User Manual

KNX MultiLight Dali

Article number: 44002

Picture: KNX MultiLight products

Table of Contents

1 The KNX MultiLight Dali

The KNX MultiLight Dali is a room controller designed to be mounted inside ceiling suspended lamps.

The main functions of the KNX MultiLight Dali are:
- Controlling heating and cooling via KNX objects
- Controlling lighting through an embedded DALI master
- Local sensor input for movement, lux, temperature and user panel
- Digital input for pull-cord

For programming and configuration: see chapters 3 to 9.

For wiring and installation instructions: see chapter 12.

For technical data: see chapter 13.

2 Introduction

KNX MultiLight Dali is designed to be an efficient room controller system embedded in lamps for use in offices and commercial buildings. The core of the KNX MultiLight Dali is the combination of a DALI gateway for constant light regulation and demand controlled two-step temperature regulator with temperature- and movement sensors.

The functionality of the product can be configured and connected to the rest of the KNX automation system by using the ETS Engineering Tool Software (see www.knx.org)

Example 1 – Heating regulator:
The KNX MultiLight Dali can be configured as a two-step heating regulator. The regulator has one temperature setpoint for a room that is occupied, and another temperature setpoint for a room that is vacant. For this example the heating temperature setpoint for an occupied room is 22°C, and the setpoint for the vacant room is set to 19°C. When the movement detector mounted in the lamp detects a person walking into the room, the setpoint will be raised from 19°C in standby mode (vacant) to 22°C in comfort mode (occupied).
The thermostat output can be linked to external actuators for electrical heat cables, thermo shunts, fan-coils and other KNX products.

Example 2 – Lighting:
The KNX MultiLight Dali can control luminaires through the DALI light control interface based on levels of daylight. So, when a person walks into the room and the temperature setpoint is changed from standby to comfort mode, the light will turn on and the constant light regulator will keep the light level at the configured lux-level. The setpoint for the constant light regulator can either be changed by parameter with the ETS Tool Software or by value and dim objects (digital input from the pull-cord or other KNX switches). The KNX MultiLight will learn the new lux setpoint and control the light accordingly.

Example 3 – Ventilation:
The KNX MultiLight Dali can control ventilation for the office space by KNX objects based on the movement detector and the temperature regulator. The ventilation can be reduced to a minimum when the room is vacant and the controller is in standby mode. The ventilation system will be told to increase the ventilation when a person enters the room.
The ventilation system will usually have a cooling effect for the room because of lower air temperature in the supplied air. The cooling regulator of the KNX MultiLight can activate added ventilation as required based on the room temperature measured by the Reed panel (see Figure 1) or an external sensor.

Figure 1 - KNX MultiLight Reed user panel

3 Start-up and general functions

The KNX MultiLight Dali can be configured by using the ETS Tool Software. The product database file can be downloaded from http://www.function-technology.com/downloads. Documentation for the parameters, objects and example configurations can be found in the chapters below.

The KNX MultiLight can be set in programming mode either by pressing the programming button on the KNX MultiLight unit, or by pressing the switch behind the movement sensor lens. See Figure 2 for the different ways to enter programming mode.

Use a small circular object like a paper clip or a bare KNX copper wire to reach the programming button on the movement sensor.

Figure 2 - Programming mode buttons

The red programming LED on the control panel and behind the movement sensor lens will be lit when the KNX MultiLight is in programming mode. The programming LED will blink when the KNX MultiLight is not programmed (un-programmed node).

The KNX MultiLight will check communication with movement detector, temperature sensor and DALI interface. If communication has failed, the object "Device self-test status" will be set to "1". When the error situation is cleared, the "Device self-test status" object changes its value to "0".

The start-up functionality for a device that has not been programmed with ETS includes:

1. Walk-in test for motion detection with the red LED behind the motion sensor lens
2. The binary input will have switch and dim functionality for the connected DALI lamps

Note: The KNX MultiLight includes basic functionality listed above for test and commissioning purposes that will be removed after the first ETS download.

3.1 General parameters

The status of the KNX MultiLight is shown by the object "Self-Test status". For normal operational nodes this status object is low. If the Dali interface, movement- or temperature sensor does not respond, the "Self-Test status" is set high. The object can be configured to be sent cyclically [1 to 24 hours].

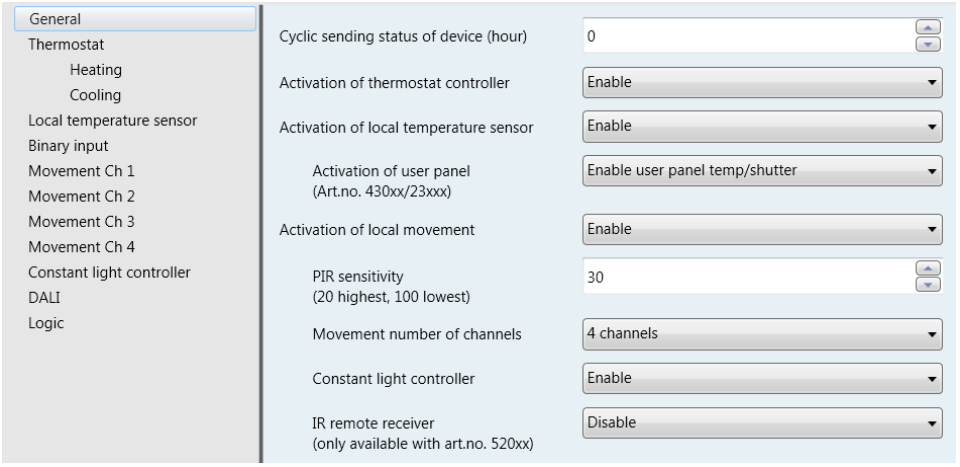


Figure 3 – General parameter window

The KNX MultiLight can be configured with or without motion- and temperature sensors. The temperature regulator can still be activated based on external temperature object even without a temperature sensor connected to the unit (see Figure 3).

PIR sensitivity can be adjusted from 20 to 100, where 20 is the highest sensitivity. This parameter is set to 30 by default, and should not be set lower than this value without testing for false detection.

Note: IR remote receiver is only available if a wall- or ceiling box sensor (art.no. 520xx) is connected to the MultiLight Dali by a cable adaptor.

3.2 Temperature measurement from the user panel

The thermostat can use either the temperature from the user panel (Figure 1) or external communication object. It is possible to choose user panels with only temperature control, temperature and shutter control or temperature and dimming control.

The local temperature measurement can be set to a resolution of 0.5 or 0.1K and can be mixed with an external temperature based on a percentage parameter (see Figure 4).

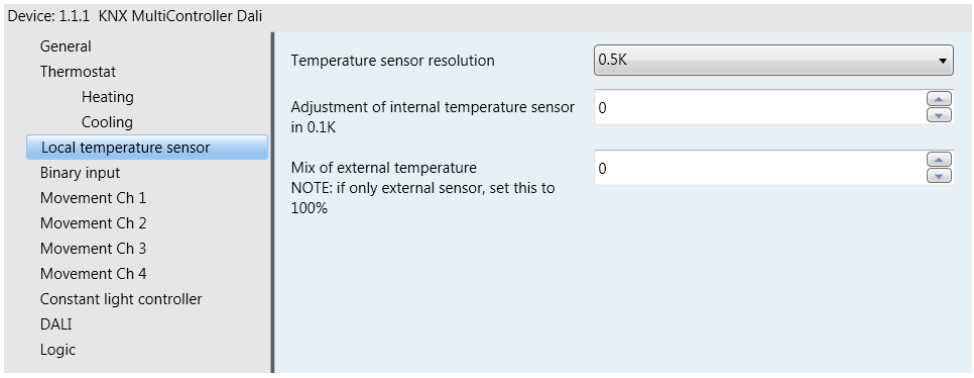


Figure 4 – Local temperature sensor parameters

Table 1 - Object list for general and user panel objects

Obj.	Object name	Description	Size, flags, DPT
0	Device: Self-Test status	This object will report self-test result and live status with a "0" if everything is ok. If it sends "1", the self-test has failed. Cyclic sending can be activated by parameter. This object will be set high if the communication with the movement detector or user panel has failed.	1 Bit R-CT-- [1.2] DPT_Bool
1	Panel: Dimming operation - Switch	This object will be visible if parameter "Activation of user panel" is set to "temp/light". The object will be transmitted with a 1 or a 0 if the up or down button is pressed (short operation)	1 Bit --CT-- [1.1] DPT_Switch
1	Panel: Shutter operation - Stop/Step	This object will be visible if parameter "Activation of user panel" is set to "temp/shutter". The object will be transmitted with a 1 or a 0 if either the up or down button is pressed (long operation).	1 Bit --CT-- [1.007] DPT_Step
2	Panel: Dimming operation - Dimming	This object will be visible if parameter "Activation of user panel" is set to "temp/light". The object will transmit a 4 bit dimming command when the up or down button is pressed (long operation)	4 Bit --CT-- [3.7] DPT_Control_Dimming
2	Panel: Shutter operation - Up/Down	This object will be visible if parameter "Activation of user panel" is set to "temp/shutter". The object will transmit a 1 or a 0 if either the up or down button is pressed (long operation).	1 Bit --CT-- [1.8] DPT_UpDown
3	Panel: Block blinds operation	If enabled by parameter, this object will block the shutter operation objects.	1 Bit -WC--- [1.2] DPT_Bool

4 Movement sensor

The combined movement and lux level (brightness) sensor is connected to the KNX MultiLight Dali node through a 4-wire cable. The parameter "Activation of local movement" in the General tab has to be enabled before the movement channel parameter windows appear.

There are 4 channels available based on the movement detector. Each channel can be individually configured with recovery time, cyclic sending and configuration for start and end of detection (see Figure 5 for the parameter window). There is also an object for blocking the movement channel and the option to send a value at start and/or end of detection.

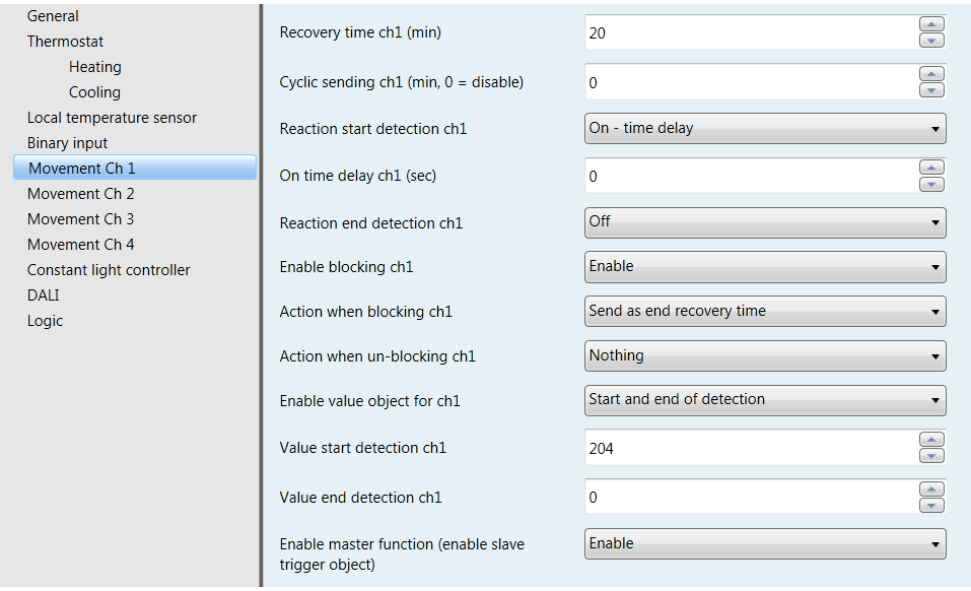


Figure 5 - Movement sensor parameter window

The movement channels can be configured individually with:

1. **Recovery time** for detection from 1 to 255 minutes. The recovery time specifies the time between the last detected movement and when the object is set low.

2. **Cyclic sending ON commands** of "Movement chX: Switch" object can be enabled or disabled. The cycle time can be between 1 and 255 minutes. 0 disables the function.

3. **Reaction start of detection**

4. **Reaction end of detection**

5. **Enable or disable movement blocking object** (see object description)

6. **Transmit value for start and end of detection** (enables a movement value)

7. **Movement Ch. 1 can be configured as a master** (i.e. the write flag is enabled for the switch object)

The lux measurement from the movement sensor is part of the constant light controller and is read-enabled as object 43 "Const.Light Controller: Current value (lux)".

Movement ch1 switch object can be triggered externally through object 31: "Movement Ch1: Slave trigger input". The parameter Movement Ch1 "**Enable Master function (enable slave trigger object)**" has to be enabled.

4.1 Cyclic sending

If the value of cyclic sending is lower than the recovery time, the sensor will not send any cyclic ON telegrams. If the two values are the same, the sensor sends one cyclic sending right before the recovery time elapses. The cyclic sending time will not be affected by a

re-trigged recovery time. There will be no cyclic telegrams if the "Reaction start of detection" is set to "No reaction".

The value object will be sent cyclically if value is set to either "Start of detection" or "Start and end of detection".

Table 2 - Object list for the movement channels

Obj.	Object name	Description	Size, flags, DPT
28	Movement Ch1: Switch	This object will be transmitted if the movement detector detects movement according to the parameter setting "Reaction start detection" ("On", "Off", "No reaction"). At the end of detection (when the "Recovery time" has elapsed) the object will be transmitted according to the "Reaction end detection" ("On", "Off or "No reaction"). The object can be set to cyclic sending depending on parameter "Cyclic sending".	1 Bit --CT-- [1.1] DPT_Switch
29	Movement Ch1: Value	Transmit predefined value at detection and/or at the end of detection.	1 Byte --CT-- [5.1] DPT_Scaling
30	Movement Ch1: Block	The movement channel can be blocked. If this object is set to true, then no switch and value object based on movement will be sent.	1 Bit -WC--- [1.2] DPT_Bool
31	Movement Ch1: Slave trigger input	This object can allow external triggering of the movement detector. All movement channels will be triggered if a "1" is received. Receiving "0" will have no effect.	1 Bit -WC--- [1.1] DPT_Switch
32	Movement Ch2: Switch	This object will be transmitted if the movement detector detects movement according to the parameter setting "Reaction start detection" ("On", "Off", "No reaction"). At the end of detection (when the "Recovery time" has elapsed) the object will be transmitted according to the "Reaction end detection" ("On", "Off" or "No reaction"). The object can be set to cyclic sending depending on parameter "Cyclic sending".	1 Bit --CT-- [1.1] DPT_Switch
33	Movement Ch2: Value	Transmit predefined value at detection and/or at the end of detection.	1 Byte --CT-- [5.1] DPT_Scaling
34	Movement Ch2: Block	The movement channel can be blocked. If this object is set to true, then no switch and value object based on movement will be sent.	1 Bit -WC--- [1.2] DPT_Bool
35	Movement Ch3: Switch	This object will be transmitted if the movement detector detects movement according to the parameter setting "Reaction start detection" ("On", "Off", "No reaction"). At the end of detection (when the "Recovery time" has elapsed) the object will be transmitted according to the "Reaction end detection" ("On", "Off" or "No reaction"). The object can be set to cyclic sending depending on parameter "Cyclic sending".	1 Bit --CT-- [1.1] DPT_Switch
36	Movement Ch3: Value	Transmit predefined value at detection and/or at the end of detection.	1 Byte --CT-- [5.1] DPT_Scaling

37	Movement Ch3: Block	The movement channel can be blocked. If this object is set to true, then no switch and value object based on movement will be sent.	1 Bit -WC--- [1.2] DPT_Bool
38	Movement Ch4: Switch	This object will be transmitted if the movement detector detects movement according to the parameter setting "Reaction start detection" (“On”, "Off", "No reaction"). At the end of detection (when the “Recovery time” has elapsed) the object will be transmitted according to the "Reaction end detection" (“On“, "Off" or "No reaction”). The object can be set to cyclic sending depending on parameter “Cyclic sending”.	1 Bit --CT-- [1.1] DPT_Switch
39	Movement Ch4: Value	Transmit predefined value at detection and/or at the end of detection.	1 Byte --CT-- [5.1] DPT_Scaling
40	Movement Ch4: Block	The movement channel can be blocked. If this object is set to true, then no switch and value object based on movement will be sent.	1 Bit -WC--- [1.2] DPT_Bool

5 Constant light controller

The constant light controller will use the LUX level measurement from the movement sensor and will control the dimming value of the lamps either by output object or the internal DALI interface.

The constant light controller will change the dimming value based on the “step size in %” and “step size in seconds” parameters. The default setting of 3% dim value change in 5 seconds should fit most lighting systems. If long delay is expected from dim value update to actual change in light level, then lower the step size in % and increase the step size in seconds.

See Figure 6 for the parameter window for the constant light controller.

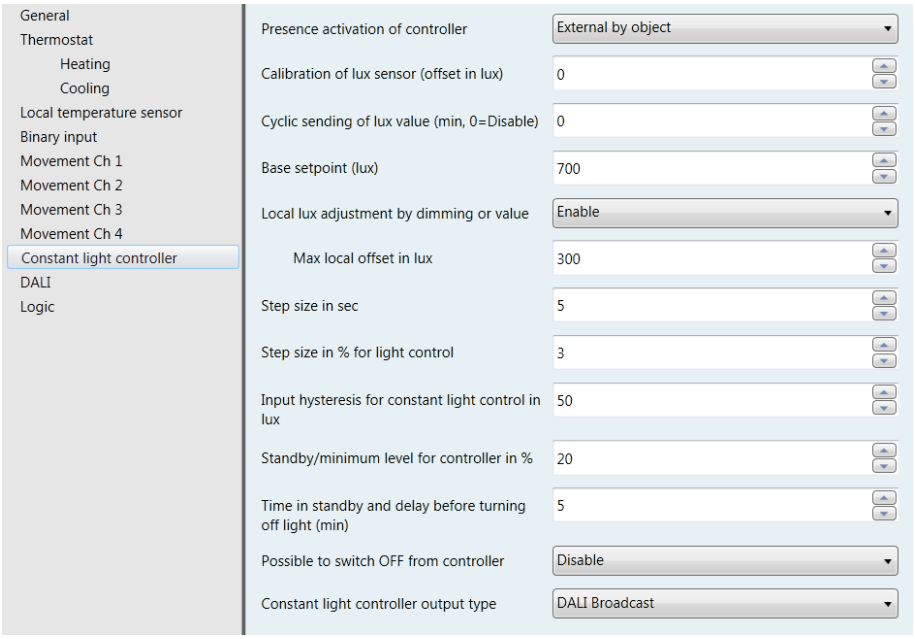


Figure 6 – Constant light controller parameter window

5.1 Constant light controller output

The output will not change as long as the current lux level is within the "input hysteresis for constant light control" which is default at 50 lux. This means that the output will be changed + or - 3% if the measured value is lower than 650 lux or higher than 750 lux for a setpoint of 700 lux.

The output from the constant light regulator can be set via parameter to:
- Communication object ("By object")
- DALI interface group 0 ("DALI Group 0")
- DALI interface group 0 and 1 ("DALI Group 0 and 1")
- DALI interface Broadcast ("DALI Broadcast")

If the output of the constant light controller is configured as "By object", then the DALI groups that should be constant light controlled must be linked manually by group addresses.

If the output of the constant light controller is configured as "DALI Broadcast", then all connected DALI lamps will follow the output value from the constant light controller.

5.1.1 Output with offset

Two value objects appear when the constant light controller output type is set to "By object"; the output value object and the value object with offset (object 50 and 51). The output value with offset can control a group of lamps with a 0 to 50% higher dimming value than the main group of lamps. Typically the main group of lamps would be closest to the facade, and the group of lamps controlled with the output value with offset would be the lamps furthest away from the facade.

The option to have offset between two DALI groups is also possible when "DALI Group 0 and 1" is the chosen output from the constant light controller. Typically in a meeting room the lamps closest to the windows (DALI Group 0) will be dimmed down and the row of lamps farthest away from the windows (DALI Group 1) will have a higher dimming value based on the offset parameter.

5.2 Minimum dimming level and turn-off

The minimum dimming level can be set to a value in per cent to prevent low dimming values. The parameter "Standby/minimum level for controller in %" will both act as this minimum dimming level as well as the standby dim level after the presence object (or internal sensor) has been switched off. The parameter "Time in standby and delay before turning off" will determine when the lamp will be turned off.

It can be unpleasant for the occupants to experience constant light control where the lamp is turned completely off. It is therefore possible to set both minimum dimming level, time delay at minimum level and disabling of turn-off from the constant light regulator.

5.3 Activation of constant light controller

The constant light controller can be activated either by communication object or by "Movement Ch. 1" (can be set via the parameter "Presence activation of controller").

> The controller can be disabled by linking one or more of the three disable objects (object 46-48). The constant light controller will be disabled until the presence activation (object 41) or internal movement ch1 is set to false.

It is possible to re-configure the disable objects to work as setpoint changers. When the "Local lux adjustment by dimming or value" parameter is set, object 47-48 will adjust the light level either by dimming or by value and make the constant light regulator learn the new lux level. The new level will be stored until the device has lost bus power.

5.3.1 LUX calibration

The lux level object, "**Const.Light Controller: Current value (lux)**", can be calibrated by writing to the object. The calibration factor is calculated as the written lux value divided by the raw lux value. The calibration factor is stored permanently in EEPROM/flash.

Both raw values and the resulting calibrated values are shown in Figure 7. The pink line is the raw value (V) from the sensor; the blue line is the wanted value (W) set by the user. The calibration factor is the ratio between the wanted lux value and the raw lux value: C=W/V

If the raw value V=1000, and the object is updated with 800, then the calibration factor will be: C=800/1000=0.8. See the graph in Figure 7.

The formula for calculating the calibrated lux value is: Lux=C*V

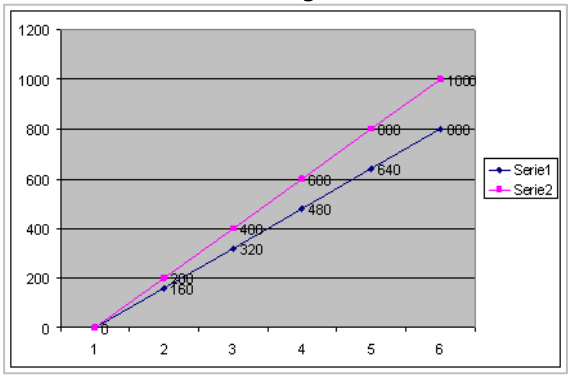


Figure 7 - Raw and calibrated lux values

The calibration factor is set to 1 and the raw value is used if "0" is written to the "Current value (lux)" object. The object should be set to 0 to clear the current calibration before re-calibrating the lux level. The lux level calibration is limited to 2 times the raw lux level (calibration factor <=2), so the calibration is limited to 2000 if the raw lux level is 1000.

5.4 Object list

Table 3 - Object list for the constant light controller

Obj.	Object name	Description	Size, flags, DPT
41	Const.Light Controller: Presence/activation	This object will activate or de-activate the constant light controller. The object is only available if the "Presence activation of controller" is set to "External by object".	1 Bit -WC--- [1.1] DPT_Switch
42	Const.Light Controller: Status	Shows the status of the constant light controller (True: controller is active, False: controller is inactive)	1 Bit R-CT-- [1.2] DPT_Bool
43	Const.Light Controller: Current value (lux)	The current lux value from the lux sensor.	2 Bytes RWCT-- [9.4] DPT_Value_Lux
44	Const.Light Controller: Base setpoint (lux)	Base setpoint for the constant light controller. Base setpoint for the constant light controller. The value will be reset to the parameter value at power-on or reset.	2 Bytes RWCT-- [9.4] DPT_Value_Lux
45	Const.Light Controller: Actual setpoint (lux)	The actual setpoint for the constant light controller. The object is only available if "Local lux adjustment by dimming or value" is enabled. This object will be reset if the base setpoint (object 45) is changed.	2 Bytes R-CT-- [9.4] DPT_Value_Lux
46	Const.Light Controller: Disable - Switch	The constant light controller can be disabled by sending "True" or "False" to this object. The light can then be turned on and off by DALI broadcast or DALI group objects. The constant light regulator will be re-enabled if the presence object or internal movement ch1 goes to "False" and then to "True" again (regardless if the regulator is in stand-by).	1 Bit -WC--- [1.1] DPT_Switch
47	Const.Light Controller: Disable - Dimming	The constant light controller can be disabled by sending a dimming telegram to this object. The constant light controller will be disabled until the presence object (41) or internal movement ch1 times out and the light turns off. The object is only available if "Local lux adjustment by dimming or value" is disabled.	4 Bit -WC--- [3.7] DPT_Control_Dimming
47	Const.Light Controller: Record Level - Dimming	This object must be linked with the DALI dimming object. When the light is dimmed, the new lux level will be recorded by the constant light controller and used as the actual setpoint (object 45). The object is only available if "Local lux adjustment by dimming or value" is enabled.	4 Bit -WC--- [3.7] DPT_Control_Dimming
48	Const.Light Controller: Record Level - Value	This object must be linked with the DALI value object. When the light is dimmed by a new value, the new lux level will be recorded by the constant light controller and used as the actual setpoint (object 45). The object is only available if "Local lux adjustment by dimming or value" is enabled.	1 Byte -WC--- [5.1] DPT_Scaling
48	Const.Light Controller: Disable - Value	The constant light controller can be disabled by sending a value telegram to this object. The constant light controller will be disabled until the presence object (41) or internal movement ch1 times out and the light turns off. The object is only available if "Local lux adjustment by dimming or value" is disabled.	1 Byte -WC--- [5.1] DPT_Scaling

49	Const.Light Controller: Output - Switch	Available if "Constant light controller output type" is set to "By object". This object will transmit "1" if the output of the constant light controller is on or "0" if it is off.	1 Bit R-CT-- [1.1] DPT_Switch
50	Const.Light Controller: Output - Value	Available if the parameter "Constant light controller output type" is set to "By object". This object will transmit the output dim value from the constant light controller.	1 Byte R-CT-- [5.1] DPT_Scaling
51	Const.Light Controller: Output - Value with offset	Available if the parameter "Constant light controller output type" is set to "By object". This object will transmit the output dim value from object 50 plus the offset % value given in parameter.	1 Byte R-CT-- [5.1] DPT_Scaling

6 Infrared remote control

The parameter "IR remote receiver" under the "General" tab should only be activated if the MultiLight is connected to a wall/ceiling box movement sensor 52001.

The remote has two sets of up/down buttons for remote input 1 and 2 that can be configured as switch, dimming or shutter/blinds. The remote has 7 buttons for temperature setpoint adjustment, allowing setpoint change from +3 to -3 °C (linked to Object 8: "Thermostat: Local adjustment of temp offset").

The ECO mode button will set the local adjustment of temp offset to 0 and also re-enable the constant light regulator, if the regulator has been disabled by manual light control.

Table 4 - Object list for the infrared remote control

Obj.	Object name	Description	Size, flags, DPT
134	Remote input 1: Dimming operation - Switch	This object appears if the remote input 1 is set to "Dimming". This object will transmit on or off if the up or down button on the remote is pressed	1 Bit -WCT-- [1.1] DPT_Switch
134	Remote input 1: Shutter operation - Stop/Step	This object appears if the remote input 1 is set to "Shutter". This object is transmitted (stop/step) if the up or down button on the remote is pressed.	1 Bit -WCT-- [1.007] DPT_Step
134	Remote input 1: Switch	This object appears if the remote input 1 is set to "Switching". The object is transmitted if the up or down button on the remote is pressed.	1 Bit -WCT-- [1.1] DPT_Switch
135	Remote input 1: Shutter operation - Up/Down	This object appears if the remote input 1 is set to "Shutter". The object is transmitted if the up or down button is pressed and held down.	1 Bit -WCT-- [1.8] DPT_UpDown
135	Remote input 1: Dimming operation - Dimming	This object appears if the remote input 1 is set to "Dimming". This object will transmitted dim up or dim down if the up or down button on the remote is pressed and held down	4 Bit -WCT-- [3.7] DPT_Control_Dimming
136	Remote input 2: Shutter operation - Stop/Step	This object appears if the remote input 2 is set to "Shutter". This object is transmitted (stop/step) if the up or down button on the remote is pressed.	1 Bit -WCT-- [1.007] DPT_Step
136	Remote input 2: Dimming operation - Switch	This object appears if the remote input 2 is set to "Dimming". This object will transmit on or off if the up or down button on the remote is pressed	1 Bit -WCT-- [1.1] DPT_Switch
136	Remote input 2: Switch	This object appears if the remote input 2 is set to "Switching". The object is transmitted if the up or down button on the remote is pressed.	1 Bit -WCT-- [1.1] DPT_Switch
137	Remote input 2: Shutter operation - Up/Down	This object appears if the remote input 2 is set to "Shutter". The object is transmitted if the up or down button is pressed and held down.	1 Bit -WCT-- [1.8] DPT_UpDown
137	Remote input 2: Dimming operation - Dimming	This object appears if the remote input 2 is set to "Dimming". This object will transmitted dim up or dim down if the up or down button on the remote is pressed and held down	4 Bit -WCT-- [3.7] DPT_Control_Dimming

7 DALI

The KNX MultiLight has a built-in DALI gateway that can control up to 8 DALI control gear (EVGs). Communication with the DALI gear is done by DALI broadcast and/or DALI group 0 to 3. The broadcast mode is enabled by default, so there is no need for group assignment unless individual control is wanted.

It is possible to use up to four DALI groups (group 0 to 3) to control lamps. The DALI lamps must be assigned to group 0 to 3 with an external DALI programming interface or by the function DALI tool application in order to use the group addressing mode.

The DALI interface can be configured with start-up dimming value, switch on/off permissions, dimming time, minimum- and maximum dimming values. These settings will be inherited by the DALI groups. The parameter "Duration in standby before off in min" is only used for broadcast communication (see chapter 7.1).

DALI addressing can be enabled by parameter after reset/power-on of the KNX MultiController or after ETS download. If this function is enabled, the DALI nodes without short address will be assigned a short address ranging from 0 to 3.

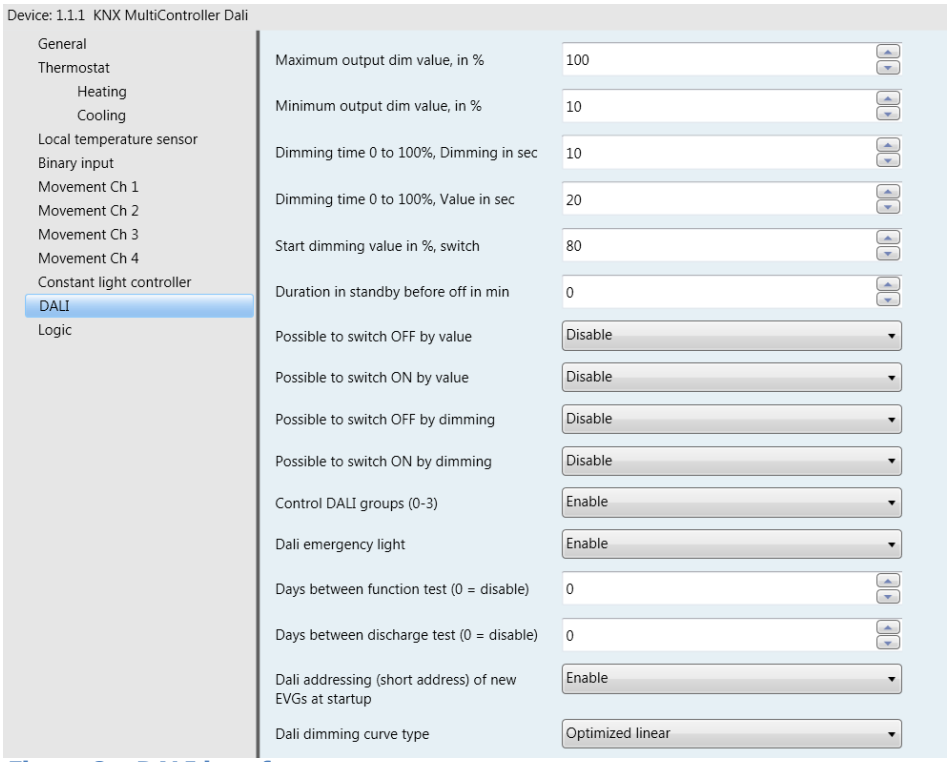


Figure 8 – DALI interface parameters

The DALI interface will not retain a list in memory of attached DALI nodes after a power failure, but searches the DALI bus for attached DALI devices at:

- Power-on (230V)
- Start-up of the KNX node either when the KNX bus is connected or after download of an application with the ETS tool

7.1 Dimming value and dimming time

Dimming times in seconds for maximum range dimming can be configured independently by parameters for the 4 bit dimming object and for the 1 byte dimming value. The DALI gateway will use this time value to set an appropriate slew rate in the EVGs based on the DALI standard fade time shown in Table 5 below.

Table 5 – Fade time enumerations according to the DALI standard

Enumeration	Fade time
0	0
1	0,7
2	1
3	1,4
4	2
5	2,8
6	4
7	5,7
8	8
9	11,3
10	16
11	22,6
12	32
13	45,3
14	64
15	90,5

Example: if the dim time 0-100% is set to 20 sec and a change in dim value from 30-100% is requested (70%*20sec = 14sec), the resulting EVG fade time would be 16 sec (the closest value rounded upwards).

Minimum and maximum output values can be defined as well as the turn-on dimming value. The maximum output value will be used as turn-on dimming value if the turn-on dimming value is set higher than the maximum output value.

It is possible to configure turn-on and turn-off permissions for both the 4-bit dimming command and the 8-bit value command.

The parameter "Duration in standby before off" should only be used for DALI broadcast. The DALI groups can be turned off instantaneously regardless of the duration in standby parameter. If the DALI gateway receives "DALI broadcast: Switch" - Off (obj. 88), then all the lamps will be dimmed down to the minimum output dim value until the standby duration elapses. The DALI groups can be controlled during the standby duration, but will be turned off when the timer elapses.

7.2 DALI broadcast object list

Table 6 – Communication objects for the DALI interface.

Obj.	Object name	Description	Size, flags, DPT
88	DALI broadcast: Switch	The broadcast switch object for the DALI interface. This object will turn all attached DALI EVGs on and off.	1 Bit -WC--- [1.1] DPT_Switch
89	DALI broadcast: Dimming	The broadcast dimming object for the DALI interface. This object will dim all the attached DALI EVGs based on the 4-bit dimming object.	4 Bit -WC--- [3.7] DPT_Control_Dimming
90	DALI broadcast: Value	The broadcast value object for the DALI interface. This object will dim all the attached DALI EVGs based on a 0-100% value.	1 Byte -WC--- [5.1] DPT_Scaling
91	DALI broadcast: Switch status	The broadcast switch status object will show the on/off status of the DALI broadcast command (groups can be turned on and off without updating this object).	1 Bit R-CT-- [1.1] DPT_Switch
92	DALI broadcast: Value status	The broadcast dimming value status object will show the dim percentage of the DALI broadcast command (groups can be dimmed without updating this object).	1 Byte R-CT-- [5.1] DPT_Scaling
93	DALI broadcast: Permanent (burn in lamps)	Permanent On command for the DALI interface. This object can be used to burn in the lamps after installation or bulb change. The lamps will be set to 100% regardless of the maximum dim value specified in parameters. The DALI group and broadcast commands are disabled when this object is set high.	1 Bit -WC--- [1.2] DPT_Bool
94	DALI broadcast: Force on	Force on command for the DALI interface. This object will force all the lamps on to the maximum dim value. The DALI group and broadcast commands are disabled when this object is set high.	1 Bit -WC--- [1.2] DPT_Bool
95	DALI broadcast: Force off	Force off command for the DALI interface. This object will force all the lamps off, unless when in permanent mode (obj. 93). The DALI group and broadcast commands are disabled when this object is set high.	1 Bit -WC--- [1.2] DPT_Bool
98	DALI broadcast: Lamp fault	Indicates lamp or EVG failure of one or more lamps connected to the DALI interface. The status for each EVG is fetched periodically with a few minutes delay.	1 Bit R-CT-- [1.2] DPT_Bool

7.3 DALI dimming curve types

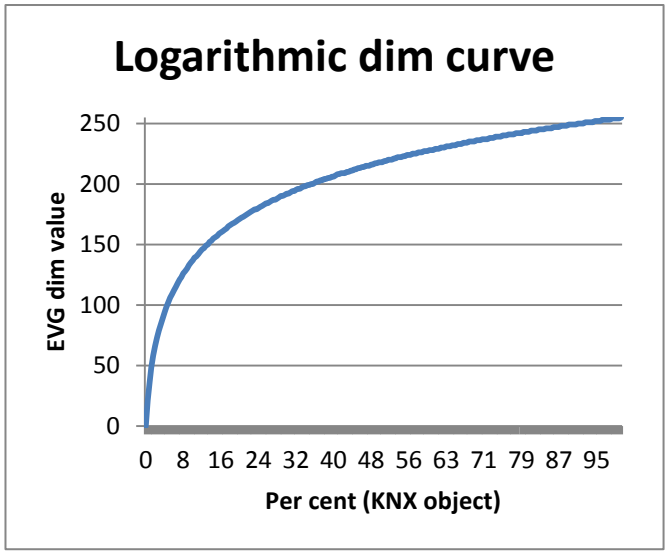
The DALI interface can be configured to use one of three dimming curve types: raw, logarithmic and optimised linear.

The **raw value curve** type will do no modification of the requested object dim value except that the value 255 will be set to 254 to avoid the DALI EVGs to mask the dimming request (see the DALI standard).

Logarithmic dimming curve will calculate the DALI dim value from the requested percentage value as shown in Table 7. If 50% dimming is requested by KNX object, the DALI interface will set the EVG dim value to 218.

Table 7 Logarithmic dim curve

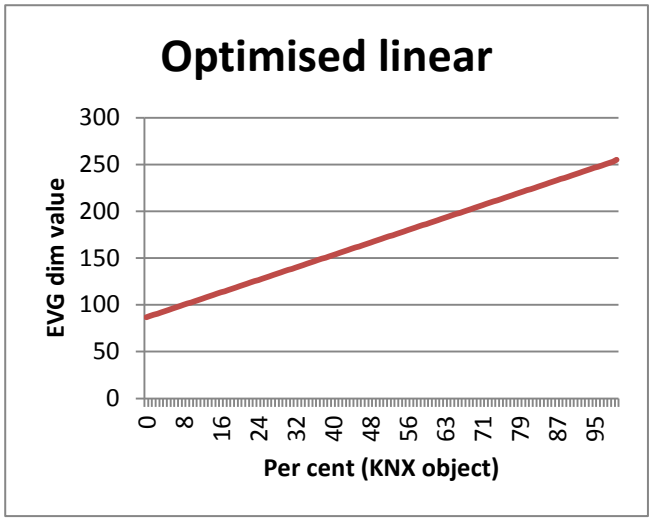
Per cent (KNX)	Byte value (KNX)	Dim value (DALI)
5,1	13	102
10,2	26	137
15	38	156
20,1	51	171
25,2	64	183
30,3	77	192
35	89	200
39,8	101	206
44,9	114	213
50	127	218
55,1	140	224
60,2	153	228
65	165	232
70,1	178	236
75,2	191	240
80,3	204	243
85	216	246
90,2	229	249
94,9	241	252
100	254	254



Optimised linear dim curve will linearize the DALI dim values as shown in Table 8. The EVGs do not usually respond to dim values below 85. The optimised linear dim curve will start at 85 and progress linearly to 254 as the highest value. The DALI dim value will be set to 171 if 50% dim value is requested by the KNX object.

Table 8 Optimised linear dim curve

Per cent (KNX)	Byte value (KNX)	Dim value (DALI)
5,1	13	95
10,2	26	103
15	38	111
20,1	51	120
25,2	64	129
30,3	77	137
35	89	145
39,8	101	153
44,9	114	162
50	127	171
55,1	140	179
60,2	153	188
65	165	196
70,1	178	204
75,2	191	213
80,3	204	222
85	216	230
90,2	229	238
94,9	241	246
100	254	254



7.4 DALI group objects

EVGs with group addresses from 0 to 3 can be controlled by KNX switch, dimming and value objects. The DALI groups will have the same maximum, minimum, on/off permissions and turn-on dim settings as DALI Broadcast (see Figure 8 – DALI interface parameters).

DALI broadcast commands for switch, dim, value, permanent and force on/off will override the group commands. In regular mode where permanent, force on and force off are disabled, the objects for the DALI groups will control the lamps.

The constant light controller (see chapter 5) can also control either DALI broadcast or the DALI group 0 and 1. If the constant light controller is enabled and individual control of light is also needed, be sure to link the appropriate constant light controller "disable" object.

Example – Combined constant light control and control by groups:

The KNX MultiLight can control both the up-light and down-light individually for ceiling suspended luminaires. The up-light EVG should be assigned to DALI group 0 and the down-light EVG to DALI group 1 by the function DALI tool application or other DALI configuration tools.
In this case, the parameter "Constant light controller output type" should be set to "DALI group 0 and 1". The controller will use the output value with offset (higher output value) to control the down-light (group 1). The up-light (group 0) will be controlled with the lowest output value. The result is that the up-light will reach 100% output only if the down-light can't provide sufficient light.

Table 9 – Communication objects for the DALI groups.

Obj.	Object name	Description	Size, flags, DPT
99	DALI group 0: Switch	The DALI group switch object. This object will turn the attached DALI EVGs assigned to group 0 on and off.	1 Bit -WC--- [1.1] DPT_Switch
100	DALI group 0: Dimming	The DALI group dimming object. This object will dim the attached DALI EVGs assigned to group 0.	4 Bit -WC--- [3.7] DPT_Control_Dimming
101	DALI group 0: Value	The DALI group value object. This object will dim the attached DALI EVGs assigned to group 0 to the given value in per cent.	1 Byte -WC--- [5.1] DPT_Scaling
102	DALI group 0: Switch status	The DALI group switch status object will show the on/off status of the DALI EVGs assigned to group 0.	1 Bit R-CT-- [1.1] DPT_Switch
103	DALI group 0: Value status	The DALI group dimming value status object will show the dim percentage of the DALI EVGs assigned to group 0.	1 Byte R-CT-- [5.1] DPT_Scaling
104	DALI group 1: Switch	The DALI group switch object. This object will turn the attached DALI EVGs assigned to group 1 on and off.	1 Bit -WC--- [1.1] DPT_Switch

105	DALI group 1: Dimming	The DALI group dimming object. This object will dim the attached DALI EVGs assigned to group 1.	4 Bit -WC--- [3.7] DPT_Control_Dimming
106	DALI group 1: Value	The DALI group value object. This object will dim the attached DALI EVGs assigned to group 1 to the given value in per cent.	1 Byte -WC--- [5.1] DPT_Scaling
107	DALI group 1: Switch status	The DALI group switch status object will show the on/off status of the DALI EVGs assigned to group 1.	1 Bit R-CT-- [1.1] DPT_Switch
108	DALI group 1: Value status	The DALI group dimming value status object will show the dim percentage of the DALI EVGs assigned to group 1.	1 Byte R-CT-- [5.1] DPT_Scaling
109	DALI group 2: Switch	The DALI group switch object. This object will turn the attached DALI EVGs assigned to group 2 on and off.	1 Bit -WC--- [1.1] DPT_Switch
110	DALI group 2: Dimming	The DALI group dimming object. This object will dim the attached DALI EVGs assigned to group 2.	4 Bit -WC--- [3.7] DPT_Control_Dimming
111	DALI group 2: Value	The DALI group value object. This object will dim the attached DALI EVGs assigned to group 2 to the given value in per cent.	1 Byte -WC--- [5.1] DPT_Scaling
112	DALI group 2: Switch status	The DALI group switch status object will show the on/off status of the DALI EVGs assigned to group 2.	1 Bit R-CT-- [1.1] DPT_Switch
113	DALI group 2: Value status	The DALI group dimming value status object will show the dim percentage of the DALI EVGs assigned to group 2.	1 Byte R-CT-- [5.1] DPT_Scaling
114	DALI group 3: Switch	The DALI group switch object. This object will turn the attached DALI EVGs assigned to group 3 on and off.	1 Bit -WC--- [1.1] DPT_Switch
115	DALI group 3: Dimming	The DALI group dimming object. This object will dim the attached DALI EVGs assigned to group 3.	4 Bit -WC--- [3.7] DPT_Control_Dimming
116	DALI group 3: Value	The DALI group value object. This object will dim the attached DALI EVGs assigned to group 3 to the given value in per cent.	1 Byte -WC--- [5.1] DPT_Scaling
117	DALI group 3: Switch status	The DALI group switch status object will show the on/off status of the DALI EVGs assigned to group 3.	1 Bit R-CT-- [1.1] DPT_Switch
118	DALI group 3: Value status	The DALI group dimming value status object will show the dim percentage of the DALI EVGs assigned to group 3.	1 Byte R-CT-- [5.1] DPT_Scaling

7.5 DALI emergency light

Emergency light function for checking the status of the emergency lights can be activated by enabling the parameter "DALI emergency light" (see Figure 8). The emergency light functionality includes:

- Manual start and stop of emergency function test and emergency duration test
- Automatic function- and discharge testing
- Objects for mode-, status- and fault indication
- Battery charge in per cent
- Length of duration test in minutes

The status of the DALI emergency lights will be updated every 2 minutes. Battery discharge data and test duration will be updated as long as all of the connected emergency lamps can supply this data. If more than one emergency lamp is connected to the KNX MultiLight, the lowest battery charge and test duration will be shown. The mode, status and failure objects will show the combined information from the connected emergency lamps.

Emergency lamps that can be turned on and off will respond to the DALI Broadcast command. In this case, the broadcast command should not be used and the DALI emergency lamps should be assigned to DALI group 3. The regular DALI lamps should be assigned to group 0-2 according to need.

7.5.1 DALI Emergency object list

Table 10 – Communication objects for the DALI Emergency function

Obj.	Object name	Description	Size, flags, DPT
119	DALI emergency: Command	Start or Stop emergency light tests (function or duration) based on the given enumeration. The running test will be aborted before the new test is started. 0 = Stop Test 1 = Start Function Test 2 = Start partial duration Test 3 = Start duration Test 4 = Start Query Battery	1 Byte -WC--- [5.10] DPT_Value_1_Ucount
120	DALI emergency: Fault status	Indication of emergency lighting fault. This object is 1 if any of the DALI object "Emergency failure" (obj. 125) bits are set.	1 Bit R-CT-- [1.2] DPT_Bool
121	DALI emergency: Duration of last test (min)	Duration of the last successful battery test in minutes.	2 Bytes R-CT-- [7.006] DPT_TimePeriodMinH

122	DALI emergency: Battery charge (%)	This object shows the battery charge in per cent. The battery charge value is set to 255 (DALI mask value) if the emergency lamp cannot give the battery charge data. The value 254 is 100% battery charge according to the DALI battery charge	1 Byte R-CT-- [5.1] DPT_Scaling
123	DALI emergency: Emergency status	Shows the DALI emergency status (response to DALI command 253) for the attached emergency gear. Bit 0: Inhibit mode (0 = No) Bit 1: Function test done and result valid (0 = No) Bit 2: Duration test done and result valid (0 = No) Bit 3: Battery fully charged (0 = In progress) Bit 4: Function test request pending (0 = No) Bit 5: Duration test request pending (0 = No) Bit 6: Identification active (0 = No) Bit 7: Physically selected (0 = No)	1 Byte R-CT--
124	DALI emergency: Emergency mode	Shows the DALI emergency mode (response to DALI command 250) for the attached emergency gear. Bit 0: Rest mode active (0 = No) Bit 1: Normal mode active (0 = No) Bit 2: Emergency mode active (0 = No) Bit 3: Extended emergency mode active (0 = No) Bit 4: Function test is in progress; (0 = No) Bit 5: Duration test is in progress (0 = No) Bit 6: Hardwired inhibit is active (0 = Not active) Bit 7: Hardwired switch is on (0 = Off)	1 Byte R-CT--
125	DALI emergency: Emergency failure	Shows the DALI emergency failure status (response to DALI command 252) for the attached emergency gear. Bit 0: Circuit failure (0 = No) Bit 1: Battery duration failure (0 = No) Bit 2: Battery failure (0 = No) Bit 3: Emergency lamp failure (0 = No) Bit 4: Function test max. delay exceeded (0 = No) Bit 5: Duration test max. delay exceeded (0 = No) Bit 6: Function test failed (0 = No) Bit 7: Duration test failed (0 = No)	1 Byte R-CT--

8 Thermostat

8.1 Regulator functionality

The thermostat can control both heating- and cooling systems either by automatic switching between heating and cooling mode or controlled by object. The regulator outputs can be configured either as ON/OFF control or continuous (0-100%) based on a PI regulator.

Regulator capability:

- Four modes of operation: comfort, standby, night and frost/heat protection
- On/off or 0-100% control for heating and cooling system
- Combined heating- and cooling regulator with automatic or manual switch-over
- Additional heating or cooling stage with on/off control or PI control
- Automatic transmission of the regulator outputs on change or cyclically every 40 minutes.
- Room temperature measurement from the user panel or movement sensor
- The temperature sensor can be calibrated (+/- 12.6K) in steps of 0.1 K with ETS parameter
- The temperature sensor can be internally calibrated (+/-1.5K) from the user panel
- The actual temperature and the setpoint temperature can be sent to the bus on change or cyclically
- Feedback from the regulator if heating or cooling mode is active

Setpoint values:

- The base temperature setpoint is defined in parameter ("Base setpoint in ºC") and is shown by object "Thermostat: Base setpoint". This object can also be configured for write access (selectable to be stored in permanent memory or not)
- The working regulator setpoint is shown by the object "Thermostat – Actual setpoint".
- The base setpoint can only be set to whole degrees (e.g. 21 or 22 °C)
- Parameters for heating and cooling temperature setpoints for standby and night mode
- Setpoints for the additional heating/cooling switching stage are derived from the values from the basic stage with an additional stage offset
- Additional heating- and cooling PI-regulators can be activated based on the PI-regulator output values of basic heating- and cooling
- Setpoint value shifting (local adjustment +/-3K) by local operation on the user panel or by object. The step size is 0.5K
- The reduced or increased temperatures for standby and night mode can be set in steps of 0.1K
- Frost/heat protection: frost protection set to 10 ºC (not adjustable) and heat protection set to 35 ºC (not adjustable)

8.2 Operational modes

The KNX MultiLight has 4 operational modes; Comfort, Stand-by, Night and Frost/heat protection. The active mode is either selected based on the three 1-bit objects "Comfort Mode", "Night Mode" and "Frost/heat protect" or based on the "Thermostat: Operation mode HVAC". The table below shows which mode is active based on the status of these three objects (X = don't care).

Table 11 – Resulting regulator modes

	Comfort Mode (obj. 9)	Night Mode (obj. 10)	Frost/ heat (obj. 11)	Operation mode object value (obj. 12)
Comfort Mode	1	X	0	1
Standby	0	0	0	2
Night Mode	0	1	0	3
Frost/heat protect	X	X	1	4

8.3 Parameters

8.3.1 Comfort mode

The thermostat is using the "Base setpoint in ºC" as the regulator setpoint for the heating regulator in comfort mode. The heating regulator starts to heat if the actual temperature falls below the base setpoint minus the parameter value for "Low hysteresis in 0.1K".

The heating regulator will turn off the heat when the actual temperature rises above the base setpoint. The regulator will turn off the heat at 21.0 ºC with the parameter settings shown in Figure 9.

The cooling system will turn on at the temperature "Base setpoint in ºC" + "Dead zone between heating and cooling in 0.1K" + "High hysteresis in 0.1K". The cooling system will be turned off when the temperature falls below the base setpoint + dead zone. The cooling system will be turned off at 21.0 + 2.0 = 23ºC with the parameter settings shown Figure 9.

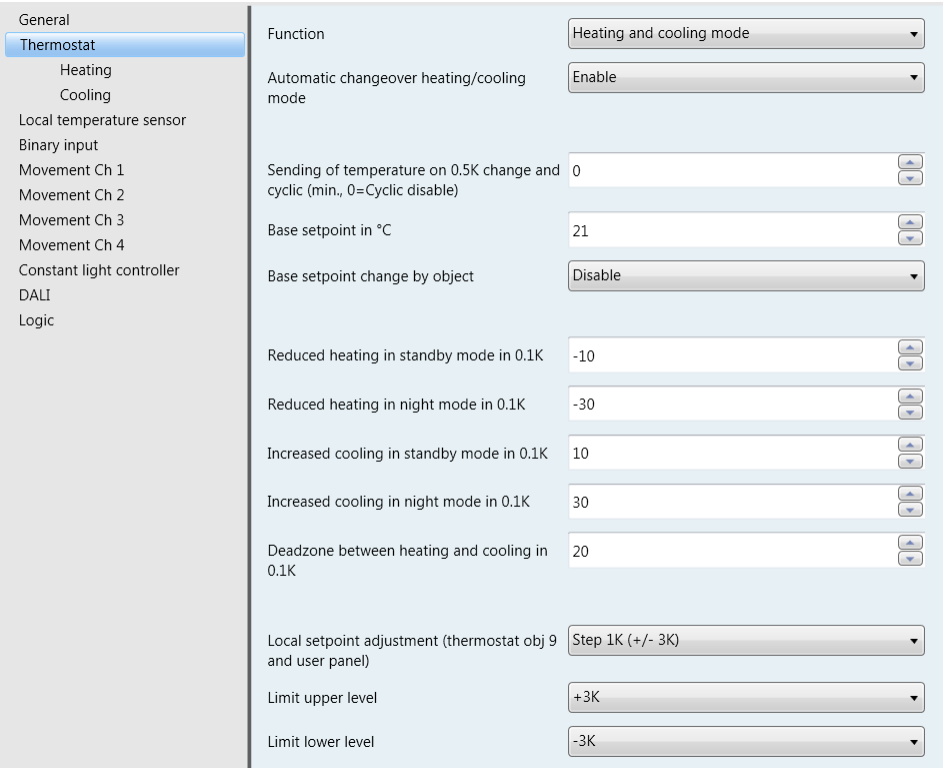


Figure 9 - Thermostat settings

It is the value from the object "Actual setpoint" that the regulator uses as the temperature setpoint. The "Actual setpoint" will change depending on the "Base setpoint", the active mode, if the regulator is in heating- or cooling mode and the local temperature adjustment.

8.3.2 Standby mode

The regulator goes to standby mode if the three communication objects "Comfort Mode", "Night Mode" and "Frost/heat protect" are low. The "Actual setpoint" in this mode will be set to "Base setpoint" + "Reduced Heating in standby mode". The "Actual setpoint" is set to: 21ºC + (-1.0ºC) = 20ºC for the parameter settings shown in Figure 9.

For the cooling system in standby mode the "Actual setpoint" is set 1 degree higher than in comfort mode: 21ºC + 2ºC + 1ºC = 24ºC

The user panel LED indication for the local temperature adjustment and the green comfort mode indicator on the movement detector will be turned off when the regulator goes into standby mode. The LED indication for the active heating- and cooling system will still be active.

8.3.3 Night mode

The regulator will go to night mode if only the "Night Mode" object is set high. The temperature setpoint for the heating and cooling systems will change according to the parameters "Reduced Heating in Night mode" and "Increased cooling in Night mode".

For the heating system the "Actual setpoint" is set to: 21ºC + (-3.0ºC) = 18ºC with the parameters shown in Figure 9. For the cooling system the "Actual setpoint" will be: 21ºC + 2ºC + 3ºC = 26ºC

The user panel LED indication for the local temperature adjustment and the green comfort mode indicator on the motion detector will be turned off when the regulator goes into night mode. The LED indication for the active heating- and cooling system will still be active.

8.3.4 Frost/Heat protection

The Frost/Heat protection regulator mode will set fixed temperature setpoints for the heating and cooling regulators. The heating system is turned on if the temperature falls below 10ºC – 0.5ºC hysteresis. The heating system is turned off if the temperature goes above 10ºC.
The cooling system will turn on if the temperature goes above 35ºC + 0.5ºC hysteresis and will turn off again when the temperature goes below 35ºC.

The user panel LED indication for the local temperature adjustment and the green comfort mode indicator on the movement detector will be turned off when the regulator goes into Frost/heat protection mode. The LED indication for the heating- and cooling system alternates between heating and cooling every second.

8.3.5 Basic heating and cooling stage

See the description of the different regulator modes in sections 8.3.1 to 8.3.4.

8.3.6 Additional heating and cooling stage

The KNX MultiLight can control an additional heating and/or cooling system with ON/OFF control or continuous PI control. The temperature limits for the additional heating- and cooling systems can be defined by parameters, see Figure 10 and Figure 11.

The additional heating stage switch output will be turned on if the room temperature has dropped 2ºC below the parameter settings in the thermostat parameter window, see Figure 9. The hysteresis for the additional heating stage is fixed to +0.5ºC.
The additional heating stage will turn on if the temperature falls below 21ºC - 2.0ºC = 19ºC and turn off at 21ºC - 2.0ºC + 0.5ºC = 19.5ºC in comfort mode according to the parameter settings shown in Figure 9 and Figure 10.

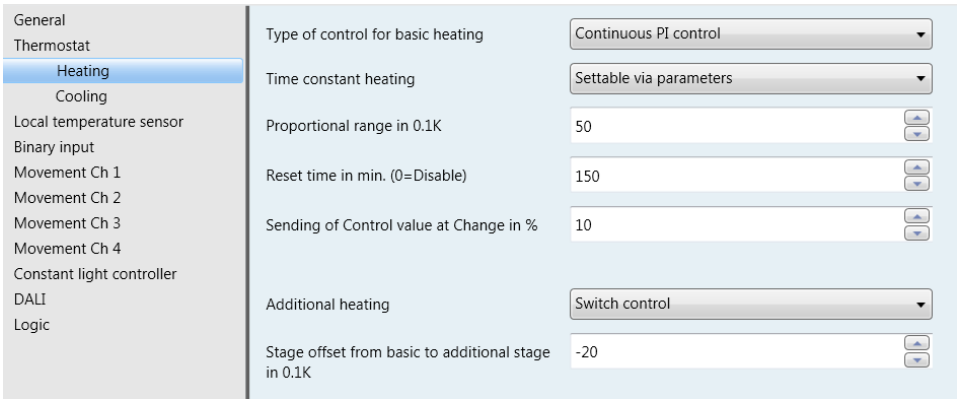


Figure 10 - Heating parameter windows

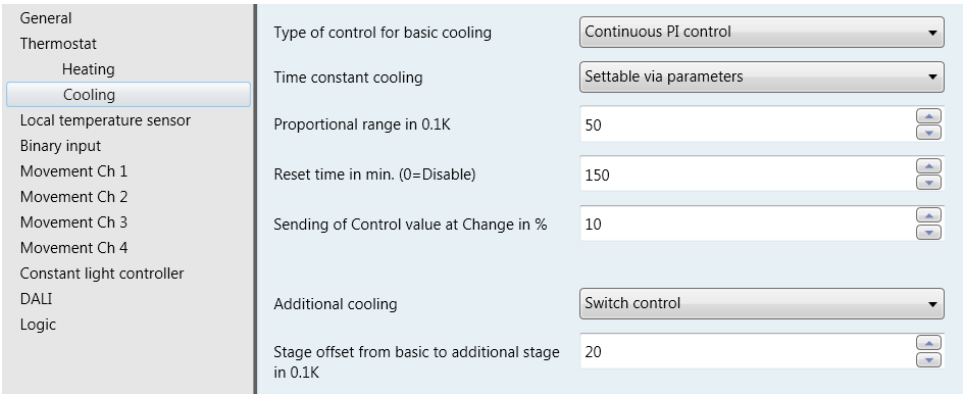


Figure 11 - Cooling parameter windows

The additional cooling stage switch output will be turned on based on the temperature offset parameter "Stage offset from basic to additional stage", as shown in Figure 11.
The additional stage cooling will turn on if the temperature rises above 23ºC + 2.0ºC = 25ºC for comfort mode (see parameters Figure 9 and Figure 13). The additional stage will turn off at 23ºC + 2.0ºC - 0.5ºC = 24.5ºC

8.3.7 Additional continuous heating and cooling stage

Additional stage can be configured with continuous PI control as shown in Figure 12 and Figure 13. The additional stage output will activate when the basic stage continuous output value reaches the parameter: Threshold for activating additional heating or cooling. The setpoint for the additional stage continuous PI control is the same as the basic setpoint.

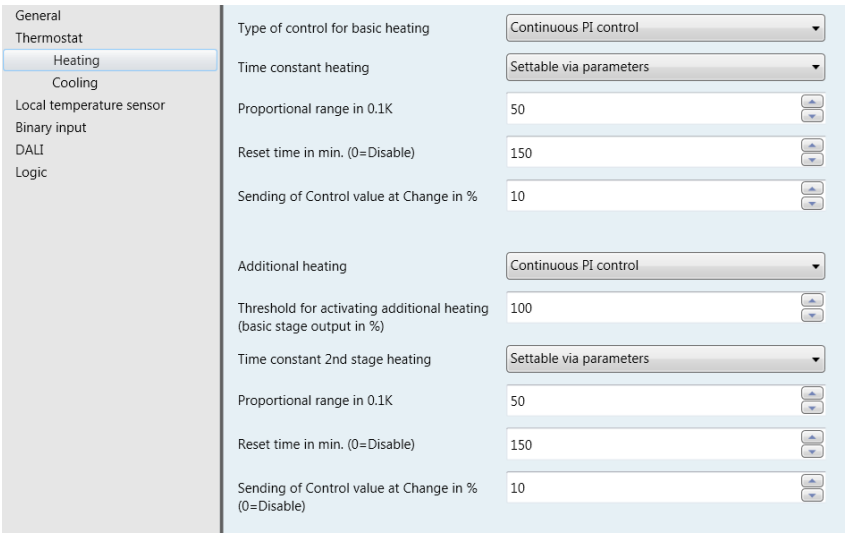


Figure 12 – Additional heating parameter windows, continuous control

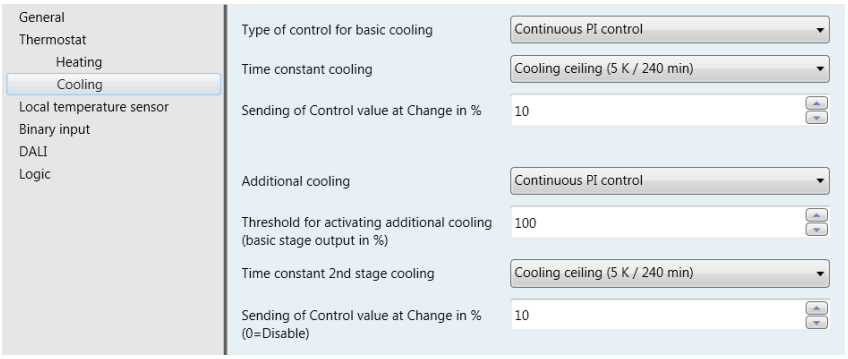


Figure 13 – Additional cooling parameter windows, continuous control

8.4 Local temperature adjustment

The temperature setpoint can be adjusted both by the communication object "Thermostat: Local adjustment of temp offset" (obj. 8), "Thermostat: Local adjustment of temp offset (step)" and via the Reed user panel (art.no. 430xx). In addition, a combination of movement sensor 52001 and IR Remote control 52801 allows wireless local adjustment of temperature. The local adjustment object can adjust the actual temperature setpoint by +/-10ºC.

The user panel and IR remote temperature adjustment is by default +/-3ºC, but can be limited by parameters. The adjustment done on the panel will update the "Thermostat: Local adjustment of temp offset" object.
The heating system, in comfort mode and with a local adjustment of -2, will be turned on at 20.5ºC - 2ºC = 18.5ºC and off at 19.0ºC with the parameters shown in Figure 9.
The cooling system will be turned on at 21ºC - 2ºC + 2ºC + 0.5ºC = 21.5ºC and off if the temperature drops below 21.0ºC.

The temperature sensor in the user panel includes a filtering algorithm that will eliminate temperature rise after the user panel has been touched. The temperature measurement will remain unchanged for 3 to 8 minutes after the buttons on the user panel have been operated.

It is possible to change the upper and lower limit of the local temperature offset, for example to +3 to -1C, +1.5C to -0.5C and +0.5 to -0C. The LED indicating +3 to -3 on the user panel will still show the full scale, so the user will not notice the limitation.

If the user panel or the combined movement and temperature sensor is removed, all regulator outputs will be set to "0", and the actual temperature object is set to 0ºC. The "Self-test status" object will indicate the error and will be transmitted as "1".

8.5 Regulator function

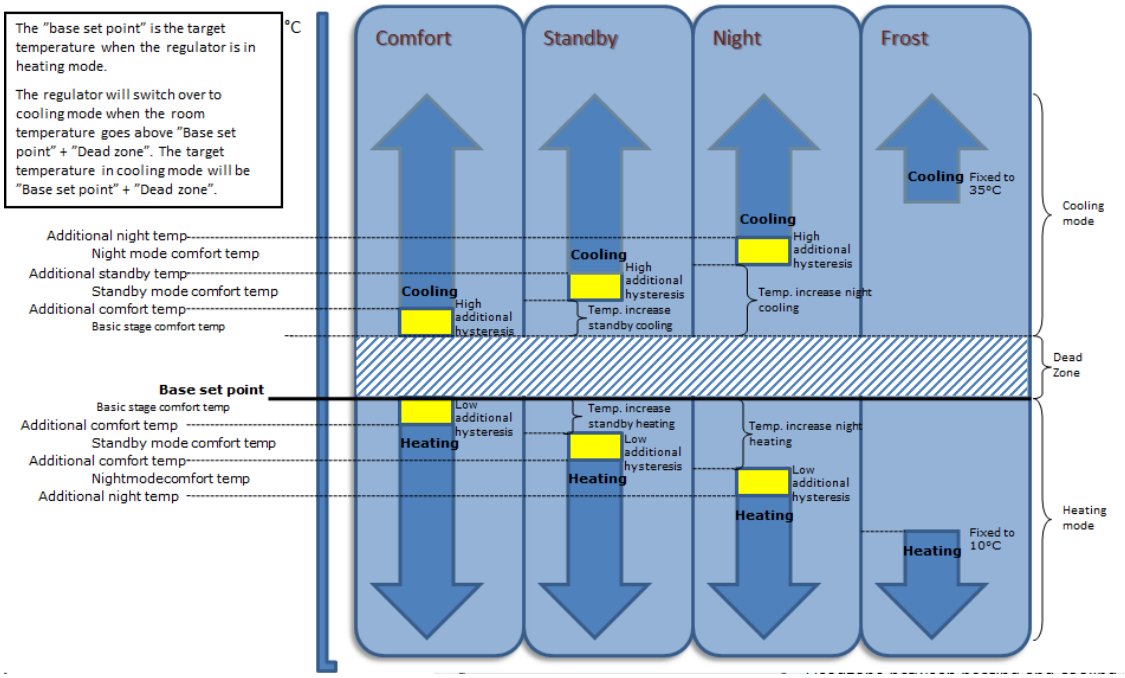


Figure 14 - Asymmetric regulator functionality

8.6 PI Regulator

The KNX MultiLight thermostat can control heating and cooling systems with Pulse-Width-Modulation. The communication object for the PWM control value output is a 1-byte 0-100% of the type DPT5.001. The control value will automatically be transmitted every 40 minutes and can also be transmitted when the value has changed a specific percentage, see Figure 15.

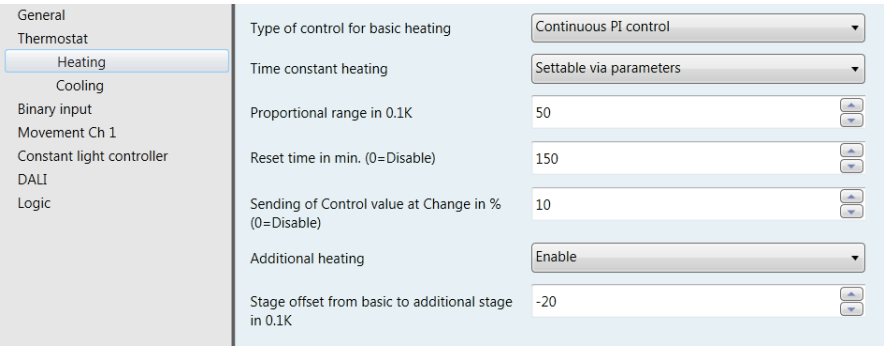


Figure 15 - Heating PI-regulator

The PI-regulator is configured with a proportional factor (K_p) and a reset time (T_i). The equation for the regulator output is shown in (3).

The integration of the error for each regulator evaluation is substituted by the step number (30 second increments) multiplied with the last error function: e(n)·n divided by the time constant, see equation (3)

The proportional factor K_p :

$$K_P = \frac{1}{proportional\_range} \quad (1)$$

The error function e(n):

e(n) = set_point - actual_temperature (2)

The regulator output equation:

$$u(n) = K_P\left[e(n) + \frac{e(n)\cdot n}{2\cdot T_i}\right] = K_P \cdot e(n)\left[1 + \frac{n}{2\cdot T_i}\right] \quad (3)$$

Example: The regulator function (3) is evaluated every half minute with the parameters for Electric heating (4K/100min) and a constant error function of e(n)=set_point-actual_temp=23-21=2. The calculated output is shown in equation (4), where n is the number of half minute intervals:

$$u(n) = \frac{1}{4}(23-21)\left[1+\frac{n}{2\cdot 100}\right] \quad (4)$$

The graph for the regulator output is shown in Figure 16.

The time factor n will be set to 0 when the error function e(n) becomes 0 or less. The regulator output is capped to maximum 1.0, which is equivalent to 100% for the control value communication object.

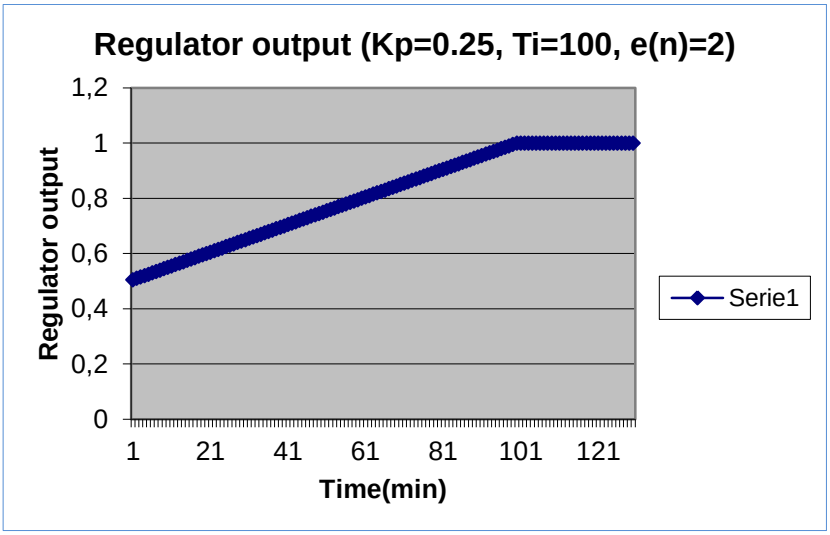


Figure 16 - Regulator output for constant e(n)=2

8.7 Object list

Table 12 - Object list for the Thermostat

Obj.	Object name	Description	Size, flags, DPT
4	Thermostat: Actual local temperature (sensor)	This object shows the measured room temperature (0.1K or 0.5K resolution). This value can also be combined with obj. 5: External temperature. The actual temperature is used as the feedback to the regulator. This object will be sent automatically when the temperature has changed 0.1k or 0.5K or more (defined in parameter). In addition, this object can be set to cyclic sending by parameter. It is only available when the user panel is enabled	2 Bytes R-CT-- [9.1] DPT_Value_Temp
5	Thermostat: External temperature	The external temperature can be weighed from 0 to 100% compared to obj. 4: Actual local temperature.	2 Bytes -WC--- [9.1] DPT_Value_Temp

6	Thermostat: Base setpoint	The base setpoint is the desired temperature in comfort mode (heating). This value is the origin for all the different regulator modes. The object can be set either to read only or read/write by parameter. The updated value can either be stored in EEPROM or in volatile memory. This object can be set to cyclic sending.	2 Bytes RWCT-- [9.1] DPT_Value_Temp
7	Thermostat: Actual setpoint	The actual setpoint value that the regulator is using. This can be either the Comfort-, standby-, frost-temperature with the local adjustment (obj. 8). The object will transmit on change, so the setpoint will be transmitted when the regulator changes mode. This object can be set to cyclic sending by parameter.	2 Bytes R-CT-- [9.1] DPT_Value_Temp
8	Thermostat: Local adjustment of temp offset	The object holds the local adjustment of temperature offset. This object can be updated either from KNX or from the user panel. Maximum adjustment is +/- 3K from the user panel and +/- 10K from the object.	2 Bytes RWCT-- [9.2] DPT_Value_Tempd
9	Thermostat: Local adjustment of temp offset (step)	Step up or down the local temperature offset 1K or 0.5K (set by parameter). Maximum and minimum value can be set by parameter (maximum +/- 3K).	1 Bit -WC--- [1.007] DPT_Step
10	Thermostat: Comfort mode	Sets the regulator in Comfort mode. This mode has 2nd priority.	1 Bit -WC--- [1.2] DPT_Bool
11	Thermostat: Night mode	Sets the regulator in Night mode. This mode has 3rd priority.	1 Bit -WC--- [1.2] DPT_Bool
12	Thermostat: Frost/Heat protecting mode	Sets the regulator in frost/heat protection mode. Frost mode setpoint is permanently at 10°C. Heat protection setpoint is 35°C (fixed limits). This mode has 1st priority.	1 Bit -WC--- [1.2] DPT_Bool
13	Thermostat: Operation mode HVAC	Byte value for setting the HVAC operation mode	1 Byte -WC--- [20.102] DPT_HVACMode
14	Thermostat: Operation mode HVAC feedback	Byte value for indication of the HVAC operation mode	1 Byte R-CT-- [20.102] DPT_HVACMode
15	Thermostat: Control value basic heating Switch	The output of the basic heating regulator. This object is set high if the actual temperature (obj. 4) is lower than obj. 7 “Actual setpoint” - hysteresis. The heating will be turned off when the actual temperature goes above “Actual setpoint”. Cyclic sending every 40 min.	1 Bit R-CT-- [1.1] DPT_Switch
16	Thermostat: Control value basic heating Continuous	The output of the PI regulator with the proportional factor and reset time from the parameter settings. The object can be automatically transmitted based on a %-value change (set by parameter). The integral part can be disabled by setting the reset time parameter to 0, resulting in a P-regulator.	1 Byte R-CT-- [5.1] DPT_Scaling

		Cyclic sending every 40 min.	
17	Thermostat: Control value basic heating Feedback	This object gives the status of the basic heating stage. If the control value for basic heating is 1% or more, this object will be set to “1” and the red heating indication in the user panel and in the motion detector will be lit.	1 Bit R-CT-- [1.1] DPT_Switch
18	Thermostat: Control value add. heating Switch	The additional heating stage is set high if the temperature falls below the basic setpoint - parameter settings for the different modes and local adjustment. Permanent hysteresis: +0,5K. Cyclic sending every 40 min.	1 Bit R-CT-- [1.1] DPT_Switch
18	Thermostat: Control value add. heating Continuous	Output of the additional stage PI regulator with the proportional factor and reset time from the parameter settings. The object can be automatically transmitted based on a %-value change (using set parameter). The threshold for activating the additional stage output can be specified as a %-value of the basic stage PI output (object 16). Additional stage output will activate if the output value from the basic stage PI output exceeds the threshold value specified by parameter. If the basic stage is configured as switch output, the additional stage will activate when the basic stage output activates (object 15). Cyclic sending every 40 min.	1 Byte R-CT-- [5.1] DPT_Scaling
19	Thermostat: Control value basic cooling Switch	The output of the basic cooling regulator. The target cooling temperature in comfort mode will be ”Base setpoint” + ”Dead zone” + regulator mode temperature parameter. This object is set high if the actual temperature (obj. 4) is higher than the target cooling temperature + hysteresis. The cooling will be turned off when the actual temperature (obj. 4) falls below the target cooling temperature. Cyclic sending every 40 min.	1 Bit R-CT-- [1.1] DPT_Switch
20	Thermostat: Control value basic cooling Continuous	The output of the PI regulator with the proportional factor and reset time from parameter settings. The object can automatically be transmitted based on a %-value change (set by parameter). The integral part can be disabled by setting the reset time parameter to 0, resulting in a P-regulator. Cyclic sending every 40 min.	1 Byte R-CT-- [5.1] DPT_Scaling
21	Thermostat: Control value basic cooling Feedback	This object gives the status of the basic cooling stage. If the control value for basic cooling is 1% or more, this object will be set to “1” and the blue cooling indication in the user panel and motion	1 Bit R-CT-- [1.1] DPT_Switch

		detector will be lit.	
22	Thermostat: Control value add. cooling Switch	The additional cooling stage that is set high if the temperature goes above the basic setpoint + dead zone + parameter settings for the different modes. Permanent hysteresis: +0,5K. Cyclic sending every 40 min.	1 Bit R-CT-- [1.1] DPT_Switch
22	Thermostat: Control value add. cooling Continuous	Output of the additional stage PI regulator with the proportional factor and reset time from the parameter settings. The object can be automatically transmitted based on a %-value change (using set parameter). The threshold for activating the additional stage output can be specified as a %-value of the basic stage PI output (object 20). Additional stage output will activate if the output value from the basic stage PI output exceeds the threshold value specified by parameter. If the basic stage is configured as switch output, the additional stage will activate when the basic stage output activates (object 19). Cyclic sending every 40 min.	1 Byte R-CT-- [5.1] DPT_Scaling
23	Thermostat: Heating or Cooling status	Feedback indicating whether the thermostat is in heating mode (true) or cooling mode (false). Can activate heating or cooling mode if the parameter "Automatic changeover heating/cooling mode" is enabled (the W-flag for the object is enabled).	1 Bit R-CT-- [1.1] DPT_Switch

9 Binary inputs

9.1 Parameter

KNX MultiLight has one digital input that can be used as a simple switch, dimming switch or shutter control switch. The simple switch can be either configured as on, off or toggle. Detection of short and long switch operation will be determined for dimming- and shutter switch.

9.1.1 Switch

Switch functionality where the object is high or low depending on the detection of rising or falling edge for the input.

Parameter choices for the Switch-function:
Rising edge – On
Rising edge – Off
Rising edge – Toggle
Rising edge – On, Falling edge – Off
Rising edge – Off, Falling edge – On

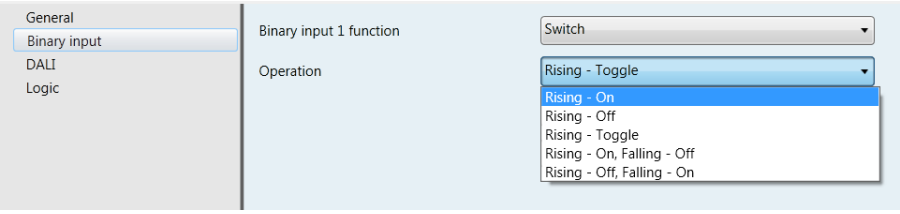


Figure 17 – Parameters for binary input switch

9.1.2 Dimming

Light dimming functionality with one communication object for "Short operation – Switch" and one for "Long operation - dimming".

Parameter choices for the dimming-function:
Reaction short operation: "Off", "On" or "Toggle"
Reaction long operation: "Dim darker", "Dim brighter" or "Dim brighter/darker"

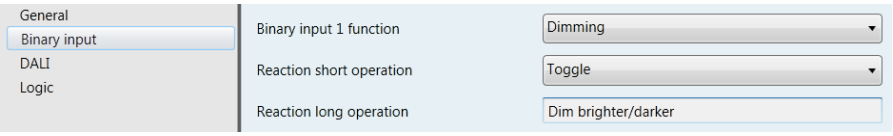


Figure 18 – Default parameters for dimming input function

Please note that the action for long operation is locked to "Dim brighter/darker" if the reaction for short operation is "Toggle"

9.1.3 Shutter

Shutter control with one object for "Short operation - stop/step" and one object for "Long operation - up/down".

Parameter choices for the shutter control:
Reaction short operation: "Stop/Up", "Stop/Down" or "Stop/Toggle Up/Down"
Reaction long operation: "Up", "Down" or "Toggle Up/Down"

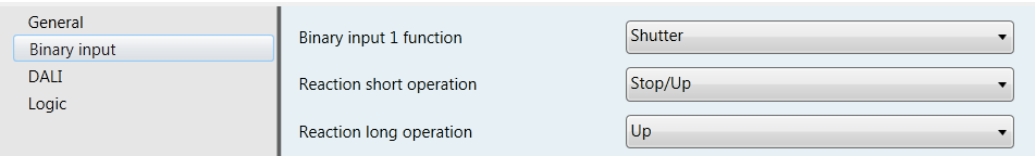


Figure 19 – Shutter input configuration

Please note that the action for long operation is locked to "Toggle Up/Down" if the reaction for short operation is "Stop/Toggle Up/Down".

9.2 Object list and block diagram

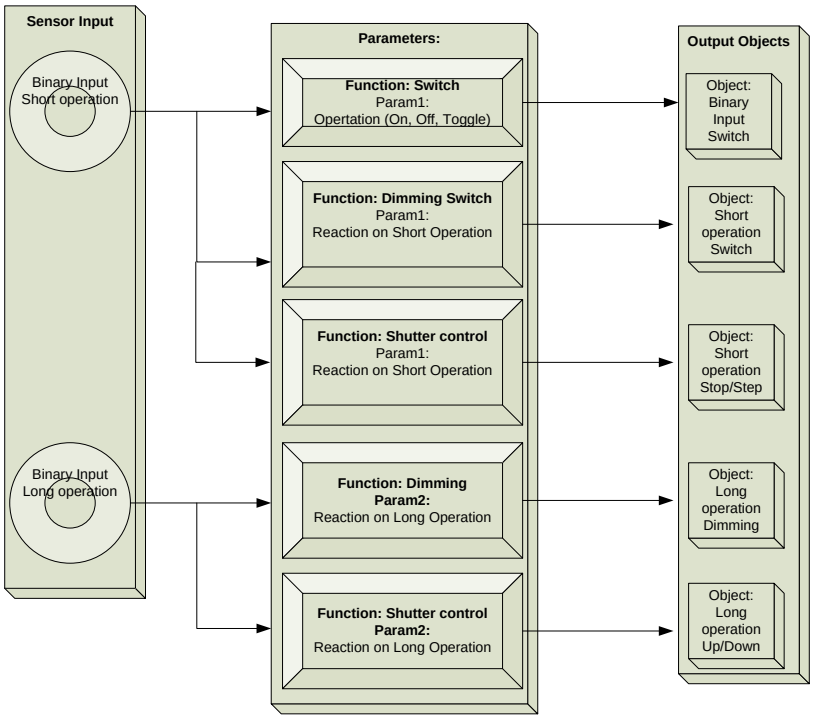


Figure 20 - Block diagram for binary inputs

Table 13 - Object list for Binary Input 1 and Binary Input 2

Obj.	Object name	Description	Size, flags, DPT
24	Binary input 1: Short operation - Stop/Step	This object appears if the input is set to “Shutter”. This object is transmitted if a pulse with duration between 50 ms and 500 ms is detected on external input 1. Action on rising edge. The action can be “Stop/Down”, “Stop/Up” or “Stop/Toggle Up/Down” depending on parameter.	1 Bit -WCT-- [1.007] DPT_Step
24	Binary input 1: Short operation - Switch	This object appears if the input is set to “Dimming”. This object is transmitted if a pulse with duration between 50 ms and 500 ms is detected on external input 1. The action depending on parameter and can be: “on” “off” “toggle"	1 Bit -WCT-- [1.1] DPT_Switch
25	Binary input 1: Switch	This object appears if the input is set to “Switching”. The object is transmitted if the pulse on the external input 1 is at least 50 ms long, with no maximum duration. Action on rising edge and falling edge: Rising – On Rising – Off Rising – Toggle Rising – On, Falling – Off Rising – Off, Falling - On	1 Bit -WCT-- [1.1] DPT_Switch
25	Binary input 1: Long operation - Up/Down	This object appears if the input is set to “Shutter”. If the external input is high for more than 500 ms, then the telegram will move the shutter up, down or toggle (depending on parameter). The action can be: “Up”, “Down” or “Toggle Up/Down”	1 Bit -WCT-- [1.8] DPT_UpDown
25	Binary input 1: Long operation - Dimming	This object appears if the input is set to “Dimming”. If the external input is high for more than 500 ms, then the telegram will dim up, down or up/down. The action can be: Dim darker Dim brighter Dim brighter/darker	4 Bit -WCT-- [3.7] DPT_Control_Dimming

10 Logic

The KNX MultiController includes three logic functions: bitwise logic, 1-byte comparator and timer function. See Figure 21 for the parameter window.

Bitwise logic:
- AND, OR, XOR or XNOR
- The output object will be updated based on the state for the two inputs
- The output can be filtered to only transmit when the output has changed.

Input 1	Input 2	Output AND	Output OR	Output XOR	Output XNOR
0	0	0	0	0	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	1	0	1

Comparator functions:
- 1-Byte highest, lowest, average
- 2-Byte highest, lowest, average
- The comparator output will transmit whenever one of the inputs are updated (no filter function for the comparator)

Timer function:
- The timer works as a staircase function with a reset time that can be set in parameters (in minutes).
- Reset time is settable via communication object.
- When the object "Staircase timer logic: In/out" is set, the timer will start and the object will be set to false after the timer duration has elapsed.

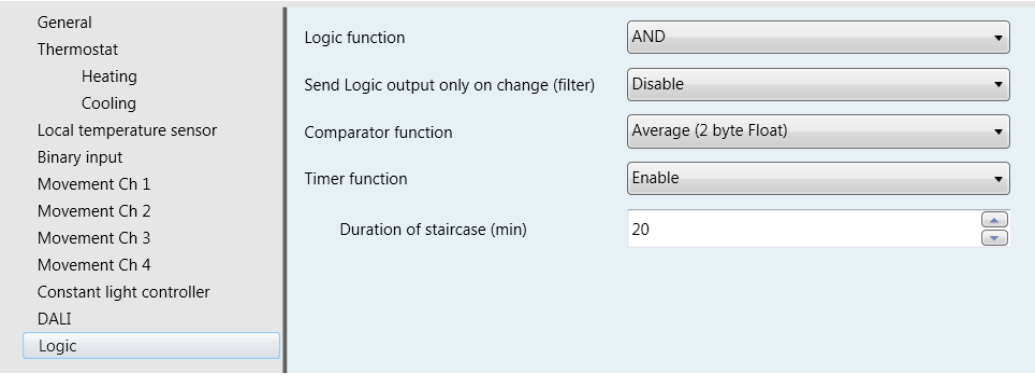


Figure 21 - Parameter window for the logic functions

10.1 Object list

Table 14 - Object list for the logic functions

Obj.	Object name	Description	Size, flags, DPT
126	Binary logic: NXOR Input 1	Input value 1 for NXOR logic function. Available if the NXOR logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
126	Binary logic: OR Input 1	Input value 1 for OR logic function. Available if the OR logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
126	Binary logic: XOR Input 1	Input value 1 for XOR logic function. Available if the XOR logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
126	Binary logic: AND Input 1	Input value 1 for AND logic function. Available if the AND logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
127	Binary logic: OR Input 2	Input value 2 for OR logic function. Available if the OR logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
127	Binary logic: XOR Input 2	Input value 2 for XOR logic function. Available if the XOR logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
127	Binary logic: NXOR Input 2	Input value 2 for NXOR logic function. Available if the NXOR logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
127	Binary logic: AND Input 2	Input value 2 for AND logic function. Available if the AND logic function is selected.	1 Bit -WC--- [1.2] DPT_Bool
128	Binary logic: NXOR Output	Result of the NXOR function based on the two input values. Available if the NXOR logic function is selected.	1 Bit R-CT-- [1.2] DPT_Bool
128	Binary logic: OR Output	Result of the OR function based on the two input values. Available if the OR logic function is selected.	1 Bit R-CT-- [1.2] DPT_Bool
128	Binary logic: XOR Output	Result of the XOR function based on the two input values. Available if the XOR logic function is selected.	1 Bit R-CT-- [1.2] DPT_Bool
128	Binary logic: AND Output	Result of the AND function based on the two input values. Available if the AND logic function is selected.	1 Bit R-CT-- [1.2] DPT_Bool
129	Comparator logic: Input 1	Input value 1 for the 1-byte comparator function. Available if one of the 1-byte comparator functions is selected.	1 Byte -WC--- [5.1] DPT_Scaling
129	Comparator logic: Input 1	Input value 1 for the 2-byte comparator function. Available if one of the 2-byte comparator functions is selected.	2 Bytes -WC--- [9.1] DPT_Value_Temp
130	Comparator logic: Input 2	Input value 2 for the 1-byte comparator function. Available if one of the 1-byte comparator functions is selected.	1 Byte -WC--- [5.1] DPT_Scaling

130	Comparator logic: Input 2	Input value 2 for the 2-byte comparator function. Available if one of the 2-byte comparator functions is selected.	2 Bytes -WC--- [9.1] DPT_Value_Temp
131	Comparator logic: Output lowest	Comparator output value for the lowest 1-byte value of input 1 and input 2. Available only if the "Lowest (1-byte)" comparator function is selected.	1 Byte R-CT-- [5.1] DPT_Scaling
131	Comparator logic: Output lowest	Comparator output value for the lowest 2-byte value of input 1 and input 2. Available only if the "Lowest (2-byte)" comparator function is selected.	2 Bytes R-CT-- [9.1] DPT_Value_Temp
131	Comparator logic: Output highest	Comparator output value for the highest 1-byte value of input 1 and input 2. Available only if the "Highest (1-byte)" comparator function is selected.	1 Byte R-CT-- [5.1] DPT_Scaling
131	Comparator logic: Output highest	Comparator output value for the highest 2-byte value of input 1 and input 2. Available only if the "Highest (2-byte)" comparator function is selected.	2 Bytes R-CT-- [9.1] DPT_Value_Temp
131	Comparator logic: Output average	Comparator output value for the 1-byte average value of input 1 and input 2. Available only if the "Average (1-byte)" comparator function is selected.	1 Byte R-CT-- [5.1] DPT_Scaling
131	Comparator logic: Output average	Comparator output value for the 2-byte average value of input 1 and input 2. Available only if the "Average (2-byte)" comparator function is selected.	2 Bytes R-CT-- [9.1] DPT_Value_Temp
132	Staircase timer logic: In/Out	Start the staircase timer by writing a "1" to this object. The object will transmit "0" when the staircase timer elapses.	1 Bit -WCT-- [1.2] DPT_Bool
133	Staircase timer logic: Change duration	Change the timer value for the Staircase function. The value is stored in volatile memory.	2 Bytes RWC-U- [7.005] DPT_TimePeriodSec

11 Mechanical dimensions

The KNX MultiLight is shown in Figure 22, movement sensor in Figure 23 and Reed user panel in Figure 24.

Figure 22 - Mechanical dimensions of the MultiLight Dali (44002) in mm (HxWxL: 22 x W 30 x L 185)

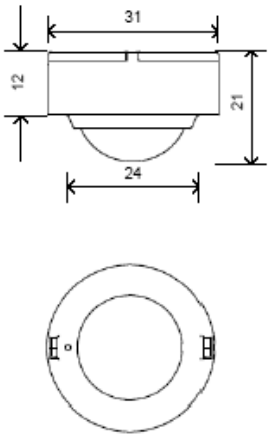


Figure 23 - Mechanical dimensions of 2Sens ML mini (42001) in mm (Ø31x21)

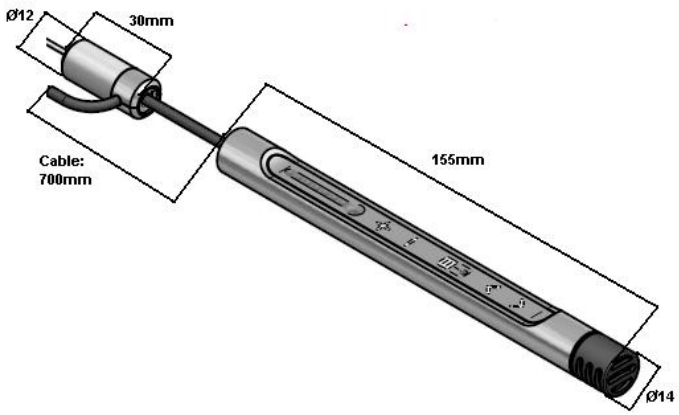
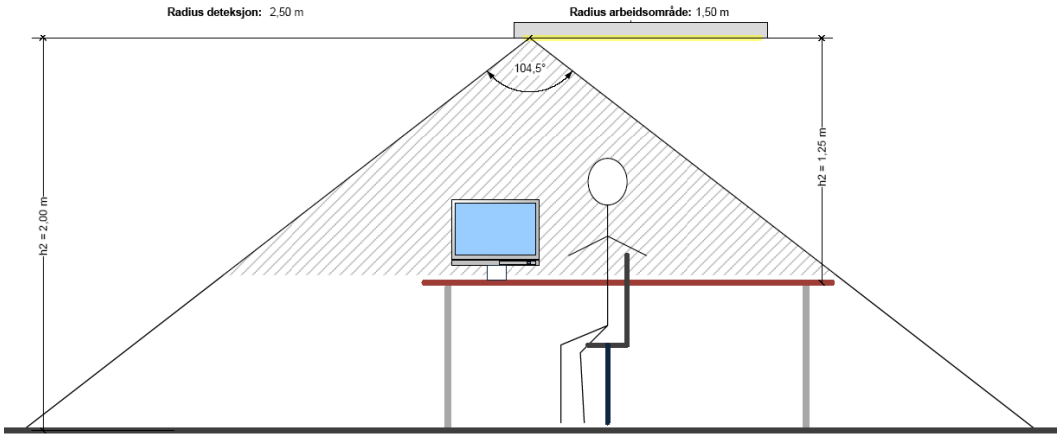


Figure 24- Mechanical dimensions of Reed MC free (231xx) user panel

11.1 Detection area movement sensor (2Sens ML mini)



11.2 Connector pin-out

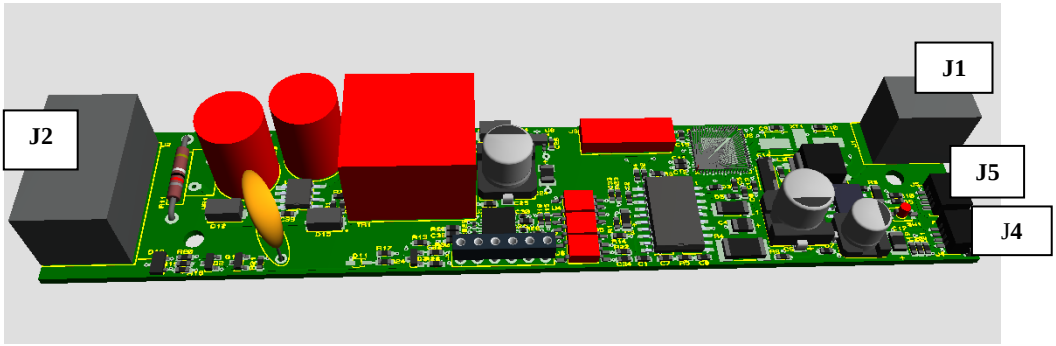


Table 15 – 6pin Wago connector for mains, DALI and digital input (J2)

Signal	Pin number
Line	1
Neutral	2
Digital input signal	3
Digital input common	4
DALI -	5
DALI +	6

Table 16 – 2pin Wago connector (J1)

Signal	Pin number
KNX -	1
KNX +	2

Table 17 – 4pin Molex connector (two parallel connectors J4 and J5)

Signal	Pin number
+3.7V	1
0-V	2
Com	3
+20V	4

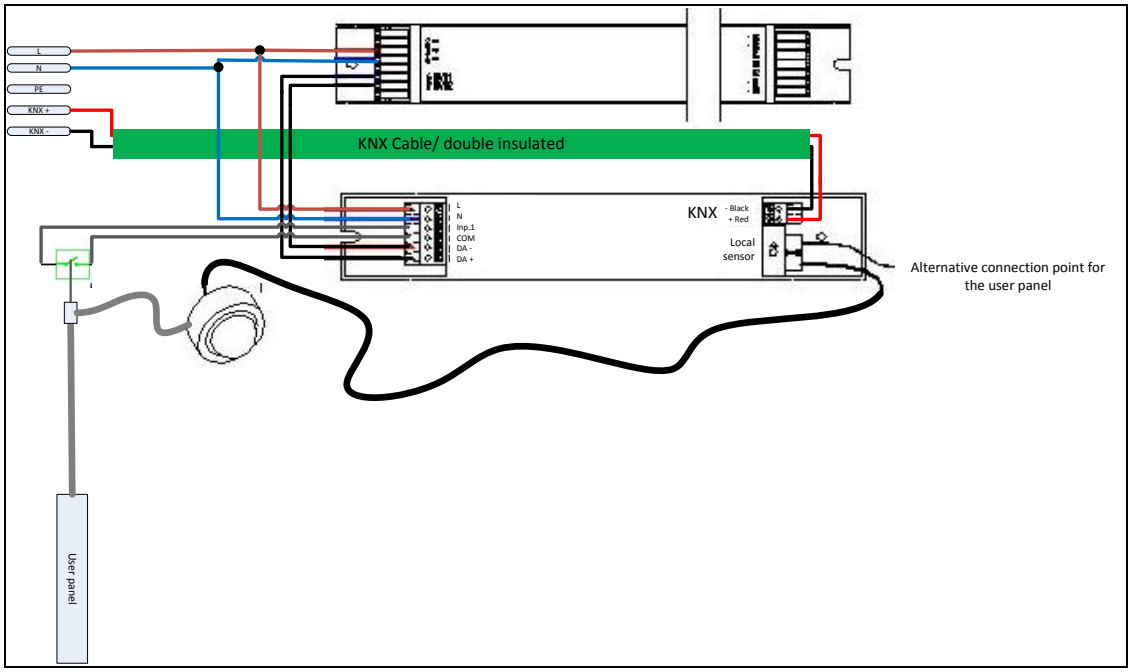
12 Lamp integration and wiring diagram

The KNX MultiLight Dali is designed to fit inside ceiling suspended light fixtures and will accommodate up to eight EVGs. Typical wiring configurations are shown in chapter 12.1 and 12.3.

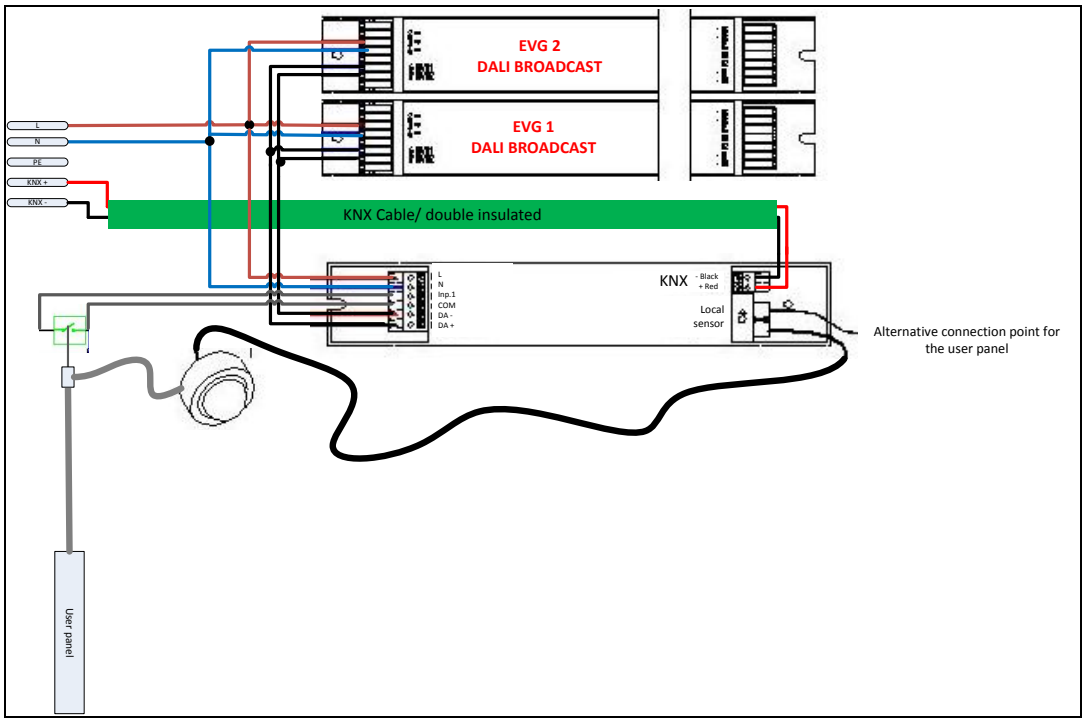
The EVGs can be of any DALI enabled type, usually ranging from single 35W to double 80W outputs, with DA+ and DA- connection. Examples EVGs: Philips HF-R TD 214-35 TL5, Osram QTi DALI 2x35/49/80 DIM, Tridonic PCA Excite and ECO series.

Wire size from 0.5 to 1.5 mm^2 can be connected to the quick connect terminals of the KNX MultiLight. Remove 9-10 mm of the wire insulation.

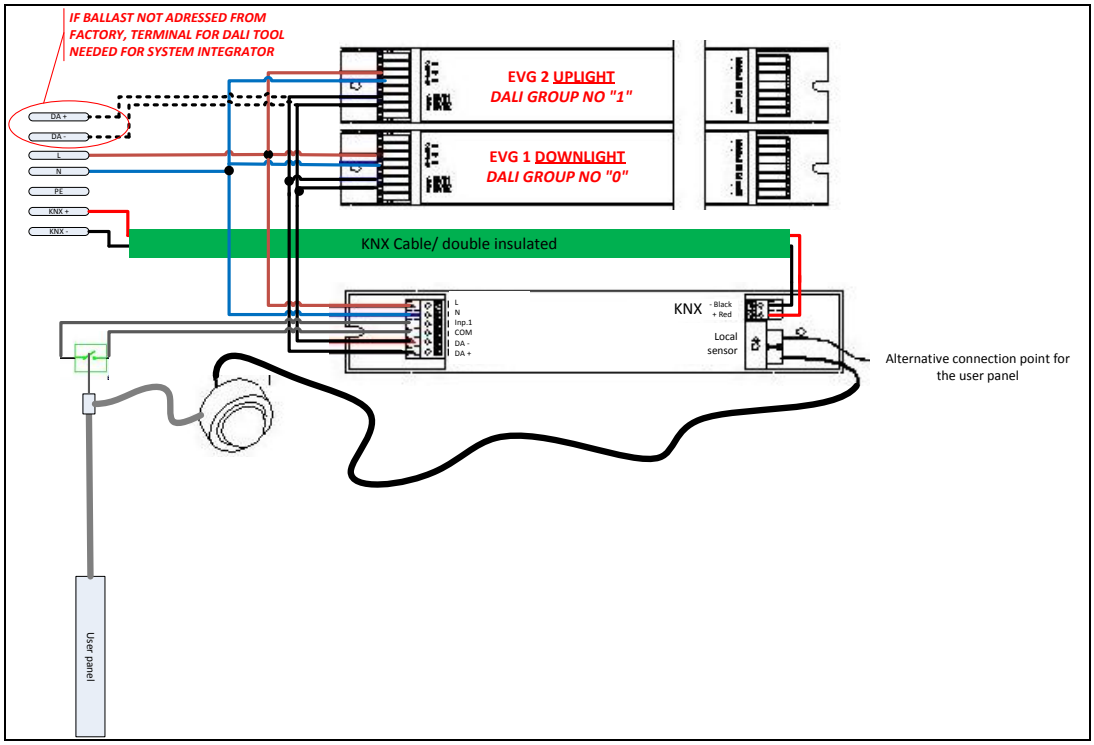
12.1 Diagram for DALI Broadcast single EVG



12.2 Diagram for DALI Broadcast up light and down light



12.3 Diagram for group 0 and 1 up light and down light EVG



13 Technical data

KNX MultiLight DALI		
Power	• Operating voltage, Main	230V AC 50Hz
	• Operating voltage, KNX	21...30 V DC
	• Power consumption, KNX	Normal 10mA / Peak 15mA
Outputs	• DALI output	Broadcast / 4 Groups
	• Numbers of EVGs	8
Inputs	• Number of inputs	1
	• Polling voltage Un	2V
	• Sensing current In	1mA
	• Permitted cable lengths	2 m
Connections	• KNX	Via connection terminal without screws
	• Load current circuits	Via connection terminal without screws
	• Inputs	Via connection terminal without screws
	• Wiring	0.5-1.5 mm2
	• Terminal for local sensor	4-pole plug Pico
Movement detector	• Detection area at floor (diameter)	4 m
	• Installation height	2 m
Operating and display elements	• LED	KNX Learning mode
	• Switch	KNX Learning key
Housing	• PC + ABS (antimony-, chlorine- and bromine-free flame retardant)	
KNX voltage	• SELV 29V DC (safety extra low voltage)	
DALI voltage	• ELV 16V DC (extra low voltage)	
Temperature range	• Operation	+5 °C ... +45 °C
	• Storage	-25 °C ... +65 °C
	• Transport	-25 °C ... +65 °C
Design	• Dimensions (H x W x D)	22 x 30 x 185 mm
Approvals	• EIB / KNX EN 50 090-2-2	Certification
CE mark	• In accordance with the EMC guideline and low voltage guideline	

Data subject to change without notice

14 Revision history

26.03.2014 Rev. A: KNX MultiLight Dali FW1.2
Major changes:
- Added chapter 6 Infrared remote control
- Added chapter 8.3.7 Additional continuous heating and cooling stage
- Updated datasheet

07.06.2013 Initial document: KNX MultiLight FW1.0

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