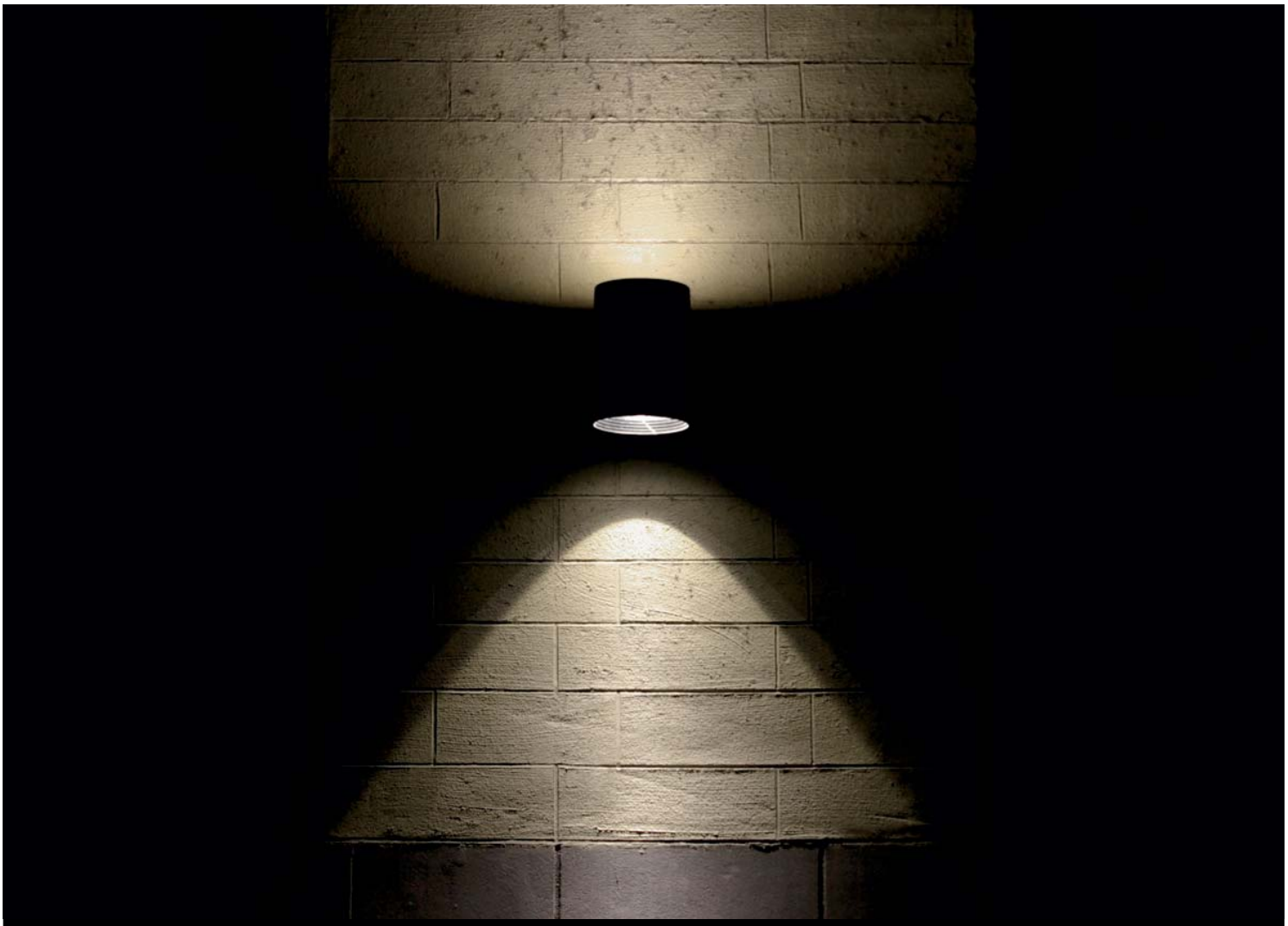

ABB i-bus® KNX
Application Manual
Lighting

Power and productivity
for a better world™

Description of the symbols:

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Table of content

General

ABB i-bus® KNX systems in residential buildings, commercial buildings and public buildings offer an attractive solution for the highest demands. The ABB i-bus® KNX systems easily combine quality living, comfort and safety with efficiency and environmental consciousness.
ABB i-bus® KNX products cover the complete range of applications in buildings: from lighting and shutter control, to heating, ventilation, energy management, security and surveillance. These requirements can be realised cost-effectively using ABB i-bus® KNX with a minimum of planning and installation expense. Furthermore, flexible usage of the rooms and a continuous adaption to changing requirements are easy to realise.
An important factor for implementing the enhanced demands of building users and occupants, is however, professional and detailed planning. This application manual – based on practical experience for practical usage – assists in simplifying planning and implementation of a project.

Planning of a project

One of the primary considerations in the planning of a building control system using ABB i-bus® KNX is whether the switch actuators for the circuits are to be installed centrally or on a distributed basis.

Central installation

In a small buildings, residential buildings or apartments all wiring to the loads can be wired to a single location.

Central installation is more transparent, fewer ABB i-bus® KNX components are required and the cost per channel is lower.

Central installation requires much more wiring effort.

Distributed installation

For distributed installation the devices are installed in the vicinity of the loads.

The distributed installation requires much less load-related wiring effort.

Distributed installation significantly increases the cost per channel. The entire system can quickly lose on transparency and the devices may possible be difficult to access. As the number of ABB i-bus® KNX devices is increased with a distributed installation, the programming effort also increases. Additional power supplies and couplers may be necessary, which will also increase costs.

Conclusion

It is important to take the constructional features of a building into account when planning. A combination of central and distributed installation methods has proven useful in the field. For example, distributed installation may not be possible due to a lack of space in a residential building. For larger buildings, a central installation can mean a room, a hall or a floor, which still complies with a distributed installation in terms of the overall concept.

A further solution for a distributed, room-oriented application is the Room Controller RC/A x.2 and Room Master RM/S x.1 from ABB.

Refer to the Room Controller product manual for further information.

Application manual ABB i-bus® KNX Lighting

After a brief introduction, the possible circuit configurations relating to the selected lighting types are explained in the following manual, e.g. operation from one or more locations. The many application examples are complemented by information, tips, benefits and disadvantages which offer a quick and simple insight into the advantages of the different control functions, e.g. Function dimming, sensor-dependent control. This is rounded off by many notes on the realisation of special features, e.g. light scenes, panic alarms.

The selection options for the individual control functions and their combination features are very comprehensive. The checklist from ABB has proven to be very useful for engineering design purposes.

A checklist template can be found in the Appendix.

The application manual is intended for persons who already have acquired basic knowledge in ABB i-bus® KNX (basic functions, topology, addressing, …), e.g. in a certified ABB i-bus® KNX training session.

1. Introduction

Lighting control is one of the basic functions of ABB i-bus® KNX. A big advantage of ABB i-bus® KNX is its high level of flexibility. Accordingly, changes to the lighting and lighting control in terms of its function, usage and floor plan can usually be realised by simple reprogramming.

In a Kindergarten there are flexible partitions which can be removed or relocated as required. So for instance, a large auditorium for parties or shows can result from combining the gymnasium and the hall. The lighting control should be easy to switch via buttons depending on daylight, event type and floor plan.
Important preliminary considerations have proven useful for optimum planning of a project.
These include:
– Selection of the basic control type (see section 1)
– Selection of the lamp types used (see section 2)
– Selection of the circuit control functions (see section 3)

During planning it is useful to select the smallest lighting unit to switch as they can be easily combined by the ABB i-bus® KNX using software.

1.1. Basic control types

There are three basic control types:

1. **Switching all types of luminaries via switch actuators**
2. **Dimming of certain luminaries via universal dimmer actuators**
3. **Dimming of certain luminaries via Light Controllers/Switch/Dim Actuators**

1.1.1. Switching all types of luminaries via switch actuators

Switch actuators are been used with ABB i-bus® KNX unlike conventional switching via light switches or pushbuttons with installation relays. Switch actuators are so-called intelligent relays. These are available with different currents (see Product Range Overview) and vary in channels per device from 1 – 12. The following switch actuator designs are available:

– MDRC modular installation devices with the types SA/S x.x
– Installation devices for mounting on the luminary (Light Fitting, LF)
– Surface mounted devices, mounting in the ceiling or intermediate floors, e.g. Room Controller RC/A x.2

For further information see Product Range Overview ABB i-bus® KNX

Dimming of luminaries

Dimming options for the lighting are important and are an ever more desired function.
Two important factors play an important role here:

1. Comfort, e.g. pleasant lighting while dining that suits the situation and mood
2. Cost-effectiveness, power consumption and cost reduction through:
   – Dimming of the lighting to suit the incidence of external light
   – Extended service life of the luminaries through reduced intensity of the switch on brightness
   – Reduced brightness for different area usages, e.g. in a sports arena during competition, a different level of brightness is required than during training sessions.

Metal-vapour, sodium-vapour and mercury vapour lamps are practically un-dimmable, as this has an uncontrollable effect on the lighting quality and the service life of these luminaries.

1.1.2. Dimming via universal dim actuators

All ABB i-bus® KNX dimmers are universal dimmers which feature a phase control or phase angle control and the control behaviour can be set to suit the load.
Incandescent and fluorescent lamps can be dimmed using universal dim actuators (Fig. 2).

Incandescent lamps and high-voltage halogen lamps are dimmed via a phase angle control. The sinusoidal voltage is phase controlled directly with a 230 V voltage (Fig. 1).

LV halogen lamps (low-voltage) with conventional transformers (inductive load) are also dimmed using phase control (Fig. 1).

LV halogen lamps with electronic transformers are dimmed using phase angle control (Fig. 1).

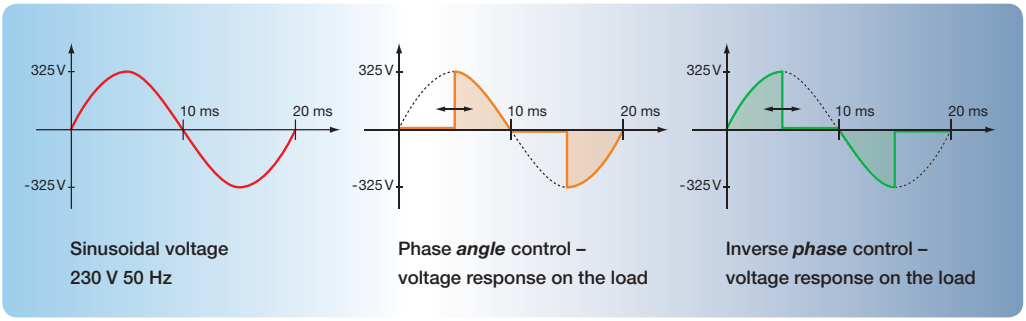


Fig. 1: Dimming via universal actuators

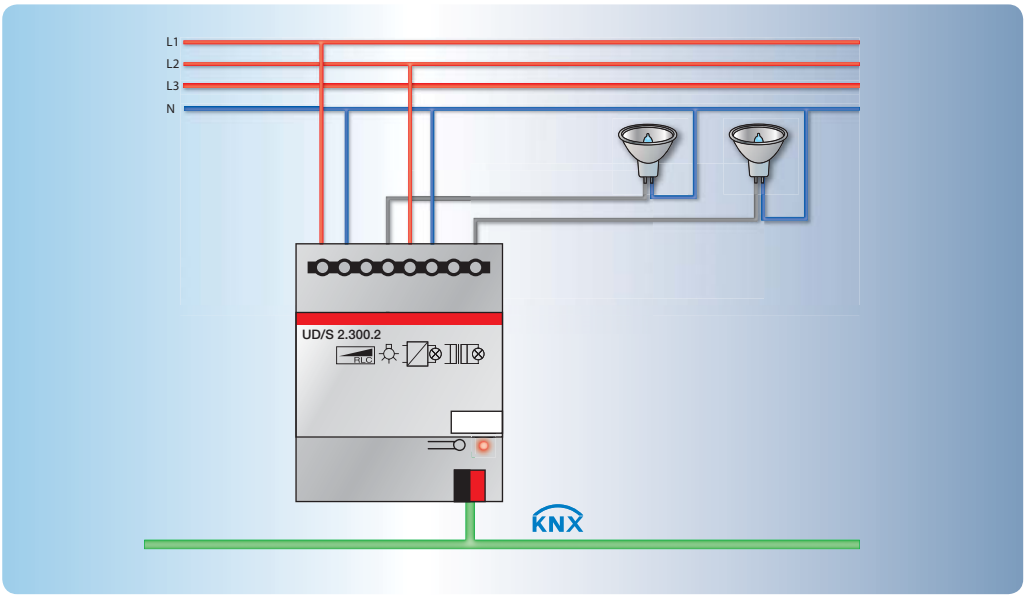


Fig. 2: Connection of an incandescent lamp load to an universal dim actuator UD/S 2.300.2

The service lives of the lamps are changed by dimming. Incandescent lamps, for example, at a slightly reduced voltage have a significantly longer service life, whereas halogen lamps at a continuously dimmed brightness have a shorter service life. However, this can be prevented by temporary illumination with maximum brightness.

1.1.3. Dimming via switch/dim actuators

It is necessary to install a suitable electronic ballast with some lamp types as not all lamp types can be dimmed directly

Fluorescent lamps (gas-discharge lamps) are dimmed via electronic ballasts which have a control input of 0 – 10 V or 1 – 10 V haben. These electronic ballasts are operated via a corresponding ABB i-bus® KNX- Switch/Dim actuator with an 0/1…10 V output.

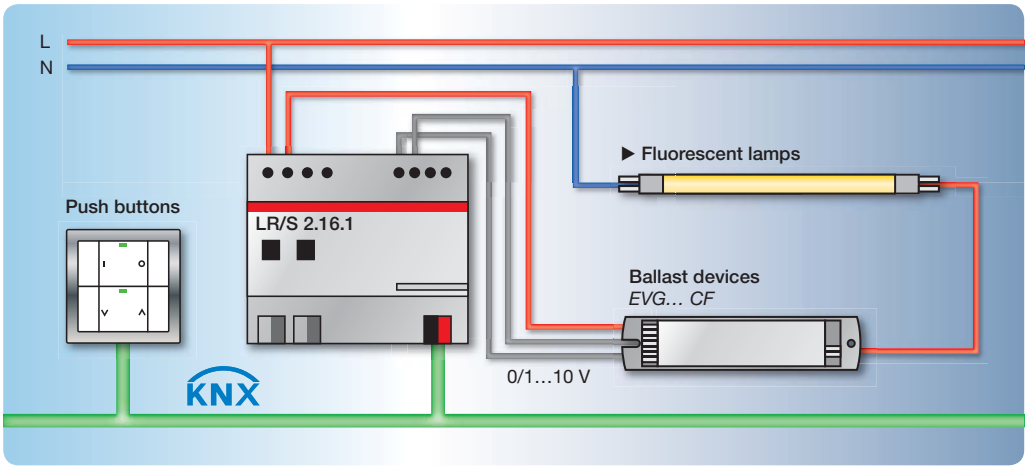


Fig. 3: Functional principal of a switch and dim actuator

Introduction

The 0/1…10 V output of the switch/dim actuator is a passive output, i.e. it behaves like a controlled resistor. The 0/1…10 V output of an electronic ballast is generally an output which provides a current limited voltage of 10 V. If a device is controlled with a switch/dim actuator which requires an input signal voltage of 0/1…10 V but does not supply this voltage, it is not possible to use a Switch/Dim Actuator. Instead a switch/dim actuator must be used to switch on and off and an analogue actuator for dimming. The Analogue Actuator AA/S 4.1 provides the input format as a communication object for switching (1 bit) and relative dimming (4 bit) during parameterisation. Linked with a push button the AA/S 4.1 outputs a changeable active 0…10 V signal.

The use of a Switch/Dim Actuator, e.g. SD/S 8.16.1, combined with an electronic transformer, e.g. ETR-U 210-230/12SF, offers a good method to dim low-voltage halogen lamps using a software operated high-performance dimmer with up to 8 channels (design: Fig. 4).
Even higher powers can be dimmed by using a corresponding electronic transformer.
Furthermore, there are dimmers such as the ABB ST AD/E 700 which can use a 1 – 10 V signal to dim 230 V incandescent lamps.
When combined it results in flexible and cost effective solution.

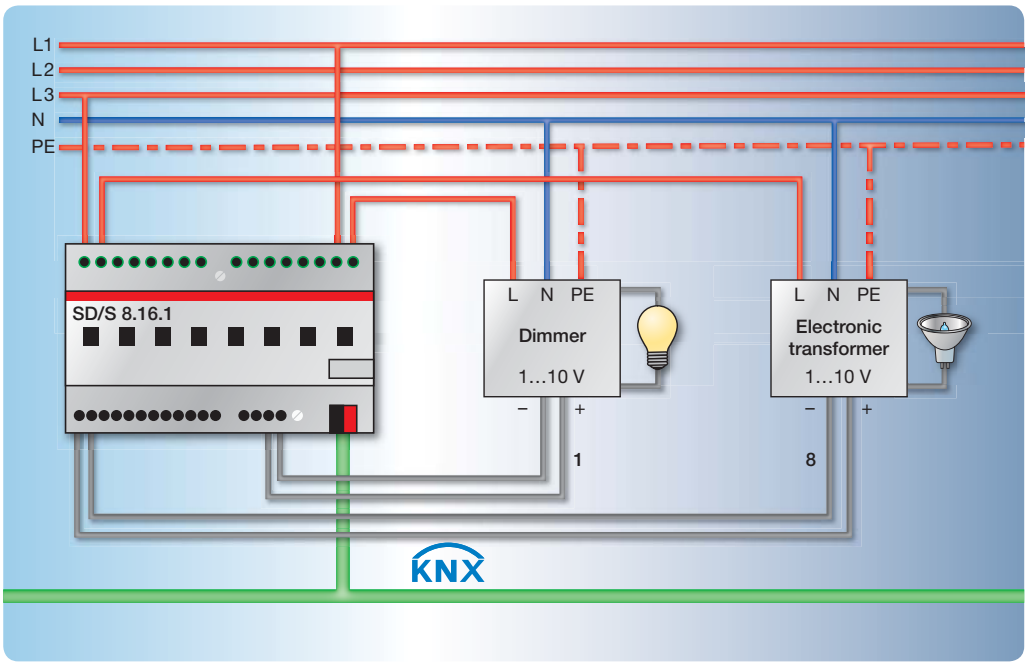


Fig. 4: Design with Switch/Dim Actuators

Introduction

A further option for the control of lighting (switching and dimming) is the use of digital technology such as **DALI**. Here communication is implemented between the ABB i-bus® KNX and a DALI electronic ballast using a digital protocol.

Furthermore, there are still proprietary systems utilising digital technology. One such system is LUXcontrol, where defined ballasts are controlled via the DSI signal.

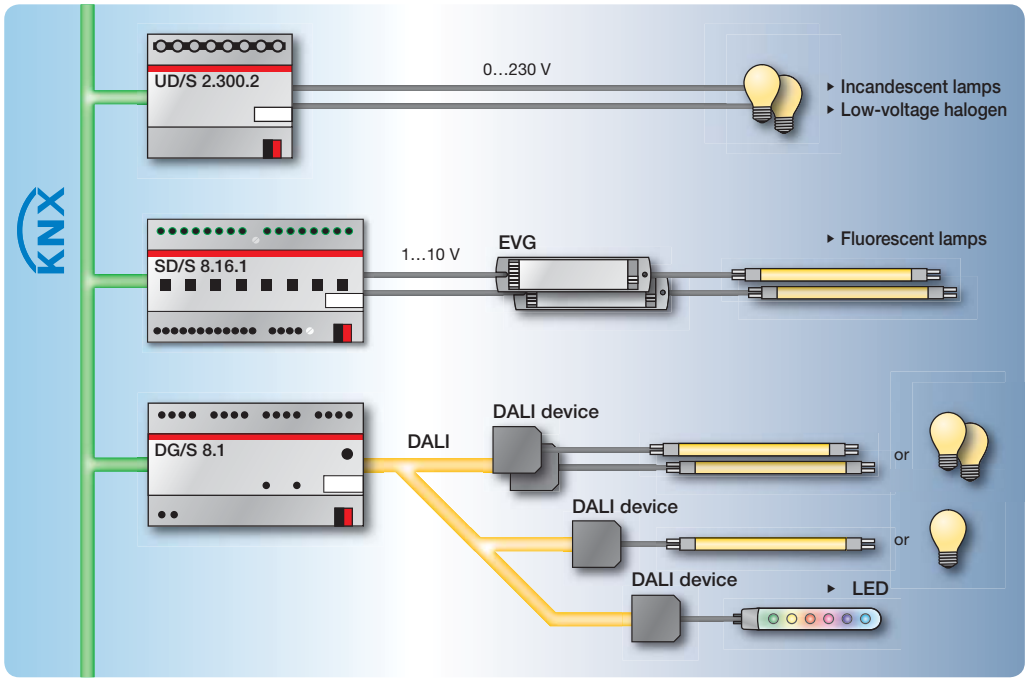


Fig. 5: Overview of the System

For further information see chapter 5.3. *Control with DALI* and chapter 3.1. *Dimming functions*.

1.2. Selection of the luminaries

Buildings use many different types of luminaries:

- Incandescent lamps
- Halogen lamps, low-voltage usually 12 V or high-voltage usually 110 – 230 V
- Fluorescent lamps
- Dulux lamps, compact fluorescent lamps
- Sodium vapour lamps
- Mercury-vapour lamps
- LED lamps

It is important to consider the required switching frequency and the use of ballasts during the selection of luminaries.

1.2.1. Switching frequency

For fluorescent lamps with conventional ballasts, the shut-off time should not be shorter than 15 minutes, otherwise the conservation of energy does not bear any relationship to the reduction in the service life of the luminaries.
Sodium and mercury-vapour lamps require 30 seconds to a few minutes after they are switched on to obtain their full brightness. After switch off there is a cooling-off phase of a few minutes, during this time they cannot not be switched on again. For safety purposes premature switch on is prevented by the ballast.

1.2.2. Ballasts

Frequently it is not been considered that when connecting electronic ballasts they are not designed according to rated current. It is a capacitive load and therefore the inrush current is significantly higher than the rated current. This means that the current rises rapidly for a brief period when switched on and then falls exponentially to the rated current. If the lay out of the design is incorrect the contacts can stick or weld. Sticking contacts can be removed by a mechanical action. If the contacts weld, the switch actuators must be exchanged with all the time and expense which this involves.

For further information see the Price List ABB i-bus® KNX or the product manual Switch Actuators.

1.3. Selection of the required control functions

Lighting control with ABB i-bus® KNX features a high level of flexibility. This includes a large range of individual control functions and their combination possibilities.

The following functions are available:

Circuit design
- – Switching from one or more positions
- – Group/central control

Control functions
- – Function Dimming
- – Function Staircase light
- – On and off delay
- – Timer control
- – Occupancy-dependent control

Light dependent control and regulation
- – Daylight dependent control
- – Constant lighting control

Status messages

Special types of control
- – Light scenes
- – Panic alarms
- – Control with DALI

The selection possibilities of the circuit design are dependent on the luminary type and the required functions are very comprehensive. For this reason, the checklist of ABB for project planning has proven to be very useful.

A checklist template can be found in the Appendix.

2. Circuit design

In order to plan a useful circuit design, the different circuit configurations must be included in the preliminary considerations and then selected appropriately:

– Switching from one or more positions
– Central and group switching

2.1. Switching of one or more positions

Even with the use of intelligent electrical installations such as ABB i-bus® KNX, the operation of the lighting is performed locally using conventional buttons or switches. These are tried-and-tested and generally well-known. Generally buttons and switches are located where they are required, i.e. two or more operating points are required for a circuit.

The hallway of an office floor should have several operating points to switch the lights on and off. The two-way connections must correspond with each other for this purpose.

A conventional electrical installation requires cable to transfer the energy and every switching signal, measurement and control or regulation command. Two operating points can be implemented with one two-way connection. If more than two operating points are to be set up, additional impulse control switches are required. This requires considerably more effort and expense for the additional cables and devices.

By contrast, electrical installations with ABB i-bus® KNX require just one cable for energy transfer and one bus cable. The sensors and switch actuators are connected parallel to the bus cable (Fig. 6). The actuators receive the sent telegrams of the sensors and switch the connected circuits on or off. For this reason, establishing several operating points with bus technology is simple and cost-effective.

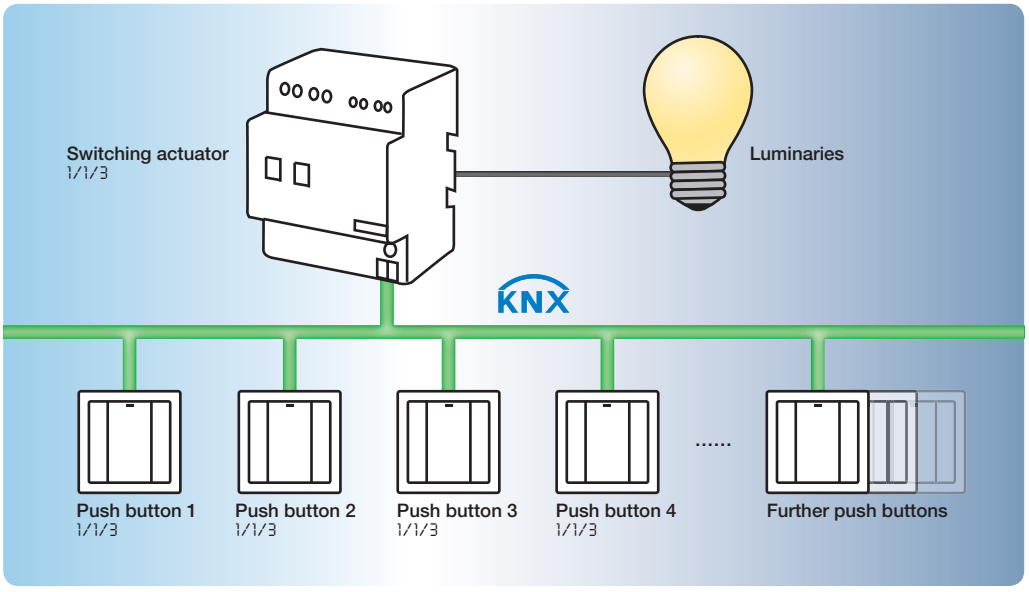


Fig. 6: Two-way connection with ABB i-bus® KNX

Circuit design

The installation is simple and cost-effective. The buttons can feature different functions, e.g. a push button exclusively for a switch-off function, another for a switch on and off functions.

A bus cable will be installed in places where operation at a later date may be required. The cable is connected to an empty switch box and is initially invisibly sealed. Subsequently a quick and cost-effective utilisation is then possible when required.

2.1.1. Selection of suitable devices

Push buttons from the ABB range incorporating different series such as alpha *nea*®, solo® or Busch-*triton*® as well as Busch-*priOn*® can be used. Use of conventional push buttons or switches is also possible. They are connected via the binary inputs on the ABB i-bus® KNX.

There are several options available here:

1. ABB i-bus® KNX push buttons with coupling to the bus
2. Binary input, MDRC type BE/S x.x
3. Distributed binary inputs flush mounted with the Universal Interface US/U 2.2 or 4.2

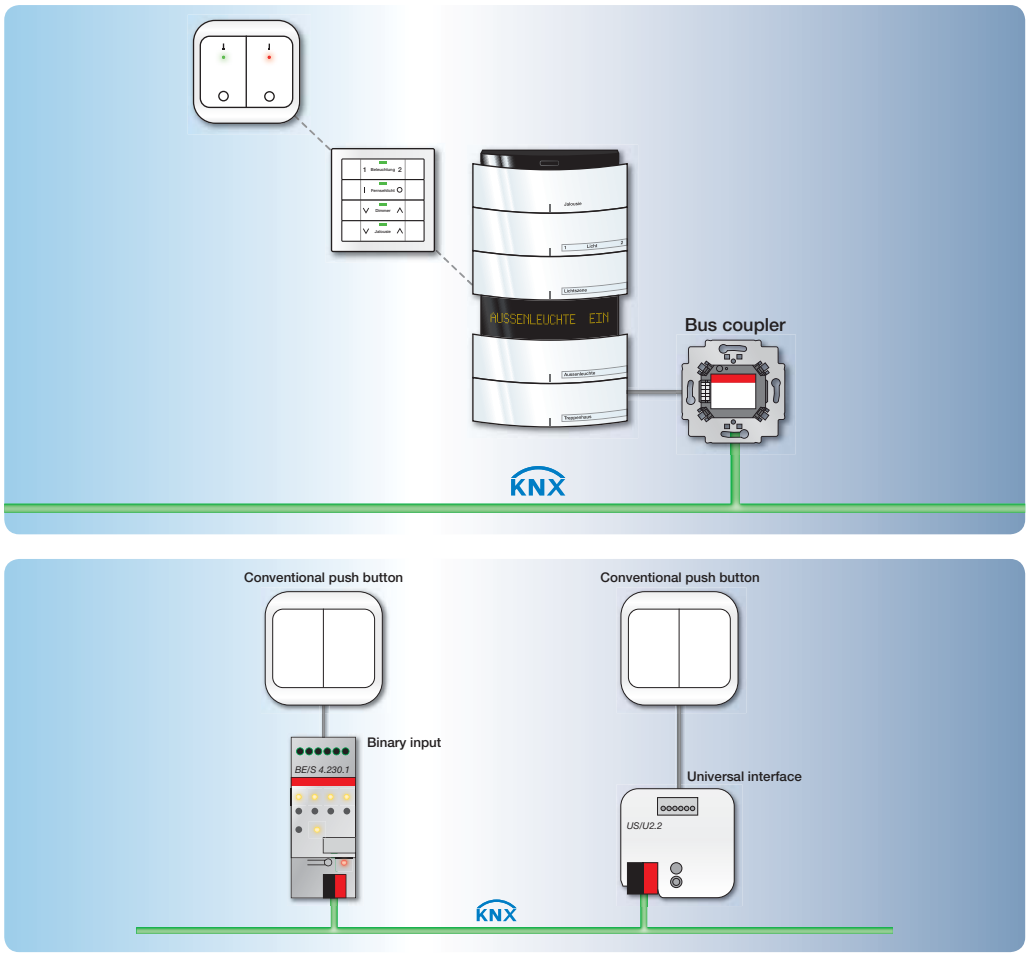


Fig. 7: ABB i-bus® KNX solution for push buttons

2.1.1.1. ABB i-bus® KNX push buttons

With a push button it is possible to select all three functionalities ON/OFF/TOGGLE, i.e. a push button has a defined function, either ON, OFF or TOGGLE.
A rocker of the push button series from ABB consists of two parts. A micro switch is located behind each rocker section. Each micro switch can be set independently of each other to implement different functions. This means, six functions can be implemented with a three-way switch.

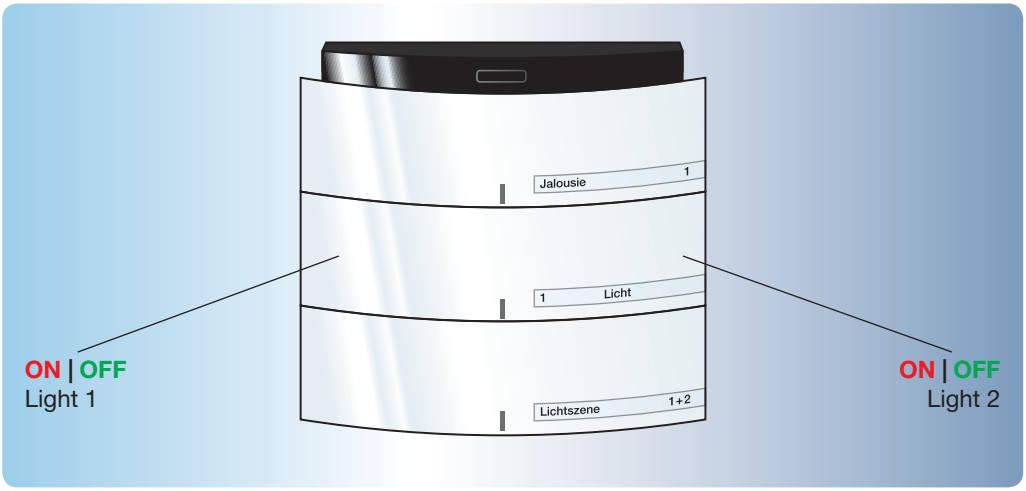


Fig. 8: Switching of a 2 groups of luminaries with rocker 2 of a Busch-*triton*® push button

When push buttons are used, the selection should be considered during planning as the rockers are arranged differently. With Busch-*triton*®, Busch-*priOn*® and solo® the rockers are arranged horizontally and with alpha *nea*® the rockers are arranged vertically.

Too many functions or rockers should not be installed at a single point. Otherwise the operational clarity is lost and operation will take too long. Push buttons from ABB offer the opportunity to label the individual rockers. Even when there are just a few operating points it is often difficult to remember the corresponding functions. For this reason labelled push buttons are part of the complete ABB i-bus® KNX system.

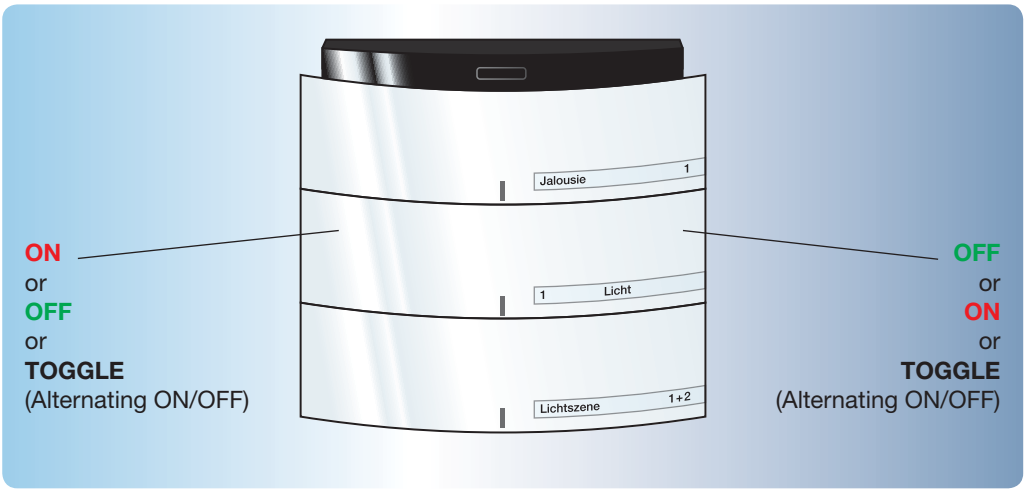


Fig. 9: Switching of a group of luminaries with rocker 2 of a Busch-*triton*® push button

Circuit design

In practice it is easier to handle the TOGGLE function, as it is not necessary to observe on which side of the rocker the lighting is switched on or off. The results of using group and central switching may be unsatisfactory with this setting.

If the light is switched on locally and then switched off from a different position, the next time that the local push button is switched an OFF telegram is sent. However, as the light is already switched off centrally, there is no visible function. Pushing once again will switch on the light which is the desired result, i.e. if from one location a light is centrally switched off, for example, the changeover button (CHANGEOVER) will “get out of step”.
In order to prevent this, the local switch of the central group address must be entered as a listening group address and the write flag must be set (Fig. 10).

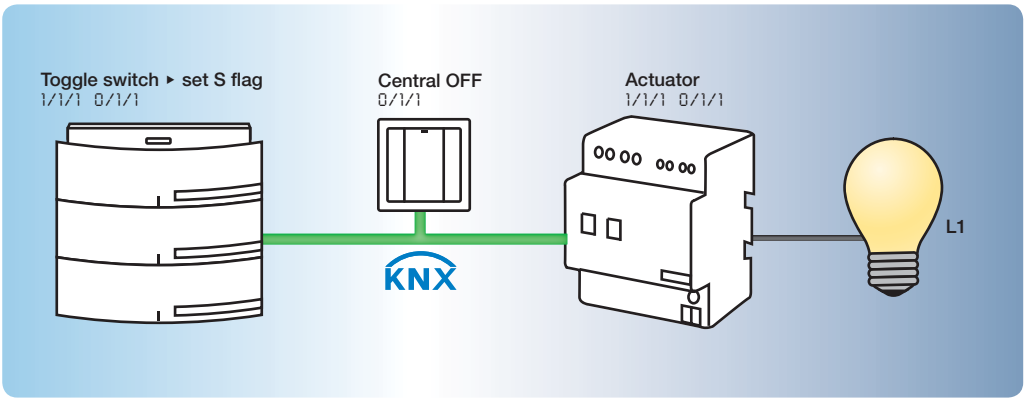


Fig. 10: Listening group address with the central OFF buttons

All group addresses which act in this manner on the circuit, must be entered as listening group addresses on the local Push button. The maximum number of addresses in the push button must be considered here.

This phenomenon does not exist with the parameterisation of the push button with defined ON and OFF switches on each side of the rocker.
Another possibility to bypass this phenomena is the use of the Binary Input BE/S x.x or of a Universal Interface US/U x.2.
Defined ON and OFF functions can be realised here with this push button, i.e. with short actuation of the switch it is switched ON, and with an extended actuation it is switched OFF or vice versa (Fig. 11).
This circuit type saves an input, wiring and a push button.

For further information see chapters 2.1.1.2 *Binary Input BE/S x.x and Universal Interface US/U x.2*.

2.1.1.2. Binary Input BE/S x.x and Universal Interface US/U x.2

Usually a universal interface is integrated into a flush mounted switch box. For hallway circuits the MDRC inputs type BE/S x.x have proven to be a good choice.

Universal Interface US/U x.2

The universal interface US/U x.2 requires little wiring effort. Accordingly the transparency of the circuit design is increased. Every conventional push button can be connected because of the comprehensive software functionality. Overall the Universal Interface US/U x.2 is a viable economical solution.

1. With the switch sensor function in the application two different functions can be actuated with the binary inputs by short or long operation of the push buttons. For example, the room light switches on or off with a short operation and the entire lighting of the building with a longer operation.
2. Different lighting circuits can be switched whereby a button is pushed once or several times. In this way for example, a multi-purpose or factory hall can be light up in different areas and be used to suit demands. By pressing the push button once, section one is lit up, by pressing the push button twice, section two is lit up, etc. up to four sections.
   Further successive pressing of the push button switches off the light circuits in reverse order.
3. A combination of the push button assignment thus enables switching of different lighting circuits in sequence as well as switching of the complete lighting by a long button push.

For further information see product manual Universal Interface US/U x.2

MDRC inputs, modular installation devices

MDRC inputs are frequently used in the area of hallway lighting circuits.
The push buttons are connected to a channel of the binary input if many push buttons are assigned to a circuit (Fig. 11). Through the reduction of the hardware, costs are reduced and the use of 230 V inputs enables the use of illuminated push buttons in accordance to workplace regulations.

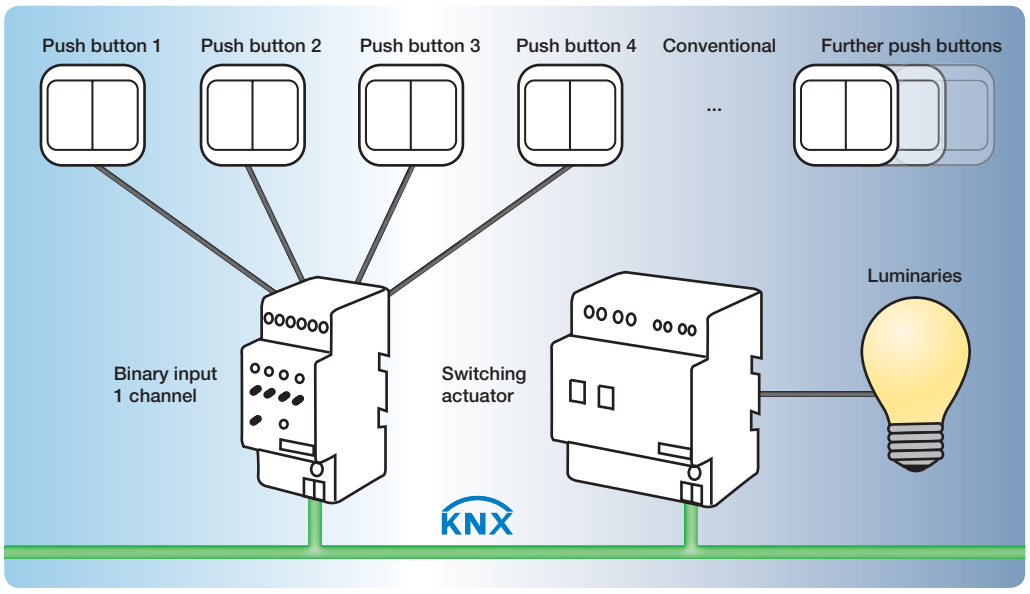


Fig. 11: Two-way connection with only one input of a binary input

Circuit design

Conventional switches and push buttons

Categorically conventional switches and push buttons can be connected to the binary inputs. The functions are set via the parameterisation of the channels (Fig. 12+13). Both important parameters are *reactions on closing the contacts* (rising edges) and the *reaction on opening the contacts* (falling edges). Thus all types of contacts and functions can be set. In principle there are three setting possibilities (Fig. 12+13):

– ON, switching the lighting on
– OFF, switching the lighting off
– TOGGLE, alternate switch on and off of the lighting

There are often mistakes made with the parameterisation of a switch or push button, e.g. a switch is parameterised even though a push button is connected. It is thus important to check if the settings correspond with the connected contact.

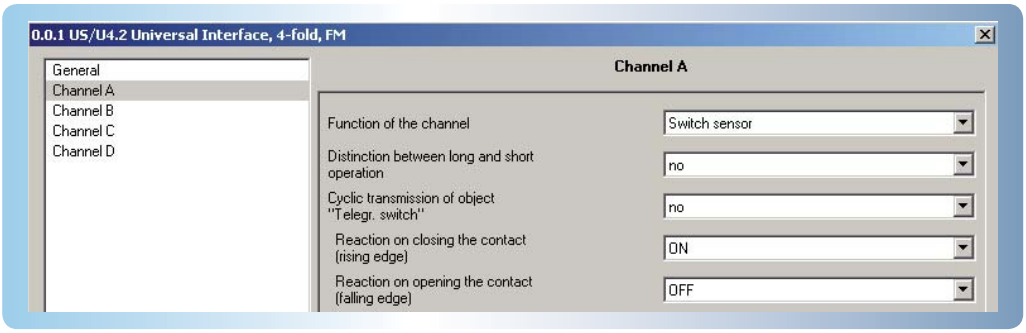


Fig. 12: Parameterisation of a switch with ON and OFF function:

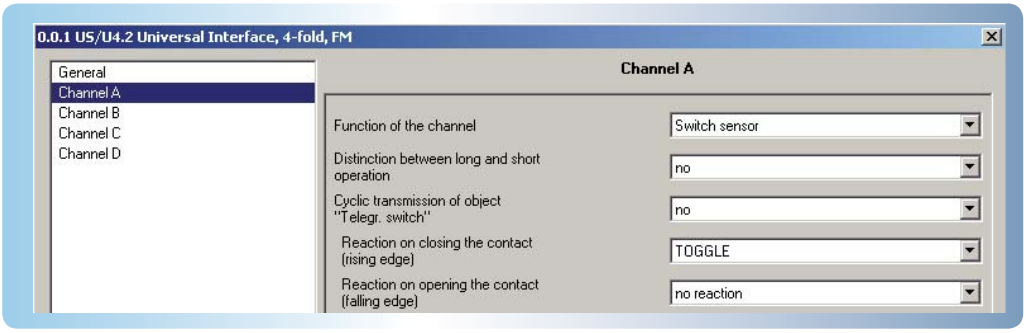


Fig. 13: Parametrization of a push button with toggle function

The mechanics of a switch are directly associated with the ON/OFF function, i.e. if the switch is closed it is ON, if the switch is opened it is OFF. For this reason the use of switches is only useful with a local circuit with only one operating point. Push buttons are almost used exclusively with all other installations, several operating points, central and group switching.

2.1.2. Bus voltage failure, bus voltage recovery, Programming

If during the installation of luminaries the cases bus voltage failure, bus voltage recovery and programming occur, critical states can occur.
Which state do the luminaries have?

A bus voltage failure often means that the main voltage has failed; if the lighting of a building fails it can be very dangerous particularly in a stairway.

The actuators offer the possibility for various settings:
– Contact closed
– Contact opened
– Contact unchanged
The unchanged contact setting ensures that the state of the relay is retained during a malfunction.

During a fault some of the lighting should be switched off and some luminaries should be switched on. The new switch-in of luminaries are powered by an emergency generator or UPS.
For these luminaries, the *closed contact* setting should be selected, for the luminaries to be switched off the *open contact* setting should be selected.

2.2. Group and central circuits

A very important function of the ABB i-bus® KNX systems is the realisation of group and central circuits. Thereby the complete building, a floor or an area composed of a combination of lighting circuits can be switched from one or more locations. This can be implemented with an ON, OFF or CHANGEOVER telegram. Using conventional methods the realisation would require considerable additional installation time and expense. With ABB i-bus® KNX this is easily implemented by programming accordingly.

The caretaker of a school must be able to switch off the entire lighting in the building when leaving. A central ON function is not useful as the increased inrush currents by simultaneous switch-on of all circuits would overload the supply. However, it should be possible to switch on selected circuits, e.g. entry halls, corridors and staircases, when the building is entered.

To prevent unauthorized from operating these functions, the actuation is undertaken via a key operated switch. This is connected by a Universal Interface US/U 2.2 to the ABB i-bus® KNX:
– On channel A: Central OFF
– On channel B: Group access ON
Alternatively this function can be implemented via an ABB i-bus® KNX push button. In this case the group function would be executed for example by a long operation of the push button. The push button is parameterised as a shutter push button and links the group address with the long actuation communication object, usually with the STOP/louvre function (Fig. 14).

For further information see: Product manual Blinds and Shutter Actuators JA/S.

Circuit design

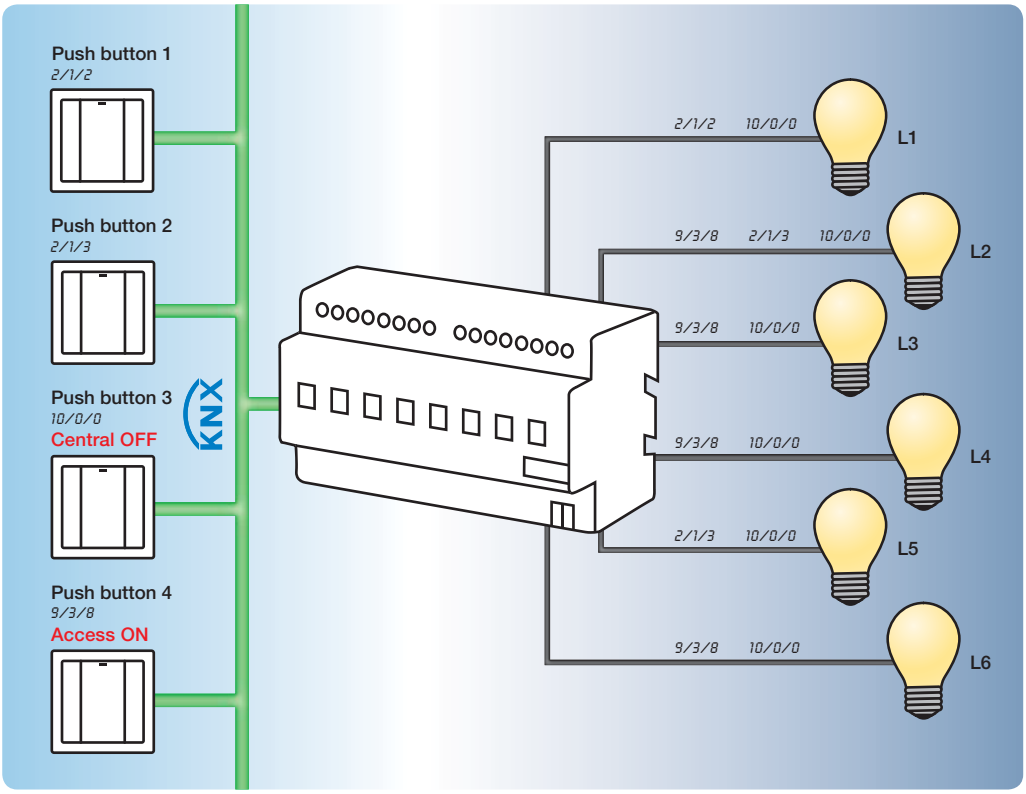


Fig. 14: Group and central switching with ABB i-bus® KNX

Each new assignment or function requires a new group address.

As the group address only consists of a sequence of numbers, it is very important to briefly describe it in the ETS (Fig. 15), to assign a name (usually the designation of the device, Fig. 16) and the basic function of the device.
ETS3 allows you to label the individual communication objects.
If these details are continually entered, a lot of time and money can often be saved during the course of a project.

Nummer	Name	Funktion	Beschreibung	Gruppenadressen
0	Eingang A	Sperren		
7	Eingang B	Sperren		
1	Eingang A	Telegr. Schalten	Zentral AUS	10/0/0
8	Eingang B	Telegr. Schalten	Zentral EIN	9/3/8

Fig. 15: Use of the description column

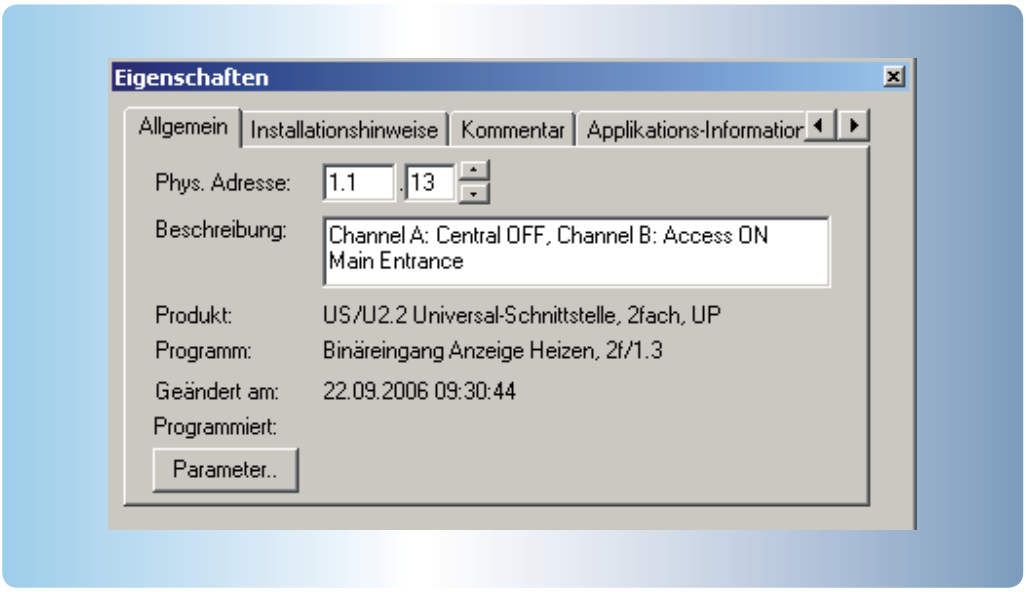


Fig. 16: Designation of the device

The basic principle of the ABB i-bus® KNX

A sensor communication object can only send one group address. An actuator communication object can however listen to several group addresses. The quantity depends on the number of bus couplers and the application. Currently up to 255 group addresses can be assigned to an actuator. This is distributed onto 12 channels taking further group addresses for functions into consideration, such as status or logic, resulting in more than 10 assignments per channel. In practice, this often results in about five or six group assignments per switch communication object. The maximum possible number of group assignments or addresses can be found in the technical data of the devices

If the maximum possible number of group address assignments is exceeded, the following error message appears on the monitor:

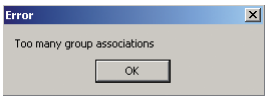


Fig. 17: Error message to many group assignments

If the maximum possible numbers of groups address assignments are not sufficient despite the most advanced devices from ABB, there is an alternative using other ABB i-bus® KNX devices. These devices enable multiplication of the telegrams.

2.2.1. Telegram multiplication

Telegrams are the communication form for all devices in a ABB i-bus® KNX system.
The following modules and components from ABB enable multiplication of telegrams:

- Logic Module LM/S 1.1
- Application Unit ABZ/S 2.1
- ABL/S 2.1 and Application LogicTime254IO/2 (path 1)
- ABL/S 2.1 and Application LogicTime254IO/2 (path 2)

The explanations of the application units relate to ABZ/S 2.1 and ABL/S 2.1.
All solutions can also be implemented with the predecessor device AB/S 1.1.

2.2.1.1. Logic Module LM/S 1.1

The function **Multiplier** enables a telegram to create 8 new ones.
The output telegram can be 4 x 1 bits and 4 x 1 bytes. This function is available up to three times per device. By cascading the output of multiplier 1 to the input of multiplier 2, more than 8 outputs are possible.

This method leads to an increased bus load and maybe even to an overload as the telegrams are sent almost simultaneously.

2.2.1.2. Application Unit ABZ/S 2.1

With the application **TimesQuantities** a generation of new telegrams is also possible in larger quantities.

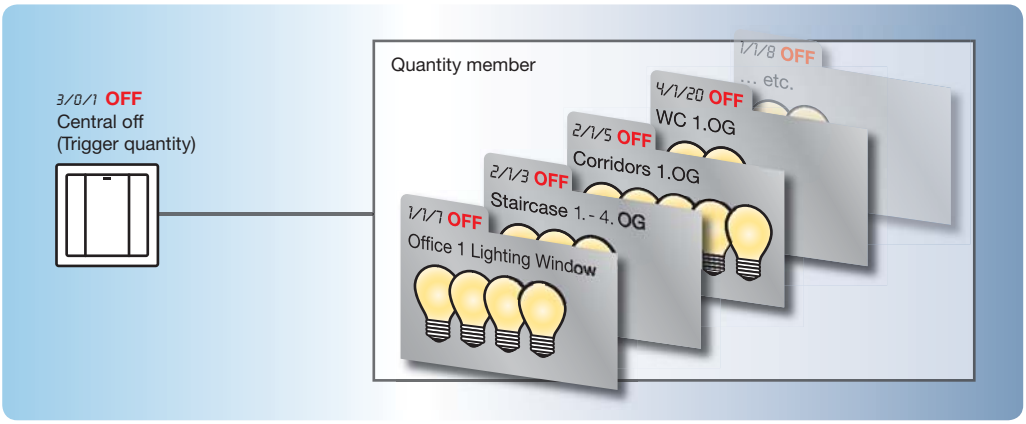


Fig. 18: Central OFF in an office building

This method leads to a high bus loading and maybe even to an overload as the telegrams are sent almost simultaneously.

In a solution with the Application Unit ABZ/S 2.1 and the application TimesQuantities/2 it is possible to send the telegrams consecutively with a delay. This can be set with the parameters between 0.1 s and 0.5 s.

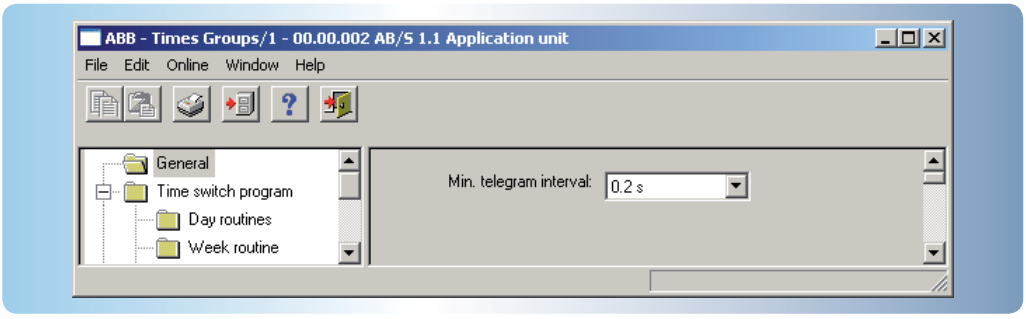


Fig. 19: Telegram delay

This solution is very flexible by the use of inverting, filtering and sending of further data types and not just a method of telegram multiplication.

2.2.1.3. ABL/S 2.1 and Application LogicTime254IO/2 (path 1)

Inputs cannot be connected directly with the outputs. Therefore an OR gate is connected with the input as an auxiliary component.

This procedure is recommended with the Application Unit AB/S 1.1 or ABL/S 2.1 already located in the systems which still have free capacity.

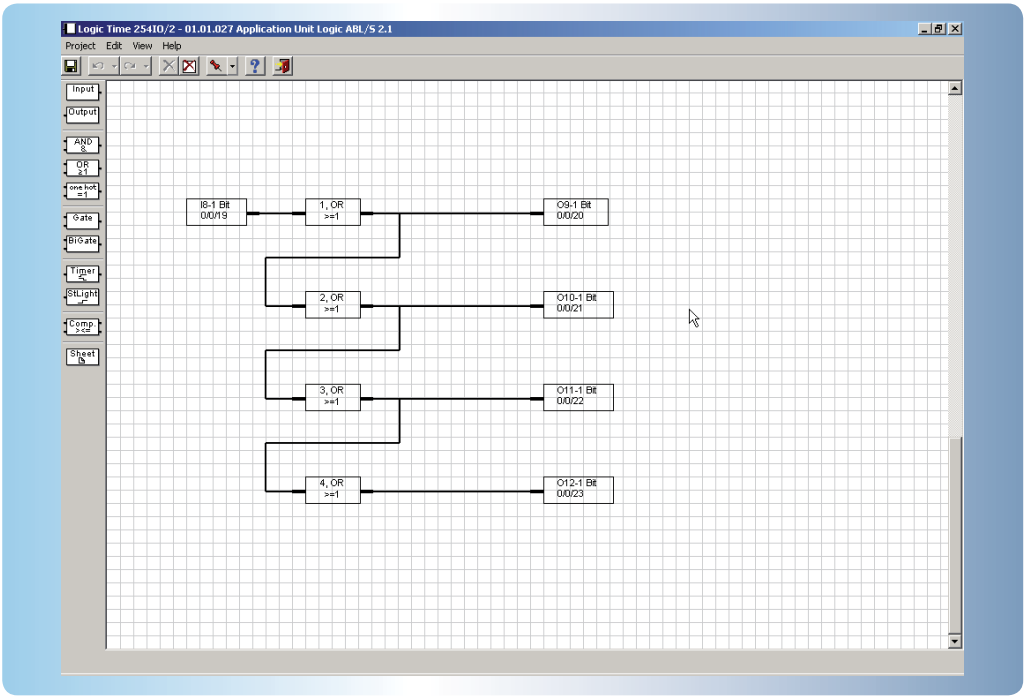


Fig. 20: Function schematic ABL/S 2.1 with telegram multiplication

This method leads to an increased bus load and maybe even to an overload as the telegrams are sent almost simultaneously.

The delay can also be achieved with the solution indicated with the ABL/S 2.1 and the software LogicTime254IO/2 (path 1). A timer is used instead of an OR gate and presets the switch on and off delay accordingly. The smallest time unit here is 1 s.

This solution is very flexible by the use of inverting, filtering and sending of further data types and not just a method of telegram multiplication.

2.2.1.4. ABL/S 2.1 and Application LogicTime254IO/2 (path 2)

All group addresses required for switching of the circuit are assigned to an input. The input is connected to the output using an auxiliary element (path 1). This output is assigned to a group address, which is then entered in a switch communication object of the actuator. In this way, group addresses and assignments are saved with the actuator communication object.

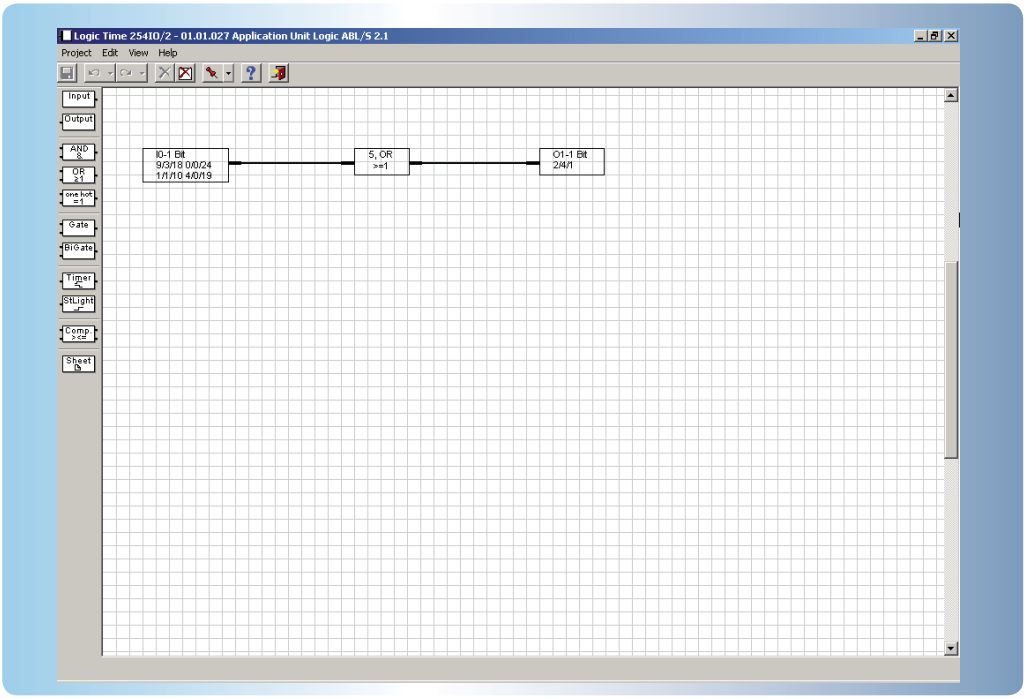


Fig. 21: Assignment of the group addreseses via an auxiliary element

The group address 1/1/2 of the output is entered in the switch communication object of the actuator. All telegrams on the input – here with the group address 4/0/19, 2/4/1, 4/0/20 or 6/4/12 – are always sent by the application unit to the output with the group address 1/1/2, and the actuator is thus switched.

3. Control functions

Various control functions are available to arrange the lighting of a building in order to make it as comfortable and economical as possible:

– Function Dimming
– Function Staircase light
– On and off delay
– Time control
– Occupancy-dependent control

3.1. Function Dimming

Dimming is a frequently desired and very pleasant control function.

In a conference room the dimmable lighting is switched via a push button.
With short operation of the push button the lighting is switched on and off, with an extended actuation the lighting is dimmed up and down. With an additional push button it is possible to send various brightness values. In our example, the lighting is dimmed to 50 % by a short operation of the push button, e.g. for cleaning purposes. With long operation of the push button the lighting is dimmed to a brightness of 0 %, i.e. it is switched off.

With ABB i-bus® KNX, there are many possibilities to establish the function dimming:

– Dimming with ABB i-bus® KNX push buttons
– Dimming with Binary Input BE/S x.x or Universal Interface US/U x.2

The universal dim actuators from ABB can be adjusted individually.
The most important adjustable parameters of a dim actuator are:

– Switch on brightness: Last brightness value or preset value
– Dimming speed
– Dimming values, upper and lower limit
– Switch on via 4-bit communication object, i.e. no short button actuation is necessary for switch on
– Switch off via 4-bit communication object

3.1.1. Dimming procedure

There are two dimming methods available to the dimming procedure:

– Stepwise dimming
– Start-stop dimming

Stepwise dimming

The dimming telegram is sent cyclically during stepwise dimming with an long operation of a push button. In the parameters the cycle time (telegram is sent every ...s) and the dimming values (brightness change per sent telegram) are set.

Stepwise dimming increases the telegram traffic on the bus.

Start-stop dimming

The dimming process during start-stop-dimming starts with a telegram 100 % BRIGHTER or 100 % DARKER. Ending of the dimming process is done with a STOP telegram.

Only two telegrams are sent with start-stop dimming.

Today start-stop dimming is the standard solution.

Setting of the dimming procedure

Both procedures are set directly on the sensors. The dimming actuators react independently of the dimming procedure and only to 4-bit telegrams.

3.1.2. Dimming with ABB i-bus® KNX push buttons

Dimming with the ABB i-bus® KNX push buttons can only be realised with the 4-bit data format.

Decimal	Hexadecimal	Binary	Dimming telegram
0	0	0000	STOP
1	1	0001	100 % DARKER
2	2	0010	50 % DARKER
3	3	0011	25 % DARKER
4	4	0100	12,5 % DARKER
5	5	0101	6,25 % DARKER
6	6	0110	3,13 % DARKER
7	7	0111	1,56 % DARKER
8	8	1000	STOP
9	9	1001	100 % BRIGHTER
10	A	1010	50 % BRIGHTER
11	B	1011	25 % BRIGHTER
12	C	1100	12,5 % BRIGHTER
13	D	1101	6,25 % BRIGHTER
14	E	1110	3,13 % BRIGHTER
15	F	1111	1,56 % BRIGHTER

Fig. 22: Table with overview of the 4 bit dimming telegrams

Operation of ABB i-bus® KNX push buttons

The operation for dimming the lighting with ABB i-bus® KNX is based on the same principle as a conventional electronic dimmer:

– Short button push: switches the lighting on or off
– Long button push: dimming of the lighting (relative dimming)

Every ABB i-bus® KNX push button has two sides. Usually one side is used for dimming down and the other side for dimming up. The product series solo® and Busch-*triton*® feature the option of assigning freely dimming up and down to the required side of the push button. With the Busch-*priOn*®, it is now also possible that each side of a rocker can switch and dim lighting, i.e. a rocker can dim two lighting circuits independently of one another, see also 1 button dimming (Fig. 23).

3.1.3. Dimming with Binary Input BE/S x.x or Universal Interface US/U x.2

A Binary Input BE/S x.x or a Universal Interface US/U x.2 allows the connection of conventional push buttons, see chapter 2.1.1.2. With the respective application, the function Dimming can also be realised with this solution.

The control possibilities of the function Dimming are differentiated with a Binary Input BE/S x.x or a Universal Interface US/U x.2 in:

– 2 push button dimming
– 1 push button dimming

2 push button dimming

The function of the 2 push button dimming, is comparable with a double end ABB i-bus® KNX push button. Two channels of a binary Input are required for operation. An input with a push button switches the lighting on through short actuation of the button push and dims the lighting up with an extended button push. Accordingly a second push button switches off the lighting with a short button push and dims the lighting down with a long button push.

1 push button dimming

With 1 push button dimming, the complete function dimming is implemented with just one channel of a binary input The function switching and dimming can be completely controlled using just one push button, where the dimming telegram BRIGHTER and DARKER are sent alternately with a long actuation of the push button. It is also possible to send 1-byte values and accordingly different brightness values.

Object value *Switch*	**Value of the last dimming telegram**	**Reaction of the dimming actuation (sends dimming telegram)**
OFF	DARKER	BRIGHTER
OFF	BRIGHTER	BRIGHTER
ON	DARKER	BRIGHTER
ON	BRIGHTER	DARKER

Fig. 23: Dimming function with 1 push button dimming

If the communication object *Switch* has the value 0, a BRIGHTER telegram is always sent. This ensures that the lighting will get brighter when dimming up without a previous switch on by a short operation of the push button. In order to evaluate the switch feedback of the actuator, the Write flag of the communication object Switch must be set.

The dimming function is implemented with classic electronic dimmers. Only one push button and a channel of the Binary Input or Universal Interface is required. This means a considerable saving in costs.

Dimming with 1-byte brightness value

In addition to both communication objects *Switch* (1 bit) and *Dim* (4 bit), dimming actuators provide the communication object *Brightness value* (1 byte). The dimmer feeds back its brightness value using this communication object. A brightness value can also be received.

If for example, a push button sends a brightness value, the dimming actuator switches on the lighting and dims down to the corresponding value.

A further possibility to realise a dimming process is to send this 1 byte brightness object cyclically with a rising or falling value. Visualisation software or the Controlpanel operate using this functionality.

Dimming without 1 byte brightness communication object (Preset)

If it is not wanted or possible to operate with the 1 byte brightness communication object, the *Preset* brightness value of the dimming actuator can be recalled using the preset. The set brightness value in the parameters can be accessed via a 1-bit telegram.

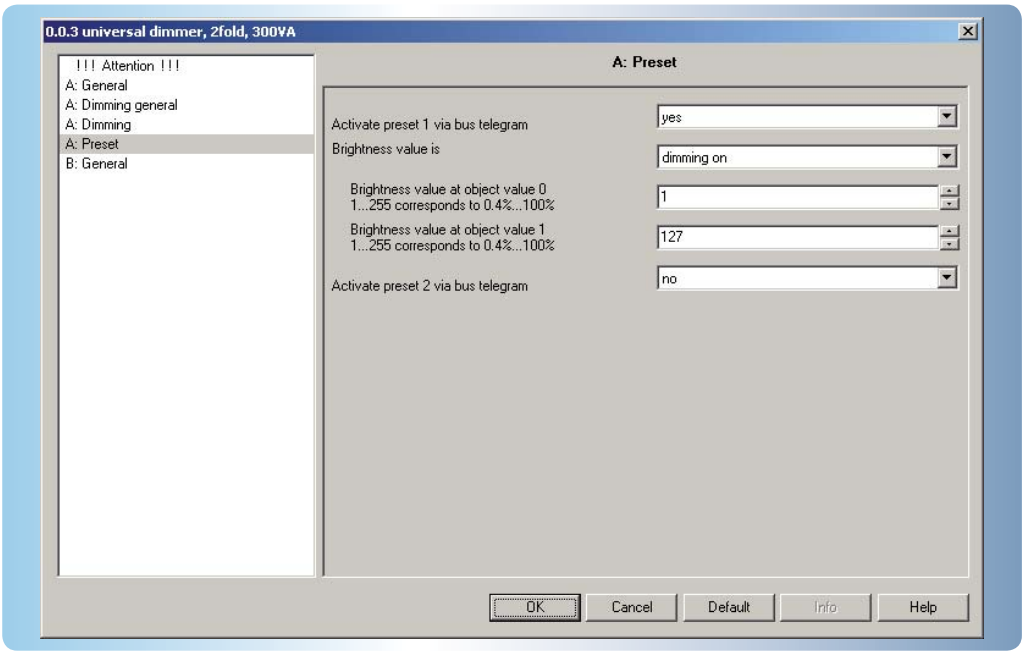


Fig. 24: Parameter *Preset*

3.2. Function Staircase lighting

A defined form of lighting is understood under the designation function staircase lighting. It lights up for a predefined time after switch on and switches off automatically. This form of lighting is known mainly from its use on staircases and stairwells, hence the name. The lighting can also be switched off before the time has elapsed using the push button if set accordingly on the actuator. The staircase lighting time can be restarted by pressing the push button again.

In a dwelling there are many rooms where someone is present only for a short time, e.g. halls, guest bathrooms, storerooms and pantries. Different staircase lighting times have been programmed for these rooms. For example, the light in the hall switches off after two minutes and the light in the guest bathroom after ten minutes.
Furthermore, an absence button has been setup in the dwelling with ABB i-bus® KNX.
This button with integrated staircase lighting circuit, triggers among other functions, the following steps: The light in the hallway remains on for one minute, the external light remains on for two minutes and the light in the garage for five minutes.

Thus a safe lighting level is ensured when leaving the building. The need to go between different light switches and contemplating if the light is really switched off is no longer an issue.

3.2.1. Setting the staircase lighting time

The function staircase lighting is a standard function of the switch actuators. The time duration is set in the actuator parameters.

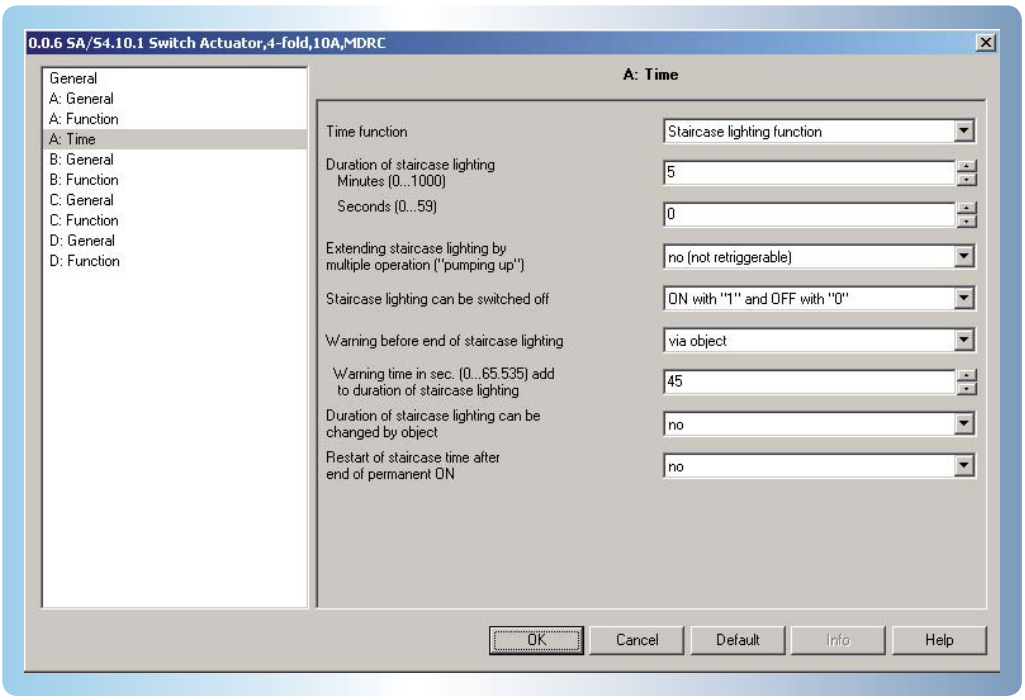


Fig. 25: Parameter *Duration of staircase lighting* SA/S 4.10.1 (all SA/S x.x actuators feature the same function)

Control functions

A system with ABB i-bus® KNX provides a whole range of special functions, e.g. extension of the staircase lighting time, warning signal before the staircase lighting time elapses etc. Some functions are described in the chapters 3.2.1.1 – 3.2.1.5.

For further information see Switch actuator documentation.

3.2.1.1. Deactivation of the function staircase lighting

If required the function staircase lighting can be deactivated for a determined time. It is thus possible, for example, to permanently illuminate the staircase in an office building during the day and to use the function staircase lighting at night. This is controlled by the *Disable Time Function*:

Number	Group Addresses	Description	Name	Object Function
0			General	In Operation
10	8/7/8	Light Window	Output A	Telegr. Switch
11			Output A	Permanent ON
12	9/3/26		Output A	Disable Time Funktion
14			Output A	Telegr. warning stair lighting
30	8/7/9	Light middle HS/S 3.1	Output B	Telegr. Switch
40	1/1/10	Light middle push button	Output B	Forced Positioning
50	8/7/10	Light Wall	Output C	Telegr. Switch

Fig. 26

If this function is established with the group address 9/3/26, the function staircase lighting can be activated or deactivated for example, via a timer on the caretakers control panel.

3.2.1.2. Function staircase lighting with an assigned switch actuator

Some functions cannot be set simultaneously. If for example, an on/off delay is used, an additional function staircase lighting is not possible on this switch actuator.
The solution is implemented by delegating the function to another ABB i-bus® KNX component:

– Logic Module LM/S 1.1
– Application Unit ABL/S 2.1

Function staircase lighting with Logic Module LM/S 1.1

The group address of the switch actuator is entered in the communication object *Staircase lighting input*. The duration time is entered in the parameters. After actuation of the function staircase lighting, Logic Module LM/S 1.1 sets the group address to the value 0 and sends it after the preset time has elapsed. The lighting switches off.

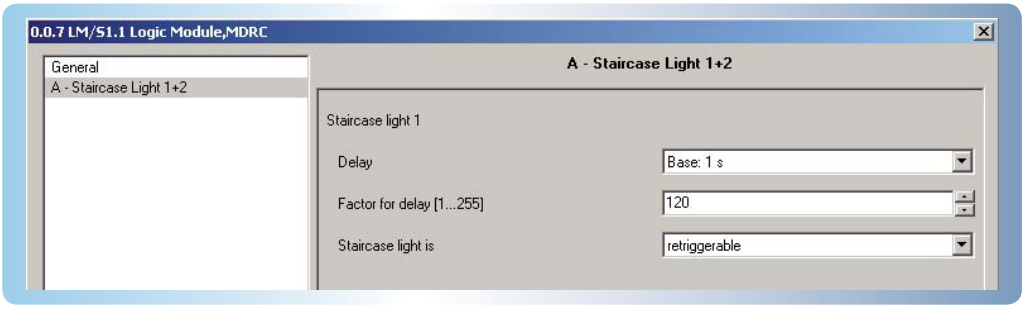


Fig. 27: Parameter window *Staircase light* of the LM/S 1.1

The option *Staircase light is retriggerable* this means it is possible to restart the switch on time while still in operation.

Using communication object *Staircase light disable*, the function staircase lighting can be deactivated.

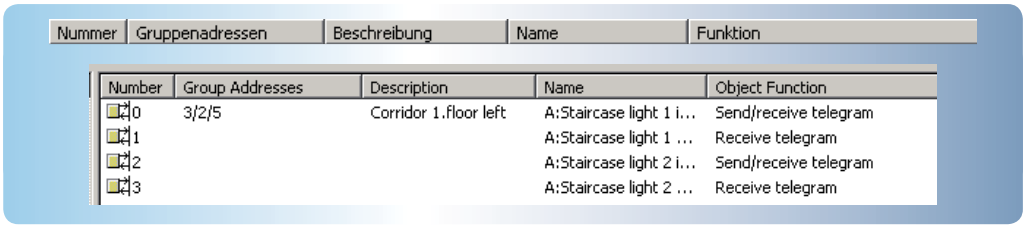


Fig. 28: Communication objects LM/S 1.1

Function staircase lighting with Application Unit ABL/S 2.1

The Application Unit ABL/S 2.1 has a graphic programming interface.
The function staircase lighting is easy to implement here.

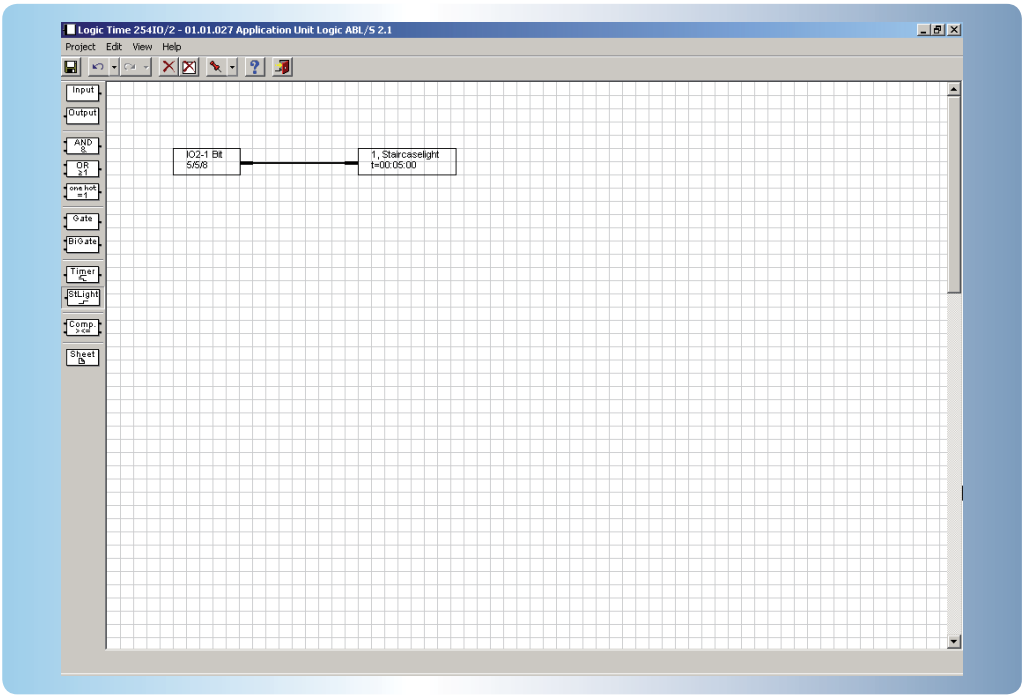


Fig. 29: Function Staircase light with ABL/S 2.1

A push button sends a telegram with the group address 1/0/4 and the value 1 to the switch actuator. The light switches on.
With this setting the group address 1/0/4 is reset to zero and sent after five minutes.
The lighting is switched off.

Special features of the function staircase lighting with LM/S 1.1 and ABL/S 2.1

With both solutions it is possible to sent back a different group address on the bus as the one received. This option is always important particularly if the switch on group address is also linked to other functions than the switch off function.

On a building alarm system different functions are linked with the electrical installations.
For example, the lighting at the entrance door should be switched on briefly when arming the alarm system if the arming process was successful. This programming feature has been implemented with the ABL/S 2.1.

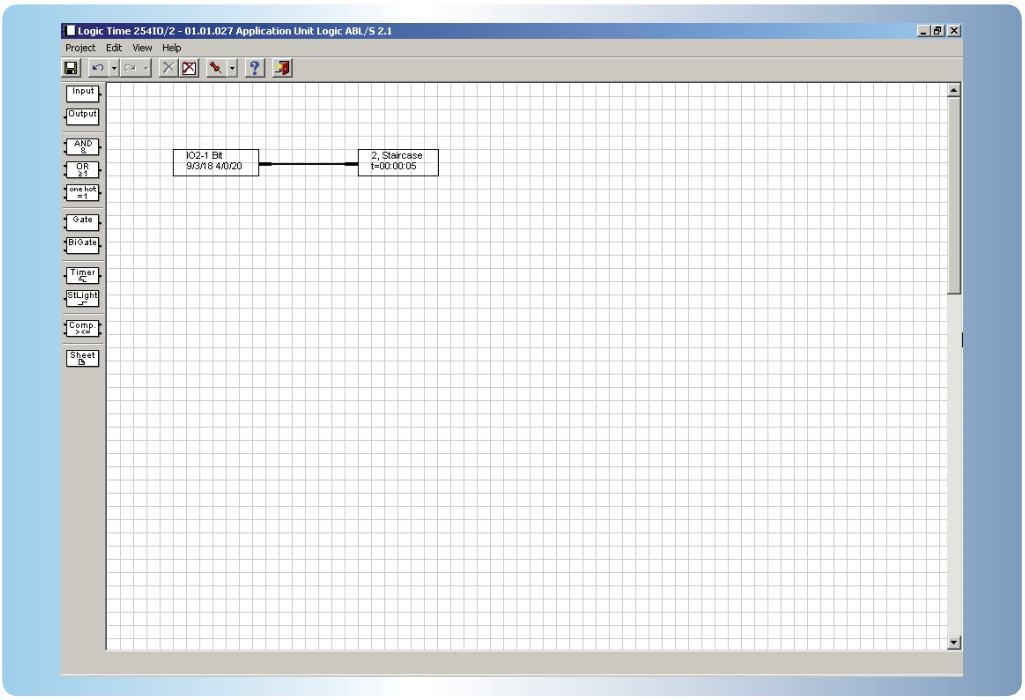


Fig. 30: Different functions when switch on and off

If arming of the alarm system has been successful, the arming feedback signal is sent on the bus via group address 4/0/20 with the value 1. The lighting at the entry door is briefly switched on, function staircase lighting = 5 s. After the staircase lighting time has elapsed, the group address 9/3/18 with the value 0 is sent on the bus.
This group address only concerns the lighting at the entrance door. If the same group address (4/0/20) is sent on the bus after the staircase time has elapsed, all other linked functions (e.g. reduction of the heating) are switched off.

The first group address entered, here 9/3/18, is always the sending group address. This means that this is sent back on the bus by the ABL/S 2.1.

3.2.1.3. Staircase light and permanent light

Depending on the function of the building, the possibility to switch from a function staircase lighting to a function permanent lighting and back again using a push button is very important. The changeover of the lighting function is realised by assigning both the long and short operation with a lighting function. This solution is possible with:

– ABB i-bus® KNX push buttons
– Binary Input BE/S x.x and Universal Interface US/U x.2

ABB i-bus® KNX push buttons

With the application *Shutter Sensor,* all ABB i-bus® KNX push buttons have the possibility to differentiate between long and short actuation and to only send one 1-bit telegrams.

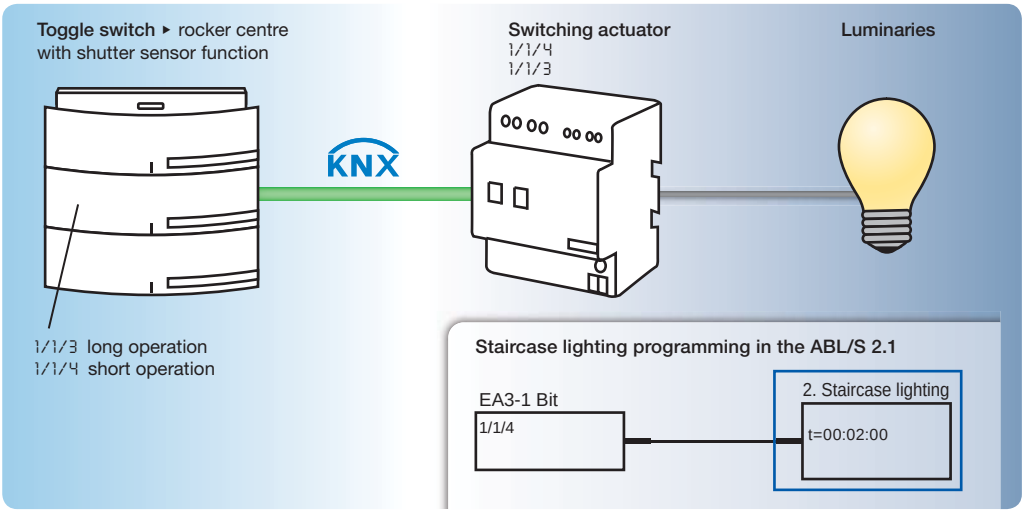


Fig. 31: Staircase lighting with ABL/S 2.1

The rocker ends can be parameterised. On one side of the rocker switch, here using the centre rocker on the right, an ON telegram and the staircase lighting time are sent by short actuation, group address 1/1/4. With longer actuation of the push button the lighting is switched on via group address 1/1/3, without a staircase lighting time.
The rocker on the left side in conjunction with the OFF telegram switches off the lighting in every operating state.

Binary Input BE/S x.x and Universal Interface US/U x.2

On both devices the function *Switch sensor with the distinction of long/short operation* is selected. The communication object *Short operation* is controlled via the function staircase lighting ABL/S 2.1 and linked with the communication object *Switch* of the switch actuator.
The communication object *Long operation* is connected directly to the switch actuator via another common group address. Now it is possible to start the staircase lighting time with a short operation and to switch on the permanent lighting with a long operation.

The solution is even easier with the switch actuators MDRC SA/S x.x and the Room Controller with the *Permanent ON* function, see following chapter.

3.2.1.4. Function staircase lighting with MDRC Switch Actuators SA/S and Room Controller RC/A

Both the MDRC SA/S as well as the Room Controller have a considerably extended range of functionality.

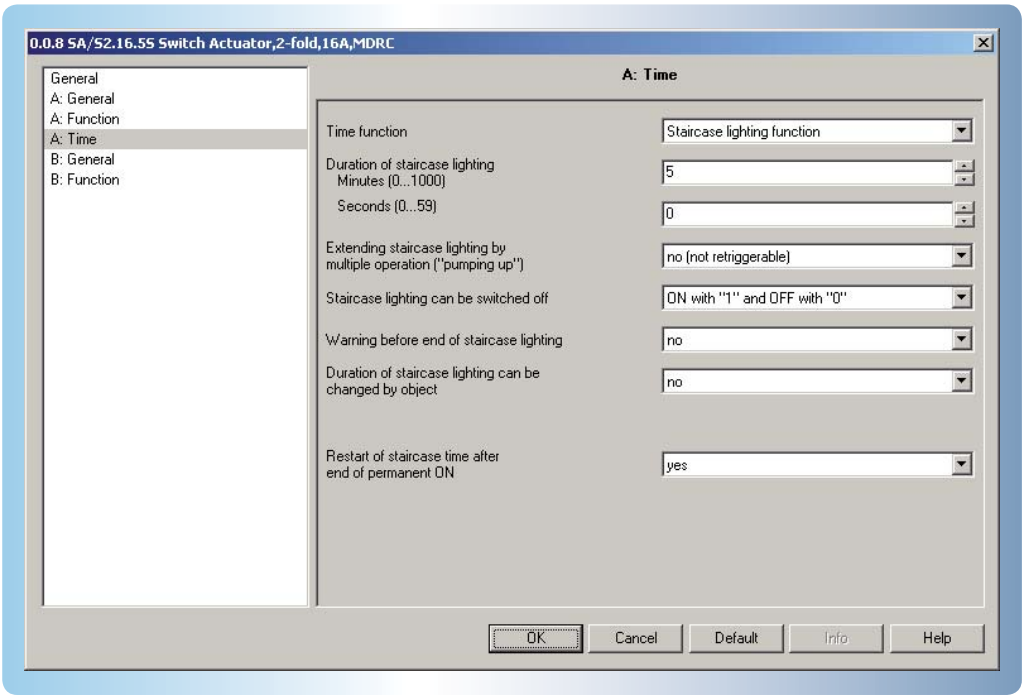


Fig. 32: Parameter window Time of the Switch Actuator SA/S with function staircase light

Pumping up function

The staircase lighting time is extended if the button is actuated several times. It can be extended up to 5 times of the original time. The basis is the time set in the parameters.

Staircase lighting switch off function

Generally the lighting can be switched off during the staircase lighting time. The function can be blocked with this parameter. This is comparable with the function deactivate staircase lighting with the previous generation of devices (AT/S 8.16.5, AT/S 8.10.1 or AT/S 8.4.1).
It is also possible to select what should happen after *Permanent ON* has ended, e.g. if the lighting should switch off immediately or only after the staircase lighting time has elapsed.

Warning before impending staircase lighting switch off function

It is possible to sound an acoustic warning shortly before the end of the staircase lighting time. This is implemented by sending a further ABB i-bus® KNX telegram with a different function.

Change duration of function staircase lighting via communication object

Up to now the duration of the staircase lighting could only be defined via the parameter setting and could only be changed there using the ETS. With the Switch Actuators SA/S x.x and the Room Controller RC/A x.2, the duration of staircase lighting can vary via a telegram, e.g. together with a display.

Permanent ON

There is a further communication object with which the channel can be switched to *Permanent ON* independently of the function staircase lighting.

3.2.1.5. Function staircase lighting with motion detectors

It is necessary to operate with the function staircase lighting if several motion detectors are connected in parallel.

For further information see chapter 3.5 Occupancy-dependent control.

3.3. On and off delay

The on and off delay is used frequently in the area of lighting. With this control function, after sending the ON telegram the function *Switch on of the lighting* is only triggered with a delay and/or after sending the OFF telegram, the function to switch off the lighting is triggered with a delay.

In internal toilets the ventilation is often switched together with the lighting. The ventilation control is comfortable to implement with an on/off delay. The lighting is immediately activated and the ventilation switches on and off with a delay. For example, the fan starts to operate 30 seconds after operation of the button and not shortly after the toilet is entered. After leaving the toilet the lighting switches off immediately but the ventilation will switch off for example, only after a delay of five minutes.
Even in very large buildings the ON/OFF delay is a very comfortable control function. During the night for example, security personnel must make their rounds at regular intervals. For this purpose the lighting for all areas is switched on. In order to avoid an overload in the energy supply (increased switch on current), switch on of the lighting should be undertaken in different areas at different time intervals. It is possible to switch the different lighting circuits to suit the times of the rounds made by security personnel.

A very useful side effect is that this switch on delay can be visualised in the control room. The security personnel in the control room always can see where the guards currently are on their rounds.

3.3.1. Setting of the On/Off delay

The time function is a standard function of the switch actuators. It is set in the parameters.

In the following the setting options are explained based on the Switch Actuators SA/S 8.16.5. The procedure is however identical with all Switch Actuators SA/S.

3.3.1.1. Enable function time

The function Time must be enable first.

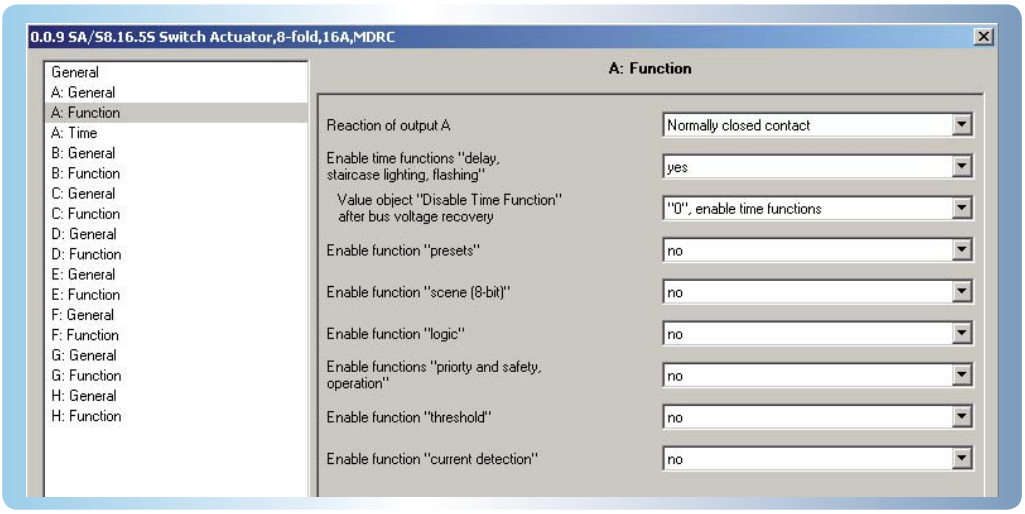


Fig. 33: Enable function Time

With the next parameters it is possible to activate the time function even after bus voltage recovery, corresponding to the first switch-in of the device.

Subsequently the delay is activated and the required delays are set in the *Time* menu.

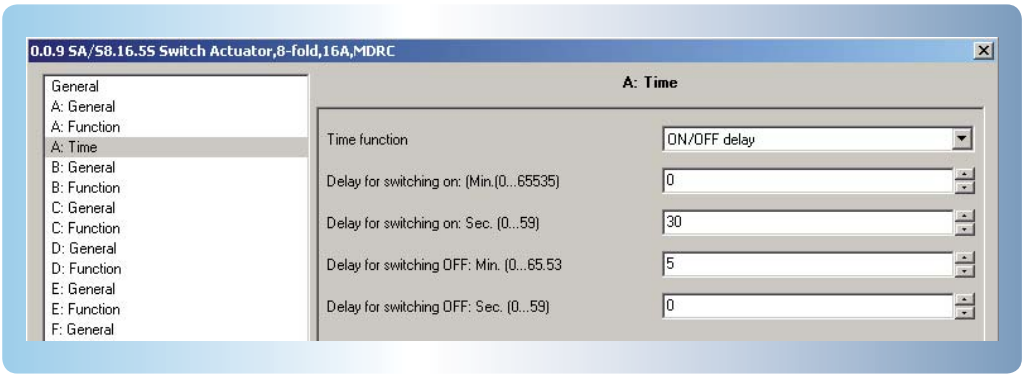
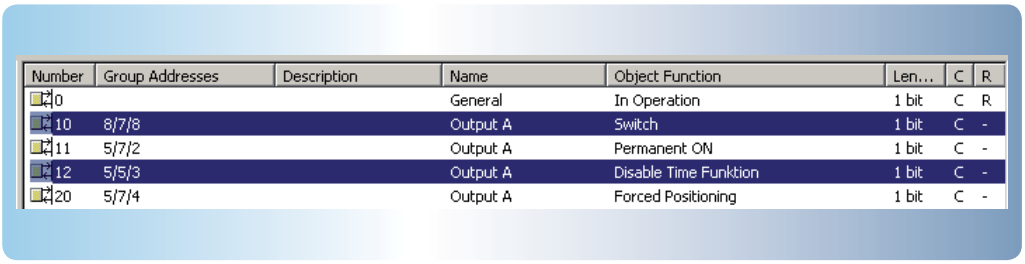


Fig. 34: On / off delay selection

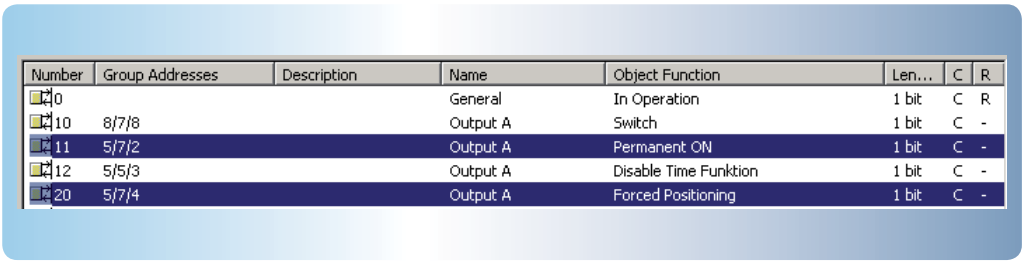
The time function is only active if the channel is addressed by the *Switch* communication object. Via communication object *Time function disable*, the time function can be deactivated with a logical 0 and activated with a 1.



Number	Group Addresses	Description	Name	Object Function	Len...	C	R
0			General	In Operation	1 bit	C	R
10	8/7/8		Output A	Switch	1 bit	C	-
11	5/7/2		Output A	Permanent ON	1 bit	C	-
12	5/5/3		Output A	Disable Time Funktion	1 bit	C	-
20	5/7/4		Output A	Forced Positioning	1 bit	C	-

Fig. 35: Communication object *Time function disable*

If the time function is enabled the lighting can be switched on or off at any time without a time function via the *Permanent ON* communication object.



Number	Group Addresses	Description	Name	Object Function	Len...	C	R
0			General	In Operation	1 bit	C	R
10	8/7/8		Output A	Switch	1 bit	C	-
11	5/7/2		Output A	Permanent ON	1 bit	C	-
12	5/5/3		Output A	Disable Time Funktion	1 bit	C	-
20	5/7/4		Output A	Forced Positioning	1 bit	C	-

Fig. 36: Communication object *Permanent ON*

There are also four additional so-called priority communication objects, which can be switched with a higher priority, e.g. forced operation.

The time delays can be deactivated at any time without external devices.
The switch actuators in the application are very flexible.

For further information see Switch actuators product manual.

3.3.1.2. On/Off delay with assigned switch actuator

If the switch actuator is assigned, e.g. when function Flash is used (both functions cannot be set simultaneously), the switch on/off delay must be delegated to another ABB i-bus® KNX module.
This can be implemented with the following solutions:

- Logic Module LM/S 1.1
- Application Unit ABL/S 2.1

Logic Module LM/S 1.1

The setting of the ON/OFF delay with the Logic Module LM/S 1.1 is undertaken in the parameters.

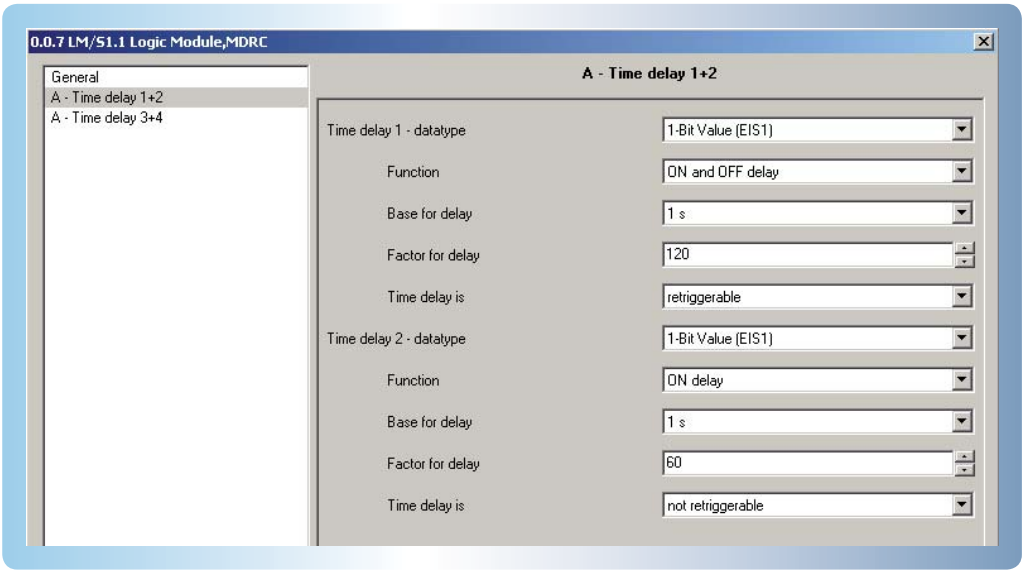
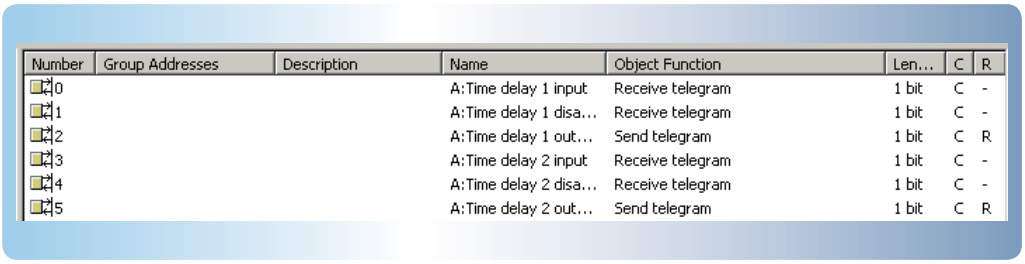


Fig. 37: Parameter timer LM/S 1.1

There are two communication objects in the Logic Module LM/S 1.1: *Input and output*. The group address of the sensor is sent to the *Input*, from the *output* a group address is sent to the Switch Actuator. Two timers of the Logic Module LM/S 1.1 must be used to implement different times for the on and off delay. In total there are twelve timers available in a LM/S 1.1.

For each of these timers the *retriggerable* function can be freely selected. Hereby it is possible to restart the delay time by sending the telegram again (pressing the button again).



Number	Group Addresses	Description	Name	Object Function	Len...	C	R
0			A:Time delay 1 input	Receive telegram	1 bit	C	-
1			A:Time delay 1 disa...	Receive telegram	1 bit	C	-
2			A:Time delay 1 out...	Send telegram	1 bit	C	R
3			A:Time delay 2 input	Receive telegram	1 bit	C	-
4			A:Time delay 2 disa...	Receive telegram	1 bit	C	-
5			A:Time delay 2 out...	Send telegram	1 bit	C	R

Fig. 38: Communication objects Timer LM/S 1.1

The time delay can be deactivated by the communication object *Block*.
Thus no telegram is sent on the output.

Application Unit ABL/S 2.1

With the graphic user interface of the Application Unit ABL/S 2.1 an on/off delay is very easy to realise.

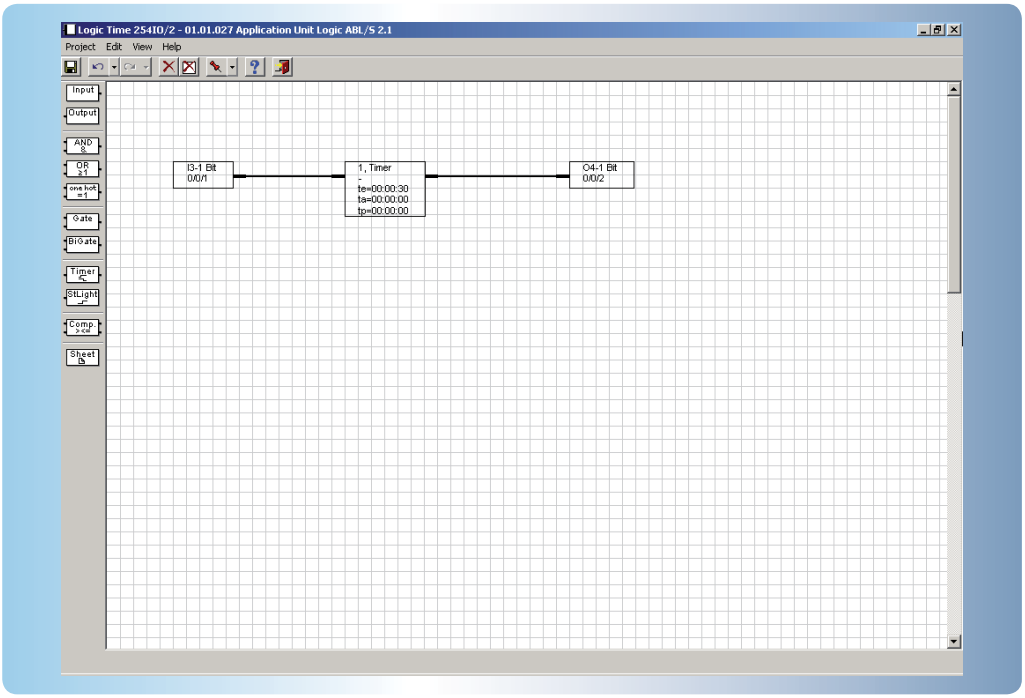


Fig. 39: Switch on/off delay with ABL/S 2.1

With this setting the group address 0/0/1 is sent with the value 1 and 30 seconds later the group address 0/0/2 is then redirected with the value 1. After sending the OFF telegram, the group address 0/0/2 is transmitted with the value 0 (switch-off telegram) only after five minutes. The pulse duration *tp* is also a type of function staircase lighting within the *Switch on/off delay*. If the pulse duration is activated the output is switched on after the switch on delay has elapsed. After the pulse duration has elapsed the output is automatically switched off again.

3.4. Time control

The time control is a favourite function for the control of lighting which allows defined circuits to be switched on and off automatically as a time dependent function.

1. In a dwelling the lighting is controlled via a timer during absence of the occupants. By simulation of the presence of the occupants it is difficult for strangers to determine if the occupants are, e.g. on holidays.
2. In a manufacturing company the production and break times are fixed. If for example, work starts at 7 a.m. with the first break from 9 a.m. to 9.15 a.m., lunch from 12.00 a.m. to 12.30 a.m. and works ends at 3.45 p.m. At these times all lighting circuits with the exception of the lighting in the walkways are switched off.

Control functions

With an ABB i-bus® KNX bus system, it is easy to control the timer with a central time control clock.

Possible devices for realisation of a time control are:

– Classic ABB i-bus® KNX clocks with 2 ... 4 channels
– LCD display MT701
– Controlpanel or Busch-*ComfortTouch*®
– Application Unit ABL/S 2.1 with Application Times/Quantities
– Visualisation software

The switch actuators alone do not provide the option of switching at certain times.
This would be too complex as each device would require its own timer (Quartz).
The actuators provide relative time functions such as switch on and off delays or staircase lighting functions, see chapters 3.2. and 3.3.

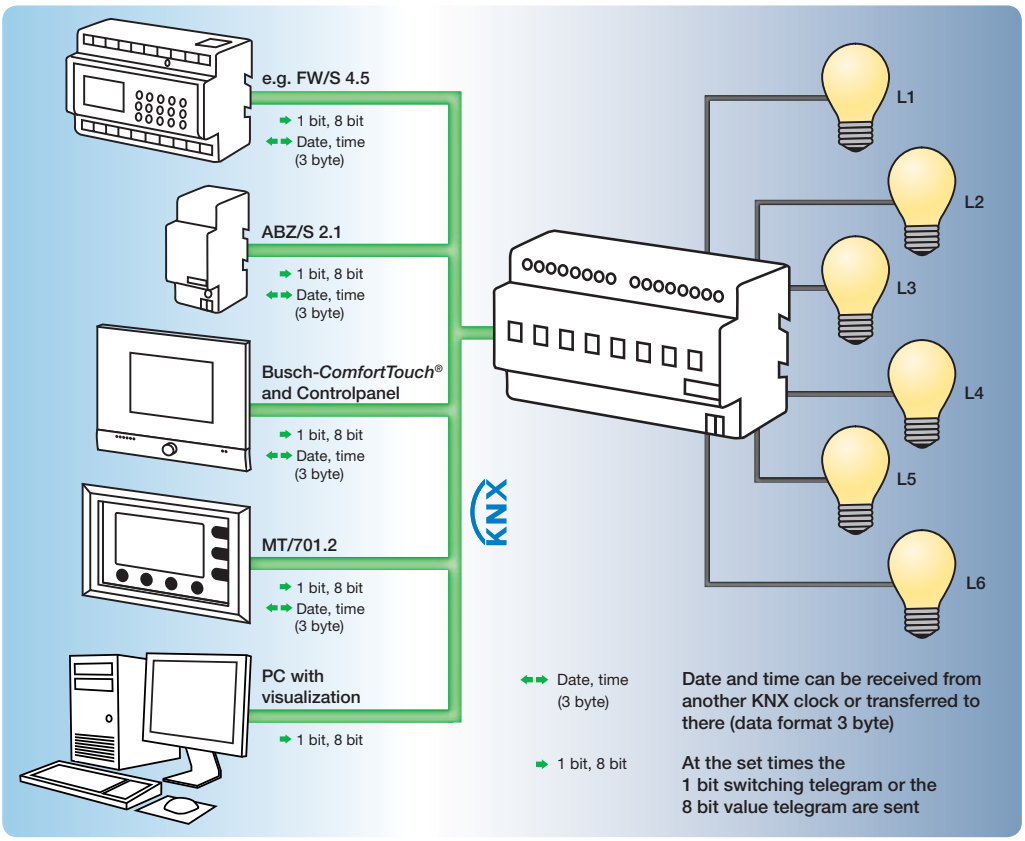


Fig. 40: Overview ABB i-bus® KNX devices with function time

3.4.1. Classic ABB i-bus® KNX clocks with 2...4 channels

The classic ABB i-bus® KNX clocks are available as weekly and yearly clocks. A weekly time switch can only differentiate between the seven days of the week. A yearly timer can be used to activate an independent timer program on a certain day of the year.
The switching times are set with a keypad on the device.

Using a programming set and a memory card it is possible to program this time switch with a PC. The memory card can be used to transfer time programs on to the FW/S 4.5 Radio Time Switches. This Time Switch is a radio time switch, i.e. it receives the exact time in a radius of 1000 km around Frankfurt/Main, Germany. Accordingly, there are no offsets in the time switches in buildings with several of these switches.
At certain times 1 bit or 8 bit telegrams can be sent

The classic ABB i-bus® KNX clocks have a limited number of channels and switch functions. The setting of the switching times via the integrated keypad takes time getting used to and therefore not very user-friendly. Assignment of the loads to the channels can be undertaken using ETS. This is generally not accessible to end customers.

3.4.2. Display and Control Tableau MT701

More and more ABB i-bus® KNX devices, which are intended for many other functions feature a timer control in their software. In the LCD Display MT701 there are 16 channels available .
The assignment of the channels is implemented via the ETS. Using the display the end customer has the opportunity to set and to change the switch times, the values, the state to be switched and the weekday.

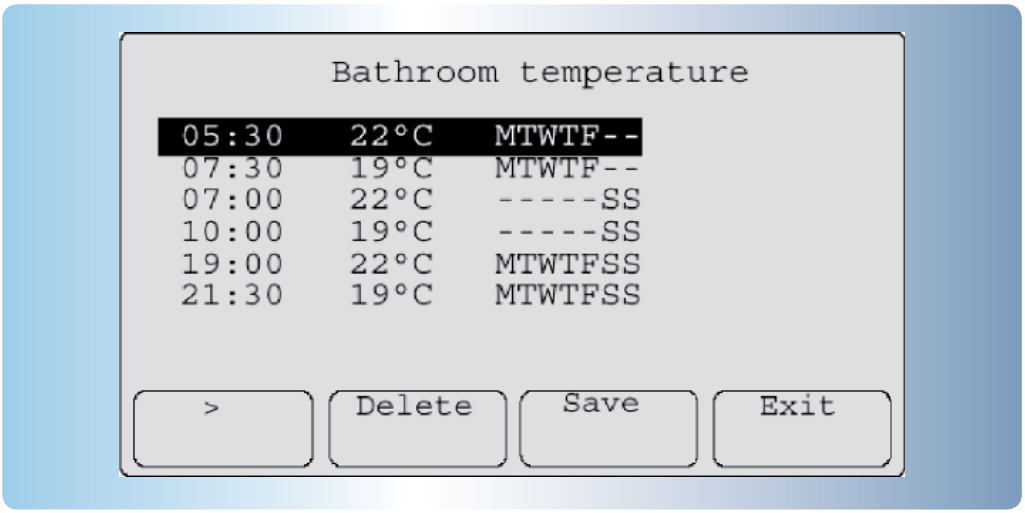


Fig. 41: Function Time MT701

The end customer can change the settings.

The Display and Control Tableau MT701 does not feature an integrated yearly time switch.

3.4.3. Busch *ComfortTouch*®, Controlpanel and Busch-*priOn*®

Both devices allow time functions to differing extents:

– Busch-*ComfortTouch*®: Comprehensive time functions with weekly programs, special days and validity intervals.

– Comfortpanel: 20 channels each with 10 time switch functions

In the following, you can see the user setting options of the panel for the time functions using the Controlpanel as an example:

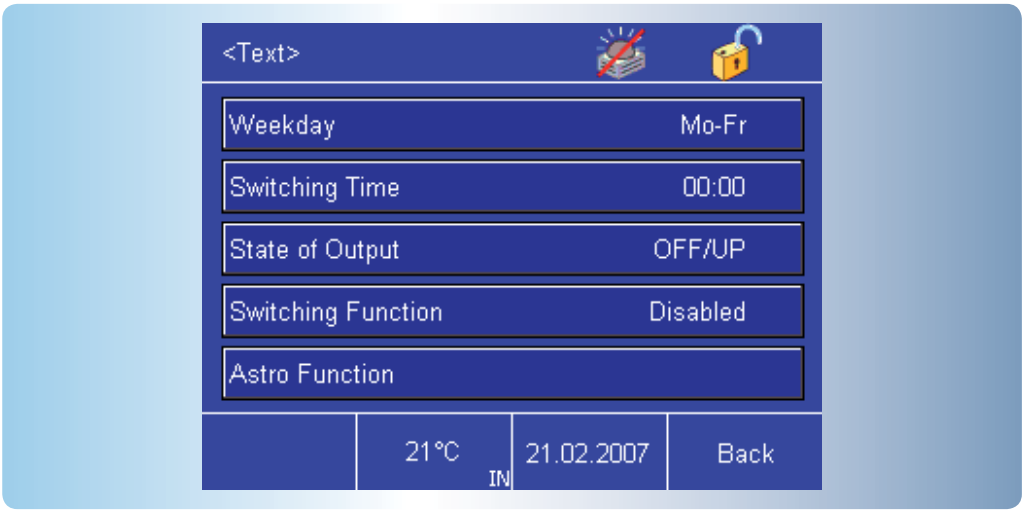


Fig. 42: Controlpanel time functions

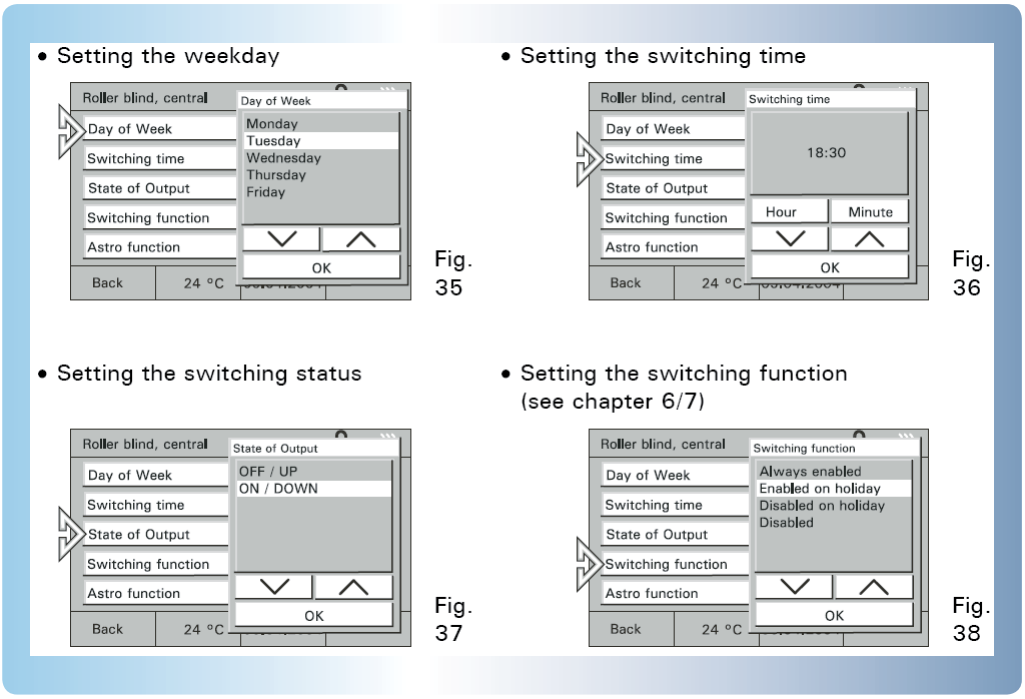


Fig. 43: Setting of the Controlpanel time function

3.4.3.1. Astro function

The Astro function is a very interesting time function of the Controlpanel and Busch-*ComfortTouch*®. A preset time control is corrected to the position of the sun, i.e. it varies slightly every day.

A defined external mood lighting should be set in a Restaurant every day, 30 minutes before the sun goes down. Over the course of a year, this does not occur at the same time. To implement the Astro function, the timer function is set exactly 30 minutes before sunset on the Controlpanel on the day it is commissioned. Furthermore, the longitude and the latitude of the project location as well as the date and the time must be programmed.
If the Astro function is activated the switching time will be adapted over the course of the year.
The mood light switches on every day 30 minutes before sunset.

3.4.4. Application Unit ABL/S 2.1 with Application Times/Quantities

The software features a very large timer with 800 switching times. It can be assigned to any number of loads. The basic programming is implemented via the ETS, but can be easily changed by the end customer using programming software PZM2 and without using ETS. In principle it is a weekly timer. By compiling up to 100 special days or time periods, individual days can be considered, e.g. holidays. Telegrams with 1 bit or 8 bits can be sent.

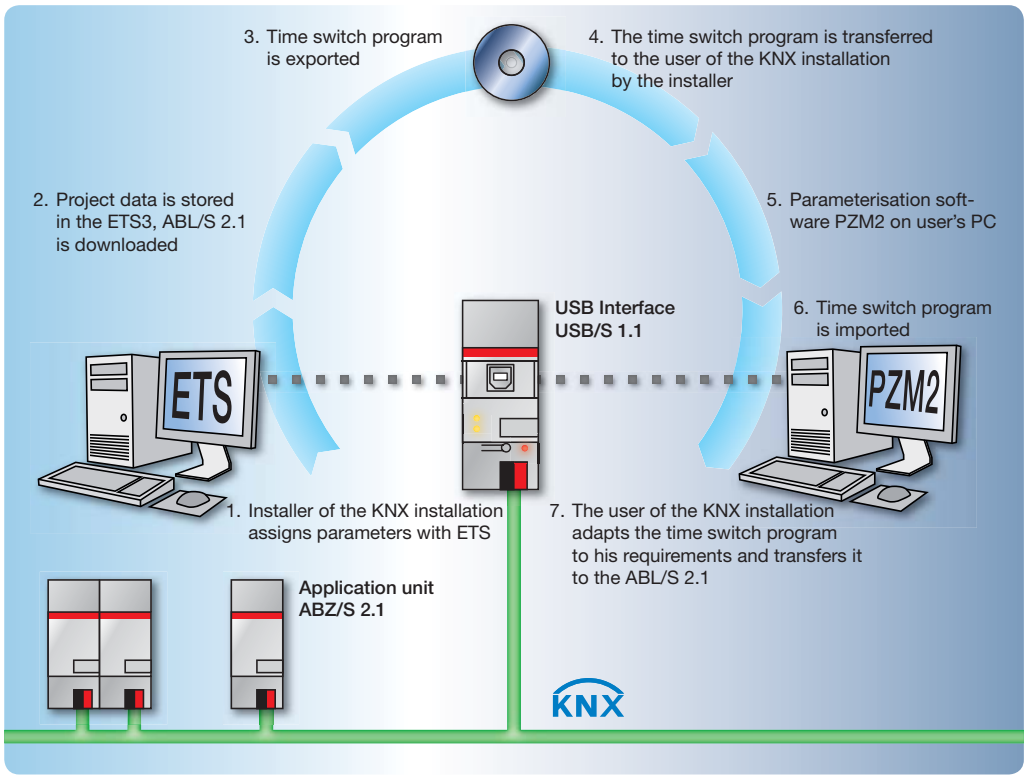


Fig. 44: Programming with ETS and PZM2

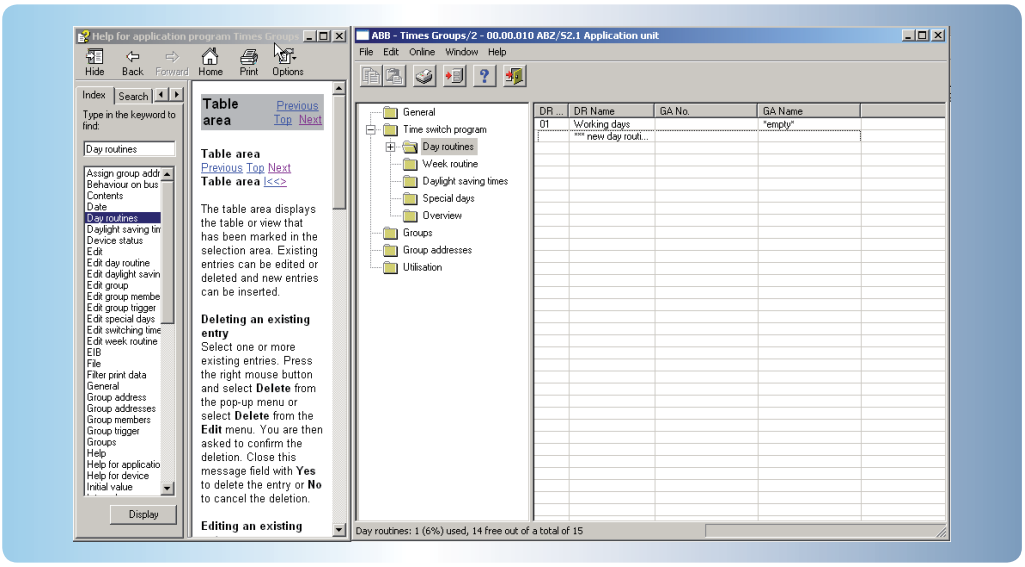


Fig. 45: View of the user interface application Times/Quantities

3.4.5. Visualisation software

A visualisation software (e.g. Eisbaer or BCON) that is installed on the PC provides a comprehensive timer. The internal clock of the computer receives the time and date. Comprehensive time switch functions can be implemented in combination with the visualisation software.
On the basis of the different software tools available on the market it is not possible to go into detail at this point.
The following images of the visualisation software WinSwitch indicate a few of the possibilities.

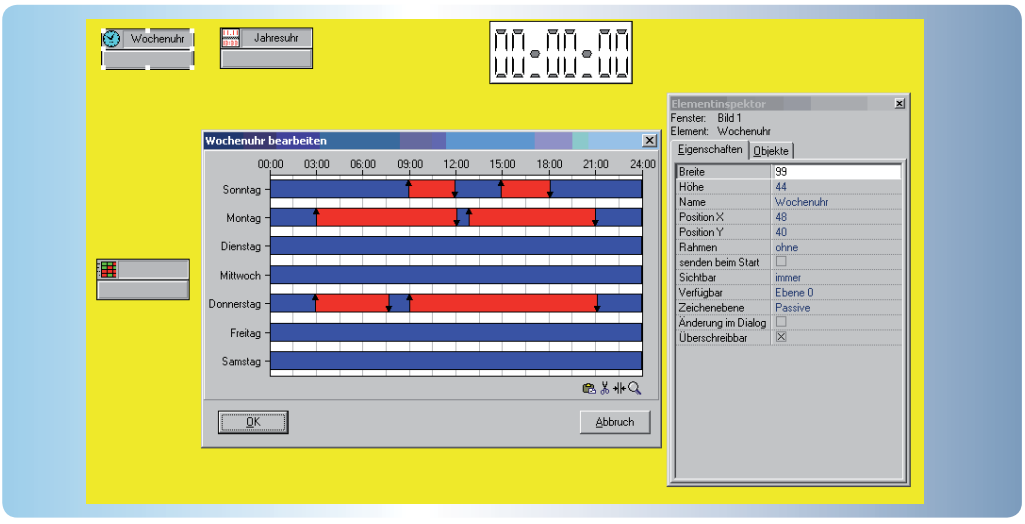


Fig. 46: Setting of the weekly timer

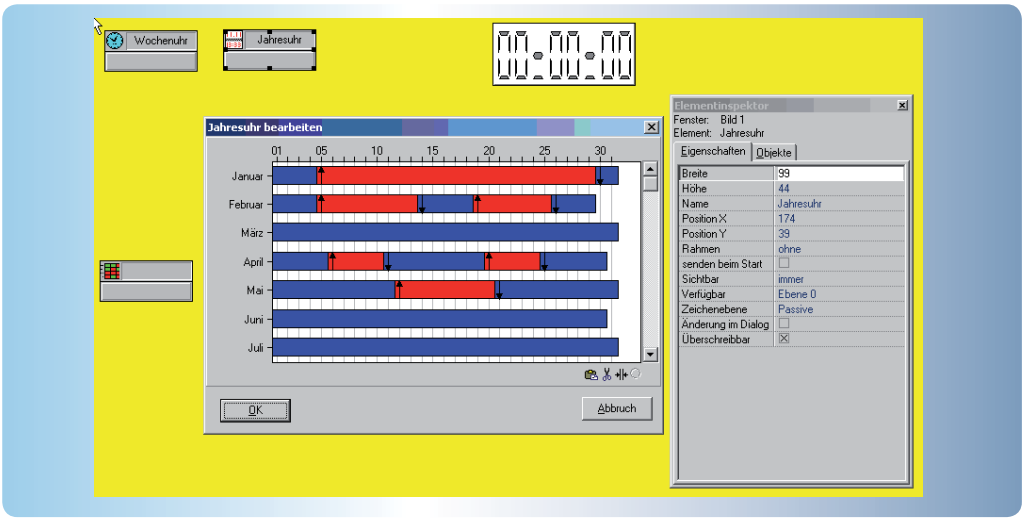


Abb. 47: Setting of the yearly timer

3.5. Occupancy-dependent control

An occupancy dependent control is a control form which uses motion or presence detectors. It detects the presence of persons in the building or in external areas and switches the corresponding lighting on or off.

In many Doctors surgeries, the toilets are within the building, i.e. as soon as a person enters the toilet area the lighting is required. One possibility would be to permanently light the area during opening hours or to allow the person to switch on and off the lights themselves. Unfortunately a lot people forget to switch off the lights.
A more economic solution here is the use of a motion detector. As soon as a person enters the room the lighting is switched on and switched off as soon as they leave the room.

The persons do not need to actuate a button or switch. Switch off of the lighting is assured.
This saves both energy and costs.

3.5.1. Function principle of detectors

In general, motion and presence detector, operate according to the infra red detection principle, i.e. body heat is detected. The detection field is subdivided into a number of segments.
The movement of a warm body from one segment to the next is detected as a motion.
The difference between motion detectors and presence detectors is in the resolution of the segments. The detection segments of a presence detector are smaller due to their higher resolution and therefore react to smaller movements of a person.

Motion detector location

ABB i-bus® KNX motoring detectors are used in areas in which people move actively in the detection area, i.e. walk in this area. Typical areas are halls, staircases and access areas outside the building. Motion detectors are suitable for indoor and outdoor use.

Presence detector locations

ABB i-bus® KNX presence detectors are used in areas that people move very little over a period of time. Typical examples are offices, conference rooms and class rooms. The use of presence detectors is only useful indoors.

alpha *nea*®

solo®

Fig. 48 a: Motion detectors for indoor use

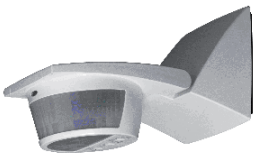


Fig. 48 b: Motion detectors for outdoor use

Fig. 48 c: Presence detector

3.5.2. Detection range of detectors

The detection range varies from detector to detector.

The sensitivity reduces with greater distance from the detector, as the segments in the detection range are larger with distance. The detection end values should therefore only be seen as theoretical values. In practice, half of the stated value is more useful. Here you must test the application or increase the follow-on time, refer to the ABB i-bus® KNX basic functions of detectors, chapter 3.5.3).
The sides of the motion detector lens can be partly taped off to reduce the detection range.
The presence detectors are subdivided into 4 x 90° areas. They can be blanked out individually using the ETS software. The detection radius can be reduced by masking off the lens.

3.5.2.1. ABB i-bus® KNX motion detectors

The motion detectors are available in different product series, e.g. alpha *nea*® and solo®.
The detection ranges are differentiated in normal and multilens types.

Normal

Normal means that the detection of the motion is undertaken as a disc. Mounting at push button height is useful here.

Pets who are underneath the mounted height are not detected.

Multilens

Multilens means a spatial detection.

Mounting on the ceiling is possible, i.e. outside the access area of persons.
The possibility of damage or theft of the detector is made more difficult or significantly reduced.

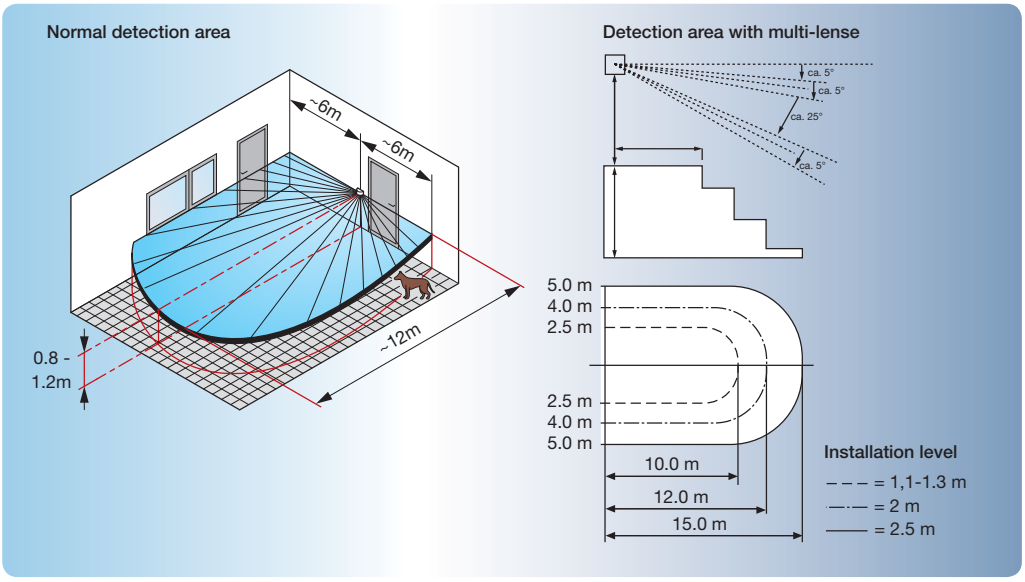


Fig. 49: Detection range of motion detectors

ABB i-bus® KNX presence detector

Presence detectors are mounted in the ceiling and have a detection range of 360°.

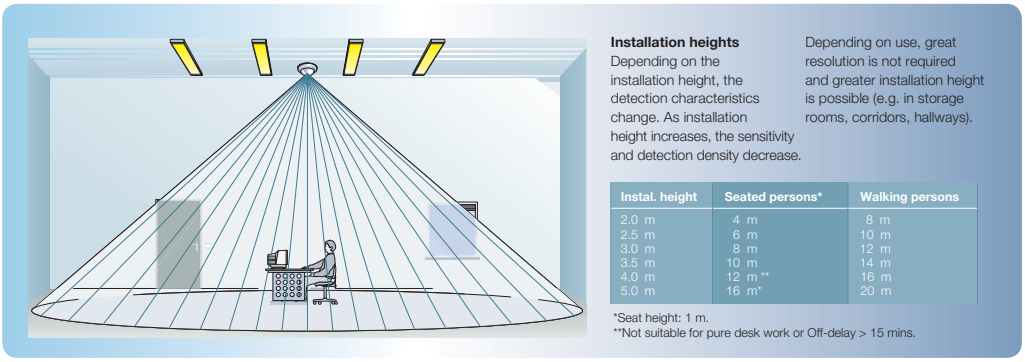


Fig. 50: Presence detector detection range

3.5.3. ABB i-bus® KNX basic functions of detectors

An ON telegram is generally sent if a person enters the detection range of a detector.
The follow-on time starts to run after the detection range has been exited. After the follow-on time has elapsed an OFF telegram is sent to the actuator. The follow-on time prevents an immediate shut-off of the lighting with little or no movement.
The time range of the follow-on time can be freely selected, e.g. in the entry area of a building 30 seconds and in the toilet area 5 minutes.

3.5.3.1. Detectors with brightness sensor

A further function of ABB i-bus® KNX detectors is brightness-dependent control.

In a glazed stairwell the lighting is switched via a motion detector.
The lighting should only be switched on if there is an insufficient incidence of external light. A motion detector with brightness sensor controls this. The brightness threshold value can be set individually.
The parameter follow-on time and brightness threshold can be changed in the ETS or on the device with a potentiometer (on a small setting screw). In the application it is possible to decide where the parameter can be set.

Benefit from setting on the device
The end customers can adjust the values without ETS. This solution is simple and cost-effective for them.

Benefit of setting in the ETS
The end customer cannot change the settings and therefore avoid possible malfunctions.

3.5.4. Working with several parallel detectors

Several detectors can be mounted in order to increase the detection range.

Several detectors are installed in order to detect the entire length of a hall. These only switch one lighting circuit. All detectors and actuators are assigned with the same group address.
The programming of the detector is undertaken in the classical manner, i.e. with an ON telegram at the start of detection, and with an OFF telegram at the end of the follow-on time. If a person enters the detection range of the first detector in the hall, an ON telegram is sent. The person moves on to the detection range of the second detector. An ON telegram is again sent to the actuator. If the person only moves in the detection area of the second detector, the first detector sends an OFF telegram at the end of the follow-on time. This is unwanted in this case.

Solution with motion detectors

If the motion detector detects a movement, this will only cyclically send an ON telegram. The switch actuator is parameterised with the function staircase lighting and switches the lighting off after the preset time. It is important to note that the cycle time of the sensor is shorter than the staircase lighting time of the actuator. Otherwise the undesired intermediate switch off state of the lighting will reoccur.

For further information see Busch detectors, presence ABB i-bus® KNX, manual for electrical specialists

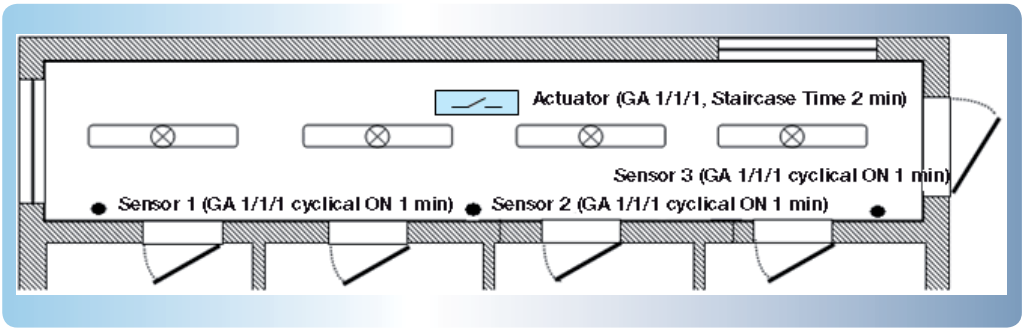


Fig. 51: Parallel operation of motion detectors

The cycle time of the sensors should not be too short in order to reduce the unnecessary telegram traffic load on the bus.

Solution with presence detectors

If several presence detectors are installed in a room, the *master/slave parameters* are used. A presence detector must be selected as the *Standard Master*. All others must be set as the *slave* function. The presence detectors with the *slave* function only send cyclic ON telegrams when motion is detected. The follow-on time is restarted with the *master* presence detector each time a new ON telegram is received.

The same group address is to be used by all presence detectors. If different group addresses are used the follow-on time will be restarted in the master, but the lighting will not be switched on.

3.5.5. Use of presence detectors for monitoring

In the presence detector, the additional *Message* communication object can be activated.

In an office building, a visualisation indicating if persons are within the rooms with presence detectors should be established from 10 p.m.

3.6 Light dependent control and regulation

Particularly comfortable and economical to implement are the control and regulation-dependent functions of ABB i-bus® KNX:

- Daylight dependent control
- Constant lighting control

3.6.1. Daylight dependent control

A daylight-dependent control utilises the available daylight to save operating and energy costs. Prerequisite for the realisation of a daylight-dependent control are windows that allow as much external light as possible into the building.

To implement the control a light sensor is mounted to the exterior of the building. This measures the level of brightness that enters the rooms through the windows. Different options are available to implement the concept:

- Simple realisation with ABB i-bus® KNX
- Optimised realisation with ABB i-bus® KNX

Three lighting strips are installed on the ceiling parallel to the window front in an open-plan office. The light sensor on the building exterior is connected to the ABB i-bus® KNX. Three brightness thresholds are set in the control. When the first threshold is reached, the lighting strip on the window front is switched off. If the second threshold is reached the lighting strip in the middle is switched off and when the third brightness threshold is reached the third lighting strip parallel to the window front is also switched off.

The daylight-dependent control is a cost-effective solution. A light sensor is sufficient for measurement of several rooms. Changes to the assignment are easy to undertake, e.g. if the lighting in the rooms on the ground floor should not be included. Furthermore, the daylight-dependent control can be combined with function dimming. Often one dim channel per room is sufficient to implement. Different brightness stages can be set to suit the brightness level.

In practice the daylight-dependent control does not generate a constant level of brightness by switching. There can be distracting jumps in brightness sometimes in the room. To improve this behaviour, the daylight-dependent control can be combined with the function dimming. This usually means a higher investment in the costs for the actuators. A further disadvantage is that the daylight-dependent control is purely a control. Interference, such as due to darkening of the room by shutters is simply not registered. A control function of this type can be implemented with constant lighting control, see chapter 3.6.2

3.6.1.1. Simple realisation with ABB i-bus® KNX

The brightness thresholds can be set in the light sensor. A 1 bit telegram is sent on the bus if the set value is exceeded or is below the threshold. Generally the threshold value is programmed so that an ON signal is transmitted if the exterior brightness drops below the threshold value, and an OFF signal is transmitted above the threshold value.

An 8 bit telegram can also be sent instead of a 1 bit telegram. This allows the dimming actuator to dim down the brightness level. If the 8 bit telegram is not available, the function *Preset* of the dimming actuator can be used. The function *Preset* allows the recall of a brightness value via a 1 bit telegram.

For further information see chapter 3.1

In the following the parameter settings and the group addressing are indicated using the Brightness Sensor HS/S 3.1 and a switch actuator as an example.

Fig. 52: Brightness Sensor HS/S 3.1 with the respective light sensor

Parent	Number	Group Addresses	Description	Name	Object Function
1.1.74 HS/S3.1 3f-Brightness sensor,MDRC	0			Channel 4	Telegr. value
	1	8/7/8	10000 Lux	Channel 1	Telegr. switch
	2	8/7/9	5000 Lux	Channel 2	Telegr. switch
	3	8/7/10	2000 Lux	Channel 3	Telegr. switch
	4			disable	Disable channel 1…4
1.1.80 SA/S4.10.1 Switch Actuator,4-fold,10A,MDRC	0			General	In Operation
	10	8/7/8	Light Window	Output A	Telegr. Switch
	30	8/7/9	Light middle	Output B	Telegr. Switch
	50	8/7/10	Light Wall	Output C	Telegr. Switch

Fig. 53: Group addressing

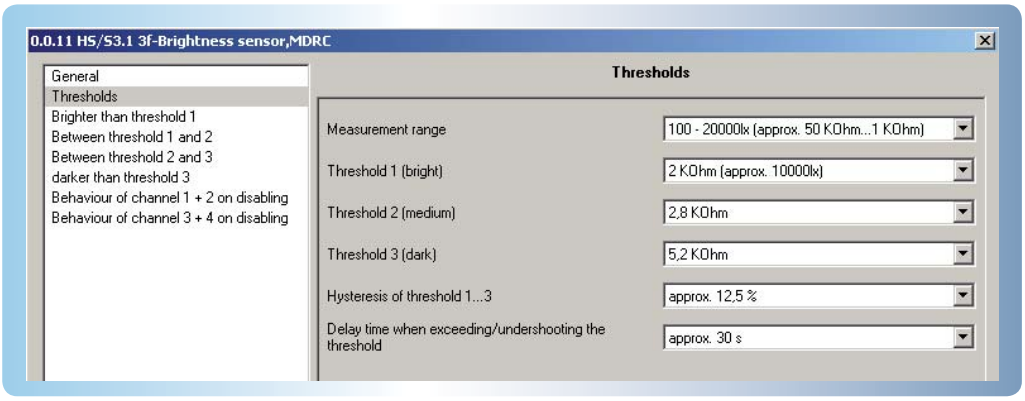


Fig. 54: Threshold values

A further setting possibility involves automatic switch on of the lighting after the brightness level falls below the brightness threshold. This setting leads however, to the effect that at the end of operating hours (work) when the lighting is switched off, it will switch back on automatically with nightfall. It is also possible that the lighting has been switched off by the lighting sensor, and now a person will enter the room and press the light switch. This will lead to the situation where the lighting is no longer switched off by the light sensor.
The optimised implementation of a daylight-dependent control with ABB i-bus® KNX provides various solutions for this effect.

3.6.1.2. Optimised realisation with ABB i-bus® KNX

Different optimised implementation possibilities can be realised with ABB i-bus® KNX using:

– Cyclical transmission
– Logical functions
– Priority control

These possibilities are not the correct choice in every case. It is important to check every project and then to decide on the pertinent option.

3.6.1.2.1. Cyclical transmission

The OFF telegram of the lighting sensor is transmitted cyclically, e.g. every ten minutes.
The ON telegram of the push button is overwritten in this case after a short time.

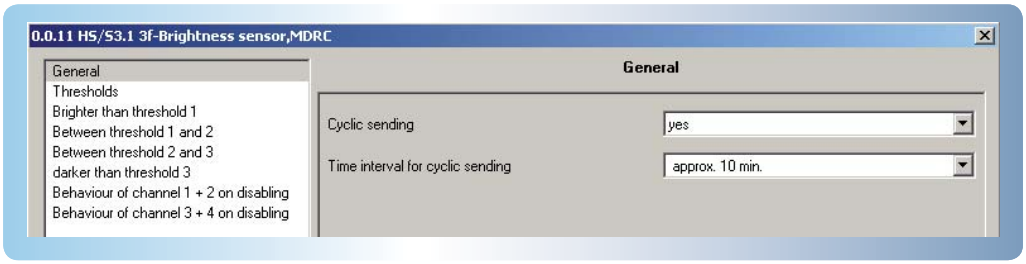


Fig. 55: Cyclical transmission with the HS/S 3.1

Intentional switching-in of the artificial lighting is practically impossible this way.

3.6.1.2.2. Logical functions

With a logical function (AND function) it is possible that only the switched on local push button can control the brightness sensor of the lighting.

The lighting can be switched on at any time.

If someone neglects to switch off the lighting when he leaves the room, the lighting will continue to be controlled via the light sensor when night falls.

Unintended lighting during nigh time can be avoided by sending a central switch OFF telegram to all the lighting in the evening.

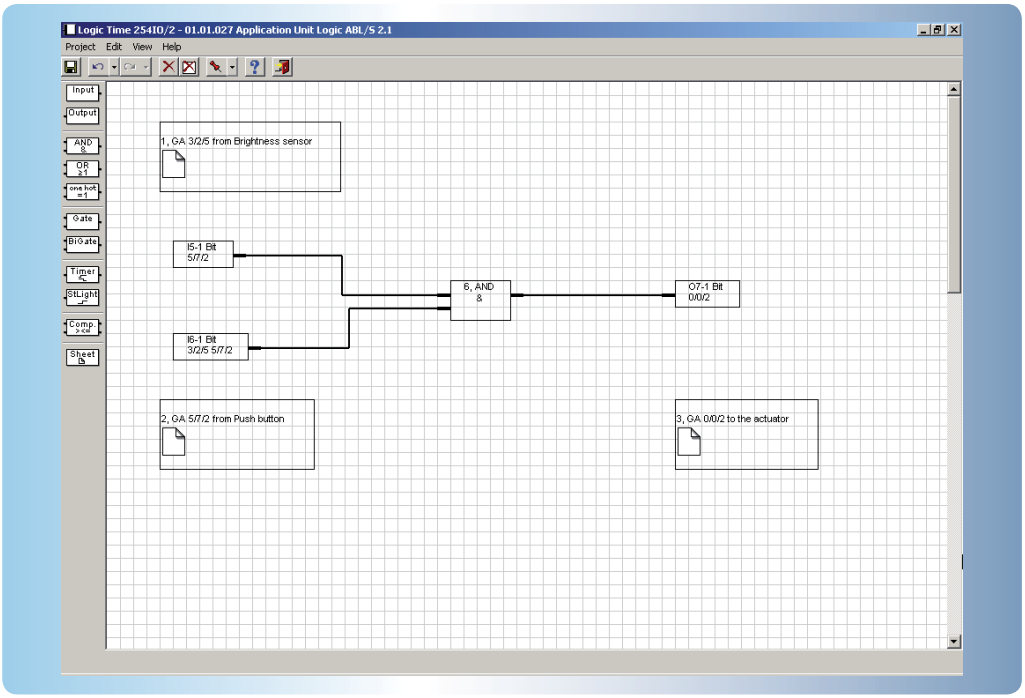


Fig. 56: AND function using the example of the Application Unit ABL/S 2.1

The group address 5/7/2 at both inputs enables switch on and switch off of the lighting using the local push button at any time. This logical function can even be implemented directly in the Switch Actuators SA/S x.x.

3.6.1.2.3. Priority control

The priority control of the switch actuator, e.g. forced operation, is logically linked with the group address of the local push button. Thus the lighting can be switched on using the push button at any time. If the priority communication object is linked with the brightness sensor, the signal of the lighting sensor has a higher priority.

Parent	Number	Group Addresses	Description	Name	Object Function	Len...
1.1.34 6125 1f-Switch sensor,FM	6	1/1/10	Light middle	Rocker 1	Switching	1 bit
1.1.80 SA/S4.10.1 Switch Actuator,4-fold,10A,MDRC	0			General	In Operation	1 bit
	10	8/7/8	Light Window	Output A	Telegr. Switch	1 bit
	30	8/7/9	Light middle HS/S 3.1	Output B	Telegr. Switch	1 bit
	40	1/1/10	Light middle push button	Output B	Forced Positioning	1 bit
	50	8/7/10	Light Wall	Output C	Telegr. Switch	1 bit

Fig. 57: Group addressing

Control functions

Devices which can be used

The Brightness Sensor HS/S 3.1 is the classical solution. Three independent brightness thresholds can be directly set In the parameters.

On the Analogue Input AE/S 4.2 conventional brightness sensors can be connected, e.g. via 0 – 10 V. Up to two brightness threshold values can be programmed.

All setting possibilities are also available with the Weather Station WS/S 4.1 or Weather Station WZ/S 4.1.

A conventional brightness sensor with a potentiometer for threshold value setting and a relay contact for signalling of the exceeded threshold values, must be connected to the bus via a binary Input.

The described system is a controlled system. This means that the light sensors may never be allowed to detect the room and the internal brightness as otherwise an “oscillating system” would result. This function only operates with integrated regulation, see chapter 3.6.2. *Constant lighting control*.

The light sensor is always mounted externally on the exterior of the building and not behind a shutter that could be closed. Even when installed in the interior behind a pane of glass the reflections and diffusion of the light in the glass can lead to malfunctions.

It is possible that more than one light sensor must be fitted per building façade, e.g. because of darkening of the ground floor due to trees. The same is true with shadow effect by other buildings in front of the façade.
A hysteresis should always be established around the threshold value, see parameter window with HS/S 3.1. This prevents frequent switch on and off should the brightness level deviate frequently around the threshold, e.g. with a threshold of 5000 Lux and hysteresis of 12.5 % the real threshold value to be exceeded is 5625 Lux (lighting OFF) and to be undershot 4375 Lux (lighting ON).

The delay time after the threshold value is exceeded or undershot can also be set in the parameters. This has the effect that brief and intense changes in the external light level, e.g. due to breaks in clouds and wind do not immediately lead to immediate switching of the light. The set time defines how long the level can be below the threshold until the switch function is actually carried out.

The limit values which lead to switching of the lighting have to be determined by testing.
Factors of influence are:

- The size of the window
- The decoration of the room, e.g. dark furniture
- Colour of the walls and floor
- Required brightness in the room

3.6.2. Constant lighting control

Optimum lighting conditions in buildings can be realised economically with the constant lighting control of the ABB i-bus® KNX. It can be used to regulate the actual brightness in the rooms. The brightness in the room is measured and the main causes of interference are detected, e.g. darkness due to shutters or partial shading due to buildings directly opposite. An almost perfect level of brightness is therefore achieved in the room without the external influences.
To implement it a dimming actuator, a controller, a brightness sensor with a connection to the ABB i-bus® KNX and a push button for switch on and off, or manual dimming are required. Most frequently, the combination Light Controller / Switch/Dim Actuator LR/S 2.16.1 or 4.16.1 and Light Sensor LF/U 2.1 are used.
Furthermore, the Room Controller RC/A x.2 is used with the Light Controller Module LR/M 1.1. This combination offers a particularly comprehensive software package for setting of the regulator.

Fig. 58: Light Controller / Switch/Dim Actuator LR/S 2.16.1

Fig. 59: Light Sensor LF/U 2.1

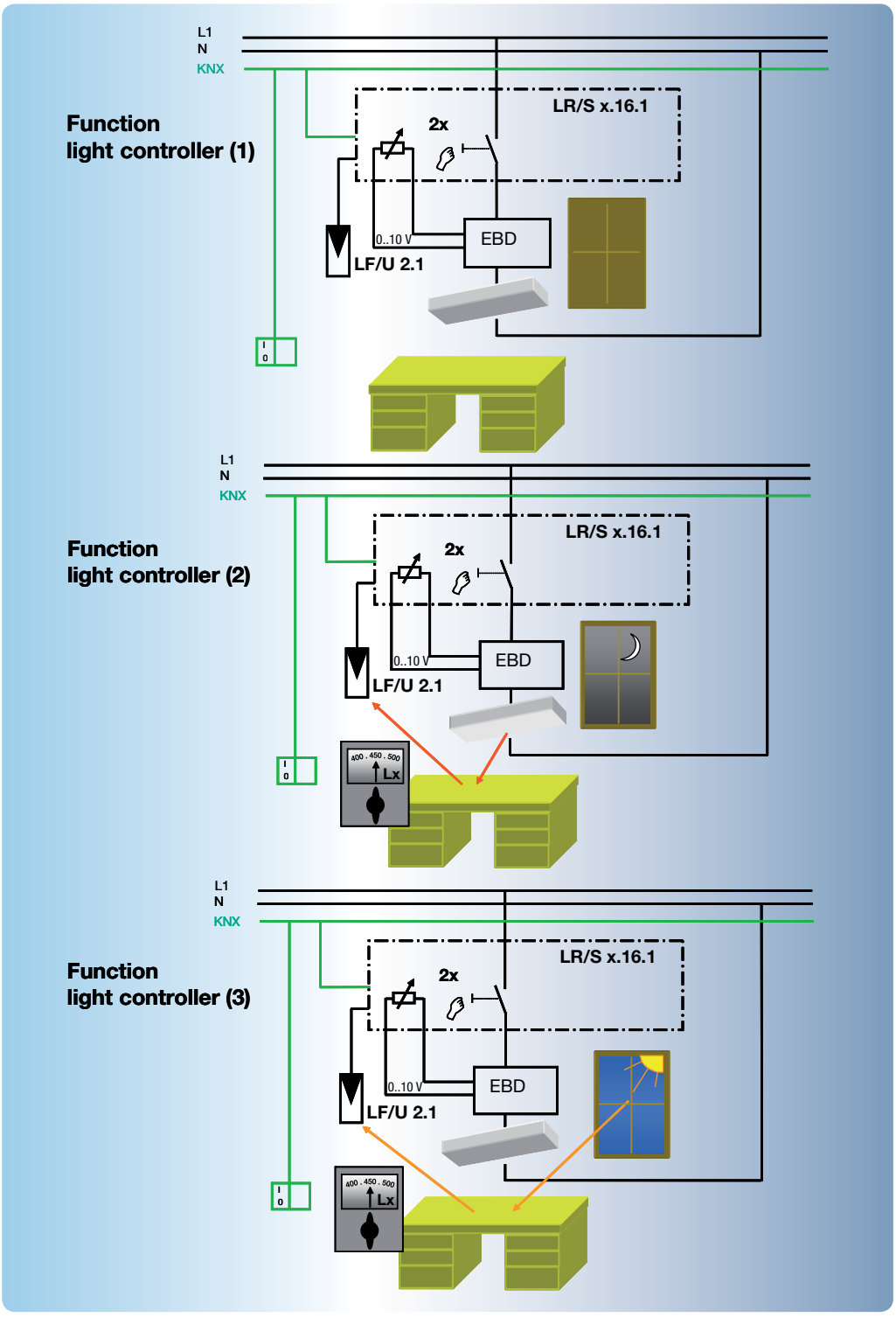


Fig. 60: Light sensor function principle

3.6.2.1. Function principle

The Light Controller / Swittch Dim Actuator LR/S x.16.1 is simultaneously a dimming actuator and controller.

The Light Sensor LF/U 2.1 is connected to the device via a two core cable. The Light Sensor LF/U 2.1 is fitted to the ceiling in the area where the lighting is to be regulated, e.g. in an office above the desk. This way the light sensor detects the “reflected brightness” from the illuminated media, i.e. the luminance. The second brightness factor measured is the lighting intensity which can be measured with the Luxmeter. This can be viewed as the direct brightness (or the luminous flux) as seen by the Luxmeter or the human eye.

Different levels of luminance result at the same lighting intensity with differing reflecting media, e.g. brighter or darker carpets. In practice, this reason and other conditions mean that an exact regulation is never established as deviations of +/– 10 to 20 % of the target value are generally the result. This tolerance is seen as insignificant and is uncritical for the human eye and the sensory perception of the people who are present. The regulation processes in the Light Controller / Switch/Dim Actuator LR/S x.16.1 are deliberately carried out slowly in order to avoid visible transitions in brightness.

For further information see: product manuals Light Controller LR/S x.16.1 and Light Sensor LF/U 2.1.

3.6.2.1.1. Light Sensor LF/U 2.1

The Light Sensor features a photo diode for detection of the brightness, which generates a brightness-dependent current.

The Light Sensors include two light rods. The following image indicates the detection range of both sensors. The diagrams shows the light sensitivity of the sensors in the room.
The percentage values refer to the maximum sensitivity of the light sensor.

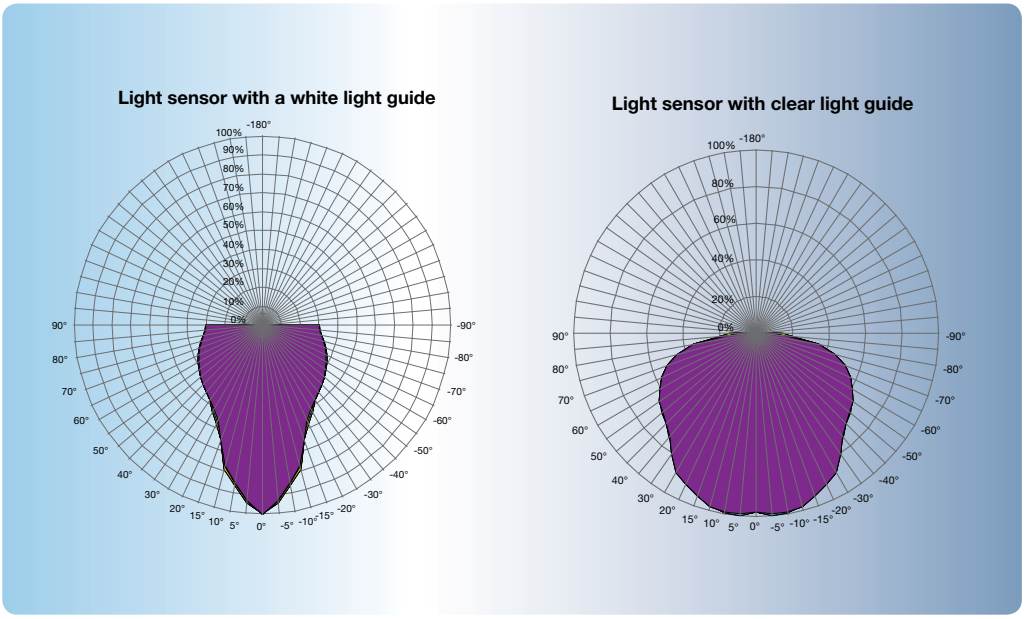


Fig. 61: Detection range of both sensors

Plexiglas rod with clear fibre-optic conductor

This has a larger detection range and is influenced by the incidence of light from the side

Plexiglas rod with white fibre-optic conductor

This rod is covered in a white jacket to provide a smaller detection range and to ensure insensitivity to incidence of light from the sides. This rod can be used if the detection range has to be limited as the reflected light may be influenced, for example, by window sills, which affect the large reference area of the clear fibre-optic rod.

In practice the Plexiglas rod has been already been completely removed in projects. As a result, the visual field is enlarged and more diffused which sometimes assists in the optimisation of the light control.

Positioning of Light Sensor LF/U 2.1

There is one fundamental rule for positioning of the sensor:
Position the sensor as low as possible in the room but not directly in front of reflecting walls.
Ensure that the sensor is not subject to direct sunlight or sources of artificial lighting.

For further information see product manuals Light Controller LR/S x.16.1 and Light Sensor LF/U 2.1.

3.6.2.2. Setting the regulation

The procedure is explained in detail in the manual of the LR/S x.16.1.
A brief summary follows to explain the operating principle:

Artificial lighting calibration

First of all a calibration with artificial lighting is performed. This means that the desired setpoint must be set exclusively using artificial lighting:

1. Deactivate lighting control Send a 0 to the communication object *activate control*.
   Control is deactivated.

2. Darken the room using the blinds or wait until it is dark outside.
   The brightness in the detection range of the light sensor should be less than 20 lx.

3. Set the artificial lighting so that the setpoint brightness is set to the reference point.
   The light sensor should be positioned above the reference surface. Adjust the setpoint via the dimming object *Relative dimming*, e.g. to 500 lx.
   The Luxmeter should be positioned vertically below the light sensor.

4. Send a telegram with the value 1 to the communication object *Enable calibration*.

5. Initiate artificial lighting calibration. Send a telegram with the value 1 to the communication object *Calibration lighting*.

6. The controller now commences with artificial lighting calibration. A jump to 100 % brightness followed by dimming down to 0 % follows. Calibration is completed after about 1 minute.

7. End of artificial lighting calibration. The light is switched on automatically, the control is active and the lighting is controlled to the set brightness value.

Calibration daylight

The daylight calibration is performed in a similar fashion to the procedure described above. For this purpose, the required setpoint must be achieved exclusively by natural daylight. In practice this is very difficult and frequently impossible.

For this reason, a compensation factor is generally used. This value is between 0 and 99 and can be changed in the parameter settings.

The standard value is 35 and is first of all loaded to the device. The rest of the procedure is described in the manual:
This factor defines the relationship between daylight and artificial lighting.
A larger value compensates more for daylight. A smaller value on the other hand gives a higher weighting to artificial lighting. After the factor has been transferred for download in the light controller, the lighting control has to be compared using the brightness measured in the detection range of the light controller by the Luxmeter. More artificial lighting is required if the desired setpoint is undershot. This is achieved by increasing the factor. Too much artificial lighting is provided if the desired setpoint is exceeded.
The artificial lighting share must be reduced. This is implemented by reducing the factor.
This is repeated until the light control controls the required brightness
.

The Switch / Dim Actuator and Light Controller LR/S x.16.1 offers various options for manual intervention with active control:

Frequently a push button is installed in the room which can be used to switch on and dim the lighting. If both of the first parameters are set as in the following parameter window, these operating options will result:

– Manual dimming (long button push) on the local push button switches off the control
– Switch on of the lighting (short button push) activates the control with an initial brightness of 70 %

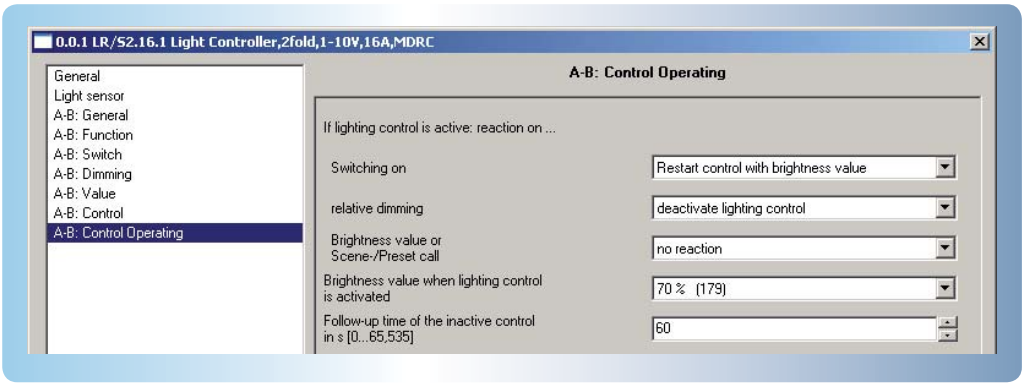


Fig. 62: Parameters LR/S x.16.1 Control Operating

From practical experience in many projects it can be said that deactivation of the regulation with manual actuation is useful and usually undertaken. The control is activated via the communication object *Switch* as mentioned above. This can be sent via the local push button and also for example, via a presence detector or centrally. However, only the local push button provides the individual room occupants the opportunity to switch on and off the automatic control at any time. The acceptance of an automatic system is greater if the user is provided with the opportunity to switch off the automatic system. Even when this option is rarely or never used.

Function Slave

With the help of the function *Slave* several dimming channels can be compiled to a controlled lighting circuit. One channel assumes the function *Master* and sends the control value via the communication object *Master: Brightness value of slave* on the bus. Further dimmers operate as slaves and can thus only be addressed via the communication object *Brightness value of slave*.

If the function *Slave* is switched off in the parameters, and if the control variable from the master dimmer is sent to the normal brightness value, separate access to the dimmer is possible.

A lighting circuit with two lighting strips is installed in an office. Lighting strip 2 should be darker than lighting strip 1 because of its proximity to the window. Lighting strip 1 is the master and lighting strip 2 is the slave with activated characteristic curve correction. This allows a difference in brightness between both lighting strips without the installation of a second light sensor.

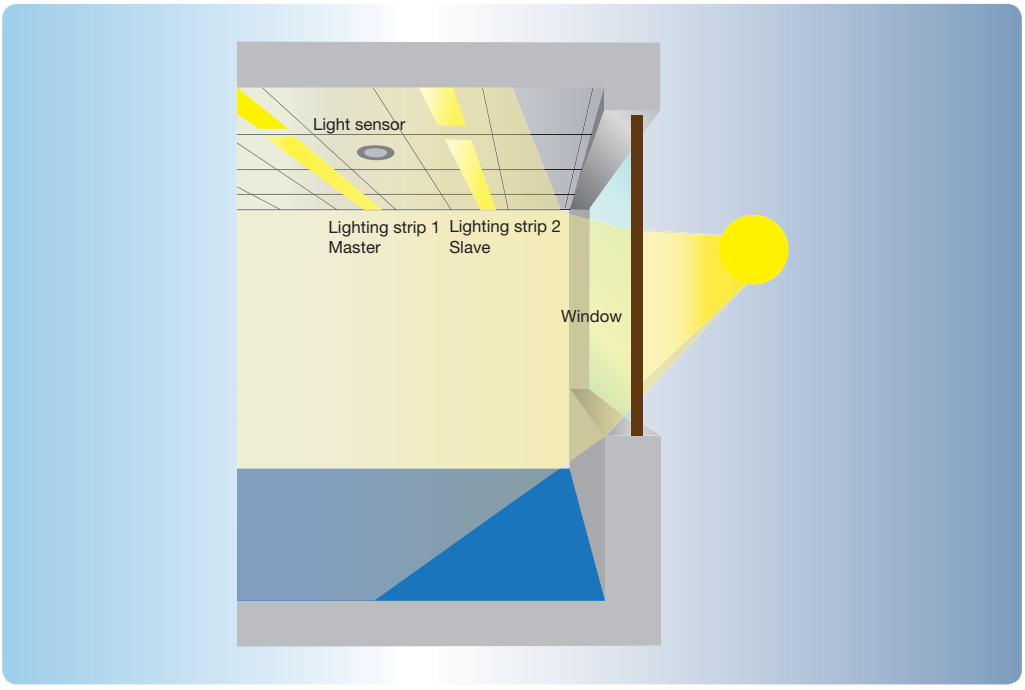


Fig. 63: Office with master/slave control

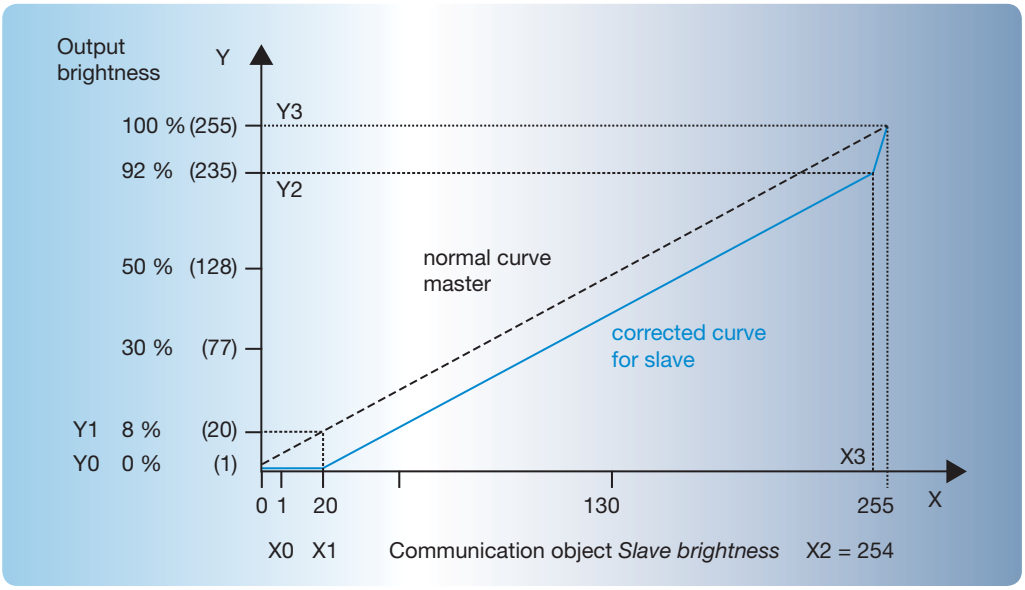


Fig. 64: Characteristic adjustment

Sometimes it is necessary to modify the dimming characteristic of the lighting. This characteristic curve can be converted by four value pairs to an adjusted curve. Thus, for example, the dimming behaviour can be adapted to the sensitivity of the human eye and a more uniform dimming process is achieved.

The characteristic adjustment acts directly on the 1-10 V output and not on the communication object *Master: Brightness value of slave* or *Status brightness value*. This means that a characteristic adjustment must be set in the output of the Light Controller or in the external slave.
In a master/slave combination of LR/S x.16.1 and DG/S 1.1, DG/S 8.1 or DG/S 1.16.1 a characteristic adjustment may not be transferred to the DG/S.

3.6.2.3. Light regulation with other ABB i-bus® KNX components

Further ABB i-bus® KNX components for lighting regulation can be used:

– Presence Detector PM/A 2.1
– External Controller

3.6.2.3.1. Presence Detector PM/A 2.1

The Presence Detector PM/A 2.1 has an integrated light detector and the application allows regulation of the light. The control variable is sent to various dimmers via the bus.
If a flush mounted Switch/Dim Actuator is used in conjunction the presence detector, it can be controlled.

Status messages

The position of the light sensor is fixed to the presence detector. If this is not considered,conflicts may arise. The presence detector should be positioned in the centre of the room and the light sensor should be as low as possible in the room.

The installation expense is reduced and the Light Sensor LF/U 2.1 is not required.

The control variable is sent on the bus. The use of many control circuits however leads to increased telegram traffic. This leads to an increased bus load and may even lead to an overload.

External regulator

A further approach is the use of an external control, e.g. Analogue Input 6157.

A light sensor is connected to its 0...10 V input.

This approach as a result has an increased installation expense. The resulting increased telegram traffic leads to an increased bus load and possibly even to an overload.

4. Status messages

The status messages indicate the state of the lighting. The direct state of a lamp can be:

– ON
– OFF
– Brightness

These direct status messages are usually displayed locally on the push button via an LED (for ON/OFF) or an LCD display (for brightness).

The state of the ceiling lighting cannot be seen from outside as a result of the reflecting mirrored surfaces due to the inclined perspective when looking into a room. The direct state is immediately recognisable via the status display on LED display on the local push buttons.
Further status messages indicate further operating states:

– Function Staircase light
– Manual/automatic
– Constant lighting control
– Light scene, etc.

As these status messages only state something about the operating state, they are usually indicated at a central point via a display or visualisation system.

4.1. ON/Off status message

The ON/OFF status message occurs frequently. The LED on the local push button indicates the switching state independently of the location where the lighting has been switched.
The colour of the LED can be programmed:

– ON = red and OFF = green
– Inverted: ON = green and OFF = red
– Fully OFF

4.1.1. Status messages without separate status object in the actuator

The communication of the ABB i-bus® KNX is implemented via telegrams. A sensor, e.g. a push button, sends a telegram with a group address. The actuator or actuators with the same group address accept the telegram and carry out the function which is specified, e.g. switch on. One actuator or actuators then sends a confirmation telegram after the telegram is received (acknowledge). The sensor, e.g. push button, now knows that the telegram has reached the recipient. A repetition is thus unnecessary.

This process does not confirm that the relay has switched and that the lighting has switched on.
It only confirms that the telegram has been sent and received.
Normally you can assume that the function has been undertaken after the telegram has been sent.
The telegram can also be used to activate the LED.

Status messages

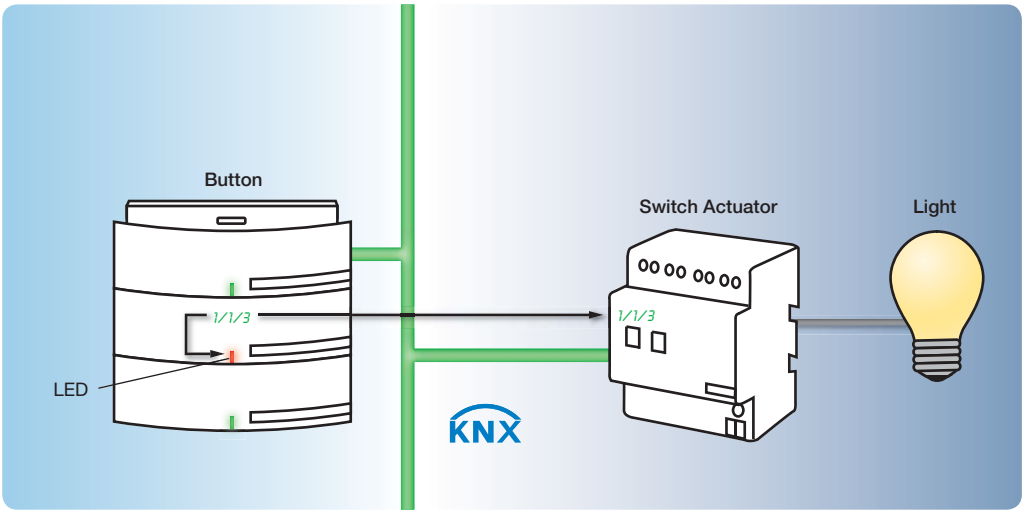


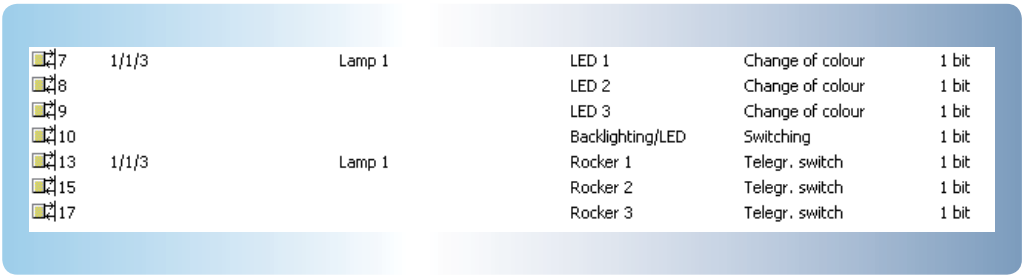
Fig. 65

Depending on the push button used, there are two possibilities to assign the group address to the LED:

– LED with its own communication object

– LED without its own communication object

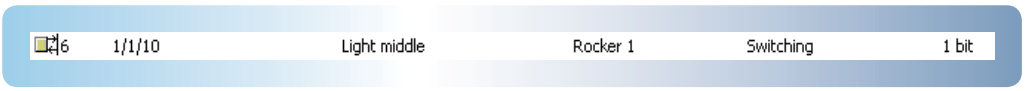
LED with its own communication object



7	1/1/3	Lamp 1	LED 1	Change of colour	1 bit
8			LED 2	Change of colour	1 bit
9			LED 3	Change of colour	1 bit
10			Backlighting/LED	Switching	1 bit
13	1/1/3	Lamp 1	Rocker 1	Telegr. switch	1 bit
15			Rocker 2	Telegr. switch	1 bit
17			Rocker 3	Telegr. switch	1 bit

Fig. 66

LED without its own communication object



6	1/1/10	Light middle	Rocker 1	Switching	1 bit

Fig. 67

In this communication object the value of the group address directly controls the state of the respective LED in this push button.

Possible settings of the parameters

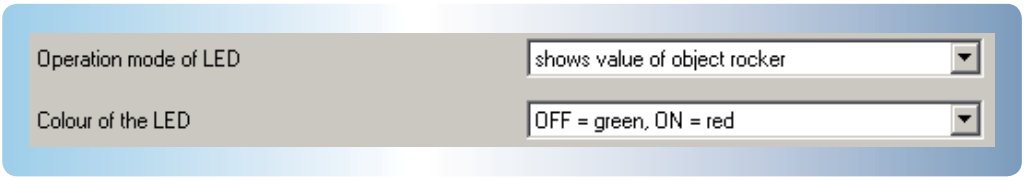


Fig. 68

4.1.2. Status messages with separate status object in the actuator

The switch actuators offer the opportunity to send a separate telegram back on the bus as a status feedback. This status telegram is only sent if the relay has been actuated by the application.

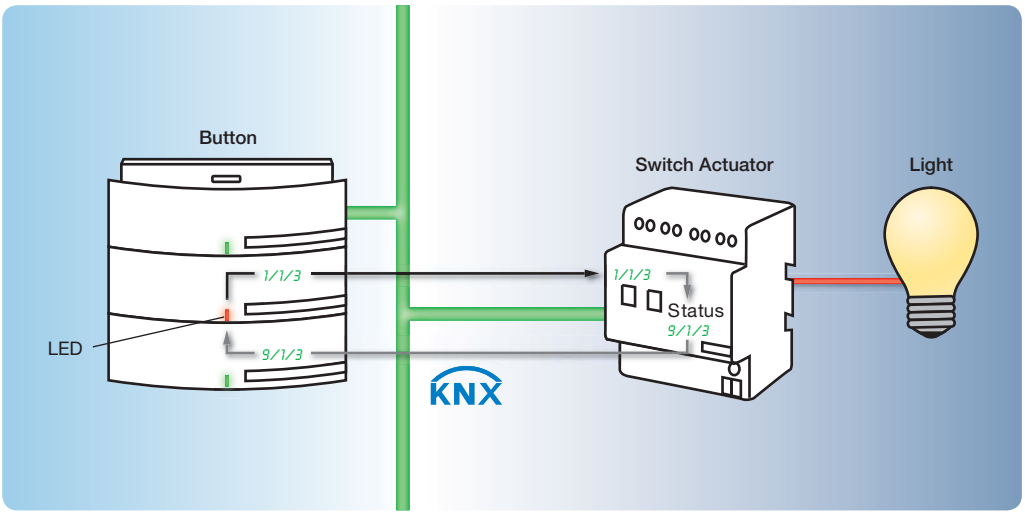


Fig. 69

In total three telegrams are sent this way: the telegram of the transmitter, the status telegram of the actuator and the confirmation telegram (acknowledge).

The lighting of a room can be operated locally via a push button and together via the lighting control of the entire building using the central switch. In the evening all lamps are switched off via a central OFF telegram. If all states of the entire lighting are sent on the bus it can lead to an increased bus load as a result of the increased telegram traffic and maybe even to an overload.

There is the possibility, e.g. with the Switch Actuators SA/S x.x, to set in the parameters if the status of the state should be always indicated, or only indicated when the value changes, Fig. 69. This considerably reduces the telegram traffic.

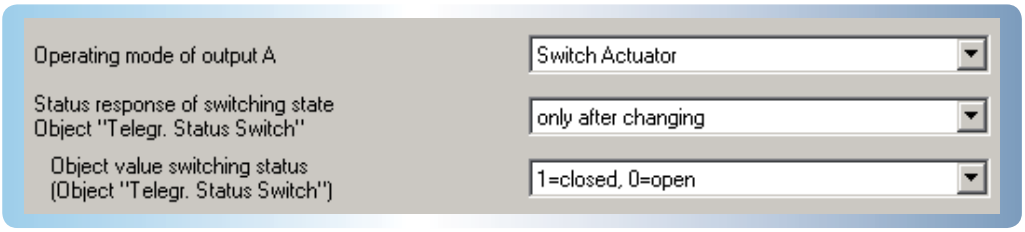
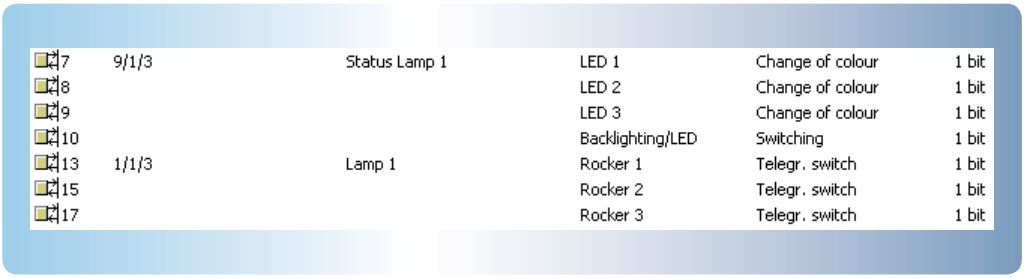


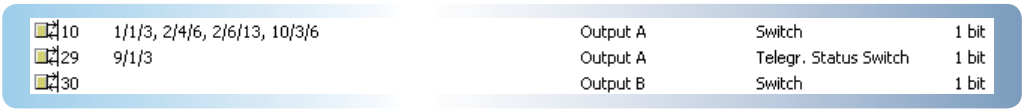
Fig. 70

A further major advantage of current value detection is the possibility to represent the state of the relay independently of the operating points, e.g. local push buttons, central push buttons or timer using a single groups address by the so-called communication object *Status switch*.
As a result only one group address must be entered in the communication object *LED display*.



7	9/1/3	Status Lamp 1	LED 1	Change of colour	1 bit
8			LED 2	Change of colour	1 bit
9			LED 3	Change of colour	1 bit
10			Backlighting/LED	Switching	1 bit
13	1/1/3	Lamp 1	Rocker 1	Telegr. switch	1 bit
15			Rocker 2	Telegr. switch	1 bit
17			Rocker 3	Telegr. switch	1 bit

Fig. 71: Communication objects push button

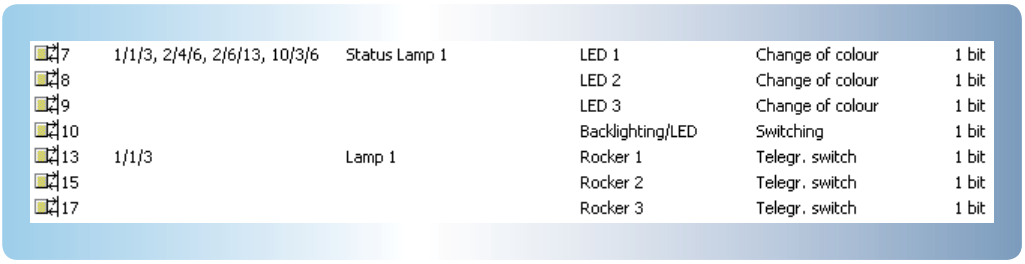


10	1/1/3, 2/4/6, 2/6/13, 10/3/6	Output A	Switch	1 bit
29	9/1/3	Output A	Telegr. Status Switch	1 bit
30		Output B	Switch	1 bit

Fig. 72: Communication objects Actuator

The group addresses 2/4/6, 2/6/13 and 10/3/6 access the channel from other positions, e.g. centrally, Brightness sensor or timer.

If no communication object *Status switch* is available in the actuator, all of these group addresses in the actuator must be also in the communication object ***LED display*** of the push button. As a result, the maximum number of possible group addresses of the push button can be reached very quickly.



7	1/1/3, 2/4/6, 2/6/13, 10/3/6	Status Lamp 1	LED 1	Change of colour	1 bit
8			LED 2	Change of colour	1 bit
9			LED 3	Change of colour	1 bit
10			Backlighting/LED	Switching	1 bit
13	1/1/3	Lamp 1	Rocker 1	Telegr. switch	1 bit
15			Rocker 2	Telegr. switch	1 bit
17			Rocker 3	Telegr. switch	1 bit

Abb. 73: Communication objects push button with actuator without communication object *Status switch*

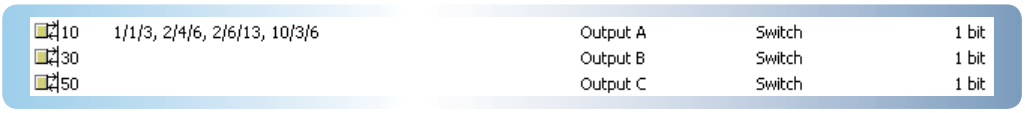


Fig. 74: Kommunikationsobjekte Aktor

If no separate communication object is available for the LED display in the push button, the assignment changes.

Fig. 75: Communication objects push button

The group addresses 2/4/6, 2/6/13 and 10/3/6 are listening group addresses. They influence the function of the LED accordingly. The LED indicates the value of the communication object of the respective push button, see LED without its own communication object (Fig. 67).

4.1.3. Central OFF telegram with status message

If in the parameters the setting *always signal status* s selected, all relays are practically switched simultaneously with an OFF command and the status messages of every channel are sent on the bus.

If now all status messages are sent to a central point, e.g. to a visualisation system, it can cause an overload of the bus system.

In order to avoid an overload of the bus system it is necessary to ensure that the central telegram is distributed and the transmission of the split telegrams occurs at staggered intervals.

An office building consists of five floors. Forty lamps are fitted on each floor. If the central OFF telegram is now triggered, only the lighting in the lowest floor will switch off. The group address for this purpose is routed via a timer, e.g. via a switch off delay with the Application Unit ABL/S 2.1, see chapter 3.3 Control functions On/Off delay. Thus the telegram is sent with a delay and consequently the lighting for the next floor is switched off with delay. The next floors are then switched via further timers.
For implementation purposes, the central telegramd is divided into sub-telegrams, which are sent at staggered intervals. If each of the timers is set to five seconds, an overall delay of 25 seconds occurs. This time factor is usually functionally negligible.

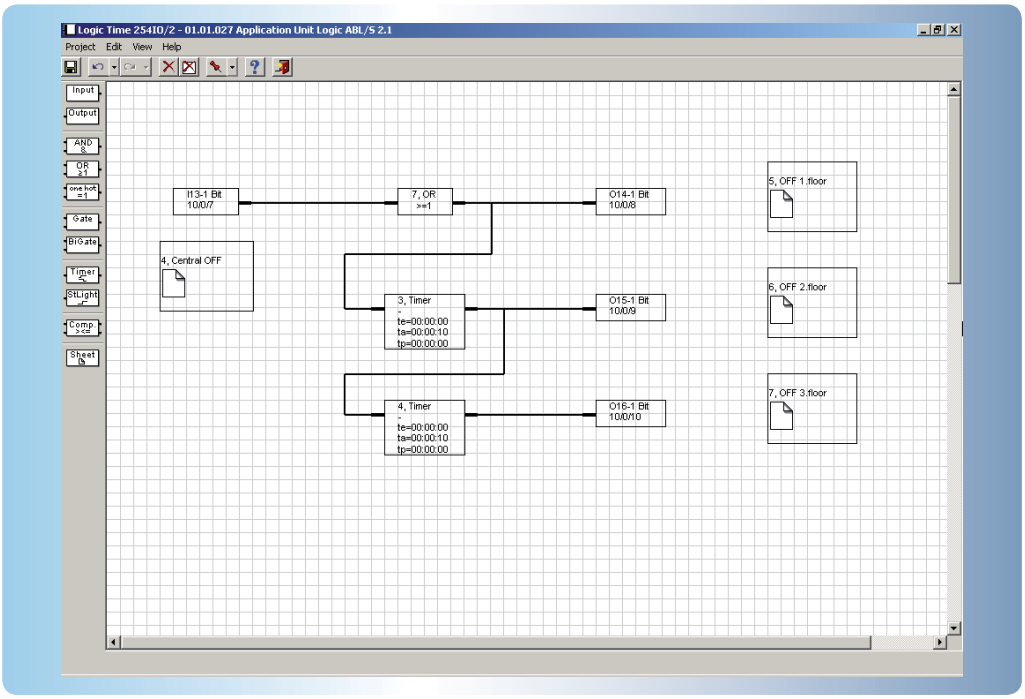


Fig. 76: Central switching with ABL/S 2.1 and delay

4.2. Current detection

A separate status message is one step closer to the objective of a correct status display, but it still does not detect if the lighting is actually switched on. The lamp could be defective. Detection of the current in the circuit is necessary in order to detect the actual state of the lamp. Some switch actuators, e.g. SA/S x.16.6.1, can measure the flow of current via the relay. The current value is detected and compared with two parameterised threshold values. With an undershoot or overshoot of a threshold value a 1 bit telegram is sent.

It is important that all lamps are functional in a staircase. Otherwise sections of the staircase can be dark, which can have serious consequences, e.g. danger of accidents. Monitoring by detection of the current flow in the loads (the lamps) ensures that the caretaker does not need to check all the lamps locally every day.
A current limit value is set in the parameters of the switch actuators which will clearly indicate if the lamp (equipment) is not active. If the value is below the current threshold, a telegram is sent to indicate this fact. A further parameter enables the evaluation of the current detection for parameterisation:
Options:
– Always
– Only with a closed contact
– Only with an opened contact

Usually the setting *only with a closed contact* is useful. This represents the switched on state.

If a value is below the current threshold this could also be due to a defective cable or to a circuitbreaker which has tripped. This is however rarely the case.

This interesting, very good and useful function can be realised with relatively little effort and expense. This is why it is used and demanded in more and more projects.

4.2.1. Contact monitoring

Contact monitoring is a “residual effect” of current detection. It is possible to detect for example, if a relay contact sticks or if the mechanical system of the relay is jammed, i.e. the contacts cannot open.

The communication object *Contact monitoring* is set to a value of 1 if a current exceeding 100 mA flows with the switch telegram *Open contact*. If no current flows with an opened contact, the value is set to 0.

4.3. Special functions of the status messages

The LED display of the status messages on the push buttons can also be used for other functions:

- Push button without function but with LED display
- Push buttons with two functions and an LED display
- LED display with other functions than lighting
- Solution with conventional push buttons
- Lighting with function Time
- LED display with switching of multiple lamps via a push button

4.3.1. Push button without function but with LED display

If a push button is not to be assigned with a function but the LED display of the push button, nothing is entered in the *Switch* function object. If the push button does not have its own communication object *LED*, the group address must be entered in the communication object *Switch* in second place (as a listening group address). In first place the so-called dummy group address is entered. This is not assigned to a communication object of another device and does not undertake any function.

A push button without its own communication object ***LED*** cannot differentiate between the function to be executed and the information to be displayed with the LED.

4.3.2. Push button with two functions and an LED display

A push button programmed with two functions can only visually represent one function for each side of the rocker. Each rocker has one LED. Generally one side of the rocker has a fixed assignment to the LED.

4.3.3. LED display with functions other than lighting

It is possible to represent other switching states than the respective lighting via the LED display. If a separate communication object is available in the push button, any required group address can be assigned. If no separate communication object is available, the desired group addresses are entered additionally in the communication object as listening group addresses. The first group address is then the address with the main function of push button.

A building is equipped with a sun protection system (shutters). Should a wind alarm occur, all LED displays on the push buttons should flash.
For this purpose a telegram is generated with alternating ON/OFF during a wind alarm via external logic, e.g. Application Unit ABL/S 2.1. This group address is additionally assigned to the communication object *LED*.

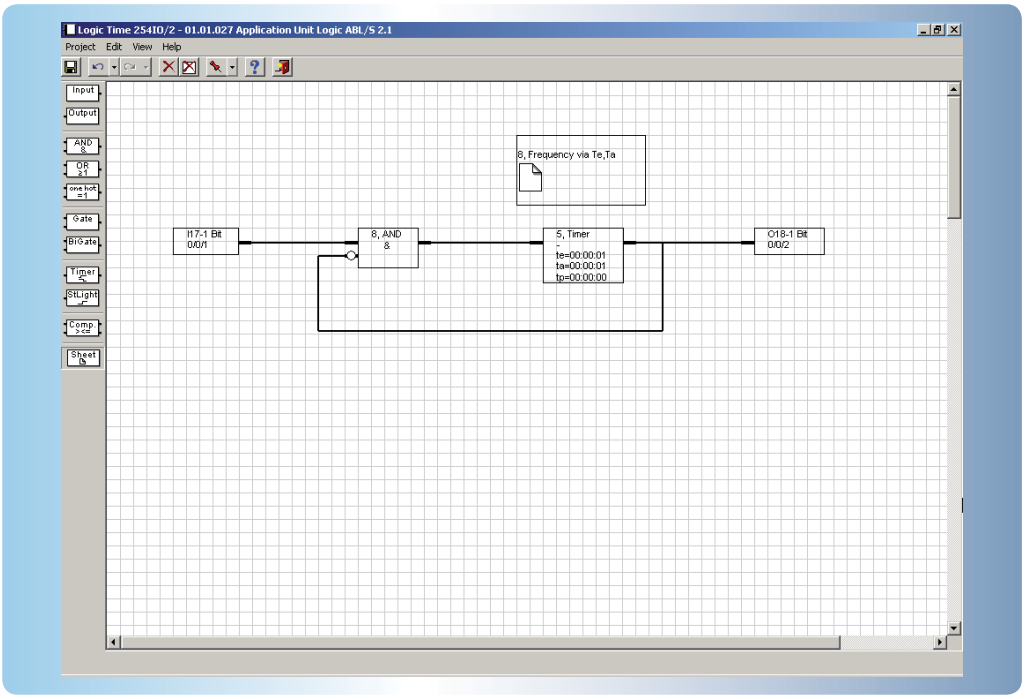


Fig. 77: Realisation of the function Flashing on the ABL/S 2.1

4.3.4. Solution with conventional push buttons

If you are operating with the Universal Interface US/U x.2 from ABB and conventional push buttons, an LED display can be controlled via an output channel of the Universal Interface US/U x.2. This solution is even more flexible than the solution with bus switches, e.g. the software of the Universal Interface US/U x.2 already includes a flashing function.

The output current per channel is 2 mA. This is sufficient for certain high efficient LED indicators.

It is often difficult to obtain conventional push buttons with LED indicators on the market. It is however possible to select push buttons with a glow lamp and to replace them with an LED.

4.3.5. Lighting with function Time

For lighting with a time delay or a function staircase lighting, there is now a direct chronological relationship between actuation of the push button and the switching state of the lighting.
If an LED display indication is required here, it must be processed with the function *Status*.
The telegram of the function *status* is sent practically at the same time with the state change of the relay.

4.3.6. LED display with switching of multiple lamps via a push button

The lighting of an entire floor or several floors is switched using a central push button.
The status of the lighting can be displayed on the LED of the push button.

The entire lighting of the upper floor of a house should be switched off from a central location with a push button. A push button with integrated LED is installed in order to check if all lights of an upper floor are actually switched off. The LED should light up red as soon as at least one light on the upper floor is switched on.

It is not sufficient here to enter all lighting group addresses in the communication object *LED button*. If then two lights are switched on and only one of them is switched off again, the LED in the push button will change to green even though a light is still on. For this purpose an OR gate is required, e.g. use of the Logic Module LM/S 1.1 or the Application Unit ABL/S 2.1.

5. Special types of control

With ABB i-bus® KNX special types of control can be economically and comfortably established:

– Light scene
– Panic alarm
– Control with DALI

5.1. Light scene

With a light scene a group of lamps can be put into a desired operating state by a defined action. The operating state of a lamp can be ON with 100 % brightness, OFF or a dimming value if dimmable lamps have been installed. An action is a ABB i-bus® KNX telegram that activates the light scene. As well as lighting, the scene can also include other functions, e.g. darkening and actions in the area of HEATING/COOLING.
The action telegram can be initiated by different elements, e.g. push buttons, motion detectors or timers.

Push buttons

The standard to switch a light scene are push buttons. These are usually used.

In a living room all the lights should be switched to TV viewing lighting at the touch of a button. The brightness values of the individual lamps are preset to the ideal brightness for TV viewing and programmed, e.g. ceiling lighting off, dimming of the wall lighting and indirect lighting on.

Motion detectors

The use of a motion detector for a light scene is a very interesting feature. This is usually selected when a soft switch-on is required.

In the halls and bathrooms of a hotel the lighting should slowly dim up when the area in question is entered. This significantly enhances comfort, as for example, the guests do not need to search for the light switch to visit the bathroom after they wake up and are not dazzled by bright light.

Timer

At a defined preset time the lighting is switched on in a predefined way.

In a large shopping mall light scenes are recalled at certain times in the window fronts, e.g. different items on show should be highlighted alternately. This form of light scene can be very easily used in museums and galleries in order to create particular moods and to represent the exhibits in a way which suits the theme of the exhibition.

Special types of control

Control panel

In place of a push button, a control panel with integrated push buttons, LCD or touch display for comfortable operation of different light scenes is used.

Different light scenes should be switched from a single position in the living room, e.g. TV viewing light, romantic lighting or a light scene for dining.
In lecture halls or conference rooms the use of a control panel is also useful. Here different light scenes are also required, e.g. *Scene presentation with beamer* or scene *Video*.

5.1.1. Setting of a light scene

The basic function of a scene is its *Recall*. The preset brightness values which have been programmed are recalled here. These values are fixed and can not generally be changed by the operator unless they are reprogrammed with ETS.

A new scene is set with the *Store* function. For this purpose, the brightness of the dimmable lamps or their operating states are determined and stored.
New or modified scenes can be easily and quickly set up by the operator without programming knowledge.

Light scenes can be set using a light scene module (1 bit scene) or in the actuators (8-bit scene).

5.1.1.1. 1 bit light scene

The classical light scene with 1-bit is supported by all ABB i-bus® KNX devices on the market. For this purpose the brightness values or operating states are stored in a push button or light scene module.

The 1-bit light scene can be implemented with different modules:

- Push buttons of the series Busch-*triton*® and solo® and Busch-*priOn*®
- Universal Interface US/U x.2, Binary Input BE/S x.x and Room Controller RC/A x.2
- Logic Module LM/S 1.1
- Display and Control Tableau MT701
- Controlpanel or Busch-*ComfortTouch*®
- DALI Gateway DG/S 1.1, DG/S 8.1 and DG/S 1.16.1
- Application Unit ABZ/S 2.1

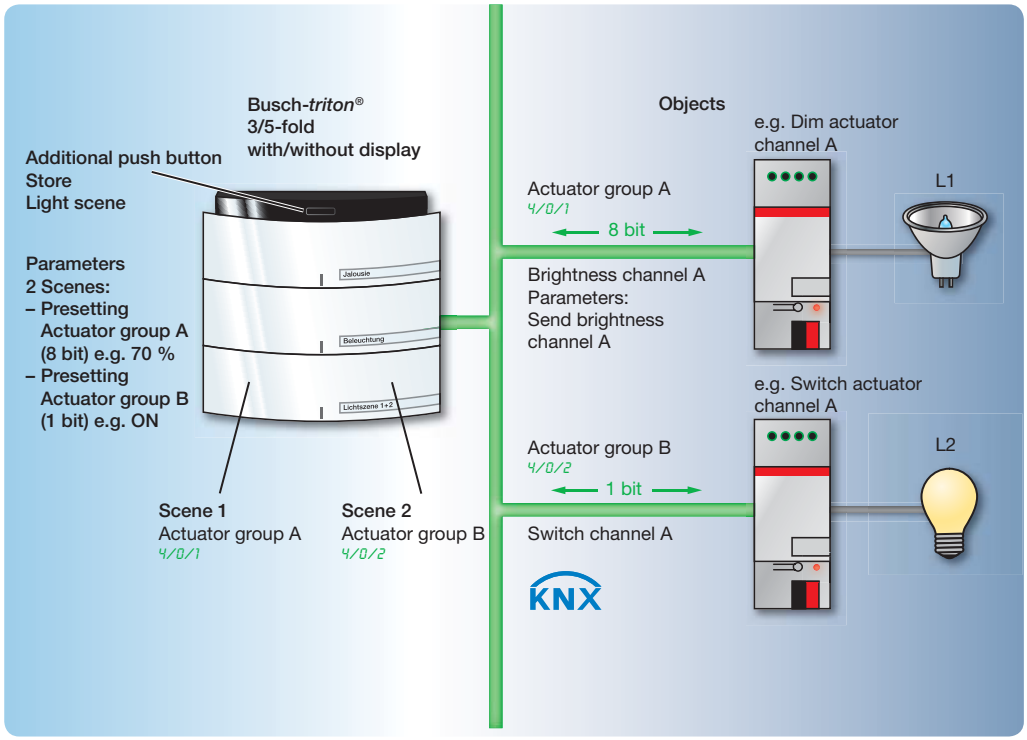


Fig. 78: Principle of the 1 bit light scene using the example of the Busch-*triton*® push button

As inputs of the light scene module serve the communication objects *Set* and *Recall the light scene* and as outputs the communication objects to the Light Controller / Switch Dim Actuators of the connected lamps (actuator groups).

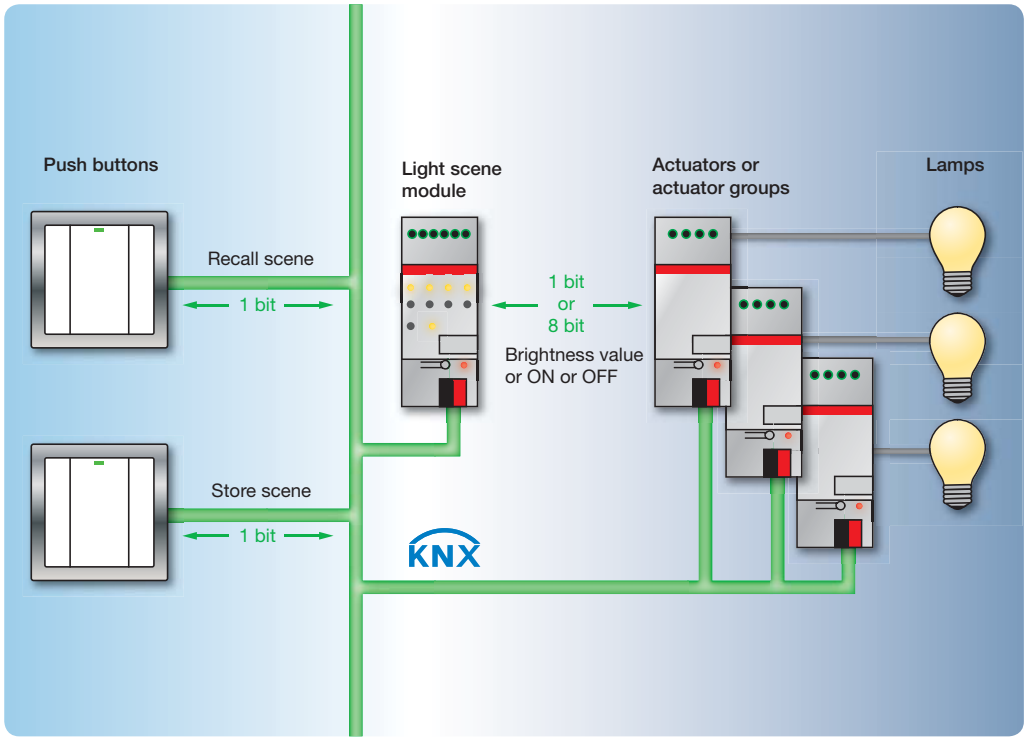


Fig. 79: Principle of the 1 bit light scene with separate light scene module

Special types of control

Busch-*triton*® push button

Light scenes can be set up using the three-fold and five-fold Busch-*triton*® push buttons with and without display from ABB as well as the thermostats. Depending on the application four or six light scenes are available with 5 actuator groups.

The recall and storing of the light scene is only undertaken with the corresponding buttons on the Busch-*triton*® push button. Es stehen keine externen Kommunikationsobjekte zur Verfügung.

Solo® push button

Eight light scenes with five actuator groups can be set up with the four-fold multifunction switches of the solo® range from ABB. 8 bit scenes are possible with the solo® push buttons.

The recall and storing of the light scene is only undertaken with the corresponding buttons on the solo® switch. There are no external communication objects available.

Universal Interface US/U x.2, Binary Input BE/S x.x and Room Controller

With this module a light scene incorporating up to five actuator groups per channel can be realised. The light scenes can be stored externally via a communication object.

The recall of a light scene is only possible via the assigned input.
This module can also realise 8 bit light scenes.

The Binary Input MDRC type BE/S x.x offers the possibility of storing the scene via the communication object *Scene stored*, e.g. via the display of the appropriate push button.

Logic Module LM/S 1.1

In the Logic Module LM/S 1.1 from ABB i-bus® KNX, there are three functions available for eight light scenes – each with six actuator groups. A total of up to 24 light scenes can be realised.
In addition to the input and output communication objects already described here, there is the communication object *Store mode* and the feedback *Scene* in the Logic Module LM/S 1.1.

For further information see product manual Logic module LM/S 1.1.

Display and Control Tableau MT701

Up to 24 light scenes with 32 group addresses (actuator assignments) can be implemented with the Display and Control Tableau MT701 from ABB i-bus® KNX.

The light scenes can be recalled and stored externally via an 8 bit subsidiary object.

Special types of control

Controlpanel

The Controlpanel from ABB can be used to implement 32 light scenes, each with 20 actuator assignments.

Busch-*ComfortTouch*®

Up to 64 scenes or sequences are available with the Busch-*ComfortTouch*®.
In contrast to scenes, the delayed processing of successive actions are possible with scenes. On sequences, different pause times can be inserted between the individual actions and sequences can also be paused or stopped.

For further information see the product manual of the Busch-*ComfortTouch*®.

DALI Gateway DG/S 1.1, DG/S 8.1 and DG/S 1.16.1

With the DALI Gateway DG/S 1.1, 15 light scenes can be established and with the DG/S 8.1, 16 light scenes can be established with all 128 lamps from just two channels of the module. Both modules can implement both 1 bit as well as 8 bit light scenes. The DG/S 1.16.1 offers 14 light scenes.

Application Unit ABZ/S 2.1

The Application Unit ABZ/S 2.1 with the application *Times/Quantities* can provide a type of light management. It is possible to program a fixed scene using the quantities of the application. The end customers can simply adjust the value if required using the additional software PZM2. For this purpose, only a PC is required as the changes are not made on the push buttons locally, as is the case with classical components.
Using the Application Unit ABZ/S 2.1 from ABB, 30 light scenes with up to 300 linked functions can be implemented.

The Application Unit ABZ/S 2.1 is particularly suitable for the implementation of special cases because of the number of possible linked functions and the implementation of light scenes, e.g. comprehensive scenes with many assigned lamps which do not need to be adjusted anymore during operation.

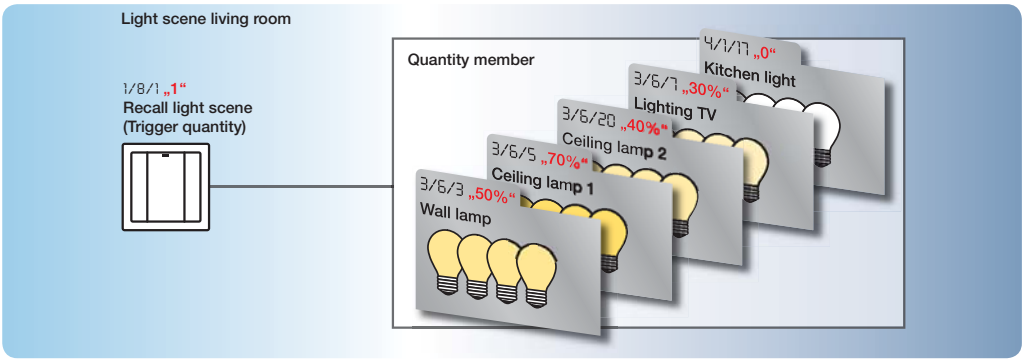


Fig. 80: Principle of the light scene with the ABZ/S 2.1

Twenty dimmable lamps are installed in an event hall. These are controlled via a 1 bit light scene. For this purpose 20 telegrams must be sent on the bus. There is a significant delay involved in recalling the scene which is not always acceptable. On Busch-*triton*® push buttons, an additional delay time between sending the individual telegrams can be set in the parameters.

The brightness values and the operating states are sent centrally from the respective component on the bus. As the ABB i-bus® KNX transmits serially, the telegrams are sent and received consecutively.
If many lamps are assigned to the scene, the recall of the scene leads to “running light”, not all the lamps are switched and dimmed simultaneously.

If an 8 bit light scene is used, this phenomena will not occur.

5.1.1.2. 8 bit light scene

A prerequisite for the implementation of an 8 bit light scene is that the ABB i-bus® KNX-devices concerned support this function. In contrast to a 1 bit light scene, the brightness values and operating states with 8 bit light scenes are not stored centrally in a light scene module but rather in the assigned actuators. The sensor which recalls or stores the scene and communicates with the actuators communicates via an 8 bit telegram.

BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
0 (Recall)	X (not defined)	Sc	en	en e.g. Scene No. 0	Nu	mb	er
1 (Store)	X	0	0	0	0	0	0

Fig. 81: Telegram structure of an 8 bit scene

Bit no. 7 defines if the scene is recalled with bit 7 = 0, or stored with bit 7 = 1. The next bit is not defined and can be 0 or 1. The remaining 6 bits define the scene number which is addressed. With the 6 bits up to 64 different scene numbers can be coded.

Scene no. 4 is recalled with the binary value 00000011 or decimal value 3. With the binary value 1001000 or the decimal value 144 scene no. 17 is stored. If the scene numbers are now assigned to a push button, a short push will recall the scene and a long push will store the scene.

With the 8 bit light scene only one telegram is sent in order to simultaneously switch or dim all assigned actuators.

For further information see the product manual for roller blinds and shutter actuators JA/S, code table

The 8 bit light scene can be implemented with the following ABB i-bus® KNX devices:

– Universal Interface US/U x.2
– Binary Input BE/S x.x
– Room Controller RC/A x.2, all modules except the switch actuator
– Shutter Actuators REG JA/S x.x
– Switch sensor solo® multifunction 4-fold
– Switch sensor Busch-*priOn*®
– Switch Actuators SA/S x.x
– DALI Gateway DG/S 1.1, DG/S 8.1 and DG/S 1.16.1
– Switch- / dim actuators SD/S x.16.1

Push buttons or binary inputs including the Universal Interface US/U x.x can generally send 8 bit values, i.e. scenes in this case can also be recalled by conventional push buttons. However it is not possible to differentiate between a short and long button push. For this reason *the Store scene* function must be installed on a second push button.

5.2. Panic alarms

Using ABB i-bus® KNX it is simple to switch different loads (circuits) centrally from one or more locations, e.g. lighting ON/OFF, defined brightness values and horn, see chapter 2 *Circuit design*.
For reasons of simplicity the use of these functionalities is useful for special applications as well. A very useful application of these functions is the so-called panic alarm.
In classic security technology in the field of intrusion alarm systems, the function is known as an emergency button. This classical push button can exclusively implement normal alarm functions, e.g. activate sirens or silent alarms via telephone. It is a special button which is covered by a protective film. The optical appearance of this push button is often not accepted.

Fig. 82: Emergency button

With ABB i-bus® KNX the function of the classical emergency button can be replaced and extended significantly which enhances the feeling of safety for the end customer. The individual functions are available as an “add on” without additional hardware and the programming effort required is clear.

1. The lighting of a dwelling is controlled with the ABB i-bus® KNX. A push button has been installed in the bedroom which switches on the entire internal and external lighting of the house when the button is pressed. If the residents of the dwelling fear that an unwanted person is in or near the house, the entire house and its surrounds can be lit up at the touch of a button. This will usually frighten away unwanted individuals.
2. In a public building which is open to the public, e.g. tax authorities, unemployment offices or court buildings, a push button is installed underneath the desks which can be actuated in case of danger, e.g. it alerts the security personnel and reception area receives a message. Furthermore, a message is sent automatically to the mobile telephone of a selected person via the telephone gateway.
3. An industrial plant has been equipped at selected locations with push buttons which fully switch on the lighting in selected areas. In dangerous situations, e.g. before the arrival of the fire brigade in the event of a fire, the entire lighting should be switched on via mobile telephone regardless of the absence of persons. In order to reduce peak loads (peak inrush currents) in the power supply, only a certain number of lamps should be switched on together simultaneously at one time using a time delay, see chapter 4.1.3

The panic alarm can be extended as required:

– The shutters in a dwelling will open additionally so that the bright illuminated building and the intruder are visible from outside.
– A music system is also switched on in order to provide an additional acoustic deterrent. If there is an intelligent link to the AV system (audio/video), an additional increase in the volume can be activated.
– An internal siren is activated.
– The lighting of the building starts to flash.
– A silent alarm is triggered via the telephone gateway.

The most important feature of a panic alarm is to ensure that it can be triggered as easily as possible. A panic alarm which cannot be triggered in an emergency due to bad planning is of no use to anyone. For this reason a panic alarm should be available at different locations if necessary. It must be simple to operate and very importantly, it must also be protected against unintended use. This is particularly important if the panic alarm triggers a siren or alerts security personnel.
A panic alarm can be implemented using different ABB i-bus® KNX devices:
– ABB i-bus® KNX push buttons
– Logic Module LM/S 1.1
– Application Unit ABL/S 2.1
– Universal Interface US/U x.2 or Binary Input BE/S x.x

5.2.1. ABB i-bus® KNX push buttons

There are two programming possibilities to implement a panic alarm with ABB i-bus® KNX push buttons:

1. An ABB i-bus® KNX push button is programmed so that both sides of the rocker trigger the required function. The labelling field of the push button is marked in colour, e.g. red background. This reduces the danger of unintentional operation.

2. An ABB i-bus® KNX push button is programmed as a shutter push button. Here the communication object UP/DOWN is used to activate the function with a long button push. With the Busch-*triton*® push button it is also possible to program the function *Long push* to up to 2.1 seconds, the standard is 0.5 seconds. This setting almost eliminates an unintended actuation.

Normally one side of the rocker will send a logical 1 for shutter DOWN and the other sends a logical 0 for shutter UP. Accordingly, only one side of the rocker usually the logical 1 side can be used for the function.

In order to achieve that both sides of the rocker send a logical 0, an OR gate with an inverted and non inverted input is used. Both inputs receive the same group address from the push button.

5.2.2. Solution with Logic Module LM/S 1.1

The function logic gate in LM/S 1.1 should be choosen.The same group addresses are assigned at input 1 and input 2.

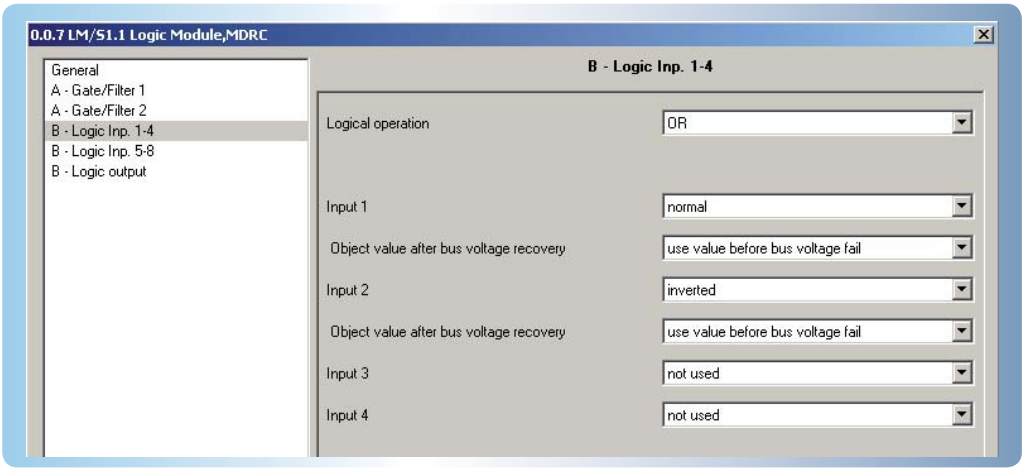


Fig. 83: Logic input on the LM/S 1.1

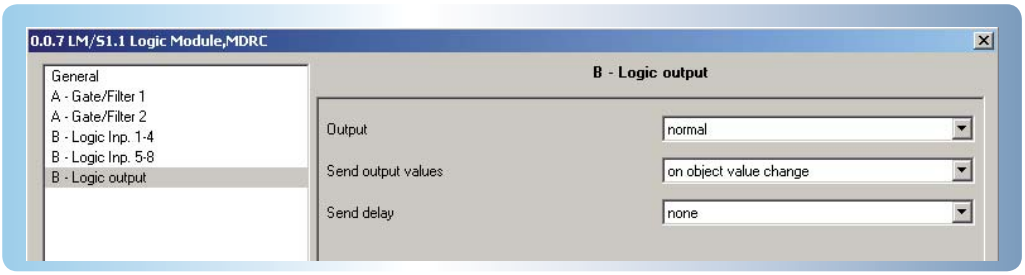


Fig. 84: Logik output of the LM/S 1.1

The output must send with *every assignment of an object value* as only value 1 is always sent.

5.2.3. Application Unit ABL/S 2.1

The solution is much simpler with graphical illustration of the Application Unit ABL/S 2.1.

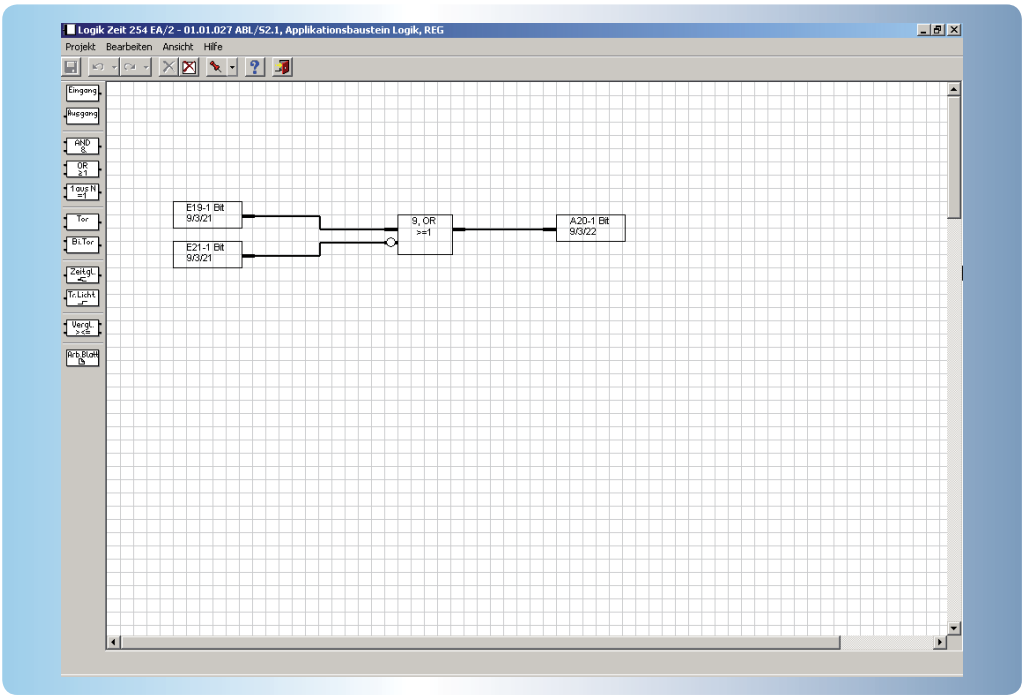


Fig. 85: Solution with ABL/S 2.1

A more complex solution is the use of two gates. This is interesting as soon as no logic gates are longer available.

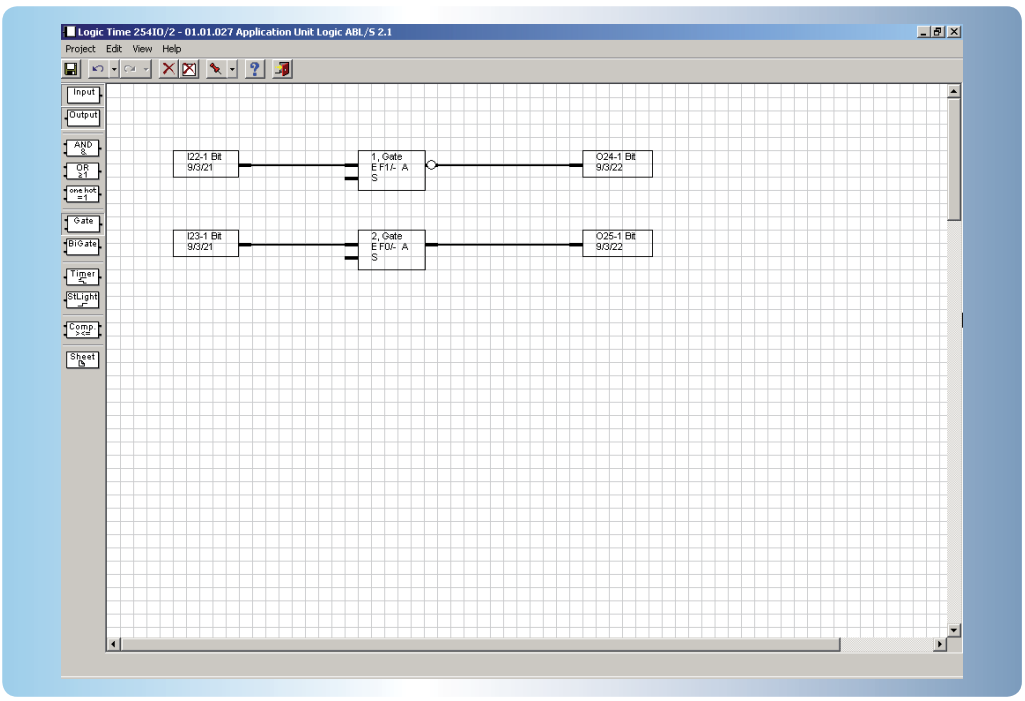


Fig.86: Use of two gates

If group address 10/0/1 is sent with the value 0 it is inverted, and with the value 1 and the group address 10/0/2 it is sent on further. In the second function block the 10/01/1 is not sent further with the filter *OFF filter*.
If the group address 10/0/1 has the value 1 it is inhibited in the first function block, in the second block the value 1 is sent on further directly as 10/0/2.
Group address 10/0/2 is assigned to all actuators which belong to the panic alarm.
This ensures that only the value 1 is sent.

In Application Unit ABL/S 2.1 a gate with an unused control input is always enabled.

The outputs must be set as follows in order to implement Application Unit ABL/S 2.1:

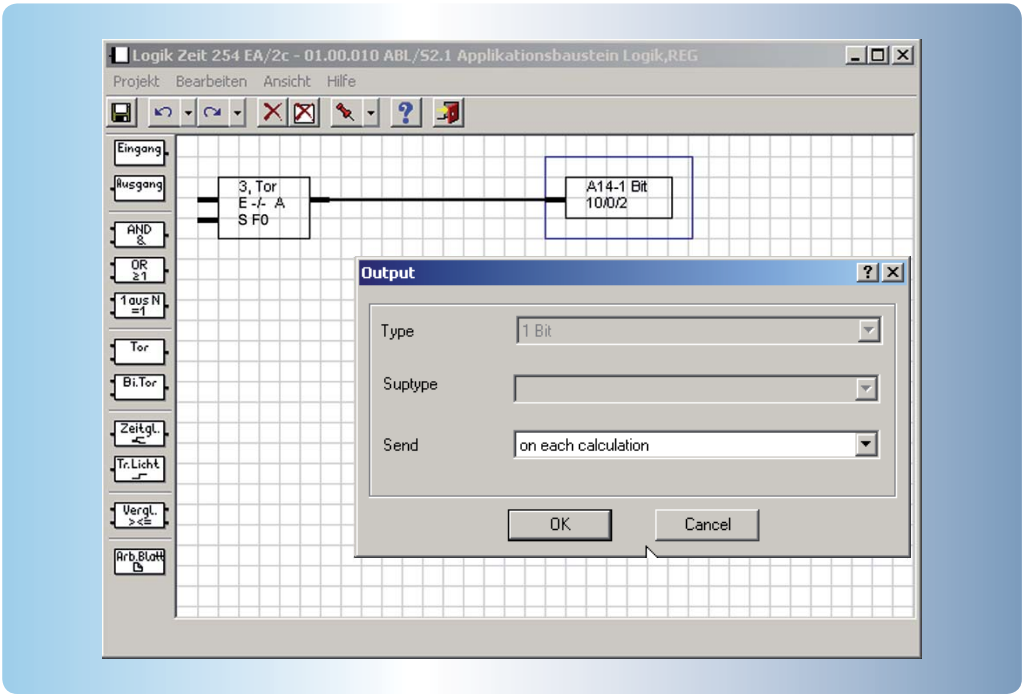


Fig. 87: Setting of the outputs

With the setting on each calculation you ensure that the group address 10/0/2 is always sent with the value 1.
If the gates are all occupied in the Application Unit ABL/S 2.1, this functionality can also be implemented with the timer.

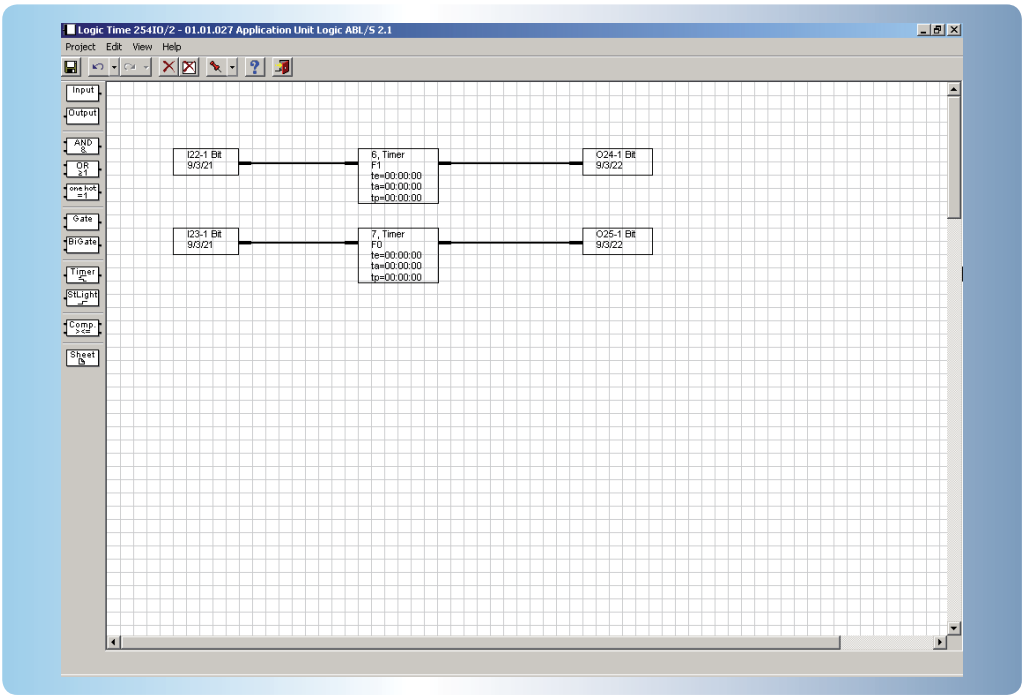


Fig. 88: Solution with timer

5.2.4. Universal Interface US/U x.2 or Binary Input BE/S x.x

Both the Universal Interface US/U x.2 as well as the Binary Input BE/S x.x from ABB i-bus® KNX offer the function *actuation via long push*. An additional time can be specified for the actuation of the button to be pressed, before the panic alarm is triggered. This can avoid unintended actuation.

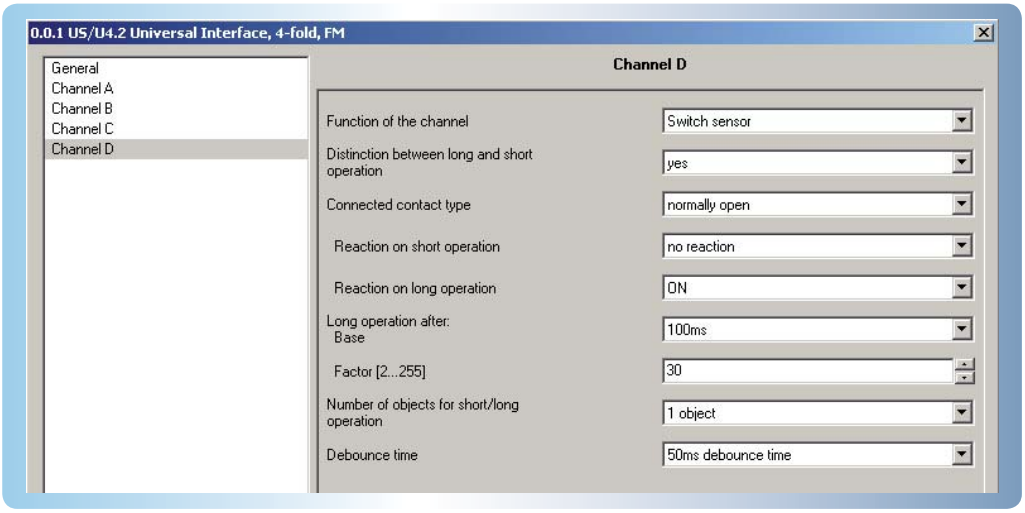


Fig. 89: Solution with US/U x.2 or BE/S x.x

With this setting the operator must press the button for three seconds to send a telegram. An actuation less than three seconds does not initiate an action.

Special solutions, e.g. pressing the button three times to initiate the function, is also possible with these devices.

5.3. Control with DALI

The lighting control and regulation offers many flexible possibilities. Dimming in particular in conjunction with the following features is becoming more and more significant in lighting technology:

- Comfort
- Conservation of energy
- Protecting the luminaries
- Light scenes
- Constant lighting control

The use of DALI normally means the use of the function dimming.
For this reason we have a brief overview of the different types of dimming from a technological point of view.

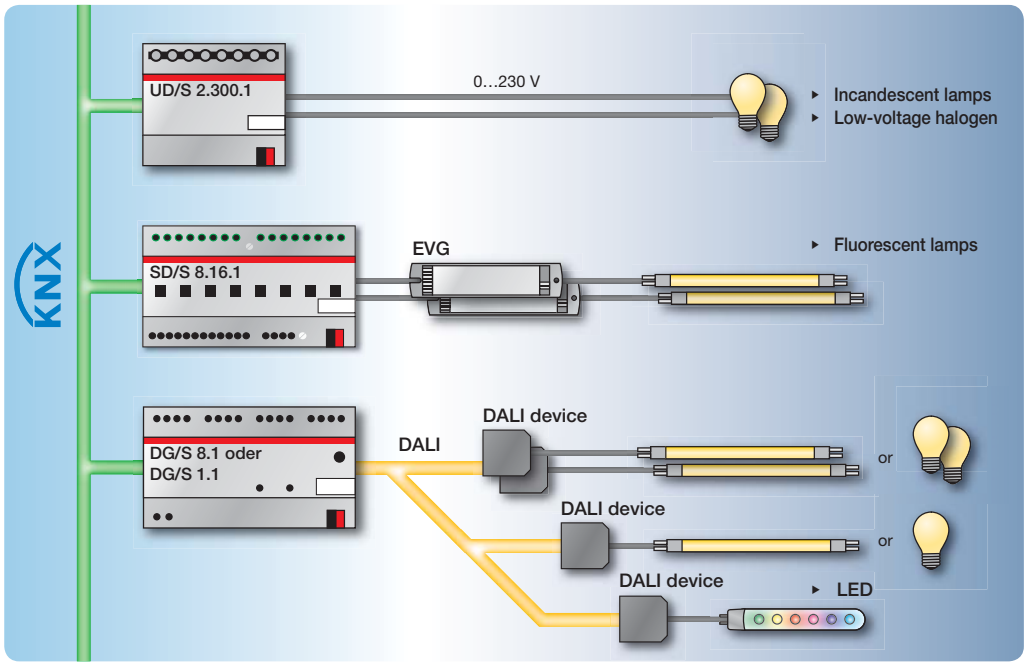


Fig.90

For further information see chapter 1.3. *Function dimming*.

Special types of control

5.3.1. DALI structure

DALI offers all functions which are required in conjunction with a complete lighting control. Fundamentally when DALI signals are used for control of DALI equipment (ballasts, transformers), they are sent via a two-core control cable in order to switch the lights, to dim and to recall light scenes.
For the different types of luminaries there are suitable DALI devices available from different manufactures. The great advantage of the DALI system is the standardization and the compatibility of the data protocol, which it incorporates that is similar to the ABB i-bus® KNX system. Accordingly, the market partners can be selected from a big range of products from different manufacturers.The DALI features are shown in the DIN IEC 60929 standard.

Features of the DALI to DIN IEC 60929

- DALI was defined by the leading manufacturers of lighting technology in 1999 as the *Interface Standard* for the control of technical lighting equipment.
- It is a protocol for digital communication between components of lighting equipment.
- Each individual lamp can be addressed individually.
- Telegrams for 64 slaves, 16 groups and 16 light scenes are possible.
- Technical lighting values transferred are: Brightness value, dimming speed and error feedback.
- DALI can operate together with bus systems for intelligent installation systems as it is a subsystem. DALI is not a bus system for intelligent installations.
- DALI features a two-core control cable.
- The structure used for cable laying can be selected as required, e.g. tree structure.
- A DALI signal cable is polarity free.
- The cable is laid together with the supply voltage in a five-core cable.
- The signal inputs are mains voltage proof.
- Feedback concerning the ballast status occurs directly, e.g. lamp ON/OFF, current brightness value, lamp error.
- Various settings, e.g. speed of the light change, dimming limits and the behaviour with a system failure are possible.
- With a recall of individual scenes all DALI ballasts simultaneously reach their dimming value.
- The dimming range which depends on the ballasts used ranges from 0.1 to 100 %.
- The logarithmic dimming curve is analogue to the sensitivity of the eye.
- Dimming and switching occur via the control line without additional switching relays, i.e. electronically switched in DALI equipment.
- Switch on and off of the lighting is silent.
- The system can be operated with emergency power, i.e. operation with DC is possible.
- It is a universal system for control (dimming) of LED's or coloured light.

DAL ballasts are permanently connected to the voltage supply and are subject to standby losses. The current DALI devices have a value of just 350 mW.

Special types of control

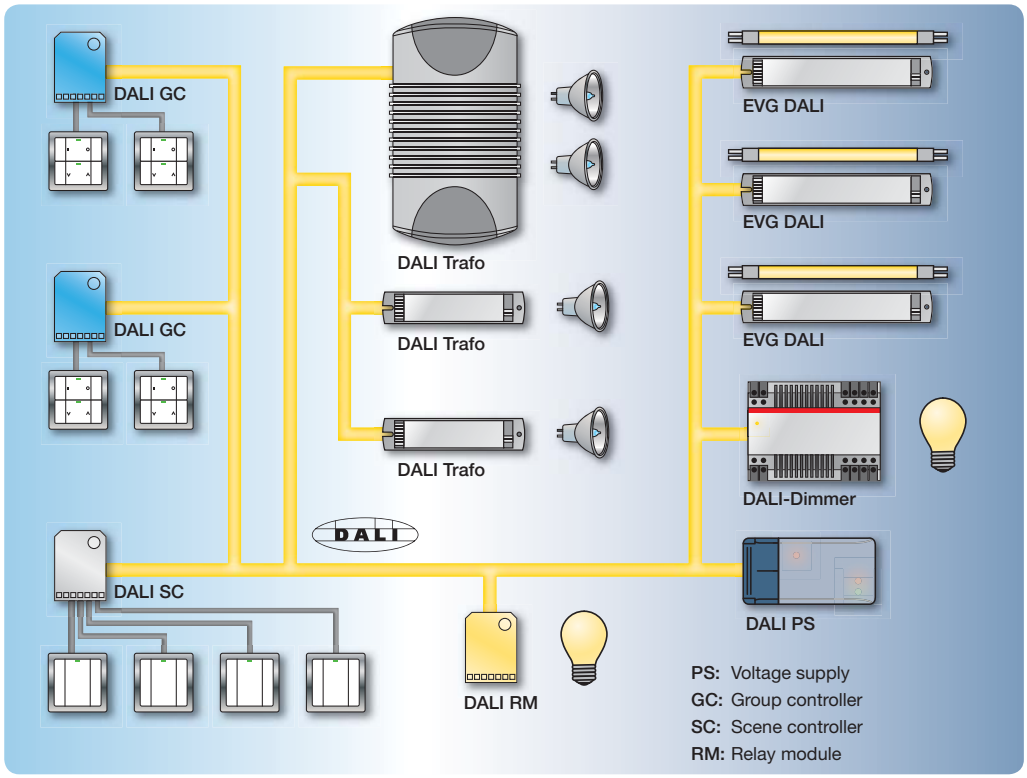


Fig. 91: Overview of a DALI system (stand-alone without gateway to another system)

The DALI PS (Power Supply), the GC (Group Controller) and SC (Scene controller) are only necessary with the stand-alone solution. These components are not required with a connection to the ABB i-bus® KNX. Every DALI device is generally addressed to ensure that they can be operated individually. Addressing is implemented using software or via multiple actuation or long actuation of the push button. The addressing is significantly easier when DALI is integrated into ABB i-bus® KNX.

For further information see Documentation of the manufacturer or www.dali-ag.org.

It can be assumed that DALI will supersede analogue 1-10 V technology in the medium to long term.

Special types of control

Here is a comparison of both systems:

1...10 V	DALI
• Potential free control input	• Potential free control input
• Two-wire cable	• Two-wire cable, insensitive to interference
• Can be controlled via bus systems ABB i-bus® KNX etc.	• Can be controlled via bus systems ABB i-bus® KNX etc.
• Dimming range 1…100 %, Linear characteristic	• Dimming range 1…100 %, Logarithmic characteristic
• No feedbacks	• Individual feedbacks
• No addresses	• Group, individual and broadcast address
	• Scene memory
	• Programmable dimming times
	• Integrated ON/OFF switch

At the moment DALI is usually used for sophisticated tasks in lighting technology, as the respective devices play a role in the costing of a system, e.g. if dimmable lighting with gas discharge lamps is intended, the price difference between a required 1-10 V ballast and a respective DALI-EVG is only minimal if not the same. This also depends on the region and country.
In the meantime there are ballasts with 1-10 V interfaces and DALI connection combined in one device.
The following aspects will further promote market penetration of the DALI:

– Standardisation of the DALI technology
– Higher demands placed on lighting control
– Price reduction of the DALI equipment
– Use of LED technology / coloured light → solution with DALI
– Interfaces to other systems

As DALI is exclusively for lighting technology with a maximum of 64 devices, the interface to ABB i-bus® KNX with its range of further functions is necessary. The objective is to realise the best of both worlds in one system.

This is the task of our DALI gateways:

– DALI Gateway 8-fold
– DALI Gateway 1-fold

5.3.2. DALI Gateway 8-fold DG/S 8.1

Features of the DALI Gateway 8-fold DG/S 8.1 from ABB i-bus® KNX:

- Modular DIN Rail device
- 6 Module Width, ABB i-bus® KNX
- 8 Channels (DALI outputs)
- Max. 128 DALI device, 16 per channel
- 230 V AC/DC operating voltage
- Integrated DALI power supply
- Channel test, ABB i-bus® KNX independent
- Display of DALI fault
- Operating voltage display
- **No DALI addressing**

Fig. 92: DG/S 8.1

The DALI Gateway 8-fold DG/S 8.1 from ABB i-bus® KNX has eight independent DALI outputs to which 16 DALI devices can be connected. Here up to 16 lamps can be simultaneously switched and dimmed. Feedback signals can only be sent on a channel basis and differentiation between individual lamps on a channel is not intended. Additional DALI addressing is not necessary.
All settings are undertaken on the DG/S 8.1 application in the ETS.
The handling of the device is comparable with an 8-fold ABB i-bus® KNX dimming actuator.
The planners or installers of the lighting control do not need to be concerned further with DALI apart from selecting the equipment suitable for the lamps. The conversion from 1-10 V technology is particularly easy with these components.

Special types of control

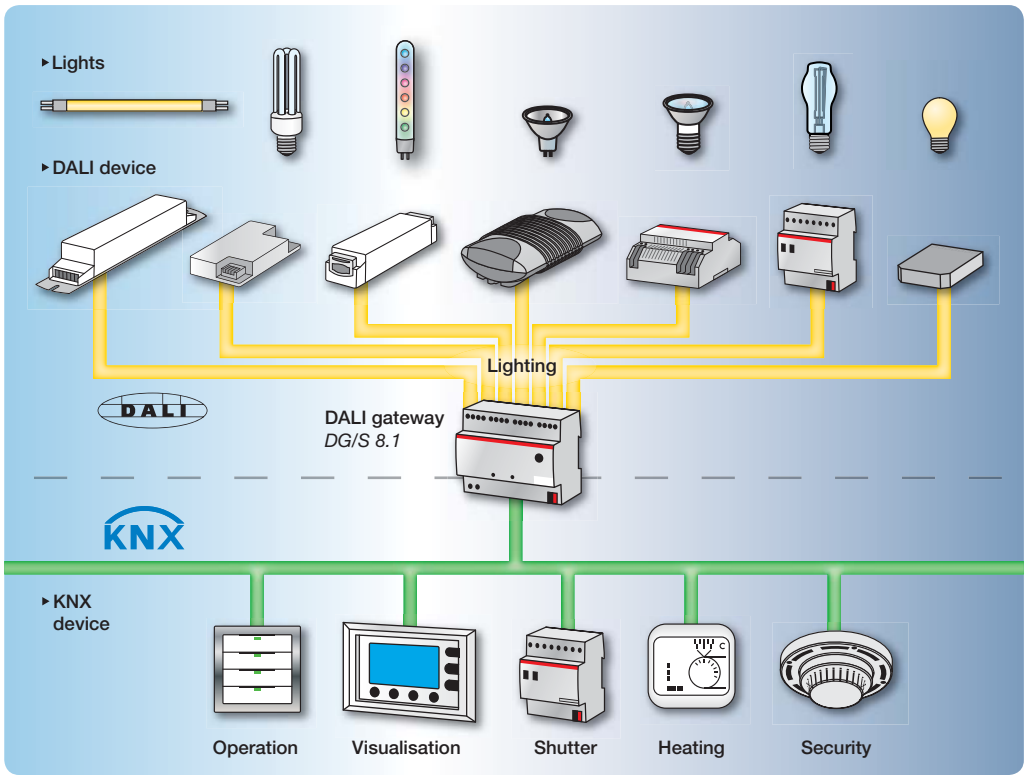


Fig. 93: Integration in ABB i-bus® KNX

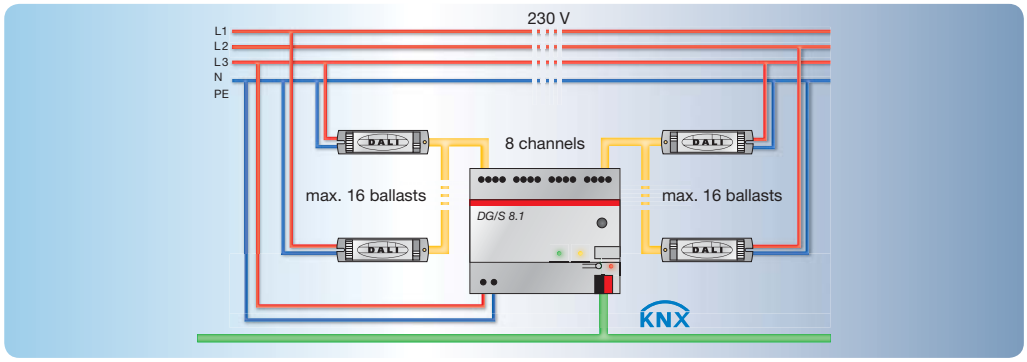


Fig. 93: Connection diagramm DG/S 8.1

The DALI devices are connected on the one hand to the DALI cable and on the other hand with the 230 V mains. Different phases can also be used within a channel. The lamps are also connected to the DALI devices equipment, not shown in Fig. 93.

The DALI control cable and mains cable can also be parallel cores in a normal cable, e.g. 5 x 1.5 mm². There is no negative influence on the control signal unlike the 1-10 V control. This is an advantage of digital technology.

With the DALI Gateway 8-fold DG/S 8.1 it is not necessary to undertake DALI commissioning or addressing. The assignment is implemented by cabling analogue to 1-10 V technology..

5.3.3. DALI Gateway 1-fold DG/S 1.1

Features of the DALI Gateway 1-fold DG/S 1.1 from ABB i-bus® KNX:

- Modular installation device
- 4 space units, ABB i-bus® KNX
- 2 channels (DALI outputs)
- Max. 128 DALI device, 64 per channel
- 230 V AC/DC operating voltage
- Integrated DALI power supply
- Channel test, ABB i-bus® KNX independent
- Display of DALI fault
- Operating voltage display
- Individual addressing of the DALI slaves

Fig. 95: DG/S 1.1

The DALI Gateway 1-fold DG/S 1.1 from ABB i-bus® KNX has two independent channels, to which up to 64 DALI devices can be connected to each. They can be switched together and dimmed (broadcast mode) but can also be addressed and operated **individually**.
This is the decisive difference from the DALI Gateway 8-fold DG/S 8.1 from ABB i-bus® KNX, with which the individual lamps in the channels **cannot** be separately controlled.
This is possible via DALI addressing, i.e. every device receives a DALI address.
The configuration tool DG/S 1.1 Tool is available for this purpose. This tool enables very simple and quick addressing.

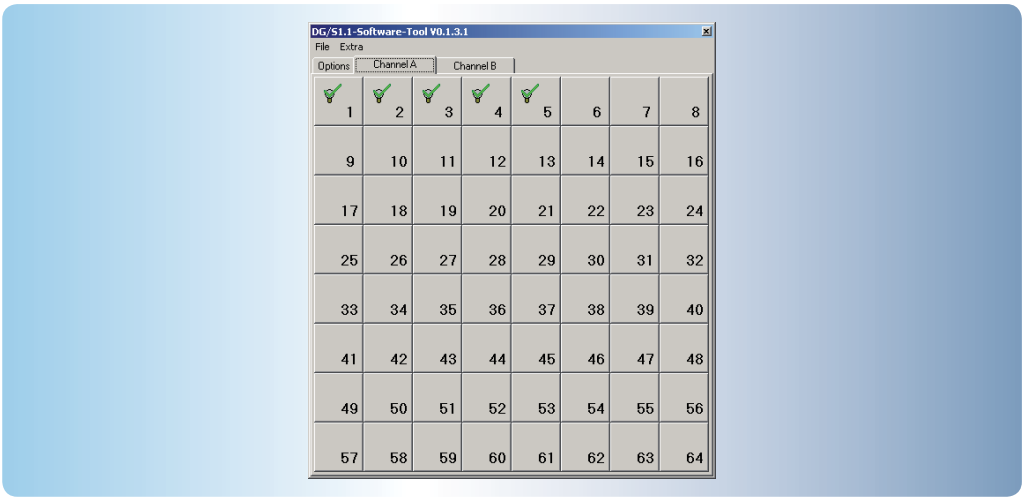


Fig. 96: DG/S 1.1 Tool

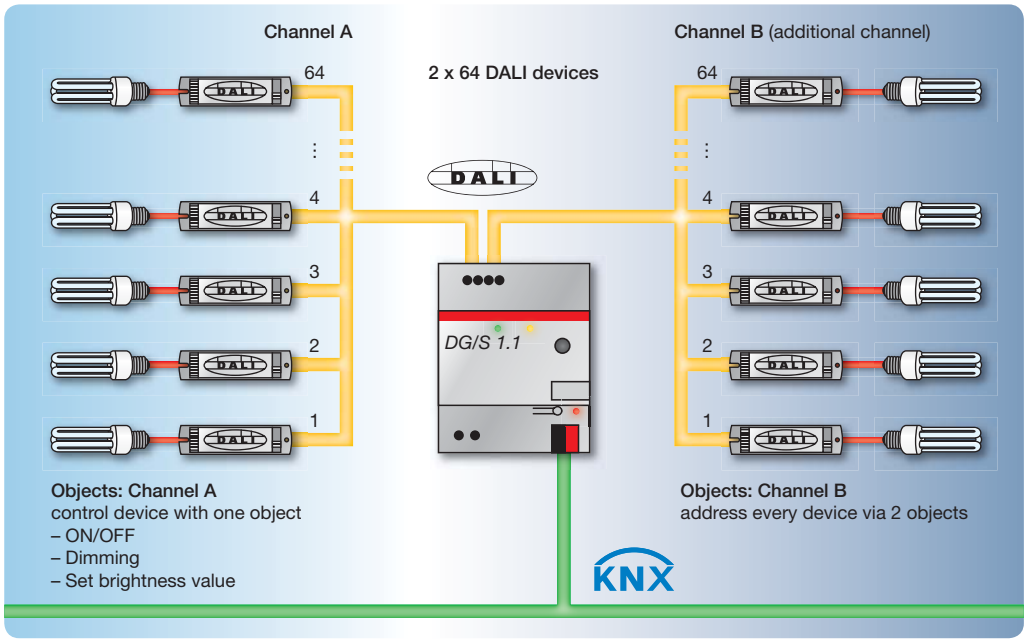


Fig. 97: DG/S 1.1 with connected lamps

Channel A

Channel A is the main channel and has separate communication objects for every device in ETS for the three standard functions ON/OFF, dimming and brightness, i.e., separate switching and dimming via any ABB i-bus® KNX sensors is easily possible.
Formation of groups and light scenes can be set in the ETS application, in the same way as the ABB i-bus® KNX dimmers.

Channel B

Channel B is an additional channel. Each individual lamp can also be separately controlled, however only using coding:

- Sending the number of the lamp in the channel via a 1 byte communication object.
- Sending the telegram with the respective function, e.g. ON or OFF.

Two telegrams must always be sent to undertake an action due to the coding. This can only generally be implemented together with a visualisation system or an LCD panel and is therefore reserved for special projects.

The background of this coding is the limited number of communication objects, max. 255, which are available for every device in the ETS.

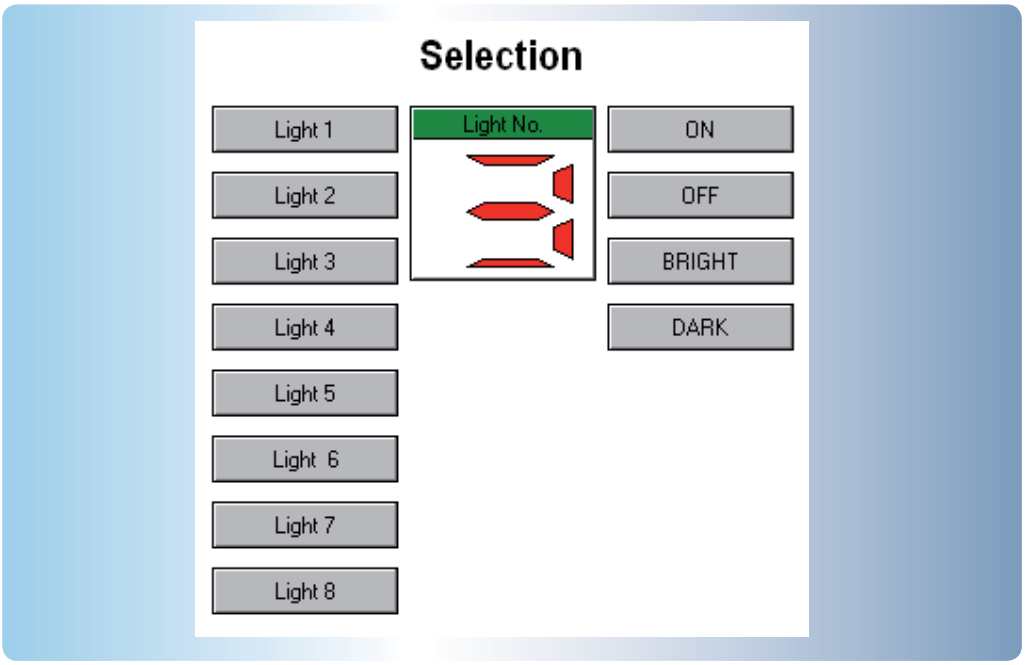


Fig. 98: Example of a solution with a visualisation system

The virtual buttons *Light 1* to *Light 8* are pre-select switches which send the number of the lamp as 1 byte telegrams on the bus. The buttons ON/OFF/BRIGHT/DARK are the corresponding function buttons.

The broadcast mode (central function) is also accessible for channel B using its own communication objects and can therefore be used at any time, e.g. for rooms in which several lamps should be switched and dimmed together such as in factory halls, staircases and halls.

With the DALI Gateway DG/S 1.1, two sets of 64 DALI devices can be individually addressed, they are individually controllable in the main channel as well as in the additional channel (in broadcast). Every channel has a control cable for up to 64 devices. As a result the DALI Gateway DG/S 1.1 from ABB i-bus KNX® offers a high-level of flexibility with modifications to the building or a change in its use.

5.3.4. DALI Gateway 1-fold DG/S 1.16.1

Features of the DALI Gateway 1-fold DG/S 1.16.1 from ABB i-bus® KNX:

- Modular installation device
- 4 space units, ABB i-bus KNX
- 1 channel (DALI outputs)
- Max. 64 DALI devices
- Max. 16 groups can be parameterised
- 110 – 240 V AC/DC operating voltage
- Integrated DALI power supply
- Channel test, KNX independent
- Display of DALI fault
- Operating voltage display
- Individual addressing of the DALI devices

Fig. 99: DG/S 1.16.1

With the DG/S 1.16.1, the individually addressed devices are assigned to up to 16 groups. A group can consist of 1 - 64 slaves, whereby the broadcast mode can be utilized to communicate with all available devices.

Overlapping groups are possible, i.e. a lamp can be a member of different groups. The groups are created using an extended configuration tool; the term DALI grouping is used.

Special types of control

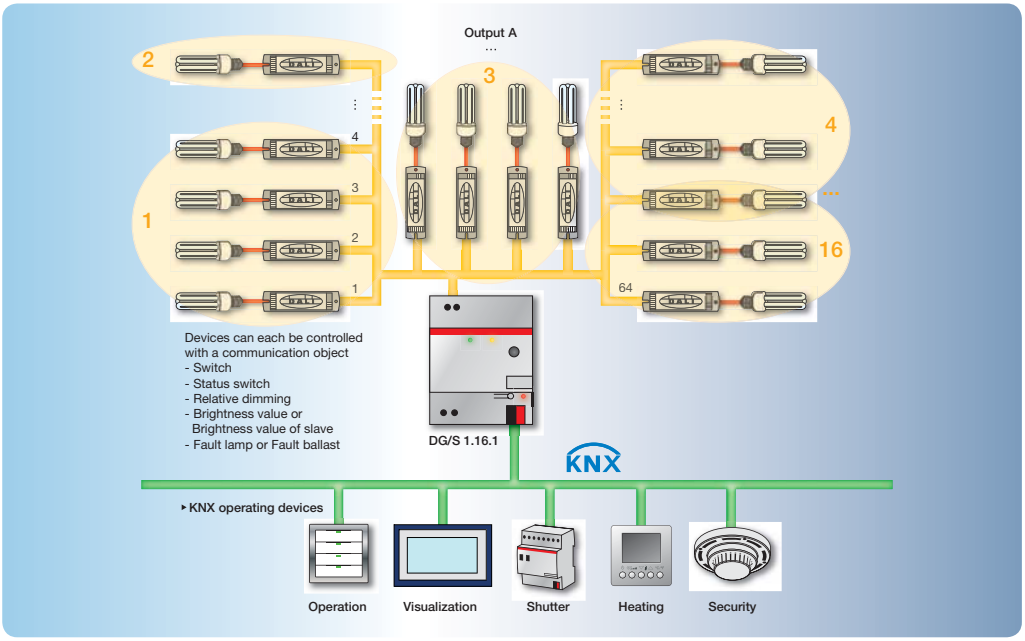


Fig. 100: DG/S 1.16.1 with connected lamps

At first glance, this device seems to have a limitation compared to the DG/S 1.1, as only a maximum of 16 groups are possible with the DG/S 1.16.1 compared to the free group assignment of the DGG/S 1.1.

The advantage with the DG/S 1.16.1 is the fact that the parameterisation effort is much less with ETS. Also important is that only one DALI telegram is sent with the control of a group. Accordingly, all lamps are controlled simultaneously and there is no delay for the function.

With the DG/S 1.1., the group assignment is implemented in the KNX via group addresses. If only a certain number of lamps are to be controlled, the respective number of DALI telegrams have to be sent successively. Any status telegrams from the individual lamps are also sent serially.

If these delay cannot be accepted, the number of lamps in a KNX group with the DG/S 1.1 should be limited to 7 units.

5.3.5. Conclusion

In principle, all DALI Gateways can be used for the integration of the ABB i-bus® KNX to DALI devices. The following special device features are worth mentioning:

DALI Gateway DG/S 8.1

– No addressing and hence no DALI setup required
– For lighting circuits with many individual lamps that do not need to be reassigned later
– Uniform dimming in large groups

DALI Gateway DG/S 1.1

– For many lighting circuits with few lamps
– Highest level of flexibility
– Up to 128 lamps can be addressed

DALI Gateway DG/S 1.16.1

– Flexibility
– For large lighting groups, 16 groups in total
– Enhanced software functionality

5.3.6. Special features of DALI

Some settings and special functions are interesting and important when using DALI:

– Burn-in of fluorescent lamps
– DALI Switch Actuator DAS/S 2.16.1
– DALI in conjunction with emergency lighting systems
– Fault messages of the gateways
– Special functions of the gateways
– Constant lighting control with DALI, ABB i-bus® KNX and DALI gateways

5.3.6.1. Burn-in of fluorescent lamps

The gas discharge lamps connected to the DALI device, usually fluorescent lamps of type T5, should normally be dimmed. If this is undertaken at the start of the operating cycle the following unpleasant effects normally result:

– The overall life time of the lamps is reduced considerably.
– The brightness behaviour of the lamps becomes worse.
– The full brightness level is no longer reached.

These effects can be prevented by operating the lamps at the beginning of their life time at 100 % brightness for about 50 hours (T8 fluorescent lamps with 26 mm diameter) or about 100 hours (T5 fluorescent lamps with 16 mm diameter). The lamps should not be dimmed for any reason and not switched off if possible during this time. Further details of the burn-in process can be found in the technical data of the manufacturer of dimmable ballasts.

If the burn-in process is to be automated or simplified, the parameters of the DALI gateway from ABB can be set with the respective duration. The burn-in mode is started via a separate communication object. During this time the light can only be switched with 100 % brightness. Dimming is deactivated. After the time has elapsed, dimming is automatically enabled.

5.3.6.2. DALI Switch Actuator DAS/S 2.16.1

The DALI Switch Actuator DAS/S 2.16.1 from ABB is a very exceptional little device.

It executes switching functions:

– DALI Switch Actuator, 2-fold, 16 A.
– Two floating contacts, suitable for capacitive loads with high inrush currents.
– Relays can also be actuated manually.
– The control is implemented via the DALI control signal.
– Both channels operate as two independent DALI devices.

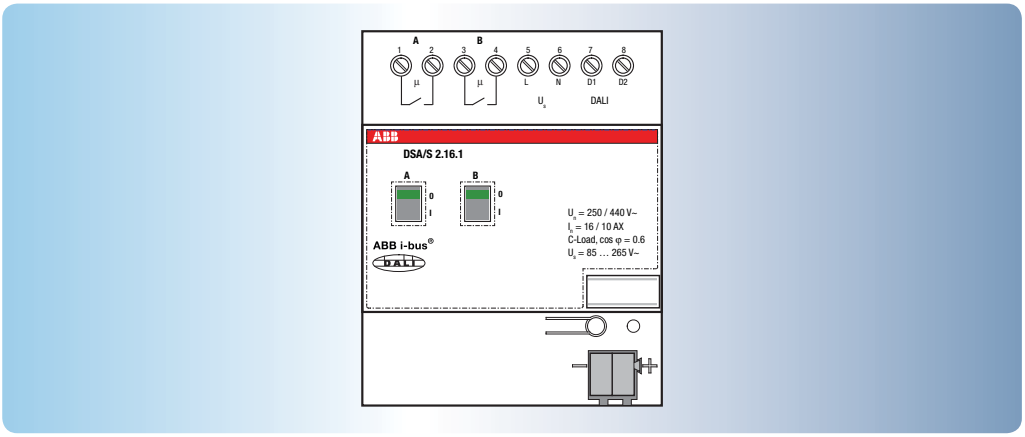


Fig. 101: DSA/S 2.16.1

If the DALI Switch Actuator DAS/S 2.16.1 is integrated into an ABB i-bus® KNX system, the circuits can only be switched via the DALI gateway with this actuator. A typical project for this device would be a lighting control in which DALI should be used due to its special features, but where not all lights need to be dimmed.

5.3.6.3. DALI in conjunction with emergency lighting systems

Up to now emergency lighting systems were designed as an independent system with separate lamps.

This conventional solution requires a lot of effort and higher costs.
Additional emergency lighting is also unwanted as it is not aesthetically pleasing.
If ABB i-bus® KNX and/or DALI is installed in a building, it is possible
to use selected lamps from the general lighting as emergency lighting.

The installation effort is reduced leading to a saving in cost.
Prerequisites for realisation are:
– The ballast can be operated with DC voltage.
– The brightness level for the dimmable ballast is adjustable.

Special types of control

Regulations for emergency lighting systems

The respective regulations compliant to DIN EN 50172 (VDE 0180 part 100) dated January 2005 must be observed. This includes the testing of the safety lighting including regular maintenance of test book documentation. This concerns both the daily test of the lamp as well as the monthly and annual tests:

– Switchover to emergency operation
– Checking for the existence of all lamps
– Checking the cleanliness and function
– Protocolling the results

Installation with DALI

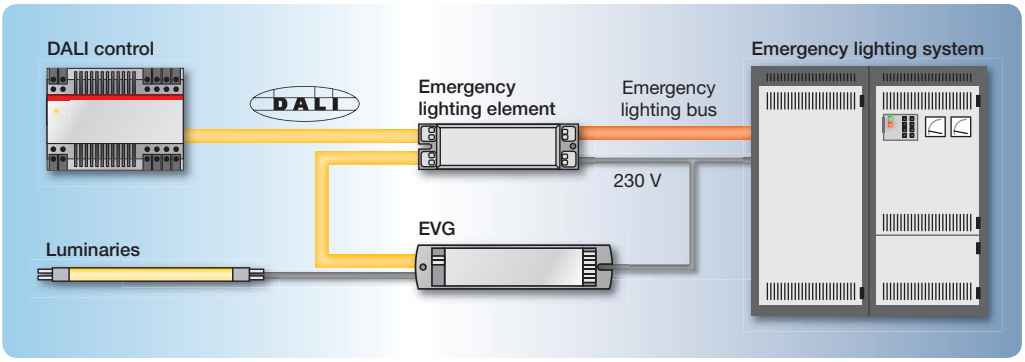


Fig.102: Solution with DALI

The emergency lighting system monitors the lamps and controls emergency lighting operation. The daily function test looks for defective lamps. The emergency lighting element is CEAG Type 2L-CG-SB. Alternatively the function test including the protocolling can be undertaken by the ABB i-bus® KNX, e.g. via a visualisation system.

With a connection to the ABB i-bus® KNX the DALI control (master) shown above is the corresponding DALI gateway.
Testing the lamps and the DALI ballasts is possible at any time using the DALI Gateway.. A telegram can be sent if there is a fault or can be transmitted on request with a cyclical function test.
An emergency lighting element, e.g. CEAG TYPE 2L-CG-SB, switches the DC voltage supply (battery) in the emergency lighting over to the ballast and the DALI gateway. They can be operated with DC voltage (110 to 240 V DC).

5.3.6.4. Error feedback

The feedback from lamp and ballast device errors is a standard function of DALI.
This is undertaken in different ways depending on the DALI gateway.

DALI Gateway DG/S 8.1

The error feedback is sent as an accumulative signal for each channel, i.e. an individual message for every lamp in the channel is not possible.

DALI Gateway DG/S 1.1

First of all an accumulative signal is also sent with the DALI Gateway DG/S 1.1 if a lamp or ballast in a channel is defective. However, in this case an individual error signal is available due to the individual addressing, both in channel A and channel B. Due to the limit on available communication objects, it is also necessary to operate with a code here.

- Send the number of the lamp in the channel via a 1 byte communication object.
- The DALI Gateway DG/S 1.1 indicates if the selected lamp exhibits a corresponding fault via a 1 bit telegram to another communication object (separate for lamp or ballast).

From a practical point of view the realisation of the individual error messages is usually implemented via a visualisation system or a panel. After the channel message is received the individual load devices are switched manually one after another by the user. The corresponding message then appears at the defective devices.

Through separate software functionality the representation and processing of individual errors can be automated and represented for the user in a clear and transparent manner:

- After sending the channel error message by the DALI gateway, a logic is controlled that consecutively sends the 1 byte communication object with the numbers of the lamps on the bus.
- If a message is sent via the communication object *Error selected device*, it must be shown in conjunction with the respective lamp number or stored.

Formation of a group would also be conceivable, i.e. only one message sent with the failure of a lamp in the group or room.

This can be implemented with suitable visualisation software (e.g. BCON or Eisbär).

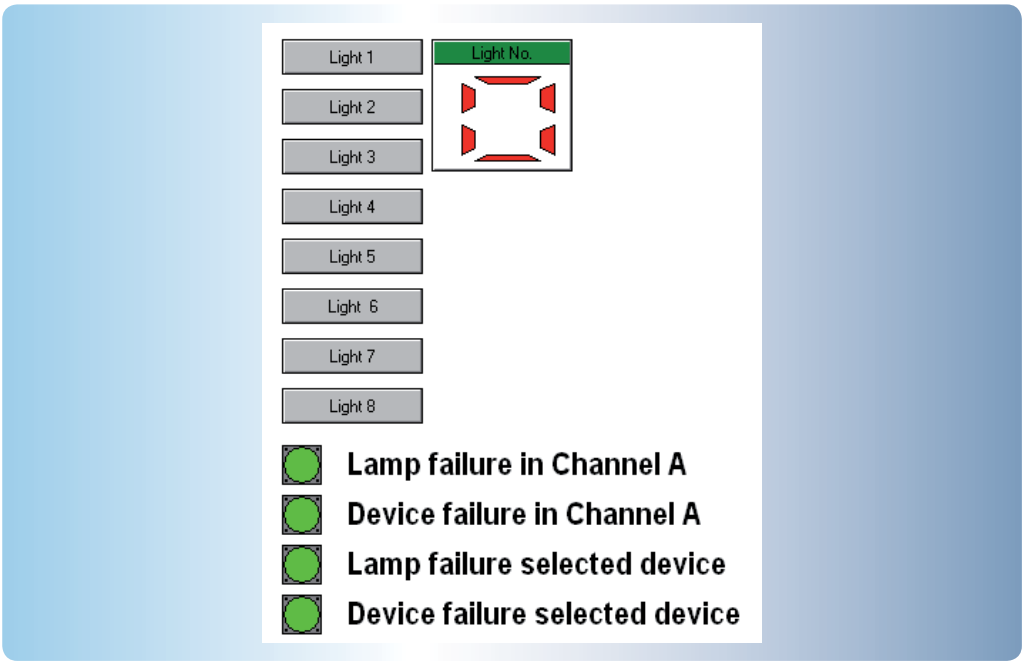


Fig. 103 a: Example of a simple representation with visualisation:

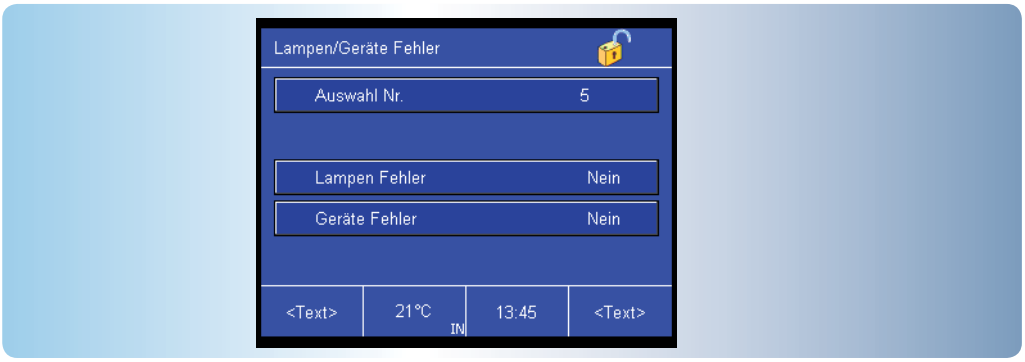


Fig. 103 b: Example of a representation using the Controlpanel:

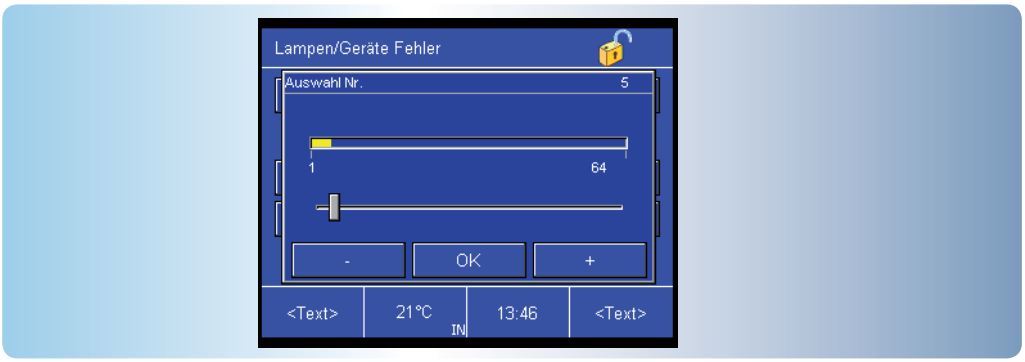


Fig. 103 c:

The selection is made via a slider (1-byte value), the display of the error via a push button (switch 1-bit) with text ‘Yes’.

DALI-Gateway 1.16.1

For every lighting group, the DG/S 1.16.1 can send the status of the group on the KNX. Independently of this fact, with DG/S 1.16.1 it is also possible to read the fault status of every DALI device individually via KNX. Coded telegrams are available for this purpose.

If there is a lamp fault or the DALI device fault, it is possible to decide in the parameters whether the respective telegrams are sent as device-based or group-based telegrams.

There are three 1 byte communication objects available:

- **Fault group/device code:** Via this communication object, the DG/S transfers the status of a fault of every lighting group or of each individual DALI device on the KNX.
- **Number of faults:** Using this communication object, the number of groups or individual DALI devices are displayed which have at least one lamp or ballast fault. The value relates to the lighting group or the individual DALI device in dependence on the *group-orientated* or *device-based* parameterisation.
- **Group number/device fault:** With this communication object, the first lighting group or the first DALI device is displayed as a figure value. The value relates directly to the lighting group or the individual DALI device in dependence on the *group-orientated* or *device-based* parameterisation.

5.3.6.5. Special functions of the DALI gateways

The DALI gateways from ABB i-bus® KNX offer two important special functions:

- Dynamic function
- Central function
- Sequence (DG/S 1.16.1 only)

Dynamic function

The dynamic function allows the recall of a lighting sequence.

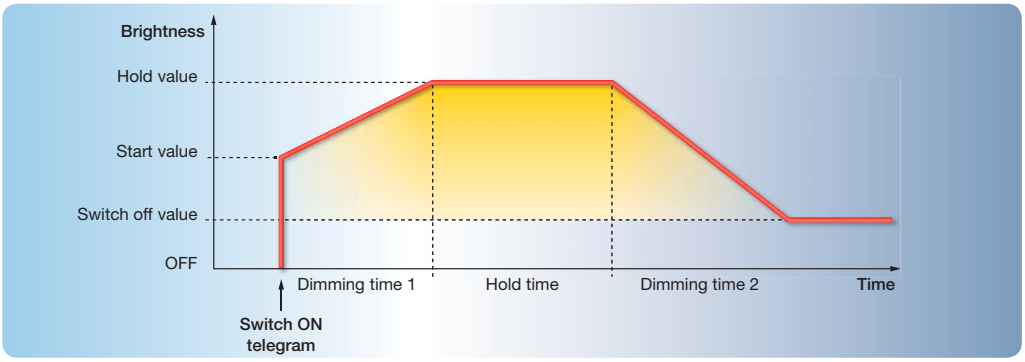


Fig. 104: Lighting sequence

Special types of control

All values, such as start, hold and switch off values as well as the times can be adjusted in the parameters.

1. Dynamic function with function staircase lighting:The dimming time is short, e.g. one second. The holding time is the staircase lighting time, e.g. five minutes and after it has elapsed the lighting slowly dims down to zero, the minimum value. The staircase lighting time is started again by repressing the respective push button.

For further information see Manual DALI Gateway DG/S 8.1 or DG/S 1.1

2. Effect lighting: In a shop window, exhibition areas, etc. effect lighting is realised by repeated start of the dynamic process.
3. Medical light therapy: Lamps with different colours are dimmed up and down and the colours cross fade.

Central function

As a central function, the broadcast mode with the DALI Gateways are available as independent communication objects for ON/OFF, dimming and brightness value.

1. A central function is used to switch on panic alarm lighting. The switch on brightness is defined at 100 % (otherwise just 80 %). The dimming time is short to ensure that the brightness level is quickly achieved.
2. In a Restaurant the lighting should dim up very slowly as it turns to dusk, so that the transition from natural to artificial lighting is hardly noticed. The dimming time up to the switch on value is set, for example, to an hour.

In addition to the simpler programming involved it must only be assigned to one group address; the following separate parameters are available for the central function, e.g.:
– Dimming limits
– Dimming time
– Switch on brightness:

Sequence (DG/S 1.16.1 only)

Up to 10 scenes can be recalled successively with a sequence. Up to 255 repetitions or an endless loop can be programmed; transition and scene runtimes can be individually set.

In this way it is possible to program running lights or lighting effects without additional logic or timer modules with the DG/S 1.16.1.

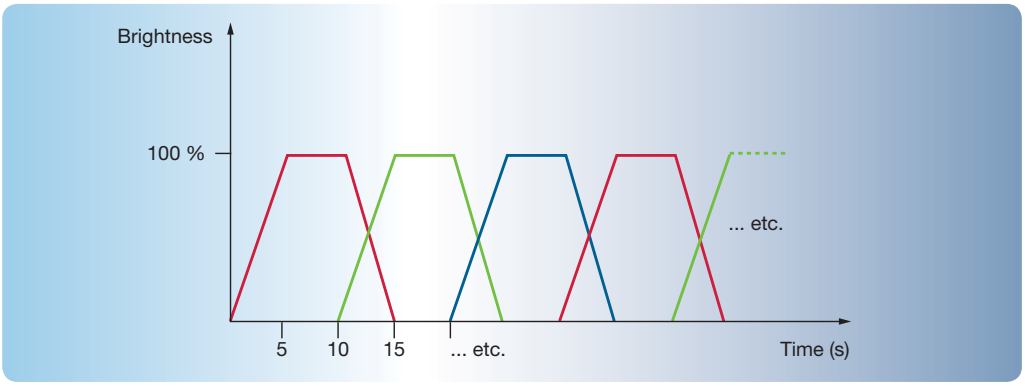


Fig. 105: Example: Colour cycling light sequence in the wellness area of a hotel

5.3.6.6. Constant lighting control with DALI, ABB i-bus® KNX and DALI gateways

In order to realise constant lighting control, the Light Controller / Switch/Dim Actuator LR/S x.16.1 using analogue 1 - 10 V technology be combined as an option with a light sensor, see chapter 3.6.2. *Constant lighting control*.

The regulation processes stay within the device and the control value is usually not sent on the bus. Accordingly, large systems with many control circuits avoid a high load on the bus.

With the DALI gateways this is not available and the only option is to use external components. Every channel with the DALI Gateway DG/S 8.1 or every lamp in channel A of the DALI Gateway DG/S 1.1 and each group of the DG/S 1.16.1 can be controlled via a 1 byte communication object (brightness value). This can be realised with
the following devices:

- Light Controller / Switch/Dim Actuator LR/S x.16.1, the device will only then operate as a regulator
- Presence Detector PM/A 2.1, has an integrated light sensor and regulator
- RC/A x.2 with module LR/M 1.6.1, same situation as with the LR/S x.16.1

The components mentioned operate as regulators and send the control variable as a telegram on the bus.

For further information see chapter 3.6.2. *Constant lighting control*.

From the manufacturers of DALI equipment, e.g. Tridonic, Helvar, constant brightness sensors are available to connect to the DALI.

The constant brightness sensors only function with DALI stand-alone solutions. When DALI gateways are used, no other DALI devices with the exception of ballasts for lighting can be used.

5.3.7. DSI (Digital Serial Interface)

DSI is also a digital interface in lighting technology for control of DSI ballast devices.
It is however a company-specific solution and not a standard like DALI. The functionality is limited compared to DALI, e.g. there is no error feedback.

DSI will loose significance due to the presence of DALI on the market.

From ABB one control devices (gateway) Typ SL/S 50.1 (MDRC unit) is available.

Checklist

Lighting control

Building: _____

Floor: _____

Room: _____

Smallest common controlled unit No. _____

Function: _____

Planned Lamps:

- ❏ Incandescent bulbs
  - ❏ Number _____
  - ❏ Power _____
- ❏ LV-Halogen
  - ❏ Number _____
  - ❏ Power _____
  - ❏ Electronic Transformer
  - ❏ Conventional Transformer
- ❏ HV-Halogen
  - ❏ Number _____
  - ❏ Power _____
- ❏ LED
  - ❏ Number _____
  - ❏ Power _____
  - ❏ Nominal Voltage _____
  - ❏ 0...10 V-Interface (Standard)
  - ❏ Active 0...10 V Signal
  - ❏ DSI-Interface
  - ❏ DALI-Interface
  - ❏ _____
- ❏ Fluorescent Lamps with EBD (conventional)
  - ❏ Number _____
  - ❏ Power _____
- ❏ Fluorescent Lamps with EBD
  - ❏ Number _____
  - ❏ Power _____
  - ❏ 0...10 V-Interface (Standard)
  - ❏ Active 0...10 V Signal
  - ❏ DSI-Interface
  - ❏ DALI-Interface
  - ❏ _____

Checklist

❑ Vapour Lamps
- ❑ Number _____
- ❑ Power _____

❑ Other Type of Lamps _____
- ❑ Number _____
- ❑ Power _____

Lamps are

❑ Switched
❑ Dimmed
❑ Constant light control

Local manual operation

❑ Conventional push button/switch with universal interface
- ❑ Switch: ON/OFF
- ❑ Push button: TOGGLE
- ❑ Push button: Short – TOGGLE / long – dimming BRIGHTER/DARKER
- ❑ 2 push buttons: short – ON / long – dimming BRIGHTER
  short – OFF / long – dimming DARKER
- ❑ Push button: short TOGGLE with multiple operation for other functions
- ❑ Push button: short – TOGGLE / long – other function
- ❑ Push button: Additional function: _____
- ❑ Status feedback via LED
- ❑ Orientation light

❑ ABB i-bus® KNX push button
- Supplier: _____
- Design: _____
- ❑ ON/OFF
- ❑ TOGGLE
- ❑ Short – TOGGLE / long – dimming BRIGHTER/DARKER
- ❑ Short – ON / long – dimming BRIGHTER
  Short – OFF / long – dimming DARKER
- ❑ Additional functions: _____
- ❑ Status feedback via LED
- ❑ Orientation light

❑ Number of assigned push buttons _____

❑ Location _____

Checklist

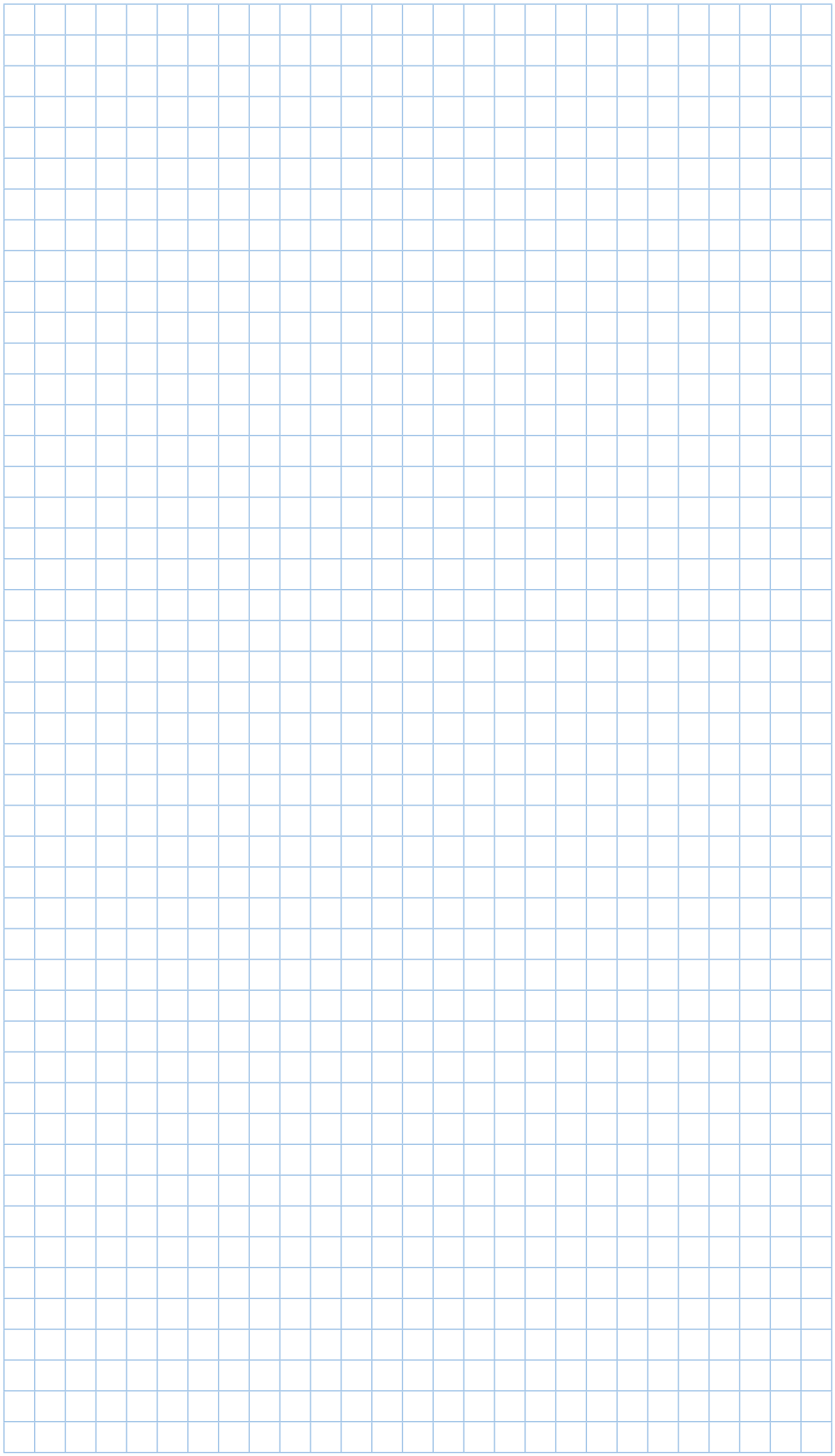
Superior manual operation

- ❏ Central switching
  - ❏ Central ON (e.g. Panic button)
  - ❏ Central OFF
  - ❏ Central ON/OFF
- ❏ Superior switching in groups
  - Number of groups _____
  - Function _____

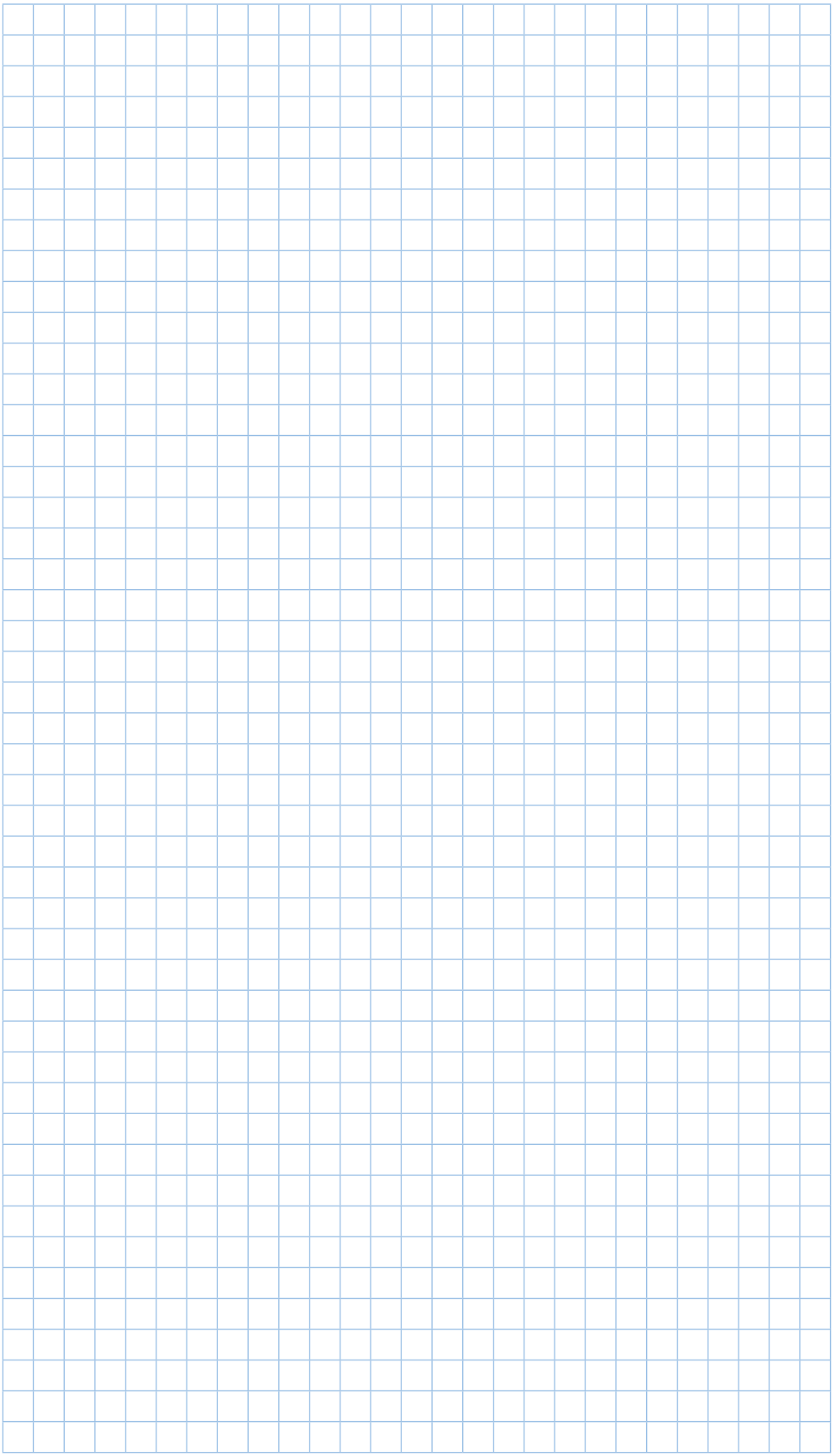
Local Automatic Control

- ❏ Motion detector
  - ❏ Number _____
  - ❏ Location of mounting _____
  - ❏ Switch ON if movement, then not OFF
  - ❏ Switch ON if movement at least for _____ s , then OFF
  - ❏ Sending ON-telegrams cyclically – as long as movement is detected
- ❏ Presence detector
  - ❏ Number_____
  - ❏ Location of mounting _____
  - ❏ Switch ON if presence at least for _____ s, then OFF
- ❏ Locally controlled by any other event
  - ❏ _____
  - ❏ _____

Notes



Notes



Contact

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