INTERNATIONAL STANDARD

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Building automation and control systems (BACS) —

Part 2: **Hardware**

Systèmes de gestion technique du bâtiment —
Partie 2: Équipement

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16484-2 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 205, *Building environment design*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 16484 consists of the following parts, under the general title *Building automation and control systems (BACS)*:

— *Part 1: Overview and definitions*

— *Part 2: Hardware*

— *Part 3: Functions*

— *Part 4: Applications*

— *Part 5: Data communication protocol*

— *Part 6: Data communication — Conformance testing*

— *Part 7: Project implementation*

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Foreword

This document (EN ISO 16484-2:2004) has been prepared by CEN /TC 247, "Building Automation, Controls and Building Management", the secretariat of which is held by the SNV, in collaboration with ISO/TC 205 "Building Environment Design".

This document has to be implemented at national level, either by publication of an identical text or by endorsement, by February 2005, and conflicting national standards have to be withdrawn by February 2005.

The EN ISO 16484-2 is part of the EN ISO 16484 series of International Standards under the general title *Building Automation and Control Systems (BACS)*, which will comprise the following parts:

Part 1: *Overview and Vocabulary*

Part 2: *Hardware*

Part 3: *Functions*

Part 4: *Applications*

Part 5: *Data communication - Protocol*

Part 6: *Data communication - Conformance testing*

Part 7: *Project specification and implementation*

In this standard, Annex A: *General safety requirements and environmental conditions* and the Bibliography are both informative.

The Annex ZA *Normative references to international publications with the corresponding European publications,* is normative.

NOTE National annexes may contain information provided for easier implementation, e.g. an alphabetical index or national footnotes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom

Introduction

This series of standards is intended for design of new buildings and retrofit of existing buildings for an acceptable indoor environment, practical energy conservation and efficiency.

The application of this series of standards for BACS is envisaged as follows:

- the environmental design for all building types requires complex methods for automation and control. The functional integration of services other than HVAC e.g. lighting and electric power distribution control, security control, transportation, maintenance management or facilities management is a general task for all parties employed to develop an integrated multi-application system. This integration allows the user to take advantage of synergies between the different applications. This standard will give guidance to architects, consultants and contractors as well as to users on how to share such resources,

- the innovation cycles between devices, systems and networks vary. To make it possible to add and to change existing devices, and extend the building automation and control network, several interfaces both proprietary and standardized are defined between the BACS network and the other systems. A manufacturer can design a product, both to meet his specific marketing objectives and to give the option to integrate that special device into a multi-application BACS. Interfaces are also defined in appropriate parts of this standard along with the necessary communications protocol and conformance test required to support the inter-working of devices,

- a manufacturer, a systems house, or an electrical or mechanical contractor can assemble an implementation of a building automation and control system,

- the application of this standard is not to standardize the hardware and software design or the architecture of a System, but to define the process for the creation of project specifications, where functionality and the quality of the solution are clearly defined.

The purpose of this series of standards is intended for use by those involved in the design, manufacture, engineering, installation, commissioning, operational maintenance and training of BACS when contracted, i.e.:

— as a guide to the terminology of the building automation and control trade. Unambiguous terminology is required for a complete and accurate conveyance of the intent and details of this standard;

— in product development, to avoid unnecessary duplication of function or terminology, but should not place a restraint on the evolution of new products, systems or applications;

— as a basis for interfacing products and systems. In order to interoperate, the elements of a BACS require a unified data communication protocol and information model;

— as a basis for drawing up a project specification for the procurement of building automation and control products for systems suppliers and customers;

— as a code of practice for expertly commissioning prior to handover of a system;

— by educational establishments wishing to train people in the field of building automation and control systems.

This entire series of BACS standards consists of the following contents:

Part 1: Overview and definitions (in preparation)

Part 1 of this standard describes the objectives and interrelationships of all parts of this standard. It provides an overview and detailed information about the structure of the related series of standards for the BACS industry. This part of the standard provides also the vocabulary with terms and definitions for the understanding of the entire series of this standard and it contains a translation of the main terms in English, French, Russian, and German in an informative annex.

This ongoing work is coordinated at expert level with standards work from ISO/TC 205 WG 3 and CEN/TC 247/ WG 3, WG 4, WG 5 and WG 6.

Part 2: Hardware (refer to the scope of this part)

Part 3: Functions

Part 3 of this standard specifies the requirements for the overall functionality and engineering services to achieve building automation and control systems. It defines terms, which shall be used for specifications and it gives guidelines for the functional documentation of project/application specific systems. It provides a template for documentation of plant/application specific functions, called BACS function list in annex A.

The informative function block examples explain a method to display the referenced functions in system documentation; they do not standardize the method for programming functions and applications.

This Part 3 of the standard covers the following:

Requirements and definitions regarding BACS and application software, generic functions for plant/project specific applications and engineering functions for building controls and operations. It provides communication functions for the integration of other dedicated special system processes. The functional requirements in this part of the standard are subdivided as follows:

— System management and application software:

  describes the requirements for plant independent system and human system interface programs related to a project, including the operating system. This standard does not dedicate the following system functionality to any particular hardware, e.g.:

  — system diagnostics, watchdog, redundancy, time keeping, access control, log lists;

  — point identification, event message handling, print control;

  — database, statistics, data archiving, remote access;

  — system communications.

— Human system interface (HSI), point information presentation, graphics, alarms, time scheduling

— Engineering process and tool software:

  describes the requirements for configuring of the hardware and control strategies, the system management and the commissioning process.

— BACS application processing programs and plant/application specific functions:

  describes the requirements for plant, application and / or project specific functions and a method for the documentation of a project. The functions are subdivided into the following types:

  — input and output functions;

  — processing functions;

  — management functions and required communications;

  — operator functions.

Part 3 defines a method for creating the procurement specifications containing all essential elements required for the operational functioning of a BACS. The successful installation and operation of a BACS requires that its procurement be based on a complete specification with accurately defined functions.

The standard provides a template called the ‘BACS function list’ that can be found in annex A (normative). Its purpose is to determine and document the options for plant / application specific functionality. Further

explanations can be given in form of plant/control descriptions, control flow chart diagrams, and plant/control schematics. Examples are given in annex B (informative). The exact specifications will be project-specific. Information about the standardized functions is given in the form of informative examples as function-blocks, textual, and graphical descriptions in 5.5.

It is recognized, that functions can be described and implemented in many different ways, depending on:

— climatic differences;

— cultural and regional differences;

— national regulations.

Part 4: Applications

Part 4 of this standard specifies the requirements for specific communicating applications/devices, e.g. for general room automation and for sophisticated optimization of controls for heating, fan coil and induction units, CAV, VAV and radiant cooling.
This work will be coordinated at expert level with standards work from ISO/TC 205 WG 3 and CEN/TC 247.

Part 5: Data Communication – Protocol

Part 5 of this standard specifies data communication services and objects for computer equipment and controllers used for monitoring and control of HVAC&R and other systems of building services.

This protocol provides a comprehensive set of objects for conveying encoded binary, analog, and alphanumeric data between devices including, but not limited to:

— input measuring: analog input object;

— output positioning/set-point: analog output object;

— binary input counting;

— input state: binary input object, multi-state input;

— output switching: binary output object, multi-state output;

— values: analog value, binary value, multi-state value, accumulated value, averaging object, trend log object;

— text string;

— schedule information;

— alarm and event information;

— files; and

— control programs and parameters respectively.

This protocol models each building automation and control system as a collection of data structures called objects, the properties of which represent various aspects of the hardware, software, and operation of the device. These objects provide a means of identifying and accessing information without requiring knowledge of the details of the device's internal design or configuration.
An overview of possible integration with other systems in buildings, e.g. fire, security, access control, maintenance and facilities management, is shown in Figure 1 of Part 2 of this standard.

Part 6: Data Communication – Conformance testing

Part 6 of the standard specifies the technical requirements of the conformance test suite and the methods for testing the products for the conformance with the protocol. It provides a comprehensive set of procedures for verifying the correct implementation of each capability claimed on a BACS network protocol implementation conformance statement (PICS) including:

a) support of each claimed BACS network service, either as an client (initiator), server (executor), or both;

b) support of each claimed BACS network object-type, including both required properties and each claimed optional property;

c) support of the BACS network layer protocol;

d) support of each claimed data link option, and

e) support of all claimed special functionality.

Part 7: Project specification and implementation

Part 7 of this standard specifies methods for project specification and implementation of BACS and for integration of other systems into the BACS. This standard defines terms to be used for project specifications and gives guidelines for integration of other systems.

a) Project specification and implementation:

This clause of the standard describes the procedures (codes of practice) required for the following:

— project specification;

These procedures also contain an example for a plant/system/customer premises wide unique structured addressing system for data point identification;

— engineering;

— installation;

— project handover.

b) System integration:

This clause of the standard describes the special requirements/procedures for the integration and implementation of intersystem communication with foreign systems and the interconnection of other units/devices with integrated communications interfaces, e.g. chillers, elevators.

1 Scope

This part of the standard specifies the requirements for the hardware to perform the tasks within a BACS. It provides the terms, definitions, and abbreviations for the understanding of Part 2 and Part 3.

Part 2 relates only to physical items/devices, i.e.:

— operator stations and other human system interface devices;
— devices for management functions;
— control devices, automation stations and application specific controllers;
— field devices and their interfaces;
— cabling and interconnection of devices;
— engineering and commissioning tools.

This part of this standard shows a generic system model to which all-different types of BACS and their interconnections (BACS network) can fit. A graphical concept of the BACS network in terms of LAN and inter-network topology will be provided in Part 5 of this standard.

National annexes:

National annexes may specify the local requirements of physical and electrical characteristics, the verifications for BACS devices and equipment, and the code of practice for the physical installation of systems. The annexes shall refer to the regional implementations of the relevant IEC standards.

2 Normative references

The following referenced documents are indispensable for the application 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 60050-351	*International Electrotechnical Vocabulary — Part 351: Automatic control*
IEC 60529:1989 + AMD1:1999	*Degrees of protection provided by enclosures (IP code)*
IEC 60664-1:1992 +AMD1:2000 +AMD2:2002	*Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests*
IEC 60715:1981 +AMD1:1995	*Dimensions of low-voltage switchgear and controlgear — Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations*
IEC 61131-3:2003	*Programmable controllers — Part 3: Programming languages*
ISO/IEC 2382-1:1993	*Information technology — Vocabulary — Part 1: Fundamental terms*
ISO/IEC 2382-18:1999	*Information technology — Vocabulary — Part 18: Distributed data processing*
ISO/IEC 2382-26:1993	*Information technology — Vocabulary — Part 26: Open Systems Interconnection*
ISO/IEC 7498-1:1994	*Information technology — Open Systems Interconnection — Basic reference model — Part 1: The basic model*
ISO/IEC 10746-2:1998	*Information technology — Open Distributed Processing — Reference model — Part 2: Foundations*
ISO/IEC Guide 2:1996	*Standardization and related activities — General vocabulary*

3 Terms and definitions

This clause presents the vocabulary used in this Part 2 and Part 3 of the standard for BACS.

The terms and definitions listed in this standard but defined by other relevant ISO/IEC International Standards are repeated below for convenience in most cases.

NOTE Other language versions may contain an alphabetical index in National Annexes.

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

3.1
3-point control
control function with a three-position output that can assume only three discrete values: zero and two values with opposite signs. These output values are used to position with two binary signals providing three control states

EXAMPLE
a) opening, stopped, closing;
b) more, neutral, less;
c) heating, neutral, cooling.

3.2
access control
<BACS> method for determining or restricting access to system and network resources
[Part 5, 3.2.1]
cf**. access control system** (3.3)

NOTE 1 Also refer to security and operator authentication.

NOTE 2 Data privacy protection is the framework conditions protecting personal data from being used by any one other than the owner (regulated by national law).

NOTE 3 Data security is the framework conditions to protect data from direct or indirect manipulation or unauthorized use. Data manipulation includes loss of data, destruction or falsification of data.

NOTE 4 Data security means are the measures and equipment to secure and maintain the safety of data.

3.3
access control system
1) <BACS> a dedicated special system for security
cf. **access control** (3.2)

2) <security> automatic checking of access rights under organizational measures and barrier/door control for buildings/rooms, including registration of events

NOTE An access control system belongs to security systems.

3.4
acknowledge
<BACS> the recognition and/or registration of an event (e.g. alarm) by an operator

NOTE An acknowledgement can be invoked by an operator using a physical device, or by using a human system interface e.g. selecting an Icon on a VDU.

3.5
acknowledgement
<communications> a function that allows a destination node to inform a sending node of the receipt of a protocol-data-unit
[ISO/IEC 7498-1:1994]

3.6
actuator
<BACS> **field device** (3.80) that interfaces to control a plant process, operated electrically, pneumatically, or hydraulically. It influences the mass flow or energy flow
c.f. **positioning actuator** (3.153)

NOTE 1 A control valve is the combination of a valve with its operating element.

NOTE 2 A regulating element (functional unit), or a final controlling element (physical unit) [IEV 351], i.e. a damper, a valve is often referred to as positioning actuator (3.1.5.3).

3.7
actuator
<HBES> bus communications output device (analog or binary), e.g. to control a load, a contactor, or a positioner
c.f. **switched actuator** (3.185)

NOTE 1 A binary actuator is sometimes also referred to as switched actuator (on/off type).

3.8
address
<BACS> unique object identifier and/or device identifier within a system or combined systems
1) cf. **point address** (3.150)
2) cf. **user address** (3.196)

NOTE 1 In BACS, each data point has an identifier named point address.

NOTE 2 In BACS, each communications object has properties named object identifier and object name.

3.9
addressing system
address scheme
unique structured method for data point identification to address the information provided in BACS, consisting of a scheme and the semantics of the elements
cf. **user address** (3.196)

NOTE 1 This scheme can apply throughout a plant, a complete BACS, or the entire customer premises as appropriate.

3.10
alarm
<BACS> warning of the presence of a hazard to a property or the environment, in security systems also to life

NOTE 1 An annunciation either audible or visual or both that alerts an operator to an abnormal condition, which can require corrective action.
[Part 5, 3.2.2]

NOTE 2 An abnormal condition detected by a device or controller that implements a rule or logic specifically designed to look for that condition, e.g. ‘frost alarm’.

3.11
algorithm
1) <BACS> calculation that results in an output by evaluating input variable(s)

2) <control technology> completely determined finite sequence of instructions by which the values of the output variables can be calculated from the values of the input variables
[ISO 60050-351]

3.12
alphanumeric
character set, that consists at least of decimal digits and letters

NOTE It is advisable to specify the extent of the character set in each case.

3.13
analog input/output
part of the hardware pertaining to a control device for measuring or positioning

3.14
analog value
information containing a numerical represented quantity

3.15
application
a set of functions that together form a logical unit supporting a process

NOTE 1 A BACS supports many different applications.

NOTE 2 A set of a user's information processing requirements.
[ISO 8649], [Part 5, 3.1.2]

3.16
application object
object located within the BACS device's application process
cf. **object type** (3.133)

NOTE See object (3.132).

3.17
application specific controller
ASC
controller
customized device fulfilling the requirements of a specified application

NOTE In BACS, a controller is any device capable of controlling/automation and possibly monitoring other devices and units.

3.18
architecture
<BACS> structure and means by which components and devices of a system are connected to intercommunicate

3.19
automation
SEE **control** (3.51)

NOTE Also refer to **processing functions** (3.155).

3.20
automation network (US)
AN
control network (GB)
CN
connections between controllers, operator stations / panels, programming units, data interface units, and data processing devices (e.g. server stations)

NOTE A schematic diagram is shown in figure 1.

3.21
backup
1) <data processing> process to copy/export data to the data storage of an external backup device to retrieve and restore this data in case of a storage fault. The copy is referred to as backup copy

2) <general> supporting services

3.22
backup power operation
operating mode using reserve power supply systems for building operation

3.23
BACS application program
software to perform one or more tasks of a BACS

3.24
BACS function list
BACS FL
information list (deprecated)
Spreadsheet list for documentation and summing up BACS functions, defined in Part 3 of this standard

NOTE A BACS points list (BACS PL) in some countries referes to the physical I/O only.

3.25
BACS network
Building automation and control system network to exchange information between digital (binary), analog, and other communication objects in different devices.

3.26
binary (signal)
signal that represents the state (e.g., on/off) of a single binary coded digital information (logic 0 and I). It applies to input and output functions of a BACS

NOTE 1 In BACS, a digital value is a variable that represents the value of digitally coded analog or binary information. It applies to shared/network data points.

NOTE 2 Devices with a number of binary inputs/outputs are often referred to as digital (3.65).

3.27
binary input/output

hardware pertaining to control devices for state processing or switching

NOTE The function is referred to as binary input state and output switching.

3.28
bridge
device that connects two or more segments of a network at the physical and data link layers of the ISO-OSI basic reference model

NOTE This device can also perform message filtering based on MAC layer addresses.
[Part 5, 3.2.6]

3.29
building
large volume individual fixed structure other than industrial structures, i.e. commercial, industrial, or commercial residential premises
cf. **house** (3.94)

NOTE BACS can be employed also for other structures, as e.g. house, tunnel, railway, ship.

3.30
building automation and control
BAC
description for products, software, and engineering services for automatic controls, monitoring and optimization, human intervention, and management to achieve energy – efficient, economical, and safe operation of building services equipment

NOTE The trade designation and the industry branch are also referred to as building automation and/or building control.

3.31
building automation and control system
BACS
system, comprising all products and engineering services for automatic controls (including interlocks), monitoring, optimization, for operation, human intervention, and management to achieve energy – efficient, economical, and