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**Home and building electronic systems (HBES) and building automation and control systems (BACS) –
Part 6: Requirements for planning and installation**

**Systèmes électroniques pour les foyers domestiques et les bâtiments (HBES) et systèmes de gestion technique du bâtiment (SGTB) –
Partie 6: Exigences de planification et d'installation**



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FDIS	Report on voting
23/972/FDIS	23/974/RVD

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INTRODUCTION

A HBES/BACS network is part of the home/building network, which includes cabling for information and communication technology (ICT) and broadcast communication technology (BCT) applications. ISO/IEC 14763-2 is the specific standard for ICT and BCT cabling installation and planning.

This document covers installation and planning requirements specific to a HBES/BACS network in addition to safety requirements for electrical installations included in the IEC 60364 series.

Installation and planning specific requirements include:

- infrastructures for cabling,
- coexistence with electric wiring,
- hints for sensors.

Wireless systems are also considered. Planning the cabled backbone for wireless systems is less complex compared to a full cabled network pathway, power supply cabling. Additional provisions are provided to guarantee coverage and reliability.

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

Part 6: Requirements for planning and installation

1 Scope

This document specifies the requirements for planning and installation of HBES/BACS and the supporting infrastructure.

Radio frequency (RF) HBES/BACS are also considered.

Safety requirements are covered by IEC 60364 (all parts).

Information and communication technology (ICT) and broadcasting and communication technology (BCT) network installations are typically interfaced with HBES/BACS.

The requirements for ICT and BCT network installations are covered by ISO/IEC 14763-2.

This document does not cover HBES/BACS implementation with:

- optical fibre,
- power lines,
- power over Ethernet (PoE).

2 Normative references

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

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

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

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

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

IEC 63044-3, *Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) – Part 3: Electrical safety requirements*

IEC 63044-4, *Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) – Part 4: General functional safety requirements for products intended to be integrated in HBES and BACS*

IEC 63044-5 (all parts), *Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) – Part 5: EMC requirements*

IEC 61386-24, *Conduit systems for cable management – Part 24: Particular requirements – Conduit systems buried underground*

ISO/IEC 11801-1, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC 14763-2, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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

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

3.1.1

BCT cabling

broadcast and communication technologies cabling

cabling system designed to support applications using the HF band (3 MHz to 30 MHz), the VHF band (30 MHz to 300 MHz) and the UHF band (300 MHz to 3 000 MHz) for transmission of sound radio, TV and two-way data services, as well as for in-home inter-networking, as defined in ISO/IEC 11801-1

3.1.2

HBES/BACS application

single automated action performed by HBES/BACS (see definition 3.1.4)

Note 1 to entry: Applications are normally integrated to perform higher-level actions.

3.1.3

home/building network

network for digital and analogue information transport for a home or a building, providing defined access points and using one or more media in any topology

3.1.4

ICT cabling

information and communication technologies cabling

cabling system designed to support applications using information and communication technologies, as defined in ISO/IEC 11801-1

3.1.5

wired HBES/BACS

HBES/BACS with wired power and signals

3.1.6

RF HBES/BACS

HBES/BACS whose signals are exchanged by radio frequency; power can be wired or not (e.g. battery)

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

AV	Audiovisual
BCT	Broadcast and communication technologies
BO	Broadcasting outlet
CO	Control outlet
HD	Home distributor
HF	High frequency
HVAC	Heating, ventilation, and air conditioning
ICT	Information and communication technologies
IT	Information technology
MATO	Multi-application telecommunication outlet
RF	Radio frequency
SHD	Secondary home distributor
TO	Telecommunications outlet
UHF	Ultra high frequency
VHF	Very high frequency

4 Home/building networks

The home/building networks:

- ensure the distribution of services, such as:
 - communication,
 - HBES/BACS;
- need components such as conduits, boxes, etc. as physical infrastructures for the system.

The implementation of the home/building network goes through the following steps:

- design,
- planning of physical infrastructure,
- installation.

The planning of a common physical infrastructure for HBES/BACS, ICT, and BCT and the supporting power distribution network is advantageous for the following reasons:

- cost optimization through common works,
- optimization of the pathways,
- planning of common installation spaces for interfacing units,
- simplify the planning of spaces for future updates.

Specific requirements for the planning and the installation of a communication services generic cabling infrastructure are given in ISO/IEC 14763-2. Requirements for the HBES/BACS physical infrastructure are given in this document.

HBES/BACS networks can be wired, wireless or a combination of both and require a supporting physical infrastructure. For example, wireless HBES/BACS are composed of the housing of the device, the supporting power network, the positioning of interfacing modules, etc.

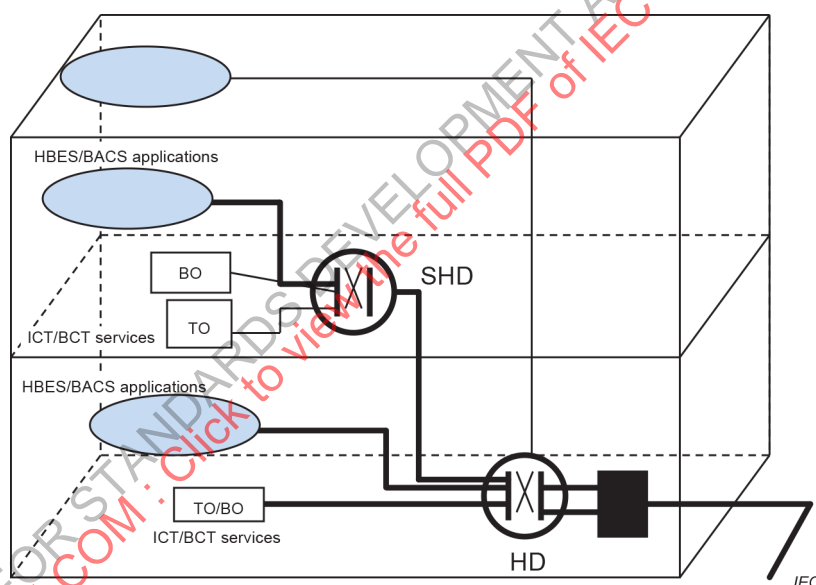
5 Home/building network model and general requirements

The design of the home/building network shall consider:

- characteristics of the premises, including surface, type of home/building, physical characteristics;
- required services:
 - communication,
 - HBES/BACS (see IEC 63044-1 for the complete list of HBES services);
- possible restrictions, in the case of existing buildings (see Annex A).

Figure 1 shows that a star topology is commonly used for ICT and BCT cabling subsystems (according to ISO/IEC 11801-1). The home distributor (HD) is the unit for service delivery to outlets (TO: telecommunication outlets; BO: broadcast outlet). A secondary home distributor (SHD) may be necessary in the case of complex premises (e.g. a home on two floors).

HBES/BACS networks may have different topologies: wired (e.g. bus, tree, loop, star and/or combinations thereof), wireless or mixed wired/wireless. However, HD and SHD spaces may be conveniently shared with ICT and BCT networks.



HD: Home distributor

SHD: Secondary home distributor

TO: Telecommunication outlet

BO: Broadcast outlet

Figure 1 – General topology of home/building network showing ICT, BCT, HBES/BACS networks

Home/building applications may be distributed over the ICT network, and communication services may have interfaces with HBES/BACS.

HBES/BACS networks may have outdoor parts.

NOTE Outdoor locations are for example front doors, garages, garden lighting.

Improvements and additions to the HBES/BACS may however occur during the building life (e.g. change/addition of devices). Flexibility is therefore required for the home/building network layout.

Wireless networks often need some wiring and spaces for housing devices which need infrastructure planning as well. See Clause 6 for infrastructure planning either for wired or wireless networks.

Some installation guidelines for typical HBES/BACS applications are reported in Annex B depending on the applications and clusters of services for HBES/BACS provided in Annex E.

6 Infrastructure requirements

6.1 Infrastructure requirements for wired HBES/BACS

6.1.1 Installation spaces for wired HBES/BACS

According to the home/building network model of Clause 5, a physical infrastructure shall be planned to allow the installation of cables and housing of the equipment.

Since the HBES/BACS may be extended to the whole building and to the outdoor grounds, corresponding installation spaces shall be foreseen.

Six levels of installation spaces are identified, labelled IS1 to IS6 and selected according to the design specification.

NOTE The selection of installation spaces depends on the complexity of the installation. For example, in a single home installation only IS2, IS4, IS5 and IS6 are usually needed.

Installation spaces IS1 to IS6 are intended for fixing cabinets, enclosures and/or boxes, for example according to IEC 60670-1 and containing active and/or passive devices as well as connecting hardware.

Each installation space shall:

- contain boxes with an appropriate fixture for fixing the devices;
- allow mounting of active and passive (modular) devices, with any insulation and separation that may be required;
- facilitate access for maintenance;
- allow foreseeable extensions of the network.

Figure 2 summarises the installation spaces IS1 to IS6.

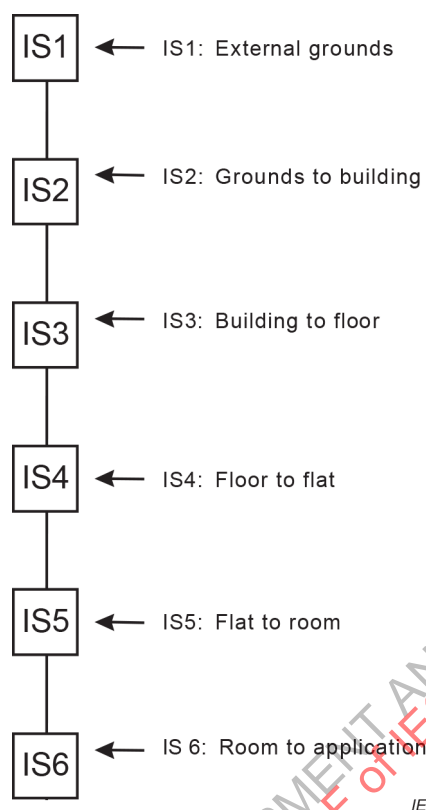


Figure 2 – Installation spaces

In 6.1.2, coexistence requirements between HBES/BACS cables and mains are specified.

If such requirements are met, the space for cable ways can be reduced accordingly.

An example of a building infrastructure is shown in Figure 3.

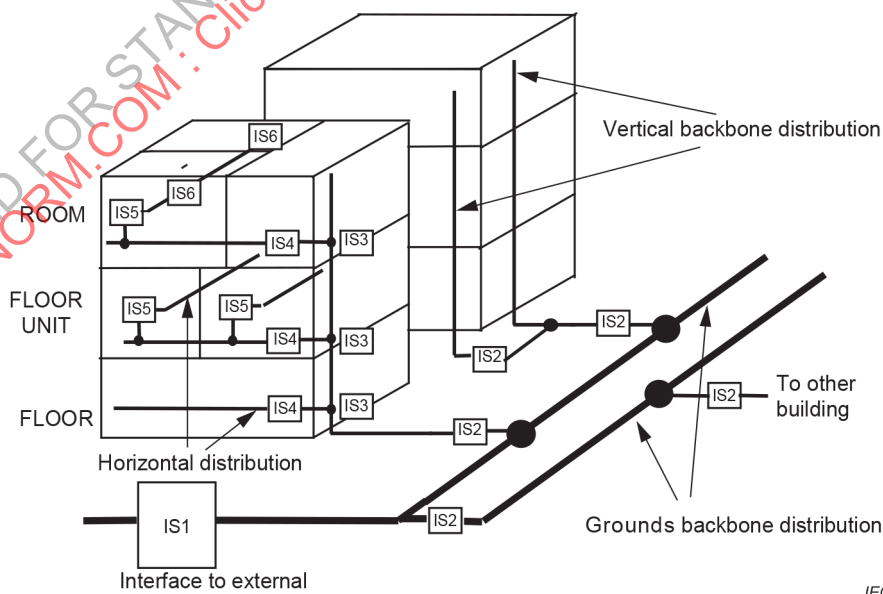


Figure 3 – Infrastructure for buildings

In Figure 3, the building in the foreground shows one single vertical backbone distribution, the building in the background shows two vertical ways of distribution connected with each other.

The gateways to external services connecting the grounds with a public network may be in an extra enclosure (IS1), which can be mandatory in certain cases, for example, IP network.

A maximum cable length between devices may be imposed for HBES/BACS functions. Infrastructure planning shall consider such aspects for distances between installation spaces.

The general infrastructure may consist of the grounds, building, floors, flats, rooms, distribution systems and shall be adapted to the needs by considering different types of buildings.

The infrastructure shall easily allow future extension/modification of the home/building network.

Figure 4 shows an example of a horizontal floor distribution infrastructure.

Horizontal floor distribution connects the floor installation space IS3 to the flat installation space IS4.

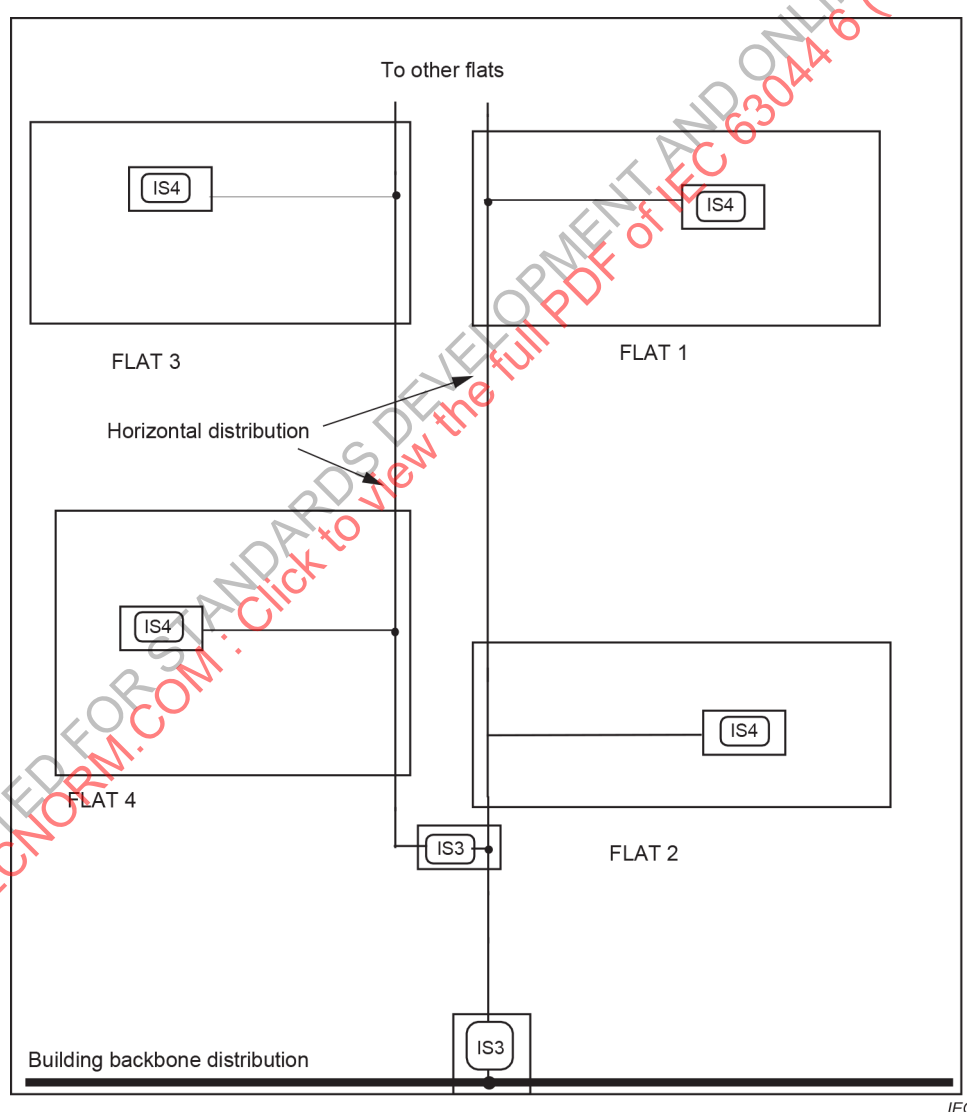
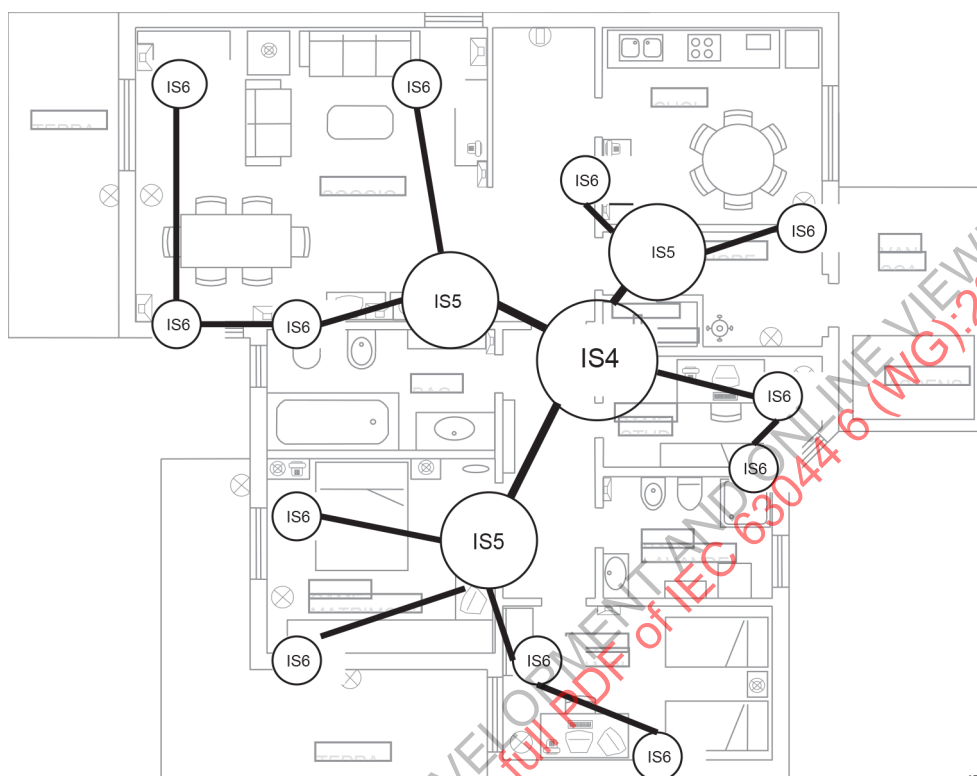


Figure 4 – Horizontal infrastructure (floor distribution)

Figure 5 and Figure 6 show examples of the topology of installation spaces inside a home.

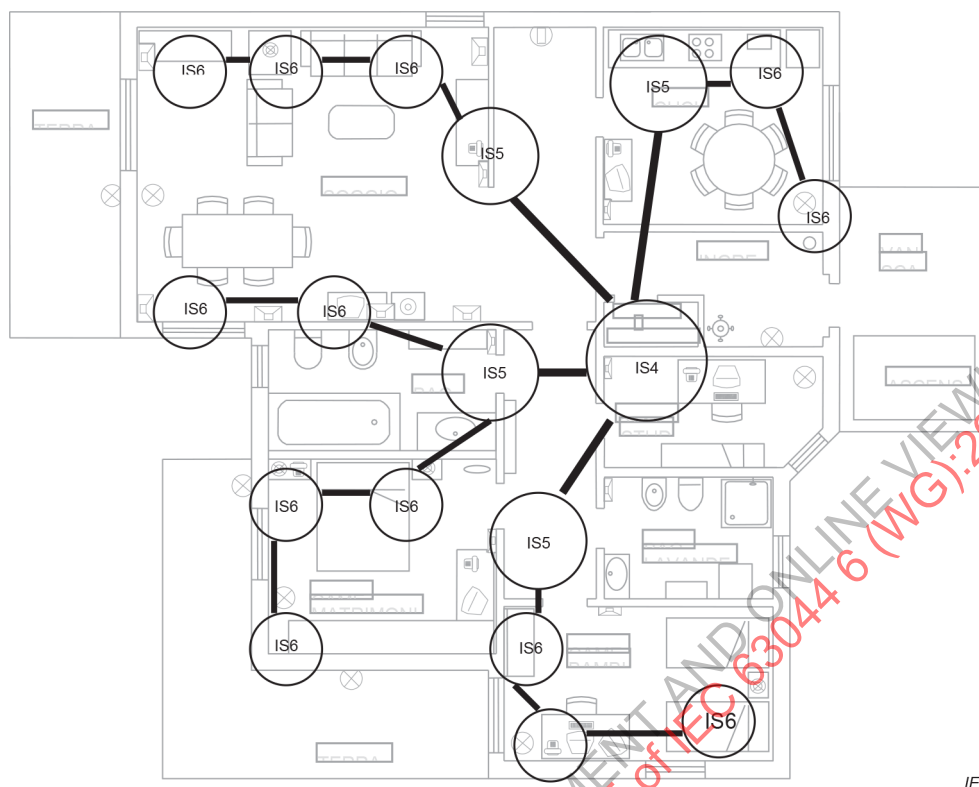
IS4 provides the space for equipment to distribute services in the home as well as home gateway to the building network.

IS5 is an intermediate space between IS4 and IS6 (terminal outlets).



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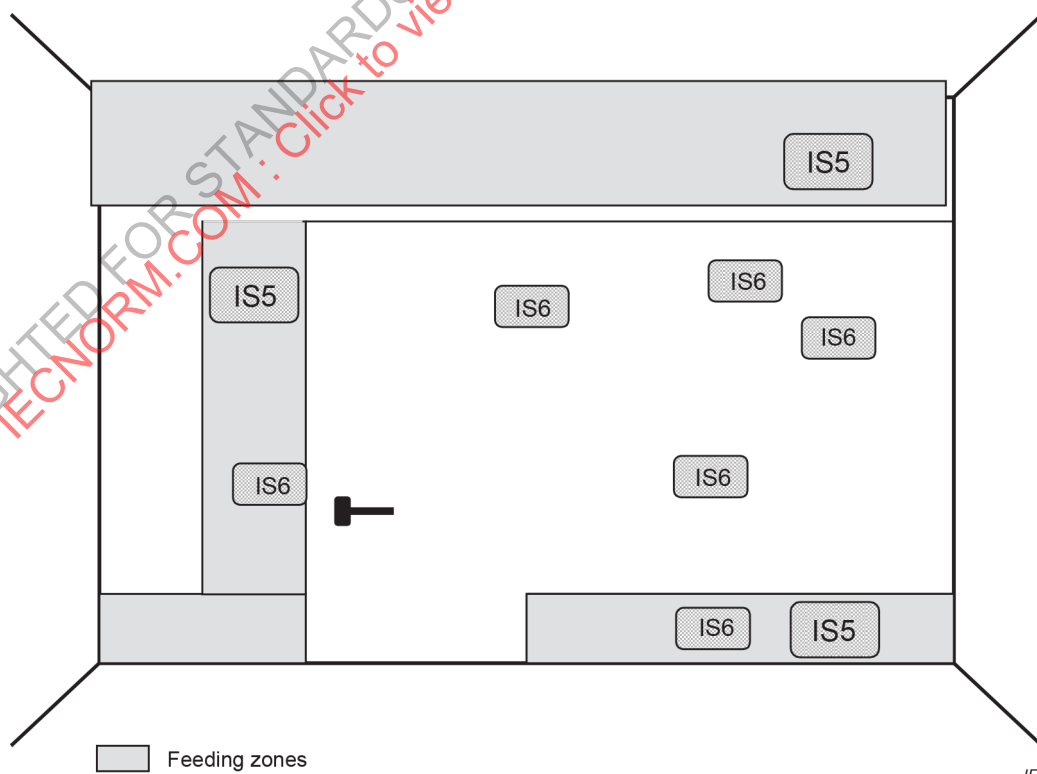
Figure 5 – Example of infrastructure for ICT and BCT cabling for a flat



IEC

Figure 6 – Example of infrastructure for HBES network for a flat

Figure 7 shows an example of the physical allocation of the installation spaces IS6 and terminal outlets inside a home.



IEC

Figure 7 – Example of allocation of installation spaces (IS5, IS6)

NOTE Pathways connecting the installation spaces can be subjected to national regulations.

The height of the IS6 depends on the device to be installed. The following are suggested values:

- floor level: flood detectors;
- heights from the floor:
 - power, TV and data sockets: 175 mm to 400 mm,
 - junction boxes (IS5), LPG detectors: 300 mm,
 - switches, pushbuttons, presence/movement sensors: 800 mm to 900 mm,
 - panel boards, HD (IS4): 1 400 mm,
 - intercom terminal displays: 1 600 mm,
 - alarm commands (bathroom), bells, fans, cameras, loudspeakers, presence/movement sensors: 2 250 mm;
- heights from the ceiling:
 - sockets for kitchen fans: 100 mm to 200 mm,
 - gas methane detector, emergency lamps: 400 mm;
- ceiling level:
 - smoke detector,
 - fans,
 - loudspeakers,
 - presence/movement sensors.

NOTE Installation heights to allow the use of equipment for special needs (e.g. to be accessed by disabled people) can be different and are outside the scope of this document.

Additional recommendations by manufacturers should be considered.

In Figure 8, the heights for IS6 are shown.

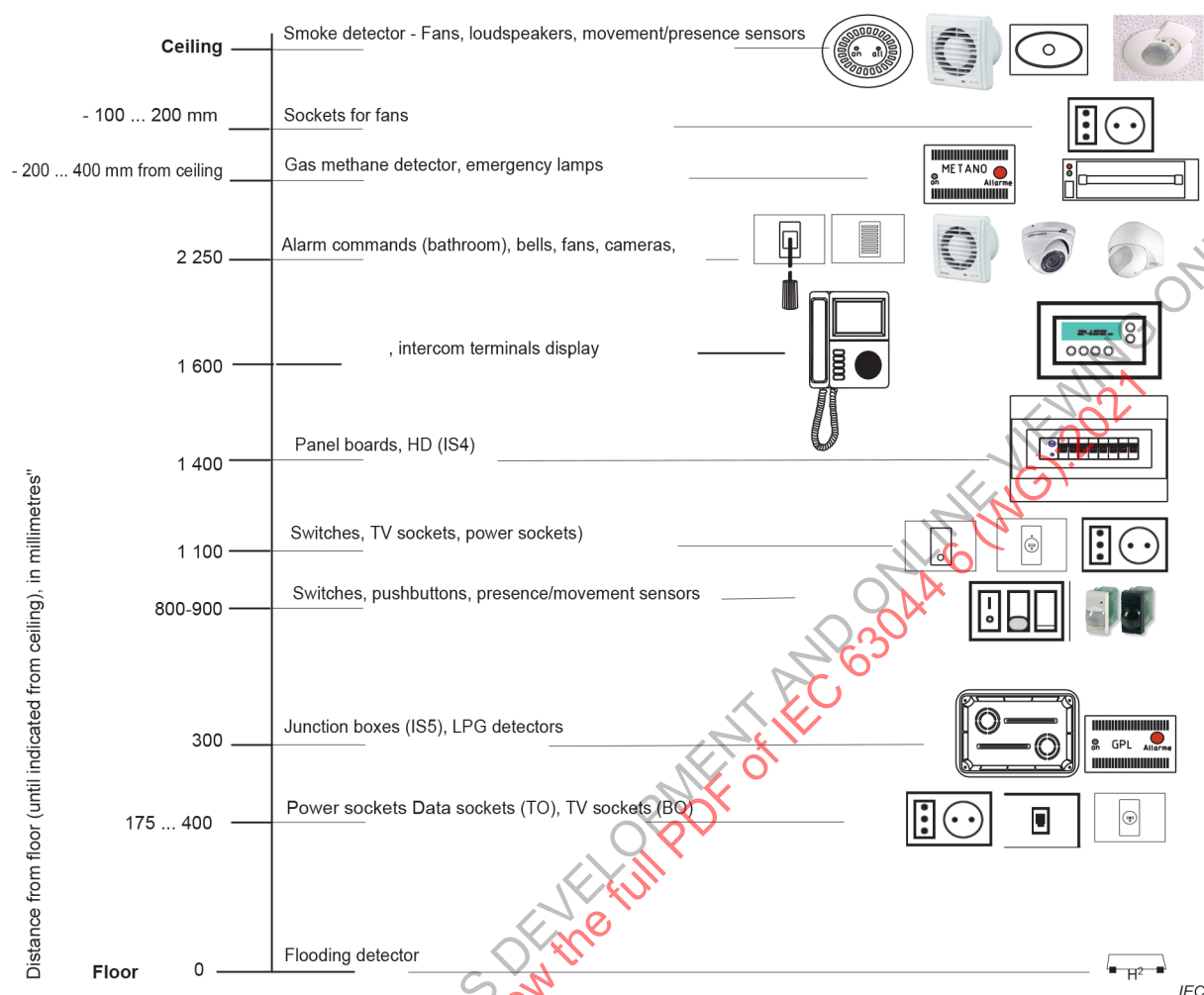


Figure 8 – Indicative installation height for the most common HBES/BACS devices

Enclosures (IS1 to IS4) should be planned to allow fixing means to be mounted, for example to allow 35 mm DIN rail (according to IEC 60715) to be mounted.

Flush mounting boxes according to IEC 60670-1 may be used to achieve IS6.

It is recommended to consider the infrastructures for a complete HBES/BACS at an early stage of the building design. This allows the installation of the cables with minimum impact and allows for future modifications and additions.

The pathway cross section shall be dimensioned to allow the installation of additional cables. Consequently, the internal diameter of conduits between IS5 and IS6 shall be not less than 20 mm (or with an equivalent cross section for other shapes of conduits).

The cable ways shall be planned in order to guarantee the bending radius and the maximum allowed pulling force of HBES cables.

6.1.2 Cohabitation of HBES/BACS and power cables

The cohabitation of HBES/BACS and power cables is subject to safety and EMC requirements and recommendations.

Safety requirements are specified in IEC 60364-4-41.

EMC requirements depend on the cable type, the application group (HBES/BACS, BCT, ICT) and the maximum allowed parallel length (e.g. 90 m for ICT).

Table 1 shows the EMC requirements for the coexistence between HBES/BACS and power cables for all the applications defined in IEC 63044-1. These requirements consider that all devices of the HBES/BACS network comply with the immunity and emission requirements specified in IEC 63044-5 (all parts) and/or the relevant product standards.

Table 1 – EMC requirements for the cohabitation of the HBES/BACS and power cable

Cluster	Applications	Cohabitation with mains	Cabling subsystem
Automation	Lighting control	Allowed	HBES/BACS
	Shutters control	Allowed	HBES/BACS
	Portal and door control	Allowed	HBES/BACS
HVAC	Heating control	Allowed	HBES/BACS
	Air conditioning control	Allowed	HBES/BACS
	Ventilation	Allowed	HBES/BACS
	Smart energy metering	Allowed	HBES/BACS
Security	Gas detection	Allowed	HBES/BACS
	Smoke detection	Allowed	HBES/BACS
	Fire detection and alarm	Allowed	HBES/BACS
	Flood detection	Allowed	HBES/BACS
	Intrusion detection	Allowed	HBES/BACS
	Access control	Not allowed	HBES/BACS
	Video surveillance	Not allowed	HBES/BACS
Communications	Social alarm	Allowed	HBES/BACS
	Building intercom systems/door entry systems	Not allowed	HBES/BACS
	Indoor voice communication	Not allowed	HBES/BACS
	Outdoor voice communication	Not allowed	HBES/BACS
AV	Music distribution	Not allowed	HBES/BACS
	Video distribution	Not allowed	HBES/BACS, BCT, ICT
	TV broadcast distribution	Not allowed	BCT
IT	PC and other peripheral devices sharing	Allowed: see ISO/IEC 14763-2, IEC 60364-4-44 for details	ICT
	Internet access	Allowed: see ISO/IEC 14763-2, IEC 60364-4-44 for details	ICT
	Network storage	Allowed: see ISO/IEC 14763-2, IEC 60364-4-44 for details	ICT
General	Home supervision	Allowed: see ISO/IEC 14763-2, IEC 60364-4-44 for details	ICT

With reference to Table 1, cohabitation is:

- allowed if no significant impact of interference is expected.
- not allowed if interference is likely to create significant disturbance. Cohabitation may be admitted for limited lengths (not longer than 2 m), if necessary for practical reasons.

6.1.3 Infrastructure requirements for outdoor wired HBES/BACS

If HBES/BACS are installed outdoors within the building premises, the following additional requirements and recommendations apply:

- the underground pathways shall comply with IEC 61386-24;
- cables shall have an outdoor sheath;
- planning of underground cableways shall avoid collection of water and moisture; a minimum slope should be foreseen as shown in Figure 9;

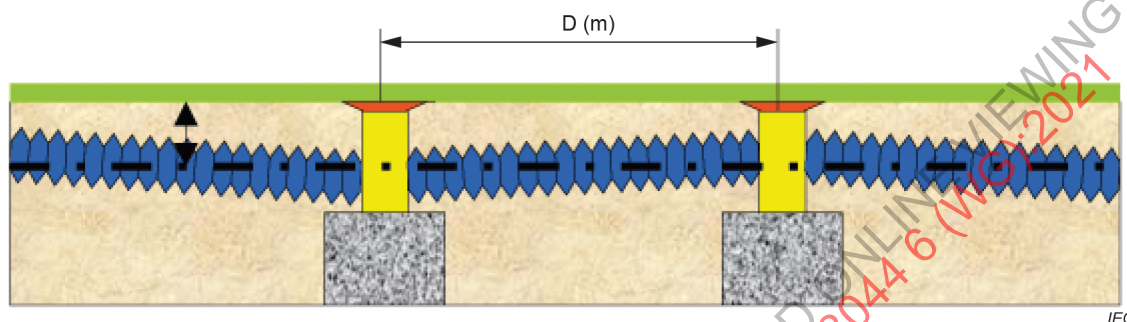


Figure 9 – Underground pathways

- the recommended depth of underground pathways is 0,5 m to 0,9 m (see also Figure 10);
- the planning of the pathways shall:
 - respect the cable bending radii (see Figure 11 showing pathways from the building to the outside). This radius depends on the type of cable. In the absence of information, 0,5 m is the recommended radius;
 - include holes for access and maintenance. The length between the holes depends on the maximum pulling strength of the cable (see Table 2);
 - consider maximum distances covered by HBES/BACS;
- boxes shall be minimum IP55.

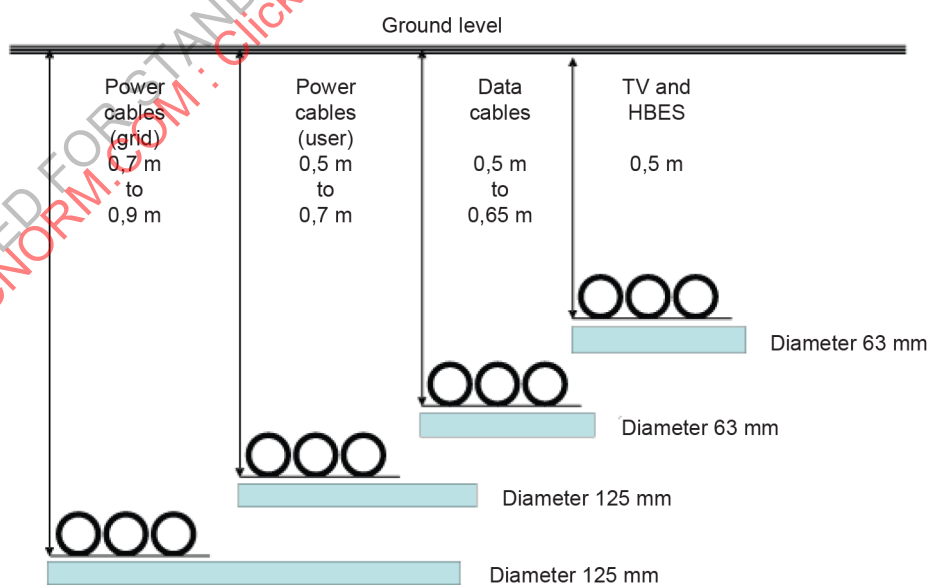
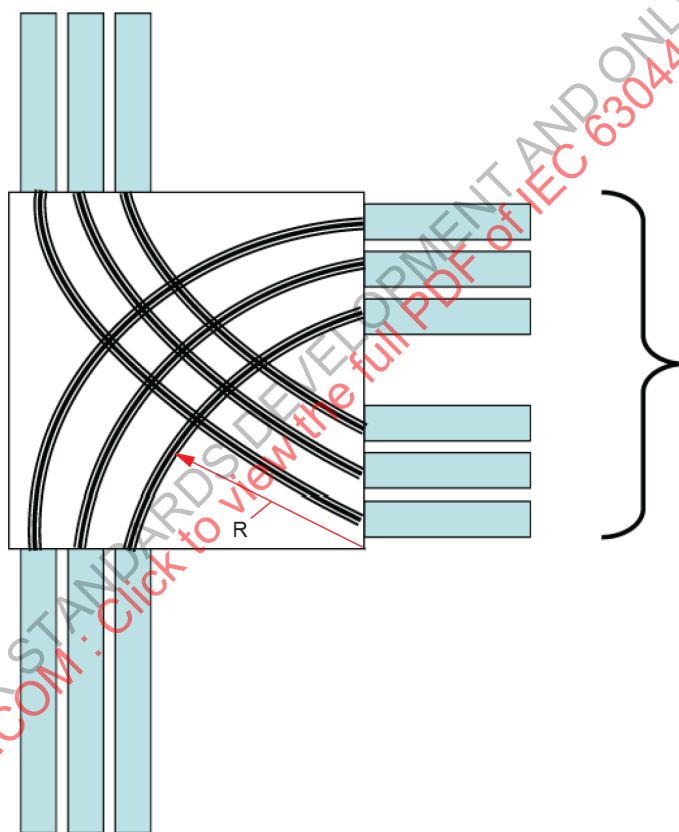


Figure 10 – Depth of underground pathways

Table 2 – Distances between pulling boxes versus type of cables

Cable type	Pulling strength (N)	Corresponding maximum distance between pulling boxes (m)
4 × TP × 24 AWG FTP/UTP	100 to 115	25 to 50
Coaxial cable 5 mm to 7 mm	60 to 90	20 to 40
Tvcc cable	90	20 to 40
TP 1,5 mm ²	75	25 to 50
TP 2,5 mm ²	125	25 to 50
HBES 4 wires	100	20 to 40
HBES 2 wires	50	20 to 40

**Figure 11 – Example of pathway planning to guarantee the respect of minimum bending radii (R): 0,5 m if no related information is provided by the cable manufacturer**

6.2 Infrastructure requirements for RF HBES/BACS

The planning of the infrastructure for RF HBES/BACS shall consider:

- positions of IS6 spaces to install devices;
- pathways to install power supply cables for RF devices;
- position of installation spaces dedicated to transmitting devices to ensure signal coverage and to minimize any potential interference of and with other equipment and systems;
- maximum distances of radio links, considering the possible attenuation from obstacles.

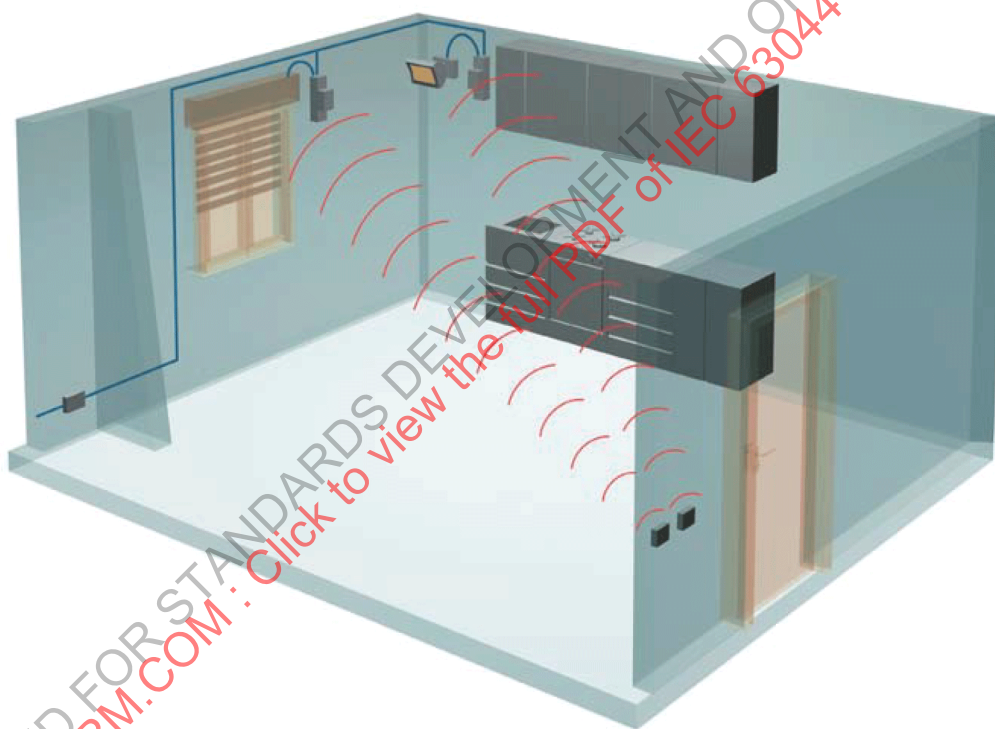
The possible presence of an obstacle between the transmitter and the receiver may be difficult to plan for, due to changes in furniture during the life of the home. For this reason, radio connections shall be planned in such a way that they have enough margin of field strength at the receiver side. Repeaters may be used to improve signal strength and coverage area.

Radio connections may also be affected by electromagnetic interferences.

EXAMPLES Interference sources in a home are

- computers and other ICT equipment,
- microwave ovens,
- electronic transformers,
- home theatre systems and television sets,
- controlgear for light sources.

HBES/BACS components may be supplied by power cable, batteries or energy harvesting (e.g. piezoelectric) as shown in Figure 12.



IEC

Figure 12 – Example of RF HBES/BACS with components supplied with power cables and batteries or energy harvesting

7 Cable for HBES/BACS

HBES cable characteristics and applications are under consideration.

8 Electrical safety and functional safety

8.1 Electrical safety

Safety requirements for HBES/BACS are in accordance with IEC 63044-3 and IEC 60364-4-41.

8.2 Functional safety

Functional safety requirements for HBES/BACS devices are in accordance with IEC 63044-4.

9 EMC

The HBES/BACS devices shall comply with the requirements of IEC 63044-5 (all parts) and of IEC 60364-4-44.

10 Earthing and bounding

Connection requirements for the screen of the bus cable (when present) shall comply with IEC 60364-5-54.

Installation of HBES devices shall consider the different earthing systems:

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

The HBES devices shall be selected accordingly.

11 Fire reaction and resistance requirements

No additional requirements to those given in IEC 60364-4-42.

12 Environmental aspects

Environmental aspects are under consideration.

13 Installation documentation

HBES/BACS should be installed based on technical documentation, with a unique reference number allocated to each installation.

The technical documentation should be handed to the user of the installation and a copy of it should be available for maintenance purposes.

This documentation may be provided electronically.

Under special circumstances, the user is allowed to modify the documentation themselves, subject to national or local regulations.

Some guidelines are provided in Annex C.

Annex A

(informative)

Guidelines on HBES/BACS installation in existing buildings

Installation spaces described in 6.1 may not be present in existing buildings. In these cases, installing HBES/BACS according to the guidelines given in this document should require refurbishment of the building.

However, HBES/BACS may be installed at reasonable costs, according to the following guidelines:

- a) external boxes are easier to be placed than those that are flush mounted;
- b) cohabitation rules reported in Table 1 allow sharing of conduits and therefore the saving of installation space;
- c) integration of a cabled network with wireless links may reduce size and total lengths of conduits;
- d) optical fibre systems may share infrastructures with non-electrical services;
- e) manufacturer's installation guidelines may give additional suggestions on sharing installation spaces.

Annex B (informative)

Installation guidelines for typical HBES/BACS applications

B.1 General

In the following subclauses, guidelines for the installation of specific applications are given.

B.2 Installation guidelines

B.2.1 Lighting and shutter control

An HBES/BACS lighting system is based on a logical connection between switches and controlled actuating devices (actuators) physically connected by a cable or an RF link (see 6.2).

The logical connection between switches and actuators may be assigned via hardware, software or a combination of both.

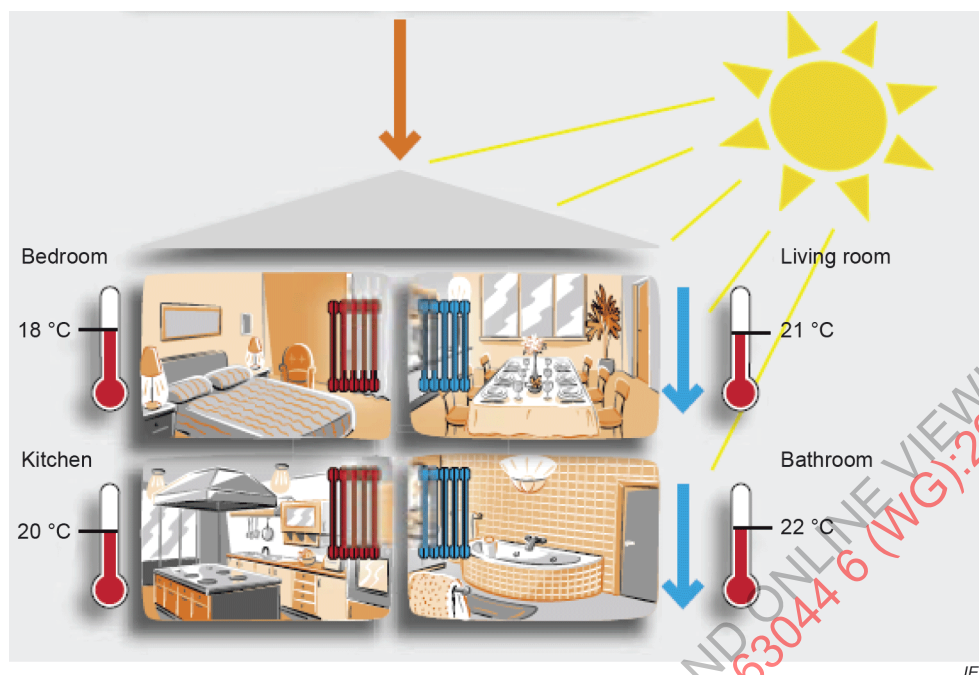
The actuators shall match the connected load: load type, power, etc. The manufacturer's instructions should include information about the compatibility between the actuators and the load.

The HBES/BACS lighting function may be activated through macro-commands releasing combinations of lighting and shutter positions (scenes). Scenes may be programmed either in sensors and/or in actuators or in specific memory devices according to manufacturer's instructions.

B.2.2 Temperature control

Home temperature control may have the following implementations:

- central automatic control: one control unit with one sensor in a home;
- zone control (see Figure B.1): each zone has an independent control unit with a local sensor.

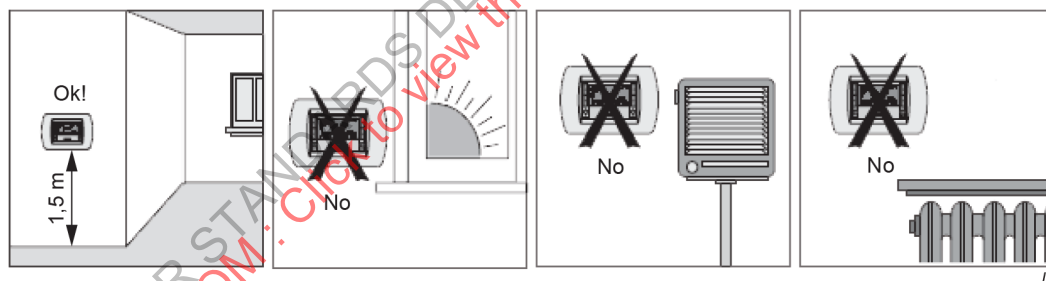


IEC

Figure B.1 – Zone temperature control concept

Temperature sensors should be located to detect a representative value (see Figure B.2):

- height from floor $1,5\text{ m} \pm 0,3\text{ m}$
- at least 1 m away from windows and heat sources.



IEC

Figure B.2 – Recommendations on temperature sensor positioning

Zone control requires a heating fluid flow control valve for each zone. Those valves are either located in a single cabinet or directly at the heat source and can be controlled independently. See Figure B.3.

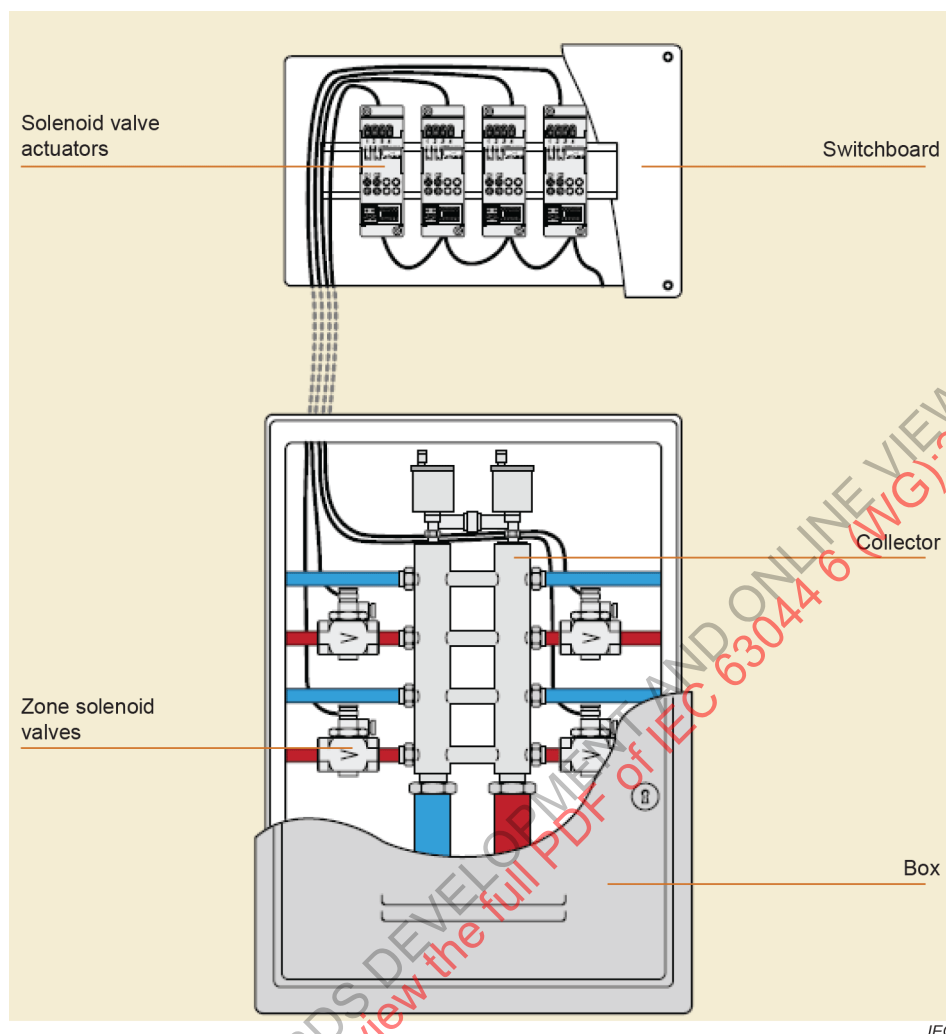
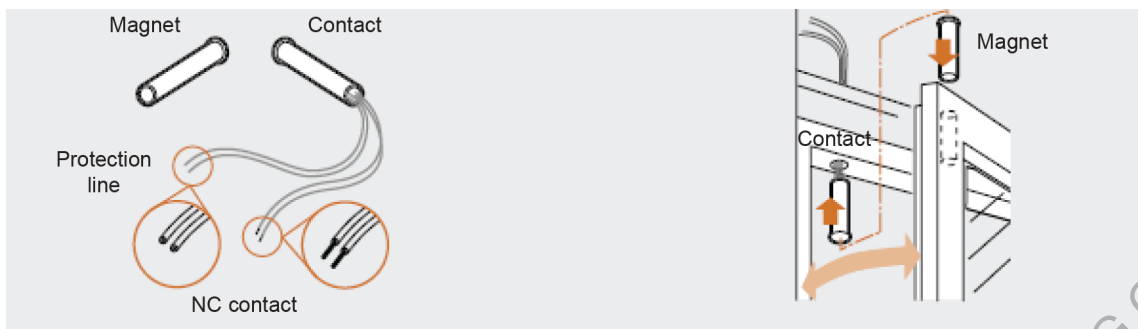
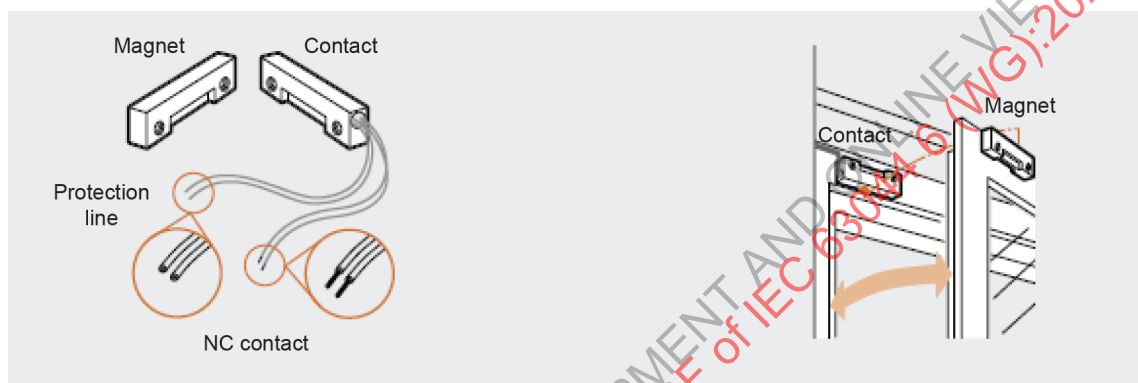
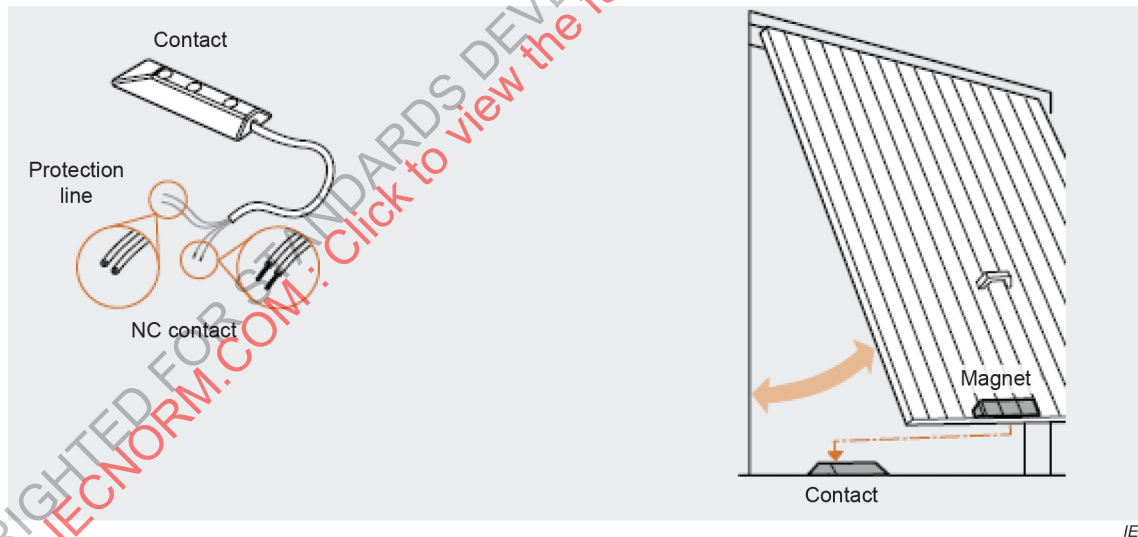
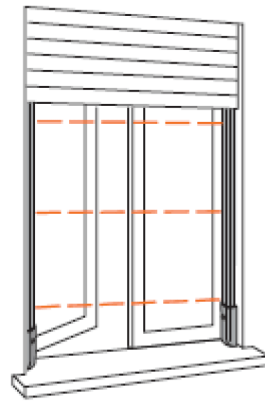


Figure B.3 – Example of home cabinet for heating flow control valves

B.2.3 Intrusion and technical alarm detection

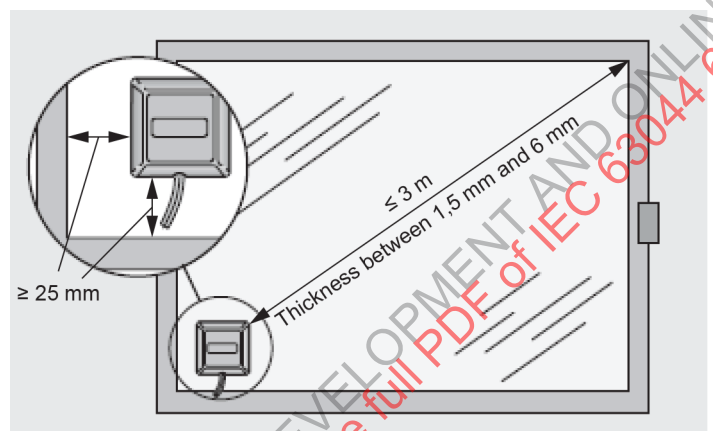
An intrusion detection function may be achieved through a network of detecting sensors communicating with a central unit able to send local or remote alarm signals. Sensors may be realised with different technologies (infrared, RF, etc.) and are specific for the type of detection: external (window/door opening, glass break) or internal (room monitoring). According to the sensor type, manufacturers provide specific installation instructions (see some examples in Figure B.4 and Figure B.5).

**a) Window opening detection****b) Window opening detection****c) Garage door detection****Figure B.4 – Examples of external detecting sensors (1 of 2)**



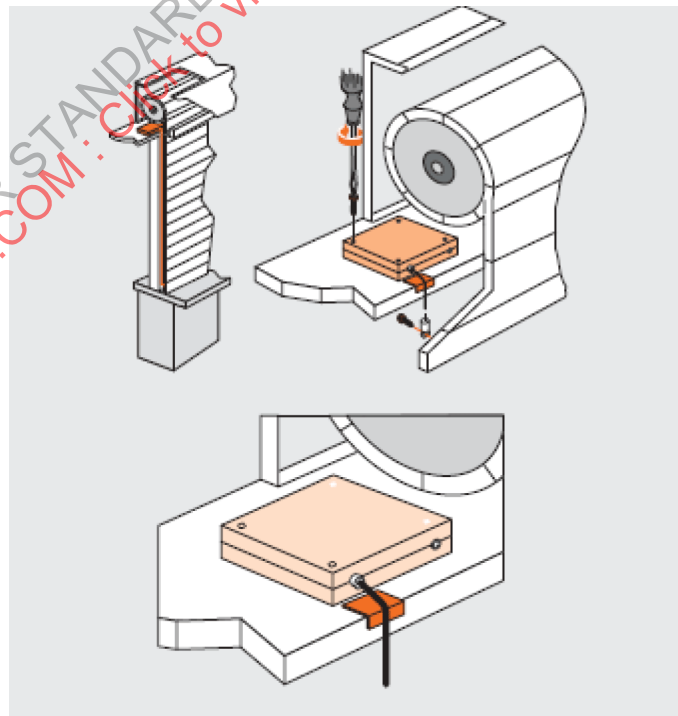
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d) Window entry detection



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e) Glass breaking detection

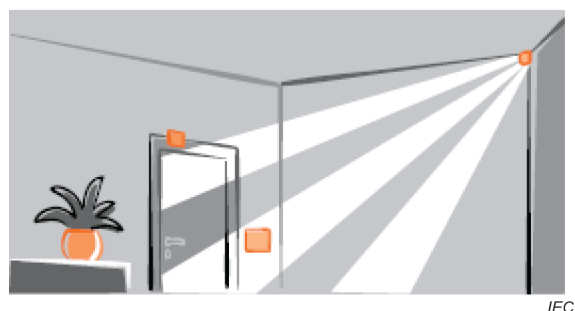


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f) Detection of forcing of shutters

Figure B.4 (2 of 2)

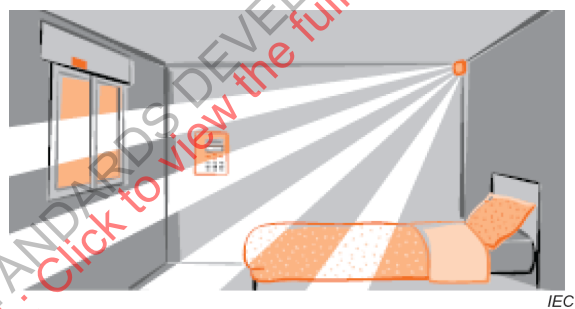
Intruder sensors should be placed to cover most of the volume of the controlled zone and any access area (e.g. doors and windows) (see Figure B.5).



a)



b)



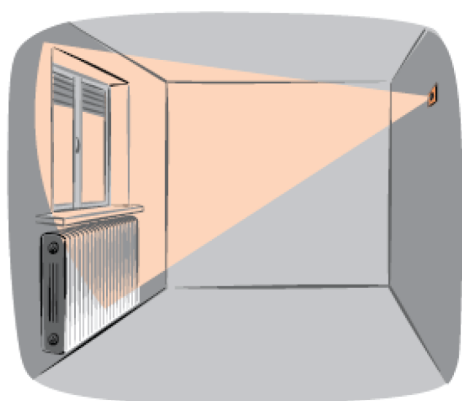
c)

Figure B.5 – Examples of internal detecting sensors and basic installation rules

Correct positioning of the internal sensor should also consider:

- the complete visibility of door and windows (Figure B.6 a);
- the presence of obstacles (Figure B.6 b);
- the opening of doors (Figure B.6 c);
- the proximity of interference sources, in the case of IR sensors, for example:
 - heat sources (Figure B.6 a),
 - direct sunlight,
 - HVAC outlets.

It should be considered that IR sensitivity may be affected by several factors such as room temperature, air flow, EMC, etc. For example: $\pm 4\text{ }^{\circ}\text{C}$ around $36\text{ }^{\circ}\text{C}$ (human body temperature).



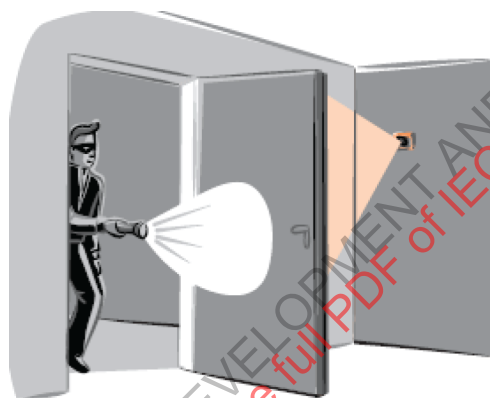
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a) Heat sources interfering with IR sensors



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b) Physical objects reducing sensor-controlled volume



IEC

c) Sensor positioning considering opening of doors

Figure B.6 – Examples of common mistakes in positioning internal sensors

Technical alarms may be integrated in the intrusion detection system including, but not limited to:

- gas sensors,
- smoke detectors,
- flooding detectors.

For those devices, the manufacturer's instructions give specific requirements for installation as for example:

- gas sensor position:
 - methane: 20 cm to 40 cm below the ceiling,
 - LPG: max. 20 cm above the floor,
 - in the kitchen and/or in proximity of gas equipment,
 - 1 m to 8 m distance from the gas equipment.
- smoke detectors:
 - positioned on the ceiling.

– flooding detectors:

- positioned in the bathroom, kitchen or other rooms with water outlets,
- ground floor,
- positioning shall consider the slope of the floor to collect water (see Figure B.7).

The alarm messages generated by these sensors may be fed into the intrusion detection system to generate corresponding alarms.



Figure B.7 – Example of flooding detection