



BSI Standards Publication

Low- voltage switchgear and controlgear

Part 5-7: Control circuit devices and switching elements —
Proximity devices with analogue output

National foreword

This British Standard is the UK implementation of EN IEC 60947-5-7:2025. It is identical to IEC 60947-5-7:2024. It supersedes BS EN 60947-5-7:2003, which will be withdrawn on 30 September 2028.

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
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English Version

Low-voltage switchgear and controlgear - Part 5-7: Control
circuit devices and switching elements - Proximity devices with
analogue output
(IEC 60947-5-7:2024)

Appareillage à basse tension - Partie 5-7: Appareils et
éléments de commutation pour circuits de commande -
DéTECTEURS de proximité à sortie analogique
(IEC 60947-5-7:2024)

Niederspannungsschaltgeräte - Teil 5-7: Steuergeräte und
Schaltelemente - Anforderungen an Näherungssensoren
mit Analogausgang
(IEC 60947-5-7:2024)

This European Standard was approved by CENELEC on 2024-10-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 121A/592/FDIS, future edition 2 of IEC 60947-5-7, 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 60947-5-7:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2026-09-30 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2028-09-30 document have to be withdrawn

This document supersedes EN 60947-5-7:2003 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 is read in conjunction with EN IEC 60947-5-2:2020.

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.

Endorsement notice

The text of the International Standard IEC 60947-5-7:2024 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 standard indicated:

IEC 60068-2-31	NOTE	Approved as EN 60068-2-31
IEC 61131-2:2017	NOTE	Approved as EN IEC 61131-2:— ¹ (not modified)
IEC 61158 series	NOTE	Approved as EN 61158 series
IEC 61784-1-0	NOTE	Approved as EN IEC 61784-1-0
IEC 61784-2-0	NOTE	Approved as EN IEC 61784-2-0
IEC 61784-5-1	NOTE	Approved as EN 61784-5-1
IEC 61784-2	NOTE	Approved as EN IEC 61784-2
IEC 62683-1:2017	NOTE	Approved as EN 62683-1:2017 (not modified)
IEC 62828-1:2017	NOTE	Approved as EN IEC 62828-1:2018 (not modified)
IEC 62828-4:2020	NOTE	Approved as EN IEC 62828-4:2020 (not modified)
IEC/TR 63201:2019	NOTE	Approved as CLC IEC/TR 63201:2020 (not modified)

¹ Under preparation. Stage at the time of publication: FprEN IEC 61131-2:2017.

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.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60947-5-2	2019	Low-voltage switchgear and controlgear - Part 5-2: Control circuit devices and switching elements - Proximity switches	EN IEC 60947-5-2	2020
-	-		+ A11	2022
IEC 61131-9	2022	Programmable controllers - Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)	EN IEC 61131-9	2022
IEC 62443-2	series	Security for industrial automation and control systems	EN IEC 62443-2	series
IEC/TS 63208	2020	Low-voltage switchgear and controlgear - Security aspects	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 5-7: Control circuit devices and switching elements –
Proximity devices with analog output**

FOREWORD

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IEC 60947-5-7 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. It is an International Standard.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

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

- a) New structure;
- b) Update and expansion of definitions on analog output properties;
- c) Expanded performance requirements on analog output;

- d) Update and new normative references;
- e) Update of EMC requirements;
- f) Harmonization with IEC 62828 series;
- g) Harmonization with IEC 62683 and IEC 61987 definitions;
- h) Harmonization with IEC 61131-2 requirements;
- i) Update of the Annex A (former Annex G), Example of the determination of the conformity;
- j) New Annex B, Overview tests and influence quantities;
- k) New Annex C, Additional requirements for proximity switches with analog output incorporating a built-in communication interface complying with IEC 61131-9;
- l) New Annex D, Main characteristics for proximity devices with analog output.

This International Standard is to be read in conjunction with IEC 60947-5-2:2019.

The text of this International Standard is based on the following documents:

Draft	Report on voting
121A/592/FDIS	121A/604/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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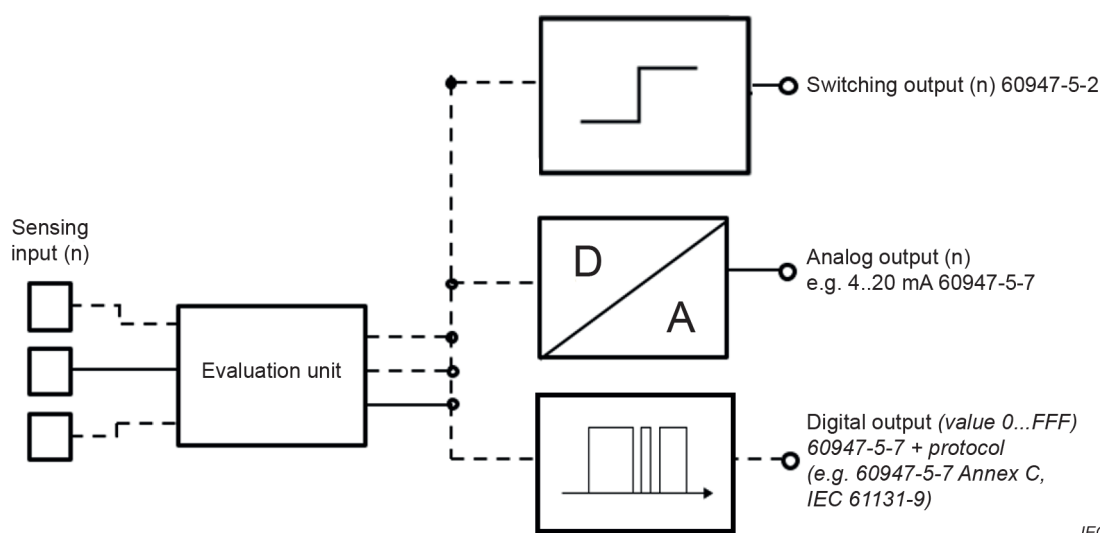
LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 5-7: Control circuit devices and switching elements – Proximity devices with analog output

1 Scope

This part of IEC 60947 states the requirements for proximity devices that correspond to the scope of IEC 60947-5-2:2019 with analog output (PDAO) and/or a digital output to transmit a corresponding digital value representing the detected sensing input. These devices can provide additional parameters. Figure 1 shows the schematic principle of such a device. They might consist of one or more parts.

The requirements of IEC 60947-5-2, *Low-voltage switchgear and controlgear – Part 5-2: Control circuit devices and switching elements – Proximity switches*, apply with the additions and modifications as stated in this document. The clause numbering in this document follows the clause numbering of IEC 60947-5-2, modified where necessary.



Key

evaluation unit Evaluating electronic circuitry, e.g. MCU, ASIC component...

**Figure 1 – Proximity device with analog output (PDAO),
schematic block diagram structure**

This document does not apply to industrial process measurement transmitters according to IEC 62828 series.

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.

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

NOTE 1 Analog proximity devices can be linear or non linear.

NOTE 2 The specific requirements, characteristics, and test procedures for an analog output interface which are described in Clauses 5, 6 and 9 of this document, are based on requirements written in IEC 61131-2:2017.

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

IEC 61131-9:2022, *Programmable controllers – Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)*

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

IEC TS 63208:2020, *Low-voltage switchgear and controlgear – Security aspects*

3 Terms, definitions and list of abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 60947-5-2:2019 and the following apply.

ISO and IEC maintain terminology 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>

3.1 Basic definitions

3.1.1

proximity device with analog output

PDAO

device producing an output signal which varies continuously depending on the physical quantity (e.g. distance, speed, rotation, etc.) detected/calculated by the proximity device in relation to its target object(s)

3.1.2

lower range value

minimum stated input value above which the output signal varies continuously

3.1.3

upper range value

maximum stated input value below which the output signal varies continuously

3.1.4

range of input values

range defined by lower range value and upper range values of the sensing element detection capability, or calculated value (e.g. distance, speed, r/min, etc.), within which the limits of uncertainty of the proximity device are specified

Note 1 to entry: A principle diagram describing the terms of 3.1.2 to 3.1.4 is given in Figure 3.

3.1.5

span

range of input values

algebraic difference between the values of the upper and lower limits of the measuring range

Note 1 to entry: Upper and lower limits do not reflect the sensing capabilities of the device, but the relevant upper and lower values for the application.

Note 2 to entry: The CDD code of this entry for Electronic Data Exchange is ABB785, modified ("other variables" removed).

[SOURCE: IEC 60050-311:2001, 311-03-13, modified — Notes to entry added]

3.2 Operation of a proximity device

3.2.1

linearity

ability of a proximity device to provide an indication having a linear relationship with a defined quantity other than an influence quantity

Note 1 to entry: The method of expression of lack of linearity is different for different kinds of device and is established in each particular instance.

[SOURCE: IEC 60050-311:2001, 311-06-05, modified – "measuring instrument" replaced by "proximity device"]

3.2.2

conformity of the output signal curve

ability of a proximity device to provide an indication having a specified characteristic curve which can be linear, logarithmic, parabolic, etc.

3.2.3

non-linearity

deviation from ideal behaviour for devices that have a linear input/output relationship, determined from the curve plotted using the overall average of corresponding upscale and downscale errors

Note 1 to entry: Non-linearity can be calculated and expressed in one of three ways: – independent: line positioned so as to minimize the maximum deviation; – terminal-based: line positioned so as to coincide with the actual characteristic curve at the upper and lower range-values; – zero-based: line positioned so as to coincide with the actual characteristic curve at the lower range-value.

Note 2 to entry: The corresponding properties can be found in the CDD.

Note 3 to entry: Linearity is defined in IEC 60050-300:2001, 311-06-06.

Note 4 to entry: Non-linearity does not include hysteresis.

Note 5 to entry: Conformity is often used in conjunction with non-linear curves.

[SOURCE: IEC 61987-13:2016, modified — Notes to entry added]

3.2.4

non-conformity of the output signal curve

deviation from ideal behaviour for devices that have a non-linear input/output relationship, determined from the curve plotted using the overall average of corresponding upscale and downscale errors

Note 1 to entry: The non-conformity is defined as the closeness with which an average error curve approximates to a specified characteristic curve (which can be linear, logarithmic, parabolic, etc.).

3.2.5

true value

<of a physical quantity value> value consistent with the definition of a given particular quantity

Note 1 to entry: This term is used in the "true value" approach.

Note 2 to entry: Value that would be obtained by a perfect measurement.

Note 3 to entry: True values are by nature indeterminate.

Note 4 to entry: The indefinite article "a", rather than the definite article "the", is used in conjunction with "true value" because there can be many values consistent with the definition of a given particular quantity.

[SOURCE: IEC 60050-311:2001, 311-01-04]

3.2.6

conventional true value

<of a physical quantity value> value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: The "conventional true value" is sometimes called "assigned value", "best estimate of the value", "conventional value" or "reference value". The term "reference value", in this sense, should not be confused with "reference value" in the sense used in IEC 60050-311:2001, 311-07-01.

Note 3 to entry: Frequently, a large number of results of measurement of a quantity are used to establish a conventional true value.

Note 4 to entry: An alternative concept of measurement uncertainty used for measurement instruments is described in IEC Guide 115:2021, *Application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector*.

3.2.7

inaccuracy

maximum positive and negative deviation from the specified characteristic curve observed in testing a device under specified conditions and by a specified procedure

Note 1 to entry: Accuracy is defined in IEC 60050-311:2001, 311-06-08.

[SOURCE: IEC 61298-1:2008, 3.5]

3.2.8

long term drift

drift in output monitored for 30 days at 90 % of span

[SOURCE: IEC 61987-1:2008, 3.22]

3.2.9**long term stability**

drift of zero output signal in percent of full scale limit after a given period of normal operating conditions

Note 1 to entry: The long term stability can be evaluated over a different period of time, e.g. 6 months, 1, 2 or 5 years. Sometimes manufacturers declare a life-time stability.

Note 2 to entry: Depending the type of a proximity device, the drift can be referred to an upper range limit, a fixed value, a full scale, etc.

3.2.10**repeatability**

value of variation of the output signal under specified conditions expressed as a percentage of the span

Note 1 to entry: This definition is more general and not equal to the definition in IEC 60947-5-2:2019.

3.2.11**resolution value**

resolution of the value of the physical quantity

Note 1 to entry: The resolution value from the digital output value and the analog output value can be different.

3.2.12**error**

discrepancy between a computed, observed or measured value or condition, and the true, specified or theoretically correct value or condition

Note 1 to entry: An error within a system may be caused by failure of one or more of its components, or by activation of a systematic fault.

[SOURCE: IEC 60050-192:2015, 192-03-02]

3.2.13**linearity error of the digital output**

maximum deviation between the real and the ideal curve of the digital output

3.2.14**linearity error of the analog output**

maximum deviation between the real and the ideal curve of the analog output

3.2.15**reference base for linearity error**

basis for stating the linearity error for analog output

Note 1 to entry: The reference base can be output span, full scale or definition by the manufacturer.

3.2.16**upscale error**

arithmetic mean of the errors at each value of each measurement cycle with increasing input value

3.2.17**downscale error**

arithmetic mean of the errors at each value of each measurement cycle with decreasing input value

3.2.18**average error**

arithmetic mean of all upscale and downscale readings at each value

3.2.19

maximum measured error

largest positive or negative value of errors of the average upscale or downscale values at each point of measurement

Note 1 to entry: Synonymous to measured error expressed as percentage ABB652 of IEC 61987.

[SOURCE: IEC 61298-1:2008]

3.2.20

total probable error

TPE

number obtained by taking the square root of the total sum of the squares of the individual error factors, adopted to consistently compare the performances of two (or more) devices

Note 1 to entry: It is assumed that the variables of the individual errors are independent of each other.

Note 2 to entry: When combining all the error factors, the units of measure shall all be the same.

3.3 Output element characteristics

3.3.1

analog current signal

current signal which varies in a continuous manner within its range

3.3.2

analog voltage signal

voltage signal which varies in a continuous manner within its range

3.3.3

range of an analog signal

all values of the signal between and including defined limits

3.3.4

output span

algebraic difference between the values of the upper and the lower limits of the output signal

3.3.5

lower limit output signal

specified minimum value of the range

Note 1 to entry: The lower limit may be either zero or a finite value; when zero is used, this is called "true zero"; when a finite value is used, this is called "live zero".

3.3.6

upper limit output signal

specified maximum value of the range

3.3.7

load impedance

<maximum load (current), minimum load (voltage)> impedance or impedances for which the output characteristics of the proximity device are specified

3.3.8

ripple content

ratio between the peak-to-peak value of the AC component and the upper limit of the signal value