SIEMENS

Ingenuity for life

The worldwide
standard for
home and
building control

KNX®

Manual for
KNX Planning

siemens.com/buildingautomation

Optimum control requires accurate measurements

This manual was written by practitioners for practitioners and has become a popular and indispensable reference book over the last few years.

Legal regulations increasingly appeal for the economic use of energy. At the same time, the indoor climate must meet stringent requirements. Both requirements can be fully met only if all necessary measured data are available and the sensors remain absolutely reliable year after year. Sensors thus form a key basis for optimizing energy efficiency in rooms.

Professional and high-quality products are needed to meet this goal – along with a few practical basic rules.

A control operation is only as good as the measuring accuracy of the sensors which detect the control variable (such as temperature, humidity and pressure) and transmit it to the controller as an actual value. While this process hasn't changed, the measuring technology and methods for mounting sensors are more cutting-edge than ever before.

Future-proof building control

Everything you need for a good working climate
Working concentrated while saving energy – products from Siemens improve the atmosphere in rooms and facilitate more economical operations.

The result: perfectly temperature-controlled and air-conditioned rooms with good lighting and reduced energy consumption.

Highlights
- Saves up to 30 percent energy with individual room control and energy saving functions
- Protects investments on the basis of reliable products and the ability to add KNX devices
- Easy commissioning and adaptation to changes in use due to tested applications
- Extremely environmentally friendly due to energy-independent variants with EnOcean technology

Contact and support

GAMMA instabus:
siemens.com/gamma

Technical documentation:
siemens.com/gamma-td

HVAC Integrated Tool (HIT):
siemens.com/hit

Support e-mail address:
support.automation@siemens.com

Support online platform:
siemens.com/automation/support-request

Contents

Legend

✖ Not suitable for mounting

✔ Most suitable for mounting

! Check influencing factors when mounting

Bus systems

Communication standards

In building control, open communication is important. It allows easy and secure integration of devices, systems and functions. Support for multiple open standards ensures communication and facilitates efficient engineering. It also makes system maintenance and interoperability easier, thereby providing greater investment protection.

Siemens supports different communication protocols in building automation. As a result, a wide range of communicating devices can be used. They form the basis for energy-efficient room and building automation. The standardized and independent communication protocols are being continuously further developed, and ensure a consistent, end-to-end exchange of information between devices and systems – whether BACnet, KNX, DALI, EnOcean or LonWorks communication.

For further information, please visit:
siemens.com/gamma

Highlights
- Easy and secure integration
- Reliable data exchange between various communication systems
- Comfortable and universal operation
- Long-term investment protection

KNX

The KNX technology allows flexible implementation and expansion of both simple as well as cross-discipline solutions in room and building automation according to individual requirements. KNX products for controlling lighting, sun protection and room climate as well as for energy management and security functions are characterized by easy installation and commissioning. The vendor-independent ETS Tool is used for commissioning.

Because coordinated room and building management frequently requires integration of other technologies and systems, appropriate KNX links and interfaces are provided to Ethernet/IP, wireless systems, lighting controls with DALI and building automation systems.

KNX is not only an international standard (ISO/IEC 14543-3), but also a European standard (CENELEC EN 50090 and CEN EN 13321-1). What's more, KNX is recognized in China as Standard GB/T 20965 and in the United States as U.S. Standard ANSI/ASHRAE 135.

For further information, please visit: **knx.org**

Highlights
- Harmonized products and systems for cross-discipline building and room automation
- Easy integration into higher-level building management systems on the basis of the open communication standard
- Uniform commissioning, due to the use of vendor- and product-independent commissioning software (ETS)
- A well-known system that is widely used in building control with guaranteed interoperability thanks to certification processes
- Corresponds to the previous European Installation Bus (EIB) and is backward compatible

Product portfolio from Siemens with KNX communication
- GAMMA instabus
- Synco™ 700 controller
- Thermostats
- Sensors
- Synco living
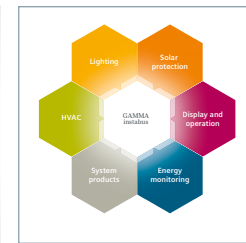
System data

Bus connection	
Cable type	YCYM 2 × 2 × 0.8 mm²
	one wire pair (red, black) for signal transmission and power supply, one wire pair (yellow, white) for additional applications (SELV or voice)

Cable lengths	
Total length of one line (wire diameter: 0.8 mm)	max. 1,000 m (including all branches)
Length between two bus devices	max. 700 m
Length between a bus device and the power supply	max. 350 m
Length between power supplies	mounted side by side (applies for Siemens products)

Bus devices	
Number of areas	max. 15
Number of lines per area	max. 15
Number of bus devices per line	max. 255
Topology	linear, star or tree structure

Power supply	
System voltage	DC 24 V (safety extra-low voltage – SELV)
Power supply per line	one power supply (160, 320, 640 mA or 2 x 640 mA)

Transmission	
Transmission technology	decentralized, event-controlled, serial, symmetrical
Baud rate	9,600 bit/s

Device properties	
Protection class acc. to EN 60529	IP20
Safety measure	bus: safety extra-low voltage – SELV DC 24 V
Overvoltage category	III
Rated insulation voltage U_i	250 V
Pollution degree	2
EMC requirements	complies with EN 50428
Resistance to climate changes	EN 50491-2

Conditions for use	
Application	for fixed indoor installation for dry rooms for installation in power distributors
Ambient temperature during operation	-5 °C to +45 °C
Humidity during operation	max. 93%
Storage temperature	-25 °C to +70 °C
Humidity during storage	max. 93%
Certification	KNX/EIB-certified
CE certification	acc. to EMC directive (residential and commercial buildings), low-voltage directive

DALI
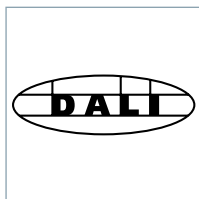
DALI (Digital Addressable Lighting Interface) is a standardized interface for lighting control. Electronic ballasts, transformers and sensors in a lighting system communicate with the building automation system via DALI. DALI is an internationally applied standard compliant with IEC 62386 requirements.

For further information, please visit: **dali-ag.org**

Highlights
- High installation capacity and system flexibility due to support for up to 64 ballasts, 16 groups and 16 scenes
- Increased reliability due to bidirectional communication with feedback of the operating device status such as dimming level, lamp errors, etc.
- Polarity-free, two-wire cable in linear, star or mixed topologies with a maximum cable length of 300 m
- Emergency lighting integrated into general lighting systems

Product portfolio from Siemens with DALI communication
- GAMMA instabus, KNX/DALI gateways
- Desigo controllers
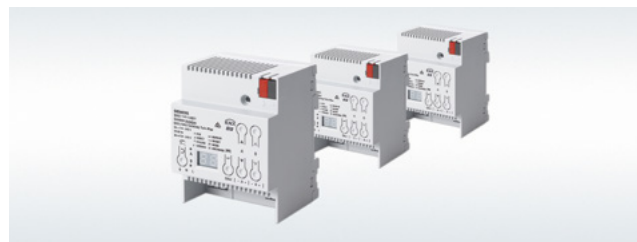
System data

Bus connection	
Cable type	NYM 5 x 1.5 mm² for mains power input and DALI, excluding the polarity. Ballast and control device can be operated at different line voltage phases.

Cable lengths	
The **length of the control line** is limited only by the voltage drop	Maximum voltage drop on the cable is 2 V at 250 mA. The maximum total cable length between the control unit and the connected ballasts is 300 m.
	Cable cross-section A is calculated from the following formula:
	A = L x I x 0.018
	L: Cable length (m) I: Max. current of the supply voltage (A) 0.018 = Spec. resistance of the copper

Bus devices	
Possible addresses	max. 64
Possible groups	max. 16
Number of bus devices per line	max. 64 ballasts and 64 sensors
Number of possible scenes per ballast	Up to 16 light values (scenes) per ballast can be stored, regardless of any group assignments that may be programmed.
Topology	Parallel, star-shaped wiring, excluding possible groups.
	Ring-shaped wiring is **not permitted.**
	Terminating resistors are not needed.
Status messages of DALI operating devices	On/off, dimmer setting, length of operation, lamp error
Control input	Galvanically isolated from the line voltage (potential-free); all bus devices operate on different phase conductors.

Power supply	
System voltage DC V	DALI bus voltage: approx. DC 16 V, potential-free, short-circuit-proof, where 0 V can range from -4.5 V to +4.5 V, and 16 V is in the range of 9.5 V to 22.5 V.
Maximum system current	Maximum current of the central interface supply is around 250 mA.
	Each connected device can consume a maximum of 2 mA in the case of ballasts, and approx. 5 mA in the case of sensors.
Power supply	No dedicated power supply is needed.

Transmission	
Transmission technology	serial, asynchronous
Baud rate	1,200 bit/s

Device properties	
Protection class	EN 60529 (DIN VDE 0470-1) and DIN EN 50102
Safety measures	Basic insulation required according to IEC 60928
EMC requirements	EN 50081/VDE 0839-81 and EN 50082/VDE 0839-82
Ballast standards	Safety (EN 61347)
	Functionality (EN 60929)
	Line current harmonics (EN 61000-3-2)
	Radio interference suppression from 9 kHz to 300 MHz (EN 55015:2006 + A1:2007)/CDN measurement
	Immunity (EN 61547)

Conditions for use	
Ambient temperature for reliable lamp ignition	From -20 °C (preheating of both lamp filaments)
Permissible temperature range for reliable lamp operation	-20 °C to +75 °C
Cable lengths as a function of cross section	DALI cable length for copper at 25 °C 2.5 mm²: max. 300 m 1.5 mm²: max. 300 m 1.0 mm²: max. 224 m 0.75 mm²: max. 168 m 0.5 mm²: max. 112 m
Loop resistance	max. 10 Ohm
Extra-low-voltage lines	2 x 2 x 0.8 (diameter)

EnOcean

Leading global companies in the building industry formed the EnOcean Alliance to implement innovative wireless solutions for sustainable building projects. The core technology is EnOcean's battery-free wireless technology for maintenance-free sensor solutions that can be flexibly positioned. The EnOcean Alliance promotes the further development of the interoperable standard as well as the future viability of innovative wireless sensor technology. The EnOcean wireless standard is an internationally applied standard compliant with ISO/EC 14543-3-10.

For further information, please visit:
enocean-alliance.org

Highlights
- EnOcean combines wireless communication with power generation methods
- Access to a large number of easy-to-integrate field devices, due to standardized EnOcean communications
- Environmentally friendly because no batteries need to be disposed of, and because of low radiant energy, which is even less than with wired sensors
- Maintenance-free
- Short installation times
- Reduces fire load

Product portfolio from Siemens with EnOcean communication
- GAMMA instabus, EnOcean sensors

System data

Bus connection	
Radio frequency	315 MHz (Asia), 868 MHz (EU countries and China), 902 MHz (USA and Canada) and 928 MHz (Japan)

Ranges	
... dependent on the nature of the building	Range reduction due to wall materials against free-field propagation (300 m):
	• Wood, plaster, uncoated glass, without metal 0 – 10%
	• Brick, pressed wood 5 – 35%
	• Concrete with iron reinforcement 10 – 90%

Bus devices	
Number of transmitters/ transmit protocols	500/minute (99.9% transmission probability)
Telegram duration	0.6 ms
Topology	Routing or direct communication between sensor/actuator

Power supply	
System voltage	Battery-free, maintenance-free wireless modules (sensor/actuator), and variants of line-connected actuators, repeaters and gateways

Transmission	
Transmission technology	Bidirectional and unidirectional possible, serial
Baud rate	125,000 bit/s

Device properties	
Standby current demand	0.08 µA
Protection class	Device-dependent

Safety measures	Device-dependent
Coexistence with other wireless systems	No interference with WLAN and PMR systems, etc.; system design verified in industrial environment

Conditions for use	
Permissible temperature range	-25 °C to +85 °C (wireless module)

Mounting tips and hints
• Reliable installation of wireless systems in a building can be achieved by repositioning the transmitter and/ or receiver antennas outside any skip zone or by using a repeater
• Ranges exceeding 30 m are possible given highly favorable prerequisites: a larger free space as well as optimum antenna designs and positioning
• The range penetrates furniture and persons within the room
• Range penetrates through up to five plasterboard drywalls, two brick or autoclaved aerated concrete walls and vertically through one to two room ceilings

Important factors that reduce the radio range:
• Divider walls, false ceilings with metal panels
• Steel furnishings or metal-coated glass
• Switch mounted on a metal wall
• Use of metallic switch frames
• Fire walls, elevator shafts, stairwells

BACnet

The communication protocol BACnet was specially developed to meet the needs of buildings, both inside and out. It is well suited for the automation level as well as the management level. It is primarily for HVAC systems as well as fire control panels, intrusion detection and access control systems. BACnet is continuously expanded to accommodate additional building-specific systems such as escalators and elevators. Some 900 manufacturers use BACnet in their products. The BACnet protocol is standardized worldwide as EN ISO 16484-5, which ensures maximum investment security. It is purely a software implementation with processor-independent and license-free use of IP communication. For BACnet/IP, the standardized UDP (User Datagram Protocol) is used, which supports connectionless transport of data packages. The UDP port number 47808 = 0xBAC0 is registered for BACnet.

For further information, please visit: **big-eu.org**

You can find the complete list of all BACnet devices from Siemens that have been tested by one of the BACnet Testing Laboratories (BTL) at the Internet address below: **tinyurl.com/bacnet2017**

Highlights
- Maximum investment security through use of the open, international standard ISO 16484-5
- Manufacturer-independent
- No license costs
- Guaranteed reliability thanks to independent testing and certification bodies for BACnet devices
- Wide range of transmission media such as BACnet IP or BACnet MS/TP can be combined as needed, and support extremely flexible topologies
- Integration of widely diverse disciplines and manufacturers without need for specialized hardware

Product portfolio from Siemens with BACnet communication
- Desigo™ CC management station
- Desigo PXC automation stations for primary plants
- Desigo PXR-BACnet router
- Desigo PXC3 automation stations and Desigo DXR2 for room automation
- Climatix™ product range
- Sinteso™ fire control panels
- MM8000 danger management station
- SINAMICS frequency converter G120P
- GAMMA instabus, IP gateway KNX/BACnet

KNX PL-Link

KNX PL-Link (PeripheraL-Link) is a Desigo-specific bus system optimized to enable communication between distributed, i.e. decentrally installed field devices and the modular PXC3 room automation stations. Its typical areas of application include controlling all disciplines within a room, such as heating, ventilation, air conditioning, lighting and sun protection. Typical devices include pushbuttons, presence detectors, brightness sensors, sensors, damper actuators, valve drives, room operator units, switching actuators, dimmers and sunblind actuators, etc. The system's communicative properties enable expanded comfort and energy saving functions – and all with no additional engineering.

Highlights
- Plug-and-play bus system with automatic device recognition
- Bus cable for up to 64 devices in linear or star topologies with a maximum line length of 1,000 m
- Power supply for up to 64 devices directly via the bus cable
- Fast, event-oriented communication for lighting and sun protection applications

Devices from Siemens with KNX PL-Link function
- Modular room automation stations Desigo PXC3
- QMX3 room operator units
- VAV compact controllers GDB/GLB181
- Gamma products, e.g. pushbuttons, presence detectors, pushbutton interfaces, switching actuators, modular installation system, sunblind actuators and dimmers, etc.
- RXM fan convector PL-I/O modules

Other communication standards

Modbus

Modbus is an open, widely used standard employed in many areas of application such as industry, buildings as well as the transport and energy sectors. The Modbus protocol is used to establish master-slave/client-server communication between intelligent devices. Via Modbus, a master, for example an automation station, and multiple slaves, such as refrigeration machines, can be connected. The data is transmitted via one of the three operating modes: Modbus ASCII, RTU or TCP. Please find more information at: **modbus.org**

M-Bus

M-Bus (Meter-Bus) is a European standard for remote meter reading, and can be used for various types of consumption meters as well as various valves and actuators. Data, such as heat quantities, can be read electronically. This data is transmitted serially via a reverse-polarity-protected two-wire cable from the connected slaves, i.e. measuring instruments, to a master. M-Bus meters are available for heat, water, electricity and gas. Please find more information at: **m-bus.com**
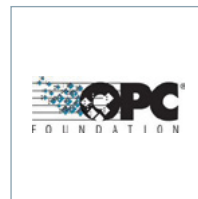
OPC

OPC is a standardized software interface that enables data exchange between various devices, control systems and applications of differing manufacturers. This interface is often used to neutrally collect process values of third-party devices and further process those data in a building automation system. Please find more information at: **opcfoundation.org**

Web (IT standard technology)

This is the umbrella term for a number of standardized communication protocols in the IT world that can be used within a local facility as well as via the Internet. It includes protocols that enable users to communicate with their plants and products, such as graphic user interfaces operable with Web browsers, e-mail messages to maintenance personnel or loading firmware modifications. In addition, there is a growing number of protocol types that support direct communication between machinery, such as exchange of device administration information or so-called "Web services" for linking plants even beyond the scope of building automation, such as with distributed facilities, infrastructure projects and energy management systems.

Product portfolio from Siemens
• Desigo Insight (Web)
• Desigo SX Open (OPC)
• Desigo PX Web (Web)
• Desigo PX Open (Modbus, M-Bus)
• Desigo TX Open (Modbus, M-Bus)
• GAMMA instabus, IP Router N 146/02 (KNXnet/IP)
• GAMMA instabus, IP Interface N 148/22 (KNXnet/IP)
• GAMMA instabus, IP Control Center N 152 (KNXnet/IP, Web)

ZigBee

ZigBee is a specification for wireless short-range radio networks that handle only low data volumes, used for example in sensor networks and lighting system engineering. The ZigBee Alliance is an international pool of various business enterprises. ZigBee is based on the IEEE 802.15.4 standard. Please find more information at: **zigbee.org**

Mounting guidelines
for sensors

Outdoor temperature sensors
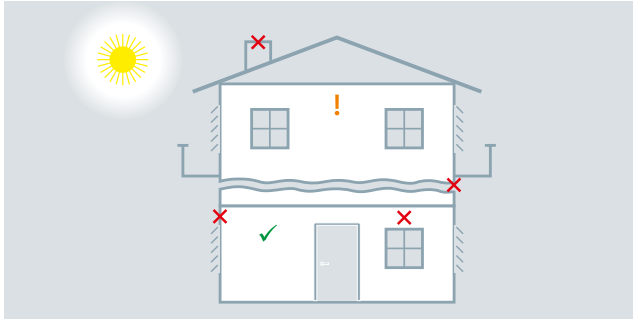
Mounting guidelines for outdoor temperature sensors
• Do not expose to direct sunlight
• Do not mount on facades with a great deal of ascending heat
• Do not attach to walls in front of a chimney
• Do not mount on eaves or a balcony
• Do not place over windows
• Do no mount over ventilation shafts
• Do not paint over sensors
• Mount sensors in an accessible location to allow easy inspection and maintenance

Depending on the application, place outdoor temperature sensors as follows:

For control
The sensors should be mounted on the building's outer wall with the windows of the main living areas. However, they should not be exposed to morning sunlight. In case of doubt, you can mount these sensors on the north or northwest wall.

For optimization
Always attach the sensors to the building wall that faces away from the sun, which is normally on the north side. They should not be exposed to sunlight. The sensors are best placed in the middle of the building or in the heating zone but at least 3 m above the ground.
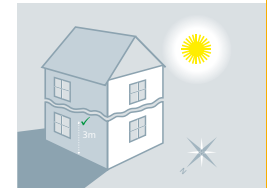
Motion and presence detectors

**Mounting guidelines for motion and presence detectors in a room**

- Do not expose motion detectors to direct sunlight
- Do not mount any lamps within the detection zone
- Avoid placing any sources of rapid temperature changes within the detection zone, e.g. air vents, fan heaters or incandescent and halogen lamps
- Ensure that the direction of air flows moves laterally to the detection zone
- Detection depends on the temperature difference between the surrounding ambient zone and the object to be detected
- The detection zone of a presence detector should not be impeded or blocked by shelves, plants or glass walls
- Minimum distance of 50 cm from cables and radiators

Mounting guidelines for motion detectors on a building

- Do not mount motion detectors on moving supports, such as poles
- In outdoor applications, mount presence detectors on stable walls
- The detection range of a presence detector should be free of interferences
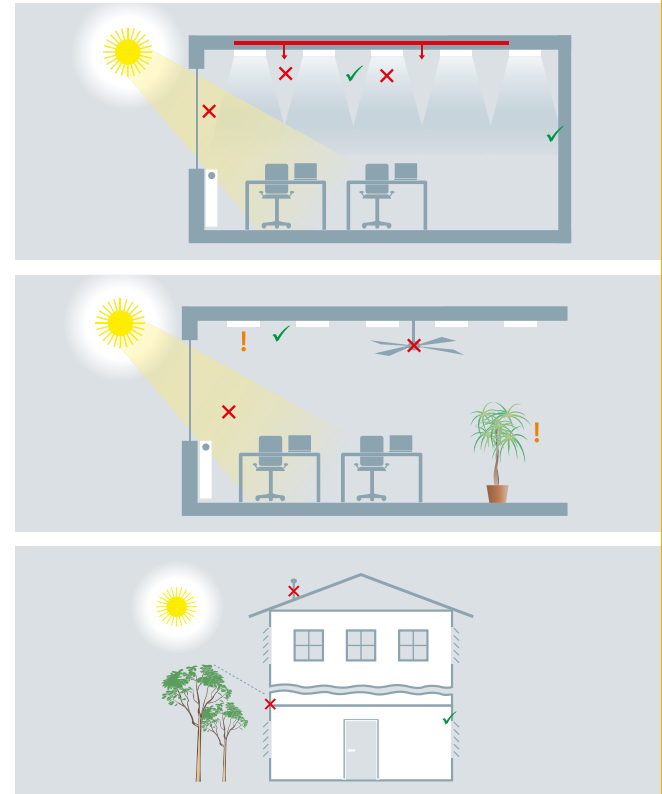
Brightness sensors
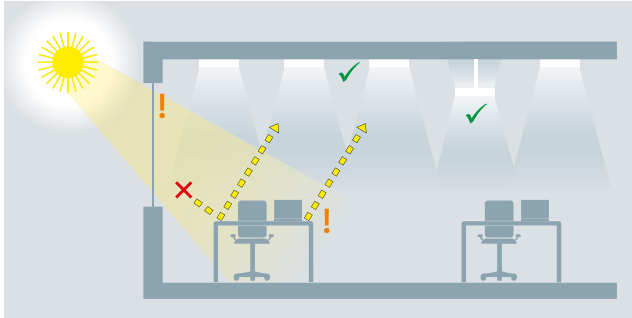
Mounting guidelines for brightness sensors
- Make sure that the brightness sensor measures only indirect, reflected light; direct sunlight distorts the measurement results
- Avoid shiny surfaces that are highly reflective, as this interferes with measurement
- Avoid surfaces that are too dark with low light reflection properties, as this impedes measurement of the current brightness level
- Keep in mind that thermal protection glass can influence the daylight measurement; the tripping value will be lower

Installation zones
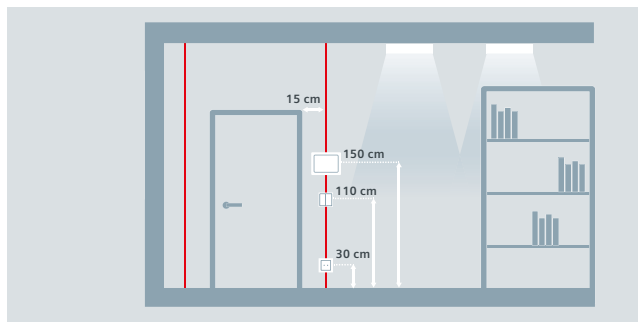
Standard switch and socket heights
- Power sockets: 30 cm
- Linking duct: 100 cm
- Switches and pushbuttons: 110 cm
- Room thermostats and touch-display devices: 150 cm

Tips for cable routing
- Cables should be routed in a way that the positioning and sheathing prevent mechanical damage to the cables
- Cables in walls should only be routed either vertically or horizontally
- Cabling laid in a fixed position is safer than cabling that can move
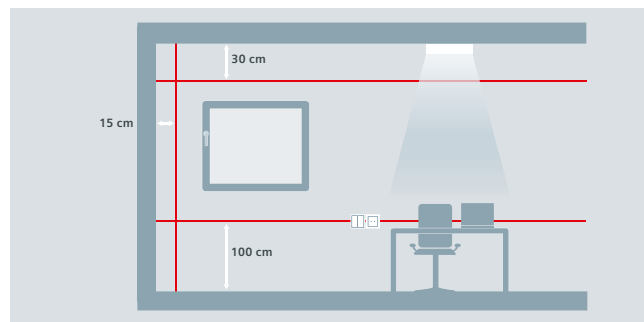
- Route cables so that they are out of people's reach
- Route cables at an adequate distance from hot piping, lightning protection systems and telecommunication lines
- In horizontal cable runs: lay the cable preferably at 30 cm below the ceiling level, and at either 30 or 100 cm above the floor level
- In vertical cable runs: lay the cable preferably at 15 cm to the side of the building carcass (shell) edges or corners

Source: DIN 18015

# Room sensors for temperature, humidity and air quality
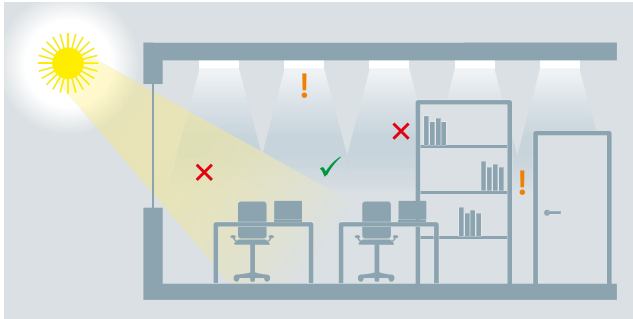
Mounting guidelines for sensors measuring room temperature, relative humidity and air quality

- Mount sensors in rooms at a height of approx. 1.5 m and a distance of at least 50 cm from the nearest wall
- Do not expose to direct sunlight
- Do not mount on external walls
- Do not place in alcoves or on shelves
- Avoid locations near to air flows and heat sources
- Reliable detection of room climate is only possible if the doors and rooms are closed
- Do not cover with curtains

In products from Siemens, the sensors within the devices are located before the wall so that the rising air flow can be accurately measured. To ensure accurate readings, it is a good idea to keep the following in mind during installation:
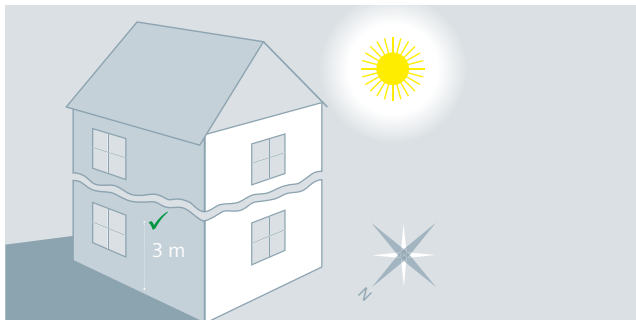
When mounting on massive walls (1) made of steel, concrete, etc., you need to place thermal insulation (2) between the room sensor (3) and the wall.
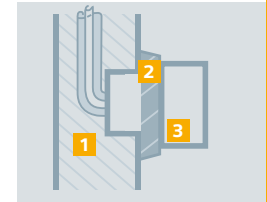
Clearances between the cable (4) or plastic hose and the installation pipe (5) need to be sealed. Otherwise, inefficient air circulation will occur, causing measuring errors.
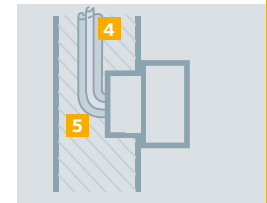
Outdoor brightness sensors

Mounting guidelines for outdoor brightness sensors
- Mount the sensors to the building wall facing away from the sun, normally the north side
- Do not expose the sensors to direct sunlight
- Mount outdoor brightness sensors in the middle of the building, at a minimum height of 3 m above the ground, while maintaining at least 0.3 m distance from windows
- Mount sensors in an accessible location to allow easy inspection and maintenance
- Avoid interference from trees and buildings, etc.
- Do not paint the sensors

Wind sensors

Main wind direction
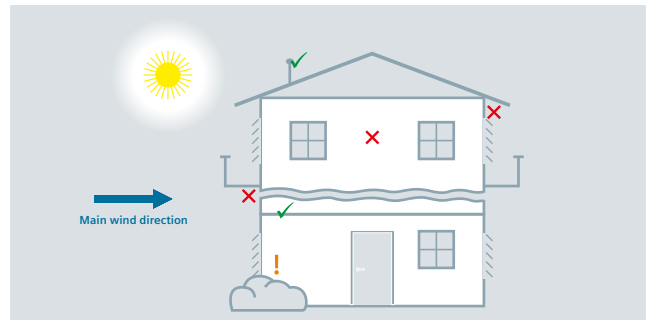
Mounting guidelines for wind sensors
- Mount on the facade along the main wind direction
- Select a site on the building where the sensor can detect the wind unhindered
- Mount sensors in an accessible location to allow easy inspection and maintenance
- Do not mount under eaves or balconies
- Do not place in alcoves
- Consider interference factors such as trees, shrubs and snow cover
- Best mounted on a pole at a minimum height of 60 cm

Door/window contacts
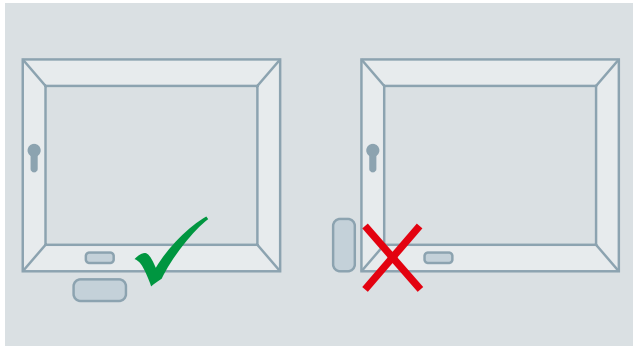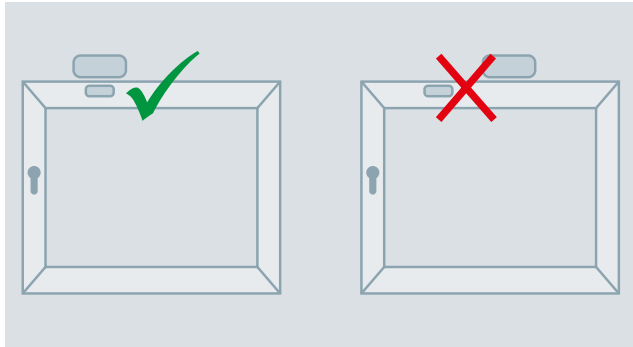
Mounting guidelines for door/window contacts
- Mount on the upper edge of the door or window to reliably detect and signal the reading even when the window is tilted open
- Attach the door/window contact to the stationary door/window frame and mount the magnet on the moving door panel or window casement
- Make sure that the mounting plate and magnet are located in close vertical alignment – with a gap of at least 3 mm, but no more than 10 mm
- Alternative mounting option: Mount on the bottom edge of the door or window; by doing so, the status is not reported when the window is tilted open, but rather only when fully opened

Weather stations/sensors
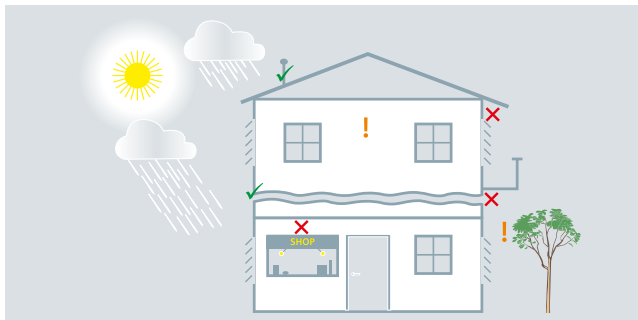
Mounting guidelines for weather stations/sensors for measuring brightness, precipitation and temperature
- Mount in a location where wind, rain and sunlight can be measured unhindered
- Mount the weather panels on a pole at a minimum height of 60 cm, or on a vertical, south-facing wall
- Mount sensors in an accessible location to allow easy inspection and maintenance
- Do not mount under eaves or balconies
- Consider interference factors such as buildings, trees, shrubs and snow cover
- Ensure the sensors mounted outdoors are protected against lightning and overvoltage

Immersion temperature sensors

Pipe carrying warm air
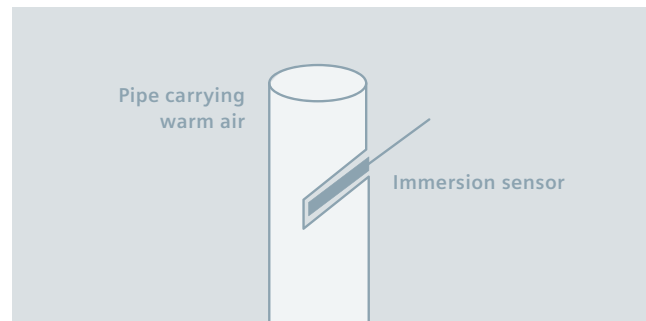
Immersion sensor

Mounting guidelines for use of immersion sensors
- While the sensor element does not have to be in any one particular position, its entire length must be exposed to the medium to be measured (water, air)

Strap-on temperature sensors

Detecting temperature at piping
- Surface must be bare (paint removed)
- The sensor must sit firmly on the surface
- Use thermal paste
- Note: Prevent influence from other heat sources

Detecting temperature at windows
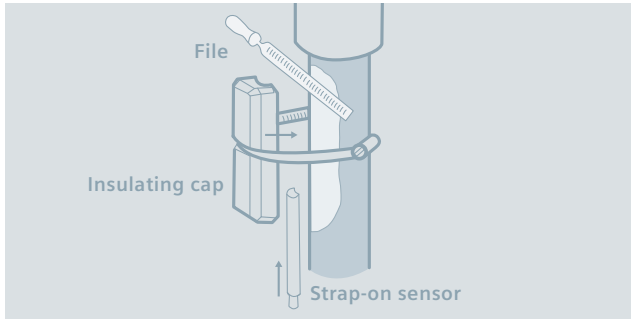- Where windows can be opened: pay attention to cable length!
- The sensor must sit directly on the window surface

Detecting temperature at surfaces
- The sensor must sit directly on the surface
- Use thermal paste

Strap-on and immersion sensors, condensation monitor
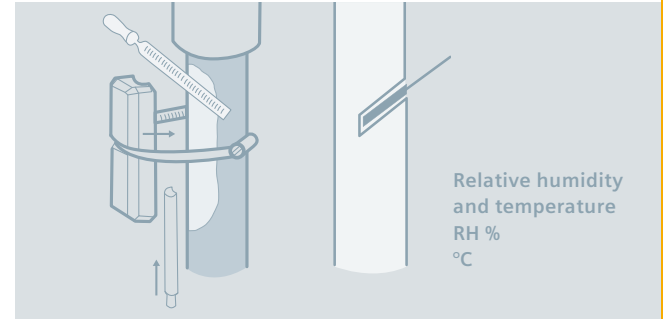
Mounting guidelines for condensation monitors for measuring temperature and humidity
- File the contact surface bare and fill the hollow space between the sensor and the pipe with thermal paste to improve thermal conductivity

Strap-on and immersion sensors in floor sensors
Floor sensors for measuring floor temperature:
- Establish a direct connection between the sensor and a temperature sensor (AQR) so that the floor temperature is transmitted via the KNX bus
- Attach metal sleeve to floor sensor so that the sensor is surrounded by air instead of screed

Application examples

Application example

Backbone and line couplers

Diagram 1: N 140 line/backbone couplers for backbone and line connection

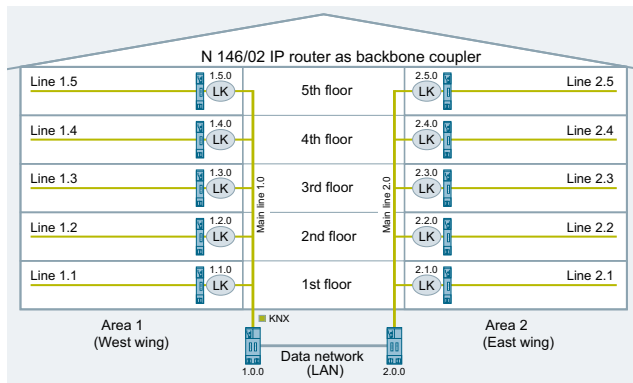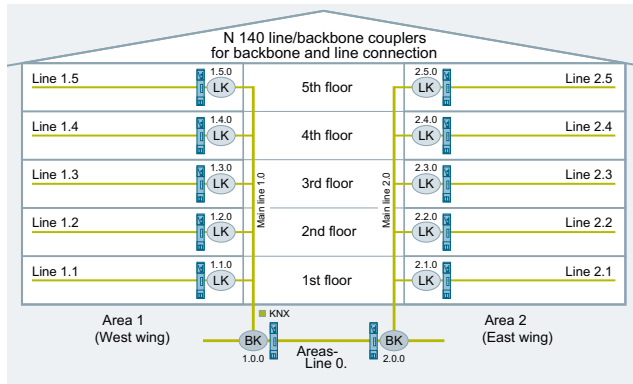| Line 1.5 | 1.5.0 LK | 5th floor | 2.5.0 LK | Line 2.5 |
Line 1.4	1.4.0 LK	4th floor	2.4.0 LK	Line 2.4
Line 1.3	1.3.0 LK	3rd floor	2.3.0 LK	Line 2.3
Line 1.2	1.2.0 LK	2nd floor	2.2.0 LK	Line 2.2
Line 1.1	1.1.0 LK	1st floor	2.1.0 LK	Line 2.1

Main line 1.0   Main line 2.0

Area 1 (West wing)   KNX   Area 2 (East wing)

BK 1.0.0   Areas-Line 0.   BK 2.0.0

Diagram 2: N 146/02 IP router as backbone coupler

Line 1.5	1.5.0 LK	5th floor	2.5.0 LK	Line 2.5
Line 1.4	1.4.0 LK	4th floor	2.4.0 LK	Line 2.4
Line 1.3	1.3.0 LK	3rd floor	2.3.0 LK	Line 2.3
Line 1.2	1.2.0 LK	2nd floor	2.2.0 LK	Line 2.2
Line 1.1	1.1.0 LK	1st floor	2.1.0 LK	Line 2.1

Main line 1.0   Main line 2.0

Area 1 (West wing)   KNX   Area 2 (East wing)

1.0.0   Data network (LAN)   2.0.0

Conventional topology

In conventional topologies, all line and backbone couplers have usually been designed as KNX couplers. This topology is proven and widely used. For the most part, the bus line lengths are limited to one building.

Modern topology

In this modern topology, the backbone couplers are replaced with N 146/02 IP routers. Thanks to the use of standard network components, the connection for example of two building sections is no longer limited to bus line lengths. Use of other media such as fiber-optic cabling or WLAN is also possible for the purpose of coupling distant buildings and exchanging group address telegrams.

Backbone and line couplers


```
N 146/02 IP router as backbone coupler

Line 1.5        1.5.0                  2.5.0        Line 2.5
                        5th floor
Line 1.4        1.4.0                  2.4.0        Line 2.4
                        4th floor
Line 1.3        1.3.0                  2.3.0        Line 2.3
                        3rd floor
Line 1.2        1.2.0                  2.2.0        Line 2.2
                        2nd floor
Line 1.1        1.1.0                  2.1.0        Line 2.1
  ■ KNX               1st floor

Area 1                                        Area 2
(West wing)                                   (East wing)
              Data network
                 (LAN)
```
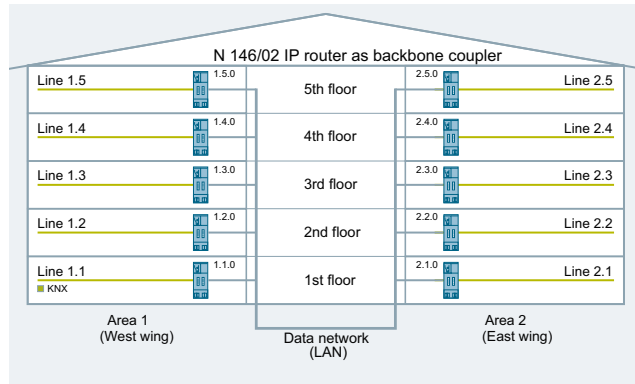
Innovative topology

In this innovative topology, all line couplers are replaced with N 146/02 IP routers. Backbone couplers are no longer needed. This configuration allows to connect every building floor by Ethernet (LAN) and utilize existing LAN networks. Moreover, correct configuration of the N 146/02 IP router enables major projects to be commissioned as smaller, individual subprojects in a simpler, clearer manner. It's possible to exchange group address telegrams despite the separation into individual projects.

Commissioning a KNX system via Ethernet (LAN)
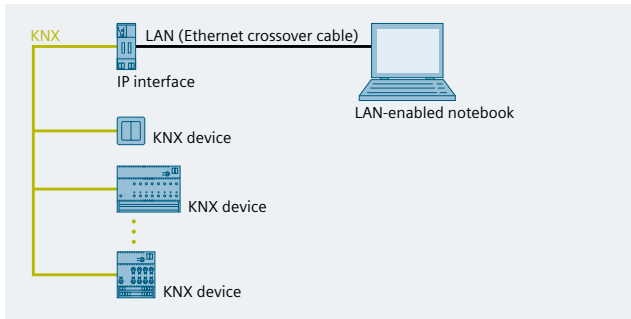
In every GAMMA instabus project, the devices are commissioned after their installation. Once the physical addresses have been assigned, application programs, parameters and addresses are loaded to the devices. This can take some time in large-scope projects with many devices.

The LAN connection from Siemens makes it all go much faster, saving you time and money. Simply connect your notebook to the GAMMA instabus via an IP interface and start the download. With a LAN connection, the download takes only half as long as it does with USB.

Benefits
- Plan, configure, commission and diagnose with ETS, the KNX commissioning software
- Simply connect your notebook and start the download
- Downloading takes only half as long, thereby halving commissioning times and significantly reducing time at the project site

Follow these steps
- Connect the IP interface to the KNX bus line
- Connect the notebook to the IP interface using the Ethernet crossover cable – and start the download

You will need
- An IP interface N 148/22, for example
- 24-V power supply for IP interface N 148/22, e.g. Power over Ethernet, unchoked bus voltage
- Crossover cable
- LAN-enabled notebook
- ETS; see **knx.org** for the latest version

Commissioning a KNX system via Ethernet (WLAN)
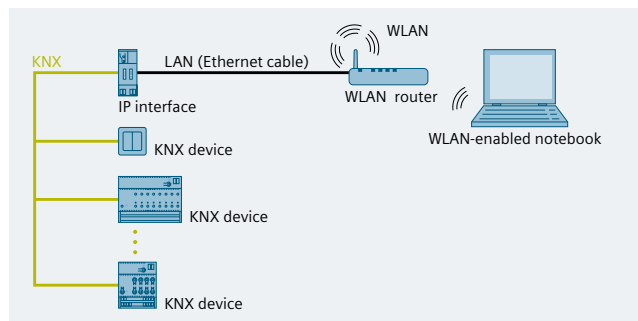
In every GAMMA instabus project, the devices are commissioned after their installation. First, the physical addresses must be assigned. To do this, select the device in ETS on the notebook and press the programming key on the device. If you have various devices at different places such as flush-mounted bus coupling units, this can result in intensive walkways. That's the reason why two people usually perform the commissioning. You can save yourself this considerable extra work by connecting your notebook wirelessly to the KNX via WLAN. This lets you move about freely during commissioning – just take your notebook with you to each room. Any errors such as mixup of devices due to misunderstandings are ruled out.

Benefits
- Wireless GAMMA instabus commissioning via WLAN
- Possible to move freely throughout the building
- Only one person needed for commissioning

Follow these steps
- Connect the IP interface with the KNX, and connect the WLAN router to the IP interface using the Ethernet cable – and you can go to each individual room with your notebook and the ETS
- The related safety and security requirements governing the LAN and WLAN have to be observed

You will need
- An IP interface N 148/22, for example
- 24-V power supply for IP interface N 148/22, e.g. Power over Ethernet, unchoked bus voltage
- Ethernet
- WLAN router
- WLAN-enabled notebook
- ETS; see **knx.org** for the latest version

Coupling KNX lines
via Ethernet (LAN)
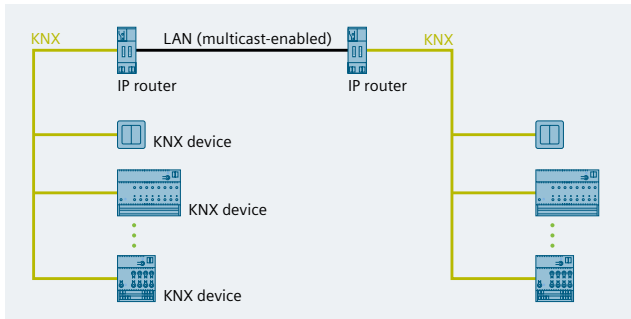
The new KNXnet/IP standard enables KNX telegrams to be transmitted via Ethernet (LAN), which leads to new applications and solutions.

Existing network infrastructure and technologies are used to transmit KNX data over longer distances.

Connections between buildings or floors can be clearly and easily implemented with KNXnet/IP.

Benefits
• LAN as the main and backbone line
• Data can be transmitted over longer distances
• Existing data network and components (LAN) can be used

Follow these steps
• Connect an IP router N 146/02 to every KNX line (instead of a line coupler N 140/03)
• Connect the IP router N 146/02 via a multicast-enabled LAN
• Commission each IP router N 146/02 just like a "conventional" line/backbone coupler using ETS
• Observe the related safety and security requirements governing the LAN

You will need
• One IP router N 146/02 per line
• 24-V power supply for IP router N 146/02, e.g. Power over Ethernet, unchoked bus voltage
• Ethernet patch cable or LAN, depending on the size
• ETS; see **knx.org** for the latest version

Remote access to a KNX system via the Internet
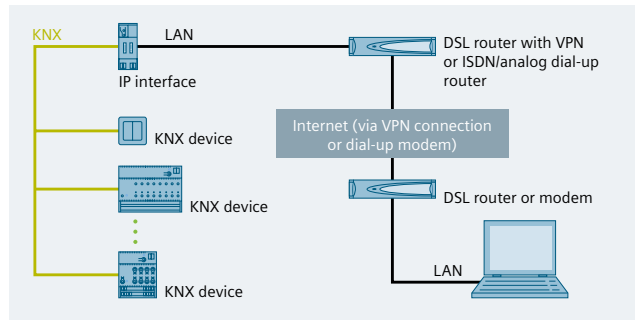
In almost every project, changes are often requested during building completion or after the building goes into operation, for example if the set lighting times are too long. Up to now this meant making an appointment with the customer, driving to the property, changing the parameter settings, driving back again. Now you can cut time and costs by making these changes remotely from your office via Internet, LAN or a wired broadband connection (fiber optics or DSL). Most buildings already have an Internet and LAN connection – thus providing global connectivity. This is why data security must be ensured using a VPN DSL router or dial-up router respectively.

Benefits
- Parameters can be quickly changed by remote access
- Remote access saves driving time and costs
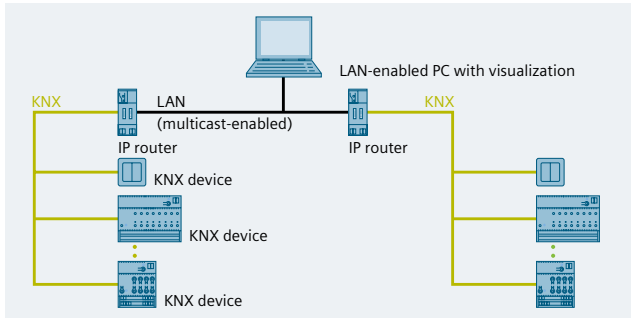- Data security is ensured

Follow these steps
- Connect IP interface N 148/22 to the KNX and LAN
- Configure the VPN DSL router or dial-up router

You will need
- An IP interface N 148/22, for example
- 24-V power supply for IP interface N 148/22, e.g. Power over Ethernet, unchoked bus voltage
- VPN DSL router or ISDN/analog dial-up router
- ETS; see **knx.org** for the latest version

KNX visualization
via Ethernet (LAN)

LAN-enabled PC with visualization

KNX

LAN (multicast-enabled)

IP router

KNX device

KNX device

KNX device

KNX

IP router

When retrieving large numbers of data points cyclically for visualization in large projects, waiting periods can sometimes occur while data is being updated.

Use your LAN as the main and backbone line and connect your PC for visualization to the LAN. This makes visualization up to 200 times faster: you can monitor larger numbers of data points and the data volume is no longer important.

Benefits
- LAN as the main and backbone line
- Visualization up to 200 times faster than previously
- High data volume possible
- No data concentrators needed

Follow these steps
- Commission the KNX devices, including the IP router N 146/02
- Install the visualization software
- Find and connect the IP router N 146/02 as the visualization interface
- Configure the visualization
- Observe the related safety and security requirements governing the LAN

You will need
- One IP router N 146/02 per line
- IP Control Center N 152
- 24-V power supply for IP interface N 146/02, e.g. Power over Ethernet, unchoked bus voltage
- Ethernet network (LAN)
- ETS; see **knx.org** for the latest version

Monitoring properties with KNX via Ethernet (LAN)
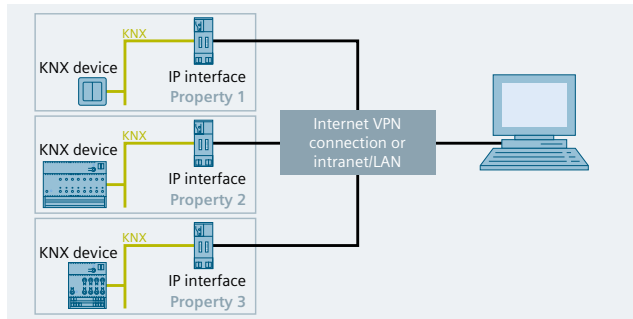
Some distributed properties need to be checked regularly for certain conditions and maintained accordingly, for example the fill levels of oil tanks in distributed apartment buildings or the operating hours of consumers.

These states can now be reported centrally to any location. This can eliminate the need for cyclical inspection walk-throughs and appropriate maintenance can be carried out when needed, such as refilling the oil tanks in distributed properties. You can even select the best time to do this, such as when oil prices are lowest.

Benefits
- Central status messages for distributed properties
- Less maintenance required
- Optimization of maintenance costs

Follow these steps
- Connect one IP interface N 148/22 to the KNX for each property
- Connect the IP interface N 148/22 to the LAN
- Configure the IP interface N 148/22 via the Internet or intranet for accessibility
- Define the IP interface N 148/22 in the visualization software or ETS respectively
- Observe the related safety and security requirements governing the LAN

You will need
- One IP interface N 148/22 for each property, for example
- 24-V power supply for IP interface N 148/22, e.g. Power over Ethernet, unchoked bus voltage
- Visualization software
- ETS; see **knx.org** for the latest version

Using DALI luminaires with easy KNX commissioning

Switch/dimmer actuator or KNX/DALI gateway

KNX

DALI-EVG (×8)   DALI-EVG (×8)

DALI

Up to 8 DALI ballasts per channel
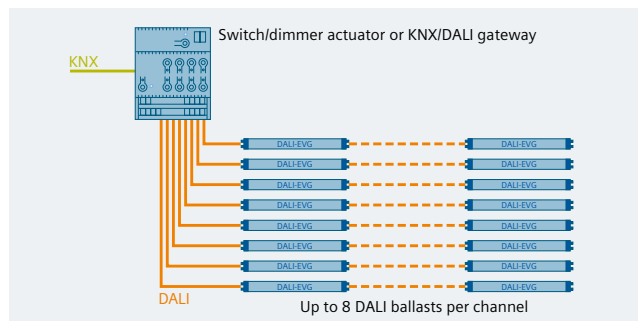
Ballasts with a DALI interface are used in lighting controls, e.g., to report lamp failure. The N 525E switch/dimmer actuator now makes it possible to completely replace DALI devices with GAMMA instabus without any knowledge of DALI or DALI commissioning procedures.

The N 525E switch/dimmer actuator switches and dims eight independent groups of fluorescent lamps with dimmable ballasts and DALI interfaces. Up to eight DALI ballasts can be connected to each of the eight channels.

Benefits
- True 0 to 100% light value control
- High operating safety due to targeted shutdown in the event of an error
- Error messages for luminaire groups
- For individual room lighting control

Follow these steps
- Connect the switch/dimmer actuator N 525E to the KNX
- Connect each group of DALI ballasts to be controlled jointly to one output of the switch/dimmer actuator N 525E
- Configure each channel in ETS just as you would a conventional actuator and program the device

You will need
- Switch/dimmer actuator N 525E
- Dimmable ballasts with DALI interfaces
- ETS; see **knx.org** for the latest version

Presence- and daylight-dependent control
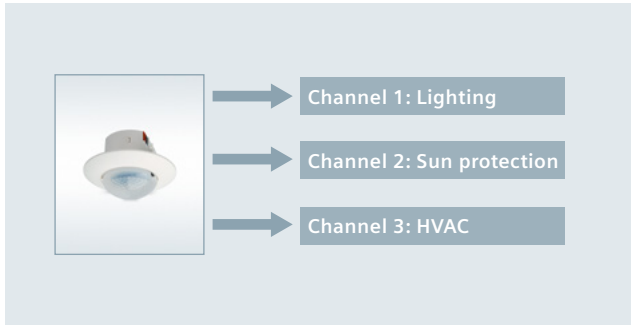
The presence detector with integrated brightness control regulates up to three independent output channels for various functions in the room, such as lighting, sun protection and HVAC systems. The automation serves to optimally adjust the room temperature and brightness to the room's actual use on a presence-dependent basis. That means optimum comfort and always a pleasant room climate, yet with low energy consumption.

At the start and end of every movement, each output channel individually actuates the respective functions. The follow-up times and brightness thresholds can be set independently of each other.

Constant light level control
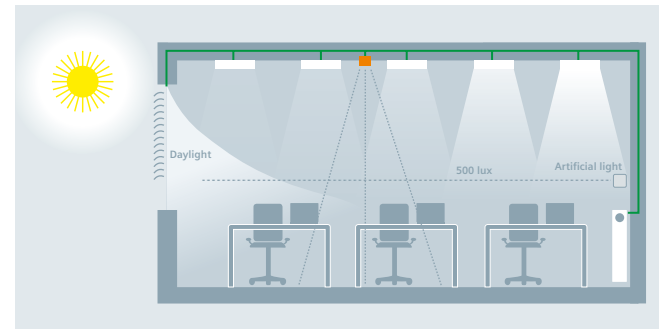
Benefits
- Integrated constant light level controller with main lighting group and up to four lighting subgroups with one brightness sensor
- Automatic assignment of the artificial light distribution in the room to enable constant light level control of the up to five lighting groups via control characteristics
- Entry of five brightness values, measured under the lights during pure daylight, as parameters in ETS
- Automatic measurement of artificial lighting in the room when it is dark (without daylight) through targeted on/off switching of the lighting groups and simultaneous measurement at the brightness sensor of the detector

Sunlight tracking control

1 Total reflection of direct sunshine
2 Portion from diffuse daylight
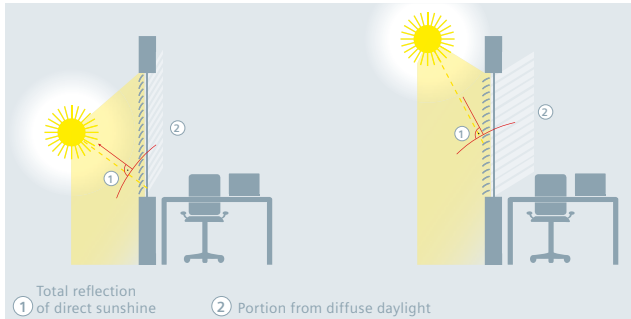
With sunlight tracking control, the position of the sun is tracked so that the blind slats are not completely closed, but rather automatically adjusted to prevent the sun from shining directly into the room. The spacing between the blind slats still allows diffuse daylight to enter the room and contribute to ensuring glare-free room lighting while lowering electricity costs.

1 Weather station
KNX
DC 24 V
2 Power supply
3 Combi/sunblind actuator
AC 230 V
Drives
4 Shutter/blind switches for manual operation
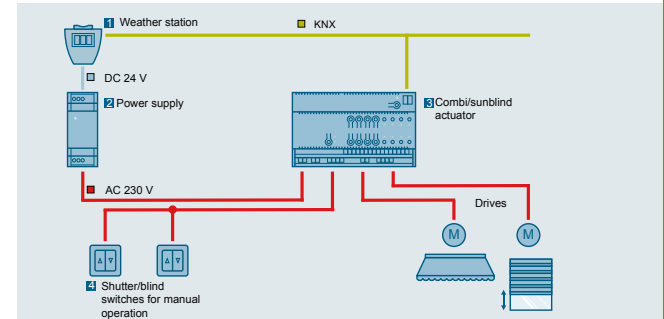
Benefits
- Reduced energy consumption and costs for room lighting
- Optimum room climate
- Glare-free workplaces

You will need
- Weather station AP 257
- Electronic power supply unit
- Sunblind actuator N 523/11
- Pushbutton, double UP 222/3
- Drives
- Bus coupling unit UP 117/12 (for pushbuttons)

Shadow tracking control

③ Maximum depth of sunlight penetration into the room
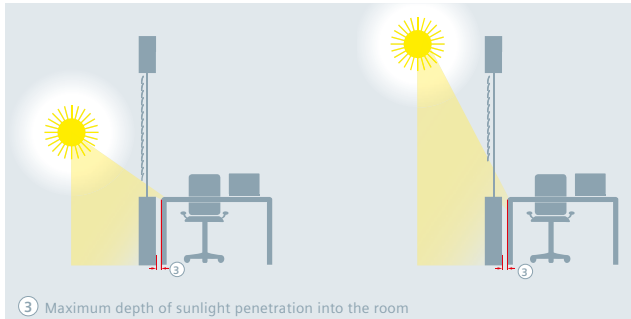
With shadow tracking control, sun protection is not low-ered completely but only so far that the sun can still shine into the room for a certain distance (e.g. 50 cm), which can be set by adjustable parameters.

Benefits: This enables room occupants to look outside through the lower part of the window, and plants ar-ranged on the windowsill can still be exposed to direct sunlight, while the room occupants are protected. This creates an optimum room climate, ensures glare-free workplaces and lowers energy demand and costs for room lighting.

Sunlight tracking control with shadow tracking control

① Total reflection of direct sunshine ② Portion from diffuse daylight ③ Maximum depth of sunlight penetration into the room

The functions of sunlight tracking control and shadow tracking control can be performed with the same devices individually or in combination.

You will need
- Weather station AP 257
- Electronic power supply unit
- Sunblind actuator N 523/11
- Pushbutton, double UP 222/3
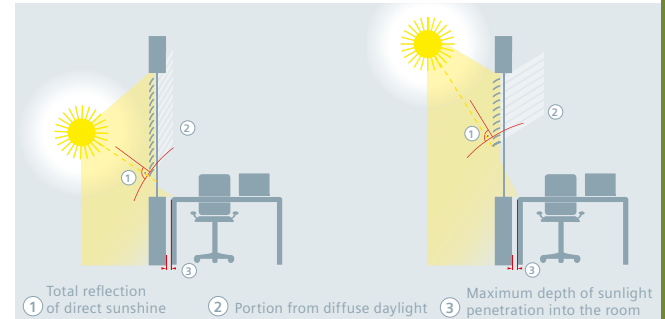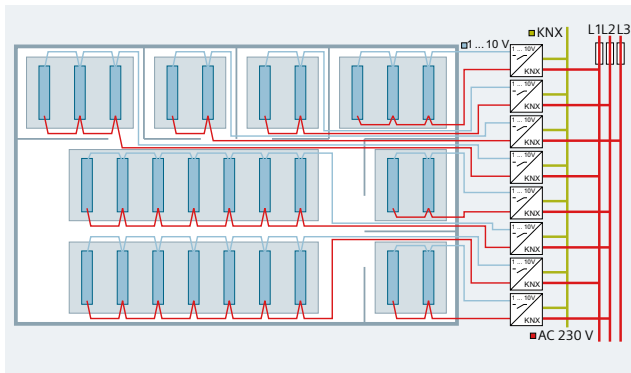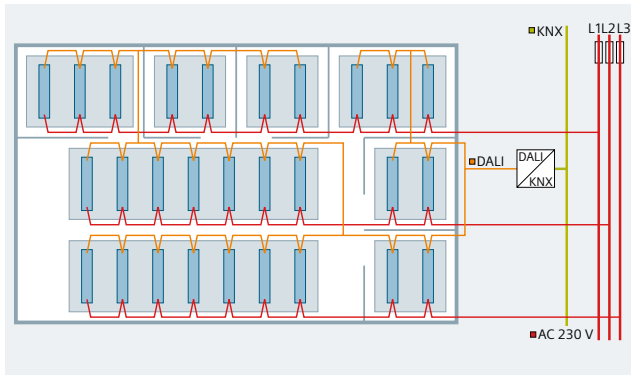- Drive
- Bus coupling unit UP 117/12 (for pushbuttons)

Wiring of lighting groups with DALI

Modern lighting systems can be controlled efficiently and conveniently with DALI. Their efficiency can be increased even more when combined with the advantages of KNX. That's why KNX/DALI gateways from Siemens offer both standards directly: for DALI digital lighting (IEC 62386) and for KNX building control (ISO/IEC 14543-3 or DIN EN 50090). It's possible to integrate DALI lighting into KNX installations quickly and easily.

Benefits
- Lighting groups are not hardwire-connected
- Possible to plan control lines and power supply separately
- Even, uniform load distribution throughout the power supply network
- Lower fire load thanks to fewer cables
- Planning is simpler and faster
- Integration of emergency lighting into the general lighting
- Support for selected sensors with DALI interface
- Switching off standby when lighting is turned off
- Replacement of defective single-channel ballasts without software

DALI topology with sensors

KNX
KNX/DALI gateway
10 more 6-mA sensors per channel
DALI multisensor (max. 8 PIR per channel)
Sensor head
Pushbutton
DALI pushbutton interface 4-fold (max. 16 per channel)
Channel A
Channel B
DALI
Max. 190 mA per DALI channel
AC 230 V
Max. 64 2-mA electronic ballasts per channel
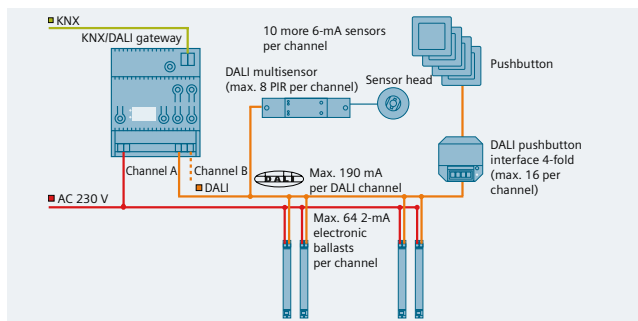
The KNX/DALI gateway can control up to 64 ballasts per channel. In addition, selected DALI sensors that meet specifications from Siemens can be commissioned together with the KNX/DALI gateway. The maximum number of DALI devices is limited to the guaranteed rated current of 190 mA per channel or to the maximum number of the DALI sensor type.

Switching off standby with DALI

KNX
KNX/DALI gateway
10 more 6-mA sensors per channel
DALI multisensor (max. 8 PIR per channel)
Sensor head
Pushbutton
Switching actuator
DALI pushbutton interface 4-fold (max. 16 per channel)
Channel A
Channel B
DALI
Max. 190 mA per DALI Channel
AC 230 V
Max. 64 2-mA electronic ballasts per channel
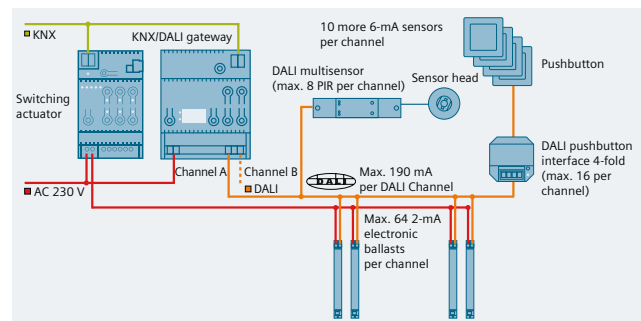
Luminaires with electronic ballasts usually need a closed-circuit current, even when the lighting system is turned off or is in standby mode. This energy consumption adds up, but can be conserved using the KNX/DALI gateway Twin plus: by automatically cutting off power to the electronic ballasts. After the lighting is turned off and as soon as all electronic ballasts in the defined area are no longer needed for lighting, the ballasts can be disconnected from the power supply via a command from a switch actuator controlled for this purpose. If one or more luminaires are in operation, the switch actuator first restores power to the electronic ballast, and the gateway dims the luminaire to the required brightness level.

Wireless remote control (KNX/EnOcean)
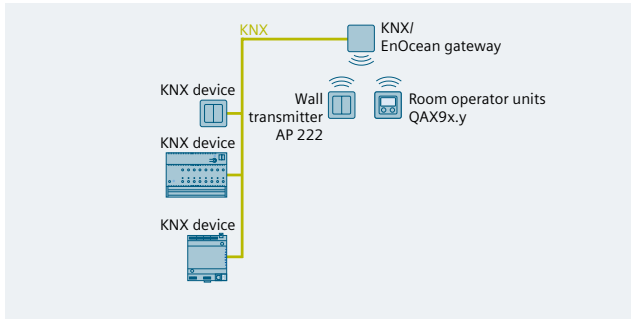
In many indoor applications, cables are either not wanted, laying cables is too labor-intensive or simply not possible at all.

Maintenance-free switches and room devices based on the open EnOcean communication standard are the ideal solution for these applications.

Benefits
- Battery-free and thus environmentally friendly and maintenance-free
- Communication via open standard
- Mounting on any surface: glue or screw them in place, done
- Can be upgraded without new cables
- Can be connected to GAMMA instabus: KNX via KNX/EnOcean gateway

Follow these steps
- Connect the KNX/EnOcean gateway RXZ97.1 with the KNX
- Configure and program the KNX/EnOcean gateway RXZ97.1 in ETS
- Program the EnOcean devices

You will need
- KNX/EnOcean gateway RXZ97.1
- Further EnOcean devices, depending on the application
- For lighting/sun protection applications: EnOcean wall transmitter AP 22x
- HVAC applications: room operator units QAX9x.y
- ETS; see **knx.org** for the latest version

Web-based visualization
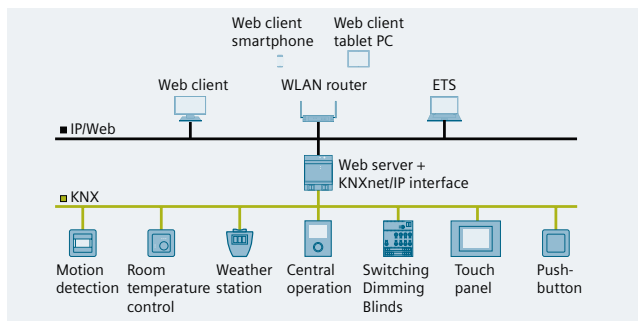
The Control Center N 152 is a compact visualization controller. It enables the entire room and building automation to be conveniently operated and visualized via Web-enabled PCs, tablets and smartphones – also in a wireless configuration via WLAN. Up to 1,250 KNX objects and group addresses are available for this purpose. In the event of a fault, an alarm message is sent via e-mail. The integrated KNX interface allows commissioning of the KNX installation. With an additional router, the KNX installation can be serviced via remote maintenance.

Benefits
- IP Control Center N 152
- An integrated Web editor
- For all Web-enabled operating devices such as PCs, notebooks, tablets and smartphones
- Create customized visualization of operating and display interfaces
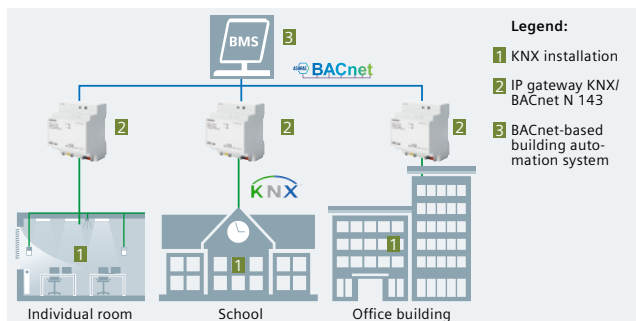
Follow these steps
- Connect the IP Control Center N 152 to the KNX, and configure and program it in ETS
- Create the visualization of the operating and display interfaces via the Web editor
- The related safety and security requirements governing the WLAN shall be observed

You will need
- IP Control Center N 152
- ETS; see **knx.org** for the latest version

Integrating KNX into BACnet

Legend:
1 KNX installation
2 IP gateway KNX/BACnet N 143
3 BACnet-based building auto-mation system

Individual room   School   Office building

The IP gateway KNX/BACnet enables KNX installations to be integrated into BACnet-based networks and building automation systems quickly, simply and efficiently. No separate commissioning interface is needed owing to the KNXnet/IP interface integrated into the gateway. This facilitates for example the integration of new KNX installations into already existing building management systems that use BACnet as their system protocol. It enables building automation systems to be expanded simply and cost-efficiently. Thanks to its KNXnet/IP interface, the KNX installation technician can commission the gateway using the ETS. The system integrator that recognizes the IP gateway KNX/BACnet as controller (B-ASC) is responsible for the integration into the BACnet system.

Benefits
- Commissioning of the IP gateway KNX/BACnet N 143 by the KNX installation technician only using the ETS
- Integration of a KNX installation into a BACnet system without KNX knowledge by the BACnet system integrator
- Clear separation of responsibility for KNX installation and BACnet system integration/building management
- Simple, flexible integration of a KNX installation
- Integrated Web server for documentation of the configuration and export of an EDE file
- Configuration of a KNX installation via IP gateway KNX/BACnet N 143

Follow these steps
- Connect the IP gateway KNX/BACnet N 143 to the KNX, and configure and program it in ETS
- 250 BACnet objects can be created, for which up to 455 BACnet entries for automatic forwarding of BACnet object values can be stored

You will need
- IP gateway KNX/BACnet N 143
- ETS; see **knx.org** for the latest version

Application example

Application exampl

Glossary

Definitions and explanations of certain technical terms used in the previous chapters

AC　Alternating current

ASCII　ASCII (American Standard Code for Information Interchange) is a 7-bit character encoding standard that enables data exchange.

ASHRAE　ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) is a globally active American association for engineers focusing on technical building services.

BTL　The BTL brand was developed by the American BACnet International for BACnet Testing Laboratories (BTL).

CEN　The CEN (Comité Européen de Normalisation) is the European Committee for Standardization.

CENELEC　The CENELEC (Comité Européen de Normalisation Électrotechnique) is the European Committee for Electrotechnical Standardization.

Certification　A process for verifying that products comply with certain specific standards

Conformity　Designates the good agreement of something with the codes and standards governing that particular context

DALI　DALI (Digital Addressable Lighting Interface) is a digital interface that is integrated into the ballasts of luminaires and permits flexible wiring and commissioning. In addition to switching and dimming functions, it also detects and transmits lamp failures.

DC　Direct current

DIN　DIN stands for Deutsches Institut für Normung e.V., the German Institute for Standardization.

ECG　Electronic control gear (ballast)

EIB　EIB (European Installation Bus) is a standard according to EN 50090. Today, EIB is continued as KNX.

EMC　Electromagnetic compatibility

EN　European Norm

EnOcean The EnOcean Alliance was formed by leading companies in the building automation industry with the goal of implementing innovative wireless solutions for sustainable building automation projects.

ETS The ETS (Engineering Tool Software) is a vendor-independent commissioning software for all KNX devices.

Group address (KNX) Communication between KNX devices is performed via group addresses. They contain a clear function or piece of information.

IEC International Electrotechnical Commission

IEEE The IEEE (Institute of Electrical and Electronics Engineers) is a global professional association of engineers.

Inter-operability The ability of independent, heterogeneous systems to work seamlessly together in order to efficiently exchange useable information or make it available to the user without the systems having to negotiate the transfer separately

IP Internet Protocol

ISO The ISO (International Organization for Standardization) is the international association of standardization organizations.

KNX Association The KNX Association is an amalgamation of over 400 companies in 35 countries who have agreed on a standard technology known as KNX for exchanging telegrams between sensors and actuators within building automation systems. The Engineering Tool Software (ETS) is a vendor-independent commissioning software for KNX devices.

KNXnet/IP KNX bus communication via the Internet Protocol

KNX PL-Link KNX PL-Link (PeripheraL-Link) corresponds entirely to the KNX standard. It is a Desigo-specific bus system optimized to enable communication between decentrally installed field devices and the modular PXC3 room automation stations.

KNX RF KNX bus communication via radio frequency

KNX TP KNX bus communication via two-wire connection (twisted pair)

LAN LAN is the abbreviation for Local Area Network. Data transfer on LANs is organized by IP (Internet Protocol) – the standard network protocol on the Internet.

LON/ LonWorks A LON (Local Operating Network) is a decentralized network. LonWorks Network Services also provides services for installation, administration, analysis and license controlling of LON networks.

Object Term denoting an example of a particular data type. Every object is characterized by state, behavior and identity. The state of an object consists of its attributes and connections to other objects.

Physical address (KNX) The physical address assigns a unique address to a device depending on the given topology.

PICS PICS stands for Protocol Implementation Conformance Statement. The PICS document belonging to a device lists all supported BIBBs, object types, character sets and communication options.

PIR PIR (Passive Infrared) is a frequently used measuring principle for motion detection.

PL PL (Power Line) is a connection via the AC 230 V power supply grid.

Plug and play The possibility of connecting new devices without having to undertake any additional settings or adjustments

PoE PoE (Power-over-Ethernet) refers to a method for supplying power to network-able devices over the 8-wire Ethernet cable.

Protocol A system of rules that specify the format, content, meaning and order of messages transmitted between various entities of the same communications system

RTU Remote terminal unit

SELV Safety extra-low voltage

TCP The TCP (Transmission Control Protocol) is part of the TCP/IP protocol family. As a connection-oriented protocol, TCP assumes within TCP/IP the task of data security and data flow control, and initiates countermeasures in the event of data loss.

UDP   Besides TCP, the UDP (User Datagram Protocol) is the most important transport protocol of the Internet protocol family. As a minimal, connectionless network protocol, it is also used in the BACnet/IP standard, and forms there the basis for efficient processing of the actual data traffic.

VDE   VDE is the Verband der Elektrotechnik Elektronik Informationstechnik e.V., the German Association for Electrical, Electronic & Information Technologies.

VPN   VPNs (Virtual Private Networks) are used to set up a secure subnetwork over an open, unprotected network such as the Internet or radio network, in which the communication is protected against monitoring and access by external users. This is done by "tunneling" the data traffic over a VPN server, where the connections must be authenticated during setup, and by simultaneously encrypting the data.

Web browser   Software applications for presenting Web sites or, generally, documents and data, e.g. Internet Explorer.

Web service   An interface based on Web technologies for exchanging data between computers on the Internet (machine-to-machine communication)

WLAN   Wireless Local Area Network, i.e. a local radio network