Continuous valve actuator CHEOPS control incl. temperature control

CHEOPS control 732 9 201

Contents

1 Functional characteristics

The Cheops control drive actuator is both a continuous EIB room temperature controller and an actuator, i.e. Cheops control measures the current room temperature (actual value) and controls the radiator valve, in order to achieve the desired room temperature (set point value).

The valve position can be transferred on the bus. If a room accommodates several radiators, these can be equipped with “Cheops drive” actuators and actuated by Cheops control.

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

In order to simply adapt to the set point values in respect of living comfort and energy saving, Cheops control has 4 operating modes:

- Comfort
- Standby
- Night mode
- Frost protection mode

A set point value is assigned to each operating mode.

Comfort mode is used when the room is occupied

In **Standby mode,** the set point 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 set point 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 outdoor 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 indicator and/or presence button and window contacts are recommended.
See also Chapter headed "Determining the current set point value".

1.1 Operation

For operation and display functions, Cheops control is fitted with 5 LEDs, a blue and a red button. The top 3 LEDs are red, the bottom 2 LEDs are blue.
The LEDs show the set point temperature, i.e. the desired room temperature.

The middle LED illuminates when the temperature determined by the Basic set point value has been reached.

The 2 buttons can be used to adapt the set point value to suit the individual requirements of the room user.
Pushing the red button increases the set point value by one programmed increment, this is possible twice from the basic set point value (middle LED).
Pushing the blue button reduces the set point value by increments.

If Cheops control is not in comfort mode, or if the set point value has already been decreased by 2 increments from the basic set point value, the bottom LED illuminates.
This indicates to the room user that the set point value cannot be further decreased.

When the red button is pushed, Cheops control automatically finds the correct function that increases the set point value - this depends on the operating mode prior to the button being pushed:

Table 1

Operating mode prior to pushing the red button	Effect of pushing the red button
Comfort mode	Set point value increased by one increment
Standby	Switches to comfort operating mode by setting the presence object - without time limit
Night and frost protection	Switches to comfort operating mode by setting the presence object – for set time and comfort extension (see "Comfort extension in night mode" on the "Operating mode" parameter page)

In comfort mode, the set point value can now be changed in increments as usual.

If the blue button is pressed until the bottom blue LED illuminates, the presence object is reset and the original operating mode is restored.

1.2 Benefits of Cheops Control

- Continuous P/PI room temperature control
- Heating mode + actuation of a cooling system via the EIB
- Alternative actuation of a second heating step with switching or continuous actuating value
- 2 buttons for set point offset (up to +/- 3K)
- Infinite valve adjustment through continuous actuating value
- Internal temperature measurement possible via either EIB or an external temperature sensor
- Valve position or set point value offset readout
- Emergency program on actual value failure
- Establishing the maximum actuating value
- Valve protection program
- External interface for window and presence contacts
- Actuating value limitation
- Precise adjustment to each valve
- Operation with both standard and inverted valves
- Site function for operation without application
- Large valve stroke enables adjustment to almost all valves
- Simple assembly with any valve adapter

1.2.1 Special features

- Monitoring of actual value

If the room temperature is measured via an external sensor or received via an object, Cheops control can start an emergency program if the sensor or temperature transmitter fails.

- Determining the maximum actuating value (= maximum position)

To adapt the forward flow temperature, Cheops drive can send an acknowledgement to the heating boiler regarding the current power requirement.
This can reduce its temperature if the requirement drops.

- Window and presence contact inputs

Cheops drive has 2 external inputs, one for a presence contact and
one for a window contact. These inputs can be used as an actuator for frost protection or comfort mode.

2 Technical data

2.1 General

Voltage supply:	Bus voltage
Permitted working temperature:	0°C ...+ 50°C
Runtime:	< 20s / mm
Controlling torque:	> 120 N
Max. control stroke:	7.5 mm (linear movement)
Detection of valve limit stops:	Automatic
Linearisation of characteristic valve curve:	Possible via software
Protection class:	III
Protection rating:	EN 60529: IP 21
Dimensions:	HxWxD 82 x 50 x 65 (mm)
Adapter rings suitable for:	Danfoss RA, Heimeier, MNG, Schlösser from 3/93, Honeywell, Braukmann, Dumser (Distributor), Reich (Distributor), Landis + Gyr, Oventrop, Herb, Onda

3 The "CHEOPS control V1.1" Application Program

3.1 Selection in the product database

Manufacturer	Theben AG
Product family	Valve actuators
Product type	Valve actuator with controller
Program name	Cheops control V1.1

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

3.2 Parameter pages

Table 2

Function	Description
Settings	Selection of control functions, standard and user-defined settings
Device settings	Valve characteristics, fine setting of valve parameters, special characteristic valve curves, valve protection
Set point values	Set point value after loading the application, values for night/frost mode, dead zone, additional step etc.
Operation	Function of LEDs and buttons
Actual value	Selection, calibration, emergency program on failure
Heating control	Heating parameters, controller type, actuating value limits etc.
Cooling control	Cooling parameters, controller type etc.
Operating mode	Presence and window status considered. Operating mode after download
External interface	Configure inputs for window / presence contact and actual value
Additional heating step	Control parameters, hysteresis reduction, bandwidth etc.
Own characteristic curve of valve	Prof. parameters for valves with known characteristic curve
linear characteristic valve curve	Parameters for high-end linear valve

3.3 Communication objects

3.3.1 Object characteristics

Cheops control features 12 communication objects.
Objects 2, 3, 4, 5, 6 and 8 can assume various functions, depending on the configuration

Table 3

No.	Function	Object name	Type	Response
0	Define set point temperature	Basic set point value	2 byte EIS5	Receive
1	shift set point temperature	Manual shift of set point value	2 byte EIS5	Send / Receive
2	Transmit actual value	Actual value	2 byte EIS5	Send
	Input actual value			Receive
3	Pre-selection of operating mode	Pre-selection of operating mode	1 byte KNX	Receive
	1 = night, 0 = standby	Night < - > Standby	1 bit	
4	Input for presence signal	Presence	1 bit	Send / receive
	1 = comfort	Comfort	1 bit	Receive
5	Input of window state	Window state	1 bit	Send / receive
	1 = frost protection	Frost/heat protection	1 bit	Receive
6	1 = decrease/0 = increase	adjustment of set point temperature	1 bit	Receive
	Calculates maximum actuating value	maximum actuating value	1 byte EIS6	Send / receive
	0 .. 100%	Actual valve position	1 byte EIS6	Send
7	Current actuating value heating	actuating value heating	1 byte EIS6	Send
8	Actuating value in cooling mode	actuating value cooling	1 byte EIS6	Send
	Switching actuating value	Actuating value of additional heating	1 bit	Send
	Continuous actuating value	Actuating value of additional heating	1 byte EIS6	Send
9	Transmit	Current set point value	2 byte EIS5	Send
10	Transmit	Current operating mode	1 byte KNX	Send
11	Heating/cooling	Switchover	1 bit	Receive

3.3.2 Object description

- **Object 0 "Basic set point value"**

The Basic set point value is first specified via the application at start-up and stored in the "Basic set point value" object.
It can then be re-specified at any time via Object 0.
If the bus voltage fails, this object is backed up and the last value is restored when the bus voltage returns.

- **Object 1 "Manual shift of set point value"**

The object sends and receives a temperature differential in EIS 5 format. The desired room temperature (current set point value) can be adjusted from the Basic set point value by this differential.
The following applies in comfort operation (heating):

current set point value (Obj. 9 = Basic set point value (Obj. 0) + manual set point value offset (Obj. 1)

This value can be changed in increments by pressing the buttons on the device or via Object 6. The value thus changed is then sent.
It is, however, possible to send the set point value offset directly to this object, this set point value offset is then indicated on the LEDs.

Values outside the programmed range are not taken into consideration.

The offset always relates to the basic set point value that is either configured or programmed via 0 and not the current set point value.

- **Object 2 "Actual value"**

The function of this object depends on the "Input for actual value" parameter on the "Actual value" parameter page.

Table 4

Selection: Input for actual value	Function
Internal sensor	Sends the temperature currently being measured by the sensor (if sending through configuration is permitted)
External sensor (Interface E2)	
Actual value object	Receives the current room temperature from an external EIB temperature sensor via the bus

- **Object 3 "Pre-selection of 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
New: Operating mode, presence window, 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 relate to the cooling operation
Old: Comfort, night, frost	With this setting, the 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
New: Opertaing mode, presence window, window status	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. If a presence indicator is connected to Interface E2, its status is sent via this object to the bus.
Old: Comfort, night, frost	A 1 on this object activates the comfort operating mode. This operating mode takes priority over night and standby operation. Comfort operation is deactivated by sending an 0 to the object.

- **Object 5 "Window state" / "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
New: Operating mode, presence window, window status	The status of a window contact can be received via this object. A 1 on this object activates the frost / heat protection operating mode. If a window contact is connected to Interface E1, its status is sent via this object to the bus.
Old: Comfort, night, frost	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 „"adjustment of set point temperature" / "maximum actuating value" / "Actual valve position"**

The function of this object depends on the "Function of Object 6" on the "Device setting" parameter page.

Table 8

Function of Object 6	Function
Increases / decreases the set point value	This object can increase or decrease the current set point value in increments. A 0 on the object results in an increase in the set point value and is equivalent to pressing the red button. A 1 on the object results in a decrease in the set point value and is equivalent to pressing the blue button. The increment is set on the "Operation" parameter page. The achieved offset can be reported by Object 1.

Continued:

Function of Object 6	Function
Determine the maximum actuating value	This object has 2 functions here: 1. Receives actuating values from the other actuators (other rooms), in order to be able to compare them with its own. 2. Sends its own actuating value to the heating boiler, if it is higher than the others. (See also: Determining maximum actuating value)
Sends the actual valve position	Sends the current valve position (0..100%). This function can be enabled (e.g. diagnosis) as and when required. This function is not required for normal operation.

- **Object 7 "Current actuating value, heating"**

This object is present only when selected on the "Heating control" page as follows.

The current actuating value (0…100%) can then be sent to other continuous actuators (Cheops drive) in the same room/control circuit.

If you wish to read out Object 7 via the bus, Object 8 must not be present ("Used control functions" on the "Settings" parameter page set to "Heating control only"). The "Read" flag must be set.

If you wish to read out Object 8 via the bus, this parameter must be set to "Not present".

- **Object 8 "actuating value cooling"/"Actuating value of additional heating"**

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

Table 9

Used control functions	Function
Heating and cooling	Sends the cooling actuating value to control a cooling ceiling, fan coil unit etc.
2-step heating with switching additional step	Sends the switching command to control the additional step (on/off)
2-step heating with continuous additional step	Sends the continuous actuating value to control the additional step (0…100%)

Note:
In the "Heating control" setting, the object is not available because neither the cooling function nor the additional step are present.
If you wish to read out Object 8 via the bus, Object 7 must be hidden (see above) and the "Read" flag must be set.

- **Object 9 "Current set point value"**

This object sends the Current set point temperature as a EIS 5 telegram (2 bytes) on the bus.
The send response can be set on the "Heating control" parameter page.

- **Object 10 "Current operating mode"**

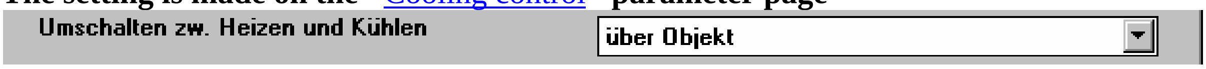
This object sends the current operating mode as a 1 byte value.
The send response can be set on the "Operating mode" parameter page.
The operating modes are coded as follows:

Table 10

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

- **Object 11 "Switchover"**

This object is available if an automatic switching between heating and cooling is not required.
The setting is made on the "Cooling control" parameter page



The cooling operation is forced via a 1 and the heating operation via a 0.

3.4 Parameters

3.4.1 Settings

Table 11

Designation	Values	Meaning
Control	**Standard** User-defined	For simple applications For specific setting of the control parameters and special applications such as heating/cooling or 2nd heating step.
Control functions	 **Heating control only** Heating and cooling 2-step heating with switching additional step 2-step heating with continuous additional step	User-defined control: Heating operation only A cooling unit can also be controlled via the bus (Object 8) A main step (typically floor heating) and an additional step (On/Off) can be controlled. A main step (typically floor heating) and an additional step (radiator) can be controlled.
Operation	 **Standard** User-defined	Function of keys and LEDs. Default setting Opens the parameter page "Operation"
Operating mode	**Standard** User-defined	Default settings Opens the parameter page "Operating mode"

Continued:

Designation	Values	Meaning
Device settings	**Standard** User-defined	Default settings Opens the parameter page Device settings
Function of external interface	**None** E1: Window contact, E2: Presence E1: Window contact, E2: Actual value E1: Window contact, E2: None	Specifies whether the external interface is occupied by window presence contact or an external temperature sensor is connected. **Note:** IF E2 is declared as actual value input, the "Input for actual value" selection cannot be changed on the "Actual value" parameter page.

3.4.2 Set point values

Table 12

Designation	Values	Meaning
Basic set point value after download of application	18 °C, 19 °C, 20 °C, **21 °C**, 22 °C, 23 °C, 24 °C, 25 °C	Output set point value for the temperature control.
Reduction in standby operating mode at 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 set point value of 21° and a 2K reduction in heating operation, Cheops control controls at a set point value of 21 – 2 = 19°C
Reduction in night operating mode at heating	3 K, 4 K, **5 K** 6 K, 7 K, 8 K	By what value should the temperature be reduced in night mode?
Set point value for frost protection mode	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).
Transmission of current set point values		How often should the currently valid Set point value be sent?
	No cyclical transmission	Send only at 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

Continued:

Designation	Values	Meaning
Parameters for heating / cooling operation		
Dead zone between heating and cooling	1 K, 1,5 K, 2 K, 2,5 K, 3 K, 3,5 K 4 K, 4,5 K, 5,5 K 6 K	Specifies the interval between set point value in heating and cooling operations. Example with set point value of 21°C and Dead zone of 2K: Cheops will only start cooling when the temperature ≥ Set point value + Dead zone is, i.e. 21°C + 2K = 23°C.
Increase in standby mode at 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 at cooling	3 K, 4 K, **5 K** 6 K, 7 K, 8 K	See increase in standby mode
Set point value for heat protection at cooling	**42 °C (no 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 on cooling as frost protection mode on heating, e.g. saves energy while prohibiting non-permitted temperatures **Important:** **In principle, Cheops control will not allow a set point value above 42°C (even via bus set point value definition)**

Continued:

Designation	Values	Meaning
Current set point value in comfort mode		Feedback of current set point value via the bus:
	Transmit mean value between heating and cooling	Same value in comfort operation mode during both heating and cooling operation, i.e.: Basic set point value + half dead zone sent, to prevent room users becoming irritated. **Example** with basic set point value of 21°C and dead zone of 2K: Mean value= 21°+1K =22°C Although control takes place at 21°C and/or 23°C
	Transmit actual temperature setpoint (Heating < > Cooling)	The set point value actually being controlled is always sent. **Example** with basic set point value of 21°C and dead zone of 2K: During heating and cooling, 21°C and basic set point value + dead zone are sent respectively (21°C + 2K = 23°C)
Parameters for 2-step heating		
Differential between main step and additional step	**1 K**, 1,5 K, 2 K, 2.5 K, 3 K, 3.5 K, 4 K	Specifies the negative interval between the current set point value and the set point value of the additional step. **Example with** basic set point value of 21°C and 1K differential: Main step controls using the basic set point value and the additional step controls using the basic set point value – 1K = 20°C

3.4.3 Actual value

Table 13

Designation	Values	Meaning
Input of actual value	 **Internal sensor** object Actual value	Cheops control can obtain its actual value from three sources. Selection can be made from 2 such sources: fitted sensor bus (Object 2). An external sensor can be selected via the "Function of external interface" parameter on the Settings parameter page. In this case, there is no option to select between internal sensor and actual value object.
Temperature offset for internal sensor (in 0,1K, -64...63)	Manual input -64.. 63	Positive or negative correction of measured temperature in 1/10 K increments Example: Cheops sends 20.3°C. A room temperature of 21.,0°C is measured using a calibrated thermometer. In order to increase the temperature of Cheops to 21 °C, an "7" (i.e. 7 x 0.1K) must be entered. Cheops sends 21.3°C. 20.5°C is measured. In order to reduce the temperature of Cheops to 20.5 °C, an "-8" (i.e. -8 x 0.1K) must be entered.
Transmission of actual value at change	Does not send by 0,2 K, 0,3 K **by 0.5 K**, 0.7 K by 1 K, 1.5 K 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
Transmission of actual value	no cyclical transmission 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 external sensors	
Temperature offset for external sensor (in 0.1K, -64...63)	Manual input -64.. 63	See above, Temperature offset for internal sensor
Position in case of failure of actual value or sensor	0% 10% 20% 30% 40% **50%** 60% 70% 80% 90% 100% Continued control with internal sensor	Cheops control continuously monitors the function of the external sensor when selected. If the line to this sensor is interrupted or short-circuited, Cheops control can either assume a fixed position (emergency program) or switch to an integrated sensor until the fault is cleared.

3.4.4 Heating control

Table 14

Designation	Values	Meaning
Setting of control parameters	**Via type of system** User-defined	Standard application Prof. application Self-configure P/PI control
Type of system	 **Radiator heating** floor heating	PI control with: Integrated time = 150 minutes Bandwidth = 4 k Integrated time = 210 minutes Bandwidth = 6 k
Minimum actuating value in heating mode	0%, 5%, **10%** 15%, 20%, 25% 30%, 40%	Smallest permitted actuating value (Exception: actuating value of 0% is always used)
Behaviour at minimum actuating value underflow (heating mode)	0% **0 % = 0 % otherwise min. actuating value**	Run to 0% as soon as the defined min. actuating value is underrun. Runs to the min. actuating value as long as the value is greater than 0% and smaller or equivalent to the min. actuating value. However, if a actuating value of 0% is required (set point temperature reached), Cheops control returns to 0%.
Object “actuating value heating”	available **not available**	The heating actuating value is not to be sent on the bus (Object 8 can be read). The heating actuating value is required to control other actuators (Cheops drive). Object 7 is added.
Transmission of actuating value heating	At change by 1% At change by 2 % At change by 3 % **At change by 5 %** At change by 7 % At change by 10 % At change by 15 %	After how many % change* in the actuating value is the new value to be sent. Small values increase control accuracy but also the bus load.

Continued:

Designation	Values	Meaning
Transmission of actuating value heating	**no cyclical transmission** 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 actuating value to be send, regardless of changes?
User-defined parameters		
Proportional band of heating control	**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.
Integral action time constant of heating controller	Only proportional controller 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 floor heating, longer 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.

*Change since last sending

3.4.5 Cooling control

Table 15

Designation	Values	Meaning
Setting of control parameters	**Via type of system** User-defined	Standard application Prof. application Self-configure P/PI control
Type of system	**Cooling ceiling** Fan Coil Unit	PI control with: Integrated time = 90 minutes Bandwidth = 4 k Integrated time = 180 minutes Bandwidth = 4 k
Transmission of actuating value cooling	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 many % change* in the actuating value is the new value to be sent. Small values increase control accuracy but also the bus load.
Switch over between heating and cooling	**Automatically** via object	Cheops control automatically switches to cooling mode when the actual temperature is above the threshold: set point value + dead zone. Cooling mode can be activated only on the bus side via Object 11 (1= cooling). Cooling mode remains off for as long as this object is reset (=0).
User-defined parameters		
Proportional band of cooling controller	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 behaviour to the room. Large values cause finer changes to the actuating values with the same control deviation and a more precise control than smaller values.

Continued:

Designation	Values	Meaning
Integral time of the cooling controller	Pure P control 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.

*Change since last sending

3.4.6 Additional heating step

See also Appendix: 2-step heating

Table 16

Designation	Values	Meaning
Hysteresis	0,3 K 0,5 K 0,7 K **1 K** 1.5 K	Interval between the switch-off point (set point value) and the re-switch on point (Set point value – hysteresis). The hysteresis prevents constant switch on/off.
Feedback of hysteresis controlled with switch point	**None** 0,1 K/min 0,2 K/min 0.3 K/min	The feedback causes a gradual decrease in the Hysteresis over time. This increases control accuracy. The hysteresis is equivalent to the programmed value for each switch-off and is gradually reduced by the feedback process. The hysteresis can reduce to 0 over prolonged periods of switch-off. At the next switch-on, it is reset to the configured value.
Cyclical transmission of additional heating system	**No cyclical transmission** 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 switching status of the additional step be sent?

Continued:

Designation	Values	Meaning
Parameters for continuous additional step		
Proportional band of additional heating system	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 actuating values with the same control deviation and a more precise control than smaller values.
Transmission of actuating value of additional heating system	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 many % change* in the actuating value is the new value to be sent. Small values increase control accuracy but also the bus load.

*Change since last sending

3.4.7 Operation

Table 17

Designation	Values	Meaning
Function of LEDs	None **Indication of set point value shift** Fixed indication of position Time-limited display of set point val. shift	The LEDs are always off The middle LED illuminates if no offset has been entered. The remainder indicate an upward or downward offset increment The 5 LEDs show the current valve position as follows (from bottom to top): All OFF: Position 0% 1st LED: Position > 0…20% 2nd LED: Position > 20..00,40% 3rd LED: Position > 40..00,60% 4th LED: Position > 60..00,80% 5th LED: Position > 80..0.100% The current set point value offset is displayed for 10s after a key is pressed. Otherwise, all LEDs remain off.
Function of push buttons	**Enabled** Disabled	The keys can be operated. Hint: Pushing both keys at the same time displays the current valve position on the LEDs (see above, fixed position display). Safeguards against undesired operation

Continued:

Designation	Values	Meaning
Maximum shift of set point value	+/-1 K (1 push button stroke corresponds to 0,5 K) **+/-2 K (1 push button stroke corresponds to 1,0 K)** +/-3 K (1 push button stroke corresponds to 1,5 K) +/-4 K (1 push button stroke corresponds to 2,0 K) +/-5 K (1 push button stroke corresponds to 2.5 K)	What is the max. amount by which the the set point value can be changed and how large is the change at each increment/key pressure?

3.4.8 Operating mode

Table 18

Designation	Values	Meaning
Objects to select operating mode	New: **Operating mode, presence, window state** Old: Comfort, night, frost	Cheops control can also respond to window and presence contact. Conventional setting
Operating mode after download of application	Frost protection Night reduction **Standby** Comfort	Operating mode after start-up, re-programming or return of bus voltage
Type of presence sensor (on Obj. 4 or Ext. interface)	 **Presence detector** Push button	The presence sensor activates comfort mode Comfort mode as long as presence is detected 1. The presence object is reset on change of operating mode definition object (Object 3). 2. If the presence object is set during night operation, it is reset after the configured comfort extension finishes (see below).
Comfort extension during night operation (with presence key) Comfort mode extension via red push button in night mode	None 30 min 1 hour 1,5 hours **2 hours** 2,5 hours 3 hours 3.5 hours	Party switching: enables the red key or presence key to switch Cheops control from night to comfort mode for a certain period.

Continued:

Designation	Values	Meaning
Transmission of current operating mode	**No cyclical transmission** 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?

3.4.9 Device settings

Table 19

Designation	Values	Meaning
Direction of control action of valve	**Normal (closed with pushed tappet)** Inverted, (open with pushed tappet)	For all standard valves Adjustment to inverted valves
Additional pressing of rubber seal in 1/100mm	0...100	with this, the valve can be closed farther if, due to the characteristics of the rubber seal, it fails to close completely. Setting: 1 is equivalent to 1/100mm 10 is equivalent to 1/10mm 100 is equivalent to 1mm See Appendix: Valves and valve seals **Caution:** In order to avoid seal damage, the value should be increased by max. 10 increments.
Type of valve seal	**Valve with Standard seal** Valve with hard seal Valve with soft seal Valve with medium-soft seal	This parameter should be changed only if the valve does not open with low actuating values. (see Troubleshooting)
Characteristic curve of valve	**Typical characteristic curve** Own characteristic curve Linear characteristic curve	For all standard valve types For special valves with known characteristic curves or for special applications For high-quality valves that have flows proportional to the path of the valve tappet.

Continued:

Designation	Values	Meaning
Valve protection*	**Active** Inactive	This function prevents the valve from stopping if it is not actuated for a prolonged period. The valve protection program (if active) is always run if after 24 hrs the actuating value has not changed. In this case, the valve is completely opened and then closed. This procedure is not indicated on the LEDs.
drive to new valve position	Position always accurate At change of actuating value >1 % At change of actuating value >2 % At change of actuating value >3 % At change of actuating value >5 % At change of actuating value >7 % At change of actuating value >10 % At change of actuating value >15 %	The valve is re-positioned each time the actuating value is changed. The valve is never re-positioned until the actuating value has changed from the last position by more than the set value. Enables frequent, small positioning increments to be suppressed **Important:** Too high a value can affect the temperature control.
Function of Object 6	**Increase or decrease set point value** Determines maximum actuating value Sends the actual valve position	Change set point value in increments via Object 6 Object 6 Determining the maximum actuating actuating value Object 6 sends the current valve position during the tappet movement. This setting is most suitable for diagnostic operations

Continued:

Designation	Values	Meaning
Transmission of maximum actuating value	**when internal actuating value is higher than the received** 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	Object 6 will only send if all other actuators have a smaller actuating value Object 6 sends its actuating value cyclically and starts a new calibration
Transmission of actual valve position	Does not send At change of 1% At change of 2 % At change of 3 % At change of 5 % At change of 7 % At change of 10 % At change of 15 %	Sends the new valve position as soon as it has changed since the last sending by the configured amount. At the end of positioning, the achieved value is sent regardless of the configured interval.

3.4.10 External interface

See also "External interface" Appendix

Table 20

Designation	Values	Meaning
Type of connected window contact	 **Window open = contact closed,** Window open = contact open	Enables both NC and NO contacts to be used If several contacts are present, these must be switched in parallel If several contacts are present, these must be switched in series
Transmission of window state	No transmission **Only in case of change** at change and cyclically with actual operating mode	Is the status of the connected window contact to be sent to the bus? Same cycle time as for sending current operating mode
Type of connected presence contact	**Present = contact closed,** Present = contact open	Enables both NC and NO contacts to be used
Transmission of presence status	No transmission **Only in case of change** at change and cyclically with actual operating mode	Is the status of the connected presence contact to be sent to the bus? Same cycle time as for sending current operating mode

3.4.11 Linear characteristic valve curve

This setting should be used only for valves described exclusively as linear.
Note: The values can be shown but not changed in this table.

Table 21

Designation	Values	Meaning
Valve position in % for 10% volume flow (1..99)	**10**	At 10% valve stroke, a volumetric flow of 10% is reached, at 20%, a volumetric flow of 20% is reached etc.
Valve position in % for 20 % volume flow (1..99)	**20**	
Valve position in % for 30 % volume flow (1..99)	**30**	
Valve position in % for 40 % volume flow (1..99)	**40**	
Valve position in % for 50 % volume flow (1..99)	**50**	
Valve position in % for 60 % volume flow (1..99)	**60**	
Valve position in % for 70 % volume flow (1..99)	**70**	
Valve position in % for 80 % volume flow (1..99)	**80**	
Valve position in % for 90 % volume flow (1..99)	**90**	

3.4.12 Own characteristic valve curve

Prof. setting for special valves.

This parameter appears only when an internal characteristic valve curve has been selected from the "Unit settings" page.
The actuator response can be accurately adjusted using the characteristic valve curve (manufacturer’s documentation).
This parameter enables the Cheops control to be adjusted on a valve at 9 points of the characteristic curve (10%.....90%). A certain flow is reached for each point at a certain % of the valve stroke.

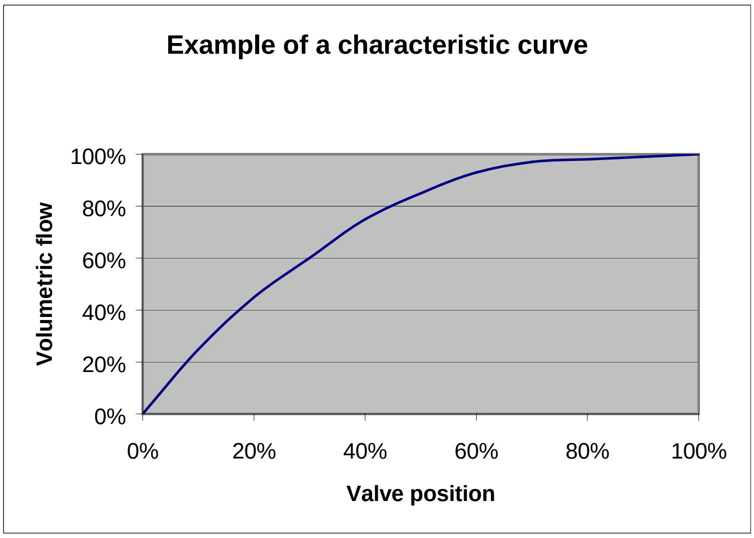
Table 22

Designation	Values	Meaning
Valve position in % for 10% volume flow (1..99)	1..99 (**10**)	At what % valve stroke is a volumetric flow of 10% reached?
Valve position in % for 20 % volume flow (1..99)	1..99 (**20**)	At what % valve stroke is a volumetric flow of 20% reached?
Valve position in % for 30 % volume flow (1..99)	1..99 (**30**)	At what % valve stroke is a volumetric flow of 30% reached?
Valve position in % for 40 % volume flow (1..99)	1..99 (**40**)	At what % valve stroke is a volumetric flow of 40% reached?
Valve position in % for 50 % volume flow (1..99)	1..99 (**50**)	At what % valve stroke is a volumetric flow of 50% reached?
Valve position in % for 60 % volume flow (1..99)	1..99 (**60**)	At what % valve stroke is a volumetric flow of 60% reached?
Valve position in % for 70 % volume flow (1..99)	1..99 (**70**)	At what % valve stroke is a volumetric flow of 70% reached?
Valve position in % for 80 % volume flow (1..99)	1..99 (**80**)	At what % valve stroke is a volumetric flow of 80% reached?
Valve position in % for 90 % volume flow (1..99)	1..99 (**90**)	At what % valve stroke is a volumetric flow of 90% reached?

The values in brackets indicate a linear valve.

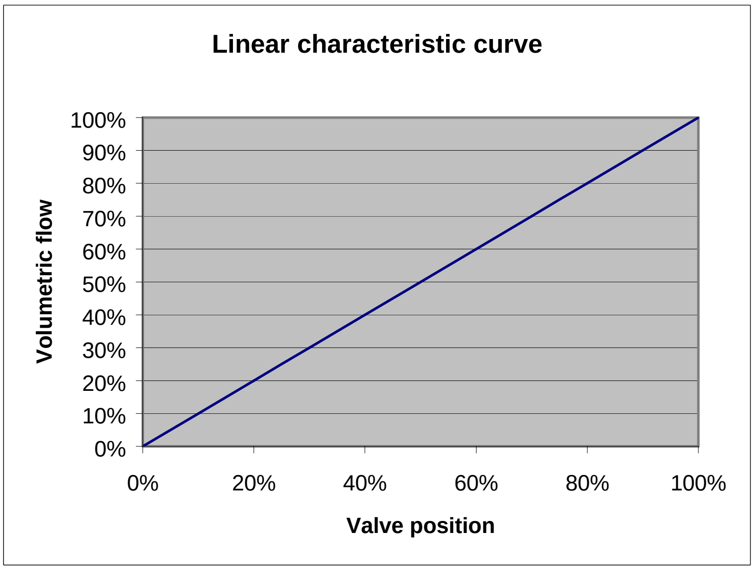
Diagram 1 shows a characteristic valve curve, as occurs frequently in practice.
In this characteristic curve, a 30% flow occurs at a valve stroke as low as 10%. At a valve stroke of 50%, the flow is over 80%.

Diagram 1



A linear characteristic curve as shown in Diagram 2 would be ideal for the control.
A non-linear characteristic curve can be linearised by inputting an own characteristic curve. To do this, the valve position (stroke) at 10, 20.....90% is taken from Diagram 1 and "internal characteristic curve" entered into the parameter page.

Diagram 2



4 Start-up

IMPORTANT INFORMATION.

- During maintenance work on the radiator, the actuator is always dismounted and the valve securely closed by an alternative method
(original protective cap etc…). The valve could be unexpectedly opened, potentially causing water damage, through either the control or the valve protector.
- Cheops must already be mounted on the valve when the application is downloaded, otherwise no adaptation can take place.

4.1 Installation

First, the unit is mounted onto the valve using the correct adapter ring.
The bus voltage can then be applied.
This automatically starts the adaption process.

4.2 Automatic adaption

Because the path (stroke) of the valve tappet can vary widely between 0% position (valve fully closed) and 100% position (valve fully open) from valve to valve, Cheops makes an automatic adaption to the present valve.

1. To do this, Cheops first moves its spindle to its rearmost position.
2. The spindle is moved forward until it touches the valve tappet (100% position)
3. The spindle continues to push the tappet until the seal is pressed into the seat (0% position)

This process can take several minutes.
Cheops is then precisely adapted to the existing valve.

The two limit positions (0% and 100%) are stored and are retained even after voltage drop / reset.
The are used as fixed reference points for positioning.
(See also: Check end position).

When does the adaption process occur?
Automatic adaption occurs for the first time after the bus voltage in the Site function is applied and afterwards each time the application is downloaded.

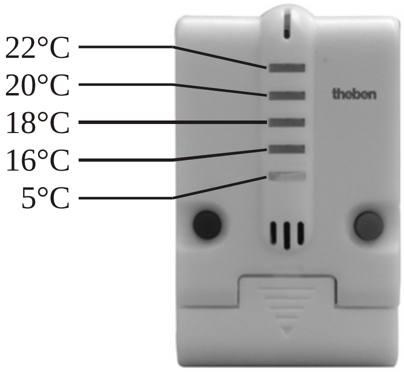
In order to correct the changes of the Valve characteristics over the course of time (aging of the rubber seal), the valve is automatically re-measured on a regular basis.

NOTE:
If an adapted unit is mounted onto a different valve, the adaption process must be repeated by downloading the application.

4.3 Site function

While the unit remains in the delivered condition, i.e. no further applications have been downloaded, Cheops control functions in field mode.
This function enables Cheops control to **be used immediately on site with basic functions.**

The set point temperature can be selected directly on the device using the red (+) and blue (-) keys.
There are 5 set point temperature values available. The selected temperature is indicated on the LEDs as follows.



This enables Cheops control to automatically control the room temperature during the period between assembly and start-up by an EIB specialist.

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

5 Appendix

5.1 Determining the current set point value

The current set point 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 “operating mode”, new operating mode is selected by the " Objects to select operating mode" parameter, the current operating mode can be defined as follows:

Table 23

Pre-selected operating mode Object 3	Presence Object 4	Window status Object 5	Current operating mode Object 10
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 of the timer.
Object 4 is connected to a presence indicator. If a presence is detected, Cheops control switches to Comfort mode (see Table).
Object 5 is connected to a window contact. As soon as a window is opened, Cheops control switches to frost protection mode.

5.1.2 Old operating modes

If on the parameter page, old operating mode is selected by the " Objects to select operating mode" parameter, the current operating mode can be defined as follows:

Table 24

Night Object 3	Comfort Object 4	Frost / heat protection Object 5	Current operating mode Object 10
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 a timer.
During holiday periods, Object 5 selects frost / heat protection via another channel on the timer.
Object 4 is connected to a presence indicator. If a presence is detected, Cheops control switches to Comfort mode (see Table).
Object 5 is connected to a window contact. As soon as a window is opened, Cheops control 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 telegrams (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 Set point value calculations

Assuming the current operating mode, the current set point value of Cheops control is calculated as follows:
A distinction is drawn between whether heating or cooling operation is currently required.

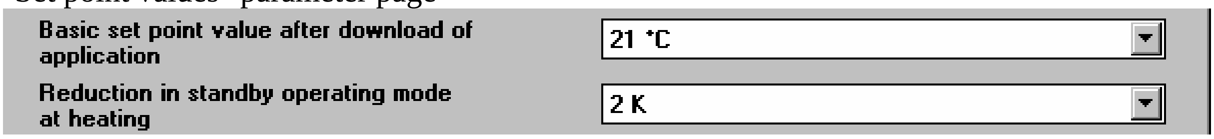
5.1.3.1 In heating operation

Table 25: Current set point value on heating

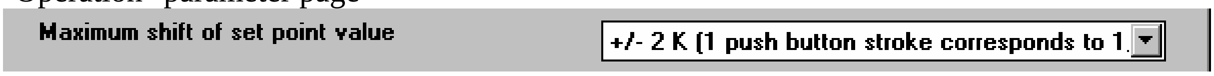
Operating mode	Current set point value
Comfort	Basic set point value + set point value offset
Standby	Basic set point value + set point value offset – reduction in standby mode
Night	Basic set point value + set point value offset – reduction in night mode
Frost/heat protection	Programmed set point value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

Example:
Heating in comfort mode.

"Set point values" parameter page



"Operation" parameter page



The set point value has previously been increased by one step using the red key (1 keystroke)

Calculation:

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

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

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

5.1.3.2 In cooling operation

Table 26: Current set point value on cooling

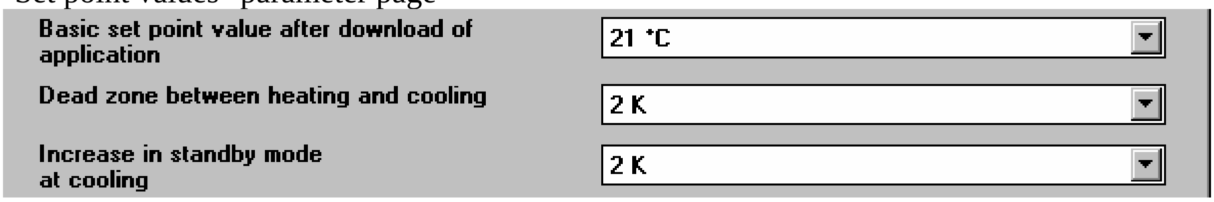
Operating mode	Current set point value
Comfort	Basic set point value + set point value offset + dead zone
Standby	Basic set point value + set point value offset + dead zone + increase in standby mode
Night	Basic set point value + set point value offset + dead zone + increase in night mode
Frost/heat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

Example:
Cooling in comfort mode.

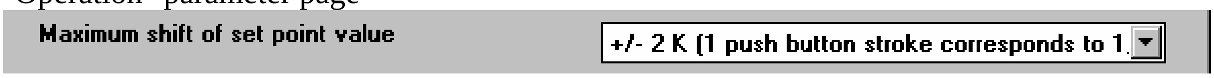
The room temperature is too high and Cheops control has switched to cooling operation

"Settings" parameter page

"Set point values" parameter page



"Operation" parameter page



The blue key is pressed once, i.e. the set point value is decreased by 1 K.

Calculation:

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

Changing to standby mode causes a further increase in the set point value (energy saving) and gives rise to the following set point value.

Set point value = basic set point value + set point value offset + dead zone + increase in standby mode
= 21°C - 1K + 2K + 2K

= 24°C

5.2 Set point value offset

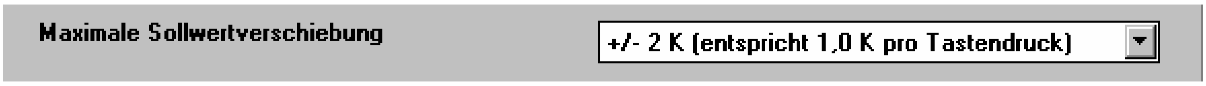
The current set point value on Cheops control can be adapted in 3 ways:

- step by step by the red (+) and the blue (-) key
- in increments via Object 5 " adjustment of set point temperature "
- directly via Object 1 " Manual shift of set point value "

The differential between the set point value offset and the Basic set point 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 set point value offset" parameter and apply for all 3 types of set point value offset.

This parameter indicates the maximum permitted offset and the increment per keystroke (or per activation of Object 6).



5.2.1 Incremental set point temperature adjustment via keys

Each time the blue key is pressed, the set point value is decreased by one increment.
Each time the red key is pressed, the set point value is decreased by one increment.

When the max. permitted offset is reached, further keystrokes have no effect.

5.2.2 Incremental set point temperature adjustment via Object 6

Each time a 1 is sent to Object 6, the set point value is decreased by one increment.
Each time a 0 is sent to Object 6, the set point value is increased by one increment.

When the max. permitted offset is reached, further send actions have no effect.

5.2.3 Direct set point temperature adjustment via Object 1

In this case, the set point value is changed by sending the desired offset to Object 1.
This involves the differential (may be preceded by a minus sign) being sent in EIS5 format.

The offset always relates to the programmed and not to the current set point value.

Example – Basic set point value 21°C:

If a value of 2.00 is sent to Object 1, the new set point value is calculated as follows:

21°C + 2,00K = 23.00°C.

To then bring the set point value to 22°C, the differential is resent to the programmed basic set point 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 and E2.
Both inputs are routed through the Cheops connection line.

The use of these inputs (presence sensor or actual value) is specified on the "Settings" parameter page.
The inputs themselves are configured on the "External interface" parameter page.

5.3.1 Connections

Table 27

Name	Colour	Function
BUS	Black (-)	EIB bus line
	Red (+)	
E1	Yellow	Binary input for window contacts(e)
	Green	
E2	White	Binary input for presence indicator, presence key or analogue input for external temperature sensor
	Brown	

5.3.2 Input E1

E1 is used exclusively for window contacts (if present).
The window contacts can be connected to E1 directly and without additional supply voltage.

On the "External interface" parameter page, the Type of connected window contact (Opener/closer) can be set.

When the "Open" window position is detected, Cheops control switches to frost operating mode.

5.3.3 Input E2

- E2 as binary input:

A presence indicator, switch or key can be directly connected here

If a **presence indicator (**or switch) is used, the period of comfort mode is determined by the indicator, i.e. comfort mode remains in force for as long as presence is indicated.

If a **presence key** is used, operation switches without time limit from standby to comfort mode when presence is indicated.

If presence is indicated during night operation, comfort mode is activated for a limited time. Because the presence key is often not reset when the room is vacated, the presence input is automatically reset when the defined operating mode is changed, so that a night reduction, for example, can take place.

The selection between key and indicator is made on the "Operating mode" parameter page. The type of presence contact can be set on the "External interface" parameter page.

- E2 as analogue input for an external sensor

With this configuration, all settings are made on the "Actual value" parameter side.

An external sensor (Order No. 907 0 191) is connected to E2.
The maximum permitted line length is 10m.

Important:
If E2 is declared as actual value input, the "Input for actual value" selection cannot be changed on the "Actual value" parameter page.

5.4 *Monitoring the actual value*

5.4.1 Application

Case 1: A sensor is connected to interface E2.
Its connection line could be inadvertently interrupted or short-circuited, e.g. during building or renovation work.

Case 2: The temperature is determined by a different EIB device and sent to Cheops control. This external temperature transmitter could fail (bus line short circuited etc…) and not longer be able to perform its function, for a short time or permanently.

Because control is not possible if the actual value fails, this value must be monitored.

5.4.2 Principle

If an external sensor is connected to E2, it is constantly monitored for short-circuit or line break.

If the temperature is received via Object 2, Cheops control can monitor whether new actual value telegrams are received at regular intervals.

In both cases, either an emergency program can be started or further control can be handled by the internal sensor, should the actual value fail.

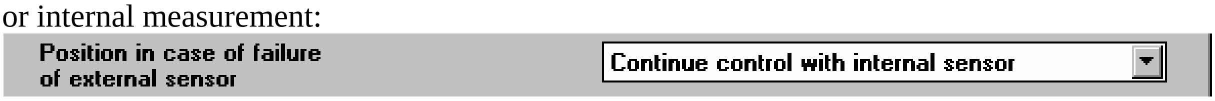
5.4.3 Practice

The response is defined as follows on the "Actual value" parameter page:

- External sensor on E2

Emergency program (0…100%)

or internal measurement:



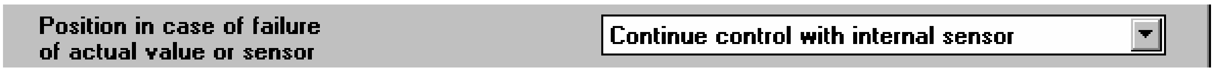
- Receive actual value via Object 2

First the monitoring period must be defined.
This should be at least double the cycle time of the temperature transmitter (e.g. if the temperature is sent to Cheops control every 5 minutes, the monitoring period must be at least 10 minutes).

The response to the actual value failure can then be programmed as above.

Emergency program (0…100%)

or internal measurement:

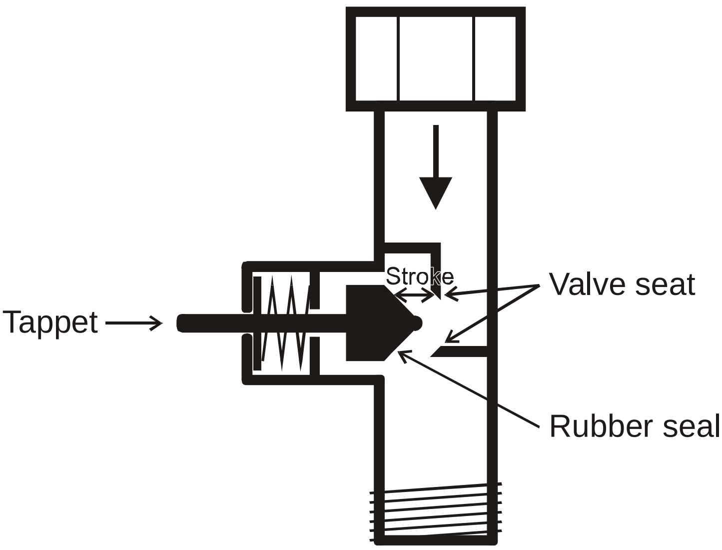


Important recommendation:

Rooms can cool down dramatically when the outdoor temperature is low. This may cause radiators to freeze. To prevent this from happening, you must not select a too low position in the emergency program.
A value of ≥ 30% is recommended.

5.5 Valves and valve seals

5.5.1 Valve structure



5.5.2 Valves and valve seals

When idle, i.e. tappet not actuated, the tappet is pushed outwards by the spring and the valve opens (100% with normal effect).
When the tappet is pushed, the rubber seal is pressed into the valve seat and the valve closes (0% position with normal effect).

The valve does not close immediately on touching the valve seat, depending on the characteristics, the existing tappet may have to move onwards until the valve is fully closed. This response depends on the hardness, shape, aging or damage to the valve seal.

To correct the influence of this parameter, Cheops allows an additional pressing of the valve seal to be entered (see also Troubleshooting).

Caution: In order to avoid seal damage, the value should be increased by max. 10 increments.

5.6 Limit of actuating value

To control the temperature, Cheops control sets an actuating value of between 0% and 100%. For practical reasons, it is not usually necessary to use the entire bandwidth of between 0% and 100%).

5.6.1 Minimum actuating value

The unpleasant whistling noise that some valves can generate at low actuating value, can be avoided by specifying a minimum actuating value.
If, for instance, this response is determined at below 8%, a minimum actuating value of 10% is specified.
On receipt of a actuating value below the specified limit value, Cheops control can respond in one of 2 ways ("Response on under-running the minimum actuating value in heating operation"):

- Either move to immediately to 0% ("0%")
- or stop at the position of the minimum actuating value and do not close valve completely until actuating value 0% is received (0%=0% otherwise minimum actuating value)

5.7 Determine the maximum actuating value

5.7.1 Application

If within a system all valve actuators are only slightly open, e.g. one at 5%, one at 12%, another at 7% etc., the heating boiler can reduce its output because only a small amount of heating energy is required.
In order to guarantee this, the heating boiler requires the following information:
How high is the actuating value in the room, which currently exhibits the greatest heat requirement?

With Cheops valve actuators, this task is handled by the "Maximum position" function.

5.7.2 Principle

The actuating values are constantly compared between all participants (Cheops valve actuators). Those participant with a higher actuating value than the one received may send it, those with a smaller one may not.
In order to accelerate the process, the greater the difference between its own and the received actuating value, the greater the speed at which the valve actuator sends.
Thus, the valve actuator with the highest actuating value sends first and beats the remainders.

5.7.3 Practice

The actuating value comparison takes place via Object 3 ("Maximum position") where for each valve actuator, a common group address for the maximum position is placed on Object 3.

In order to start the actuating value comparison between the participants, one (and only one) participant must send a value to this group address cyclically.
This task can be handled by either boiler or valve actuator.
If it is the boiler, it must send the smallest possible value, i.e. 0%.
If it is a Cheops valve actuator, the parameter " Transmission of object "Max. actuating value"(for boiler control)" on parameter page " Security and forced mode" must be set to any cycle time.
This valve actuator then regularly sends its own actuating value and the others can respond accordingly.

Irrespective of which participants act as initiator, the "Transm. of object "max. actuating value" (for heating system)" must be set to the default value for all other valve actuators, see Figure:

5.8 2-step heating

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

Typically, Cheops control is plugged into the floor heating system (main step) and the radiators are controlled as the additional step.

Cheops controls the two steps in parallel, the additional step being controlled at a lower set point value.
The differential between main and additional step is defined on the "Set point value" parameter page.

Cheops drive valve actuators can be used as a continuous additional step (recommended).

Thermal valve actuators (Order No. 907 0 248) or possibly an electrical additional heater can be used as a switching additional step.

5.9 Temperature control

5.9.1 Introduction

Cheops Control can be used as a P or a PI controller, although the PI control is always preferred.

With the proportional control (P control), the actuating value is rigidly adjusted to the temperature differential.
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 drain.

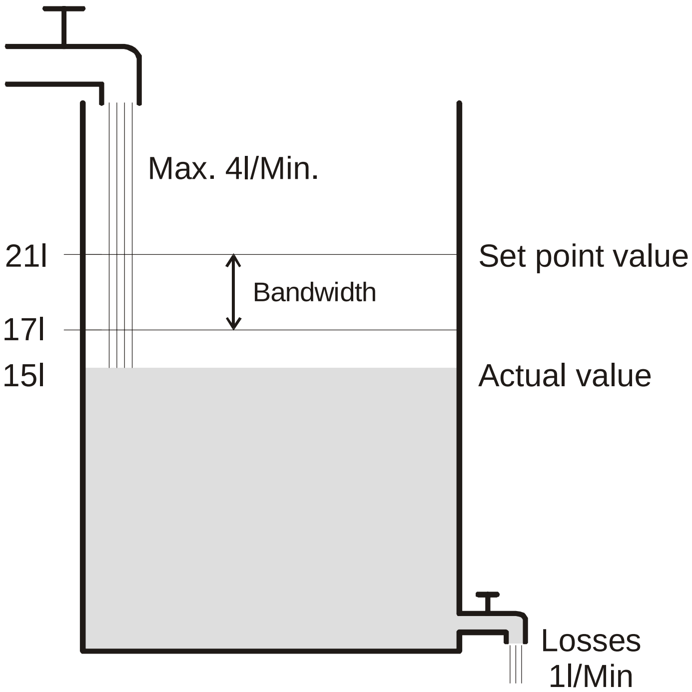
In our example, the maximum supply volume is 4 litres per minute and also denotes the maximum radiator output.
This maximum output is achieved with an actuating value of 100%.
Accordingly, at an actuating value of 50%, only half the water volume, i.e. 2 litres per minute would flow into our vessel.

The bandwidth is 4l.
This means that the controller will send an actuating value of 100% while the actual value is smaller than or equal to (211 – 41) 171.

Function:

- Desired filling quantity:
  21 litres (= set point 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 losses amount to 1l/minute

5.9.2 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 (actuating value) is calculated from the control deviation
(set point value – actual value) and the bandwidth.
Actuating value = (control deviation / bandwidth) x 100

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

<table>
<tr><th>Filling level</th><th>Actuating value</th><th>Supply</th><th>Losses</th><th>Increase in filling level</th></tr>
<tr><td>15l</td><td>100%</td><td>4 l/min</td><td rowspan="3">1 l/min</td><td>3 l/min</td></tr>
<tr><td>19l</td><td>50%</td><td>2 l/min</td><td>1 l/min</td></tr>
<tr><td>20l</td><td>25%</td><td>1 l/min</td><td>0 l/min</td></tr>
</table>

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 set point 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.

P-control as temperature control

The P-control behaves during heating control as shown in the previous example.
The set point temperature (21^{o}C) can never quite be reached.
The permanent control deviation increases as the heat loss increases and as the ambient temperature decreases.

5.9.3 Response of the PI-control

Unlike the pure P-control, the PI-control works dynamically.
With this type of control, the actuating value will not remain unchanged, even at constant deviation.

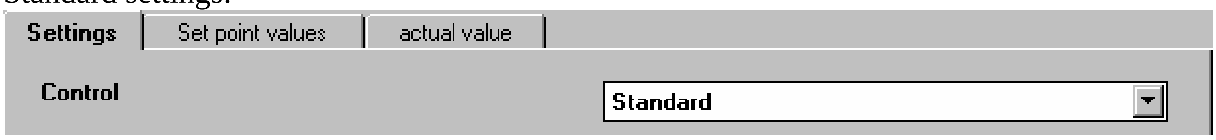
In the first instant, the PI-control sends the same actuating value as the P-control, although the longer the set point value is not reached, the more this value increases.
This increases is time-controlled over the integration time.
With this calculation method, the actuating value does not change if the set point 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 integration time with the room to be heated.
The bandwidth influences the increment of the actuating value change:
Large bandwidth = finer increment on actuating value change.
The integration time influences the response time to temperature changes:
Long integration time = slow response.
Poor agreement can result in either the set point value being exceeded (overshoot) or the control taking too long to reach the set point value.

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

Standard settings:



Control by system type

6 Troubleshooting

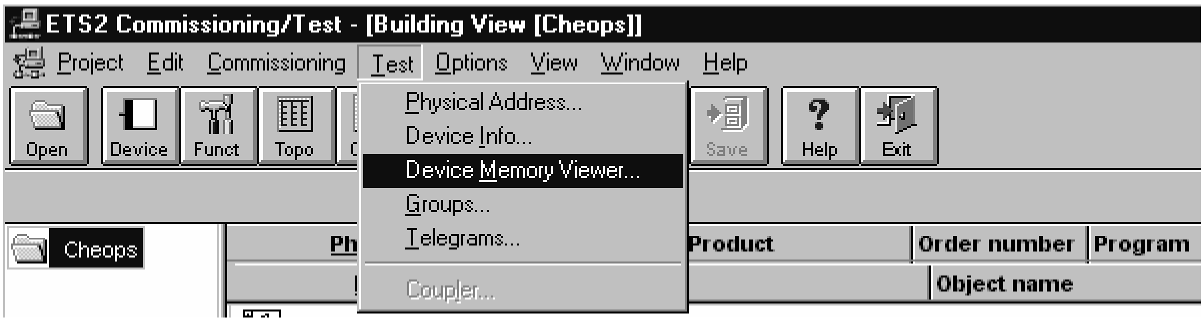
Table 28

Response	Error code	Potential cause	Remedy
All LEDs flash as continuous light from bottom to top, i.e. valve adaption was unsuccessful	82	No valve	Plug unit onto valve and reload application
	84	Valve tappet is already touched, although the spindle of the valve actuator is fully returned.	Use other valve adapter. Please contact our Customer Service. When the spindle is returned, the valve tappet must be at least 3/10 mm away from the spindle (see below, Check adapter ring).
	81	Valve tappet cannot be moved, even with maximum force (120N).	Check whether tappet sits correctly, if so, replace valve.
	81	Following start-up, valve actuator with valve was mounted onto a different valve and must be readapted.	Re-download the application, valve actuator is then automatically adapted
	81	Valve seal too heavily pressed	Cancel additional pressing of rubber seal
	83	Valve jams	Check valve
Valve does not close when actuating value is 0%		Valve seal is insufficient for pressing onto the valve seat	Enter additional pressing of rubber seal. **Caution:** Increase parameter by max. increments of 10
		Valve seal is damaged	Replace valve.
Valve opens only with an unexpectedly large actuating value		Existing valve seal is too soft	Adapt parameter type of valve seal. Valve opens only with actuating values over: 5% ⇒Standard valve seal 10% ⇒ medium-soft seal 20% ⇒ select soft seal
Valve does not move to positions below or above a certain value		Minimum or maximum actuating value parameter(s) have been changed	Check minimum and maximum actuating value parameters

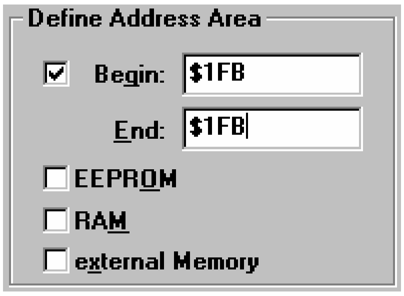
6.1 Read-out error code

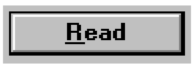
If the valve causes an error message and the LEDs flash as continuous light, Cheops generates an error code.
This remains in the BCU memory and can (start-up/test) be read-out using the ETS software.

1. Select device in the project and click on Test / Device memory viewer menu item



2. Enter memory area 1FB, deselect RAM and EEPROM



3. Click the  button

4. The error code appears in the results window

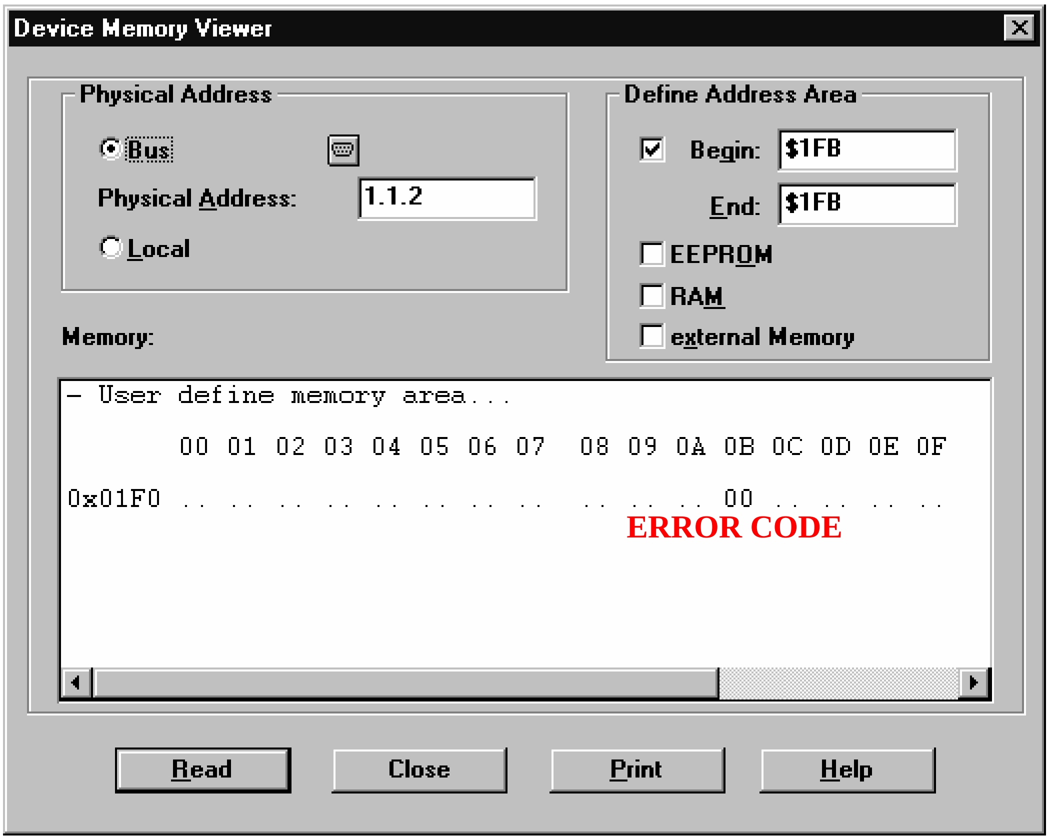


Table 29

Code	Name
00	No error
81	Overload switch-off (overcurrent)
82	Valve not found
83	Valve does not move
84	Stroke too short

6.2 Checking end position

The end positions stored during the adaption process can be read out in exactly the same way as the error numbers using the ETS software.

The internal stop position (spindle inserted, valve open) is stored in Hex-format under the address $1FC and the external stop position under $1FD.

After downloading the application, these values are reset (i.e. $1FC = 00 and $1FD = FF).
The found stop positions are stored here following successful adaption.
If both addresses show 00 after adaption, the adaption is deemed to have been unsuccessful.

To determine the stop positions in millimetres, the values are converted into decimal and divided by 20.

Example calculation:

Table 30

Position	Valve	Address	Hexadecimal Value	Equivalent to decimal value	Result decimal value/20 =
Internal stop	Open	$1FC	24	36	1,8 mm
External stop	Closed	$1FD	61	97	4,85 mm

The stroke is calculated from the two values as follows:

Stroke = external stop - internal stop

In our example:
Stroke = 4.85 – 1.8 mm = 3.05 mm

Limit values for successful adaption

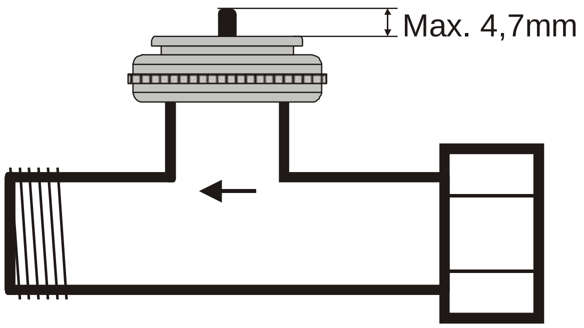
The following values must be respected:

Table 31

Internal stop		External stop		Stroke	
Dimension	Hex value	Dimension	Hex value	Dimension	Hex value
≥ 0,3mm	≥ 6	≤ 7,5mm	≤ 96	≥ 1.2mm	≥ 18

6.3 Checking adapter ring

The maximum dimension between top edge of adapter ring and end of tappet is 4.7 mm.
If this dimension is over-run, an alternative adapter ring must be used.



7 Glossary

7.1 Basic set point value

The basic set point value is the standard temperature for comfort mode and the reference temperature for reduction in standby and night modes.
The programmed basic set point value (see "Basic set point value after download of application" is stored in Object 0 and can be changed at any time by sending a new value to Object 0 (EIS5).
After reset (bus returned), the last used basic set point value is restored.

7.2 Hysteresis

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

Without hysteresis, the controller would switch on and off continuously provided the temperature is within the set point value range.

7.3 Continuous and switching control

With a continuous actuating value, the valve is brought to any position between 0% and 100%. This achieves in a pleasant and precise control.
A switching control has only 2 statuses, On or Off, i.e. in our case, valve fully open or fully closed.

7.4 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 Cheops control switches to cooling operation, the set point 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 set point value had been under-run, the heating would activate and when the set point value would be achieved, cooling were to be started immediately and the temperature would fall to below the set point value and switch on the heating again.

7.5 Valve stroke

Mechanical path that is between the two end positions, i.e. 0% (valve closed) and 100% (valve fully open) covered (see Valve arrangement diagram).