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GUIDE

Home control systems – Guidelines relating to safety

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HOME CONTROL SYSTEMS – GUIDELINES RELATING TO SAFETY

FOREWORD

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This second edition of IEC Guide 110 has been prepared, in accordance with the ISO/IEC Directives, Part 1, Annex A, by the IEC Advisory Committee on Safety (ACOS). This is a non-mandatory guide in accordance with SMB Decision 136/8.

This second edition of IEC Guide 110 cancels and replaces the first edition published in 1996.

The main changes with respect to the previous edition are as follows (minor changes are not listed):

– addition of several new electrical safety aspects;
– inclusion of cyber security;
– consistent use of the term "equipment" to replace terms such as "device", "system", "product", etc.;
– bringing the document structure in line with the latest ISO/IEC Directives;

– updating the references to standards and IEC technical committees to reflect the current situation.

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

Four months' vote	Report on voting
C/1785A/DV	C/1796/RV

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

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

A bilingual version of this publication may be issued at a later date.

HOME CONTROL SYSTEMS – GUIDELINES RELATING TO SAFETY

1 Scope

This Guide provides background information to technical committees when dealing with safety requirements for products intended to be integrated in a home control system. It includes information on functional safety as well as conventional safety aspects relevant to home control systems.

This Guide defines the safety-related characteristics of systems intended for signal transmission through building wiring carrying low voltage or extra low-voltage, through fibre optics, through air or by electromagnetic waves in household and similar premises (home control systems).

This Guide deals with home control systems providing control communication for equipment used within homes. This includes the control of equipment for cooling, heating, lighting, audio/video, telecommunications, security, etc., in fact, any equipment controlled by the home control system. It also includes residential gateways between the internal home control system network and external wide-area networks such as the internet. The Guide also covers similar building management functions in commercial buildings of similar complexity.

EMC aspects are not covered, since these are dealt with by IEC Guide 107.

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

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

EN 50491-3*, General requirements for home and building electronic systems (HBES) and building automation and control systems (BACS) – Part 3: Electrical safety requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 51 as well as the following apply.

3.1
home network
internal network for digital and analog information transport in a single family dwelling or business premises of similar complexity, providing defined access points and using any transmission medium in any topology

3.2
home control system
home network together with all the equipment attached to it, including the rules for control, communication and management among application processes

3.3
application protocol
standardized language, used by application processes to exchange information in a home control system, transported without interpretation by the home network resources

3.4
functional safety
ability of a home control system to carry out the actions necessary to achieve and maintain an appropriate level of safety both under normal conditions and in case of a fault that might result in a hazard

4 Home control systems

A variety of electrically-controlled equipment may be used in homes and similar environments for many different applications.

Examples of such applications are:

– lighting;
– heating;
– washing;
– entertainment (audio/video);
– energy management;
– water control;
– fire alarm;
– blinds control;
– garage door openers;
– different forms of security control (audio/video).

When several pieces of equipment are able to interwork via a home network, wired or wireless, the resulting total system is referred to as a home control system.

A home network may be based on different transmission media (for example, power network, twisted pair, infrared or radio, wireless) and may also be connected to outside networks (for example, telephone networks, cable networks).

A home control system will typically first be assembled to cover certain basic applications, for example control of lighting, heating and ventilation. It may include equipment from different manufacturers. This equipment is, in many cases, the responsibility of different IEC product committees.

Furthermore, it is likely that the system will be later extended to cover more applications. In many cases, these extensions will not be made by the person who installed the original system.

In a conventional electrical installation system, each function needs its own cable and each control system is a separate network. In contrast, a home electronic system may enable sensing, switching, control, monitoring and signaling on all functions and sequences by a single wired or wireless connection. The power can be directly connected to a piece of equipment or may be derived from the network.

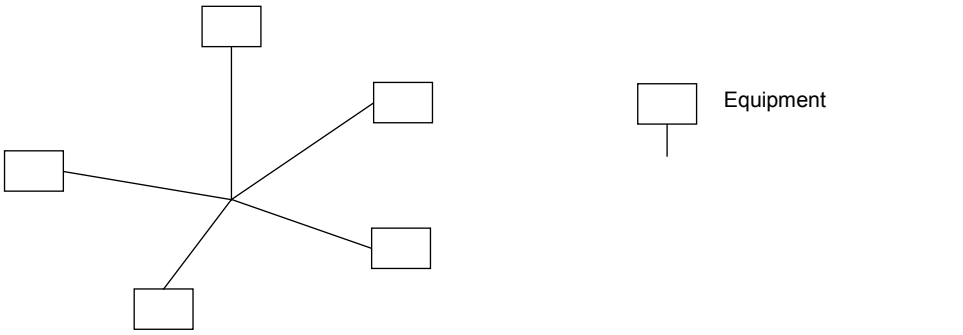
A home control system comprises a network for transmission of signals between pieces of equipment connected to the home network. The equipment is connected via an interface. The interface may be integrated into the equipment. All pieces of equipment connected to the home control system may be able to communicate with one another without the need for a central computer.

The size of the home control system can vary from only a few types up to hundreds of different types of equipment, connected as one system.

The home network is intended for general control applications and allows several topologies, as shown in Figure 1. Combinations of the topologies are possible.

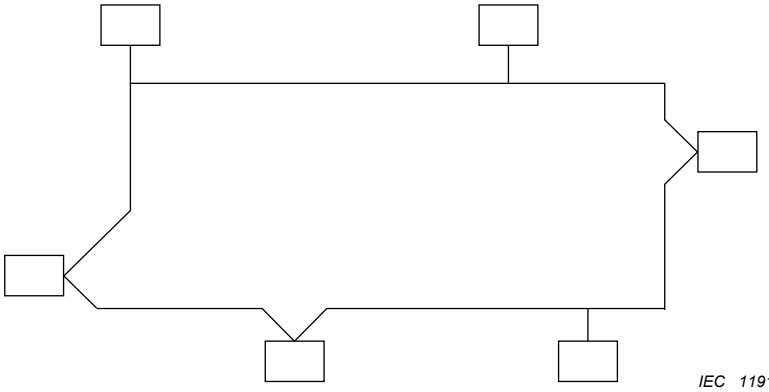
IEC 1189/14

Figure 1a – Bus topology



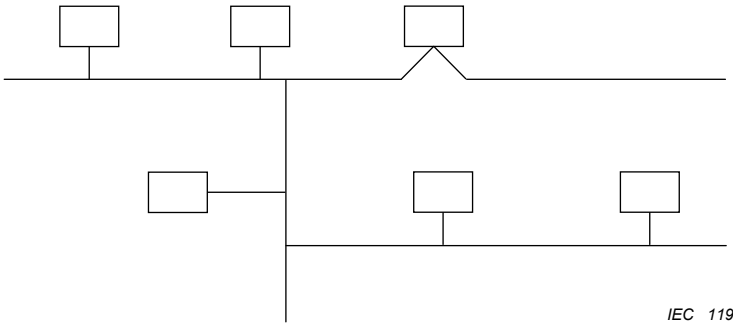
IEC 1190/14

Figure 1b – Star topology



IEC 1191/14

Figure 1c – Loop or ring topology



IEC 1192/14

Figure 1d – Tree topology

Figure 1 – Examples of possible topologies

Equipment connected to a home network can be powered in different ways, as shown in Figure 2.

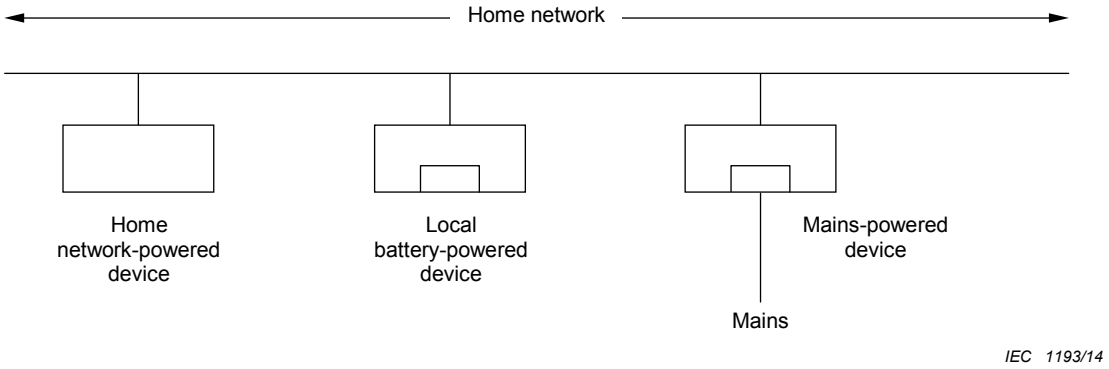


Figure 2 – Example of different ways of powering equipment

5 Safety aspects

5.1 General considerations

The level of safety of a product, process or service is a balance between freedom from unacceptable risk of harm and other demands, such as suitability for purpose and cost.

For determination of the safety requirements, a home control system should be considered as follows:

– equipment intended for connection to the network;
– network;
– installation of equipment in the network;
– system;
– connection of the home control system to other systems, such as telecom or alarm systems.

It is common to the concept of a home control system that the safety aspects are significantly affected by system configuration and installation in addition to the design of the connected equipment.

Therefore, guidance for the design, installation, configuration, extension and maintenance of such systems needs to be provided so that potential safety problems are avoided.

When specifying safety requirements for a home control system, the following should be considered:

– functional safety;
– equipment safety;
– cyber security.

Equipment used in a home network shall, as a minimum, comply with the equipment's respective product safety standard.

Equipment which is considered safe according to the relevant product safety standard shall remain safe when connected to a home network. This Guide specifies, in addition to the specific product standard, equipment and functional safety requirements that should be taken

into account when the equipment can be connected to a network. The equipment shall remain safe under normal and single fault conditions of the home network and at the same time under normal and single fault conditions of any piece of equipment within the home network. This includes protection from over-voltages on the network, protection from hazards caused by connection of different types of circuits, the limitation of the touch current to a network and protection of the communication wiring from overheating.

In addition, several additional issues should be taken into account. Standards that describe several of these issues in more detail include, but are not limited to:

– IEC 61508 series for functional safety issues;
– EN 50491-3, which explains in somewhat more detail the additional safety requirements, when equipment or systems are connected to a network;
– EN 50491-4-1, which explains in somewhat more detail how to take functional safety into account together with some electrical safety issues;
– IEC 60730-1, for controls used as system components in home control systems, to ensure functional safety home control systems including cyber security by communication through open networks such as mobile or internet.

5.2 Functional safety aspects

It is essential that no part of a home control system rely upon unconfirmed safety critical information. This applies equally to new and modified systems (extensions, changes of configuration).

Confirmation of safety critical information can be:

– explicit (for example, by a validation process);
– implicit (for example, by a message format which is unlikely to be simulated by spurious events).

The network or any other part of a home control system should not interfere with the safety of the equipment; all safety requirements of the product standard of the equipment should be complied with. Similarly, connection of the equipment should not interfere with the safety of the home control system.

If a piece of equipment relies upon the system for its safe operation but cannot verify correct functioning of the system, the equipment has to maintain an appropriate level of safety.

Taking these aspects into account, the intended applications have to be analyzed to identify all dangerous situations that may occur during operation.

Examples:

– A miniature circuit-breaker with a bus-operated remote actuator has tripped. Consequences of allowing a remote reset of the miniature circuit-breaker via the home control system should be analyzed as to the risk of creating a dangerous situation.
– Some appliances according to the IEC 60335 series are not intended for unattended use. Appliances for attended use should not be integrated in a home control system.
– Traditionally it is allowed to control a cooking hob by, for example, a timer, which means that it may be operated unattended. If the range or hob forms part of a home control system, it can be operated in the same way. However, unintentional operation (start) could cause the cooking hob to be switched on without this being noticed. A fire may then be caused by burning packaging or food that was put on the hob with the intention to cook it at a later time.
– More and more safety-related controls are driven by software. To upgrade the software or to improve the performance of the control, function parameters could be updated. To keep the service cost low, remote access, for example through internet, is more and more

common. As part of steps to address “foreseeable misuse”, appropriate measures should be taken into account to ensure cyber security.

The analysis of the intended applications should ensure compatibility between products from different manufacturers and between different generations of the product from the same manufacturer.

Guidelines for functional safety of home control systems can be found in ISO/IEC 14762.

5.3 Equipment safety aspects

5.3.1 General

Equipment safety for the different parts of the system is mainly covered by the existing IEC product standards. However, the connection to a home control system of products covered by different IEC standards creates a need for the harmonization of requirements. Therefore, some safety aspects, for example, accumulation of leakage current or different earthing needs, should be considered in view of the connection of many different pieces of equipment to the system. Especially in the area of work of TC 61 and TC 108 this might lead to additional requirements in product or system standards.

The same applies to the connection of different systems to each other, for example home control systems, telecom systems, alarm systems and local area networks (LAN).

It is also important that safety aspects be treated in a compatible way for items covered differently in their product standards, for example SELV/PELV, creepage distance and clearances.

The safety aspects related to the use of home control systems between two different buildings not belonging to the same equipotential zone should be studied.

5.3.2 Startup after failure

In case of failure, equipment shall restart safely when the power is restored. Failure could be a failure within the equipment itself, as well as failure due an external cause, such as a power failure. It should be taken into account that equipment in a home network might be working unattended.

5.3.3 Lifetime safety

Equipment shall be designed for a defined useful lifetime. At the end of the lifetime, equipment should fail safely, taking into account the fact that equipment in a home network might be working unattended.

5.3.4 Reasonably foreseeable misuse

Equipment used in a home network system shall be designed to take into account any reasonable foreseeable misuse, during which the equipment should remain safe.

5.3.5 Summation of touch current

Equipment that provides a home network connection for connection of multiple items of other equipment shall not create a hazard due to summation of touch current. Guidance to detailed requirements can be found in IEC 60950-1:2005, Annex W, in IEC 62368-1 and in EN 50491-3.

5.3.6 Communication

Equipment used in a home network system should remain safe, independent of the communication on the home network. Any disturbance or wrong commands through the

network should not create an unsafe situation. The home network should be immune to cyber threats.

6 Conclusions and recommendations

In view of the convergence of technologies used in home control systems, information technology equipment, telecommunications etc., the relevant TCs should align their terminology and harmonize requirements in accordance with the principles of IEC Guide 104.

Functional safety in a home control system relies on the unambiguous transmission of information, by means of an application protocol, and on the stability and compatibility of all the software involved.

ISO/IEC JTC 1/SC 25/WG 1 and/or IEC TC 72 should prepare guidelines to be taken into consideration by IEC product committees when they prepare requirements for the functional safety of products intended to be integrated in a home control system.

NOTE IEC SC 65A, System aspects, has a horizontal safety function as defined in IEC Guide 104 for "Functional safety of electric/electronic/programmable electronic systems, which encompasses safety-related software".

With reference to the above, IEC product committees should note the possible need for inclusion in their standards of additional safety requirements for products intended to be integrated in a home control system.

Examples of IEC product committees include the following:

TC 13 Electrical energy measurement and control

TC 20 Electric cables

TC 23 Electrical accessories

TC 34 Lamps and related equipment

TC 61 Safety of household and similar electrical appliances

TC 66 Safety of measuring, control and laboratory equipment

TC 72 Automatic electrical controls

TC 79 Alarm and electronic security systems

TC 96 Transformers, reactors, power supply units and combinations thereof

TC 108 Safety of electronic equipment within the field of audio/video, information technology and communication technology

SC 121A Low-voltage switchgear and controlgear

SC 121B Low-voltage switchgear and controlgear assemblies

Bibliography

IEC 60335 (all parts), *Household and similar electrical appliances – Safety*

IEC 60730-1, *Automatic electrical controls – Part 1: General requirements*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety equipment*

IEC Guide 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications*

IEC Guide 107:2010, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

ISO/IEC 14762, *Information technology – Functional safety requirements for Home and Building Electronic Systems (HBES)*

EN 50491-4-1, *General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) – Part 4-1: General functional safety requirements for products intended to be integrated in Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS)*

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