Continuous Room Temperature Controller RAM 713

RAM 713	713 9 200

Contents

1 Functional characteristics

The room temperature controller RAM 713 is a continuous EIB room temperature controller with 3 binary inputs.
It measures the current room (actual value) and sends a continuous control variable (0...100%) to an actuating drive or heating actuator in order to achieve the desired room temperature (setpoint value).

Using the binary inputs, switches and keys (floating) can be connected to switch, dim and control blinds.
An external temperature sensor can be alternatively connected to input 3 (analogue).

Possible actuators are, for instance: Cheops drive, HMT 6, HMT 12, HMG 8

In addition to the heating system, RAM 713 can also control a cooling system.

In order to easily adapt to the setpoint values in respect of living comfort and energy saving, RAM 713 has four operating modes:

- Comfort
- Standby
- Night mode
- Frost protection mode

A setpoint value is assigned to each operating mode.

Comfort mode is used when the room is occupied.

In **standby mode,** the setpoint value is reduced slightly. This operating mode is used when the room is not occupied but is expected to be shortly.

In **night mode,** the setpoint value is drastically reduced, since the room is not expected to be occupied for several hours.

In **frost protection mode,** the room is controlled to a temperature that eliminates the risk of damage to the radiators through freezing at low ambient temperatures:
This can be desirable for 2 reasons:
- The room is not occupied for several days.
- A window has been opened and no further heating is required for the time being.

The operating modes are usually controlled by a timer.
For optimum control, however, presence indicators and/or presence keys and window contacts are recommended.
See also the chapter headed “Determining the current setpoint value”.

1.1 Operation

For operation and display functions, RAM 713 is fitted with 5 LEDs and a rotary control.

The left LED shows the status display of the control variable:

Red	Heating control variable	greater 0%
Blue	Cooling control variable	greater 0%
Off	Both control variables	= 0%

The other 4 LEDs show the current operating mode.

Comfort
Standby
Night
Frost protection

The rotary control can be used to either **set** or **offset** the setpoint value, depending on the configuration.

1.2 Benefits of RAM 713

- Continuous P/PI room temperature control
- Change of operating mode by means of presence and window objects
- Heating and cooling operation
- Alternative actuation of a second heating stage with switching or continuous control variable
- Rotary control for setting or offsetting setpoint values
- Infinite regulation through continuous control variable
- Input for external temperature sensor to measure the temperature of the room or the underfloor, limitation of the underfloor temperature thus possible
- 3 Binary inputs for conventional keys/switches or to control blinds/dimmer

1.2.1 Special features

RAM 713 has 3 external inputs for keys, switches or an external sensor (to heat floors, for example).

2 Technical data

2.1 General

Voltage supply:	Bus voltage
Permitted working temperature:	0°C ...+ 50°C
Protection class:	III
Protection rating:	EN 60529: IP 21
Dimensions:	HxWxD 80x84x28 (mm)

3 The application program "RAM 713 V1.0"

3.1 Selection in the product database

Manufacturer	Theben AG
Product family	Heating, ventilation, air conditioning
Product type	Controller
Program name	RAM 713 V1.0

Download the application from: http://www.theben.de

3.2 Parameter pages

Table 1

Function	Description
Settings	Selection of control functions, Standard and user-defined settings, function of the external interface
Setpoint values	Setpoint value after download, values for night, frost mode etc.
Setpoint values for cooling	Dead zone and temperature increases conditional to the operating mode
Operation	Function of the control elements
Actual value	Mode/function of the sensor, calibration
Heating control	Heating parameters, controller type etc.
Cooling control	Cooling parameters, controller type etc.
Operating mode	Operating mode after download, presence sensor
Additional stage for heating	Control parameters, hysteresis Reduction, bandwidth etc.
Switching E1...E3	Function of the contact connected
Blinds	Sets the duration for pressing the key
Dimming	Sets the duration for pressing the key

3.3 Communication objects

3.3.1 Object characteristics

RAM 713 features 12 communication objects.
Some objects can assume various functions depending on their configuration.

Table 2

No.	Function	Object name	Type	Behaviour
0	Defines the setpoint temperature	Basic setpoint value	2 bytes EIS5	Receive
	offsets/reports	Manual setpoint value offset	2 bytes EIS5	Send / Receive
1	Report current setpoint value	Current setpoint value	2 bytes EIS5	Send
2	Sends actual value	Actual value	2 bytes EIS5	Send
3	Pre-selections operating mode	Pre-selected operating mode	1 byte KNX	Receive
	1 = night, 0 = standby	Night < - > Standby	1 bit	
4	Input for presence signal	Presence	1 bit	Receive
	1 = comfort	Comfort	1 bit	Receive
5	Input for window status	Window position	1 bit	Receive
	1 = frost protection	Frost/heat protection	1 bit	Receive
6	Heating = 0, Cooling = 1	Switches between heating and cooling	1 bit	Receive
	Reports current operating mode	Current operating mode	1 byte KNX	Send /
7	Sends control variable	Heating control variable	1 byte EIS6	Send
8	Sends control variable	Cooling control variable	1 byte EIS6	Send
	Sends control variable	Control variable for additional heating stage	1 bit	Send
	Sends control variable	Control variable for additional heating stage	1 byte EIS6	Send
9,10,11	Sends ON/OFF message	Switches input 1,2,3	1 bit	Send / receive
	Sends ON/OFF message	Dimmer On/Off	1 bit	
	Controls slat	Blinds Step/Stop	1 bit	
	Sends dim message	Dims up/down	4 bit	

Table 3

Number of communication objects:	12
Number of group addresses:	36
Number of associations:	36

3.3.2 Object description

- **Object 0 “Basic setpoint value” / “Manual setpoint value offset”**

This object can assume 2 different functions.
With it, either a new setpoint temperature can be specified or the current setpoint temperature can be offset a certain value, depending on the configuration of the rotary control.

Table 4.

Parameters: Function of the rotary control	Function of the object
Manual offset / Disabled, but object basic setpoint value present	**Defining the setpoint temperature:** The basic setpoint value is first specified via the application at start-up and stored in the “Basic setpoint value” object. Afterwards it can be specified again at any time using the object 0 (limited by minimum or maximum valid setpoint value). If the bus voltage fails, this object is backed up and the last value is restored when the bus voltage returns. The object can be described indefinitely often.
Basic setpoint value / Disabled, but object manual offset available	**Offsetting the setpoint temperature** The object receives a temperature differential in EIS 5 format. The desired room temperature (current setpoint value) can be adjusted from the basic setpoint value by this differential. The following applies in comfort mode (heating): current setpoint value (Obj. 1) = basic setpoint value (rotary control) + manual setpoint value offset (Obj. 0) Values outside of the programmed range (see “Max. setpoint value offset on the rotary control”) are limited to the highest or the lowest value. Note: The offset always refers to the set basic setpoint value and not to the current setpoint value.

- **Object 1 "Current setpoint value"**

This object sends the current setpoint temperature as a EIS 5 message (2 bytes) to the bus. The sending behaviour can be set on the "Setpoint values" parameters page.

- **Object 2 "Actual value"**

This object sends the temperature currently being measured by the sensor (if sending through configuration is permitted)

- **Object 3 "Pre-selected operating mode" / "Night <-> Standby"**

The function of this object depends on the "Objects for determining operating mode" parameter on the "Operating mode" parameter page.

Table 5

Objects for determining the operating mode	Function of the object
New: operating mode, presence, window status	With this setting, the object is a 1 byte object. One of 4 operating modes can be directly activated. 1 = comfort, 2 = standby, 3 = night, 4 = frost protection (heat protection) The details in brackets refer to cooling mode
Old: comfort, night, frost	With this setting, this object is a 1 bit object. Night or standby operating mode can be activated. 0=standby 1=night

- **Object 4 "Presence" / "Comfort"**

The function of this object depends on the "Objects for determining operating mode" parameter on the "Operating mode" parameter page.

Table 6

Objects for determining the operating mode	Function of the object
New: operating mode, presence, window status	**Presence:** The status of a presence indicator (e.g. sensor, movement indicator) can be received via this object. A 1 on this object activates the comfort operating mode.
Old: comfort, night, frost	**Comfort:** A 1 on this object activates the comfort operating mode. This operating mode takes priority over night and standby operation. Comfort mode is deactivated by sending an 0 to the object.

- **Object 5 "Window position" / "Frost/heat protection"**

The function of this object depends on the "Objects for determining operating mode" parameter on the "Operating mode" parameter page.

Table 7

Objects for determining the operating mode	Function of the object
New: operating mode, presence, window status	**Window position:** The status of a window contact can be received via this object. A 1 on this object activates the frost / heat protection operating mode.
Old: comfort, night, frost	**Frost/heat protection:** A 1 on this object activates the frost protection operating mode. During the cooling operation, the heat protection mode is activated. The frost/heat protection operating mode takes top priority. The frost/heat protection mode remains until it is cleared again by a 0.

- **Object 6 "Current operating mode" / "Switching between heating and cooling"**

The function of this object depends on the parameter "Switching between heating and cooling" on the parameter page "Cooling control".

Table 8

Switches between heating and cooling	Function of the object
Automatic	**Current operating mode:** sends the current operating mode as a 1 byte value (see below: coding of the operating modes). The sending behaviour can be set on the "Operating mode" parameter page.
Via object	**Switches between heating and cooling:** This object is used if automatic switching between heating and cooling is not desired. The cooling operation is forced via a 1 and the heating operation via a 0.

Table 9: Coding of the operating modes:

Value	Operating mode
1	Comfort
2	Standby
3	Night
4	Frost protection/heat protection

- **Object 7 “Current control variable, heating”**

Sends the current control variable (0..100%).

- **Object 8 “Cooling control variable” / “Control variable for additional heating stage”**

The function of this object depends on the “Input for actual value” parameter on the “Settings” parameter page.

Table 10

Used control functions	Function of the object
Heating and cooling	Sends the cooling control variable to control a cooling surface, fan coil unit etc.
2-stage heating with switching additional stage	Sends the switching command to control the additional stage (on/off)
2-stage heating with continuous additional stage	Sends the continuous control variable to control the additional stage (0…100%)

Note:
In the “Only heating control” setting, the object is not available because neither the cooling function nor the additional stage are available.

- **Objects 9...11 “Switching 1...3” / “Dimming channel” / Blinds Step/Stop” / “Dim up/down”**

The function of these objects depends on the “Function of the external interface” parameter on the “Settings” parameter page.

The status of these objects can be determined via both the external interface and the bus.*

Table 11

Function of the external interface	Function		
	Object 9	Object 10	Object 11
EI, E2, switch, E3: ext. actual value	Sends the switching status of the E1 input	Sends the switching status of the E2 input	Not available
E1-E3: Switching	Sends the switching status of the E1 input	Sends the switching status of the E2 input	Sends the switching status of the E3 input
E1, E2, blinds, E3: Switching	Sends the Step/Stop command to the blinds actuator	Sends the Step/Stop command to the blinds actuator	Sends the switching status of the E3 input
E1, E2, dimming, E3: Switch	Sends a command to switch the dimmer on/off	Sends a up/down dimming command to the dimmer	Sends the switching status of the E3 input

* Exception: Should a gate input be programmed as an On-Off switch, the status of the object is determined only by the switch connected to the interface.

3.4 Parameters

The standard values are **in bold**.

3.4.1 Settings

Table 12

Designation	Values	Meaning
Control	**Standard** User-defined	For simple applications For specific settings of the control parameters and special applications such as heating/cooling or 2nd heating stage.
Used control functions	 **Heating control only** Heating and cooling 2-stage heating with switching additional stage 2-stage heating with continuous additional stage	User-defined control: Heating operation only An additional cooling system should be controlled (Object 8) . A main stage (typically underfloor heating) and an additional stage (On/Off) should be controlled. A main stage (typically underfloor heating) and a additonal stage (radiator) should be controlled (P control).
Operating mode	**Standard** User-defined	Default settings Opens the parameter page „Operating mode
Function of the external interface	**None** E1-E3: Switching E1,E2 blinds, E3: Switching E1, E2, dimming, E3: Switching E1, E2, switching, E3: ext. actual value	Occupancy of the interface: with switch with key to control blinds. with key for the dimming function E1-2 with switch. E3 with temperature sensor

3.4.2 Setpoint values

Table 13

Designation	Values	Meaning
Basic setpoint value after download of application	18 °C, 19 °C, 20 °C, **21 °C**, 22 °C, 23 °C, 24 °C, 25 °C	Output setpoint value for the temperature control.
Maximum valid setpoint value offset	+/- 1 K, **+/- 2 K**, +/- 3 K	Should a setpoint value offset which is outside the set +/- limits be sent to Object 0, it will be limited to this value.
Maximum valid basic setpoint value	20°C, 21°C, 22°C 23°C, 24 °C, 25°C 27 °C, 30 °C, **32 °C**	Should a basic setpoint value which is higher than the set value here be sent to Object 0, it will be limited to this value.
Minimum valid basic setpoint value	5°C, **6°C**, 7°C, 8°C, 9°C, 10°C, 11°C, 12 °C, 13°C, 14°C, 15°C,16°C 17°C, 18°C, 19 °C, 20 °C	Should a basic setpoint value which is lower than the set value here be sent to Object 0, it will be limited to this value.
Reduction in standby mode (during heating)	0.5 K, 1 K, 1.5 K **2 K**, 2.5 K, 3 K 3.5 K, 4 K	Example: with a basic setpoint value of 21°C in heating operation and a 2K reduction, RAM 713 controls at a setpoint value of 21 – 2 = 19°C
Reduction in night mode (during heating)	3 K, 4 K, **5 K** 6 K, 7 K, 8 K	By what value should the temperature be reduced in night mode?
Setpoint value for frost protection operation (during heating)	3 °C, 4 °C, 5 °C **6°C**, 7 °C, 8 °C 9 °C, 10 °C	Preset temperature for frost protection operation in heating mode (Heat protection operation applies in cooling mode).

Continued:

Designation	Values	Meaning
Current setpoint value in comfort mode		Feedback of current setpoint value via the bus:
	Sends actual value (Heating < > Cooling)	The setpoint value actually being controlled is always sent (= current setpoint value) **Example** with a basic setpoint value of 21°C and a dead zone of 2K: During heating and cooling, 21°C and basic setpoint value + dead zone are sent respectively (21°C + 2K = 23°C)
	Sends average value between heating and cooling	Same value in comfort operation mode during both heating and cooling operation, i.e.: Basic setpoint value + half dead zone are sent to prevent room users becoming irritated. **Example** with a basic setpoint value of 21°C and a dead zone of 2K: Mean value= 21°+1K =22°C Although control takes place at 21°C or 23°C

Continued:

Designation	Values	Meaning
Sends the current setpoint value cyclically		How often should the currently valid setpoint value be sent?
	Not cyclical, only in the event of change	Send only in the event of a change.
	Every 2 min. Every 3 min. Every 5 min. Every 10 min. Every 15 min. Every 20 min. Every 30 min. Every 45 min. Every 60 min.	Send cyclically

3.4.3 Setpoint values for cooling

This page is displayed only when the control function “Heating and cooling” has been selected (“user-defined” control) on the “Settings” parameter page.

Table 14

Designation	Values	Meaning
Dead zone between heating and cooling	1 K **2 K** 3 K 4 K 5 K 6 K	Specifies the interval between setpoint value in heating and cooling operations. Example with a basic setpoint value of 21°C and a dead zone of 2K: RAM 713 will only start cooling when the temperature is ≥ setpoint value + dead zone, i.e. 21°C + 2K = 23°C.
Increase in standby mode (during cooling)	0.5 K, 1 K, 1.5 K **2 K**, 2.5 K, 3 K 3.5 K, 4 K	The temperature is increased in standby mode during cooling operation
Increase in night mode (during cooling)	3 K, 4 K, **5 K** 6 K, 7 K, 8 K	See increase in standby mode
Setpoint value for heat protection mode (during cooling)	**42 °C (does not represent heat protection)** 29 °C, 30 °C, 31 °C 32 °C, 33 °C, 34 °C **35 °C**	The heat protection represents the maximum permitted temperature for the controlled room. It performs the same function during cooling as the frost protection mode during heating, e.g. saves energy while prohibiting non-permitted temperatures

3.4.4 Actual value

Table 15

Designation	Values	Meaning
Use which actual value	From internal sensor	Fixed setting: The room temperature is measured using the fitted sensor An external sensor can be selected via the “Function of external interface” parameter on the Settings parameter page. Actual value)
Calibration value for internal sensor	Manual input – 64 ... 63	Positive or negative correction of measured temperature in 1/10 K increments. Examples: a) RAM 713 sends 20.3°C. A room temperature of 21.0°C is measured using a calibrated thermometer. In order to increase the temperature of RAM 713 to 21 °C, “7” (i.e. 7 x 0.1K) must be entered. b) RAM 713 sends 21.3°C. 20.5°C is measured. In order to reduce the temperature of RAM 713 to 20.5 °C, “8” (i.e. -8 x 0.1K) must be entered.
Sending the actual value	Not in the event of change at a change of 0.2 K at a change of 0.3 K **at a change of 0.5 K** at a change of 0.7 K at a change of 1 K at a change of 1.5 K at a change of 2 K	Is the current room temperature to be sent? If so, from which minimum change should this be sent again? This setting keeps the bus load as low as possible.

Continued:

Designation	Values	Meaning
Send the actual value cyclically	Does not send cyclically every 2 min., every 3 min. every 5 min., every 10 min. every 15 min., every 20 min. **every 30 min**., every 45 min. every 60 min.	How often should the values be sent, regardless of the temperature changes?
Parameters for the external actual value		
Function of the external sensor	**Sensor for temperature control** Sensor for temperature control	The room temperature is measured using the external sensor. The internal sensor is deactivated. The room temperature is measured using the internal sensor. The external sensor monitors the underfloor temperature (see below: minimum and maximum floor temperature).
Minimum floor temperature	No lower limit 10°C, 12°C, 14°C **16°C**, 18°C, 20 °C 22°C, 24°C, 26°C 28°C, 30°C	The floor temperature is controlled by RAM 713 depending on the room temperature. However, the floor temperature is not exceeded even when the setpoint temperature has reached the set minimum value. This setting prevents “cold feet.”
Maximum floor temperature	24°C, 26°C, 28°C, 30°C, 32°C, **34°C**, 36°C, 38°C, 40°C, 42°C, 44°C, 46°C,	The floor temperature is controlled by RAM 713 depending on the room temperature. However, the floor temperature is not exceeded even when the setpoint temperature has not reached the set maximum value. This setting prevents, among other things, the floor from becoming deformed through overheating.

Continued:

Designation	Values	Meaning
Calibration value for the external sensor (in 0.1K, -64...63)	Manual input – 64 ... 63	See above, calibration for internal sensor
Sends the external actual value	Not in the event of change by 0.2 K, 0.3 K **by 0.5 K**, 0.7 K by 1 K, 1.5 K by 2 K	See above, sending the actual value
Sends the external actual value cyclically	Does not send cyclically every 2 min., every 3 min. every 5 min., every 10 min. every 15 min., every 20 min. **every 30 min**., every 45 min. every 60 min.	See above, sends the actual value cyclically

3.4.5 Heating control

Table 16

Designation	Values	Meaning
Sets the control parameters	**Via system type** User-defined	Standard application Prof. application: Self-configure P/PI control
System type	**Radiator heating** Underfloor heating	PI control with: Integrated time = 90 minutes Bandwidth = 2.5 k Integrated time = 180 minutes Bandwidth = 4 k
Sends the heating control variable cyclically	On change by 1% On change by 2 % On change by 3 % **On change by 5 %** On change by 7 % On change by 10 % On change by 15 %	After how much % change* in the control variable is the new value to be sent. Small values increase control accuracy and also the bus load.
Sends the heating control variable cyclically	**Not cyclical, only in the event of change** every 2 min. every 3 min. every 5 min. every 10 min. every 15 min. every 20 min. every 30 min. every 45 min. every 60 min.	How often is the current heating control variable to be sent (regardless of changes)?
	User-defined parameters	
Proportional band of heating control	1 K, 1.5 K, **2 K**, 2.5 K, 3 K 3.5 K, 4 K, 4.5 K 5 K, 5.5 K, 6 K 6.5 K, 7 K, 7.5 K 8 K, 8.5 K	Prof. setting to adapt the control response to the room. Small values cause large changes in control variables, larger values cause finer control variable adjustment. See Appendix: Temperature control

*Change since last sending

Continued:

Designation	Values	Meaning
Integrated time of heating control	Pure P control 15 min., 30 min., 45 min., 60 min., 75 min., 90 min., 105 min.,, 120 min., 135 min., **150 min**., 165 min., 180 min., 195 min., 210 min., 225 min.	See Appendix Temperature control For PI control only: The integrated time determines the reaction time of the control. For radiators, times of approx. 150 min and for underfloor heating, long times of approx. 210 min are recommended. These times can be adapted to suit particular circumstances. If the heating is over-dimensioned and therefore too fast, shorter values should be used. Conversely, under-dimensioned heating (slow) benefits from longer integrated times.

3.4.6 Cooling control

Table 17

Designation	Values	Meaning
Sets the control parameters	**Via system type** User-defined	Standard application Prof. application: Self-configure P/PI control
System type	**Cooling surface** Fan coil unit	PI control with: Integrated time = 90 mins Bandwidth = 2 k Integrated time = 180 minutes Bandwidth = 4 k
Sends the cooling control variable	On change by 1% On change by 2 % On change by 3 % **On change by 5 %** On change by 7 % On change by 10 % On change by 15 %	After how much % change* in the control variable is the new value to be sent. Small values increase control accuracy and also the bus load.
Switches between heating and cooling	**Automatic** Via object	RAM 713 automatically switches to cooling mode when the actual temperature is above the threshold: Setpoint value + dead zone. Cooling mode can be activated only on the bus side via Object 6 (1= cooling). Cooling mode remains off for as long as this object is not set (=0).
	User-defined control parameters	
Proportional band of the cooling control	1 K, 1.5 K, 2 K, 2,5 K, 3 K 3.5 K, **4 K**, 4.5 K 5 K, 5.5 K, 6 K 6.5 K, 7 K, 7.5 K 8 K, 8.5 K	Prof. setting to adapt the control response to the room. Large values cause finer changes to the control variables with the same control deviation and more precise control than smaller values.

Continued:

Designation	Values	Meaning
Integrated time of the cooling control	Pure P control 15 min., 30 min., 45 min., 60 min., 75 min., **90 min.**, 105 min.,, 120 min., 135 min., 150 min., 165 min., 180 min., 195 min., 210 min., 225 min.	See Appendix Temperature control For PI control only: The integrated time determines the reaction time of the control. These times can be adapted to suit particular circumstances. If the cooling system is over-dimensioned and therefore too fast, shorter values should be used. Conversely, under-dimensioned cooling (slow) benefits from longer integrated times.
Sends the cooling control variable cyclically	**not cyclical, only in the event of change** every 2 min. every 3 min. every 5 min. every 10 min. every 15 min. every 20 min. every 30 min. every 45 min. every 60 min.	How often is the current cooling control variable to be sent (regardless of changes)?

*Change since last sending

3.4.7 Additional stage heating

See also Appendix: 2-stage heating

Table 18

Designation	Values	Meaning
Differential between main stage and additional stage	**1 K**, 1.5 K, 2 K, 2.5 K, 3 K, 3.5 K, 4 K	Specifies the negative interval between the current setpoint value and the setpoint value of the additional stage. **Example** with a basic setpoint value of 21°C and a differential of 1K: The main stage controls using the basic setpoint value, and the additional stage controls using the basic setpoint value – 1K = 20°C
Proportional band for additional stage	1 K, 1.5 K, 2 K, 2.5 K 3 K, 3.5 K, **4 K**, 4.5 K 5 K, 5.5 K, 6 K, 6.5 K, 7 K, 7.5 K, 8 K, 8.5 K	With a continuous additional stage, prof. setting to adapt the control response to the room. Large values cause finer changes to the control variables with the same control deviation and more precise control than smaller values.
Hysteresis	0.3 K 0.5 K 0.7 K **1 K** 1.5 K	With a switching additional stage, Interval between the switch-off point (setpoint value) and the re-switch on point (setpoint value – hysteresis). The hysteresis prevents constant switching on/off.

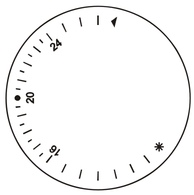
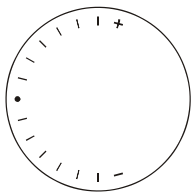
Continued:

Designation	Values	Meaning
Reduction of hysteresis after switching point	**None** 0.1 K/min 0.2 K/min 0.3 K/min	For the switching additional stage. The Reduction causes a gradual decrease in the hysteresis over time, and the control accuracy is increased. The hysteresis is equivalent to the programmed value for each switch-off and is gradually reduced by the Reduction process. The hysteresis can reduce back to 0 when switched off over prolonged periods. At the next switch-on, it is reset to the configured value.
Sends the control variable for the 2nd heating stage	On change by 1% On change by 2 % On change by 3 % **On change by 5 %** On change by 7 % On change by 10 % On change by 15 %	After how much % change* in the control variable is the new value to be sent. Small values increase control accuracy but also the bus load.
Sends the additional heating stage cyclically	**Does not send cyclically** every 2 min. every 3 min. every 5 min. every 10 min. every 15 min. every 20 min. every 30 min. every 45 min. every 60 min.	At what intervals should the switching status of the additional stage be sent?

*Change since last sending

3.4.8 Operation

Table 19

Designation	Values	Meaning
Function of the rotary control	Basic setpoint value (please using the following rotary control) 	The rotary control is used to specify the basic setpoint value. A setpoint value offset is possible via Object 0. The rotary control with the figures is plugged back onto the device.
	Manual offset (please using the following rotary control) 	The basic setpoint value can be increased or decreased using the rotary control within the programmed limits (see next table row). The +/- rotary control is plugged back onto the device.
	Disabled, but object basic setpoint value available	The rotary control does not function (protection from undesired operation). The basic setpoint value can be changed in the application or by sending to Object 0.
	Disabled, but object manual offset available	The rotary control does not function (protection from undesired operation). The basic setpoint value is changed in the application and can be increased or decreased via Object 0.
Minimum setting on the rotary control	10°C, 11°C, 12 °C 13°C, **14°C**, 15°C 16°C, 17°C, 18°C 19 °C, 20 °C	Lowest permissible setting for the basic setpoint value on the rotary control. Prevents unauthorised individuals from adjusting it.

Continued:

Designation	Values	Meaning
Max. setpoint offset on the rotary control	+/- 1 K **+/-2 K** +/-3 K	Permitted offset by user on the rotary control The programmed max. or min. value is always achieved at the stopping point (+ or -).
Function of the LEDs	None	The 4 operating mode LEDs always remain off.
	Show operating modes	The current operating mode is always shown by the respective LED
	Shows time-limited operating modes	The current operating mode can, if enabled, be shown by pressing the key for a short time (10s).
Function of the key	Disabled	Operation not possible.
	Presence key	Presence is recognised upon pressing the key and RAM 713 switches to the comfort operating mode.
	Selects operating modes	The operating mode can be manually selected at all times.

3.4.9 Operating mode

Table 20

Designation	Values	Meaning
Objects for determining the operating mode	New: operating mode, presence, window status **Old: comfort, night, frost (not recommended)**	RAM 713 can switch the operating mode depending on the window and presence contacts. Traditional setting without window and presence status.
Operating mode after download of application	Frost protection Night reduction **Standby** Comfort	Operating mode after start-up or re-programming
Type of presence sensor (to Obj. 4)	 **Presence indicator** Presence keys	The presence sensor activates comfort mode Comfort operating mode as long as the presence object is set. 1. The presence object is reset on change of operating mode definition object (Object 3). 2. If the presence object is set during night / frost operation, it is reset after the configured comfort extension finishes (see below).
Comfort extension by presence keys in night mode	None 30 min 1 hour 1.5 hours **2 hours** 2.5 hours 3 hours 3.5 hours	- Party switching: Using this RAM 713 can be switched again by the presence object from night / frost mode to comfort mode for a limited time.

Continued:

Designation	Values	Meaning
Sends the current operating mode cyclically	**Not cyclical, only in the event of change** every 2 min., every 3 min. every 5 min., every 10 min. every 15 min., every 20 min. every 30 min., every 45 min. every 60 min.	How often should the current operating mode be sent?

3.4.10 Switching E1, E2, E3

See also Appendix: External interface

Table 21

Designation	Values	Meaning
Function of the contact connected		Reaction of the object to the status or change of status of the switch / key connected (external interface)
	On/Off switch	During On → 1, during Off → 0
	Mode switch	The status of the object is reversed each time the switch is pressed
	On key	Each time the key is pressed → 1
	Off key	Each time the key is pressed → 0
	Mode key	The status of the object is reversed each time the key is pressed
Send cyclically	not cyclical, only in the event of change every 2 min. every 3 min. every 5 min. every 10 min. every 15 min. every 20 min. every 30 min. every 45 min. every 60 min.	At what intervals should the switching status of the switching object be sent?

3.4.11 Blinds

Table 22

Designation	Values	Meaning
Long press of the key starting at	300 ms 400 ms **500 ms** 600 ms 700 ms 800 ms 900 ms 1000 ms	Limit in differentiating between a short and long press of the key (in 1/1000s) Depending on whether the keys are pressed for a short or long time, they will trigger a Up/Down or a Step/Stop function. See Appendix: External interface

3.4.12 Dimming

Table 23

Designation	Values	Meaning
Long press of the key starting at	300 ms 400 ms **500 ms** 600 ms 700 ms 800 ms 900 ms 1000 ms	Limit in differentiating between a short and long press of the key (in 1/1000s) Depending on whether the keys are pressed for a short or long time, they will trigger a dimming up/down or an on/off function. See Appendix: External interface

4 Start-up

The ETS database can be found on our downloads page:
http://www.theben.de/downloads.htm.

4.1 Actuators to control heating and cooling

There are several possibilities available for controlling the heating and cooling equipment.

4.1.1 Heating control variable

- The control variable is sent directly to a continuous Cheops actuating drive (Order No. 731 9 200), which is plugged onto the valve
- The control variable is sent to a heating actuator HMG 8 (Order No. 490 0 270) / HMT 6 (Order No. 490 0 273) / HMT 12 (Order No. 490 0 274), which controls on its part one or more thermal actuators.

4.1.2 Cooling control variable

- The control variable is sent directly to a continuous Cheops actuating drive (Order No. 731 9 200), which is plugged onto the valve

4.1.3 Continuous additional stage

- The control variable is sent directly to a continuous Cheops actuating drive (Order No. 731 9 200), which is plugged onto the valve
- The control variable is sent to a heating actuator HMG 8 (Order No. 490 0 270) / HMT 6 (Order No. 490 0 273) / HMT 12 (Order No. 490 0 274), which controls on its part one or more thermal actuators.

4.1.4 Switching additional stage

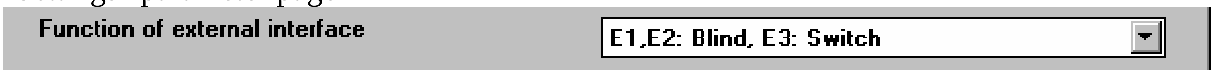
- The switching commands are sent to an actuator which controls on its part thermal actuators or an electrical additional heating.
- The control variable is sent to a heating actuator HMG 8 (Order No. 490 0 270) / HMT 6 (Order No. 490 0 273) / HMT 12 (Order No. 490 0 274), which controls on its part one or more thermal actuators.

4.2 Typical applications:

4.2.1 Heating, blinds and switching

In addition to its function as a heating controller, RAM 713 can control blinds and room lighting and switch on and off via the external interface.

“Settings” parameter page



Keys for controlling the blinds (Up/Down and Step/Stop) are connected to E1 and E2.
The Objects 9 and 10 are linked with the corresponding control objects of the blinds actuator.

The switch is connected to input E3, and the switching object (Obj. 11) is linked with the corresponding channel of the switching actuator.

Hint: Both functions can be realised with the same actuator if necessary.
RMG 8 as a switching and blinds actuator or JMG 4 (blinds actuator) with a switching actuator upgrade module RME 8 or RMX 4. (See chapter entitled External interface)

4.2.2 Frost protection via window contact

A window contact should cause automatic switching to frost protection mode (heat protection mode).

A contact is mounted on the window. This is connected directly to an input of the external interface, E1 for instance.

The device is programmed as follows:

“Settings” parameter page

“Operating mode” parameter page

The corresponding switching object (Obj. 9 for E1) is linked with Object 5 (window position) via the group address.

RAM 713 will recognise when the window opens and automatically switch to frost protection mode (heat protection mode). When the window is closed the previously set operating mode will be restored. See also New operating modes.

5 Appendix

5.1 *Determining the current operating mode*

The current setpoint value can be adapted in line with certain requirements by selecting the operating mode.
The operating mode can be specified by Objects 3..5.
There are two methods available:

5.1.1 New operating modes

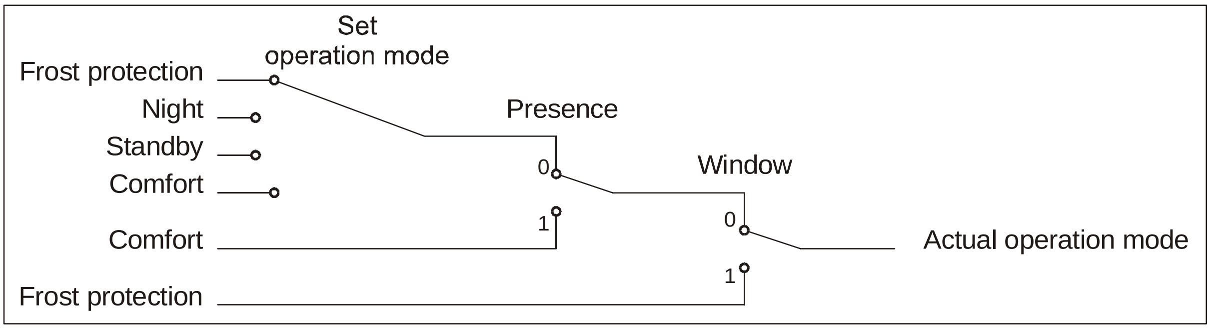
If on the parameter page, new operating mode is selected by the “Determining operating mode” parameter, the current operating mode can be defined as follows:

Table 24

Pre-selected operating mode Object 3	Presence Object 4	Window status Object 5	Current operating mode (Object 6)
Any	Any	1	Frost / heat protection
Any	1	0	Comfort
Comfort	0	0	Comfort
Standby	0	0	Standby
Night	0	0	Night
Frost / heat protection	0	0	Frost / heat protection

Typical application:

In the mornings Object 3 activates “Standby” or “Comfort” mode and in the evenings “Night” mode via a timer (e.g. TR 648).
During holiday periods, Object 3 also selects frost / heat protection via another channel on the timer.
Object 4 is connected to a presence indicator. If a presence is detected, RAM 713 control switches to Comfort mode (see Table).
Object 5 is connected to a window contact via the bus. As soon as a window is opened, RAM 713 switches to frost protection mode.



5.1.2 Old operating modes

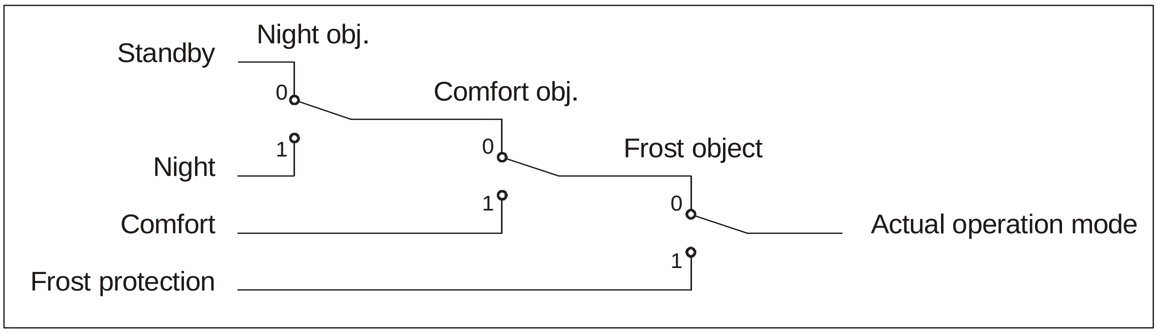
If on the parameter page, old operating mode is selected by the “Determining operating mode” parameter, the current operating mode can be defined as follows:

Table 25

Night Object 3	Comfort Object 4	Frost / heat protection Object 5	Current operating mode Object 6
Any	Any	1	Frost / heat protection
Any	1	0	Comfort
Standby	0	0	Standby
Night	0	0	Night

Typical application: In the mornings “standby” mode and in the evenings “night” mode is activated via Object 3.

During holiday periods, Object 5 selects frost / heat protection via another channel via Object 5.
Object 4 (comfort) is connected to a presence indicator. If a presence is detected, RAM 713 switches to comfort mode (see table).
Object 5 is connected to a window contact. As soon as a window is opened, RAM 713 switches to frost protection mode.



The old method has two advantages over the new method:

1. To switch from comfort to night operating mode, 2 messages (2 timer channels if necessary) are required.
   Object 4 must be set to “0” and object 3 to “1”.
2. If during periods when “frost / heat protection” is selected via the timer, the window is opened and then closed again, the “frost / heat protection” mode is cleared.

5.1.3 Determining the setpoint value

5.1.3.1 Calculating the setpoint value in heating operation

See also: Basic setpoint value and current setpoint value

Table 26: Current setpoint value during heating

Operating mode	Current setpoint value
Comfort	Basic setpoint value +/- setpoint value offset
Standby	Basic setpoint value +/- setpoint value offset – reduction in standby mode
Night	Basic setpoint value +/- setpoint value offset – reduction in night mode
Frost / heat protection	Programmed setpoint value for frost protection mode

Example:
Heating in comfort mode.

“Setpoint values” parameter page:

Base set point value after reset	21 °C
Reduction in standby operating mode at heating	2 K

“Operation” parameter page

Max setpoint offset at set knob	+/- 2 K

The setpoint value was previously increased by 1 K using the control variable.

Calculation:

Current setpoint value = basic setpoint value + setpoint value offset
= 21°C + 1K
= 22°C

If operation is switched to standby mode, the current setpoint value is calculated as follows:

Current setpoint value = basic setpoint value + setpoint value offset – reduction in standby mode
= 21°C +1K -2K
= 20°C

5.1.3.2 Calculating the setpoint value in cooling operation

Table 27: Current setpoint value during cooling

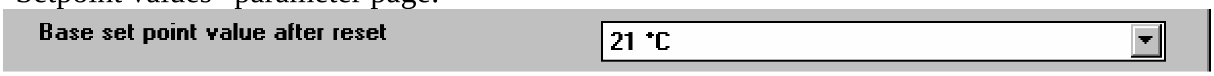
Operating mode	Current setpoint value
Comfort	Basic setpoint value + setpoint value offset + dead zone
Standby	Basic setpoint value + setpoint value offset + dead zone + increase in standby mode
Night	Basic setpoint value + setpoint value offset + dead zone + increase in night mode
Frost / heat protection	Programmed setpoint value for heat protection mode

Example:
Cooling in comfort mode.

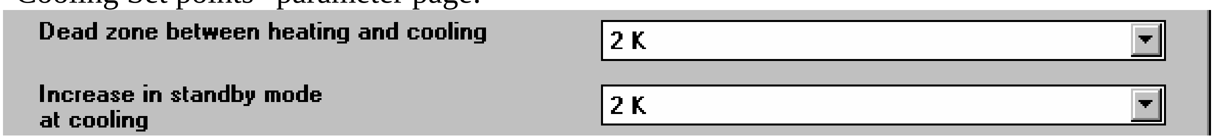
The room temperature is too high and RAM 713 has switched to cooling operation

“Settings” parameter page

“Setpoint values” parameter page:



“Cooling Set points” parameter page:



“Operation” parameter page

The setpoint value was previously lowered by 1 K using the rotary control.

Calculation:

Current setpoint value = basic setpoint value + setpoint value offset + dead zone
= 21°C -1K +2K
= 22°C

Changing to standby mode causes a further increase in the setpoint value (energy saving) and gives rise to the following setpoint value.
Setpoint value = basic setpoint value + setpoint value offset + dead zone + increase in standby mode
= 21°C - 1K + 2K + 2K
= 24°C

5.2 Setpoint value offset

For the RAM 713, the current setpoint value can be adjusted in two ways.

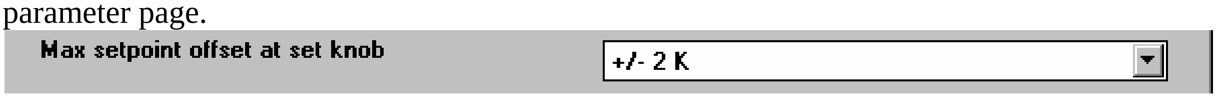
- In increments using the rotary control (see “Operation” parameter page, function of the rotary control)
- Directly via Object 0 “Manual setpoint value offset”

The differential between the setpoint value offset and the basic setpoint value is sent by Object 1 at each change (e.g. -1.00).

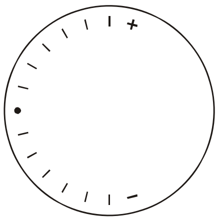
The offset limits are specified on the “Operation” parameter page by the “Maximum setpoint value offset on the rotary control” parameter and apply to both types of setpoint value offset.

5.2.1 Setpoint temperature offset using the rotary control

This option is available when the rotary control has been enabled on the “Operation” parameter page.



The +/- rotary control is plugged onto the device for this function (see illustration).



In the central position of the rotary control, the setpoint value offset is zero.
Should the rotary control be turned to the left (+) until it can be turned no further, the setpoint value will be increased by the programmed maximum setpoint offset.

The offset can be very finely adjusted using the rotary control’s notch.
The change in temperature per scale line depends on the maximum setpoint value offset which has been programmed.

Table 28

Maximum setpoint value offset on the rotary control	Kelvin / °C per scale line
+/- 1 K (i.e. +/-1°C)	1/6
+/-2 K	1/3
+/-3 K	1/2

5.2.2 Setpoint temperature offset via Object 0

This option is available only when the following settings have been selected on the “Operation” parameter page:

or

In this case, the setpoint value is changed by sending the desired offset to Object 0.
This involves the differential (may be preceded by a minus sign) being sent to Object 0 in EIS5 format.

The offset always refers to the basic setpoint value (as programmed or specified by the rotary control) and not to the current setpoint value.

Example Basic setpoint value of 21°C:

If a value of 2.00 is sent to Object 0, the new setpoint value is calculated as follows:
21°C + 2.00K = 23.00°C.
To then bring the setpoint value to 22°C, the differential is resent to the programmed basic setpoint value (here 21°C), in this case 1.00K (21°C+1.00K=22°C)

5.3 External interface

The external interface consists of inputs E1, E2 and E3.
E1 and E2 are pure binary inputs, and E3 can be used as both a binary and an analogue input.
All 3 inputs are connected in the base via the connection terminals.

The type of use for these inputs is specified on the “Settings” parameter page (function of the external interface.
4 functions are available: switching (E1...E3), blinds (E1, E2), dimming (E1, E2) and external sensor (E3)

Programming of the inputs themselves takes place, depending on the configuration, on the “Switching E1, E2, E3” “Blinds” and “Dimming” parameter pages.

The following devices can be used as actuators for switching or blinds:

Table 29

Designation	Order No.	Description
RMG 4/RME 4	490 0 204 490 0 205	Actuator for basic device and upgrade
RMG 8	490 0 251	Switching and blinds actuator for basic device
JMG 4	490 0 250	Blinds actuator for basic device
JMG 4 24VDC	490 0 253	24V DC blinds actuator for basic device
RMX 4	490 0 256	Upgrade for RMG 8*, JMG 4* and HMG 8**
RME 8	490 0 252	Upgrade for RMG 8*, JMG 4* and HMG 8**

* May be used as a switching and blinds actuator
** May only be used as a switching actuator

EIB product manuals for the above-mentioned devices are available on our downloads page http://www.theben.de/downloads.htm.

5.3.1 E1...E3 as switching inputs

If an input is programmed to be a switching input, switches can also be used as keys. The status of the corresponding object (Obj. 9...11) is switched according to the configuration.

An object is assigned to each input.

Table 30

Input	Object
E1	9
E2	10
E3	11

5.3.2 E1...E2 for blinds keys

2 keys can be connected to control blinds.
In this case the objects 9 (Step/Stop) and 10 (Up/Down) are linked with an EIB blinds actuator (JMG 4, RMG 8, JMG 4 24 VDC).

For both input it is differentiated between short time and long time operation.* The time difference between a long and a short press of the key is set on the “Blinds” parameter page. If operation is for a short period of time, the respective message (ON or OFF) is sent to the slat object (Obj. 9). For a longer period of operation, the message, the message is sent to the drive object (Obj. 10).
Only one of the two objects is operated at a time.
If one key is held down, the other will not react.

Table 31

Pressing key	E1	E2
long (Affects Object 10)	Drive up message (0)	Drive down message (1)
short (Affects Object 9)	Step/Stop message in upward direction (0)*	Step/Stop message in downward direction (1)*

*The decision between Step and Stop occurs in the blinds actuator itself depending on the operating position.

5.3.3 E1...E2 for dimming keys

2 keys can be connected to realise a dimming function.
The objects 9 (Dimming on/of) and 10 (Dimming up/down) must then be linked with an EIB dimming actuator.

For both inputs it is differentiated between short time and long time operation. The time difference between a long and a short press of the key is set on the “Dimming” parameter page.
If pressed for a short period of time, the respective message (ON or OFF) is sent. If pressed for a longer period of time, the message is sent to the dimming object (Obj. 10).

Table 32

Pressing key	E1	E2
long (Affects Object 10)	- Pressing the key sends a start message for brighter dimming - Letting go sends a stop message	- Pressing the key sends a start message for darker dimming - Letting go sends a stop message
short (Affects Object 9)	Switch on message	Switch off message

5.3.4 E3 as an analogue input for an external sensor

A remote sensor is connected to E3.
The maximum permitted line length is 10m.

The external sensor can be configured in 2 ways.

1. As a sensor for temperature control (Order No. 907 0 191), i.e. it takes over the function of the fitted sensor.
2. As a sensor for temperature limitation in the underfloor (Order No. 907 0 321), i.e measures the underfloor temperature, and the devices sees to it that the temperature remains within the programmed maximum and minimum values, thus maintaining a comfortable atmosphere.

All the settings are entered on the “Actual value” parameter page.

5.4 2-stage heating

A 2-stage heating system consists of a slow main stage and a fast additional stage.

RAM 713 is usually used for underfloor heating (main stage) and for the additional stage for the radiators.

RAM 713 controls the two stages in parallel, the additional stage being controlled at a lower setpoint value.
The differential between main and additional stage is defined on the “Additional stage heating” parameter page.

Cheops actuating drives (Order No. 731 9 200) can be used for the continuous additional stage (recommended).
It is also possible to use thermal actuators in connection with a HMT 6/12 or HMG 8 thermal actuator.

Thermal actuators (Order No. 907 0 248) can be used as actuators for the switching additional stage.

An electrical additional heating can be controlled via the heating actuators HMT 6/12 or HMG 8.

5.5 Temperature control

5.5.1 Introduction

RAM 713 can be used as a P or a PI control, although the PI control is preferred.

With the proportional control (P control), the control variable is statically adjusted to the control deviation.
The proportional integral control (PI control) is far more flexible, i.e. controls more quickly and more accurately.

To explain the function of both temperature controls, the following example compares the room to be heated with a vessel.

The filling level of the vessel denotes the room temperature.
The water supply denotes the radiator output.
The heat loss from the room is illustrated by a curve.

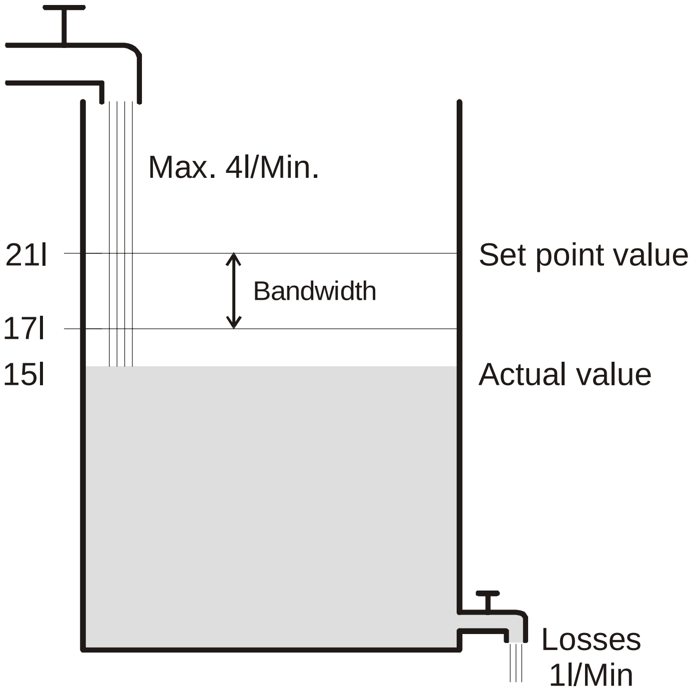
In our example, the maximum supply volume is 4 litres per minute and also denotes the maximum radiator output.
This maximum output is achieved with a control variable of 100%.
Accordingly, at a control variable of 50%, only half the water volume, i.e. 2 litres per minute, would flow into our vessel.

The bandwith is 4l.
This means that the control controls at 100% provided the actual value is smaller than or equal to (211 – 41) = 171.

Function:

- Desired filling quantity:
  21 litres (= setpoint value)
- From when should the supply flow gradually be reduced in order to avoid an overflow? :
  4l below the desired filling volume, i.e. at 21l – 41 = 171 (=bandwidth)
- Original filling volume
  15l (=actual value)
- The loss amounts to 1l/minute

5.5.2 Response of the P-control



A filling volume of 15l gives rise to a control deviation of 211 – 151 = 61
Because our actual value lies outside the bandwidth, the control will control the flow at 100% i.e. at 4l / minute

The supply quantity (control variable) is calculated from the control deviation
(setpoint value – actual value) and the bandwidth.
Control variable = (control deviation / bandwidth) x 100

The table below shows the response and therefore also the limits of the P-control

Table 33

Filling level	Control variable	Supply	Loss	Increase in filling level
15l	100%	4 l/min	1 l/min	3 l/min
19l	50%	2 l/min		1 l/min
20l	25%	1 l/min		0 l/min

The last line indicates that the filling level cannot increase any further, because the flow allows only the same amount of water to flow in as can flow out through loss.
The result is a permanent control deviation of 11 and the setpoint value can never be reached.
If the loss was 1l higher, the permanent control deviation would increase by the same amount and the filling level would never exceed the 19l mark.
In a room this would mean that the control deviation increases with a decreasing outside temperature.

P-control as temperature control

The P-control behaves during heating control as shown in the previous example.
The setpoint temperature (21^{o}C) can never quite be reached.

The permanent control deviation increases as the heat loss increases and decreases as the ambient temperature decreases.

5.5.3 Response of the PI-control

Unlike the pure P-control, the PI-control works dynamically.
With this type of control, the control variable remains unchanged, even at a constant deviation.

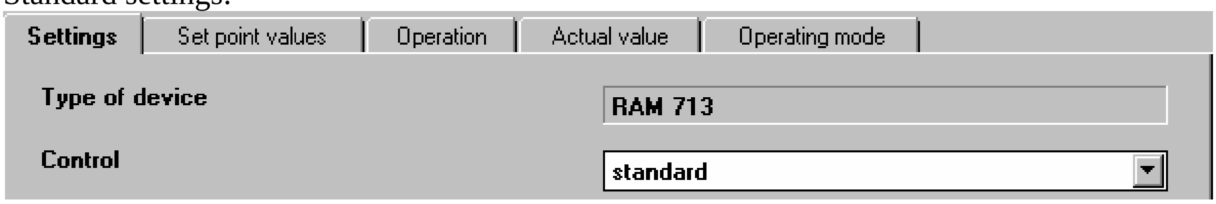
In the first instant, the PI-control sends the same control variable as the P-control, although the longer the setpoint value is not reached, the more this value increases.
This increases is time-controlled over the so-called integrated time.
With this calculation method, the control variable does not change if the setpoint value and the actual value are the same.
Our example, therefore, shows equivalent in and outflow.

Notes on temperature control:

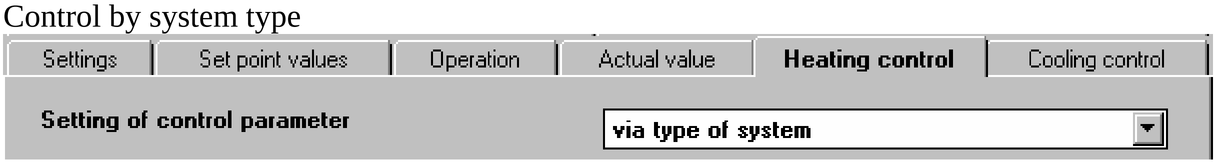
Effective control depends on agreement of bandwidth and integrated time with the room to be heated.
The bandwidth influences the increment of the control variable change:
Large bandwidth = finer increment on control variable change.
The integrated time influences the response time to temperature changes:
Long integrated time = slow response.
Poor agreement can result in either the setpoint value being exceeded (overshoot) or the control taking too long to reach the setpoint value.

Usually, the best results are achieved with the standard settings or the settings via system type.

Standard settings:



Control by system type



6 Glossary

6.1 Hysteresis

The hysteresis determines how far the temperature should drop below the setpoint value before the control switches on the additional stage again.
Example with setpoint value (additional stage) 20°C, hysteresis 0.5 K and starting temperature 19°C.
The additional stage is switched on and does not switch off again until the setpoint value (20°) is reached.
The temperature falls and the additional stage does not switch on again until 20°C-0.5K= 19.5°C.

Without hysteresis, the control would switch on and off continuously provided the temperature is within the setpoint value range.

6.2 Continuous and switching control

A switching control recognises only 2 statuses, On or Off.
A continuous control works with a control variable between 0% and 100% and can thus exactly dose the energy input. This achieves a pleasant and precise control.

6.3 Dead zone

The dead zone is a buffer area between heating and cooling operation.
Neither heating nor cooling takes place within this dead zone.

If RAM 713 switches to cooling operation, the setpoint value is increased internally by the amount of the dead zone.

Without this buffer zone, the system would switch continuously between heating and cooling. As soon as the setpoint value had been under-run, the heating would activate and the setpoint value would not be achieved. If cooling were then to be started immediately, the temperature would fall to below the setpoint value and switch on the heating again.

6.4 Basic setpoint value and current setpoint value

The **basic setpoint value** is the standard temperature for comfort mode and the reference temperature for reduction in standby and night modes.
The programmed basic setpoint value (see “Basic setpoint value after reset”) is stored in Object 0 and can be changed at all times via the bus by sending a new value to Object 0 (EIS5).
After reset (bus returned), the last used basic setpoint value is restored.

The **current setpoint value** is the setpoint according to which control actually occurs. It is the result of all the operating mode reductions or increases depending on the control function.

Example:
At a basic setpoint value of 22°C and a reduction in night mode of 4K, the current setpoint value (in night mode) is: 22°C – 4K = 18°C. During the day (in comfort mode) the current setpoint value is 22°C (insofar as cooling operation is not active).

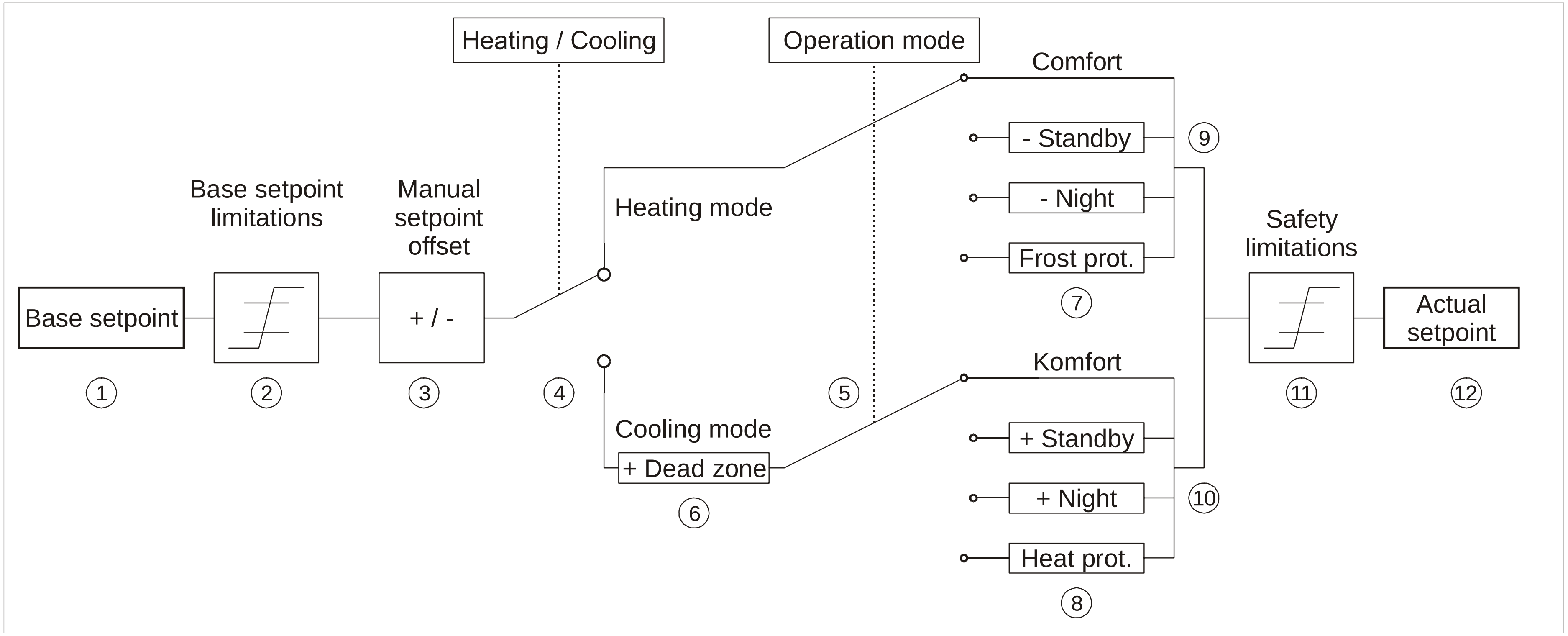
The formation of the current setpoint value due to the basic setpoint value can be observed in the block diagram on the next page.
The basic setpoint value is on the left, which was specified via Object 0 or set on the rotary control.
The current setpoint value is on the right, i.e. the value upon which the room temperature is effectively controlled.

As you can see in the block diagram, the current setpoint value depends on the operating moce (5) and the control function (4) selected.

The basic setpoint value limits (2) prevent an incorrect basic setpoint value from being specified to Object 0. These are the following parameters:

- Minimum valid basic setpoint value
- Maximum valid basic setpoint value
- Minimum setting on the rotary control
- Minimum setting on the rotary control

Should the setpoint value be outside of the values programmed for frost and heat protection due to a setpoint value offset, it is limited by the safety limits (11) for these values.



1 Specified basic setpoint value of Object 0 or rotary control
2 Max. and min. valid basic setpoint values / Set-up on the rotary control
3 Manual setpoint value offset
4 Switches between heating and cooling: Automatically or via Object 6
5 Selects operating mode
6 The setpoint value is increased in cooling operation by the amount of the dead zone
7 The setpoint value is replaced by the setpoint value for frost protection mode
8 The setpoint value is replaced by the setpoint value for heat protection mode
9 Setpoint value after reductions conditional to the operating mode
10 Setpoint value after increases conditional to the operating mode
11 The limits for frost and heat protection must be adhered to.
12 Current setpoint value according to increases, reductions and limits conditional to the operation.