



DPC: 24 / 30495069 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 18 June 2024

Origin: International

Latest date for receipt of comments: 7 August 2024

Project No. 2022/00921

Responsible committee: PEL/23 Electrical accessories

Interested committees:

Title: BS EN IEC 60669-2-1 Switches for household and similar fixed electrical installations

Part 2-1: Particular requirements - Electronic control devices

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

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

**WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD.
THIS DRAFT IS NOT CURRENT BEYOND 7 August 2024**

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <http://standardsdevelopment.bsigroup.com>

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

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



23B/1513/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 60669-2-1/AMD1 ED5	
DATE OF CIRCULATION: 2024-06-14	CLOSING DATE FOR COMMENTS: 2024-09-06
SUPERSEDES DOCUMENTS: 23B/1466/CD, 23B/1481A/CC	

IEC SC 23B : PLUGS, SOCKET-OUTLETS AND SWITCHES	
SECRETARIAT: Italy	SECRETARY: Mr Cristiano Masini
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 34,TC 72	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☒ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	

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

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE: IEC 60669-2-1 ED 6 - Switches for household and similar fixed electrical installations - Part 2-1: Particular requirements - Electronic control devices
--

NOTE FROM TC/SC OFFICERS: This 2nd CD is based on the comments received on document 23B/1466/CD and other modifications agreed by MT6. The comments received will be considered by MT6 during its next meeting. MT6 proposed, looking at the amount of modifications introduced, to published a new edition of IEC 60669-2-1 instead of an Amendment to Ed. 5. This decision will be reported to the next SC23B meeting. Please refer to document 23B/1514/INF for the track changes version.

Copyright © 2024 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

1	CONTENTS	2
2	FOREWORD	6
3	1 Scope	8
4	2 Normative references	9
5	3 Terms and definitions	11
6	4 General requirements	16
7	5 General remarks on tests	16
8	6 Ratings	18
9	7 Classification	18
10	8 Marking	20
11	9 Checking of dimensions	23
12	10 Protection against electrical shock	23
13	11 Provision for earthing	26
14	12 Terminals	26
15	13 Constructional requirements	27
16	14 Mechanism	29
17	15 Resistance to ageing, protection provided by enclosures of switches and 18 resistance to humidity	30
19	16 Insulation resistance and electric strength	30
20	17 Temperature rise	31
21	18 Making and breaking capacity	39
22	19 Normal operation	39
23	20 Mechanical strength	47
24	21 Resistance to heat	48
25	22 Screws, current-carrying parts and connections	49
26	23 Creepage distances, clearances and distances through sealing compound	49
27	24 Resistance of insulating material to abnormal heat, to fire and to tracking	60
28	25 Resistance to rusting	60
29	26 EMC requirements	60
30	101 Abnormal conditions	69
31	102 Components	76
32	103 Electromagnetic fields (EMF)	83
33	Annex A (normative) <i>Replacement of title to Annex A as follows:</i> Additional 34 requirements for electronic control devices having facilities for the outlet and 35 retention of flexible cables	84
36	Annex B (informative) Changes planned for the future in order to align IEC 60669-1 37 with the requirements of IEC 60998 (all parts), IEC 60999 (all parts) and 38 IEC 60228	85
39	Annex C (informative) Circuit development (19.3)	86
40	Annex D (informative) Additional requirements for insulation-piercing terminals	87

45	Annex E (informative) Additional requirements and tests for switches intended to be	
46	used at a temperature lower than $-5\text{ }^{\circ}\text{C}$	88
47	Annex AA (informative) Examples of types of electronic switches or HBES/BACS	
48	switches and their functions	93
49	Annex BB (informative) Circuit development: 19.106 explained	94
50	Annex CC (normative) Additional requirements for electronic control devices using	
51	DLT-technology in accordance with IEC 62756-1	100
52	Annex DD (informative) Test set-ups	102
53	Annex EE (informative) Electrical interface specification for phase-cut dimmer in	
54	phase-cut dimmed lighting systems	109
55	Annex FF (normative) Additional requirements for electronic RCS and electronic TDS	
56	that provide the function, markings, and connection configuration in accordance	
57	with IEC 60669-2-2 and IEC 60669-2-3	140
58	Annex GG (informative) Test procedure for the tests of subclause 101.2.2.2	147
59	Annex HH (informative) Temperature rise test for control gear dimmed in leading	
60	edge: 17.101.4 explained	148
61	Bibliography	149
62		
63		
64	Figure 101 – Test pin for checking the protection against electric shock	28
65	Figure 102 – Current path tested in the looping through circuit	39
66	Figure 103 – Circuit diagram for testing electronic switches and HBES/BACS switches	40
67	Figure 104 – Protective separation between circuits	54
68	Figure 105 – Multilayer printed circuit board example	59
69	Figure 106 – Minimum creepage and clearances on printed circuit boards	73
70	Figure 107 – Surge test	81
71	Figure BB.1 – 120 V 15 W (LT spice model)	95
72	Figure BB.2 – 230 V 15 W (LT spice model)	96
73	Figure BB.3 – Model for multiple lamp loads	97
74	Figure BB.4 – I_{peak} and I^2t for multiple lamp loads	97
75	Figure DD.1 – Test setup for AC mains connection according to IEC 61000-4-4	102
76	Figure DD.2 – Test setup for bus and DC mains connection according to	
77	IEC 61000-4-4	103
78	Figure DD.3 – Test setup for AC mains connection according to IEC 61000-4-5	104
79	Figure DD.4 – Test setup for bus and DC mains connection according to	
80	IEC 61000-4-5	105
81	Figure DD.5 – Test setup for the ESD according to IEC 61000-4-2	106
82	Figure DD.6 – Test setup for AC mains connection according to IEC 61000-4-6	107
83	Figure DD.7 – Test setup for bus and DC mains connection according to	
84	IEC 61000-4-6	108
85	Figure EE.1 – Example of wiring diagram	112
86	Figure EE.2 – Timing leading edge dimming method	115
87	Figure EE.3 – Timing trailing edge dimming method	120
88	Figure EE.4 – Circuit to test the properties of the phase-cut dimmer during the non-	
89	conducting phase (Method 1)	126
90	Figure EE.5 – Circuit to test the properties of the phase-cut dimmer during the non-	
91	conducting phase (Method 2)	127

92	Figure EE.6 – Circuit to test the properties of the phase-cut dimmer during the	
93	transition from the non-conducting to the conducting phase	128
94	Figure EE.7 – Circuit to test the properties of the phase-cut dimmer during the	
95	electronic off-state	130
96	Figure EE.8 – Waveform of AC voltage source – Leading edge	131
97	Figure EE.9 – Waveform of AC voltage source – Trailing edge	131
98	Figure EE.10 – Equivalent circuit for controlgear in the on state to be used during	
99	dimmer tests	132
100	Figure EE.11 – Equivalent circuit for controlgear being in off state	133
101	Figure EE.12 – Test enclosure	136
102	Figure EE.13 – Geometry of microphone placement in regard to device under test	136
103	Figure EE.14 – Test circuit to test stability of phase angle	137
104	Figure EE.15 – Possibilities for proper triggering	138
105	Figure EE.16 – Equivalent circuit EC_CG2	139
106		
107		
108	Table 1 – Number of specimens needed for the tests (to be updated according the	
109	changes confirmed)	16
110	Table 15 – Test voltage, points of application and minimum values of insulating	
111	resistance for the verification of electric strength	30
112	Table 16 – Cross-sectional areas of copper conductors for the temperature-rise test	32
113	Table 101 – Permissible temperature rise values	34
114	Table 105 – Test loads for electronic switches and HBES/BACS switches for heating	
115	installations	45
116	Table 23 – Creepage distances, clearances and distances through insulating sealing	
117	compound	49
118	Table 106 – Relation between the rated voltage of the HBES/BACS switch, the rated	
119	insulation voltage and the rated impulse voltage	52
120	Table 107 – Minimum clearances without verification test	53
121	Table 108 – Test voltages and corresponding altitudes	54
122	Table 109 – Minimum clearances with verification test	54
123	Table 110 – Minimum creepage distances of basic, supplementary and reinforced	
124	insulation without verification test for clearances	55
125	Table 111 – Minimum creepage distances of basic, supplementary and reinforced	
126	insulation with verification test for clearances	55
127	Table 112 – Type of insulation	57
128	Table 113 – Immunity tests (overview)	62
129	Table 114 – Voltage dip and short-interruption test values	62
130	Table 115 – Surge immunity test voltages	63
131	Table 116 – Fast transient test values	64
132	Table 117 – Values for radiated electromagnetic field test of IEC 61000-4-3 ^a	66
133	Table 119 – Capacitors	77
134	Table A.101 – Maximum current and minimum cross-sectional area	84
135	Table E.101 – Energy for impact tests	91
136	Table AA.1 – Functions overview	93
137	Table BB.1 – Lamp	94

138	Table EE.1 – Nominal mains voltage 100 V – Frequency 50 Hz or 60 Hz.....	116
139	Table EE.2 – Nominal mains voltage 120 V – Frequency 50 Hz or 60 Hz.....	116
140	Table EE.3 – Nominal mains voltage 200 V – Frequency 50 Hz or 60 Hz.....	116
141	Table EE.4 – Nominal mains voltage 230 V – Frequency 50 Hz or 60 Hz.....	116
142	Table EE.5 – Nominal mains voltage 277 V – Frequency 50 Hz or 60 Hz.....	116
143	Table EE.6 – Slew rate for voltage decrease across the phase-cut dimmer	117
144	Table EE.7 – Nominal mains voltage 100 V – Frequency 50 Hz or 60 Hz.....	118
145	Table EE.8 – Nominal mains voltage 120 V – Frequency 50 Hz or 60 Hz.....	118
146	Table EE.9 – Nominal mains voltage 200 V – Frequency 50 Hz or 60 Hz.....	118
147	Table EE.10 – Nominal mains voltage 230 V – Frequency 50 Hz or 60 Hz.....	118
148	Table EE.11 – Nominal mains voltage 277 V – Frequency 50 Hz or 60 Hz.....	119
149	Table EE.12 – Nominal mains voltage from 100 V to 277 V – Frequency 50 Hz or	
150	60 Hz	121
151	Table EE.13 – Nominal mains voltage 100 V – Frequency 50 Hz or 60 Hz.....	122
152	Table EE.14 – Nominal mains voltage 120 V – Frequency 50 Hz or 60 Hz.....	122
153	Table EE.15 – Nominal mains voltage 200 V – Frequency 50 Hz or 60 Hz.....	122
154	Table EE.16 – Nominal mains voltage 230 V – Frequency 50 Hz or 60 Hz.....	123
155	Table EE.17 – Nominal mains voltage 277 V – Frequency 50 Hz or 60 Hz.....	123
156	Table EE.18 – Currents and voltages for controlgear during the electronic off state	124
157	Table EE.19 – Parameters for testing purposes	125
158	Table EE.20 – Parameters for testing purposes	134
159		
160		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SWITCHES FOR HOUSEHOLD AND
SIMILAR FIXED ELECTRICAL INSTALLATIONS –****Part 2-1: Particular requirements – Electronic control devices****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60669-2-1 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories.

This fifth edition cancels and replaces the fourth edition published in 2002, Amendment 1:2008 and Amendment 2:2015. This edition constitutes a technical revision.

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

- a) incorporation of the requirements about lamp controlgear which replaces externally ballasted and self-ballasted lamps
- b) incorporation of the requirements for MOV
- c) modification of the overload test
- d) modification of Table 101 for temperature rise test
- e) incorporation of the requirements for Multilayer PCB
- f) improvements of requirements / compliance criteria in all clauses

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

FDIS	Report on voting
23B/1326/FDIS	23B/1342/RVD

216
217 Full information on the voting for the approval of this International Standard can be found in the
218 report on voting indicated in the above table.

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

220 This part of IEC 60669 is to be used in conjunction with IEC 60669-1:2017, hereinafter referred
221 to as Part 1. It lists the changes necessary to convert that standard into a specific standard for
222 electronic control devices.

223 In this document, the following print types are used:

- 224 – requirements proper: in roman type;
225 – *test specifications: in italic type*;
226 – notes: in smaller roman type.

227 Subclauses, figures, tables or notes which are additional to those in Part 1 are numbered
228 starting from 101.

229 A list of all the parts in the IEC 60669 series, published under the general title *Switches for*
230 *household and similar fixed electrical installations*, can be found on the IEC website.

231 The committee has decided that the contents of this document will remain unchanged until the
232 stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to
233 the specific document. At this date, the document will be

- 234 • reconfirmed,
235 • withdrawn,
236 • replaced by a revised edition, or
237 • amended.

238

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

239

240

SWITCHES FOR HOUSEHOLD AND SIMILAR FIXED ELECTRICAL INSTALLATIONS –

Part 2-1: Particular requirements – Electronic control devices

1 Scope

This clause of Part 1 is replaced by:

This part of IEC 60669 applies to electronic control devices, a general term to cover electronic switches, home and building electronic systems (HBES) / building automation and control systems (BACS) switches and electronic extension units.

It applies to electronic switches and to HBES/BACS switches, for alternating current (AC) only with a rated switching voltage not exceeding 250 V and a rated current not exceeding 16 A, intended for household and similar fixed electrical installations, either indoors or outdoors.

It also applies to electronic extension units with a rated supply voltage not exceeding 250 V AC and 120 V DC, such as sensors and push buttons.

This document also applies to electronic remote control switches (RCS) and electronic time delay switches (TDS). Particular requirements are given in Annex FF.

Switches including only passive components such as resistors, capacitors, inductors, positive temperature coefficient (PTC) and negative temperature coefficient (NTC) components, varistors, printed wiring boards and connectors are not considered as electronic control devices.

This document also applies to electronic switches and HBES/BACS switches of which the control is realized by an electronic signal for the operation of lighting equipment circuits and the control of the brightness of lighting equipment (dimmers) as well as the control of the speed of motors (for example, those used in ventilating fans) and for other purposes (for example, heating controls).

The operation and/or control as mentioned above can be transmitted by an electronic signal via several media, for example, powerline (mains), twisted pair, optical fibre, radio frequency, infrared, etc. and are performed:

- intentionally by a person via an actuating member, a key, a card, etc., via a sensing surface or a sensing unit, by means of touch, proximity, turn, optical, acoustic, thermal;
- by physical means, for example, light, temperature, humidity, time, wind velocity, presence of people;
- by any other influence.

This document also applies to electronic control devices which include integrated radio receivers and transmitters.

This document also applies to boxes for switches, with the exception of mounting boxes for flush-type switches.

NOTE 1. General requirements for boxes for flush-type electronic control devices are given in IEC 60670-1.

This document applies to electronic control devices for use at ambient temperature not normally exceeding 25 °C but occasionally reaching 35 °C with a lower limit of the ambient air temperature of –5 °C.

NOTE 2 For temperatures below –5 °C down to and including –45 °C, see Annex E (informative). Functional safety aspects are not covered by this document. Functional safety requirements are covered by the standards of the controlled devices.

In locations where special conditions prevail, such as in ships, vehicles and the like and in hazardous locations, for example where explosions are liable to occur, special construction and/or additional requirements may be required.

This document is not intended to cover devices which are designed to be incorporated in appliances or are intended to be delivered together with a specific appliance and which are within the scope of IEC 60730 (all parts) or IEC 61058 (all parts).

Examples of designs of electronic switches and HBES/BACS switches and functions are shown in Annex AA.

For electronic control devices using DLT-technology in accordance with IEC 62756-1 see Annex CC.

Electrical interface specification for phase-cut dimmer used in phase-cut dimmed lighting systems are given for information only in Annex EE.

2 Normative references

This clause of Part 1 applies except as follows.

Addition:

IEC 60050-845, *International Electrotechnical Vocabulary (IEV) – Part 845: Lighting* (available at www.electropedia.org)

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60127 (all parts), *Miniature fuses*

IEC 60317 (all parts), *Specifications for particular types of winding wires*

IEC 60317-0-1:2013, *Specifications for particular types of winding wires – Part 0-1: General requirements – Enamelled round copper wire*

IEC 60384-14:2005 *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60669-1:2017, *Switches for household and similar fixed electrical installations – Part 1: General requirements*

IEC 60669-2-2:2006, *Switches for household and similar fixed electrical installations – Part 2-2: Particular requirements – Electromagnetic remote-control switches (RCS)*

- 320 IEC 60669-2-3:2006, *Switches for household and similar fixed electrical installations – Part 2-3:*
321 *Particular requirements – Time-delay switches (TDS)*
- 322 IEC 60670 (all parts), *Boxes and enclosures for electrical accessories for household and similar*
323 *fixed electrical installations*
- 324 IEC 60704-1, *Household and similar electrical appliances – Test code for the determination of*
325 *airborne acoustical noise – Part 1: General requirements*
- 326 IEC 60715, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on*
327 *rails for mechanical support of switchgear, controlgear and accessories*
- 328 IEC 60730 (all parts), *Automatic electrical controls*
- 329 IEC 60990, *Methods of measurement of touch current and protective conductor current*
- 330 IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for*
331 *screw-type and screwless-type clamping units – Part 1: General requirements and particular*
332 *requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*
- 333 IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility*
334 *levels for low-frequency conducted disturbances and signaling in public low-voltage power*
335 *supply systems*
- 336 IEC 61000-3-2:2018, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for*
337 *harmonic current emissions (equipment input current ≤ 16 A per phase)*
- 338 IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of*
339 *voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for*
340 *equipment with rated current ≤ 16 A per phase and not subject to conditional connection*
341 *IEC 61000-3-3:2013/AMD1:2017*
- 342 IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement*
343 *techniques – Electrostatic discharge immunity test*
- 344 IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement*
345 *techniques – Radiated, radio-frequency, electromagnetic field immunity test*
- 346 IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement*
347 *techniques – Electrical fast transient/burst immunity test*
- 348 IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement*
349 *techniques – Surge immunity test*
- 350 IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement*
351 *techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
- 352 IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement*
353 *techniques – Power frequency magnetic field immunity test*
- 354 IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement*
355 *techniques – Voltage dips, short interruptions and voltage variations immunity tests for*
356 *equipment with input current up to 16 A per phase*
- 357 IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and*
358 *measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM)*
359 *waveguides*

- 360 IEC 61051-2, *Varistors for use in electronic equipment - Part 2: Sectional specification for surge*
361 *suppression varistors*
- 362 IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for*
363 *supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating*
364 *transformers and power supply units incorporating safety isolating transformers*
- 365 IEC 61558-2-16, *Safety of transformers, reactors, power supply units and similar products for*
366 *supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode*
367 *power supply units and transformers for switch mode power supply units*
- 368 IEC 62504, *General lighting – Light emitting diode (LED) products and related equipment –*
369 *Terms and definitions*
- 370 IEC 62756-1, *Digital load side transmission lighting control (DLT) – Part 1: Basic requirements*
- 371 IEC/TR 63037:2019, *Electrical interface specifications for self ballasted lamps and controlgear*
372 *in phase-cut dimmed lighting systems*
- 373 IEC 63044-3:2017, *Home and Building Electronic Systems (HBES) and Building Automation*
374 *and Control Systems (BACS) – Part 3: Electrical safety requirements*
- 375 CISPR 15:2018, *Limits and methods of measurement of radio disturbance characteristics of*
376 *electrical lighting and similar equipment*
- 377 CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission*
378 *requirements*
379 CISPR 32:2015/AMD1:2019
- 380 ISO 306:2013, *Plastics – Thermoplastic materials – Determination of Vicat softening*
381 *temperature (VST)*
- 382 ISO 3741, *Acoustics – Determination of sound power levels and sound energy levels of noise*
383 *sources using sound pressure – Precision methods for reverberation test rooms*
- 384 ISO 3744, *Acoustics – Determination of sound power levels and sound energy levels of noise*
385 *sources using sound pressure – Engineering methods for an essentially free field over a*
386 *reflecting plane*

387 **3 Terms and definitions**

388 This clause of Part 1 applies with the following additions:

389 **3.101**

390 **electronic switch**

391 stand-alone device designed to make or break and/or control directly the current in one or more
392 electric circuits either through mechanical switching element(s) via an electronic control circuit,
393 or through an electronic switching element via a mechanical/electronic control circuit

394 Note 1 to entry: A stand-alone device can still be controlled remotely via RF, IR or a dedicated electronic extension
395 unit.

396 Note 2 to entry: To make or break and/or to control directly means that an actuator makes or breaks the current
397 and/or controls the current.

3.102**HBES/BACS**

system consisting of control devices, processing equipment, network interfaces and gateways, where the functions are distributed and linked through a common communication process, managing multiple applications in the home and building premises.

Note 1 to entry: Examples of applications are heating, alarming, shading and lighting.

Note 2 to entry: The term “managing” includes one or more activities such as measuring, monitoring and controlling.

Note 3 to entry: Other terms that are used in the market to refer to HBES/BACS include the following: “home control network”, “home control system”, “smart home”, “building system” and “building automation system”.

Note 4 to entry: The principles of HBES/BACS can also be used for single application systems if no specific standards are available.

Note 5 to entry: A common communication process is a process using a common data-model (such as KNX, LON, Bacnet, Dotdot, etc...), independent of the physical layer.

Note 6 to entry: An application can comprise of individual products or systems.

Note 7 to entry: The controlled device is not part of HBES/BACS except for the interface to the HBES/BACS network.

[SOURCE: IEC 63044-1 A1:2021, 3.1.3,]

3.103**HBES/BACS switch**

network operated electronic device intended to be used in an HBES/BACS, using two-way communication and designed to make or break and/or to control directly the current in one or more electric networks

Note 1 to entry: The communication can use different media, for example twisted pair (TP), power line (PL), infrared (IR) and radio frequency (RF).

Note 2 to entry: To make or break and/or to control directly means that an actuator makes or breaks the current and/or controls the current.

3.104**electronic extension unit**

device connected to an electronic switch, an HBES/BACS switch, and to lighting products used in lighting systems in the building environment in order to remotely control and/or to monitor the electronic switch, the HBES/BACS switch, and lighting products used in lighting systems in the building environment

Note 1 to entry: The electronic extension unit does not control directly the current in one or more circuits (e.g. sensors, HBES/BACS push buttons, status display).

3.105**ELV****extra low voltage**

nominal voltage in the electrical installation of buildings according to the voltage band I specified in IEC 61140:2016

Note 1 to entry: Voltage band I according to IEC 61140 is a voltage below or equal to 50 V AC or 120 V DC.

[SOURCE: IEC 63044-3:2017, 3.1.7, modified – The publication IEC 61140 has been dated.]

3.106**FELV network****functional extra low voltage network**

electrical network in which the nominal voltage cannot exceed ELV under normal conditions

Note 1 to entry: FELV has simple separation from mains.

Note 2 to entry: A FELV network is not safe to touch and may be connected to protective earth.

444 [SOURCE: IEC 63044-3 A1:2021, 3.1.9,

445 **3.107**

446 **SELV network**

447 **safety extra low voltage network**

448 electrical network in which the nominal voltage cannot exceed ELV

449 – under normal conditions,

450 – under single fault conditions, including earth fault in other networks

451 Note 1 to entry: SELV has simple separation from PELV and other SELV systems, and earth and protective
452 separation from all other networks.

453 Note 2 to entry: Under normal conditions and single-fault conditions in a dry location inside a building, a SELV
454 network with a voltage not higher than 25 V AC or 60 V DC is safe to touch.

455 [SOURCE: IEC 63044-3 A1:2021, 3.1.10]

456 **3.108**

457 **PELV network**

458 **protective extra low voltage network**

459 electrical network in which the nominal voltage cannot exceed ELV

460 – under normal conditions,

461 – under single-fault conditions, except earth fault in other networks

462 Note 1 to entry: PELV has protective separation from all networks other than PELV, SELV or earth.

463 Note 2 to entry: PELV network is safe to touch within the same equipotential bonding area inside a building under
464 the following conditions: under normal and single-fault conditions in dry locations and with no large contact area with
465 a voltage not higher than 25 V AC or 60 V DC; otherwise not higher than 12 V AC or 30 V DC.

466 [SOURCE: IEC 63044-3 A1 :2021, 3.1.11]

467 **3.109**

468 **simple separation**

469 separation between network or between a network and earth by means of basic insulation

470 [SOURCE: IEC 63044-3 A1:2021, 3.1.12]

471 **3.110**

472 **protective separation**

473 separation of one electric network from another by means of

474 – double insulation, or

475 – basic insulation and protective screening (shielding), or

476 – reinforced insulation

477 [SOURCE: IEC 63044-3 A1:2021, 3.1.13]

478 **3.111**

479 **basic insulation**

480 insulation of hazardous-live-parts which provides basic protection

481 Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

482 [SOURCE: IEC 63044-3:2017, 3.1.14, modified – The note has been added.]

483 **3.112**

484 **supplementary insulation**

485 independent insulation applied in addition to basic insulation for fault protection



486 [SOURCE: IEC 63044-3:2017, 3.1.16]

487 **3.113**

488 **double insulation**

489 insulation comprising both basic insulation and supplementary insulation

490 [SOURCE: IEC 63044-3:2017, 3.1.15]

491 **3.114**

492 **reinforced insulation**

493 insulation of hazardous-live-parts which provides a degree of protection against electric shock
494 equivalent to double insulation

495 Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation
496 or supplementary insulation.

497 [SOURCE: IEC 63044-3:2017, 3.1.18, modified – The note has been added.]

498 **3.115**

499 **rated load**

500 **load assigned by the manufacturer to the electronic switch, HBES/BACS switch,**
501 **electronic TDS switch or electronic RCS switch**
502 **3.116**
503 **minimum load**

503 lowest load at which the electronic switch, HBES/BACS switch, electronic TDS switch or
504 electronic RCS switch still operates correctly

505 **3.117**

506 **minimum current**

507 lowest current at which the electronic switch, HBES/BACS switch, electronic TDS switch or
508 electronic RCS switch still operates correctly

509 **3.118**

510 **electromechanically operated contact mechanism**

511 component which operates the parts used to open and close the circuit electromechanically

512 **3.119**

513 **semiconductor switching device**

514 switching device designed to make or break the current in an electric circuit by means of the
515 controlled conductivity of a semiconductor in that circuit

516 Note 1 to entry: In a circuit where the current passes through zero (periodically or otherwise), the effect of "not
517 making" the current following such a zero value is equivalent to breaking the current.

518 Note 2 to entry: Typical examples of semiconductor switching devices are:

- 519 – electronic switching devices using the phase-cut-on principle to control the load by electronic switching on the
520 current at any phase angle at or after zero crossing in each half-wave, for example, by a thyristor;
- 521 – electronic switches or HBES/BACS switches using the phase-cut-off principle to control the load by switching off
522 the current at any phase angle after zero crossing in each half-wave, for example, by a transistor in a diode
523 bridge.

524 **3.120**

525 **phase-cut dimmer**

526 electronic switch or HBES/BACS switch that is connected in series with a load and changes the
527 supply voltage waveform applied to the load from the pure mains voltage waveform to a leading
528 edge (forward phase) or a trailing edge (reverse phase) AC voltage waveform or is capable of
529 switching between both waveforms

530 Note 1 to entry: The output voltage waveform of a phase-cut dimmer is applied to one or more loads.

531 Note 2 to entry: The conduction angle of the voltage waveform is adjustable.

532 Note 3 to entry: Within this document, where the term "dimmer" is used the term "phase-cut dimmer" is meant.

533 **3.121**

534 **mechanical control unit**

535 unit directly adjustable by mechanical means (for example, potentiometer) which controls the
536 output via electronic components

537 **3.122**

538 **electronic output control unit**

539 unit adjustable by other than mechanical means (for example, sensing unit), containing
540 electronic components and controlling the output via electronic components

541 **3.123**

542 **protective impedance**

543 impedance connected between hazardous live parts and accessible conductive parts, of such
544 value that the current, in normal use and under likely fault conditions in the electronic switch,
545 is limited to a safe value, and which is so constructed that the reliability is maintained throughout
546 the life of the electronic switch or HBES/BACS switch

547 **3.124**

548 **external flexible cable**

549 cable, a part of which is external to the electronic output control unit

550 Note 1 to entry: Such a cable may either be a supply cable or a connecting cable between separate parts of an
551 accessory.

552 **3.125**

553 **live part**

554 conductive part intended to be energized in normal operation

555 **3.126**

556 **hazardous live part**

557 live part with a voltage higher than 25 V AC or 60 V DC ripple free in dry conditions or 12 V AC
558 or 30 V DC in wet conditions

559 Note 1 to entry: Ripple free is conventionally an RMS ripple voltage not more than 10 % of the DC component.

560 **3.127**

561 **looping through function**

562 Function of the line or both line and neutral terminals to power other devices in the circuit of
563 the installation

564 **3.128**

565 **lamp controlgear**

566 one or more components between the supply and one or more lamps which may serve to
567 transform the supply voltage, limit the current of the lamp(s) to the required value, provide
568 starting voltage and preheating current, prevent cold starting, correct power factor or reduce
569 radio interference

570 Note 1 to entry: Independent dimmers are not considered to be lamp controlgear

571 Note 2 to entry: The lamp controlgear can be included in the lamp or can be an independent device

572 [SOURCE: IEC 61347-1]

573 **3.129**

574 **U_{REF}**

575 **reference test voltage**

576 r.m.s. value of voltage used for testing which depends on the mode of protection of the surge
577 protective device (SPD), the nominal system voltage, the system configuration and the voltage
578 regulation within the system

3.130**U_c****maximum continuous operating voltage**

maximum r.m.s. voltage, which may be continuously applied to the SPD's mode of protection

Note 1 to entry: The U_c value covered by this standard may exceed 1 000 V.**3.131****SPD****surge protective device**

device that is intended to protect the electrical apparatus from transient overvoltages and to divert surge currents

Note 1 to entry: A surge protective device contains at least one non-linear component

[SOURCE: IEC 614-03-48]

4 General requirements

This clause of Part 1 applies, as far as applicable.

5 General remarks on tests

This clause of Part 1 applies, as far as applicable, except as follows.

*Replace Table 1 by the following Table 1:***Table 1 – Number of specimens needed for the tests (to be updated according the changes confirmed)**

	Clauses and subclauses	Specimens	Notes
6	Ratings	A	
7	Classification	A	
8	Marking	A	
9	Checking of dimensions	ABC	
10	Protection against electric shock	ABC	a
11	Provision for earthing	ABC	b
12	Terminals	ABC	c, d, e
13	Constructional requirements	ABC	f, g
14	Mechanism	ABC	
15	Resistance to ageing, protection provided by enclosures of switches, and resistance to humidity	ABC	t
16	Insulation resistance and electric strength	ABC	h
17	Temperature rise	ABC	
18	Making and breaking capacity	ABC	i, j
19	Normal operation	ABC	i, j
20	Mechanical strength	ABC	k, l
21	Resistance to heat	ABC	m
22	Screws, current-carrying parts and connections	ABC	
23	Creepage distances, clearances and distances through sealing compound	ABC	
24	Resistance of insulating material to abnormal heat, to fire and to tracking	DEF	n, o

25	Resistance to rusting	DEF	
26	EMC requirements	G	
101	Abnormal conditions	HIJ	p, q, r
102	Components	HIJ	s
	TOTAL	10	
a) One extra set of specimens of touch sensitive electronic control devices with a protective impedance may be used for the tests of 10.2. b) One extra set of specimens of electronic control devices with printed conductors used to provide protective earthing continuity is needed for the tests of 11.101. c) Two extra sets of specimens of terminals suitable for rigid and flexible conductors are required for 12.2.5, 12.2.6 and 12.2.7. d) Five extra screwless terminals are used for the test of 12.3.11 and one extra set of specimens is used for the test of 12.3.12 e) Number of specimens required for insulation-piercing terminals (IPTs) are shown in Table D.1. f) An extra set of membranes are needed for each of the tests of 13.15.1 and 13.15.2. g) For switches with pilot light units if the electronic circuitry is so enclosed that the short-circuiting or disconnecting of components is impossible or difficult, the manufacturer shall provide additional prepared test specimens. h) One extra set of specimens of switches fitted with pilot light may be used for the tests of Clause 16. i) Only the complete contact mechanism may be submitted. j) For electronic switches and HBES/BACS switches with mechanical and electromechanical switching devices, one extra set of specimens is needed for each additional type of load (see also Table 102). k) Extra sets of specimens are needed for the tests of 20.5.2 and 20.5.3. l) One extra set of specimens of cord-operated switches is needed for the test of 20.10 m) One extra set of specimens may be used for the tests of 21.2 and 21.3. In this case the specimens shall be subjected first to the tests of 15.1. n) The test is made on one specimen (D). In case of doubt, the test shall be repeated on two further specimens (E and F). o) For electronic control devices with an IP code higher than IPX0, one extra set of specimens may be used for the test of 24.2. p) It may be necessary to provide 3 additional specimens for the test of 101.2.2.2 q) It may be necessary to provide 6 additional sets of 3 specimens for the test of 101.4. r) It may be necessary to provide 3 additional specimens for the test of 101.5. s) For electronic switches and HBES/BACS switches with a cut-out, one extra set of specimens may be used for the tests of 102.5.2.2 or 102.5.2.3. t) Two extra sets of specimens may be used for IP test IP > 20 according to 15.2.2 and 15.2.3. The specimens shall be preliminarily submitted to the ageing test of 15.1.			

599

600 5.101 Particular requirements

601 Applied voltage and current measuring instruments shall indicate true RMS values and shall not be
602 affected by factors such as waveform.

603 If the electronic circuitry is so enclosed that the short-circuiting or disconnecting of components is
604 impossible or difficult, the manufacturer shall provide one additional test specimen with leads
605 connected for measurements, short-circuiting, etc.

606 It is not necessary to connect leads to the interior of hybrid and monolith integrated circuits.

607 It may be necessary to disconnect electronic components for tests.

608 In this document the term instructions is understood to mean manufacturer's instructions.

609 NOTE Instructions can be on paper or in electronic format.

610 When the clause of Part 1 is applicable, the term "live part" used in Part 1 is considered as "hazardous
611 live part" with the exception of non-hazardous live parts of SELV circuits.

6 Ratings

This clause of Part 1 applies, as far as applicable, except as follows.

6.1 Rated voltage

Replace the first paragraph by:

Preferred rated voltages of the load circuits are 110 V, 120 V, 130 V, 220 V, 230 V and 240 V.

NOTE For electronic extension units, other AC or DC voltages are common for the power supply and communication.

6.2 Rated current

Replace the entire text of Subclause 6.2 by:

Subclause 6.2 of Part 1 applies to switches classified according to 7.102.1.

For switches classified according to 7.102.2, subclause 6.2 of Part 1 does not apply and there are no preferred values.

6.3 Preferred combinations of number of poles and ratings

Replace the entire text of Subclause 6.3 by:

There are no preferred combinations of number of poles and ratings.

6.101 Preferred rated supply frequency

The preferred rated supply frequencies are 50 Hz and/or 60 Hz.

7 Classification

This clause of Part 1 applies, as far as applicable, except as follows.

7.5 according to the method of actuating the switch:

Addition:

- touch;
- proximity;
- optical;
- acoustic;
- other external influences.

7.7 according to the method of installation, as a consequence of the design of the switch:

Addition:

NOTE This classification is not applicable for SELV electronic control devices

7.8 according to the type of connection:

Addition:

- electronic control devices without terminals equipped with connecting leads.

644 **7.9** according to the suitability to accept conductors:

645 *Add the following note at the end:*

646 NOTE 101 This classification does not apply to terminals used for communication purpose only.

647 **7.101** according to the type of product:

648 **7.101.1** electronic control devices classified as an electronic switch;

649 **7.101.2** electronic control devices classified as an HBES/BACS switch;

650 **7.101.3** electronic control devices classified as an electronic extension unit.

651 **7.102** according to the kind of load intended to be controlled by the electronic switch or
652 HBES/BACS switch:

653 **7.102.1** for general purpose use according to Part 1 up to and including 16 A;

654 **7.102.2** for dedicated loads:

655 **7.102.2.1** incandescent lamps;

656 **7.101.2.2** iron core transformers lamp controlgear for extra-low voltage incandescent lamps;

657 **7.102.2.3** electronic step-down converters lamp controlgear for extra-low voltage
658 incandescent lamps;

659 **7.102.2.4** other lamp controlgear

660 **7.102.2.5** motors;

661 **7.102.2.6** heating installations (a combination of resistive load and a motor load with a power
662 factor not less than 0,6);

663 **7.102.2.7** specific load, defined in the instructions

664 NOTE Specific loads are loads which are not listed above

665 **7.103** according to the presence of SELV, PELV or FELV parts:

666 **7.103.1.** electronic control devices with SELV, PELV or FELV parts only;

667 **7.103.2** electronic control devices without SELV, PELV or FELV parts;

668 **7.103.3** electronic control devices having a combination of parts connected to the mains
669 and SELV, PELV or FELV parts.

670 **7.104** according to the installation environment:

671 **7.104.1** electronic control devices intended to be used in a SELV/PELV environment only;

672 **7.104.2** electronic control devices intended to be used in a FELV environment only;

673 **7.104.3** electronic control devices intended to be used in a SELV/PELV, FELV and/or mains
674 environment.

675 **7.105** according to the connection to the network port based on SELV/PELV:

676 **7.105.1** connected to a network which is installed wholly within the same equipotential
677 earthing system;

678 **7.105.2** connected to a network which is not installed wholly within the same equipotential
679 earthing system.

680 **7.106** according to the mounting area

681 **7.106.1** electronic control devices intended for floor installation

682 **7.106.2** electronic control devices intended for wall installation

683 **7.106.3** electronic control devices intended for ceiling installation

684 **7.107** according to the type of switching device for electronic switches or HBES/BACS
685 switches:

686 **7.107.1** with mechanical switching mechanism;

687 **7.107.2** with semiconductor switching device to make or break the current;

688 **7.107.3** with phase-cut dimmer

689 **8 Marking**

690 This clause of Part 1 applies except as follows.

691 **8.1 General**

692 *Replace item a) by the following:*

693 *a) rated current(s)*

694 - *for switches classified according to 7.102.1, the rated current(s)*

695 - *in amperes (A) if the switch is tested according to 19.1 of Part 1 only, or*

696 - *in amperes (A) if the switch is tested according to 19.1 and 19.3 of Part 1 only, or*

697 - *in amperes (AX) if the switch is tested according to 19.1, 19.2 and 19.3 of Part 1*
698 *when the rated currents in amperes (A) and (AX) are equal, or*

699 - *in amperes (A and AX) if the switch is tested according to 19.1, 19.2 and 19.3 of Part*
700 *1 when the rated currents in amperes (A) and (AX) are not equal;*

701 - *for switches classified according to 7.102.2, the rated current(s) in amperes or rated load(s)*
702 *in volt-amperes or watts;*

703 *Add at the end of the clause:*

704 *In addition, electronic switches and HBES/BACS switches shall be marked with*

705 - *rated frequency in hertz, unless the electronic switch and HBES/BACS switch is designed for*
706 *both 50 Hz and 60 Hz;*

707 - *rating and type of any fuse incorporated in the electronic switch and HBES/BACS switch, if*
708 *intended to be replaceable;*

709 - *symbols for the kind of load (see 8.2); except for electronic switches and HBES/BACS switches*
710 *classified according to 7.102.1 for general purpose use for which Part 1 applies;*

711 - *the minimum height for mounting the electronic switch and the HBES/BACS switch shall be*
712 *indicated in the instructions if there is a restriction (see 10.1).*

713 *In addition, electronic switches and HBES/BACS switches with screwless terminals shall be*
714 *marked with an indication of the suitability to accept rigid conductors only, for those electronic*
715 *switches and HBES/BACS switches having this restriction. This information may be put on the*
716 *electronic switch*

717 For electronic switches and HBES/BACS switches with included automatic function, a higher
 718 declared number of operations than that indicated in 19.101, 19.102, 19.104, 19.106 and 19.107
 719 shall be stated in the instructions.

720 Electronic extension units are marked as for electronic switches and HBES/BACS switches but
 721 electronic extension units which are supplied by the network do not need to be marked with:

722 - rated voltage in volts;

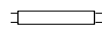
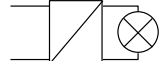
723 - rated current in amperes or rated load in volt-amperes or watts;

724 - symbol for nature of supply.

725 The method for the correct installation of the product shall be provided in the instructions.

726 8.2 Symbols

727 Addition:

Volt-ampere	VA
Hertz	Hz
Terminal for regulated load (IEC 60417-6165:2012-06)	
Type of load:	
LED light sources	LED
Incandescent lamps (IEC 60417-5012:2002-10)	
Fluorescent lamps (IEC 60417-6153:2012-04)	
Motors (ISO 7000-0147:2004-01)	
Electronic step-down converter for extra-low-voltage incandescent lamps (for example, halogen)	
Iron core transformer for extra-low-voltage incandescent lamps (for example, halogen)	

728 NOTE 101 LED light sources and fluorescent light sources are always connected to a lamp controlgear. The electronic
 729 switch and the HBES/BACS switch will switch the lamp controlgear. Since a dedicated symbol for lamp controlgear
 730 is not available, the symbols for LED light sources and fluorescent light sources are needed for the end user.

731 For electronic switches or HBES/BACS switches intended for heating installations suitable for
 732 resistive load and for motor load, the rated current for motor load is placed between round
 733 brackets and immediately follows the rated current for resistive load.

734 Example: 16(3), where 16 A is the rated current for resistive load and 3 A is the rated current
 735 for motor load.

736 NOTE 102 The rating and type of any fuse can be marked with symbols (see IEC 60127 (all parts)).

737 If other symbols are used, they shall be explained in the installation instructions.

In the case of specific load, it shall be defined in the instructions. This includes the number of operations .

Additional markings according to IEC 61140 can only be used if the protection class is not dependent on the installation conditions.

8.3 Visibility of markings

Replacement of the second paragraph with the following:

Markings a) as given in 8.1 of Part 2-1 and b), c), d), e) and, if applicable, f), g), h), k), and l) as given in 8.1 of Part 1 shall be placed on the main part of the switch and HBES/BACS switch.

The rating and type of any incorporated fuse shall be marked on the fuse-holder or in the proximity of the fuse of the switch and HBES/BACS switch.

Where an electronic switch or HBES/BACS switch classified in 7.102.2 is suitable for more than one type of load if not already marked on the electronic switch or HBES/BACS switch, the information concerning these shall be stated in the instructions. In addition, the minimum, if any, and the maximum current or the minimum, if any, and the maximum load in volt-ampere or watt shall be stated for each type of load.

If a phase-cut dimmer is intended to be used together with an iron core transformer, information shall be given in the instructions that only a transformer intended to be used with a phase-cut dimmer shall be used.

8.4 Marking on terminals for phase conductors

Addition:

If there are more than two terminals, the load terminal shall be marked with an arrow pointing away from the terminal or with one of the symbols mentioned in 8.2 and any other terminals such as those intended for signal and control lines, SELV or similar connections shall be marked in accordance with the installation instructions.

Unless the installation of the electronic control device is made clear by the markings of the terminals, a wiring diagram shall be provided with each electronic control device.

If switched circuits cannot be used in SELV/PELV network, the relevant information shall be provided in the instructions.

If a product is classified according to 7.105.1, this shall be stated in the instructions.

8.6 Marking of the switch position

Addition:

The off-state shall not be marked with an "O" if the circuit on the load side is considered as live, in accordance with Clause 10.

8.7 Additional requirements for marking

Addition after the second paragraph:

If an electronic control device containing a viewing window (lens) for a sensing device is intended to be mounted at a height greater than 1,7 m, this information shall be stated in the instructions.

If the electronic control device provides a looping through function on the input terminals through other components inside the electronic switch, such as PCBs, then the maximum rated current of the upstream fuse/circuit breaker to be installed shall be declared in the instructions.

Addition to NOTE 2:

- Information concerning external, directly associated fuses/current limiting devices, where applicable.

8.101 Other markings

It is recommended that the actual state of the electronic switch and HBES/BACS switch intended to control the brightness of lighting products be indicated when used as intended. This can be achieved by one of the following:

- with marking of the on-/off-state position, or
- with an indicator lamp, or
- by adjusting the lamp dimmer so that at the lowest control state and at rated voltage minus 10 %, the light is still visible.
- with an audible sound indicator

Adjustment is to be made by the installer using an appropriate load specified in the instructions.

9 Checking of dimensions

This clause of Part 1 applies except as follows.

Addition:

Electronic control devices may be of dimensions other than those specified in the standard sheets (if any) provided they are supplied with specific boxes.

10 Protection against electrical shock

This clause of Part 1 applies except as follows.

10.1 Prevention of access to hazardous live parts

Addition after the second paragraph:

For the purpose of this document, metal sensing surfaces which are connected to hazardous live parts by means of protective impedances (see 10.2) shall not be considered to be hazardous live parts.

Electronic switches and HBES/BACS switches without a mechanical switch in the main circuit do not provide a "full off-state". Therefore, the circuit on the load side shall be considered to be live.

Add before the last paragraph:

Viewing windows (lenses) for a sensing device or the like on electronic control devices intended for ceiling installation or for wall installation at a height greater than 1,7 m are subjected to a force of 30 N.

10.2 Requirements for operating parts

Addition:

For touch sensitive electronic control devices, the associated protective impedance does not have to comply with the requirements of Clause 16 and Clause 23.

812 For electronic control devices with a protection degree of IPX0, accessible parts which are
813 needed for the operation of electronic control devices (for example, sensing surfaces) may be
814 connected to hazardous live parts. If they are connected to hazardous live parts, it shall be by
815 means of a protective impedance.

816 The protective impedance shall consist of at least two resistors or independent capacitors in
817 series, of the same nominal value or a combination of both. The resistors shall comply with the
818 requirements given in 102.4, and the capacitors shall comply with the requirements given
819 in 102.3.

820 The removal of protective impedance shall only be possible by destruction of the electronic
821 control device or by rendering it unusable.

822 *Compliance is checked by inspection and by the following test.*

823 *The measurements are carried out between either a single accessible metal part or any*
824 *combination of accessible metal parts and earth, through a non-inductive resistor of 2 kΩ at*
825 *rated voltage (and rated load in on-state), in on- and off-state, and/or at lowest and highest*
826 *setting values. During the measurements, each one of the resistors and all other components,*
827 *if any, in the protective impedance, are alternatively short-circuited.*

828 *The current shall not exceed, in any measurement, 0,7 mA (peak value) for AC up to 1 kHz or*
829 *2 mA for DC.*

830 *For frequencies above 1 kHz, the limit of 0,7 mA is multiplied by the value of the frequency in*
831 *kilohertz but shall not exceed 70 mA.*

832 **10.101 Requirements for fuse replacement or adjustment of control setting**

833 During the replacement of fuses or adjustment of control setting there shall be no risk of electric
834 shock for the user.

835 If a cover or cover-plate or a fuse can be removed without the use of a tool, or if the instructions
836 indicate that for the purpose of maintenance, fuse replacement or adjustment of control settings,
837 covers and cover-plates fastened by means of a tool have to be removed, the protection against
838 contact with hazardous live parts shall be assured even after removal of the covers or cover-
839 plates.

840 This requirement does not apply when the electronic control device is to be dismantled from
841 its supporting means for the replacement of the fuse-link and adjustment.

842 The conditions for the safe replacement of the fuse and the safe adjustment of the setting(s)
843 shall be specified in the instructions, if relevant.

844 *Compliance is checked by applying test probe B according to IEC 61032:1997 with a force not*
845 *exceeding 10 N. The test probe shall not touch hazardous live parts.*

846 If an electronic control device is provided with a hole for adjusting the setting of the electronic
847 control device and this hole is indicated as such, there shall be no risk of electric shock for the
848 user.

849 *Compliance is checked by applying a test pin according to Figure 101 through that hole only.*
850 *The pin shall not touch hazardous live parts.*

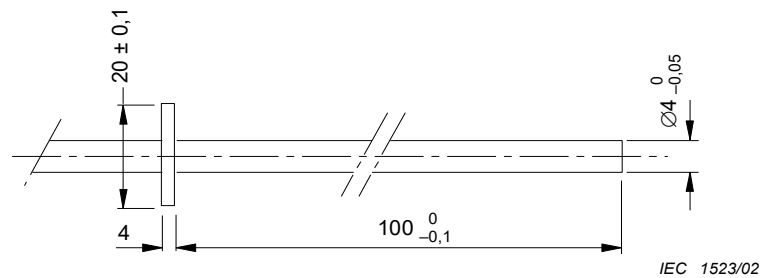


Figure 101 – Test pin for checking the protection against electric shock

10.102 Ventilation openings

Ventilation openings over hazardous live parts shall be so designed that a foreign body introduced into these openings shall not come into contact with any hazardous live parts with the electronic control device installed as in normal use.

Compliance is checked by applying the test probe 13 of IEC 61032:1997 through the openings. The pin of the test probe shall not touch hazardous live parts.

10.103 SELV, PELV or FELV networks

Live parts of SELV, PELV or FELV networks shall be electrically separated from each other and from other networks by simple or protective separation as given in Clause 23.

If the SELV / PELV is higher than 25 V AC or 60 V DC in dry conditions or 12 V AC or 30 V DC in wet conditions, protection against direct contact shall be provided by:

- barriers or enclosures giving at least the degree of protection IP2X or IPXXB, or
- insulation capable of withstanding a test voltage of 500 V AC for 1 min.

Compliance is checked by inspection and the tests of Clause 16 and Clause 23.

10.104 Protection from touch current

10.104.1 General

For an explanation on touch current, see IEC 63044-3.

10.104.2 Permissible touch current when touching accessible parts of HBES/BACS switches

The touch current of HBES/BACS switches shall not be higher than 0,5 mA RMS (0,7 mA peak) even during single fault condition.

Compliance is checked by inspection and, if necessary, by tests in accordance with IEC 60990.

10.104.3 Limitation of the touch current from the HBES/BACS switch to the dedicated HBES/BACS network

The touch current to the HBES/BACS network from HBES/BACS switches supplied from the mains supply, or from interfaces to other networks, shall be limited to 0,25 mA RMS.

Compliance is checked by measurement in accordance with IEC 60990.

881 *This test does not apply to HBES/BACS switches where the circuit to be connected to the*
882 *HBES/BACS network is connected to the protective or functional earthing terminal in the*
883 *HBES/BACS switch. In this case the touch current from the HBES/BACS switch to the network*
884 *is considered to be zero.*

885 NOTE When it is possible to touch the HBES/BACS network during maintenance, the limitation of the summation
886 of touch current can be considered to be in accordance with IEC 63044-3.

887 **11 Provision for earthing**

888 This clause of Part 1 applies except as follows.

889 Clause 11 does not apply to SELV electronic switches or to SELV HBES/BACS switches.

890 **11.101 Protective earthing continuity via printed circuit boards**

891 The printed conductors of printed circuit boards may be used to provide protective earthing
892 continuity under the following conditions only:

- 893 – at least two tracks are used each having independent soldering points which will withstand
894 a single short circuit test according to 101.4 ensuring that the current goes through the track
895 and immediately after the switch shall fulfil the requirements of 11.4, or
- 896 – a single track is used with two independent means of connection on each end which will
897 withstand a single short circuit test according to 101.4 ensuring that the current goes
898 through the track and immediately after the switch shall fulfil the requirements of 11.4.

899 In addition,

- 900 – the material of the printed circuit board shall consist of epoxide woven glass fabric copper-
901 clad laminated sheet and
- 902 – the printed circuit board shall comply with the overload test according to 101.2.2.2.

903 *Three new specimens are submitted to the test.*

904 **12 Terminals**

905 This clause of Part 1 applies except as follows.

906 **12.1 General**

907 *Replace the first paragraph of 12.1 by:*

908 *Electronic control devices classified according to 7.8 with terminals shall be provided with*
909 *terminals having screw clamping or with screwless terminals.*

910 *Addition after the last paragraph:*

911 *Terminals having screw clamping complying with IEC 60998-2-1 are considered to be in*
912 *compliance with the requirements and tests of 12.2, except those of 12.2.6 and 12.2.7 and*
913 *12.2.8, provided they are chosen according to Table 4.*

914 *Terminals for other than the main circuit (load circuit) may have different connecting capability*
915 *in relation to this circuit. This means that these terminals need not necessarily have the same*
916 *connecting capability as the mains terminals. Terminals for conductors smaller than 0,5 mm²*
917 *shall fulfil the requirements of IEC 60999-1.*

918 *Terminals having screwless clamping complying with IEC 60998-2-2 are considered to be in*
919 *compliance with the requirements and tests of 12.3 provided they are chosen according to*

920 *Table 8, except for the requirements of 12.3.7 and 12.3.9. The tests of 12.3.7 and 12.3.9 shall*
921 *be carried out in addition.*

922 **12.2 Terminals with screw clamping for external copper conductors**

923 *Addition to footnote b) of Table 4:*

924 This requirement may be achieved using terminal(s) with two separate clamping units.

925 **13 Constructional requirements**

926 This clause of Part 1 applies except as follows.

927 **13.3.1**

928 *Addition before the last paragraph*

929 Cover and cover plates of ceiling mounted electronic control devices are allowed to be fixed by
930 means of a rotating movement.

931 *Replace the last paragraph by*

932 Compliance is checked according to 13.3.2, 13.3.3, 13.3.4 or 13.3.101

933 **13.3.3**

934 *Replacement of the text in Table 12 of the last row of the first column with "To insulating parts,*
935 *earthed metal parts, the live parts of SELV or metal parts separated from hazardous live parts*
936 *by creepage distances and by clearances twice those according to 23.1".*

937 *Addition*

938 **13.3.101** For covers and cover plates of ceiling mounted electronic control devices, which are
939 intended to ensure protection against electric shock, whose fixing is not dependent on screws
940 and whose removal is obtained by applying a torque by the test of 20.101

941 **13.4 Openings in normal use**

942 *Addition after the first paragraph:*

943 Free openings according to 10.101 and 10.102 are accepted.

944 **13.5 Attachment of knobs**

945 *Replacement:*

946 Knobs of electronic control devices shall be securely fixed in a reliable manner so that they will
947 not work loose in normal use, if loosening may result in a hazard.

948 If knobs are used to indicate the position of electronic control devices, it shall not be possible
949 to fix them in a wrong position, if this may result in a hazard.

950 *Compliance is checked by inspection and by the following tests.*

951 *Where it is possible to apply an axial pull in normal use, an axial pull shall be applied for 1 min*
952 *to try to pull off the knob.*

953 *The pull force to be applied is normally 15 N, but if the knob is intended to be pulled in normal*
954 *use this is increased to 30 N.*

955 *An axial push of 30 N for 1 min is then applied to all knobs.*

956 *During and after these tests, the electronic control device shall show no damage, nor shall a*
957 *knob have moved so as to impair compliance with this document.*

958 NOTE Sealing compound and the like, other than self-hardening resins are not considered to be adequate to prevent
959 loosening.

960 **13.9 Surface-type switches having an IP code higher than IP20**

961 *Replace the second paragraph by:*

962 Wall mounted surface-type switches that have degrees of protection IPX4, IPX5 and IPX6 shall
963 have provisions for opening a drain hole.

964 **13.15 Requirements for membranes in inlet openings**

965 *Replace the title by:*

966 **13.15 Requirements for membranes in inlet opening and lenses**

967 **13.15.1**

968 *Replacement:*

969 Membranes, lenses and the like shall be reliably fixed and shall not be displaced by the
970 mechanical and thermal stresses occurring in normal use.

971 *Compliance is checked by the following tests.*

972 *Membranes, lenses and the like are tested when assembled in the electronic control devices.*

973 *First, the electronic control devices are fitted with the membranes, lenses and the like which*
974 *have been subjected to the treatment specified in 15.1.*

975 *The electronic control devices are then placed for 2 h in a heating cabinet as described in 15.1,*
976 *the temperature being maintained at $(40 \pm 2) ^\circ\text{C}$.*

977 *Immediately after this period, a force of 30 N is applied for 5 s to various parts of the*
978 *membranes, lenses and the like, by means of the tip of test probe 11 according to IEC 61032.*

979 *During these tests, the membranes, lenses and the like shall not deform to such an extent that*
980 *hazardous live parts become accessible.*

981 *For membranes, lenses and the like likely to be subjected to an axial pull in normal use, an*
982 *axial pull of 30 N is applied for 5 s.*

983 *During this test, the membranes, lenses and the like shall not come out.*

984 *The test is then repeated with membranes, lenses and the like which have not been subjected*
985 *to any treatment.*

986 **13.101 Cut-outs**

987 Cut-outs in electronic switches and HBES/BACS switches for motors shall be non-self-resetting

988 *Compliance is checked by inspection.*

989 **13.102 Electronic switches and HBES/BACS switches for the control of the voltage of**
990 **iron core transformers for extra-low-voltage incandescent lamps**

991 Electronic switches and HBES/BACS switches for the control of the voltage of iron core
992 transformers for extra-low-voltage incandescent lamps (for example, halogen) shall have a
993 maximum tolerance of the phase-control angle between the positive and negative half-wave of
994 $\pm 2^\circ$.

995 NOTE 1 Higher tolerances will generate a DC current influencing the temperature rise in the windings of the iron
996 core transformer.

997 NOTE 2 The maximum tolerance between the phase-control angle of the positive and negative half-wave can be
998 measured directly or as DC voltage as a percentage of the rated voltage. This corresponds at 90° to 1,1 % of the
999 peak value of the rated voltage.

1000 *Compliance is checked by measurement.*

1001 **13.103 Free ends of leads**

1002 Free ends of leads of electronic switches and HBES/BACS switches, if any, may be prepared
1003 but pre-soldering shall not be used.

1004 *Compliance is checked by inspection.*

1005 **13.104 Conductors used in the electronic switch and HBES/BACS switch**

1006 Internal wiring that is accessible during and/or after installation, if any, shall be secured in such a way
1007 that it cannot become loose or detached and impair the safety of the electronic switch and
1008 HBES/BACS switch.

1009 Conductor terminations using solder shall be mechanically secured. Hooking the conductor through a
1010 hole of the conductive termination or affixing conductors in thermal tubing, sealing compound or glue
1011 are examples of acceptable securement.

1012 This requirement is not applicable to internal wiring that cannot be so displaced such that clearances
1013 or creepage distances are reduced below the specified values or such that, if it becomes loose, it
1014 cannot create hazardous connections between different circuits such as primary and secondary.

1015 *Compliance is checked by inspection.*

1016 The insulation of conductors which is including internal wiring shall provide sufficient resistance to the
1017 foreseeable temperatures inside the electronic switch and HBES/BACS switch and/or the enclosure
1018 when installed in normal use. In addition, the insulation of conductors running between circuits of
1019 different voltage bands shall meet the insulation requirement of the highest voltage present.

1020 Means used for the method to secure the conductor in place shall be selected according to the
1021 foreseeable temperature conditions present inside the electronic switch and HBES/BACS switch.

1022 Means used to secure the conductor shall not reduce the clearances and creepage distances.

1023 Compliance is checked by the tests of Clause 17 Temperature rise and Clause 21 Resistance
1024 to heat and by Clause 23 Creepage distances, clearances and distances through sealing
1025 compound.

1026 **14 Mechanism**

1027 This clause of Part 1 only applies to electronic switches and HBES/BACS switches provided
1028 with mechanical switching devices.

1029 **15 Resistance to ageing, protection provided by enclosures of switches and**
 1030 **resistance to humidity**

1031 This clause of Part 1 applies.

1032 **16 Insulation resistance and electric strength**

1033 This clause of Part 1 applies except as follows.

1034 **16.1 General**

1035 *Addition after the first paragraph:*

1036 *Insulation resistance and electric strength are measured with the protective impedances*
 1037 *disconnected as described in 10.2.*

1038 *Replace the 2nd paragraph by:*

1039 *One pole of any pilot light or electronic circuit is disconnected for the test of item 3 of Table 15*
 1040 *in Clause 16.*

1041 **16.3 Electric strength test**

1042 *Replace Table 15 by the following new Table 15:*

Table 15 – Test voltage, points of application and minimum values of insulating resistance for the verification of electric strength

Insulation to be tested		Minimum value of insulation resistance MΩ	Test voltage V	
			Switches having a rated voltage not exceeding 130 V	Switches having a rated voltage exceeding 130 V
1	Between all poles connected together and the body, with the switch in the "on" position.	5	1 250	2 000
2	Between each pole in turn and all other poles connected to the body, with the switch in the "on" position.	2	1 250	2 000
3	Between the terminals which are electrically connected together when the switch is in the "on" position, the switch being in the "off" position:			
	– normal/mini-gap construction;	2	1 250	2 000
	– micro-gap construction;	2	500 ^{NOTE 1}	1 250 ^(NOTE 2)
4	Between metal parts of the mechanism, when insulated from hazardous live parts, and			
	– hazardous live parts;	5	1 250	2 000
	– metal foil in contact with the surface of the knob or a similar actuating member;	5	1 250	2 000
	– the key of key-operated switches, if insulation is required (see 10.6);	5	1 250	2 000
	– the point of anchorage of the cord, chain or rod of switches operated by such means, if insulation is required (see 10.6);	5	1 250	2 000
	– accessible metal parts, including fixing screws, of the main part, if insulation is required (see 10.5).	5	1 250	2 000

Insulation to be tested	Minimum value of insulation resistance MΩ	Test voltage V	
		Switches having a rated voltage not exceeding 130 V	Switches having a rated voltage exceeding 130 V
5 Between any metal enclosure and metal foil in contact with the inner surface of its insulating linings, if any (NOTE 3).	5	1 250	2 000
6 Between hazardous live parts and accessible metal parts, if the metal parts of the mechanism are not insulated from hazardous live parts.	—	2 000	3 000
7 Between hazardous live parts and parts of the mechanism			
– if the latter parts are not insulated from accessible metal parts (see 10.5);	—	2 000	3 000
– if the latter parts are not insulated from the point of contact with a removable key or operating cord, chain or rod (see 10.6).	—	2 000	3 000
8 Between hazardous live parts and metal knobs, push-buttons and the like (see 10.2).	—	2 500	4 000 ^(NOTE 3)
9 Between LV (mains) network(s) and FELV network(s)	5	1 500	1 500
10 Between SELV/PELV networks and other network(s) having a higher voltage than SELV/PELV	5	3 000	3 750
11 Between a SELV or PELV network below 25 V AC or 60 V DC and a SELV or PELV network above 25 V AC or 60 V DC	5	500	500
12 Between a SELV or PELV network above 25 V AC or 60 V DC and accessible surfaces (see Clause 10)	5	500	500
13 Between a SELV and PELV networks or between different SELV or different PELV networks from different sources	5	500	500
14 Between switching circuit(s) and control circuit(s) if they are electrically separated	5	2 000	3 000
NOTE 1 This value also applies for the electric strength test after normal operation. NOTE 2 For switches having a rated voltage up to and including 250 V, this value is reduced to – 750 V for the electric strength test after resistance to humidity; – 500 V for the electric strength test after normal operation. NOTE 3 In the following country the test of item 8 is conducted between hazardous live parts and metal knobs, push-buttons and metal foil in contact with the outer surface of accessible external parts and operating keys of insulating material. The test voltage for switches with a rating voltage exceeding 130 V is to be 3000 V: AU. NOTE 4 The test according to item 3 is carried out only on electronic switches and HBES/BACS switches combined with mechanical switches. NOTE 5 Only items 10, 11, 12 and 13 are applicable to SELV or PELV parts of electronic control devices. NOTE 6 Items 1 to 9 are not applicable to SELV or PELV parts of electronic control devices.			

1045

1046 **17 Temperature rise**

1047 This clause of Part 1 is completely replaced by the following:

17.101 Temperature rise due to the load

17.101.1 General requirements and test conditions

Electronic switches and HBES/BACS switches shall be so constructed that the temperature rise due to the load in normal use is not excessive.

The metal and the design of the contacts, if any, shall be such that the operation of the electronic switches and HBES/BACS switches is not adversely affected by oxidation or any other deterioration.

The design and the material of the electronic switch and HBES/BACS switch shall be such that the material and the components in the electronic switch and HBES/BACS switch are not adversely affected by the temperature rise in normal use.

Compliance is checked by the following temperature rise test with the particular test conditions set out in 17.101.2, 17.101.3 and 17.101.4 according to the type of switching device.

The electronic switches and HBES/BACS switches shall be connected as for normal use with the fuses, circuit breakers or other current-limiting means, if any, specified in the instruction sheets.

The electronic switches and HBES/BACS switches are fitted with the conductors as specified in Table 16; the terminal screws or nuts, if any, are tightened with a torque equal to two-thirds of that specified in Table 5.

Table 16 – Cross-sectional areas of copper conductors for the temperature-rise test

Rated current A	Nominal cross-sectional area of conductors mm ²
Up to and including 6	1,5
Above 6 up to and including 13	2,5
Above 13 up to and including 16	4 ^a
^a For switches provided with screwless terminals, the test shall be carried out with conductors having a cross-sectional area of 2,5 mm ² .	

If the electronic switch provides a looping through function to power other devices in the circuit via the input terminals and where the circuit current is transferred not only via the terminals but through other components inside the electronic switch, then this looping through circuit is loaded in addition to the rated current of the upstream fuse/circuit breaker declared in the instructions minus the rated load already connected to the switch.

NOTE 101 The rated loads are verified at the rated voltage with the electronic switch or HBES/BACS switch short-circuited.

Flush-mounted electronic switches and HBES/BACS switches are mounted in flush-mounted boxes. The box is placed in a block of pinewood filled around the box with plaster, so that the front edge of the box does not protrude and is not more than 5 mm below the front surface of the pinewood block.

The test assembly shall be allowed to dry for not less than seven days when first made.

The size of the pinewood block, which may be fabricated from more than one piece, shall be such that there is at least 25 mm of pinewood surrounding the plaster, the plaster having a thickness between 10 mm and 15 mm around the maximum dimensions of the sides and rear of the box.

NOTE 102 The sides of the cavity in the pinewood block can have a cylindrical shape.

1082 *The cables connected to the electronic switch shall enter through the top of the box, the point(s)*
1083 *of entry being sealed to prevent the circulation of air. The length of each conductor within the*
1084 *box shall be (80 ± 10) mm.*

1085 *Surface-type electronic switches and HBES/BACS switches shall be mounted as in normal use,*
1086 *centrally on the surface of a wooden block, which shall be at least 20 mm thick, 500 mm wide*
1087 *and 500 mm high.*

1088 *The other types of electronic switches and HBES/BACS switches shall be mounted according*
1089 *to the instructions or, in the absence of such instructions, in the position of normal use*
1090 *considered to give the most onerous conditions.*

1091 *The test assembly shall be placed in a draught-free environment for the test.*

1092 *The temperature is determined by thermocouples, so chosen and positioned that they have*
1093 *negligible effect on the temperature being determined.*

1094

1095

Table 101 – Permissible temperature rise values

Parts of the electronic switch			Permissible temperature rise K	
			Clause 17	Clause 101
External accessible parts when installed during normal use				
1	Metal parts	Knobs, handles, sensing surfaces, etc.	40	75
2	Metal parts	Enclosure ^a	50	75
3	Non-metallic parts	Knobs, handles, sensing surfaces, etc. ^b	60	75
4	Non-metallic parts	Enclosure ^{a, b}	70	75
Windings of transformers and core laminations in contact therewith ^c				
5	Class A		75	115
6	Class E		90	130
7	Class B		95	140
8	Class F		115	155
9	Class H		140	175
10	Class N		160	195
11	Class R		180	215
12	Class 250		210	245
Other insulations (^c) except thermoplastic:				
13	Non-impregnated paper		65	-
14	Non-impregnated cardboard		70	-
15	Impregnated cotton, silk, paper and textile		80	-
16	Urea resins		80	-
17	Laminates bonded with phenol-formaldehyde resins		95	-
18	Phenol-formaldehyde mouldings with cellulose fillers		95	-
19	Phenol-formaldehyde mouldings with mineral fillers		105	-
20	Printed Circuit Board on the area subject to heat		130 ^g	160 ^f
21	Natural rubber		55	-
22	Silicone rubber		135	-
23	Thermoplastic materials on the area subject to heat, with the exception of thermoplastic materials supporting live part, and accessible when installed during normal use ^d		e	-
24	Terminals and parts which may come into contact with external cable insulation when installed		55	110
The values of the permissible temperature rises are based on an ambient temperature of 25 °C, but the measurements are made under normal conditions.				
^a For areas not exceeding 5 cm ² and which are not likely to be touched in normal use, temperature rises up to 75 K are allowed under normal operating conditions.				
^b If these temperature rises are higher than those allowed by the class of the assessed insulating material, the nature of the material is the governing factor.				
^c For the purpose of this document, the permissible temperature rises are based on the recommendations in IEC 60085. The materials quoted above are shown only as examples. If materials other than those listed in IEC 60085 are used, the maximum temperatures shall not exceed those which have been proved to be satisfactory.				
^d Natural and synthetic rubbers are not considered as being thermoplastic materials.				
^e The temperature, if any, is measured in relation with Clause 21.4 "Ball-pressure test on parts of insulating material not necessary to retain current carrying parts and parts of the earthing circuit in position" of IEC 60669-1.				
^f The temperature rise may exceed the above value (160 K, for Clause 101)) by not more than 100 K for a maximum period of 1 min.				
^g For the test of Clause 17 the maximum measured temperature shall not exceed the typical value of the maximum operational temperature (MOT) of the printed circuit board as given in the data sheets.				

1096 NOTE 103 For the purpose of the test of 21.4, the temperature rise of external parts of insulating material not
 1097 necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact
 1098 with them, is also determined.

1099 NOTE 104 Undue oxidation of contacts can be prevented by sliding action or by the use of silver or silver-faced
 1100 contacts.

1101 NOTE 105 In the case of combination of electronic switches, the test is carried out separately on each electronic
 1102 switch.

1103 *For the purposes of the tests of 102.3, 102.4 and 102.5.2, the reference temperature surrounding a*
 1104 *component in an electronic switch and HBES/BACS switch is the maximum temperature rise*
 1105 *measured on the component during the test plus 25 °C.*

1106 **17.101.2 Particular test conditions for electronic switches and HBES/BACS switches**
1107 **with mechanical switching mechanism**

1108 *The temperature rise test shall be performed on the three specimens A, B and C prior to the*
1109 *normal operation tests of clause 19.*

1110 *The specimens shall be loaded with the maximum rated current or rated power that results in*
1111 *the maximum temperature rise.*

1112 *In addition, the temperature rise test shall be performed on all specimens already submitted to*
1113 *the normal operation tests of clause 19 but with the same load used for the relevant normal*
1114 *operation test.*

1115 NOTE 101 Due to the contact degradation temperature rise test may be more critical after the normal operation
1116 test.

1117 NOTE 102 Specimens A, B and C are submitted to the temperature rise test twice, before and after the normal
1118 operation test.

1119 *The electronic switches and HBES/BACS switches are loaded until steady-state temperature is*
1120 *reached or for 4 h, whichever is the shorter time, at a voltage between 0,9 and 1,1 times rated*
1121 *voltage, whichever is the more unfavourable. Steady-state value is reached when the variation*
1122 *of the temperature rise does not exceed 1 K/h.*

1123 *During the test, the state of the electronic switches and HBES/BACS switches shall not change,*
1124 *fuses and other protective devices shall not operate, and the permissible temperature rises*
1125 *determined in Table 101, column concerning Clause 17, shall not be exceeded and the*
1126 *components shall operate within their operating temperature range.*

1127 *After this test, the electronic switches and HBES/BACS switches shall be in operating condition.*

1128 *If sealing compounds are used, they shall not have flowed to such an extent that hazardous*
1129 *live parts are exposed.*

1130 *Compliance is checked by inspection.*

1131 **17.101.3 Particular test conditions for electronic switches and HBES/BACS switches**
1132 **with semiconductor switching device**

1133 *The temperature rise test shall be performed on three specimens once prior to the normal*
1134 *operation tests of clause 19.*

1135 NOTE In the case of semiconductor switching devices the normal operation tests do not have
1136 any influence on the result of the temperature rise test.

1137 *The specimens shall be loaded with the maximum rated current or rated power that results in*
1138 *the maximum temperature rise.*

1139 *The electronic switches and HBES/BACS switches are loaded until steady-state temperature is*
1140 *reached or for 4 h, whichever is the shorter time, at a voltage between 0,9 and 1,1 times rated*
1141 *voltage, whichever is the more unfavourable. Steady-state value is reached when the variation*
1142 *of the temperature rise does not exceed 1 K/h.*

1143 *During the test, the state of the electronic switches and HBES/BACS switches shall not change,*
1144 *fuses and other protective devices shall not operate, and the permissible temperature rises*

1145 *determined in Table 101, column concerning Clause 17, shall not be exceeded and the*
 1146 *components shall operate within their operating temperature range.*

1147 *After this test, the electronic switches and HBES/BACS switches shall be in operating condition.*

1148 *If sealing compounds are used, they shall not have flowed to such an extent that hazardous*
 1149 *live parts are exposed.*

1150 *Compliance is checked by inspection.*

1151 **17.101.4 Particular test conditions for electronic switches and HBES/BACS switches** 1152 **with phase-cut dimmer**

1153 **17.101.4.1 General**

1154 *The temperature rise test shall be performed once prior to the normal operation tests of clause*
 1155 *19.*

1156 NOTE 101 In the case of electronic switches and HBES/BACS switches with phase-cut dimmer
 1157 the normal operation tests do not have any influence on the result of the temperature rise test.

1158 *The specimens shall be loaded with a resistive load derived from the loads given in the*
 1159 *instructions that will result in the highest temperature rise.*

1160 *The resistive load resulting in the highest current between the following types of load is chosen*
 1161 *as basis to perform the test.*

1162 *For each type of rated load as given in the instructions the current (A) is calculated as follows:*

- 1163 - *For incandescent lamp loads the current (A) = Rated load (W) / Rated Voltage (V)*
- 1164 - *For iron core transformers the current (A) = Rated load (VA) / Rated Voltage (V)*
- 1165 - *For controlgear for leading edge operation (e.g. LED loads) the current (A) = 0,025 x*
 1166 *value of Rated load (W)*
- 1167 - *For controlgear for trailing edge operation (e.g. LED loads) the current (A) = Rated load*
 1168 *(W) / Rated Voltage (V)*

1169 *The type of load that results in the highest calculated current is used as a basis for performing*
 1170 *the temperature rise test.*

1171 EXAMPLE Defined loads of dimmer / Rated Voltage = 230V

Rated load (W/VA)	I (A)
Incandescent lamps 300 W	= 300 W / 230 V = 1,3 A
Iron-core transformers 300 VA	= 300 VA / 230 V = 1,3 A
Controlgear leading edge 100 W	= 0,025 * 100 W = 2,5 A
Controlgear trailing edge 200 W	= 200 W / 230 V = 0,87 A

1172 Result: the controlgear load for leading edge is chosen for this dimmer to perform the temperature rise test.

1173 NOTE 102 The value of 0,025 is the average rms Current / Watt that has been measured on dimmable lamp
 1174 controlgear when dimmed at 90° phase angle. Further explanation is given in Annex HH.

1175 **17.101.4.2 Test procedure A**

1176 *When the highest calculated current is representing the controlgear with leading edge the*
1177 *following procedure applies.*

1178 *The specimens are loaded with a resistive load that at Rated Voltage will have a current equal*
1179 *to 0,015 x value of the Rated load (W).*

1180 *The setting is set at 90° phase angle.*

1181 *The specimens are loaded until steady-state temperature is reached or for 4 h, whichever is the*
1182 *shorter time, at a voltage 1,1 times rated voltage. Steady-state value is reached when the*
1183 *variation of the temperature rise does not exceed 1 K/h.*

1184 *During this test, the state of the electronic switches and HBES/BACS switches shall not change,*
1185 *fuses and other protective devices shall not operate and the permissible temperature rises*
1186 *determined in Table 101, column concerning Clause 17, shall not be exceeded and the*
1187 *components shall operate within their operating temperature range.*

1188 *After this test, the electronic switches and HBES/BACS switches shall be in operating condition.*

1189 *The test is then extended by increasing the load in steps of 10 % to reach a current of 0,025 x*
1190 *value of the Rated load. The dimmer setting remains at 90° phase angle.*

1191 NOTE This load is calculated without the dimmer in the circuit.

1192 EXAMPLE Controlgear 100 W leading edge. The maximum rated load is a resistive load resulting in a power of
1193 575 W at 230 V.

1194 *During this test, the state of the electronic switches and HBES/BACS switches can change, in*
1195 *which case the temperature rise measured 1 minute before the change is recorded and the*
1196 *permissible temperature rises determined in Table 101, column concerning Clause 17, shall not*
1197 *be exceeded and the components shall operate within their operating temperature range.*

1198 *After this test and after cooling down the electronic switches and HBES/BACS switches shall*
1199 *function as intended.*

1200 *If sealing compounds are used, they shall not have flowed to such an extent that hazardous*
1201 *live parts are exposed.*

1202 *Compliance is checked by inspection.*

1203 **17.101.4.3 Test procedure B**

1204 *When the highest calculated current is representing any of the other loads the following*
1205 *procedure applies.*

1206 *At the rated voltage of the load, the highest calculated current will be obtained.*

1207 *For dimmers operating in leading and trailing edge mode the dimmer is operated respectively*
1208 *in leading and trailing edge mode.*

1209 *The setting of the dimmer is adjusted such that the highest temperature rise will occur.*

1210 *The specimens are loaded until steady-state temperature is reached or for 4 h, whichever is the*
1211 *shorter time, at a voltage 1,1 times rated voltage. Steady-state value is reached when the*
1212 *variation of the temperature rise does not exceed 1 K/h.*

1213 *During this test, the state of the electronic switches and HBES/BACS switches shall not change,*
1214 *fuses and other protective devices shall not operate and the permissible temperature rises*

1215 *determined in Table 101, column concerning Clause 17, shall not be exceeded and the*
1216 *components shall operate within their operating temperature range.*

1217 *After this test, the electronic switches and HBES/BACS switches shall be in operating condition.*

1218 *If sealing compounds are used, they shall not have flowed to such an extent that hazardous*
1219 *live parts are exposed.*

1220 *Compliance is checked by inspection.*

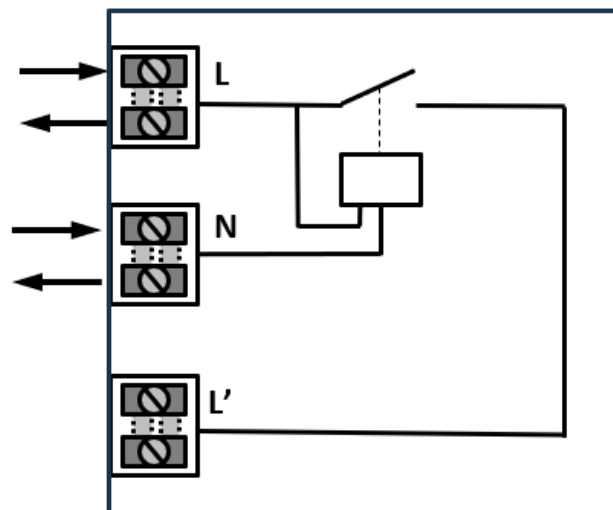
1221 **17.102 Temperature rise due to looping through the circuit**

1222 Electronic control devices connected to the mains providing means for the continuation of the
1223 circuit current, and where the circuit current is transferred not only via the terminals but through
1224 other components inside the electronic switch, such as PCBs, shall be submitted to the following
1225 test.

1226 *The electronic switch and the HBES/BACS switch are mounted according to Clause 17.101 and*
1227 *connected with conductors with the maximum accepted cross-sectional area being not less than*
1228 *1,5 mm².*

1229 *The looping through function of the electronic switch is loaded for 1 h with the rated current of*
1230 *the upstream fuse/circuit breaker declared in the instructions.*

1231 *During this test no current is transferred through the switch contacts as given in Figure 102.*



1232

1233 **Figure 102 – Current path tested in the looping through circuit**

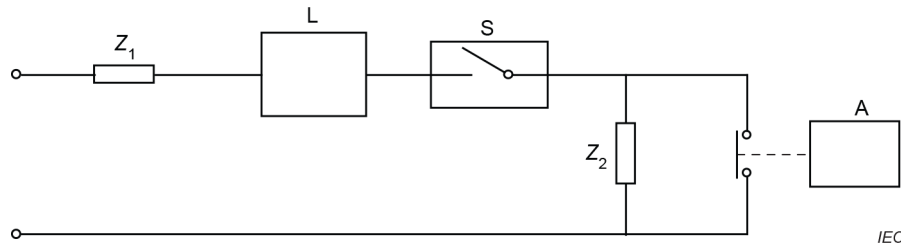
1234 *The temperature is determined by means of thermocouples, so chosen and positioned that they*
1235 *have negligible effect on the temperature being determined.*

1236 *The temperature rise of the terminals shall not exceed 55 K.*

1237 *The temperature rise of the PCB shall not exceed the maximum operational temperature (MOT)*
1238 *of the printed circuit board as given in the data sheets of this component.*

1239 *After the test the looping through circuit shall in addition be tested according to 101.4 with the*
 1240 *following modifications:*

1241 *The short circuit is applied one time by the auxiliary switch A without any synchronization with*
 1242 *respect to the voltage as given in Figure 103.*



1243

1244 **Components**

1245 Z_1 impedance for adjusting the prospective short-circuit current (non-inductive)

1246 Z_2 impedance for adjusting the load current (non-inductive)

1247 L limiting device for the prospective let-through I^2t

1248 S specimen

1249 A auxiliary switch for causing the short circuit

1250 **Figure 103 – Circuit diagram for testing electronic switches**
 1251 **and HBES/BACS switches**

1252 **18 Making and breaking capacity**

1253 This clause of Part 1 is completely replaced by the following:

1254 **18.101 General**

1255 Electronic switches and HBES/BACS switches with mechanical switching mechanism shall have
 1256 adequate making and breaking capacity.

1257 The requirements and tests of this clause apply only to electronic switches and HBES/BACS
 1258 switches provided with mechanical switching mechanisms in the load circuit.

1259 *For electronic switches and HBES/BACS switches classified for general purpose use according*
 1260 *to 7.102.1, compliance is checked by the tests of Clause 18 of Part 1.*

1261 *For electronic switches and HBES/BACS switches classified for dedicated loads according to*
 1262 *7.102.2, compliance is checked by the tests of the relevant subclauses of Clause 19.*

1263 **19 Normal operation**

1264 This clause of Part 1 is completely replaced by the following:

1265 **19.101 General**

1266 Electronic switches and HBES/BACS switches shall withstand, without excessive wear or other
 1267 harmful effect, the mechanical, electrical and thermal stresses occurring in normal use.

1268 Electronic switches and HBES/BACS switches classified for general purpose use according to
 1269 7.102.1, shall be tested according to Clause 19 of Part 1, with the exception of the electric
 1270 strength tests and the temperature rise tests which are performed according to this clause.

1271 Electronic switches and HBES/BACS switches classified for dedicated loads according to
1272 7.102.2 shall be tested as follows.

1273 *Compliance is checked by the tests of 19.102, 19.103 and 19.104 according to the type of*
1274 *switching device.*

1275 *During these tests the electronic switches and HBES/BACS switches are tested at their rated*
1276 *voltage and loaded as specified in Clause 17, unless otherwise specified.*

1277 *The electronic extension units are tested when installed according to the instructions so as to*
1278 *verify that they are capable of controlling the electronic switch or the HBES/BACS switch in*
1279 *accordance with this clause.*

1280 *During the tests, the specimens shall function correctly.*

1281 *The specimens shall then not show:*

- 1282 – *wear impairing their further use;*
- 1283 – *discrepancy between the position of the actuating member and that of the moving contacts,*
1284 *if any, if the position of the actuating member is indicated;*
- 1285 – *deterioration of enclosures, insulating linings or barriers to such an extent that the electronic*
1286 *switch or HBES/BACS switch cannot be further operated or that the requirements of*
1287 *Clause 10 are no longer complied with;*
- 1288 – *loosening of electrical or mechanical connections;*
- 1289 – *seepage of sealing compound;*
- 1290 – *relative displacement of the moving contacts of electronic switches or HBES/BACS switches*
1291 *of pattern number 2.*

1292 *During the test, the specimens are not lubricated.*

1293

1294 **19.102 Normal operation tests for electronic switches and HBES/BACS switches with**
1295 **mechanical switching mechanism**

1296 **19.102.1 General test conditions**

1297 *Electronic switches and HBES/BACS switches classified for dedicated loads according to*
1298 *7.102.2 with mechanical switching mechanism shall be tested according to Table 102.*

1299 **Table 102 – Application of tests for normal operation for electronic switches and**
1300 **HBES/BACS switches**

Kind of load	Number of specimens	Normal operation
incandescent lamps	3	19.102.2
iron core transformer lamp controlgear for extra low voltage incandescent lamps	3	19.102.2
electronic step-down converter lamp controlgear for extra low-voltage incandescent lamps	3	19.102.2

other lamp controlgear	3	19.102.3
motors	3	19.102.5
heating installations	3	19.102.4
specific load	3	19.102.6

1301 *For HBES/BACS switches, the tests are conducted on the complete HBES/BACS switch which*
 1302 *shall be controlled by the electronic extension units.*

1303 *For electronic switches and HBES/BACS switches with included automatic function the number*
 1304 *of operations is that specified in the relevant subclause. If the declared number of operations*
 1305 *is higher than those indicated in the relevant subclause, the tests shall be made according to*
 1306 *the declared value.*

1307 *Sticking of the contacts, which does not prevent the next operation of the electronic switch or*
 1308 *HBES/BACS switch, is not regarded as welding.*

1309 *Sticking of contacts is permitted for maximum 5 times if the contacts can be separated either*
 1310 *automatically at the next cycle or manually with a force applied to the actuator of a value which*
 1311 *does not damage the electronic switch or HBES/BACS switch mechanically.*

1312 *Electronic switches and HBES/BACS switches including electronic circuits which close the*
 1313 *contact of the mechanical switching mechanism always at zero-crossing $\pm 20^\circ$ phase angle, shall*
 1314 *be tested together with their electronic circuit.*

1315 NOTE 101 For the purpose of this test, the manufacturer can provide the specimens with a special circuit that
 1316 simulates the automatic operations.

1317 NOTE 102 For electronic switches and HBES/BACS switches whose cycle of operation is limited by their
 1318 applications (for example, passive infrared, time delay electronic switches, etc.), the rate of operation during the
 1319 tests can be specified in the instructions.

1320 *After the tests, the specimen shall withstand the following:*

1321 – *an electric strength test as specified in Clause 16, the test voltage of 4 000 V being,*
 1322 *however, reduced by 1 000 V and the other test voltages except for 10, 11, 12 and 13 by*
 1323 *500 V;*

1324 – *a temperature rise test as specified in Clause 17.101.*

1325 *The humidity treatment according to 15.3 is not repeated before the electric strength test of this*
 1326 *Subclause.*

1327 **19.102.2 Mechanical switching mechanisms incorporated in electronic switches and** 1328 **HBES/BACS switches intended for incandescent lamp circuits**

1329 Mechanical switching mechanisms incorporated in electronic switches and HBES/BACS
 1330 switches intended for incandescent lamp circuits with or without step-down converters are
 1331 subjected to the following test.

1332 *The test is made on three new specimens of the complete mechanical switching mechanism.*

1333 *The circuit details are as described in 18.101, unless otherwise specified.*

1334 *The number of operations is 40 000.*

1335 *The rate of operation is as specified in 18.102. There shall be no forced actuation. The on-*
 1336 *period shall be $25 \left(\frac{+5}{0}\right)$ % of the total cycle and the off-period $75 \left(\frac{0}{-5}\right)$ %.*

1337 *For rotary electronic switches and HBES/BACS switches intended to be operated in either*
 1338 *direction, the actuating member is turned in one direction for half the total number of operations*
 1339 *and in the reverse direction for the remainder.*

1340 *While testing one part, the other part is in the "off" position. The test is followed by the test of*
 1341 *14.3, if applicable.*

1342 **19.102.3 Mechanical switching mechanisms incorporated in electronic switches and**
 1343 **HBES/BACS switches intended for lamp controlgear**

1344 Mechanical switching mechanisms incorporated in electronic switches and HBES/BACS
 1345 switches intended for lamp controlgear shall withstand, without excessive wear or other harmful
 1346 effect, the electrical and thermal stresses that can occur.

1347 *The test is made on three new specimens of the complete mechanical switching mechanism.*

1348 *Compliance is checked by connecting the test circuit, including Load B, as given in Figure 12b*
 1349 *via the electronic switches and HBES/BACS switches under test to a power supply with the*
 1350 *following test conditions.*

1351 *The test circuit, including the cables for connecting the test specimen and the Load B, shall be*
 1352 *adjusted to reach, downstream the switch under test, the I_{peak} and I^2t values of Table 103.*

1353 *Indicative values for C and R2 of Load B are given in Table 104 which is given for information*
 1354 *only.*

1355 NOTE 101 The values for C and R2 in Table 104 are calculated to have the required values for inrush current and
 1356 I^2t and considering:

1357 a prospective short-circuit current (RMS) of the supply of 3 kA at $\cos \varphi = 0,9$ (lagging).

1358 a resistance R3 equal to 0,25 Ω and an inductance L equal to 20 μH simulating the twin-core cable in the test circuit.

1359 *The tolerance of the test voltage is ± 5 %. The circuit details are as described in 18.101.*

1360 *For electronic switches and HBES/BACS switches with rated power for lamp controlgear up to*
 1361 *and including 250 W: 40 000 operations with 30 operations per minute.*

1362 *For electronic switches and HBES/BACS switches with rated power for lamp controlgear higher*
 1363 *than 250 W: 40 000 operations with 15 operations per minute.*

1364 NOTE 102 R1 is the total series resistance in the lamp circuit including the ESR (equivalent series resistance) value
 1365 of the capacitor.

1366 *The values of R2 and C in load B shall be chosen in order to reach the values (± 5 %) for I_{peak}*
 1367 *and I^2t as given in Table 103 when the switching contact closes at $(90 \pm 5)^\circ$ phase-angle. The*
 1368 *value of R4 shall be chosen to reach the rated power in W (± 5 %).*

1369 **Table 103 – Values for I_{peak} and I^2t depending on the type of distribution system**

Rated power (W)	I_{peak}	I^2t	I_{peak}	I^2t
-----------------	------------	--------	------------	--------

	A Distribution system: 220/380, 230/400 240/415	A2s Distribution system: 220/380, 230/400 240/415	A Distribution system: 120/208 127/220	A2s Distribution system: 120/208 127/220
15	22	0,08	69	0,56
30	41	0,3	109	1,9
60	73	1,2	162	5,9
100	108	2,8	200	11,5
150	142	5,5	231	18,5
200	170	9	248	24,5
250	192	13	255	30
300	209	16,5	260	35
350	223	20,5	262	39
400	235	24,5	263	43
NOTE 1 For values not given in this Table 103 the test values are determined by interpolation.				
NOTE 2 The values of I_{peak} and I_{2t} were determined based on the models given in Annex BB.				

1370

1371

Table 104 – Calculated circuit parameters

Rated power (W)	R2(Ω) 230 V	C (μF) 230 V	R2 (Ω) 120 V	C (μF) 120 V
15	13	20	1,36	70
30	6,5	40	0,65	140
60	3,25	80	0,28	280
100	1,9	125	0,17	445
150	1,25	180	0,11	640
200	0,95	240	0,10	830
250	0,8	310	0,10	1 000
300	0,7	355	0,11	1 250
350	0,64	420	0,13	1 500

**Documents**

Document Sharing Hub

400	0,59	480	0,135	1 660
-----	------	-----	-------	-------

1372 *The test specimens shall be connected to the test circuit with cables of length $(1 \pm 0,1)$ m so*
 1373 *that the temperature rise measurement can be made without disturbing the terminals.*

1374 *The metal support of the electronic switch and HBES/BACS switch, if any, on which the*
 1375 *electronic switch and HBES/BACS switch is mounted, and the accessible metal parts of the*
 1376 *electronic switch and HBES/BACS switch, if any, shall be earthed through a wire fuse which*
 1377 *shall not blow during the test. The fuse element shall consist of a copper wire of 0,1 mm*
 1378 *diameter and not less than 50 mm in length.*

1379 *During this test, the electronic switch and HBES/BACS switch shall be operated so that the test*
 1380 *apparatus does not interfere with the normal action of the switching mechanism and the free*
 1381 *movement of the actuating member.*

1382 *There shall be no forced actuation. The on-period shall be $25 \left(\begin{smallmatrix} +5 \\ 0 \end{smallmatrix} \right)$ % of the total cycle and the*
 1383 *off-period $75 \left(\begin{smallmatrix} 0 \\ -5 \end{smallmatrix} \right)$ %.*

1384 *For electronic switches and HBES/BACS switches with a rated power exceeding 400W, the test*
 1385 *shall be conducted with the I_{peak} and I^2t values corresponding to 400W. In addition, the test is*
 1386 *performed on a new set of specimens in accordance with Figure 12b with the following*
 1387 *modifications:*

1388 *The prospective short-circuit current (rms) of the supply shall be between 3 kA and 4 kA at $\cos$*
 1389 *$\varphi = 0,9 \pm 0,05$ (lagging). F is a copper-wire fuse of 0,1 mm diameter having a length not less*
 1390 *than 50 mm. R1 is a resistor limiting the current to approximately 100 A.*

1391 *- The twin-core cable shall have a suitable length to give a resistance R3 equal to 0,25*
 1392 *Ω in the test circuit to the load. It shall have a cross-sectional area of 1,5 mm² when*
 1393 *electronic switches and HBES/BACS switches with rated current up to and including 10*
 1394 *A are being tested and 2,5 mm² when electronic switches and HBES/BACS switches*
 1395 *with rated current over 10 A up to and including 16 A are being tested.*

1396 *- Replace the Load B by the rated load declared in the instructions.*

1397 **19.102.4 Mechanical switching mechanisms incorporated in electronic switches and** 1398 **HBES/BACS switches designed for heating installations**

1399 *Mechanical switching mechanisms incorporated in electronic switches and HBES/BACS*
 1400 *switches intended for heating installations are subjected to the following test.*

1401 *The test is made on three new specimens of the complete mechanical switching mechanism.*

1402 *The circuit details are as described in 18.101, unless otherwise specified.*

1403 *The number of operations shall be 200 000.*

1404 *The rate of operation is as specified in 18.102. There shall be no forced actuation. The on-*
 1405 *period shall be $25 \left(\begin{smallmatrix} +5 \\ 0 \end{smallmatrix} \right)$ % of the total cycle and the off-period $75 \left(\begin{smallmatrix} 0 \\ -5 \end{smallmatrix} \right)$ %.*

1406 *For rotary electronic switches and HBES/BACS switches intended to be operated in either*
 1407 *direction, the actuating member is turned in one direction for half the total number of operations*
 1408 *and in the reverse direction for the remainder.*