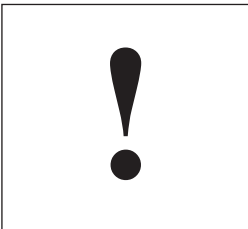


## Quality- Management

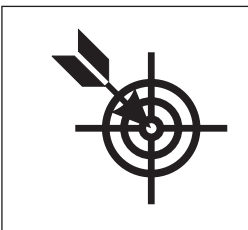


### Quality problems?



### We know,

- what you expect regarding reliability
  - what costs are involved when a product does not function properly straight away.
- Costs several times higher than the price of the product can be the result.



### So

we got going in order to supply our customers with consistently reliable parts. For example, the automotive sector: error rates of less than 50ppm (parts per million) is a natural requirement here.



### In order to achieve this,

our QM System is already operative in the developing stages and continues operating until the product finally leaves our plant:

- Customers' needs are translated into clear specifications.
- Production planning draws up the production instructions from these specifications.
- Testing specifications are laid down.
- Quality inspections are undertaken by well-trained personnel at all relevant production stages.
- Each individual part is checked again before being dispatched.

**TÜV-CERT** confirmed to us that our QM System really does function according to **ISO 9001**.



### We know ... what you expect of us!



## Safety

### The 3 Safety steps

#### What is safety?

Safety is a situation in which the risk  $R_x$  presented by a certain technical procedure or state is not any bigger than the biggest and still justifiable risk.

Safety:  $R_x < R_{\text{max, justifiable}}$

#### How is safety attained?

In that suitable protective measures are taken which facilitate the exclusion or at least the reduction of the risk to the greatest possible extent.

#### Which protective measures?

Constructive modifications, guards and trip devices can be used. The protective measure to be taken depends on the type of danger and the risk level.

#### How to proceed?

When choosing the correct protective measure, the 3 Safety Steps Method can be helpful:

1. Danger analysis
2. Risk assessment
3. Protective measures

This method of 3 safety steps is to be used in accordance with the EC Machinery Directive 98/37/EC (incl. the amendment of 98/79/EC) already in the development and design phase. It can also be used where, according to the Machine Use Regulation 89/655/EEC, machines have to be retrofitted.

### Step 1: Danger analysis

#### What is danger?

A potential source of damage, exists permanently or occurs unexpectedly.

#### What kinds of danger exist?

Electrical danger:

Touching live parts

Mechanical danger:

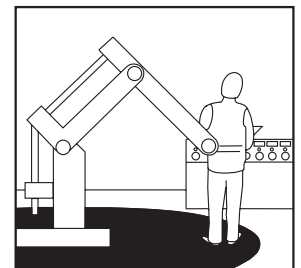
Nipping of limbs

Crushing of limbs

Drawing-in of limbs/body into the machine

Trapping by moving machine parts

Impact blow from a robot



Thermal danger:

Touching very cold materials

Splashes from hot materials

#### Further types of danger

are listed in the

EC Directive 98/37/EC (Appendix I, 1.3/1.5) and  
ISO Standard 12100-1 (Paragraph 4)

# Safety

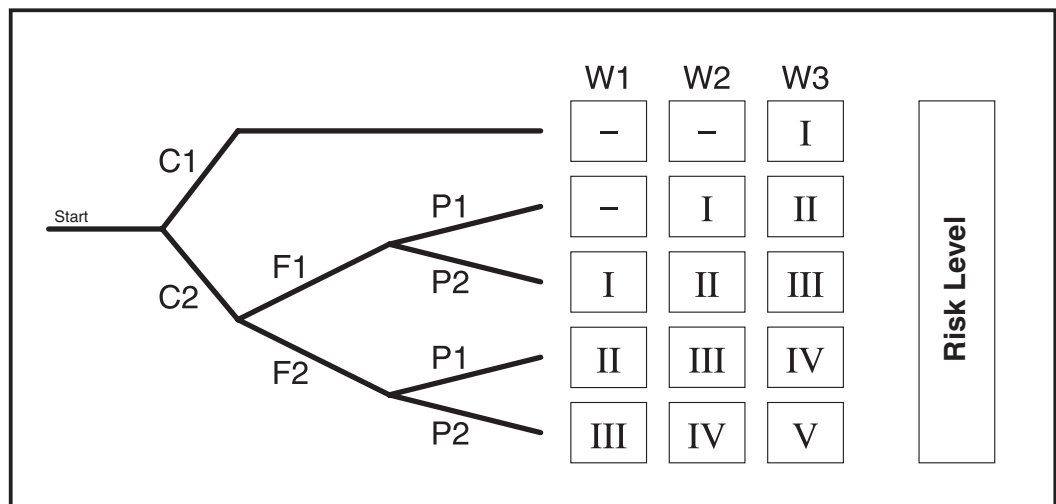
## Step 2: Risk assessment

### How can the danger risk be determined?

Beginning with the actual danger, the risk level is determined according to the following 4 risk parameters:

Result (C)	Possibility of avoidance(P)
C1: slight injury	P1: possible
C2: severe injury, death	P2: virtually impossible

Frequency and duration of stay (F)	Probability of the event (W)
F1: seldom to often	W1: very low
F2: often to constant	W2: low
	W3: high



## Step 3: Protective measures

### Suitable protective measures can be:

- inherently safe design (risk reduction: see ISO 12100-2)
- technical safety measures: these can be guards (e.g. safety fence) and/or protective devices (e.g. safety mats)
- detailed user information

If protective devices are used, it is frequently necessary to take action in the machine control. Depending on the risk level, the necessary control category can then be determined using the following table.

	Control Category				
	B	1	2	3	4
-	●	+			
I	-	●	+		
II	-	●	●	+	
III		-	●	●	+
IV			-	●	+
V				-	●

- preferential category for safety-related parts of control
- possible category, additional measures are necessary
- + disproportionate measure in relation to the risk in question

# Safety

## Regarding step 3: Control categories

### What do the control categories B to 4 conceal?

A subtly differentiated knowledge of these categories is of advantage when making a selection which must suit all safety requirements. The following table, taken from EN 954-1, gives further details:

	Synopsis of requirements	System behaviour	Principle
<b>B</b>	Those parts of control systems relating to safety and/or their safety devices, as well as their components must be designed, built, selected, assembled and combined in accordance with the appropriate standards in such a way that they can withstand the expected influences.	<ul style="list-style-type: none"> <li>♦ The occurrence of a fault can lead to the loss of the safety function.</li> </ul>	Safety attained by the selection of safety components
<b>1</b>	<p>The requirements of B must be fulfilled.</p> <p>Proven components and proven safety principles must be used.</p>	<ul style="list-style-type: none"> <li>♦ The occurrence of a fault can lead to the loss of the safety function but the probability of the occurrence is smaller than in category B.</li> </ul>	
<b>2</b>	The requirements of B and the use of proven safety principles must be fulfilled. The safety function must be tested by the machine controls at suitable intervals.	<ul style="list-style-type: none"> <li>♦ The occurrence of a fault can lead to the loss of the safety function between test intervals.</li> <li>♦ The test picks up the loss of the safety function.</li> </ul>	Safety attained by the structure
<b>3</b>	<p>The requirements of B and the use of proven safety principles must be fulfilled. Safety related parts must be designed in such a way that:</p> <ul style="list-style-type: none"> <li>- one single fault in each of these parts does not lead to the loss of the safety function and</li> <li>- whenever reasonably feasible, the single fault will be recognised.</li> </ul>	<ul style="list-style-type: none"> <li>♦ If the single fault occurs, the safety function will always be maintained.</li> <li>♦ Some, but not all faults are recognised.</li> <li>♦ An accumulation of faults which have not been recognised can lead to the loss of the safety function.</li> </ul>	
<b>4</b>	<p>The requirements of B and the use of proven safety principles must be fulfilled. Safety related parts must be designed in such a way that:</p> <ul style="list-style-type: none"> <li>- one single fault in each of these parts does not lead to the loss of the safety function and</li> <li>- the single fault is recognised when or before the safety function is next required, or if this is not possible, an accumulation of faults may not then lead to the loss of the safety function.</li> </ul>	<ul style="list-style-type: none"> <li>♦ If faults occur, the safety function will always be maintained.</li> <li>♦ The faults will be recognised on time, in order to avoid a loss of the safety functions.</li> </ul>	

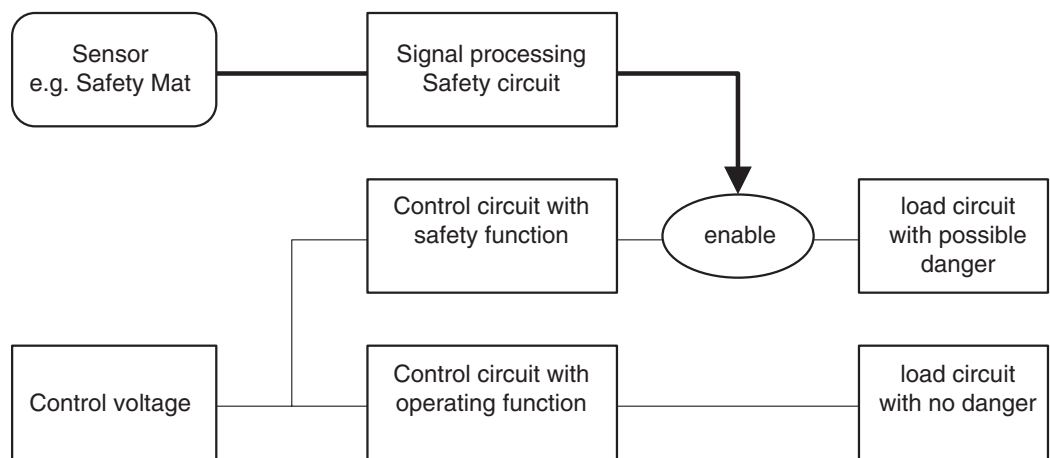
# Safety

## Example result

### What is a typical example of the result of the 3 Steps Method?

1. Danger analysis: e.g. getting trapped by a moving machine part
2. Risk assessment: C2 – F1 – P2 – W3 risk class III
3. Protective measure: assuming that guards would not be appropriate here, a trip device of control category 3 (e.g safety mat incl. signal processing control unit)

The machine controls are therefore laid out as follows:



## Regulations, Standards

### Which regulations and standards apply?

#### International

98/37/EC	EC Directive "Safety of Machinery (SoM)	06/1998
EN 294	SoM: Safety distances to prevent danger zones from being reached by the upper limbs	06/1992
EN 954-1	SoM: Safety-related parts of control systems	12/1996
EN 999	SoM: Positioning of safety devices with regard to approach speeds of parts of the human body	10/1998
EN 1050	SoM: Guidelines on risk assessment	11/1996
EN 1760	SoM: Pressure-sensitive safety devices	03/2001
EN 12978	Safety devices for power-operated doors and gates	09/2003
IEC 60204-1	SoM: Electrical equipment of machinery	09/2002
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems	11/2002
ISO 12100	SoM: General design guidelines	04/2004

#### National (FRG)

9. GSGV	9th ordinance of the safety law for machines	09/1995
---------	--	---------

Where can these regulations and standards be obtained?

EU regulations, laws and ordinances are available in specialist bookshops.

Standards: Beuth-Verlag GmbH  
 Burggrafenstr. 6  
 10787 Berlin  
 Germany  
 Tel: +49 30 26 01-22 60  
 Fax: +49 30 26 01-12 60

## Table of contents

### Definitions

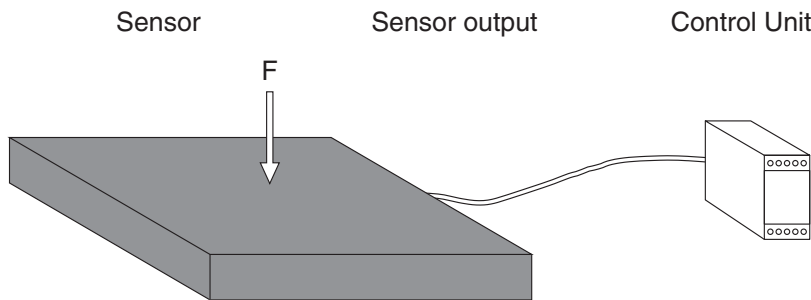
Proven safety.....	1.1
--------------------	-----

### Operation principles

Operation principle 2-wire connection system (with monitoring resistor) .....	1.2
Operation principle 4-wire connection system (without monitoring resistor) .....	1.3
Operation principle NC contact system .....	1.4

**PSPD – pressure sensitive protective device**

PSPD is a safeguard comprising pressure-sensitive sensor(s), signal processing and output signal switching device(s). The Control Unit is made up of the signal processing and output signal switching device(s). The PSPD is triggered when the sensor is activated.

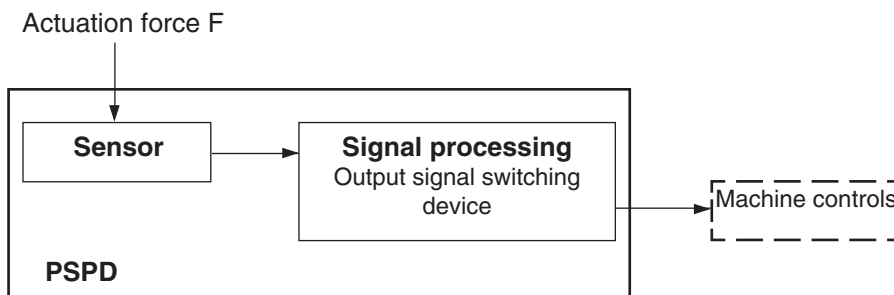


**Sensor**

The sensor is that part of the PSPD that generates a signal when the actuating force F is applied. Mayser safety systems have a sensor whereby the actuating surface is deformed locally.

**Signal processing**

The signal processing is that part of the PSPD which converts the output signal of the sensor and controls the status of the output signal switching device. The output signal switching device is that part of the signal processing which is connected to the machine controls and transmits safety output signals such as STOP.



**The following points should be considered when choosing the sensor:**

- temperature range
- response time
- stopping distance of the movement to be safeguarded
- category in accordance with EN 954
- protection class in accordance with EN 60529. IP65 is the standard for Safety Mats, Safety Edges and Mini Safety Edges. IP53 is the standard for Safety Bumpers – taking the installation position into account. Higher protection classes must be checked individually
- environmental influences (swarf, oil, coolant, outdoor use...)
- for Safety Mats: suitability for children weighing > 20 kg
- for Safety Edges: finger detection necessary?

**ATTENTION:**

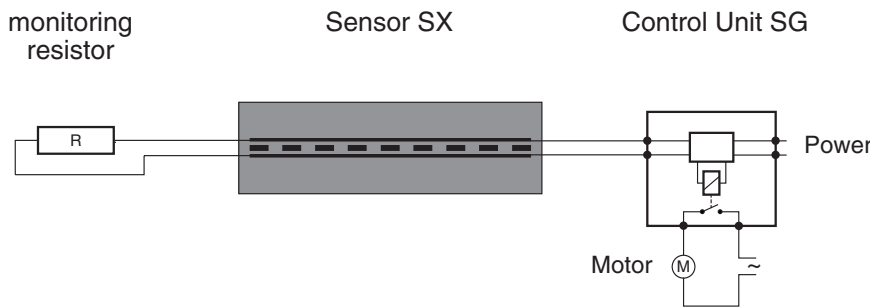
The certification of design becomes invalid if our products are used with control units or sensors which do not comply with the tested types.

*Subject to technical modifications.*

**Operation principle 2-wire connection system  
(with monitoring resistor)**

**Operation principle**

1.2

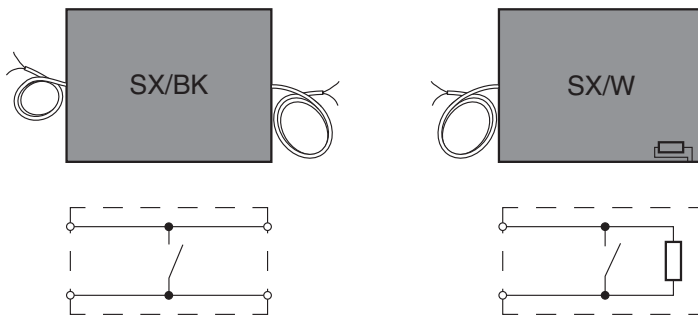


Sensor SX:  
SM = Safety Mat  
SL = Safety Edge  
SB = Safety Bumper

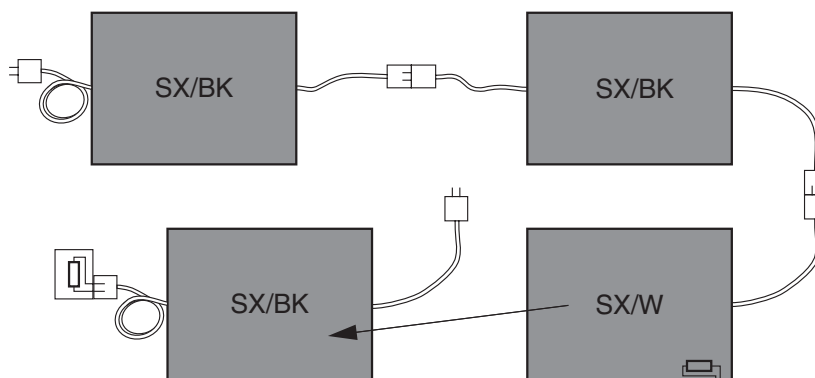
**Design**

SX/BK with cables on both sides as a through sensor or for connection of an external monitoring resistor  
SX/W with integrated monitoring resistor

For your safety:  
The sensor and the connecting cable are constantly monitored for function. A control function is attained by bridging the conductive areas with a monitoring resistor.



**Combination of sensors**



Combination:  
- connection of more than one sensor  
- only one Control Unit required  
- with Safety Mats: individual design of control areas with regard to size and shape  
- with Safety Edges: individual adaptation of closing edges with regard to length and angle  
- with Safety Bumpers: individual bumper design with regard to depth and shape

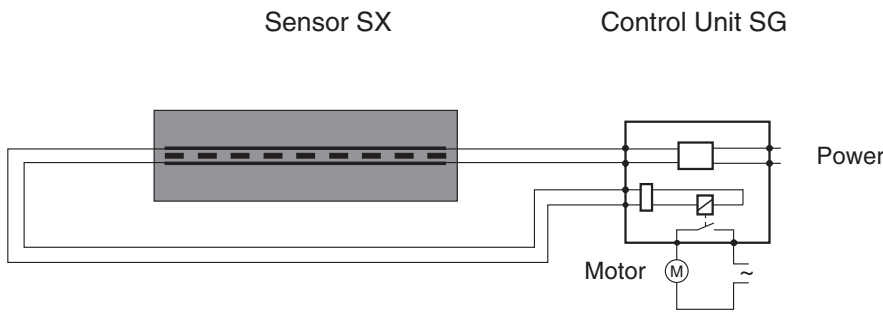
Model with external resistor, thus avoiding variety in type

Subject to technical modifications.

**Operation principle 4-wire connection system  
(without monitoring resistor)**

**Operation principle**

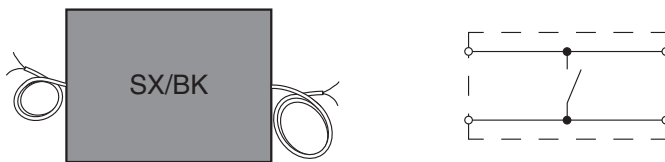
1.3



Sensor SX:  
SM = Safety Mat  
SL = Safety Edge  
SB = Safety Bumper

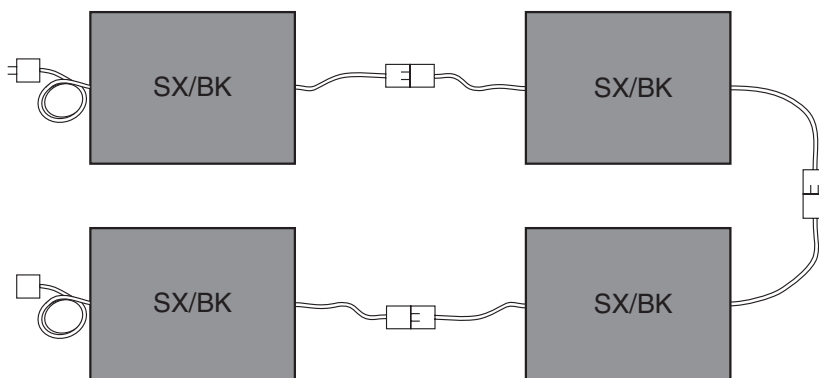
**Design**

SX/BK with cables on both sides as a through sensor



For your safety:  
The sensor and the connecting cable are constantly monitored for function. The monitoring resistor is not required due to signal transmission feedback.

**Sensor combination**



- Combination:
- Connection of more than one sensor
  - only one Control Unit required
  - Combinations with Safety Mats, Safety Edges and Safety Bumpers possible
  - with Safety Mats: individual switching area design with regard to size and shape
  - with Safety Edges: individual adaptation of closing edges with regard to length and angle
  - with Safety Bumpers: individual bumper design with regard to depth and shape

**Note:**

The 4-wire connection system can be used only together with Control Unit SG-SUE 41X4 NA or SG-EFS 104 /4L; with safety mats also with PNOZ e4.1p or PNOZ e4vp 10s.

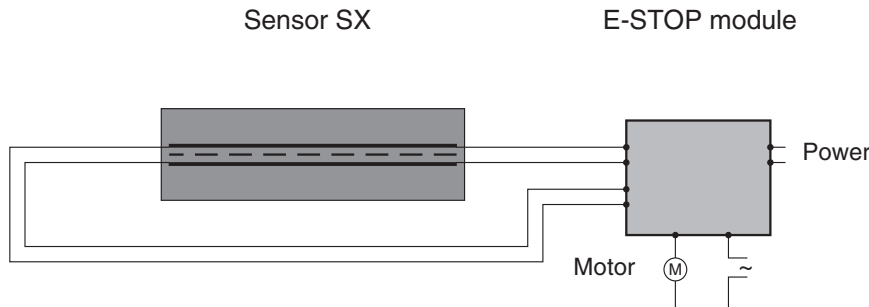
Subject to technical modifications

## Operation principle NC contact system

Signal processing and output signal switching device(s) are combined in the EMERGENCY-STOP module. Instead of an E-STOP module, machine controls in accordance with EN 954 category 3 can also be used.

## Operation principle

1.4

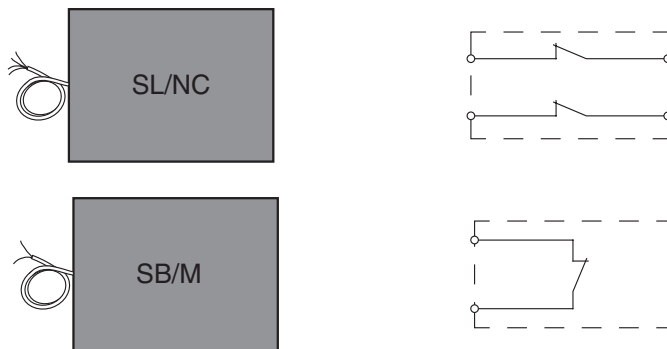


Sensor SX:

- SL/NC = Safety Edge with redundant NC contact chain
- SB/M = Safety Bumper with force guided NC contact chain

### Design

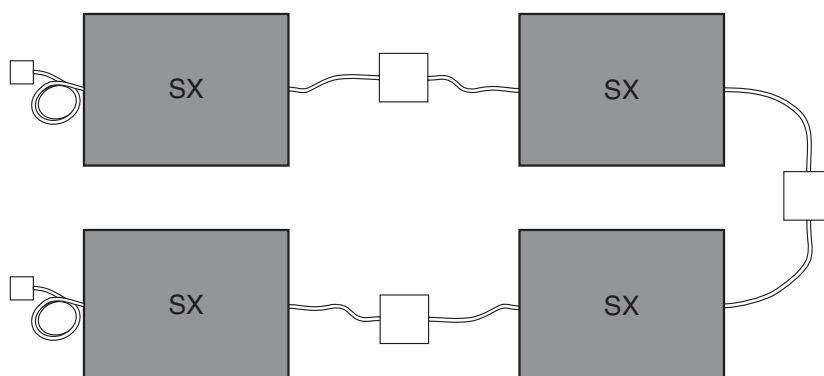
SL/NC with two 2-stranded cables as a through sensor  
SB/M with 2-stranded cable as a through sensor



For your safety:

The sensor and connecting cable can be constantly monitored for function via the external signal processing system. Single-fault-safety with redundant set-up (SL/NC) or NC contact chain (SB/M).

### Combination of sensors



Combination:

- Connection of more than one sensor
- only one E-STOP module necessary
- with Safety Edges: individual adaptation of closing edges with regard to length and angle
- with Safety Bumpers: individual bumper design with regard to depth and shape

#### ATTENTION:

Combination of SL/NC and SB/M is not possible due to the different technology

Subject to technical modifications.