INTERNATIONAL STANDARD

ISO 16484-3

First edition
2005-01-15

Corrected version
2007-11-15

Building automation and control systems (BACS) —

Part 3: **Functions**

Systèmes de gestion technique du bâtiment (SGTB) —

Partie 3: Fonctions

Reference number
ISO 16484-3:2005(E)

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

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 16484-3 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 247, *Building automation, controls and building management*, 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)

This corrected version of ISO 16484-3:2005 contains numerous changes to be consistent with EN/ISO 16484-3:2005.

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

— *Part 2: Hardware*

— *Part 3: Functions*

— *Part 5: Data communication protocol*

— *Part 6: Data communication conformance testing*

Two parts are under development:

— Part 4 dealing with applications

— Part 7 dealing with project implementation

Annex A (normative): *BACS function list (BACS FL),* forms a normative part of this standard.

The Annex B (informative): *Examples for control schematic and BACS function list,* and Annex C (informative): *Bibliography,* are for information only.

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

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 is a general task for all parties employed to develop an integrated multi-application system. The Integration comprises, e.g. lighting and electric power distribution control, security control, transportation, maintenance management, or facilities management. This system 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 (withdrawn)

Part 2: Hardware

Part 2 of this 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.

Part 3: Functions (refer to the scope of this part)

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 object types for conveying encoded binary, analog, and alphanumeric data between devices including, but not limited to:

— input measuring: analog input object;

— output positioning/setpoint: 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 object types, 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.

NOTE 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 this 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:

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

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

— support of the BACS network layer protocol;

— support of each claimed data link option, and

— support of all claimed special functionality.

Part 7: Project 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.

Building automation and control systems (BACS) —

Part 3:
Functions

1 Scope

This International Standard specifies the characteristics of software and functions used in Building automation and control systems as well as a method for documentation of the design. It gives guidelines for the engineering. It specifies a template for documentation of plant/application specific datapoints and 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 International Standard covers the following:

Requirements and definitions regarding BACS and application software, generic function types 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:

This clause 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:

  This clause 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 function types:

This clause 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.

This International Standard 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 accurate 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.

2 Normative references

The following referenced documents are indispensable for the application of this International Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10628:1997, *Flow diagrams for process plants — General rules*

ISO 16484-2:2004, *Building automation and control systems (BACS) — Part 2: Hardware*

ISO 16484-5, *Building automation and control systems (BACS) — Part 5: Data communication protocol*

IEC 60617-12:1997[1)], *Graphical symbols for diagrams — Part 12: Binary logic elements*

IEC 60617-13:1993[1)], *Graphical symbols for diagrams — Part 13: Analogue elements*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 16484-2:2004 apply.

4 Symbols, abbreviations and acronyms

For the purposes of this standard, the symbols, abbreviations and acronyms given in ISO 16484-2:2004 apply.

NOTE The abbreviations used and explained within the tables for the function block examples are for information only.

1) Withdrawn. Replaced by IEC 60617:2001.

5 Requirements

5.1 Overview

5.1.1 Structure of the requirements and functions

5.1.1.1 General

This standard does not dedicate the system functionality to any particular hardware. The functional requirements in this part of the standard are subdivided as follows:

— system application and management software:

  describes the requirements for plant independent system programs and human system interface programs related to a project in general;

— engineering and commissioning tools:

  describes the requirements for the configuration of hardware, of control strategies and management functions,
  and the commissioning process;

— project/plant specific functions:

  describes the requirements for plant applications and/or project specific functions and methods for the functional documentation of project and/or application specific systems.

The functions of a BACS in general are structured into three levels. These levels indicate functions for

— management,
— automation/control as processing functions, and
— input/output as interface to field devices.

Operator functions are not assigned to a specific level.

NOTE Requirements for the hardware and communication means to perform the BACS software and functions that are specified in Part 2 of this standard.

5.1.1.2 Operator functions

Human system interface for plant operation, i.e. for supervision, alarm annunciation, state monitoring and human interaction are not assigned to any functional level.

The range of functionality covers:

a) system management, event management and state management, parameter adjustment and manual on/off control;

b) local room operation;

c) local override/indication device functions to provide restricted access for service operation;

d) system engineering and servicing, engineered operator functions are, e.g. dynamic display, event instruction text, remote messaging (see 5.5.5).

NOTE Human system interface devices in a BACS are on different types of hardware, as specified in Part 2:
- direct acting elements, as switches and signal lights;
- local override and/or indication devices;
- handheld units;
- monitoring and operator units or panels;
- operator stations including visual display units and
- Internet based browsers.
A VDU can provide a graphical user interface.

5.1.1.3 Management functions

Management functions are performed by the software of a BACS. The plant/application specific management functions are for the activity of a user taking decisions for supervision of plant and evaluating energy use and operational costs. The required functionality at this level is:

a) communications with devices of the control network, and any attached foreign systems;

b) communications for data exchange with dedicated special, or foreign systems to provide for operator and management functions within the BACS;

c) recording, archiving and statistical analysis;

d) decision support for e.g. energy management.

5.1.1.4 Processing function types

The plant/project specific application software and parameters provide all automatic functionality for building services in real-time within self-contained controllers/automation stations. The required groups of processing function types are:

a) monitoring;

b) interlocks;

c) closed loop and open loop control;

d) calculation/cross plant/system optimization;

e) room control functions, e.g. individual zone control, lighting control, shades/blinds control, details will be given in Part 4.

5.1.1.5 I/O function types

The I/O functions provide the interface between processing functions and the field devices. These function types are subdivided in

a) physical input and output functions, and

b) shared input and output functions for communication with foreign products.

5.1.1.6 Field devices

Field devices are generally sensors and actuators, coupling units and local override/indication devices that are connected to input/output interfaces of controllers/automation stations. Field devices can be connected to controllers via field network or direct wiring. The field devices perform connection to the physical items of plant providing the necessary information about the conditions, states, and values of the processes and effect the programmed operations. Functions supported by field devices are

a) Switching;

b) Positioning;

c) state monitoring;

d) counting, and

e) measuring.

NOTE For field device requirements see Part 2 of this standard.

5.1.2 Description of functions

The normative functional descriptions within this section are provided for use by the specifier, e.g. consultant, to describe the project functionality. The descriptions in 5.5 contain no direct hardware related specifications, but the number of input and output functions help to determine the required physical or communication inputs and outputs of a BACS, the processor performance, and memory size.

NOTE For the required hardware components see Part 2 of this standard.

For each project the system programs and the plant/application specific functions are to be specified to determine the required engineering services.

The plant specific functions can be documented in plant/control schematics, control flow chart diagrams and the BACS function list, preferred as spreadsheet for further data processing, which is shown in annex A as a template.

Some complex projects and/or sophisticated control algorithms for optimal control performance require additional information and methods in order to describe the requirements clearly and completely. These additional requirements include plant and control descriptions, control flow charts, psychrometric charts, reset schedules, field device mounting instructions/illustrations.

Annex B provides informative examples to indicate methods for creation of accurate documentation for a design project.

5.1.3 Description of function block examples

This standard has adopted (where appropriate) a function block (FB) method of describing BACS applications. The FB examples are designed according to the graphical symbols for diagrams in IEC 60617-12[2)], Binary logic elements and in IEC 60617-13[2)], Analog elements.

The information in the FB examples provides common wording and descriptions of BACS functions. The terminology provided by these descriptions should be used in any discussions and documents that represent BACS applications. This involves describing inputs, outputs, parameters and functions in a common textual and graphic format. A complete application scheme can be engineered using a series of interconnected function blocks as shown in the informative examples. The function block principle can be used to introduce new BACS functions and can be referred to using the BACS FL.

5.1.4 Description of the BACS function list

5.1.4.1 Scope

The BACS FL shown in annex A is based on the definitions in 5.5, and it provides the following benefits:

— the determination of functions is based on the plant/control schematic, the plant/control description and the control flow chart diagram if necessary;

2) Withdrawn. Replaced by IEC 60617:2001.

— it allows one to determine the number of engineered function types for specific projects by using a spread sheet program that provides for electronic data interchange;

— it provides a common structured method for the plant/system design and specifying process;

— it provides for the use of a unique structured point naming convention or addressing system, required in 5.3.2.7;

— the structured numbering scheme for the sections and columns of functions provides for the addition of individually defined functions in the given categories, if required.

5.1.4.2 Purpose

The BACS FL allows a supplier-independent description of the controls requirements. It can be used for tendering, costing, and billing purposes, although this aspect of its use is outside the scope of this standard. It should be considered that the main expenditure when implementing a BACS is in the engineering. These efforts are in direct relation to the number and type of functions required for the application.

BACS specifications shall contain all relevant detailed documents required to fully interpret the overall functionality. This should enable comparable and thought through bids at tendering.

For each plant to be controlled and supervised a plant control schematic shall be drawn. The data points, processing functions, and communication functions for complete control, as well as human system interface for operation, energy, and maintenance management can be listed in a separate BACS FL by the specifier.

The control flow chart method or a state machine diagram can be used for description and documentation of extensive control strategies and interlocks.

5.2 General system criteria

A BACS mainly consists of field and control devices, switchgear assembly, cabling, network, communication, and computing devices (hardware), system software and functions achieved by engineering services.

Decisions regarding functionality are normally defined before determination of the structure and the hardware of a BACS.

The following descriptions define the performance criteria and options to be specified and stated in each project regarding the manufacturer specific and the project specific application software.

NOTE For Hardware requirements refer to Part 2 of this standard.

5.3 Software

5.3.1 BACS programs general

For this standard the software of a BACS is subdivided into

— system management programs;

— communication programs;

— general application and optimization programs;

— human system interface programs;

— engineering programs.

5.3.2 System management programs

5.3.2.1 General

System management involves the initialization (see Part 2, 3.99), co-ordination, and maintenance of all configuration information (see Part 2, 3.47) relating to the operation of the system as a whole including network management. Each system function may be configured manually or automatically.

Remote system management and human system interface for system maintenance capabilities shall be specified. These programs need not be mandatory due to system size and resources.

5.3.2.2 System time keeping

The management methods for time, date, and calendar within all management and control functions shall be stated.

Performance criteria for system time keeping are:

1) internal/external clock, type of external clock;

2) system clock accuracy;

3) overall system time synchronization, e.g. by radio clock;

4) summer/winter time change handling for daylight savings;

5) change of time and date for local data processing device or server station;

6) change of time and date for networked and stand-alone devices.

5.3.2.3 Watchdog functions

Watchdog function requirements and system responses in case of a fault shall be specified for each project.

5.3.2.4 System diagnostics

Devices and functions of a BACS are supported by diagnostic tools to ensure constant operation, quality, and performance. The system's diagnostic features monitor a variety of functions and report on failure situations, or invoke corrective actions. Remote system diagnostics capabilities shall clearly be specified. The system diagnostic features shall indicate:

a) memory usage and system resources;

b) failure percentage of communication activity on all system networks;

c) causes of system failures.

Further system diagnostic features shall be stated for a specific project.

5.3.2.5 Power down management and recovery

Any consequences due to loss of power shall be specified, i.e. for:

a) power down;

b) power return;

c) associated internal system functions;