

## ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ ๔๙๘๑ (พ.ศ. ๒๕๖๐)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. ๒๕๑๑

เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

สวิตช์ไฟฟ้าใช้ในที่อยู่อาศัยและสิ่งติดตั้งทางไฟฟ้ายึดกับที่ที่คล้ายกัน

เล่ม ๒ (๕) คุณลักษณะที่ต้องการเฉพาะ - สวิตช์ไฟฟ้าและอุปกรณ์ประกอบ

สำหรับใช้ในระบบอิเล็กทรอนิกส์ของอาคารบ้านเรือน (HBES)

อาศัยอำนาจตามความในมาตรา ๑๕ แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. ๒๕๑๑ ซึ่งแก้ไขเพิ่มเติมโดยพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม (ฉบับที่ ๗) พ.ศ. ๒๕๕๘ รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม สวิตช์ไฟฟ้าใช้ในที่อยู่อาศัยและสิ่งติดตั้งทางไฟฟ้ายึดกับที่ที่คล้ายกัน เล่ม ๒ (๕) คุณลักษณะที่ต้องการเฉพาะ - สวิตช์ไฟฟ้าและอุปกรณ์ประกอบสำหรับใช้ในระบบอิเล็กทรอนิกส์ของอาคารบ้านเรือน (HBES) มาตรฐานเลขที่ มอก. 824 เล่ม 2 (5) - 2559 ไว้ ดังมีรายละเอียดต่อท้ายประกาศนี้

ทั้งนี้ ให้มีผลตั้งแต่วันที่ประกาศในราชกิจจานุเบกษาเป็นต้นไป

ประกาศ ณ วันที่ ๒๓ กุมภาพันธ์ พ.ศ. ๒๕๖๐

อุตตม สาวนายน

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

# มาตรฐานผลิตภัณฑ์อุตสาหกรรม สวิตช์ไฟฟ้าใช้ในที่อยู่อาศัยและสิ่งติดตั้งทางไฟฟ้า ยึดกับที่ที่คล้ายกัน

## เล่ม 2(5) คุณสมบัติที่ต้องการเฉพาะ – สวิตช์ไฟฟ้าและอุปกรณ์ประกอบ สำหรับใช้ในระบบอิเล็กทรอนิกส์ของอาคารบ้านเรือน (HBES)

### 0. บททั่วไป

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดขึ้นโดยรับ IEC 60669-2-5 Edition 1.0 (2013-10) Switches for household and similar fixed electrical installations - Part 2-5: Particular requirements - Switches and related accessories for use in home and building electronic systems (HBES) มาใช้โดยวิธีพิมพ์ซ้ำ (reprinting) ในระดับเหมือนกันทุกประการ (identical) โดยใช้ IEC ฉบับภาษาอังกฤษเป็นหลัก

#### 0.1 ขอบข่าย

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ครอบคลุมสวิตช์ไฟฟ้า HBES (home and building electronic system) มีแรงดันไฟฟ้าทำงานไม่เกิน 250 V a.c. และกระแสไฟฟ้าที่กำหนดไม่เกิน 16 A สำหรับใช้ในที่อยู่อาศัยและสิ่งติดตั้งทางไฟฟ้ายึดกับที่ที่คล้ายกัน ได้ทั้งภายในอาคารและภายนอกอาคาร และครอบคลุมหน่วยต่อขยายอิเล็กทรอนิกส์ (electronic extension unit) ที่เกี่ยวข้อง ดังนี้

- สวิตช์ไฟฟ้า HBES สำหรับการทำงานของวงจรหลอดไฟฟ้า ตัวควบคุมความสว่างของหลอดไฟฟ้า (ตัวหรี่ไฟฟ้า) และตัวควบคุมความเร็วของมอเตอร์ไฟฟ้า (เช่น สวิตช์ไฟฟ้า HBES ที่ใช้ในพัดลมระบายอากาศ) และสำหรับวัตถุประสงค์อื่น ๆ (เช่น สิ่งติดตั้งทางไฟฟ้าทำให้ร้อน)
- ตัวรับรู้ ตัวกระตุ้น เต้ารับแบบสวิตช์ (switched-socket-outlet) และหน่วยต่อขยายอิเล็กทรอนิกส์ที่เกี่ยวข้อง เป็นต้น

คำว่า “สวิตช์ไฟฟ้า HBES” หมายความว่ารวมถึง อุปกรณ์ HBES (HBES device) ทุกชนิด เช่น สวิตช์ไฟฟ้า ตัวรับรู้ตัวกระตุ้น เต้ารับแบบสวิตช์ และหน่วยต่อขยายอิเล็กทรอนิกส์ที่เกี่ยวข้อง เป็นต้น ด้วย

การทำงานและตัวควบคุมสามารถทำได้ ดังนี้

- โดยคนผ่านส่วนกระตุ้น (actuating member) ทุญแจ บัตร์ เป็นต้น ผ่านพื้นผิวรับรู้หรือหน่วยรับรู้ โดยวิธีแตะ (touch) ใกล้ชิด (proximity) บิด (turn) ทางแสง (optical) ทางเสียง (acoustic) ทางความร้อน (thermal)
- โดยตัวกลางทางกายภาพ เช่น แสง อุณหภูมิ ความชื้น เวลา ความเร็วลม การมีคนอยู่
- โดยสิ่งกระทบอื่น

และสามารถส่งผ่าน

- โดยสัญญาณอิเล็กทรอนิกส์ผ่านตัวกลางหลายอย่าง เช่น สายไฟฟ้ากำลัง (ประธาน) สายไฟฟ้าตีเกลียวคู่ ไยแก้วนำแสง ความถี่วิทยุ อินฟราเรด

สวิตช์ไฟฟ้า HBES ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้เหมาะสำหรับใช้ที่อุณหภูมิโดยรอบ โดยปกติไม่เกิน 25 °C แต่มีบางโอกาสสูงถึง 35 °C

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ครอบคลุมกล่องติดตั้ง (mounting box) สำหรับสวิตช์ไฟฟ้า HBES ยกเว้นกล่องติดตั้งสำหรับสวิตช์ไฟฟ้า HBES ชนิดฝังเรียบ (flush-type HBES switch) ตาม IEC 60670-1

**หมายเหตุ 1** ใน UK กล่องติดตั้งฝังเรียบ (flush mounted box) ต้องเป็นไปตามทั้ง EN 60670-1 และ BS 4662

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ไม่ครอบคลุมถึงประเด็นปัญหาความปลอดภัยตามหน้าที่ (functional safety aspect) ของสวิตช์ไฟฟ้า HBES ข้อกำหนดความปลอดภัยตามหน้าที่ (functional safety requirement) มีอยู่ในมาตรฐานของอุปกรณ์ที่ถูก HBES ควบคุม

สถานที่ที่มีภาวะพิเศษเด่นชัด เช่น ที่อุณหภูมิสูงกว่า เป็นต้น อาจต้องกำหนดสิ่งสร้างเป็นพิเศษ

**หมายเหตุ 2** มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ไม่ครอบคลุมถึงอุปกรณ์ซึ่งอยู่ในขอบข่ายตาม IEC 60730

**หมายเหตุ 3** มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ ส่วนที่อ้างถึง IEC 60699-2-1 ให้แทนคำว่า “สวิตช์ไฟฟ้าอิเล็กทรอนิกส์” ด้วยคำว่า “สวิตช์ไฟฟ้า HBES”

**หมายเหตุ 4** ใน CN สวิตช์ไฟฟ้า HBES ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้เหมาะสำหรับใช้ที่อุณหภูมิโดยรอบ โดยปกติไม่เกิน 35 °C แต่มีบางโอกาสสูงถึง 40 °C

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 1.

## 0.2 เอกสารอ้างอิง

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 2.

## 0.3 บทนิยาม

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 3.

## 0.4 ข้อกำหนดทั่วไป

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 4.

## 0.5 ข้อกำหนดทั่วไปสำหรับการทดสอบ

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 5.

## 0.6 พิกัด

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 6.

## 0.7 การจำแนกประเภท

รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 7.

- 0.8 การทำเครื่องหมาย  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 8.
- 0.9 การตรวจสอบมิติ  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 9.
- 0.10 การป้องกันช็อกไฟฟ้า  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 10.
- 0.11 การจัดเตรียมสำหรับการต่อกับดิน  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 11.
- 0.12 ขั้วต่อ  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 12.
- 0.13 ข้อกำหนดการสร้าง  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 13.
- 0.14 กลไก  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 14.
- 0.15 ความต้านทานต่อการแรงอายุ การป้องกันโดยเปลือกหุ้มของสวิตช์ไฟฟ้าและความต้านทานต่อความชื้น  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 15.
- 0.16 ความต้านทานฉนวนและความทนทานไฟฟ้า  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 16.
- 0.17 อุณหภูมิที่เพิ่มขึ้น  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 17.
- 0.18 วิสัยสมารถตัดและต่อกระแสไฟฟ้า  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 18.
- 0.19 การทำงานปกติ  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 19.
- 0.20 ความแข็งแรงทางกล  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 20.
- 0.21 ความต้านทานต่อความร้อน  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 21.



มอก. 824 เล่ม 2(5)-2559

IEC 60669-2-5(2013-10)

- 0.22 หมุดเกลียว ส่วนนำพากระแสไฟฟ้า และสิ่งต่อวงจร  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 22.
- 0.23 ระยะห่างตามผิวฉนวน ระยะห่างในอากาศ และระยะห่างผ่านสารประกอบปิดผนึก  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 23.
- 0.24 ความต้านทานของวัสดุฉนวนต่อความร้อนผิดปกติ ต่อการลุกไหม้ และต่อการเกิดรอยทาง  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 24.
- 0.25 ความต้านทานต่อการเกิดสนิม  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 25.
- 0.26 ข้อกำหนดความเข้ากันได้ทางแม่เหล็กไฟฟ้า (EMC)  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 26.
- 0.101 ภาวะผิดปกติ  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 101.
- 0.102 ส่วนประกอบ  
รายละเอียดให้เป็นไปตาม IEC 60669-2-5: 2013 ข้อ 102.

© IEC:2013

เอกสารนี้เป็นลิขสิทธิ์ของ IEC หากมิได้กำหนดไว้เป็นอย่างอื่นห้ามนำมาตรฐานฉบับนี้หรือส่วนหนึ่งส่วนใดไปทำซ้ำหรือใช้ประโยชน์ในรูปแบบ หรือโดยวิธีใดๆ ไม่ว่าจะเป็นรูปแบบอิเล็กทรอนิกส์หรือทางกล รวมถึงการถ่ายสำเนาถ่ายไมโครฟิล์มโดยไม่ได้รับอนุญาตเป็นลายลักษณ์อักษรจาก IEC ตามที่อยู่ข้างล่างหรือจากสมาชิก IEC ในประเทศของผู้ร้องขอ

IEC Central Office  
3, rue de Varembé  
CH - 1211 Geneva 20  
Switzerland  
E-mail: [info@iec.ch](mailto:info@iec.ch)  
Web: [www.iec.ch](http://www.iec.ch)

## CONTENTS

FOREWORD .....	4
1 Scope .....	6
2 Normative references .....	7
3 Terms and definitions .....	8
4 General requirements .....	10
5 General notes on tests .....	10
6 Rating .....	10
7 Classification .....	11
8 Marking .....	12
9 Checking of dimensions .....	12
10 Protection against electric shock .....	12
11 Provision for earthing .....	13
12 Terminals .....	13
13 Constructional requirements .....	14
14 Mechanism .....	14
15 Resistance to ageing, protection provided by enclosures of switches, and resistance to humidity .....	14
16 Insulation resistance and electric strength .....	14
17 Temperature rise .....	15
18 Making and breaking capacity .....	15
19 Normal operation .....	15
20 Mechanical strength .....	16
21 Resistance to heat .....	16
22 Screws, current-carrying parts and connections .....	16
23 Creepage distances, clearances and distances through sealing compound .....	16
24 Resistance of insulating material to abnormal heat, to fire and to tracking .....	22
25 Resistance to rusting .....	22
26 EMC requirements .....	22
101 Abnormal conditions .....	29
102 Components .....	30
Annex A (normative) Survey of specimens needed for tests .....	31
Annex B (normative) Additional requirements for switches having facilities for the outlet and retention of flexible cables .....	32
Annex C (informative) Examples of types of electronic switches and their functions .....	33
Annex AA (normative) Measurement of clearances and creepage distances .....	34
Annex BB (informative) Test set-ups .....	37
Bibliography .....	44
Figure 201 – Protective separation between circuits .....	19
Figure AA.1 – Narrow groove .....	34
Figure AA.2 – Wide groove .....	34
Figure AA.3 – V-shaped groove .....	34

Figure AA.4 – Rib.....	35
Figure AA.5 – Uncemented joint with narrow groove.....	35
Figure AA.6 – Uncemented joint with wide groove .....	35
Figure AA.7 – Uncemented joint with narrow and wide grooves .....	35
Figure AA.8 – Intervening, unconnected conductive part .....	36
Figure AA.9 – Narrow recess.....	36
Figure AA.10 – Wide recess .....	36
Figure BB.1 – Test setup for AC mains connection according to IEC 61000-4-4 .....	37
Figure BB.2 – Test setup for bus and DC mains connection according to IEC 61000-4-4.....	38
Figure BB.3 – Test setup for AC mains connection according to IEC 61000-4-5 .....	39
Figure BB.4 – Test setup for bus and DC mains connection according to IEC 61000-4-5.....	40
Figure BB.5 – Test setup for the ESD according to IEC 61000-4-2 .....	41
Figure BB.6 – Test setup for AC mains connection according to IEC 61000-4-6 .....	42
Figure BB.7 – Test setup for bus and DC mains connection according to IEC 61000-4-6.....	43
Table 201 – Test loads for HBES switches for heating installations .....	16
Table 202 – Relation between the rated voltage of the HBES switch, the rated insulation voltage and the rated impulse voltage .....	17
Table 203 – Minimum clearances without verification test.....	19
Table 204 – Test voltages and corresponding altitudes .....	20
Table 205 – Minimum clearances with verification test .....	20
Table 206 – Minimum creepage distances of basic, supplementary and reinforced insulation without verification test.....	21
Table 207 – Minimum creepage distances of basic, supplementary and reinforced insulation with verification test.....	21
Table 208 – Immunity tests (overview) .....	24
Table 209 – Voltage dip and short-interruption test values .....	24
Table 210 – Surge immunity test voltages .....	25
Table 211 – Fast transient test values .....	26
Table 212 – Values for radiated electromagnetic field test of IEC 61000-4-3 .....	27

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SWITCHES FOR HOUSEHOLD AND  
SIMILAR FIXED ELECTRICAL INSTALLATIONS –****Part 2-5: Particular requirements –  
Switches and related accessories for use in home  
and building electronic systems (HBES)**

## 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 60669-2-5 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories.

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

FDIS	Report on voting
23B/1110/FDIS	23B/1129/RVD

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

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

This part of IEC 60669 is partially based on IEC 60669-1:1998, its Amendment 1:1999 and Amendment 2:2006 and IEC 60669-2-1:2002 and its Amendment 1:2008. In cases where parts of these standards apply, this will be mentioned explicitly by a normative cross-reference describing the extent to which the referenced element (clause, subclause, figure, table, etc.) applies. Subclauses, figures, tables or notes which are additional to those in IEC 60669-1 and IEC 60669-2-1 and their amendments are numbered starting from 101 and 201 respectively, additional annexes are lettered AA, BB, etc.

This part of IEC 60669 lists the changes necessary to convert those standards into a specific standard for home and building electronic systems (HBES) switches and related accessories.

In this standard, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- notes: in smaller roman type.

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

The following differences exist in the countries indicated below.

- Clause 26: all CENELEC countries.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

**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.**

## **SWITCHES FOR HOUSEHOLD AND SIMILAR FIXED ELECTRICAL INSTALLATIONS –**

### **Part 2-5: Particular requirements – Switches and related accessories for use in home and building electronic systems (HBES)**

#### **1 Scope**

This part of IEC 60669 applies to HBES switches with a working voltage not exceeding 250 V a.c. and a rated current up to and including 16 A for household and similar fixed electrical installations either indoors or outdoors and to associated electronic extension units.

It applies to:

- HBES 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 installations);
- sensors, actuators, switched-socket-outlets, associated electronic extension units, etc.

In the present standard the word "HBES switch" is applied to describe all kinds of HBES devices e.g. switches, sensors, actuators, switched-socket-outlets, associated electronic extension units, etc.

The operation and control 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, e.g. light, temperature, humidity, time, wind velocity, presence of people;
- by any other influence;

and transmitted:

- by an electronic signal via several media, e.g. powerline (mains), twisted pair, optical fibre, radio frequency, infra-red, etc.

HBES switches complying with this standard are suitable for use at ambient temperatures not normally exceeding 25 °C, but occasionally reaching 35 °C.

This part of IEC 60669 also applies to mounting boxes for HBES switches, with the exception of those for flush-type HBES switches which are covered by IEC 60670-1.

**NOTE 1** In the following country flush mounted boxes are covered by both EN 60670-1 and BS 4662: UK

Functional safety aspects of HBES switches are not covered by this standard. Functional safety requirements are covered by the standards of the devices which are controlled by the HBES.

In locations where special conditions prevail, e.g. higher temperature, special constructions may be required.

**NOTE 2** This standard is not intended to cover devices falling within the scope of IEC 60730.

NOTE 3 Within this Part 2-5, for any reference to IEC 60669-2-1 and its Amendment 1:2008, the term "electronic switches" is replaced by "HBES switches".

NOTE 4 In the following country, HBES switches complying with this standard are suitable for use at ambient temperatures not normally exceeding 35 °C, but occasionally reaching 40 °C: CN.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary*, available at: <<http://www.electropedia.org>>

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60669-1:1998, *Switches for household and similar fixed-electrical installations – Part 1: General requirements*  
Amendment 1:1998  
Amendment 2:2006

IEC 60669-2-1:2002, *Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic switches*  
Amendment 1:2008

IEC 60364-4-41, *Low-voltage electrical installations– Part 4-41: Protection for safety – Protection against electric shock*

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

IEC 60670-1, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 1: General requirements*

IEC 60715, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations*

IEC 60990, *Methods of measurement of touch current and protective conductor current*

IEC 61000-2-2, *Electromagnetic compatibility (EMC) – Part 2-2: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public low-voltage power supply systems*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16A per phase)*

IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*



IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-20:2010, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

IEC 61058-1, *Switches for appliances – Part 1: General requirements*  
Amendment 1:2000  
Amendment 2:2007

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

CISPR 14 (all parts), *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus*

CISPR 15, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

### 3 Terms and definitions

Clause 3 of IEC 60669-2-1:2002 and its Amendment 1:2008 is applicable with the following additions:

#### 3.201

#### **HBES**

#### **home and building electronic systems**

multi-application systems where functions are decentrally distributed and linked through a common communication process

Note 1 to entry: HBES is used in homes and buildings plus their surroundings. Functions of the system are for example: switching, open loop controlling, closed loop controlling, monitoring and supervising.

Note 2 to entry: This note applies to the French language only.

[SOURCE: ISO/IEC 14762:2009, 3.1.10]

### **3.202**

#### **HBES switch**

electronic switch intended to be used in an HBES system, used for two way communication and designed to make or break and/or to control, directly (e.g. actuator) or indirectly (e.g. sensor), the current in one or more electric circuits

Note 1 to entry: The communication can use different media e.g. Twisted Pair (TP), Power Line (PL), Infra-Red (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.

### **3.203**

#### **ELV**

#### **extra-low voltage**

for the purpose of this standard, a voltage not exceeding 50 V a.c. or d.c. between conductors, or in the case of three-phase circuits, not exceeding 29 V between conductors and neutral, the no-load voltage of the circuit not exceeding 50 V and 29 V, respectively

Note 1 to entry: The use of ELV other than for protection by SELV or PELV in such circuits is not a protective measure.

### **3.204**

#### **FELV**

#### **functional extra-low voltage circuit**

electrical circuit in which the voltage cannot exceed ELV used for functional purposes and having simple separation from LV.

Note 1 to entry: FELV does not fulfil the requirements for SELV (or PELV).

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

### **3.205**

#### **SELV system**

#### **safety extra-low-voltage system**

electrical system in which the voltage cannot exceed ELV

- under normal conditions
- under single fault conditions, including earth faults in other circuits

[SOURCE: IEC 61140:2001, 3.26.1]

### **3.206**

#### **PELV system**

#### **protected extra-low-voltage system**

electrical system in which the voltage cannot exceed ELV

- under normal conditions
- under single fault conditions, except earth faults in other circuits

[SOURCE: IEC 61140:2001, 3.26.2]

### **3.207**

#### **simple separation**

separation between circuits or between a circuit and earth by means of basic insulation

[SOURCE: IEC 61140:2001, 3.23]

**3.208****protective separation**

separation of one electric circuit from another by means of

- double insulation, or
- basic insulation and protective screening, or
- reinforced insulation

[SOURCE: IEC 60050-195, Amendment 1:2001, 195-06-19]

**3.209****basic insulation**

insulation of hazardous-live-parts which provides basic protection

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

[SOURCE: IEC 60050-195:1998, 195-06-06]

**3.210****supplementary insulation**

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

[SOURCE: IEC 60050-195:1998, 195-06-07]

**3.211****double insulation**

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-195:1998, 195-06-08]

**3.212****reinforced insulation**

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

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

[SOURCE: IEC 60050-195:1998, 195-06-09]

**4 General requirements**

Clause 4 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 is applicable.

**5 General notes on tests**

Clause 5 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

**5.4** *Replacement in Table 101 of the number of specimens in the column "Additional specimens for clause or subclause 26" from 3 and 6 to 1 and 1.*

**6 Rating**

Clause 6 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

*Addition:*

For this standard the ELV is limited to 50 V a.c. and 50 V d.c.

NOTE For three phase circuits, see 3.203.

## 7 Classification

Clause 7 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

### 7.1.5 Replacement:

#### 7.1.5 Addition:

- touch;
- proximity;
- optical;
- acoustic;
- other external influences, e.g. communication system.

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

*Additions:*

### 7.1.7 Replacement:

7.1.7 Not applicable for SELV switches.

### 7.1.8 Replacement:

7.1.8 according to the wiring connection:

- switches with screw-type terminals;
- switches with screwless terminals for rigid conductors only;
- switches with screwless terminals for rigid and flexible conductors;
- switches without terminals equipped with connecting leads.

#### 7.1.101 Addition of the following dashed item:

- load for heating installations (e.g. resistive load, a motor load with a power factor not less than 0,6 or a combination of both);

*Additional subclauses:*

7.1.201 according to the presence of SELV or PELV part:

- switches with SELV or PELV parts only,
- switches without SELV or PELV parts,
- switches having a combination of parts connected to the mains and SELV or PELV parts.

7.1.202 according to the installation environment:

- switches intended to be used in SELV/PELV environment only;
- switches intended to be used in SELV/PELV and/or mains environment.

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

- a) Connected to a network which is installed wholly within the same equipotential earthing system;
- b) Connected to a network which is not installed wholly within the same equipotential earthing system.

## 8 Marking

Clause 8 of IEC 60669-2-1:2002 and its Amendment 1:2008 is applicable, with the following exceptions:

**8.1** *Replacement of the penultimate paragraph starting with "For general purpose electronic switches with included automatic function" by:*

In addition, for HBES switches with contact mechanism(s) classified for more than 20 000 operating cycles, the number of operating cycles shall be indicated. This information may be put on the HBES switch and/or on the packaging unit and/or on the accompanying instruction sheet.

Sensors, actuators and associated electronic extension units which do not control directly the load and which are supplied by the network do not need the following markings:

- rated voltage in volts;
- rated current in amperes or rated load in volt-amperes or watts;
- symbol for nature of supply;

The correct installation of the product shall be provided in the manufacturer's instructions.

**8.4** *Addition, at the end of the subclause, of the following paragraph:*

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

## 9 Checking of dimensions

Clause 9 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

## 10 Protection against electric shock

Clause 10 of IEC 60669-2-1:2002 and its Amendment 1: applies, except as follows:

*Additional subclauses:*

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

SELV / PELV is 50 V a.c. or d.c. maximum under no fault and one single fault condition.

FELV is 50 V a.c. or d.c. maximum under no fault.

In addition, if the SELV / PELV is higher than 25 V a.c. in dry conditions or 12 V a.c. or 30 V d.c. 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 a.c. for 1 min.

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

## **10.202 Protection from touch current**

NOTE For an explanation on touch current, see IEC 60950-1:2005 Annex W.

### **10.202.1 Permissible touch current when touching accessible parts of HBES switches**

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

*Compliance is checked by inspection and if necessary by tests according to IEC 60990.*

### **10.202.2 Limitation of the touch current from the device to the dedicated HBES network**

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

*Compliance is checked by measurement according to IEC 60990.*

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

NOTE When it is possible to touch the HBES network during maintenance, the limitation of the summation of touch current can be considered in accordance to IEC 60950-1.

## **11 Provision for earthing**

Clause 11 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

## **12 Terminals**

Clause 12 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies, except as follows:

### **12.1 Addition after the first paragraph:**

The connecting capability of terminals for circuits other than those of the main circuit need not be related to the rated current of the HBES switch. This means that these terminals need not necessarily have the same connecting capability as the mains terminals of the HBES switch. Terminals for conductors smaller than 0,5 mm<sup>2</sup> shall fulfil the requirements of IEC 60999-1.

*Addition after the third paragraph:*

Terminals having screw clamping which are in compliance with IEC 60998-2-1 can be used.

*Addition before the last paragraph:*

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

**12.2** *Addition to Note 2 of Table 2:*

This requirement can be achieved by using terminal(s) with two separate clamping units.

**13 Constructional requirements**

Clause 13 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

*Addition:*

**13.3.2** *Replacement of the text in Table 11 of the last line of the first column with "To insulating parts, earthed metal parts, the live parts of SELV or metal parts separated from live parts by creepage distances and by clearances twice those according to Table 20".*

*Additional subclause:*

**13.201** Free ends of leads of HBES switches, if any, may be prepared but pre-soldering shall not be used.

*Compliance is checked by inspection.*

**14 Mechanism**

Clause 14 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

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

Clause 15 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies.

**16 Insulation resistance and electric strength**

Clause 16 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

*Replacement of the addition to Table 14 by:*

9	Between LV (mains) circuit(s) and FELV circuit(s)	5	1 250	2 000
10	Between SELV/PELV circuits and other circuit(s) having a higher voltage than SELV/PELV	7	2 500	3 750
11	Between a SELV or PELV circuit below 25 V a.c. and a SELV or PELV circuit above 25 V a.c.	5	500	500
12	Between a SELV or PELV circuit above 25 V a.c. and accessible surfaces (see Clause 10)	5	500	500
13	Between a SELV and PELV circuits or between different SELV- or different PELV circuits from different sources	5	500	500
14	Between a SELV or PELV circuit(s) and FELV circuit(s)	5	1 250	2 000

*Addition of the following new notes to Table 14:*

NOTE 201 Only items 10, 11, 12 and 13 are applicable to SELV or PELV parts of HBES switches.

NOTE 202 Items 1 to 9 are not applicable to SELV or PELV parts of HBES switches.

## 17 Temperature rise

Clause 17 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

*Addition:*

NOTE 201 HBES switches having no load switching means need not be subjected to this test.

## 18 Making and breaking capacity

Clause 18 IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows:

*Addition after "For electronic RCS, Clause 18 of IEC 60669-2-2:2006 applies":*

HBES switches having no load switching means are not subjected to this test.

## 19 Normal operation

Clause 19 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows.

*Replacement of the second paragraph by:*

*Compliance is checked by the tests of IEC 60669-2-1:2002 and its Amendment 1:2008, 19.101, 19.102, 19.103, 19.104 and 19.105 as well as 19.201 of this standard, during which the HBES switches are tested at rated voltage and loaded as specified in Clause 17, unless otherwise specified.*

*The test according to subclause 19.101 is conducted on the complete HBES switch which shall be controlled by the sensors, actuators or electronic extension units as described by the manufacturer of the system.*

*The sensors, actuators or electronic extension units are tested when installed according to the manufacturer's instructions so as to verify that they are capable of controlling the HBES switch according to this paragraph.*

*Additional subclause:*

**19.201** For HBES switches designed for heating installations the number of operations shall be 200 000.

Contact mechanisms incorporated in HBES switches intended for heating installations are subjected to the test described in subclause 19.101 but with the electrical conditions specified in Table 201.



**Table 201 – Test loads for HBES switches for heating installations**

Type of load as classified in 7.1.101	Operation of contacts	Test voltage	Test current r.m.s.	Power factor <sup>c</sup>
Resistive and motor	Making <sup>b</sup>	Rated voltage	$6 \times I-M$ or $I-R$ <sup>a</sup>	0,60 (+0,05) $\geq 0,9$
	Breaking	Rated voltage	$I-R$ or $I-M$ <sup>a</sup>	$\geq 0,9$
<p>NOTE</p> <p>I-M: motor-load current; and</p> <p>I-R: resistive-load current</p> <p><sup>a</sup> Whichever is arithmetically greater or whichever is the most unfavourable value in case of equal values.</p> <p><sup>b</sup> The specified making conditions are maintained for a period between 50 ms and 100 ms, and are then reduced by an auxiliary switch to the specified breaking conditions. The reduction to the break current should be achieved without any open circuiting of the simulated inductive loads circuit to ensure that no abnormal voltage transients are generated. A typical method of achieving this is shown in Figure 19 of IEC 61058-1, Amendment 2:2007.</p> <p><sup>c</sup> Resistors and inductors are not connected in parallel except that if any air-core inductor is used, a resistor taking approximately 1 % of the current through the inductor is connected in parallel with it. Iron-core inductors may be used provided that the current has a substantially sine-wave form.</p>				

## 20 Mechanical strength

Clause 20 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies.

## 21 Resistance to heat

Clause 21 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies.

## 22 Screws, current-carrying parts and connections

Clause 22 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies.

## 23 Creepage distances, clearances and distances through sealing compound

Clause 23 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies, except as follows.

*Replacement of the addition except for Notes 1 and 2 by:*

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

The values given in items 1 and 6 of Table 20 apply to terminals for external wiring and do not apply to other live parts if one of the following conditions is fulfilled:

- for HBES switch without contact gap if Clause 101 is fulfilled;
- If the printed wiring board and/or circuit is coated and the coating complies with the specifications of IEC 60664-3;
- If the PTI value of the printed circuit board has a value of at least 600 and the creepage distance is at least 0,56 mm but not less than the contact gap.

*Additional subclauses:*

### 23.201 General

The following subclauses are only intended to give requirements for insulation between different electrical parts to verify insulation conditions between SELV/PELV and other circuits.

### 23.202 Specifications of insulation

The following parameters apply:

- a) Overvoltage category: III
- b) Pollution degree: 2
- c) Material class: min.IIIa

**Table 202 – Relation between the rated voltage of the HBES switch, the rated insulation voltage and the rated impulse voltage**

Rated voltage of HBES switch (r.m.s.)	Rated insulation voltage	Rated impulse withstand voltage
Up to and including 50 V	50 V	2 500 V <sup>a</sup>
Above 50 V up to and including 250 V	250 V	4 000 V
230/400 V (three phase)	250 V	4 000 V
<sup>a</sup> When the HBES switch is classified according to 7.1.203 a), the value can be reduced to 800 V.		
NOTE 1 For clarification see IEC 60664-1.		

### 23.203 Separation between circuits

Arrangements shall ensure protective separation between mains (and other hazardous voltages) and SELV/PELV circuit.

The protective separation can be achieved by one of the methods given in Figure 201.

HBES switches containing hazardous voltages and SELV/PELV circuits shall provide double or reinforced insulation for the rated insulation voltage and the rated impulse withstand voltage externally (between HBES switches and other circuits outside the HBES switch) and internally (between the different circuits inside the HBES switch).

NOTE 1 Figure 201 a) addresses the SELV/PELV part within HBES switches which are intended to be used either in SELV/PELV installations or in mains installations where basic insulation of mains live parts can be expected. Figure 201 b) addresses the SELV/PELV part within single mains HBES switches which are intended to be used in installations where hazardous voltages appear (including mains installations).

HBES switches containing only SELV/PELV circuits shall provide double or reinforced insulation for the rated insulation voltage and the rated impulse withstand voltage (between SELV/PELV circuit of the HBES switch and other circuits outside the HBES switch (see Figure 201 c)) according to the 230/400 V mains environment unless the usage in another environment is made clearly visible either by marking, an instruction sheet or similar means (see Figure 201 d)).

When connecting a HBES switch based on SELV/PELV circuits to a network based on SELV/PELV circuits the simple separation is required based on the rated insulation voltage of 50 V and the highest rated impulse withstand voltage of the circuits.

NOTE 2 A SELV HBES switch circuit and a SELV network circuit of the same rated insulation voltage and the same rated impulse withstand voltage can be considered as the same circuit and therefore no separation is needed.

NOTE 3 A PELV HBES switch circuit and a PELV network circuit of the same rated insulation voltage and the same rated impulse withstand voltage can be considered as the same circuit and therefore no separation is needed.

NOTE 4 Figure 201 c) addresses SELV/PELV HBES switches which are intended to be used in installations where hazardous voltages appear (including mains installations). Figure 201 d) addresses SELV/PELV HBES switches which are intended to be used as standalone in SELV/PELV installations. Figure 201 e) addresses SELV/PELV HBES switches which are intended to be used as standalone in mains installation where basic insulation of mains live parts can be expected.

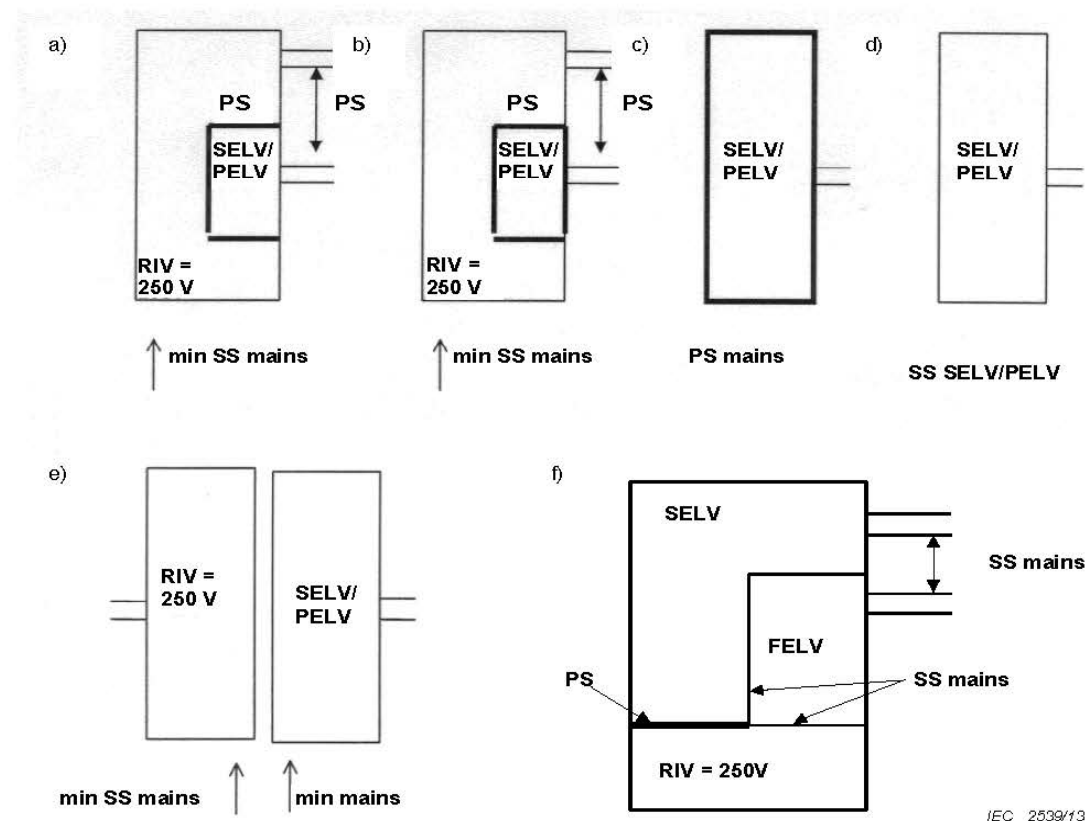
SELV circuits shall be insulated from FELV circuits by simple separation (see Figure 201 f)

FELV circuits shall be insulated from the mains by at least basic insulation (based upon a working voltage equal to mains voltage) (see Figure 201 f).

It is not required that FELV circuits shall be insulated from other FELV circuits except for functional purpose.

It is not required that FELV circuits shall be insulated from the protective earth circuit except for functional purpose.

FELV circuits shall be insulated from non-earthed accessible metal parts by simple separation (based upon a working voltage equal to mains voltage).



# Key

Methods to achieve protective separation:

SS mains = simple separation = Basic insulation for rated insulation voltage and for rated impulse withstand voltage in mains environment according to Table 202

SS SELV/PELV	= simple separation	= Basic insulation for rated insulation voltage and for rated impulse withstand voltage in SELV/PELV environment according to Table 202
PS mains	= protective separation	= Double insulation or reinforced insulation for rated insulation voltage and for rated impulse withstand voltage in mains environment according to Table 202
RIV	= rated insulation voltage	

**Figure 201 – Protective separation between circuits****23.204 Dimensioning of clearances of basic, double or reinforced insulation between circuits**

If no verification test is carried out, clearances of basic insulation shall be dimensioned as specified in Table 203 taking into account that the required impulse withstand voltage is equal to the rated impulse withstand voltage of the HBES switch (as defined in Table 202).

Clearances through openings in enclosures of insulating material shall not be less than those specified for inhomogeneous field conditions since the configuration is not controlled, which may have an adverse effect on the homogeneity of the electric field (5.1.3.2 of IEC 60664-1:2007).

Double insulation consists of basic insulation and supplementary insulation. Each shall be dimensioned as specified in Table 203, if no verification test is carried out.

For HBES switches provided with double insulation where basic insulation and supplementary insulation cannot be tested separately, the insulation system is considered as reinforced insulation.

Clearances of reinforced insulation shall be dimensioned as specified in Table 203 taking into account that the required impulse withstand voltage is one step higher than the rated impulse withstand voltage of the HBES switch.

**Table 203 – Minimum clearances without verification test**

Required impulse withstand voltage V	Minimum clearances without verification test mm
800	0,2
2 500	1,5
4 000	3,0
6 000	5,5

Compliance is checked by measurements taking into account the figures of Annex BB.

Clearance values (for required impulse withstand voltage = 800 V) shall not be less than the values given in Table 203.

Clearance values (for required impulse withstand voltage higher than 800 V) smaller than the prescribed values in Table 203 can be used:

- if the parts are rigid or located by mouldings or if the construction is such that the distances have no likelihood of being reduced during mounting, connection and normal use and
- if the clearances are not less than the ones given in Table 205 and

NOTE 1 When selecting clearances according to Table 205 the requirements of IEC 60664-1 regarding influencing factors can be taken into account.

- if the clearances withstand the impulse voltage dielectric test in accordance with IEC 60664-1.

*Compliance is checked by the following impulse withstand voltage test.*

*The test voltage is equal to the required impulse withstand voltage specified in Table 202 corrected to Table 204.*

*The test is carried out on the complete assembly as in normal use.*

*All conductors of the FELV or SELV part are connected together and all conductors of the mains part are connected together.*

*There will be 6 pulses applied to the equipment, being 3 positive impulses and 3 negative impulses.*

*The generator output impedance shall not be higher than 500  $\Omega$ .*

*There shall be*

- *no flash over and*
- *the waveform of the impulse shall not be distorted (6.1.4.5 of IEC 60664-1:2007). This means that the amplitude of the waveform when the impulse is applied to the equipment shall be not less than 90 % of the amplitude of the waveform when the generator is open circuit.*

**Table 204 – Test voltages and corresponding altitudes**

Rated impulse withstand voltage	Test voltages and corresponding altitudes				
	kV				
	Sea level	200 m	500 m	1 000 m	2 000 m
4,0	4,8	4,8	4,7	4,4	4,0
6,0	7,4	7,2	7,0	6,7	6,0

**Table 205 – Minimum clearances with verification test**

Required impulse withstand voltage	Minimum clearances with verification test
V	mm
2 500	0,5
4 000	1,2
6 000	2,0

NOTE 2 The minimum clearances without verification test (see Table 203) are in accordance with Table F.2 inhomogeneous field of IEC 60664-1:2007. The minimum clearances with verification test (see Table 205) are in accordance with Table F.2 homogeneous field of IEC 60664-1:2007.

The clearance between SELV parts and earth shall not be less than 1,5 mm.

When the HBES switch is classified according to 7.1.203 a) the clearance can be reduced to 0,2 mm.

### 23.205 Dimensioning of creepage distances of basic, double or reinforced insulation between circuits

In accordance with IEC 60664-1:2007, 5.2.2.6 a creepage distance cannot be less than the associated clearance, so the shortest creepage distance possible is equal to the required clearance.

If no verification test is carried out, creepage distances of basic, supplementary and reinforced insulation shall be selected from Table 206.

Creepage distances of double insulation are the sum of the values of the basic and supplementary insulation, which composes the double insulation system.

**Table 206 – Minimum creepage distances of basic, supplementary and reinforced insulation without verification test**

Rated insulation voltage (r.m.s.) V	Minimum creepage distance mm							
	Basic and supplementary insulation				Reinforced insulation			
	Printed wiring material	Material group I	Material group II	Material group III	Printed wiring material	Material group I	Material group II	Material group III
50 V when classified according to 7.1.203 a)	0,2 <sup>a</sup>	0,6	0,85	1,2	N.A.	N.A.	N.A.	N.A.
50V when classified according to 7.1.203 b)	1,5 <sup>a</sup>	1,5 <sup>a</sup>	1,5 <sup>a</sup>	1,5 <sup>a</sup>	N.A.	N.A.	N.A.	N.A.
250	3,0 <sup>a</sup>	3,0 <sup>a</sup>	3,0 <sup>a</sup>	3,0 <sup>a</sup>	5,5 <sup>a</sup>	5,5 <sup>a</sup>	5,5 <sup>a</sup>	5,5 <sup>a</sup>
NOTE N.A.: These values are not applicable, as these situations are not mentioned in Figures 201 a) to 201 e).								
<sup>a</sup> These cases are limited to these values as a creepage distance should not be less than the associated clearance.								

Creepage distances (for rated insulation voltage up to and including 50 V) shall not be less than the values given in Table 206.

Creepage distances (for rated insulation voltage above 50 V up to and including 250 V) smaller than the prescribed values in Table 206 shall not be less than the values given in Table 207.

**Table 207 – Minimum creepage distances of basic, supplementary and reinforced insulation with verification test**

Rated insulation voltage (r.m.s.)	Minimum creepage distance mm							
	Basic and supplementary insulation				Reinforced insulation			
	Printed wiring material	Material group I	Material group II	Material group III	Printed wiring material	Material group I	Material group II	Material group III
Above 50 V up to and including 250 V	1,2 <sup>a</sup>	1,25	1,8	2,5	2,5	2,5	3,6	5,0
<sup>a</sup> This case is limited to these values as a creepage distance should not be less than the associated clearance								

The creepage distance between SELV and earth shall not be less than 0,2 mm.

*Compliance is checked by measurements taking into account the figures of Annex BB.*

**23.206 Solid insulation**

The dielectric strength of the solid insulation (if any) of the simple and protective separation between circuits is covered by Clause 16.

*Compliance is checked by the test of Clause 16.*

**23.207 Protective separation of the supply for the SELV/PELV circuit**

According to IEC 60364-4-41, the protective separation of the supply for the SELV/PELV circuit shall be at least as good as for safety transformers in accordance with IEC 61558-2-6.

*Compliance is checked by the appropriate tests according to IEC 61558-2-6.*

**23.208 External creepage and clearance distance between clamping units**

Terminals for SELV circuits and main circuits intended for external wiring shall be so located that the external creepage and clearance distance between these clamping units is not less than 10 mm in order to prevent any loose conductor from touching the other circuit. If that distance is achieved by a barrier, this barrier shall be of insulating material and be permanently fixed to the switch or only removable with the aid of a tool for the wiring of the accessory. If the barrier is omitted, the HBES switch shall be rendered inoperable or manifestly incomplete.

*Compliance is checked by inspection and by measurement disregarding intermediate metal parts.*

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

Clause 24 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies, except as follows:

**24.1.1 Glow-wire test**

*Add after the first paragraph:*

*For insulating material necessary to retain current-carrying parts with a current less than 0,2 A in position a test temperature of 650°C shall be used.*

**25 Resistance to rusting**

Clause 25 of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies.

**26 EMC requirements****26.1 General**

HBES switches shall be designed to operate correctly under the conditions of electromagnetic environment in which they are intended to be used. This applies particularly for HBES 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 61000-2-2.

The tests are carried out with one new specimen.

The test set-ups are described in Annex CC for HBES switches using TP-Media.

The use of dedicated software for testing purposes is allowed, providing that all significant functions are exercised.

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

For HBES switches using RF (Radio Frequency), the relevant RF requirements applicable in the specific country shall apply.

NOTE 1 In the following countries, ETSI EN 300 220-1, ETSI EN 300 220-2 and ETSI EN 301 489-3 apply: all CENELEC countries.

For immunity the requirements of IEC 60669-2-1:2002 and its Amendment 1:2008 apply in addition to 26.2.

For HBES switches using PL (power line), the emission requirements applicable in the specific country shall apply.

NOTE 2 In the following countries, EN 50065-1 and in addition the relevant requirements of EN 50065-2-2 or EN 50065-2-3 apply: all CENELEC countries.

For immunity, if no national standards exist, the requirements of IEC 60669-2-1:2002 and its Amendment 1:2008 apply.

*Compliance is checked by the tests of 26.2 and 26.3.*

## **26.2 Immunity**

### **26.2.1 General**

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

For the following tests, the HBES switch is mounted as in normal use in the relevant box, if any, and loaded with all kinds of loads according to the product specifications, unless otherwise stated in the relevant paragraph.

The HBES switch is loaded at 100 % of the rated load for dimming devices and with a functional load for other HBES switches.

All tests shall be done with a minimum HBES configuration. A minimum HBES configuration is a set of devices which makes it possible to test the proper function of a HBES switch under test (EUT).

The HBES switch shall be tested according to Table 208 with or without operation as indicated in the relevant paragraph.

NOTE "With operation" means: control of the HBES switch manually and/or by communication. Control by communication is preferred. "Without operation" means: the HBES switch is not controlled during the test.

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

a) in the on-state

For HBES switches where the setting can alter (e.g. dimming devices), the HBES switch is set at a firing angle of approx. 90° which results in an output power  $P_o$  (rms).

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

b) in the off-state.



**Table 208 – Immunity tests (overview)**

EM phenomena	Test set-up	Subclause	Test specification
Voltage dips and short interruptions	IEC 61000-4-11	26.2.2	Table 209
Surge	IEC 61000-4-5	26.2.3	Table 210
Fast transients (burst)	IEC 61000-4-4	26.2.4	Table 211 Level 2 Level 3
Electrostatic discharge	IEC 61000-4-2	26.2.5	± 4 kV contact discharge ± 8 kV air discharge
Radiated electromagnetic field test	IEC 61000-4-3	26.2.6	3 V/m , 1 V/m , 10 V/m
Radio frequency voltage	IEC 61000-4-6	26.2.7	3 V r.m.s
Power frequency magnetic field	IEC 61000-4-8	26.2.8 <sup>a</sup>	3 A/m, 50 Hz
<sup>a</sup> This test is applicable only to HBES switches containing devices susceptible to magnetic fields, for example, Hall elements, electrodynamic microphones, etc.			

**26.2.2 Voltage dips and short interruptions**

The HBES switch shall be tested with the test equipment specified in IEC 61000-4-11 as specified in 26.2.1, in accordance with Table 209, with a sequence of three dips/interruptions with intervals of 10 s minimum between each test event.

The test shall be done on the power supply lines of the EUT.

*During the test, the device is not operated.*

*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 209 – Voltage dip and short-interruption test values**

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 the test, the state and setting may alter; flickering is neglected.*

*After the test, the HBES switch shall be in the original state and setting and shall operate as intended.*

### 26.2.3 Surge immunity test for 1,2/50 wave impulses

HBES switches shall be tested for immunity to unidirectional surges caused by over-voltages from switching and lightning transients.

During the test, the device is not operated.

The equipment under test shall be mounted in a similar way as it is done in the field. If the equipment under test has a metallic mounting plate this plate shall be connected to earth.

*The test is carried out according to IEC 61000-4-5 by applying two positive discharges and two negative discharges at each of the following angles 0 °, 90 °, 270 °, at a repetition rate of  $(60 \pm 5)$  s with an open-circuit test voltage according to Table 210.*

*If the EUT has an earthing terminal or is connected to a load the test is repeated between line and earth with the test voltage according to Table 210. In case that there is not an earthing terminal each EUT load terminal is connected via a capacitor of 3,3 nF to earth. The EUT shall be placed on a copper plane connected to the same earth as the generator.*

**Table 210 – Surge immunity test voltages**

Conductors / Terminals	Coupling	Test voltage
Mains	Line to line	1 kV
	Line to earth	2 kV
TP media, Signal and Control Lines	Unbalanced transmission Line to line	0,5 kV
	Balanced transmission Line to line	–
	Line to earth	2 kV
DC – Power Ports <sup>a</sup>	Line to line	0,5 kV
<sup>a</sup> Does not apply to: <ul style="list-style-type: none"> <li>– DC-power ports also serving as ports for TP-media, or</li> <li>– ports for accumulators or batteries.</li> </ul>		

*During the test, the state and setting may alter; flickering is neglected.*

*After the test, the HBES switch shall be in the original state and setting and shall operate as intended.*

### 26.2.4 Electrical fast transient/burst test

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

During the test, the test is conducted first without operation for level 2 and level 3 and secondly with operation for level 2.

If there is a metallic mounting plate (e.g. rails according to IEC 60715) at the equipment under test, the test shall be done both with the mounting plate not connected and connected to earth by a HF connection (low inductance), unless otherwise declared by the manufacturer.

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

The levels of the repetitive fast transients consisting of bursts coupled into the supply and control terminals/terminations of the HBES switch is specified in Table 211.

**Table 211 – Fast transient test values**

Open-circuit output test voltage $\pm 10\%$		
Level	Supply terminals/terminations	Control terminals/terminations – TP terminals
2	$\pm 1$ kV	$\pm 0,5$ kV
3	$\pm 2$ kV	$\pm 1$ kV

The repetition rate is 5 kHz.

The duration of the test shall be not less than  $(60^{+5}_0)$  s for each positive and negative polarity.

The duration shall be not less than the time necessary for the HBES switch to respond.

For level 2:

During the test without operation the state and setting shall not alter. Flickering is neglected. A change of the firing angle of  $\pm 10\%$  is considered not to be a change of setting.

After the test the HBES switch shall be in the original state and setting and shall operate as intended.

During and after the test with operation the device shall operate as intended. Flickering is neglected.

For level 3:

During the test the state and setting may alter and flickering is neglected.

After the test the HBES switch shall be in the original state and setting and shall operate as intended.

### **26.2.5 Electrostatic discharge test**

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

The test shall be carried out with incandescent lamps. If the HBES switch is not intended to operate incandescent lamps, the test shall be carried out with only one of the loads specified within the manufacturer's instructions.

During the test the device is not operated.

Equipment under test with two Media Interfaces (e.g. router) shall be active on both sides with a power supply unit and communication unit connected to each.

The test is carried out according to IEC 61000-4-2 by applying 10 positive and 10 negative discharges in the following manner:

- contact discharge to the conductive surfaces and to coupling planes,
- air discharge at insulating surfaces, if applicable.

*The static electricity discharges shall be applied only to such points and surfaces of the HBES switch which are accessible in normal use.*

*The discharges are applied to the pre-selected points designated by the manufacturer, which shall include different materials, if any.*

*The following levels apply:*

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

*During the test the state and setting may alter and flickering is neglected.*

*After the test, the HBES switch shall be in the original state and setting and shall operate as intended.*

NOTE Certain HBES switches, for example, passive infra-red switches, PIR switches with an adjustable time delay device can be adjusted in such a way that the time delay is higher than the testing time.

## 26.2.6 Radiated electromagnetic field test

HBES switches shall withstand the radiated electromagnetic field test.

*The test is carried out according to IEC 61000-4-3 by applying requirements in Table 212.*

*EUT with each side dimension below 5 cm shall be tested on front face only with vertical and horizontal polarization.*

*Cables shall run either vertically or horizontally in the field uniform area for at least 1 m. Connection with AE outside the chamber shall be released through a bypass filter with no effects on signal transmission.*

**Table 212 – Values for radiated electromagnetic field test of IEC 61000-4-3**

Environmental phenomena	Test specifications	Units	Basic standards
Radio-frequency Electromagnetic field. Amplitude modulated	80 to 1 000 3 or 10 <sup>b</sup> 80	MHz V/m % AM (1 kHz)	IEC 61000-4-3 <sup>a</sup>
Radio-frequency Electromagnetic field. Amplitude modulated	1,4 to 2,0 3 80	GHz V/m % AM (1 kHz)	IEC 61000-4-3 <sup>a</sup>
Radio-frequency Electromagnetic field. Amplitude modulated	2,0 to 2,7 1 80	GHz V/m % AM (1 kHz)	IEC 61000-4-3 <sup>a</sup>
<sup>a</sup> IEC 61000-4-20 may be used for small EUTs as defined in IEC 61000-4-20:2010, 6.1.			
<sup>b</sup> For the 10 V/m: except for the ITU broadcast frequency bands 87 MHz to 108 MHz, 174 MHz to 230 MHz and 470 MHz to 790 MHz, where the level shall be 3 V/m different criteria apply.			

*During the test the device is operated.*

*During and after the test the device shall operate as intended and flickering is not allowed.*

*For the test with 10V/m during the test the device is not operated. The HBES switch shall not block the transmission and no unrequested transmission shall occur during the test. After the test the device shall operate as intended.*

### **26.2.7 Radio-frequency voltage test**

HBES switches shall withstand the radio-frequency voltage test.

*The test is carried out according to IEC 61000-4-6 by applying a conducted radio-frequency voltage of 3 V r.m.s. on TP media, supply lines and control lines.*

*During the test the device is operated.*

*During and after the test the device shall operate as intended and flickering is not allowed.*

*In addition the test is carried out according to IEC 61000-4-6 by applying a conducted radio-frequency voltage of 10V r.m.s. on TP media, supply lines and control lines except for the ITU broadcast frequency band 47 MHz to 68 MHz, where the level shall be 3 V.*

*During the test the device is not operated.*

*A change of state is not allowed and the HBES switch shall not block the transmission during the test.*

*After the test the device shall operate as intended.*

### **26.2.8 Power-frequency magnetic field test**

This test is applicable only to HBES switches containing devices susceptible to magnetic fields, for example, Hall elements, electrodynamic microphones, etc.

HBES switches shall withstand the power frequency magnetic field test.

*The test is carried out according to IEC 61000-4-8 by applying a magnetic field of 3 A/m, 50 Hz.*

*During the test the device is operated.*

*During and after the test the device shall operate as intended and flickering is not allowed.*

## **26.3 Emission**

### **26.3.1 Low-frequency emission**

HBES switches shall be so designed that they do not cause excessive disturbances.

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

NOTE 1 HBES switches other than those incorporating automatic controls giving rise to fluctuation of the firing angle, for example, automatic systems to be used in dance halls, discos and the like, are deemed to meet the requirements of IEC 61000-3-3 without need for testing.

NOTE 2 According to IEC 61000-3-2, there is no need to test independent HBES dimmers for incandescent lamps up to and including 1 000 W. HBES switches with semiconductor switching for the load current are regarded as dimmers.

### **26.3.2 Conducted radio-frequency emission**

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

The HBES switch shall comply with the requirements of CISPR 14 or CISPR 15. For HBES switches used for electrical lighting application, CISPR 15 applies.

8.1.4.1 and 8.1.4.2 of CISPR 15:2005 are applicable with the following modifications.

*Compliance is checked as follows:*

*a) At the main terminals (8.1.4.1 of CISPR 15:2005)*

*An initial survey or scan of the complete frequency range 9 kHz to 30 MHz shall be made in the on-state at the highest setting. In addition, at the following frequencies and at all frequencies at which there is a local maximum disturbances found in the initial survey above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:*

*9 kHz, 50 kHz, 100 kHz, 150 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.*

*b) At the load terminals (8.1.4.2 of CISPR 15:2005).*

*An initial survey or scan of the complete frequency range 150 kHz to 30 MHz shall be made in the on-state at the highest setting. In addition, the following frequencies and at all frequencies at which there is a local maximum disturbances above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:*

*160 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.*

### **26.3.3 Conducted radio frequency emission 0,15 MHz to 30 MHz on TP media**

HBES switches based on TP media shall be so designed that they do not cause excessive common mode noise current on the bus cable.

The HBES switch and network based on TP cable shall be in accordance with class B of CISPR 22.

Tests have to be performed on TP cable only according to the method defined in CISPR 22.

### **26.3.4 Radiated radio frequency emission above 30 MHz.**

HBES switches based on TP shall be so designed that they do not cause excessive disturbances.

The HBES switch and network shall be in accordance with class B of CISPR 22. Tests shall be performed according to the method defined in CISPR 22.

## **101 Abnormal conditions**

Clause 101 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

## **102 Components**

Clause 102 of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

**Annex A**  
(normative)

**Survey of specimens needed for tests**

Annex A of IEC 60669-1:1998 and its Amendment 1:1999 and Amendment 2:2006 applies.



**Annex B**  
(normative)

**Additional requirements for switches having facilities  
for the outlet and retention of flexible cables**

Annex B of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

**Annex C**  
(informative)

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

Annexe AA of IEC 60669-2-1:2002 and its Amendment 1:2008 applies.

## Annex AA (normative)

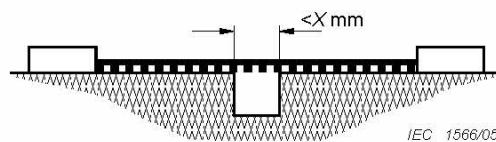
### Measurement of clearances and creepage distances

The methods of measuring and clearances and creepage distances which are specified in Figures AA.1 to AA.10 are used in interpreting the requirements of this standard.

The minimum value of distance  $X$  is 1,0 mm.

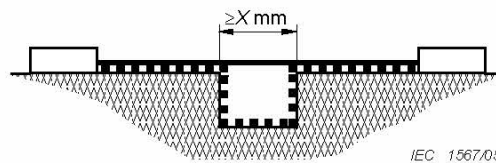
However, if the requirement for the clearance associated with the concerned creepage distance is less than 3,0 mm, the value  $X$  is one-third of the specified clearance, but not less than 0,2 mm.

..... creepage distance      ——— clearance



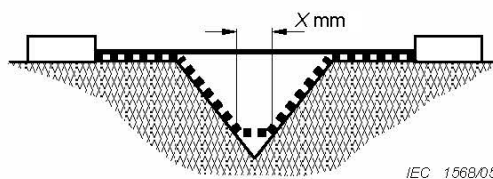
Condition: Path under consideration includes a parallel or converging-sided groove of any depth with width less than  $X$  mm. Rule: Clearance and creepage distance are measured directly across the groove.

**Figure AA.1 – Narrow groove**



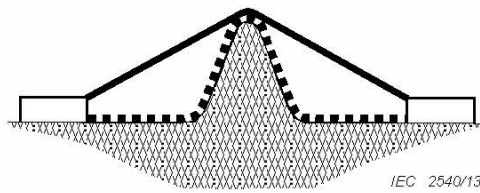
Condition: Path under consideration includes a parallel-sided groove of any depth, and equal to or more than  $X$  mm wide. Rule: Clearance is the "line-of-sight" distance, creepage distance path follows the contour of the groove.

**Figure AA.2 – Wide groove**



Condition: Path under consideration includes a V-shaped groove with internal angle of less than  $80^\circ$  and a width greater than  $X$  mm. Rule: Clearance is the "line-of-sight" distance. Creepage distance path follows the contour of the groove but "short-circuits" the bottom of the groove by 1 mm (subclause 13.2) respectively 0,25 mm (subclause 13.3).

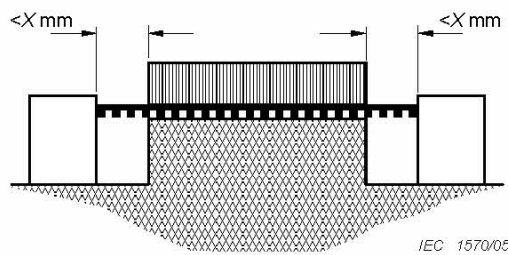
**Figure AA.3 – V-shaped groove**



Condition: Path under consideration includes a rib.

Rule: Clearance is the shortest direct air path over the top of the rib. Creepage distance path follows the contour of the rib.

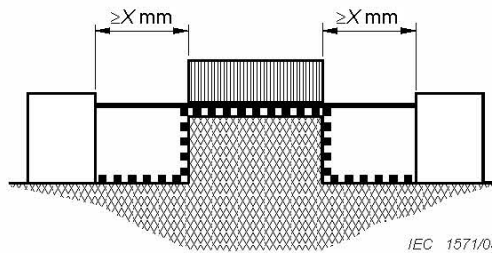
**Figure AA.4 – Rib**



Condition: Path under consideration includes an uncemented joint with grooves less than X mm wide on either side.

Rule: Creepage distance and Clearance path is the "line-of-sight" distance shown.

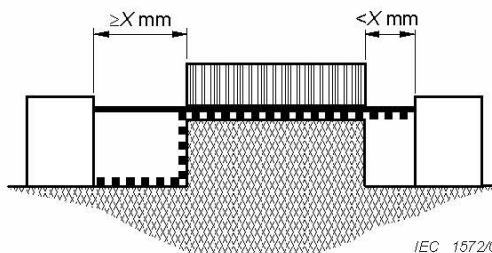
**Figure AA.5 – Uncemented joint with narrow groove**



Condition: Path under consideration includes an uncemented joint with a groove equal to or more than X mm wide each side.

Rule: Clearance is the "line-of-sight" distance. Creepage distance path follows the contour of the groove.

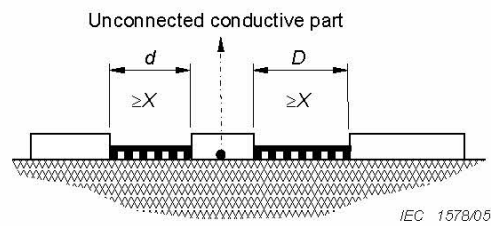
**Figure AA.6 – Uncemented joint with wide groove**



Condition: Path under consideration includes an uncemented joint with a groove on one side less than X mm wide and a groove on the other equal to or more than 1 mm wide.

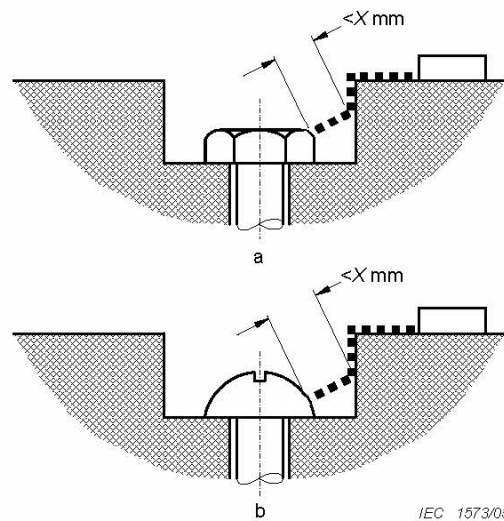
Rule: Clearance and Creepage distance paths are as shown in Figure AA.7.

**Figure AA.7 – Uncemented joint with narrow and wide grooves**



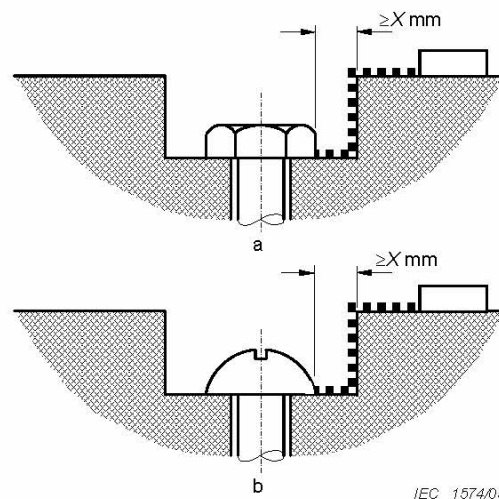
Condition: Insulation distance with intervening, unconnected conductive part. Rule: Clearance is the distance  $d+D$ , creepage distance is also  $d+D$ . Where the value of  $d$  or  $D$  is smaller than  $X$  it shall be considered as zero.

**Figure AA.8 – Intervening, unconnected conductive part**



Gap between head of screw and wall of recess too narrow to be taken into account.

**Figure AA.9 – Narrow recess**



Gap between head of screw and wall of recess wide enough to be taken into account.

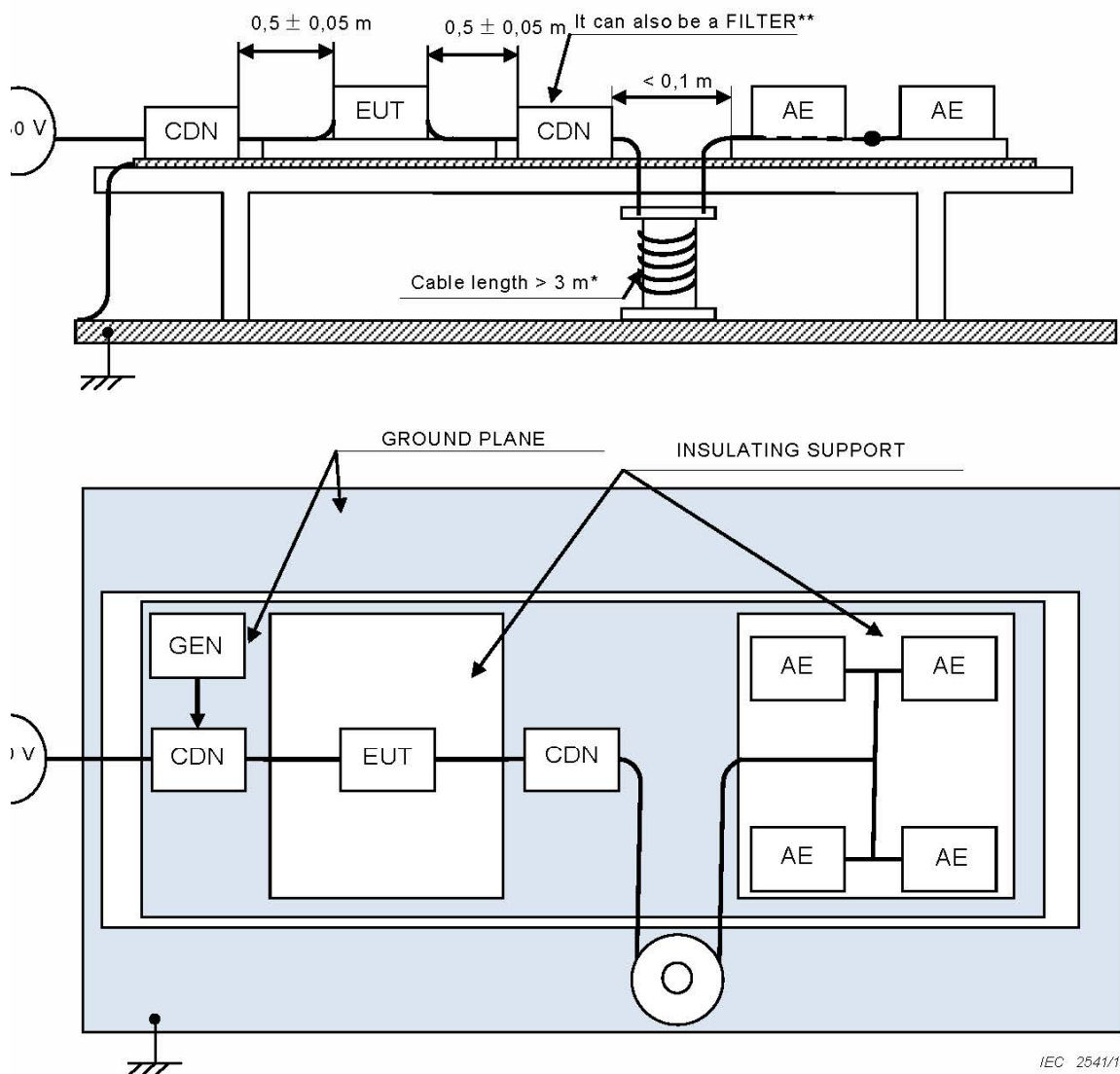
**Figure AA.10 – Wide recess**

## Annex BB (informative)

### Test set-ups

#### BB.1 Fast transients (bursts)

The general test requirements and the test procedure shall follow IEC 61000-4-4. Specific test arrangements are shown in Figures BB.1 to BB.2.



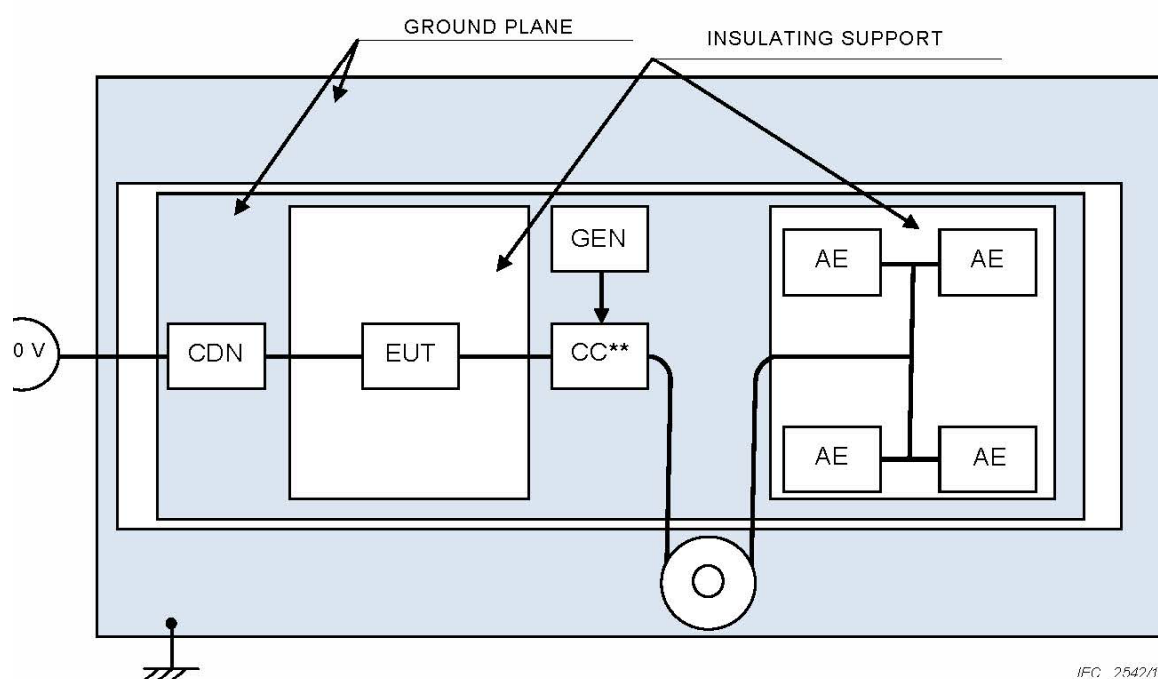
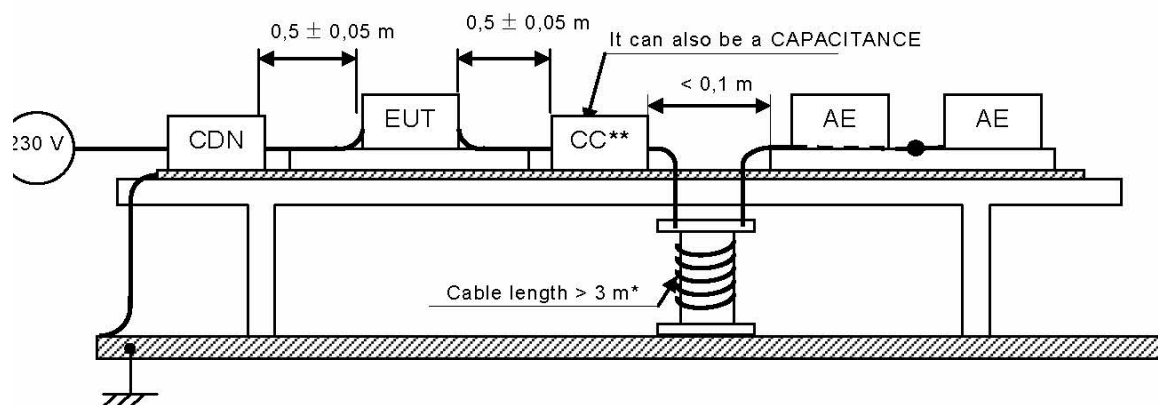
\* If a cable as decoupling network is not used the AE shall be in a distance of not more than  $(0,5 \pm 0,05)$  m

\*\* The coupling/decoupling network (CDN) shall be loaded with  $50 \Omega$  on the RF input

NOTE 1 A decoupling network is always to be used and it can be a CDN, a filter or a cable to make a coil with a minimum cable length of 3 m.

NOTE 2 For dimensions, refer to IEC 61000-4-4

**Figure BB.1 – Test setup for AC mains connection according to IEC 61000-4-4**



IEC 2542/13

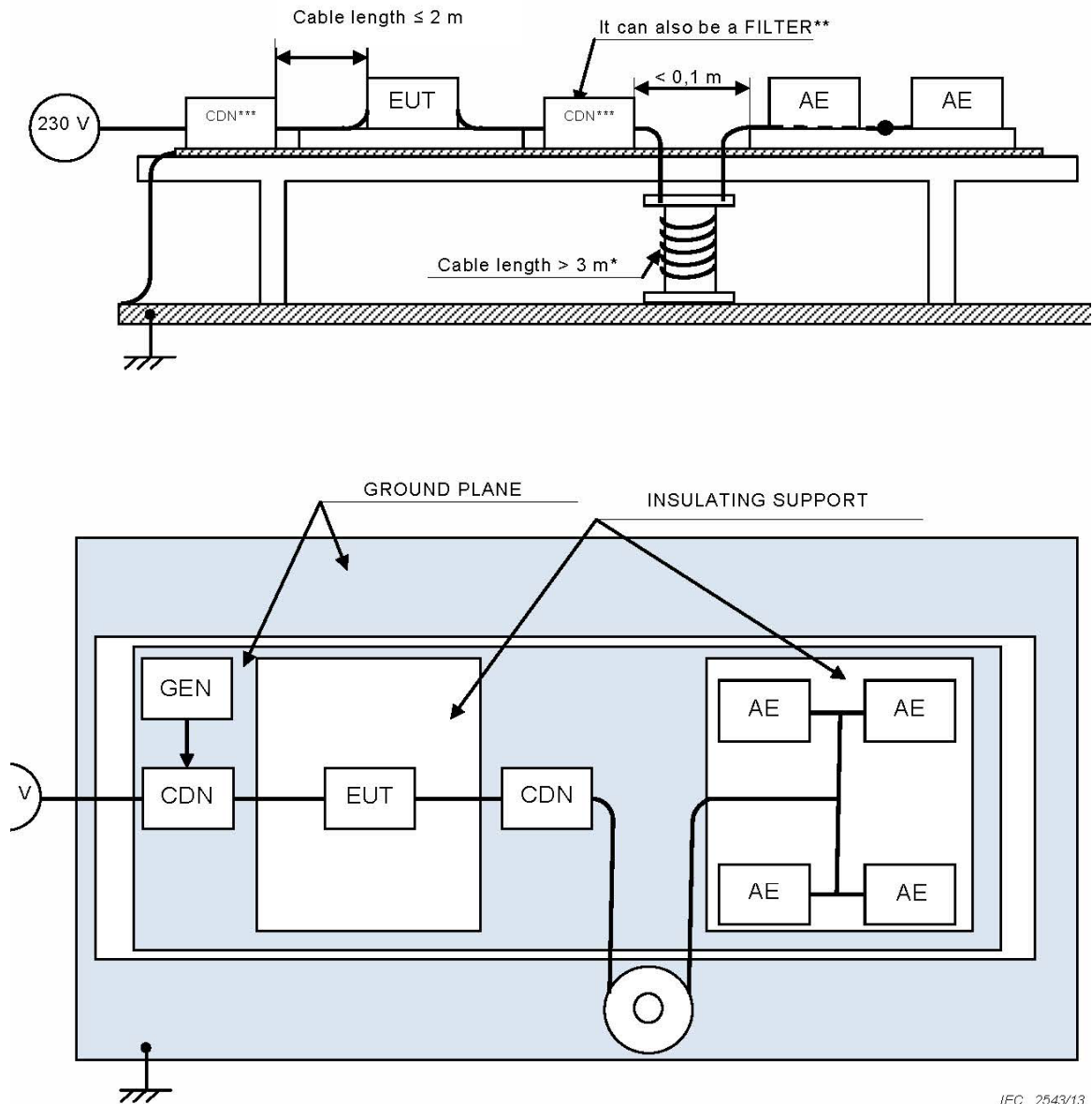
\* If a cable as decoupling network is not used the AE shall be in a distance of not more than  $(0,5 \pm 0,05)$  m.

\*\* CC means capacitive clamp

**Figure BB.2 – Test setup for bus and DC mains connection according to IEC 61000-4-4**

## BB.2 Transients (surge)

The general test requirements and the test procedure shall follow IEC 61000-4-5. Specific test arrangements are shown in Figures BB.3 to BB.4.



\* If a cable as decoupling network is not used the AE shall be in a distance of not more than 0,3

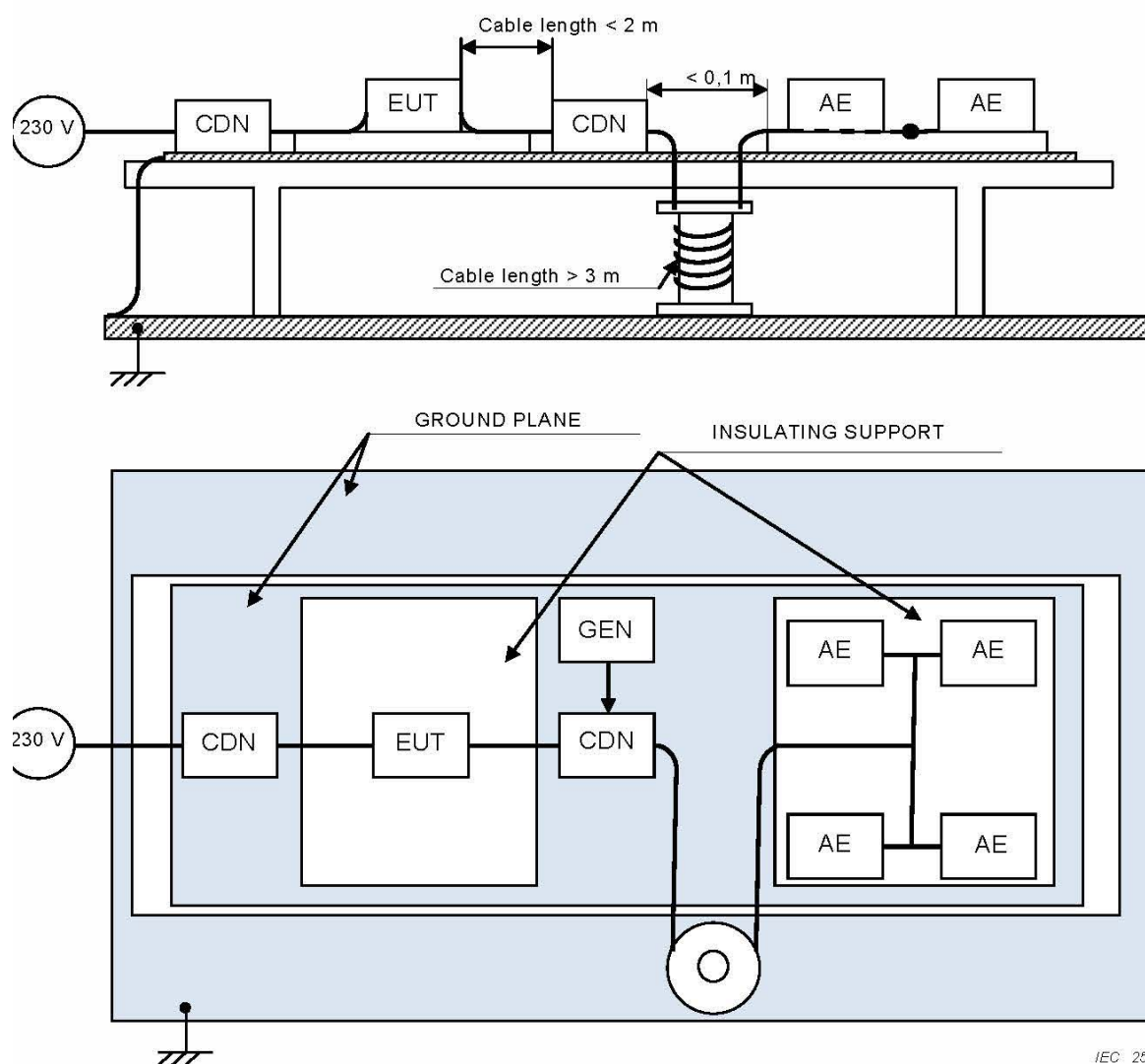
\*\* The CDN shall be loaded with  $50 \Omega$  on the RF input

\*\*\* A decoupling network is always to be used and it can be a CDN, a filter or a cable to make a coil with a minimum cable length of 3 m.

NOTE For dimensions, refer to IEC 61000-4-5.

**Figure BB.3 – Test setup for AC mains connection according to IEC 61000-4-5**



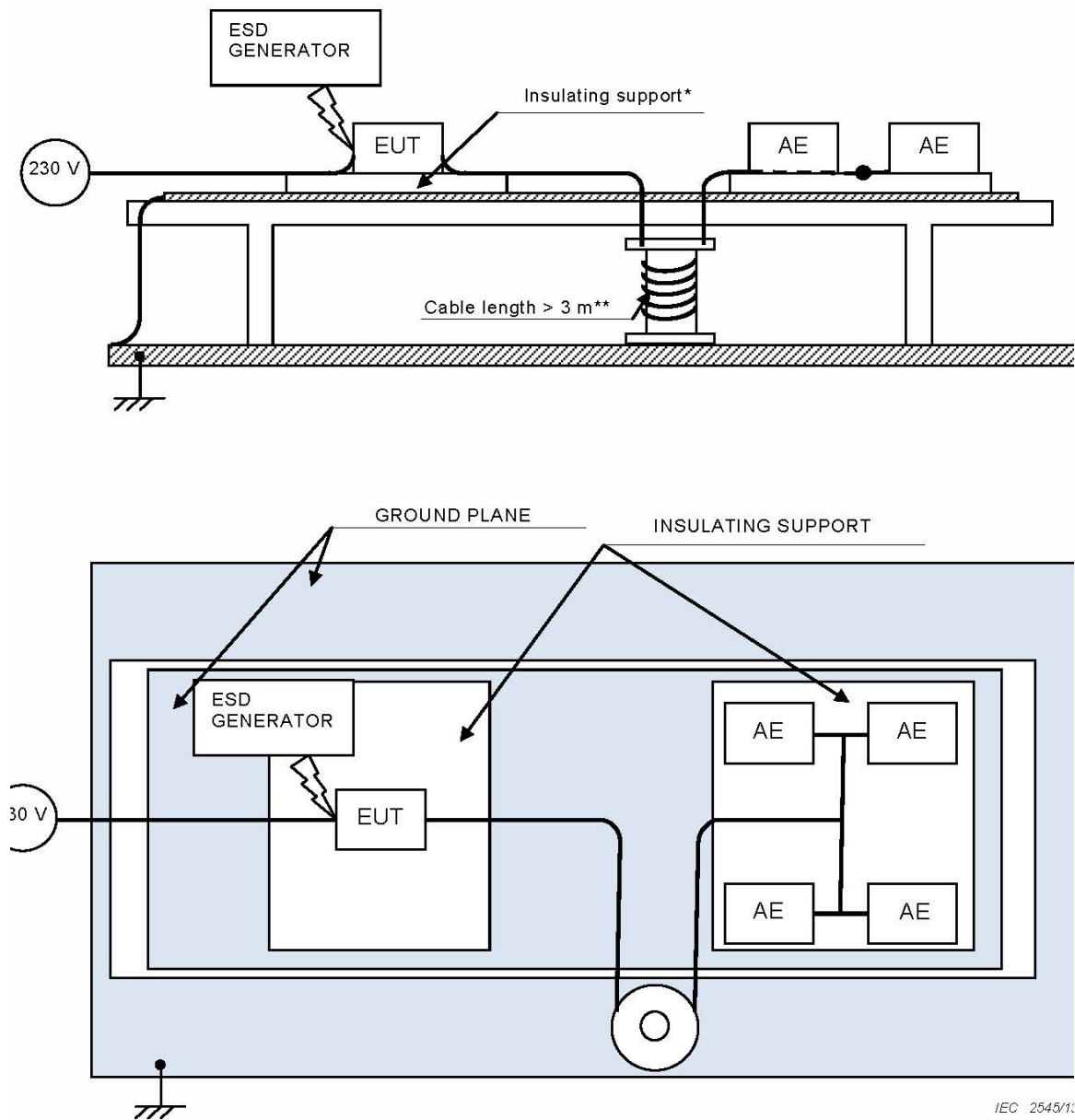


IEC 25

Figure BB.4 – Test setup for bus and DC mains connection according to IEC 61000-4-5

### BB.3 Electrostatic discharge (ESD)

The general test requirements and test procedure shall follow IEC 61000-4-2. The specific test arrangement is shown in Figure BB.5.



\* In alternative, instead of the insulating support, an insulating foil of  $(0,5 \pm 0,05)$  mm width can be used. In this case, the ground plane shall be connected to earth via a resistance of  $2 \times 470 \text{ k}\Omega$ .

\*\* A decoupling network is always to be used and it can be a filter or a cable to make a coil with a minimum cable length of 3 m.

NOTE For dimensions, refer to IEC 61000-4-2.

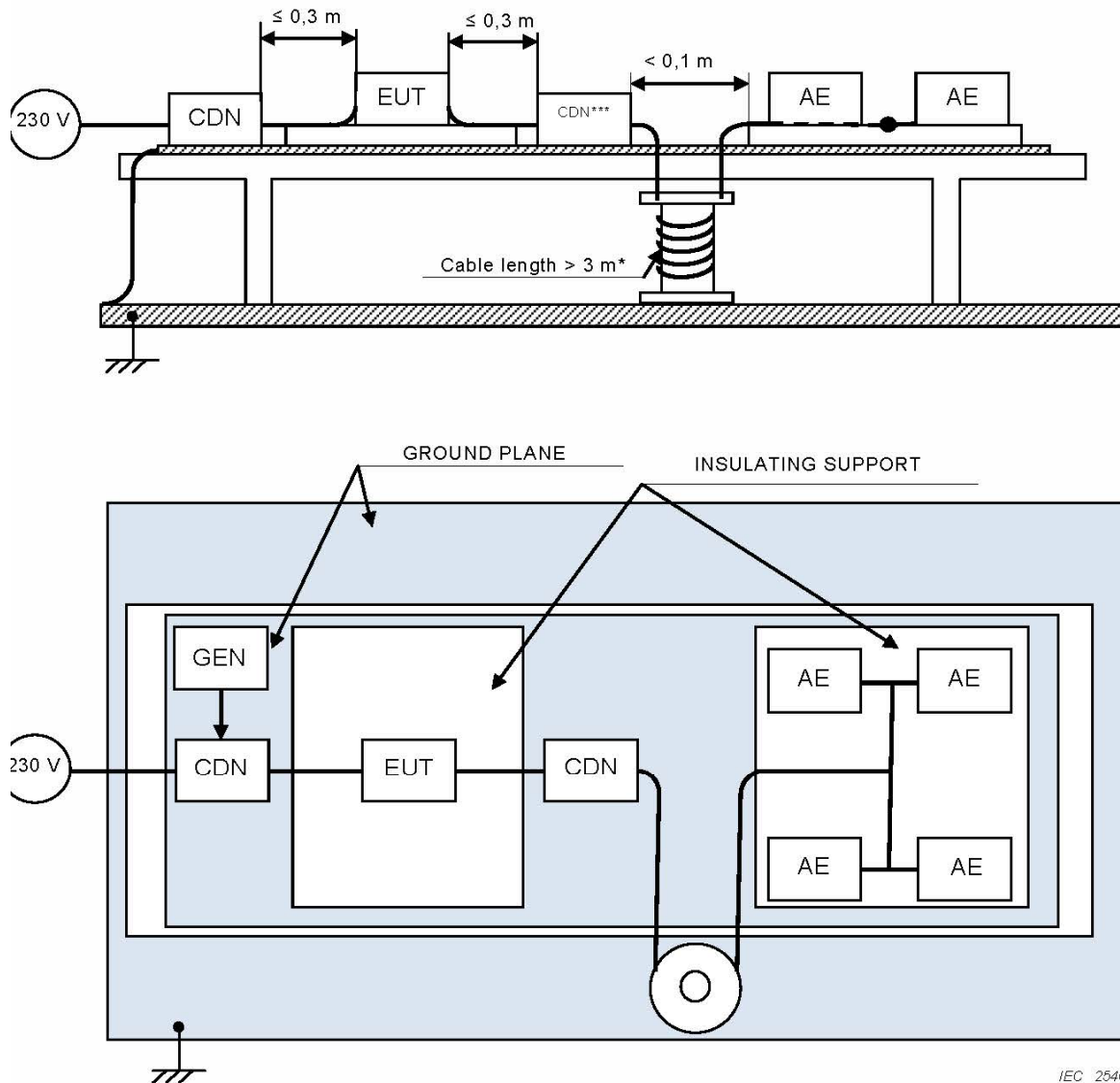
**Figure BB.5 – Test setup for the ESD according to IEC 61000-4-2**

#### BB.4 Radio frequency fields

The test procedure and the test arrangements have to follow IEC 61000-4-3.

#### BB.5 Radio frequency common mode voltage

The test procedure shall follow IEC 61000-4-6. Specific test arrangement is shown in Figures BB.6 and BB.7.



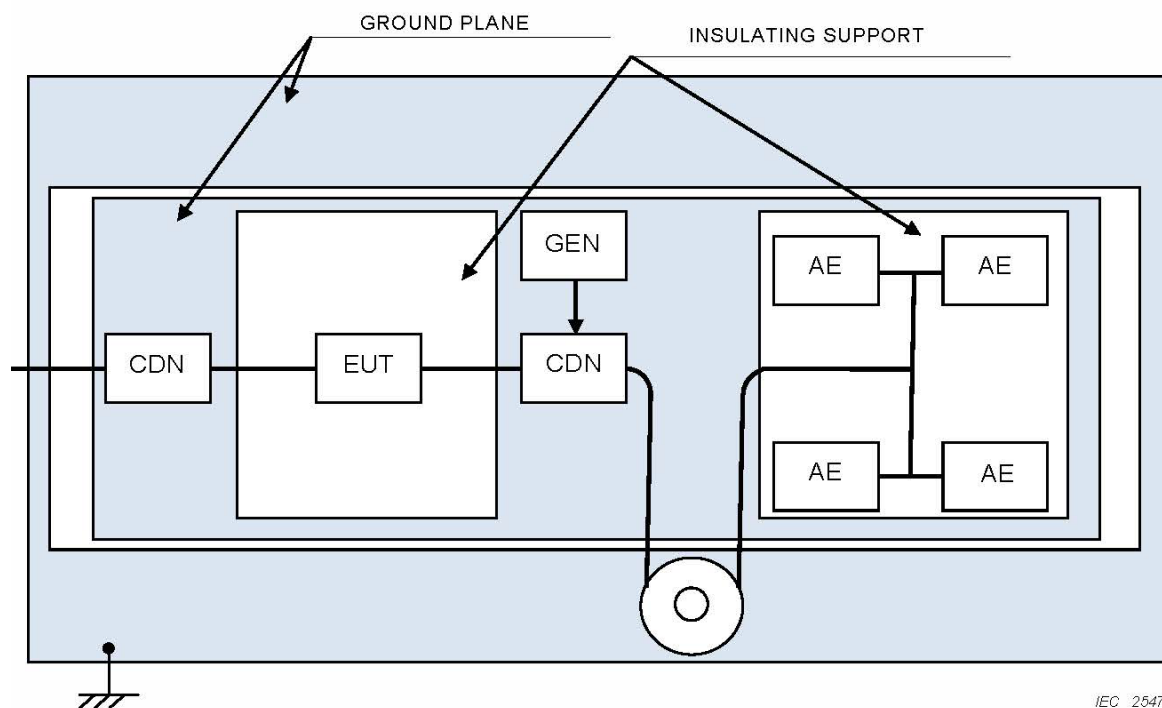
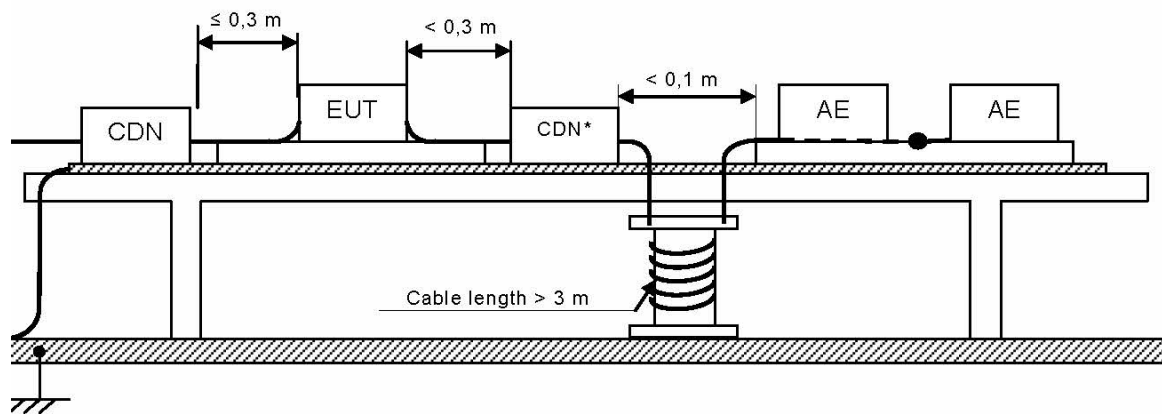
\* If a cable as decoupling network is not used the AE shall be in a distance of not more than 0,3.

\*\* The CDN shall be loaded with 50  $\Omega$  on the RF input.

\*\*\* A decoupling network is always to be used and it can be a CDN, a EM CLAMP, or a cable to make a coil with a minimum cable length of 3 m.

NOTE For dimensions, refer to IEC 61000-4-6

**Figure BB.6 – Test setup for AC mains connection according to IEC 61000-4-6**



\* A decoupling network is always to be used and it can be a CDN, an EM CLAMP, or a cable to make a coil with a minimum cable length of 3 m.

**Figure BB.7 – Test setup for bus and DC mains connection according to IEC 61000-4-6**

## Bibliography

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 60730 (all parts), *Automatic electrical controls for household and similar use*

IEC 60998-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements*

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

EN 50065-1, *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 1: General requirements, frequency bands and electromagnetic disturbances*

EN 50065-2-1, *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 2-1: Immunity requirements for mains communications equipment and systems operating in the range of frequencies 95 kHz to 148,5 kHz and intended for use in residential, commercial and light industrial environments*

EN 50065-2-2, *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 1485 kHz – Part 2-2: Immunity requirements for mains communications equipment and systems operating in the range of frequencies 95 k*

EN 50065-2-3, *Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz – Part 2-3: Immunity requirements for mains communications equipment and systems operating in the range of frequencies 3 kHz to 95 kHz and intended for use by electricity suppliers and distributors*

EN 50090-2-2, *Home and building electronic systems (HBES) – Part 2-2: System overview – General technical requirements*

EN 60670-1, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 1: General requirements*

ETSI EN 300 220-1, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW – Part 1: Technical characteristics and test methods*

ETSI EN 300 220-2, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW – Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive*

ETSI EN 301 489-3, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services – Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz*

BS 4662, *Boxes for flush mounting of electrical accessories. Requirements, test methods and dimensions*