

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

**Artisan Technology Group**
(217) 352-9330 | sales@artisantg.com | artisantg.com

**Full-service, independent repair center**
with experienced engineers and technicians on staff.

**We buy your excess, underutilized, and idle equipment**
along with credit for buybacks and trade-ins.

**Custom engineering**
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

**Expert team | Trust guarantee | 100% satisfaction**

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

**Visit our website - *Click HERE***

# Operation Manual

| | |
|---|---|
| Language | **English** |
| | Translation |
| Document No. | 5.09013.08 |
| Part No. | 432449 |
| Date | August 01, 2019 |

be in motion be in motion

BAUMÜLLER

## BM5-O-SAF-000/-001

**Safety Module for b maXX 5000**

CE

| | |
|---|---|
| **E** | 5.09013.08 |

**Read the Operating Instructions before beginning!**

© **Baumüller Nürnberg GmbH**

Ostendstr. 80 - 90
90482 Nürnberg
Germany

Tel. +49 9 11 54 32 - 0
Fax: +49 9 11 54 32 - 1 30

E-Mail: mail@baumueller.de
Internet: www.baumueller.de

# Table of Contents


**1 Document history . . . . . 7**

**2 General . . . . . 9**

2.1 Information on the Operation Manual . . . . . 9
2.2 Legend . . . . . 10
2.3 Limitation of liability . . . . . 11
2.4 Preliminary information . . . . . 11
2.5 Copyright . . . . . 12
2.6 Further applicable documents from other manufacturers . . . . . 12
2.7 Replacement parts . . . . . 12
2.8 Disposal . . . . . 12
2.9 Warranty and liability . . . . . 13
2.10 Customer service . . . . . 13
2.11 Terms used . . . . . 13
2.12 Certification . . . . . 13
2.12.1 Approvals, directives and standards . . . . . 14

**3 Use of this manual . . . . . 15**

**4 Safety . . . . . 17**

4.1 Contents of the operation manual . . . . . 17
4.2 Alterations and rebuilding of the device . . . . . 17
4.3 Intended use . . . . . 18
4.4 Operator responsibility . . . . . 19
4.5 Protective equipment . . . . . 19
4.6 Personnel training . . . . . 20
4.7 Personnel protective equipment . . . . . 21
4.8 Special dangers . . . . . 22
4.9 Fire fighting . . . . . 22
4.10 Electric safety . . . . . 23
4.10.1 Notice on power supply . . . . . 23
4.11 Safety equipment . . . . . 23
4.12 Conduct in the event of danger and accidents . . . . . 24
4.13 Signage . . . . . 24

**5 Functional safety . . . . . 25**

5.1 Safety-related parameters . . . . . 25
5.1.1 SAF-001-000-xxx . . . . . 26
5.1.2 SAF-001-001-xxx . . . . . 27

**6 Packaging and shipping . . . . . 29**

6.1 Shipping . . . . . 29
6.2 Unpacking . . . . . 29
6.3 Disposing of the packaging . . . . . 30
6.4 To be observed when shipping . . . . . 30

**7 Description of the Default and Parameter Module . . . . . 31**

7.1 General . . . . . 31
7.2 Compatibility list . . . . . 31
7.3 Working principle parameter module (BM5-O-SAF-000-000-000) . . . . . 32
7.4 Setting of the switch-on behavior . . . . . 33

7.5 Structure of the SAF-000 Default- and Parameter module . . . . . 35
7.6 Identification of the SAF-000 Default- and Parameter module . . . . . 35

**8 Description of the Safety Module (SAF-001) . . . . . 37**

8.1 General . . . . . 37
8.1.1 Safety Module SAF-001-000-xxx and SAF-001-001-000 with safety function STO . 37
8.1.2 Safety Module SAF-001-001-001 with safety function SS1 (time controlled) . . . . . 37
8.2 Compatibility list . . . . . 38
8.2.1 Compatibility list SAF-001-000-xxx . . . . . 38
8.2.2 Compatibility list SAF-001-001-xxx . . . . . 38
8.2.3 Compatibility list SAF-001-000-002 with automatic restart . . . . . 39
8.3 Safety notes on the STO (Safe Torque Off) . . . . . 39
8.4 Working principle . . . . . 40
8.4.1 SAF-001-000-xxx . . . . . 40
8.4.2 SAF-001-001-xxx . . . . . 40
8.5 Input circuitry . . . . . 42
8.5.1 SAF-001-000-xxx . . . . . 42
8.5.2 SAF-001-001-xxx . . . . . 46
8.6 Structure . . . . . 48
8.6.1 Structure of the Safety Module (SAF-001-000-xxx) . . . . . 48
8.6.2 Structure of the Safety Module (SAF-001-001-000) . . . . . 49
8.6.3 Structure of the Safety Module (SAF-001-001-001) . . . . . 49
8.7 Pin assignment . . . . . 50
8.7.1 Pin assignment of connector X1 (SAF-001-000-xxx) . . . . . 50
8.7.2 Pin assignment of connector X1 (SAF-001-001-xxx) . . . . . 51
8.7.3 Pin assignment of connector X1 (SAF-001-000-002 with automatic restart) . . . . . 51
8.8 Switching thresholds for voltage and current . . . . . 52
8.9 Maximum response time . . . . . 53
8.10 Properties of the parameter memory . . . . . 53
8.11 Operation and display elements . . . . . 54
8.11.1 LEDs for indicating the operation statuses . . . . . 54
8.11.2 Button for verification purposes . . . . . 55
8.12 Restart inhibit (SAF-001-000-xxx) . . . . . 56
8.13 Automatic restart (SAF-001-000-002 and SAF-001-001-xxx) . . . . . 58
8.14 Marking of the Safety Module (SAF-001) - type code . . . . . 59

**9 Description of the Reset-Module . . . . . 61**

9.1 General . . . . . 61
9.2 Compatibility list . . . . . 61
9.3 Operating mode of the Reset-Module (BM5-O-SAF-100) . . . . . 61
9.4 Structure of the Reset-Module (BM5-O-SAF-100) . . . . . 62
9.5 Identification of the Reset-Module (SAF-100) . . . . . 62
9.6 Mode of operation module replacement . . . . . 63

**10 Resetting of the safety level by the controller . . . . . 65**

10.1 General . . . . . 65
10.2 Operation mode of the reset command . . . . . 65

**11 Planning of a safety-oriented control system . . . . . 67**

11.1 Risk assessment . . . . . 67
11.2 Installation and wiring plan . . . . . 69
11.3 Course of the planning phase . . . . . 69

**12 Assembly and installation . . . . . 71**

12.1 General safety regulations . . . . . 71

12.2 Requirements on the personnel conducting the work . . . . . 72
12.3 Assembly instructions . . . . . 72
12.4 Installation . . . . . 74
12.4.1 Requirements for the electrical connection . . . . . 74
12.4.2 Requirements on the connection cable . . . . . 75

**13 Commissioning and exchange of the module. . . . . 77**

13.1 General safety regulations . . . . . 77
13.2 Requirements on the personnel conducting the work . . . . . 78
13.3 Exchanging the module . . . . . 79

**14 System validation . . . . . 83**

14.1 Function test . . . . . 83

**15 Operation . . . . . 85**

**16 Troubleshooting and rectification . . . . . 87**

16.1 Safety regulations . . . . . 87
16.2 Requirements on the personnel conducting the work . . . . . 87
16.3 Error diagnosis . . . . . 87
16.4 Detecting errors in the periphery . . . . . 88
16.5 Safe status . . . . . 88

**17 Maintenance . . . . . 89**

**18 Repair . . . . . 91**

**19 Disassembly, storage . . . . . 93**

19.1 Safety regulations . . . . . 93
19.2 Requirements on the personnel conducting the work . . . . . 94
19.3 Disassembly . . . . . 94
19.4 Storage conditions . . . . . 94
19.5 Recommissioning . . . . . 94

**20 Disposal . . . . . 95**

20.1 Safety regulations . . . . . 95
20.2 Requirements on the personnel conducting the work . . . . . 95
20.3 Disposal instructions . . . . . 95
20.4 Recycling collection center/offices . . . . . 96

**Appendix A - Abbreviations . . . . . 97**

**Appendix B - Checklists . . . . . 99**

B.1 Planning checklist . . . . . 99
B.2 Installation checklist . . . . . 101
B.3 Commissioning and validation checklist . . . . . 102
B.4 Modification and retrofitting checklist . . . . . 102

**Appendix C - Technical data . . . . . 103**

C.1 Connection values . . . . . 103
C.2 Operational conditions . . . . . 103
C.3 Pin assignment of Safety Module (SAF-001-000-xxx) connector X1 . . . . . 104
C.4 Pin assignment of Safety Module (SAF-001-001-xxx and SAF-001-000-002) connector X1 105

**Appendix D - Declaration of conformity . . . . . 107**

**Index . . . . . 113**

# 1

# DOCUMENT HISTORY

| Revision level | State | Modifications |
|---|---|---|
| 01 | 16.11.2010 | Initial document |
| 02 | 17.05.2011 | SAF-000 Default- and Parameter module added |
| 03 | 07.08.2012 | Push button combination for push button S1 added;<br>Chap. 8.12 times added<br>Mode of operation SAF-000 and SAF-001 changed<br>Type code SAF-000 and SAF-001 changed<br>Chap. 8.11.1 LED display corrected<br>Chap. 9 SAF-100 Reset module added<br>Chap. 10 Resetting by the controller added<br>Chap. 13.3 Exchanging the module changed |
| 04 | 27.05.2014 | SAF-001-000-002 (automatic restart) added<br>Chap. 8.3 Compatibility list SAF-001-000-002 new<br>Chap. 8.9 Pin assignment SAF-001-000-002 new<br>Chap. 8.15 Automatic restart SAF-001-000-002 new<br>Chap. 8.16 Type code SAF-001-000-002 added<br>Chap.8: SAF-001-000-001 removed |
| 05 | 08.11.2016 | New declaration of conformity |
| 06 | 20.09.2017 | Safety Module SAF-001-001-xxx added<br>Chap. 8.3 Compatibility list SAF-001-001-xxx new<br>Chap. 8.6.2 Working principle SAF-001-001-xxx new<br>Chap. 8.7.2 Input circuitry SAF-001-001-xxx new<br>Chap. 8.8.2 Structure Safety Module (SAF-001-001-xxx) added<br>Chap. 8.9.2 Pin assignment of connector X1 (SAF-001-001-xxx) added<br>Chap. 8.10 Switching thresholds SAF-001-001-xxx added<br>Chap. 8.16 Type code SAF-001-001-xxx added<br>Declaration of conformity SAF-001-001-xxx added |
| 07 | 19.11.2018 | Safety Module SAF-001-001-001 (Safe Stop 1) added<br>Chap. 8.1.2 SAF-001-001-001 added<br>Chap. 8.2.2 Compatibility list SAF-001-001-001 added<br>Chap. 8.4.2 Working principle SAF-001-001-001 added<br>Chap. 8.14 Type code SAF-001-001-001 added |
| 08 | 01.08.2019 | Chap. 8.4.2 Firmware versions changed |

2

# GENERAL

## 2.1 Information on the Operation Manual

This operation manual provides important information for the use of the device. Respect of the safety guidelines and instructions in this operation manual are prerequisites for the safe work.

Furthermore, the local accident prevention legislation and general safety regulations applying to the device's field of application must also complied with.

Read the operation manual completely, in particular the chapter on safety instructions, before beginning any work on the device. The operation manual is a component of the product and must be kept accessible in the immediate vicinity of the device at all times.

## 2.2 Legend

**Warning notices**

Warning notices are marked by symbols in this operation manual. The notices are introduced by signal words which express the extent of the hazard.

Comply with the notices under all circumstances and act with caution in order to avoid accidents, personal injury and property damage.



**DANGER!**

....notifies of an imminent dangerous situation which will lead to death or serious injuries if not avoided.



**WARNING!**

....notifies of a potentially dangerous situation which can lead to death or serious injuries if not avoided.



**CAUTION!**

....notifies of a potentially dangerous situation which can lead to minor or slight injuries if not avoided.



**CAUTION!**

....notifies of a potentially dangerous situation which can lead to property damage if not avoided.

**Recommendations**



**NOTICE!**

....draws attention to useful tips and recommendations as well as information for efficient and trouble-free operation.

## 2.3 Limitation of liability

All statements and instructions in this operation manual have been compiled in compliance with the applicable standards and legislation while taking the current level of technology and our long-term experience and findings into account.

The manufacturer assumes no liability for damages resulting from:

- failure to observe the operation manual
- application for purposes other than those intended
- use by untrained personnel

The actual scope of materials delivered can vary from the explanations and illustrations described here in the event of custom designs, the use of additional ordering options or due to the most recent changes in technology.

The user assumes the responsibility of conducting maintenance and commissioning in accordance with the safety regulations of the applicable standards and all other relevant national or regional legislation relating to conductor dimensioning and protection, grounding, circuit breakers, overvoltage protection, etc.

The person who conducted the assembly or installation shall be accountable for damages occurring during assembly or connection.

## 2.4 Preliminary information



**CAUTION!**

The following shall apply if the document you are reading is designated as preliminary information:
This version pertains to preliminary technical information which the user of the described devices and functions should receive ahead of time, in order to be able to adjust to potential changes and/or functional expansions.
This information is to be seen as preliminary, since it has not yet been subjected to the Baumüller internal review process. In particular, this information is still subject to changes, meaning that this preliminary information cannot be construed as legally binding. Baumüller assumes no liability for damages resulting from this potentially incorrect or incomplete version.
Should you detect or suspect content-related and/or serious formal errors in this preliminary information, please contact the contact person at Baumüller assigned to you and inform us of your findings and comments, so that they can be taken into account and potentially incorporated during the transition from the preliminary information to the final (reviewed by Baumüller) information.

## 2.5 Copyright

Treat the operation manual as confidential. It is intended exclusively for those working with the device. It is not permissible to transfer the operation manual to third parties without the written approval of the manufacturer.



**NOTICE!**

The content-related statements, texts, diagrams, images and other illustrations are copyright protected and subject to industrial property rights. Any improper use is liable to prosecution.

## 2.6 Further applicable documents from other manufacturers

Components from other manufacturers are built into the device. Hazard evaluations for these bought-in parts have been conducted by the applicable manufacturers. The conformity of the designs with the applicable European and national legislation has been declared by the respective component manufacturers.

## 2.7 Replacement parts



**WARNING!**

Improper or defective replacement parts can lead to damage, malfunctions or total failure as well as jeopardize safety.

**Therefore:**

- Only use original replacement parts from the manufacturer

Procure replacement parts from authorized dealers or directly at the manufacturer.

## 2.8 Disposal

If no return or disposal agreement has been made, dismantled components can be taken for recycling after proper disassembly.

See also ▹Disposal◃ on page 95.

## 2.9 Warranty and liability

All the information in this operation manual is non-binding customer information; it is subject to ongoing further development and is updated on a continuous basis by the permanent change management system of Baumüller Nürnberg GmbH.

Claims of warranty or liability towards Baumüller Nürnberg GmbH are rejected, in particular if one or more of the reasons listed in chapter ▹Intended use◃ on page 18 has/ have been the cause of the damage/s.

The operation of the devices described here in accordance with the specified methods/ procedures/requirements is permissible. Everything else, even the operation of devices in installation positions not depicted here, for instance, is not permissible and must be clarified with the factor on a case-by-case basis. The warranty will be rendered null and void if the devices are operated differently than described here.

## 2.10 Customer service

Our customer service is available for technical support.

Information on the competent contact person can be found at any time via telephone, fax, E-mail or over the Internet.

## 2.11 Terms used

A list of the abbreviations used can be found in ▹Appendix A - Abbreviations◃ from page 97 onward.

## 2.12 Certification

The Safety Module (BM5-O-SAF-001-000) from Baumüller Nürnberg GmbH has been developed in accordance with the standards specified in ▹Chapter 2.12.1◃ and certified by TÜV Rheinland.

| | |
|---|---|
| EC Type Examination Certificate Number: | 01/205/5031.01/16 |
| Test report no.: | 968/M 264.05/16 |
| Notified Body: | 0035 |

The Safety Module (BM5-O-SAF-001-001) from Baumüller Nürnberg GmbH has been developed in accordance with the standards specified in ▹Chapter 2.12.1◃ and certified by TÜV Rheinland.

| | |
|---|---|
| EC Type Examination Certificate Number: | 01/205/5563.03/18 |
| Test report no.: | 968/FSP 1400.03/18 |
| Notified Body: | 0035 |

### 2.12.1 Approvals, directives and standards

| **Safety engineering standards and directives** | **Area of application** | **Approvals** |
|---|---|---|
| IEC 61508, Parts 1-7 | Functional safety of safety-related electric, electronic and programmable electronic systems | up to SIL 3 |
| DIN EN ISO 13849-1 | Safety-related components of control units | up to performance level e<br>up to category 4 |
| IEC 62061 | Functional safety of safety-related electric, electronic and programmable electronic systems<br><br>Fulfillment of increased stability requirements in accordance with reference to EN 61326-3-1 | |
| **Additional standards** | **Area of application** | |
| DIN EN 61800-3 | Adjustable speed electrical power drive systems - Part 3: EMC requirements | |
| DIN EN 61800-5-1 | Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy | |
| DIN EN 61800-5-2 | Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional | |
| EN 61131-2 | Programmable controllers - Part 2: Equipment requirements and tests | |
| EN 60204-1 | Electrical equipment of machines | |

3

# USE OF THIS MANUAL

This safety manual contains information on the intended use of the Baumüller plug-in module.

Knowledge of the regulations and proper technical implementation of the safety instructions in this manual by qualified personnel are prerequisites for the safe installation, commissioning and safety during the operation and maintenance of the Baumüller plug-in module. Unqualified interference with the devices during shutdown or use of the safety functions or failure to comply with the instructions of this manual can lead to serious personal injury, property damage or environmental harm, for which Baumüller assumes no liability.

Baumüller safety components and systems are developed, manufactured and tested in compliance with the applicable safety standards. They may only be used under the specified environmental conditions and only in connection with approved external devices.

The operation manual contains safety instructions, descriptions of the interfaces and information on the phases of the product's life cycle:

- Planning
- Installation/Assembly
- Commissioning
- Validation
- Operation
- Modification/Retrofitting
- Troubleshooting
- Maintenance/Repair
- Disassembly

# 4

# SAFETY

This chapter provides an overview of all important safety aspects for the optimum protection of the personnel as well as for safe and trouble-free operation.

## 4.1 Contents of the operation manual

All persons assigned to work on or with the device must have read and understood that operation manual before beginning work with the device. This also applies if the person concerned has already worked with such a device or a similar device or has been trained by the manufacturer.

## 4.2 Alterations and rebuilding of the device

In order to avoid hazards and ensure optimum performance, neither alterations, additions nor rebuilding work may be conducted on the device unless explicitly authorized by the manufacturer.

## 4.3 Intended use

The plug-in module is exclusively designed and constructed for the intended purpose of use described here.

You are using the device according to the terms, as soon as you regard all notes and information in this operation manual.



**WARNING!**

**Danger due to use other than intended!**

Any use of the device different from and/or exceeding beyond the scope of the intended use can lead to dangerous situations.

Therefore:

- Only use the plug-in module as intended.
- Only use the plug-in module in combination with compatible converters (see ▹Compatibility list SAF-001-000-xxx◃ on page 38, ▹Compatibility list SAF-001-001-xxx◃ on page 38 and ▹Compatibility list SAF-001-000-002 with automatic restart◃ on page 39).
- Follow all specifications of this operation manual.
- Ensure that exclusively qualified personnel work on or with the plug-in module.
- Take care in project planning to see that the plug-in module is always used within its specifications.
- Ensure that the power supply meets the required specifications.
- Only operate the plug-in module if it is in technically faultless condition.
- Only use the plug-in module in combination with components approved by Baumüller Nürnberg GmbH.

## 4.4 Operator responsibility

The plug-in module is implemented in an industrial zone. The operator of the device is thus subject to the legal work safety obligations.

In addition to the work safety instructions in this operation manual, the safety, accident prevention and environmental protection regulations applicable to the area of application of this device must also be complied with. In doing so, the following applies in particular:

- The operator must inform himself of the applicable work safety regulations and additionally ascertain hazards arise through the special work conditions at the place of use of the device in a risk assessment. The operator must implement this in the form of operation instructions for the operation of the device.
- This operation manual must be kept in the immediate vicinity of the device and be accessible to persons working on and with the device at all times.
- The statements of the operation manual are to be followed completely and absolutely!
- The device may only be operated in technically faultless condition and must be safe for operation.

## 4.5 Protective equipment

When installed in the converter, the plug-in module complies with the protective category IP20.

## 4.6 Personnel training



**WARNING!**

**Risk of injury if operated by insufficiently qualified persons!**

Improper handling can lead to severe personal injury and property damage.

Therefore:

- Only allow certain activities to be conducted by persons specified in the respective chapters of this operation manual.

The following qualifications for various areas of operation are specified in the operation manual:

- **Operating personnel**
  The drive system may only be operated by persons who have been trained, instructed and authorized to do so.
  Troubleshooting, repairs, cleaning, maintenance and exchange may only be conducted by trained or instructed personnel. These persons must be familiar with the operation manual and act according to it.
  Commissioning and instruction may only be conducted by qualified personnel.
- **Qualified personnel**
  Electrical engineers and specialist electricians of the customer or a third party who are authorized by Baumüller Nürnberg GmbH, trained and certified in the installation and commissioning of Baumüller drive systems and commissioning, grounding and designating electrical systems and devices in accordance with the safety engineering standards.
  Qualified personnel is educated or trained in the maintenance and use of suitable safety equipment in accordance with the respective local safety engineering standards.

## 4.7 Personnel protective equipment

Wearing the appropriate personal protective equipment when working is required in order to minimize hazards to the health.

- Always wear the respective protective equipment required for the respective task when working.
- Observe signs on personal safety in the work area!



**Protective work clothes**

consists of close-fitting workwear of low tear strength, without loose sleeves or projecting parts. Intended mainly to protect the wearer from moving machine parts.

Do not wear any rings and necklaces.



**Protective helmet**

for protection from falling and flying parts.



**Safety shoes**

for protection from heavy falling objects.



**Safety gloves**

to protect hands from friction, abrasions, puncture, prick wounds or deeper injuries as well as from contact with hot objects.

**To be worn during special work**



**Protective glasses**

to protect the eyes from flying parts and spraying liquids.

## 4.8 Special dangers

The residual risks arising as a result of the hazard analysis will be specified in the following section.

Observe the safety instructions described here and the warning notices in the following chapters in order to reduce health hazards and avoid dangerous situations.

**Moving parts**



**WARNING!**

**Danger of injury due to moving parts!**

Rotating and/or linear moving parts can cause severe injuries.

Therefore:

- Do not interfere with moving parts during operation.
- Do not open covers during operation.
- The mechanical residual energy depends on the application. Powered parts will also keep rotating/moving for a certain time after the power supply has been shut off. Make sure to provide suitable safety equipment.

## 4.9 Fire fighting



**DANGER!**

**Live-threatening danger from electrical current!**

Electric shock can occur if a conductive fire extinguishing medium is used.

Therefore:

- Use the following fire extinguishing medium:



ABC-Pulver / $CO_{2<Default\ Font>}$

## 4.10 Electric safety

The plug-in module is designed for contamination level 2 in accordance with DIN EN 61800-5-1. This means that only non-conductive contamination may appear during operating time. Short-term conductivity from condensation is only permissible if the module is not in operation.



**WARNING!**

**Risk of injury from conductive contaminants!**

No conductive contaminants may appear during operating time.

Therefore:

- Before installing the system, check that contamination degree 2 is not exceeded, and ensure so by additional measures, if necessary.

### 4.10.1 Notice on power supply



**WARNING!**

**Risk of injury from electric current!**

Only devices which have a safe disconnection to the 230 volt mains may be connected to the plug-in module.

The power supply unit for generating the 24 Volt supply must meet the requirements for PELV in accordance with EN 60204-1.

## 4.11 Safety equipment



**WARNING!**

**Live-threatening danger from inoperable safety equipment!**

Safety equipment provides a maximum of safety during operation. Even if the safety equipment may make work processes more complicated, they may not be put out of operation under any circumstances. Safety is only ensured if the safety equipment is intact.

Therefore:

- Check to make sure that the safety equipment is functional and installed properly before beginning work.

## 4.12 Conduct in the event of danger and accidents

**Preventive measures**

- Always be prepared for accidents or fire!
- Keep first aid equipment (first-aid box, blankets, etc.) and fire extinguishers on hand!
- Instruct personnel in accident reporting, first aid and rescue equipment.

**In case of emergency: Act properly**

- Put the device out of operation immediately with the EMERGENCY STOP.
- Introduce first aid measures.
- Keep people out of the danger zone.
- Inform the supervisors at the site.
- Notify a doctor and/or fire department.
- Clear access routes for rescue vehicles.

## 4.13 Signage

The following symbols and notification signs are found in the work area. They relate to their immediate installation environment.



**WARNING!**

**Injury hazard due to illegible symbols!**

In the course of time, stickers and symbols on the device can become dirty or otherwise illegible.

Therefore:

- Keep all safety, warning and operation signs on the device in easily legible condition at all times.



**Electric current**

Only qualified personnel may work in work spaces with this marking.

Unauthorized persons may not touch work equipment bearing this marking.

# 5

# FUNCTIONAL SAFETY

This chapter describes parameters in relation to functional safety. First of all, in accordance with IEC 61508, safety means that a system is free of unwarranted risks. Functional safety is the part of the overall safety, which ensures that a safety system's response to its input conditions is free of errors. Internal safety-related device errors must be detected and brought into a safe condition in the process.

## 5.1 Safety-related parameters

The following table lists the safety-related parameters of the Safety Module (BM5-O-SAF-001) for an operation of 20 years. Safety-related parameters of local I/O terminals and decentralized components can be found in the applicable documentation.



**CAUTION!**

If the user calculates his safety application with 20 years for the specified values, the safety module will have to be decommissioned and sent back to the manufacturer within not more than 20 years. The user cannot perform a proof test.

### 5.1.1 SAF-001-000-xxx

The values in the following table relate exclusively to the Safety Module (BM5-O-SAF-001-**000**-xxx).

| **Parameters in accordance with IEC 61508** | |
|---|---|
| **Safety Module (SAF-001) configuration** | **PFH** (Probability of Failure per Hour) |
| Single axis @ 40°C | $7.21 * 10^{-10}$/h |
| Double axis @ 40°C | $1.18 * 10^{-9}$/h |
| Single axis @ 55°C | $1.20 * 10^{-9}$/h |
| Double axis @ 55°C | $2.11 * 10^{-9}$/h |
| | |
| **Safety Module (SAF-001) configuration** | **$PFD_{Av}$ (T=20 years)** (Probability of Failure on Demand = mean residual error probability of a dangerous error on demand) |
| Single axis @ 40°C | $6.32 * 10^{-5}$ |
| Double axis @ 40°C | $1.04 * 10^{-5}$ |
| Single axis @ 55°C | $1.05 * 10^{-4}$ |
| Double axis @ 55°C | $1.85 * 10^{-4}$ |
| | |
| SFF according to SIL 3 | Safe Failure Fraction = fraction of failures which lead to a safe status. |

| **Parameters in accordance with DIN EN ISO 13849-1** | | |
|---|---|---|
| **Safety Module (SAF-001) configuration** | **$MTTF_D$** (Mean Time To Failure) | **Classification** |
| Single axis @ 40°C | 1460 years | HIGH |
| Double axis @ 40°C | 770 years | HIGH |
| Single axis @ 55°C | 819 years | HIGH |
| Double axis @ 55°C | 432 years | HIGH |
| | | |
| **Safety Module (SAF-001) configuration** | **$DC_{avg}$** Diagnostic Coverage | **Classification** |
| All configurations | 97.7% | HIGH[a] |

a. This values lies within the permissible tolerance of 5% according to EN ISO 13849-1 for the classification HIGH.

No proof test is necessary during the expected life cycle of the device of up to 20 years.

### 5.1.2 SAF-001-001-xxx

The values in the following table relate exclusively to the Safety Module (BM5-O-SAF-001-**001**-xxx) per axis.

- Parameters in accordance with IEC 61508-1 to 7 and IEC 62061
  (Data if the device is used as part of a safety function)
  - SIL CL 3
  - PFH: 3,6 x $10^{-10}$ 1/h, according to 0,4 % of SIL 3
  - $PFD_{av}$: 3,2 x $10^{-5}$ according to 3,2 % of SIL 3
  - Proof test interval 20 years

  Note: If the PFH value is less than 1% of the allowed SIL level, the execution of a special proof test is not considered to be necessary within the operating time of the device.

- Parameters in accordance with EN ISO 13849-1
  - Performance Level PL e
  - Category: Kat 4
  - $MTTF_D$: HIGH (751 a)
  - Diagnostic Coverage DC: HIGH (99 %)

# 6

# PACKAGING AND SHIPPING

Before shipping, we package every Baumüller device in such a manner that damaging occurring during transport is very unlikely.

## 6.1 Shipping

Modules are packaged at the factory according to the order.

- Avoid heavy shaking and concussions when shipping.
- Avoid static discharges on the electronic components of the module.
- Only remove the module from the protective packaging immediately before assembly.

## 6.2 Unpacking

Upon receiving the still-packaged module:

- Check to see if any shipping damages can be found!

If so:

- Immediately file a complaint to the supplier. Confirm the complaint in writing and immediately contact the representative of Baumüller Nürnberg GmbH who is assigned to assist you.



**CAUTION!**

**Danger due to electrostatic discharge!**

The plug-in module (specifically its electronic components) can be damaged or totally destroyed if exposed to electrostatic discharges by being touched by hand.

Therefore:

- Follow the rules and instructions on handling components sensitive to electrostatic discharge when handling the plug-in module.

If no damage from shipping can be found:

- Open the packaging of the device.
- Check the items included in the delivery against the bill of delivery.

The items included in the delivery are:

- **Plug-in module for b maXX 5000**
- This operation manual including certificate of conformity / declaration of manufacturer.

- If any shipping damages can be found or any items are missing from the delivery, file a complaint to the Baumüller representative assigned to you.

## 6.3 Disposing of the packaging

The packaging consists of cardboard and plastic.

- Follow local regulations on disposal if you dispose of the packaging.

## 6.4 To be observed when shipping

The module has been packaged at the factory for the initial shipping. If you subsequently need to ship the module again, please observe the following:

- Use the original packaging

or

- use suitable packaging for the components groups which are sensitive to electrostatic discharge.

Make sure that the shipping conditions (see ▹Appendix C - Technical data◃ from page 103 onward) are consistently fulfilled throughout the entire shipping process.

7

# DESCRIPTION OF THE DEFAULT AND PARAMETER MODULE

This chapter describes the SAF-000 (Default and Parameter module) with it´s functions and the type code applied to the module.

## 7.1 General

To operate the axis units of the b maXX 5000 device series, the slot A of the device has to be assembled with a module (see 5.09021, Manual b maXX 5000, too). If no safety functions are required, the module SAF-000 can be used. There are two variants available:

- BM5-O-SAF-000-001-001-#00 Default module
  - The module itself has no functionality and is used if no additional functions such as parameter storage or safety functions, for example, are required.
- BM5-O-SAF-000-000-000-#00 Parameter module
  - The module is provided with a user storage for the functional parameters for the axis unit. In case of service the module can be plugged in an exchange unit. Therefore it is possible to transmit the parameters to the exchange unit in an easy way.

## 7.2 Compatibility list

The SAF-000 modules Default and Parameter can only be operated in combination with converters of the type b maXX 5000 released by the company Baumüller GmbH.

If the converter was previously equipped with a module with a higher safety level (SAF-001/002/003), the parameter storage of the converter must be reset with the Reset-Module.

## 7.3 Working principle parameter module (BM5-O-SAF-000-000-000)

The adjusted parameters of the b maXX 5000 axis unit can be stored on the SAF-000 parameter module. The parameter backup is carried out by the parameterization software ProDrive. The software provides this function with adequate buttons at the page „Data set management“. By selecting these buttons parameter data can be written to or read from the SAF-000.

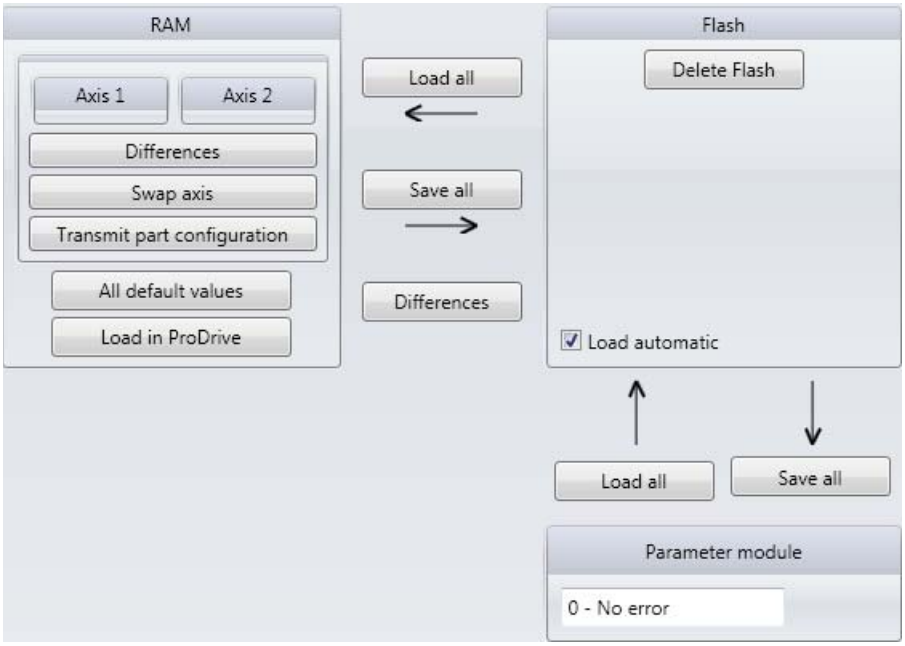



Figure 1: Data set management ProDrive

**NOTICE!**

The parameter data cannot be copied to the SAF-000 Parameter module, if a complete data set which was loaded before of that from the RAM with **all** the parameters, was loaded in the flash memory of the b maXX 5000 again.

## 7.4 Setting of the switch-on behavior

The switch-on behavior of the SAF-000 parameter module from a b maXX 5000 axis unit can be set by ProDrive at the page „Data set management“ by means of the checkbox „Load automatical“.

Two switch-on behaviors can be set:

| „Load automatical“ | Description |
|---|---|
| OFF | The parameters are not loaded automatically. |
| ON | The parameters are loaded from the parameter module at every re-start (Default setting). |

The setting „OFF“ is usually used during the commissioning of the axis unit. Here it is often not necessary to backup the parameter data while changes happen. If the commissioning is done, the setting „ON“ can be done at the device.

In this setting the SAF-000 parameter module checks at every re-start whether there is a difference between the parameters of the axis unit and the saved data of the module. If the data differs, the parameters saved at the SAF-000 parameter module are transmitted to the axis unit automatically and stored to the flash of the axis unit. At the next re-start both parameter sets are equal, that means no new transmission has to be done.

This behavior assures, that the parameters are only in the case of service written back from the module to the axis unit.

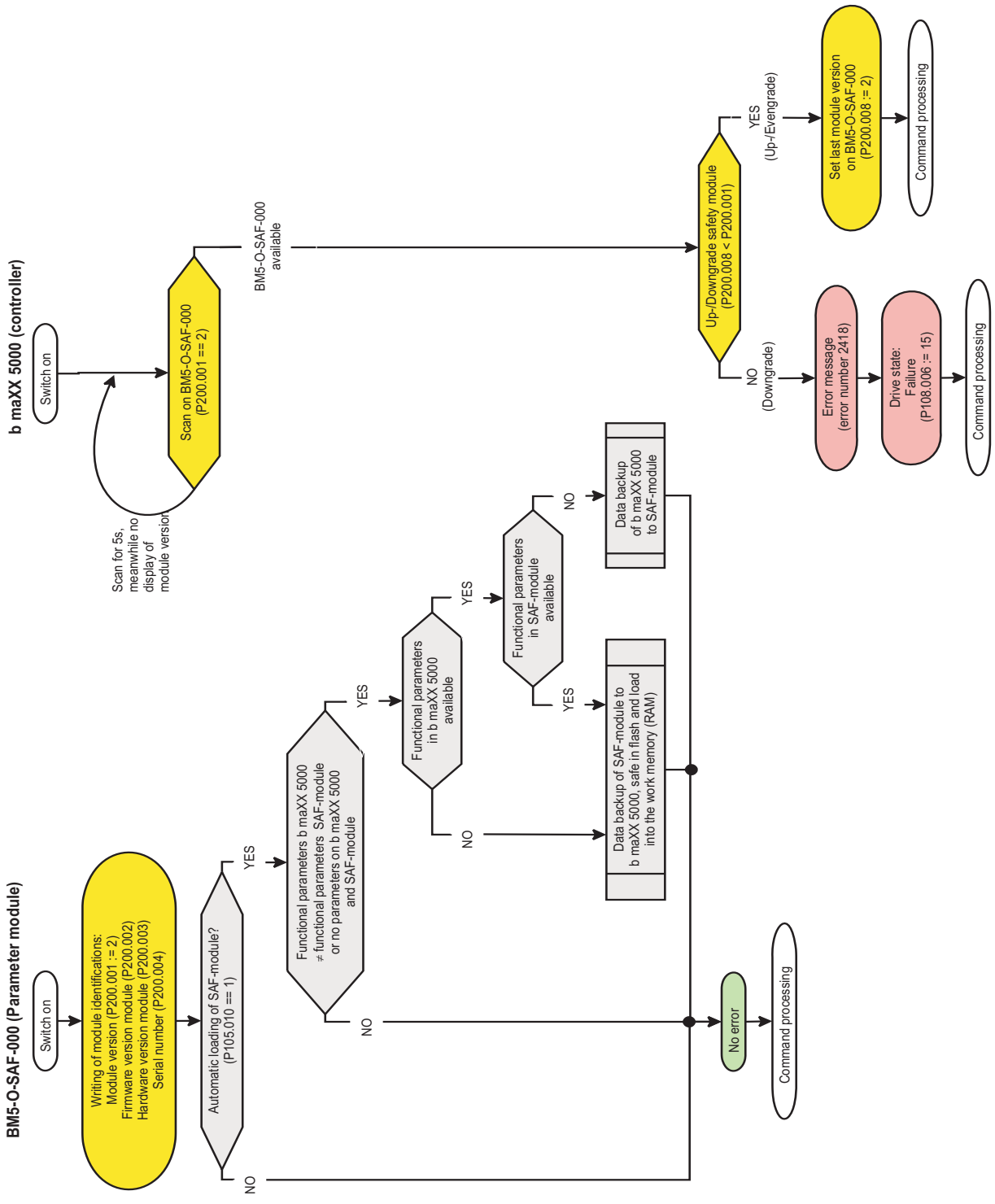



Figure 2: Flow diagram switch-on behavior

## 7.5 Structure of the SAF-000 Default- and Parameter module

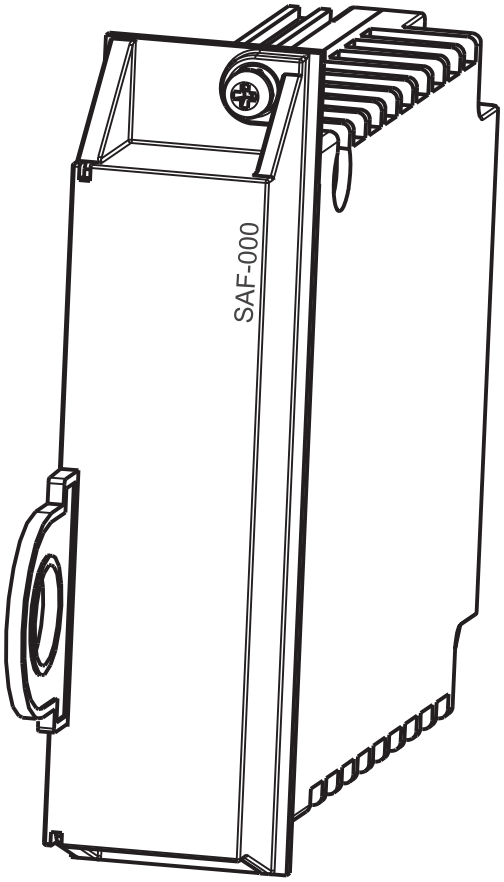



Figure 3: SAF-000 Default- and Parameter module

## 7.6 Identification of the SAF-000 Default- and Parameter module

The type plate of the SAF module with the appropriate type key is to be found on the right hand side of the module (see the following example).




Figure 4: Example type plate SAF-000 Modul

**NOTICE!**

The third and fourth digit of the serial number provide information on the year of production. Example: Serial number „S310045208“ corresponds to production year 2010.

## 7.6 Identification of the SAF-000 Default- and Parameter module



**NOTICE!**

This type code applies exclusively to the Default- and Parameter module. Other modules have their own type codes.

| | |
|---|---|
| BM5 - O - SAF - 000 - xxx - xxx - #xx | Generation of the device in which the module can be used (BM5 = BM5000). |
| BM5 - O - SAF - 000 - xxx - xxx - #xx | Optional module |
| BM5 - O - SAF - 000 - xxx - xxx - #xx | Safety module |
| BM5 - O - SAF - X0X - xxx - xxx - #xx | Version of the safety module<br>000: Default parameter module<br>100: Reset module |
| BM5 - O - SAF - 000 - xxx - xxx - #xx | Hardware version of the safety module |
| BM5 - O - SAF - 000 - xxx - xxx - #xx | Software version of the safety module<br>000: Parameter module<br>001: Default module |
| BM5 - O - SAF - 000 - xxx - xxx - #xx | Safety level (identification for the compatibility between converter and safety module) |

8

# DESCRIPTION OF THE SAFETY MODULE (SAF-001)

This chapter describes the Safety Module (SAF-001), the meaning of the display and operation elements and the type code applied to the module.

## 8.1 General

### 8.1.1 Safety Module SAF-001-000-xxx and SAF-001-001-000 with safety function STO

The Safety Module (SAF-001-**000**-xxx) is a pure hardware solution for realization of the safe shutdown of the optocouplers in the driver stage of converters (the parameterization via software is not possible).

The safety module (SAF-001-**001**-xxx) enables the safe shutdown of the optocouplers in the driver of converters by means of the microcontroller. A software parameterizing is not possible.

The modules SAF-001-000-xxx and SAF-001-00**1**-000 only perform the safety function „Safe Torque Off (STO)“ (according to EN 61800-5-2). With the safety function STO, the drive is shut down by the safe pulse inhibitor.

**Safe Torque Off (STO):**

- With the safety function STO, the actuation of the power output module is safely interrupted. Thus, the motor can no longer generate a rotary field. The motor coasts down in an uncontrolled manner when this safety function is activated.
- The safety function STO corresponds to Stop Category 0 of EN 60204-1.

### 8.1.2 Safety Module SAF-001-001-001 with safety function SS1 (time controlled)

After expiry of a specified time the safety module (SAF-001-00**1**-00**1**) allows a safe switching off of the optocouplers in the driver stage of converters by means of microcontrollers. A parameterization via the software is not possible.

The module SAF-001-00**1**-00**1** carries out the safety function "Safe Stop 1 (SS1)" (safe stop 1 with time control according to EN61800-5-2), exclusively. After the expiry of the

fixed SS1 time of 200 ms the drive is switched off by a safe pulse inhibit. After that the module is in the STO state (safe torque off).

**Safe Stop 1 (SS1) with time control:**

- When using the safety function SS1 the control of the power output stage is safely interrupted after a delay time of 200 ms. The drive can be braked to a standstill by the drive control within the SS1 time if appropriate parameterizations were made in the controller (see Working Principle ▹SAF-001-001-xxx◃ on page 40).
- The safety function SS1 corresponds to Stop Category 1 of EN 60204-1.

## 8.2 Compatibility list

### 8.2.1 Compatibility list SAF-001-000-xxx

The Safety Module (SAF-001-000-xxx) can only be operated in combination with converters of the type b maXX 5000 released by the company Baumüller Nürnberg GmbH.

If the converter was previously equipped with a module with a higher safety level (SAF-002/003), the parameter storage of the converter must be reset with the Reset-Module.

### 8.2.2 Compatibility list SAF-001-001-xxx

The Safety Module (SAF-001-001-xxx) with automatic restart can only be operated in combination with converters of the type b maXX 5000 with firmware version V01.10.02 or higher by the company Baumüller Nürnberg GmbH. A firmware version V01.14.00 or higher must be used for the Safety Module with SS1 function (SAF-001-001-001).

If the converter was previously equipped with a module with a higher safety level (SAF-001 without automatic restart, SAF-002 or SAF-003), the parameter storage of the converter must be reset with the Reset-Module or with the reset command (see ▹Operation mode of the reset command◃ on page 65).

If the converter was previously equipped with a module which includes a STO function (SAF-001-000-xxx, SAF-001-001-000) and is equipped with the module STO 001-001-001 (SS1 function), the safety level of the converter must be reset to zero by the Reset module or by the Reset command (see ▹Operation mode of the reset command◃ on page 65).



**WARNING!**

A converter b maXX 5000 with a firmware version V01.14.00 or higher must be used for the Safety Module with SS1 function (SAF-001-001-001).

### 8.2.3 Compatibility list SAF-001-000-002 with automatic restart

The Safety Module (SAF-001-xxx-002) with automatic restart can only be operated in combination with converters of the type b maXX 5000 with firmware version V01.07.02 or higher by the company Baumüller Nürnberg GmbH.

If the converter was previously equipped with a module with a higher safety level (SAF-001 without automatic restart, SAF-001-001-xxx, SAF-002 or SAF-003), the parameter storage of the converter must be reset with the Reset-Module or with the reset command.

## 8.3 Safety notes on the STO (Safe Torque Off)



**WARNING!**

- When STO is activated, the drive is not disconnected from power supply.
- The safety function Safe Torque Off (STO) is not sufficient as the only safety function for drives which are affected by a permanent moment, for example, in case of suspended loads.
- Use the Safety Module (SAF-001) only in combination with converters released by the company Baumüller Nürnberg GmbH (see the chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38).
- The Safety Module (SAF-001) may only be operated in combination with emergency stop devices according to DIN EN ISO 13850 or safety sensors according to EN 61496.



**WARNING!**

In the unlikely event of a total failure of an internal driver (IGBT) or a control element, a temporary excitation of the drive can occur (also if STO is active). The angular movement covered depends on the rotor position and the number of pole pairs of the motor. The maximum is 180°/number of pole pairs.



**DANGER!**

**Danger due to moving engine parts!**

The supply of the inputs by a connected safety component (emergency stop device, safety light curtain) leads to the immediate supply of the driver stage. A converter failure may lead to an unexpected start-up. Ensure by the use of the external safety components that an unexpected start-up is prevented during commissioning.

Therefore:

- Maintain an adequate distance from moving machine parts/line parts or from the moving machine/line.



**WARNING!**

If a module with STO function is reset (such as SAF 001-001-000) by a module with SS1 function (such as SAF-001-001-001) the user must consider the SS1 time. Not before the SS1 time has expired after the module was activated, the module changes into the safe state STO (safe torque off).

## 8.4 Working principle

### 8.4.1 SAF-001-000-xxx

The Safety Module (SAF-001-000-xxx) provides the power for the power stage of the converter. The voltage applied on the input side of the Safety Module (SAF-001-000-xxx) is converted to an alternating signal and transferred to the secondary side by the DC/DC converter of the module. Power can only be transferred to the secondary side of the DC/DC converter, if the Safety Module (SAF-001-000-xxx) is supplied on the input side via an emergency stop device, an electromagnetic safety sensor (for example safety light curtain) or another safety device (for example output of a safety control).

In case of a failure or on request (by activating an emergency stop device, interrupting a safety light curtain), the Safety Module (SAF-001-000-xxx) ensures that the power supply of the converter in the power stage is shut down safely and the pulse inhibitor is activated. Thus, the motor can no longer generate a rotating field. The mains supply is not disconnected from the motor when the shut down function is activated.

### 8.4.2 SAF-001-001-xxx

The Safety Module (SAF-001-001-xxx) provides the supply for the driver of the converter. The voltage applied on the input side of the Safety Module (SAF-001-001-xxx) is evaluated by two microcontrollers monitoring each other. They enable the driver of the converter if the Safety Module (SAF-001-001-xxx) provides an emergency device, an electric safety sensor (such as a safety light array) or another safety device (such as a safety control output).

An internal short circuit detection is provided by the device: If the STO requirement is made by a single channel, only (STO_A or STO_B) then the device remains in the STO status and cannot be enabled anymore. If voltage is on both channels simultaneously then the axis can be enabled again after re-applying 24 V to both channels.

In case of a failure or on request (by activating an emergency stop device, interrupting a safety light curtain), the Safety Module (SAF-001-001-xxx) ensures that the power supply of the converter in the power stage is shut down safely and the pulse inhibitor is activated. Thus, the motor can no longer generate a rotating field. The mains supply is not disconnected from the motor when the shut down function is activated.

After activating the module SAF-001-001-001 the SS1 time runs for the full period before it changes into the STO state even though 24 V are applied to both of the input channels of the module again while the SS1 is running. The drive enable is only possible if there was no voltage at both channels at the same time after reaching STO and the 24 V are applied again.

- The module SAF-001-001-001 carries out the safety function "Safe Stop 1 (SS1)" (safe stop 1 including the time control according to EN 61800-5-2), only.
- The SS1 time of the Safety Module SAF-001-001-001 is a fixed amount of 200 ms and cannot be parameterized.
- The tolerance of the SS1 time of the SAF-001-001-001 module is -6 ms to 1 ms due to component tolerances and tolerances in the STO reaction time. Therefore the reaction time is 194 ms to 201 ms until the change of the input states to < 5 V.
- Once the fixed SS1 time of 200 ms has passed the drive is switched off by a safe pulse inhibit. The module returns to the STO state (safe torque off) after this.
- The safety function SS1 corresponds to Stop Category 1 of EN 60204-1.
- The start of activation can be reported to the controller in order to initiate a steep braking ramp of the drive or to send the information of the coming STO to a fieldbus master (refer to the following information):

Time controlled SS1 function

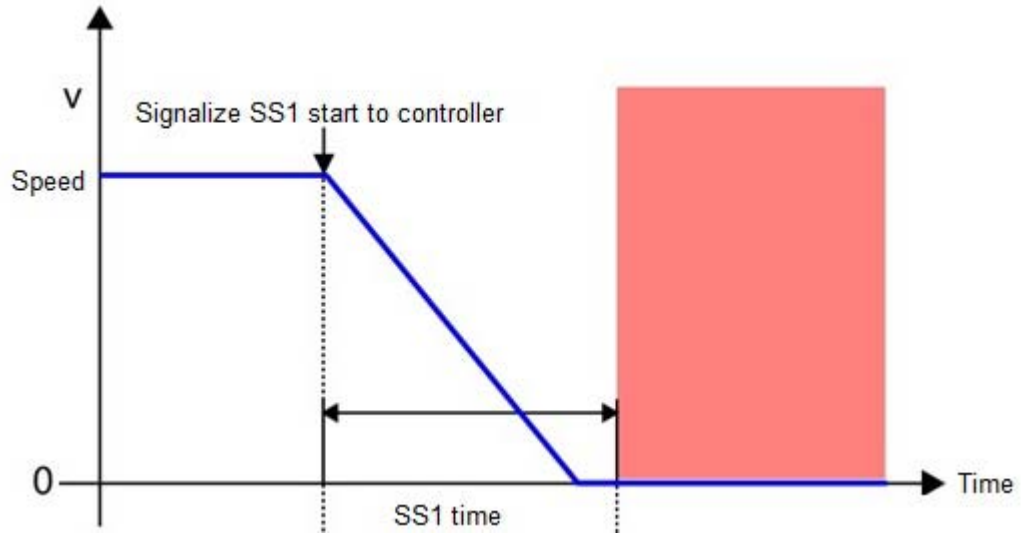



Figure 5: Time-controlled SS1-function with the option "Signal SS1 start to the controller"

The SS1-signaling can be evaluated via bit 1 from the controller FW V01.14.01 in the parameter 108.5 (status word 2 of the drive manager).

As soon as the bit is set the SS1-time begins to run.

This bit information can be used to enable a braking procedure at the ramp in the controller (SS1-stop, stop at the current limit) or to map to a fieldbus parameter in order to send the information to a higher-level fieldbus master (bit 1 = 0: not activated; bit 1 = 1: SS1-time is running).

For the required settings of a braking procedure in the controller refer to the current parameter manual b maXX BM5000 ("SS1" stop, "SS1 stop time" and error reaction).

Besides the error reaction "SS1 stop" another available error reaction can be parameterized as well (such as "stop at the current limit").

The module SAF-001-001-001 is displayed in parameter 200.1 (SAF module version) from the controller FW V01.14.00 (value 28):

## 8.5 Input circuitry

### 8.5.1 SAF-001-000-xxx

Depending on the input circuitry of the Safety Module (SAF-001-000-xxx), the module can be operated with different safety components (emergency stop device, electronic safety sensor). The examples in the following sections show the wiring of the Safety Module (SAF-001-000-xxx) for the operation with an emergency stop device, a safety light curtain and the Baumüller Safety I/O terminal SO4000.



**WARNING!**

The power supply unit for generating the 24 Volt electrical supply must meet the requirements for PELV according to EN 60204-1.

### 8.5.1.1 Operation with emergency stop device

The following example for the wiring of an emergency stop device with the Safety Module (SAF-001-000-xxx) ensures that short circuits on the input side are detected. In case of a short circuit on the input side, the converter always switches to the STO (Safe Torque Off) status.

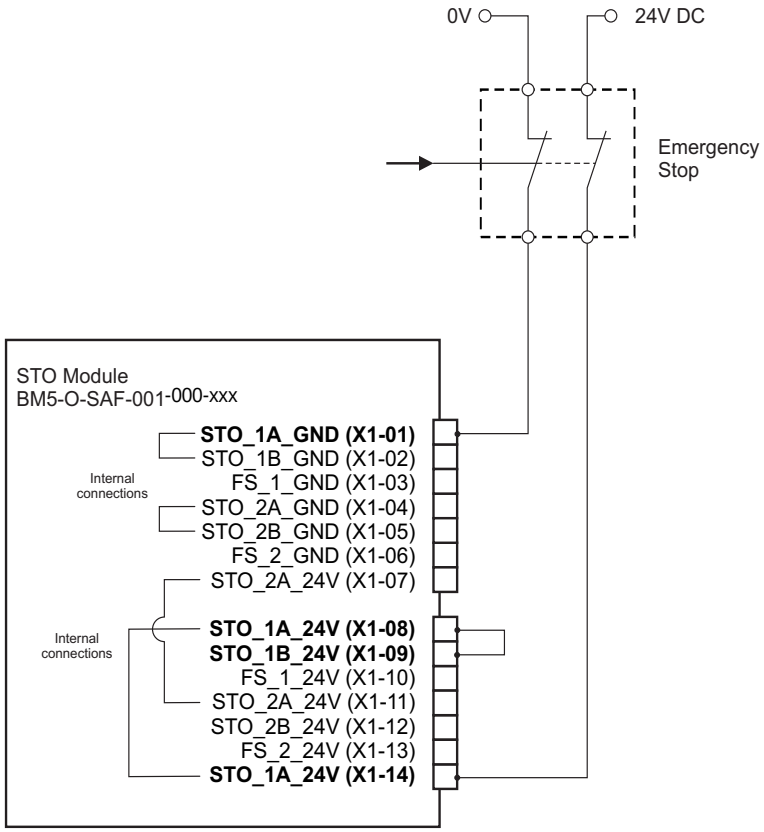



Figure 6: Safety Module (SAF-001-000-xxx) with emergency stop device

### 8.5.1.2 Operation with safety light curtain

If the Safety Module (SAF-001-000-xxx) is operated with a safety light curtain or a safety control, the reference potential (0 V) is hard-wired on the input side. The two-channel shut down is then performed by two safety outputs (monitored by the safety sensor) which provide the two-channel supply for the Safety Module (SAF-001-000-xxx).

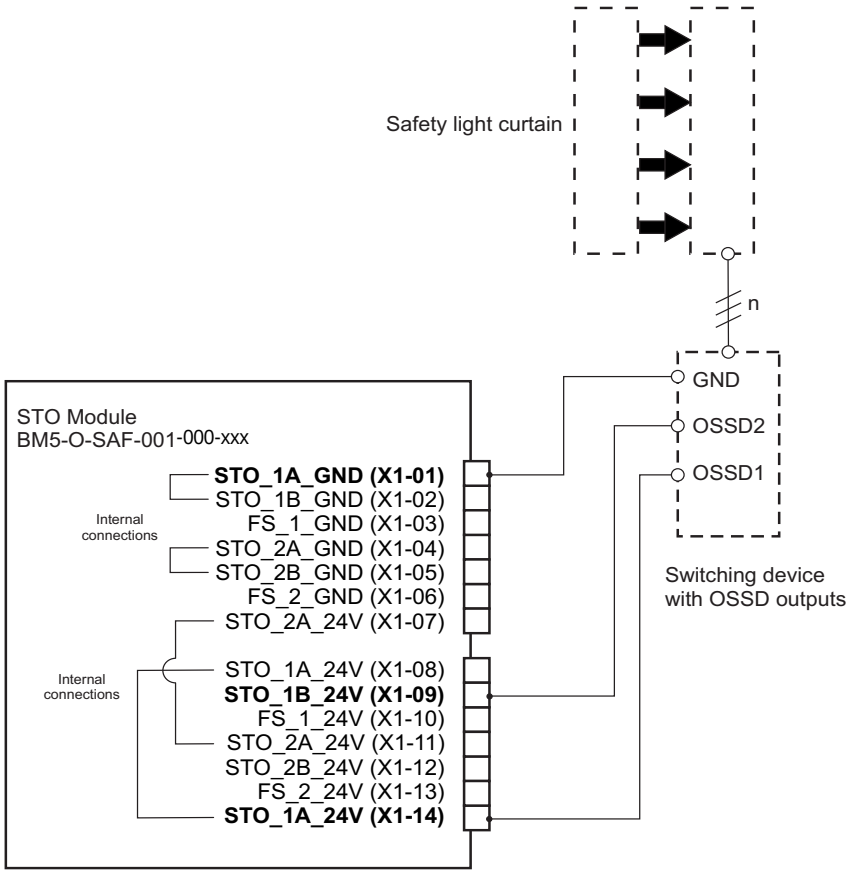



Figure 7: Safety Module (SAF-001-000-xxx) with safety light curtain

### 8.5.1.3 Operation with Baumüller Safety I/O terminal SO4000

The output terminal SO4000 shown in ▹Figure 8◃ on page 45 provides bipolar safety outputs. For connection of the Safety Module (SAF-001-000-xxx), the 0 V switching output is wired with STO_1A_GND (for axis 1) and STO_2A_GND (for axis 2). The corresponding 24 V switching output is wired with terminal STO_1A_24V (for axis 1) and STO_2A_24V (for axis 2). The inputs STO_1B_24V and STO_2B_24V are supplied by an external wire strap.

Short circuits of the outputs of the Baumüller Safety output terminal SO4000 to supply potentials or between the outputs are detected by the output terminal and lead to the shut down.

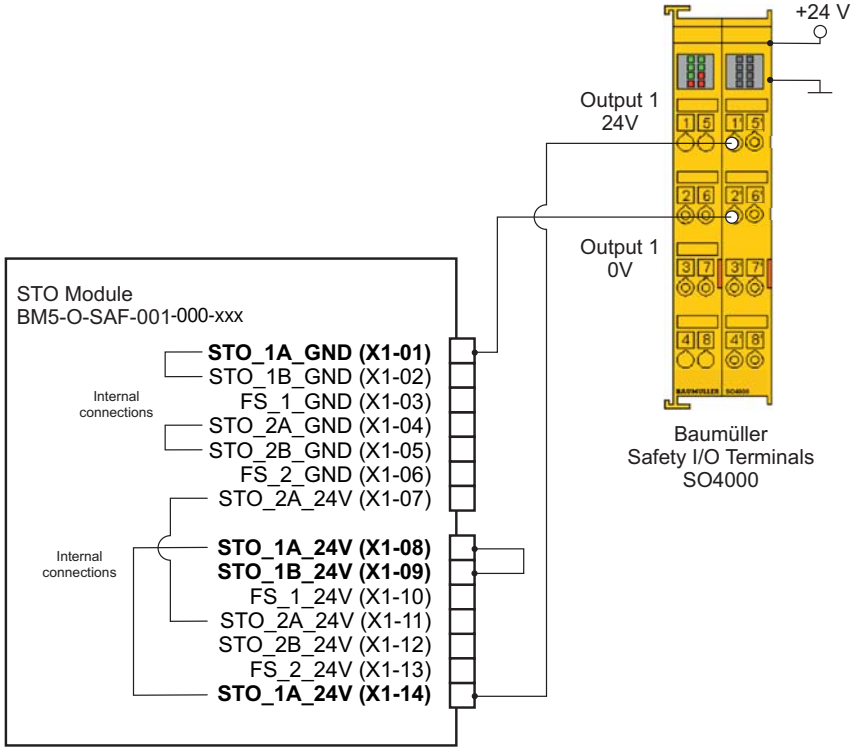



Figure 8: Safety Module (SAF-001-000-xxx) with SO4000

### 8.5.2 SAF-001-001-xxx

Depending on the input circuitry of the Safety Module (SAF-001-001-xxx), the module can be operated with different safety components (emergency stop device, electronic safety sensor). The examples in the following sections show the wiring of the Safety Module (SAF-001-001-xxx) for the operation with an emergency stop device and a safety light curtain.



**WARNING!**

The power supply unit for generating the 24 Volt electrical supply must meet the requirements for PELV according to EN 60204-1.

#### 8.5.2.1 Operation with emergency stop device

The following example for the wiring of an emergency stop device with the Safety Module (SAF-001-001-xxx) ensures that short circuits on the input side are detected. In case of a short circuit on the input side, the converter always switches to the STO (Safe Torque Off) status.

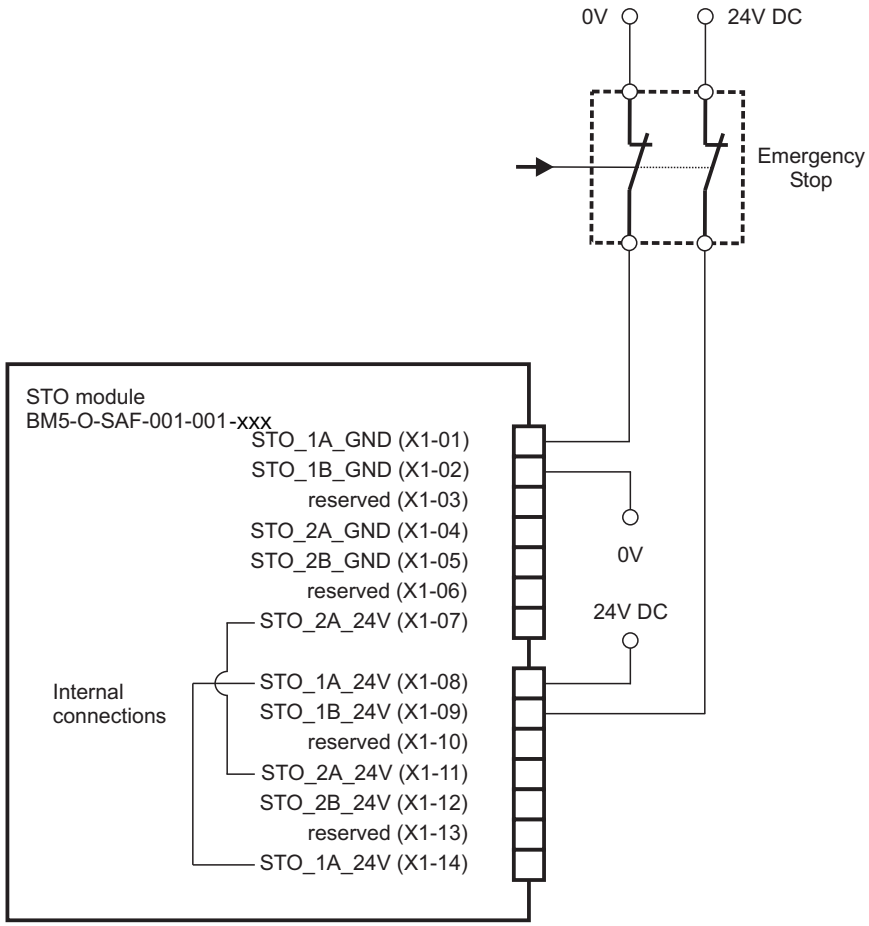



Figure 9: Safety Module (SAF-001-001-xxx) with emergency stop device

### 8.5.2.2 Operation with safety light curtain

If the Safety Module (SAF-001-001-xxx) is operated with a safety light curtain or a safety control, the reference potential (0 V) is hard-wired on the input side. The two-channel shut down is then performed by two safety outputs (monitored by the safety sensor) which provide the two-channel supply for the Safety Module (SAF-001-001-xxx).

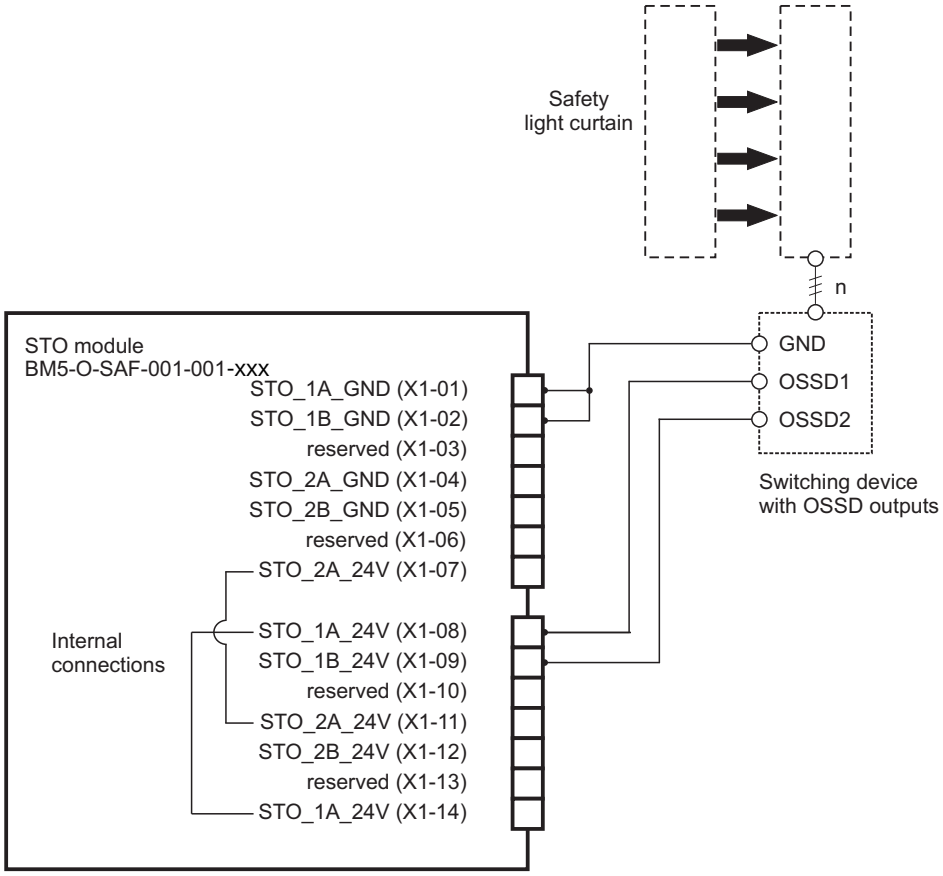
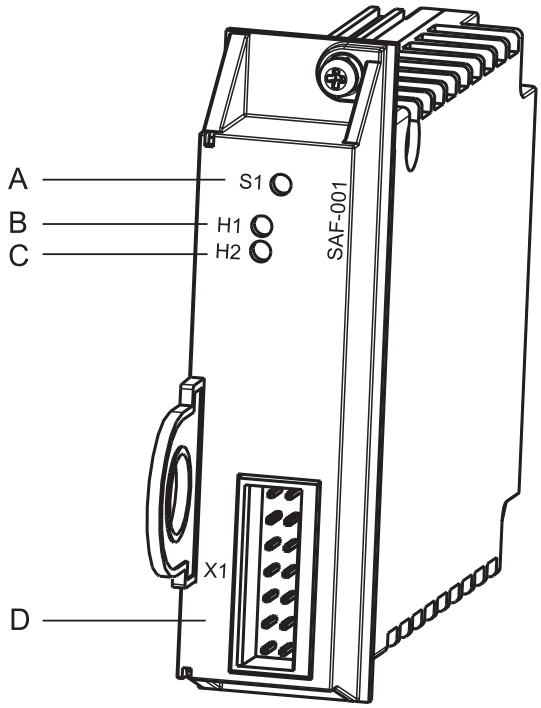



Figure 10: Safety Module (SAF-001-001-xxx) with safety light curtain

## 8.6 Structure

### 8.6.1 Structure of the Safety Module (SAF-001-000-xxx)




A = Button S1
B = LED H1 - green
C = LED H2 - red
D = Connector X1

Figure 11: Safety Module (SAF-001-000-xxx)

### 8.6.2 Structure of the Safety Module (SAF-001-001-000)

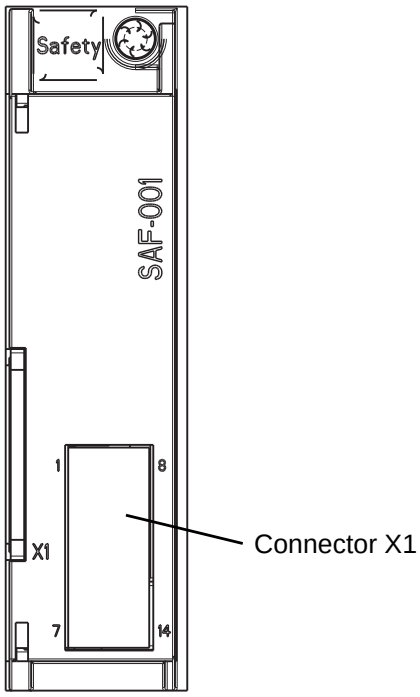



Figure 12: Safety Module (SAF-001-001-000)

### 8.6.3 Structure of the Safety Module (SAF-001-001-001)

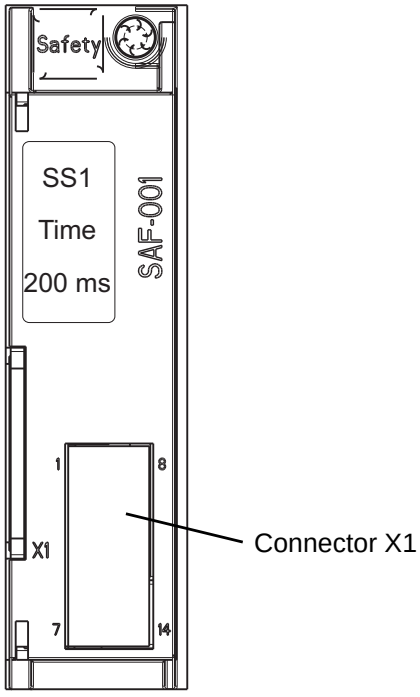



Figure 13: Safety Module (SAF-001-001-001)

## 8.7 Pin assignment

### 8.7.1 Pin assignment of connector X1 (SAF-001-000-xxx)

The Safety Module (SAF-001-000-xxx) provides a 14-pin connector on the front with the following assignment.

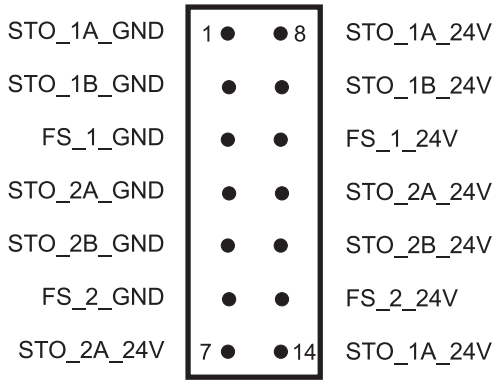



Figure 14: Pin assignment of connector X1 (on front of Safety Module (SAF-001-000-xxx))

| Pin | Assignment | Description |
|---|---|---|
| 1 | STO_1A_GND | 0V safety device axis 1 / channel A |
| 2 | STO_1B_GND | 0V safety device axis 1 / channel B |
| 3 | FS_1_GND | 0V input restart axis 1 |
| 4 | STO_2A_GND | 0V safety device axis 2 / channel A |
| 5 | STO_2B_GND | 0V safety device axis 2 / channel B |
| 6 | FS_2_GND | 0V input restart axis 2 |
| 7 | STO_2A_24V | +24V safety device axis 2 / channel A |
| 8 | STO_1A_24V | +24V safety device axis 1 / channel A |
| 9 | STO_1B_24V | +24V safety device axis 1 / channel B |
| 10 | FS_1_24V | +24V input restart axis 1 |
| 11 | STO_2A_24V | +24V safety device axis 2 / channel A |
| 12 | STO_2B_24V | +24V safety device axis 2 / channel B |
| 13 | FS_2_24V | +24V input restart axis 2 |
| 14 | STO_1A_24V | +24V safety device axis 1 / channel A |

### 8.7.2 Pin assignment of connector X1 (SAF-001-001-xxx)

Pin assignment see ▹Chapter 8.7.3 Pin assignment of connector X1 (SAF-001-000-002 with automatic restart)

### 8.7.3 Pin assignment of connector X1 (SAF-001-000-002 with automatic restart)

The Safety Module (SAF-001-000-002) provides a 14-pin connector on the front with the following assignment.

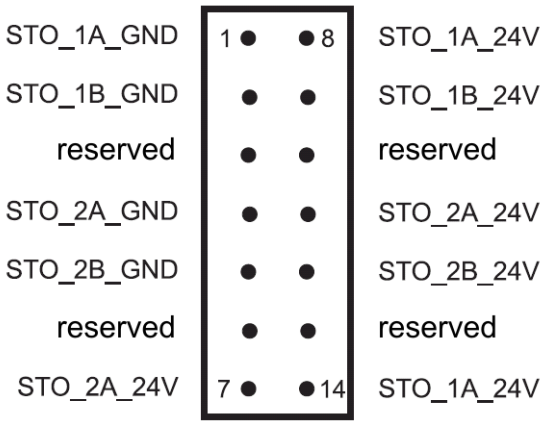



Figure 15: Pin assignment of connector X1 (on front of Safety Module (SAF-001-000-002))

| Pin | Assignment | Description |
|---|---|---|
| 1 | STO_1A_GND | 0V safety device axis 1 / channel A |
| 2 | STO_1B_GND | 0V safety device axis 1 / channel B |
| 3 | Reserved | |
| 4 | STO_2A_GND | 0V safety device axis 2 / channel A |
| 5 | STO_2B_GND | 0V safety device axis 2 / channel B |
| 6 | Reserved | |
| 7 | STO_2A_24V | +24V safety device axis 2 / channel A |
| 8 | STO_1A_24V | +24V safety device axis 1 / channel A |
| 9 | STO_1B_24V | +24V safety device axis 1 / channel B |
| 10 | Reserved | |
| 11 | STO_2A_24V | +24V safety device axis 2 / channel A |
| 12 | STO_2B_24V | +24V safety device axis 2 / channel B |
| 13 | Reserved | |
| 14 | STO_1A_24V | +24V safety device axis 1 / channel A |

## 8.8 Switching thresholds for voltage and current



**NOTICE!**

If electronic sensors such as safety light curtains are used, it must be ensured that these components can provide the input currents required for the supply of the Safety Module (SAF-001).



**NOTICE!**

If electronic sensors with OSSD outputs are used, it must be considered that the maximum test pulse width of 2 ms is not exceeded.



**NOTICE!**

If the STO connections are connected to the 24V supply system external safety devices against surge voltages are required.

**Inputs STO_1A_24V, STO_1B_24V, STO_2A_24V and STO_2B_24V**

Voltage and current switching thresholds (on input side) of the inputs STO_1A_24V, STO_1B_24V, STO_2A_24V and STO_2B_24V:

| Voltage / Current | Switching threshold SAF-001-000-xxx | Switching threshold SAF-001-001-xxx |
|---|---|---|
| U high max | 30 V | 30 V |
| U high min | 20 V | 20 V |
| U low max | 5 V | 5 V |
| U low min | -0.3 V | -0.3 V |
| I high max eff | 135 mA (per axis at 20 V) | approx.31 mA (per axis at 20 V) |
| I high min eff | 105 mA (per axis at 30 V) | approx. 35 mA (per axis at 30 V) |
| I low max eff | 17 mA (per axis at 5 V) | approx. 23 mA (per axis at 5 V) |
| Input capacitance | 47 µF (per input) | 1 µF (per input) |

**Inputs FS_1_24V and FS_2_24V (restart axis 1 and 2)**

The inputs FS_1_24V and FS_2_24V (restart axis 1 and 2) are in the normal range for digital inputs according to type 1 (EN 61131-2).

## 8.9 Maximum response time

The maximum response time of the Safety Module (SAF-001-**000**-xxx) is $t_R \leq 20$ ms.

The maximum response time of the Safety Module (SAF-001-**001**-xxx) is $t_R \leq 45$ ms.

For the input voltage range specified in chapter ▹Switching thresholds for voltage and current◃ from page 52 onward, the voltage threshold on the output side of the corresponding power module is underrun during this response time. Below this threshold the pulse inhibitor of the converter (see chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38) is active.

## 8.10 Properties of the parameter memory

The default parameterization of the converter is stored in the parameter memory. If the converter should be exchanged, the parameter data are available and can be copied from the Safety Module (SAF-001) to the new converter.



**NOTICE!**

The parameter data cannot be copied to the Safety Module (SAF-001), if a complete data set which was loaded before of that from the RAM with **all** the parameters, was loaded in the flash memory of the b maXX 5000 again.

The Safety Module (SAF-001-001-xxx) has no parameter memory.

## 8.11 Operation and display elements

### 8.11.1 LEDs for indicating the operation statuses

There are two LEDs (LED H1 - green, LED H2 - red) on the front of the Safety Module (SAF-001-000-xxx) that indicate the current operation status.

- LED H1 (green) - Indicates the trouble-free operation
- LED H2 (red) - Indicates failures or incompatibility with the converter

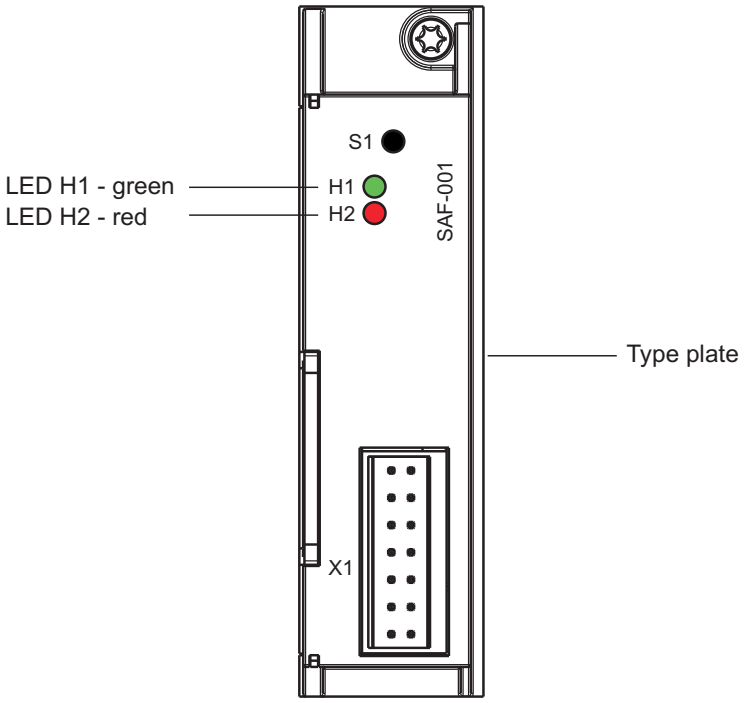



Figure 16: LEDs on front of the Safety Module (SAF-001-000-xxx)

The following table lists the possible combinations of the status LEDs and the corresponding meaning:

| LED | | Meaning |
|---|---|---|
| H1 (green) | H2 (red) | |
| Off | Off | No supply voltage. |
| On | Off | Trouble-free operation. |
| Off | Flashes | Device error or unallowed replacement of the module (commissioning not possible). |
| Off | On | Firmware and parameter data of the Safety Module (SAF-001) do not correspond with the data of the converter. The parameter data of the converter has to be copied to the Safety Module (SAF-001) by pressing the button S1 (long - short - short - long). |

The Safety Module (SAF-001-001-xxx) has no LEDs.

### 8.11.2 Button for verification purposes

The button on the front of the Safety Module (SAF-001-000-xxx) is used to confirm the data transfer of the default parameter data of the converter to the parameter memory of the Safety Module (SAF-001-000-xxx). The button must be actuated as follows: Long – short – short – long (long > 1000 ms, 500 ms < short < 1000 ms, see also the chapter ▹Exchanging the module◃ from page 79 onward).

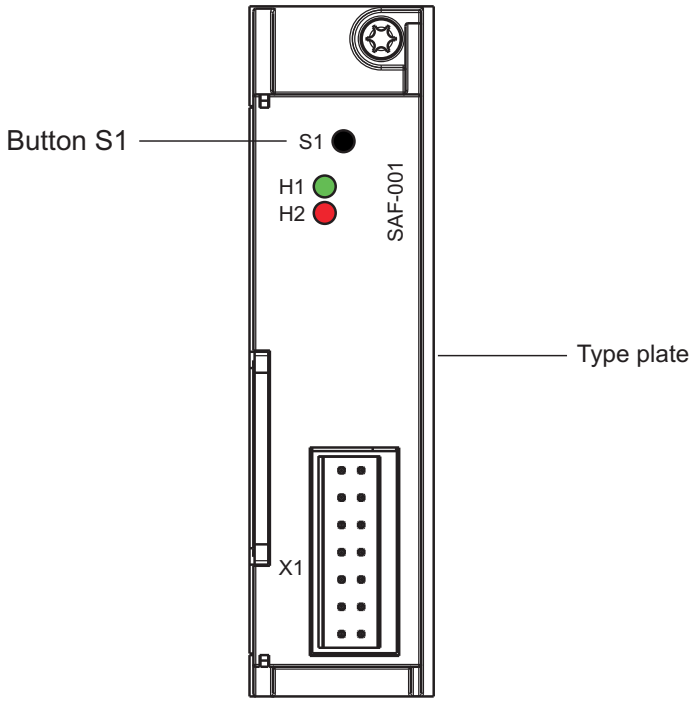



Figure 17: Button S1 on the Safety Module (SAF-001-000-xxx)

The Safety Module (SAF-001-001-xxx) has no button.

## 8.12 Restart inhibit (SAF-001-000-xxx)

The Safety Module (SAF-001-000-xxx) provides an input for the connection of a restart switch or for the activation of a control. The diagram in ▹Figure 18◃ on page 56 shows the recommended timing of the signal statuses to activate the safe approval of the pulse.

**1** Power supply of the control switched on.

**2** Connected safety device, for example, emergency stop device enabled (note: function STO inactive!)

**3** Signal change from „off“ to „on“ at the restart input.

If this sequence is followed, the restart inhibit is subsequently canceled.

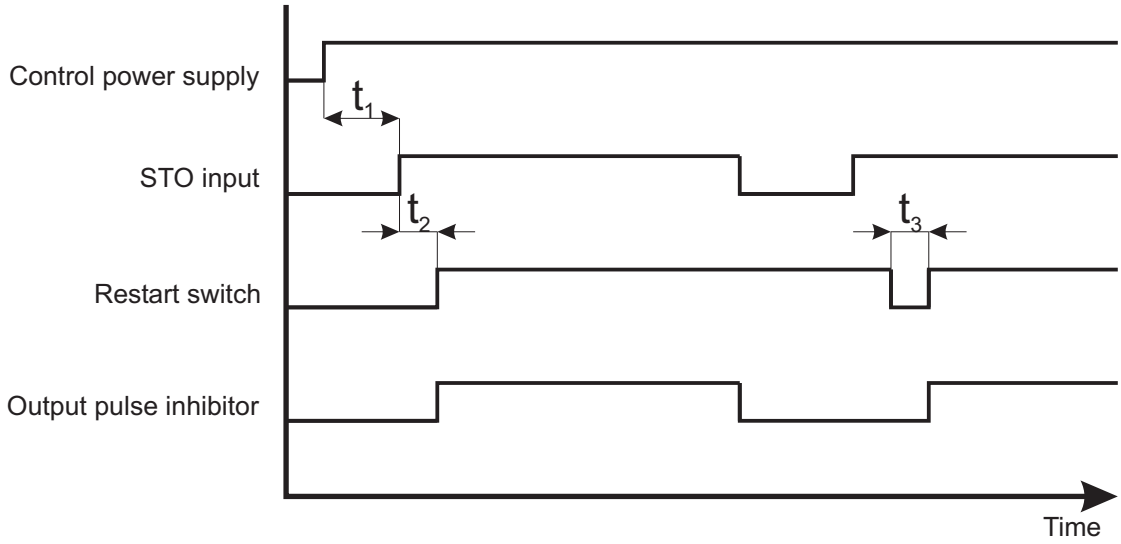



Figure 18: Timing of signal statuses for restart inhibit

| | min | max |
|---|---|---|
| $t_1$ | 0 ms | - |
| $t_2$ | 50 ms | - |
| $t_2$ with $t_1 = 0$ | 0 ms | - |
| $t_3$ | 30 ms | - |

The controller is operational at once and the safety function STO is not active, when $t_1 = 0$ and $t_2 = 0$.

### Wiring of the restart inputs

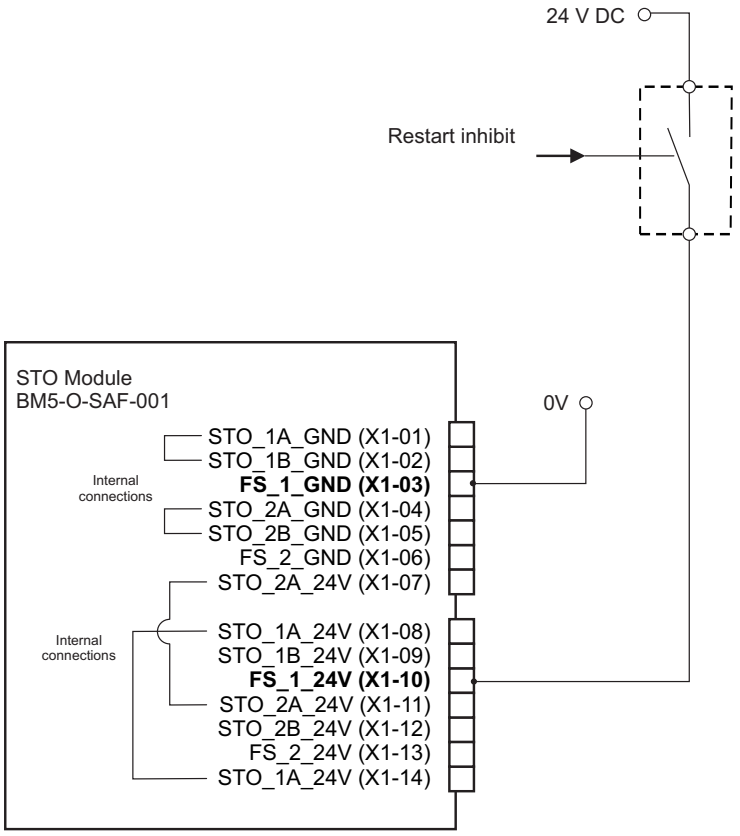



Figure 19: Wiring of restart inhibit inputs axis 1

**NOTE!**

The restart inputs of the Safety Module (SAF-001) must remain activated after the restart, i.e., after the activation of the driver supply. The cancellation of the activated status („on“) leads to the deactivation of the driver supply.

**DANGER!**

The restart inputs may in no case be used for the safety-related shut down of the driver supply. A safe activation of the safety function STO is only permitted by the STO inputs and the connected safety components.



**DANGER!**

The safety function STO is already canceled by resetting the safety component which has triggered the function STO. From that point on, the machine can be restarted in case of a failure even if the restart input is deactivated.

## 8.13 Automatic restart (SAF-001-000-002 and SAF-001-001-xxx)

The safety module SAF-001 is available in the version SAF-001-000-002 and SAF-001-001-xxx with automatic restart. The connection of a restart switch is not necessary here.

The pulse inhibit for the drive is deactivated from the module immediately after reset of STO. The restart of the drive depends only on the operating state of the controller. Thus, the restart is no part of the safety function.



**NOTICE!**

If a restart inhibit is necessary in the application, the SAF-001-000-000 module should be used. If the module version SAF-001-000-002 or SAF-001-001-xxx is used, the restart inhibit must be realized externally.



**DANGER!**

The safety function STO is already canceled by resetting the safety component which has triggered the function STO. From that point on, the machine can be restarted.

## 8.14 Marking of the Safety Module (SAF-001) - type code

On the type plate of the Safety Module (SAF-001) (on the right of the module), you will find the type code of the module.

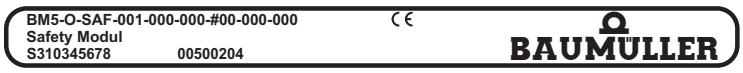



Figure 20: Type plate on the Safety Module (SAF-001)

**NOTICE!**

The third and fourth digit of the serial number provide information on the year of production. Example: Serial number „S310045208“ corresponds to production year 2010.

**NOTICE!**

This type code applies exclusively to the Safety Modules (BM5-O-SAF-xxx). Other modules have their own type codes.

| | |
|---|---|
| BM5 - O- SAF - 001 - xxx - xxx - #xx | Generation of the device in which the module can be used (BM5 = BM5000). |
| BM5 - O - SAF - 001 - xxx - xxx - #xx | Optional module |
| BM5 - O - SAF - 001 - xxx - xxx - #xx | Safety module |
| BM5 - O - SAF - 001 - xxx - xxx - #xx | Safety module version (001 = STO) |
| BM5 - O - SAF - 001 - xxx - xxx - #xx | Hardware version of the safety module<br>000: Standard<br>001: with short circuit detection |
| BM5 - O - SAF - 001 - xxx - xxx - #xx | Software version of the safety module at hardware version 000 (standard):<br>000: with parameter memory<br>002: with parameter memory and with automatic restart<br><br>at hardware version 001:<br>000: without parameter memory, with automatic restart<br>001: without parameter memory, with SS1 function with fixed SS1 time (= 200 ms) |
| BM5 - O - SAF - 001 - xxx - xxx - #xx | Safety level (identification for the compatibility between converter and safety module) |

## 8.14 Marking of the Safety Module (SAF-001) - type code

# 9

# DESCRIPTION OF THE RESET-MODULE

This chapter describes the BM5-O-SAF-100 (Reset-Module) with its function and explains the type code on the module.

## 9.1 General

In order to operate the axis unit of the series b maXX 5000 the slot A of the device must be equipped with a module (also see 5.09021, instruction handbook b maXX 5000). In case the device was previously equipped with a higher safety level, the parameter storage of the converter must be reset with the Reset-Module (BM5-O-SAF-100) or with a reset command (see ▹Resetting of the safety level by the controller◃ on page 65).

## 9.2 Compatibility list

The Reset-Module (BM5-O-SAF-100) can only be used in the combination with converters of the type b maXX 5000, which where released by Baumüller Nürnberg GmbH.

## 9.3 Operating mode of the Reset-Module (BM5-O-SAF-100)

In order to reset the module ID of the converter the slot A of the device must be equipped with a Reset-Module. After switching on the voltage supply of the converter the ID of the previously equipped modules is deleted.

After 15 seconds the voltage supply can be switched off and the slot A can be equipped with the requested Safety Module.

An operation of the converter with the Reset-Module is not possible, because the module does not provide supply for the converter's drivers.

## 9.4 Structure of the Reset-Module (BM5-O-SAF-100)

Analog BM5-O-SAF-000, but another ID.

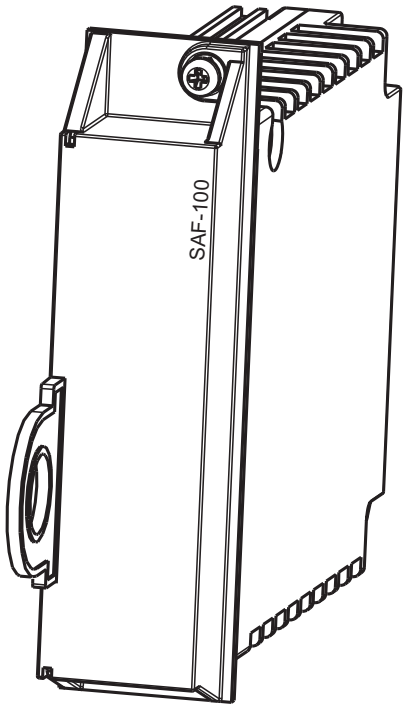



Figure 21: SAF-100 Reset-Module

## 9.5 Identification of the Reset-Module (SAF-100)

The type plate of the SAF module with its corresponding type code is found on the right side of the module (see the example below).




Figure 22: Example type code SAF-100 Reset-Module



**NOTICE!**

- The exchange of the module must only be performed by authorized and qualified personnel.
- Prior to the exchange of the module, ensure that the Safety Module and the converter are compatible.

For a list of the converters compatible with the Safety Module refer to the chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38.

**NOTE!**

The third and fourth digit of the serial number provide information on the year of production. Example: Serial number „S310045208“ corresponds to production year 2010.

## 9.6 Mode of operation module replacement

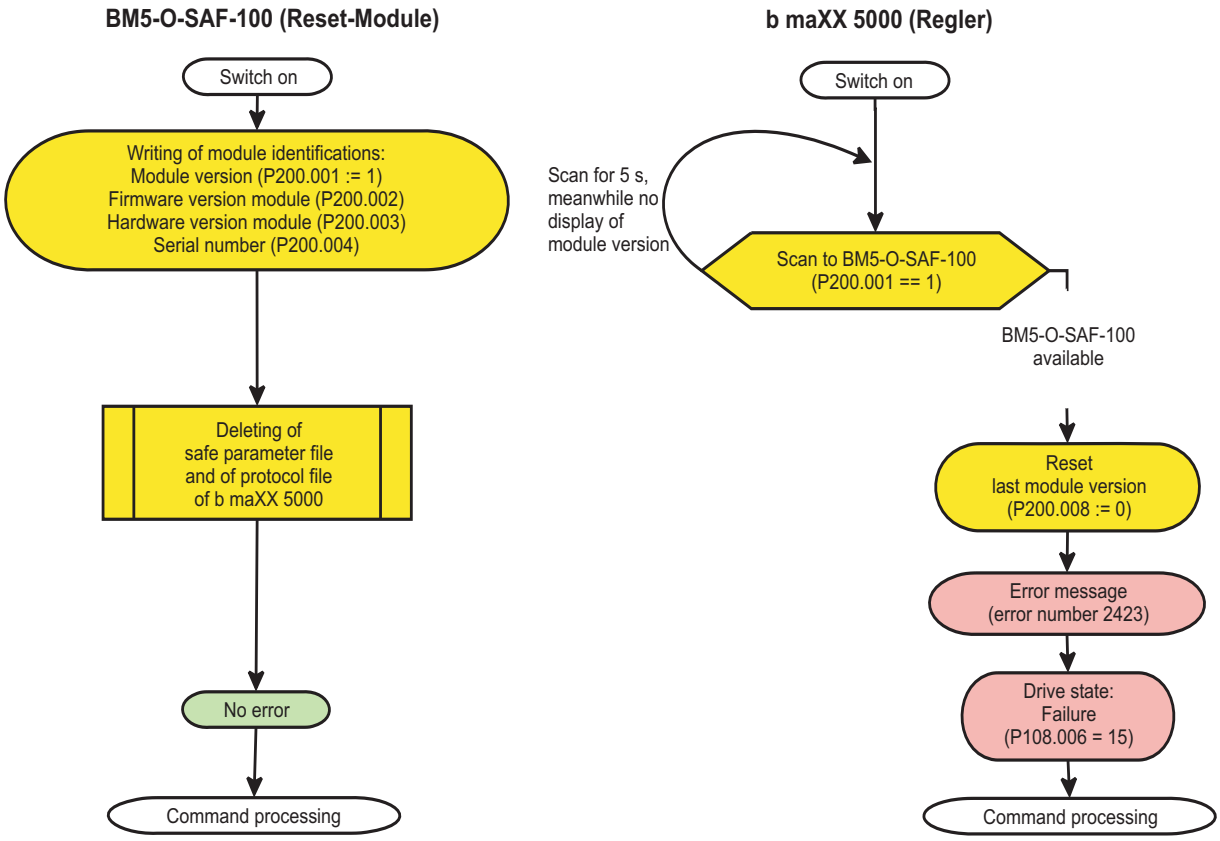



Figure 23: Mode of operation module replacement BM5-O-SAF-100

10

# RESETTING OF THE SAFETY LEVEL BY THE CONTROLLER

## 10.1 General

For the operation of an axis unit of the series b maXX 5000, the slot A of the device must be equipped with a module (also see 5.09021, Instruction handbook b maXX 5000). In case the device was already equipped with a module of a higher safety level, the safety level of the converter can be reset without a Reset-Module with a controller command also.

## 10.2 Operation mode of the reset command

The safety level of the converter is reset to the value zero by the command. The parameter files remain in the converter.

The following mode of operation for resetting must be followed:

**1** Writing of the value 4096 into parameter 139.023.0.0 (system command)

**2** On the 7-segment-display a four-digit code is displayed after the prefix „C“

**3** This code must be written in parameter 200.020.0.0 (reset code).

**4** After 15 seconds the voltage supply can be switched off and slot A can be equipped with the required module.

## 10.2 Operation mode of the reset command

# 11

# PLANNING OF A SAFETY-ORIENTED CONTROL SYSTEM

The entire process of defining the safety system is carried out in the planning phase. In addition to risk assessment, the planning contains the detailed definition of all system components, the definition of the system parameters and the detailed installation and wiring of the components.



**DANGER!**

Conducting the planning thoroughly aids in avoiding failures. Failures in safety-oriented machines can lead to permanent injuries and death.



**CAUTION!**

The „Planning checklist“ reproduced in the appendix is to be used in the planning phase.

## 11.1 Risk assessment

The risk assessment establishes which dangers a machine can present and which plant parts will have to be equipped with safety technology devices. The residual risk is reduced to a justifiable level by means of safety technology measures.



**CAUTION!**

As machine manufacturer, the applicable machine guidelines obligate you to conduct a risk assessment in order to establish the dangers associated with the machine and reduce the residual risk to a justifiable minimum.

**CAUTION!**

It is absolutely necessary to conduct the risk assessment during the planning phase and before conducting retrofitting work.

The risk assessment should be conducted according to the procedure described in the following.

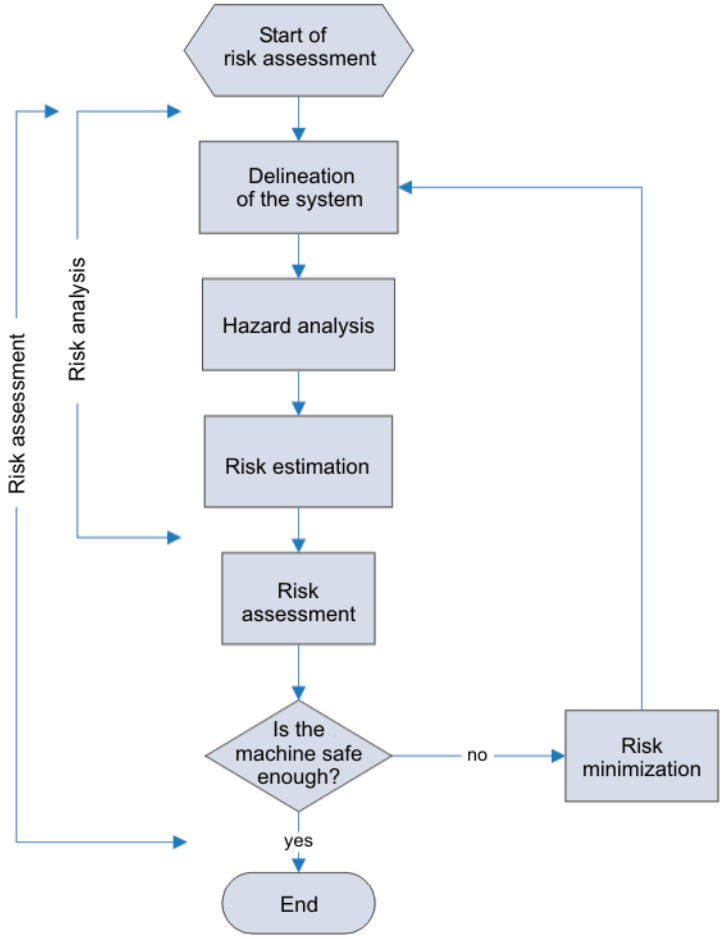



Figure 24: Risk assessment procedure in accordance with DIN EN ISO 12100-1 and EN ISO 14121

| | |
|---|---|
| **Delineation of the system**: | Determination of the limits of the system's boundaries and the intended use |
| **Hazard analysis**: | Identification of hazards and the related hazardous situations |
| **Risk estimation**: | Estimation of the risks for each hazard identified |
| **Risk assessment**: | Assessment of the risks and establishment of risk reduction measures |

The determination of the required safety class (SIL, performance level) is carried out in the scope of risk assessment. The course of action for the determination of the Performance Level is described in DIN EN ISO 13849-1. Annex A of IEC 62061 contains an informative part for the determination of the required SIL.

## 11.2 Installation and wiring plan

An installation and wiring plan for the entire safety system is to be developed in the planning phase. It contains all system components and their wiring.



**CAUTION!**

The applicable standards and guidelines on laying electrical lines are to be observed when developing the wiring plan.

## 11.3 Course of the planning phase

The system is planned according to the respective requirements of the plant or the machine. The components available for the automation of the available components are described in the Automation catalog of the company Baumüller Nürnberg GmbH. There, you can find information on concepts, PLCs, fieldbuses, motion control, technology blocks, HMIs, IPCs and I/Os.

Prior to commissioning of the Safety Module (SAF-001), the following has to be checked and guaranteed:

- Compatibility of the Safety Module (SAF-001) with the converter (see chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38, ▹Compatibility list SAF-001-001-xxx◃ on page 38 and ▹Compatibility list SAF-001-000-002 with automatic restart◃ on page 39).
- Adequate supply of the converter by the connected power supply unit or safety components.

12

# ASSEMBLY AND INSTALLATION

This chapter describes the mechanical assembly and electrical installation of the plug-in module.

The assembly and installation process consists of the following steps:

**1** Assemble the plug-in module.

**2** Connect the plug-in module to the safety components (for example, emergency stop device, electromechanical safety component, ...).

**3** Check the assembly and installation by means of the „Installation checklist“ listed in Appendix ▹B.2◃ on page 101.

## 12.1 General safety regulations



**CAUTION!**

The „Installation checklist“ reproduced in Appendix ▹B.2◃ on page 101 should be used during the assembly and installation phase.

- Make sure that the installation process is carried out entirely in accordance with the installation and wiring plan.
- Conduct a visual inspection and check all system components for visible damage.
- Check the system for wiring errors.
- Inspect the tightening torque and make sure that the electrical connection is not interrupted by insulation material.
- Inspect the tensile-load capacity of the electrical terminal and screw connections.
- Make sure that the installation and cable routing are carried out in accordance with applicable standards and guidelines.
- Make sure that the system's environmental properties specified in Appendix ▹C.2.1◃ on page 103 are not exceeded.
- Make sure that the design of the system's type of protection is sufficient.
- Make sure that the safety system is not damaged by moving parts or work in the area surrounding the installed safety components.
- Make sure that the system components do not come into contact with aggressive substances (such as acids, bases, transmission oil).

Follow the information in the chapter ▹Safety◃ from page 17 onward.

## 12.2 Requirements on the personnel conducting the work



**DANGER!**

**Live-threatening danger from electrical current!**

The device and surrounding area in the electrical cabinet can carry life-threatening voltages.

Therefore:

- Make sure that power to the device and surrounding area is shut off before beginning work.
- Follow the applicable safety regulations when handling devices carrying high voltages.
- Ensure that this module is assembled and installed exclusively by qualified personnel.

Qualified personnel refers to persons who have been authorized by the parties in charge of the plant safety to conduct the necessary activities applicable and are able to detect and avail potential dangers due to their training, experience, instruction and knowledge of the relevant standards and provisions, accident prevention regulations and operating conditions. Example of the qualifications required for work with the unit include:

- Training or instruction in accordance with the safety technology standards in the maintenance and use of suitable safety equipment.

## 12.3 Assembly instructions

The assembly of the converter is described in the operation manual for the converter.



**DANGER!**

**Live-threatening danger from electrical current!**

The device and surrounding area in the electrical cabinet can carry life-threatening voltages.

Therefore:

- Make sure that power to the device and surrounding area is shut off before beginning work.
- Follow the applicable safety regulations when handling devices carrying high voltages.

The following tools will be needed:

- Torx screwdriver (size TX8) for fastening the plug-in module in the converter.

✪ Ensure that the suitable converter is available (see chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38).

Perform the assembly as follows:

**1** Plug the plug-in module into the mounting opening of the frequency converter.

**2** Secure the module against unintentional falling out with the torx screw.

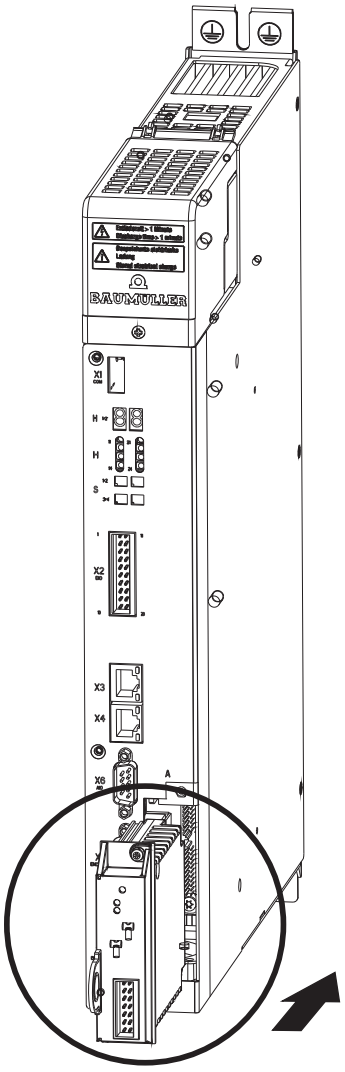
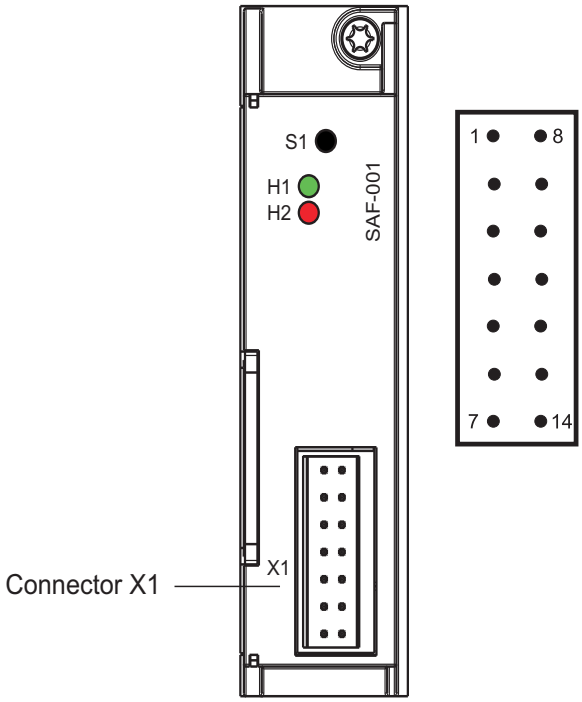



Figure 25: Assembly of plug-in module

## 12.4 Installation

Wire the Safety Module (SAF-001) in accordance with the following connection diagram.

See also chapter ▷Input circuitry◁ from page 42 onward.




**Pin assignment connector X1**

| Pin | Assignment |
|---|---|
| 1 | STO_1A_GND |
| 2 | STO_1B_GND |
| 3 | FS_1_GND |
| 4 | STO_2A_GND |
| 5 | STO_2B_GND |
| 6 | FS_2_GND |
| 7 | STO_2A_24V |
| 8 | STO_1A_24V |
| 9 | STO_1B_24V |
| 10 | FS_1_24V |
| 11 | STO_2A_24V |
| 12 | STO_2B_24V |
| 13 | FS_2_24V |
| 14 | STO_1A_24V |

Figure 26: Connection diagram of the Safety Module (SAF-001)

### 12.4.1 Requirements for the electrical connection



**CAUTION!**

**Danger due to faulty wiring!**

The module can be damaged or destroyed if the requirements for the electrical connection of the module are not met.

Therefore:

- Make sure that the connection values specified in technical data are met and that the connections are carried out according to the specifications.
- Prevent a short circuit between inputs and outputs. A short circuit between inputs and outputs can destroy the plug-in module.

In order to be able to fulfill the EN 60204-1 standard (electrical equipment of machines), you will have to use the cables it recommends. The connection plugs must not be able to fall out - otherwise, the danger of short circuits, external voltage, etc. will arise.

- Make sure that the connection cable is routed in an EMC-compatible manner.

### 12.4.2 Requirements on the connection cable

The connection cable must be selected in accordance with the EN 60204-1 standard.

13

# COMMISSIONING AND EXCHANGE OF THE MODULE

This chapter describes the commissioning process of the Safety Module. The process of commissioning ensures that the Safety Module functions properly. In addition, the chapter describes how the module is exchanged.

Before beginning the commissioning process, make sure that the following prerequisites have been fulfilled:

**1** The Safety Module is installed correctly.

**2** No people or parts are in the danger zone.

**3** The converter is ready for use.



**CAUTION!**

The commissioning of the Safety Module is only allowed after the acclimation of the module.

Please take note of ▹Troubleshooting and rectification◃ from page 87 for rectifying errors during the commissioning process.

## 13.1 General safety regulations

➲ Follow the chapter ▹Safety◃ from page 17 .



**DANGER!**

**Danger of injury due to moving parts!**

Machine parts/line parts or the entire machine/line can move during commissioning. The „Planning checklist“ reproduced in the appendix ▹Commissioning and validation checklist◃ from page 102 is to be used in the commissioning phase.

Therefore:

- Maintain an adequate distance from moving machine parts/line parts or from the moving machine/line.
- Note that the machine parts/line parts or machine/line can be set in motion via additional modules connected to the Safety Module.
- Activate the safety devices in any case prior to switching on the system.
- Make sure that the system is commissioned exclusively by qualified personnel.
- Make sure that there are no people in the danger zone during the initial commissioning. Always anticipate that a machine, system or safety device may not behave as it is intended to.
- If changes or expansions are conducted during the commissioning process, the effects on the behavior of the system will have to be inspected. To do this, it will be necessary to process the checklists for the planning and installation phase again.

## 13.2 Requirements on the personnel conducting the work

The commissioning work may only be conducted by professionally trained personnel, in particular personnel which understands the safety regulations and can follow them.



**DANGER!**

**Danger from mechanical action!**

The machine/line or parts of the machine or line can be started during the commissioning of the Safety Module.

Therefore:

- Maintain an adequate distance from moving machine parts/line parts or from the moving machine/line.

## 13.3 Exchanging the module



**DANGER!**

If a defect in the Safety Module is detected, the converter must be put out of operation immediately and the Safety Module must be exchanged.



**CAUTION!**

- The exchange of the module must only be performed by authorized and qualified personnel.
- No further changes in the configuration of the system may be made during the exchange of the module.
- Prior to the exchange of the module, ensure that the safety module and the converter are compatible.

  For a list of the converters compatible with the Safety Module refer to the chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38.

**Course of the exchanging process**

After insertion of the Safety Module (SAF-001) into the converter and switching on the converter, the following processes are performed in the converter and Safety Module (SAF-001) (see also ▹Figure 27◃ on page 80).

1 **Scan of the automatic parameter adjustment by the Safety Module (SAF-001).**

  If, the checkbox „Load automatic“ is set in ProDrive on the page „Dataset management“, the parameters are automatically loaded from the safety module into the converter.

  If there is no data set in the Safety Module, the data of the converter is loaded into the Safety Module.

2 **Check, if the converter was equipped with a higher level Safety Module before module replacement (SAF-002/003).**

  - Converter was equipped with a Safety Module (downgrade) of higher level
    The converter indicates error 2418 (module change to lower safety level). A release of the controller is only possible by resetting of the converter with a Reset-Module. (see ▹Description of the Reset-Module◃ from page 61 ).
  - The converter was not already equipped with a higher level Safety Module (see step 3).

3 **Checking the parameters with Safety Module (SAF-001)**.
  If the data sets between the converter and the Safety Module (SAF-001) still are different, this is displayed by a red LED H2 at the Safety Module, which always is on and the error message 2403 (different parameter data on the controller and the SAF-Module) in parameter 100.010.0.0 (Safety Module state). By acceptance with button S1 (long-short-short-long) by the user, the parameters are copied from the controller to the Safety Module.

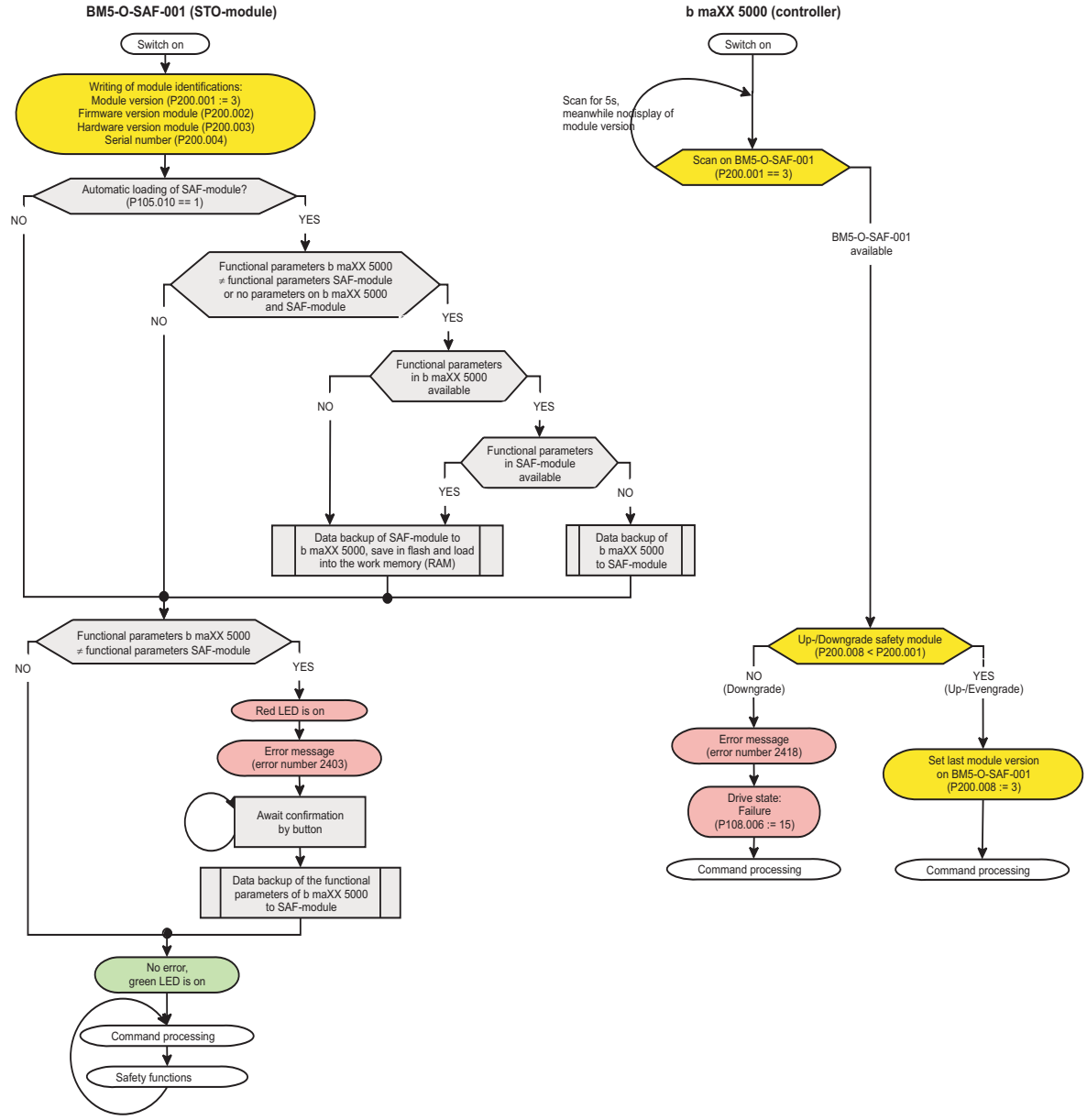



Figure 27: Course of the module exchange process

**CAUTION!**

Once the module has been exchanged, a complete function test for the system has to be conducted and documented accordingly.



**CAUTION!**

Ensure by the use of the external safety components (for example emergency stop device) that an unexpected start-up is prevented after the module has been exchanged.



**CAUTION!**

It is necessary to label defective components to indicate that they are defective. It is absolutely necessary to prevent defective components from being reused by taking measures in the scope of quality management on the user's side (see the chapter ▹Repair◃ from page 91 ).

# 14

# SYSTEM VALIDATION

All safety functions as well as the trouble-free functioning of the installed system must be tested with the initial operation. The testing of the system must be documented.



**WARNING!**

**Danger during commissioning!**

The Safety Module may only be put into operation after being tested successfully by a technical expert.

Therefore:

- Conduct a complete function test. In doing so, check the correct allocation of the connected safety components.
- A checklist for the commissioning and validation of the system is reproduced in Appendix ▹B.3 Commissioning and validation checklist◃ from page 102 onward. Conduct the validation of the system in accordance with this checklist and document the procedure accordingly.
- Make sure that operating personnel has been instructed in the handling of the Safety Module.

## 14.1 Function test

The function test is a major part of the validation of the entire system. The function test is used to determine the trouble-free allocation of the network safety components and the programmed logic of the system.

Depending on the complexity of the logic circuit of the respective project, it is recommended to conduct the function tests in steps.

The following course of action is recommended when conducting the function tests:

**1** Only connect the actuators and drives to the safe output terminals once no errors have been detected in the inspection of the logic circuit.

**2** Conduct a complete function test with all sensors (initiators), switches, actuators and drives.

To conduct the function tests, trigger all safety functions sequentially and document the system's reaction. Check whether their action corresponds with the expected behavior.

15

# OPERATION

Instructions on the operation of the system components connected to the converter used can be found in the corresponding operation manuals and application manuals for these components.



**DANGER!**

It is not permitted to make any changes to the system configuration during the operation of the Safety Module.

Therefore:

- Before expanding the system and removing individual system components and making changes in the wiring, the safety module must as a rule be disconnected from the power source and put into safe condition by technical trained personnel.

16

# TROUBLESHOOTING AND RECTIFICATION

This chapter describes the error indications of the Safety Module (SAF-001).

## 16.1 Safety regulations

Observe the applicable safety regulations, see ▹Safety ab Seite 17.

## 16.2 Requirements on the personnel conducting the work

Personnel working with the Safety Module (SAF-001) must be instructed in the safety regulations and the operation of the module and be familiar with the proper operation of the system. The reaction to error indications and statuses in particular requires special knowledge which the operator must have.

## 16.3 Error diagnosis

**Fail-safe principle**

The Safety Module (SAF-001) is based on the fail-safe principle. This means that each error automatically causes the module to switch into the safe status STO (Safe Torque Off).

The red LED on the front panel of the Safety Module (SAF-001) indicates the error status (see chapter ▹LEDs for indicating the operation statuses ab Seite 54).



**WARNING!**

Do not put a defective safety-oriented system back into operation as long as the cause of the error is unknown to you or an error has not been rectified.

## 16.4 Detecting errors in the periphery

- Electromechanical error detection is ensured by the input circuitry (see the chapter ▹Input circuitry ab Seite 42).
- Electronic sensors must have an own error detection regarding short circuits on the output.

## 16.5 Safe status

In the safe status, the Safety Module (SAF-001) safely shuts off the driver supply of the converter. Thus, the actuation of the power output module of the converter is already interrupted.

# 17

# MAINTENANCE

If you are complying with the mandatory environmental conditions, see ▹Appendix C - Technical data◃ from page 103 onward, then the plug-in module is maintenance-free. If you detect or suspect a defect in the plug-in module, contact Baumüller Nürnberg GmbH.



**CAUTION!**

Take organizational measures to make sure that the interval for the repeat testing of all system components (proof test interval, see ▹Safety-related parameters◃ from page 25 onward) is complied with.

# 18

# REPAIR

You cannot repair a defective plug-in module. Please contact Baumüller Nürnberg GmbH for a replacement.



**CAUTION!**

Defective components may only be repaired by the manufacturer.

# 19

# DISASSEMBLY, STORAGE

This chapter describes how to decommission the plug-in module and store it.

## 19.1 Safety regulations

➲ Follow the chapter ▹Safety◃ from page 17 onward.



**CAUTION!**

**Damage through electrical destruction.**

The component assembly can be destroyed by electricity if it is removed when the power is turned on.

Therefore:

- Make sure that the power to all electrical connections is shut off and secured to prevent from being turned back on.
- Using suitable measuring equipment, check to make sure that none of the connections are carrying live current before beginning work on the electrical connections.
- Only disassemble the connections and remove the connection once you are completely certain that the component assembly is not under power.



**WARNING!**

**Danger of injury due to uncontrollable behavior of the machine/line.**

The behavior of the machine/line can change as a result of removing the component assembly with the power source connected.

Therefore:

- Make sure that the power to all electrical connections is shut off and secured to prevent from being turned back on.
- Using suitable measuring equipment, check to make sure that none of the connections are carrying live current before beginning work on the electrical connections.
- Only disassemble the connections and remove the connection once you are completely certain that the component assembly is not under power.

## 19.2 Requirements on the personnel conducting the work

The personnel you assign to carry out the disassembly must have the knowledge and training necessary to perform this work properly. The personnel should be selected so that it will be able to understand and use the safety instructions attached to the device and its components as well as the connections.

## 19.3 Disassembly

The personnel carrying out the disassembly must meet the requirements above.

Carry out the disassembly process in the following order:

**1** Make sure that the power has been disconnected and cannot be turned back on accidentally.

**2** Disassemble the plug-in module in the reverse order of the assembly (see chapter ▹Assembly and installation◃ from page 71 onward).

**3** Document the disassembly (or exchange) of the plug-in module.

Document the disassembly (or exchange) of the converter, if applicable.

Document the disassembly (or exchange) of the additional system components, if applicable.

## 19.4 Storage conditions

Store the plug-in module in a suitable package under the storage conditions specified in the ▹Technical data◃ from page 103 onward.

## 19.5 Recommissioning

If you want to put the plug-in module back into operation, observe the specifications under „Storage conditions“. Then conduct the ▹Commissioning and exchange of the module◃ from page 77 onward again.

20

# DISPOSAL

This chapter describes the proper and safe disposal of the Safety Module (STO). For the most part, it can be classified as electronic scrap.

- Prerequisite: The disassembly process has already been carried out, see ▷Disassembly, storage◁ from page 93 onward.

## 20.1 Safety regulations

The disposal may only be conducted in compliance with the safety regulations. Observe special local regulations as well, if applicable. If you are not able to conduct the disposal yourself, hire a suitable waste removal company to do so.

## 20.2 Requirements on the personnel conducting the work

The personnel you assign to carry out the disposal/disassembly must have the knowledge and training necessary to perform this work properly. The personnel should be selected so that it will be able to understand and use the safety instructions attached to the converter and its components.

## 20.3 Disposal instructions

| | |
|---|---|
| **Prerequisites** | Safety Module (STO) has already been disassembled properly. |
| **Sheet steel** | Parts of the module are made of galvanized sheet steel. Sheet steel must be put into the cycle of potential recyclables for ferrous metals. |
| **Electronic scrap** | Electronic scrap (circuit boards), which cannot be disassembled further must be disposed of as special waste. Observe the applicable regulations in doing so. |
| **Plastic** | The housing is made of plastic. Plastic must be put into the cycle of potential recyclables for plastics. |

## 20.4 Recycling collection center/offices

Make sure that the disposal is carried out in compliance with your company's disposal guidelines as well as those of the competent recycling collection centers and offices. In the event of uncertainty, contact the industrial inspectorate responsible for your company or the environmental agency.

# APPENDIX A - ABBREVIATIONS

| | |
|---|---|
| **DC** | Diagnostic Coverage |
| **EMC** | Electromagnetic compatibility |
| **EN** | European standard |
| **ESD** | Electrostatic sensitive device |
| **EXT, ext** | External |
| **I/O** | Input/Output |
| **ISO** | International Organization for Standardization |
| **LED** | Light-emitting diode |
| **$MTTF_d$** | Mean Time To Failure |
| **PFD** | Probability of Failure on Demand (mean residual error probability of a dangerous error on demand) |
| **PFH** | Probability of Failure per Hour |
| **SAF** | Safety module |
| **SIL** | Safety Integrity Level |
| **SFF** | Safe Failure Fraction (fraction of failures which lead to safe status) |
| **STO** | Safe Torque Off |

# APPENDIX B - CHECKLISTS

The use of checklists serves documentation purposes and guides in the implementation of a safety system. The checklists reproduced in this chapter serve to prevent errors and must be processed carefully for every project. It is also required to make copies of the printed checklists.

No claim is made that the checklists are complete. There may be additional requirements depending on the specific plant.

## B.1 Planning checklist

| Serial no. | Requirement | Fulfilled | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| 1 | Planning | | | |
| 1.1 | Has a risk assessment been carried out and have the required SIL and performance levels in accordance with DIN EN ISO 13849-1 or IEC 62061 been determined? | | | |
| 1.2 | Are power supplies according to PELV specifications being used exclusively? | | | |
| 1.3 | Is the line routing carried out in accordance with the applicable standards and guidelines? | | | |
| 1.4 | Is the electrical supply for the local I/O terminals and field bus components properly dimensioned? | | | |
| 1.5 | Do all safety-oriented system components meet the requirements of the established SIL (IEC 61508), performance levels and safety category (DIN EN ISO 13849-1)? | | | |

| Serial no. | Requirement | Fulfilled | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| 1.6 | Does the wiring of the safety components meet the requirements of the previously determined safety classification? (Example: Dual-channel wiring of an emergency stop for SIL 2 application) | | | |
| 1.7 | Do the components meet the environmental conditions prevailing in the application? | | | |
| 1.8 | Does the system fulfill the required type of protection? | | | |
| 1.9 | Is degree of pollution 2 complied with? | | | |
| 1.10 | Has the maximum permissible reaction time of the safety functions been established by means of a risk analysis? | | | |
| 1.11 | Is the maximum permissible reaction time reached? Has computational evidence been provided? | | | |
| 1.12 | Is the system protected from mechanical overloading? | | | |
| 1.13 | Is the system protected from corrosive substances? | | | |

| Date | Name | Signature |
|---|---|---|
| | | |

## B.2 Installation checklist

| Serial no. | Requirement | Fulfilled | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| 2 | Installation | | | |
| 2.1 | Has it been ensured that there are no short circuits from the wiring of the input and output terminals? | | | |
| 2.2 | Has it been ensured that the safety switch devices have not been bypassed as a result of wiring errors? | | | |
| 2.3 | Has a wiring inspection in accordance with the installation plan been conducted? | | | |
| 2.4 | Are all connection plugs labeled according to their allocation? | | | |
| 2.5 | Are the connection terminals loaded with the specified clamping torque? | | | |
| 2.6 | Has it been ensured that the insulation of the lines is not causing any faulty contacts? | | | |
| 2.7 | Has the reliability of all terminal connections been tested through mechanical tensile loading? | | | |
| 2.8 | Has a visual inspection of the installed components been conducted? | | | |
| 2.10 | Do the components meet the environmental conditions prevailing in the application? | | | |
| 2.11 | Does the system fulfill the required type of protection? | | | |
| 2.12 | Is degree of pollution 2 complied with? | | | |
| 2.13 | Is the system protected from corrosive substances? | | | |

| Date | Name | Signature |
|---|---|---|
| | | |

## B.3 Commissioning and validation checklist

| Serial no. | Requirement | Fulfilled | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| 3 | Commissioning | | | |
| 3.1 | Has a complete function test been conducted and documented? | | | |
| 3.2 | Has the operating personnel been instructed in the handling of the module? | | | |

| Date | Name | Signature |
|---|---|---|
| | | |

## B.4 Modification and retrofitting checklist

| Serial no. | Requirement | Fulfilled | | Remarks |
|---|---|---|---|---|
| | | Yes | No | |
| 4 | Modification and retrofitting | | | |
| 4.1 | Is the modification/retrofitting of the system compatible? Do all of the checklist's requirements on the planning, installation and commissioning/validating continue to be fulfilled? | | | |
| 4.2 | Are the calculated reaction times still complied with after the modification/ retrofitting? Proof is required! | | | |
| 4.3 | Has a complete function test been conducted and documented? | | | |

| Date | Name | Signature |
|---|---|---|
| | | |

C

# APPENDIX C - TECHNICAL DATA

This appendix contains the technical data for the plug-in module from Baumüller Nürnberg GmbH.

## C.1 Connection values

| | |
|---|---|
| Potential separation | Channels are potential-free |

## C.2 Operational conditions

### C.2.1 Climatic properties

| | SAF-000 / SAF-001 |
|---|---|
| Environmental conditions operation<br><br>Climate classification (EN 60721-3-3) | 5°C ... 55°C<br><br>3K3 |
| Storage conditions<br><br>Climate classification (EN 60721-3-1) | -25°C ... 55°C<br><br>1K4 |
| Transport conditions<br><br>Climate classification (EN 60721-3-2) | -25°C ... 70°C<br><br>2K3 |
| Installation height | Up to 2000 m above sea level |



**WARNING!**

The operating conditions specified in the table above may not be exceeded at any time.

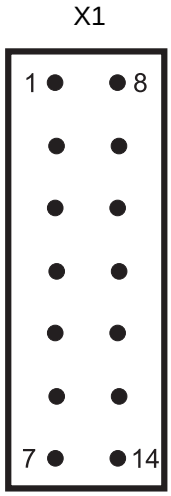
### C.2.2 Mechanical properties

| | |
|---|---|
| Dimensions (W x H x D) | 120 mm x 87 mm x 23.5 mm |
| Weight | approx. 110 g (SAF-001)<br>approx. 100 g (SAF-000) |
| Assembly | In frequency converter of the type b maXX 5000 (see chapter ▹Compatibility list SAF-001-000-xxx◃ on page 38) |
| Installation position | Vertical, parallel to the vertically installed frequency converter into which the module is inserted |
| Protection class | IP 20 |
| Permissible degree of pollution | Pollution degree 2 |

### C.2.3 EMC properties

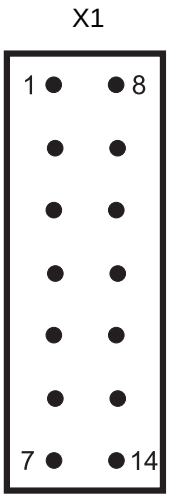
| | |
|---|---|
| EMC resistance / emission | In accordance with En 62061 Annex E / DIN EN 61800-3 |

## C.3 Pin assignment of Safety Module (SAF-001-000-xxx) connector X1




| Pin no. | Assignment |
|---|---|
| 1 | STO_1A_GND |
| 2 | STO_1B_GND |
| 3 | FS_1_GND |
| 4 | STO_2A_GND |
| 5 | STO_2B_GND |
| 6 | FS_2_GND |
| 7 | STO_2A_24V |
| 8 | STO_1A_24V |
| 9 | STO_1B_24V |
| 10 | FS_1_24V |
| 11 | STO_2A_24V |
| 12 | STO_2B_24V |
| 13 | FS_2_24V |
| 14 | STO_1A_24V |

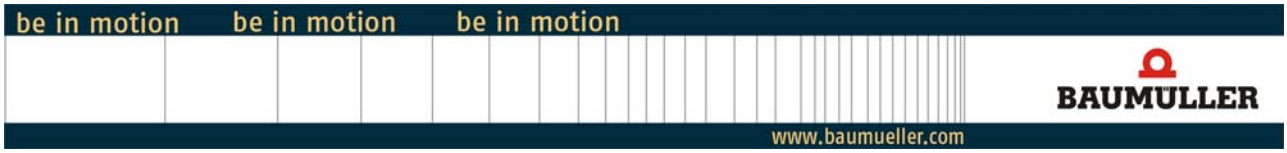
## C.4 Pin assignment of Safety Module (SAF-001-001-xxx and SAF-001-000-002) connector X1




| Pin no. | Assignment |
|---|---|
| 1 | STO_1A_GND |
| 2 | STO_1B_GND |
| 3 | Reserved |
| 4 | STO_2A_GND |
| 5 | STO_2B_GND |
| 6 | Reserved |
| 7 | STO_2A_24V |
| 8 | STO_1A_24V |
| 9 | STO_1B_24V |
| 10 | Reserved |
| 11 | STO_2A_24V |
| 12 | STO_2B_24V |
| 13 | Reserved |
| 14 | STO_1A_24V |

D

# APPENDIX D - DECLARATION OF CONFORMITY




# EC - Declaration of Conformity

**Doc.-No. 5.10060.03**
**Date: 17.05.2017**

## according to Machinery Directive 2006/42/EC

The Manufacturer: Baumüller Nürnberg GmbH
Ostendstraße 80-90
90482 Nürnberg, GERMANY

declares, that the product:

Designation: b maXX 5000 option module with safety function STO
Type: BM5-O-SAF-001-000-xxx
manufactured since: 04.11.2010

is developed, designed and manufactured in accordance with the Machinery Directive 2006/42/EC.
This product complies with the requirements of the EMC Directive 2014/30/EU.

Applied harmonized standards:

| Standard | Title |
|---|---|
| EN 62061:2005 + AC:2010 + A1:2013 + A2:2015 | Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems |
| EN ISO 13849-1:2015 | Safety of machinery - Safety-related parts of control systems<br>Part 1: General principles for design |
| EN 61800-5-1:2007 | Adjustable speed electrical power drive systems -<br>Part 5-1: Safety requirements - Electrical, thermal and energy |
| EN 61800-5-2:2007 | Adjustable speed electrical power drive systems -<br>Part 5-2: Safety requirements - Functional |
| EN 60204-1:2006 + A1:2009 + AC:2010 (in extracts) | Safety of machinery - Electrical equipment of machines<br>Part 1: General requirements |
| EN 61800-3:2004 + A1:2012 | Adjustable speed electrical power drive systems.<br>Part 3: EMC requirements and specific test methods |

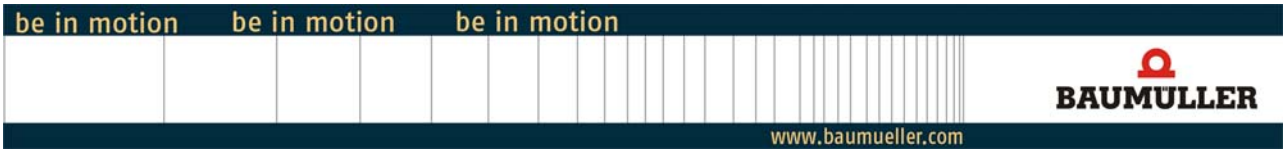
Authorized person to compile the technical files:
Name: Engelbert Meier, Baumüller Nürnberg GmbH
Address: Ostendstraße 80-90, 90482 Nürnberg, Germany

Notified body executed the EC type-examination procedures according to Machinery Directive 2006/42/EC:
Name: TÜV Rheinland Industrie Service GmbH
Address: Am Grauen Stein, 51105 Köln / Germany
Identification number: 0035
Registration number: 01/205/5031.01/16

Attention should be paid to the safety instructions in the manual.
This product is to be used in machinery and must not put into operation until the machinery, into with it is incorporated, has been declared to be in conformity with the Machinery Directive 2006/42/EC.

Nuremberg / 17.05.2017
Location / Date

Subject to change of this declaration of EC conformity without notice. Actual valid edition on request.




# EC - Declaration of Conformity

**Doc.-No.** **5.10060.03**
**Date:** **17.05.2017**

## according to EMC Directive 2014/30/EU

The Manufacturer: Baumüller Nürnberg GmbH
Ostendstraße 80-90
90482 Nürnberg, GERMANY

declares, that the product:

Designation: b maXX 5000 Option module with safety function STO
Type: BM5-O-SAF-001-000-xxx

Designation: b maXX 5000 Parameter module
Type: BM5-O-SAF-000-000-000

Designation: b maXX 5000 Default module
Type: BM5-O-SAF-000-000-001

manufactured since: 04.11.2010

are developed, designed and manufactured in accordance with the EMC Directive 2014/30/EU.

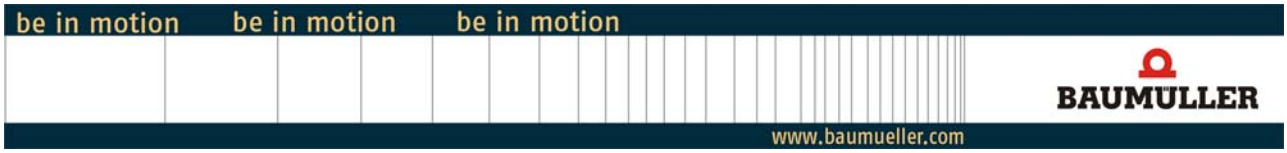
Applied harmonized standards:

| Standard | Title |
|---|---|
| EN 61800-3:2004 + A1:2012 | Adjustable speed electrical power drive<br>Part 3: EMC requirements and specific test methods |

Attention should be paid to the safety instructions in the manual.

Nuremberg / 17.05.2017
Location / Date

Subject to change of this declaration of EC conformity without notice. Actual valid edition on request.




# EC - Declaration of Conformity

**Doc.-No.** **5.17011.01**
**Date:** **24.09.2018**

## according to Machinery Directive 2006/42/EC

The Manufacturer: Baumüller Nürnberg GmbH
Ostendstraße 80-90
90482 Nürnberg, GERMANY

declares, that the product:

Designation: b maXX 5000 option module with safety function STO
Type: BM5-O-SAF-001-001-00x (gen2)
manufactured since: 26.09.2018

is developed, designed and manufactured in accordance with the Machinery Directive 2006/42/EC.
This product complies with the requirements of the EMC Directive 2014/30/EU.

Applied harmonized standards:

| Standard | Title |
|---|---|
| EN 62061:2015 | Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems |
| EN ISO 13849-1:2015 | Safety of machinery - Safety-related parts of control systems<br>Part 1: General principles for design |
| EN 61800-5-1:2007 + A1:2017 | Adjustable speed electrical power drive systems -<br>Part 5-1: Safety requirements - Electrical, thermal and energy |
| EN 61800-5-2:2016 | Adjustable speed electrical power drive systems -<br>Part 5-2: Safety requirements - Functional |
| EN 61800-3:2004 + A1:2012 | Adjustable speed electrical power drive systems.<br>Part 3: EMC requirements and specific test methods |
| IEC 61508 Parts 1-7:2010 | Functional safety of electrical/electronic/programmable electronic safety-related systems |

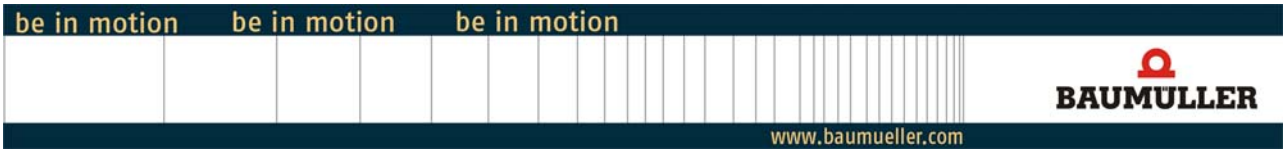
Authorized person to compile the technical files:
Name: Heinrich März, Baumüller Nürnberg GmbH
Address: Ostendstraße 80-90, 90482 Nürnberg, Germany

Notified body executed the EC type-examination procedures according to Machinery Directive 2006/42/EC:
Name: TÜV Rheinland Industrie Service GmbH
Address: Am Grauen Stein, 51105 Köln / Germany
Identification number: 0035
Registration number: 01/205/5563.03/18

Attention should be paid to the safety instructions in the manual.
This product is to be used in machinery and must not put into operation until the machinery, into with it is incorporated, has been declared to be in conformity with the Machinery Directive 2006/42/EC.

Nuremberg / 24.09.2018
Location / Date

Subject to change of this declaration of EC conformity without notice. Actual valid edition on request.




# EC - Declaration of Conformity

**Doc.-No.** **5.17011.01**
**Date:** **24.09.2018**

# according to EMC Directive 2014/30/EU

The Manufacturer: Baumüller Nürnberg GmbH
Ostendstraße 80-90
90482 Nürnberg, GERMANY

declares, that the product:

Designation: b maXX 5000 Option module with safety function STO
Type: BM5-O-SAF-001-001-xxx

manufactured since: 26.09.2018

are developed, designed and manufactured in accordance with the EMC Directive 2014/30/EU.

Applied harmonized standards:

| Standard | Title |
|---|---|
| EN 61800-3:2004 + A1:2012 | Adjustable speed electrical power drive<br>Part 3: EMC requirements and specific test methods |

Attention should be paid to the safety instructions in the manual.

Nuremberg / 24.09.2018
Location / Date

Subject to change of this declaration of EC conformity without notice. Actual valid edition on request.

# Index


**A**
Abbreviations 97
Approvals 14
Assembly instructions 72
Automatic restart 38, 39, 51, 58

**B**
Baumüller 29
Button 55

**C**
CE symbol 99
Checklist 99
Connection
  electrical 74
Connection cable 75
Connector X1 50, 51
Copyright 12

**D**
Declaration of conformity 107
Device generation 36, 59
Diagnostic Coverage (DC) 26
Directives 14
Disassembly 94
Disposal 95

**E**
EC directive 99
Electrical connection 74
Emergency stop device, connection 43, 46
Error diagnosis 87
Exchanging the module 79

**F**
Fail-safe principle 87
Fire fighting 22
Function test 83

**I**
Identification SAF-000 35
Input circuitry 42
Inputs 50
Installation plan 69
Intended use 18

**L**
LEDs 54
Limitation of liability 11

**M**
Mean Time To Failure (MTTFd) 26
Mechanical properties 104
Module type 36, 59

**O**
Operating personnel 20
Operation status, indication 54
Optional module 36, 59
Output terminal SO4000 45

**P**
Parameter memory 53
Pin assignment X1 50, 51, 104, 105
Planning phase 69
Preface 9
Probability of Failure on Demand (PFD) 26
Probability of Failure per Hour (PFH) 26
Protective equipment 19, 21

**Q**
Qualified personnel 20, 72

**R**
Restart inhibit 56
  Wiring 57
Risk assessment 67

**S**
Safe Stop 1 (SS1) 37
Safe Torque Off (STO) 37
Safety 17
Safety I/O terminal SO4000, connection 45
Safety instructions 17
Safety light curtain, connection 44, 47
Safety Module (module type) 36, 59
Safety Module (SAF-001) 48
  Button S1 55
  Connection of emergency stop device 43, 46
  Connection of safety light curtain 44, 47
  Exchange 79
  LEDs 54
  Restart inhibit wiring 57
  Working principle 40
Safety-related parameters 25
SO4000, connection 45
SS1 time
  tolerance 41
Standards 14
Storage 94
Structure SAF-000 35
Switching thresholds
  Inputs FS_1_24V, FS_2_24V 52
  Inputs STO_1A_24V, STO_1B_24V, STO_2A_24V, STO_2B_24V 52
switch-on behavior 33

## T

Technical data 103
Terms
  Definition 13
Type code
  Module 59
Type plate 59

## W

Warning notices, general 10
Warranty and liability 13
Wiring plan 69

## X

X1
  Pin assignment 50
  Switching thresholds of inputs 52

**be in motion**

Baumüller Nürnberg GmbH Ostendstraße 80-90 90482 Nürnberg Tel: +49(0)911-5432-0 Fax: +49(0)911-5432-130 **www.baumueller.de**

All the information in these Operating Instructions is non-binding customer information; it is subject to ongoing further development and is updated on a continuous basis by our permanent change management system.
Note that all the data/numbers/information that are quoted are current values at the time of printing.
This information is not legally binding for dimensioning, calculation and costing. Before using the information listed in these Operating Instructions as the basis for your own calculations and/or applications, make sure that you have the latest most current information.

This means that we accept no resonsibility for the accuracy of the information.

**Artisan Technology Group** is an independent supplier of quality pre-owned equipment

## Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

## We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

## Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP