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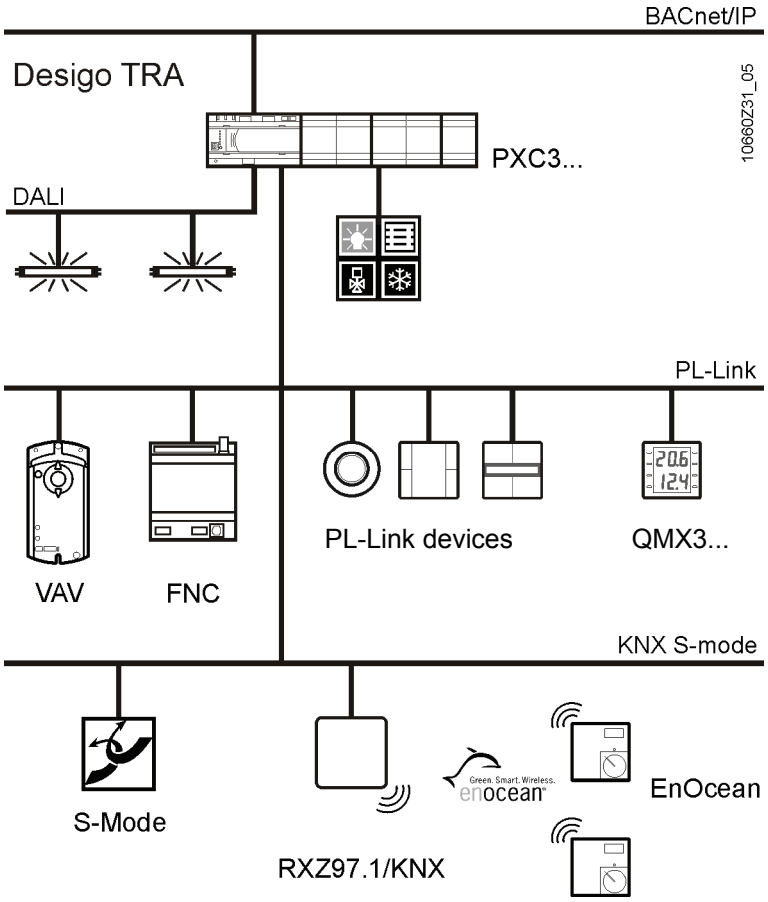

Desigo™ TRA
Mounting and installation
Manual

Contents

1 About this document

1.1 Revision history

Revision	Date	Changes	Section	Pages
_01	Mar 2012	First edition	All	

1.2 Reference documents

Ref.	Document title	Document number
[1]	TX-I/O™ Functions and operation.	CM110561
[2]	TX-I/O™ Engineering and installation manual.	CM110562
[3]	Desigo Technical principles manual, Section 21.	CM110664
[6]	Ethernet, TCP/IP as well as BACnet on Ethernet/IP principles	CM110666
[7]	TX-I/O™ Product range overview.	CM2N8170
[8]	TX-I/O™ Module datasheets.	CM2N8172 ff
[9]	Data sheet TX-I/O™ supply module and bus interface module.	CM2N8183
[10]	Data sheet Room units EnOcean QAX9x.4.	CM2N1663
[11]	Data sheet Room units EnOcean QAX95.1, QAX96.1.	CM2N1660
[12]	Data sheet Gateway EnOcean/KNX	CM2N1662
[13]	Desigo PX Mounting and installation guide	CA110396
[14]	Data sheet PXC3... Room automation station	CM1N9203
[15]	Data sheet RXM21.1 PL-Link I/O Block	CM2N3835
[16]	Data sheet RXM39.1 PL-Link I/O Block	CM2N3836
[17]	Gamma Instabus documentation: http://www.buildingtechnologies.siemens.com/bt/low-voltage/EN/product-portfolio/building-management-systems/gamma-instabus-KNX/System_Products/Pages/system_products_electrical_installation.aspx	

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EnOcean®	EnOcean LLC, Germany 82041 Oberhaching www.enocean.com
DALI ™	ZVEI - Zentralverband Elektrotechnik- und Elektronikindustrie e.V., Stresemannallee 19, D-60596 Frankfurt am Main http://www.dali-ag.org

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1.4 Document validity

Desigo V5

2 Introdution

2.1 About this document

Main target audience

The mounting and installation guide is targeted at

- **Panel builders and factory installers**
- **Electricians**
- **Engineers**

Purpose

The mounting and installation guide provides all the information needed by the aforementioned personnel for:

The proper mounting and wiring of Desigo TRA in the installation box and connections to the plant.

An overview of the room automation station product range and its design is provided for general understanding.

Additional use

The mounting and installation guide is provided to internal engineering personnel at Siemens Building Technologies and system houses with information on the following topics:

– Installation variants for room automation station.
– Regulations and notes.

Restrictions

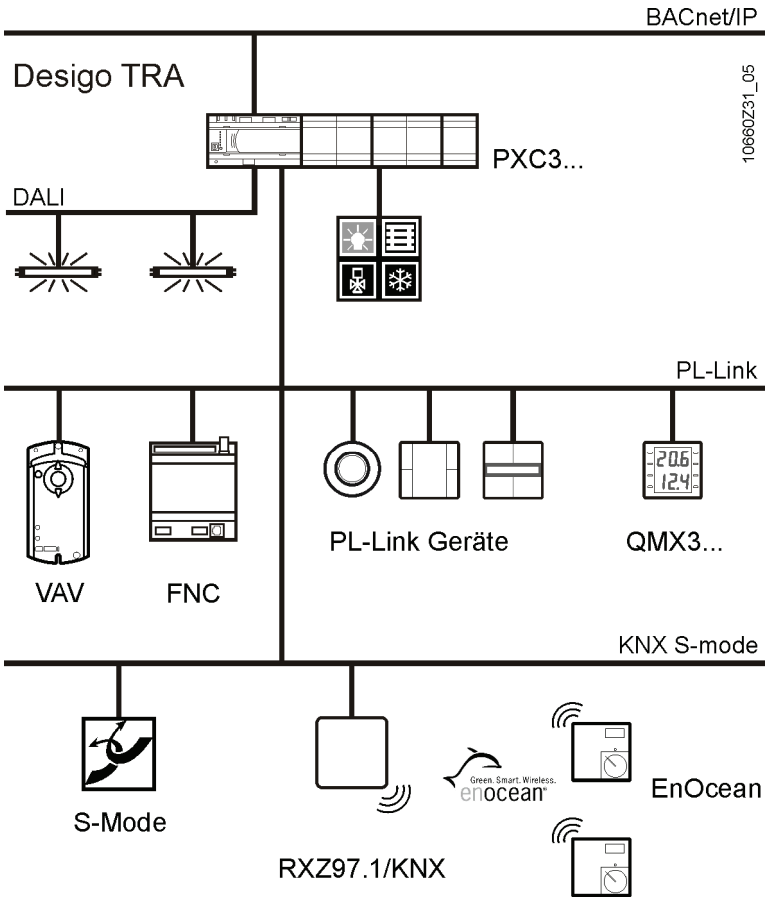
The mounting and installation guide includes all documentation in the form of text and images required fort he aforementioned target groups and intended use.
It does not include information of plant-specific mounting and wiring work. This information is available in the appropriate project documentation.

2.2 What does this document describe?

Overview

The document describes proper mounting and wiring for
– the room automation station.
– the TX-I/O modules in an installation box or panel.
– for peripheral devices connected to the TX-I/O modules.
– for peripheral devices connected via PL-Link, DALI and EnOcean.

Topology



The areas indicated above can be briefly described as follows:

Range	Brief description
Installation boxes.	The following devices are installed in the installation box: – PXC3... room automation station. – TX-I/O modules connected to the room automation station via the island bus.
Building services equipment	Connected plants and systems, including: Heating, ventilation and air conditioning plants, electrical systems, etc., as well as electrical areas (switches, buttons, lighting groups, blinds).

Connections

In general the following connections exist from and to the installation box:

- **Ethernet**
  Room automation stations as well as Desigo Insight and the primary plant level PX are connected via Ethernet cables and switches.
- **Island bus / island bus expansion:**
  A bus cable runs from the room automation station to the external I/O modules.
- **Wiring form I/O modules to field devices** (sensors, switches/buttons, control values, motors, etc).
- **PL-Link**
  A bus cable runs from the automation station to the PL-Link/KNX devices.
- **DALI**
  A bus cable runs from the automation station to DALI devices.
- **USB:**
  The room automation station includes an USB Device interface. It serves for commissioning and service. ABT and SSA can communicate with the PXC3... via this interface. Furthermore, access to other PXC3... via the network is possible. All testing and commissioning functions including download, online test etc. are available. For details see SSA (Setup & Service Assistant) Commissioning, CA111050.
- **Wireless connections:**
  A KNX gateway integrates wireless EnOcean devices (room units, sensors, buttons).

3 Important information on safety

Please comply with these notes

This section deals with general and system-specific regulations. It includes important information for your safety and the safety of the entire plant.

⚠ Safety notes

Sections flagged with the warning symbol to the left contain safety-related requirements and restrictions that must be adhered to at all times to prevent physical injury and equipment damage.

⚠. General Regulations

Please comply with the following general regulations during engineering and execution:

- Electrical and mains power ordinances for the given country.
- Other applicable, national regulations.
- Building installation regulations for the given country.
- Regulations of the facility supplying electricity.
- Diagrams, cable lists, dispositions, specifications and orders by the customer or authorized engineering office.
- Third-party regulations, e.g. by the general contractor or building owner.

3.1 System-specific regulations

Safety

The electrical safety for building automation and control systems by Siemens Building Technologies is essentially based on **safely separating low voltage from mains voltage.**

SELV, PELV

Application as per SELV or PELV pursuant to HD 384 "Electrical installation of buildings" depending on the grounding (⊥ AC24V) of the low voltage:
Ungrounded = Safety Extra-Low Voltage (SELV).
Grounded = Protection by Extra Low Voltage (PELV).

⚠. Device safety

Device-related safety is guaranteed, among others, by
– Low-voltage power supply AC 24 V per SELV or PELV
– Double insulation between mains voltage AC 230 V and SELV/PELV circuits and housing.

Comply with specific regulations for electrical wiring per the following sections.

⚠. Grounding of ⊥ (System neutral)

Observe the following points when grounding ⊥ AC 24 V (system neutral):

- Operating voltage of AC 24 V is permitted in principle for both grounded as well as non-grounded system neutral. Local regulations and customers apply accordingly.
- Grounding may be required or not allowed for functional reasons.

Recommendation on Grounding ⊥

- **AC 24 V systems are generally grounds** unless otherwise not recommended by the manufacturer.
- In order to avoid ground loops, connect systems with PELV to the ground at one location only (especially for transformers), if no other indication exists.

⚠. Mains and operating voltage

The following regulations apply to mains and operating voltage:

Item	Regulations
Operating voltage AC 24 V	It must meet requirements for SELV or PELV. Permitted deviation for nominal voltage AC 24 V on the device: -10 - + 20%.
Transformer specification AC 24 V	• Use safety insulating transformers as per EN 61558 with double insulation designed for 100% duty to supply SELV or PELV circuits.. • Power taken from the transformer should be at least 50% of nominal load for efficiency reasons (effectiveness). • Transformer nominal power should be at least 25 VA. For smaller transformers, the ratio of open circuit voltage to full load is unfavorable (> + 20%).
Operational voltage fuse AC 24 V	Transformers on the secondary side correspond to the actual load of all connected devices as per transformer sizing: – AC 24 V line (system potential) must always be fused. – We required, an additional line ⊥ (system neutral).
Mains fuse	Transformer, primary side: Installation box fuse (control circuit fuse).

⚠. Caution with regard to foreign voltages!

Any insertion or drawing of dangerous voltages to the system's low-voltage circuit, e.g. caused by improper wiring directly places people at risk can may result in the partial or complete destruction of the building automation and control system!

⚠. Measures against lightening

All wiring existing the building is at severe risk of over-voltage caused by atmospheric discharges (lightening). Overvoltages can be inductively, capacitive or galvanically into electronic systems and may cause faults or even destroy sensitive components.

This overvoltage must be diverted to the earth to limit the damage. This may be achieved with the help of gas-filled surge arrestors, varistors and diodes as well as capacitors and chokes.

Specialized companies (e.g. Siemens, Phoenix) combines these elements into protective components to provide optimum protection for various systems.

Mains filter

Spikes and high-frequency interference may occur in areas with high levels of interference. The disturbances not only impact the transformer on the primary side, but may also influence secondary connected components.

A mains filter should be attached on the primary transformer if such interference is anticipated. Mains filters should be installed as close to the network transformer as possible and grounded.

Emergency intervention of power components

Peak loads occur when switching inductive loads that may cause faults to the system. In addition, sparks may damage switching contacts. Power components must include effective protection against disturbances to prevent such faults. Inductivity (transformers, fuses, relays) are wired directly at the terminals using transzorbs, MOVs (metalloxyd varistors) or RC elements. The breakdown voltage of the transzorbs or MOVs must equate to the 1.7 to 2 times the applicable nominal voltage.

Inductive DC consumers can also be suppressed using diodes or RC elements.

The transzorbs, MOVs, diodes or RC elements must be optimally matched to the power components and mounted using short wiring.

3.2 Device-specific regulations

⚠. Field device connection

Devices using different power circuits

Devices must have the required insulation of the power circuits from each other to be able to connect them directly without additional insulation.

Interfaces for different voltage circuits

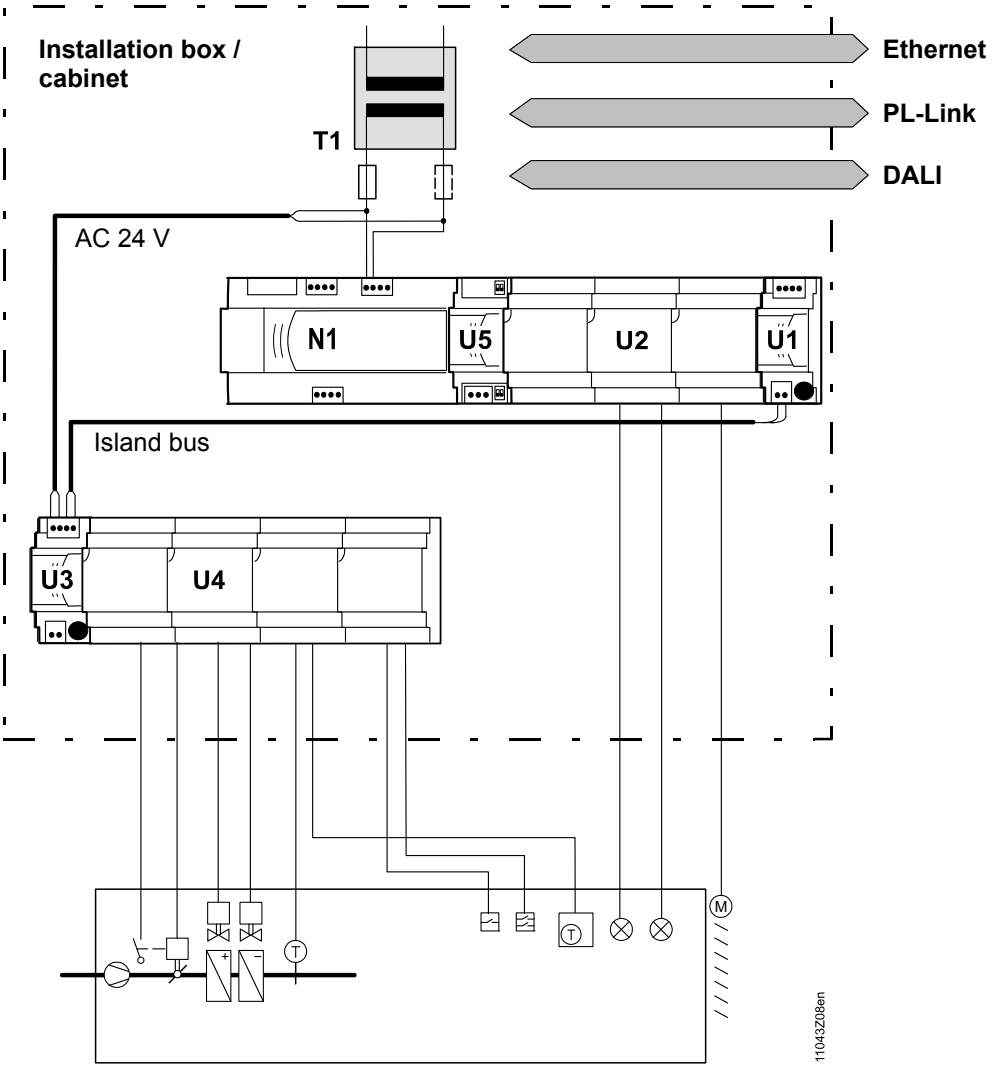
Connections via interfaces increase the risk of distributing dangerous voltage through the building. Ensure that the required insulation is available at all times and installed per applicable regulations.

PXC3... supply AC 24 V

The supply terminals of the PXC3... (terminals 7 and 8) bare a max current of 10 A, otherwise the pins get too warm.
An external T10 A fuse is compulsory

4 Devices

The illustration is a diagram of a PXC3 room automation station in an installation box / panel, the TX-I/O modules, connections to the field devices as well as bus connections (Ethernet, PL-Link, DALI)..



Key

T1	Transformer AC 230 V / AC 24 V
N1	PXC3... room automation station.
U1, U3	TXS1.EF10Bus connection modules
U2	I/O row, supplied by the PXC3...
U4	I/O row supplied by a TXS1.EF10Bus connection module
U5	TXA1.IBE Island bus expansion module (optional)

5 Installation box TRA

5.1 Installation box requirements

Please comply with these notes

Please read Sections 5.1 "Installation box requirements" and 5.2 "EMC compliant panel" in the TX-I/O engineering and installation guide [2] prior to engineering and executing the installation box.

Space requirements

Observer the following for mounting and installation.

- Installation depth
- Maintain sufficient cable distance to be able to easily snap on and remove the screw terminal blocks, even if the automation stations are mounted.
- Room automation stations can be mounted directly next to one another; a distance of ca. 2 cm is recommended, however, for facilitate access.
- Reserve sufficient free space for subsequent extensions.

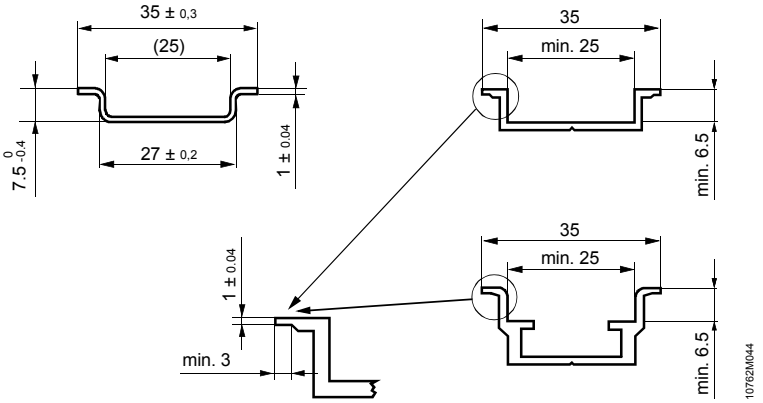
Installation mode

Standard rails

The room automation stations and TX-I/O modules are designed for installation on standard rails (prerequisite to establishing the island bus connection using TX-I/O modules).

Permissible standard rails:

- Top hat rails TH35-7.5 as per EN60715 (35 x 7.5 mm).
- Other top hat rails that meet the following conditions:
  - Material thickness exterior max. 1 mm, min. 3 mm in depth
  - Internal opening at least 25 mm.



Wall mounting

The room automation station may also be attached to a wall if used without TX-I/O modules.

5.2 Installation box layout

Requirements

The table below provides information on general installation box requirements. Check to ensure the individual requirements are met.

Bullet	Requirements	OK
Mechanical execution	Construction, stability and sealing meet applicable regulations at the plant's location.	
Ambient conditions	• Desigo TRA is designed for an ambient temperature of -5 - 50°C. PXC3...: 45°C for certain mounting positions, see below. Please make sure that the installation box is sufficiently ventilated to ensure compliance with the ambient temperature for all devices. • For devices, the permissible values as per the data in "Technical data" in the datasheet must be observed with regard to: – Humidity, vibration. – Device IP class and device protective type.	
EMC compliant installation box	The installation box corresponds to the rules described in Section 5.4.	

Mechanical dimensions

The following help to determine the required installation box dimensions:

– Data on placement in this section.
– Device dimensions in the datasheets [8].

5.3 Geometric design

5.3.1 Mounting position

TX-I/O devices can be mounted in any position:

Recommended	Permissible
• Wall, horizontal from left to right or from right to left • Wall, vertical from top to bottom or from bottom to top.	• Over head. • On a horizontal surface.
Ambient temperature -5...50 °C	**Ambient temperature -5...50 °C**

For the **PXC3...**, the following **restrictions** apply:

Recommended	With restrictions *)
• Wall, horizontal from left to right or from right to left • Wall, vertical from bottom to top.	• Over head. • On a horizontal surface. • Wall, vertical from top to bottom.
Ambient temperature -5...50 °C	**Ambient temperature -5...45 °C *)**

*) 50°C is admissible if the bus supplies use max. 2/3 of the specified load: PL-Link 105mA, DALI 85mA and island bus 400mA.

Note **You must ensure, however, that sufficient ventilation is available to maintain the permissible ambient temperature for the devices (inside the cabinet / installation box).**
Outside, the temperature should be 10 K lower.

5.3.2 Space requirements

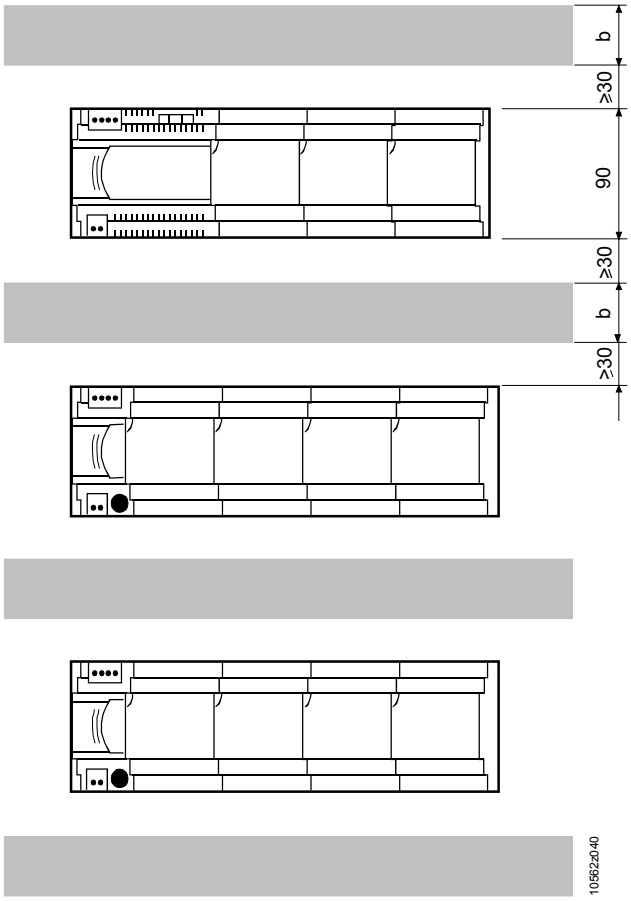
Bill of quantity

Space requirements in the installation box can be calculated as follows:

- Number of I/O modules x 64 mm.
- Number of power modules x 96 mm.
- Number of bus interface modules x 32 mm.
- DESIGO PXC3 room automation station x 162 mm.
- Transformers
- Terminal strips.

Observe free space!

All connection terminals must be connected unhindered and inspected. We recommend at least 30 mm between the modules and the cable ducts.
This results in the following distance of the standard rails/cable ducts:
90 mm (module width) + (b = cable duct width) + 2 x ≥30 mm (available space for wiring).



5.4 EMC compliant installation box

Introduction

One duty of the installation box is to reduces electromagnetic interference. The influence depends on the **internal** and/or **external** EMC disturbances of the installation box.

The internal EMC disturbance can be, for example, an inverter in the same installation box; an external disturbance a nearby RF transmitter.
The installation boxes are the reference point for shielding cables and housings. They must decouple faults and short-circuit surges.

General rules

The following generally applicable rules apply to an EMC compliant installation box:

Installation box mechanical design

- Interior walls cannot be painted if difficult EMC conditions prevail.
- Grates and rails must be conductive and may not be painted.
- Screws are attached directly on blank areas in the installation box.
- Grounding connections with doors through flat copper banks (eventually including a connection to normal protective grounds).

Device order

Strongly disruptive devices must be separated as far as possible from victim when setting up the installation box. Special attention must be placed on the connections between the two device groups:

- Use separate installation boxes for strong disturbances and victims.
- Place stronger source of disturbances outside the installation box. Do not violate safety requirements.
- Separate the device groups within the installation box with a separating plate.

Screens

- Cable screens must be installed as close as possible to the installation box insert on its metal structure and connected to the building's potential equalization.
- Screen connection terminals must be used and suitable installation space be provided to this end
  (see drawing on Page 19).

Exception

Using screens to power the TX-I/O modules: See TX-I/O engineering and installation, CM110562.

5.5 EMC compliant wiring

Wiring rules

If heavy EMC disturbance is expected in an installation box or in the building, the following wiring rules can better protect potential victims:

Installation box wiring

- In the installation box, separate unshielded lines from shielded lines at the terminal connections and cable ducts.
- Avoid cable loops.
- Plan sufficient space to correctly connect the cable screens.
- Connect cable screens to the installation box directly at the inlet to the installation box. Leave screen intact to the module.
- Integrate the installation box with the building's potential equalization.

Building wiring

Different types of cable in one cable duct.

When setting up cable ducts, separate strongly disruptive cables from victims.

Cable types

- Disruptive cable: Motor cables, energy cables.
- Possible victims: Control cables, low-voltage cables, interface cables, LAN cables, digital and analog signal cables.

Separate cables

- Both types of cables may be in the same cable duct, but should be place is separate compartments.
- If not three-sided duct with separating wall is available, the disruptive cables must be separated by at least 150 mm from the others or placed in separate ducts.
- The crossing of strongly disruptive cables should be at a right angle to potential victims.

Shielded cables

- Comply with the manufacturer's installation recommendations for the selection of shielded or unshielded cables. In general, **unshielded twisted pair cables** have sufficient EMC properties for building-technical applications (including data applications.
- Unshielded round wires can also be used for the **island bus** (wire CS, CD).
- Benefit: Unscreened cables do not need to be coupled to the surrounding ground.

Screened cable

Screening improves EMC properties. Please note the following, however:

- The grounding (common reference point), is tasked with diverting and short circuiting existing interference voltage.
- Special emphasis must be placed on the grounding concept to prevent grounding loops or differences in potential○.
- Against low-frequency interference: Ground the screen on one side only.
- Screens must be connected on both sides with the ground against high frequencies. Potential equalization must never take place via the cable screens. A separate potential equalization must be installed when missing. Alternative: hard wired earthing on one side, via a capacitor on the other side.
- The cable screens must be properly connected to the ground to achieve a solid level of screening (see below).
- Island bus extension, see: TX-I/O engineering and installation, CM110562)

Attaching cables to the installation box

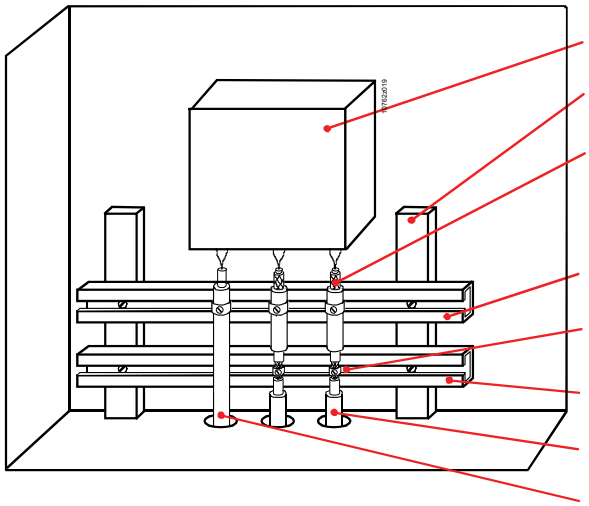
Strain releaf of cables is done on the outside of the installation box.

Attaching cables in the cabinet

Cable screens for screened wiring must be installed as close as possible to the cabinet inlet on its metal structure and connected to the building's potential equalization.

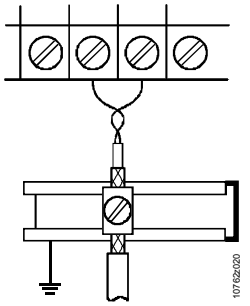
The following illustrations display the correct connections for shielded and unshielded cables to the screen and cable fastening rails.
Use only off-the-shelf screen terminal connections for trouble-free screen connections.

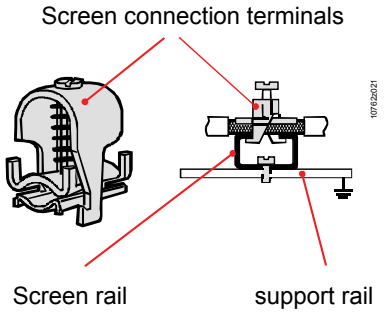
Attaching cables in the cabinet

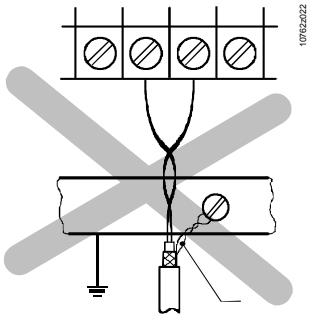


The screen rail cannot be used to relieve cable strain.

Screen connection with screen connection terminals







Avoid screen braid.

6 Wiring of field devices (without bus)

As a rule, comply with local regulations for electrical installations.
These take precedence over any notes in this document.

6.1 Power lines AC 230 V

The sizing and fusing of the power lines are oriented to overall load and local regulations.

6.2 Wiring for Triac outputs AC 24 V

The following applies for wiring to actuating devices such as valves, damper actuators or protection connected to the Triac outputs:

- Use stranded, 2 or multiple core round cables, screened (standard off-the-shelf installation cable).
- Single wires may not be used.
- Wiring may be laid together with power lines (AC 230 V).
  They must be isolated from the power lines per regulations. Isolation must meet PELV requirements.
- Wiring can not be led in the same cable as the power lines.
- See table below for maximum single cable lengths.
  However, the length must not exceed 300 m (EM interference).

Cable designation		**A**	**Ø**	**R**		**Cable length Lmax [m]** **Outgoing and return cables may each have the indicated length!**			
			□		**mA**	**125**	**250**	**375**	**500**
VDE / DIN	AWG	[mm2]	[mm]	[Ohm/km]	**VA**	**3**	**6**	**9**	**12**
LiYYP		1.5	1.382	11.91		(571.1)	285.6	190.4	142.8
	16	1.23	1.251	14.52		(468.3)	234.2	156.1	117.1
LiYYP		1	1.128	17.86		(380.7)	190.4	126.9	95.2
	18	0.96	1.106	18.60		(365.5)	182.8	121.8	91.4
LiYYP		0.75	0.977	23.81		285.6	142.8	95.2	71.4
	20	0.56	0.844	31.89		213.2	106.6	71.1	53.3
LiYYP		0.5	0.798	35.72		190.4	95.2	63.5	47.6
	22	0.34	0.658	52.53		129.5	64.7	43.2	32.4

6.3 Signal wiring

The following applies in common for signal wiring of field devices such as temperature sensors, window switches, presence detectors, dew point sensors or electrical buttons:

- Use stranded, 2 or multiple core round cables, without screen (standard off-the-shelf installation cable).
- Single wires or ribbon cables may not be used.
- Signal wiring may be laid together with power lines (AC 230 V).
  They must be isolated from the power lines per regulations. Isolation must meet PELV requirements.
- Signal wiring can *not be led in the same cable* as the power lines.
- The length must not exceed 300 m (measuring errors, EM interference).

6.4 Relay outputs

The following applies for the 230 V wiring:

- The maximum load of the relay contracts must be observed (see data sheets for the corresponding devices)
- The sizing and fusing of the power lines are oriented to overall connected load and local regulations.
- The fused electrical values must therefore be reviewed in the data sheets for the corresponding devices.
- The lines must be secured on the device with strain relief.
- Cable length: as per load and local regulations.

RXM39.1 also has a relay contract (Q14) for switching electrical heating coils (see data sheet N3836). Observe the following:

- The maximum power is 1.8 kW ohm load. Larger loads close the contact too much.
- A external fuse of max. 10 A is planned to protect circuits on the PCB of the PL-Link I/O Block.

TXM1.6RL can switch lighting groups up to 10 A. Fusing max. 16 A.
See data sheet N8177.

7 Wiring for AC 24 V and island bus

Introduction

Before starting the wiring, please comply with "Important information on safety" in Section 3 and the "Supplemental notes on safety" listed below.

Note

Detailed information on wiring for AC24V and island bus is available in the TX-I/O engineering and installation guide CM110562 [2].

7.1 Supplemental notes on safety

Safety notes

The following notes are closely related to Section 3.2 “Device-specific regulations“and must be observed accordingly.

Cabling, duct cross-section

Wire the devices in the standard manner in the cable ducts.
Recommendation: Design the duct cross-section with at least 30% in reserve.

Wiring and connection terminals

Use wiring types and diameters as per the specifications below:

Item	Specification
Cabling	Use standard stranded cable and wiring. The ends can be connected directly or strengthen with conductor sleeves or pin connectors. ⚠.**Important**: If **low-voltage wiring** runs alongside **mains voltage**, it must have the **same level of insulation** as wiring for mains voltage.
Device connection terminals	The device connection terminals are designed for wiring for: • min. 0.5 mm ∅. • max. 2 x 1.5 mm^2 or 1 x 2.5 mm^2 Connection terminals are lifting clams; the contact plate between the wire end and screw end is easy on the wiring. ⚠.**Important:** Only the **original pluggable connection terminals** may be used as the connection facility.

Tightening torque

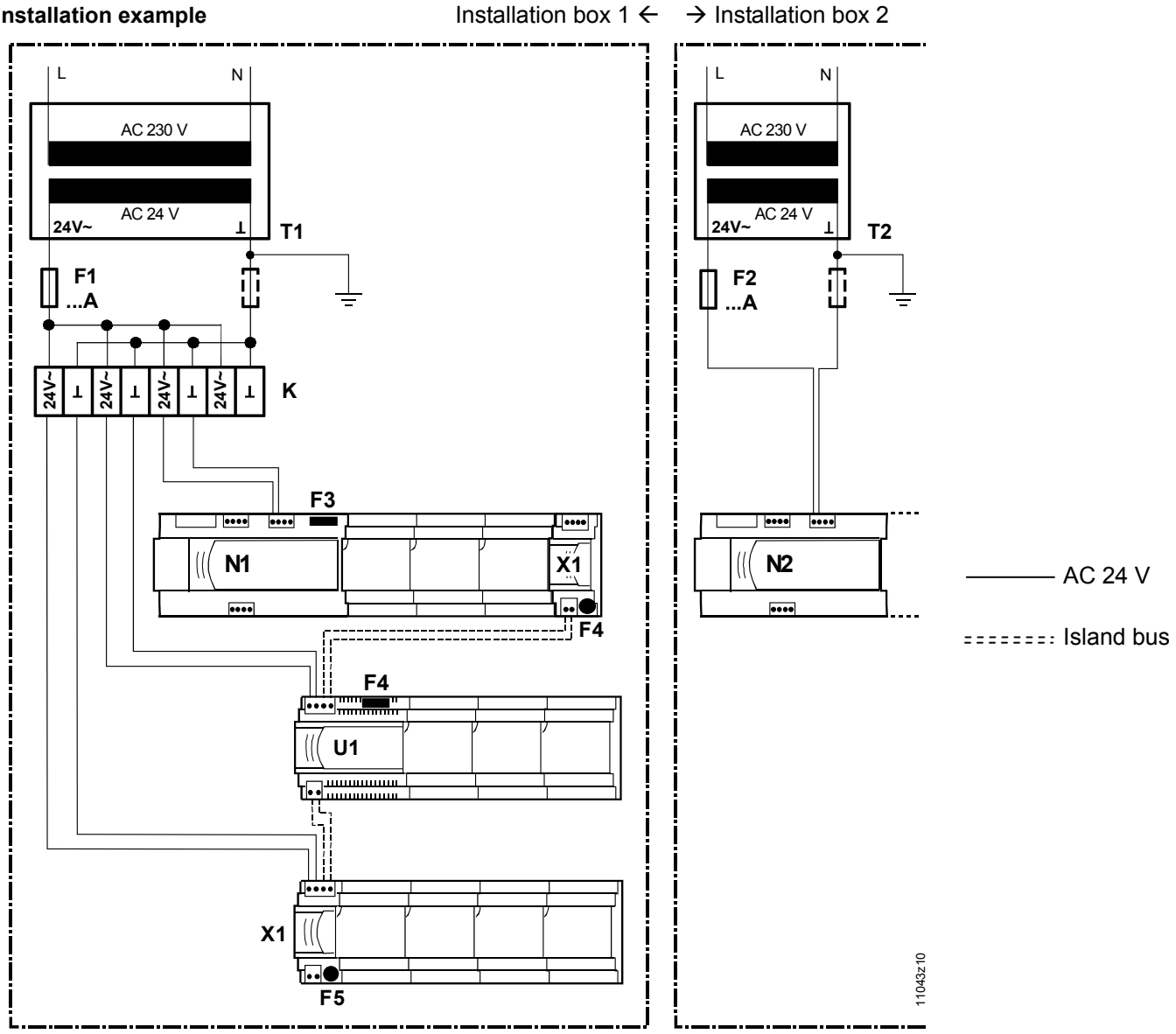
Set the torque to 0.5-0.6 Nm or 50-60 Ncm when using electrical screwdriver on the connection terminals.

7.2 Wiring for AC 24 V

This section describes the wiring between the transformer and power point(s) (Room automation station, power module, bus interface module).

The following diagram illustrates basic wiring for power lines for modular room automation stations using AC 24 V operating voltage as per PELV:

Installation example



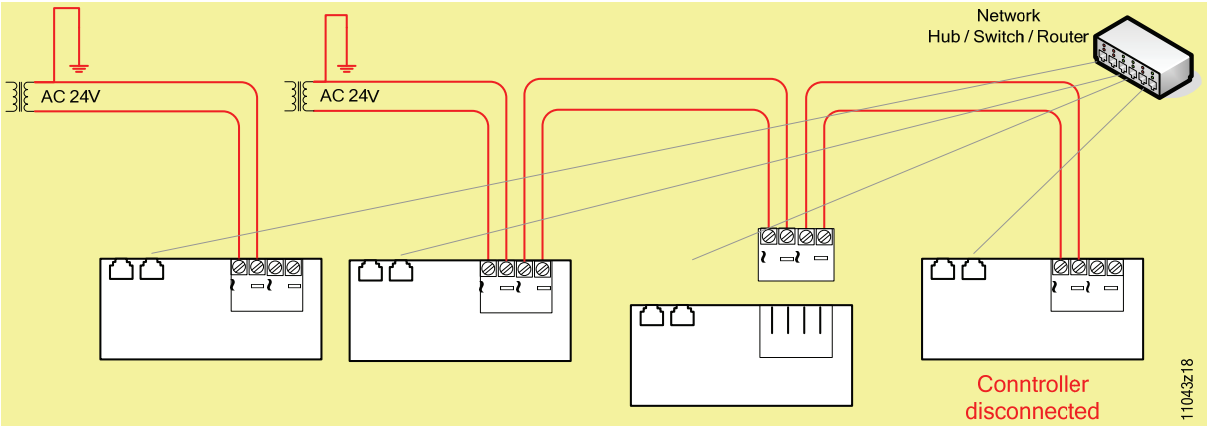
Key

T, T2	Safety transformer AC 230 V / AC 24 V as per EN 61 558.
K	Terminal block for star distribution of AC 24 V and ⊥.
N1	DESIGO PXC3 room automation station.
N2	Room automation station PXC3, with separate power AC 24 V (looped power from T1 admitted but not recommended).
U1	Power supply module TXS1.12F10
X1	Bus interface module TXS1.EF10
F1, F2	Low-voltage fuse, for max. power with AC 24 V.
F3	10 A fuse holder in the PXC3
F4	10 A fuse holder in power module.
F5	10 A fuse holder in the bus interface module.

Secure operation

Note!

- The next device has no AC 24 V power when a room automation station is removed. The connection exists only on the board, but not on the terminal block.
- The Ethernet switch is inactive when a room automation station has no AC 24 V power. The next devices, if in line topology, are disconnected from the network. **For secure operation of the system it is recommended to supply each room automation station separately with AC 24 V.**



7.3 Transformer sizing

The AC 24 V is wired in star distribution for one PXC3... room automation station. The AC24V may be looped via terminals 7 and 8 as well for multiple PXC3... . **However, 10 A must never be exceeded at AC input terminals 5 and 6.** Possible wiring lengths are half as long at the same power when wired for star distribution.

The permissible voltage drop of 0.6 V on the power wire between the transformer and the most distant power point (room automation station, power module, bus interface module) is the basis for calculations.

The engineering office is responsible for sizing transformer output.

Power consumption PXC3

Max. permissible input current AC 24 V (through terminals 5 and 6)	**Total max. 10 A (Ext. fusing compulsory)**
Base load (without loading by modules and field devices)	8 VA / 0.33 A
Island bus supply DC 24 V / max. 600 mA	30 VA / 1.25 A
PL-Link supply DC 29 V / max. 160 mA *)	12 VA / 0.50 A
*) The bus supply can be switched off manually via ABT if not used. Factory setting: "Auto detection"	
DALI supply DC 16 V / max. 128 mA	9 VA / 0.37 A
Transit power AC 24 V	
TX-IO: AC 24V / 6 A (island bus)	144 VA / 6 A
PL-Link: AC 24V / 2 A(terminals 3 and 4)	48 VA / 2 A
AC 24 V / 6 A (terminals 7 and 8, for additional AV 24 V consumers)	144 VA / 6 A (only if the sum of 10 A at terminals 5 and 6 is not exceeded)

Power consumption TX-I/O: Consumption data DC 24 V per I/O point
(values in mA, for supply sizing)

Type	TXM1.8D	TXM1.16D	TXM1.8U	TXM1.6R	TXM1.6RL	TXM1.8RB	TXM1.8T
Intrinsic consumption [1]	**25**	**25**	**35**	**20**	**25**	**25**	**10**
Digital input [2] (contact closed)	**3.5**	**2.5**	**3**				
Analog input [3] (Temp. sensors Ni, PT, T1)			**0**				
Analog input [3] (Temperature sensor NTC)			**0**				
Analog input [3] (Resistance)			**1**				
Analog input (10 V) [2]			**1**				
Digital output (relay active) [2]				**8**	**12**	**8**	
Digital output (triac active) [2] [5]							**4**
Analog output (10 V) [2]			**3**				
Unconfigured I/O point (Reserve for later configuration)	**3.5**	**2.5**	**3**	**8**	**12**	**8**	**4**

[1] Including module status LED; includes LCD and all override LEDs if applicable
[2] Including I/O status LED
[3] Included in intrinsic consumption (no I/O status LED for temperature inputs)
[5] The triacs have a switch capacity of ***AC*** 24 V, 125 / 250 mA (max 500 mA for 90 s). This power is supplied by the 24 V ~ conductor, not by the DC 24 V power supply.

Power consumption of PL-Link devices

Typically 5 mA at DC 24 V
However, check each device's data sheet.
In particular, the QMX3 room unit uses max. 12.4 mA.

Power consumption of DALI devices

Typically 2 mA at DC 16 V

Load-dependent cable lengths

The table below provides permissible loads based on cable lengths and cable cross sections. It is the distance between the transformer and the most distant supply point.

Permissible load [VA]

Cable cross-section	Cable length for AC 24 V				
	2.5 m	5.0 m	10 m	20 m	50 m
1.50 mm^2 AWG16	**200 VA**	**100 VA**	**50 VA**	**25 VA**	**10 VA**
2.50 mm^2 AWG14	**320 VA**	**160 VA**	**80 VA**	**40 VA**	**16 VA**

Notes

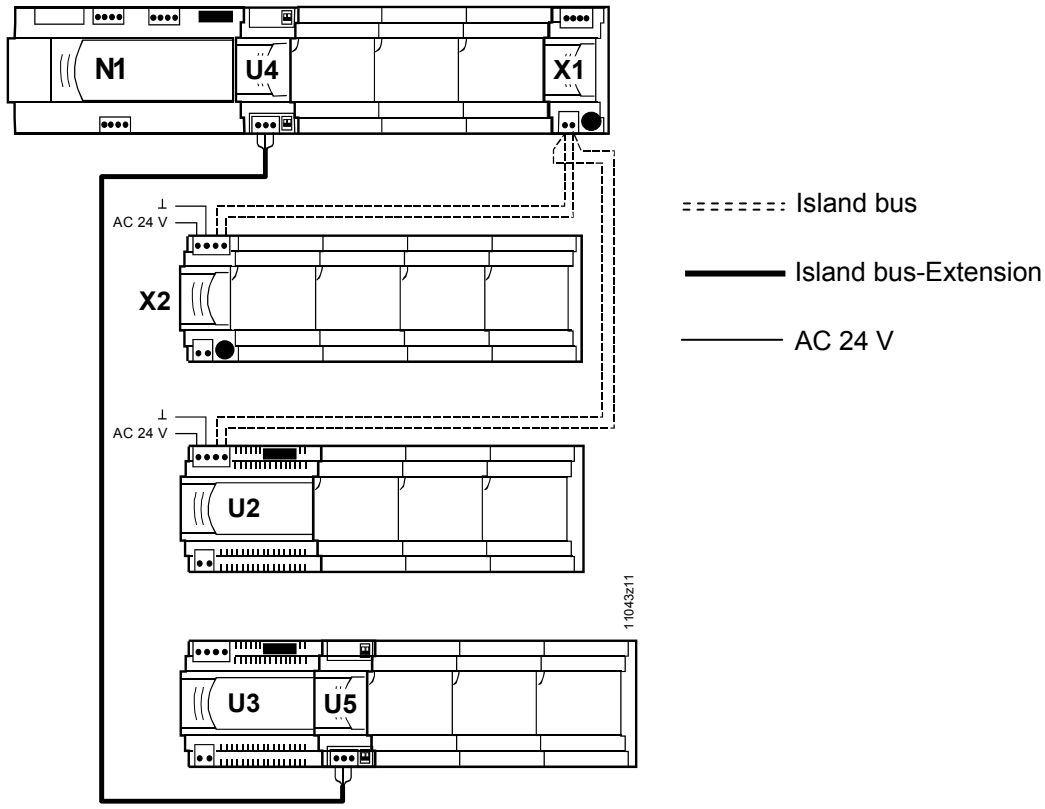
- The supply wire (AC 24 V) and return lines (⊥) can each have the indicated lengths.
- Power is added together for multiple back-to-back looped stations which reduces the cable length accordingly.
- Each supply point (room automation stations/power module/bus interface module) is either connected separately to the transformer's terminal block (star wiring) or looped via the room automation station.
- Cables **may** be wired in parallel to increase the cross section.
- **In practice, the small level of permissible voltage drop off means that the transformer must always be installed in close proximity to the consumers and that any cascading powering of room automation stations is only possible over short distances or at small outputs.**

7.4 Island bus wiring

- PXC3 room automation stations each have switchable TX-I/O DC 24 V / 600 mA module power supply. They are switched on at the factory.
- The mounting and installation guide TX-I/O engineering and installation guide 10562 [2] includes detailed information on island bus wiring and island bus extension for PXC3 room automation stations and TX-I/O modules.
- Island bus and island bus expansion are designed for indoor use in one building only.

The following diagram displays basic wiring variants of the island bus together with the room automation station:

– TX-I/O modules on the **same standard rail as the PXC3**.
– TX-I/O modules on a different standard rail, connected via an additional **bus interface modules X1, X2**.
– TX-I/O modules on a different standard rail, connected via an additional **power supply module U2**.
– TX-I/O modules in an offset installation box; connected via **island bus extension modules U4, U5**.



Key

N1	PXC3 room automation station.
X1, X2	TXS1.EF10Bus interface modules
U2, U3	TXS1.12F10Power supply modules
U4, U5	TXB1.IBE Island bus extension modules

Notes

- The **bus connection module** (X1) must be placed at the end of the TX-I/O row. Modules to the right side of the bus connection module would otherwise have no supply of AC 24 V.
- The **island bus extension modules** (U4, U5) may be anyplace in their TX-I/O row. For signal quality reasons, however, the best place is directly after the power supplying device

8 Ethernet network

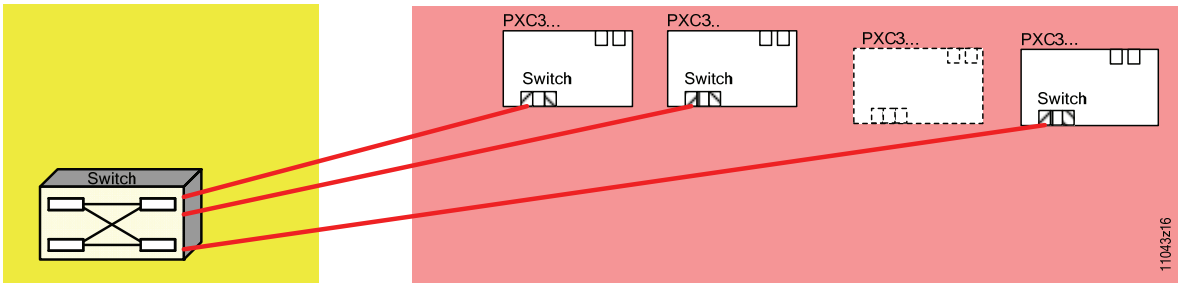
8.1 Network topologies

Topologies

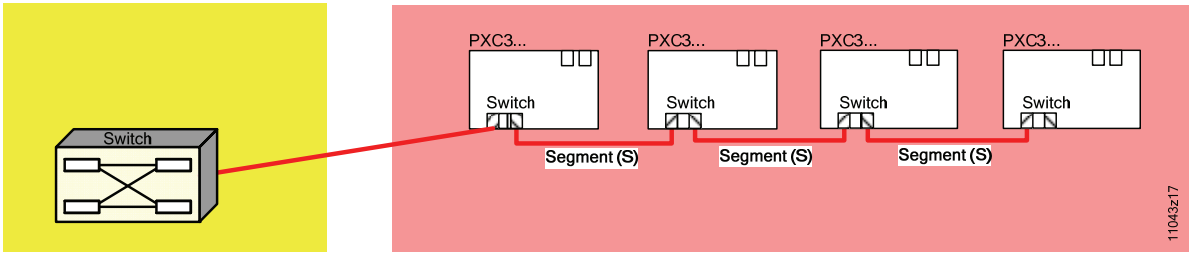
You can use the following bus topologies:

- Star topology (general).
- Line topology (for room automation).

Star topology



Line topology



Notes

- The number of room automation stations is limited to 20 for a line topology (daisy chain).

Note! Availability / reliability

- The next device has no AC 24 V power when a room automation station is removed. The connection exists only on the board, but not on the terminal block.
- The Ethernet switch is inactive when a room automation station has no AC 24 V power. The next devices, if in line topology, are disconnected from the network. For secure operation of the system it is recommended to supply each room automation station separately with AC 24 V.

8.2 Cables

PXC3 room automation stations are connected to one another via switches and Ethernet cables with RJ45 connectors.
The following conditions must be met:

Bus cable and length

- Standard Ethernet cable — min. category 5
- Shielded or unshielded
  STP (**S**hielded **T**wisted **P**air) or UTP (**U**nshielded **T**wisted **P**air).
- Length between switch and PXC3 — max. 100 m.
- Length between PXC3 devices — Max. 100 m.
- Number of devices under a line topology — max. 20.

Switch

- Standard IT product at 100 MB or 1 GB.

Reference documents

Additional information:

- Desigo Technical principles manual [3], Section 3 (overview), 16 (network view) and 18 (system limits).
- Ethernet, TCP/IP as well as BACnet on Ethernet/IP principles [6].

9 PL-Link room bus

- The PL-Link bus facilities communications from the PXC3 room automation station to a maximum 64 PL-Link / KNX bus devices for various manufacturers.
- The PL-Link bus basic version comprises one cable and two stranded bus wires.
- The PXC3 has one internal bus power supply of 160mA.
- The PXC3 also includes an AC 24 V / 2A output for PL-Link / KNX bus devices with increase power consumption that is supplied via AC 24 V rather than via the PL-Link bus.
- The PL-Link is physically based on the KNX bus (Konnex).
- In PL-Link networks area/line couplers and IP routers are not admitted.
- Interconnection of PXC3 room automation stations via the PL-Link is not admissible; the connection is done exclusively via Ethernet switches (Section 8).
- The polarity of the PL-Link bus conductors must be respected (terminals PL+ and PL–)

In most countries, specific /KNX know-how is transmitted through training centers certified by the EIBA (see www.eiba.com or www.konnex.org).

9.1 Bus power supply

A bus power supply is required for bus communications. Throttled voltage DC 29 V is used.

9.1.1 PXC3 internal PL-Link power supply

The PXC3 room automation station has an internal bus power supply of 29 V / 160 mA. The ABT recognizes if any devices are connected to the PL-Link rail (auto detection) and the PXC3 then switches the power supply on. **If an external supply is used, the internal supply must be switched off manually in the ABT** (PL-Link rail properties), as parallel operation is not permitted.

Note

Bus power and the PL-Link bus are galvanically isolated from device electronics for devices with bus power.

Parallel operation not permitted

Parallel operation of the internal PL-Link bus supply with an external bus power supply is not permitted.

The internal bus power supply must be switched off in ABT when an external bus power supply is used. Default = "Auto Detection".

9.1.2 External bus supply

An external bus power supply unit (PSU) is required when the 160mA of the PXC3 is insufficient to cover the power demand of the connected devices.

Power supply units for **160, 320** and **640 mA** available in specialty stores. The total power supply for the devices must be calculated to determine the appropriate size. Comply with the corresponding details in the datasheet.

A 640 mA power supply unit suffices for a line featuring 64 bus devices with an average power demand of 10 mA each.

Parallel operation

- In principle, parallel operation of external bus supplies is possible. However, check if the specific PSU is allowed to be operated in parallel with other PSUs. Refer to the technical specifications.
- A minimum cable distance is required between two PSU, see section 9.3.

Siemens power supply units

We recommend the following Siemens power supply units for PL-Link networks (see links below).

Ordering

- 5WG1 125-1AB01, short designation N125/**01** (with integrated throttle). Parallel operation **160 mA**
- 5WG1 125-1AB11, short designation N125/**11** (with integrated throttle). Parallel operation **320 mA**
- 5WG1 125-1AB21, short designation N125/**21** (with integrated throttle). **NO parallel operation!** **640 mA**

Data

- Operating voltage AC 120…230 V, 50…60 Hz
- Bus supply output DC 29 V (21…30 V, throttled)

Additional information

- Product and function description (inserted with each device).
- GAMMA Instabus site: http://www.buildingtechnologies.siemens.com/bt/low-voltage/EN/product-portfolio/building-management-systems/gamma-instabus-KNX/System_Products/Pages/system_products_electrical_installation.aspx
- Technical product information: https://support.automation.siemens.com/WW/llisapi.dll?func=cslib.csinfo&lang=en&objID=22342171&subtype=133300

9.2 Bus topologies

64 bus devices on one line

Up to 64 bus devices can be installed on one line (main line as well). No restrictions apply to the type mix.

Notes

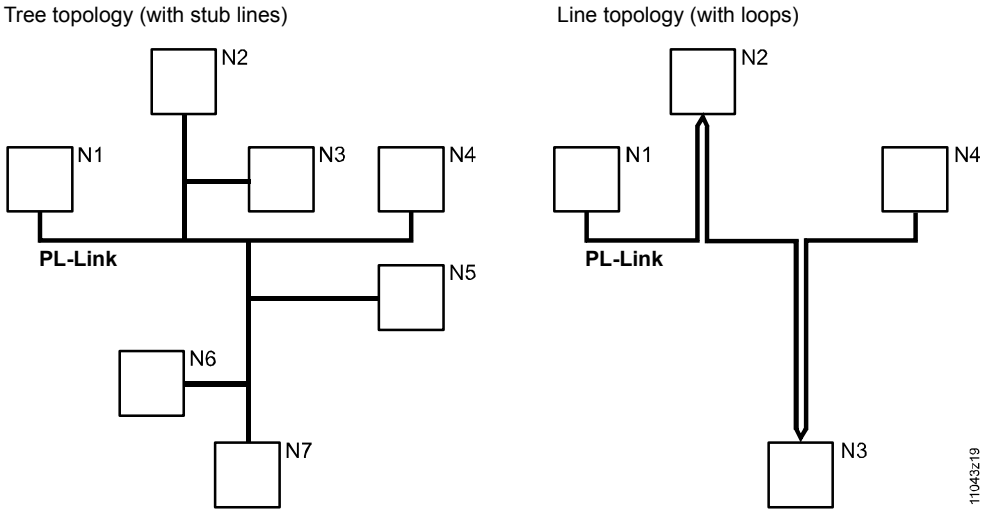
- There is no need to calculate the bus load number E for up to 64 devices.
- A maximum of 64 devices may be installed even if devices requiring less power are used.

Permissible bus topologies

Permissible bus topologies are: Tree, line, and star topologies. These topologies can be mixed as needed. However, ring topologies are not allowed.

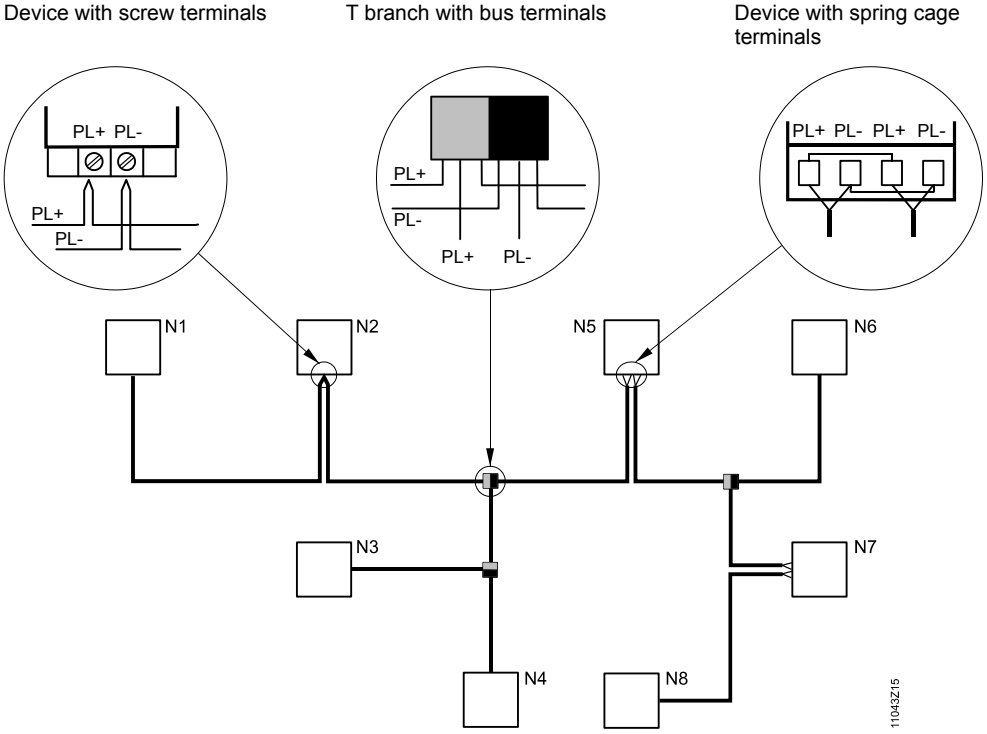
Advantage: Tree topology

The tree topology is advantageous if a large network must be created.



N1 .. N7 Bus devices

Branching and connection variants

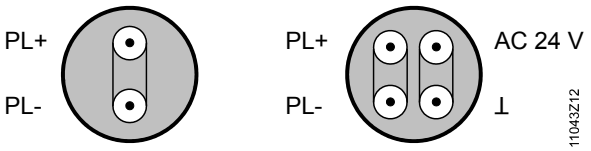


N1 .. N8 Bus devices

9.3 Cables

Bus lines

The bus lines (= wired pair) are connected via PL+ (red) and PL– (black).



Bus cable selection

Choose the bus cable as per country-specific offerings. Comply with values indicated in this data sheet under "Technical data PL-Link".

AC24V can be provided in the same (2 x 2 stands) or in a separate cable.

Recommended bus cable are available on the KNX homepage under Downloads / Support – 06 KNX Certification – 02 KNX Certified Products – Cable: http://www.knx.org/downloads-support/downloads/:

Commonly used cable sizes:

– 1 x 2 x 0.8 mm (e.g. Belden YE00819 or YE00905).
– 2 x 2 x 0.8 mm (e.g. Belden YE00820 or YE00906).

Bus cable screening

In TRA plants, bus cables **without screen** are permitted. The screens available for bus cables do not need to be connected.

If interference is expected on the PL-Link (KNX) bus, use a cable **with screen**. Connect the screen as per standard installation rules.

Bus cable: KNX specified.

The indications for distances and line lengths in a network are designed for bus cables specified by KNX.

Network with internal PXC3 power supply

Comply with the following distances for a PL-Link network with the PXC3 internal power supply:

- Distance between bus device and internal supply Max. 350 m.
- Distance between bus devices Max. 350 m.
- Total length of all lines on one line Max. 350 m.

Network with external power supply

Comply with the following distances for a PL-Link network with external bus power supply (PSU) (see Section 9.1.2):

- Distance PSU to PXC3 with switched off internal supply Min. 0 m.
- Distance bus device to next PSU Max. 350 m.
- Distance between two PSU operated in parallel Min. 200 m.
- Distance between bus devices Max. 700 m.
- Total length of all lines on one line Max.1000 m.

Polarity

Important: The bus conductors must NOT be inverted.
(terminals PL+ and PL–).

Notes

- At least one supply (internal or external) is required for each line, and max. two supplies (external) are allowed per line.
- Install the power supply unit as close to the network center as possible to achieve maximum line size.
- The distance between the bus device and the next neighboring PSU may not exceed 350 meters. As a result:
  Even if the power demand from the bus devices does not require it, two power units must be used depending on the line length.

Power supply AC 24 V

The PXC3 room automation station also includes an AC24V / 2 A / 48 VA output for PL-Link / KNX bus devices with increased power consumption that is supplied via AC 24V rather than via the PL-Link bus.

Voltage drop off between the room automation station and bus devices is maximum -7 % (-1.7 V).

The table below provides permissible loads based on cable lengths and cable cross sections.

Permissible load [VA]

	Cable length for AC 24 V				
AWG NO. Cable cross section (diameter)	**10 m**	**20 m**	**50 m**	**100 m**	**200 m**
AWG20 (*) 0.5 mm^2 (0.8mm)	**48 VA**	**30 VA**	**12 VA**	**6 VA**	**3 VA**
AWG18 (*) 0.8 mm^2 (1.0mm)	**48 VA**	**48 VA**	**20 VA**	**10 VA**	**5 VA**
AWG16 1.3 mm^2 (1.3 mm)	**48 VA**	**48 VA**	**32 VA**	**16 VA**	**8 VA**
AWG14 2.1 mm^2 (1.6mm)	**48 VA**	**48 VA**	**48 VA**	**24 VA**	**12 VA**

9.4 Commissioning notes

Observer the following commissioning aspects to commission a PL-Link network as intended.

Wiring PL-Link bus

Check the bus wiring prior to commissioning, and make sure that the bus line polarity is not interchanged (terminals PL+ and PL–).

Important: **Do <u>not</u> interchange the bus line polarity.**

Operating voltage

Check the operating voltage wiring to make sure that the devices are connected to AC 24 V or AC 230 V (as per the technical device information). Apply operating voltage only after this check.

Bus power supply

After switching on operating voltage, you must check whether bus power from the PXC3 or the PSU is available.

9.5 Technical data PL-Link

PL-Link bus	Transmission medium (bus cable)	TP (twisted pair)
	Baud rate	9.6 kbps (fixed for TP)
	Bus line polarity	PL+, PL– (not interchangeable)
	Bus terminating resistor	Not required
Communication signal	The communication signal (information) is transferred symmetrically, i.e., as voltage difference between the two bus lines (and not as a voltage difference to the earthing potential). The sign preceding the voltage between PL+ and PL– determines signal values 0 and 1.	
PL-Link bus cable	Cable type	2-wire, stranded (one wire pair)
		or 2x2-wire, stranded
		or spiral quad
	Wire diameter	Min. 0.8 mm (AWG20)
		Max. 1.0 mm (AWG18)
	Line resistance	20 … 75 Ω/km
	Specific capacity	10 …100 nF/km at 10 kHz
	Specific inductivity	450 …850 µH/km at 10 kHz
	Screens	Not required
Note	PXC3 devices do not have a connection for bus cable screens	
Bus power supply	Internal bus power from room automation station PXC3	DC 30 V, 160 mA
	160 mA from the internal bus power supply is sufficient for max. 32 PL-Link devices with 5 mA each.	
	If the consumption is more than 160 mA (more than 32 devices or more than 5 mA per device), one or two external bus power supplies are required. In this case the internal bus power supply must be disabled via ABT, as parallel operation of the internal supply with external supplies is not admissible.	
Max. number of devices	64 devices in a PL-Link network.	

10 DALI network

- The DALI network allows the PXC3 room automation station to a maximum 64 DALI operational devices.
- The DALI network comprises one cable and two stranded bus wires. The mains power may also be available in the same cable (L, N, PE).
- The PXC3 possesses a DALI bus supply of 128mA to power up to 64 DALI operational devices.

For basic and planning know-how see the DALI manual: http://www.dali-ag.org/c/manual_gb.pdf.

10.1 Bus power supply

Introduction

A bus power supply is required for bus communications.

Power consumption PXC3

PXC3 room automation stations each have switchable (via the ABT) bus supply of 16 V / 128 mA. They are switched on at the factory.

Notes

- Parallel switching with an external power supply is **not** permitted.
- An external power supply cannot be connected if the internal power supply is switched off.
- Power consumption of all operational devices on the DALI circuit may not exceed 128 mA (64 x 2 mA).
- Bus power and the DALI bus must be galvanically isolated from device electronics for devices with bus power.

10.2 Bus topologies

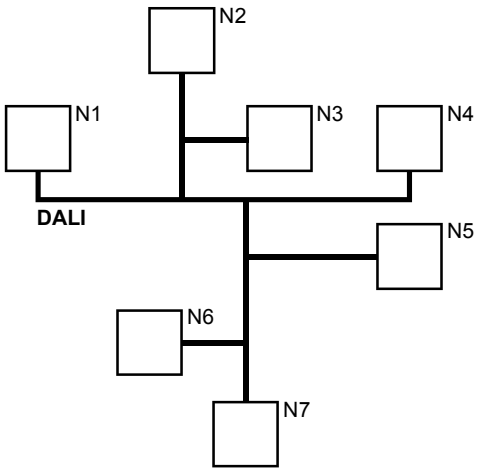
64 operational devices in a circuit

Up to 64 DALI operational devices may be installed on one DALI circuit. No restrictions apply to the type mix.

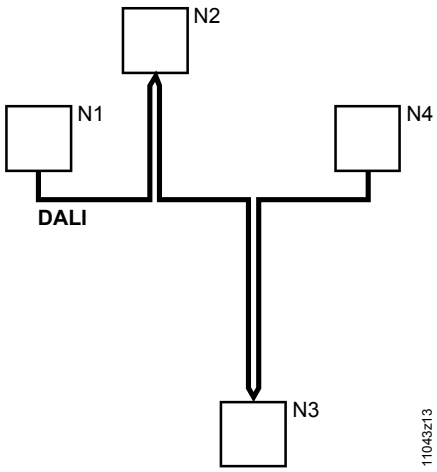
Permissible bus topologies

Permissible bus topologies are: Tree, line, and star topologies. These topologies can be mixed as needed. However, ring topologies are not allowed.

Tree topology (with stub lines)



Line topology (with loops)



N1 .. N7 Operational devices

10.3 Cables

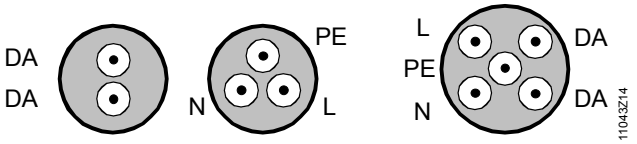
Bus lines

The bus lines (= wired pair) are connected via DALI (DA).
Observe polarity.

Bus cable selection

Use standard off-the-shelf installation materials to wiring mains power. You must observe the values indicated in this data sheet under "Technical data DALI".

AC24V can be provided in the same (2 + 3 stands) or in a separate cable (5 wire).



Commonly used cable sizes (as per DIN VDE 0100/T520/Section 6):

– NYM 5 x 1.5 mm^2
– NYM 7 x 1.5 mm^2
– NYM 2 x 1.5 mm^2 und 3 x 1.5 mm^2
– NYM 2 x 1.5 mm^2 und 5 x 1.5 mm^2

A 1.5 mm^2 cable corresponds to a AWG16 cable.

Distances

The overall length is 300 meters for a wiring cross-section of at least 1.5 mm^2.

Note:

The permissible voltage drop off over the DALI line and the terminals is a maximum of 2 V. The voltage drop off over the DALI line is typically 90% of 2V (1.8V) and via the terminals 10% of 2V (0.2V).

⚠. Regulations

Must comply with low-voltage installation regulations since the DALI signal is not SELV.

Faulty wiring

NO protection against miswiring with AC 24 V or AC 230 V:
Applying a voltage between DA+ / DA+ or between DA– / DA– will destroy the DALI PCB!
This is particularly the case when the AC 24 V supply plug is connected to the DALI socket.

10.4 Technical data DALI

DALI bus	Transmission medium (bus cable)		TP (twisted pair)
	Baud rate		1.2 kbps
	Bus line polarity		DA, DA (interchangeable)
	Bus terminating resistor		Not required
Communication signal	The communication signal (information) is transferred symmetrically, i.e., as voltage difference between the two bus lines (and not as a voltage difference to the earthing potential). The sign preceding the voltage between DA+ and DA– determines signal values 0 and 1.		
DALI bus cable	Cable type		2-wire, stranded (one wire pair)
		or	5-wire, stranded
		or	7-wire, stranded
	Wiring cross section		Min. 1.5 mm^2 (AWG16).
	Distance (sum of all bus sections)		Max. 300 m
	Screens		Not required
Note	PXC3… devices do not have a connection for bus cable screens.		
Bus power supply	Bus power through the PXC3… room automation station		DC 16 V, 128 mA. (for max. 64 DALI devices)

11 EnOcean RF networks

11.1 Technology

(This section is based on the document "EnOcean Range planning" by Engineer Armin Anders, EnOcean LLC).

The patented EnOcean RF technology creates a surprisingly far-reaching signal with remarkably little energy. So that devices can be operated trouble-free without solar cells, Piezo elements or thermocouples.

The patented EnOcean RF technology creates a surprisingly far-reaching signal with remarkably little energy. So that devices can be operated trouble-free without solar cells (for room temperature sensors) or Piezo elements (switches/buttons).

At just 50 µWs, a standard EnOcean RF modules can transmit a signal over a distance of 300 meters (in a free field). The secret is the signal duration is just one one thousandth of a second and triggers, executes and concludes the entire process.

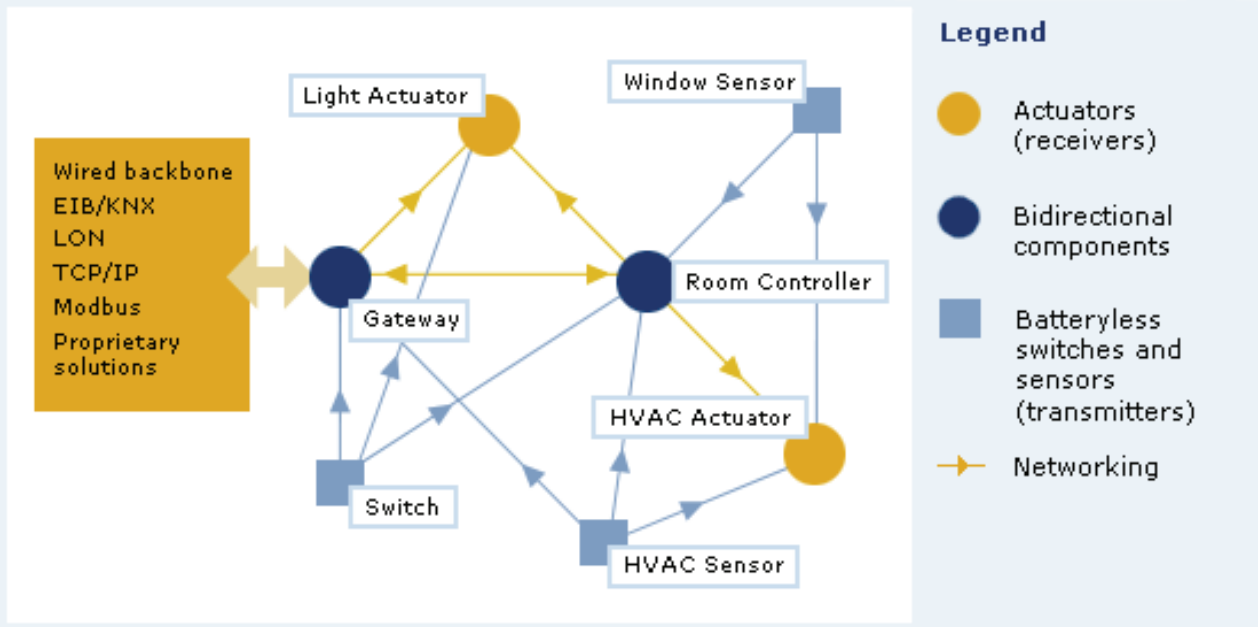


Figure: EnOcean technology uses

Summary of EnOcean RF standards (http://www.enocean-alliance.org/en/enocean_standard/)

High reliability

- License-free frequency ranges 868 MHz or 315MHz at 1% duty cycle (comply with local law/releases).
- Multiple telegram transmission with checksum.
- Short telegrams (ca. 1ms) results in a low probability of collisions.
- High range: 30 meters in buildings & 300 meters unhindered.
- Repeater available for extensions.
- Uni and bidirectional communications.

Low energy demand.

- High data transmission rate of 125 kbps.
- Low "data overhead".
- ASK modulation.

Interoperability

- RF protocol is defined and integrated in the modules.
- Sensor profiles are established and followed by users.
- Unique transmission ID (32 bit).

Coexistence with other RF systems

- No interference with DECT, WLAN, PMR systems, etc.
- System design verified in an industrial environment.

Specially suited for

- Renovation projects (old buildings, museums, churches, historical buildings, etc.).
- Rooms where wall reworking is difficult or even impossible (sandstone, glass, metal)
- Spaces requiring adjustable room division (open plan offices, museums, TV studios)
- Rooms with flexible furnishing or frequently changing decor
- System extensions

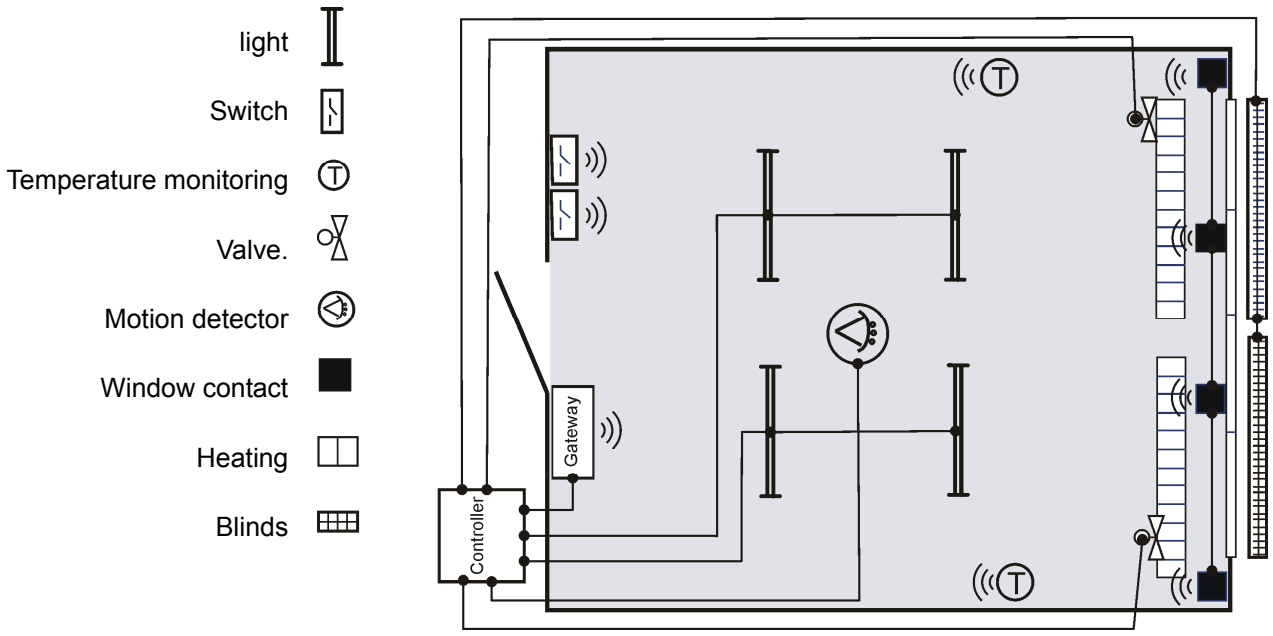
Use

Switches, sensors and actuators in building technology.

Wireless range in building is ca. 30 m.

For operation with a control unit, the connection to the gateway must first be set up. See data sheet N1661 (Gateway EnOcean/LonWorks) or N1662 (Gateway EnOcean/KNX).

Typical application
(example with additional third-party components)



Function

Data telegrams from EnOcean devices are received by the receiver (e.g. EnOcean / KNX Gateway) and forwarded as communications objects to the control unit.

This type of cooperation requires that the receiver "trained" the sender. See data sheet N1662 (Gateway EnOcean/KNX).

Current room device data are sent only every ca. 15 minutes to consume as little energy as possible. However, this signal, a so-called presence signal, is always

sent. Moreover, some events are sent with a ca. 2-minute delay or immediately. For details, see the technical data "Frequency of transmission".

The room device stops transmitting if the energy store is not charged sufficiently and/or the battery is empty.

100% functionality cannot be guaranteed under all circumstances. There are simply too many possible sources of interference, both legal and illegal, impacting range tremendously. This includes radio applications using the same frequency for transmission, e.g. other control systems with wireless connection. In addition, reflection based on room design or interior décor impacts signal quality and transmission security.

Additional information

Detailed information is available on the EnOcean homepage at:
www.enocean.com/de
The EnOcean Alliance homepage includes a list of all manufacturers offering compatible devices: www.enocean-alliance.org/de/

11.2 Lighting conditions at mounting location

This section refers to room units equipped with solar cells. The data provided below is based on QAX9x.4 room units.

For guaranteed operation (without battery), at least 200 Lux illuminance must be present for at least 3 to 4 hours daily. Avoid direct exposure to the sun, as this results in fault temperature readings. Avoid also shading by furniture as well as mounting in wall recesses without sufficient lighting.

Startup time at empty energy store:	Approx. 1 min. at 400 lx
Illumination time required to charge the empty energy store for 14 hours operation in total darkness:	Approx. 6 h at 400 lx 1), 2)
Illumination time to recharge a working energy store for 14 hours operation in total darkness:	Approx. 2 h at 200 lx 1), 2)
Maximum operating time at 100% charge and total darkness:	Approx. 4 days

1) Sending a radio signal ca. every 15 minutes (average).
2) Typical value depending on prior charging of energy cell.

As brightness is hard to evaluate, we recommend control measurements using a device to measure illuminance.

11.2.1 Definition: Illuminance

Brightness refers to how the human eye perceives the intensity of a light source. Brightness is measured in Lux [lx]. The human eye can perceive various light sources with the same brightness. Depending on the technology, solar cells have varying degrees of efficiency for daylight and artificial light. Fluorescent lights require at least 30% greater brightness to generate the same level of charging as daylight.

The value of the product light (Lux) and duration (h) are referred to as Lux h.

The amount of available daylight in the winter is minimal. Winter must be used for calculations if the intent is to guarantee functionality. Of further note is that illuminance differs on horizontal versus vertical surfaces. As a matter of principle, horizontal surfaces are better then vertical, of course with the exception of roofs.

11.2.2 Minimum room conditions

The following minimum conditions must be guaranteed for the mounting location of STM solar cells:

- Check the STM initialization parameters as described in the user's guide.
- Check light sources (daylight or artificial light). Assume a worst case involving fluorescent lamps if the light source cannot be clearly defined.
- Define minimum brightness and duration of illuminance required to ensure operation.
- Check lighting conditions on the planned mounting location for the module assuming the least favorable conditions (e.g. in winter).

Note

The energy cell drains too mush if the average illuminance drops below the defined, indicated values and transmission ceases. Transmissions resumes automatically as soon as the energy cell is sufficiently charged.

The list provides typical illuminance values. Please use a Lux meter to measure actual values.
A satisfactory Luxmeter is available as of EUR 30.

Building type	Room type	Typical brightness
Apartments	Normally	100 - 500 lx
Schools	Hallway	100 - 300 lx.
	Class rooms in general	300 - 750 lx.
	Reading rooms, labs	500 - 1500 lx.
Offices	PC rooms, working on PCs	200 - 500 lx.
	Meeting rooms	300 - 700 lx.
	Cafeteria	150 - 300 lx.
	Hallways	50 - 100 lx.
	Reception area	300 - 700 lx.
	Bathrooms	100 - 300 lx.
production	Manufacturing halls	500 - 1500 lx.
	Development, office	300 - 750 lx.
	Design CAD	500 - 1500 lx.
	Labs and inspections	750 - 1500 lx.
	Product packaging	150 - 500 lx.

	Storage	100 - 300 lx.
Hospitals	Visitor rooms	300 - 500 lx.
	First aide, surgery	500 - 1500 lx.
	Patient rooms	100 - 300 lx.
	Pharmacies	500 - 1000 lx.
	Laundry rooms	150 - 300 lx.
Hotels	Reception area	200 - 500 lx.
	Reception areas	100 - 300 lx.
	Restaurant	150 - 300 lx.
	Bathrooms	100 - 300 lx.
	Bars	50 - 150 lx.
	Hallways	50 - 100 lx.
	Stairwells	50 - 150 lx.
Business	Sales room	300 - 1000 lx.
	Showroom	500 - 1500 lx.
	Packaging area	200 - 300 lx.
	Break room	300 - 500 lx.
	Conference room	300 - 700 lx.
Showroom	Both	300 - 500 lx.
Sports facility	Interior	200 - 500 lx.

11.2.3 Notes on mounting location of room units

- Select the best compromise between Illuminance, ventilation locations and aesthetic requirements.
- Where possible, install room units opposite windows with the longest daylight exposure.
- Avoid recesses without sufficient daylight.
- With regard to future room use: Select a mounting location where the room unit is not shaded by users (e.g. by moving around furniture).

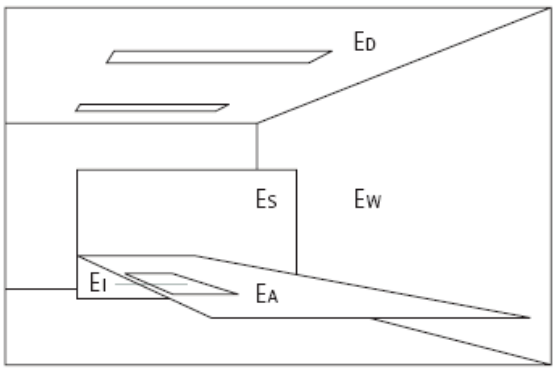


Fig.: Examples for brightness on various locations in a typical office (desk EA = 500 lx)
Whether illuminance on the wall is actually 200 lx, depends in large measure on local conditions. We recommend conducting reference measurements using a luxmeter. A device with battery backup can be used is illuminance is insufficient (see Section 11.3).

11.2.4 Prior to commissioning

Solar energy cells must be charged prior to commissioning (especially after storage for long periods in darkness prior to initial installation). This occurs automatically as soon as the solar cell is exposed to light.

The device is fully operational after 3 to 4 days if the initial charge is not enough.

The energy is now sufficient to ensure full functionality even after darkness (even at night or on weekends for up to 90 hours).

11.3 Battery operation

This section refers to room units equipped with solar cells.

Normally, ambient light suffices to charge the energy store required to operate the room device. If, however, lighting conditions at the mounting location are insufficient to meet guide values provided in Section 11.2 "Lighting conditions at mounting location", insert a battery in the battery holder. This ensures device operation even under unfavorable lighting conditions.

Use a lithium button cell battery (type CR2032).
It is widely available in electrical supply shops.
A battery can have a typical battery life of up to 5 years.
The battery will be emptied sooner if the device is operated in total darkness and radio telegrams are transmitted frequently.

Battery-supported operation is neither necessary nor recommended if there is sufficient light!

11.4 RF link properties

General information on "radio signals"

In Europe, room devices use frequency 868.3 MHz and 315 Mhz reserved for this purpose. This frequency may be used for various applications (ISM) with some limitations.

If radio signals on this frequency overlap and interfere, data transmission from a room device to a receiver module may temporarily be impaired. The distance of sender and receiver to various interference sources (e.g. audio/video systems, computer) should at least be 50 cm.

Caution!

Check sensitive medical devices using this frequency range in a case-by-case basis.

Used together with third-party receivers

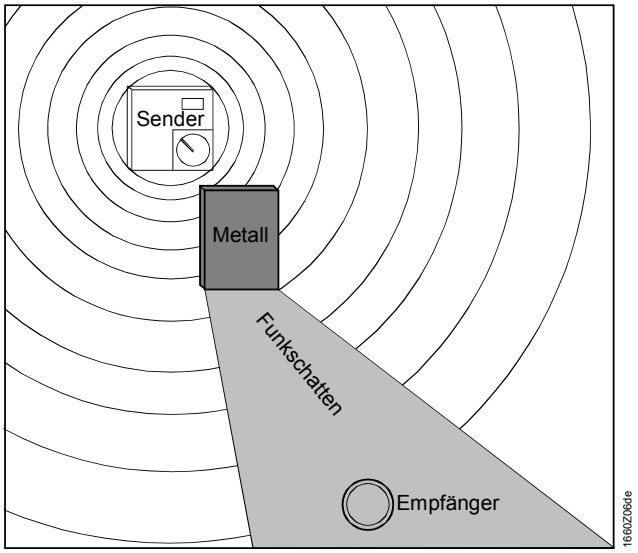
For detailed information, see the description of the radio signal modules available for download at: http://www.enocean-alliance.org/de/home.

11.4.1 RF signals

Radio signal range

A radio signal's strength decreases with distance as it is sent in all directions. In addition, other factors influence the radio signal strength.

Below are a few examples of interference and attenuating impact of different materials.

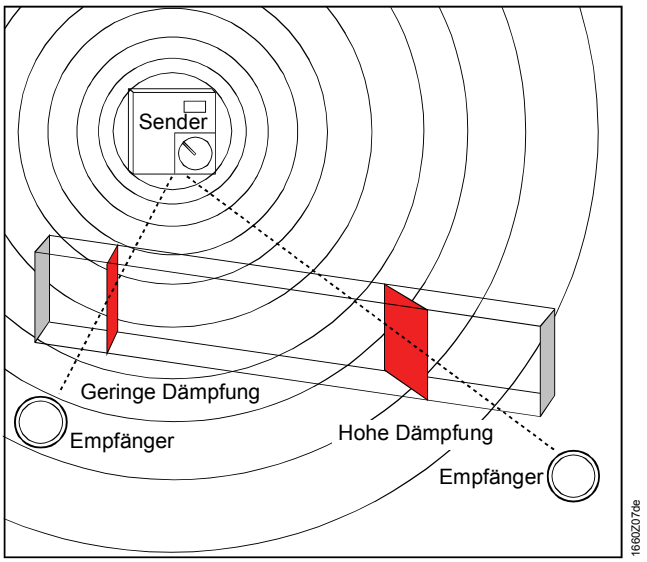


Material:	Passage of radio signals
Wood, gypsum, uncoated glass	90...100 %
Brick, pressboards	65...95 %
Reinforced concrete	10...90 %
Metal, aluminum lamination	0...10 %

Avoid under all circumstances to **metallically screen** a room device.

Building materials as well as wall angles in particular influence the radio signal range with the radio link. The greater the angle at which electromagnetic waves hit a wall, the greater signal attenuation.

As a result, avoid flat angles and wall niches.



Examples:	Radio signal range	Passage
Visual contact:		
In hallways	Up to 30 m	
In halls	Up to 100 m	
RIGIPS walls, dry wood	Ca. 27 m up to 30 m	Max. 5 walls
Brick walls, aerated concrete	Ca. 19 m	Max. 3 walls
Reinforced concrete walls	Ca. 10 m	Max. 1 wall
Fire protection walls, elevator shafts, stairwells, supply areas	The radio signal is isolated	

11.5 Planning RF networks

11.5.1 RF signal range

Send RF signals are electromagnetic waves, the field strength at the receiver decreases as the distance to the transmitter increases, in other words, the RF rang e is limited. Any materials in the transmission field reduces the range accordingly. RF waves do penetrate walls, but dampen the strength versus pure line of sight.

Reduction in range from walls versus a free field of view:

Material	**Reduction in range versus a free field of view**
Wood, gypsum, uncoated glass, without metal	0...10%
Brick, pressboards	5...35%
Reinforced cement	10...90%
Metal, aluminum lamination	see Section 11.5.2

The **geometric shape of the room** determines the RF range, since transmission is not in the form of rays, but rather requires a certain room volume (ellipsoid with sender Tx and receiver Rx in both focal points). At 30 meter in range, the ellipsoid center diameter is theoretically around 10 meters (868 MHz). Narrow hallways with large walls are unfavorable.

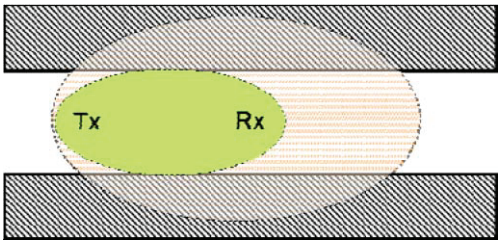


Fig: Narrow hallways with large walls.

The **antenna setup** and the **distance from ceilings, floors and walls** plays an important role. Internal antennas typically have better RF properties versus flush-mount receivers. People and objects in the room also reduce range. The generally standard range of "30 meters in buildings" should be viewed in a differential manner dues to the numerous influences. Planning for reserves in the range is necessary to achieve a reliable function of the RF system, even under unfavorable conditions.

Robust and reliable installation in buildings is achieved by ensuring sufficient range reserves.

Practical hints

- **> 30 meter** for very good conditions: Large free space, optimum antenna installation and placement.
- **Planning security** with furniture and people in the room, through up to 5 gypsum drywall or 2 brick/aerated concrete:
  - **> 20 meters** for transmitters and receivers with solid antenna execution and positioning.
  - **> 10 meters** for received installed in the room wall or corner. Or small receives with internal antennas. Also together with switches on or wire antenna near metal. Or narrow hallway.
- Vertical through 1-2 room corners depending on fixtures and antenna execution.
- Learning by EnOcean devices can greatly increase availability. A receiver can work with multiple, received signals.

11.5.2 RF signal shielding

Metal surfaces reflect electromagnetic waves, e.g. metal partitions and metal ceilings, massive steel reinforcement in the concrete walls and metal foils from insulation. Creating RF shading in a "silent zone". Individual, thin metal strips have little impact, for example, strips in a gypsum drywall.

Metal surfaces

Mounting a transmitter directly on a metal surface (e.g. panel doors, steel door frames) prevent the free transmission of the RF signal. This may impact RF connection or even cause a loss of connection. Functions are only possible as an exception for a device mounted in this manner and cannot be guaranteed accordingly.

Metal partitions

RF technology does work with metal room partitions. The signals are reflects: Metal and concrete walls reflect RF waves. RF waves penetrate to neighboring hallways or rooms through opening, e.g. a wood door or glass partition. The range can be significantly reduced based on the specific local conditions. An additional repeater in the right place is an easy way to provide and alternative RF path.
An EnOcean RF signal can be amplified at most two times by a repeater.

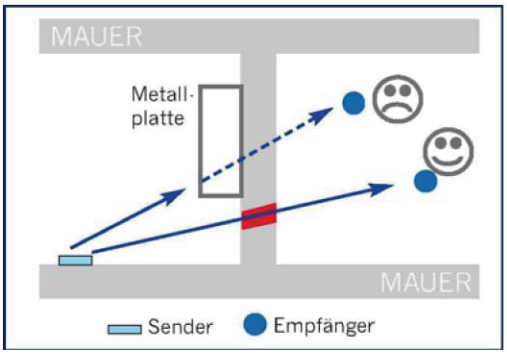
Factors reducing range

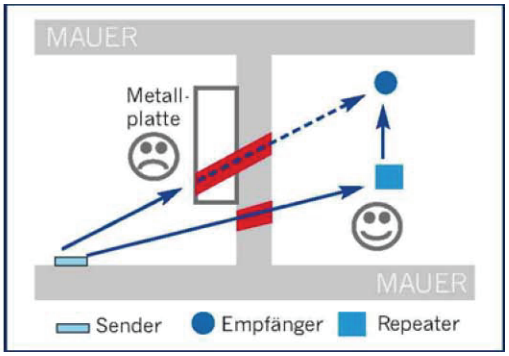
- Metal partitions or hallow walls with insulation on metal foil.
- Suspending ceilings with panels made of metal or carbon fibers.
- Steel furniture or glass with metal coating.
- Mounting the switch on a metal wall (typically results in a loss of 30% in range).
- User of metal switch frames (typically results in a loss of 30% in range).

Fire protection walls, elevator shafts, stairwells and supply areas should be considered shielding.

Solution

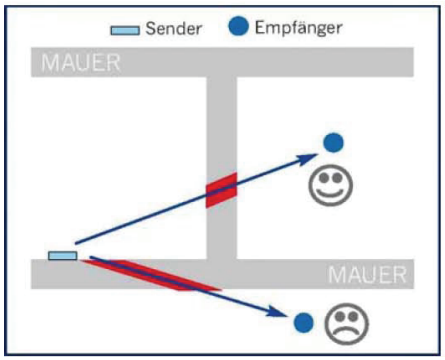
You can eliminate shielding by repositioning the transmitter and/or receiver antenna from the silent zone or using a repeater.

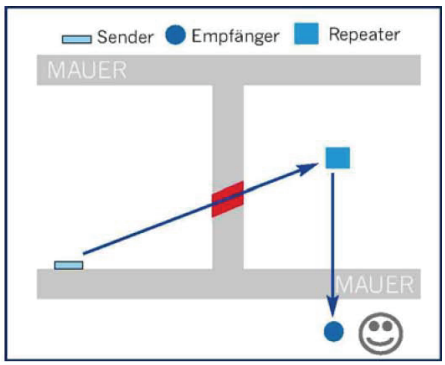




11.5.3 Penetration angle

The angle at which a transmitted signal hits the wall plays an important role. The effective wall strength and thus the dampening of the signal depends on the angle. The signals should run vertical to the walls as much as possible. Avoid wall recesses as much as possible.



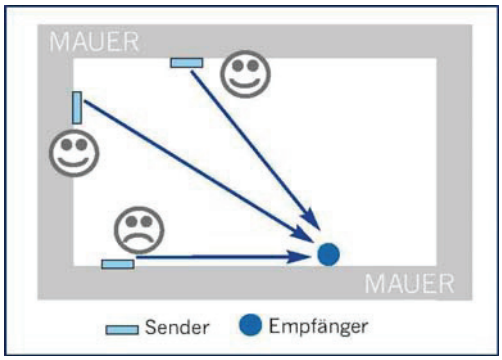


Solution

Eliminate excessively flat penetration angles by repositioning the transmitter and/or receiver antenna or use a repeater.

11.5.4 Mounting the antenna

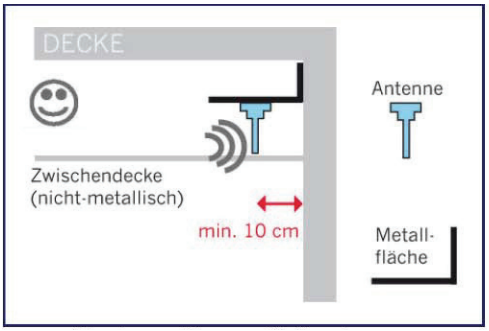
Do not mount the receiver antenna or a receiver with internal antenna on the same wall as the transmitter. RF waves are subject to disruptive refraction or reflection near walls. It is better to mount the receiver on the next or opposite wall. The antenna for devices with featuring external antennas should be mounted in a centralized location in the room. Where possible, the antenna should be at least 10 cm from corners or cement ceilings.



Tip Avoid RF transmission along wall surfaces (e.g. in a long hallway as well).

The ideal mounting location of the receiver's antenna is a central location in the room. "Magnetic foot antenna" (e.g. Hirschmann MCA 1890 MH) must attach to a large a metal surface as possible to provide a sufficient counter polarity. For example, mounting the antenna on a ventilation duct. Conversely, a "patch antenna" (surface antenna, e.g. HAMA MiniPlanar 38499) must be mounted in a non-metal ceiling or drywall, for example, in a cavity wall socket of the right size (see image below). A patch antenna cannot normally be mounted directly in cement or in direct proximity to metal. One exception is the "metal patch antenna MCA 1890MP“ by the Hirschmann company. The flat antenna can be attached discretely

and directly to a metal ceiling. For additional details on selected suitable plugs, please refer to the application note "AN103 External Antennas" by EnOcean.



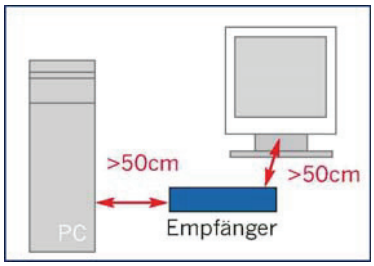
Mounting magnetic foot antenna Mounting patch antenna

Tip Then laying the antenna cable it is important not to bend the cable, causing irreparable damage (reduction in performance caused by a change to wave resistance).

A "active antenna" is a RF receiver with integrated antenna. It communicates with an actuator unit, for example, via a simply RS485 cable (RS485 Gateway). So that no shielded antenna is required that suffers from reduced performance as the length increases and that can be bent during installation.

11.5.5 Distances from receive to other sources of interference

EnOcean **transmitters** can be placed next to any transmitter without a problem. Conversely, the distance from the EnOcean **receiver** to other transmitters (e.g. GSM / DECT / Wireless LAN) and high frequency sources of interference (computer, audio and video systems) must be at least 50 cm.



The distance of the EnOcean receiver to other high frequency transmitters should be at least 50 cm.

The transmitter position is non-critical.

11.5.6 Repeaters

Repeaters (i.e. amplifiers) can help overcome problems with reception quality. The EnOcean repeater requires no configuring (e.g. self learning). Simply connect to the supply voltage to commission. The Sections on "Shielding" and "Penetration" include illustration on possible deployment.

Tip Post-installation of repeaters should be considered (electrical connection) during planning for unfavorable situations. Too many repeaters is counter-productive (higher costs, collision of telegrams).

EnOcean repeaters cannot be cascaded in their "1-level" basic function, previously repeated telegrams will not be repeated again. Repeaters switchable to 2-level function do allow for cascading via two repeaters. But it should only be used under exceptional building-technical cases.

11.5.7 Field strength measuring equipment

Off-the-shelf field strength measures devices that easily find the best mounting locations for transmitter and receiver. Faulty connection from previously installed devices can also be reviewed. The RF telegrams and disruptive RF signals are displayed in the relevant frequency range.

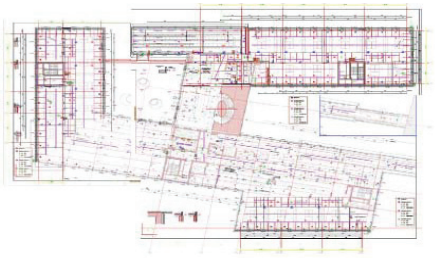
Additional information available at: http://www.enocean-alliance.org/de/home.

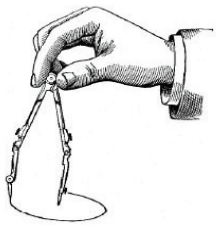
11.6 Range planning

RF range is typically limited by fire protection walls that are considered shielding. Within fire protection areas, light walls or glass partitions with solid RF properties are often used. Avoid metal reinforcement or metalized glass!.

The following diagrams illustrate how to implement a reliable RF plan in three steps.

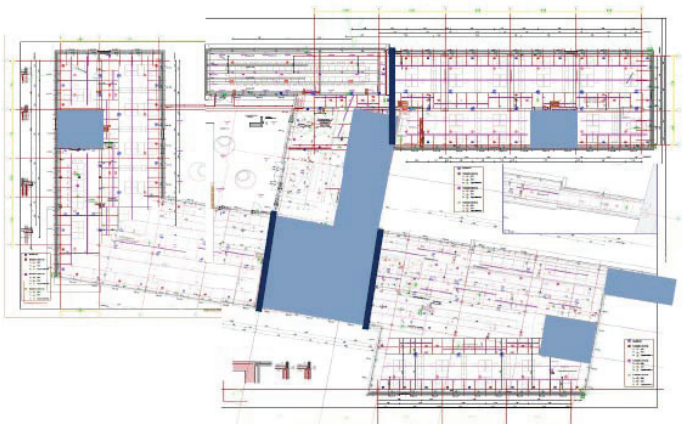
STEP 1: Floor plan and compass





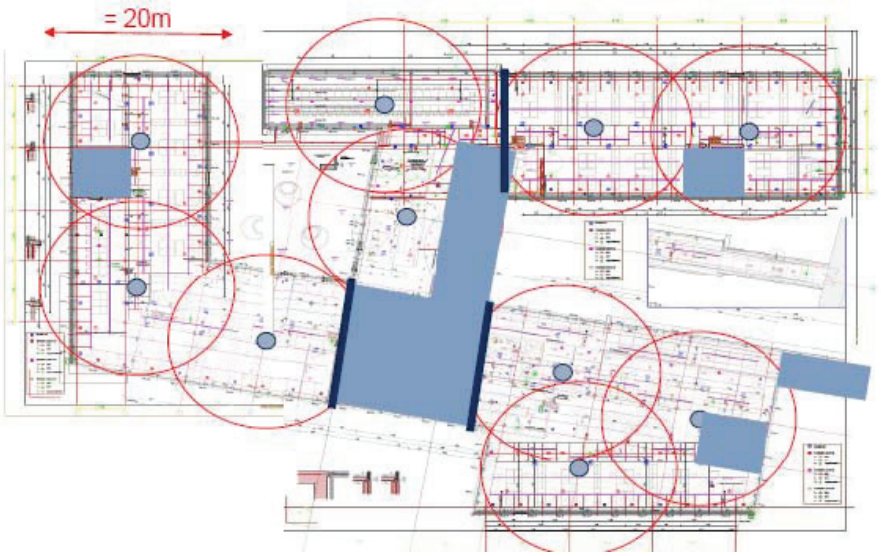
STEO 2: Draw relevant RF shielding on the floor plan

- Fire protection walls
- Elevator shafts, stairwells and other supply areas



STEP 3: Draw range circles

- The center of the circle represents the ideal position for RF gateways.
- This allows for a shield-free connection in all corners of the fire protection section (possible sensor positions).



Real-world experience suggests that unfavorable conditions and shortcomings are commonplace. Planning at 10-12 meter radiuses provide a high level of security; against future changes to environmental changes as well (light walls, furniture, personnel in the room, etc.). One meter either way for the gateway position is not an issue due to reserves, even later.

A very robust RF system can be achieved by implementing a redundant RF reception path. This can be accomplished by programming neighboring RF gateways for parallel reception of the RF transmitter.

Even if carefully planned, the field strength measuring device should be used on site to test ranges. Unfavorable conditions can be improved through more suitable re-positioning of the devices or through the use of a repeater.

11.7 Troubleshooting

Trouble free operation of the devices is normally guaranteed if you follow all the notes on the selection of mounting locations for transmitters and receivers. The following overview of potential problems may help should problems nevertheless arise:

Transmitter is not received

Check with EPM100	Possible cause and solution
In close proximity to the transmitter (ca. 20-50 cm distance), the EPM 100 does not receive any transmission telegrams. Trigger transmission telegram, the LED HI is unlit on the EPM.	**Transmitter is not transmitting.** Check transmitter: Solar-powered transmitter is supplied with sufficient light as applicable (for quick function test, briefly expose the device to daylight or under a bright lamp).
In close proximity to the receiver (ca. 20-50 cm distance), the EPM 100 does not receive any transmission telegrams. Trigger transmitter telegram, the corresponding LO/HI LED is unlit on EPM (HI for flush-mounted receiver, LO for receiver with external antenna).	**Transmitter mounted beyond the receiver range (or the transmitter was removed in the meantime).** Change the mounting location for the transmitter or receiver, or use repeater. Comply with notes in Section 1.
In close proximity to the receiver (ca. 20-50 cm distance), the EPM 100 has solid reception of the transmitter telegram. Trigger transmission telegram, the LED HI is lit on the EPM.	**a) Transmitter did not learn or incorrectly learned.** Have receiver self learn the transmitter. **b) Receiver is not receiving.** Check receiver, as needed, the receiver antenna and cabling for antenna cable as well.
Invalid EnOcean telegrams are permanently received. One of the two LO/HI LEDs is continuously lit on EPM 100, but not the VALID LED.	**a) High-frequency disruptions in the vicinity of the receiver.** Remove sources of interference (PC, wireless phone, etc., at least 50 cm from EnOcean receiver). **b) Jammer (continuous transmission).** Eliminate jammer.

Transmitter is occasionally not received

Check with EPM100	Possible cause and solution
In close proximity to the receiver antenna (ca. 20-50 cm distance), the EPM 100 receives transmitter telegram at the limits. Trigger transmission telegram, the corresponding LO/HI LED is unlit on the EPM. (HI for flush-mount receiver; LO for receiver with external antenna).	**a) Transmitter is within the limits of the transmitter.** Move the transmitter or receiver antenna or use a repeater. Comply with notes in Section 1. **b) Transmitter not installed where expected (or incorrectly assigned transmitter/receiver).** Properly assign transmitter. **c) Transmitter mounting location changes on occasion (e.g. not tightly attached).** Move the mounting location of the transmitter within the receiver range.
In close proximity to the receiver antenna (ca. 20-50 cm distance), the EPM 100 has solid reception of the transmitter telegram.	**Receiver is not receiving.** Check receiver, as needed, the receiver antenna and cabling for antenna cable as well.
Invalid EnOcean telegrams are occasionally received. One of the two LO/HI LEDs is occasionally lit on EPM 100, but not the VALID LED.	**Jammer exists.** Eliminate jammer.

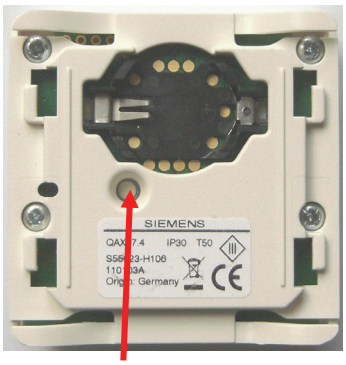
11.8 Commissioning RF link

For operation, the connection to the gateway must first be set up. See data sheet N1661 (Gateway EnOcean/LonWorks) or N1662 (Gateway EnOcean/KNX).

Send "Init" telegrams

The LEARN button is located on the lower section of the housing below the battery. Press this button to create and immediately send a complete learning telegram. The current switching status of LEARN – pressed – is also transmitted.

If the corresponding receiver is being configured, the information helps assign a specific output channel to the sender.



LEARN button

This procedure is referred to as "learning". A normal telegram does not initiate this procedure.

Repeat the procedure if you want to assign **several output channels** to one sender.

Simple function check

The LEARN button allows for a simple function and range test. **Make sure the room device was charged sufficiently prior to testing.**

Depending on receiver type and configuration, an LED indicates if the receiver finds the LEARN button was pressed on a learned room device. No acknowledgement occurs if the telegram is not received completely. Possible causes: Distance too great or unfavorable mounting location with too many interference sources within the radio link.

Off-the-shelf field strength measures devices that easily find the best mounting locations for transmitter and receiver.

Additional information available at: http://www.enocean-alliance.org/de/home.

11.9 Gateways

Wireless room units together with a gateway (EnOcean/KNX) can be used with all controllers on a PL-Link or KNX network.

EnOcean gateways

Type	Stock number	Name
RXZ97.1/KNX	S55842-Z101	Gateway EnOcean/KNX

Engineering KNX LONWORKS page

See description of the gateway datasheet [12].

12 Disposal

The devices are considered electronics devices for disposal in terms of European Directive 2002/96/EC (WEEE) and may not be disposed of as domestic waste.
Dispose of the devices via the proper channels.
Follow all local and currently applicable laws and regulations.

Siemens Switzerland Ltd
Infrastructure & Cities Sector
Building Technologies Division
Gubelstrasse 22
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