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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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by publication of an identical text or by endorsement, by February 2005, and conflicting national standards have to be withdrawn by February 2005.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

safe operation of building services

NOTE 1 The use of the word ‘control’ does not imply that the system/device is restricted to control functions. Processing of data and information is possible.

NOTE 2 If a building control system, building management system, or building energy management system complies with the requirements of the EN ISO 16484 standard series, it should be designated as a building automation and control system (BACS).

3.32
building management
BM
all services related to the operation and management of buildings including structural and technical properties based on integral strategies. BM is structured in:
- technical building management (TBM);
- infrastructural building management;
- commercial building management;
There are interfaces to area and facility management (3.76)

cf. **technical building management** (3.188)

NOTE A BACS is the essential tool for TBM.

3.33
building services
BS
utilities and installations supplied and distributed within a building such as electricity, gas, heating, water, and communications

3.34
bus
communication medium and method between two or more devices with interface for serial data transfer

NOTE 1 A line-form network topology often is referred to simply as a bus.

NOTE 2 A bus is also called a trunk in the US.

3.35
cabling
system of cables and connecting hardware that supports the connection of BACS and other equipment

3.36
cascade control
the output signal or value of a master control loop is used as set-point input to the slave control loop(s)
[derived from IEC 60050-351]

3.37
change of state
COS
event that occurs when a measured or calculated Boolean or discrete enumerated value changes
cf. **change of value** (3.38)

3.38
change of value
COV
an event that occurs when a measured or calculated analog value changes by a predefined amount
cf. **change of state** (3.37)

3.39
class
a category or rank attributed to entities having the same function as their use but are subject to quality demands

NOTE The entity is the item under consideration defined according to function and scope.

3.40
client
a system or device that uses another device for a particular purpose via a service request instance. A client requests a service from a server
[Part 5, 3.2.10]

NOTE The customer (landlord) also is referred to as a client.

3.41
closed loop control
system where the output acts upon the process in such a way as to reduce the difference between the measured value and the desired set-point value to zero
cf. **interlocks** (3.105), **open loop control (**3.137)

NOTE The control action describes the control algorithm (i.e. proportional, integral, derivative) as a relationship between the input signal and the output signal of a control function.

3.42
commissioning
the project and system-specific process of calibrating field devices, testing data points, parameters, functions, and system software — as part of the engineering services according to 3.71 — for the various functional elements of a BACS application

NOTE 1 To take out of commission/to commission: To put a system out of service/into service for a undefined time.

NOTE 2 Commissioning electrical switchgear and control gear is referred to as putting into operation or service.

NOTE 3 For automation and IT systems and mechanical plants, commissioning is also referred to as taking into service, system startup, startup procedure.

NOTE 4 Commissioning reports are proof for the completeness of tasks and work.

3.43
communications
the transfer of information, in accordance with pre-established protocols

3.44
communications interface
the specification of physical and electrical requirements for the connection components of communicating products

3.45
compatibility
capability of devices of different types and from different manufacturers to operate in a specific network under the same conditions and rules
[ISO/IEC 2382-1:1993]

NOTE 1 See Annex A of this standard for electromagnetic compatibility/interference according to 3.70.

NOTE 2 Also see interoperability in 3.106.

3.46
compliance
adherence to the requirements of a standard or the necessary consistency between the individual standards within a family of standards
[ISO/IEC 10746-2]

3.47
configuration
configuring
1) <BACS> site-specific information related to physical and functional units, entered during system engineering that generally does not change once the system is functioning. The result is the system configuration.

2) <IT> host and target computers, any operating system(s) and software used to operate a processor

NOTE IT refers to devices/systems of information technology providing services at their interfaces.

3.48
confirmation
a representation of an interaction in which a performing function confirms the completion of some procedure previously invoked
1) cf. **feedback (variable), checkback (signal)** (3.79)
2) cf. **response** (3.171)

3.49
conformance
conformity
fulfillment of specified conformance requirements by a product, protocol, process, or service. If an incorporated system meets the required specification, this is termed conformance (conformity)
[ISO/IEC TR 13233 and ISO Guide 2]

3.50
conformity
SEE **conformance** (3.49)

3.51
control
purposeful action on or in a process to meet specified objectives
[ISO 60050-351]
cf. **automation** (3.19)

<BACS> automatic **closed-loop control** (3.41) and **open-loop control** (3.137), **interlocks** (3.105), optimization and **monitoring** (3.124), as well as operating of one or more physical values and states for operation of **building services** (3.33)
cf. **building automation and control** (3.30)

NOTE 1 The term control often is used not only for the process in a control system, it is also used for the system (3.187) itself that performs the control functions (3.53).

NOTE 2 To automate employs means to enable self-acting functions in a system, whereas the term automation depicts the ready to use state.
[Derived from ISO 60050-351].

NOTE 3 An automaton is a self-acting artificial system, the behavior of which is governed either in a step-wise manner by given decision rules or continuously by defined relations and the output variables of which are created from its input and state variables
[ISO 60050-351]

NOTE 4 Control of an operation by human intervention is referred to as manual control.
[ISO 5598, IEC 60050-351]

NOTE 5
The functional areas in control technology differ in the French and German language as follows:
a) (en) closed loop control,
(fr) regulation en boucle fermee
(de) Regeln,
b) (en) open loop control / positioning,
(fr) regulation en boucle ouverte
(de) Stellen (analog Steuern / Stellen),
c) (en) interlocks
(fr) Asservissements
(de) Steuern (Steuerlogik, Verknüpfung),
d) (en) ⟨BACS⟩ control (automation USA),
(fr) ⟨GTB⟩ Surveillance (automation),
(de) ⟨GA-System⟩ Beherrschen, (Messen, Steuern, Regeln, Leiten).

3.52
control diagram
process flow diagram (deprecated)
piping and instrument diagram (P&ID) (deprecated)
flow diagram representing the procedure, configuration, and function of a plant for building services including the instrumentation and functions for a BACS

3.53
control function
automatic **closed loop (**3.41), **open loop** (3.137) and **interlock** (3.105) **function** (3.84) for a **process** (3.154)
cf. **processing function** (3.155).

3.54
control strategy
diagram and/or software that represents the functional requirements of a BACS application

3.55
controller
automation station
outstation (obsolete)
device for regulation and/or logic control as well as monitoring and processing of information, e.g. temperature, humidity, pressure
[Part 5, 3.2.12]

NOTE 1 Digital controller (DDC) can be subdivided into the following types:

1) fixed-function controller
as application-specific controller ASC where the manufacturer supplies one or more fixed control strategies for specific applications;

2) configurable controller
where the manufacturer supplies one or more configurable control strategies for specific applications;

3) programmable controller
automation station where the control strategies can be programmed

NOTE 2 Outstation was the term for remote multiplexer in SCADA systems without control functionality (SCADA = Supervisory Control And Data Acquisition). An outstation with control functionality but without optimization function was referred to as DDC outstation.

NOTE 3 The use of the word automation/control does not imply that the device/system is restricted to control functions only. Monitoring and processing of other information is possible.

NOTE 4 <IT> A device that controls the transfer of data between a computer and a peripheral device also is referred to as a controller.

EXAMPLES Controller for disk drive, display screen, keyboard, printer.

3.56
counter input
hardware pertaining to a control device for pulse counting

3.57
cycle time
time associated with one complete operation of a repetitive process

3.58
data
data is the formalized, prepared representation of information dedicated to communications, interpretation, or automatic processing
[ISO/IEC 2382-1:1993]

NOTE Data processing is not synonymous with information processing.

3.59
data communication protocol
standardized specification for the exchange of information between application processes in a BACS and/or between the BACS and other dedicated special systems

NOTE 1 Information is transported without interpretation by the building automation and control network resources

NOTE 2 There are normative and non-normative protocols.

3.60
data interface unit
DIU
functional or physical unit for communications between devices of a BACS and devices / systems in other networks, e.g. to comply with the relevant national standards if connected via public data networks

NOTE 1 The DIU may be of different type, e.g. modem, router, gateway.

NOTE 2 A repeater (3.169) is not a DIU in this standard.

3.61
data-point
DP
<BACS> an input/output function consisting of all assigned **information** (3.98, Note) describing fully the point's meaning (semantic)

NOTE 1 There are physical and virtual data points. A physical data point is related to a direct or network connected field device within a homogeneous system. A virtual datapoint can be derived from the result of a processing function, or it is related to a device within a different system as a shared (networked) data point.

NOTE 2 The data point’s information includes the present value and/or state and parameters (properties and attributes), e.g. signal type, signal characteristics, measured range, unit, and state texts.

NOTE 3 A point address and/or a point mnemonic, referred to as user address, identifies a data point

NOTE 4 A parameter having its own user address is a virtual data point.

NOTE 5 A BACS FL (function list) enumerates all data points, and outlines and summarizes their functions for a project.

NOTE 6 A virtual data-point can represent the derivation of various processing functions to model the behavior of a functional unit, e.g. any type of actuator, control device, and human interface. A virtual data-point also can be referred to as a BACS object (3.132). The BACS PL can be used for listing physical data-points and communication objects with focus on engineering elements and for BACS objects with focus on modeling the process (3.154) - see examples in Annex B of Part 3.

NOTE 7 The data-point is a historically evolved term that formerly described only a physical value or state

3.62
data processing device
server station
a digital computer controlled by internally stored programs to perform arithmetic and logical operations on discrete digital data for one or more user(s)
[ISO/IEC 2382-1:1993]
cf. **server** (3.179)

3.63
dedicated special system
DSS
foreign system
system used for a non-BACS application

EXAMPLES Fire alarm system, intrusion detection system, access control system, elevator control system, or system for maintenance, building and facility management, industrial automation.

NOTE These systems can be provided for with their own dedicated network.

3.64
device
1) <BACS> physical product designed and implemented to perform specified or programmable functions

2) <electrotechnology> operational equipment

NOTE As a rule, a device forms a self-contained physical unit in this standard.

3.65
digital
based on numerics (digits)

<IT> method for representation, transmission, and processing of information based on numerics (digits)

NOTE 1 A digital variable may assume one out of a set of discrete values.
[IEC 60050-351]

NOTE 2 Microprocessor-based devices are often referred to as digital devices.

NOTE 3 In BACS a digital signal is a variable signal that represents the value of digitally coded analog or binary information respectively of a binary coded decimal (BCD) information.

EXAMPLES Networked or shared (communication) data point (3.61), BCD time signal.

3.66
direct digital control
DDC
control of equipment or plant by means of a digital computer or microprocessor

3.67
disabled state
state of an item characterized by its inability for any reason to perform a required function

NOTE Also refer to failure (3.77) and fault (3.78).

3.68
download
a particular type of file transfer that refers to the transfer of an executable program, image, or contents of a database to a remote device where it can be executed
[Part 5, 3.2.17]

3.69
dynamic display
current states or values of data points displayed on a user interface

3.70
electromagnetic compatibility
EMC
electromagnetic interference
EMI
electromagnetic compatibility or interference applies to products which is liable to cause electromagnetic disturbance or the performance of which is liable to be affected by such disturbance

NOTE 1 Products means all electrical and electronic appliances, systems, installations, and networks containing electrical or electronic components.

NOTE 2 Appliance means a finished product having a direct function, its own enclosure and, if applicable, ports and connections intended for end users.

NOTE 3 System means a combination of several appliances or, if applicable, electrical or electronic components designed, produced or put together by the same manufacturer so as to operate together to perform a specific task after proper installation; a system is placed on the market as a single functional unit.

NOTE 4 Installation means appliances, systems, or electrical or electronic components interconnected at a given place so as to operate together to perform a specific task; these parts are not required to be placed on the market as a single functional or commercial unit.

NOTE 5 Network means a combination of several transmission links connected at individual points by electrical or optical means as part of an installation, system, appliance, or component.

NOTE 6 Electromagnetic disturbance means any electromagnetic phenomenon which is able to degrade product performance; electromagnetic disturbance can be electromagnetic noise, an unwanted signal, or a change in the propagation medium itself.

NOTE 7 Electromagnetic compatibility means the ability of a product to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to other apparatus in that environment.

3.71
engineering
project and system-specific services for the system planning process, configuration, and commissioning of the various parts of a BACS

NOTE 1 The tasks to perform are, e.g., configuration of the physical and logical connections and relationships between all items of a system to achieve the required application.

NOTE 2 ISO/IEC describes engineering as a systematic application of scientific and technical know-how, methods and experiences for design, implementation, testing, and documentation of software and devices for a system.
[derived from ISO/IEC 2382-1:1993]

3.72
entity
something that having a separate and distinct existence. An identifiable item that is described by a set or collection of properties
[Part 5, 3.2.18]

3.73
equipment
apparatus (depecated)
aggregation of functional elements or assembly of components and modules, thatbelong together in one physical unit of a **plant** (3.149) or in a functional unit of a **system** (3.187)

NOTE 1 From a controls point-of-view, these are e.g. the components and modules of a control device.

NOTE 2 From the process point-of-view these are e.g. a boiler, a chiller, a pre-heater, a humidifier, a fan. The components are in this case e.g. a heating coil, control valve, preheater pump, sensor. These are made up of subcomponents, i.e., parts and elements such as actuator, inverter drive, motor protection feature.

3.74
event
a change of state or value detected for processing and/or reporting

NOTE The meaning (value) of an event represents the physical or logical state of a device or equipment.

EXAMPLE Operational plant states (on/off), limits (high/low), alarm and fault conditions.

3.75
extra low voltage
ELV
<BACS> any voltage which cannot exceed 50 Vac or 120 Vdc

3.76
facility management
FM
all the services before, during, and after utilisation of real estate properties and infrastructure based on a holistic (integral) strategy

NOTE Also refer to building management in 3.32.

3.77
failure
the termination of an item's ability of an item to perform a required function

NOTE 1 After a failure, the item has a fault, which can be complete or partial.

NOTE 2 Failure" is an event, as distinguished from "fault", which is a state.

3.78
fault
the state of an item characterized by its inability to perform a required function, excluding inability during preventive maintenance or other planned actions, or due to a lack of external resources

NOTE 1 A fault is often the result of a failure of the item itself, but can exist without prior failure [IEV 195-04-25].

NOTE 2 In the field of machinery, the English term 'fault' is commonly used in accordance with the definition in IEV 191–05–01, whereas the French term "défaut" and the German term "Fehler" are used rather than the terms "Panne" and "Fehlzustand" that appear in the IEV with this definition.

NOTE 3 The terms "fault", "failure" (for a physical inability to perform) and “error” (for mistake or mismatch) are often used synonymously.

3.79
feedback
<BACS> a signal or state which either provides confirmation of a requested action, or provides an indication of some response from a device as a result of a requested action

EXAMPLES The state feedback of a fan, the positional feedback of a valve.

NOTE 1 Feedback often is referred to as read back and check back.

NOTE 2 Check back applies to the command failure algorithm of the command execution check function.

3.80
field device
physical connection from the input/output interface of a controller to an item of plant, thereby providing the necessary information or action for the conditions, states, and values of the process

EXAMPLES sensor and actuator, coupling unit, local override/indication device, switch and indication light, operator panel, local monitoring and control device, room device/setting knob.

3.81
field network
FN
communications connection between actuators/sensors and room devices with control devices

NOTE A schematic diagram is shown in Figure 1.

3.82
flow coefficient
Cvs
coefficient for mass flow of liquids through a valve at defined operating conditions and when the stroke has reached 100%

NOTE 1 The *Cv (Cvs)* value is determined as the mass flow in m^3/h at the density of $1000kg/m^3$ at 5 to 50°C for a pressure

drop of 100 kPa across the valve.

NOTE 2 A unique procedure to measure the mass flow capacity is determined in IEC 543-4.

3.83
format
a defined arrangement of data

3.84
function
<BACS> effect of programs and parameters

NOTE 1 Functions within a BACS are referred to as control functions, I/O, processing, optimization, management, and operator functions. Listed in the BACS FL (function list) for a specification of work, they comprise (if required) the complete operational engineering service according to 3.71 for a defined function in a project (see Part 3, annex A, of this standard).

NOTE 2 Function is a program unit that delivers exactly one data element, which can be a multiple value (i.e. an array or a structure). Functions can be an operand in a program.
[IEC 1131-3:1993]

3.85
function block
graphical representation of software for a function block type used in a function block diagram as a program element consisting of a data structure divided into input, output, and internal variables

3.86
function block diagram
one or more networks of interconnecting graphically represented functions, function blocks, data elements, labels, and elements
[IEC 1131-3:1993]

3.87
function block – type
a programmable controller programming language element consisting of the definition of a data structure partitioned into input, output, and internal variables; and a set of operations to be performed upon the elements of the data structure when an instance of the function block type is invoked
[IEC 1131-3]

3.88
gateway
a device that connects two or more dissimilar networks, permitting information exchange between them
[Part 5, 3.2.21]

NOTE A gateway function performs any necessary or possible protocol translations for information exchange in all layers of the ISO-OSI Basic Reference Model.

3.89
global function
a function that applies to a system as a whole

NOTE 1 Global is pertaining to all devices or nodes (3.129) on a communication internetwork.
[Part 5, 3.2.22]

NOTE 2 Internetwork is a set of two or more networks interconnected by routers. In a BACS internetwork, there exists exactly one message path between any two nodes.
[Part 5, 3.2.26]

3.90
hazardous state
state of an item assessed as likely to result in an injury to persons, significant material damage, or other unacceptable consequences

3.91
heterogeneous system
system characterized by using components having different behavior due to products of different make and type, different communication protocols, and engineering tools relative to the overall functionality
cf. **homogeneous system** (3.93)

NOTE 1 Interconnecting a gateway or special software makes possible an integration (or combination) of heterogeneous systems, if not all functional units or devices involved conform to the same communications protocol and profile. This does not mean that 100% interoperability can always be achieved.

NOTE 2 See also open systems interconnection reference model in 3.139, communications protocol in Part 5, and system integration in Part 7.

3.92
historical data
<BACS> data that is recorded on a storage **medium** (3.120) for an undefined time

NOTE The data logging performed by storing historical data is referred to as historical database function.

3.93
homogeneous system
<BACS> system characterized by components having unique behavior relative to the overall functionality, often by employment of a common unique engineering tool for programming
cf. **heterogeneous system** (3.91)

NOTE 1 As a rule, a homogeneous BACS consists of products from one manufacturer.

NOTE 2 See also interoperability 3.106, open systems interconnection reference model 3.139, and communications protocol in Part 5.

3.94
house
a structure designed for lodgings (local dwelling)
cf. **building** (3.29)
[ISO 6707-1:1989]

3.95
human system interface
HSI
the boundary that represents the point of physical interaction between a human being and the application platform
[ISO/IEC TR 10000-3:1998 and ISO/IEC TR 14252:1996]

NOTE 1 Also referred to as human/computer interface, HCI (deprecated).

NOTE 2 In the field of machine tools, the user interface often is referred to as man machine interface, MMI (for BACS deprecated).

NOTE 3 See also operator function in 3.144.

3.96
input/output
I/O
1) function comprising the processing of a value or signal from a sensor or for an actuator of the plant to be controlled. This function also provides specific state/value information for a data point to system users
SEE **analog value** (3.14), **binary signal** (3.26)

NOTE An I/O function is a shared I/O function if it is contained within a separate system or device and its information is communicated to or from a distinct system for common use.

2) physical module
SEE **analog input/output** (3.13), **binary input/output** (3.27), **output** (3.146)

3.97
individual room / zone control
control of the physical environment in an area of a building, e.g. zone or individual room
cf. **room control** (3.173)

NOTE 1 This term is evolving due to the upcoming integration of other technical services such as electrical installation.

NOTE 2 A zone is a defined area in a building, where a form of control can be executed.

EXAMPLES A floor, section of a floor, or a room.

3.98
information
knowledge concerning an object, a fact, an event, a thing, a process, or an idea, including a notion; and which, in a given context, carries a particular significance
[ISO/IEC 2382-1]

NOTE A statement about the process value or state assigned to an address (point address), e.g. a command ON is an item of information, state ON is also an item of information, the measured process value (with unit) is an item of information. One BACS data point, object or function can contain multiple dedicated items of information.

3.99
initialization
the process of establishing a known state, usually from a power-up condition.

NOTE Initialization can require re-establishment of a node's logical or physical address.

3.100
installation
physical delivery and connection of mechanical, electrical, and communication services within a building

3.101
integration
the implementation of specific processes and procedures to enable communications between different systems/units/devices
cf. **interoperability** (3.106)

NOTE Integration of heterogeneous BACS (3.91) is distinct from system combination, the implementation however is referred to as system integration.

3.102
integrity
the ability of an application to function as designed within a BACS

3.103
interface
functional or physical unit as a defined interconnection between a device/system to another device/system or a person

EXAMPLES This standard describes the following interfaces for BACS:
a) communications interface (e.g. communication controller);
b) data interface unit (DIU);
c) human-system interface (HSI) and graphical user interface (GUI);
d) physical I/O interface, e.g., interface module.

3.104
interface standard
standard that specifies requirements concerned with the compatibility of products or systems at their points of interconnection.
[ISO/IEC Guide 2]

NOTE 1 Specific applications and functions as well as profiles are represented in interface standards above the ISO/OSI reference model that presents the general basis for communication protocols.

NOTE 2 It is possible and permissible to structure protocols in interface standards so that individual layers of the ISO/OSI reference model are unused.

3.105
interlocks
programmable logic for a control sequence that links one equipment to another by means of Boolean logic and on/off actions
cf. **closed loop control** (3.41), **open loop control** (3.137)

NOTE Boolean data is represented as a single binary digit.

3.106
interoperability
<BACS> the capability of devices of different types and from different manufacturers to exchange information and commands via the communications network
cf. **integration** (3.101)

3.107
key
1) <communications> sequence of symbols that controls the operations of encryption and decryption
[Part 5, 3.2.28]

2) <hardware> device used to open/close and lock an enclosure/control panel

3) <software> method to open/close a lock to access control capabilities

3.108
local operation
a device or data item that operates within the vicinity of other associated equipment

NOTE Local is pertaining to devices on the same network as the referenced device.
[Part 5, 3.2.29]

3.109
local area network
LAN
network that links a number of nodes within the same locality

NOTE 1 In general, LANs offer very fast data communication to directly connect computers or other devices.

NOTE 2 To interconnect different LANs or to communicate long-distance, e.g. gateways/routers can be used.

3.110
local override/indication device
LO/ID
local override device
interface to field equipment for limited operation independent of the processing unit providing priority indication, switching, and/or positioning

EXAMPLE For manual operation of fans, valves, dampers, pumps.

NOTE 1 LO/ID are assigned to field devices.

NOTE 2 The functionality is referred to as a local override.

3.111
logbook
1) operator activity logbook
2) system activity logbook
a record book (one or more) or its electronic equivalent where all relevant details of the operation, the system, its performance, and its maintenance can be entered in a secure manner for subsequent retrieval

3.112
logical interlock
SEE **interlocks** (3.105)

3.113
low voltage
operating voltage between 50 to 1000 Vac or 75 to 1500 Vdc
[IEC 60664-1:1992]

3.114
maintenance
combination of all technical, administrative, and managerial actions during the life cycle of an item intended to retain it in or restore it to a state in which it can perform the required function

3.115
management function
plant and application specific software for supervising plants, and carrying out application engineering

EXAMPLE Calculation of energy consumption and operational costs.

NOTE The data to transmit for management functions are listed in two columns of the BACS FL (see Part 3).

3.116
management network
MN
connection between operator stations and data processing devices, e.g., server stations, programming units, peripheral devices

NOTE A schematic diagram is shown in Figure 1.

3.117
mean operating time between failures
MTBF
mathematical expectation of the operating time between failures

NOTE Also refer to mean operating time between maintenance (MTBM) in 3.118.

3.118
mean operating time between maintenance
MTBM
mathematical expectation of the operating time between two preventive service actions

NOTE Also refer to mean operating time between failures (MTBF) in 3.117.

3.119
mechanical equipment room
MER
set of controllers
<BACS> location-related consolidation of data points to one or more control devices, for structured presentation of BACS requirements in the BACS function list

EXAMPLES Basement MER, Penthouse MER

NOTE 1 The examples Basement MER or Penthouse MER describe rooms where the building service's equipment (e.g. AHU) is installed.

NOTE 2 The structuring by MER should generally be left to the vendor to select the mix of large and small devices appropriate to the control/monitoring tasks to be performed. However, it is recommended that a single large piece of equipment or a plant, for example, an air handling unit, be controlled by a "single" controller to prevent control problems in the case of a network failure.

NOTE 3 An MER can comprise several sets of controllers/automation stations.

3.120
medium
1) <BACS> a physical substance (e.g. water, air) that is controlled

2) <communications> the physical transmission entity. Typical media are twisted-pair wires, fiber optic cable and coaxial cable
[Part 5, 3.2.31]

NOTE The transmission medium often is referred to as medium only.

3) <IT> storage medium, the type of device that stores data in a non-volatile manner

NOTE The storage medium often is referred to as medium only.

3.121
menu
a list of options for selection by the operator

3.122
message delay
function to disregard any action from an input **change-of-state** (3.37) for further action unless the input signal is sustained for a pre-set time

NOTE Referred to as change-of-state delay.

3.123
message suppression
function to inhibit the propagation of an input **change-of-state** (3.37) according to defined criteria under consideration of parameters

NOTE 1 Referred to as change-of-state suppression also.

NOTE 2 Also refer to event in 3.74.

3.124
monitoring
<BACS> system activity, intended to observe the actual state of an item and annunciation of a defined deviation from the normal state as a state message about the event

3.125
monitoring and operator unit
MOU
SEE **operator station**/panel (3.145)

3.126
network
1) <BACS> a set of one or more segments interconnected by bridges having the same network address
[Part 5, 3.2.33]

2) <IT> assembly consisting of nodes and the branches that link the nodes
[ISO 2382-18:1999]

NOTE Network segments interconnecting devices are, e.g., nodes, bridges, routers, gateways.

3.127
network architecture
method by which a network is structured:
1) from the point-of-view of the arrangement of its components

EXAMPLES Architecture in the shape of a star, a ring, a line (bus), hierarchical, matrix, and free topology.

2) from the point-of-view of its functions

EXAMPLES Client-server architecture, allocated and distributed.

3) from the point-of-view of its dimensions

EXAMPLES Local area network (LAN) metropolitan area network (MAN), wide area network (WAN).

3.128
network-powered device
a device that derives its power from the network or bus, (differentiated from a mains powered device)

3.129
node
1) <BACS> the point where an addressable device is connected to the communication medium
[Derived from Part 5, 3.2.35]

2) <IT> in a network, the point at the extremity of a branch
[ISO 2382-18:1999]

3.130
normally closed contact
NC contact
contact that is closed when no power is applied to the relay

3.131
normally open contact
NO contact
contact that is open when no power is applied to the relay

3.132
object
1) <BACS> set of data with associated **functions** (3.84) applicable to it

2) <IT> a model of an **entity** (3.72)
[ISO/IEC 10746-2]

3.133
object type
a generic classification of data defined by a set of **properties** (3.159)
cf. **application object** (3.16)
[Part 5, 3.2.36]

NOTE 1 BACS object types (3.133) for achieving interoperability (3.106) are specified in Part 5.

3.134
on/off control
two-point control
control method to position an actuator or to switch a plant or device under consideration of a preselected set-point and hysteresis with one signal providing two control states (e.g. on/off, open/close)

NOTE A functional on-off element is a two-position element in which one of the two discrete values of the output variable is assigned the value zero.

3.135
online
operating in direct connection to the data processing

3.136
online help
provides usage of help information in **real time** (3.165) from each application program
SEE **online** (3.135)

3.137
open loop control
mode of action where one ore more measured inputs controls the outputs without any influence of feedback from the process
cf. **closed-loop control** (3.41), **interlocks** (3.105)

3.138
open system
system (3.187) characterized by using components from different manufacturers using the same public available protocol as defined in 3.162 1), and 2).

NOTE 1 Adapted from ISO/IEC 2382-26: 1993.

NOTE 2 Also see heterogeneous system in 3.91 and homogeneous system in 3.93.

3.139
open system interconnection reference model
ISO-OSI Basic Reference Model
description of the 7-layer model for open communication
[ISO/IEC 7498-1:1994]

3.140
operating system
software to control program operation and to provide the services for resource allocation, task scheduling, I/O control, and data management

3.141
operating mode
<BACS> basic designation of a particular mode (among various modes) of plant operation where the controller maintains the preset condition
cf. **operating state** (3.142)

EXAMPLES Boost mode, occupancy mode, comfort mode, economy mode, night setback mode.

NOTE Also refer to state in 3.182 and status in 3.183.

3.142
operating state
currently active state of a plant or equipment, normally as a result of an active operating mode
cf. **operating mode** (3.141), **state** (3.182), **status** (3.183)

NOTE The physical operating state is independent of the operating mode, as the operating mode can be overridden by local manual intervention or remote operation.

3.143
operator authentication
the corroboration that the operator logging on to a device is identified as the entity claimed
[Part 5, 3.2.37]

3.144
operator function
plant/application-specific function for a human-system interface to operate the plant(s) via the BACS spanning all operational levels, i.e., graphic, dynamic display, remote messaging, local operation

NOTE A local override/indication device according to 3.110 is not a operator function and not a function according to 3.83.

3.145
operator station
operator panel
sum of devices for a user to interface with the operator functions and management functions of a BACS for plant supervision

3.146
output
1) function
SEE **analog value** (3.14), **binary signal** (3.26), **input/output**, I/O (3.96)

2) physical module
SEE **analog output** (3.13), **binary output** (3.27)

3.147
peer-to-peer
communications model in which each peer entity has the same capability and either entity can initiate a communication session

NOTE Entities within the same layer of the ISO-OSI Basic Reference Model in 3.139.
[ISO 7498-1]

3.148
peripheral device
<computer> any equipment controlled by a certain computer and communicating with it

EXAMPLE Input/output device, i.e. VDU terminal, printer, external storage device.

3.149
plant
physical unit for a comprehensive process including the dedicated functional unit for control (3.51)
cf. **system** (3.187)

EXAMPLES Heating plant, ventilating plant, air conditioning plant, chiller plant, sanitary installation, or electrical installation.

NOTE 1 A plant can consist of several partial plants that are assembled from equipment, units or aggregates (e.g., boiler), devices, modules, components, and elements

NOTE 2 The definition indicates plant as a physical unit, and system as a functional unit.

3.150
point address
<BACS> unique data point identifier within a system used for accessing the point's information
1) cf. **address** (3.8)
2) cf. **user address,** mnemonic (3.196)

NOTE A BACS FL (function list according to 3.24 can be used to define the point identifiers or user addresses [mnemonics].

3.151
point-to-point communication
serial communication via virtual direct connection between DTEs (Data Terminal Equipment)
cf. **point-to-point connection** (3.152)

EXAMPLE Connection via ISDN [CCITT Rec.I.140, A.2].

3.152
point-to-point connection
communication via direct connection between two devices
cf. **point-to-point communication** (3.151)

EXAMPLE Connection via CCITT V.24/V.28/ EIA RC 232C [CCITT Rec.I.140, A.2].

3.153
positioning actuator
field device (3.80) as physical unit consisting of an actuating drive and the related final controlling element
cf. **actuator** (3.6)

NOTE Also refer to switched actuator in 3.185.

3.154
process
<BACS> specific method to treat media (e.g. water, air, electric power) in a plant for building services

3.155
processing function
<BACS> function (3.84) comprising engineering service for defined application software and parameters for monitoring, interlocks, closed loop and open-loop control, and optimization of building services
cf. **control function** (3.53)

NOTE Processing functions are the main section of the BACS function list, and are specified according to 3.24 in Part 3, clause 5.5, examples are given in Part 3, annex B.

3.156
profile
<BACS> communication object with object classes and properties for application and device-specific distinctions, which identify chosen classes, subsets, options and parameters, conforming to the protocol standard, necessary to accomplish a particular function for a specific application

NOTE 1 A profile is a part of the respective standard, or it is created and published by the relevant organization.

NOTE 2 For each different application the profile to implement is distinguished by its version number.

NOTE 3 Profiles refer to applications above the ISO-OSI Basic reference model according to 3.139.

3.157
program
syntactic unit following the rules of a certain programming language consisting of agreements and instructions or

commands, necessary to carry out special functions or to solve a special task or problem
[ISO/IEC 2382-1:1993]

3.158
programming unit
PU
a functional unit used in programming a BACS

NOTE A PU may consist of a specialized device or it can be a function of an operator station or other data processing unit (e.g. server station).

3.159
property
a particular characteristic of an **object type** (3.133)
[Part 5, 3.2.41]

3.160
proprietary
company specific solution

NOTE Proprietary within a standardized communications protocol is any extension of or addition to the object types, properties, private transfer services, or enumerations specified in this standard.
[Part 5, 3.2.43]

3.161
proprietary protocol
usually a company specific communication method, protected by intellectual property rights

NOTE Proprietary protocols can be subject to special licensing agreements which have to be considered.

3.162
protocol
the set of rules and formats regulating the information exchange between the elements of a system, including the specification of requirements for the application
[ISO/IEC 2382-26:1993]

NOTE A communications protocol should be structured in layers referring to the concept of the ISO-OSI - Basic Reference Model in 3.139.

3.163
pulsed signal
signal from a device coupled to a sensor or a meter that produces incremental pulses with a defined value of the measured media

3.164
RAID
redundant array of independent disks

3.165
realtime
the time during which a physical process occurs

3.166
redundancy
in an item, the existence of more than one means at a given instant of time for performing a required function

3.167
remote operation
a device or data item that operates outside the vicinity of other associated equipment

3.168
report
output of formatted event messages or statistics on a display or a printer
cf. **protocol** (3.162)

NOTE In BACS an output of formatted information from data either on VDU or as a list on a printer, normally in chronological order, in some cases is referred to as protocol.

3.169
repeater
a device that connects two or more physical segments at the physical layer as defined in ISO-OSI Basic Reference Model (3.139)
[Part 5, 3.2.46]

NOTE This device/unit amplifies and regenerates signals in a network to extend the range of transmissions between medium attachment points.

3.170
resolution
smallest increment of the measured value in the data content or indicated on the meter index

NOTE In this standard, resolution applies to analog inputs/outputs, and actuators, VDUs, printers, for each in its own context.

3.171
response
the completion of some procedure previously invoked
1) cf. **confirmation** (3.48)
2) cf. **feedback** (3.79)

3.172
response time
time taken for an action to occur as the result of a requesting or initating event

3.173
room control
integrated room automation
plant/application-specific devices and functions for single zone or individual room control including integrated monitoring, interlocks, open and closed-loop control, and optimization of combined building services such as HVAC&R, lighting, window blinds/shades control, electrical power distribution, and other trades, by communication functions
cf. **individual room / zone control** (3.97)

NOTE Individual zone/room control according to 3.97 can be a part of integrated room automation.

3.174
room device
the human-system interface device for room occupants to influence operation modes and parameters of the application and or to indicate functions for room control/automation

NOTE A room device or setting knob can comprise the room temperature sensing element.

3.175
router
a device that connects two or more networks at the network layer as defined in the ISO-OSI Basic Reference Model in 3.139

NOTE Typical application is the connection of local area networks.

3.176
security
any of a variety of procedures used to ensure that information exchange is guarded to prevent disclosure to unauthorized individuals

3.177
segment
1) <BACS> a delimited part of a message or of a control program (that can be downloaded) too large to be transferred as a single unit

2) <communications> in networks, a segment consists of one or more physical segments interconnected by repeaters
[Part 5, 3.2.51]

3.178
sensor
device or instrument designed to detect or measure a variable

NOTE 1 There are passive, active, and binary sensors, also for network connection.

NOTE 2 In BACS, a sensor is a field device for providing the necessary information (signal) about the physical conditions, states, and values of the **processing functions** (3.155) to enable the processing functions to perform the programmed operations.

NOTE 3 The term sensor does not provide a differentiation between a binary or analog type. The distinctive feature should be stated, e.g., switch/pushbutton sensor (binary), thermostat (binary), temperature sensor (analog).

NOTE 4 Sensors also are differentiated by their housing and mounting type (e.g. surface type) and by their purpose.

3.179
server
system, software, or device that responds to a service request instance to provide service for some particular purpose to a client
[Part 5, 3.2.53]
cf. **data processing device** (3.62)

3.180
site
in construction, a clearly defined functional and organizational local area for mounting and installation of the devices

EXAMPLE A building or a group of buildings.

3.181
specification
document outlining detailed requirements

EXAMPLE Product specification, test specification.

NOTE 1 Specifications are used to define raw materials, in-process materials, products, equipment, plants, and systems.

NOTE 2 A bill of quantities (BoQ) in the field of bid call, award and billing of construction work forms part of the tender specification. A bid call includes e.g. a specification of work with a bill of quantities that lists in items the number of work items.

NOTE 3 Each work item of a specification is considered to be a homogeneous unit for pricing purposes (based on its technical characteristics). The BACS functions specified in Part 3, 5.5 are understood as description of such work items.

3.182
state
<BACS> basic description to designate a particular operating state (condition)
cf. **operating state** (3.142)

NOTE Also refer to event in 3.74, operating mode in 3.141 and status in 3.183.

3.183
status
description of the specific states an entity can have
cf. **state** (3.182)

3.184
stroke
movement of a final controlling element, e.g. from a valve between the two end positions

3.185
switched actuator
on-off type actuator
SEE **actuator** <BACS> (3.6), **actuator** <HBES> (3.7).
cf. **switchgear assembly** (3.186)

3.186
switchgear assembly
motor control gear
circuit-breaker pole unit for single or multistage switching
cf. **switched actuator** (3.185)

3.187
system in its context a given arrangement of functional units such as equipment/devices, elements, and programs related to each other. Physical units can put functional units into effect
cf. **plant** (3.149)

NOTE The definition indicates system as a functional unit, and plant as a physical unit.

3.188
technical building management
TBM
all the services related to operation and management of buildings including structural and technical properties
– operation;
- documentation;
- energy management and optimization;
- information management;
- modernization;
- renovation;
- conversion;
- monitoring technical warranties
cf. **building management** (3.32)

NOTE A BACS is the essential tool for TBM.

3.189
template
part of a pro forma, which can be used as the basis for developing a complete pro forma
[ISO/IEC 9646-1:1994]

3.190
test
technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process, or service according to a specified procedure

3.191
time stamp
the date and time recorded for and accompanying the record of an event or operation
[Part 5, 3.2.55]

3.192
topology
<network> structure of the communication paths between the medium attachment points

EXAMPLES Network topology forms are bus, ring, star, and tree.

NOTE 1 The logical topology is the way that the signals act on the network media.

NOTE 2 A network's logical topology is not necessarily the same as its physical topology.

3.193
transmitter
measuring transducer
signal converter
physical unit that converts an input value into a clear related output value (signal). Measuring transducers are higher-precision converters

NOTE Transmitters often are referred to as (measuring) transducers.

3.194
trend log
trend diagram
presentation of a set of measured value(s) over time

NOTE 1 The values are displayed within a timeframe recorded by a fixed time period or by fixed threshold values (do not confuse threshold value with change of value in 3.38).

NOTE 2 A trend log with current values is a trend display shown as a curve for the progress of a value over time.

NOTE 3 A trend log with stored or archived values is a trend history (type of presentation applied to statistical analysis).

3.195
upload
the process of transferring an executable program, an image, or a database from a remote device in such a manner as to allow subsequent **download** according to 3.68

NOTE Adapted from Part 5, 3.2.57.

3.196
user address
<BACS> the point address used by an operator at the human system interface
1) cf. **address** (3.8)
2) cf. **point address** (3.150)
3) cf. **addressing system** (3.9)

NOTE User address often is referred to as mnemonic.

3.197
valve authority
the ratio of the pressure difference across a fully open control valve to the pressure difference across the entire system including the control valve

3.198
voltage-free contact
potential-free contact
1) contact of a field device for electrical/metallic isolated binary input;
2) contact of a BACS device for electrical/metallic isolated binary output

NOTE 1 Voltage-free contacts are often referred to as “dry contacts”.

NOTE 2 A binary signal source is input for BACS functions, e.g. binary input state, message processing.

3.199
watchdog
function that monitors the performance of a software program or other item of a system
SEE **monitoring** (3.124)

NOTE In the event of a program failure, a watchdog function can indicate it and/or cause a reset to restart the software program.

4 Abbreviations, acronyms and symbols,

For the purposes of this Part 2 and Part 3 of this standard, the following abbreviations and acronyms apply.

ac	alternating current
ACU	Air Conditioning Unit
AHU	Air Handling Unit
AI	Analog Input (analogue input GB)
AO	Analog Output (analogue output GB)
AS	Automation Station (also controller, control device)

ASC	Application Specific Controller
BAC	Building Automation and Control
BACS	Building Automation and Control System
BACS FL	Building Automation and Control System Function List (also points list for I/Os)
BCD	Binary Coded Decimal
BI	Binary Input
BO	Binary Output
BS	Building Services
CAV	Constant Air Volume
CI	Counter Input
CN	Control Network (also AN Automation Network)
COV	Change of Value
CRT	Cathode Ray Tube
Cv	Coefficient, valve flow
DBMS	Data Base Management System
dc	direct current
DDC	Direct Digital Control
DIU	Data Interface Unit
DN	Diameter Nominal (for pipes, valves, and fittings)
DP	Data Point
DSS	Dedicated Special System
DTE	Data Terminal Equipment
EMC, EMI	Electro Magnetic Compatibility, Electro Magnetic Interference (US)
FN	Field Network (also Field Bus)
GUI	Graphical User Interface
HBES	Home and Building Electronic Systems
HSI	Human-System Interface
HVAC&R	Heating, Ventilating, Air-conditioning and Refrigeration
I/O	Input / Output
IP	Internet Protocol
IT	Information Technology
LAN	Local Area Network
LO/ID	Local Override / Indication Device
MN	Management Network
MODEM	MOdulator / DEModulator
MOU	Monitoring and Operator Unit
MTBM	Mean Time Between Maintenance
OSI	Open Systems Interconnection
P	Proportional control
PI	Proportional Integral control
PID	Proportional Integral Derivative control

PN	Pressure Nominal (for pipes, valves, fittings, and tanks)
PPP	Point-to-Point Protocol
PTP	Point-to-Point
PU	Programming Unit
***R* / Ω**	Resistance in Ohm
RTD	Resistive Temperature Detector
UDP	User Datagram Protocol
VAV	Variable Air Volume
VDU	Visual Display Unit
WAN	Wide Area Network

5 Requirements

5.1 BACS components

5.1.1 Hardware components and system functionality

A BACS mainly consists of

a) hardware:
   - — field devices,
   - — control devices,
   - — cabling,
   - — communications,
   - — computing devices;

b) software to perform the functions, and

c) services (achieved by engineering).

Each BACS will be individually designed by a combination of:

- — standard computer hardware (data processing devices);
- — standard data communications hardware;
- — manufacturer specific hardware;
- — standard software (e.g. operating system, database management system);
- — manufacturer specific application software (e.g. programs and engineering tools);
- — project specific application software (e.g. functions that have been engineered).

5.1.2 System configuration

Decisions regarding functionality are normally defined before the determination of the project specific configuration with structure and hardware components of a BACS. There are many different solutions of hardware, communications, and software design to achieve the required functionality. The general options of system communications are provided in 5.6.1, the communication services and objects for interoperable BACS are specified in Part 5 of this standard.

The BACS related functions performed by software and engineering are described in Part 3 of this standard. It also includes a method for the determination of the required functions that are necessary for the specification of the system's hardware.

5.1.3 Basic hardware performance criteria

For all system components/equipment the following typical mechanical, electrical, and environmental performance criteria shall be stated according to the requirements of the project:

1) power consumption;
2) mains voltage;
3) heat dissipation;
4) acoustic noise emission;
5) environmental conditions: temperature, relative humidity and dust;
6) use of non corrosive bolts for fastening;
7) degrees of protection provided by enclosures, IP-code protection class (IEC 60529);
8) protection against physical shock/vibration;
9) electrical safety class (e.g. protection against electric shock);
10) EMC (EMI) compliance/environment class.

For general safety requirements and environmental conditions of BACS see the Annex A, of this Part 2 of the standard EN ISO 16484.

5.2 Management devices

5.2.1 General

Management devices usually perform the following functionality:

— communications with devices at the automation/control network;

— history recording and archiving, statistical analysis for operations- and energy management;

— communications for data exchange with dedicated special systems (e.g. fire alarm systems) to provide for operator and management functions.

For description of management system software and functions refer to Part 3 of this standard.

The management functions will normally be supported by the use of data processing devices. This also applies to operator stations, monitoring and operator units and/or to programming units that may also consist of monitors (visual display units).

The stated requirements shall match with the following:

— building operational requirements;

— size of system caused by the number of input, output, processing and management functions and by human system interface functions;

— degree of sophistication required by the functional structure;

— system response times;

— number and type of interfaces to peripheral devices;

— capability of enhancement/upgrade.

If industrial grade computing equipment (suitable for industrial environment) is required, then this shall be specified. The conditions for setting up and mounting this equipment shall also be stated.

5.2.2 Data processing device, server station

The selection of a computing device, e.g. personal and/or mini computing products (as standard computers) shall follow the stated demands of a specific BACS project according to its performance requirements.

Performance criteria:

a) General:

   1) Processing power;

   2) Type of unit, e.g., desktop, tower, rack mounted;

   3) Number of slots for boards and type of computing device's internal and external system bus to enhance peripherals.

b) Main storage:

   1) Size and technology of main storage required;

   2) Average data access time required.

c) Communications for I/O controllers, all networks, dedicated special systems (DSS) and others:

   1) Number and type of supported interfaces;

   2) Number and type of supported protocols for communications interfaces.

5.2.3 Peripherals

5.2.3.1 Storage and archiving device

For each project the appropriate functionality and performance of devices for data storage and archiving shall be stated. These requirements shall match with the basic hardware performance criteria according to 5.1.3 and the following requirements:

a) the amount of information to be stored;

b) the requirements for the archiving media used and ability to retrieve data;

c) the requirements for the redundancy of storage devices.

Performance criteria:

   1) Speed of data access;

   2) Time needed for system data backup;

   3) Capacity of storage.

5.2.3.2 Visual display unit

Visual display units (VDUs) as Terminals provide human system interface for following operator functionality:

— supervision, alarm function and operation;

— graphical user interface (GUI), for operator functions, e.g. point information presentation, graphics, alarm handling, time scheduling.

Monitoring and operator units (MOU) or operator stations are either connected to server functions or the server functions are integrated in the MOU. The server functions can also be integrated in controllers. In general, functions for human system interface are possible with management devices, control devices and field devices.

The visual display unit resides at an operator station that comprises the monitor, the keyboard, and possibly the pointing device. For each project the appropriate functionality and performance of these devices shall be stated according to the following:

a) size of unit and screen size (monitor size);

b) CRT or flat screen;

c) resolution required;

d) capability for alphanumeric and/or graphics;

e) monitor monochrome or color;

f) protection against reflection;

g) capacity of storage for graphical schemes;

h) protection against X rays;

i) keyboard and pointing device e.g.: mouse, trackball, touch screen, light pen;

j) user access control capabilities e.g.: access card, key, (for password see human system interface functions in Part 3 of this standard).

Performance criteria:

1) Type of the visual display unit: VDU terminal or PC operator station;

2) Refreshing frequency;

3) Conformance to standards.

5.2.3.3 Printer

For each project the appropriate functionality and performance of these devices shall be stated. These requirements shall match with the basic hardware performance criteria according to 5.1.3 and the following requirements:

The type of printer shall be specified by:

a) capability for graphics and/or colors;

b) printing technology, e.g., impact, non impact;

c) requested characters per line, lines per page;

d) requested printing speed, characters per second, pages per minute;

e) paper type (sheet, continuous);

f) acoustic noise emission.

The type of printer connection shall be specified by:

g) direct interface (e.g. parallel, serial or infra red);

h) network interface.

Performance criteria:

1) Printers, interfaces and drivers supported;

2) Resolution;

3) Conformance to standards (graphic/special language characters);

4) Printing technology;

5) Paper capacity.

5.2.4 Interfaces

5.2.4.1 Data interface unit

Data interface units (DIU) are used for tasks to exchange information between BACS and dedicated special systems (DSS) on their own network. Where interfacing across public data networks there is a requirement for use of a DIU. A list of DIU devices (e.g. gateway, router, MODEM), and drivers supported by the BACS shall be provided when required.

NOTE Repeaters are not DIU's in this context.

In general a DIU shall be specified according to the following:

a) name/type/specifications of network providers. The networks used must comply with the relevant national standards;

b) requested data transfer rate according to application used;

c) type or standard of network access (e.g. MODEM, router).

Performance criteria:

1) Supported protocols/interfaces;

2) Conformance to local regulations;

3) Conformance to standards;

4) Compression and correction method;

5) Bit rate/baud rate.

5.2.4.2 Interfaces to dedicated special systems

In combination with BACS dedicated special systems (DSS) can be deployed, respective developed, for applications such as:

— service/maintenance management;

— analysis of real-time data or long term event storage;

— analysis of archived historical data from data bases;

— paging systems;

— fire and security collection and reporting.

In order to exchange information between BACS systems and DSSs communication links for interaction can be via a DIU. For system integration refer to Part 7 of this standard.

The communications shall be specified by:

a) number of interfaces to DSSs;

b) required performance;

c) type of interface:

   — on line communication links via network or DIU's,

   — voltage free contacts;

d) direction of communications;

e) specification of network type and protocol;

f) capacity of requested storage in the BACS for supporting the DSS.

5.2.5 Alarm indication and annunciation devices

5.2.5.1 Acoustic indication device

An alarm or system information event can produce an acoustic indication. It has to be specified if this indication shall be acknowledged manually or automatically. Acoustic indication properties are to be specified according to the following:

a) volume;

b) type of acknowledgement;

c) activating device, e.g. relay in management or control device;

d) first-up signal or last-up signal handling.

5.2.5.2 Optical annunciation device

An alarm or system information event can produce an optical indication. It has to be specified if this indication shall be acknowledged manually or automatically. Optical indication properties are to be specified according to the following:

a) brightness;

b) type of acknowledgement;

c) activating device e.g. relay in management or control device;

d) first-up signal or last-up signal handling.

5.3 Control devices

5.3.1 General

The devices, stations, units, and control peripherals for the automation/control functions provide the environment for the following main tasks of a BACS:

— Direct Digital Control, automation;

— energy and operational optimization;

— plant operation monitoring;

— alarm, fault, maintenance and operations information;

— automatic and manual control (local override operation excluded);

— data for statistics and analysis of values and states;

— information exchange between processing functions with field devices and functions of operator and management programs.

The majority of the plant oriented real-time processing functions are carried out in self-contained controllers. The main processing functions are:

— physical input- and output functions;

— communication input- and output functions for shared data points;

— monitoring;

— interlocks;

— closed and open loop control;

— calculation/optimization;

— functions for room control (i.e. individual zone control, lighting control, shades/blinds control).

For description of processing functions refer to Part 3 of this standard.

DSS can be connected to the BACS processing functions via DIU at the automation/control network, and to BACS management functions also via connection to the management network.

The hardware may vary according to application requirements and be physically organized by mechanical equipment rooms (MER):

a) devices for monitoring and manual operation can be provided at automation/control devices;

b) local override/indication devices (LO/ID) should be provided at the plant equipment;

c) safety functions do not need to be performed within control devices;

d) some field devices may initiate functions for control (e.g. limiting, 2-point control etc.).

The stated hardware requirements for typical control devices shall match, besides the basic hardware performance criteria as specified in 5.1.3, with the following:

1) type and amount of input/output functions and processing functions necessary for the control of HVAC and other connected plant equipment;

2) intended local human system interface functions;

3) type and amount of communication functions necessary for management functions;

4) type and amount of local override/indication devices necessary for operation of plant under any exceptional condition;

5) type and amount of coupling modules/communication devices interfacing other plant equipment;

6) communication timing constraints demanded by the human system interface.

5.3.2 Controller

5.3.2.1 Tasks and structures

The BACS controllers or automation stations automatically operate the plant equipment delivering efficient operation as well as high plant availability by implementation of project specific functions described in Part 3 of this standard.

A controller can consist of either one compact module with a fixed number of inputs/outputs, or of a group of control modules (e.g. one basic module, to which expansion modules and/or input/output modules can be connected directly to, or by a serial communications system).

The way information can be transmitted shall be stated:

a) via parallel wiring;

b) via devices within a network.

General performance criteria for controller:

1) number and type of physical I/O points of each device or module;

2) number and type of each communications interface;

3) number of accessible/possible addresses for data points and information.

5.3.2.2 Power supply

Modules of a controller can be equipped with their own power supplies or groups of control modules can be supplied from a common power supply. Modular controllers have a basic unit to combine the modules; the basic unit can contain the power supply module.

The power supply has to satisfy all regional and project specific performance and safety requirements. It shall be specified if low voltage or extra low voltage (< 50V) and AC or DC is to be used.

Performance criteria besides the basic hardware performance criteria:

1) input voltage according to regional criteria;

2) connection to AC and/or DC;

3) output voltage and current;

4) short circuit proof (or not);

5) local signal lamps/LEDs for mains, secondary voltage, fault;

6) binary outputs for signalling of power failure and fault.

5.3.2.3 Processing unit

The processing unit of a controller operates on its' physical and virtual data points for the purpose of operating any physical I/O or communication modules that are connected.

To address its information and to perform its software functions the controller has to be programmed and set up with the required parameters (see Part 3 of this standard).

When a controller is not supplied by an uninterruptible power supply, then in the case of a power failure:

— programs, parameters and data shall remain stored;

— the system internal clock (time and calendar function) shall continue working for a specified time, depending on the application. The necessary value has to be specified with each project.

On resumption of power, the embedded functions of the controller shall restart automatically without manual intervention of an operator, but the behavior of specific applications have to be specified.

The controller can include a hardware device and software function for self-monitoring (e.g. a watchdog) and should report a failure; this may be carried out by communications.

A processing unit can be equipped with the following types of interfaces:

a) interface to a power supply;

b) interface(s) to physical data points (inputs/outputs);

c) interface(s) for human system communication;

d) interface with communications networks.

Hardware related performance criteria (for other/functional criteria see Part 3):

1) maximum number of points for the different physical and virtual point types to be processed;

2) minimum cycle time for scanning maximum number of data points within each processing unit;

3) maximum number of control loops available within each processing unit;

4) minimum cycle time for closed loop control;

5) minimum buffering time for programs and data during power failure;

6) minimum time for storing programs and data, as well as for the system internal clock (time and calendar function) to continue working during power failure, depending on local or application specific requirements:

   — either 48 h

   — or 72 h;

7) self test capabilities and run/failure display possibilities.

5.3.2.4 Input/output interfaces

5.3.2.4.1 General

The controller processing unit may have integrated (internal) input/output (I/O) interfaces for physical data points, connectors to local external I/O interfaces and / or connectors to remote external I/O interfaces. The connection between a processing unit and local external I/O modules for physical I/O may be either one connection for each data point (parallel type) or local bus (serial type). Communication I/O interfaces for remote installation are connected to a field network. Requirements for communication inputs and outputs as specified in 5.3.2.6.

The I/O interface devices, modules, coupling units and connectors shall be mounted to be easily accessible for maintenance. They shall also be clearly and permanently marked. The I/O interfaces should provide test plug facilities and have an indicating device (e.g. LED) to show the state of the signals. Non-corrosive bolt and/or plug and socket connectors are recommended.

Physical inputs/ outputs shall be specified according to the following:

a) over voltage and EMC protection limits;

b) galvanic separation of input/output signals;

c) nominal voltage;

d) maximum current rating of binary, digital and analog outputs;

e) if required, type of explosion protection, e.g. intrinsic i, details as given in annex A.

Performance criteria:

1) Maximum number of physical I/O;

2) Maximum number of communications interfaces;

3) Type of available input/output signals;

4) Display of the operational state of input/output signals.

Signal interchange between field devices for operational plant and controllers shall be done via the following inputs and outputs:

5.3.2.4.2 Binary input

A BI is used for entering one binary coded input signal. Bounce free and voltage free contacts are recommended.

Physical binary input requirements, to be specified:

a) maximum frequency that would be recognized;

b) required quality of transmitting contacts, (maximum resistance).

5.3.2.4.3 Binary output

A BO is typically used for commanding an actuator or to energize a contactor for switching an electric motor (e.g. fan, pump). Where necessary, coupling relays with voltage free contacts may be connected in line with the BO. Binary outputs can be able to produce momentary-contact (pulsed signal) or maintained-contact (steady state or permanent signal) control commands for multi-position control, e.g. to three point actuators.

Physical binary output requirements, to be specified:

a) integral or external relays for binary output;

b) type of signal: (e.g. triac, relay contact; normally open, normally closed, change over, remanent);

c) maximum voltage and nominal switching capacity (voltage and current rating);

d) if external relay is used:

— nominal coil operating voltage and impedance;

— switching capacity, nominal voltage, maximum, and voltage and current rating.

5.3.2.4.4 Analog input

An AI is used for measuring the magnitude of a value (i.e. voltage, current). Active sensors (transmitters) with signal ranges 1…5 V, 0(2)…10 V respectively (0)4…20 mA and passive resistance's should be connected directly. Normally, analog inputs have no galvanic isolation and are connected to the reference ground potential of the controller/communications interface.

Low resistance passive sensors (e.g. Pt 100, Ni 100) have to be connected using a three or four wire technique and are supplied with constant current or voltage.

Physical analog input requirements, to be specified:

a) signal range, measuring range;

b) accuracy class of analog inputs;

c) type of sensors/transmitters;

d) type of analog inputs (e.g. passive/active);

e) resolution of process value handled by the controller input circuitry.

5.3.2.4.5 Analog output

An AO shall be short circuit proof. Actuators can be connected to analog outputs either directly or via coupling modules.

Outputs with a signal range of (0)4…20 mA shall drive into a load with a defined maximum resistance (e.g. 250 Ω). Outputs with a signal range of 1…5 V or 0(2)…10 V shall be able to drive a load with a defined minim um resistance (e.g.10 kΩ).

Physical analog output requirements, to be specified:

a) maximum resistance for current output;

b) minimum resistance for voltage output;

c) range for current/voltage;

d) resolution of process value handled by DAC (digital – analog converter).

5.3.2.4.6 Counter input

A CI is used for counting pulsed signals. CI are designed as binary inputs for connection of voltage free or solid-state momentary contacts. In the case of hardware functions the counter has to operate as a forward accumulator. The counted values shall remain stored in non-volatile memory for a specified time of power failure. The required storage time has to be specified for each project, e.g. at least for 48 h or 72 h depending on the application. Functions and measuring ranges are described in Part 3. It is possible to provide a pre-setting/resetting facility for the accumulated value.

Physical counter input requirements, to be specified are:

a) maximum pulse rate and minimum duration;

b) required quality of transmitting contacts;

c) totalized value range (if applicable in hardware);

d) resetting / pre-setting capabilities (if applicable in hardware);

e) roll-over value (maximum value before counter resets to 0).

5.3.2.5 Communications interface

Control devices can be equipped with interfaces for data communications for all network types, e.g. for data exchange with bus/network input/output interfaces, ASC, operator and programming units, operator stations, management devices or DSS.

A graphical explanation of a generic system structure and written explanations are given in 5.6. Specific communication functions for inputs/outputs and functions for communications with management devices, to be specified project/plant specific, are described in Part 3 of this standard. The protocol for interoperable systems is described in Part 5.

The communications can be performed either via interfaces for point-to-point, bus system, network, data interface units, or via a MODEM to the public telephone network or a data network service provider.

The communications may be carried out by manufacturer specific or by standardized interfaces/protocols, as specified. The hardware for the components of each interface shall comply with specified standards e.g. IEEE, ITU (CCITT), EIA, or equivalent.

For remote operation or programming, an integrated or an external MODEM to a public network may be used. Disconnection of one communications interface should not effect the efficiency of a BACS with the remaining connections.

The number of different communication interfaces supported simultaneously shall be stated, e.g. for bus/network I/O interfaces, ASC, operator and programming units, operator stations, management devices or DSS.

The typical communications interfaces and their physical performance criteria should be stated for each network as follows:

a) type of network for FN, CN, MN or direct links, e.g., proprietary, conformance to a standard protocol;

b) protocol implementation conformance statement (if applicable);

c) the total number of nodes supported by the networks;

d) maximum distance/length of the communication system/cable;

e) maximum distance between network devices;

f) amplifier free cable length (amplifier used as repeater);

g) maximum number of amplifiers or repeaters;

h) type of interface/standards used for the communications medium and connectors at layer 1 in the ISO/OSI basic reference model according to ISO 7498-1:1994;

i) possibility to use portable MOU/PU, type and requirements for network connection;

j) maximum bit rate (bit/s) of the communications interface per network;

k) type of MODEM protocol interface used, e.g. CCITT V25bis (for Hayes-AT-commands), CCITT V35, etc.;

l) if required, type of explosion protection, e.g. intrinsic i, details as given in annex A;

m) EMC protection class;

n) over voltage protection limits.

5.3.2.6 Monitoring and operator unit, programming unit

The processing unit of a controller can have the ability to be connected to one or more HSI for interaction. The devices used are monitoring and operator units (MOU), operator panels, programming units (PU) or operator stations.

The requirements for visual display units as part of operator stations are given in 5.2.3.2. The programming units in general are similar to the engineering/commissioning tools, as described in 5.7.

The MOU/PU can consist of built in, local permanently mounted, portable handheld devices, or of units/stations within a network. MOU/PU used as interfaces for human system interaction can be either manufacturer specific or a standardized type. The functions of MOU/PU can be supported by a variety of different products. The selection depends on specific project requirements.

The following list gives the general requirements for the specification of MOU/PU:

— building operation and service requirements;

— level of training required for the operating staff;

— mechanical, electrical and environmental demands

— enclosure type (e.g. built-in, wall or flush mounted, portable).

The following is a list of typical requirements to be stated:

a) power supply;

b) operating time without a mains supply;

c) network interface;

d) size and type of visual display (e.g. CRT, flat screen, touch screen);

e) requirements for alphanumeric or graphics;

f) monitor type (e.g., monochrome or color);

g) type of keyboard, pointing device, etc.;

h) requirements for printer connection.

Performance criteria:

1) Weight;

2) Operator interfaces (e.g. switch, setting knob).

5.3.2.7 Enclosure

Control devices and local MOU can use one of the following installation methods:

— front door panel mounted;

— snap-on mounting for top hat rails 35 mm, IEC 60715;

— rack mounted;

— wall mounted.

Enclosures and mounting locations of control equipment shall be clearly and permanently identified. The control schematics/plant schematics and further documentation shall correspond. All components have to be easily accessible and exchangeable for maintenance.

The following requirements shall be specified:

a) maximum size of housing;

b) type of mounting;

c) material;

d) provisions to lock the enclosure;

e) color.

Performance criteria:

1) Enclosure and/or module easily exchangeable;

2) Screw terminals or plug and socket connectors.

5.3.3 Application specific controller

5.3.3.1 Task and structure

The application specific controller (ASC) is a control device specifically designed to achieve a fixed application control task (e.g. for room control and terminal units). Due to the normal location close to the field devices an ASC often is connected to a field network.

An ACS usually is a compact, fully integrated single device performing the complete local application. A room device for adjustment of set point and operating mode(s) can complement it.

The functionality of ASC for plants/projects is further described in Part 4 of this standard.

Performance criteria: the ability to perform the specified functionality.

5.3.3.2 ASC processing unit

Customized electronics and programs fulfilling all the requirements of the specific application. Any non-volatile memory contains the structure of the application(s) and default parameters.

5.3.3.3 ASC physical inputs/outputs

A set of binary/analog inputs/outputs with fixed hardware allocation designed for the specific application of the control device.

5.3.3.4 ASC communication capabilities

Connection of drive circuitry and terminals to the network shall be provided. Integrated communications terminals allow different interfaces for MOU/PU, for room devices, for field devices and connections to other ASC attached to the network.

5.3.3.5 ASC enclosure

ASC hardware can be provided as follows (the type is to be specified according to the application requirements):

a) unpackaged electronic printed circuit boards in order to be integrated in the application equipment;

b) electronic panels including those with specific human system interface capabilities;

c) separate, full complete devices that can be fixed or snapped on to mounting rails.

The devices shall be clearly and permanently marked with identification. Allocation for labelling instructions (e.g. address, mode) has to be provided in order to clearly identify the product and its function in the plant.

Performance criteria as specified in 5.1.3.

5.4 Field devices

5.4.1 General

BACS field devices include sensors and actuators. They are connected to input/output interfaces of controllers either directly or via communications devices/networks. The sensors, actuators, and other field devices provide the necessary information about the conditions, state(s) and values of the processes in the plant, and the effect of programmed operations. The following functions shall be provided:

a) sensors:

- binary input, state monitoring;
- pulse input, counting;
- analog input, measuring;
- communication input state/value;

b) actuators:

- binary output, switching;
- analog output, positioning;
- communication output state/value;

c) other field devices:

- coupling modules;
- local manual control override and indication;
- local room operation;
- devices for local control and automatic safety functions, e.g. limiting.

Direct wired field devices as specified shall perform safety functions

It is recommended that all field devices are clearly and permanently marked in relation to the point addresses within the BACS.

For description of input and output functions refer to Part 3 of this standard.

5.4.2 Coupling module

Coupling modules perform galvanic separation between signals to and from a controller and external voltages. The nominal coil voltage of coupling modules for binary outputs (coupling relays) shall be specified according to local requirements. The contact rating shall be specified according to the interfaced hardware. It is required that the controller and coupling modules are compatible.

The coupling modules can be mounted within power cabinets to allow extra low voltage installation cables or field bus interfaces to be used for connections between control cabinets and power cabinets. The coupling modules may form a unit in combination with the LO/ID as specified in 5.4.3. The cable connections/terminals of the coupling modules shall be clearly and permanently marked.

The following requirements for coupling modules shall be specified:

a) easily accessible and exchangeable for maintenance;

b) use of remanent relays (depending on the application);

c) method of mounting (e.g. fixed on wall, snap-on mounting rails);

d) screw or plug in terminals;

e) test plug connectors available;

f) integrated switch/indication for local override/indication available.

Performance criteria, besides the basic hardware performance criteria as specified in 5.1.3:

1) available types of coupling modules.

5.4.3 Local override/indication device

5.4.3.1 Task and use

Devices for local override and indication (LO/ID) interface to field equipment providing manually switching, positioning and/or indicating, for limited operation of HVAC plant (e.g. of fans, valves, dampers, pumps).

The plant components can directly be switched on/off or positioned independently of the processing unit by the user and the state is directly indicated e.g. by LED.

The LO/ID ensure that plant can be controlled locally by manually disconnecting the control signals (for example at the control cabinet) with some restrictions. Any restrictions involved shall be explicitly specified, e.g., devices for safety functions.

The LO/ID does not provide for remote or dialogue oriented manual operation.

5.4.3.2 LO/ID hardware design

Local override for manual direct service operation can be provided by LO/ID's as follows:

— as separate operational elements (e.g. switches, potentiometers);

— operational elements that are integrated into the input/output interface modules;

— combined with the coupling relays;

— with the specific modules for manual direct service operation.

Indicating devices (e.g. LED's) should indicate the state (e.g. on/off) and the actual position (e.g. Open/Closed) of the outputs to the plant components and of the commands from controllers.

It is recommended that the (operational) state of a LO/ID's signal is monitored by the controller (e.g. manual override active/inactive, present state and positioning value of the override).

Requirements for LO/ID, to be specified depending on the specific application:

a) ergonomics of the device;

b) range of modules available for switching, positioning, indication, etc.;

c) signal indicators for binary inputs/outputs available;

d) display of analog input/outputs signals that are possible and method of display;

e) ease of changing devices in case of failure.

5.4.3.3 LO/ID security of use

There shall be protection against unauthorized use of local override/indication devices (e.g. mounted within a lockable panel). Important security or safety interlocks shall not be disabled by manual override.

5.4.4 Sensors

5.4.4.1 General

Sensors are subdivided into three groups:

Group 1, binary signal sources:

a) normally open/closed switches or pulsed for counting functions;

b) switches with limiting functions and optional manual reset;

Group 2, passive analog sensors

(e.g. variable resistance output);

Group 3, active sensors/transmitters:

active signal output to be specified per project/application, e.g. 1…5 V, 0(2)...10 V, or (0)4...20 mA.

Additionally, there are binary/analog bus-/network sensors for connection to a FN according to 5.4.4.5, or with digital output, e.g. in BCD.

Performance criteria in addition to the basic hardware performance criteria as specified in 5.1.3:

1) required range of sensors/transmitters;

2) required output voltage(s)/current(s) for active sensors/transmitters;

3) accuracy or accuracy class of measurements for active and passive sensors is to be stated (e.g. Class 1, accuracy 1 % of full scale output);

4) MTBM, maintenance free period;

5) required cable specification;

6) requirements for EMC.

5.4.4.2 Binary signal source

Normally open or closed voltage free contacts have to be provided for binary signal sources. For indication of the 'ON' operating state a contact shall close (a normally open contact). One contact is required per active function (one information in a data point per contact state). For some safety and alarm functions it is required to have normally closed contacts (for fault detection).

Switches used as binary signal sources must comply with local regulations.

Binary signal sources performance criteria:

1) Minimum duration of a change of state that the system will recognize;
2) Maximum contact resistance;
3) Maximum contact bounce time.

5.4.4.3 Passive sensor

Passive sensors provide an analog resistance value for signal generation. They have to comply with the following requirements:

a) where RTD sensors with a maximum resistance of 200 Ω or less are used (e.g. Pt 100, Ni 100) they shall be connected using the three or four wire method;

b) passive sensors may be connected using two wire techniques when their minimum resistance is 1000 Ω (e.g. Pt 1000, Ni 1000, thermistors).

5.4.4.4 Active sensor/transmitter

Analog active sensors and transmitters provide analog signal outputs. Active sensors consist of a passive sensing element and an integral transmitter.

Transmitters are electronic devices that convert signals from passive sensors and provide either a 1...5 V, 0(2)...10 V, or (0)4...20 mA output signal that is to be specified for each part of an application within a project.

They shall comply with the following requirements:

a) the specified type of output signal;

b) the output signals shall be short circuit proof;

c) the supply voltage or current for active sensors/transmitters has to be delivered by a separate or a built in power supply from the controller as specified in 5.3.2.2;

d) the nominal and range of output impedance must be specified (e.g. 250 Ω, with a relative tolerance of ± 5 %).

For active sensors or transmitters providing field network capabilities see 5.4.4.5.

5.4.4.5 Bus/network sensor/transmitter

The sensors/transmitters with field network coupling units should use a standardized communications protocol. The protocol shall be specified according to the specific application in a project, it shall be interoperable with the communications interface as specified in 5.3.2.5 and/or 5.3.3.4. If not defined, a supplier specific protocol may be employed.

Sensors or transmitters providing field network capabilities shall comply with the following requirements:

a) the supply voltage or current for communicative sensors/ transmitters has to be delivered by a separate or a built in power supply or the field device derives its power from the network (network powered device);

b) the communications protocol shall be clearly stated.

Performance criteria, to be specified:

1) Signal range, measuring range;

2) Accuracy class;

3) Resolution of process value.

5.4.5 Actuators

5.4.5.1 General

5.4.5.1.1 Types of actuators

Actuators (including drives for positioning actuators) are devices that are connected directly, via coupling modules or via LO/ID to the binary or analog outputs or to communications interfaces of the controller.

For each control application the appropriate type and function of the actuator shall be specified.

Actuators are subdivided into switched (single or multistage) or positioning (3-point or 2-direction on/off- or analog) types. There are also actuators with a communications input for connection to a FN.

Examples:

a) electrical switchgear:

   1) single and multi stage motor starters;

   2) relays for fans, pumps etc.

b) on/off type actuators (switched):

   1) open/close valve;

   2) pulse width modulated valve actuator;

   3) open/close damper actuators.

c) 3-point/2-direction on/off type and analog actuators:

   1) reversible actuator drives for valves and dampers (3- point / 2-direction);

   2) analog controlled positioners with standard signal range as specified in 5.3.2.4.5;

   3) drives for modulating control by standard or supplier specific signals.

5.4.5.1.2 General application requirements for actuators

For each actuator it has to be determined whether or not and which safety positions have to be performed without auxiliary energy. It is to be stated which events shall cause safety functions to be performed e.g.:

— in case of a power failure;

— in case of an electrical fuse/trip failure;

— danger of frost;

— danger of smoke/fire.

The following is a list of typical requirements to be stated in addition to the basic hardware performance criteria as specified in 5.1.3:

a) type of power supply, (by control/bus cable, separate cable);

b) nominal voltage and power consumption;

c) maximum power consumption;

d) direct manual override;

e) level of vibration;

f) maximum/minimum conditions of controlled media (temperature, humidity, pressure etc.);

g) mounting position (e.g. horizontal or vertical);

h) type of mechanical linkage (to damper or valve);

i) field network capabilities according to communication interfaces of the control devices;

j) type of electrical isolation class;

k) if required, type of explosion protection, e.g. intrinsic i, details as given in annex A;

l) MTBM, maintenance free period;

m) required cable specification.

5.4.5.1.3 General application requirements for electrical switchgear

Electrical switchgear devices shall be installed and wired in switchgear assembly cabinets/panels according to the local regulations.

The type of overload detection of each electrical motor and the specific start up condition to be respected has to be stated, e.g.:

— thermal relay on the actuator's contactor;

— thermistors in coil windings;

— star delta start up.

The following switchgear specific requirements have to be stated:

a) electrical rating;

b) single or multistage switching;

c) type and number of electrical motor coils for different speeds (e.g. separate windings);

d) on/off indication/check back signal provided from additional contacts on the starter relay.

If the control function of the plant equipment is effected by the control devices, then the following application specific functional requirements shall be stated:

e) maximum number of start/stop commands per time interval (e.g. starts per hour, pause time after last start);

f) start up time a component needs to handle full load conditions;

g) maximum and minimum off time, e.g. for load shedding as specified in Part 3;

h) for fan belt check by an air flow detector or equivalent device.

5.4.5.2 Positioning actuators

5.4.5.2.1 General

Closed loop control criteria shall be considered according to the required quality of control. The following list of requirements shall be fulfilled, depending on the type of a positioning actuator.

Each application shall be individually defined as to whether the modulating actuators shall be equipped with position feedback indication signals, independent of the positioning signal. These feedback values can have resistances between 0...200 Ω or 0...5 kΩ or be standardized voltage/current signal with a minimum accuracy of ± 2,5 %.

Performance criteria:

1) Actuator positioning resolution;
2) Type of valve (e.g. single seated, 3-way diverting/mixing);
3) Valve authority or valve flow coefficient (*Cv*);
4) Nominal valve size (DN) and nominal body rating (PN in kPa);
5) Required materials of valve body and trim;
6) Valve characteristics linear or equal percentage;
7) Cycle time in case of pulse with modulation;
8) Stroke time for valve or damper applications for full stroke, (2-point and 3- point/2-direction on/off type);
9) Required close off rating for valve/actuator (in kPa);
10) Type of medium and nominal and maximal medium pressure (in kPa);
11) Acoustic noise level.

5.4.5.2.2 Switched actuator (on/off type)

The following specific requirements shall be stated:

a) open/closed indication/confirmation by auxiliary contact(s) on the actuator;

b) opening/closing times for electro thermal actuators with pulse width modulation;

c) cycle time in case of pulse width modulation.

5.4.5.2.3 Positioning actuator for 3-point control

The servomotors of modulated actuators with 3-point signal for valves, dampers, etc. shall use the specified voltage. For requirements and performance criteria see 5.4.5.2.1.

5.4.5.2.4 Positioning actuator with analog signal

The servomotors of analog positioning actuators should use standardized signals to be specified according to the application, details as given in 5.3.2.4.5. If not defined, supplier specific signals may be used for e.g. V or I/P (pneumatic pressure) converters, frequency transformers, modulating solenoid valves and bus/network communicating devices.

5.4.5.3 Bus/network actuator

Switched actuators (on/off type) and positioning actuators with field network coupling units should use a standardized communications protocol. The protocol shall be specified according to the specific application in a project, it shall be interoperable with the communications interface of the controller/ASC described in 5.3.2.5 and/or in 5.3.3.4. If not defined, a manufacturer specific protocol may be employed.

Switched and positioning actuators providing field network capabilities shall comply with the following requirements:

a) the supply voltage or current for communicative actuators has to be delivered by a separate or a built in power supply or the field device derives its power from the network (network powered device);

b) the communications protocol shall be clearly stated.

Performance criteria, to be specified:

1) Range for current/voltage output (if applicable);

2) Resolution of the output value for positioning.

5.4.6 Room device

A room device influences operation modes and parameters (e.g. by a knob) of the room control application and/or indicates functions for it. This human-system interface device is designed for operation by room occupants. Further hardware details as given in 5.3.3.

Basic hardware performance criteria as specified in 5.1.3.

NOTE The functionality of application specific devices for room control/integrated room automation will be further described in Part 4.

5.5 Cabling

This clause specifies characteristics for the connections and cabling between BACS devices. For electrical installation standards and other cabling, e.g. from electrical switchgear/control gear to plant equipment as fans, pumps, refer to annex A.

The connection methods for BACS devices can be subdivided into 2 groups:

1) The connection method or cabling of field devices to controllers:

— direct connection;

— direct connection via local override / indication devices;

— matrix cabling;

— field network or bus.

2) The connection method or cabling of other BACS devices:

— direct connection;

— communication with point-to-point connection;

— communications via network or bus.

Electrical cables and installations shall comply with regional standards, given in annex A, for:

— control and measuring signals;

— extra low voltage;

— low voltage;

— high voltage, if applicable.

All cables shall be clearly and permanently marked at both ends and correlate to the cabling list and circuit diagrams. If specified, the individual wires, internal and external shall also be marked.

Cabling requirements, to be specified:

a) Cable specification, e.g. stranding, shielding, number of wires, conductor area/diameter of wires, voltage and current rating, capacitance, insulation rating;

b) Type of mounting;

c) Wires with special colors for specific applications:

— signal wires: according to regional standards if they exist, otherwise any color may be specified for use between field cable/cabinet terminals and controller but there shall be consistency within a system/project;

— wires for security/life safety applications: according to local legal regulations and regional standards;

— mains: according to regional/national standards.

5.6 System communications

5.6.1 General

The communications infrastructure, e.g. data transmission medium, the electrical specifications of the interfaces and the communications protocol may differ according to the required functionality. The application/project specific topology of a system and the length of network segments shall be specified.

The management functions in general demand high transmission rates for data, particularly when large file transfers are involved (i.e. graphic files, archive data, and system configuration files). Automation/control functions in general require peer-to-peer communication. Sensors and actuators, which are interfaced to a field network, can be supplied with electrical energy either via the network (network powered devices) or they derive power from other sources.

The network/bus architecture shall provide or allow the insertion of surge protection devices, test and analyzing tools for each communications partner.

In the interest of application flexibility, this standard does not prescribe rigid system architecture. Rather, it describes a generic system model for the BACS network to which all-different types of BACS and their interconnections can fit. A graphical concept for BACS network in terms of LAN topology will be provided in Part 5 of this standard.

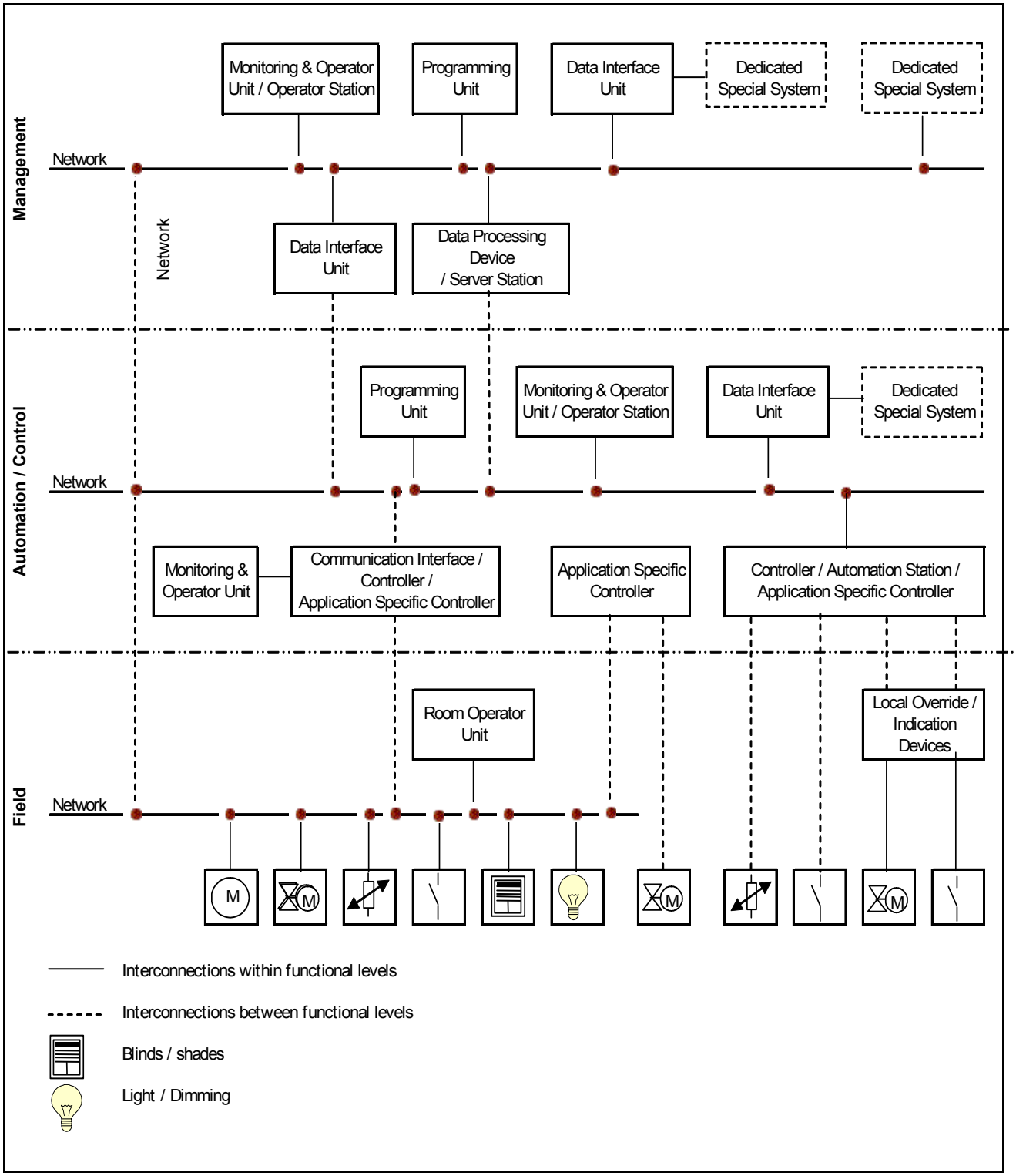

Figure 1 - Options of interconnections within BACS

5.6.2 Interconnection of devices within networks

5.6.2.1 Management network

Operator stations, monitoring and operator units, programming units and other peripheral computer devices are connected to a data processing device (e.g. one or more server station(s)) by the BACS MN.

Within the MN, several autonomous systems can be connected, e.g. a dedicated special system direct or via a data interface unit to a BACS. Dedicated special systems are for example fire alarm systems, intrusion detection systems, access control systems or maintenance-/building-/facility-management-systems. Such systems can utilize their own proprietary or a standardized network.

5.6.2.2 Automation/control network

Control devices and monitoring and operator units, operator stations or panels and/or programming units are connected to a data processing device (e.g. one or more server station(s)) by the BACS AN/CN.

Dedicated special systems can be connected via data interface units to the processing functions of a BACS.

5.6.2.3 Field network

Field devices and electrical operational equipment (also room devices) are connected to one or more control devices by the BACS FN.

Units or equipment with self contained controls and foreign field devices can be connected via FN standard protocol or data interface units to the processing functions of a BACS.

NOTE Figure 1 also shows the connection of ASC with room devices for room control and with sensors/actuators via a FN.

5.6.3 Interconnection of devices between networks

5.6.3.1 Management network to automation/control network

Three methods of interconnection are shown in Figure 1:

a) direct MN to AN/CN,
in this case the MN and the CN are the same network;

b) through data processing device or server station,
one or more data processing devices or server stations contain bridge, router or gateway functions to connect the MN to the AN/CN;

c) via data interface unit,
a data interface unit (e.g. MODEM, PAD, gateway) is providing a communications connection between the MN and the AN/CN.

5.6.3.2 Automation/control to field network

Three methods of interconnection are shown in Figure 1:

a) direct AN/CN to FN,
in this case the AN/CN and the FN are the same network;

b) through communications interface/controller/ASC,
one or more devices, (e.g. controller, communications interface), contains bridge, router or gateway functions to connect the AN/CN to the FN;

c) direct to field devices,
the controllers are connected directly or via LO/ID to the field devices.

5.6.4 Communications protocol

A BACS communications protocol describes the form and framework of data exchange for communication between devices. It consists of a collection of data structures named 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 detailed knowledge of the device's internal design or configuration. It describes a set of messages for conveying encoded binary, analog, and alphanumeric data between devices, including definitions and specifications, e.g. physical medium, data transfer rate, data transfer, and protection mechanisms.

All of these conventions are summarized under the term protocol or protocol definition in this standard. All communication protocols are, in the end, a collection of arbitrary solutions to the problems of information exchange and all are subject to change as time and technology advance.

Details of the protocol for interoperable BACS are given in Part 5 of this standard.

5.7 Engineering/commissioning tools

5.7.1 General

For servicing and commissioning the BACS, a commissioning engineer should be equipped with portable engineering tools which can be connected locally to the controller or to the network.

Engineering functions are described in Part 3 of this standard.

5.7.2 Engineering tools

Engineering tools are used for the following tasks:

— collection and documentation of project specific data, parameters, text and schematics;

— design, implementation and test of the project specific control functions.

The most common tools likely to be used are personal computers and associated peripherals.

The BACS manufacturer shall state in his offer the type and characteristics of the engineering tools if required, e.g. capability for using management devices for engineering of functions, described in Part 3 of this standard, via management/automation network.

5.7.3 Commissioning tools

Commissioning tools are used for the following tasks, e.g.:

— calibration of field devices;

— testing of physical I/O functions of all data points;

— testing of all processing functions and system software;

— generation of commissioning reports for proving the completion of work;

— generation of the BACS FL – implemented version.

NOTE Details for the BACS function list are given in Part 3 of this standard.

Examples of tools used for commissioning are:

— personal computer, VDU terminal and handheld device;

— simulators for calibration;

— meters for measurements of voltage, electrical current, temperature, humidity, air velocity etc.;

— logic and communications protocol analyzers;

— Modem or router can be used to enable some commissioning tasks to be carried out remotely.

In the case that the manufacturer supplies commissioning tools, specification details of the equipment required shall be provided.

Annex A
(informative)

General safety requirements and environmental conditions

A.1 General

The details for general safety requirements and environmental conditions, tests and verifications for BACS are to be specified in regional amendments to this part of the standard.

A.2 National annexes

It is recommended that the national annexes define the requirements of BACS safety requirements and environmental conditions for compliance with:

— electrical safety standards;

— product safety standards;

— electrical installation standards;

— electromagnetic compatibility - immunity and emissions;

— lightning/over voltage protection;

— classification of environmental conditions.

NOTE
Within the tasks of the Joint Working Group CEN/TC247 – CLC/TC205 "General Technical Requirements" a common European Standard *General safety requirements* is in preparation.
This standard shall amend the series EN 50090-x.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE
Where an International Publication has been modified by common modifications, indicated by (mod.), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60529 +AMD1	1989 1999	*Degrees of protection provided by enclosures (IP code)*.	EN 60529 +A1	1991 2000
IEC 60664-1 +AMD1 +AMD2	1992 2000 2002	*Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests*.	EN 60664-1	2003
IEC 60715 +AMD1	1981 1995	*Dimensions of low-voltage switchgear and controlgear — Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations*.	EN 60715	2001
IEC 61131-3	2003	*Programmable controllers — Part 3: Programming languages*	EN 61131-3	2003
ISO/IEC Guide 2	1996	*Standardization and related activities — General vocabulary*.	EN 45020	1998

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[1] ANSI/ASHRAE Standard 135; *BACnet A Data Communication Protocol for Building Automation and Control Networks*

[2] ISO 7498-2; *Information processing systems — Open Systems Interconnection — Basic reference model — Part 2: Security architecture*

[3] ISO/IEC 7498-3; *Information technology — Open Systems Interconnection — Basic reference model — Part 3: Naming and addressing*

[4] ISO/IEC 7498-4; *Information processing systems — Open Systems Interconnection — Basic reference model — Part 4: Management framework*

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