

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Cable networks for television signals, sound signals and interactive services –
Part 11: Safety**

**Réseaux de distribution par câbles pour signaux de télévision, signaux de
radiodiffusion sonore et services interactifs –
Partie 11: Sécurité**



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INTERNATIONAL STANDARD

NORME INTERNATIONALE



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Part 11: Safety**

**Réseaux de distribution par câbles pour signaux de télévision, signaux de
radiodiffusion sonore et services interactifs –
Partie 11: Sécurité**

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**CABLE NETWORKS FOR TELEVISION SIGNALS,
SOUND SIGNALS AND INTERACTIVE SERVICES –****Part 11: Safety****FOREWORD**

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International Standard IEC 60728-11 has been prepared by technical area 5: Cable networks for television signals, sound signals and interactive services, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This fourth edition cancels and replaces the third edition published in 2010. This edition constitutes a technical revision.

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

- Correction of minimum cross-section of bonding conductor in Figure 6, Figure 14 and Figure 17.
- Verbal modification of 11.3.1.2.

- Creation of new symbols for “overvoltage protective device – (OPD)” and for “coaxial overvoltage protective device – (COPD)”.
- Introduction of new OPD symbol to 3.2, Figure 3 and Figure 6.
- Introduction of new COPD symbol to 3.2 and Figure 19.
- In 3.1 replacement of terms CATV, MATV and SMATV by new terms and definitions due to changes in technology and use of cable networks.
- New Figures 18a to 18d.
- Deletion of Figure 19.
- Extension for remote feeding voltage on subscriber feeder.
- Adaption to Edition 2.0 of the IEC 62305 series.
- Deletion of informative Annex C and normative reference to the simplified software for the calculation of risk due to lightning (Annex J of IEC 62305-2:2006¹).
- New subclause 10.2.6 Fully-isolated system outlet provided by means of a FTTH system.

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

FDIS	Report on voting
100/2592/FDIS	100/2636/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.

The list of all the parts of the IEC 60728 series, under the general title *Cable networks for television signals, sound signals and interactive services*, can be found on the IEC website.

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

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

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The contents of the corrigendum of July 2016 have been included in this copy.

¹ IEC 62305-2:2006, *Protection against lightning – Part 2: Risk management*

INTRODUCTION

Standards and other deliverables of the IEC 60728 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques.

This includes for instance

- regional and local broadband cable networks,
- extended satellite and terrestrial television distribution networks and systems
- individual satellite and terrestrial television receiving systems,

and all kinds of equipment, systems and installations used in such cable networks, distribution and receiving systems.

The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input of the customer premises equipment.

The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals, etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

CABLE NETWORKS FOR TELEVISION SIGNALS, SOUND SIGNALS AND INTERACTIVE SERVICES –

Part 11: Safety

1 Scope

This part of IEC 60728 deals with the safety requirements applicable to fixed sited systems and equipment. As far as applicable, it is also valid for mobile and temporarily installed systems, for example, caravans.

Additional requirements may be applied, for example, referring to

- electrical installations of buildings and overhead lines,
- other telecommunication services distribution systems,
- water distribution systems,
- gas distribution systems,
- lightning systems.

This standard is intended to provide specifically for the safety of the system, personnel working on it, subscribers and subscriber equipment. It deals only with safety aspects and is not intended to define a standard for the protection of the equipment used in the system.

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 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-4-44, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

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

IEC 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60728-2, *Cable networks for television signals, sound signals and interactive services – Part 2: Electromagnetic compatibility for equipment*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

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

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

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*
IEC 61140:2001/AMD1:2004

IEC 62305 (all parts), *Protection against lightning*

IEC 62305-2:2010, *Protection against lightning – Part 2: Risk management*

IEC 62305-3:2010, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62305-4:2010, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

ISO 3864-1:2011, *Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas*

EN 50117 (all parts), *Coaxial cables*

EN 50164-1, *Lightning Protection Components (LPC) – Part 1: Requirements for connection components*

EN 50164-2, *Lightning Protection Components (LPC) – Part 2: Requirements for conductors and earth electrodes*

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

EN 50310, *Application of equipotential bonding and earthing in buildings with information technology equipment*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Some terms have been taken from IEC 60050-195, IEC 60050-826 and IEC 60050-851, with the reference number in square brackets, and from other IEC standards, also referenced to in square brackets.

3.1.1

air-termination system

part of an external LPS using metallic elements such as rods, mesh conductors or catenary wires intended to intercept lightning flashes

[SOURCE: IEC 62305-3:2010, 3.6]

3.1.2**amplifier**

device to compensate for attenuation

3.1.3**attenuation**

ratio of the input power to the output power

Note 1 to entry: The ratio is expressed in decibel.

3.1.4**cable networks**

<television signals, sound signals and interactive services> regional and local broadband cable networks, extended satellite and terrestrial television distribution networks or systems and individual satellite and terrestrial television receiving systems

Note 1 to entry: These networks and systems can be used in downstream and upstream directions.

3.1.5**CATV network**

regional and local broadband cable networks designed to provide sound and television signals as well as signals for interactive services to a regional or local area

Note 1 to entry: Originally defined as Community Antenna Television network.

3.1.6**class I equipment**

equipment with basic insulation as provision for basic protection and protective bonding as provision for fault protection, in accordance with IEC 61140:2001, 7.1

[SOURCE: IEC 60050-851:2008, 851-15-10]

3.1.7**class II equipment**

equipment with basic insulation as provision for basic protection, and supplementary insulation as provision for fault protection, or in which basic and fault protection are provided by reinforced insulation, in accordance with IEC 61140:2001, 7.3

[SOURCE: IEC 60050-851:2008, 851-15-11]

3.1.8**earthing arrangement**

all the electric connections and devices involved in the earthing of a system, an installation and equipment

[SOURCE: IEC 60050-195:1998, 195-02-20, modified – The preferred term "grounding arrangement (US)", and the deprecated term "earthing system" have been deleted.]

3.1.9**earthing conductor**

conductor which provides a conductive path, or part of the conductive path, between a given point in a system or in an installation or in equipment and an earth electrode or an earth-electrode network

Note 1 to entry: In the electrical installation of a building, the given point is usually the main earthing terminal, and the earthing conductor connects this point to the earth electrode or the earth-electrode network.

[SOURCE: IEC 60050-826:2004, 826-13-12, modified – The preferred term "grounding conductor (US)", and the deprecated term "earth conductor" have been deleted.]

3.1.10

earth electrode

conductive part, which may be embedded in the soil or in a specific conductive medium, e.g. concrete or coke, in electric contact with the Earth

[SOURCE: IEC 60050-826:2004, 826-13-05, modified – The preferred term "ground electrode (US)" has been deleted.]

3.1.11

earthing terminal

terminal provided on equipment or on a device and intended for the electric connection with the earthing arrangement

[SOURCE: IEC 60050-195:1998, 195-02-31, modified – The preferred term "grounding terminal (US), and the deprecated term "earth terminal" have been deleted.]

3.1.12

electric shock

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

[SOURCE: IEC 60050-826:2004, 826-12-01]

3.1.13

equipotential bonding

provision of electric connections between conductive parts, intended to achieve equipotentiality

[SOURCE: IEC 60050-826:2004, 826-13-19]

3.1.14

equipotential bonding bar

bar which is part of an equipotential bonding system and enables the electric connection of a number of conductors for equipotential bonding purposes

[SOURCE: IEC 60050-826:2004, 826-13-35]

3.1.15

protective bonding conductor

protective conductor provided for protective-equipotential-bonding

[SOURCE: IEC 60050-826:2004, 826-13-24, modified – The deprecated term "equipotential bonding conductor" has been deleted.]

3.1.16

exposed conductive part

conductive part of equipment which can be touched and which is not normally live, but which can become live when basic insulation fails

[SOURCE: IEC 60050-195:1998, 195-06-10]

3.1.17

extended satellite television distribution network or system

distribution network or system designed to provide sound and television signals received by satellite receiving antenna to households in one or more buildings

Note 1 to entry: This kind of network or system can be combined with terrestrial antennas for the additional reception of TV and/or radio signals via terrestrial networks.

Note 2 to entry: This kind of network or system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.18

extended terrestrial television distribution network or system

distribution network or system designed to provide sound and television signals received by terrestrial receiving antenna to households in one or more buildings

Note 1 to entry: This kind of network or system can possibly be combined with a satellite antenna for the additional reception of TV and/or radio signals via satellite networks.

Note 2 to entry: This kind of network or system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.19

extraneous conductive part

conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the electric potential of a local earth

[SOURCE: IEC 60050-195:1998, 195-06-11]

3.1.20

feeder

transmission path forming part of a cable network

Note 1 to entry: Such a path may consist of a metallic cable, optical fibre, waveguide or any combination of them.

Note 2 to entry: By extension, the term is also applied to paths containing one or more radio links.

3.1.21

galvanic isolator

device providing electrical isolation below a certain frequency range

3.1.22

hazardous voltage

electrical condition of an object from which a hazardous touch current (electric shock) could be drawn

[SOURCE: IEC 60065:2014, 2.6.10, modified – The term "hazardous live" has been replaced by "hazardous voltage".]

3.1.23

headend

equipment connected between receiving antennas or other signal sources and the remainder of the cable network, to process the signals to be distributed

3.1.24

home distributor

HD

physical distribution point within a home where cables terminate

Note 1 to entry: This note applies to the French language only.

3.1.25

individual satellite television receiving system

system designed to provide sound and television signals received from satellite(s) to an individual household

Note 1 to entry: This kind of system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.26

individual terrestrial television receiving system

system designed to provide sound and television signals received via terrestrial broadcast networks to an individual household

Note 1 to entry: This kind of system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.27

let-go threshold current

maximum value of electric current through the body of a person at which that person can release himself or herself

[SOURCE: IEC 60050-195:1998, 195-03-09, modified – Current has been included in the preferred term and the deprecated terms "releasing current" and "let-go current (US)" have been deleted.]

3.1.28

lightning protection system

LPS

complete system used to protect a space against the effects of lightning consisting of both external and internal lightning protection systems

Note 1 to entry: In particular cases, an LPS may consist of an external LPS or an internal LPS only.

3.1.29

local broadband cable network

network designed to provide sound and television signals as well as signals for interactive services to a local area (e.g. one town or one village)

3.1.30

main earthing terminal

main earthing bar

terminal or bar which is part of the earthing arrangement of an installation and enabling the electric connection of a number of conductors for earthing purposes

[SOURCE: IEC 60050-826:2004, 826-13-15, modified – The preferred terms "main grounding terminal (US)" and "main grounding busbar (US)" have been deleted and in the definition the term busbar has been abbreviated to "bar".]

3.1.31

MATV network

extended terrestrial television distribution networks or systems designed to provide sound and television signals received by terrestrial receiving antenna to households in one or more buildings

Note 1 to entry: Originally defined as master antenna television network.

Note 2 to entry: This kind of network or system can possibly be combined with a satellite antenna for the additional reception of TV and/or radio signals via satellite networks.

Note 3 to entry: This kind of network or system can also carry other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.32

metal installation

extended metal items in the structure to be protected which may form a path for lightning current, such as pipework, staircases, elevator guide rails, ventilation, heating and air conditioning ducts, and interconnected reinforcing steel

[SOURCE: IEC 62305-3:2010, 3.18]

3.1.33**natural component of LPS**

conductive component installed not specifically for lightning protection which can be used in addition to the LPS or in some cases could provide the function of one or more parts of the LPS

Note 1 to entry: Examples of the use of this term include:

- natural air-termination;
- natural down-conductor;
- natural earthing electrode.

[SOURCE: IEC 62305-3:2010, 3.15]

3.1.34**network interface unit****NIU**

interface between the cable network and the network inside an apartment

Note 1 to entry: The network interface unit can contain an overvoltage protective element and/or a galvanic isolation.

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

3.1.35**neutral conductor****N conductor**

conductor electrically connected to the neutral point and capable of contributing to the distribution of electric energy

[SOURCE: IEC 60050-826:2004, 826-14-07, modified – An identification symbol has been added.]

3.1.36**PEN conductor**

conductor combining the functions of both a protective earthing conductor and a neutral conductor

Note 1 to entry: The acronym PEN results from the combination of both symbols PE for the protective conductor and N for neutral conductor.

[SOURCE: IEC 60050-826:2004, 826-13-25, modified – An note to entry has been added.]

3.1.37**protective conductor****PE conductor**

conductor provided for purposes of safety, for example protection against electric shock

Note 1 to entry: In an electrical installation, the conductor identified PE is normally also considered as protective earthing conductor.

[SOURCE: IEC 60050-826:2004, 826-13-22, modified – An identification symbol has been added.]

3.1.38**receiver lead**

lead, which connects the system outlet to the subscriber equipment

3.1.39

receiving antenna

device with proper electrical characteristics that intercepts desired signals in the atmosphere and transfers these to the remainder of the cable network

3.1.40

regional broadband cable network

network designed to provide sound and television signals as well as signals for interactive services to a regional area covering several towns and/or villages

3.1.41

remote power feeding voltage

voltage for supplying power to network equipment via the cable network or a separate line

3.1.42

safety distance

minimum distance between two conductive parts within the space to be protected between which no dangerous sparking can occur

3.1.43

service person

person having appropriate technical training and experience necessary to be aware of hazards to which that person may be exposed in performing a task and of measures to minimize the risks to that person or other persons

[SOURCE: IEC 60950-1:2005, 1.2.13.5]

3.1.44

SMATV network

extended distribution networks or systems designed to provide sound and television signals received by satellite receiving antenna to households in one or more buildings

Note 1 to entry: Originally defined as satellite master antenna television network

Note 2 to entry: This kind of network or system can possibly be combined with terrestrial antennas for the additional reception of TV and/or radio signals via terrestrial networks.

Note 3 to entry: This kind of network or system can also carry control signals for satellite switched systems or other signals for special transmission systems (e.g. MoCA or WiFi) in the return path direction.

3.1.45

splitter

spur unit

device in which the signal power at the (input) port is divided equally or unequally between two or more (output) ports

Note 1 to entry: Some forms of this device may be used in the reverse direction for combining signal energy.

3.1.46

spur feeder

feeder to which splitters, subscriber taps or looped system outlets are connected

3.1.47

subscriber equipment

equipment at the subscriber premises such as receivers, tuners, decoders, video recorders, multimedia terminals

3.1.48

subscriber feeder

feeder connecting a subscriber tap to a system outlet or, where the latter is not used, direct to the subscriber equipment

3.1.49**subscriber tap**

device for connecting a subscriber feeder to a spur feeder

3.1.50**surge protective device**

device that is intended to limit transient overvoltages and divert surge currents

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

3.1.51**surge suppressor**

device designed to limit the surge voltage between two parts within the space to be protected, such as spark gap, surge diverter or semiconductor device

3.1.52**system outlet**

device for interconnecting a subscriber feeder and a receiver lead

3.1.53**(effective) touch voltage**

voltage between conductive parts when touched simultaneously by a person or an animal

Note 1 to entry: The value of the effective touch voltage may be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts.

[SOURCE: IEC 60050-826:2004, 826-11-05]

3.1.54**transfer point**

interface between the cable network and the building's internal network, each of which may be separately owned and which may contain a voltage-dependent device and/or galvanic isolator

3.2 Symbols

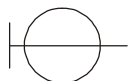
The following graphical symbols are used in the figures of this standard. These symbols are either listed in IEC 60617 or based on symbols defined in IEC 60617.



Coaxial conductor
[IEC 60617-S00011:
2001-07-01]



Amplifier
[IEC 60617-S01240:
2001-07-01]



System outlet



Galvanic isolator



Overvoltage protective device



Coaxial overvoltage protective
device

3.3 Abbreviations

AC	alternating current
AM	amplitude modulation
ATS	air termination system
CATV	community antenna television (network)
COPD	Coaxial overvoltage protective device

DC	direct current
DTH	direct to home
HD	home distributor
FTTH	fiber to the home
IP	international protection (class)
IT	isolated earth
LNB	low noise block converter
LPS	lightning protection system
LSR	lightning stroke risk
MATV	master antenna television (network)
MDU	multi dwelling unit
N	neutral (conductor)
NIU	network interface unit
NTP	network termination point
OPD	overvoltage protective device
OTP	optical transfer point
PE	protective conductor
PEN	PEN conductor
RCD	residual current device
RF	radio frequency
RMS	root mean square
SMATV	satellite master antenna television (network)
SPD	surge protective device
STB	set top box
TV	television

4 Fundamental requirements

4.1 General

The cable network shall be so designed, constructed and installed as to present no danger, either under normal condition or abnormal (any single fault) condition, to subscribers, personnel working on, or externally inspecting, the system, or to any other person, providing particularly

- personal protection against electric shock,
- personal protection against physical injury,
- protection against fire.

For further details, see the IEC 60364 series.

The above does not apply to service persons (according to 3.1.43) working on the equipment, who may be exposed to live parts of the equipment by the removal of protective covers.

4.2 Mechanical requirements

All parts of the system shall be so constructed that there is no danger of physical injury from contact with sharp edges or corners or from rotating or moving parts.

4.3 Accessible parts

Access to parts presenting hazardous voltages shall not be possible to the general public without first removing a protective cover by use of a tool or a key. IEC 60065 defines accessible parts and test procedures.

4.4 Laser radiation

If equipment embodying laser products is used, special attention shall be paid to radiation safety. Safety information in the product documentation shall be noted. Refer to IEC 60825-1 and IEC 60825-2 for requirements and recommendations.

5 Protection against environmental influences

All system parts, taking into account external influences to which they might be exposed, have to be selected and set up in such a way that, when used properly, the effectiveness of the required protective measures is ensured.

NOTE Special measures are required, for example, for protection against corrosive atmosphere, temperature and humidity.

6 Equipotential bonding and earthing

6.1 General requirements

The cable network shall be designed and constructed in accordance with the requirements of the IEC 60364 series, as appropriate, so that no hazardous voltages can be present on the outer conductors of any cable or accessible metalwork of any equipment, including passive items. The requirements for the system outlet are specified in Clause 10, the requirements for equipotential bonding and lightning protection of antenna systems are given in Clause 11.

These bonding requirements are intended to protect only the cable network and shall not be considered to provide protection against electric shock currents from electrical installations.

Earthing arrangements and protective conductors shall be designed and constructed in accordance with the requirements of IEC 60364-5-54.

Where cable networks are installed outdoors on the same poles as those of the electric supply, a common earthing may be used.

NOTE 1 For requirements in France, see C.1.1

NOTE 2 For requirements in Japan, see C.1.2

6.2 Equipotential bonding mechanisms

All parts belonging to the equipotential bonding mechanisms shall fulfil the following requirements.

- a) In order to prevent potential differences between a cable network and other extraneous conductive parts, which might do harm to persons or cause damage (e.g. ignition or failure of equipment by arcing), the cable network shall be included in the equipotential bonding system of the building.

NOTE 1 Equipotential bonding between metal installations and electrical systems in and on the building is generally carried out at the main earthing bar of the building. Multiple, meshed equipotential bonding increases its effectiveness.

- b) Equipotential bonding can be achieved by means of protective bonding conductors, cable shielding or conductive housings or system parts. Heating pipes, water pipes, gas pipes shall not be used because they do not guarantee permanent equipotential bonding efficiency.
- c) The protective bonding conductors connected to earthing terminals shall be mechanically stable and shall have a minimum cross-sectional area of 2,5 mm² Cu (protected) or 4 mm² (not protected). They shall comply with IEC 60364-5-54.
- d) Metallic enclosures containing mains supplied equipment shall be connected to the main earthing bar regardless if they are located outside or inside of buildings. See examples in Figure 1, in Figure 2 and in Figure 14.
- e) Where direct connection to an earthing system is not suitable because high balancing currents are expected to flow in the outer conductor, for example, in extensive cable networks, special protection shall be provided.

This protection can be achieved by

- mounting the equipment within a non-metallic enclosure, or
- isolating the equipment from a metallic enclosure.

In both cases an overvoltage protective device (OPD) shall be connected between the equipment and the main earthing bar as shown in Figure 3.

The impedance of the coaxial cable should be maintained when installing such an OPD.

The safety sign “Warning about hazardous electrical voltage”  according to sign 6.4 of ISO 3864-1:2011 shall be attached to the enclosure.

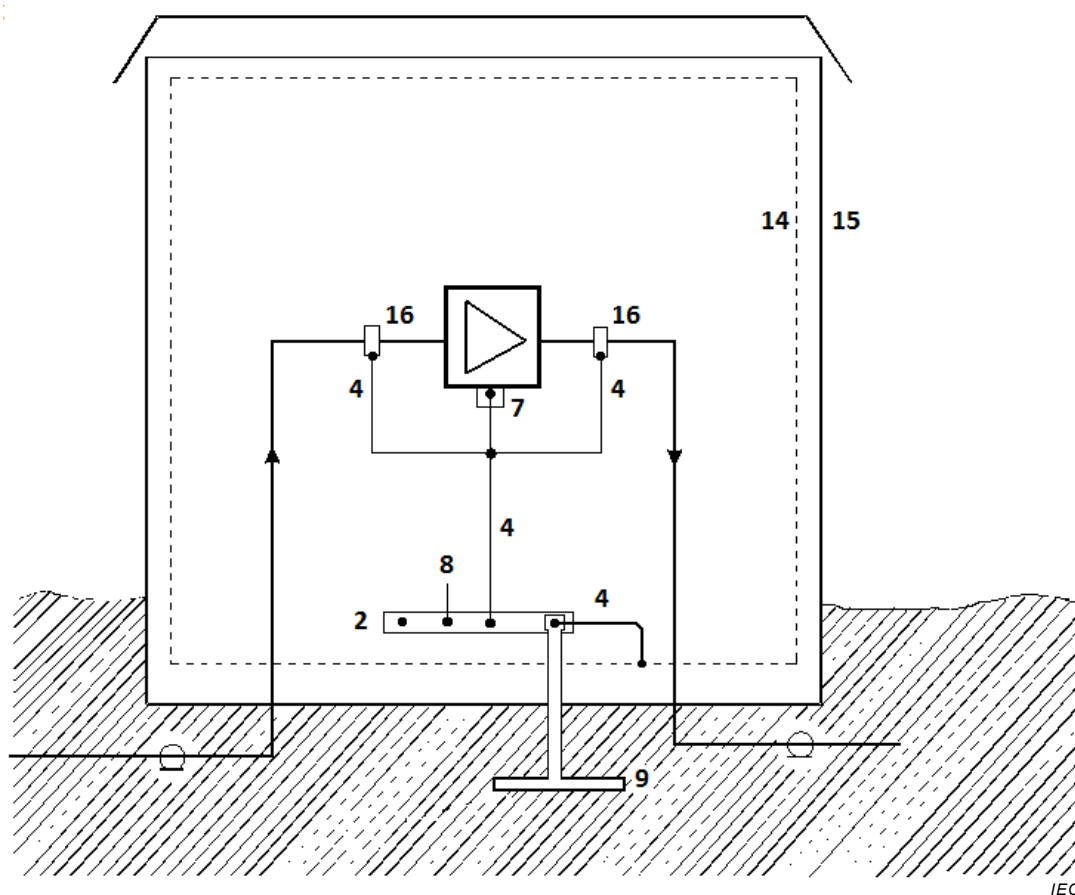
The maximum balancing current allowed by the manufacturer shall be taken into account for different types of cables.

If balancing currents are expected to exceed the maximum current allowed by the manufacturer of the cable and/or of the cable connectors, a galvanic isolation may be used as described hereafter. When installed, it shall not be possible to touch simultaneously both input and output terminals of the isolator.

Figures 1 to 7 show various examples of bonding mechanisms.

NOTE 2 The numbering of equivalent parts in Figure 1 to Figure 19 is unified, where applicable. Therefore the numbering in an individual figure may not be in consecutive order.

Figure 1 shows an example of equipotential bonding and earthing of a metal enclosure inside a non-conductive cabinet for outdoor-use.

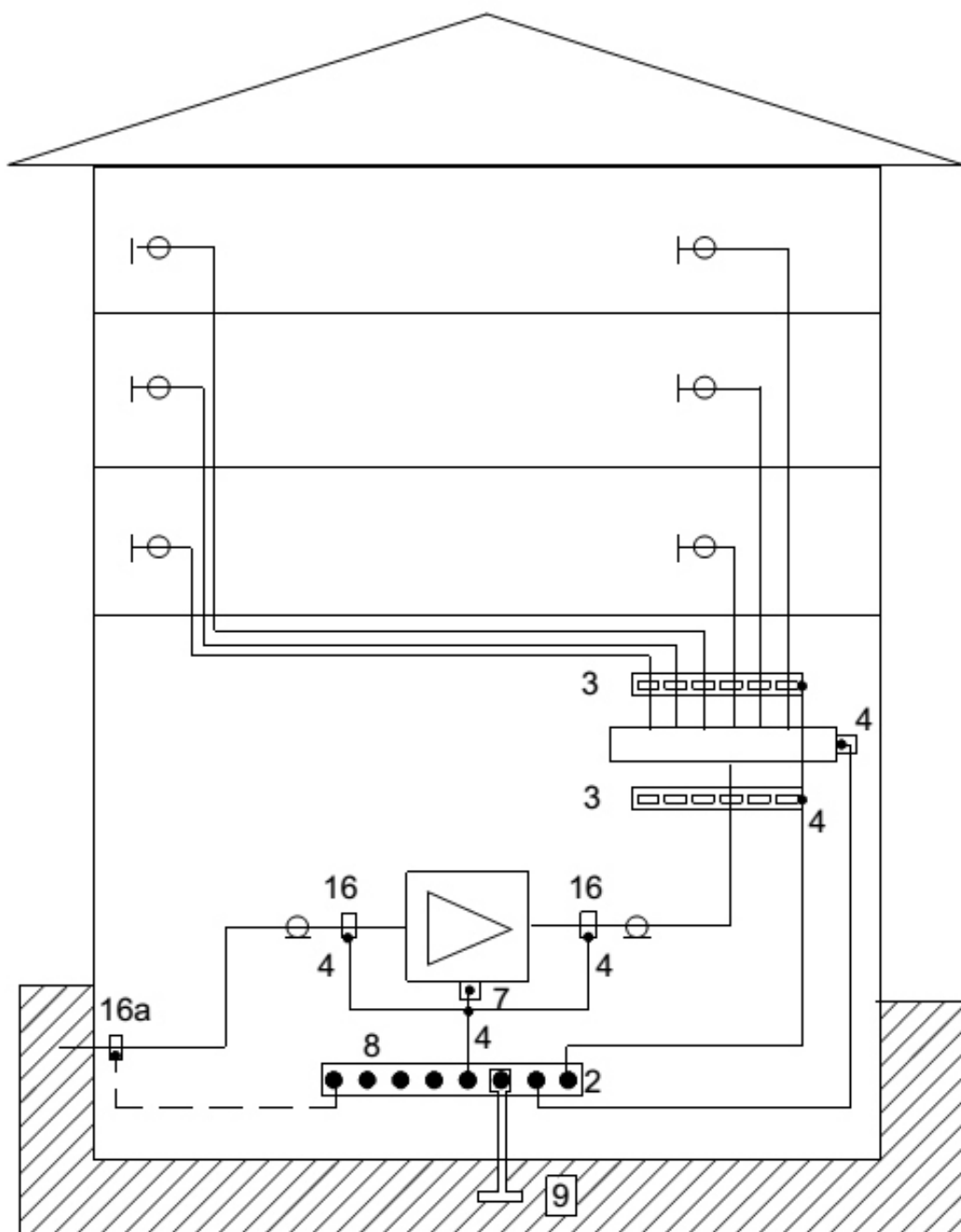


Key

2 Main earthing bar	4 Protective bonding conductor (minimum cross-section according to 6.2 c)
7 Earthing terminal (see 6.2 j and 6.2 k)	8 Protective conductor (PE)
9 Earth electrode	14 Metallic enclosure (dashed line)
15 Non-metallic enclosure	16 Equipotential bonding clamp ^a
^a The equipotential bonding bars 3 connecting the outer conductors of the input and output cables of the amplifier with the protective bonding conductors 4 are to ensure safety during equipment replacement. They could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors and may be a temporary installation (see 6.2 i).	

Figure 1 – Example of equipotential bonding and earthing of a metal enclosure inside a non-conductive cabinet for outdoor-use

Figure 2 shows an example of equipotential bonding of an installation in a building.



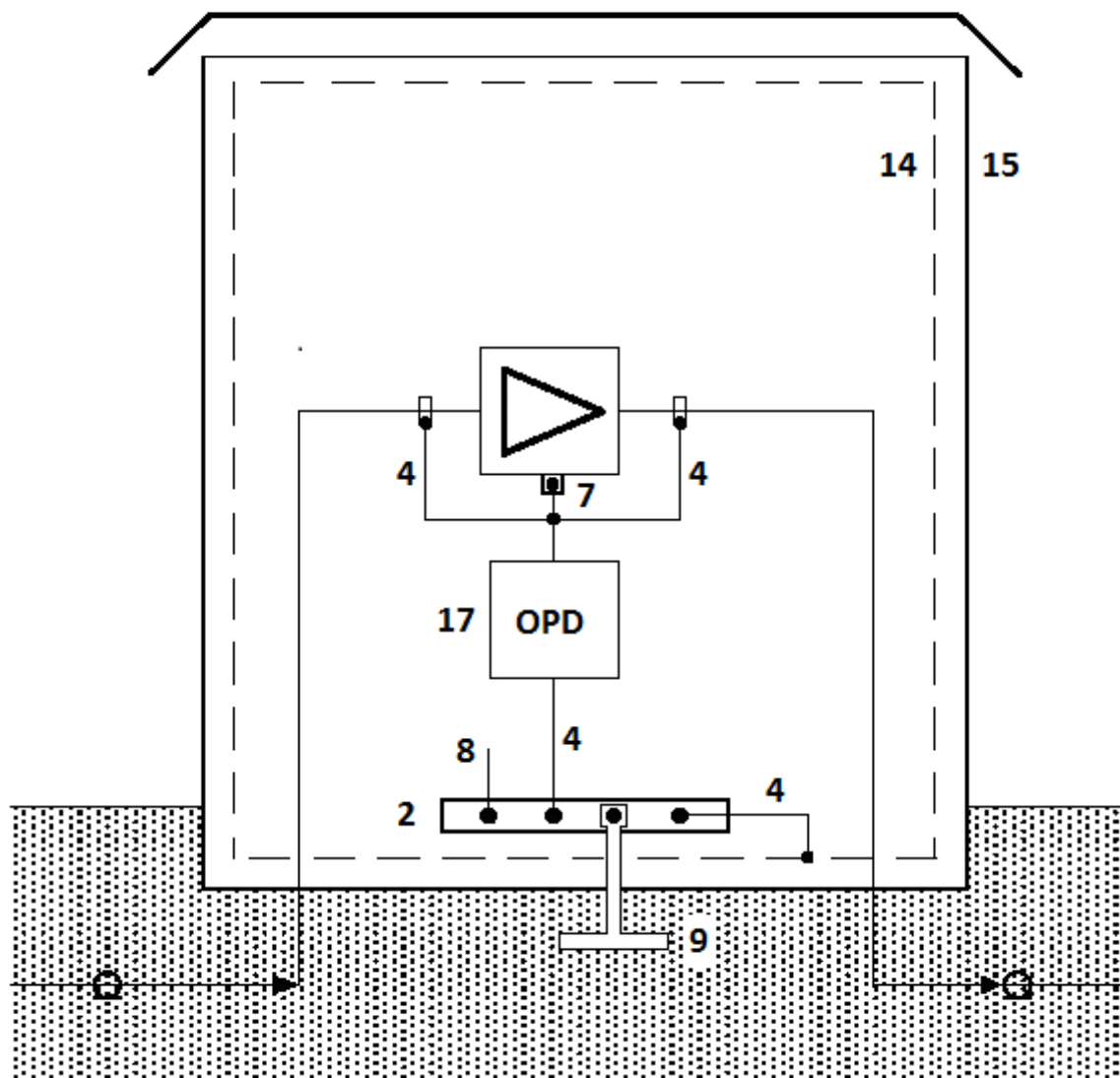
IEC

Key

2 Main earthing bar	3 Equipotential bonding bar ^a
4 Protective bonding conductor (minimum cross-section according to 6.2 c)	7 Earthing terminal (see 6.2 j and 6.2 k)
8 Protective conductor (PE)	9 Earth electrode
16 Equipotential bonding clamp ^a	16a Equipotential bonding clamp (optional bonding, alternative bonding point for the entering coaxial cable)
^a The equipotential bonding bars 3 or bonding clamp 16 connecting the outer conductors of the input and output cables of the amplifier with the protective bonding conductors 4 are to ensure safety during equipment replacement. They could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors and may be a temporary installation (see 6.2 i).	

Figure 2 – Example of equipotential bonding of a building installation

Figure 3 shows an example of equipotential bonding and indirect earthing of a metal enclosure inside a non-conductive cabinet for outdoor-use.



IEC

Key

2	Main earthing bar	4	Protective bonding conductor (minimum cross-section according to 6.2 c)
7	Earthing terminal (see 6.2 j and 6.2 k)	8	Protective conductor (PE)
9	Earth electrode	14	Metallic enclosure (dashed line)
15	Non-metallic enclosure	17	Overvoltage protective device

NOTE For details concerning the case of balancing currents, see 6.2 e.

Figure 3 – Example of equipotential bonding and indirect earthing of a metal enclosure inside a non-conductive cabinet for outdoor-use

- f) Where galvanic isolation is provided between sections of the network, to eliminate balancing currents due to local potential differences, the outer conductors of each isolated section shall be connected directly to earth or to earth via an equipotential bonding system.

Galvanic isolators, in case of improper design, can radiate or pick up inadmissible high-frequency energy. Therefore, compliance with the requirements of IEC 60728-2 should be checked carefully.

NOTE 3 Galvanic isolators can be damaged by overvoltages.

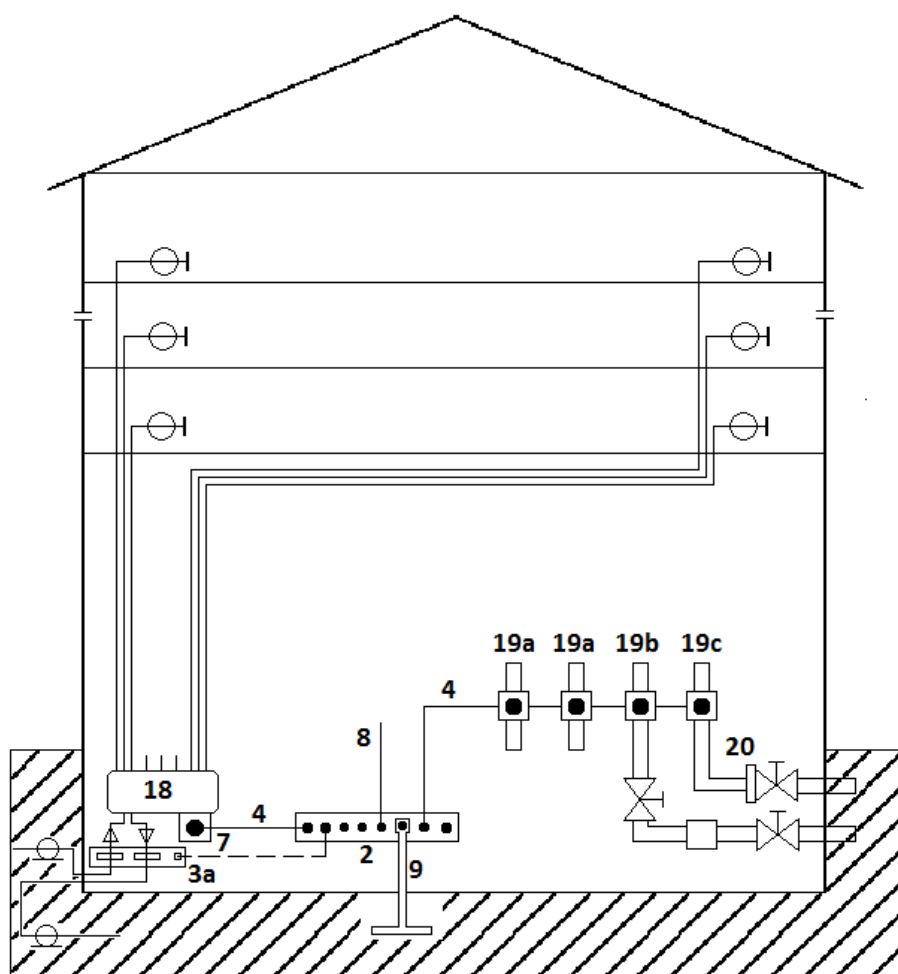
NOTE 4 For requirements in France, see C.2.1.

- g) The outer conductors of coaxial cables entering or leaving a building shall be included in the equipotential bonding system of the building, either at the equipment or separately. Examples are shown in Figure 4, in Figure 5 and in Figure 6. The subscriber feeder cables need not be bonded if a galvanic isolator or fully isolated outlets (see Clause 10) or transfer points each with a galvanic isolation for the inner and the outer conductor are used.

NOTE 5 For requirements in Norway, see C.2.2.

NOTE 6 For requirements in Japan and Poland, see C.2.3.

Figure 4 shows an example of equipotential bonding and earthing of an installation in a building with underground connection.



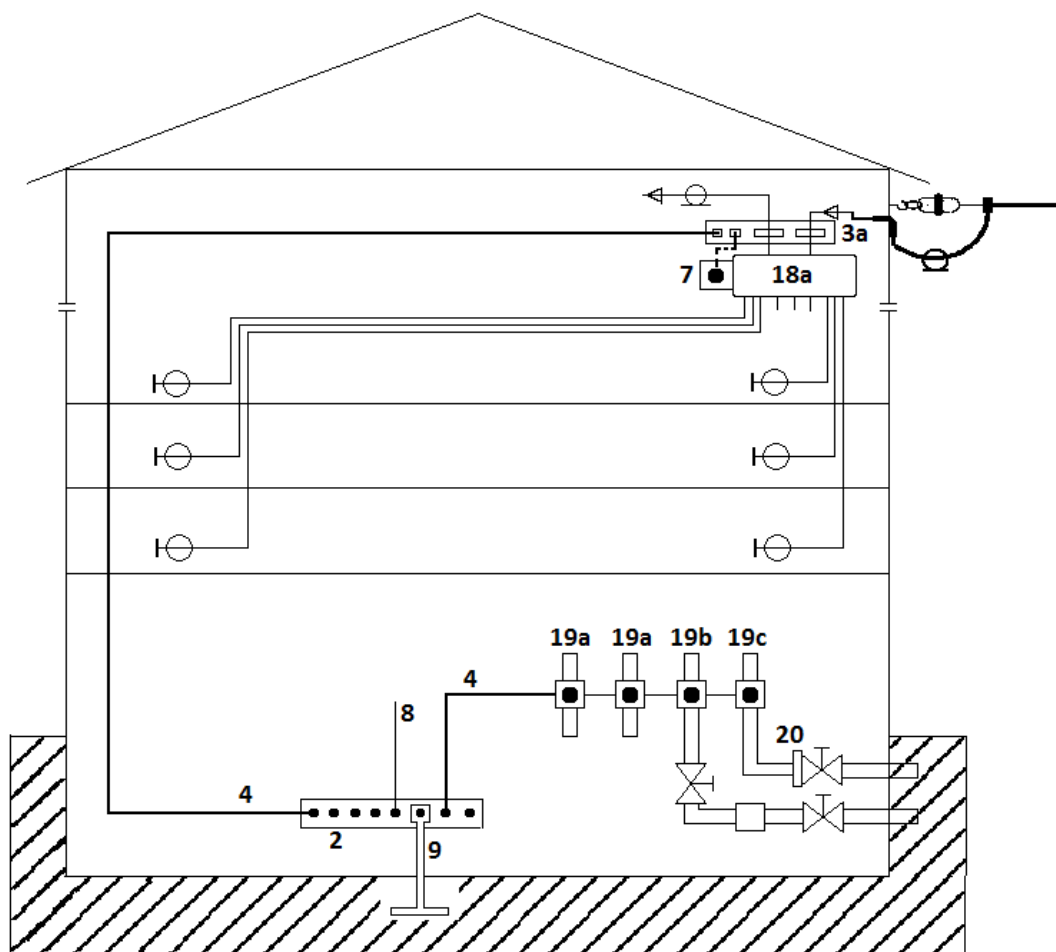
IEC

Key

2	Main earthing bar	3a	Equipotential bonding bar (optional bonding if the entering and leaving coaxial cables are not included in the equipotential bonding system via the equipment 1)
4	Protective bonding conductor (minimum cross-section according to 6.2 c)	7	Earthing terminal (see 6.2 j and 6.2 k)
8	Protective conductor (PE)	9	Earth electrode
18	Subscriber tap	19a	Heating pipes
19b	Water pipe	19c	Gas pipe
20	Galvanic isolation		

Figure 4 – Example of equipotential bonding and earthing of a building installation (underground connection)

Figure 5 shows an example of equipotential bonding and earthing of an installation in a building through above ground connection.



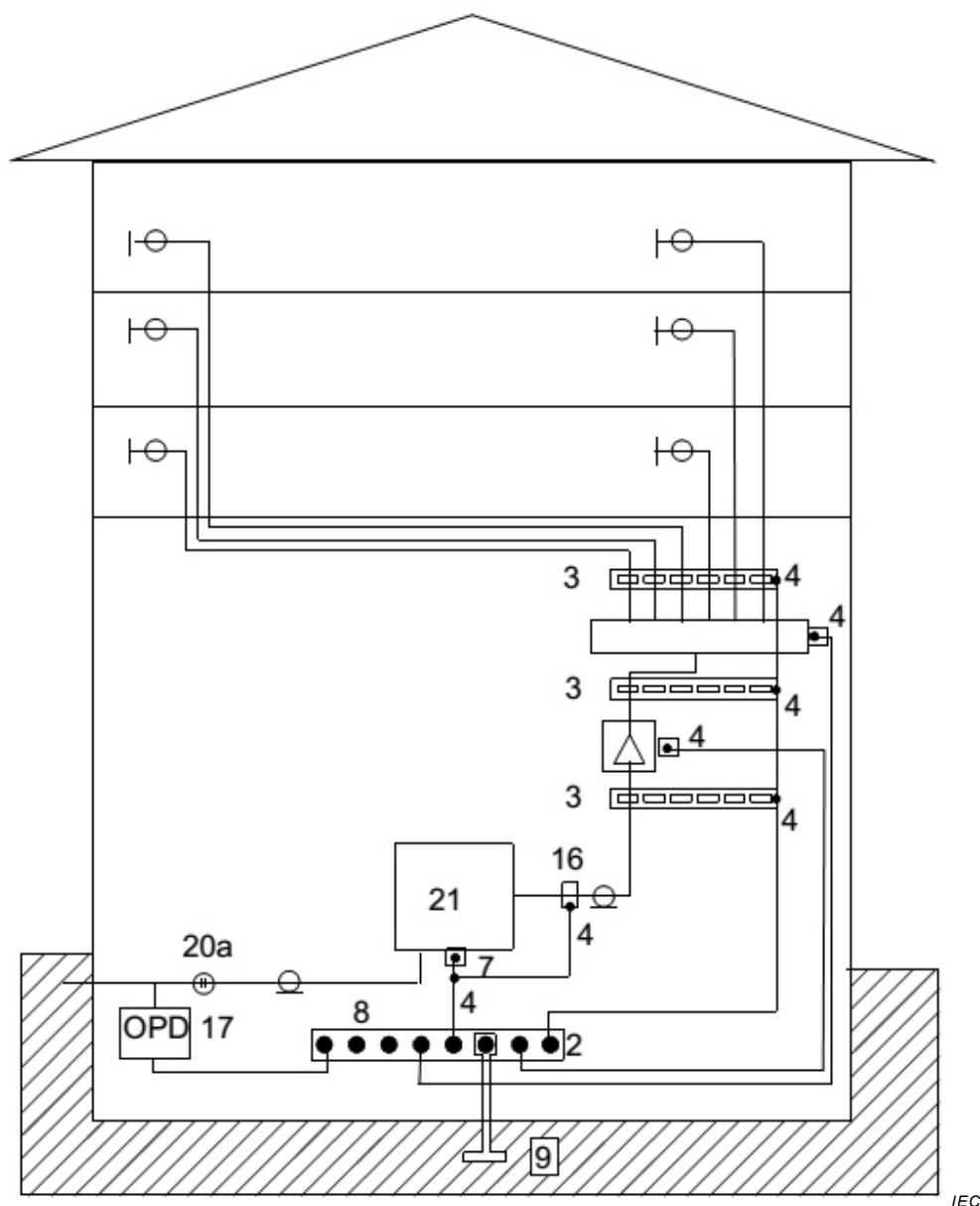
IEC

Key

2	Main earthing bar	3a	Equipotential bonding bar (optional bonding if the entering coaxial cable is not included in the equipotential bonding system via the equipment 1)
4	Protective bonding conductor (minimum cross-section according to 6.2 c)	7	Earthing terminal (see 6.2 j and 6.2 k)
8	Protective conductor (PE)	9	Earth electrode
18a	Wall-mounted subscriber tap	19a	Heating pipes
19b	Water pipe	19c	Gas pipe
20	Galvanic isolation		

Figure 5 – Example of equipotential bonding and earthing of a building installation (above ground connection)

Figure 6 shows an example of equipotential bonding and earthing of a galvanic isolated cable entering a building via an underground connection.



Key

2	Main earthing bar	3	Equipotential bonding bar ^a
4	Protective bonding conductor (minimum cross-section according to 6.2 c)	7	Earthing terminal (see 6.2 j and 6.2 k)
8	Protective conductor (PE)	9	Earth electrode
16	Equipotential bonding clamp ^a	17	Overvoltage protective device (minimum cross-section according to 6.2 c)
20a	Galvanic isolator	21	Transfer point

^a The equipotential bonding bars 3 or bonding clamp 16 connecting the outer conductors of the input and output cables of the amplifier with the protective bonding conductors 4 are to ensure safety during equipment replacement. They could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors and may be a temporary installation (see 6.2 i).

The impedance of the coaxial cable should be maintained when installing such an OPD.

Figure 6 – Example of equipotential bonding with a galvanic isolated cable entering a building (underground connection)

- h) Where equipotential bonding is not possible and to avoid balancing currents between the cable network and the building installation, a galvanic isolator shall be used. An example is shown in Figure 6.

Note that galvanic isolators, in case of improper design, can radiate or pick up inadmissible high-frequency energy. Therefore, compliance with the requirements of IEC 60728-2 should be checked carefully.

NOTE 7 Galvanic isolators can be damaged by overvoltages.

- i) When changing or removing active or passive pieces of equipment (e.g. amplifiers, taps, etc.) or coaxial cable, care shall be taken to avoid hazardous voltages between the interrupted parts (inner and/or outer conductors) by opening the loop caused by leakage currents from subscriber equipment. Provision shall be made to maintain continuity of the outer conductor system while units are changed or removed to avoid electric shock (shock currents). Examples are shown in Figure 6 and Figure 7. In addition, the inner conductors shall be safeguarded against contact.

Note that before applying a temporary solution for equipotential bonding the parts to be disconnected (e.g. the F connector of a disconnected cable) should maintain continuity to the temporary equipotential bonding link during the complete de-installation/installation process.

NOTE 8 For requirements in Norway, see C.2.2.

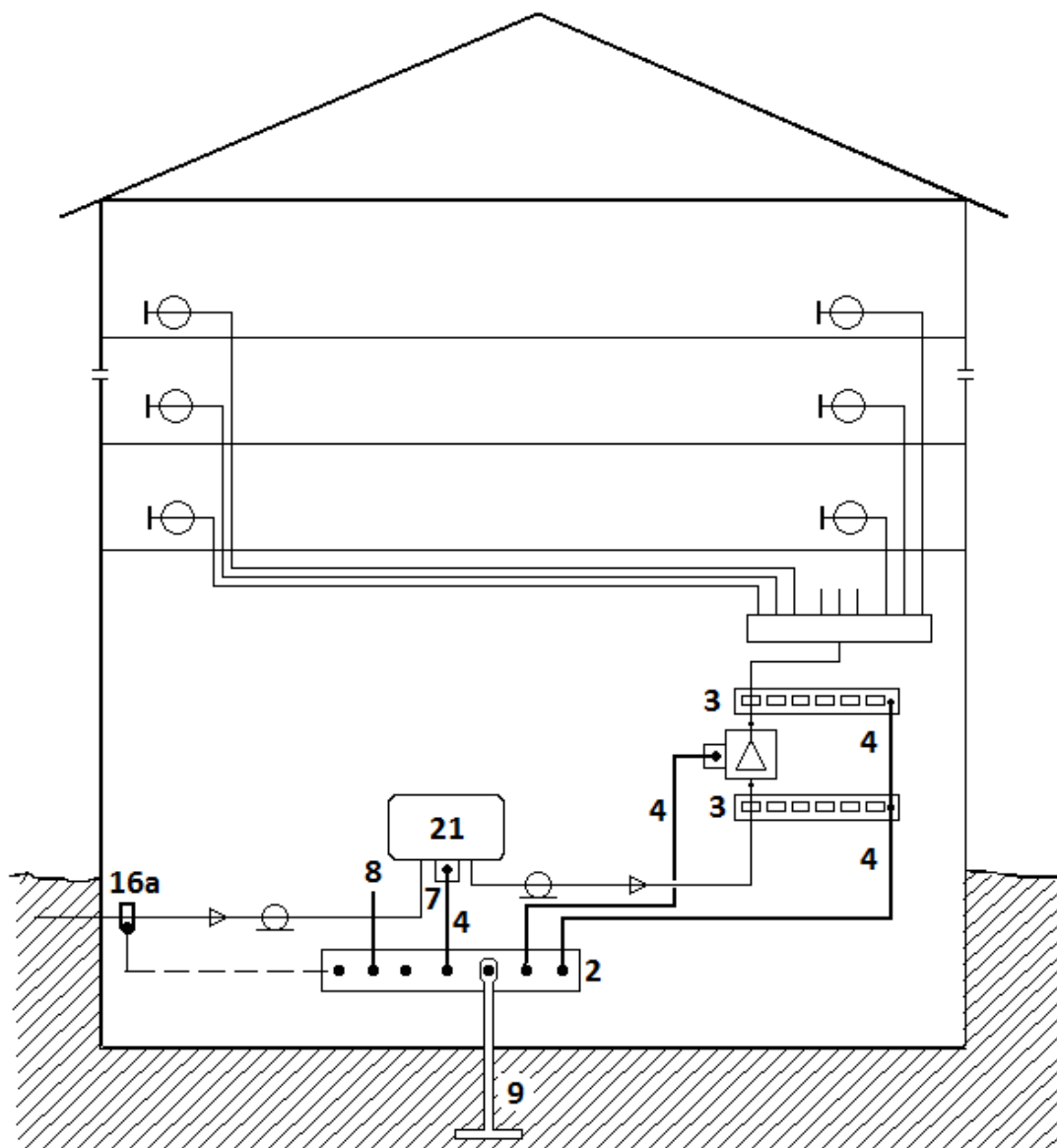
- j) Every connection of an protective bonding conductor or an earthing conductor to an earthing terminal shall be readily accessible and soundly made by the use of crimps, clamps, welded or hard-soldered joints.
- k) All metallic enclosures, housings, mounting bays, racks and mains-supplied equipment, shall be provided with an external earthing terminal complying with IEC 60065 or IEC 60950-1.

Line-powered amplifiers, taps, splitters and transfer points should also be fitted with earthing terminals.

- l) For antennas, which, according to Clause 11, do not have to be grounded, it is strongly recommended that at least the outer conductor of the coaxial cable connected to the antenna should be included in the equipotential bonding. Furthermore, all interconnected, conductive, accessible parts of the installation should be included in the equipotential bonding. For these connections, either of the following solutions is permitted.
- Connection to a bonding terminal or bonding bar by means of an protective bonding conductor (according to 6.2 c).
 - Connection by means of the shielding of the coaxial cable. The DC resistance to the nearest point of equipotential bonding (or PE) shall be less than or equal to $5\ \Omega$ in order that no hazardous touch voltage appears on exposed conductive parts (see also Annex A). The connection of the shield of the coaxial cable to the protective conductor shall only be disconnectable by means of a tool.

NOTE 9 For requirements in Norway, see C.2.2.

Figure 7 shows an example of maintaining equipotential bonding whilst a unit is removed.



IEC

Key

2	Main earthing bar	3	Equipotential bonding bars ^a
4	Protective bonding conductor (minimum cross-section according to 6.2 c)	7	Earthing terminal (see 6.2 j and 6.2 k)
8	Protective conductor (PE)	9	Earth electrode
16a	Equipotential bonding clamp (optional bonding if the entering coaxial cable is not included in the equipotential bonding system via equipment 1)	21	Transfer point
^a The equipotential bonding bars 3 connecting the outer conductors of the input and output cables of the amplifier with the protective bonding conductors 4 are to ensure safety during equipment replacement. They could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors and may be a temporary installation (see 6.2 i).			

Figure 7 – Example of maintaining equipotential bonding whilst a unit is removed

6.3 Equipotential bonding in meshed systems

6.3.1 References to other standards

Equipotential bonding shall comply with IEC 60364-4-44, IEC 60364-5-54, EN 50174-2, and EN 50310.

6.3.2 General on AC mains

Due to the varying load, locally and versus time, of the individual phases of the AC mains supply in a building high balancing currents can occur in the neutral conductors. The neutral conductor currents are even increased by harmonic currents, which are emitted by certain electric loads like switching power supplies, energy-saving lights, etc.

NOTE For example, the third harmonic currents of the mains frequency in the three phases add linearly in the neutral conductor.

6.3.3 AC power distribution and connection of the protective conductor

6.3.3.1 General

In low-voltage installations, different systems are distinguished by the type of earthing connection on the one hand and by the exposed conductive part otherwise (IEC 60364-1 or EN 50310).

6.3.3.2 TN systems

There are three different TN subsystems with the following general characteristics.

- a) TN-S system: Separate neutral and protective conductors throughout the system connected at the earthing point of the system.

NOTE No neutral conductor currents flow in the protective conductor.

- b) TN-C system: Neutral and protective functions combined in a single conductor throughout the system.
- c) TN-C-S system: Neutral and protective functions combined in a single conductor in part of the system.

6.3.3.3 TT system

The TT system has one point directly earthed, the exposed conductive parts of the installation being connected to earth electrodes electrically independent of the earth electrodes of the power system.

6.3.3.4 IT system

The IT system is isolated from earth, except that one point may be connected to earth through an impedance or a voltage limiter. The exposed conductive parts of the equipment installation required to be earthed are connected to earth electrodes at the user's premises.

NOTE For requirements in Norway concerning IT systems, see Clause C.3.

6.3.4 Dangers and malfunction

6.3.4.1 Within buildings

Due to the connecting of the PEN conductor in TN-C and TN-C-S systems to earthed shielding of the cable network, currents can be carried off from the PEN conductor to the cable network and leak away via the cable shielding.

NOTE When connecting equipment of protection Class I to mains and simultaneously to the cable network, the connection between the PEN conductor and earthed shielding is established via the protective conductor of the equipment.

In the case of insufficient conductor cross-section of the shield, the currents from the PEN conductor can cause heating and overheating of cables and shieldings (risk of fire).

If the currents flow through non-linear elements (for example, ferrite transformers in taps, splitters, system outlets, etc.) they can cause hum modulation. Coupling loops can also cause hum interference.

Data transmission errors and malfunctions can occur in signalling systems.

6.3.4.2 Between buildings

Due to different currents in N or PEN conductors, the equipotential bonding bars in the individual buildings can carry different potentials which can cause critically high balancing currents to flow through the shielding of the coaxial cables or the shielding of data cables between buildings.

6.3.5 Measures

The following measures are recommended.

- a) Equipment of telecommunications and information technology should be connected to a TN-S system.
- b) If possible, use equipment of protection Class II.
- c) When using equipment of protection Class I, galvanic isolators should be used in the coaxial connector to avoid PEN conductor currents being carried over.

Care should be taken that the inner conductor and shielding of the coaxial cable are electrically isolated.

Galvanic isolators, in case of improper design, can radiate or pick up inadmissible high-frequency energy. Therefore, compliance with the requirements of IEC 60728-2 should be checked carefully.

NOTE For requirements in Norway, see C.2.2.

- d) To avoid interference according to 6.3.4.2:
 - use relieving equipotential bonding (see IEC 60364-5-54);
 - galvanic isolation at NIU.

7 Mains-supplied equipment

The equipment used in a cable network shall meet the requirements of IEC 60065 or IEC 60950-1. Preferably, equipment of protection Class II should be used.

NOTE 1 If Class I equipment is used in a coaxial cable network different potentials can build up between the PE conductor and the equipotential bonding terminal. The occurring balancing currents could produce excessive heat.

NOTE 2 For the application of either of the two standards, see IEC Guide 112.

Devices installed outdoors and operated from the mains supply shall be so constructed that the harmful effects of moisture, water, dust, etc. are prevented. Alternatively, they shall be installed in an appropriate drip-proof, splash-proof or watertight enclosure of appropriate IP rating so as to provide the appropriate degree of protection (see IEC 60529).

8 Remote power feeding in cable networks

8.1 Remote power feeding

8.1.1 Maximum allowed voltages

The rated value of the remote powering voltage shall not exceed $65 V_{AC}$ or $120 V_{DC}$.

NOTE 1 Direct currents (DC) can destroy parts of the system by corrosion.

A true RMS reading instrument shall be used to determine this voltage.

The following conditions shall be complied with:

- remote powering shall not extend to the subscriber feeder (for an exception, see 8.2); the necessary isolation shall be provided by equipment according to 8.1.2;
- the remote powering voltage shall only be accessible to service persons and then only by removal of equipment covers by means of a tool.

NOTE 2 For requirements in Japan, see Clause C.4.

8.1.2 General requirements for equipment

The pieces of equipment used in a cable network shall meet the requirements of IEC 60065 or IEC 60950-1. For protection against atmospheric overvoltages in cable networks, see 11.1.

NOTE 1 For the application of either of the two standards, see IEC Guide 112.

NOTE 2 A conductive connection between a terminal of the remote supply voltage and the accessible housing of remotely powered equipment is allowed.

The occurrence of hazardous currents shall be prevented by a suitable selection of fuses or by the power supply (for example, a power-supply unit with integrated current limitation).

8.1.3 Current-carrying capacity and dielectric strength of the components

The heating caused by operating and short-circuit currents (in case of failure) of the components used shall not cause any danger. Particularly, components like cables, plugs and screw connections shall meet these requirements. With respect to the current-carrying capacity and dielectric strength, only coaxial cables specified for the current and operating voltage according to Table 1 should be used in the absence of specific values provided by the manufacturer.

Table 1 – Maximum allowed operation voltages and maximum recommended currents for coaxial cables in the EN 50117 series

Application	Typical diameter of the coaxial cable mm	Maximum allowed operation voltage V		Maximum recommended current A	
		AC _{RMS}	DC	Operation	Permanent short circuit
Drop or subscriber cable ^a	5 to 10	34	50	2	4
Feeder or distribution cable	>10	65	120	7	15
Trunk cable	>10	65	120	15	30
NOTE 1 Specific test conditions for coaxial cables are laid down in the EN 50117 series.					
NOTE 2 For back-powering applications these values are reduced according to 8.2.					
^a Drop or subscriber cable with a diameter <5 mm have to be operated according to the specifications of the manufacturer.					

8.2 Remote powering from subscriber premises

Where back-powering to a network or to outdoor equipment such as preamplifiers, low-noise converters, polarizers, transmitters in antenna installations is incorporated, the system shall comply with the following requirements.

- The maximum voltage applied between the inner and outer conductors of the subscriber feeder shall not exceed 24 V AC, RMS, or 34 V DC. A true RMS reading instrument shall be used to determine the AC voltage. Higher values of remote feeding voltage than 24 V AC, RMS and 34 V DC shall be only allowed if this remote powering voltage shall only be accessible to service persons and then only by removal of equipment covers by means of a tool, but in any case shall not exceed 65 V AC or 120 V DC.
- The equipment shall be so designed and constructed that no dangerous currents can flow under normal operating or single-fault conditions.
- The equipment providing the power shall, if that power is derived from a mains supply, comply with all the relevant clauses of IEC 60065 or IEC 60950-1, as specified in Clause 7.
- Repointing motors and de-icing devices are normally separately fed. Specific requirements and recommendations are not specified here. Reference is made to IEC 60065 or IEC 60950-1.

9 Protection against contact and proximity to electric power distribution systems

9.1 General

The risk of hazardous voltages in cable networks due to an accidental contact to electric power lines shall be minimized. These protection requirements are intended, where no local regulations exist, to protect cable networks against potentially hazardous voltages.

NOTE For requirements in France, see Clause C.5.

9.2 Overhead lines

9.2.1 Overhead lines up to 1 000 V

The distance between any part of the antenna and the antenna support structure and electric power distribution systems shall be not less than 1 m or according to national regulations, if more stringent.

NOTE 1 This value provides sufficient margin that the swinging of the electric power cables need not be taken into account.

NOTE 2 For requirements in Japan, see Clause C.6.

9.2.2 Overhead lines above 1 000 V

For phase conductors carrying voltages of more than 1 kV, the distance to any part of an antenna structure shall be at least 3 m or according to national regulations, if more stringent. The cable network shall not cross over in open air any open power-distribution system carrying voltages of more than 1 kV.

NOTE For requirements in Japan, see Clause C.6.

9.3 House installations up to 1 000 V

The distance between conductive parts of a cable network and conductive parts, including all support structures, of an electric power-distribution system carrying voltages between 50 V and 1 000 V shall be at least 10 mm when installed indoors and 20 mm when installed outdoors.

These distances may be less only if there is sufficient insulating material, for example, cable with insulating jacket, between the conductors of the two systems, thus guaranteeing that these conductors do not touch each other. For isolation requirements of coaxial cables, see the EN 50117 series.

With respect to common line routing for cable networks and electrical building installations, IEC 60364-5-52 shall be taken into account.

The installation of a power outlet and a system outlet in a common box is allowed only if the system outlet can be installed in such a way that hazardous live parts of the electric power distribution system cannot be touched by the installer.

10 System outlets and transfer points

10.1 General

The terminal equipment can be connected to the cable network directly or preferably by means of a system outlet or transfer point, which provides the necessary overvoltage protection.

Except in the case of fully isolated outlets (see 10.2.2), the protection achieved depends on equipotential bonding of the outer conductor of the subscriber feeder. It should be pointed out that, under certain combinations of fault conditions and when using Class I equipment, the outer conductor of the subscriber feeder can act as a protective conductor of the electricity supply with the result that large fault currents may flow for a considerable period of time, depending on the protection provided in the electrical distribution system.

Where system outlets or transfer points are not used, overvoltage protection shall be provided at the output of the subscriber tap.

Where overvoltage protection is provided by means of isolating capacitors or transformers, the isolated conductors, for example, inner conductors shall withstand a continuous DC test voltage of 2 120 V for a period of not less than 1 min and maintain an insulation resistance of not less than 3,0 MΩ.

NOTE 1 Compliance with this requirement can be shown to be achieved if the leakage current during the test does not exceed 0,7 mA.

The manufacturer shall design the isolating means in such a way that, under fault conditions of equipment connected to the outlet or transfer point, the AC leakage current (50 Hz or 60 Hz) does not exceed $8 \text{ mA}_{\text{RMS}}$ with an applied voltage of $230 \text{ V}_{\text{RMS}}$.

NOTE 2 For requirements in Sweden, see C.7.1.

NOTE 3 For requirements in the UK, see C.7.2.

NOTE 4 For requirements in Norway, see C.2.2.

10.2 System outlet

10.2.1 Types of system outlets

There are four types of system outlets in common use providing varying degrees of protection against electric shock (shock currents), and also more or less liable to radiate or pick up high-frequency energy.

10.2.2 Fully isolated system outlet

This type of outlet incorporates isolating components in series with both the inner and the outer conductors of the coaxial connections. The isolating components may be either high-voltage capacitors or double-wound transformers. When installed, it shall not be possible to touch simultaneously both input and output terminals of the isolator.

NOTE In cases where induced voltages resulting from lightning discharges exceed the isolator specification additional over-voltage protection (e.g. surge protecting devices) may be needed.

Fully isolated system outlets, in case of improper design, can radiate or pick up inadmissible high-frequency energy. Therefore, compliance with the requirements of IEC 60728-2 should be checked carefully.

10.2.3 Semi-isolated system outlet

This type of outlet incorporates an isolating component in series with the inner conductors only of the coaxial connections. If this type of outlet is used, the protection shall be provided by equipotential bonding of the outer conductor of the subscriber feeder. In this case, the DC resistance between the outer conductor and the nearest point of equipotential bonding (or PE) shall be such that no hazardous touch voltage appears on exposed conductive parts (see NOTE 1 and Annex A). The isolating component may be either a high-voltage capacitor or a double-wound transformer.

NOTE 1 In 230 V systems a value of the DC resistance $\leq 5 \Omega$ is used as a good practice.

NOTE 2 For requirements in Japan, see Clause C.8.

10.2.4 Non-isolated system outlet with protective element

This type of outlet does not incorporate any series isolation. Protection shall be provided by equipotential bondings as described in 10.2.3. A protective element to improve safety (for example, an RF coil) shall be connected between the inner and outer conductors of the coaxial connections. The DC resistance of this protective element shall be less than 1Ω . The DC resistance between the outer conductor and the nearest point of equipotential bonding (or PE) shall be such that no hazardous touch voltage appears on exposed conductive parts (see NOTE 1 and Annex A).

NOTE 1 In 230 V systems a value of the DC resistance $\leq 5 \Omega$ is used as a good practice.

NOTE 2 For requirements in Japan, see Clause C.8.

10.2.5 Non-isolated system outlet without protective element

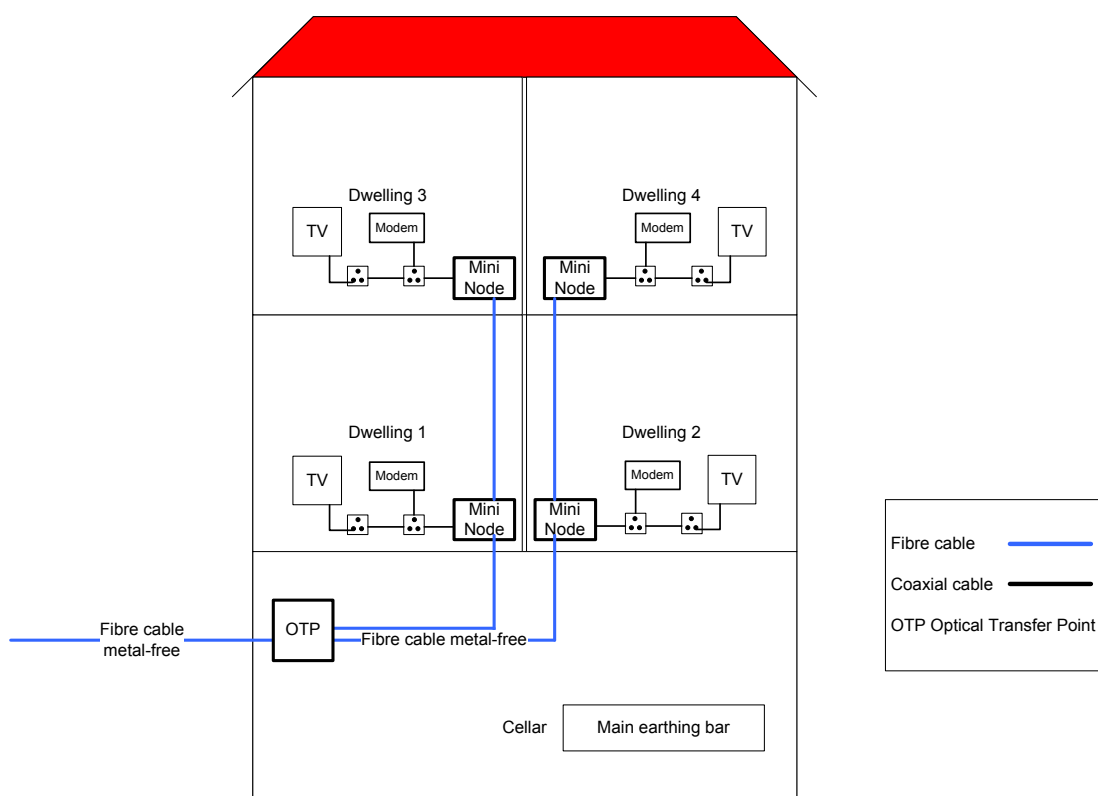
This type of outlet incorporates coaxial connector(s) only and does not contain any isolation component or protective element.

When this type of system outlet is used for back-powering, basic insulation according to IEC 60950-1 should be implemented to prevent the power from reaching other outlets.

The protection shall be provided by equipotential bonding as described in 10.2.3.

10.2.6 Fully-isolated system outlet provided by means of a FTTH system

In FTTH installations in a multi-dwelling-unit (MDU) building the individual homes are galvanically separated each from the others if the connections to the individual homes are realised by metal-free optical fibre cables (Figure 8). In this case the metal-free optical fibre cable has the same isolation function as an electrical isolating component applied to the inner and outer conductor of a coaxial cable.



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Figure 8 – MDU building installed with FTTH technology

If a metallic sheath is used for mechanical protection purposes of fibre cables, galvanic isolation of this sheath and/or external earthing shall be provided as described in 6.2 f).

10.3 Transfer point

This device can also provide varying degrees of protection against electric shock (shock currents), depending on the elements incorporated. The same requirements as for the system outlet are applicable.

Fully isolated transfer points, in case of improper design, can radiate or pick up inadmissible high-frequency energy. Therefore, compliance with the requirements of IEC 60728-2 should be checked carefully.

11 Protection against atmospheric overvoltages and elimination of potential differences

11.1 General

These protection requirements are intended, where no more stringent local regulations exist, to protect antenna systems, including satellite antennas against static atmospheric overvoltages and lightning discharges.

The outer antenna system shall be so designed and installed that it will withstand a lightning discharge without danger of fire or separation of the antenna system from the supporting structure.

These protection requirements shall not be considered as providing protection for buildings or any other structures.

The following cases are excluded from these protection requirements on the basis that the increased risk of lightning strike due to the installation of the antenna is negligible:

- antenna systems on buildings which are located at a minimum distance of 2 m below the roof covering or the eaves and less than 1,5 m from the external building walls (see Figure 9);
- antenna systems enclosed within the building structure;
- antenna systems serving only a single dwelling installation and with a low risk to be hit by lightning (see 11.2.3.1).

NOTE For requirements in Germany, see C.10.1.

A single dwelling installation is defined as an installation in a single dwelling unit where the summation of the leakage currents of the STBs or home terminals and connected Class II devices does not exceed 3,5 mA RMS. A single Class II device can have a maximum leakage current of 0,25 mA RMS or 0,5 mA RMS for devices covered by IEC 60950-1 and IEC 60065, respectively. The touch current hazard, safe let-go threshold current (defined in IEC 60990) shall be $\leq 3,5$ mA RMS as per the "touch voltage" requirement in IEC 60950-1. The maximum allowable summation of leakage current for connected devices is therefore 3,5 mA RMS before equipotential bonding becomes mandatory.

Antennas shall not be installed on buildings having roofs covered with highly flammable materials (e.g. thatch, reed-like material, etc.).

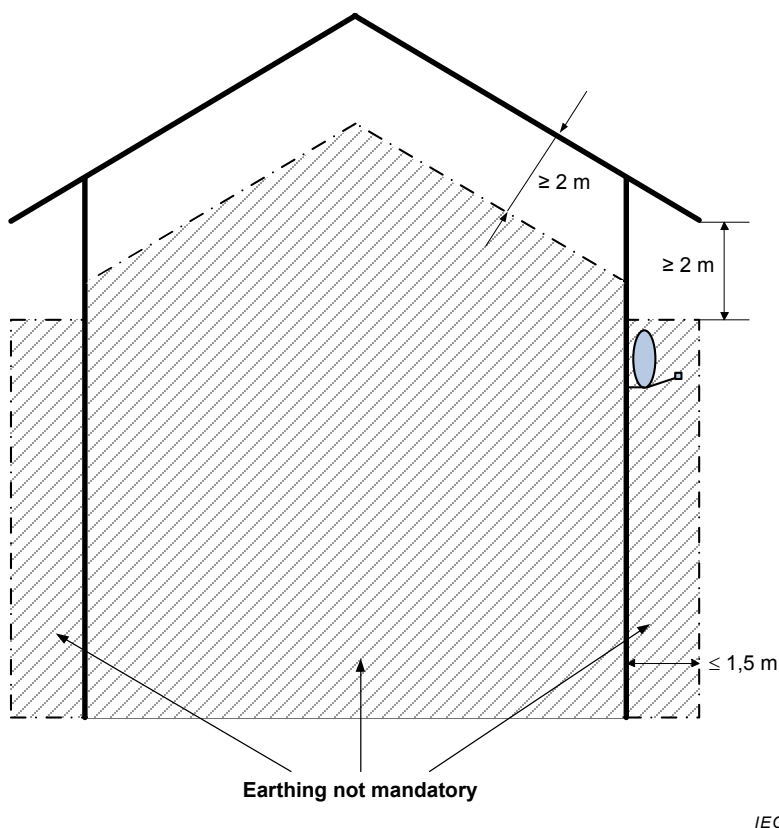
Antenna systems which are installed remotely from buildings shall be earthed, if outside the protected area of the building LPS.

Antenna cables and earthing conductors shall not be laid in areas used for the storage of easily ignitable materials such as hay, straw and similar substances, or in areas in which explosive gases can develop or collect.

For large antenna systems, such as AM broadcasting receiving antennas, it is recommended that an overvoltage protective device to a bonding conductor is incorporated.

The use of shield wires to protect installations with coaxial cables is described in informative Annex B.

Figure 9 shows areas of antenna-mounting in or on buildings in cases where earthing is not mandatory.



NOTE 1 The protected area on the side of buildings is limited up to a height of 45 m (for LPS Class III) due to the possible side flashes (see IEC 62305-3).

NOTE 2 For requirements in Japan, see Clause C.9.

Figure 9 – Areas of antenna-mounting in or on buildings, where earthing is not mandatory

11.2 Protection of the antenna system

11.2.1 Selection of appropriate methods for protection of antenna systems

Figure 10 shows a flow chart which serves as decision tree to select the appropriate method for protecting the antenna system under consideration against atmospheric overvoltages. The decision tree has four outputs which belong to the four solutions for installation of the antenna system, described in Table 2. It is important to distinguish between the responsibilities of the antenna installer (solid line boxes in Figure 10) and the responsibilities of the LPS installer (dashed line boxes in Figure 10).

Table 2 – Solutions for protection of antenna systems against atmospheric overvoltages

Solution	Protection measures	Related standards
1	Antenna system not directly earthed but connected to an equipotential bonding system	
1a	In protected area of the building according to Figure 9.	This standard
1b	In protected volume of the existing or newly installed LPS, see Figure 11.	IEC 62305-3
1c	In protected volume of external isolated ATS, see Figure 12 and Figure 13	IEC 62305 series
1d	If lightning stroke risk $R \leq$ tolerable risk R_T ; see Figure 16	IEC 62305-2
2	Antenna system directly earthed and connected to an equipotential bonding system	
	Building without an LPS and no data applicable or available for risk calculation, see Figure 15.	This standard
3	Antenna system connected to an equipotential bonding system and with connection to an LPS	
	Building with an LPS; antenna mast serves as non-isolated air-termination system (ATS), see Figure 14	IEC 62305 series This standard
4	Antenna system without connection to an equipotential bonding system and not directly earthed	
	Installation in protected area of a single dwelling unit and for single dwelling installations according to 11.1.	This standard
NOTE For installations covered by solution 4, it is nonetheless strongly recommended that the system is equipotentially bonded.		

11.2.2 Building equipped with a lightning protection system (LPS)

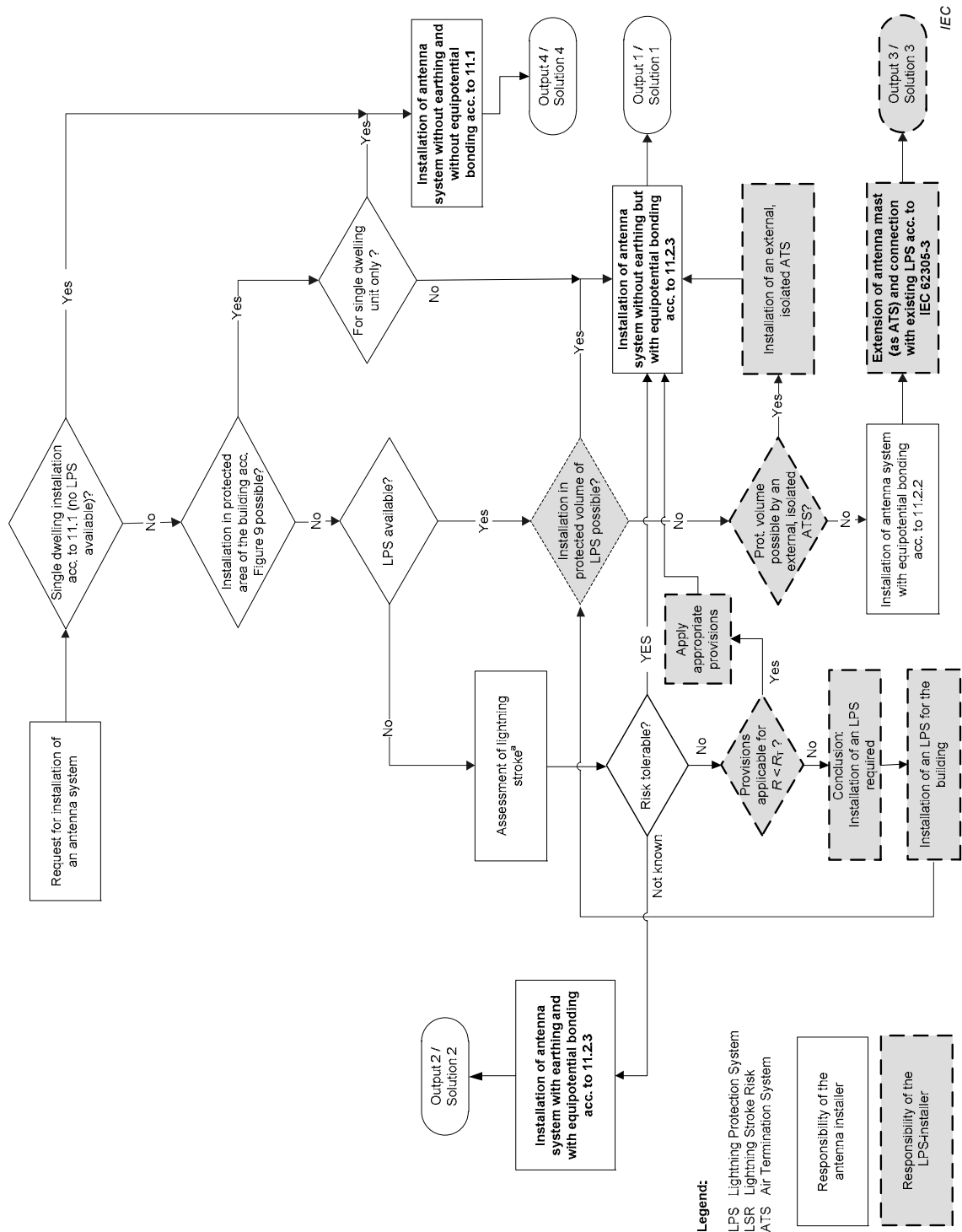
If the building is already equipped or will be equipped (on the request of the antenna installer) with an LPS conforming to the IEC 62305 series the best solution for installing an antenna system is to use a protected volume of this LPS (solution 1b in Table 2) as described in the IEC 62305 series of publications. The possibility to use such a protected volume shall be determined by the skilled LPS installer. Figure 11 shows an example of such an installation.

If a protected volume performed by the building LPS is not available, for example due to the size of the antenna system, the use of an external isolated ATS shall be determined by the LPS installer (solution 1c in Table 2). Figure 12 and Figure 13 show examples of such installations.

If neither of the above mentioned installation principles are possible, the antenna mast, being a metal installation, shall be connected to the building's LPS via the shortest possible path and using an earthing conductor as specified in 11.3.2 (solution 3 in Table 2). In this case the antenna mast may be extended in length to form a non-isolated air termination system and shall fulfil the requirements of 5.2 of IEC 62305-3:2010 for an air-termination system. It is assumed that the antenna system and its mast are able to withstand a lightning stroke.

An example of this kind of installation is shown in Figure 14.

The separation distance S , shown in Figure 11, Figure 12, Figure 13 and Figure 14, between each ATS equipment and the LPS and all LPS connected parts shall meet or exceed the required value (see IEC 62305-3).

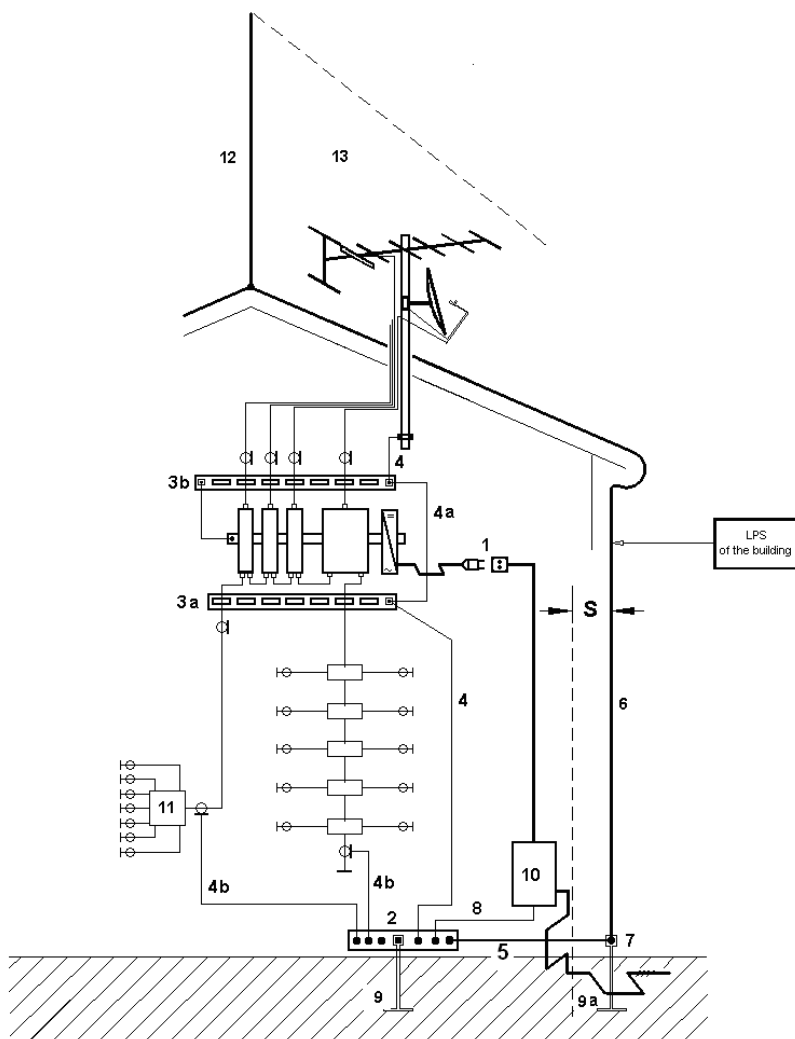


- ^a An assessment should be made of the risk of lightning strike R . If a definitive value of R is known (by calculation using available data) this should be compared with the tolerable risk R_T to determine whether consideration should be given to the installation of an LPS or whether to proceed to output 1/solution 1. If it is impossible to determine the value of R (e.g. lack of local data) then local common practice should be used to determine a solution or, as a minimum, the option output 2 / solution 2 shall be realised.

Figure 10 – Flow chart for selection of the appropriate method for protecting the antenna system against atmospheric overvoltages

NOTE The numbering of equivalent parts in Figure 1 to Figure 19 is unified, where applicable. Therefore the numbering in an individual figure may not be in consecutive order.

Figure 11 shows an example of equipotentially bonded headends and antennas in a protected volume of the building LPS.



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Key

1	Mains supply	2	Main earthing bar
3a, 3b	Equipotential bonding bars	4, 4a, 4b	Protective bonding conductors (minimum cross-section according to 6.2 c)
5	Earth bonding conductor (e.g. $\geq 16 \text{ mm}^2 \text{ Cu}$) according to 11.3.2	6	External earthing conductor of the buildings LPS (e.g. $\geq 50 \text{ mm}^2 \text{ Cu}$, solid round, according to IEC 62305-3)
7	Earthing terminal	8	Protective conductor (PE)
9	Earth electrode	9a	LPS earth electrode
10	Mains power distribution box with SPD	11	Home distributor (HD)
12	Interception rod	13	Protected volume by isolated LPS (see IEC 62305-3)
S	Separation distance according to IEC 62305-3		

NOTE 1 The equipotential bonding bar 3a connecting the outer conductors of the output cables of the headend with the protective bonding conductor 4a can be a temporary installation to ensure safety during equipment replacement.

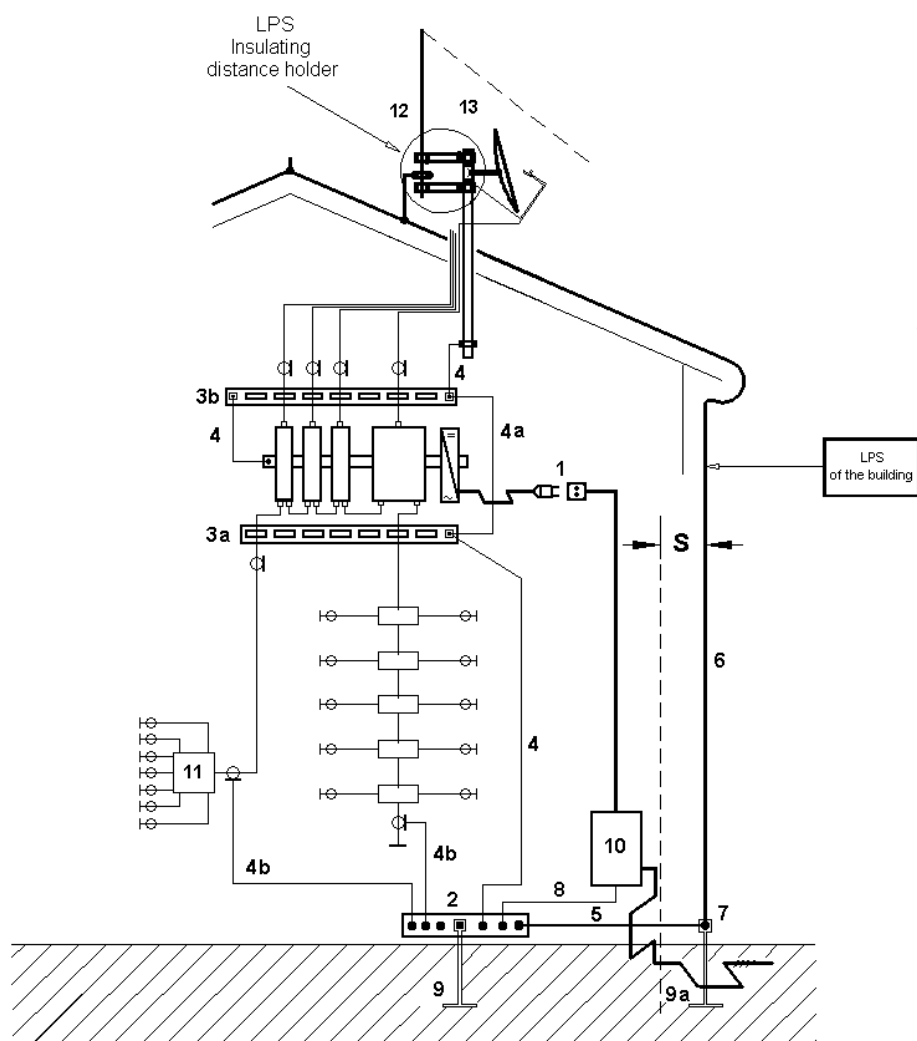
NOTE 2 The equipotential bonding bars 3a and 3b could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors.

NOTE 3 The bonding connection between the headend equipment and the metallic mounting bar is either performed via the metallic equipment enclosure or by an additional protective bonding conductor 4.

NOTE 4 The example refers to Table 2, solution 1b.

Figure 11 – Example of equipotential bonded headends and antennas in a protected volume of the building LPS

Figure 12 shows an example of equipotentially bonded headends and antennas in a protected volume of the building LPS.



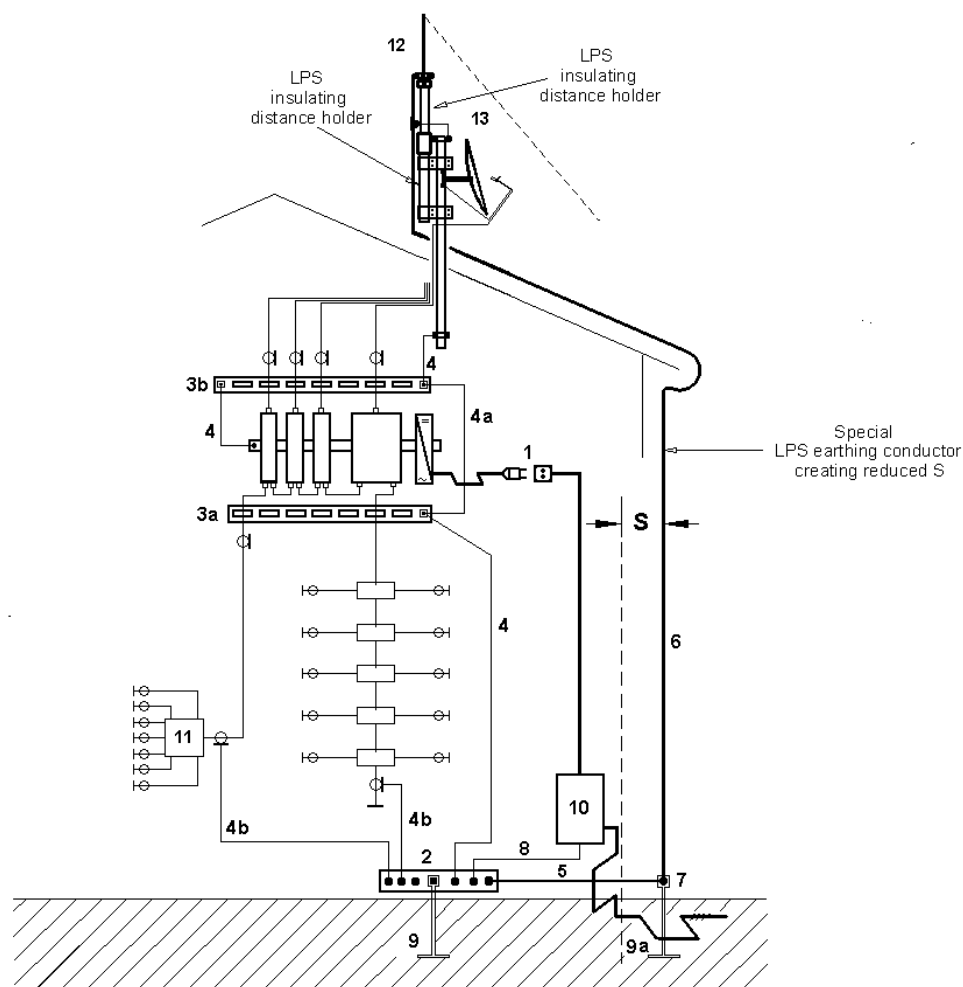
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Key

1	Mains supply	2	Main earthing bar
3a, 3b	Equipotential bonding bars	4, 4a, 4b	Protective bonding conductors (minimum cross-section according to 6.2 c)
5	Earth bonding conductor (e.g. $\geq 16 \text{ mm}^2 \text{ Cu}$) according to 11.3.2	6	External earthing conductor of the buildings LPS (e.g. $\geq 50 \text{ mm}^2 \text{ Cu}$, solid round, according to IEC 62305-3)
7	Earthing terminal	8	Protective conductor (PE)
9	Earth electrode	9a	LPS earth electrode
10	Mains power distribution box with SPD	11	Home distributor (HD)
12	Interception rod	13	Protected volume by isolated LPS (see IEC 62305-3)
S	Separation distance according to IEC 62305-3		
NOTE 1 The equipotential bonding bar 3a connecting the outer conductors of the output cables of the headend with the protective bonding conductor 4a can be a temporary installation to ensure safety during equipment replacement. NOTE 2 The equipotential bonding bars 3a and 3b could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors. NOTE 3 The bonding connection between the headend equipment and the metallic mounting bar is either performed via the metallic equipment enclosure or by an additional protective bonding conductor 4. NOTE 4 The example refers to Table 2, solution 1c.			

Figure 12 – Example of equipotential bonded headends and antennas in a protected volume of the building LPS

Figure 13 shows an example of equipotentially bonded headends and antennas in a protected volume of an external isolated ATS.



IEC

Key

1	Mains supply	2	Main earthing bar
3a, 3b	Equipotential bonding bars	4, 4a, 4b	Protective bonding conductors (minimum cross-section according to 6.2 c)
5	Earth bonding conductor (e.g. $\geq 16 \text{ mm}^2 \text{ Cu}$) according to 11.3.2	6	External earthing conductor of the buildings LPS (e.g. $\geq 50 \text{ mm}^2 \text{ Cu}$, solid round, according to IEC 62305-3)
7	Earthing terminal	8	Protective conductor (PE)
9	Earth electrode	9a	LPS earth electrode
10	Mains power distribution box with SPD	11	Home distributor (HD)
12	Interception rod	13	Protected volume by isolated LPS (see IEC 62305-3)
S	Separation distance according to IEC 62305-3		

NOTE 1 The equipotential bonding bar 3a connecting the outer conductors of the output cables of the headend with the protective bonding conductor 4a can be a temporary installation to ensure safety during equipment replacement.

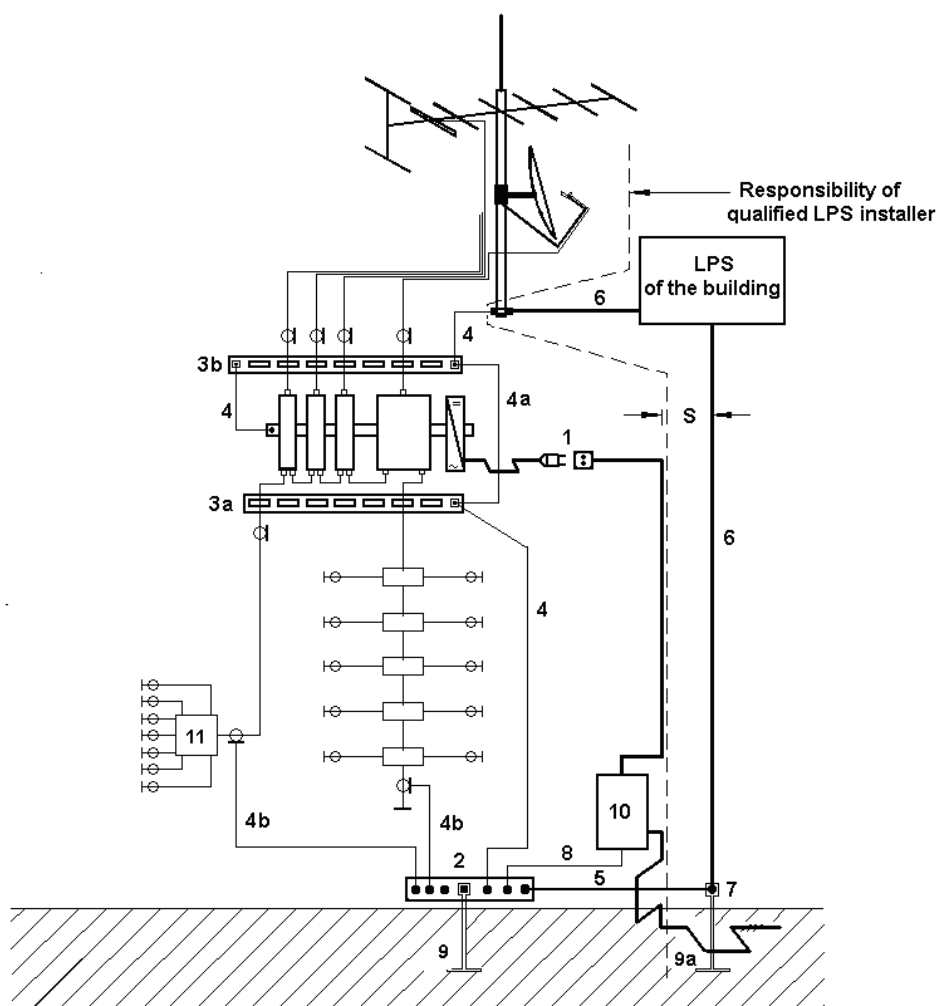
NOTE 2 The equipotential bonding bars 3a and 3b could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors.

NOTE 3 The bonding connection between the headend equipment and the metallic mounting bar is either performed via the metallic equipment enclosure or by an additional protective bonding conductor 4.

NOTE 4 The example refers to Table 2, solution 1c.

Figure 13 – Example of equipotential bonded headends and antennas in a protected volume of an external isolated ATS

Figure 14 shows an example of equipotentially bonded antennas (not installed in a protected volume) and a headend with direct connection to the building LPS.



IEC

Key

1	Mains supply	2	Main earthing bar
3a, 3b	Equipotential bonding bars	4, 4a, 4b	Protective bonding conductors (minimum cross-section according to 6.2 c)
5	Earth bonding conductor (e.g. $\geq 16 \text{ mm}^2 \text{ Cu}$) according to 11.3.2	6	External earthing conductor of the building's LPS (e.g. $\geq 50 \text{ mm}^2 \text{ Cu}$, solid round, according to IEC 62305-3)
7	Earthing terminal	8	Protective conductor (PE)
9	Earth electrode	9a	LPS earth electrode
10	Mains power distribution box with SPD	11	Home distributor (HD)
S	Separation distance		

NOTE 1 The equipotential bonding bar 3a connecting the outer conductors of the output cables of the headend with the protective bonding conductor 4a can be a temporary installation to ensure safety during equipment replacement.

NOTE 2 The equipotential bonding bars 3a and 3b could be either metallic bars for directly fixing and contacting the sheath of the coaxial cables or a block of double sided F connectors.

NOTE 3 The bonding connection between the headend equipment and the metallic mounting bar is either performed via the metallic equipment enclosure or by an additional protective bonding conductor 4.

NOTE 4 The example refers to Table 2, solution 3.

Figure 14 – Example of equipotential bonded antennas (not installed in a protected volume) and headend with direct connection to building LPS

The outer conductors of all coaxial cables coming from the antennas (see Figure 11, Figure 12, Figure 13 and Figure 14) shall be connected to the mast via a protective bonding conductor having a minimum cross-sectional area according to 6.2 c.

To ensure the maintenance of protection of an LPS when an antenna system is installed, the LPS should be inspected according to IEC 62305-3:2010, Clause 7.

NOTE For requirements in Japan, see C.10.2.

11.2.3 Building not equipped with an LPS

11.2.3.1 General

Where the risk due to lightning is less than the tolerable risk according to 11.2.3.2, for individual satellite and/or terrestrial television receiving networks or systems and extended satellite and/or terrestrial television distribution systems confined to one building, protection against lightning is not mandatory unless required by local regulations (but nonetheless strongly recommended). As examples, cases described in 11.2.3.3 to 11.2.3.6 shall be considered as shown in the decision tree of

Figure 10 and in Table 2.

For cases B, C and D the risk assessment of the building with the antenna system shall be performed according to IEC 62305-2.

NOTE For requirements in Germany, see C.10.1.

11.2.3.2 Tolerable risk

Identifying the maximum value of the risk which can be tolerated in a building (the "tolerable risk") is the responsibility of the authority having jurisdiction. If the tolerable risk is not available by local regulations, the risk of the building is taken as indicated in IEC 62305-2:2010, Table 4

loss of human life or permanent injuries	$R_T = 10^{-5}$,
loss of service to the public	$R_T = 10^{-3}$,
loss of cultural heritage	$R_T = 10^{-4}$.

Computer programmes exist within National Standards Bodies for calculation of the tolerable risk, which can assist installers in order to evaluate the lightning risk R of the complete building including the antenna installation and compare it to the tolerable risk R_T . However, difficult cases should be calculated according to IEC 62305-2.

11.2.3.3 Case A – Bonding required without LPS

If the building is not equipped with an LPS conforming to the IEC 62305 series, and

- LPS is not mandatory by local authority regulations, or
- risk assessment data are not available or not applicable,

the mast and outer conductors of the coaxial cables shall be earthed as specified in 11.3.2. This is shown as output 2/solution 2 in Figure 10 and in Table 2. However, risk assessment is always recommended.

An example of earthing and equipotential bonding according to solution 2 is shown in Figure 15.

11.2.3.4 Case B – Bonding required without LPS

If the building is not equipped with an LPS conforming to the IEC 62305 series, and

- LPS is not mandatory by local authority regulations. or
- the risk of the building with antenna systems due to lightning was calculated (according to 11.2.3.1) and is below or equal the maximum value of risk which can be tolerated,

protection against lightning is not required. This leads to output 1/solution 1 in Figure 10 and is described as solution 1d in Table 2.

NOTE For requirements in Germany, see C.10.1.

An example of antenna system bonding according to solution 1d is shown in Figure 16. The outer conductors of all coaxial cables coming from the antennas shall be connected to earth via a bonding conductor with a cross-section according to 6.2 c.

11.2.3.5 Case C – Lightning protection by risk-reducing measures

If the building is not yet equipped with an LPS conforming to the IEC 62305 series, and the risk of the building with antenna systems due to lightning was calculated (according to 11.2.3.1) and is above the maximum value of risk which can be tolerated, it is possible, according to the IEC 62305 series, to apply additional measures in order to reduce the risk.

These additional measures, to be specified by an LPS installer (or lightning protection expert), are dependent on the causes that have produced the $R > R_T$ condition. These additional measures can be the provision of

- SPD devices, according to IEC 62305-4,
- screening for incoming power line, overhead or underground services,
- fire extinguishers.

If after considering the provision of one or more of these solutions the condition $R < R_T$ can be obtained, this provision shall be applied and then an LPS is not required. This leads to output 1/solution 1 in

Figure 10 and is described as solution 1d in Table 2.

NOTE 1 For requirements in Germany, see C.10.1.

NOTE 2 This may be a more cost effective solution than a provision of an LPS.

11.2.3.6 Case D – LPS required

If after considering the placement of these provisions the condition $R > R_T$ is still valid, the installation of an LPS by a skilled LPS installer is required before installing the antenna system.

After the installation of the LPS the requirements of 11.2.2 apply for the antenna system.

To ensure the maintenance of protection of an LPS when an antenna system is installed, the LPS should be inspected according to IEC 62305-3:2010, Clause 7.

Figure 15 shows an example of an equipotentially bonded headend and earthed antennas in a building without LPS.