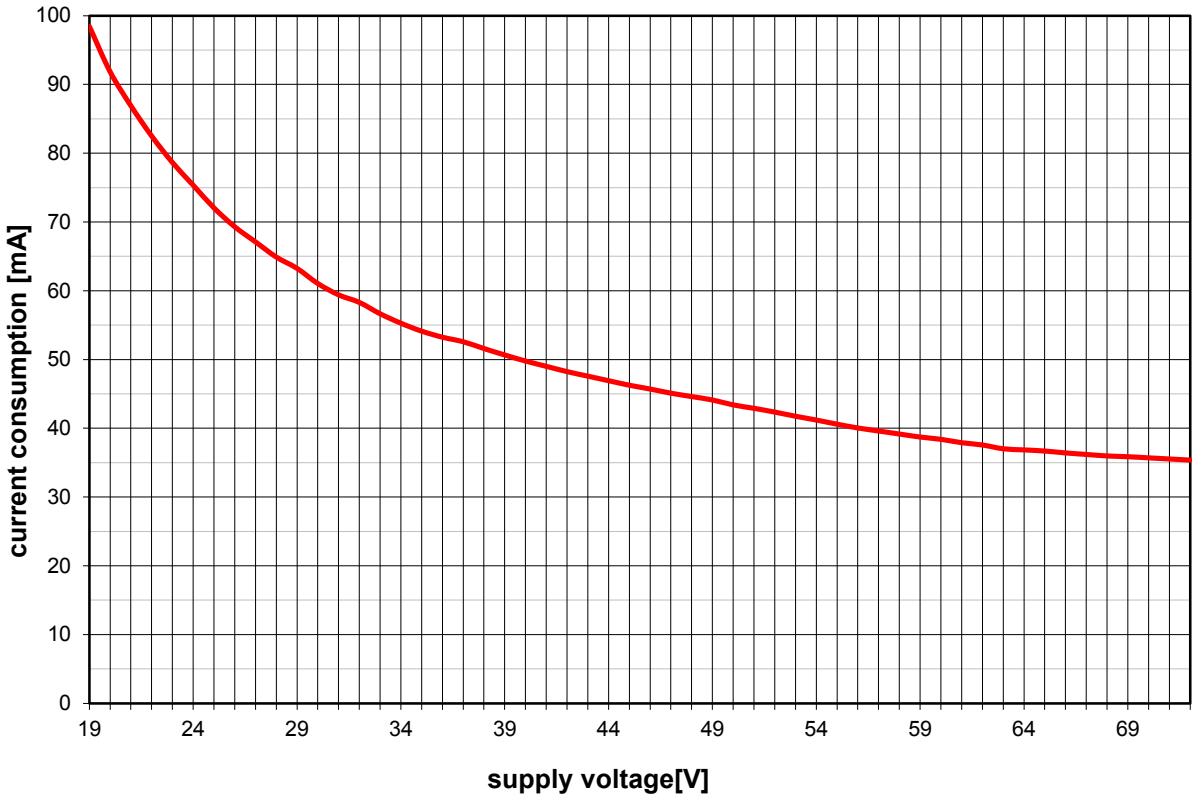


Figure 1.14: Typical power consumption of an ACB per channel

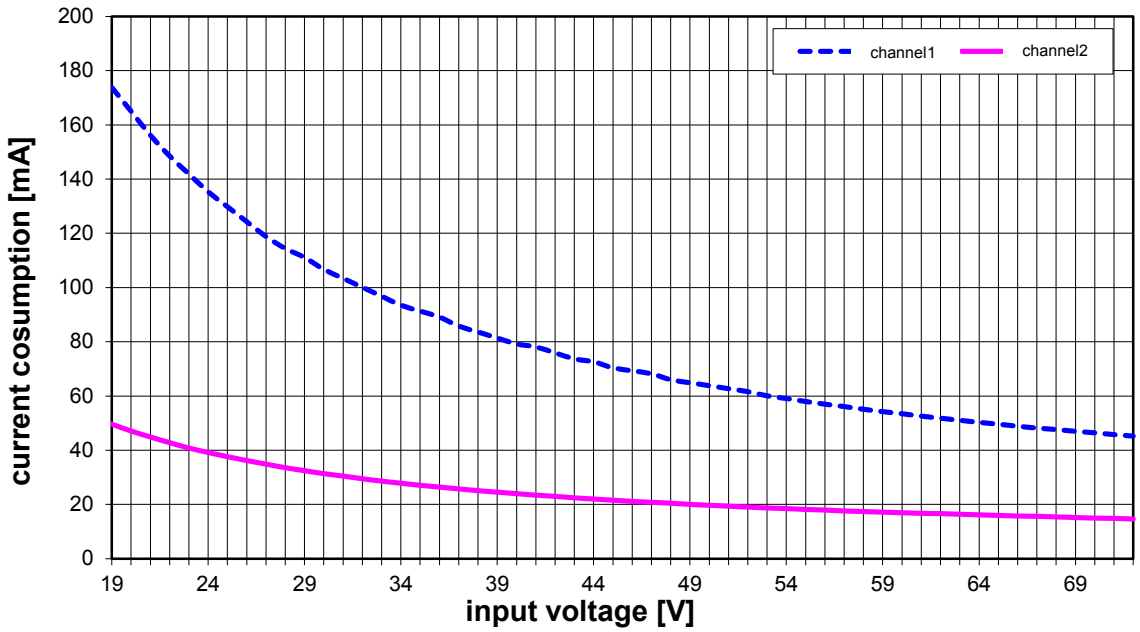


Figure 1.15: Typical power consumption of an IMC GS01 with RSR180 per channel

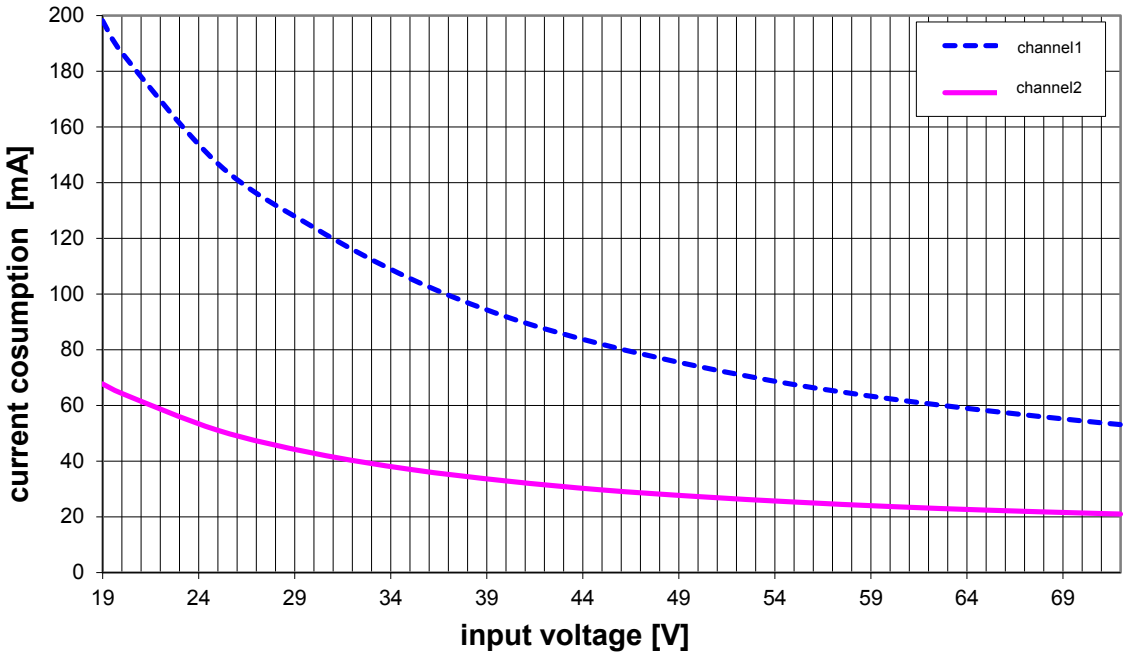


Figure 1.16: Typical power consumption of an IMC GS03 with RSR180 per channel

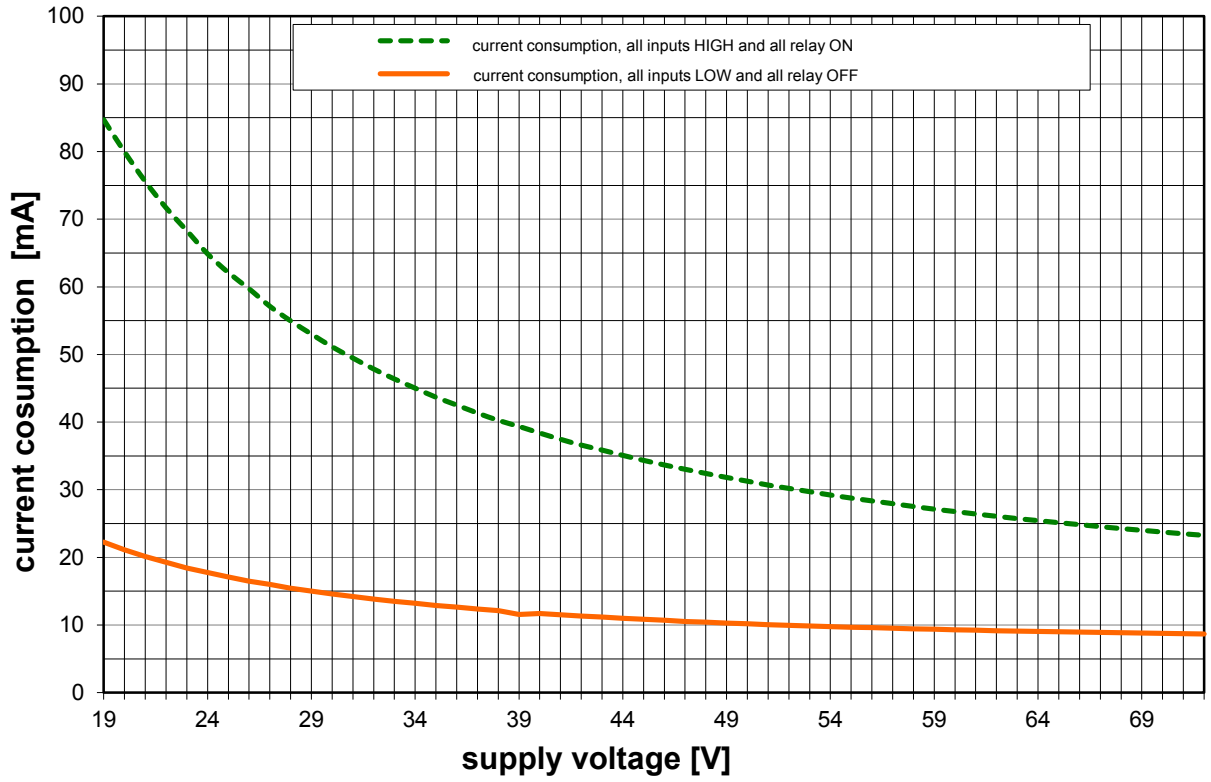


Figure 1.17: Typical power consumption of a DIOB per channel

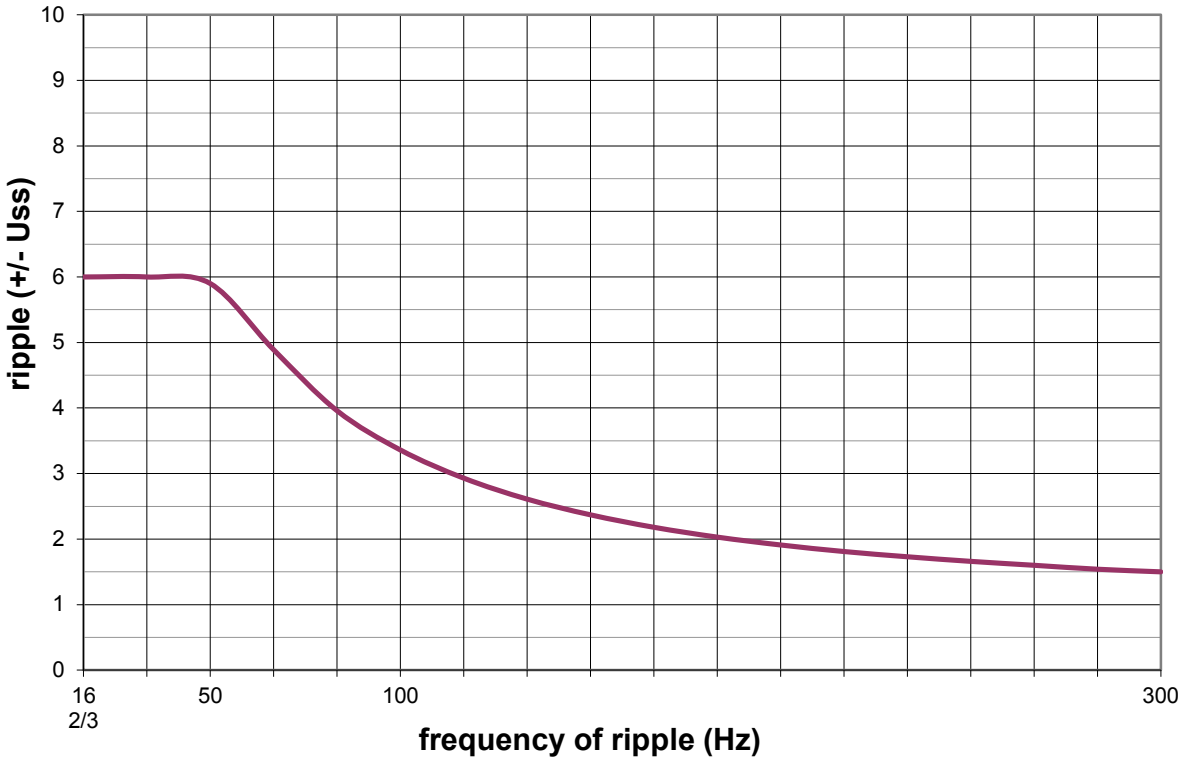


Figure 1.18: Maximum permitted ripple on the supply voltage

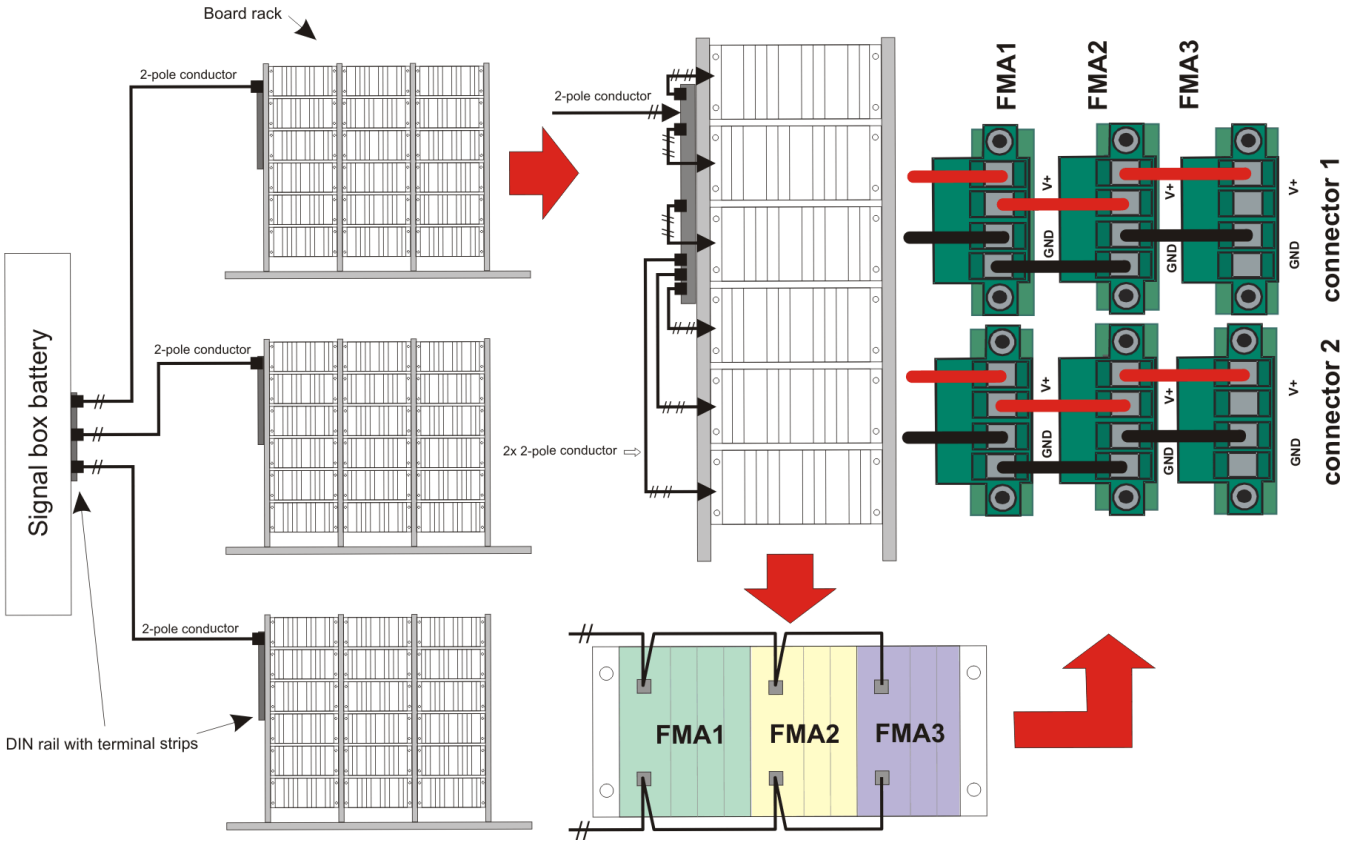


Figure 1.19: Power supply concept (example)

The power supply is characterised by the following:

- The entire complex of the boards of a rack frame is supplied through a 2-pin wire.
- Within a rack frame, the individual board racks are each supplied with a 2 x 2-pin wire (one 2-pin wire per channel).
- Within the board rack, the supply for each channel is looped through from one track section to the next track section.

1.8 Pin assignment

1.8.1 Mechanical structure

The following plugs and associated cable housings (see Figure 1.21) are located on the backplane ABP and are accessible from the rear of the housing of the board rack. The plugs and associated cable housings are supplied with the ABP (see Part II "System description). All multipole connectors correspond to the F shape [16] and have different codings.

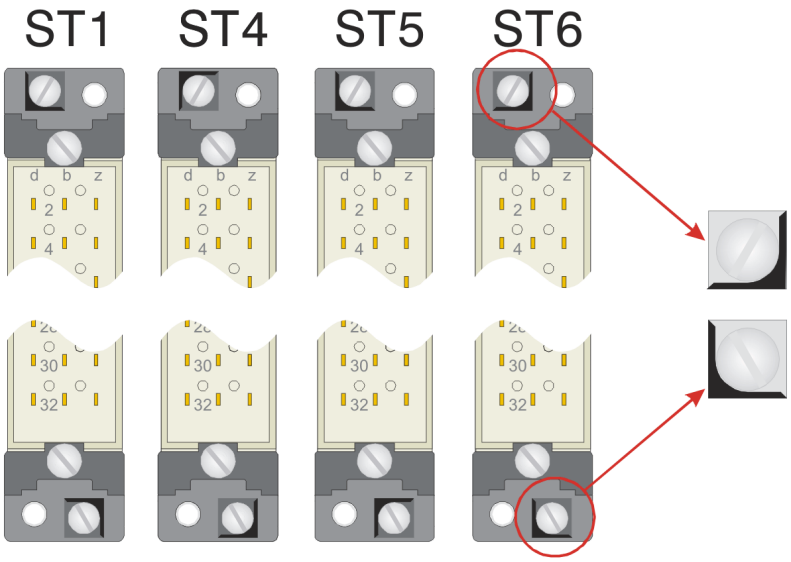


Figure 1.20: Coding of the multipole connectors

None of the pin codings and labellings applied in the factory may be modified or removed.

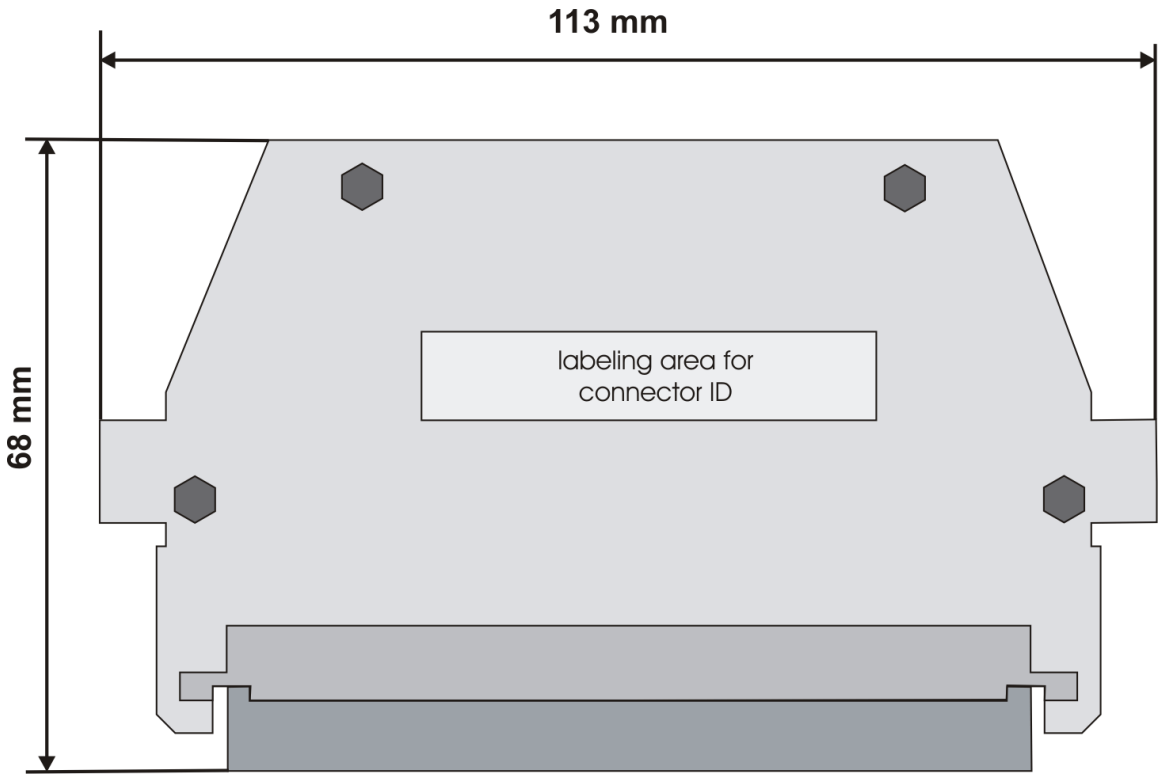


Figure 1.21: Cable housing

1.8.2 ST1 – wheel sensor inputs

2d	RSR 1 SYS 1	2b	not used	2z	RSR 1 SYS 2
4d	RSR 2 SYS 1	4b	not used	4z	RSR 2 SYS 2
6d	RSR 3 SYS 1	6b	not used	6z	RSR 3 SYS 2
8d	RSR 4 SYS 1	8b	not used	8z	RSR 4 SYS 2
10d	RSR 5 SYS 1	10b	not used	10z	RSR 5 SYS 2
12d	RSR 6 SYS 1	12b	not used	12z	RSR 6 SYS 2
14d	not used	14b	not used	14z	not used
16d	not used	16b	not used	16z	not used
18d	not used	18b	not used	18z	not used
20d	not used	20b	not used	20z	not used
22d	RSR 1 Vcc	22b	not used	22z	RSR 1 GND
24d	RSR 2 Vcc	24b	not used	24z	RSR 2 GND
26d	RSR 3 Vcc	26b	not used	26z	RSR 3 GND
28d	RSR 4 Vcc	28b	not used	28z	RSR 4 GND
30d	RSR 5 Vcc	30b	not used	30z	RSR 5 GND
32d	RSR 6 Vcc	32b	not used	32z	RSR 6 GND

Interfaces on the ST1 plug

"Wheel sensor inputs" interface for wheel sensor RSR180

1.8.3 Counting head outputs EB1 to EB6 (RJ45 socket)

Counting head outputs are only available if an evaluation board is plugged into the ABP.

DOUBLE OUT 1/J9 (double usage EB1)	
1	not used
2	SYS A(+) and /SYS B(+)
3	SYS B(+) and /SYS A(+)
4	SYS A(-)
5	/SYS B(-)
6	SYS B(-)
7	/SYS A(-)
8	not used

DOUBLE OUT 2/J12 (double usage EB2)	
1	not used
2	SYS A(+) and /SYS B(+)
3	SYS B(+) and /SYS A(+)
4	SYS A(-)
5	/SYS B(-)
6	SYS B(-)
7	/SYS A(-)
8	not used

DOUBLE OUT 3/J15 (double usage EB3)	
1	not used
2	SYS A(+) and /SYS B(+)
3	SYS B(+) and /SYS A(+)
4	SYS A(-)
5	/SYS B(-)
6	SYS B(-)
7	/SYS A(-)
8	not used

DOUBLE OUT 4/J18 (double usage EB4)	
1	not used
2	SYS A(+) and /SYS B(+)
3	SYS B(+) and /SYS A(+)
4	SYS A(-)
5	/SYS B(-)
6	SYS B(-)
7	/SYS A(-)
8	not used

DOUBLE OUT 5/J21 (double usage EB5)	
1	not used
2	SYS A(+) and /SYS B(+)
3	SYS B(+) and /SYS A(+)
4	SYS A(-)
5	/SYS B(-)
6	SYS B(-)
7	/SYS A(-)
8	not used

DOUBLE OUT 6/J24 (double usage EB6)	
1	not used
2	SYS A(+) and /SYS B(+)
3	SYS B(+) and /SYS A(+)
4	SYS A(-)
5	/SYS B(-)
6	SYS B(-)
7	/SYS A(-)
8	not used

Interface "Counting head outputs" for SYS A(-), /SYS B(-) double usage
Interface "Counting head outputs" for SYS B(-), /SYS A(-) double usage
Interface "Counting head outputs" for SYS A(+), /SYS A(+), SYS B(+), /SYS B(+) double usage

1.8.4 Direction outputs EB1 to EB6 (RJ45 socket)

TRIPPLE OUT / DEACT IN 1/J7 (direction EB1)	
1	short-circuited with Pin8
2	Ri1(+) and /Ri2(+)
3	Ri2(+) and /Ri1(+)
4	/Ri2(-)
5	Ri1(-)
6	/Ri1(-)
7	Ri2(-)
8	short-circuited with Pin1

TRIPPLE OUT / DEACT IN 2/J10 (direction EB2)	
1	short-circuited with Pin8
2	Ri1(+) and /Ri2(+)
3	Ri2(+) and /Ri1(+)
4	/Ri2(-)
5	Ri1(-)
6	/Ri1(-)
7	Ri2(-)
8	short-circuited with Pin1

TRIPPLE OUT / DEACT IN 3/J13 (direction EB3)	
1	short-circuited with Pin8
2	Ri1(+) and /Ri2(+)
3	Ri2(+) and /Ri1(+)
4	/Ri2(-)
5	Ri1(-)
6	/Ri1(-)
7	Ri2(-)
8	short-circuited with Pin1

TRIPPLE OUT / DEACT IN 4/J16 (direction EB4)	
1	short-circuited with Pin8
2	Ri1(+) and /Ri2(+)
3	Ri2(+) and /Ri1(+)
4	/Ri2(-)
5	Ri1(-)
6	/Ri1(-)
7	Ri2(-)
8	short-circuited with Pin1

TRIPPLE OUT / DEACT IN 5/J19 (direction EB5)	
1	short-circuited with Pin8
2	Ri1(+) and /Ri2(+)
3	Ri2(+) and /Ri1(+)
4	/Ri2(-)
5	Ri1(-)
6	/Ri1(-)
7	Ri2(-)
8	short-circuited with Pin1

TRIPPLE OUT / DEACT IN 6/J22 (direction EB6)	
1	short-circuited with Pin8
2	Ri1(+) and /Ri2(+)
3	Ri2(+) and /Ri1(+)
4	/Ri2(-)
5	Ri1(-)
6	/Ri1(-)
7	Ri2(-)
8	short-circuited with Pin1

Interface "Direction outputs" for Ri1(-), /Ri2(-)
Interface "Direction outputs" for Ri2(-), /Ri1(-)
Interface "Direction outputs" for Ri1(+) and /Ri2(+) or Ri2(+) and /Ri1(+)

1.8.5 ST6 – ACB inputs/outputs

2d	+5V (SYS A(+) and /SYS B(+))	2b	GND	2z	+5V' (SYS B(+) and /SYS A(+))
4d	1 SYS A(-)	4b	not used	4z	1 /SYS B(-)
6d	1 SYS B(-)	6b	not used	6z	1 /SYS A(-)
8d	2 SYS A(-)	8b	not used	8z	2 /SYS B(-)
10d	2 SYS B(-)	10b	not used	10z	2 /SYS A(-)
12d	not used	12b	not used	12z	not used
14d	Reset 1+	14b	not used	14z	Reset 1-
16d	pre-Reset 1+	16b	not used	16z	pre-Reset 1-
18d	Reset 2+	24b	not used	18z	Reset 2-
20d	pre-Reset 2+	26b	not used	20z	pre-Reset 2-
22d	not used	22b	not used	22z	not used
24d	Fm	24b	not used	24z	Fm'
26d	P	26b	not used	26z	P'
28d	not used	28b	not used	28z	not used
30d	Fm	30b	not used	30z	Fm'
32d	P	32b	not used	32z	P'

Interfaces on the ST6 plug

Interface supply for "counting head inputs" (chapter 1.4.1 ""Counting head inputs" interface“)
Interface "counting head inputs" for channel 1
Interface "counting head inputs" for channel 2
Interface "Reset" (chapter 1.4.3 ““Reset” interface“)
Interface "clear/occupied" (chapter 1.4.2 ""Clear/occupied" interface“)

Legend to symbols

A.....System 1 B.....System 2 /..... Expression denied

1.8.6 Double usage inputs EB3 to EB6 (RJ45 socket)

DOUBLE IN 3/J1		DOUBLE IN 4/J2		DOUBLE IN 5/J3		DOUBLE IN 6/J4	
1	GND	1	GND	1	GND	1	GND
2	+5V	2	+5V	2	+5V	2	+5V
3	+5V'	3	+5V'	3	+5V'	3	+5V'
4	3 SYS A	4	4 SYS A	4	5 SYS A	4	6 SYS A
5	3 /SYS B	5	4 /SYS B	5	5 /SYS B	5	6 /SYS B
6	3 SYS B	6	4 SYS B	6	5 SYS B	6	6 SYS B
7	3 /SYS A	7	4 /SYS A	7	5 /SYS A	7	6 /SYS A
8	not used	8	not used	8	not used	8	not used

Interface supply for "counting head inputs" (chapter 1.4.1 “"Counting head inputs" interface“)
Interface "counting head inputs" for channel 1
Interface "counting head inputs" for channel 2

1.8.7 Counting head control outputs (RJ45 socket)

DEACT OUT 1/J5	
1	Fm’
2	not used
3	not used
4	Fm’
5	not used
6	not used
7	V-‘_SIC
8	V+’_SIC

DEACT OUT 2/J6	
1	Fm’
2	not used
3	not used
4	Fm’
5	not used
6	not used
7	V-‘_SIC
8	V+’_SIC

Fused voltage according to the fuse board
Interface "counting head control"

The counting head control outputs are physically available, however they are not used in this system.

1.8.8 ST4 – DIOB inputs/outputs (channel 2)

2d	OUT 9a	2b	OUT 10a	2z	OUT 11a
4d	OUT 9b	4b	OUT 10b	4z	OUT 11b
6d	OUT 12a	6b	OUT 13a	6z	OUT 14a
8d	OUT 12b	8b	OUT 13b	8z	OUT 14b
10d	OUT 15a	10b	OUT 16a	10z	ERROR 2a
12d	OUT 15b	12b	OUT 16b	12z	ERROR 2b
14d	not used	14b	not used	14z	not used
16d	not used	16b	not used	16z	not used
18d	not used	18b	not used	18z	not used
20d	not used	20b	not used	20z	not used
22d	IN 9+	22b	IN 10+	22z	IN 11+
24d	IN 9-	24b	IN 10-	24z	IN 11-
26d	IN 12+	26b	IN 13+	26z	IN 14+
28d	IN 12-	28b	IN 13-	28z	IN 14-
30d	IN 15+	30b	IN 16+	30z	optional:Reset 2a
32d	IN 15-	32b	IN 16-	32z	optional:Reset 2b

Interfaces on the ST4 plug

Interface "DIOB inputs" (chapter 1.5.1 ""DIOB inputs" interface“)
Interface "DIOB outputs" (chapter 1.5.2 ""DIOB outputs" interface“)
Interface "ERROR" (chapter 1.5.5 ""ERROR" interface“, relay contacts Figure 1.5)
Interface “optional:Reset” (chapter 1.5.6 ““Optional:Reset” interface“)

Legend to symbols

a.....connection a
b.....connection b

1.8.9 ST5 – DIOB inputs/outputs (channel 1)

2d	OUT 1a	2b	OUT 2a	2z	OUT 3a
4d	OUT 1b	4b	OUT 2b	4z	OUT 3b
6d	OUT 4a	6b	OUT 5a	6z	OUT 6a
8d	OUT 4b	8b	OUT 5b	8z	OUT 6b
10d	OUT 7a	10b	OUT 8a	10z	ERROR 1a
12d	OUT 7b	12b	OUT 8b	12z	ERROR 1b
14d	not used	14b	not used	14z	not used
16d	not used	16b	not used	16z	not used
18d	not used	18b	not used	18z	not used
20d	not used	20b	not used	20z	not used
22d	IN 1+	22b	IN 2+	22z	IN 3+
24d	IN 1-	24b	IN 2-	24z	IN 3-
26d	IN 4+	26b	IN 5+	26z	IN 6+
28d	IN 4-	28b	IN 5-	28z	IN 6-
30d	IN 7+	30b	IN 8+	30z	optional:Reset 1a
32d	IN 7-	32b	IN 8-	32z	optional:Reset 1b

Interfaces on the ST5 plug

Interface "DIOB inputs" (chapter 1.5.1 “"DIOB inputs" interface“)
Interface "DIOB outputs" (chapter 1.5.2 “"DIOB outputs" interface“)
Interface "ERROR" (chapter 1.5.5 “"ERROR" interface“, relay contacts Figure 1.5)
Interface “optional:Reset” (chapter 1.5.6 ““Optional:Reset” interface“)

Legend to symbols

a.....connection a
b.....connection b

2 Configuration

With regard to project planning of the ACS2000 axle counting system, the guidelines [12] must be observed.

In principle, it must be decided whether the ACS2000 axle counting system needs to be used in isolated operation or in modem operation.

2.1 ACS2000 in isolated operation

Area of application

The ACS2000 is used in isolated operation for monitoring a track section. The length of the track section to be monitored is determined by the regulations of the relevant railway operator and by the maximum cable length between the wheel sensors and their evaluation boards. For information on cable lengths, see chapter 3.2 “Cable between the wheel sensor and KA (and/or BSI)“.

Properties

- In isolated operation, a ACS2000 system operates independently.
- A maximum of 6 independent counting heads can be evaluated. These 6 counting heads can be traversed simultaneously, in any direction and at any speed (0-450 km/h).
- Double usage for adjacent track sections (double usage of counting heads) is possible.

With the assistance of the DIR-DIP-switches, the counting direction can be configured for each counting head.

2.2 ACS2000 in modem operation

Area of application

The ACS2000 is used here in modem operation, where long track sections (limited only by the type of transmission) need to be monitored or where more than 6 counting heads are connected to a track section. In addition, up to 16 arguments can optionally be transmitted between both ACS2000 systems used in modem operation.

Properties

- Both of the ACS2000 systems used in modem operation can operate equivalently and synchronously. If an axle is counted in on one ACS2000 system, this axle information is transmitted to the other ACS2000 system.
- Both ACS2000 systems communicate through a modem. The distance of the two ACS2000 system is only dependent on the modem. However, the data transmission section must comply with the requirements of closed transmission systems in accordance with [9].

During the project planning of an axle counting circuit it must be borne in mind that only components with an identical transmission rate should be used.

During modem operation, the speed dependent minimum length of the track section must be taken into account (see Part V "Types of boards"). The minimum section length is also adjusted in accordance with the regulations of the relevant railway administration.

- Optionally, up to 16 arguments (in safety-relevant applications, up to 8 arguments) can be transmitted between the two ACS2000 systems. The arguments are input through an optocoupler, galvanically isolated, and output at the receiver through voltage-free relays.
- A maximum of 12 independent counting heads can be evaluated in modem operation.
- Double usage for adjacent track sections (double usage of counting heads) is possible.
- The counting direction can be configured in modem operation by changing the wheel sensor systems (Sys1 ↔ Sys2).
- If, for instance, more than 6 counting heads (12 counting heads maximum) are required for a gridiron, it is possible to replace the modem connection with a null-modem cable (maximum cable length = 3 m).

2.3 Counting head outputs

2.3.1 Double usage

Thanks to the counting head double usage it is possible to use one counting head for two adjacent track sections. Furthermore, the digital information of the corresponding counting heads is forwarded to the ACB of the adjacent track section (see Part II "System description").

For the double usage wiring, the counting head outputs must be connected to the ACB inputs.

In the case of safety-relevant applications of double usage, all 4 system outputs (Sys1, /Sys1, Sys2, /Sys2) must be used by the downstream system.

The double usage outputs at the RJ45 sockets 1/J9, 2/J12, 3/J15, 4/J18, 5/J21 and 6/J24, when in use, are normally connected to the ACB inputs at the RJ45 sockets 3/J1 to 6/J4.

When using the ACB inputs EB1 and EB2 as double usage, the cable must be connected to the ST6 plug.

The connection for double usage wiring is simplified, as each evaluation board has its own RJ45 socket.
It does not matter to which of the ACB inputs these double usage outputs are connected, as all 6 inputs are equivalent. The double usage output at socket 2/J12 can therefore also be connected to the socket 3/J1 or 6/J4 of the ACB input.
When using the first two ACB inputs as double usage, the cable must be separated. It is therefore recommended to only use double usage from the third ACB input.

It is important that the ACB input is not already used by an evaluation board. In this case, the input should NOT be used for double usage wiring.

For example, for a track section with two evaluation boards (on the first and second plug socket), only counting head inputs 3 to 6 should be used for double usage, as counting heads 1 and 2 are already used by the evaluation boards. It does not matter which input (3, 4, 5 or 6) is used.

Advantage:	Counting heads can be saved. Saving of cost and effort.
Disadvantage:	In the event of a faulty counting head, both track sections are affected.
Wiring:	For the wiring of a counting head double usage, at least one 8-pin patch cable of category 5 (CAT 5, maximum length = 30 m) is required. The cable for counting head double usage must be protected against the following faults: • Short circuit between the wires of a double usage • Short circuit between the wires to other double usage connections

When using the patch cable supplied by Frauscher for wiring of the counting head double usage, the faults mentioned under "wiring" can be avoided with appropriate laying of the cable (e.g. cable routing in wide radii and not over pointy angles).

2.4 Function and configuration of the ABP

The DIR-, MODE- and DN-DIP-switches are accessible from the rear of the board rack and are located above and below the ST6 plug. The DIP-switches DIP1 – 7, DIP2 – 7 and DIP2 – 8 for channel 1 and DIP1' – 7, DIP2' – 7 and DIP2' – 8 have no function.

Only the DIP-switches and soldering jumpers that are described in chapter 2.4 may be modified. Modifications to the DIP-switches and soldering jumpers may only be carried out by specially trained personnel, taking into account the project planning documents.

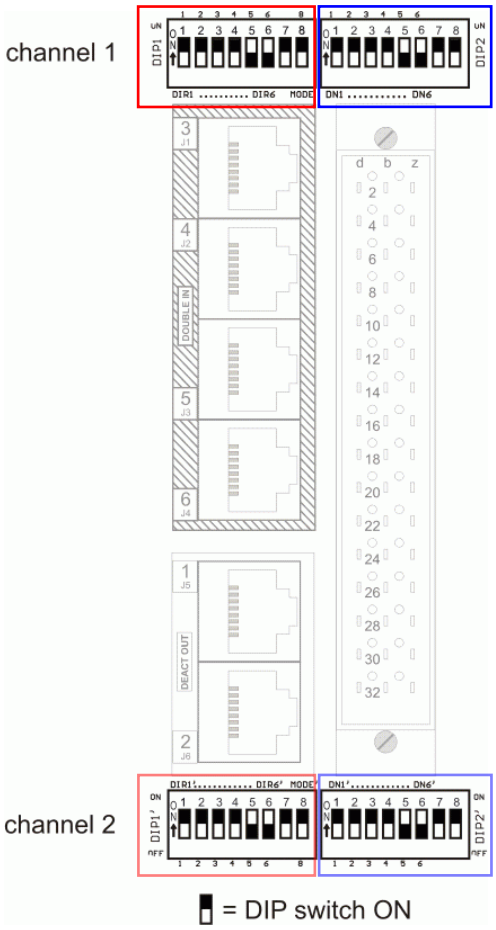


Figure 2.1: Position of the DIP-switches on the rear of the ABP

The positions of the DIR, MODE and DN-DIP-switches of channel 1 must not differ in isolated operation from channel 2.

The positions of the MODE and DN-DIP-switches of channel 1 must not differ in modem operation from channel 2 of the same ACS2000 system. The DIR-DIP-switches fulfil an addressing function in modem operation.

2.4.1 MODE-DIP-switches

The operating mode of the ACS2000 is set with the assistance of both DIP-switches MODE and MODE' (channel 1 and channel 2).

The configuration of isolated or modem operation takes place in the factory. The DIP-switches are set in the factory.

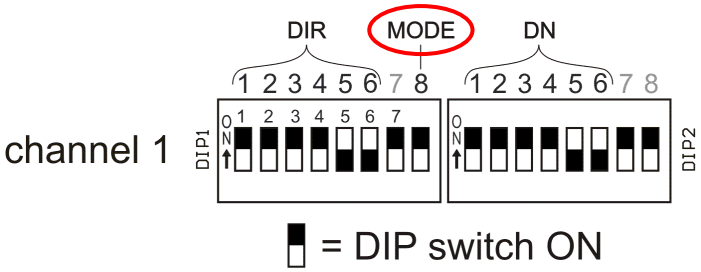


Figure 2.2: Overview of the DIP-switches for channel 1

DIP-switches		status	function
channel 1	**channel 2**		
DIP1 - 8	DIP1' - 8	OFF	isolated operation
		ON	modem operation

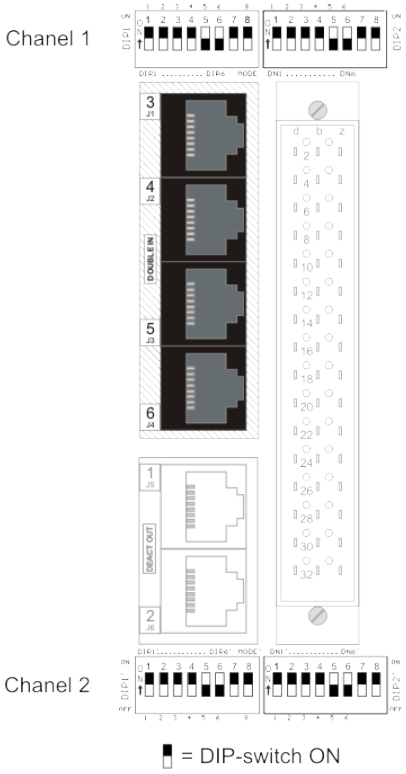
Table 2.1: Functions of the DIP-switches

The MODE-DIP-switches are accessible from the rear of the board rack and are located above and below the ST6 plug.

The configuration of the MODE-DIP-switches of channel 1 must not differ from the configuration of the MODE'-DIP-switches of channel 2 (both OFF or both ON)!

2.4.2 DN-DIP- switches

With the assistance of the DN-DIP-switches, the ACS2000 system can find out at which input of the ACB a counting head double usage is located.



In the case of double usage, a counting head is evaluated by two axle counting boards ACB on adjacent track sections.

The configuration of the DN-DIP-switches of channel 1 must not differ from the configuration of the DN'-DIP-switches of channel 2 (both OFF or both ON)!

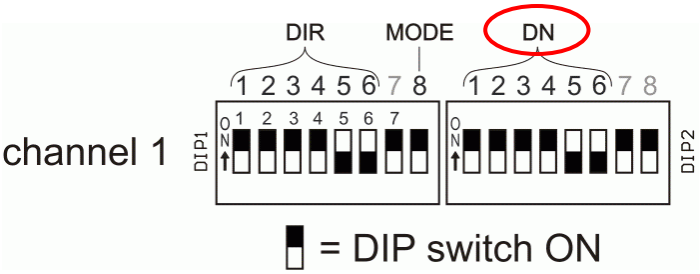


Figure 2.3: Overview of the DIP-switches and of the inputs to counting head double usage

DIP- switches		status	function
channel 1	**channel 2**		
DIP2 - 1	DIP2' - 1	OFF	counting head double usage ST6
		ON	no counting head double usage ST6
DIP2 - 2	DIP2' - 2	OFF	counting head double usage ST6
		ON	no counting head double usage ST6
DIP2 - 3	DIP2' - 3	OFF	counting head double usage input 3(J1)
		ON	no counting head double usage input 3(J1)
DIP2 - 4	DIP2' - 4	OFF	counting head double usage input 4(J2)
		ON	no counting head double usage input 4(J2)
DIP2 - 5	DIP2' - 5	OFF	counting head double usage input 5(J3)
		ON	no counting head double usage input 5(J3)
DIP2 - 6	DIP2' - 6	OFF	counting head double usage input 6(J4)
		ON	no counting head double usage input 6(J4)

Table 2.2: Functions of the DIP-switches

The plug assignments of the counting head double usage for inputs 3 - 6 are shown in chapter 1.8.6.

2.4.3 DIR-DIP-switches in isolated operation

The counting direction of each counting head can be configured with the assistance of the DIR-DIP-switches.

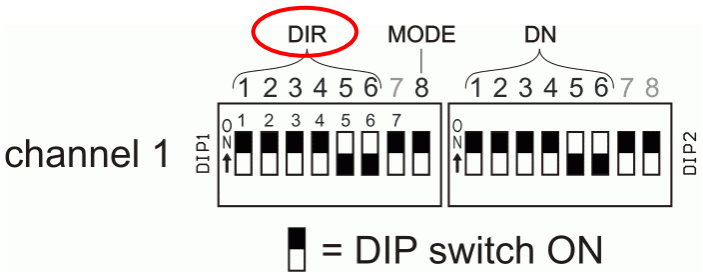


Figure 2.4: Overview of the DIP-switches for channel 1

If both systems of the relevant counting head are connected in accordance with the plug assignment, see chapter 1.8 “Pin assignment”) the following functions apply:

DIP-switches “OFF“: An axle is counted in at the relevant counting head when it traverses from System 1 to System 2 (see Table 2.3).

DIP-switches “ON“: An axle is counted out at the relevant counting head when it traverses from System 1 to System 2 (see Table 2.3).

In the event of double usage of a counting head, the counting direction must be configured on both axle counting systems using the corresponding DIR-DIP-switches on the ABP. If an input of the ACB is not used, the associated DIR-DIP-switch will have no function. However, both channels must have the same setting (both OFF or both ON).

isolated operation		
traversing of	DIR	counting process
Sys1 to Sys2	OFF	count in
Sys1 to Sys2	ON	count out
Sys2 to Sys1	OFF	count out
Sys2 to Sys1	ON	count in

modem operation		
traversing of	RSR systems	counting process
Sys1 to Sys2	not reversed	count in
Sys1 to Sys2	reversed	count out
Sys2 to Sys1	not reversed	count out
Sys2 to Sys1	reversed	count in

Table 2.3: Counting direction in isolated operation and in modem operation

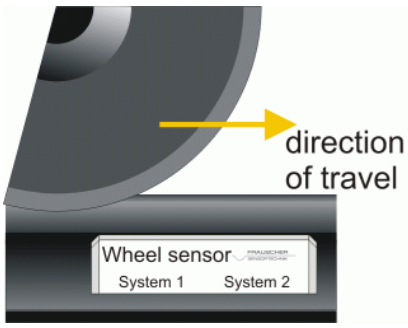
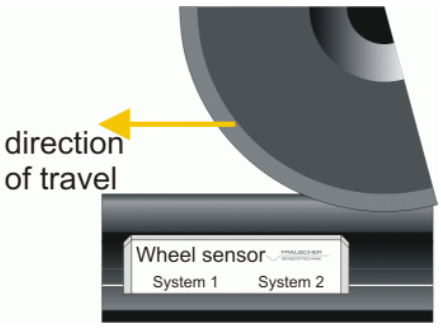


Figure 2.5: Traversing from Sys1 to Sys2



Traversing from Sys2 to Sys1

Whether the axle counting board ACB counts in or out as the axles traverse over the wheel sensor, depends on the following factors:

- direction from which the axles roll over the counting head
- side of the track on which the wheel sensor is mounted
- DIR-DIP-switches OFF or ON
- wheel sensor systems connection reversed or not reversed

It is possible to change the direction by:

- DIR-DIP-switches OFF or ON
- cross-bonding of both sensor systems (Sys1 ↔ Sys2), only to be applied in modem operation (Figure 2.7)
- For information on changing the wheel sensor's mounting side, if permitted by the mounting and commissioning instructions for the wheel sensor, see Part I "Outline of documents".

2.4.4 DIR-DIP- switches in modem operation

In modem operation, the counting direction of the counting heads cannot be influenced, as it is in isolated operation, with the DIR-DIP-switches.

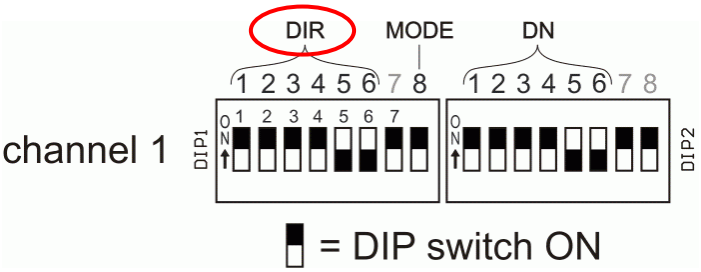


Figure 2.6: Overview of the DIP-switches for channel 1

The DIR-DIP-switches have the following function in modem operation:

DIR1 and DIR1': By switching the DIP-switches DIR1- and DIR1' to ON, the axle counting board is defined as the Master. By doing this it is determined which of the two axle counting boards that communicate with one another starts in modem operation with the serial communication set-up. Only one axle counter board may be defined as the Master in each case. For the other axle counter boards, the DIR1- and DIR1'-DIP-switches must be in the OFF position.
This setting has no influence on axle counting.

DIR2 to DIR6 and DIR2' to DIR6': By switching the DIP-switches DIR2 to DIR6 and DIR2' to DIR6', a 10-bit address is set for identification of serial data. This 10-bit address must be the same in all ACS2000 systems that actually need to communicate with one another. If several ACS2000 systems are used in the same equipment in modem operation, this 10-bit address must be set differently, so that an accidental swapping of the modem cable can be detected.

Whether the axle counting boards ACB count in or out as the axles traverse over the wheel sensor depends on the following factors:

- direction from which the axles roll over the counting head
- side of the track on which the counting head (wheel sensor) is mounted
- wheel sensor systems connection reversed or not reversed

It is possible to change the direction by:

- cross-bonding of both sensor systems (Sys1 ↔ Sys2), only to be applied in modem operation (Figure 2.7)
- For information on changing the wheel sensor's mounting side, if permitted by the mounting and commissioning instructions for the wheel sensor, see Part I "Outline of documents". This method is useless in the event of double usage.

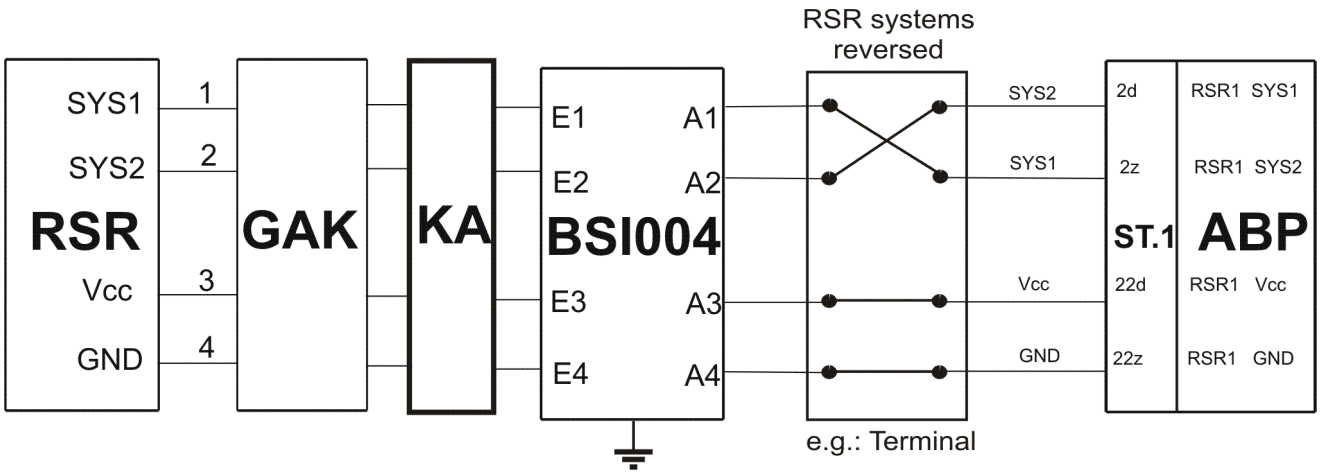


Figure 2.7: Systems of the wheel sensor reversed (connection RSR1 used)

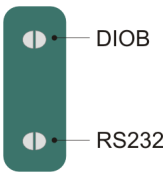
In the case of modem operation with the DIP-switches DIR2 to DIR6 and DIR2' to DIR6', a user defined code (10 bit code) must be set on the backplane ABP. This code must match for both axle counting systems (same configuration of the DIP-switches).

In the case of modem operation with the DIP-switches DIR2 to DIR6 and DIR2' to DIR6', a user defined code (10 bit code) must be set on the backplane ABP. The code must be set differently for neighbouring or adjacent track sections.

2.4.5 Soldering jumpers

DIOB soldering jumper: The DIOB soldering jumper is set (closed) if no digital input/output board (DIOB) is used.

RS232 soldering jumper: The RS232 soldering jumper is set (closed), if the system is operated in isolated operation.



The DIOB and RS232 soldering jumpers are accessible from the inner side of the board rack and are located between the plugs of the fuse board and of the ACB and are set in the factory.

Soldering jumpers MODE (VAL): The soldering jumpers MODE (VAL) are set if the antivalent input signals need to the acquired immediately and the valent input signals after an additional transmission cycle. If neither of the soldering jumpers are set, then the valent input signals are acquired immediately and the antivalent input signals after an additional transmission cycle. The soldering jumpers MODE (VAL) have no influence if the ACS2000 is used without DIOB.

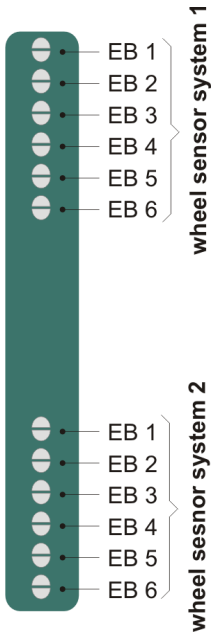
Both MODE (VAL) soldering jumpers must be in the same status (set or not set).

For further details on the DIOB's transmission times, see Part V "Types of boards".

The soldering jumpers MODE (VAL) are accessible from the inner side of the board rack, they are located between the plugs of the DIOB and of the fuse board and are set in the factory.

Soldering jumpers EB: The axle counting board ACB generally evaluates signals from up to 6 evaluation boards. The number of EB soldering jumpers on the ABP corresponds to the number of evaluation boards that can be plugged in.

Example: 3 counting heads are evaluated in one track section (evaluation boards 1, 2 and 3). An ABP with 3 plug-in units is used for the evaluation boards, which has 6 soldering jumpers (3 for counting head system 1 (EB1-EB3) and 3 for the counting head system 2 (EB1-EB3) for the 3 evaluation boards.



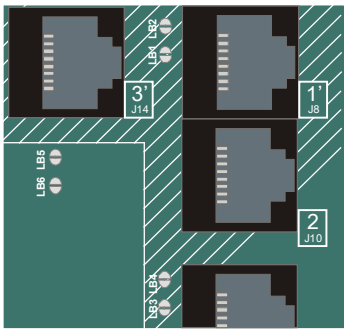
The EB soldering jumpers are accessible from the inner side of the board rack, they are located between the plugs of the ACB and are set in the factory.

The EB soldering jumpers of counting head system 1 must coincide with those of counting head system 2 and must not differ in any way.

When ordering, it must be stated whether the ACB should operate in isolated or modem operation, with or without DIOB, with 0, 1, 2,..., or 6 evaluation boards.

Soldering jumpers LB1-LB12: The soldering jumpers must be open during direction output.

The soldering jumpers LB1 to LB12 are accessible from the outer side of the board rack and are located between the sockets TRIPPLE OUT / DEACT IN and DOUBLE OUT.



3 Cable types and cable routing

3.1 General information

- Cables in the indoor equipment must be laid via the shortest route.
- Wheel sensor cables and cables for the wiring of counting head double usage must be laid so that they are isolated from electric power lines, motor lines, lines in which transients occur due to switching actions, etc., in order to minimise electromagnetic interferences. Raised levels of interference, caused by crosstalk, result in reduced system availability.
- For the wiring of a counting head double usage, an 8-pole patch cable of at least category 5 (CAT 5) is required for each wheel sensor (= 2 sensor systems), the length of which must not exceed 30 m and must be kept as short as possible.
- Multiple wheel sensor signals are possible in a single cable.
- Cables upstream and downstream of the BSI must be laid separately (EMC).
- When laying the cable, the regulations regarding routing must be observed.

In order to ensure high availability, the manufacturer recommends that a star-quad signalling cable is used for the wheel sensor cabling between the KA (BSI) and the ABP. This cable must have the same electric strength as the cables in the outdoor equipment (permitted transient overvoltage 1500 V). In the event that the cable is equipped with shielding, this shielding must be fitted in accordance with the applicable railway regulations. If there are no applicable railway regulations available on this matter, the shielding should not be earthed.

An interwire or earth short circuit between the overvoltage protection board BSI and the evaluation board IMC, or between two IMC evaluation boards in the case of analogue double usage, must be prevented by routing the cables in a suitable manner.

It is essential to protect the cable to the interfaces "DIOB inputs", "optional:Reset", "DIOB outputs", "ERROR", "Reset", "pre-Reset", "Counting head inputs" and "Counting head outputs" interface against the following faults:

- short circuit between the wires
- short circuit between the wire and shield
- short circuit between the wire and earth

The cable of the serial connection (cable between the D-SUB plug of the ABP and the modem, cable between the D-SUB plugs on two ABPs, cable between the D-SUB socket of the ACB/DIOB and the modem/data evaluation device, cable between the RJ45 socket of the IMC and the data evaluation device) must not exceed a maximum length of 3 m.

The cable on the diagnostic interface of the ACB (D-SUB socket or RJ45 socket) must not exceed a maximum length of 3 m.

As the coding of ST1 to ST6 plugs is standardised in all backplanes ABP and must not be changed, it must be ensured, during planning and installation of the equipment, that the plugs are not swapped (between several backplanes ABP). This is possible through appropriate cable routing, cable lengths and clear cable marking.

After any modification of the cabling, the patch cable must be tested to check whether the marking on the plugs coincides with the designation on the sockets in accordance with the project planning documents.

For the cabling (ABP - RJ45 sockets), only the cables supplied by the manufacturer or equivalent cables may be used. A defective cable may only be replaced by an equivalent cable .

3.2 Cable between the wheel sensor and KA (and/or BSI)

A 5 m-long PUR cable with colour-coded connecting wires is cast-in on the wheel sensor as standard.

A protection tube provides the cable with additional mechanical protection. However, this must be requested separately! The RSR connecting cable is connected to the ongoing cable in a trackside connection box, by means of a screw terminal.

For the cabling between the trackside connection box and KA (or BSI), signal cable (such as, e.g., a signal cable in a star-quad formation with PE insulation and PE coating according to the specifications of the technical functional specifications documents 416.0115 (formerly Dlk 1.013.109y) and 416.0116 (formerly Dlk 1.013.110y) published by Deutsche Bahn AG or in accordance with DIN VDE 0816 Part 2) or paired cables must be used and laid according to Figure 3.1 (each pair of diametrically opposed wires form a wire circuit). If other cables are used in existing systems, this may impair the availability of the axle counting system.

When laying the cables from the wheel sensor to the overvoltage protection board, it must be ensured that no other signals except those from the wheel sensors are transmitted in the cable. However, signals from various wheel sensors may be transmitted in one cable.

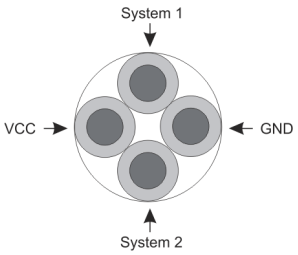


Figure 3.1: Arrangement of the wires when using a star-quad signalling cable

In the event that the cable is equipped with shielding, this shielding must be fitted in accordance with the applicable railway regulations. If there are no applicable railway regulations available on this matter, the cable should not be earthed.

The maximum admissible loop resistance is 250 Ω.

wire diameter	loop resistance/km	maximum cable length 250 Ω
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	10.6 km

Table 3.1: Cable lengths with various wire diameters

For wheel sensor cables longer than 10 km, please consult the manufacturer!

4 Transient overvoltages, permanent voltages and EMC limit values

The indoor equipment of the ACS2000 has been subjected to an EMC type test in accordance with [7].

The wheel sensor (outdoor equipment) has been subjected to an EMC type test in accordance with [7].

In order to prevent wheel sensor faults, emissions (e.g. from traction converters) must be ruled out in the direct vicinity of the wheel sensors and in the frequency area of the wheel sensor systems. See Part I "Outline of document".

The maximum permitted transient overvoltage between:

- the voltage supply of both channels is 3.1 kV[1],
- the interfaces "wheel sensor", "diagnostics", "test sockets" and the digital outputs is 3.1 kV[1],
- the interfaces "voltage supply" and "wheel sensor", "diagnostics" or "test sockets" is 3.1 kV[1],
- "wheel sensor", "diagnostics", "test sockets" and "counting head control inputs" is 3.1 kV[1],
- "voltage supply" and "counting head control inputs" is 1.2 kV[1],
- "digital outputs" and "counting head control inputs" is 1.2 kV[2],
- the digital outputs and inputs is 1.2 kV[2],
- the voltage supply and the digital outputs is 2.8 kV[3].

The maximum permanent voltage in accordance with [8] between the SIC channels is 350 V.

The maximum permitted transient overvoltage in accordance with [8] at the interfaces with galvanic isolation is 1500 V. This applies to the " clear/ occupied", "Reset", pre-Peset", "DIOB inputs", "Optional:Peset" and "Power supply" interfaces, and to both optocoupler outputs on the D-SUB socket of the ACB.

Only signals that are voltage-free to the earth may be connected to the "Counting head inputs" and "Serial Communication" interfaces (no galvanic isolation or a functional galvanic isolation).

The maximum permanent voltage is 50 V, the maximum permitted transient overvoltage is 100 V. The maximum permitted transient overvoltage in accordance with [8] on the "DIOB outputs" and "ERROR" interfaces is 900 V.

These values apply when using at a height of up to 2000 m. If using at a height of up to 3000 m, the maximum permitted transient overvoltages and maximum permanent voltages must be reduced by 13 %. When using at a height of more than 3000 m, please consult the manufacturer.

1 corresponds to 4 mm clearance and creepage distance

2 corresponds to 0.91 mm clearance and creepage distance

3 corresponds to 3.45 mm clearance and creepage distance

5 Earthing and shielding concept

5.1 Earthing concept

Unless prescribed otherwise by the operating earthing concept, the following earthing regulations apply:

- earth the overvoltage protection board BSI in accordance with the mounting instructions (see Part I "Outline of documents")
- earth the board rack BGT (protection from ESD)

The yellow-green earth wire (at least 6 mm^2) of the overvoltage protection board BSI must be connected to an earth rail via the shortest possible route. Attention must be paid to low transfer resistances.

5.2 Shielding concept

In the event that the cable is equipped with shielding, this shielding must be fitted in accordance with the applicable railway regulations. If there are no applicable railway regulations available on this matter, the cable should not be earthed.

The use of a shielded cable is not compulsory by law; this applies to both the cables of the outdoor equipment and the cables of the indoor equipment.

6 Installation regulations

6.1 Indoor equipment

6.1.1 Required tools

- screwdriver (2.8 mm x 0.6 mm)
- soldering iron (soldering tip 1 mm)
- wire stripper
- side cutter
- flat-nosed pliers
- knife for cable coating
- tin solder (diameter 0.75 mm or 1 mm)
- fixing material for installation of a 19” board rack (BGT) in the support/frame, and appropriate tools

6.1.2 Preparation and mounting

- Install the overvoltage protection board BSI in accordance with the mounting instructions (see Part I "Outline of documents").

The yellow-green earth wire (at least 6 mm^2) from the overvoltage protection board BSI must be connected to an earthing terminal via the shortest possible route. Attention must be paid to low transfer resistances.

- Fix the 19" board rack (BGT) to the support/frame.
- Earth the board rack (protection from ESD).
- For cable types and laying of cables, see chapter 3 “Cable types and cable routing“.
- Signal wires to the clear contact relays, to the Reset toggle switches and between the overvoltage protection board BSI and the backplane ABP must be laid so that a wire short circuit between the wires, to any screening in place or to other leads, can be excluded.

If the IMC is installed in an area that lies at most 3 m from the centre line of the nearest track, additional EMC-tests should be carried out for the serial interface.

Only with modem operation:

- Connect RS232-compatible modem in accordance with the system planning, or connect a null-modem cable to the serial communication of the ABP.

Ensure cleanliness (remove soldering residues, remove wire scraps, etc.).

Ensure that the cables are laid correctly.

6.1.3 Mechanical fixing to the support/frame

- Support/frame suitable for the installation of 19" board racks (BGT).
- Protection against falling conductive parts.

In order to prevent any external influences, the components of the indoor equipment of the ACS2000 must be installed inside a completely enclosed board rack that complies with at least protection class IP20. Unused plug sockets in a board rack must be sealed with suitable covers.

When multiple board racks are installed above one another, care must be taken to ensure that these are not installed directly above one another without clearance space. The board racks should have a separation distance of at least 15 mm.

Furthermore, it must be ensured that there is adequate air circulation, so that the rising heat from the boards can be discharged.

6.2 Outdoor equipment

6.2.1 Required tools

see Mounting and commissioning of the wheel sensor (Part I "Outline of documents")

6.2.2 Environmental conditions

see Application guidelines of the wheel sensor (Part I "Outline of documents")

6.2.3 Arrangement of sensors

see Mounting and commissioning of the wheel sensor (Part I "Outline of documents")

6.2.4 Preparation and mounting

Mounting of the wheel sensor must be carried out in accordance with Mounting and commissioning of the wheel sensor (Part I "Outline of documents", chapter 5).

7 Mechanical dimensions

7.1 Type BGT04

The board rack measures 3 HE in height and 84 TE in width, and is therefore suitable for 19” supports. Depending on the configuration, a board rack can be used for up to 4 track sections. The dimensions required for mounting of the housing are detailed in Figure 7.1 and in Figure 7.3.

During project planning and installation of the board rack, the required space for the label bar (optional, see Figure 7.1) must be taken into account.

Dimensions/measurements of the figures are given in millimetres.

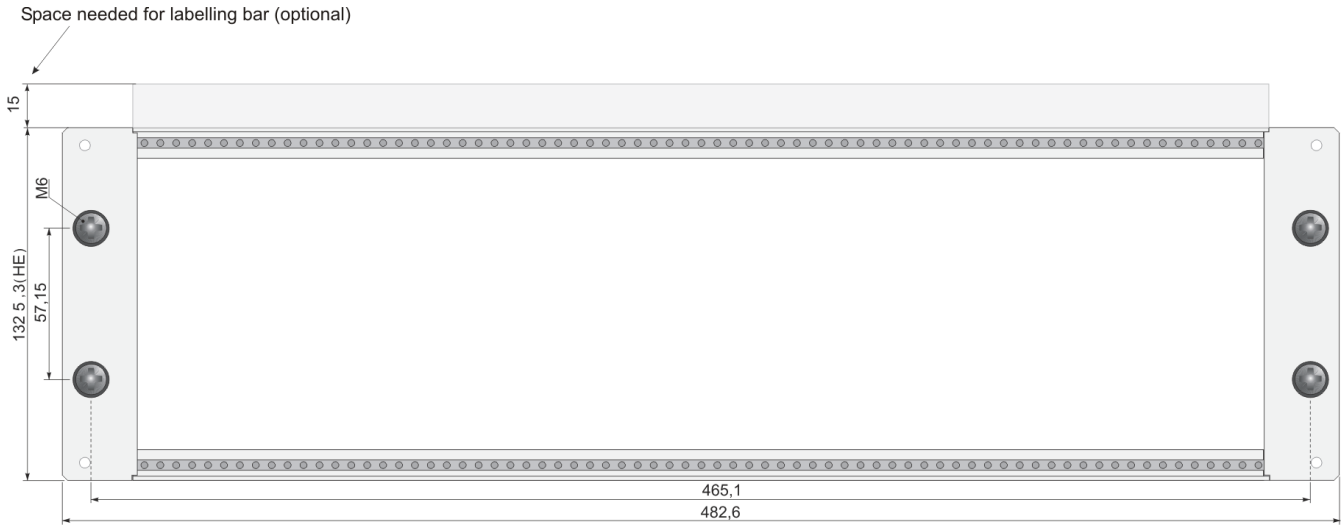


Figure 7.1: Front view of the board rack, type BGT04, with label bar

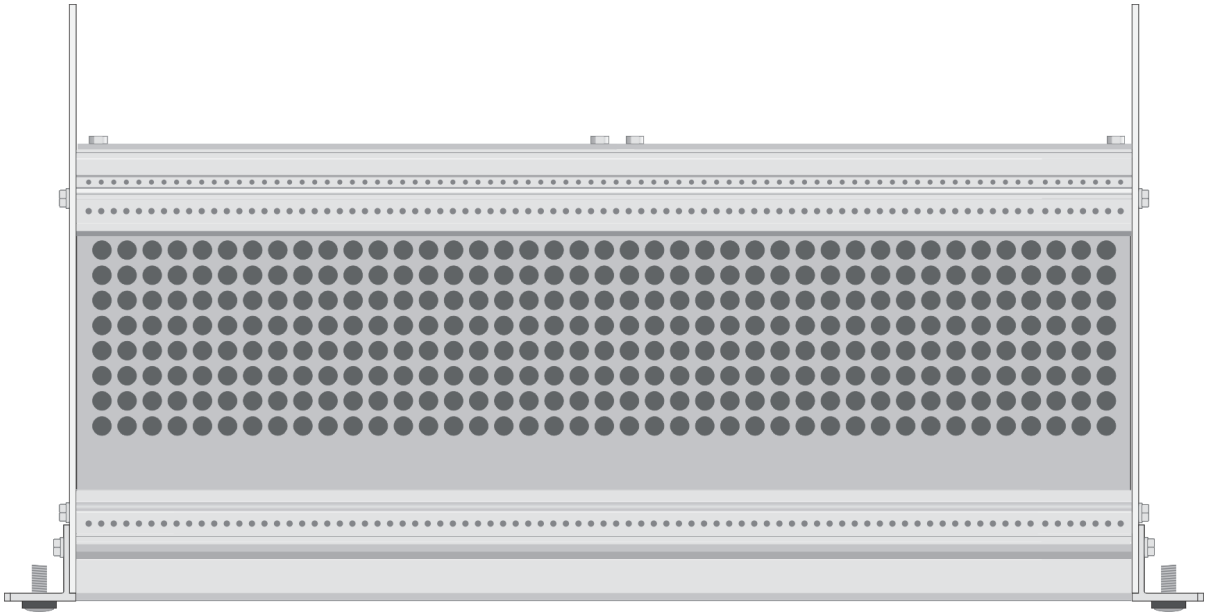


Figure 7.2: Top view of the board rack, type BGT04, with label bar

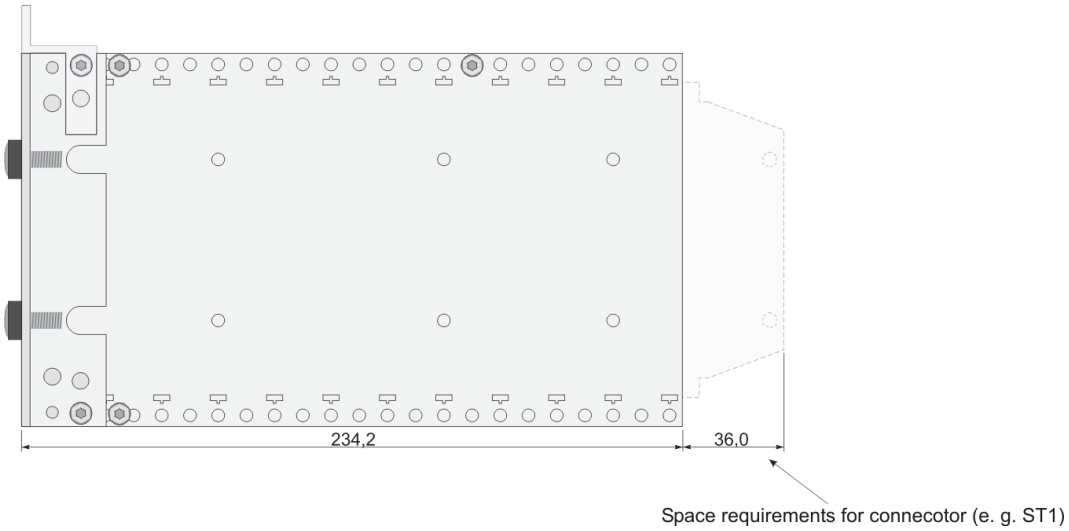


Figure 7.3: Lateral view of the board rack, type BGT04, with label bar (identical to BGT05)

7.2 Type BGT05

The board rack measures 3 HE in height and 42 TE in width. Depending on the configuration, a board rack can be used for up to 2 track sections. The dimensions required for mounting of the housing are detailed in Figure 7.4 and in Figure 7.5.

During project planning and installation of the board rack, the required space for the label bar (optional, see Figure 7.4) must be taken into account.

Dimensions/measurements of the figures are given in millimetres.

Figure 7.4: Front view of the board rack, type BGT05, with label bar

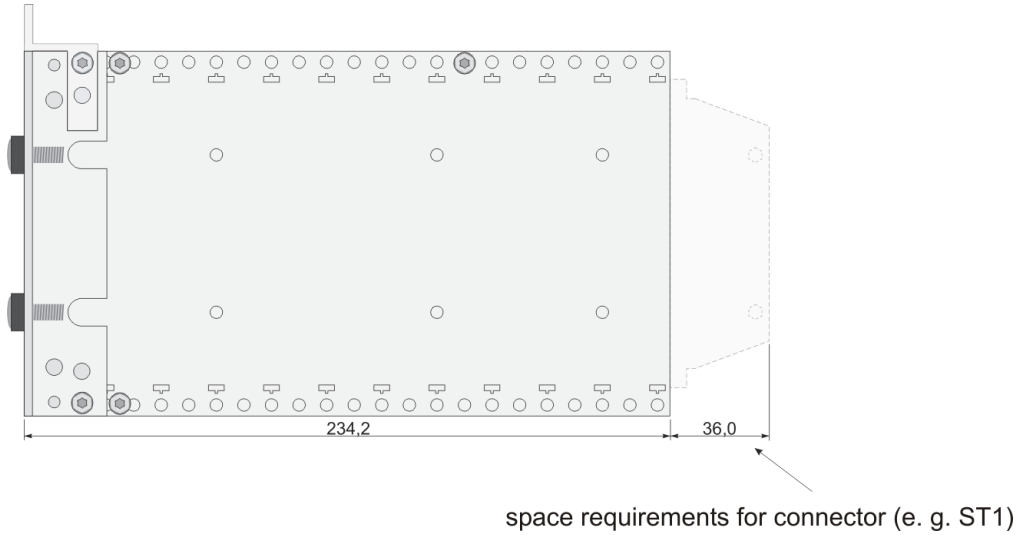


Figure 7.5: Lateral view of the board rack, type BGT05, with label bar (identical to BGT04)

8 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. Mounting of the wheel sensor must be carried out in accordance with Mounting and commissioning of the wheel sensor (Part I "Outline of documents", chapter 5) (see chapter 6.2.4 “Preparation and mounting“).
2. The interface conditions stated in this document must be observed (see chapter 1.1 “General“).
3. During modem operation, the speed dependent minimum length of the track section must be taken into account (see Part V "Types of boards"). The minimum section length is also adjusted in accordance with the regulations of the relevant railway administration (see chapter 2 “Configuration“).
4. An evaluation board and the corresponding double usage input may not be used simultaneously for a single counting head (see chapter 2.3.1 “Double usage“).
5. In order to prevent any external influences, the components of the indoor equipment of the ACS2000 must be installed inside a completely enclosed board rack that complies with at least protection class IP20. Unused plug sockets in a board rack must be sealed with suitable covers (see chapter 6.1.3 “Mechanical fixing to the support/frame“).
6. If the IMC is installed in an area that lies at most 3 m from the centre line of the nearest track, additional EMC-tests should be carried out for the serial interface (see chapter 6.1.2 “Preparation and mounting“).
7. When installing the overvoltage protection board BSI, the mounting instructions (see Part I "Outline of documents") must be observed (see chapter 6.1.2 “Preparation and mounting“).

Counting head outputs interface

8. If the requirements of the axle counting system ACS2000 exceed the axle counting (direction output, individual requirements), the manufacturer must be consulted. The relevant product-specific documentation of the evaluation boards must be requested and the safety-related application conditions (SABs) contained within, as well as any additional SABs, must be observed in switching applications. Information regarding the failure detection periods, measures and wiring in safety-relevant applications must be obtained from the manufacturer. Please contact the manufacturer in the event of non safety-relevant applications (see chapter 1.3 “Counting head outputs“).
9. In the case of safety-relevant applications of double usage, all 4 system outputs (Sys1, /Sys1, Sys2, /Sys2) must be used by the downstream system (see chapter 2.3.1 “Double usage“).

Counting head inputs interface

10. There are no measures available to protect against overvoltage. The output voltages provided at the interface (+5 V and +5 V') may only be used for the wiring of the counting head double usage and not for the supply of other boards. Furthermore, it must be ensured that the independence of the channels is not lost in any of the boards when connecting the counting heads to the axle counter (see chapter 1.4.1 “"Counting head inputs" interface“).
11. The output voltage of +5 V provided at the interface may only be used for channel 1 of the ACB, whereas the output voltage of +5 V' may only be used for channel 2 of the ACB (see chapter 1.4.1 “"Counting head inputs" interface“).
12. The output information of this interface can, alternatively, also be processed further for individual requirements, however in this case, safety-relevant aspects must be considered (see chapter 2.3.1 “Double usage“).

Clear/occupied interface

13. No internal protective circuit for the relay outputs with spark suppression elements is available! In the event that inductive loads are activated through the ACB relays, suitable measures must be taken to extinguish the sparks on the load! Spark suppression elements must not be connected in parallel to the relay contacts. For suitable measures see Figure 1.3 (see chapter 1.4.2 “"Clear/occupied" interface“).
14. The nominal load on the "clear/occupied" interface may not exceed, in the event of activation, 600 mA AC/DC under an ohmic load and 300 mA AC/DC under an inductive load. The maximum permitted voltage on the Fm and P interfaces of 72 V AC/DC must not be exceeded (see chapter 1.4.2 “"Clear/occupied" interface“).

Reset

15. The reset operation connected to the “Reset” interface must be designed in accordance with the applicable railway regulations (see chapter 1.4.3 ““Reset” interface“).
16. The reset operation connected to the “pre-Reset” interface must be designed in accordance with the applicable railway regulations (see chapter 1.4.4 ““pre-Reset” interface“).

Modem

17. Modems or external data evaluation systems may only be connected to a D-SUB socket or to a D-SUB plug if their interface is designed in accordance with EIA/TIA-232E (see chapter 1.6.1.1 “Requirements“).
18. The D-SUB plug for connection of a modem is available on the ABP and with the same function as the D-SUB socket on the ACB and DIOB. Simultaneous connection of modems to the D-SUB plug and to a D-SUB socket or to both D-SUB sockets is not permitted in order to set up a serial connection (see chapter 1.6.1.1 “Requirements“).
19. The diagnostic interface is available on the ACB as a D-SUB socket and as a RJ45 socket. Simultaneous connection of evaluation systems to the diagnostic interface of the D-SUB socket and RJ45 socket of the ACB is not permitted (see chapter 1.6.2 “Diagnostics“).
20. The diagnostic input/output and the optocoupler outputs on the D-SUB socket or the RJ45 socket of the ACB may only be used for safety-relevant processes (see chapter 1.6.2 “Diagnostics“).
21. The modem must show a safe galvanic isolation of 2500 V AC. If safe galvanic isolation cannot be demonstrated, a suitable additional device (e.g. isolating transformer) must be used to prevent the fault of "short circuit between input and output with a test voltage of 2500 V AC" (see chapter 1.6.1.1 “Requirements“).
22. Transmission in modem operation through the "Serial Communication" interface is designed only for use in closed transmission systems in accordance with [9]. Use in open transmission systems is possible with additional measures and with appropriate verification, provided the data for the ACB or DIOB are not modified (see chapter 1.6.1.2 “Serial transmission protocol“).

Supply voltage

23. The supply voltage of the ACS2000 must be in the range of +19 to +72 V DC (see chapter 1.7 “Power supply“).
24. The supply voltage may not exceed or fall short of +19 to +72 V DC at any time as a result of ripple. For the maximum permitted ripple see Figure 1.16 (see chapter 1.7 “Power supply“).

Maximum permitted transient overvoltages and maximum permanent voltages

25. The values of the maximum permitted transient overvoltages and maximum permanent voltages in accordance with chapter 4 “Transient overvoltages, permanent voltages and EMC limit values“ must be complied with.

Cable routing

26. The cables connected to the counting head outputs must not exceed a maximum length of 30 m, and should be kept as short as possible (see chapter 1.3 “Counting head outputs“).

27. The cables connected to the "counting head inputs" must not exceed a maximum length of 30 m, and should be kept as short as possible (see chapter 1.4.1 “"Counting head inputs" interface“).

28. An interwire or earth short circuit between the overvoltage protection board BSI and the evaluation board IMC, or between two IMC evaluation boards in the case of analogue double usage, must be prevented by routing the cables in a suitable manner (see chapter 3.1 “General information“).

29. It is essential to protect the cable to the interfaces "DIOB inputs", "optional:Reset", "DIOB outputs", "ERROR", "Reset", "pre-Reset", "Counting head inputs" and "Counting head outputs" interface against the following faults:

    • short circuit between the wires

    • short circuit between the wire and shield

    • short circuit between the wire and earth
    (see chapter 3.1 “General information“)

30. The cable of the serial connection (cable between the D-SUB plug of the ABP and the modem, cable between the D-SUB plugs on two ABPs, cable between the D-SUB socket of the ACB/DIOB and the modem/data evaluation device, cable between the RJ45 socket of the IMC and the data evaluation device) must not exceed a maximum length of 3 m (see chapter 3.1 “General information“).

31. The cable on the diagnostic interface of the ACB (D-SUB socket or RJ45 socket) must not exceed a maximum length of 3 m (see chapter 3.1 “General information“).

32. After any modification of the cabling, the patch cable must be tested to check whether the marking on the plugs coincides with the designation on the sockets in accordance with the project planning documents (see chapter 3.1 “General information“).

33. After any modification of the cabling, the patch cable must be tested to check whether the marking on the plugs coincides with the designation on the sockets in accordance with the project planning documents (see chapter 3.1 “General information“).

34. For the cabling (ABP - RJ45 sockets), only the cables supplied by the manufacturer or equivalent cables may be used. A defective cable may only be replaced by an equivalent cable (see chapter 3.1 “General information“).

ABP

35. Only the DIP-switches and soldering jumpers that are described in chapter 2.4 may be modified. Modifications to the DIP-switches and soldering jumpers may only be carried out by specially trained personnel, taking into account the project planning documents (see chapter 2.4 “Function and configuration of the ABP“).

36. In the case of modem operation with the DIP-switches DIR2 to DIR6 and DIR2' to DIR6', a user defined code (10 bit code) must be set on the backplane ABP. This code must match for both axle counting systems (same configuration of the DIP-switches) (see chapter 2.4.4 “DIR-DIP-switches in modem operation “).

37. In the case of modem operation with the DIP-switches DIR2 to DIR6 and DIR2' to DIR6', a user defined code (10 bit code) must be set on the backplane ABP. The code must be set differently for neighbouring or adjacent track sections (see chapter 2.4.4 “DIR-DIP- switches in modem operation“).

38. None of the pin codings and labellings applied in the factory may be modified or removed (see chapter 1.8.1 “Mechanical structure“).

39. Soldering jumpers or DIP-switch settings may only be modified by specially trained personnel in accordance with chapter 2.4 “Function and configuration of the ABP“ .

DIOB

40. Opening of the DIOB outputs must be processed by the downstream board as a failsafe status (see chapter 1.5.2 “"DIOB outputs" interface“).

41. No internal protective circuit for the relay outputs with spark suppression elements is available! In the event of the activation of inductive loads by the relays of the DIOB, suitable measures must be taken to carry out the spark suppression on the load! Spark suppression elements must not be connected in parallel to the relay contacts. For suitable measures see Figure 1.3 (see chapter 1.5.2 “"DIOB outputs" interface“).

42. Within one year, the outputs of the DIOB input/output board that have been used must be tested to check whether these open due to non-activation of the corresponding input. In the event of a failure, maintenance must be carried out within 24 hours (see chapter 1.5.2 “"DIOB outputs" interface“).

43. In safety-relevant applications, each argument must be input in valent form over two channels ("DIOB Inputs" interface) and evaluated over two channels at the receiver ("DIOB outputs" interface) (see Figure 1.6). With regard to this, an input of channel 1 must be used with an input of channel 2 in each case. The same process must be carried out with the outputs (see chapter 1.5.3 “DIOB – Switching in safety-relevant applications“).

44. The downstream signalling equipment must tolerate an antivalent status for a period of time of 10 ms. If the antivalent status of an argument lasts longer than 10 ms, this must be detected by the downstream signalling equipment as a fault. Until the error is resolved, the downstream equipment must remain in a failsafe status (the failsafe status is defined according to the specif-

ic application) (error memory). The error must be resolved within 24 hours. The downstream equipment must ensure that the failsafe status is preserved until the error is eliminated or until the defective board is replaced (see chapter 1.5.3 “DIOB – Switching in safety-relevant applications “).

45. DIOB: The OUT status (= failsafe status) or IN status (= active status) must correspond to the input and output statuses shown in Table 1.3. The OUT argument is deemed to be a failsafe status (see chapter 1.5.3 “DIOB – Switching in safety-relevant applications“).
46. All input and output statuses that deviate from the statuses shown in Table 1.3 must be rated as faults (see chapter 1.5.3 “DIOB – Switching in safety-relevant applications“).
47. The two voltage-free relay outputs ERROR must not be used for safety-relevant applications, as these two outputs only open in the event of a data transmission fault or a hardware error and therefore the detection of failure of an error related relay that no longer opens cannot be guaranteed (see chapter 1.5.5 “"ERROR" interface“).
48. The nominal load on the output and ERROR interface may not exceed, in the event of activation, 60 mA AC/200 mA DC under an ohmic load, and 30 mA AC/100 mA DC under an inductive load (see chapter 1.5.2 “"DIOB outputs" interface“).

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Part V

Types of boards

of the axle counting system

ACS2000

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Checked:	R. Thalbauer	sign. Thalbauer	2012-03-30		D10041-05-2
Released:	M. Rosenberger	sign. Rosenberger	2012-03-30		Page 1 of 17

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Review list

version	date	prepared by	sections modified	reason
1	2011-10-07	J. Böttger	all	new version
2	2012-04-16	J. Böttger	all	addition

Translation list

concerning version	date	prepared by	sections modified	reason
2	2012-07-09	J. Böttger	all	new english version
2	2012-08-03	A. Ecker	all	wording, formatting

Masthead

1 Evaluation boards IMC

If there are further requirements of the axle counting system ACS2000 than axle counting (driving direction, counting head control) consult with the manufacturer and, if necessary, request the product-specific documentation of the evaluation boards.

2 Axle counting board ACB

2.1 Brief overview of the ACB types

The properties of the ACB types are summarised in the table below.

ACB type	baud rate	outputs	diagnostic protocol	optocoupler activation[1]	assessment
119	9600	2x Fm/2x P	FDS	variant 1	Cenelec
119-001	9600	2x Fm/2x P	FDS	variant 2	Cenelec
119-002	9600	2x Fm/2x P	diagnostics of ACS2000	variant 1	Cenelec
120	9600	2x Fm/2x P	FDS	variant 1	Cenelec
120-001	9600	2x Fm/2x P	FDS	variant 2	Cenelec
120-002	9600	2x Fm/2x P	diagnostics of ACS2000	variant 1	Cenelec

Table 2.1: Properties of the ACB types

[1] see chapter 2.6

2.2 Switching times of the ACB outputs in isolated operation

The test relay contact P may only be used in combination with the clear contact Fm for the failsafe indication of a clear status.

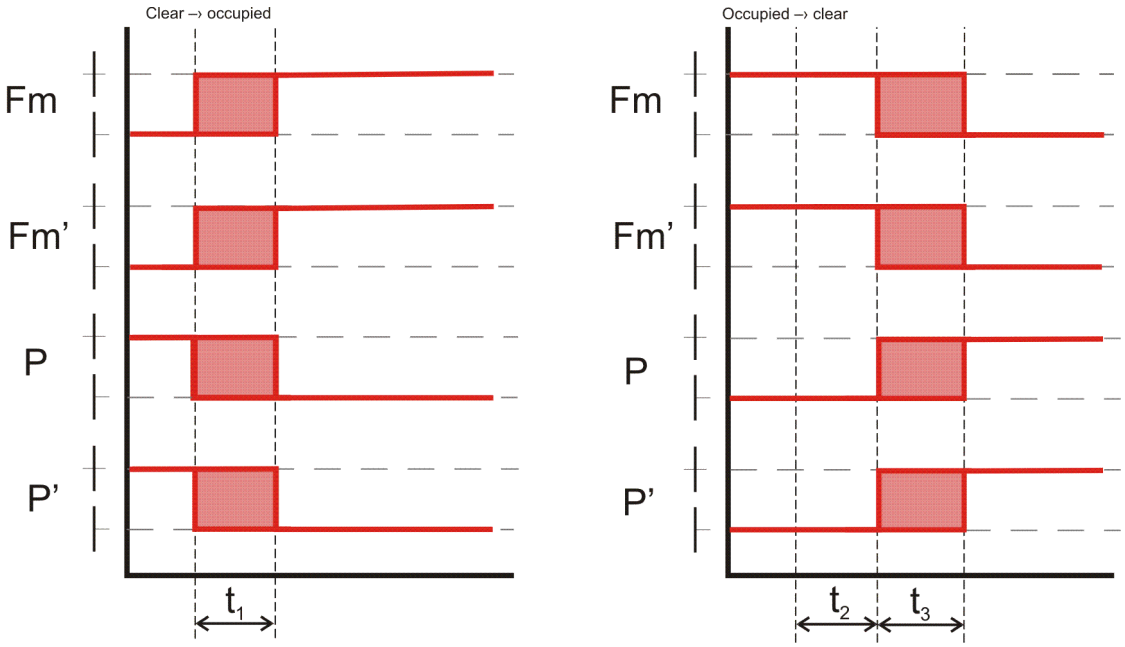

Figure 2.1: Switching times when changing from the clear to the occupied status and from the occupied to the clear status

The time t_1 is any time during which the outputs can have valent (same) statuses.

The status change from occupied to clear is delayed by the software by the occupied extension time t_2. The time t_3 is any time during which the outputs can have valent (same) statuses.

During the timespan t_1 and t_3 it is possible for the contacts (Fm/P) to be opened together. A simultaneous closing of the contacts is, however, not possible within this timespan.

2.3 Switching times of the ACB outputs in modem operation

2.3.1 General Statement

Occupied statuses are exchanged between two axle counting systems (ACBa/ACBb) within time $t_Ü$ (see ACB type).

If no data package is correctly received for longer than time t_A, an occupied status is issued. If the serial communication can be reproduced within t_B from when the last data package was correctly received, the outputs of the "clear/occupied" interface will capture the actual statuses again. If the transmission is disrupted for longer than this time, a minor error occurs and the track section will remain occupied (see ACB type).

2.3.2 Transmission time with modem operation

During traversing of a counting head which is connected directly with the ACB, the outputs are switching as descriped in chapter 2.2 “Switching times of the ACB outputs in isolated operation“.The second ACB, which is connected to the first ACB through a modem, requires in addition the transmission time $t_Ü$, in order to change from clear to occupied status and back again.

The response time for a status change from clear to occupied of this second ACB is calculated from transmission time $t_Ü$ and the output times as described in chapter 2.2 “Switching times of the ACB outputs in isolated operation“.

The status change from occupied to clear is delayed by the software by the occupied status extension time. After occupied status extension time the outputs changing as descriped in chapter 2.2 “Switching times of the ACB outputs in isolated operation“. The second ACB, which is connected to the first ACB through a modem, requires in addition the transmission time $t_Ü$, in order to change from occupied to clear status.

The response time for a status change from occupied to clear of this second ACB is calculated from transmission time $t_Ü$, occupied status extension time and the output time as descriped in chapter 2.2 “Switching times of the ACB outputs in isolated operation“.

The transmission time $t_Ü$ is dependent upon which ACB type is used, whether a DIOB is present and whether disruptions occur during transmission (see ACB type).

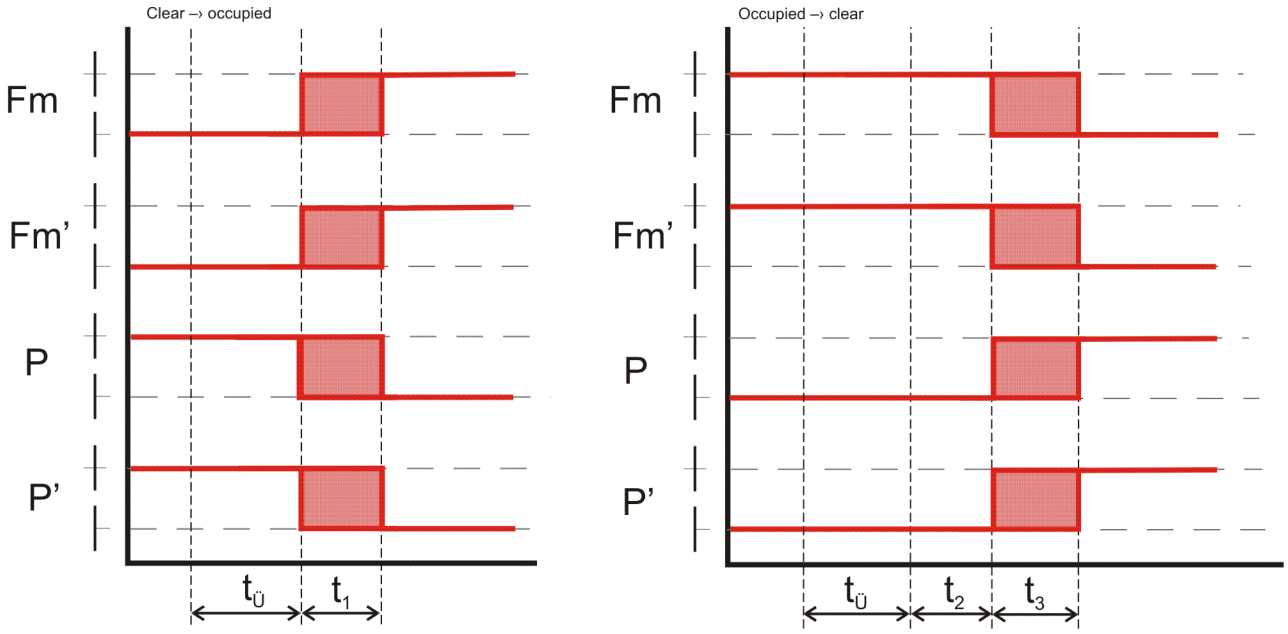

Figure 2.2: Transmission time and switching time when changing from clear to occupied status and from occupied to clear status for the outputs 2 x Fm / 2 x P

2.4 Minimum length of the track section in modem operation

maximum operating speed km/h	minimum length of the track section [m] in modem operation	
	4800 baud	9600 baud
20	24	13
40	47	26
60	70	39
80	94	52
100	117	64
120	140	77
140	164	90
160	187	103
180	210	115
200	234	128
220	257	141
240	280	154
260	304	167
280	327	179
300	350	192
320	374	205
340	397	218
360	420	230

Table 2.2: Minimum length of the track section during modem operation

2.5 Reset

2.5.1 General Conditions

During a reset:

- there must be no axles in the track section
- none of the wheel sensors may be damped or traversed

Between the pre-Reset, Reset operation and clearing of the track, a wait of 10 ms must be observed in each case.

The reset operation is an exception operation.Therefore the complete system must be tested if the cause for the occupied status is unclear or reset operations are required several times within a few train journeys.
The complete system must be tested in the following manner:

wheel sensor:	• Inspect wheel sensor for damage, cracks and parts lying about in the vicinity of the wheel sensor. • Check correct mounting of the wheel sensor. • Measure wheel sensor currents.
cabling:	• Check connections to the terminal strips.
boards:	• Measure wheel sensor current on the evaluation boards. • Traversing at each counting head: ACB must become occupied and clear again. • Check voltage supply.

If two axle counting systems are operated in modem operation, the reset only needs to be carried out in one axle counting system. The second ACS2000 subsystem is automatically reset.

If during power-up, a wheel sensor system assigned to the track section is occupied, 4 slashes ('////') will appear on the display. During this time, reset is not possible. If the sensor is no longer occupied, the original statuses appear on the display again.

Information on the representation of the error code on the ACB's display can be found in Part IX "Diagnostics".

In order to remove a reset restriction, the pre-Reset toggle switches must be pressed simultaneously on the ACB, for longer than 0.5 s (execution only after the toggle switches has been released - only one toggle switch is available on the ACB up to GS02).

2.5.2 Advanced reset "pre-Reset"

A removal of the reset restriction can be carried out directly on the axle counting board (pre-Reset toggle switches on the front panel) or by a reset help toggle switch wired externally. A simple reset operation must subsequently take place for reset.

In order to remove the reset restriction, the pre-Reset toggle switches on the ACB must be pressed simultaneously and for longer than 0.5 s (execution only after the toggle switches have been released).

If pre-Reset toggle switches are externally wired, switching procedures as described in Figure 2.3 apply. Both inputs of pre-Reset 1 and pre-Reset 2 must be supplied within 500 ms with a voltage of 19 to 72 V for at least 500 ms without interruption. Subsequently, both inputs must be disconnected from the supply again within 500 ms.

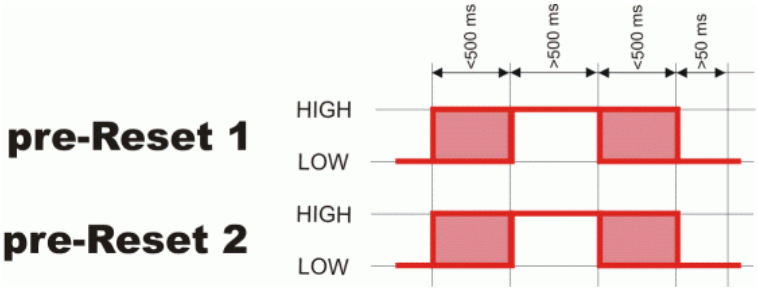

Figure 2.3: Operation of pre-Reset 1 and pre-Reset 2

Example for the input wiring, see Part IV "Project planning and construction“.

2.5.3 Simple reset "Reset"

A simple reset is used for resetting of the counter status or of a minor error and is controlled by means of the reset toggle switch that is wired externally, generally by the operating personnel. This process is not possible (is ignored) if one or more wheel sensor systems of the track section are occupied.

If reset toggle switches are externally wired, switching procedures as described in Figure 2.4 apply. Both inputs of Reset 1 and Reset 2 must be supplied within 500 ms with a voltage of 19 to 72 V DC for at least 500 ms without interruption. Subsequently, both inputs must be disconnected from the supply again within 500 ms.

Reset is only performed after the sequence shown in Figure 2.4 has been completely processed. In the event of a deviation from the sequence, the activation of the inputs is ignored.

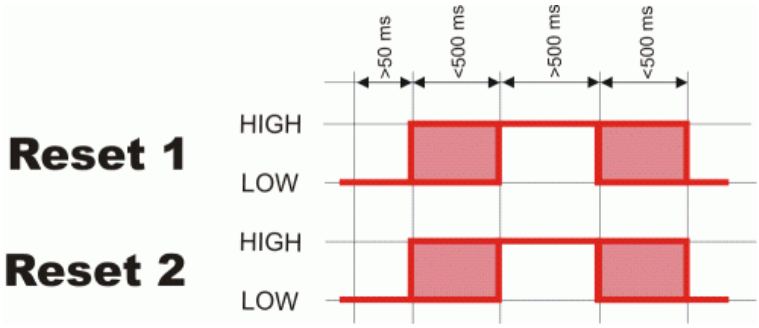

Figure 2.4: Operation of Reset 1 and Reset 2

Example for input wiring, see Part IV "Project planning and construction".

2.5.4 Reset by clearing the track

In the case of different software types, clearing of track may be necessary in the course of the reset operation.

During clearing of track in isolated operation, depending on the software type, one or more axles must be counted in or out on at least one counting head or on two different counting heads.

During clearing of track in modem operation, a counting in or counting out process must take place on both ACB boards of a counting section. If it is not possible to count one axle in and out again on one counting head of the subsystem only, the track section remains occupied.

2.5.5 Reset after partial traversing

Partial traversing means that one or both sensor systems are occupied without complete traversing. Any possible case of partial traversing is detected and displayed as an error on the display.

If a clear section is subject to partial traversing (e.g. shunting operations), the track section remains occupied, although no axle is on the track section. The error is reset again by carrying out a correct traversing.

However, this error can be also be reset by means of a software dependent reset procedure (see relevant ACB type).

2.5.6 Last axle counted in or out

If a track section is traversed from outside to inside, axles are counted in during this. Similarly, if a track section is traversed from inside to outside, axles are counted out. The last counting process carried out is definitive for the status "last axle counted in or our" (e.g. 100 axles are counted in and one axle is counted out, so a reset must be carried out after the "last axle counted out").

If "last axle counted in" appears with the following reset conditions, this means that immediately before or after the error occurred, at least one axle has passed over the track section from outside to inside.

This also applies for the condition "last axle counted out".

2.6 Optocoupler outputs and diagnostics

Both the optocoupler outputs and the diagnostic display must not be used for safety-relevant actions. They do not deliver any vital information, but only have an informative character.

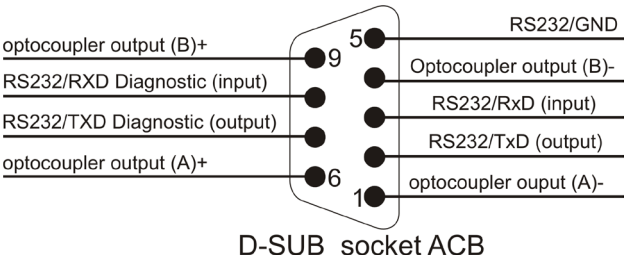

Figure 2.5: Pin assignment "Serial Interface" D-SUB

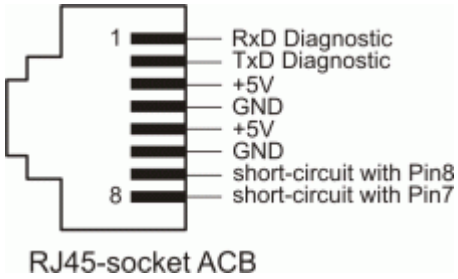

Figure 2.6: Pin assignment RJ45 socket

- maximum switching voltage: 72 V DC
- maximum switching current: 10 mA
- maximum switching loss performance: 150 mW
- maximum current in the event of reverse polarity: 150 mA DC

The assignment of the ACB types to the optocoupler activation variants is stated in chapter 2.1.

Optocoupler activation variant 1:

optocoupler A

open	error-free status (track section occupied or clear)
closed	partial traversing or "waiting for clearing of track"

optocoupler B

open	error-free status (track section occupied or clear), minor error
closed	serious error

Table 2.3: ACB119, ACB119-002, ACB120 and ACB120-002 optocoupler A and optocoupler B

Optocoupler activation variant 2:

optocoupler A

open	error-free status (track section occupied or clear)
closed	partial traversing or "waiting for clearing of track"

optocoupler B

open	error status (minor or serious error, partial traversing with clear track section)
closed	error-free status (track section occupied or clear, partial traversing with occupied track section)

Table 2.4: ACB119-001 und ACB120-001 optocoupler A and optocoupler B

2.7 ACB types

Output times in isolated operation for all ACB types

The table relates to Figure 2.1.

clear → occupied t_1		occupied status extension time t_2	occupied → clear t_3	
min.	max.		min.	max.
0 ms	30 ms	1030 ms	0 ms	30 ms

Due to error filtering by the evaluation board, an additional delay of the fault output on the ACB axle counting board of 200 ms (e.g. wire short circuit), 10 min (e.g. single-channel sensor drift) or 3 ms (e.g. wire break) may occur. A check must be carried out to determine whether the delay of the fault output has an impact on safe operation.

Transmission times $t_Ü$ in modem operation for all ACB types

The table relates to Figure 2.2 and chapter 2.3.1.

baud rate	without DIOB		with DIOB		t_A	t_B
	min.	max.	min.	max.		
9600	80 ms	2.3 s	160 ms	2.3 s	2.3 s	30 d

Due to error filtering by the evaluation board, an additional delay of the fault output on the ACB axle counting board of 200 ms (e.g. wire short circuit), 10 min (e.g. single-channel sensor drift) or 3 ms (e.g. wire break) may occur. A check must be carried out to determine whether the delay of the fault output has an impact on safe operation.

Reset operation of ACB119, ACB119-001 and ACB119-002

reset after:		possible by[5]:
power-up [1]		Reset
section occupied (x axles)	last axle counted out [2]	Reset
	last axle counted in [2]	(pre-Reset + Reset)
minor error	last axle counted out [2]	Reset
	last axle counted in [2]	(pre-Reset + Reset)
partial traversing [3]	last axle counted out [2]	Reset
	last axle counted in [2]	(pre-Reset + Reset)
serious error		(pre-Reset + Reset)

Reset operation of ACB120, ACB120-001 and ACB120-002

reset after:		possible by[5]:
power-up [1]		(Reset + clearing of track [4]) or (pre-Reset + Reset)
section occupied (x axles)	last axle counted out [2]	(Reset + clearing of track [4]) or (pre-Reset + Reset)
	last axle counted in [2]	(Reset + clearing of track [4]) or (pre-Reset + Reset)
minor error	last axle counted out [2]	(Reset + clearing of track [4]) or (pre-Reset + Reset)
	last axle counted in [2]	(Reset + clearing of track [4]) or (pre-Reset + Reset)
partial traversing [3]	last axle counted out [2]	(Reset + clearing of track [4]) or (pre-Reset + Reset)
	last axle counted in [2]	(Reset + clearing of track [4]) or (pre-Reset + Reset)
serious error		(pre-Reset + Reset)

1 If between power-up and reset operation, a sensor system belonging to the track section is occupied, the axle counting system reports a serious error.

2 See chapter 2.5.6 “Last axle counted in or out“.

3 See chapter 2.5.5 “Reset after partial traversing“.

4 During clearing of track (isolated operation) one or more axles must be counted in or out on two different counting heads. During clearing of track (modem operation) one or more axles must be counted in and/or counted out on each counting point of a part system (see chapter 2.5.4 “Reset by clearing the track“).

5 **"or"** means that either the first or second reset procedure can be executed.
"+" means that the various reset steps must be executed sequentially. The reset process can only be carried out successfully with the correct sequence and combination of the various reset steps.

Relay outputs

operating status		relay output			
		Fm	Fm'	P	P'
1	axle counter disconnected from power supply (not in operation) axle counter in fault status axle counter when changing from clear to occupied status	open	open	open	open
2	axle counter after power-up and in the event of a minor error track section occupied	open	open	closed	closed
3	track section clear	closed	closed	open	open
4	not applicable as operating status	closed	closed	closed	closed

All other switching combinations of the relay outputs Fm, Fm', P and P' are not applicable as an operating status and should be treated as operating status 4.

If there is no differentiation from the following equipment with respect to the fault and occupied statuses, then statuses 1 and 4 are to be assessed as occupied statuses.

In safety-relevant applications, at least one clear contact must be evaluated.

If one or more contacts are evaluated, this must take place using the dependencies shown in the table for relay outputs.

Display version

display version	properties
200, 201	Displays of the axles and error codes in the ACB display, optocoupler outputs on the front panel, diagnostics (see chapter 2.6 "Optocoupler outputs and diagnostics")

3 Digital input/output board DIOB

3.1 DIOB104

Arguments are exchanged between two axle counting systems (DIOBa / DIOBb) within 160 ms (9600 baud).

In the event of disrupted transmission, all relay outputs of the DIOB switch to LOW (relay outputs open) at most 2.3 s after the last correctly received data package and remain at LOW until a valid transmission occurs again. If serial communication can be established again, the outputs of the DIOB take on the actual statuses again.

During transmission of an argument by the DIOB it must be observed that a maximum tripping delay of 2.3 s can occur at the receiver.

During transmission of an argument by the DIOB it must be observed that the minimum input pulse length must be >2.3 s.

In fault-free operation, the output pulse length = input pulse length +/- 0.8 s.

In the event of disrupted transmission, where the disruption is shorter than 2.3 s, the output pulse length = input pulse length +/- 2.3 s, but at least 160 ms.

Transmission times

DIOB type	baud rate	min.	max.
104	9600	160 ms	2.3 s

4 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. The reset operation is an exception operation.Therefore the complete system must be tested if the cause for the occupied status is unclear or reset operations are required several times within a few train journeys (see chapter 2.5.1 “General Conditions“).
2. Both the optocoupler outputs and the diagnostic display must not be used for safety-relevant actions. They do not deliver any vital information, but only have an informative character (see chapter 2.6 “Optocoupler outputs and diagnostics“).
3. The values cited in chapter 2.4 “Minimum length of the track section in modem operation“ must be observed.

ACB

4. The switching statuses of the relay outputs must be interpreted by the following equipment, as described in chapter 2 “Axle counting board ACB“ and the output times for the ACB type must be observed (see chapter 2 “Axle counting board ACB“).
5. The test relay contact P may only be used in combination with the clear contact Fm for the fail-safe indication of a clear status (see chapter 2 “Axle counting board ACB“).
6. If the downstream equipment cannot make a distinction with respect to the fault and occupied statuses, then statuses 1 and 4 are to be assessed as occupied statuses (see chapter 2 “Axle counting board ACB“).
7. During the operating status switches from clear to occupied and from occupied to clear, the interfaces Fm/P for the time t_1 or t_3 have valent statuses (corresponds to the fault status). Therefore the fault status must be tolerated by the downstream signalling equipment during this time (30 ms maximum) (see chapter 2 “Axle counting board ACB“).
8. Due to error filtering by the evaluation board, an additional delay of the fault output on the ACB axle counting board of 200 ms (e.g. wire short circuit), 10 min (e.g. single-channel sensor drift) or 3 ms (e.g. wire break) may occur. A check must be carried out to determine whether the delay of the fault output has an impact on safe operation (see chapter 2.7 “ACB types“).
9. The interface conditions pursuant to chapter 2.6 must be complied with.

DIOB

10. The values cited in chapter 3.1 “DIOB104“ must be observed.

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SENSOR TECHNOLOGY

D10041-06-2

Part VI

Commissioning

of the axle counting system

ACS2000

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Checked:	R. Thalbauer	sign. Thalbauer	2012-03-30		D10041-06-2
Released:	M. Rosenberger	sign. Rosenberger	2012-03-30		Page 1 of 17

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Review list

version	date	prepared by	sections modified	reason
1	2011-10-07	J. Böttger	all	new version
2	2012-04-16	J. Böttger	all	wording

Translation list

concerning version	date	prepared by	sections modified	reason
2	2012-07-09	J. Böttger	all	new english version
2	2012-08-03	A. Ecker	chapter 1, 5	wording

Masthead

This document is the translation of the German original.

1 General remarks on correct mounting and commissioning

- checking of the wiring/cabling using the project documentation
- measurement of the supply voltage (e.g. +19 to +72 V DC, depending on the board type)
- apply supply voltage to the axle counting system ACS2000
- carry out mounting and commissioning of the wheel sensor in accordance with the documentation (Part I "Outline of documents")
- wheel sensor RSR180 must exhibit an wheel sensor current of between 2.8 mA and 5.0 mA
- adjustment of IMC (see chapter 3.3 “Adjustment of the board IMC“)
- perform a reset on the axle counting board ACB (dependent on the software type, see Part V "Types of board")
- functional check (see chapter 6 “Functional check“)

During commissioning the axle counting system ACS2000

- none of the wheel sensors may be damped or traversed
- there must be no axles in the track section

Before commissioning, a check must be carried out to verify that the type in use is the planned type.

The axle counting system ACS2000 may only be commissioned when it is in full working order and has been checked.

2 Power supply and integration into safety systems

2.1 Power supply

It must be checked whether the project planning and construction specifications have been complied with, see Part IV "Project planning and construction".

These include, among other things:

- voltage supply in the range + 19 to +72 V DC
- the ripples must be observed in accordance with Part IV "Project planning and construction"
- the power consumption must be observed in accordance with Part IV "Project planning and construction"

2.2 Integration into safety systems

The occurrence of following failure events must be precluded for the cable connected to interfaces “clear/occupied“ or “reset“, the cables connecting the over voltage boards BSI with the back planes ABP and for the cable for double usage or direction output.

- short circuit between the wires
- short circuit between the wire and cable shield

Always use the plugs supplied with the equipment (safety design).

3 System current measurement and/or board adjustment

3.1 Measurements on the board

A voltage proportional to the sensor current, which is used for control purposes, is output at the test sockets of the evaluation board's front panel.

These test sockets must not be either short-circuited, interconnected or attached to an external voltage.

Measurement and recording devices which are installed at the test sockets during regular operation or without supervision must incorporate measurement inputs with the following properties: independence, short-circuit immunity, external voltage immunity and ground immunity.

The test sockets of the IMC have wheel sensor potential and are not protected against transient overvoltages and permanent voltages .

Required tools and measuring equipment

mV meter: range 1000 mV DC, +/- 0.5 % basic accuracy

2 measurement lines with 2 mm male connectors

Measuring system currents

Measure the system currents at the test sockets (the voltage proportional to the current is measured via a 100 Ω shunt, 100 mV therefore corresponds to 1 mA system current).

3.2 Wheel sensor current on the wheel sensor RSR180

The wheel sensor current in System 1 and System 2 must be between 2.8 mA and 5.0 mA. This corresponds to 280 mV and 500 mV at the test socket.

In the comparison of the measured values on the IMC, the difference between the systems may range from 0.2 mA or 5 % max. of the sensor current. If the difference is greater, this error must be resolved before commissioning, by checking the installation of the wheel sensor and replacing the wheel sensor if necessary.

Commission the wheel sensor RSR180 in accordance with the documentation ("Mounting and commissioning of the wheel sensor RSR180" - Part I "Outline of the documents").

3.3 Adjustment of the board IMC

The IMC must be adjusted even if the IMC is replaced, the wheel sensor is replaced or removed and then reinstalled for repair or cleaning or due to track work, or if the cable section has been modified (loop resistance modification).

Before adjustment, it must be ensured that the wheel sensor attached to the IMC is correctly mounted.
During adjustment, it must be ensured that the wheel sensor attached to the IMC is not damped as in this case, adjustment will not be carried out or it will be carried out incorrectly.

Required tools and measuring equipment

mV meter: range 1000 mV DC, +/- 0.5 % basic accuracy

measurement lines with 2 mm male connectors

The wheel sensor system currents must be measured before adjustment (see chapter 3 “System current measurement and/or board adjustment“).

The following toggle switch actuation sequence must be complied with:

A Both toggle switches must be pushed to the left within 500 ms ("Adjust").

B Both toggle switches must remain in this position for at least 500 ms.

C Both toggle switches must be released within 500 ms.

D The toggle switches must remain in the normal position for a maximum of 2 s.

E Both toggle switches must be pushed to the right within 500 ms ("Test").

F Both toggle switches must remain in this position for at least 500 ms.

G Both toggle switches must be released within 500 ms.

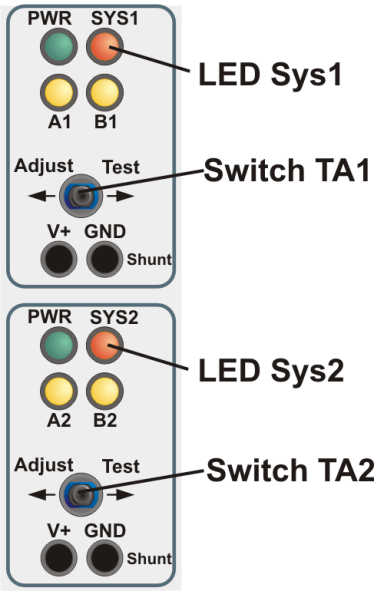

Figure 3.1: Toggle switches on the IMC front panel

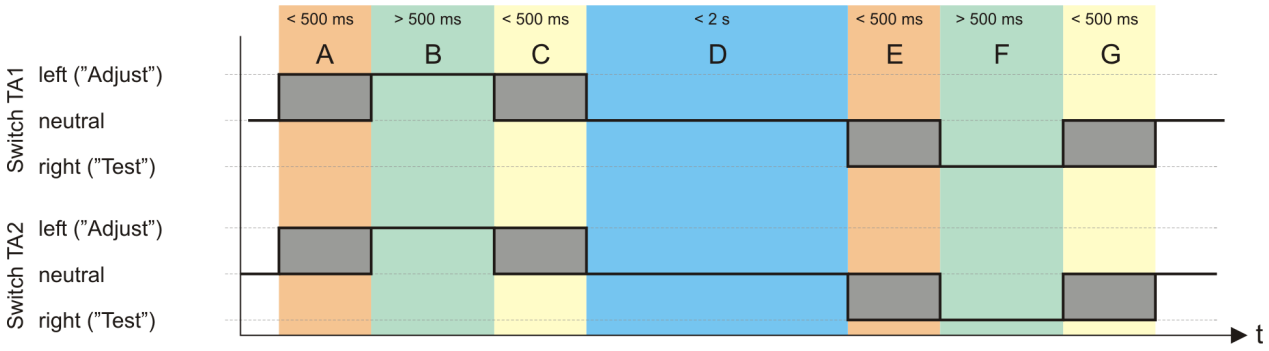

Figure 3.2: Actuation sequence for start of adjustment process

Evaluation board IMC outputs are not switched during the independent adjustment process.

The adjustment process will not be executed if the pushing of the toggle switches deviates from the above sequence. To start a new adjustment process, the actuation sequence described above (A-G) must be recommenced from the start. The actuation sequence should prevent accidental actuation of one or both toggle switches starting a adjustment process.

After the correct initiation of the actuation sequence, the adjustment process will be displayed by the LEDs of Sys1 and Sys2 for approximately 2 s. Once adjustment has been carried out correctly, the Sys1 and Sys2 LEDs will go out. Unsuccessful adjustment is indicated by rapid flashing (10 times per second) of the LEDs of Sys1 and Sys2 for 4 s.

Mounting and commissioning should be carried out with an error-free traversing of the counting head.

4 ACB display and power-up

4.1 Display

The display works independently of the evaluation processing units and relates the information of the serial data flow of the individual channels. In a fault-free status, the number of axles is shown on the display. In the event of a fault, a relevant error code (see Part IX "Diagnostics") is output.

If serial communication is interrupted or disrupted, "SCI" will appear on the display.

	S	C	I	Serial Communication Interface

The indication of axle counting by the display of the ACB and the occupied indication by the "occupied" LED are for information only and are not failsafe in terms of signalling. Consequently, the ACB information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel.

4.2 Power-up

L	R	N	0	no processing unit initialised
L	R	N	1	1. ACB channel initialised after power-up
L	R	N	2	2. ACB channel initialised after power-up
L	R	N	3	3. ACB channel initialised after power-up (only in modem operation)
L	R	N	4	4. ACB channel initialised after power-up (only in modem operation)
L	R	N	5	1. DIOB channel initialised after power-up (only in modem operation)
L	R	N	6	2. DIOB channel initialised after power-up (only in modem operation)
L	R	N	7	3. DIOB channel initialised after power-up (only in modem operation)
L	R	N	8	4. DIOB channel initialised after power-up (only in modem operation)
x	x	x	x	flashing, after initialisation is successfully completed

For more information, see Part IX "Diagnostics".

If the serial communication is interrupted or disrupted, "LRN0" or "LRN1" is displayed.

4.3 Reset

The reset procedure is dependent upon the ACB type.

For further information on the reset procedure, see Part IX "Diagnostics" or Part V "Types of boards".

5 Function and configuration of the ABP

Modifications to the DIP-switches on the ABP may only be carried out by specially trained personnel, taking into account the project planning documents.

The DIR-, MODE- and DN-DIP-switches are accessible from the rear of the board rack and are located above and below the ST6 plug. The DIP-switches DIP1 – 7, DIP2 – 7 and DIP2 – 8 for channel 1 and DIP1' – 7, DIP2' – 7 and DIP2' – 8 have no function.

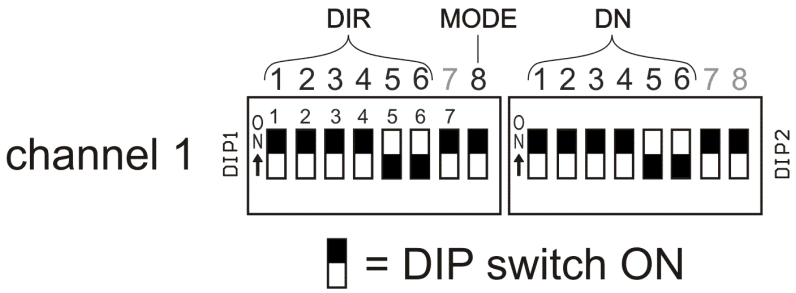

Figure 5.1: Overview of the DIP-switches for channel 1

The positions of the DIR, MODE and DN-DIP-switches of channel 1 must not differ in isolated operation from channel 2.

The positions of the MODE and DN-DIP-switches of channel 1 must not differ in modem operation from channel 2 of the same ACS2000 system. The DIR-DIP-switches fulfil an addressing function in modem operation.

For the exact functional description of the DIP-switches on the ABP, see Part IV "Project planning and construction".

5.1 MODE-DIP-switch

The operating mode of the ACS2000 is set with the assistance of both DIP-switches MODE and MODE' (channel 1 and channel 2).

DIP- switch "OFF": isolated operation

DIP- switch "ON": modem operation

The configuration of the MODE-DIP-switches of channel 1 must not differ from the configuration of the MODE'-DIP-switches of channel 2 (both OFF or both ON)!

5.2 DN-DIP-switch

With the assistance of the DN-DIP-switches, the ACS2000 system can find out at which input of the ACB a counting head double usage is located.

DIP-switch "OFF": counting head double usage at the relevant input

DIP-switch "ON": no counting head double usage at the relevant input

In the case of double usage, a counting head is evaluated by two axle counting boards ACB on adjacent track sections.

5.3 DIR-DIP-switch in isolated operation

The counting direction of each counting head can be configured with the assistance of the DIR-DIP-switches. If both systems of the relevant counting head are connected in accordance with the plug assignment (see Part IV "Project planning and construction") the following functions apply:

DIP-switches "OFF": An axle is counted in at the relevant counting head when it traverses from System 1 to System 2 (seeTable 5.1).

DIP-switches "ON": An axle is counted out at the relevant counting head when it traverses from System 1 to System 2 (see Table 5.1).

For further information on the possible settings, see Part IV "Project planning and construction".

5.4 DIR-DIP-switch in modem operation

In modem operation, the counting direction of the counting heads cannot be influenced, as it is in isolated operation, with the DIR-DIP-switches.

The DIR-DIP-switches have the following function in modem operation:

DIR1 and DIR1': By switching the DIP-switches DIR1- and DIR1' to ON, the axle counting board is defined as the Master. By doing this it is determined which of the two axle counting boards that communicate with one another starts in modem operation with the serial communication set-up. Only one axle counter board may be defined as the Master in each case. For the other axle counter boards, the DIR1- and DIR1'-DIP-switches must be in the OFF position. This setting has no influence on axle counting.

DIR2 to DIR6 and DIR2' to DIR6': By switching the DIP-switches DIR2 to DIR6 and DIR2' to DIR6', a 10-bit address is set for identification of serial data. This 10-bit address must be the same in all ACS2000 systems that actually need to communicate with one another. If several ACS2000 systems are used in the same equipment in modem operation, this 10-bit address must be set differently, so that an accidental swapping of the modem cable can be detected.

isolated operation		
traversing of	DIR	counting process
Sys1 to Sys2	OFF	count in
Sys1 to Sys2	ON	count out
Sys2 to Sys1	OFF	count out
Sys2 to Sys1	ON	count in

Table 5.1: Counting direction in isolated operation

modem operation		
traversing of	RSR systems	counting process
Sys1 to Sys2	not reversed	count in
Sys1 to Sys2	reversed	count out
Sys2 to Sys1	not reversed	count out
Sys2 to Sys1	reversed	count in

Table 5.2: Counting direction in modem operation

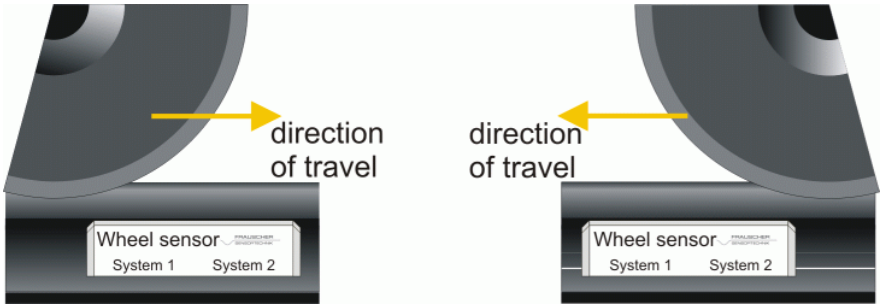

Figure 5.2: Traversing from Sys1 to Sys2 – Traversing from Sys2 to Sys1

6 Functional check

- Functional checks are carried out during initial commissioning and after any physical modifications.
- A reconciliation check must be carried out (occupancy of the wheel sensor in the outdoor equipment, correct function in the indoor equipment and at the operating terminal).
- It may be necessary to carry out a reset between each functional check.
- After a reset, the respective ACB must respond.

During initial commissioning of the axle counting system ACS2000 or during replacement of the ABP, the assignment and direction of the connected counting heads and the status of the soldering jumpers on the ABP must be checked (see chapter 6.1 “Assignment check“, chapter 6.2 “Check of the counting direction in isolated operation“ and chapter 6.3 “Check of the counting direction in modem operation“).

During initial commissioning, it must be checked that the wheel sensors have been correctly mounted in accordance with the mounting and commissioning guidelines (see Part I "Outline of documents").

During initial commissioning of the ACB board, it must be checked that all counting heads connected to this board are in working order (this can be done by traversing, using a testing plate or by using the toggle switches).

During initial commissioning of a DIOB board, it must be checked that all inputs and outputs are in working order (see Part IX: Diagnostics) .

6.1 Assignment check

The assignment of the counting heads must be checked during initial commissioning of the ACS2000.

The association of the wheel sensors must be checked for each wheel sensor that is associated with a track section.

- Apply testing plate PB200 to wheel sensor RSR.
- The Sys1 and Sys2 LEDs of the associated evaluation board must light up.
- The associated axle counting boards ACB must display an "occupied" status (double or triple usage).

6.2 Check of the counting direction in isolated operation

Counting direction of the axle counting system is verified as follows:

- Move one or more axles into the track section (axles can also be simulated with the help of testing plate PB200):

  The axle counting system signals "occupied" and the number of axles appears on the display of the axle counting board ACB.
- Axle(s) removed from the track section:

  The axle counting system signals "occupied" and "0" appears on the display of the axle counting board ACB.
- Repeat the process for every wheel sensor associated with the track section.
- If the counting direction is wrong, both DIR- and DIR'-DIP-switches for the corresponding input are set to ON or OFF. The counting direction is reversed due to this.

Whether the axle counting board ACB counts in or out as the axles traverse the wheel sensor, depends on the following factors:

- side of the track on which the counting head is mounted
- direction from which the axles roll over the counting head
- DIR-DIP-switch ON or OFF
- wiring of wheel sensor systems

It is possible to change the direction by:

- DIR-DIP-switch ON or OFF
- Changing the mounting side (if permitted by the mounting and commissioning instructions for the wheel sensor). This method is useless in the event of double usage.

6.3 Check of the counting direction in modem operation

Counting direction of the axle counting system is verified as follows:

- Move one or more axles into the track section (axles can also be simulated with the help of testing plate PB200):

  Both axle counting systems used in modem operation signal "occupied" and the number of axles appears on the display of both axle counting boards ACB.
- Axle(s) removed from the track section:

  Both axle counting systems used in modem operation signal "occupied" and "0" appears on the display of both axle counting boards ACB.
- Repeat the process for every wheel sensor associated with the track section.
- If the counting direction is wrong, change the wheel sensor systems at the corresponding input (Sys1 ↔ Sys2), see Part IV "Project planning and construction".

The DIR-DIP-switches have a different function in modem operation than in isolated operation.

Whether the axle counting boards ACB count in or out as the axles traverse the wheel sensor, depends on the following factors:

- side of the track on which the counting head is mounted
- direction from which the axles roll over the counting head
- wiring of wheel sensor systems

It is possible to change the direction by:

- changing both sensor systems (Sys1 ↔ Sys2), see Part IV "Project planning and construction"
- Changing the mounting side, if permitted by the mounting and commissioning instructions for the wheel sensor in question. This method is useless in the event of double usage.

7 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. Before commissioning, a check must be carried out to verify that the type in use is the planned type (see chapter 1 “General remarks on correct mounting and commissioning“).
2. The axle counting system ACS2000 may only be commissioned when it is in full working order and has been checked (see chapter 1 “General remarks on correct mounting and commissioning“).
3. The indication of axle counting by the display of the ACB and the occupied indication by the "occupied" LED are for information only and are not failsafe in terms of signalling. Consequently, the ACB information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel (see chapter 4 “ACB display and power-up“).
4. Mounting and commissioning of the wheel sensor must be carried out in accordance with the documentation (Part I "Outline of documents") (see chapter 1 “General remarks on correct mounting and commissioning“).

Test sockets

5. These test sockets must not be either short-circuited, interconnected or attached to an external voltage (see chapter 3.1 “Measurements on the board“).
6. Measurement and recording devices which are installed at the test sockets during regular operation or without supervision must incorporate measurement inputs with the following properties: independence, short-circuit immunity, external voltage immunity and ground immunity (see chapter 3.1 “Measurements on the board“).
7. The test sockets of the IMC have wheel sensor potential and are not protected against transient overvoltages and permanent voltages (see chapter 3.1 “Measurements on the board“).

Adjustment of IMC

8. The IMC must be adjusted even if the IMC is replaced, the wheel sensor is replaced or removed and then reinstalled for repair or cleaning or due to track work, or if the cable section has been modified (loop resistance modification) (see chapter 3.3 “Adjustment of the board IMC“).
9. Before adjustment, it must be ensured that the wheel sensor attached to the IMC is correctly mounted (see chapter 3.3 “Adjustment of the board IMC“).
10. During adjustment, it must be ensured that the wheel sensor attached to the IMC is not damped as in this case, adjustment will not be carried out or it will be carried out incorrectly (see chapter 3.3 “Adjustment of the board IMC“).

ABP

11. Modifications to the DIP-switches on the ABP may only be carried out by specially trained personnel, taking into account the project planning documents (see chapter 5.4 “DIR-DIP-switch in modem operation“).

Functional check

12. During initial commissioning of the axle counting system ACS2000 or during replacement of the ABP, the assignment and direction of the connected counting heads and the status of the soldering jumpers on the ABP must be checked (see chapter 6 “Functional check“).
13. During initial commissioning, it must be checked that the wheel sensors have been correctly mounted in accordance with the mounting and commissioning guidelines (see Part I "Outline of documents") (see chapter 6 “Functional check“).
14. The assignment and direction of all connected counting heads must be checked during initial commissioning of the ACS2000 (see chapter 6 “Functional check“).
15. During initial commissioning of the ACB board, it must be checked that all counting heads connected to this board are in working order (this can be done by traversing, using a testing plate or by using the toggle switches) (see chapter 6 “Functional check“).
16. During initial commissioning of a DIOB board, it must be checked that all inputs and outputs are in working order (see Part IX: Diagnostics) (see chapter 6 “Functional check“).

D10041-07-2

Part VII

Acceptance

of the axle counting system

ACS2000

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Masthead

This document is the translation of the German original.

1 General

If any of the following questions cannot be answered YES in the subsequent acceptance, the ACS2000 should not be commissioned.

2 Boards

		Yes	No
Are all boards used permitted types?	Type numbers:		
	Equipment version:		

3 Environmental conditions

Do the ambient temperatures to be expected lie in the range of 25 °C to +70 °C?		
Is the occurrence of mould growth and animal pests unlikely?		

4 Settings

Are DIP-switches set in accordance with the project planning documents?		
Is the coding of the plugs present?		
Is it guaranteed that the modems attached or the external data evaluation systems feature an interface in accordance with EIA/TIA-232E?		

5 Cabling and mounting

Is the yellow and green earth lead of the overvoltage protection board BSI connected by the shortest distance to the earthing terminal and does the earthing terminal have a diameter of at least 6 mm^2?		
Has it been ensured that the sockets on the front panel of the evaluation board are neither short-circuited, interconnected nor attached to an external voltage?		
Is the cable length between ACS2000 and the modem shorter than 3 m?		
Is a separate cable system available for track vacancy detection?		

6 Components

6.1 Input/output board DIOB

Is the output ERROR (ST4 / Pin 10z, 12z and ST5 / Pin 10z, 12z) used only for safety-relevant applications?		

6.2 Wheel sensors

Is the wheel sensor mounted on the inside of the track (wheel flange side)?		
Has it been ensured that the edge of the wheel sensor housing is not in contact with the rail head?		
Is the distance between two RSR180 wheel sensors in the longitudinal rail direction at least the distance of two spaces between sleepers?		

6.3 Overvoltage protection board BSI

Is the BSI004 overvoltage protection board used?		

7 Reconciliation

Correct allocation of the connected counting heads?		
Correct counting direction?		
Correct allocation of the reset inputs?		
Clear status is given after reset?		
Is the reconciliation check correct (external wheel sensor occupied, internal equipment and operating terminal respond correctly)?		

8 Comments

Date: **Signature:**

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Part VIII

Maintenance

of the axle counting system

ACS2000

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Masthead

This document is the translation of the German original.

1 Checks

The checks listed in this document must be carried out at the designated intervals in accordance with the regulations.

In the event of a fault where the causes are unclear, carry out the respective repairs and maintenance immediately.

2 Tools and measuring equipment

- mV-meter, range 1000 mV, DC, +/- 0.5 % basic accuracy
- 2 measurement lines with 2 mm male connectors
- 2 measurement lines with test probes
- testing plate PB200

3 Measurements at the test sockets of the evaluation board

Cycle: <2 years

Tests: Carry out the measurements in accordance with Part IX "Diagnostics" and if necessary, adjust the evaluation board.

The wheel sensor current of the wheel sensor RSR180 is set at 2.8 to 5.0 mA.

Sensor system currents must be measured in the undamped status, with the sensor correctly mounted.

It is recommended that the measured values are documented.

4 Wheel sensor check

4.1 Checking the wheel sensor RSR180

Cycle: <2 years

Check: Visual and mechanical checks must be carried out on the wheel sensor RSR180 (see Part I "Outline of documents", chapter 5).

Check of the occupancy detection capability of the wheel sensor by means of an error-free traversing with a track vehicle. This is carried out through traversing (both System1 and System2) of at least one axle, during which the corresponding ACB must be counted in/out correctly.

Another option for checking the occupancy detection capability of the wheel sensor is possible through occupancy by means of the testing plate PB200 (see also brief instructions for the testing plate PB200).

The provisions regarding mounting, commissioning and maintenance (see Part I "Outline of documents", chapter 5) must be complied with.

5 Checking of the ACB

Cycle: <2 years

Check a) Traverse a counting head connected to the ACB to be checked with a track vehicle and during this, count in and then out again at least one axle or

Check b) count in and then out again at least one axle with the help of testing plate PB200 or

Check c) simulate a traversing at the evaluation board, whereby at least one axle must be counted in and then out again.

Within 2 years, the axle counting system must be changed at least once from the clear to the occupied status and from the occupied to the clear status (clear-occupied-clear or occupied-clear-occupied).

6 DIOB

Cycle: <1 year

Check: There are two variants for checking the functionality of the DIOB:

Variant 1: For checking purposes, the information at the DIOB inputs must be able to be switched on and off individually by the system (e.g. interlocking). The information of the DIOB outputs that is evaluated by the downstream equipment (e.g. interlocking) must be visible for monitoring purposes. The repair service must be assisted by another person in a different subsystem (switching on and off of the input information, monitoring of the output information).

Variant 2: Test plugs are required in order to test the system. The repair service must be assisted by another person in another subsystem (connecting the test plug).

Note: The system does not need to provide a test signal.
Checking of all inputs and outputs takes place in one checking stage, as the output signals of the DIOB are sent back through its inputs to the outputs of the DIOB in the first subsystem by the test plug in the second subsystem.

Within one year, the outputs of the DIOB input/output board that have been used must be tested to check whether these open due to non-activation of the corresponding input**.**

The indication of the input and output statuses by the LEDs on the front panel is for information only and is not failsafe in terms of signalling. Consequently, the DIOB information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel.

7 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. In the event of a fault where the causes are unclear, the maintenance measures specified in each case must be carried out immediately (see chapter 1 “Checks)“.

Evaluation board

2. The sensor system currents must be measured with a correctly mounted sensor in an undamped status, at intervals of two years (see chapter 3 “Measurements at the test sockets of the evaluation board“).

Wheel sensor

3. Maintenance cycles in accordance to chapter 4 “Wheel sensor check“ are to be complied with.

ACB

4. Within 2 years, the axle counting system must be changed at least once from the clear to the occupied status and from the occupied to the clear status (clear-occupied-clear or occupied-clear-occupied) (see chapter 5 “Checking of the ACB“).

DIOB

5. Within one year, the outputs of the DIOB input/output board that have been used must be tested to check whether these open due to non-activation of the corresponding input (see chapter 6 “DIOB“).
6. The indication of the input and output statuses by the LEDs on the front panel is for information only and is not failsafe in terms of signalling. Consequently, the DIOB information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel (see chapter 6 “DIOB“).

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Part IX

Diagnostics

of the axle counting system

ACS2000

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Masthead

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1 General

1. Troubleshooting should begin in the indoor installation.
2. Record and evaluate the current display.
3. If a fault still persists after a basic and/or advanced reset by the operating or safety personnel,
   - the measurements listed in chapter 6 “Troubleshooting“ must be carried out,
   - the ACB and, if necessary, the evaluation board must be removed and plugged in again,
   - the relevant boards must be replaced (see chapter 8 “Replacement of boards“).

If the track section affected is connected to another track section through double usage, a reset must also be carried out on this, after the evaluation board has been removed and plugged in again.

The information of the display elements that is shown on the front panel of all boards is for information only and is not failsafe in terms of signalling. Consequently, the information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel. The diagnostic input/output and the optocoupler outputs on the D-SUB socket or the RJ45 socket of the ACB may only be used for safety-relevant processes.

The reset operation is an exceptional operation. Therefore, the complete system must be tested if the cause for the occupied status is unclear or reset operations are required several times within a few train journeys.

2 Display of error codes

2.1 Power-up

L	R	N	0	no processing unit initialised
L	R	N	1	1. ACB channel initialised after power-up
L	R	N	2	2. ACB channel initialised after power-up
L	R	N	3	3. ACB channel initialised after power-up (only in modem operation)
L	R	N	4	4. ACB channel initialised after power-up (only in modem operation)
L	R	N	5	1. DIOB channel initialised after power-up (only in modem operation)
L	R	N	6	2. DIOB channel initialised after power-up (only in modem operation)
L	R	N	7	3. DIOB channel initialised after power-up (only in modem operation)
L	R	N	8	4. DIOB channel initialised after power-up (only in modem operation)
*	*	*	*	flashing, after initialisation is successfully completed

If during power-up, a wheel sensor system assigned to the track section is occupied, four slashes ('////') will appear on the display.

If a wheel sensor system assigned to the track section is occupied during a serious or minor error, a slash will appear on the display in the first position ('/xxx').

SCI: If the serial connection or communication is interrupted or disrupted after power-up, but before reset, "SCI" will appear as the error message. Other causes can be a defective modem, ACB or DIOB.

BOOT: This error message is shown in the event of a defective display processing unit; in this case, the ACB must be sent for repair.

LRN0 or LRN1: If the serial connection or communication is interrupted before or during power-up, "LRN0" or "LRN1" will appear as the error message. Possible causes for this can be incorrect "MODE" settings, incorrect soldering jumpers of the DIOB or RS232 or different baud rates.

****** flashing:** This code is shown after a power-up.

****** not flashing:** This code is shown after a power-up and after an axle is counted in or out.

2.2 Display statement

In error-free status, the number of axles counted in is shown on the display.

In the event of a fault, instead of the axle number, a four-digit code is displayed, which is composed as described below:

a	x	y	z

display of the ACB board

Place holder **a**: status indicator, which shows the type of error

- ..... minor error, last axle counted out

+ .....minor error, last axle counted in

/ ..... displayed for as long as one or more systems are occupied

∗ .....serious error

∗ .....flashing, error signal after pre-Reset

Place holder **x**: display of the channel, for which the error code (yz) applies

1.....channel 1

2.....channel 2

3.....channel 1 of the second counting board (second subsystem)

4.....channel 2 of the second counting board (second subsystem)

Place holder **yz**: error code

yz..... two-digit hexadecimal number (00 to FF)

An error occurring is shown on the display in the form of a "yz" error code. If another error occurs at a later time, the error signal and the associated error code will change. In principle, the last error to occur is displayed. A serious error, however, has display priority.

<00> Display indicator while the first axle is counted in or the last axle is counted out.

3 Error codes, causes and remedies

If a minor or serious error occurs, this can be resolved, depending on the ACB type, by carrying out a suitable reset procedure. If the error occurs again, the board affected must be replaced.

ACB type	power up			partial traversing			last axle						serious error		
							counted out			counted in					
	pre- Reset	Reset	clearing of track	pre- Reset	Reset	clearing of track	pre- Reset	Reset	clearing of track	pre- Reset	Reset	clearing of track	pre- Reset	Reset	clearing of track
119		✓			✓			✓		✓	✓		✓	✓	
119-001		✓			✓			✓		✓	✓		✓	✓	
119-002		✓			✓			✓		✓	✓		✓	✓	
120		✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	
	✓	✓		✓	✓		✓	✓		✓	✓				
120-001		✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	
	✓	✓		✓	✓		✓	✓		✓	✓				
120-002		✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	
	✓	✓		✓	✓		✓	✓		✓	✓				

Table 3.1: Reset procedure for each ACB type

For details, see chapter 2 “Display of error codes“.

4 Minor error

Minor error, error code 00 bis 7F.

error code	brief description	cause	remedy
00	no fault is present	fault-free operation	
01	another subsystem is reporting a minor error	see error code of the other subsystem	
02	another subsystem is not responding to the applied Reset	serial communication has been temporarily interrupted or disrupted (component error of a board)	repeat Reset, check the transmission medium, if necessary replace the board
03	partial traversing on another subsystem	see error code of the other subsystem	
04	waiting for clearing of track after Reset (modem operation)	At least one axle must be correctly counted in and out again, whereby one counting process must take place on each subsystem (a train must traverse from one subsystem to the other).	
05	occupied/clear comparison faulty in transmission mode	EMC-interference (see [7]) (Hardware error)	carry out a reset; if the error occurs again, replace the affected ACB
06	negative axle in modem operation	for errors 21 to 26, if the serial communication is interrupted or disrupted	carry out a reset; if the error occurs again, replace the affected ACB
07	pre-Reset carried out in modem operation	reset restriction removed through pre-Reset operation; the code is displayed after successful execution as confirmation	
08	results of the counting logic and hardware evaluation not the same	EMC-interference (see [7]) (Hardware error)	
09	waiting for clearing of track after Reset (isolated operation)	At least one axle must be correctly counted in and out again. This counting in and out process can be carried out at each counting head belonging to a track section.	

error code	brief description	cause	remedy
0A	result - comparison at channel 1 and 2 faulty	overcurrent due to e.g. - wire break, short circuit or interference on the wheel sensor cabling - evaluation board has been removed or is not adjusted correctly - short circuit or interruption in double usage wiring - evaluation board defective - DIP-switches different	
0B	comparison of hardware evaluation 1 and 2 different		
0C	negative axle in isolated operation	the same causes as with errors 21 to 26; display of this error code, if the serial communication is interrupted or disrupted	
0E	pre-Reset carried out in isolated operation	If a reset restriction has been removed with a pre-Reset operation, this code is displayed as confirmation after successful execution.	
0F	failure of the serial communication	serial communication (modem connection) is out of action for longer than 30 days	establish connection again; reverse the axle counting system by carrying out a simple reset

error code	brief description	cause	remedy
11	partial traversing at the 1. evaluation board	- partial traversing e.g. during shunting works - very small wheel - check wheel sensor mounting (mounted too deep)	see chapter 6 “Troubleshooting“
12	partial traversing at the 2. evaluation board		
13	partial traversing at the 3. evaluation board		
14	partial traversing at the 4. evaluation board		
15	partial traversing at the 5. evaluation board		
16	partial traversing at the 6. evaluation board		

error code	brief description	cause	remedy
21	negative axle at the 1. evaluation board	- reset, although at least one axle was in the track section - very small wheel - check wheel sensor mounting (mounted too deep)	see chapter 6 “Troubleshooting“
22	negative axle at the 2. evaluation board		
23	negative axle at the 3. evaluation board		
24	negative axle at the 4. evaluation board		
25	negative axle at the 5. evaluation board		
26	negative axle at the 6. evaluation board		

31	system pulse of the 1. evaluation board too short	- EMC-interference (see [7]) - interference on the double usage wiring - evaluation board defective	if this error occurs with increasing frequency, the evaluation board affected should be replaced
32	system pulse of the 2. evaluation board too short		
33	system pulse of the 3. evaluation board too short		
34	system pulse of the 4. evaluation board too short		
35	system pulse of the 5. evaluation board too short		
36	system pulse of the 6. evaluation board too short		

41	system 1 and 2 simultaneously on the 1. evaluation board	- very large wheel - wire short circuit on the wheel sensor cabling - EMC-interference on the wheel sensor cabling (see [7]) - interference on the double usage wiring - check wheel sensor mounting (mounted too deep)	see chapter 6 “Troubleshooting“
42	system 1 and 2 simultaneously on the 2. evaluation board		
43	system 1 and 2 simultaneously on the 3. evaluation board		
44	system 1 and 2 simultaneously on the 4. evaluation board		
45	system 1 and 2 simultaneously on the 5. evaluation board		
46	system 1 and 2 simultaneously on the 6. evaluation board		

error code	brief description	cause	remedy
51	pulse edge sequence not correct, too many edges at the 1. evaluation board	- EMC-interference (see [7]) - very large wheel - wire short circuit on the wheel sensor cabling - EMC-interference on the wheel sensor cabling - interference on the double usage wiring	see chapter 6 “Troubleshooting“
52	pulse edge sequence not correct, too many edges at the 2. evaluation board		
53	pulse edge sequence not correct, too many edges at the 3. evaluation board		
54	pulse edge sequence not correct, too many edges at the 4. evaluation board		
55	pulse edge sequence not correct, too many edges at the 5. evaluation board		
56	pulse edge sequence not correct, too many edges at the 6. evaluation board		

60	relay test	- relay test active	unplug /plug in the board
61	the other subsystem is reporting clearing of track	- see error code of the other subsystem	
62	occupancy at the wrong time	- defective wheel sensor - defective evaluation board	

71	relay feedback faulty [1)]	overcurrent due to e.g. - wire break, short circuit or interference on the wheel sensor cabling - short circuit or interruption in double usage wiring - evaluation board defective - DIP-switches different - relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, troubleshooting should be executed in the sequence opposite (cause column); if necessary, the voltage supply should be interrupted and a reset should be carried out; if the fault occurs again, the affected ACB should be replaced
72	relay feedback faulty [1)]		
73	relay feedback faulty [1)]		

1) Detection of error during change from the clear to the occupied status or from the occupied to the clear status.

5 Serious error

Serious error, error code 80 bis FF.

error code	brief description	cause	remedy
80	power-up, 4 asterisks are shown on the display	status after application of the supply voltage	reset required
83	pre-Reset and Reset actuated simultaneously	- pre-Reset and Reset actuated simultaneously - short circuit between the pre-Reset and reset inputs	
84	DIP-switches changed in operation	- DIP-switches have been changed during operation	check using the project planning documents
90	another subsystem is reporting a serious error	see error code of the other subsystem	

A4	relay feedback faulty [1)]	- relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, if necessary the supply voltage should be interrupted and a reset carried out; if this error occurs again, the affected ACB should be replaced
A5			
A6			
A7			

A9	relay feedback faulty [1)]	- relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, if necessary the supply voltage should be interrupted and a reset should be carried out; if the error occurs again, the affected ACB should be replaced
AA			
AB			
AC			
AD			
AE			
AF			

1) Detection of error during change from the clear to the occupied status or from the occupied to the clear status.

error code	brief description	cause	remedy
B1	relay feedback faulty [1]	- relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, if necessary the voltage supply should be interrupted and a reset should be carried out; if this error occurs again, the affected ACB should be replaced
B2			
B3			
B4			
B5			
B6			
B7			
B9	relay feedback faulty [1]	- relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, if necessary the voltage supply should be interrupted and a reset should be carried out; if this error occurs again, the affected ACB should be replaced
BA			
BB			
BC			
BD			
BE			
BF			
C1	relay feedback faulty [1]	- relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, if necessary the voltage supply should be interrupted and a reset should be carried out; if this error occurs again, the affected ACB should be replaced
C2			
C3			
C4			
C5			
C6			
C7			
C9	relay feedback faulty [1]	- relay contacts oxidised - relay activation defective - relay defective - fault on the readback wire	if this error occurs, if necessary the voltage supply should be interrupted and a reset should be carried out; if this error occurs again, the affected ACB should be replaced
CA			
CB			
CC			
CD			
CE			
CF			

[1] Detection of error during change from the clear to the occupied status or from the occupied to the clear status.

error code	brief description	cause	remedy
D0	error in the program code test [2)]	- program code faulty - EMC-interference (see [7])	if this error occurs, if necessary the supply voltage should be interrupted and a reset should be carried out; if the error occurs again, the affected ACB should be replaced
D1	error in the data storage test [2)]	- SRAM faulty - EMC-interference (see [7])	
D2	error in the register test [2)]	- register faulty - EMC-interference (see [7])	
D3	error in the WatchDogTimer test [2)]	- WatchDogTimer faulty - EMC-interference (see [7])	
D4			
D5			
D6	error in the overvoltage test [2)]	- overvoltage monitoring faulty - EMC-interference (see [7])	if this error occurs, if necessary the supply voltage should be interrupted and a reset should be carried out; if the error occurs again, the affected ACB should be replaced
D7			
D8	error in the undervoltage test [2)]	- undervoltage monitoring faulty - EMC-interference (see [7])	
D9			
DA	error in the edge readout [2)]	- ACB faulty - EMC-interference (see [7])	
DD	error in the readback input [2)]		

2) Detection of error during a power-up or caused by cyclical tests.

6 Troubleshooting

It is essential to follow the safety provisions contained in Part XI "Safety provisions".

In the case of safety-relevant applications, an error must be resolved within 24 hours, otherwise the installation must be taken out of operation.

The information of the display elements that is shown on the front panel of all boards is for information only and is not failsafe in terms of signalling. Consequently, the information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel. The diagnostic input/output and the optocoupler outputs on the D-SUB socket or the RJ45 socket of the ACB may only be used for safety-relevant processes.

A voltage proportional to the sensor current, which can be used for checking purposes, is output at the test sockets of the evaluation board's front panel. These sockets must not be either short-circuited, interconnected or attached to an external voltage. The input resistance of a measuring instrument connected to the test sockets of the evaluation board must be ≥ 10 kΩ, so that the measuring error remains < 1 %.

The test sockets of the IMC have wheel sensor potential and are not protected against transient overvoltages and permanent voltages .

Measurement and recording devices which are installed at the test sockets during regular operation or without supervision must incorporate measurement inputs with the following properties: independence, shortcircuit immunity, external voltage immunity and ground immunity.

As soon as a measuring cable is connected to the test sockets of the evaluation board or during measurement, no radio-telephone devices may be used in the immediate vicinity, as these may result in an incorrect measurement or interference to the evaluation board.

6.1 LED indicator IMC

Slow flashing of the Sys1 and Sys2 LED:

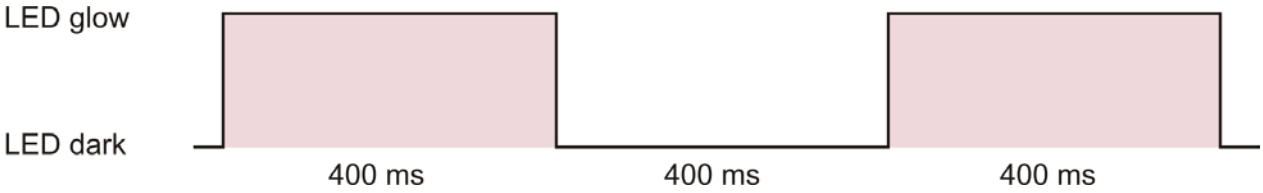

Figure 6.1: Slow flashing

- incorrect connection of the wheel sensor RSR180
- wire break or wire short circuit in wheel sensor cable
- overcurrent
- evaluation board IMC not (yet) adjusted.

Fast flashing of the Sys1 and Sys2 LED:

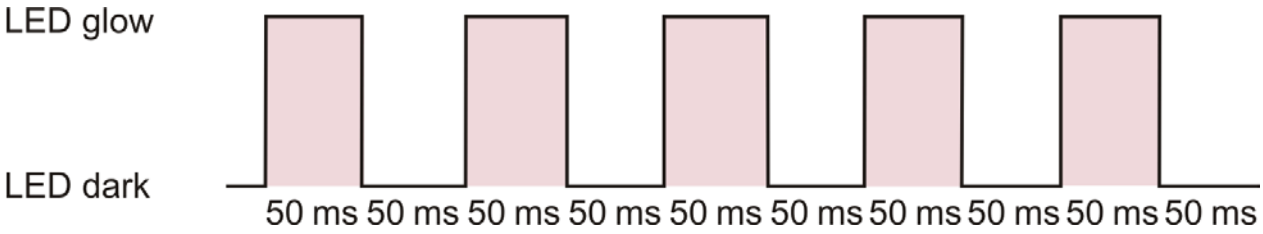

Figure 6.2: Fast flashing

- adjustment procedure was interrupted
- invalid actuation sequence was instigated
- internal fault in the evaluation board IMC

Short flashing of the Sys1 and Sys2 LED:

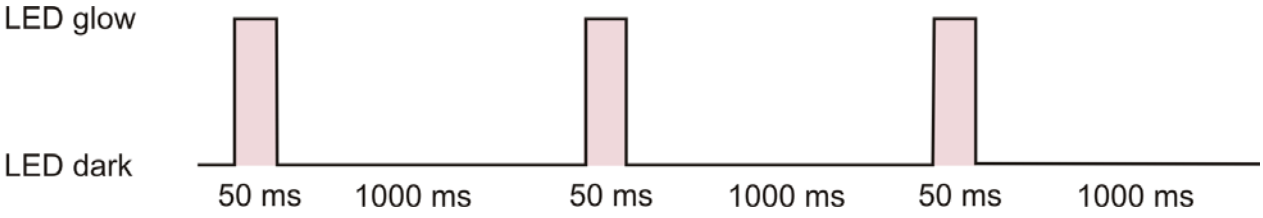

Figure 6.3: Short flashing

- wheel sensor RSR180 current drift (display after 1 minute)

6.2 Indoor equipment

6.2.1 Measurements on the IMC when the RSR180 wheel sensor is connected

Measure voltage at test sockets for Sys1 and/or for Sys2: 280 to 500 mV DC

The measured voltage corresponds to the wheel sensor system current via a 100 Ohm shunt (100 mV corresponds to 1 mA wheel sensor system current). The voltage must be measured in the undamped status.

The wheel sensor current of wheel sensor RSR180 depends on:

- the mounting position,
- the type of mounting (claw, web, etc.),
- the rail profile (large e. g. UIC60, small e.g. VST36)

200-280 mV and/or 500-600 mV:

- metal parts in the vicinity of the wheel sensor RSR180,
- wheel sensor RSR180 not mounted centrally between the sleepers,
- check wheel sensor mounting,
- rail profile is too small or too large,
- incorrect clamping bolts in the case of claw mounting
- wheel sensor RSR180 damped (traversed)

> 600 mV:

- wire short circuit wire 1 with 2 and/or wire 3 with 4,
- wheel sensor RSR180 incorrectly connected

0 mV:

- no wheel sensor RSR180 connected,
- wire discontinuity wire 1, 2 and 3, 4,
- SLAVE board (if configured as SLAVE, check the OFF position of the DIP-switches)
- overvoltage protection board BSI, wheel sensor RSR180 or evaluation board IMC defective (the earth fault cable should be checked if replacing the BSI004 overvoltage protection board)

Difference between the two voltages <20 mV and/or max 5%:

- check wheel sensor mounting,
- wheel sensor RSR180 not mounted centrally between the sleepers,
- metal parts below the wheel sensor RSR180,
- a wheel sensor system is defective

6.2.2 Measurements at the overvoltage protection board BSI

Voltage measurements between clamps 3 and 4: 12 to 28 V DC (with wheel sensor connected).

The current should be measured at wire 3 and should be 57 to 65 mA.

6.3 Outdoor equipment

6.3.1 Wheel sensor mounting

Check the wheel sensor mounting in accordance with the guidelines for mounting and commissioning of the wheel sensor (see Part I "Outline of documents").

Repair of the wheel sensor by the user is not permitted.

6.3.2 Measurements in the GAK when the RSR180 wheel sensor is connected

current in wire 1 and/or 2: 2.8 to 5 mA

current in wire 3: 57 to 65 mA

If the current is < 55 mA the loop resistance must be checked.

voltage between wires 3 and 4: 12 to 14 V

If the voltage is less than 12 V DC, the loop resistance must be tested.

The maximum loop resistance of the cable from the GAK to the backplane ABP is 250 Ω.

6.4 Measurements with an oscilloscope or another recording device

The measurement is carried out at the evaluation board at the test sockets of Sys1 and/or Sys2.

Requirements for the recording device:

- at least 2 channels
- sample rate of around 2 kS/s is sufficient
- The recording depth, depending on the train length and speed, can vary between 5 and 30 s (at 2 kS/s this is 10 kB to 60 kB storage per channel).

7 Handling of boards

Before touching a board, always balance the charge by touching a bare metal surface of the frame, rack or cubicle. Charge balancing prevents the charge from passing through the electronic circuit components.

- If possible, note the error code before handling the defective boards (see chapter 4 “Minor error“ and chapter 5 “Serious error“).
- Always remove boards using the corresponding hand grip.
- Do not touch board connections, circuit board tracks, components or socket boards.
- Always hold boards at the edge, by the front panel or by the hand grip.
- If not installed, boards must always be stored in antistatic packaging.
- Always transport boards in antistatic packaging.
- If boards are handed from one person to another without packaging, touch hands to balance potential before handover.

Defective boards must not be repaired, they may only be replaced (exception: changing of the fuses on the fuse board). Defective boards must be sent to the manufacturer as soon as possible with as precise as possible a description of the faulty behaviour (error code where applicable, see chapter 4 “Minor error“and chapter 5 “Serious error“) and any special circumstances.

8 Replacement of boards

The safety provisions pursuant to Part XI "Safety provisions" must be observed.

Repair of the boards by the user is not permitted.

A board may only be replaced by a board with the same type number.

A fuse may only be replaced by a fuse with the same type designation (F 2A).

Resetting of the DIP-switches on the IMC evaluation board by the user is not permitted. Exception: The DIP-switch settings for analogue double usage (DIP103 and DIP203) must be transferred from the IMC to be replaced to the new one.

Adjust the evaluation board IMC pursuant to Part VI "Commissioning".

If the cause of a fault is not known, the evaluation board and the respective overvoltage protection board should be replaced and sent to the manufacturer for inspection.

All boards can be replaced with voltage applied.

When replacing the ACB board or after a fault, it must be checked that all counting heads connected to this board are in working order after re-commissioning (this can be done by traversing, using a testing plate or by using the toggle switches).

If a defective overvoltage protection board is replaced, the sensor currents and the occupancy detection capability of the related wheel sensor must be checked after this. If an earth fault is present or is detected during maintenance work, this must be eliminated in any case .

After replacing a defective board or changing a fuse on the fuse board, the functionality of the associated track section must be checked.

When replacing the evaluation boards, the following steps must be carried out:

- measure sensor currents at the test sockets
- adjust the board
- By pushing the toggle switches on the front panel of the evaluation board, traversing from Sys1 and Sys2 can be simulated (count axle in and out).
  Important: When counting an axle in, the axle counting section must switch to the occupied status.

During replacement of the ABP, the assignment and direction of all connected counting heads and the status of the soldering jumpers on the ABP must be checked.

After a fault or when replacing the DIOB board, it must be checked that all inputs and outputs are in working order. There are 2 variants for checking the functionality to choose from.

Variant 1: For checking purposes, the information at the DIOB inputs must be able to be switched on and off individually by the system (e.g. interlocking). The information of the DIOB outputs that is evaluated by the downstream equipment (e.g. interlocking) must be visible for monitoring purposes. The repair service must be assisted by another person in a different subsystem (switching on and off of the input information, monitoring on the output information).

Variant 2: Test plugs are required in order to check the system. The repair service must be assisted by another person in another subsystem (connecting the test plug).

Note: The system does not need to provide a test signal.
Checking of all inputs and outputs takes place in one checking stage, as the output signals of the DIOB are sent back through its inputs to the outputs of the DIOB in the first subsystem by the test plug in the second subsystem.

Replacement of a defective board or a fault restoring error reset in the regular operating status must take place within 24 hours.

If an evaluation board that is set in double usage is replaced, a reset must be carried out after this on both (adjacent) track sections.

9 Disposal and decommissioning

Defective boards, which are not sent to the manufacturer in accordance with chapter 7 “Handling of boards“ must be disposed of in accordance with the regulations specific to the country.

Planning and implementation of a decommissioning, and disposal of components and system parts is within the scope of competence of the relevant railway administration.

10 Diagnostic software

The "Serial Interface" interfaces of the ACB board and of the IMC board with GS03 form the diagnostic interfaces and may be used for diagnostic purposes. For more detailed information, refer to the corresponding documentation of the diagnostic system.

Diagnostic data are not failsafe in terms of signalling safety and therefore are for information only. These data may therefore only be used as a support in troubleshooting or for optimising maintenance activities.

The cable on the diagnostic interface of the ACB (D-SUB socket or RJ45 socket) must not exceed a maximum length of 3 m.

The diagnostic interface of the ACB and IMC boards may only be used if there is galvanic separation between the diagnostic interface and the external diagnostic device.

The diagnostic interface is available on the ACB as a D-SUB socket and as a RJ45 socket. Simultaneous connection of evaluation systems to the diagnostic interface of the D-SUB socket and RJ45 socket of the ACB is not permitted.

11 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. The information of the display elements that is shown on the front panel of all boards is for information only and is not failsafe in terms of signalling. Consequently, the information displayed must not be used as the basis for safety-relevant actions by operating, maintenance and repair personnel. The diagnostic input/output and the optocoupler outputs on the D-SUB socket or the RJ45 socket of the ACB may only be used for safety-relevant processes (see chapter 1 “General“, chapter 6 “Troubleshooting“).
2. The reset operation is an exceptional operation. Therefore, the complete system must be tested if the cause for the occupied status is unclear or reset operations are required several times within a few train journeys (see chapter 1 “General“).
3. In the case of safety-relevant applications, an error must be resolved within 24 hours, otherwise the installation must be taken out of operation (see chapter 6 “Troubleshooting“).
4. Repair of the wheel sensor by the user is not permitted (see chapter 6.3.1 “Wheel sensor mounting“).

Test sockets

5. A voltage proportional to the sensor current, which can be used for checking purposes, is output at the test sockets of the evaluation board's front panel. These sockets must not be either short-circuited, interconnected or attached to an external voltage (see chapter 6 “Troubleshooting“).
6. The test sockets of the IMC have wheel sensor potential and are not protected against transient overvoltages and permanent voltages (see chapter 6 “Troubleshooting“).
7. Measurement and recording devices which are installed at the test sockets during regular operation or without supervision must incorporate measurement inputs with the following properties: independence, shortcircuit immunity, external voltage immunity and ground immunity (see chapter 6 “Troubleshooting“).

Handling of boards

8. Defective boards must not be repaired, they may only be replaced (exception: changing of the fuses on the fuse board) (see chapter 7 “Handling of boards“).
9. After replacing a defective board or changing a fuse on the fuse board, the functionality of the associated track section must be checked (detailed functionality test see chapter 8 “Replacement of boards“).

10. Replacement of a defective board or a fault restoring error reset in the regular operating status must take place within 24 hours (see chapter 8 “Replacement of boards“).
11. A board may only be replaced by a board with the same type number (see chapter 8 “Replacement of boards“).
12. A fuse may only be replaced by a fuse with the same type designation (F 2A) (see chapter 8 “Replacement of boards“).
13. Resetting of the DIP-switches on the IMC evaluation board by the user is not permitted. Exception: The DIP-switch settings for analogue double usage (DIP103 and DIP203) must be transferred from the IMC to be replaced to the new one (see chapter 8 “Replacement of boards“).
14. When replacing the ACB board or after a fault, it must be checked that all counting heads connected to this board are in working order after re-commissioning (this can be done by traversing, using a testing plate or by using the toggle switches) (see chapter 8 “Replacement of boards“).
15. Repair of the boards by the user is not permitted (see chapter 8 “Replacement of boards“).
16. After a fault or when replacing the DIOB board, it must be checked that all inputs and outputs are in working order (see chapter 8 “Replacement of boards“)
17. If a defective overvoltage protection board is replaced, the sensor currents and the occupancy detection capability of the related wheel sensor must be checked after this. If an earth fault is present or is detected during maintenance work, this must be eliminated in any case (see chapter 8 “Replacement of boards“).
18. During replacement of the ABP, the assignment and direction of all connected counting heads and the status of the soldering jumpers on the ABP must be checked (see chapter 8 “Replacement of boards“)
19. Planning and implementation of a decommissioning, and disposal of components and system parts is within the scope of competence of the relevant railway administration (see chapter 9 “Disposal and decommissioning“).

Diagnostics

20. Diagnostic data are not failsafe in terms of signalling safety and therefore are for information only. These data may therefore only be used as a support in troubleshooting or for optimising maintenance activities (see chapter 10 “Diagnostic software“).
21. The cable on the diagnostic interface of the ACB (D-SUB socket or RJ45 socket) must not exceed a maximum length of 3 m (see chapter 10 “Diagnostic software“).

22. The diagnostic interface of the ACB and IMC boards may only be used if there is galvanic separation between the diagnostic interface and the external diagnostic device (see chapter 10 “Diagnostic software“).
23. The diagnostic interface is available on the ACB as a D-SUB socket and as a RJ45 socket. Simultaneous connection of evaluation systems to the diagnostic interface of the D-SUB socket and RJ45 socket of the ACB is not permitted (see chapter 10 “Diagnostic software“).

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D10041-10-2

Part X

Operation

of the axle counting system

ACS2000

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Checked:	R. Thalbauer	sign. Thalbauer	2012-03-30		D10041-10-2
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2	2012-03-29	J. Böttger	chapter 2, chapter 3	wording

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2	2012-07-09	J. Böttger	all	new english version
2	2012-08-06	A. Ecker	chapter 3	wording

Masthead

1 Axle counting board ACB

There are two "pre-Reset" toggle switches on the front panel of the axle counting board, which are used for preparation of the reset of the axle counting system.

"pre-Reset": Simultaneous pushing of both toggle switches for more than 0.5 s is comparable to a pre-Reset operation, as described in Part V "Types of boards".

"Reset": During reset, the operating provisions of the installation's switching logics must be observed.

For details on the reset procedure, see Part V "Types of boards".

2 Evaluation board IMC

A toggle switch is present on the front panel for each system (Sys1 and Sys2).

"Test": The effect of pushing a toggle switch “Test” is the equivalent of an occupancy of the corresponding wheel sensor system.

"Adjust": Pushing the toggle switch in direction “Adjust”, the toggle switch is required for adjustment, see Part VI "Commissioning".

3 Simulation of traversing on the evaluation board IMC

To be able to simulate a traversing with the toggle switches, there must be a wheel sensor connected to the corresponding evaluation board and the axle counting system must be reset.

The traversing can now be simulated with the toggle switch combinations shown in Figure 3.1. The actuation time is negligible but an overlap is required.

The toggle switches must be pushed in the specified sequence (see Figure 3.1), otherwise errors may occur (see Part IX "Diagnostics").

Depending on the way the toggle switches are pushed and the configuration of the counting direction (e.g. DIR-DIP-switch in isolated operation), an axle is counted in or out in each case (see Part IV "Project planning and construction").

If the ACS2000 has been connected with another ACS2000 through at least one incidence of double usage, axles are also counted in or out accordingly on this system during a simulation of traversing. The counting direction is therefore dependent on the counting direction configuration of the corresponding input on the ACS2000 opposite.

The operating personnel must be consulted before pushing the toggle switches on the front panels of the ACS2000 boards.

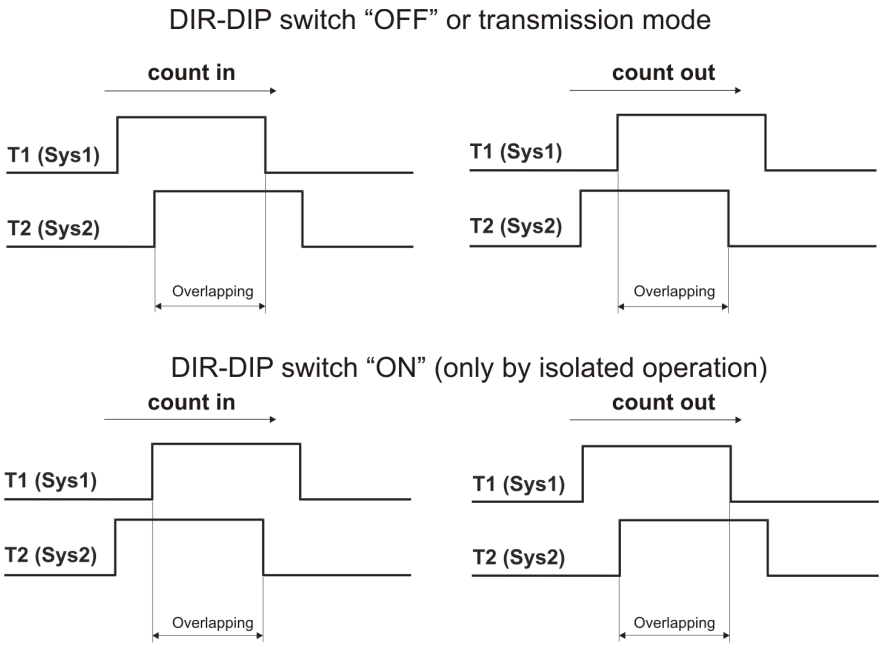

Figure 3.1: Key combination for a traversing

4 Diagnostics

See Part IX "Diagnostics".

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Part XI

Protection provisions

of the axle counting system

ACS2000

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Masthead

This document is the translation of the German original.

1 General protection provisions

In order to avoid injury to persons and damage to property, the following safety provisions must be carefully observed and applied. Personnel must be familiar with the sections of these safety provisions in order to guarantee safe and correct working on the ACS2000 axle counting system.

- Installation and maintenance work may only be carried out during periods in which there are no trains on the relevant track section.
- All parts of the signal cable, the distributor, the cable termination and the connecting cable between the ACS2000 axle counting system and the evaluation board may be subject to transient overvoltages and permanent voltages: The relevant provisions regarding protection must be satisfied before touching the wires and testing sockets.
- Prior to and during work on the track, safety measures must be implemented in accordance with the applicable railway provisions.
- Moreover, all the safety provisions in force within the railway operator's company shall apply.

2 Qualified personnel

No measures are in place to prevent unauthorised access to the ACS2000. The operator must ensure that access to the safety system is only possible for authorised personnel, or in the company of authorised personnel. The operation, mounting and commissioning of the ACS2000, as well as all maintenance, start-up and repair work on it, may only be carried out by personnel who have been briefed accordingly.

3 Safety-conscious working

- The qualified personnel specified in chapter 2 “Qualified personnel” are responsible for operational safety.
- The ACS2000 axle counting system may only be operated if it is in undamaged condition.
- No method of operation that could have a negative impact on the safety of persons or the function of the ACS2000 axle counting system may be used.
- No unauthorised alterations or modifications may be made to the ACS2000 axle counting system.
- Repair of the wheel sensor by the user is not permitted.
- Repair of the boards by the user is not permitted.
- Faulty components may only be replaced and repaired by the manufacturer.

4 Summary of safety-related application conditions (SAB)

The following rules and conditions must be observed.

1. In order to avoid injury to persons and damage to property, the safety provisions stated in chapter 1 “General protection provisions“ must be carefully observed and applied. Personnel must be familiar with the sections of these safety provisions in order to guarantee safe and correct working on the ACS2000 axle counting system.
2. No measures are in place to prevent unauthorised access to the ACS2000. The operator must ensure that access to the safety system is only possible for authorised personnel, or in the company of authorised personnel. The operation, mounting and commissioning of the ACS2000, as well as all maintenance, start-up and repair work on it, may only be carried out by personnel who have been briefed accordingly (see chapter 2 “Qualified personnel“).
3. Repair of the wheel sensor by the user is not permitted (see chapter 3 “Safety-conscious working“).
4. Repair of the boards by the user is not permitted (see chapter 3 “Safety-conscious working“).

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Part XII

Board specifications

of the axle counting system

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2	2012-07-09	J. Böttger	all	new english version
2	2012-08-06	A. Ecker	all	formatting

Masthead

This document is the translation of the German original.

1 Version and item number

designation	item number	version
wheel sensor RSR180/S-250	11749	03
wheel sensor RSR180/K-250	11904	03
wheel sensor RSR180/K-307	12057	03
wheel sensor RSR180/N-250	13180	03
protection tube	12205	
rail claw SK140	10021	
rail claw SK140-002	12827	
rail claw SK140-003	12825	
rail claw SK140-004	12998	
rail claw SK140-006	14492	
rail claw SK140-007	14926	
rail claw SK140-008	16872	
rail claw SK140-009	17050	
rail claw SK140-010	17274	
clamping bolt BBK5	10022	
clamping bolt BBK11	10023	
clamping bolt BBK17,5	10024	
clamping bolt BBK22	10025	
clamping bolt BBSK5	13097	
clamping bolt BBSK22	12968	
clamping bolt BBSK32	13498	
clamping bolt BBSK42	12911	
clamping bolt BBSK48	12911	
QUANTE trackside connection box SKV20 with terminal block	10034	
eccentric bolt for web of rail mounting EXC10	10019	

designation	item number	version
eccentric bolt for web of rail mounting EXC10/16	12782	
eccentric bolt for web of rail mounting EXC10/21	10020	
testing plate PB200 GS03	17825	03
board rack BGT04 84TE	10108	
board rack BGT05 42TE	10265	
grooved rail claw SK420-001	11753	
grooved rail claw SK420-002	12257	
grooved rail claw SK420-003	12866	
grooved rail claw SK420-004	12634	
grooved rail claw SK420-006	12868	
grooved rail claw SK420-007	13056	
grooved rail claw SK420-008	13527	
grooved rail claw SK420-009	13649	
grooved rail claw SK420-010	13833	
grooved rail claw SK420-011	14202	
grooved rail claw SK420-012	14455	
grooved rail claw SK420-013	15326	
grooved rail claw SK420-014	15778	
grooved rail claw SK420-015	16502	
grooved rail claw SK420-016	16633	
grooved rail claw SK420-017	17655	
grooved rail claw SK420-018	18504	
grooved rail claw SK420-019	18890	
overvoltage protection board BSI004	13753	01
backplane ABP002-2 21TE	13516	03
backplane ABP002-3 25TE	13517	03

designation	item number	version
backplane ABP002-4 29TE	13518	03
backplane ABP002-5 33TE	13519	03
backplane ABP002-6 37TE	13520	03
backplane ABP002-D2 28TE	13521	03
backplane ABP002-D3 32TE	13522	03
backplane ABP002-D4 36TE	13523	03
backplane ABP002-D5 40TE	13524	03
backplane ABP002-D6 44TE	13525	03
counting board ACB119	14747	04
counting board ACB119-001	15331	04
counting board ACB119-002	18396	04
counting board ACB120	14952	04
counting board ACB120-001	16496	04
counting board ACB120-002		
fuse board SIC006	13641	01
digital input/output board DIOB104	14735	04
evaluation board IMC001	13754	01
evaluation board IMC001	16209	03
evaluation board IMC003	13878	01
evaluation board IMC003	16210	03
evaluation board IMC006	13881	01
evaluation board IMC006	16213	03
evaluation board IMC008	13883	01
evaluation board IMC008	16214	03
evaluation board IMC011	13886	01
evaluation board IMC011	16217	03

designation	item number	version
evaluation board IMC013	13888	01
evaluation board IMC013	16222	03
evaluation board IMC016	14243	01
evaluation board IMC016	16227	03
evaluation board IMC018	14245	01
evaluation board IMC018	16228	03
evaluation board IMC024	14251	01
evaluation board IMC024	16234	03
evaluation board IMC025	14252	01
evaluation board IMC025	16235	03
evaluation board IMC026	14268	01
evaluation board IMC026	16236	03
evaluation board IMC058	16476	01
evaluation board IMC060	16426	03
evaluation board IMC065	17833	03
evaluation board IMC066	17960	03
evaluation board IMC068	17909	03

The items of indoor equipment are available in the "conformal coating" variant upon request.

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D10041-13-2

Part XIII

Boundary conditions to the assessment report

of the axle counting system

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Review list

version	date	prepared by	sections modified	reason
1	2011-10-07	J. Böttger	all	new version
2	2012-03-29	J. Böttger	chapter 1	wording

Translation list

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2	2012-07-09	J. Böttger	all	new english version
2	2012-08-06	A. Ecker	all	wording

Masthead

This document is the translation of the German original.

1 Boundary conditions to the assessment report

The following boundary conditions of the generic assessment report must be observed and complied with by the operator and the relevant safety authorities.

1. It must be checked whether the system delivered, as described in Parts I to XII, corresponds to the system that is required and was ordered, and that there are no discrepancies with the records and documentations.
2. For all connections of the following interfaces:
    a. switching outputs of IMC
    b. inputs and outputs of DIOB
    c. clear/occupied outputs of ACB
    d. Reset and pre-Reset inputs of ACB
    e. counting head inputs of ACB

    an interwire or earth short circuit must be prevented by routing the cables in a suitable manner.
3. For IMC types with Mg suppression, the operator must confirm that within 30 s after the last traversing of the counting head, no occupied axle counting section can be resetted, as well as released again and traversed.
4. When using 1-edge direction outputs, more than 12 axles must traverse the relevant wheel sensor, in any direction, within 2 years. As a result, the 1-edge direction outputs must output the relevant pulses, otherwise the error status is output, which must be rectified within 24 h, or the system must be decommissioned.
5. With regard to no. 4, it is also possible to check the accuracy of switching at the system outputs, in accordance with the axles that traverse the wheel sensor.
6. The user must confirm that the group of EMC guidelines comply with EN50121.
7. The system has been tested successfully in the field for all significant features, through validation and testing by Frauscher. Should other individual or additional tests be required, it is possible to have these carried out by the operator or the safety authorities.