



SLOVENSKI STANDARD
oSIST prEN IEC 60947-5-7:2022
01-oktober-2022

Nizkonapetostne stikalne in krmilne naprave - 5-7. del: Krmilne naprave in stikalni elementi - Zahteve za bližinske naprave z analognim izhodom

Low-voltage switchgear and controlgear - Part 5-7: Control circuit devices and switching elements - Requirements for proximity devices with analogue output

Niederspannungsschaltgeräte - Teil 5-7: Steuergeräte und Schaltelemente - Anforderungen an Näherungssensoren mit Analogausgang

Appareillage à basse tension - Partie 5-7: Appareils et éléments de commutation pour circuits de commande - Exigences pour les détecteurs de proximité à sortie analogique

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121A/514/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

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IEC SC 121A : LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR	
SECRETARIAT: France	SECRETARY: Mr Michaël LAHEURTE
OF INTEREST TO THE FOLLOWING COMMITTEES: SC 65B	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: <input checked="" type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input checked="" type="checkbox"/> SAFETY	
<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	<input type="checkbox"/> NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

Low-voltage switchgear and controlgear - Part 5-7: Control circuit devices and switching elements - Requirements for proximity devices with analogue output

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

SC121A Officers support circulation of CDV for project IEC 60947-5-7 ED2.

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

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CONTENTS

1		
2		
3	FOREWORD.....	5
4	1 Scope.....	7
5	2 Normative references.....	7
6	3 Terms, definitions and list of abbreviations.....	8
7	3.1 Basic definitions.....	8
8	3.2 Operation of a proximity device.....	8
9	3.3 Output element characteristics.....	11
10	3.4 List of abbreviations.....	14
11	4 Classification.....	14
12	4.1 General.....	14
13	5 Analog Characteristics.....	15
14	5.1 General.....	15
15	5.3 Rated and limiting values for the proximity device and output elements.....	15
16	5.3.1 Voltages.....	15
17	5.3.2 Currents.....	15
18	5.3.3 Load conditions.....	15
19	5.3.4 Linearity.....	16
20	6 Product information.....	16
21	6.1 Identification.....	16
22	6.1.1 Adding information.....	16
23	6.1.2 Specific information of 6.1.1 bc) Output characteristics.....	16
24	6.4 Environmental information.....	17
25	6.4.1 Environmentally conscious design process (ECD process).....	17
26	6.4.2 Procedure to establish material declaration.....	17
27	7 Normal service, mounting and transport conditions.....	17
28	8 Constructional and performance requirements.....	17
29	8.1 General.....	17
30	8.1.1 Load conditions.....	17
31	8.2 Performance requirements.....	17
32	8.2.5.2.1 Acceptance criteria.....	17
33	8.5 Analog output limit values.....	17
34	8.5.1 Environmental test conditions.....	18
35	8.5.1.4 Non-Repeatability.....	18
36	9 Tests.....	19
37	9.1 General.....	19
38	9.3.1 Test sequences.....	19
39	9.6 Verification of the electromagnetic compatibility.....	19
40	9.6.1 General.....	19
41	9.8 Additional requirements for proximity switches with analog output.....	20
42	9.8.1 Requirements for test programs and proper functioning verification procedures (PFVPs).....	20
43	9.8.2 Verification of analog output.....	21
44	9.8.3 Accuracy and related factors.....	22
45	9.9 Testing of detection capabilities of physical sizes like operating distance, speed, rotation speed, frequency,.....	22
46		
47		

48	9.9.1	General	22
49	Annex G (informative)	Example of the determination of the conformity	24
50	G.1	Example 1 of the determination of the conformity of an angle sensor, with linear output characteristics	24
51			
52	G.2	Example 2 of the determination of the conformity of a position sensor, with nonlinear output characteristics	27
53			
54	G.3	Test report and technical documentation	29
55	G.3.1	Test report	29
56	G.3.2	Technical documentation	29
57	G.3.3	Total probable error TPE	29
58	Annex H (informative)	Overview tests and influence quantities	31
59	H.1	Tests at the standard reference conditions	31
60	H.2	Tests at ambient and process reference conditions for influence quantities	32
61	Annex I (normative)	Additional requirements for proximity switches with analog output incorporating a built-in communication interface complying with IEC 61131-9	34
62			
63	I.1	Scope	34
64	I.3	Terms and definitions	34
65	I.3.1	Basic definitions	34
66	I.3.3	Output element characteristics	34
67	I.3.3.12	Single drop digital communication interface (SDCI)	34
68	I.5	Analog Characteristics	34
69	I.5.4	Rated and limiting values for SDCI	34
70	I.6	Product information	34
71	I.8	Constructional and performance requirements	34
72	I.8.1	General	34
73	I.8.2	Performance requirements	35
74	I.9	Tests	35
75	I.9.1	General	35
76	Annex J (informative)	Main characteristics for proximity devices with analog output	36
77	J.1	Properties of proximity devices with analog output	36
78	J.2	Library of product properties and value lists	37
79	J.2.1	Library of properties used in the device classes	38
80	J.2.2	Value lists of properties	40
81	Bibliography		42
82			
83	Figure 1 – Proximity device with analog output (PDAO), schematic block diagram structure		7
84			
85	Figure 2 – Principle diagram of time values and their meanings		13
86	Figure 3 – Principle diagram of limit values and their ranges		14
87	Figure 4 – limit values of analog output signals		18
88	Figure G.1 – Output values diagram corresponding to example of Table G.1		25
89	Figure G.2 – Error curves corresponding to example of Table G.1		26
90	Figure G.3 – Non-linearity error curves corresponding to the example of Table G.1		27
91	Figure G.4 – Output values diagram corresponding to example of Table G.2		28
92	Figure G.5 – Error curves corresponding to example of Table G.2		29
93			
94	Table 1 – Range of analog voltage signals		15

95	Table 2 – Range of analog current signals.....	15
96	Table 3 – Load conditions	15
97	Table 4 – Analog output signal static characteristics	16
98	Table 5 – Analog output dynamic characteristics	17
99	Table 6 – Analog output overload immunity test.....	21
100	Table 7 – Number of measurement cycles and number and position of test points	22
101	Table G.1 – Example table for the errors of a linear sensor.....	24
102	Table G.2 – Example table for the errors of a nonlinear sensor	28
103	Table H.1 – Summary of the tests at the reference conditions	31
104	Table H.2 – Summary of tests for influence quantities at the operating conditions	32
105	Table J.1 – proximity devices with analog output	36
106	Table J.2 – Library of properties used in the device classes	38
107	Table J.3 – Value lists of properties	40
108		
109		

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110 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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113 **LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –**

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

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118 **FOREWORD**

119 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising
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121 co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and
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151 International Standard IEC 60947-5-7 has been prepared by subcommittee 121A: Low-voltage
152 switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and
153 their assemblies for low voltage.

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

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

Draft	Report on voting
121A/XX/FDIS	121A/XX/RVD

157

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

160 The main changes with respect to the previous Edition 1 are the followings:

161 – New structure;

- 162 – Update and expansion of definitions on analog output properties;
163 – Expanded performance requirements on analog output;
164 – Update and new normative references;
165 – Update of EMC requirements;
166 – Harmonization with IEC 62828 series;
167 – Harmonization with IEC 62683 and IEC 61987 definitions;
168 – Harmonization with IEC 61131-2 requirements;
169 – Update of the Annexe G Example of the determination of the conformity
170 – New Annex H Overview tests and influence quantities
171 – New Annex I Additional requirements for proximity switches with analog output incorporating
172 a built-in communication interface complying with IEC 61131-9
173 – New Annex J Main characteristics for proximity devices with analog output
174 The language used for the development of this International Standard is English.

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

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

- 182 • reconfirmed,
 - 183 • withdrawn,
 - 184 • replaced by a revised edition, or prEN IEC 60947-5-7:2022
 - 185 • amended. <https://standards.iteh.ai/catalog/standards/sist/3204719f-61dc-4db4-b5b4-fbc1d333ef19/osist-pren-iec-60947-5-7-2022>
- 186

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

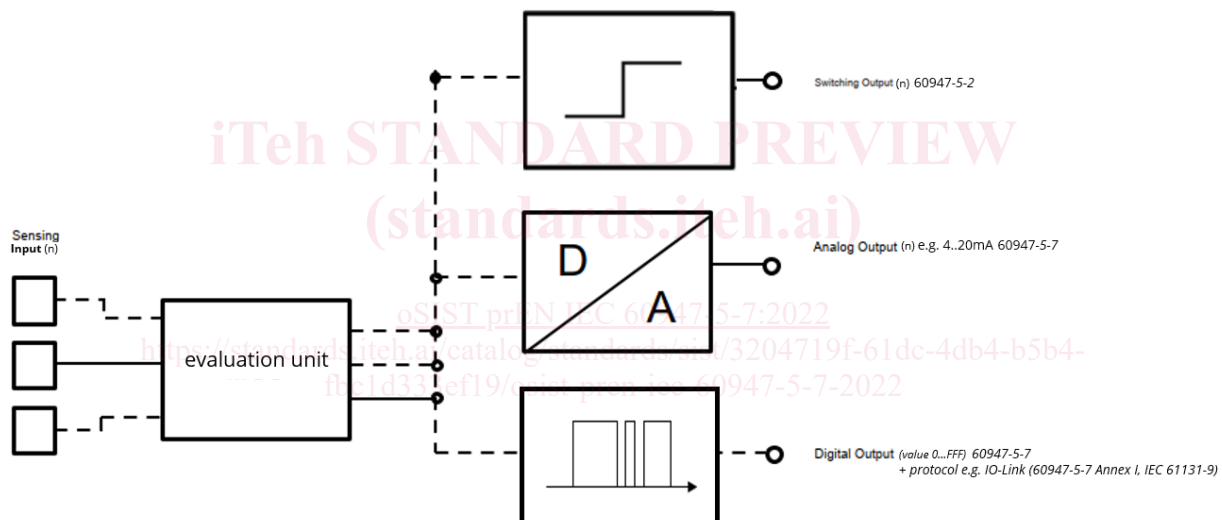
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1 Scope

196 This part of IEC 60947 states the requirements for proximity devices with analog output (PDAO)
197 and/or a digital output to transmit a corresponding digital value representing the detected
198 sensing input. These devices can provide additional parameters. Figure 1 shows the schematic
199 principle of such a device. They may consist of one or more parts.

200 The requirements of IEC 60947-5-2 (proximity switches) apply with the additions and
201 modifications as stated in this document. The clause numbering in this document follows the
202 clause numbering of IEC 60947-5-2, modified where necessary.

203



204

Key

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

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

209

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

212 NOTE Analog proximity devices are not necessarily linear devices.

2 Normative references

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

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

220 IEC 61131-2:2017, *Industrial-process measurement and control – Programmable controllers –*
 221 *Part 2: Equipment requirements and tests*

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

224

225 **3 Terms, definitions and list of abbreviations**

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

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

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

232 **3.1 Basic definitions**

233 **3.1.1**

234 **proximity device with analog output (PDAO)**

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

238 **3.1.2**

239 **lower range value**

240 minimum stated input value above which the output signal varies continuously

241 **3.1.3**

242 **upper range value**

243 maximum stated input value below which the output signal varies continuously

244 **3.1.4**

245 **range of input values**

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

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

250 **3.1.5**

251 **span**

252 synonymous: range of input values

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

254 Note 1 to entry: Limit has not to be intend as physical limits regarding the capabilities of the device, rather the
 255 upper and lower values defined for the relevant application.

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

258 [SOURCE: IEC 60050-311:2001, 311-03-13, modified: Notes added]

259 **3.2 Operation of a proximity device**

260 **3.2.1**

261 **linearity**

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

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

266 [SOURCE: IEC 60050-311:2001, 311-06-05]

- 267 **3.2.2**
 268 **conformity of the output signal curve**
 269 ability of a proximity device to provide an indication having a specified characteristic curve which can
 270 be linear, logarithmic, parabolic, etc.
- 271 **3.2.3**
 272 **non-linearity**
 273 deviation from ideal behaviour for devices that have a linear input/out relationship, determined
 274 from the curve plotted using the overall average of corresponding upscale and downscale errors
- 275 Note 1 to entry: Non-linearity can be calculated and expressed in one of three ways: – independent: line positioned
 276 so as to minimize the maximum deviation; – terminal-based: line positioned so as to coincide with the actual
 277 characteristic curve at the upper and lower range-values; – zero-based: line positioned so as to coincide with the
 278 actual characteristic curve at the lower range-value.
- 279 Note 2 to entry: The corresponding properties can be found in the CDD.
- 280 Note 3 to entry: Linearity is defined in IEC 60050(300). definition 311-06-06.
- 281 Note 4 to entry: Non-linearity does not include hysteresis.
- 282 Note 5 to entry: Conformity is often used in conjunction with non-linear curves.
- 283 [SOURCE: IEC 61987-13:2016, modified: Notes added]
- 284 **3.2.4**
 285 **non-conformity of the output signal curve**
 286 deviation from ideal behaviour for devices that have a non-linear input/output relationship, determined
 287 from the curve plotted using the overall average of corresponding upscale and downscale errors
- 288 Note 1 to entry: The non-conformity is defined as the closeness with which a calibration curve approximates to a
 289 specified characteristic curve (which can be linear, logarithmic, parabolic, etc.).
- 290 **3.2.5**
 291 **true value (of a physical quantity value)**
 292 value consistent with the definition of a given particular quantity
- 293 Note 1 to entry: This term is used in the "true value" approach.
- 294 Note 2 to entry: Value that would be obtained by a perfect measurement.
- 295 Note 3 to entry: True values are by nature indeterminate.
- 296 Note 4 to entry: The indefinite article "a", rather than the definite article "the", is used in conjunction with "true
 297 value" because there can be many values consistent with the definition of a given particular quantity.
- 298 [SOURCE: VIM 1.19, IEV 311-01-04]
- 299 **3.2.6**
 300 **conventional true value (of a physical quantity value)**
 301 value attributed to a particular quantity and accepted, sometimes by convention, as having an
 302 uncertainty appropriate for a given purpose
- 303 Note 1 to entry: This term is used in the "uncertainty" approach.
- 304 Note 2 to entry: The "conventional true value" is sometimes called "assigned value", "best estimate of the value",
 305 "conventional value" or "reference value". The term "reference value", in this sense, should not be confused with
 306 "reference value" in the sense used in 311-07-01.
- 307 Note 3 to entry: Frequently, a large number of results of measurement of a quantity are used to establish a
 308 conventional true value.
- 309 Note 4 to entry: An alternative concept of measurement uncertainty used for measurement instruments is described
 310 in IEC Guide 115:2021 Ed.2 "Application of uncertainty of measurement to conformity assessment activities in the
 311 electrotechnical sector".
- 312 **3.2.7**
 313 **inaccuracy**
 314 maximum positive and negative deviation from the specified characteristic curve observed in
 315 testing a device under specified conditions and by a specified procedure
- 316 Note 1 to entry: Accuracy is defined in IEC 60050-300, definition 311-06-08.
- 317 [SOURCE: IEC 61298-1:2008]

- 318 **3.2.8**
319 **long term drift**
320 drift in output monitored for 30 days at 90 % of span
- 321 [SOURCE: IEC 61987-1:2008, 3.22]
- 322 **3.2.9**
323 **long term stability**
324 drift of zero output signal in percent of full scale limit after a given period of normal operating
325 conditions
- 326 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
327 years. Sometime manufacturers declare a life-time stability.
- 328 Note 2 to entry: Depending the type of a proximity device, the drift can be referred to an upper range limit, a fixed
329 value, a full scale, etc.
- 330 **3.2.10**
331 **repeatability**
332 value of variation of the output signal under specified conditions expressed as a percentage of
333 the span
- 334 Note 1 to entry: This definition is more general and not equal to the definition in IEC 60947-5-2:2019
- 335 **3.2.11**
336 **resolution value**
337 resolution of the value of the physical quantity
- 338 Note 1 to entry: The resolution value from the digital output value and the analog output value can be different
- 339 **3.2.12**
340 **error**
341 discrepancy between a computed, observed or measured value or condition, and the true,
342 specified or theoretically correct value or condition
- 343 Note 1 to entry: An error within a system may be caused by failure of one or more of its components, or by activation
344 of a systematic fault.
<https://standards.iteh.ai/catalog/standards/sist/3204719f-61dc-4db4-b5b4-pren-iec-60947-5-7-2022>
- 345 [SOURCE: IEC 60050-192:2015, 192-03-02]
- 346 **3.2.13**
347 **linearity error of the digital output**
348 maximum deviation between the real and the ideal curve of the digital output
- 349 **3.2.14**
350 **linearity error of the analog output**
351 maximum deviation between the real and the ideal curve of the analog output
- 352 **3.2.15**
353 **reference base for linearity error**
354 basis for stating the linearity error for analog output
- 355 Note 1 to entry: The reference base can be output span, full scale or definition by the manufacturer.
- 356 **3.2.16**
357 **upscale error**
358 arithmetic mean of the errors at each value of each measurement cycle with increasing input
359 value
- 360 **3.2.17**
361 **downscale error**
362 arithmetic mean of the errors at each value of each measurement cycle with decreasing input
363 value
- 364 **3.2.18**
365 **average error**
366 arithmetic mean of all upscale and downscale readings at each value

367 **3.2.19**
368 **maximum measured error**
369 largest positive or negative value of errors of the average upscale or downscale values at each
370 point of measurement

371 Note 1 to entry: synonymous to measured error expressed as percentage ABB652 of IEC/CDD IEC 61987

372 [SOURCE: IEC 61298-1:2008]

373 **3.2.20**
374 **Total Probable Error TPE**
375 number obtained by taking the square root of the total sum of the squares of the individual error
376 factors, adopted to consistently compare the performances of two (or more) devices

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

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

379 **3.3 Output element characteristics**

380 **3.3.1**
381 **analog current signal**
382 current signal which varies in a continuous manner within its range

383 **3.3.2**
384 **analog voltage signal**
385 voltage signal which varies in a continuous manner within its range

386 **3.3.3**
387 **range of an analog signal**
388 all values of the signal between and including defined limits

389 **3.3.4**
390 **output span**
391 synonymous: range of an analog signal
392 algebraic difference between the values of the upper and lower limits of the output signal

393 **3.3.5**
394 **lower limit output signal**
395 specified minimum value of the range

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

398 **3.3.6**
399 **upper limit output signal**
400 specified maximum value of the range

401 **3.3.7**
402 **load impedance (maximum load (current), minimum load (voltage))**
403 impedance or impedances for which the output characteristics of the proximity device are
404 specified

405 **3.3.8**
406 **ripple content**
407 ratio between the peak-to-peak value of the AC component and the upper limit of the signal
408 value

409 **3.3.9**
410 **recovery time**
411 time taken, following the removal of an external influence for the output signal to return to its
412 previous value within the limits of repeatability as defined in 3.2.10.

413 **3.3.10**
414 **warm-up time**
415 duration between the instant when the power supply is energized and the instant when the
416 device can be used, as specified by the manufacturer