Power Rail Booster

User's Guide

Version 12/2005

Exclusion of liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Technical specifications are subject to change without prior notice.

Foreword

Purpose of this manual

This manual provides an overview of the Power Rail Booster for PROFIBUS-DP and supports users in configuration, installation and commissioning.

It is directed at persons, whose work involves the configuration, commissioning and/or servicing of automation systems.

Basic knowledge requirements

General knowledge in the field of automation is required to use this manual.

Validity of this manual

The manual is designed for use with the Power Rail Booster for PROFIBUS-DP with the order No. 6ES7 972-4AA02-0XA0.

This manual describes components that are valid at the time of publishing. We reserve the right to include current product information on any new components and components with a newer release level.

Comparison with the previous version

The previous version of this manual was revised and supplemented to create this latest version:

- “General Remarks” revised and Table “Overview of Compatibility with Previous Versions” supplemented.
- Chapter 2 „Introduction“ revised.
- Chapter 3.2.3 „LED Test on Activating the Voltage Supply“ added.
- Chapter 3.3 „Mode-dependent Functions“ added.
- Chapter 4.3.1 „Cascading“ revised.
- Chapter 4.3.2 „Point-to-point Connection” revised.
- Chapter 4.4 „Rail Sections“ revised.
- Chapter 5.2 „Configuration with the PRB Checker“ revised.
- Chapter 5.3 „Configuration of the Bus Parameters“ revised.
- Chapter 6.3.2 „Interfaces and Connections“ revised.
- Chapter 7.1 „Diagnostic Displays fort he PRB“ revised.
- Chapter 7.2 „Diagnostics Message Frame“ added.
- Chapter 8 „Technical Specifications“ revised.
- Chapter 9.1 „Additional Hardware and Hardware for PRB Applications“ replaced by Chapter 9.1 „Examples for Applications“ of the previous version.
- Chapter 10 „Standards and Certifications“ added.

Certification

See the Chapter on Standards and Certifications.

CE Compliance

See the Chapter on Standards and Certifications.

Standards

See the Chapter on Standards and Certifications.

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Overview of “Compatibility with Previous Versions“

Function/Properties	6ES7 972-4AA02-0XA0	6ES7 972-4AA01-0XA0	6ES7 972-4AA00-0XA0
Housing	Plastic	Plastic	Metal
Dimensions W x H x D (mm) Incl. plugs with assembly to 7.5 mm Top-hat rail Minimum installation space W x H x D (mm)	90x132x75 90x165x75	90x132x75 90x165x75	120x110x135 120x170x135
Terminal connectors Power Rail DC24 SF signalling contact	Pluggable Max. cross-section: 2.5 sqmm max. cross-section: 2.5 sqmm max. cross-section: 2.5 sqmm	Pluggable Max. cross-section: 2.5 sqmm Max. cross-section: 2.5 sqmm Max. cross-section: 2.5 sqmm	Integrated Max. cross-section: 2.5 sqmm Max. cross-section: 2.5 sqmm Max. cross-section: 4.0 sqmm
Hybrid operation permissible with PRB:	6ES7 972-4AA00-0XA0 6ES7 972-4AA01-0XA0	6ES7 972-4AA02-0XA0	6ES7 972-4AA02-0XA0
SF signalling contact	Non-wearing semi-conductor: 24..230V UC / 0.2A	Relay 24..230V UC / 2A	Relay 24..230V UC / 6A
Cascadeable	Yes, up to 10 PRBs in series	Yes, up to 10 PRBs in series	No
UL-approved	Yes	No	Yes
Operating modes of SF relay Signalling contact / diagnostics	Yes / yes, product release 3 and above 3	Yes / no	Yes / no

Contents

1 General Remarks

Safety-related remarks

This User’s Guide contains warnings that you must observe for your own personal safety as well as to avoid material damage. The warnings are emphasized by a warning triangle and appear as follows in dependence of the danger level:

Danger

This means that death, serious injury or substantial material damage **will** occur if the prescribed precautionary measures are not taken.

Warning

This means that death, serious injury or substantial material damage may occur if the prescribed precautionary measures are not taken.

Caution

This means that minor injuries or light material may occur if the prescribed precautionary measures are not taken.

Note

Provides important information about the product, the handling of the product or about a specific part of the documentation to which attention needs to be called.

Qualified personnel

A device may be put into operation or operated only by **qualified personnel**. For the purpose of this manual, qualified personnel are persons who are authorized to put into operation, ground and designate devices, systems and electrical circuits according to the safety-related standards.

Control cabinet

For the purposes of this User's Guide, a **control cabinet** must fulfil the fire enclosure requirements to EN 60950.

Warning

The device is intended for operation in control cabinets or closed equipment rooms.
The device may not be opened.

Warning

The configuring engineer is always responsible for ensuring that data transmission errors cannot produce a dangerous situation. In the case of systems connected by contact conductors, it is not possible to exclude brief interruptions to communication due to the mechanical link of the electrical transfer paths. The control software must take this into account.

Use as prescribed

The device may be used only for the applications described in this Guide and only in conjunction with non-Siemens devices and components recommended or authorized by Siemens.

Proper transport, storage and installation as well as careful operation and maintenance of the device are prerequisites for problem-free and safe operation.

2 Introduction

The PRB (Power Rail Booster) is intended for use as a network component in electrical PROFIBUS networks. Its purpose is the amplification and safe, reliable transmission of PROFIBUS signals. The PRB enables the transmission of PROFIBUS signals over contact rails, loops and other cable types (such as telephone cables) not compliant with the PROFIBUS Specification. The PRB also enables data transmission in the face of an excessive EMC load.

The PRB can be easily integrated in existing PROFIBUS fieldbus networks. It is also possible to configure a complete PROFIBUS fieldbus network in line and/or star topology. Except for the Power Booster itself, no other filters or terminating elements are required for safe, reliable data transmission. In the case of increased EMC loading above the limit values stated in the technical specifications, using interference suppressor filters can allow you to achieve higher limit values.

Every PRB has two independent, isolated interfaces, each in turn consisting of a transmitter component and a receiver component.

The primary channel is designated as 9-pin D subminiature (female) socket connector. An RS 485 bus segment to PROFIBUS Standard EN 50170 can be connected to this channel.

The secondary channel is run to a terminal strip. There are two pins for each signal (A1, A2 and B1, B2). A power rail segment can be connected to this channel. The nominal cross-sectional area measures 2,5mm².

LEDs signal the current status as well as any malfunctions.

The operating voltage supply comes from 24 V direct voltage.

At least two Power Rail Boosters are required for a transmission link.

2.1 Applications

Primary applications for the Power Rail Booster include:

- Motor-driven overhead trolley conveyors,
- Storage/retrieval devices,
- Crane installations,
- Rotary feed through units and rotary tables,
- Lifts and hoisting apparatus,
- Traversing tracks.

It is also generally recommended that the Power Rail Booster be used for cost-efficient, safe and reliable PROFIBUS transmissions via contact rails or cables.

The following illustration shows a sample application.

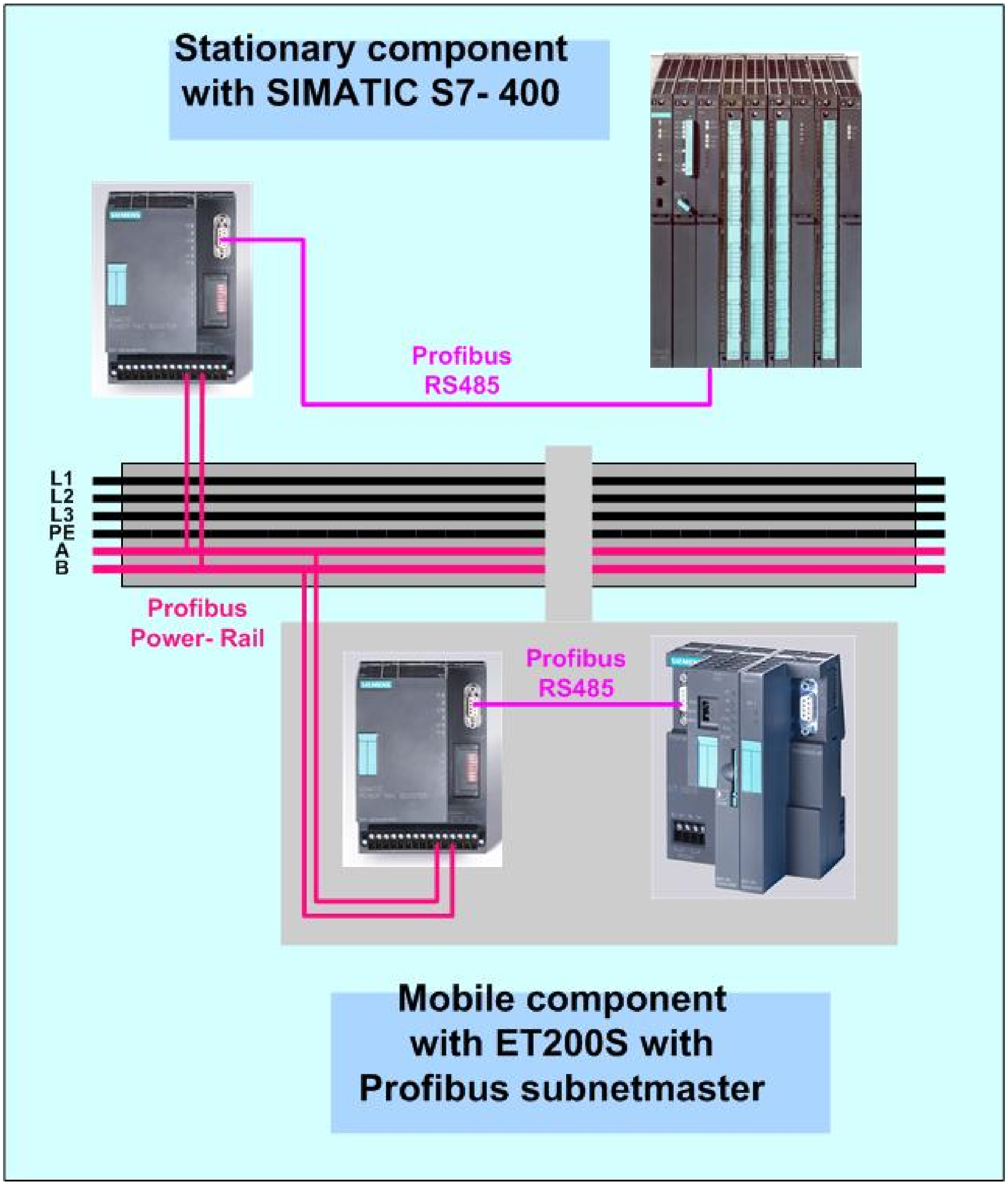

Fig. 1: Sample application of the Power Rail Booster

3 General Functions

3.1 Basic Function

The basic functionality of the Power Rail Booster is safe, reliable, bidirectional data transmission. Following power-up, the PRB begins an automatic search for the baud rate. Data transmission is activated as soon as a valid baud rate is found. If the master then sends a request to its slave, data coming in over the RS485 interface are received by the stationary PRB, elevated to a noise-free level, and sent to the moving PRB on the power rail side, which receives the data, converts them to the RS485 level and sends them to the slave. The slave's response to the master is transferred the same manner, but in reverse order.

3.2 Functions

These are the functions which are permanently executed or supported by the Power Rail Booster.

3.2.1 Supported Protocols

The PRB is designed for use as a network component in electrical PROFIBUS networks. It is a pure transformer, and is largely transparent as PROFIBUS device. It has no PROFIBUS address. Messages are checked for syntax, but the data are not checked for correctness as regards their content. The Power Rail Booster supports mono- and multi-master systems. PROFIBUS DP/FMS, as well as FDL and MPI, are transferred as protocols.

Warning

If there are active stations on both sides of the power rail section, all stations are at risk of a brief failure in the wake of line interruptions.

3.2.2 Transmission Speed

The Power Rail Booster supports the following EN 50170-compliant transmission speeds (baud rates):

9,6 kBit/s, 19,2 kBit/s, 45,45 kBit/s, 93,75 kBit/s, 187,5 kBit/s and 500 kBit/s

The transmission speed is set automatically as soon as the Power Rail Booster receives valid messages over an interface. If the transmission speed is not yet known, the outputs for all interfaces are disabled. The PRBs recognize any changes in the transmission speed during operation and reconfigure themselves accordingly. Brief transmission problems may occur at the moment of switch-over.

3.2.3 LED Test on activating the Voltage Supply

When you power up, the PRB activates the LEDs on the front for approximately 1 second.

3.2.4 Signal Regeneration

The PRB regenerates the signal waveshape of the data received, making it possible to cascade as many as 10 PRBs. The signal throughput time is max. 6 tbit per PRB.

3.2.5 Short Circuit Detection

The Power Rail interface on the PRB is monitored for short circuits. If a short circuit is detected, the transmitter components are shut down. When the problem has been rectified, they are automatically put back into operation as described in Chapter 3.1 „Basic Function“. Critical states are signalled as described in Chapter 7 „LED display and troubleshooting“.

3.2.6 Monitoring of the Output Temperature

The output element is protected against overload by a temperature monitor. The monitor shuts the output element down when a critical temperature is exceeded. When the output has cooled down, the PRB automatically restarts data transmission. Critical states are signalled as described in Chapter 7 „LED Display and Troubleshooting“.

3.2.7 Commissioning Aids

At least one active station is required to test the Power Rail connection during installation. That station is usually the PROFIBUS master on the stationary side of the Power Rail. This station serves as message source. On power-up, the Power Rail Boosters are passive. They recognize the transmission speed based on the messages sent by the station. The diagnostic LEDs on the front of the Power Rail Booster provide a visual aid.

3.3 Settable Additional Functions (product Release 3 and above)

You can activate various additional functions using the DIP switch.

3.3.1 Display of the Firmware Version

Users can activate display of the firmware version on the PRB using DIP switch "DIP-4".

- DIP-4 → „OFF“: displaying the firmware version is deactivated
- DIP-4 → „ON“: displaying the firmware version is activated

When display of the firmware version is activated, the LEDs have the following meanings:

- LED „ϑ“ = “ON” corresponds to 2^0
- LED „PR“ = “ON” corresponds to 2^1
- LED „DP“ = „ON“ corresponds to 2^2

3.3.2 Controlling the "IS-Master" signal

When deploying several nodes with an active interface, customers must set DIP switches DIP7 and DIP8 in accordance with the following Table.

	Active node stationary	Passive node stationary
At least one active node travelling	With all stationary PRBs DIP-7→ ON, DIP-8→ON With all travelling PRBs DIP-7→ ON, DIP-8→OFF	With all stationary PRBs DIP-7 → ON, DIP-8 → ON With all travelling PRBs DIP-7 → ON, DIP-8 → OFF
Only passive nodes travelling	With all stationary PRBs DIP-7 → OFF, DIP-8 → OFF With all travelling PRBs DIP-7 → OFF, DIP-8 → OFF (Factory default setting)	

Fig. 2: Setting of DIP switches for controlling the "IS-Master" signal

If the structure of the Power Rail network is a "point-to-point connection", as described in Chapter 4.3.2, you must set DIP switches DIP-7 and DIP-8 to "ON" on both the stationary and travelling PRB.

3.3.3 Diagnostic Message

Using DIP switch "DIP-6", users can choose between two diagnostics modes.

- DIP-6 → „OFF“: The electronic signalling contact maps the behaviour of the SF-LED as described in the Table in Chapter 7.1 "Diagnostic Displays of the Power Rail Booster"

For a detailed description of the behaviour and assignment of the signalling contact refer to Chapter 6.3.2 “Interfaces and Connections".

- DIP-6 → „ON“: The system reports detected errors via the electronic signalling contact as a serial message frame. This allows you to make a more exact differentiation between the causes of errors.

For a more detailed description of the diagnostics message frame refer to Chapter 7.2 "Diagnostics message frame".

4 Network Topologies for Contact Rail Systems

4.1 Term Definitions

Contact Rail System

The communication between stationary plant control system and mobile vehicles takes place over PROFIBUS DP. Signals from the master are amplified by the PRB and fed into the contact rails. The vehicle picks off the amplified signals with the collector. The moving PRB then transforms the signals back to the Standard PROFIBUS signal level.

DP Master Segment

A contact rail system can be connected to the PROFIBUS via one or more than one PROFIBUS master. The segment of a contact rail system in which data interchange takes place via a PROFIBUS master is referred to as a “DP master segment”. Normally, a contact rail system consists of only one DP master segment. If there are multiple DP master segments, care must be taken to see that no electrical connection (short circuit) can be established between DP master segments via the double collector. This can be done using rail sections (see Chapter 4.4 „Rail sections“).

PRB Segment

As a rule, more than one stationary Power Rail Booster is required to supply a contact rail system with PROFIBUS signals. The subsegment of a contact rail system in which data interchange takes place via a PRB is referred to as “PRB segment”. A PRB segment is thus a subsegment of a DP master segment. It must be ensured that no electrical connection (short circuit) can be established between two PRB segments via the double collector. This can be done using rail sections (see Chapter 4.4 „Rail sections“).

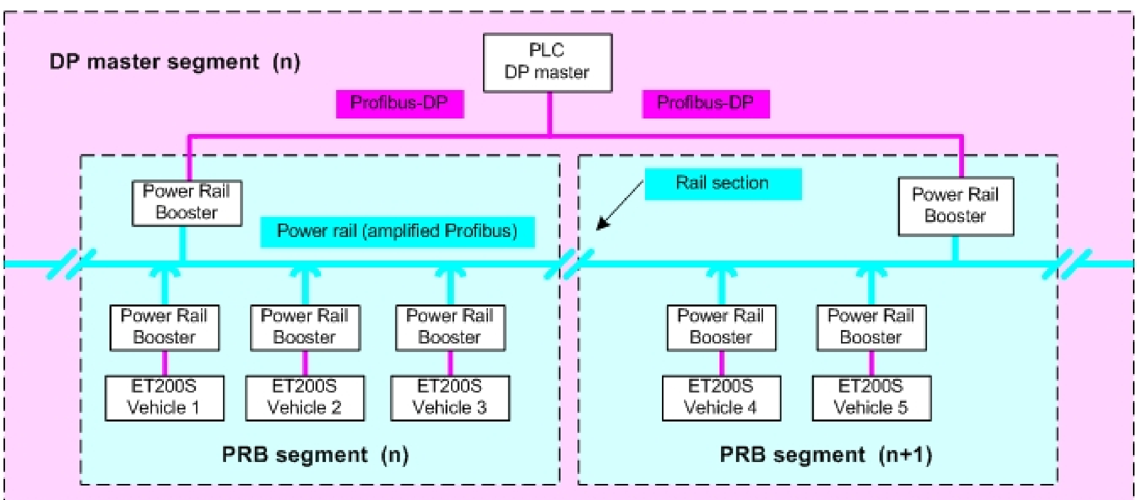

Fig. 3: Block diagram of a DP master segment with two PRB segments

4.2 Introduction

The following network topologies can be implemented using the Power Rail Booster:

- Cascading of Power Rail sections,
- Point-to-point connections
- Line topology
- Star topology (contact rail system)
- Closed loop

Combinations of the above are also possible. Two contact rails or cable strands are used to set up the Power-Rail sections for these network topologies. All cabling or wiring for the contact rails must be done with PROFIBUS cable.

4.3 Examples of Topologies

4.3.1 Cascading

The PRB regenerates the signal waveshape of the data received, making it possible to cascade as many as 10 PRBs. You must consider the increased signal throughput time (6 T-bits per PRB) when configuring in STEP 7, see Chapter 5.3.1!

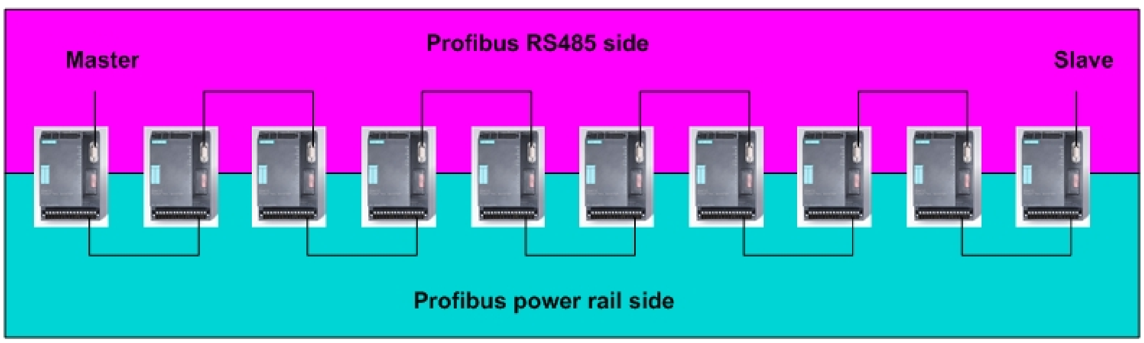

Fig. 4: Example of cascading

4.3.2 Point-to-point Connection

This configuration is distinguished by the fact that only one PRB is installed on each side of the Power Rail section. To optimize interference immunity, users must set the "IS-Master" signal on both PRBs. To do this, you must set on both PRBs DIP switches DIP-7 and DIP-8 to "ON".

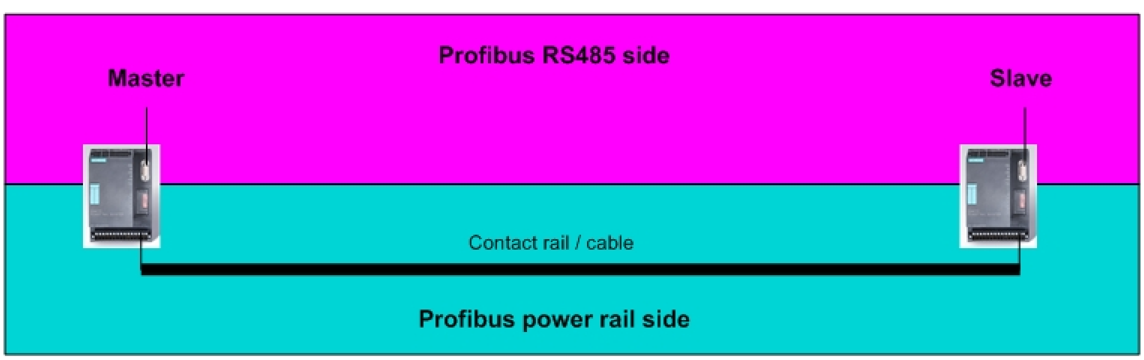

Fig. 5: Example of a point-to-point connection

4.3.3 Line Topology

This configuration is distinguished by the fact that multiple contact rail segments are cabled as one line and multiple PRBs are installed on the moving side.

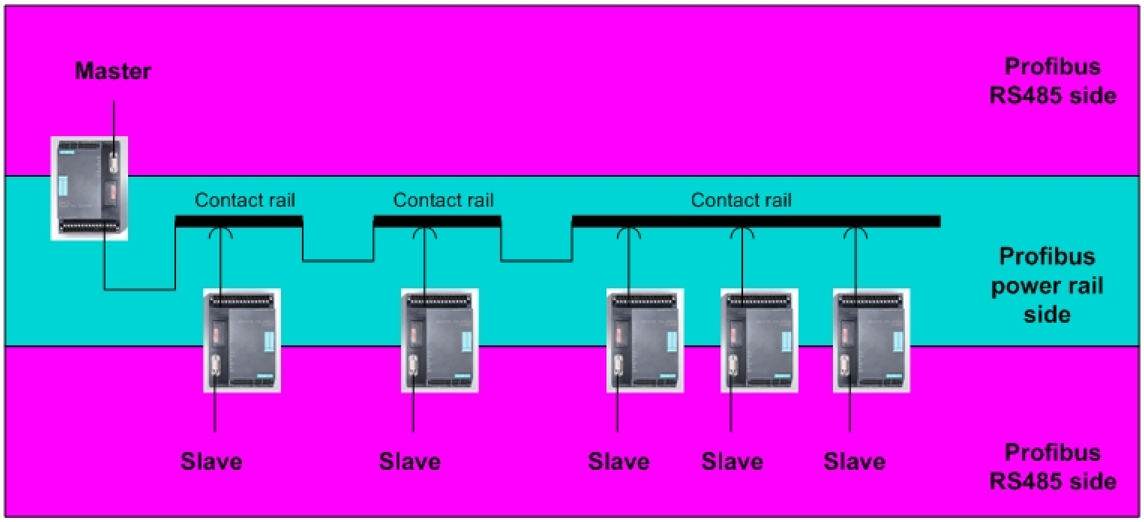

Fig. 6: Example of line topology

4.3.4 Star Topology

This configuration is distinguished by the fact that multiple contact rail segments are cabled in a star structure and that more than one PRB is installed on the moving side. The star structure is permissible on no more than two levels (paths and branches.

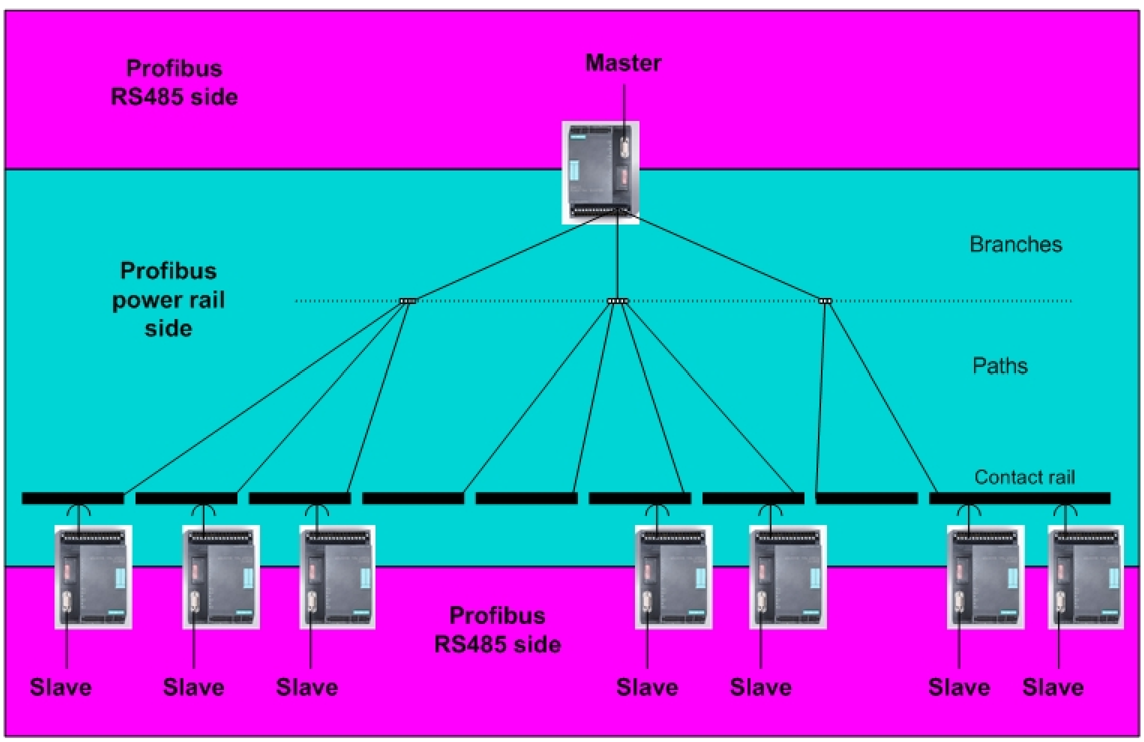

Fig. 7: Example of star topology

4.3.5 Closed Ring Circuits

When using systems with closed loops, it is recommended to establish a low-resistance connection to ground with the steel construction parallel to the contact rail.

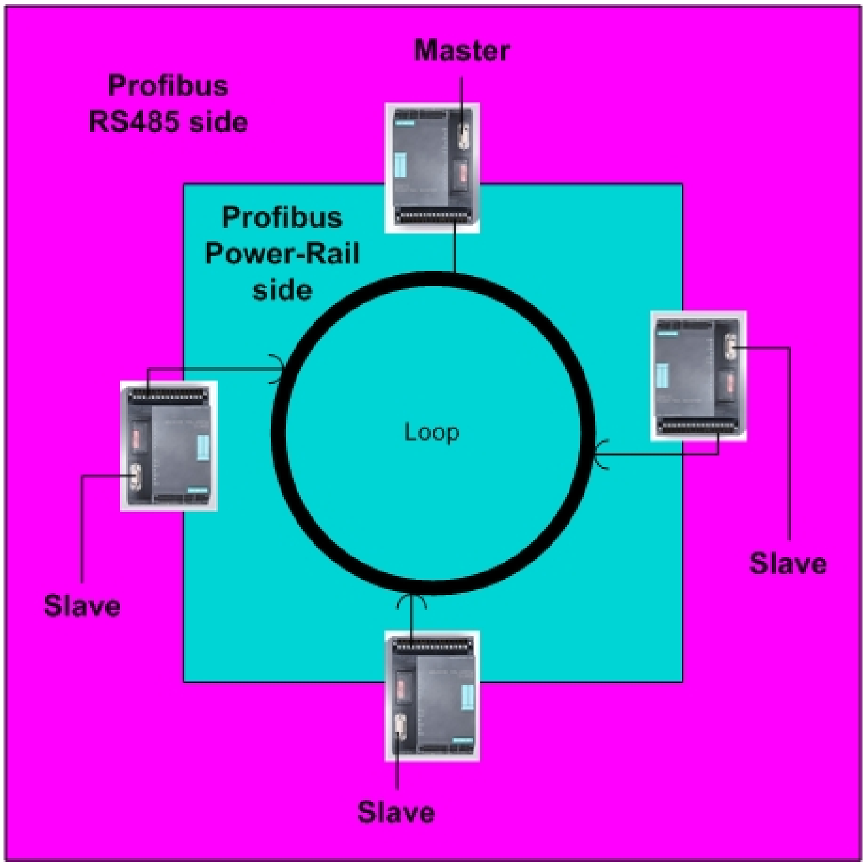

Fig. 8: Example of a closed loop

4.4 Rail Sections

Two types of rail section (Fig.: 9 and 10) can be used. A double rail section can maintain communication even during a segment change through suitable switching of the PRB segments by an PRB Segment Controller.

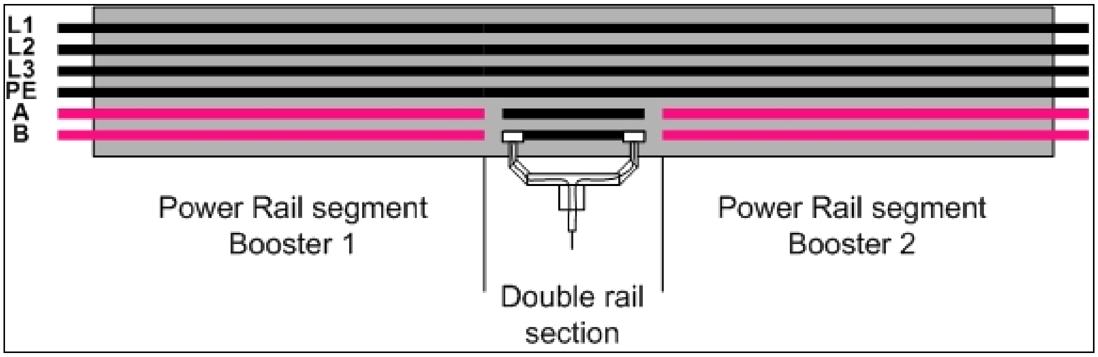

Fig. 9: Example of a double rail section

The isolating rail section is the cost-optimized solution for a segment change. Here, the contact rails in the two segments are separated by a non-conductive section. In this case, the plant controller and the vehicle cannot communicate during the transition.

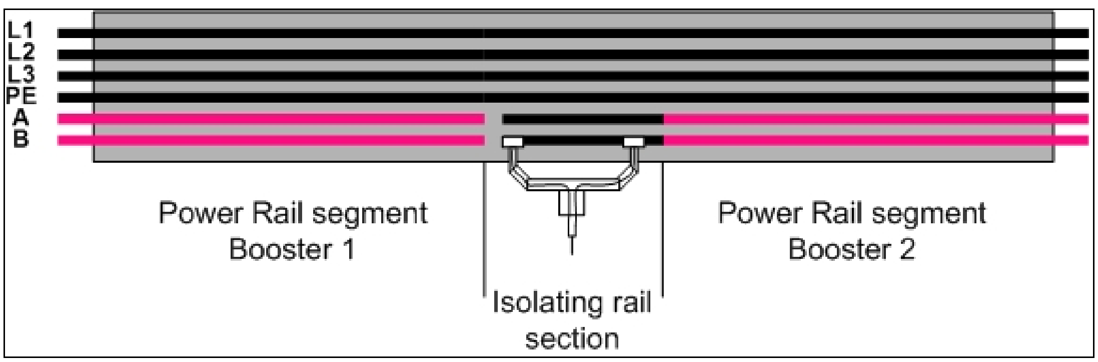

Fig. 10: Example of an isolating rail section

The isolating rail section can be created by isolating the contact rail with a suitable isolator. In addition to isolating properties, it is also necessary to take into account mechanical properties, particularly those relating to abrasion.

Another way of creating an isolating rail section is to use an isolator instead of a conductor as contact rail.

Note

When installing rail sections, care must be taken when aligning the junctions in order to avoid bounce.

5 Configuration

5.1 Procedure

Configuration is handled in steps with the aid of the „PRB-Checker“ tool and application-specific data as described below.

1. Checking to see whether there is a need for dividing the layout into multiple DP master segments.

Prerequisites:

- Knowledge of the total number of vehicles in the plant
- Knowledge of the maximum permissible typical bus cycle time for the application

Division of the layout is always required when:

- there are more than 125 vehicles in the plant
  or
- shorter typical bus cycle times are required
  or
- the base load of the infeed PRB is to be reduced

Result:

- Number of DP master segments
- Transmission speed used.

2. Checking to see whether there is a need to divide the number of DP master segments specified in Step 1 into multiple PRB segments. This step must be performed separately for each DP master segment specified in Step 1.

Prerequisites:

- Results from Step 1
- „PRB Checker“ configuring tool
- Layout of the plant with dimensions
- Number of slaves in the relevant DP master segment
- Number of vehicles in the relevant PRB segment. Each Power Rail Segment Controller connected to the segment also has to be treated as vehicle.
- Length of the cable between collector and vehicle
- Maximum length of the data in the input/output bytes to be interchanged between stationary control system and vehicle control system.

Division is always required when it is not possible

- to supply the entire rail length of the relevant DP master segment
  or
- to supply the maximum possible number of vehicles in the relevant DP master segment

with a stationary PRB.

Result:

Division of the relevant DP master segment into PRB segments?

4→ Continue with Step 3 (configuration of the PRB segments)
8→ Continue with Step 4 (configuration of the bus parameters)

3. Defining the required topology of a PRB segment, determining the required lengths (cable + collector wire) and the number of vehicles with the help of the layout, using the PRB Checker to find out whether the configuration data are permissible. This step must be performed separately for each PRB segment in every DP master segment.

Prerequisites:

- Results from Step 1
- Results from Step 2
- Prerequisites from Step 2

Result:

Is the relevant PRB segment approved by the PRB Checker?

4→ All PRB segments in the relevant DP master segment configured?
  4 → all PRB segments in all DP master segments configured?
    4→ Continue with Step 4 (configuration of the bus parameters)
  8 → Continue with Step 3 (configuration of the PRB segments)
8→ Continue with Step 3 (configuration of the PRB segments)

4. Adjusting the bus parameters for the DP master segments.

Prerequisites:

- All PRB segments in the relevant DP master segment configured

Result:

Have the bus parameters in all DP master segments been adjusted?

4→ Configuration completed
8→ Continue with Step 4 (configuration of the bus parameters)

5. Additional procedures for ensuring the functionality of the application.l

The lengths of the PRB segments computed with the PRB Checker should always be entered in the circuit manual. When the circuit manual is handed over to the electricians following configuration, a detailed discussion must be held regarding cable lengths and structures of the individual PRB segments. The electricians must follow the configuring engineer's instructions exactly. If that is not possible for reasons of practicality (cable routes, location of the subdistribution boards and terminal boxes), the configuring engineer must be informed and must check and, where applicable, modify the configuration accordingly. The modifications must once again be briefly discussed with the electricians.

5.2 Configuration with the „PRB Checker“

The Table below provides an overview of the maximum permissible lengths of PRB segments depending on the transmission speed.

Baud rate	Maximal permissible length
9600 bit/s	1250 m
19200 bit/s	625 m
45450 bit/s	264 m
93750 bit/s	128 m
187500 bit/s	81 m
500000 bit/s	25 m

Fig. 11: Maximum rail length depending on the selected transmission speed

In addition to the transmission speed, other parameters such as total capacitance and contact resistance must also be taken into account. The applications engineer has at his/her disposal, free of cost, the “PRB Checker” software tool for easy, fast and reliable calculation of the lengths of the individual PRB segments. This tool can be obtained through Siemens Customer Support under the ID: 13884116 for downloading over the Internet.

Installation is not necessary following downloading. All files must be copied into one directory. After calling “PRB-Checker.exe”, you can select the relevant PRB from the start screen based on Order No. and the language you wish to use.

Note: Before working with the program, you must set the language in Windows Control Panel to German [Germany].

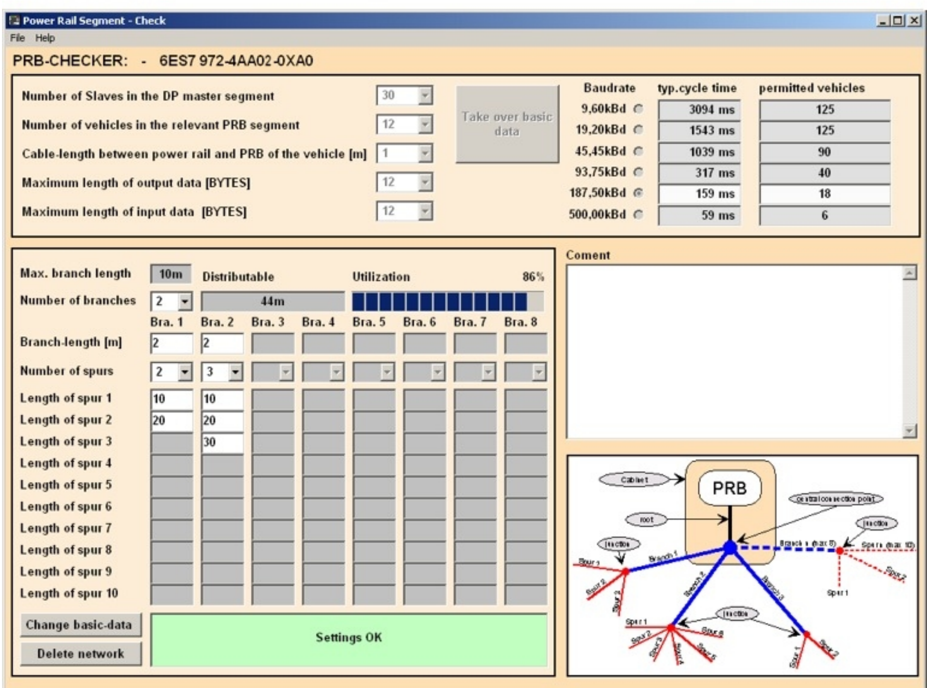

Fig. 12: The PRB Checker configuring tool – input screen form

All application data relevant to the configuration of the segments must be entered in their entirety in the PRB Checker’s input screen form.

The program checks the input data immediately after each modification. If the result for the data entered is positive (green field), the relevant segment may be regarded as operational. If the result is negative (red field), there are two possibilities:

- the permissible line length (reflection limit) has been exceeded

or

- the permissible load (capacitance) has been exceeded.

If the permissible line length has been exceeded, you must reduce the length of the PRB segment until the Checker gives you the green light for your configuration.

If the permissible load has been exceeded, you can reduce the length of the line, the number of vehicles in the PRB segment or the number of vehicles in the DP master segment.

In this way, you configure segment by segment as described in section 5.1 „Procedure“, until you have structured the entire length of your contact rail, including cabling, in the DP master and PRB segments.

You can also add comments and store your configuration segment by segment. The files can then be sent by e-mail and downloaded at another location. In the past, this has proven very successful as installation, documentation and quality control support.

Note

The information in Figure 10 "Overview of maximum permissible lengths of PRB segments" does **not** make it unnecessary to use PRB-Checker to calculate the line or rail length!

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Note

When using PRB-Checker to configure segments, you must treat each Power Rail Segment Controller that is connected to a PRB segment as an additional vehicle. This is due to the Power Rail Segment Controller's input capacitance.

5.3 Configuration of the Bus Parameters

Because of the way the PRB functions (see Chapter 3.2.4 „Signal regeneration“), the network parameters for the DP master segment must be configured depending on topology. This is done using the Hardware Configuration in STEP 7 or COM PROFIBUS in STEP 5.

5.3.1 Configuring the Parameter: „Number of OLMs “

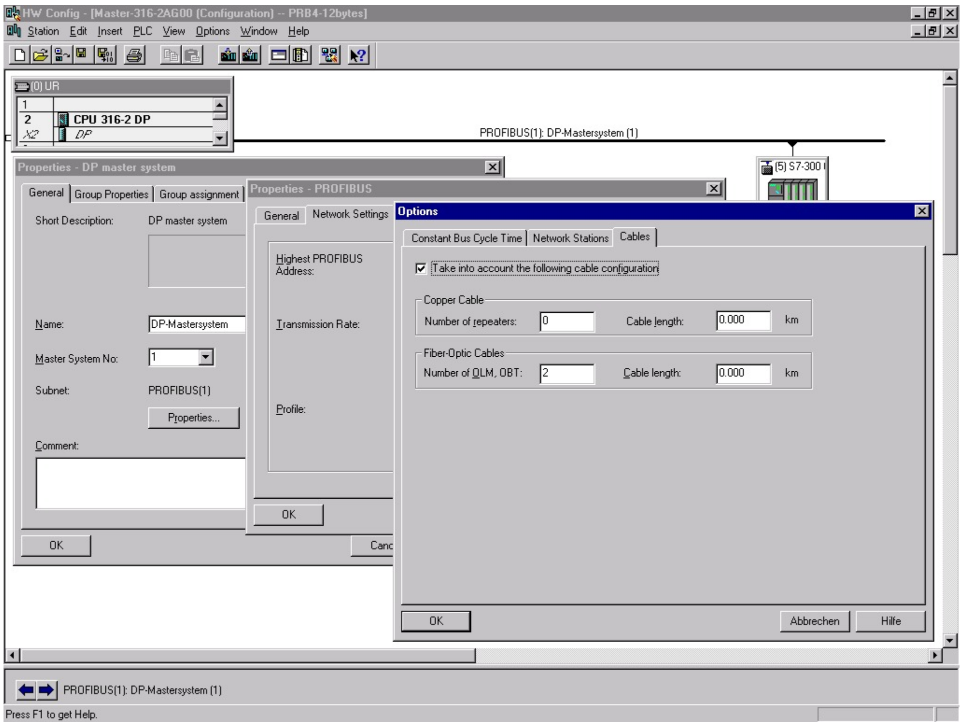

Fig. 13: Configuring the network parameters in Step 7´s Hardware Configuration

In the screen form shown above, the number of OLMs (Optical Link Modules) must be entered on the “Fiber Optics” line. The following applies:

- One OLM is equivalent to one PRB
- The line length remains unchanged

The configuration tools then check to see whether the Slot Time parameter in the selected communications profile can be left unchanged. If the slot time were to be exceeded due to additional delays caused by Power Rail Boosters, a warning message is issued and the parameters are modified accordingly.

The number of OLMs to be entered as the equivalent of the existing PRBs depends on the selected topology. The minimum number of OLMs to be configured when using PRBs is 2.

<u>The following computational rule is applied to cascade configurations:</u>

Number of OLMs = Number of PRBs connected in series

The delay level is: T_V *(in Tbit) = 2 *Number of OLMs in series * 6Tbit*

5.3.2 Adapting the„Retry Limit“ Parameter

It is advisable to set the "Retry Limit" parameter in the hardware configuration to a value of 4 to make the DP Master System less sensitive to short line interruptions, due, for example, to bouncing of sliding contacts when transitioning between rail sections.

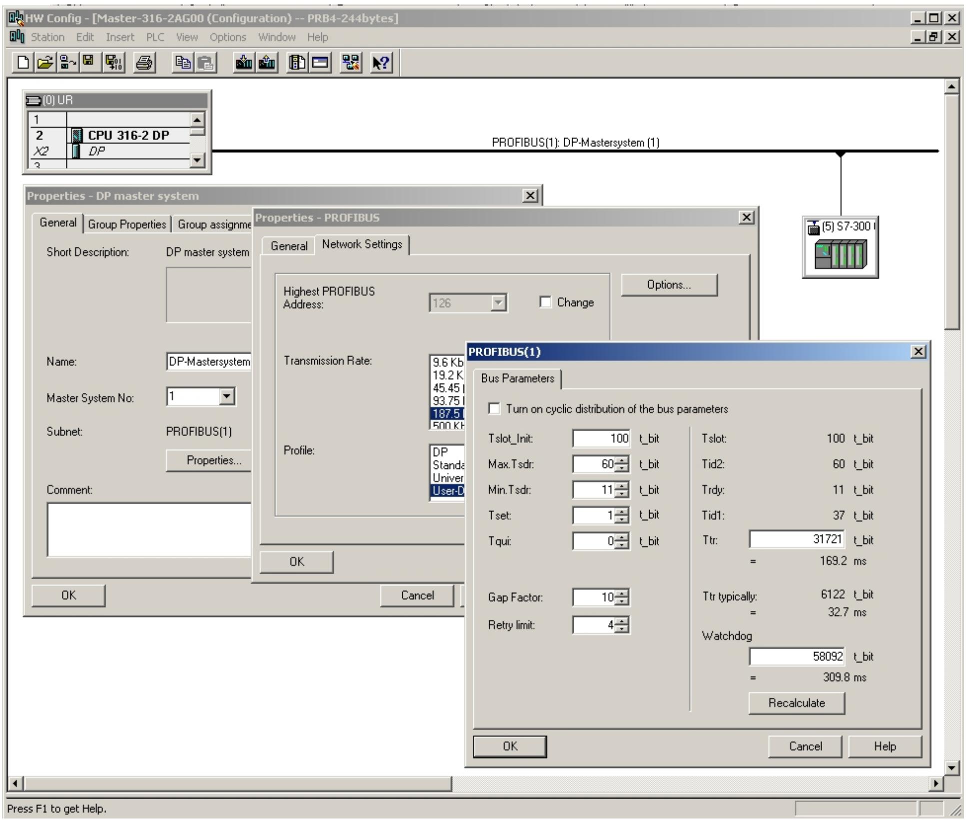

Fig. 14: Configuring the network parameters in Step 7´s Hardware Configuration

5.4 Configuring the Contact Rails and Sliding Contacts

5.4.1 Introduction

The PRB enables PROFIBUS transmission over contact rails. Over than the limit values for capacitance (Chapter 5.4.2) and contact resistance (Chapter 5.4.3), the PRB makes no special demands on the contact rail systems. Double collectors must be used in order to ensure continuous contact. The maintenance instructions provided by the contact rail supplier must be observed to ensure long-term compliance with the limit values.

5.4.2 Contact Rail Capacitance

The higher the capacitance of the contact rails, the lower the distributable rail length per Power Booster segment. The “PRB Checker” configuration tool’s internal calculations are based on rail capacitance of 45nF/km. Contact rails with a higher capacitance per unit length should not be used.

5.4.3 Contact Resistance between Contact Rails and Sliding Contacts

In order to ensure reliable data transmission, the contact resistance between the connecting terminals of the PRB involved in communication must be maximum of 100 ohms. In this connection, you must take into account all the transition resistors of contact elements in this transition path (contactors, switches, terminals, sliding contacts, etc.).

Depending on the existing ambient conditions, contamination and oxidation of the contact rails, particularly those made of copper (alloys), must always be reckoned with in all contact rail systems, although the constant travel of sliding contacts over a contact rail does have a certain self-cleaning effect. Particular attention must be paid to maintenance on those sections over which there is little travel, such as servicing areas, sidings, out-of-the-way areas and so on.

It is therefore of the utmost importance that maintenance and cleaning be sufficiently frequent so as not to endanger problem-free data transmission through contaminated or oxidized contact rails, sliding contacts or switching contacts.

5.4.4 Preferred Arrangement of the Contact Conductors

For optimizing immunity to interference, it is advisable to arrange the contact conductors as follows:

- Maximum distance between the contact conductors for Power Rail (A, B) and the contact conductors for protective earth and power (PE, L1, L2, L3).
- Lay the contact conductor for PE between the contact conductors for the phases and the Power Rail
- Minimum distance between the two contact conductors for Power Rail A and B
- To avoid contamination due to abrasion, you must mount contact conductors for the Power Rail above the other contact conductors and slightly offset the rail sections

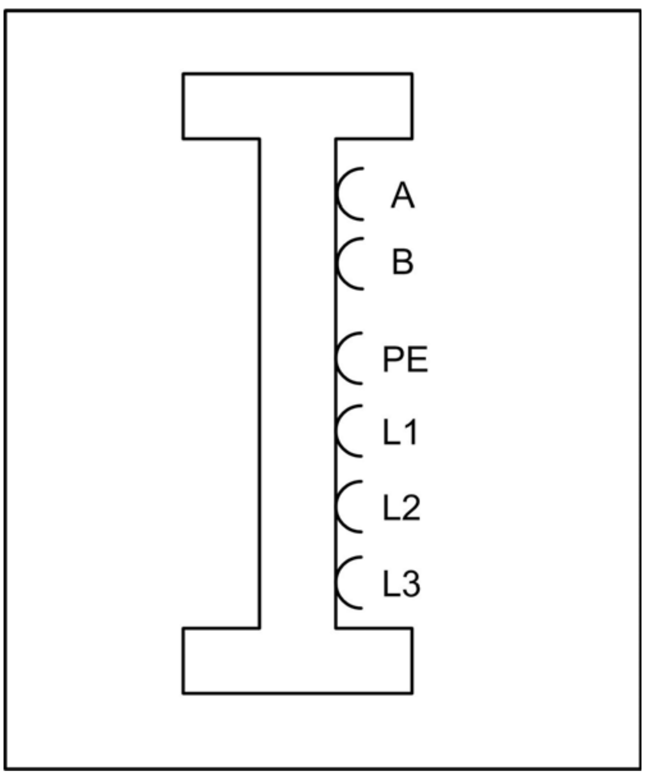

Fig. 15: Preferred arrangement of the contact conductors

5.4.5 Preferred Arrangement of the wires in cables

For optimizing immunity to interference, it is advisable to arrange the wires in the cables as follows:

- The wires for the Power Rail signals (A, B) are separated from the wires for power (L1, L2, L3) by the Function Earth (FE) at one side and the Protective Earth (PE) on the other.

or

- The wires for the Power Rail signals (A, B) are separated from the wires for power (L1, L2, L3) by a shield.

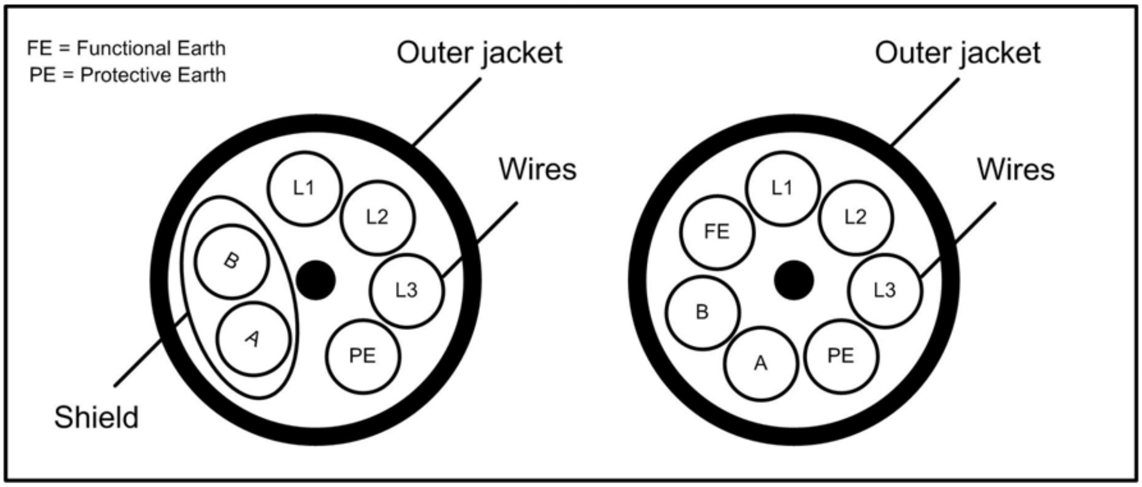

Fig. 16: Preferred arrangement of the wires in cables

Note

To ensure reliable, safe data transmission, the use of mechanically independent double sliding contacts is mandatory. These sliding contacts must be installed and set so that there is adequate surface pressure between sliding contacts and contact rails at all times. The slider's freedom of movement must not be impaired by cable ties, for example. Too little pressure and poorly adjusted contact rail junctions result in bounce and thus lead to interruptions in data transmission.

6 Commissioning

6.1 Safety Information

Use PRBs only as described in this User’s Guide. Pay particular attention to all warnings and safety-related information.

Operate a PRB only with a safety extra-low voltage to IEC 950/EN 60 950/VDE 0805 of no more than +32 V (typ. +24 V). In accordance with UL/CSA, the voltage source must be NEC Class 2-compliant.

Observe the electrical limit values when connecting voltage to the signalling contacts: 250 V AC / 30 V DC, rated operating current: 0,2A, rated operating current: 6W. These data only apply to **resistive l**oads. In the case of interconnection with inductive loads, you must suppress interference using suitable protective circuits (varistors or free wheeling diodes).

Danger

Never connect the Power Rail Booster to mains voltage.

Select a location for installation which fulfils the ambient conditions and mechanical limit values shown in the technical specifications.

Take steps to ensure that an installation error such as wire break, cannot result in undefined states within the plant.

Take the necessary measures and/or install suitable elements to ensure that all interfaces are protected against lightning strikes affecting the plant, whether indoors or outdoors.

6.2 General Information regarding Commissioning

When configuration has been completed, the following steps must be taken to put the PRB into operation:

1. Set all DIP switches to the position according the desired additional functions
2. Install the PRB
3. Connect the supply voltage and signalling contacts
4. Connect the Power Rail
5. Connect the RS 485 bus cable with preassembled bus connector

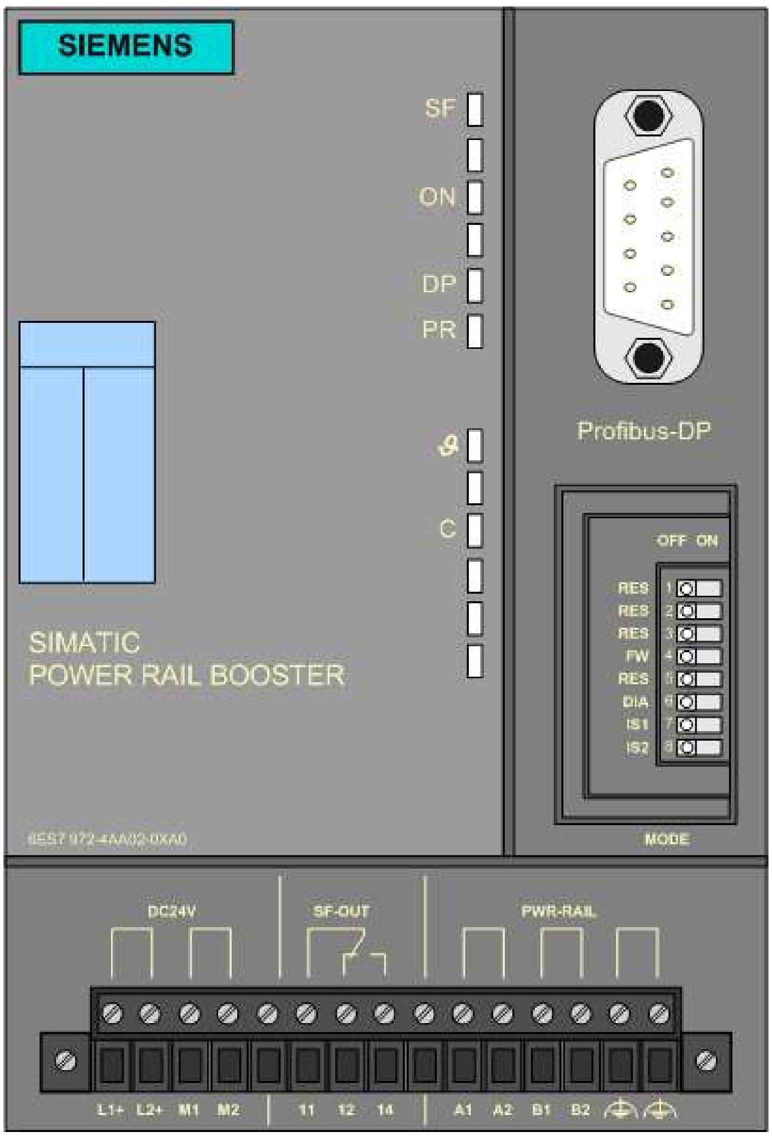

Fig. 17: Front view of the Power Rail Booster.

6.3 Installation

6.3.1 Installing a PRB

A PRB can be mounted on a DIN EN 50022-compliant standard top hat rail with the dimensions 35x15mm or 7.5x15mm. A PRB must be installed or removed only when the supply voltage is switched off.

→ The PRB must be installed horizontally on a vertical wall as shown in Fig. 14. All other installation positions result in derating to the permissible ambient temperature. See Chapter 8 „Technical Specifications".

→ The location must be selected to suit the ambient conditions and mechanical limit values shown in the technical specifications.

→ Sufficient space to connect all lines and cables must be available at the chosen location. In order to ensure sufficient heat dissipation, a space of at least 15mm must separate the upper corner of the PRB from the housing.

→ Install the PRB only on a low-resistance and low reactance-grounded mounting plate.

On/removing a PRB from a top hat rail

→ Insert the upper locking hook on the PRB into the standard rail and press the bottom surface against the rail until the PRB dicks into place.

→ The PRB is removed by pulling the locking lever downward. With the lever held down, the PRB can be simply lifted off the top hat rail.

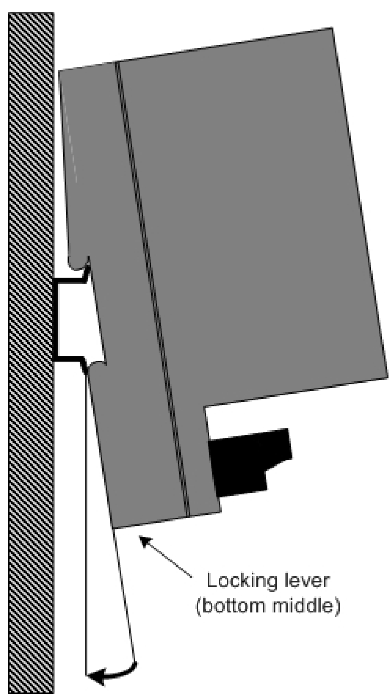

Fig. 18: Installing a PRB on a standard top hat rail

6.3.2 Interfaces and Connector Pin Assignment

6.3.2.1 Graphical interface diagram, galvanic isolation

The PRB is equipped with a number of interfaces, which are shown in the diagram below.

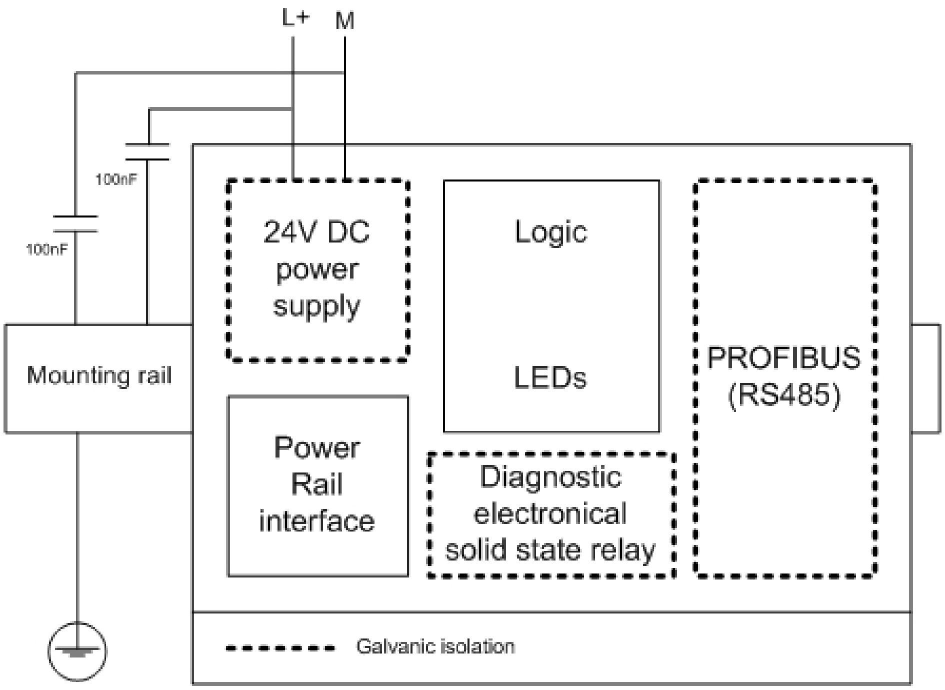

Fig. 19: Overview of interfaces on the Power Rail Booster

6.3.2.2 Wiring guidelines for interfaces

The following figure gives an overview about the wiring of the PRB interfaces.

Wiring guidelines for ...		Power 24 V DC	Power Rail A / B	SF OUT
Usable wires / cables		Unshielded / shielded solid / flexible	Unshielded / shielded solid / flexible	
Shield		Not necessary	Not necessary	
Wire routing		No special requirement	Carry functional ground parallel (for example: additional wire, connected on both sides) Preferably use of 3-/5-wired cables	No special requirement
Connectable cross sections for solid wires		0,2 to 2,5 mm²		
Connectable cross sections for flexible wires	Without sleeve	0,2 to 2,5 mm²		
	With sleeve	0,25 to 2,5 mm²		
Skinning length		10 mm		
Sleeves		See DIN 46228		

Fig. 20: Wiring guidelines for the interfaces of the Power Rail Booster

6.3.2.3 Connecting the Power Rail interface

The connection is established via the 15-pin terminal block on the front of the PRB.

→ Because of their low capacitance, all cables to the contact rail on the Power Rail side, such as incoming cables and connecting cables, should be PROFIBUS cables. In principle, however, it is also possible to use other cable types, in which case the maximum cable length must match the cable capacitance.

Pin - Nr.	Name	Function
10	A1	Contact rail A, first sliding contact
11	A2	Contact rail A, second sliding contact
12	B1	Contact rail B, first sliding contact
13	B2	Contact rail B, second sliding contact
14	⏚	Functional ground
15	⏚	Functional ground

Fig. 21: Terminal assignment for the Power Rail interface

6.3.2.4 Connecting the PROFIBUS interface

PRBs are equipped with an electrical port with RS 485 level. This port takes the form of a 9-pin D Subminiature socket with screw-type locking mechanism. Bus lines A and B are galvanically isolated from the 24 V supply voltage and the Power Rail voltage. The port is located on the front of the PRB.

→ For the PROFIBUS DP side, the installation guidelines contained in the "SIMATIC NET PROFIBUS Networks" manual apply.

→ Connect the RS 485 bus segment using a PROFIBUS bus connector. If the PRB is located at the beginning or end of a bus segment, the bus terminator on this interface must be switched on.

→ All PROFIBUS bus connectors in the network must be screwed tightly into the RS 485 interface.

→ Make sure that the bus segment connected to the RS485 interface is terminated at both ends.

Pin - Nr.	Name	Function
1	n.c.	Reserved
2	n.c.	Reserved
3	RxD/TxD-P	Data line B
4	RTS	Request to send
5	GND	Ground
6	VCC	Supply voltage
7	n.c.	Reserved
8	RxD/TxD-N	Data line A
9	n.c.	Reserved

Fig. 22: Terminal assignment for the PROFIBUS RS485 interface

6.3.2.5 Connecting the operating voltage

The operating voltage is connected via the 15-pin terminal block on the front of the PRB. The connection is protected against polarity reversal. Pins 1-2 and pins 3-4 are jumpered internally.

→ Supply the PRB only with safety extra-low voltage to IEC 60634-4-41 "Generation as Functional Extra-low Voltage with Safe Electrical Isolation", DC 20, 4-28.8 V DC (+24 V typical).

→ The PRB must be operated with a grounded incoming supply. The reference potential (ground) of the 24 V DC supply voltage must be connected to PE.

→ Be sure there is sufficient tensile load and observe the cable's minimum bending radii.

Pin No.	Name	Function
1	L1+	24 V DC
2	L2+	24 V DC
3	M1	Ground
4	M2	Ground

Fig. 23: Terminal assignment for the supply voltage interface

6.3.2.6 Connecting the signalling contacts

An electronic semi-conductor relay with potential-free contacts is provided for signalling faults or the failure of the operating voltage. The signalling contact can be connected to a controller's digital I/0 via the 15-pin terminal block on the front of the PRB.

→ Be sure there is a sufficient tensile load and observe the cable's minimum bending radii.

Pin - Nr.	Name	Function
6	11	Shared connector pin
7	12	Conducts potential from terminal 11 when SF LED is on (fault)
8	14	Conducts potential from terminal 11 when SF LED is out (ready)

Fig. 24: Terminal assignment for the signalling contact interface

When the PRB is deenergized, terminals 12 and 14 are separated from terminal

6.3.2.7 Connection scheme for wiring PRB

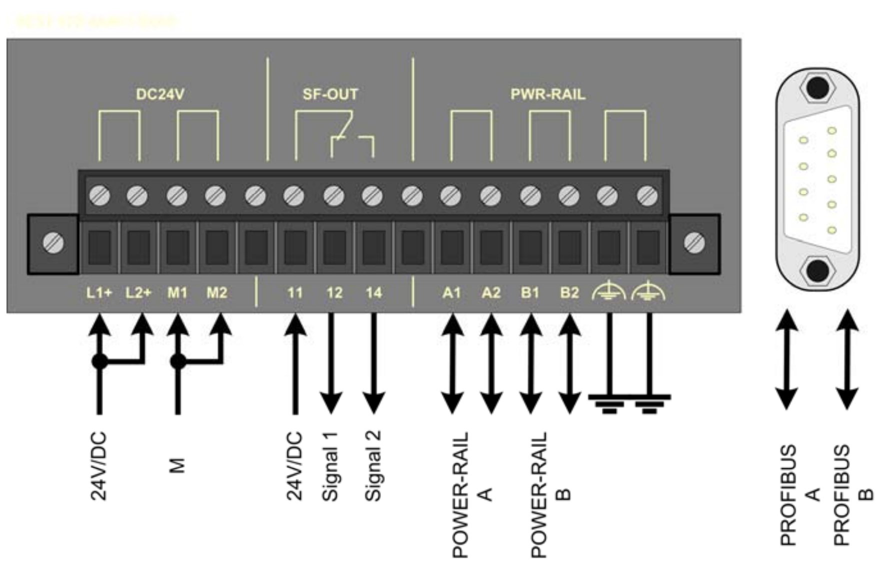

Fig. 25: Connection scheme PRB

6.4 Determining the Transfer Resistance of Collectors

The transfer resistors for the collectors, a major factor in total resistance, can be determined in the following ways.

6.4.1.1 Measuring individual resistances

Individual resistances can be measured by determining the resistance between sliding contacts and contact rail on a vehicle which is stationary and has been switched off using a hand-held multimeter. If necessary, sliding contacts and/or contact rail must be disconnected from the Power Rail Boosters.

The following applies to the resistors measured:

→ R measurement ≤ 100 ohms

6.4.1.2 Measuring the series resistances on individual double sliding contacts

In order to measure the transfer resistances on a moving vehicle, a pair of double sliding contacts can be used as substitute:

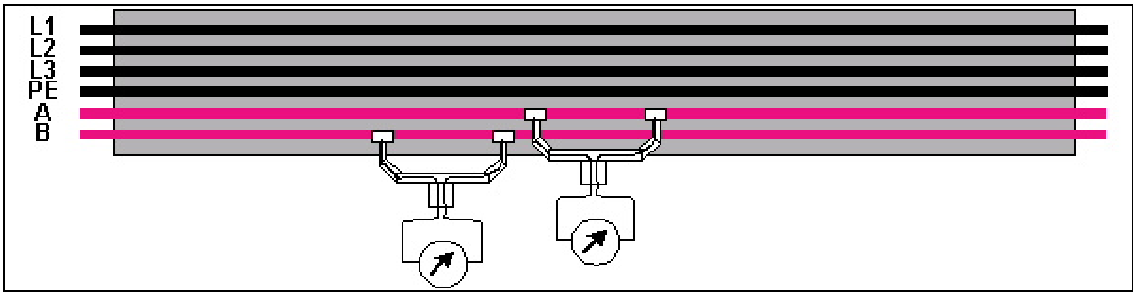

Fig. 26: Measuring the series resistances on individual double sliding contacts

The following applies to resistors R1+R2 measured via the two double sliding contacts:

→ (R1+R2)/4 ≤ 100 ohms

6.4.1.3 Measuring the serial resistances on both double sliding contacts

In order to measure the transfer resistances on a moving vehicle, measure the resistance over the entire series connection of double sliding contacts. Before doing so, all Power Rail Boosters on the segment to be measured must be disconnected.

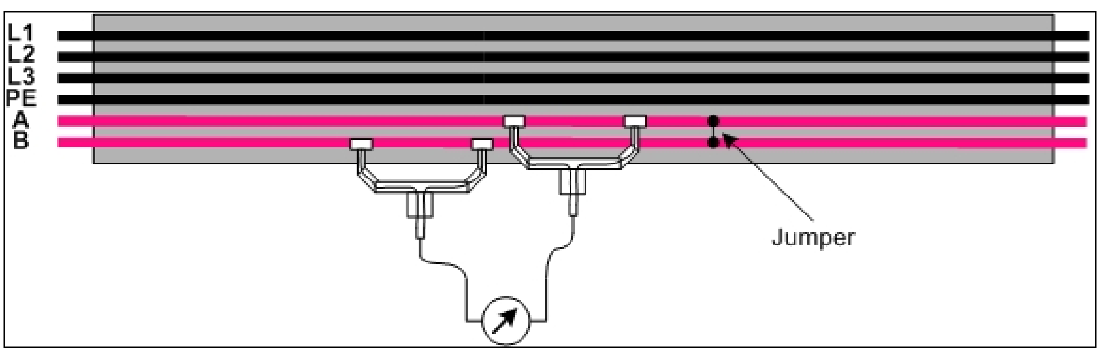

Fig. 27: Measuring the series resistances on both double sliding contacts

The following applies to the resistance (R) measured via both double sliding contacts:

→ R ≤ 100 ohms

7 LED Display and Troubleshooting

7.1 Diagnostic Displays for the Power Rail Booster

The front of the Power Rail Booster features 6 LEDs for quick diagnosis of faults and operating states. The Table below describes the faults and operating states indicated by the LEDs and their causes.

LED	Meaning	Display	State	Cause/Remarks
SF	PRB Group error	Off	No fault	
		Red	Group error	- Short circuit on Power Rail. - Line interruption on PROFIBUS (feed booster only) - Line interruption on Power Rail (moving booster only) - Baud rate not found or invalid baud rate - Baud rate lost following invalid message frames (frame collision on the bus) - Shutdown due to excessively high temperature
		Yellow flashing (2Hz)	Warning	- Warning threshold exceeded for output temperature
ON	PRB ready	Off	No supply voltage	24V DC supply voltage not connected
			Internal logic not ready	PRB defective
		Green	Supply voltage OK	
DP	Bus activity PROFIBUS	Off		- No message frames received on PROFIBUS side
		On Flickers		- No message frames received on PROFIBUS side
PR	Bus activity Power Rail	Off		- No message frames received on Power Rail side
		On Flickers		- No message frames received on Power Rail side
ϑ	Temperature	Off	Temperature within permissible range	Safe, reliable communication ensured for this parameter
		Red	Shutdown due to overtemperature	- Output temperature too high. Reliable, safe communication no longer ensured. Power section shut down following termination of last message frame
		Yellow flashing (2Hz)	Warning due to overtemperature	- Output temperature just before critical range. Safe communication is still possible.
C	Reserve	Off		Not currently used

Fig. 28: Possible LED displays and their causes

7.2 Diagnostics Message Frame

The PRB's SF contact can be evaluated in two different ways.

- DIP switch DIP-6→“Off“: The PRB's SF contact can be evaluated in two different ways, as described in chapter 7.1
- DIP switch DIP-6→“On“: The system issues a bit-serial diagnostics message frame via the SF contact to terminal 14. Evaluation is carried out by means of a standard function block for S7 as described in chapter 9.1.3

The system transfers the message frame on an event-driven basis. A new transfer always takes place when the status of one or more bits in the message frame changes, e.g. in the case of a coming and going error. If the status of one or more bits changes while a message frame is being sent or in the break between two message frames (approximately 1 second), it is transferred in the next status message frame. If the status changes more than once in this time – such that the status bits of the first message frame are valid again at the end of the message frame break – the system does not send a new status message frame, since the current status corresponds to that of the last message frame! If there is a change, the system carries out transmission with the current status bits.

7.2.1 Message Frame Structure

The transferred character is one byte comprising eight bits of user data. For synchronization, the system additionally transfers one start bit, one zero bit and one stop bit. Data backup is carried out with one parity bit. The system functions with even parity.

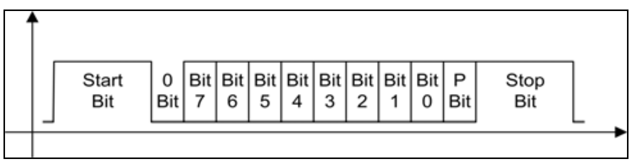

Fig. 29: Structure of the Diagnostics Message Frame

7.2.2 Contents of the Message Frame

The following table lists the data bits and explains their meanings.

Bit	Name	Meaning
Start bit	Start	Short circuit on Power Rail
0 Bit	Zero bit	Sequence bit logical 0
7 (MSB)	SF	0=OK 1=Group error
6	KS	0=OK 1=Short circuit on Power Rail
5	Limit_Temp	0=OK 1=Limit temperature reached
4	Over_Temp	0=OK 1=Overtemperature reached
3	<Reserve>	<Reserve>
2	<Reserve>	<Reserve>
1	Bd-Lost	0=OK 1=Baud rate lost
0 (LSB)	<Reserve>	<Reserve>
Parity	Parity	Parity bit (even)
Stop bit	Stop	Stop bit logical 1

Fig. 30: Contents of the Diagnostics Message Frame

7.2.3 Timing

When a message frame is transferred, the bit time for the zero bit, the data bits and the parity bit is 50 ms. The start and stop bits have a bit time of 150 ms. The transfer time may not deviate by more than +/- 2%. The total transfer time for one message frame is 800 ms. There must be a pause of at least one second (minimum character delay time) between transfers of two message frames.

7.3 Fault Scenarios in a DP Master System with PRBs

The Figure below shows possible fault locations in a DP master system with Power Rail Boosters.

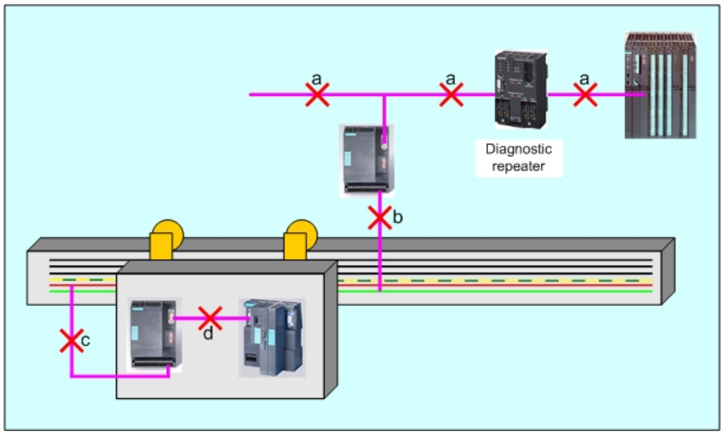

Fig. 31: Possible fault locations in a DP master system with Power Rail Boosters

Locations and displays for the various faults are listed below:

Fault location	Type	Failure of...	Localization through diagnostic repeater	Master-side PRB LED				PRB-LED vehicle			
				ON	PR	DP	SF	ON	PR	DP	SF
a	Interruption prior to DR	Vehicles in master segment	BF: continuous light DR: flashing ERR DP2: flashing	on	off	off	on	on	off	off	on
	Interruption after DR	Vehicles in master segment	DP2: off	on	off	off	on	on	off	off	on
	Termination resistor on master PRB: OFF	Comment: Termination resistor on vehile PRB or IM151-7 or or master CPU has not effect on PRB/DR LED	SF: continuous light ERR-DP2: continuous light Diagnosis with PG possible	※	※	※	※	※	※	※	on
	Short circuit	Vehicles in master segment	yes	on	off	off	on	on	off	off	on
b	Interruption A1	Vehicles in relevant PRB segment respectively in relevant branch / path	DP2: off	on	off	on	off	on	off	off	on
	Interruption B1	Vehicles in relevant PRB segment respectively in relevant branch / path	DP2: off	on	off	on	off	on	on	on	off
	Short circuit	Vehicles in relevant PRB segment respectively in relevant branch / path	no	on	off	on	on	on	off	off	on
c	Interruption	...relevant vehicles	3)	on	※	※	※	※	※	※	on
	Short circuit	...vehicles in relevant PRB segment	no	on	off	on	on	on	off	off	on
d	Interruption	...relevant vehicles	DP2: off	on	off/ on 1)	on	off	on	on	off	off 1)
	Short circuit	...relevant vehicles	no	on	on 1)	on	off	on	off	off	on

1) if more vehicles in the PRB segment
2) no effect on display
3) same as b

Fig. 32: Fault location

8 Technical Specifications

Power Rail Booster	
Voltage and current supply	
Operating voltage	20,4 V to 28,8V DC, typ. 24 V, SELV, galv. isolated
Power consumption (rated current)	Max. 1,2 A
Current at make	Max. 15 A approx. 200 µs
Fusing for supply voltage	6 A Category C circuit-breaker
Power dissipation	Max. 20W
Signal transmission	
Transmission speed	9,6; 19,2; 45,45; 93,75; 187,5; 500kbit/s
Setting of transmission speed	Automatic
Signal propagation time	$\leq 6\ t_{bit}$
Compatibility to	
6ES7 972 4AA00 0XA0	Mixed configuration possible
6ES7 972 4AA00 0XA0 with fan	Mixed configuration possible, fan not necessary
6ES7 972 4AA01 0XA0	Mixed configuration possible
Safety	
VDE / EN Specifications	EN61010
PROFIBUS interface	
Input / Output signal	RS485 level
Input voltage insurance	-7V to +12V
Characteristic PIN 6 (Vcc)	5V ± 10%, 50mA
PIN assignments	See Documentation, Chapter 6.3.2.4
Galvanic isolation	Yes
POWER RAIL interface	
Input / Output signal	Differential signal up to 40V
Input voltage endurance	Differential signal up to 60V, against ground 2,5kV
PIN assignment	See Documentation, Chapter 6.3.2.2
Shock-proof	Yes, to EN 61131-2
Galvanic isolation	Yes (not to internal logic)
Supply voltage interface	
PIN assignment	See Documentation, Chapter 6.3.2.5
Galvanic isolation	Yes
Signalling contact interface	
Maximum switching voltage	30 V DC; 230 V AC
Maximum switching current	0,20A
Maximum braking capacity	6 W (resistive load) In the case of interconnection with inductive loads, you must suppress interference using suitable protective circuits (varistors or free wheeling diodes)
PIN assignment	See Documentation, Chapter 6.3.2.6
Galvanic isolation	Yes
Electromagnetic compatibility (EMC)	
Emitted interference	Limit value class B (EN55022)
Immunity to static discharges	Shield connection and housing components: ± 6 kV Contact discharge (EN61000-4-2)

Power Rail Booster	
Immunity to high-frequency discharge	Testing following EN 61000-4-3:Frequency range 80 MHz - 1 GHz, test field intensity: 10 V/m at 80% amplitude modulation with 1 kHz. Range 87 MHz to108 MHz, 174 MHz to 230 MHz and 470 MHz to 790 MHz: 3V/m
Immunity to conducted interference	Power and bus cables ± 2 kV (Burst) (EN61000-4-4)
Immunity to conducted interference (Surge)	Power cables ± 1 kV symmetrical (Surge) Bus cables ± 2kV unsymmetrical (EN61000-4-5)
Climatic service environment	
Ambient temperature with preferred mounting position	0 °C to +60 °C (IEC 68-2-1, IEC 68-2-2)
Ambient temperature with other mounting position	0 °C to +45 °C
Storage temperature	–40 °C to +70 °C (IEC 68-2-14)
Relative humidity	<95 %, no condensation (IEC 68-2-30)
Mechanical ambience conditions	
Vibration during operation	10 to 58 Hz, 0,075 mm displacement; 58 to 150 Hz, 9,8 m/s 2 (1 g) acceleration (IEC 68–2–6)
Vibration during transport	5 to 9 Hz, 3,5 mm displacement; 9 to 500 Hz, 9,8 m/s 2 (1 g) acceleration
Type of protection	IP20
Dimensions	90,1x132x75 (WxHxD) with top hat rail 7,5 mm 90,1x132x82,5 (WxHxD) with top hat rail 15 mm
Preferred mounting position	Horizontal installation on vertical wall
Weight	360g

9 Appendix

9.1 Additional Hardware and Software for PRB Applications

9.1.1 PRB Segment Controller

Function

Depending on the length and baud rate of a contact rail system, you will generally need several stationary Power Rail Boosters to supply it with PROFIBUS signals. The sub-area of a contact rail system, which transfers data via a stationary PRB, is referred to as a PRB segment.

Two adjoining PRB segments "Segment A" and "Segment B" must be separated by an isolating rail section "Segment A-B" or a double rail section such that a segment short-circuit does not occur due to the current collector's sliders while transitioning this PRB segment limit. During the transition across a PRB segment limit of this type,

there is a break in communications due to operating conditions.

The PRB Segment Controller prevents this break in communications by switching the PROFIBUS supply of interim segment A-B from Segment A to Segment B during the transition. This segment switching process is carried out automatically and has no effect on PROFIBUS message frame traffic.

The input signal of an external sensor triggers switchover of PRB segments A and B. The Segment Controller chooses a break between two message frames as the switchover instant. This means that switchover is carried out without disturbing PROFIBUS communication

Advantages for users

- No operational interruptions to message frames
  => therefore no effects to the system as a whole
- All vehicles can be reached even on interim segments
- No control software necessary in the stationary plant control
- Easy configuration (you can position PRB segment limits anywhere you like)
- Easy configuration (you can position PRB segment limits anywhere you like)
- Support for controller in the case of a DP Master segment change
- Support at commissioning and preventive maintenance by means of LEDs
- Safe operation even in the case of errors by activating interim segment A-B

You can also integrate the PRB Segment Controller in existing Power Rail networks on a retrospective basis.

The following illustration shows an example application.

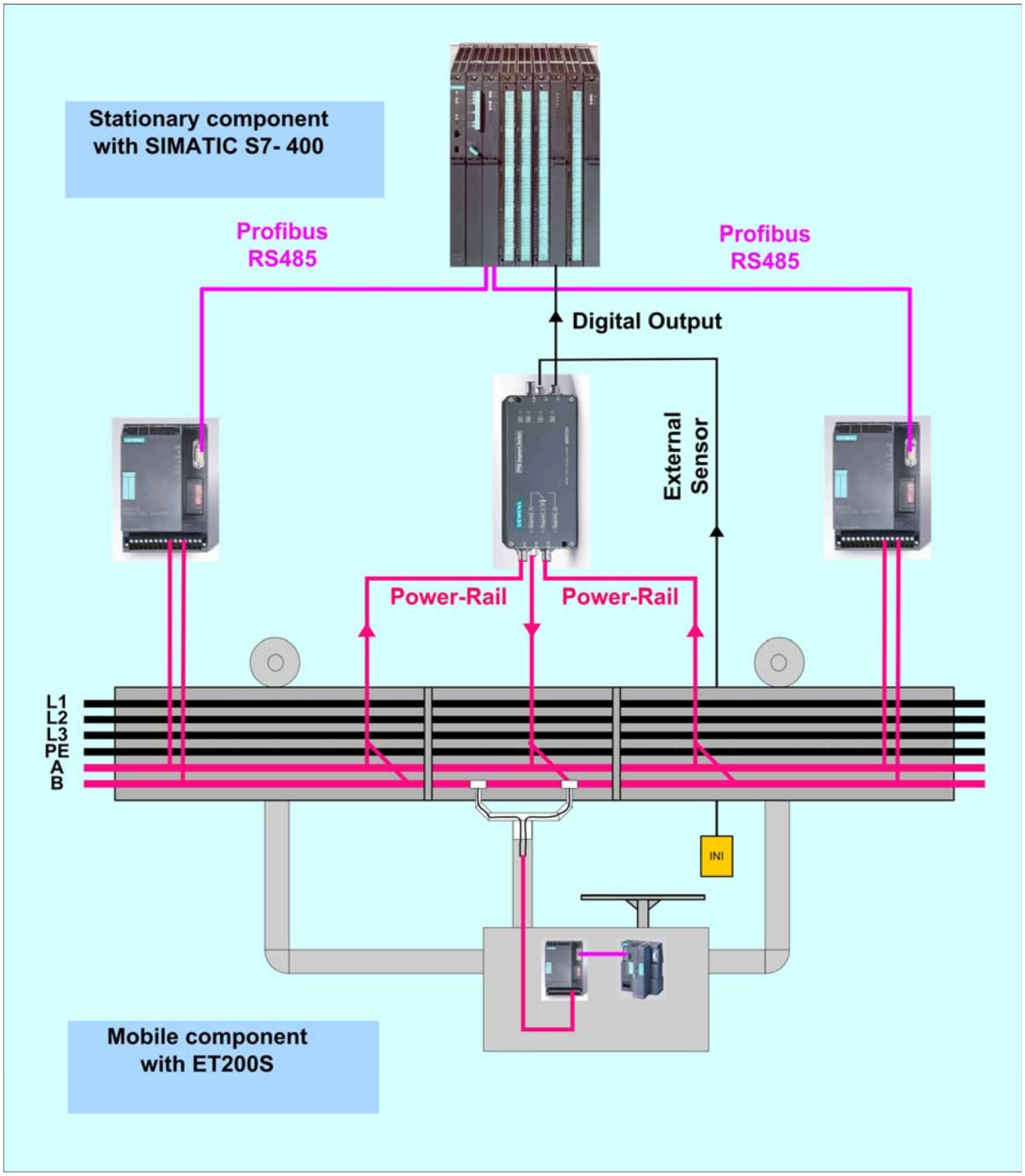

Fig. 33: Example of a Segment Controller

Note

For more comprehensive information on the sample application, refer to the: "PRB Segment Controller" manual.
.

9.1.2 Update Manager for Applications with Overhead Conveyor

Function

The Update Manager program allows you to automatically download a selected STEP 7 program (including the system data and all the blocks) to selected vehicles in an overhead conveyor system. When doing this, the head-end (plant control) of the automation system transfers the PROFIBUS address of the target station (vehicle) to the application, which then carries out the download to the stated station (vehicle).

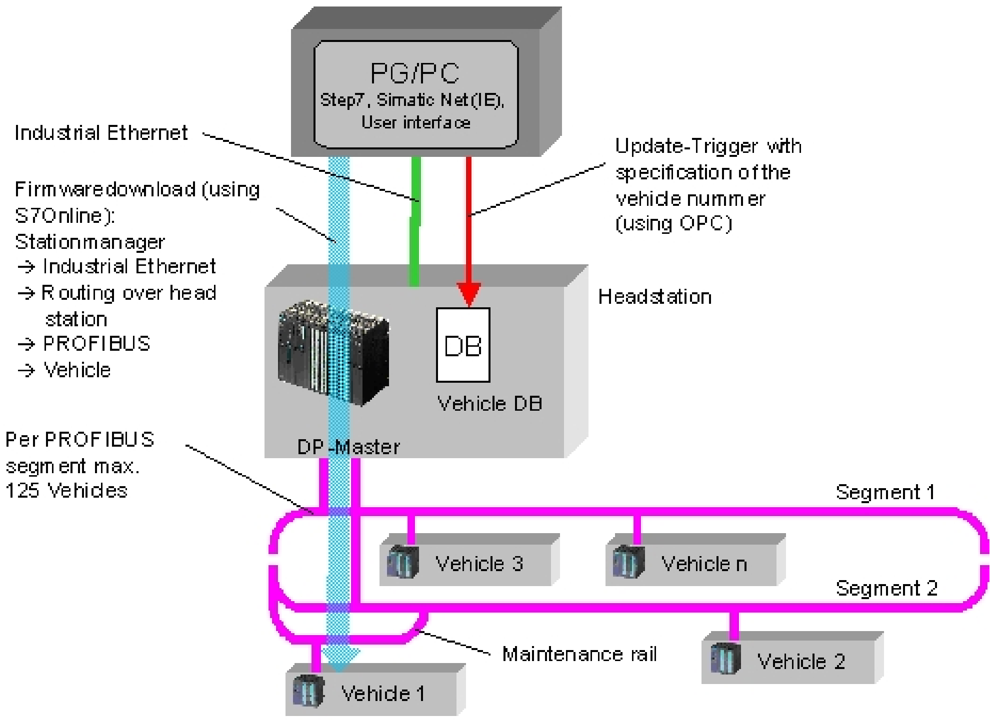

Fig. 34: Plant overview

In this connection, the head-end communicates with the application via OPC. When doing this, the application accesses the data of the SIMATIC NET OPC server as an OPC client. Downloading is carried out controlled by the S7 command interface by means of routing via the plant's head-end directly into the overhead conveyor system's vehicle.

Advantages for users

- Completely automatic updating of the vehicles' software in the case of changes
- No need for staff members to be involved during updating
- All vehicles are considered during updating; vehicles can no longer be "forgotten"..

Since the Update Manager is a sample application for using PROFIBUS functionality in a plant Siemens AG offers users no warranty or support. You can download the software and the user manual from the Siemens Customer Support on the Internet under ID:xxxxxx.

9.1.3 S7 – Function Block “PRB Diagnostics“

Function

This software is a function block for the SIMATIC S7. You can use the function block in the ET200S, the S7-300 and the S7-400.

The function block receives via a digital input a square-wave pulse that corresponds to several serially transferred bits. The system evaluates the square-wave pulse and makes available the received diagnostics datum to the user program.

Advantages for users

- Detailed diagnosing of an error established by the PRB
- No longer necessary for time-consuming searches for the causes of errors
- Possible to quickly initiate selective measures to remove the error

Since function block PRB Diagnostics is a sample application for use in a plant, Siemens AG offers users no warranty or support. You can download the library containing the function blocks for your S7 project together with the user manual on the Internet from Siemens Customer Support under ID: xxxxxx

10 Standards and Certifications

CE certification

Product identification: Power Rail Booster 6ES7 972-4AA02-0XA0

EMC guideline: The product described in this Manual is compliant with the following EU guidelines:

CE	Guideline 89/336/EWG "Electromagnetic Compatibility " Guideline 73/23/EWG „Electrical Resources For Use Within Specific Voltage Limits“ (Low-voltage Guideline)

Application: The product is designed for use in the following applications:

Application	Requirements regarding:	
	Emitted interference	**Interference immunity**
Industrial sector	EN 61000-6-4: 2001	EN 61000-6-2: 1999

Installation guidelines: The product satisfies the requirements as long as the installation guidelines, operating guidelines and safety information presented in the „User’s Guide for the Power Rail Booster” are carefully followed.

Certificate of conformity: The EU certificates of conformity are held for viewing by the appropriate authorities at:

Siemens Electronic Design and Manufacturing
Services GmbH & Co. KG
SEDM
Weissacher Straße 11
70499 Stuttgart
Germany

The Power Rail Booster is not a machine as defined by the EU´s “Machines” guideline. There is therefore no certificate of conformity relating to the EU´s “Machines” guideline 89/392/EWG for the interface module. The Power Rail Booster is part of the electrical components of a machine and must therefore be included by the machine manufacturer in the process culminating in a certificate of conformity.

UL conformity (valid with labelling of the device)

Underwriters Laboratories Inc. following

- UL 508 (Industrial Control Equipment)
- File number: NRAQ.E256131 und NRAQ7. E256131

11 Glossary

Automation System
An automation system is a programmable controller consisting of at least one CPU, a variety of input and output modules, and HMI devices.

Baud Rate
The baud rate is the speed at which data are transmitted, and specifies the number of bits transmitted per second (baud rate = bit rate). The Power Rail Booster can accommodate baud rates of between 9.6 kbaud to 500 kbaud.

Bounce
Single or repeated, coincidental or reproducible disengaging or re-engaging of a sliding contact from resp. with the contact rail.

Bus
Shared transmission path to which all nodes are connected; has two defined ends. On the Power Rail Booster, the bus is a two-wire line or a pair of contact rails.

Bus Connector
Physical connector between bus node and bus cable.

Contact Rail
Stationary component of a control rail system.

Contact Rail System
A contact rail system consists of sliding contacts and contact rails. A contact rail system can be used to transport power and data, the contact rail system ensuring mobile contact between stationary and mobile components.

Distributed I/O
Distributed I/O are input/output units which are not plugged into the central controller, but are set up at a greater distance from the CPU, e.g. ET 200M, ET 200B, ET 200X, ET 200L, ET 200S. Distributed I/O are connected to the DP master via PROFIBUS DP.

Double Rail Section
A rail section in "double" design to prevent short circuits between two contact rail segments, which can occur when a (double) sliding contact travels over a rail section.

Double Sliding Contacts/Double Collectors
An arrangement of two primarily mechanical, independently supported sliding contacts, which together establish contact with a high level of contact stability.

DP
Distributed I/O

DP Master
A master with behavioural characteristics to Standard EN 50170, Volume 2, PROFIBUS is referred to as a DP master.

DP Master Segment
A contact rail system can be connected to the PROFIBUS via one or more than one PROFIBUS master. The segment of a contact rail system in which data interchange takes place via a PROFIBUS master is referred to as a “DP master segment”. Normally, a contact rail system consists of only one DP master segment. If there are multiple DP master segments, care must be taken to see that no electrical connection (short circuit) can be established between DP master segments via the double collector. This can be done using rail sections.

DP Slave
A slave that is operated on the PROFIBUS with the PROFIBUS DP protocol and has behavioural characteristics which accord with EN 50170, Volume 2, PROFIBUS is referred to as a DP slave.

DP Standard
The DP Standard is the bus protocol which can be transmitted over the Power Rail Booster to EN 50170, Volume 2, PROFIBUS.

Equipotential Bonding
Electrical connection (equipotential bonding conductor) which brings the exposed conductive part(s) of an electrical device and extraneous conductive parts to the same or almost the same potential in order to prevent damaging or dangerous voltages between these parts.

FO
Fiber optics

Ground
Conductive ground whose electrical potential can be set to equal zero at any point. In the presence of a grounding electrode, ground can have a potential unequal zero. The term "reference potential" is often used to describe this set of circumstances.

Isolated
In isolated input/output modules, the reference potentials of control current circuit and load current circuit are galvanically isolated, e.g. by optical coupler, relay contact or transformer. Input/output current circuits can be connected to common potential.

Isolating Rail Section
A rail section on which the data contact rails are isolated over the length of a double sliding contact in order to prevent short circuits between two contact rail segments, which can occur when a (double) sliding contact travels over a rail section.

Master
When it has the Token, a master can send data to other nodes and request data from other nodes (= active node). DP masters are e.g. the CPU 315-2 DP or the IM 308-C.

Non-isolated
In non-isolated input/output modules, the reference potentials of control current circuit and load current circuit are electrically connected.

OLM
Optical Link Module

PELF
Protective Extra Low Voltage

Power Rail Booster
Amplifier for PROFIBUS. For transmitting bus signals via contact rail

PR
Power Rail

PRB Segment
As a rule, more than one stationary Power Rail Booster is required to supply a contact rail system with PROFIBUS signals. The subsegment of a contact rail system in which data interchange takes place via a PRB is referred to as “PRB segment”. A PRB segment is thus a subsegment of a DP master segment. It must be ensured that no electrical connection (short circuit) can be established between two PRB segments via the double collector. This can be done using rail sections.

PROFIBUS
PROcess **FI**eld **BUS**, a German process- und fieldbus standard to EN 50170, Volume 2, PROFIBUS which defines functional, electrical and mechanical properties and characteristics for a bit-serial fieldbus system. PROFIBUS is available with DP (= Distributed I/Os), FMS (= Fieldbus Message Specification), PA (= Process Automation) or TF (= Technological Functions) protocol.

PROFIBUS Address
Every bus node must have a PROFIBUS address for unambiguous identification of that node on the PROFIBUS. PCs/PGs have the PROFIBUS address “0”.

PTP Connection
Point-to-point connection.

Reference Potential
Potential at which the voltages flowing through electrical circuits are viewed and/or measured.

Segment
The section of bus cable between two terminating resistors forms a segment. A PROFIBUS DP segment contains between 0 and 32 bus nodes. Segments can be joined to one another using RS485 repeaters. All galvanically connected contact rails forma a contact rail segment. As many as 124 bus nodes can be operated on one contact rail segment. Segments can be coupled over RS485.

SELF
Safety Extra Low Voltage

Self-cleaning
The cleaning of contact rail and sliding contact caused by operation of the contact rail system. The movement of a sliding contact over a contact rail pushes aside dust

particles and rubs off oxide layers. The greater the frequency of travel over a contact rail and the greater the pressure of the sliding contact against the rail, the greater the self-cleaning effect.

SF
Group error

Slave
A slave may exchange data with a master only at the master´s request. Slaves are e.g. all DP slaves, such as ET 200L, ET 200X, ET 200M, ET 200S etc.

Sliding Contact
Mobile component of a contact rail system.

Tbit
Bit duration, length of a bit

To ground
To ground means to connect an electrically conductive component with the grounding electrode via a grounding system.

Transfer Resistance
Electrical resistance between a contact rail and a sliding contact during travel. The transfer resistance depends on the amount of contamination on sliding contact and contact rail, as well as on the oxidation of both their surfaces.

Zero Potential
Zero potential is seen as the entirety of all interconnected inactive electrical parts of a device which cannot assume a dangerous level of touch voltage even in the event of a fault.

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