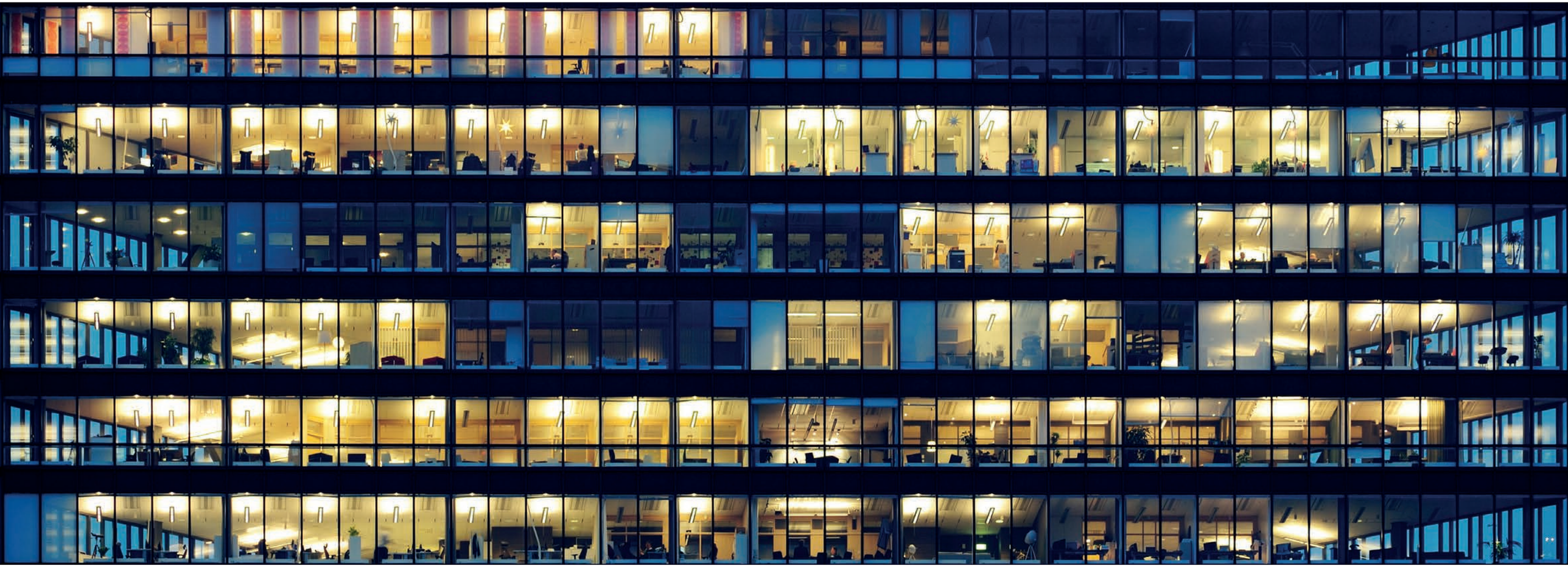
HVAC APPLICATIONS

INTRODUCTION



Quality of living

The quality of living at home has become increasingly important in recent years, both for the general improvement of living conditions, which has greatly increased the needs, and for the time spent daily by people inside buildings, which in many cases exceeds 90% of the total.

The combination of thermal, visual, acoustic comfort and indoor air quality is the discipline that guides the design, construction and evaluation of contemporary buildings: it is the concept known today as IEQ or Indoor Environmental Quality.

The quality of indoor environments has important relationships and effects with the well-being experienced by end-users at the home, with productivity and health in the workplace and with the energy performance and sustainability of buildings. Among the four dimensions of IEQ, the climatic quality of the building - understood as the combination of thermo-hygrometric conditions and air quality - is taken over by the HVAC functions and is of fundamental importance for its energy implications.

ekinex | HVAC APPLICATIONS

HVAC with Ekinex®

Ekinex®, the Italian company specialized in the realization of KNX devices, offers advanced solutions for the control of room climatization. The Ekinex® KNX product range includes pushbuttons with integrated temperature sensor and thermostat function, room thermostats (also in the version with relative humidity sensor), multisensors with temperature, relative humidity and air quality control function, touch-displays, actuators/controllers for fan-coils and electrothermal drives, controllers for mixing groups, gateways to VRF systems and other standard protocols in the HVAC sector (such as Modbus, BACnet and M-Bus). Ekinex® also offers the Delégo supervision system with a user-friendly App for the control and monitoring of the entire home automation system via smartphone (iOS or Android) and the innovative voice control by means of the popular home speakers with voice assistant. All devices are ideal for use in existing or new buildings to increase energy efficiency and ensure highest comfort.

The KNX standard

Great developments in the field of home and building automation were made possible especially thanks to an open, modular and interoperable standard like KNX. This innovative standard was born from the merging of three European systems (EIB, BatiBUS and EHS), developed and brought to the market in the early 90's. The diffusion of the system was facilitated by an intense work of cooperation at normative level in the standard committee at European level. For this reason, too, KNX is a standard characterized by a total conformity with norm EN 50090 on electronic systems for the control of homes and buildings (HBES, Home and Building Electronic Systems).
The presence on the market of this standard since 1991 offers the best guarantee in terms of reliability and consolidation of the technology used. The openness of the standard and that of the KNX Association, on the other hand, ensure availability of products in the long run and a constant development, both in terms of technology and offering of products, functions and applications.

The vitality of KNX proposals is witnessed by the sustained expansion of the association, seeing the entry of manufacturers, coming from many different areas, and from the tens of thousands of technicians who chose it to specialize in the field of building automation.

Achievable savings with the adoption of the KNX system for Home & Building control:
- 40% over shutters control
- 50% over individual ambient control
- 60% over ambient lighting control
- 60% over ventilation control

For customers, the variety and availability of KNX products has no comparison in other technological areas, and the system openness translates into the highest free choice, thereby avoiding the disadvantageous dependence of having to buy from a single supplier. Thanks to the modularity of the system, a project can be extended in time, starting with a basic configuration and adding more functions later. The native interoperability of KNX products is fundamental to technicians, as it allows to design a system by always choosing the most suitable technical options, reducing compromise and ties caused by proprietory systems which do not communicate with one another.
Moreover, the system offers new professional opportunities to designers and system integrators, making it possible to receive a consistent and high-level technical training and become certified KNX Partners.

The KNX standard is entirely compliant with norm EN 50090 on HBES (Home and Building Electronic Systems) systems)

Products

4 configurable input interface with room thermostat function
Configurable 4-channel KNX input for connecting potential-free contacts or passive NTC 10 kΩ at 25°C temperature sensors (to be ordered separately). 4 output channels for the control of low consumption LEDs. Room thermostat function for channels configured for connection to NTC sensors (up to 4 independent zones). Flush-mounting in wall box or on a DIN EN 60715 rail using the EK-SMG-35 support (to be ordered separately). Power supply via KNX bus.

4 input / 2 output (5A) interface with room thermostat function
Configurable 4-channel KNX input for the connection of potential-free contacts of which 1 configurable for the connection of a temperature probe (NTC 10 kΩ at 25°C, to be ordered separately) and 2 output channel with 5A relay for the control of electrical loads. 4 output channels for the control of low consumption LEDs. Room thermostat function for the channel configured for connection to the NTC sensor. Flush-mounting in wall box or on DIN rail EN 60715 using the EK-SMG-35 support (to be ordered separately). Power supply via KNX bus.

CG2

CE2

Art.-No.	Art.-No.
EK-CG2-TP	**EK-CE2-TP**

4-fold pushbutton with room thermostat function (FF series)
4-fold KNX pushbutton (max. 8 independent bus functions), with integrated temperature sensor and room thermostat function, for controlling loads, dimming luminaires, controlling blinds and shutters or other programmable bus functions. Configurable LEDs available in two colour combinations (blue / green or white / red). Flush-mounting on round wall box. Power supply via KNX bus.

To be completed with:
- square or rectangular rockers (plastic, aluminium or Fenix NTM®)
- optional frame of form or flank series (plastic or aluminium)

Art.-No.

EK-ED2-TP

4-fold pushbutton with room thermostat function (71 series)
4-fold KNX pushbutton (max. 8 independent bus functions), with integrated temperature sensor and room thermostat function, for controlling loads, dimming luminaires, controlling blinds and shutters or other programmable bus functions. Configurable LEDs available in two colour combinations (blue / green or white / red). Flush-mounting on wall box. Power supply via KNX bus.

To be completed with:
- square or rectangular rockers (plastic, aluminium or Fenix NTM®)
- plate with 60x60 mm window (plastic, aluminium or Fenix NTM®)
- optional frame of form or flank series (plastic or aluminium)

Art.-No.

EK-E12-TP (for round or square wall-mounting box)
EK-E12-TP-R (for rectangular 3-modules wall-mounting box)

Room thermostat (serie FF series)
KNX room thermostat with 2-point (ON / OFF) or proportional (PWM or continuous) control in combination with KNX actuators. Heating and cooling modes with local or via bus switching. 4 operating modes: comfort, standby, economy and building protection with separate setpoints for heating and cooling. Integrated temperature sensor (also available with relative humidity sensor), two freely configurable inputs, LCD display with adjustable backlighting and configurable LEDs in two colour combinations (blue/green or white/red). Flush-mounting on round wall box. Power supply via KNX bus.

To be completed with:
- set of 2 square rockers with symbols (plastic, aluminium or Fenix NTM®)
- optional frame of form or flank series (plastic or aluminium)

EP2

EQ2

Art.-No.

EK-EP2-TP
EK-EQ2-TP (with relative humidity sensor)

EK-ER2-TP (versione easy)

Room thermostat (71 series)
KNX room thermostat with 2-point (ON / OFF) or proportional (PWM or continuous) control in combination with KNX actuators. Heating and cooling modes with local or via bus switching. 4 operating modes: comfort, standby, economy and building protection with separate setpoints for heating and cooling. Integrated temperature sensor and LCD display with adjustable backlighting. Flush-mounting on wall box. Power supply via KNX bus.

To be completed with
- plate with 60x60 mm window (plastic, aluminium or Fenix NTM®)
- optional frame of form or flank series (plastic or aluminium)

Art.-No.

EK-E72-TP (for round or square wall-mounting box)
EK-E72-TP-R (for rectangular 3-modules wall-mounting box)

Presence sensors
KNX sensors for detecting people standing or walking with 360° (EK-Dx2-TP) or 180° (EK-SM2-TP) detection range. 2 channels for lighting control and 2 channels for HVAC equipment. Motion/presence detection by PIR (passive infrared) sensors. The detection area can be extended by using other sensors configured as slave devices. Brightness sensor and IR receiver (EK-Dx2-TP only). Versions for ceiling (EK-Dx2-TP) or wall mounting (EK-SM2-TP). Power supply via KNX bus.

Versions for ceiling (EK-Dx2-TP) or wall mounting (EK-SM2-TP). Power supply via KNX bus.

Wall-mounting version EK-SM2-TP to be completed with:
- plate with 60x60 mm window (plastic, aluminium or Fenix NTM®)
- front cover EK-CLM-... with prismatic lens

DF2

DG2

SM2

Nr. art.

EK-DF2-TP (max. range 9 m with 2.5 m installation)
EK-DG2-TP (max. range 12 m when installed at 2.5 m)

EK-SM2-TP

Multisensor with thermostat function
KNX multisensor can be used as probe or controller for temperature, relative humidity and air quality (CO2 equivalent, TVOC). 2-point (ON / OFF) or proportional (PWM or continuous) room temperature control in combination with KNX actuators; threshold control of relative humidity, CO2 (equivalent) and TVOC, LEDs for signalling operation mode (heating / cooling), R.H., CO2 and TVOC thresholds. Wall mounting on flush-mounted box. Power supply via KNX bus.

Versions:
EK-ET2-... for T, R.H., CO2 equiv.
EK-ES2-... for T, R.H., CO2 eq., TVOC
To be completed with:
- front cover with symbols (plastic, aluminium or Fenix NTM®)
- plate with 60x60 mm window (plastic, aluminium or Fenix NTM®)
- optional frame from form or flank series (plastic or aluminium)

ET2

ES2

Nr. art.

EK-ET2-TP (for round or square flush mounting box)
EK-ET2-TP-R (for 3-part rectangular flush mount box)

EK-ES2-TP (for round or square flush mount box)
EK-ES2-TP-R (for 3-part rectangular flush-mounting box)

Display and control unit Touch & See
KNX display and control unit for switching, control and display of bus functions. 3.5“ touchscreen operating surface with sequence of graphic pages: home (with direct access to other pages), room thermostat (up to 8 independent zones), switching and control, calendar, weather information, multimedia, service functions (presence simulation, timer, alarms). Flush-mounting on wall box. Power supply via KNX bus, auxiliary power supply 30 Vdc required.

Also available with integrated 2-fold pushbutton and temperature sensor.

To be completed:
- optional frame of form or flank series (plastic or aluminium)
- square rockers (only for EK-EF2-TP, plastic or aluminium)

EC2

EF2

Art.-No.

EK-EC2-TP
EK-EF2-TP (with 2-fold pushbutton and temperature sensor)

Delégo
Complete system for the supervision and control of a KNX standard installation. Developed with web-oriented technologies, it features a uniform interface with high graphic impact on every platform with local and remote connection.

Nr. art.

EK-DEL-SRV-BAS-TP (BASIC, 400 KNX addresses)
EK-DEL-SRV-ADV-TP (ADVANCED, 1,200 KNX addresses)
EK-DEL-SRV-PRM-TP (PREMIUM, 2,500 KNX addresses)

EK-DEL-5PAN Delégo panel 5” (black panel)
EK-DEL-8PAN Delégo panel 8” (black panel)
EK-DEL-5FR-GB... Aluminium frame for 5” Delégo panel

NTC temperature sensors
NTC sensors (10 kΩ at 25°C, ß = 3435) for measuring the temperature of the room air mass or the heat transfer fluid in the heating / cooling system; in combination with Ekinex® KNX devices dedicated to HVAC functions, they optimise the operation of the building’s heating / cooling system, increasing the level of comfort and exploiting all opportunities for energy saving. Versions: external (E), immersion (I), contact (C), air mass (L).

Art.-No.

EK-STx-10K-3435 (x = E, I, C, L)

Time / astronomic digital switch
Electronic digital KNX switch for time scheduling (daily, weekly, monthly or annual) or astronomical. Control of 9 channels on the KNX bus. Scheduling of channel 1 is replicated also on the on-board relay. Assignment to each channel of a different time or astronomical programming. Possibility of connecting one EK-GPS-1 optional module (to be ordered separately) for the acquisition of time, date and geographical position through the GPS satellite system (time synchronisation every 30 minutes). Backup battery. Panel mounting on DIN rail EN 60715 (3 MU).

GPS module
GPS module for acquisition of date, time and geographical coordinates information from global positioning system (GPS) satellites and synchronization of the EK-TM1-TP time / astronomic digital switch. Pole mounting adapter included.

TM1

GPS-1

Art.-No.	Art.-No.
EK-TM1-TP	**EK-GPS-1**

Actuator / controller for electrothermal drives
KNX module that can be used as an actuator (in combination with a KNX room thermostat) or actuator / controller (receiving the temperature value from a KNX sensor or other KNX devices). For systems with 2- or 4-pipe hydraulic distribution, with 8 TRIAC outputs for ON / OFF control of electrothermal drives or motors for zone valves. Panel mounting on DIN rail EN 60715 (4 MU).

Art.-No.
EK-HE1-TP

Actuator / controller for fan-coils
KNX module that can be used as an actuator (in combination with a KNX room thermostat) or actuator / controller (receiving the temperature value from a KNX sensor, another KNX device or an NTC temperature sensor connected to an analogue input). Versions for controlling 3-speed fan units or with brushless motor and inverter board (control voltage 0...10V). For systems with 2- or 4-pipe hydraulic distribution. ON / OFF control of one or two electrothermal valve drives. The outputs not used for the control of fan-coils can be used as outputs to carry out other bus functions. Panel mounting on DIN rail EN 60715 (4 MU).

HA1

HB1

HC1

Art.-No.
EK-HA1-TP (3-speed fan, 2-pipe distribution)
EK-HB1-TP (0...10V fan control, 2-pipe distribution)
EK-HC1-TP (3-speed fan or 0...10V fan control, 2- or 4-pipe distribution)

Mixing group controller
KNX controller for fluid mixing group. Control of a motor for mixing valve (3-point floating or with 0...10V signal) and control of a circulating pump. Inputs for acquisition of flow and return temperatures (warm and cold water) and external air temperature. Control of the flow temperature of the heat transfer fluid with separate control functions for heating and cooling. Panel mounting on DIN rail EN 60715 (8 MU).

Art.-No.
EK-HH1-TP

Office module
KNX input / output module for controlling the bus functions of an office room: lighting, temperature control and shading. Panel mounting on DIN rail EN 60715 (8 MU).

1 input for NTC temperature sensor (room thermostat function)

Fan-coil unit control function
- 2 outputs for controlling electrothermal drives on hot / cold valves
- 3 outputs for 3-speed fan control
- 1 output for 0-10V control of fan with brushless motor and inverter board

Art.-No.
EK-HU1-TP

Hotel module
KNX input / output module for controlling the bus functions of a hotel room: lighting, temperature control, shading and input and output signals. Panel mounting on DIN rail EN 60715 (8 MU).

1 input for NTC temperature sensor (room thermostat function)

Fan-coil unit control function
- 2 outputs for controlling electrothermal drives on hot / cold valves
- 3 outputs for 3-speed fan control
- 1 output for 0-10V control of fan with brushless motor and inverter board

Art.-No.
EK-HO1-TP

CoolMasterNet with KNX interface
Plug and play interface for bi-directional data exchange between KNX and the communication bus systems of VRF and split units. Monitoring and control by KNX of all the units connected to the system dedicated to air conditioning. Touch-screen LCD screen for direct local control of each unit. Communication lines for Mitsubishi Electric, Daikin, Toshiba, Panasonic, Sanyo, Hitachi, Mitsubishi Heavy Industries, LG, Samsung, and Gree. Panel mounting on DIN rail EN 60715.

Available controls*:
- on / off
- mode (Cool, Heat, Auto, Fan)
- fan speed
- temperature setpoint
- feedback of room temperature
- error code

*) Some control options may be restricted by VRF and split system manufacturers.

Art.-No.
EK-BQ1-TP

Configurable logic module
KNX module to carry out logic functions and calculations on values of KNX communication objects. 4 configurable channels for the connection of potential-free contacts. Flush-mounting in wall box or on DIN rail EN 60715 using the EK-SMG-35 support (included in the delivery). Power supply via KNX bus.

Implementable blocks
- Logic: combination of binary inputs according to logical operations
- Mathematical: mathematical calculations on one or more inputs
- Range: scaling (or limitation) of input values to different ranges
- Mapping: translation of a set of values of an input (up to 8 points) into a different set of output values
- Conversion: conversion of one communication object to another with different KNX data type (DPT)
- Timer: one-shot (monostable) or oscillator (astable) timing with delays that can be set on activation and deactivation
- Comparison: return of the result of an arithmetic comparison (equal, greater, lesser, etc.) between two input values
- Multiplexer: copy the value of an input object into one of the N output objects or onto the selected output objects

Art.-No.
EK-LM2-TP

CODESYS PLC with KNX interface
Programmable logic controller in CODESYS* development environment for executing complex control programs not available in standard KNX devices. Integrated interface for KNX bus system and USB programming port. Panel mounting on DIN rail EN 60715 (4 MU).

*) Brand of 3SSmart Software Solutions GmbH, Kempten (Germany).

Art.-No.
EK-IA1-TP

Modbus - KNX gateway for RDZ residential air handling units
Dedicated gateway for protocol conversion between Modbus RTU and KNX (TP). It allows bidirectional communication between a RDZ air handling unit (equipped with RS-485 communication port on the control board) and a KNX system (TP). Master function on Modbus. Mounting on DIN rail EN 60715 (2 MU). Compatible with the following units:
- CHR 100-FC, CHR 200-FC, CHR 400-FC
- WHR 200, WHR 400
- UAP 200-PDC
- UC 300 V1, UC 360 V1
- UC 360-MHE, UC 500-MHE, UC 500-MVHE

Further information about RDZ air handling units, mechanical ventilation with energy recovery and dehumidification systems on the RDZ catalogue and technical documentation at www.rdz.it/en.

Art.-No.

EK-BO1-TP-RMA

Modbus - KNX gateway
General-purpose gateway for protocol conversion between a Modbus RTU network and a KNX (TP) bus system. Available for RS485 or TCP / IP Modbus RTU serial networks. Master function on Modbus network. Mounting on DIN rail EN 60715 (4 MU).

TCP

485

Art.-No.

EK-BH1-TP-485 (serial RS485)
EK-BH1-TP-TCP (TCP / IP)

BACnet - KNX gateway
General-purpose gateway for protocol conversion between a BACnet* network and a KNX (TP) bus system. Available for MS / TP (master-slave / token-passed) or RS485 serial network. Mounting on DIN rail EN 60715 (4 MU).

*) ASHRAE brand (American Society of Heating, Refrigerating and Air-Conditioning Engineers).

IP

MS/TP

Art.-No.

EK-BJ1-TP-IP (IP over Ethernet)
EK-BJ1-TP-MSTP (MS / TP over RS485)

M-Bus - KNX gateway
General-purpose gateway for protocol conversion between an M-Bus network and a KNX (TP) bus system. Available for 20, 40, 80 and 160 M-Bus meters. Master function on the M-Bus network. Mounting on DIN rail EN 60715 (4 MU).

Art.-No.

EK-BM1-TP-20 (max 20 M-Bus meters)
EK-BM1-TP-40 (max 40 M-Bus meters)
EK-BM1-TP-80 (max 80 M-Bus meters)
EK-BM1-TP-160 (max 160 M-Bus meters)

ekinex | HVAC APPLICATIONS

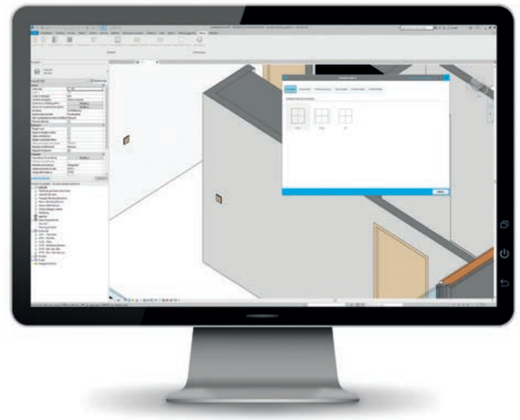
BIM ready

BIM stands for Building Information Modeling and indicates a methodology to optimize and better manage the phases of design and construction of a building. BIM is used to follow a working method that involves the generation of a building model that can also manage the data of the entire life cycle through multi-dimensional virtual models generated digitally by means of specific software.
The main benefit of adopting the BIM methodology is the 3D representation at the design stage, which speeds up processes, reduces delivery times and allows errors and inaccuracies to be detected first. The greater efficiency in sharing information and a more precise control over all the processes involved, also make it possible to contain costs and schedule in advance maintenance operations.

BIM is a standard process for all buildings and is being integrated into legislation across Europe following the transposition of Directive 2014/24/EU on public procurement which requires its inclusion in the procurement procedures of the Member States. In Italy, the transposition of the directive took place with Decree no. 560 of December 1, 2017, which established the methods and time schedules for the progressive introduction of electronic modelling methods and tools for construction and infrastructure. The decree provides for the obligation to operate with the BIM methodology from January 1, 2019 for works worth more than 100 million euros and then from 2019 to 2025 will be introduced in Italy the obligation for all contracts for new public works.

BIM Ekinex® database
Ekinex® is "BIM ready": the BIM product database is available in Autodesk Revit® 2019 / 2021 format for download at www.ekinex.com
The Ekinex® BIM Content Creator software is a true advanced configurator of the product range that will be enriched with future updates and expansions.

References
Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement



Planner

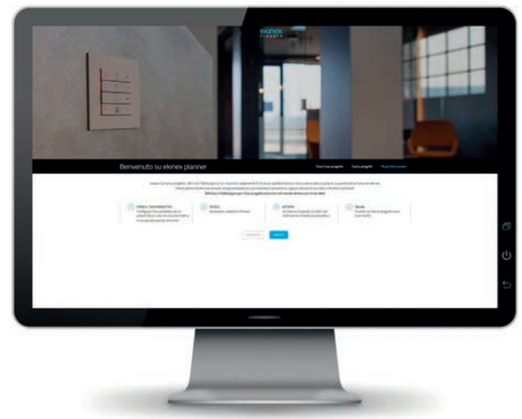
Planner is a useful tool that Ekinex® makes available on the website www.ekinex.com to create your own project, define the requirements of a home automation system, choose the most suitable finishes and give a personal touch to the control points of the system. There are four simple steps to use the Planner:

1) CREATE YOUR PROJECT
Configures the product with the possibility of inserting a plan in which to place the several elements

2) CHOOSE
Allows you to select devices, versions, materials and finishes

3) OBTAIN
Produces a complete list of codes to forward the request for quote

4) SAVE
Allows you to manage the list of projects according to individual needs



HVAC WITH EKINEX®

Examples of applications

Further information

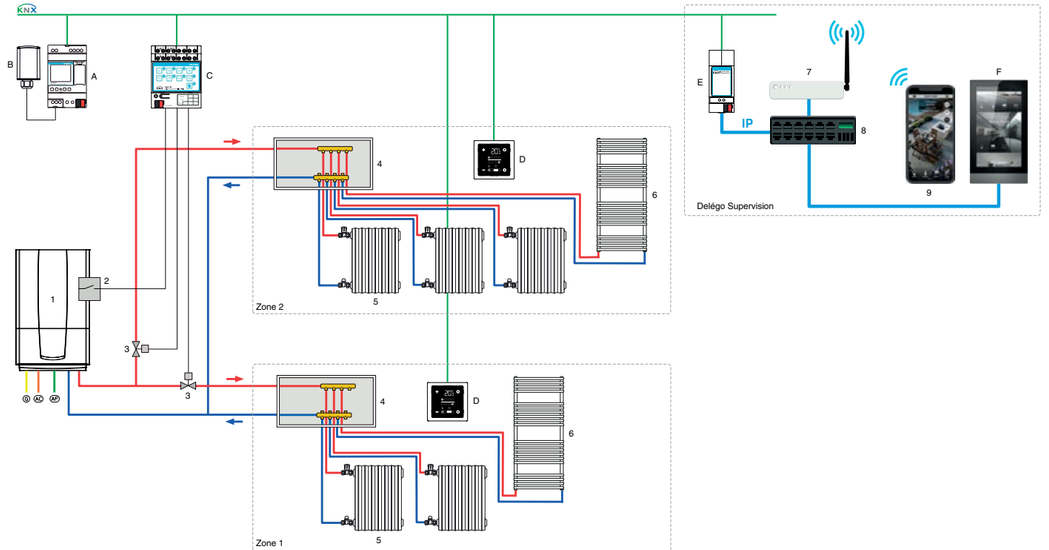
Heaters system

The room heaters, available in the different forms of radiators, decorative radiators and towel warmers, represent the most common heat exchange terminals in residential buildings. The heaters are used in hydronic systems for room heating only, which uses small terminals for the convection heat exchange (with prevailing natural effect), thanks to a relevant temperature difference between the heat transfer fluid and the room air. The system shown in the example is intended for a residential building and provides for the distribution of the heat transfer fluid to zones by means of two distribution manifolds.

Control with Ekinex

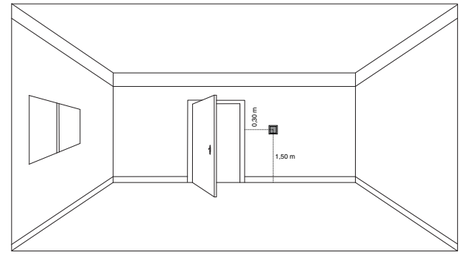
The room air temperature is controlled by room thermostats EK-E72-TP **(D)**, installed in the pilot rooms of the two zones, in combination with the actuator EK-HE1-TP **(C)** which controls the ON / OFF servomotors of the zone valves **(3)**.
The EK-TM1-TP time / astronomical digital switch **(A)** ensures that the system operate according to predefined time scheduling and is constantly synchronised with date and time by the (optional) GPS module EK-GPS-1 **(B)**.
The optional supervision by means of the Delégo Server **(E)** allows you to monitor and control the home automation system by means of an App for mobile devices **(9)** and/ or a Delégo touch-panel **(F)**.

Example



Mounting position for room thermostats

For optimum adjustment, Ekinex® room thermostats should preferably be installed on an interior wall at a height of 1.5 m and at least 0.3 m from the doors. Thermostats may not be installed near heat sources such as radiators or appliances or in locations subject to direct sunlight. If necessary, a weighted average between the temperature value measured by the sensor integrated in the room thermostat and the value received via bus from another device (e.g. from an Ekinex® pushbutton or multisensor) can be used for adjustment.



Ekinex devices

A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Actuator-controller for electrothermal drives EK-HE1-TP
D) Room thermostat EK-E72-TP
E) Server Delègo EK-DEL-SRV-...
F) Touch-panel Delégo EK-DEL-xPAN...

Other system components

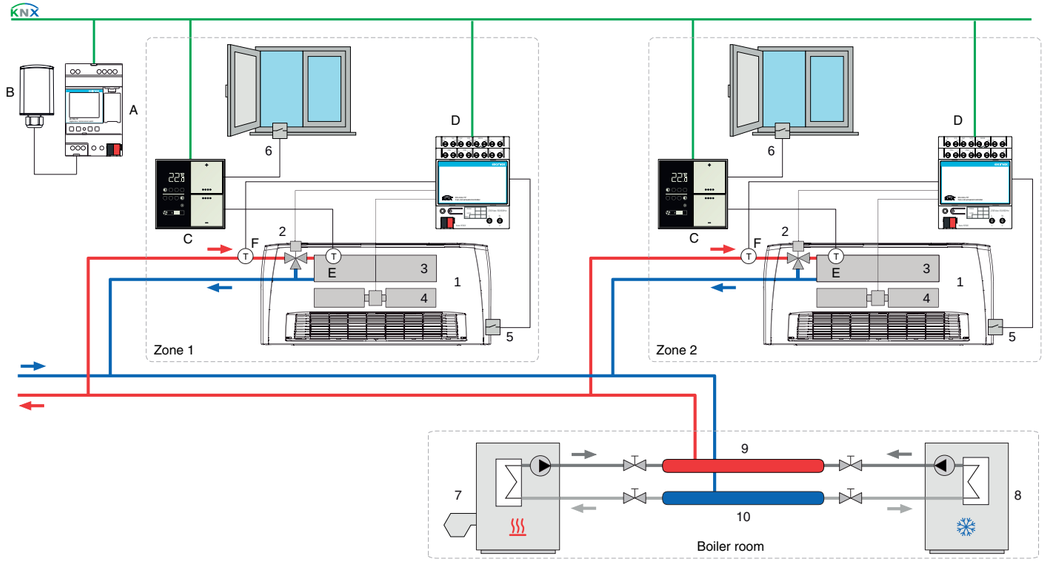
1) Thermal generator
2) Run / stop contact
3) Zone valve with ON / OFF servomotor
4) Distribution manifold
5) Radiator
6) Towel warmer
7) Access point LAN Wi-Fi
8) Switch
9) Smartphone with Delégo App (Apple iOS or Android)

Fan-coil systems

Fan-coils are terminal units that are widely used in offices, shopping centres, hotels and hospitals and, in general, in medium-large buildings.
Fan-coils are used in hydronic systems for room heating and cooling, using small terminals for convection heat exchange (with prevailing forced effect). One or two batteries for water-air heat exchange, a fan unit and the actuating devices (2 or 3-way valves with electrothermal actuators or servomotors) to regulate the flow rate of the heat transfer fluid to the exchange battery provide for this. Some versions can be equipped with an auxiliary heating battery powered by electricity.
In addition to the units with the traditional 3-speed fans, there are also versions with brushless motor and inverter board that allow a continuous control of the fan speed by means of a 0-10V control voltage.
From a construction point of view, the fan-coil units can have different shapes, such as cabinets for ceiling or wall mounting; the ceiling versions can be stand-alone or connected to air ducts installed in the plenum.

Control with Ekinex
The application examples show two different and very common system configurations. In the first case **(example I)**, the fan-coils **(1)** are equipped with a 3-speed fan unit and connected to a 2-pipe heat transfer fluid distribution system. In the heat exchange battery **(3)**, warm or cold fluid circulates alternately and the flow is controlled by the valve **(2)**.
The room air temperature is controlled by room thermostats EK-EP2-TP **(C)** and actuator-controllers for fan-coils EK-HA1-TP **(D)**. The room thermostats **(C)** are connected to the window contacts **(6)** and contact temperature sensor EK-STC-10K-3435 **(E)**, while the actuators **(D)** are connected to condensate drip tray contacts **(5)** and immersion temperature sensors EK-STI-10K-3435 **(F)** installed on the inflow pipe of the heat transfer fluid.
In this application, the switchover between heating and cooling can be carried out automatically, by measuring the temperature of the fluid arriving from the distribution by means of an immersion temperature sensor **(F)** connected to an actuator input **(D)**. Alternatively, Ekinex® devices can receive the switching control via bus (centralised manual switching mode).

Example I (2-pipe distribution)



Ekinex devices
A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Room thermostat EK-EP2-TP
D) Actuator-controller for fan-coils EK-HA1-TP
E) NTC temperature sensor (contact) EK-STC-10K-3435
F) NTC temperature sensor (immersion) EK-STI-10K-3435

Other system components
1) Fan-coils units
2) Valve with ON / OFF servomotor
3) Heat exchange battery
4) Fan group
5) Contact for condensate drip tray
6) Window contact
7) Thermal generator (warm fluid)
8) Thermal generator (cold fluid)
9) Boiler room manifold (flow)
10) Boiler room manifold (return)

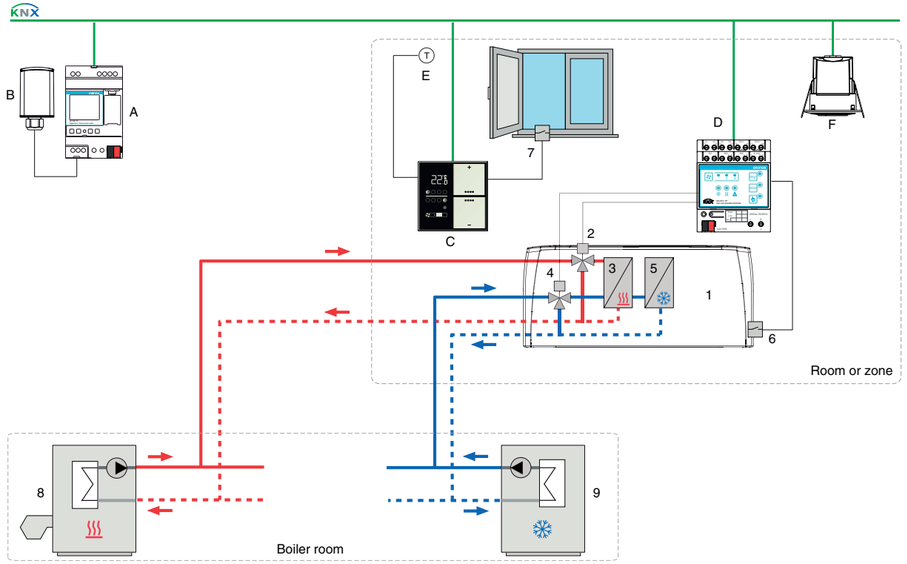
In the second case **(example II)**, the fan-coils **(1)** are equipped with two heat exchange batteries **(3, 5)** and a fan unit with brushless motor controlled by an inverter board. The units are connected to a 4-pipe heat transfer fluid distribution system. With this kind of distribution, if both fluids are available from the boiler room, there can be heated and cooled rooms simultaneously in the same building; the flow is controlled by two valves with ON / OFF servomotor **(2, 4)**.
The room air temperature is controlled by room thermostats EK-EQ2-TP **(C)** and actuator-controller for fan-coils EK-HC1-TP **(D)** which have an output with the 0-10V voltage required for a continuous control of the fan speed, obtaining all the advantages of these terminals: more precise response to the variation of heat loads, better temperature stability, reduced noise and high efficiency even at partial load with a consequent reduction in electricity consumption. Temperature attenuations can be called up automatically in the absence of people, thanks to the presence sensor EK-DF2-TP **(F)**.
In this application, an automatic switchover between heating and cooling, based on measured temperature and setpoint values, can be advantageous. Alternatively, and with both transfer fluids available, the switchover can also be performed locally on the room thermostat in manual mode. In both cases, several utility functions for comfort, energy efficiency and system maintenance can be added according to the needs of customers and end-users: a few examples are given below.

Comfort
The contact temperature sensor **(E)** installed on the heat exchange coil allows the fan unit **(4)** to be started only when the temperature of the heat transfer fluid is comfortable for the users (warm-start function). If the sensor **(E)** is missing, the function can also be performed by setting a simple start-up delay.
In rooms with big height and volume (atriums, gyms, commercial rooms), air stratification can occur, with energy waste and discomfort for the end-users. To limit this effect, a temperature sensor **(E)** is connected to the thermostat **(C)** and a maximum temperature gradient is configured that must not be exceeded.

Energy saving
The window contact **(6)** connected to an input of room thermostat **(C)** automatically switches the operating mode from comfort to building protection, avoiding the loss of heating and cooling energy to the outside.

Maintenance
The actuator-controller **(D)** is provided with an operating hours counter which increases the count when the fan unit **(4)** is set at least at first speed. When the set time interval is reached, a signal is activated to replace the filter of the fan-coil unit.

Example II (4-pipe distribution)



Ekinex devices
A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Room thermostat EK-EQ2-TP
D) Actuator-controller for fan-coils EK-HC1-TP
E) NTC temperature sensor (air) EK-STL-10K-3435
F) Presence sensor EK-DF2-TP

Other system components
1) Fan-coil unit
2) Valve with ON / OFF servomotor (warm fluid)
3) Heat exchange battery (warm fluid)
4) Valve with ON / OFF servomotor (cold fluid)
5) Heat exchange battery (cold fluid)
6) Contact for condensate drip tray
7) Window contact
8) Thermal generator (warm fluid)
9) Thermal generator (cold fluid)

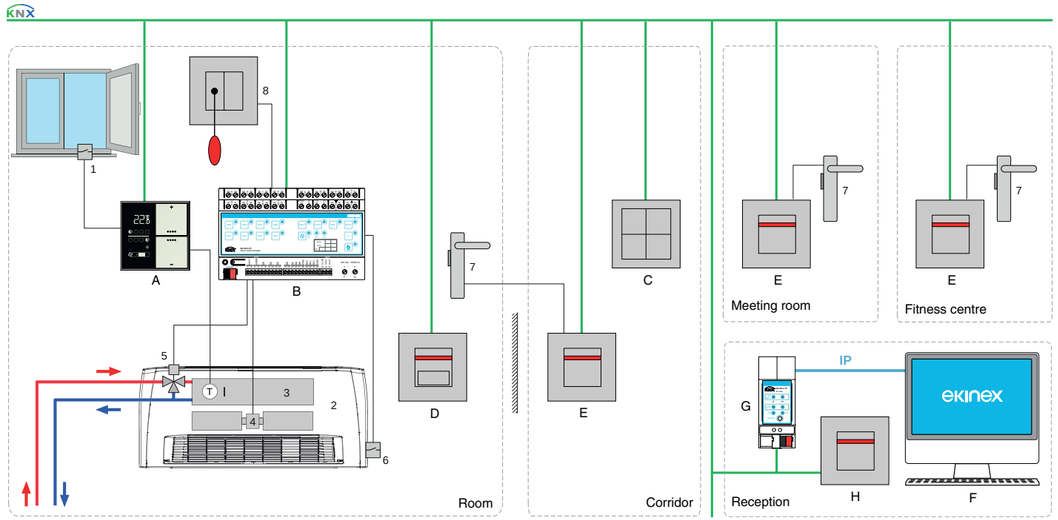
Room control in hotel building

The use of Ekinex® temperature control devices makes it possible to offer guests of a hotel maximum comfort and, at the same time, to safeguard the objectives of energy efficiency and cost savings defined in the technical and economic planning.
Through the Ekinex® home automation system it is also possible to reduce operating and maintenance costs, thanks to the possibility of transmitting the most important operating parameters of the system to a centralised workstation and the real-time notification of faults and anomalies, guaranteeing maximum operational continuity. The Ekinex® thermoregulation devices **(A, B)**, in combination with the Ekinex® access control system **(D, E, F, H)**, make it possible to increase energy efficiency and, at the same time, save costs with simple measures such as, for example:

- the activation of heating or cooling in comfort mode shortly before the guest's arrival or directly when the guest is at the check-in desk;
- switching heating or cooling from comfort to stand-by (or night) mode with an appropriate time delay when the guest leaves the room or during the check-out;
- the temporary and automatic deactivation of the heating or cooling when opening room doors or windows;
- the setting of ventilation for air renewal at a minimum flow level in the absence of the guest from the room and its automatic reactivation at the design flow rate upon return to the room;
- limitation of the temperature modification allowed to the guest with respect to the defined setpoint.

Thanks to the Ekinex® **(C)** pushbuttons, equipped with an integrated temperature sensor and the room thermostat function, it is also possible to carry out independent climate control in the common and transit areas, without having to install a device with a user interface, by setting the setpoints and operating modes centrally from reception. For larger rooms, Ekinex® room thermostats and pushbuttons can carry out the control using a weighted average of temperature values, receiving a temperature value from the bus.

Example



Ekinex devices
A) Room thermostat EK-EQ2-TP
B) Hotel module EK-HO1-TP
C) 4-fold pushbutton EK-E12-TP
D) Card holder EK-TH2-TP
E) Card reader EK-TR2-TP
F) (PC with) programming and supervision software EK-TSW
G) KNX / IP router EK-BC1-TP
H) Card programmer EK-TR2-TP
I) NTC temperature sensor (contact) EK-STC-10K-3435

Other system components
1) Window contact
2) Fan-coil unit
3) Heat exchange battery
4) Fan group
5) Valve with ON / OFF servomotor
6) Contact for condensate drip tray
7) Electric door lock
8) Bathroom alarm rope pushbutton

Access control

In hotel buildings, in combination with thermoregulation solutions, it is ideal the use of the Ekinex® system for access and presence detection control. The system is based on transponder technology, which makes full use of its flexibility and security features. The devices **(D, E)**, fully compatible with the KNX system, can be combined with the FF and 71 series of Ekinex® wall-mounting devices. The supervision and programming software for PC EK-TSW **(F)** completes the system offer and can also represent the interface to other communication protocols commonly used in the HVAC sector such as BACnet, Modbus or M-Bus. The Ekinex® access control system combines the needs of comfort and energy saving in the best possible way and allows for the creation of flexible and advanced systems, optimising the services offered to the guests.

Access control
The EK-TR2-TP **(E)** card reader is used for access control. The device is installed outside the rooms or other rooms to which access must be controlled. Each card is equipped with an electronic circuit and, once it is close to the card reader, it transmits the unique access code. Entry is allowed or denied depending on the authorisation programmed.

Presence detection
The EK-TH2-TP **(D)** card holder is used to detect the guest presence in the room. The device is installed inside the room. The card is inserted by the guest in the special slot; with this action, the system gives consent to the activation of the HVAC system of the room (in addition to other room utilities such as lighting or TV). At the same time, the presence is notified to the supervision software installed on the PC at the reception desk. Information on the status of the room (such as the need to rearrange, to replenish the bar, the need for maintenance or the inactivity of the room) is instead notified to the reception by the hotel staff, thanks to special cards (master card).

The devices have a 4A (24V) relay output and a freely programmable binary input; the output can be used for load control, while the binary input allows the connection of devices such as bathroom alarm rope pushbuttons or window contacts. The programming of the cards and the configuration of the devices can be carried out from the reception or from another workstation where the card programmer **(H)** is installed, connected via KNX / IP interface or router **(G)** to a PC with the programming and supervision software EK-TSW **(F)** installed.

The devices

Card reader
Card reader with transponder technology for presence detection with KNX communication. Equipped with a relay (4A @24V AC/DC) and an input for potential-free contacts. Two-colour front LED for monitoring device operation. Wall mounting in round flush-mounted box. Power supply via KNX bus, auxiliary power supply 12-24 AC/DC required.

To be completed with:
- front cover (plastic) with symbols and LED light guide
- plate with 45x45 mm window (plastic, aluminium or Fenix NTM®)
- optional frame of form or flank series (plastic or aluminium)

Art.-No.

EK-TR2-TP

Card holder
Card holder with transponder technology for presence detection with KNX communication. Equipped with a relay (4A @24V AC/DC) and an input for potential-free contacts. Two-colour front LED for monitoring device operation. Wall mounting in round flush-mounted box. Power supply via KNX bus, auxiliary power supply 12-24 AC/DC required.

To be completed with:
- front cover (plastic) with symbols and LED light guide
- plate with 45x45 mm window (plastic, aluminium or Fenix NTM®)
- optional frame of form or flank series (plastic or aluminium)

Art.-No.

EK-TH2-TP

Accédo software suite
Software for the integrated management of technological systems, particularly suitable for accommodation and hospitality structures (hotels, residences, guest houses or bed & breakfasts). Client-server architecture with HTML5 web server functionality. Programming of transponder cards for access control, presence detection and (optional) electronic money functionality. Automatic import of ETS projects with easy and intuitive creation of graphic pages, drag&drop, advanced copy/paste and undo/redo functions. Integrated management of calendars, scenarios and schedules. Interface to other communication protocols such as BACnet, Modbus, M-Bus, etc.

Requirements
- Operating system: Microsoft Windows® 7 or later (recommended: Windows® 10). In a server environment, it is possible to use Windows® Server 2016 (in its Essential, Standard, Professional or Enterprise versions) can be used in a server environment or later - RS232 I/O
- Processor: Intel Core i5 3.3 GHz or higher
- RAM memory: 4 GB minimum, 8 GB for server installation
- Hard drive: 40 GB minimum free for server installation
- SSD: 240 GB
- Monitor: Full HD

Nr. art.

EK-ACC-SW Transponder Supervisor Software

EK-ACC-Lx Software licence for x readers (x = 12, 25, 50, 100, 200)

Control of a mixing group

More and more often in systems designed for room heating, cooling and ventilation there are simultaneously heat exchange, air handling or air renewal terminals with different operating principles (such as radiators, radiant floor or ceiling panels, fan-coils, dehumidifiers, mechanical ventilation units with integration of the sensible contribution for cooling, etc.) that make it necessary to produce heat transfer fluid at different temperatures. This can be done directly in the boiler room or locally, by controlling a mixing group.

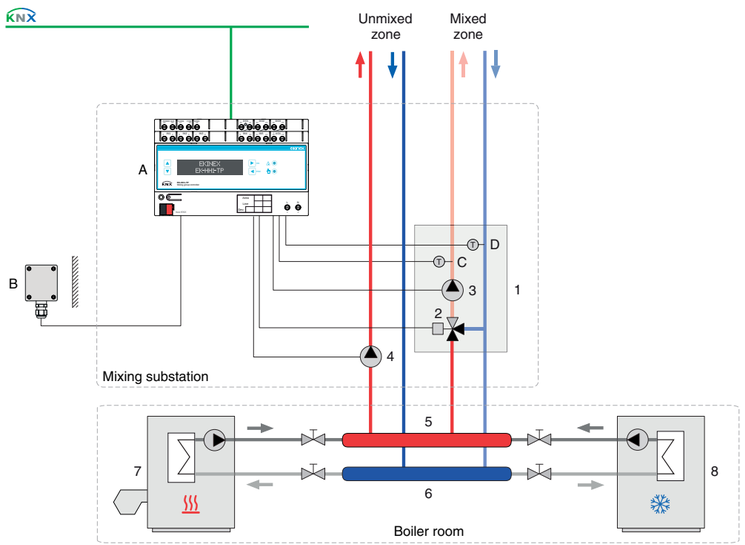
Control with Ekinex

The unmixed zone directly serves the heat exchange terminals with heat transfer fluid at the temperature produced in the boiler room. The EK-HH1-TP unit **(A)** controls the mixing group **(1)** by adjusting the flow temperature of the heat transfer fluid for the mixed zone. For this purpose, the mixing valve **(2)** equipped with a servomotor and the circulating pump **(3)** of the mixed zone are controlled, measuring the flow temperature by means of an immersion sensor **(C)**. Optionally, it is also possible to measure the return temperature by means of a second immersion sensor **(D)**. The outdoor temperature sensor **(B)** measures the outdoor air temperature for climate compensation control.

In the case of radiant panel systems also used for summer cooling, the ideal use of the controller **(A)** is in combination with a maximum of 16 room thermostats EK-EQ2-TP equipped with temperature and relative humidity sensors to have an effective integration between the boiler room regulation (primary) and the room or zone control (secondary).
In this way, the system on and off as well as the optimal flow temperature of the heat transfer fluid are automatically selected according to the actual internal conditions of the building; in cooling mode it is also possible to select the optimal flow temperature with active protection from condensation.

Control options	Heating	Cooling
Fixed point	√	√
Climatic compensation	√	√
Adjusting to internal conditions	√	-
Adjusting to return temperature	√	-
Climatic compensation and adjusting to internal conditions	√	-
Adjusting to internal thermo-hygrometric conditions	-	√
Climatic compensation and adjusting to internal thermo-hygrometric conditions	-	√

Example

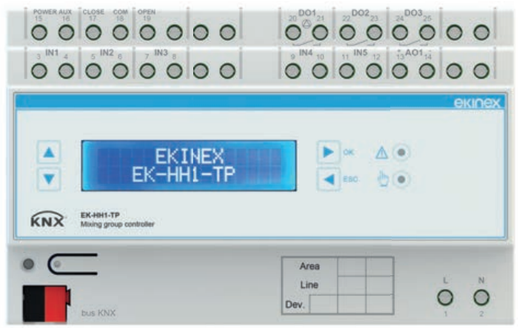


Ekinex devices
A) Mixing group controller EK-HH1-TP
B) NTC temperature sensor (external) EK-STE-10K-3435
C) NTC temperature sensor (immersion) EK-STI-10K-3435
D) NTC temperature sensor (immersion) EK-STI-10K-3435

Other system components
1) Mixing group
2) Mixing valve with servomotor
3) Circulating pump (mixed zone)
4) Circulating pump (unmixed zone)
5) Boiler room manifold (flow)
6) Boiler room manifold (return)
7) Thermal generator (warm fluid)
8) Thermal generator (cold fluid)

Focus on the EK-HH1-TP mixing group controller

The EK-HH1-TP controller **(A)** is a KNX device, fully programmable via ETS, which allows the flow temperature of the heat transfer fluid to be regulated in heating and cooling hydronic systems.
The device can be used as a stand-alone unit or in combination with one or more Ekinex® room thermostats to create single-zone or multi-zone systems (up to a maximum of 16 zones), controlling the servomotor of a 3-point floating mixing valve, powered at 230 Vac or 24 Vac, or with 0-10V signal and controlling the circulating pump of the mixed circuit in run / stop mode. The device manages over-temperature (in heating) and under-temperature (in cooling) alarms.
The controller has a backlit LCD text display, four membrane buttons for navigating through the display menu and two LEDs for alarms and switching to manual mode.



The display allows the operating parameters to be monitored; some control parameters can also be modified with respect to the initial configuration carried out with ETS.
The switchover of the system conduction mode (heating / cooling) can be done from the bus, from a digital input (configured for this purpose) or manually from the front keyboard. Alarms from anti-condensation probes can be managed.
The digital outputs, not used to activate a circulating pump, can be configured to control a zone valve servomotor located on a circuit dedicated to fan-coil units or dehumidifiers.
To create automation logic, the device is also equipped with 2-channel logic functions (16 inputs per channel) with exclusive AND, OR, NOT and OR blocks and delayed activation of the corresponding output.

Inputs and outputs

Terminal no.	Label	Connection
3-4	IN1	Input 1 (flow temperature sensor)
5-6	IN2	Input 2 (return temperature sensor)
7-8	IN3	Input 3 (outdoor temperature sensor)
9-10	IN4	Input 4 (configurable as AI or DI)
11-12	IN5	Input 5 (configurable as AI or DI)
13-14	AO1	0-10 V control output for servomotor
15-16	POWER AUX	TRIAC power supply (230 Vac o 24 Vac)
17	CLOSE	Control output for servomotor (closing)
18	COM	Control output for servomotor (common)
19	OPEN	Control output for servomotor (opening)
20-21	DO1	Uscita a relè comando circolatore
22-23	DO2	Relais output (additional functions)
24-25	DO3	Relais output (additional functions)

Switching the seasonal conduction mode

The seasonal (heating / cooling) mode can be switched in three ways:
- from the KNX bus;
- via the front keypad of the controller;
- by means of a switch connected to an input of the controller.

If switching from the KNX bus is selected, the controller receives the conduction mode from another bus device (via a communication object), such as an Ekinex® room thermostat, which has been assigned the master function for seasonal switching.
Switching can be carried out manually using the keypad and the display on the front of the device: in this case, it is the EK-HH1-TP controller that performs the master function of seasonal switching for all Ekinex® devices (sensors, actuators) that are on the same system or part of a system served by the controller.
Switching via a switch connected to input IN5 (configured as DI) is suitable for stand-alone applications in which there is no need for integration between the boiler room (primary adjustment) and the rooms or zones (secondary adjustment). The switch can be the same as the external selector used in the boiler room for switching the operation of heat generators or shut-off valves of fluids.
The current operating mode is stored in the non-volatile memory of the controller.

Activating the mixing group

The mixing group can be activated in three ways:
- from the KNX bus;
- from a controller input;
- from a controller input and the KNX bus.

By selecting the activation from the KNX bus, the controller connects in logical OR the flow requests coming from a maximum of 16 Ekinex® room thermostats. To activate the mixing group it is sufficient that a single room thermostat requires flow.
The activation from an input is suitable for stand-alone applications in which there is no need for integration between the boiler room (primary adjustment) and the rooms or zones (secondary adjustment). A time programmer can be connected to input IN4 to activate the group according to scheduled time slots or the request of a stand-alone room thermostat. In systems with distribution manifolds, the limit switches of the electrothermal drives mounted on the individual valves can be connected in parallel.
An intermediate solution, on the other hand, involves activation both from the binary input and from the KNX bus. The input can have priority over the flow requests coming from the zones via bus (for example an external time zone programming device) or it behaves as an additional zone (without priority).
In all cases it is possible to set an activation delay (from 1 to 255 seconds) for the start of mixing; in fact, it is advisable to wait for the electrothermal drives to bring the valves into the open position to prevent the circulating pump from exerting pressure on hydraulically closed circuits.

Floor radiant system in residential buildings

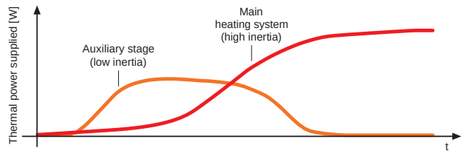
The floor radiant system is a widespread hydronic system for heating and cooling rooms. The heat transfer fluid circulates inside circuits made up of plastic pipes placed under the surface covering of the floor; in the most common version, the pipes are laid on an insulating layer and embedded in the cement base. The system is invisible and uses the whole surface of the floor as a large terminal for the heat exchange prevailing at radiation. In both seasons the system works with a very limited temperature difference between the heat transfer fluid and the room air; for this reason it is also defined as a"low-temperature difference" heating and cooling system.
The system shown in the example is intended for a residential building. It is a combined system, i.e. it combines the radiant floor panels with one or more fan-coil units, mainly for the integration of sensible loads in cooling conduction mode.

Control with Ekinex

The EK-TM1-TP time / astronomical digital switch **(A)** ensures that the system is allowed to operate according to predefined time scheduling and is constantly synchronised with date and time by the (optional) GPS module EK-GPS-1 **(B)**.
The need to produce heat transfer fluid at two different temperatures for the combined system (consisting in floor radiant panels / fan-coil units) is solved by controlling a mixing group with the EK-HH1-TP controller **(I)**. The device controls a mixing valve and a circulating pump; by means of the EK-STI-NTC-3435 sensors **(M, N)** it can measure the flow and return temperatures of the heat transfer fluid. On the unmixed circuit it can also control, as required, a circulating pump **(7)** or a zone valve.
The room air temperature is controlled by room thermostats EK-EQ2-TP **(E)**, measuring temperature and relative humidity, in combination with actuators-controllers for electrothermal drives EK-HE1-TP **(O)** and actuators-controllers for fan-coils EK-HC1-TP **(C)**. The thermostats are able to calculate and send to the bus the dew temperature; if the thermo-hygrometric conditions of the room are close to those critical for the formation of condensation on the cooled surfaces, it is possible to implement one of the several protection strategies provided by the Ekinex® thermoregulation system (see table on the right); for example, recalibration of the flow temperature of the heat transfer fluid through the EK-HH1-TP controller **(I)**.
The optional supervision by means of the Delégo Server **(G)** allows you to monitor and control the home automation system by means of an App for mobile devices **(9)** and/ or a Delégo touch-panel **(H)**.

Two-stage system (main / auxiliary)

In the system configuration of the example, the room thermostat EK-EQ2-TP **(E)** allows you to easily realise a two-stage heating / cooling system. When the main stage consists of a radiant panel system, the high inertia (especially typical of the version with cement base), makes it rather slow in the start-up phase to achieve comfort conditions. In this case, it is possible to configure the fan-coils as an auxiliary stage; thanks to their much lower inertia, they contribute in the initial phase to quickly heat or cool the room and then stop their action when the difference between the measured and setpoint temperatures can be satisfactorily addressed by the main stage alone. The auxiliary stage works in automatic mode with a configurable offset with respect to the temperature setpoint set for the radiant floor (main stage).



Prevention of condensation in cooling conduction mode

In summer cooling operation, the latent loads (due to the increase in the humidity level in the room) are taken care of by the air handling integration.
If this is not done satisfactorily, or in the event of a sudden change in thermohygrometric conditions (e.g. due to accidental stopping of the machines or opening of windows), additional safety measures must be taken to prevent or limit the formation of condensation on cold surfaces. The EK-EQ2-TP **(E)** room thermostats provide various active and passive protection strategies depending on the system configuration and the presence of home automation devices.

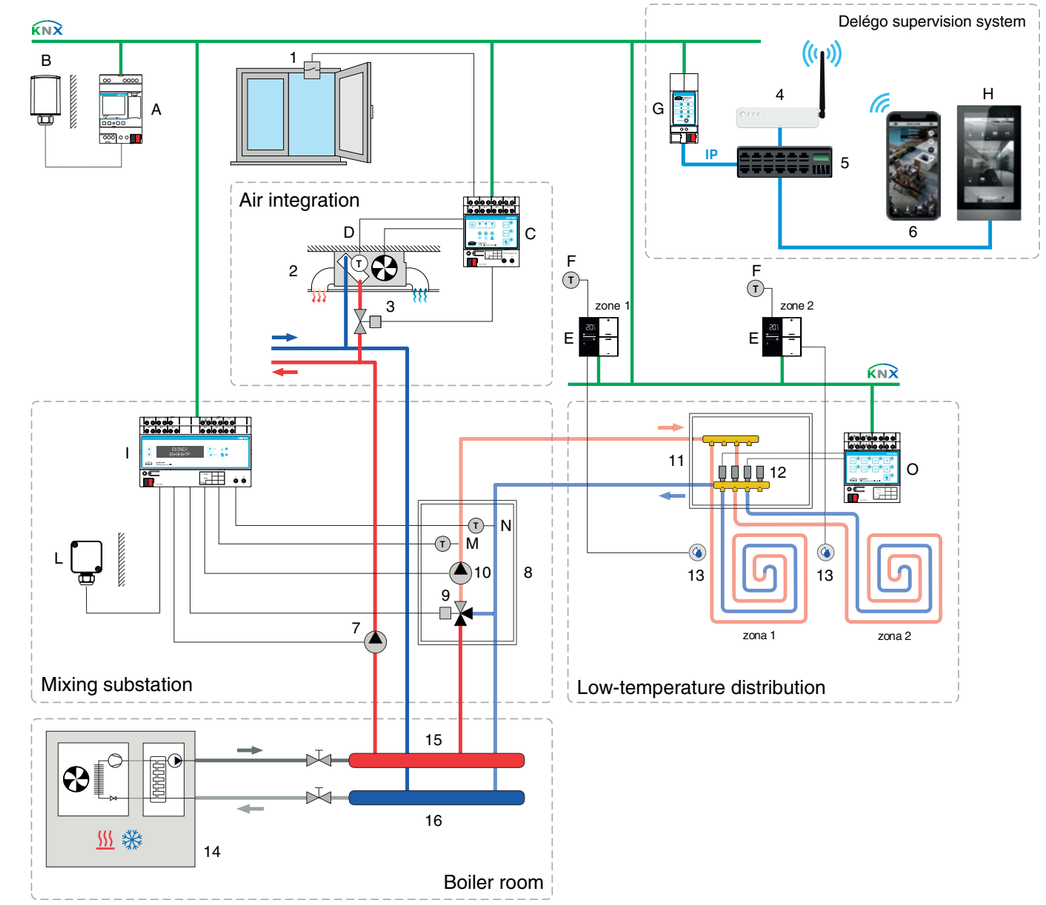
Type	Mode	Action
Passive	With condensation sensor (13) connected to an input of the room thermostat (E)	Closing of the circuit serving the involved room by means of the actuator (O)
	With condensation sensor communicating with the thermostat (E) via KNX bus	Closing of the circuit serving the involved room by means of the actuator (O)
Active	Comparison between flow temperature (fixed design value, ETS parameter) and dew temperature calculated by the room thermostat (E)	Closing of the circuit serving the involved room by means of the actuator (O) when the flow temperature is lower than the dew temperature
	Comparison between flow temperature (measured value received from the KNX bus) and dew temperature calculated by the room thermostat (E)	Closing of the circuit serving the involved room by means of the actuator (O) when the flow temperature is lower than the dew temperature
	The dew temperature from the thermostat (E) is sent via KNX bus to the mixing group controller (I)	Calibration of the cold fluid flow temperature by the controller (I) and maintenance of the opening of the circuit serving the involved room by the actuator (O)

Active protection is always preferable, as the intervention tends to prevent the conditions of formation of condensation, while passive protection intervenes when the formation of condensation has already begun.

Surface temperature limitation

In some cases it is advisable to limit the surface temperature when the radiant floor system is used as an auxiliary stage for heating; the dispersions to the outside of the building are handled by the main heating system, while the auxiliary stage works only to maintain the temperature of the floor at a pleasant level in the bathrooms of residential buildings or in the rooms of sports centers, spas, etc. This limitation is also included in the EN 1264 standard (Underfloor heating, Part 3) which defines the maximum allowed temperature (TS_{max}) for the surface of the floor from a physiological point of view as follows:
- $TS_{max} \leq 29°C$ for areas of normal occupancy of the rooms;
- $TS_{max} \leq 35°C$ for the peripheral areas of the rooms.

Example



Ekinex devices

A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Actuator-controller for fan-coils EK-HC1-TP
D) NTC temperature sensor (contact) EK-STC-NTC-3435
E) Room thermostat EK-EQ2-TP
F) NTC temperature sensor (air) EK-STL-NTC-3435
G) Delégo server EK-DEL-SRV-...
H) Touch panel Delégo EK-DEL-xpan...
I) Mixing group controller EK-HH1-TP
L) NTC temperature sensor (external) EK-STE-NTC-3435
M) NTC temperature sensor (immersion, flow) EK-STI-NTC-3435
N) NTC temperature sensor (immersion, return) EK-STI-NTC-3435
O) Actuator-controller for electrothermal drives EK-HE1-TP

Other system components

1) Window contact
2) Fan-coil unit
3) Valve with ON / OFF servomotor
4) Access point LAN Wi-Fi
5) Switch
6) Smartphone with App Delégo (Apple iOS or Android)
7) Circolating pump for unmixed circuit
8) Mixing group
9) Mixing valve with servomotor
10) Circolating pump for mixed circuit (floor radiant system)
11) Distribution manifold for low-temperature circuits
12) ON / OFF electrothermal actuators
13) Condensation sensor (with signal contact)
14) Thermal generator (warm and cold fluids)
15) Boiler room manifold (flow)
16) Boiler room manifold (return)

Ceiling radiant system in residential buildings

The ceiling radiant system is a hydronic system for room heating and cooling, which was added to the floor version over time; in common it maintains the characteristic of having a low temperature difference between the heat transfer fluid and the room air. The heat transfer fluid circulates inside circuits made up of metal or plastic pipes integrated in a suspended false ceiling; the series of panels are fed by distribution manifolds installed above the circuits served. In residential applications, the false ceiling has a plasterboard finish towards the rooms, suitable for civil buildings, and an insulation layer towards the top. The system is invisible and uses the whole surface of the ceiling as a large terminal for the thermal exchange prevailing at radiation. As in the case of the floor radiant system, the ceiling radiant panels only handle the heat loads of a sensible type; in general, the ceiling solution offers a higher yield in cooling.

The radiant ceiling system shown in the example is used to heat and cool the rooms of a residential building. This particular system is a combined system; it combines the ceiling radiant panels with one or more units for energy recovery ventilation (ERV), whose basic function is the renewal of the room air with high efficiency heat recovery. In this case, moreover, they are complete machines for the air handling of the rooms, able to support the operation of the system in summer cooling, also performing the functions of dehumidification (with reduction of the cooling latent load) and handling of part of the sensible cooling load.
Usually these machines do not serve a single room, but several rooms or an area of a building. In the residential sector, for example, it is common to use one machine for the living zone and a second one for the night zone. The installation is typically made in a central position with respect to the served zone, for example recessed in the false ceiling in the hallway or in the corridor.

Control with Ekinex

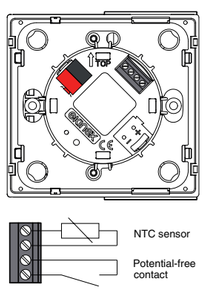
The EK-TM1-TP time / astronomical digital switch **(A)** ensures that the system is allowed to operate according to predefined time scheduling and is constantly synchronised with date and time by the GPS module (optional) EK-GPS-1 **(B)**.
The room thermostat EK-EQ2-TP **(E)** measures temperature and relative humidity and is installed in a position exposed to the air flow generated by the machine **(1)**. In heating or cooling mode, at the request of the thermostat, the actuator-controller EK-HE1-TP **(D)** controls the opening of the zone valve **(8)** of the radiant ceiling. If necessary, an additional NTC temperature sensor **(F)** can be connected to the room thermostat **(E)** to carry out adjustment based on a weighted average temperature value.
At the seasonal switchover to cooling mode, the actuator-controller **(D)** closes the seasonal valve **(5)** to avoid feeding the towel warmers with cold heat transfer fluid.
The contacts for the start / stop of the cooling integration **(2)** and dehumidification **(3)** are activated by the binary output EK-FE1-TP **(C)**. Cooling integration is activated when the temperature measured by the room thermostat **(E)** exceeds the setpoint value by a predefined offset value (for example: 1.5 °C). Dehumidification is activated when the relative humidity measured by the room thermostat **(E)** exceeds the threshold value predefined in the system design (for example: 50%).
A sensor **(10)** to detect the formation of condensation during cooling operation can be connected to the room thermostat **(E)**. This optimization makes it possible to increase the operational safety of the system, closing the circuits involved by means of the zone valve **(8)** if the thermohygrometric conditions should cause the beginning of condensation on the cooled surfaces.
The optional Delégo supervision (not shown in the diagram) allows you to monitor and control the entire home automation system through an App for smartphones.

Focus on the EK-EQ2-TP thermostat

The Ekinex® room thermostat EK-EQ2-TP **(E)** allows the measurement of the temperature and relative humidity of the room air mass by means of integrated sensors with the possibility of sending values on the KNX bus. The relative humidity measurement significantly expands the room air conditioning functions and increases the comfort and safety of the room. Thanks to the calculation of the dew temperature, it is possible to carry out active strategies to protect against the formation of condensation when using radiant panel systems for summer cooling. In combination with the Ekinex® actuators-controllers for HVAC functions, the device allows a complete independent climatization for each room or zone, adding to the function of controller for heating and cooling the possibility to effectively control the dehumidification and humidification of the rooms.
The display also allows you to view a series of information such as:
- temperature (measured and setpoint in °C o °F);
- relative humidity (measured and setpoint in %);
- CO_2 concentration (received by the KNX bus in ‰);
- perceived temperature (calcolated according to the Humidex index in °C);
- outdoor temperature (received by the KNX bus or a NTC sensor in °C o °F).

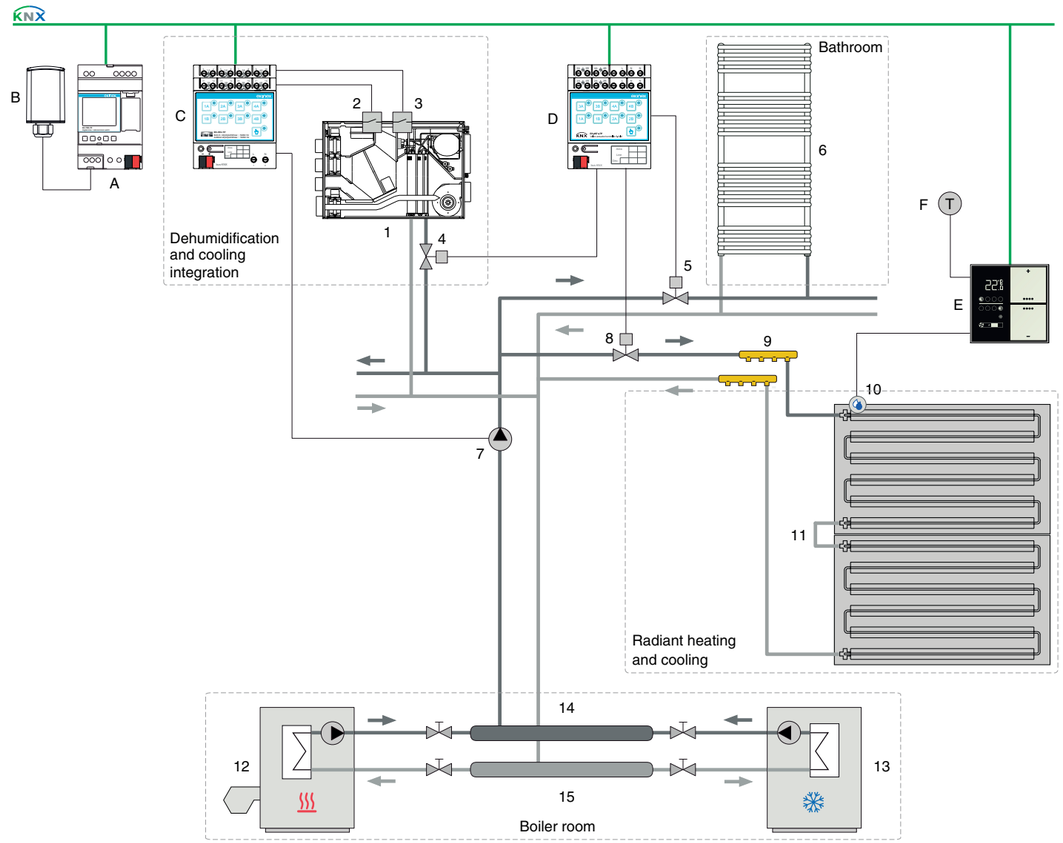
Using configurable inputs

Thanks to the two configurable inputs of the device, the thermostat allows additional functions to be carried out that can increase comfort and energy saving, without the need for additional input bus devices. If configured as analogue, to the input is only allowed the connection of a NTC temperature sensor with characteristic resistance value 10 kΩ at 25°C, ß = 3435 (Ekinex® codes EK-STx-10K-3435 with x = E, I, C, L).



Input configuration	Predefined applications
Digital [DI]	window contact
	card holder contact
	condensation sensor
Analogue [AI]	heat exchange battery temperature sensor
	room temperature sensor
	stratification temperature sensor
	floor surface temperature sensor
	outside temperature sensor
	NTC generic temperature sensor

Example



Ekinex devices
A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Binary output EK-FE1-TP
D) Actuator-controller for electrothermal drives EK-HE1-TP
E) Room thermostat EK-EQ2-TP
F) NTC temperature sensor (air) EK-STL-10K-3435

Other system components
1) Energy recovery ventilation (ERV) unit with dehumidification and cooling integration
2) Contact for dehumidification start / stop
3) Contact for cooling integration start / stop
4) Valve with ON / OFF servomotor
5) Seasonal valve with ON / OFF servomotor (towel warmer)
6) Towel warmer
7) Circolating pump
8) Zone valve (ceiling radiant system) with ON / OFF servomotor
9) Distribution manifold for radiant ceiling circuits
10) Condensation sensor (with signal contact)
11) Ceiling radiant system panels (series)
12) Thermal generator (warm fluid)
13) Thermal generator (cold fluid)
14) Boiler room manifold (flow)
15) Boiler room manifold (return)

Ceiling radiant system in functional buildings

The ceiling radiant panel system is widely used in offices and, more generally, in large functional buildings such as hospitals, shopping malls, schools, universities, airports or stations.
In these cases, the suspended ceiling is made up of metal panels **(7)** that can be inspected completely similar to those usually used in these buildings, but with hydronic circuits applied to the upper part and possibly an insulating layer towards the plenum. The hydronic circuits consist of metal or plastic pipes and metal thermal diffusers that exchange heat between the pipes and the metal surface of the false ceiling.
The series of radiant panels are powered by distribution manifolds installed above the circuits served. The system is invisible and uses the entire surface of the ceiling as a large terminal for the heat exchange (prevailing as radiation). As in the case of the floor system, the ceiling radiant panels only handle the sensible heat loads; in general, the ceiling solution offers a higher yield in cooling.

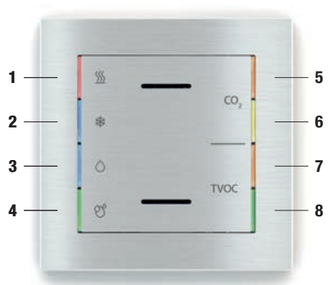
The ceiling radiant system shown in the example is used for heating and cooling the rooms of a functional building. The distribution is made with a 4-pipe system that make available both fluids at the same time to heat or cool the room. This type of distribution can be advantageous when it is expected that the thermal loads can vary greatly during the same day or depending on the different exposures of the building.
In this application, the air renewal and dehumidification functions are performed by a system with air centrally treated by an air handling unit and distributed in the rooms by means of ducted systems and diffusers. As an alternative to the diffusers, and in the absence of insulation towards the plenum, the microperforation present on the metal panels can be used for the diffusion of renewal and dehumidified air in the rooms.

Control with Ekinex
The room air temperature is controlled in each zone or room by means of an EK-ET2-TP **(F)** multisensor in combination with the EK-HE1-TP actuator-controller **(C)** that controls the servomotors of the zone valves that regulate the flow of hot or cold heat transfer fluid to the series of radiant panels. Thanks to the relative humidity measurement, the multisensor **(F)** is also able to calculate the dew temperature and send it via bus to higher level systems (BMS) through appropriate gateways.
Where necessary, the multisensor **(F)** can receive a measured temperature value from an Ekinex® pushbutton **(E)**, normally used to control other bus functions such as lighting or shading, to control with a weighted temperature value. This can typically be done in large or high rooms, where the temperature value measured by the multisensor is not fully significant of the general temperature conditions in the room.
The input interface EK-CD2-TP **(H)** provides for the acquisition of signals from condensation sensors **(5)** and window contacts **(6)**. The condensation sensor **(5)** is installed in contact with the first heat exchange element served by the hydronic circuits in order to timely detect the possible formation of condensation when the cooling mode is active and let the actuator-controller **(C)** close the zone valve **(4)**, bringing the system to safety.
To reduce energy consumption, the operating mode can be automatically switched when detecting the absence of people within the zone using the EK-DF2-TP presence sensor **(G)**, recalling temperature attenuations of an opposite sign in the heating and cooling conduction modes.

Focus on the multisensor
The Ekinex® multisensor **(F)** is a complete device for controlling indoor room comfort that combines many functions usually distributed among several sensors and different controllers. The device measures temperature, relative humidity and air quality (parameters: TVOC concentration in ppb and/or equivalent CO_2 concentration in ppm) using the integrated sensors, with the possibility of sending values to the KNX bus, and can also act as a controller for each of the measured parameters. With a single compact device it is therefore possible to control both the thermohygrometric conditions and the quality of the room air mass.
In special cases (large or high rooms, in the presence of strong asymmetry in the temperature distribution or when the device is installed in an unsuitable position), the room air temperature can be controlled by using a weighted average between two temperature values: the first measured by the integrated sensor and the second received by the KNX bus. Two independent thresholds for relative humidity and three thresholds for CO_2 and TVOC concentration can be configured. To implement automation logic, combinatorial functions such as AND, OR, NOT and exclusive OR are available; thanks to these functions, it is possible to use the information available on the home automation system to control air renewal according to the actual need (DCV or Demand Controlled Ventilation).

Versions
EK-ET2-TP with temperature, relative humidity and CO_2 eq. measurement
EK-ES2-TP with temperature, relative humidity, TVOC and CO_2 eq. measurement

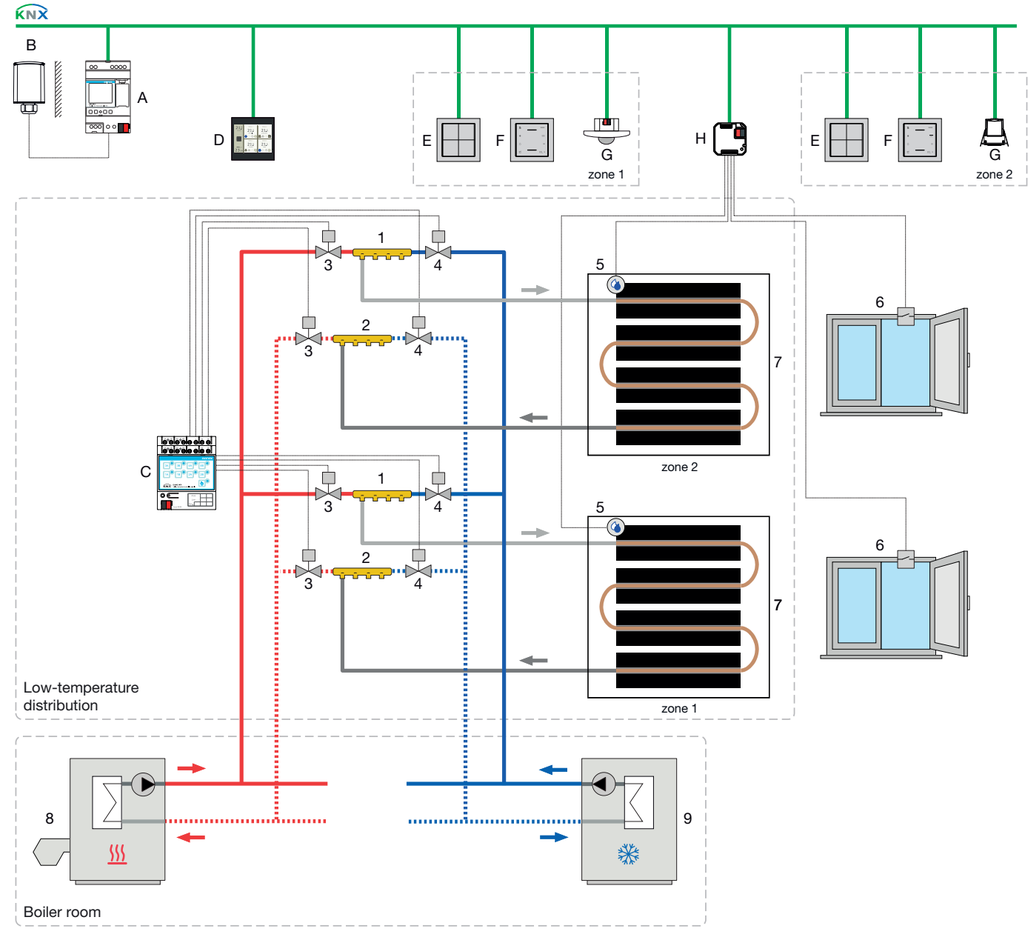
LEDs
The eight integrated LEDs (with light guide), positioned on the sides of the front cover, can be configured to indicate the active operating mode of the heating system (heating or cooling), the concentration of CO_2 (equivalent) and TVOC (only for EK-ES2-TP version) and the activation of the dehumidification or humidification function.



LED	Colour and meaning (EK-ES2-TP version)
1	white (heating mode) or red (heating ON)
2	white (cooling mode) or blue (cooling ON)
3	blue (dehumidification ON)
4	green (humidification ON)
5	red blinking (CO_2 eq. concentration > threshold 3) orange (CO_2 eq. concentration between thresholds 2 and 3)
6	yellow (CO_2 eq. concentration between thresholds 1 and 2) green (CO_2 eq. concentration < threshold 1)
7	red blinking lampeggiante (TVOC concentration > threshold 3) orange (TVOC concentration between thresholds 2 and 3)
8	yellow (TVOC concentration between thresholds 1 and 2) green (TVOC concentration < threshold 1)

ekinex | HVAC APPLICATIONS

Example



Ekinex devices
A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Actuator-controller for electrothermal drives EK-HE1-TP
D) Touch&See display EK-EC2-TP
E) 4-fold pushbutton (8 functions) EK-E12-TP
F) Multisensor EK-ET2-TP
G) Presence sensor EK-DF2-TP
H) Universal interface EK-CD2-TP

Other system components
1) Distribution manifold for low temperature circuits (flow)
2) Distribution manifold for low temperature circuits (return)
3) Valve with ON / OFF servomotor (warm fluid)
4) Valve with ON / OFF servomotor (cold fluid)
5) Condensation sensor (with signal contact)
6) Window contact
7) Ceiling radiant panels (series)
8) Thermal generator (warm fluid)
9) Thermal generator (cold fluid)

Air renewal with energy recovery ventilation units

The high level of insulation and the high-performance windows and doors used in new buildings or in buildings that have undergone major renovation to meet the energy efficiency requirements of EPBD directive (91/2002/EC and following releases) have greatly reduced heat losses to the outside and, at the same time, have in many cases made it necessary to use mechanical ventilation units for air renewal with energy recovery. The manual control of these units alone is inadequate to ensure energy efficiency in their operation and even a simple time scheduling is not fully satisfactory. As pointed out by EU Regulations no. 1253 and 1254 of 2014, for these ventilation units it is necessary to use an environmental control by measuring one or more parameters to automatically adjust the flow of fresh air to be introduced into the rooms.

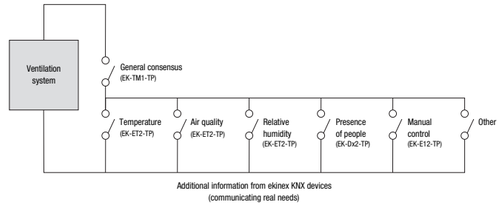
Control with Ekinex

The EK-ET2-TP multisensor **(D)** measures three environmental parameters that are representative of the ventilation requirement: the main one is the air quality (as CO_2 concentration in ppm), together with the relative humidity (in %) and the temperature (in °C). Other useful environmental parameters are the detection of the presence or movement of people inside the rooms by means of the EK-DF2-TP sensor **(E)** or signals due to the activation of other home automation functions, such as lighting switching by means of the pushbutton **(F)** of 20venti series. The EK-TM1-TP **(B)** digital time / astronomical switch **(B)** also provides start / stop command for the ventilation system according to predefined time scheduling and is constantly synchronised with the date and time by the (optional) GPS module EK-GPS-1 **(C)**.

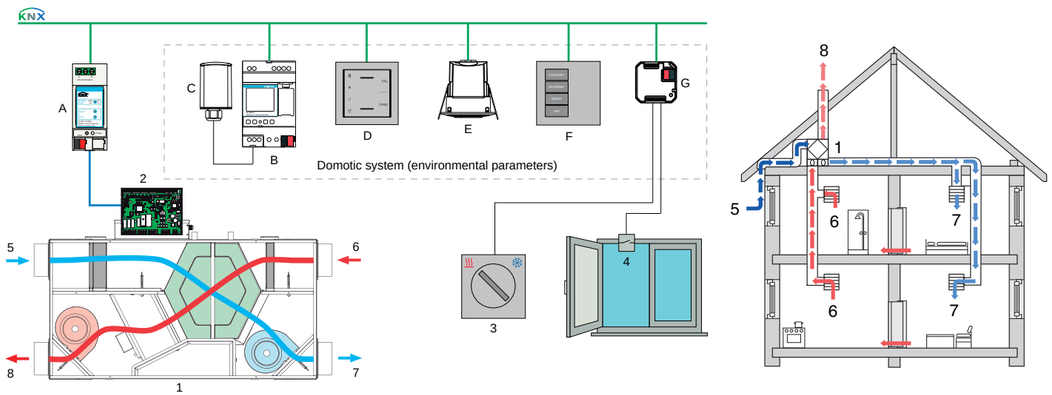
The EK-BO1-TP-RMA interface **(A)** for RDZ mechanical ventilation units with energy recovery provides bidirectional communication between KNX devices and the control board **(2)** of the unit. The EK-CC2-TP universal interface **(G)** acquires signals from traditional components, such as a manual switch for seasonal changeover **(3)** or a window contact **(4)**.

Demand controlled ventilation

Thanks to the many environmental parameters made available by the Ekinex® home automation system, it is possible to carry out ventilation control according to the actual need for air renewal (a strategy known as DCV or Demand Controlled Ventilation). This allows to constantly adjust the air flow rate to be introduced into the rooms to the real needs with the aim of maintaining a constantly high air quality, while minimizing the energy consumption. Air quality can typically be controlled by measuring the CO_2 concentration. With this kind of control, energy savings are twofold: the operating time of the fan units is reduced and the flow rate of fresh air to be handled, before release into the rooms, through heating, cooling, humidification and dehumidification processes.



Example



Ekinex devices
A) Modbus / KNX interface for RDZ air renewal units
B Time / astronomical digital switch EK-TM1-TP
C) GPS module EK-GPS-1
D) Multisensor EK-ET2-TP or EK-ES2-TP
E) Presence sensor EK-DF2-TP
F) Pushbutton Serie 20venti
G) Universal interface EK-CC2-TP

Other components
1) Mechanical ventilation unit with energy recovery
2) Control board of RDZ ventilation unit
3) Two-position switch
4) Window contact
5) Fresh air (from outside)
6) Stale air (from inside)
7) Pre-heated air (to inside)
8) Exhaust air (to outside)

Air renewal with VAV boxes

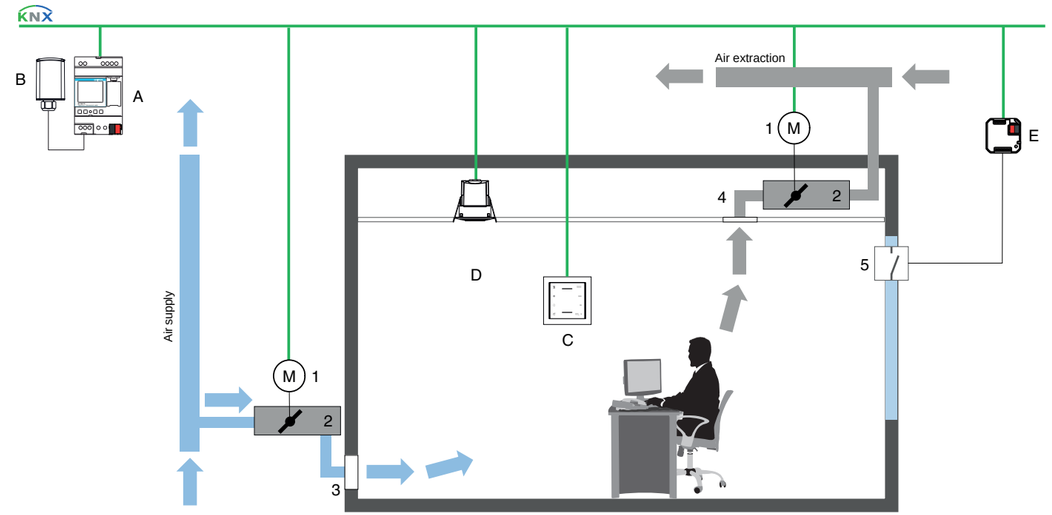
The VAV (Variable Air Volume) systems are designed for room ventilation according to the actual needs, having inside the appropriate boxes **(2)** motorized dampers **(1)** that act as a regulator of the fresh air flow. In combination with the home automation sensors installed in the room, the system guarantees high energy efficiency, since the room can be ventilated according to one or more parameters measured in the room.
The use of an EK-TM1-TP time digital switch **(A)**, possibly with optional GPS module **(B)**, allows not only to define the operating time scheduling for the ventilation system according to the expected occupation of the building, but also advanced functions like, for example, the activation of a washing cycle of the room air before the beginning of working hours.
The use of a presence sensor EK-DF2-TP **(D)** is indicated when you want to make an automatic control of simplified type with opening of the damper of the VAV box in conditions of occupied room and setting the minimum flow rate to save energy when the room is not occupied. Higher efficiency is achieved by using a multisensor **(C)** that can adjust the flow rate of incoming air according to the measurement of air quality and the predefined thresholds.

The signal of a window contact **(5)**, detected by an input interface EK-CC2-TP **(E)**, allows to temporarily deactivate the ventilation so as not to waste unnecessarily energy; the reactivation takes place automatically when the window is closed.

Control based on CO_2 or TVOC values

The choice of the control parameter depends mainly on the intended use of the rooms. Where the variability in the occupancy rate is very high or unpredictable (such as in meeting rooms, classrooms or small commercial environments) CO_2 is the most used indicator because its concentration is directly related to human activity and, in particular, to breathing. Although CO_2 is not harmful to human health (except in very high concentrations, which are difficult to achieve), it has a direct impact on the concentration capacity and productivity of the occupants. When the number of people in the room is predictable and limited, the detection of volatile organic compounds (or TVOC), a set of organic chemicals continuously emitted from furniture, paints, cleaning solvents, adhesives or other synthetic materials due to their high volatility, may be more significant.

Example



Ekinex devices
A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Multisensor EK-ET2-TP
D) Presence sensor EK-DF2-TP
E) Universal interface EK-CC2-TP

Other system components
1) KNX servomotor for dumper (not delivered by Ekinex)
2) VAV (Variable Air Volume) box
3) Air supply outlet
4) Air extraction outlet
5) Window contact

Interfacing VRF systems

Variable Refrigerant Flow (VRF) systems are used in the summer and winter air conditioning of buildings and in the production of domestic hot water. They are based on the expansion of the refrigerant fluid that passes through the heat exchange terminals (indoor units); in this way the transformations of the fluid (evaporation in cooling and condensation in heating) take place directly in the room through the exchange coils.

Control with Ekinex

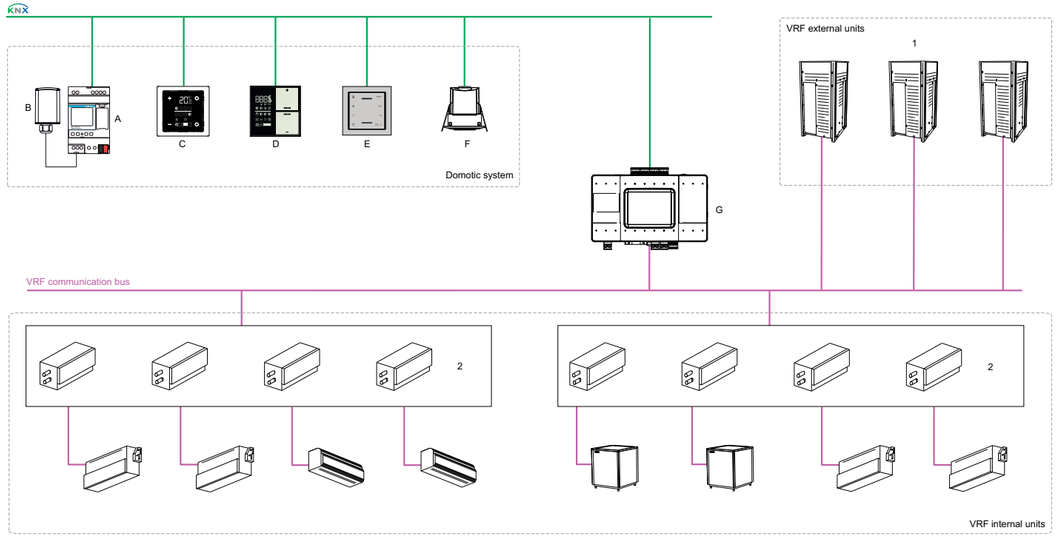
VRF systems generally have their own bus system for communication between the various devices making up them; thanks to the EK-BQ1-TP gateway **(G)** it is possible to interface Ekinex control devices, such as EK-TM1-TP **(A)** time / astronomic digital switches, EK-EQ2-TP **(C)** or EK-E72-TP **(D)** room thermostats, EK-ET2-TP **(E)** multisensors or EK-DF2-TP **(F)** presence sensors, to the communication bus dedicated to air conditioning systems realised with VRF and split heat exchange terminals.

Among the controls* that the gateway **(G)** provides on the KNX side are for example:
- on / off
- mode (Cool, Heat, Auto, Fan)
- fan speed
- temperature setpoint
- feedback of room temperature
- error code

The device supports systems of the following manufacturers: Mitsubishi Electric, Daikin, Toshiba, Panasonic, Sanyo, Hitachi, Mitsubishi Heavy Industries, LG, Samsung, and Gree.

*) Some control options may be restricted by manufacturers.

Example



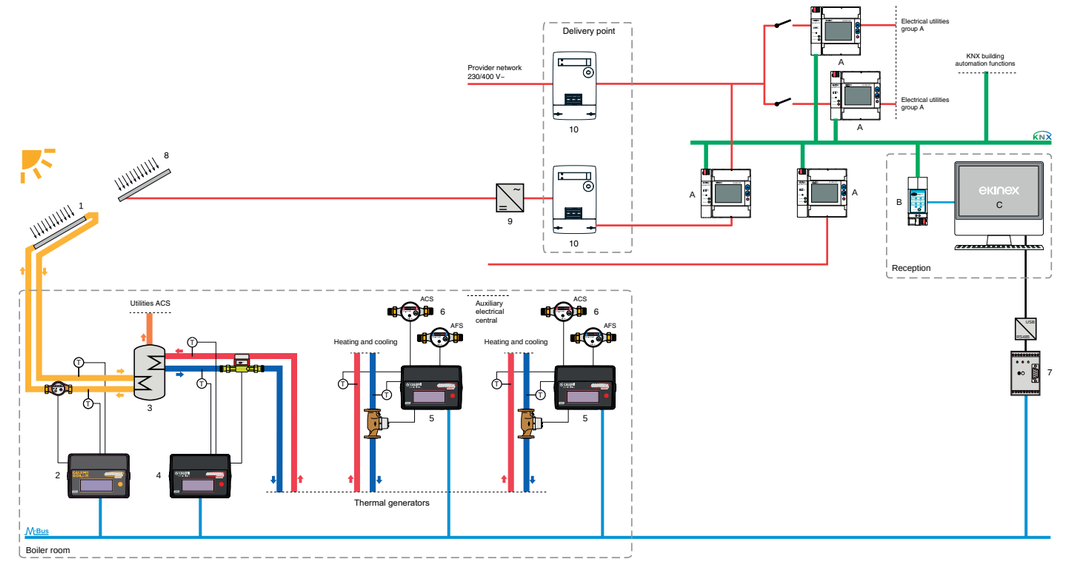
Ekinex devices
A) Time / astronomical digital switch EK-TM1-TP
B) GPS module EK-GPS-1
C) Room thermostat EK-E12-TP
D) Room thermostat EK-EP2-TP
E) Multisensor EK-ET2-TP
F) Presence sensor EK-DF2-TP
G) CoolMasterNet gateway EK-BQ1-TP

Other system components
1) Outdoor units (VRF system)
2) Indoor units (VRF system)

Consumption monitoring

An increasing number of European and national measures require the provision of timely and detailed information to end-users on the consumption of their buildings. This corresponds to the need to make users more aware of their behaviour and to trigger a virtuous process to reduce the waste of resources in buildings. The inspiring principle of the European Union's measures is that energy efficiency should be equated with a real source of energy; in other words, increased energy efficiency and better management of demand should be put on an equal footing with generation capacity.
As far as the thermal part is concerned, the measurement of consumption and local energy production is particularly important, since in residential buildings space heating and domestic hot water production account on average for about 80% of final energy consumption.
Directive 2006/32/EC initially identified the widespread use of smart metering systems as an essential action to improve energy efficiency. Directive 2012/27/EU then required that final customers of electricity, natural gas, district heating, district cooling and domestic hot water receive individual meters of actual consumption; its transposition by Legislative Decree No. 102 of 2014 led in buildings with centralised heating generation (or served by a district heating network) to the installation by the end of 2016 of individual meters or heat energy meters. Finally, Directive 2018/2002/EU requires newly installed heat meters and heat cost allocators to be remotely readable from 2020. By 10 January 2027, already installed meters and heat meters that do not have remote reading capability must also be equipped with remote reading capability or replaced with devices that can be read remotely. To this end, it is advantageous to exploit the infrastructure of the home automation system, where present, not only for its numerous monitoring and visualisation possibilities, but also for its ability to control in real time and intervene on all the system functions that may cause waste.

Example



Ekinex devices
A) Electricity meter with KNX communication module EK-MC1-TP
B) KNX / IP router EK-BC1-TP
C) Supervision software

Other system components
1) Solar panels
2) Heat meter (solar system)
3) Hot water storage tank
4) Thermal energy meter (domestic hot water)
5) Central heat energy meter (heating/cooling)
6) Domestic hot and cold water meters
7) M-Bus power supply
8) Photovoltaic solar panels
9) Photovoltaic inverter
10) Electricity meter (delivery point)

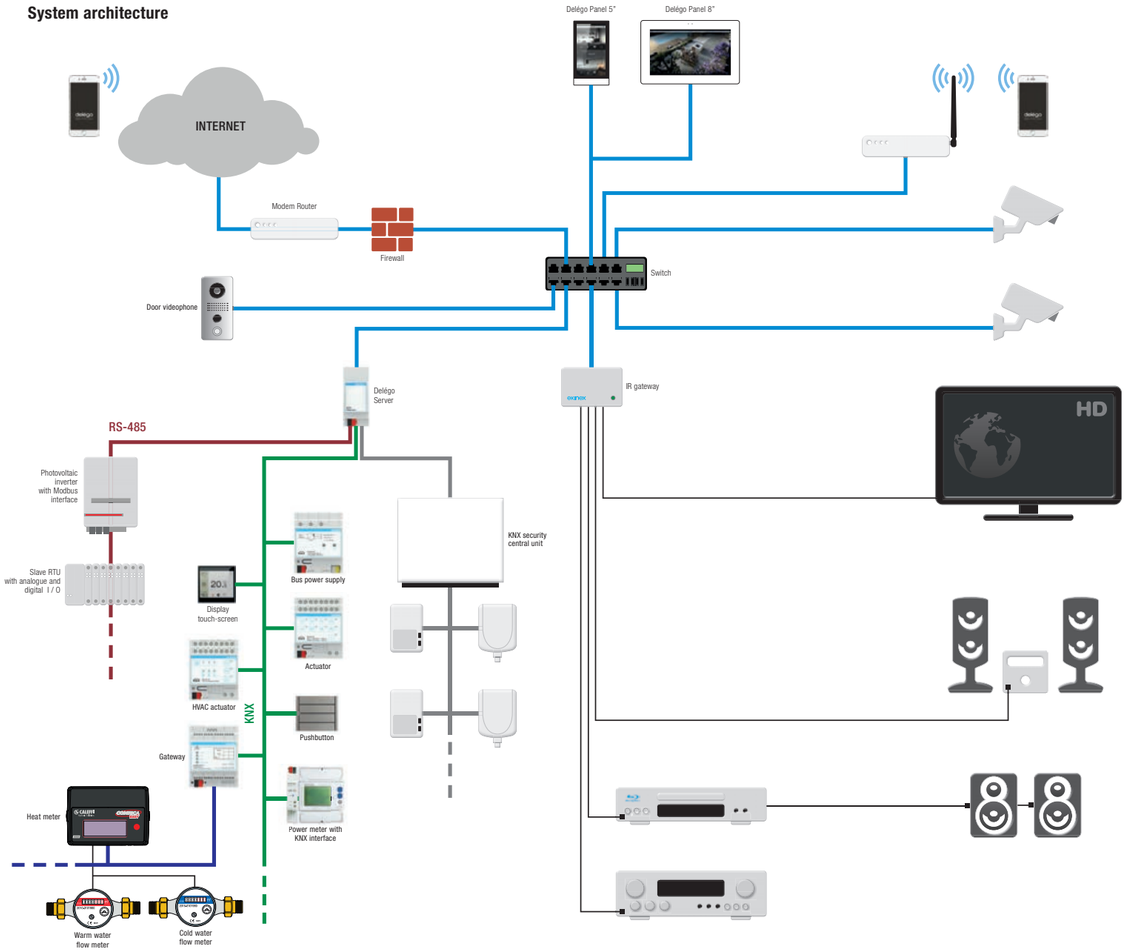
Delégo supervision system

Delégo is a complete system for the supervision and control of a KNX standard system. Developed with web-oriented technologies, it features a uniform interface with high graphical impact on each platform with local and remote connection. The system consists of the EK-SRV-... server to be installed in an electrical cabinet which is directly connected to the KNX bus; the connection to the router is made via the Ethernet port on the local area network (LAN). Delégo offers multiple possibilities of use:

- via desktop PCs
- from mobile devices, smartphones and tablets (Apple iOS and Android);
- with one or more Delégo panel (available with 5" or 8" capacitive display).

The system is characterized by a simple and at the same time extremely complete configuration, thanks to the direct import of the ETS project file. The functional definition of the various imported objects and the correspondence with a rich and customizable set of controls (widgets) for the user is also very easy. The interface is simple and intuitive and allows the user to interact with the building automation system through the use of different devices, with absolute uniformity of use. The app allows you to control all functions with a simple touch, from a single device and from anywhere in the building reached by the Wi-Fi network, or remotely via web connection.

System architecture



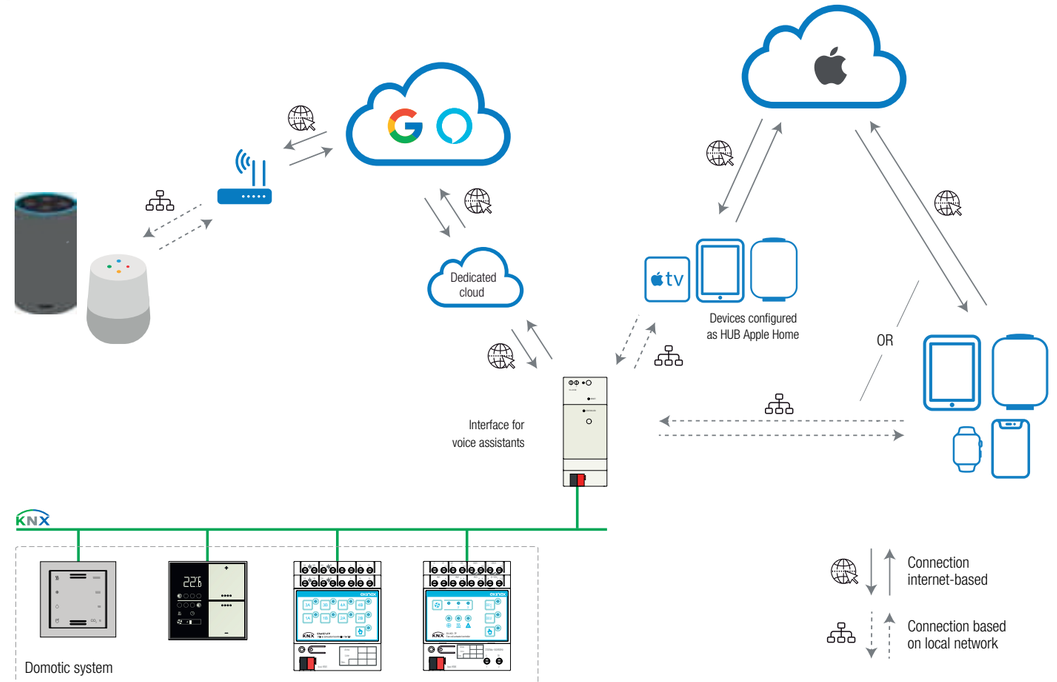
Control with home speaker / voice assistants

In recent years, voice assistants integrated into home speakers have become firmly established, not only for interaction with the web, but also as an easy and intuitive control interface for a smart building.
Voice control offers the ability to control several room functions in the most natural and immediate way. For many users, it can be even simpler than an app for smartphones, since it does not require them to read selection menus or interpret graphic symbols: it is sufficient to pronounce the action to be carried out. Even in hospitality facilities there are environments and users who can benefit from this; voice commands can make systems and technologies more accessible, whose use is seen as too demanding by users who are unfamiliar with technology.

Control with Ekinex

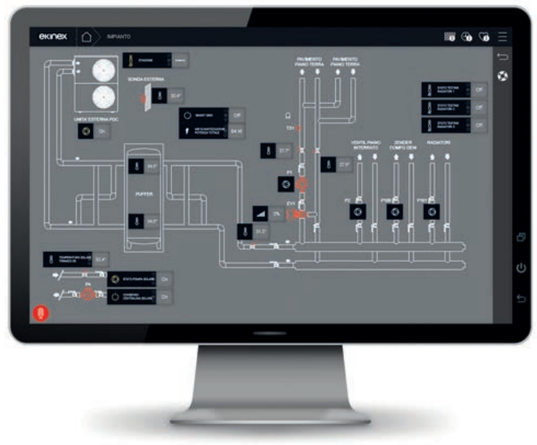
The Ekinex home speaker interface allows the most popular voice assistants to interact with the building automation system. Thanks to the device, it is possible to interface all KNX devices from the Ekinex range and control a multitude of functions, such as the control of lighting, heating and cooling or shading, using simple voice controls.

System architecture



Monitoring of technical systems

The monitoring and supervision of technical systems plays a fundamental role in functional buildings: in fact, it is absolutely essential for users to ensure a high level of service and maximum continuity of operation of the systems.
Based on the needs of the individual building, the system allows to keep under control a set of values, parameters, states and quantities relevant to the operation of the several systems; the comparison with the values of design and reference standards allows to highlight any anomalies, analyze the deviations and quickly restore the optimal operation. The inclusion in the system of the signaling of technical alarms is decisive for the timely intervention of the service and maintenance personnel. The integration between the monitoring of technical systems and the building automation system offers the possibility to increase the efficiency in the use of resources, reducing waste, to exploit the full potential of technical systems, to limit the need for inspections and to allow a longer life of individual components or complex equipments.
Thanks to centralization and real-time availability of information, it is easier for building maintenance personnel to identify problems on the synoptic diagrams and then report them to the technicians responsible for service. This is especially important for facilities spread across multiple buildings with a multitude of technical rooms and substations.



Indoor environmental quality (IEQ)

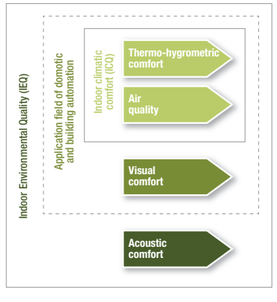
The legislative and standard framework for building design has evolved profoundly since the early 2000s. The European Union has drawn attention to the fact that buildings are responsible for 40% of final energy consumption - and 75% of them are still energy inefficient - requiring Member States to make a major recovery of efficiency through mandatory transposition directives. On the other hand, this action must not decrease the comfort and well-being of the end-users of buildings, also considering the high proportion of time spent indoors. The concept of Indoor Environmental Quality (IEQ) has therefore been affirmed, underlining the importance of ensuring high environmental quality within confined spaces, together with the recovery of energy efficiency.
This is a comprehensive approach in four dimensions:
- thermo-hygrometric comfort;
- air quality;
- visual comfort;
- acoustic comfort.

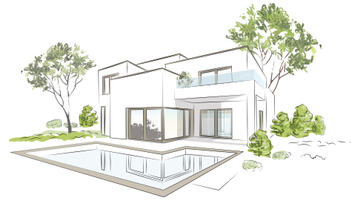
The first two dimensions are representative of the Indoor Climate Quality (ICQ) and are directly influenced by the heating, cooling, dehumidification, air renewal and ventilation systems and by the functions carried out by the building automation and control system.

In 2008, the IEQ concepts were recognised with the publication of EN 15251 standard, which was replaced in 2019 by EN 16798-1 standard.

References

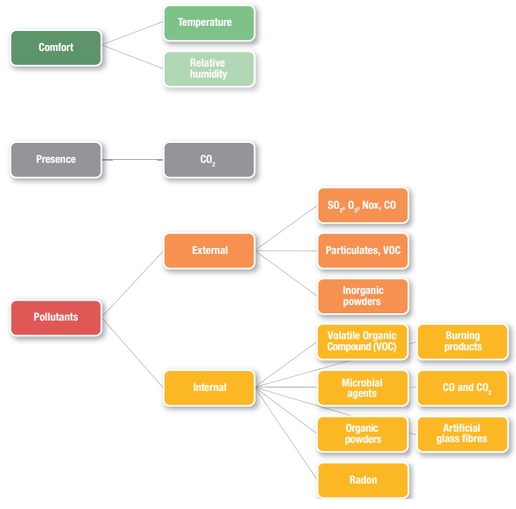
EN 16798-1:2019 Energy performance of buildings. Ventilation for buildings. Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6





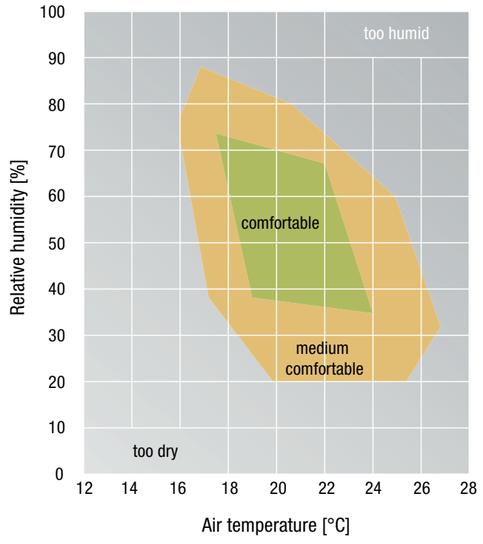
Indoor Climatic Quality (ICQ)

There are many parameters that influence indoor climate quality (ICQ); as a first approximation, they can be grouped into three categories.
- Temperature and relative humidity mainly concern the thermo-hygrometric comfort and the well-being felt by the end-users of a building. In moderate thermal rooms these parameters do not have an impact on human health.
- CO_2 is mostly produced by breathing people and animals, but it is only harmful above very high concentrations that are usually not reached inside buildings. However, a high concentration of CO_2 in confined spaces negatively affects people's productivity and cognitive abilities; this parameter is often used as a reference for evaluating the quality of the room air mass.
- The actual pollutants can instead have consequences on human health; the extent varies and ranges from simple olfactory stress and headaches, through biological effects such as irritation and allergic reactions, to serious diseases in case of very prolonged exposure. Pollutants can be divided into two categories according to their origin: internal or external. Due to the inevitable exchange of air between outside and inside, external pollutants are generally also detectable inside. Indoor pollutants are numerous and heterogeneous, but particular attention should be paid to Volatile Organic Compounds (VOCs) and airborne dust (PM or Particulate Matter). Many synthetic substances introduced on the market in recent decades belong to the VOC class and for most of these there is still not enough information to determine their hazardousness.



Thermo-hygrometric comfort

Climatic comfort is a complex concept, since it depends on a large number of variables, both objective and subjective; moreover, the conditions within confined spaces are subject to transients and the occupants themselves, aware or not, can implement adaptive behaviours.
In terms of thermo-hygrometric comfort, the two main parameters to be controlled are the temperature and relative humidity of the air; during the design of the HVAC system, desired values are defined, which are then taken as a setpoint values by the control and regulation devices.
Actually, there are several combinations of temperature and relative humidity resulting in a comfortable climate defining a "comfort zone" that may be represented in a diagram. Some home automation devices allow this zone to be defined by means of five parameters (minimum and maximum temperature, minimum and maximum relative humidity and absolute humidity), informing system supervision when the combination of measured values is outside the comfort zone.
The EN ISO 7730 standard offers the design tools to assess not only the overall comfort experienced by occupants of moderate thermal environments using the PMV (Predicted Mean Vote) and PPD (Predicted Percentage of Dissatisfied) indexes, but also any local discomfort using four indexes that consider respectively the air currents, the vertical air temperature gradient, the temperature, the floor temperature and the radiant asymmetry.



References

EN ISO 7730:2005 Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria

Air quality

When we talk about air quality, we generally think of the outdoor air, due to polluting and climate-altering emissions caused by production activities, vehicle traffic or winter heating of buildings. But today we are aware that problems of poor air quality can arise even indoors, due to pollutants from both inside and outside the building and by the increase in the concentration of CO_2 produced by human presence.
This is not to be underestimated, since in Europe, on average, more than 90% of one's time is spent indoors: in Italy, for example, 55% in the home, 33% in the workplace, 4% in other environments, while only a residual percentage of time is spent outdoors. In addition, 10 to 20 m^3 of air are inhaled every day, depending on age and activity: this corresponds to an air mass that varies between 12 and 24 kg, much greater than that of food and drinking water consumed every day.
In this case we are talking about air quality in confined spaces (IAQ, or Indoor Air Quality), a topic that has come back in recent years when we began to build and renovate buildings in accordance with the provisions of the law following the directive on energy performance in buildings (2002/91/EC). With the aim of minimising heat loss to the outside, buildings are now strongly insulated and fitted with sealed doors and windows; this increases energy efficiency, but still makes them airtight. In these conditions, air renewal by manual opening of windows alone is inadequate and people are exposed to the risks of increased concentration of slowly but constantly emitted pollutants from the synthetic products used in the construction sector and from the consumer products present in all buildings.

If exposure to pollutants becomes very prolonged over time, the problem is no longer just the well-being in confined spaces, but can also seriously affect people's health. It is therefore clear why it is important to take all the necessary precautions to ensure high air quality.
Several studies show that adequate ventilation in the workplace leads to higher productivity and fewer absences for health reasons. In school environments, high air quality helps students to concentrate, while in commercial buildings it makes shopping time more enjoyable. On the other hand, the room ventilation means an energy cost that can become relevant. The control of air renewal by the home automation system makes it possible to reach the best compromise between high air quality and high energy efficiency. Using home automation for this purpose also means reducing the number of sensors to be installed and making multifunctional use of the devices and signal wiring already provided in the building for other functions, such as air conditioning, lighting or shading control.

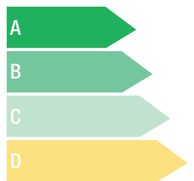
Building automation and European directives

In recent years, the interest in building control and automation systems has considerably increased: now they are considered by directives and standards as a fundamental element to achieve the ambitious energy efficiency objectives of the European Union, while maintaining a high level of comfort in all situations.
The energy efficiency and performance of buildings has been a focus of attention for designers, builders and end-users since 2002, when Directive 2002/91/EC on the energy performance of buildings was published. The second revision of this Directive (2018/844/EU) aims at spreading intelligent technologies as much as possible inside buildings. This latest version is therefore particularly important for the sector of home automation and building automation, as it actively promotes the widespread use of these systems. The directive requires that non-residential buildings with heating (or heating and ventilation combined) systems with an effective rated output of more than 290 kW must be equipped with automation and control systems by 2025, while for residential buildings there is a requirement for continuous electronic monitoring to measure the efficiency of the systems and inform owners (or administrators) if significant efficiency drops or need for maintenance occur. To these must be added effective control capabilities to optimize power generation, distribution, storage and consumption.
The Directive also introduces the Smart Readiness Indicator (SRI), which provides summary information on the intelligence of the building to all interested parties: end-users, designers, builders, investors, operators and service providers. The indicator summarises the ability of the building to maintain energy efficiency and its functioning by adapting its energy consumption using, for example, available renewable sources. In addition, the building must adapt its operation to the needs of end-users, ensuring ease of use, the thermo-hygrothermal comfort of the interior and the ability to communicate data on energy consumption.
The Directive also recognises that building automation and monitoring is a cost-effective alternative to technical inspections, particularly in large non-residential buildings and condominiums.
The way in which certain articles of Directive 2018/844/EU are implemented has been described in more detail in the recommendations subsequently drawn up by the European Commission, which serve to support Member States in preparing national transposition measures. The recommendations definitively recognise that the use of intelligent systems in buildings is essential to achieve the targets set for energy efficiency by 2030 and decarbonisation of the building stock by 2050.

References

Directive 2018/844 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency
Recommendation 2019/786 on the renovation of buildings
Recommendation 2019/1019 on the modernisation of buildings

Energy classification of buildings (EN 15232)



Buildings constructed or renovated in accordance with the latest legal requirements offer considerable potential for increasing energy efficiency, but to fully exploit this potential it is necessary to optimise the operation of the various technical systems. Building automation systems provide for this; the control functions of the heating system are a fundamental part of it. According to the EN 15232 standard, during the design phase it is possible to evaluate the energy savings obtained by adopting increasing levels of automation and to place the building in one of the four energy efficiency classes defined: from A (more efficient) to D (less efficient). The functions of HVAC systems contribute significantly to energy efficiency: heating, cooling, ventilation, humidification, dehumidification and production of hot water for sanitary use.
This European Standard specifies also:

- a structured list of control, building automation and technical building management functions which contribute to the energy performance of buildings; functions have been categorized and structured according to building disciplines and so called Building automation and control (BAC);
- a method to define minimum requirements or any specification regarding the control, building automation and technical building management functions contributing to energy efficiency of a building to be implemented in building of different complexities;
- a factor based method to get a first estimation of the effect of these functions on typical buildings types and use profiles;
- detailed methods to assess the effect of these functions on a given building.

Class A: includes buildings with high energy performance, equipped with control and automation systems (BACS) and technical plant management (TBM) characterized by high levels of accuracy and completeness of automatic control.
Class B: this includes energy advanced buildings, with control and automation systems (BACS) and technical plant management systems (TBM) that allow centralised control.
Class C: includes standard buildings from the energy point of view, equipped with control and automation systems (BACS) with basic functionality. It is also the class used as a reference for calculating efficiency factors.
Class D: includes buildings that are not energy efficient and have only traditional technical systems, without any automation.

The Italian Interministerial Decree of 26 June 2015 ("Minimum Requirements" decree) prescribes for non-residential buildings a minimum level of automation corresponding to Class B for the control, regulation and management of building and heating system technologies (BACS).

References

EN 15232-1:2017 Energy Performance of Buildings - Energy performance of buildings - Part 1: Impact of Building Automation, Controls and Building Management

Energy classification of radiant systems (UNI / TR 11619)

In 2016, the CTI (Italian Thermotechnical Committee) published the technical report UNI TR 11619, which defines the normative references and the calculation methodology for determining the energy efficiency index of radiant systems for heating and cooling with low temperature difference, in the floor, wall and ceiling versions in compliance with the EN 1264 standard, combined with strategies for regulating, balancing and controlling the circulation pumps.

The index defined by the technical report considers the performance of:
- emission of the radiant system (η_e)
- thermoregulation of the ambient air and the heat transfer fluid (η_{rg})
- balancing of circuits (η_{bal})
- circolating pumps (η_{circ})

RSEE index

The energy efficiency index, called RSEE (Radiant System Energy Efficiency), is expressed as a product of the yields of the various systems and components of the system:

$$RSEE = \eta_e \cdot \eta_{rg} \cdot \eta_{bal} \cdot \eta_{circ}$$

The overall efficiency of a system can vary considerably: the most significant factor is the choice of temperature control devices (the values vary from 0.91 to 0.99). η_{rg} represents the control efficiency and is directly influenced by the design choices (such as the independent control for zones or single rooms, the climatic compensation function) and by the configuration of the devices (ON / OFF or PI proportional-integral control). Depending on the value of the index, the radiant system can be placed in 5 classes, from AAA (> 0.98) to D (< 0.88).

Simulations (source: UNI / TR 11619)

Control	Description	η_{rg}
Only zone ON / OFF	Thermostat in living room, setpoint temperature: 20°C ± 1°C. Fixed flow temperature equal to the design temperature determined in the most disadvantaged room.	0,848
(intermediate situations)	...	da 0,862 a 0,916
For single room, PID controller	A thermostat in each room (living room, bedrooms, bathroom), setpoint temperature: 20°C. The digital electronic control unit controls the electrothermal actuators located on the manifold valves and the three-way mixing valve. The control unit receives the temperature data from all the zones in the room..	0,987
Ideal situation	Maintain an internal temperature of 20°C in all rooms..	1,00

Sustainability certification

As time goes by, more and more projects of buildings are submitted to sustainability certification. The concept of “sustainability”, which is now common in many sectors, was defined in the “Our Common Future” report (known also as Brundtland Report) published in 1987 by the World Commission on Environment and Development. Sustainable development is a process that ensures “that the needs of the present generation are met without compromising the ability of future generations to meet their own needs”. In this sense, sustainability must ensure compatibility between development and environmental protection.
Buildings are major consumers of resources and therefore this principle also applies to them; for this reason, certification schemes have been developed over the years to certify their sustainability. Building projects that are subject to sustainability certification can receive points in different categories: in the case of LEED* (Leadership in Energy and Environmental Design), for example, they include location and transport, site, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation and more. Based on the number of credits obtained, a project obtains one of the levels of assessment provided for in the certification scheme.
Building automation plays a very important role in achieving sustainability certification. The use of the KNX system can contribute to obtaining up to 54 credits** out of a maximum of 110 provided for by LEED certification. 80% of the credits to which KNX contributes relate to three LEED categories: water efficiency, energy and atmosphere, and indoor environmental quality.

**) Developed by U.S. Green Building Council (USGBC)*
***) KNX for LEED, 2013, Jesús Arias García, Miguel Ángel Jiménez Ibiricu, KNX Association cvba (Bruxelles)*

In order to better define the concept of sustainability with reference to the construction sector, the ISO 15392 standard was also published in 2008, which sets out sustainability objectives and general principles. The standard defines sustainability as “the condition in which the components of the ecosystem and their functions are maintained for the present and future generations”. To complete ISO 15392, the technical specification ISO/TS 12720 has been published, which provides guidelines for its application. In addition, ISO 21931-1 identifies and describes the factors to be considered when assessing the environmental performance of new or existing buildings in the design, construction, operation, maintenance, renovation and decommissioning phases.

References

ISO 15392:2008 Sustainability in building construction - General principles
ISO/TS 12720:2014 Sustainability in buildings and civil engineering works - Guidelines on the application of the general principles in ISO 15392
ISO 21931-1:2010 Sustainability in building construction - Framework for methods of assessment of the environmental performance of construction works - Part 1: Buildings.

HVAC applications - March 2021

Credits

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Graphical project	Ekinex® Marketing & Communication
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