D4586-1

Technical documentation

Wheel sensor Signal Converter

WSC001

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	Name	Signature	Date	**Technical documentation Wheel sensor Signal Converter WSC001**	Classified	
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Released:	Martin Rosenberger	sign. Rosenberger	2017-03-31		EN	1 / 58

Masthead

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Review list

Version	Date	Prepared by	Sections modified	Modifications
1	2017-03-31	Manuela Kothbauer	all	initial version

Bibliography

D-Number	Title	Version[1]
D2860	Brief instruction testing plate PB200 GS03	4
D4231	Mounting, commissioning and maintenance manual wheel sensor RSR110	1
D4232	Application guide wheel sensor RSR110	1
D21004	Brief description Advanced Service Display ASD101	2

1 The stated or a higher version is valid.

List of standards

Number	Title	Issue/ version
DIN 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
EN 50121-4	Railway applications – Electromagnetic compatibility – Part 4: Emission and immunity of the signalling and telecommunications apparatus	2015
EN 50124-1	Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment	2006
EN 50125-3	Railway applications – Environmental conditions for equipment – Part 3: Equipment for signalling and telecommunications	2003
EN 50128	Railway applications – Communication, signalling and processing systems – Software for railway control and protection systems	2011
EN 60529	Degrees of protection provided by enclosures (IP Code)	2014
EN 60721-3-1	Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 1: Storage	1997
EN 60721-3-2	Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation	1997
EN 60721-3-3	Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations	1995

1 About this documentation

This documentation provides information about the product features and the required information for the configuration and installation of the Wheel sensor Signal Converter WSC001.

1.1 Typographical conventions

The following typographical conventions are applied in this documentation:

1.1.1 Pictograms

Important notes

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

Important information and notes are shown as follows:

 Description

1.1.2 Styles of writing and other formal principles

Orders

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

Numbers

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

1.2 Units of measurement

In this documentation the following units of measurement are used:

bit	bit
°C	degree in Celsius (degree in Fahrenheit °F = °C * 1,8 + 32)
m	metre (yard = m * 1,09361)
mA	milliampere
mm	millimetre (inch = mm * 0,0393701)
ms	millisecond
Ω	ohm
s	second
V	volt

1.3 Abbreviations

In this documentation the following abbreviations are used:

0b	prefix of a binary number
0x	prefix of a hexadecimal number
A	measurement A, vertical mounting position of the wheel sensor
AEI	Automatic Equipment Identification
AMB	Adjustment and Maintenance Box
ASD	Advanced Service Display
B	measurement B, horizontal mounting position of the wheel sensor
DC	direct current
DIN	German Institute for Standardization
DIP	Dual In-line Package (DIP-switch)
EMC	electromagnetic compatibility
EN	European standard
GAK	trackside connection box
GND	ground
GS	equipment version
IEC	International Electrotechnical Commission
IPxx	International Protection (protection type, e.g. IP65)
LED	light-emitting diode
PB	testing plate
PWR	Power supply
Ri	direction pulse of a traversing
Ri1	direction pulse, direction 1
Ri2	direction pulse, direction 2

RJ45	Registered Jack (standardised connectors/sockets for data transmission in networks)
RSR	wheel sensor
RSR110	wheel sensor, type RSR110
SIL	Safety Integrity Level
SPS	Programmable Logic Controller (PLC)
Sys	system pulse
Sys1	system pulse of sensor system 1
Sys2	system pulse of sensor system 2
SYS1	sensor system 1
SYS2	sensor system 2
USB	Universal Serial Bus
WSC	Wheel sensor Signal Converter

1.4 Terms and definitions

commissioning	Test on an item carried out on site, to prove that it is correctly installed and can operate correctly (IEC 60050-151-16-24).
damped	One or two sensor systems of a wheel sensor indicate an occupancy (generally in the case of traversing by a train wheel and/or when damped by a testing plate).
digital filtering time	The digital filtering time is the time for which the sensor current must fall below the trigger level or exceed the tripping level, before the sensor system is considered to be “damped” or “not damped”.
direction pulse duration	The direction pulse duration is the time for which the direction pulse applies at the output. The direction pulse duration is retriggerable.
interference voltage	Voltage that may occur at the ends of outdoor equipment cables as a result of inductive or capacitive influences to earth.
maintenance, corrective	The maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function (IEC 60050-191-07-08). Synonym: repair
maintenance, preventive	The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item (IEC 60050-191-07-07). Synonym: servicing
maintenance, servicing	The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item (IEC 60050-191-07-07). Synonym: preventive maintenance

normal operating sensor current level	The normal operating sensor current level corresponds to the sensor current at the time of a successfully carried out adjustment and is to be equated with 100 % (adjustment value).
normal operating sensor current (RSR110)	The sensor current is referred to as “normal operating sensor current” if the wheel sensor is correctly mounted on the rail, successfully adjusted and not damped.
overcurrent level	If the sensor current exceeds the overcurrent level for the time > overcurrent suppression time, then the evaluation board identifies the behaviour as “overcurrent”.
overcurrent suppression time	The overcurrent suppression time is the minimum time for which the sensor current must exceed the overcurrent level, so that the evaluation board identifies the behaviour as “overcurrent”. The sensor system is then considered to be “faulty”.
overlap	“Overlap” means that both sensor systems are damped.
repair	The maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function (IEC 60050-191-07-08). Synonym: corrective maintenance
system output delay time	The system output delay time is the time, which passes after the digital filtering time until the switching operation at the system output, when the sensor current falls below the trigger level.
system output extension time	The system output extension time is the time, which passes after the digital filtering time until the switching operation at the system output, when the sensor current exceeds the tripping level. The system output extension time is retriggerable.
top-hat rail	rail with hat-shaped cross-section according to DIN EN 60715, type TH 35-7.5, perforated

trigger level	If the sensor current falls below the trigger level for the time > digital filtering time, then the sensor system is considered to be “damped”.
tripping level	If the sensor current exceeds the tripping level for the time > digital filtering time, then the sensor system is considered to be “not damped”.
wire break level	If the sensor current falls below the wire break level for the time > wire break suppression time, then the evaluation board identifies the behaviour as “wire break”.
wire break suppression time	The wire break suppression time is the minimum time for which the sensor current must fall below the wire break level, so that the evaluation board identifies the behaviour as “wire break”. The sensor system is then considered to be “faulty”.
wire short-circuit level	If the sensor current exceeds the wire short-circuit level for the time > overcurrent suppression time, then the evaluation board identifies the behaviour as “wire short-circuit”.

1.5 Target group

This documentation is intended for project engineers and technicians with subject-specific knowledge who are responsible for configuration, installation, commissioning, operation and maintenance of Frauscher components.

2 Safety

This documentation contains important warning and safety information, which must be observed by the user. Only by compliance with these prerequisites and safety measures, a correct operation can be ensured.

2.1 General protective provisions

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

The component described in this documentation must only be used for non-safety-relevant applications.

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

The railway operator must ensure that only authorised personnel or people in the company of authorised personnel have access to Frauscher components.

Prior to and during works on the track, safety measures must be carried out according to the applicable railway regulations.

2.2 Qualified personnel

Working on Frauscher components (configuration, installation, commissioning and maintenance) must only be carried out by trained and skilled personnel.

2.3 Safety-conscious working

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

2.4 Intended use

The product is intended for a specific operation purpose described in the documentation. If applied outside the intended use described, in the case of non-compliance with the documentation or in the case of non-compliance with required prerequisites and safety measures, no warranty and/or liability shall apply.

3 Structure and function

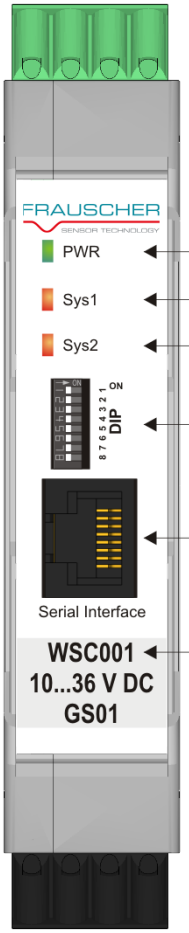
The WSC in combination with the wheel sensor RSR110 provides outputs that are triggered by a passing wheel of a rail vehicle.

Examples of possible applications:

- trigger for AEI card reader
- trigger for lubrication system
- trigger for hot box detection system
- trigger for vision monitoring system
- trigger for warning system
- trigger for flat wheel detection system

3.1 Front panel elements and function

The front panel of the WSC is designed as follows:



Element	Description
PWR (LED)	status indicator of the power supply
Sys1 (LED)	status indicator of sensor system 1
Sys2 (LED)	status indicator of sensor system 2
DIP-switches	configuration of the outputs and adjustment of the wheel sensor via WSC
Serial Interface (RJ45-socket)	connection socket for diagnostic interface (Advanced Service Display ASD)
Type key:	
WSC001	board identification
10…36 V DC	permissible supply voltage
GSxx	equipment version (starting at 01)

Figure 3.1: Front panel of the WSC

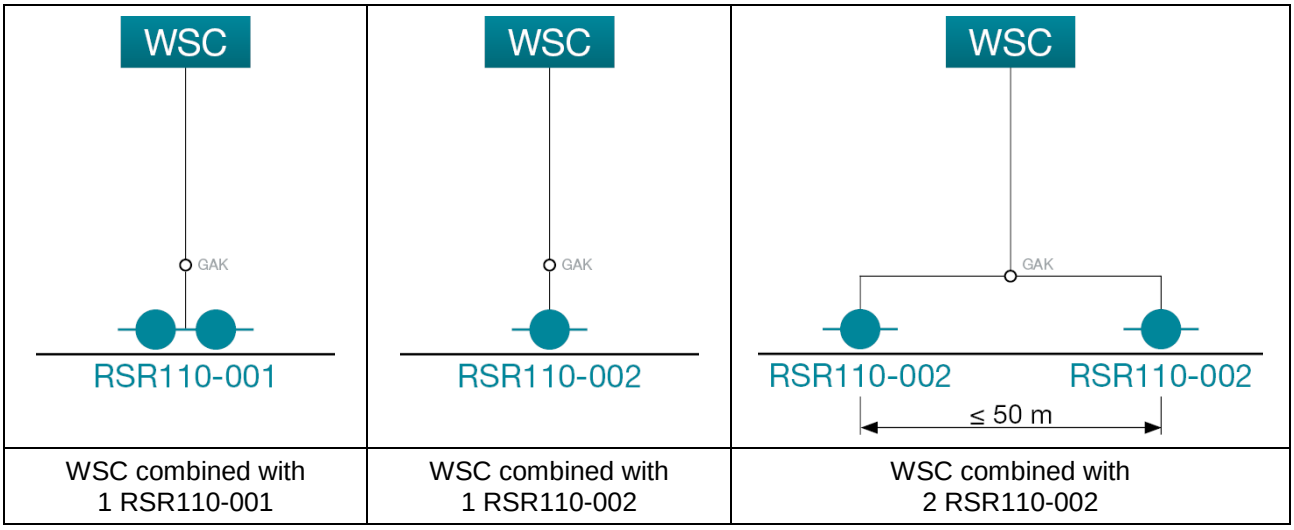
The WSC complies with the requirements of SIL 0 according to EN 50128.

The WSC processes the wheel sensor information of the wheel sensors RSR110-001 and RSR110-002.

The wheel sensor **RSR110-001** is equipped with **2 sensor systems** and can output the status of the sensor systems (damped, not damped or faulty) and the travel direction.

The wheel sensor **RSR110-002** is equipped with **1 sensor system** and can output the status of the sensor system (damped, not damped or faulty).

The WSC can be combined with:
- 1 wheel sensor RSR110-001
- 1 wheel sensor RSR110-002
- 2 wheel sensors RSR110-002



WSC combined with 1 RSR110-001	WSC combined with 1 RSR110-002	WSC combined with 2 RSR110-002

Figure 3.2: Block diagrams with possible combinations of the WSC with RSR110-001 or RSR110-002

In order to limit the interference voltage, the distance between 2 wheel sensors RSR110-002 that are connected to the same WSC must not exceed 50 m and the distance between the WSC and the higher-ranking system must not exceed 30 m.

The WSC supplies the wheel sensors with voltage and converts the analogue signals of the wheel sensors into digital signals. The digital signals are transmitted as digital switching signals to a higher-ranking system via optocoupler outputs.

The sensor current is evaluated level-related (normal operating sensor current level is 100 %) by the WSC depending on the occupancy of the wheel sensor. Based on the normal operating sensor current of the sensor system, the WSC detects a current change downwards or upwards that results in a respective switching operation at the interfaces “optocoupler output 1 and 2” and “optocoupler output 3 and 4”.

Errors are indicated via the LEDs “Sys1” and/or “Sys2” on the front panel of the WSC.
Information regarding the behaviour of the LEDs can be found in chapter “LED indications on the WSC”.

The required information and prerequisites for the application of the wheel sensor RSR110 can be found in the documentation D4232 “Application guide wheel sensor RSR110”.

3.2 Interfaces

The WSC provides interfaces, which are depicted in the following figure:

- diagnostic interface “Serial Interface”
- interface “wheel sensor”
- interface “power supply”
- interface “optocoupler output 1 and 2”
- interface “optocoupler output 3 and 4”

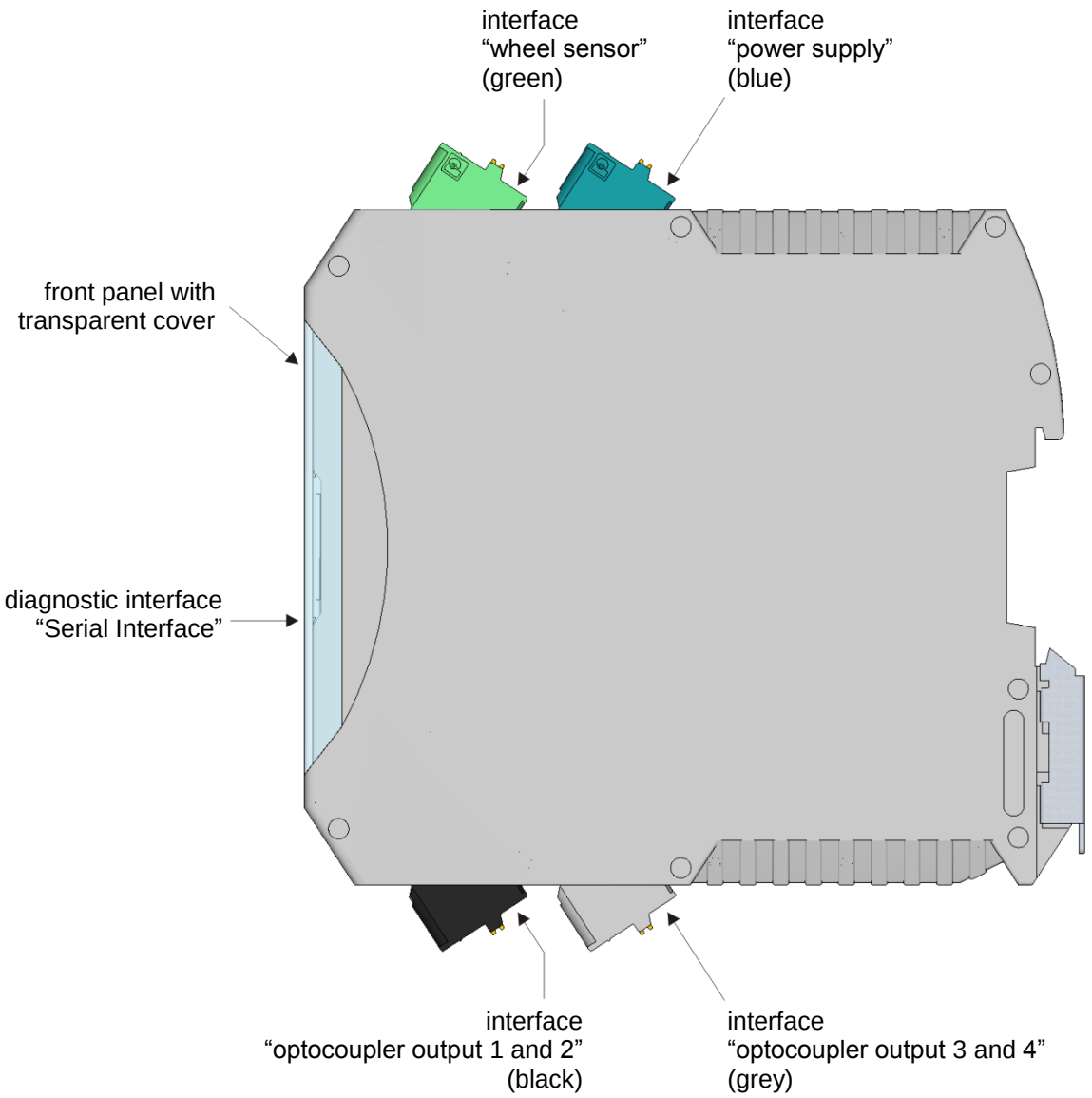


Figure 3.3: Interfaces of the WSC, side view

The diagnostic interface “Serial Interface” is designed as an RJ45-socket, the other interfaces are arranged on pluggable cage clamp terminals.

In order to avoid accidentally mixing up the cage clamp terminals, each cage clamp terminal has a different colour.

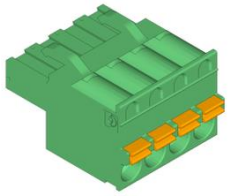
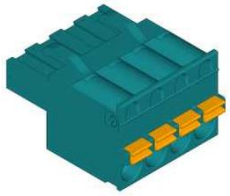
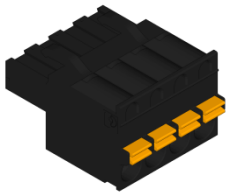
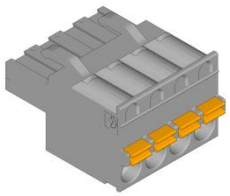
Cage clamp terminal	Interface	Colour
	“wheel sensor”	green
	“power supply”	blue
	“optocoupler output 1 and 2”	black
	“optocoupler output 3 and 4”	grey

Table 3.1: Cage clamp terminals of the WSC

3.2.1 Diagnostic interface “Serial Interface”

The diagnostic interface “Serial Interface” is designed as an RJ45-socket on the front panel of the WSC. Via this interface, diagnostic data and error information can be read out and saved in a text file by means of the diagnostic tool Advanced Service Display ASD.

Further information regarding the data request of the WSC can be found in chapter “Data request with Advanced Service Display ASD”.

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

Only the Advanced Service Display ASD with the associated Service Display Cable may be connected to the diagnostic interface “Serial Interface”.

3.2.2 Interface “wheel sensor”

The wheel sensors are supplied and evaluated via the interface “wheel sensor”.

- The WSC provides +24 V DC supply voltage for the wheel sensors.
- The interface “wheel sensor” is short-circuit-proof.
- The loop resistance in the wheel sensor cable must not exceed 500 Ω.

If the WSC is used with the wheel sensor **RSR110-001**, then 1 wheel sensor can be supplied and evaluated by the WSC.

If the WSC is used with the wheel sensor **RSR110-002**, then up to 2 wheel sensors can be supplied and evaluated by the WSC.

Pin assignment of the wheel sensor cable

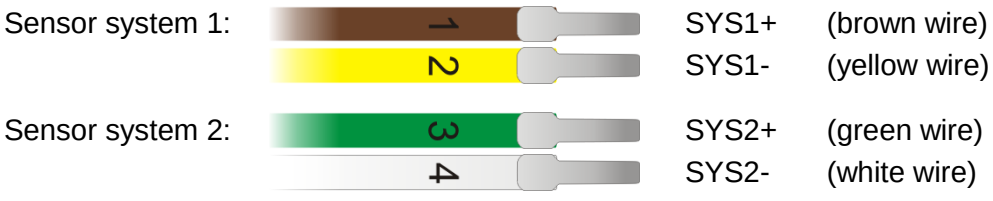


Figure 3.4: Pin assignment of the wheel sensor cable

3.2.3 Interface “power supply”

The WSC is supplied with voltage via the interface “power supply”.

- The interface “power supply” is galvanically separated from all other interfaces.
- The permissible supply voltage is +10 to +36 V DC.
- The insulation voltage is +1 000 V DC.
- The insulation distance is 2 mm according to EN 50124-1.
- It is recommended to use an uninterruptible power supply.

The maximum power-up current of the WSC connected to 1 wheel sensor RSR110-001 or 2 wheel sensors RSR110-002 is 260 mA.
The maximum power-up current of the WSC connected to 1 wheel sensor RSR110-002 is 240 mA.

The current consumption of the WSC varies depending on the connected sensor systems of wheel sensors.

The current consumption of the WSC is depicted in the following figures. The depicted values apply when all outputs are closed and the sensor current is 5 mA.

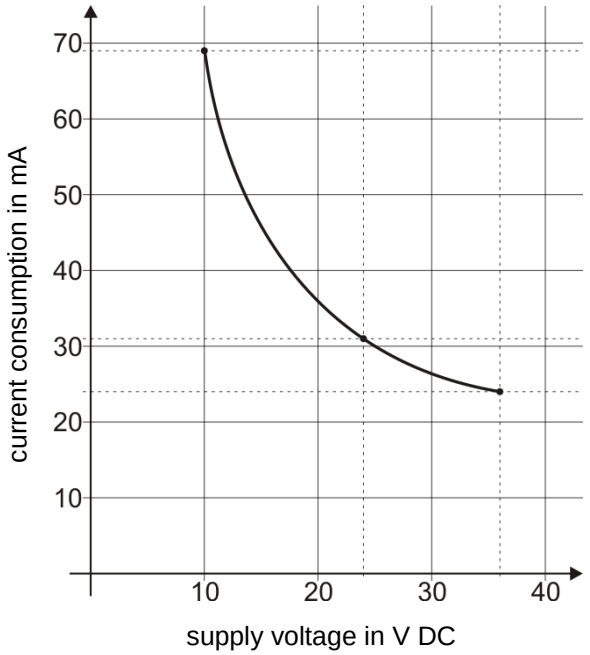


Figure 3.5: Current consumption of the WSC connected to 1 RSR110-001 or 2 RSR110-002

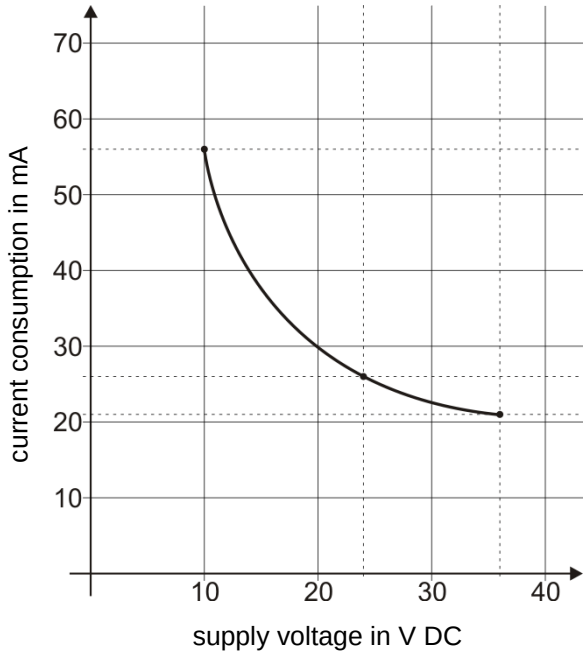


Figure 3.6: Current consumption of the WSC connected to 1 RSR110-002

Values of current consumption dependent on the used wheel sensor/s:

1 RSR110-001 or 2 RSR110-002	
supply voltage in V DC	**current consumption in mA**
10	69
24	31
36	24

Table 3.2: Values of current consumption (1 RSR110-001 or 2 RSR110-002)

1 RSR110-002	
supply voltage in V DC	**current consumption in mA**
10	56
24	26
36	21

Table 3.3: Values of current consumption (1 RSR110-002)

At the interface “power supply”, an interference voltage against earth can apply. When handling the interface “power supply”, safety precautions against dangerous contact voltages must be taken.

3.2.4 Interfaces “optocoupler outputs”

The interfaces “optocoupler outputs”

- are optocoupler outputs with galvanic separation and open-collector outputs,
- consist of the interfaces “optocoupler output 1 and 2” and “optocoupler output 3 and 4”,
- support switching currents of 1 to 100 mA,
- withstand a maximum switching voltage of +3,3 to +72 V DC,
- withstand an insulation voltage of +3 100 V DC.

Sample configuration

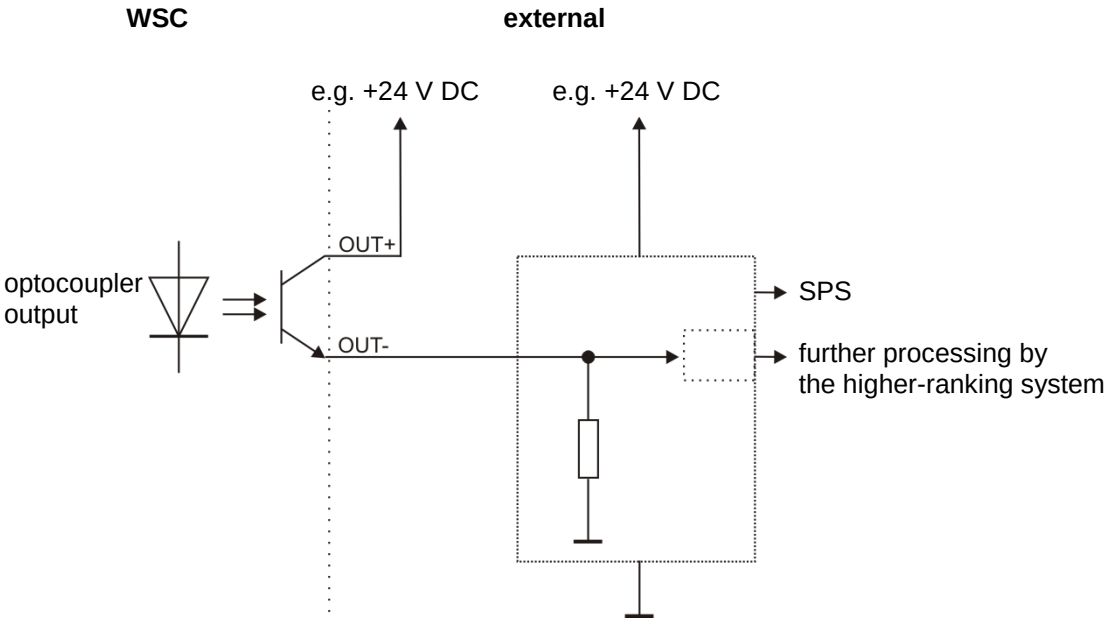


Figure 3.7: Sample configuration

At the interface “optocoupler output 1 and 2”, digital signals of 2 bits are output that provide information regarding **system occupancy** and/or **travel direction**.

At the interface “optocoupler output 3 and 4”, digital signals of 2 bits are output that provide information regarding **travel direction** and/or **error**.

4 Basic conditions for the installation

4.1 Environmental conditions

- The WSC is intended for installation in a cubicle or an outdoor cabinet according to the specifications in EN 60721-3-3.
- The WSC corresponds to degree of protection IP20 according to EN 60529 and is protected against access by a finger to hazardous parts and the ingress of solid foreign objects ≥ 12,5 mm. The WSC is not protected against dust and the harmful ingress of water.
- The WSC may be operated in the temperature range of -40 to +70 °C (corresponding to the environmental classification “In the cubicle”, T2 of EN 50125-3).
- The WSC may be operated in the relative humidity range of 5 to 100 % (corresponding to the environmental classification “In the cubicle”, T2 of EN 50125-3).
- The WSC may be operated up to a maximum height of 1 400 m above sea level (corresponding to the environmental classification A1 of EN 50125-3).
- For the storage, the same environmental conditions apply as for the operation according to EN 60721-3-1.
- For the transportation, the same environmental conditions apply as for the operation according to EN 60721-3-2.

In the case of a deviation from the specified environmental conditions, Frauscher must be consulted.

4.2 Electromagnetic compatibility

EMC type testing according to EN 50121-4 was carried out successfully.

5 Configuration

The configuration of the WSC is carried out by means of the DIP-switches on the front panel of the WSC. In order to set the DIP-switches, the transparent cover of the front panel of the WSC must be opened. The cover can be opened at the bottom by hand or with the help of a flat-blade screw-driver.

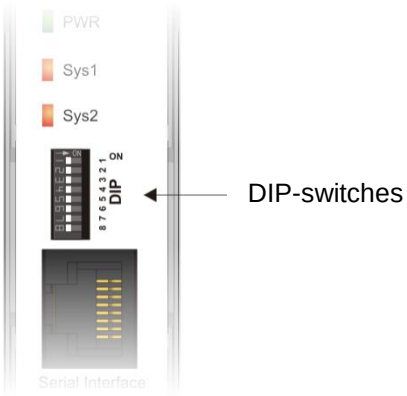


Figure 5.1: DIP-switches on the front panel of the WSC

5.1 General setting of the DIP-switches

There are 2 possible DIP-switch positions:

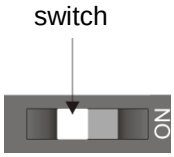


Figure 5.2: DIP-switch position “OFF”

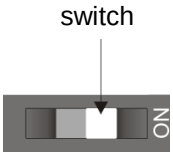


Figure 5.3: DIP-switch position “ON”

The following applies:

- The DIP-switch position “OFF” corresponds to the binary value of ‘0’.
- The DIP-switch position “ON” corresponds to the binary value of ‘1’.
- In order to change the position of the switch, a suitable insulated object is required, e.g. an insulated flat-blade screwdriver with a blade thickness of ≤ 1 mm or a similar small insulated tool with a fine tip.
- When delivered, the DIP-switches are set to “OFF”.

5.2 DIP-switches of the WSC

There are 8 DIP-switches on the front panel of the WSC.
The DIP-switches with the DIP-no. 1 to 7 are used for the configuration of the WSC.
The DIP-switch with the DIP-no. 8 is used for the adjustment of the wheel sensor.

DIP-no.	DIP-switches	Possible settings	Function
1		OFF/ON	configuration of • system outputs • direction outputs • error output
2		OFF/ON	
3		OFF/ON	• configuration of the normal status of all optocoupler outputs (system outputs and direction outputs) • it is not possible to configure the normal status of the error output
4		OFF/ON	configuration of the system output extension time
5		OFF/ON	
6		OFF/ON	configuration of the direction pulse duration
7		OFF/ON	
8		OFF/ON	adjustment (information regarding the DIP-switch with the DIP-no. 8 can be found in chapter “Adjustment”)

Table 5.1: DIP-switches of the WSC

The actually output signals depend on the configuration of the WSC.
The signal diagrams in chapter “Signal diagrams” show all signals that can be output.

In order to accept a new configuration (due to a change of the DIP-switches), the WSC must be restarted by interrupting the power supply.

5.2.1 Configuration of system outputs and/or direction outputs

System outputs:
System outputs are used to get information about the status of the sensor system (damped, not damped or faulty).

Direction outputs:
Direction outputs are used to get information about the travel direction of a passing wheel, when a wheel sensor RSR110-001 is used. The travel direction can be determined because of the 2 sensor systems of the wheel sensor RSR110-001.

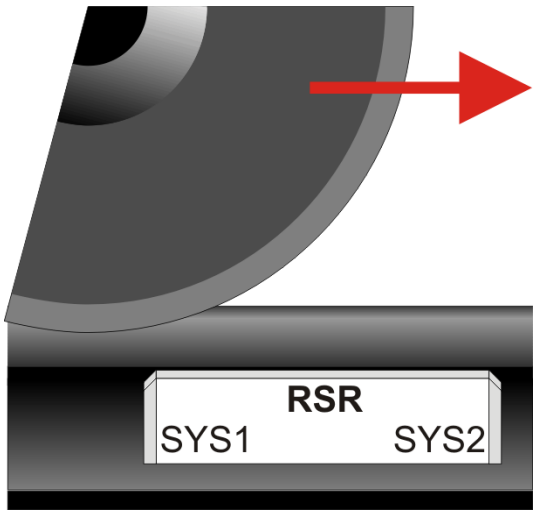


Figure 5.4: Traversing direction 1

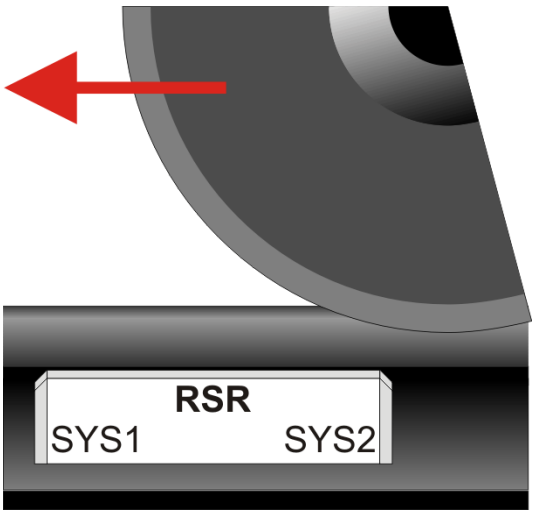


Figure 5.5: Traversing direction 2

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

The system outputs and/or direction outputs can be configured with
- 1 wheel sensor RSR110-001,
- 1 wheel sensor RSR110-001 or 2 wheel sensors RSR110-002,
- 1 wheel sensor RSR110-002 or 1 wheel sensor RSR110-001.

5.2.1.1 Configuration with 1 wheel sensor RSR110-001

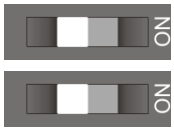
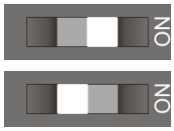
DIP-no.	DIP-switches	Setting	Output
1 2		OFF OFF	**2 system outputs:** • the status of sensor system 1 is output at interface “optocoupler output 1 and 2” at OUT1+ and OUT1- • the status of sensor system 2 is output at interface “optocoupler output 1 and 2” at OUT2+ and OUT2- **2 direction outputs:** • direction 1 is output at interface “optocoupler output 3 and 4” at OUT3+ and OUT3- • direction 2 is output at interface “optocoupler output 3 and 4” at OUT4+ and OUT4-
1 2		ON OFF	**2 direction outputs:** • direction 1 is output at interface “optocoupler output 1 and 2” at OUT1+ and OUT1- • direction 2 is output at interface “optocoupler output 1 and 2” at OUT2+ and OUT2- **1 error output**, which is output twice (normal status = closed): • the error is output at interface “optocoupler output 3 and 4” at OUT3+, OUT3-, OUT4+ and OUT4-

Table 5.2: Configuration with 1 wheel sensor RSR110-001

5.2.1.2 Configuration with 1 wheel sensor RSR110-001 or 2 wheel sensors RSR110-002

DIP-no.	DIP-switches	Setting	Output

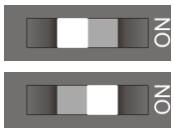
1
2
		OFF
		ON
			2 system outputs:
			• if 1 wheel sensor RSR110-001 is used,
			  • then the status of sensor system 1 is output at interface “optocoupler output 1 and 2” at OUT1+ and OUT1-
			  • then the status of sensor system 2 is output at interface “optocoupler output 1 and 2” at OUT2+ and OUT2-
			
			• if 2 wheel sensors RSR110-002 are used,
			  • then the status of sensor system of wheel sensor 1 is output at interface “optocoupler output 1 and 2” at OUT1+ and OUT1-
			  • then the status of sensor system of wheel sensor 2 is output at interface “optocoupler output 1 and 2” at OUT2+ and OUT2-
			
			1 error output, which is output twice (normal status = closed):
			• the error is output at interface “optocoupler output 3 and 4” at OUT3+, OUT3-, OUT4+ and OUT4-

Table 5.3: Configuration with 1 wheel sensor RSR110-001 or 2 wheel sensors RSR110-002

5.2.1.3 Configuration with 1 wheel sensor RSR110-001 or 1 wheel sensor RSR110-002

DIP-no.	DIP-switches	Setting	Output
1		ON	It is recommended to use this configuration with **1 wheel sensor RSR110-002**.
2		ON	If this configuration is used with 1 wheel sensor RSR110-001, then it is recommended to connect only 1 sensor system of the wheel sensor. **1 system output**, which is output twice: • if 1 wheel sensor RSR110-001 is used, then the status of the connected sensor system is output at interface “optocoupler output 1 and 2” at OUT1+, OUT1-, OUT2+ and OUT2- • if 1 wheel sensor RSR110-002 is used, then the status of the sensor system is output at interface “optocoupler output 1 and 2” at OUT1+, OUT1-, OUT2+ and OUT2- **1 error output**, which is output twice (normal status = closed): • the error is output at interface “optocoupler output 3 and 4” at OUT3+, OUT3-, OUT4+ and OUT4-

Table 5.4: Configuration with 1 wheel sensor RSR110-001 or 1 wheel sensor RSR110-002

Further information regarding the interfaces and the pin assignment can be found in chapter “Wiring of the Wheel sensor Signal Converter WSC”.

5.2.2 Configuration of the normal status of all optocoupler outputs

The normal status of the optocoupler outputs is given under the following conditions:
- wheel sensor mounted correctly
- wheel sensor adjusted correctly
- wheel sensor not damped
- no error

The normal status of the optocoupler outputs can be configured as follows:

DIP-no.	DIP-switches	Setting	Configuration
3		OFF	closed in normal status (recommended setting)
3		ON	open in normal status

Table 5.5: Configuration of the normal status of all optocoupler outputs

In order to correctly output occupancies, faults and/or errors of a sensor system, the optocoupler outputs must be closed in normal status.
If the normal status is configured with “open”, then the system pulse and the direction pulse are not output in case faults and/or errors occur (e.g. wire break, overcurrent).
Therefore, it is recommended to configure “closed in normal status”.

If an error, fault or voltage interruption occurs, then all outputs are open as long as the error, fault or voltage interruption continues to apply.

The normal status of the error output is closed and cannot be configured.

If the recommended configuration “closed in normal status” is used in combination with a configuration that includes 2 direction outputs, then the 2 direction outputs output a 4-edges direction pulse in the case of an error.

5.2.3 Configuration of the system output extension time

The system output extension time can be configured as follows:

DIP-no.	DIP-switches	Setting	Configuration
4		OFF	system output extension time = 0 ms
5		OFF	
4		OFF	system output extension time = 5 ms (tolerance time = ±0,25 ms)
5		ON	
4		ON	system output extension time = 500 ms (tolerance time = ±25 ms)
5		OFF	
4		ON	system output extension time = 5 s (tolerance time = ±250 ms)
5		ON	

Table 5.6: Configuration of the system output extension time

If an error, fault or voltage interruption occurs, then all outputs are open as long as the error, fault or voltage interruption continues to apply.

If a configuration without system outputs is used, then the DIP-switches with the DIP-no. 4 and 5 must be set to “OFF”.

5.2.4 Configuration of the direction pulse duration

The direction pulse duration can be configured as follows:

DIP-no.	DIP-switches	Setting	Configuration
6		OFF	direction pulse duration = 10 ms (tolerance time = ±0,5 ms)
7		OFF	
6		OFF	direction pulse duration = 100 ms (tolerance time = ±5 ms)
7		ON	
6		ON	direction pulse duration = 1 s (tolerance time = ±50 ms)
7		OFF	
6		ON	direction pulse duration = 10 s (tolerance time = ±500 ms)
7		ON	

Table 5.7: Configuration of the direction pulse duration

If an error, fault or voltage interruption occurs, then all outputs are open as long as the error, fault or voltage interruption continues to apply.

If a configuration without direction outputs is used, then the DIP-switches with the DIP-no. 6 and 7 must be set to “OFF”.

6 Signal diagrams

The following signal diagrams depict all signals that can be output. Only signals whose output was configured must be taken into account.
Information regarding the output signals of the used configuration can be found in chapter “Configuration”.

For the following signal diagrams, the normal status of the optocoupler outputs is depicted with the recommended configuration “**closed in normal status**”.

If the optocoupler outputs are configured with “**open in normal status**”, then in the case of a traversing, the signals “Sys” and “Ri” are inverted to the respective signals in the following diagrams.
In the case of a wire break or overcurrent or error, the system outputs and direction outputs remain in the open status.

It is not possible to configure the normal status of the error output. Therefore, the normal status of the error output is always closed.

6.1 Switching times and switching levels

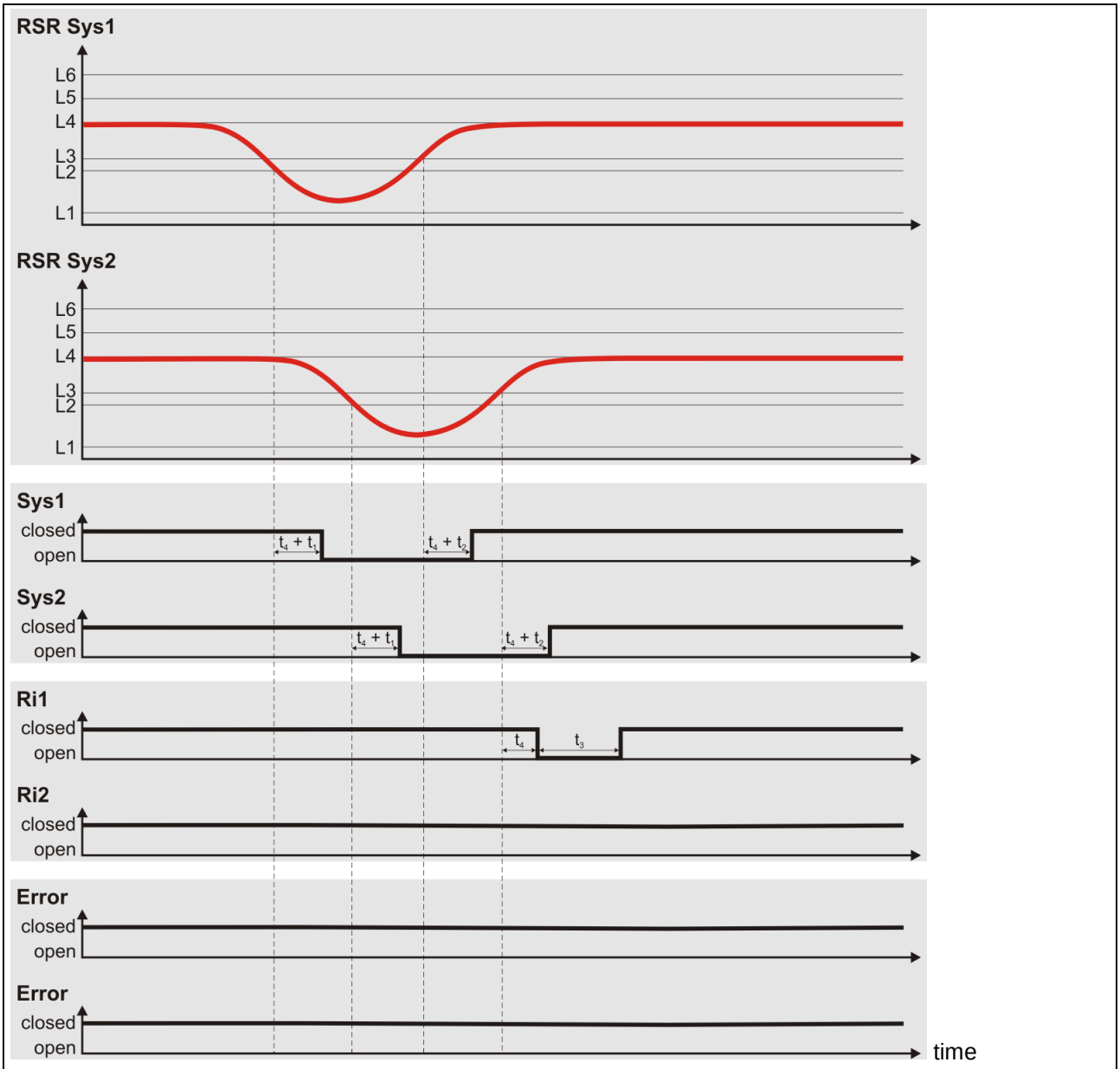
The following switching times and switching levels are valid for the WSC:

Designation	Abbreviation	Value
system output delay time	t_1	0 ms
system output extension time	t_2	configurable
direction pulse duration	t_3	configurable
digital filtering time	t_4	1,5 ms
overcurrent suppression time	t_5	200 ms
wire break suppression time	t_7	200 ms
wire break level	L1	0,2 mA
trigger level	L2	75 %
tripping level	L3	86 %
normal operating sensor current level	L4	100 %
overcurrent level	L5	120 %
wire short-circuit level	L6	-
“-” in the column “Value” means that the respective parameter is not relevant for the WSC. The percentage values refer to the normal operating sensor current level.		

Table 6.1: Switching times and switching levels of the WSC

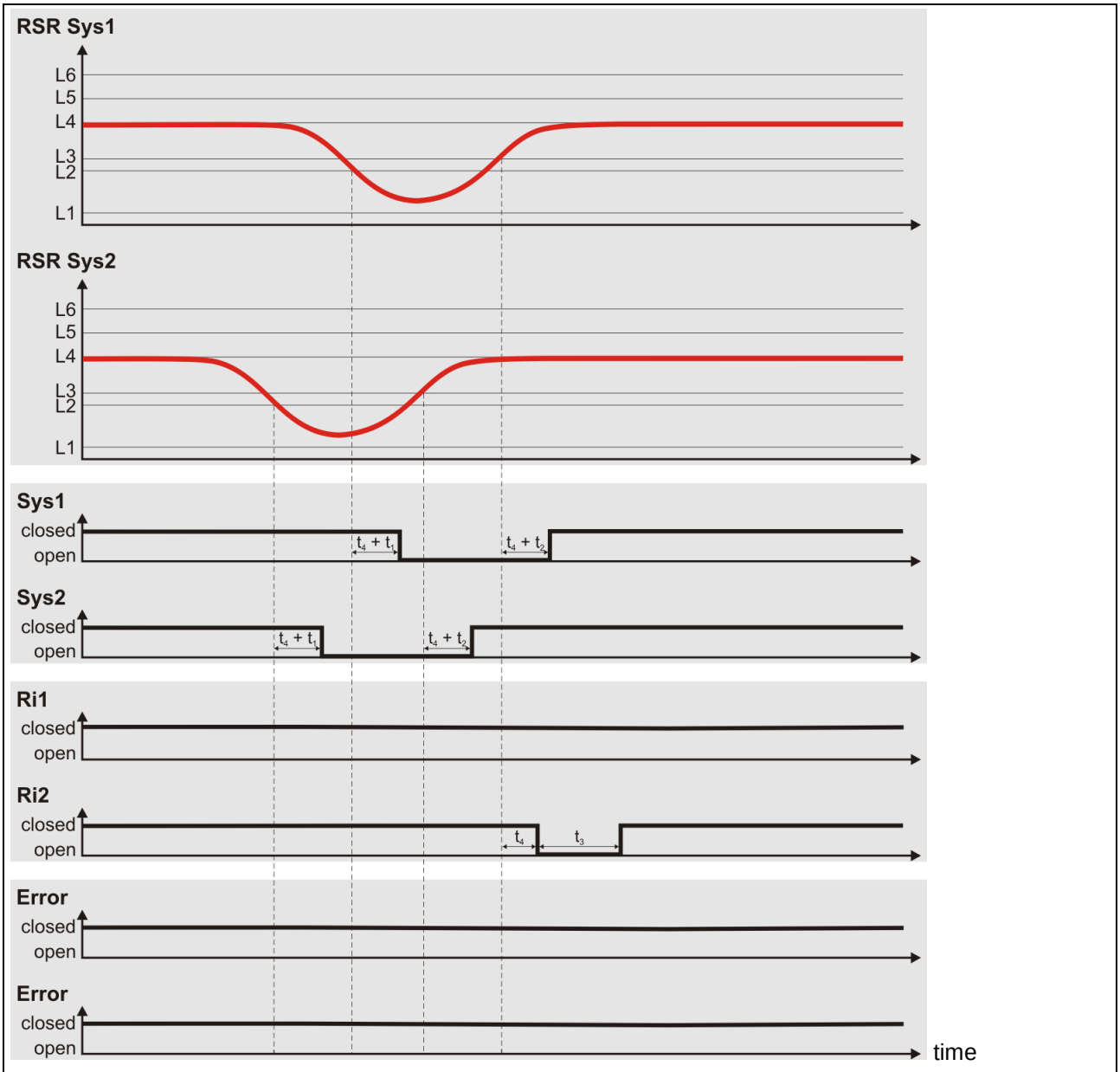
6.2 Traversings

6.2.1 Correct traversing of one wheel



L1: wire break level	L2: trigger level	L3: tripping level
L4: normal operating sensor current level	L5: overcurrent level	L6: wire short-circuit level
t_1: system output delay time	t_2: system output extension time	t_3: direction pulse duration
t_4: digital filtering time		

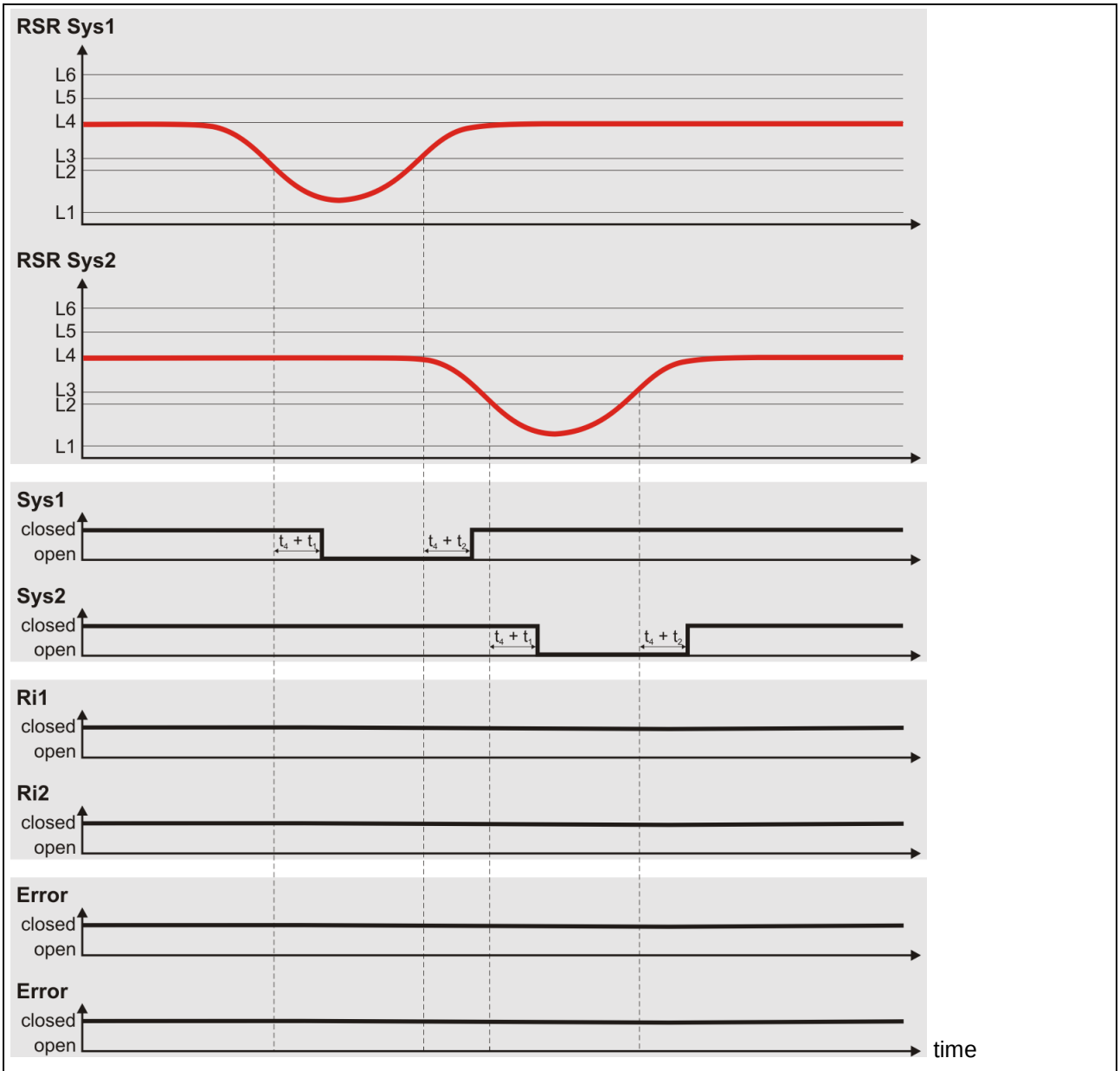
Figure 6.1: Correct traversing of one wheel in direction 1



L1: wire break level	L2: trigger level	L3: tripping level
L4: normal operating sensor current level	L5: overcurrent level	L6: wire short-circuit level
t_1: system output delay time	t_2: system output extension time	t_3: direction pulse duration
t_4: digital filtering time		

Figure 6.2: Correct traversing of one wheel in direction 2

6.2.2 Traversing of one wheel without overlap

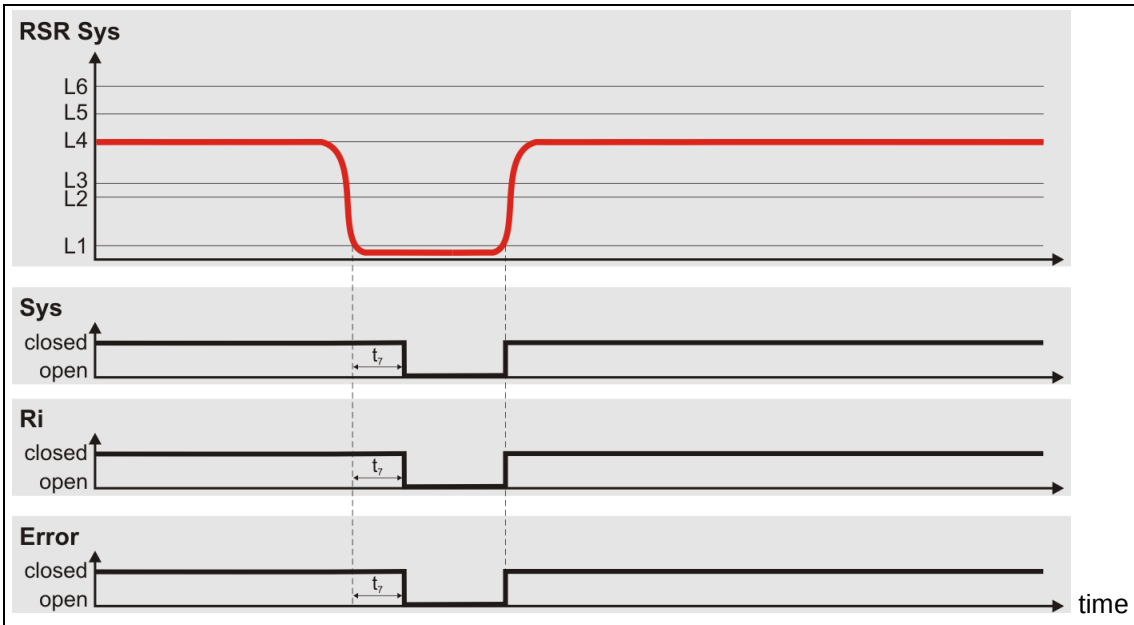


L1: wire break level	L2: trigger level	L3: tripping level
L4: normal operating sensor current level	L5: overcurrent level	L6: wire short-circuit level
t_1: system output delay time	t_2: system output extension time	t_4: digital filtering time

Figure 6.3: Traversing of one wheel in direction 1, without overlap

6.3 Behaviour in case of wire break

The depicted signal course is valid for system 1 and system 2.

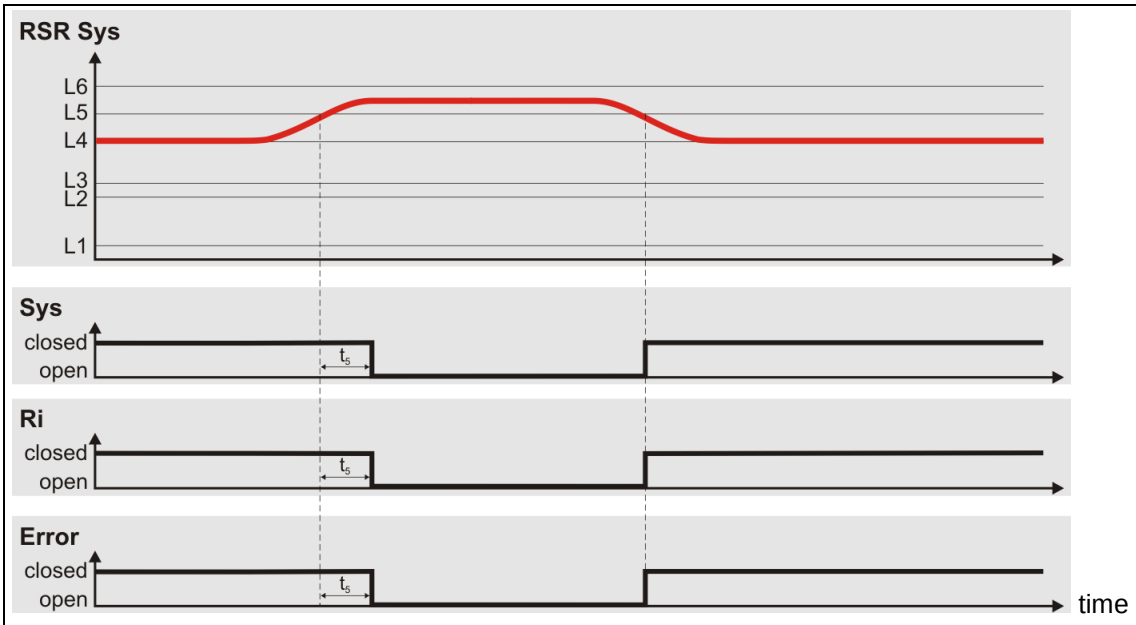


L1: wire break level	L2: trigger level	L3: tripping level
L4: normal operating sensor current level	L5: overcurrent level	L6: wire short-circuit level
t_7: wire break suppression time		

Figure 6.4: Behaviour in case of wire break

6.4 Behaviour in case of overcurrent

The depicted signal course is valid for system 1 and system 2.



L1: wire break level	L2: trigger level	L3: tripping level
L4: normal operating sensor current level	L5: overcurrent level	L6: wire short-circuit level
t_5: overcurrent suppression time		

Figure 6.5: Behaviour in case of overcurrent

7 Installation

7.1 Wiring of the Wheel sensor Signal Converter WSC

To carry out the wiring of the WSC, the cage clamp terminals can be removed.

A cage clamp terminal can be levered out by using a flat-blade screwdriver. The cage clamp terminal can simply be pushed back in.

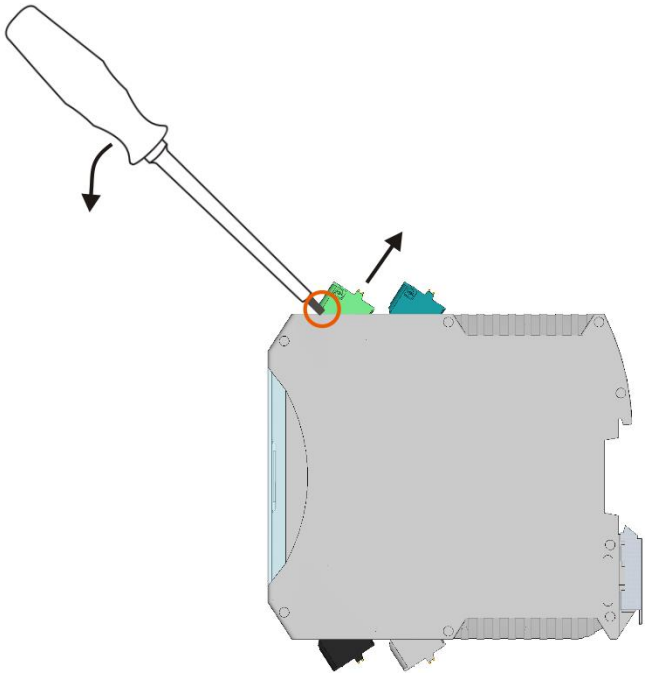


Figure 7.1: Levering out a cage clamp terminal

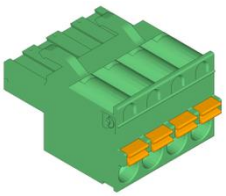


Figure 7.2: Cage clamp terminal (green)

When handling the WSC, safety precautions (e.g. insulated tools) against dangerous contact voltages must be taken.

In order to insert/remove the wires into/from the cage clamp terminal, the orange push-in spring connection must be pushed down with the help of a flat-blade screwdriver.

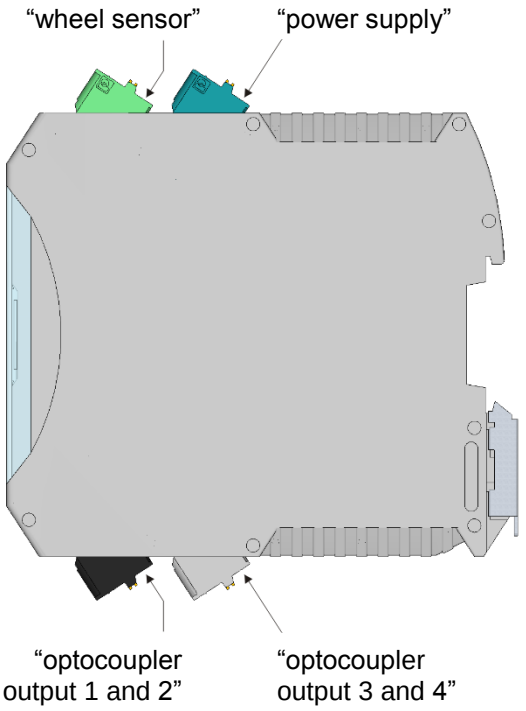


Figure 7.3: Interfaces of the WSC for the wiring

The wiring of the WSC must be carried out according to the pin assignment in the following tables:

Interface “wheel sensor”

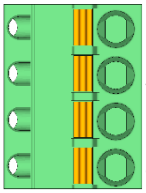
Cage clamp terminal	Spring connection	Pin assignment	Colour
	1	SYS1+	green
	2	SYS1-	
	3	SYS2+	
	4	SYS2-	

Table 7.1: Pin assignment of the interface “wheel sensor” (input)

Interface “power supply”

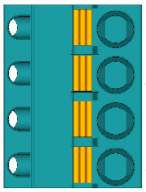
Cage clamp terminal	Spring connection	Pin assignment	Colour
	1	V+	blue
	2	V+	
	3	GND	
	4	GND	

Table 7.2: Pin assignment of the interface “power supply” (input)

Interface “optocoupler output 1 and 2”

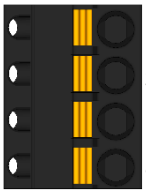
Cage clamp terminal	Spring connection	Pin assignment	Colour
	1	OUT2-	black
	2	OUT2+	
	3	OUT1-	
	4	OUT1+	

Table 7.3: Pin assignment of the interface “optocoupler output 1 and 2” (output)

Interface “optocoupler output 3 and 4”

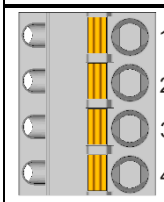
Cage clamp terminal	Spring connection	Pin assignment	Colour
	1	OUT4-	grey
	2	OUT4+	
	3	OUT3-	
	4	OUT3+	

Table 7.4: Pin assignment of the interface “optocoupler output 3 and 4” (output)

7.2 Mounting and dismounting of the WSC

The WSC is mounted by clicking the WSC into place on the TH 35 top-hat rail (DIN EN 60715). When a “click” is heard, then the WSC is mounted correctly on the top-hat rail.

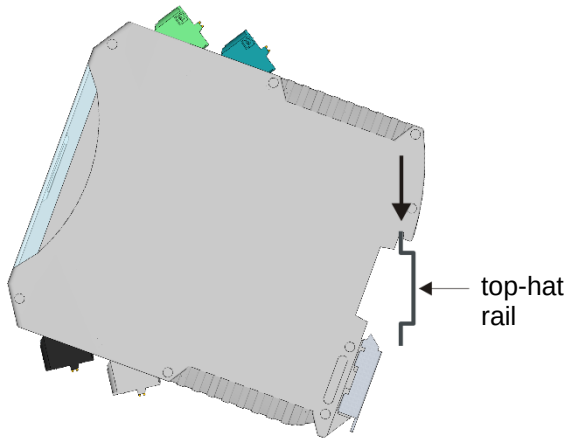


Figure 7.4: Mounting of the WSC, step 1

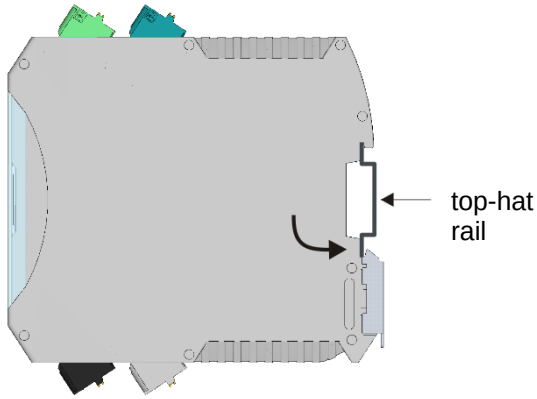


Figure 7.5: Mounting of the WSC, step 2

The WSC is dismounted by pushing down the fixing clip of the WSC with a flat-blade screwdriver and lifting the WSC from the top-hat rail.

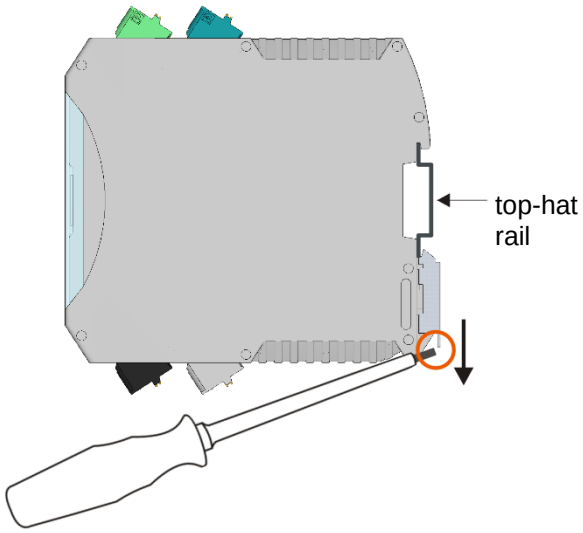


Figure 7.6: Dismounting of the WSC, step 1

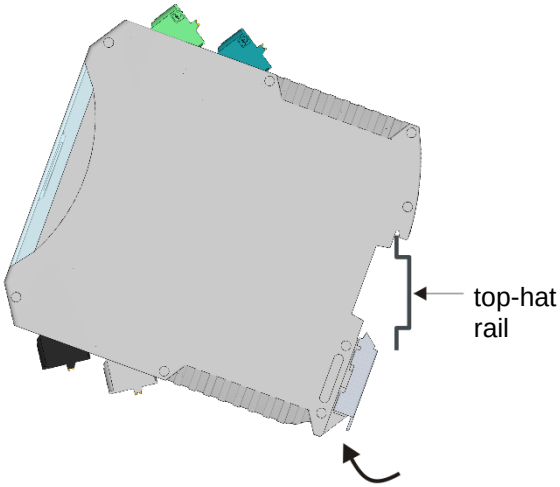


Figure 7.7: Dismounting of the WSC, step 2

8 Commissioning

The WSC may only be operated in a proper and checked condition. During commissioning, no wheel sensor may be damped or traversed.

Before the WSC is put into operation, an adjustment of the connected wheel sensor(s) must be carried out.

8.1 Adjustment

In order to carry out the adjustment, it must be checked that the wheel sensor RSR110 is mounted correctly. The adjustment may only be carried out if the wheel sensor RSR110 is mounted correctly and not damped.

The adjustment is carried out by using the Adjustment and Maintenance box AMB001 or by means of the DIP-switch with the DIP-no. 8 on the front panel of the WSC.

The outputs of the WSC do not switch during the adjustment process.

8.1.1 Adjustment by using the AMB

The adjustment of the RSR110 by using the AMB is described in the documentation D4231 “Mounting, commissioning and maintenance manual wheel sensor RSR110” and must be carried out accordingly.

8.1.2 Adjustment by means of the DIP-switch with DIP-no. 8

The adjustment of the RSR110 can also be carried out by means of the DIP-switch with DIP-no. 8 on the front panel of the WSC.

To request the adjustment process, the following actuation sequence must be carried out:

1. When delivered, the DIP-switch with DIP-no. 8 is “OFF”.
2. Set DIP-switch to position “ON”.
   Keep DIP-switch in this position for more than 2 s and less than 6 s.
3. Set DIP-switch back to position “OFF”.

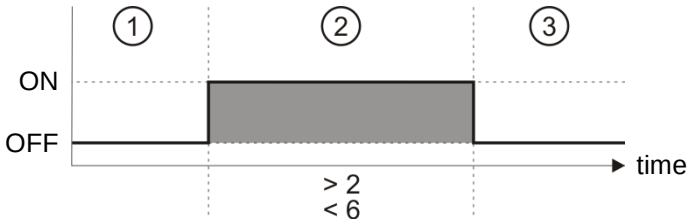


Figure 8.1: Actuation sequence for the adjustment process, time data in s

After the actuation sequence, an initialisation sequence of 40 s follows.

If a configuration with 2 system outputs and/or 2 direction outputs is used, then the LEDs “Sys1” and “Sys2” are illuminated. When the adjustment process is completed, the LEDs “Sys1” and “Sys2” go off.

If a configuration with 1 system output is used, then only the LED “Sys1” is illuminated. When the adjustment process is completed, the LED “Sys1” goes off.

If 2 wheel sensors RSR110-002 are used, then the 2 wheel sensors are adjusted at the same time.

If the actuation sequence is not carried out correctly or if the DIP-switch is set to “ON” accidentally and remains in this position for more than 6 s, then an error is output. The error is output until the DIP-switch is set back to “OFF”.

8.2 Data request with Advanced Service Display ASD

The Advanced Service Display ASD is used to read out diagnostic data and error information. For data request, the diagnostic interface “Serial Interface” on the front panel of the WSC is to be connected to the appropriate USB port of the computer using the Service Display Cable.

Information regarding the hardware requirements, the installation of the ASD and the program interface of the ASD can be found in the documentation D21004 “Brief description Advanced Service Display ASD101”.

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

Only the Advanced Service Display ASD with the associated Service Display Cable may be connected to the diagnostic interface “Serial Interface”.

3 different tabs are displayed in the upper area of the program interface:

- “INFO” tab
- “STATUS” tab
- “STATISTICS” tab

8.2.1 “INFO” tab

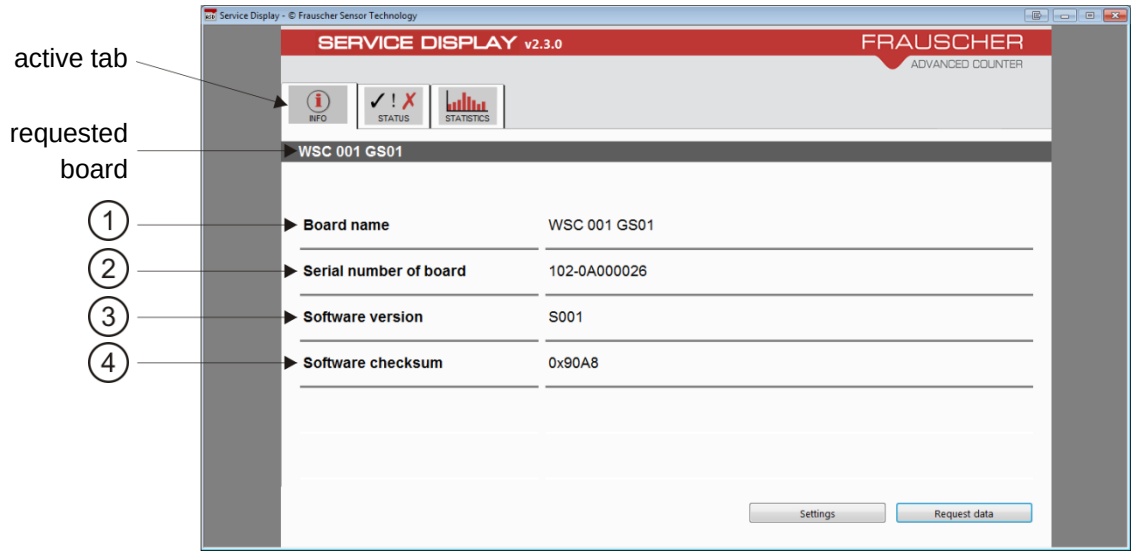


Figure 8.1: “INFO” tab

(1) Board name (“WSC”), type (e.g. “001”) and equipment version (e.g. “GS01”) of the requested WSC

(2) Serial number of the WSC (e.g. “102-0A000026”)

(3) Software version of the WSC (e.g. “S001”)

(4) Checksum of the software version of the WSC (e.g. “0x90A8”)

8.2.2 “STATUS” tab

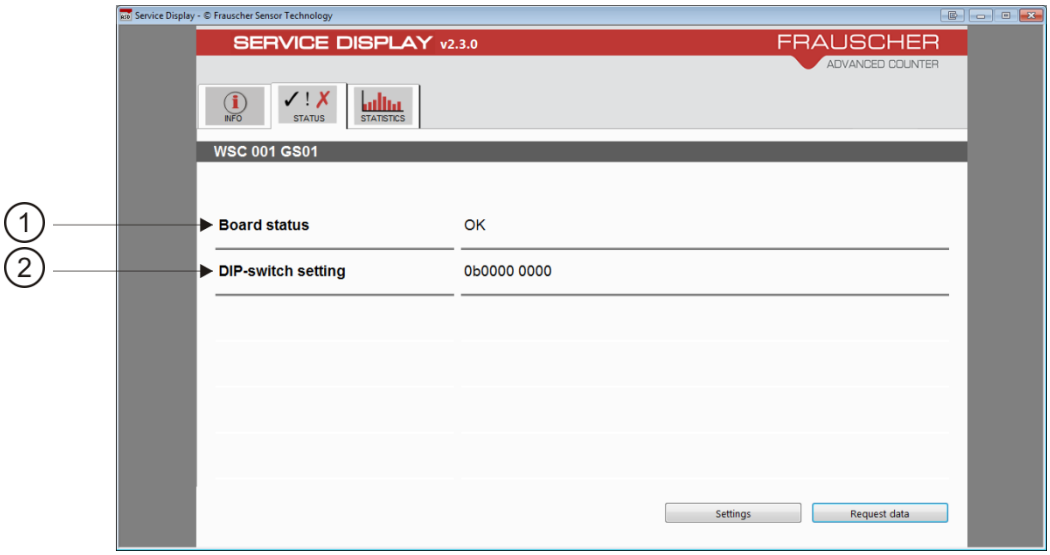


Figure 8.2: “STATUS” tab

(1) Status information of the WSC
(“OK”, “Internal error”, “Overcurrent Sys1”, “Overcurrent Sys2”, “Wire break Sys1”, “Wire break Sys2”, “Wrong position DIP-no. 8”)

(2) Position of the DIP-switches of the WSC (see the following table).
For reasons of better readability, the 8-digit number is displayed in groups of 4 binary figures each.

Prefix of a binary number	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0b	DIP-no. 8	DIP-no. 7	DIP-no. 6	DIP-no. 5	DIP-no. 4	DIP-no. 3	DIP-no. 2	DIP-no. 1
	adjustment	configuration of the direction pulse duration		configuration of the system output extension time		configuration of the normal status of all optocoupler outputs	configuration of system outputs and/or direction outputs and/or error output	

Table 8.1: Position of the DIP-switches of the WSC

8.2.3 “STATISTICS” tab

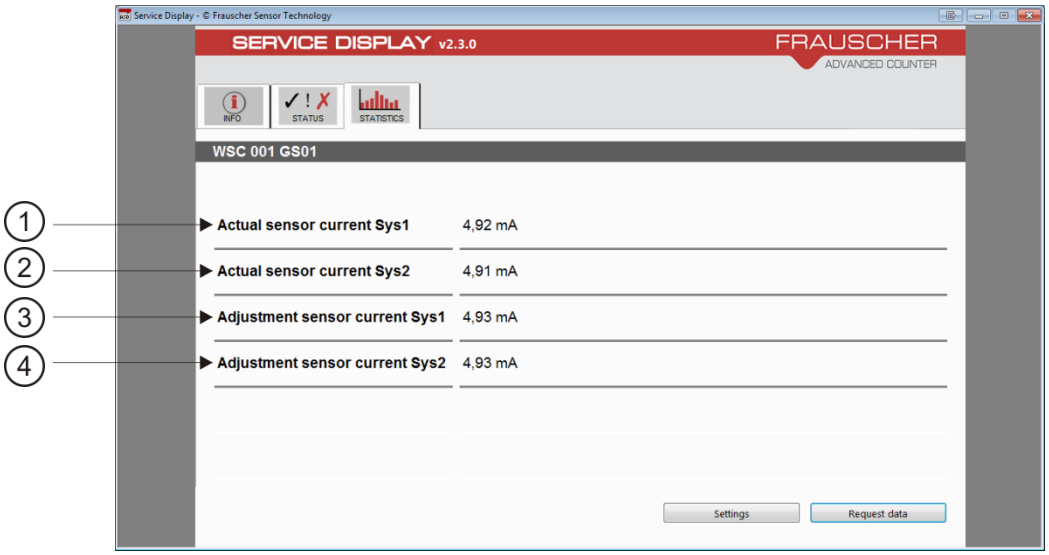


Figure 8.3: “STATISTICS” tab

1. Measured sensor current at the time of data request, system 1
2. Measured sensor current at the time of data request, system 2
3. Adjustment sensor current, system 1
   (stored reference value of the last successful adjustment[2])
4. Adjustment sensor current, system 2
   (stored reference value of the last successful adjustment[3])

2 For WSC GS01, the displayed value deviates from the actual value.

3 For WSC GS01, the displayed value deviates from the actual value.

9 Maintenance

The WSC is maintenance-free, but in order to maintain the availability and reliability of the wheel sensors RSR110, it is recommended to carry out the checks described in this chapter at least every 24 months.

In order to ensure an error-free operation, maintenance and all actions in the course of maintenance must be coordinated by the railway operator.

During maintenance, only the actions described in the following chapters may be carried out. If there are still other actions that must be carried out, e.g. the replacement of the WSC because of a defect or if faults and errors with unclear causes occur, then the respective repair measures must be carried out immediately (see chapter “Repair”).

9.1 Required measuring equipment and tools

To carry out maintenance, the following measuring equipment and tools are required:

- measuring tape
- testing plate PB200
- Advanced Service Display ASD (software incl. Service Display Cable)
- Windows computer

9.2 Visual inspection and mechanical check of the wheel sensor

The cycle of the visual inspection and the mechanical check of the wheel sensor for dirt, wear etc. depends on the railway operator's maintenance strategy.

In this context, particularly the spacing between the wheel sensor top and the top of rail (measurement A) must be checked and corrected if necessary.

The visual inspection and the mechanical check of the wheel sensor RSR110 are described in the documentation D4231 “Mounting, commissioning and maintenance manual wheel sensor RSR110” and must be carried out accordingly.

Adapted to the conditions of the track (but at least every 24 months), the following maintenance work must be carried out at the wheel sensor RSR110:

- a visual inspection and mechanical check
  - check wheel sensor for heavy dirt, remove loose dirt dryly
  - check wheel sensor for external mechanical damages
  - check fixing elements of the wheel sensor for correct fitting
  - check protection tube for mechanical damage
  - check cable connecting terminals for correct fitting
- a check of measurement A

9.3 Check of the sensor currents of the wheel sensor

The sensor current of each sensor system can be read out via the diagnostic interface “Serial Interface” on the front panel of the WSC using the ASD.
Reading the sensor current using the ASD is described in chapter “Diagnostic interface ‘Serial Interface’” and must be carried out accordingly.

The normal operating sensor current of the wheel sensor RSR110 is 4,75 to 5,25 mA.
If the measured values do not match the required values, then this must be rectified before commissioning (check the mounting of the wheel sensor, carry out an adjustment or replace the wheel sensor if necessary).

9.4 Check of the occupancy detection capability

The check of the occupancy detection capability can be carried out in 2 ways:

Check with a rail vehicle:

- The wheel sensor must be traversed error-freely with a rail vehicle (traversing sensor system 1 and sensor system 2, in case RSR110-001 is used; or traversing sensor system 1, in case RSR110-002 is used).
- The traversing must cause the associated outputs of the WSC to switch correctly.

Check with the testing plate PB200:

- If the wheel sensor **RSR110-001** is used, then at least 1 traversing over sensor system 1 and sensor system 2 must be carried out correctly using the testing plate PB200 (see documentation D2860 “Brief instruction testing plate PB200 GS03”) and the associated outputs of the WSC must switch correctly.
- If the wheel sensor **RSR110-002** is used, then at least 1 traversing over sensor system 1 must be carried out correctly using the testing plate PB200 (see documentation D2860 “Brief instruction testing plate PB200 GS03”) and the associated outputs of the WSC must switch correctly.

10 Repair

Defective components must not be repaired by unauthorized persons but can either be returned to Frauscher for repair or can be replaced by Frauscher components of the same type.

After repair or replacement of the WSC, the setting of the DIP-switches must be checked for compliance with the actual configuration.

10.1 Troubleshooting of the WSC

Troubleshooting of the WSC can be carried out as follows:

- with the LED indications on the front panel of the WSC
- by means of the Advanced Service Display ASD via diagnostic interface “Serial Interface” on the front panel of the WSC

10.1.1 LED indications on the WSC

LED “PWR”

If the LED “PWR” is off, then this indicates an error status:

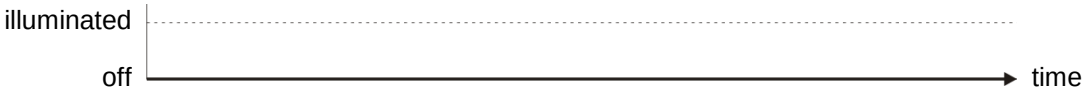


Figure 10.1: LED “PWR” off

Meaning	Possible measure(s)
no power supply	apply power supply
wrong polarity	reverse polarity
fuse broken	replace WSC

Table 10.1: LED “PWR” off

If the LED “PWR” is illuminated, then this indicates an operating status:

Figure 10.2: LED “PWR” illuminated

Meaning	Possible measure(s)
power supply applies	-

Table 10.2: LED “PWR” illuminated

LED “Sys1” and “Sys2”

If the LED “Sys1” and/or “Sys2” is off, then this indicates an operating status:

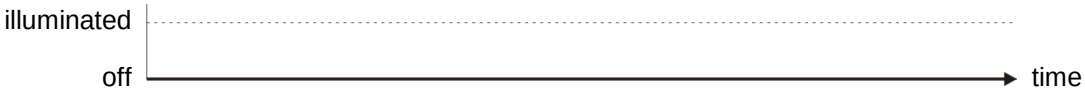


Figure 10.3: LED “Sys1” and/or “Sys2” off

Meaning	Possible measure(s)
wheel sensor not damped	-
no error at the wheel sensor	-
no power supply	apply power supply

Table 10.3: LED “Sys1” and/or “Sys2” off

If the LED “Sys1” and/or “Sys2” is illuminated, then this indicates an operating status:

Figure 10.4: LED “Sys1” and/or “Sys2” illuminated

Meaning	Possible measure(s)
wheel sensor damped	-
wheel sensor adjustment not yet completed	wait for the adjustment process to be completed

Table 10.4: LED “Sys1” and/or “Sys2” illuminated

If the LED “Sys1” and/or “Sys2” flashes slowly, then this indicates an error status:

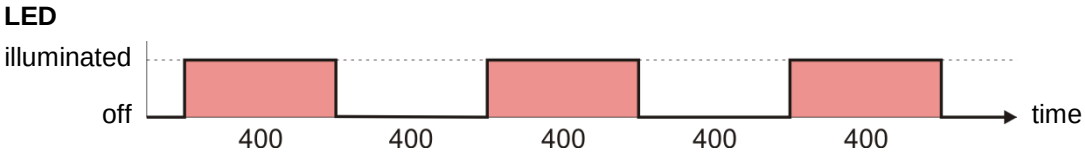


Figure 10.5: LED “Sys1” and/or “Sys2” flashes slowly, time data in ms

Meaning	Possible measure(s)
wheel sensor not adjusted	adjust wheel sensor
incorrect actuation sequence for adjustment	carry out correct actuation sequence
wire break in the wheel sensor cable e.g. due to: • interrupted cable connection between outdoor and indoor equipment • defective wheel sensor	 check cable connection between outdoor and indoor equipment replace wheel sensor
overcurrent e.g. due to: • wire short-circuit in the wheel sensor cable • wheel sensor adjusted incorrectly • defective wheel sensor	 rectify short-circuit adjust wheel sensor correctly replace wheel sensor

Table 10.5: LED “Sys1” and/or “Sys2” flashes slowly

As soon as the error is rectified, the LED “Sys1” and/or “Sys2” will go off.

In case a configuration with 1 system output is used, the LED “Sys2” is not used and therefore always off.

10.1.2 Measurements on the WSC with connected wheel sensor RSR110

The sensor currents of the wheel sensor RSR110 can be read out with the ASD.
Further information regarding the data request of the WSC can be found in chapter “Data request with Advanced Service Display ASD”.

Value read out via ASD	Meaning	Possible measure(s)
< 0,2 mA	wire break in the wheel sensor cable	check cabling and connections
	interrupted cable connection between outdoor and indoor equipment	check cable connection between outdoor and indoor equipment
	wheel sensor has dropped off the rail	check mounting of wheel sensor and correct it if necessary, carry out adjustment again
	defective wheel sensor	replace wheel sensor
	(no wheel sensor connected)	(connect wheel sensor)
≥ 0,2 mA < 4,75 mA	wheel sensor not adjusted	adjust wheel sensor
	wheel sensor damped (traversed)	-
≥ 4,75 mA ≤ 5,25 mA	normal operating sensor current (5 mA nominal value)	-
> 5,25 mA < 6 mA	wheel sensor not adjusted	adjust wheel sensor
≥ 6 mA	overcurrent e.g. due to: • wire short-circuit in the wheel sensor cable • wheel sensor adjusted incorrectly • wheel sensor connected incorrectly • defective wheel sensor	 rectify short-circuit adjust wheel sensor correctly connect wheel sensor correctly replace wheel sensor

Table 10.6: Measurements on the WSC with connected wheel sensor

11 Removal from service

Decommissioning and disposal

Defective components, which are not returned to Frauscher according to chapter “Repair”, are to be disposed of in accordance with the national regulations. Planning and performance of a de-commissioning as well as the disposal of components and parts fall under the responsibility of each railway operator.