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Responsible committee: PEL/121/1 Low voltage switchgear and controlgear

Interested committees:

Title: BS EN IEC 60947-5-3 Low-voltage switchgear and controlgear

Part 5-3: Control circuit devices and switching elements - Requirements for proximity devices with defined behaviour under fault conditions (PDDb)

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- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

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## Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

## UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

## Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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## Template for comments and secretariat observations

|                  |                        |
|------------------|------------------------|
| Date: xx/xx/20xx | Document: ISO/DIS xxxx |
|------------------|------------------------|

| 1  | 2                                          | (3)                          | 4               | 5                                                                                                                                  | (6)                                                                      | 7                                                  |
|----|--------------------------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| MB | Clause No./ Subclause No./Annex (e.g. 3.1) | Paragraph/Figure/ Table/Note | Type of comment | Commend (justification for change) by the MB                                                                                       | Proposed change by the MB                                                | Secretariat observations on each comment submitted |
|    | 3.1                                        | Definition 1                 | ed              | Definition is ambiguous and needs clarifying.                                                                                      | Amend to read '...so that the mains connector to which no connection...' |                                                    |
|    | 6.4                                        | Paragraph 2                  | te              | The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK. | Delete reference to UV photometer.                                       |                                                    |



|                                                           |                                                 |
|-----------------------------------------------------------|-------------------------------------------------|
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| SUPERSEDES DOCUMENTS:<br><b>121A/568/CD, 121A/576A/CC</b> |                                                 |

|                                                             |                                   |
|-------------------------------------------------------------|-----------------------------------|
| IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR        |                                   |
| SECRETARIAT:<br>France                                      | SECRETARY:<br>Mr Michaël LAHEURTE |
| OF INTEREST TO THE FOLLOWING COMMITTEES:<br>TC 44, TC 65    | HORIZONTAL FUNCTION(S):           |
| ASPECTS CONCERNED:<br>Electromagnetic Compatibility, Safety |                                   |

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Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (See [AC/22/2007](#) or [NEW GUIDANCE DOC](#)).

**TITLE:**

**Low-voltage switchgear and controlgear – Part 5-3: Control circuit devices and switching elements – Requirements for proximity devices with defined behaviour under fault conditions (PDDB)**

**NOTE FROM TC/SC OFFICERS:**

TC121 Officers support circulation of CD3 for project IEC 60947-5-3;

NC experts are kindly requested to refer their comments to line number

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 5-3: Control circuit devices and switching elements –  
Requirements for proximity devices with defined  
behaviour under fault conditions (PDDB)**

## FOREWORD

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International Standard IEC 60947-5-3 has been prepared by subcommittee SC121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This edition includes the following significant technical changes with respect to the previous edition:

- a) ...under consideration

This standard is to be read in conjunction with IEC 60947-1, *Low voltage switchgear and controlgear – Part 1: General rules* and IEC 60947-5-2, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches*. The provisions of Part 1 and Part 5-2 are only applicable to this standard where specifically called for. The numbering of the subclauses of this standard is sometimes not continuous because it is based on the numbering of the subclauses of IEC 60947-1 or IEC 60947-5-2.

The text of this standard is based on the following documents:

| FDIS | Report on voting |
|------|------------------|
| xxx  | xxx              |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60947 series, published under the general title *Low-voltage switchgear and controlgear*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

### Part 5-3: Control circuit devices and switching elements – Requirements for proximity devices with defined behaviour under fault conditions (PDDB)

#### 1 Scope

This part of IEC 60947 series provides additional requirements to those given in IEC 60947-5-2 and IEC 60947-5-1:2024 Annex D (reed contact magnetic switches). It addresses the fault performance aspects of proximity devices with a defined behaviour under fault conditions (PDDB). It does not address any other characteristics that can be required for specific applications.

This document does not apply to protective equipment to directly detect the presence of persons, that are covered by IEC 61496 series or IEC/TS 62998 series.

NOTE A PDDB device can be used to detect indirectly the presence of a person, for example by detecting the position of a platform on which the operator stands (example, garbage trucks)

This product standard does not specify requirements for the analogue output of PDDB, if any.

This product standard does not deal with any specific requirements on acoustic noise as the noise emission of proximity devices is not considered to be a relevant hazard.

A PDDB product is intended to be used as sensing subsystem of a safety related control system according to IEC 62061 or ISO 13849-1. Depending on construction principles and complexity, this standard is based on product development of IEC 61508 series in order to meet the product specific requirements of IEC 61508 series, IEC 62061 and/or ISO 13849 series.

NOTE The Functional Safety Device Type classification regarding functional safety correlates with IEC 62683-2-3 DB.

This standard includes requirements for PDDBs when designed for use as part of an interlocking devices according to ISO 14119.

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12 h cycle)*

IEC 60204-1:2016, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60529:1989+AMD1:1999+AMD2:2013 CSV, *Degrees of protection provided by enclosures (IP Code)*

IEC 60812:2018, *Failure modes and effects analysis (FMEA and FMECA)*

- 41 IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*
- 42 IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and*  
43 *switching elements – Electromechanical control circuit devices*
- 44 IEC 60947-5-2:2019, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and*  
45 *switching elements – Proximity switches*
- 46 IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement*  
47 *techniques – Electrostatic discharge immunity test*
- 48 IEC 61000-4-3:2020, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement*  
49 *techniques – Radiated, radio-frequency, electromagnetic field immunity test*
- 50 IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement*  
51 *techniques – Electrical fast transient/burst immunity test*
- 52 IEC 61000-4-5:2014+AMD1:2017 CSV, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and*  
53 *measurement techniques – Surge immunity test*
- 54 IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement*  
55 *techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
- 56 IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement*  
57 *techniques – Power frequency magnetic field immunity test*
- 58 IEC 61000-4-11:2020, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement*  
59 *techniques – Voltage dips, short interruptions and voltage variations immunity tests*
- 60 IEC 61131-2:2017, *Programmable controllers – Part 2: Equipment requirements and tests*
- 61 IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*
- 62 IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related*  
63 *systems – Part 1: General requirements*
- 64 IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related*  
65 *systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related*  
66 *systems*
- 67 IEC 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related*  
68 *systems – Part 3: Software requirements*
- 69 IEC 62061:2021, *Safety of machinery – Functional safety of safety-related electrical, electronic and*  
70 *programmable electronic control systems*
- 71 IEC 62683-2-3 DB,
- 72 ISO 13849-1:2016, *Safety of machinery – Safety-related parts of control systems – Part 1: General*  
73 *principles for design*
- 74 ISO 14119:2024, *Safety of machinery — Interlocking devices associated with guards — Principles for*  
75 *design and selection*
- 76 ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of*  
77 *uncertainty in Measurement (GUM)*
- 78 ISO/IEC Guide 99:2007, *International vocabulary of metrology – basic and general concepts and*  
79 *associated terms (VIM)*
- 80 IEC Guide 115:2021, *Application of uncertainty of measurement to conformity assessment activities in*  
81 *the electrotechnical sector*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60947-1 and IEC 60947-5-2, as well the following, apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp/ui/#>

### 3.1 General terms and definitions

#### 3.1.1

##### **PDDB proximity device with a defined behaviour**

proximity switch used as a safety-related sensing subsystem to detect the presence of an object or the position of a part

Note 1 to entry: In a safety function, the PDDB is a device and a safety related subsystem characterized according to clause 4.9 (Functional Safety Device Type)

Note 2 to entry: A PDDB is often used as interlocking device according to ISO 14119:2023, 3.1)

#### 3.1.2

##### **interlocking device**

mechanical, electrical or other type of device, the purpose of which is to prevent the operation of hazardous machine functions under specified conditions (generally as long as a guard is not closed)

Note 1 to entry: An interlocking device may be combined with a guard locking device

[SOURCE: ISO 14119:2024, 3.1]

#### 3.1.3

##### **OSSD output signal switching device**

component(s) or output terminal(s) of the PDDB connected to the machine control system which, when the PDDB detects the presence or absence of the specified target, responds by going to the OFF-state according to the defined behaviour

Note 1 to entry: The PDDB is designed with one or more redundant components per logical signal, depending on the HFT or category

[SOURCE: IEC 61496-1:2020, 3.19 modified for a PDDB]

#### 3.1.4

##### **SSD secondary switching device**

device which, in a lock-out condition goes to the OFF-state. It may be used to initiate an appropriate machine control action, for example de-energizing the machine secondary control element

Note 1 to entry: SSD is corresponding with OTE (output of test equipment) according to ISO 13849-1:2023, 6.1.3.2.4

[SOURCE: IEC 61496-1:2020, 3.24]

#### 3.1.5

##### **ON-zone**

range of switching distance where the ON-state of the OSSDs is reached

123 Note 1 to entry: Illustrated in Figure 1 and Figure 2 as area named 'State ON'

124 **3.1.6**

125 **ON-state**

126 state in which the OSSDs permit the flow of current

127 Note 1 to entry: For Interface Types A0 and B0 according to Annex B.3 and B.4, the test pulses coming from the  
128 sink pass through

129 **3.1.7**

130 **OFF-zone**

131 range of switching distance where the OFF-state of the OSSDs is reached

132 Note 1 to entry: Illustrated in Figure 1 and Figure 2 as area named 'State OFF'

133 **3.1.8**

134 **OFF-state**

135 state in which the OSSDs interrupt the flow of current

136 Note 1 to entry: In general, the OFF-state corresponds with the safe state according to IEC 61508-4:2010, 3.1.14,  
137 but it may differ according to 5.3.7

138 **3.1.9**

139 **fault response time**

140 maximum period of time during which OSSDs can deviate from the defined behaviour.

141 Note to entry: Within this time the output gets into OFF-state in case of a detected failure

142 **3.1.10**

143 **EUT Equipment under Test**

144 representative test sample of a PDDb, usually assembled in the manufacturing line without a  
145 selection of components or any special settings or adjustments

146 Note 1 to entry: Adjustments, if any, are done according to the product documentation

147 Note 2 to entry: ISO/IEC GUIDE 98-3:2008 uses the term 'specimen' for a EUT

148 [SOURCE: IEC 60947-1:2020, 9.3.2.1 Paragraph 1]

149 **3.1.11**

150 **modified EUT**

151 test sample, modified to test the behaviour of a EUT at the limit of the specified  
152 characteristics of its components and assembly

153 Note 1 to entry: Normally, components are selected, or configurations adjusted at the limit of its specified  
154 operating range

155 EXAMPLE Adjustment of an amplifier to the specified minimum or maximum gain

156 **3.1.12**

157 **test-lot**

158 a group of EUTs, used for verification tests. A test-lot number or identifier is used for unique  
159 identification

160 **3.1.13**

161 **technical documentation**

162 documentation that enables the conformity of the product with the requirements of the  
163 standard(s) to be assessed

164 Note 1 to entry: Technical documentation is intended for use upon request from authorities

165 [SOURCE: IEC 60050 IEV ref 426-27-06, modified, note 1 and 2 deleted]

166 **3.1.14**

167 **quantity (measurable)**

168 attribute of a phenomenon or body that may be distinguished qualitatively and determined  
169 quantitatively

170 Note 1 to entry: The measurable quantity is a value measured (ISO/IEC Guide 98-3:2008, B.2.2), of a measurand  
171 (B.2.9), expressed with a measurement result (B.2.11), accompanied by a statement of the uncertainty (B.2.18)

172 EXAMPLE Quantities in a general sense: length, time, mass, temperature, electrical resistance

173 [SOURCE: ISO/IEC Guide 98-3:2008, B.2.1 and 3.1.1]

174 **3.1.15**

175 **quantity (Influence Quantity)**

176 quantity that is not the measurand but that affects the result of the measurement

177 EXAMPLE Influence of the ambient temperature to the output voltage

178 Note 1 to entry: The term 'influence quantity' is used in ISO/IEC GUIDE 98-3:2008 and as 'Input quantity' in  
179 IEC 60947-1:2020. It is used in the meaning of physical input quantities as temperature and supply voltage and  
180 others, which may have an impact to the behaviour and the measurement result.  
181 IEC 60947-1:2020, 9.3.2 General test conditions IEC 60947-1:2020, 9.3.2.2 Test quantities

182 [SOURCE: ISO/IEC Guide 98-3:2008, B.2.10, 3.1.5, 4.1.3]

183 **3.1.16**

184 **set of influence quantity**

185 A grouped set of quantities, each specified with a range or a specific value

186 EXAMPLE 1 Ambient temperature:  $20 \pm 2$  °C, humidity  $50 \pm 5$  %, Supply Voltage DC  $29 \pm 0.2$  V, Load Current DC 1.0  
187 A  $\pm 0.05$ A

188 EXAMPLE 2 Ambient Temperature: 0 - 80 °C, humidity 40 - 90 %, Supply Voltage DC 19.2 - 28.8 ( $\pm 0.1$ ) V,  
189 Load Current DC 0.0 - 1.0 ( $\pm 0.05$ )

190 Note 1 to entry: Value or range of temperature, humidity, supply voltage, load current, operating condition, etc

191 [SOURCE: ISO/IEC Guide 98-3:2008, 4.1.3]

192

193 **3.2 Terms and definitions concerning Annex B**

194 **3.2.1**

195 **information source**

196 device transmitting information to the information sink

197 Note 1 to entry: Typically, the information source is the PDDb and the information sink is the control system which  
198 processes the OSSD data from the PDDb

199 **3.2.2**

200 **information sink**

201 device receiving information from the information source

202 The information sink (hereafter referred to as sink) is receiving information from the information  
203 source. The sink input is connected to the output of the source. A sink can meet requirements  
204 of several interface types at the same time

205 Note 1 to entry: The input of the information sink is connected to the output of the information source

206 Note 2 to entry: An information sink can meet requirements of several interface types at the same time

207 EXAMPLE The information sink could be a control system, which is receiving the signal information. The term refers  
208 to the analysis of the information and not to the analysis of the test pulses. Analysis of test pulses can be located in  
209 different parts of the system, depending on the interface type

### 210 3.2.3

#### 211 Interface type

212 standardized interface for information sources and information sinks

213 Note 1 to entry: Generation and analysis of test pulses is specified per interface type

### 214 3.2.4

#### 215 Interface class

216 group of information sources and information sinks with compatible technical data within an  
217 interface type

218 EXAMPLE interface type C is divided in interface classes C0 to C3 according to different test pulse lengths in use

### 219 3.2.5

#### 220 test pulse generator

221 part of the system that generates test pulses used for system diagnosis

### 222 3.2.6

#### 223 Test pulse evaluator

224 part of the system that evaluates test pulses for system diagnosis

### 225 3.2.7

#### 226 supply voltage

227 voltage with which a device is continuously supplied

### 228 3.2.8

#### 229 test pulse

230 temporary change of a signal voltage level to the low state, used to verify the proper operation  
231 of the output or device or the transmission path

### 232 3.2.9

#### 233 test pulse duration $t_i$

234 time from the start of the test pulse until the end of the test pulse

235 EXAMPLE Time from falling edge of the test pulse until the rising edge of the test pulse

### 236 3.2.10

#### 237 test pulse interval T

238 time between the start of a test pulse and the start of the subsequent test pulse on the same  
239 output

### 240 3.2.11

#### 241 test pulse delay $\Delta t_i$

242 delay introduced by the information source, between the test pulse on the input and the test  
243 pulse on the output of the information source

244 Note 1 to entry: This parameter describes the behaviour of information sources of interface type B, forwarding a test  
245 pulse on the input to the output of the device

### 246 3.2.12

#### 247 discrepancy time $\Delta t_{dis}$

248 temporal shift of the rising edge or falling edge between output signals of different channels

249 Note 1 to entry: This parameter describes the simultaneity of the signals at interface type C

**3.2.13****test pulse phase shift  $\Delta t_c$** 

time shift of test pulses between different output channels

Note 1 to entry: This parameter describes the time shift of test pulses between two output channels of interface type C

**3.2.14****output current  $I_n$** 

nominal ON state current of an output

**3.2.15****leakage current  $I_r$** 

remaining current of an output of an information source (PDDb) in the OFF-state

Note 1 to entry: In IEC 60947series, the term 'OFF-state current' is used for leakage current (see clause 8.2.1.10). The term 'residual current' is also often used in this context

**3.2.16****capacitive load  $C_L$** 

capacitive part of the load impedance

**3.2.17****inductive load  $L_L$** 

inductive part of the load impedance

**3.3 Symbols and abbreviations****Table 1 – Symbols and abbreviations**

| Symbol or abbreviation         | Description                                                                                       | Definition                  |
|--------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------|
| DC                             | diagnostic coverage                                                                               | ISO 13849-1:2023, 3.1.35    |
| EUT                            | Equipment under Test                                                                              | 3.1.10                      |
| EE Class                       | Electrical Equipment Class                                                                        | 4.8                         |
| FIT                            | failures in time, number of failures in total $10^9$ hours of operation of one or more components | IEC 62061:2021, 7.4.3.2     |
| HFT                            | hardware fault tolerance                                                                          | IEC 61508-2:2010, 7.4.4.1.1 |
| MTTF <sub>D</sub>              | mean time to dangerous failure                                                                    | ISO 13849-1:2015 3.1.25     |
| OSSD                           | output signal switching device                                                                    | 3.1.3                       |
| OTE                            | output of test                                                                                    | 3.1.4                       |
| PDDb                           | Proximity device with a defined behaviour                                                         | 3.1.1                       |
| PFH <sub>D</sub> <sup>a)</sup> | average frequency of a dangerous failure over a given period of time                              | IEC 61508-4:2010, 3.6.19    |
| PFD                            | probability of dangerous failure on demand                                                        | IEC 61508-4:2010, 3.6.17    |
| PL                             | performance level                                                                                 | ISO 13849-1:2015, 3.1.23    |
| $S_{As}$ <sup>b)</sup>         | absent switching distance, safety related, in operating mode TP and TP&TA                         | 5.2                         |
| $S_{Ai}$                       | true or measured absent switching position of a PDDb                                              | 5.2.1                       |
| $S_{Ps}$ <sup>b)</sup>         | present switching distance, safety related, in operating mode TA and TP&TA                        | 5.2                         |
| $S_{Pi}$                       | true or measured present switching position of a PDDb                                             | 5.2.1                       |

| Symbol or abbreviation | Description                                                          | Definition               |
|------------------------|----------------------------------------------------------------------|--------------------------|
| SDT                    | switching distance test (A, B and C)                                 | 9.4.2                    |
| SFF                    | safe failure fraction                                                | IEC 61508-4:2010, 3.6.15 |
| SIL                    | safety integrity level                                               | IEC 61508-4:2010, 3.5.8  |
| SRP/CS                 | safety-related part of a control system                              | ISO 13849-1:2023, 3.1.1  |
| TP                     | Target Present Operating Mode                                        | 4.12.2                   |
| TA                     | Target Absent Operating Mode                                         | 4.12.3                   |
| $T_M$                  | mission time                                                         | ISO 13849-1:2015, 3.1.28 |
| TG                     | test pulse generator                                                 | 3.2.5                    |
| TE                     | test pulse evaluator                                                 | 3.2.6                    |
| $t_i$                  | test pulse duration                                                  | 3.2.9                    |
| T                      | test pulse interval                                                  | 3.2.10                   |
| $\Delta t_i$           | test pulse delay                                                     | 3.2.11                   |
| $\Delta t_{dis}$       | discrepancy time                                                     | 3.2.12                   |
| $\Delta t_c$           | test pulse phase shift                                               | 3.2.13                   |
| $I_n$                  | output current                                                       | 3.2.14                   |
| $I_r$                  | leakage Off-state current                                            | 3.2.15 and 8.2.1.10      |
| $C_L$                  | capacitive Load                                                      | 3.2.16                   |
| $L_L$                  | inductive load                                                       | 3.2.17                   |
| a                      | Index 'D' is often used to indicate 'dangerous' fault or probability |                          |
| b                      | safety related variable is marked with an index 's'                  |                          |

## 4 Classification

### 4.1 General

PDDb devices vary in terms of technology, operating mode, safety level, application, and availability.

Clause 4.1 of IEC 60947-5-2:2019 applies, if relevant.

### 4.2 Classification according to sensing means

Clause 4.2 of IEC 60947-5-2:2019 applies, if relevant.

The designated capital letter can be omitted, when the applied sensing mean is not listed in IEC 60947-5-2:2019 Table 1, Column 1 (Sensing Means).

### 4.3 Classification according to the mechanical installation

Clause 4.3 of IEC 60947-5-2:2019 applies, if relevant.

### 4.4 Classification according to the construction form and size

Clause 4.4 of IEC 60947-5-2:2019 applies, if relevant.

## 4.5 void

## 4.6 Classification according to type of output

### 4.6.1 General

Clause 4.6 of IEC 60947-5-2:2019 applies, if relevant.

NOTE For functional safety devices often the term 'device type' is being used.

### 4.6.2 Interface Type

When the OSSDs are intended for use with digital inputs according to IEC 60947-1:2021, S.3.2.2, an interface type is defined according to Table 2.

**Table 2 – Interface types of PDDBs**

| Interface Type <sup>a)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                   | Designation       | Description                                                                            | Clause                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------|-----------------------|
| A0                                                                                                                                                                                                                                                                                                                                                                                                                                             | Interface Type A0 | Test pulse generated from the control unit (sink), without any delay of the test pulse | B.3 <sup>b),d)</sup>  |
| B0                                                                                                                                                                                                                                                                                                                                                                                                                                             | Interface Type B0 | Test pulses generated from the control unit (sink). Test pulse may be delayed.         | B.4 <sup>c), d)</sup> |
| C0                                                                                                                                                                                                                                                                                                                                                                                                                                             | Interface Type C0 | Test pulse generated from the PDDB (source), any test pulse duration                   | B.5                   |
| C1                                                                                                                                                                                                                                                                                                                                                                                                                                             | Interface Type C1 | Test pulse generated from the PDDB (source), maximum test pulse duration = 1000 µs     | B.5                   |
| C2                                                                                                                                                                                                                                                                                                                                                                                                                                             | Interface Type C2 | Test pulse generated from the PDDB (source), maximum test pulse duration = 500 µs      | B.5                   |
| C3                                                                                                                                                                                                                                                                                                                                                                                                                                             | Interface Type C3 | Test pulse generated from the PDDB (source), maximum test pulse duration = 100 µs      | B.5                   |
| <sup>a</sup> Interface types according to Annex B<br><sup>b</sup> Interface Type A0 interrupts in the OFF-state the flow of the current and the transmission of the test pulses from the sink through the PDDB according to B.3.<br><sup>c</sup> Interface Type B0 interrupts in the OFF-state the flow of the current and the transmission of the test pulses from the sink according to B.4.<br><sup>d</sup> Alternate safe state, see 5.3.7 |                   |                                                                                        |                       |

The identifying key according to B.2.3 is defined for interface types A0, B0, C0, C1, C2 and C3.

NOTE Annex B defines the characteristics and aspects of the interface types.

## 4.7 Classification according to method of connection

Clause 4.7 of IEC 60947-5-2:2019 applies, if relevant.

## 4.8 Electrical Equipment Class

### 4.8.1 General

Protection against electrical shock is achieved by provisions of IEC 61140:2016 for devices, assigned for a class of electrical equipment according to the following subclauses.

#### 4.8.2 Electrical Equipment Class I

Electrical Equipment Class I devices are equipped with provisions for basic protection and a connection to a protective conductor according to IEC 61140:2016.

SOURCE IEC 61140:2016, 7.3 and table 3

#### 4.8.3 Electrical Equipment Class II

Electrical Equipment Class II devices are equipped with provisions for basic protection and supplementary insulation as provision for fault protection or by reinforced insulation according to IEC 61140:2016.

SOURCE IEC 61140:2016, 7.4 and table 3

#### 4.8.4 Electrical Equipment Class III

Devices of Electrical Equipment Class III are connected only to SELV or PELV systems.

SOURCE IEC 61140:2016, 7.5 and table 3, IEC 60204-1:2016, 6.4.1 and IEC 60947-1:2020, Annex N

### 4.9 Functional Safety Device Types

#### 4.9.1 General

The functional safety device types define the functional safety characteristic values, used for information exchange for the user. The manufacturer of the PDDB specifies the type classification.

NOTE 1 For functional safety devices often the term 'device type' is being used.

NOTE 2 The Functional safety device type corresponds with the device type according to ISO 13849-1:2022 ANNEX O, IEC 62683 DB and IEC 62683-2-3 DB

NOTE 3 Characteristic safety values for each Functional safety device type are given in clause 5.5.2

#### 4.9.2 Functional safety device type 1

A Functional safety device type 1 has the highest integration level. Pre-designed safety systems with integrated diagnostics are typical. This type is SIL or PL-classified in line with the intended use.

EXAMPLE A PDDB with two channels where an analog-digital converter is transforming a sensor signal and two microcontrollers with software is evaluating the value of the signal and generating the OSSD signal. Diagnosis is included within the microcontroller functionality.

#### 4.9.3 Functional safety device type 2

Additional application data as circuit structure, diagnostic coverage (DC) and consideration of common cause failure (CCF) are needed in order for the user to assess a safety function.

EXAMPLE A PDDB containing mainly two elements, a photoelement senses the transmitted light of a source in the defined target and an electronic transistor switches the OSSD when the light intensity is high when the target is close to the switch.

#### 4.9.4 Functional safety device type 3

Functional safety device type 3 are devices with a failure mode, which depends on the operating cycles.

EXAMPLE Pddb with electromechanical components that are subject to wear, e.g. reed contacts

### 4.10 Interlocking Device Type

#### 4.10.1 General

If a Pddb is intended for use as an interlocking device according to ISO 14119:2024, the interlocking type and target code is defined according to the subclauses 4.10.2, 4.10.3, and 4.11.

NOTE 1 ISO 14119 uses the term actuator for the specified target according to IEC 60947-5-3.

NOTE 2 IEC 60947-1:2020, 3.5.17 uses the term actuator as the part which actuates the contacts

#### 4.10.2 Interlocking Device Type 3

Non-mechanically actuated Pddb which is actuated by an uncoded target.

EXAMPLE Inductive, magnetic, capacitive, ultrasonic or optic proximity switch

SOURCE ISO 14119:2024, 3.17, modified for a Pddb

#### 4.10.3 Interlocking Device Type 4

Non-mechanically actuated Pddb which is actuated by a coded target.

EXAMPLE Inductive, magnetic, capacitive, ultrasonic or optic proximity switch

Non-contact actuated Pddb (e.g. inductive, magnetic, capacitive, ultrasonic or optic proximity switch) which is actuated by a coded actuator.

SOURCE ISO 14119:2024, 3.18, modified for a Pddb

The coding level of the target is defined to low, medium or high according to 4.11.2, 4.11.3 or 4.11.4.

### 4.11 Target Coding

#### 4.11.1 General

When specified targets with coding levels are defined product documentation, the coding levels is stated in the user documentation according to this clause.

SOURCE ISO 14119:2024, 3.12

#### 4.11.2 Coding Level low

The target is designed as coded actuator according to ISO 14119:2024, 3.12.1 for which 1 to 9 variations in code are available and the different codes are evaluated by the Pddb.

#### 4.11.3 Coding Level medium

The target is designed as coded actuator according to ISO 14119:2024, 3.12.2 for which 10 to 1000 variations in code are available and the different codes are evaluated by the Pddb.

#### 4.11.4 Coding Level high

The target is designed as coded actuator according to ISO 14119:2024, 3.12.2 for which more than 1000 variations in code are available and the different codes are evaluated by the Pddb.

### 4.12 Operating Mode

#### 4.12.1 General

The Pddb is defined with an operating mode TP, TA or both.

**Table 3 – Operating Modes of Pddbs**

| Operating Mode                                                    | TP <sup>a)</sup> | TA <sup>b)</sup> |
|-------------------------------------------------------------------|------------------|------------------|
| OSSD state when Target is present to the switch                   | ON               | OFF              |
| OSSD state when Target is absent from the switch                  | OFF              | ON               |
| safety related switching distances                                | $s_{As}$         | $s_{Ps}$         |
| Reference                                                         | 4.12.2, Figure 1 | 4.12.3, Figure 2 |
| <sup>a</sup> TP: Target Present<br><sup>b</sup> TA: Target Absent |                  |                  |

#### 4.12.2 Operating Mode TP (Target Present)

The OSSDs are in the ON-state when the target is present to the switch ( $s < s_P$ ).

The OSSDs are getting in the OFF-state, when the target is absent from the switch ( $s > s_{As}$ ) according to Figure 1.

#### 4.12.3 Operating Mode TA (Target Absent)

The OSSDs are in the ON-state when the target is absent from the switch ( $s > s_A$ ).

The OSSDs are getting in the OFF-state, when the target is present to the switch ( $s < s_{Ps}$ ) according to Figure 2.

#### 4.12.4 Combined operating Mode TP&TA

The OSSDs are in the ON-state when the target is between the distance  $s_P$  and  $s_A$ .

The OSSDs are getting in the OFF-state, when the target is absent from the switch (Figure 1,  $s > s_{As}$ ) and when it is close to the switch (Figure 2,  $s < s_{Ps}$ ).

## 5 Characteristics

### 5.1 General

NOTE Clause 5 in this standard deviate from the Clause 5 of IEC 60947-5-2:2019.

The characteristics of a Pddb are stated according to the following subclauses of clause 5.

### 5.1.1 Safety function

The PDDB is a subsystem of a of a safety function, where the OSSDs are initiated by the presence or absence (or both) of the specified target. The state of the outputs depends on the operating mode and the position of the target to the sensing face of the switch. The state is defined according to Table 3 and clause 5.2.

NOTE See input subsystem of Figure 5 of ISO 13849-1:2022

## 5.2 Safety related switching distances

### 5.2.1 General

Figure 1 and Figure 2 are showing the zones and the limits, where the OSSDs has changed its state, when the target is moved from the OFF-zone to the ON-zone or vice versa. The OSSDs are changing its state at any position in the transition zone.  $s_A$ ,  $s_{As}$  and  $s_P$ ,  $s_{Ps}$  are defining the limits, where the state has been changed at latest.

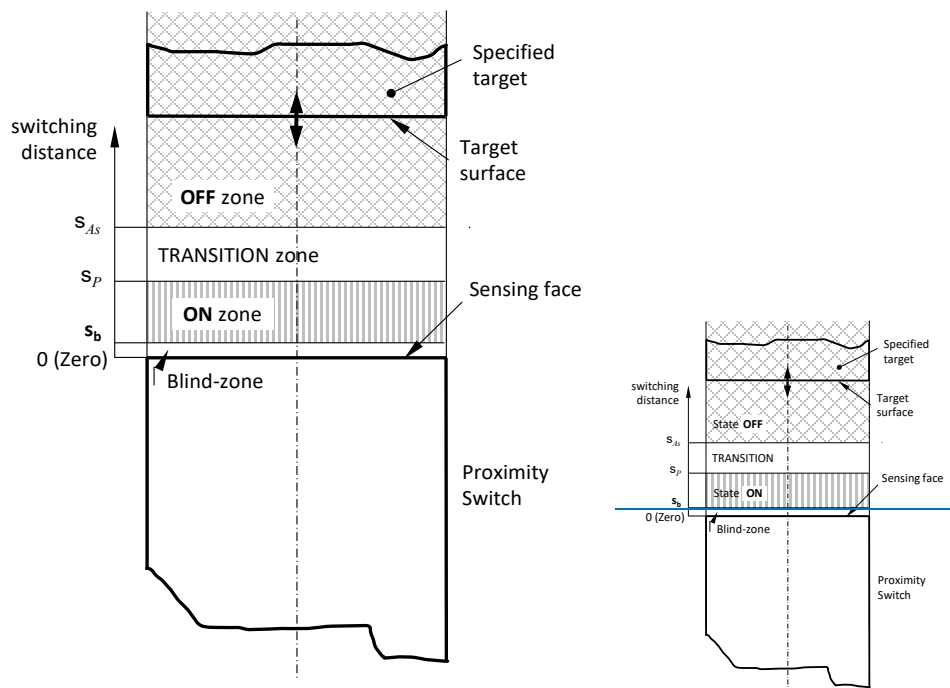
The switching distances may be defined as safety related or not, according to the operating mode (4.12). Safety related switching distances are marked with an index 's'. When the target (surface) is in the OFF-zone, the OSSD state is OFF and, in the ON-zone, the state is ON.

where  $s_{As}$  is the safety related switching distance in operating mode TP and TP&TA (Figure 1)  
 $s_{Ai}$  is a true or measured absent switching distance of a PDDB, located in the transition zone  
 $s_{Ps}$  is the safety related switching distance in operating mode TA and TP&TA (Figure 2)  
 $s_{Pi}$  is a true or measured present switching distance or measured position of a PDDB, located in the transition zone  
 Index A indicates the "absent" position  
 Index P indicates the "present" position

### 5.2.2 Switching distance $s_{As}$

The switching distance  $s_{As}$  is the distance of the target to the switch, where in operating mode TP and TP&TA the OSSDs have changed its state at latest, when the target is moved away from the switch. The switching distance  $s_{As}$  is safety related and is marked with an index 's'.

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426 **Figure 1 – Safety related switching distance  $s_{As}$  and switching distance  $s_p$**   
 427 **for a PDDb with Operating Mode TP (Target Present)**

428 NOTE 1 distance  $s_A$  or  $s_{As}$  to be distinguished from  $s_a$  according to IEC 60947-5-2:2019, 3.3.1.7

429 NOTE 2 distance  $s_p$  correspondent with  $s_{u min}$  of IEC 60947-5-2:2019

430 NOTE 3 In the blind-zone (switching distances between 0 (Zero) to  $s < s_p$ ), if specified with  $s_b$ , the state of the  
 431 OSSD is undefined.