

Safety Relays / Definitions

Relays with forcibly guided contacts

General information

Relays with forced guidance contacts play a decisive role in avoiding accidents on machines and in systems. Safety control circuits enable to switch into the fail safe state. Forcibly guided contacts monitor the function of the safety control circuits. For this safety function, all the assumed faults that can occur must already have been taken into consideration and their effects examined. Standard EN 50205 "Relays with forcibly guided contacts" contains current internationally-defined design requirements. Relays with forcibly guided contacts that comply with EN 50205 are also referred as "safety" relays.

Function

Power relays with forcibly guided (linked) contacts:

Power relays with at least one break contact and at least one make contact designed that by mechanical means make and break contacts can never be simultaneously in the closed position.

Contact gaps shall never be less than 0.5 mm over the operating life, not only under normal operating conditions, but also when a fault occurs.

This requirement allows the respective exclusive-or contact to detect the fault of a contact to open. For example, the welding of a make contact is indicated by the non-closing of the break contact when the energization is switched off.

To fulfill the specifications of the standard, the assumed faults must be considered:

Assumed fault	Effect
Failure of the contact to open due to welding	The failure of any make contact to open has the effect that none of the break contacts close even when the relay is not energized. The failure of any break contact to open has the effect that none of the make contacts close when the relay is energized.
Failure of the contact to open due to failure of the drive	The drive has no effect on the forcibly guided contact operation.
Breakage of the contact spring	Simultaneous closing of the break and make contacts is not possible even as a result of breakage. Completely insulated contact chambers (SR2, SR4, SR6) or barriers (SR2M) guarantee a contact gap of 0.5 mm.

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Application example

The configuration of safety control circuits is basically only possible with specified fault conditions. Safety relays have the characteristic that make and break contacts can never both be closed at the same time.

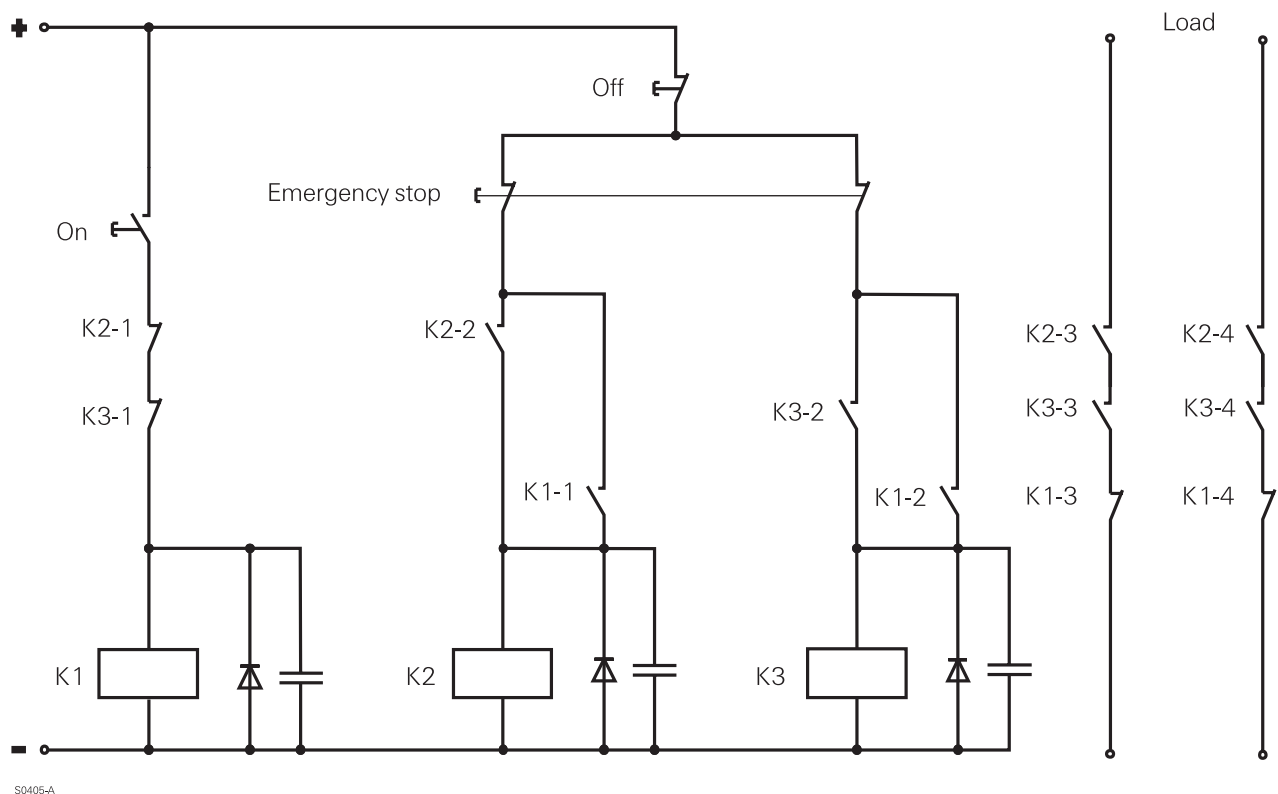
The following circuit diagram shows an emergency stop control circuit consisting of three 4-pole safety relays.

The first fault to occur

- does not cause the safety function to fail because more components are used than required for the circuit to function (redundancy).
- prevents an restart and can be detected as a result (self monitoring)

Operation

- Closing the "ON" switch causes the K1 relay to be pulled in
- The K2 and K3 relays are energized via the make contacts K1-1 and K1-2 and hold themselves via K2-2 or K3-2
- The break contacts K2-1 and K3-1 cause the drop-out of K1 where the load circuit is released via the break contacts of K1-3 or K1-4.



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Fault analysis (examples):

Type of fault	Is there any danger arising from the fault?	Is a restart possible?
Failure of contact K2-3 to open	No, K3-3 opens when the emergency stop switch is actuated	No, K2-1 and K2-3 cannot be closed at the same time (fault excluded by forcibly guid). "ON" button does not cause K1 to close
Failure of contact K1-3 to open	No, K2-3 and K3-3 open when the emergency stop switch is actuated	No, K1-1 and K1-2 cannot close due to closed K1-3. K2 and K3 are not energized

Processing

Mounting

Unless otherwise stated the relay can be mounted in any position. The relays can be further processed in all of the usual commercial soldering and cleaning plants.

Insertion

No pressure should be exerted on the terminal pins after the relay has been inserted in the printed circuit board. After insertion in the printed circuit board, the terminal pins should not be bent in order to fix them. Bending the terminal pins in relays sealed against washing can damage the sealing and could alter the relay parameters. However, if fixing must be carried out before soldering, use a pressure plate or similar.

Fluxing

The fluxing process should be set up so that the flux wets only the underside of the printed circuit board. The flux should only be visible as foam flux through any open perforations in the printed circuit board. If the printed circuit board is flooded by foam flux, bursting flux bubbles can lead to contamination in open relays and, consequently, to failures. To protect against corrosion, no acidiferous flux should be used. The recommended flux types are 1.1.3, 1.2.3 or 2.2.3 according to DIN EN 29454 T.1.

Preheating

In the normal preheating of flux, the temperature of the upper surface of the printed circuit board should not exceed 100°C. Ensure that any not completely dry flux exploding on being submerged in the solder wave does not penetrate the insides of open relays.

Soldering

PIN version

The relays in the PIN version are soldered according to the S-Sn60Pb40 or S-Sn63Pb37 solder types in accordance with DIN EN 29453. The solder bath temperature should be max. 260°C with a solder duration of approx. 3 s.

SMD version

The soldering processes approved for relays of the SMD version are condensation soldering (vapour phase), infrared soldering (radiation and/or convection) and full wave soldering.

Approved Soldering Techniques	Max. sold. duration	Max. sold. temp.
Condensation soldering (vapour phase)	40 s	215°C
Infrared soldering	40 s	215°C
Full wave soldering	10 s	260°C

Refer to the recommendations of CECC 00802 for the complete soldering profile.

Manual soldering

For manual soldering, we recommend a soldering temperature of 300 to 350 °C for a maximum soldering time of 2 s. The recommended solder type is pipe solder 1 DIN 8516-LSnPb zh/F-SW 32 to 34 (1 mm , 2.5 percentage by weight flux portion).

Cooling

The thermal loading resulting from the soldering process can be reduced at the end of the process by cooling.

Cleaning

We recommend avoiding washing processes in order to protect the environment. The fluxes we specify render a wash process unnecessary. If cleaning is required for other reasons, the following points must be observed independently of the washing process:

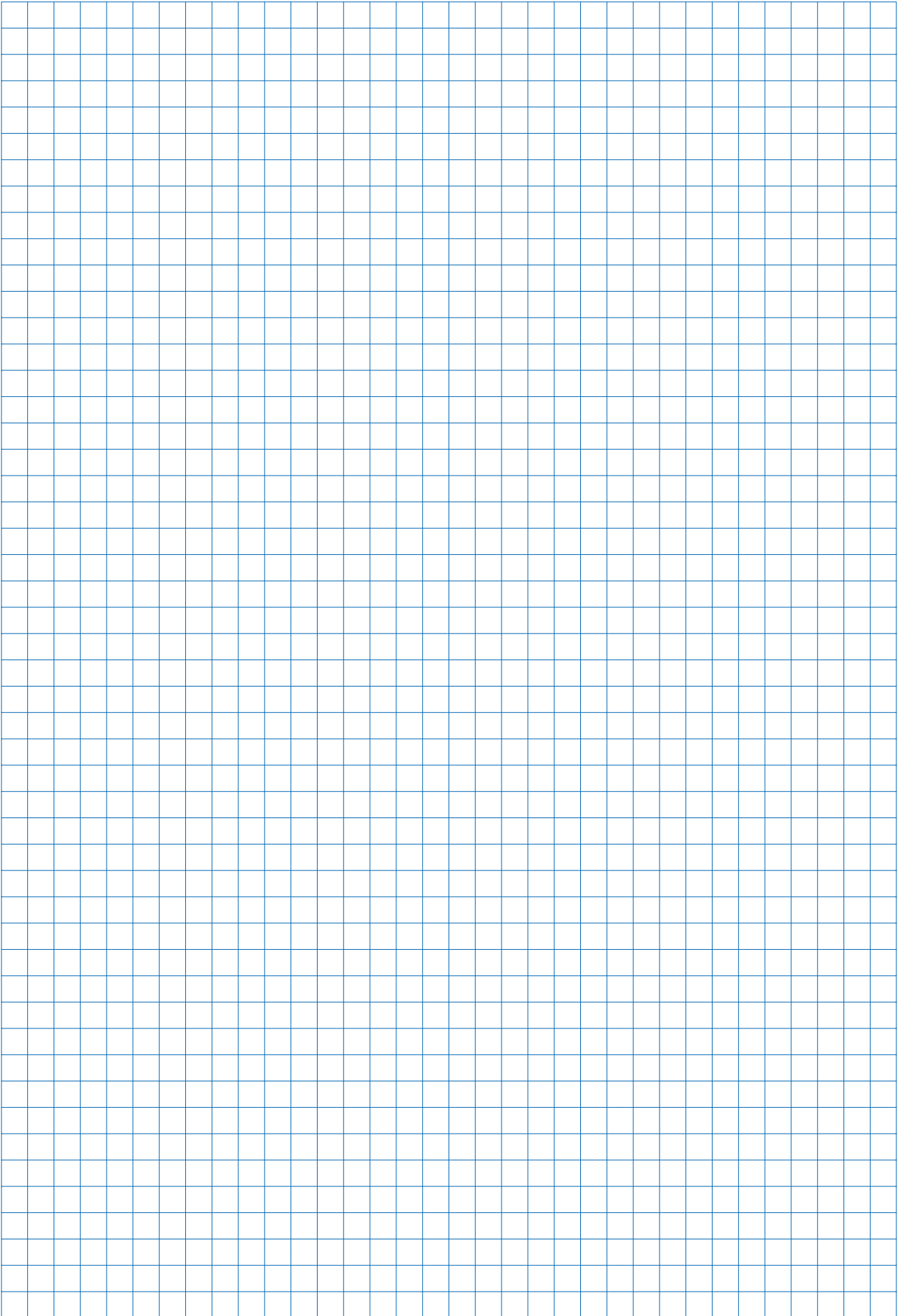
- the printed circuit boards must be washed immediately after the soldering process!
- the washing process must be set up so that any accumulation of washing fluid inside the relay is avoided!
- the individual wash stations must be separate from one another to prevent cross-contamination!
- after the final washing process, the printed circuit boards must be cleaned again using a clean washing medium!
- After washing, compressed air should be used to blow off the printed circuit board to speed up the drying process.

Protective lacquering

For the protective lacquering of the mounted printed circuit boards, we recommend single-component lacquer that is applied by immersion.

The maximum drying temperature should be 70 °C.

Notice



Notice

