BRITISH STANDARD

BS EN 50310:2000

Application of equipotential bonding and earthing in buildings with information technology equipment

The European Standard EN 50310:2000 has the status of a British Standard

ICS 35.020; 91.140.50

National foreword

This British Standard is the official English language version of EN 50310:2000.

The UK participation in its preparation was entrusted by Technical Committee TCT/7, Installation requirements, to Subcommittee TCT/7/-/1, Cabling installation experts panel, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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Summary of pages

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EUROPEAN STANDARD **EN 50310**

NORME EUROPÉENNE

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ICS 33.100;35.020;91.140.50

English version

Application of equipotential bonding and earthing in buildings with information technology equipment

Application de liaision équipotentielle et de la mise à la terre dans les locaux avec équipement de technologie de l'information

Anwendung von Maßnahmen für Potentialausgleich und Erdung in Gebaüden mit Einrichtungen der Informationstechnik

This European Standard was approved by CENELEC on 2000-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Ref. No. EN 50310:2000 E

Foreword

This European Standard has been prepared by CENELEC/TC 215/WG 4, which is composed of experts of both CENELEC/TC 215 and ETSI/TC EE/WG EE 2 (former ETSI/STC EE 2). The work started in Technical Committee Environmental Engineering (TC EE) of the European Telecommunications Standards Institute (ETSI) as sub-contracted work on behalf of Technical Committee CENELEC/TC 215 under mode 3, as agreed on the CENELEC-ETSI work repartition meeting held in 1992 and as approved by the ETSI/TA and CENELEC/BT at that time.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50310 on 2000-08-1.

The following dates were fixed.

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2001-08-01
- latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2003-08-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only.

In this standard, annex A is normative; Annexes B and C are informative.

This standard has been produced within the framework of the following considerations:

a) With the ongoing growth of the liberalized telecommunication market, the increasing advent of private telecommunication network operators, and the flourishing use of networking computers, the amount of Information Technology equipment installed in buildings and the complexity of these Information Technology installations are permanently growing.

b) Information Technology equipment is generally installed either as stand alone equipment (e.g. personal or network computers, small PBXs), or held in racks, cabinets or other mechanical structures (e.g. switching systems, transmission systems, mobile base stations).

c) The existing ITU-T and ITU-R recommendations in such matters do not ensure the required standardization at the equipment level.

d) CENELEC/SC 64B, *Electrical installations of buildings: Protection against thermal effects*, has decided during their meeting in November 1997 not to harmonize IEC 60364-5-548:1996, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Section 548: Earthing arrangements and equipotential bonding for information technology installations*.

e) This European Standard shall give guidance to Network operators, equipment providers and building owners to agree on a standardized bonding configuration that facilitates:

- compliance of the Information Technology Equipment installation with functional requirements including Electromagnetic Compatibility (EMC) aspects of emission and immunity;
- compatible building installation and equipment provisions;
- installation of new equipment in buildings as well as expansion or replacement of installations in existing buildings with equipment coming from different suppliers;
- a structured installation practice;
- simple maintenance rules;
- contracting on a common basis;
- harmonization in development, manufacturing, installation and operation.

Contents

Introduction

This standard addresses earthing and bonding of information technology equipment in buildings in relation to safety, functional and electromagnetic performance, taking into account that the draft does not specify another earthing and bonding system but selects out of the existing ones (specified in HD 384 series together with IEC 60364-5-548) the best suitable system to information technology needs (CBN, MESH-BN, TN-S system).

Information regarding the general principles on earthing for (small) telecommunication installations in buildings has been published in Recommendation ITU-T K.31.

Depending on the degree of complexity and the size of the information technology installation, different levels of earthing and bonding are required. Starting from basic requirements on earthing and bonding this standard defines the refinements necessary to operate information technology equipment. The underlined concepts of this standard are in harmony with ETS 300 253. Therefore large information technology installations in buildings, which may require special care to avoid damage or upset from electromagnetic sources can make use of the bonding configurations and earthing techniques of ETS 300 253.

The specifications of EN 50310 are intended to provide optimum earthing and bonding conditions for buildings, where information technology installations are to be operated. EN 50310 should be applied at least in the case of newly constructed buildings and whenever possible in existing buildings (e.g. on the occasion of refurbishment). EN 50174-2 details the considerations for satisfactory installation and operation of information technology cabling within the environment of a building operating a low-voltage electricity distribution system (up to AC 1 000 V rms). For the relationship of EN 50310 and European Standards on information technology cabling and their usage see Table 1.

Table 1 - Relationship between EN 50310 and European Standards dealing with information technology cabling

Building design phase	**Cabling design phase**	**Planning phase**	**Implementation phase**	**Operation phase**
EN 50310 5.2: Common bonding network (CBN) within a building 6.3: AC distribution system and bonding of the protective conductor (TN-S)	EN 50173 **or (and)** EN 50098-1 **or (and)** EN 50098-2 **or (and)** Other application standards	EN 50174-1 4: Specification considerations 5: Quality assurance 7: Cabling administration **and** EN 50174-2 4: Safety requirements 5: General installation practices for metallic and optical fibre cabling 6: Additional installation practice for metallic cabling 7: Additional installation practice for optical fibre cabling **and** EN 50174-3 **and** **(for equipotential bonding)** EN 50310 5.2: Common bonding network (CBN) within a building 6.3: AC distribution system and bonding of the protective conductor (TN-S)	EN 50174-1 6: Documentation 7: Cabling administration **and** EN 50174-2 4: Safety requirements 5: General installation practices for metallic and optical fibre cabling 6: Additional installation practice for metallic cabling 7: Additional installation practice for optical fibre cabling **and** EN 50174-3 **and** **(for equipotential bonding)** EN 50310 5.2: Common bonding network (CBN) within a building 6.3: AC distribution system and bonding of the protective conductor (TN-S)	EN 50174-1 5: Quality assurance 7: Cabling administration 8: Repair and maintenance

1 Scope

This European Standard applies to the equipotential bonding inside buildings in which information technology equipment is going to be installed. It contributes to the standardization of information technology equipment and co-ordinates with the pre-requirements of the generic installation conditions as outlined in IEC 60364-5-548 to achieve the following targets:

a) safety from electrical hazards;

b) reliable signal reference within the entire information technology installation;

c) satisfactory electromagnetic performance of the entire information technology installation.

A defined bonding configuration down to the equipment level – independent of the equipment supplier – is intended to facilitate:

- the installation, operation and maintenance of information technology installations in buildings;

- the interworking between different information technology equipment (interconnected by metallic links).

The specification of information technology equipment and of the pre-requirements of installation are subject to agreement of the parties (e.g. the equipment supplier and the purchaser or building owner).

This standard applies to buildings with information technology equipment or in which the installation of information technology equipment is intended. It does not apply to buildings which may be subject to a harsh electromagnetic environment, or rooms containing the generation, transmission or termination of voltages over AC 1 000 V. This standard does not address the specific requirements for telecommunication centres; these are specified in ETS 300 253.

2 Normative references

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

EN 41003, *Particular safety requirements for equipment to be connected to telecommunication networks.*

EN 50174-2, *Information technology – Cabling installation – Part 2: Installation planning and practices inside buildings.*

EN 60950, *Safety of information technology equipment (IEC 60950:1999, modified).*

ETS 300 253, *Equipment Engineering (EE) – Earthing and bonding of telecommunication equipment in telecommunication centres.*

HD 384.2 S1, *International Electrotechnical Vocabulary – Chapter 826: Electrical installations of buildings (IEC 60050-826:1982).*

HD 384.3 S2, *Electrical installations of buildings – Part 3: Assessment of general characteristics of installations (IEC 60364-3:1993, modified).*

HD 384.4.41 S2, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock (IEC 60364-4-41:1992, modified).*

HD 384.5.54 S1, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 54: Earthing arrangements and protective conductors (IEC 60364-5-54:1980, modified).*

IEC 60050-604, *International Electrotechnical Vocabulary – Chapter 604: Generation, transmission and distribution of electricity – Operation.*

3 Definitions, abbreviations and symbols

3.1 Definitions

For the purposes of this European Standard, the following definitions apply.

NOTE 1 The definitions with respect to earthing and bonding are taken from series IEC 60050 and HD 384.2 S1, respectively. Furthermore, definitions specific to information technology installations given in ETS 300 253:1995 are used. Reference to these standards is indicated, where appropriate, in square brackets. These definitions are reproduced here to assist the reader of this standard.

NOTE 2 The concept of the various electricity distribution systems (TN-S, TN-C, TT and IT) is introduced in detail in HD 384.3 S2.

3.1.1
bonding mat
essential means to provide a SRPP by a discernible, nearly regular mesh structure. The bonding mat may be located either below or above a collection of equipment constituting a system block

[3.2.2 of ETS 300 253:1995]

3.1.2
bonding network (BN)
set of interconnected conductive structures that provides an “electromagnetic shield“ for electronic systems and personnel at frequencies from direct current (DC) to low radio frequency (RF). The term “electromagnetic shield“ denotes any structure used to divert, block or impede the passage of electromagnetic energy. In general, a BN need not be connected to earth but all BNs considered in this standard will have an earth connection

[3.2.2 of ETS 300 253:1995]

3.1.3
bonding ring conductor (BRC)
an earthing bus conductor which forms a closed connected ring. Normally a BRC has multiple connections to the CBN and therefore improves its quality

3.1.4
common bonding network (CBN)
principal means for effective bonding and earthing inside a telecommunication building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal BN in a building. These components include: structural steel or reinforcing rods, metallic plumbing, alternating current (AC) power conduit, protective conductors (PE), cable racks and bonding conductors. The CBN always has a mesh topology and is connected to the earthing network

[3.2.2 of ETS 300 253:1995]

3.1.5
DC return conductor
(+) conductor of the –48 V or –60 V secondary DC supply

[3.2.2 of ETS 300 253:1995]

3.1.6
earth
conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero

[826-04-01 of HD 384.2 S1:1986]

3.1.7
earth electrode
conductive part or group of conductive parts in intimate contact with and providing an electrical connection with earth

[826-04-02 of HD 384.2 S1:1986]

3.1.8
earthing conductor
protective conductor connecting the main earthing terminal or bar to the earth electrode

[826-04-07 of HD 384.2 S1:1986]

3.1.9
earthing network
part of an earthing installation which is restricted to the earth electrodes and their interconnections

[604-04-07 of IEC 60050-604:1989]

3.1.10
equipotential bonding
electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential

[826-04-09 of HD 384.2 S1:1986]

3.1.11
equipotential bonding conductor
protective conductor for ensuring equipotential bonding

[826-04-10 of HD 384.2 S1:1986]

3.1.12
main earthing terminal; main earthing bar
terminal or bar provided for the connection of protective conductors, including equipotential bonding conductors and conductors for functional earthing, if any, to the means of earthing

[826-04-08 of HD 384.2 S1:1986]

3.1.13
meshed bonding network (MESH-BN)
bonding network in which all associated equipment frames, racks and cabinets and usually the DC power return conductor, are bonded together as well as at multiple points to the CBN. Consequently, the MESH-BN augments the CBN

[3.2.2 of ETS 300 253:1995]

3.1.14
neutral conductor (N)
conductor connected to the neutral point of a system and capable of contributing to the transmission of electrical energy

[826-01-03 of HD 384.2 S1:1986]

3.1.15
PEN conductor
earthed conductor combining the functions of both protective conductor and neutral conductor

[826-04-06 of HD 384.2 S1:1986]

3.1.16
power supply

– **primary supply:** public mains or, under emergency conditions, locally generated AC supply
– **secondary supply:** supply to the telecommunication equipment, racks or system block, derived from the primary supply

– **tertiary supplies:** supplies to the telecommunication equipment, derived from the secondary supply

[3.2.2 of ETS 300 253:1995]

3.1.17
protective conductor (PE)
conductor required by some measures for protection against electric shock for electrically connecting any of the following parts:

– exposed conductive parts
– extraneous conductive parts
– main earthing terminal
– earth electrode
– earthed point of the source or artificial neutral

[826-04-05 of HD 384.2 S1:1986]

3.1.18
signalling earth conductor (SE)
conductor referring signalling circuits to earth potential. The signalling functions of such circuits may include signalling with earth return between different locations. A protective conductor (PE) may serve simultaneously as an SE if the characteristics of the signalling functions harmonize with the imposed safety requirements. The CBN (of which the PE is part) can provide the SE function

3.1.19
system
regularly interacting or interdependent group of items forming a unified whole

[3.2.2 of ETS 300 253:1995]

3.1.20
system block
functional group of equipment depending in its operation and performance on its connection to the same system reference potential plane, inherent to a MESH-BN

[3.2.2 of ETS 300 253:1995]

3.1.21
system reference potential plane (SRPP)
conductive solid plane, as an ideal goal in potential equalizing, is approached in practice by horizontal or vertical meshes. The mesh width thereof is adapted to the frequency range to be considered. Horizontal and vertical meshes may be interconnected to form a grid structure approximating to a Faraday cage

[3.2.2 of ETS 300 253:1995]

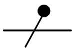
NOTE The SRPP facilitates signalling with reference to a common potential.

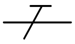
3.2 Abbreviations

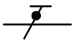
AC	alternating current
BN	bonding network
BRC	bonding ring conductor
CBN	common bonding network
DC	direct current
EMC	electromagnetic compatibility
FE	functional earthing conductor
L+	positive DC conductor
L–	negative DC conductor
LPS	lightning protection system

MDF	main distribution frame
MESH-BN	meshed bonding network
MET	main earthing terminal or bar
N	neutral conductor
NT	network termination
PE	protective conductor
PEN conductor	combined protective conductor and neutral conductor
SE	signal earthing conductor
SPD	surge protective device
SRPP	system reference potential plane
TE	terminal equipment

3.3 Symbols


neutral conductor (N)


protective conductor (PE)


PEN conductor

4 General requirements

4.1 Safety from electrical hazards

Equipment attached to IT cabling shall be in accordance with EN 60950 or EN 41003, as appropriate. The installation of protective conductors (PEs) and equipotential bonding conductors shall be performed according to HD 384.4.41 and HD 384.5.54 (requirements for installations in buildings). For the separation between power cabling and IT cabling, EN 50174-2 shall apply (see 5.5).

The conductors involved shall provide sufficiently high current conducting capability and low impedance according to the relevant safety standards in order to avoid electric shock, risk of fire, or damage to the equipment under normal or faulty operating conditions within an equipment or the electricity distribution system, or due to the impact of induced voltage and current, e.g. by lightning.

4.2 Signal reference

In order to maintain a good signal reference, emphasis should be placed on proper equipotential bonding of both the information technology and the electricity distribution systems. Signalling via earth return should be avoided, but if used the impedance of the earthing network shall be kept as low as possible.

Where a complex installation (see Figure 3) is required, a reliable signal reference shall be provided by a system reference potential plane (SRPP) dedicated at least to a functional unit or a System Block. In order to avoid undue functional distortion or risk of component failure, the SRPP shall provide sufficiently low impedance up to the highest frequency considered in the design of the equipment by using a metal plane or a meshed configuration having adequate mesh dimensions, e.g. a bonding mat. The frequency band to be covered shall include the spectral components of transients caused by switching, short circuits and atmospheric discharges.

NOTE Signal reference to the SRPP does not always imply signal return via the SRPP.

4.3 Electromagnetic compatibility (EMC)

EMC performance of information technology installations is eased if the installation of the building is a TN-S system according to 312.2.1 of HD 384.3 S2:1995.

For a complex information technology installation (see Figure 3), measures to achieve a satisfactory EMC system-performance shall be assisted by a SRPP. This SRPP shall provide sufficiently low impedance for efficient connection of filters, cabinets and cable screens. The requirement to avoid undue emission of, or susceptibility to electromagnetic energy under normal operating conditions may govern the properties of the SRPP ahead of what is required in 4.2. The EMC requirements addressed include the discharge of electrostatic energy.

NOTE Requirements for the protection against overvoltages and (or) atmospheric discharge are outside the scope of this EN.

5 Requirements on bonding networks

5.1 Bonding configurations

Bonding configurations can be addressed at a building level (i.e. CBN), at an installation level (i.e. merging of CBN and meshed bonding network – MESH-BN) and at an equipment level (i.e. MESH-BN).

The bonding configuration at an equipment level adopted in this standard is a MESH-BN.

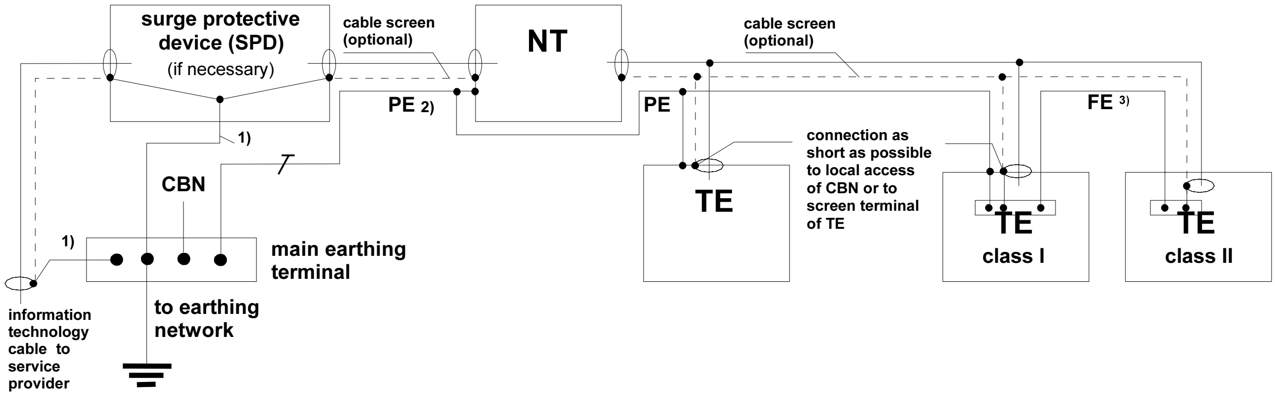
NOTE For bonding configurations of telecommunication equipment at a building and installation level, in a subscriber's building, see also Recommendation ITU-T K.31.

5.2 Common bonding network (CBN) within a building

In each building there are metallic components which shall be used to construct a basic CBN (e.g. main earthing terminal or bar, protective conductors (PE), metalic plumbing, structural steel, reinforcement rods). Such a basic CBN can be improved by additional conductive components (e.g. equipotential bonding conductors, bonding ring conductors, cable racks) to the extent that the CBN has a sufficiently low impedance and high current conducting capability to meet the general requirements of clause 4. Equipotential bonding conductors shall be used (see 547.1.2 of HD 384.5.54 S1:1988). For examples of simple CBN configurations for an information technology installation inside a building see Figures 1 and 2.

Each building shall be provided with a designated main earthing terminal or bar (MET), located as close as possible to the AC distribution and information technology cable entrance facilities. Depending on the degree of complexity and the size of the information technology installation, the MET of the building shall be extended by a bonding ring conductor (BRC) along the inside perimeter of the equipment room or the inside perimeter of the building (see Figure 3) when required. This BRC shall at least comprise a system block by its outer perimeter.

In order to minimize surge currents and voltages in the building, the screens of all cables entering the building shall be bonded to the MET via a low-impedance path, i.e. by the shortest possible connection (see Figures 1, 2 and 3).



1) Low impedance path; keep as short as possible (see 5.2).

2) Protective conductor (PE) to be routed in close proximity to signal cables to minimize loop area (see 5.5).

3) Functional earthing conductor (FE), e.g. signal earthing conductor, optional for equipment using earth return signalling.

NOTE If NT and TE have non-conducting cases, then the PE is not connected to the case.

Figure 1 - Example of a simple common bonding network (CBN) configuration (installation of network termination e.g. for ISDN basic access)

An extension of the information technology installation inside a building, e.g. information technology systems situated on different floors and interconnected by metallic links, may require such a minimum CBN version to be augmented into a three dimensional grid structure, approximating a Faraday cage (see Figure 1 of ETS 300 253:1995). The impact of interfering energy in an exposed location or the need for information security may enforce the provision of shielded rooms as a maximum requirement to the CBN. For an example of an improved CBN/MESH-BN installation inside a building see Figure 3. The earthing conductor and the equipotential bonding conductors should have insulation colored in accordance to international and national regulations.

5.3 Bonding network (BN) within an information technology system

Within an information technology system, especially a system block, the BN shall be of the mesh type. The SRPP shall provide sufficiently low impedance and high current conducting capability to meet the general requirements in clause 4.

The MESH-BN shall interconnect shelves, cabinets, rack rows, cable racks, ducts, conduits, distribution frames, cable screens and where appropriate a bonding mat to provide the required low impedance of the BN.

All metallic parts of the MESH-BN shall form an electrically continuous whole. This does not necessarily require bonding by additional bonding straps, but that improvements should be taken into account when determining the finishing and fastening methods to be used.

For an example of the implementation principles of the MESH-BN concept on an equipment see Figure 2 of ETS 300 253:1995.

5.4 Merging of common bonding network (CBN) and meshed bonding network (MESH-BN)

All bonding networks (BN) of information technology systems shall be connected to the CBN.
The MESH-BN shall enlarge the CBN including the main earthing terminal by multiple interconnections to the CBN (see Figures 1, 2 and 3).

5.5 Bonding and routing aspects of cabling within and between bonding networks

All information technology cabling entering the equipment room should be located close together.

Electricity distribution cables and signal cables within and between MESH-BNs shall be run tightly along the parts of the enlarged CBN.

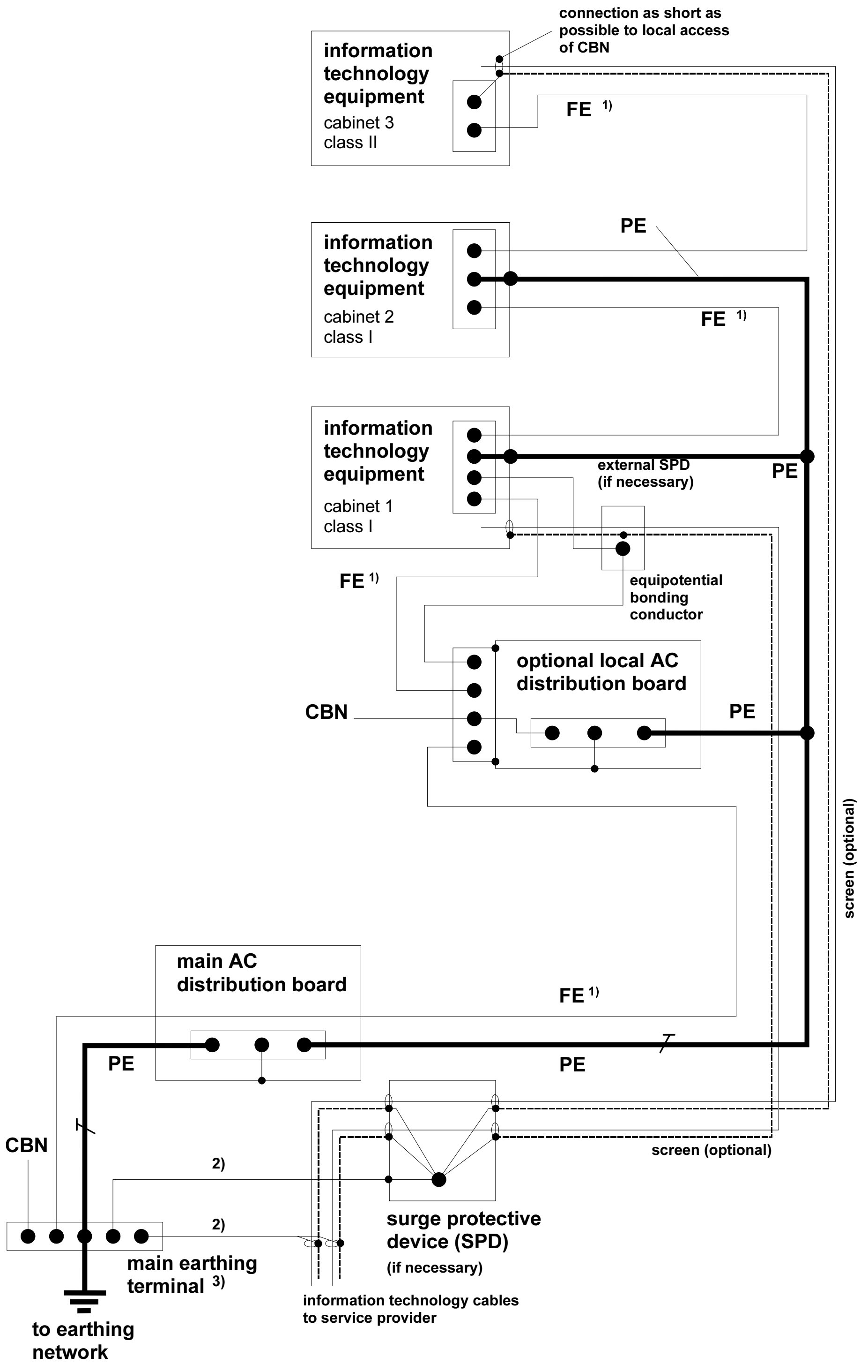
There shall be a separation distance in accordance with EN 50174-2 between cable tracks of AC distribution cables and signal cables. This separation distance may be reduced if adequate screening is provided.

Cable screens shall be bonded directly to racks, cabinets or where required to the dedicated SRPP at least at each end. Circumferential (i.e. 360) connections are most effective.

NOTE 1 So far, when extending cable connections from existing to new equipment, it is being common use to avoid bonding the existing side by cable screens originating from the new equipment side. However, it is a consequential demand of this standard to provide a lower impedance path by improved bonding between the equipment locations.This can be achieved by connecting the cable screens both ends at least.

NOTE 2 Although cable screens usually are dimensioned too weak to be used for equipotential bonding or protective earthing purposes and have significant values of resistance, they can improve the quality of the MESH-BN due to their multiple implementation.

For more information about information technology cabling installation see EN 50174 series.



1) Optional for equipment using earth return signalling.
2) Low impedance path; keep as short as possible (see 5.2).
3) The main earthing terminal (MET) may be located in the main AC distribution board.

Figure 2 - Example of a common bonding network (CBN) configuration for an information technology installation inside a building

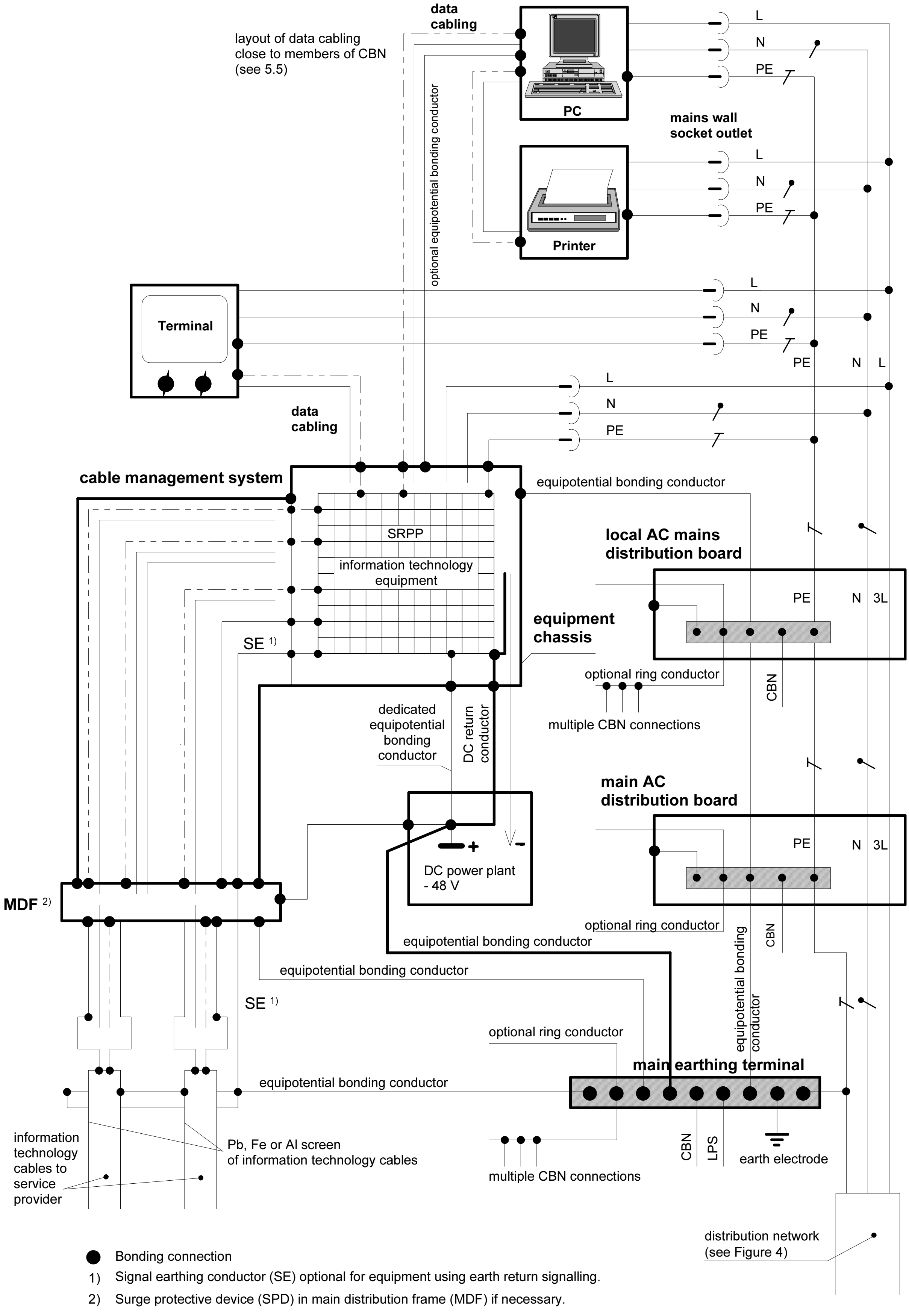


Figure 3 - Example of an improved bonding network (CBN/MESH-BN) installation inside a building

6 Requirements for electricity distribution system

6.1 DC distribution system of secondary supply

The DC distribution system, if present, shall use L+ and L– conductors routed close together. Each DC return conductor serving an information technology system shall be bonded to the CBN at least at the main earthing terminal or bar (MET) and at the service panel of the DC power plant and to the MESH-BN to at least one point of the SRPP.

The maximum DC voltage drop along each dedicated DC distribution return conductor shall be dimensioned to be less than 1 V. The calculation shall take into account the maximum load current on the associated supply conductor at maximum or minimum source voltage respectively under normal operating conditions. In practice this voltage drop will be substantially reduced by virtue of additional DC return paths provided by the CBN.

NOTE 1 One purpose of this requirement is to avoid electrochemical corrosion by stray currents.

NOTE 2 To achieve a minimum voltage drop in spite of high currents in L+ and L– conductors, these should have sufficient cross-sections, being important parts of the merged CBN/MESH-BN. In addition, since the parallel impedance of the equipment connected to the conductors is low, the non-earthed L– conductor reduced still further the CBN/MESH-BN impedance.

NOTE 3 For the special arrangements of DC distribution of secondary supply see ETS 300 253 and EG 201 147.

The DC return path in its entire length shall be capable of carrying over-currents in the case of a fault between a negative DC conductor of the secondary supply and the MESH-BN.

The DC return terminal of a power plant powering the information technology system(s) shall be earthed at its DC service panel by a connection to the MET (see Figure 3).

For information about necessary agreements if, under exceptional conditions, DC return conductors of a single equipment group cannot be integrated into the merged CBN/MESH-BN see annex C.

6.2 DC distribution system of tertiary supply

The reference potential terminal of tertiary power supplies shall be connected to the MESH-BN.

6.3 AC distribution system and bonding of the protective conductor

For a detailed description of the AC distribution systems see HD 384.3 S2.

The AC distribution system inside a building shall conform to the requirements of the TN-S system. This requires that there shall be no PEN conductor within the building, i.e. the option in 546.2.1 of HD 384.5.54 S1:1980 shall not be used.

Depending on the type of outdoor electricity distribution system serving a building, one of the following requirements shall apply (see Table 2 and Figure 4 to Figure 8):

a) service by a TN-S system of the outdoor electricity distribution system:

   solely the protective conductor (PE) shall be connected to the main earthing terminal or bar (MET) (see Figure 4, and Figure 9, mode 1);

b) service by a TN-C system of the outdoor electricity distribution system:

   1) the PEN conductor shall be connected to the main earthing terminal or bar (MET) only;

   2) from the MET to and within the consumer locations inside the building the neutral conductor (N) shall be treated as a live part (826-03-01 of HD 384.2 S1:1986);

   3) a dedicated protective conductor (PE) shall be provided (see Figure 5 and Figure 9, mode 2).

c) service by a TT or IT system of the outdoor electricity distribution system:

   1) the protective conductor (PE) shall be derived via the main earthing terminal or bar (MET) from the earthing network (see Figure 7 or Figure 8, and Figure 9, mode 3);

2) the dimensioning of the protective conductor (PE) shall follow the rules of the TN-S system.

NOTE Public electricity distribution systems implemented as an IT system are known to be special national conditions. Because of the fact that the IT system sometimes is leading up to a TT system, these two system types are treated together in this standard. For information regarding unacceptable interference by an IT system see annex B.

In each room containing information technology equipment or terminals which are connected to information technology equipment the bonding bar of each local AC distribution cabinet which serves the information technology equipment shall be bonded directly to the CBN (see Figure 3). If an optional bonding ring conductor (BRC) is installed, it shall be bonded directly to the CBN, at least in the four corners of the equipment room.

6.4 AC distribution system from tertiary power supply

The neutral point of a tertiary AC power supply shall be derived by bonding the terminal of the star point, or of an outer conductor (L) respectively, to the MESH-BN at the source only. The distribution to the assigned loads shall follow the rules of the TN-S system.

When using different sources for establishing power supply of information technology equipment (e.g. to provide remote power feeding for long range cable lines or the uninterruptible power supply of a sub-arrangement), the appropriate safety precautions shall be implemented without degrading the effectiveness of the general requirements in clause 4.

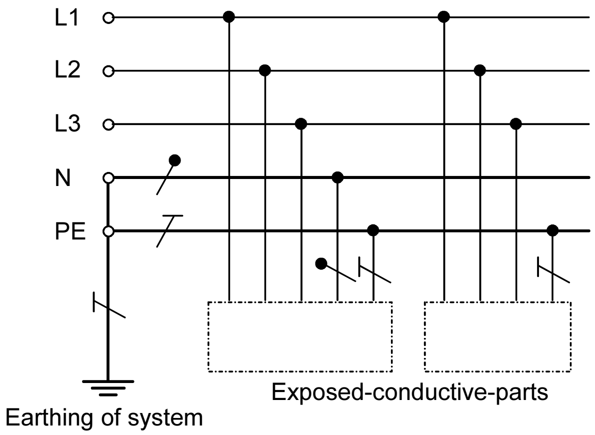
Table 2 - Survey of electricity distribution system configurations in relation to EMC

<table>
<tr><th>No.</th><th>External distribution</th><th colspan="2">Indoor installation</th><th>Remarks</th></tr>
<tr><td>1</td><td>TN-S 1)</td><td colspan="2">TN-S 1)</td><td>Best electricity distribution system in relation to EMC.</td></tr>
<tr><td>2</td><td>TN-C 2)</td><td colspan="2">TN-S 1)</td><td>Recommended.</td></tr>
<tr><td>3</td><td>TN-C 2)</td><td colspan="2">TN-C 2)</td><td>Not recommended for EMC reasons, see 4.3.</td></tr>
<tr><td>3 a)</td><td>TN-C 2)</td><td colspan="2">TN-C-S 2)</td><td>Not recommended for EMC reasons, see 4.3.</td></tr>
<tr><td>3 b)</td><td>TN-C 2)</td><td>TN-C 2)
at basement up to main earthing terminal</td><td>TN-S 1)
between floors and at floors</td><td>Recommended.</td></tr>
<tr><td>4</td><td>TT</td><td colspan="2">TT</td><td>– EMC covered for indoor installations of information technology;
– EMC not covered for interconnection of buildings with information technology; by-pass equipotential bonding conductor required.</td></tr>
<tr><td>5</td><td>TT</td><td colspan="2">An isolating transformer 3) shall be installed to realize TN-S.</td><td>Positive for EMC.</td></tr>
<tr><td>6</td><td>IT</td><td colspan="2">IT</td><td>This system is widely used isolated from earth, in some installations in France, with impedance to earth, at 230/440 V, and in Norway, with a voltage limiter, neutral not distributed, at 230 V line-to-line.
What conerns EMC see remarks to line 4 (TT system).</td></tr>
<tr><td>7</td><td>IT</td><td colspan="2">An isolating transformer 3) shall be installed to realize TN-S.</td><td>Positive for EMC.</td></tr>
</table>

1) TN-S systems for distribution purposes are used to be applied at premises between buildings or facilities where high EMC quality is required with respect to operational necessities. Examples are groups of buildings with cable networks for interactive services (see EN 50083 series), hospitals, broadcasting stations and transmitters as well as telecommunication centres.

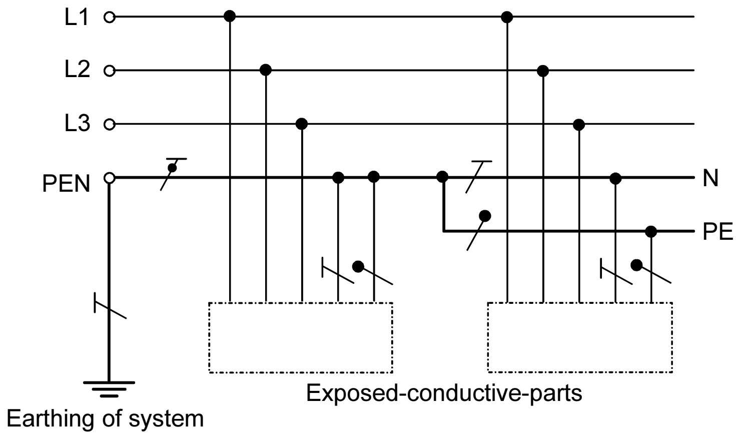
2) TN-C systems, in some countries, are used for public distribution systems and similar networks.

3) For isolating transformers (definition see EN 61558-1) a type with basic insulation between the separately arranged primary and secondary windings is sufficient.



Separate neutral and protective conductor

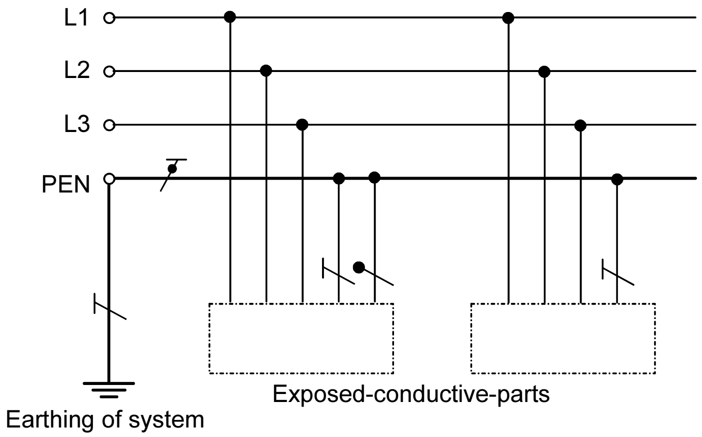
Figure 4 - TN-S system (taken from HD 384.3 S2:1995)



Neutral and protective functions combined in a single conductor in part of the system (PEN)

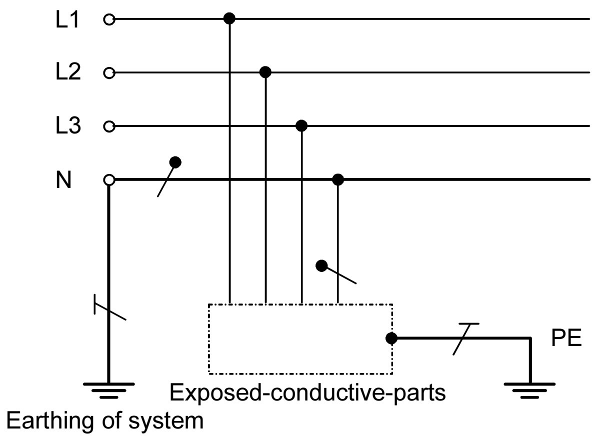
NOTE The point where the incoming PEN conductor is split up into a separate protective conductor (PE) and a neutral conductor (N) should be as close as possible to the origin of the electrical installation or (and) at the distribution panels of the building.

Figure 5 - TN-C-S system (taken from HD 384.3 S2:1995)



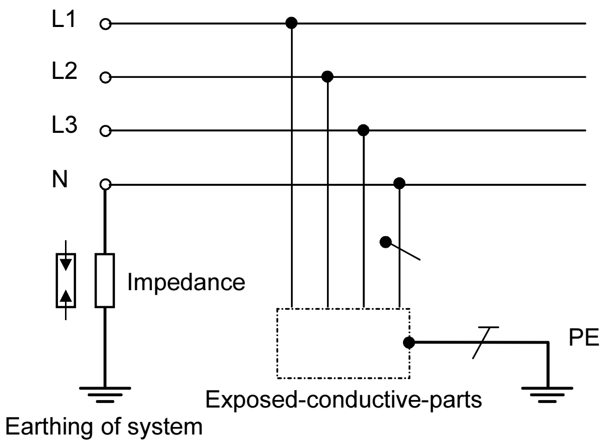
Neutral and protective functions combined in a single conductor throughout the system

Figure 6 - TN-C system (taken from HD 384.3 S2:1995)



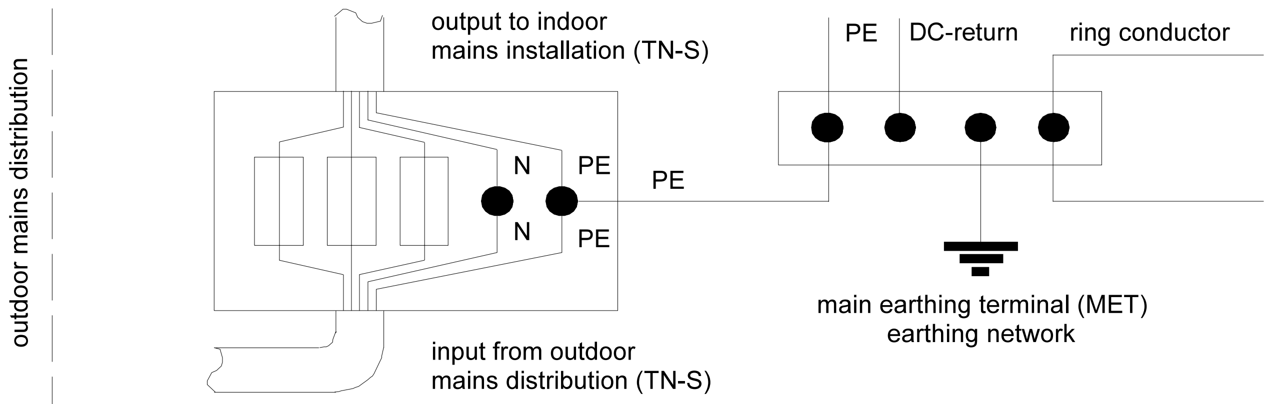
Earthed neutral and independent earthing of equipment

Figure 7 - TT system (taken from HD 384.3 S2:1995)

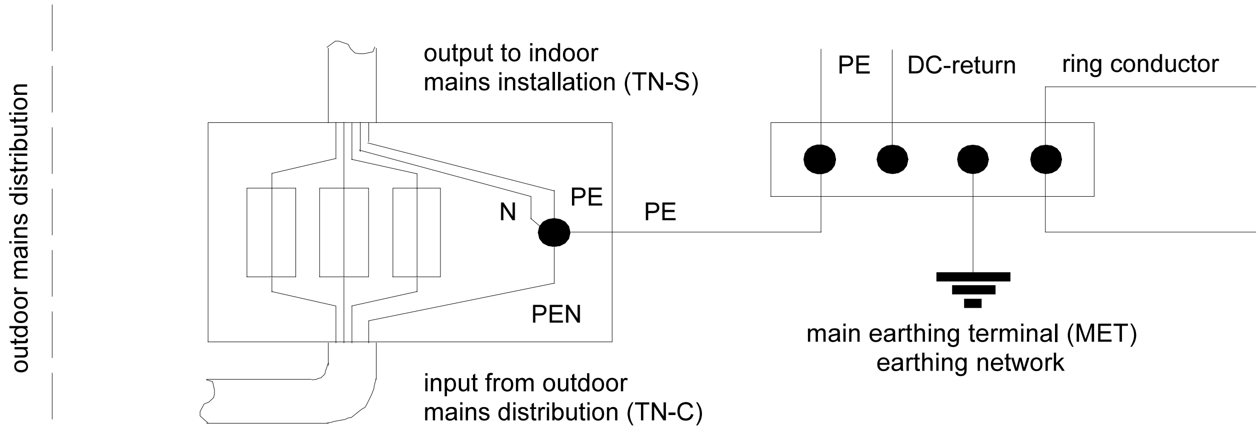


The neutral may be connected to earth through an impedance or a voltage limiter, or isolated from earth

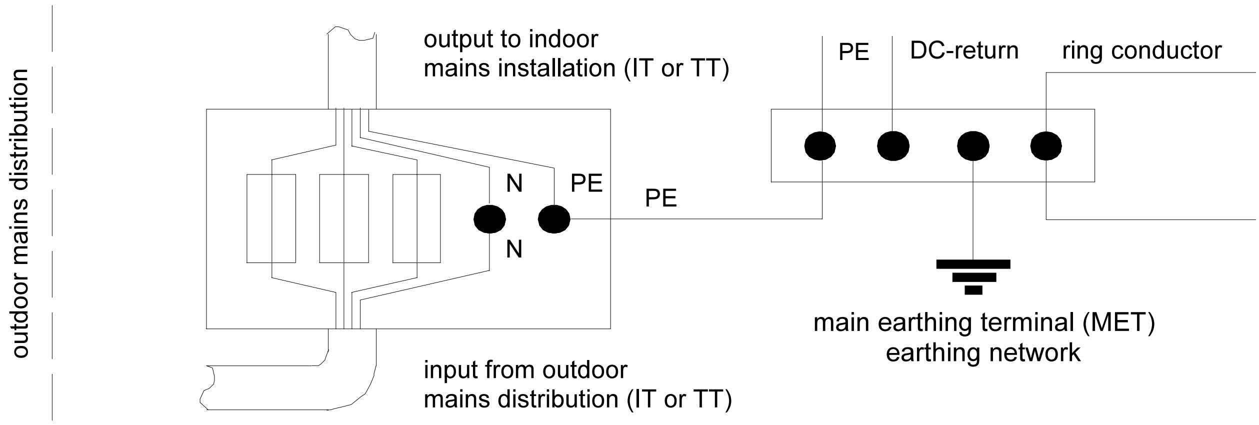
Figure 8 - IT system (according to HD 384.3 S2:1995 and EN 60990:1999)



Mode 1: TN-S/TN-S



Mode 2: TN-C/TN-S



Mode 3: IT/IT or TT/TT

Figure 9 - Arrangements for the transition from the outdoor electricity distribution system to the indoor electricity distribution system

Annex A (normative)

Special national conditions

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

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

Clause	**Special national condition**
5.5	In **Austria** the Function and Protective Earth system (FPE system, also called island system) is still used in many information technology applications. The faultless operation of this system does not permit to bond cable screens directly at each end. The FPE system is directly connected to earth only by the FPE conductor and has to be insulated from other connections to earth.

Annex B (informative)

Rationale about common bonding network (CBN) co-ordination

In order to achieve sufficient EMC performance, especially two aspects of the building construction are needing careful consideration and co-ordination:

– the complete extent of the building and all its ordinary metallic installations to be planned;

– the complete amount of information technology equipment to be installed in the building.

For new buildings, with respect to EMC, it is advantageous to provide adequate preconditions constituting a common bonding network (CBN) by:

- a reliable foundation earth electrode system, i.e. a ring conductor immediately beneath the first concrete bed (see DIN 18014 and [1]);

NOTE This electrode system qualifies prior to a ring conductor along the outer perimeter of a building.

- welded joints of building steel or concrete reinforcement rods (see DIN 4099 and ENV 61024-1) and a sufficient number of access terminals to these highly conductive elements;

- an enhanced outdoor lightning protection system (LPS) co-ordinated with the building structure (see ENV 61024-1);

- service pipes and air-conditioning ducts interconnected according to the CBN strategy, including potential equalization in excess of safety regulations;

- electricity distribution system as required for the TN-S system, i.e. without any PEN section downstream from the main earthing terminal or bar (MET) and regardless of the distribution system principle applied to the electricity distribution section upstream. The option in 546.2.1 of HD 384.5.54 S1:1988 permitting for a PEN conductor with a minimum cross sectional area shall not be used.

Information technology equipment which is designed in accordance to this standard can be installed and interconnected to the CBN outlined above. The resulting meshed bonding network (MESH-BN), e.g. see Figure 3, corresponds to EMC requirements with ease.

Some existing buildings do not provide a CBN sufficient to meet the operational requirements. When a decision is made to extend or replace existing information technology installations in such buildings, the objective should be to move towards a CBN by enhancements.

Besides the fact that such enhancements require consultation on-site, two subjects can be addressed in general:

- an outdoor lightning protection system (LPS) may be installed at first according to ENV 61024-1 including a ring conductor as an essential member of the earthing network. The LPS may be improved with conductive roof layers, closely spaced down conductors or application of metallic facades;

- unacceptable conductive interference from the outdoor electricity distribution section can be mitigated by a separation transformer dedicated to the building or by an equivalent measure. An indoor installation according to the rules of the IT system or TT system can be upgraded by additional protective conductors (PE) and dedicated equipotential bonding conductors, thereby reducing the mesh width. A residual current protection may also be adapted if necessary.

An existing CBN can be augmented by the information technology installation regarding dedicated ring conductors per room and floor, cable management systems and any other supporting metal work. In contrast to the traditional practice to indulge into a restricted number of conductors with enlarged cross sectional area, it is recommended to aim at a large conductive surface, e.g. by providing bonding at both side bars, at joints within the run of a ladder type cable rack.

Annex C (informative)

Rationale for the integration of the DC return conductor into the merging of common bonding network (CBN) and meshed bonding network (MESH-BN)

For the integration of the DC return conductor see 5.4 and 6.1. When existing equipment requires replacement, it is essential that equipment design and installation conforms to a single standard without ambiguity. Agreement to this aim is stated in the Foreword of this standard.

It is recognized that in existing installations groups of equipment may be operated with “isolated” DC return conductors, whereby “isolated” denotes the application of the DC-I principle (3-wire system) addressed in Recommendation ITU-T K.27 (see also ETS 300 253 and EG 201 147).

If the design of such equipment allows for operation with integrated DC return conductors, the existing installation should be adapted to this standard.

If the operation of such equipment requires the existing installation to be unchanged, precautions have to be taken to facilitate the desired inter system signal exchange and compliance to other EMC requirements.

Selection of such precautions shall take into account:

- inter system signal exchange by isolated and symmetrically operated circuitry;
- routing of cables with screens via a common bonding point, located as near as possible to the main earthing terminal or bar (MET), e.g. the main distribution frame, if transmission parameters allow for an additional length of the transmission path;
- appropriate conductor arrangements in parallel to the inter system cabling route with minimized length dictated by transmission requirements, i.e. provision of screening and potential equalization simultaneously;
- upgrading of the current conducting capability of the drain path for short circuit currents, i.e. provision of dedicated conductors without the steady state DC return function.

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