



# Sensor Switch

# safe cap<sup>®</sup>

*Two-hand control for stamping and press machines*



SC4-DB-01-E.CDR 3392

Edition 2

**safecap 4** is a recently developed intelligent proximity sensor replacing the use of the mechanical sensor with two-hand control within control category 4 of safety level III-C.



### Touch control

No overstraining of wrists



### No muscle power, no pressure

Humane operation, high user comfort



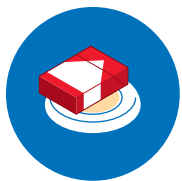
### Extensive service life

More than 100 million hystereses



### Highly shock-resistant, robust

Sensor completely sealed in cast resin



### Foreign matter control

Detects interfering items



### Soiling control

Detects damp dirt



### 100 % water & oil-proof

System of protection IP 68

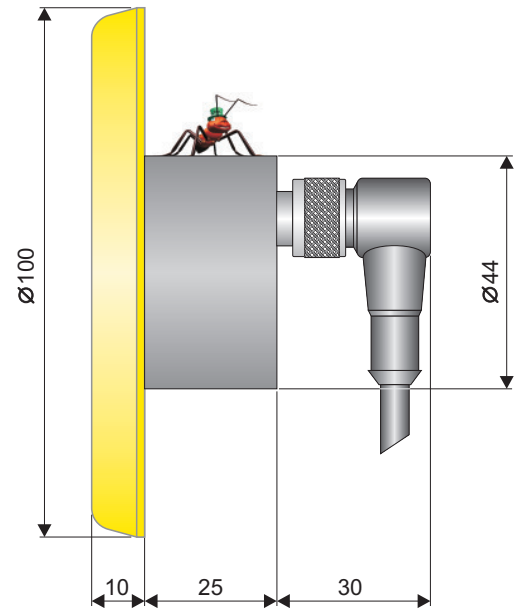
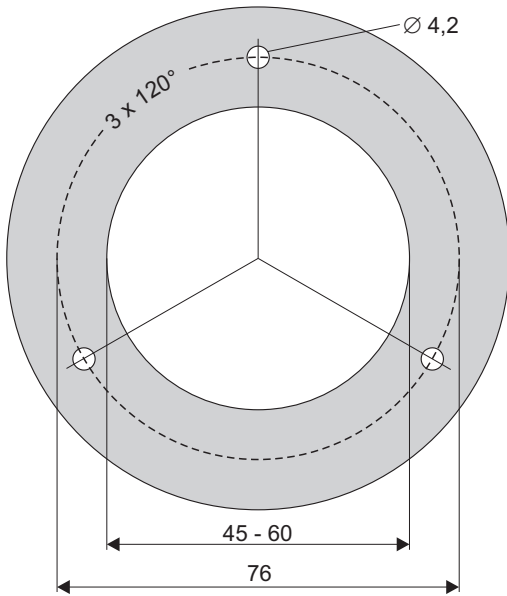
What makes the new **safecap 4** so safe ?

The difference between conventional capacitive proximity switches and **safecap4** is its unique linkage of static, as well as dynamic working principles, combined with a higher degree of diversification between the two proximity sensors **safecap4 A+B**. Both sensors are equipped with two PhotoMos relays each. Both relays are controlled by two independent logic systems. This allows the immediate stoppage of the machine even if there is only one fault in one of the channels. The high degree of safety is also achieved by a particular feature that requires the two sensors to be connected by a functional safety lead which secures the use of the two sensors **safecap4 A+B** within a dual control. This concept is supported by two mix-up-proof plug-in connections with connection cables in black (A) and yellow (B) sleeves for connection of the operating voltage and the dual safety relay **mastercap MCR-225**. The total width of this case is only 22.5 mm and is to be mounted on a standard rail.

Why is **safecap4** so easy to operate?

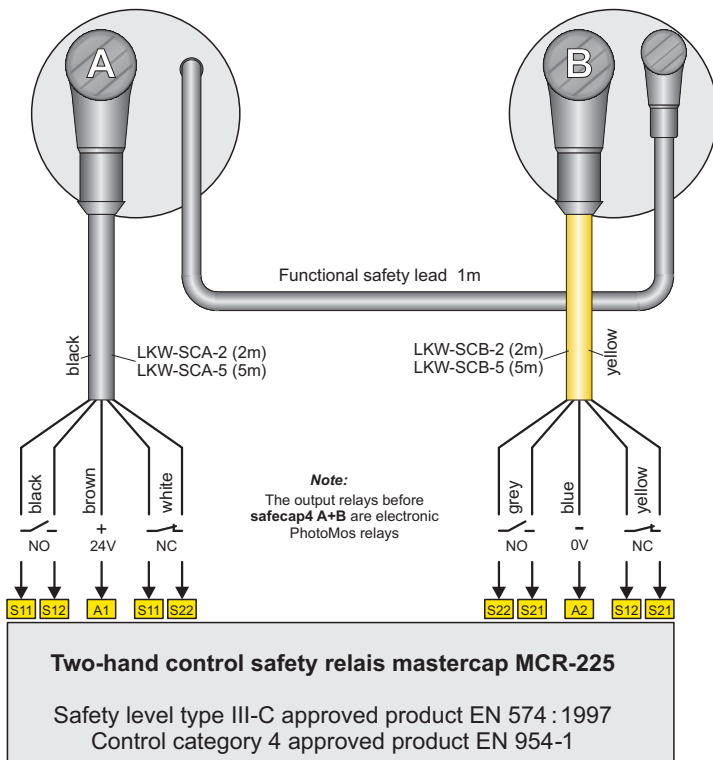
The control of the sensors is achieved without undue effort or muscle power: simply touching the sensor disk, which is made to fit the human hand, is sufficient and ensures non-tiring operating. The operator receives information about the operating state of the sensors via the red and green LED's. The flashing of the red LED's will for instance indicate a soiled sensor disk which prevents its further use. Due to its high protection class IP 68 it can be easily cleaned and, as it is completely sealed in cast resin and therefore highly shock-proof, it is well equipped for the use in a rough industrial environment. The extensive service life of several 100 million hystereses (more than 20 years in real life) the electronic PhotoMos relay of **safecap4** completes the image of a new innovative sensor for the safety sector of the future.





## safecap A

## safecap B



## Coloured Standard Rings



## Input

|                     |                |
|---------------------|----------------|
| Operating voltage   | 24V DC +/- 10% |
| Residual ripple     | max. 10%       |
| Drawing of current  | < 65 mA        |
| Switching frequency | 1 Hz           |
| Scanning speed      | > 50 mm / s    |

## Output

|                         |                                   |
|-------------------------|-----------------------------------|
| Contact components      | 1 NO, 1 NC                        |
| Relay type              | PhotoMos, electronic              |
| Min. current rating     | >10 mA / contact                  |
| Breaking capacity       | 200 mA / 24V DC / contact         |
| Service Life            | >100 x 10 <sup>6</sup> hystereses |
| Operational reliability | Semiconductor level               |

## General data

|                      |                           |
|----------------------|---------------------------|
| Sensor principle     | capacitive static-dynamic |
| Temperature range    | 0°C...+55°C               |
| System of protection | IP 68, plug IP 67         |
| Material of case     | polycarbonate (PC)        |

## EMC

|                                   |         |               |
|-----------------------------------|---------|---------------|
| Static discharge (operating time) | 8 kV    | EN 61 000-4-2 |
| High frequency beam               | 10 V/m  | EN 61 000-4-3 |
| Rapid transient (burst)           | 4 kV    | EN 61 000-4-4 |
| High frequency conduit            | 10 V    | EN 61 000-4-6 |
| Interference suppression          | class B | EN 55 011     |



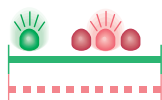
## Monitoring Units



► **Operation** 8 green LED's on, if current-carrying without touching



► **Output** 8 red LED's on - 8 green LED's will switch off as soon as sensor disk is touched

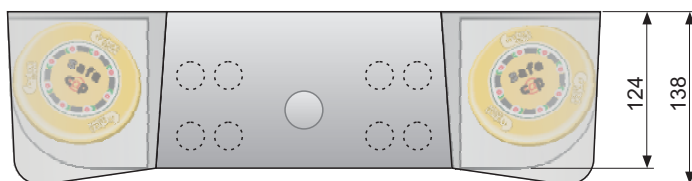
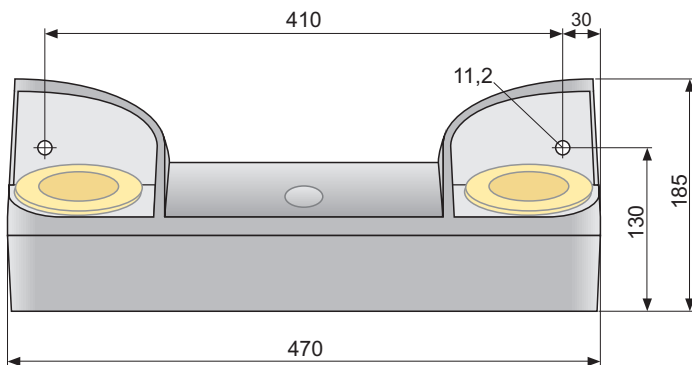
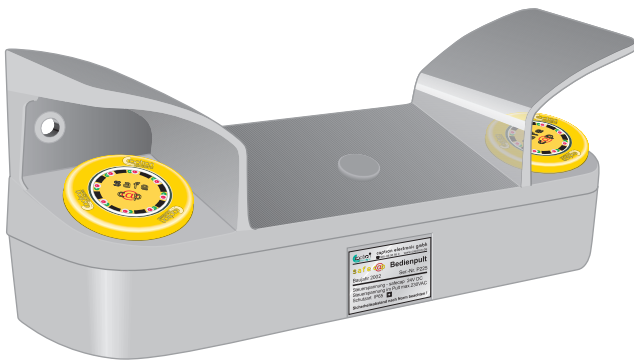


► **Error** 8 green LED's on + 8 red LED's flashing, safecap will not work because:

- Touch speed too low (faulty control)
- Sensor disk dirty or damp
- Disrupting items on sensor disk

## Control Panel

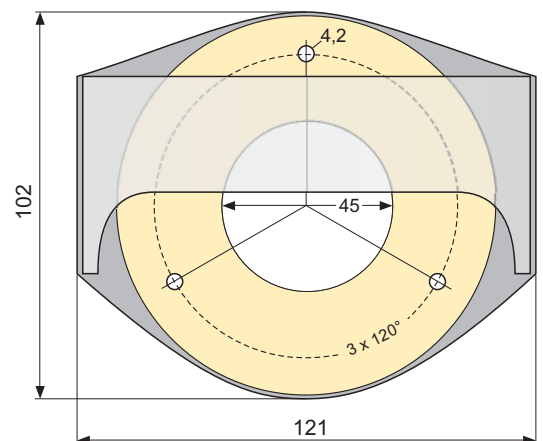
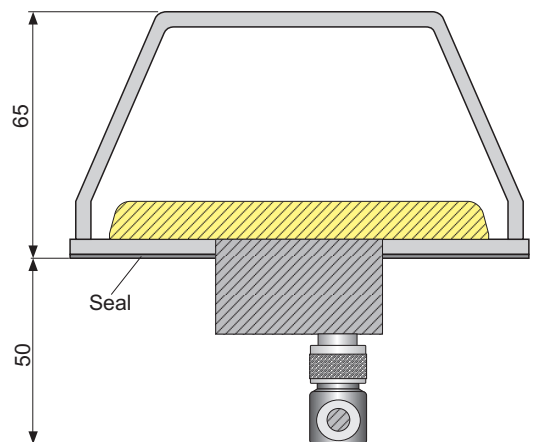
Material: Polycarbonate - grey, glass fibre enforced  
Degree of protection: IP 65



The control panel can be fitted with 9 additional M22 alarm and command devices (e.g. emergency switch, lamp, push button, switch). For the installation of any of these devices it is absolutely essential to refer to the "Assembly and fitting instructions for dual control panels in accordance with EN 574: 1997!"

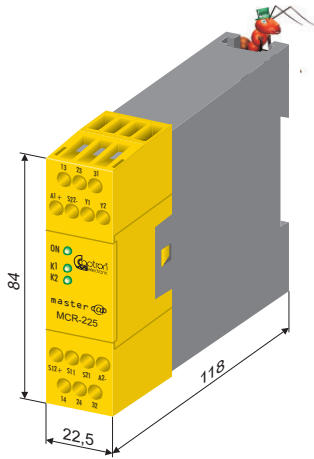
## Protector SCP-1

Material: Polycarbonate - transparent



Detailed technical drawings on paper or data carrier (dwg-dxf) can be obtained from us on request.

# Two-hand safety relay MCR-225



- ▲ According to European Standard EN 574
- ▲ Safety level Type III-C according to EN 574 (02-1997)
- ▲ Safety category 4 according to DIN EN 954-1
- ▲ According to the EU directive for machines 98/37/EG
- ▲ Complies with the safety regulations for two-hand controls on power-operated presses in metalworking ZH 1-456
- ▲ Input for 2 safecap with 1 NC and 1 NO each
- ▲ Output: 2 NO and 1 NC
- ▲ Feedback circuit Y1 - Y2 to monitor external contactors used for reinforcement of contacts
- ▲ Overvoltage and short circuit protection

## Input

|                                    |  |
|------------------------------------|--|
| Operating voltage                  | 24V DC +/- 10%                                 |
| Residual ripple                    | max. 10%                                       |
| Nominal consumption                | ca. 2,3W                                       |
| Delay time for simultaneity demand | max. 0,5 s                                     |
| Recovery time                      | 1 s  |
| Control contacts                   | 2 x (1 NO, 1 NC contact)                       |
| Current via control contacts       | typ. 50 mA NO contact<br>typ. 20 mA NC contact |
| Fuse protection                    | internal with PTC                              |
| Overvoltage protection             | by MOV   |

## Output

|  |   |
|--|---|
| Contacts                                   | 2 NO, 1 NC contacts   |
| Contact type                               | relay, positively driven  |
| Operate time                               | typ. 40 ms  |
| Release time                               | typ. 15 ms  |
| Nominal output voltage                     | AC 250 V<br>DC, see cont. current limit curve   |
| Switching of low loads                     | ≥ 100 mV  |
| Thermal current I <sub>th</sub>            | see cont. current limit curve   |
| Switching capacity to AC15 (EN 60 947-5-1) | max. 5A in one contact path<br>3 A / 230 V for the NO contact<br>2 A / 230 V for the NC contact |
| Electrical life to AC 15 at 2A, AC 230V    | 10 <sup>5</sup> Switching cycles (EN 60947-5-1)   |
| Permissible switching cap.                 | max. 1800 switching cycles / h  |
| Short circuit strength                     |   |
| max. fuse rating                           | 6 A gL (EN 60 947-5-1)  |
| Line circuit breaker                       | C 8 A   |
| Mechanical life                            | 10 x 10 <sup>6</sup> switching cycles   |

## Hints

If both safecaps are touched while switching on the operating voltage (e.g. after voltage failure) the output contacts do not energize.  
The terminal S22 also serves as reference point for checking the control voltage.

## General data

|                                  |                              |
|----------------------------------|------------------------------|
| Temperature range                | 0°C...+55°C                  |
| Clearance and creepage distances |                              |
| overvoltage category             |                              |
| contamination level              | 4 kV/2 DIN VDE 0110-1 (4.97) |

## EMC

|   |         |               |
|---|---------|---------------|
| Electrostatic discharge                       | 8 kV    | EN 61 000-4-2 |
| Fast Transients                               | 2 kV    | EN 61 000-4-4 |
| Surge voltages between wires for power supply | 1 kV    | EN 61 000-4-5 |
| between wire and ground                       | 2 kV    | EN 61 000-4-5 |
| HF-wire guided                                | 10 V    | EN 61 000-4-6 |
| Interference suppression                      | class B | EN 55 011     |

## Degree of protection

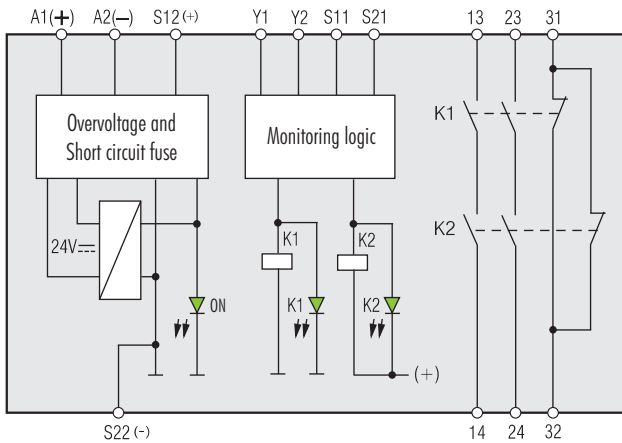
|                      |   |               |
|----------------------|---|---------------|
| Housing              | IP 40   | EN 60 529     |
| Terminals            | IP 20   | EN 60 529     |
| Housing              | Thermoplast UL - 94 - V0  |               |
| Vibration resistance | Amplitude 0,35 mm<br>f= 10...55 Hz  | EN 60 068-2-6 |
| Climate resistance   | 15 / 055 / 04   | EN 60 068-1   |
| Terminal designation | EN 50 005   |               |
| Wire connection      | 1 x 2,5 mm <sup>2</sup> isolated or<br>1 x 4 mm <sup>2</sup> solid or<br>2 x 1,5 mm <sup>2</sup> isolated |               |
|                      | DIN 46 228  |               |
| Wire fixing          | Terminal screws M 3,5<br>Box terminals with self-lifting wire protection                                  |               |
| Mounting             | DIN rail  | EN 50 022     |
| Weight               | 200 g   |               |
| Dimensions           | W= 22,5 H= 84 D=118 mm  |               |

## Indication

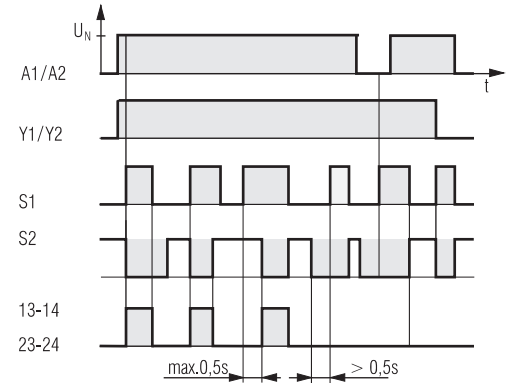
|        |                                    |
|--------|------------------------------------|
| LED ON | on, when operating voltage applied |
| LED K1 | on, when relay K1 active           |
| LED K2 | on, when relay K2 active           |



### Block Diagram

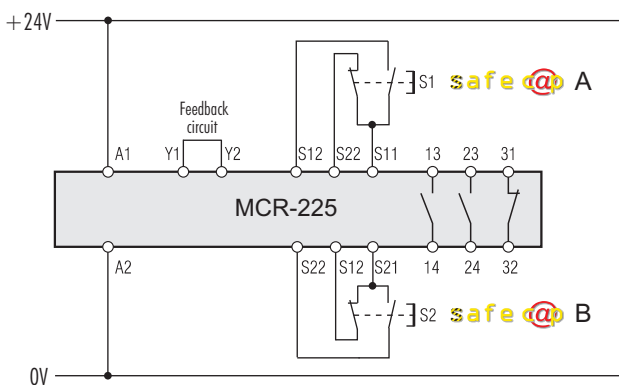


### Action Chart

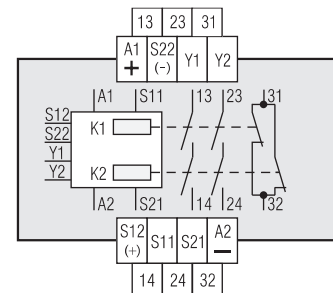


- ▶ "S1, S2 switched" means NO open, NC closed
- ▶ switched S1, switches "+" potential on
- ▶ switched S2, switches "-" potential on

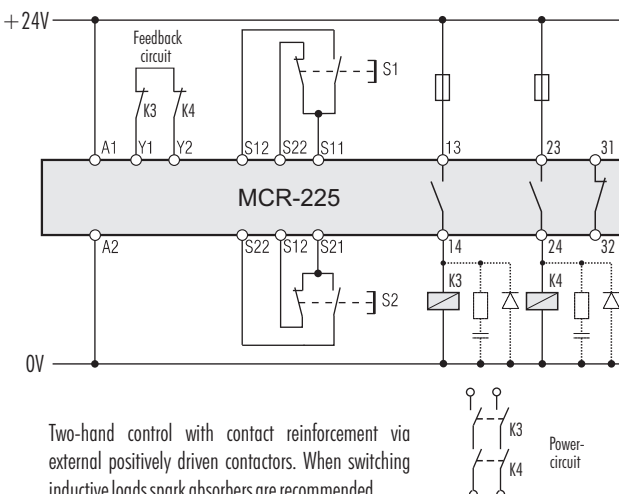
### Connection diagram



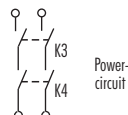
### Power circuit



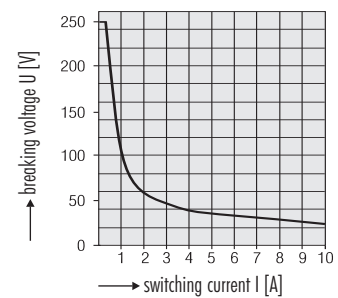
### Connection diagram with contact reinforcement



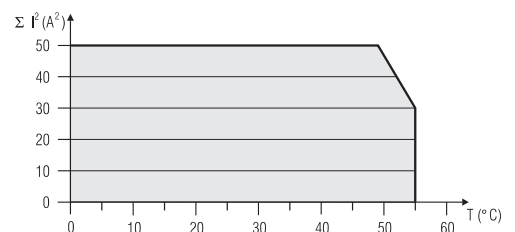
Two-hand control with contact reinforcement via external positively driven contactors. When switching inductive loads spark absorbers are recommended.



### Electric Arc Limit Curve



### Limit Curve of Root Sum Square Current



Root sum square current.....  $\Sigma I = I_1^2 + I_2^2 + I_3^2$   
 Current via contact paths.....  $I_1, I_2, I_3$   
 Max. voltage via 3 contact banks of  $T_u = 55^\circ$   $2 \times 4A \hat{=} (4A)^2 + (4A)^2 = 32A^2$



# Safety Rules and Regulations

***It is absolutely essential that the regulations stated in EN 574 : 1997 are complied with for assemblies involving the installation and commissioning of safecap A+B!***

### Definition - Two-hand control

Two-hand control systems require simultaneous operation using both hands in order to start or maintain the operation of a machine as long as there are any risks involved. They must be positioned outside the danger area so that the operator cannot enter this area before the machine has been completely switched off.

### Avoiding inadvertent operation and overruling (see also EN 574 section 8)

The **safecaps** of a two-hand control have to be arranged according to the risk evaluation made for every single application so that the protective effect of the two-hand control cannot be overruled easily and the possibility of inadvertent operation is kept to a minimum.

The use of only one hand, possible combinations of one hand and/or other parts of the body and/or the use of simple aids which might make avoidance possible are to be taken into account in order to prevent any person from entering the danger area during a hazardous situation. Inadvertent operation (e.g. through clothing of the operators) has also been taken into consideration.

**Safecap A+B** have to be separated by partition walls which are arranged in relationship to the operating side or rear side in such a way that the **safecap** cannot be operated from the operating side with the help of the tip of a cone, i.e. the elbow.

Open fitting (without operating panel and without **safecap** protector) of **safecap A+B** is to be avoided in order to prevent the start of operation through falling items.

### Case - Fitting of safecap

(see also EN 574 section 9.3)

Case and fittings have to be assembled in such a way that they can withstand the expected operating strain.

### Selection, assembly and fitting of safecap

(see also EN 574 section 9.4)

The **safecaps** have to be fitted in such a way that they can be operated without causing fatigue (e.g. as a result of awkward positioning or inadequate movements).

### Inadvertent starting of mobile and portable machines

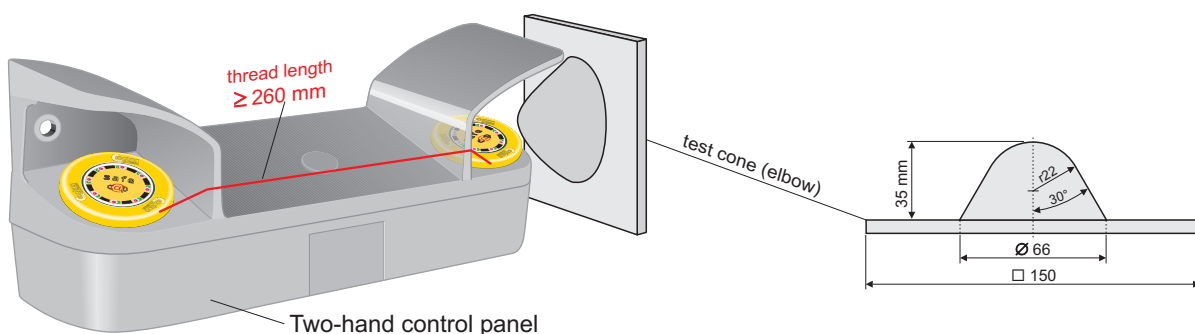
(see also EN 574 section 9.6)

The design of a dual control system must prevent inadvertent operation due to normal handling of mobile and/or portable machines that are controlled by it.

### Mobile two-hand control systems

(see also EN 574 section 9.7)

The **safecaps** of a two-hand control system and its case must be stable during normal use. Mobile dual control systems have to be fitted with appliances that prevent a change of position during operation.







# Safety Rules and Regulations

**It is absolutely essential that the regulations stated in EN 574 : 1997 are complied with for assemblies involving the installation and commissioning of safecap A+B!**

### Safety Distance

(see also EN 574 section 9.8) (in prEN 999 minimum distance)

The safety distance between the **safecaps** and the danger area has to be determined with the time in mind that it would take for the hazardous movement to come to a stop before the operator can reach the danger area after releasing the **safecap**.

The safety distance "S" in mm is calculated using the following formula:

$$S = V \times T + C$$

V= touch velocity = 1600 mm/s

T= slowing down period in seconds

C= additional value = 250 mm

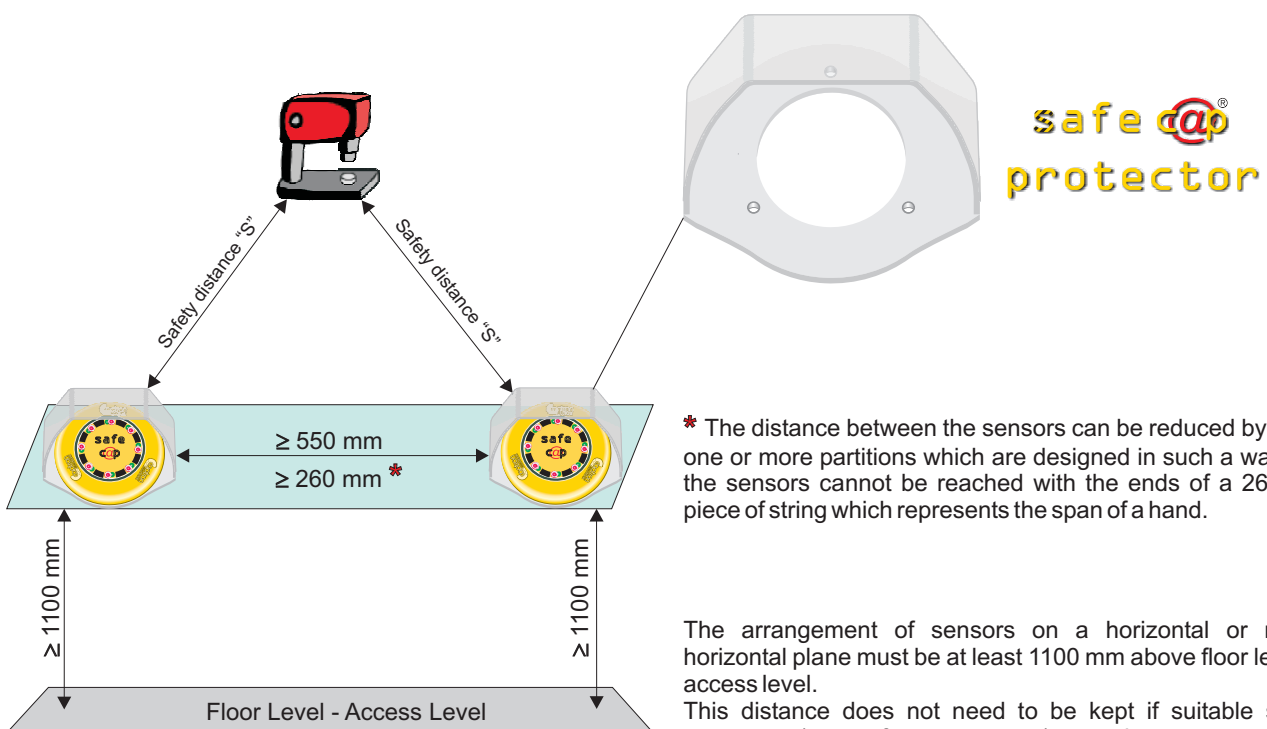
If the intrusion into the danger area during the operating time of the **safecaps** is successfully prevented, e.g. using a safety cover for the **safecaps** the value 0 can be put for C.

However, a minimum safety distance of 100 mm is to be applied at all times.

### Notes on Installation

The mastercap relay must only be connected as shown in the examples for applications. Series parallel connection or series connection of **safecap** relay contacts will eliminate the secure operation of the devices. The secondary contactor or relay needs to be fitted with guide contacts and need to be monitored in the feedback circuit.

To initiate a hazardous movement, two sensors - **safecap A** and **safecap B** - will have to be used. An output signal will be given if both sensors are touched within a time period that is shorter or equal 0.5 s. The sensors have to be of a kind and have to be arranged in a way that makes it difficult to render them ineffective or use them inadvertently.



\* The distance between the sensors can be reduced by fitting one or more partitions which are designed in such a way that the sensors cannot be reached with the ends of a 260-mm piece of string which represents the span of a hand.

The arrangement of sensors on a horizontal or nearly horizontal plane must be at least 1100 mm above floor level or access level.

This distance does not need to be kept if suitable safety measures (e.g. safecap protector) are taken to prevent any other bodypart (e.g. Knee, hip) in conjunction with a hand from actuating the equipment.

# Test Certificates

**Fachausschuss Elektrotechnik  
Prüf- und Zertifizierungsstelle  
im BG-PRÜFZERT**

Hauptverband der gewerblichen  
Berufsgenossenschaften

## Baumusterprüfbescheinigung

02071

Bescheinigungs-Nummer

Name und Anschrift des Bescheinigungsinhabers: (Auftraggeber)  
captron electronic gmbh  
Bodensestraße 129  
81243 München

Name und Anschrift des Herstellers:  
siehe Auftraggeber

Zeichen des Auftraggebers: Zeichen der Prüf- und Zertifizierungsstelle: Ausstellungsdatum:  
23.520.39/02-15-378 Gom/Ow 27.02.2002

Produktbezeichnung: Zweihandschaltung

Typ: safecap4 set

Bestimmungsgemäße Verwendung:

Prüfgrundlage: 73/23/EWG „Niederspannungsrichtlinie“ (02.97)  
89/336/EWG „EMV-Richtlinie“ (02.97)  
DIN EN 574 „Zweihandschaltungen“ (03.99)  
GS-ET-20 „Grundsätze für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen“ (03.00)  
DIN EN 55011 „EMV-Geräte - Funkstörungen“ (03.00)  
DIN EN 61000-6-2 „Störfestigkeit - Industriebereich“ (03.00)

Bemerkungen: Die o.g. Zweihandschaltung ist eine Zweihandschaltung des Typs III C. Die Anforderungen der Kategorie 4 nach DIN EN 954-1 (03.97) sind erfüllt.  
**Die Installationshinweise (Sicherheitsregeln) sind unbedingt einzuhalten.**

Das geprüfte Baumuster entspricht den einschlägigen Bestimmungen der Richtlinie 98/37/EG (Maschinen).

Diese Bescheinigung wird spätestens ungültig am: 31.12.2006

Weiters über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

Unterschrift (Dipl.-Ing. Mehlert)

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## Zeichengenehmigung

02072

Bescheinigungs-Nummer

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siehe Auftraggeber

Zeichen des Auftraggebers: Zeichen der Prüf- und Zertifizierungsstelle: Ausstellungsdatum:  
23.520.39/02-15-378 Gom/Ow 27.02.2002

Produktbezeichnung: Zweihandschaltung

Typ: safecap4 set

Bestimmungsgemäße Verwendung:

Der Inhaber dieser Zeichengenehmigung ist berechtigt, das nebenstehend abgebildete BG-PRÜFZERT-Zeichen an den mit dem geprüften Baumuster übereinstimmenden Produkten anzubringen. Die Berechtigung zum Anbringen des Zeichens erlischt mit dem Ungültigwerden der Baumusterprüfbescheinigung ET 02071.

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00233

Bescheinigungs-Nummer

Name und Anschrift des Bescheinigungsinhabers: (Auftraggeber)  
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Zeichen des Auftraggebers: Zeichen der Prüf- und Zertifizierungsstelle: Ausstellungsdatum:  
23.520.39/00-77-378 Gom/Ow 29.11.2000

Produktbezeichnung: Zweihand-Sicherheitsrelais

Typ: MCR-225

Bestimmungsgemäße Verwendung:

Prüfgrundlage: 73/23/EWG „Niederspannungsrichtlinie“ (02.97)  
89/336/EWG „EMV-Richtlinie“ (02.97)  
GS-ET-20 „Grundsätze für die Prüfung und Zertifizierung von Relais-Sicherheitskombinationen“ (03.99)  
DIN EN 574 „Zweihandschaltungen“ (02.97)  
DIN EN 50381-2 „Störaussendung - Industriebereich“ (03.94)  
DIN EN 61000-6-2 „Störfestigkeit - Industriebereich“ (03.00)

Bemerkungen: Das o.g. Zweihand-Sicherheitsrelais entspricht dem Typ III C nach DIN EN 574. Die sicherheitsrelevanten Strompfade mit den Ausgangskontakten 13-14 und 23-24 erfüllen die Anforderungen der Kategorie 4 nach DIN EN 954-1 (03.97).

Das geprüfte Baumuster entspricht den einschlägigen Bestimmungen der Richtlinie 98/37/EG (Maschinen).

Diese Bescheinigung wird spätestens ungültig am: 31.12.2005

Weiters über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

Unterschrift (Dipl.-Phys. Peuker)

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## GS-Prüfbescheinigung

00234

Bescheinigungs-Nummer

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DIN EN 574 „Zweihandschaltungen“ (02.97)  
DIN EN 50381-2 „Störaussendung - Industriebereich“ (03.94)  
DIN EN 61000-6-2 „Störfestigkeit - Industriebereich“ (03.00)

Bemerkungen: Das o.g. Zweihand-Sicherheitsrelais entspricht dem Typ III C nach DIN EN 574. Die sicherheitsrelevanten Strompfade mit den Ausgangskontakten 13-14 und 23-24 erfüllen die Anforderungen der Kategorie 4 nach DIN EN 954-1 (03.97).

Das geprüfte Baumuster stimmt mit den in § 3 Absatz 1 des Gerätesicherheitsgesetzes genannten Anforderungen überein. Das Baumuster entspricht somit auch den einschlägigen Bestimmungen der Richtlinie 98/37/EG (Maschinen). Der Bescheinigungsinhaber ist berechtigt, das umeiltig abgebildete GS-Zeichen an den mit dem geprüften Baumuster übereinstimmenden Produkten anzubringen. Der Bescheinigungsinhaber hat dabei die umeiltig aufgeführten Bedingungen zu beachten. Diese Bescheinigung einschließlich der Berechtigung zur Anbringung des GS-Zeichens wird spätestens ungültig am: 31.12.2005

Weiters über die Gültigkeit, eine Gültigkeitsverlängerung und andere Bedingungen regelt die Prüf- und Zertifizierungsordnung vom Oktober 1997.

Unterschrift (Dipl.-Phys. Peuker)

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## Price List

| Products | Order Code                                   |   | Price / € |
|----------|--|---|-----------|
|          | <b>safecap4 set 1</b>                        | safecap A+B<br>mastercap<br>cable A+B 2m each           | 810,-     |
|          | <b>safecap4 set 2</b>                        | safecap A+B<br>mastercap<br>cable A+B 5m each           | 818,-     |
|          | <b>safecap4 set 5-panel</b>                  | safecap A+B mit Panel<br>mastercap<br>cable A+B 5m each | 1118,-    |
|          | <b>A</b><br><b>SCA4-185Z-S</b>               | safecap A   | 300,-     |
|          | <b>B</b><br><b>SCB4-185Z-S</b>               | safecap B   | 300,-     |
|          | <b>A - 2 m</b><br><b>LKW-SCA-2</b>           | cable A - 2m  | 11,-      |
|          | <b>B - 2 m</b><br><b>LKW-SCB-2</b>           | cable B - 2m  | 11,-      |
|          | <b>A - 5 m</b><br><b>LKW-SCA-5</b>           | cable A - 5m  | 14,-      |
|          | <b>B - 5 m</b><br><b>LKW-SCB-5</b>           | cable B - 5m  | 14,-      |
|          | <b>MCR-225</b>                               | safety relay<br>mastercap                               | 200,-     |
|          | <b>SCP-1</b><br>2 pieces / set<br>required   | safecap protector                                       | 50,-/pc.  |
|          | <b>AR4-1X1</b><br>2 pieces / set<br>required | coloured cover ring                                     | 10,-/pc.  |
|          | <b>AR4-1X2</b><br>2 pieces / set<br>required | coloured cover ring                                     | 10,-/pc.  |