BS EN IEC 60947-5-2:2020+A11:2022
Incorporating corrigendum January 2023

BSI Standards Publication

Low-voltage switchgear and controlgear

Part 5-2: Control circuit devices and switching elements — Proximity switches

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Full document details: BS EN IEC 60947-5-2:2020+A11:2022

National foreword

This British Standard is the UK implementation of EN IEC 60947-5-2:2020+A11:2022. It is derived from IEC 60947-5-2:2019, incorporating CENELEC amendment A11:2022.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A11 is indicated by [A11] 〈A11〉.

The UK participation in its preparation was entrusted to Technical Committee PEL/121/1, Low voltage switchgear and controlgear.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Amendments/corrigenda issued since publication

Date	Text affected
31 July 2022	Implementation of CENELEC amendment A11:2022
31 January 2023	Correction to implemented A11 text; incorporation of Annex ZZC

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 60947-5-2+A11

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Supersedes EN 60947-5-2:2007 and all of its amendments and corrigenda (if any)

English Version

Low-voltage switchgear and controlgear - Part 5-2: Control circuit devices and switching elements - Proximity switches (IEC 60947-5-2:2019)

Appareillage à basse tension - Partie 5-2: Appareils et éléments de commutation pour circuits de commande - Détecteurs de proximité
(IEC 60947-5-2:2019)

Niederspannungsschaltgeräte - Teil 5-2: Steuergeräte und Schaltelemente - Näherungsschalter
(IEC 60947-5-2:2019)

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Comité Européen de Normalisation Electrotechnique
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European foreword

The text of document 121A/313/FDIS, future edition 4 of IEC 60947-5-2, prepared by SC 121A "Low-voltage switchgear and controlgear" of IEC/TC 121 "Switchgear and controlgear and their assemblies for low voltage" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60947-5-2:2020.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2020-09-27
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2023-03-27

This document supersedes EN 60947-5-2:2007 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directives see informative Annexes ZZA and ZZB, which are an integral part of this document.

Endorsement notice

The text of the International Standard IEC 60947-5-2:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60825 (series)	NOTE	Harmonized as EN 60825 (series)
IEC 61000-3-2:2018	NOTE	Harmonized as EN IEC 61000-3-2:2019 (not modified)
IEC 61000-3-3:2013	NOTE	Harmonized as EN 61000-3-3:2013 (not modified)
IEC 61000-3-3:2013/A1:2017	NOTE	Harmonized as EN 61000-3-3:2013/A1:2019 (not modified)
IEC 61076-2-101	NOTE	Harmonized as EN 61076-2-101
IEC 61076-2-104	NOTE	Harmonized as EN 61076-2-104
IEC 61076-2-105	NOTE	Harmonized as EN 61076-2-105
IEC 62471:2006	NOTE	Harmonized as EN 62471:2008 (modified)
IEC 62683-1:2017	NOTE	Harmonized as EN 62683-1:2017 (not modified)
ISO 7010	NOTE	Harmonized as EN ISO 7010

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European foreword to A11

This document (EN IEC 60947-5-2:2020/A11:2022) has been prepared by CLC/TC 121A “Low-voltage switchgear and controlgear”.

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2023–02–28
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2025–02–28

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document is read in conjunction with EN IEC 60947-5-2:2020.

It specifies additional safety and EMC requirements for proximity switches that incorporate radio functionality in a fixed and permanent manner.

This document has been prepared under a Standardization Request given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZZC, which is an integral part of this document.

Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60068-2-6	2007	Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008
IEC 60068-2-14	2009	Environmental testing – Part 2-14: Tests – Test N: Change of temperature	EN 60068-2-14	2009
IEC 60068-2-27	2008	Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock	EN 60068-2-27	2009
IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60364	series	Low-voltage electrical installations	HD 60364	series
IEC 60445	2017	Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors	EN 60445	2017
IEC 60695-2-10	2013	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2013
IEC 60695-2-11	2014	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (GWEPT)	EN 60695-2-11	2014
IEC 60695-2-12	2010	Fire hazard testing - Part 2-12: Glowing/hot-wire based test methods - Glow-wire flammability index (GWFI) test method for materials	EN 60695-2-12	2010
+ A1	2014		+ A1	2014

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Publication	Year	Title	EN/HD	Year
IEC 60825-1	2014	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	2014
			+ AC	2017
IEC 60947-1	2007	Low-voltage switchgear and controlgear - Part 1: General rules	EN 60947-1	2007
+ A1	2010		+ A1	2011
+ A2	2014		+ A2	2014
IEC 61000-4-2	2008	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	2009
IEC 61000-4-3	2006	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006
+ A1	2007		+ A1	2008
+ A2	2010		+ A2	2010
IEC 61000-4-4	2012	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2012
IEC 61000-4-6	2013	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	2014
			+ AC	2015
IEC 61000-4-8	2009	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	EC 61000-4-8	2010
IEC 61000-4-11	2004	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004
+ A1	2017		+ A1	2017
IEC 61000-4-13	2002	Electromagnetic compatibility (EMC) - Part 4-13: Testing and measurement techniques - Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests	EN 61000-4-13	2002
+ A1	2009		+ A1	2009
+ A2	2015		+ A2	2016
IEC 61076-2	series	Connectors for electronic equipment – Product requirements – Part 2: Circular connectors	EN 61076-2	series
IEC 61140	-	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2016

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Publication	Year	Title	EN/HD	Year
IEC 62443	series	Security for industrial automation and control systems	EN 62443	series
IEC 62471	series	Photobiological safety of lamps and lamp systems	EN 62471	series
IEC TR 62471-2	2009	Photobiological safety of lamps and lamp systems - Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety	-	-
CISPR 11 (mod)	2015	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	EN 55011	2016
+ A1	2016		+ A1	2017
IEC Guide 117	2010	Electrotechnical equipment - Temperatures of touchable hot surfaces	CLC Guide 29	2007

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Annex ZC
(normative)

Proximity switches with integrated radio functionality

ZC.1 General

The requirements of the main body of this standard apply unless otherwise stated in this Annex.

This Annex defines additional requirements with respect to safety under article 3.1(a) and Electromagnetic Compatibility (EMC) under article 3.1(b) of Directive 2014/53/EU for proximity switches that incorporate one or more radio technologies as set out in ZC.4 in a fixed and permanent manner.

ZC.2 Additional normative references

The Normative references added to Clause 2 of this document are related specifically to this Annex ZC.

ZC.3 Additional Terms and Definitions

The Terms and Definitions added to Clause 3 of this document are related specifically to this Annex ZC.

ZC.4 Incorporated radio technologies

This annex is applicable if a proximity switch incorporates one or more of the radio technologies set out in Table ZC.1.

Table ZC.1 — Incorporated radio technologies

Incorporated radio technology	Radio EMC standard	Exclusion band definition
Short range [a]	ETSI EN 301 489–3 (V2.1.1)	Subclause 4.6
Broadband data transmission [b]	ETSI EN 301 489–17 (V3.2.3)	Subclause 4.3
ROMES and ROGNSS [c]	ETSI EN 301 489–19 (V2.1.1)	Subclause 4.3
UWB [d]	ETSI EN 301 489–33 (V2.2.1)	Subclause 4.3
NOTE The subclause number relates to that subclause in the radio EMC standard.		
a Short range devices as defined in the scope of ETSI EN 301 489–3 (V2.1.1).		
b Broadband Data Transmission Systems as defined in the scope of ETSI EN 301 489–17 (V3.2.4) and further pointed out in Annex B of that standard.		
c ROMES operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing position, navigation and timing data as defined in the scope of ETSI EN 301 489–19 (V2.1.1).		
d Ultra-Wideband devices as defined in the scope of ETSI EN 301 489–33 (V2.2.1).		

ZC.5 Technical requirements

ZC.5.1 General

ZC.5.2 sets out requirements related to the risk of human exposure to electromagnetic fields.

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The requirements specified in 8.2.6 shall be replaced by those defined in ZC.5.3.

NOTE The term “performance requirements” which is used throughout the EN 60947 series of standards is equivalent to the term “technical requirements”.

ZC.5.2 Basic restrictions related to human exposure of electromagnetic fields

The radio function shall first be assessed in accordance with the requirements set out in EN 62479:2010 by applying either route B or route C as specified in EN 62479:2010, 4.1. The radio function is deemed to comply with the requirements if the available antenna power and/or the average total radiated power is less than or equal to the applicable low-power exclusion level P_{max} of the ICNIRP Guidelines, as specified in the first 4 rows of EN 62479:2010, Table A.1.

If the proximity switch is exclusively intended to be used in an industrial environment, the limit P_{max} is 200 mW. If P_{max} is between 100 mW and 200 mW then the manufacturer’s documentation shall state that this product shall not be used near to head and trunk.

If the intended use of the proximity switch includes exposure to the general public, the limit P_{max} is 40 mW. If P_{max} is between 20 mW and 40 mW then the manufacturer’s documentation shall state that this product shall not be used near to head and trunk.

If the low-power exclusion level P_{max} is not met when applying route B or route C, the radio function shall be further assessed according to EN IEC 62311:2020, Clause 5.

Information on the intended environment (industrial or general public) and any restrictions shall be provided in addition to the requirements of 6.1.

NOTE A proximity switch without radio functionality is inherently compliant with the exposure limits related to EMF and therefore falls into route A of EN 62479:2010.

ZC.5.3 Electromagnetic compatibility

ZC.5.3.1 Introduction

The EUT in configuration(s) typical for its intended operating conditions shall be assessed according to the requirements defined in ZC.5.3.4 and ZC.5.3.5. The EUT shall be configured so as to:

— maximize the emissions of the EUT;

— ensure the EUT is most susceptible to the effects of external electromagnetic interference.

For the non-radio function, this configuration shall satisfy the conditions specified in 9.6.1. The radio function shall be configured in accordance with the test conditions specified in Clause 4 of the radio technology specific radio EMC standard(s) set out in Table ZC.1. The configuration(s) used shall be recorded in the test report together with the rationale for these choices.

Where there are alternative test methods and test configurations in this document, those selected shall be detailed in the test report, so that it is possible to use them for re-testing to ensure consistency of the results.

NOTE It can be necessary to perform the assessment in several configurations to cover all intended operating conditions and to ensure that the EUT complies in all configurations.

ZC.5.3.2 Performance criteria

ZC.5.3.2.1 General

Performance criteria applied during the tests shall be detailed in the test report.

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ZC.5.3.2.2 Performance criteria for non-radio functions

The non-radio functions shall comply with the performance criteria defined in Table 9 (acceptance criteria).

ZC.5.3.2.3 Performance criteria for radio functions

The performance of the radio function(s) shall comply with the performance criteria defined in Clause 6 of the radio technology specific radio EMC standard(s) set out in Table ZC.1.

ZC.5.3.3 Exclusion bands

The exclusion bands defined in Table ZC.1, 3rd column shall be applied, depending on the incorporated radio technology(s).

ZC.5.3.4 Emissions requirements

ZC.5.3.4.1 General

For the non-radio function, the EUT shall be configured in accordance with the requirements specified in 9.6.1.

The radio function shall be in each of the following mode(s) if they can be achieved in intended operation:

— standby;

— receive-only;

— transmit or combined transmit/receive mode.

If emission tests are performed in transmit or combined transmit/receive mode, the exclusion band(s) defined in ZC.5.3.3 shall be applied.

NOTE 1 The transmit mode of the radio function is part of the assessment under article 3.2 of the Directive 2014/53/EU applicable to the radio technology used.

NOTE 2 To prevent saturation of the measuring receiver, it is good practice to include filter(s) rejecting the transmitter frequency in the measurement chain for tests performed in transmit mode.

NOTE 3 Typically the worst case emission occurs when transmitting at the maximum rate of information.

ZC.5.3.4.2 Radiated emissions

For radiated emissions, the EUT shall be assessed in accordance with 9.6.3.

For the frequency range from 1 GHz to 6 GHz, the test requirements of EN IEC 61000-6-4:2019, Table 3 shall apply to the maximum frequency specified in EN IEC 61000-6-4:2019, Table 2.

When applying EN IEC 61000-6-4:2019, Table 2, the EUT is considered to be the proximity switch including the radio function. Therefore, the highest internal frequency of the EUT includes the frequencies used in the radio function.

ZC.5.3.4.3 Conducted emissions

ZC.5.3.4.3.1 Ports

Figure ZC.1 show examples of relevant ports.

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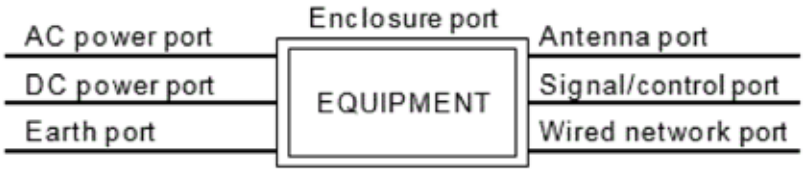

SOURCE: ETSI EN 303 446-2 (V1.2.1)

Figure ZC.1 — Examples of relevant ports

ZC.5.3.4.3.2 Special provisions for combined power and network ports

Wired network ports that also provide AC or DC power as an integral part of a communication function shall be tested in the following configuration(s):

— with the network function activated, it shall be tested as a wired network port according ZC.5.3.4.3.4.

— if connection of such a port to a pure power supply port is permissible, it shall additionally be tested with the network function deactivated as a power port according ZC.5.3.4.3.3.

ZC.5.3.4.3.3 AC or DC power port

For conducted emissions on the power port(s), the EUT shall be assessed in accordance with 9.6.3.

ZC.5.3.4.3.4 Wired network port

For conducted emissions on wired network ports, the EUT shall meet the requirements given in EN IEC 61000-6-4:2019, Table 5.

ZC.5.3.4.3.5 Antenna Port

Where the EUT has a port intended for the connection of an external antenna via coaxial cable longer than 3 m, the Class A requirements of EN 55032:2015, Clause A.3 for antenna ports apply.

ZC.5.3.5 Immunity requirements

ZC.5.3.5.1 Configuration of the EUT during immunity tests

For the non-radio function, the EUT shall be configured in accordance with the requirements specified in 9.6.1.
The radio function shall be configured in accordance with the test conditions specified in Clause 4 of the radio technology specific radio EMC standard(s) set out in Table ZC.1.
Configuration(s) used during the tests shall be detailed in the test report.
Different operating modes may be tested simultaneously when this is representative of normal usage.

ZC.5.3.5.2 Electrostatic discharge

The EUT shall be tested in accordance with the requirements defined in 9.6.2.1.

The non-radio functionality shall be assessed in accordance with the performance criterion set out in ZC.5.3.2.2.

The radio functionality shall be assessed in accordance with the performance criteria for transient phenomena as defined in ZC.5.3.2.3.

ZC.5.3.5.3 Radiated immunity

The EUT shall be tested in accordance with the requirements defined in 9.6.2.2.
The non-radio functionality shall be assessed in accordance with the performance criterion set out in ZC.5.3.2.2.

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The radio functionality shall be assessed in accordance with the performance criteria for continuous phenomena as defined in ZC.5.3.2.3.

The exclusion band(s) defined in ZC.5.3.3 shall only be applied when assessing the radio function.

ZC.5.3.5.4 Fast transients, common mode

The EUT shall be tested in accordance with the requirements defined in 9.6.2.3.

The non-radio functionality shall be assessed in accordance with the performance criterion set out in ZC.5.3.2.2.

The radio functionality shall be assessed in accordance with the performance criteria for transient phenomena as defined in ZC.5.3.2.3.

ZC.5.3.5.5 Surges

No requirements apply (see 8.2.6.2.5).

NOTE In their intended application, proximity switches are well protected against surges as they are not directly connected to AC distribution networks. In case proximity switches are directly connected to AC distribution networks, additional external surge protection can be applied.

ZC.5.3.5.6 Radio frequency, common mode

The EUT shall be tested in accordance with the requirements defined in 9.6.2.4.

The non-radio functionality shall be assessed in accordance with the performance criterion set out in ZC.5.3.2.2.

The radio functionality shall be assessed in accordance with the performance criteria for continuous phenomena as defined in ZC.5.3.2.3.

The exclusion band(s) defined in ZC.5.3.3 shall only be applied when assessing the radio function.

ZC.5.3.5.7 Voltage dips and interruptions

The EUT shall be tested in accordance with the requirements according 9.6.2.6.

The non-radio functionality shall be assessed in accordance with the performance criterion set out in ZC.5.3.2.2.

The radio functionality shall be assessed in accordance with the performance criteria for transient phenomena as defined in ZC.5.3.2.3.

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Annex ZZA
(informative)

Relationship between this European standard and the essential requirements of Directive 2014/30/EU [2014 OJ L96] aimed to be covered

This European standard has been prepared under the European Commission standardisation request C(2016) 7641 final of 30.11.2016[1], ('M/552'), as regards harmonised standards in support of Directive 2014/30/EU relating to electromagnetic compatibility, to provide one voluntary means of conforming to essential requirements of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZZA.1 — Correspondence between this European standard and the Essential Requirements set out in Directive 2014/30/EU [2014 OJ L96]

Essential requirements of Directive 2014/30/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
Annex I. 1(a) Electromagnetic disturbances	8.2.6.1, 8.2.6.3, 9.6.1, 9.6.3	
Annex I. 1(b) Electromagnetic immunity	8.2.6.1, 8.2.6.2, 9.6.1, 9.6.2	Full coverage of requirements for conducted and radiated disturbances in the range 150 kHz to 6 GHz

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

[1] COMMISSION IMPLEMENTING DECISION C(2016) 7641 final of 30.11.2016 on a standardisation request to the European Committee for Standardisation, to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards harmonised standards in support of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.

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Annex ZZB
(informative)

Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered

This European standard has been prepared under a Commission's standardisation request relating to harmonised standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding safety objectives of that Directive, and associated EFTA regulations.

Table ZZB.1 — Correspondence between this European standard and Annex I of Directive 2014/35/EU [2014 OJ L96]

Safety objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks/note
1 a)	1, 2, 3, 4, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 7.1, 8.1, 8.2, 9.1, 9.2, 9.3, ANNEX B	
1 b)	1, 2, 3, 4, 5, 6.1, 6.2, 6.3, 7, 8.1, 8.2 ANNEX B	
1 c)	1, 2, 3, 4, 5, 6, 7, 8 Also refer to 2 a) to 2 d) and 3 a) to 3 c) in this table	
2 a)	1, 2, 3, 4, 5.3, 6.1, 8.1, 8.2, 8.4, 9.1, 9.2, 9.3, ANNEX B, ANNEX C	
2 b)	1, 2, 3, 4, 5.3, 5.4, 6.1, 6.3, 7.1, 8.1, 8.2, 9.2, 9.3	This document does not deal with any specific requirement on acoustic noise. Photobiological radiation risk (8.1) is covered by using the standard informed (EN 60825- 1/EN 62471 (all parts)).
2 c)	1, 2, 3, 4, 5, 6.4, 7, 8.1, 8.4, 9.1, ANNEX B, ANNEX C	

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Safety objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks/note
2 d)	1, 2, 3, 4, 5.3, 5.4, 6.1 7, 8.1, 8.2, 9.1, 9.2, 9.3, ANNEX B	
3 a)	1, 2, 3, 4, 5, 7, 8.4, 9.1, ANNEX B, ANNEX C	
3 b)	1, 2, 3, 4, 5, 8.1	In reference to the scope of this document the risk about biological/chemical effects and chemical stress (8.1) is not recognized and therefore not covered.
3 c)	1, 2, 3, 4, 5, 7.1, 8.1, 8.2, 9.3	

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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Annex ZZC
(informative)

Relationship between this European Standard and the essential requirements of Directive 2014/53/EU [2014 OJ L153] aimed to be covered

This European Standard has been prepared under a Commission's standardization request as regards radio equipment in support of Directive 2014/53/EU, M/536 / C(2015) 5376 final of 4.8.2015, to provide one voluntary means of conforming to essential requirements of Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [2014 OJ L153].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZC.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZZC.1 — Correspondence between this European Standard and Article 3 of Directive 2014/53/EU [2014 OJ L153]

Essential requirements of Directive 2014/53/EU		Clause(s) / sub-clause(s) of this EN	Remarks / Notes
Article 3.1(a)	As in Annex I (1)(a) of Directive 2014/35/EU	4, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4, 7.1, 8.1, 8.2, 9.1, 9.2, 9.3, ANNEX B	
Article 3.1(a)	As in Annex I (1)(b) of Directive 2014/35/EU	4, 5, 6.1, 6.2, 6.3, 7, 8.1, 8.2 ANNEX B	
Article 3.1(a)	As in Annex I (1)(c) of Directive 2014/35/EU	4, 5, 6, 7, 8	Also refer to the following two rows of this table
Article 3.1(a)	As in Annex I (2)(a) of Directive 2014/35/EU	4, 5.3, 6.1, 8.1, 8.2, 8.4, 9.1, 9.2, 9.3, ANNEX B, ANNEX C	
Article 3.1(a)	As in Annex I (2)(b) of Directive 2014/35/EU	4, 5.3, 5.4, 6.1, 6.3, 7.1, 8.1, 8.2, 9.2, 9.3, ZC.5.2	This document does not address acoustic noise. Photobiological radiation risk is addressed using the standards cited in subclause 8.1 (EN 60825-1/EN 62471 (all parts)).
Article 3.1(a)	As in Annex I (2)(c) of Directive 2014/35/EU	4, 5, 6.4, 7, 8.1, 8.4, 9.1, ANNEX B, ANNEX C	
Article 3.1(a)	As in Annex I (2)(d) of Directive 2014/35/EU	4, 5.3, 5.4, 6.1 7, 8.1, 8.2, 9.1, 9.2, 9.3, ANNEX B	
Article 3.1(a)	As in Annex I (3)(a) of Directive 2014/35/EU	4, 5, 7, 8.4, 9.1, ANNEX B, ANNEX C	
Article 3.1(a)	As in Annex I (3)(b) of Directive 2014/35/EU	4, 5, 8.1	With reference to the scope of this document, the risks concerning biological and chemical effects and chemical stress (8.1) are considered negligible and are therefore not covered.

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Article 3.1(a)	As in Annex I (3)(c) of Directive 2014/35/EU	4, 5, 7.1, 8.1, 8.2, 9.3	
Article 3.1(b)	(electromagnetic compatibility), disturbances	8.2.6.1, 8.2.6.3, ZC.5.3.1, ZC.5.3.3, ZC.5.3.4	
Article 3.1(b)	(electromagnetic compatibility), immunity	8.2.6.1, ZC.5.3.1, ZC.5.3.2, ZC.5.3.3, ZC.5.3.5	

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-2: Control circuit devices and switching elements – Proximity switches

FOREWORD

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International Standard IEC 60947-5-2 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This fourth edition cancels and replaces the third edition published in 2007 and Amendment 1:2012. This edition constitutes a technical revision.

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

- update of the scope;
- adaptation and update of the construction requirements according to IEC Guide 116 (e.g. material requirements, artificial optical radiation, instruction requirements, hot surface, unattended operation, foreseeable misuse…);
- modification of the specifications concerning the sensing range and operating distance;

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- new definitions for photoelectric proximity switch type D with background suppression;
- integration of the requirements and test procedures of photoelectric proximity switch type D with background suppression;
- update of EMC requirements in Table 9 and Table 10;
- integration of environmental information requirements and environmental condition by referencing Annexes O, W and Q of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014;
- modification of impulse withstand voltage test (5.3.1.3, 9.3.3.4.5);
- modification of the references in the (normative) standard body to the (informative) Annex A;
- major update of Annex A (definitions update, new dimensions and shapes);
- update of C.9.1.1;
- update of Annex D in order to consider new connector types and normative references;
- update of Annex F (additional symbols for photoelectric proximity switches).

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

FDIS	Report on voting
121A/313/FDIS	121A/322/RVD

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

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

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

This International Standard should be used in conjunction with IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014.

The provisions of the general rules, IEC 60947-1, are applicable to this document, where specifically called for. General rules, clauses and subclauses thus applicable, as well as tables, figures and annexes are identified by a reference to IEC 60947-1, for example 1.2.3, Table 4 or Annex A of IEC 60947-1:2007.

The following differing practices of a less permanent nature exist in the countries indicated below.

- 8.1.7.3: recommendations are given in the National US Electrical Code about connections means;
- 8.1.7.4: in the United States of America, there are other documents that define conductor colour coding schemes that can apply to the installation of proximity switches;
- 8.1.15.2: for European Union Countries: in certain ranges the defined limits of exposure values in IEC 60825-1:2014 exceed the requirements of the European directive 2006/25/EC Directive on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation).

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

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-2: Control circuit devices and switching elements – Proximity switches

1 Scope

This part of IEC 60947 applies to inductive and capacitive proximity switches that sense the presence of metallic and/or non-metallic objects, ultrasonic proximity switches that sense the presence of sound reflecting objects, photoelectric proximity switches that sense the presence of objects and non-mechanical magnetic proximity switches that sense the presence of objects with a magnetic field.

Products covered by the scope of this document are not subjected to defined behaviours under fault conditions. Proximity switches with defined behaviour are covered by IEC 60947-5-3 and have to fulfil additional requirements.

These proximity switches are self-contained, have semiconductor switching element(s) and are intended to be connected to circuits, the rated voltage of which does not exceed 250 V 50 Hz/60 Hz AC RMS or 300 V DC.

Examples of typical applications for in-scope products:

- factory automation and machinery industry;
- logistic and packaging industry;
- conveyor belts, lifts;
- process industry;
- power plants.

Special applications (e.g. corrosive atmosphere) can cause additional requirements. This

document is not intended to cover proximity switches with analogue outputs. The object of

this document is to state for proximity switches:

- definitions;
- classification;
- characteristics;
- product information;
- normal service, mounting and transport conditions;
- constructional and performance requirements;
- tests to verify rated characteristics.

Products covered by the scope of this document are expected to be selected, installed, and maintained by skilled personnel only.

Annex ZC of this document defines requirements in respect of safety under article 3.1(a) and Electromagnetic Compatibility (EMC) under article 3.1(b) of Directive 2014/53/EU for proximity switches that incorporate one or more radio technologies as set out in ZC.4 in a fixed and permanent manner.

NOTE Requirements applicable to the efficient use of radio spectrum are not included in this document. These requirements can be found in the applicable ETSI product standard(s) for the effective use of the radio spectrum under article 3.2 of Directive 2014/53/EU.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

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

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60417, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*
IEC 60695-2-12:2010/AMD1:2014

IEC 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

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)*

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

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

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

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

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

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*
IEC 61000-4-11:2004/AMD1:2017

IEC 61076-2 (all parts), *Connectors for electronic equipment – Product requirements – Part 2: Circular connectors*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 62443 (all parts), *Industrial communication networks – Network and system security*

IEC 62471 (all parts), *Photobiological safety of lamps and lamp systems*

IEC TR 62471-2:2009, *Photobiological safety of lamps and lamp systems – Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016

IEC Guide 117:2010, *Electrotechnical equipment – Temperatures of touchable hot surfaces*

EN 10084:2008, *Case hardening steels – Technical delivery conditions*

〈A11〉 EN 55032:2015, *Electromagnetic compatibility of multimedia equipment - Emission Requirements*

EN IEC 61000-6-4:2019, *Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments*

EN IEC 62311:2020, *Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz)*

EN 62479:2010, *Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)*

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ETSI EN 301-489-3, V2.1.1, *ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU*

ETSI EN 301-489-17, V3.2.4, *ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard for ElectroMagnetic Compatibility*

ETSI EN 301-489-19, V2.1.1, *ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications and GNSS receivers operating in the RNSS band (ROGNSS) providing positioning, navigation, and timing data; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU*

ETSI EN 301-489-33, V2.2.1, *ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 33: Specific conditions for Ultra-WideBand (UWB) devices; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU* 〈A11〉

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Clause 2 of IEC 60947-1:2007, IEC 60947-1:2007AMD1:2010, IEC 60947-1:2007/AMD2:2014 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Basic terms and definitions

〈A11〉 **3.1.1**
antenna port
port for connection of an antenna used for intentional transmission and/or reception of radiated RF energy

[SOURCE: ETSI EN 303 446-2 (V1.2.1), modified – Note deleted.]

3.1.2 exclusion band

frequency range where during immunity test, the radio functionality is not required to meet the performance criteria defined for the specific test and where the emissions are not assessed

[SOURCE: ETSI EN 303 446-2 (V1.2.1)]

3.1.3
function
operation carried out by an equipment

Note 1 to entry: Functions are related to basic technologies incorporated in the equipment such as radio reception, radio transmission, emitting light, conversion of physical dimensions to electrical signals.

[SOURCE: ETSI EN 303 446-2 (V1.2.1)]

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3.1.4
port
particular interface, of the specified equipment, with the electromagnetic environment

Note 1 to entry: For example, any connection point on an equipment intended for connection of cables to or from that equipment is considered as a port (see Figure ZC.1).

Note 2 to entry: In the case of integral antenna equipment the antenna port is the same as the enclosure port.

[SOURCE: ETSI EN 303 446-2 (V1.2.1), modified – Figure 1 deleted from definition and inserted as Figure ZC.1, Note 1 to entry updated.]

3.1.5
radio equipment
electrical or electronic product, which intentionally emits and/or receives radio waves for the purpose of radio communication and/or radio determination, or an electrical or electronic product which must be completed with an accessory, such as antenna, so as to intentionally emit and/or receive radio waves for the purpose of radio communication and/or radio determination

[SOURCE: Radio Equipment Directive 2014/53/EU, Article 2.1(1)]

3.1.6
wired network port
point of connection for data and signalling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network (for example LAN and similar networks)

Note 1 to entry: These ports can support screened or unscreened cables and can also carry AC or DC power where this is an integral part of the telecommunication specification. 〈A11〉

3.1.7
proximity switch
position switch which is operated without mechanical contact with the moving part

[SOURCE: IEC 60050-441:2000, 441-14-51]

3.1.7.1
inductive proximity switch
proximity switch producing an electromagnetic field within a sensing zone for detecting objects and having a semiconductor switching element

3.1.7.2
capacitive proximity switch
proximity switch producing an electric field within a sensing zone for detecting objects and having a semiconductor switching element

Note 1 to entry: Objects could be either solids or liquids

3.1.7.3
ultrasonic proximity switch
proximity switch which detects objects that either reflect or interrupt ultrasound energy and having a semiconductor switching element

Note 1 to entry: Objects could be either solids or liquids.

Note 2 to entry: The principle is described in Figure 2 and Figure 3.

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3.1.7.4
photoelectric proximity switch
proximity switch which detects objects that either reflect or interrupt visible or invisible light and having a semiconductor switching element

Note 1 to entry: Objects could be either solids or liquids.

Note 2 to entry: The principle is described in Figure 4.

3.1.7.4.1
Type D
diffuse reflective photoelectric proximity switch which is directly operated through lateral or axial approach to its reference axis by a defined object

3.1.7.4.1.1
Type D with background suppression
photoelectric proximity switch which is directly operated through lateral or axial approach to its reference axis by a defined object and specifically optimized for more predictable detection at the desired distance of objects with different reflectivity and capable of non-detection of objects in a precisely defined region called the background zone

3.1.7.4.2
Type R
retroreflective photoelectric proximity switch which is indirectly operated through lateral approach to its reference axis between emitter-receiver and reflector by a defined object

3.1.7.4.3
Type T
through beam photoelectric proximity switch which is indirectly operated through lateral approach to its reference axis between emitter and receiver by a defined object

3.1.7.5
non-mechanical magnetic proximity switch
proximity switch which senses the presence of a magnetic field and has a semiconductor switching element and no moving parts in the sensing element

3.1.7.6
direct operated proximity switch
proximity switch which detects its target without the use of an external means, e.g. a reflector

3.1.7.7
indirect operated proximity switch
proximity switch which detects its target with the use of an external means, e.g. a reflector

3.1.7.8
neutral density filter
filter which uniformly attenuates the intensity of light over a broad spectral range

Note 1 to entry: Attenuation is accomplished by using either a light-absorbing glass or a thin-film metal coating that combines absorption and reflection.

3.2 Parts of a proximity switch

3.2.1
semiconductor switching element
an element designed to switch the current of an electric circuit by controlling conductivity of a semiconductor

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3.2.2
reference axis

3.2.2.1
reference axis
<inductive, capacitive, non-mechanical magnetic and ultrasonic proximity switches> axis perpendicular to the sensing face and passing through its centre

3.2.2.2
reference axis
<Types R and D photoelectric proximity switches> axis located midway between the optical axis of the emitter and receiver elements or lenses (see Figure 4)

3.2.2.3
reference axis
<Type T photoelectric proximity switches> axis perpendicular to the centre of the emitter

3.2.3
standard target
specified object used for making comparative measurements of the operating distances and sensing distances

3.2.4
free zone
volume around the proximity switch which is kept free from any material capable of affecting the characteristics of the proximity switch

3.2.5
damping material
material which has an influence on the characteristics of a proximity switch

3.2.6
non-damping material
material which has negligible influence on the characteristics of a proximity switch

3.2.7
sound-reflecting object
object which reflects the ultrasound energy and gives detectable echoes

3.2.8
sound-absorbing object
object with negligible reflecting characteristics for ultrasound energy which gives no detectable echo

3.2.9
embeddable proximity switch
proximity switch is "embeddable" when any damping material can be placed around the sensing face plane without influencing its characteristics

3.2.10
non-embeddable proximity switch
proximity switch is "non-embeddable" when a specified free zone around its sensing face is necessary in order to maintain its characteristics

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3.2.11
sensing face

3.2.11.1
sensing face
<inductive proximity switch> surface of the proximity switch through which the electromagnetic field emerges

3.2.11.2
sensing face
<capacitive proximity switch> surface of the proximity switch through which the electric field emerges

3.2.11.3
sensing face
<ultrasonic proximity switch> surface of the proximity switch where ultrasound is transmitted and received

3.2.11.4
sensing face
<non-mechanical magnetic proximity switch> surface of the proximity switch through which the change in a magnetic field is detected

3.2.12
emitter
light source, lens and necessary circuitry which provide the light beam

3.2.13
receiver
detector, lens and necessary circuitry to monitor the presence of the light beam from the emitter

3.2.14
reflector
specified device used to reflect light back to the receiver for Type R photoelectric proximity switches

3.2.15
adjuster

3.2.15.1
adjuster
<capacitive proximity switch> part of capacitive proximity switch used to set the operating distance, compensating for influence of target material, medium transmission and installation (mounting) conditions

3.2.15.2
adjuster
<ultrasonic or photoelectric proximity switch> part of an ultrasonic or a photoelectric proximity switch used to set the operating distance within the sensing range

3.3 Operation of a proximity switch

3.3.1
operating distance
s
distance at which the target approaching the sensing face along the reference axis causes the output signal to change

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3.3.1.1
rated operating distance
s_n
conventional quantity used to designate the operating distances

Note 1 to entry: It does not take into account either manufacturing tolerances or variations due to external conditions such as voltage and temperature.

Note 2 to entry: s_n+ stands for extended rated operating distance.

3.3.1.2
sensing range
s_d
range within which the operating distance may be adjusted

3.3.1.2.1
minimum operating distance
lower limit of the specified sensing range of an ultrasonic or photoelectric proximity switch

3.3.1.2.2
maximum operating distance
upper limit of the specified sensing range of an ultrasonic or photoelectric proximity switch

3.3.1.3
blind zone
zone between the sensing face and the minimum operating distance, where no object can be detected

3.3.1.4
total beam angle
solid angle around the reference axis of an ultrasonic proximity switch, where the sound level drops by 3 dB

3.3.1.5
effective operating distance
s_r
operating distance of an individual proximity switch, measured at stated temperature, voltage and mounting conditions

3.3.1.6
usable operating distance
s_u
operating distance of an individual proximity switch, measured under specified conditions

3.3.1.7
assured operating distance
s_a
distance from the sensing face within which the correct operation of the proximity switch under specified conditions is assured

3.3.1.8
operating range
r_o
range within which a lateral approach of the target causes the output signal of a through beam or retroreflective proximity switch to change

3.3.2
lateral approach
approach of the target perpendicular to the reference axis

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3.3.3
axial approach
approach of the target with its centre maintained on the reference axis

3.3.4
repeatability
R
value of variation of the effective operating distance (s_r) under specified conditions

3.3.5
differential travel
H
distance between the operating point when the target approaches the proximity switch and the release point when the target moves away

3.4 Switching element characteristics

3.4.1
switching element function

3.4.1.1
make function
function which causes load current to flow when a target is detected and load current not to flow when a target is not detected

3.4.1.2
break function
function which causes load current not to flow when a target is detected and load current to flow when a target is not detected

3.4.1.3
make-break function
changeover function
switching element combination which contains one make function and one break function

3.4.1.4
turn-on and turn-off time
<proximity switch> time required for the device switching element to turn-on or turn-off after the target enters or exits the sensing zone

3.4.1.5
turn-on time
<photoelectric proximity switch> time required for the switching element to respond after the target enters the sensing range with excess gain of 2 (see 3.4.6) for Types R, T and D

3.4.1.6
turn-off time
<photoelectric proximity switch> time required for the switching element to respond after the target exits the sensing range with excess gain of less than 0,5 (see 3.4.6) for Types R, T and D

3.4.1.7
active optical signal
optical signal activating the sensor

[SOURCE: IEC 62683-1:2017, ACE258]

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3.4.1.7.1
light operated
LO
switching element function which causes the output element in ON-state in case of the presence of active optical signal at the optical receiver (and in OFF-state in case of the absence of active optical signal)

3.4.1.7.2
dark operated
DO
switching element function which causes the output element in OFF state in case of the presence of active optical signal at the optical receiver (and in ON-state in case of the absence of active optical signal)

3.4.2
independent action
snap action
switching element function substantially independent from the velocity of the target

3.4.3
frequency of operating cycles
f
number of operating cycles performed by a proximity switch during a specified period of time

3.4.4
time delay before availability
t_v
time delay before availability is the time between the switching on of the supply voltage and the instant at which the proximity switch becomes ready to operate correctly

3.4.5
currents

3.4.5.1
OFF-state current
I_r
current which flows through the load circuit of the proximity switch in the OFF-state

3.4.5.2
minimum operational current
I_m
current which is necessary to maintain ON-state conduction of the switching element

3.4.5.3
no-load supply current
I_o
current drawn by a three- or four-terminal proximity switch from its supply when not connected to a load

3.4.6
excess gain
ratio of the light received by the photoelectric proximity switch to the light required to operate the photoelectric proximity switch

Note 1 to entry: This is applicable for photoelectric proximity switch Types R, T and D.

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3.4.6.1
sensing range displacement
calculated number that defines the ability of a device to detect objects of different reflectivity at the same distance and also defines the ability of the device to ignore objects regardless of reflectivity beyond a certain distance

Note 1 to entry: This is only applicable for photoelectric proximity switch Type D with background suppression.

3.4.7
ambient light
<photoelectric proximity switch> light which is received by the receiver other than that originating from the emitter

3.5 Abbreviations

For the purpose of Annex ZC, the abbreviations defined elsewhere in this standard and the following apply:

EMF	electromagnetic fields
EUT	equipment under test
GNSS	global navigation satellite system
LAN	local area network
RF	radio frequency
RNSS	radio-navigation satellite service
ROGNSS	receive only global navigation satellite system
ROMES	receive only mobile earth station
UWB	ultra wide band

4 Classification

4.1 General

Proximity switches shall be classified according to various characteristics as shown in Table 1. It is recommended that their dimensions are in accordance with those listed in Annex A.

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Table 1 – Classification of proximity switches

1st pos./1 digit	2nd pos./1 digit	3rd pos./3 digits	4th pos./1 digit	5th pos./1 digit	6th pos./1 digit
SENSING MEANS **4.2**	**MECHANICAL INSTALLATION** **4.3**	**CONSTRUCTION FORM AND SIZE** **4.4**	**SWITCHING ELEMENT FUNCTION (OUTPUT)** **4.5**	**TYPE OF OUTPUT** **4.6**	**METHOD OF CONNECTION** **4.7**
I = inductive C = capacitive U = ultrasonic D = diffuse reflective photoelectric M = non-mechanical magnetic R = retroreflective photoelectric T = through beam photoelectric	1 = embeddable 2 = non-embeddable 3 = either	FORM (1 capital letter) A = cylindrical threaded barrel B = cylindrical smooth barrel C = rectangular with square cross-section D = rectangular with rectangular cross-section DIMENSION (2 numbers) for diameter or side length	A = NO (make) B = NC (break) C = changeover (make-break) P = programmable by user S = other	P = PNP-output 3 or 4 terminal DC N = NPN-output 3 or 4 terminal DC D = 2 terminal DC F = 2 terminal AC U = 2 terminal AC or DC S = other	1 = integral leads 2 = plug-in 3 = screw 9 = other
Ultrasonic proximity switch example:					
U Ultrasonic	3 Either	A30 Cylindrical threaded ∅ 30 mm	A NO (make) function	D 2 terminal DC	2 Plug-in

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4.2 Classification according to sensing means

In this document, the sensing means is designated by a capital letter in the first position.

4.3 Classification according to the mechanical installation

The mechanical installation is designated by one digit in the second position.

4.4 Classification according to the construction form and size

The construction form and the size are designated by three digits, one capital letter and two numbers. This three-digit designation is placed in the third position.

The capital letter designates the construction form, e.g. cylindrical or rectangular.

The two numbers designate the size, e.g. the diameter of cylindrical types or a length of one side for rectangular types.

4.5 Classification according to switching element function

The switching element function is designated by a capital letter placed in the fourth position.

4.6 Classification according to type of output

The type of output is designated by a capital letter and placed in the fifth position.

4.7 Classification according to method of connection

The method of connection is designated by a one-digit number placed in the sixth position.

5 Characteristics

5.1 General

5.1.1 Summary of characteristics

The characteristics of a proximity switch shall be stated in the following terms.

- Operating conditions (5.2)
- Rated and limiting values (5.3)
  - Voltages (5.3.1)
  - Currents (5.3.2)
  - Rated supply frequency (5.3.3)
  - Frequency of operating cycles (5.3.4)
  - Normal load and abnormal load characteristics (5.3.5)
  - Short-circuit characteristics (5.3.6)
- Utilization categories for the switching element (5.4).

5.1.2 Operation of an inductive or capacitive proximity switch

The output signal is determined by the presence or absence of a designated object in the electromagnetic or electric field which absorbs or alters energy radiated from the sensing face.

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