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Date: 05 May 2022

Origin: International

Latest date for receipt of comments: 8 June 2022

Project No. 2022/00729

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

Interested committees:

Title: BS EN 60947-5-3 Ed. 3.0 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)

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

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

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Responsible Committee Secretary: **Mr Simon Bounds (BSI)**Direct tel: **0208 996 7281**E-mail: simon.bounds@bsigroup.com

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 Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.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

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Comment (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.	



121A/494/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 60947-5-3 ED3

DATE OF CIRCULATION:

2022-04-15

CLOSING DATE FOR COMMENTS:

2022-07-08

SUPERSEDES DOCUMENTS:

121A/484/RR

IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR

SECRETARIAT:

France

SECRETARY:

Mr Michaël LAHEURTE

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 44, TC 65, ISO/TC 99

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☒ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

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.

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:

Secretary Note1: NC experts are kindly requested to refer their comments to line numbers.

Secretary Note2: this document integrates blue text either for additional information, comments from the group or for highlighting the need for NCs to provide inputs on a specific item or subclause.

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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.

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

FDIS	Report on voting
xxx	xxx

241
242 Full information on the voting for the approval of this standard can be found in the report on
243 voting indicated in the above table.

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

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

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

- 250 • reconfirmed,
- 251 • withdrawn,
- 252 • replaced by a revised edition, or
- 253 • amended.

254

255

256

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. 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 detect the presence of persons, that are covered by IEC 61496 series or IEC/TS 62998 series.

This product standard does not cover proximity devices with analogue output.

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.

For a PDDB used in applications where additional characteristics, dealt with in other standards, are required, the requirements of all relevant standards apply.

Editor Comment:

Remark regarding the following option1 and option2:

Replies to Questionnaire to National Committees 121A(secretary)/12757/RQ 2021-08-23:

Option 1 is the preferred solution for the future edition of IEC 60947-5-3.

TC44 and other technical committees are invited to submit CD1 comments on the topic scope (option1 and option2).

(option1)

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, a safety related proximity switch is designed and evaluated according to IEC 62061, or ISO 13849-1, or IEC 61508 series. This document provides product specific requirements for the relevant application of IEC 62061, ISO 13849-1, and IEC 61508 to PDDB products.

(option2)

~~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 in order to meet the product specific requirements of IEC 62061 and/or ISO 13849.~~

The use of this product standard alone does not demonstrate suitability for the implementation of any specific safety related functionality. In particular, this product standard does not provide requirements for the actuation characteristics of a PDDB, or for means to reduce the effects of mutual interference between devices, e.g., coded targets. Therefore, these and any other

297 application-specific requirements will need to be considered in addition to the requirements of
298 this product standard.

299 NOTE 1 Due to their behaviour under fault conditions, PDDBs can, for example, be used as interlocking devices
300 (see ISO 14119).

301 NOTE 2 This document does not include combined separated proximity switches put on the market as one product

302 **2 Normative references** (revision is needed)

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

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

308 IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic*
309 *(12 + 12 h cycle)*

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

312 IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*

313 IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit*
314 *devices and switching elements – Electromechanical control circuit devices*

315 IEC 60947-5-2:2019, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit*
316 *devices and switching elements – Proximity switches*

317 IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and*
318 *measurement techniques – Electrostatic discharge immunity test*

319 IEC 61000-4-3:2020, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and*
320 *measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

321 IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and*
322 *measurement techniques – Electrical fast transient/burst immunity test*

323 IEC 61000-4-5:2014+AMD1:2017 CSV, *Electromagnetic compatibility (EMC) – Part 4-5:*
324 *Testing and measurement techniques – Surge immunity test*

325 IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and*
326 *measurement techniques – Immunity to conducted disturbances, induced by radio-frequency*
327 *fields*

328 IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and*
329 *measurement techniques – Power frequency magnetic field immunity test*

330 IEC 61000-4-11:2020, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and*
331 *measurement techniques – Voltage dips, short interruptions and voltage variations immunity*
332 *tests*

333 IEC 61131-2:2017, *Programmable controllers – Part 2: Equipment requirements and tests*

334 IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-*
335 *related systems – Part 1: General requirements*

336 IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-*
337 *related systems – Part 2: Requirements for electrical/electronic/programmable electronic*
338 *safety-related systems*

339 IEC 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-*
340 *related systems – Part 3: Software requirements*

341 IEC 62061:2021, *Safety of machinery – Functional safety of safety-related electrical, electronic*
342 *and programmable electronic control systems*

343 ISO 13849-1:2016, *Safety of machinery – Safety-related parts of control systems – Part 1:*
344 *General principles for design*

345 **3 Terms and definitions**

346 For the purposes of this document, the terms and definitions given in IEC 60947-1 and IEC
347 60947-5-2, as well the following, apply.

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

- 350 • IEC Electropedia: available at <http://www.electropedia.org/>
- 351 • ISO Online browsing platform: available at <http://www.iso.org/obp>

352 **3.1 Definitions**

353 **3.1.1**

354 **Performance Level**

355 **PL**

356 discrete level (from a to e) used to specify the ability of safety-related parts of control systems
357 to perform a safety function under foreseeable conditions

358 [SOURCE: ISO 13849-1:2006, 3.1.23, modified – update of the definition]

359 **3.1.2**

360 **Safety Integrity Level**

361 **SIL**

362 discrete level (one out of a possible three), corresponding to a range of safety integrity values,
363 where safety integrity level 3 has the highest level of safety integrity and safety integrity level 1
364 has the lowest

365 NOTE 1 Safety integrity levels are used for specifying the safety integrity requirements of the safety functions to be
366 allocated to the E/E/PE safety-related systems.

367 NOTE 2 to entry: SIL 4 is not considered in this standard. For requirements applicable to SIL 4, see IEC 61508
368 series.

369 [SOURCE: IEC 61508-4:2010, 3.5.8, modified – update of the note 2]

370 **3.1.3**

371 **low complexity component**

372 component in which:

- 373 – the failure modes are well-defined; and
- 374 – the behaviour under fault conditions can be completely defined

375 NOTE 1 to entry: Behaviour of the low complexity component under fault conditions may be determined by analytical
376 and/or test methods.

377 NOTE 2 to entry: A subsystem or subsystem element comprising one or more limit switches, operating, possibly via
378 interposing electro-mechanical relays, one or more contactors to de-energise an electric motor is an example of a
379 low complexity component.

380 [SOURCE: IEC 62061:2005, 3.2.7]

381 **3.1.4**
382 **complex component**
383 component in which:

- 384 – the failure modes are not well-defined; or
- 385 – the behaviour under fault conditions cannot be completely defined

386 [SOURCE: IEC 62061:2005, 3.2.8]

387 **3.1.5**
388 **failure**
389 the termination of the ability of an item to perform a required function

390 NOTE 1 to entry: After failure the system has a fault.

391 NOTE 2 to entry: "Failure" is an event, as distinguished from "fault", which is a state.

392 NOTE 3 to entry: The concept of failure as defined does not apply to items consisting of software only.

393 [SOURCE: IEC 60050-191:1990, 191-04-01]

394 **3.1.6**
395 **dangerous failure**
396 failure of a Pddb that has the potential to cause a hazard or non-functional state

397 [SOURCE: IEC 62061:2005, 3.2.40, modified – deletion of the notes]

398 **3.1.7**
399 **safe failure**
400 failure of a Pddb that does not have the potential to cause a hazard

401 [SOURCE: IEC 62061:2005, 3.2.41 modified – update of the definition]

402 **3.1.8**
403 **fault**
404 state of an item characterized by inability to perform a required function, excluding the inability
405 during preventive maintenance or other planned actions, or due to lack of external resources

406 NOTE 1 to entry: A fault is often the result of the item itself but can exist without prior failure.

407 NOTE 2 to entry: In English the term "fault" and its definition are identical to those given in IEC 60050-191:1990,
408 191-05-01. In the field of machinery, the French term "défaut" and the German term "Fehler" are used rather than
409 the term "panne" and "Fehlzustand" that appear with this definition.

410 [SOURCE: IEC 62061:2005, 3.2.30, modified – new definition and new notes]

3.1.9**Assured Function**

Proper operational function according to the defined behaviour.

NOTE 1 Comment: Commonly the term “assured” and “safety” is used in German language with the one term “Sicherheit”.

The following significance applies:

- “safety related” (German “sicherheitsgerichtet”) in the meaning of functional safety.

Example: The device achieves the safe state in case of an error.

- “assured” (German: “zugesichert”) in the meaning of proper operational function.

Example: The device is achieving the ON state when the target is present. The operational function is assured.

3.1.10**Safety-Related Control Function****SRCF**

control function with a specified integrity level, partly or completely implemented by a PDDb, that is intended to achieve or maintain the safe condition of the equipment under control or prevent an immediate increase of the risk(s)

NOTE 1 to entry: ISO 13849-1 uses the term SRF (safety related function), IEC 61508 series uses SF (safety function), Terms and definitions concerning the integrity.

See 3.1.9 NOTE 1

[SOURCE: IEC 62061:2005, 3.2.16 modified – new definition and new note]

3.1.11**safety integrity**

probability of a safety related control system or its PDDb satisfactorily performing the required safety-related control functions under all stated conditions

[SOURCE: IEC 62061:2005, 3.2.19, modified – update of the definition and deletion of the notes]

3.1.12**hardware safety integrity**

part of the safety integrity of a safety related control system or its PDDb comprising requirements for both the probability of dangerous random hardware failures and architectural constraints

[SOURCE: IEC 62061:2005, 3.2.20, modified – update of the definition]

3.1.13**software safety integrity**

part of the safety integrity of a PDDb relating to systematic failures in a dangerous mode of failure that are attributable to software

NOTE 1 to entry: Software safety integrity cannot usually be quantified precisely.

[SOURCE: IEC 61508-4:2010, 3.5.5, modified – update of the definition and addition of a note]

3.1.14**systematic safety integrity**

part of the safety integrity of a PDDb relating to systematic failures in a dangerous mode of failure

NOTE 1 to entry: Systematic safety integrity cannot usually be quantified (as distinct from hardware safety integrity which usually can).

NOTE 2 to entry: Requirements for systematic safety integrity apply to both hardware and software aspects of a Pddb.

[SOURCE: IEC 61508-4:2010, 3.5.6 modified – update of the definition and addition of a note]

3.1.15

mode of operation

way in which a safety function operates, which may be either:

- **low demand mode:** where the safety function is only performed on demand, in order to transfer the EUC into a specified safe state, and where the frequency of demands is no greater than one per year; or

NOTE 1 to entry: The E/E/PE safety-related system that performs the safety function normally has no influence on the EUC or EUC control system until a demand arises. However, if the E/E/PE safety-related system fails in such a way that it is unable to carry out the safety function then it may cause the EUC to move to a safe state.

- **high demand mode:** where the safety function is only performed on demand, in order to transfer the EUC into a specified safe state, and where the frequency of demands is greater than one per year; or

- **continuous mode:** where the safety function retains the EUC in a safe state as part of normal operation

[SOURCE: IEC 61508-4:2010, 3.5.16, modified – update of the note]

3.1.16

target failure measure

intended probability of dangerous mode failures to be achieved in respect of the safety integrity requirements, specified in terms of either:

- the average probability of dangerous failure to perform the design function on demand PFD_{avg} (for a low demand mode of operation);
- the average frequency of a dangerous failure over a given period of time PFH_D (for a high demand or continuous mode of operation)

NOTE 1 to entry: The term “probability of dangerous failure per hour” is not used in the standard but the abbreviation PFH has been retained but when it is used it means “average frequency of dangerous failure”.

NOTE 2 to entry: The numerical values for the target failure measures are given in Table 2 and Table 3 of IEC 61508-1:2010. These limit values are valid for the whole safety related function.

[SOURCE: Adapted from IEC 61508-4:2010, 3.5.17]

3.1.17

mean time to dangerous failure

MTTF_D

expectation of the mean time to dangerous failure

NOTE 1 to entry: Adapted from IEC 62061:2005, definition 3.2.34.

[SOURCE: ISO 13849-1:2006, 3.1.25]

3.1.18

failure in time

FIT

the number of failures in 10^9 device-hours of operation

3.2 Terms and definitions concerning the architectural constraints

3.2.1

safe failure fraction

SFF

ratio of the average failure rates of safe failures plus dangerous detected failures of the PDDb to the total average failure rate (sum of safe failure rate and all dangerous failure rate) of the PDDb

[SOURCE: Adapted from IEC 61508-4:2010, 3.6.15]

3.2.2

diagnostic coverage

DC

measure of the effectiveness of diagnostics, which may be determined as the ratio between the failure rate of detected dangerous failures and the failure rate of total dangerous failures

[SOURCE: ISO 13849-1:2006, 3.1.26, modified – deletion of the notes]

fraction of dangerous failures detected by automatic on-line diagnostic tests

NOTE 1 to entry: The fraction of detected dangerous failures is computed to be the rate of dangerous failures that are detected by automatic on-line diagnostic tests divided by the rate of total dangerous failures.

NOTE 2 to entry: There is a different approach between the IEC 62061/IEC 61508 and ISO 13849-1 failure concepts. Prescriptions for architectural constraints on subsystems according to IEC 62061:2005 (Table 5) are given as a function of the hardware fault tolerance and the safe failure fraction. ISO 13849-1 does not consider any safe failure/safe failure fraction. Performance levels are based on well-defined architectures. The achieved PL is then a function of the architecture, the $MTTF_d$, the diagnostic coverage and the common cause failures.

[SOURCE: IEC 62061:2005, 3.2.38, modified – update of the notes]

3.2.3

hardware fault tolerance

HFT

ability of a system to perform its safety function in the presence of faults

NOTE 1 to entry: Hardware fault tolerance of N means that N+1 faults could cause a loss of the safety function. In determining the hardware fault tolerance no consideration is given to other faults, for example in diagnostics.

[SOURCE: Adapted from IEC 61508-2:2010, 7.4.4.1.1]

3.2.4

diagnostic test interval

interval between on-line tests to detect faults in a safety-related system that has a specified diagnostic coverage

[SOURCE: IEC 61508-4:2010, 3.8.7]

3.2.5

proof test

periodic test performed to detect failures in a safety-related system so that, if necessary, the system can be restored to an “as new” condition or as close as practical to this condition

[SOURCE: IEC 61508-4:2010, 3.8.5, modified – update of the definition and deletion of the notes]

3.2.6**safety-related system**

designated system that both

- implements the required safety functions necessary to achieve or maintain a safe state for the Equipment Under Control; and
- is intended to achieve, on its own or with other E/E/PE safety-related systems, other technology safety-related systems or external risk reduction facilities, the necessary safety integrity for the required safety functions

[SOURCE: IEC 61508-4:2010, 3.4.1, modified – deletion of the notes]

3.2.7**equipment under control****EUC**

equipment, machinery, apparatus or plant used for manufacturing, process, transportation, medical or other activities

NOTE 1 to entry: The EUC control system is separate and distinct from the EUC.

[SOURCE: IEC 61508-4:2010, 3.2.1]

3.3 Terms and definitions concerning the parts of a PDDB**3.3.1****sensing means**

part of the PDDB which detects the presence or absence of a defined target

3.3.2**output signal switching device****OSSD**

component of the PDDB which goes to the OFF-state according to the defined behaviour

3.3.3**control and monitoring device**

device which receives and processes signals from the sensing means, provides signals to the OSSD(s) and monitors correct operation

3.4 Terms and definitions concerning the operation of a PDDB**3.4.1****defined behaviour**

changing of the OSSD(s) to the OFF-state in the defined position of the specified target and in accordance with the requirements of this standard

3.4.2**OFF-state**

state in which the output circuits interrupt the flow of current other than residual current (I_r)

3.4.3**ON-state**

state in which the output circuits permit the flow of current

3.4.4**Target Absent Safe Mode (Mode TA-SAFE)**

The outputs are in the OFF-state when the target is farther than the distance of s_{sr} from the sensing face. (See Figure 1)

3.4.5**safety related release distance S_{sr} in TA-SAFE Mode**

safety related distance from the sensing face beyond which the absence of the specified target leads to the OFF-state (Figure 1).

3.4.6**Operating distance S_o in TA-SAFE Mode**

The distance from the sensing face within which the presence of the specified target leads to the ON-state. (Figure 1)

NOTE distance s_o correspondent with $s_{u\ min}$ of IEC 60947-5-2

3.4.7**Target Present Safe Mode (Mode TP-SAFE)**

The outputs are in the OFF-state when the target is closer than the distance s_{so} from the sensing face. (Figure 2)

3.4.8**safety related operating distance S_{so} in TP-SAFE Mode**

safety related distance from the sensing face within which the presence of the specified target leads to the OFF-state. (Figure 2)

3.4.9**Release distance S_r in TP-SAFE Mode**

The distance from the sensing face beyond which the absence of the specified target leads to the ON-state. (Figure 2)

NOTE distance s_r correspondent with $s_{u\ max} + H$ of IEC 60947-5-2

3.4.10**risk time**

maximum period of time during which OSSD(s) can deviate from the defined behaviour

3.4.11**mission time**

T_M

period of time covering the intended use of a PDDb

3.4.12**lock-out state**

state in which at least one OSSD is OFF and remains in OFF-state until the fault is corrected.
The device enters the lock-out state whenever a fault is detected

3.5 Terms and definitions concerning Annex B**3.5.1****Information source (source)**

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

NOTE For example, the source could be a PDDb and the sink a control system. The term refers to the generation of the information and not to the generation of the test pulses. Generation of test pulses can be located in different parts of the system, depending on the interface type.

3.5.2**Information sink (sink)**

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

NOTE For example, the sink could be a control system. The term refers to the analysis of the information and not to the analysis of the test pulses. Analysis of test pulses can be located in different parts of the system, depending on the interface type.

3.5.3**Interface type**

The interface type is a standardised interface for transmitters of signals (sources) and receivers of signals (sinks). Generation and analysis of test pulses is specified per interface type.

3.5.4**Class**

The class is a group of sources and sinks with compatible technical data within an interface type based on the test pulses in use.

3.5.5**Test pulse generation (TG)**

Part of the system that generates test pulses used for system diagnosis.

3.5.6**Test pulse evaluation (TE)**

Part of the system that evaluates test pulses for system diagnosis.

3.5.7**Supply voltage**

Supply voltage is the voltage continuously supplied to a device.

3.5.8**Test pulse**

A test pulse is a temporary change of a signal voltage level used to verify the proper operation of the output or device or the transmission path.

3.5.9**Test pulse duration t_i**

The test pulse duration t_i is the time from the start of the test pulse (e.g. falling edge) until the end of the test pulse (e.g. rising edge).

3.5.10**Test pulse interval T**

The test pulse interval is the time between the start of a test pulse and the start of the next test pulse on the same output.

3.5.11**Test pulse delay Δt_i**

The test pulse delay Δt_i is a pulse delay introduced by the source, between the input and the output of the information source.

3.5.12**Test pulse phase shift Δt_c**

Time shift of test pulses between different test generation channels (interface type C).

3.5.13**Output current I_n**

The output current I_n is the nominal ON state current of an output.

3.5.14**Leakage current I_{Leakage}**

The leakage current I_{Leakage} is the remaining current of an output for a source (PDDb) or sink in the OFF-state.

3.5.15**Load capacitance C_L**

The load capacitance C_L is the capacitive part of the load impedance.

3.5.16**Inductive load L_L**

The load inductance L_L is the inductive part of the load impedance.

3.5.17**Discrepancy time Δt_{dis}**

Temporal shift of the rising and falling signal flanks between different output channels.
(Concurrency of the signals at interface type C).