Safety-Related Segment Circuit

R911335486
Edition 01

Application Description

06/2011

1 Introduction

The R-IB IL 24 PWR IN-PAC power terminal is suitable for creating a safety-related segment circuit in conjunction with an external safety device as described in this document.

The principle of the safety circuit is that when the supply voltage for the R-IB IL 24 PWR IN-PAC power terminal is disconnected by the external safety device, the I/O of the subsequent segment circuit of the Rexroth Inline system is shut down safely.

Only Rexroth Inline terminals that are specifically designed for the safety-related segment circuit may be used. They are listed under "Rexroth Inline Terminals Approved for the Safety-Related Segment Circuit" on page 2.

Rexroth Inline terminals of a specific hardware version and later are approved for the safety-related segment circuit. The revision index is marked on the side of the housing of every terminal (1 in Fig. 1).

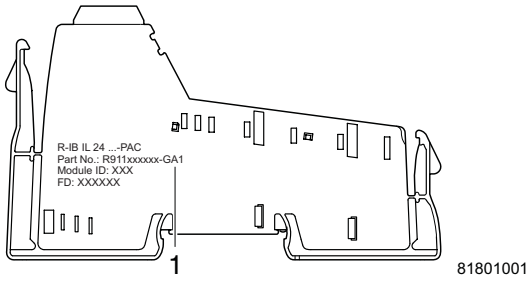

Fig. 1 Revision index on an Rexroth Inline terminal

Make sure you always use the latest documentation.
It can be downloaded at www.boschrexroth.com.

In addition to this application note, please also refer to the following documentation:

- Documentation for the controller used
- "Automation Terminals of the Rexroth Rexroth Inline Product Range" application description

(See "Ordering Data" on page 2).

2 Ordering Data

2.1 The safety terminal to create a safety-related segment circuit.

Description	Type	MNR	As of revision index
Rexroth Inline power terminal without fuse; including connector and labeling field	R-IB IL 24 PWR IN-PAC	R911170789	GA1

2.2 Rexroth Inline Terminals Approved for the Safety-Related Segment Circuit

Description	Type	MNR	As of revision index
Rexroth Inline terminal with two digital outputs; including accessories (connector and labeling field)	R-IB IL 24 DO 2-2A-PAC	R911170754	GA1
Rexroth Inline terminal with eight digital outputs; including accessories (connectors consecutively numbered and labeling fields)	R-IB IL 24 DO 8-PAC	R911170756	GA1
Rexroth Inline terminal with eight digital outputs; including accessories (connectors consecutively numbered and labeling fields)	R-IB IL 24 DO 8-2A-PAC	R911170759	GA1
Power terminal			
Rexroth Inline power terminal without fuse; including accessories (connector and labeling field)	R-IB IL 24 PWR IN-PAC	R911170789	GA1

2.3 Documentation

Description	Type	MNR
"Automation Terminals of the Rexroth Rexroth Inline Product Range" application description	DOK-CONTRL-ILSYSINS***-AW..-EN-P	R911317021
"Rexroth Inline Power Terminal Without Fuse" data sheet	DOK-CONTRL-ILPWRIN****-KB01-EN-P	R911170608

Please refer to the corresponding documentation for more information about the listed terminals.
It can be downloaded at www.boschrexroth.com.

For additional ordering data (accessories), please refer to the product catalog at www.boschrexroth.com.

3 Technical Data

For the technical data, please refer to the R-IB IL 24 PWR IN-PAC terminal data sheet.

4 Explanation of Symbols Used

WARNING

This indicates a hazardous situation which, if not avoided, could result in death or serious injury.

This symbol and the accompanying text provide the reader with additional information, such as tips and advice on the efficient use of hardware and on software optimization. It is also used as a reference to other sources of information (user manuals, data sheets).

5 Safety Instructions

Loss of safety function

Use the safety terminal or the Rexroth Inline terminals in the safety-related segment circuit correctly.

WARNING Damage and personal injury will occur when these regulations are not observed.

The following points must be observed:

- When working on safety terminals, on terminals in safety-related segment circuits, and/or on the system, the latest version of the data sheets for the terminals and other product documentation must always be at hand and referred to.
- It is prohibited for unqualified personnel to work on terminals in safety-related segment circuits, on the system, or in their vicinity.
- Only qualified personnel who are familiar with applicable safety regulations in the workplace and accident prevention measures should install and operate the safe segment circuit while observing the information given in this document. Electrical work is only to be carried out by qualified electricians.
- Observe all applicable regulations, especially those regarding safety equipment.
- Repairs to Rexroth Inline terminals, especially if the housing must be opened, should only be carried out by the manufacturer or authorized personnel.
- Manufacturers and users of the machine, in which the R-IB IL 24 PWR IN-PAC terminal is used as described in these application notes, must ensure that all applicable safety instructions, safety regulations, and standards are agreed with the relevant authorities and observed at all times.
- **Check the shutdown process regularly**
  At regular intervals, check the shutdown process for the external safety device and therefore the shutdown process for the segment voltage and the outputs.
  The interval at which testing is to take place depends on the applicable standard and the application.

Observe the following points during installation:

- Observe the safety instructions given in the "Automation Terminals of the Rexroth Inline Product Range" application description.
- Mount the Rexroth Inline terminal in housing protected from dust and humidity (IP 54 or higher); dust and humidity can lead to malfunctions.
- Take measures to prevent the incorrect connection, polarity reversal, and manipulation of connections.
- Disconnecting an output via the bus system does not guarantee the safety-related function of the system (e.g.,emergency stop, safety door). The safety-related function is only obtained if the supply voltage of the output groups is disconnected via the safety device.
- Establish a conductive connection between the ground contact (GND) of the power supply unit and the protective conductor/grounding terminal directly on the power supplies that supply the Rexroth Inline station to ensure reliable functional earth grounding.
- Connect the power terminal for the safe segment circuit with PE using a grounding terminal (see Fig. 5 on page 10).
- Provide the supply voltage, which can be safely disconnected by the preconnected safety device, to the power terminal at a supply point for the segment circuit. "Terminal Point Assignment" on page 8

6 Requirements of Terminal Wiring in the Safety-Related Segment Circuit

WARNING

Loss of safety function in case of power feedback

When wiring Rexroth Inline terminals in the safety applications, ensure that errors are prevented in terms of feedback for:

- All connected cables supplying the device with actuator voltage, and
- The connecting cables of the actuators.

Please also take all connected loads into consideration. This means, for example, that the cables must be wired using separate cable sheaths.

Observe the relevant DIN and VDE regulations, which must be met to prevent errors.

Feedback is the voltage supply into an outgoing cable (caused, for example, by generator effects of the connected load, by an insulation fault or by supply from a connected load due to an internal insulation fault).

6.1 Demands on the Voltage Supply

WARNING

Loss of the safety function when using unsuitable power supplies.

Rexroth Inline terminals are designed exclusively for protective extra-low voltage (PELV) operation according to EN 60204-1. Only PELV according to the defined standard may be used for supply purposes.

The following applies to the network (INTERBUS, PROFIBUS...) and the I/O devices used in it:
Only use power supply units that meet EN 61204-1 with safe isolation and PELV according to EN 50178 / VDE 0160 (PELV). This prevents short circuits between primary and secondary sides.

Also make sure that the output voltage of the voltage supply does not exceed 32 V even in the event of error.

6.2 Requirements for DO Terminals:

- Only use the terminals listed under "Rexroth Inline Terminals Approved for the Safety-Related Segment Circuit" on page 2 in the safety-related segment circuit.

WARNING

Loss of the safety function due to parasitic voltages

The ground contact of the connected load is only to be connected to the ground contact of the Rexroth Inline terminal. This means, for example, that 1-wire terminations are not permitted.

6.3 Requirements for Controlled Devices/ Actuators

- Dimension the controlled device used such that a leakage current of 2 mA does not cause a hazardous system condition. This requirement is met if the connected loads are adapted to the outputs since the outputs of the Rexroth Inline terminals meet the requirements of EN 61131-2 .
- Use only loads that have an insulated structure, therefore:
  - Make sure there is no electrically conductive connection between GND and PE/FE at the load.
  - Make sure that - even in the event of an error - no external voltage is conducted via the load onto the device outputs (no feedback).
- Only use appropriately qualified actuators.
- Use reliable components. These include, for example:
  - Control contactors according to EN 60947-4-1
  - Power contactors
  - Relays with forcibly guided contacts according to DIN EN 50205
- Use relays or contactors with forcibly guided N/C contacts to safely monitor the state (pick-up, drop-out).

7 Use of the Rexroth Inline Terminals in Systems According to EN ISO 13849-1

Abbreviations used

Cat.	Category
PL	Performance level
MTTFd	Mean time to dangerous failure

Various safety categories can be achieved depending on the safety device and the wiring (see safety device documentation).

When observing the installation guidelines the listed Rexroth Inline terminals may be used in systems up to Cat. 4/PL e.

To achieve the required Cat./PL, implement the measured listed in Chapter 8 "Required Measures to Be Taken to Obtain a Certain Category" .

The Rexroth Inline terminals are PL-neutral. That means they do not carry out any safety functions and do not have any influence on the safety function.

The safety function is realized with the external wiring of the module. A short-circuit between the internal U_L and U_S voltage supplies can be ruled out. Thus, the module is not part of the safety function. The $MTTF_d$ values do not have to be taken into consideration according to TC30805-002. The requirement for this is that the module is used in accordance with operating conditions described in "Requirements of Terminal Wiring in the Safety-Related Segment Circuit" on page 4 or the measures listed in Chapter 8.

Please note that these Rexroth Inline terminals do not have a diagnostic coverage (DC = 0). Ensure that the application (e.g., safety devices) provides the diagnostic coverage required for the diagnostic function.

The duration of use of the Rexroth Inline terminals is not limited.

8 Required Measures to Be Taken to Obtain a Certain Category

Please also observe the information in the EN ISO 13849 standard.

Cat. 2

- Use proven and basic safety principles according to EN ISO 13849.
- Use appropriately qualified actuators (see "Requirements for Controlled Devices/ Actuators" on page 5).
- Please note that mechanical failure of the switching device can result in the loss of the safety function.
- Prevent the welding of contacts on the connected contactors or safety relays with appropriate protection against overcurrent and surge voltage.
- Please note that **a single** error can result in the loss of the safety function between tests.
- Ensure that the external wiring is tested by the machine control system on machine startup and at suitable intervals. This test must detect the loss of the safety function.
- Make sure that in the event of an error, the application disconnects the machine or system safely or generates a warning (optical and/or audible).

Cat. 3

- Use proven and basic safety principles according to EN ISO 13849.
- Use appropriately qualified actuators (see "Requirements for Controlled Devices/ Actuators" on page 5).
- Please note that mechanical failure of the switching device can result in the loss of the safety function.
- Prevent the welding of contacts on the connected contactors or safety relays with appropriate protection against overcurrent and surge voltage.
- All errors that cannot be detected can result in the loss of the safety function. Take appropriate measures to prevent such errors. Suitable measures include, for example, protected cable installation or double insulation.
- Please take into consideration errors with a common cause.
- Ensure that **a single** error does not result in the loss of the safety function.
- Test the shutdown capability of the actuators at regular intervals.

Cat. 4

- Use proven and basic safety principles according to EN ISO 13849.
- Use appropriately qualified actuators (see "Requirements for Controlled Devices/ Actuators" on page 5).
- Please note that mechanical failure of the switching device can result in the loss of the safety function.
- Prevent the welding of contacts on the connected contactors or safety relays with appropriate protection against overcurrent and surge voltage.
- An accumulation of errors must not result in the loss of the safety function. Following the third error, evaluation can be aborted if the probability of further errors occurring is low.
- All errors that cannot be detected can result in the loss of the safety function. Take appropriate measures to prevent such errors. Suitable measures include, for example, protected cable installation or double insulation.
- Please take into consideration errors with a common cause.
- Test the shutdown capability of the actuators at regular intervals.

9 Application Description

The R-IB IL 24 PWR IN-PAC power terminal is designed for use within a 24 V area of an Rexroth Inline station. A safe segment circuit is created by supplying a 24 V voltage from an external safety device to the power terminal.

The safe segment circuit starts at the R-IB IL 24 PWR IN-PAC terminal in conjunction with the external safety device and finishes at the last terminal before another power supply unit or at the end of a station.

Various safety categories can be achieved depending on the safety device and the wiring (see safety device documentation).

Only Rexroth Inline terminals that are specifically designed for the safety-related segment circuit may be used (see "Rexroth Inline Terminals Approved for the Safety-Related Segment Circuit" on page 2).

By using these terminals within the safe segment circuit, the category (Cat.) achieved by the supply or the Performance Level (PL) according to EN ISO 13849-1 are not restricted. This means that when you provide the supply voltage via an external safety device, which corresponds to Cat.4//PL e according to EN ISO 13849-1), to the R-IB IL 24 PWR IN-PAC terminal, the segment voltage is disconnected as defined in Cat. 4/PL e according to EN ISO 13849-1.

10 Diagnostic/Status Indicators and Terminal Point Assignment

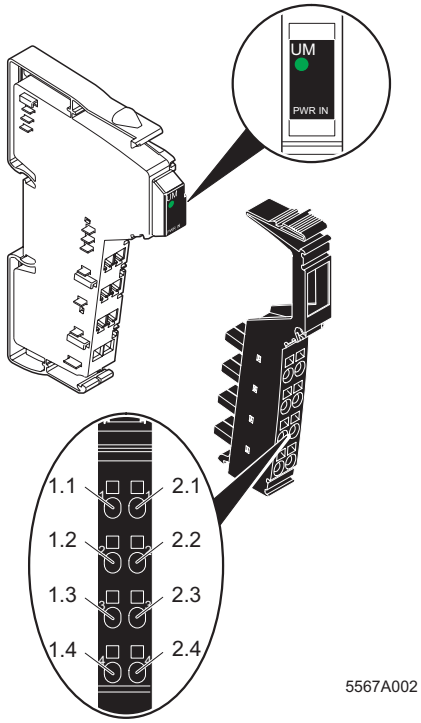

Fig. 2 *R-IB IL 24 PWR IN-PAC with appropriate connector*

10.1 Function Identification

Black

10.2 Local Diagnostic Indicator

Des.	Color	Meaning
UM	Green	24 V voltage (in the main circuit U_M)

The supply voltage, which can be safely disconnected by the pre-connected safety device, should only be provided in the segment circuit, therefore, the LED has no significance in this application and should **not** light up.

10.3 Terminal Point Assignment

This section describes the assignment of the terminal points for a specific application. It differs from the representation given in the R-IB IL 24 PWR IN-PAC terminal data sheet.

Terminal point	Assignment
1.1, 2.1	Supply point for the segment circuit U_S (+24 V)
1.2, 2.2	**These terminal points must not be used.** (Supply point for the main circuit)
1.3, 2.3	Ground contact (GND) The reference potential is directly led to the potential jumper GND and is, simultaneously, ground reference for the segment voltage.
1.4, 2.4	FE connection The contacts are directly connected with the potential jumper FE and the FE spring on the bottom of the housing. The terminal is grounded when it is snapped onto a grounded DIN rail.
	Terminal points 1.1, 1.2, and 1.3 are connected with a capacitor to FE.

WARNING

Electronics is damaged when overloaded

Make sure that the maximum permissible current of 8 A flowing through potential jumper U_S is not exceeded.

In this application the power terminal must be supplied via the supply points for the segment circuit.
The terminal supplies the segment circuit U_S on the output side. The main circuit U_M is not available after the power terminal.

11 Connection Note

The supply to the power terminal used to create a **safety-related** segment circuit (Fig. 3) differs from the supply to the power terminal used to create a **non**-safe segment circuit (Fig. 4).

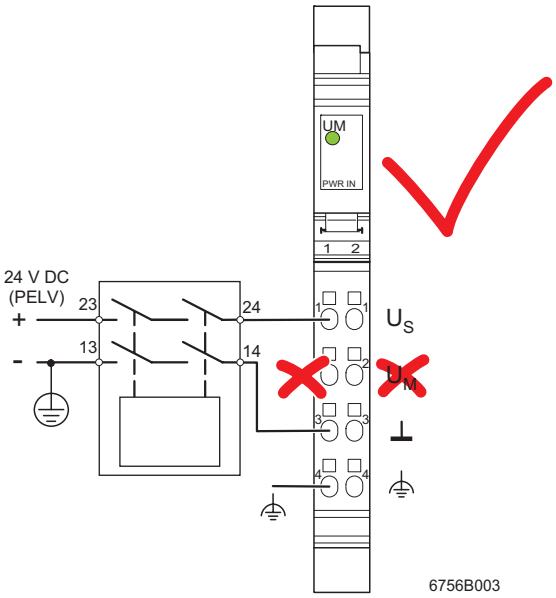

Fig. 3 *Supply to the power terminal used to create a safety-related segment circuit*

The supply voltage, which is supplied to the power terminal, can be safely disconnected by the **pre-connected safety device**.

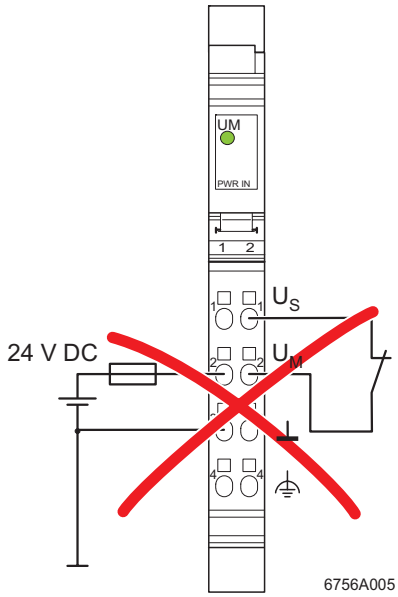

Fig. 4 *Supply to the power terminal used to create a non-safe segment circuit*

See also the R-IB IL 24 PWR IN-PAC terminal data sheet.

12 Application Example

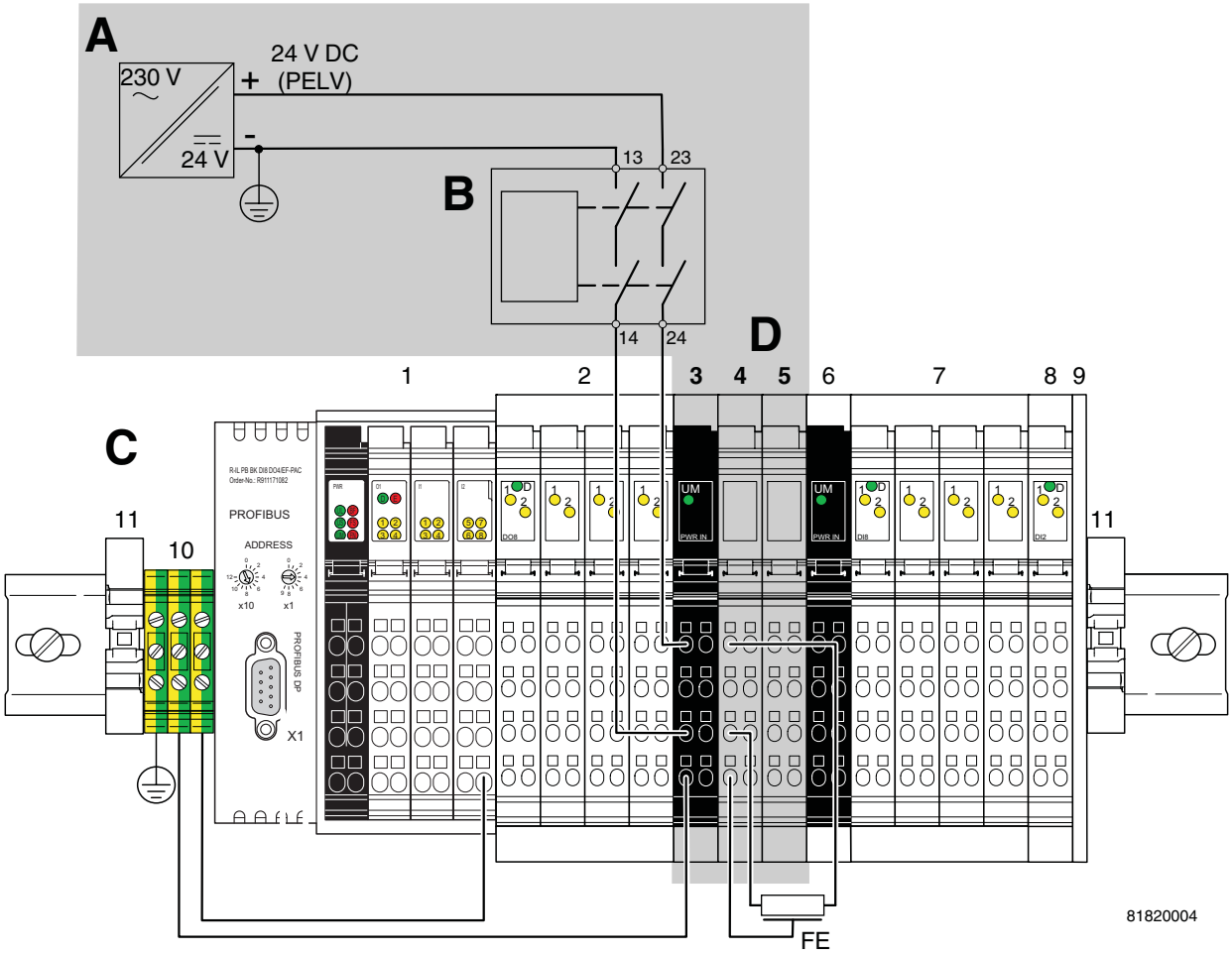

Fig. 5 Typical connection of the supply voltage

Key:

Protective earth (PE)

Key for Fig. 5:

A	Power supply unit
B	Safety device
C	Rexroth Inline station with one safe and several non-safe segment circuits
D	Safety-related segment circuit

No.	Function	Example
1	Bus coupler	R-IL PB BK DI8 DO4/EF-PAC
2	Terminals corresponding to the application in the non-safety-related segment circuit	R-IB IL 24 DO 8-PAC
3	Power terminal as the start of a **safe** segment circuit	R-IB IL 24 PWR IN-PAC
4	Approved terminals for the **safety-related** segment circuit according to the application	Approved terminals see "Rexroth Inline Terminals Approved for the Safety-Related Segment Circuit" on page 2
5		
6	Power terminal as termination of the safety-related segment circuit and start of a non-safety-related segment circuit	R-IB IL 24 PWR IN-PAC
7	Terminals corresponding to the application in the non-safety-related segment circuit	R-IB IL 24 DI 8-PAC
8		R-IB IL 24 DI 2-PAC
9	End plate as termination of the Rexroth Inline station	Supplied with the bus coupler
10	Grounding terminal (universal ground terminal block)	According to the configuration
11	End clamps	SUP-M01-ENDHALTER

If the Rexroth Inline station is not to be continued after the safety-related segment circuit, the end plate (9) must be installed instead of the power terminal (6).

Notes

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