Operating Instructions

Language **English**

Translation

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be in motion   be in motion

BAUMÜLLER

b maXX® Systems

b maXX safe PLC

BMC-M-SAF-02

E	5.07020.05

Read the Operating Instructions before beginning

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DOCUMENT HISTORY

Revision level	State	Modifications
5.07020.01	18.10.2007	Initial document
5.07020.02	31.03.2009	Revision and CFI module extension
5.07020.03	25.08.2009	Editorially checked contents
5.07020.04	07.02.2011	New declaration of conformity
5.07020.05	08.11.2016	New declaration of conformity

Operation Manual **b maXX safe PLC** BMC-M-SAF-02

Document no.: 5.07020.05

Baumüller Nürnberg GmbH

PREFACE

2.1   Information on the Operation Manual

This Operation Manual provides important information on handling the device. Compliance with all safety instructions operation instructions specified is a prerequisite for work safety.

Furthermore, it is also necessary to comply with the local accident prevention legislation and general safety regulations applying to the device's field of application.

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 to personnel in the immediate vicinity of the device at all times.

2.2 Legend

Warning notices

Warning notices are indicated 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 may vary from the explanations and illustrations described here in cases involving custom designs or the use of additional ordering options, or as a result of 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 considered 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 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. The obligations specified in the following section under "Obligations" do not apply to preliminary 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.

b maXX® is a registered trademark of Baumüller Nürnberg GmbH

Cage Clamp® is a registered trademark of the company WAGO Kontakttechnik

2.6 Further applicable documents

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 from the manufacturer.

See also ▷Appendix B - Accessories◁ from page 101 onward.

2.8 Disposal

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

See also ▷18 Disposal◁ from page 97 onward.

2.9 Warranty conditions

The warranty conditions can be found as a separate document in the sales documentation.

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 contact person responsible can be found at any time via telephone, fax, E-mail or over the internet.

2.11 Terms used

The terms "PLC" or "safety control" or "BMC-M-SAF-02" are also used for the product "**b maXX safe PLC**."

The terms "module" or "power supply" are also used in this documentation for the Baumüller product "power supply for b maXX controller/safe PLC."

The term "b maXX System" is also used for the product consisting of "power supply for b maXX controller/safe PLC," "b maXX safe PLC" and further system components.

A list of the abbreviations used can be found in ▷Appendix A - Abbreviations◁ from page 99 onward.

2.12 Certification

The programmable safety controller b maXX safe PLC 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:	01/205/5093.01/16
Test report no.:	968/EZ 358.03/16
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 security-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 up to category 4
IEC 62061	Functional safety of security-related electric, electronic and programmable electronic systems Fulfillment of increased stability requirements in accordance with reference to EN 61326-3-1	
Additional standards	**Area of application**	
EN 61131-2	General device requirements and tests for control systems	
EN 50178	Equipping of high voltage equipment with electronic utilities Use of ventilation and leakage paths	
EN 60204	Electrical machine equipment	

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Baumüller Nürnberg GmbH

USE OF THIS HANDBOOK

This safety handbook contains information on the intended use of the Baumüller b maXX safe PLC.

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

Baumüller control devices are developed, manufactured and tested in compliance with the applicable safety standards. They may only be used under the specified environmental conductions 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

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SAFETY

This section 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 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

This device is exclusively designed and constructed for the intended purpose of use described here.

The **b maXX safe PLC** uses for operation an attached power supply (BMC-M-PSB-02). Furthermore, the safety control can be expanded by the addition of various system components.

Your use of the device is considered to be compliant with its intended use if you have read all instructions 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 device as intended.
- Follow all specifications of this Operation Manual.
- Ensure that exclusively qualified personnel work on or with this device.
- Take care in project planning to see that the device is always used within its specifications.
- The device and/or mounting rail is mounted on a wall which is sufficiently sturdy.
- Ensure that the power supply meets the required specifications.
- Only operate the device if it is in technically faultless condition.
- Only use the device in combination with components approved by Baumüller Nürnberg GmbH.
- Only operate the device in type two environments. The device has been developed to meet the requirements of the category C3 according to IEC 61800-3:2005. The device is not intended to be connected to the public power grid. For operation of the device in a type one environment of the category C2/C1 (residential, business and commercial zone without an intermediate transformer directly to the low-voltage grid), special measures to reduce emitted interference (grid-bound and radiated) are to be arranged by a electrical cabinet engineer and must be demonstrated, since electromagnetic compatibility disturbances can occur unless additional measures are taken. It can not be guaranteed that a device described here will achieve category C2/C1 even with additional measures.

4.4 Operator responsibility

The device 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

Protection category	
BMC-M-SAF-0x	IP 20

All BMC-M-xxx-xx devices must be built into a suitable electrical cabinet in order to comply with the protective categories (IP22) required in EN61800-5-1, Chapter 4.2.3.3.

	DANGER!
	Life-threatening danger through electric current!
	Immediate life-threatening danger is present if contact with live parts is made.
	Therefore:
	● Operate the device in an electrical cabinet which provides protection from direct contact with the devices and meets the requirements of at least EN 61800-5-1, Chapter 4.2.3.3.

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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

denotes tight-fitting work clothing with low tear resistance, tight sleeves and no protruding parts. It primarily serves in protecting from...

Do not wear any rings and necklaces.

Protective helmet

for protection from falling and flying parts.

Safety shoes

for protection from heavy falling parts.

Safety gloves

to protect the hands from friction, abrasions, 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.

Electric current

DANGER!

Live-threatening danger from electric current!

Immediate life-threatening danger is present if contact with live parts is made. Damage to the insulation or individual component can be life-threatening.

Therefore:

- Shut down immediately if the insulation on the power supply is damaged.
- Only allow the work to be conducted on the electrical system by qualified personnel.
- Turn the current off when conducting any work on the electrical system and secure it before turning it back on.

Dangers from residual energy

DANGER!

Live-threatening danger from electric current!

After the device has been disconnected from the mains, live parts such as line connectors may only be touched once the capacitors in the device have been discharged.

Therefore:

- Take the capacitors' discharge time into account and do not touch live parts beforehand.
- Follow commensurate instructions on the device.
- If you have connected additional capacitors to the intermediate circuit, it can also take considerably longer for the intermediate circuit to discharge. In such case, you will have to establish the necessary waiting period yourself or measure whether the device has been de-energized.

Moving parts

⚠️	**WARNING!** **Risk of energy from 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 Firefighting

⚠️	**DANGER!** **Live-threatening danger from electric current!** Electric shock can occur if a conductive fire extinguishing medium is used. Therefore: ● Use the following fire extinguishing medium: 🧯 ABC powder/CO2

4.10 Electric safety

The safety control is designed for contamination level 2 in accordance with EN 50178. This means that only non-conductive contamination may appear during operating time. Short-term conductivity from condensation is only permissible if the control 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 control. The power supply for generation the 24-volt supply must meet the requirements for PELV in accordance with EN 50178.

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

Preventative mea-sures
- Always be prepared for accidents or fire!
- Keep first aid equipment (first aid kits, blankets, etc.) and fire extinguishers readily available.
- Instruct personnel in accident reporting, first aid and rescue equipment.

In case of emer-gency: Act proper-ly
- 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 the immediate environment in which they are placed.

WARNING!

Live-threatening danger from electric current!

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.

DANGER!

Live-threatening danger from electric current!

Discharge time > 1 minute

Saved electric charge.

Therefore:

● Keep the discharge time of the capacitors in mind and do not touch live parts beforehand.

● Follow the commensurate instructions on the device.

● If you have connected additional capacitors to the intermediate circuit, it can also take considerably longer for the intermediate circuit to discharge. In such case, you will have to establish the necessary waiting period yourself or measure whether the device has been de-energized.

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.

The user can decide on setting the safety control in safety applications with a proof test interval of 10 years or 20 years. Different safety characteristic values apply depending on this.

5.1 Safety-related parameters for 20 years of operation

The safety-related parameters of the b maXX safe PLC will be described in the following Safety-related parameters of local I/O terminals and decentral components can be found in the applicable documentation. The values specified here relate exclusively to the PLC.

Parameters in accordance with IEC 61508	Meaning
PFH = $2.23 * 10^{-9}$/h	Probability of Failure per Hour
PFD$_{avg}$ = $1.91 * 10^{-4}$	Probability of Failure on Demand = mean residual error probability of a dangerous error on demand
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	Meaning
MTTF$_d$ > 100 years	Mean Time To Failure
DC$_{avg}$ according to SIL 3	Diagnostic Coverage

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

	CAUTION!
⚠️	If the user calculates his safety application with 20 years for the specified values, the safety control will have to be decommissioned and sent back to the manufacturer within not more than 20 years.

	NOTICE!
ℹ️	If the PFD_{avg} value of an application is too large the life cycle can be decreased to 10 years. The controller must sent back to Baumueller to the proof test after 10 years. For a proof test interval of 10 years is necessary: $PFD_{avg} = 9.35 * 10^{-5}$.

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 to 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 there are:

◖ 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 from 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:

- **b maXX safe PLC**,
- this Operation Manual including certificate of conformity / manufacturer's declaration

○ 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 component groups which are sensitive to electrostatic discharge.

Make sure that the shipping conditions (see ▷ Appendix D - Technical data◁ from page 109 onward) are consistently fulfilled throughout the entire shipping process.

DESCRIPTION OF THE B MAXX SAFE PLC MODULE

This chapter describes the b maXX safe PLC module and the type code applied to the module.

7.1 General

The b maXX safe PLC is an SPC for the implementation of central, hybrid and decentral automation technology.

It primarily consists of the following components:

1 SW module for control and regulation programming (standard PLC)

2 SW module for programming safety applications (safety PLC)

The functions of the SPC, such as configurable control and regulation technology, digital and analog inputs and outputs, connection to various bus systems as well as the control and regulation of decentral drives (such as cam disk) via these bus systems (such as EtherCAT) are implemented by means of the b maXX safe PLC and further system components connected to it.

Safety applications can also be programmed in parallel to this. The safety core used for this purposes is certified in accordance with SIL 3 (IEC61508).

The system can have both central and decentral I/O terminals. Standard data as well as safe data can be transmitted via network components and the local I/O bus.

Safe drives which respond by means of safety protocols via bus systems are considered to be I/O slaves in the system. The implementation of further safety functions such as SS1, SS2 or SBC is carried out in the drives locally.

The safety programming is carried out by means of the ethernet activation communication component group.

Control and regulation programming is carried out also by means of the same ethernet activation system components. Alternatively, it can be programmed by means of the standard RS232 interface.

Also HMI interfaces (operator control panels, touch screens, etc.) can be connected by means of this ethernet activation system. Alternatively, it can be connected to 3964R$^{®}$ procedure (data block connection) by means of the integrated RS485 interface, since the 3964R$^{®}$ procedure is assigned to the standard PLC and not to the safety PLC.

The 3964R® protocol is a registered trademark of Siemens AG.

System components

The scope of operation of the b maXX safe PLC can be expanded by the use of system components. Examples of available system components include:

- CANopen master
- EtherCAT master
- Ethernet activation
- Ethernet activation with CANopen master
- Digital and analog input and output modules
- Safe digital and analog input and output modules

IEC 61131-3 programming languages

Control and regulation programming is carried out in a modularized manner with the IEC 61131-3 programming interface ProProg wt III version 1.1 or higher in following programming languages:

- Sequential Function Chart SFC
- Structured Text ST
- Instruction List AWL
- Logic Diagram FUP
- Ladder Diagram LD

Safety programming languages

Safety programming is carried out in a modularized manner with the ProSafety programming interface in the following programming languages

- Logic Diagram FUP
- Ladder Diagram LD

Technology functions

Furthermore, intelligent technology functions can be implemented via libraries, such as:

- Cam disk
- Winder

In addition to the IEC 61131-3 programming interface PROPROG, an OPC server for connecting visualization tasks and parametrization can be integrated into the overall machine concept via OPC clients.

7.1.1 Applicable reductions in the functional range of the IEC programming language in the safety programming

Data types

Supported Data Types	Supported	Comment
SAFEBOOL	X	
BOOL	X	
INT	X	
DINT		
REAL		
WORD	X	
TIME	X	

Supported Data Types	Supported	Comment
DWORD	X	
SAFEWORD	X	
SAFEINT	X	
SAFETIME	X	
SAFEBYTE	X	

Supported Functions and Function Blocks at Basic Level

Supported Functions and FBs-Basic Level	Supported	Comment
AND	X	
OR	X	
Type Conversion functions	X	SAFEWORD_TO_SAFEBOOLS SAFEBOOLS_TO_SAFEWORD SAFEBOOL_TO_BOOL SAFEBYTE_TO_BYTE SAFEDWORD_TO_DWORD SAFEINT_TO_INT SAFETIME_TO_TIME SAFEWORD_TO_WORD
TON	X	
TOF	X	
TP	X	
CTU	X	
CTD	X	
CTUD	X	

Supported Functions and Function Blocks at Extended Level

Supported Functions and FBs-Extended Level	Supported	Comment
AND	X	
OR	X	
XOR	X	
NOT	X	
ADD	X	
MUL		
SUB	X	
DIV		

Supported Functions and FBs-Extended Level	Supported	Comment
GT, GE, EQ, LE, LT, NE	X	GE, GT, EQ, LE, LT, NE
Type conversion functions	X	SAFEWORD_TO_SAFEBOOLS SAFEBOOLS_TO_SAFEWORD
TON	X	
TOF	X	
TP	X	
CTU	X	
CTD	X	
CTUD	X	
Bistable FBs	X	SR, RS
Edge detection	X	F_TRIG, R_TRIG

Overview of the safety function blocks

Function Blocks	Supported	Comment
SF_Equivalent	X	
SF_Antivalent	X	
SF_ModeSelector	X	
SF_EmergencyStop	X	
SF_ESPE	X	
SF_SafeStop1		
SF_SafeStop2		
SF_GuardMonitoring	X	
SF_SafelyLimitedSpeed		
SF_TwoHandControlTypeII	X	
SF_TwoHandControlTypeIII	X	
SF_GuardLocking	X	
SF_TestableSafetySensor	X	
SF_MutingSeq	X	
SF_MutingPar	X	
SF_MutingPar_2Sensors	X	
SF_EnableSwitch	X	
SF_SafetyRequest	X	
SF_OutControl	X	
SF_EDM	X	

7.2 Configuration of the BMC-M-SAF-02

A = Jack (for additional
system components
on the side)
B = Plug (for power supply
or CF card,
if present;
on the side)
C = Unlocking handle
(white, bottom)
D = Abbreviated designa-
tion
E = Type plate (on the
side)
F = LEDs
G = RS232 interface
H = RS485 interface
J = Rotary switch
K = Switch / button
L = 7-segment display
M = Button

Channel 1   Channel 2
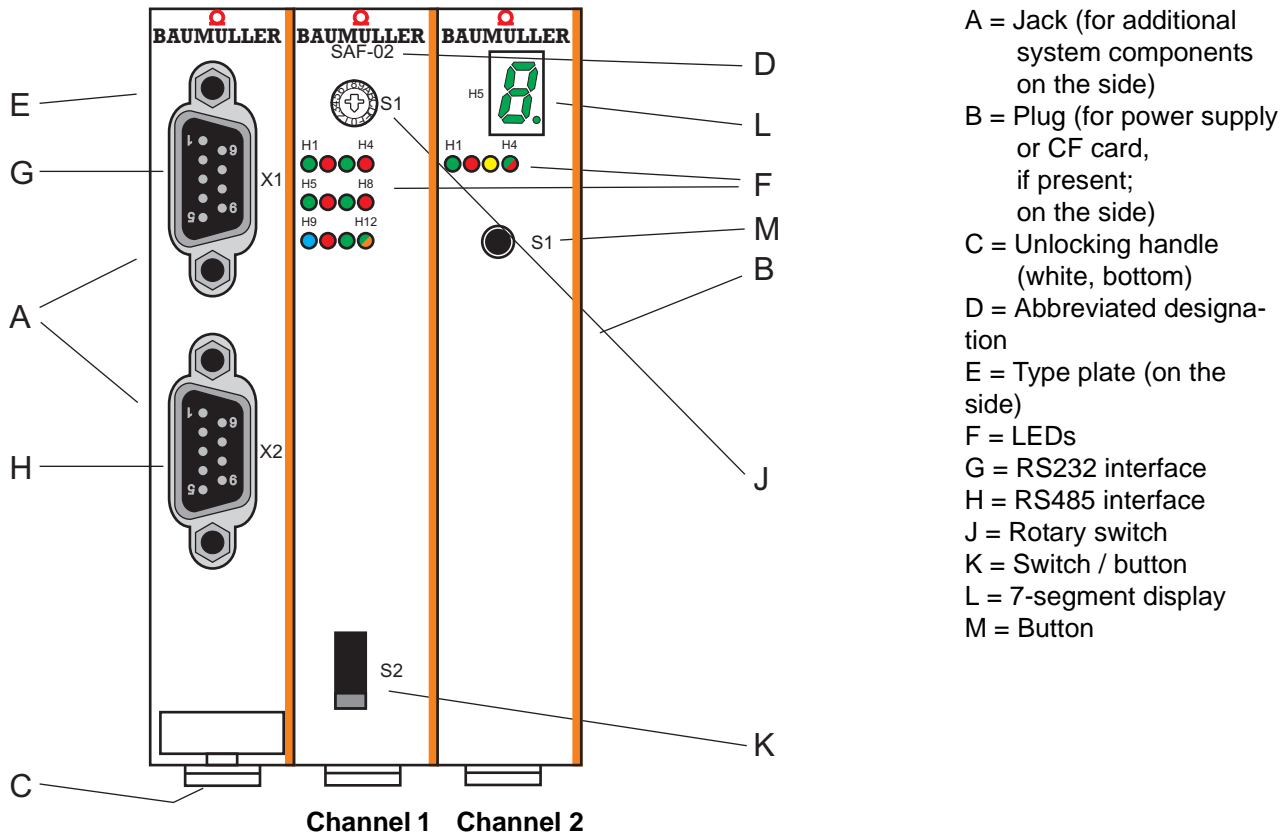
Figure 1:   b maXX safe PLC (BMC-M-SAF-02)
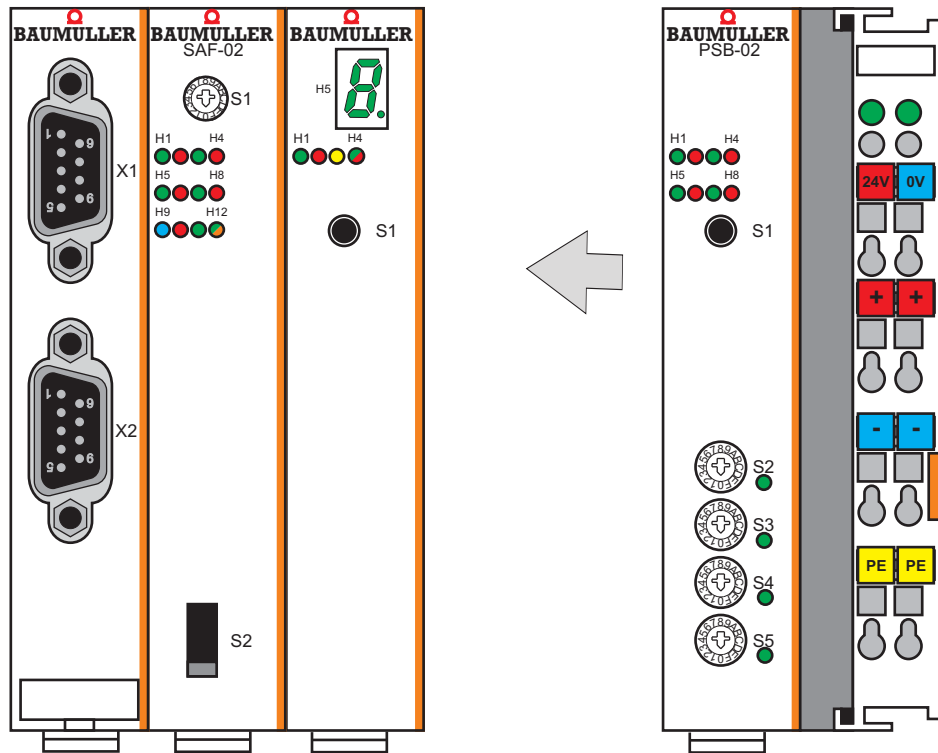**Dual channel safety PLC**

Figure 2:   b maXX safe PLC (BMC-M-SAF-02) with power supply
              Dual channel safety PLC
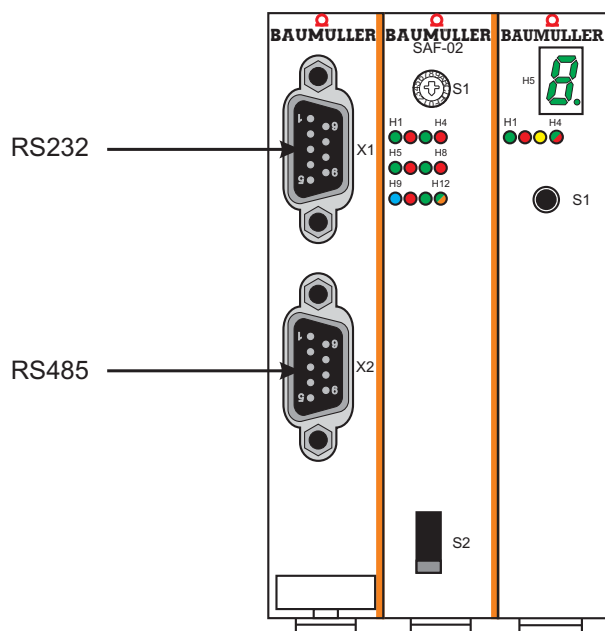
7.3   Interfaces

Figure 3:   Connection diagram b maXX safe PLC taking the dual-channel safety PLC as an example

7.4 Properties of the standard PLC

- 32-Bit RISC CPU 667 MHz
- Program memory (Flash, 16-bit length) for saving the boot project 15 MB
- Program memory (SDRAM, 32-bit length) 14 MB for executable program code
  - max. 1 750 000 instruction list lines (LD/ST instructions on the global version)
  - type 525 000 instruction list (typical IL instructions on structures and instance variables)
- Approx. 9 MB memory (SDRAM) for debugging and logic analyzer functions
- Memory for remanent data 100 KB NOVRAM
- FDisk memory (for storing cam disks and configuration data): 22 MB
- IEC data memory (SDRAM) of 1.75 MB expandable up to approx. 8.75 MB.
- Cycle time approx. 25 µs per 1000 lines of instruction list (IL) for standard PLC
- RS232 serial programming interface, visually separated from the b maXX safe PLC
- Alternative programming interface via system components ethernet connection.
- RS485 serial terminal interface, visually separated from the b maXX safe PLC
- up to 5 additional modules (system components) can be addressed:
  - additional EtherCAT masters
  - additional CANopen masters
  - additional ethernet connections
  - additional ethernet connections with CANopen master
- Motion control support
- Power consumption of approx. 5 W

7.5 Properties of the safety PLC

The 32-bit RISC-CPU 667 MHz of the standard PLC is used jointly with the BMC-M-SAF-02 for safety programming.

A 32-bit RISC-CPU with 400 MHz is also used.

- Program memory of 1 MB for the executable program code of the safety application which has been created with ProSafety.
- With the dual-channel solution, the IEC program code is translated via the ProSafety programming user interface with two different compilers; the output of compiler 1 is executed on channel 1, while the output of compiler 2 is executed on channel 2 (1 MB of executable program code each).
- IEC data memory (SDRAM) 256 KB
  Programming interface via system components ethernet connection.
- Safety PLC file system Flash 6 MB in total, of which:
  - 1 MB of program memory per channel,
  - 100 KB of configuration data,
  - 750 KB of configuration data stacks,
  - 2 MB reloadable stack area

7.6 Properties of the power supply module

See the Operation Manual on the power supply for the b maXX controller/safe PLC

7.7 Properties of the memory card module

A = Jack (for PLC; on the side)
B = Plug (for the power supply; on the side)
C = Unlocking handle (white, bottom)
D = Abbreviated designation
E = Type plate (on the side)
F = LEDs
G = 7 segment display
H = Button
J = Rotary switch
K = Slot for memory card incl. ejector
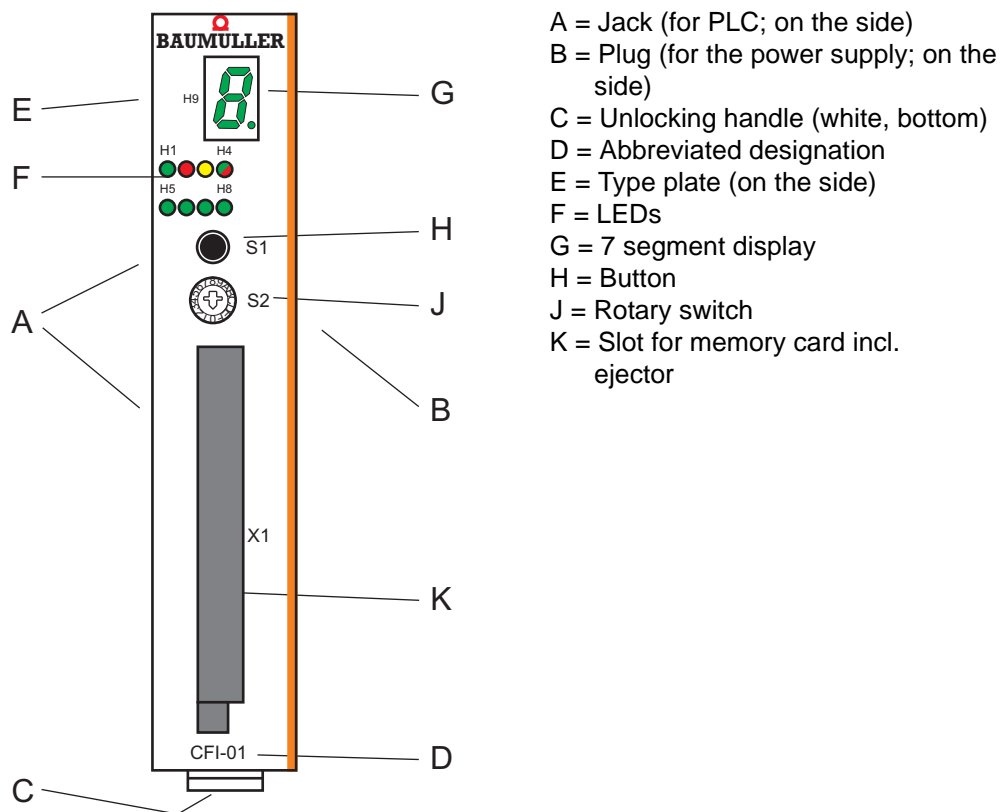
Figure 4: Memory card module BMC-M-CFI-01

The memory card module is optional and is usually mounted between the PLC and the BMC-M-PSB-02 power supply.

CF type I (42.8 mm x 36.4 mm x 3.3 mm) compact Flash cards can be used as memory cards.

7.7.1 Data on the memory card

The memory card serves in downloading and uploading both security application projects as well as standard application projects including configuration data.

- Copy the data from the CFI card to the PLC
- Copy the data from the PLC to the CFI card

7.8 Danger zones

The following illustration provides an overview of the danger zones present on the module.
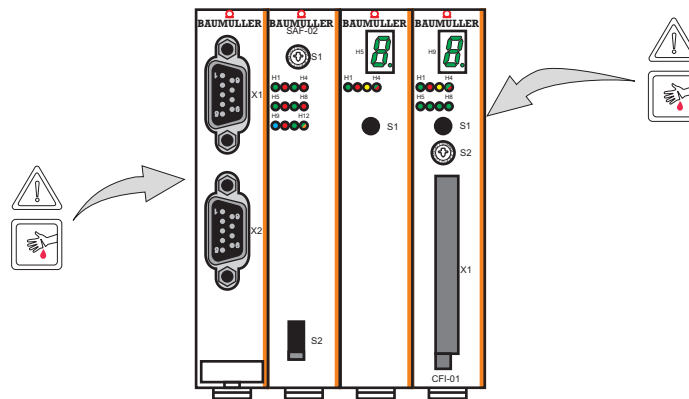
Figure 5:   Danger zones of the BMC-M-SAF-02 with memory card
Dual-channel safety PLC

7.9 Marking of the control - type code

On the front plate, you will find the type code on the module's type plate ("E" in ▷Figure 1◁ on page 35 for the BMC-M-SAF-02).

> **NOTICE!**
>
> This type code applies exclusively to the b maXX safe PLC module. Other modules have their own type codes.

<u>BMC</u> - M - SAF - XX - YY - ZZ	Generation of device in which the module can be used
BMC - <u>M</u> - SAF - XX - YY - ZZ	Module
BMC - M - <u>SAF</u> - XX - YY - ZZ	Module type (b maXX safe PLC)
BMC - M - SAF - <u>XX</u> - YY - ZZ	Module version:
	02: Two-channel version
BMC - M - SAF - XX - <u>YY</u> - ZZ	Hardware version
	11: Standard version (with 4 MB Flash NOVRAM; altered knife-edge contact between power supply, PLC and field bus modules)
BMC - M - SAF - XX - YY - <u>ZZ</u>	Software
	02: Standard version (operating system with motion control function)

> **NOTICE!**
>
> All modules in hardware version "-**1**x-" are **not compatible** with modules in hardware version "-**0**x-", since the knife-edge contacts between the power supply, PLC and potential field bus modules have been changed. Only modules in version "-**1**x-" can be connected for that reason.
>
> Example: b maXX safe PLC and   BMC-M-SAF-02-**1**1-02
> Power supply b maXX controller/safe PLC   BMC-M-PSB-02-**1**0-00

This type code can be found on the front side of the module ("E" in ▷Figure 1◁ on page 35 for the BMC-M-SAF-02). The type code contains the module's essential data. A summary of all technical data can be found in ▷Appendix D - Technical data◁ from page 109 onward.

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.

8.1 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.

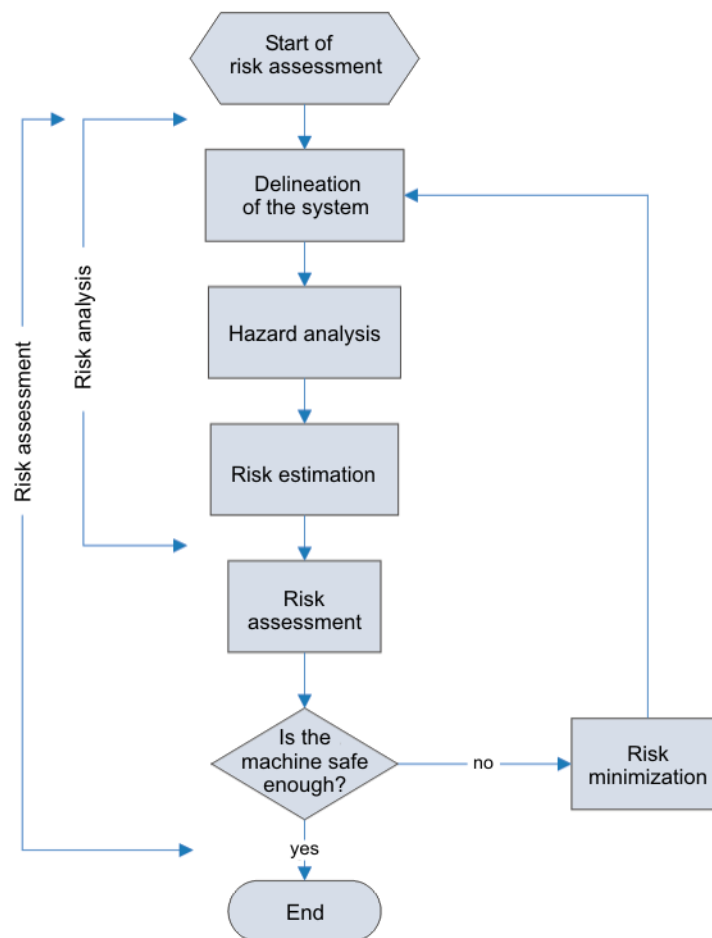Figure 6:   Risk assessment procedure in accordance with DIN EN ISO 12100-1 and EN ISO 14121

Delineation of the system: Determination 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 in accordance with DIN EN ISO 13849-1 and IEC 62061 is described in the Application Handbook.

8.2 Installation and wiring plan

An installation and wiring plan for the entire safety system is to be compiled 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 compiling the wiring plan.

8.3 Determination of the device parameters

⚠	**CAUTION!** A list of the parameters to be set is to be set and a determination of the individual parameter values is to be established in the planning phase.

The safe parameters available can be found in the Application Handbook of the b maXX safe PLC and Operation Manual on the safety I/O modules.

Further (standard) parameters are provided in the operating instructions on the communication modules.

8.4 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 Baumüller publication ▷Automation - Complete Catalog◁. There, you can find information on concepts, PLC, field buses, motion control, technology blocks, HMIs, IPCs and I/Os.

The minimum version consists of a b maXX controller or safe PLC, a power supply for the b maXX controller or safe PLC and an ethernet communication component assembly.

The system can be expanded to the left with up to five additional modules, such as communication component assemblies like EtherCAT master/slave, CANopen master/slave, ethernet connections, etc. If a CF card is present, only four more modules can still be added.

The system can be expanded to the right with the direct connection of I/O modules such as digital input and output modules, analog input and output modules, thermal elements such as PT100, counter modules, feed terminals as well as with digital input and output terminals.

The power consumption of the individual modules can be found in Appendix D of the operation manual of the respective component assembly.

9

ASSEMBLY AND INSTALLATION

This chapter describes the mechanical assembly and electrical installation of the b maXX safe PLC.

The assembly and installation process consists of the following steps:

1   Assemble the module.
2   Connect the module to the power supply.

9.1   General safety regulations

> **CAUTION!**
>
> The "Installation checklist" reproduced in Appendix ▷C.2◁ on page 105 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 ▷D.2.1◁ on page 110 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.

○ Be aware of all areas of the b maXX System which could pose a danger to you during the assembly process.

The following illustration provides an overview of the danger zones present on the module.
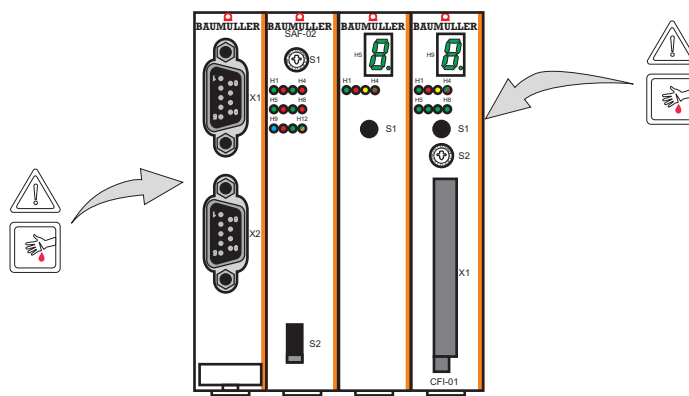
Figure 7: Danger zones of the BMC-M-SAF-02 with memory card
Dual-channel safety PLC

9.2 Requirements on the personnel conducting the work

DANGER!

Life-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.

9.3 Preparation for assembly

You can prepare for the assembly by using the project planning documents for your plant. You can determine the installation location and the dimensions for the mounting holes for the 35mm C-rails based on the installation space needed (see ▷Installation space ◁ from page 47 onward).

⚠

CAUTION!

Danger of eye injury due to flying particles!

Metal particles will be propelled into the air when drilling the holes and making the cutout.

Therefore:

👓 **Safety glasses**

for protection the eyes from flying parts and spraying liquids

---

◉ Drill the holes and fasten the 35 mm C-rails as needed.

9.4 Installation space

The following diagrams show you the height and depth dimensions of the modules of the b maXX system. Use these diagrams to determine the amount of space you will need in the electrical cabinet.

The width of the modules used varies. In order to establish the weight of your b maXX system, add the width of the individual modules (which you want to use). Take note of potential limitations to the number of the modules which can be used on one power supply.

Figure 8:   Installation space b maXX System

NOTICE!

The specified spacings are minimum spacings. These spacings can be greater due to cable routing (see ▷Installation procedure ◁ from page 55 onward).

NOTICE!

The b maXX safe PLC must be installed in the position shown in the illustrations. This means that the support rails must be fasted to the wall horizontally. Other installation positions are not possible.

9.5   Assembly instructions

When assembling the power supply for the b maXX safe PLC, be advised that the power assembly can only be mounted with the b maXX safe PLC (and potentially additional system components on the b maXX safe PLC).

For that reason, keep the b maXX safe PLC power supply and other system components for the b maXX safe PLC (if applicable) ready for the assembly process.

> **DANGER!**
>
> **Life-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 has been shut off before beginning work.
>
> ● Follow the applicable safety regulations when handling devices carrying high voltages.

The following tools will be needed:

● A suitable tool to open the spring clamps of the electrical connections (such as a screwdriver with a 2 mm blade width).

● A suitable tool for pulling out the white handle on the bottom of the module (such as a pair of needlenose pliers for electronic work).

◑ Check the type code on the type plate ("E" in ▷Figure 1◁ on page 35 for BMC-M-SAF-02) to make sure that you have the correct module ready
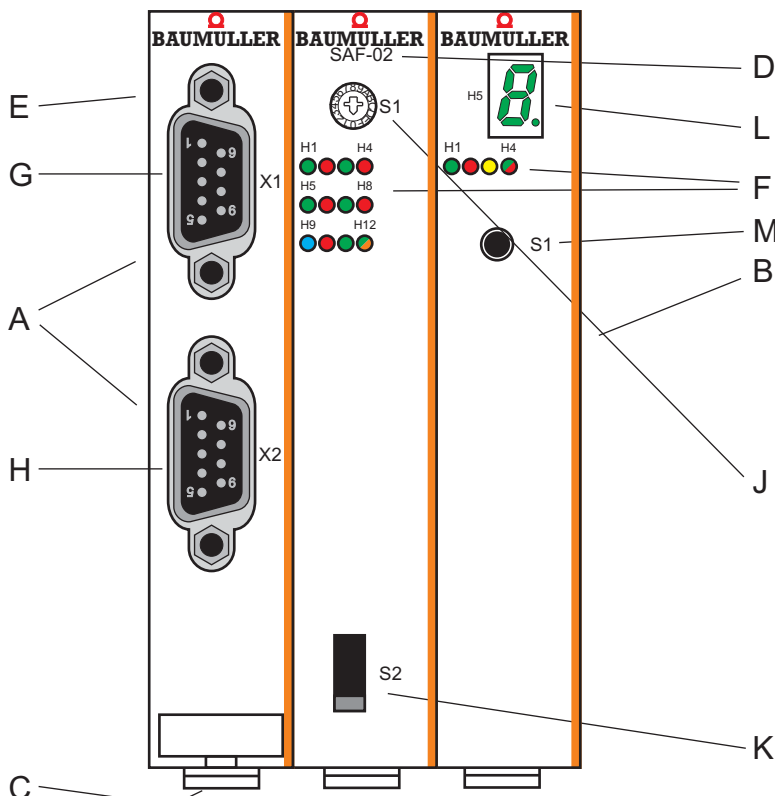
A = Jack (for additional system components on the side)
B = Plug (for power supply or CF card, if present; on the side)
C = Unlocking handle (white, bottom)
D = Abbreviated designation
E = Type plate (on the side)
F = LEDs
G = RS232 interface
H = RS485 interface
J = Rotary switch
K = Switch / button
L = 7-segment display
M = Button

Figure 9: b maXX safe PLC (BMC-M-SAF-02) **dual-channel safety PLC**

1 Shut off the power to the power supply if necessary and make sure that it does not turn back on accidentally during the assembly work. Disconnect any already attached cables or lines from the connections

2 Open the electrical cabinet

3 Plug the b maXX safe PLC into the power supply
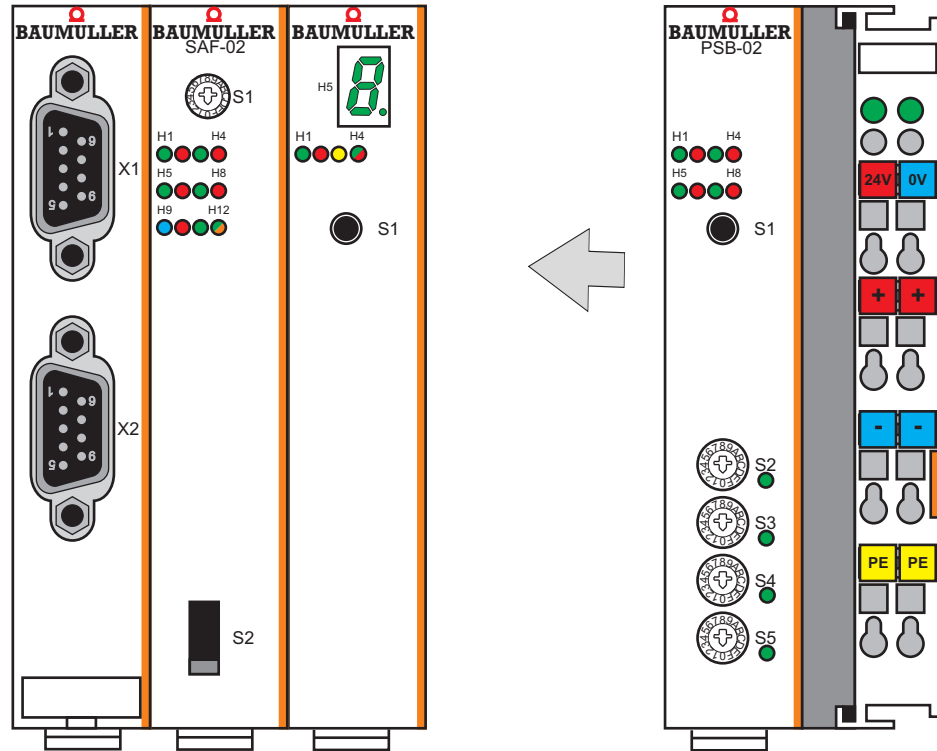
Figure 10: b maXX safe PLC (BMC-M-SAF-02) with power supply
dual-channel safety PLC

If you are using additional system components for the b maXX safe PLC, plug them into the b maXX safe PLC from the left.

NOTICE!

The b maXX system will not work if you plug the b maXX safe PLC into the another module of the b maXX system instead of plugging it into the power supply.

The memory card module (CFI-01) is the only element which is allowed to be between the PLC and the power supply. The b maXX safe PLC requires the PSB-02 power supply.

4 There is a white handle on the bottom of the left part of the power supply. Pull this handle downward and then to the left. The handle will lock into place easily.
Repeat this step with the b maXX safe PLC (3 handles with the BMC-M-SAF-02; 4 handles with the BMC-M-SAF-02 with memory card module).
Repeat this step with any further system components for the b maXX safe PLC (which are plugged into the left side of the maXX safe PLC).
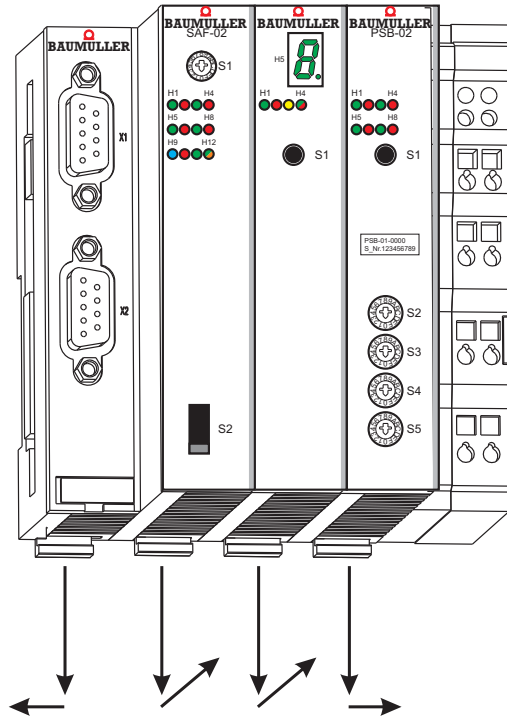
Figure 11:   b maXX safe PLC with power supply

5 Use a small screwdriver to pull the orange handle on the right part of the power supply forward so that you can grip the handle easily
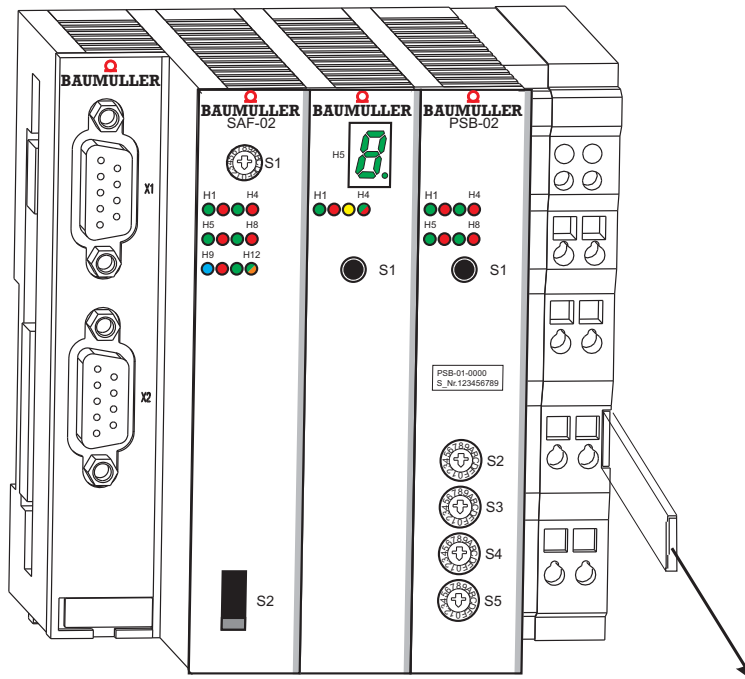
Figure 12:   b maXX safe PLC (left) with power supply (right)

6 Set the module block onto the 35 mm C-rail and hold it firmly.

7 Pull the orange handle on the right part of the power supply further forward and press the module block backward at the same time.

8 Release the orange handle. The right part of the power supply will engage with the 35 mm C-rails.

9 Push the orange handle into the module. This will prevent the orange handle from being broken off accidentally.

10 Push the white handle on the bottom of the left part of the power supply to the right. This will cause the white handle to unlatch and the left part of the power supply to engage with the 35 mm C-rail.

Repeat this step with the b maXX safe PLC (3 handles with the BMC-M-SAF-02; 4 handles with the BMC-M-SAF-02 with memory card module). This will cause the fb maXX safe PLC to engage with the 35 mm C-rail.

Repeat this step with additional system components for the b maXX safe PLC (which are plugged into the left side of the b maXX safe PLC), if any. This will cause the additional system components to engage with the 35 mm C-rail.

11 You can now mount additional system components (such as I/O modules on the right side of the power supply. Follow the applicable operating instructions in the process.

The assembly of the b maXX safe PLC module is now complete. Information on connecting lines and commissioning can be found in the following sections.

9.6   Installation

Wire the b maXX safe PLC module during the installation process.

9.6.1   Connection diagram

RS232 — X1

RS485 — X2
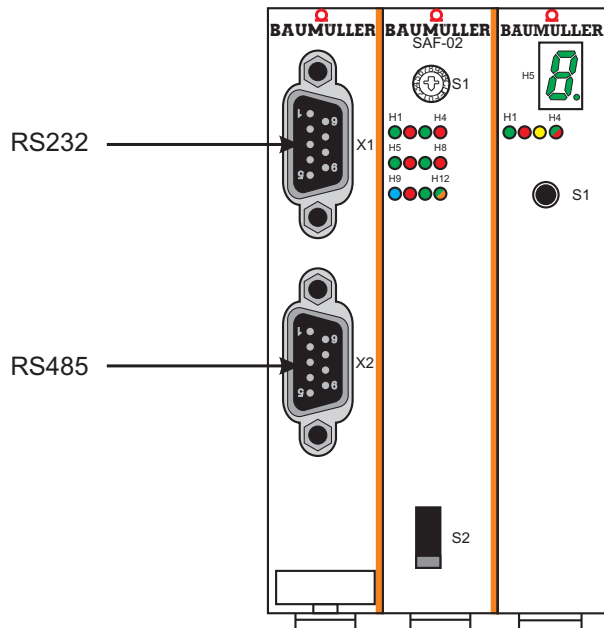
Figure 13:   Connection diagram of the b maXX safe PLC taking the dual-channel safety PLC as an example

9.6.2   Requirements for the electrical connection

CAUTION!

Danger from electrical current!

The module can be damaged or destroyed if the requirements for the electrical con-nection 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.
- The +5 V on pin 2 of the sub-D jack X2 of the b maXX safe PLC module is only intended to supply external original Baumüller RS485/RS232 converters and may not be bypassed or connected with one another in a ring.

In order to be able to fulfil the EN 60 204-1 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 a EMC-compatible manner.

9.6.3 Safety-related connection technology

The b maXX safe PLC can be connected by means of the local I/O bus or by means of a field bus with safety-oriented I/O terminals.

CAUTION!

Special care is to be given to ensure that the electromechanical sensors (safety switching devices) are supplied with suitable timing signals for short circuit recognition.

Electromechanical switches must meet the requirements of IEC 60947-5-1.

9.6.4 Requirements on the connection cable

Baumüller approves the following cables for use:

● RS485 interface:

Stranded cables in pairs with a recommended cross-sectional area of 0.5 mm², PVC outer jacked and overall shielding made of tin-plated mesh may be used.

Such as: Type LIYCY   6 x 2 x 0.14 mm²

● RS232 interface:

Shielded cable with a recommended cross-sectional area of 0.5 mm².

Further information can be found in ▷Appendix B - Accessories◁ from page 101 onward.

NOTICE!

Use 60°/75° copper cable if you are following UL 508 C

NOTICE!

The climatic properties namend in appendix ▷D.2.1◁ on page 110 are also valid for the used cables.

9.6.5 Installation procedure

- ❍ Make sure that the power to the b maXX System has been switched off.

- ❍ Make sure that the external power supply has been shut off and is secured from being switched back on.

- ❍ Connect the 9-way SUB-D jack X1 to the front plate of the left part of the b maXX safe PLC with the PROPROG programming cable (for more on this, see ▷Requirements on the connection cable ◁ on page 54 and ▷Appendix D - Technical data◁ from page 109 onward).

- ❍ Connect the 9-way SUB-D jack X2 to the front plate of the left part of the b maXX safe PLC with the connection cable for a terminal or another device with the RS485 interface (for more on this, see ▷Requirements on the connection cable ◁ on page 54 and ▷Appendix D - Technical data◁ from page 109 onward).

Uncover the shielding of the cable and connect it with PE of the control cabinet

Uncover the shielding of the cable and connect it with PE of the control cabinet
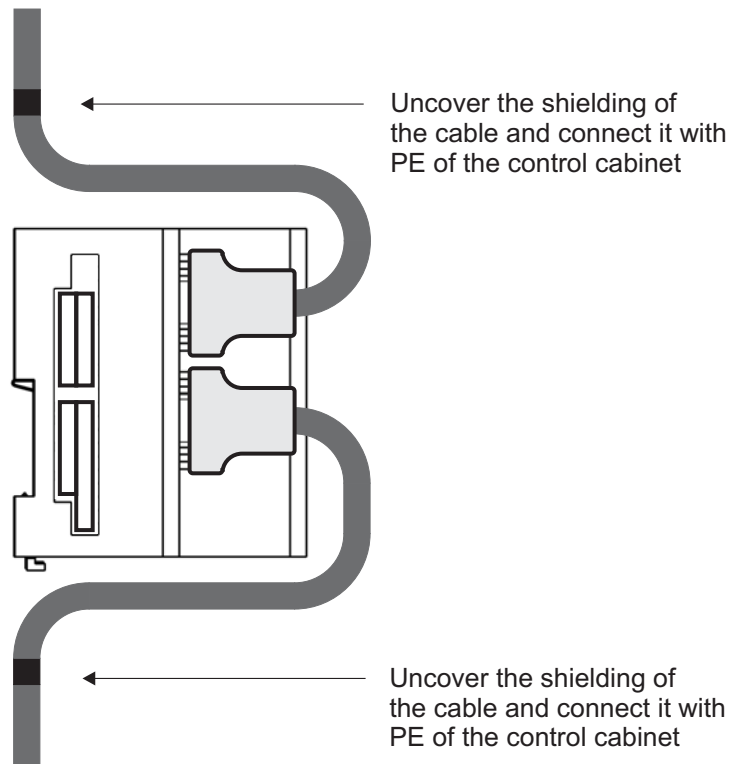
Figure 14:   Cable routing

- ❍ Route the connection lines according to the specifications in ▷Figure 14◁. The cable shielding must be laid open first. The length of the exposed shielding should correspond to the width of the fastening clamp. The cable is fastened with the clamp in such a manner as to create a connection between the cable shielding and the PE of the electrical cabinet.

The installation is now complete.

PROGRAMMING, CONFIGURATION AND PARAMETERIZATION WITH PROSAFETY

	NOTICE!
	Since the user administration is not initialized after the installation of ProSafety, the installation of ProSafety should be limited to authorized persons by company policy.

Detailed instructions on programming the safety control can be found in

the Application Handbook for the b maXX safe PLC or

in ProSafety's online help system

Operation Manual **b maXX safe PLC** BMC-M-SAF-02

Document no.: 5.07020.05

Baumüller Nürnberg GmbH

COMMISSIONING

This chapter describes the process of starting up the assembled and installed (see ▷Assembly and installation ◁ from page 45 onward) b maXX safe PLC module for the initial operation. The process of commissioning ensures that the b maXX safe PLC module functions properly.

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

1 The module is assembled correctly.

2 The module is installed correctly.

3 All safety devices are in operation.

4 The b maXX system is ready for use.

⚠️	**WARNING!** **Danger of injury from electric current!** The ▷Commissioning and validation checklist ◁ from page 106 onward reproduced in the Appendix should be used during the commissioning phase. Therefore: - 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. - Never leave the system unsupervised during commissioning with manually set variables in debug mode (forcing). The important safety functions may not be active in this form of operation. Make sure that no one enters the danger zone. - 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.

If the internal watchdog is triggered during the commissioning of the PLC, it is possible that the cycle time of the safe application has been exceeded. In this case, the distribution of resources between the standard and safe process will have to be adjusted.

	CAUTION!
	Adjusting the safe cycle time is only permissible if the reaction times established in the planning phase are complied with. In this case, computational evidence will have to be provided.

Please take note of ▷Troubleshooting and rectification ◁ from page 83 onward for rectifying errors during the commissioning process.

11.1 Description of the operation modes, RUN/STOP switch

Due to the run-time system implemented, the safety system consists of two function units, namely the standard PLC and the safety PLC.

The IEC application program is run on the standard PLC. The programming is carried out in ProProg with the full extent of IEC languages. The standard motion control function is also available.

The safe IEC application program is run on the safety PLC. The programming is carried out in ProSafety in function diagram/ladder diagram. The standard motion control function is also available.

The configuration for both function units is conducted in ProMaster (see ▷Application Manual b maXX safe PLC◁). There are the following two operation modes for the safety control in relation to the function units.

11.1.1 Solitary safety PLC

If the functions of the standard PLC are not needed, then the safety PLC can be run by itself. This way, it puts the full scope of functions of a conventional safety control at your disposal.

The operation mode is set when an IEC project is not transferred to the standard PLC or when an existing project is erased. The safe parameter for the distribution of computing time between safety PLC and standard PC should be set on 90% for this operation mode (see ▷Determination of the device parameters ◁ on page 43).

Running the safety PLC in solitary operation will result in the following behavior:

Safety IEC projects including configuration files can be transferred to the safety PLC. The bus configurations must be transferred to the standard PLC, by downloading in ProMaster, for example (see ▷Application Handbook b maXX safe PLC◁).

The safety PLC can be started and stopped using the RUN/STOP switch (see ▷S2 switch/button for changing operating statuses of the BMC-M-SAF-02 ◁ from page 67 onward), or using debug operation in ProSafety. If the safety PLC is supposed to start up after being turned on, a project must be present and the RUN/STOP switch must be in the "RUN" position.

If a new bus configuration is loaded on the standard PLC, the safe communication will be interrupted by the idleness of the standard communication, after that it will start back up again. If there are dependencies on the standard communication, then additional slaves

may be potentially reached after the download or certain slaves may not be reached any longer (display in diagnostic markers).

NOTICE!

If a bus configuration on the standard PLC is present and a safety project including configuration files is present on the safety PLC, the safe communication will run in RUN status as well as the STOP status of the safety PLC. All original data is set on 0 (failsafe value) in STOP status. Safe communication will no longer run if the safety PLC goes into error status. The connected safety devices then recognize the breakdown in safe communication and go into safe status independently.

CAUTION!

Danger due to non-safe status!

Do not attempt to bring about the safe status of the system by using the stop position of the run/stop switch. This status is not safe, since the run/stop switch only serves functional purposes.

Therefore:

● In order to establish safe status, a correspondingly configured and suitable emergency stop device should be actuated or the power to the safe system should be shut off.

11.1.2 Combined operation of the safety PLC

In this operation mode, the standard PLC and the safety PLC run on a processor in the safety control in very short time alternation (time slicing).

The functionalities of the standard PLC and safety PLC can be operated practically in parallel. The processing power is distributed between 10% and 90% by means of the safe parameters (▷ Determination of the device parameters ◁ on page 43).

This operation mode is set by transferring an IEC project to the standard PLC and activating it.

Combined operation results in the following system behavior:

The RUN/STOP switch affects the standard PLC and the safety PLC.

If both PLCs are to start up after being switched on, then a project must be present on each PLC and the RUN/STOP switch must be in the "RUN" position.

Other actions (other than the RUN/STOP switch) will only take effect on the respective piece being addressed (standard PLC or safety PLC). However, every action will stop, since the standard PLC also stops the safe communication. (The reason for this is that the communication is coupled to the status of the standard PLC and the safe communication cannot run if the standard communication is not running.)

NOTICE!

The safe communication will only run if a bus configuration is present on the standard PLC, a safety project including configuration files is present on the safety PLC and the standard PLC is in RUN status. The status of the safety PLC ("RUN" or "STOP"), on the other hand, is of no concern. In STOP status, all original data will be set to 0 (fail safe value). If the safety PLC goes into error status, the safe communication will no longer run. The connected safety devices then detect a breakdown of the safe communication and automatically go into safe status.

If the user deletes the IEC project in the RAM of the standard PLC, then the safety PLC will stop (if it had previously been in "RUN" status). The configured standard communication will stop in the process, thus stopping the safe communication as well. After subsequently being restarted, it will switch into "solitary operation" mode and the standard communication will be started again. This will start up the safe communication again.

CAUTION!

Danger due to non-safe status!

Do not attempt to bring about the safe status of the system by using the stop position of the run/stop switch. This status is not safe, since the run/stop switch only serves functional purposes.

Therefore:

In order to establish safe status, a correspondingly configured and suitable emergency stop device should be actuated or the power to the safe system should be shut off.

11.2 General safety regulations

○ Follow the chapter ▷Safety◁ from page 17 onward.

WARNING!

Danger of injury from moving parts!

Machine parts/line parts or the entire machine/line can move during commissioning.

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 b maXX safe PLC.
- Activate the safety devices in any case.

11.3 Requirements on the personnel conducting the work

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

11.4 Description/inspection of the safety and monitoring equipment

Before commissioning the b maXX safe PLC module, you will have to make sure that the +24 V supply is properly connected to the power supply for the b maXX controller/safe PLC and that the +24 V supply matches the specifications. You may only proceed with the commissioning once you have inspected this and ensured that everything is in order.

Note that you can only put the b maXX safe PLC into operation together with the power supply and any additional system components during the commissioning process.

11.5 Loading applications

See ▷Application Manual b maXX safe PLC◁.

11.5.1 Downloading projects from the PC

See ▷Application Manual b maXX safe PLC◁.

11.6 Setting the station number

1 The station number setting is activated by pushing the S1 button on channel 2 of the PLC and the S1 button on the BMC-M-PSB-02 power supply simultaneously.

2 After pushing the buttons, the LED on rotary switch S2 (1st digit) on the power supply will light up.

3 The 7-segment display on channel 2 of the PLC will blink and show the value of rotary switch S2 on the power supply.

4 The value of the 1st digit of the station number can now be set on the rotary switch.

5 Push the S1 button on channel 2 of the PLC and the S1 button on the BMC-M-PSB-02 power supply.

6 The LED on rotary switch S2 will remain set and the 7-segment display on channel 2 of the PLC will stay lit and display the values overtaken from rotary switch S2 of the power supply.

7 The value set is confirmed by pushing the S1 button on channel 2 of the PLC and the S1 button on the BMC-M-PSB-02 power supply once again. In doing so, the user will have to compare the rotary switch position with the value displayed. If an error is indicated in the process, the safety control will have to be sent back to Baumüller for repair.

8 The LED on rotary switch S3 of the power supply will light up and the 7-segment display on channel 2 of the PLC will blink and display the value of rotary switch 3.

9 After this, conduct the settings for the second digit, beginning again at step 4, the same way for rotary switches S3 through S5.

Once the fourth address is confirmed, the address will be overtaken and will enter into effect after the next restarting.

The entry is aborted if you stop pushing button S1 on channel 2 of the PLC and button S1 on the power supply. After a defined maximum time (10 seconds), the entry mode will be exited and the address which was previously set will remain.

The position of the rotary switch need not correspond to the set station address at all times, since a turn of the rotary switch outside of entry mode will not be overtaken.

As long as the entry mechanism is not activated, the current station address overtaken will always scroll to the H5 7-segment display on channel 2 of the PLC with a brief interruption to recognize the initial position. In the process, the decimal point will always light up at each second digit, so that sequential identical digits can be recognized at the turning of the decimal point (for instance, 1.2 2.4 means 1224). Initial digits which are zero are not displayed.

You can find additional information on the meaning of the station number and address/ID allocation in the ▷Application Manual b maXX safe PLC◁.

11.7 Description and inspection of the operation and display elements

11.7.1 LEDs for displaying the operation statuses of the BMC-M-SAF-02 (channel 1)

The display elements on the b maXX safe PLC module consist of twelve LEDs on channel 1: five green (H1, H3, H5, H7, H11), five red(H2, H4, H6, H8, H10), one blue (H9) and one orange/green (H12) (see "F" in ▷Figure 1◁ on page 35).

The LEDs are used during the initialization (run-up phase) of the operation system of the b maXX safe PLC.

During operation (after the operating system's run-up phase), the LEDs can be used by the user in the application program on the b maXX safe PLC (standard PLC).

After the power is turned on, all system components in the b maXX system will have to have reached a certain internal operation status (global ready message) before they can be addressed by the b maXX safe PLC.
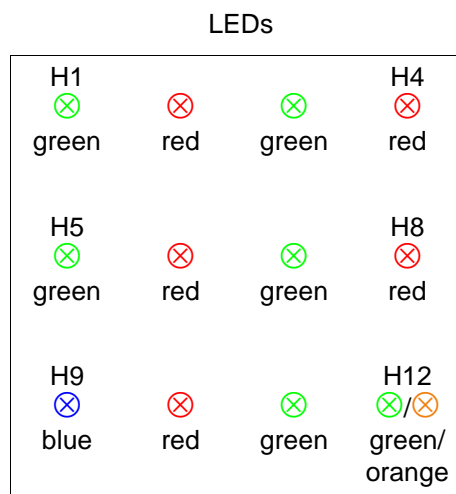

Figure 15:   LEDs on the b maXX safe PLC of the BMC-M-SAF-02

11.7.1.1 Switching on and initialization the BMC-M-SAF-02

- After being switched on, a basis initialization of the b maXX safe PLC is carried out which is necessary for the further initialization. H9 (blue) will turn on once this basis initialization is complete.
- The b maXX safe PLC module will then wait for the global ready message of the following modules:
  - Power supply module for the b maXX controller/safe PLC
  - Modules plugged in to the left of the b maXX safe PLC (such as the ethernet with CANopen master module).

  This phase is indicated by an LED pattern rotating to the left. In the process, four LEDs will light up in the sequence H1 (green) → H5 (green) → H6 (red) → H2 (red) → H1 (green) etc. at an alternation of 500 ms. H9 (blue) is off again.

  If the modules' ready message is not given within a maximum of 8 seconds, H4 (red) will turn on.

  See ▷Troubleshooting and rectification ◁ from page 83 onward in order to remedy the cause of an error.

- After the modules' global ready message, the b maXX safe PLC will initialize the I/O bus.

  This phase is indicated by an LED pattern rotating to the right. In the process, four LEDs will light up in the sequence H1 (green) → H2 (red) → H6 (red) → H5 (green) → H1 (green) etc. at an alternation of 500 ms.

  If the I/O bus is cannot be initialized within a maximum of 8 seconds or an error appears during the initialization of the I/O bus, H8 (red) will turn on.

Both of the above-described procedures can be completed very quickly, so that it is not absolutely crucial to observe the related operating displays.

Afterward, a PROPROG communication can generally be carried out via the serial RS232 interface (X1) between the PC and the b maXX safe PLC.

Starting now, the PROPROG communication is also possible by means of TCP/IP, if a module with ethernet functionality (such as the ethernet with CANopen master module) is plugged in on the left side of the b maXX safe PLC and has been configured for communication with the b maXX safe PLC.

- If a boot project is present, the boot project will now be loaded (the boot project is read, translated and stored in the SDRAM as an executable program code by Flash). The loading of the boot project is indicated by a rapid blinking of LEDs H1 and H2.

NOTICE!

If the modules' ready message has not been given (H4 [red] is on), it will **not be possible** to run **any** user program code; a PLC error message will be generated. The PLC will remain in "STOP" status.

The LEDs will show the following PLC-specific operation statuses at the end of the run-up phase:

- No project present, status "POWER ON"
  → LED H5 (green) and H6 (red) light up.

- Project present, status "STOP":
  → only LED H6 (red) lights up.
- Project present, status "INIT", the control is in cold start or warm start phase:
  → only LED H5 (green) lights up.
- Project present, status "RUN":
  → LED H1 (green) and H5 (green) light up.
- Global ready message absent:
  → LED H4 (red) lights up; PLC does **not** go into "RUN".
- I/O bus cannot be initialized:
  → LED H8 (red) lights up.

NOTICE!

Even if the I/O bus initialization was not successful (H8 [red] is turned on), the boot project will be loaded and the user program code will be executed.

This means that you can use the b maXX safe PLC and the further modules without the I/O bus modules.

11.7.1.2 Operation of the BMC-M-SAF-02

The LEDs will show the following PLC-specific operation statuses at the end of the run-up phase:

- No project present, status "POWER ON"
  → LED H5 (green) and H6 (red) light up.
- Project present, status "STOP":
  → only LED H6 (red) lights up.
- Project present, status "INIT", the control is in cold start or warm start phase:
  → only LED H5 (green) lights up.
- Project present, status "RUN":
  → LED H1 (green) and H5 (green) light up.
- Global ready message absent:
  → LED H4 (red) lights up; PLC does **not** go into "RUN".
- I/O bus cannot be initialized:
  → LED H8 (red) lights up.

The twelve LEDs can be programmed freely by the user in the "RUN" status. For information on programming, see the "Application Manual b maXX controller PLC" in chapter "b maXX controller PLC Board Functions / Function block LED12"

NOTICE!

Even if the I/O bus initialization was not successful (H8 [red] is turned on), the boot project will be loaded and the user program code will be executed

This means that you can use the b maXX safe PLC and the further modules without the I/O bus modules.

11.7.2 Rotary switch S1 of BMC-M-SAF-02

Rotary switch S1 of BMC-M-SAF-02 is intended for future developments and is not in use at this time.

11.7.3 S2 switch/button for changing operating statuses of the BMC-M-SAF-02

The b maXX safe PLC module has the S2 switch/button to change the operation statuses ("K" in ▷Figure 1◁ on page 35).

The switch affects both the standard PLC and the safety PLC (see ▷Description of the operation modes, RUN/STOP switch ◁ from page 60 onward).

Button in up position:	RESET
Switch middle:	STOP
Switch down:	RUN

Figure 16:   S2 switch on the b maXX safe PLC module of the BMC-M-SAF-02

NOTICE!

The user project can only start up if the switch/button S2 is in the lower "RUN" position and all modules have sent their global ready message to the b maXX safe PLC (H4 [red] is off).

With the button in the up position, a reset is conducted for the b maXX safe PLC module, for the power supply module for the b maXX controller/safe PLC and for the further system components (modules which are plugged in to the left of the b maXX safe PLC or to the right of the power supply).

DANGER!

Danger from mechanical action!

The machine/line or parts of the machine or line can be started during the commissioning of the b maXX safe PLC and the power supply connected to the b maXX safe PLC (as well as additional connected system components) by having an application program completely ready. Improperly setting an address on the power supply (see ▷Operation Manual for the power supply for the b maXX controller/safe PLC◁ and ▷Setting the station number ◁ from page 63 onward) can cause the machine/line or parts of the machine or line to behave in an unexpected manner.

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 b maXX safe PLC.

● Activate the safety devices in any case.

11.7.4 Display on channel 2 with the BMC-M-SAF-02

The 7-segment display has the following functions:

Status	Function
Normal operation	Station number display. See ▷Setting the station number ◁ from page 63 onward. One number of the four-digit station number is displayed per second. Initial zeros are automatically omitted. The new display of the station number always starts with one second of blank display. Furthermore, the status of the decimal points is inverted with each number, so that identical numbers following one another in sequence can be differentiated from one another.
Error status	The display will go into "E" status if an error appears. It is possible to enter the station number.
"Saved stopped" status	"Saved stopped" status is indicated by an "F".
Entry mode station number	See ▷Setting the station number ◁ from page 63 onward.
Startup	After the internal self-tests, a "S" will be displayed. This means that channel 2 is now waiting for a starting cross-communication from channel 1. If the cross-communication begins and a project is present, the display will change to "8". If the initialization process has been carried out completely, the display will change to indicate normal operation.

The LEDs on channel 2 have the following meaning:

- StartUp:

When starting up, the respective uppermost LED row of the controls will indicate the status. Normally, the display runs from left to right, signalizing the statuses "CPU test", "memory test", "timer test" and "firmware inspection", one after another.

If an error occurs, all 4 LEDs in the upper row will light up. The control will no longer be able to function in such case.

LEDs				Meaning
H1	H2	H3	H4	
⊗				CPU test
	⊗			Memory test
		⊗		Other hardware tests (CPU, timer)
			⊗	Firmware inspection
⊗	⊗	⊗	⊗	Control stopped

- Run-time

LEDs				Meaning
H1	H2	H3	H4	
⊗ (green)	X	X	X	Control in RUN
	X	X	X	Control in STOP
X	⊗ (red)	X	X	Error in the control has occurred
X		X	X	Control status OK
X	X	⊗ (yellow)	X	BLINKING: Inserted CF card detected during start-up or safety code entry is running
X	X	X	⊗ (green)	BLINKING: Copy code entry is running
X	X	⊗ (yellow)	X	STEADY: Copying process from card to control running, LED goes out once the copying process is complete
X	X	X	⊗ (green)	STEADY: Copying process from control to card, LED goes out once the copying process is complete
X	X	X	⊗ (red)	Error has occurred during the copying process.

X: LED status user-defined

11.8 Commissioning procedure

The commissioning process is divided into the following sections:

1 Switching on.

2 Testing the function.

11.8.1 Switching on the BMC-M-SAF-02

- Read and observe the ▷General safety regulations ◁ from page 62 onward.
- The "Assembly and installation" section will have to have been conducted properly.
- Position the S2 switch/button on the b maXX safe PLC on "STOP" (middle position).
- Switch the +24 V DC of the voltage feed on.

CAUTION!

Damage through electrical destruction.

You may not connect the b maXX safe PLC module with other system components or separate it from other system components when the +24 V DC of the voltage feed is on.

Therefore:

- Switch off the +24 V DC of the voltage feed of the power supply beforehand.

11.8.2 Testing the functioning of the BMC-M-SAF-02 (standard PLC)

- Two statuses can occur when the b maXX systems is switched on:
  - No boot project (= no user project on the standard PLC) present:
    The LED H2 (red) will light up briefly and then the LEDs H5 (green) and H6 (red) will light up steadily.
    This means that no project is present on the standard PLC.
    In "POWER ON" status, the b maXX safe PLC is waiting for PROPROG communication
  - Boot project present:
    The boot project is loaded upon switching on. The upper LEDs will blink in the process. After a short time, the LED H6 (red) will light up. The standard PLC is in "STOP" status.
- As long as switch/button S2 on the b maXX safe PLC is on "STOP" (middle position), a boot project present will not be able to start up.
  If you want to start an existing boot project by setting the S2 switch on the b maXX safe PLC on "RUN" (lowermost position), make certain **before doing so** that the **correct** boot project for your application has been imported for **this** system in **this** b maXX safe PLC and that the **correct** address has been set on the power supply (if it is being evaluated in your project)!

Further information on how you can ensure this or how you can conduct the "Send a boot project" to the b maXX safe PLC can be found in the "Application Handbook b maXX controller PLC".

11.9 Startup and operation options with inserted memory card

11.9.1 Safety-related instructions on the use of memory cards

Memory cards of the b maXX safe PLC contain all configuration data, parameter data and application data of an allocated control system. This pertains to data of the standard control as well as data of the safety control. Further explanations on the memory card data can be found in chapter ▷Data on the memory card ◁ on page 38.

The use of a memory card is optional. The use of a memory card enables control data to be copied onto the control and control data to be copied onto the card.

Copying memory card data onto the control is only possible when the control system is in Stop mode. The description of the available operation modes can be found in ▷Description of the operation modes, RUN/STOP switch ◁ from page 60 onward.

> **CAUTION!**
>
> Memory cards may only be used as data sources in the event of repairs. Loading a new configuration or application of the memory card is not permissible without verification by the programming environment.

CAUTION!

The programming of serial machines with a memory card is the responsibility of the machine manufacturer. In the process, special organizational measures will be necessary, which are also the responsibility of the machine manufacturer.

If a memory card is inserted during the system startup, the data from the card will initially be compared to the data of the internal memory. If they correspond to one another, the system can be started without transferring data.

As long as the data from the memory card does not correspond to the data of the internal control memory, the system will not be able to be started.

In this case, it will be necessary either to copy the internal control data onto the card or copy the data from the card onto the control system.

Copying data onto the control system is only permitted if the user is authorized to do so. The user will have to verify his authorization by entering a project-specific identification number.

After the transfer of data from the memory card, an inspection will be carried out the next time the safety control is started to check whether the safe devices configured in the project are actually present in reality. Only then with the safety application program be permitted to start.

CAUTION!

The project ID may never be written the on the memory card where it is externally visible so that the mechanism which protects the control system from unauthorized manipulation will remain effective.

CAUTION!

Organizational measures must be determined in order to enable the unique allocation of projects.

A suitable measure would be labelling the memory cards with unique numbers which can be allocated by using a cross-reference table, for example. The cross-reference table is only accessible to authorized personnel.

CAUTION!

Only memory cards which are specified for industrial use may be used.

> **CATION!**
>
> Memory cards of the b maXX safe PLC-Systems may only contain the data of a b maXX safe PLC system and may not be used simultaneously for systems of other applications or for storing data not related to the application.

The copying data procedures when using memory cards are explained in detail in ▷Data transfer from the card to the control ◁ on page 74 and in ▷Data transfer from the control to the card ◁ on page 75 in the scope of commissioning.
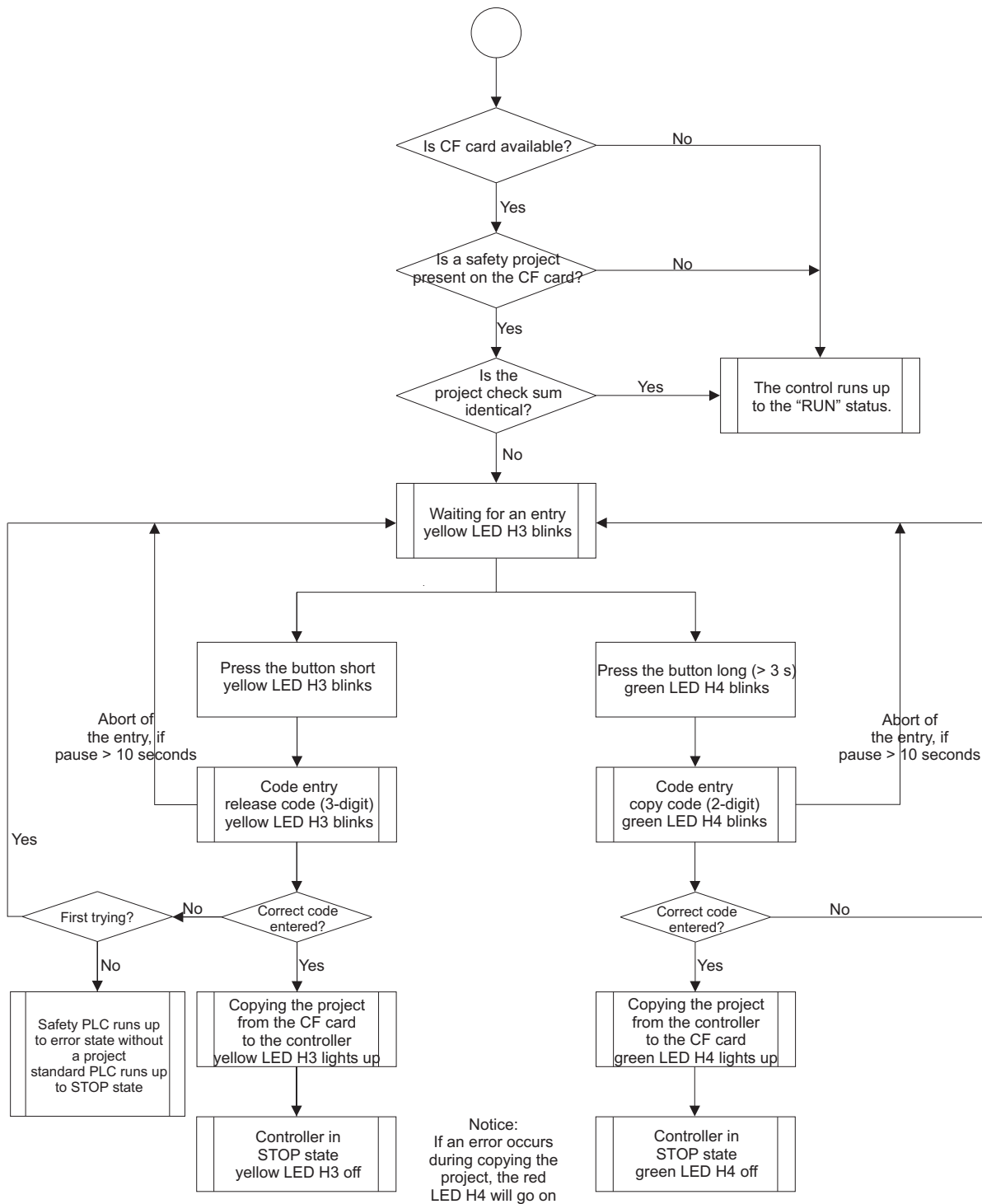
11.9.2 Starting behavior with inserted memory card

Figure 17:   Flow diagram

- Read and observe chapter ▷Safety◁ on page 17.
- The "Assembly and installation" section will have to have been conducted correctly.

- Insert the memory card into the first slot of the CFI-01 CF module (see ▷Figure 4◁ on page 38).
- Set the S2 switch/button on the b maXX safe PLC to "RUN" (switch down).
- Switch on the +24 V DC of the electrical supply.

After being switch on, the safety PLC will initially check if a safety project is present on the CF module. If it is, the inquiry will then be made whether the project check sum is identical to the check sum of the safety project which is already present on the safety PLC. If no safety project is present on the CF module, or the project check sums are identical, the control will run up to the "RUN" status.

If the project check sums are not identical, the LED H3 (yellow) will blink and an entry from the user will be waited for.

The user will now have to press the S1 button on the CF module and the S1 button on channel 2 of the PLC at the same time:

- **A short push** of the button to transfer the project from the CF module to the control (see ▷Data transfer from the card to the control ◁ from page 74 onward).
- **A long push** of the button (> 3 s) to copy the project from the control to the CF module (see ▷Data transfer from the control to the card ◁ from page 75 onward).

11.9.3 Data transfer from the card to the control

Once the user has pushed the S1 button on the CF module and the S1 button on the channel 2 of the PLC simultaneously for a short amount of time, the LED H3 (yellow) will continue to blink and the safety PLC will wait for the release code (3-digit) to be entered.

The release code is the last 3 digits of the project check sum of the safety project, which is displayed in the project information in ProSafety or, if a connection to the internet is present, in the resource control to the safety PLC under "Info".

Code entry:

1 The H5 7-segment display on channel 2 of the PLC shows a blinking display of the value of the S2 rotary switch of the CF module. The position of the code entry is displayed with the LEDs H5 through H8 on the CF module. That means that the H5 will light up first. In total, a 3-digit (max. 4-digit) code must be entered.

2 Setting the value with the S2 rotary switch on the CF module.

3 Confirm by pushing the S1 button on channel 2 and the S1 channel on CF module simultaneously.

4 The value of the S2 rotary switch will now be displayed steadily on the H5 7-segment display.

5 After that, the second confirmation will be carried out be means of pushing the S1 button on channel 2 and the S1 channel on CF module simultaneously and the transition to the next digit of the code entry will take place. The next digit will be displayed with the LEDs H5 through H8 on the CF module. In the process, the user will have to compare the position of the rotary switch with the value displayed. If an error is indicated in the process, the safety control will have to be sent back to Baumüller for repairs.

Once the third code digit has been entered, the entry mode will be exited and LEDs H5 through H8 will go out.

If the pause during the entry process lasted longer than 10 seconds the process will be aborted and will have to be restarted by briefly pushing the S1 button on the CF module and the S1 button on channel 2 of the PLC simultaneously.

The entry process can be repeated once if an incorrect code has been entered. The repeat entry is activated by briefly pushing the S1 button on the CF module and the S1 button on channel 2 of the PLC simultaneously. If the second code entry is also incorrect, it will not be possible to enter the code again. The code entry process can only be conducted again after turning the safely control off and then on again.

If the correct code has been entered, the project will be copied from the CF module to the control. The yelllow LED H3 will light up in the process.

When the copying process has ended, the yellow LED H3 will go out and the control goes into "STOP" status. The control can then be started manually (by turning on or off, resetting or changing the RUN/STOP switch from RUN to STOP and back to RUN).

If an error occurs during the project, the red LED H4 on channel 2 of the PLC will go on.

If there is a new project on the CF module in which only the files for the standard PLC have been changed, that is, the project check sum between the CF module and the safety PLC correspond with one another, it will be possible to transfer the project from the CF module to the control by force by doing the following. To do this, the safety PLC will have to be in "STOP" status and the standard PLC will have to be in "STOP" or "ON" status.

The transfer is started by a short push and entering the release code (3 digit), as described above.

NOTICE!

When the user starts the entry process of the release code by briefly pushing the S1 button on the CF module and the S1 button on channel 2 of the PLC, the safety PLC will be in practically the same status as during the power-on procedure, that is, online communication at the safety PLC will no longer be possible until one of the end statuses has been reached. Online communication at the PLC will be possible, although the project-related commands (download, activated, reset, run, stop) will be blocked.

11.9.4 Data transfer from the control to the card

NOTICE!

Before using a compact flash card for the **first time**, the user must create on this memory card the following directory structure (e.g. with a card reader connected to a PC):

- SYS00001\SAF02_00\V000\AppSt
- SYS00001\SAF02_00\V000\Applic

All files both for the standard PLC and for the safety PLC part are copied at restoring from the CF card and storing to the CF card respectively.

The files of the standard PLC part are in the subdirectory „AppSt" and the files of the safety PLC part are in the subdirectory „Applic".

Once the user has pushed the S1 button on the CF module and the S1 button on channel 2 of the PLC simultaneously and held them down for a long time (> 3 s), LED H4 (green) on channel 2 of the PLC will blink and will wait for the copying code (2-digit) to be entered.

The code for triggering the entire project transfer including the configuration files of the standard PLC and safety PLC on the CF module is "01". No further codes are assigned at this time.

Code entry:

1 The 7-segment display on channel 2 of the PLC indicates the value of rotary switch S2 of the CF module in blinking numbers. The digit of the code entry is displayed by LEDs H5-H8. This means that H5 will light up first. A 2-digit code will have to be entered in total.

2 Setting the value using the S2 rotary switch on the CF module.

3 Confirmation is given by pushing the S1 button on channel 2 and the S1 button on the CF module simultaneously.

4 The value of the S2 rotary switch will now be displayed steadily on the H5 7-segment display on channel 2 of the PLC.

5 After that, there will be a second confirmation by pushing the S1 button on channel 2 and the S1 button on the CF module simultaneously and the transition to the next digit will take place. The next digit will be shown on H5 through H8.

Once the second code digit has been entered, the entry mode will be exited and LEDs H5 through H8 will go out. The code which has been entered will be checked for correctness. The H9 7-segment display of the CF module is not used for entering codes with safety applications.

The procedure will be aborted if an incorrect code has been entered or the pause during the entire process was too long. It will have to be restarted by holding down the S1 button on channel 2 and the S1 button on the CF module for a long (> 3 s) time.

If the correct code has been entered, the project will be copied from the control to the CF module. In the process, the green LED H4 on channel 2 of the PLC will light up.

Once the copying procedure is complete, the green LED H4 on channel 2 of the PLC will go out and the control will go into "STOP" status. It can then be started manually.

If an error occurs during the project copying process, the red H4 LED on channel 2 of the PLC will go on.

NOTICE!

Neither the standard PLC nor the safety PLC will be running during the entire processing process until the end statuses have been reached. Online communication at the safety PLC will no longer be possible; online communication at the PLC will be possible, although the project-related commands (download, activated, reset, run, stop) will be blocked.

A project can also be trasferred from the control to the CF module during operation. In the process, the safety PLC will be in "RUN" or "STOP" status, the status of the standard PLC is not relevant here. The transfer is started is by holding down the S1 button on channel 2 and the S1 button on the CF module for a long time (> 3 s). The activation is indicated by the blinking of the H4 LED (green) on channel 2 of the PLC. The copying code can then be carried out as described above.

	NOTICE!
(info icon)	The standard PLC and the safety PLC will continue to run in the entire processing process, meaning that the online communication will also be running.

	NOTICE!
(info icon)	Once the project has been copied to the memory card during only the residual time of the control, the procedure can take considerably longer than in running up or when the control is in "STOP" status. If you want to copy the project to the memory card in "RUN" status, care must be taken that sufficient reserves still remain between the safety cycle time set and the actual amount of execution time needed, especially with the safety PLC.
	The execution time is displayed in the safety PLC on diagnostic flags and should not exceed 95% of the parameterized safety cycle time for long periods of time (see Application Handbook b maXX safe PLC).

11.9.5 Description and inspection of the operating and display elements

The BMC-M-CFI-01 module has eight LEDs (five green [H1, H5, H6, H7, H8)] a red one [H2], a yellow one [H3] and a red/green [H4]) (see "F" in ▷Figure 4◁ on page 38).

LEDs

H1			H4	
⊗ green	⊗ red	⊗ yellow	⊗/⊗ green/red	not used in connection with the safety control.
H5			H8	
⊗ green	⊗ green	⊗ green	⊗ green	indicates the digit during code entry

Figure 18:   LEDs of the BMC-M-CFI-01 CF module

The S1 button (see "H" in ▷Figure 4◁ on page 38) is located below the LEDs. This is used to start data transfers.

Below that is the S2 rotary switch (see "J" in ▷Figure 4◁ on page 38) for setting the individual values of the code.

11.10 Programming, configuration and parameterization with ProSafety

See ▷Application Handbook b maXX safe PLC◁.

12

SYSTEM VALIDATION

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

> **WARNING!**
>
> **Danger during commissioning!**
>
> The control system may only be put into commission 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 Ap-pendix ▷C.3 Commissioning and validation checklist◁ from page 106 onward. Conduct the validation of the system in accordance with this checklist and docu-ment the procedure accordingly.
> - Make sure that operating personnel has been instructed in the handling of the con-trol system.

12.1 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.

Use the project documentation printed out by ProSafety to conduct the function test. The instructions on handling the project documentation can be found in the programming handbook.

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

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

1 Separate all actuators and drives from the output terminals electrically.

2 Test the logic circuit by forcing variables in the ProSafety safe programming interface (see chapter "FORCING AND OVERWRITING" in the ▷Application Handbook b maXX safe PLC◁). Check whether the behavior of the logic corresponds with the expected function. Also check whether the evaluation of multi-channel safety components is conducted in a multi-channel manner.

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

4 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 the reaction corresponds with the expected behavior.

The function test must lead to the following results:

- the logical allocation of all system components is **correct**
- the allocation of all system components is **complete**

In deviation from the I/O terminals, the logical allocation of drives is determined by inspection the display of an LED (see documentation on the safe drive). For this purpose, the bit xx (see documentation on the safe drive) of the bit string (see Figure xy in the documentation on the safe drive) is set in the safe programming environment. Once this bit has been activated, the display on the anticipated drive will have to be inspected. The corresponding displays of the drives which are not being addressed must not be active during this test. But if this is the case, it means there is a configuration error in the system. The system may not be put into operation in such case.

5 Archiving the project data on a memory card

Once the function test has been completed successfully, it is recommended to copy all data of the control system onto a memory card authorized for this system. Creating this copy serve serves in exchanging devices in the event of a device failure in the control. When handling the memory card, the procedure and safety instructions are to be followed in accordance with chapter ▷Startup and operation options with inserted memory card ◁ from page 70 onward.

13

OPERATION

	DANGER!
⚠	It is not permitted to make any changes to the system configuration during the operation of the safety control.
	Therefore:
	• Before expanding the system and removing individual system components and making changes in the wiring, the control must as a rule be disconnected from the power source and put into safe condition by technical trained personnel.

Instructions on the operation of the b maXX safe PLC (BMC-M-SAF-02) can be found in the Application Handbook b maXX controller PLC and the online help for ProProg wt III.

Instructions on the operation of the power supply for the b maXX controller/safe PLC can be found in the operation manual for the power supply for the b maXX controller/safe PLC.

Instructions on the operation of the system components connected to the b maXX safe PLC can be found in the respective operation manuals and application handbooks of those system components.

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TROUBLESHOOTING AND RECTIFICATION

This chapter describes the error indications of the b maXX safe PLC module. We will describe the meaning of each error indication and what you should do as a reaction.

14.1 Safety regulations

Observe the applicable safety regulations, see ▷Safety ◁ from page 17 onward.

14.2 Requirements on the personnel conducting the work

Personnel working with the b maXX System must be instructed in the safety regulations and the operation of the system 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. In the following, we will inform you of the various malfunctions and the resulting error messages. The malfunctions can be caused by either mechanical or electrical problems.

14.3 Error diagnosis

In order to achieve the degree of diagnostic coverage described in the chapter ▷Safety-related parameters for 20 years of operation ◁ from page 27 onward, the control system contains software functions which are executed as cyclical self-tests to detect hardware failures.

14.3.1 Detecting internal device errors by using self-tests

- The random access memory (RAM) of the safety control is tested by a cyclical RAM test.
- Non-RAM memory (Flash) of the safety control is tested by a cyclical CRC test.
- Safety-relevant power sources are monitored for over-voltage and low voltage.

- The file system for the administration of application programs and program code is protected from being changed by CRC values. Any changes detected will cause the system to go into safe status.

Detecting errors with BMC-M-SAF-02

The standard PLC signals errors by means of the H4 LED (red) and H8(red). The LEDs can be freely programmed by the user In "RUN" status of the b maXX safe PLC.

Note that the following error description dues not apply in "RUN" status if the user has programmed the LEDs in his application project.

H4 (red) on — The b maXX safe PLC module is not receiving the global ready message of the following modules (see ▷Switching on and initialization the BMC-M-SAF-02 ◁ from page 65 onward):

- Power supply module for the b maXX controller/safe PLC
- Modules which are plugged in to the left of the b maXX safe PLC (such as the ethernet module with CANopen master).

The reason for this can be:

- There is a defect or connection error in a module.

  →   Does the error also occur when only the b maXX safe PLC and its power supply are being used?

  The modules may only be assembled and disassembled when the power has been disconnected. See the respective operation manual of the modules for assembly and disassembly.

  Yes: Check the contacts between the b maXX safe PLC and power supply for bent pins.

  Exchange the b maXX safe PLC or the power supply if necessary.

  No: Assemble the other modules and their connections sequentially until you can determine the defective module.

H2 (red) and H6 (red) on — The module cannot address the internal memory properly.

Exchange the module.

H10 (blue) on, H9 (red) blinking — Blinking pattern: 1 s on, 1 s off

The module has detected an error in loading the FPGA.

Exchange the module.

14.3.2 Detecting errors in the periphery

Input and output terminals are only connected to the safety control via field bus and module bus. Protocol errors of the safety protocol are detected by the control system.

> **CAUTION!**
>
> I/O terminals which are used in a safety oriented manner must have suitable approval. Safe I/O terminals must have an own diagnostic procedure.

Diagnostic results can be transmitted to the safety control via the bus protocol. The extent of the diagnostic options depends on the I/O terminals used.

Error

H8 (red) on   The b maXX safe PLC module could not initialize the I/O bus.

> **NOTICE!**
>
> Even if the initialization of the I/O bus was not successful (H8[red] is on), the boot project will still be loaded and the user program code will still be executed.
>
> This means that you can use the b maXX safe PLC and the further modules without the I/O bus modules.

The reason for an unsuccessful I/O bus initialization may be:

- There is a defect or connection error of a module (such as the I/O module) which is plugged in on the right of the power supply.

    →   Does the error also occur if only the b maXX safe PLC, its power supply, an I/O module and an end module are being used?

    The assembly and disassembly of the modules may only be conducted when the power has been disconnected. See the respective operation manual of the modules for assembly and disassembly.

    Yes: At first exchange the IO/ module. If the error recurs exchange the end module. If you plug the end module direct to the power supply, i.e. operate without an I/O module, you always get an error message.

    Check the contacts between the b maXX safe PLC and power supply for bent pins. Exchange the b maXX safe PLC or the power supply if necessary.

    No: Assemble the other modules (and always an end module) sequentially until you can detect the defective module.

    →   Are multiple I/O modules and one end module plugged in?

    The assembly and disassembly of the modules may only be conducted when the power has been disconnected. See the respective operation manual of the modules for assembly and disassembly.

    No: Assemble the other modules (and always an end module) sequentially until you can detect the defective module.

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THis LED will not be relevant to you if you want to use the b maXX safe PLC and further modules without the I/O bus.

Yes: Check the contacts between the b maXX safe PLC and power supply for bent pins. Exchange the b maXX safe PLC or the power supply if necessary.

Error messages from the modules can be found in the respective operation manuals of the modules.

14.4   Reaction im the event of an error, diagnostic messages

Error reactions are defined by the control's error treatment routine. Safety-relevant errors lead to the following potential reactions:

- the application software will no longer be executed, all safe outputs will be set to "0" in the data protocol.
- the safety control will go into safe status in the event of serious errors.

Error messages of the safety PLC can be read out with ProSafety. Error messages of the standard PLC can be read out with ProProg wt.

The safety control has a red LED to indicate errors. Diagnostic messages which support the localization of errors can be displayed with diagnostic flags in the safety PLC and standard PLC.

CAUTION!

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

14.5   Safe status

If the safety control has to engage in safe status due to a safety-relevant error, this process will be carried out by setting the communication to all local and decentral I/O terminals.

CAUTION!

The safety-oriented output terminals used will have to engage in safe status if a safety-oriented communication is defective or has been interrupted. This means that in the event of an error, safety-oriented outputs will automatically shut off by means of the output terminals.

14.6 Exchanging devices

If a defect in the safety system is detected, the safety control will have to be taken out of operation immediately. If a memory card with a complete copy of the application and configuration data for the affected safety control is available, the safety control can be replaced with a new safety control without having to use the safe programming interface.

The following prerequisites will have to be fulfilled in order to exchange the device without the use of the safe programming environment:

CAUTION!

- There is a memory card available with contents which guarantee a 1:1 copy of the applicable system by means of complying with organizational measures.

- No further changes in the configuration of the system may be made during the exchange of the device.

- The procedure of transferring data from the card to the control described in the chapter ▷Data transfer from the card to the control ◁ from page 74 onward must be followed.

- The safety instructions related to memory cards in accordance with the chapter ▷Safety-related instructions on the use of memory cards ◁ from page 70 onward must be complied with.

Once the device has been exchanged and the data from the memory card has been copied to the control, an appropriate spot check type function test will have to be conducted for the system. This must be documented accordingly.

CAUTION!

If there is no memory card with a definite copy of the control data available, the commissioning of the safety control will only be permissible by means of the ProSafety safe programming environment.

If the project is recompiled before being transferred to the control, a complete validation in accordance with the chapter ▷System validation ◁ from page 79 onward will be required.

If the project data is loaded without a renewed compilation of the control system, a spot check type function test will be sufficient. In doing so, it must be ensured that the allocation of the project data is correct by means of organizational measures.

For the handling of defective component groups, see the chapter ▷Repairs ◁ from page 91 onward.

> **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 also the chapter ▷Repairs ◁ from page 91 onward).

14.7 Error messages on channel 2 of the BMC-M-SAF-02

14.7.1 7-segment display

E When an error occurs, the display will go into "E" status (entering the station number will be possible).

F The status "Saved stopped" is indicated by an "F".

14.7.2 Error indication of the LEDs on channel 2

H4 (red) on The status of the control is not in order. Either an error has been entered in the SafeOS error memory or there is a problem with cross-communication.

Maintenance

If you are complying with the mandatory environmental conditions, see ▷Appendix D - Technical data◁ page 115), then the b maXX safe PLC is maintenance-free. If you detect or suspect a defect in the b maXX safe PLC 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 for 10 years of operation◁ page 27) is complied with.

REPAIRS

You cannot repair a defective b maXX safe PLC module. Please contact Baumüller Nürnberg GmbH for a replacement.

	CAUTION! Defective components may only be repaired by the manufacturer.

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DISASSEMBLY, STORAGE

This chapter describes how to decommission the b maXX safe PLC module and store it.

17.1 Safety regulations

○ Observe ▷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 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.

17.2 Requirements on the personnel carrying out 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.

17.3 Disassembly

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

The b maXX safe PLC is assembled together with the power supply for the b maXX controller/safe PLC and any further system components for the b maXX safe PLC.

In the disassembly process, the b maXX safe PLC and the power supply as well as any further system components for the b maXX safe PLC are detached from the 35 mm C-rails (and the I/O modules attached to the right on the power supply).

The b maXX safe PLC is then removed from the power supply.

The following equipment will be needed:
- Suitable packaging for the b maXX safe PLC; use the original packaging if possible.
- Suitable packaging for the power supply module for the b maXX controller/safe PLC (if applicable); use the original packaging if possible.
- Suitable packaging for further system components for the b maXX safe PLC (if applicable); use the original packaging if possible.
- A suitable tool to open the spring clamps of the electrical connects (such as a screwdriver with a 2mm wide blade).
- A suitable tool for pulling out the white handles on the bottom of the module (such as a pair of needlenose pliers for electronic work).

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   Open the electrical cabinet.
3   Remove the cables to the electrical connections.
    To do this, disengage the spring clamps (with a screwdriver, for instance) and pull out the respective cable.
4   Remove the cables to the b maXX safe PLC
5   Remove the cables to further system components (if applicable) which are attached to the b maXX safe PLC (for more on this, see the respective operation manuals for the system components in question).
6   There is a white handle on the bottom of the left part of the power supply. Pull this handle downward and then to the left (with a pair of needlenose pliers for electronic work, for instance). The handle will engage easily.
    Repeat this step for the b maXX safe PLC (3 handles with the BMC-M-SAF-02; 4 handles with the BMC-M-SAF-02 with storage card module).
    Repeat this step for further system components (if applicable) for the b maXX safe PLC (which are plugged in on the left side of the power supply or of the b maXX safe PLC)
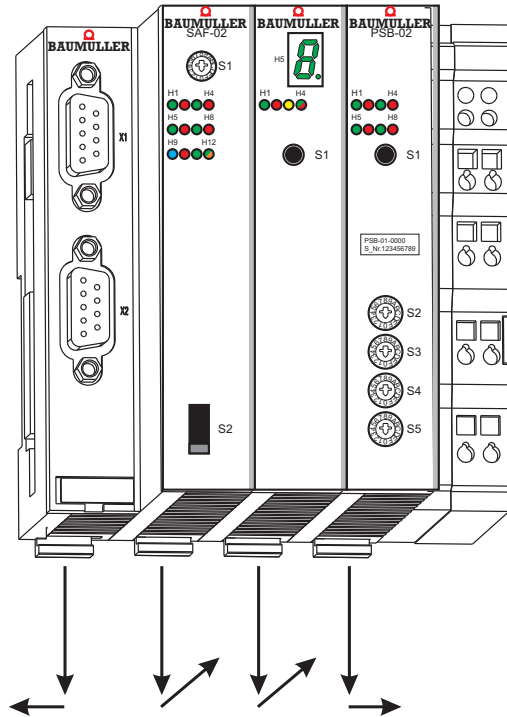
Figure 19:   b maXX safe PLC with power supply, taking the dual-channel safety PLC as an example

7 Pull the orange handle on the right part of the power supply forward (with a screw-driver, for instance), so that you can get a good grip on it.
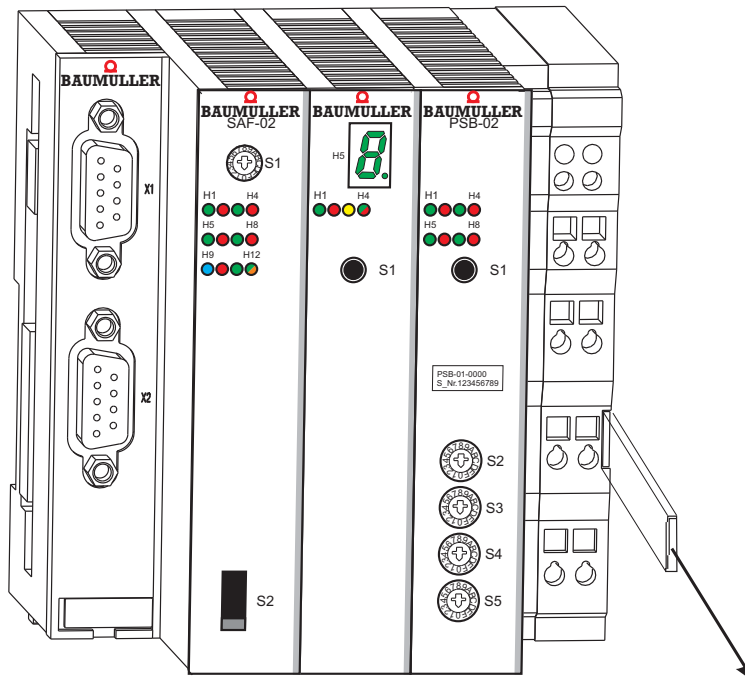

Figure 20:   b maXX safe PLC (left) with power supply (right), using the dual-channel safety PLC as an ex-ample

8 Pull (by hand) the orange handle on the right part of the power supply further forward and then pull the module block forward, thus removing it from the 35 mm C-rail.
The module block comprises the power supply, the b maXX safe PLC and, if applicable, additional system components for the b maXX safe PLC.

9 Disconnect the b maXX safe PLC from the power supply by actuating the disconnection mechanism on the back side of the b maXX safe PLC with the screwdriver. To do this, insert the screwdriver into the groove horizontally and then press it upwards. Now remove the power supply from the b maXX safe PLC.

10 Place the b maXX safe PLC into the prepared packaging.
Place the power supply (if applicable) into the prepared packaging.
Place the additional system components (if applicable) into the prepared packaging for each component in question.

11 If you want to exchange the b maXX safe PLC, now mount the new b maXX safe PLC (see ▷Assembly and installation ◁ from page 45 onward).

12 Close the electrical cabinet.

13 Document the disassembly (or exchange) of the b maXX safe PLC module.
Document the disassembly (or exchange) of the power supply for the b maXX controller/safe PLC, if applicable.
Document the disassembly (or exchange) of the additional system components, if applicable.

If you have exchanged the b maXX safe PLC, the entire system can now be switched back on. If you wish to dispose of the module, you will find further information in chapter ▷Disposal ◁ from page 97 onward.

17.4 Storage conditions

Store the b maXX safe PLC module in a suitable package under the storage conditions specified in the ▷Appendix D - Technical data◁ from page 109 onward.

17.5 Recommissioning

If you want to put the b maXX safe PLC module back into operation, observe the specifications under "Storage conditions". Then conduct the ▷Commissioning ◁ from page 59 onward again.

18

DISPOSAL

This chapter describes the proper and safe disposal of the b maXX safe PLC module. 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.

18.1 Safety regulation

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.

18.2 Requirements for the personnel carrying out the work

The personnel you assign to conduct the disposal/disassembly must have the knowledge and training required to carry out this work properly. The personnel selected must understand and apply the safety instructions on the b maXX System and its components.

18.3 Disposal instructions

Prerequisites
- The b maXX safe PLC module has already been disassembled properly.
- All of the tools and equipment necessary for the disassembly are available and in good working order.

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.

18.4 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

CAN Controller Area Network

CPU Central Processing Unit

DC Diagnostic Coverage

DRAM Dynamic RAM

EMC Electromagnetic compatibility

EN European standard

ESD Electrostatic sensitive device

EXT, ext External

I/O Input/Output

I/O bus Bus between b maXX safe PLC and the modules right of the PLC and/or power supply

LED Light-emitting diode

MTTF$_d$ Mean Time To Failure

NOVRAM **No**n-**v**olatile RAM

OPC OLE for Process Control (OLE: Object Linking and Embedding)

PFD Probability of Failure on Demand

PFH Probability of Failure per Hour

PLC Process loop control, stored Program Control, SPS

ProProg wt III
Tool for programming the b maXX PLC (BMC-M-PLC-01/2, or BMC-M-SAF-02)

RAM Random Access Memory

RISC Reduced Instruction Set Computers

SDRAM Synchronized Dynamic RAM

SFF Safe Failure Fraction (Fraction of failures which lead to safe status)

SIL Safety Integrity Level

SW Software

A

APPENDIX B - ACCESSORIES

This appendix lists all accessory items which are available from Baumüller Nürnberg GmbH for the b maXX safe PLC module.

If you have enquiries or suggestions on the accessory items, the Baumüller product management will be glad to assist you.

B.1   List of all accessory items

B.1.1   Programming cable (serial RS232)

Conduction type: K-SS-01-xx (9-way sub-D, 9-way sub-D):

Type	Length [m]	Item number
K-SS-01-03	3	213 846
K-SS-01-05	5	213 283
K-SS-01-15	15	231 086

B.1.2   Cable for connection HMI interfaces (operator control panels, touchscreens, etc.) to the RS485 interface

Since the pin configuration of a RS485 interface is not standardized, Baumüller cannot offer a finished cable.

A cable stranded in pairs with a recommended cross-sectional area of 0.5 mm², PVC outer jacket and overall shielding made of tinned copper meshwork will have to be used.

The overall shielding will have to be applied to the metallic cable sockets or plugs, if applicable.

Such as: Type LIYCY   6 x 2 x 0.14 mm²

B.1 List of all accessory items

APPENDIX C - CHECKLISTS

The use of checklists serves documentation purposes and guides in the implementation of a safety system. The checklists reproduced in Appendix C - Checklists 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.

C.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 guide-lines?			
1.4	Is the electrical supply for the local I/O ter-minals 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 fulfil 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?			
1.14	Are the specified electrical values of the output terminals complied with?			
1.15	Are all electromechanical sensors supplied with timing signals for recognizing short circuits?			
1.16	Has a list of the device parameters to be set been compiled and have all parameters been determined?			

Date	Name	Signature

C.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 labelled 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?			
2.9	Have the required installation spacings to other components been complied with?			
2.10	Do the components meet the environmental conditions prevailing in the application?			
2.11	Does the system fulfil the required type of protection?			
2.12	Is degree of pollution 2 complied with?			
2.13	Is the system protected against corrosive substances?			

Date	Name	Signature

C.3   Commissioning and validation checklist

Serial no.	Requirement	Fulfilled		Remarks
		Yes	No	
3	Commissioning			
3.1	Has it been ensured that all safe communication participants of a system have a unique safe device address? This also applies to participants belonging to different safety controls, if the controls are connected to one another via gateways (such as ethernet).			
3.2	Is the station number of this safety control set correctly?			
3.3	Has the safety cycle time been established and set in the safety control?			
3.4	Has the maximum reaction time with the set cycle time been demonstrated with computational evidence?			
3.5	Has the project data been copied onto a memory card?			
3.6	Has a complete function test been conducted and documented?			
3.7	Has the operating personnel been instructed in the handling of the control system?			

Date	Name	Signature

C.4 Modification and retrofitting check list

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 the project data been copied onto a memory card?			
4.4	Has a complete function test been conducted and documented?			

Date	Name	Signature

APPENDIX D - TECHNICAL DATA

This appendix contains the technical data for the b maXX safe PLC module from Baumüller Nürnberg GmbH.

D.1 Connection values

D.1.1 BMC-M-SAF-02

Processor	ARM
Clock frequency	Channel 1: 667 MHz Channel 2: 400 MHz
Power supply	+5 V DC internal
Power consumption	typ. 1800 mA
Potential separation	720 V DC

D.1.2 BMC-M-CFI-01

Processor	Micro32
Clock frequency	40 MHz
Power supply	+5 V DC internal
Power consumption	typ. 300 mA

D.2 Operational conditions

D.2.1 Climatic properties

Environmental conditions	0°C ... 55°C 95% relative humidity, no condensation
Storage conditions	-25°C ... 85°C 95% relative humidity, no condensation
Transport conditions	-25°C ... 85°C 95% relative humidity, no condensation

WARNING!

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

D.2.2 Mechanical properties

Dimensions (W x H x T)
    BMC-M-SAF-02:
 	
    BMC-M-CFI-01:
	
	76 mm x 100 mm x 91 mm
	(Width: 84 mm assembled)
	
	19 mm x 100 mm x 91 mm
	(Width: 27 mm assembled)

Weight
    BMC-M-SAF-02:
 	
    BMC-M-CFI-01:
	
	approx. 320 g
	
	approx. 100 g

Vibration test	1 g (9 - 150 Hz sinusoidal) in accordance with DIN EN 60068-2-6
Shock resistance	15 g on the basis of DI EN 60068-2-27
Assembly	On 35 mm C-rail according to EN 50022 with locking mechanism (also known as a top hat rail)
Installation position	as shown in ▷Figure 8◁ on page 48, other installation positions are not possible
Protection class	IP 20
Permissible degree of pollution	Pollution degree 2

D.2.3 EMC properties

EMC resistance / emission	in accordance with EN 61000-6-2 / EN 61000-6-4

D.3 Pin configuration of sub-D socket for RS232 interface
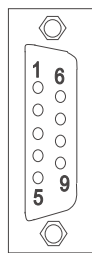
9-way sub-D socket

Pin no.	Configuration
1	Not allocated
2	TxD (transmit data)
3	RxD (receive data)
4	Connected to pin 6
5	GND (signal ground)
6	Connected to pin 4
7	CTS (clear to send)
8	RTS (request to send)
9	Not allocated

NOTICE!

The signal grounds of the RS232 and RS485 interfaces are connected to one another.

D.4 Pin configuration of sub-D socket for RS485 interface
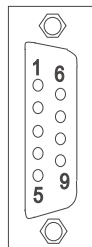
9-way sub-D socket

Pin no.	Configuration
1	TxD- (transmit data negative)
2	VCC (+5 V output for supply of external RS485/RS232 converter)
3	GND (signal ground RS232 / RS485)
4	GND (signal ground RS232 / RS485)
5	RxD- (receive data negative)
6	RxD+ (receive data positive)
7	GND (signal ground RS232 / RS485)
8	GND (signal ground RS232 / RS485)
9	TxD+ (transmit data positive)

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BAUMÜLLER

NOTICE!

The signal grounds of the RS232 and RS485 interfaces are connected to one another.

CAUTION!

Danger from electrical short circuit.

An electrical short circuit can damage the device.

Therefore:

- The +5 V on pin 2 of the X2 sub-D socket of the b maXX safe PLC module are only intended for the supply of external Baumüller RS485/RS232 converters and may not be bypassed or connector to one another in a ring.

D.5   Memory cards for CF cards (BMC-M-CFI-01)

CF type I (42.8 mm x 36.4 mm x 3.3 mm) Compact Flash memory cards can be used as memory cards.

APPENDIX E - DECLARATION OF CONFORMITY

Declaration of EC conformity

Doc.-Nr: 5.10069.01
Date: 12.10. 2016

according to machinery directive 2006/42/EC

We the manufacturer:	Baumüller Nürnberg GmbH
	Ostendstraße 80-90
	90482 Nürnberg, GERMANY

declare that our product

Name:	Programmable Safety Controller b maXX safe PLC
Type:	BMC-M-SAF-02/BMC-M-CFI-01/BMC-M-PSB-02
Date of manufacture:	20 January 2011

was developed, constructed and manufactured according to the machinery directive 2006/42/EC.
This product also applies to the EMC directive 2014/30/EU (Electromagnetic Compatibility directive).

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 – Part 1: General principles for design
EN 61131-2:2007	Programmable controllers. Equipment requirements and tests
EN 60204-1:2006 + A1:2009 + AC:2010 (in extracts)	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Authorized person for preserving relevant technical documents:
| Name: | Engelbert Meier, Baumüller Nürnberg GmbH |
| Address: | Ostendstraße 80-90, 90482 Nürnberg, Germany |

Notified body which has provided the EC type-Examination Certificate in accordance with the machinery directive 2006/42/EC:
Name:	TÜV Rheinland Industrie Service GmbH
Address:	Am Grauen Stein, 51105 Köln / Germany
Notified body number:	0035
Registration number:	01/205/5093.01/16

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.

Nürnberg / 12 October 2016
Location / Date

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

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be in motion

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