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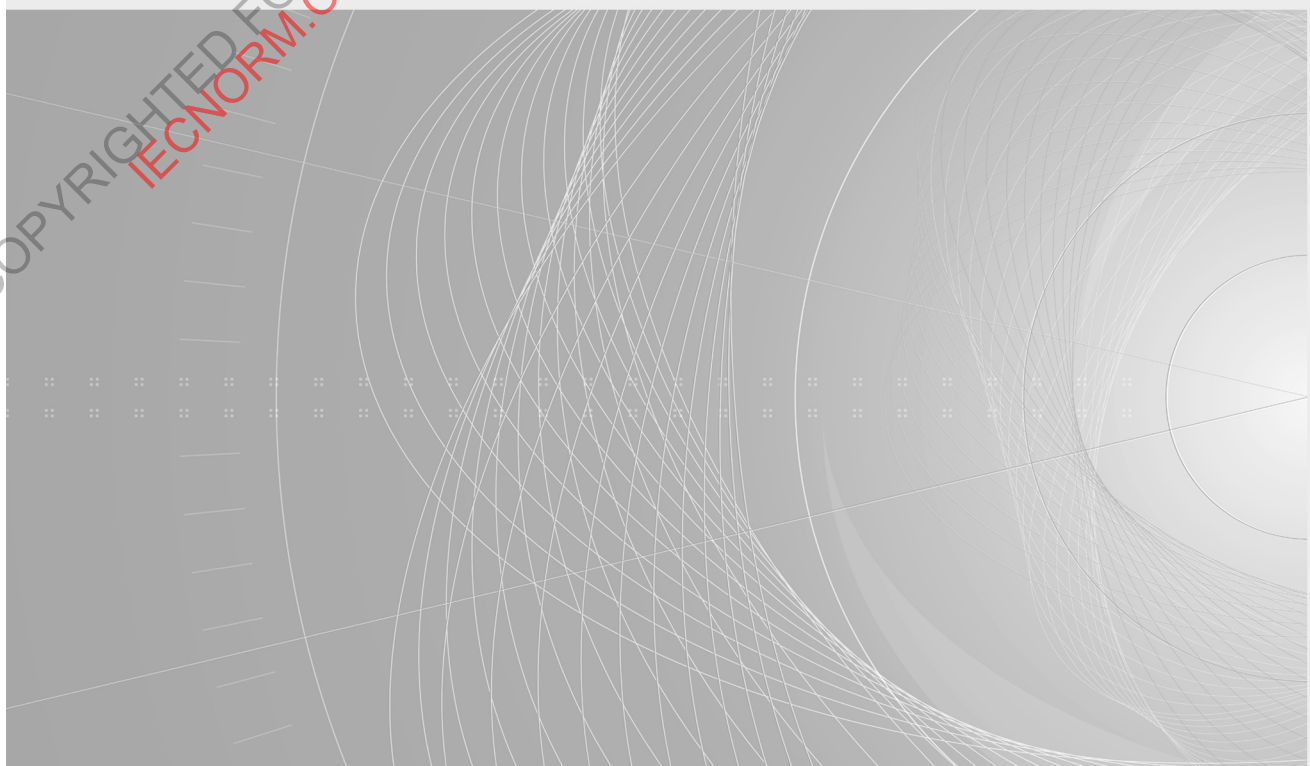
Home and building electronic systems (HBES) and building automation and control systems (BACS) –
Part 3: Electrical safety requirements



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HOME AND BUILDING ELECTRONIC SYSTEMS (HBES) AND BUILDING AUTOMATION AND CONTROL SYSTEMS (BACS) –

Part 3: Electrical safety requirements

FOREWORD

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 63044-3 edition 1.1 contains the first edition (2017-01) [documents 23/735/CDV and 23/747/RVC] and its amendment 1 (2021-05) [documents 23/912/CDV and 23/961A/RVC].

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 63044-3 has been prepared by IEC technical committee 23: Electrical accessories.

A list of all parts in the IEC 63044 series, published under the general title *Home and Building Electronic Systems (HBES) and Building Automation Control Systems (BACS)*, can be found on the IEC website.

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

In this publication, the following print types are used:

– Requirements proper: in roman type.
– *Test specifications: in italic type.*

This document shall be used in conjunction with relevant product safety standards.

The committee has decided that the contents of the base publication and its amendment 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- withdrawn,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.

INTRODUCTION

The IEC 63044 series deals with developing and testing Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS).

This document deals with electrical safety requirements for HBES/BACS.

This document is based on the philosophy that a device considered electrically safe according to an appropriate product safety standard should also remain safe when connected to a network. This document specifies in addition to the specific product standard the electrical safety requirements necessary in order for an HBES/BACS device connected to a network to remain safe under normal and single-fault conditions of the HBES/BACS network and at the same time under normal and single-fault conditions of one or more HBES/BACS devices connected to the HBES/BACS network. This includes protection from overvoltages on the network, protection from hazards caused by connection of different types of network, the limitation of the touch current to a network and protection of the communication wiring from overheating.

The HBES/BACS network is any interconnection between HBES/BACS devices. The HBES/BACS networks can be either an ICT network with interfaces classified according to IEC 62949 or a dedicated network classified as a mains, ELV, FELV, SELV or PELV network.

For HBES/BACS devices connected to an ICT network, the requirements in IEC 62949 apply.

For HBES/BACS devices connected to a dedicated HBES/BACS network, the requirements for the electrical separation between the device and the network are specified (see Table 1). These specifications of the electrical separations follow the principle in the basic safety publications IEC 60664-1 and IEC 61140, together with the installation requirements of IEC 60364. The following compromises are used.

– According to the principles of IEC 60664-1, the rated impulse voltage for the separation shall be the higher of the impulse voltage on the network and the rated impulse voltage of the device circuit to be connected to the network.
– The overvoltage categories considered by IEC 60664-1 refer to overvoltages derived directly from the mains through the power supply.
– The overvoltages coming from other sources (e.g. capacitive couplings) are not specified in IEC 60664-1. IEC 60664-1 recommends that technical committees specify overvoltage categories or rated impulse voltages as appropriate.

For the purposes of this document, the following impulse voltages have been specified.

- For networks with galvanic electrical separation from mains (FELV, SELV or PELV), the impulse overvoltage coming from the network side of the separation has been limited to 2,5 kV for fixed installed networks and 1,5 kV for detachable networks.
- For ICT networks, particular requirements apply (see 6.3.2.1).

HOME AND BUILDING ELECTRONIC SYSTEMS (HBES) AND BUILDING AUTOMATION AND CONTROL SYSTEMS (BACS) –

Part 3: Electrical safety requirements

1 Scope

This document specifies the electrical safety requirements for HBES/BACS.

In addition, it defines safety requirements for the interface of equipment intended to be connected to an HBES/BACS. It does not apply to interfaces to other networks.

NOTE An example of other networks is a dedicated ICT network covered by IEC 62949.

This document covers the following requirements and compliance criteria:

- protection against hazards from the device;
- protection against overvoltages on the network;
- protection against touch current;
- protection against hazards caused by different types of network;
- protection of the communication wiring against overheating caused by excessive current.

2 Normative references

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

IEC 60038:2009, *IEC standard voltages*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-5-52, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

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

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

IEC 61180, *High-voltage test techniques for low-voltage equipment –Definitions, test and procedure requirements, test equipment*

IEC 62151:2000, *Safety of equipment electrically connected to a telecommunication network*

IEC 62949, *Particular safety requirements for equipment to be connected to information and communication networks*[1]

IEC 63044-1, *Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) – Part 1: General requirements*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 63044-1 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
ICT network
information and communication technology network
metallically terminated transmission medium consisting of two conductors intended for communication between equipment that may be located in separate buildings, excluding:

– the mains system for supply, transmission and distribution of electrical power, if used as a communication transmission medium;
– dedicated HBES/BACS networks;
– external networks using ES1 connecting units of audio/video, information and communication technology equipment

Note 1 to entry: This may include twisted pairs, and may include networks which are subjected to transients as indicated in Table 14, ID1 of IEC 62368-1:2014 (assumed to be 1,5 kV).

Note 2 to entry: An ICT network may be:

– publicly or privately owned;
– subject to transient overvoltages due to atmospheric discharges and faults in power distribution systems;
– subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

Note 3 to entry: Examples of ICT networks are:

– a public switched telephone network;
– a public data network;
– an Integrated Services Digital Network (ISDN);
– a private network with electrical interface characteristics similar to the above.

Note 4 to entry: For information about network voltages and signals which may be present, see Annex B of IEC 60950-1:2005.

3.1.2
electric shock
physiological effect resulting from an electric current through a human or animal body

[SOURCE: IEC 60050-195:1998, 195-01-04]

[1] Under preparation. Stage at the time of publication: IEC/FDIS 62949:2016.

3.1.3
basic protection
protection against electric shock under fault-free conditions

[SOURCE: IEC 60050-195:1998, 195-06-01]

3.1.4
fault protection
protection against electric shock under single-fault conditions

[SOURCE: IEC 60050-195:1998, 195-06-02]

3.1.5
mains
power supply system with nominal voltage according Table 1 of IEC 60038:2009

3.1.6
mains network
electrical network in which the nominal voltage cannot exceed mains voltage under normal conditions

3.1.7
extra low voltage
ELV
nominal voltage in the electrical installation of buildings according to the voltage band I specified in IEC 61140

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

3.1.8
extra low voltage network
ELV network
electrical network in which the nominal voltage cannot exceed ELV under normal conditions

Note 1 to entry: An ELV network is not safe to touch.

3.1.9
functional extra low voltage network
FELV network
electrical network in which the nominal voltage cannot exceed ELV under normal conditions

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

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

3.1.10
safety extra low voltage network
SELV network
electrical network in which the nominal voltage cannot exceed ELV

– under normal conditions,
– under single-fault conditions, including earth fault in other networks

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

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

3.1.11
protective extra low voltage network
PELV network
electrical network in which the nominal voltage cannot exceed ELV

– under normal conditions,

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

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

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

3.1.12
simple separation
separation between networks or between a network and earth by means of basic insulation

3.1.13
protective separation
separation of one electric network from another by means of

– double insulation, or

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

– reinforced insulation

[SOURCE: IEC 60050-195:1998, 195-06-19, modified – "(electrically)" has been omitted from the term and "circuit" has been replaced with "network" in the definition.]

3.1.14
basic insulation
insulation of hazardous-live parts which provides basic protection

[SOURCE: IEC 60050-826:2004, 826-12-14]

3.1.15
double insulation
insulation comprising both basic insulation and supplementary insulation

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

3.1.16
supplementary insulation
independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-826:2004, 826-12-15]

3.1.17
electrically protective screening
separation of electric networks or conductors from hazardous-live parts by an electrically protective screen (shield) connected to the protective-equipotential-bonding system and intended to provide protection against electric shock

[SOURCE: IEC 60050-195:1998, 195-06-18, modified – "circuits" has been replaced with "networks" in the definition.]

3.1.18
reinforced insulation
insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

[SOURCE: IEC 60050-826:2004, 826-12-17]

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in IEC 63044-1 and the following apply.

ELV Extra Low Voltage
FELV Functional Extra Low Voltage
SELV Safety Extra Low Voltage
PELV Protective Extra Low Voltage

4 Void

5 Safety requirements and compliance criteria

This document shall be used together with the electrical safety standard for the device to be part of the HBES/BACS. See Annex A.

This document applies in the following way.

a) If the safety standard for the device to be part of the HBES/BACS does not specify electrical safety requirements for HBES/BACS, this document (IEC 63044-3) applies.
b) If the safety standard for the device to be part of the HBES/BACS specifies electrical safety requirements for HBES/BACS, the requirements of this document (IEC 63044-3) shall be used as the minimum levels required.

6 Requirements

6.1 General

The entire HBES/BACS, media and devices as well as their installation, shall ensure safe operation and protection against electric shock, burns and fire during normal use as well as under single-fault conditions.

Compliance is checked by the classification requirements of installation areas in 6.2, the electrical safety requirements in 6.3 and the installation requirements in 6.4.

6.2 Classification requirements of installation areas

6.2.1 Overvoltage category

Devices to be installed as a part of the fixed installation of an HBES/BACS shall be classified as overvoltage category III according to IEC 60664-1.

Devices that are not part of the fixed installation but to be supplied from the fixed installation of an HBES/BACS shall be classified at least as overvoltage category II according to IEC 60664-1.

Compliance is checked by inspection of the product descriptions and/or installation instructions.

6.2.2 Pollution degree

All devices of an HBES/BACS shall be classified at least for pollution degree 2 according to IEC 60664-1.

Compliance is checked by inspection of the product descriptions and/or installation instructions.

6.2.3 Material class

All devices of an HBES/BACS shall comply with the minimum material class IIIa (CTI = 175 V).

6.3 Electrical safety requirements

6.3.1 Protection from hazards in the device

Devices of an HBES/BACS shall comply with the electrical safety requirements in the appropriate product standard in consideration of the required overvoltage category and pollution degree specified in 6.2.1 and 6.2.2.

An informative non-exhaustive list of product standards for electrical safety is provided in Annex A.

Compliance is checked by the requirements in the relevant product standard.

6.3.2 Protection from overvoltage on the network and from hazards caused by different types of network

6.3.2.1 HBES/BACS devices connected to an ICT network

For HBES/BACS devices connected to an ICT network, as defined in 3.1.1, the appropriate requirements in IEC 62949 apply in addition to the product standard.

Compliance is checked by the requirements and tests according to IEC 62949.

6.3.2.2 Devices interconnected via a dedicated HBES/BACS network

For devices connected to an HBES/BACS network as defined in IEC 63044-1:2017, 3.1.2 and IEC 63044-1:2017/AMD1:2021, 3.1.2, the protection against electric shock in accordance with 6.3.1 applies. Table 1 specifies the required electrical separation between the device network and the HBES/BACS network and applies in addition to the product standard.

If the separation between the mains and SELV is done with a transformer, this shall be a safety transformer according to IEC 61558-2-6 or IEC 61558-2-16.

NOTE Table 1 can also be used as guidance for the separation between different circuits within a device in case the relevant product standard does not specify these requirements.

The relevant information about the safety classification (overvoltage category and type of circuit) of the ports and any restrictions applicable (e.g. the network topology) shall be stated in the manufacturer's documentation.

Table 1 – Requirements for connection of devices to a dedicated HBES/BACS network

	HBES/BACS network circuit (overvoltage category III)				
	Mains	**ELV**	**FELV**	**SELV**	**PELV**
Voltage range V AC [a]	≤ 230	≤ 50	≤ 50	≤ 50	≤ 50

Voltage range V DC [a]	≤ 400	≤ 120	≤ 120	≤ 120	≤ 120
Device circuits (overvoltage category III or II) other than the HBES/BACS network circuit	**Requirement for the electrical separation between the HBES/BACS network circuit and other device circuits [b]**				
Mains ≤ 230 V AC/400 V DC	None	Functional [d]	Simple	Protective	Protective
		A 230 V	A 230 V	A 230 V	A 230 V
		B -	B 1,5 kV	B 3,0 kV	B 3,0 kV
		C 4 kV	C 4 kV	C 6 kV	C 6 kV
		D 2,5 kV	D 2,5 kV	D 4 kV	D 4 kV
ELV ≤ 50 V AC/120 V DC	Functional [d]	None	Simple	Protective	Protective
	A 230 V		A 230 V	A 230 V	A 230 V
	B -		B 1,5 kV	B 3,0 kV	B 3,0 kV
	C 4 kV		C 4 kV	C 6 kV	C 6 kV
	D 2,5 kV		D 2,5 kV	D 4 kV	D 4 kV
FELV ≤ 50 V AC/120 V DC	Simple	Simple	Functional [c d]	Simple [f]	Simple [f]
	A 230 V	A 230 V	A 50 V	A 230 V	A 230 V
	B 1,5 kV	B 1,5 kV	B -	B -	B -
	C 4 kV	C 4 kV	C 2,5 kV	C 4 kV	C 4 kV
	D 2,5 kV	D 2,5 kV	D 1,5 kV	D 2,5 kV	D 2,5 kV
SELV ≤ 50 V AC/120 V DC	Protective	Protective	Simple [f]	Simple [c]	Simple
	A 230 V	A 230 V	A 230 V	A 50 V	A 50 V
	B 3,0 kV	B 3,0 kV	C 4 kV	B -	B -
	C 6 kV	C 6 kV	D 2,5 kV	C 2,5 kV[e]	C 2,5 kV[e]
	D 4 kV	D 4 kV		D 1,5 kV	D 1,5 kV
PELV ≤ 50 V AC/120 V DC earthing	Protective	Protective	Simple [f]	Simple	Simple [c]
	A 230 V	A 230 V	A 230 V	A 50 V	A 50 V
	B 3,0 kV	B 3,0 kV	B -	B -	B -
	C 6 kV	C 6 kV	C 4 kV	C 2,5 kV[e]	C 2,5 kV[e]
	D 4 kV	D 4 kV	D 2,5 kV	D 1,5 kV	D 1,5 kV

[a] Values according to IEC 60664-1. Voltages are nominal.

[b] Requirements for the insulation:

A = Rated insulation AC voltage (r.m.s.) for the electrical separation;

B = Test AC voltage (r.m.s.) for the electrical separation due to temporary overvoltage;

C = Rated impulse voltage for the electrical separation for devices classified as overvoltage category III;

D = Rated impulse voltage for the electrical separation for devices classified as overvoltage category II.

Impulse tests for C and D according to IEC 61180 (1,2 µs / 50 µs impedance 42 Ω).

[c] A SELV device circuit and a SELV network circuit of the same rated voltage and overvoltage category can be considered as the same circuit and therefore no separation is needed.

A PELV device circuit and a PELV network circuit of the same rated voltage and overvoltage category can be considered as the same circuit and therefore no separation is needed.

A FELV device circuit and a FELV network circuit of the same rated voltage and overvoltage category can be considered as the same circuit and therefore no separation is needed.

[d] Functional means functional separation for the highest voltage present.

[e] When the HBES/BACS is installed wholly within an equipotential earthing system, the values C and D can be reduced to 800 V and 500 V, respectively.

[f] This separation covers also the required protective separation between FELV and SELV or PELV circuits.

Compliance with the required electrical separation between the device circuit and the HBES/BACS network circuit shall be tested in accordance with the test requirements in the specific product standard with the appropriate test levels specified in Table 1 under the following conditions.

– *If the electrical separation (simple and protective separation) has a creepage distance, the voltage specified by the letter A shall be used for dimension of the creepage distance. However this creepage distance shall not be less than the clearance for the electrical separation.*

– *If the electrical separation (simple and protective separation) has a clearance and/or a solid insulation, the voltage specified by the letters B and either C or D shall be used for dimension of the clearance and/or the solid insulation.*

– *If the product standard has no test requirements for the impulse voltage test, the requirement specified Table 1 shall be used.*

– *The test voltage related to the rated impulse voltage, when used for testing the clearances, shall be corrected according to corresponding test altitudes according to IEC 60664-1. If clearances have been chosen for inhomogeneous field conditions according to IEC 60664-1:2007, Table F.2, no verification by a voltage withstand test is needed.*

– *As an alternative to the impulse voltage test of IEC 60664-1:2007 (6.1.2.2.1), the dielectric test with AC voltage (6.1.2.2.2.2) or the dielectric test with DC voltage (6.1.2.2.2.3) may be used.*

6.3.3 Protection from touch current

6.3.3.1 General

NOTE Devices complying with IEC 62368-1 fulfil the requirements.

If the nominal voltage exceeds 25 V AC or 60 V DC or if the equipment is immersed, basic protection shall be provided for SELV and PELV circuits by insulation or barriers or enclosures.

Basic protection is generally unnecessary in normal dry conditions for

– SELV circuits where the nominal voltage does not exceed 25 V AC or 60 V DC, and

– PELV circuits where the nominal voltage does not exceed 25 V AC or 60 V DC and exposed-conductive-parts and/or the live parts are connected by a protective conductor to the main earthing terminal.

In all other cases, basic protection is not required if the nominal voltage of the SELV or PELV system does not exceed 12 V AC or 30 V DC.

Compliance is checked by measurement of the voltage and, if relevant, by testing the basic protection according to the product standard.

If no product standard exist, the test voltage for basic protection shall be 500 V.

6.3.3.2 Limitation of touch current from the HBES/BACS device to an ICT network

For HBES/BACS devices connected to an ICT network, as defined in 3.1.1, the appropriate requirements in IEC 62949 apply in addition to the product standard.

6.3.3.3 Limitation of the touch current from the device to the HBES/BACS network

The touch current from devices supplied from the mains supply to the HBES/BACS network shall be limited to 0,25 mA r.m.s. according to IEC 62151:2000, 5.4.

Compliance is checked by measurement according to the test circuits in Figures 5 and 6 in IEC 62151:2000.

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

6.3.3.4 Summation of touch current

6.3.3.4.1 General

A device that provides an HBES/BACS network connection for connection of multiple items of other HBES/BACS equipment shall not create a hazard due to summation of touch current.

NOTE The values used for these requirements are taken from IEC 61140:2016.

In these requirements, abbreviations have the following meanings:

– I_1 is the touch current received from other equipment via a network at a port of the device;

– $\sum I_1$ is the summation of touch currents received from other equipment at all such network ports of the device;

– I_2 is the touch current due to the AC mains supply of the device.

It shall be assumed that each HBES/BACS network port receives 0,25 mA (I_1) from the other devices, unless the actual current from the other equipment is known to be lower. The following requirements, 6.3.3.4.2 or 6.3.3.4.3 as applicable, shall be met.

6.3.3.4.2 Devices with earthed network ports

For a device in which each network port is connected to the main protective earthing terminal of the device, the following items 1) and 2) shall be considered.

1) If $\sum I_1$ (not including I_2) exceeds 3,5 mA AC RMS or 10 mA ripple-free DC,

   – the equipment shall have provision for a permanent connection to protective earth in addition to the protective earthing conductor in the power supply cord if any, and

   – the installation instructions shall specify the provision of a permanent connection to protective earth with a cross-sectional area of not less than 2,5 mm^2, if mechanically protected, or otherwise 4,0 mm^2, and

   – a label with the following wording or similar wording shall be affixed adjacent to the permanent earth connection:

WARNING
HIGH TOUCH CURRENT
EARTH CONNECTION ESSENTIAL
BEFORE MAKING NETWORK
CONNECTIONS

2) $\sum I_1$ plus I_2 shall comply with the limits, if any, in the relevant product safety standard.

Compliance with item 1) is checked by inspection and if necessary by the following test.

If the equipment has provision for a permanent protective earth connection in accordance with item 1) above, it is not necessary to make any measurements, except that I_2 shall comply with the relevant requirements of the product safety standard.

Touch current tests, if necessary, are made using the relevant measuring instrument described in IEC 60990 or any other instrument giving the same results. A capacitive coupled AC source of the same line frequency and phase as the AC mains supply is applied to each communication port such that 0,25 mA, or the actual current from other devices if known to be lower, is available to flow into that communication port. The current flowing in the earthing conductor is then measured.