

Protection of the Control Circuit

Basic Safety Principle



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- Specialist in pneumatics
- Specialist in electrical engineering
- Specialist for the programming of control systems and safety switching devices

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1 General

1.1 Objectives of this Document

- This document describes the basic safety principle “Protection of the control circuit.”
- The objectives for this safety principle and the different implementation options are described.
- Templates with justifications are provided indicating when this safety principle applies or does not apply.

1.2 General notes

- This document contains possible interpretations of the ISO 13849-2 standard. It must always be evaluated in relation to the specific application whether these interpretations apply.
- The interpretations relate to the use of electrical components for installation in machines. How these are to be implemented within the limits of a component, e.g., an electrically actuated valve, is not specified.
- The circuits shown are schematic representations that, due to clarity and scope, cannot be complete. They are recommendations and do not exclude other possibilities.

2 Basic Safety Principle "Protection of the Control Circuit"

Basic safety principle	Remarks	Relevant for	Source
Protection of the control circuit	The control circuit should be protected in accordance with IEC 60204-1:2016 + AMD1:2021, 7.2 and 9.1.1.	Components Subsystems	ISO 13849-2, Table D.1

Notes

- The standard DIN EN 60204-1:2019, sections 7.2, 9.1.1 and 9.4.3.1 is used. Section 9.4.3.1 shows various methods by which control circuits can be protected.

2.1 Objectives

The following measures are to be implemented as part of the basic safety principle "Protection of the control circuit" (IEC 60204-1, 7.2 and 9.1.1):

- Overcurrent protection
Overcurrent protection should be provided when the current can exceed the rated value of a component or the current-carrying capacity of the conductors.
- Separation of power and control circuits
Separation between power (main) and control circuits by transformers with separate windings. This is intended to protect the control circuit against malfunctions, e.g., due to short circuits and cross-connections.

2.2 Implementation — Overcurrent protection (IEC 60204-1, 7.2)

- The control circuit must be provided with overcurrent protection. The sizing must be based either on the rated value of the components or on the current carrying capacity of the conductors. The lower value shall be selected.
- The overcurrent protective device shall be installed in the switched conductor.
- Sizing based on the rated value of the components should be performed according to the manufacturer's data.
- For machines, the overcurrent protection design should take into account the conductor current-carrying capacities according to IEC 60204-1, Annex D.
- If a control transformer is used, the type and value of the overcurrent protection must comply with the transformer manufacturer's specifications. It must be considered that the transformer's inrush current does not cause unnecessary tripping of the overcurrent protection and that, in case of a short circuit on the secondary side, the winding temperature is limited to an allowable value according to the insulation class.

2.3 Implementation — Separation of power and control circuits

The power and control circuits must be separated from each other by transformers with separate windings. Suitable options include:

- PELV power supplies according to IEC 61010-2-201
- Control transformers with separate windings according to IEC 61558-2-16
- SELV power supplies according to IEC 61010-2-201

Note

- IEC 60204-1 references other standards for PELV/SELV supplies for which few or no supplies are offered. Therefore, the application of IEC 61010-2-201 is recommended based on the ZVEI 2019 [“Guide for selecting safety standards for power supplies”](#) for industrial enclosures.

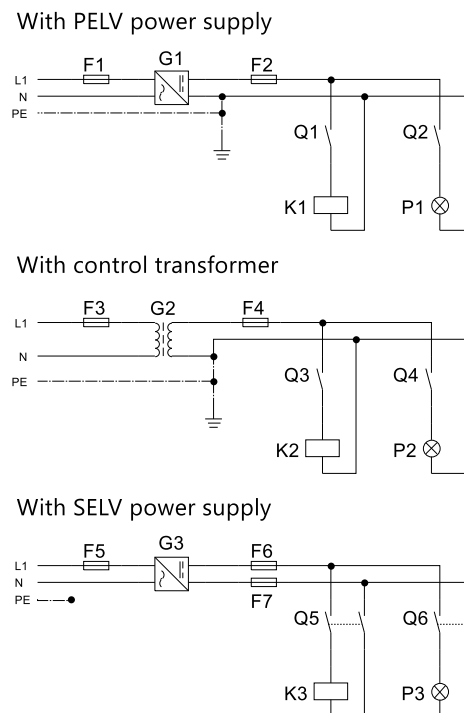


Figure 1 Protection of the control circuit

3 Evaluation: safety principle not applicable

If the safety circuit is implemented without electrical power, e.g., purely pneumatic, this safety principle is not applicable.

Table 1 Templates for evaluation: Safety principle not applicable

Implementation	Fulfilled Evidence
The safety circuit is implemented purely pneumatically. No electrical control circuit exists.	x Safety principle not applicable

4 Evaluation: safety principle applicable

If a safety circuit with electrical power supply is present, this safety principle always applies.

Table 2 Templates for evaluation: Safety principle applicable

Implementation	Fulfilled Evidence
A PELV power supply according to IEC 61010-2-201 is used. Overcurrent protection is present. Sizing based on component rated values or conductor current-carrying capacity.	☒ • See wiring diagram • Sizing documentation • Visual inspection of the control cabinet
A control transformer with separate windings according to IEC 61558-2-16 is used. Overcurrent protection is present. Sizing based on component rated values or conductor current-carrying capacity and in accordance with the control transformer's manufacturer.	☒ • See wiring diagram • Sizing documentation • Visual inspection of the control cabinet
A SELV power supply according to IEC 61010-2-201 is used. Overcurrent protection present. Sizing based on component rated values or conductor current-carrying capacity.	☒ • See wiring diagram • Sizing documentation • Visual inspection of the control cabinet

4.1 Replacement of the safety principle by implementing alternative measures

For overcurrent protection there is the possibility of implementing an alternative measure:

- If the power supply has a current limitation that is below the current-carrying capacity of the conductors and the connected components and devices, overcurrent protection is not required (IEC 60204-1, 7.2.4, exception). This can be implemented with PELV/SELV supplies with integrated current limiting and suitable component and conductor selection.

Table 3 Templates for evaluation: Replacement of the safety principle by implementing alternative measures

Implementation	Fulfilled Evidence
A PELV power supply according to IEC 61010-2-201 is used. The PELV supply has a current limit below the current-carrying capacity of the conductors and connected components. Sizing based on component rated values or conductor current-carrying capacity.	☒ • See wiring diagram • Sizing documentation • Visual inspection of the control cabinet
A SELV power supply according to IEC 61010-2-201 is used. The SELV supply has a current limit below the current-carrying capacity of the conductors and connected components. Sizing based on component rated values or conductor current-carrying capacity	☒ • See wiring diagram • Sizing documentation • Visual inspection of the control cabinet

5 Used Literature

5.1 Standards

- [1] DIN EN ISO 4414:2011-04 – Pneumatic fluid power - General rules and safety requirements for systems and their components (ISO 4414:2010); German version EN ISO 4414:2010
- [2] ISO 5598:2020-01 – Fluid power systems and components - Vocabulary
- [3] DIN EN ISO 12100:2011-03 - Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010); German version EN ISO 12100:2010
- [4] DIN EN ISO 13849-1:2023-12 – Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023); German version EN ISO 13849-1:2023
- [5] DIN EN ISO 13849-2:2013-02 – Safety of machinery - Safety-related parts of control systems - Part 2: Validation (ISO 13849-2:2012); German version EN ISO 13849-2:2012
- [6] ISO 19973-1:2015-08 - Pneumatic fluid power - Assessment of component reliability by testing - Part 1: General procedures
- [7] VDMA 24584:2022-06 – Safety functions of regulated and unregulated (fluid) mechanical systems; German Version
- [8] DIN EN 60204-1:2026-06 - Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2016, modified + AMD1:2021); German version EN 60204-1:2018 + A1:2025
- [9] DIN EN 61508:2011-02 - Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508:2010); German version EN 61508:2010
- [10] DIN EN 61508-4:2011-02 - Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations (IEC 61508-4:2010); German version EN 61508-4:2010
- [11] DIN EN 61511:2019-02 - Functional safety - Safety instrumented systems for the process industry sector - (IEC 61511:2016); German version EN 61511:2017
- [12] EN IEC 61558-2-16:2025-03 - Safety of transformers, reactors, power supply units and combinations thereof - Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units for general applications (IEC 61558-2-16:2021 + COR1:2023)
- [13] DIN EN IEC 62061:2023-02 - Safety of machinery - Functional safety of safety-related control systems (IEC 62061:2021); German version EN IEC 62061:2021

5.2 Legal Regulations

- [14] Machinery Directive: Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)
- [15] Machinery Regulation: Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC

5.3 Other Documents

- [16] [Guideline: Selection of safety standards for power supplies](#), publisher ZVEI, September 2019, 1. Edition, available from the Internet pages of ZVEI

6 Information about the Document

6.1 General Information

Document Number	100619
Basic Safety Principle	Protection of Control Circuit

6.2 Revision History

Ver.	Date	Ed.	Chapter	Description of Change/Impact
1.10	09.07.2026	JKHL	All	Creation of document

6.3 Approval/Release of the Document

Role	Signature
Release	

6.4 Period of Validity

Document is valid until 2031-07-09 or until one of the documents used or the required relevant base are changed.



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