KNX-Flash

ABB i-bus® KNX

Based on simple and proven KNX technology, ABB i-bus® KNX is an intelligent installation system that meets the most exacting requirements for applications in modern home and building automation.
This system is the world’s first open standard for controlling intelligent buildings such as industrial, commercial or residential buildings.

Contents

1. KNX and ABB i-bus® KNX

Intelligent Building Control

1.1 Introduction

In many areas of our private and working lifes, the increasing level of automation is a trend that confronts us on a daily basis without actually being noticed.

Automation in buildings aims to combine individual room functions with one another and to simplify the implementation of individual customer preferences.

KNX is the logical development for implementing traditional and new requirements in electrical building installations and thus replacing conventional installation techniques.

The intelligent installation bus system efficiently performs the conventional functions and offers an additional broad range of expanded features, which could not be realized without a bus system.

ABB offers consultants, system integrators and electrical installers a comprehensive product range with ABB i-bus® KNX, in order to meet the challenges posed to electrical building installations both today and in the future.

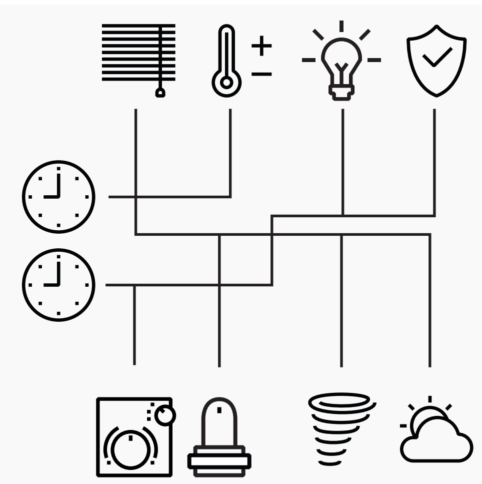

Image 1: The conventional solution: many separate cables, separate functions and little flexibility

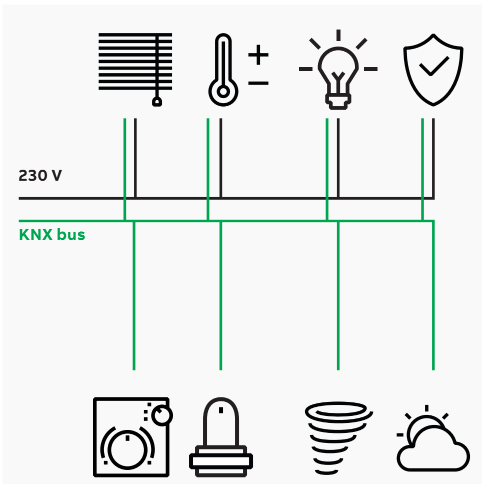

Image 2: The intelligent solution: KNX – a system, a standard, many interoperable functions for maximum flexibility

1.2 What does KNX stand for?

KNX resulted from the merger of major bus systems, including the wellknown EIB (European Installation Bus) that has been successfully on the market since 1992.

1.2.1 What does KNX stand for?

- KNX is the first globally standardized system for the automation of residential and non-residential buildings in accordance with...
  - International standard (ISO/IEC 14543-3)
  - European standard (CENELEC EN 50090 and CEN EN 13321-1 und 13321-2)
  - Chinese standard (GB/T 20965)
  - US standard (ANSI/ASHRAE 135)
- KNX has established a clearly defined system platform where the KNX products of different manufacturers can be operated with one another.
- Both the data protocol and the devices are certified compliant to the KNX standard.
- KNX thus guarantees the networkability, interoperability, is both upward and downward compatible and thus future-proof.
- Just one common software tool (ETS) is required for planning, engineering and commissioning of all KNX installations.
- Both the manufacturers and the KNX Association support professionals during planning, commissioning and maintenance worldwide.
- Extensive training courses for beginners and experts are available at 459 certified training locations in 70 countries.
- More than 469 certified manufacturers from 44 countries are organized in the KNX Association.
- More than 81,000 qualified KNX planners in 164 countries plan, install and integrate KNX systems worldwide.
- Thousands of buildings, ranging from private houses to airport complexes around the world, are equipped with millions of KNX products.

1.2.2 For consultants, system integrators and electrical installers

Benefits for professionals

- Efficient planning
- Economic installation
- Fast integration
- Simple to commission
- International community

Benefits for customers

- Comfortable to operate
- Comprehensive functionality
- Quick to change and expand
- Energy saving
- Future-proof investment
- Reliable standard worldwide
- Unlimited options
- KNX is a byword for comfort, safety and ease

1.3 What does KNX do?

The use of new materials and the application of renewable energies are considered as the most significant innovations in the building industry over the last few years. The growing desire for comfort and functionality simultaneously with the limited availability of resources and increasing energy costs provide the basis for intelligent building control in modern constructions.

Image 3: Communication

KNX interconnects all the components in the electrical installation to form a networked system and thus guarantees the transparency and utilization of information across the installation. In this system, all users "communicate" via a single bus cable. Thus it is possible to integrate all the different fuctional subsystems within the building into a seamless solution.

KNX bus systems can be used both in residential and non-residential buildings.

Image 4: Heating, ventilation, air conditioning

Applications

- Lighting
- Heating, ventilation and air conditioning (HVAC)
- Blinds
- Security
- Energy management
- Operation
- Automation
- Communication

Image 5: Energy management

2. Energy efficiency with ABB i-bus® KNX

Energy savings in the double-figure % range

2.1 Potential savings

Climate change and growing shortages of resources are the big challenges of our time. Efficient and sustainable energy usage is therefore an urgent necessity.

Scientific studies and measured values in practice show a high energy saving potential when bus technology is used in room and building automation.
The ABB i-bus® KNX intelligent building control system provides its customers with a broad range of options for optimum energy efficiency.

On the basis of the KNX standard, energy in the double-figure % range can be saved.

Around the world new legislation is promoting the use of energy efficient technologies.
In Europe, for example, the criteria for energy efficiency in buildings is detailed in the European Standard EN 15232; the allocation into energy efficiency classes A to D serves as the basis for the evaluation.

The following diagram (**Table 1**) shows the differences in energy consumption for three building types in the energy efficiency classes A, B and D relative to the basis values in class C. For example, by using class A, 30% of the thermal energy can be saved in offices.

Energy efficiency class		Efficiency factor for thermal energy			Efficiency factor for electric energy		
		Office	School	Hotel	Office	School	Hotel
A	Highly energy efficient room automation and networked subsections	0.70	0.80	0.68	0.87	0.86	0.90
B	Higher-quality single solution optimized for subsections, partially networked	0.80	0.88	0.85	0.93	0.93	0.95
C	Standard room automation, reference basis	1	1	1	1	1	1
D	No room automation, not energy efficient	1.51	1.2	1.31	1.10	1.07	1.07

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Table 1: Energy efficiency classes to EN 15232

2.2 Energy consumption in buildings

In principle, optimization of the energy consumption in buildings means

- Energy is only consumed when it is actually needed (for example through the usage of presence detectors)
- Only the amount of energy actually required is used (for example through the use of constant lighting control)
- The energy used is employed at the highest possible degree of efficiency (for example through the use of electronic ballasts)

Using the versitile functionality that intelligent building control offers real energy savings can be made. ABB i-bus® KNX is making a significant contribution to global climate protection and at the same time reducing operating costs in today's buildings.

In total, the average energy savings that result through optimization with KNX lie **in the range of 11 to 31%** (**Table 2**).

2.2.1 How does ABB i-bus® KNX work?

Within the KNX bus system, all sensors (e.g. buttons or motion detectors) are interconnected to the actuators (e.g. dimming actuators, roller shutter actuators) via a data cable as opposed to directly wired switches and consumers (conventional installation). The actuators control the power circuit to the consumer.

Communication for all devices is implemented using data telegrams on the same bus cable. The sensors send commands, actuators "listen in" and execute a defined function as soon as they are addressed.

A broad range of functions can be parameterized with ABB i-bus® KNX, such as group commands, logical sequences, control and regulation tasks.

Function	Energy savings in percent
Room heating control	about 14 to 25 %
Heating automation	about 7 to 17 %
Shutter control	about 9 to 32 %
Lighting control	about 25 to 58 %
Air-conditioning control	about 20 to 45 %

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Table 2: Potential savings according to scientific studies

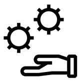
2.2.2 What does system integration mean?

During system integration, all the requirements of the investor or building owner are implemented using KNX devices and the respective product software.

Planning: During planning, the preliminary requirements of the building owner are incorporated into the concept and are summarized in the functional description.

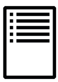
Engineering: The most suitable components and software applications are selected. The planning of the bus topology is realized during the engineering phase. The system devices required for implementing the KNX network are defined. The project engineering using the ETS on the basis of the functional description also takes place in this phase.

Commissioning: During the commissioning phase, the KNX devices are installed and programmed. The ETS project that has already been created is downloaded into the devices using the ETS software.



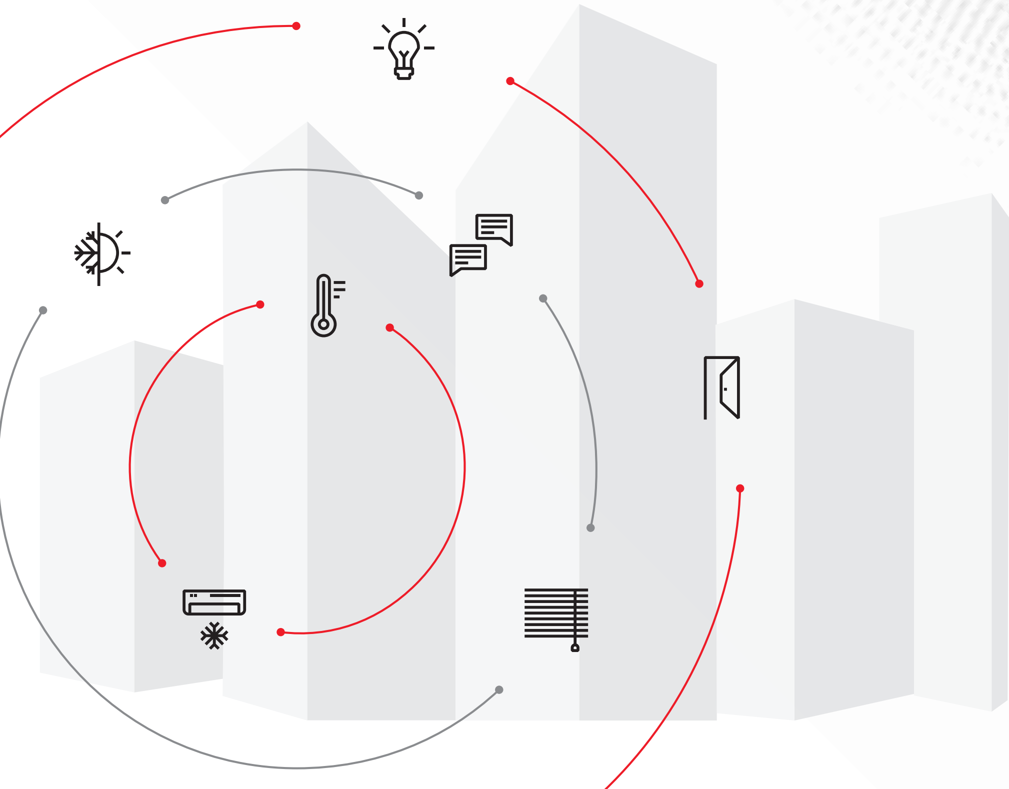
Handover: During the handover phase, the programmed functions are checked for compliance to the requirements in the functional description. In this way, the correct function of the installation can be determined and documented.

Documentation: The customer receives the project documentation (schematics, function description and ETS project data) after the handover.



3. KNX – The intelligent bus system

Structure and elements



3.1 Management, structure and topology

The communication medium – the KNX cable
In simple terms, the KNX bus consists of a pair of twisted-pair wires (cable type, e.g. YCYM 2 x 2 x 0.8 or J-H(ST) H 2 x 2 x 0.8 halogenfree) that connect the KNX devices. Over this cable, data telegrams are transmitted, and the electronics of the bus devices are supplied with energy. The KNX system can also be extended over IP-Networks and using RF solutions.

The KNX structure
The KNX structure created is very flexible in its design due to the possible connection of the devices: linear, tree and star wiring configurations are allowed. (**Image 6**).

The KNX topology
The KNX topology is arranged in lines that can be inter connected via couplers depending on the size of the network. The devices in the respective lines (sensors and actuators) are supplied with energy by a power supply (30 V) whereby the entire KNX bus system can be configured with more than 50.000 bus devices.

Physical address structure:

xx.xx.xxx	Area number (0–15)
xx.**xx**.xxx	Line number (0–15)
xx.xx.**xxx**	Device number (0–255)

The device number for line couplers (twisted pair [TP], IP) must be 0! (xx.xx.000)

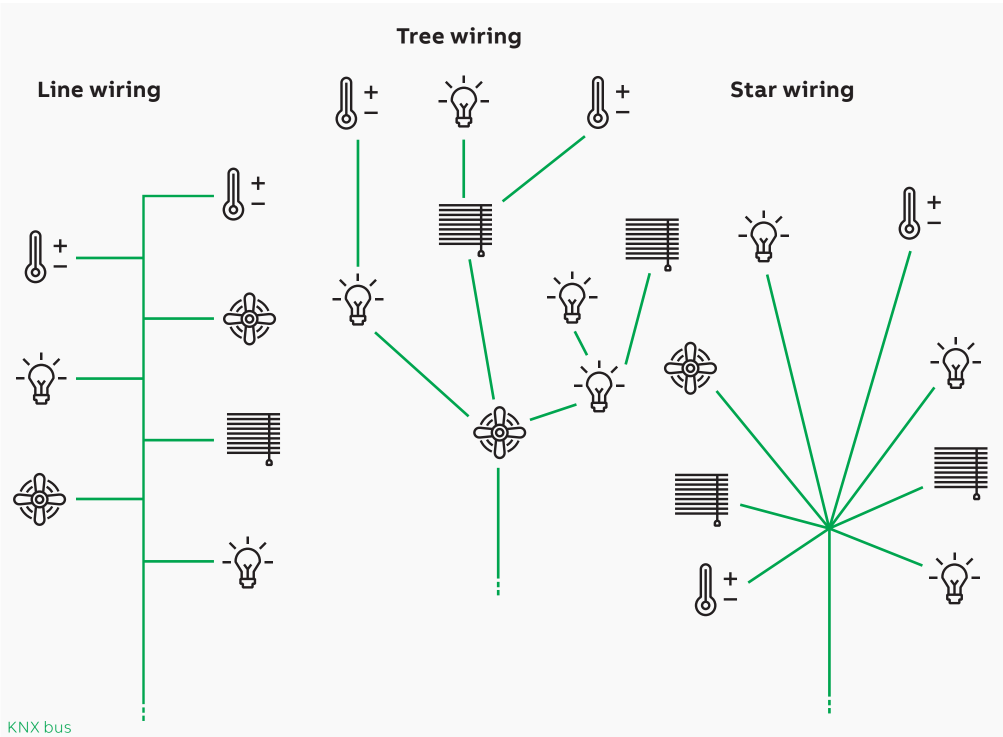


Image 6: Schematic representation of the KNX bus

3.2 Telegrams

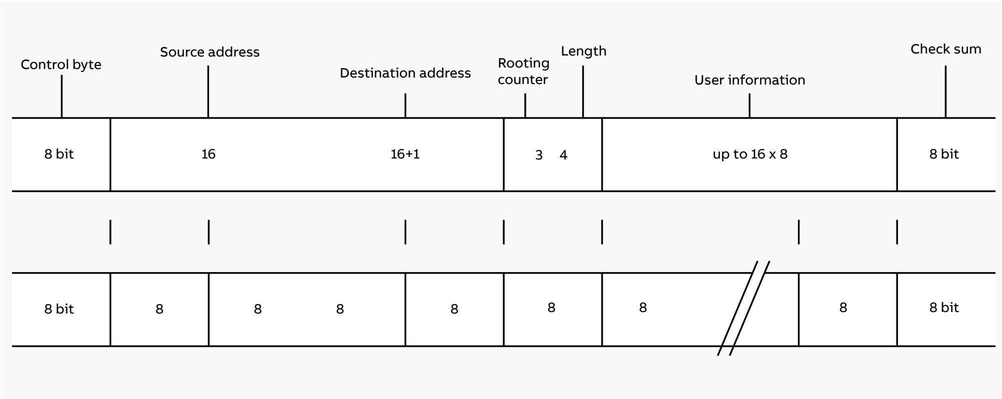


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Image 7: Telegram structure

3.2.1 Telegram Structure

Devices communicate with one another using “telegrams” which are sent via the bus. A telegram consists of bus-specific information and the actual user information in which the event (e.g. pressing of a button) is communicated. The entire information is sent packaged as characters each 8 bit long. (**Image 7**)

3.2.2 Telegram Acknowlegdement

After the telegram has been received by the devices, it will then send a receipt of acknowledgement.
(**Table 3**)

a By acknowledging with NAK (receipt not correct) the telegram is repeated up to three times.
b By acknowledging with BUSY the transmitting device will wait for a short time and then resend the telegram.
c If the sending device does not receive an acknowledgement, the telegram is repeated up to three times before the sent request is terminated.

D7	D6	D5	D4	D3	D2	D1	D0	Read direction of the data bit	
N	N	0	0	B	B	0	0		Acknowledge message
1	1	0	0	0	0	0	0	BUSY	still busy
0	0	0	0	1	1	0	0	NAK	receipt not correct
1	1	0	0	1	1	0	0	ACK	receipt correct

B = 99 BUSY N = 00 NAK

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Table 3: Telegram Acknowlegdement

3.3 Flags

Caution: The flags should only be modified in exceptional cases!

Flags[01] are settings in the ETS. The behaviour of each communication object can be set on the bus by using flags.

Communication flag

- ✓ The communication object has a normal connection to the bus.
- – Telegrams are acknowledged, but the communication object is not changed.

Read flag

- ✓ The object value can be read out via the bus.
- – The object value cannot be read via the bus.

Write flag

- ✓ The object value can be modified via the bus.
- – The object value cannot be modified via the bus.

Transmit flag

- ✓ If (on the sensor) the object value is changed, a corresponding telegram is sent.
- – The communication object only sends a response telegram with a read request.

Update flag

- ✓ Value response telegrams are interpreted as write commands, the value of the communication object is updated.
  (always enabled in the BA – mask version 1.0 – 1.2).
- – Value response telegrams are interpreted as write commands, the value of the communication object is not changed.

[01] (✓) = flag set, (–) = flag not set

3.4 Data Formats

DPT is the acronym for data point type. This defines the properties of the useful information in telegrams used by all manufacturers, guaranteeing that all KNX-certified devices are mutually compatible and can exchange information with other systems.
A clear benefit of KNX technology.

DPT-Type	EIS-Type	Description	English description
DPT 1.0xx	EIS 01	Switch	Boolean
DPT 2.0xx	EIS 08	Forced operation	1-Bit Controlled
DPT 3.0xx	EIS 02	Relative dimming	3-Bit Controlled
DPT 4.0xx	EIS 13	Character	Character Set
DPT 5.0xx	EIS 06	Value	8-Bit Unsigned Value
DPT 6.010	EIS 14	Signed counter value (8 bits)	8-Bit Signed Value
DPT 6.020		Status with operating mode	Status with Mode
DPT 7.0xx	EIS 10	Unsigned counter value (16 bits)	2-Octet Unsigned Value
DPT 8.0xx	EIS 10 signed	Signed counter value (16 bits)	2-Octet Signed Value
DPT 9.0xx	EIS 05	Floating-point value (16 bits)	2-Octet Float Value
DPT 10.001	EIS 03	Time	Time
DPT 11.001	EIS 04	Date	Date
DPT 12.001	EIS 11	Signed counter value (32 bits)	4-Octet Unsigned Value

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Table 4 (Continuation on next page): Definition of the Data Formats / EIS Types

Bit/Byte	Data point types
1 bit	On/Off
2 bit	value 0,1: control inactive value 2: control active Off value 3: control active On
4 bit	0 = Stop, 1…7 darker, 8 = Stop, 9….15 brighter
8 bit	ASCII character
8 bit	percentual value: 0% = 0....255 = 100%, unsigned Value: 0…255
8 bit	signed Value: -128…+127
8 bit	status with 3 modes
2 octets	value: 0…65'535
2 octets	value: -32'768…..+32'767
2 octets	temperature: -271…+ 670'760 °C temperature difference: +/- 670'760 K change of temperature: +/- 670'760 K/h illumination level : +/- 670'760 lux wind speed: +/- 670'760 m/s air pressure: +/- 670'760 Pa time difference: +/- 670'760 ms voltage: +/- 670'760 mV current: +/- 670'760 mA and others...
3 octets	day, hour, minute, second
3 octets	day, month, year
4 octets	value: 0…4'294'967'295

DPT-Type	EIS-Type	Description	English description
DPT 13.0xx	EIS 11 signed	Unsigned counter value (32 bits)	4-Octet Signed Value
DPT 14.0xx	EIS 09	Floating-point value (32 bits)	4-Octet Float Value
DPT 15.000		Access data	Access
DPT 16.00x		Text (14 bytes)	String
DPT 17.00x		Scene number	Scene number
DPT 18.00x		Scene control	Scene control
DPT 19.00x		Time + date	time + data
DPT 20.00x		8-bit numbering	8-bit enumeration
DPT 29.012		Signed counter value (64 bits)	8-Octet Signed Value

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Table 4 (Continuation): Definition of the Data Formats / EIS Types

Bit/Byte	Data point types
4 octets	value: -2'147'483'648….+2'147'483'647 (typical energy values like Wh, kWh, VAh..)
4 octets	value: 0…8'388'607 (typical values like V, Hz, A, W…)
4 octets	
14 octets	text with max. 14 characters
8 octets	Scene number without control function
8 octets	Scene control 1–64 (0–63)
8 octets	Combined time, date and day information
8 octets	For example, for HVAC modes Auto, Comfort, Standby, Economy and Protection
8 octets	value: -9 223 372 036 854 775 808….+9 223 372 036 854 775 807 (typical Wh, VAh, VARh)

3.5 Installation Instructions

a Check for compliance of allowable line lengths: The maximum permissible bus line lengths are defined by the voltage drops and the capacitances of the bus cables, and thus the telegram transmission times.
The measurement of the loop impedance of the bus line concerned can prove to be useful. (**Image 8**)

b Visual inspection for marking of bus cable ends: The ends of the bus cables should be labelled with “KNX” or “bus” clearly identifying them as the installation bus. Furthermore, details of the area and line will assist in the location of specifi c bus lines.

c Check for incorrect cable connections: Different lines may only be connected using a (line) coupler. Inadmissible connections between the individual lines can be verified by switching off the power supply on the lines to be checked. If the power LED continues to light on the line coupler, an inadmissible connection has been made.

d Measure the insulation resistance of the bus lines: The insulation resistance of the bus cable should be measured with DC 250 V (DIN VDE 0100 part 610). The insulation resistance should be at least 250 kOhms. Measurement is performed from the conductor to PE, and not conductor to conductor.
CAUTION: Overvoltage surge protection connectors should be removed before testing in order to avoid influencing the measurement or avoid damaging the surge protectors.

e Polarity test of all bus nodes: The polarity test should be performed on all bus devices. For this purpose switch to programming mode on the bus device with the programming button. The bus device is correctly connected if the LED lights up. By renewed pressing of the programming button the bus device is switched over to operating mode and the programming LED switches off.

f Measure the voltage on the bus cable ends (at least 21 V): The bus voltage should be checked with a voltmeter at the end of every bus cable after all bus devices have been installed. It must be at least 21 V.

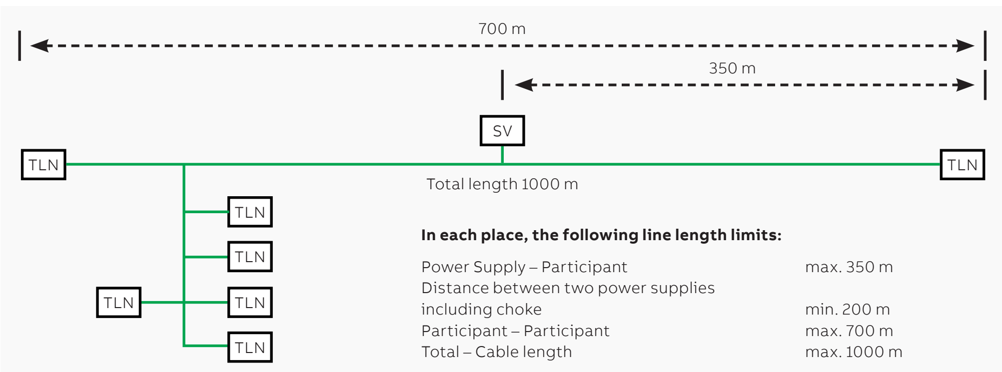

Image 8: Line lengths within a line

3.6 Software

ETS is an all-new generation of intelligent automation software. ETS stands for Engineering Tool Software. This manufacturer-independent configuration software is used to plan and configure intelligent home and building control with the KNX system. ETS runs on Windows©-based computers.
Using ETS5 Professional or a newer version, you can compile solutions for all application fields for which KNX-certified products are available. ETS5 Professional therefore strengthens your company not only technologically, but above all economically **(Image 9)**.

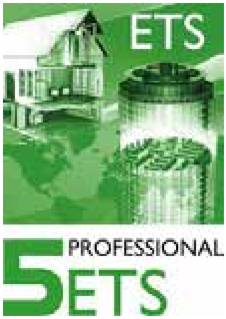

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Image 9: ETS

Manufacturer-specific additional software/apps
Manufacturers can offer special tools (ETS apps) for configuration or simplified commissioning/analysis.

Image 10 Example applications from ABB (additional applications available from the KNX Store):

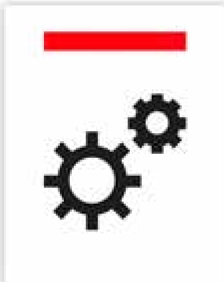

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Image 10: ABB Update & Convert

The **i-bus® Tool** from ABB is an entirely new approach to software.
It assists system integrators in commissioning and servicing KNX systems (**Image 11**).

This app provides a number of useful functions for editing device configurations (parameters and group addresses) in an ETS project.

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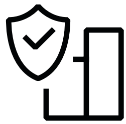
Image 11: ABB i-bus® Tool

3.7 KNXnet/IP / IP Secure

IP networks have now become standard in larger buildings. These networks can also be used to transmit KNX telegrams.

A flat hierarchy can be established by the use of IP Gateways and IP Routers which feature similar functionalities as line and area couplers. 255 KNX lines can be compiled to an IP world. 255 IP worlds can also co-exist on a LAN or WAN. Thus, even sections of the building which are further away can be integrated into the system. **(Image 12)**

Replacement of line or area couplers by IP Routers facilitates higher data speeds between devices.
It combines interfacing of other systems (e.g. building control engineering or visualization) to the KNX via the IP network using OPC.
KNX devices can be programmed via the IP network and remote access (remote programming or remote control) is possible via the Internet.



Using KNX Secure IP Routers effectively protects KNX installations against cyberattacks and unauthorized access. The Secure Routers encrypt all communication over a building's IP backbone and provide protection during the commissioning phase as well, greatly reducing the risk of attacks via the IP network.
KNX IP Secure is designed to provide the best possible security on the market, based on the ISO/IEC 18033-3 AES 128 encryption standard.

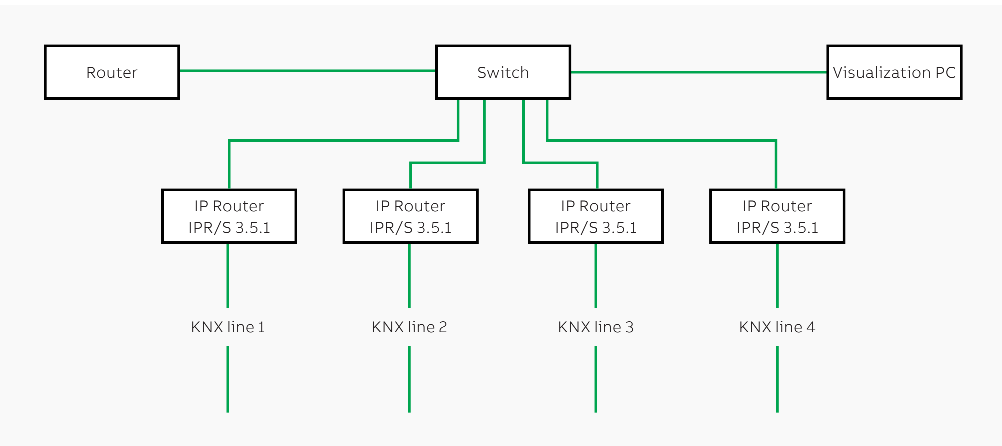


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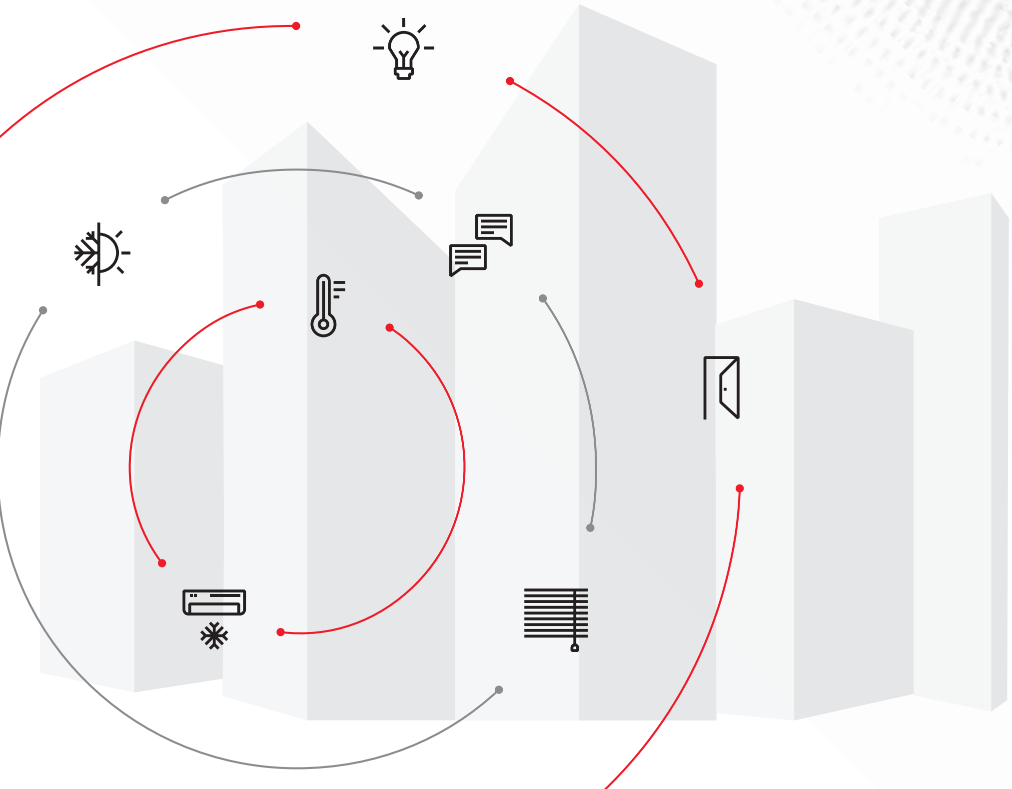
Image 12: Flat hierarchy with KNX lines

4. Customer requirements and commissioning

Important information at a glance



4.1 Tips and Tricks

Before we commence with commissioning, the
- RS 232/USB interface must be programmed locally to suit the line. Failure to do so will mean the line couplers cannot be correctly programmed.
- Program the line couplers, possibly, setting the parameters then to route all telegrams unfiltered.
- ETS diagnostics ensures that no bus device is in programming mode (programming button pressed, programming LED lights up.).

Commissioning of the bus devices
- Initially all of the bus devices will be physically addressed.
- If all devices are physically programmed, we can commence loading the applications. (In order to save time, the applications should be loaded during a break, e.g. lunch.
- The following points should be checked if communication problems occur:
  - The RS 232/USB interface is not physically programmed.
  - A device with an address corresponding to line x is located in another line.
  - Two different lines are interconnected with each other.
  - The line couplers are not programmed.

Caution: Line couplers must always be programmed at the start of commissioning. If they are not programmed, they interfere with the bus communication.

ETS4 enables simultaneous programming of devices in several lines in conjunction with the connection with IP Routers. This helps you to save time during set-up.

Additional software and ETS apps (see page 21) simplify commissioning and troubleshooting.

Selecting the right devices for the application is crucial (switching capacity, functional scope, etc.).

4.2 DALI basics

DALI, or Digital Addressable Lighting Interface, is a special protocol for digital lighting control that makes it easy to install robust, scalable and flexible lighting networks. DALI is covered by the IEC/EN 62386 standard, and defines a digital interface for electronic lighting equipment (such as ballasts, LED converters and emergency lighting converters).

Technical characteristics

- Single-/multi-Master System
- 2-wire power supply and data transmission cable
- Power supply: 2 mA per DALI device at 16 V (9.5 to 22.5 V)
- Data transmission: 1200 baud (KNX: 9600 baud)
- DALI device may consume max. 2 mA (max. system current: 250 mA)
- No SELV; normal NYM cable can be used

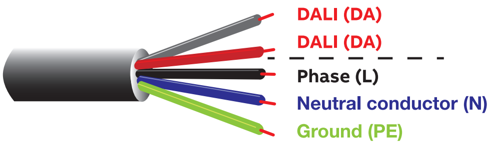
Cable installation

- DALI is not an SELV system and therefore requires basic 230 V insulation
- Standard NYM installation cables can be used
- Installation together with the supply voltage in a 5-core cable
- Two-wire control cable (polarity-free)
- Cable length is dependent on cross section (max. voltage drop between device and gateway max. 2 volts!)

Formula

A = L * I * 0.018

A = cable cross section [mm²]
L = cable length [m]
I = max. current of supply voltage [A]



Cable cross section [mm²]	2 x 0.5	2 x 0.75	2 x 1.0	2 x 1.5
One-way cable length [m] (= max. distance from PS)	100	150	200	300

Table 5: Cable cross sections and corresponding cable lengths (rounded values)

Basic information

DALI as single Master control System is defind for:

- max. 64 single devices (individual addresses)
- max. 16 groups (group addresses)
- max. 16 scenes (scene lighting values)

The system intelligence was not centralized in the DALI interface definition for operating devices. Many settings and lighting values are therefore stored in the ballast:

- Individual address
- Group assignment(s)
- Light scene value(s)
- Dimming speed
- Controller faulty value (system failure level)
- Lighting value on voltage recovery (power on level)

4.3 LED dimming

There is a range of variants for dimming LEDs. Some of the factors to note when using these variants include the following.

Universal dimmers (forward/reverse phase control)
Note in this regard that LED(i) loads in general have a very high starting current (approx. LED load specification x factor of 5). It is therefore essential to observe the respective technical data for the dimmers when designing the universal dimmers.

Info

ABB LED universal dimmers from 2018 onward have this starting current factored in, which means that: ABB dimmer power = LED load

Main application:
Retrofit (residential construction)

DALI
The dimming behavior or range (0–100%) differs depending on the converter/driver. The effective lower dimming limit could be 50%. It is therefore essential to observe the technical data for the respective DALI devices! Additionally bear in mind that the DALI dimming curve is logarithmic, and not linear (as with KNX).

Main application:
New installations (purpose-built, residential construction)

DMX
The range of available lamps with DMX is smaller than with DALI. Special expertise is required!

Main application:
Stage equipment, lighting with high requirements

Info

In general, DALI is the preferred option for dimming LEDs.

Analog (1-10 V)
Flexibility is limited compared to DALI, DMX and ZigBee. The advantage lies in simple installation (no addressing) and no standby consumption by converters/dimmers.

Main application:
Existing systems

zigbee

ZigBee (including Philips Hue)
Requires specific interfaces for communication (KNX-ZigBee). Depending on the KNX product, the end user can independently change or integrate ZigBee (Philips Hue) lamps.

Main application:
Residential construction (new and retrofit)
Garden lighting

4.4 Checklist

Lighting
- O Operation from one or more positions
- O Central/group operation
- O Dimming from one or more positions
- O Staircase lighting
- O On and off delay
- O Time control
- O Presence-dependent control
- O Logical combination
- O Daylight dependent control
- O Constant lighting control
- O Light) scenes
- O Status report
- O Panic alarm
- O Connection to DALI
- O Light temperature and color control (RGB, T_c, etc.)

Shading / Windows / Skylights / Awning
- O Operation from one/several positions
- O Central/group operation
- O Time control
- O Movement to position
- O Adjustment/movement of louvre positions
- O Weather-dependent control (wind, rain, frost)
- O Sun position dependent control (daylight reflection)
- O Temperature dependent control
- O Heating/cooling automatic
- O Scene control
- O State message
- O Night cool down (window opening)
- O Gutter heating control
- O Control of heated areas

Heating / Ventilation / Air conditioning
- O Individual room temperature control
- O Time control
- O Presence control
- O Remote control (e.g. telephone)
- O Boiler control/monitoring
- O Window position monitoring
- O Controlled ventilation
- O Exhaust air control
- O Fault messages
- O Parallel control of smoke and heat extraction systems
- O Primary/secondary system control

Safety functions
- O Peripheral protection
- O Internal surveillance
- O External surveillance
- O Smoke detection
- O Water detection
- O Gas detection
- O Emergency call
- O Internal alarm signal
- O External alarm signal
- O Presence simulation
- O Triggering of in-house actions on alarm/arming
- O Panic alarm
- O Coupling of arming device with KNX
- O Access control
- O Connection to video monitoring

Operation / Display
- Intelligent KNX push buttons
- Design program
- Several operational functions from one location
- Status feedback via LED in push button
- Labelling of the functions on the push button
- Remote control via infrared
- Conventional push buttons via interface
- LCD display for visualisation and operation
- Visualisation via PC
- Display and operation via internet/ telephone/TV
- Room control via Intranet
- Voice control
- Combination with intercom system

Energy management
- Optimization of intrinsic consumption
- Display of energy consumption data
- Peak-load management (e.g. for electric vehicle charging infrastructure)
- Combination

Different interdisciplinary functions
- Detection/processing of (error) messages
- Control of watering (Garden)
- Switching of hot water circulation pumps
- Mains enabling
- Switching of electrical outlets/circuits
- Monitoring of circuits
- Detection of power consumption values
- Room occupancy display
- Interface to other systems (OPC server, IP gateway,...)
- Control of audio/video systems
- Connection of other systems via digital and analogue inputs and outputs
- Connection of power line and radio system via interfaces
- Solutions for special-needs and nursing homes
- Acquisition of operating hours
- Acquisition of weather data
- Central KNX timer

4.5 Lamp and Consumer Loads

The following table provides and overview of the rated values, switching performance, lamp loads or the number of lamps, which can be connected to a contact:

	SAH/S 8.6.7.1 **SAH/S 16.6.7.1** **SAH/S 24.6.7.1**	**SAH/S 8.10.7.1** **SAH/S 16.10.7.1** **SAH/S 24.10.7.1**	**SAH/S 8.16.7.1** **SAH/S 16.16.7.1** **SAH/S 24.16.7.1**
Range	Combi	Combi	Combi
I_n rated current (A) 3)	6 A	10 A 5)	16 A 5)
U_n rated voltage (V)	230 V AC	230 V AC	230 V AC
AC1 operation (cos ϕ = 0.8) acc. to EN 60947-4-1	6 A	10 A	16 A
AC3 operation (cos ϕ = 0.45) acc. to EN 60947-4-1	6 A	6 A	6 A
C-Load switching capacity (200 µF)	–	–	–
Fluorescent lighting load AX acc. to EN 60669-1	6 AX (140 µF) 3)	10 AX (140 µF) 3)	10 AX (140 µF) 3)
Minimum switching capacity	100 mA/12 V	100 mA/12 V	100 mA/12 V
DC current switching capacity (resistive load)	6 A/24 V =	6 A/24 V =	6 A/24 V =
Mechanical service life	> 10^6	> 10^6	> 10^6
Electronic endurance to IEC 60947-4-1:			
– Rated current AC1 (240 V/cos ϕ = 0.8)	100,000	100,000	100,000
– Rated current AC3 (240 V/cos ϕ = 0.45)	6,000	6,000	6,000
Incandescent lamp load at 230 V AC	1,200 W	1,200 W	1,200 W
Fluorescent lamp T5 / T8:			
– Uncorrected	800 W	800 W	800 W
Low-voltage halogen lamps:			
– Inductive transformer	800 W	800 W	800 W
– Electronic transformer	1,000 W	1,000 W	1,000 W
Halogen lamp 230 V	1,000 W	1,000 W	1,000 W
Mercury-vapour lamps:			
– Uncorrected	1,000 W	1,000 W	1,000 W
– Parallel compensated	800 W	800 W	800 W
LED lamps/energy-saving lamps	250 W	250 W	250 W
Rated motor power	1,380 W	1,380 W	1,380 W
Max. peak inrush-current Ip (150 µs)	200 A	200 A	200 A
Max. peak inrush-current Ip (250 µs)	160 A	160 A	160 A
Max. peak inrush-current Ip (600 µs)	100 A	100 A	100 A
Number of ballasts (T5/ T8, single element): 2)			
18 W (ABB ballasts 1 x 18 SF)	10 ballasts	10 ballasts	10 ballasts
24 W (ABB ballasts 1 x 24 CY)	10 ballasts	10 ballasts	10 ballasts
36 W (ABB ballasts 1 x 36 CF)	7 ballasts	7 ballasts	7 ballasts
58 W (ABB ballasts 1 x 58 CF)	5 ballasts	5 ballasts	5 ballasts
80 W (Helvar EL 1 x 80 SC)	3 ballasts	3 ballasts	3 ballasts

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1) = The number of ballasts is limited by the protection with B16/B20 circuit-breakers.
2) = For multiple element lamps or other types, the number of electronic ballasts must be determined using the peak inrush-current of the electronic ballasts.
3) = The maximum peak inrush-current may not be exceeded.
4) = Not intended for AC3 operation, see Technical Data for maximum AC3 current.
5) = Max. load current per device: 8-fold = 100 A, 16-fold = 160 A, 24-fold = 200 A

The following table provides an overview of the functions possible with the Switch Actuators and their application programs:

	SAH/S 8.6.7.1 SAH/S 16.6.7.1 SAH/S 24.6.7.1	SAH/S 8.10.7.1 SAH/S 16.10.7.1 SAH/S 24.10.7.1	SAH/S 8.16.7.1 SAH/S 16.16.7.1 SAH/S 24.16.7.1
Range	Combi	Combi	Combi
Type of installation	DIN-Rail	DIN-Rail	DIN-Rail
Number of outputs (Switch [Blind])	8 [4]/16[8]/24 [12]	8 [4]/16[8]/24 [12]	8 [4]/16[8]/24 [12]
Module width (space unit)	4/8/12	4/8/12	4/8/12
Manual operation	■	■	■
Switching position indication	■	■	■
I_n rated current (A)	6 A	10 A	16 A
Current measurement	–	–	–
Switch function			
– Central On/Off	■	■	■
– Staircase lighting	■	■	■
– Staircase lighting advance warning	■	■	■
– Change staircase lighting time via group object	■	■	■
– Flashing	■	■	■
– Selection of N.O./N.C. contact	■	■	■
– Switching on/off delay	■	■	■
Energy Function	–	–	–
Load control integration	–	–	–
Priority objects/forced operation/blocking	■	■	■
Function Scene	■	■	■
Blind/shutter function			
– Central up/down/position/stop	■	■	■
– Blind/shutter control	■	■	■
– Wind/Rain/Frost alarm	■	■	■
– Automatic sun protection	■	■	■
– Parameterizable reversing time	■	■	■
– Reference movement	■	■	■
– Travel range limitation	■	■	■
– Adjustable delay time for drives	■	■	■
Function Logic (independet of output)			
– Logic AND function	■	■	■
– Logic OR function	■	■	■
– Logic exclusive OR function	■	■	■
– Gate function	■	■	■
– 1 bit Inverter	–	–	–
Function Threshold (independent of output)	■	■	■
Additional functions			
– Request status values	■	■	■
– Template parameter windows	■	■	■
– Reaction on bus voltage failure/recovery	■	■	■
– Advanced status group objects	■	■	■

—
■ = Function is supported
– = Function is not supported

The following table provides and overview of the rated values, switching performance, lamp loads or the number of lamps, which can be connected to a contact:

	SA/S 2.6.2.2 SA/S 4.6.2.2 SA/S 8.6.2.2 SA/S 12.6.2.2	SA/S 2.10.2.2 SA/S 4.10.2.2 SA/S 8.10.2.2 SA/S 12.10.2.2	SA/S 2.16.2.2 SA/S 4.16.2.2 SA/S 8.16.2.2 SA/S 12.16.2.2
Range	Standard	Standard	Standard
I_n rated current (A) 3)	6 A	10 A	16 A
U_n rated voltage (V)	230 V AC	230 V AC	230 V AC
AC1 operation (cos ϕ = 0.8) acc. to EN 60947-4-1	6 A	10 A	16 A
AC3 operation (cos ϕ = 0.45) acc. to EN 60947-4-1	6 A	8 A	8 A
C-Load switching capacity (200 µF)	–	–	–
Fluorescent lighting load AX acc. to EN 60669-1	6 AX (140 µF) 3)	10 AX (140 µF) 3)	16 A (140 µF) 3)
Minimum switching capacity	100 mA/12 V	100 mA/12 V	100 mA/12 V
DC current switching capacity (resistive load)	6 A/24 V =	10 A/24 V =	16 A/24 V =
Mechanical service life	> 3 x 10^6	> 3 x 10^6	> 3 x 10^6
Electronic endurance acc. to IEC 60947-4-1:			
– Rated current AC1 (240 V/cos ϕ = 0.8)	100,000	100,000	100,000
– Rated current AC3 (240 V/cos ϕ = 0.45)	30,000	30,000	30,000
– Rated current AC5a (240 V/cos ϕ = 0.45)	30,000	30,000	30,000
Incandescent lamp load at 230 V AC	1,380 W	2,500 W	2,500 W
Fluorescent lamp T5 / T8:			
– Uncorrected	1,380 W	2,500 W	2,500 W
– Parallel compensated	1,380 W	1,500 W	1,500 W
– DUO circuit	1,380 W	1,500 W	1,500 W
Low-voltage halogen lamps:			
– Inductive transformer	1,200 W	1,200 W	1,200 W
– Electronic transformer	1,380 W	1,500 W	1,500 W
Halogen lamp 230 V	1,380 W	2,500 W	2,500 W
Dulux lamps:			
– Uncorrected	1,100 W	1,100 W	1,100 W
– Parallel compensated	1,100 W	1,100 W	1,100 W
Mercury-vapour lamps:			
– Uncorrected	1,380 W	2,000 W	2,000 W
– Parallel compensated	1,380 W	2,000 W	2,000 W
LED lamps/energy-saving lamps	400 W	400 W	400 W
Rated motor power	1,380 W	1,840 W	1,840 W
Max. peak inrush current Ip (150 µs)	400 A	400 A	400 A
Max. peak inrush current Ip (250 µs)	320 A	320 A	320 A
Max. peak inrush current Ip (600 µs)	200 A	200 A	200 A
Number of ballasts (T5/T8, single element): 2)			
18 W (ABB ballasts 1 x 18 SF)	23 ballasts	23 ballasts	23 ballasts
24 W (ABB ballasts 1 x 24 CY)	23 ballasts	23 ballasts	23 ballasts
36 W (ABB ballasts 1 x 36 CF)	14 ballasts	14 ballasts	14 ballasts
58 W (ABB ballasts 1 x 58 CF)	11 ballasts	11 ballasts	11 ballasts
80 W (Helvar EL 1 x 80 SC)	10 ballasts	10 ballasts	10 ballasts

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1) = The number of ballasts is limited by the protection with B16/B20 circuit-breakers.
2) = For multiple element lamps or other types, the number of electronic ballasts must be determined using the peak inrush-current of the electronic ballasts.
3) = The maximum peak inrush-current may not be exceeded.
4) = Not intended for AC3 operation, see Technical Data for maximum AC3 current.

The following table provides an overview of the functions possible with the Switch Actuators and their application programs:

	SA/S 2.6.2.2 SA/S 4.6.2.2 SA/S 8.6.2.2 SA/S 12.6.2.2	SA/S 2.10.2.2 SA/S 4.10.2.2 SA/S 8.10.2.2 SA/S 12.10.2.2	SA/S 2.16.2.2 SA/S 4.16.2.2 SA/S 8.16.2.2 SA/S 12.16.2.2
Range	Standard	Standard	Standard
Type of installation	DIN-Rail	DIN-Rail	DIN-Rail
Number of outputs	2/4/8/12	2/4/8/12	2/4/8/12
Module width (space unit)	2/4/8/12	2/4/8/12	2/4/8/12
Manual operation	■	■	■
Switching position indication	■	■	■
I_n rated current (A)	6 A	10 A	16 A
Current measurement	–	–	–
Switch function			
– Central On/Off	■	■	■
– Staircase lighting	■	■	■
– Staircase lighting advance warning	■	■	■
– Change staircase lighting time via group object	■	■	■
– Flashing	■	■	■
– Selection of N.O./N.C. contact	■	■	■
– Switching on/off delay	■	■	■
Energy Function	–	–	–
Load control integration	–	–	–
Priority objects/forced operation/blocking	■	■	■
Function Scene	■	■	■
Blind/shutter function	–	–	–
Function Logic (independet of output)			
– Logic AND function	■	■	■
– Logic OR function	■	■	■
– Logic exclusive OR function	■	■	■
– Gate function	■	■	■
– 1 bit Inverter	–	–	–
Function Threshold (independent of output)	■	■	■
Additional functions			
– Request status values	■	■	■
– Template parameter windows	■	■	■
– Reaction on bus voltage failure/recovery	■	■	■
– Advanced status group objects	■	■	■

■ = Function is supported
– = Function is not supported

The following table provides and overview of the rated values, switching performance, lamp loads or the number of lamps, which can be connected to a contact:

	SA/S 2.16.5.2 SA/S 4.16.5.2 SA/S 8.16.5.2 SA/S 12.16.5.2	SA/S 2.16.6.2 SA/S 4.16.6.2 SA/S 8.16.6.2 SA/S 12.16.6.2
Range	Professional	Professional with Energy Function
I_n rated current (A) [3]	16/20 A C-Load	16/20 AX C-Load
U_n rated voltage (V)	230 V AC	230 V AC
AC1 operation (cos ϕ = 0.8) acc. to EN 60947-4-1	20 A	20 A
AC3 operation (cos ϕ = 0.45) acc. to EN 60947-4-1	16 A	16 A
C-Load switching capacity (200 µF)	20 A	20 A
Fluorescent lighting load AX acc. to EN 60669-1	20 AX (200 µF) [3]	20 AX (200 µF) [3]
Minimum switching capacity	100 mA/12 V	100 mA/12 V
DC current switching capacity (resistive load)	20 A/24 V =	20 A/24 V =
Mechanical service life	> 10^6	> 10^6
Electronic endurance acc. to IEC 60947-4-1:		
– Rated current AC1 (240 V/cos ϕ = 0.8)	100,000	100,000
– Rated current AC3 (240 V/cos ϕ = 0.45)	30,000	30,000
– Rated current AC5a (240 V/cos ϕ = 0.45)	30,000	30,000
Incandescent lamp load at 230 V AC	3,680 W	3,680 W
Fluorescent lamp T5 / T8:		
– Uncorrected	3,680 W	3,680 W
– Parallel compensated	2,500 W	2,500 W
– DUO circuit	3,680 W	3,680 W
Low-voltage halogen lamps:		
– Inductive transformer	2,000 W	2,000 W
– Electronic transformer	2,500 W	2,500 W
Halogen lamp 230 V	3,680 W	3,680 W
Dulux lamps:		
– Uncorrected	3,680 W	3,680 W
– Parallel compensated	3,000 W	3,000 W
Mercury-vapour lamps:		
– Uncorrected	3,680 W	3,680 W
– Parallel compensated	3,000 W	3,000 W
LED lamps/energy-saving lamps	650 W	650 W
Rated motor power	3,680 W	3,680 W
Max. peak inrush current Ip (150 µs)	600 A	600 A
Max. peak inrush current Ip (250 µs)	480 A	480 A
Max. peak inrush current Ip (600 µs)	300 A	300 A
Number of ballasts (T5/ T8, single element): [2]		
18 W (ABB ballasts 1 x 18 SF)	26 [1] ballasts	26 [1] ballasts
24 W (ABB ballasts 1 x 24 CY)	26 [1] ballasts	26 [1] ballasts
36 W (ABB ballasts 1 x 36 CF)	22 ballasts	22 ballasts
58 W (ABB ballasts 1 x 58 CF)	12 [1] ballasts	12 [1] ballasts
80 W (Helvar EL 1 x 80 SC)	12 [1] ballasts	12 [1] ballasts

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1) = The number of ballasts is limited by the protection with B16/B20 circuit-breakers.
2) = For multiple element lamps or other types, the number of electronic ballasts must be determined using the peak inrush-current of the electronic ballasts.
3) = The maximum peak inrush-current may not be exceeded.
4) = Not intended for AC3 operation, see Technical Data for maximum AC3 current.

The following table provides an overview of the functions possible with the Switch Actuators and their application programs:

	SA/S 2.16.5.2 SA/S 4.16.5.2 SA/S 8.16.5.2 SA/S 12.16.5.2	SA/S 2.16.6.2 SA/S 4.16.6.2 SA/S 8.16.6.2 SA/S 12.16.6.2
Range	Professional	Professional with Energy Function
Type of installation	DIN-Rail	DIN-Rail
Number of outputs	2/4/8/12	2/4/8/12
Module width (space unit)	2/4/8/12	2/4/8/12
Manual operation	■	■
Switching position indication	■	■
I_n rated current (A)	16/20 A C-Load	16/20 A C-Load
Current measurement	–	■
Switch function		
– Central On/Off	■	■
– Staircase lighting	■	■
– Staircase lighting advance warning	■	■
– Change staircase lighting time via group object	■	■
– Flashing	■	■
– Selection of N.O./N.C. contact	■	■
– Switching on/off delay	■	■
Energy Function	–	■
– Current measurement	–	■
– Power calculation	–	■
– Energy consumption calculation	–	■
– Load monitoring	–	■
Load control integration	–	■
Priority objects/forced operation/blocking	■	■
Function Scene	■	■
Blind/shutter function	–	–
Function Logic (independet of output)		
– Logic AND function	■	■
– Logic OR function	■	■
– Logic exclusive OR function	■	■
– Gate function	■	■
– 1 bit Inverter	–	■
Function Threshold (independent of output)	■	■
Additional functions		
– Request status values	■	■
– Template parameter windows	■	■
– Reaction on bus voltage failure/recovery	■	■
– Advanced status group objects	■	■

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■ = Function is supported

– = Function is not supported

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