



SLOVENSKI STANDARD
oSIST prEN 50539-11:2011
01-oktober-2011

Nizkonapetostne naprave za zaščito pred prenapetostnimi udari - Naprave za zaščito pred prenapetostnimi udari za specifične aplikacije, vključno z enosmernimi - 11. del: Zahteve in preskusi za SPD v fotovoltaičnih aplikacijah

Low-voltage surge protective devices - Surge protective devices for specific application including d.c. - Part 11: Requirements and tests for SPDs in photovoltaic applications

Überspannungsschutzgeräte für Niederspannung - Überspannungsschutzgeräte für besondere Anwendungen einschließlich Gleichspannung - Teil 11: Anforderungen und Prüfungen für Überspannungsschutzgeräte für den Einsatz in Photovoltaik Installationen

Parafoudres basse tension - Parafoudres pour applications spécifiques incluant le courant continu - Partie 11: Exigences et essais pour parafoudres connectés aux installations photovoltaïques

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ICS:

29.120.50	Varovalke in druga medtokovna zaščita	Fuses and other overcurrent protection devices
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**Low-voltage surge protective devices -
Surge protective devices for specific application including d.c. -
Part 11: Requirements and tests for SPDs in photovoltaic applications**

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Überspannungsschutzgeräte für
Niederspannung -
Überspannungsschutzgeräte für
besondere Anwendungen einschließlich
Gleichspannung -
Teil 11: Anforderungen und Prüfungen
für Überspannungsschutzgeräte für den
Einsatz in Photovoltaik-Installationen

iTeh STANDARD PREVIEW
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This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
Deadline for CENELEC: 2011-11-04.

It has been drawn up by CLC/TC 37A.

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CENELEC

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91

Foreword

92 This draft European Standard was prepared by the Technical Committee CENELEC TC 37A, Low voltage
93 surge protective devices. It is submitted to the second CENELEC enquiry.

94

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95 1 Scope

96 This European Standard defines the requirements and tests for SPDs intended to be installed on the d.c.
97 side of photovoltaic installations to protect against induced and direct lightning effects. These devices are
98 connected to d.c. power circuits of photovoltaic generators, rated up to 1 500 V.

99 It takes into account that photovoltaic generators

- 100 • behave like current generators,
- 101 • that their nominal current depends on the light intensity,
- 102 • that their short-circuit current is almost equal to the nominal current,
- 103 • are connected in series and/or parallel combinations leading to a great variety of voltages, currents
104 and powers from a few hundreds of W (in residential installations) to several MW (photovoltaic
105 fields).

106 The very specific electrical parameters of PV installations on the d.c. side require specific test requirements
107 for SPDs.

108 SPDs with separate between input and output terminal(s) that contain a specific series impedance between
109 these terminal(s) (so called two port SPDs according to IEC 61643-11) are currently not sufficiently covered
110 by the requirements of this standard and require additional consideration

111 NOTE In general SPDs for PV applications do not contain a specific series impedance between the input/output terminals due to power
112 efficiency considerations.

113 SPDs complying with this standard are exclusively dedicated to be installed on the d.c. side of photovoltaic
114 generators. PV installation including batteries and other d.c. applications are not taken into account and
115 additional requirements and tests may be necessary for such applications.

116 SPDs for which the manufacturers declares short circuit mode overload behaviour, shall require specific
117 measures to ensure that such devices will not endanger the operator during maintenance and replacement
118 due to possible d.c. arcing.

119 2 Normative references

120 The following referenced documents are indispensable for the application of this document. For dated
121 references, only the edition cited applies. For undated references, the latest edition of the referenced
122 document (including any amendments) applies.

123 HD 588.1 S1:1991, High-voltage test techniques – Part 1: General definitions and test requirements
124 (IEC 60060-1:1989 + corrigendum Mar. 1990)

125 EN 60529:1991, Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)

126 EN 61000-6-1:2007, Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for
127 residential, commercial and light-industrial environments (IEC 61000-6-1:2005)

128 EN 61000-6-3:2007, Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard
129 for residential, commercial and light-industrial environments (IEC 61000-6-3:2006)

130 EN 61180-1:1994, High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and
131 procedure requirements (IEC 61180-1:1992)

132 IEC 61643-11:2011 Low-voltage surge protective devices – Part 11: Surge protective devices connected to
133 low-voltage power systems – Requirements and tests methods

134 3 Terms, definitions and abbreviations

135 For the purposes of this document, the following terms, definitions and abbreviations apply.

136 3.1 Terms and definitions

137 3.1.1

138 **Surge Protective Device**

139 **SPD**

140 device that contains at least one nonlinear component that is intended to limit surge voltages and divert
141 surge currents

142 [IEC 61643-11:2011]

143 NOTE An SPD is a complete assembly, having appropriate connecting means.

144 3.1.2

145 **one-port SPD**

146 SPD having no intended series impedance

147 NOTE A one port SPD may have separate input and output connections.

148 [IEC 61643-11:2011]

149 3.1.3

150 **voltage switching type SPD**

151 SPD that has a high impedance when no surge is present, but can have a sudden change in impedance to a
152 low value in response to a voltage surge

153 NOTE Common examples of components used in voltage switching type SPDs are spark gaps, gas tubes and thyristors. These are
154 sometimes called "crowbar type" components.

155 [IEC 61643-11:2011]

156 3.1.4

157 **voltage limiting type SPD**

158 SPD that has a high impedance when no surge is present, but will reduce it continuously with increased
159 surge current and voltage

160 NOTE Common examples of components used in voltage limiting type SPDs are varistors and avalanche breakdown diodes. These
161 are sometimes called "clamping type" components.

162 [IEC 61643-11:2011]

163 3.1.5

164 **combination type SPD**

165 SPD that incorporates both, voltage switching components and voltage limiting components. The SPD may
166 exhibit voltage switching, limiting or both

167 [IEC 61643-11:2011]

168 3.1.6

169 **modes of protection**

170 an intended current path between terminals, that contains one or more protective components, for which the
171 manufacturer declares a protection level, e.g. + to -, + to earth, - to earth

172 NOTE Additional terminals may be included within this current path.

173 [IEC 61643-11:2011, modified]

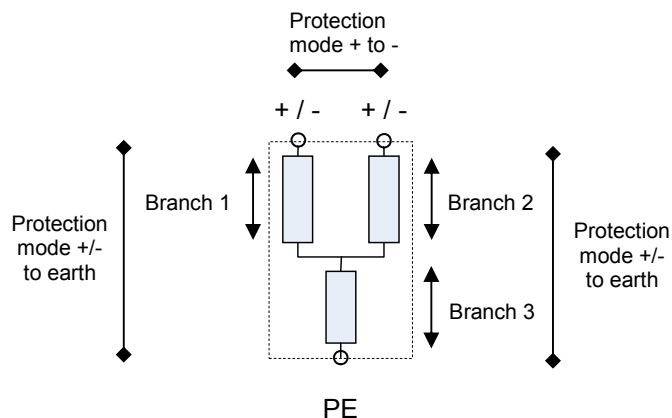
174 3.1.7

175 **current branch of an SPD**

176 an intended current path, between two nodes that contains one or more protective components

177 NOTE 1 A current branch of an SPD may be identical with a mode of protection of a SPD.

178 NOTE 2 This intended current path does not include additional terminals.



179

180

Figure 1 – Current branches vs. modes of protection of an SPD

181

3.1.8

182

nominal discharge current

183

 I_n

184

crest value of the current through the SPD having a current waveshape of 8/20

185

[IEC 61643-11:2011]

186

3.1.9

187

impulse discharge current for class I test

188

 I_{imp}

189

crest value of a discharge current through the SPD with specified charge transfer Q and specified energy W/R in the specified time

190

[IEC 61643-11:2011]

192

3.1.10

193

maximum discharge current

194

 I_{max}

195

crest value of a current through the SPD having an 8/20 waveshape and magnitude according to the manufacturer's specification. I_{max} is equal to or greater than I_n

196

[IEC 61643-11:2011]

198

3.1.11

199

maximum continuous operating voltage for PV application

200

 U_{CPV}

201

maximum d.c. voltage which may be continuously applied to the SPDs mode of protection

202

3.1.12

203

continuous operating current for PV application

204

 I_{CPV}

205

current flowing between active lines of the SPD when energized at U_{CPV} , when connected according to the manufacturer's instructions

206

207

3.1.13

208

residual current

209

 I_{PE}

210

current flowing through the PE terminal of the SPD while energized at U_{CPV} when connected according to the manufacturer's instructions

211

[IEC 61643-11:2011, modified]

213

3.1.14

214

follow current

215

 I_f

216

peak current supplied by the electrical power system and flowing through the SPD after a discharge current impulse

217

218

NOTE The follow current is significantly different from the continuous operating current I_{CPV} .

219

[IEC 61643-11:2011, modified]

- 220 **3.1.15**
 221 **rated load current**
 222 I_L
 223 maximum continuous rated d.c. current that can be supplied to a resistive load connected to the protected
 224 output of an SPD
 225 [IEC 61643-11:2011, modified]
- 226 **3.1.16**
 227 **voltage protection level**
 228 U_p
 229 maximum voltage to be expected at the SPD terminals due to an impulse stress with defined voltage
 230 steepness and an impulse stress with a discharge current with given amplitude and waveshape
- 231 NOTE The voltage protection level is given by the manufacturer and should not be exceeded by the measured limiting voltage,
 232 determined for front-of-wave sparkover (if applicable) and the measured limiting voltage, determined from the residual voltage
 233 measurements at amplitudes up to I_n and/or I_{imp} for test classes I and II.
- 234 [IEC 61643-11:2011, modified]
- 235 **3.1.17**
 236 **measured limiting voltage**
 237 highest value of voltage that is measured across the terminals of the SPD during the application of impulses
 238 of specified waveshape and amplitude
 239 [IEC 61643-11:2011]
- 240 **3.1.18**
 241 **residual voltage**
 242 U_{res}
 243 crest value of voltage that appears between the terminals of an SPD due to the passage of discharge current
 244 [IEC 61643-11:2011]
- 245 **3.1.19**
 246 **1,2/50 voltage impulse**
 247 voltage impulse with a nominal virtual front time of 1,2 μ s and a nominal time to half-value of 50 μ s
- 248 NOTE Clause 6 of HD 588.1 S1:1991 defines the voltage impulse definitions of front time, time to half-value and waveshape tolerance.
 249 [IEC 61643-11:2011]
- 250 **3.1.20**
 251 **8/20 current impulse**
 252 current impulse with a nominal virtual front time of 8 μ s and a nominal time to half-value of 20 μ s
- 253 NOTE The Clause 8 of HD 588.1 S1:1991 defines the current impulse definitions of front time, time to half-value and waveshape
 254 tolerance.
 255 [IEC 61643-11:2011]
- 256 **3.1.21**
 257 **thermal runaway**
 258 operational condition when the sustained power dissipation of an SPD exceeds the thermal dissipation
 259 capability of the SPD component, housing and connection, leading to a cumulative increase in the
 260 temperature of the internal elements and resulting in failure
 261 [IEC 61643-11:2011]
- 262 **3.1.22**
 263 **thermal stability**
 264 SPD is thermally stable if, after heating up during the operating duty test, its temperature decreases with time
 265 while energized at specified maximum continuous operating voltage and at specified ambient temperature
 266 conditions
 267 [IEC 61643-11:2011]

- 268 **3.1.23**
269 **degradation (of performance)**
270 undesired permanent departure in the operational performance of equipment or a system from its intended
271 performance
272 [IEC 61643-11:2011]
- 273 **3.1.24**
274 **short-circuit current rating**
275 I_{SCPV}
276 maximum prospective short-circuit current from the power system for which the SPD, in conjunction with the
277 disconnectors specified, is rated
278 [IEC 61643-11:2011, modified]
- 279 **3.1.25**
280 **SPD disconnector (disconnecter)**
281 device for disconnecting an SPD, or part of an SPD, from the power system in the event of SPD failure
- 282 NOTE This disconnecting device is not required to have isolating capability for safety purposes. It is to prevent a persistent fault on the
283 system and is used to give an indication of an SPD's failure. Disconnectors can be internal (built in) or external (required by the
284 manufacturer). There may be more than one disconnector function, for example an over-current protection function and a thermal
285 protection function. These functions may be in separate units.
286 [IEC 61643-11:2011, modified]
- 287 **3.1.26**
288 **degree of protection of enclosure**
289 **IP**
290 classification preceded by the symbol IP indicating the extent of protection provided by an enclosure against
291 access to hazardous parts, against ingress of solid foreign objects and possibly harmful ingress of water
292 [IEC 61643-11:2011, modified]
- 293 **3.1.27**
294 **type test**
295 conformity test made on one or more items representative of the production
296 [IEC 60050-151:2001, 151-16-16]
- 297 **3.1.28**
298 **routine test**
299 test made on each SPD or on parts and materials as required to ensure that the product meets the design
300 specifications
301 [IEC 60050-151:2001, 151-16-17, modified]
- 302 **3.1.29**
303 **acceptance tests**
304 contractual test to prove to the customer that the item meets certain conditions of its specification
305 [IEC 60050-151:2001, 151-16-23]
- 306 **3.1.30**
307 **Impulse test classification**
- 308 **3.1.30.1**
309 **class I test**
310 test carried out with the impulse discharge current I_{imp} , with an 8/20 current impulse with a crest value equal
311 to the crest value of I_{imp} , and with a 1,2/50 voltage impulse
312 [IEC 61643-11:2011]
- 313 **3.1.30.2**
314 **class II test**
315 test carried out with the nominal discharge current I_n , and the 1,2/50 voltage impulse
316 [IEC 61643-11:2011]

- 317 **3.1.31**
 318 **sparkover voltage or trigger voltage of a voltage switching SPD**
 319 maximum voltage value at which the sudden change from high to low impedance starts for a voltage
 320 switching SPD
 321 [IEC 61643-11:2011]
- 322 **3.1.32**
 323 **specific energy for class I test**
 324 **W/R**
 325 energy dissipated by a unit resistance of 1Ω with the impulse discharge current I_{imp}
- 326 NOTE This is equal to the time integral of the square of the current ($W/R = \int i^2 dt$).
 327 [IEC 61643-11:2011]
- 328 **3.1.33**
 329 **prospective short-circuit current of a power supply**
 330 **I_p**
 331 current which would flow at a given location in a circuit if it were short-circuited at that location by a link of
 332 negligible impedance
 333 [IEC 61643-11:2011]
- 334 **3.1.34**
 335 **status indicator**
 336 device that indicates the operational status of an SPD, or a part of an SPD.
- 337 NOTE Such indicators may be local with visual and/or audible alarms and/or may have remote signalling and/or output contact
 338 capability.
 339 [IEC 61643-11:2011]
- 340 **3.1.35**
 341 **output contact**
 342 contact included in a circuit separate from the main circuit of an SPD, and linked to a disconnecter or status
 343 indicator
 344 [IEC 61643-11:2011]
- 345 **3.1.36**
 346 **multipole SPD**
 347 type of SPD with more than one mode of protection, or a combination of electrically interconnected SPDs
 348 offered as a unit
 349 [IEC 61643-11:2011]
- 350 **3.1.37**
 351 **total discharge current**
 352 **I_{Total}**
 353 current which flows through the earth conductor of a multipole SPD during the total discharge current test
- 354 NOTE 1 The aim is to take into account cumulative effects that occur when multiple modes of protection of a multipole SPD conduct at
 355 the same time.
- 356 NOTE 2 I_{Total} is particularly relevant for SPDs tested according to test class I, and is used for the purpose of lightning protection
 357 equipotential bonding according to EN 62305 series.
 358 [IEC 61643-11:2011, modified]
- 359 **3.1.38**
 360 **maximum prospective short-circuit current from battery**
 361 **I_{SCbat}**
 362 maximum prospective d.c. short circuit current that may be delivered in a PV system incorporating batteries
 363 to an SPD
- 364 NOTE This short circuit current may be much higher than the I_{SCPV} .

365 **3.1.39**
 366 **voltage for clearance determination**
 367 U_{\max}
 368 highest measured voltage during surge applications according to 7.3.4 for clearance determination
 369 [IEC 61643-11:2011]

370 3.2 Abbreviations

371 The Table 1 below provides the list of abbreviations used in this document.

372 **Table 1 – List of Abbreviations**

Abbreviation	Description	Definition/clause
General abbreviations		
DUT	device under test	General
IP	degree of protection of enclosure	3.1.26
SPD	surge protective device	3.1.1
W/R	specific energy for class I test	3.1.32
T_1 , T_2	product marking for test classes I and II	6.1.1
Abbreviations related to Voltage		
U_{CPV}	maximum continuous operating voltage	3.1.11
U_p	voltage protection level	3.1.16
U_{res}	residual voltage	3.1.18
U_{\max}	voltage for clearance determination	3.1.39
Abbreviations related to Current		
I_{imp}	impulse discharge current for class I test	3.1.9
I_{max}	maximum discharge current	3.1.10
I_n	nominal discharge current for class II test	3.1.8
I_f	follow current	3.1.14
I_L	rated load current	3.1.15
I_{SCPV}	short-circuit current rating	3.1.24
I_P	prospective short-circuit current of the power supply	3.1.33
I_{PE}	residual current at U_{CPV}	3.1.13
I_{Total}	total discharge current for multipole SPD	3.1.37

373 4 Service conditions

374 4.1 Voltage

375 the voltage applied continuously between the terminals of the Surge Protective Device (SPD) shall not
 376 exceed its maximum continuous operating voltage U_{CPV} .

377 4.2 Air pressure and altitude

378 Air pressure is 80 kPa to 106 kPa. These values represent an altitude of +2 000 m to -500 m respectively.

379 4.3 Temperatures

380 - normal range: -5 °C to $+40\text{ °C}$

381 NOTE This range addresses SPDs for indoor use in weather protected locations having neither temperature nor humidity control and
382 corresponds to the characteristics of external influences code AB4 in HD 60364-5-51.

383 - extended range: -40 °C to $+70\text{ °C}$

384 NOTE This range addresses SPDs for outdoor use in non weather protected locations.

385 4.4 Humidity

386 - normal range: 5 % to 95 %

387 NOTE This range addresses SPDs for indoor use in weather protected locations having neither temperature nor humidity control and
388 corresponds to the characteristics of external influences code AB4 in HD 60364-5-51.

389 - extended range: 5 % to 100 %

390 NOTE This range addresses SPDs for outdoor use in non weather protected locations.

391 5 Classification

392 The manufacture shall classify the SPDs in accordance with the following parameters.

393 5.1 SPD design**394 5.1.1 Voltage switching****395 5.1.2 Voltage limiting****396 5.1.3 Combination****397 5.2 Types 1 and 2 SPDs- Class I and II tests**

398 Information required for class I and class II tests is given in Table 2.

399

Table 2 – Tests of types 1 and 2 SPDs

Type of SPD	Tests	Required information	Test procedures (see subclauses)
Type 1	Class I	I_{imp}	7.1.1; 7.1.2; 7.1.3
Type 2	Class II	I_n	7.1.2; 7.1.3

400 5.3 Location**401 5.3.1 Indoor**

402 SPDs intended for use in enclosures and/or inside buildings or shelters.

403 SPDs installed in outdoor enclosures or shelters are considered for indoor use.

404 5.3.2 Outdoor

405 SPDs intended for use without enclosures and outside of buildings or shelters.

406 5.4 Accessibility**407 5.4.1 Accessible**

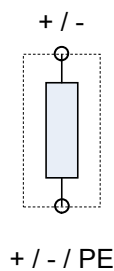
408 An SPD which can be fully or partly touched by an unskilled person, without the use of a tool to open any
409 covers or enclosures, once installed.

410 **5.4.2 Inaccessible**

411 An SPD which cannot be touched by an unskilled person either due to being mounted out of reach (e.g.
412 mounted on overhead lines) or due to being located within enclosures which can only be opened by using a
413 tool, once installed.

414 **5.5 Disconnectors (including overcurrent protection)**415 **5.5.1 Location**416 **5.5.1.1 Internal**417 **5.5.1.2 External**418 **5.5.1.3 Both (one part internal and one part external)**419 **5.5.2 Protection functions**420 **5.5.2.1 Thermal**421 **5.5.2.2 Leakage current**422 **5.5.2.3 Overcurrent**423 **5.6 Degree of protection provided by enclosures**424 **5.7 Temperature and humidity range**425 **5.7.1 Normal**426 **5.7.2 Extended**427 **5.8 Multipole SPD**428 **5.9 Connection configuration**

429 NOTE Each dotted rectangle represents one or more components connected in parallel and/or in series.

430 **5.9.1 I configuration**

431

432

Figure 2 – I configuration