

Switches for household and similar fixed electrical installations —

Part 2-1: Particular requirements — Electronic switches

The European Standard EN 60669-2-1:2000 has the status of a
British Standard

ICS 29.120.40

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National foreword

This British Standard is the official English language version of EN 60669-2-1:2000. It was derived by CENELEC from IEC 60669-2-1:1996. It supersedes BS EN 60669-2-1:1998 which is withdrawn.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by a side line in the margin.

The UK participation in its preparation was entrusted to Technical Committee PEL/23, Installed electrical accessories, which has the responsibility to:

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- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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Summary of pages

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Part 2-1: Particular requirements - Electronic switches
 (IEC 60669-2-1:1996 + A1:1997, modified)

Interrupteurs pour installations électriques
 fixes domestiques et analogues
 Partie 2-1: Prescriptions particulières -
 Interrupteurs électroniques
 (CEI 60669-2-1:1996 + A1:1997,
 modifiée)

Schalter für Haushalt und ähnliche
 ortsfeste elektrische Installationen
 Teil 2-1: Besondere Anforderungen -
 Elektronische Schalter
 (IEC 60669-2-1:1996 + A1:1997,
 modifiziert)

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CENELEC

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Foreword

The text of the International Standard IEC 60669-2-1:1996 and its amendment 1:1997, prepared by IEC SC 23B, Plugs, socket-outlets and switches, of IEC TC 23, Electrical accessories, together with the common modifications prepared by the Technical Committee CENELEC TC 23B, Switches for household and similar fixed electrical installations, was submitted to Unique Acceptance Procedure and was approved by CENELEC as EN 60669-2-1 on 2000-04-01.

This European Standard replaces EN 60669-2-1:1996 and its amendment A11:1997. It shall be used in conjunction with EN 60669-1:1999.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2001-04-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2005-10-01

Annexes designated "normative" are part of the body of this standard.

Annexes designated "informative" are given for information only.

In this standard, Annexes ZA and ZB are normative and annexe AA is informative.

Annexes ZA and ZB have been added by CENELEC.

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SWITCHES FOR HOUSEHOLD AND SIMILAR FIXED ELECTRICAL INSTALLATIONS –

Part 2-1: Particular requirements – Electronic switches

1 Scope

This clause of part 1 is replaced by the following:

This standard applies to electronic switches and to associated electronic extension units for household and similar fixed electrical installations either indoors or outdoors.

It applies to electronic switches for the operation of lamp circuits and the control of the brightness of lamps (dimmers) as well as the control of the speed of motors (e.g. those used in ventilating fans) and for other purposes (e.g. heating controls), with a working voltage not exceeding 250 V a.c. and a rated current up to and including 16 A.

The operation and control as mentioned above are performed by a person via an actuating member, a sensing surface or a sensing unit, by means of touch, proximity, turn, optical, acoustic, thermal or any other influence. This standard also applies to electronic switches where the operation or control is made by physical means, e.g. light, wind velocity, presence of persons, etc.

NOTE 1 This standard is not intended to cover devices falling within the scope of IEC 60730 or EN 61058-1.

Examples of designs of electronic switches and functions are shown in annex AA.

NOTE 2 Electronic switches without a mechanical switch in the main circuit do not provide a "full off-state". Therefore, the circuit on the load side should be considered to be live.

2 Normative references

NOTE – Normative references to international publications are listed in Annex ZA (normative).

3 Definitions

This clause of part 1 applies with the following additions:

After the first paragraph.

Addition:

The term "Electronic switch" is used as a general term to cover both switching and control devices.

Additional definitions:

3.101

rated load

load assigned to the electronic switch by the manufacturer

3.102

minimum load

minimum load at which the electronic switch still operates correctly

3.103

minimum current

permissible minimum current at which the electronic switch still operates correctly

3.104

electromechanically operated contact mechanism

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

3.105

semiconductor switching device

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

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

NOTE 2 Typical examples of semiconductor switching devices are:

- electronic switching devices using the phase-cut-on principle to control the load by switching on the current at any phase angle at or after zero crossing in each half-wave, e.g. by a thyristor;
- electronic switches using the phase-cut-off principles to control the load by switching off the current at any phase angle after zero crossing in each half-wave, e.g. by a transistor in a diode bridge.

3.106

electronic momentary contact switch

electronic switch with an electromechanical switching mechanism or a semiconductor switching device which returns automatically to the initial state after operation

3.107

mechanical control unit

unit directly adjustable by mechanical means (e.g. potentiometer) which controls the output via electronic components

3.108

electronic output control unit

unit adjustable by other than mechanical means (e.g. sensing unit), containing electronic components and controlling the output

3.109

electronic extension unit

unit permitting the control of an electronic switch from a distance

3.110

protective impedance

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

3.111

working voltage

highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the switch is supplied at rated voltage.

NOTE 1 Transients are disregarded.

NOTE 2 Both open-circuit conditions and normal operating conditions are taken into account.

3.112

flexible cable

cable, a part of which is external to the electronic output control unit. Such cable may either be a supply cable or a connecting cable between separate parts of an accessory

4 General requirements

This clause of part 1 applies.

5 General notes on tests

This clause of part 1 applies with the following modifications:

5.4 Additions

The number of test specimens is shown in table 101.

Three specimens are subjected to all the relevant tests, except for the tests of 18.2 and 19.1 where one further set of three specimens is used (or two further sets for switches of pattern number 2), and the tests of clause 24 where another three specimens are used.

For each test sequence of clause 26 and 101 three new specimens are used as shown in table 101.

Table 101

Type of electronic switch	Number for general tests	Additional specimens for clause or subclause				
		18.2	19.1	24	26	101
Marked with one rated current and						
– one voltage	3	3 ¹⁾	3 ¹⁾	3	3	3
– two voltages	6	6 ¹⁾	6 ¹⁾	6	6	6

1) For electronic switches with mechanical and electromechanical switching devices; only the complete contact mechanism may be submitted.

Note 1 – For checking compliance with the EMC requirements only the tests of clause 26 have to be carried out.

NOTE 2 – The manufacturer may submit the same set of specimens to one or more test sequences as an alternative to the table, provided all the tests are carried out on one set of three specimens.

Additional subclauses:

5.101 *All measurements shall be carried out by methods which are suitable for the purpose, which do not appreciably affect the values to be measured and which are not affected by factors such as waveform.*

NOTE Care should be taken to use instruments giving true r.m.s. indications.

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

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

5.103 *It may be necessary to disconnect electronic components for tests.*

5.104 *For electronic switches equipped with cut-outs, it may be necessary to provide three additional specimens for the test of 102.4.1.*

6 Rating

This clause of part 1 is replaced as follows:

6.1 Preferred rated a.c. voltages are 110 V, 120 V, 130 V, 220 V, 230 V and 240 V.

6.2 This subclause of part 1 does not apply.

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

7 Classification

This clause of part 1 applies with the following additions:

7.1.5 *Addition:*

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

NOTE Actuating the switch includes on/off operation, and/or regulating the brightness of lamps or speed of motors.

7.1.6 *Addition:*

- Switches only intended to be mounted at a height greater than 1,7 m.

7.1.9 According to the kind of load controlled by the switch:

- incandescent lamps;
- fluorescent lamps;
- motors;
- declared load.






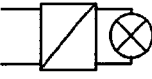
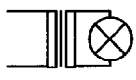
8 Marking

This clause of part 1 applies amended as follows:

8.1 Additions:

- Note to the first dashed text:
NOTE – As an alternative to the rated current, the rated load in volt-amperes or watts may be given.
- Minimum current in amperes, or minimum load in volt-amperes or watts.
- Rated frequency in hertz, unless the electronic switch is designed for both 50 Hz and 60 Hz.
- Rating and type of any fuse incorporated in the electronic switch.
- Symbols for kind of load (see 8.2).
- The term "extension unit", if applicable, or the relevant translation in the official language(s) of the country in which the product is to be sold, followed by an identifying reference.
- The minimum height for mounting the switch shall be indicated in the installation instructions of the manufacturer if there is a restriction (see 10.1).

8.2 Addition:

Volt-ampere	VA
Watt	W
Hertz	Hz
Transformer connection	
Terminal for regulated load	
Kind of load:	
Incandescent lamps	
Fluorescent lamps	
Motors	
Electronic step-down converter for low-voltage incandescent lamps (e.g. halogen)	
Iron core transformer for low-voltage incandescent lamps (e.g. halogen lamps)	

NOTE The rating and type of any fuse may be marked with symbols (see IEC 60127).

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

8.3 Replace the first line and the first dashed text by:

The following marking shall be placed on the main part of the electronic switch:

- the rated current and rated load, rated voltage, nature of supply, rated frequency, kind of load, the rating and type of any fuse.

Add after the last dashed text the following paragraph:

The rating and type of fuse shall be marked on the fuse-holder or in proximity of the fuse.

Add the following note:

NOTE 2 - The value for the minimum load or minimum current may also be given in the installation instructions.

Renumber the present notes 2 and 3 as 3 and 4, respectively.

8.4 *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 shall be marked corresponding to the installation instructions.

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

8.6 *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 1.

*Additional subclauses***8.6.101**

8.6.102 It is recommended that the actual state of the electronic switches intended to control the brightness of lamps be known when used as intended. This can be achieved either:

- with marking on 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.

NOTE A test to verify that the light is still visible is under consideration.

When the indication of the switch state is given only by the lamp, the adjusting of the lamp at the lowest control state is made as specified in the following:

For incandescent lamps, the adjusting of lamp dimmers shall be made by the manufacturer. It shall not be possible to reduce the lowest setting without a tool.

For fluorescent lamps, the adjusting of lamp dimmers shall be made by the manufacturer. It may, however, be possible for the installer to alter the lowest setting if such an adjustment is indicated in an installation instruction.

8.8 Addition:

If an electronic switch 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 instruction sheet.

9 Checking of dimensions

This clause of part 1 applies with the following addition:

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

10 Protection against electric shock

This clause of part 1 applies with the following additions and modifications:

10.1 Addition:

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

Replace the 6th and 7th paragraphs of part 1 by:

During this additional test, the switches are subjected for 1 min to a force applied through the tip of a straight unjointed test finger, of the same dimensions as the standard test finger shown in figure 9.

This finger, with an electrical indicator as described above, is applied with a force of 75 N to all places where yielding of the insulating material could impair the safety of the switch, but is applied to thin-walled knock-outs with a force of 10 N.

Viewing windows or the like on electronic switches intended to be mounted at a height greater than 1,7 m are subjected to a force of 30 N.

The finger is not applied to membranes and the like. These parts are tested according to 13.15.1.

NOTE For the purpose of this standard, parts connected to a supply operating at SELV are not considered to be live parts.

10.2 Addition:

For touch sensitive switches the associated protective impedance does not have to comply with the requirements of clauses 16 and 23.

The protective impedance shall consist of at least two resistors or independent capacitors in series of the same nominal value or a combination of both. These resistors shall comply with the requirements given in 102.3, and the capacitors shall comply with the requirements given in 102.2.

Compliance is checked by inspection and by the following test:

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

The current shall not exceed, in any measurement, 0,7 mA (peak value) for a.c. up to 1 kHz or 2 mA for d.c.

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

The protective impedance shall only be used in switches classified as "ordinary switches" (see 7.1.4).

Additional subclauses:

10.101 If a cover or cover-plate, or a fuse can be removed without the use of a tool or if the installation instructions for the user indicate that, for the purpose of maintenance, when replacing the fuse, covers and cover-plates fastened by means of a tool have to be removed, the protection against contact with live parts shall be assured even after removal of the cover or cover-plate.

Compliance is checked with the standard test finger as shown in figure 9 of part 1.

10.102 If an electronic switch is provided with a hole for adjusting the setting of the electronic switch and this hole is indicated as such, the adjustment shall not involve the risk of an electric shock.

Compliance is checked by applying a test pin according to figure 101a) through the hole. The pin shall not touch live parts.

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

Compliance is checked by applying a test pin according to figure 101b) through the openings. The pin shall not touch live parts.

11 Provision for earthing

This clause of part 1 applies.

This clause does not apply to SELV electronic switches.

12 Terminals

This clause of part 1 applies.

NOTE The connecting capability of terminals for other circuits than the main circuit (load circuit) is not in relation to the rated current of the switch. That means that the terminals for the conductors to an external sensing unit may not necessarily have the same connecting capability as the supply and load side terminals of the switch.

13 Constructional requirements

This clause of part 1 applies amended as follows:

13.4 Add, after the first paragraph:

Free openings according to 10.102 and 10.103 are accepted.

13.5 Replacement:

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

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

Compliance is checked by inspection and by the following tests:

Where it is possible to apply an axial pull in normal use, an axial pull shall be applied for 1 min to try to pull off the actuating member.

If the shape of the actuating member is such that an axial pull is likely to be applied in normal use, the force is 30 N.

If the shape of the actuating member is such that an axial pull is unlikely to be applied in normal use, the force is 15 N.

An axial push of 30 N for 1 min is then applied to all actuating members.

During and after these tests the switch shall show no damage, nor shall an actuating member have moved so as to impair compliance with this standard.

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

13.15.1 Replacement

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

Compliance is checked by the following tests:

Membranes, lenses and the like are tested when assembled in the switches.

First the switches are fitted with the membranes, lenses and the like which have been subjected to the treatment specified in 15.1.

The switches are then placed for 2 h in a heating cabinet as described in 15.1, the temperature being maintained at $40\text{ °C} \pm 2\text{ °C}$.

Immediately after this period, a force of 30 N is applied for 5 s to various parts of the membranes, lenses and the like, by means of the tip of a straight unjointed test finger of the same dimensions as the standard test finger shown in figure 2.

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

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

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

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

Additional subclauses:

13.101

13.102 Automatic protective devices incorporated in electronic switches for lamp circuits shall have at least micro-disconnection (according to IEC 60730).

Cut-outs in electronic switches for motor speed control circuits shall be non-self-resetting.

Compliance with 13.101 and 13.102 is checked by inspection.

13.103 Electronic switches for the control of the voltage of iron core transformers for low-voltage incandescent lamps (e.g. halogen lamps) shall have a maximum tolerance of the phase-control angle between the positive and negative half-wave of $\pm 2^\circ$.

NOTE 1 Higher tolerances will generate a d.c. current influencing the temperature rise in the windings of the iron core transformer.

NOTE 2 The maximum tolerance between the phase-control angle of the positive and negative half-wave may be measured directly or as d.c. voltage in per cent of the rated voltage. This corresponds at 90° to 1,1 % of the peak value of the rated voltage.

Compliance is checked by measurement.

13.104 If the insulation of an external flexible cable is not at least electrically equivalent to that of flexible cables according to the relevant IEC standard, or it does not comply with the electric strength test carried out between the conductor and a metallic foil wrapped around the cable under the conditions specified in 16.2, the cable shall be considered as a bare conductor.

NOTE These requirements are not applicable to flexible cables connected to electronic extension units supplied at SELV.

14 Mechanism

This clause of part 1 only applies to electronic switches provided with mechanical switching devices.

15 Resistance to ageing, to harmful ingress of water and to humidity

This clause of part 1 applies.

16 Insulation resistance and electric strength

This clause of part 1 applies with the following addition:

Insulation resistance and electric strength are measured with the protective impedances according to 10.2 disconnected.

16.2 Additional note to table 14:

The test according to item 3 is carried out only on electronic switches combined with mechanical switches.

17 Temperature rise

This clause of part 1 is replaced as follows:

Electronic switches shall be so constructed that the temperature rise in normal use is not excessive.

The metal and the design of the contacts shall be such that the operation of the switch is not adversely affected by oxidation or any other deterioration.

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

Compliance is checked by the following tests where applicable:

The electronic switches are fitted with the conductors as specified in table 15, the cross-sectional area being not less than 1,5 mm²; the terminal screws or nuts, if any, are tightened with a torque equal to two-thirds of that specified in 12.2.8.

Electronic switches for incandescent lamps (lamps rated for public supply voltage use) are loaded by lamps which have a rated value of 200 W (lamps of lower rated values and resistors, if any, may be used) so that at rated voltage the rated load will be obtained.

Electronic switches for fluorescent lamps and motors are loaded in accordance with the manufacturer's instructions. The rated load shall be determined with the electronic switch short-circuited.

Other electronic switches are loaded with the types of load as stated in the manufacturer's instructions. The rated load shall be determined with the electronic switch short-circuited.

NOTE 2 If the electronic switch is intended to be loaded with different kinds of load, the test should be carried out with each kind of load declared.

In the case of motor speed controls the electronic switches are loaded until steady-state temperature at a voltage between 0,9 and 1,1 times rated voltage is reached, whichever is the more unfavourable.

For other electronic switches the test is carried out at 1,1 times the rated voltage.

In lamp dimmers and speed controllers, the setting is adjusted such that the highest temperature rise will occur.

Flush-mounted 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.

NOTE 3 The test assembly should be allowed to dry for at least 7 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 wood 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 4 The sides of the cavity in the pinewood block may have a cylindrical shape.

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

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

The other types of electronic switches shall be mounted according to the manufacturer's instructions or, in the absence of such instructions, in the position of normal use considered to give the most onerous conditions.

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

The temperature is determined by means of melting particles, colour-changing indicators or thermocouples, so chosen and positioned that they have negligible effect on the temperature being determined.

During the test, the electronic switch state shall not change, fuses and other protective devices shall not operate and the permissible temperature rises determined in table 102 first column, shall not be exceeded.

After this test, the electronic switch shall be in operating condition.

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

Compliance is checked by inspection.

NOTE 5 For the purpose of the test of 21.3, the temperature rise of external parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, is also determined.

NOTE 6 Undue oxidation of the contacts may be prevented by sliding action or by the use of silver or silver-faced contacts.

NOTE 7 Pellets of beeswax (melting-point 65 °C) with a diameter of 3 mm may be used as melting particles.

NOTE 8 In the case of combination of switches, the test is carried out separately on each electronic switch.

For the purposes of the tests of clause 102.2, 102.3 and 102.4.1, the reference temperature surrounding a component in an electronic switch is the maximum temperature rise measured on the component during the test plus 25 °C.

Addition

Table 102
(This table is based on table III of IEC 60065)

Parts of the electronic switch		Permissible temperature rise K	
		Clause 17	Clause 101
External parts			
Metal parts	Knobs, handles, sensing surfaces, etc.	40	75
	Enclosure (note 1)	50	75
Non-metallic parts	Knobs, handles, sensing surfaces, etc. (note 2)	60	75
	Enclosure (notes 1 and 2)	70	75
Inside of enclosures of insulating material		(note 3)	(note 3)
Windings (note 4)			
	Class A.	75	115
	Class E.	90	130
	Class B	95	140
	Class F	115	155
	Class H	140	175
	Class 200	160	195
	Class 220	180	115
	Class 250	210	245
Core laminations		As for relevant windings	
Supply cable and wiring			
	Insulated with ordinary polyvinyl chloride (note 8)		
	not under mechanical stress	70	110
	under mechanical stress	55	110
	Insulated with natural rubber	55	110
Other insulations (notes 4 and 7) except thermoplastic			
	Non-impregnated paper	65	80
	Non-impregnated cardboard	70	90
	Impregnated cotton, silk, paper and textile, urea resins	80	100
	Laminates bonded with phenol-formaldehyde resins, phenol-formaldehyde mouldings with cellulose fillers	95	120
	Phenol-formaldehyde mouldings with mineral fillers	105	140
	Laminates bonded with epoxy resins	130	160
	Natural rubber	55	110
Thermoplastic materials (note 5)		(note 6)	
Terminals and parts which may come into contact with cable insulation when installed		55	110

Table 102 (continued)

The values of the temperature rises are based on an ambient temperature of 25 °C, but the measurements are made under normal conditions.

NOTE 1 For areas not likely to be touched in normal use, temperature rises up to 75 K are allowed under normal operating conditions.

NOTE 2 If these temperature rises are higher than those allowed by the class of the relevant insulating material, the nature of the material is the governing factor.

NOTE 3 The permissible temperature rises for the inside of enclosures of insulating material are those indicated for the relevant materials.

NOTE 4 For the purpose of this standard, 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.

NOTE 5 Natural and synthetic rubbers are not considered as being thermoplastic materials.

NOTE 6 Due to their wide variety, it is not possible to specify permissible temperature rises for thermoplastic materials. While the matter is under consideration, the following method shall be used:

a) The softening temperature of the material is determined on a separate specimen, under the conditions specified in ISO 306, modified as follows:

- the depth of penetration is 0,1 mm;
- the total thrust of 10 N (1 kgf) is applied before the dial gauge is set to zero or its initial reading noted.

b) The temperature limits to be considered for determining the temperature rises are:

- under normal operating conditions, a temperature 10 °C lower than the softening temperature as obtained under a);
- under fault conditions, the softening temperature itself.

NOTE 7 The table does not apply to components which comply with relevant IEC standards.

NOTE 8 The possibility of raising the values for wires and cables insulated with heat-resistant polyvinyl chloride is under consideration.

18 Making and breaking capacity

NOTE 1 Where the term "switch" is used in part 1, this term is replaced by "contact mechanism" as appropriate.

NOTE 2 In the case of switches using relays, the relay is operated at the specified rate of operation with the appropriate load(s) as in normal use.

This clause of part 1 applies amended as follows:

Replacement of the text before 18.1:

Electronic switches shall have adequate making and breaking capacity.

This test is carried out only on electronic switches provided with mechanically or electromechanically operated contact mechanisms.

Contact mechanisms shall have adequate making and breaking capacity.

The test is made on three new specimens of the complete contact mechanism.

Compliance is checked by the following tests:

- for fluorescent lamps loads as specified in 18.1 of part 1;
- for motor speed control circuits as specified in 18.1 of part 1 and additionally in 18.101;
- for other kinds of loads as specified in 18.1 and 18.2 of part 1.
- for low-voltage incandescent lamps as specified in 18.1 and 18.2 of part 1 and for electronic switches for the control of the voltage of iron core transformer for low-voltage incandescent lamps as specified in 18.1, 18.2 and 18.102.

NOTE 3 – For electronic switches whose cycle of operation is limited by their application (e.g. passive infrared, time delay switches, etc), the rate of operation during the tests may be specified by the manufacturer.

The tests are made by means of an apparatus the principle of which is shown in figure 12 and which is arranged to simulate normal operation.

The connections are as shown in figure 13.

Electronic switches are fitted with conductors as for the test of clause 17.

18.1 *Add after the second paragraph:*

For electronic switches whose rate of operation is limited by their application (e.g. heat and light sensors) the rate of operation is as follows:

The electronic switch is set to the shortest cycle time possible. The switch is re-activated at the end of each cycle within a time of $(2 \pm 0,5)$ s.

Additional subclauses:

18.101 *The contact mechanism is subjected to tests of 50 cycles of operation each at rated voltage and at the rate of operations specified in 18.1 of part 1:*

- *the contact mechanism closes a circuit through which a current of $9 I_n$ ($\cos \varphi = 0,8 \pm 0,05$) passes, this current being interrupted by means of an auxiliary switch 50 ms to 100 ms after each closure;*
- *the circuit through which a current of $6 I_n$ ($\cos \varphi = 0,6 \pm 0,05$) passes is closed by an auxiliary switch and opened by the contact mechanism 300 ms to 500 ms after each closure.*

NOTE 1 I_n is the rated current of the electronic switch.

NOTE 2 If the electronic switch has a rated load instead of a rated current, I_n is calculated under the assumption that $\cos \varphi$ of the motor load is 0,6.

During the tests no sustained arcing shall occur.

After these tests, the specimens shall show no damage impairing their further use.

18.102 *The electronic switches for the control of the voltage of iron core transformers for low-voltage incandescent lamps (e.g. halogen lamps) shall be subjected to the following test:*

The test is made on three specimens.

To simulate making, the test circuit shall be adjusted to a test current 10 times the rated current of the electronic switch for one half-cycle.

During the tests no sustained arcing shall occur.

After the tests the specimens shall show no damage impairing their future use.

NOTE Tests for switches which can be operated with a transformer on no-load are under consideration.

19 Normal operation

This clause of part 1 is replaced as follows:

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

Compliance is checked by the tests of 19.1, 19.2, 19.3 and 19.4, during which the electronic switches are tested at rated voltage and loaded as specified in clause 17, unless otherwise specified.

Electronic switches which are provided with connecting means for one or more electronic extension units are tested with one electronic extension unit connected, the connecting conductors being 1 m long.

During the test, the specimens shall function correctly.

After the test, the samples shall withstand an electric strength test as specified in clause 16, the test voltage of 4 000 V being, however, reduced by 1 000 V and the other test voltages by 500 V, and a temperature-rise test as specified in clause 17.

The specimens shall then not show:

- wear impairing their further use;*
- discrepancy between the position of the actuating member and that of the moving contacts, if the position of the actuating member is indicated;*
- deterioration of enclosures, insulating linings or barriers to such an extent that the electronic switch cannot be further operated or that the requirements of clause 10 are no longer complied with;*
- loosening of electrical or mechanical connections;*
- seepage of sealing compound;*
- relative displacement of the moving contacts of switches of pattern number 2.*

NOTE 1 The humidity treatment as per 16.2 is not repeated before the electric strength test of this subclause.

NOTE 2 During the test, the specimens are not lubricated.

19.1 *A contact mechanism incorporated in electronic switches intended for incandescent lamp circuits is subjected to the following test.*

The test is made on three new specimens of the complete contact mechanism.

The circuit details and the manner of operation of the selector switches S are as described in 18.1, unless otherwise specified.

NOTE – For electronic switches whose cycle of operation is limited by their application (e.g. passive infra-red, time delay switches, etc), the rate of operation during the tests may be specified by the manufacturer.

The number of operations is 40 000.

The rate of operation is as specified in 18.1.

For rotary switches of pattern numbers 1 and 2 intended to be operated in either direction, the actuating member is turned in one direction for half the total number of operations and in the reverse direction for the remainder.

For other electronic rotary switches intended to be operated in either direction, 3/4 of the total number of operations is effected in the clockwise direction and the remainder in the reverse direction.

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

Contact mechanisms incorporated in electronic switches intended for motor speed control circuits are tested as above, but they close a circuit through which a current of $6 \times I_n$ ($\cos \varphi = 0,65 \pm 0,05$) passes and open a circuit through which a current of I_n ($\cos \varphi = 0,65 \pm 0,05$) passes, the ratio between recovery voltage U_s and rated operational voltage U_e being 0,17.

NOTE Tests for fluorescent lamp circuits are under consideration.

19.2 *Semiconductor switching devices and/or electronic regulating units incorporated in electronic switches are subjected to the following tests.*

NOTE Examples of electronic regulating units are controls used for the adjustment of time, light level, sensitivity, etc., of the device.

The electronic switch is loaded with rated load until steady-state temperature at 1,1 times rated voltage is reached.

The switch state is changed 10 times and/or the setting value is altered 10 times over the whole range from minimum to maximum and back to minimum by means of the sensing surface or unit.

Additionally, where appropriate, the switch state is changed 10 times and/or the setting value is altered 10 times over the whole range from minimum to maximum and back to minimum by means of an electronic extension unit.

During the test, the specimens shall operate correctly.

19.3 *Mechanical control units incorporated in electronic switches are subjected to the following test:*

The electronic switch is loaded with its rated load and the voltage is then increased to 1,1 times the rated voltage, the setting is altered 10000 times over the whole range from minimum to maximum and back to minimum by means of its control unit, the rate of operation being between 10 and 15 operations per minute.

NOTE – Mechanical control units are push buttons, potentiometers, etc. requiring a manual operation.

19.4 *For electronic switches for which a minimum load or current is specified by the manufacturer, the characteristic is additionally tested with the specified minimum load or current at 0,9 times rated voltage.*

The switch state is changed 10 times and/or the setting value is altered 10 times over the whole range from minimum to maximum and back to minimum.

In addition, where appropriate, the switch state is changed ten times and/or the setting value is altered ten times over the whole range from minimum to maximum and back to minimum by means of an electronic extension unit.

During the test, the electronic switch shall function correctly.

20 Mechanical strength

This clause of part 1 applies.

21 Resistance to heat

This clause of part 1 applies.

22 Screws, current-carrying parts and connections

This clause of part 1 applies.

23 Creepage distances, clearances and distances through sealing compound

This clause of part 1 applies with the following additions:

The values given in items 1, 2, 6 and 7 of table 20 apply only to terminals for external wiring.

The values of items 1, 2, 6 and 7 of table 20 do not apply to live parts, with the exception of terminals for external wiring, which are protected by a directly associated fuse with adequate breaking capacity or other current-limiting means, under the provision that the requirements of clause 101 are fulfilled. If there is no associated fuse or directly associated fuse, or other current-limiting means the electronic switch shall comply with table 20.

NOTE An associated fuse, a directly associated fuse and/or current limiting device are devices inserted in the circuit and whose primary function is to protect the electronic switch.

24 Resistance of insulating material to abnormal heat, to fire and to tracking

This clause of part 1 applies with the following addition:

24.1 Addition at the end:

More detailed requirements are under consideration.

Additional clauses:

25 Resistance to rusting

This clause of part 1 applies.

26 EMC requirements

This clause of Part 1 is replaced by:

Electronic switches shall be designed to operate correctly under the conditions of electro-magnetic environment in which they are intended to be used. This applies particularly for electronic switches intended to be connected to a.c. low-voltage public supply systems where the design shall take into account the normal disturbances on the supply system as defined by the compatibility levels given in IEC 61002-2-2.

Electronic switches shall be designed so that the switch state (on or off) and/or the setting value are protected against interference.

For electronic switches designed to operate a load via a transformer, the manufacturer shall specify all details related to the load.

NOTE – Measured values within the test limits are acceptable for the test results until the situation on uncertainty of measurement is clarified by TC 210.

For electronic switches the manufacturer shall specify all details related to the load.

Compliance is checked by the tests of 26.1 and 26.2.

26.1 Immunity

For the following tests, the electronic switch is mounted as in normal use in the relevant box, if any, as specified by the manufacturer and is loaded as specified in clause 17, so that at rated voltage, the rated load will be obtained.

For the purpose of this test, the electronic switch is set to the measured or calculated value of the output power (r.m.s.).

A variation of less than $\pm 10\%$ is not considered to be a change of setting.

Each electronic switch is tested, if applicable, in the following states:

- a) in the ON state, highest setting;*
- b) in the ON state, lowest setting;*
- c) in the OFF state, highest setting;*
- d) in the OFF state, lowest setting.*

Three new specimens are subjected to all the tests.

26.1.1 Voltage dips and short interruptions

The electronic switch shall be tested with the test equipment specified in IEC 61000-4-11 as specified in 26.1, in accordance with table 103 with a sequence of three dips/interruptions with intervals of 10 s minimum between each test event.

Abrupt changes in supply voltage shall occur at zero crossings.

The output impedance of the test voltage generator shall be low, even during the transition.

The change between the test voltage U_T and the changed voltage is abrupt.

NOTE 100 % U_T is equal to the rated voltage.

A test level of 0 % corresponds to a total supply voltage interruption.

Table 103

Test level % U_T	Voltage dip/interruptions % U_T	Duration (number of cycles at rated frequency)
0	100	10
40	60	10
70	30	10

During this test, the electronic switch state and/or setting may alter.

Occasional flickering of lamps or irregular running of motors during the test is neglected.

After the test, the electronic switch state shall be in the original switch state and the setting shall be unchanged.

26.1.2 Surge immunity test for 1,2/50 μ s wave impulses

Electronic switches shall be tested for resistance to unidirectional surges caused by overvoltages from switching and lightning transients.

The test is carried out according to IEC 61000-4-5 by applying ten times, at a repetition rate of 30 s \pm 5 s an open-circuit test voltage of 1 kV (level 2).

During the test, the electronic switch state and/or setting shall not alter. Occasional flickering of lamps or irregular running of motors during the test is neglected.

After the test, the electronic switch shall be in the original switch state and the setting shall be unchanged.

26.1.3 Electrical fast transient/burst test

Electronic switches shall be tested for resistance to repetitive fast transients/bursts on supply and control terminals/terminations.

The test is carried out according to IEC 61000-4-4 with the following specification:

The level of the repetitive fast transients consisting of bursts coupled into the supply and control terminals/terminations of the electronic switch is in accordance with table 104.

Table 104

Open-circuit output test voltage ± 10 %	
Supply terminals/terminations	Control terminals/terminations
1 kV	0,5 kV

Both polarities of the test voltage are mandatory.

The duration of the test shall be not less than 1 min.

During the test, the electronic switch state and/or the setting may alter.

Occasional flickering of lamps or irregular running of motors during the test is neglected.

After the test, the electronic switch state shall be in the original switch state and the setting shall be unchanged.

NOTE – If any change in the setting occurs, it should be possible to restore the setting by operation of the control(s).

26.1.4 Electrostatic discharge test

Electronic switches mounted as in normal use shall withstand electrostatic contact and air discharges.

The test is carried out according to IEC 61000-4-2 by applying one positive and one negative discharge, of both types air/contact, if necessary. The discharges are applied to each of 10 preselected points designated by the manufacturer.

The following levels apply:

- *test voltage of contact discharge: 4 kV;*
- *test voltage of air discharge: 8 kV.*

During the test, the electronic switch state and/or the setting may alter.

Occasional flickering of lamps or irregular running of motors during the test is neglected.

After the test, the electronic switch state shall be in its original switch state and the setting shall be unchanged.

NOTE 1 – If any change in the setting occurs, it should be possible to restore the setting by operation of the control(s).

NOTE 2 – Certain electronic switches (e.g. passive infrared switches - PIR switches) with adjustable time delay should be adjusted in such a way that the time delay is higher than the testing time.

26.1.5 Radiated electromagnetic field test

Electronic switches shall be tested for resistance to electromagnetic fields such as those generated by portable radio transceivers or any other device that will generate continuous wave radiated electromagnetic energy.

The test is carried out according to IEC 61000-4-3 by applying a field strength of 3 V/m.

Occasional flickering of lamps or irregular running of motors during the test is neglected.

After the test, the electronic switch state shall be in the original switch state and the setting shall be unchanged.

NOTE A revision of this test is under consideration.

26.2 Emission

26.2.1 Low-frequency emission

Electronic switches shall be so designed that they do not cause excessive disturbances in the network.

Requirements are deemed to be met if the electronic switch complies with EN 61000-3-2 and EN 61000-3-3.

26.2.2 Radiofrequency emission

Electronic switches shall be so designed that they do not cause excessive radio interference.

The requirement is deemed to be met if the electronic switch complies with the requirements of EN 55014 or EN 55015 as appropriate.

101 Abnormal conditions

Electronic switches shall not create hazard under abnormal conditions.

Compliance is checked by the tests specified in 101.1, 101.2 and 101.3.

NOTE For these tests additional components of the switch may be necessary.

101.1 When electronic switches are operated under abnormal conditions no part shall reach such a temperature that there is danger of fire to the surroundings of the electronic switches.

Compliance is checked by subjecting the electronic switches to a heating test under fault conditions, as described in 101.1.1.

During the test, the temperature rises shall not exceed the values given in table 102 second column.

101.1.1 *Unless otherwise specified, the tests are made on electronic switches while they are mounted, connected and loaded as specified in clause 17.*

Each of the abnormal conditions indicated in 101.1.1.1 and 101.1.1.2 is applied in turn.

NOTE Other faults may occur during the test, which are a direct consequence.

The abnormal conditions are applied in the order which is the most convenient for testing.

101.1.1.1 *The following fault conditions shall be simulated:*

- *short circuit across creepage distances and clearances, other than those complying with the requirements in clause 23, if they are less than the values given for curve "A" of table II of IEC 60065;*
- *short circuit across insulating coating consisting, for example, of lacquer or enamel.
Such coatings are ignored in assessing the creepage distances and clearances.
If enamel forms the insulation of a conductor and withstands the voltage test prescribed for grade 2 in clause 13 of IEC 60317-0-1, it is considered as contributing 1 mm to those creepage distances and clearances.*

NOTE The change of grade 2 is under consideration.

- *short circuit or interruption of semiconductor devices;*

- short circuit of electrolytic capacitors;
- short circuit or interruption of capacitors or resistors which do not comply with the requirements of clause 102;
- short circuit of the terminals on the load side.

If a fault condition simulated during the test influences other fault conditions, all these fault conditions are applied simultaneously.

If the temperature of the electronic switch is limited by the operation of automatic protective devices (including fuses), the temperature is measured approximately 2 min after the operation of the device.

If no temperature-limiting device operates, the temperature is measured after a steady state has been reached or after 4 h, whichever is the shorter time.

101.1.1.2 *The following overload tests are carried out, where applicable.*

Electronic switches without incorporated temperature-limiting devices and without incorporated fuses are loaded for 1 h with the conventional tripping current for the fuse which in the installation will protect the electronic switch.

Electronic switches protected by automatic protective devices (including fuses) are loaded in such a way that the current through the electronic switch is 0,95 times the current with which the protecting device releases after 1 h.

The temperature rise is measured after a steady state has been reached or after 4 h, whichever is the shorter time.

Electronic switches protected by incorporated fuses complying with IEC 60127 shall have those fuses replaced by links of negligible impedance and shall be loaded in such a manner that the current through the links shall be 2,1 times the rated current of the fuse.

The temperature rise is measured after the electronic switch has been loaded for 30 min.

Electronic switches protected both by enclosed fuses and by automatic protective devices are loaded either as described above with incorporated fuses or with another automatic protective device, choosing the test requiring the lower load.

Electronic switches protected by automatic protective devices which will short-circuit only in case of overload shall be tested both as electronic switches with automatic protective devices and as electronic switches without automatic protective devices.

101.2 *Protection against electric shock is required, even though an electronic switch is being used or has been used during fault conditions.*

Compliance is checked by carrying out the tests described in 101.1.

The electronic switch, having been subjected to the test, shall comply with the requirements of clause 10.

101.3 *Electronic switches shall, without endangering their surroundings, withstand the short circuits they may be subjected to.*

Compliance is checked by the following test:

The electronic switch is tested in a substantially non-inductive circuit in series with a load impedance and a device for limiting the let-through I^2t .

The prospective short circuit of the supply shall be 1500 A r.m.s. at a voltage equal to the rated voltage of the electronic switch under test.

The prospective let-through I^2t value shall be 15 000 A²s.

NOTE 1 The prospective current is a current that would flow in the circuit if the electronic switch, the limitation device and the load impedance were replaced by links of negligible impedance without any other change in the circuit.

NOTE 2 The prospective I^2t value is a value that would be let through by the limitation device if the electronic switch and the load impedance were replaced by links of negligible impedance. The I^2t value may be limited by using an open wire fuse, an ignitron or other suitable devices.

NOTE 3 The I^2t value of 15 000 A²s corresponds to an unfavourable let-through I^2t value of 16 A miniature circuit-breakers measured at 1 500 A prospective short-circuit current.

The diagram of the circuit in which the electronic switch is tested is shown in figure 102.

The impedance Z_1 (short-circuit impedance) shall be adjustable to satisfy the specified prospective short-circuit current.

The impedance Z_2 (load impedance) shall be so adjusted that the electronic switch is loaded with its minimum load or with approximately 10 % of the rated load, whichever is the higher.

NOTE 4 A load is necessary for the electronic switch to be in the on-state.

The circuit is calibrated with the following tolerances: current $^{+5}_0$ %, voltage $^{+10}_0$ %, frequency ± 5 %, Pt value ± 10 %.

The incorporated fuse, if any, recommended by the manufacturer, is inserted into the electronic switch which is loaded. The variable control, if any, is set at the position of maximum output.

The short circuit is caused six times by the auxiliary switch A without any synchronizing with respect to the voltage wave.

NOTE 5 Six tests are made in view of the need to avoid the complication on point-on-wave timing.

NOTE 6 Experience shows that at least one of these tests will result in near maximum total I^2t .

During the test, emission of flames or burning particles shall not occur.

After the test, accessible metal parts shall not be live.

It is not necessary for the specimens to remain in operating condition. However, the contacts of any incorporated automatic protective device shall not be welded, unless the electronic switch is obviously useless.

The six tests may be carried out on the same specimen provided that with the replacement of an incorporated fuse, the electronic switch is still capable of operation. Otherwise new specimens shall be used until a total of six tests have been completed.

102 Components

Components which, if they fail, may impair the safety of the electronic switch shall comply with the safety requirements specified in the relevant IEC standards as far as applicable.

If components are marked with their operating characteristics, the conditions under which they are used in the electronic switch shall be in accordance with these markings, unless a specific exception is made in this standard.

The testing of components which have to comply with other standards is, in general, carried out separately, according to the relevant standard as follows.

If the component is marked and used in accordance with its marking, the number of samples is that required by the relevant standard.

Where no IEC standard exists, or where the component is not marked or is not used in accordance with its marking, the component is tested under the conditions occurring in the electronic switch, the number of specimens being, in general, that required by the relevant standard.

Components incorporated in the electronic switch are subjected to all the tests of this standard as parts of the electronic switch.

NOTE Compliance with the IEC standard for the relevant component does not necessarily ensure compliance with the requirements of this standard.

102.1 Fuses

Fuses, if any, shall comply with IEC 60127 or other relevant IEC publications and have a rated breaking capacity of 1500 A unless any fault current through the fuse is limited to 35 A.

102.2 Capacitors which may cause a shock or fire hazard and capacitors for electromagnetic interference

Capacitors,

- the short-circuiting or disconnecting of which would cause an infringement of the requirements under fault conditions with regard to shock or fire hazard, and/or
- the short-circuiting of which would cause a current of 0,5 A or more through the terminals of the capacitor, and/or
- for suppression of electromagnetic interference,

shall comply with IEC 60384-14 and shall be in accordance with table 106.

These capacitors shall be marked with their rated voltage in volts (V), their rated capacitance in microfarads (μF) and their reference temperature in degrees Celsius ($^{\circ}\text{C}$).

When determining the current, fuses and relevant capacitors are considered to be short-circuited.

For other protective devices the resistive element is to be replaced by an equivalent impedance.

Table 106 – Capacitors

Application of capacitor	Approved type(s) of capacitor according to IEC 60384-14		
	$U_n \leq 125 \text{ V}$	$125 \text{ V} < U_n \leq 250 \text{ V}$	
		Without overcurrent protection ¹⁾	With overcurrent protection ¹⁾
Between live conductors (L or N) and earth (PE)	Y4	Y2	Y2
Between live conductors (L and N or L1 and L2):			
– without impedance in series	X2	X1	X2
– with impedance in series, which, when capacitor(s) is (are) short-circuited, limits the current to a value of:			
• 0,5 A and higher	X3	X2	X3
• below 0,5 A	Any type	Any type	Any type

¹⁾ External to the capacitor or built into the capacitor (e.g. a fusing resistor)

102.3 Resistors

Resistors, the short-circuiting or interrupting of which would cause an infringement of the requirements with regard to the protection against fire and electric shock in case of a defect, shall have an adequately constant value under the overload conditions prevailing in the electronic switch.

These resistors shall comply with the requirements of 14.1 of IEC 60065, modified with regard to the reference temperature of the resistor in the electronic switch (clause 17).

NOTE Additional requirements are under consideration for composite-type resistors.

102.4 Automatic protective devices (other than fuses)

Automatic protective devices shall be in compliance with IEC 60730, as far as that standard is applicable and with additional requirements specified in 102.4.1 for automatic protective devices which switch off the current (hereinafter called cut-outs) and in 102.4.2 for automatic protective devices which only decrease the current.

102.4.1 *Cut-outs shall have adequate making and breaking capacity*

Compliance is checked by subjecting three specimens to the tests of 102.4.1.1 or 102.4.1.2.

If the cut-out in the electronic switch is subjected to a reference temperature above 55 °C, according to clause 17, the specimens are tested at this reference temperature.

During the test, the other conditions shall be similar to those occurring in the electronic switch.

During the test, no sustained arcing shall occur.

After the test, the specimens shall show no damage impairing their further use or the safety of the electronic switch.

The switching frequency of the cut-out may be increased above the normal switching frequency inherent to the electronic switch, provided that no greater risk of failure of the cut-out is induced.

If it is not possible to test the cut-out separately, it will be necessary to submit additional specimens of the electronic switch in which the cut-out is used.

102.4.1.1 *Non-self-resetting cut-outs in the load circuit of the electronic switch are tested at 1,1 times the rated voltage of the electronic switch and with loads as specified below.*

The cut-outs are reset after each operation and thus caused to operate 10 times successively.

- Cut-outs in electronic switches for incandescent lamps are tested in a non-inductive circuit and are loaded with 2,1 times the rated current of the protecting fuse (if this fuse is in accordance with IEC 60127) or with the relevant conventional fusing current for other fuses.*
- For cut-outs in electronic switches for fluorescent lamps, the tests shall be carried out in the same way as for electronic switches for incandescent lamps.*
- Cut-outs in electronic switches for speed control circuits are subjected to two series of 10 operations.*

In the first series, the cut-out under test closes a circuit through which a current of $9 I_n$ ($\cos \varphi = 0,8 \pm 0,05$) passes, this current being interrupted by means of an auxiliary switch 50 ms to 100 ms after each closure.

In the second series, the circuit through which a current of $6 I_n$ ($\cos \varphi = 0,6 \pm 0,05$) passes is closed by an auxiliary switch and opened by the cut-out under test.

NOTE 1 The values $6 I_n$ and $9 I_n$ are provisional.

NOTE 2 " I_n " is the rated current of the electronic switch. If the electronic switch has a rated load instead of a rated current, I_n is calculated under the assumption that $\cos \varphi$ of the motor load is 0,6.

102.4.1.2 *Self-resetting cut-outs in the load circuit of the electronic switch are tested at 1,1 times the rated voltage of the electronic switch and with loads as specified below:*

- cut-outs in electronic switches for incandescent lamps are operated automatically for 200 cycles in a non-inductive circuit and are loaded with 2,1 times the rated current of the*

protective fuse (if this fuse is in accordance with IEC 60127) or with the relevant conventional fusing current for other fuses.

- *For cut-outs in electronic switches for fluorescent lamps, the tests shall be carried out in the same way as for electronic switches for incandescent lamps.*

During the tests of 102.4.1, no sustained arcing shall occur.

After the tests of 102.4.1, the specimens shall show no damage impairing their further use or the safety of the electronic switch.

The cut-outs shall withstand for 1 min a test voltage between the open contacts, the voltage being:

- *for cut-outs in electronic switches for incandescent lamp circuits: 500 V;*
- *for cut-outs in electronic switches for speed control circuits: 1 200 V for rated voltages up to 130 V and 2 000 V for rated voltages above 130 V.*

102.4.2 *Automatic protective devices which only decrease current to the electronic switch are tested as follows:*

The electronic switch is loaded for 4 h with a current as given in clause 17. At the end of this period the load is increased by closing an auxiliary switch which increases the load so that the prospective current through the electronic switch will be 2,1 times the rated current of the protective fuse (if the fuse is in accordance with IEC 60127) or the relevant conventional tripping current for other fuses.

The auxiliary switch is closed for 30 min and then opened until the current through the electronic switch is stabilized to the original value after which the auxiliary switch is closed again.

This procedure is repeated 10 times.

After this test, the device shall function correctly.

Compliance is checked by an additional test according to clause 17.

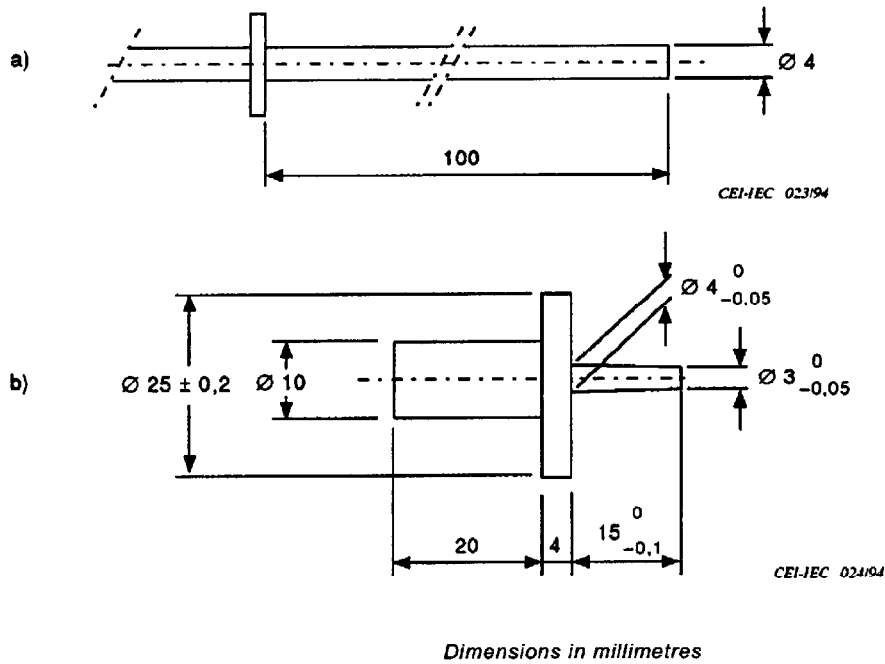
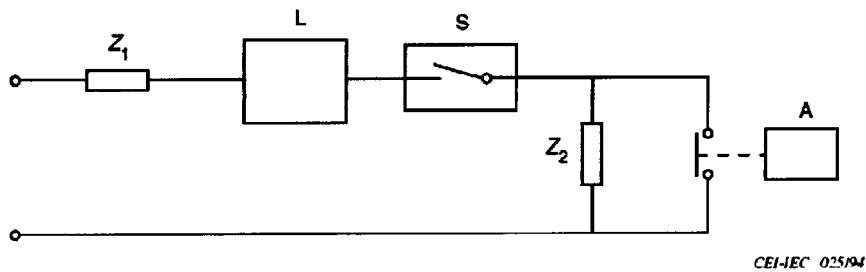


Figure 101 – Test pins for checking the protection against electric shock



- Z_1 is the impedance for adjusting the prospective short-circuit current (non-inductive)
- Z_2 is the impedance for adjusting the load (non-inductive)
- L is the limiting device for the let-through I^2t
- S is the specimen
- A is the auxiliary switch for causing the short circuit

Figure 102 – Circuit diagram for testing electronic switches according to 101.3

Annex AA
(informative)

**Examples of types of electronic switches
and their functions**

Electronic switches*	Functions
Touch switch, etc.	Electronically operated semiconductor switching device
	Electronically operated mechanical switching device
Light dimmer, etc. Speed controller, etc.	Mechanically operated regulator with an electronic control circuit
	Electronically operated regulator with an electronic control circuit
Light dimmer, etc., with switch Speed controller, etc., with switch	Mechanically operated regulator with an electronic control circuit and a mechanical switching device
	Mechanical operated regulator with an electronic control circuit and an electronically operated mechanical switching device
	Mechanically operated regulator with an electronic control circuit and an electronically operated mechanical switching device.
	Electronically operated regulator with an electronic control circuit and a semiconductor switching device
	Electronically operated regulator with an electronic control circuit and an electronically operated mechanical switching device
Electronic switches incorporating heat or light sensors	Electronically operated semiconductor switching device
	Electronically operated mechanical switching device
* All electronic switches can be operated by auxiliary control circuits.	
Incorporating heat or light sensors	Electronically operated semiconductor switching device
	Electronically operated mechanical switching device

Annex B

Annex B of part 1 applies with the following additions:

13 Constructional requirements

13.16 *Add after the first paragraph the following text:*

Switches intended to be connected via a flexible cable to an electronic extension unit having a rated current equal to the rated current of the switch, shall allow the connection to the electronic extension unit by means of a flexible cable, complying with IEC 60245-4, code designation 60245 IEC 66 or IEC 60227-5, code designation 60227 IEC 53 with a minimum nominal cross sectional area of 0,75 mm².

Switches intended to be connected via a flexible cable to an electronic extension unit having a rated current lower than the rated current of the switch shall allow the connection to the electronic extension unit by means of a flexible cable, complying with the requirements of 13.104.

NOTE These requirements are not applicable to flexible cables connected to electronic extension units supplied at SELV.

Annex ZA (normative)

Normative references to international publications
with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60065 (mod) + A2 (mod) + A3 (mod)	1985 1989 1992	Safety requirements for mains operated electronic and related apparatus for household and similar general use	EN 60065 + A11 ¹⁾	1993 1997
IEC 60085	1984	Thermal evaluation and classification of electrical insulation	HD 566 S1	1990
IEC 60127	Series	Miniature fuses	EN 60127	Series
IEC 60161	1965	Capacitors for radio interference suppression	-	-
IEC 60317-0-1	1990	Specifications for particular types of winding wires Part 0: General requirements Section 1: Enamelled round copper wire	EN 60317-0-1 ²⁾	1994
IEC 60730 (mod)	Series	Automatic electrical controls for household and similar use	EN 60730	Series
IEC 61000-2-2 (mod)	1990	Electromagnetic compatibility (EMC) Part 2: Environment – Section 2: Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems	ENV 61000-2-2	1993
IEC 61000-3-2	1995	Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current up to and including 16A per phase)	EN 61000-3-2 + corr. July + A1	1995 1997 1998
IEC 61000-4-2	1995	Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995
IEC 61000-4-3 (mod)	1995	Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	1996
IEC 61000-4-4	1995	Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	1995

1) EN 60065:1993 + A11:1997 are superseded by EN 60065:1998, which is based on IEC 60065:1998, mod.

2) EN 60317-0-1:1994 is superseded by EN 60317-0-1:1998, which is based on IEC 60317-0-1:1997.

EN 60669-2-1:2000

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-5	1995	Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	1995
IEC 61000-4-11	1994	Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	1994
IEC 61058-1	1990	Switches for appliances – Part 1: General requirements	EN 61058-1	1992
CISPR 14-1	1993	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus Part 1: Emission - Product family standard	EN 55014-1	1993
CISPR 15	1996	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	EN 55015	1996
ISO 306	1987 ³⁾	Plastics - Thermoplastics materials - Determination of Vicat softening temperature	-	-

3) ISO 306:1987 is superseded by ISO 306:1994.

Annex ZB (normative)**Special national conditions**

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions. If it affects harmonization, it forms part of the European Standard or Harmonization Document.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

Clause Special national condition**101.1.1.2 Belgium, France, Spain, Switzerland**

Electronic switches designed without an associated incorporated protection are loaded for one hour with the conventional tripping current of the associated protection of the lighting circuit (10 A for fuses and 16A for CB's).

102.1 United Kingdom

Fuses according to BS 646 and BS 1362 are deemed to satisfy this requirement.

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