# Rexroth Inline Terminal With Four SPDT Relay Contacts

**R911170540**
Edition 01

**R-IB IL 24/230 DOR 4/W(-2MBD)-PAC**

4 Relay Outputs
SPDT Contacts
230 V AC/DC

02/2007

## Description

The terminal is designed for use within an Inline station. It has four floating SPDT relay contacts.

The terminal can be used in the SELV area and in the AC area. Observe the appropriate regulations and safety notes when using the terminal in the AC area.

### Features

- Safe isolation according to EN 50178
- Floating connection for four actuators
- Nominal current at the output: 3 A
- Total current of the terminal: 4 x 3 A = 12 A
- Diagnostic and status indicators

This data sheet is only valid in association with the application descriptions for the Rexroth Inline system (see "Documentation" on page 2).

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

## Ordering Data

**Products**

| Description | Type | MNR | Pcs./Pck. |
|---|---|---|---|
| Rexroth Inline terminal with four digital relay outputs; complete with accessories (connector and labeling field); transmission speed of 500 kbps | R-IB IL 24/230 DOR 4/W-PAC | R911170758 | 1 |
| Rexroth Inline terminal with four digital relay outputs; complete with accessories (connector and labeling field); transmission speed of 2 Mbps | R-IB IL 24/230 DOR 4/W-2MBD-PAC | R911170417 | 1 |

**Documentation**

| Description | Type | MNR | Pcs./Pck. |
|---|---|---|---|
| "Automation Terminals of the Rexroth Inline Product Range" application description | DOK-CONTRL-ILSYSINS***-AW..-EN-P | R911317021 | 1 |
| "Configuring and Installing the Rexroth Inline Product Range for INTERBUS" application description | DOK-CONTRL-ILSYSPRO***-AW..-EN-P | R911317023 | 1 |

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

## Technical Data

| General Data | |
|---|---|
| Housing dimensions (width x height x depth) | 48.8 mm x 120 mm x 71.5 mm |
| Weight | 153 g (with connector) |
| Operating mode | Process data mode with 4 bits |
| Connection method for actuators | At a floating SPDT relay contact |
| Ambient temperature (operation) | -25°C to +55°C |
| Ambient temperature (storage/transport) | -25°C to +85°C |
| Permissible humidity (operation/storage/transport) | 10% to 95%, according to DIN EN 61131-2 |
| Permissible air pressure (operation) | 80 kPa to 106 kPa (up to 2000 m above sea level) |
| Permissible air pressure (storage/transport) | 70 kPa to 106 kPa (up to 3000 m above sea level) |
| Degree of protection | IP20 according to IEC 60529 |
| Connection data for Inline connector | |
| Connection method | Spring-cage terminals |
| Conductor cross section | 0.2 $mm^2$ to 1.5 $mm^2$ (solid or stranded), 24 - 16 AWG |

| Mechanical Requirements (Deviation From the Inline Specifications) | |
|---|---|
| Vibration test<br>Sinusoidal vibrations according to IEC 60068-2-6; EN 60068-2-6 | 2g load, 2 hours in each space direction |
| Shock test according to<br>IEC 60068-2-27; EN 60068-2-27 | 2g load for 11 ms, half sinusoidal wave, three shocks in each space direction and orientation |

| Interface | |
|---|---|
| Local bus | Through data routing |

| Transmission Speed | |
|---|---|
| R-IB IL 24/230 DOR 4/W-PAC | 500 kbps |
| R-IB IL 24/230 DOR4/W-2MBD-PAC | 2 Mbps |

| Power Consumption | 500 kbps | 2 Mbps |
|---|---|---|
| Communications power | 7.5 V DC | 7.5 V DC |
| Current consumption at $U_L$ off/on | 22 mA/187 mA | 45 mA/220 mA |
| Power consumption at $U_L$ | 0.17 W/1.4 W | 0.34 W/1.65 W |

| Supply of the Module Electronics and I/O Through Bus Coupler/Power Terminal | |
|---|---|
| Connection method | Through potential routing |

| Relay Output | |
|---|---|
| Number | 4 |
| Contact material | $AgSnO_2$, hard gold-plated |
| Contact resistance | 50 mΩ at 100 mA/6 V |
| Limiting continuous current (at maximum ambient temperature) | 3 A |
| Maximum switching voltage | 253 V AC, 250 V DC |
| Maximum switching power (AC/DC) | 750 VA (see derating) |
| Minimum load | 5 V; 10 mA |
| Switching current at 30 V DC | 3 A |
| Switching current at 250 V DC | 0.15 A |
| Maximum inrush current peak for lamp loads and capacitive loads | 6 A for T = 200 µs |

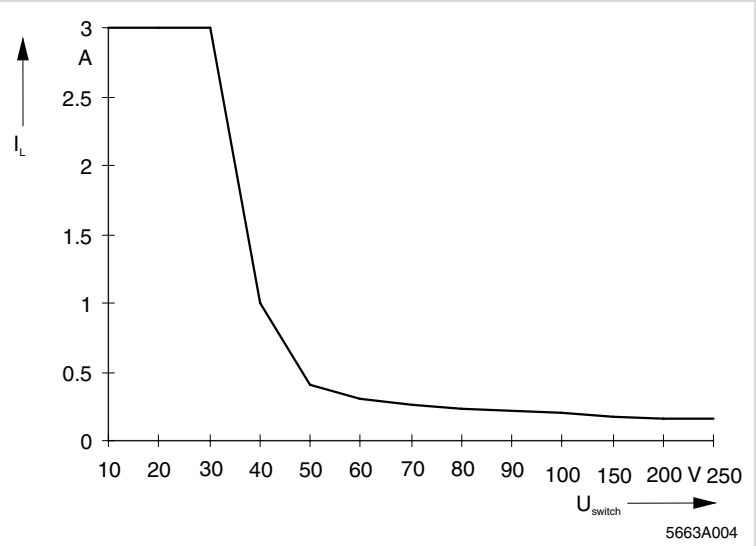
See also Table "Maximum Switching Current for Ohmic Load Depending on the Switching Voltage (With DC Voltage)" on page 4.

| | |
|---|---|
| Nominal power consumption of the coil (at 20°C) | 330 mW from the 7.5 V supply |
| Resistance of the coil (at 20°C) | 119 Ω ±12 Ω |
| Maximum switching frequency (without load) | 1200 cycles/minute |
| Maximum switching frequency (with nominal load) | 6 cycles/minute |
| Response delay | 5 ms, typical |
| Bouncing time | 5 ms, typical |
| Release time | 6 ms, typical |
| Mechanical service life | $2 \times 10^7$ cycles |
| Electrical service life | $10^5$ cycles (at 20 cycles/minute) |
| Common potentials | All contacts floating |

**Maximum Switching Current for Ohmic Load Depending on the Switching Voltage (With DC Voltage)**

| Switching Voltage (V DC) | Switching Current (A) |
|---|---|
| 10 | 3.0 |
| 20 | 3.0 |
| 30 | 3.0 |
| 40 | 1.0 |
| 50 | 0.4 |
| 60 | 0.3 |
| 70 | 0.26 |
| 80 | 0.23 |
| 90 | 0.215 |
| 100 | 0.2 |
| 150 | 0.18 |
| 200 | 0.165 |
| 250 | 0.155 |

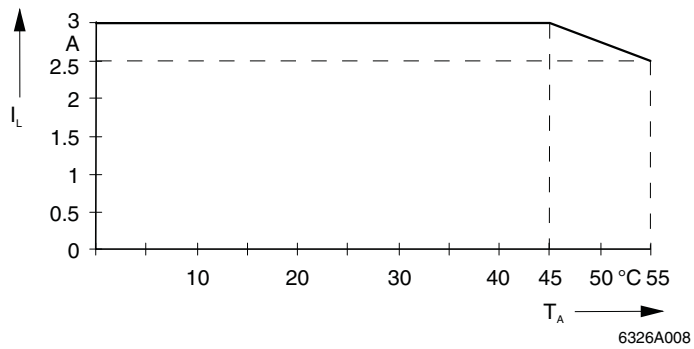
**Load Current ($I_L$ in A) as a Function of the Switching Voltage ($U_{switch}$ in V)**




**Maximum Switching Current Depending on the Temperature (With AC Voltage)**

With a switching current of 3 A, AC switching voltages must not exceed 253 V AC. Observe the derating.

**Load Current ($I_L$ in A) as a Function of the Ambient Temperature ($T_A$ in °C)**



## Power Dissipation

**Formula to Calculate the Power Dissipation in the Terminal (500 kbps)**

$P_{TOT} = P_{BUS} + (P_{REL}) + P_L$

$$P_{TOT} = 0.17\ W + \sum_{i=1}^{n} (0.31\ W + I_L^2 \times 0.04\ \Omega)$$

**Formula to Calculate the Power Dissipation in the Terminal (2 Mbps)**

$P_{TOT} = P_{BUS} + (P_{REL}) + P_L$

$$P_{TOT} = 0.34\ W + \sum_{i=1}^{n} (0.31\ W + I_L^2 \times 0.04\ \Omega)$$

For an N/C contact, the term $P_{REL}$ is omitted from the formula.

Where:

| | |
|---|---|
| $P_{TOT}$ | Total power dissipation in the terminal |
| $P_{BUS}$ | Power dissipation through bus operation |
| $P_{REL}$ | Power dissipation of the relay coil |
| $P_L$ | Power dissipation through the load current via the contacts |
| n | Numer of the set outputs (n = 1 to 4) |
| i | Index |
| $I_L$ | Load current of the output |

## Power Dissipation of the Housing Depending on the Ambient Temperature

$P_{HOU} = 2.7\ W$ $-25°C < T_A \leq +25°C$

$P_{HOU} = 2.7 - ((T_A - 25°C) \times 0.02\ W/°C)$ $+25°C < T_A \leq +55°C$

Where:

$P_{HOU}$ Power dissipation of the housing

$T_A$ Ambient temperature

## Safety Equipment

None

## Error Messages to the Higher-Level Control or Computer System

None

## Air and Creepage Distances (According to EN 50178, VDE 0109, VDE 0110)

| Isolating Distance | Clearance | Creepage Distance | Test Voltage |
|---|---|---|---|
| Relay contact/bus logic | ≥ 5.5 mm | ≥ 5.5 mm | 4 kV, 50 Hz, 1 min. |
| Contact/contact | ≥ 3.1 mm | ≥ 3.1 mm | 1 kV, 50 Hz, 1 min. |
| Contact/PE | ≥ 3.1 mm | ≥ 3.1 mm | 1 kV, 50 Hz, 1 min. |

## Approvals

For the latest approvals, please visit www.boschrexroth.com.

## Safety Notes for Inline Terminals Used in Areas Outside the SELV Area (AC Area)

**CAUTION**

Only qualified personnel may work on Inline terminals in the AC area.

Qualified personnel are people who, because of their education, experience and instruction, and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized by those responsible for the safety of the plant to carry out any required operations, and who are able to recognize and avoid any possible dangers.
(Definitions of skilled workers according to EN 50110-1:1996).

**The instructions given in the DOK-CONTRL-ILSYSPRO***-AW..-EN-P application description and in this data sheet must be strictly observed during installation and startup.**

Technical modifications reserved.

## Correct Usage

The terminal is only to be used within an Inline station as specified in this data sheet and in the "Configuring and Installing the Rexroth Inline Product Range for INTERBUS" application description. Bosch Rexroth accepts no liability if the device is used for anything other than its designated use.

**CAUTION**

**Dangerous contact voltage**

Please note that there are dangerous voltages when switching circuits that do meet SELV requirements.

Only remove and insert the AC terminals when the power supply is disconnected.
When working on terminals and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

## Installation Instructions and Notes

**CAUTION**

Install the system according to the requirements of EN 50178.

**CAUTION**

**Use grounded AC networks**
Inline AC terminals must only be operated in grounded AC networks.

**CAUTION**

**Read the application description**
Observe the installation instructions and notes in the DOK-CONTRL-ILSYSPRO***-AW..-EN-P application description, especially the notes on the low voltage area.

## Special Features of the Terminal

The terminal can be used to switch loads up to 230 V.

Please note that the terminal interrupts the potential jumpers $U_M$, $U_S$, and GND (24 V area) as well as L and N (120 V⁄230 V areas). If required, these supply voltages must be resupplied/provided using an appropriate power terminal after the relay terminal.

### Switching Loads in the 230 V Area

To switch voltages outside the SELV area, an AC area must be created according to the installation instructions and notes provided in the application description.

**CAUTION**

**Operation on an AC network**
Operate the terminal from a single phase on an AC network.

### Switching Voltages That Are Not Available in the Segment

A relay terminal can be used to switch voltages that are not available in the segment in which the terminal is located (e.g., switching 230 V AC within a 24 V DC segment). In this case, insert a terminal before and after the terminal to separate the relay terminal (see "Ordering Data" on page 2). The isolating distances between the individual areas are thus maintained.

See also "Connection Examples" on page 10.

## Local Diagnostic and Status Indicators

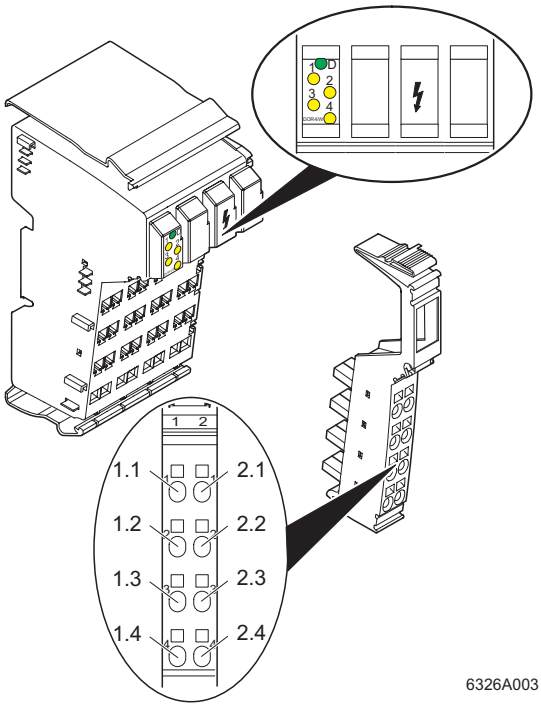



*Fig. 1* *Terminal with one of the appropriate connectors*

### Local Diagnostic and Status Indicators

| Des. | Color | Meaning |
|---|---|---|
| **D** | Green | Diagnostics |
| **1, 2, 3, 4** | Yellow | Output status indicator (relay has picked up) |

### Function Identification

Red with lightning bolt

2 Mbps: White stripe in the vicinity of the D LED

### Housing/Connector Colour

Dark gray housing

Dark gray connectors

### Terminal Point Assignment for Each Connector

| Terminal Points | Assignment |
|---|---|
| **1.1, 2.1** | Not used (no contact present) |
| **1.2, 2.2** | Relay N/C contact |
| **1.3, 2.3** | Relay main contact |
| **1.4, 2.4** | Relay N/O contact |

Adjacent contacts 1.2/2.2, 1.3/2.3, and 1.4/2.4 are jumpered in the corresponding R-IB IL SCN-8-AC-REL connector.

## Internal Circuit Diagram

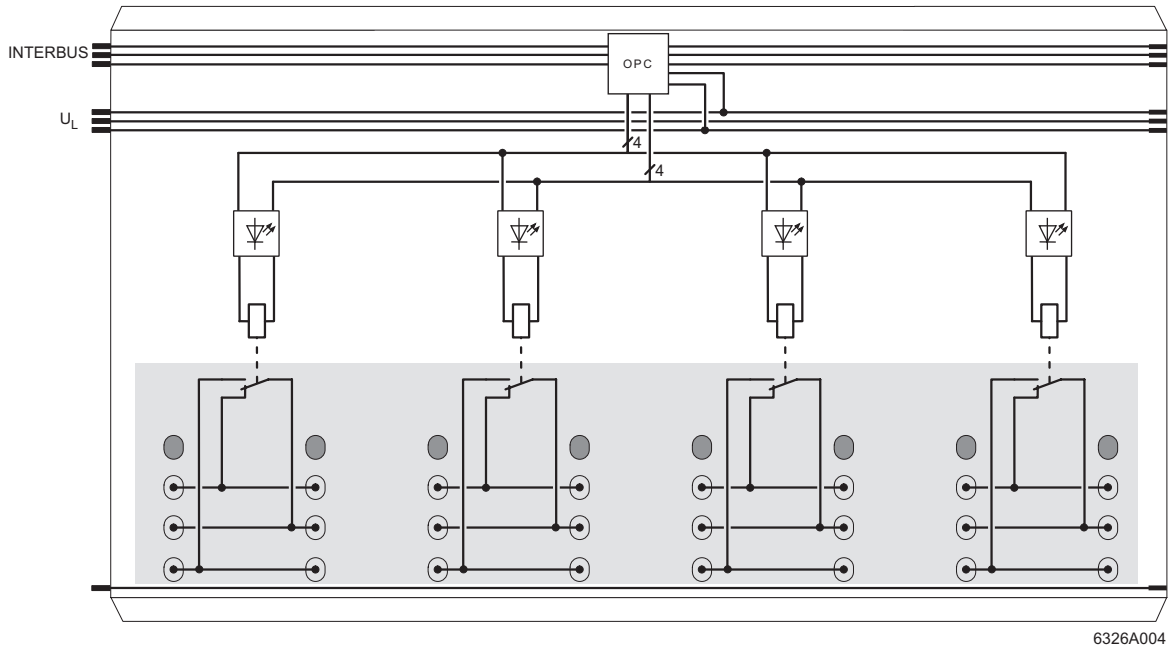



*Fig. 2 Internal wiring of the terminal points*

Key:

| | |
|---|---|
| OPC | Protocol chip (bus logic including voltage conditioning) |
| | LED |
| | Terminal point, without metal contact |
| | Relay |
| | Electrically isolated area<br>I/O area including relay contact isolated from the logic area including the relay coil through "safe isolation" according to EN 50178 |

Other symbols used are explained in the application descriptions of the Rexroth Inline System or the application description of your bus system.

# Connection Examples

## Connecting Actuators

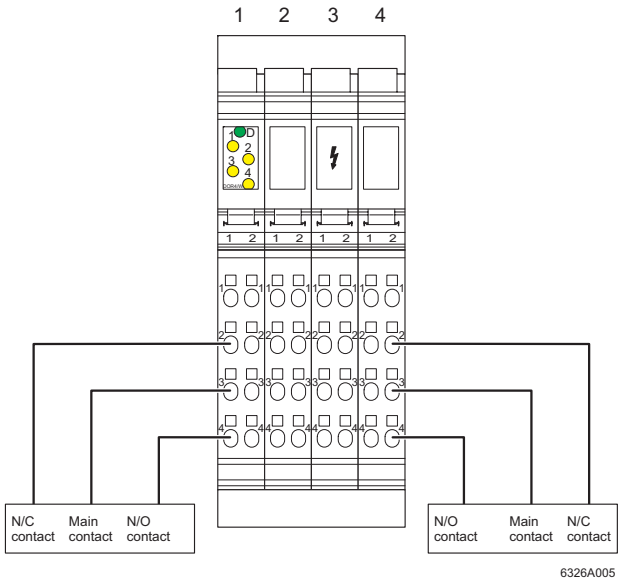



*Fig. 3 Typical actuator connection*

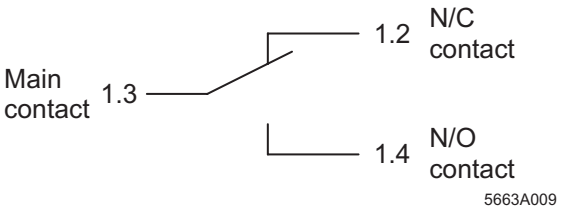



*Fig. 4 Output relay contacts*

## Switching Voltages That Are Not Available in the Segment

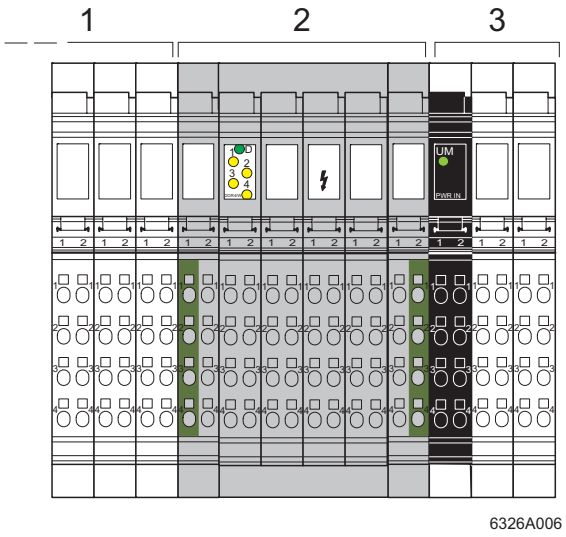



*Fig. 5 Example: Switching 230 V within a 24 V area*

1 24 V area consisting of station head and I/O terminals

2 Terminal separated from the 24 V area by appropriate terminals

3 24 V area consisting of power terminal and I/O terminals

See also "Special Features of the Terminal" on page 7.

Also insert separating terminals if you want to switch a 24 V channel within a 230 V AC area.

### Switching Voltages That Are Available in the Segment

The separating terminals are not required to switch a 24 V channel within a 24 V area or to switch a 230 V channel within a 230 V area.

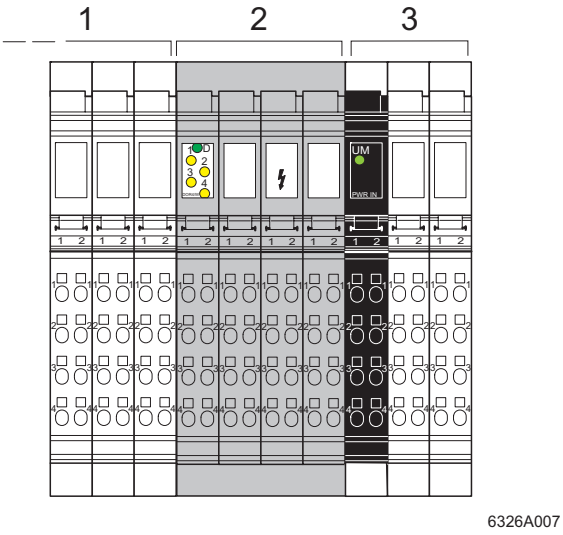



*Fig. 6 Switching 24 V within a 24 V area*

| | |
|---|---|
| 1 | 24 V area consisting of station head and I/O terminals |
| 2 | Terminal |
| 3 | 24 V area consisting of a power terminal and I/O terminals |

## Interference Suppression Measures on Inductive Loads/Switching Relay

Each electrical load is a mix of ohmic, capacitive, and inductive elements. Depending on the proportion of the elements, switching these loads results in a larger or smaller load on the switch contact.

In practice, loads are generally used with a large inductive element, such as contactors, solenoid valves, motors, etc. Due to the energy stored in the coils, voltage peaks of up to a few thousand volts may occur when the system is switched off. These high voltages cause an arc on the controlling contact, which may destroy the contact through material vaporization and material migration.

This pulse, which is similar to a square wave pulse, emits electromagnetic pulses over a wide frequency range (spectral elements reaching several MHz) with a large amount of power.

To prevent such arcs from occurring, the contacts/loads must be fitted with protective circuits. In general, the following protective circuits can be used:

- Contact protective circuit
- Load protective circuit
- Combination of both protective circuits

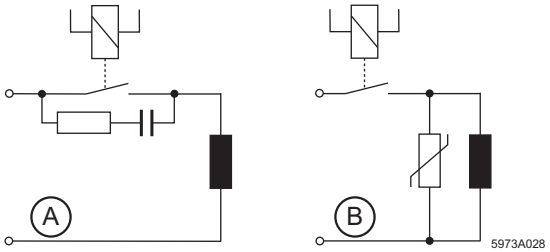


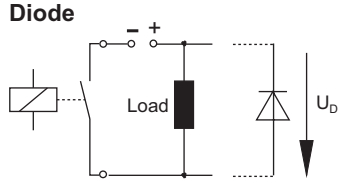
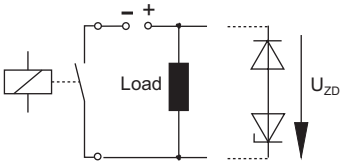
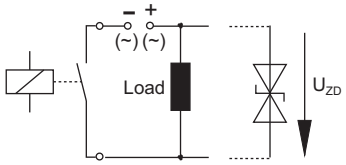
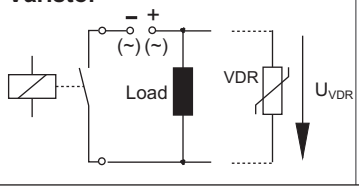

*Fig. 7 Contact protective circuit (A), load protective circuit (B)*

If sized correctly, these circuit versions do not differ greatly in their effectiveness. In principle, safety equipment should intervene directly at the source of the interference. The following points speak in favor of a load protective circuit:

- When the contact is open, the load is electrically isolated from the operating voltage.
- It is not possible for the load to be activated or to "stick" due to undesired operating currents, e.g., from RC elements.
- Shutdown voltage peaks cannot be coupled in control lines that run in parallel.

Today the majority of contactor manufacturers offer diode, RC or varistor elements that can be snapped on. For solenoid valves, connectors with an integrated protective circuit can be used.

## Circuit Versions

| Load Wiring | Additional Drop Delay | Defined Inductive Voltage Limitation | Bipolar Attenuation | Advantages/Disadvantages |
|---|---|---|---|---|
| **Diode**<br>  | Large | Yes ($U_D$ ) | No | Advantages:<br>- Easy implementation<br>- Cost-effective<br>- Reliable<br>- No critical sizing<br>- Small inductive voltage<br><br>Disadvantages:<br>- Attenuation only via load resistance<br>- Large drop delay |
| **Series connection Diode/Zener diode**<br>  | Medium to small | Yes ($U_{ZD}$ ) | No | Advantages:<br>- Not critical sizing<br><br>Disadvantages:<br>- Attenuation only above $U_{ZD}$ |
| **Suppressor diode**<br>  | Medium to small | Yes ($U_{ZD}$ ) | Yes | Advantages:<br>- Cost-effective<br>- No critical sizing<br>- Limiting positive peaks<br>- Suitable for AC voltage<br><br>Disadvantages:<br>- Attenuation only above $U_{ZD}$ |
| **Varistor**<br>  | Medium to small | Yes ($U_{VDR}$) | Yes | Advantages:<br>- High energy absorption<br>- No critical sizing<br>- Suitable for AC voltage<br><br>Disadvantages:<br>- Attenuation only above $U_{VDR}$ |

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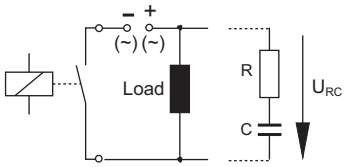
## RC Circuit Versions

### RC Series Circuit:

| Load Wiring | Additional Drop Delay | Defined Inductive Voltage Limitation | Bipolar Attentuation | Advantages/Disadvantages |
|---|---|---|---|---|
| **R/C combination**   | Medium to small | No | Yes | Advantages:<br>- HF attenuation due to energy absorption<br>- Suitable for AC voltage<br>- Level-independent attenuation<br>- Compensating reactive current<br>Disadvantages:<br>- Exact sizing required<br>- High inrush current |

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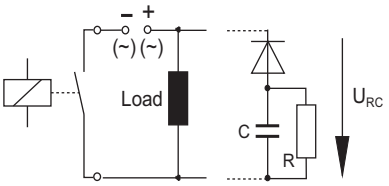
### Sizing:

- Capacitor: $C \approx L_{Load}/4 \times R_{Load}^2$
- Resistor: $R \approx 0.2 \times R_{Load}$

### RC Parallel Circuit With Series Diode

| Load Wiring | Additional Drop Delay | Defined Inductive Voltage Limitation | Bipolar Attentuation | Advantages/Disadvantages |
|---|---|---|---|---|
| **R/C combination with diode**   | Medium to small | No | Yes | Advantages:<br>- HF attentuation due to energy absorption<br>- level-independent attenuation<br>- Current reversing not possible<br>Disadvantages:<br>- Exact sizing required<br>- Only suitable for DC voltage |

5663A031

### Sizing:

- Capacitor: $C \approx L_{Load}/4 \times R_{Load}^2$
- Resistor: $R \approx 0.2 \times R_{Load}$

## Switching AC/DC Loads

### Switching Large AC Loads

When switching large AC loads, the relay can be operated up to the corresponding maximum values for the switching voltage, current, and power. The arc that occurs during shutdown depends on the current, voltage, and phase relation. This shutdown arc switches off automatically the next time the load current passes through zero.

In applications with an inductive load, an effective protective circuit must be provided, otherwise the service life of the system will be reduced considerably.

To prolong the life of the terminal as much as possible when using lamp loads or capacitive loads, the current peak must not exceed 6 A when the load is switched on.

### Switching Large DC Loads

In DC operation, a relay can only switch a relatively low current compared with the maximum permissible alternating current. This maximum DC value is also highly dependent on the voltage and is determined in part by design conditions, such as the contact distance and contact opening speed.

The corresponding current and voltage values are shown using the example in Fig. 8.

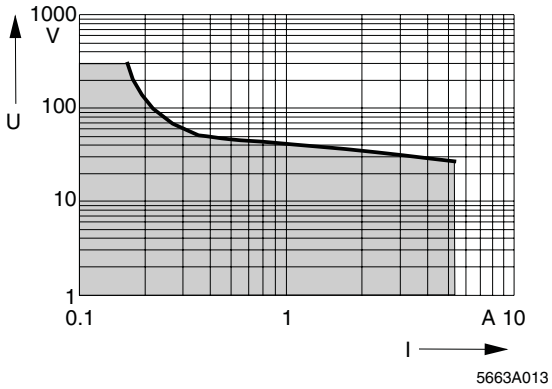



*Fig. 8 DC load limit curve (REL-SNR-1XU/G 5 GOLD relay)*

*I* Switching current in A

*U* Switching voltage in V

Definition of the load limit curve: For 1000 cycles, no constant arc should occur with a burning life > 10 ms.

A non-attenuated inductive load further reduces the values for switching currents given here. The energy stored in the inductance can cause an arc to occur, which forwards the current via the open contacts. Using an effective contact protection circuit, virtually the same currents can be switched as for an ohmic load and the service life of the relay contacts is the same.

If it is permitted to switch higher DC loads, several relay contacts can be switched in parallel.

The technical data for this is available on request.

## Programming Data

### Local Bus

| | |
|---|---|
| ID code | $BD_{hex}$ ($189_{dec}$) |
| Length code | $41_{hex}$ |
| Process data channel | 4 bits |
| Input address area | 0 bits |
| Output address area | 4 bits |
| Parameter channel (PCP) | 0 bits |
| Register length (bus) | 4 bits |

### Other Bus Systems

For the programming data/ configuration data of other bus systems, please refer to the corresponding electronic device data sheet (e.g. GSD, EDS).

## Process Data

### Assignment of Terminal Points to OUT Process Data

| (Byte.Bit) view | Bit | 0.3 | 0.2 | 0.1 | 0.0 |
|---|---|---|---|---|---|
| Assignment | Slot | 4 | 3 | 2 | 1 |
| | N/C contact | 1.2 | 1.2 | 1.2 | 1.2 |
| | Main contact | 1.3 | 1.3 | 1.3 | 1.3 |
| | N/O contact | 1.4 | 1.4 | 1.4 | 1.4 |
| Status indicator | LED | 4 | 3 | 2 | 1 |

If the bits are set to 1, the corresponding N/O contact is closed.

The LEDs light up if the corresponding N/O contact is closed.

## Notes:

DOK-CONTRL-ILDOR4/
W***-KB01-EN-P

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