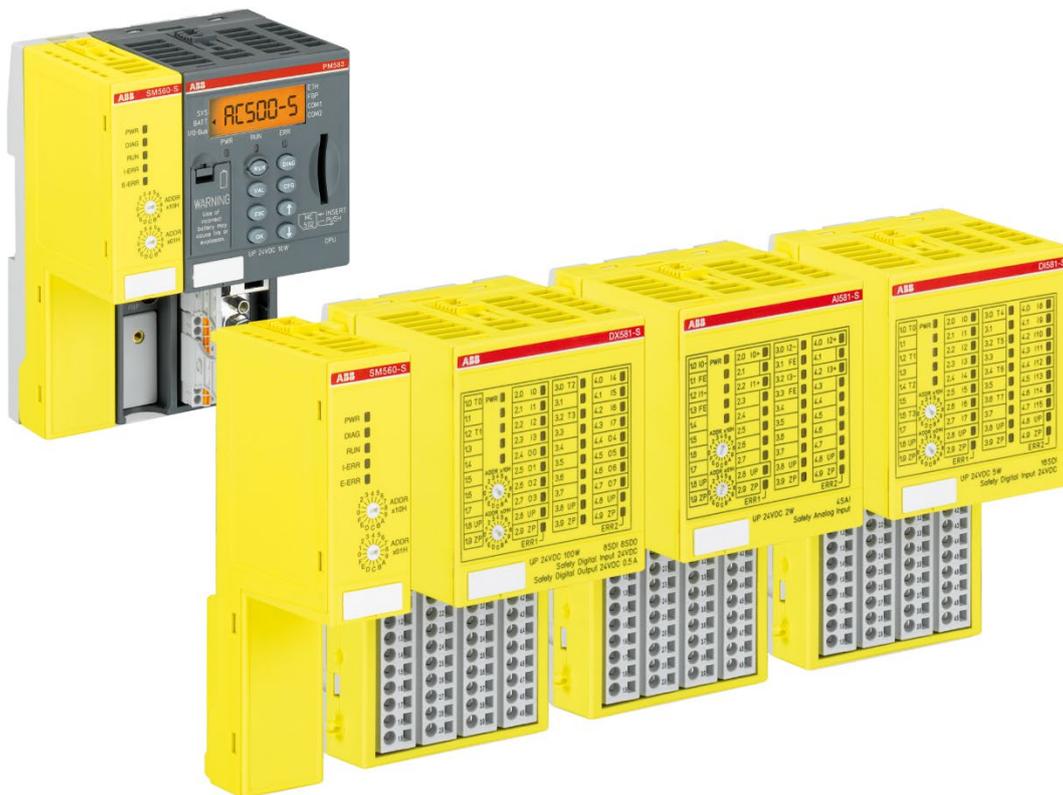


APPLICATION NOTE

# AC500-S safety PLC

## DX581-S safety I/O module with BSR23 safety relay



---

# Contents

|   |          |
|---|----------|
| <b>1. Introduction</b> .....                              | <b>3</b> |
| 1.1. Purpose.....   | 3        |
| 1.2. Document history.....                                | 3        |
| 1.3. Validity.....  | 3        |
| 1.4. Important user information.....                      | 3        |
| 1.5. Definitions, expressions, abbreviations .....        | 4        |
| 1.6. References / related documents .....                 | 4        |
| <b>2. Using the BSR23 safety relay with DX581-S</b> ..... | <b>5</b> |
| <b>3. Connection example</b> .....                        | <b>7</b> |
| 3.1. Overview.....  | 7        |
| 3.2. Connections with BSR23 .....                         | 7        |

# 1. Introduction

## 1.1. Purpose

This application note provides technical details on how to connect ABB DX581-S safety I/O module to the BSR23 safety relay for potential-free switching of 6 A/5 A (+24 V DC / 250 V AC) electrical loads, such as safety solenoid valves. A wiring example is included.

The ABB BSR23 safety relay connected to a DX581-S safety I/O module is one of the most suitable solutions for these applications.

## 1.2. Document history

| Rev.       | Description of version / changes   | Who | Date       |
|------------|--|-----|------------|
| A (V1.0.0) | First release  | ABB | 26.08.2019 |
| B          | Company name was changed.<br><br>Various typos were corrected and various improvements in the texts and illustrations were made. | ABB | 15.09.2021 |

## 1.3. Validity

The data and illustrations in this document are not binding. ABB reserves the right to modify its products in line with its policy of continuous product development.

ABB assumes no liability or responsibility for any consequences that arise from the use of this document information. ABB is in no way liable for missed profits, loss of income, loss of life, loss of use, loss of production, capital costs or costs associated with an interruption of operation, the loss of expected savings or for indirect or follow up damages or losses regardless of kind.

## 1.4. Important user information

This documentation is intended for qualified personnel who are familiar with functional safety. You must read and understand the safety concepts and requirements presented in AC500-S Safety User Manual [1.] and the other referenced documents before you operate the AC500-S safety PLC system.

The following special notices may appear throughout this documentation to warn of potential hazards or to call attention to specific information.



### **⚠ DANGER**

**The notices that refer to your personal safety are highlighted in the manual with this safety symbol, which indicates that death or severe personal injury may result if proper precautions are not taken.**

**NOTICE**

This symbol of importance identifies information that is critical to the successful application and understanding of the product. It indicates that an unintended result can occur if the corresponding information is not considered.

## 1.5. Definitions, expressions, abbreviations

|         |   |
|---------|---|
| AC500   | ABB PLC, refer also to <a href="http://www.abb.com/PLC">www.abb.com/PLC</a> for further details   |
| AC500-S | ABB Safety PLC for applications up to SIL3 (IEC 61508 and IEC 61511), SILCL3 (IEC 62061) and PL e (ISO 13849-1), refer also to <a href="http://www.abb.com/PLC">www.abb.com/PLC</a> for further details                               |
| AB      | Automation Builder (ABB Automation Builder is the integrated software suite for machine builders and system integrators which covers the engineering of ABB AC500 PLC, AC500-S safety PLC, control panels, drives, motion and robots) |
| BSR23   | ABB Sentry BSR23 safety relay   |
| CPU     | Central Processing Unit   |
| FSDT    | Functional Safety Design Tool (ABB tool for functional safety calculation according to ISO 13849-1 and/or IEC 62061)  |
| IEC     | International Electro-technical Commission Standard   |
| I/O     | Input/Output  |
| PCB     | Printed Circuit Board   |
| PL      | Performance Level according to ISO 13849-1  |
| PLC     | Programmable Logic Controller   |
| SFRT    | Safety Function Response Time   |
| SIL     | Safety Integrity Level (IEC 61508 and IEC 61511)  |
| SILCL   | Safety Integrity Level Claim (IEC 62061)  |
| TÜV     | Technischer Überwachungs-Verein (Technical Inspection Association)  |

## 1.6. References / related documents

- [1.] AC500-S Safety User Manual, 3ADR025091M0207 or newer
- [2.] AC500 Documentation, refer to [www.abb.com/PLC](http://www.abb.com/PLC) and then navigate to “Downloads” area
- [3.] ABB Sentry safety relays – Original instructions, 2TLC010002M0201

## 2. Using the BSR23 safety relay with DX581-S

The potential-free control of safety actuators with the DX581-S safety I/O module requires an external safety relay, as shown in Fig. 1 To use the DX581-S safety I/O module with the AC500-S safety PLC, you have to create a valid system setup as described in [1] and [2].

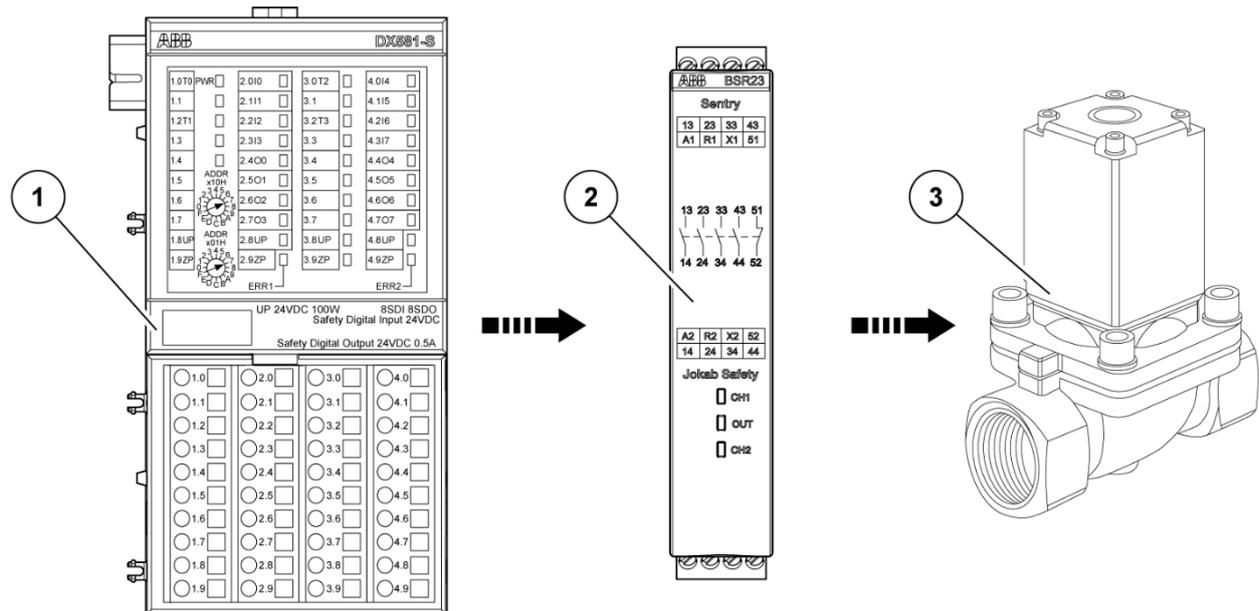


Fig. 1: The BSR23 extends the safety outputs of the DX581-S to control a safety device.

In the example in Fig. 1, the BSR23 safety relay (2) allows the DX581-S safety I/O module (1) to control a safety solenoid valve (3).

Refer to [3.] for detailed information on the BSR23 safety relay, such as installation, operation and technical data.

The BSR23 safety relay has two input channels that control four NO (normally open), one NC (normally closed) contacts and a test connection with NC (normally closed) contacts.

Refer to Fig. 2 for the terminals of the BSR23 safety relay.

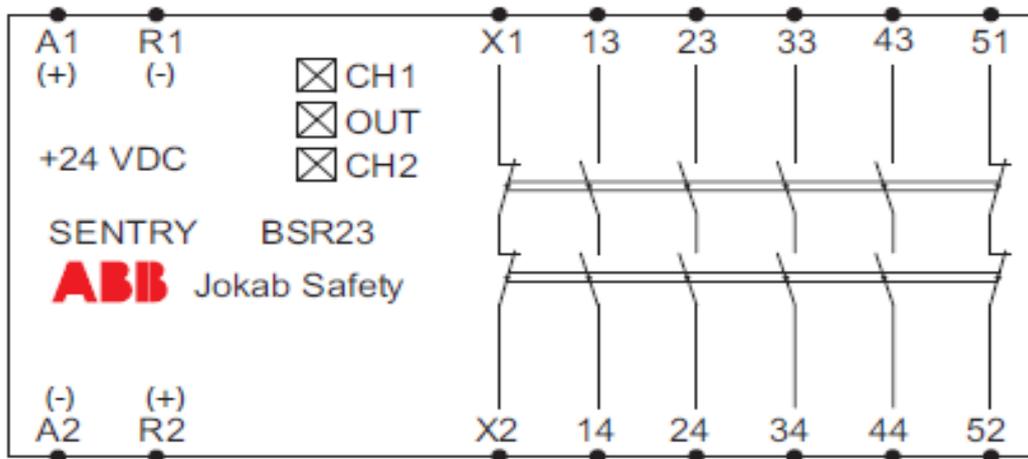


Fig. 2: Terminals of the BSR23 safety relay

The terminal connections of the BSR23 safety relay:

- Channel 1 (CH1) input (+24 V DC): A1 (+) / R1 (-)
- Channel 2 (CH2) input (+24 V DC): A2 (-) / R2 (+)
- Test connection: X1/X2
- Relay connections:
  - Normally open (NO): 13/14, 23/24, 33/34 and 43/44
  - Normally closed (NC): 51/52

For details on how to connect the DX581-S safety I/O module and the BSR23 safety relay, refer to chapter 3.

You can install the BSR23 safety relay in the same control cabinet as the DX581-S safety I/O module to extend its digital safety outputs.

If it is necessary, you can connect several safety relays to a DX581-S safety I/O module if the current drain per digital safety output does not exceed 0.5 A, +24 V DC.

The benefits of using the BSR23 safety relay with the DX581-S safety I/O module:

- The BSR23 is a cost-effective safety relay that uses PCB safety relays and no other electronic components. You can connect readback contacts from the BSR23 safety relay to the safety digital input channels on the DX581-S safety I/O module.
- The BSR23 safety relay has four active potential-free contacts. This permits simultaneous control of up to four safety actuators, for example, to stop four valves or motors up to PL e (ISO 13849-1) simultaneously for the given safety function. This makes it possible to decrease the number of required safety digital outputs in the DX581-S safety I/O module for the given safety function.
- Enables driving inductive loads, such as safety solenoid valves with a current of more than 0.5 A, +24 V DC.
- Enables driving large safety contactors and, safety solenoid valves with a current of up to 6 A / 5 A (+24 V DC / 250 V AC).
- Saves space in the control cabinet.

For detailed information on the DX581-S safety I/O module and the BSR23 safety relay, refer to [1.] and [3.], respectively.

## 3. Connection example

The example in this application note shows how to connect a BSR23 safety relay to a DX581-S safety I/O module to drive a high-current load, such as a safety solenoid valve.

### 3.1. Overview

This example describes how to connect and control the BSR23 safety relay with two digital outputs of the DX581-S safety I/O module. In this example, we connect one BSR23 safety relay to the safety I/O module. If the current drain does not exceed the specifications of the DX581-S safety I/O module for one digital safety output, you can connect several safety relays to it.

For information on the possible connections to the DX581-S safety I/O module, refer to Section 3.4.7 “Circuit examples” in [1.].

### 3.2. Connections with BSR23



#### **⚠ DANGER**

**To install and connect electrical devices you must be a qualified electrician and obey the applicable safety regulations, standards and the machinery directive.**

**Disconnect the power supply before you connect or disconnect the connection blocks or wires.**

The BSR23 safety relay has four removable connection blocks. Each connection block has four screw terminals. For detailed information on the connections of the BSR23 safety relay and how to code the connection blocks, refer to [3.].

Notes on the electrical connections:

- Make sure that the wires are fitted with crimp terminals or ferrules or use solid copper conductors.
- Make sure that the connection blocks and wires are clearly marked to avoid incorrect connections.

The example connection from the DX581-S safety I/O module to the BSR23 safety relay uses two digital outputs from the DX581-S safety I/O module to connect to the two input channels on the BSR23 safety relay. With an error exclusion for wiring DX581-S digital safety output channels to BSR23 inputs, you can use a single digital safety output channel to reach the required safety integrity level for the given safety function. Refer to Section 3.4.7 “Circuit examples” in [1.] for information on which SIL and PL can be reached for the selected connections. Note that both the DX581-S safety I/O module and the BSR23 safety relay are designed for up to SIL 3 and PL e safety applications.

Refer to Fig. 3 for an overview of the connection example with two digital safety output channels in use on the DX581-S safety I/O module.

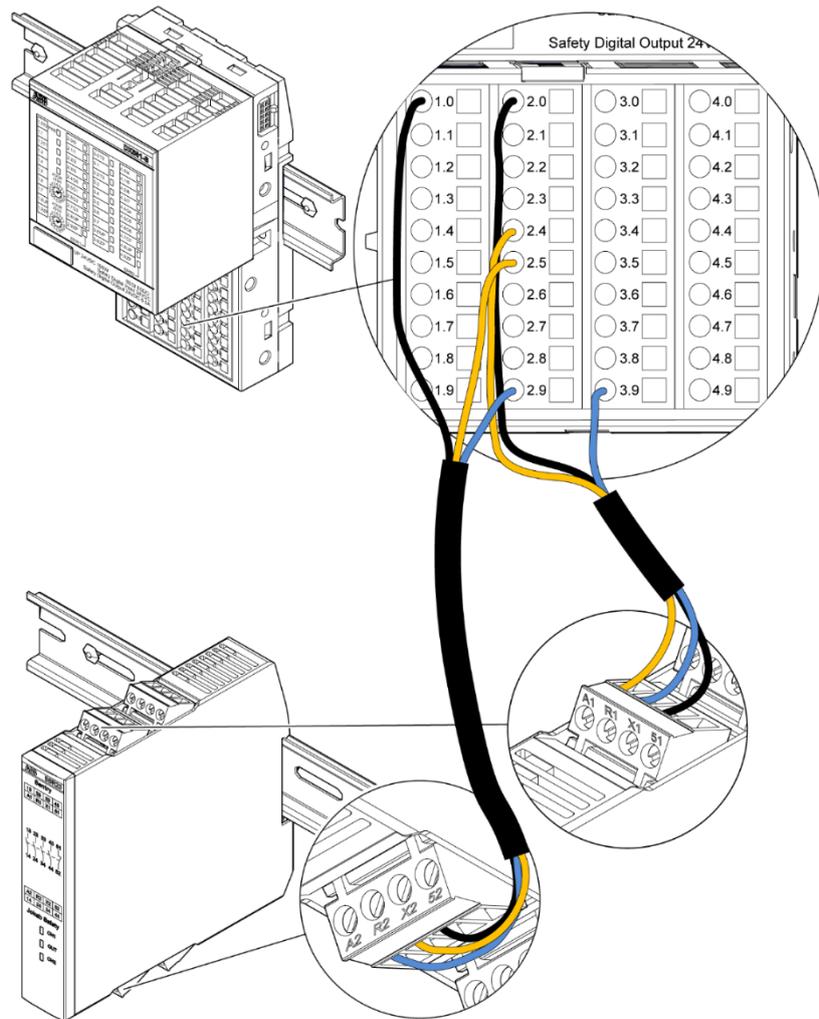


Fig. 3: Example of connecting the BSR23 safety relay to the DX581-S safety I/O module

An example of the connections (refer to Fig. 3) between the DX581-S safety I/O module and the BSR23 safety relay:

1. Connect one digital output of the DX581-S to channel 1 on the BSR23.
  1. Connect digital output 0 (2.4:O0) to terminal A1 on the top front terminal block.
  2. Connect the zero potential (3.9:ZP) to terminal R1 on the top front terminal block.
2. Connect the second digital output of the DX581-S to channel 2 on the BSR23.
  3. Connect digital output 1 (2.5:O1) to terminal R2 on the bottom front terminal block.
  4. Connect the zero potential (2.9:ZP) to terminal A2 on the bottom front terminal block.
3. Connect the readback contact (test connection) of the BSR23 to the DX581-S digital safety inputs to safely monitor the status of BSR23 contacts.
  5. Connect digital input 0 (2.0:I0) to terminal X1 on the top front terminal block.
  6. Connect test pulse output 0 (1.0:T0) to terminal X2 on the bottom front terminal block.

Note that you can freely select the order of the connections as well as select and group the digital safety input and output channels on the DX581-S safety I/O module.

Overview of the connections in the example:

| DX581-S terminals |  | BSR23 terminals |  |  |  |
|-------------------|--|-----------------|--|--|--|
|-------------------|--|-----------------|--|--|--|

Wire bundle 1 for channel 1 connections:

|         |                         |   |    |                 |                            |
|---------|-------------------------|---|----|-----------------|----------------------------|
| 2.4: O0 | Digital safety output 0 |  | A1 | Channel 1 (+)   | Top front connection block |
| 3.9: ZP | Zero potential          |  | R1 | Channel 1 (-)   |                            |
| 2.0: I0 | Digital safety input 0  |  | X1 | Test connection |                            |

Wire bundle 2 for channel 2 connections:

|         |                         |   |    |                 |                               |
|---------|-------------------------|---|----|-----------------|-------------------------------|
| 2.5: O1 | Digital safety output 1 |  | R2 | Channel 2 (+)   | Bottom front connection block |
| 2.9: ZP | Zero potential          |  | A2 | Channel 2 (-)   |                               |
| 1.0: T0 | Test pulse output 0     |  | X2 | Test connection |                               |

You can now control the BSR23 safety relay with the DX581-S safety I/O module from the safety application on the AC500-S safety CPU using the PLCopen function blocks, for example, SF\_OutControl and SF\_EDM. Refer to Section 7.4 in [1.] for an application example of the AC500-S safety PLC program.

**NOTICE**



**Section 4.6.6 in [1.] provides an overview on PLCopen safety function blocks and their usage in AC500-S safety CPU application programs.**

Connect the devices to be controlled to the relay contacts of the BSR23 safety relay. For example, to control four safety solenoid valves, connect them to normally open contacts 13 and 14, 23 and 24, 33 and 34, as well as 43 and 44, respectively on the BSR23 safety relay. Refer to Fig. 4 for more details on a general connection example of safety solenoid valves.

**⚠ DANGER**



**It is mandatory to follow all instructions [3.] for BSR23 usage in functional safety applications.**

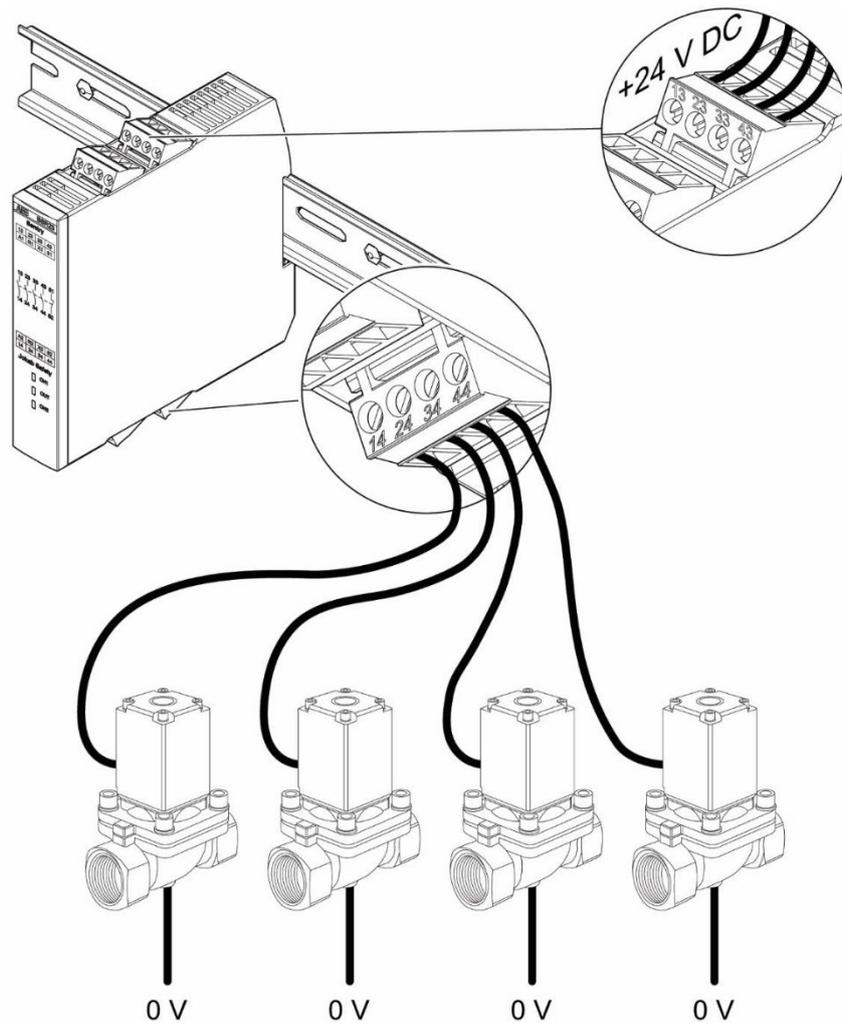


Fig. 4: Example of connecting four safety solenoid valves to the BSR23 safety relay



**⚠ DANGER**

You can calculate the reachable SIL and PL for the safety function implemented with DX581-S and BSR23 using ABB FSDT software with the related safety values. The safety values for DX581-S safety I/O modules can be found in Section 2.4 of [1.] and at [www.abb.com/PLC](http://www.abb.com/PLC).

You can calculate the safety function response time for the safety function implemented with the DX581-S safety I/O module and the BSR23 safety relay using the safety times in Section 5 of [1.] and in [3.], respectively.

---

ABB AG  
Eppelheimer Straße 82  
69123 Heidelberg, Germany  
Phone: +49 62 21 701 1444  
Fax: +49 62 21 701 1382  
Mail: [plc.support@de.abb.com](mailto:plc.support@de.abb.com)  
[www.abb.com/plc](http://www.abb.com/plc)

---

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB AG does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in parts – is forbidden without prior written consent of ABB AG.  
Copyright© 2019-2021 ABB. All rights reserved