



BSI Standards Publication

Energy Performance of Buildings

Part 1: Impact of Building Automation, Controls and
Building Management Modules M10-4,5,6,7,8,9,10

National foreword

This British Standard is the UK implementation of EN 15232-1:2017. It supersedes BS EN 15232:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/16, Performance requirements for control systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Performance énergétique des bâtiments - Partie 1:
Impact de l'automatisation, de la régulation et de la
gestion technique - Modules M10-4, 5, 6, 7, 8, 9, 10

Energieeffizienz von Gebäuden - Teil 1: Einfluss von
Gebäudeautomation und Gebäudemanagement -
Module M10-4, 5, 6, 7, 8, 9, 10

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European foreword

This document (EN 15232-1:2017) has been prepared by Technical Committee CEN/TC 247 “Building Automation, Controls and Building Management”, the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2017, and conflicting national standards shall be withdrawn at the latest by November 2017.

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

This document supersedes EN 15232:2012.

The most important changes are:

- respect the presentation of this project in the frame EPB in accordance with the drafting rules;
- a structured updated list of Building Automation and Control (BAC) functions;
- a set of new BMS function introduced in the new EPBD standard EN 16947-1 has been added to the list of functions thus completing the former TBM functions.

This document has been prepared under a mandate [22] given to CEN by the European Commission and the European Free Trade Association.

This document is part of the set of standards on the energy performance of buildings (the set of EPB standards).

In case this standard is used in the context of national or regional legal requirements, mandatory choices may be given at national or regional level for such specific applications, in particular for the application within the context of EU Directives transposed into national legal requirements.

Further target groups are users of the voluntary common European Union certification scheme for the energy performance of non-residential buildings (EPBD art.11.9) and any other regional (e.g. Pan European) parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

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

Introduction

This European Standard is part of a series of standards aiming at international harmonization of the methodology for the assessment of the energy performance of buildings, called “EPB set of standards”.

As part of the “EPB set of standards” it complies with the requirements for the set of basic EPB documents EN ISO 52000-1 (see Normative references), CEN/TS 16628 and CEN/TS 16629 (see Bibliography [2] and [3]) developed under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/480).

The standards issued by TC 247 for M/480 belong to the EPB set of standards and are in line with the over-arching standard (EN ISO 52000-1) and drafted in accordance with the basic principles and detailed technical rules developed in the Phase I of the mandate.

Also these standards are clearly identified in the modular structure developed to ensure a transparent and coherent EPB standard set. BAC (Building Automation and Control) is identified in the modular structure as Technical Building System M10. However, the standards of TC 247 deal with control accuracy, control functions and control strategies using standards communications protocol (these last standards do not belong to the EPB standards set).

To avoid a duplication of calculation due to the BAC (avoid double impact), no calculation are done in BAC EPB standard set, but in each underlying standard of EPB set of standards (from M1 to M9 in the Modular Structure), an IDENTIFIER developed and present in the M10 covered by EN 15232-1 is used where appropriate. These way of interaction is described in detailed in the Technical Report (CEN ISO/TR 52000-2) accompanying the over-arching standard. As consequence, the Annex A and Annex B concept as EXCEL sheet with the calculation formulas used in the EPB standards are not applicable for the standards issued by TC 247 for M/480.

The main target groups of this standard are all the users of the set of EPB standards (e.g. architects, engineers, regulators).

Further target groups are parties wanting to motivate their assumptions by classifying the building energy performance for a dedicated building stock.

More information is provided in the Technical Report accompanying this standard (CEN/TR 15232-2 [5]).

1 Scope

This European Standard specifies:

- a structured list of control, building automation and technical building management functions which contribute to the energy performance of buildings; functions have been categorized and structured according to building disciplines and so called Building automation and control (BAC);
- a method to define minimum requirements or any specification regarding the control, building automation and technical building management functions contributing to energy efficiency of a building to be implemented in building of different complexities;
- a factor based method to get a first estimation of the effect of these functions on typical buildings types and use profiles;
- detailed methods to assess the effect of these functions on a given building.

Table 1 shows the relative position of this standard within the set of EPB standards in the context of the modular structure as set out in EN ISO 52000-1.

NOTE 1 In CEN ISO/TR 52000-2 the same table can be found, with, for each module, the numbers of the relevant EPB standards and accompanying technical reports that are published or in preparation.

NOTE 2 The modules represent EPB standards, although one EPB standard may cover more than one module and one module may be covered by more than one EPB standard, for instance a simplified and a detailed method respectively.

Table 1 — Position of this standard (in casu M10–4,5,6,7,8,9,10), within the modular structure of the set of EPB standards

	Over-arching	Building (as such)	Technical Building System									
Submodule	Descriptions	Descriptions	Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot waters	Lighting	Building automation and control	PV, wind, ..
sub1	M1	M2		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General	General	General									
2	Common terms and definitions; symbols, units and subscripts	Building Energy Needs	Needs									
3	Application	(Free) Indoor Conditions without Systems	Maximum Load and Power									
4	Ways to Express Energy Performance	Ways to Express Energy Performance	Ways to Express Energy Performance								x	
5	Building Functions and Building Boundaries	Heat Transfer by Transmission	Emission and control								x	
6	Building Occupancy and Operating Conditions	Heat Transfer by Infiltration and Ventilation	Distribution and control								x	
7	Aggregation of Energy Services and Energy Carriers	Internal Heat Gains	Storage and control								x	
8	Building Partitioning	Solar Heat Gains	Generation and control								x	
9	Calculated Energy Performance	Building Dynamics (thermal mass)	Load dispatching and operating conditions								x	
10	Measured Energy Performance	Measured Energy Performance	Measured Energy Performance								x	
11	Inspection	Inspection	Inspection									
12	Ways to Express Indoor Comfort		BMS									
13	External Environment Conditions											
14 ^a	Economic Calculation											

^a The shaded modules are not applicable.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13779, *Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems*

EN 15193-1, *Energy performance of buildings — Energy requirements for lighting*

EN 15243:2007, *Ventilation for buildings — Calculation of room temperatures and of load and energy for buildings with room conditioning systems*

EN 15316 (all parts), *Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies*

EN 15316-2, *Energy performance of buildings — Method for calculation of system energy requirements and system efficiencies — Part 2: Space emission systems (heating and cooling), Module M3-5, M4-5*

EN 15316-4-5, *Energy performance of buildings — Method for calculation of system energy requirements and system efficiencies — Part 4-5: District heating and cooling, Module M3-8-5, M4-8-5, M8-8-5, M11-8-5*

EN 16798-5-1, *Energy performance of buildings — Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8 — Ventilation for buildings — Calculation methods for energy requirements of ventilation and air conditioning systems — Part 5-1: Distribution and generation (revision of EN 15241) — Method 1*

EN 16798-7, *Energy performance of buildings — Part 7: Ventilation for buildings — Modules M5-1, M5-5, M5-6, M5-8 — Calculation methods for the determination of air flow rates in buildings including infiltration*

EN 16798-9, *Energy performance of buildings — Part 09: Ventilation for buildings — Module M4-1, M4-4, M4-9 — Calculation methods for energy requirements — Calculation methods for energy requirements of cooling systems — General*

EN 16798-13, *Energy performance of buildings — Part 13: Module M4-8 — Calculation of cooling systems — Generation*

EN 16798-15, *Energy performance of buildings — Part 15: Module M4-7 — Calculation of cooling systems — Storage — General*

EN 16947 series, *Energy Performance of Buildings — Building Management*

EN ISO 7345:1995, *Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

EN ISO 50001:2011, *Energy management systems — Requirements with guidance for use (ISO 50001:2011)*

EN ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures (ISO 52000-1:2017)*

EN ISO 52016-1, *Energy performance of buildings — Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads — Part 1: Calculation procedures (ISO 52016-1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, in EN ISO 52000-1:2017 and the following apply.

3.1 auxiliary energy

electrical energy used by technical building systems to support energy transformation to satisfy energy needs

Note 1 to entry: This includes energy for fans, pumps, electronics etc. Electrical energy input to the ventilation system for air transport and heat recovery is not considered as auxiliary energy, but as energy use for ventilation.

Note 2 to entry: In EN ISO 9488 the energy used for pumps and valves is called “parasitic energy”.

[SOURCE: EN ISO 52000-1]

3.2 building automation and control BAC

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

[SOURCE: EN ISO 52000-1:2017, modified – The symbol BAC was added.]

3.3 building automation and control system BACS

system, comprising all products, software 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 to entry: BACS is also referred to as BMS (Building management system).

Note 2 to entry: 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 3 to entry: If a building control system, building management system, or building energy management system complies with the requirements of the EN ISO 16484- series, it should be designated as a building automation and control system (BACS).

Note 4 to entry: Building services is divided in technical, infrastructural and financial building services and energy management is part of technical building management.

Note 5 to entry: Building energy management system is part of a BMS.

Note 6 to entry: Building energy management system comprising data collection, logging, alarming, reporting, and analysis of energy usage etc. The system is designed to reduce the energy consumption, improve the utilization, increase the reliability, and predict the performance of the technical building systems, as well as optimize energy usage and reducing its cost.

[SOURCE: EN ISO 16484-2:2004, modified – Notes 1, 4 and 5 have been added.]

3.4 building management BM

totality of services involved in the management operation and monitoring of buildings (including plants and installations)

Note 1 to entry: Building management can be assigned as part of facility management.

[SOURCE: CEN/TS 15379:2006, modified – Second part of the definition became Note 1 to entry.]

3.5 control function

BAC effect of programs and parameters

Note 1 to entry: BAC functions are referred to as control functions, I/O, processing, optimization, management and operator functions. They are listed in the BAC FL (function list) for a specification of work.

Note 2 to entry: 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. [EN 61131-3]

3.6 delivered energy

energy, expressed per energy carrier, supplied to the technical building systems through the assessment boundary, to satisfy the uses taken into account or to produce the exported energy

Note 1 to entry: Delivered energy can be calculated for defined energy uses or it can be measured.

[SOURCE: EN ISO 52000-1]

3.7 energy carrier

substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes

[SOURCE: EN ISO 52000-1]

3.8 energy need for heating or cooling

heat to be delivered to or extracted from a thermally conditioned space to maintain the intended space temperature conditions during a given period of time

Note 1 to entry: The energy need can include additional heat transfer resulting from non-uniform temperature distribution and non-ideal temperature control, if they are taken into account by increasing (decreasing) the effective temperature for heating (cooling) and not included in the heat transfer due to the heating (cooling) system.

3.9

energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy

EXAMPLE Efficiency conversion energy; energy required/energy used; output/input; theoretical energy used to operate/energy used to operate.

Note 1 to entry: Both input and output need to be clearly specified in quantity and quality, and be measurable.

[SOURCE: EN ISO 50001-1:2011 modified - Symbol removed]

3.10

energy efficiency improvement

increase in energy efficiency as a result of technological, behavioural or economic changes

[SOURCE: EN ISO 50001-1:2011]

3.11

integrated building automation and control systems

BACS designed to be interoperable and with the ability to be connected to one or more specified 3rd party building automation and control devices/systems through open data communication network or interfaces performed by standardized methods, special services and permitted responsibilities for system integration

EXAMPLE Interoperability between 3rd party BACS devices/systems for HVAC, domestic hot water, lighting, electrical power distribution, energy metering, elevators and escalators, other plants, as well as systems for communications, access control, security, life safety etc.

3.12

integrated function

BAC effect of programs, shared data points and parameters for multi-discipline interrelationships between various building services and technologies

3.13

measured energy performance

energy performance based on measured amounts of delivered and exported energy

Note 1 to entry: The measured rating is the weighted sum of all energy carriers used by the building, as measured by meters or derived from measured energy by other means. It is a measure of the in-use performance of the building after correction or extrapolation. This is particularly relevant to certification of actual energy performance.

Note 2 to entry: Also known as “operational rating”.

[SOURCE: EN ISO 52000-1]

3.14

set-point temperature of a conditioned zone

internal (minimum) temperature, as fixed by the control system in normal heating mode, or internal (maximum) temperature, as fixed by the control system in normal cooling mode

Note 1 to entry: The corrected value of a temperature setpoint is used for the calculation of energy performance. It enables the impact of the accuracy of the control system on the energy performance to be taken into account.

3.15 thermally activated building systems

TABS

massive building fabric actively heated or cooled by integrated air or water based systems

3.16 technical building management

TBM

process(es) and services related to operation and management of buildings and technical building system through the interrelationships between the different disciplines and trades

Note 1 to entry: The disciplines and trades comprise all technical building services for the purpose of optimized maintenance and energy consumption.

EXAMPLE Optimization of buildings through interrelationships ranging from heating, ventilation and air conditioning (HVAC) to lighting and day lighting to life safety and security to electric power systems and energy monitoring and metering; to its services, including communications and maintenance and to its management.

3.17 technical building system

technical equipment for heating, cooling, ventilation, humidification, dehumidification, domestic hot water, lighting and electricity production

Note 1 to entry: A technical building system can refer to one or to several building services (e.g. heating, heating and DHW).

Note 2 to entry: A technical building system is composed of different subsystems.

Note 3 to entry: Electricity production can include cogeneration and photovoltaic systems.

[SOURCE: EN ISO 52000-1]

4 Symbols, subscripts and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in EN ISO 52000-1:2017, Clause 4 and Annex C and the specific symbols listed in Table 2 apply.

Table 2 — Symbols and units

Symbol	Quantity	Unit
a	normalized level, e.g. occupancy or gains	-
$\bar{\beta}$	mean part load	-
ϕ	heat flow rate, thermal power	kW

4.2 Subscripts

For the purposes of this document, the subscript given in EN ISO 52000-1:2017, Clause 4 and Annex C and the specific subscripts listed in Table 3 apply.

Table 3 — Subscripts

Subscript	Term	Subscript	Term	Subscript	Term
amb	ambient	end	end	th	thermal
BAC	building automation and control	r	room	trans	transfer
cor	correction	ref	reference		
DHW	domestic hot water	sta	start		

5 Description of the method

5.1 Output of the method

This standard describes two methods of how to calculate the contribution of building automation and controls to the energy performance of buildings. The two methods are:

- Detailed method: Output of the detailed method is a list of automation, control and management function types that is used to run a detailed calculation of building energy performance based on other EPBD standards. Beside this the detailed method would also allow classification of a building automation and control system according to a set of criteria defined in this standard. There is no limitation regarding the time step.
- Factor based method: Output of the factor based method is the energy demand of a building according to a given building automation and control classification. The time step of the output is a yearly step.

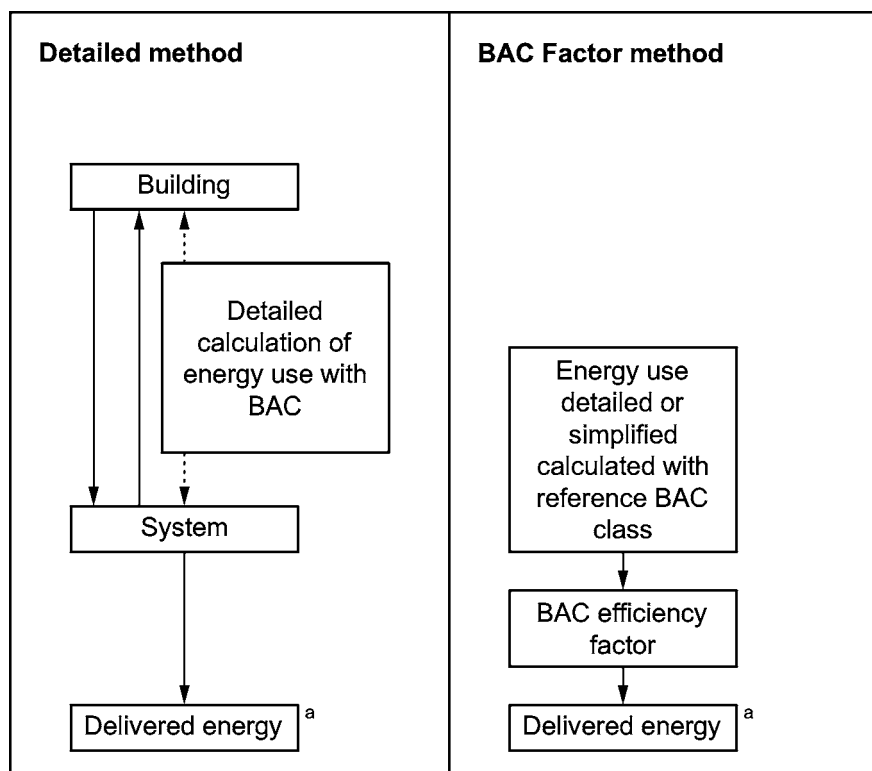
5.2 General description of the method(s)

Two methods are given:

- method 1, defined in Clause 6 “Method 1 – Detailed method”, is meant for a detailed energy performance analysis of a building in case detailed information about the building, the HVAC systems and especially the type of automation, control and management functions is available that can be applied in a holistic EPBD calculation method.
- method 2, defined in Clause 7 “Method 2 – Factor based method” is intended for easily calculating a rough estimate of the impact of building automation, control and management on the energy performance of a building just based on a given energy performance (either a consumption metered, or a demand calculated) correlated to a certain BAC efficiency classification of the building.

5.3 Selection criteria between the methods

For the calculation of the impact of building automation, control and management functions on the building energy performance the detailed method is method 1 in this standard. The following Figure 1 illustrates how to use the detailed method compared to the simplified BAC Factor method.

**Key**

a delivered energy is the total energy, expressed per energy carrier (gas, oil, electricity etc.) used for heating, cooling, ventilation, domestic hot water or lighting

NOTE Arrows illustrate only the calculation process and do not represent energy and/or mass flows.

Figure 1 — Detailed method in comparison with BAC Factor method

The detailed method should be used only when a sufficient knowledge about automation, control and management functions used for the building and the energy systems is available. The application of the detailed calculation procedure implies that all automation, control and management functions that have to be account for the operation of a building and its energy systems are known. Clause 6 gives a general survey of those functions and declares how to use them in the context of energy performance calculations.

5.4 BAC and TBM functions having an impact on the energy performance of buildings

Building Automation and Control (BAC) provide effective control functions for any building energy system, e.g. heating, ventilating, cooling, hot water and lighting appliances, that lead to improve operational and energy efficiencies. Complex and integrated energy saving functions and routines can be configured based on the actual use of a building, depending on real user needs, to avoid unnecessary energy use and CO₂ emissions.

Technical Building Management (TBM) functions as part of Building Management (BM) provide information about operation, maintenance, services and management of buildings, especially for energy management – measurement, recording trending, and alarming capabilities and diagnosis of unnecessary energy use. Energy management provides requirements for documentation, controlling, monitoring, optimization, determination and to support corrective action and preventive action to improve the energy performance of buildings. Standard EN 15232 can be used to evaluate the contribution of these building management functions to the energy performance of buildings.

The BAC functions described in Table 4 are based on the energy demand and supply model for a building in Figure 2.

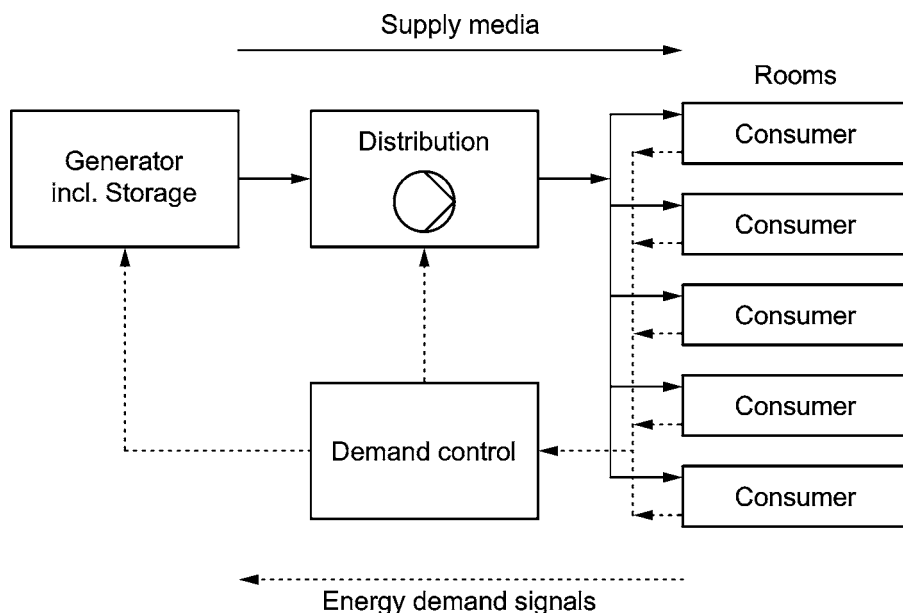


Figure 2 — Energy demand and supply model (Example: Heating plant)

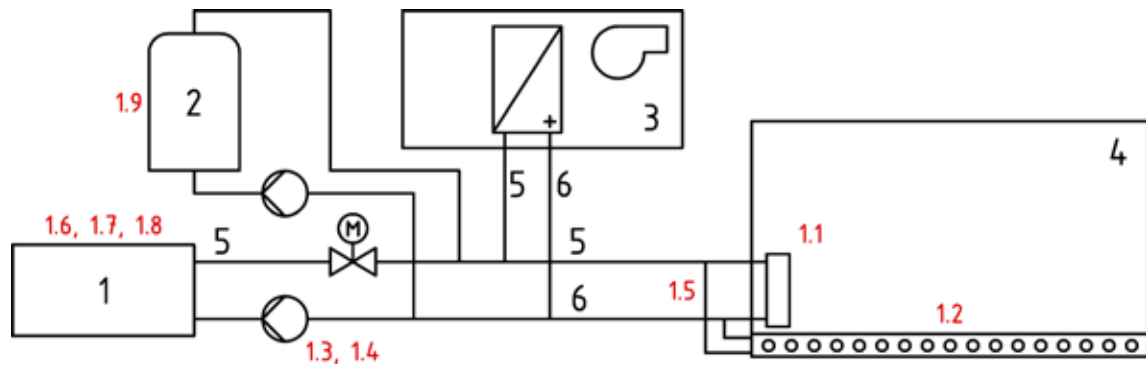
Rooms represent the source of the energy demand. Suitable equipment should ensure comfortable conditions in the rooms with regard to temperature, humidity, air quality and light as needed and with due consideration of minimum or maximum requirements specified in local regulations.

Supply media is provided to the consumer according to energy demand keeping losses in distribution and generation to an absolute minimum.

The building automation and control functions described in Table 4 are aligned in accordance with the energy demand and supply model. The relevant energy-efficiency functions are handled starting with the room, via distribution up through generation.

The most common BAC and TBM functions having an impact on the energy performance of buildings have been described and summarized in Table 4.

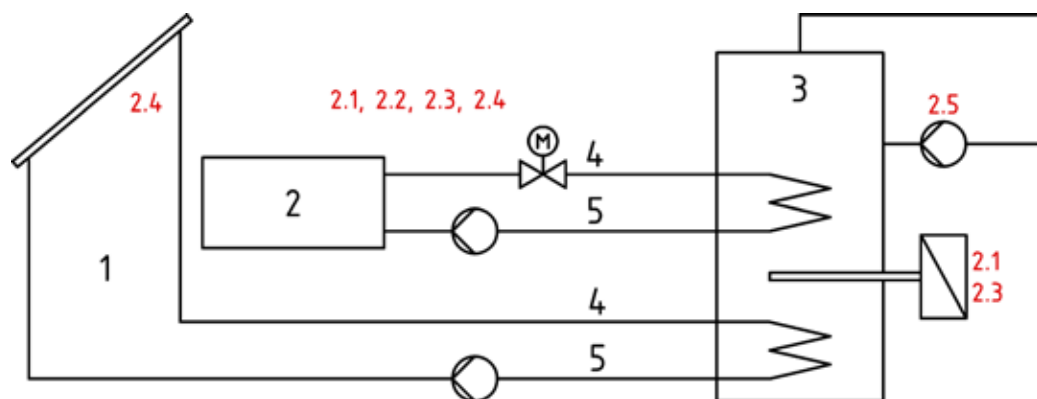
The following Figures 3 to 7 illustrate basic system designs for heating, domestic hot water, cooling, ventilation and air conditioning purposes. The numbers refer to the control functions summarized in Table 4. These basic elements can be combined to more or less complex systems that also account for local, regional or national specifics. The building automation and control functions defined in Table 4 are according to these basic system designs. Air side system control of HVAC shall be treated as ventilation and air-conditioning control, separately from heat generators, chillers, terminal units and water and refrigerant side controls.

**Key**

- 1 heat generator
- 2 thermal energy storage
- 3 air handling unit
- 4 room
- 5 heating water supply
- 6 heating water return

NOTE The numbers in red refer to the numbers in Table 4.

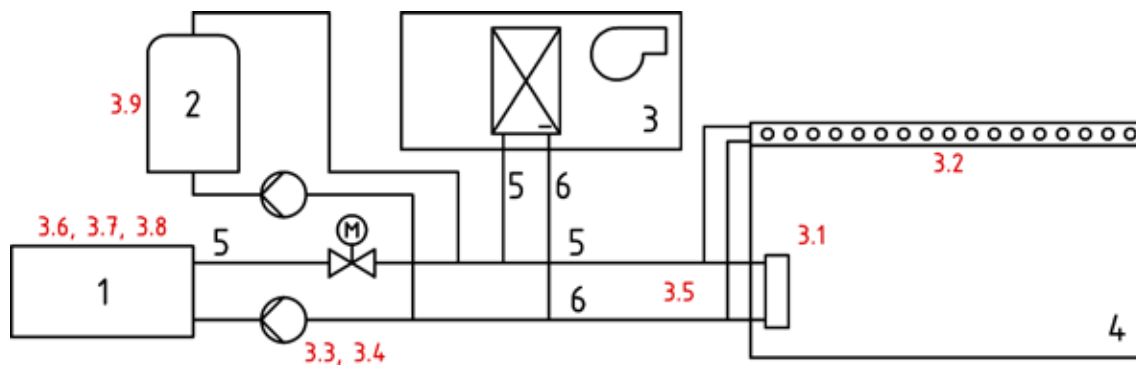
Figure 3 — Space heating system

**Key**

- 1 solar collector
- 2 boiler/district heating heat pump
- 3 domestic hot water storage
- 4 heating water supply
- 5 heating water return

NOTE The numbers in red refer to the numbers in Table 4.

Figure 4 — Domestic hot water heating system

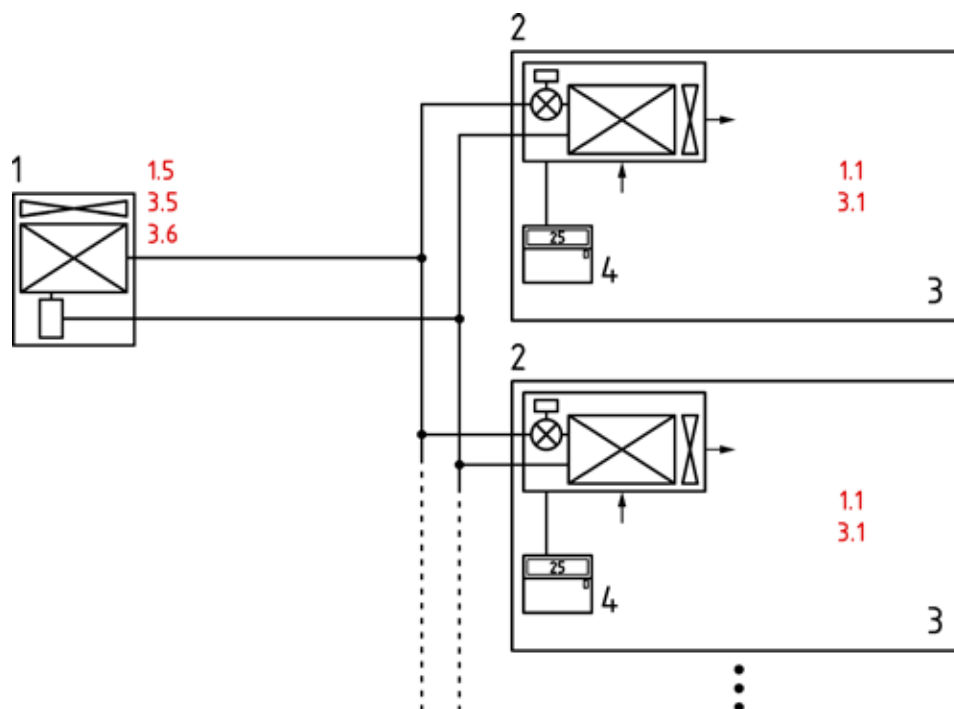


Key

- 1 chiller
- 2 thermal energy storage
- 3 air handling unit
- 4 room
- 5 chilled water supply
- 6 chilled water return

NOTE The numbers in red refer to the numbers in Table 4.

Figure 5 — Cooling system

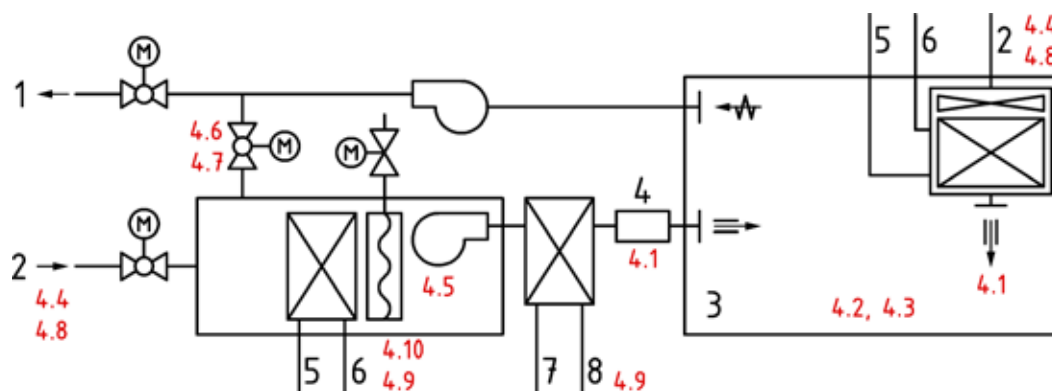


Key

- 1 outdoor unit
- 2 indoor unit
- 3 room 1
- 4 room 2

NOTE The numbers in red refer to the numbers in Table 4.

Figure 6 — Split system/VRF (heating and/or cooling)

**Key**

- 1 exhaust air
- 2 outside air
- 3 room
- 4 variable air volume
- 5 chilled water supply
- 6 chilled water return
- 7 heating water
- 8 heating water return

NOTE The numbers in red refer to the numbers in Table 4.

Figure 7 — Ventilation and air-conditioning System

Table 4 — BAC and TBM functions having an impact on the energy performance of buildings

Automatic control			
1	Heating control		
1.1	Emission control	HEAT_EMIS_CTRL_DEF	M3-5
		The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for type 1 one function can control several rooms	
	0	No automatic control of the room temperature	
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to EN 12098-1 or EN 12098-3; one system can control several rooms	
	2	Individual room control: By thermostatic valves or electronic controller	
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature setpoint)	
	4	Individual room control with communication and occupancy detection: Between controllers and BACS; Demand control/occupancy detection (this function level is usually not applied to any slow reacting heat emission systems with relevant thermal mass, e.g. floor heating, wall heating)	

1.2	Emission control for TABS (heating mode)	HEAT_EMIS_CTRL_TABS	M3-5
	0	No automatic control of the room temperature	
	1	Central automatic control: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose set-point is dependent on the filtered outside temperature, e.g. the average of the previous 24 h.	
	2	Advanced central automatic control: This is a central automatic control of the TABS zone that is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by the room temperature heating set-point). "Optimal" means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also is as low as possible to reduce the energy demand for heating.	
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control: a) Advanced central automatic control with intermittent operation. This is an advanced central automatic control according to 2) with the following supplement: The pump is switched off regularly to save electrical energy, either with a fast frequency - typically 6 h on/off cycle time - or with a slow frequency, corresponding to 24 h on/off cycle time. If the TABS is used for cooling, intermittent operation with 24 h on/off cycle time can also be used to reject the heat to the outside air if the outside air is cold. b) Advanced central automatic control with room temperature feedback control. This is an advanced central automatic control according to 2) with the following supplement: The supply water temperature set-point is corrected by the output of a room temperature feedback controller, to adapt the set-point to non-predictable day-to-day variation of the heat gain. Since TABS reacts slowly, only day-to-day room temperature correction is applied, an instant correction cannot be achieved with TABS. The room temperature that is fed back is the temperature of a reference room or another temperature representative for the zone. c) Advanced central automatic control with intermittent operation and room temperature feedback control	
1.3	Control of distribution network hot water temperature (supply or return)	HEAT_DISTR_CTRL_TMP	M3-6
		Similar function can be applied to the control of direct electric heating networks	
	0	No automatic control	
	1	Outside temperature compensated control: Actions generally lower the mean flow temperature	
	2	Demand based control: e.g. based on indoor temperature control variable; Actions generally lower the mean flow temperature	

1.4	Control of distribution pumps in networks	HEAT_DISTR_CTRL_PMP	M3-6
		The controlled pumps can be installed at different levels in the network. Control is to reduce the auxiliary energy demand of the pumps.	
	0	No automatic control	
	1	On/off control: switch on and off automatically, pumps run with no control at maximum speed	
	2	Multi-Stage control: Speed of pumps is controlled by a multi-step control	
	3	Variable speed pump control: constant or variable Δp based on pump unit (internal) estimations	
	4	Variable speed pump control: variable Δp following an external demand signal, e.g. hydraulic requirement, ΔT , energy optimization	
1.5	Intermittent control of emission and/or distribution	HEAT_DISTR_CTRL	M3-5 / M3-6
		One controller can control different rooms/zones having same occupancy patterns	
	0	No automatic control	
	1	Automatic control with fixed time program: To lower the operation time	
	2	Automatic control with optimum start/stop: To lower the operation time	
	3	Automatic control with demand evaluation: To lower the operation time	
1.6	Heat generator control for combustion and district heating	HEAT_GEN_CTRL_CD	M3-8
		The goal consists generally in minimizing the heat generator operation temperature	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: e.g. depending on supply water temperature setpoint	
1.7	Heat generator control (heat pump)	HEAT_GEN_CTRL_HP	M3-8
		The goal consists generally in minimizing the heat generator operation temperature and by this in maximizing the heat generator efficiency	
	0	Constant temperature control	
	1	Variable temperature control depending on outside temperature	
	2	Variable temperature control depending on the load: e.g. depending on supply water temperature setpoint	

1.8	Heat generator control (outdoor unit)		HEAT_GEN_CTRL_OU	M3-8
		The goal consists generally in maximizing the heat generator efficiency		
	0	On/Off-control of heat generator		
	1	Multi-stage control of heat generator capacity depending on the load or demand (e.g. on/off of several compressors)		
	2	Variable control of heat generator capacity depending on the load or demand (e.g. hot gas bypass, inverter frequency control)		
1.9	Sequencing of different heat generators		HEAT_GEN_CTRL_SEQ	M3-8
		This control function only applies to a system with a set of different heat generator sizes or types including Renewable Energy Sources		
	0	Priorities only based on running time		
	1	Control according to fixed priority list: e.g. heat pump prior to hot water boiler		
	2	Control according to dynamic priority list (based on current efficiency and capacity of generators)e.g. solar, geothermal heat, cogeneration plant, fossil fuels)		
	3	Control according to dynamic priority list (based on predicted and current load, efficiency and capacity of generators)		
1.10	Control of Thermal Energy Storage (TES) charging		HEAT_TES_CTRL	M3-7
		The TES is part of the heating system.		
	0	Continuous storage operation		
	1	2-sensor charging of storage		
	2	Load prediction based storage operation		
2	Domestic hot water supply control			
2.1	Control of DHW storage charging with direct electric heating or integrated electric heat pump		DHW_STRG_CTRL_EL	M8-7 / M8-8
	0	Automatic on/off control		
	1	Automatic on/off control and scheduled charging enable		
	2	Automatic on/off control and scheduled charging enable and multi-sensor storage management		
2.2	Control of DHW storage charging using hot water generation		DHW_STRG_CTRL_HG	M8-7 / M8-8
	0	Automatic on/off control		
	1	Automatic on/off control and scheduled charging enable		

	2	Automatic on/off control, scheduled charging enable and demand based supply temperature control or multi-sensor storage management		
2.3	Control of DHW storage charging with solar collector and supplementary heat generation	DHW_STRG_CTRL_SOL	M8-7 / M8-8	
	0	Manual control		
	1	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2)		
	2	Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2) plus demand based supply temperature control or multi-sensor storage management		
2.4	Control of DHW circulation pump	DHW_CIRC_CTRL	M8-6	
	0	No control, continuous operation		
	1	With time program		
3	Cooling control			
3.1	Emission control	CLG_EMIS_CTRL_DEF	M4-5	
		The control function is applied to the emitter (cooling panel, fan-coil unit or indoor unit) at room level; for type 1 one function can control several rooms		
	0	No automatic control of the room temperature		
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to EN 12098-1 or EN 12098-3		
	2	Individual room control: By thermostatic valves or electronic controller		
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature setpoint)		
	4	Individual room control with communication and occupancy detection: Between controllers and BACS; Demand control/occupancy detection (this function level is usually not applied to any slow reacting cool emission systems with relevant thermal mass, e.g. floor cooling)		
3.2	Emission control for TABS (cooling mode)	CLG_EMIS_CTRL_TABS	M4-5	
	0	No automatic control of the room temperature		
	1	Central automatic control: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose set-point is dependent on the filtered outside temperature, e.g. the average of the previous 24 h.		

	2	Advanced central automatic control: This is a central automatic control of the TABS zone that is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by the room temperature cooling set-point). “Optimal” means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also is as high as possible to reduce the energy demand for cooling.		
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control: a) Advanced central automatic control with intermittent operation. This is an advanced central automatic control according to 2) with the following supplement: The pump is switched off regularly to save electrical energy, either with a fast frequency - typically 6 h on/off cycle time - or with a slow frequency, corresponding to 24 h on/off cycle time. If the TABS is used for cooling, intermittent operation with 24 h on/off cycle time can also be used to reject the heat to the outside air if the outside air is cold. b) Advanced central automatic control with room temperature feedback control. This is an advanced central automatic control according to 2) with the following supplement: The supply water temperature set-point is corrected by the output of a room temperature feedback controller, to adapt the set-point to non-predictable day-to-day variation of the heat gain. Since TABS reacts slowly, only day-to-day room temperature correction is applied, an instant correction cannot be achieved with TABS. The room temperature that is fed back is the temperature of a reference room or another temperature representative for the zone. c) Advanced central automatic control with intermittent operation and room temperature feedback control		
3.3	Control of distribution network chilled water temperature (supply or return)	CLG_DISTR_CTRL_TMP	M4–6	
		Similar function can be applied to the control of direct electric cooling (e.g. compact cooling units, split units) for individual rooms		
	0	Constant temperature control		
	1	Outside temperature compensated control: Actions generally raise the mean flow temperature		
	2	Demand based control: e.g. based on indoor temperature control variable; Actions generally raise the mean flow temperature		
3.4	Control of distribution pumps in hydraulic networks	CLG_DISTR_CTRL_PMP	M4–6	
		The controlled pumps can be installed at different levels in the network		
	0	No automatic control		
	1	On off control: To reduce the auxiliary energy demand of the pumps		
	2	Multi-Stage control: To reduce the auxiliary energy demand of the pumps		

	3	Variable speed pump control: constant or variable Δp based on pump unit (internal) estimations to reduce the auxiliary energy demand of the pumps		
	4	Variable speed pump control: variable Δp following an external demand signal, e.g. hydraulic requirements, ΔT , energy optimization to reduce the auxiliary energy demand of the pumps		
3.5	Intermittent control of emission and/or distribution		CLG_DISTR_CTRL	M4-5 / M4-6
		One controller can control different rooms/zones having same occupancy patterns		
	0	No automatic control		
	1	Automatic control with fixed time program: To lower the operation time		
	2	Automatic control with optimum start/stop: To lower the operation time		
	3	Automatic control with demand evaluation: To lower the operation time		
3.6	Interlock between heating and cooling control of emission and/or distribution		CLG_GEN_CTRL	M4-8
		To avoid at the same time heating and cooling in the same room depends on the system principle (e.g. cooling panel/heat emitter, TABS/ventilation, several indoor units)		
	0	No interlock: the two systems are controlled independently and can provide simultaneously heating and cooling		
	1	Partial interlock (depending on the HVAC system): The control function is set up in order to minimize the possibility of simultaneous heating and cooling. This is generally done by defining a sliding setpoint for the supply temperature of the centrally controlled system		
	2	Total interlock: The control function enables to warranty that there will be no simultaneous heating and cooling.		
3.7	Generator control for cooling		CLG_GEN_CTRL	M4-8
		The goal consists generally in maximizing the chiller water temperature		
	0	Constant temperature control		
	1	Variable temperature control depending on outside temperature		
	2	Variable temperature control depending on the load: This includes control according to room temperature		
3.8	Sequencing of different chillers (generators for chilled water)		CLG_GEN_CTRL_SEQ	M4-8
		This control function only applies to a system with a set of different chiller sizes or chilled water generator types including Free Cooling and/or Renewable Energy Sources		

	0	Priorities only based on running time	
	1	Fixed Sequencing based on loads only: e.g. depending on the generators characteristics, e.g. absorption chiller vs. centrifugal chiller	
	2	Priorities based on generator efficiency and characteristics: The generator operational control is set individually to available generators so that they operate with an overall high degree of efficiency (e.g. outside air, river water, geothermic heat, refrigeration machines)	
	3	Load prediction based sequencing: The sequence is based on e.g. COP and available power of a device and the predicted required power.	
3.9	Control of Thermal Energy Storage (TES) charging		CLG_TES_CTRL M4-7
		The TES is part of the cooling/chilled water system.	
	0	Continuous storage operation	
	1	Time-scheduled storage operation	
	2	Load prediction based storage operation	
4	Ventilation and air-conditioning control		
	This section is for building energy systems that bring air into the building: both ventilation and air conditioning systems. Heating and Cooling of air requires additional heating and cooling devices. Control functions related to heating/cooling systems are defined in sections 1 and 3 resp.		
4.1	Supply air flow control at the room level (e.g. fan on/off)	VENT_RMFLOW_CTRL	M5-5
	Control of supply air flow related to occupancy (availability of air flow, i.e. fan on/off control)).		
	0	No automatic control: The system runs constantly (e.g. manual controlled switch)	
	1	Time control: The system runs according to a given time schedule	
	2	Occupancy detection: The system runs dependent on the occupancy (light switch, infrared sensors etc.)	
4.2	Room air temperature control by the ventilation system (all-air systems; combination with static systems as cooling ceiling, radiators, etc.)	VENT_RTEMP_CTRL	M5-5 / M5-6
	Room air temperature depends on air flow (4.1, 4.5) as well as supply air temperature (4.9). This control function is related to a closed loop controller for the room air temperature acting on the air flow or supply air temperature. It can work with or without an additional static heating system (radiators etc.). Minimum air flow rates are maintained.		
	0	On-off control: fixed air flow rate and fixed supply air temperature at the room level; Room temperature setpoints are set individually.	

	1	Continuous control: either air flow rate or supply air temperature at the room level can be varied continuously ; Room temperature setpoint s are set individually		
	2	Optimized control: Minimum energy demand by optimized control. Both air flow rate as well as supply air temperature at the room level are controlled dependent on heating/cooling load.		
4.3	Coordination of room air temperature control by ventilation and by static system	VENT_RTEMP_COORD	M5-5 / M5-6	
	Interaction of the different systems has to be coordinated.			
	0	Interaction is not coordinated, e.g. closed loop controllers are dedicated to each system to maintain the room air temperature independently.		
	1	Interaction is coordinated, i.e. only one system is controlled by a closed loop controller for the room air temperature and the other system conditions the room only to that extent that allows the closed loop controller to benefit from internal and external heat gains.		
4.4	Outside air flow control	VENT_OAFLOW_CTRL	M5-6 / M5-8	
	This control function is applied to ventilation systems that allow varying the OA ratio or flow respectively.			
	0	Fixed OA ratio/OA flow: The system runs according to a given OA ratio, e.g. modified manually.		
	1	Staged (low/high) OA ratio/OA flow: depending on a given time schedule		
	2	Staged (low/high) OA ratio/OA flow: depending on the occupancy, e.g. light switch, infrared sensors etc.		
	3	Variable control: The system is controlled by sensors which detect the number of people or indoor air parameters or adapted criteria (e.g. CO ₂ , mixed gas or VOC sensors). The used parameters shall be adapted to the kind of activity in the space.		
4.5	Air flow or pressure control at the air handler level	VENT_AHUFLOW_CTRL	M5-6 / M5-8	
	0	No automatic control: Continuously supplies of air flow for a maximum load of all rooms		
	1	On off time control: Continuously supplies of air flow for a maximum load of all rooms during nominal occupancy time		
	2	Multi-stage control: To reduce the auxiliary energy demand of the fan		
	3	Automatic flow or pressure control without pressure reset: Load dependent supplies of air flow for the demand of all connected rooms.		
	4	Automatic flow or pressure control with pressure reset: Load dependent supplies of air flow for the demand of all connected rooms (for variable air volume systems with VFD).		

4.6	Heat recovery control: icing protection	VENT_HRICE_CTRL	M5-5
	This control function is to avoid icing of the heat exchanger.		
	0	Without icing protection control: There is no specific action to avoid icing of the heat exchanger	
	1	With icing protection control: A control loop enables to warranty that the exhaust air temperature leaving the heat exchanger is not too low to avoid frosting	
4.7	Heat recovery control: prevention of overheating	VENT_HRHEAT_CTRL	M5-5
	This control function is to avoid overheating at the heat recovery unit.		
	0	Without overheating control: There is no specific action to avoid overheating	
	1	With overheating control: During periods where the effect of the heat exchanger will no more be positive a control loop between “stops” and “modulates” or bypass the heat exchanger	
4.8	Free mechanical cooling	VENT_FREECOOL_CTRL	M5-8
	0	No automatic control	
	1	Night cooling: The amount of outside air is set to its maximum during the unoccupied period provided: 1) the room temperature is above the setpoint for the comfort period; 2) the difference between the room temperature and the outside temperature is above a given limit; if free night cooling will be realized by automatically opening windows there is no air flow control	
	2	Free cooling: Both the amount of outside air and recirculation air are modulated during all periods of time to minimize the amount of mechanical cooling. Calculation is performed on the basis of temperatures	
	3	H,x-directed control: The amount of outside air and recirculation air are modulated during all periods of time to minimize the amount of mechanical cooling. Calculation is performed on the basis of temperatures and humidity (enthalpy).	
4.9	Supply air temperature control at the AHU level	VENT_AHUSAT_CTRL	M5-5
	There might be several supply air temperatures in an air conditioning system: the supply air temperature at the outlet of the AHU, the supply air temperature at the outlet of central re-heaters as well as supply air temperature at the room level (terminal re-heat boxes). This control function is about how to determine the supply air temperature setpoint (in case there is one) at the air handler level not how to control the temperature (e.g. control of heat emission at the water-to-air HX).		
	0	No automatic control: No control loop enables to act on the supply air temperature;	
	1	Constant setpoint: A control loop enables to control the supply air temperature, the setpoint is constant and can only be modified by a manual action	

	2	Variable setpoint with outside temperature compensation: A control loop enables to control the supply air temperature. The setpoint is a simple function of the outside temperature (e.g. linear function)		
	3	Variable setpoint with load dependent compensation: A control loop enables to control the supply air temperature. The setpoint is defined as a function of the loads in the room. This can normally only be achieved with an integrated control system enabling to collect the temperatures or actuator position in the different rooms		
4.10	Humidity control		VENT_HUM_CTRL	M6-5 / M7-5
	The control of the air humidity may include humidification and/or dehumidification. Controllers may be applied as “humidity limitation control” or “constant control”			
	0	No automatic control: No control loop enables to act on the air humidity		
	1	Dew point control: Supply air or room air humidity is expressed with the dew point temperature and reheat of the supply air to bring the relative humidity to the setpoint		
	2	Direct humidity control: Supply air or room air humidity; a control loop enables the supply air or room air humidity at a given setpoint. The setpoint is either fixed and predefined by the user or an fluctuating optimal value at a minimum energy but within min/max limits of room air condition		
5	Lighting control			
5.1	Occupancy control		LIGHT_OCC_CTRL	M9-5
	0	Manual on/off switch: The luminaire is switched on and off with a manual switch in the room		
	1	Manual on/off switch + additional sweeping extinction signal: The luminaire is switched on and off with a manual switch in the room. In addition, an automatic signal automatically switches off the luminaire at least once a day, typically in the evening to avoid needless operation during the night		
	2	Automatic detection Auto On/Dimmed Off: The control system switches the luminaire(s) automatically on whenever the illuminated area is occupied, and automatically switches them to a state with reduced light output (of no more than 30 % of the normal 'on state') no later than 10 min after the last occupancy in the illuminated area. In addition, no later than 20 min after the last occupancy in the room as a whole is detected, the luminaire(s) is automatically and fully switched off Auto On/Auto Off: The control system switches the luminaire(s) automatically on whenever the illuminated area is occupied, and automatically switches them entirely off no later than 10 min after the last occupancy is detected in the illuminated area		

	3	Automatic detection Manual On/ Partial Auto On /Dimmed Off: The luminaire(s) can only be switched on by means of a manual switch or automatically by occupancy detection sensor located in (or very close to) the area illuminated by the luminaire(s), and, if not switched off manually, is/are automatically switched to a state with reduced light output (of no more than 30 % of the normal 'on state') no later than 10 min after the last occupancy in the illuminated area. In addition, no later than 20 min after the last occupancy in the room as a whole is detected, the luminaires are automatically and fully switched off Manual On/ Partial Auto On /Auto Off: The luminaire(s) can only be switched on by means of a manual switch or automatically by occupancy detection sensor located in (or very close to) the area illuminated by the luminaire(s), and, if not switched off manually, is automatically and entirely switched off by the automatic control system no later than 20 min after the last occupancy is detected in the illuminated area		
5.2	Light control (daylight harvesting)	level/Daylight (daylight harvesting)	LIGHT_LEVEL_CTRL	M9-5
	0	Manual central: Luminaires are controlled centrally, there is no manual switch in the room/zone		
	1	Manual: Luminaires can be switched off with a manual switch in the room		
	2	Automatic switching: The luminaires are automatically switched off when more than enough daylight is present to fully provide minimum illuminance required and switched on when there is not enough daylight.		
	3	Automatic dimming: The luminaires are dimmed down and finally fully switched off when daylight is available. The luminaires will be switched on again and dimmed up if the amount of daylight is decreasing.		
6	Blind control			
6.1	Blind control		BLIND_CTRL	M2.5/M2.8/M9-5
	There are two different motivations for blind control: solar protection to avoid overheating and to avoid glaring			
	0	Manual operation: Mostly used only for manual shadowing, energy saving depends only on the user behaviour		
	1	Motorized operation with manual control: Mostly used only for easiest manual (motor supported) shadowing, energy saving depends only on the user behaviour		
	2	Motorized operation with automatic control: Automatic controlled dimming to reduce cooling energy		
	3	Combined light/blind/HVAC control: To optimize energy use for HVAC, blind and lighting for occupied and non-occupied rooms		
7	Technical home and building management			

	The Technical Home and Building Management enables to adapt easily the operation to the user needs. One shall check at regular intervals that the operation schedules of heating, cooling, ventilation and lighting is well adapted to the actual used schedules and that the setpoints are also adapted to the needs. – Attention shall be paid to the tuning of all controllers this includes setpoints as well as control parameters such as PI controller coefficients. – Heating and cooling setpoints of the room controllers shall be checked at regular intervals. The users often modify these setpoints. A centralized system enables to detect and correct extreme values of setpoints due to misunderstanding of users. – If the Interlock between heating and cooling control of emission and/or distribution is only a partial interlock. The setpoint shall be regularly modified to minimize the simultaneous use of heating and cooling. – Alarming and monitoring functions will support the adaptation of the operation to user needs and the optimization of the tuning of the different controllers. This will be achieved by providing easy tools to detect abnormal operation (alarming functions) and by providing easy way to log and plot information (monitoring functions).		
7.1	Setpoint management	BMS_SP	M10-12
	Management, set back and adaptation of BAC setpoints according to the room/zone operating modes		
	0	Manual setting room by room individually	
	1	Adaptation from distributed/decentralized plant rooms only	
	2	Adaptation from a central room (e.g. work station, web operation; room operating units are excluded)	
	3	Adaptation from a central room (e.g. work station, web operation; room operating units are excluded) with frequent set back of user inputs	
7.2	Runtime management	BMS_RT	M10-12
	Adaptation of system/plant operating hours according to given time schedule and/or calendar		
	0	Manual setting (plant enabling)	
	1	Individual setting following a predefined schedule including fixed preconditioning phases	
	2	Individual setting following a predefined schedule; adaptation from a central room (e.g. work station, web operation; room operating units are excluded); variable preconditioning phases	
7.3	Detecting faults of technical building systems and providing support to the diagnosis of these faults	BMS_FD	M10-12
	0	No central indication of detected faults and alarms	
	1	With central indication of detected faults and alarms	

	2	With central indication of detected faults and alarms including diagnosing functions		
7.4	Reporting information regarding energy consumption, indoor conditions	BMS_RPR	M10-12	
	0	Indication of actual values only (e.g. temperatures, meter values)		
	1	Trending functions and consumption determination		
	2	Analysing, performance evaluation, benchmarking of indoor environment and energy		
7.5	Local energy production and renewable energies	BMS_RES	M10-12	
	Managing local renewable energy sources and other local energy productions as CHP			
	0	Uncontrolled generation depending on the fluctuating availability of RES and or run time of CHP; overproduction will be fed into the grid		
	1	Coordination of local RES and CHP with regard to local energy demand profile including energy storage management; Optimization of own consumption		
7.6	Heat recovery and heat shifting	BMS_HRC	M10-12	
	Using of waste heat recovery on the building level and heat shifting			
	0	Instantaneous use of waste heat or heat shifting		
	1	Managed use of waste heat or heat shifting (including charging/discharging TES)		
7.7	Smart grid integration	BMS_SG	M10-12	
	Interactions between building and any smart grid including demand side management			
	0	No harmonization between grid and building energy systems; building is operated independently from the grid load		
	1	Building energy systems are managed and operated depending on grid load; demand side management is used for load shifting		

5.5 BAC Efficiency Class

Four different BAC efficiency classes (A, B, C, D) of functions are defined both for non-residential and residential buildings.

- Class D corresponds to non-energy efficient BAC. Building with such systems shall be retrofitted. New buildings shall not be built with such systems.
- Class C corresponds to standard BAC.
- Class B corresponds to advanced BAC and some specific TBM functions.
- Class A corresponds to high-energy performance BAC and TBM functions.